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ARIZONA DEPARTMENT OF WATER RESOURCES

HYDROGEOLOGY AND SIMULATION OF GROUNDWATER FLOW

PRESCOTT ACTIVE MANAGEMENT AREA

YAVAPAI COUNTY, ARIZONA

SEPTEMBER, 1995

GROUNDWATER MODELING REPORT NUMBER 9

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ABSTRACT

The Arizona Department of Water Resources has developed a numerical groundwater flow model of groundwater basins of the Prescott Active Management Area. The model was developed to evaluate Predevelopment groundwater conditions (circa 1940), and developed groundwater conditions from 1940 through 1993. The model simulates groundwater flow through and between the Lower Volcanic Unit and the Upper Alluvial Unit aquifers.

Analysis of groundwater conditions circa 1940 indicates that natural recharge and natural discharge were in long-term balance (steady-state conditions), and were each about 7,000 acre-feet per year. Analysis of transient groundwater conditions from 1940 through 1993 indicates that a total of about 860,000 acre-feet of groundwater was pumped from the aquifers of the Little Chino and Upper Agua Fria sub-basins. Additional groundwater discharge of about 320,000 acre-feet occurred as spring flow at Del Rio Springs, stream baseflow along the Agua Fria River near Humboldt, and as groundwater underflow to the Big Chino sub-basin north of Del Rio Springs.

The estimated groundwater recharge for 1940-1993 from incidental, natural, and artificial sources was about 770,000 acre-feet. The volume of water removed from aquifer storage during the period 1940-1993 was estimated at about 410,000 acre-feet. The estimated annual overdraft for the period 1980-1993 was about 6,000 acre-feet per year.

ACKNOWLEDGEMENTS

The authors would like to take this opportunity to acknowledge those individuals and organizations which supplied assistance and/or data for the modeling study. We express our sincere apprecation to Phil Foster, Director of the Prescott AMA. Phil's assistance in providing cropped acreage summaries, irrigation efficiency data, and numerous other types of data was essential to the development of the model. Thanks also go to Bill Remick, and the Arizona Department of Water Resources Basic Data Section for providing water level, and stream gaging data which was vital to the modeling effort. We would also like to acknowledge the contributions of Frank Putman for overall project coordination and supervision.

The authors also would like to express their appreciation to Brad Huza and the City of Prescott for providing various historical pumpage and recharge data. Further thanks also go to Paul Sebenik, and Bill Wellendorf for providing additional geologic data which was useful to the modeling effort. Thanks also go to Richard Wilson and Don Pool of the United States Geological Survey, and Dr. Tom Maddock III of the University of Arizona for their helpful review and comments concerning this report.

EXECUTIVE SUMMARY

This modeling study provides an improved understanding of the hydrologic system of the Prescott AMA based on the collection, analysis, and utilization of large amounts of geologic and hydrologic data. The data analysis has provided conceptual models of the predevelopment and developed groundwater systems. These analyses have shown that the groundwater system was in a long-term state of equilibrium (steady-state) up until about 1940. Beginning about 1940 the equilibrium of the groundwater system was disrupted by the introduction of significant agricultural pumpage in the Little Chino sub-basin. Due to the lack of significant groundwater development it is believed that near-equilibrium conditions probably persisted in the Upper Agua Fria sub-basin until about the mid-1960's.

From 1940 to the mid-1970's or early 1980's increasing groundwater withdrawls, principally for agriculture, caused water-levels to decline throughout most of the model area, to a maximum of about 70 to 80 feet in the Little Chino sub-basin. Beginning in the late 1970's the rate of water level decline decreased in many parts of the model area. In some areas water levels stabilized or actually began to rise. The recent stabilization of water levels in some wells is not interpreted to indicate a return to steady-state conditions within the model area. The stabilization trend is believed to be a transient phenomenon which reflects the groundwater system's temporary adjustments to a new, reduced pumpage regime, and a period of increased precipitation, and increased natural recharge from major flood flows. Water budget analysis indicates that groundwater overdraft continues in the Prescott AMA under present conditions (see Tables 10 and 11).

The data collection and analysis efforts provided sufficient information to conceptualize and develop a numerical computer model of the steady-state and transient groundwater systems. The model was calibrated to the steady-state conditions (circa 1940), and the transient conditions from 1940 to 1993. The accuracy of the calibration was gaged using statistical error analyses on model predicted water levels, comparisons of model simulated and actual well hydrographs, and comparisons of model simulated and conceptual water budget components. The evaluation of model results indicated that the model reasonably replicated measured water levels and groundwater fluxes in most parts of the model area. Based on these results it is appropriate to believe that the model will provide reliable predictions of future groundwater conditions.

RECOMMENDATIONS

During the course of the modeling study it became apparent that several data deficiencies existed which limited the conceptualization and modeling of the groundwater system. The following recommendations are made in order to improve these deficiencies:

1) Collect more annual water level data in the model area.

This model study relied heavily on the annual water level data which is measured and collected by the ADWR-Basic Data Section. Future model updates and statutorily mandated assessments of "safe-yield" conditions will require the number of regularly measured "index" wells to be increased. Specific recommendations to increase the number of wells measured per year have been made as a part of a new Prescott AMA Groundwater Monitoring Program which is currently being developed by the ADWR.

2) Install stream gages on important drainages in the Prescott AMA.

Current stream gage data is absolutely vital to the analysis of groundwater recharge and discharge in the model area. This modeling study has demonstrated the relative importance of natural recharge and natural discharge as components of the annual groundwater budget. Recently a continuous recording stream gage was installed by the ADWR on Little Chino Creek below Del Rio Springs. This gage will provide current spring discharge data which have been collected only on a sporadic basis since 1945. The gage at Del Rio Springs represents the first of several gages and monitoring devices which are to be installed throughout the Prescott AMA as part of the proposed Groundwater Monitoring Program.

3) Collect more aquifer test data.

The model calibration and sensitivity analysis indicated that the hydraulic conductivity, and storativity data were among the most influential of the various model input data. In many parts of the model area such data were unavailable and the model inputs were therefore estimated. In the interests of continued model improvement it is recommended that these data be collected for future analysis when new well pump tests are performed.

4) C_{14} age-dating, and other geochemical analyses should be conducted on groundwater samples collected from the volcanic aquifer and on spring water from Del Rio Springs.

C_{14} age-dating of groundwater samples from the Lower Volcanic Unit aquifer and from Del Rio Springs would provide valuable data concerning the age of groundwater which would be compared to model simulated particle-tracking estimates of the resident-time required for groundwater to flow from recharge areas to points of natural discharge (such as Del Rio Springs). These comparisions would provide completely independant data concerning the model's predictive accuracy.

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CHAPTER ONE - INTRODUCTION

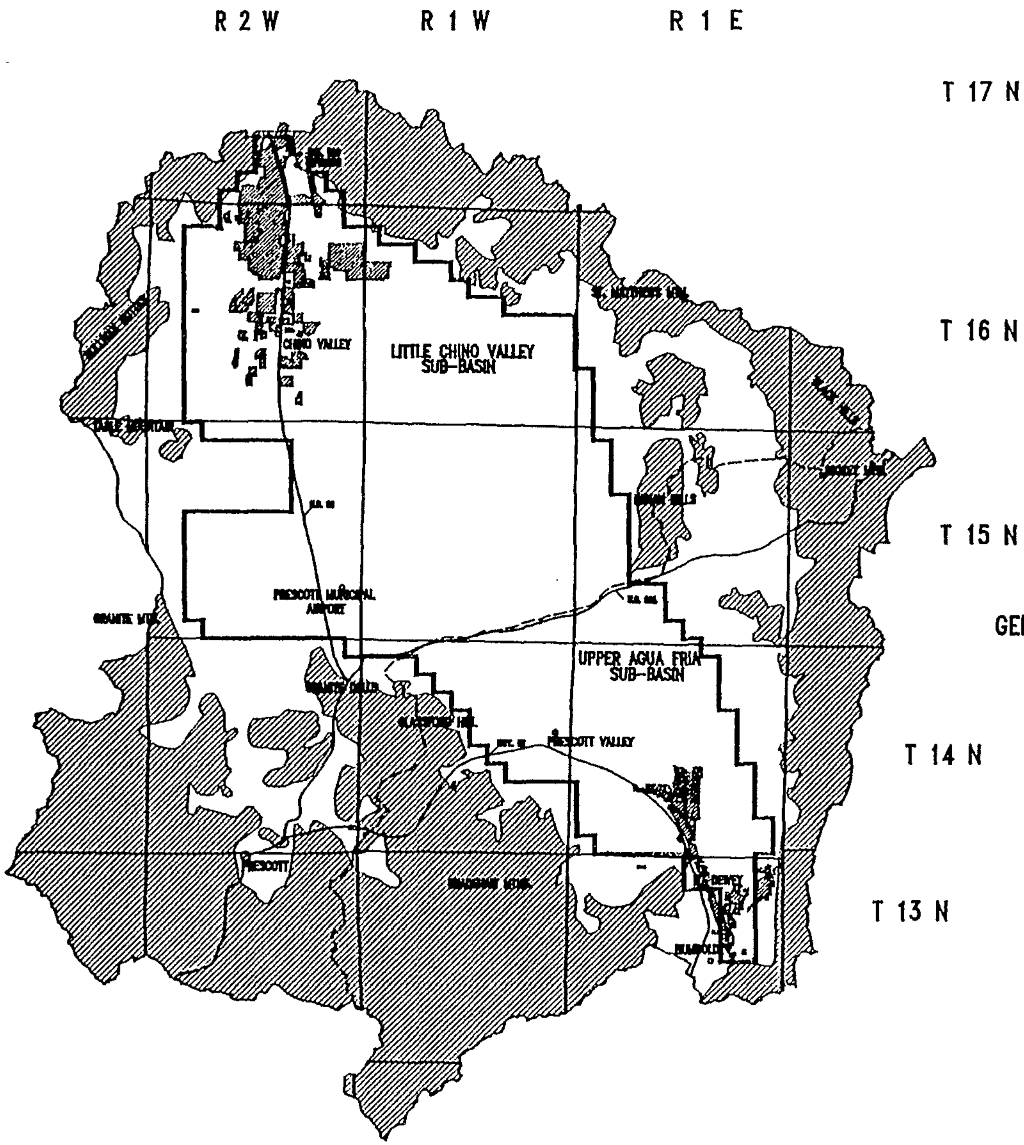
I. INTRODUCTION

The Arizona Department of Water Resources' Prescott Active Management Area is located in Central Arizona (Figure 1). The Prescott **A**ctive **M**anagement **A**rea **(AMA)** is one of four AMAs which were established by the Groundwater Management Act of 1980. The Active Management Areas are areas in which intensive groundwater management is required to address the impacts on groundwater supplies due to extensive groundwater withdrawls.

The management goal of the Prescott AMA is to achieve "safe-yield" by the year 2025, or earlier. The safe-yield goal is defined as the condition where groundwater withdrawls do not exceed recharge to the aquifer-system within the AMA. To achieve the safe-yield goal the AMA has established several groundwater management programs which include: **1)** groundwater quality assessment and managment, **2)** agricultural conservation, **3)** municipal conservation, **4)** industrial conservation, **5)** augmentation and reuse.

In order to evaluate the potential impacts of these programs towards achieving safe-yield the **A**rizona **D**epartment of **W**ater **R**esources **(ADWR)** has developed a regional groundwater flow model of the Prescott AMA. The study began in 1993 with activities designed to characterize the geology and hydrology of the model area.
The model study area was restricted to the groundwater basin area of the Prescott AMA (Figure 1). The surrounding mountainous area

FIGURE 1



ARIZONA DEPARTMENT OF WATER RESOURCES

PRESCOTT AMA

GENERAL LOCATION MAP AND IGFR ACREAGE IN THE PRESCOTT AMA MODEL AREA

SCALE

2 1 0 1 2

MILES

LEGEND

- AMA BOUNDARY
- HIGHWAYS
- SUB-BASIN BOUNDARY
- BASEMENT UNIT
- IRRIGATED GRANDFATHER RIGHT AREAS (IGFR)

MAP PRODUCED BY ADWR HYDROLOGY DIVISION – MODELING SECTION of the AMA provided a physical boundary to much of the groundwater flow system.

Recent activities have included the construction, calibration, and evaluation of a three-dimensional groundwater flow model of the study area. Future activities will involve the utilization of the groundwater flow model to simulate future groundwater conditions based upon projected water use scenarios.

II. GOALS AND OBJECTIVES

The primary goal of the Prescott AMA groundwater modeling study was to develop an analytical tool capable of quantifying the effects of various groundwater management and conservation programs on the groundwater supplies within the study area. This goal was achieved by establishing and fulfilling a set of intermediate goals which included: **1)** conduct a comphrehensive collection and compilation of all current and historic hydrologic, geologic, and land use data, **2)** develop a three-dimensional groundwater flow model, **3)** identify areas of data deficiency and model limitations that need to be addressed in future model updates, **4)** develop recommendations to guide and improve future data collection efforts, and model updates. As the previous discussion indicates, it is the intention of the ADWR to re-visit and improve the model as time and new data allow.

III. PURPOSE AND SCOPE

The purpose of the report is to describe the geology and hydrology of the groundwater basin area of the Prescott AMA. The report documents the data collection, data analysis, and model construction phases of the model study. The report also provides recommendations concerning future model updates, improvements, and uses. Additionally, the report also describes the conceptual and numerical models which have been developed of the groundwater flow system of the model area. Temporally, the report covers the Predevelopment groundwater flow system circa 1940, and the developed groundwater water flow system (1940-1993).

IV. MODEL AREA

The Prescott AMA includes 485 square miles in central Yavapai County, Arizona. The AMA is comprised of the **L**ittle **C**hino **(LIC)** and **U**pper **A**gua **F**ria **(UAF)** groundwater sub-basins. The model covers the groundwater basin portion of the AMA which is about 220 square miles (Figure 1). The model does not cover the mountainous area of the AMA.

The model area includes the towns of Dewey, Humboldt, Prescott Valley, and Chino Valley (Figure 1). The City of Prescott is located outside the model area in the bedrock foothills region immediately north of the Bradshaw Mountains. Although the City of Prescott is outside the model area, the population of the City of Prescott relies on groundwater pumped from the aquifers of the Little Chino sub-basin. In 1990, the population of the Prescott

AMA was about 57,000 (ADWR, 1993). The Arizona Department of Economic Security projects that about 135,000 people will reside in the AMA by the year 2025 (ADWR, 1993).

V. PREVIOUS INVESTIGATIONS

The hydrology and geology of the model area has been studied and described by several researchers. One of the most informative geological reports on the area was provided by Krieger (1965) of the **U**nited **S**tates **G**eological **S**urvey **(USGS)**. This report provides a detailed discussion of stratigraphy and structure along with a brief description of the geography, physiography, and mineral and water resources of the Prescott and Paulden USGS Topographic Quadrangles. Other useful reports include the USGS report on the geology of the Mingus Mountain quadrangle (USGS, 1958), and Lehner (1958) who reported on the geology of the Clarkdale quadrangle. Anderson and Creassey (1967) produced a geologic map of the Mingus Mountain quadrangle.

Schwalen (1967) descibed a groundwater study of the artesian area of the Little Chino Valley (Figure 1) which was conducted by the Agricultural Experiment Station at the University of Arizona. The Schwalen (1967) report provides a detailed and valuable description of the geology, hydrology, streamflow data, and groundwater development of the Little Chino sub-basin from 1940-1965. The report was subsequently updated by Matlock, Davis, and Roth (1973) to cover groundwater use and development from 1966-1972.

Over the years the USGS and the ADWR have conducted annual water level measurement, and water quality sampling surveys. Littin (1981) of the USGS produced maps showing groundwater conditions in the Agua Fria area in 1979. Other USGS reports and maps of the general area include: The ADWR report by Remick (1983) contained maps showing groundwater conditions in the Prescott AMA in 1982.

Wilson (1988) reported on the water resources and hydrogeology of the northern part of the Upper Agua Fria area including the Upper Agua Fria sub-basin. Other geologic and hydrologic reports on the model area may be found referenced in the ADWR "Bibliography of Selected Reports on Groundwater in Arizona", by Remick (1987). Additional USGS reports and activities may be found referenced in the USGS "Activities of the Water Resources Division in Arizona, 1986-91", by Spicer and Van De Vanter (1993).

VI. SOURCES OF WATER LEVEL DATA

The collection and analysis of water level data was an essential part of the model study. Water level data were collected and analyzed for the period 1940-1993. Water level maps which were prepared from the data aided in the conceptualization of the groundwater flow system. The water level data and water level maps were also used to provide numerical model inputs and calibration standards.

The availability of water level data was quite variable throughout the model area. Water level data were readily available in the agricultural area of the Little Chino sub-basin (Figure 1) where an organized study of groundwater conditions and water level measurements was begun in 1937 by the University of Arizona Agricultural Engineering Department. However, in most other areas of the Little Chino and Upper Agua Fria sub-basins little groundwater development has occurred, and consequently fewer water level data available, especially for the earlier years.

For the most part, water level data were derived from the ADWR **G**round **W**ater **S**ite **I**nventory **(GWSI)** database. Information stored in the GWSI database consists of water levels and other related data which are measured or collected by the ADWR Basic Data Section and by personnel from the USGS. Additional water level data were derived from driller's log descriptions of "first water" encounters, and reports of static water levels recorded at the time of drilling.

VII. SOURCES OF HYDROGEOLOGIC DATA

The extent and character of the groundwater basins in the model area were determined through a detailed analysis of geologic and hydrologic data. The main sources of geologic data were driller's logs, and gravity data. Hydrologic data, such as aquifer transmissivities and storativities, were derived from application of the Drillers Log Program (Long and Erb, 1980), flow net analysis, specific capacity measurements, and pump test data.

Well Log Data

Drillers' well logs provided the major source of geologic data in the model area. Over 800 drillers' logs were reviewed during this study to help delineate the vertical and areal extent of the aquifer-system within the model area.

Although many logs were examined, it should be recognized that many logs were of questionable quality, and there were many areas where log data were unavailable (Figure 2). Additionally, most wells were not drilled to bedrock, thus total aquifer thicknesses were necessarily inferred from other data.

Gravity Data

Gravity data were used to make geologic interpretations in many parts of the model area. Due to the total lack of wells in many areas it was essential to use gravity information to estimate bedrock depths and aquifer thicknesses where no other data were available. The gravity data utilized included the Depth-to-Bedrock Map (Prescott) by Oppenheimer and Sumner (1980), and the Complete Residual Bouger Gravity Anomaly Map (Prescott) by Lysonski, and others (1981).

Drillers' Log Program

The **D**rillers' **L**og **P**rogram **(DLP)** was used to provide preliminary estimates of hydraulic conductivity **(K)**, aquifer transmissivity **(T)**, and specific yield **(SY)**. The DLP utilizes the relationship between driller's lithological descriptions and hydraulic conductivity, and specific yield which has been described by Long and Erb (1980), and Kisser and Haimson (1981). In many areas the DLP estimates were the sole source of aquifer parameter data. The locations of wells where the DLP was applied are shown in Figure 2.

Flow Net Analysis

In addition to the DLP, flow net analysis was also utilized to provide additional estimates of transmissivity within the model area. The flow net analysis was performed using the 1940 water level map to provide estimates of the steady-state transmissivity distribution. The results of the flow net analysis were used in conjunction with the results of the DLP and specific capacity analyses to provide initial estimates of hydraulic conductivity.

Specific Capacity Measurements

Specific capacity data were used to provide general estimates of the potential range of transmissivities of volcanic formations found in the Little Chino sub-basin. Specific capacity data were also used to estimate the transmissivity of alluvial deposits in the Upper Agua Fria sub-basin. The use of specific capacity data to estimate aquifer transmissivity is based on an application of the Cooper-Jacob equation (1946):

$$s = \frac{264*Q}{T} \log \frac{0.3*T*t}{r^2 S} \qquad (1)$$

where

s = drawdown (ft)
Q = yield of the well (gpm)
T = transmissivity of the well (gpd/ft)
t = time of pumping (days)
r = radius of well (ft)

S = storage coefficient of the aquifer
$\frac{Q}{s}$ = specific capacity (gpm/ft of drawdown)

The application of the Cooper-Jacob equation (1946) is based on the direct relationship between specific capacity and aquifer transmissivity for an individual pumping well. As shown in Driscoll (1986, Appendix 16.D.) Equation 1 may be rearranged and solved in terms of specific capacity:

$$\frac{Q}{s} = \frac{T}{264 * \log \frac{0.3 * T * t}{r^2 S}} \qquad (2)$$

Applying typical values for the assumed variables such as t=1 day, r=0.5 ft, T=30,000 gpd/ft, and S=.001 for a confined aquifer the specific capacity of the confined aquifer is given by the equation:

$$\frac{Q}{s} = \frac{T}{2000} \qquad (3)$$

It should be noted that the use of this relationship presumes an average aquifer transmissivity of 30,000 gpd/ft, however as pointed out in Driscoll (1986), the value of assumed transmissivity appears in the log term of Equation 2, and even if the assumed value of transmissivity was increased to 120,000 gpd/ft the divisor in Equation 3 would only increase to 2,133 (a difference of less than 7 percent). The transmissivities of volcanic and alluvial deposits were estimated by applying Equation 3 to specific capacity data which were compiled by Schwalen (1967, Table 6). The locations of wells where specific capacity data were available are shown in Figure 2.

Pump Test Data

Pump test data were available for only a few wells in the model area. Pump test data were supplied for a water supply well in the Chino Valley area (Gookin, and Associates, 1987), and from hydrogeologic reports covering the Del Rio Springs area (Gookin, and Associates, 1977), the eastern section of Lonesome Valley (Sebenick, 1989), and the Upper Agua Fria sub-basin (Water Resources Associates, 1992). Estimates of aquifer parameters provided from the pump test data were used to supplement estimates provided from the other previously mentioned sources of hydrogeologic data. The locations of wells with available pump test data are shown in Figure 2.

CHAPTER TWO - THE HYDROGEOLOGIC SYSTEM

I. REGIONAL SETTING: GEOGRAPHY, PHYSIOGRAPHY, AND CLIMATE

The Prescott AMA groundwater model area is located in central Arizona. The model covers the groundwater basin portion of the AMA, an area of approximately 220 square miles (Figure 1).

The model area is located within the Transition Zone of the Basin and Range physiographic province as defined by Fenneman (1931). The model area is typified by gently rolling or undulating topography with broad sloping alluvial fans which were formed at the base of the surrounding hills or mountains. Land surface elevations range from about 4,450 to 4,900 feet in the basin area of the model to over 7,000 feet in the Black Hills and Bradshaw Mountains.

A surface drainage divide bisects the model area forming a topographic boundary between the Little Chino and Upper Agua Fria groundwater sub-basins (Figure 1). Runoff from the Little Chino sub-basin flows northward to the Verde River, while runoff in the Upper Agua Fria sub-basin flows southward to the Agua Fria River.

Native vegetation varies from high desert grasslands in the basin areas to coniferous forests in the surrounding mountains. Annual precipitation varies from about 12 inches per year at the Town of Chino Valley, to about 19 inches per year at Prescott (EarthInfo, 1994). The average daily temperatures range from about 22°F to 57°F in January, and from about 50°F to 89°F in July (ADWR, 1991).

II. HYDROGEOLOGIC FRAMEWORK

Part of the information presented in this section was derived from the reports by Krieger (1967), Schwalen (1967), Remick (1983) Wilson (1988), and others. However, a large part of the information which will be presented was developed by the authors of this report.

Geologic Structure

The Prescott AMA model area is located in the Transition Zone geomorphic province of central Arizona. The Little Chino groundwater sub-basin comprises the northern portion of the model area, and the Upper Agua Fria groundwater sub-basin comprises the southern portion (Figure 1).

The geologic structure of the model area is characterized by a deep structural trough which trends north-northwest for a distance of about 25 miles from near Humboldt in the southern part of the Upper Agua Fria sub-basin to near Del Rio Springs in the northern part of the Little Chino sub-basin. The trough is filled with alluvial, sedimentary, and volcanic rocks of Quaternary and upper Tertiary age (Figure 3).

The trough appears to have formed due to basin-and-range faulting and warping which created a downdropped structural basin in the northern and eastern portions of the Little Chino and Upper Agua Fria sub-basins. The trough is bounded to the east by the Coyote fault that forms the western edge of the Black Hills (Wilson, 1988). Vertical offset on the Coyote fault is estimated by Krieger (1965) to range from 0 feet at Humboldt to about 1,200 feet southwest of the Indian Hills (Figure 3). In the northern part of the Little Chino sub-basin the trough is bounded by a late Cenozoic fault (Figure 3) which has been informally referred to as the Del Rio Springs fault (Ostenaa, and others, 1993, p. 23). The vertical offset on the Del Rio Springs fault is estimated by Ostenaa (1993) to be at least 1000 feet. The floor and sides of the trough consist of low-permeability igneous and metamorphic rocks.

Rock Units

A wide variety of rock types are found in the model area. In this modeling study the numerous rock types have been grouped into three hydrogeologic model units which have similar hydrologic properties. From oldest to youngest, the units are the **B**asement **U**nit **(BU)**, the **L**ower **V**olcanic **U**nit **(LVU)**, and the **U**pper **A**lluvial **U**nit **(UAU)**. The geologic structure and stratigraphy of the model area is shown in generalized geologic cross-sections A-A' to E-E' (Plate 1).

Basement Unit

The Basement Unit is composed of a wide variety of crystalline or foliated igneous and metamorphic rocks that are generally dense, nonporous, and nearly impermeable (Wilson, 1988). Common Basement Unit rock types include granite, diorite, gabbro, schist, metavolcanics, and metasediments. The unit is equivalent to the

Basement Unit defined by Wilson (1988)

The Basement Unit forms the impermeable floor and sides of the structural groundwater basins and is exposed at the land surface throughout the mountainous areas which surround the basins. In the Little Chino sub-basin the Basement Unit generally underlies the Lower Volcanic Unit. In the Upper Agua Fria sub-basin the Basement Unit generally underlies the Upper Alluvial Unit. Although minor volumes of water are produced from Basement Unit wells outside the modeled area, the unit is not regarded as an aquifer for modeling purposes.

Lower Volcanic Unit

The Lower Volcanic Unit is of Tertiary age, and overlies the Basement Unit in the northern half of the model area. The unit is composed of a thick sequence of basaltic and andesitic lava flows which are interbedded with layers of pyroclastic and alluvial material. The lava flows which comprise the Lower Volcanic Unit are differentiated from other younger, and shallower volcanic flows described in many well logs throughout the model area. These younger flows seem to lack continuity and appear to be restricted to old stream channels cut into the alluvium (Water Resources Associates, 1992).

Confined conditions are observed in the Lower Volcanic Unit aquifer in the northwestern section of the Little Chino sub-basin. These conditions are primarily caused by the thick sequence of fine-grained alluvial and pyroclastic materials which overly the

Lower Volcanic Unit, and serve as an aquitard which restricts the vertical movement of groundwater. In some areas the volcanic flows probably also serve as aquitards. However, in most locations it was not possible to determine which type of material serves as the main confining layer, because of the highly interbedded nature of the materials and the general lack of knowledge concerning the exact depth at which confined conditions were first encountered.

Groundwater flow in the Lower Volcanic Unit occurs primarily through fractures, cavities or vugs in the volcanic deposits, and also through the interbedded, coarse-grained alluvial materials, such as sands and conglomerates. The Lower Volcanic Unit forms a highly productive (artesian) confined aquifer which has been clearly delineated from well logs in the northwestern section of the Little Chino sub-basin (Townships 16 and 17 North, Range 2 West). Many large-discharge (1,000 to 3,000 gal/min) irrigation wells tap the confined zone of the Lower Volcanic Unit in this area. In the past, many wells drilled into the Lower Volcanic Unit flowed at ground surface. However, the hydrostatic pressure of the Lower Volcanic Unit has declined substantially from earlier periods, and only a few flowing wells remain.

The extent of the Lower Volcanic Unit in the eastern part of the Little Chino sub-basin is not well known, however its existence in that area has been inferred from the available well logs, and gravity data. Some wells completed in volcanic flows overlying bedrock about two to three miles west of the Indian Hills have large specific capacities (Sebenik, 1989). Additionally, the interpretation of water level data suggests that the Lower Volcanic Unit recieves groundwater recharge in the southern and eastern parts of the Little Chino sub-basin.

The southern extent of the Lower Volcanic Unit is probably limited to the Little Chino sub-basin. However, recently a deep, large-capacity production well (3000 gal/min) was drilled into volcanic rocks in the Prescott Valley area of the Upper Agua Fria sub-basin (Wellendorf, 1994). Undoubtly, this well has penetrated well-fractured, and/or vesicular volcanic flows. However, the high degree of fracturing or vesicularity may only be a local feature. At this time, the available well data do not indicate the presence of a major artesian aquifer-system in the Upper Agua Fria sub-basin. The approximate areal extent and top elevation contours of the Lower Volcanic Unit are shown in Figure 4.

The total thickness of the Lower Volcanic Unit is not well known, except at a few locations where wells have been drilled through the unit's entire thickness. Although the total thickness of the Lower Volcanic Unit is not well known, the productive thickness of the unit is probably only a few hundred feet. This estimate is based on the average depth-of-penetration of water wells which tap the Lower Volcanic Unit, and from depth-to-bedrock maps produced from gravity data (Oppenheimer and Sumner, 1980).

The transmissivity of the Lower Volcanic Unit in the confined area of the Little Chino sub-basin has been estimated using the relation between specific capacity and transmissivity which was described earlier in this report. The estimated transmissivities in the Lower Volcanic Unit ranged from less than 5,000 to about 110,000 Feet^2/day. The estimated average Lower Volcanic Unit transmissivity was about 25,000 Feet^2/Day.

At this point it is important to remember that the hydraulic conductivity and overall transmissivity of the Lower Volcanic Unit is highly dependent upon the presence of fractures and cavities, and there is substantial spatial variabilty in the distribution of these features. Because of the heterogeneities, zones of exteremely high and low transimissivity may exist in close proximity. Therefore, the estimated average Lower Volcanic Unit transmissivity of 25,000 Feet^2/Day should be taken only as an area average and not necessarily representative of any specific location, especially outside the well-defined artesian zone in the northwestern portion of the Little Chino sub-basin.

The Driller's Log Program was used to provide estimates of the specific yield of the Lower Volcanic Unit which ranged from .03 to .08. The storage coefficent of the Lower Volcanic Unit was estimated from published data to be about .0001 (Fetter, 1988).

Upper Alluvial Unit

The Upper Alluvial Unit is composed of a heterogenous mixture of sedimentary, volcanic, and younger alluvial rocks. The unit includes Quaternary and Tertiary sedimentary rocks described by Krieger (1967), and the informal sedimentary, volcanic, and basin-fill units defined by Wilson (1988). The exposed sedimentary rocks in the southern part of the model area consist of fanglomerate, mud flows, and some interbedded volcanic tuff around the margins; in the interior of the basin sedimentary rocks include channel gravel, sand, silt, clay, marl, and some rhyolite tuff (Krieger, 1967, p. 71) In the northern portion of the Little Chino sub-basin many logs contain descriptions of clays, volcanic ash, and conglomerate. Many of the sedimentary rocks are believed to be of Tertiary age, and have textures and bedding structures which indicate lacustrine origin (Krieger, 1967).

Volcanic rocks found in the Upper Alluvial Unit are generally deposited as thin, discontinuous flows which have limited vertical and areal extent. As mentioned earlier, the volcanic flows found in the Upper Alluvial Unit appear to have been deposited in ancient drainages, and are differentiated from the extensive volcanic flows and deposits which comprise the Lower Volcanic Unit of the Little Chino sub-basin.

The Upper Alluvial Unit also contains recent alluvium which is younger than the Tertiary sedimentary rocks. The recent alluvial deposits consist of unconsolidated to moderately consolidated sand, gravel, silt, clay, and conglomerate. In many locations the recent alluvium is indistinguishable from the older sedimentary rocks. The recent alluvium is found at the land's surface in most locations in the basin.

Due to the limited availability of sub-surface geologic data, it was not possible to further sub-divide the various rock types of the Upper Alluvial Unit into seperate hydrogeologic model units. The similarity in hydraulic characteristics between the older sedimentary rocks and the younger alluvial rocks, combined with the limited extent of volcanic rocks supports this decision.

The saturated Upper Alluvial Unit deposits form an unconfined aquifer which is areally extensive throughout the model area (Figure 5). Locally, confined aquifer conditions may be found in a few areas where overlying fine-grained sediments or lava flows restrict vertical groundwater flow. However, these areas have limited areal extent. As noted in previous sections, the limited availability of well logs, and other sub-surface geological data (Figure 2) made it necessary to infer much about the areal extent, thickness, and hydrologic character of both the Lower Volcanic and Upper Alluvial Units. Keeping these uncertainities in mind, it is believed that the Upper Alluvial Unit overlies the Lower Volcanic Unit in most of the Little Chino sub-basin, and overlies the Basement Unit throughout most of the Upper Agua Fria sub-basin. The estimated elevation of the base of the Upper Alluvial Unit is shown in Figure 4.

Production capacities vary substantially for Upper Alluvial Unit wells. In many instances the yields are governed more by pump size than the aquifer's ability to produce water (Remick, 1983). In the Little Chino sub-basin the Upper Alluvial Unit has been tapped mainly by shallow domestic wells with limited pump sizes. Most of these wells yield about 10 to 30 (gal/min). In the Upper Agua Fria sub-basin the Upper Alluvial Unit has been tapped by municipal, agricultural, and domestic wells. Well yields are greatest in the Prescott Valley area, where larger wells yield from

100 to 1,750 (gal/min) (Wilson, 1988), and one recently drilled well has a reported yield of 3000 (gal/min) (Wellendorf, 1994). Well yields decline to the south, but are more than 100 (gal/min) in the Dewey and Humboldt areas (Wilson, 1988).

The hydraulic conductivity of the Upper Alluvial Unit was estimated using the Driller's Log Program. Estimated hydraulic conductivities ranged from about 1 to 200 feet/day. The average Upper Alluvial Unit hydraulic conductivity was about 9 feet/day. The DLP estimates of specific yield ranged from about .03 to .18 , with an average of about .06.

CHAPTER THREE - THE SURFACE WATER SYSTEM

I. SURFACE WATER - GROUNDWATER RELATIONSHIPS

The surface water and groundwater systems of the Prescott AMA are interconnected at several important locations of the model area. The surface water system is characterized by numerous ephemeral streams that head in the mountains surrounding the groundwater basin area of the Prescott AMA (Figure 6). The streams carry snow melt and rainfall runoff from the mountains to the groundwater basins of the model area.

Typically, much of the ephemeral streamflow which reaches the groundwater basins infiltrates and recharges the underlying groundwater system before exiting the basins. However, some streamflow does exit the model area, when unusually high runoff conditions occur. Areas of ephemeral stream channel infiltration and groundwater recharge are discussed in detail later in this report.

The surface water and groundwater systems are also connected at the northern and southern ends of the groundwater basins where groundwater is discharged as spring baseflow at Del Rio Springs, and along a baseflow reach of the Agua Fria River near Humboldt. The springs occur because stream channels have been cut down into the shallow, unconfined Upper Alluvial Unit aquifer at those locations, and groundwater is discharged to the surface water drainage system. These areas of groundwater discharge are discussed later in the report.

II. SURFACE WATER DRAINAGE - GENERAL CHARACTERISTICS

The surface water drainage in the model area divides along a low-lying, east-west trending topographic high which marks the boundary between the Little Chino and Upper Agua Fria groundwater sub-basins (Figure 6). In the Little Chino sub-basin surface water runoff which is not recharged, diverted, or otherwise consumed eventually drains northward through the surface drainage system to the Verde River (Figure 6). Surface water runoff in the Upper Agua Fria sub-basin drains southeast to the Agua Fria River.

III. SURFACE WATER DRAINAGE - LITTLE CHINO SUB-BASIN

The Little Chino sub-basin is drained by five main streams: Granite Creek, Willow Creek, Lonesome Valley Draw, Little Chino Creek, and Big Draw (Figure 6).

Granite Creek

Granite Creek is an ephemeral stream which heads in the Bradshaw Mountains south of Prescott (Figure 6). In 1915 a dam was constucted on Granite Creek at Granite Dells to provide water to the **C**hino **V**alley **I**rrigation **D**istrict (CVID). The reservoir created by the dam, Watson Lake, usually impounds all of the runoff to Granite Creek.

TABLE 1
SUMMARY OF SURFACE WATER FLOW DATA IN THE PRESCOTT AMA
(FIGURES ROUNDED TO NEAREST 100 ACRE-FEET)

LOCATION	TYPE OF MEASUREMENT	PERIOD OF RECORD	MEAN FLOW	MEDIAN FLOW	LOW FLOW	HIGH FLOW
GRANITE CREEK	ANNUAL INFLOW TO WATSON LAKE **(1)**	1933 TO 1947	4800	2300	600	19300
WILLOW CREEK	ANNUAL INFLOW TO WILLOW CREEK RES. **(1)**	1933 TO 1947	1400	900	500	4800
DEL RIO SPRINGS	ANNUAL DISCHARGE **(2)**	1940 TO 1945	2800	2800	2300	3400
DEL RIO SPRINGS	ANNUAL DISCHARGE **(3)**	1984 TO 1989	2400	2200	1400	4200
AGUA FRIA RIVER AT HUMBOLDT	ANNUAL BASEFLOW **(3)**	1981 TO 1993	1100	1100	100	2300

Notes:

1) Source: Schwalen (1967), Table 5, page 20.
2) Source: Schwalen (1967), Table 9, page 47.
3) Based on quarterly streamflow measurements made by Arizona Department of Water Resources, Basic Data Section (ADWR, 1994d).

Stream flow measurments were made on Granite Creek at the inflow to Watson Lake from 1933 to 1947 (Table 1). During that period the average annual inflow to Watson Lake was approximately 4,800 acre-feet, and the median annual inflow was approximately 2,300 acre-feet.

From 1958 through 1987 the City of Prescott discharged effluent to Granite Creek from the Sundog Waste Water Treatment

Plant (WWTP). Over the years, the volume of effluent discharged increased as the population of Prescott grew. The effluent discharges ranged from about 1,100 acre-feet in 1958 to about 2,800 acre-feet in 1987 (Prescott, 1993). The average annual effluent discharge for the 1958-1987 period was 2,900 acre-feet, with a median discharge of 1,800 acre-feet (Prescott, 1993).

Until 1988, most runoff and effluent discharges were stored in Watson Lake, and subsequently diverted by the Chino Valley Irrigation District. Since 1988, effluent has not been discharged to Granite Creek. Instead, the effluent has been recharged in infiltration ponds at a groundwater recharge facility located near the Prescott Municipal Airport.

Normally, controlled releases of water from Watson Lake flow north in Granite Creek for approximately 1.5 miles to a point where the flow is diverted into a mostly unlined canal by the Chino Valley Irrigation District. However, in times of unusually high precipitation, Watson Lake may fill and spill water into Granite Creek.

Water flowing in Granite Creek below the CVID diversion usually infiltrates before it can flow 12 miles northward across the Little Chino sub-basin, and exit the basin floor into the low-lying volcanic hills approximately 4 miles northeast of the Town of Chino Valley. Flows in Granite Creek eventually join the Verde River about 2.5 miles southeast of Paulden.

Willow Creek

Willow Creek is an ephemeral stream which heads in the Sierra Prieta Mountains west of Prescott (Figure 6). In 1937, a dam was constructed on Willow Creek near Granite Dells to increase the supply of irrigation water to the Chino Valley Irrigation District. Stream flow measurements were made on Willow Creek from 1933 through 1947 and are summarized in Table 1. Between 1933 and 1947 the average annual inflow to the Willow Creek Reservoir was 1,400 acre-feet with a median annual inflow of 900 acre-feet.

The Willow Creek Dam and reservoir normally impound the runoff to Willow Creek. Controlled releases of the stored water flow approximately one mile north in Willow Creek to the point where Willow Creek joins Granite Creek. Controlled flows on Willow Creek are usually diverted to the CVID canal just upstream of the confluence with Granite Creek. Any flow past the CVID diversion follows the channel of Granite Creek.

Lonesome Valley Draw

Lonesome Valley Draw is an ephemeral stream which drains the eastern half of the Little Chino sub-basin (Figure 6). Lonesome Valley Draw forms the major north-south drainage in the Lonesome Valley area. Lonesome Valley Draw carries runoff from several small ephemeral streams which originate in the Indian Hills and Black Hills areas to the east. Ephemeral flows in Lonesome Valley Draw either infiltrate or flow north-northwest and join Granite Creek near the location where Granite Creek enters the low-lying volcanic hills northeast of the Town of Chino Valley. Stream flow data is unavailable for Lonesome Valley Draw, however flows are believed to be low due to the limited drainage area.

Little Chino Creek

Little Chino Creek is an ephemeral stream in its upper reach which drains the west-central portion of the Little Chino sub-basin (Figure 6). Little Chino Creek heads in the southwestern section of the Little Chino sub-basin, and flows due north through the Chino Valley Irrigation District and the Del Rio Springs area.

At Del Rio Springs groundwater is discharged at the land surface in a series of springs. Spring discharge provides essentially permanent baseflow conditions in Little Chino Creek below the springs. Spring discharge data are available for the periods 1940 to 1946, and 1984 to 1989 (Table 1). During the 1940's both the mean and median discharges from Del Rio Springs were about 2,800 acre-feet per year. By the mid-1980's the mean and median spring discharges had decreased to about 2,400 and 2,200 acre-feet per year, respectively.

Little Chino Creek flows northward from Del Rio Springs for approximately 3 miles to Sullivan Lake near Paulden. Sullivan Lake is a small, man-made lake constructed to control the head cutting of the Verde River into the lower portion of the Big Chino Valley.

Big Draw

Big Draw is an emphemeral stream which drains the extreme western section of the Little Chino sub-basin (Figure 6). Big Draw heads in the foothills of Granite Mountain and flows northeast to join Little Chino Creek about a mile north of Del Rio Springs. Streamflow data is unavailable for Big Draw, however flows are believed be very low due to the small drainage area.

IV. SURFACE WATER DRAINAGE - UPPER AGUA FRIA SUB-BASIN

The Upper Agua Fria sub-basin is drained by three main streams: the Agua Fria River, Lynx Creek, and Yeager Canyon Wash (Figure 6).

Agua Fria River

The Agua Fria River is an ephemeral stream in its upper reach near the Town of Prescott Valley, approximately 7 miles northeast of the City of Prescott (Figure 6). Runoff in the upper Agua Fria River flows south through the center of the Upper Agua Fria sub-basin to a location near Humboldt where the river exits the basin floor into volcanic and metamorphic rock formations.

Approximately one-half mile north of Humboldt perennial stream conditions occur as the groundwater surface (water table) intersects the channel of the Agua Fria River. The gaining stream conditions in that location are due to the constriction and pinch-out of the Upper Alluvial Aquifer against the impermeable, enclosing Basement Unit. The mean and median baseflow along the perennial reach of the Agua Fria River near Humboldt was about 1,100 acre-feet per year from 1981 through 1993 (Table 1). A previous study of long-term baseflow conditions on the Agua Fria River near Mayer indicates that base flows along the Agua Fria River and its tributaries during the 1981 water year probably were the greatest since 1942 (Wilson, 1988). In 1981, baseflow at Humboldt was about 1,000 acre-feet per year.

Lynx Creek

Lynx Creek is an ephemeral stream which heads in the Bradshaw Mountains south of Prescott (Figure 6). Lynx Creek is dammed approximately 4 miles southeast of the City of Prescott. Lynx Lake, which is formed by the dam, is used for recreational purposes, and impounds much of the runoff to Lynx Creek. Annual peak stream flow measurements were made on a small tributary to Lynx Creek from 1967 through 1976, however annual streamflow data are unavailable for the main stream itself.

During times of high runoff the dam may spill water to the normally dry channel of Lynx Creek. Flows below the dam either infiltrate in the sand and gravels of the streambed, or travel approximatly 10 miles northeast to the central part of the Upper Agua Fria sub-basin where Lynx Creek joins the Agua Fria River.

Yeager Canyon Wash

Yeager Canyon Wash is an ephemeral stream which heads in the Black Hills near Mingus Mountain (Figure 6). Yeager Canyon Wash drains much of the mountainous, northeastern portion of the Upper Agua Fria sub-basin. Streamflow in the wash either infiltrates or is carried to the confluence with Agua Fria River just east of the Town of Prescott Valley. No streamflow data is available for Yeager Canyon Wash, however flows are believed to be low due to the limited drainage area.

CHAPTER FOUR - CONCEPTUAL MODEL OF THE HYDROLOGIC SYSTEM

I. THE AQUIFER SYSTEM

Figure 7 is a conceptual diagram which illustrates the basic features of the groundwater system in the model area. Figure 7 shows that the Upper Alluvial Unit and Lower Volcanic Unit aquifers occur in the Little Chino sub-basin, while the Upper Alluvial Unit aquifer occurs in most of the Upper Agua Fria sub-basin.

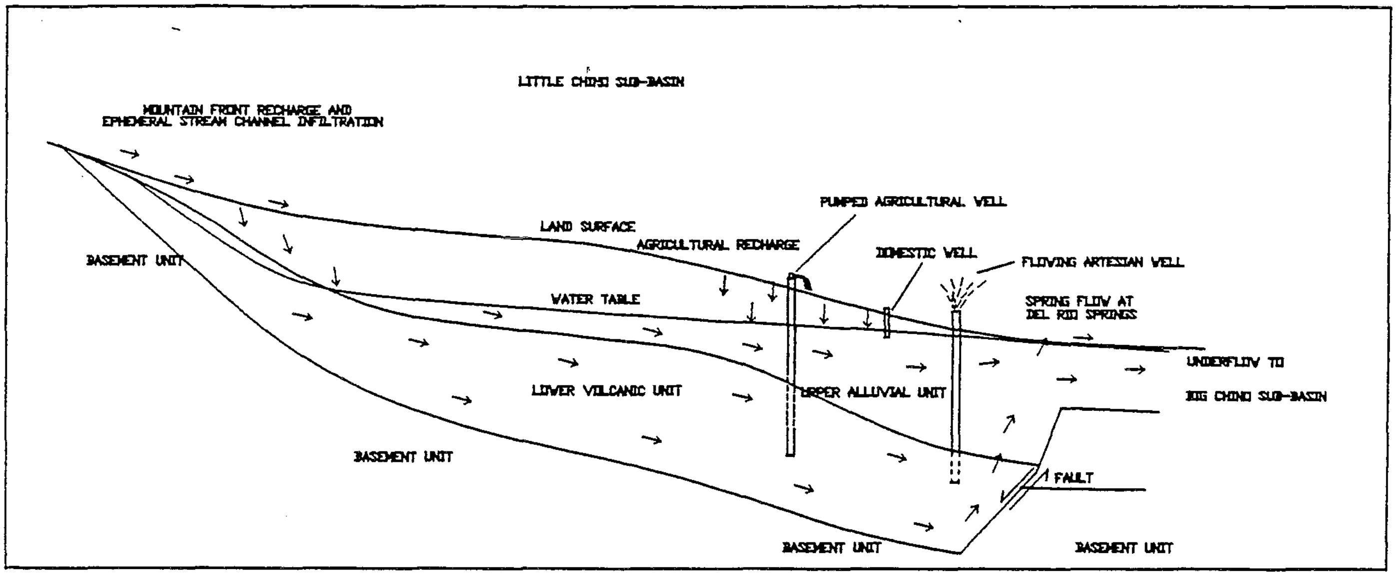
The Upper Alluvial Unit Aquifer

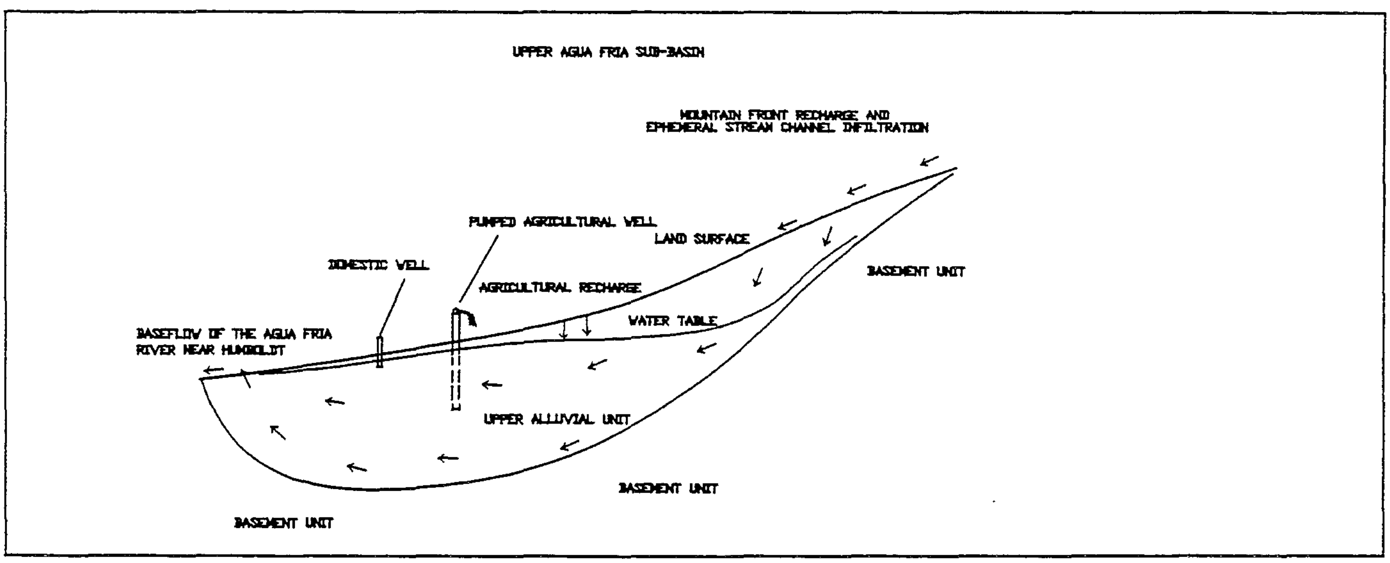
Thick, saturated, sedimentary, and volcanic deposits fill the deep structural trough which trends northwest-southeast across the entire length of the Little Chino and Upper Agua Fria sub-basins (Figure 3). As mentioned earlier the deposits are collectively referred to as the unconfined Upper Alluvial Unit aquifer which extends throughout the model area.

The saturated rocks of the Upper Alluvial Unit constitute the main, unconfined aquifer in the model area. For the most part, natural recharge to the Upper Alluvial Unit aquifer occurs through infiltration of runoff in ephemeral stream channels and along the mountain fronts of the model area Figure 7. In agricultural areas (mainly in the Little Chino sub-basin) infiltration from canals and from excess irrigation water recharges the Upper Alluvial Unit aquifer. Additional recharge also occurs from the infiltration of treated effluent at the City of Prescott's artificial recharge facility which is located near the Prescott Airport (Figure 6).

FIGURE 7

CONCEPTUAL MODEL OF GROUNDWATER FLOW IN THE PRESCOTT AMA MODEL AREA





Natural discharge from the Upper Alluvial Unit aquifer occurs at three locations in the model area. In the Little Chino sub-basin natural discharge occurs as spring flow at Del Rio Springs, and as underflow through the narrow gap in the bedrock hills located just northwest of Del Rio Springs (Figure 1). In the Upper Agua Fria sub-basin natural discharge occurs as perennial baseflow along the channel of the Agua Fria River near Humboldt (Figure 6).

Discharge from the Upper Alluvial Unit aquifer also occurs through groundwater pumpage. In the agricultural area of the Little Chino sub-basin (Figure 1) numerous small-capacity domestic wells tap the Upper Alluvial Unit aquifer, while most irrigation wells tap the deeper Lower Volcanic Unit aquifer. Outside the agricultural area of the Little Chino sub-basin the Upper Alluvial Unit aquifer is the major source of groundwater, however it should be noted that many domestic wells do tap fractured volcanic or crystalline rocks around the margins of the sub-basins.

The Lower Volcanic Unit Aquifer

A thick unit of vesicular volcanic flows interbedded with saturated alluvial and pyroclastic materials underlie the main Upper Alluvial Unit aquifer in much of the Little Chino sub-basin (Figure 3). These interbedded volcanic, alluvial, and pyroclastic materials are designated as the Lower Volcanic Unit aquifer in this report, however they are the same deposits which were described by Schwalen (1967) as the "artesian" aquifer of the Little Chino

Valley.

Natural recharge to the Lower Volcanic Unit aquifer occurs mainly through infiltration of runoff in ephemeral stream channels and along the mountain fronts of the model area (Figure 7). In unconfined areas, where the overlying Upper Alluvial Unit aquifer is unsaturated, recharge may directly reach the water table in the Lower Volcanic Unit aquifer through deep percolation. In other areas, where the Upper Alluvial Unit aquifer is saturated, and confining layers do not exist, recharge may reach the Lower Volcanic Unit aquifer through vertical groundwater flow. In other small areas, basalt outcrops at land surface, and precipitation may move downward through openings and crevices and ultimately reach the watertable in the volcanic aquifer (Schwalen, 1967).

Some recharge to the Lower Volcanic Unit aquifer occurs from canal seepage and the City of Prescott's artificial recharge project in the southwestern portion of the Little Chino sub-basin. Some recharge to the Lower Volcanic Unit aquifer also occurs in the the main agricultural area of the Little Chino sub-basin during the summer irrigation pumping season. During the summer pumping season the hydraulic head in the confined area of Lower Volcanic Unit aquifer is reduced to levels which permit some downward vertical flow and recharge from the overlying Upper Alluvial Unit aquifer.

During the non-pumping winter months the heads in the Lower Volcanic Unit aquifer recover to levels which are generally higher than the heads in the overlying Upper Alluvial Unit aquifer, and no downward vertical flow occurs. It should be noted that the presence of intervening confining layers in the artesian area of the Little Chino sub-basin also restricts the vertical flow of groundwater, in either direction, between the two aquifers.

Natural discharge from the Lower Volcanic Unit aquifer occurs at two locations in the Little Chino sub-basin. Near Del Rio Springs the hydraulic head in the Lower Volcanic Unit aquifer is greater than the head in the overlying Upper Alluvial Unit aquifer, and groundwater flows upward from the Lower Volcanic Unit aquifer to eventually become spring flow. Some groundwater underflow in the Lower Volcanic Unit aquifer may also leave the model area through the bedrock gap located just northwest of Del Rio Springs.

Since the 1940's groundwater pumpage has been the major source of discharge from the Lower Volcanic Unit aquifer of the Little Chino sub-basin. As previously mentioned, the Lower Volcanic Unit aquifer of the Little Chino sub-basin has supplied most of the irrigation and municipal water which has been pumped in the model area.

II. THE PREDEVELOPMENT HYDROLOGIC SYSTEM (CIRCA 1940)

Predevelopment Groundwater Conditions

Prior to 1940 steady-state conditions characterized the groundwater flow system of the model area, long-term groundwater inflows were in approximate balance with long-term outflows, and water levels remained essentially constant with time. The assumption of equilibrium conditions was proposed by Schwalen (1967) who stated that the recharge to the artesian basin (Little

Chino) reached approximate equilibrium with natural discharge prior to the construction of dams on Granite Creek and Willow Creek in 1915 and 1937. Schwalen (1967) noted that there was no appreciable pumping in the Little Chino sub-basin between 1915 and 1937, and no evidence that the visible outflow from the artesian basin was affected by the storage of water on Granite Creek by the Chino Valley Irrigation District. Additionally, Schwalen (1967) asserted that if there were an effect, the 22-year period was probably sufficent to establish a new level of equilibrium.

The assumption that equilibrium conditions existed in the Upper Agua Fria sub-basin prior to the 1940's is also reasonable. In fact, it is likely that near equilibrium conditions generally persisted in the Upper Agua Fria sub-basin until sometime in the 1960's because there was little development prior to that time.

The predevlopment (circa 1940) hydrologic system of the Prescott AMA has been studied to serve as the time-frame for the steady-state calibration of the groundwater flow model. The various components of groundwater inflow and outflow have been identified and analyzed for the predevlopment hydrologic system. The inflow components included ephemeral stream channel infiltration, and mountain front recharge. The outflow components included spring discharge, stream baseflow, groundwater underflow, and evapotranspiration. The following sections discuss the characteristics, water levels, inflows and outflows of the predevelopment hydrologic system.

Steady-State Water levels and Groundwater Flow

As mentioned earlier, water level data was generally unavailable for the time around 1940, except in the agricultural area of the Little Chino sub-basin. This data deficiency was overcome, however, by utilizing water level and driller's initial depth-to-water measurements from later periods when a greater distribution of data was available. Later data were utilized only in those areas where little or no groundwater development had occurred (for example, in the Upper Agua Fria sub-basin). By following this policy it could be reasonably assumed that the later data were still generally representative predevelopment conditions.

Two sets of predevelopment (circa 1940) water level contours were prepared for the steady-state calibration (Plate 2). The first set of contours corresponds to the configuration of the 1940 water levels of the unconfined Upper Alluvial Unit aquifer, which extends throughout the model area. The second set shows the configuration of the potentiometric surface of the confined-unconfined Lower Volcanic Unit aquifer. It has been assumed that there was little vertical head difference between the aquifers outside the confined portion of the Little Chino sub-basin, and therefore only one set of contours is shown beyond that area.

The 1940 water level contours shown on Plate 2 provide much useful information concerning the steady-state groundwater flow system. One of the most significant features of the groundwater flow system was the groundwater divide which roughly separates the Little Chino and Upper Agua Fria sub-basins. Groundwater flowed north from the divide into the Little Chino sub-basin and south into the Upper Agua Fria sub-basin. The groundwater divide was apparently located just to the south of the surface water divide which is also located in that area.

The groundwater divide is closely associated with the two major groundwater recharge areas of the Upper Agua Fria sub-basin. On the western side of the sub-basin infiltration from ephemeral stream flows recharged the Upper Alluvial Unit aquifer along the gravelly channels of Lynx Creek, Clipper Wash, and the upper reaches of the Agua Fria River. To the east, minor groundwater underflow entered the sub-basin in the area south of the Indian Hills, and recharge from ephemeral stream flow occured along the channels of Yeager Canyon and Coyote Wash (Plate 2). The estimated recharge from mountain-front recharge and ephemeral stream channel infiltration has been estimated to be about 2,500 acre-feet per year for the Upper Agua Fria sub-basin. The derivation of natural recharge estimates is discussed in greater detail in the next section of this report.

In other parts of the model area groundwater flow originated from recharge along the western slopes of the Indian Hills, and as ephemeral stream channel infiltration from Granite Creek, Willow Creek, and other small streams and washes. Natural recharge from mountain-front recharge and ephemeral stream channel infiltration has been estimated to have been about 4,500 acre-feet per year for the Little Chino sub-basin during the predevelopment era.

Groundwater flowed northwest, from the Lonesome Valley area, toward the sub-basin outflows at and near Del Rio Springs (Plate 2). The predevelopment hydraulic gradient in the Lonesome Valley area was very small (less than 10 feet per mile) compared to most other parts of the model area. The small gradient indicates that the deep, broad structural trough in that part of the sub-basin provides a comparatively low resistance pathway for groundwater flow. Groundwater flow in the western half of the Little Chino sub-basin followed a steeper gradient which was directed mainly to the north and east from the Granite Mountain and Granite Dells area where infiltration from Granite Creek and Willow Creek recharged both the alluvial and Lower Volcanic Unit aquifers (Plate 2).

Groundwater flow converged in the northwestern part of the Little Chino sub-basin near Del Rio Springs. Examination of the contours (Plate 2) reveals that a substantial increase in the hydraulic gradient of both the Upper Alluvial Unit and Lower Volcanic Unit aquifers (about 150 feet per mile in the Lower Volcanic Unit aquifer) occurred in the area about 1 to 1.5 miles south of Del Rio Springs.

This zone of increased gradient was interepreted by Schwalen (1967) to be caused by a structural barrier located immediately south of Del Rio Springs. Indeed, the geologic analysis does indicate the presence of a structural barrier in that area (Figure 7). However, there is also an abrupt decrease in the width of the aquifer-system in that area; which also constricts groundwater flow and causes an increase in the hydraulic gradient.

Another important feature of the predevelopment groundwater flow system in the artesian zone of the Little Chino sub-basin was the upward vertical hydraulic gradient between the confined Lower Lower Volcanic Unit aquifer and the unconfined Upper Alluvial Unit aquifer. In that area the hydraulic head of the Lower Volcanic Unit aquifer was as much as 100 feet greater than the head in the Upper Alluvial Unit aquifer (Plate 2). The large vertical hydraulic gradients existed in that area because vertical groundwater flow was substantially restricted due to the presence of impermeable confining layers. The upward gradient also indicates that the Lower Volcanic Unit aquifer recieved recharge from locations outside the artesian zone, and that there was little head loss in the Lower Volcanic Unit aquifer until the underflow reached the structural barrier south of Del Rio Springs.

Between the structural barrier and Del Rio Springs the vertical hydraulic gradient lessens and groundwater flows from the Lower Volcanic Unit to the Upper Alluvial Unit. At Del Rio Springs most of the underflow is transmitted through the Upper Alluvial Unit and groundwater discharge occurs from a cienega area, and from the springs. The volume of groundwater discharged from the springs during the predevelopment era was estimated using available gaging data to be about 3,000 acre-feet per year (Table 1).

Although most of the groundwater underflow in the Little Chino sub-basin was discharged at Del Rio Springs, some underflow was not captured by the springs and exited the sub-basin through the bedrock gap immediately south of Sullivan Lake (Plate 2). The volume of underflow which exited the Little Chino sub-basin was estimated using flow net analysis to range from 1,500 to 2,000 acre-feet per year during the predevelopment era.

As mentioned earlier, a groundwater divide occured slightly south of the surface water divide between the Little Chino sub-basin and the Upper Agua Fria sub-basin. On the south side of the divide groundwater flowed from the Lynx Creek, Coyote Wash, and Yeager Canyon toward Humboldt. Hydraulic gradients in the Upper Alluvial Unit aquifer ranged from about 10 to 20 feet per mile in the northern portion of the Upper Agua Fria sub-basin to about 50 feet per mile in the southern portion near Humboldt. Groundwater flow converged near Humboldt as the Upper Alluvial Unit aquifer thinned and narrowed against the surrounding rocks of the Basement Unit. About a half mile north of Humboldt the underflow intersected the land surface to provide baseflow in the channel of the Agua Fria River. Based on Wilson's (1988) estimates, and on other gaging data it is likely that predevelopment baseflow on the Agua Fria River near Humboldt ranged from 1,500 to 2,500 acre-feet per year.

Groundwater Recharge

During the predevelopment era the major source of groundwater recharge to the Little Chino and Upper Agua Fria sub-basins was from mountain front recharge and ephemeral stream channel infiltration. It is assumed that little recharge occurs from direct precipitation on the groundwater basin floors themselves, because most of this water is initially absorbed by the soil, and is subsequently lost through evaporation and transpiration.

Estimates of the volume and distribution of natural recharge in the model area have been made using stream gaging data and watershed area measurements. The long-term natural recharge in the model area from these sources has been estimated to have been about 7,000 acre-feet per year during the predevelopment period. This estimate is in excellent agreement with the combined estimates of Schwalen (1967) who estimated that natural recharge in the Little Chino sub-basin was about 5,000 acre-feet per year, and Wilson (1988) who estimated typical recharge in the Upper Agua Fria sub-basin was about 2,000 to 3,000 acre-feet per year.

The first step taken to estimate the volume and areal distribution of natural recharge was to estimate the runoff or discharge rate per square mile for the Granite Creek and Willow Creek watersheds. This was accomplished using the 1933-1947 stream gage data for Granite and Willow Creeks (Table 2), and watershed areas.

Examination of the stream flow data for Granite and Willow Creeks (Table 2) reveals that the average stream flow for the two creeks was about 4,800 and 1,400 acre-feet per year, and the median flow was about 2,300 and 900 acre-feet per year, respectively, for the period 1933-1947. According to historical accounts most of the stream flow on Granite and Willow Creeks infiltrates into the sandy river channel within a short distance of the point where the streams join north of Granite Dells and flow north across the Little Chino sub-basin (Schwalen, 1967, p. 51). Only in unusually wet years does any runoff from Granite and Willow Creeks reach the lower end of the sub-basin.

Since runoff typically infiltrates into the channel of Granite Creek it is assumed that much of the water eventually recharges the groundwater system. Previous modeling studies in central Arizona have shown that long-term recharge from ephemeral streams which discharge into groundwater basins may be reasonably estimated from annual stream flow data (Corkhill and others, 1993, p.42). In this study it has been assumed that the median annual flow provides a reasonable approximation of potential recharge from the Granite and Willow Creek watersheds. Based on the available gaging data, it is estimated that the long-term recharge from the Granite and Willow Creek watersheds was about 2,300 and 900 acre-feet per year, respectively, during the predevelopment era.

Once the annual recharge per watershed was estimated for Granite and Willow Creeks it was then possible to estimate the recharge for other watersheds of varying size. This was accomplished by measuring each watershed's surface area, and then dividing the annual recharge total by the estimated watershed area. The estimated recharge for the Granite Creek watershed was about 48 acre-feet per square mile, and the estimated recharge for the Willow Creek watershed was about 39 acre-feet per square mile (Table 3). Based on an annual precipitation rate of about 19.5 inches per year, the recharge estimates represent about 4 to 5 percent of the annual precipitation on the Granite Creek and Willow Creek watersheds (ADWR, 1994a).

Natural recharge for other watersheds in the model area was estimated using the following procedure. First, the boundary and surface area of each watershed was measured (Figure 8). Second, the average annual precipitation on each watershed was estimated from the annual precipitation contours (Figure 8) (ADWR, 1994). Third, the average annual precipitation rate for each watershed was normalized as a percentage of the average annual precipitation rate for the Granite Creek and Willow Creek watersheds (about 19.5 inches per year). Fourth, the normalized watershed precipitation rates were multiplied by the average estimated annual recharge rate for the Granite Creek and Willow Creek watersheds (about 44 acre-feet per square mile) to give the estimated recharge rate per square mile of watershed (Table 3). Finally, the total annual median recharge per watershed was estimated by multiplying the individual recharge rates by the watershed surface areas (Table 3).

TABLE 2
SUMMARY OF INFLOW TO WATSON AND WILLOW LAKES
(ACRE-FEET)

YEAR	WATSON LAKE INFLOW	WILLOW CREEK INFLOW
1933 [2]	895	436
1934	625	495
1935	6,485	1,404
1936	985	580
1937	14,775	3,750
1938	6,020	1,750
1939	2,090	830
1940	1,530	710
1941	19,300	4,770
1942	2,070	830
1943	2,750	970
1944	4,415	1,370
1945 [3]	7,555	2,025
1946	2,330	900
1947	615	485
TOTAL	72,440	21,305
MEAN	4,829	1,420
MEDIAN	2,330	900

NOTES:

1 Data from Table 5, p. 20. Schwalen (1967).
2 Records for water years 1933-1944 from a 1946 Report by Bureau of Reclamation, as referenced in Schwalen (1967).
3 Records for 1945-1947 adjusted from USGS records of Granite Creek near Prescott, as referenced in Schwalen (1967).

TABLE 3
ESTIMATED NATURAL RECHARGE IN THE PRESCOTT MODEL AREA
(FIGURES ARE ROUNDED TO NEAREST 50 ACRE-FEET)

WATERSHED	AREA [1] MILES^2	AVERAGE PRECIP.[2] INCH/YR	MEDIAN RECHARGE RATE [3] AF/MI^2	MEDIAN ANNUAL RECH.[4] AF/YR
WILLOW CREEK	23.3	19	39	900
SOUTH GRANITE CREEK	49.1	20	48	2,350
GRANITE MOUNTAIN	3.6	18	41	150
WEST INDIAN HILLS	3.2	14	32	100
COYOTE SPRINGS	10.1	16	36	350
WILDCAT DRAW	7.4	14	32	250
NORTH GRANITE CREEK	21.4	12	27	0
NORTH SULLIVAN BUTTES	4.4	12	27	0
SOUTH SULLIVAN BUTTES	9.7	14	32	300
LYNX CREEK	40.4	19	43	1,700
GLASSFORD HILL	1.1	16	36	50
GREEN GULTCH	14.2	16	36	0
TEXAS GULTCH	8.9	13	29	0
GRAPEVINE GULTCH	7.1	14	32	200
YEAGER CANYON	15.4	16	36	550
EAST INDIAN HILLS	2.1	14	32	50

NOTES:

1 Estimated watershed areas include only mountainous highland areas, and may therefore vary slighlty from other area estimates.
2 Estimated precipitation rates from Figure II-5 (ADWR,1993a).
3 Granite and Willow Creek recharge rates were estimated to equal the median annual streamflow on those creeks for the period 1933-1947, divided by the watershed areas. Rates for other watersheds were estimated by normalizing the individual watershed precipitation rates to the average Granite and Willow Creek rate of about 19.5 in./yr., and then multipying the normalized precipitation rate by the average Granite Creek and Willow Creek recharge rate of about 44 acre-feet per sq. mile.
4 Annual watershed recharge is estimated to be zero for some watersheds which are located at or near sub-basin outflow areas.

Natural recharge estimates have been calculated using the best (and only) data currently available. The estimated total natural recharge from all watershed areas was about 4,400 acre-feet per year for the Little Chino sub-basin, and about 2,600 acre-feet per year for the Upper Agua Fria sub-basin during the predevelopment era. These rates compare favorably with the individual estimates proposed by Schwalen (1967) for the Little Chino sub-basin of about 5,000 acre-feet per year, and Wilson (1988) for the Upper Agua Fria sub-basin of about 2,000 to 3,000 acre-feet per year. Additional support for the recharge estimates is provided by the natural discharge and underflow data and estimates which are discussed in the next section of this report.

Groundwater Discharge

Since steady-state conditions are indicated when recharge and discharge are in approximate balance, then the predevelopment natural recharge and discharge should have been about equal. Natural discharge from the Little Chino sub-basin is estimated to have been about 4,500 TO 5,000 acre-feet per year (about 3,000 acre-feet per year as spring discharge and evapotranspiration at Del Rio Springs, and about 1,500 TO 2,000 acre-feet per year as groundwater underflow to the Big Chino sub-basin). Natural discharge from the Upper Agua Fria sub-basin is estimated to have been about 1,500 to 2,500 acre-feet per year (mainly as perennial stream baseflow and evapotranspiration along the Agua Fria River near Humboldt). The estimated total discharge from the predevelopment groundwater system in the model area was about 6,000 to 7,500 acre-feet per year.

Although evapotranspiration has been mentioned, it thought to have not been a significant source of discharge from the groundwater system. Evapotranspiration was confined to a few sparse cottonwood trees and the cienega area near Del Rio Springs, and to a few medium to dense stands of cottonwoods along the Agua Fria River near Humboldt. Riparian growth was estimated from airphotos and USGS topographic maps to have covered an area of about 40 acres in the Del Rio Springs area, and about 35 acres along the Agua Fria River near Humboldt. Assuming average evapotranspiration rates range from about 2 to 5 acre-feet per acre (Culler, and others, 1982) the total evapotranspiration from the groundwater system was probably no more than a few hundred acre-feet per year. Due to the small magnitude of the evapotranspiration losses, and the close proximity of the riparian communities to the points of natural discharge, the evapotranspiration losses have been grouped with other natural discharge components in the conceptual water budget.

Conceptual Water Budget

A conceptual water budget for the predevelopment period (circa 1940) has been prepared (Table 4). The budget inflows include mountain-front recharge, and recharge from ephemeral stream channel infiltration. The budget outflows include spring discharge, stream baseflow, evapotranspiration, and groundwater underflow.

TABLE 4
CONCEPTUAL PREDEVELOPMENT WATER BUDGET (CIRCA 1940)
(FIGURES ROUNDED TO NEAREST 100 ACRE-FEET)

INFLOW	AF/YR
MOUNTAIN-FRONT RECHARGE AND EPHEMERAL STREAM CHANNEL RECHARGE (1)	7,000
TOTAL INFLOW	7,000
OUTFLOW	AF/YR
SPRING BASEFLOW (2)	3,000
STREAM BASEFLOW (3)	2,000
UNDERFLOW (4)	2,000
TOTAL OUTFLOW	7,000

NOTES:

1) Long-term estimates for model area made using streamgage, precipitation, and watershed area data (see text for details).
2) Spring baseflow at Del Rio Springs includes estimated evapotranspiration (approx. 100 AF/yr).
3) Stream baseflow discharge along the Agua Fria River near Humboldt includes estimated evapotranspiration (approx. 100 AF/Yr).
4) Groundwater underflow to Big Chino sub-basin, north of Del Rio Springs.

III. THE DEVELOPED HYDROLOGIC SYSTEM (1940-1993)

Developed Groundwater Conditions

Around 1940, a period of significant groundwater development began in the model area. Prior to that time there was little exploitation of the groundwater resources of the Little Chino and Upper Agua Fria sub-basins. Long-term groundwater recharge and discharge were in approximate balance, water levels remained more-or-less constant, and steady-state groundwater conditions generally prevailed.

Steady-state groundwater conditions ended in the Little Chino sub-basin around 1940 due to the major increase in groundwater pumpage for agricultural irrigation. According to Schwalen (1967) the use of artesian water for irrigation was just beginning in 1937, and the annual and seasonal lowering in artesian pressure had become a cause for concern (Schwalen, 1967, p. 11).

Farming and ranching operations also began in the Upper Agua sub-basin during the mid-1930's (Wigal, 1988). However, the amount of acreage farmed was small, and the volume of groundwater pumped was insufficient to significantly alter the long-term equilibrium. Near steady-state groundwater conditions probably existed in the Upper Agua Fria sub-basin until the mid-1960's when agricultural development and groundwater pumpage both increased significantly.

The period of groundwater development from 1940 to the late 1970's and early 1980's was generally characterized by increased groundwater pumpage and significant water level declines in many parts of the model area (see hydrographs, Plate 2). From the late 1970's to the present time the rate of water level decline has lessened substantially in many parts of the model area. In some areas water levels have stabilized or risen. The stabilization and rise of water levels in certain areas is attributed to substantial decreases in cropped acreage and agricultural groundwater pumpage, and also due to an increase in groundwater recharge from major flood events.

The era of groundwater development from 1940-1993 serves as the transient-state model simulation period. The 1940-1993 period was selected as the transient model calibration period. The various components of groundwater inflow and outflow have been identified and analyzed for this period of groundwater development. The inflow components include incidental recharge, ephemeral stream channel infiltration, mountain-front recharge, and artificial recharge. The outflow components include groundwater pumpage, spring discharge, stream baseflow, groundwater underflow, and evapotranspiration. The following sections discuss the characteristics, water levels, inflows and outflows of the developed groundwater system.

Transient Water Levels and Groundwater Flow

Between 1940 and 1960 agricultural pumpage had caused water level declines in both the Upper Alluvial Unit and Lower Volcanic Unit aquifers throughtout most of the Little Chino sub-basin (Plate 2). Water level declines in excess of 40 feet were noted in the much of the confined area of the Lower Volcanic Unit aquifer. Water level declines decreased in both aquifers towards the southern and eastern margins of the Little Chino sub-basin. Water level declines were probably minimal in the Upper Agua Fria sub-basin.

Although groundwater declines occurred in most of the Little Chino sub-basin, the general pattern and direction of groundwater flow in 1960 was still very similar to the steady-state, predevelopment flow patterns of 1940. However, in the agricultural area of the Little Chino sub-basin, water levels remained constant or rose in the shallow Upper Alluvial Unit aquifer (see shallow well hydrographs, Plate 2).

In this area "perched" water levels developed due to the presence of intervening, fine-grained layers in the vadose zone which substantially restricted the downward flow of excess, deep-percolating irrigation water. It is also possible that the zone of shallow water levels delineated a groundwater mound in the Upper Alluvial Unit aquifer, under which there was no unsaturated zone. Hydrographs of shallow Upper Alluvial Unit aquifer wells indicate that the area of perched or mounded water levels continued to develop until sometime in the late 1960's or early 1970's.

One interesting feature of the transient groundwater system was the seasonal fluctuation of water levels (Figure 9). The extreme fluctuations were the result of the seasonal variation in agricultural pumpage. Seasonal fluctuations of about 40 feet occured in the confined Lower Volcanic Unit aquifer between the low water level summer pumping season, and the high water level winter non-pumping season (Figure 9).

Seasonal water level fluctuations in the "perched" area of the Upper Alluvial Unit aquifer were smaller in magnitude and opposite in direction. Summer water levels rose by 10 to 20 feet in response to excess agricultural recharge, and declined during the non-irrigation season winter months (Figure 9).

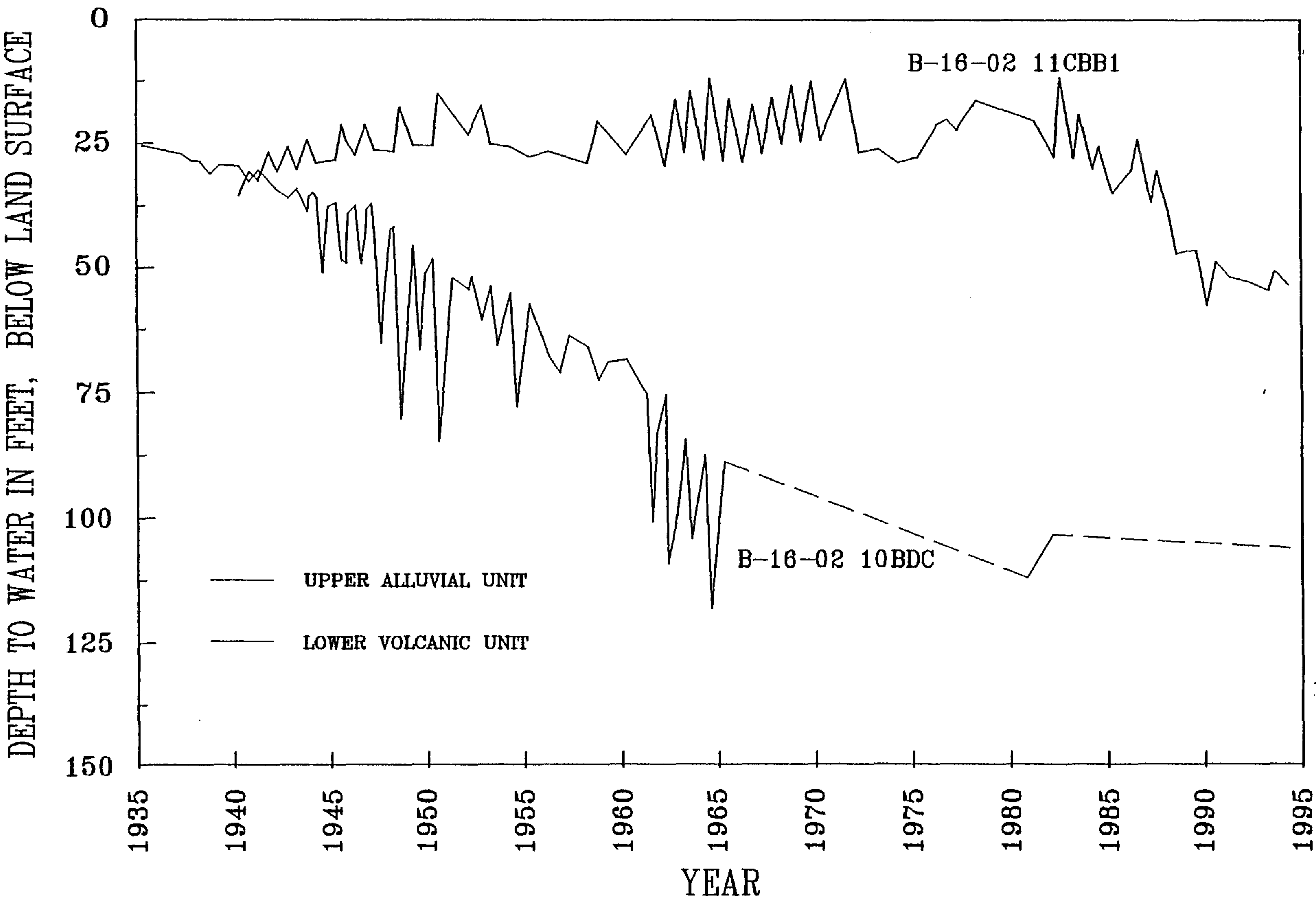


FIGURE 9

HYDROGRAPHS SHOWING SEASONAL WATER LEVEL FLUCTUATIONS IN THE UPPER ALLUVIAL UNIT AND LOWER VOLCANIC UNIT AQUIFERS IN THE LITTLE CHINO SUB-BASIN.

From 1961 to the late 1970's and early 1980's water levels continued to decline in much of the model area (Plate 2). By 1981, groundwater pumpage had caused water level declines of about 70 to 80 feet from predevelopment levels in the the confined zone of the Lower Volcanic Unit aquifer in the Little Chino sub-basin. By 1981 the vertical hydraulic gradient between confined Lower Volcanic Unit aquifer and the unconfined Upper Alluvial Unit aquifer had decreased substantially from the predevelopment gradient, and annual groundwater discharge to Del Rio Springs had declined from about 3,000 to around 2,200 to 2,400 acre-feet per year (Table 1). In the Lonesome Valley area water levels declined by 40 to 60 feet from predevelopment levels. By the end of the 1970's water levels in the "perched" or "mounded" area had also begun to decline due to the increase of shallow domestic well pumpage (Plate 2).

By 1981, groundwater pumpage in the Upper Agua Fria sub-basin had created a localized cone of depression in the Prescott Valley area (Plate 2). Groundwater discharge as baseflow on the Agua Fria River near Humboldt was reduced from predevelopment levels of about 1,500 to 2,500 acre-feet per year to about 1,100 acre-feet per year (Table 1).

As mentioned earlier, the general rate of water level decline decreased substantially during the late 1970's and 1980's (see hydrographs, Plate 2). The recent stabilization of water levels in some wells does not necessarily signal a return to steady-state conditions within the model area. The stabilization trend is probably a transient phenomenon which reflects the groundwater system's temporary adjustments to a new reduced pumpage regime, and a period of increased precipitation (Figure 10), and increased natural recharge from major flood flows.

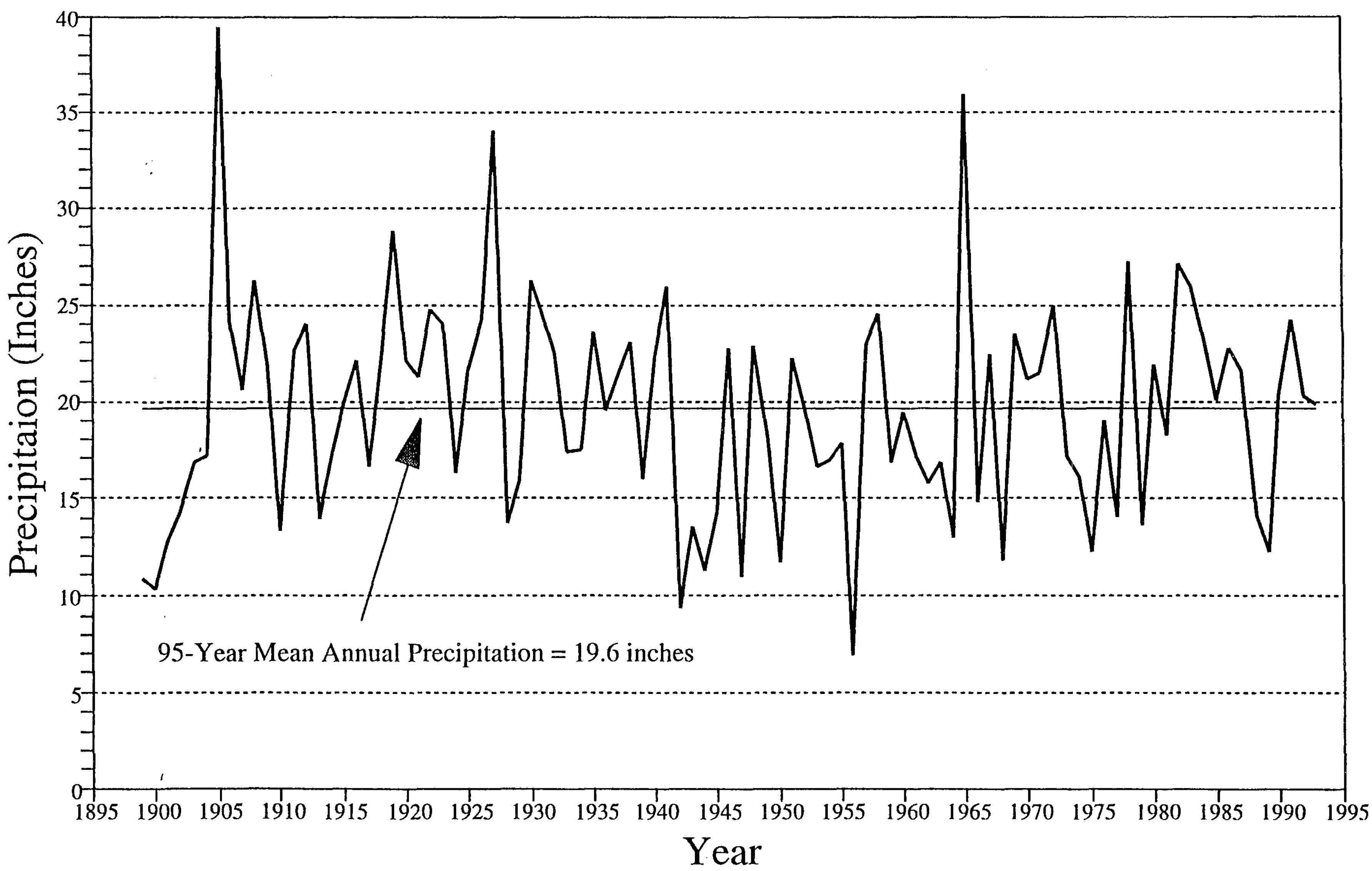
From the early 1980's to 1993 water levels continued to decline in many parts of the model area, however the rate of decline was less than in previous periods (see hydrographs, Plate 2). In the northwestern section of the agricultural area of the Little Chino sub-basin water levels declined by 10 to 20 feet in the Lower Volcanic Unit (Plate 3). Water levels also declined by as much as 40 feet in the "perched" or "mounded" zone of the Upper Alluvial Unit aquifer (Plate 3). The water level decline in the "perched" zone is attributed to the reduction in agricultural recharge and an increse in shallow domestic well pumpage which taps the "perched" zone. Water level declines in the Upper Alluvial Unit aquifer near Humboldt generally measured less than 5 feet.

Water levels rose slightly (5 to 10 feet) or remained stable in the northern and western sections of Lonesome Valley in the Little Chino sub-basin (Plate 3). Water levels also rose in some wells in the Prescott Valley area, and along Lynx Creek in the Upper Agua Fria sub-basin. It should be noted that the areas of water level rise were generally located near the major surface water drainages in the model area. It is believed that increased recharge from flood flows partially accounts for the rises in these areas.

The 1993 Upper Alluvial Unit and Lower Volcanic Unit aquifer

Prescott Mean Annual Precipitation
Period of Record: 1899 - 1993

Figure 10



water levels are shown in Plate 2. The orientation of the contours indicates that the general directions of groundwater flow have remained very similar to the predevelopment flow patterns (circa 1940). Composite Upper Alluvial Unit and Lower Volcanic Unit water level data from 1994 are shown in Plate 3. The depth-to-water in 1994 is also presented in Plate 3.

The recent (1993-1994) water level data shows that the east-west oriented groundwater divide still exists in the northern part of the Upper Agua Fria sub-basin (Plates 2 and 3). Groundwater flows north from the divide into the Little Chino sub-basin, and south into the Upper Agua Fria sub-basin. Groundwater underflow still converges at the basin outflows near Del Rio Springs, and Humboldt. In 1993, the estimated groundwater underflow through the bedrock narrows northwest of Del Rio Springs was about 1,500 acre-feet per year (estimate based on flow-net analysis).

Groundwater Recharge

The major sources of groundwater recharge for the 1940-1993 transient model calibration period are divided into four categories: 1) agricultural recharge, 2) natural recharge (with individual flood events analyzed seperately), 3) artificial recharge, and 4) canal recharge. It should be noted that minor incidental recharge may also be generated by septic tanks in areas where the depth-to-water is shallow, such as in the perched water table area of the Little Chino sub-basin. However, the total volume of recharge from septic tanks is assumed to be negligible when compared to the other sources of recharge, and therefore recharge from septic tanks was not simulated in this modeling study.

The recharge estimates discussed and tabulated in this report represent either long-term average values or maximum potential values. The natural recharge estimates were long-term average estimates, and therefore natural recharge in any particular year may be greater than or less than the tabulated value. Annual recharge volumes from agricultural irrigation, canal leakage, and flood flows were estimated at levels which were believed to be the maximum potential value for any specific year. Due to this differrence between the two types of recharge estimates the natural recharge estimates remained unchanged during the model calibration, while the maximum potential estimates were subject to reduction if necessary.

The estimated maximum potential recharge from all sources for the period 1940-1993 was about 770,000 acre-feet. Annual recharge estimates are tabulated for both the Little Chino and Upper Agua Fria sub-basins (Tables 5 and 6). The methodologies utilized to make the estimates are discussed in the following sections.

1) Agricultural Recharge

Recharge of excess agricultural irrigation water represents the single, largest source of groundwater recharge during the period of groundwater development from 1940-1993. Agricultural recharge estimates were made using the maximum potential recharge

TABLE 5
ESTIMATED RECHARGE LIC SUB-BASIN (1940-1993) (ACRE-FEET)

YEAR	NATURAL (1)	FLOOD (2)	AG (3)	CANAL (4)	ARTIFICIAL (5)	TOTAL RECHARGE
1940	2,050	0	2,540	1,500	0	6,090
1941	2,050	0	2,291	1,500	0	5,841
1942	2,050	0	3,104	1,500	0	6,654
1943	2,050	0	3,442	1,500	0	6,992
1944	2,050	0	4,257	1,500	0	7,807
1945	2,050	0	4,535	1,500	0	8,085
1946	2,050	0	4,709	1,500	0	8,259
1947	2,050	0	5,696	1,500	0	9,246
1948	2,050	0	7,467	1,500	0	11,017
1949	2,050	0	7,450	1,500	0	11,000
1950	2,050	0	7,489	1,500	0	11,039
1951	2,050	0	7,292	1,500	0	10,842
1952	2,050	0	7,197	1,500	0	10,747
1953	2,050	0	7,716	1,500	0	11,266
1954	2,050	0	7,375	1,500	0	10,925
1955	2,050	0	8,698	1,500	0	12,248
1956	2,050	0	8,684	1,500	0	12,234
1957	2,050	0	8,814	1,500	0	12,364
1958	2,050	0	8,942	1,500	0	12,492
1959	2,050	0	9,281	1,500	0	12,831
1960	2,050	0	8,331	1,586	0	11,967
1961	2,050	0	8,400	0	0	10,450
1962	2,050	0	8,608	760	0	11,418
1963	2,050	0	8,562	1,290	0	11,902
1964	2,050	0	7,542	1,790	0	11,382
1965	2,050	0	6,580	4,090	0	12,720
1966	2,050	0	6,199	3,072	0	11,321
1967	2,050	0	6,201	1,586	0	9,837
1968	2,050	0	6,381	1,500	0	9,931
1969	2,050	0	6,342	1,500	0	9,892
1970	2,050	0	6,673	1,500	0	10,223
1971	2,050	0	7,502	1,500	0	11,052
1972	2,050	0	7,573	1,500	0	11,123
1973	2,050	0	8,675	1,500	0	12,225
1974	2,050	0	10,312	1,500	0	13,862
1975	2,050	0	7,802	1,500	0	11,352

YEAR	NATURAL (1)	FLOOD (2)	AG (3)	CANAL (4)	ARTIFICIAL (5)	TOTAL RECHARGE
1976	2,050	0	6,422	1,500	0	9,972
1977	2,050	0	9,168	1,500	0	12,718
1978	2,050	4,320	8,222	1,500	0	16,092
1979	2,050	0	4,773	1,500	0	8,323
1980	2,050	6,240	5,544	2,207	0	16,041
1981	2,050	0	5,940	221	0	8,211
1982	2,050	0	6,365	2,249	0	10,664
1983	2,050	1,920	6,317	1,681	0	11,968
1984	2,050	0	6,251	1,685	0	9,986
1985	2,050	0	7,256	3,976	0	13,282
1986	2,050	0	5,670	4,202	0	11,922
1987	2,050	0.	4,066	2,980	0	9,096
1988	2,050	0	3,635	2,669	1,100	9,454
1989	2,050	0	3,165	175	2,100	7,490
1990	2,050	0	2,608	0	2,100	6,758
1991	2,050	0	3,872	2,702	2,100	10,724
1992	2,050	0	2,912	2,500	2,100	9,562
1993	2,050	18,720	4,082	2,500	2,100	29,452
TOTAL	110,700	31,200	344,930	91,921	11,600	590,351

NOTES:

1) Little Chino natural recharge estimate is a long-term average. This estimate has been reduced from the predevelopment estimate of 4,400 acre-feet per year to account for the diversion of surface flows from south Granite Creek. See natural recharge section for more details.
2) Estimated natural recharge from specific flood events on Granite Creek flows across the Little Chino sub-basin 1978-1993. See flood recharge section for more details.
3) Estimated incidental recharge from excess agricultural irrigation water. The listed figures are calculated as 50 percent of the total agricultural water demand assuming a 50 percent irrigation efficiency. Source of irrigation efficiency data is Foster (1993a).
4) Estimated incidental recharge from seepage along the Chino Valley Irrigation District (CVID) main canal. The listed figures are equal to the 50 percent of the total estimated annual diversion of surface flows from Granite and Willow Creek. Source of seepage rate estimates is Foster (1994).
5) Estimated artificial recharge at the City of Prescott Airport Recharge Facility. Source of data: (Huza, 1993).

TABLE 6
ESTIMATED RECHARGE UAF SUB-BASIN (1940-1993)
(ACRE-FEET)

YEAR	NATURAL (1)	AG (2)	TOTAL RECHARGE
1940-1964	63,750	0	63,750
1965	2,550	2,400	4,950
1966	2,550	2,400	4,950
1967	2,550	2,400	4,950
1968	2,550	2,400	4,950
1969	2,550	2,400	4,950
1970	2,550	2,400	4,950
1971	2,550	2,400	4,950
1972	2,550	2,400	4,950
1973	2,550	2,400	4,950
1974	2,550	2,400	4,950
1975	2,550	2,400	4,950
1976	2,550	2,400	4,950
1977	2,550	2,160	4,710
1978	2,550	2,160	4,710
1979	2,550	1,920	4,470
1980	2,550	1,920	4,470
1981	2,550	1,440	3,990
1982	2,550	910	3,460
1983	2,550	480	3,030
1984	2,550	317	2,867
1985	2,550	423	2,973
1986	2,550	407	2,957
1987	2,550	390	2,940
1988	2,550	392	2,942
1989	2,550	392	2,942
1990	2,550	351	2,901
1991	2,550	389	2,939
1992	2,550	320	2,870
1993	2,550	380	2,930
			0
TOTAL	137,700	43,551	181,251

NOTES:

1) Upper Agua Fria natural recharge estimate is a long-term average. This number equals the estimated predevelopment natural recharge rate. See natural recharge section for further details.
2) Estimated incidental recharge from excess agricultural irrigation. The listed figures are calculated as 50 percent of the total agricultural water demand assuming a 50 percent irrigation efficiency. Source of irrigation efficiency data is Foster (1993a).

approach, where it was initially assumed that the entire volume of water associated with irrigation inefficency could potentially be recharged. Subsequently, during the transient model calibration the initial estimates of agriculture recharge could be reduced if it was found appropriate to do so.

The annual volume of agriculture recharge was estimated to be equal to the average annual irrigation inefficiency (that is, one minus the irrigation efficiency) multiplied times the total annual agricultural water use. The average annual irrigation efficiency for farms in the model area was estimated by personnel of the Prescott AMA to be about 50 percent (Foster, 1993a). The irrigation efficiency was estimated using US Soil Conservation Service methodologies which consider average field slopes, soil types, irrigation methods, etc. (Foster, 1993a). Based on a 50 percent irrigation efficiency, the maximum potential recharge from agricultural irrigation in the Little Chino sub-basin was about 345,000 acre-feet for the period 1940-1993. During that same period the maximum potential recharge from agricultural irrigation in the Upper Agua Fria sub-basin was estimated to be about 43,000 acre-feet. The areal distribution of the annual agricultural recharge volumes for the period 1940-1983 was proportional to the Irrigation Grandfathered Rights (IGFR) cropped acreage distribution throughout the model area. The areal distribution of the annual agricultural recharge volumes for the period 1984-1993 was proportional to the average distribution of ROGR agricultural pumpage for that period. This change in distribution patterns was made to account for agricultural land which was no longer in production, and therefore places recharge in areas where current agricultural activity exists.

It should be noted that the annual recharge volume estimates are made using the assumption that there is no time-lag associated with the downward percolation of recharge water through the vadose zone. Therefore, agricultural recharge water is assumed to reach the water table instantaneously. This assumption is appropriate in the model area because the depth-to-water under agricultural land is relatively shallow, and the actual period of downward flow through the vadose zone is relatively short, as shown by the rapid response of shallow wells to the summer application of irrigation water.

2) Natural Recharge

The major sources of natural recharge to the Little Chino and Upper Agua Fria sub-basins are from mountain front recharge and ephemeral stream channel infiltration. Estimates of the volume and distribution of natural recharge have been discussed earlier in this report. Although the estimates were made for the predevelopment era, they also generally apply for the modern developmental era (except for the natural recharge associated with South Granite Creek).

During the period 1940-1993, natural recharge from ephemeral stream flow along South Granite Creek (2,350 acre-feet per year) was essentially eliminated due to the diversion of surface flow by the Chino Valley Irrigation District (CVID). During that period streamflow only occured along Granite Creek below the CVID diversion in times of exceptional precipitation and runoff. For that reason the natural recharge from Granite Creek was eliminated for the transient model calibration period of 1940-1993 except for certain flood years (see next section for details on natural recharge from specific flood events).

It should be noted that the estimated natural recharge for the Willow Creek (900 acre-feet per year) watershed was not reduced during the transient model calibration. The Willow Creek recharge was not reduced from the predevelopment levels in order to account for occasional spills from either Willow Creek or Granite Creek that did not carry across the Little Chino sub-basin, and therefore were not analyzed as separate flood recharge events. Maintaining the Willow Creek recharge is also supported by the interpretation of water level data and water level contours which indicates that a source of mountain front recharge still exists immediately to the north of the Willow Creek watershed (Plates 2 and 3).

After making reductions to account for the diversions from Granite Creek the estimated natural recharge for the Little Chino sub-basin during the period 1940-1993 was about 2,050 acre-feet per year. Due to the general lack of surface water diversion or use in the Upper Agua Fria sub-basin natural recharge is believed to occur at the estimated predevelopment level of about 2,550 acre-feet per year.

3) Flood Recharge

Infiltration from flood events on Granite Creek was analyzed as a potential source of recharge. As mentioned earlier the sandy channel of Granite Creek north of the Granite Dells was the major groundwater recharge zone in the Little Chino sub-basin prior to the construction of dams on Granite Creek and Willow Creek. Today, recharge from Granite Creek occurs only during periods of significant precipitation and runoff when flood waters flow across the entire length of the Little Chino sub-basin and join the Verde River southeast of Paulden.

Recharge from major spills and flood events on Granite Creek was estimated from the mid 1970's to 1993. It is assumed that major flooding did not occur from 1940 to the mid-1970's. This assumption is based upon **1)** Schwalen's account (1967, p.51) that there was no evidence that spills from the Granite Creek reservoir were sufficient to carry any water out of the drainage basin from 1941 to the mid-1960's, **2)** the close agreement between the groundwater storage changes calculated from the conceptual water budget (which did not account for any flood recharge) for the period 1940-1975, and the groundwater storage changes calculated from measured water level changes and an assumed value of 7 percent for specific yield, **3)** an analysis of stream gage data for the Verde River near Paulden (USGS Streamgage #09503700) and precipitation data at Prescott which suggested that significant flood events probably did not occur on Granite Creek from 1963 thru 1977, **4)** anecdotal accounts from residents of the Chino Valley area concerning specific years when Granite Creek flooded, and flowed across the entire length of the Little Chino sub-basin.

Since there are no recent streamflow measurements available from the combined Granite Creek-Willow Creek watershed it was necessary to estimate the probable time and duration of significant flooding on Granite Creek by analyzing the record of streamflow on the Verde River near Paulden, and precipitation data from a gage located at Prescott (EarthInfo, 1994).

The analysis of the stream gage data showed that median monthly baseflows on the Verde River near Paulden ranged from 23 CFS to 27 CFS during the period 1963-1991 (USGS, 1994). Analysis of the daily mean flows further showed that there were a few short periods, usually from January to March, when streamflow ranged from several hundred to several thousand CFS. Many of these periods of exceptionally high stream flow correlated closely with periods of above average precipitation at Prescott.

Although high stream flows at the Paulden streamgage can also be caused by runoff from the Big Chino sub-basin the assumption was made that flood flows on Granite Creek probably crossed the Little Chino sub-basin during periods of above average precipitation at Prescott when unusually high stream flows were also observed on the Verde River at the Paulden gage. Table 7 provides a listing of the periods when significant flood flows on Granite Creek are believed to have crossed the Little Chino sub-basin.

Recharge from the flood events was estimated using a wetted area approach. The area of inundation was estimated from eyewitness accounts of residents of the Chino Valley area who have reported that flood flows north of the Prescott Airport (Figure 1) spread to widths as great as a half mile. Although the creek may

TABLE 7
ESTIMATED FLOOD RECHARGE FROM GRANITE CREEK 1978-1993

YEAR	ESTIMATED FLOOD DAYS (1)	EXCESS MONTHLY PRECIPITATION DURING FLOOD (2) (INCHES)	ESTIMATED FLOOD RECHARGE (3) (ACRE-FEET)
1978	9	3.4	4,320
1980	13	4.6	6,240
1983	4	8.3	1,920
1993	39	NA	18,720

1) Flood days estimated from analysis of continuous days of significantly above average streamflow (in excess of several hundred CFS) at the USGS streamgage on the Verde River near Paulden.
2) Total monthly rainfall in excess of the 94-year monthly average rainfall at the raingage at Prescott.
3) Recharge estimated by multiplying the days of flooding by an estimated flooded area and an assumed infiltration rate. See text for further details.

spread up to a half a mile in width at that location, the initial assumption was made that it probably averaged no more than a quarter-mile in width for its entire 12 mile reach across the Little Chino sub-basin. The estimated maximum wetted area based on those dimensions was 1920 acres.

The next step consisted of multiplying the estimated wetted area by an assumed infiltration rate of .5 foot/day. The infiltration rate of .5 foot/day is about half the average infiltration rate of .92 foot/day estimated for flood events on the Salt River (Briggs, and Werho, 1966), (Corkhill, and others, 1993). This reduction in rate seemed justified considering the fact that the Salt River channel is primarily composed of cobbles and boulders which can easily transmit large infiltration volumes. The

Granite Creek channel is less coarse and probably unable to sustain similar infiltration rates for extended periods of time. The volume of recharge calculated assuming a wetted area of 1920 acres, and an infiltration rate of .5 foot/day was 960 acre-feet per day. This volume was multiplied by the estimated number of flood days to derive an estimate of recharge from any particular flood event. Using the described methodology, the estimated total maximum potential recharge from Granite Creek flood events for the period 1975-1993 was 62,400 acre-feet. It should be noted that the original estimates of flood recharge proved excessive when simulated during the transient model calibration. The original volumes were eventually reduced by 50 percent of their original volume to a total of 31,200 acre-feet, and it is those reduced volumes which are listed in Table 7. The reduction from the maximum potential estimates is a reflection of uncertainity in the estimated duration of flooding, area of inundation, and the assumed infiltration rate.

4) Artificial Recharge

Artificial recharge from the City of Prescott Airport Recharge facility has become a new and important source of recharge in the model area. Historically, the City of Prescott discharged most of the effluent generated at the Sundog Waste Water Treatment Facility into Granite Creek where it was impounded along with other Granite Creek surface flows in the Watson Lake Reservoir.

Since mid-1988 the treated effluent has been recharged at a specially constructed artificial recharge facility near the Prescott airport. The facility currently recharges between 2,000 and 2,200 acre-feet per year (Huza, 1993). The total effluent recharged by the City of Prescott from 1988 through 1993 was estimated to have been about 11,600 acre-feet (Table 5).

5) Canal Recharge

Recharge from the Chino Valley Irrigation District's unlined main canal (Figure 1) was estimated for the transient model calibration period. The annual recharge has been estimated as a maximum potential volume which is equal to 50 percent of the total annual diversion to the canal from the surface water flows of Granite Creek and Willow Creek.

For most years data regarding diversions or water deliveries to the farmers of the CVID were unavailable, and therefore estimates were made assuming that the average annual surface water diversion to the main canal was about 3,000 acre-feet per year (Schwalen, Table 11, 1967). Based on an estimated 50 percent seepage loss rate (Foster, 1994) the estimated maximum potential recharge from seepage losses averaged about 1,500 acre-feet per year. For years when water delivery data was available it was assumed that the seepage losses equaled the reported water deliveries to the farmers of the district. The maximum potential recharge from canal seepage was estimated to be about 92,000 acre-feet for the period 1940-1993 (Table 5).

The areal distribution of canal recharge was accomplished by measuring the canal reach length per model cell and prorating the total annual recharge volume in proportion to the canal reach length per model cell divided by the total canal length. Based on an average recharge volume of 1,500 acre-feet per year and a total canal length of about 15 miles the average annual recharge per mile of canal was about 100 acre-feet.

Groundwater Pumpage

Groundwater pumpage represents the major outflow from the groundwater system in the model area. Annual pumpage volumes, based on estimates and reported data, were developed for the period 1940-1993 for the Little Chino and Upper Agua Fria sub-basins (Tables 8 and 9). Groundwater pumpage was considered negligible prior to 1940. The total volume of groundwater pumpage in the model area grew from about 3,600 acre-feet per year in 1940 to an average maximum of about 24,000 acre-feet per year during the mid-1970's. The decline in agriculutural pumpage during the late 1970's and 1980's resulted in the average annual pumpage volume decreasing to about 15,000 acre-feet per year for the period 1979-1993. The total volume of groundwater pumpage for the period 1940-1993 is estimated to have been about 860,000 acre-feet.

Historically, over 78 percent of all groundwater pumpage in the model area has been for agricultural irrigation (Tables 8 and 9). However, due to a decline in agricultural activity during the 1980's and 1990's, the volume of agricultural pumpage has decreased substantially. During the period 1984-1993 agricultural pumpage in

TABLE 8
ESTIMATED PUMPAGE IN THE LIC SUB-BASIN (1940-1993)
(ACRE-FEET)

YEAR	AG ACRES (1)	AVE. C.U. (2)	AG DEMAND (3)	SURFACE WATER (4)	AG PUMPAGE (5)	PRESCOTT PUMPAGE (6)	MISC. PUMPAGE (7)	DOMESTIC PUMPAGE (8)	TOTAL PUMPAGE
1940	1,147	2.10	4,817	1,500	3,317	0	262	10	3,589
1941	1,085	2.10	4,557	1,500	3,057	0	25	10	3,092
1942	1,197	2.10	5,027	1,500	3,527	0	1,181	11	4,719
1943	1,365	2.10	5,733	1,500	4,233	0	1,151	12	5,396
1944	1,808	2.10	7,594	1,500	6,094	0	920	12	7,026
1945	1,962	2.10	8,240	1,500	6,740	0	830	16	7,586
1946	2,012	2.10	8,450	1,500	6,950	0	968	17	7,935
1947	2,453	2.10	10,303	1,500	8,803	0	1,088	18	9,909
1948	3,361	2.10	14,116	1,500	12,616	572	817	18	14,023
1949	3,285	2.10	13,797	1,500	12,297	374	1,102	18	13,791
1950	3,405	2.10	14,301	1,500	12,801	855	677	21	14,354
1951	3,361	2.10	14,116	1,500	12,616	1,129	468	21	14,234
1952	3,427	2.10	14,393	1,500	12,893	282	0	22	13,197
1953	3,577	2.10	15,023	1,500	13,523	733	408	22	14,686
1954	3,500	2.10	14,700	1,500	13,200	815	50	22	14,087
1955	3,266	2.61	17,049	1,500	15,549	1,054	347	23	16,973
1956	3,23[illegible]	2.61	16,866	1,500	15,366	1,543	501	24	17,434
1957	3,377	2.61	17,628	1,500	16,128	1,663	0	25	17,816
1958	3,426	2.61	17,884	1,500	16,384	1,463	0	26	17,873
1959	3,556	2.61	18,562	1,500	17,062	1,594	0	28	18,684
1960	3,493	2.38	16,661	1,586	15,075	1,688	0	33	16,796
1961	3,522	2.39	16,800	0	16,800	1,840	0	36	18,676
1962	3,609	2.39	17,215	760	16,455	1,934	0	40	18,429
1963	3,590	2.39	17,124	1,290	15,834	1,974	0	43	17,851
1964	3,162	2.39	15,083	1,790	13,293	2,141	0	44	15,478
1965	2,759	2.38	13,160	4,090	9,070	1,810	0	47	10,927
1966	2,599	2.39	12,397	3,072	9,325	1,610	0	48	10,983
1967	2,600	2.39	12,402	1,586	10,816	1,960	0	53	12,829
1968	2,671	2.39	12,761	1,500	11,261	1,610	0	57	12,928
1969	2,659	2.38	12,683	1,500	11,183	2,140	0	61	13,384
1970	2,588	2.58	13,345	1,500	11,845	1,940	0	73	13,858
1971	2,758	2.72	15,004	1,500	13,504	2,330	0	93	15,927
1972	2,729	2.78	15,146	1,500	13,646	2,200	0	118	15,964
1973	3,622	2.39	17,349	1,500	15,849	2,136	0	144	18,129
1974	4,100	2.52	20,623	1,500	19,123	2,973	0	176	22,272
1975	3,299	2.37	15,604	1,500	14,104	2,830	0	199	17,133

YEAR	AG ACRES (1)	AVE. C.U. (2)	AG DEMAND (3)	SURFACE WATER (4)	AG PUMPAGE (5)	PRESCOTT PUMPAGE (6)	MISC. PUMPAGE (7)	DOMESTIC PUMPAGE (8)	TOTAL PUMPAGE
1976	3,618	1.78	12,844	1,500	11,344	2,711	0	214	14,269
1977	3,828	2.40	18,336	1,500	16,836	2,967	0	245	20,048
1978	3,322	2.48	16,444	1,500	14,944	3,221	0	289	18,454
1979	2,042	2.34	9,546	1,500	8,046	3,139	0	340	11,525
1980	2,310	2.40	11,088	2,207	8,881	3,614	0	404	12,899
1981	2,475	2.40	11,880	221	11,659	3,714	0	487	15,860
1982	2,652	2.40	12,730	2,249	10,481	3,483	0	546	14,510
1983	2,632	2.40	12,634	1,681	10,953	3,407	0	608	14,968
1984	2,632	2.37	12,501	1,685	10,816	3,662	242	692	15,412
1985	3,141	2.31	14,511	3,976	10,535	3,474	326	766	15,101
1986	2,978	1.90	11,340	4,202	7,138	3,351	245	811	11,545
1987	1,694	2.40	8,132	2,980	5,152	3,798	259	869	10,078
1988	1,514	2.40	7,269	2,669	4,600	4,734	319	920	10,573
1989	1,319	2.40	6,329	175	6,154	5,492	312	978	12,936
1990	1,087	2.40	5,216	0	5,216	5,014	339	1025	11,594
1991	1,613	2.40	7,743	2702	5,041	5,240	285	1061	11,627
1992	1,213	2.40	5,823	2,500	3,323	5,075	249	1061	9,708
1993	1,701	2.40	8,164	2,500	5,664	5,652	434	1061	12,811
TOTAL			679,043	91,921	587,122	116,941	13,805	14,018	731,886

NOTES:

1) Ag acreage estimates from Schwalen (1967), Matlock (1973), and Foster (1993a).
2) Average consumptive use values 1940-1959 estimated based on Schwalen's estimated crop mixes of alfalfa, corn, beans, permanent pasture, small grains, and vegetables (Schwalen, pg. 48, 1967). 1960-1993 consumptive use values based on analysis of annual crop records (Foster, 1993a).
3) Ag Demand = (Ag acres * Average C.U.)/Irrigation Efficiency; Irrigation Efficiency = .5; Source: (Foster, 1993a).
4) Surface water delivered to lands by the Chino Valley Irrigation District. Volumes for some years estimated at 1,500 acre-feet (Schwalen, p. 52, 1967).
   1993 CVID surface water deliveries estimated from previous year.
5) Ag Pumpage = Ag Demand - Surface Water
6) City of Prescott pumpage from its Chino Valley Well field. Data from Schwalen (1967), Matlock (1972), Prescott (1993), ADWR (1994b).
7) Miscellaneous pumpage from 1940-1956 is agriculutral pumpage (Schwalen, Table 10, 1967). Miscellaneous pumpage 1984-1993 includes industrial, schools, small water providers, and others.
8) Domestic pumpage estimates based on ADWR "55" Well Registry File data (ADWR,1994c).
   Assumed domestic well pumpage rate = .5 acre-feet per year per domestic well (Foster, 1993b).

TABLE 9
ESTIMATED PUMPAGE UAF SUB-BASIN (1940-1993)
(ACRE-FEET)

YEAR	ESTIMATED AG ACRES (1)	AVERAGE C.U. (2)	AG PUMPAGE (3)	SHAMROCK PUMPAGE (4)	GOLF COURSE PUMPAGE (5)	MISC. PUMPAGE (6)	DOMESTIC PUMPAGE (7)	TOTAL PUMPAGE
1940 - 1964	0	0	0	0	0	0	231	231
1965	1000	2.4	4,800	200	0	0	17	5,017
1966	1000	2.4	4,800	200	0	0	18	5,018
1967	1000	2.4	4,800	200	0	0	19	5,019
1968	1000	2.4	4,800	200	0	0	21	5,021
1969	1000	2.4	4,800	200	750	0	24	5,774
1970	1000	2.4	4,800	200	750	0	26	5,776
1971	1000	2.4	4,800	200	750	0	31	5,781
1972	1000	2.4	4,800	200	750	0	36	5,786
1973	1000	2.4	4,800	200	750	0	39	5,789
1974	1000	2.4	4,800	200	750	0	46	5,796
1975	1000	2.4	4,800	200	750	0	49	5,799
1976	1000	2.4	4,800	200	750	0	53	5,803
1977	900	2.4	4,320	200	750	0	66	5,336
1978	900	2.4	4,320	200	750	0	75	5,345
1979	800	2.4	3,840	200	750	0	93	4,883
1980	800	2.4	3,840	300	750	0	123	5,013
1981	600	2.4	2,880	350	750	0	137	4,117
1982	400	2.4	1,920	500	750	0	150	3,320
1983	200	2.4	960	500	750	0	163	2,373
1984	132	2.4	635	543	701	46	181	2,106
1985	172	2.4	826	638	528	90	183	2,265
1986	170	2.4	814	677	778	152	204	2,625
1987	163	2.4	780	791	795	77	217	2,660
1988	166	2.4	795	1007	865	87	232	2,986
1989	165	2.4	794	1271	841	100	247	3,253
1990	146	2.4	703	1403	767	83	257	3,213
1991	162	2.4	779	1511	808	102	261	3,461
1992	134	2.4	641	1704	702	88	261	3,396
1993	158	2.4	760	1866	785	86	261	3,758
TOTAL			87,207	16,061	18,820	911	3,721	126,720

NOTES:

(1) Ag acreage estimates provided by Foster (1993a), Wigal (1988), ADWR (1994a).
Any ag pumpage prior to 1965 is considered negligible.

(2) Average consumptive use provided by Phil Foster, Prescott AMA.

(3) 1965-1983 ag pumpage estimated using the following relationship:
AG PUMPAGE = (AG ACREAGE x AVERAGE C.U.)/IRRIGATION EFFICIENCY; IRRIGATION EFFICENCY = .5 (FOSTER, 1993a).
1984-1993 ag pumpage from ADWR ROGR pumpage database records.

(4) 1965-1983 Shamrock Water Company Pumpage estimated. 1984-1993 Shamrock Water Company pumpage from ROGR database (ADWR, 1994a).

(5) Prescott Country Club (PCC) turf-related pumpage.

(6) Miscellaneous pumpage includes industrial, schools, small water provider, and other types of pumpage.

(7) Domestic pumpage estimates based on ADWR "55" Well Registry File Data.
Assumed domestic well pumpage rate = .5 acre-feet per year per domestic well.

the Prescott AMA model area decreased from about 65 to 39 percent of the total annual pumpage, while municipal pumpage by water providers increased from about 24 to 45 percent. During the same period domestic pumpage increased from about 5 to 8 percent. Groundwater withdrawls for industrial and miscellaneous uses comprised the balance of the annual pumpage which grew from about 6 to 8 percent.

1) Agricultural Pumpage

Due to the lack of well specific pumpage data prior to 1983 it was necessary to estimate agricultural pumpage for the period 1940-1983. Agricultural pumpage is known for the period 1984-1993 because the individual Irrigation Grandfathered Right (IGFR) holders reported their well-specific pumpage annually to the ADWR. Agricultural pumpage totals prior to 1984 were estimated for the Little Chino and Upper Agua Fria sub-basins based on available cropped acreage data, surface water delivery data, and crop-specific consumptive use and irrigation efficency data (Tables 8 and 9).

The annual agricultural pumpage totals were estimated in the following manner. First, annual cropped acreage totals were tabulated for the period 1940-1983. The sources for these estimates included Schwalen (1967), Matlock (1972), and Foster (1993a), Wigal (1988), and ADWR (1994b). Second, an average consumptive use value was calculated based on the average mix of crops during specified time periods (see Table 1 and Table 2 footnotes). Third, the average consumptive use values were multiplied by the annual cropped acreage totals to derive the annual consumptive use by crops. Fourth, the annual crop consumptive use totals were divided by an irrigation efficency factor of 50 percent to derive the total water use by agriculture. Fifth, in the Little Chino sub-basin surface water deliveries to farmers by the CVID were subtracted from the annual agricultural water use totals to estimate the annual agricultural pumpage totals (Tables 8 and 9).

It should be noted that the Little Chino estimates differ somewhat from previous estimates made by Schwalen (Table 10, 1967), and Matlock (Table 2, 1972). The primary differences between the estimates made in this report and those made by Schwalen and Matlock are: **1)** the agricultural water use estimates for this study are based on an average irrigation efficiency of 50 percent (Foster, 1993a). Schwalen and Matlock mention, but did not account for irrigation efficencies in their analyses. According to Matlock (1994) it was their belief that most of the extra water required due to irrigation inefficency would ultimately be recharged through deep percolation and therefore they only considered net pumpage. There is no disagreement between Schwalen and the current study concerning the idea that a large percentage of the excess irrigation water is recharged, however the approach has been taken in this study to estimate the gross agricultural pumpage, and separately estimate the agricultural recharge, **2)** the estimated average consumptive use values used in this analysis are lower than those used by Schwalen and Matlock. This difference may be partly due to the fact that this study utilized more recent consumptive use data than the Schwalen and Matlock studies, however the crop mix estimates were identical, **3)** the agricultural water use totals were adjusted for surface water deliveries. This adjustment was not performed by Schwalen or Matlock.

2) Water Provider Pumpage

Prior to about 1980 the only major water provider in the Prescott AMA was the City of Prescott. In the early part of the century the City of Prescott supplied some of its municipal water needs with spring water from Del Rio Springs. Spring water was pumped to Prescott until 1926 or 1927 when its use was discontinued (Schwalen, p. 45, 1967).

In 1948 the City of Prescott began pumping water from wells located near the Town of Chino Valley. The total pumpage is estimated at about 117,000 acre-feet for the period 1948-1993 (Table 8), (Schwalen, 1967), (Matlock, 1972), (Prescott, 1993). Pumpage for other small water providers has been summed into the miscellaneous pumpage category (Table 9).

As previously mentioned, major development and population growth has occurred in the Upper Agua Fria sub-basin only since the mid to late 1970's. Shamrock Water Company is the major water provider supplying the municipal water needs of the Town of Prescott Valley, and other smaller developments. Municipal pumpage totals for Shamrock Water Company are listed in Table 9, (Wigal, 1988), (ADWR, 1994b). It should be noted that the annual totals reported by Shamrock Water Company were reduced to reflect water pumped for turf irrigation at the Prescott Country Club. The golf course pumpage for turf irrigation is listed as a separate budget category in Table 9. Smaller water company pumpage has summed into the miscellaneous pumpage category.

3) Domestic Pumpage

In addition to the reported ROGR pumpage there is a substantial volume of unreported "exempt" pumpage from domestic wells which by law are not permitted to pump at a rate greater than 35 gallons per minute, or in excess of 10 acre-feet per year. Pumpage from exempt wells is estimated to average about 0.5 acre-feet per well per year (Foster, 1993b). As of 1993 there were approximately 5,500 registered domestic wells within the Prescott AMA (ADWR, 1994b). Approximately 2,600 of those wells are located within the model area. Assuming that most of those wells are operational, it is estimated that 1993 domestic well pumpage amounted to about 1,300 acre-feet within the model area.

4) Industrial and Miscellaneous Pumpage

Industrial and miscellaneous pumpage were summed into a single miscellaneous category. As mentioned previously this category comprises about 8 percent of total water use in the model area.

The miscellaneous pumpage category also includes pumpage for schools, small water providers, the Prescott Country Club golf course, and various other small volume water needs. It should also be noted that the Little Chino sub-basin miscellaneous pumpage from 1940 through 1956 (Table 8) was actually additional agricultural pumpage listed by Schwalen (1967).

5) Areal Distribution of Pumpage

Pumpage was distributed areally throughout the model area based on estimates and well-specific pumpage records. As mentioned earlier, individual well pumpage data were unavailable prior to 1984. Well-specific pumpage data were available for all non-domestic wells for the period 1984-1993, and those totals are listed in Tables 8 and 9.

Pre-1984 pumpage was areally distributed throughout the model area in the following manner. Annual agricultural pumpage totals for each sub-basin (Tables 8 and 9) were distributed to the agricultural model cells in proportion to the cropped acreage distribution. For example, in 1950 the total estimated agriculutral pumpage in the Little Chino sub-basin was 12,801 acre-feet (Table 8). This total was apportioned to the individual agricultural model cells within the sub-basin by multiplying the annual total pumpage by the ratio of the individual cell cropped acreage divided by the total cropped acreage in each sub-basin. The same methodology was followed to distribute the annual agricultural pumpage totals to agricultural model cells in the Upper Agua Fria sub-basin.

All major water provider pumpage by the City of Prescott and

Shamrock Water Company pumpage was distributed to individual wells based upon historical pumpage data Prescott (1993), Wigal (1988), ADWR (1994b). Annual domestic well pumpage was estimated for each model cell based upon domestic well counts supplied by the ADWR "55" Well Registration database.

6) Vertical Distribution of Pumpage

Pumpage was vertically distributed throughout the model area in the following manner. Most miscellaneous and domestic pumpage was distributed to the unconfined Upper Alluvial Unit aquifer. This approach is reasonable because most of the domestic wells within the basin areas of the model are shallow and do not penetrate the Lower Volcanic Unit aquifer, or the Basement Unit. However, pumpage was assigned to the Lower Volcanic Unit in the Little Chino sub-basin in areas where the Upper Alluvial Unit was unsaturated.

All pumpage within the Upper Agua Fria sub-basin was assigned to the Upper Alluvial Unit aquifer. This distribution was obviously required because the Lower Volcanic Unit aquifer was not simulated in that part of the model area (see previous sections on geology, and the conceptual groundwater system).

Individual agricultural model cell pumpage in the Little Chino sub-basin was distributed vertically between the Upper Alluvial Unit and Lower Volcanic Unit aquifers on a percentage basis. Initially, it was assumed that about 90 percent of the agricultural pumpage was derived from the Lower Volcanic Unit aquifer. This was based on well completion data and also on the relative average transmissivities of the Upper Alluvial Unit and Lower Volcanic Unit aquifers. The vertical distribution of pumpage in the Little Chino sub-basin was tested extensively, during the model calibration process, as a result the final percentage of agricultural pumpage assigned to the Lower Volcanic Unit was 75 percent of the total.

7) Seasonal Distribution of Pumpage

The annual pumpage is tabulated by major categories in Tables 8 and 9. However, these tables do not reflect the seasonal variation in agricultural pumpage which is characteristic of the Prescott AMA.

The agricultural pumping season begins generally in mid-March and extends through October. Since the agricultural pumping season is so well defined it was necessary to simulate two stress periods per year for the transient model calibration period. The "on" period for agricultural pumpage lasts for 7 months. All agricultural and golf course pumpage was applied to the model during the "on" period. Other types of pumpage such as municipal, domestic, and miscellaneous pumpage was simulated to occur year round with no "off" season. Therefore the annual totals in these categories were distributed uniformly throughout the year.

Groundwater Discharge

Natural discharges at Del Rio Springs, and along the baseflow reach of the Agua Fria River near Humboldt decreased during the period of groundwater development which lasted from the early 1940's to the early 1980's (Schwalen, 1967), (ADWR, 1994d). The decrease in natural discharge was caused by the decline in water levels in those areas.

The available stream gaging data show that the mean annual groundwater discharge at Del Rio Springs was about 2,800 acre-feet per year during the period 1940-1945. By 1984, the mean annual discharge had decreased to about 1,800 acre-feet per year (Figure 11). The 6-year mean annual discharge at Del Rio Springs was about 2,400 acre-feet per year for the period 1984-1989 (Table 1). Although the period of record is very short, and it is difficult to draw any definite conclusions, the increase in mean annual discharge from the 1984 low is probably due to a slight recovery of local water levels in the immediate vicinity of the spring (Plate 3). This slight water level recovery is attributed to decreased agricultural pumpage and increased precipitation and natural recharge.

Early (circa 1940) stream gage data were unavailable for the Agua Fria River near Humboldt. However, based on a steady-state assumption, the predevelopment mean annual baseflow should have been about eqaul to the natural recharge for the Upper Agua Fria sub-basin which is estimated to range from about 1,500 to 2,500 acre-feet per year (Wilson, 1988). By 1981, the mean annual baseflow on the Agua Fria near Humboldt had decreased to about 800 acre-feet per year (Figure 11). The 13-year mean annual baseflow was about 1,100 acre-feet per year for the period 1981-1993 (Table

1).

Examination of the recent gaging data from Del Rio Springs and the Agua Fria River near Humboldt shows that spring and stream baseflows are quite variable on an annual basis (Figure 11). The years of higher spring discharge and stream baseflow generally correlate to years of greater annual precipitation and natural recharge in the area (Figure 11). The annual variation in spring discharge and stream baseflow is also related to variations in groundwater pumpage, and incidental recharge.

It is interesting to note that there is a definite correlation between the Agua Fria baseflow and precipitation at Prescott. The two curves appear to be separated by a short time-lag of less than a year (Figure 11). The apparent lag is partly caused by significant differences in the measurement frequency of the precipitation data (daily) and the baseflow data (quarterly), and also to the mathematical averaging process. However, the lag may also reflect a natural time-delay associated with release of groundwater from bank storage after surface runoff conditions have ceased.

Conceptual Water Budget

The conceptual groundwater budgets for the Little Chino and Upper Agua Fria sub-basins for the transient model calibration period of 1940 through 1993 are presented in (Tables 10 and 11). Included in the budgets are all the major inflow and outflow components of the modern groundwater flow system in the model area.

FIGURE 11

MEAN ANNUAL DISCHARGE AT DEL RIO SPRINGS AND BASE FLOW ALONG THE AGUA FRIA RIVER AT HUMBOLDT COMPARED TO MEAN ANNUAL PRECIPITATION AT PRESCOTT (1981–1993)

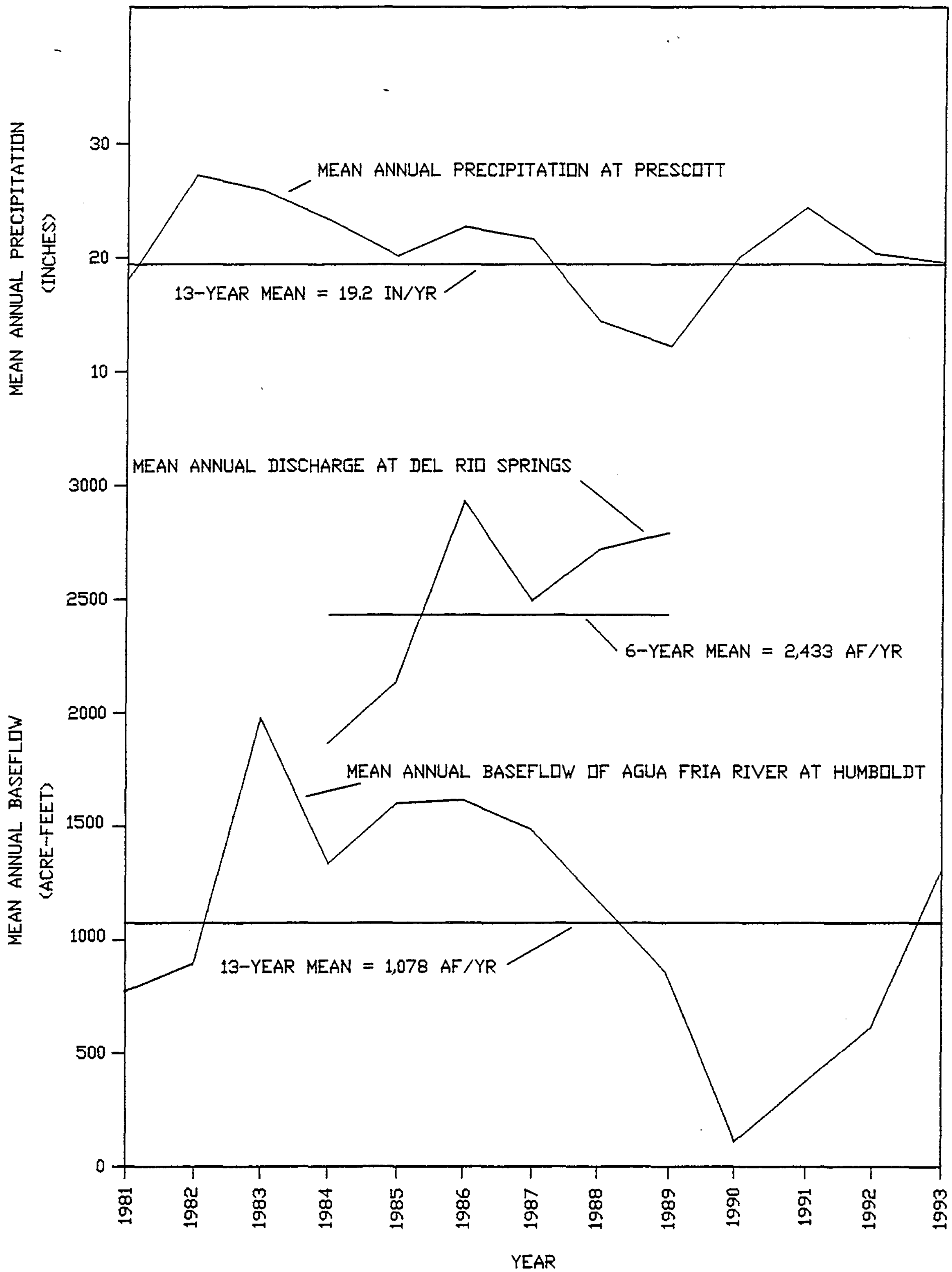


TABLE 10
CONCEPTUAL WATER BUDGET LIC SUB-BASIN (1940-1993)
(ACRE-FEET)

YEAR	TOTAL RECHARGE (1)	TOTAL INFLOW		TOTAL PUMPAGE (2)	NATURAL DISCHARGE (3)	TOTAL OUTFLOW	INFLOW MINUS OUTFLOW
1940	6,090	6,090		3,589	4,400	7,989	-1,899
1941	5,841	5,841		3,092	4,400	7,492	-1,651
1942	6,654	6,654		4,719	4,400	9,119	-2,465
1943	6,992	6,992		5,396	4,400	9,796	-2,804
1944	7,807	7,807		7,026	4,400	11,426	-3,619
1945	8,085	8,085		7,586	4,400	11,986	-3,901
1946	8,259	8,259		7,935	4,400	12,335	-4,076
1947	9,246	9,246		9,909	4,400	14,309	-5,063
1948	11,017	11,017		14,023	4,400	18,423	-7,406
1949	11,000	11,000		13,791	4,400	18,191	-7,191
1950	11,039	11,039		14,354	4,400	18,754	-7,715
1951	10,842	10,842		14,234	4,400	18,634	-7,792
1952	10,747	10,747		13,197	4,400	17,597	-6,850
1953	11,266	11,266		14,686	4,400	19,086	-7,820
1954	10,925	10,925		14,087	4,400	18,487	-7,562
1955	12,248	12,248		16,973	4,400	21,373	-9,125
1956	12,234	12,234		17,434	4,400	21,834	-9,600
1957	12,364	12,364		17,816	4,400	22,216	-9,852
1958	12,492	12,492		17,873	4,400	22,273	-9,781
1959	12,831	12,831		18,684	4,400	23,084	-10,253
1960	11,967	11,967		16,796	4,300	21,096	-9,129
1961	10,450	10,450		18,676	4,300	22,976	-12,526
1962	11,418	11,418		18,429	4,300	22,729	-11,311
1963	11,902	11,902		17,851	4,300	22,151	-10,249
1964	11,382	11,382		15,478	4,200	19,678	-8,296
1965	12,720	12,720		10,927	4,200	15,127	-2,407
1966	11,321	11,321		10,983	4,200	15,183	-3,862
1967	9,837	9,837		12,829	4,200	17,029	-7,192
1968	9,931	9,931		12,928	4,100	17,028	-7,097
1969	9,892	9,892		13,384	4,100	17,484	-7,592
1970	10,223	10,223		13,858	4,100	17,958	-7,735
1971	11,052	11,052		15,927	4,100	20,027	-8,975
1972	11,123	11,123		15,964	4,000	19,964	-8,841
1973	12,225	12,225		18,129	4,000	22,129	-9,904
1974	13,862	13,862		22,272	4,000	26,272	-12,410
1975	11,352	11,352		17,133	4,000	21,133	-9,781
1976	9,972	9,972		14,269	3,900	18,169	-8,197
1977	12,718	12,718		20,048	3,900	23,948	-11,230

YEAR	TOTAL RECHARGE (1)	TOTAL INFLOW		TOTAL PUMPAGE (2)	NATURAL DISCHARGE (3)	TOTAL OUTFLOW	INFLOW MINUS OUTFLOW
1978	16,092	16,092		18,454	3,900	22,354	-6,262
1979	8,323	8,323		11,525	3,900	15,425	-7,102
1980	16,041	16,041		12,899	3,800	16,699	-658
1981	8,211	8,211		15,860	3,800	19,660	-11,449
1982	10,664	10,664		14,510	3,800	18,310	-7,646
1983	11,968	11,968		14,968	3,800	18,768	-6,800
1984	9,986	9,986		15,412	3,800	19,212	-9,226
1985	13,282	13,282		15,101	3,800	18,901	-5,619
1986	11,922	11,922		11,545	3,800	15,345	-3,423
1987	9,096	9,096		10,078	3,800	13,878	-4,782
1988	9,454	9,454		10,573	3,800	14,373	-4,919
1989	7,490	7,490		12,936	3,800	16,736	-9,246
1990	6,758	6,758		11,594	3,800	15,394	-8,636
1991	10,734	10,734		11,627	3,800	15,427	-4,693
1992	9,562	9,562		9,708	3,800	13,508	-3,946
1993	29,452	29,452		12,811	3,800	16,611	12,841
TOTAL	590,361	590,361		731,886	223,200	955,086	-364,725

NOTES:

1) Total recharge includes natural recharge, incidental recharge, and artificial recharge (see recharge section for further details).

2) Total pumpage includes agricultural, municipal, domestic, industrial and miscellaneous pumpage (see pumpage section for further details).

3) Natural discharge includes Del Rio Springs spring flow, and groundwater underflow to the Big Chino sub-basin in the Sullivan Lake area.
Natural discharge declines represent reductions in springflow and groundwater underflow from the estimated predevelopment level of about 4,400 AF/YR to the currently estimated level of about 3,800 AF/YR.

TABLE 11
CONCEPTUAL WATER BUDGET UAF SUB-BASIN (1940-1993)
(ACRE-FEET)

YEAR	TOTAL RECHARGE (1)	TOTAL INFLOW		TOTAL PUMPAGE (2)	NATURAL DISCHARGE	TOTAL OUTFLOW	INFLOW MINUS OUTFLOW
1940-1964	63,750	63,750		231	63,750	63,981	-231
1965	4,950	4,950		5,017	2,550	7,567	-2,617
1966	4,950	4,950		5,018	2,500	7,518	-2,568
1967	4,950	4,950		5,019	2,400	7,419	-2,469
1968	4,950	4,950		5,021	2,300	7,321	-2,371
1969	4,950	4,950		5,774	2,200	7,974	-3,024
1970	4,950	4,950		5,776	2,100	7,876	-2,926
1971	4,950	4,950		5,781	2,000	7,781	-2,831
1972	4,950	4,950		5,786	1,900	7,686	-2,736
1973	4,950	4,950		5,789	1,800	7,589	-2,639
1974	4,950	4,950		5,796	1,700	7,496	-2,546
1975	4,950	4,950		5,799	1,600	7,399	-2,449
1976	4,950	4,950		5,803	1,500	7,303	-2,353
1977	4,710	4,710		5,336	1,400	6,736	-2,026
1978	4,710	4,710		5,345	1,300	6,645	-1,935
1979	4,470	4,470		4,883	1,200	6,083	-1,613
1980	4,470	4,470		5,013	1,100	6,113	-1,643
1981	3,990	3,990		4,117	1,100	5,217	-1,227
1982	3,460	3,460		3,320	1,100	4,420	-960
1983	3,030	3,030		2,373	1,100	3,473	-443
1984	2,867	2,867		2,106	1,100	3,206	-339
1985	2,973	2,973		2,265	1,100	3,365	-392
1986	2,957	2,957		2,625	1,100	3,725	-768
1987	2,940	2,940		2,660	1,100	3,760	-820
1988	2,942	2,942		2,986	1,100	4,086	-1,144
1989	2,942	2,942		3,253	1,100	4,353	-1,411
1990	2,901	2,901		3,213	1,100	4,313	-1,412
1991	2,939	2,939		3,461	1,100	4,561	-1,622
1992	2,870	2,870		3,396	1,100	4,496	-1,626
1993	2,930	2,930		3,758	1,100	4,858	-1,928
TOTAL	181,251	181,251		126,720	107,600	234,320	-53,069

NOTES:
1) Total recharge includes natural recharge, and incidental recharge (see recharge section for further details).
2) Total pumpage includes agricultural, municipal, domestic, industrial and miscellaneous pumpage (see pumpage section for further details).
3) Natural discharge consists of baseflow along the perennial reach of the Agua Fria River near Humboldt.
Natural discharge declines represent reductions in baseflow from the estimated predevelopment level of about 2,550 AF/YR to the currently estimated level of about 1,100 acre-feet per year.

It should be noted, that the number of significant digits does not indicate the accuracy of the estimate of the components. The volumes tabulated in the budgets comprise the initial input data for transient model calibration period of 1940-1993.

The groundwater inflow components of transient water budget include recharge from excess agricultural irrigation, canal seepage, and effluent recharge at the City of Prescott's Airport Recharge site. Groundwater inflows also include natural recharge of surface water runoff along the mountain fronts which border most of the model area, ephemeral stream channel infiltration, and infiltration from major flood events on Granite Creek.

The groundwater outflow components include natural discharge of groundwater as spring flow at Del Rio Springs, perennial stream baseflow along the Agua Fria River near Humboldt, and groundwater underflow through the bedrock narrows at the northern end of the Little Chino sub-basin to the Big Chino sub-basin. The groundwater outflows also include pumpage for agricultural, municipal, domestic, industrial and miscellaneous purposes.

The budget inflows and outflows were combined for both sub-basin in order to estimate the conceptual change in the volume of groundwater in storage. The conceptual change in the volume of groundwater in storage in the model area was about -418,000 acre-feet for the 54-year period 1940 through 1993, or an average groundwater overdraft of about 7,700 acre feet per year.

As a verification the change in the volume of groundwater in storage was also estimated using 1940-1993 water level change data and an assumed average specific yield of 7 percent. The estimated change in the volume of groundwater in storage (based on the water level change/specific yield methodology) in the model area was -322,000 acre-feet for the period 1940-1993. The general agreement between the two types of estimates indicates that the transient model stress inputs are reasonable.

CHAPTER FIVE - THE NUMERICAL GROUNDWATER MODEL

This chapter discusses the numerical model which has been develeloped to simulate groundwater flow conditions in the aquifer-system of the Prescott AMA. The model simulates the steady-state groundwater flow conditions of the predevelopment era (circa 1940), and the transient-state flow conditions of the period of groundwater development (1940-1993). The model is three-dimensional and simulates groundwater flow in and between the Upper Alluvial Unit and the Lower Volcanic Unit aquifers. The model simulates all the major inflows and outflows of the groundwater system which have been discussed in previous sections of the report. A computer database of the model input data was also developed and is available in a variety of file formats from the ADWR-Groundwater Modeling Section (see Appendices I and II for database content). A description of the model follows.

I. SELECTION OF THE MODEL CODE

The model code selected for this study was the Modular Three-Dimensional Finite-Difference Groundwater Flow Model (MODFLOW), developed by the USGS (McDonald and Harbaugh, 1988). The criteria considered for making this selection include:

1) the modular format of MODFLOW permits independent examination of specific hydrologic features,

2) the model code is flexible and can accomodate hydraulic interconnection between multiple hydrogeologic units,

3) documentation of the model code is relatively complete and comphrehensive,

4) the model code has been widely used in the hydrologic professional community and is generally accepted as a valid model to simulate groundwater flow. A detailed explanation of the mathematical theory, optional packages, and solution techniques are provided in the MODFLOW documentation (MacDonald and Harbaugh, 1988).

II. MODELING ASSUMPTIONS AND LIMITATIONS

Several assumptions have been made during the construction of the Prescott AMA groundwater flow model. The assumptions were necessary to analyze the complex aquifer-system of the model area. However, the assumptions also place certain limitations on the model. This section discusses some of the major assumptions and limitations.

1) The Prescott AMA groundwater flow model is a regional model which is not intended to provide site-specific determinations of hydrologic conditions.

2) Hydraulic heads computed within each model cell represent the average head within the saturated area of that cell.

3) Simulated groundwater recharge is applied directly to the uppermost active model cell.

4) The Lower Volcanic Unit aquifer can be treated as an isotropic, porous medium. Additionally, groundwater flow in the Lower Volcanic Unit aquifer is laminar (that is, non-turbulent), and can be approximated using Darcy's equation (Darcy, 1856). On a regional scale these assumptions are reasonable, however they may not apply on the local level due to non-laminar and turbulent flow conditions which may occur in fractures or cavities.

5) The available water level data adequately represent the groundwater flow system within the model area. In most areas this assumption is reasonable, however there are certain data deficient areas where the assumption is questionable (see Plate I).

6) Recharge from precipitation falling directly on the groundwater basin areas of the model domain is considered neglible. Because annual precipitation in basin areas averages about 12 to 14 inches per year, and surface water evaporation rates exceed 60 inches per year (see Chapter 4, natural recharge section). In addition, depth-to-water considerations preclude effective recharge by direct precipitation on the basins.

7) Evaporation of water from the water table is considered negligible. This is due to the fact that the depth-to-water in most parts of the study area is greater than 50 feet.

8) Evapotranspiration losses from riparian vegetation are neglible. This assumption is due to the very limited area of riparian vegetation in the active model area (see Chapter 4, groundwater discharge section). Evapotranspiration losses in those areas are included with the groundwater outflows of the basin.

III. PERIOD OF MODEL SIMULATED GROUNDWATER FLOW

The model has been used to simulate the steady-state groundwater flow conditions of the predevelopment era (circa 1940). The model also simulates the transient flow conditions of the period of groundwater development from 1940 through 1993.

IV. GENERAL CHARACTERISTICS OF THE GROUNDWATER MODEL

The general characteristics of the Prescott AMA groundwater flow model are discussed in the following section, and are summarized in Table 12.

TABLE 12
CHARACTERISTICS OF THE PRESCOTT AMA GROUNDWATER MODEL

MODEL CHARACTERISTIC	DESCRIPTION	MODEL UNITS
Steady-State Calibration	Predevelopment Era (Circa 1940)	
Transient-State Calibration	Developed Era (1940-1993)	Time = Days
Finite-Difference Model Grid	48 Rows by 44 Columns	Length = Feet
Layer 1 (UAU)	Unconfined Aquifer	Length = Feet
Layer 2 (LVU)	Confined/Unconfined Aquifer	Length = Feet
Horizonal Hydraulic Conductivity	No Horizontal Anisotrophy	Feet/Day
Vertical Hydraulic Leakance (Vcont)	$K_{Vertical}$/Vertical Flow Path Length	1/Days
Specific Yield	Volume of water yielded per unit area per unit drop in water table	Dimensionless
Storage Coefficient	Volume of water yielded per unit area per unit drop in confined aquifer potentiometric surface	Dimensionless
Recharge	Applied to uppermost active cell	Feet/Day
Pumpage	Distributed between all model layers	$Feet^3$/Day
Model Cell Types	No-Flow, Constant and Variable Head	
Boundary Conditions	Constant Head, Constant Flux	
Numerical Solution Technique	Strongly Implicit Procedure	0.01 Feet Closure Criterion

MODFLOW Input Packages

The model was constructed using six modular input packages offered by MODFLOW. The packages used were: 1) the BASIC package, 2) the **B**lock-**C**entered **F**low package (BCF), 3) the WELL package, 4) the RECHARGE package, 5) the DRAIN package, 6) and the **S**trongly **I**mplicit **P**rocedure (SIP) package. The following brief descriptions of the modular input packages were taken, in-part, from the MODFLOW manual (McDonald and Harbaugh, 1988).

The BASIC package handled a number of administrative tasks for the model. The package read data on the number of rows, columns, layers, and stress periods. The package also read data specifying initial water levels, boundary conditions, the discretization of time, and calculated an overall water budget. The BASIC package also controlled the allocation of computer memory.

The BCF package contained the basic geologic inputs which were used to compute the conductance components of the finite-difference equations which determined flow between adjacent model cells. The package also computed the terms that determined the rate of movement of water to and from storage.

The WELL package simulated groundwater pumpage from the aquifer-system in the model area. The package simulated groundwater withdrawls for agricultural, municipal, industrial and miscellaneous uses.

The RECHARGE package simulated groundwater recharge to the aquifer-system in the model area. The package simulated natural recharge, recharge from excess agricultural irrigation, flood recharge, artificial recharge, and canal recharge.

The DRAIN package was used to simulate naturally occurring groundwater discharge as spring flow at Del Rio Springs, and as stream baseflow along the Agua Fria River near Humboldt.

The SIP package was used to implement the Strongly Implict Procedure, a numerical method for solving the large system of simultaneous linear finite-difference equations by iteration.

Model Grid

The Prescott AMA model grid is an orthogonal grid consisting of 2 layers, 48 rows, and 44 columns. The principal axes of the grid are closely aligned with the local baseline and meridian. Grid cells are a half mile in length and width (Figure 12).

The "active" model domain corresponds to the groundwater basin areas of the Little Chino and Upper Agua Fria sub-basins. The active model domain is that region of the model where groundwater flow conditions are simulated to occur. The active model area encompasses about 220 square miles (Figure 12).

Model Layers and Aquifer Conditions

Two model layers were used to represent the aquifer-system in the model area. The upper layer, Layer 1, corresponds to the Upper Alluvial Unit aquifer. The bottom layer, Layer 2, corresponds to the Lower Volcanic Unit aquifer.

The Upper Alluvial Unit aquifer is modeled as an unconfined, water table aquifer, which extends throughout the model area (Figure 4). The Lower Volcanic Unit aquifer is modeled as a fully convertible confined/unconfined aquifer which extends throughout the northern half of the model area (Figure 4). The Lower Volcanic Unit aquifer is confined in areas where the overlying Upper Alluvial Unit aquifer is saturated, and unconfined in areas where the Upper Alluvial Unit is unsaturated.

The thicknesses of the model layers were defined by well log data, and gravity data (Chapter 2). The thickness of the Upper Alluvial Unit aquifer, Layer 1, varied from 0 feet at the basin margins, to over 1,000 feet in the central trough of the Little

Chino and Upper Agua Fria groundwater basins (Figure 3). For modeling purposes the Lower Volcanic Unit aquifer, Layer 2, was assigned a uniform thickness of 200 feet. This simplification was made based on the sparse geologic and gravity data available which indicate that the productive thickness of the Lower Volcanic Unit aquifer is limited to the upper few hundred feet (see Chapter 2).

Boundary Conditions

The active model boundary was setup to encompass the main groundwater basin area of the Prescott AMA. In most locations the active model region is bounded by impermeable Basement Unit formations which form the "inactive" portion of the model. The location of the active model boundary is shown in Figure 12.

Groundwater flow in the active portion of the model was simulated using two specific types of model cells. Variable head cells were used throughout most of the active model region. Variable head cells permit water level changes to occur in response to changing groundwater storage conditions. Constant head cells were used in Layer 1 at the groundwater outflow boundary north of Del Rio Springs (Figure 12). Constant head cells fix water levels at specified elevations, and are typically located at model boundaries in areas of relatively stable water levels where groundwater fluxes enter or exit the active model domain.

Other boundary fluxes such as mountain front recharge, and ephemeral stream channel infiltration were simulated using constant flux conditions. Constant fluxes were implemented by applying recharge to the variable head cells which are located near and along the border of the active model domain. Head-dependent, naturally occurring groundwater discharge from Del Rio Springs and along the baseflow reach of the Agua Fria River near Humboldt were simulated using the DRAIN package.

Vertical Leakance

In the model, the vertical groundwater flux between the Upper Alluvial Unit aquifer (Layer 1) and the Lower Volcanic unit aquifer (Layer 2) is controlled by the vertical hydraulic gradient, and MODFLOW's vertical leakance factor, Vcont. The Vcont factors were originally estimated by dividing the harmonic mean vertical hydraulic conductivity of two vertically adjacent model cells by the vertical flow path length between the midpoints of the cells.

V. BASIC DATA REQUIREMENTS

Data Estimation and Discretization

The basic geologic and hydrologic data inputs to the groundwater flow model have been discussed earlier in this report. As mentioned in previously, there were many data deficient areas where geologic and/or hydrologiic data were unavailable. Due to these deficiencies it was necessary to estimate model data inputs over much of the model domain.

In many instances model data were estimated and hand contoured by the authors based on the their analysis of the available data. However, geostatistical methods were also utilized to help estimate model data inputs. The geostatistical methods included semivariogram analysis and krieging. The reader is referred to Davis (1973) for a detailed discussion of these techniques.

Semivariogram analysis was performed using the geostatistical computer program GEO-EAS (US Environmental Protection Agency,1988) on hydraulic conductivity, transmissivity, specific yield data (and log transformed data) which were generated using the Driller's Log Program. Unfortunately, the results of the semivariogram analysis indicated no apparent structure to the data (it being horizontal or "nugget-like" in form), and therefore were of little value in selecting krieging parameters. Krieging, and computer contouring were employed in the analysis of some of the water level data using the statistical and graphical program, SURFER (R), (Golden Software, 1990).

The discrete data inputs which were required for each active model cell were generally obtained from contour maps using a manual discretization process. An example of the discretization process was as follows: the 1940 Upper Alluvial Unit aquifer water level contour map was created from the available water level data. The model grid was superimposed over the water level contour map and a discrete water level value was assigned for each model cell. In areas where model cells lay between water level contours, the water level for the model cell was interpolated. Table 13 summarizes the hydrologic and data inputs for the model.

TABLE 13
SUMMARY OF HYDROGEOLOGICAL MODEL INPUT DATA

MODEL INPUT DATA	STEADY-STATE	TRANSIENT	DESCRIPTION	SOURCE OF DATA
WATER LEVELS	X		Predevelopment (Circa 1940)	ADWR-GWSI Schwalen (1967)
		X	1959-60,1981-82,1993-94	ADWR-GWSI
RECHARGE	X		Predevelopment (Circa 1940) Natural Recharge	ADWR-Modeling Schwalen (1967) Wilson (1988)
		X	1940-1993 Natural Recharge	ADWR-Modeling Schwalen (1967) Wilson (1988)
		X	1940-1993 Ag Recharge	ADWR-Modeling Foster (1993a)
		X	1940-1993 Canal Recharge	Schwalen (1967) Foster (1994)
		X	1988-1993 Artificial Recharge	Huza (1993)
PUMPAGE		X	1940-1983 Pumpage	ADWR-Modeling Schwalen (1967) Matlock (1973) Prescott (1993) Wigal (1988) Foster (1993)
		X	1984-1993 Pumpage	ADWR-ROGR
NATURAL DISCHARGE	X	X	Del Rio Springs Discharge Predevelopment (Circa 1940) 1940-1993	ADWR-Modeling Schwalen (1967) ADWR-Basic Data
	X	X	Agua Fria River Baseflow near Humboldt Predevelopment (Circa 1940) 1940-1993	ADWR-Modeling Wilson (1988) ADWR-Basic Data
AQUIFER PARAMETERS	X	X	Hydraulic Conductivity Specific Yield Storage Coefficient	ADWR-Modeling Specific Capacity and Pump Test Data
HYDROGEOLOGIC CONTACT ELEVATIONS	X	X	Top and Bottom Elevations of Model Layers	Driller's Logs Gravity Data

ADWR-Modeling: ADWR Modeling Section Analysis and Estimates
ADWR-Basic Data: ADWR Basic Data Section Field Data
ADWR-GWSI: ADWR Groundwater Site Inventory Database
ADWR-ROGR: ADWR Registry of Groundwater Rights Database

Water Level Data

Water level data were required for initial model inputs, and for the evaluation of the accuracy of the model calibration. Water level data were obtained mainly from the ADWR-Groundwater Site Inventory (GWSI). Some water level data were supplied from the Schwalen (1967) report. In certain areas driller's estimates of static water levels were also used (see Chapter 4).

Groundwater Recharge Data

Groundwater recharge data were supplied from a variety of sources and estimates for the steady-state and transient model calibrations (see Chapter 4). The sources of groundwater recharge data and estimates include: Schwalen (1967), Matlock (1973), Wilson (1988), Foster (1993a), Foster(1994), and Huza (1993). Steady-state recharge inputs consisted of natural recharge along mountain-fronts and ephemeral stream channel infiltration. Transient inputs included natural recharge, incidental recharge from excess agricultural irrigation, canal leakage, and artificial recharge. Total recharge from 1940-1993 is tabulated per model cell in Appendix I.

Groundwater Pumpage Data

Groundwater pumpage data were supplied from several sources and estimates for the transient model calibration (see Chapter 4). The sources of groundwater pumpage data and estimates include: Schwalen (1967), Matlock (1973), Wigal (1988), Foster (1993b), and

Prescott (1993), and the ADWR-ROGR database. Groundwater pumpage for agricultural, municipal, industrial, domestic, and miscellaneous purposes was simulated during the 1940-1993 transient model calibration period. Total pumpage from 1940-1993 is tabulated per model cell in Appendix I.

Groundwater Discharge Data

Groundwater discharge data from Del Rio Springs and the perennial baseflow reach of the Agua Fria River near Humboldt were used to evaluate the accuracy of the steady-state and transient model calibrations. The sources of these data were Schwalen (1967), Wilson (1988), and ADWR (1994d).

Aquifer Parameter and Geologic Data

Aquifer parameter data (hydraulic conductivity, specific yield, storage coefficent) and geologic contact data (top and bottom elevations of model layers) were obtained from several sources of information which include: well logs, gravity surveys, pump tests, specific capacity measurments, and others (see Chapter 2). A tabulation of aquifer parameter and related data is provided in Appendix II.

CHAPTER SIX - THE MODEL CALIBRATION

I. STEADY-STATE CALIBRATION

Details of Calibration

The model was initially calibrated to the steady-state conditions which characterized the predevelopment era (circa 1940). The steady-state calibration process consisted of the adjustment of several important model inputs to the extent necessary to achieve a reasonable correspondence between model simulated output data (heads and fluxes) and the measured or independently estimated data. The steady-state calibration required 55 model runs before an acceptable calibration was obtained. The model input data which were adjusted during the steady-state calibration included: drain conductances, hydraulic conductivities, Vconts, and natural recharge.

The initial water level inputs (starting heads) for the predevelopment (circa 1940) steady-state model calibration were obtained by discretizing the 1940 water level contour map (Plate 2). The Layer 1 heads correspond to the Upper Alluvial Unit aquifer water level contours, and the Layer 2 heads correspond to the Lower Volcanic Unit aquifer contours.

Drain conductances (for Del Rio Springs, and the baseflow reach of the Agua Fria River near Humboldt) were originally estimated in proportion to the wetted areas, with assumed drain hydraulic conductivities of 1 foot per day. The choice of these parameters was arbitrary, and substantial calibration adjustments were anticipated and required before the simulated drain discharges sufficently approximated the measured data and independant estimates.

Details concerning the estimation of the hydraulic conductivity, Vcont, and natural recharge inputs have been discussed in previous sections of this report. These model inputs were adjusted on a cell-by-cell basis until an acceptable calibration was achieved. It should be noted that the estimated total volume of natural recharge was not changed during the model calibration, only the local distribution of recharge per watershed was varied.

Calibration Error Analysis

An error analysis was performed on the final model-simulated water level data in order to quantify the accuracy, and acceptability of this form of output from the steady-state model calibration. The final model simulated steady-state heads, for the Upper Alluvial Unit and the Lower Volcanic Unit, are shown superimposed on the measured 1940 water levels in Figures 13 and 14, respectively.

The analysis was performed over the entire model area by subtacting the final model-simulated water levels from the initial water levels (being steady-state, the model-simulated heads should closely match the initial head data). Figures 15 and 16 show the areal distribution of the differences between measured and simulated heads for the Upper Alluvial Unit and the Lower Volcanic

Unit, respectively. The absolute values of the individual cell differences (model errors) were summed, and the mean absolute head difference per cell, standard deviation, and maximum head difference were calculated for each model layer. The results of the error analysis show that the mean absolute head difference per cell (model error), and the standard deviation were both less than 10 feet for the Upper Alluvial Unit and the Lower Volcanic Unit (Table 14).

TABLE 14
STATISTICAL SUMMARY OF STEADY-STATE ERROR ANALYSIS
MEASURED WATER LEVELS (CIRCA 1940) - CALIBRATED WATER LEVELS

LAYER	HEAD DIFFERENCE	CELLS PER LAYER	MEAN ABSOLUTE HEAD DIFFERENCE/CELL (FEET)	STANDARD DEVIATION (FEET)	ABSOLUTE MAXIMUM HEAD DIFFERENCE (FEET)
1 (UAU)	H1940L1-HSSL1	600	9.51	7.0	66
2 (LAU)	H1940L2-HSSL2	485	8.3	9.7	55

H1940L1, H194012 = 1940 measured water levels.
HSSL1, HSSL2 = 1940 model simulated steady-state water levels.

The mean absolute head difference and standard deviation for both layers are less than 2 percent of the total head loss in the model area (the water level elevation near Granite Mountain is about 5,000 feet, and the water level elevation near Del Rio Springs is about 4,450 feet). This small percentage indicates that the model simulated head errors are only a small part of the overall model response, and indicative of an acceptable model calibration (Anderson and Woessner, 1992).

Water Budgets

The acceptability of the steady-state calibration was also evaluated by examining the correspondence between components of the conceptual and model simulated water budgets (Table 15). Acceptable steady-state simulations should have small differences between total inflows and outflows, and reasonable agreement with the conceptual estimates. The water budget data (Table 15) shows that the overall budgets were in excellent agreement, and that the specific model simulated fluxes fell well within the range of the conceptual estimates.

TABLE 15
SIMULATED AND CONCEPTUAL STEADY-STATE WATER BUDGETS
(FIGURES ROUNDED TO NEAREST 100 ACRE-FEET)

INFLOW	**MODEL SIMULATED**	**CONCEPTUAL**	**PERCENT OF CONCEPTUAL (MODEL/CONCEPTUAL)**
GROUNDWATER RECHARGE	6,900	7,000	99%
TOTAL INFLOW	**6,900**	**7,000**	**99%**
OUTFLOW			
DEL RIO SPRINGS DISCHARGE	3,300	3,000	110%
AGUA FRIA RIVER BASEFLOW	1,500	1,500 - 2,500	60 - 100%
GROUNDWATER UNDERFLOW TO BIG CHINO	2,100	1,500 - 2,000	105 - 140%
TOTAL OUTFLOW	**6,900**	**7,000**	**99%**

II. TRANSIENT CALIBRATION

Details of Calibration

Following the steady-state calibration (circa 1940), the model was calibrated to the transient flow conditions of the period of groundwater development from 1940-1993. Initially, it had been planned to calibrate the model for the period 1940-1981, and use the period 1982-1993 as a verification period during which time no model inputs would be further modified. Unfortunately, the results of the verification run indicated that the original estimates of natural recharge from flood events on Granite Creek for the period 1978-1993 were overestimated and required modification. Therefore the original plan to use 1982-1993 as a verification period was abandoned in favor of improving the long-term calibration by modifying the flood recharge estimates.

The transient model calibration involved making adjustments to storage terms (specific yield and storage coefficient), and to the main stress inputs to the model (recharge and pumpage). The transient model calibration required 49 model runs before an acceptable correspondence was achieved between the model simulated output data (heads and fluxes) and the measured or independently estimated data.

The model generated final heads from the 1940 steady-state calibration were used for initial conditions for the 1940-1993 transient model calibration. The use of "model-conditioned" starting heads for transient simulations (as opposed to the use of measured water levels) is a standard procedure which provides assurance that any simulated water level fluctuations are responses to changing model stresses, and not adjustments to numerically inconsistent initial head distributions (Franke, and others, 1987).

As mention earlier, the storage properties of the aquifer-system were adjusted during the transient model calibration. The primary storage coefficient of the confined Lower Volcanic Unit aquifer, Layer 2, was varied from .001 to .00001. A uniform storage coefficient of .0001 was selected for the transient calibration. An areally distributed specific yield array was assigned as the primary storage coefficient for Layer 1, the Upper Alluvial Unit aquifer (Appendix II). The specific yield for unconfined areas of the Lower Volcanic Unit was assigned a uniform value of 7 percent.

Simulated stresses were also adjusted during the transient calibration. The vertical distribution of agricultural groundwater pumpage was tested extensively during the transient model calibration. Initially, it was assumed that about 90 percent of the agricultural pumpage in the Little Chino sub-basin was derived from the confined Lower Volcanic Unit aquifer (see Chapter 4). During the transient calibration it became clear that the initial 90 percent estimate was too large, and the percentage of agricultural pumpage from the Lower Volcanic Unit aquifer, Layer 2, was reduced to 75 percent of the total agricultural pumpage. It should be noted that the annual groundwater pumpage totals (Tables 8 and 9) remained unchanged during the transient calibration. The distribution of total pumpage per model cell for the period 1940-

1993 is tabulated in Appendix I.

The total volume of simulated Granite Creek flood recharge was reduced during the transient model calibration. Originally, it was estimated that as much as 62,000 acre-feet of water may have been recharged along Granite Creek during the flood events from 1978 to 1993 (Chapter 4). However, during the transient calibration, the original maximum potential estimates of flood recharge were shown to produce excessive simulated water level rises, and were eventually reduced to 50 percent of the original estimates. Annual groundwater recharge totals and distributions from other sources (Tables 5 and 6) were not modified during the transient model calibration. The distribution of total recharge per model cell for the period 1940-1993 is tabulated in Appendix I.

Calibration Error Analysis

Error analyses were performed on the model-simulated water level output data in order to quantify the accuracy, and acceptability of the transient model calibration. Model simulated water levels at the end of 1993, for the Upper Alluvial Unit and the Lower Volcanic Unit, are shown superimposed on measured water level data for the winter of 1993-1994 (Figures 17 and 18, respectively).

The error analyses were performed over the entire model area by subtracting the model-simulated water levels from measured water level data. Figures 19 and 20 show the 1993-1994 areal distribution of the differences between measured and simulated heads for the Upper Alluvial Unit and the Lower Volcanic Unit, respectively. The absolute values of the individual cell differences (model errors) were summed and the mean absolute head difference per cell, mean absolute head difference per cell per year of model simulation, standard deviation, and maximum head difference were calculated for each model layer (Table 16). The results of the error analyses indicate that the mean absolute head difference per cell (model error), and the standard deviation were 22.9 and 20.7 feet for the Upper Alluvial Unit, and 16.8 and 18.2 feet for the Lower Volcanic Unit for the 1993-1994 simulated water levels. These errors represent less than 5 percent of the total head loss in the system, and are an acceptably small part of the overall model response (Anderson and Woessner, 1992).

TABLE 16
STATISTICAL SUMMARY OF TRANSIENT ERROR ANALYSIS
MEASURED WATER LEVELS (1993) - CALIBRATED WATER LEVELS

LAYER	HEAD DIFFERENCE	MEAN ABSOLUTE HEAD DIFFERENCE/CELL (FEET)	MEAN ABSOLUTE HEAD DIFFERENCE/CELL PER YEAR OF MODEL SIMULATION (FEET/YEAR)	STANDARD DEVIATION (FEET)	ABSOLUTE MAXIMUM HEAD DIFFERENCE (FEET)
1 (UAU)	H93/94L1 - HTRL1	22.9	.42	20.7	98
2 (LVU)	H93/94L2 - HTRL2	16.8	.31	18.2	91

H93/94L1, H93/94L2 = 1993-1994 measured water levels.
HTRL1, HTRL2 = Model simulated transient water levels.

The error analysis was also applied over a smaller portion of the model area which was selected to cover areas of greater current and historic water level availability (mainly the agriculural areas of the the Little Chino and Upper Agua Fria sub-basin). The results of the selected error analysis for the 1993-1994 model simulated heads indicate that the mean absolute head difference and standard deviation were 20.6 and 36.5 feet for the Upper Alluvial Unit, and 10.8 and 21.4 feet for the Lower Volcanic Unit.

The results for the selected areas show that the mean absolute error was slighly improved for the Upper Alluvial Unit and substantially improved for the Lower Volcanic Unit when compared to the model-wide results (Table 16). However, the results also show that the standard deviation of the error was significantly greater for the Upper Alluvial Unit, and slighlty greater for the Lower Volcanic Unit. The increase in standard deviations are attributed to a few statistical outliers that were included in the selected areas of analysis. In general, the results of the selected error analysis indicate that the model calibration is statistically more accurate in the areas of greater water level data availability.

The magnitude of the mean absolute error was also analyzed in relation to the length of time of the transient model simulation. The 1993-1994 mean absolute head difference per cell per year of model simulation were shown to be .42 foot/year for the Upper Alluvial Unit, and .31 foot/year for the Lower Volcanic Unit (Table 16). The significance of this parameter is that it indicates that the model had a small long-term average absolute error over the 54 years of transient model simulation. This small rate of error per unit time suggests that future, long-term predictive simulations should be reliable.

Hydrographs

The accuracy of the transient model calibration was also evaluated by comparing hydrographs of measured water level data from selected wells to model simulated water levels. This was accomplished by plotting measured well data with model simulated water level data from the corresponding model cells (Figure 21). It is clear from the examination of the hydrographs that the model was generally successful in replicating the long-term water level fluctuations and trends throughout most of the model area.

Water Budgets

The accuracy of the transient calibration was also evaluated by comparing the degree of correspondence between components of the conceptual and model simulated water budgets (Table 17). Review of the various budget components shows that the simulated recharge and pumpage were in excellent agreement with the conceptual estimates, and that the simulated head-dependent fluxes (natural discharge and underflow) were within an acceptable percentage of the conceptual estimates. It should be noted that the model results may be more accurate than the conceptual estimates in cases where the conceptual estimates were made from limited data.

TABLE 17
SIMULATED AND CONCEPTUAL TRANSIENT WATER BUDGETS
(FIGURES ROUNDED TO NEAREST 100 ACRE-FEET)

INFLOW	**MODEL SIMULATED**	**CONCEPTUAL**	**PERCENT OF CONCEPTUAL (MODEL/CONCEPTUAL)**
GROUNDWATER RECHARGE	746,000	771,600	97%
TOTAL INFLOW	**746,000**	**771,000**	**97%**
OUTFLOW			
NATURAL DISCHARGE (DEL RIO SPRINGS & AGUA FRIA BASEFLOW)	181,200	236,300	77%
GROUNDWATER UNDERFLOW TO BIG CHINO	75,900	94,500	80%
GROUNDWATER PUMPAGE	820,500	858,600	96%
TOTAL OUTFLOW	**1,077,600**	**1,189,400**	**91%**
CHANGE-IN-STORAGE	**-331,600**	**-418,400**	**79%**

CHAPTER SEVEN - SENSITIVITY ANALYSIS

A sensitivity analysis was conducted on the Prescott Groundwater Flow Model to determine the relative sensitivity of the final model solution to changes in the various hydrologic input parameters. In numerical modeling not all of the hydrologic input parameters are well known. Consequently, there may be uncertainty in some of the hydrologic input parameters. The sensitivity analysis was designed to identify which hydrologic input parameters exert the most influence over the final model solution, and therefore may introduce the most error into the model solution. A better understanding of the model's sensitivity to the hydrologic input parameters will help guide future data collection, model development and use.

I. SENSITIVITY PROCEDURES

The sensitivity of the model to changes in the hydrologic input parameters was tested by establishing the final 1940-1993 transient calibration run heads, change-in-storage, drain output, and underflow as benchmark values. Additional model simulations, called sensitivity runs, were then conducted while one of the hydrologic input parameters was varied over a reasonable range of values. Model output from the sensitivity runs was then compared to the benchmark values to provide a quantitative measure of the model's sensitivity to the hydrologic input parameter. The choice of which parameters to change was based on the parameter's overall importance in the conceptual water budget, or as a structural component of the model.

A series of sensitivity tests were also conducted on the final steady-state model calibration. The procedure was the same as with the transient calibration, the final steady-state heads, drain discharge, and underflow values were used as benchmark values and compared to the results of model simulations in which steady-state hydrologic input parameters were varied. The steady-state sensitivity simulations were conducted to determine which hydrologic input parameters exert the most influence on the final steady-state model calibration.

The hydrologic model input parameters that were varied for the sensitivity analysis are summarized in Table 18. The range of input parameter variation and quantitative measures of the results are provided for each sensitivity run. The sensitivity data presented in Table 18 is grouped by hydrologic input parameter. For each sensitivity run 6 quantitative measures of model output change are presented. The measures of change are: the mean of the absolute value of the head change in each cell in the active model domain, the standard deviation the mean absolute head change, the range of the head change, the percent change of the model simulated change-in-storage, the percent change of simulated drain output, and the percent change of simulated underflow. The absolute mean head change, standard deviation, and range of head change for the Upper Alluvial Unit, Layer 1, and the Lower Volcanic Unit, Layer 2 are presented separately.

TABLE 18
SUMMARY OF SENSITIVITY ANALYSIS RESULTS

Hydrologic Parameter	Change Factor	Upper Alluvial Unit: Mean Absolute Head Change	Upper Alluvial Unit: Standard Deviation	Upper Alluvial Unit: Range of Head Change	Lower Volcanic Unit: Mean Absolute Head Change	Lower Volcanic Unit: Standard Deviation	Lower Volcanic Unit: Range of Head Change	Sensitivity Results: Storage	Sensitivity Results: Change in Drain Output	Sensitivity Results: UnderFlow
Transient Model Analysis										
Specific Yield	1.25x	7.2 Ft	2.4 Ft	-1 to 17 Ft	6.7 Ft	2.3 Ft	-4 to 11 Ft	+3.1%	+4.8%	+3%
Specific Yield	0.75x	10.8 Ft	3.6 Ft	-25 to 3 Ft	10.1 Ft	3.5 Ft	-16 to 2 Ft	-4.1%	-7%	-6%
Hydraulic Conductivity	1.25x	9.0 Ft	5.5 Ft	-26 to 4 Ft	6.7 Ft	5.1 Ft	-38 to 4 Ft	+21%	+22%	+22%
Hydraulic Conductivity	0.75x	9.7 Ft	7.3 Ft	-4 to 33 Ft	6.9 Ft	7.1 Ft	-5 to 55 Ft	-22%	-26%	-25%
Vertical Conductance	0.1x	Run Failed								
Vertical Conductance	10x	Run Failed								
Vertical Conductance	0.5x	1.5 Ft	2.2 Ft	-3 to 18 Ft	2.2 Ft	1.7 Ft	-5 to 14 Ft	+0.5%	+3%	-5%
Vertical Conductance	5x	2.9 Ft	5.0 Ft	-44 to 12 Ft	2.9 Ft	2.6 Ft	-23 to 13 Ft	-0.2%	-9%	+13%
Ag Pumpage 1940-83	1.25x	11.9 Ft	5.3 Ft	-20 to 0 Ft	14.8 Ft	5.6 Ft	-23 to 6 Ft	+27%	-26%	-8%
Ag Pumpage 1940-83	0.75x	11.4 Ft	4.5 Ft	-1 to 19 Ft	12.6 Ft	4.7 Ft	-9 to 19 Ft	-25%	+26%	+7%
UAU & LVU Pumpage Ratio	10%/90%	3.4 Ft	2.4 Ft	-6 to 11 Ft	4.7 Ft	1.7 Ft	-11 to 9 Ft	+5%	-1%	-0.5%
UAU & LVU Pumpage Ratio	40%/60%	2.9 Ft	2.2 Ft	-12 to 5 Ft	3.3 Ft	1.4 Ft	-9 to 5 Ft	+0.8%	-9%	-0.2%
Agricultural Recharge	0.75x	6.3 Ft	4.3 Ft	-23 to 0 Ft	5.8 Ft	2.4 Ft	-12 to 2 Ft	+14%	-22%	-14%
Agricultural Recharge	0.50x	Run Failed								
CVID Canal Recharge	0.50x	5.1 Ft	3.8 Ft	-26 to 0 Ft	7.1 Ft	2.9 Ft	-24 to 2 Ft	+11%	-3%	-3%
Natural Recharge	2.0x	16.3 Ft	27.9 Ft	0 to 92 Ft	17.8 Ft	28.7 Ft	-2 to 163 Ft	-67%	+10%	+7%
Natural Recharge	0.5x	Run Failed								
Flood Event Recharge	2.0x	3.8 Ft	4.1 Ft	0 to 40 Ft	5.5 Ft	3.2 Ft	-1 to 34 Ft	-9%	+0.5%	+2%
Flood Event Recharge	0.50x	1.9 Ft	2.7 Ft	-21 to 0 Ft	2.7 Ft	1.7 Ft	-18 to 0 Ft	+4%	-0.2%	-1%
Drain Conductance	2.0x	0.3 Ft	0.5 Ft	-1 to 0 Ft	0.3 Ft	0.4 Ft	-1 to 0 Ft	+0.6%	+3%	-2%
Drain Conductance	0.50x	0.5 Ft	0.5 Ft	0 to 2 Ft	0.5 Ft	0.5 Ft	-1 to 1 Ft	-1%	-5%	+4%
Steady-state Model Analysis										
Natural Recharge	1.25x	35.8 Ft	9.8 Ft	0 to 53 Ft	36.1 Ft	6.5 Ft	8 to 68 Ft	N/A	+31%	+11%
Natural Recharge	1.50x	70.2 Ft	19 Ft	0 to 163 Ft	71.2 Ft	12.9 Ft	16 to 137 Ft	N/A	+62%	+22%
Natural Recharge	0.75x	25.5 Ft	40.9 Ft	-58 to 0 Ft	32.3 Ft	51.2 Ft	-66 to 6 Ft	N/A	-31%	-11%
Natural Recharge	0.50x	Run Failed								
Changed Boundary Conditions		10.1 Ft	8.5 Ft	-66 to 41 Ft	12.6 Ft	10.2 Ft	-67 to 32 Ft	N/A	-3%	0.2%

Transient and Steady-State Groundwater Flux Benchmark Values

Total Transient Change in Storage = -331,460 Acre-Feet (6,255 Acre-Feet/Yr)
Total Transient Drain Output = 181,150 Acre-Feet (3,420 Acre-Feet/Yr)
Transient Underflow = 1,608 Acre-Feet/Yr
Steady-State Drain Output = 4,790 Acre-Feet/Yr
Steady-State Underflow = 2,080 Acre-Feet/Yr

The mean absolute head change is the mean of the absolute value of the difference between the sensitivity run heads and the final transient model calibration heads for each active model cell. The standard deviation measures the distribution of the absolute change in head values about the mean absolute head value. Assuming the head changes are normally distributed, about 68 percent of the values will fall within +/- one standard deviation from the mean. The range of head change describes the maximum and minimum head changes which were observed for each sensitivity run.

The change of the model simulated change-in-storage measurement is the percent change between the simulated change-in-storage of the sensitivity run and the simulated change-in-storage of the final transient model calibration (-331,460 acre-feet). This measurement does not apply to steady-state runs since there should be no actual or simulated change-in-storage.

The model contains two drains which discharge groundwater from the model. One drain represents groundwater discharged from Del Rio Springs and the second drain represents groundwater discharged as baseflow by the Agua Fria River near Humbolt. The change in simulated drain output is the percent change between the total simulated drain output of the sensitivity run and the simulated benchmark drain output of 118,150 acre-feet. The steady-state benchmark value for simulated drain discharge was 4,790 acre-feet per year.

Groundwater underflow which exits the model area to the north into the Big Chino sub-basin of the Verde River basin is also simulated in the model by a constant head boundary northwest of Del Rio Springs. The change in underflow is the percent change between the model simulated underflow of each sensitivity run and the benchmark underflow values of 1,608 acre-feet per year for the transient simulations and 2,080 acre-feet per year for the steady-state simulations.

The relative sensitivity of the model solution to changes in the hydrologic input parameters was evaluated based on the mean of the absolute head change values and the percent change in storage produced by varying input parameters. The combination of these two factors was most illustrative of model-wide impacts produced by a sensitivity run.

Both the steady-state and transient model simulations were most sensitive to changes in natural recharge. Changes in natural recharge caused major impacts to model heads and the simulated change-in-storage terms. Changes in 1940-1983 agricultural pumpage, hydraulic conductivity, and agricultural recharge closely followed natural recharge in the magnitude their effects on model results. The transient model was least sensitive to changes in the drain conductances, and the steady-state model was least sensitive to changes in boundary conditions.

It is important to keep in mind two things when examining the data: 1) changes that produced minor model-wide impacts may have major local impacts, and 2) the magnitude of simulated parameter changes varied from the "order-of-magnitude" level to +/- 25 percent of the calibrated model input values. Therefore, the sensitivity results for different changed model input parameters are really not directly comparable, other than in relative terms. A discussion of individual sensitivity runs follows.

II. STEADY-STATE MODEL SENSITIVITY ANALYSIS

Determining the correct magnitude and distribution of natural recharge, and appropriate natural recharge boundary conditions were essential parts of the steady-state model calibration. The final calibrated steady-state model natural recharge was distributed as an array of constant fluxes applied to variable head cells. The constant fluxes represented stream channel infiltration along ephemeral washes and mountain-front recharge along model boundaries.

Due to its relative importance, the model's sensitivity to variations in natural recharge was evaluated in great detail. Four sensitivity runs were made in order to test this model input. The amount of recharge distributed by the steady-state RECHARGE package to the model was changed in four of the sensitivity runs by varying the natural recharge by +/- 25 percent (1.25x and 0.75x) and +/- 50 percent (1.50x and 0.5x). A fifth sensitivity run was made in which the constant flux cells which were used to simulate natural recharge were changed to constant head cells. This change was designed to test impacts of alternate boundary conditions on the the steady-state model.

Natural Recharge

The steady-state model was sensitive to changes in natural recharge. Increasing and decreasing natural recharge by 25 percent (1.25x) and 50 percent (1.50x) had major impacts on heads, drain discharges, and underflow.

Simulated heads rose and drain discharge and underflow increased as natural recharge increased. The mean absolute head change for the Upper Alluvial Unit was 36 feet for the 25 percent increase in natural recharge, and 70 feet for the 50 percent increase (Table 18). The rise in simulated heads resulting from increasing natural recharge was fairly uniform at 30 to 45 feet throughout most of the model area. The smallest head rises, 10 feet or less, occurred north of Del Rio Springs in the Little Chino sub-basin and in the very southern part of the Upper Agua Fria sub-basin.

Drain output increased significantly as natural recharge increased; however, the underflow percentages did not increase nearly as much as the drain discharge (Table 18).

Decreasing natural recharge 25 percent had a major impact on steady-state model results. Model heads declined, the maximum decline was 66 feet, and drain discharge output and underflow decreased (Table 18). Reducing natural recharge by 50 percent caused the model to fail to converge, and the sensitivity run to abort.

Reducing natural recharge by 25 percent affected the Lower Volcanic Unit more than the Upper Alluvial Unit. The mean absolute head change for the Upper Alluvial Unit was 25 feet, and 32 feet for the Lower Volcanic Unit (Table 18). Head declines of 30 to 45 feet were occurred throughout most of the model area. The smallest head declines, less than 10 feet, occurred in both model layers in the artesian area north of Del Rio Springs and in Upper Alluvial Unit in the very southern part of the Upper Agua Fria sub-basin. Reducing natural recharge by 25 percent caused the drain discharge and underflow to decreased by 31 percent and 11 percent, respectively (Table 18).

The results of the sensitivity analysis have shown that the steady-state model solution is highly sensitive to the amount of simulated natural recharge. Based on the rather significant and unrealistic head and flux changes for any of the sensitivity runs it seems likely that the benchmark natural recharge volume of about 7,000 acre-feet per year is a good estimate for the steady-state calibration.

Boundary Conditions

The appropriate choice of boundary conditions is very important to model construction. As described earlier, the steady-state model was constructed using constant fluxes to simulate long-term natural recharge from ephemeral stream channel infiltration and mountain-front recharge at model boundaries. The model's sensitivity to the choice of boundary conditions was tested by replacing the constant flux cells with constant head cells.

The results of this sensitivity run indicate that on a regional scale the model heads, drain discharge, and underflow are insensitive to changing the steady-state boundary conditions. Large head changes were confined to areas immediately adjacent to the constant head cells. Heads generally declined by less than 6 feet in non-adjacent cells, except in the southern part of the Upper Agua Fria sub-basin where head rose by as much as 13 feet. Underflow and drain discharge were marginally affected, drain output decreased 3 percent and underflow decreased only 0.2 percent.

Based on the results of the sensitivity analysis it seems that either boundary condition (constant flux or constant head) would have been acceptable for the steady-state model calibration. However, the choice of the constant flux boundary is more appropriate for the transient model calibration because the boundary water levels have changed from 1940-1993, while natural recharge has remained more-or-less constant with time.

III. TRANSIENT MODEL SENSITIVITY ANALYSIS

Specific Yield

The specific yield is a fundamental hydrologic input parameter of the model. The magnitude and distribution of the specific yield defines the storage properties of the regional water table aquifer throughout the model area. Two sensitivity runs were made during which the specific yield values were varied by +/- 25 percent to test the models sensitivity to changes in the specific yield.

The 25 percent reduction in specific yield values produced water level head elevations that were generally lower than the calibrated model head elevations. The Upper Alluvial Unit was affected slightly more than the Lower Volcanic Unit by the reduced specific yield. The Upper Alluvial Unit had a mean absolute head change of 11 feet compared to 10 feet for the Lower Volcanic Unit. Except for a couple of areas the distribution of head decline values for the Upper Alluvial Unit was fairly uniform ranging from -10 to -12 feet. The exceptions were the artesian area in the northern Little Chino sub-basin and the southern Agua Fria sub-basin near Humbolt, which had declines of less than 7 feet, and the Prescott Valley area where declines ranged from -16 to -25 feet. The Lower Volcanic Unit head declines followed the same pattern as the Upper Alluvial Unit declines, fairly uniform at -11 to -12 feet, but smaller in the artesian area, less than -8 feet, and in the southern part of the model near Granite Creek, less than -6 feet. The net model change-in-storage declined by about 4 percent from -331,500 acre-feet to -317,800 acre-feet. Drain output and underflow also declined by 7 percent and 6 percent, respectively (Table 18).

Increasing the specific yield by 25 percent produced head elevations that were generally higher than the calibrated model head elevations. Once again the Upper Alluvial Unit had a slightly greater head changes with a mean absolute head change of 7 feet compared to 6 feet for the Lower Volcanic Unit. The Upper Alluvial Unit heads increased 7 to 8 feet model-wide. The greatest increases occurred in the Prescott Valley area, ranging from 10 to

17 feet. Uniform rises of 7 to 8 feet occured throughout most of the model, but smaller increases occurred in the artesian area of the Little Chino sub-basin and along Granite Creek. The percent change in the simulated change-in-storage was small, +3 percent, as were the change in drain output, +5 percent, and the change in underflow, +3 percent (Table 18).

Based on the sensitivity analysis the model is only moderately sensitive to changes in specific yield. However, there are localized areas of higher sensitivity. These areas have very large head changes associated with specific yield changes. The areas of greater sensitivity need further study to help quantify the specific yield values in those areas.

Hydraulic Conductivity

Hydraulic conductivity is a fundamental hydrologic input parameter in any groundwater model. The relative distribution and magnitude of the hydraulic conductivities are major factors controlling the movement of groundwater. Two sensitivity runs were conducted to determine the impacts of varying the calibrated hydraulic conductivities. The sensitivity runs consisted of varying the calibrated model values by +/- 25 percent.

Reducing hydraulic conductivities by 25 percent produced head elevations that generally were higher than calibrated model heads for both the Upper Alluvial Unit and the Lower Volcanic Unit. The mean absolute head change for the Upper Alluvial Unit and the Lower Volcanic Unit were 10 feet and 7 feet, respectively. The largest head rise, 33 feet, that occurred in the Upper Alluvial Unit was in the southern part of the Little Chino sub-basin. Head rises were generally less than 10 feet throughout most of the rest of the Little Chino sub-basin. The maximum head rise in the Lower Volcanic Unit was 53 feet. The maximum rise occurred in the southern part of the Little Chino sub-basin. Lower Volcanic Unit head rises were 2 to 5 feet in most of the central Little Chino sub-basin and heads declined 2 to 6 feet in the artesian area in the northern Little Chino sub-basin.

The percent change in the simulated change-in-storage declined by 22 percent from -331,500 acre-feet to -258,400 acre-feet. Drain output and underflow values also declined by large amounts. Drain output decreased by 26 percent and underflow decreased by 25 percent (Table 18).

Increasing hydraulic conductivities by 25 percent lowered the sensitivity run heads below calibrated model heads. The Upper Alluvial Unit again had the largest mean absolute head change, 10 feet, while the Lower Volcanic Unit had a mean absolute head change of 7 feet. The largest head declines in the Upper Alluvial Unit were in the Upper Agua Fria sub-basin and the southern parts of the Little Chino sub-basin. The majority of the Little Chino sub-basin experienced declines of 5 to 8 feet. The Lower Volcanic Unit heads generally declined due to the increased hydraulic conductivities. The largest head declines were in the southern parts of the model, the central part of the Little Chino sub-basin had head declines of 2 to 6 feet, and the artesian area had either no head change or rises of 1 to 2 feet.

The percent change in the simulated change-in-storage increased 21 percent to -401,600 acre-feet when the hydraulic conductivities were increased 25 percent. The drain output and underflow both increased by 22 percent (Table 18).

The results of the sensitivity analysis indicates that the model solution is more sensitive to proportionately equal changes in hydraulic conductivity than to specific yield. Although the head changes were not as great as the changes produced by varying the specific yield values, the impact of varying the hydraulic conductivity values was much greater on the simulated change-in-storage, drain discharge, and underflow.

Vertical Conductance

The vertical conductance is another fundamental component of any multi-layered groundwater flow model. The vertical conductance (Vcont) value controls the vertical leakage of water between model layers, or the Upper Alluvial Unit and the Lower Volcanic Unit. Four sensitivity runs were conducted to determine the impacts on the model solution of varying the Vcont values. The first two sensitivity runs varied Vcont values by (10x and 0.1x), both runs failed to reach the model closure criteria. Subsequently, two additional sensitivity runs were made in which Vcont values were increased by 500 percent (5x) and decreased 50 percent (0.5x).

Decreasing Vcont by 50 percent (0.5x) had very little effect model-wide on the Upper Alluvial Unit or Lower Volcanic Unit heads.

The mean absolute head change was slightly greater for the Lower Volcanic Unit (2.2 feet) than for the Upper Alluvial Unit (1.5 feet) (Table 18). Head elevations changed only slightly in the southern and eastern portions of the Little Chino sub-basin because the Upper Alluvial Unit aquifer and the Lower Volcanic Unit aquifer are directly connected in those areas, and Vcont values were initially large compared to other areas. Therefore, the 50 percent reduction in Vcont had little impact in those areas. However, in the artesian area of the Little Chino sub-basin the heads rose in both the Upper Alluvial Unit and the Lower Volcanic Unit. Heads in the artesian area rose as much as 18 feet in the Upper Alluvial Unit and 12 feet in the Lower Volcanic Unit. The head increases in the Lower Volcanic Unit were restricted to the very northern part of the model north of Del Rio Springs. The percent change in the simulated change-in-storage was negligible (+0.5%) as were the change in drain output (+3%) and the change in underflow (-5%) (Table 18).

Increasing Vcont by 500 percent (5x) also had little effect on simulated heads model-wide. The mean absolute head change was 3 feet for both the Upper Alluvial Unit and the Lowere Volcanic Unit. The sensitivity heads in the Upper Alluvial Unit were 1 to 3 feet higher throughout most of the model. However, the Upper Alluvial Unit sensitivity heads declined as much as 44 feet in the artesian area of the Little Chino sub-basin. Lower Volcanic Unit sensitivity heads increased 1 to 4 feet in most of the active model area. Declines of up to 23 feet occurred in the Lower Volcanic Unit in the northern part of the Little Chino artesian area.

The percent change in the simulated change-in-storage was again negligible (-0.2%); however, the change in drain output (-9%) and change in underflow (+13%) were larger than when the Vcont was decreased (Table 18).

The sensitivity results indicate that the model is generally insensitive to simulated changes in vertical conductance, except in the artesian area of the Little Chino sub-basin. This is consistent with concept that groundwater flow between the Upper Alluvial Unit and the Lower Volcanic Unit occurs with little restriction outside the artesian area. The results further indicate that further study of vertical flow in the artesian area may be useful.

Agricultural Pumpage

Agricultural pumpage is the largest source of water withdrawal in the Prescott AMA. Prior to 1984 agricultural pumpage was not required to be reported to the Department. Although considerable effort has been spent developing historical pumpage totals, there still remains some uncertainty regarding the 1940-1983 agricultural pumpage estimates. These uncertainites are mainly related to questions concerning the historical estimates of cropped acreage in the Upper Agua Fria sub-basin, and also questions concerning the selection of an average irrigation efficiency of 50 percent. In addition, there remains some question as to whether some farmers employed deficit irrigation practices. For these reasons, two sensitivity runs of +/- 25 percent of estimated 1940-1983 agricultural pumpage values were made.

Increasing agricultural pumpage by 25 percent had major impacts for both the Upper Alluvial Unit and the Lower Volcanic Unit. Increased agricultural pumpage affected the Lower Volcanic Unit more than the Upper Alluvial Unit since most irrigation wells are located in the Little Chino sub-basin and mainly derive water from the Lower Volcanic Unit. The mean absolute head change for the Lower Volcanic Unit was 15 feet and head declines of 15 to 20 feet occurred throughout most of the active model area (Table 18). Head declines of less than 10 feet occurred in the northern part of the Little Chino artesian area and along the southwestern margin of the active model area.

The mean absolute head change for the Upper Alluvial Unit was about 12 feet (Table 18). In the Upper Agua Fria sub-basin, where Lower Volcanic Unit is absent, head declines were generally less than 10 feet. In most of the Little Chino sub-basin the Upper Alluvial Unit head declines ranged from 12 to 20 feet; however, in the Little Chino artesian area head declines were less than 10 feet.

The increased agricultural pumpage caused the percent change in the simulated change-in-storage to increase 27 percent, from -331,600 acre-feet to -421,900 acre-feet. The increased agricultural pumpage lowered water levels in the areas of natural discharge at Del Rio Springs and the along the Agua Fria River near Humboldt. As a result, the total drain output decreased 26 percent and underflow decreased 8 percent (Table 18).

Decreasing agricultural pumpage by 25 percent caused model heads to rise in both the Upper Alluvial Unit and the Lower Volcanic Unit. The mean absolute head change again was greater for the Lower Volcanic Unit (12.6 feet) than for the Upper Alluvial Unit (11.4 feet) (Table 18). The pattern of simulated head changes was similar to the pattern obtained when pumpage was increased, however the heads increased rather than decreased. Lower Volcanic Unit heads increased by as much as 14 to 16 feet throughout much of the model area, except along the southwestern margin and the artesian area of the Little Chino sub-basin. In those areas head increases were less than 10 feet. Upper Alluvial Unit head increases ranged from 1 to 10 feet in the Little Chino artesian area and in the Upper Agua Fria sub-basin. Head increases in most of the rest of the Little Chino sub-basin were between 12 to 16 feet.

Decreasing agricultural recharge caused the percent change in the simulated change-in-storage to decrease 25 percent from about -331,600 acre-feet to -248,000 acre-feet (Table 18). Less agricultural pumpage caused water levels to rise at the locations of natural discharge. As a result, drain discharge increased 26 percent and underflow increased 7 percent (Table 18).

As expected, the results indicate that the model is sensitive to changes in pre-1984 agricultural pumpage. Due to this fact, it is possible that further collection and analysis of historic pumpage (especially in the Upper Agua Fria sub-basin), irrigation efficiency, and farming practice data may prove worthwhile in improving the 1940-1983 portion of the transient model calibration.

Agricultural Pumpage Ratio

Large scale agricultural development in the Little Chino sub-basin of the Prescott AMA occurred after it was discovered that high capacity irrigation wells could be drilled in the artesian area of the Lower Volcanic Unit aquifer. Although the Lower Volcanic Unit aquifer is believed to be the main source of water, many irrigation wells are completed in both the Upper Alluvial Unit and the Lower Volcanic Unit.

During the transient model calibration it was found that a pumpage distribution of 25 percent from Upper Alluvial Unit to 75 percent from Lower Volcanic Unit (25%/75%) provided the best model results. Two sensitivity runs were performed in order to further evaluate the model's sensitivity to this parameter. The pumpage ratio was changed to 10% from the Upper Alluvial Unit and 90% from the Lower Volcanic Unit in one sensitivity run. A second sensitivity run varied the ratio to 40% from the Upper Alluvial Unit and 60% from the Lower Volcanic Unit.

Changing the agricultural pumpage ratio to 10:90 had minor minor model-wide impacts on the Upper Alluvial Unit and the Lower Volcanic Unit. The mean absolute head change was greater for the Lower Volcanic Unit (4.7 feet) than for the Upper Alluvial Unit (3.4 feet) (Table 18). Upper Alluvial Unit heads declined 4 to 6 feet in the Little Chino sub-basin in areas outside of the artesian area and increased as much as 11 feet in the artesian area. Heads also declined 4 to 6 feet in the northern Upper Agua Fria sub-basin. The southern Upper Agua Fria sub-basin experienced little or no change in heads. Lower Volcanic Unit heads generally declined 4 to 6 feet, except in the very northern part of the Little Chino artesian area where heads declined only 1 to 5 feet.

The percent change in the simulated change-in-storage, drain discharge, and underflow changed very little. The percent change in the simulated change-in-storage increased 5 percent and the drain discharge and underflow decreased 1 percent and 0.5 percent, respectively (Table 18).

Changing the pumpage ratio to 40:60 had the opposite effect as the 10:90 ratio. The increased pumpage from the Upper Alluvial Unit caused Upper Alluvial Unit heads to decline 2 to 12 feet in the Little Chino artesian area and increase as much as 5 feet in the rest of the Upper Alluvial Unit model area. The mean absolute head change for the Upper Alluvial Unit was slightly less (2.9 feet) than the Lower Volcanic Unit mean absolute head change (3.3 feet) (Table 18). Lower Volcanic Unit heads generally increased 2 to 5 feet, except for the Little Chino artesian area where head increases were 2 feet or less.

The percent change in the simulated change-in-storage, drain discharge, and underflow had minimal changes. The percent change in the simulated change-in-storage increased by 0.8 percent and underflow decreased by 0.2 percent. Drain discharge decreased by 9 percent (Table 18).

The sensitivity analysis indicates that the agricultural pumpage ratio has significant impacts on the model results in the artesian area of the Little Chino sub-basin. Outside the artesian area the vertical pumpage ratio has little impact on the model results. Field studies, such as spinner logging, could provide more information concerning the vertical pumpage ratio, however the sensitivity analysis indicates that the 25:75 calibrated ratio is probably a reasonable average value for this parameter. Therefore, further study and modification of this ratio would probably not significantly improve the model-wide results.

Agricultural Recharge

Agricultural recharge is the single largest source of groundwater recharge in the model. As discussed previously, agricultural recharge estimates were based on an average irrigation efficiency of 50 percent (Foster, 1993a). Due to uncertainty associated with the irrigation efficiency estimate, two sensitivity runs were conducted in which the original agricultural recharge rates were decreased by 25 percent (0.75x) and by 50 percent (0.5x).

Decreasing agricultural recharge by 25 percent had a moderate affect on heads and underflow, and a large affect on the drain discharge. The mean absolute head change for both the Upper Alluvial Unit and the Lower Volcanic Unit was nearly 6 feet. As might be expected the area most affected by changes in agricultural recharge was the northern part of the Little Chino sub-basin where most irrigated agriculture is located. Upper Alluvial Unit heads declined from 8 to 23 feet in the Little Chino artesian area. Upper Alluvial Unit heads declined from 2 to 6 feet in the rest of the model area. Uniform head declines of 4 to 7 feet occurred in the Lower Volcanic Unit in most of the model area.

The percent change in the simulated change-in-storage and underflow both changed by 14 percent. The percent change in the simulated change-in-storage increased 14 percent from -331,500 acre-feet to -378,200 acre-feet, while the underflow decreased 14 percent. The drain discharge showed an almost direct relationship to agricultural recharge with a decrease of 22 percent (Table 18).

The second sensitivity run, which consisted of a 50 percent reduction in agricultural recharge, failed to meet the model closure criteria and aborted.

The sensitivity analysis indicates that the model is sensitive to changes in agricultural recharge. As with many of the other runs, the Little Chino artesian area was shown to be more sensitive to changes than the rest of the model area. The results demonstrate the relative importance of the estimated irrigation efficiency to the model solution, and also suggest that the assumption that there is little lag-time through the vadose zone in the agricultural areas is also reasonable.

Canal Recharge

As discussed earlier, the recharge from seepage of irrigation water flowing through Chino Valley Irrigation District (CVID) main canal was estimated to be 50 percent of total reported surface water diversions. Although canal recharge represented only about 12 percent of the total estimated recharge, it was necessary to test the impacts of changing the recharge, especially in the vicinity of the canal. One sensitivity run was conducted in which canal recharge was decreased by 50 percent.

Decreasing the amount of canal recharge caused a general head decrease in both model layers. The mean absolute head change was about 5 feet for the Upper Alluvial Unit, and about 7 feet for the Lower Volcanic Unit (Table 18). The greatest head decreases occurred along the canal in the southern part of the Little Chino sub-basin.

The percent change in the simulated change-in-storage increased by about 11 percent to -370,100 acre-feet. Drain discharge and underflow both decreased by about 3 percent (Table 18).

Results of the sensitivity analysis indicate that the model is locally sensitive to changes in canal recharge. Field studies that determine CVID canal infiltration rates would be useful for future model updates.

Natural Recharge

Natural recharge is a major component of inflow to the groundwater system. From 1940 to 1993 natural recharge accounted for about 32 percent of the total groundwater recharged. Due to its relative importance, two sensitivity runs were conducted to test the model's response to modifictions of natural recharge. Natural recharge was doubled (2x) and halved (0.5x) in the two sensitivity runs.

Doubling natural recharge caused model-wide head rises and the largest mean absolute head changes of any sensitivity run. The mean absolute head changes for the Upper Alluvial Unit and the Lower Volcanic Unit were 16.3 feet and 17.8 feet, respectively (Table 18).

The largest head changes for the Upper Alluvial Unit occurred in the Upper Agua Fria sub-basin where heads increased from 20 to 85 feet. Upper Alluvial Unit heads increased only about 10 to 25 feet in the Little Chino sub-basin. Lower Volcanic Unit heads increased from 17 to 25 feet throughout most of the Little Chino sub-basin. An exception to this pattern occurred in the northern part of the Little Chino artesian area where head rises were less than 10 feet.

Doubling the natural recharge also produced the largest percent change in the simulated change-in-storage (-67 percent) of any sensitivity run. The simulated change-in-storage decreased to about -108,400 acre-feet for the (x2) sensitivity run from the calibrated benchmark level of -331,500 acre-feet. Although increasing natural recharge produced the largest changes in model heads and model storage, the drain discharge and underflow experienced relatively little change. Drain discharge increased only 10 percent and underflow increased 7 percent (Table 18).

Reducing natural recharge by 50 percent (0.5x) caused the model to fail to reach closure criteria and the sensitivity run aborted.

The sensitivity analysis indicates that the model is sensitive to the amount of simulated natural recharge. The results indicate that a (x2) increase in natural recharge causes substantial head increases throughout the model area. The sensitivity analysis also shows that a (x2) increase in transient natural recharge results in a simulated change-in-storage which is about one-third the volume estimated by any other means (conceptual water budget, or water level change times specific yield). The analysis suggests that the current estimates of long-term transient natural recharge are (about 4,600 acre-feet per year in 1993, see Tables 5 and 6) reasonable approximations.

Although the long-term estimates of natural recharge may be adequate, the annual volume of natural recharge for any future year, or series of years, may vary significantly from the long-term average, therefore further study of natural recharge will still prove useful.

Flood Recharge

During predevelopment times infiltration of flows in the channel of Granite Creek was a major source of natural recharge for the Little Chino sub-basin. Since construction of the Granite Creek and Willow Creek dams the flows across the Little Chino sub-basin in Granite Creek have been eliminated except for flood flows that occur when water is spilled past the dams. As detailed previously in the text, major flood events on Granite Creek which cross the entire length of the Little Chino sub-basin are believed to have occurred only 4 times since the 1940's. The recharge from these flood events is a small but locally important component of the calibrated model recharge. To test the sensitivity of the model to variations in the flood recharge two model simulations were run, one doubling (2x) the flood recharge and one decreasing the flood recharge by 50 percent (0.5x).

Doubling flood recharge caused moderate rises in model heads but only slight changes in model storage, drain discharge, and underflow. The mean absolute head change was 3.8 feet for the Upper Alluvial Unit and 5.5 feet for the Lower Volcanic Unit (Table 18). Head rises in the Upper Alluvial Unit occurred almost exclusively in the Little Chino sub-basin, only a small area in the northern part of the Upper Agua Fria sub-basin experienced head changes. The greatest head rises occurred along Granite Creek. The pattern of head rises was generally the same for the Lower Volcanic Unit, however the head rises were slightly greater.

Increasing the flood recharge by a factor of two caused a 9 percent decrease in the simulated change-in-storage (-302,700 acre-feet). The drain discharge and underflow were virtually unaffected by the increased flood recharge. Drain discharge increased by 0.5 percent and underflow increased 2 percent (Table 18).

Reducing the flood recharge by 50 percent had only a slight impact on model results. Heads declined slightly in both the Upper Alluvial Unit and the Lower Volcanic Unit. The percent change in the simulated change-in-storage, drain discharge, and underflow values were marginally affected. Head declines in the Lower Volcanic Unit were slightly greater than declines in the Upper Alluvial Unit. The mean absolute head change for the Upper Alluvial Unit was 1.9 feet, while the mean absolute head decline for the Lower Volcanic Unit was 2.7 feet (Table 18). Head declines in the Upper Alluvial Unit were generally less than 5 feet and occurred almost exclusively in the Little Chino sub-basin. Lower Volcanic Unit head declines were generally less than 5 feet.

The percent change in the simulated change-in-storage, drain discharge, and underflow were all minimal. The percent change in the simulated change-in-storage increased by about 4 percent to -345,850 acre-feet. Drain discharge declined 0.2 percent and underflow declined 1 percent (Table 18).

The results of the sensitivity analysis indicate that the model is generally insensitive on a regional scale to changes in simulated Granite Creek flood recharge. However, the model is locally sensitive to changes in simulated flood recharge, specifically in the Little Chino sub-basin. The results indicate that recharge from Granite Creek flood events can be significant and should be quantified during future flood events.

Drain Conductance

Natural discharges from Del Rio Springs and from the baseflow of the Agua Fria River near Humboldt were simulated in the model using the MODFLOW Drain Package. Two sensitivity runs were made to test the impacts of varying the drain conductances. Drain conductance values were doubled (2x) and decreased 50 percent (0.5x) in the two sensitivity model simulations.

The sensitivity results indicate that the model is relatively insensitive over the selected range of change in the drain conductances. The mean absolute head change for Layers 1 and 2 was less than 1 foot for either sensitivity run (Table 18). The largest head change for any model cell in either of the two sensitivity simulations was 2 feet.

The percent change in the simulated change-in-storage, drain discharge, and underflow from the two sensitivity simulations were also negligible. Drain discharge increased by 3 percent when the drain conductance was doubled and decreased by 5 percent when the drain conductance was reduced 50 percent (Table 18). The results indicate that further analysis and modification of drain conductances would have little impact on model results.

IV. SENSITIVITY ANALYSIS SUMMARY

The results of the steady-state and transient sensitivity analyses indicate that the model is sensitive to the changes in many of its input parameters. The steady-state sensitivity analysis showed that the model is sensitive to changes in the volume of simulated natural recharge. Model-wide head changes averaged in excess of +/- 25 feet for natural recharge changes of +/- 25 percent. The steady-state sensitivity analysis also showed that the model was relatively insensitive to the choice of selected boundary conditions (constant heads, or constant flux).

The results of the transient sensitivity analysis showed that the model was sensitive to the selected changes in aquifer parameters and changes to the simulated transient stresses. The model was shown to be much more sensitive to +/- 25 percent changes to hydraulic conductivity than to equivalent changes to specific yield. The model failed to reach the closure criteria for x10 and x0.1 changes in Vcont. The model was relatively insensitive to x5 and x.5 Vcont changes except in the agricultural area of the Little Chino sub-basin. The model was almost completely insensitive to the x2 and x.5 changes in drain conductance.

The transient sensitivity results indicated that the model was most sensitive to the x2 increase in natural recharge, and also moderately sensitive to a 25 percent decrease in agricultural recharge. A 50 percent decrease in agricultural recharge failed to reach the closure criteria. Variations of +/- 25 percent to the 1940-1983 agricultural pumpage also significantly impacted model results.

The results of the transient sensitivity analysis indicate that the model has definite sensitivity to the selected changes. However, the model solution is acceptably stable over a reasonable range of parameter variation. The results have also indicated which parameters exert the most influence over the model solution, and therefore merit future study and refinement.

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APPENDIX I - TABULATED PUMPAGE AND RECHARGE (1940-1993)

ESTIMATED TOTAL PUMPAGE AND RECHARGE PER MODEL CELL PER DECADE 1940-1993

(ACRE-FEET)

LOCATION	CELL	ROW	COL	40-49 PUMPAGE	40-49 RECHARGE	50-59 PUMPAGE	50-59 RECHARGE	60-69 PUMPAGE	60-69 RECHARGE	70-79 PUMPAGE	70-79 RECHARGE	80-89 PUMPAGE	80-89 RECHARGE	90-93 PUMPAGE	90-93 RECHARGE
A13_1_01A	1802	41	42	0	0	0	0	170	85	327	163	69	34	0	0
A13_1_01B	1801	41	41	0	0	0	0	265	135	510	258	121	59	4	0
A13_1_01C	1845	42	41	0	0	0	0	1240	620	2381	1191	535	259	11	0
A13_1_01D	1846	42	42	0	0	0	0	15	10	30	19	7	3	0	0
A13_1_02C	1843	42	39	0	0	0	0	85	45	165	86	44	17	5	0
A13_1_02D	1844	42	40	0	0	0	0	70	35	133	66	262	127	145	73
A13_1_03A	1798	41	38	0	0	5	0	145	70	276	135	116	39	19	0
A13_1_03B	1797	41	37	0	0	0	0	941	470	1845	901	625	231	155	36
A13_1_03C	1841	42	37	5	0	5	0	280	135	580	261	278	54	89	0
A13_1_03D	1842	42	38	1	0	15	0	418	200	808	384	286	102	68	17
A13_1_04A	1796	41	36	0	0	0	0	3	0	26	0	60	0	37	0
A13_1_04B	1795	41	35	5	0	5	0	5	0	10	0	66	0	41	0
A13_1_05A	1794	41	34	0	0	0	0	75	35	152	69	80	14	32	0
A13_1_05B	1793	41	33	0	0	0	0	0	0	2	0	14	0	7	0
A13_1_05C	1837	42	33	0	0	0	0	0	0	3	0	57	0	32	0
A13_1_05D	1838	42	34	0	0	0	0	1	0	18	0	77	0	43	0
A13_1_06C	1835	42	31	0	0	0	0	2	0	6	0	22	0	11	0
A13_1_06D	1836	42	32	0	0	0	0	0	0	4	0	12	0	9	0
A13_1_10A	1886	43	38	5	0	5	0	665	330	1273	633	443	214	133	49
A13_1_10D	1930	44	38	0	0	0	0	570	285	1096	547	243	114	7	0
A13_1_11A	1888	43	40	0	0	0	0	790	395	1523	758	633	279	135	49
A13_1_11B	1887	43	39	1	0	5	0	975	485	1874	931	1940	946	977	474
A13_1_11C	1931	44	39	0	0	0	0	1235	620	2372	1189	677	286	433	197
A13_1_11D	1932	44	40	0	0	0	0	120	60	233	116	220	27	39	0
A13_1_12B	1889	43	41	0	0	0	0	900	450	1729	864	374	180	7	0
A13_1_12C	1933	44	41	0	0	0	0	0	0	3	0	139	0	71	0
A13_1_13B	1977	45	41	0	0	0	0	0	0	7	0	92	0	62	0
A13_1_13C	2021	46	41	0	0	0	0	0	0	27	0	97	1	49	0
A13_1_14A	1976	45	40	0	0	0	0	0	0	6	0	930	395	183	49
A13_1_14B	1975	45	39	0	0	7	0	1166	575	2239	1105	748	305	417	121
A13_1_14C	2019	46	39	20	0	28	0	397	180	749	345	275	72	45	0
A13_1_14D	2020	46	40	0	0	0	0	83	35	182	67	159	15	57	1
A13_1_15A	1974	45	38	5	0	6	0	190	90	354	172	93	36	9	0
A13_1_15D	2018	46	38	15	0	16	0	25	0	31	0	45	0	22	0
A13_1_22A	2062	47	38	0	0	0	0	0	0	1	0	5	0	2	0
A13_1_22B	2061	47	37	5	0	5	0	5	0	6	0	19	0	9	0
A14_1_03B	1269	29	37	0	333	0	333	0	333	4	333	5	333	2	125
A14_1_03C	1313	30	37	0	117	0	117	0	117	0	117	0	117	0	44
A14_1_03D	1314	30	38	0	117	0	117	0	117	0	117	0	117	0	44
A14_1_04A	1268	29	36	0	333	0	333	0	333	0	333	0	333	0	125

ESTIMATED TOTAL PUMPAGE AND RECHARGE PER MODEL CELL PER DECADE 1940-1993

(ACRE-FEET)

LOCATION	CELL	ROW	COL	40-49 PUMPAGE	40-49 RECHARGE	50-59 PUMPAGE	50-59 RECHARGE	60-69 PUMPAGE	60-69 RECHARGE	70-79 PUMPAGE	70-79 RECHARGE	80-89 PUMPAGE	80-89 RECHARGE	90-93 PUMPAGE	90-93 RECHARGE
A14_1_04B	1267	29	35	0	333	0	333	0	333	0	333	0	333	0	125
A14_1_04C	1311	30	35	0	333	0	333	0	333	0	333	0	333	0	125
A14_1_04D	1312	30	36	0	333	0	333	0	333	1	333	5	333	2	125
A14_1_05A	1266	29	34	0	333	0	333	0	333	0	333	0	333	0	125
A14_1_05D	1310	30	34	0	333	0	333	0	333	0	333	0	333	0	125
A14_1_10A	1358	31	38	0	117	0	117	0	117	0	117	0	117	0	44
A14_1_10B	1357	31	37	0	117	0	117	0	117	0	117	0	117	0	44
A14_1_10C	1401	32	37	0	117	0	117	0	117	0	117	0	117	0	44
A14_1_10D	1402	32	38	0	117	0	117	0	117	0	117	0	117	0	44
A14_1_11A	1360	31	40	0	0	0	0	0	0	1	0	5	0	2	0
A14_1_14A	1448	33	40	0	0	0	0	0	0	1	0	5	0	2	0
A14_1_14B	1447	33	39	0	117	0	117	0	117	0	117	0	117	0	44
A14_1_14C	1491	34	39	0	117	0	117	0	117	0	117	0	117	0	44
A14_1_15A	1446	33	38	0	117	0	117	0	117	0	117	0	117	0	44
A14_1_15B	1445	33	37	0	117	0	117	0	117	0	117	0	117	0	44
A14_1_15C	1489	34	37	0	117	0	117	0	117	0	117	0	117	0	44
A14_1_15D	1490	34	38	0	117	0	117	0	117	0	117	0	117	0	44
A14_1_19A	1528	35	32	0	461	0	461	0	461	0	461	0	461	0	173
A14_1_19B	1527	35	31	0	461	0	461	0	461	0	461	0	461	0	173
A14_1_19C	1571	36	31	0	461	0	461	0	461	0	461	0	461	0	173
A14_1_19D	1572	36	32	0	461	0	461	0	461	0	461	0	461	0	173
A14_1_20C	1573	36	33	0	461	0	461	0	461	0	461	141	529	38	191
A14_1_20D	1574	36	34	0	461	0	461	0	461	0	461	0	461	0	173
A14_1_21D	1576	36	36	0	0	0	0	935	465	1794	894	373	187	0	0
A14_1_22A	1534	35	38	0	117	0	117	0	117	0	117	0	117	0	44
A14_1_22C	1577	36	37	0	0	0	0	1495	750	2870	1440	598	300	0	0
A14_1_22D	1578	36	38	0	117	0	117	0	117	0	117	0	117	0	44
A14_1_23B	1535	35	39	0	117	0	117	0	117	0	117	0	117	0	44
A14_1_23C	1579	36	39	0	117	0	117	0	117	0	117	0	117	0	44
A14_1_23D	1580	36	40	0	117	0	117	0	117	0	117	0	117	0	44
A14_1_27B	1621	37	37	0	0	0	0	1890	945	3629	1814	757	378	0	0
A14_1_27C	1665	38	37	0	0	0	0	1755	875	3367	1681	700	350	0	0
A14_1_28A	1620	37	36	0	0	0	0	1730	865	3321	1661	1495	748	666	332
A14_1_28B	1619	37	35	0	0	0	0	1215	610	2334	1171	487	243	0	0
A14_1_28C	1663	38	35	0	0	0	0	0	0	2250	0	6008	0	3062	0
A14_1_28D	1664	38	36	0	0	0	0	2075	665	7795	1275	2030	266	0	0
A14_1_29A	1618	37	34	0	416	0	416	290	561	556	694	336	583	0	156
A14_1_29B	1617	37	33	0	416	0	416	0	416	0	416	0	416	0	156
A14_1_29C	1661	38	33	0	416	0	416	0	416	0	416	0	416	0	156
A14_1_30A	1616	37	32	0	416	0	416	0	416	0	416	0	416	0	156

ESTIMATED TOTAL PUMPAGE AND RECHARGE PER MODEL CELL PER DECADE 1940-1993

(ACRE-FEET)

LOCATION	CELL	ROW	COL	40-49 PUMPAGE	40-49 RECHARGE	50-59 PUMPAGE	50-59 RECHARGE	60-69 PUMPAGE	60-69 RECHARGE	70-79 PUMPAGE	70-79 RECHARGE	80-89 PUMPAGE	80-89 RECHARGE	90-93 PUMPAGE	90-93 RECHARGE
A14_1_30B	1615	37	31	0	416	0	416	0	416	0	416	0	416	0	156
A14_1_30C	1659	38	31	0	416	0	416	0	416	0	416	0	416	0	156
A14_1_30D	1660	38	32	0	416	0	416	0	416	0	416	0	416	0	156
A14_1_31A	1704	39	32	0	416	0	416	0	416	0	416	0	416	0	156
A14_1_31B	1703	39	31	0	416	0	416	0	416	0	416	0	416	0	156
A14_1_31C	1747	40	31	0	0	0	0	1	0	5	0	5	0	2	0
A14_1_31D	1748	40	32	0	416	0	416	0	416	0	416	0	416	0	156
A14_1_32B	1705	39	33	0	416	0	416	0	416	0	416	0	416	0	156
A14_1_32C	1749	40	33	0	416	0	416	0	416	0	416	0	416	0	156
A14_1_33A	1708	39	36	0	0	0	0	525	265	1009	507	210	106	0	0
A14_1_33D	1752	40	36	0	0	0	0	120	60	229	115	47	23	0	0
A14_1_34B	1709	39	37	0	0	0	0	1250	625	2400	1199	507	252	2	0
A14_1_34C	1753	40	37	0	0	0	0	790	395	1516	758	445	223	50	24
A14_1_35B	1711	39	39	0	0	0	0	0	0	2	0	5	0	2	0
A14_1_35D	1756	40	40	0	0	0	0	5	0	8	0	22	0	13	0
A15_1_02C	787	18	39	0	0	1	0	5	0	5	0	5	0	2	0
A15_1_06B	735	17	31	0	291	0	291	0	291	0	291	0	291	0	109
A15_1_06C	779	18	31	0	41	0	41	0	41	0	41	7	41	4	16
A15_1_06D	780	18	32	0	41	0	41	0	41	0	41	0	41	0	16
A15_1_07A	824	19	32	0	41	0	41	0	41	0	41	6	41	7	16
A15_1_07B	823	19	31	0	41	0	41	0	41	0	41	0	41	0	16
A15_1_07C	867	20	31	0	41	0	41	0	41	0	41	9	41	7	16
A15_1_07D	868	20	32	0	41	0	41	0	41	0	41	0	41	0	16
A15_1_17B	913	21	33	0	41	0	41	0	41	0	41	1	41	2	16
A15_1_17C	957	22	33	0	41	0	41	0	41	0	41	1	41	2	16
A15_1_18A	912	21	32	0	41	0	41	0	41	0	41	0	41	0	16
A15_1_18B	911	21	31	0	41	0	41	0	41	0	41	0	41	0	16
A15_1_18C	955	22	31	0	41	0	41	0	41	0	41	0	41	0	16
A15_1_18D	956	22	32	0	41	0	41	0	41	0	41	0	41	0	16
A15_1_19A	1000	23	32	0	41	0	41	0	41	0	41	4	41	6	16
A15_1_19B	999	23	31	0	41	0	41	0	41	0	41	0	41	0	16
A15_1_19C	1043	24	31	0	41	0	41	0	41	1	41	11	41	7	16
A15_1_19D	1044	24	32	0	41	0	41	0	41	0	41	0	41	0	16
A15_1_20B	1001	23	33	0	41	0	41	0	41	0	41	0	41	0	16
A15_1_20C	1045	24	33	0	41	0	41	0	41	0	41	0	41	0	16
A15_1_28C	1135	26	35	0	333	0	333	0	333	0	333	0	333	0	125
A15_1_29B	1089	25	33	0	41	0	41	0	41	0	41	0	41	0	16
A15_1_29C	1133	26	33	0	333	0	333	0	333	0	333	0	333	0	125
A15_1_29D	1134	26	34	0	333	0	333	0	333	0	333	0	333	0	125
A15_1_30A	1088	25	32	0	41	0	41	0	41	0	41	0	41	0	16

ESTIMATED TOTAL PUMPAGE AND RECHARGE PER MODEL CELL PER DECADE 1940-1993

(ACRE-FEET)

LOCATION	CELL	ROW	COL	40-49 PUMPAGE	40-49 RECHARGE	50-59 PUMPAGE	50-59 RECHARGE	60-69 PUMPAGE	60-69 RECHARGE	70-79 PUMPAGE	70-79 RECHARGE	80-89 PUMPAGE	80-89 RECHARGE	90-93 PUMPAGE	90-93 RECHARGE
A15_1_30B	1087	25	31	0	41	0	41	0	41	0	41	0	41	0	16
A15_1_32A	1178	27	34	0	333	0	333	0	333	0	333	0	333	0	125
A15_1_32B	1177	27	33	0	333	0	333	0	333	0	333	0	333	0	125
A15_1_32C	1221	28	33	0	333	0	333	0	333	0	333	0	333	0	125
A15_1_32D	1222	28	34	0	333	0	333	0	333	0	333	0	333	0	125
A15_1_33A	1180	27	36	0	333	0	333	0	333	0	333	0	333	0	125
A15_1_33B	1179	27	35	0	333	0	333	0	333	0	333	0	333	0	125
A15_1_33C	1223	28	35	0	333	0	333	0	333	0	333	0	333	0	125
A15_1_33D	1224	28	36	0	333	0	333	0	333	0	333	0	333	0	125
A16_1_30C	603	14	31	0	291	0	291	0	291	0	291	0	291	0	109
A16_1_31B	647	15	31	0	291	0	291	0	291	0	291	0	291	0	109
A16_1_31C	691	16	31	0	291	0	291	0	291	0	291	0	291	0	109
B14_1_03B	1257	29	25	0	36	0	36	0	36	0	36	0	36	0	13
B14_1_03C	1301	30	25	0	36	0	36	0	36	0	36	0	36	0	13
B14_1_04A	1256	29	24	0	36	0	36	0	36	0	36	0	36	0	13
B14_1_04B	1255	29	23	0	36	0	36	0	36	0	36	0	36	0	13
B14_1_04C	1299	30	23	0	36	0	36	0	36	0	36	0	36	0	13
B14_1_04D	1300	30	24	0	36	0	36	0	36	0	36	0	36	0	13
B14_1_05A	1254	29	22	0	36	0	36	0	36	0	36	0	36	0	13
B14_1_05D	1298	30	22	0	36	0	36	0	36	0	36	0	36	0	13
B14_1_06B	1251	29	19	5	0	5	0	5	0	5	0	5	0	2	0
B14_1_09A	1344	31	24	0	36	0	36	0	36	0	36	0	36	0	13
B14_1_09B	1343	31	23	0	36	0	36	0	36	0	36	0	36	0	13
B14_1_09D	1388	32	24	0	36	0	36	0	36	0	36	0	36	0	13
B14_1_10B	1345	31	25	0	36	0	36	0	36	0	36	0	36	0	13
B14_1_10C	1389	32	25	0	36	0	36	0	36	0	36	0	36	0	13
B14_1_10D	1390	32	26	0	0	0	0	0	0	633	0	3988	0	4668	0
B14_1_13A	1438	33	30	0	461	0	461	0	461	0	461	0	461	0	173
B14_1_13B	1437	33	29	0	461	0	461	0	461	0	461	0	461	0	173
B14_1_13C	1481	34	29	0	461	0	461	0	461	0	461	0	461	0	173
B14_1_13D	1482	34	30	0	461	0	461	0	461	0	461	0	461	0	173
B14_1_14A	1436	33	28	0	461	0	461	1000	461	833	461	1839	461	1174	173
B14_1_14B	1435	33	27	0	461	0	461	0	461	0	461	0	461	0	173
B14_1_14C	1479	34	27	0	461	0	461	0	461	0	461	0	461	0	173
B14_1_14D	1480	34	28	0	461	0	461	0	461	0	461	0	461	0	173
B14_1_15A	1434	33	26	0	461	0	461	0	461	533	461	750	461	148	173
B14_1_15B	1433	33	25	0	36	0	36	0	36	0	36	0	36	0	13
B14_1_15C	1477	34	25	0	461	0	461	3	461	5	461	5	461	2	173
B14_1_15D	1478	34	26	0	461	0	461	0	461	0	461	0	461	0	173
B14_1_22A	1522	35	26	0	461	0	461	0	461	0	461	0	461	0	173

ESTIMATED TOTAL PUMPAGE AND RECHARGE PER MODEL CELL PER DECADE 1940-1993

(ACRE-FEET)

LOCATION	CELL	ROW	COL	40-49 PUMPAGE	40-49 RECHARGE	50-59 PUMPAGE	50-59 RECHARGE	60-69 PUMPAGE	60-69 RECHARGE	70-79 PUMPAGE	70-79 RECHARGE	80-89 PUMPAGE	80-89 RECHARGE	90-93 PUMPAGE	90-93 RECHARGE
B14_1_23A	1524	35	28	0	461	0	461	0	461	0	461	0	461	0	173
B14_1_23B	1523	35	27	0	461	0	461	0	461	0	461	0	461	0	173
B14_1_23C	1567	36	27	0	461	0	461	0	461	0	461	0	461	0	173
B14_1_23D	1568	36	28	0	461	0	461	0	461	0	461	0	461	0	173
B14_1_24A	1526	35	30	0	461	0	461	0	461	0	461	0	461	0	173
B14_1_24B	1525	35	29	0	461	0	461	0	461	0	461	0	461	0	173
B14_1_24C	1569	36	29	0	461	0	461	0	461	0	461	0	461	0	173
B14_1_24D	1570	36	30	0	461	0	461	0	461	0	461	0	461	0	173
B14_1_26A	1612	37	28	0	0	0	0	0	0	4	0	5	0	2	0
B14_2_01A	1250	29	18	0	540	0	540	0	615	0	720	0	1126	0	1054
B14_2_01B	1249	29	17	0	0	0	0	2	0	5	0	18	0	7	0
B14_2_01D	1294	30	18	0	540	0	540	0	615	0	720	3	1126	2	1054
B14_2_03B	1245	29	13	5	0	5	0	5	0	5	0	5	0	2	0
B14_2_05A	1242	29	10	0	0	0	0	3	0	23	0	87	0	44	0
B14_2_05B	1241	29	9	0	0	0	0	1	0	31	0	109	0	54	0
B14_2_05D	1286	30	10	5	0	5	0	5	0	6	0	18	0	9	0
B14_2_09C	1375	32	11	0	0	0	0	0	0	2	0	19	0	13	0
B15_1_01A	734	17	30	0	291	0	291	0	291	0	291	0	291	0	109
B15_1_01B	733	17	29	0	291	0	291	0	291	0	291	3	291	2	109
B15_1_01D	778	18	30	0	41	0	41	0	41	0	41	7	41	6	16
B15_1_06A	724	17	20	0	0	0	0	0	0	0	180	0	340	0	780
B15_1_06D	768	18	20	0	0	0	0	0	0	0	180	0	340	0	780
B15_1_07A	812	19	20	0	0	0	0	0	0	0	180	0	340	0	780
B15_1_07D	856	20	20	0	0	0	0	0	0	0	180	0	340	0	780
B15_1_12A	822	19	30	0	41	0	41	0	41	0	41	3	41	2	16
B15_1_12D	866	20	30	0	41	0	41	0	41	0	41	0	41	0	16
B15_1_18A	900	21	20	0	0	0	0	0	0	0	180	0	340	0	780
B15_1_18C	943	22	19	0	830	0	830	0	950	0	830	0	1219	0	425
B15_1_18D	944	22	20	0	0	0	0	0	0	0	180	0	340	0	780
B15_1_19A	988	23	20	0	0	0	0	0	0	0	180	0	340	0	780
B15_1_19B	987	23	19	0	500	0	500	0	572	0	500	0	733	0	256
B15_1_19C	1031	24	19	0	660	0	660	0	750	0	660	0	964	0	336
B15_1_19D	1032	24	20	0	0	0	0	0	0	0	180	0	340	0	780
B15_1_23A	996	23	28	0	0	0	0	0	0	2	0	5	0	2	0
B15_1_23B	995	23	27	0	0	1	0	5	0	5	0	5	0	2	0
B15_1_25C	1129	26	29	0	0	0	0	0	0	2	0	33	0	15	0
B15_1_30A	1076	25	20	0	0	0	0	0	0	0	180	0	3639	0	9043
B15_1_30B	1075	25	19	0	510	0	510	0	584	0	510	0	749	0	262
B15_1_30C	1119	26	19	0	550	0	550	0	628	0	550	0	806	0	281
B15_1_30D	1120	26	20	0	0	0	0	0	0	0	180	0	340	0	780

ESTIMATED TOTAL PUMPAGE AND RECHARGE PER MODEL CELL PER DECADE 1940-1993

(ACRE-FEET)

LOCATION	CELL	ROW	COL	40-49 PUMPAGE	40-49 RECHARGE	50-59 PUMPAGE	50-59 RECHARGE	60-69 PUMPAGE	60-69 RECHARGE	70-79 PUMPAGE	70-79 RECHARGE	80-89 PUMPAGE	80-89 RECHARGE	90-93 PUMPAGE	90-93 RECHARGE
B15_1_31B	1163	27	19	0	0	0	0	0	0	0	180	0	340	0	780
B15_1_31C	1207	28	19	5	0	5	0	5	0	9	180	10	340	4	780
B15_2_01C	765	18	17	0	540	0	540	0	620	0	540	0	797	0	278
B15_2_02B	719	17	15	0	820	0	820	0	942	0	820	0	1207	0	422
B15_2_02D	764	18	16	0	790	0	790	0	902	0	790	0	1157	0	404
B15_2_03A	718	17	14	0	760	0	760	0	875	0	760	8	1124	4	392
B15_2_05B	713	17	9	0	0	0	0	0	0	1	0	8	0	6	0
B15_2_10D	850	20	14	0	0	0	0	0	0	3	0	5	0	2	0
B15_2_12B	809	19	17	0	540	0	540	0	615	0	540	0	788	0	275
B15_2_12C	853	20	17	0	600	0	600	0	692	0	600	0	889	0	311
B15_2_13A	898	21	18	0	560	0	560	0	647	0	560	0	829	0	290
B15_2_13B	897	21	17	0	720	0	720	0	826	0	720	0	1063	0	372
B15_2_13D	942	22	18	0	0	0	0	0	0	5	0	5	0	2	0
B15_2_15B	893	21	13	0	0	0	0	0	0	5	0	5	0	2	0
B15_2_19C	1019	24	7	0	0	0	0	2	0	5	0	7	0	4	0
B15_2_20C	1021	24	9	0	166	0	166	0	166	0	166	0	166	0	62
B15_2_20D	1022	24	10	0	166	0	166	0	166	0	166	0	166	0	62
B15_2_24A	986	23	18	0	200	0	200	0	229	0	200	0	293	0	102
B15_2_24D	1030	24	18	0	310	0	310	0	357	0	310	0	457	0	160
B15_2_26A	1072	25	16	0	375	0	375	0	375	0	375	0	375	0	140
B15_2_26B	1071	25	15	0	375	0	375	0	375	0	375	0	375	0	140
B15_2_26C	1115	26	15	0	375	0	375	0	375	0	375	0	375	0	140
B15_2_26D	1116	26	16	0	375	0	375	0	375	0	375	5	375	2	140
B15_2_27A	1070	25	14	0	375	0	375	0	375	0	375	0	375	0	140
B15_2_27B	1069	25	13	0	375	0	375	0	375	0	375	0	375	0	140
B15_2_27C	1113	26	13	0	375	0	375	0	375	0	375	0	375	0	140
B15_2_27D	1114	26	14	0	375	0	375	0	375	0	375	0	375	0	140
B15_2_28A	1068	25	12	0	375	0	375	0	375	0	375	0	375	0	140
B15_2_28B	1067	25	11	0	375	0	375	0	375	0	375	0	375	0	140
B15_2_28C	1111	26	11	0	375	0	375	0	375	0	375	0	375	0	140
B15_2_28D	1112	26	12	0	375	0	375	0	375	0	375	0	375	0	140
B15_2_29A	1066	25	10	0	166	0	166	0	166	0	166	0	166	0	62
B15_2_29B	1065	25	9	0	166	0	166	0	166	0	166	0	166	0	62
B15_2_29C	1109	26	9	0	166	0	166	0	166	0	166	0	166	0	62
B15_2_29D	1110	26	10	0	166	0	166	0	166	0	166	0	166	0	62
B15_2_30A	1064	25	8	0	0	0	0	0	0	7	0	26	8	31	0
B15_2_30D	1108	26	8	0	0	0	0	1	0	110	0	257	0	109	0
B15_2_31A	1152	27	8	0	0	0	0	0	0	83	0	251	0	109	0
B15_2_32A	1154	27	10	0	166	0	166	3	166	7	166	18	166	7	62
B15_2_32B	1153	27	9	0	166	0	166	0	166	1	166	7	166	7	62

ESTIMATED TOTAL PUMPAGE AND RECHARGE PER MODEL CELL PER DECADE 1940-1993

(ACRE-FEET)

LOCATION	CELL	ROW	COL	40-49 PUMPAGE	40-49 RECHARGE	50-59 PUMPAGE	50-59 RECHARGE	60-69 PUMPAGE	60-69 RECHARGE	70-79 PUMPAGE	70-79 RECHARGE	80-89 PUMPAGE	80-89 RECHARGE	90-93 PUMPAGE	90-93 RECHARGE
B15_2_32C	1197	28	9	0	0	4	0	5	0	30	0	95	0	47	0
B15_2_32D	1198	28	10	0	166	0	166	0	166	39	166	117	166	50	62
B15_2_33A	1156	27	12	0	375	0	375	0	375	0	375	0	375	0	140
B15_2_33B	1155	27	11	0	375	0	375	0	375	0	375	0	375	0	140
B15_2_33C	1199	28	11	0	375	0	375	0	375	0	375	0	375	0	140
B15_2_33D	1200	28	12	0	375	0	375	0	375	0	375	0	375	0	140
B15_2_34A	1158	27	14	0	375	0	375	0	375	0	375	0	375	0	140
B15_2_34B	1157	27	13	0	375	0	375	0	375	0	375	0	375	0	140
B15_2_34C	1201	28	13	0	375	0	375	0	375	0	375	0	375	0	140
B15_2_34D	1202	28	14	0	375	0	375	0	375	0	375	0	375	0	140
B15_2_35A	1160	27	16	0	375	0	375	0	375	0	375	0	375	0	140
B15_2_35B	1159	27	15	0	375	0	375	0	375	0	375	0	375	0	140
B15_2_35C	1203	28	15	0	375	0	375	0	375	0	375	0	375	0	140
B15_2_35D	1204	28	16	0	375	0	375	0	375	0	375	0	375	0	140
B15_2_36A	1162	27	18	0	580	0	580	0	663	0	580	0	853	0	299
B15_2_36D	1206	28	18	0	540	0	540	0	615	0	540	0	788	0	275
B15_3_12A	798	19	6	0	0	0	0	1	0	5	0	5	0	2	0
B16_1_07B	283	7	19	448	225	874	437	764	383	823	413	248	123	0	0
B16_1_07C	327	8	19	2455	1227	4778	2390	4169	2086	4499	2248	1968	982	0	0
B16_1_07D	328	8	20	1258	631	2453	1226	2139	1069	2308	1154	696	349	0	0
B16_1_08B	285	7	21	0	0	0	0	0	0	0	180	0	340	0	780
B16_1_08C	329	8	21	0	0	0	0	0	0	0	180	0	340	0	780
B16_1_15C	421	10	25	0	147	0	147	0	147	0	147	0	147	0	55
B16_1_15D	422	10	26	0	147	0	147	0	147	0	147	0	147	0	55
B16_1_16A	376	9	24	0	147	0	147	0	147	0	147	0	147	0	55
B16_1_16D	420	10	24	0	147	0	147	0	147	0	147	0	147	0	55
B16_1_17B	373	9	21	0	0	0	0	0	0	0	180	0	340	0	780
B16_1_17C	417	10	21	0	0	0	0	0	0	0	180	0	340	0	780
B16_1_20B	461	11	21	0	0	0	0	0	0	0	180	0	340	0	780
B16_1_20C	505	12	21	0	0	0	0	0	0	0	180	0	340	0	780
B16_1_22A	466	11	26	0	147	0	147	0	147	0	147	0	147	0	55
B16_1_22B	465	11	25	0	147	0	147	0	147	0	147	0	147	0	55
B16_1_22D	510	12	26	0	147	0	147	0	147	0	147	0	147	0	55
B16_1_23A	468	11	28	0	147	0	147	0	147	0	147	0	147	0	55
B16_1_23B	467	11	27	0	147	0	147	0	147	0	147	0	147	0	55
B16_1_23C	511	12	27	0	147	0	147	0	147	0	147	0	147	0	55
B16_1_23D	512	12	28	0	147	0	147	0	147	0	147	0	147	0	55
B16_1_24A	470	11	30	0	147	0	147	0	147	0	147	0	147	0	55
B16_1_24B	469	11	29	0	147	0	147	0	147	0	147	0	147	0	55
B16_1_24C	513	12	29	0	147	0	147	0	147	0	147	0	147	0	55

ESTIMATED TOTAL PUMPAGE AND RECHARGE PER MODEL CELL PER DECADE 1940-1993

(ACRE-FEET)

LOCATION	CELL	ROW	COL	40-49 PUMPAGE	40-49 RECHARGE	50-59 PUMPAGE	50-59 RECHARGE	60-69 PUMPAGE	60-69 RECHARGE	70-79 PUMPAGE	70-79 RECHARGE	80-89 PUMPAGE	80-89 RECHARGE	90-93 PUMPAGE	90-93 RECHARGE
B16_1_24D	514	12	30	0	147	0	147	0	147	0	147	0	147	0	55
B16_1_25A	558	13	30	0	147	0	147	0	147	0	147	0	147	0	55
B16_1_25B	557	13	29	0	147	0	147	0	147	0	147	0	147	0	55
B16_1_25C	601	14	29	0	291	0	291	0	291	0	291	0	291	0	109
B16_1_25D	602	14	30	0	291	0	291	0	291	0	291	0	291	0	109
B16_1_30A	548	13	20	0	0	0	0	0	0	0	180	0	340	0	780
B16_1_30D	592	14	20	0	0	0	0	0	0	0	180	0	340	0	780
B16_1_31A	636	15	20	0	0	0	0	0	0	0	180	0	340	0	780
B16_1_31D	680	16	20	0	0	0	0	0	0	0	180	0	340	0	780
B16_1_36A	646	15	30	0	291	0	291	0	291	0	291	0	291	0	109
B16_1_36B	645	15	29	0	291	0	291	0	291	0	291	0	291	0	109
B16_1_36C	689	16	29	0	291	0	291	0	291	0	291	0	291	0	109
B16_1_36D	690	16	30	0	291	0	291	0	291	0	291	0	291	0	109
B16_2_01D	238	6	18	0	0	0	0	0	0	1	0	5	0	2	0
B16_2_02A	192	5	16	345	174	673	337	593	293	639	317	4066	2030	1648	824
B16_2_02C	235	6	15	269	131	519	260	454	226	494	246	164	73	9	0
B16_2_03A	190	5	14	1712	855	3336	1667	2911	1454	3138	1570	1025	472	49	0
B16_2_03B	189	5	13	2382	1191	4636	2319	4046	2022	4368	2183	2185	1075	1107	545
B16_2_03C	233	6	13	2298	1148	4477	2238	3911	1951	4218	2104	2966	1461	1585	783
B16_2_03D	234	6	14	1651	825	3217	1606	2820	1404	3049	1512	1285	613	34	0
B16_2_04A	188	5	12	2337	991	4551	1933	3972	1686	4281	1818	1817	812	66	32
B16_2_04B	187	5	11	1	174	5	342	5	300	5	323	81	97	63	0
B16_2_04C	231	6	11	68	32	129	65	113	57	124	59	207	19	96	0
B16_2_04D	232	6	12	1283	640	2500	1248	2181	1088	2353	1175	1067	528	4	0
B16_2_05C	229	6	9	0	136	0	136	0	136	4	136	130	136	84	51
B16_2_05D	230	6	10	41	157	81	177	70	171	113	174	237	147	102	51
B16_2_07C	315	8	7	0	0	0	0	0	0	2	0	83	0	50	0
B16_2_07D	316	8	8	0	0	0	0	0	0	11	0	165	0	98	0
B16_2_08A	274	7	10	0	136	0	136	0	136	4	136	29	136	17	51
B16_2_08B	273	7	9	0	136	0	136	0	136	13	136	72	136	39	51
B16_2_08C	317	8	9	0	136	0	136	10	136	19	136	83	136	48	51
B16_2_08D	318	8	10	0	136	0	136	0	136	11	136	46	136	19	51
B16_2_09A	276	7	12	2053	1028	3998	1999	3488	1745	3765	1881	1148	568	6	0
B16_2_09B	275	7	11	84	41	161	81	141	70	209	74	270	23	99	0
B16_2_09C	319	8	11	0	0	0	0	4	0	69	0	228	0	109	0
B16_2_09D	320	8	12	490	244	953	477	832	416	923	448	2587	1208	93	0
B16_2_10A	278	7	14	2111	1055	4112	2057	3593	1796	3877	1937	1322	642	21	0
B16_2_10B	277	7	13	2460	1227	4783	2390	4174	2086	4506	2248	1366	677	4	0
B16_2_10C	321	8	13	2189	1096	4268	2134	3726	1860	4017	2010	1213	606	37	0
B16_2_10D	322	8	14	1658	827	3225	1611	2814	1406	3049	1515	2322	1139	272	122

ESTIMATED TOTAL PUMPAGE AND RECHARGE PER MODEL CELL PER DECADE 1940-1993

(ACRE-FEET)

LOCATION	CELL	ROW	COL	40-49 PUMPAGE	40-49 RECHARGE	50-59 PUMPAGE	50-59 RECHARGE	60-69 PUMPAGE	60-69 RECHARGE	70-79 PUMPAGE	70-79 RECHARGE	80-89 PUMPAGE	80-89 RECHARGE	90-93 PUMPAGE	90-93 RECHARGE
B16_2_11A	280	7	16	104	50	198	97	177	84	204	91	147	31	44	0
B16_2_11B	279	7	15	1740	866	3382	1688	2955	1473	3212	1589	1900	892	286	105
B16_2_11C	323	8	15	1452	725	2827	1415	2468	1234	2674	1331	969	453	185	66
B16_2_11D	324	8	16	540	271	1053	528	922	460	1017	495	489	211	50	0
B16_2_12A	282	7	18	2455	1227	4778	2390	4169	2086	4499	2248	2424	1211	0	0
B16_2_12B	281	7	17	1996	999	3889	1944	3392	1697	3660	1828	1102	552	0	0
B16_2_12C	325	8	17	1098	549	2139	1070	1867	932	2011	1008	615	303	4	0
B16_2_12D	326	8	18	2213	1106	4311	2157	3762	1883	4059	2030	2757	1379	13	6
B16_2_14A	368	9	16	293	146	575	286	508	249	578	267	236	80	32	0
B16_2_14B	367	9	15	1016	509	1978	989	1729	863	1863	931	936	466	9	4
B16_2_14C	411	10	15	1243	148	11710	289	19211	252	26995	272	38453	82	19169	0
B16_2_14D	412	10	16	0	0	0	0	0	0	4	0	77	0	38	0
B16_2_15A	366	9	14	921	1047	1795	1480	1571	1451	1729	1426	785	1196	77	304
B16_2_15B	365	9	13	354	176	693	345	610	300	776	325	2840	1253	156	0
B16_2_15C	409	10	13	2109	1054	4107	2054	3582	1790	3871	1931	1683	831	20	6
B16_2_15D	410	10	14	1006	1136	1957	1605	1722	1575	1876	1549	2437	2108	341	479
B16_2_16A	364	9	12	490	244	958	477	837	416	901	448	386	136	82	0
B16_2_16B	363	9	11	22	11	45	20	38	18	40	20	12	6	0	0
B16_2_16C	407	10	11	583	292	1136	567	990	495	1068	534	321	161	0	0
B16_2_16D	408	10	12	1323	662	2578	1287	2248	1123	2425	1214	735	365	29	0
B16_2_17A	362	9	10	0	136	0	136	0	136	1	136	47	136	45	51
B16_2_17B	361	9	9	0	136	0	136	0	136	3	136	73	153	41	59
B16_2_17C	405	10	9	90	181	174	223	153	212	166	218	88	160	19	51
B16_2_17D	406	10	10	0	136	0	136	0	136	2	136	61	136	31	51
B16_2_20A	450	11	10	0	136	0	136	0	136	0	136	2	136	2	51
B16_2_20B	449	11	9	0	136	0	136	0	136	0	136	0	136	0	51
B16_2_20C	493	12	9	0	136	0	136	0	136	0	136	0	136	0	51
B16_2_20D	494	12	10	0	136	0	136	0	136	0	136	0	136	0	51
B16_2_21A	452	11	12	459	934	893	1149	789	1198	861	1122	325	1176	50	375
B16_2_21C	495	12	11	24	28	47	40	42	38	45	38	71	30	43	9
B16_2_21D	496	12	12	262	802	503	917	443	984	484	904	376	1155	183	427
B16_2_22A	454	11	14	1071	1228	2089	1736	1831	1703	2002	1674	817	1333	116	360
B16_2_22B	453	11	13	1267	1453	2468	2050	2165	2014	2346	1978	804	1586	31	424
B16_2_22C	497	12	13	327	362	625	512	553	504	614	494	276	387	51	105
B16_2_22D	498	12	14	11	0	17	0	20	0	28	0	494	0	463	0
B16_2_23A	456	11	16	593	293	1154	570	1006	497	1083	538	506	161	317	0
B16_2_23B	455	11	15	913	1043	1779	1478	1556	1451	1685	1426	701	1204	30	311
B16_2_23C	499	12	15	185	213	361	300	314	296	340	289	108	227	4	62
B16_2_23D	500	12	16	51	60	102	85	87	82	94	80	28	63	0	18
B16_2_25A	546	13	18	0	0	0	0	0	0	3	0	5	0	2	0

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(ACRE-FEET)

LOCATION	CELL	ROW	COL	40-49 PUMPAGE	40-49 RECHARGE	50-59 PUMPAGE	50-59 RECHARGE	60-69 PUMPAGE	60-69 RECHARGE	70-79 PUMPAGE	70-79 RECHARGE	80-89 PUMPAGE	80-89 RECHARGE	90-93 PUMPAGE	90-93 RECHARGE
B16_2_26A	544	13	16	0	0	0	0	0	0	43	0	189	0	98	0
B16_2_26B	543	13	15	1270	1451	2471	2050	2160	2013	2359	1978	1230	1774	213	505
B16_2_26C	587	14	15	98	112	195	160	201	157	269	154	219	120	75	33
B16_2_26D	588	14	16	0	0	0	0	0	0	1	0	17	0	11	0
B16_2_27A	542	13	14	883	998	1712	1409	1503	1383	1636	1360	531	1068	21	289
B16_2_27B	541	13	13	706	809	1380	1142	1209	1122	1333	1102	522	869	91	234
B16_2_27C	585	14	13	33	98	68	115	63	130	75	114	55	135	24	46
B16_2_27D	586	14	14	748	859	1463	1214	1282	1190	1388	1170	500	942	17	249
B16_2_28A	540	13	12	37	687	70	700	74	794	144	698	173	998	76	346
B16_2_28B	539	13	11	364	417	708	589	619	577	667	568	223	446	137	181
B16_2_28D	584	14	12	674	1391	1311	1711	1149	1780	1244	1672	406	1734	26	542
B16_2_29A	538	13	10	0	136	0	136	0	136	4	136	83	136	49	51
B16_2_29B	537	13	9	0	136	0	136	0	136	1	136	48	136	34	51
B16_2_29C	581	14	9	0	136	0	136	0	136	2	136	53	136	35	51
B16_2_29D	582	14	10	0	136	0	136	0	136	5	136	120	136	60	51
B16_2_30A	536	13	8	0	0	0	0	0	0	4	0	5	0	2	0
B16_2_31A	624	15	8	0	0	0	0	0	0	1	0	33	0	24	0
B16_2_31C	667	16	7	0	0	0	0	0	0	2	0	18	0	11	0
B16_2_32A	626	15	10	0	136	0	136	0	136	0	136	0	136	0	51
B16_2_32B	625	15	9	0	136	0	136	0	136	0	136	0	136	0	51
B16_2_32C	669	16	9	0	136	0	136	0	136	0	136	0	136	0	51
B16_2_32D	670	16	10	0	136	0	136	0	136	0	136	0	136	0	51
B16_2_33A	628	15	12	0	280	0	280	0	323	1	280	58	412	30	145
B16_2_33B	627	15	11	0	0	0	0	0	0	1	0	67	0	52	0
B16_2_33D	672	16	12	0	0	0	0	0	0	1	0	44	0	42	0
B16_2_34A	630	15	14	0	0	4	0	6	0	14	0	31	0	13	0
B16_2_34B	629	15	13	0	850	0	850	8	969	19	850	29	1242	11	434
B16_2_34C	673	16	13	0	0	0	0	0	0	4	0	7	0	4	0
B16_2_34D	674	16	14	0	520	0	520	0	593	7	520	99	761	79	265
B16_2_35A	632	15	16	0	0	0	0	0	0	7	0	48	0	21	0
B16_2_35B	631	15	15	378	433	735	611	642	599	711	589	275	463	35	126
B16_2_35C	675	16	15	5	0	5	0	5	0	41	0	76	0	34	0
B16_2_35D	676	16	16	5	0	5	0	5	0	9	0	13	0	6	0
B17_2_26B	15	1	15	0	100	0	195	0	171	0	185	0	55	0	0
B17_2_27A	14	1	14	1500	651	2927	1265	2553	1107	2751	1193	831	360	0	0
B17_2_27B	13	1	13	692	344	1346	671	1174	586	1266	634	382	191	0	0
B17_2_27C	57	2	13	1731	866	3373	1687	2945	1470	3174	1588	957	478	0	0
B17_2_27D	58	2	14	1083	539	2105	1053	1836	920	1981	990	2309	1155	5629	2815
B17_2_33A	100	3	12	0	230	0	453	0	394	0	428	0	129	0	0
B17_2_33D	144	4	12	2088	1044	4070	2035	3551	1776	3829	1915	1154	577	0	0

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LOCATION	CELL	ROW	COL	40-49 PUMPAGE	40-49 RECHARGE	50-59 PUMPAGE	50-59 RECHARGE	60-69 PUMPAGE	60-69 RECHARGE	70-79 PUMPAGE	70-79 RECHARGE	80-89 PUMPAGE	80-89 RECHARGE	90-93 PUMPAGE	90-93 RECHARGE
B17_2_34A	102	3	14	1313	657	2558	1278	2232	1115	2407	1204	727	364	2	0
B17_2_34B	101	3	13	2291	914	4463	1779	3900	1551	4207	1674	3718	1728	2705	1351
B17_2_34C	145	4	13	2329	1165	4534	2270	3957	1980	4268	2134	9026	3199	126	63
B17_2_34D	146	4	14	2081	1042	4056	2028	3543	1768	3819	1907	3811	1905	1069	533
B17_2_35A	104	3	16	405	203	790	394	690	344	744	371	223	112	0	0
B17_2_35C	147	4	15	1218	610	2375	1185	2070	1037	2234	1116	4380	2190	1780	890
B17_2_35D	148	4	16	1304	651	2539	1270	2216	1108	2390	1195	5211	2606	2019	1009
				77122	106399	159441	142400	174203	148247	223657	165413	162897	139401	56174	66759

APPENDIX II - TABULATED AQUIFER PARAMETERS AND RELATED DATA

SUMMARY OF CALIBRATED MODEL INPUT PARAMETERS AND RELATED DATA

LOCATION	CELL	ROW	COL	LSURF ELEV	UAUBOT ELEV	LVUBOT ELEV	UAU_K FT/D	LVU_K FT/D	UAU_94T F^2/D	LVU_94T F^2/D	UAU_SY	LVU_SY	LVU_SC	VCONT 1/D	UAU_94WL ELEV	LVU_94WL ELEV	94DTW FEET
A13_1_02A	1800	41	40	4650	4150	----	9	----	3555	----	0.07	----	----	----	4545	----	105
A13_1_02B	1799	41	39	4590	3950	----	10	----	5980	----	0.08	----	----	----	4548	----	42
A13_1_02C	1843	42	39	4580	3950	----	10	----	5700	----	0.12	----	----	----	4520	----	60
A13_1_02D	1844	42	40	4620	4100	----	9	----	3753	----	0.08	----	----	----	4517	----	103
A13_1_03A	1798	41	38	4590	4100	----	7	----	3199	----	0.12	----	----	----	4557	----	33
A13_1_03B	1797	41	37	4630	4400	----	7	----	1141	----	0.08	----	----	----	4563	----	67
A13_1_03C	1841	42	37	4680	4250	----	1	----	310	----	0.08	----	----	----	4560	----	120
A13_1_03D	1842	42	38	4580	4000	----	7	----	3850	----	0.12	----	----	----	4550	----	30
A13_1_11A	1888	43	40	4570	4150	----	9	----	3222	----	0.08	----	----	----	4508	----	62
A13_1_11B	1887	43	39	4540	3950	----	10	----	5570	----	0.12	----	----	----	4507	----	33
A13_1_11C	1931	44	39	4530	4000	----	10	----	4980	----	0.12	----	----	----	4498	----	32
A13_1_11D	1932	44	40	4560	4150	----	9	----	3132	----	0.08	----	----	----	4498	----	62
A13_1_14A	1976	45	40	4520	4200	----	10	----	2930	----	0.08	----	----	----	4493	----	27
A13_1_14B	1975	45	39	4510	4100	----	10	----	3930	----	0.12	----	----	----	4493	----	17
A13_1_14C	2019	46	39	4500	4300	----	10	----	1730	----	0.12	----	----	----	4473	----	27
A13_1_14D	2020	46	40	4500	4380	----	25	----	2625	----	0.08	----	----	----	4485	----	15
A14_1_03B	1269	29	37	5060	4600	----	0.05	----	7.5	----	0.06	----	----	----	4750	----	310
A14_1_03C	1313	30	37	5000	4585	----	3	----	345	----	0.06	----	----	----	4700	----	300
A14_1_03D	1314	30	38	5010	4590	----	3	----	360	----	0.06	----	----	----	4710	----	300
A14_1_04A	1268	29	36	5055	4590	----	3	----	360	----	0.06	----	----	----	4710	----	345
A14_1_04B	1267	29	35	5030	4450	----	3	----	750	----	0.06	----	----	----	4700	----	330
A14_1_04C	1311	30	35	4965	4400	----	3	----	870	----	0.06	----	----	----	4690	----	275
A14_1_04D	1312	30	36	4970	4450	----	3	----	720	----	0.06	----	----	----	4690	----	280
A14_1_05A	1266	29	34	4920	4350	----	2	----	660	----	0.06	----	----	----	4680	----	240
A14_1_05B	1265	29	33	4955	4250	----	1	----	440	----	0.06	----	----	----	4690	----	265
A14_1_05C	1309	30	33	4870	4200	----	1	----	480	----	0.06	----	----	----	4680	----	190
A14_1_05D	1310	30	34	4880	4250	----	3	----	1290	----	0.06	----	----	----	4680	----	200
A14_1_06A	1264	29	32	4890	4200	----	1	----	471	----	0.06	----	----	----	4671	----	219
A14_1_06B	1263	29	31	4920	4150	----	1	----	520	----	0.06	----	----	----	4670	----	250
A14_1_06C	1307	30	31	4940	4000	----	1	----	680	----	0.06	----	----	----	4680	----	260
A14_1_06D	1308	30	32	4920	4150	----	1	----	530	----	0.06	----	----	----	4680	----	240
A14_1_07A	1352	31	32	4880	4000	----	1	----	680	----	0.06	----	----	----	4680	----	200
A14_1_07B	1351	31	31	4990	3900	----	1	----	790	----	0.06	----	----	----	4690	----	300
A14_1_07C	1395	32	31	4995	4000	----	1	----	700	----	0.06	----	----	----	4700	----	295
A14_1_07D	1396	32	32	4920	3950	----	1	----	740	----	0.06	----	----	----	4690	----	230
A14_1_08A	1354	31	34	4850	4200	----	3	----	1425	----	0.06	----	----	----	4675	----	175
A14_1_08B	1353	31	33	4840	4150	----	3	----	1575	----	0.06	----	----	----	4675	----	165
A14_1_08C	1397	32	33	4930	4000	----	3	----	2040	----	0.06	----	----	----	4680	----	250
A14_1_08D	1398	32	34	4820	4150	----	3	----	1575	----	0.06	----	----	----	4675	----	145
A14_1_09A	1356	31	36	4940	4350	----	3	----	990	----	0.06	----	----	----	4680	----	260

SUMMARY OF CALIBRATED MODEL INPUT PARAMETERS AND RELATED DATA

LOCATION	CELL	ROW	COL	LSURF ELEV	UAUBOT ELEV	LVUBOT ELEV	UAU_K FT/D	LVU_K FT/D	UAU_94T F^2/D	LVU_94T F^2/D	UAU_SY	LVU_SY	LVU_SC	VCONT 1/D	UAU_94WL ELEV	LVU_94WL ELEV	94DTW FEET
A14_1_09B	1355	31	35	4900	4250	----	3	----	1290	----	0.06	----	----	----	4680	----	220
A14_1_09C	1399	32	35	4880	4200	----	3	----	1410	----	0.06	----	----	----	4670	----	210
A14_1_09D	1400	32	36	4900	4300	----	3	----	1110	----	0.06	----	----	----	4670	----	230
A14_1_10A	1358	31	38	4940	4550	----	3	----	420	----	0.06	----	----	----	4690	----	250
A14_1_10B	1357	31	37	4970	4450	----	3	----	690	----	0.06	----	----	----	4680	----	290
A14_1_10C	1401	32	37	4910	4400	----	3	----	810	----	0.06	----	----	----	4670	----	240
A14_1_10D	1402	32	38	4920	4500	----	3	----	525	----	0.06	----	----	----	4675	----	245
A14_1_14B	1447	33	39	4900	4560	----	3	----	270	----	0.06	----	----	----	4650	----	250
A14_1_14C	1491	34	39	4880	4555	----	3	----	255	----	0.06	----	----	----	4640	----	240
A14_1_15A	1446	33	38	4850	4400	----	3	----	735	----	0.06	----	----	----	4645	----	205
A14_1_15B	1445	33	37	4880	4300	----	3	----	1035	----	0.06	----	----	----	4645	----	235
A14_1_15C	1489	34	37	4860	4200	----	3	----	1320	----	0.06	----	----	----	4640	----	220
A14_1_15D	1490	34	38	4800	4300	----	3	----	1014	----	0.06	----	----	----	4638	----	162
A14_1_16A	1444	33	36	4830	4200	----	3	----	1380	----	0.06	----	----	----	4660	----	170
A14_1_16B	1443	33	35	4810	4100	----	3	----	1710	----	0.06	----	----	----	4670	----	140
A14_1_16C	1487	34	35	4785	4000	----	3	----	1980	----	0.07	----	----	----	4660	----	125
A14_1_16D	1488	34	36	4780	4100	----	3	----	1650	----	0.07	----	----	----	4650	----	130
A14_1_17A	1442	33	34	4790	4000	----	3	----	2028	----	0.06	----	----	----	4676	----	114
A14_1_17B	1441	33	33	4940	3900	----	3	----	2340	----	0.06	----	----	----	4680	----	260
A14_1_17C	1485	34	33	4860	3950	----	3	----	2190	----	0.07	----	----	----	4680	----	180
A14_1_17D	1486	34	34	4830	3900	----	3	----	2310	----	0.07	----	----	----	4670	----	160
A14_1_18A	1440	33	32	4970	3950	----	3	----	2250	----	0.06	----	----	----	4700	----	270
A14_1_18B	1439	33	31	5010	4050	----	1	----	660	----	0.06	----	----	----	4710	----	300
A14_1_18C	1483	34	31	5025	4100	----	1	----	625	----	0.07	----	----	----	4725	----	300
A14_1_18D	1484	34	32	5000	4050	----	3	----	1950	----	0.07	----	----	----	4700	----	300
A14_1_19A	1528	35	32	5005	4050	----	3	----	1950	----	0.07	----	----	----	4700	----	305
A14_1_19B	1527	35	31	5030	4150	----	1	----	585	----	0.07	----	----	----	4735	----	295
A14_1_19C	1571	36	31	4860	4300	----	0.5	----	225	----	0.12	----	----	----	4750	----	110
A14_1_19D	1572	36	32	4820	4100	----	3	----	1800	----	0.12	----	----	----	4700	----	120
A14_1_20A	1530	35	34	4940	3950	----	3	----	2085	----	0.07	----	----	----	4645	----	295
A14_1_20B	1529	35	33	4960	4000	----	3	----	2055	----	0.07	----	----	----	4685	----	275
A14_1_20C	1573	36	33	4850	4050	----	3	----	1890	----	0.12	----	----	----	4680	----	170
A14_1_20D	1574	36	34	4850	4000	----	3	----	1965	----	0.08	----	----	----	4655	----	195
A14_1_21A	1532	35	36	4745	4000	----	3	----	1890	----	0.07	----	----	----	4630	----	115
A14_1_21B	1531	35	35	4750	3900	----	3	----	2190	----	0.07	----	----	----	4630	----	120
A14_1_21C	1575	36	35	4810	3900	----	3	----	2127	----	0.08	----	----	----	4609	----	201
A14_1_21D	1576	36	36	4720	3900	----	3	----	2130	----	0.08	----	----	----	4610	----	110
A14_1_22A	1534	35	38	4770	4200	----	3	----	1290	----	0.06	----	----	----	4630	----	140
A14_1_22B	1533	35	37	4700	4100	----	3	----	1584	----	0.07	----	----	----	4628	----	72
A14_1_22C	1577	36	37	4700	4000	----	3	----	1845	----	0.07	----	----	----	4615	----	85

SUMMARY OF CALIBRATED MODEL INPUT PARAMETERS AND RELATED DATA

LOCATION	CELL	ROW	COL	LSURF ELEV	UAUBOT ELEV	LVUBOT ELEV	UAU_K FT/D	LVU_K FT/D	UAU_94T F^2/D	LVU_94T F^2/D	UAU_SY	LVU_SY	LVU_SC	VCONT 1/D	UAU_94WL ELEV	LVU_94WL ELEV	94DTW FEET
A14_1_22D	1578	36	38	4760	4100	----	5	----	2640	----	0.07	----	----	----	4628	----	132
A14_1_23B	1535	35	39	4860	4500	----	5	----	650	----	0.06	----	----	----	4630	----	230
A14_1_23C	1579	36	39	4850	4300	----	5	----	1625	----	0.07	----	----	----	4625	----	225
A14_1_23D	1580	36	40	4920	4525	----	5	----	505	----	0.07	----	----	----	4626	----	294
A14_1_26A	1624	37	40	4860	4500	----	5	----	575	----	0.07	----	----	----	4615	----	245
A14_1_26B	1623	37	39	4820	4200	----	5	----	2050	----	0.07	----	----	----	4610	----	210
A14_1_26C	1667	38	39	4730	4100	----	3	----	1500	----	0.08	----	----	----	4600	----	130
A14_1_26D	1668	38	40	4820	4400	----	3	----	600	----	0.07	----	----	----	4600	----	220
A14_1_27A	1622	37	38	4720	4050	----	5	----	2800	----	0.07	----	----	----	4610	----	110
A14_1_27B	1621	37	37	4680	3900	----	3	----	2124	----	0.08	----	----	----	4608	----	72
A14_1_27C	1665	38	37	4650	3950	----	7	----	4550	----	0.12	----	----	----	4600	----	50
A14_1_27D	1666	38	38	4680	3950	----	7	----	4550	----	0.08	----	----	----	4600	----	80
A14_1_28A	1620	37	36	4695	3900	----	2	----	1416	----	0.08	----	----	----	4608	----	87
A14_1_28B	1619	37	35	4720	4000	----	2	----	1272	----	0.12	----	----	----	4636	----	84
A14_1_28C	1663	38	35	4650	4050	----	2	----	1100	----	0.08	----	----	----	4600	----	50
A14_1_28D	1664	38	36	4690	4000	----	2	----	1200	----	0.12	----	----	----	4600	----	90
A14_1_29A	1618	37	34	4770	4050	----	2	----	1316	----	0.12	----	----	----	4708	----	62
A14_1_29B	1617	37	33	4840	4100	----	2	----	1200	----	0.12	----	----	----	4700	----	140
A14_1_29C	1661	38	33	4800	4200	----	2	----	1020	----	0.07	----	----	----	4710	----	90
A14_1_29D	1662	38	34	4800	4100	----	2	----	1120	----	0.08	----	----	----	4660	----	140
A14_1_30A	1616	37	32	4950	4200	----	0.5	----	255	----	0.07	----	----	----	4710	----	240
A14_1_30B	1615	37	31	5000	4400	----	0.5	----	175	----	0.07	----	----	----	4750	----	250
A14_1_30C	1659	38	31	4890	4600	----	0.5	----	87.5	----	0.07	----	----	----	4775	----	115
A14_1_30D	1660	38	32	4850	4400	----	0.5	----	167.5	----	0.07	----	----	----	4735	----	115
A14_1_31A	1704	39	32	5000	4500	----	0.5	----	125	----	0.07	----	----	----	4750	----	250
A14_1_31B	1703	39	31	5110	4700	----	0.5	----	50	----	0.07	----	----	----	4800	----	310
A14_1_31D	1748	40	32	5000	4650	----	0.5	----	45	----	0.07	----	----	----	4740	----	260
A14_1_32A	1706	39	34	4800	4300	----	2	----	700	----	0.07	----	----	----	4650	----	150
A14_1_32B	1705	39	33	4860	4400	----	0.5	----	150	----	0.07	----	----	----	4700	----	160
A14_1_32C	1749	40	33	4960	4500	----	0.5	----	95	----	0.07	----	----	----	4690	----	270
A14_1_32D	1750	40	34	4830	4400	----	1	----	240	----	0.07	----	----	----	4640	----	190
A14_1_33A	1708	39	36	4680	4150	----	2	----	886	----	0.08	----	----	----	4593	----	87
A14_1_33B	1707	39	35	4720	4200	----	2	----	800	----	0.07	----	----	----	4600	----	120
A14_1_33C	1751	40	35	4760	4350	----	1	----	250	----	0.07	----	----	----	4600	----	160
A14_1_33D	1752	40	36	4770	4300	----	1	----	285	----	0.08	----	----	----	4585	----	185
A14_1_34A	1710	39	38	4650	3950	----	7	----	4431	----	0.08	----	----	----	4583	----	67
A14_1_34B	1709	39	37	4640	4050	----	7	----	3731	----	0.12	----	----	----	4583	----	57
A14_1_34C	1753	40	37	4630	4200	----	7	----	2646	----	0.08	----	----	----	4578	----	52
A14_1_34D	1754	40	38	4620	4000	----	7	----	4046	----	0.12	----	----	----	4578	----	42
A14_1_35A	1712	39	40	4800	4200	----	8	----	2960	----	0.07	----	----	----	4570	----	230

SUMMARY OF CALIBRATED MODEL INPUT PARAMETERS AND RELATED DATA

LOCATION	CELL	ROW	COL	LSURF	UAUBOT	LVUBOT	UAU_K	LVU_K	UAU_94T	LVU_94T	UAU_SY	LVU_SY	LVU_SC	VCONT	UAU_94WL	LVU_94WL	94DTW
				ELEV	ELEV	ELEV	FT/D	FT/D	F^2/D	F^2/D				1/D	ELEV	ELEV	FEET
A14_1_35B	1711	39	39	4680	4100	----	8	----	3880	----	0.08	----	----	----	4585	----	95
A14_1_35C	1755	40	39	4700	4000	----	8	----	4544	----	0.08	----	----	----	4568	----	132
A14_1_35D	1756	40	40	4700	4200	----	8	----	2800	----	0.07	----	----	----	4550	----	150
A14_1_36B	1713	39	41	4780	4450	----	8	----	960	----	0.07	----	----	----	4570	----	210
A14_1_36C	1757	40	41	4690	4400	----	8	----	1200	----	0.07	----	----	----	4550	----	140
A15_1_06B	735	17	31	4990	4590	4390	5	15	0	2625	0.06	0.07	0.0001	0.001	4565	4565	425
A15_1_06C	779	18	31	4980	4585	4385	8	15	0	2700	0.06	0.07	0.0001	0.001	4565	4565	415
A15_1_06D	780	18	32	5020	4800	4600	0	1	0	10	0	0.07	0.0001	0.001	4610	4610	410
A15_1_07A	824	19	32	5010	4800	4600	0	1	0	5	0	0.07	0.0001	0.001	4605	4605	405
A15_1_07B	823	19	31	4970	4585	4385	8	15	0	2625	0.06	0.07	0.0001	0.001	4560	4560	410
A15_1_07C	867	20	31	4965	4585	4385	8	15	0	2700	0.06	0.07	0.0001	0.001	4565	4565	400
A15_1_07D	868	20	32	4985	4800	4600	0	1	0	0	0	0.07	0.0001	0.001	4600	4600	385
A15_1_17B	913	21	33	4990	4850	4650	0	0.05	0	2.5	0	0.07	0.0001	0.001	4700	4700	290
A15_1_17C	957	22	33	5000	4850	4650	0	0.05	0	2.5	0	0.07	0.0001	0.001	4700	4700	300
A15_1_18A	912	21	32	4960	4800	4600	0	1	0	10	0	0.07	0.0001	0.001	4610	4610	350
A15_1_18B	911	21	31	4950	4700	4500	0	15	0	1200	0	0.07	0.0001	0.001	4580	4580	370
A15_1_18C	955	22	31	4940	4700	4500	0	15	0	1230	0	0.07	0.0001	0.001	4582	4582	358
A15_1_18D	956	22	32	4965	4800	4600	0	1	0	50	0	0.07	0.0001	0.001	4650	4650	315
A15_1_19A	1000	23	32	4980	4800	4600	0	0.08	0	4	0	0.07	0.0001	0.001	4650	4650	330
A15_1_19B	999	23	31	4945	4700	4500	0	15	0	1500	0	0.07	0.0001	0.001	4600	4600	345
A15_1_19C	1043	24	31	4950	4700	4500	0	15	0	1830	0	0.07	0.0001	0.001	4622	4622	328
A15_1_19D	1044	24	32	4990	4800	4600	0	0.08	0	6.4	0	0.07	0.0001	0.001	4680	4680	310
A15_1_20B	1001	23	33	5010	4850	4650	0	0.05	0	3.75	0	0.07	0.0001	0.001	4725	4725	285
A15_1_20C	1045	24	33	5020	4850	4650	0	0.05	0	5	0	0.07	0.0001	0.001	4750	4750	270
A15_1_28C	1135	26	35	5040	4850	4650	0	0.5	0	50	0	0.07	0.0001	0.001	4750	4750	290
A15_1_29B	1089	25	33	5040	4900	4700	0	0.05	0	2.5	0	0.07	0.0001	0.001	4750	4750	290
A15_1_29C	1133	26	33	5030	4625	4425	0.5	1	50	200	0.06	0.07	0.0001	0.001	4725	4725	305
A15_1_29D	1134	26	34	5055	4900	4700	0	1	0	45	0	0.07	0.0001	0.001	4745	4745	310
A15_1_30A	1088	25	32	4980	4700	4500	0	0.08	0	15.84	0	0.07	0.0001	0.001	4698	4698	282
A15_1_30B	1087	25	31	4940	4600	4400	2	15	92	3000	0.06	0.07	0.0001	0.001	4646	4646	294
A15_1_30C	1131	26	31	4940	4500	4300	2	15	296	3000	0.06	0.07	0.0001	0.001	4648	4648	292
A15_1_30D	1132	26	32	4990	4600	4400	0.5	1	40	200	0.06	0.07	0.0001	0.001	4680	4680	310
A15_1_31A	1176	27	32	4980	4500	4300	2	1	360	200	0.06	0.07	0.0001	0.001	4680	4680	300
A15_1_31B	1175	27	31	4960	4350	4150	2	15	620	3000	0.06	0.07	0.0001	0.001	4660	4660	300
A15_1_31C	1219	28	31	4890	4200	----	2	----	920	----	0.06	----	----	----	4660	----	230
A15_1_31D	1220	28	32	5010	4300	----	1	----	371	----	0.06	----	----	----	4671	----	339
A15_1_32A	1178	27	34	4960	4625	4425	1	1	95	200	0.06	0.07	0.0001	0.001	4720	4720	240
A15_1_32B	1177	27	33	5010	4600	4400	1	1	100	200	0.06	0.07	0.0001	0.001	4700	4700	310
A15_1_32C	1221	28	33	4960	4450	----	1	----	230	----	0.06	----	----	----	4680	----	280
A15_1_32D	1222	28	34	4950	4500	----	2	----	380	----	0.06	----	----	----	4690	----	260

SUMMARY OF CALIBRATED MODEL INPUT PARAMETERS AND RELATED DATA

LOCATION	CELL	ROW	COL	LSURF ELEV	UAUBOT ELEV	LVUBOT ELEV	UAU_K FT/D	LVU_K FT/D	UAU_94T F^2/D	LVU_94T F^2/D	UAU_SY	LVU_SY	LVU_SC	VCONT 1/D	UAU_94WL ELEV	LVU_94WL ELEV	94DTW FEET
A15_1_33B	1179	27	35	5040	4625	4425	0.05	0.5	5.75	100	0.06	0.07	0.0001	0.001	4740	4740	300
A15_1_33C	1223	28	35	5010	4600	----	3	----	360	----	0.06	----	----	----	4720	----	290
A15_1_33D	1224	28	36	5070	4610	----	0.05	----	7	----	0.06	----	----	----	4750	----	320
A16_1_30C	603	14	31	4990	4590	4390	5	15	0	2805	0.06	0.07	0.0001	0.001	4577	4577	413
A16_1_31B	647	15	31	4970	4585	4385	5	15	0	2850	0.06	0.07	0.0001	0.001	4575	4575	395
A16_1_31C	691	16	31	4985	4585	4385	5	15	0	2775	0.06	0.07	0.0001	0.001	4570	4570	415
B14_1_01A	1262	29	30	4920	3950	----	2	----	1428	----	0.06	----	----	----	4664	----	256
B14_1_01B	1261	29	29	4940	3900	----	2	----	1496	----	0.06	----	----	----	4648	----	292
B14_1_01C	1305	30	29	4980	4000	----	2	----	1350	----	0.06	----	----	----	4675	----	305
B14_1_01D	1306	30	30	4990	3900	----	2	----	1560	----	0.06	----	----	----	4680	----	310
B14_1_02A	1260	29	28	4940	4000	----	2	----	1284	----	0.06	----	----	----	4642	----	298
B14_1_02B	1259	29	27	4950	4050	----	2	----	1180	----	0.06	----	----	----	4640	----	310
B14_1_02C	1303	30	27	4980	4100	----	4	----	2192	----	0.06	----	----	----	4648	----	332
B14_1_02D	1304	30	28	5010	4050	----	5	----	3100	----	0.06	----	----	----	4670	----	340
B14_1_03A	1258	29	26	5000	4100	----	2	----	1090	----	0.06	----	----	----	4645	----	355
B14_1_03B	1257	29	25	5025	4100	----	2	----	1088	----	0.06	----	----	----	4644	----	381
B14_1_03C	1301	30	25	5060	4150	----	1	----	495	----	0.06	----	----	----	4645	----	415
B14_1_03D	1302	30	26	5000	4150	----	4	----	1968	----	0.06	----	----	----	4642	----	358
B14_1_04A	1256	29	24	5065	4150	----	2	----	1000	----	0.06	----	----	----	4650	----	415
B14_1_04B	1255	29	23	5080	4200	----	1	----	445	----	0.06	----	----	----	4645	----	435
B14_1_04C	1299	30	23	5140	4400	----	1	----	270	----	0.06	----	----	----	4670	----	470
B14_1_04D	1300	30	24	5185	4200	----	1	----	445	----	0.06	----	----	----	4645	----	540
B14_1_05A	1254	29	22	5100	4400	----	1	----	245	----	0.07	----	----	----	4645	----	455
B14_1_05B	1253	29	21	5180	4500	----	1	----	170	----	0.12	----	----	----	4670	----	510
B14_1_05D	1298	30	22	5180	4550	----	0.5	----	67.5	----	0.07	----	----	----	4685	----	495
B14_1_06A	1252	29	20	5160	4595	----	1	----	103	----	0.12	----	----	----	4698	----	462
B14_1_06B	1251	29	19	5040	4600	----	1	----	150	----	0.12	----	----	----	4750	----	290
B14_1_09A	1344	31	24	5100	4400	----	1	----	295	----	0.06	----	----	----	4695	----	405
B14_1_09B	1343	31	23	5140	4625	----	0.1	----	7	----	0.06	----	----	----	4695	----	445
B14_1_09D	1388	32	24	5140	4640	----	0.5	----	40	----	0.06	----	----	----	4720	----	420
B14_1_10A	1346	31	26	5020	4200	----	4	----	1940	----	0.06	----	----	----	4685	----	335
B14_1_10B	1345	31	25	5025	4250	----	1	----	425	----	0.06	----	----	----	4675	----	350
B14_1_10C	1389	32	25	5080	4400	----	0.5	----	125	----	0.06	----	----	----	4650	----	430
B14_1_10D	1390	32	26	5080	4300	----	20	----	4400	----	0.06	----	----	----	4520	----	560
B14_1_11A	1348	31	28	5030	4150	----	2	----	1100	----	0.06	----	----	----	4700	----	330
B14_1_11B	1347	31	27	5040	4200	----	4	----	1980	----	0.06	----	----	----	4695	----	345
B14_1_11C	1391	32	27	5090	4250	----	4	----	1800	----	0.06	----	----	----	4700	----	390
B14_1_11D	1392	32	28	5075	4200	----	2	----	1024	----	0.06	----	----	----	4712	----	363
B14_1_12A	1350	31	30	5000	4000	----	1	----	700	----	0.06	----	----	----	4700	----	300
B14_1_12B	1349	31	29	5030	4050	----	1	----	650	----	0.06	----	----	----	4700	----	330

SUMMARY OF CALIBRATED MODEL INPUT PARAMETERS AND RELATED DATA

LOCATION	CELL	ROW	COL	LSURF ELEV	UAUBOT ELEV	LVUBOT ELEV	UAU_K FT/D	LVU_K FT/D	UAU_94T F^2/D	LVU_94T F^2/D	UAU_SY	LVU_SY	LVU_SC	VCONT 1/D	UAU_94WL ELEV	LVU_94WL ELEV	94DTW FEET
B14_1_12C	1393	32	29	5055	4100	----	1	----	620	----	0.06	----	----	----	4720	----	335
B14_1_12D	1394	32	30	5020	4050	----	1	----	662	----	0.06	----	----	----	4712	----	308
B14_1_13A	1438	33	30	5045	4100	----	1	----	624	----	0.06	----	----	----	4724	----	321
B14_1_13B	1437	33	29	5070	4200	----	1	----	530	----	0.06	----	----	----	4730	----	340
B14_1_13C	1481	34	29	5085	4300	----	1	----	450	----	0.06	----	----	----	4750	----	335
B14_1_13D	1482	34	30	5060	4200	----	1	----	535	----	0.07	----	----	----	4735	----	325
B14_1_14A	1436	33	28	5100	4300	----	2	----	864	----	0.06	----	----	----	4732	----	368
B14_1_14B	1435	33	27	5110	4350	----	2	----	750	----	0.06	----	----	----	4725	----	385
B14_1_14C	1479	34	27	5140	4600	----	1	----	165	----	0.06	----	----	----	4765	----	375
B14_1_14D	1480	34	28	5110	4600	----	1	----	150	----	0.06	----	----	----	4750	----	360
B14_1_15A	1434	33	26	5130	4400	----	1	----	245	----	0.06	----	----	----	4645	----	485
B14_1_15B	1433	33	25	5150	4640	----	0.5	----	0	----	0.06	----	----	----	4620	----	530
B14_1_15C	1477	34	25	5180	4675	----	0.5	----	72.5	----	0.06	----	----	----	4820	----	360
B14_1_15D	1478	34	26	5170	4675	----	1	----	118	----	0.06	----	----	----	4793	----	377
B14_1_22A	1522	35	26	5190	4750	----	0.5	----	69	----	0.06	----	----	----	4888	----	302
B14_1_23A	1524	35	28	5100	4675	----	1	----	125	----	0.07	----	----	----	4800	----	300
B14_1_23B	1523	35	27	5160	4700	----	1	----	145	----	0.07	----	----	----	4845	----	315
B14_1_23C	1567	36	27	4980	4750	----	0.5	----	75	----	0.12	----	----	----	4900	----	80
B14_1_23D	1568	36	28	5010	4750	----	0.5	----	50	----	0.12	----	----	----	4850	----	160
B14_1_24A	1526	35	30	5060	4350	----	1	----	400	----	0.07	----	----	----	4750	----	310
B14_1_24B	1525	35	29	5080	4500	----	1	----	275	----	0.07	----	----	----	4775	----	305
B14_1_24C	1569	36	29	4960	4720	----	0.5	----	55	----	0.12	----	----	----	4830	----	130
B14_1_24D	1570	36	30	4870	4500	----	0.5	----	150	----	0.12	----	----	----	4800	----	70
B14_2_01A	1250	29	18	4975	4650	----	1	----	100	----	0.12	----	----	----	4750	----	225
B15_1_01A	734	17	30	4960	4550	4350	8	75	0	14925	0.06	0.07	0.0001	0.001	4549	4549	411
B15_1_01B	733	17	29	4910	4450	4250	8	75	784	15000	0.06	0.07	0.0001	0.001	4548	4548	362
B15_1_01C	777	18	29	4910	4500	4300	8	75	384	15000	0.06	0.07	0.0001	0.001	4548	4548	362
B15_1_01D	778	18	30	4945	4550	4350	8	75	0	14925	0.06	0.07	0.0001	0.001	4549	4549	396
B15_1_02A	732	17	28	4855	4375	4175	8	75	1384	15000	0.06	0.07	0.0001	0.001	4548	4548	307
B15_1_02B	731	17	27	4830	4275	4075	8	75	2176	15000	0.06	0.07	0.0001	0.001	4547	4547	283
B15_1_02C	775	18	27	4850	4400	4200	8	75	1168	15000	0.06	0.07	0.0001	0.001	4546	4546	304
B15_1_02D	776	18	28	4885	4450	4250	8	75	776	15000	0.06	0.07	0.0001	0.001	4547	4547	338
B15_1_03A	730	17	26	4820	4175	3975	8	100	2968	20000	0.06	0.07	0.0001	0.001	4546	4546	274
B15_1_03B	729	17	25	4850	4100	3900	8	100	3560	20000	0.06	0.07	0.0001	0.001	4545	4545	305
B15_1_03C	773	18	25	4850	4200	4000	8	100	2760	20000	0.06	0.07	0.0001	0.001	4545	4545	305
B15_1_03D	774	18	26	4815	4300	4100	8	100	1968	20000	0.06	0.07	0.0001	0.001	4546	4546	269
B15_1_04A	728	17	24	4845	4050	3850	10	100	4940	20000	0.06	0.07	0.0001	0.001	4544	4544	301
B15_1_04B	727	17	23	4885	3950	3750	10	100	5940	20000	0.06	0.07	0.0001	0.001	4544	4544	341
B15_1_04C	771	18	23	4875	4000	3800	10	100	5440	20000	0.06	0.07	0.0001	0.001	4544	4544	331
B15_1_04D	772	18	24	4850	4100	3900	8	100	3552	20000	0.06	0.07	0.0001	0.001	4544	4544	306

SUMMARY OF CALIBRATED MODEL INPUT PARAMETERS AND RELATED DATA

LOCATION	CELL	ROW	COL	LSURF	UAUBOT	LVUBOT	UAU_K	LVU_K	UAU_94T	LVU_94T	UAU_SY	LVU_SY	LVU_SC	VCONT	UAU_94WL	LVU_94WL	94DTW
				ELEV	ELEV	ELEV	FT/D	FT/D	F^2/D	F^2/D				1/D	ELEV	ELEV	FEET
B15_1_05A	726	17	22	4900	3900	3700	10	100	6440	20000	0.06	0.07	0.0001	0.001	4544	4544	356
B15_1_05B	725	17	21	4855	3950	3750	10	100	5950	20000	0.1	0.07	0.0001	0.001	4545	4545	310
B15_1_05C	769	18	21	4860	3950	3750	10	100	5970	20000	0.1	0.07	0.0001	0.001	4547	4547	313
B15_1_05D	770	18	22	4930	3950	3750	10	100	5950	20000	0.06	0.07	0.0001	0.001	4545	4545	385
B15_1_06A	724	17	20	4830	4100	3900	10	100	4450	20000	0.1	0.07	0.0001	1E-05	4545	4545	285
B15_1_06B	723	17	19	4870	4250	4050	10	100	2920	20000	0.06	0.07	0.0001	1E-05	4542	4542	328
B15_1_06C	767	18	19	4880	4200	4000	10	100	3450	20000	0.06	0.07	0.0001	0.001	4545	4545	335
B15_1_06D	768	18	20	4880	4000	3800	10	100	5470	20000	0.1	0.07	0.0001	0.001	4547	4547	333
B15_1_07A	812	19	20	4850	4000	3800	8	100	4400	20000	0.1	0.07	0.0001	0.001	4550	4550	300
B15_1_07B	811	19	19	4880	4100	3900	8	100	3600	20000	0.06	0.07	0.0001	0.001	4550	4550	330
B15_1_07C	855	20	19	4875	4100	3900	8	75	3640	15000	0.06	0.07	0.0001	0.001	4555	4555	320
B15_1_07D	856	20	20	4855	3950	3750	8	100	4840	20000	0.1	0.07	0.0001	0.001	4555	4555	300
B15_1_08A	814	19	22	4970	3950	3750	8	100	4776	20000	0.06	0.07	0.0001	0.001	4547	4547	423
B15_1_08B	813	19	21	4870	3900	3700	8	100	5200	20000	0.1	0.07	0.0001	0.001	4550	4550	320
B15_1_08C	857	20	21	4900	3900	3700	8	100	5240	20000	0.1	0.07	0.0001	0.001	4555	4555	345
B15_1_08D	858	20	22	4940	3975	3775	8	100	4592	20000	0.06	0.07	0.0001	0.001	4549	4549	391
B15_1_09A	816	19	24	4900	4200	4000	8	100	2776	20000	0.06	0.07	0.0001	0.001	4547	4547	353
B15_1_09B	815	19	23	4900	4050	3850	8	100	3984	20000	0.06	0.07	0.0001	0.001	4548	4548	352
B15_1_09C	859	20	23	4900	4100	3900	8	100	3584	20000	0.06	0.07	0.0001	0.001	4548	4548	352
B15_1_09D	860	20	24	4920	4400	4200	8	100	1184	20000	0.06	0.07	0.0001	0.001	4548	4548	372
B15_1_10A	818	19	26	4840	4450	4250	8	100	776	20000	0.06	0.07	0.0001	0.001	4547	4547	293
B15_1_10B	817	19	25	4885	4400	4200	8	100	1168	20000	0.06	0.07	0.0001	0.001	4546	4546	339
B15_1_10C	861	20	25	4890	4450	4250	8	100	776	20000	0.06	0.07	0.0001	0.001	4547	4547	343
B15_1_10D	862	20	26	4850	4500	4300	8	75	376	15000	0.06	0.07	0.0001	0.001	4547	4547	303
B15_1_11A	820	19	28	4880	4500	4300	8	75	384	15000	0.06	0.07	0.0001	0.001	4548	4548	332
B15_1_11B	819	19	27	4850	4500	4300	8	75	384	15000	0.06	0.07	0.0001	0.001	4548	4548	302
B15_1_11C	863	20	27	4840	4525	4325	8	75	184	15000	0.06	0.07	0.0001	0.001	4548	4548	292
B15_1_11D	864	20	28	4855	4550	4350	8	75	0	14850	0.06	0.07	0.0001	0.001	4548	4548	307
B15_1_12A	822	19	30	4940	4575	4375	8	75	0	13125	0.06	0.07	0.0001	0.001	4550	4550	390
B15_1_12B	821	19	29	4910	4525	4325	8	75	192	15000	0.06	0.07	0.0001	0.001	4549	4549	361
B15_1_12C	865	20	29	4880	4550	4350	8	75	0	14925	0.06	0.07	0.0001	0.001	4549	4549	331
B15_1_12D	866	20	30	4930	4580	4380	8	75	0	12750	0.06	0.07	0.0001	0.001	4550	4550	380
B15_1_13A	910	21	30	4930	4580	4380	8	15	0	2550	0.06	0.07	0.0001	0.001	4550	4550	380
B15_1_13B	909	21	29	4895	4550	4350	8	15	0	2985	0.06	0.07	0.0001	0.001	4549	4549	346
B15_1_13C	953	22	29	4890	4550	4350	3	15	0	3000	0.06	0.07	0.0001	0.001	4550	4550	340
B15_1_13D	954	22	30	4910	4585	4385	3	15	0	2820	0.06	0.07	0.0001	0.001	4573	4573	337
B15_1_14A	908	21	28	4865	4500	4300	8	75	384	15000	0.06	0.07	0.0001	0.001	4548	4548	317
B15_1_14B	907	21	27	4875	4450	4250	8	75	784	15000	0.06	0.07	0.0001	0.001	4548	4548	327
B15_1_14C	951	22	27	4895	4350	4150	8	15	1592	3000	0.06	0.07	0.0001	0.001	4549	4549	346
B15_1_14D	952	22	28	4880	4400	4200	8	15	1192	3000	0.06	0.07	0.0001	0.001	4549	4549	331

SUMMARY OF CALIBRATED MODEL INPUT PARAMETERS AND RELATED DATA

LOCATION	CELL	ROW	COL	LSURF	UAUBOT	LVUBOT	UAU_K	LVU_K	UAU_94T	LVU_94T	UAU_SY	LVU_SY	LVU_SC	VCONT	UAU_94WL	LVU_94WL	94DTW
				ELEV	ELEV	ELEV	FT/D	FT/D	F^2/D	F^2/D				1/D	ELEV	ELEV	FEET
B15_1_15A	906	21	26	4885	4450	4250	8	75	784	15000	0.06	0.07	0.0001	0.001	4548	4548	337
B15_1_15B	905	21	25	4890	4400	4200	8	100	1176	20000	0.06	0.07	0.0001	0.001	4547	4547	343
B15_1_15C	949	22	25	4925	4200	4000	8	75	2784	15000	0.06	0.07	0.0001	0.001	4548	4548	377
B15_1_15D	950	22	26	4910	4275	4075	8	75	2184	15000	0.06	0.07	0.0001	0.001	4548	4548	362
B15_1_16A	904	21	24	4925	4250	4050	8	100	2384	20000	0.06	0.07	0.0001	0.001	4548	4548	377
B15_1_16B	903	21	23	4950	4100	3900	8	100	3584	20000	0.06	0.07	0.0001	0.001	4548	4548	402
B15_1_16C	947	22	23	4960	4000	3800	8	75	4400	15000	0.06	0.07	0.0001	0.001	4550	4550	410
B15_1_16D	948	22	24	4920	4100	3900	8	75	3592	15000	0.06	0.07	0.0001	0.001	4549	4549	371
B15_1_17A	902	21	22	4950	3950	3750	8	100	4800	20000	0.06	0.07	0.0001	0.001	4550	4550	400
B15_1_17B	901	21	21	4900	3900	3700	8	100	5320	20000	0.1	0.07	0.0001	0.001	4565	4565	335
B15_1_17C	945	22	21	4900	3900	3700	8	75	5360	15000	0.1	0.07	0.0001	0.001	4570	4570	330
B15_1_17D	946	22	22	4960	3900	3700	8	75	5240	15000	0.06	0.07	0.0001	0.001	4555	4555	405
B15_1_18A	900	21	20	4860	3950	3750	8	75	5000	15000	0.1	0.07	0.0001	0.001	4575	4575	285
B15_1_18B	899	21	19	4980	4050	3850	8	75	4200	15000	0.06	0.07	0.0001	0.001	4575	4575	405
B15_1_18C	943	22	19	4930	4050	3850	8	75	4280	15000	0.06	0.07	0.0001	0.001	4585	4585	345
B15_1_18D	944	22	20	4880	3950	3750	8	75	5080	15000	0.1	0.07	0.0001	0.001	4585	4585	295
B15_1_19A	988	23	20	4900	4000	3800	8	15	4800	3000	0.1	0.07	0.0001	0.001	4600	4600	300
B15_1_19B	987	23	19	4915	4100	3900	8	15	4200	3000	0.06	0.07	0.0001	0.001	4625	4625	290
B15_1_19C	1031	24	19	4935	4100	3900	8	15	4400	3000	0.06	0.07	0.0001	0.001	4650	4650	285
B15_1_19D	1032	24	20	4900	4050	3850	8	15	4800	3000	0.1	0.07	0.0001	0.001	4650	4650	250
B15_1_20A	990	23	22	5000	3850	3650	8	15	5680	3000	0.06	0.07	0.0001	0.001	4560	4560	440
B15_1_20B	989	23	21	4910	3900	3700	8	15	5440	3000	0.1	0.07	0.0001	0.001	4580	4580	330
B15_1_20C	1033	24	21	4960	4000	3800	8	15	4720	3000	0.1	0.07	0.0001	0.001	4590	4590	370
B15_1_20D	1034	24	22	5015	3900	3700	8	15	5400	3000	0.06	0.07	0.0001	0.001	4575	4575	440
B15_1_21A	992	23	24	4960	4000	3800	8	15	4400	3000	0.06	0.07	0.0001	0.001	4550	4550	410
B15_1_21B	991	23	23	4960	3900	3700	8	15	5216	3000	0.06	0.07	0.0001	0.001	4552	4552	408
B15_1_21C	1035	24	23	5000	3850	3650	8	15	5680	3000	0.06	0.07	0.0001	0.001	4560	4560	440
B15_1_21D	1036	24	24	4960	3900	3700	8	15	5240	3000	0.06	0.07	0.0001	0.001	4555	4555	405
B15_1_22A	994	23	26	4910	4100	3900	8	15	3600	3000	0.06	0.07	0.0001	0.001	4550	4550	360
B15_1_22B	993	23	25	4940	4050	3850	8	15	4000	3000	0.06	0.07	0.0001	0.001	4550	4550	390
B15_1_22C	1037	24	25	4950	3950	3750	8	15	4800	3000	0.06	0.07	0.0001	0.001	4550	4550	400
B15_1_22D	1038	24	26	4950	4000	3800	8	15	4440	3000	0.06	0.07	0.0001	0.001	4555	4555	395
B15_1_23A	996	23	28	4880	4300	4100	3	15	753	3000	0.06	0.07	0.0001	0.001	4551	4551	329
B15_1_23B	995	23	27	4890	4200	4000	8	15	2824	3000	0.06	0.07	0.0001	0.001	4553	4553	337
B15_1_23C	1039	24	27	4920	4100	3900	3	15	1365	3000	0.06	0.07	0.0001	0.001	4555	4555	365
B15_1_23D	1040	24	28	4890	4200	4000	3	15	1080	3000	0.06	0.07	0.0001	0.001	4560	4560	330
B15_1_24A	998	23	30	4920	4585	4385	3	15	0	2850	0.06	0.07	0.0001	0.001	4575	4575	345
B15_1_24B	997	23	29	4905	4500	4300	3	15	165	3000	0.06	0.07	0.0001	0.001	4555	4555	350
B15_1_24C	1041	24	29	4890	4400	4200	3	15	495	3000	0.06	0.07	0.0001	0.001	4565	4565	325
B15_1_24D	1042	24	30	4925	4585	4385	3	15	0	2850	0.06	0.07	0.0001	0.001	4575	4575	350

SUMMARY OF CALIBRATED MODEL INPUT PARAMETERS AND RELATED DATA

LOCATION	CELL	ROW	COL	LSURF ELEV	UAUBOT ELEV	LVUBOT ELEV	UAU_K FT/D	LVU_K FT/D	UAU_94T F^2/D	LVU_94T F^2/D	UAU_SY	LVU_SY	LVU_SC	VCONT 1/D	UAU_94WL ELEV	LVU_94WL ELEV	94DTW FEET
B15_1_25A	1086	25	30	4905	4500	4300	2	15	240	3000	0.06	0.07	0.0001	0.001	4620	4620	285
B15_1_25B	1085	25	29	4910	4300	4100	2	15	564	3000	0.06	0.07	0.0001	0.001	4582	4582	328
B15_1_25C	1129	26	29	4920	4200	4000	2	15	820	3000	0.06	0.07	0.0001	0.001	4610	4610	310
B15_1_25D	1130	26	30	4920	4350	4150	2	15	556	3000	0.06	0.07	0.0001	0.001	4628	4628	292
B15_1_26A	1084	25	28	4920	4100	3900	2	15	936	3000	0.06	0.07	0.0001	0.001	4568	4568	352
B15_1_26B	1083	25	27	4930	4000	3800	2	15	1126	3000	0.06	0.07	0.0001	0.001	4563	4563	367
B15_1_26C	1127	26	27	4960	3950	3750	2	15	1248	3000	0.06	0.07	0.0001	0.001	4574	4574	386
B15_1_26D	1128	26	28	4960	4000	3800	2	15	1180	3000	0.06	0.07	0.0001	0.001	4590	4590	370
B15_1_27A	1082	25	26	4955	3950	3750	2	15	1224	3000	0.06	0.07	0.0001	0.001	4562	4562	393
B15_1_27B	1081	25	25	4975	3900	3700	2	15	1330	3000	0.06	0.07	0.0001	0.001	4565	4565	410
B15_1_27C	1125	26	25	5000	3950	3750	2	15	1240	3000	0.06	0.07	0.0001	0.001	4570	4570	430
B15_1_27D	1126	26	26	4970	3900	3700	2	15	1344	3000	0.06	0.07	0.0001	0.001	4572	4572	398
B15_1_28A	1080	25	24	4990	3900	3700	2	15	1330	3000	0.06	0.07	0.0001	0.001	4565	4565	425
B15_1_28B	1079	25	23	5000	3950	3750	2	15	1230	3000	0.06	0.07	0.0001	0.001	4565	4565	435
B15_1_28C	1123	26	23	5055	4025	3825	2	15	1096	3000	0.06	0.07	0.0001	0.001	4573	4573	482
B15_1_28D	1124	26	24	5045	4000	3800	2	15	1136	3000	0.06	0.07	0.0001	0.001	4568	4568	477
B15_1_29A	1078	25	22	5040	4000	3800	2	15	1160	3000	0.07	0.07	0.0001	0.001	4580	4580	460
B15_1_29B	1077	25	21	4990	4050	3850	2	15	1150	3000	0.12	0.07	0.0001	0.001	4625	4625	365
B15_1_29C	1121	26	21	5080	4100	3900	2	15	1050	3000	0.12	0.07	0.0001	0.001	4625	4625	455
B15_1_29D	1122	26	22	5060	4075	3875	2	15	992	3000	0.07	0.07	0.0001	0.001	4571	4571	489
B15_1_30A	1076	25	20	4910	4100	3900	2	15	1150	3000	0.12	0.07	0.0001	0.001	4675	4675	235
B15_1_30B	1075	25	19	4955	4200	4000	2	15	950	3000	0.06	0.07	0.0001	0.001	4675	4675	280
B15_1_30C	1119	26	19	4960	4300	4100	1	15	365	3000	0.06	0.07	0.0001	0.001	4665	4665	295
B15_1_30D	1120	26	20	4940	4250	4050	1	15	405	3000	0.12	0.07	0.0001	0.001	4655	4655	285
B15_1_31A	1164	27	20	5000	4400	4200	1	15	270	3000	0.12	0.07	0.0001	0.001	4670	4670	330
B15_1_31B	1163	27	19	4950	4500	4300	1	15	180	3000	0.12	0.07	0.0001	0.001	4680	4680	270
B15_1_31C	1207	28	19	5000	4550	4350	1	0.1	150	20	0.12	0.07	0.0001	0.001	4700	4700	300
B15_1_31D	1208	28	20	5090	4500	----	1	----	165	----	0.12	----	----	----	4665	----	425
B15_1_32A	1166	27	22	5080	4100	3900	2	15	1004	3000	0.07	0.07	0.0001	0.001	4602	4602	478
B15_1_32B	1165	27	21	5090	4200	4000	2	15	838	3000	0.12	0.07	0.0001	0.001	4619	4619	471
B15_1_32C	1209	28	21	5110	4400	----	1	----	245	----	0.12	----	----	----	4645	----	465
B15_1_32D	1210	28	22	5125	4250	----	2	----	766	----	0.07	----	----	----	4633	----	492
B15_1_33A	1168	27	24	5035	4050	3850	2	15	1076	3000	0.06	0.07	0.0001	0.001	4588	4588	447
B15_1_33B	1167	27	23	5075	4050	3850	2	15	1096	3000	0.06	0.07	0.0001	0.001	4598	4598	477
B15_1_33C	1211	28	23	5090	4100	----	2	----	1032	----	0.06	----	----	----	4616	----	474
B15_1_33D	1212	28	24	5080	4100	----	2	----	1032	----	0.06	----	----	----	4616	----	464
B15_1_34A	1170	27	26	5000	3950	3750	2	15	1290	3000	0.06	0.07	0.0001	0.001	4595	4595	405
B15_1_34B	1169	27	25	5025	4000	3800	2	15	1176	3000	0.06	0.07	0.0001	0.001	4588	4588	437
B15_1_34C	1213	28	25	5050	4050	----	2	----	1124	----	0.06	----	----	----	4612	----	438
B15_1_34D	1214	28	26	5025	4000	----	2	----	1230	----	0.06	----	----	----	4615	----	410

SUMMARY OF CALIBRATED MODEL INPUT PARAMETERS AND RELATED DATA

LOCATION	CELL	ROW	COL	LSURF ELEV	UAUBOT ELEV	LVUBOT ELEV	UAU_K FT/D	LVU_K FT/D	UAU_94T F^2/D	LVU_94T F^2/D	UAU_SY	LVU_SY	LVU_SC	VCONT 1/D	UAU_94WL ELEV	LVU_94WL ELEV	94DTW FEET
B15_1_35A	1172	27	28	4960	3900	3700	2	15	1414	3000	0.06	0.07	0.0001	0.001	4607	4607	353
B15_1_35B	1171	27	27	4980	3900	3700	2	15	1404	3000	0.06	0.07	0.0001	0.001	4602	4602	378
B15_1_35C	1215	28	27	4975	3950	----	2	----	1344	----	0.06	----	----	----	4622	----	353
B15_1_35D	1216	28	28	4960	3950	----	2	----	1356	----	0.06	----	----	----	4628	----	332
B15_1_36A	1174	27	30	4930	4200	4000	2	15	852	3000	0.06	0.07	0.0001	0.001	4626	4626	304
B15_1_36B	1173	27	29	4960	4000	3800	2	15	1250	3000	0.06	0.07	0.0001	0.001	4625	4625	335
B15_1_36C	1217	28	29	4920	3900	----	2	----	1488	----	0.06	----	----	----	4644	----	276
B15_1_36D	1218	28	30	4910	4100	----	2	----	1098	----	0.06	----	----	----	4649	----	261
B15_2_01A	722	17	18	4915	4450	4250	10	100	900	20000	0.06	0.07	0.0001	1E-05	4540	4540	375
B15_2_01B	721	17	17	4880	4515	4315	10	100	250	20000	0.06	0.07	0.0001	1E-05	4540	4540	340
B15_2_01C	765	18	17	4920	4525	4325	10	100	200	20000	0.06	0.07	0.0001	0.001	4545	4545	375
B15_2_01D	766	18	18	4920	4400	4200	10	100	1450	20000	0.06	0.07	0.0001	0.001	4545	4545	375
B15_2_02A	720	17	16	4830	4650	4450	0	100	0	9000	0	0.07	0.0001	1E-05	4540	4540	290
B15_2_02B	719	17	15	4840	4750	4550	0	100	0	0	0	0.07	0.0001	1E-05	4540	4540	300
B15_2_02C	763	18	15	4880	4750	4550	0	100	0	0	0	0.07	0.0001	0.001	4542	4542	338
B15_2_02D	764	18	16	4870	4650	4450	0	100	0	9000	0	0.07	0.0001	0.001	4540	4540	330
B15_2_03A	718	17	14	4840	4750	4550	0	100	0	0	0	0.07	0.0001	1E-05	4538	4538	302
B15_2_03B	717	17	13	4860	4750	4550	0	100	0	0	0	0.07	0.0001	1E-05	4540	4540	320
B15_2_04A	716	17	12	4900	4750	4550	0	2	0	0	0	0.07	0.0001	1E-05	4540	4540	360
B15_2_04B	715	17	11	4920	4800	4600	0	1	0	0	0	0.07	0.0001	1E-05	4590	4590	330
B15_2_05A	714	17	10	4930	4800	4600	0	1	0	20	0	0.07	0.0001	1E-05	4620	4620	310
B15_2_11A	808	19	16	4900	4535	4335	3	75	45	15000	0.06	0.07	0.0001	0.001	4550	4550	350
B15_2_11B	807	19	15	4900	4750	4550	0	75	0	0	0	0.07	0.0001	0.001	4550	4550	350
B15_2_11C	851	20	15	4935	4750	4550	0	75	0	2250	0	0.07	0.0001	0.001	4580	4580	355
B15_2_11D	852	20	16	4945	4540	4340	3	75	75	15000	0.06	0.07	0.0001	0.001	4565	4565	380
B15_2_12A	810	19	18	4960	4400	4200	8	75	1200	15000	0.06	0.07	0.0001	0.001	4550	4550	410
B15_2_12B	809	19	17	4920	4500	4300	8	75	400	15000	0.06	0.07	0.0001	0.001	4550	4550	370
B15_2_12C	853	20	17	4940	4450	4250	8	75	840	15000	0.06	0.07	0.0001	0.001	4555	4555	385
B15_2_12D	854	20	18	4980	4300	4100	8	75	2040	15000	0.06	0.07	0.0001	0.001	4555	4555	425
B15_2_13A	898	21	18	4905	4200	4000	8	75	3040	15000	0.06	0.07	0.0001	0.001	4580	4580	325
B15_2_13B	897	21	17	4920	4400	4200	8	75	1400	15000	0.06	0.07	0.0001	0.001	4575	4575	345
B15_2_13C	941	22	17	4975	4325	4125	8	75	2168	15000	0.06	0.07	0.0001	0.001	4596	4596	379
B15_2_13D	942	22	18	5000	4200	4000	8	75	3120	15000	0.06	0.07	0.0001	0.001	4590	4590	410
B15_2_14A	896	21	16	4970	4550	4350	3	75	90	15000	0.06	0.07	0.0001	0.001	4580	4580	390
B15_2_14B	895	21	15	4990	4700	4500	0	75	0	7500	0	0.07	0.0001	0.001	4600	4600	390
B15_2_14C	939	22	15	4975	4575	4375	2	75	158	15000	0.06	0.07	0.0001	0.001	4654	4654	321
B15_2_14D	940	22	16	4960	4500	4300	2	75	230	15000	0.06	0.07	0.0001	0.001	4615	4615	345
B15_2_15C	937	22	13	5045	4850	4650	0	2	0	60	0	0.07	0.0001	0.001	4680	4680	365
B15_2_15D	938	22	14	5010	4800	4600	0	2	0	124	0	0.07	0.0001	0.001	4662	4662	348
B15_2_16C	935	22	11	5050	4925	4725	0	3	0	45	0	0.07	0.0001	0.001	4740	4740	310

SUMMARY OF CALIBRATED MODEL INPUT PARAMETERS AND RELATED DATA

LOCATION	CELL	ROW	COL	LSURF ELEV	UAUBOT ELEV	LVUBOT ELEV	UAU_K FT/D	LVU_K FT/D	UAU_94T F^2/D	LVU_94T F^2/D	UAU_SY	LVU_SY	LVU_SC	VCONT 1/D	UAU_94WL ELEV	LVU_94WL ELEV	94DTW FEET
B15_2_16D	936	22	12	5070	4900	4700	0	2	0	20	0	0.07	0.0001	0.001	4710	4710	360
B15_2_17C	933	22	9	5150	4950	4750	0	0.3	0	22.5	0	0.07	0.0001	0.001	4825	4825	325
B15_2_17D	934	22	10	5120	4950	4750	0	0.3	0	7.5	0	0.07	0.0001	0.001	4775	4775	345
B15_2_20A	978	23	10	5105	4950	4750	0	0.3	0	15	0	0.07	0.0001	0.001	4800	4800	305
B15_2_20B	977	23	9	5125	4975	4775	0	0.3	0	23.1	0	0.07	0.0001	0.001	4852	4852	273
B15_2_20C	1021	24	9	5160	5000	4800	0	0.3	0	22.5	0	0.07	0.0001	0.001	4875	4875	285
B15_2_20D	1022	24	10	5120	4975	4775	0	0.3	0	8.1	0	0.07	0.0001	0.001	4802	4802	318
B15_2_21A	980	23	12	5085	4900	4700	0	1	0	40	0	0.07	0.0001	0.001	4740	4740	345
B15_2_21B	979	23	11	5070	4925	4725	0	3	0	75	0	0.07	0.0001	0.001	4750	4750	320
B15_2_21C	1023	24	11	5115	4925	4725	0	3	0	105	0	0.07	0.0001	0.001	4760	4760	355
B15_2_21D	1024	24	12	5120	4900	4700	0	2	0	100	0	0.07	0.0001	0.001	4750	4750	370
B15_2_22A	982	23	14	5035	4750	4550	0	2	0	280	0	0.07	0.0001	0.001	4690	4690	345
B15_2_22B	981	23	13	5060	4850	4650	0	2	0	120	0	0.07	0.0001	0.001	4710	4710	350
B15_2_22C	1025	24	13	5100	4800	4600	0	2	0	250	0	0.07	0.0001	0.001	4725	4725	375
B15_2_22D	1026	24	14	5100	4700	4500	0	2	0	400	0	0.07	0.0001	0.001	4700	4700	400
B15_2_23A	984	23	16	5000	4425	4225	2	15	450	3000	0.06	0.07	0.0001	0.001	4650	4650	350
B15_2_23B	983	23	15	5025	4575	4375	2	2	174	400	0.06	0.07	0.0001	0.001	4662	4662	363
B15_2_23C	1027	24	15	5060	4500	4300	2	2	360	400	0.06	0.07	0.0001	0.001	4680	4680	380
B15_2_23D	1028	24	16	5010	4400	4200	2	15	530	3000	0.06	0.07	0.0001	0.001	4665	4665	345
B15_2_24A	986	23	18	5000	4200	4000	2	15	850	3000	0.06	0.07	0.0001	0.001	4625	4625	375
B15_2_24B	985	23	17	5000	4300	4100	2	15	650	3000	0.06	0.07	0.0001	0.001	4625	4625	375
B15_2_24C	1029	24	17	4980	4300	4100	3	15	1050	3000	0.06	0.07	0.0001	0.001	4650	4650	330
B15_2_24D	1030	24	18	4945	4200	4000	2	15	900	3000	0.06	0.07	0.0001	0.001	4650	4650	295
B15_2_25A	1074	25	18	4990	4250	4050	2	15	830	3000	0.06	0.07	0.0001	0.001	4665	4665	325
B15_2_25B	1073	25	17	5005	4300	4100	2	15	716	3000	0.06	0.07	0.0001	0.001	4658	4658	347
B15_2_25C	1117	26	17	5020	4350	4150	1	15	322	3000	0.06	0.07	0.0001	0.001	4672	4672	348
B15_2_25D	1118	26	18	5040	4300	4100	1	15	375	3000	0.06	0.07	0.0001	0.001	4675	4675	365
B15_2_26A	1072	25	16	5000	4400	4200	2	15	550	3000	0.06	0.07	0.0001	0.001	4675	4675	325
B15_2_26B	1071	25	15	5040	4550	4350	1	2	150	400	0.06	0.07	0.0001	0.001	4700	4700	340
B15_2_26C	1115	26	15	5090	4550	4350	1	2	175	400	0.06	0.07	0.0001	0.001	4725	4725	365
B15_2_26D	1116	26	16	5045	4450	4250	1	5	248	1000	0.06	0.07	0.0001	0.001	4698	4698	347
B15_2_27A	1070	25	14	5100	4625	4425	1	2	102	400	0.06	0.07	0.0001	0.001	4727	4727	373
B15_2_27B	1069	25	13	5115	4750	4550	0	2	0	354	0	0.07	0.0001	0.001	4727	4727	388
B15_2_27C	1113	26	13	5100	4675	4475	1	2	75	400	0.06	0.07	0.0001	0.001	4750	4750	350
B15_2_27D	1114	26	14	5100	4650	4450	1	2	100	400	0.06	0.07	0.0001	0.001	4750	4750	350
B15_2_28A	1068	25	12	5155	4900	4700	0	2	0	104	0	0.07	0.0001	0.001	4752	4752	403
B15_2_28B	1067	25	11	5180	4950	4750	0	3	0	105	0	0.07	0.0001	0.001	4785	4785	395
B15_2_28C	1111	26	11	5240	4950	4750	0	3	0	150	0	0.07	0.0001	0.001	4800	4800	440
B15_2_28D	1112	26	12	5220	4850	4650	0	2	0	250	0	0.07	0.0001	0.001	4775	4775	445
B15_2_29A	1066	25	10	5180	5125	4925	0	0.2	0	0	0	0.07	0.0001	0.001	4850	4850	330

SUMMARY OF CALIBRATED MODEL INPUT PARAMETERS AND RELATED DATA

LOCATION	CELL	ROW	COL	LSURF ELEV	UAUBOT ELEV	LVUBOT ELEV	UAU_K FT/D	LVU_K FT/D	UAU_94T F^2/D	LVU_94T F^2/D	UAU_SY	LVU_SY	LVU_SC	VCONT 1/D	UAU_94WL ELEV	LVU_94WL ELEV	94DTW FEET
B15_2_29B	1065	25	9	5170	5100	4900	0	0.3	0	15	0	0.07	0.0001	0.001	4950	4950	220
B15_2_29C	1109	26	9	5220	5100	4900	0	0.3	0	27	0	0.07	0.0001	0.001	4990	4990	230
B15_2_29D	1110	26	10	5190	5000	4800	0	0.3	0	22.5	0	0.07	0.0001	0.001	4875	4875	315
B15_2_32A	1154	27	10	5250	5000	4800	0	0.2	0	30	0	0.07	0.0001	0.001	4950	4950	300
B15_2_32B	1153	27	9	5260	5200	5000	0	0.2	0	0	0	0.07	0.0001	0.001	4990	4990	270
B15_2_32D	1198	28	10	5220	5050	4850	0	0.2	0	23	0	0.07	0.0001	0.001	4965	4965	255
B15_2_33A	1156	27	12	5170	4850	4650	0	3	0	480	0	0.07	0.0001	0.001	4810	4810	360
B15_2_33B	1155	27	11	5240	4950	4750	0	2	0	200	0	0.07	0.0001	0.001	4850	4850	390
B15_2_33C	1199	28	11	5260	4950	4750	0	0.2	0	40	0	0.07	0.0001	0.001	4950	4950	310
B15_2_33D	1200	28	12	5240	4800	4600	0	0.1	294.14	20	0	0.07	0.0001	0.001	4922	4922	318
B15_2_34A	1158	27	14	5160	4650	4450	1	2	115	400	0.06	0.07	0.0001	0.001	4765	4765	395
B15_2_34B	1157	27	13	5130	4700	4500	1	2	85	400	0.06	0.07	0.0001	0.001	4785	4785	345
B15_2_34C	1201	28	13	5220	4750	4550	0	0.5	374.36	100	0	0.07	0.0001	0.001	4820	4820	400
B15_2_34D	1202	28	14	5160	4700	4500	1	0.1	100	20	0.06	0.07	0.0001	0.001	4800	4800	360
B15_2_35A	1160	27	16	5050	4550	4350	1	0.5	175	100	0.06	0.07	0.0001	0.001	4725	4725	325
B15_2_35B	1159	27	15	5110	4600	4400	1	0.5	150	100	0.06	0.07	0.0001	0.001	4750	4750	360
B15_2_35C	1203	28	15	5110	4650	4450	1	0.1	125	20	0.06	0.07	0.0001	0.001	4775	4775	335
B15_2_35D	1204	28	16	5055	4600	4400	1	0.1	150	20	0.06	0.07	0.0001	0.001	4750	4750	305
B15_2_36A	1162	27	18	4975	4500	4300	1	15	190	3000	0.06	0.07	0.0001	0.001	4690	4690	285
B15_2_36B	1161	27	17	5010	4500	4300	1	0.5	197	100	0.06	0.07	0.0001	0.001	4697	4697	313
B15_2_36C	1205	28	17	5030	4550	4350	1	0.1	200	20	0.06	0.07	0.0001	0.001	4750	4750	280
B15_2_36D	1206	28	18	4960	4550	4350	1	0.1	150	20	0.12	0.07	0.0001	0.001	4700	4700	260
B16_1_06C	239	6	19	4650	4200	4000	20	100	6500	20000	0.07	0.07	0.0001	1E-06	4525	4537	125
B16_1_07A	284	7	20	4715	4250	4050	15	100	4200	20000	0.07	0.07	0.0001	1E-06	4530	4541	185
B16_1_07B	283	7	19	4665	4050	3850	15	100	7125	20000	0.07	0.07	0.0001	1E-06	4525	4538	140
B16_1_07C	327	8	19	4670	4200	4000	15	100	5100	20000	0.07	0.07	0.0001	1E-06	4540	4540	130
B16_1_07D	328	8	20	4750	4150	3950	15	100	5880	20000	0.07	0.07	0.0001	1E-06	4542	4542	208
B16_1_08B	285	7	21	4740	4500	4300	15	100	525	20000	0.06	0.07	0.0001	1E-06	4535	4542	205
B16_1_08C	329	8	21	4735	4200	4000	15	100	5130	20000	0.1	0.07	0.0001	0.0001	4542	4542	193
B16_1_08D	330	8	22	4735	4300	4100	15	100	3630	20000	0.1	0.07	0.0001	0.0001	4542	4542	193
B16_1_09C	331	8	23	4735	4500	4300	15	100	645	20000	0.06	0.07	0.0001	0.0001	4543	4543	192
B16_1_15C	421	10	25	4795	4400	4200	15	100	2190	20000	0.06	0.07	0.0001	0.0001	4546	4546	249
B16_1_15D	422	10	26	4825	4500	4300	10	100	470	20000	0.06	0.07	0.0001	0.0001	4547	4547	278
B16_1_16A	376	9	24	4760	4375	4175	15	100	2550	20000	0.06	0.07	0.0001	0.0001	4545	4545	215
B16_1_16B	375	9	23	4735	4300	4100	15	100	3660	20000	0.06	0.07	0.0001	0.0001	4544	4544	191
B16_1_16C	419	10	23	4750	4100	3900	15	100	6645	20000	0.06	0.07	0.0001	0.0001	4543	4543	207
B16_1_16D	420	10	24	4770	4250	4050	15	100	4425	20000	0.06	0.07	0.0001	0.0001	4545	4545	225
B16_1_17A	374	9	22	4755	4150	3950	15	100	5910	20000	0.1	0.07	0.0001	0.0001	4544	4544	211
B16_1_17B	373	9	21	4750	4150	3950	15	100	5895	20000	0.1	0.07	0.0001	0.0001	4543	4543	207
B16_1_17C	417	10	21	4750	4150	3950	15	100	5880	20000	0.1	0.07	0.0001	0.0001	4542	4542	208

SUMMARY OF CALIBRATED MODEL INPUT PARAMETERS AND RELATED DATA

LOCATION	CELL	ROW	COL	LSURF ELEV	UAUBOT ELEV	LVUBOT ELEV	UAU_K FT/D	LVU_K FT/D	UAU_94T F^2/D	LVU_94T F^2/D	UAU_SY	LVU_SY	LVU_SC	VCONT 1/D	UAU_94WL ELEV	LVU_94WL ELEV	94DTW FEET
B16_1_17D	418	10	22	4780	4100	3900	15	100	6645	20000	0.06	0.07	0.0001	0.0001	4543	4543	237
B16_1_18A	372	9	20	4805	4200	4000	15	100	5145	20000	0.07	0.07	0.0001	1E-05	4543	4543	262
B16_1_18B	371	9	19	4690	4325	4125	15	100	3225	20000	0.07	0.07	0.0001	1E-06	4540	4540	150
B16_1_18C	415	10	19	4715	4300	4100	15	100	3390	20000	0.07	0.07	0.0001	1E-05	4526	4535	189
B16_1_18D	416	10	20	4820	4200	4000	15	100	5100	20000	0.1	0.07	0.0001	0.0001	4540	4540	280
B16_1_19A	460	11	20	4800	4350	4150	15	100	2670	20000	0.1	0.07	0.0001	1E-05	4528	4538	272
B16_1_19B	459	11	19	4785	4425	4225	15	100	1470	20000	0.07	0.07	0.0001	1E-05	4523	4536	262
B16_1_19C	503	12	19	4820	4450	4250	15	100	1140	20000	0.07	0.07	0.0001	1E-05	4526	4535	294
B16_1_19D	504	12	20	4775	4300	4100	15	100	3390	20000	0.1	0.07	0.0001	1E-05	4526	4538	249
B16_1_20A	462	11	22	4805	4050	3850	15	100	7380	20000	0.06	0.07	0.0001	0.0001	4542	4542	263
B16_1_20B	461	11	21	4770	4150	3950	15	100	5850	20000	0.1	0.07	0.0001	0.0001	4540	4540	230
B16_1_20C	505	12	21	4780	4100	3900	10	100	4280	20000	0.1	0.07	0.0001	0.0001	4528	4539	252
B16_1_20D	506	12	22	4805	4000	3800	10	100	5400	20000	0.06	0.07	0.0001	0.0001	4540	4540	265
B16_1_21A	464	11	24	4755	4100	3900	15	100	6675	20000	0.06	0.07	0.0001	0.0001	4545	4545	210
B16_1_21B	463	11	23	4770	4050	3850	15	100	7380	20000	0.06	0.07	0.0001	0.0001	4542	4542	228
B16_1_21C	507	12	23	4780	4000	3800	10	100	5420	20000	0.06	0.07	0.0001	0.0001	4542	4542	238
B16_1_21D	508	12	24	4770	4050	3850	10	100	4940	20000	0.06	0.07	0.0001	0.0001	4544	4544	226
B16_1_22A	466	11	26	4820	4350	4150	10	100	1970	20000	0.06	0.07	0.0001	0.0001	4547	4547	273
B16_1_22B	465	11	25	4785	4250	4050	15	100	4440	20000	0.06	0.07	0.0001	0.0001	4546	4546	239
B16_1_22C	509	12	25	4780	4150	3950	10	100	3950	20000	0.06	0.07	0.0001	0.0001	4545	4545	235
B16_1_22D	510	12	26	4820	4250	4050	10	100	2970	20000	0.06	0.07	0.0001	0.0001	4547	4547	273
B16_1_23A	468	11	28	4880	4475	4275	8	75	600	15000	0.06	0.07	0.0001	0.0001	4550	4550	330
B16_1_23B	467	11	27	4850	4450	4250	8	100	784	20000	0.06	0.07	0.0001	0.0001	4548	4548	302
B16_1_23C	511	12	27	4835	4300	4100	8	100	1976	20000	0.06	0.07	0.0001	0.0001	4547	4547	288
B16_1_23D	512	12	28	4870	4400	4200	8	75	1184	15000	0.06	0.07	0.0001	0.0001	4548	4548	322
B16_1_24A	470	11	30	4950	4575	4375	5	75	0	14250	0.06	0.07	0.0001	0.0001	4565	4565	385
B16_1_24B	469	11	29	4910	4540	4340	5	75	75	15000	0.06	0.07	0.0001	0.0001	4555	4555	355
B16_1_24C	513	12	29	4915	4500	4300	5	75	250	15000	0.06	0.07	0.0001	0.0001	4550	4550	365
B16_1_24D	514	12	30	4960	4550	4350	5	75	10	15000	0.06	0.07	0.0001	0.0001	4552	4552	408
B16_1_25A	558	13	30	4960	4500	4300	5	75	250	15000	0.06	0.07	0.0001	0.001	4550	4550	410
B16_1_25B	557	13	29	4920	4400	4200	5	75	745	15000	0.06	0.07	0.0001	0.001	4549	4549	371
B16_1_25C	601	14	29	4915	4400	4200	5	75	745	15000	0.06	0.07	0.0001	0.001	4549	4549	366
B16_1_25D	602	14	30	4955	4475	4275	5	75	375	15000	0.06	0.07	0.0001	0.001	4550	4550	405
B16_1_26A	556	13	28	4880	4300	4100	8	75	1984	15000	0.06	0.07	0.0001	0.001	4548	4548	332
B16_1_26B	555	13	27	4845	4250	4050	8	100	2376	20000	0.06	0.07	0.0001	0.001	4547	4547	298
B16_1_26C	599	14	27	4845	4250	4050	8	100	2376	20000	0.06	0.07	0.0001	0.001	4547	4547	298
B16_1_26D	600	14	28	4880	4300	4100	8	75	1984	15000	0.06	0.07	0.0001	0.001	4548	4548	332
B16_1_27A	554	13	26	4820	4175	3975	10	100	3720	20000	0.06	0.07	0.0001	0.001	4547	4547	273
B16_1_27B	553	13	25	4795	4100	3900	10	100	4450	20000	0.06	0.07	0.0001	0.001	4545	4545	250
B16_1_27C	597	14	25	4795	4075	3875	10	100	4700	20000	0.06	0.07	0.0001	0.001	4545	4545	250

SUMMARY OF CALIBRATED MODEL INPUT PARAMETERS AND RELATED DATA

LOCATION	CELL	ROW	COL	LSURF ELEV	UAUBOT ELEV	LVUBOT ELEV	UAU_K FT/D	LVU_K FT/D	UAU_94T F^2/D	LVU_94T F^2/D	UAU_SY	LVU_SY	LVU_SC	VCONT 1/D	UAU_94WL ELEV	LVU_94WL ELEV	94DTW FEET
B16_1_27D	598	14	26	4820	4150	3950	10	100	3960	20000	0.06	0.07	0.0001	0.001	4546	4546	274
B16_1_28A	552	13	24	4785	4000	3800	10	100	5420	20000	0.06	0.07	0.0001	0.001	4542	4542	243
B16_1_28B	551	13	23	4805	3950	3750	10	100	5900	20000	0.06	0.07	0.0001	0.001	4540	4540	265
B16_1_28C	595	14	23	4850	3900	3700	10	100	6400	20000	0.06	0.07	0.0001	0.001	4540	4540	310
B16_1_28D	596	14	24	4790	4000	3800	10	100	5420	20000	0.06	0.07	0.0001	0.001	4542	4542	248
B16_1_29A	550	13	22	4850	3950	3750	10	100	5850	20000	0.06	0.07	0.0001	0.001	4535	4539	315
B16_1_29B	549	13	21	4790	4100	3900	10	100	4350	20000	0.1	0.07	0.0001	0.001	4535	4538	255
B16_1_29C	593	14	21	4800	4050	3850	10	100	4850	20000	0.1	0.07	0.0001	0.001	4535	4538	265
B16_1_29D	594	14	22	4870	3900	3700	10	100	6380	20000	0.06	0.07	0.0001	0.001	4538	4539	332
B16_1_30A	548	13	20	4780	4300	4100	10	100	2330	20000	0.1	0.07	0.0001	0.0001	4533	4536	247
B16_1_30B	547	13	19	4830	4400	4200	10	100	1300	20000	0.06	0.07	0.0001	0.0001	4530	4535	300
B16_1_30C	591	14	19	4840	4400	4200	10	100	1300	20000	0.06	0.07	0.0001	0.0001	4530	4534	310
B16_1_30D	592	14	20	4790	4250	4050	10	100	2800	20000	0.1	0.07	0.0001	0.0001	4530	4536	260
B16_1_31A	636	15	20	4800	4200	4000	10	100	3360	20000	0.1	0.07	0.0001	0.001	4536	4536	264
B16_1_31B	635	15	19	4830	4350	4150	10	100	1850	20000	0.06	0.07	0.0001	0.001	4535	4535	295
B16_1_31C	679	16	19	4855	4300	4100	10	100	2400	20000	0.06	0.07	0.0001	1E-05	4540	4540	315
B16_1_31D	680	16	20	4830	4100	3900	10	100	4420	20000	0.1	0.07	0.0001	1E-05	4542	4542	288
B16_1_32A	638	15	22	4860	3950	3750	10	100	5910	20000	0.06	0.07	0.0001	0.001	4541	4541	319
B16_1_32B	637	15	21	4825	4000	3800	10	100	5400	20000	0.1	0.07	0.0001	0.001	4540	4540	285
B16_1_32C	681	16	21	4850	4000	3800	10	100	5410	20000	0.1	0.07	0.0001	0.001	4541	4541	309
B16_1_32D	682	16	22	4920	3900	3700	10	100	6420	20000	0.06	0.07	0.0001	0.001	4542	4542	378
B16_1_33A	640	15	24	4805	4000	3800	10	100	5430	20000	0.06	0.07	0.0001	0.001	4543	4543	262
B16_1_33B	639	15	23	4850	3900	3700	10	100	6420	20000	0.06	0.07	0.0001	0.001	4542	4542	308
B16_1_33C	683	16	23	4850	3900	3700	10	100	6420	20000	0.06	0.07	0.0001	0.001	4542	4542	308
B16_1_33D	684	16	24	4840	4000	3800	10	100	5440	20000	0.06	0.07	0.0001	0.001	4544	4544	296
B16_1_34A	642	15	26	4810	4150	3950	8	100	3160	20000	0.06	0.07	0.0001	0.001	4545	4545	265
B16_1_34B	641	15	25	4800	4075	3875	10	100	4700	20000	0.06	0.07	0.0001	0.001	4545	4545	255
B16_1_34C	685	16	25	4805	4100	3900	10	100	4450	20000	0.06	0.07	0.0001	0.001	4545	4545	260
B16_1_34D	686	16	26	4815	4150	3950	8	100	3160	20000	0.06	0.07	0.0001	0.001	4545	4545	270
B16_1_35A	644	15	28	4880	4300	4100	8	75	1984	15000	0.06	0.07	0.0001	0.001	4548	4548	332
B16_1_35B	643	15	27	4850	4225	4025	8	100	2568	20000	0.06	0.07	0.0001	0.001	4546	4546	304
B16_1_35C	687	16	27	4855	4225	4025	8	75	2576	15000	0.06	0.07	0.0001	0.001	4547	4547	308
B16_1_35D	688	16	28	4880	4300	4100	8	75	1984	15000	0.06	0.07	0.0001	0.001	4548	4548	332
B16_1_36A	646	15	30	4940	4500	4300	5	75	250	15000	0.06	0.07	0.0001	0.001	4550	4550	390
B16_1_36B	645	15	29	4910	4400	4200	8	75	1192	15000	0.06	0.07	0.0001	0.001	4549	4549	361
B16_1_36C	689	16	29	4915	4400	4200	8	75	1192	15000	0.06	0.07	0.0001	0.001	4549	4549	366
B16_1_36D	690	16	30	4950	4500	4300	8	75	392	15000	0.06	0.07	0.0001	0.001	4549	4549	401
B16_2_01B	193	5	17	4590	3975	3775	20	0.1	10300	20	0.12	0.07	0.0001	1E-06	4490	4500	100
B16_2_01C	237	6	17	4595	3950	3750	20	100	11360	20000	0.12	0.07	0.0001	1E-06	4518	4515	77
B16_2_01D	238	6	18	4620	3975	3775	20	100	10900	20000	0.07	0.07	0.0001	1E-06	4520	4535	100

SUMMARY OF CALIBRATED MODEL INPUT PARAMETERS AND RELATED DATA

LOCATION	CELL	ROW	COL	LSURF ELEV	UAUBOT ELEV	LVUBOT ELEV	UAU_K FT/D	LVU_K FT/D	UAU_94T F^2/D	LVU_94T F^2/D	UAU_SY	LVU_SY	LVU_SC	VCONT 1/D	UAU_94WL ELEV	LVU_94WL ELEV	94DTW FEET
B16_2_02A	192	5	16	4510	4000	3800	20	7	9840	1400	0.12	0.07	0.0001	1E-06	4492	4500	18
B16_2_02B	191	5	15	4510	4050	3850	3	0.1	1335	20	0.12	0.07	0.0001	1E-06	4495	4500	15
B16_2_02C	235	6	15	4570	4050	3850	3	125	1374	25000	0.12	0.07	0.0001	1E-06	4508	4510	62
B16_2_02D	236	6	16	4520	4025	3825	20	125	9760	25000	0.12	0.07	0.0001	1E-06	4513	4508	7
B16_2_03A	190	5	14	4540	4050	3850	3	7	1335	1400	0.07	0.07	0.0001	1E-06	4495	4500	45
B16_2_03B	189	5	13	4535	4100	3900	3	7	1179	1400	0.07	0.07	0.0001	1E-06	4493	4495	42
B16_2_03C	233	6	13	4580	4150	3950	3	125	1029	25000	0.07	0.07	0.0001	1E-06	4493	4510	87
B16_2_03D	234	6	14	4570	4100	3900	3	125	1209	25000	0.07	0.07	0.0001	1E-06	4503	4510	67
B16_2_04A	188	5	12	4565	4200	4000	1	7	295	1400	0.07	0.07	0.0001	1E-06	4495	4502	70
B16_2_04B	187	5	11	4580	4350	----	1	----	137	----	0.07	----	----	----	4487	----	93
B16_2_04C	231	6	11	4600	4350	4150	1	2	148	400	0.07	0.07	0.0001	1E-05	4498	4495	102
B16_2_04D	232	6	12	4590	4250	4050	1	125	245	25000	0.07	0.07	0.0001	1E-06	4495	4507	95
B16_2_05C	229	6	9	4650	4465	----	1	----	52	----	0.07	----	----	----	4517	----	133
B16_2_05D	230	6	10	4600	4400	4200	1	2	102	400	0.07	0.07	0.0001	1E-06	4502	4502	98
B16_2_08A	274	7	10	4625	4400	4200	1	2	102	400	0.07	0.07	0.0001	1E-06	4502	4508	123
B16_2_08B	273	7	9	4660	4480	4280	1	0.01	40	2	0.07	0.07	0.0001	0.0001	4520	4510	140
B16_2_08C	317	8	9	4690	4510	4310	1	0.01	18	2	0.07	0.07	0.0001	0.0001	4528	4525	162
B16_2_08D	318	8	10	4650	4500	4300	1	2	23	400	0.07	0.07	0.0001	1E-06	4523	4523	127
B16_2_09A	276	7	12	4620	4300	4100	1	125	233	25000	0.07	0.07	0.0001	1E-06	4533	4515	87
B16_2_09B	275	7	11	4630	4350	4150	1	2	160	400	0.07	0.07	0.0001	1E-06	4510	4510	120
B16_2_09C	319	8	11	4660	4350	4150	1	2	174	400	0.07	0.07	0.0001	1E-06	4524	4521	136
B16_2_09D	320	8	12	4650	4350	4150	1	175	170	35000	0.07	0.07	0.0001	1E-06	4520	4518	130
B16_2_10A	278	7	14	4605	4150	3950	3	175	1170	35000	0.07	0.07	0.0001	1E-06	4540	4515	65
B16_2_10B	277	7	13	4610	4225	4025	3	175	930	35000	0.07	0.07	0.0001	1E-06	4535	4515	75
B16_2_10C	321	8	13	4640	4275	4075	3	175	735	35000	0.07	0.07	0.0001	1E-06	4520	4518	120
B16_2_10D	322	8	14	4630	4225	4025	3	175	915	35000	0.07	0.07	0.0001	1E-06	4530	4518	100
B16_2_11A	280	7	16	4540	4075	3875	15	100	6900	20000	0.12	0.07	0.0001	1E-06	4535	4515	5
B16_2_11B	279	7	15	4595	4100	3900	3	175	1326	35000	0.12	0.07	0.0001	1E-06	4542	4515	53
B16_2_11C	323	8	15	4625	4200	4000	3	175	1071	35000	0.07	0.07	0.0001	1E-06	4557	4520	68
B16_2_11D	324	8	16	4555	4150	3950	15	175	5925	35000	0.07	0.07	0.0001	1E-06	4545	4522	10
B16_2_12A	282	7	18	4630	4000	3800	15	100	7845	20000	0.07	0.07	0.0001	1E-06	4523	4530	107
B16_2_12B	281	7	17	4590	4025	3825	15	100	7425	20000	0.12	0.07	0.0001	1E-06	4520	4515	70
B16_2_12C	325	8	17	4595	4100	3900	15	100	6525	20000	0.07	0.07	0.0001	1E-06	4535	4525	60
B16_2_12D	326	8	18	4630	4150	3950	15	100	5625	20000	0.07	0.07	0.0001	1E-06	4525	4530	105
B16_2_13A	370	9	18	4650	4325	4125	15	100	3000	20000	0.07	0.07	0.0001	1E-06	4525	4532	125
B16_2_13B	369	9	17	4620	4150	3950	15	100	5850	20000	0.07	0.07	0.0001	1E-06	4540	4525	80
B16_2_13C	413	10	17	4640	4325	4125	15	100	3225	20000	0.07	0.07	0.0001	1E-06	4540	4528	100
B16_2_13D	414	10	18	4685	4350	4150	15	100	2625	20000	0.07	0.07	0.0001	1E-06	4525	4532	160
B16_2_14A	368	9	16	4590	4200	4000	15	175	5175	35000	0.07	0.07	0.0001	1E-06	4545	4523	45
B16_2_14B	367	9	15	4635	4300	4100	3	175	750	35000	0.07	0.07	0.0001	1E-06	4550	4523	85

SUMMARY OF CALIBRATED MODEL INPUT PARAMETERS AND RELATED DATA

LOCATION	CELL	ROW	COL	LSURF ELEV	UAUBOT ELEV	LVUBOT ELEV	UAU_K FT/D	LVU_K FT/D	UAU_94T F^2/D	LVU_94T F^2/D	UAU_SY	LVU_SY	LVU_SC	VCONT 1/D	UAU_94WL ELEV	LVU_94WL ELEV	94DTW FEET
B16_2_14C	411	10	15	4670	4350	4150	15	175	2775	35000	0.07	0.07	0.0001	1E-06	4535	4524	135
B16_2_14D	412	10	16	4615	4325	4125	15	175	3255	35000	0.07	0.07	0.0001	1E-06	4542	4526	73
B16_2_15A	366	9	14	4660	4300	4100	3	175	654	35000	0.07	0.07	0.0001	1E-06	4518	4522	142
B16_2_15B	365	9	13	4670	4350	4150	3	175	480	35000	0.07	0.07	0.0001	1E-06	4510	4521	160
B16_2_15C	409	10	13	4700	4400	4200	3	175	345	35000	0.07	0.07	0.0001	1E-06	4515	4522	185
B16_2_15D	410	10	14	4680	4350	4150	3	175	540	35000	0.07	0.07	0.0001	1E-06	4530	4524	150
B16_2_16A	364	9	12	4685	4400	4200	3	175	360	35000	0.07	0.07	0.0001	1E-06	4520	4521	165
B16_2_16B	363	9	11	4710	4450	4250	3	100	255	20000	0.07	0.07	0.0001	1E-05	4535	4525	175
B16_2_16C	407	10	11	4740	4500	4300	3	175	105	35000	0.07	0.07	0.0001	1E-05	4535	4529	205
B16_2_16D	408	10	12	4710	4450	4250	3	175	225	35000	0.07	0.07	0.0001	1E-06	4525	4525	185
B16_2_17A	362	9	10	4690	4505	4305	1	2	37	400	0.07	0.07	0.0001	1E-05	4542	4530	148
B16_2_17B	361	9	9	4720	4525	4325	1	0.01	19	2	0.07	0.07	0.0001	0.0001	4544	4534	176
B16_2_17C	405	10	9	4720	4540	4340	1	0.01	0	1.94	0.07	0.07	0.0001	0.0001	4540	4534	180
B16_2_17D	406	10	10	4735	4520	4320	1	2	25	400	0.07	0.07	0.0001	1E-05	4545	4532	190
B16_2_20A	450	11	10	4770	4530	4330	1	2	10	400	0.07	0.07	0.0001	1E-05	4540	4531	230
B16_2_20B	449	11	9	4740	4560	4360	1	0.01	0	1.94	0.07	0.07	0.0001	0.0001	4542	4554	198
B16_2_20C	493	12	9	4750	4560	4360	2	0.01	0	1.95	0.07	0.07	0.0001	0.0001	4560	4555	190
B16_2_20D	494	12	10	4780	4535	4335	2	2	10	380	0.07	0.07	0.0001	0.0001	4540	4525	240
B16_2_21A	452	11	12	4730	4500	4300	3	175	75	35000	0.07	0.07	0.0001	1E-05	4525	4528	205
B16_2_21B	451	11	11	4770	4510	4310	3	100	75	20000	0.07	0.07	0.0001	1E-05	4535	4533	235
B16_2_21C	495	12	11	4790	4515	4315	2	100	30	20000	0.07	0.07	0.0001	1E-05	4530	4527	260
B16_2_21D	496	12	12	4760	4510	4310	3	100	45	20000	0.07	0.07	0.0001	1E-06	4525	4527	235
B16_2_22A	454	11	14	4710	4400	4200	3	175	345	35000	0.07	0.07	0.0001	1E-06	4515	4526	195
B16_2_22B	453	11	13	4720	4450	4250	3	175	201	35000	0.07	0.07	0.0001	1E-06	4517	4525	203
B16_2_22C	497	12	13	4760	4495	4295	3	100	60	20000	0.07	0.07	0.0001	1E-06	4515	4528	245
B16_2_22D	498	12	14	4730	4475	4275	3	100	120	20000	0.07	0.07	0.0001	1E-06	4515	4527	215
B16_2_23A	456	11	16	4640	4375	4175	15	175	2250	35000	0.07	0.07	0.0001	1E-06	4525	4528	115
B16_2_23B	455	11	15	4675	4375	4175	15	175	2130	35000	0.07	0.07	0.0001	1E-06	4517	4526	158
B16_2_23C	499	12	15	4660	4450	4250	15	100	975	20000	0.07	0.07	0.0001	1E-06	4515	4527	145
B16_2_23D	500	12	16	4705	4450	4250	15	100	1020	20000	0.07	0.07	0.0001	1E-06	4518	4528	187
B16_2_24A	458	11	18	4730	4425	4225	15	100	1500	20000	0.07	0.07	0.0001	1E-06	4525	4532	205
B16_2_24B	457	11	17	4690	4375	4175	15	100	2340	20000	0.07	0.07	0.0001	1E-06	4531	4530	159
B16_2_24C	501	12	17	4740	4450	4250	15	100	1080	20000	0.07	0.07	0.0001	1E-06	4522	4531	218
B16_2_24D	502	12	18	4830	4450	4250	15	100	1110	20000	0.07	0.07	0.0001	1E-05	4524	4532	306
B16_2_25A	546	13	18	4840	4500	4300	15	100	450	20000	0.07	0.07	0.0001	1E-05	4530	4532	310
B16_2_25B	545	13	17	4750	4500	4300	15	100	360	20000	0.07	0.07	0.0001	1E-05	4524	4531	226
B16_2_25C	589	14	17	4770	4500	4300	10	100	260	20000	0.07	0.07	0.0001	0.0001	4526	4533	244
B16_2_25D	590	14	18	4820	4500	4300	10	100	260	20000	0.06	0.07	0.0001	0.0001	4526	4532	294
B16_2_26A	544	13	16	4750	4490	4290	10	100	300	20000	0.07	0.07	0.0001	1E-06	4520	4530	230
B16_2_26B	543	13	15	4710	4490	4290	10	100	300	20000	0.07	0.07	0.0001	1E-06	4520	4528	190

SUMMARY OF CALIBRATED MODEL INPUT PARAMETERS AND RELATED DATA

LOCATION	CELL	ROW	COL	LSURF ELEV	UAUBOT ELEV	LVUBOT ELEV	UAU_K FT/D	LVU_K FT/D	UAU_94T F^2/D	LVU_94T F^2/D	UAU_SY	LVU_SY	LVU_SC	VCONT 1/D	UAU_94WL ELEV	LVU_94WL ELEV	94DTW FEET
B16_2_26C	587	14	15	4750	4500	4300	10	100	300	20000	0.07	0.07	0.0001	0.0001	4530	4532	220
B16_2_26D	588	14	16	4760	4500	4300	10	100	300	20000	0.07	0.07	0.0001	0.0001	4530	4532	230
B16_2_27A	542	13	14	4740	4500	4300	3	100	57	20000	0.07	0.07	0.0001	1E-06	4519	4528	221
B16_2_27B	541	13	13	4770	4500	4300	3	100	75	20000	0.07	0.07	0.0001	1E-06	4525	4530	245
B16_2_27C	585	14	13	4800	4625	4425	0	100	0	10500	0	0.07	0.0001	0.0001	4525	4530	275
B16_2_27D	586	14	14	4770	4600	4400	0	100	63.51	13000	0	0.07	0.0001	0.0001	4525	4530	245
B16_2_28A	540	13	12	4790	4510	4310	3	100	60	20000	0.07	0.07	0.0001	1E-06	4530	4530	260
B16_2_28B	539	13	11	4910	4650	4450	0	100	0	8500	0	0.07	0.0001	1E-05	4535	4535	375
B16_2_28C	583	14	11	4850	4650	4450	0	1	0	80	0	0.07	0.0001	0.0001	4538	4530	312
B16_2_28D	584	14	12	4820	4650	4450	0	100	0	8000	0	0.07	0.0001	0.0001	4530	4530	290
B16_2_29A	538	13	10	4810	4650	4450	0	5	0	295	0	0.07	0.0001	0.0001	4540	4509	270
B16_2_29B	537	13	9	4780	4580	4380	0	0.3	264.72	52.5	0	0.07	0.0001	0.0001	4570	4555	210
B16_2_29C	581	14	9	4810	4700	4500	0	0.3	0	21	0	0.07	0.0001	0.0001	4580	4570	230
B16_2_29D	582	14	10	4835	4700	4500	0	5	0	125	0	0.07	0.0001	0.0001	4540	4525	295
B16_2_32A	626	15	10	4850	4725	4525	0	5	0	35	0	0.07	0.0001	0	4536	4532	314
B16_2_32B	625	15	9	4845	4750	4550	0	0.7	0	17.5	0	0.07	0.0001	0	4580	4575	265
B16_2_32C	669	16	9	4850	4800	4600	0	0.5	0	12.5	0	0.07	0.0001	1E-05	4630	4625	220
B16_2_32D	670	16	10	4880	4750	4550	0	5	0	175	0	0.07	0.0001	1E-05	4540	4585	340
B16_2_33A	628	15	12	4840	4700	4500	0	100	0	3300	0	0.07	0.0001	1E-05	4537	4533	303
B16_2_33B	627	15	11	4875	4725	4525	0	1	0	5	0	0.07	0.0001	1E-05	4538	4530	337
B16_2_33C	671	16	11	4880	4750	4550	0	1	0	0	0	0.07	0.0001	1E-05	4539	4537	341
B16_2_33D	672	16	12	4880	4750	4550	0	2	0	0	0	0.07	0.0001	1E-05	4538	4538	342
B16_2_34A	630	15	14	4800	4650	4450	0	100	0	8400	0	0.07	0.0001	1E-05	4530	4534	270
B16_2_34B	629	15	13	4820	4700	4500	0	100	0	3500	0	0.07	0.0001	1E-05	4535	4535	285
B16_2_34C	673	16	13	4860	4725	4525	0	100	0	1000	0	0.07	0.0001	1E-05	4537	4535	323
B16_2_34D	674	16	14	4825	4700	4500	0	100	0	3500	0	0.07	0.0001	1E-05	4536	4535	289
B16_2_35A	632	15	16	4770	4600	4400	0	100	50.14	13500	0	0.07	0.0001	1E-05	4528	4535	242
B16_2_35B	631	15	15	4780	4625	4425	0	100	0	10800	0	0.07	0.0001	1E-05	4530	4533	250
B16_2_35C	675	16	15	4820	4700	4500	0	100	0	3400	0	0.07	0.0001	1E-05	4536	4534	284
B16_2_35D	676	16	16	4790	4650	4450	0	100	0	8800	0	0.07	0.0001	1E-05	4535	4538	255
B16_2_36A	634	15	18	4820	4500	4300	10	100	330	20000	0.06	0.07	0.0001	1E-05	4533	4533	287
B16_2_36B	633	15	17	4830	4500	4300	10	100	300	20000	0.06	0.07	0.0001	1E-05	4530	4535	300
B16_2_36C	677	16	17	4880	4510	4310	16	100	416	20000	0.06	0.07	0.0001	1E-05	4536	4535	344
B16_2_36D	678	16	18	4880	4475	4275	10	100	630	20000	0.06	0.07	0.0001	1E-05	4538	4537	342
B17_1_27A	14	1	14	4425	4275	4075	25	25	3500	5000	0.12	0.07	0.0001	0.0001	4415	4420	10
B17_2_26C	59	2	15	4460	4200	4000	20	25	5200	5000	0.12	0.07	0.0001	0.0002	4460	4455	0
B17_2_27B	13	1	13	4460	4275	4075	25	25	4000	5000	0.12	0.07	0.0001	0.0001	4435	4440	25
B17_2_27C	57	2	13	4460	4250	4050	25	25	5175	5000	0.12	0.07	0.0001	0.0001	4457	4464	3
B17_2_27D	58	2	14	4440	4250	4050	25	25	4675	5000	0.12	0.07	0.0001	0.0001	4437	4464	3
B17_2_33A	100	3	12	4500	4150	----	1	----	328	----	0.12	----	----	----	4478	----	22

APPENDIX III - FIGURES

SUMMARY OF CALIBRATED MODEL INPUT PARAMETERS AND RELATED DATA

LOCATION	CELL	ROW	COL	LSURF	UAUBOT	LVUBOT	UAU_K	LVU_K	UAU_94T	LVU_94T	UAU_SY	LVU_SY	LVU_SC	VCONT	UAU_94WL	LVU_94WL	94DTW
				ELEV	ELEV	ELEV	FT/D	FT/D	F^2/D	F^2/D				1/D	ELEV	ELEV	FEET
B17_2_33C	143	4	11	4525	4300	----	1	----	185	----	0.07	----	----	----	4485	----	40
B17_2_33D	144	4	12	4530	4200	4000	1	0.1	282	20	0.07	0.07	0.0001	1E-06	4482	4486	48
B17_2_34A	102	3	14	4465	4000	3800	15	25	6900	5000	0.12	0.07	0.0001	0.0002	4460	4468	5
B17_2_34B	101	3	13	4490	4000	3800	10	25	4700	5000	0.12	0.07	0.0001	0.0001	4470	4461	20
B17_2_34C	145	4	13	4515	3950	3750	5	25	2650	5000	0.12	0.07	0.0001	1E-06	4480	4495	35
B17_2_34D	146	4	14	4500	3950	3750	15	25	7950	5000	0.12	0.07	0.0001	1E-06	4480	4483	20
B17_2_35A	104	3	16	4540	4200	4000	20	0.1	5400	20	0.12	0.07	0.0001	0.0001	4470	4470	70
B17_2_35B	103	3	15	4500	4100	3900	20	25	7400	5000	0.12	0.07	0.0001	0.0001	4470	4475	30
B17_2_35C	147	4	15	4475	3950	3750	20	25	10300	5000	0.12	0.07	0.0001	1E-06	4465	4495	10
B17_2_35D	148	4	16	4530	4000	3800	20	7	9500	1400	0.12	0.07	0.0001	1E-06	4475	4472	55
B17_2_36C	149	4	17	4740	4300	4100	20	0.1	3600	20	0.12	0.07	0.0001	1E-06	4480	4480	260

APPENDIX III - FIGURES

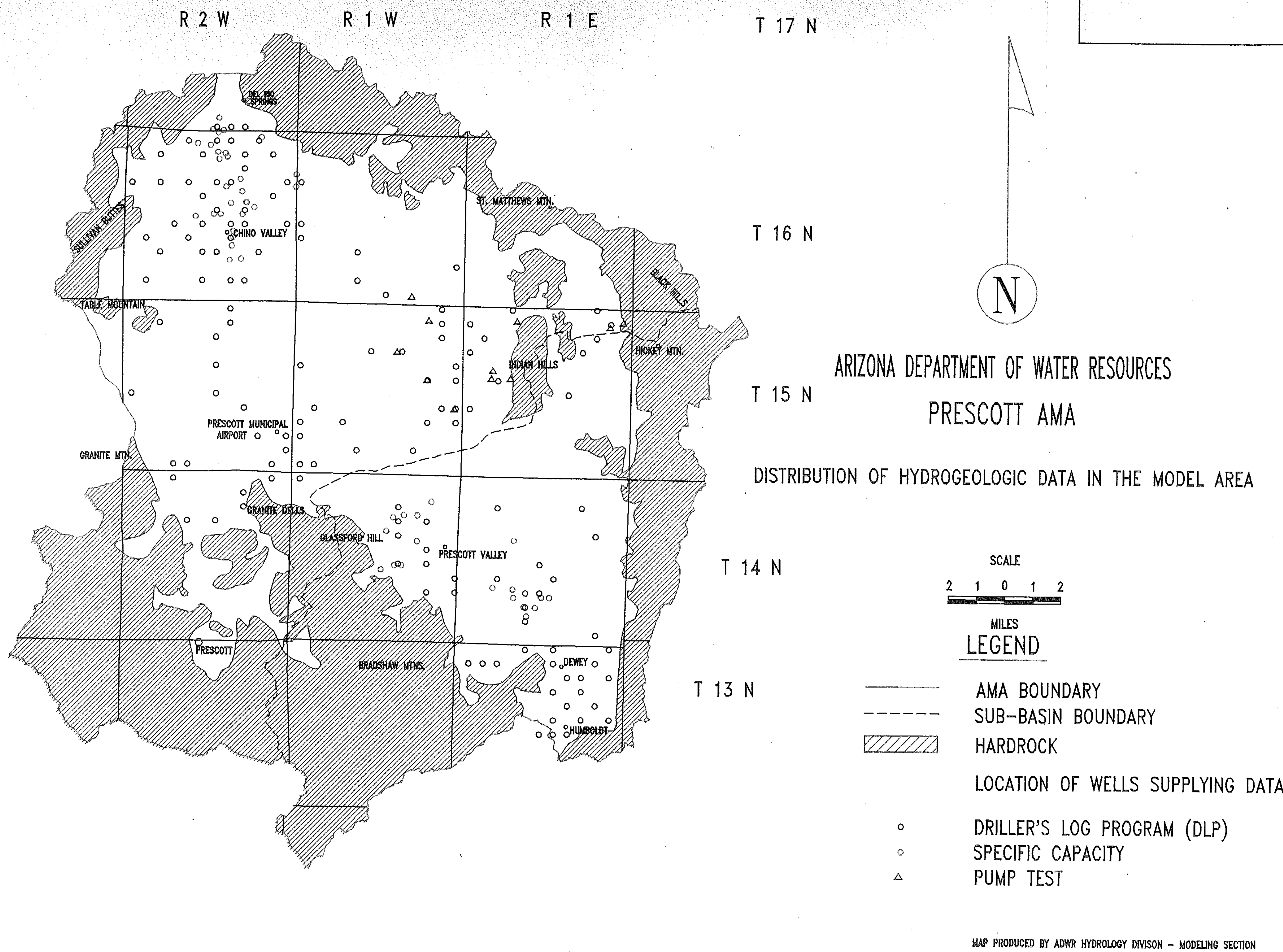


FIGURE 2

ARIZONA DEPARTMENT OF WATER RESOURCES
PRESCOTT AMA

DISTRIBUTION OF HYDROGEOLOGIC DATA IN THE MODEL AREA

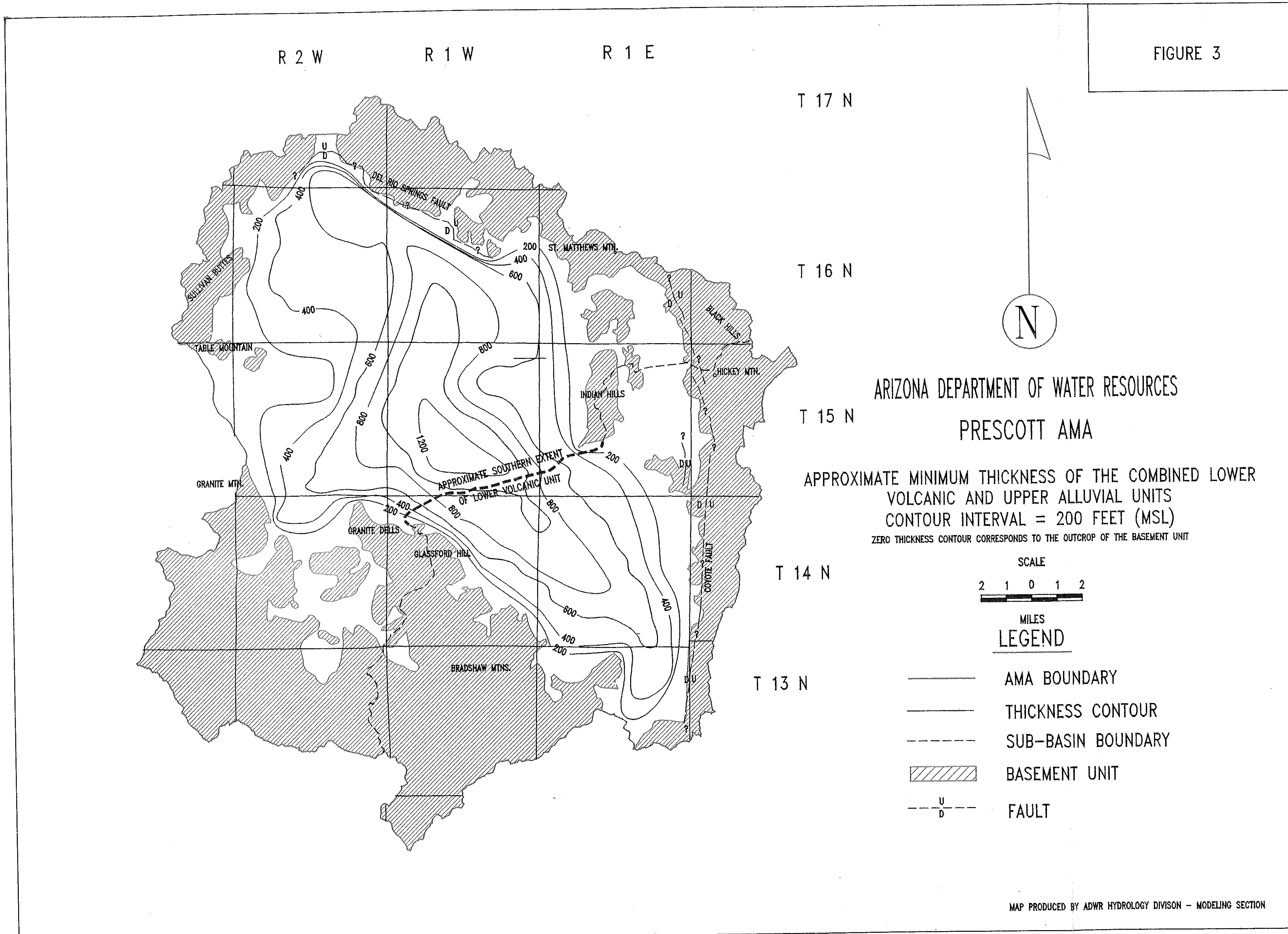


FIGURE 3
R 2 W
R 1 W
R 1 E
T 17 N
T 16 N
T 15 N
T 14 N
T 13 N
N
DEL RIO SPRINGS FAULT
ST. MATTHEWS MTN.
SULLIVAN BUTTES
TABLE MOUNTAIN
INDIAN HILLS
HICKEY MTN.
BLACK HILLS
GRANITE MTN.
APPROXIMATE SOUTHERN EXTENT OF LOWER VOLCANIC UNIT
GRANITE DELLS
GLASSFORD HILL
COYOTE FAULT
BRADSHAW MTNS.
200
400
600
800
1200
ARIZONA DEPARTMENT OF WATER RESOURCES
PRESCOTT AMA
APPROXIMATE MINIMUM THICKNESS OF THE COMBINED LOWER VOLCANIC AND UPPER ALLUVIAL UNITS
CONTOUR INTERVAL = 200 FEET (MSL)
ZERO THICKNESS CONTOUR CORRESPONDS TO THE OUTCROP OF THE BASEMENT UNIT
SCALE
2 1 0 1 2
MILES
LEGEND
AMA BOUNDARY
THICKNESS CONTOUR
SUB-BASIN BOUNDARY
BASEMENT UNIT
FAULT
MAP PRODUCED BY ADWR HYDROLOGY DIVISON – MODELING SECTION

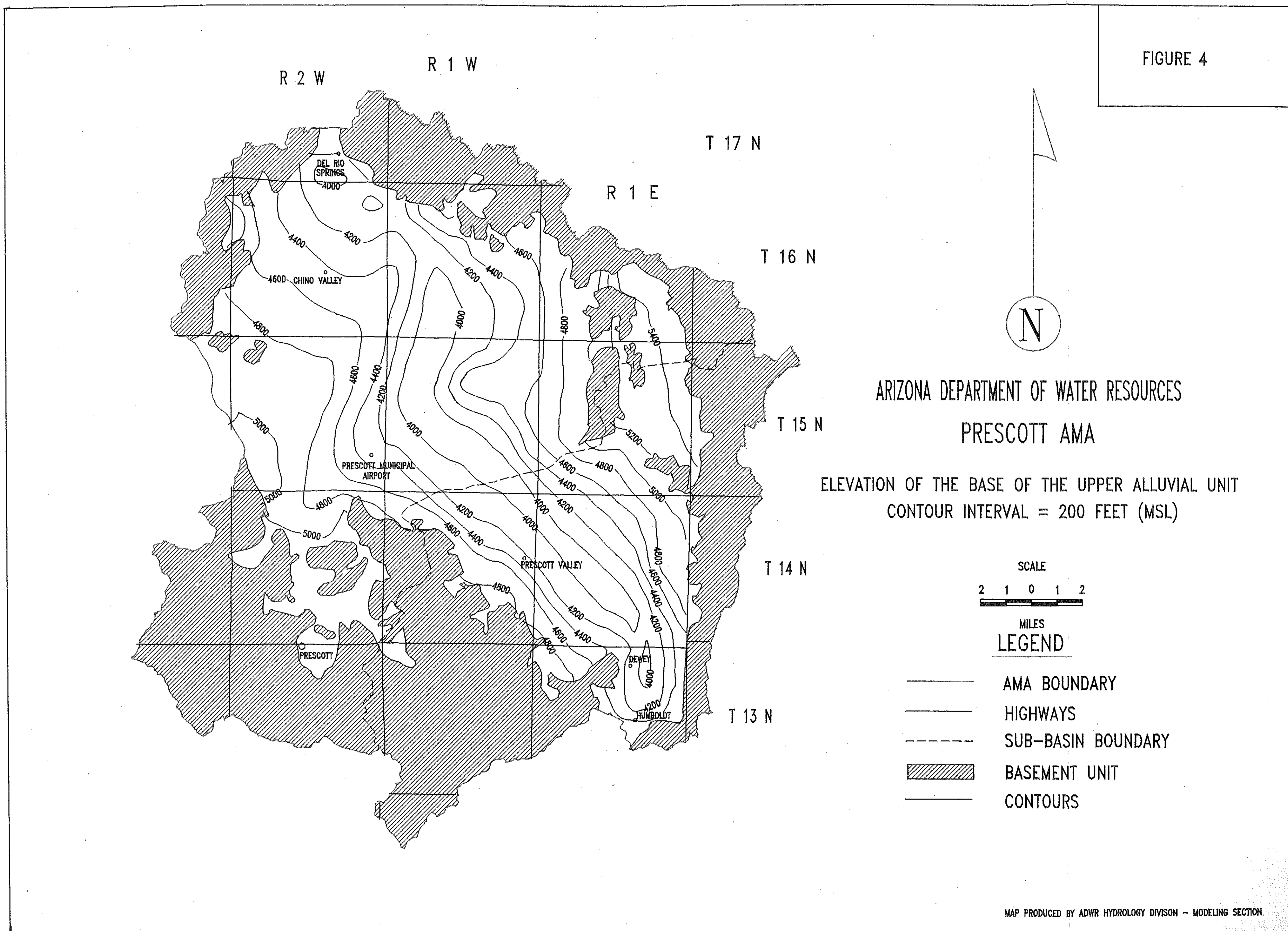
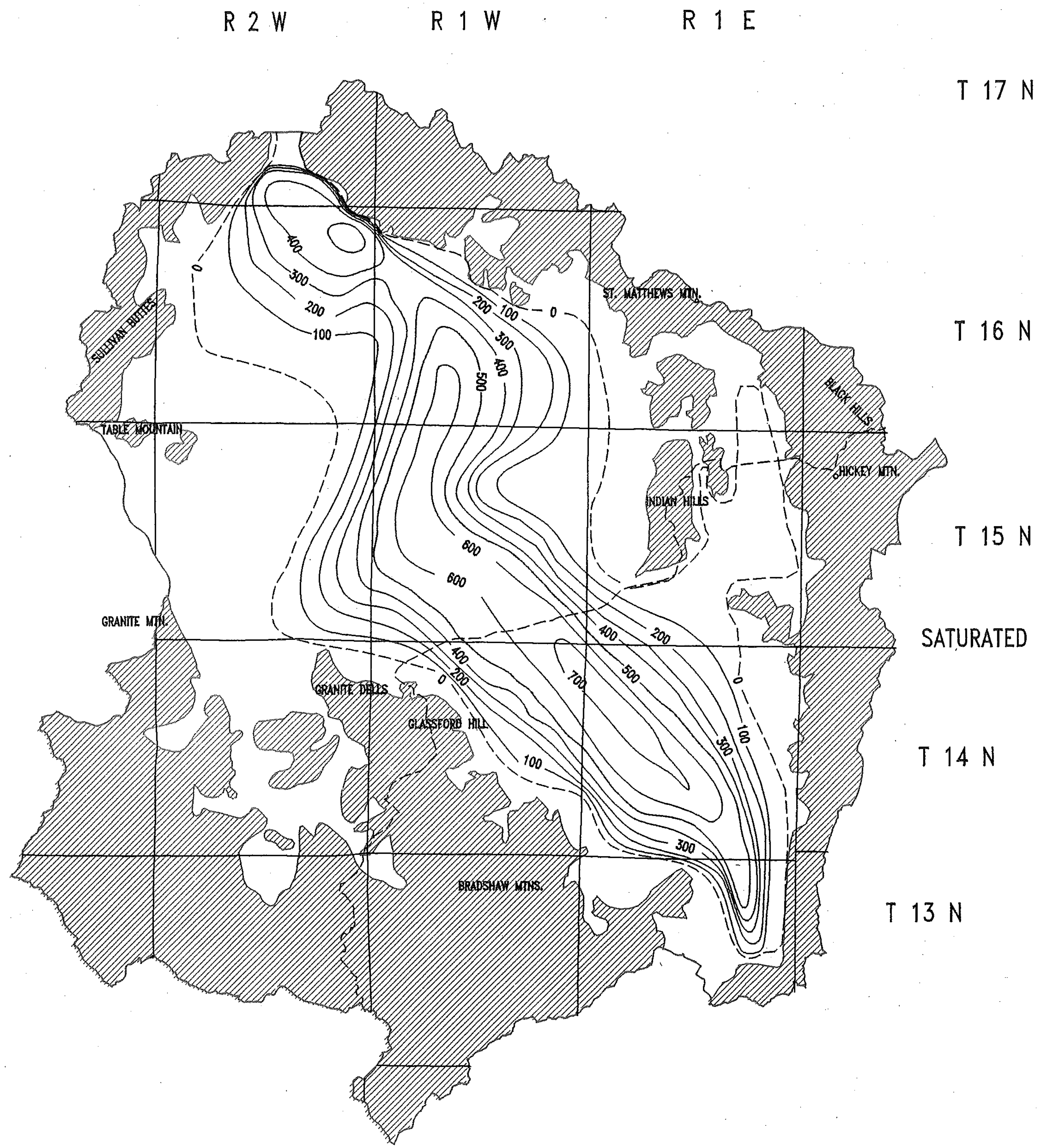


FIGURE 4
R 2 W
R 1 W
R 1 E
T 17 N
T 16 N
T 15 N
T 14 N
T 13 N
DEL RIO SPRINGS
CHINO VALLEY
PRESCOTT MUNICIPAL AIRPORT
PRESCOTT VALLEY
PRESCOTT
DEWEY
HUMBOLDT
N
ARIZONA DEPARTMENT OF WATER RESOURCES
PRESCOTT AMA
ELEVATION OF THE BASE OF THE UPPER ALLUVIAL UNIT
CONTOUR INTERVAL = 200 FEET (MSL)
SCALE
2 1 0 1 2
MILES
LEGEND
AMA BOUNDARY
HIGHWAYS
SUB-BASIN BOUNDARY
BASEMENT UNIT
CONTOURS
MAP PRODUCED BY ADWR HYDROLOGY DIVISON – MODELING SECTION

FIGURE 5



N

ARIZONA DEPARTMENT OF WATER RESOURCES

PRESCOTT AMA

SATURATED THICKNESS OF THE UPPER ALLUVIAL UNIT AQUIFER IN 1994

CONTOUR INTERVAL = 100 FEET

SCALE

2 1 0 1 2

MILES

LEGEND

AMA BOUNDARY

THICKNESS CONTOUR

SUB-BASIN BOUNDARY

BASEMENT UNIT

MAP PRODUCED BY ADWR HYDROLOGY DIVISON - MODELING SECTION

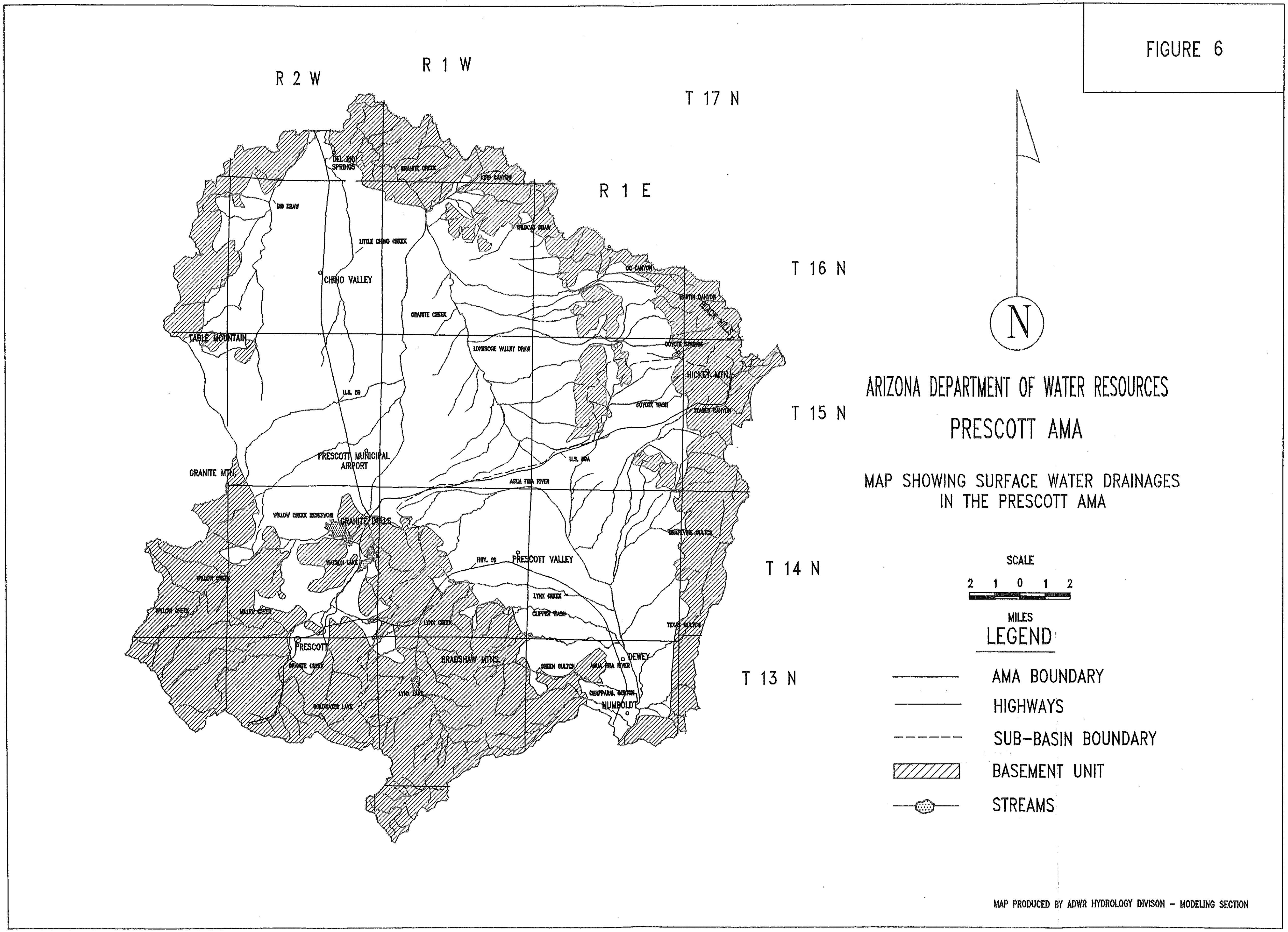


FIGURE 6
R 2 W
R 1 W
R 1 E
T 17 N
T 16 N
T 15 N
T 14 N
T 13 N
DEL RIO SPRINGS
GRANITE CREEK
KING CANYON
BIG DRAW
LITTLE CHINO CREEK
WILDCAT DRAW
CHINO VALLEY
OC CANYON
MARTIN CANYON
BLACK HILLS
TABLE MOUNTAIN
LONESOME VALLEY DRAW
COYOTE SPRINGS
HICKEY MTN.
U.S. 89
COYOTE WASH
PRESCOTT MUNICIPAL AIRPORT
GRANITE MTN.
U.S. 89A
AGUA FRIA RIVER
WILLOW CREEK RESERVOIR
GRANITE DELLS
WATSON LAKE
HWY. 69
PRESCOTT VALLEY
WILLOW CREEK
LYNX CREEK
CLIPPER WASH
PRESCOTT
BRADSHAW MTNS.
GREEN GULCH
DEWEY
LYNX LAKE
CHAPPARAL GULCH
HUMBOLDT
TEXAS GULCH
N
ARIZONA DEPARTMENT OF WATER RESOURCES
PRESCOTT AMA
MAP SHOWING SURFACE WATER DRAINAGES IN THE PRESCOTT AMA
SCALE
2 1 0 1 2
MILES
LEGEND
AMA BOUNDARY
HIGHWAYS
SUB-BASIN BOUNDARY
BASEMENT UNIT
STREAMS
MAP PRODUCED BY ADWR HYDROLOGY DIVISON - MODELING SECTION

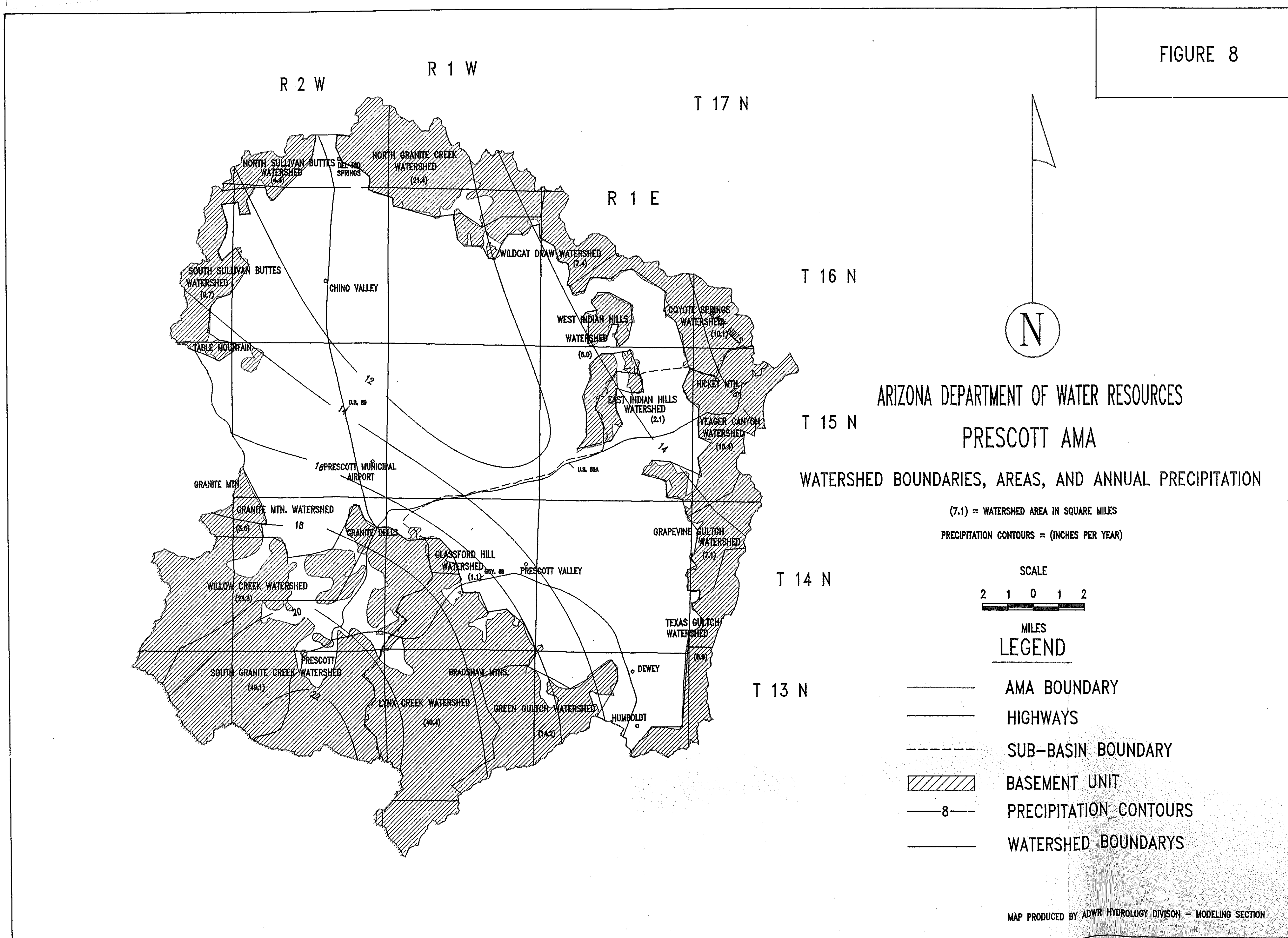
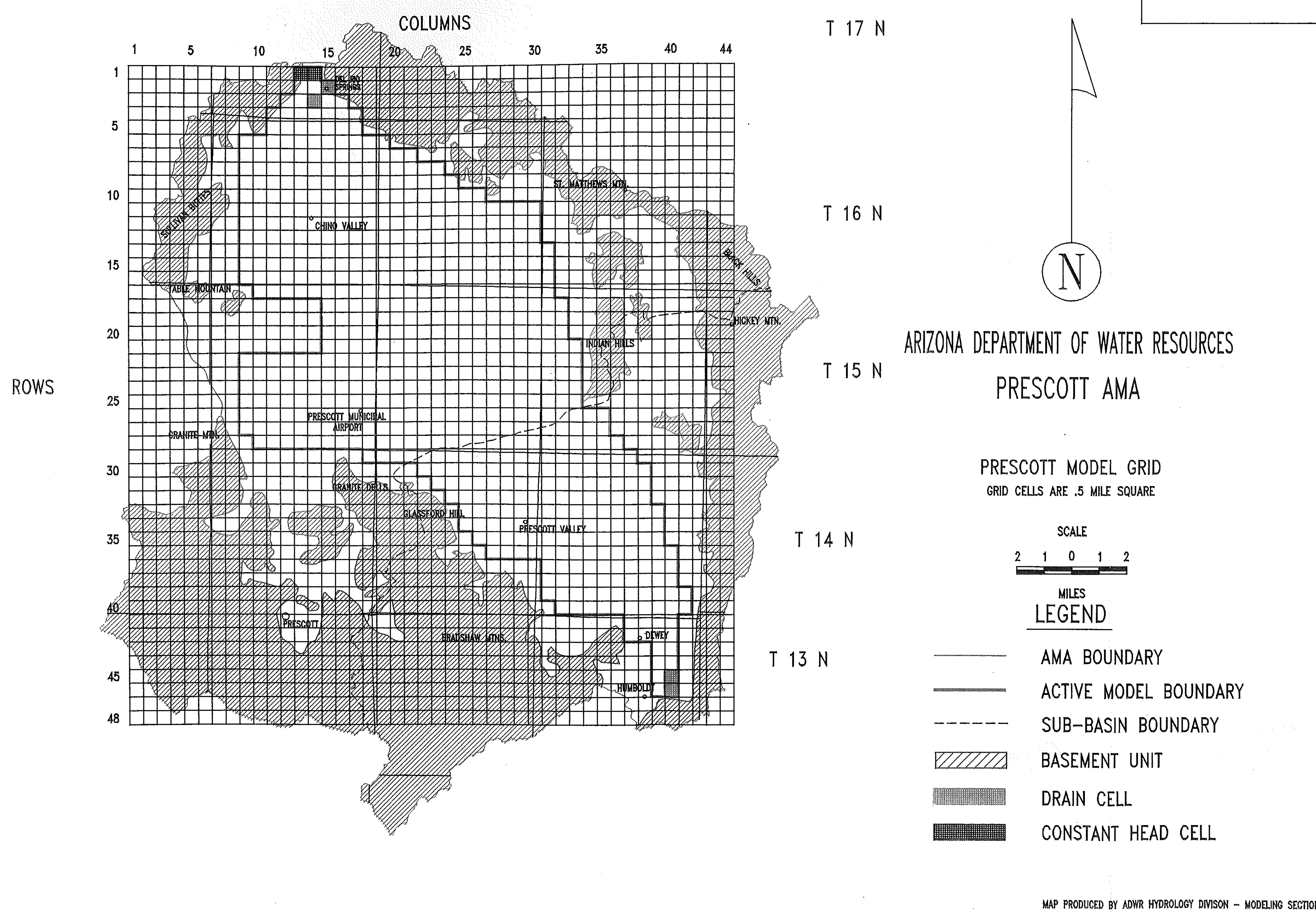
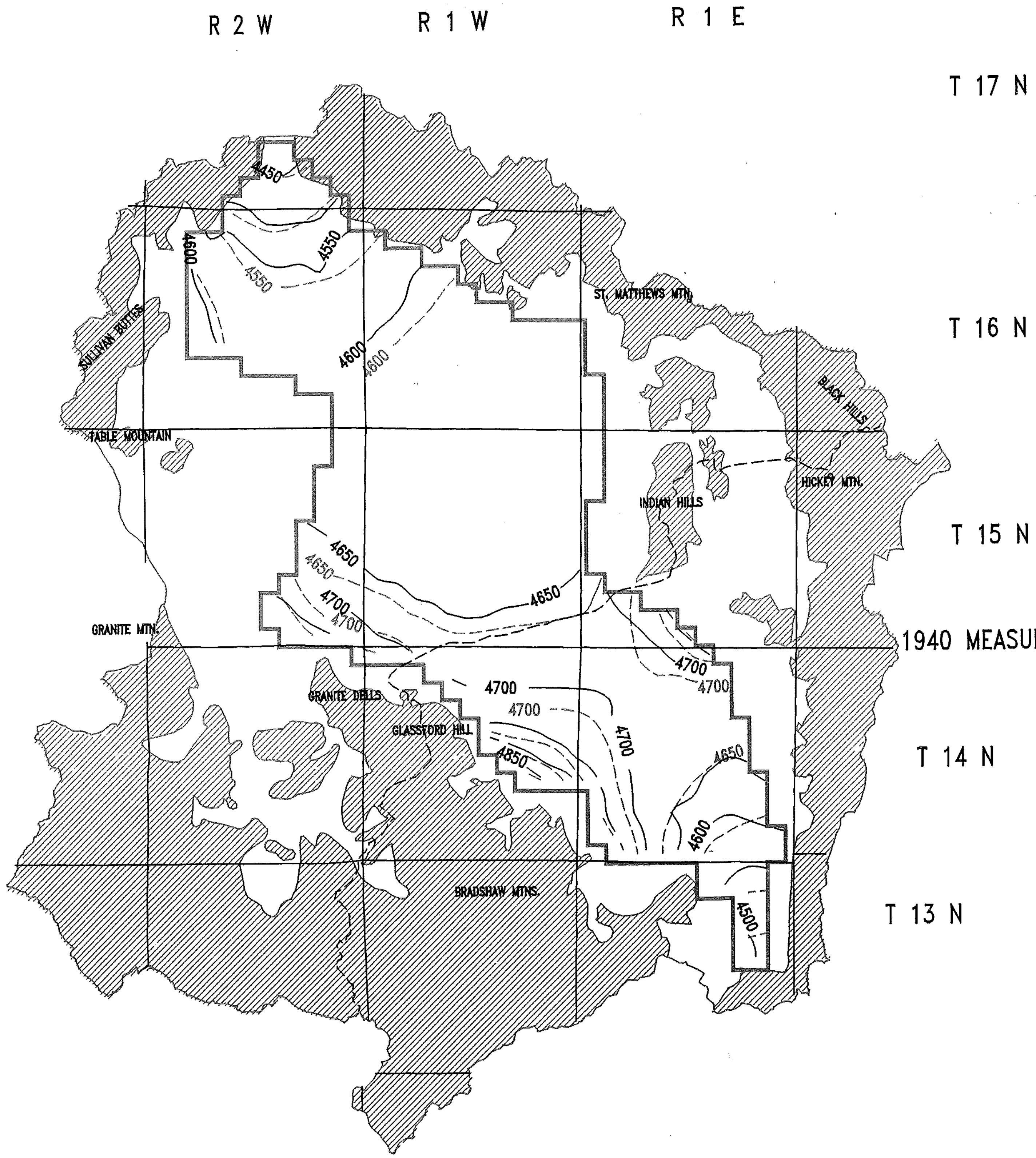


FIGURE 8
ARIZONA DEPARTMENT OF WATER RESOURCES
PRESCOTT AMA
WATERSHED BOUNDARIES, AREAS, AND ANNUAL PRECIPITATION
(7.1) = WATERSHED AREA IN SQUARE MILES
PRECIPITATION CONTOURS = (INCHES PER YEAR)
SCALE
2 1 0 1 2
MILES
LEGEND
AMA BOUNDARY
HIGHWAYS
SUB-BASIN BOUNDARY
BASEMENT UNIT
PRECIPITATION CONTOURS
WATERSHED BOUNDARYS
MAP PRODUCED BY ADWR HYDROLOGY DIVISON - MODELING SECTION
N
R 2 W
R 1 W
R 1 E
T 17 N
T 16 N
T 15 N
T 14 N
T 13 N
NORTH SULLIVAN BUTTES WATERSHED (4.4)
DEL RIO SPRINGS
NORTH GRANITE CREEK WATERSHED (21.4)
WILDCAT DRAW WATERSHED (7.4)
SOUTH SULLIVAN BUTTES WATERSHED (6.7)
CHINO VALLEY
TABLE MOUNTAIN
WEST INDIAN HILLS WATERSHED (6.0)
COYOTE SPRINGS WATERSHED (10.1)
HICKEY MTN.
EAST INDIAN HILLS WATERSHED (2.1)
YEAGER CANYON WATERSHED (15.4)
U.S. 89
U.S. 89A
PRESCOTT MUNICIPAL AIRPORT
GRANITE MTN.
GRANITE MTN. WATERSHED (3.6)
GRANITE DELLS
GLASSFORD HILL WATERSHED (1.1)
HWY. 69
PRESCOTT VALLEY
GRAPEVINE GULTCH WATERSHED (7.1)
WILLOW CREEK WATERSHED (23.3)
TEXAS GULTCH WATERSHED (6.9)
PRESCOTT
SOUTH GRANITE CREEK WATERSHED (40.1)
BRADSHAW MTNS.
DEWEY
LYNX CREEK WATERSHED (40.4)
GREEN GULTCH WATERSHED (14.2)
HUMBOLDT
12
14
16
18
20
22


R 2 W
R 1 W
R 1 E
COLUMNS
T 17 N
T 16 N
T 15 N
T 14 N
T 13 N
ROWS
DEL RIO SPRINGS
ST. MATTHEWS MTN.
SULLIVAN BUTTES
CHINO VALLEY
BLACK HILLS
TABLE MOUNTAIN
HICKEY MTN.
INDIAN HILLS
PRESCOTT MUNICIPAL AIRPORT
GRANITE MTN.
GRANITE DELLS
GLASSFORD HILL
PRESCOTT VALLEY
PRESCOTT
BRADSHAW MTNS.
DEWEY
HUMBOLDT
N
ARIZONA DEPARTMENT OF WATER RESOURCES
PRESCOTT AMA
PRESCOTT MODEL GRID
GRID CELLS ARE .5 MILE SQUARE
SCALE
2 1 0 1 2
MILES
LEGEND
AMA BOUNDARY
ACTIVE MODEL BOUNDARY
SUB-BASIN BOUNDARY
BASEMENT UNIT
DRAIN CELL
CONSTANT HEAD CELL
MAP PRODUCED BY ADWR HYDROLOGY DIVISON - MODELING SECTION



ARIZONA DEPARTMENT OF WATER RESOURCES

PRESCOTT AMA

1940 MEASURED AND SIMULATED UPPER ALLUVIAL UNIT WATER LEVELS

CONTOUR INTERVAL = 50 FEET (MSL)

SCALE

2 1 0 1 2

MILES

LEGEND

AMA BOUNDARY

ACTIVE MODEL BOUNDARY

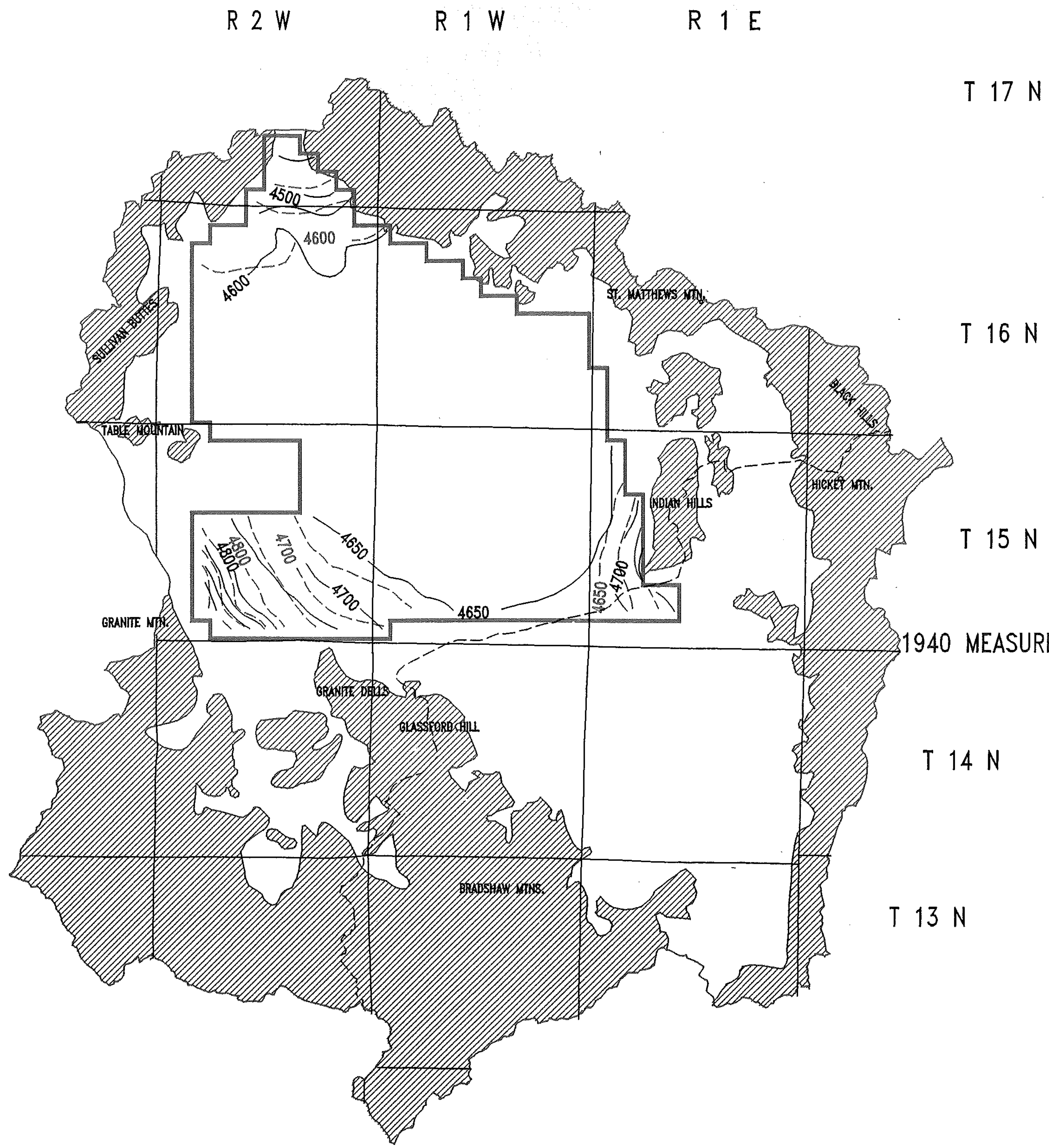
SUB-BASIN BOUNDARY

MEASURED WATER LEVEL CONTOUR

SIMULATED WATER LEVEL CONTOUR

MAP PRODUCED BY ADWR HYDROLOGY DIVISON – MODELING SECTION

FIGURE 14



ARIZONA DEPARTMENT OF WATER RESOURCES

PRESCOTT AMA

1940 MEASURED AND SIMULATED LOWER VOLCANIC UNIT WATER LEVELS

CONTOUR INTERVAL = 50 FEET (MSL)

SCALE

2 1 0 1 2

MILES

LEGEND

AMA BOUNDARY

ACTIVE MODEL BOUNDARY

SUB-BASIN BOUNDARY

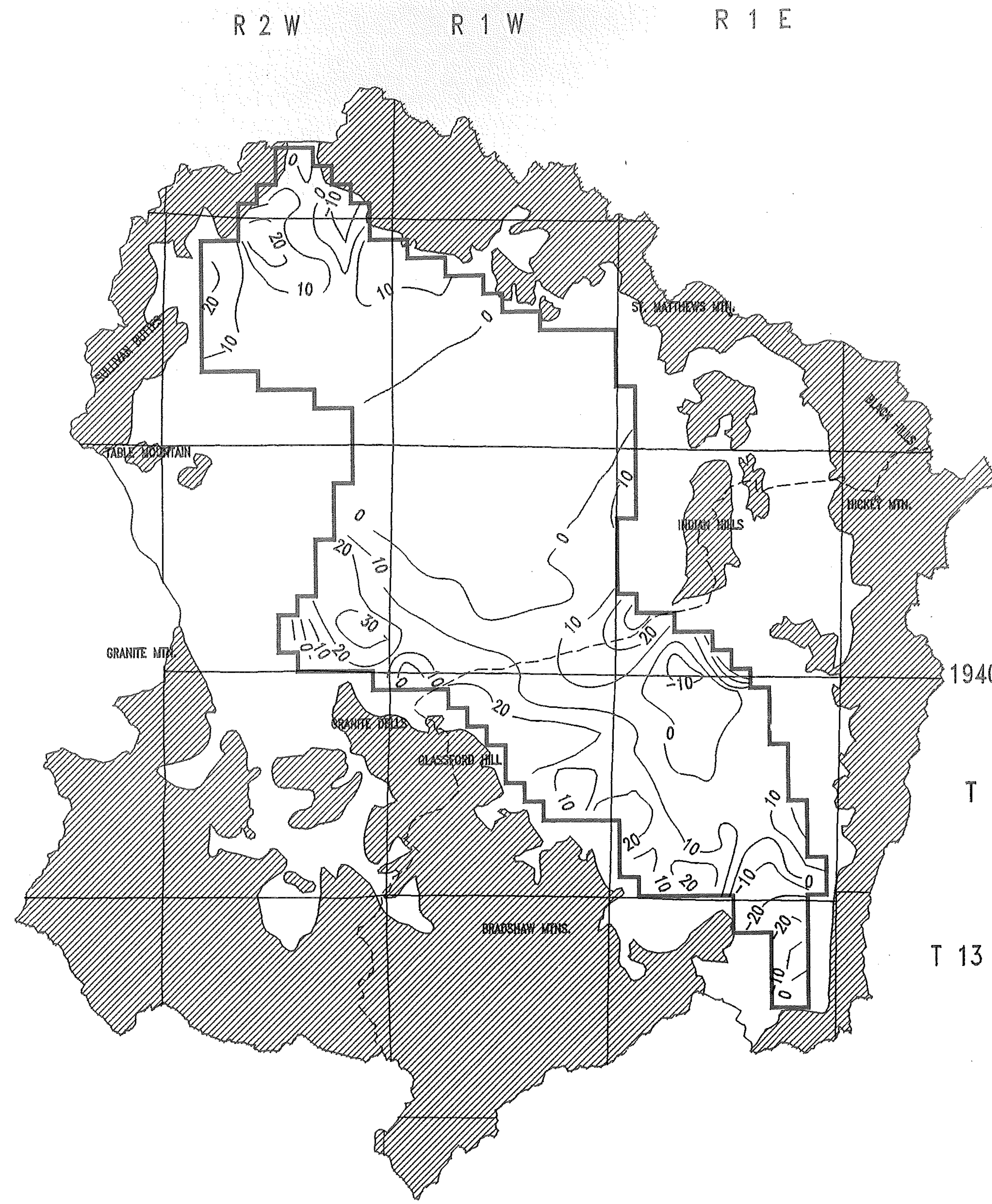
BASEMENT UNIT

MEASURED WATER LEVEL CONTOUR

SIMULATED WATER LEVEL CONTOUR

MAP PRODUCED BY ADWR HYDROLOGY DIVISON – MODELING SECTION

FIGURE 15



ARIZONA DEPARTMENT OF WATER RESOURCES

PRESCOTT AMA

1940 MEASURED MINUS SIMULATED UPPER ALLUVIAL UNIT WATER LEVELS
CONTOUR INTERVAL = 10 FEET

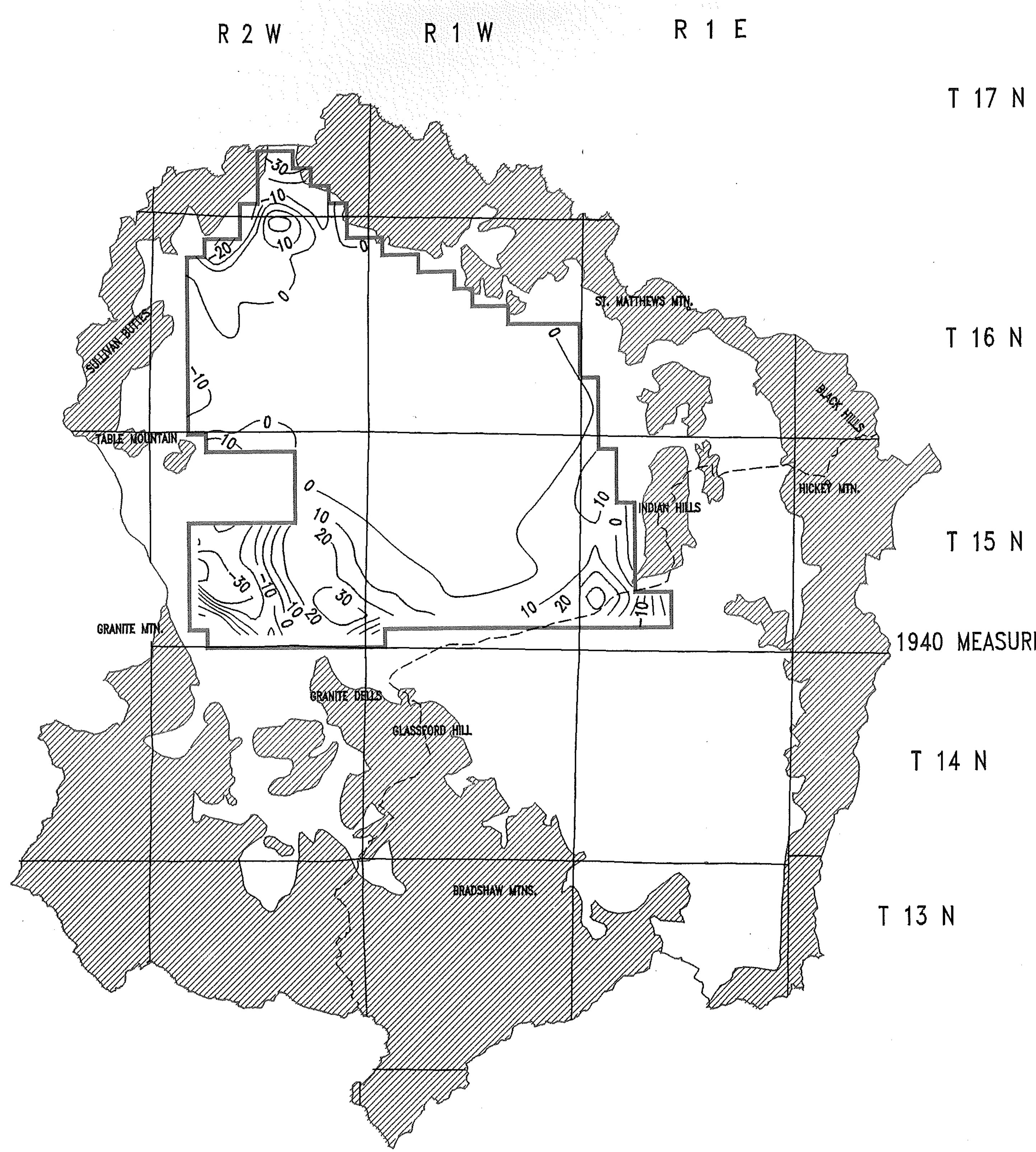
SCALE
2 1 0 1 2
MILES

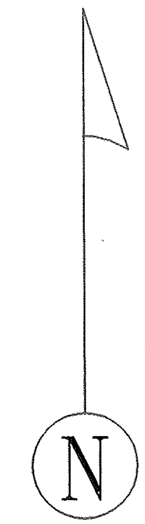
LEGEND

AMA BOUNDARY
ACTIVE MODEL BOUNDARY
SUB-BASIN BOUNDARY
BASEMENT UNIT
WATER LEVEL DIFFERENCE CONTOUR

MAP PRODUCED BY ADWR HYDROLOGY DIVISON – MODELING SECTION

FIGURE 16





ARIZONA DEPARTMENT OF WATER RESOURCES

PRESCOTT AMA

1940 MEASURED MINUS SIMULATED LOWER VOLCANIC UNIT WATER LEVELS

CONTOUR INTERVAL = 10 FEET

SCALE

2 1 0 1 2

MILES

LEGEND

AMA BOUNDARY

ACTIVE MODEL BOUNDARY

SUB-BASIN BOUNDARY

BASEMENT UNIT

WATER LEVEL DIFFERENCE CONTOUR

MAP PRODUCED BY ADWR HYDROLOGY DIVISON – MODELING SECTION

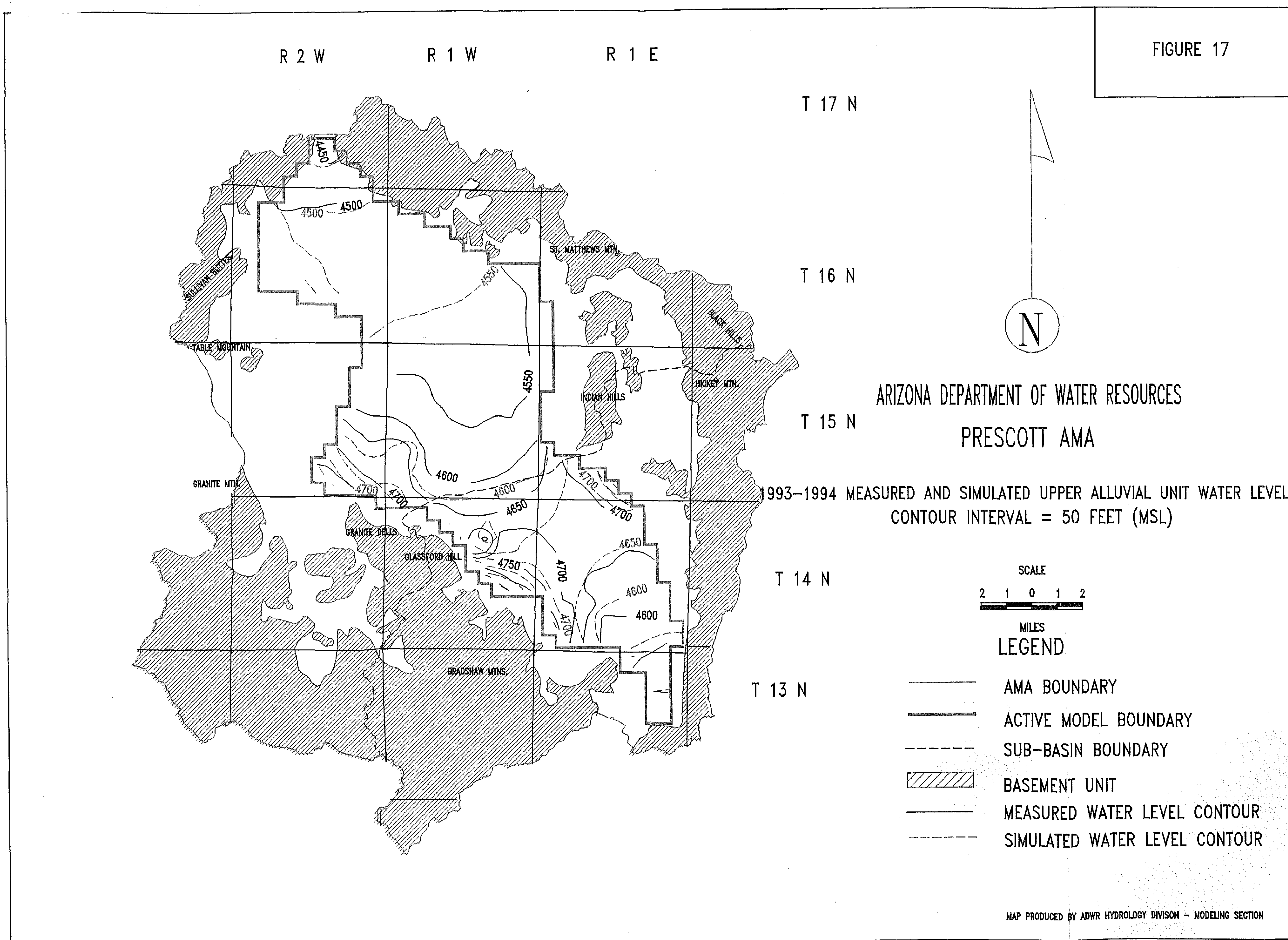
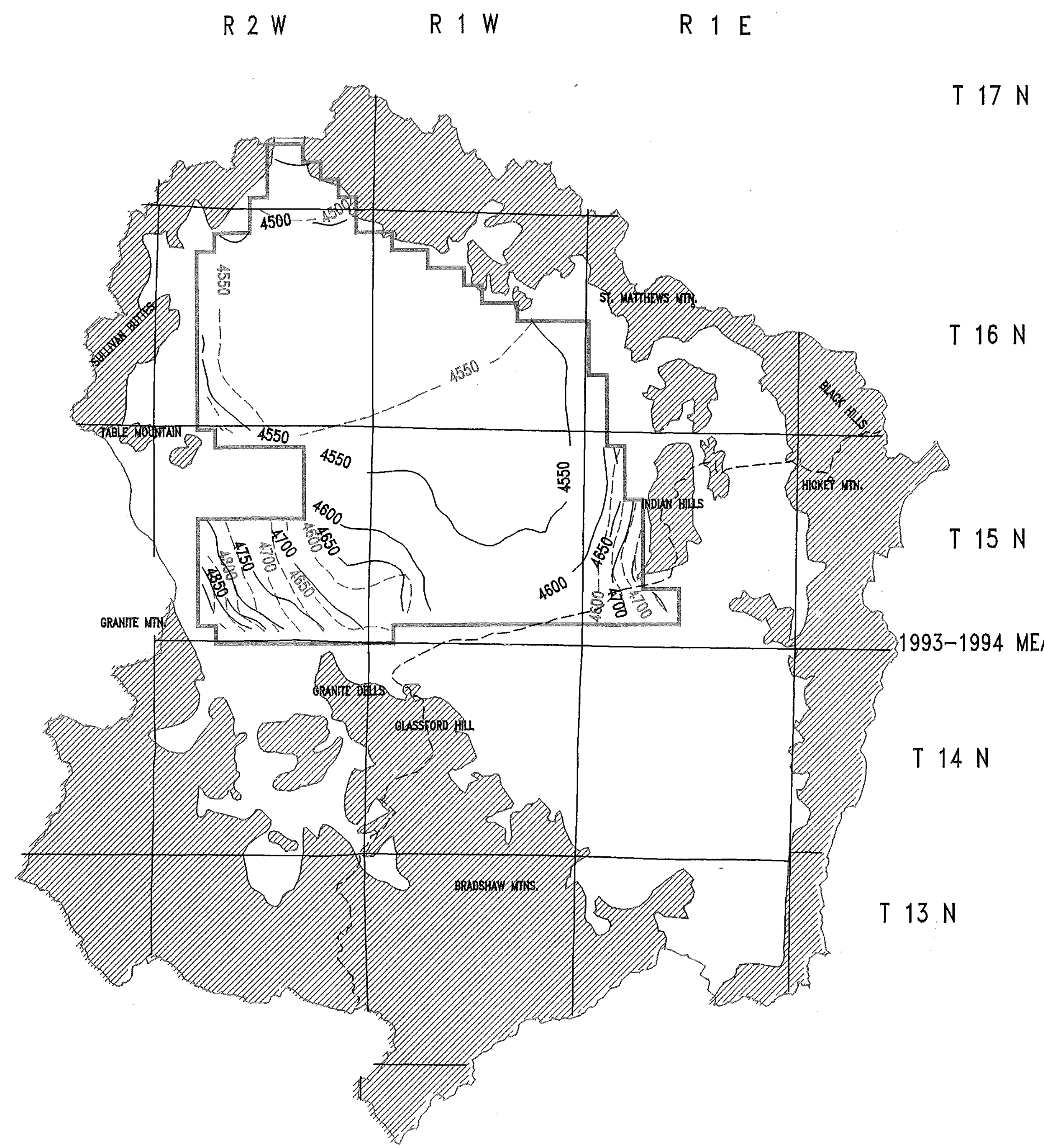


FIGURE 17
ARIZONA DEPARTMENT OF WATER RESOURCES
PRESCOTT AMA
1993-1994 MEASURED AND SIMULATED UPPER ALLUVIAL UNIT WATER LEVELS
CONTOUR INTERVAL = 50 FEET (MSL)
R 2 W
R 1 W
R 1 E
T 17 N
T 16 N
T 15 N
T 14 N
T 13 N
N
SULLIVAN BUTTES
TABLE MOUNTAIN
GRANITE MTN.
GRANITE DELLS
GLASSFORD HILL
BRADSHAW MTNS.
ST. MATTHEWS MTN.
BLACK HILLS
HICKEY MTN.
INDIAN HILLS
4450
4500
4550
4600
4650
4700
4750
SCALE
2 1 0 1 2
MILES
LEGEND
AMA BOUNDARY
ACTIVE MODEL BOUNDARY
SUB-BASIN BOUNDARY
BASEMENT UNIT
MEASURED WATER LEVEL CONTOUR
SIMULATED WATER LEVEL CONTOUR
MAP PRODUCED BY ADWR HYDROLOGY DIVISON - MODELING SECTION

FIGURE 18



ARIZONA DEPARTMENT OF WATER RESOURCES

PRESCOTT AMA

1993–1994 MEASURED AND SIMULATED LOWER VOLCANIC UNIT WATER LEVELS

CONTOUR INTERVAL = 50 FEET (MSL)

SCALE

2 1 0 1 2

MILES

LEGEND

- AMA BOUNDARY
- ACTIVE MODEL BOUNDARY
- SUB–BASIN BOUNDARY
- BASEMENT UNIT
- MEASURED WATER LEVEL CONTOUR
- SIMULATED WATER LEVEL CONTOUR

MAP PRODUCED BY ADWR HYDROLOGY DIVISON – MODELING SECTION

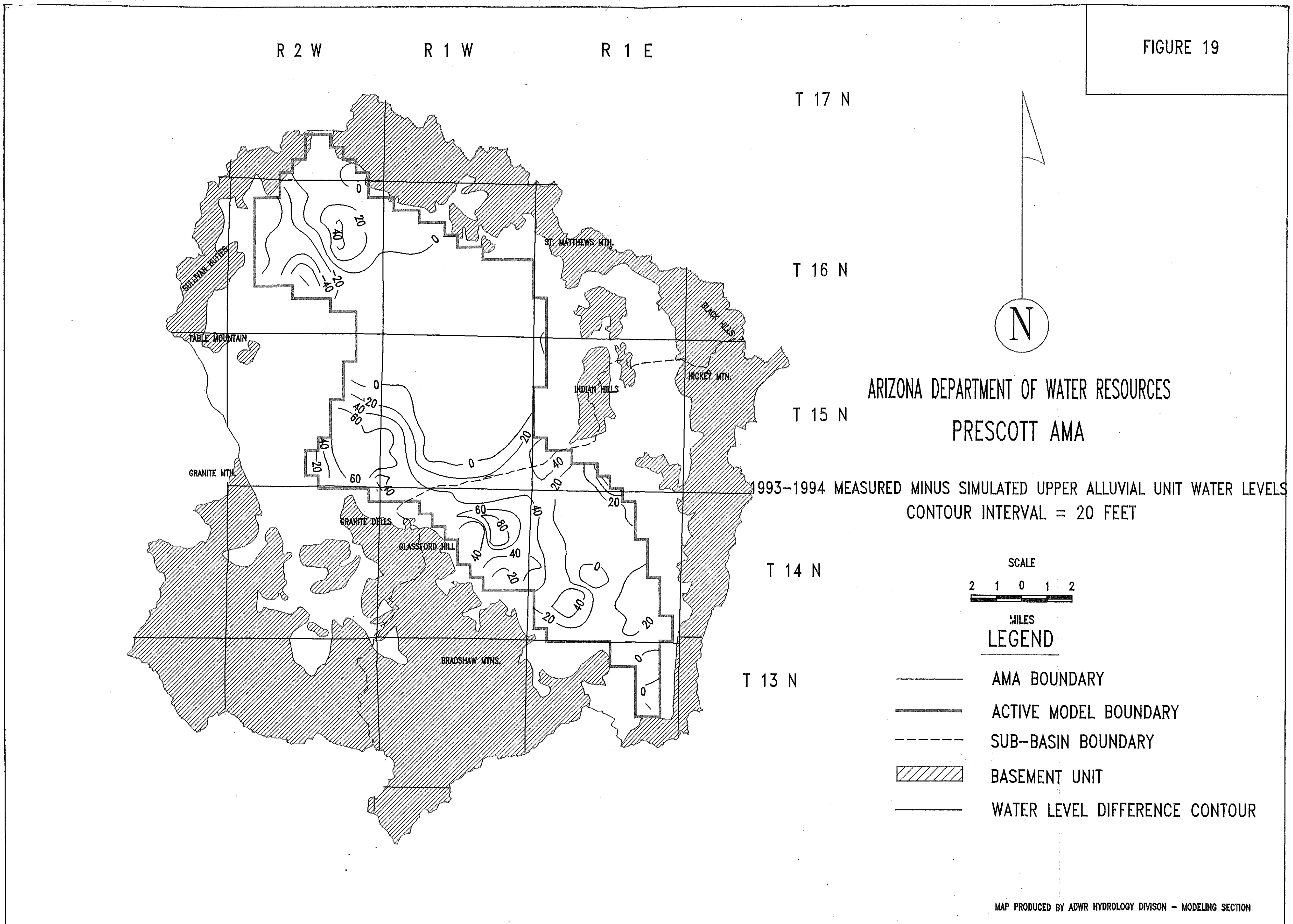
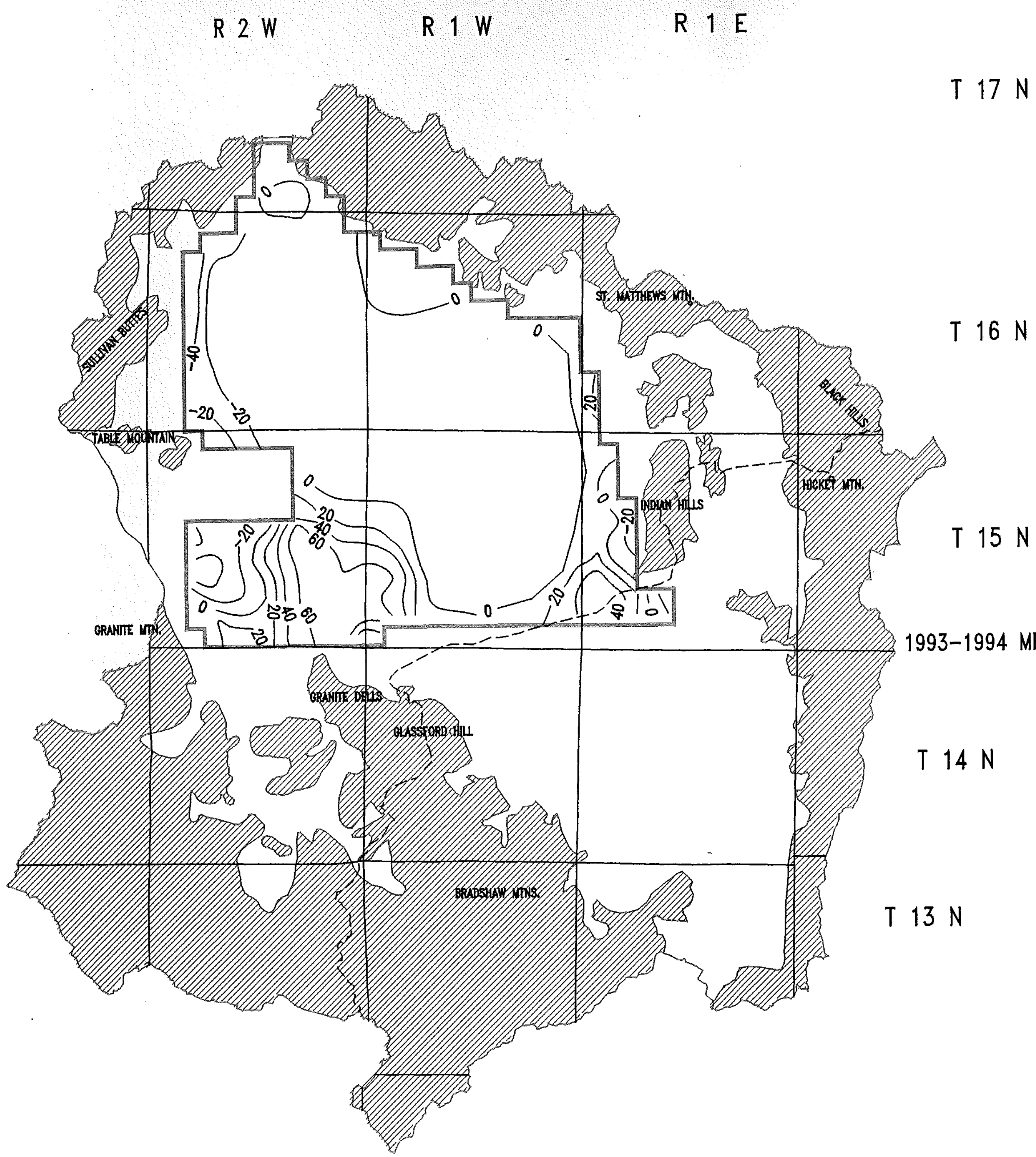


FIGURE 19
R 2 W
R 1 W
R 1 E
T 17 N
T 16 N
T 15 N
T 14 N
T 13 N
ST. MATTHEWS MTN.
SULLIVAN BUTTES
TABLE MOUNTAIN
BLACK HILLS
HICKEY MTN.
INDIAN HILLS
GRANITE MTN.
GRANITE DELLS
GLASSFORD HILL
BRADSHAW MTNS.
N
ARIZONA DEPARTMENT OF WATER RESOURCES
PRESCOTT AMA
1993–1994 MEASURED MINUS SIMULATED UPPER ALLUVIAL UNIT WATER LEVELS
CONTOUR INTERVAL = 20 FEET
SCALE
2 1 0 1 2
MILES
LEGEND
AMA BOUNDARY
ACTIVE MODEL BOUNDARY
SUB-BASIN BOUNDARY
BASEMENT UNIT
WATER LEVEL DIFFERENCE CONTOUR
MAP PRODUCED BY ADWR HYDROLOGY DIVISON – MODELING SECTION

FIGURE 20



N

ARIZONA DEPARTMENT OF WATER RESOURCES

PRESCOTT AMA

1993–1994 MEASURED MINUS SIMULATED LOWER VOLCANIC UNIT WATER LEVELS
CONTOUR INTERVAL = 20 FEET

SCALE

2 1 0 1 2

MILES

LEGEND

AMA BOUNDARY

ACTIVE MODEL BOUNDARY

SUB-BASIN BOUNDARY

BASEMENT UNIT

WATER LEVEL DIFFERENCE CONTOUR

MAP PRODUCED BY ADWR HYDROLOGY DIVISON – MODELING SECTION

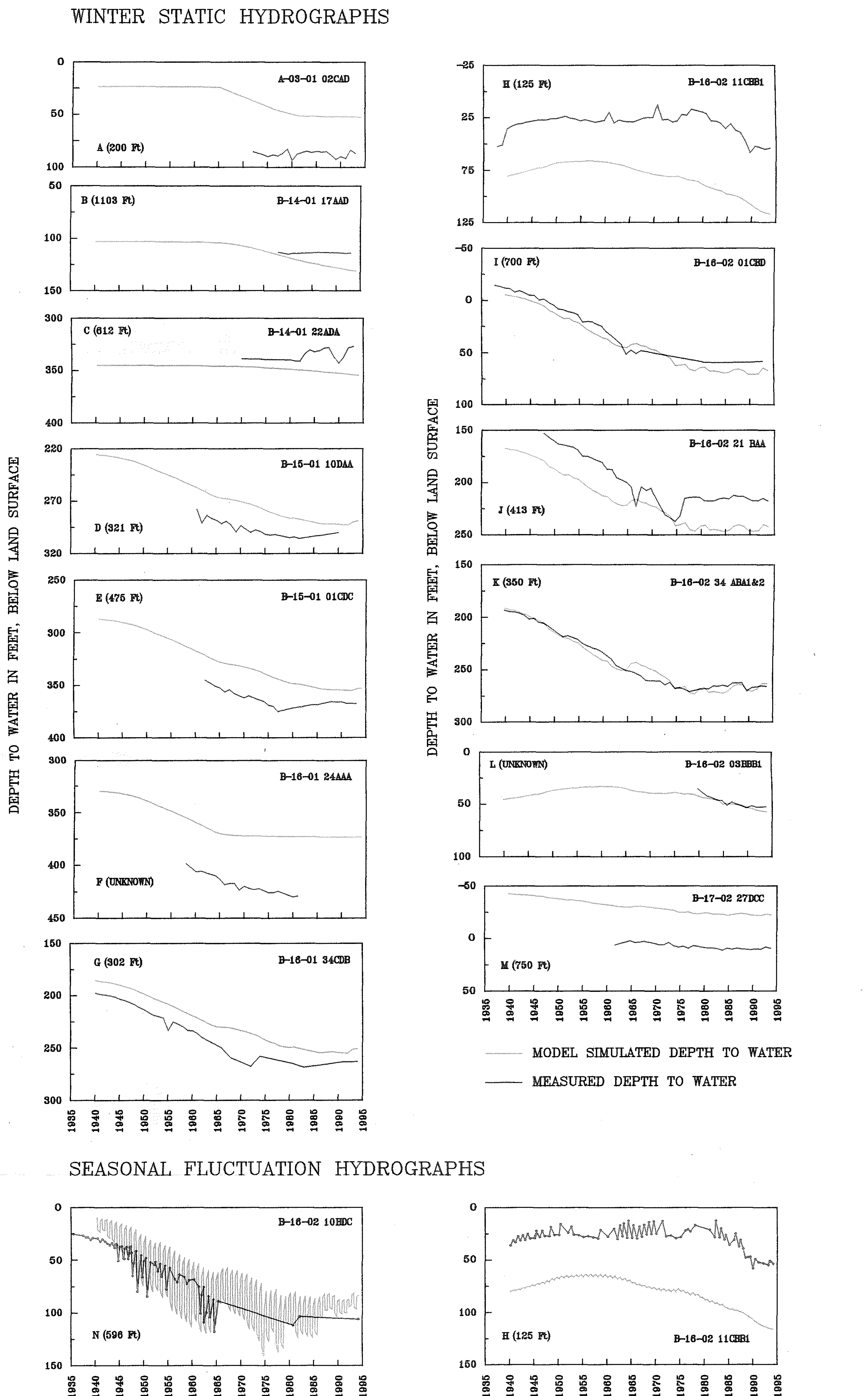


FIGURE 21. MEASURED AND SIMULATED DEPTH TO WATER IN SELECTED WELLS IN THE MODEL AREA.