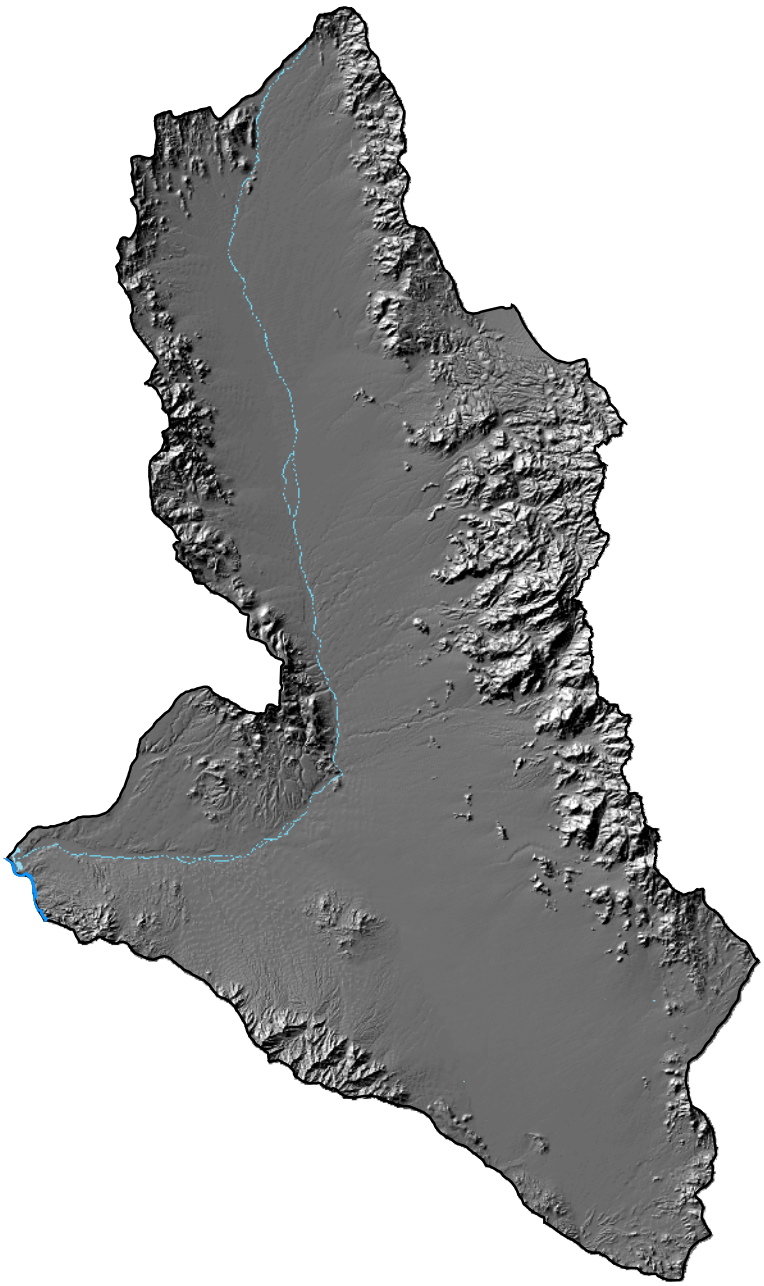
Arizona Department of Water Resources
Hydrology Division



Preliminary Estimate of Groundwater in Storage for the Sacramento Valley Groundwater Basin, Mohave County, Arizona

Open-File Report Number 10

March 2008

By Brian D. Conway and Paul A. Ivanich

Table of Contents

List of Figures ii
List of Tables ii
Acknowledgements iii
Abstract 1
Introduction 1
Purpose and Scope 1
Depth-to-Bedrock Methodology 3
Existing Gravity Data 3
GPS Data Collection 3
Gravity Data Collection 4
Gravity Reduction 5
Terrain Correction and Curvature Correction 6
Residual Anomaly 6
Gravity Modeling 7
Well Data 8
Depth-to-Bedrock Discussion and Results 9
Groundwater Storage Calculation Methodology 10
Land Surface Elevation 10
Groundwater-level Surface Elevation 10
Depth-to-Bedrock Surface 10
Saturated Alluvial Sediments 11
Storage Calculations 11
Groundwater Storage Discussion and Results 11
Summary 12
Selected References 27
Appendix A – GPS Results A-1
Appendix B – Gravity Results B-1

List of Figures

Figure 1. Sacramento Valley Groundwater Basin overview 17
Figure 2. Gravity points 18
Figure 3. Complete Bouguer Anomaly (CBA) 19
Figure 4. Regional Anomaly 20
Figure 5. Residual Anomaly 21
Figure 6. GM-SYS modeling profiles 22
Figure 7. GM-SYS cross-section Sac12 23
Figure 8. Depth-to-Bedrock 24
Figure 9. Depth-to-Bedrock comparison to Oppenheimer and Sumner (1980) 25
Figure 10. 2006 Water level elevation map with selected data points 26

List of Tables

Table 1. Estimated volume of recoverable groundwater 12
Table 2. Potential recoverable groundwater in storage 13
Table 3. Appendix A – GPS Results A-1
Table 4. Appendix B – Gravity Results B-1

Acknowledgements

This Open-File Report was completed with the help of many individuals who contributed data, helped with the data analysis, or provided editorial help and suggestions. Contributors include, but are not limited to, Frank Corkhill and Dale Mason of the ADWR Hydrology Division who offered editorial suggestions and Maurice Tatlow, who reviewed the gravity section of this report. Michael Winn aided in gravity data collection and Rachel Henderson gathered and interpreted well logs and constructed GIS coverages. The ADWR Basic Data Unit collected groundwater level data for the wells in Mohave County. Bill Remick provided assistance with water level elevation data. We also thank the Arizona Geological Survey and the United Stated Geological Survey for their reviews of this report and their suggestions.

The help provided by these individuals and all those not listed is deeply appreciated.

Abstract

ADWR collected gravity and groundwater level data in 2006 to calculate the water in storage volume in the Sacramento Valley Groundwater Basin. ADWR collected 316 new gravity measurements to produce a depth-to-bedrock model for the basin, which updates the Oppenheimner and Sumner (1980) model. Groundwater levels collected from 167 wells (historical and collected in 2006) were used to create a water-level elevation map. The groundwater-level data were combined with the depth-to-bedrock model to update the ADWR water in storage volume for the Sacramento Valley Groundwater Basin, which is similar to previous estimates.

Introduction

The Sacramento Valley Groundwater Basin is located in northwestern Arizona in Mohave County. The central portions of Mohave County, Arizona are expected to undergo rapid residential development in the near future. The areas expected to undergo development include the Detrital Valley, Hualapai Valley, and Sacramento Valley groundwater basins. The projected development in northern Mohave County has created a need for updated information about the region's water resources. To update and improve the groundwater data available for northern Mohave County, the Arizona Department of Water Resources (ADWR) started a series of water-resource investigations in the Fall of 2005 focusing on the Detrital Valley, Hualapai Valley, and Sacramento Valley groundwater basins. This is the second (ADWR OFR #9 published December 2006) in a series of preliminary reports on the water resources of the northern Mohave County and examines the estimated groundwater in storage for a selected study area within the alluvial portion of the Sacramento Valley Groundwater Basin (Figure 1). To update and improve the groundwater data available for the Sacramento Valley Groundwater Basin, ADWR conducted a basin-wide water-level sweep and a detailed gravity survey of the basin in the Spring and Summer of 2006.

This open-file report is intended to present a preliminary estimate of groundwater in storage in the Sacramento Valley Groundwater Basin, and was undertaken to meet ADWR's immediate need for a more refined estimate of groundwater availability for the Assured and Adequate Water Supply Program (AWS). The fieldwork undertaken for this report also supports a more extensive regional study of the Sacramento Valley Groundwater Basin being conducted by the United States Geological Survey (USGS) on behalf of ADWR and Mohave County. The results of the USGS study are expected to supplant the estimate made in this report. A description of the hydrogeology of the Sacramento Valley Groundwater Basin can be found in Gillespie and Bentley (1971) and Rascona (1991).

Purpose and Scope

An important outcome of this investigation is to generate a current estimate of the amount of groundwater in storage for the Sacramento Valley Groundwater Basin. Estimating the amount of groundwater in storage to 1,200 feet below land surface (bls) is important to assist in evaluating the groundwater resources available in the basin for the AWS Program. Previous estimates of groundwater in storage to 1,200 feet bls for the Sacramento Valley Groundwater Basin are approximately 8 million acre-feet (Freethey and Anderson, 1986; ADWR, 1988). As described later

in this report, ADWR used water-level data and depth-to-bedrock data to make a new estimate of the amount of groundwater in storage to 1,200 feet bls in the Sacramento Valley Groundwater Basin. Additional storage estimates were also generated for 1,500 feet bls, and 2,000 feet bls.

Depth-to-Bedrock Methodology

Gravity surveying is a common and well-established geophysical technique for estimating depth-to-bedrock in the alluvium-filled basins of Arizona. This technique requires that a lateral density variation exits in the shallow subsurface across a basin, and assumes that this density variation is caused by bedrock having a higher density than the alluvium filling the basin. The varying thickness of alluvium causes the lateral variations in gravity. This situation exists in the Sacramento Valley of northwestern Arizona. However, to properly employ this geophysical technique, a large number of relative gravity data measurements must exist throughout the basin and within the bedrock areas surrounding the basin. This was not the case in the Sacramento Valley prior to ADWR's gravity data acquisition.

The primary purpose of ADWR's gravity survey work was to acquire new relative gravity measurements in areas where no measurements previously existed, or where the spatial density of previous measurements was low. The goal of this effort was to create a database of relative gravity measurements, sufficient in number and extent, so that a useful depth-to-bedrock model could be created.

ADWR established 316 new gravity stations during 11 days of surveying in August and September 2006. One additional field day was used for completing gravity base station ties. Gravity data were collected at one-mile intervals along existing roads and passable 4x4 trails (Figure 2). This resulted in a generally evenly spaced grid in most of the basin. To optimize data collection, data were not collected in areas where previously established gravity data existed.

Existing Gravity Data

Previously collected gravity data were obtained from the Pan-American Center for Earth and Environmental Studies (PACES) (Figure 2). PACES contains a gravity dataset collected from multiple sources and is available online at http://paces.geo.utep.edu. There were 6,144 useful gravity points in the PACES database for the Sacramento, Detrital and Hualapai Valley Groundwater Basins. Of those, 1,488 gravity points were within the Sacramento Valley Groundwater Basin. A quality check was performed on the PACES data and a small number of gravity points were removed that had obviously erroneous gravity values. A comparison was made between the newly collected data and the PACES gravity data to account for any possible bias in the data, which could come from datum differences, different reduction equations, or other causes. The PACES data compared well with the ADWR data, so no data shifts were performed.

GPS Data Collection

Post-Processed Kinematic (PPK) surveying was used to collect accurate horizontal and vertical coordinates for each ADWR gravity station. Trimble 4800 and Trimble R8 GNSS GPS receivers were used for the survey. The PPK base station (ADOT) was set up at the southwest corner of the Arizona Department of Transportation Kingman Maintenance Shop on Andy Devine Road, and was used throughout the survey. The position of ADOT was established by performing a network adjustment of the processed baselines between the Kingman Continuously Operating Reference

Station (CORS) and an all day occupation of Q262 (a first order horizontal/vertical and fourth order ellipsoid control point). The position was confirmed using the National Geodetic Survey's Online Positioning User Service (OPUS). This service uses simultaneous data recorded at the three closest CORS stations and the base station to perform a network adjustment and derive new coordinates for the base station.

Each gravity point was surveyed for a minimum of sixty seconds using the rover receivers. These GPS occupations were post-processed using Trimble Geomatics Office v. 1.63, holding the derived coordinates fixed for the PPK base station ADOT (Appendix A). The reported instrument error for PPK surveying is:

- Horizontal
  - 1 cm + 2 ppm (times baseline length ≤ 10 km)
  - 2 cm + 1 ppm (times baseline length ≥ 10 km)
- Vertical:
  - 2 cm + 1 ppm (times baseline length)

Based on this reported error (Trimble 4800 and R8 GNSS datasheets), the maximum horizontal and vertical errors are 11.2 centimeters (for the longest baseline, which is 92 km). Station B391 (an NGS monument) had a baseline of 50 km, and the observed vertical elevation difference was -0.011 m from the NGS published vertical elevation. The point data are in UTM NAD83 Zone 12N, and NAVD88 elevations were estimated using GEOID03.

Gravity Data Collection

Gravity data were collected using ADWR's Scintrex CG-3M Autograv relative gravity meters (gravimeters), numbers 711395 and 411. The gravity measurements were collected in conjunction with GPS measurements. Stations were placed in areas that were relatively flat whenever possible in order to minimize near-zone terrain effects.

A standardized procedure was used at each gravity station. The gravimeter was placed over or directly next to the GPS point and rough level was acquired, the gravimeter was then allowed to stabilize for one minute, during which exact level was established, and finally, a one-minute reading was recorded. At some points, more than one reading was taken due to excessive disturbance to the gravimeter during transportation or to check the stability of the measurement (such as at a base station).

A standard gravity looping procedure was used for gravity data collection. A measurement was taken at a local base station to start and end each day. Secondary base stations were established if necessary to account for instrument drift. Several stations (other than secondary bases) had multiple measurements on different days. They show errors ranging from 0.002 mgal to 0.071 mgal, with an average of 0.017 mgal.

The local base stations were tied to an absolute gravity excenter station named Dolan Springs CA located at Mount Tipton School, 16500 Pierce Ferry Rd, Dolan Springs, AZ 86441. The gravity value at Dolan Springs CA is 979,446.531 mGal (Daniel Winester, Geodesist, NOAA – NOS – National Geodetic Survey, electronic communication).

Gravity Reduction

Gravity data must be corrected for tidal effects and instrument drift, and adjusted to a reference value. The Tide Correction is automatically calculated and applied by the gravimeter using the Longman (1959) formula. Gravity values within a loop are corrected for drift using the following equations:

$$\Delta d / \Delta t = \left(r_{base2} - r_{base1}\right) / \left(t_2 - t_1\right) \qquad (1)$$

where $\Delta d/\Delta t$ is the drift rate, t_1 is the time of the first reading (r_{base1}) at the base station and t_2 is the time for the second reading (r_{base2}) at the same base station. The drift-corrected value for each station within the loop is given by:

$$\text{drift-corrected value} = r_{station} - \left(\Delta d / \Delta t\right)\left(t - t_1\right) \qquad (2)$$

where $r_{station}$ is the uncorrected gravity value at a station and t is the time of the reading. The drift-corrected value is converted to an observed gravity value (g_{obs}) using the base ties to Dolan Springs CA.

After corrections to the gravity data are made, the data are reduced using standard procedures. The corrections required are the latitude correction, the free-air correction, the Bouguer correction, and the terrain and curvature corrections.

The normal gravity (g_n) is calculated using the 1967 International Gravity Formula (Sharma, 1997),

$$g_n = 978{,}031.85\left(1 + 0.0053024 \sin^2 \lambda - 0.0000059 \sin^2 2\lambda\right) \text{ mGal} \qquad (3)$$

where λ is the latitude established during the PPK GPS survey.

The Free Air Correction (C_F) is:

$$C_F = 0.3086h \text{ mGal} \qquad (4)$$

where h is the elevation in meters established during the PPK GPS survey and with mean sea-level as zero elevation.

The Bouguer Correction (C_B) is:

$$C_B = 0.04193\rho h \text{ mGal} \qquad (5)$$

using a density (ρ) of 2.67g/cm^3 (grams per cubic centimeter) to represent the average density of crustal rock (granitic composition).

The three corrections shown above are combined with the observed gravity value to produce the Simple Bouguer Anomaly (SBA):

$$SBA = g_{obs} - g_n + C_F - C_B \tag{6}$$

Terrain Correction and Curvature Correction

Software developed by Cogbill (2000) was used to calculate Terrain Corrections (TCs) and Curvature Corrections (CCs) for each station (software licensed by Geophysical Software, available at geopotential.com). The two main programs used in the Geopotential suite were RasterTC and OuterTC.

RasterTC uses a user-defined terrain model to calculate terrain corrections within a few kilometers of a station. A seamless combination of 10-meter USGS Digital Elevation Models (DEMs) downloaded from seamless.usgs.gov was used in the model. RasterTC was used to calculate the terrain correction from an inner radius of 5 m to an outer radius of 2 km.

OuterTC, developed by Plouff (1966) and modified by Cogbill (2000), was used to calculate the rest of the terrain correction from 2 km to 166.7 km (following Nowell, 1999). A coarser United States topography dataset was used for OuterTC (usterrain.dat, downloaded from geopotential.com). OuterTC also calculated the Curvature Correction for each gravity station.

A reduction density of 2.67 g/cm^3 (corresponding to crystalline crustal rock) was used for both RasterTC and OuterTC. The Total Terrain Correction (TTC) is the sum of the corrections obtained from each program (RasterTC + OuterTC). The TTC in the study area ranges from 0.253 – 3.726 mGal, with an average of 0.801 mGal.

The station elevations established during the PPK GPS surveys were not used in the RasterTC and OuterTC processes. Instead, the terrain model (seamless 10m DEMs for RasterTC and usterrain.dat for OuterTC) elevations at the LAT/LONG of each station were used. This ensures that variations in the terrain model elevations versus the PPK GPS elevations do not degrade the TTC calculation.

Residual Anomaly

Summing the Simple Bouguer Anomaly with the Terrain Correction and the Curvature Correction gives the Complete Bouguer Anomaly (*CBA*):

$$CBA = SBA + TTC - CC \tag{7}$$

The CBA is a representation of lateral density variations in the subsurface (Figure 3). These density variations could be due to shallow sources (such as alluvial basins, salt or ore deposits, or the presence of different types of rocks) or deep-rooted sources (such as variations in crustal thickness). Regionally, the CBA dips to the east in the Sacramento Valley Groundwater Basin. This variation

corresponds to the general thickening of the crust towards the Colorado Plateau from the relatively thin crust of the Basin and Range.

In order to model features such as basins, the regional gravity trend must first be removed (Figure 4). This yields a Residual Anomaly that represents the gravitational field of the near-surface, small-scale features of interest. It is obtained by subtracting the Regional Anomaly from the CBA:

$$\textit{Residual Anomaly} = \textit{CBA} - \textit{Regional Anomaly} \qquad (8)$$

The Residual Anomaly (Figure 5) represents the gravity anomaly produced by near-surface geology and is used to model depth-to-bedrock.

The best Regional Anomaly is one that accounts for the known geology of an area. The Regional Anomaly was produced by determining CBA values at bedrock points throughout the study area. These points were gridded using Surfer's™ minimum curvature technique to produce the Regional Anomaly (Figure 4). This method has the effect of accounting for both large-scale geologic features such as crustal thickness as well as density variations of the bedrock in the study area.

Gravity Modeling

GM-SYS (Northwest Geophysical Associates, Inc., 2002) was used to model the residual anomaly. GM-SYS is a 2-D gravity modeling program, meaning the models extend to infinity in the ±Y directions (X is the horizontal dimension along the model profile and Z is the vertical dimension). The program allows manipulation of a geologic model to fit the observed gravity data.

Thirty-six profiles were modeled through the study area, which start and end on bedrock (Figure 6). The bedrock boundary was determined using a geologic map (Richard et al., 2000) along with a shaded-relief map of the basin. The profiles intersect residual minimums and other areas of interest. Most profiles are perpendicular to the residual anomaly trend rather than exactly east-west or north-south across the basin.

For all profiles, three layers were modeled for the depth-to-bedrock interpretation. The layers included a bedrock layer, an unsaturated alluvial layer, and a saturated alluvial layer (Figure 7). A density of 2.0 g/cm^3 (a density contrast of 0.67 g/cm^3) was used for the unsaturated alluvium and a density of 2.25 g/cm^3 was used for the saturated alluvium layer (a density contrast of 0.42 g/cm^3). The typical density of 2.67 g/cm^3 was used for bedrock. Densities of 2.0 g/cm^3 for unsaturated alluvium and 2.25 g/cm^3 for saturated alluvium both represent a porosity of approximately 0.25 assuming an average clast density of 2.67 g/cm^3.

Reynolds (1997) reports the average textbook density of unsaturated alluvium as 2.0 g/cm^3. Assuming the same porosity for the saturated alluvium yields a density of 2.25 g/cm^3. Density data from other basins in Arizona are similar to these values. A density log from the TranAm Energy Red Lake Test #1 (B-26-16 16AAA), drilled in the Hualapai Valley basin, shows the average density for unsaturated alluvium as 2.05 g/cm^3. A density log for well B-26-16 22CCC, also in the Hualapai Valley basin, shows the density increasing from approximately 1.85 g/cm^3 near the surface to 2.0

g/cm^3 at 300 feet below land surface (bls). Its shows an average density of 2.0 g/cm^3 from 300 to approximately 1200 feet bls, and increases from approximately 2.0 g/cm^3 at 1200 feet bls to 2.25 g/cm^3 at 1600 feet bls. Another density log from the Hualapai Valley basin (Southwest Energy Red Lake # 1D – B-27-17 13DB) shows the average density of saturated alluvium as 2.25 g/cm^3. Eaton et al. (1972) reported an average unsaturated alluvium density of 2.1 g/cm^3 and a saturated alluvium density of 2.2 g/cm^3 for a well west of Phoenix, based on a density log. Tucci et al. (1982) used borehole gravity in six wells in four basins in central and southern Arizona and found densities ranging from 1.73 to 2.26 g/cm^3 for unsaturated alluvium and densities ranging from 2.01 to 2.46 g/cm^3 for saturated alluvium. Pool et al. (2001) described three alluvial facies in the Picacho Basin and their associated densities. The density of the upper unit ranges from 1.9 to 2.1 g/cm^3, the middle unit ranges from 2.1 to 2.3 g/cm^3 and the lower unit ranges from 2.3 to 2.5 g/cm^3.

The 2-D gravity models were combined to produce a depth-to-bedrock contour map of the study area. The depth-to-bedrock map (Figure 8) was gridded using minimum curvature with a grid spacing of 1,640 ft (500m).

The following steps were used to create the depth-to-bedrock map from the residual anomaly:

- Create profiles through the residual anomaly and obtain residual values along each profile.
- Input the residual anomaly into GM-SYS and construct gravity models.
- Convert the profile distance and depth data from GM-SYS into UTM coordinates.
- Grid the UTM profile coordinates with the depth-to-bedrock data.

Gravity modeling does not provide a unique solution to an observed gravity field. Many combinations of geologic conditions, such as differing combinations of geologic unit thicknesses and densities, can produce the same gravity response. To reduce the number of possible viable models, the known geologic conditions must be taken into account. This was done by first choosing a regional anomaly that accounts for both crustal-scale geologic features and smaller-scale density variations, producing a residual gravity anomaly that is the result of the density difference between bedrock and basin fill. The second step is choosing a representative density contrast for the geologic units being modeled. Modeled depth-to-bedrock increases as the density of the alluvium increases, or the density contrast between the alluvium and the bedrock decreases.

Well Data

Well log data from 189 wells in the Sacramento Valley Groundwater Basin were obtained from the ADWR Wells55 database. A selection of those wells is shown in Figure 8. Well logs were from wells drilled for water production and wells drilled for oil and mineral exploration. Nine wells from Oppenheimer and Sumner (1980) were also included. The well logs indicate that 54 wells terminated in intrusive igneous or metamorphic bedrock, 43 well terminated in volcanics, and 83 wells terminated in alluvium.

Most of the well logs (drillers' logs) available from the ADWR Wells55 database were not logged by geologists and do not use technical terms for geologic materials. This makes it difficult to pick actual bedrock depths for those wells which the logs suggest reach bedrock. Of the wells that indicate that they may penetrate bedrock, most are near the basin margins and therefore do not

provide good constraints for the middle of the basin. Therefore, the well data were not used to strictly constrain the depth-to-bedrock model. The well data were used in some of the gravity profiles, but the gravity anomaly was given preference over the well log data. The depth-to-bedrock model fits with much of the available well data (Figure 8).

Depth-to-Bedrock Discussion and Results

The depth-to-bedrock model developed in this report is significantly different from Oppenheimer and Sumner's (1980) model (Figure 9). Oppenheimer and Sumner (1980) modeled five profiles in the Sacramento Valley, four in the northern half and one in the southern half. The model developed for this report shows bedrock to be much shallower in the area of the northeast corner of Township 21 North Range 19 West to the center of Township 21 North Range 18 West. The model is also shallower in the south of the basin, centered at Township 15 North Range 17 West. This is likely because Oppenheimer and Sumner (1980) used a varying-density model, resulting in an assumed density of alluvium in the center of the basin that was greater than the value used here. Even though Oppenheimer and Sumner (1980) show bedrock to be deeper, that has a minimal effect on the water storage estimates as they are only calculated to a maximum depth of 2000 feet (610 m) bls, a depth that is generally exceeded in either depth-to-bedrock interpretation. Some of this difference can also be accounted for by the larger amount of gravity data and the larger number of modeled gravity profiles produced for this report, as well as the use of different regional anomalies.

Two seismic refraction surveys performed in the Sacramento Valley Groundwater Basin are reported in Gillespie and Bentley (1971). Gravity profile Sac11 is near one of those lines (B – B'). The lowermost layer from the seismic refraction results puts the bedrock depth at 4400 feet. The maximum depth-to-bedrock of the gravity model in this area is approximately 4500 feet, but this maximum is roughly one mile west of the maximum depth indicated by the seismic refraction line. The depth-to-bedrock is approximately 3600 feet in roughly the same area as the maximum depth reported for the seismic refraction line. These differences could be due to projection or mapping problems with the seismic data. They may also indicate that the density of the alluvium is higher than the value chosen for the model, possibly increasing with depth.

A gravity high exists in Township 17 North Range 17 West (near Yucca). It is evident in the Complete Bouguer Anomaly (Figure 3) and propagates through the data processing to the Residual Anomaly (Figure 5). Because of the gravity high in this area, the depth-to-bedrock model indicates a very shallow bedrock surface. While this is likely an area with shallow bedrock, the well logs available from the area indicate that the bedrock surface is probably deeper than this model suggests. The second seismic refraction survey performed in this area shows the depth to volcanics of between 700 and 1000 feet (Gillespie and Bentley, 1971). The Regional Anomaly (Figure 4) used to produce the Residual Anomaly (Figure 5) does not fully account for the geologic framework in this area. This is due to the amount of volcanics in the basin as well as the volcanic outcrop to the west (Figure 1). A greater proportion of higher density volcanic rock versus lower density alluvium results in the smaller observed Residual Anomaly. Modeling just the unsaturated and saturated alluvium here results in an artificially shallow depth-to-bedrock model. Although the depth-to-bedrock model is too shallow, any error in the water storage estimates would be very small due to the small area affected by the gravity high.

Groundwater Storage Calculation Methodology

The groundwater storage estimates for the Sacramento Valley Groundwater Basin were generated using three surfaces: 1) the land surface, 2) the water-level surface, and 3) the bedrock surface. The three surfaces were defined using an orthogonal grid of nodes (points) with 235 rows and 146 columns that are 1,640 feet (500 meters) apart that was overlaid on the Sacramento Valley groundwater basin. A land surface elevation, water level elevation, and bedrock elevation was then assigned to each grid node. The elevation data for each node that defined the three surfaces was combined and entered into a spreadsheet that was then used to calculate the estimated volume of groundwater in storage in the basin. The methods used to generate the various surface elevation data and the storage estimates are discussed below.

Land Surface Elevation

Ten-meter DEM tiles were downloaded from the seemless.usgs.gov website. Using Leica Erdais Imagine software, a mosaic of the DEM tiles was produced, projected, re-sampled, and re-gridded to conform to the same dimensions and cell size of the water-level and depth-to-bedrock data. The Sacramento Valley node locations were then overlaid onto the land elevation surface and each node location was assigned a land surface elevation.

Groundwater-level Surface Elevation

The Department conducted a water-level sweep of the Sacramento Valley groundwater basin in the spring of 2006. The 2006 water-level data points were combined with previously measured water-level data into a set of 167 static water-level measurement data points that were used to develop a map of the basin's water-level elevation surface. The historic water-level data were deemed appropriate to use in creating a water-level elevation surface because the basin is considered to be in a state of dynamic equilibrium with groundwater discharges equaling long-term natural recharge. Of the 167 static water-level data points only 65 data points were believed to represent basin-fill water-level elevations. The 102 water-level data points were excluded from the water-level elevation surface because they were located in areas of bedrock which did not represent a water level in basin fill. The basin-fill water-level data points were imported into the contouring software Surfer™ and an initial set of water level contours was created using the Sacramento Valley node grid. The initial water-level elevation contours were edited to produce a set of water-level contours that were deemed to reasonably reflect the current regional groundwater flow system. Figure 10 presents the water-level elevation contour map with selected 2006 water-level data points. A set of X, Y, and Z data points was exported from Surfer™ with the X and Y values corresponding to the Sacramento Valley node locations and the Z data representing the interpolated water level surface elevation at a node location.

Depth-to-Bedrock Surface

As discussed earlier in this report a depth-to-bedrock surface was developed for the basin. Figure 8 presents the depth-to-bedrock contour map and Figure 6 identifies the profiles used in GM-SYS to model the depth-to-bedrock. The depth-to-bedrock surface was converted to a set of X, Y, and Z

data points using Surfer™ for the Sacramento Valley node locations as described in the previous section.

Saturated Alluvial Sediments

The extent of the saturated alluvial aquifer was estimated by combining the land surface, depth-to-bedrock and the water-level elevation surface data for each node in the Sacramento Valley basin grid. The alluvial sediment thickness for each node was calculated by subtracting the land elevation from the bedrock elevation, and the saturated alluvial thickness at each node was calculated by subtracting the 2006 water level elevation from the bedrock elevation. Nodes with positive saturated alluvial thickness values were used to define the extent of the saturated alluvial aquifer. The approximate limit of the saturated alluvial aquifer used in the groundwater storage estimates is shown in Figure 1.

Storage Calculations

The node locations with data that defined the top and bottom of various surfaces were used to calculate the volume of groundwater in storage for the saturated alluvial portion of the Sacramento Valley Groundwater Basin. Figure 1 illustrates the extent of the saturated alluvial material where groundwater in storage was calculated. The node locations can be considered as the center point of a prism that is 1,640 feet (500 meters) in the horizontal plane on each side. The volume of saturated aquifer material for each prism can be calculated using the saturated thickness of each prism.

The volume of saturated aquifer material (ft^3) was calculated by multiplying the area of the sides of the prism (ft^2) by the saturated thickness above the indicated depth limit (ft). The saturated aquifer material volume was converted into estimates of groundwater in storage (acre-feet) using a conversion of cubic feet to acre-feet times the selected range of specific yield estimates.

Groundwater Storage Discussion and Results

The total estimated groundwater in storage for the Sacramento Valley Groundwater Basin is presented in Table 1 and the estimated amount of groundwater in storage by township is presented in Table 2.

The groundwater in storage estimates are presented with a range of specific yield values from 3 to 8 percent, which reflect a possible range of average specific yields found in the geologic units described in well logs from the area. The range of specific yield values is slightly lower than estimated regional specific yield values used by other investigators for northwestern Arizona (Gillespie and Bentley, 1971). The lower specific yield values were used in Tables 1 and 2 to present a conservative estimate of the volume of groundwater in storage. In the future, as more data regarding specific yield values become available, the groundwater in storage estimates will be revised.

Table 1. Estimated volume of groundwater in the Sacramento Valley Groundwater Basin

Specific Yield	To 1,200 feet bls	To 1,500 feet bls	To 2,000 feet bls
3%	3,600,000	4,800,000	6,400,000
6%	7,100,000	9,600,000	12,800,000
8%	9,500,000	12,900,000	17,100,000

All values are in acre-feet and rounded to the nearest 100,000 acre-feet

The values in column 2 (to 1,200 feet bls) of Table 1 are the estimated volume of groundwater in storage in the AWS Program depth limit of 1,200 feet bls or bedrock, whichever is higher, in the alluvial portion of the Sacramento Valley Groundwater Basin. The estimated storage to a depth of 1,200 feet bls ranges from about 3.6 million acre-feet to 9.5 million acre-feet. Previous storage estimates for the Sacramento Basin have been 6.5 to 13 million acre-feet (Gillespie and Bentley, 1971), 7 million acre-feet (ADWR 1984), and 8 million acre-feet (Freethey and Anderson, 1986).

Table 1 also presents estimates of groundwater in storage to a depth of 1,500 and 2,000 feet bls or bedrock, whichever occurs first (columns 3 and 4). The volume of groundwater in storage to 1,500 feet bls ranges from 4.8 to 12.9 million acre-feet, depending on the assumed specific yield value. The estimated volume of groundwater in storage ranges from 6.4 to 17.1 million acre-feet to a depth of 2,000 feet bls.

Caution should be exercised when utilizing the estimates in Tables 1 and 2 for proving physical availability for water supply calculations. Not all of the estimated groundwater in storage may be physically or practically available for withdrawal from wells due to the location of future production wells, localized variations in the saturated thickness of the regional aquifer, and other localized hydrogeologic conditions.

Summary

ADWR collected gravity and groundwater level data in 2006 to calculate the water in storage volume in the Sacramento Valley Groundwater Basin. The ADWR depth to bedrock model updates the Oppenheimner and Sumner 1980 depth to bedrock model. The updated ADWR water in storage volume for the Sacramento Valley Groundwater Basin is similar to previous estimates.

Table 2a. Estimated groundwater in storage by township in the Sacramento Valley Groundwater Basin at 3 percent specific yield.

Township	Volume in Storage to 1,200 feet bls	Volume in Storage to 1,500 feet bls	Volume in Storage to 2,000 feet bls
T13N, R15W	22,600	26,200	27,000
T13N, R16W	48,600	54,300	56,600
T14N, R15W	15,600	31,500	46,700
T14N, R16W	89,000	142,800	203,000
T14N, R17W	144,000	196,400	258,900
T14N, R18W	800	800	800
T15N, R16W	47,300	79,800	115,700
T15N, R17W	409,600	614,300	936,200
T15N, R18W	119,800	147,100	168,400
T15N, R19W	149,800	178,000	192,900
T16N, R17W	198,300	291,300	415,900
T16N, R18W	379,100	486,200	627,300
T16N, R19W	290,200	293,100	293,400
T16N, R20W	173,200	187,500	197,900
T16N, R20½W	92,300	106,800	118,700
T16N, R21W	47,300	51,000	51,500
T16½N, R17W	8,400	8,800	8,800
T16½N, R18W	124,300	138,200	141,000
T16½N, R19W	30,800	30,800	30,800
T16½N, R20W	120,200	142,800	163,300
T16½N, R20½W	1,700	2,200	3,100
T17N, R18W	9,800	9,800	9,800
T17N, R19W	300	300	300
T17N, R20W	6,100	6,100	6,100
T18N, R18W	158,700	175,900	185,500
T19N, R18W	379,800	523,600	732,100
T19N, R19W	50,000	67,000	88,000
T20N, R18W	199,200	290,600	402,700
T20N, R19W	108,700	175,000	274,100
T21N, R18W	48,700	86,000	112,600
T21N, R19W	65,900	140,300	229,200
T22N, R18W	12,200	126,300	295,600
T22N, R19W	800	2,800	2,900
T23N, R18W	800	8,600	10,100

All values are in acre-feet and rounded to the nearest 100 acre-feet.

Not all estimated groundwater in storage may be physically or practically recovered due to the depths and locations of wells and other physical characteristics of the aquifer system.

Table 2b. Estimated groundwater in storage by township in the Sacramento Valley Groundwater Basin at 6 percent specific yield.

Township	Volume in Storage to 1,200 feet bls	Volume in Storage to 1,500 feet bls	Volume in Storage to 2,000 feet bls
T13N, R15W	45,200	52,400	54,000
T13N, R16W	97,100	108,500	113,300
T14N, R15W	31,200	63,000	93,400
T14N, R16W	178,000	285,500	406,000
T14N, R17W	288,000	392,900	517,700
T14N, R18W	1,700	1,700	1,700
T15N, R16W	94,600	159,600	231,500
T15N, R17W	819,200	1,228,600	1,872,500
T15N, R18W	239,500	294,300	336,800
T15N, R19W	299,500	355,900	385,700
T16N, R17W	396,600	582,500	831,900
T16N, R18W	758,200	972,400	1,254,500
T16N, R19W	580,300	586,200	586,700
T16N, R20W	346,400	374,900	395,900
T16N, R20½W	184,600	213,600	237,400
T16N, R21W	94,600	102,100	103,000
T16½N, R17W	16,800	17,500	17,500
T16½N, R18W	248,600	276,400	281,900
T16½N, R19W	61,600	61,600	61,600
T16½N, R20W	240,500	285,500	326,500
T16½N, R20½W	3,300	4,400	6,300
T17N, R18W	19,700	19,700	19,700
T17N, R19W	500	500	500
T17N, R20W	12,200	12,200	12,200
T18N, R18W	317,400	351,900	371,100
T19N, R18W	759,500	1,047,100	1,464,300
T19N, R19W	100,100	134,000	175,900
T20N, R18W	398,300	581,100	805,500
T20N, R19W	217,500	349,900	548,300
T21N, R18W	97,500	172,100	225,300
T21N, R19W	131,700	280,700	458,400
T22N, R18W	24,500	252,500	591,300
T22N, R19W	1,500	5,700	5,700
T23N, R18W	1,500	17,200	20,200

All values are in acre-feet and rounded to the nearest 100 acre-feet.

Not all estimated groundwater in storage may be physically or practically recovered due to the depths and locations of wells and other physical characteristics of the aquifer system.

Table 2c. Estimated groundwater in storage by township in the Sacramento Valley Groundwater Basin at 8 percent specific yield.

Township	Volume in Storage to 1,200 feet bls	Volume in Storage to 1,500 feet bls	Volume in Storage to 2,000 feet bls
T13N, R15W	60,200	69,800	72,000
T13N, R16W	129,500	144,700	151,000
T14N, R15W	41,600	84,000	124,600
T14N, R16W	237,400	380,700	541,400
T14N, R17W	384,100	523,800	690,300
T14N, R18W	2,200	2,200	2,200
T15N, R16W	126,100	212,900	308,700
T15N, R17W	1,092,300	1,638,100	2,496,700
T15N, R18W	319,300	392,400	449,000
T15N, R19W	399,400	474,500	514,300
T16N, R17W	528,800	776,700	1,109,200
T16N, R18W	1,010,900	1,296,500	1,672,700
T16N, R19W	773,800	781,600	782,300
T16N, R20W	461,800	499,900	527,800
T16N, R20½W	246,100	284,700	316,500
T16N, R21W	126,200	136,100	137,300
T16½N, R17W	22,400	23,400	23,400
T16½N, R18W	331,500	368,500	375,900
T16½N, R19W	82,200	82,200	82,200
T16½N, R20W	320,700	380,700	435,400
T16½N, R20½W	4,400	5,900	8,400
T17N, R18W	26,200	26,200	26,200
T17N, R19W	700	700	700
T17N, R20W	16,300	16,300	16,300
T18N, R18W	423,200	469,200	494,700
T19N, R18W	1,012,700	1,396,200	1,952,400
T19N, R19W	133,500	178,600	234,600
T20N, R18W	531,100	774,800	1,073,900
T20N, R19W	290,000	466,600	731,000
T21N, R18W	130,000	229,400	300,400
T21N, R19W	175,600	374,200	611,200
T22N, R18W	32,700	336,700	788,400
T22N, R19W	2,100	7,500	7,600
T23N, R18W	2,000	22,900	27,000

All values are in acre-feet and rounded to the nearest 100 acre-feet.

Not all estimated groundwater in storage may be physically or practically recovered due to the depths and locations of wells and other physical characteristics of the aquifer system.

Figures

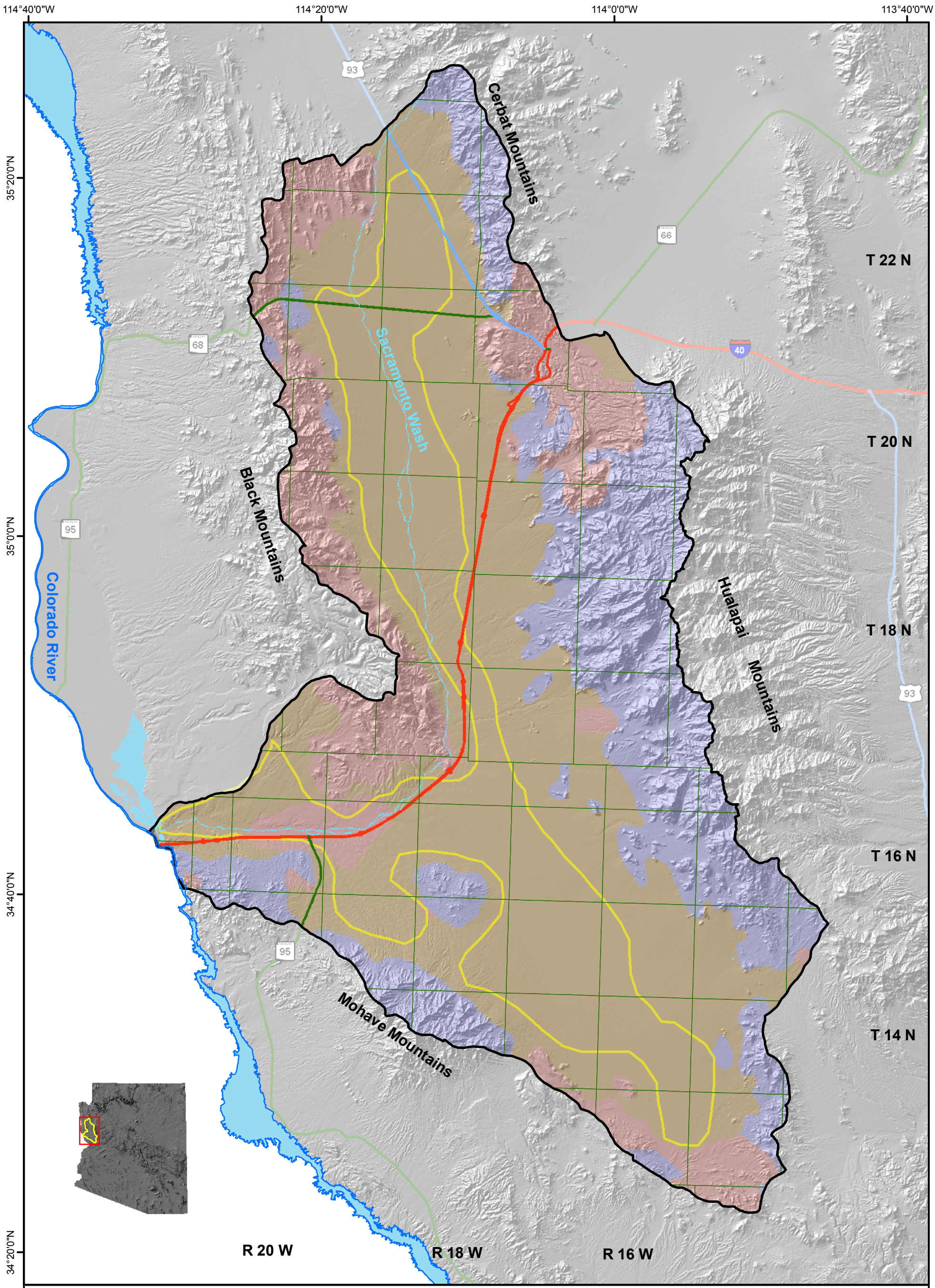


FIGURE 1.
SACRAMENTO VALLEY GROUNDWATER BASIN
Basin Overview with Generalized Geology

Estimated Extent of the Saturated Alluvium
Tertiary Volcanics and Sediments
Granitic and Metamorphic Bedrock
Unconsolidated Sediments
Township
Rivers
Lakes
Sacramento Valley Groundwater Basin

Geology Modified From Richard et al., 2000

1:372,719

0 1.5 3 6 9 12 Miles

N W E S

ARIZONA DEPARTMENT OF WATER RESOURCES ©

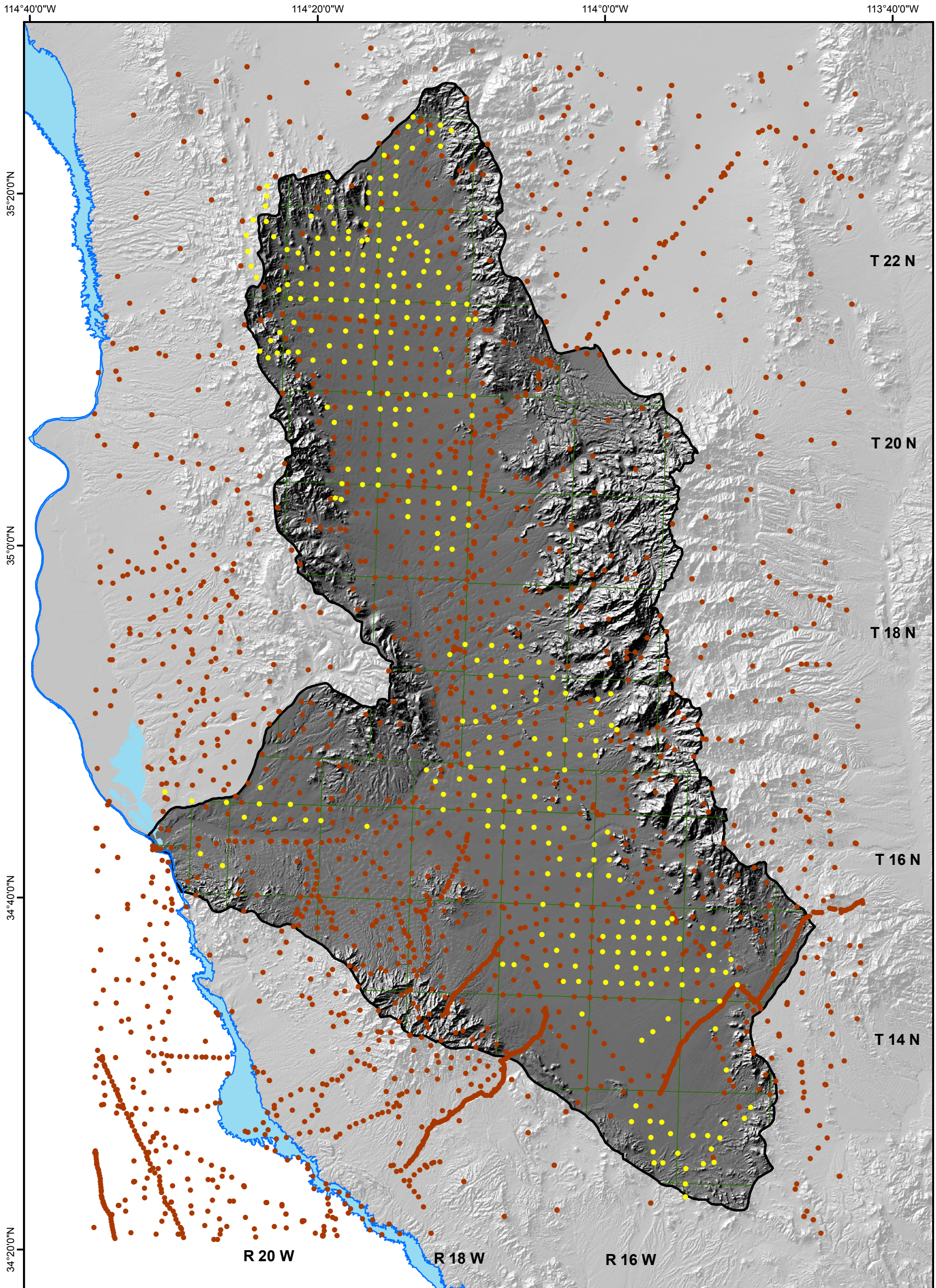


FIGURE 2.
SACRAMENTO VALLEY GROUNDWATER BASIN
Gravity Points Used For Modeling

ADWR Gravity Points
UTEP PACES Gravity Points
Township
Rivers
Lakes
Sacramento Valley Groundwater Basin

1:380,864
0 1.5 3 6 9 12 Miles

N W E S

ARIZONA DEPARTMENT OF WATER RESOURCES ©

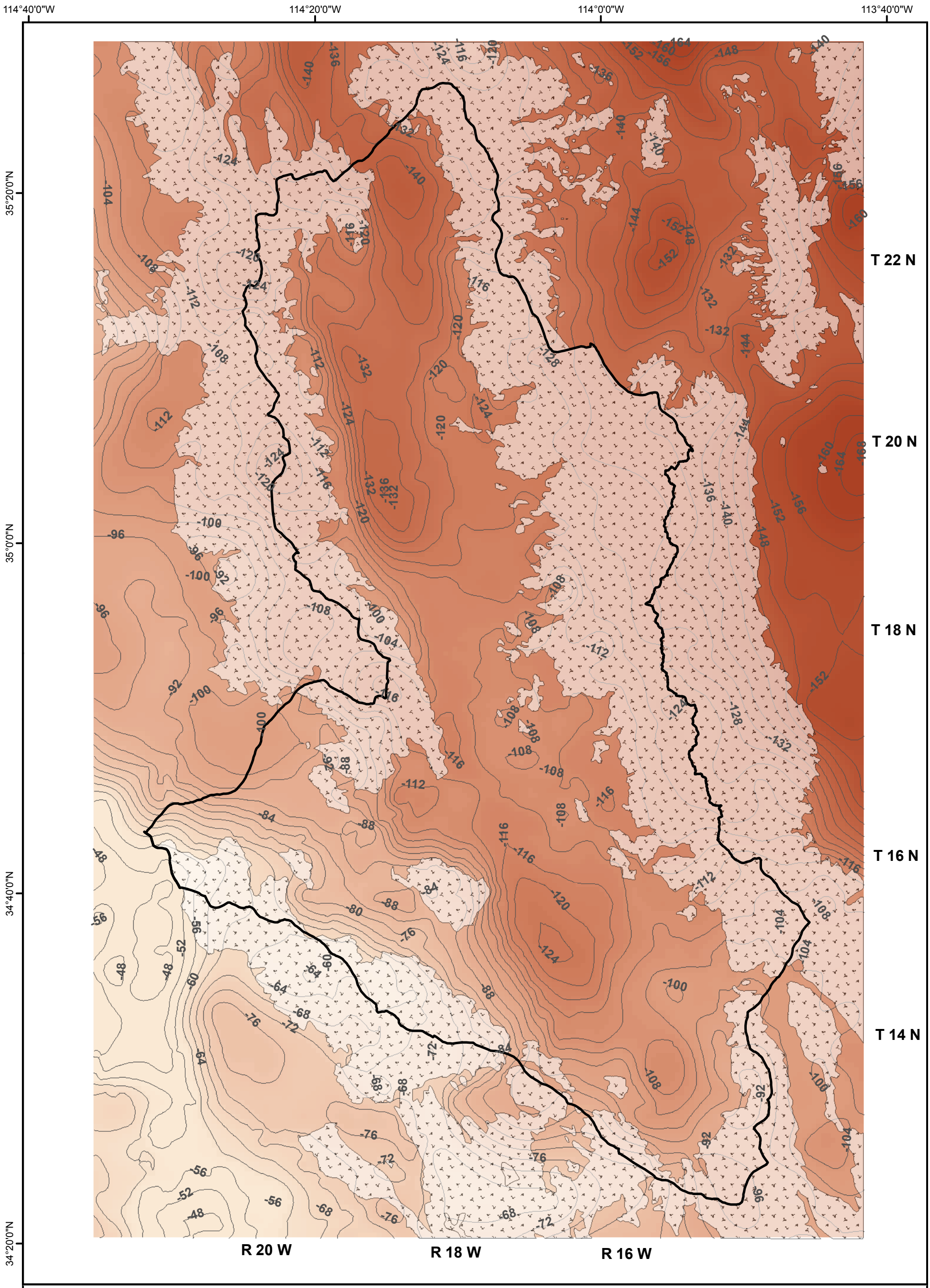


FIGURE 3.
SACRAMENTO VALLEY GROUNDWATER BASIN
Complete Bouguer Anomaly
Contour Interval = 4 mGals

1:380,864

0 1.5 3 6 9 12 Miles

CBA Contours
High : -44 mGals
Low : -168 mGals
ADWR Hardrock
Sacramento Valley Groundwater Basin

ARIZONA DEPARTMENT OF WATER RESOURCES ©

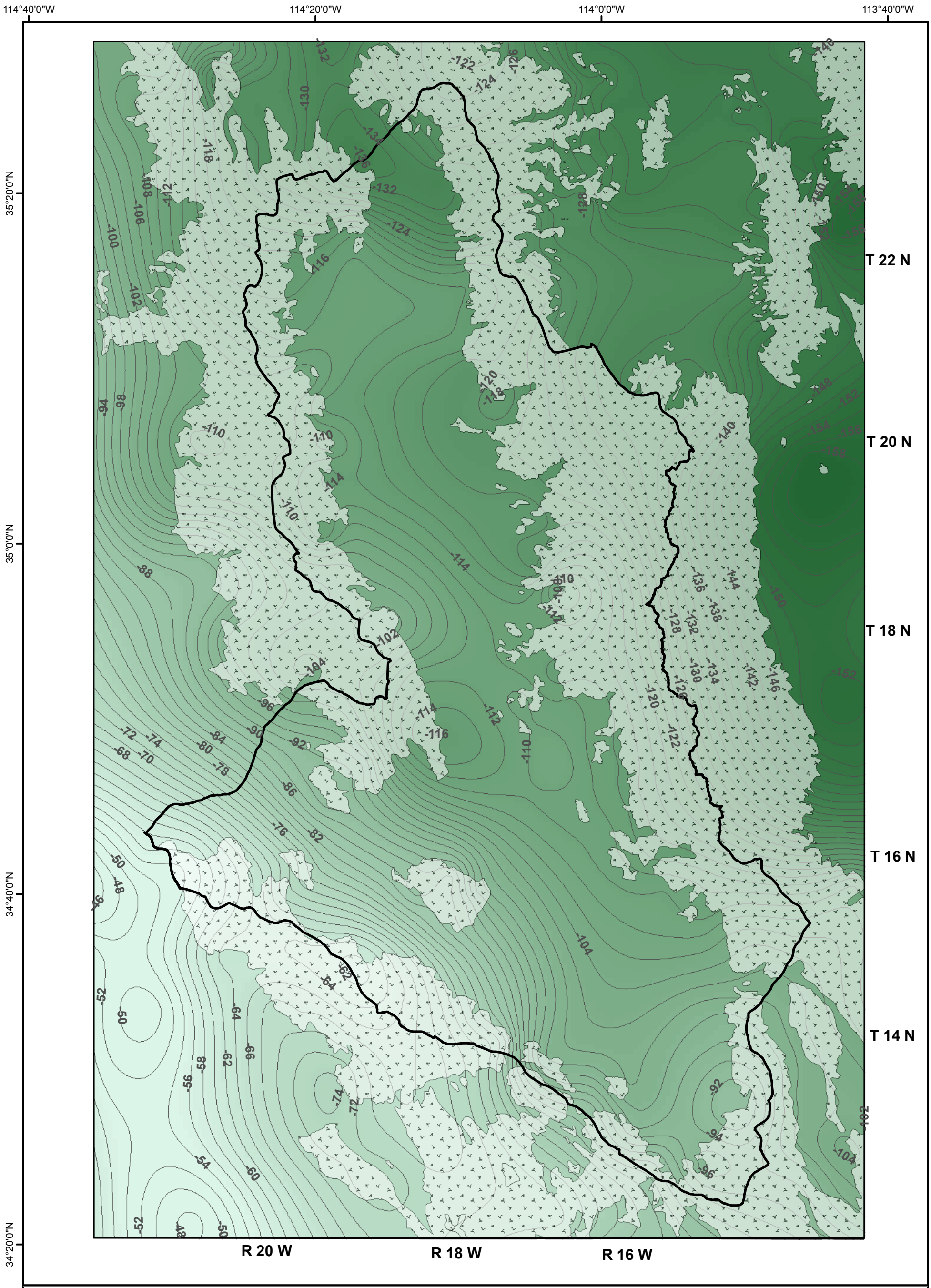


FIGURE 4.
SACRAMENTO VALLEY GROUNDWATER BASIN
Regional Anomaly
Contour Interval = 2 mGals

1:380,864

0 1.5 3 6 9 12 Miles

Regional Anomaly Contours
High : -45 mGals
Low : -160 mGals
ADWR Hardrock
Sacramento Valley Groundwater Basin

ARIZONA DEPARTMENT OF WATER RESOURCES ©

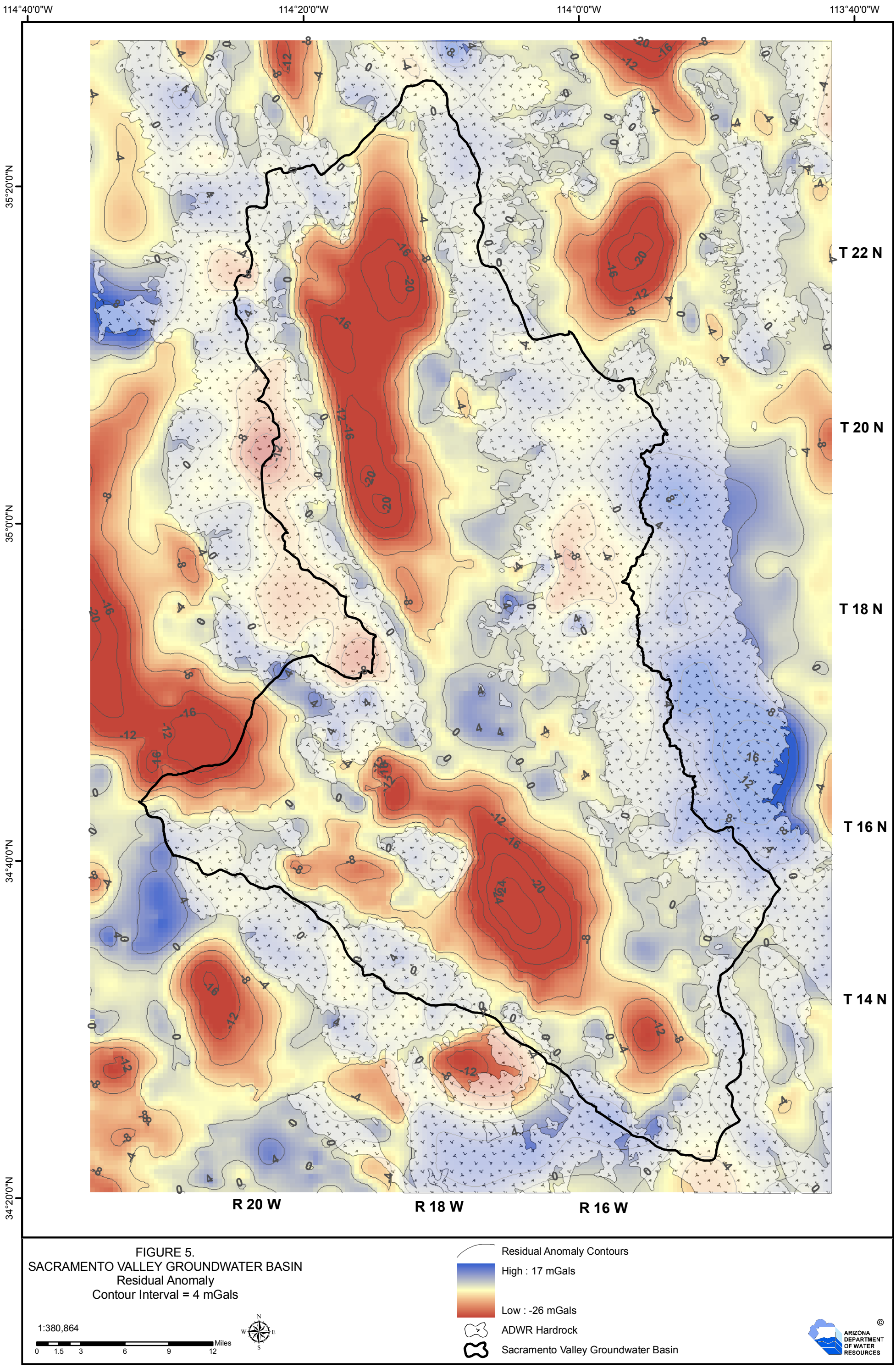


FIGURE 5.
SACRAMENTO VALLEY GROUNDWATER BASIN
Residual Anomaly
Contour Interval = 4 mGals

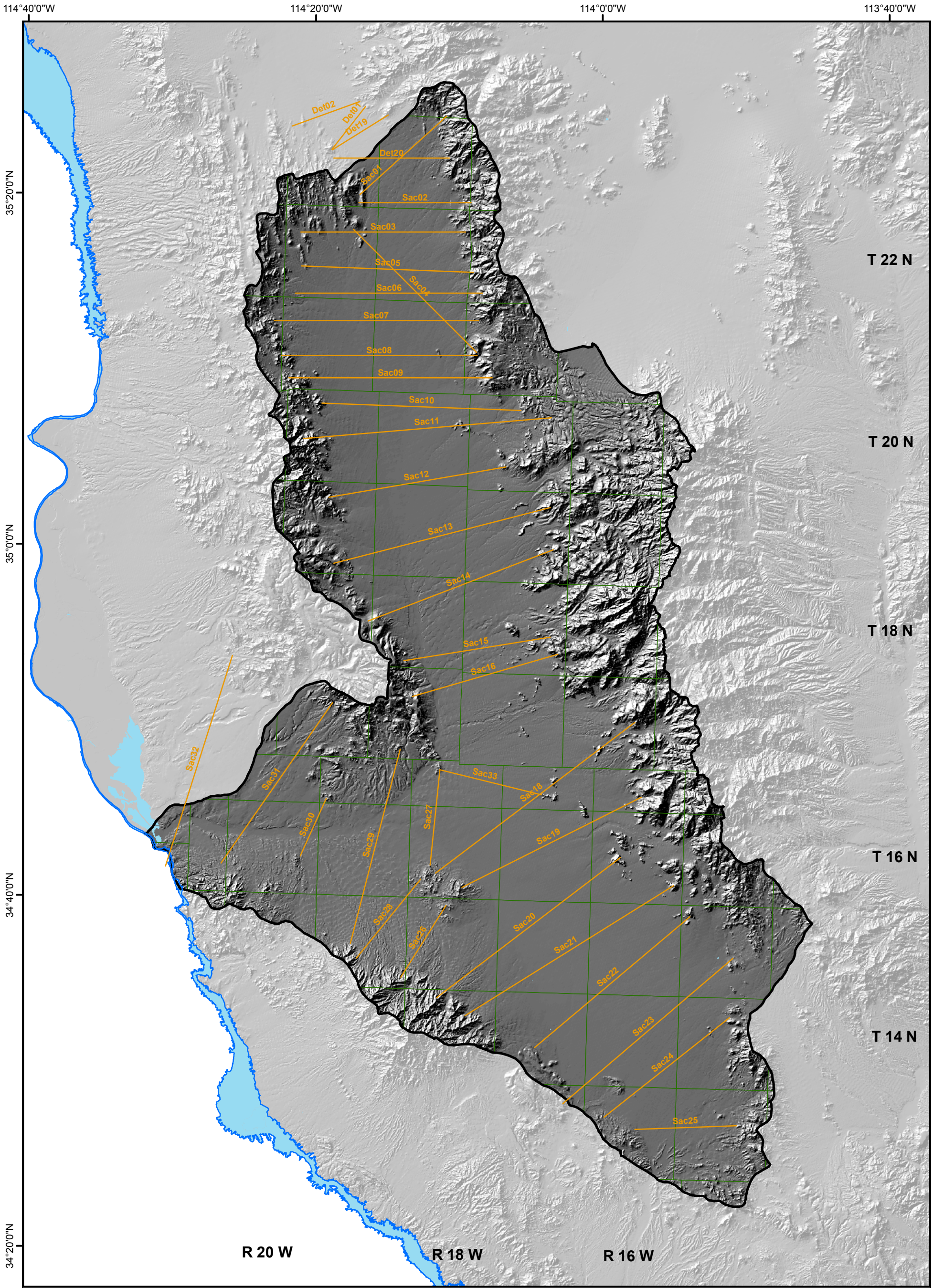


FIGURE 6.
SACRAMENTO VALLEY GROUNDWATER BASIN
GM-SYS Modeling Profiles

GM-SYS Profiles
Township
Rivers
Lakes
Sacramento Valley Groundwater Basin

1:380,864
0 1.5 3 6 9 12 Miles

© ARIZONA DEPARTMENT OF WATER RESOURCES

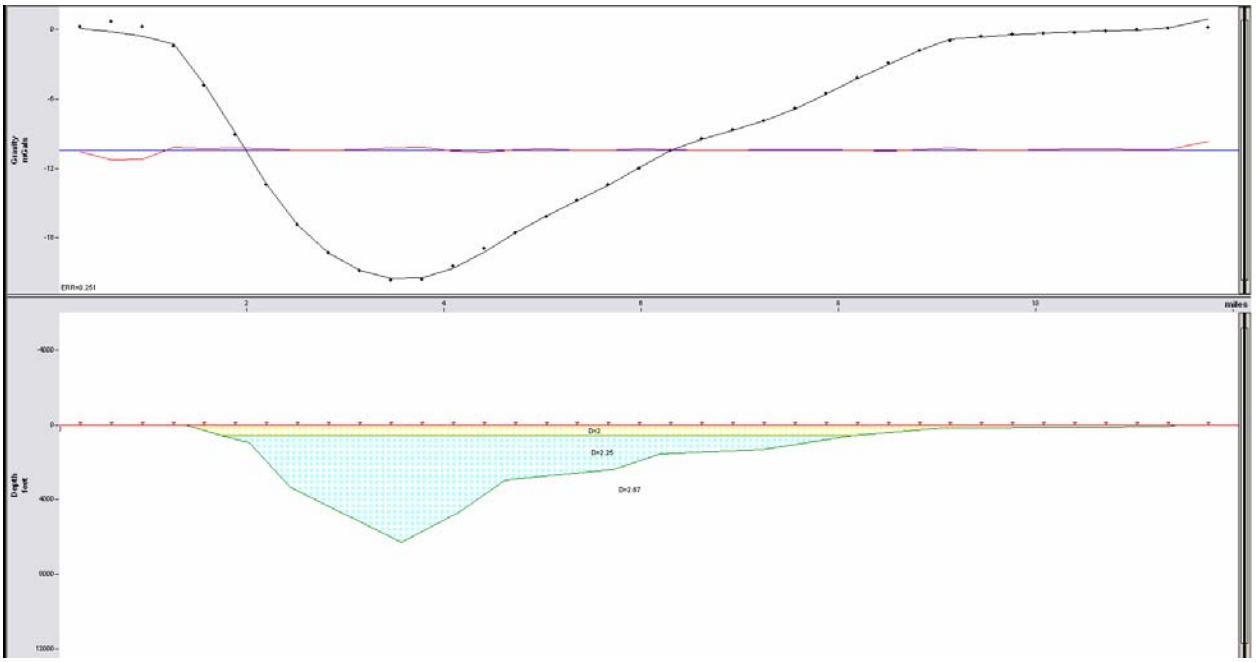


Figure 7. GM-SYS model of profile Sac12 (see Figure 6) with no vertical exaggeration. The top frame is the residual anomaly profile (dots) with the model's fit (black line) to the anomaly. The red line shows the error in fit between the gravity data and the model, and the blue line represents zero error. The vertical axis is the residual gravity value in mGals. The bottom frame shows the bedrock model. Each color represents a different density of the alluvial fill. Yellow represents a density of 2.0 g/cm^3 (unsaturated alluvium) and blue represents a density of 2.25 g/cm^3 (saturated alluvium). The vertical axis in the bottom frame is depth in feet, and the horizontal axis for both frames is distance in miles.

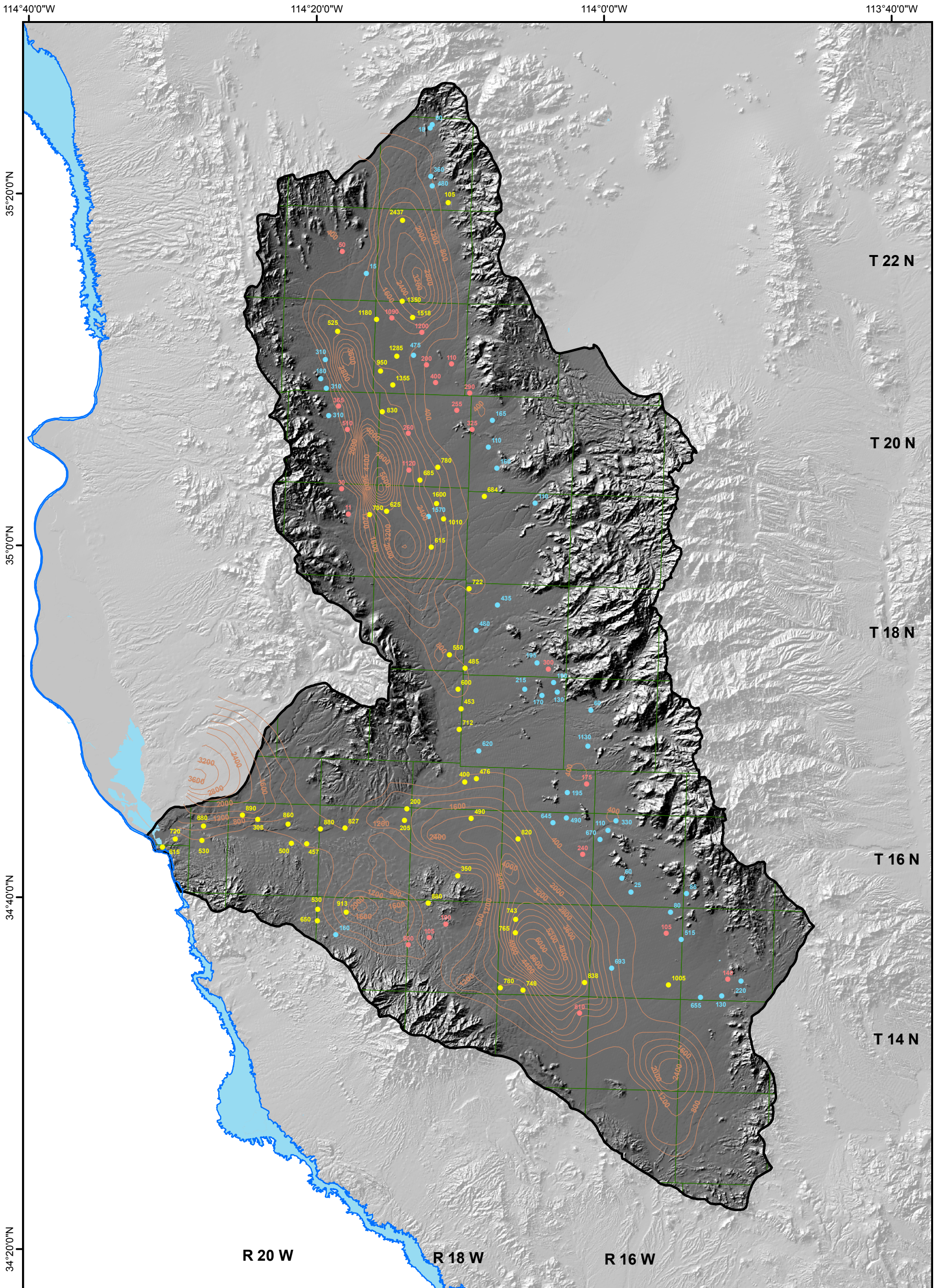


FIGURE 8.
SACRAMENTO VALLEY GROUNDWATER BASIN
Depth-To-Bedrock
Contour Interval = 400 Feet

1:380,864

0 1.5 3 6 9 12 Miles

Depth-To-Bedrock Contours (Feet)
WellsThat Did Not Encounter Bedrock (Total Depth)
Wells That Did Encounter Bedrock (Depth-To-Bedrock)
Wells That Did Encounter Volcanics (Depth-To-Volcanics)
Township
Rivers
Lakes
Sacramento Valley Groundwater Basin

ARIZONA DEPARTMENT OF WATER RESOURCES ©

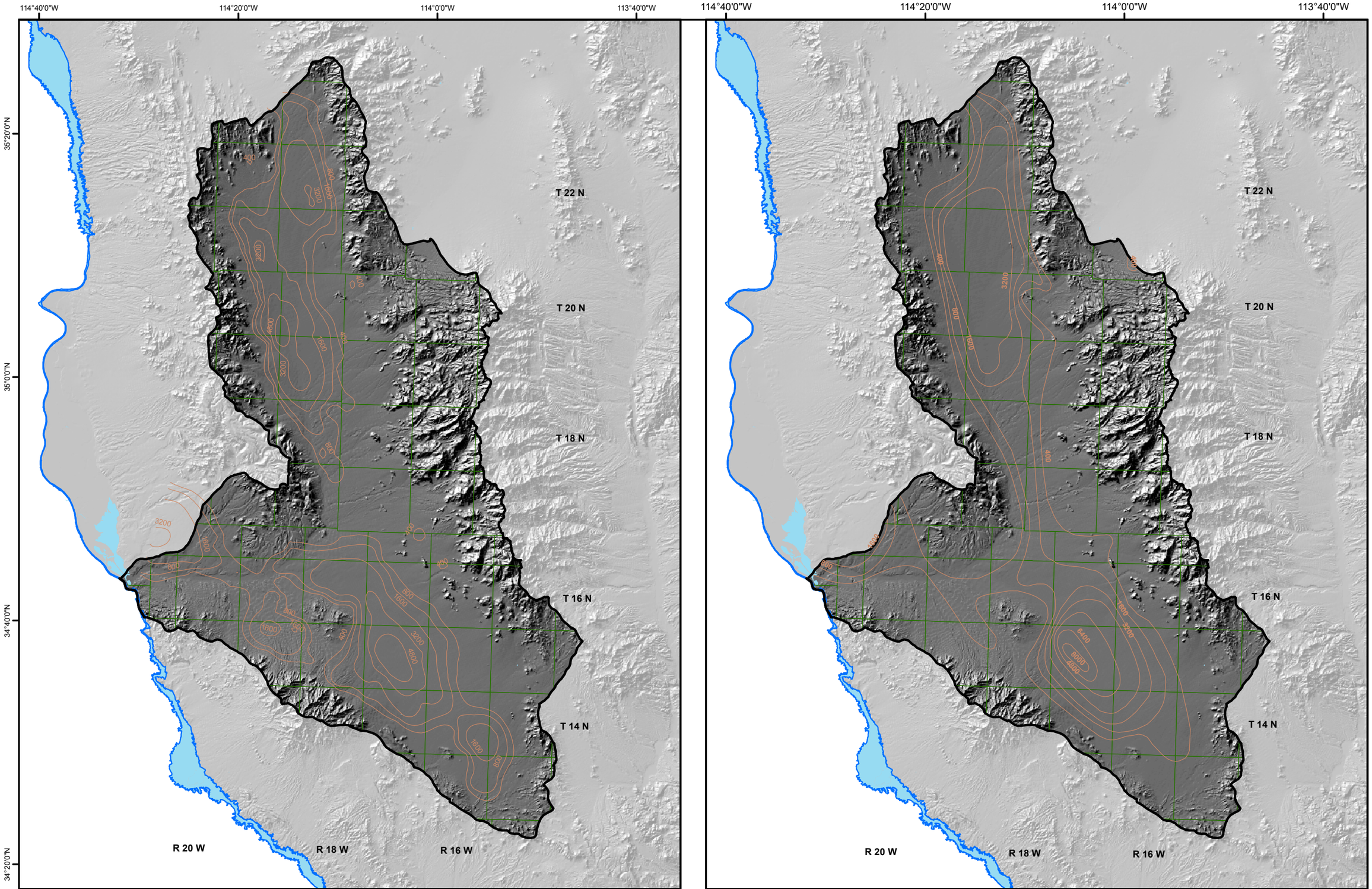


FIGURE 9.
SACRAMENTO VALLEY GROUNDWATER BASIN
Depth-To-Bedrock Model Comparison

ADWR Depth-To-Bedrock Model

Oppenheimer and Sumner (1980) Depth-To-Bedrock Model

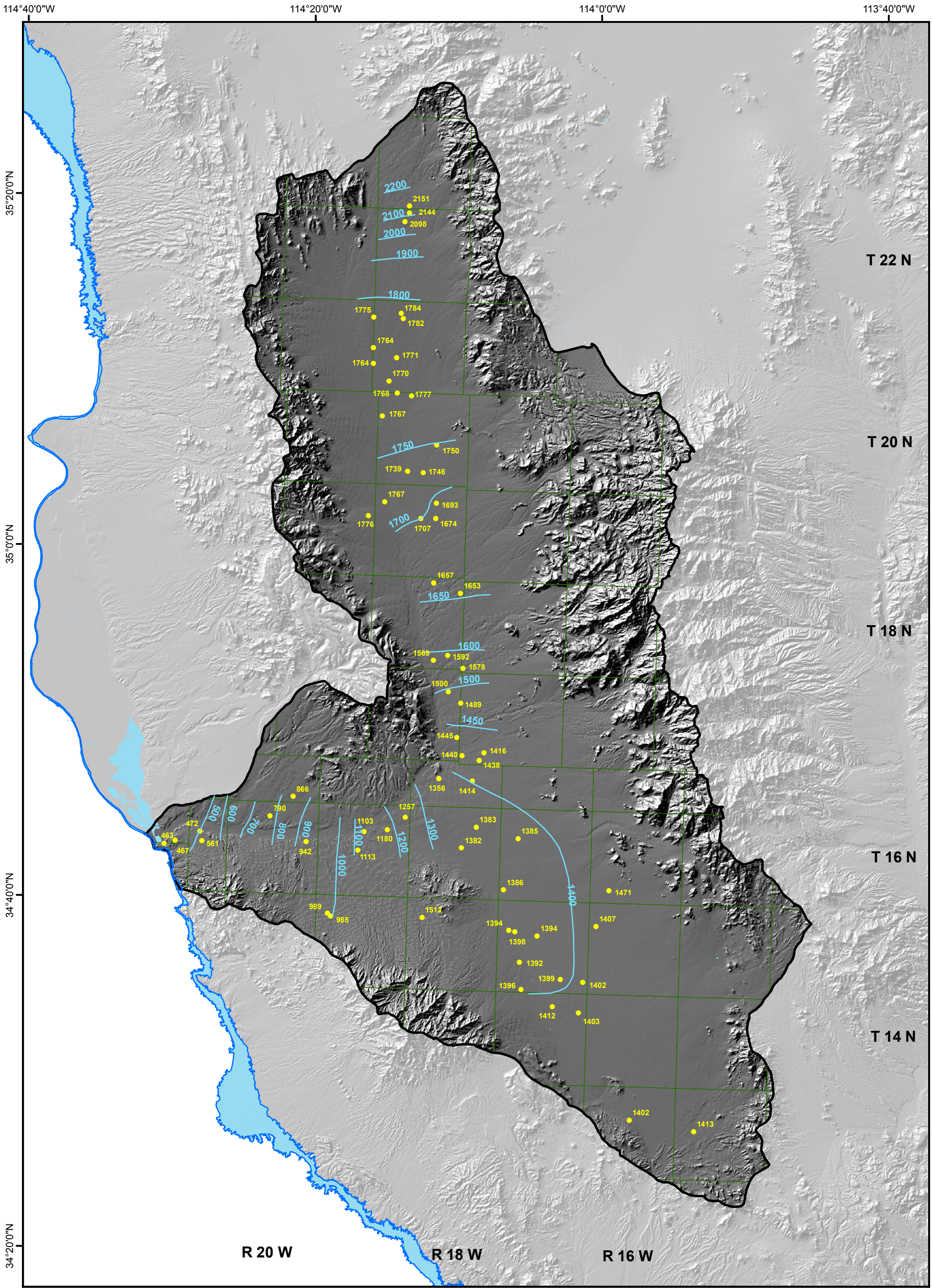


FIGURE 10.
SACRAMENTO VALLEY GROUNDWATER BASIN
2006 Water Level Elevation Map
Contour Interval = 100 Feet

1:380,864

0 1.5 3 6 9 12 Miles

N W E S

Wells Measured Spring 2006 (Water Level Elevation in Feet ASL)
Water Level Elevation Contour
Township
Rivers
Lakes
Sacramento Valley Groundwater Basin

© ARIZONA DEPARTMENT OF WATER RESOURCES

Selected References

Arizona Department of Water Resources, 1984, File Data, Water Resources Assessment.

Arizona Department of Water Resources, 1988, File Data, Water Resources Basin Files.

Arizona Department of Water Resources, 2006, **G**round**W**ater **S**ite **I**nventory (GWSI) Database.

Cogbill, A.H., 2000, InnerTC and DemRead, RasterTC: Geophysical Software, http://www.geopotential.com.

Cogbill, A.H., 1990, Gravity terrain corrections calculated using Digital Elevation Models: Geophysics, v. 55, p. 102-106.

Eaton, G.P., Peterson, D.L., and Schumann, H.H., 1972, Geophysical, geohydrological, and geochemical reconnaissance of the Luke Salt Body, Central Arizona: U.S. Geological Survey Professional Paper 753, 28 p.

Freethey, G.W. and Anderson, T.W., 1986, Predevelopment hydrologic conditions in the alluvial basins of Arizona and adjacent parts of California and New Mexico: U.S. Geological Survey Hydrologic Atlas HA-664, 3 sheets, scale 1:500 000.

Gillespie, J.B. and Bentley, C.B., 1971, Geohydrology of Hualapai and Sacramento Valleys, Mohave County, Arizona: U.S. Geological Survey Water-Supply Paper 1899-H, 1 sheet, scale 1:125 000, 37 p.

Longman, I.M., 1959, Formulas for computing tidal accelerations due to the moon and the sun: Journal of Geophysical Research, v. 64, no. 12, p. 2351-2355.

Nowell, D.A.G., 1999, Gravity terrain corrections – an overview: Journal of Applied Geophysics, v. 42, p. 117-134.

Oppenheimer, J.M., 1980, Gravity modeling of the alluvial basins, southern Arizona [M.S. thesis]: Tucson, University of Arizona, 81 p.

Oppenheimer, J.M., and Sumner, J.S., 1980, Depth-to-bedrock map, Basin and Range province, Arizona: Tucson, University of Arizona, Laboratory of Geophysics, 1 sheet, scale 1:1 000 000.

Oppenheimer, J.M., and Sumner, J.S., 1981, Gravity modeling of the basins in the Basin and Range Province, Arizona *in* Stone, C., and Jenney, J.P., eds., 1981, Arizona Geological Society Digest, v. 13: Tucson, p. 111-115, scale 1:1 000 000.

Plouff, D., 1966, Digital terrain corrections based upon geographic coordinates [abstract]: Geophysics, v. 31, p. 1208.

Pool, D.R., Carruth, R.L., and Meehan, W.D., 2001, Hydrogeology of Picacho Basin, south-central Arizona: U.S. Geological Survey Water-Resources Investigations Report 00-4277, 65 p.

Rascona, S.J., 1991, Map showing groundwater conditions in the Sacramento Valley Basin, Mohave County, Arizona – 1991: State of Arizona Department of Water Resources Hydrologic Map Series Report No. 21, 1 sheet, scale 1:250 000.

Reynolds, J.M., 1997, An introduction to applied and environmental geophysics: West Sussex, England, John Wiley & Sons, Ltd., 796 p.

Richard, S.M., Reynolds, S.J., Spencer, J.E., and Pearthree, P.A., 2000, Geologic map of Arizona: Tucson, Arizona Geological Survey Map 35, scale 1:1 000 000, 1 sheet.

Sharma, P.V., 1997, Environmental and engineering geophysics: Cambridge, UK, Cambridge University Press, 475 p.

Tucci, P., Schmoker, J.W., and Robbins, S.L., 1982, Borehole-gravity surveys in basin-fill deposits of central and southern Arizona: U.S. Geological Survey Open-File Report 82-473, 23 p.

Appendix A

GPS Results

Table 3. GPS results. UTM North and UTM East are UTM NAD83 Zone 12N. Heights are the WGS84 ellipsoid heights. Elevations are NAVD88 and are estimated using GEOID03. RADAR, Q262, and B391 (in red) are NGS monuments.

Station	Latitude (NAD83)	Longitude (NAD83)	Northing (m)	Easting (m)	Height (m)	Elevation (m)
ADOTGRAV	35°13'30.09863"N	114°00'07.38912"W	3902129.153	226767.643	1020.804	1049.037
DOLANCA	35°36'12.79283"N	114°15'20.68741"W	3944859.851	205054.160	1071.206	1099.145
RADAR	35°11'49.89741"N	114°02'29.78037"W	3899150.576	223071.958	1123.977	1152.35
Q262	35°15'13.04233"N	113°57'26.35345"W	3905179.559	230934.745	1001.970	1030.099
B391	34°47'24.50124"N	114°10'07.87296"W	3854348.413	210048.555	440.381	470.494
S292	35°24'34.92046"N	114°13'27.98503"W	3923255.773	207187.406	1138.509	1166.745
S293	35°25'09.67817"N	114°13'08.46414"W	3924311.034	207714.911	1183.785	1211.960
S294	35°24'43.58329"N	114°11'12.48209"W	3923411.821	210615.269	1239.452	1267.515
S295	35°24'27.07827"N	114°10'26.95304"W	3922866.109	211747.748	1321.651	1349.686
S296	35°24'15.87002"N	114°11'47.66150"W	3922586.313	209699.950	1182.605	1210.744
S297	35°24'19.88147"N	114°12'31.83329"W	3922746.092	208589.274	1150.969	1179.157
S298	35°23'32.12285"N	114°11'09.59138"W	3921206.891	210617.184	1177.917	1206.061
S299	35°23'23.51668"N	114°14'12.92485"W	3921091.996	205981.293	1074.031	1102.402
S300	35°23'23.07629"N	114°13'06.40481"W	3921023.587	207659.826	1105.024	1133.323
S301	35°22'33.59429"N	114°14'11.49519"W	3919552.068	205966.993	1049.420	1077.845
S302	35°22'54.23862"N	114°15'03.34004"W	3920231.329	204679.116	1040.922	1069.377
S303	35°21'45.73432"N	114°14'11.84201"W	3918077.180	205909.950	1031.224	1059.701
S304	35°20'44.86073"N	114°14'10.56269"W	3916199.837	205880.862	1000.348	1028.884
S305	35°20'44.66816"N	114°15'14.09781"W	3916246.530	204276.146	988.317	1016.902
S306	35°20'45.49181"N	114°16'03.64999"W	3916313.164	203025.583	977.235	1005.852
S307	35°21'36.77876"N	114°16'01.90341"W	3917892.523	203121.907	995.590	1024.163
S308	35°21'36.51256"N	114°15'13.99895"W	3917844.440	204331.210	1009.012	1037.551
S309	35°19'52.09877"N	114°15'09.23471"W	3914622.158	204345.699	965.378	994.005
S310	35°19'51.89563"N	114°14'00.75059"W	3914559.213	206075.310	979.317	1007.896
S311	35°19'52.31581"N	114°16'03.17971"W	3914673.731	202983.335	960.962	989.619
S312	35°18'57.35739"N	114°16'10.34258"W	3912985.729	202746.456	935.352	964.055
S313	35°18'57.42888"N	114°15'15.72444"W	3912942.470	204126.377	942.730	971.405
S314	35°19'05.53593"N	114°13'30.04764"W	3913104.990	206804.266	968.380	996.976
S315	35°18'12.93729"N	114°13'52.53381"W	3911502.293	206183.304	941.434	970.098
S316	35°18'21.14425"N	114°13'09.09219"W	3911719.505	207289.170	954.726	983.347
S317	35°18'57.08779"N	114°12'18.10367"W	3912785.578	208613.317	987.021	1015.558
S318	35°17'59.87413"N	114°12'38.67108"W	3911038.960	208036.545	954.038	982.653
S319	35°16'15.19294"N	114°13'26.33953"W	3907851.570	206727.065	899.725	928.490
S320	35°15'28.35086"N	114°14'04.19555"W	3906438.964	205723.058	873.860	902.703
S321	35°14'36.21660"N	114°14'06.30632"W	3904833.808	205617.273	853.612	882.510
S322	34°50'53.07290"N	114°08'22.21399"W	3860692.079	212936.336	527.608	557.449
S323	34°50'52.92782"N	114°07'28.37278"W	3860644.836	214304.178	559.512	589.296
S324	34°51'44.14581"N	114°06'16.04259"W	3862166.214	216190.841	609.624	639.269
S325	34°52'12.17587"N	114°03'21.07041"W	3862893.359	220662.005	722.218	751.597
S326	34°52'23.03043"N	113°59'06.57279"W	3863032.867	227136.219	881.694	910.670
S327	34°52'41.18786"N	113°58'11.93099"W	3863551.174	228540.651	923.854	952.725
S328	34°52'39.00821"N	114°01'19.64050"W	3863626.682	223771.306	807.462	836.624

Station	Latitude (NAD83)	Longitude (NAD83)	Northing (m)	Easting (m)	Height (m)	Elevation (m)
S329	34°51'36.97395"N	113°59'10.05646"W	3861616.118	227005.409	872.090	901.131
S330	34°50'54.71016"N	113°58'05.20602"W	3860264.653	228614.188	943.198	972.194
S331	34°50'40.55386"N	113°57'42.53600"W	3859811.336	229177.249	962.576	991.556
S332	34°50'51.84860"N	114°00'11.93012"W	3860272.420	225391.946	838.037	867.227
S333	34°51'03.82869"N	113°59'25.61263"W	3860606.424	226579.742	863.189	892.295
S334	34°50'01.67296"N	114°06'30.21397"W	3859019.212	215732.845	576.203	605.969
S335	34°50'55.76378"N	114°04'25.49515"W	3860588.487	218953.313	662.631	692.178
S336	34°49'09.23627"N	114°05'36.77705"W	3857361.126	217040.896	597.630	627.378
S337	34°49'01.85695"N	114°07'53.58922"W	3857241.665	213556.513	508.905	538.825
S338	34°49'09.40828"N	114°02'19.61278"W	3857213.158	222052.195	727.723	757.209
S339	34°49'59.64053"N	114°03'21.95565"W	3858809.431	220514.898	693.956	723.475
S340	34°50'01.13278"N	114°01'15.31599"W	3858757.847	223734.389	784.863	814.205
S341	34°49'10.38758"N	114°00'12.25757"W	3857145.795	225289.916	821.734	851.042
S342	34°50'00.36683"N	113°59'08.90174"W	3858637.971	226946.010	887.383	916.541
S343	34°49'09.20799"N	113°59'09.01597"W	3857061.431	226896.142	868.551	897.770
S344	34°48'17.24477"N	114°01'14.54494"W	3855555.574	223657.511	764.407	793.861
S345	34°48'17.79358"N	114°03'14.24180"W	3855664.642	220615.300	682.793	712.405
S346	34°48'17.94265"N	114°05'28.72539"W	3855773.981	217196.800	595.352	625.139
S347	34°48'17.81919"N	114°07'43.00256"W	3855876.035	213783.246	506.974	536.921
S348	34°47'34.98268"N	114°08'28.00326"W	3854591.586	212597.934	483.463	513.486
S349	34°47'32.45301"N	114°06'22.98081"W	3854414.638	215774.167	556.255	586.149
S350	34°47'37.59965"N	114°04'02.29223"W	3854463.184	219355.955	645.064	674.779
S351	34°46'39.36071"N	114°05'20.19558"W	3852729.085	217320.081	585.940	615.808
S352	34°46'41.44640"N	114°07'26.47274"W	3852892.770	214110.952	514.977	544.977
S353	34°46'40.72124"N	114°09'33.21799"W	3852971.327	210887.200	449.047	479.163
S354	34°45'49.96514"N	114°09'31.83494"W	3851405.925	210873.136	451.372	481.515
S355	34°52'39.41547"N	114°05'28.87885"W	3863832.532	217441.538	651.004	680.532
S356	34°52'39.05027"N	114°03'22.17175"W	3863722.459	220659.315	734.407	763.758
S357	34°53'30.34344"N	114°02'13.90968"W	3865250.497	222441.000	823.423	852.608
S358	34°54'22.22514"N	114°03'13.88601"W	3866895.802	220966.797	779.456	808.677
S359	34°53'30.85735"N	114°04'25.46154"W	3865368.337	219100.913	709.264	738.652
S360	34°53'31.25042"N	114°06'31.92955"W	3865479.665	215889.782	621.889	651.450
S361	34°54'20.46809"N	114°05'28.58666"W	3866946.700	217545.172	666.369	695.797
S362	34°55'15.00072"N	114°04'29.63061"W	3868581.231	219093.710	719.250	748.537
S363	34°55'14.79417"N	114°06'31.64948"W	3868670.641	215996.075	632.873	662.335
S364	34°55'14.54156"N	114°08'22.14103"W	3868750.492	213190.982	590.773	620.366
S365	34°54'22.44297"N	114°07'30.08167"W	3867103.416	214462.349	600.020	629.603
S366	34°54'39.20043"N	114°09'24.68114"W	3867711.254	211568.990	565.927	595.609
S367	35°09'24.46358"N	114°09'55.65015"W	3895020.643	211648.963	770.030	799.001
S368	35°09'22.96926"N	114°11'39.92688"W	3895059.026	209007.983	742.731	771.819
S369	35°09'23.11953"N	114°12'57.98534"W	3895127.372	207032.254	740.669	769.831
S370	35°08'29.58047"N	114°12'46.14835"W	3893467.517	207278.555	724.979	754.182
S401	34°36'22.01200"N	113°48'54.29250"W	3832967.385	241857.148	908.748	938.140
S402	34°33'49.02304"N	113°50'20.66949"W	3828314.610	239523.581	809.562	839.173
S403	34°31'29.57591"N	113°49'29.66657"W	3823980.966	240703.547	739.755	769.468
S404	34°29'23.48433"N	113°47'46.18688"W	3820021.991	243235.222	720.834	750.613

Station	Latitude (NAD83)	Longitude (NAD83)	Northing (m)	Easting (m)	Height (m)	Elevation (m)
S405	34°28'46.37565"N	113°48'10.22460"W	3818895.462	242590.202	708.064	737.891
S406	34°28'26.06119"N	113°49'29.04914"W	3818325.431	240561.252	658.105	688.002
S407	34°27'36.04948"N	113°49'49.13313"W	3816798.628	240005.588	637.984	667.939
S408	34°27'44.18806"N	113°50'39.70589"W	3817085.623	238721.799	612.806	642.788
S409	34°27'42.25770"N	113°51'40.48297"W	3817069.881	237168.852	592.510	622.534
S410	34°26'39.54343"N	113°52'40.52502"W	3815180.757	235581.366	554.807	584.913
S411	34°26'06.32401"N	113°53'41.08225"W	3814201.158	234006.090	525.869	556.030
S412	34°26'05.08692"N	113°54'17.75061"W	3814189.853	233068.760	517.922	548.102
S413	34°26'42.78559"N	113°54'22.38027"W	3815354.970	232983.907	532.297	562.454
S414	34°27'33.01538"N	113°54'32.42372"W	3816910.224	232772.000	551.252	581.382
S415	34°28'23.99648"N	113°55'54.92849"W	3818542.068	230711.575	559.136	589.277
S416	34°29'18.51734"N	113°55'37.78548"W	3820209.533	231197.720	578.770	608.869
S417	34°25'48.45422"N	113°52'05.35783"W	3813580.925	236434.562	567.116	597.236
S418	34°24'55.83209"N	113°52'05.57871"W	3811959.501	236382.995	552.708	582.866
S419	34°24'11.60322"N	113°52'04.34066"W	3810595.669	236376.028	548.116	578.306
S420	34°26'08.15207"N	113°50'53.65237"W	3814136.239	238282.544	588.162	618.225
S421	34°26'12.42287"N	113°50'10.44617"W	3814236.875	239389.367	604.969	635.000
S422	34°26'58.26298"N	113°50'22.87988"W	3815658.356	239111.545	601.678	631.685
S423	34°48'02.34694"N	114°10'45.71429"W	3855545.266	209123.377	419.005	449.114
S424	34°44'43.95056"N	114°14'44.27171"W	3849624.820	202860.760	329.908	360.236
S425	34°42'12.43768"N	114°24'35.62313"W	3845453.402	187657.659	301.456	331.981
S426	34°42'52.35814"N	114°26'08.97294"W	3846764.772	185323.516	213.179	243.744
S427	34°46'18.35507"N	114°28'43.62173"W	3853249.689	181607.407	163.253	193.933
S428	34°45'49.75028"N	114°26'51.42736"W	3852269.516	184430.692	190.933	221.586
S429	34°45'49.15403"N	114°24'28.08359"W	3852126.611	188076.207	222.480	253.088
S430	34°45'00.69083"N	114°23'12.41201"W	3850567.715	189950.600	227.927	258.493
S431	34°45'49.45788"N	114°22'12.52682"W	3852019.551	191524.546	260.501	291.047
S432	34°46'43.54078"N	114°22'09.17707"W	3853683.638	191665.717	285.355	315.893
S433	34°45'49.78389"N	114°20'03.13225"W	3851919.677	194816.115	285.551	316.030
S434	34°44'57.89277"N	114°18'59.61259"W	3850266.789	196378.924	286.554	317.008
S435	34°44'58.01289"N	114°17'55.98613"W	3850217.168	197997.681	305.941	336.362
S436	34°44'57.78157"N	114°21'07.97302"W	3850371.804	193113.332	250.188	280.703
S437	34°46'42.75076"N	114°03'14.73452"W	3852735.915	220513.601	665.068	694.780
S438	34°46'03.52448"N	114°02'11.73874"W	3851478.404	222078.908	696.454	726.124
S439	34°46'41.98112"N	114°00'52.35909"W	3852602.728	224133.258	755.070	784.595
S440	34°45'50.37060"N	114°04'17.95624"W	3851170.682	218856.559	610.987	640.827
S441	34°45'50.44744"N	114°06'23.29917"W	3851271.147	215668.753	542.359	572.333
S442	34°44'58.05340"N	114°06'24.50273"W	3849657.350	215588.176	531.526	561.538
S443	34°44'57.88613"N	114°05'22.12711"W	3849603.244	217174.717	563.567	593.521
S444	34°44'58.28006"N	114°03'14.11487"W	3849515.782	220431.412	640.486	670.299
S445	34°44'58.29188"N	114°01'08.75523"W	3849419.728	223620.231	723.195	752.851
S446	34°42'21.08455"N	114°02'10.63912"W	3844622.306	221899.677	629.938	659.829
S447	34°42'21.42221"N	114°00'04.46613"W	3844536.292	225111.162	712.233	741.980
S448	34°42'21.56777"N	113°57'58.52689"W	3844445.656	228316.479	793.616	823.205
S449	34°42'07.77508"N	113°57'11.85416"W	3843985.632	229491.817	820.303	849.846
S450	34°43'14.05354"N	113°57'58.49872"W	3846063.124	228364.926	798.447	827.973

Station	Latitude (NAD83)	Longitude (NAD83)	Northing (m)	Easting (m)	Height (m)	Elevation (m)
S451	34°35'23.67284"N	113°50'06.05433"W	3831220.852	239978.132	851.122	880.629
S452	34°35'23.70539"N	113°51'40.72522"W	3831289.998	237565.495	809.764	839.357
S453	34°34'18.22502"N	113°53'36.15442"W	3829356.062	234565.897	744.976	774.740
S454	34°33'32.92987"N	113°54'37.75369"W	3828005.388	232955.421	703.536	733.397
S455	34°33'03.34499"N	113°55'21.87606"W	3827126.192	231804.131	674.457	704.381
S763	35°15'29.12259"N	114°18'25.11842"W	3906680.366	199127.268	871.261	900.230
S764	35°17'13.88502"N	114°18'24.37822"W	3909908.845	199253.722	913.594	942.458
S765	35°18'05.42322"N	114°18'24.93931"W	3911497.890	199292.576	938.486	967.302
S766	35°18'57.09674"N	114°18'23.74080"W	3913089.623	199376.047	964.249	993.020
S767	35°19'51.18802"N	114°18'40.16234"W	3914770.762	199016.947	1006.030	1034.764
S768	35°20'43.37358"N	114°18'53.41673"W	3916390.507	198736.038	1052.474	1081.178
S769	35°21'34.92227"N	114°18'56.25027"W	3917981.814	198717.739	1107.322	1135.997
S770	35°18'04.87486"N	114°19'28.53808"W	3911534.791	197684.962	962.918	991.760
S771	35°19'18.87208"N	114°19'59.69326"W	3913842.108	196974.499	1032.495	1061.289
S772	35°17'21.75726"N	114°21'34.73282"W	3910313.357	194451.096	1024.874	1053.797
S773	35°18'04.54617"N	114°22'32.45291"W	3911681.869	193037.302	1106.634	1135.556
S774	35°18'55.33850"N	114°23'04.50620"W	3913275.139	192280.860	1189.068	1217.979
S775	35°18'59.14756"N	114°24'00.10213"W	3913440.682	190880.270	1184.863	1213.816
S776	35°18'06.90782"N	114°24'26.68055"W	3911853.517	190153.361	1178.451	1207.465
S777	35°17'12.09246"N	114°24'19.04071"W	3910157.236	190288.324	1209.843	1238.890
S778	35°16'20.90536"N	114°24'01.85081"W	3908564.515	190668.630	1234.484	1263.558
S779	35°15'43.50703"N	114°23'38.29636"W	3907391.338	191224.572	1251.994	1281.081
S780	35°19'48.21365"N	114°23'11.10666"W	3914910.671	192169.862	1202.256	1231.140
S781	35°20'22.70143"N	114°23'07.79220"W	3915970.863	192289.957	1152.865	1181.727
S782	35°20'57.61325"N	114°23'07.42448"W	3917046.673	192336.071	1123.705	1152.549
S783	35°15'27.98522"N	114°19'28.57069"W	3906698.960	197521.888	894.757	923.747
S784	35°15'27.95761"N	114°20'31.79528"W	3906751.853	195923.396	931.687	960.693
S785	35°15'23.38639"N	114°21'27.78506"W	3906658.783	194503.065	979.661	1008.689
S786	35°15'03.45224"N	114°22'02.64773"W	3906074.234	193600.766	1019.021	1048.081
S787	35°14'36.20211"N	114°21'13.05786"W	3905191.795	194826.224	968.689	997.754
S788	35°14'35.94372"N	114°20'31.82100"W	3905148.630	195868.709	931.447	960.499
S789	35°14'36.06382"N	114°19'28.03876"W	3905098.125	197481.682	881.438	910.476
S790	35°14'35.74673"N	114°18'24.85901"W	3905034.941	199078.961	856.332	885.354
S791	35°14'36.62118"N	114°17'21.50961"W	3905008.626	200681.741	843.451	872.450
S792	35°14'35.66034"N	114°16'17.75490"W	3904925.688	202292.885	844.669	873.642
S793	35°13'43.23230"N	114°16'17.51216"W	3903309.517	202245.730	825.959	854.986
S794	35°13'43.57981"N	114°15'11.89385"W	3903265.660	203905.619	830.434	859.427
S795	35°14'36.75664"N	114°15'13.95702"W	3904906.411	203907.202	849.412	878.351
S796	35°15'28.03459"N	114°15'14.23032"W	3906487.151	203952.153	867.575	896.461
S797	35°15'28.90790"N	114°16'16.19833"W	3906565.622	202386.385	863.546	892.463
S798	35°16'20.13776"N	114°18'25.04999"W	3908252.753	199181.456	888.441	917.359
S799	35°17'12.66949"N	114°19'28.22797"W	3909925.383	197638.792	930.953	959.842
S800	35°16'20.38936"N	114°20'31.78795"W	3908367.974	195978.073	949.033	977.990
S801	35°17'12.53844"N	114°20'47.89463"W	3909989.133	195625.220	994.249	1023.164
S802	35°16'21.51922"N	114°17'21.18526"W	3908241.613	200797.209	875.571	904.462
S803	35°16'21.25659"N	114°16'17.58869"W	3908180.310	202404.486	882.736	911.598

Station	Latitude (NAD83)	Longitude (NAD83)	Northing (m)	Easting (m)	Height (m)	Elevation (m)
S804	35°17'13.41834"N	114°16'17.56954"W	3909788.064	202458.050	900.696	929.504
S805	35°17'14.86844"N	114°17'21.28198"W	3909886.074	200849.348	899.913	928.749
S806	35°18'06.16825"N	114°17'21.40505"W	3911467.391	200898.745	922.350	951.137
S807	35°18'31.23406"N	114°17'21.02150"W	3912239.674	200934.097	935.190	963.953
S808	35°18'00.62575"N	114°16'25.24948"W	3911249.541	202312.045	974.928	1003.693
S809	35°18'04.84514"N	114°16'01.52132"W	3911359.797	202915.911	921.532	950.281
S810	35°18'04.77610"N	114°15'13.55001"W	3911317.765	204127.984	926.020	954.744
S811	35°17'36.74166"N	114°14'08.06271"W	3910399.465	205754.489	924.869	953.580
S812	35°16'58.12459"N	114°14'19.40995"W	3909218.562	205428.831	907.109	935.868
S813	35°16'06.68684"N	114°14'24.72699"W	3907637.519	205242.614	887.631	916.447
S814	35°17'12.30581"N	114°15'13.86260"W	3909700.752	204066.962	906.005	934.782
S815	35°11'58.70555"N	114°18'25.11290"W	3900194.686	198911.231	835.331	864.495
S816	35°11'33.99073"N	114°20'34.67925"W	3899542.674	195607.508	924.528	953.728
S817	35°11'33.08491"N	114°21'15.31539"W	3899549.427	194578.361	966.422	995.637
S818	35°11'28.51038"N	114°22'00.33501"W	3899446.974	193434.455	1012.943	1042.184
S819	35°11'11.34100"N	114°22'38.65997"W	3898950.683	192446.705	1060.972	1090.254
S820	35°11'33.21573"N	114°23'14.12319"W	3899655.505	191572.309	1131.658	1160.948
S821	35°12'08.75155"N	114°22'30.80231"W	3900713.521	192705.694	1103.554	1132.778
S822	35°12'38.15269"N	114°21'53.01737"W	3901587.316	193692.367	1004.522	1033.697
S823	35°13'15.04788"N	114°20'55.90092"W	3902675.684	195175.629	926.416	955.540
S824	35°12'48.33121"N	114°19'42.68749"W	3901789.887	196999.860	878.732	907.863
S825	35°11'07.03443"N	114°19'32.05886"W	3898658.598	197164.142	880.004	909.211
S826	35°11'06.95621"N	114°17'20.35347"W	3898545.211	200496.824	805.669	834.868
S827	35°11'06.28107"N	114°15'13.71427"W	3898418.856	203700.668	774.181	803.338
S828	35°12'00.44552"N	114°16'16.83064"W	3900140.799	202158.545	792.941	822.074
S829	35°12'51.28474"N	114°17'19.75394"W	3901760.393	200618.512	818.211	847.317
S830	35°12'51.95151"N	114°15'12.24510"W	3901674.644	203844.565	810.877	839.924
S831	35°12'51.42278"N	114°14'11.60562"W	3901608.200	205377.913	811.798	840.808
S832	35°13'43.38168"N	114°13'06.99900"W	3903156.537	207064.076	835.660	864.567
S833	35°14'36.71660"N	114°13'05.99426"W	3904799.606	207142.817	858.303	887.155
S834	35°15'35.20544"N	114°12'20.21990"W	3906564.866	208358.530	892.708	921.455
S835	35°16'21.12779"N	114°12'02.58243"W	3907965.880	208850.116	919.161	947.840
S836	35°16'20.76175"N	114°10'59.98856"W	3907903.644	210431.909	945.699	974.306
S837	35°17'00.63140"N	114°11'48.99216"W	3909172.373	209232.910	943.331	971.954
S838	35°17'30.85020"N	114°11'50.42112"W	3910104.944	209226.853	957.441	986.035
S839	35°15'31.36199"N	114°10'19.15019"W	3906347.965	211415.438	938.450	967.058
S840	35°14'35.98874"N	114°10'58.37402"W	3904673.042	210369.055	890.414	919.133
S841	35°14'35.90151"N	114°09'55.48036"W	3904619.462	211959.265	926.453	955.092
S842	35°14'35.17900"N	114°08'59.34796"W	3904552.010	213377.884	959.661	988.224
S843	35°13'44.19526"N	114°08'50.27252"W	3902973.338	213557.509	935.768	964.377
S844	35°13'44.54463"N	114°08'21.62568"W	3902961.156	214282.319	971.408	999.978
S845	35°13'44.22181"N	114°09'53.97647"W	3903025.401	211946.474	891.560	920.254
S846	35°13'44.21870"N	114°10'57.07022"W	3903076.343	210350.834	862.779	891.553
S847	35°13'45.82551"N	114°12'02.68449"W	3903179.244	208693.040	845.872	874.718
S848	35°02'01.99200"N	114°08'23.56638"W	3881309.398	213549.699	702.147	731.418
S849	35°03'15.29964"N	114°08'25.71186"W	3883570.496	213566.493	715.377	744.594

Station	Latitude (NAD83)	Longitude (NAD83)	Northing (m)	Easting (m)	Height (m)	Elevation (m)
S850	35°05'00.27966"N	114°08'23.79101"W	3886804.519	213717.156	740.624	769.747
S851	35°05'00.05403"N	114°10'31.08678"W	3886899.826	210491.886	710.653	739.924
S852	35°04'07.67286"N	114°09'27.20791"W	3885233.932	212059.087	708.647	737.893
S853	35°03'14.27050"N	114°10'31.90869"W	3883640.130	210367.133	679.703	709.066
S854	35°01'30.95059"N	114°10'30.58434"W	3880454.644	210299.273	652.139	681.576
S855	35°00'38.96718"N	114°10'30.85717"W	3878852.691	210241.353	642.326	671.798
S856	35°00'38.70269"N	114°09'27.39887"W	3878793.465	211850.249	661.350	690.758
S857	35°02'22.55722"N	114°09'28.14977"W	3881994.938	211932.562	680.340	709.670
S858	35°02'23.48789"N	114°12'36.12613"W	3882175.809	207168.493	641.879	671.391
S859	35°03'15.64070"N	114°12'37.64580"W	3883784.468	207181.747	655.463	684.937
S860	35°05'01.09841"N	114°12'37.30379"W	3887034.543	207295.166	682.475	711.862
S861	35°05'52.72609"N	114°13'41.26900"W	3888678.186	205726.168	690.655	720.042
S862	35°05'01.09029"N	114°14'44.54131"W	3887138.795	204071.519	687.319	716.778
S863	35°04'09.35097"N	114°14'43.63642"W	3885543.348	204042.479	677.433	706.931
S864	35°04'08.05439"N	114°15'48.61346"W	3885557.180	202394.633	698.112	727.619
S865	35°03'16.16495"N	114°17'14.73066"W	3884029.593	200159.599	756.487	786.030
S866	35°03'19.09723"N	114°17'39.90947"W	3884141.048	199524.426	801.936	831.481
S867	35°04'09.14677"N	114°17'14.24522"W	3885662.202	200225.785	748.201	777.706
S868	35°05'00.04580"N	114°16'50.96122"W	3887211.568	200867.496	734.792	764.262
S869	35°09'22.50054"N	114°08'19.98553"W	3894883.352	214068.538	802.204	831.068
S870	35°08'15.63364"N	114°08'22.66100"W	3892824.588	213935.738	804.656	833.593
S871	35°09'24.90940"N	114°09'55.72742"W	3895034.446	211647.445	770.012	798.983
S872	35°10'41.74371"N	114°10'04.82929"W	3897409.921	211492.550	788.560	817.463
S873	35°11'59.82461"N	114°11'03.09983"W	3899863.637	210095.125	808.021	836.913
S874	35°11'59.80903"N	114°13'03.14551"W	3899961.062	207058.049	793.456	822.467
S875	35°11'07.51010"N	114°14'07.74072"W	3898402.204	205371.310	775.879	804.994
S876	35°09'23.18161"N	114°14'16.34776"W	3895193.683	205048.731	743.398	772.617
S877	35°09'21.86354"N	114°15'32.20520"W	3895215.812	203127.208	750.980	780.240
S878	35°08'30.19947"N	114°16'50.36688"W	3893688.488	201096.117	770.755	800.072
S879	35°07'38.33003"N	114°17'54.49847"W	3892143.458	199419.401	818.289	847.641
S880	35°08'30.27318"N	114°18'25.97656"W	3893770.952	198675.536	843.464	872.781
S881	35°08'29.70116"N	114°14'45.47775"W	3893569.356	204257.540	733.733	763.017
S882	35°08'29.63060"N	114°13'41.73985"W	3893514.647	205871.165	728.714	757.960
S883	35°07'37.84244"N	114°13'40.95770"W	3891917.799	205839.157	716.326	745.619
S884	34°37'07.93762"N	114°02'05.67482"W	3834967.878	221735.017	569.845	599.945
S885	34°34'26.37873"N	113°59'32.08090"W	3829872.001	225500.393	604.047	634.125
S886	34°28'26.33980"N	113°54'37.92967"W	3818557.521	232678.741	571.636	601.736
S887	34°28'26.34525"N	113°53'50.35626"W	3818522.828	233892.852	580.932	611.004
S888	34°27'46.14521"N	113°53'12.13178"W	3817256.131	234833.009	573.037	603.114
S889	34°37'08.45493"N	114°04'18.43874"W	3835086.326	218353.001	555.351	585.473
S890	34°37'08.31184"N	114°05'04.94050"W	3835118.112	217168.107	561.240	591.360
S891	34°36'15.86663"N	114°00'52.35523"W	3833307.090	223555.002	591.563	621.646
S892	34°36'15.85458"N	113°59'49.54371"W	3833258.989	225155.529	612.898	642.940
S893	34°36'16.03485"N	113°57'57.82992"W	3833180.342	228002.317	657.392	687.332
S894	34°36'15.87691"N	113°56'53.02560"W	3833127.032	229653.466	686.578	716.450
S895	34°36'16.10712"N	113°55'46.15086"W	3833084.446	231357.710	717.021	746.819

Station	Latitude (NAD83)	Longitude (NAD83)	Northing (m)	Easting (m)	Height (m)	Elevation (m)
S896	34°36'16.06517"N	113°54'49.42363"W	3833041.258	232803.133	746.156	775.893
S897	34°36'15.71276"N	113°52'41.92948"W	3832937.066	236051.462	802.819	832.421
S898	34°37'08.39607"N	113°50'37.14518"W	3834470.319	239276.827	863.764	893.195
S899	34°37'08.31919"N	113°51'41.57143"W	3834514.413	237635.444	844.356	873.847
S900	34°37'07.98246"N	113°52'45.39108"W	3834550.350	236009.276	820.973	850.529
S901	34°37'08.49587"N	113°53'47.55556"W	3834611.560	234426.015	792.095	821.716
S902	34°37'08.42793"N	113°55'54.40916"W	3834702.931	231194.185	725.200	754.964
S903	34°37'09.00240"N	113°57'11.60832"W	3834778.069	229227.932	686.698	716.549
S904	34°37'08.15357"N	114°00'05.93861"W	3834883.152	224785.767	610.555	640.582
S905	34°40'00.72847"N	113°53'31.10597"W	3839907.160	234997.510	904.818	934.234
S906	34°39'44.87489"N	113°53'49.72607"W	3839432.238	234509.351	880.270	909.726
S907	34°39'45.02463"N	113°54'50.02322"W	3839481.172	232974.140	835.942	865.471
S908	34°39'44.83241"N	113°55'54.24103"W	3839522.732	231338.783	790.711	820.320
S909	34°39'45.15241"N	113°56'56.65740"W	3839579.023	229749.748	750.586	780.274
S910	34°40'37.40430"N	114°00'05.56654"W	3841331.511	224987.488	657.553	687.413
S911	34°40'36.45065"N	114°02'27.45671"W	3841410.601	221374.156	584.001	614.002
S912	34°38'52.11046"N	114°02'27.71889"W	3838195.223	221270.322	565.488	595.558
S913	34°38'00.47299"N	114°01'23.95639"W	3836554.955	222846.481	586.213	616.271
S914	34°38'52.66410"N	114°00'20.52070"W	3838115.007	224510.370	619.978	649.950
S915	34°38'52.23217"N	113°58'14.71829"W	3838006.608	227713.925	683.716	713.553
S916	34°38'00.65835"N	113°58'14.33064"W	3836416.944	227676.914	667.078	696.960
S917	34°38'00.97491"N	113°57'11.57658"W	3836379.693	229275.691	700.931	730.740
S918	34°38'52.53160"N	113°57'11.09445"W	3837968.169	229334.563	719.271	749.031
S919	34°38'52.24802"N	113°56'08.53111"W	3837912.837	230927.655	756.338	786.021
S920	34°38'00.35787"N	113°56'08.04453"W	3836313.372	230893.435	735.429	765.163
S921	34°38'01.04811"N	113°55'05.43657"W	3836288.304	232488.804	771.306	800.964
S922	34°38'52.59321"N	113°55'04.69811"W	3837876.220	232553.639	796.670	826.274
S923	34°38'52.16288"N	113°54'02.23390"W	3837816.995	234144.062	835.408	864.939
S924	34°38'00.24817"N	113°54'01.92928"W	3836216.929	234105.743	804.968	834.553
S925	34°38'52.43109"N	113°52'59.40010"W	3837779.302	235744.509	878.004	907.463
S926	34°37'58.54675"N	113°50'53.71862"W	3836027.697	238898.295	882.657	912.050
S927	34°37'02.16574"N	113°49'43.31742"W	3834239.730	240642.740	887.077	916.467
S928	34°37'47.39510"N	113°49'23.76020"W	3835619.543	241180.038	901.142	930.467
S929	34°38'39.78439"N	113°50'37.51266"W	3837286.821	239346.966	912.781	942.112
S930	34°39'30.96852"N	113°50'37.79530"W	3838864.327	239384.318	948.473	977.744
S931	34°39'31.34632"N	113°51'25.50873"W	3838910.372	238169.687	953.384	982.701
S932	34°40'36.98075"N	113°54'50.13336"W	3841082.385	233017.696	862.613	892.081
S933	34°40'36.90454"N	113°55'52.62575"W	3841126.249	231426.655	818.765	848.312
S934	34°41'29.68433"N	113°55'00.00686"W	3842713.838	232813.421	887.882	917.298
S935	34°44'49.13690"N	113°58'09.23871"W	3849001.450	228178.240	848.720	878.150
S936	34°44'06.27550"N	113°59'01.79652"W	3847720.172	226802.060	790.739	820.288
S937	34°44'06.09146"N	114°02'11.36076"W	3847859.004	221979.088	665.083	694.870
S938	34°43'13.73346"N	114°01'23.88888"W	3846208.995	223138.303	675.570	705.354
S939	34°43'13.65710"N	113°59'01.54350"W	3846098.393	226760.346	771.400	801.009
S940	34°42'21.46173"N	113°59'18.49853"W	3844502.661	226281.089	738.288	767.978

Appendix B

Gravity Results

Table 4. Gravity results. Meter is the serial number of the gravity meter used to make the gravity measurement; Obs Date is the observation date; Gobs is the observed gravity value in mGal; Gn is the normal gravity (or theoretical gravity) in mGal; FAC is the free-air correction in mGal; BC is the Bouguer correction in mGal; TTC is the total terrain correction (sum of the inner zone correction and the outer zone correction) in mGal; CC is the curvature correction in mGal; CBA is the Complete Bouguer Anomaly in mGal. DOLANCA and RADAR are excenters for absolute gravity stations.

Station	Meter	Obs Date	Gobs(mgal)	Gn(mgal)	FAC(mgal)	BC(mgal)	TTC(mgal)	CC(mgal)	CBA(mgal)
ADOTGRAV	Both	Various	979413.615	979752.006	323.733	117.443	0.461	1.147	-132.787
DOLANCA	Both	Various	979446.531	979784.320	339.196	123.053	1.138	1.183	-121.690
RADAR	Both	10/03/2006	979395.220	979749.636	355.615	129.009	2.169	1.218	-126.859
Q262	411	07/25/2006	979408.936	979754.442	317.890	115.323	0.426	1.133	-143.646
B391	Both	Various	979511.369	979715.071	145.194	52.673	0.540	0.611	-111.252
S292	711395	08/28/2006	979409.265	979767.752	360.058	130.621	1.030	1.227	-129.247
S293	711395	08/28/2006	979402.670	979768.577	374.011	135.683	1.282	1.256	-127.552
S294	711395	08/28/2006	979392.168	979767.958	391.155	141.902	2.277	1.288	-125.548
S295	711395	08/28/2006	979374.167	979767.566	416.513	151.102	3.721	1.333	-125.599
S296	711395	08/28/2006	979399.988	979767.301	373.636	135.547	1.536	1.255	-128.942
S297	711395	08/28/2006	979405.583	979767.396	363.888	132.010	1.260	1.235	-129.910
S298	711395	08/28/2006	979400.259	979766.263	372.190	135.022	2.025	1.252	-128.064
S299	711395	08/28/2006	979411.254	979766.059	340.201	123.417	0.707	1.185	-138.499
S300	711395	08/28/2006	979405.972	979766.049	349.743	126.879	0.879	1.206	-137.539
S301	711395	08/28/2006	979412.371	979764.876	332.623	120.668	0.649	1.168	-141.070
S302	711395	08/28/2006	979416.073	979765.365	330.010	119.720	0.597	1.162	-139.568
S303	711395	08/29/2006	979414.239	979763.742	327.024	118.637	0.591	1.155	-141.680
S304	711395	08/29/2006	979418.874	979762.299	317.514	115.187	0.565	1.133	-141.666
S305	711395	08/29/2006	979424.553	979762.295	313.816	113.845	0.561	1.124	-138.334
S306	711395	08/29/2006	979433.155	979762.314	310.406	112.608	1.255	1.115	-131.222
S307	711395	08/29/2006	979427.147	979763.530	316.057	114.658	0.780	1.129	-135.333
S308	711395	08/29/2006	979420.189	979763.523	320.188	116.157	0.552	1.139	-139.890
S309	711395	08/29/2006	979430.257	979761.049	306.750	111.282	0.531	1.106	-135.900
S310	711395	08/29/2006	979423.714	979761.045	311.037	112.837	0.539	1.117	-139.709
S311	711395	08/29/2006	979440.832	979761.055	305.396	110.791	0.833	1.103	-125.887
S312	711395	08/29/2006	979450.442	979759.753	297.507	107.929	0.823	1.083	-119.992
S313	711395	08/29/2006	979438.265	979759.754	299.776	108.752	0.499	1.089	-131.055
S314	711395	08/29/2006	979425.259	979759.946	307.667	111.615	0.533	1.109	-139.211
S315	711395	08/29/2006	979432.566	979758.701	299.372	108.605	0.484	1.088	-135.972
S316	711395	08/29/2006	979427.756	979758.895	303.461	110.089	0.532	1.098	-138.333
S317	711395	08/29/2006	979421.538	979759.746	313.401	113.695	0.627	1.123	-138.999
S318	711395	08/29/2006	979428.336	979758.391	303.247	110.011	0.562	1.098	-137.356
S319	711395	08/29/2006	979438.329	979755.913	286.532	103.947	0.456	1.055	-135.598
S320	711395	08/29/2006	979445.122	979754.804	278.574	101.060	0.423	1.034	-132.780
S321	711395	08/29/2006	979450.242	979753.571	272.343	98.800	0.413	1.017	-130.389
S322	711395	09/11/2006	979495.921	979719.980	172.029	62.408	0.727	0.706	-114.417
S323	711395	09/11/2006	979492.325	979719.976	181.857	65.974	0.716	0.740	-111.792
S324	711395	09/11/2006	979485.701	979721.182	197.278	71.568	0.814	0.792	-109.748
S325	711395	09/11/2006	979463.161	979721.842	231.943	84.144	1.202	0.901	-110.581
S326	711395	09/11/2006	979427.496	979722.098	281.033	101.952	3.129	1.040	-113.433
S327	711395	09/11/2006	979417.998	979722.525	294.011	106.661	3.726	1.074	-114.525
S328	711395	09/11/2006	979443.268	979722.474	258.182	93.663	2.513	0.978	-113.152
S329	711395	09/11/2006	979430.892	979721.013	278.089	100.884	2.037	1.033	-111.912

Station	Meter	Obs Date	Gobs(mgal)	Gn(mgal)	FAC(mgal)	BC(mgal)	TTC(mgal)	CC(mgal)	CBA(mgal)
S330	711395	09/11/2006	979414.063	979720.018	300.019	108.840	2.297	1.090	-113.569
S331	711395	09/11/2006	979409.759	979719.685	305.994	111.008	2.488	1.105	-113.556
S332	711395	09/11/2006	979437.558	979719.951	267.626	97.089	1.497	1.004	-111.362
S333	711395	09/11/2006	979432.125	979720.233	275.362	99.895	1.735	1.025	-111.931
S334	711395	09/12/2006	979489.534	979718.770	187.002	67.840	0.728	0.758	-110.103
S335	711395	09/12/2006	979475.224	979720.043	213.606	77.491	0.906	0.844	-108.642
S336	711395	09/12/2006	979485.266	979717.535	193.609	70.237	0.731	0.780	-108.946
S337	711395	09/12/2006	979497.141	979717.362	166.281	60.323	0.663	0.686	-114.285
S338	711395	09/12/2006	979459.539	979717.539	233.675	84.772	0.955	0.906	-109.049
S339	711395	09/12/2006	979469.027	979718.722	223.264	80.995	0.926	0.874	-107.374
S340	711395	09/12/2006	979448.683	979718.757	251.264	91.153	1.157	0.958	-109.764
S341	711395	09/12/2006	979435.928	979717.562	262.632	95.277	1.203	0.990	-114.066
S342	711395	09/12/2006	979424.088	979718.739	282.845	102.610	1.516	1.045	-113.944
S343	711395	09/12/2006	979427.565	979717.535	277.052	100.508	1.509	1.030	-112.947
S344	711395	09/12/2006	979448.363	979716.312	244.986	88.875	0.991	0.940	-111.787
S345	711395	09/12/2006	979468.235	979716.325	219.848	79.756	0.823	0.864	-108.039
S346	711395	09/12/2006	979484.861	979716.328	192.918	69.986	0.695	0.777	-108.617
S347	711395	09/12/2006	979496.307	979716.325	165.694	60.110	0.631	0.684	-114.488
S348	711395	09/12/2006	979501.054	979715.317	158.462	57.486	0.554	0.659	-113.393
S349	711395	09/12/2006	979487.614	979715.258	180.886	65.621	0.620	0.737	-112.496
S350	711395	09/12/2006	979472.677	979715.379	208.237	75.544	0.732	0.827	-110.103
S351	711395	09/12/2006	979481.394	979714.009	190.038	68.942	0.622	0.768	-111.664
S352	711395	09/12/2006	979496.440	979714.058	168.180	61.012	0.540	0.693	-110.603
S353	711395	09/12/2006	979508.226	979714.041	147.870	53.644	0.493	0.620	-111.716
S354	711395	09/12/2006	979507.149	979712.847	148.596	53.907	0.445	0.623	-111.188
S355	711395	09/21/2006	979477.909	979722.484	210.012	76.188	0.924	0.833	-110.659
S356	711395	09/21/2006	979460.348	979722.475	235.696	85.505	1.290	0.912	-111.558
S357	711395	09/21/2006	979440.494	979723.683	263.115	95.452	1.802	0.992	-114.717
S358	711395	09/21/2006	979451.703	979724.906	249.558	90.534	1.670	0.953	-113.462
S359	711395	09/21/2006	979465.509	979723.695	227.948	82.694	1.154	0.889	-112.668
S360	711395	09/21/2006	979484.040	979723.705	201.037	72.932	0.870	0.804	-111.493
S361	711395	09/21/2006	979476.986	979724.864	214.723	77.897	1.076	0.848	-110.824
S362	711395	09/21/2006	979466.755	979726.149	230.999	83.801	1.449	0.898	-111.646
S363	711395	09/21/2006	979484.691	979726.144	204.397	74.150	0.974	0.815	-111.048
S364	711395	09/21/2006	979491.266	979726.138	191.445	69.452	0.745	0.772	-112.907
S365	711395	09/21/2006	979488.709	979724.911	194.295	70.486	0.807	0.782	-112.367
S366	711395	09/21/2006	979495.032	979725.306	183.805	66.680	0.718	0.747	-113.178
S367	711395	09/21/2006	979469.182	979746.198	246.572	89.451	0.556	0.944	-120.283
S368	711395	09/21/2006	979469.786	979746.162	238.183	86.408	0.456	0.920	-125.064
S369	711395	09/21/2006	979465.564	979746.166	237.570	86.185	0.404	0.918	-129.731
S370	711395	09/21/2006	979468.313	979744.901	232.741	84.433	0.412	0.903	-128.771
S401	711395	09/18/2006	979412.305	979699.504	289.510	105.028	0.496	1.063	-103.284
S402	711395	09/18/2006	979434.236	979695.915	258.969	93.948	0.480	0.980	-97.158
S403	711395	09/18/2006	979447.597	979692.645	237.458	86.144	0.626	0.917	-94.025
S404	711395	09/18/2006	979451.253	979689.690	231.639	84.033	0.651	0.900	-91.081
S405	711395	09/18/2006	979452.553	979688.821	227.713	82.609	0.602	0.888	-91.450
S406	711395	09/18/2006	979461.258	979688.345	212.317	77.024	0.424	0.840	-92.209
S407	711395	09/18/2006	979462.870	979687.173	206.126	74.778	0.380	0.820	-93.395
S408	711395	09/18/2006	979468.486	979687.364	198.364	71.962	0.332	0.795	-92.939
S409	711395	09/18/2006	979466.749	979687.319	192.114	69.695	0.296	0.775	-98.629
S410	711395	09/18/2006	979478.004	979685.850	180.504	65.483	0.318	0.736	-93.242
S411	711395	09/18/2006	979486.281	979685.072	171.591	62.249	0.356	0.705	-89.798

Station	Meter	Obs Date	Gobs(mgal)	Gn(mgal)	FAC(mgal)	BC(mgal)	TTC(mgal)	CC(mgal)	CBA(mgal)
S412	711395	09/18/2006	979493.779	979685.043	169.144	61.362	0.446	0.696	-83.732
S413	711395	09/18/2006	979485.531	979685.926	173.573	62.968	0.330	0.712	-90.172
S414	711395	09/18/2006	979474.928	979687.102	179.414	65.088	0.281	0.732	-98.298
S415	711395	09/18/2006	979475.462	979688.296	181.851	65.971	0.262	0.740	-97.433
S416	711395	09/18/2006	979471.166	979689.574	187.897	68.165	0.254	0.761	-99.183
S417	711395	09/18/2006	979480.077	979684.654	184.307	66.862	0.318	0.748	-87.561
S418	711395	09/18/2006	979482.005	979683.422	179.872	65.254	0.396	0.733	-87.135
S419	711395	09/18/2006	979481.567	979682.386	178.465	64.743	0.748	0.729	-87.079
S420	711395	09/18/2006	979466.908	979685.115	190.784	69.212	0.376	0.770	-97.029
S421	711395	09/18/2006	979463.838	979685.215	195.961	71.090	0.368	0.787	-96.925
S422	711395	09/18/2006	979470.461	979686.288	194.938	70.719	0.368	0.784	-92.024
S423	711395	09/19/2006	979519.247	979715.961	138.597	50.280	0.774	0.586	-108.210
S424	711395	09/19/2006	979551.762	979711.295	111.169	40.330	0.417	0.482	-88.758
S425	711395	09/19/2006	979583.195	979707.734	102.449	37.166	0.479	0.447	-59.224
S426	711395	09/19/2006	979599.934	979708.672	75.219	27.288	0.394	0.336	-60.749
S427	711395	09/19/2006	979592.147	979713.515	59.848	21.711	0.290	0.271	-83.213
S428	711395	09/19/2006	979587.024	979712.842	68.381	24.807	0.292	0.307	-82.259
S429	711395	09/19/2006	979575.760	979712.828	78.103	28.334	0.311	0.348	-87.336
S430	711395	09/19/2006	979579.082	979711.689	79.771	28.939	0.314	0.355	-81.816
S431	711395	09/19/2006	979567.529	979712.835	89.817	32.584	0.311	0.396	-88.158
S432	711395	09/19/2006	979559.222	979714.107	97.485	35.365	0.337	0.427	-92.856
S433	711395	09/19/2006	979561.490	979712.843	97.527	35.381	0.338	0.427	-89.296
S434	711395	09/19/2006	979560.335	979711.623	97.829	35.490	0.338	0.429	-89.040
S435	711395	09/19/2006	979556.474	979711.626	103.801	37.657	0.342	0.453	-89.118
S436	711395	09/19/2006	979570.675	979711.620	86.625	31.426	0.324	0.383	-85.804
S437	711395	09/19/2006	979468.069	979714.089	214.409	77.783	0.737	0.847	-109.503
S438	711395	09/19/2006	979460.223	979713.166	224.082	81.292	0.781	0.877	-110.249
S439	711395	09/19/2006	979449.179	979714.071	242.126	87.838	0.904	0.931	-110.631
S440	711395	09/19/2006	979474.283	979712.857	197.759	71.743	0.633	0.793	-112.717
S441	711395	09/19/2006	979487.167	979712.859	176.622	64.074	0.546	0.722	-113.320
S442	711395	09/19/2006	979487.744	979711.627	173.291	62.866	0.514	0.711	-113.655
S443	711395	09/19/2006	979479.369	979711.623	183.161	66.447	0.553	0.745	-115.731
S444	711395	09/19/2006	979465.207	979711.632	206.854	75.042	0.651	0.823	-114.784
S445	711395	09/19/2006	979455.474	979711.632	232.330	84.284	0.778	0.902	-108.236
S446	711395	09/19/2006	979462.524	979707.937	203.623	73.870	0.582	0.812	-115.890
S447	711395	09/19/2006	979448.233	979707.945	228.975	83.067	0.701	0.892	-113.995
S448	711395	09/19/2006	979432.050	979707.948	254.041	92.160	0.896	0.966	-114.088
S449	711395	09/19/2006	979427.308	979707.624	262.262	95.143	0.944	0.989	-113.242
S450	711395	09/19/2006	979434.811	979709.182	255.512	92.694	1.110	0.970	-111.413
S451	711395	09/19/2006	979423.702	979698.135	271.762	98.589	0.465	1.015	-101.811
S452	711395	09/19/2006	979432.291	979698.136	259.026	93.969	0.435	0.980	-101.334
S453	711395	09/19/2006	979441.418	979696.600	239.085	86.735	0.374	0.922	-103.379
S454	711395	09/19/2006	979445.603	979695.538	226.326	82.106	0.331	0.884	-106.267
S455	711395	09/19/2006	979449.953	979694.844	217.372	78.858	0.317	0.856	-106.916
S763	Both	Various	979456.038	979754.823	277.811	100.784	0.540	1.032	-122.249
S764	411	08/30/2006	979448.176	979757.303	290.843	105.511	0.572	1.066	-124.289
S765	411	08/30/2006	979444.971	979758.523	298.509	108.292	0.604	1.086	-123.817
S766	411	08/30/2006	979444.011	979759.747	306.446	111.172	0.737	1.106	-120.830
S767	411	08/30/2006	979435.447	979761.028	319.328	115.845	1.033	1.137	-122.202
S768	411	08/30/2006	979423.851	979762.264	333.652	121.041	0.943	1.170	-126.030
S769	411	08/30/2006	979412.143	979763.486	350.569	127.178	1.144	1.207	-128.016
S770	411	08/30/2006	979442.987	979758.510	306.057	111.031	0.757	1.105	-120.845

Station	Meter	Obs Date	Gobs(mgal)	Gn(mgal)	FAC(mgal)	BC(mgal)	TTC(mgal)	CC(mgal)	CBA(mgal)
S771	411	08/30/2006	979428.927	979760.262	327.514	118.815	1.022	1.156	-122.770
S772	411	08/30/2006	979432.050	979757.489	325.202	117.976	1.291	1.151	-118.073
S773	411	08/30/2006	979415.181	979758.502	350.433	127.129	2.210	1.207	-119.014
S774	411	08/30/2006	979397.483	979759.705	375.868	136.357	2.834	1.259	-121.135
S775	411	08/30/2006	979399.534	979759.795	374.584	135.890	2.642	1.257	-120.183
S776	411	08/30/2006	979401.762	979758.558	372.624	135.179	2.837	1.253	-117.768
S777	411	08/30/2006	979392.971	979757.260	382.321	138.698	2.920	1.272	-119.017
S778	411	08/30/2006	979384.207	979756.048	389.934	141.459	2.791	1.286	-121.862
S779	411	08/30/2006	979378.689	979755.163	395.342	143.421	2.800	1.296	-123.049
S780	411	08/30/2006	979397.321	979760.957	379.930	137.830	1.850	1.267	-120.954
S781	411	08/30/2006	979406.875	979761.774	364.681	132.298	2.068	1.237	-121.685
S782	411	08/30/2006	979412.900	979762.602	355.677	129.031	1.585	1.218	-122.689
S783	711395	09/05/2006	979451.733	979754.796	285.068	103.416	0.653	1.051	-121.809
S784	711395	09/05/2006	979450.587	979754.795	296.470	107.553	0.867	1.081	-115.505
S785	711395	09/05/2006	979440.518	979754.687	311.281	112.926	1.327	1.117	-115.603
S786	711395	09/05/2006	979431.398	979754.215	323.438	117.336	1.929	1.147	-115.934
S787	711395	09/05/2006	979444.623	979753.570	307.907	111.702	1.021	1.109	-112.830
S788	711395	09/05/2006	979450.474	979753.564	296.410	107.531	0.820	1.080	-114.471
S789	711395	09/05/2006	979450.270	979753.567	280.973	101.931	0.629	1.040	-124.666
S790	711395	09/05/2006	979457.167	979753.560	273.220	99.118	0.524	1.019	-122.786
S791	711395	09/05/2006	979460.717	979753.580	269.238	97.673	0.454	1.009	-121.854
S792	711395	09/05/2006	979457.260	979753.557	269.606	97.807	0.409	1.010	-125.100
S793	711395	09/05/2006	979458.585	979752.317	263.849	95.718	0.404	0.994	-126.192
S794	711395	09/05/2006	979455.414	979752.325	265.219	96.216	0.386	0.997	-128.518
S795	711395	09/05/2006	979453.572	979753.583	271.059	98.334	0.394	1.014	-127.906
S796	711395	09/05/2006	979450.047	979754.797	276.648	100.362	0.407	1.029	-129.086
S797	711395	09/05/2006	979453.721	979754.818	275.414	99.914	0.422	1.025	-126.200
S798	711395	09/05/2006	979451.093	979756.030	283.097	102.701	0.558	1.046	-125.029
S799	711395	09/05/2006	979446.069	979757.274	296.207	107.457	0.709	1.080	-122.826
S800	711395	09/05/2006	979443.922	979756.036	301.808	109.489	0.892	1.094	-119.998
S801	711395	09/05/2006	979438.133	979757.271	315.748	114.546	0.972	1.128	-118.092
S802	711395	09/06/2006	979453.378	979756.063	279.117	101.257	0.496	1.035	-125.364
S803	711395	09/06/2006	979452.413	979756.057	281.319	102.056	0.434	1.041	-124.988
S804	711395	09/06/2006	979454.287	979757.291	286.845	104.061	0.466	1.056	-120.811
S805	711395	09/06/2006	979454.468	979757.326	286.612	103.976	0.515	1.055	-120.762
S806	711395	09/06/2006	979455.693	979758.540	293.521	106.483	0.573	1.073	-116.309
S807	711395	09/06/2006	979453.746	979759.134	297.476	107.918	0.678	1.083	-116.234
S808	711395	09/06/2006	979442.569	979758.409	309.740	112.367	1.251	1.114	-118.331
S809	711395	09/06/2006	979449.742	979758.509	293.257	106.387	0.544	1.072	-122.426
S810	711395	09/06/2006	979442.151	979758.508	294.634	106.887	0.462	1.076	-129.223
S811	711395	09/06/2006	979437.276	979757.844	294.275	106.756	0.458	1.075	-133.666
S812	711395	09/06/2006	979440.741	979756.929	288.809	104.773	0.444	1.061	-132.770
S813	711395	09/06/2006	979443.373	979755.712	282.816	102.599	0.423	1.045	-132.745
S814	711395	09/06/2006	979444.767	979757.265	288.474	104.652	0.436	1.060	-129.300
S815	711395	09/06/2006	979455.307	979749.845	266.783	96.783	0.505	1.002	-125.034
S816	711395	09/06/2006	979450.718	979749.260	294.320	106.773	0.985	1.075	-111.084
S817	711395	09/06/2006	979440.251	979749.239	307.254	111.465	1.716	1.108	-112.591
S818	711395	09/06/2006	979429.428	979749.130	321.618	116.676	1.913	1.142	-113.989
S819	711395	09/06/2006	979422.840	979748.724	336.452	122.057	1.608	1.176	-111.058
S820	711395	09/06/2006	979407.855	979749.242	358.269	129.972	3.013	1.224	-111.301
S821	711395	09/06/2006	979410.903	979750.082	349.575	126.818	1.870	1.205	-115.757
S822	711395	09/06/2006	979432.934	979750.778	318.999	115.726	1.520	1.136	-114.186

Station	Meter	Obs Date	Gobs(mgal)	Gn(mgal)	FAC(mgal)	BC(mgal)	TTC(mgal)	CC(mgal)	CBA(mgal)
S823	711395	09/06/2006	979450.504	979751.650	294.880	106.976	0.837	1.077	-113.483
S824	711395	09/06/2006	979453.636	979751.018	280.167	101.638	0.629	1.038	-119.263
S825	711395	09/06/2006	979460.119	979748.623	280.583	101.789	0.681	1.039	-110.068
S826	711395	09/06/2006	979453.066	979748.621	257.640	93.466	0.445	0.976	-131.912
S827	711395	09/06/2006	979461.695	979748.605	247.910	89.936	0.384	0.948	-129.500
S828	711395	09/06/2006	979457.530	979749.886	253.692	92.034	0.404	0.965	-131.258
S829	711395	09/06/2006	979455.827	979751.088	261.482	94.860	0.435	0.987	-129.191
S830	711395	09/06/2006	979457.778	979751.104	259.201	94.032	0.385	0.981	-128.754
S831	711395	09/06/2006	979457.486	979751.091	259.473	94.131	0.399	0.981	-128.845
S832	711395	09/06/2006	979451.037	979752.321	266.805	96.791	0.445	1.002	-131.826
S833	711395	09/06/2006	979446.024	979753.582	273.776	99.320	0.457	1.021	-133.667
S834	711395	09/06/2006	979438.335	979754.967	284.361	103.160	0.522	1.049	-135.957
S835	711395	09/06/2006	979434.305	979756.054	292.503	106.114	0.570	1.070	-135.859
S836	711395	09/06/2006	979435.376	979756.045	300.671	109.077	0.698	1.091	-129.467
S837	711395	09/06/2006	979431.822	979756.989	299.945	108.813	0.619	1.089	-134.505
S838	711395	09/06/2006	979429.803	979757.704	304.290	110.390	0.630	1.100	-134.471
S839	711395	09/06/2006	979439.230	979754.876	298.434	108.265	0.789	1.086	-125.774
S840	711395	09/06/2006	979442.874	979753.565	283.644	102.900	0.641	1.047	-130.352
S841	711395	09/06/2006	979441.654	979753.563	294.741	106.926	0.816	1.076	-124.353
S842	711395	09/06/2006	979440.712	979753.546	304.966	110.635	1.207	1.102	-118.398
S843	711395	09/06/2006	979444.404	979752.340	297.607	107.965	1.089	1.083	-118.288
S844	711395	09/06/2006	979437.951	979752.348	308.593	111.951	1.510	1.111	-117.355
S845	711395	09/06/2006	979446.247	979752.340	283.990	103.025	0.774	1.048	-125.403
S846	711395	09/06/2006	979448.020	979752.340	275.133	99.812	0.622	1.025	-129.403
S847	711395	09/06/2006	979446.920	979752.378	269.938	97.927	0.515	1.010	-133.943
S848	711395	09/07/2006	979471.888	979735.747	225.716	81.885	0.635	0.882	-120.275
S849	711395	09/07/2006	979468.720	979737.477	229.782	83.360	0.621	0.894	-122.609
S850	711395	09/07/2006	979467.320	979739.956	237.544	86.176	0.606	0.918	-121.580
S851	711395	09/07/2006	979468.491	979739.951	228.341	82.837	0.463	0.890	-126.383
S852	711395	09/07/2006	979469.485	979738.714	227.714	82.609	0.532	0.888	-124.480
S853	711395	09/07/2006	979472.572	979737.453	218.818	79.382	0.482	0.861	-125.825
S854	711395	09/07/2006	979476.000	979735.015	210.334	76.305	0.517	0.834	-125.302
S855	711395	09/07/2006	979477.972	979733.788	207.317	75.210	0.526	0.824	-124.007
S856	711395	09/07/2006	979476.792	979733.782	213.168	77.332	0.571	0.843	-121.426
S857	711395	09/07/2006	979474.631	979736.233	219.004	79.450	0.556	0.861	-122.352
S858	711395	09/07/2006	979470.744	979736.254	207.191	75.164	0.479	0.824	-133.829
S859	711395	09/07/2006	979469.641	979737.486	211.372	76.681	0.462	0.837	-133.529
S860	711395	09/07/2006	979469.443	979739.975	219.681	79.695	0.432	0.863	-130.978
S861	711395	09/07/2006	979466.691	979741.195	222.205	80.611	0.433	0.871	-133.348
S862	711395	09/07/2006	979465.439	979739.975	221.198	80.246	0.499	0.868	-133.953
S863	711395	09/07/2006	979465.918	979738.754	218.159	79.143	0.515	0.859	-134.164
S864	711395	09/07/2006	979467.792	979738.723	224.543	81.459	0.640	0.878	-128.085
S865	711395	09/07/2006	979470.146	979737.498	242.569	87.998	1.308	0.933	-112.406
S866	711395	09/07/2006	979459.990	979737.567	256.595	93.087	1.839	0.973	-113.203
S867	711395	09/07/2006	979471.928	979738.749	240.000	87.067	1.095	0.925	-113.717
S868	711395	09/07/2006	979474.660	979739.951	235.851	85.562	0.854	0.913	-115.059
S869	711395	09/07/2006	979459.203	979746.151	256.468	93.041	0.751	0.973	-123.744
S870	711395	09/07/2006	979457.400	979744.571	257.247	93.323	0.559	0.975	-123.664
S871	711395	09/07/2006	979469.232	979746.208	246.566	89.449	0.556	0.944	-120.247
S872	711395	09/07/2006	979469.216	979748.025	252.269	91.518	0.650	0.961	-118.368
S873	711395	09/07/2006	979458.769	979749.871	258.271	93.695	0.577	0.978	-126.927
S874	711395	09/07/2006	979458.469	979749.871	253.813	92.078	0.427	0.965	-130.204

Station	Meter	Obs Date	Gobs(mgal)	Gn(mgal)	FAC(mgal)	BC(mgal)	TTC(mgal)	CC(mgal)	CBA(mgal)
S875	711395	09/07/2006	979460.882	979748.634	248.421	90.122	0.381	0.950	-130.021
S876	711395	09/07/2006	979463.522	979746.167	238.430	86.497	0.387	0.920	-131.245
S877	711395	09/07/2006	979461.435	979746.136	240.782	87.350	0.406	0.927	-131.791
S878	711395	09/07/2006	979462.141	979744.915	246.902	89.571	0.519	0.945	-125.869
S879	711395	09/07/2006	979462.458	979743.690	261.582	94.896	0.763	0.987	-114.770
S880	711395	09/07/2006	979458.261	979744.917	269.340	97.711	1.466	1.009	-114.569
S881	711395	09/07/2006	979464.545	979744.903	235.467	85.422	0.402	0.912	-130.823
S882	711395	09/07/2006	979465.626	979744.902	233.906	84.856	0.394	0.907	-130.738
S883	711395	09/07/2006	979465.677	979743.678	230.098	83.474	0.400	0.895	-131.873
S884	411	09/11/2006	979461.616	979700.582	185.143	67.166	0.337	0.751	-121.403
S885	411	09/11/2006	979459.822	979696.791	195.691	70.992	0.287	0.786	-112.770
S886	411	09/11/2006	979467.618	979688.351	185.696	67.366	0.253	0.753	-102.903
S887	411	09/11/2006	979464.923	979688.351	188.556	68.404	0.257	0.763	-103.782
S888	411	09/11/2006	979469.032	979687.410	186.121	67.520	0.270	0.755	-100.262
S889	411	09/11/2006	979478.452	979700.594	180.677	65.546	0.348	0.736	-107.399
S890	411	09/11/2006	979483.758	979700.591	182.494	66.205	0.362	0.742	-100.924
S891	411	09/11/2006	979456.315	979699.360	191.840	69.595	0.321	0.774	-121.253
S892	411	09/11/2006	979451.902	979699.360	198.411	71.979	0.336	0.795	-121.484
S893	411	09/11/2006	979448.838	979699.364	212.111	76.949	0.373	0.839	-115.831
S894	411	09/11/2006	979448.412	979699.360	221.096	80.209	0.394	0.868	-110.534
S895	411	09/11/2006	979446.190	979699.366	230.468	83.609	0.418	0.896	-106.795
S896	411	09/11/2006	979442.982	979699.365	239.441	86.864	0.437	0.923	-104.292
S897	411	09/11/2006	979435.042	979699.357	256.885	93.192	0.464	0.974	-101.131
S898	411	09/11/2006	979421.565	979700.593	275.640	99.996	0.539	1.026	-103.872
S899	411	09/11/2006	979424.985	979700.591	269.669	97.830	0.529	1.010	-104.248
S900	411	09/11/2006	979429.103	979700.583	262.473	95.219	0.528	0.990	-104.689
S901	411	09/11/2006	979434.093	979700.595	253.582	91.994	0.518	0.965	-105.361
S902	411	09/11/2006	979443.464	979700.594	232.982	84.521	0.474	0.904	-109.098
S903	411	09/11/2006	979446.766	979700.607	221.127	80.220	0.438	0.868	-113.365
S904	411	09/11/2006	979451.502	979700.587	197.684	71.715	0.366	0.793	-123.543
S905	411	09/12/2006	979411.834	979704.639	288.305	104.590	0.906	1.060	-109.245
S906	411	09/12/2006	979416.845	979704.267	280.741	101.847	0.839	1.040	-108.728
S907	411	09/12/2006	979425.590	979704.271	267.084	96.892	0.785	1.003	-108.707
S908	411	09/12/2006	979432.311	979704.266	253.151	91.837	0.718	0.963	-110.887
S909	411	09/12/2006	979436.538	979704.274	240.793	87.354	0.661	0.927	-114.563
S910	411	09/12/2006	979452.819	979705.501	212.136	76.958	0.588	0.840	-117.756
S911	411	09/12/2006	979462.974	979705.478	189.481	68.739	0.481	0.766	-122.047
S912	411	09/12/2006	979462.343	979703.028	183.789	66.675	0.399	0.747	-123.918
S913	411	09/12/2006	979456.264	979701.816	190.181	68.993	0.376	0.768	-124.755
S914	411	09/12/2006	979453.315	979703.041	200.575	72.764	0.452	0.802	-122.265
S915	411	09/12/2006	979445.079	979703.031	220.202	79.884	0.527	0.865	-117.972
S916	411	09/12/2006	979446.063	979701.820	215.082	78.027	0.467	0.849	-119.084
S917	411	09/12/2006	979443.349	979701.827	225.506	81.809	0.503	0.881	-115.159
S918	411	09/12/2006	979440.919	979703.038	231.151	83.856	0.571	0.899	-115.152
S919	411	09/12/2006	979436.677	979703.031	242.566	87.997	0.610	0.933	-112.108
S920	411	09/12/2006	979440.331	979701.813	236.129	85.662	0.534	0.914	-111.395
S921	411	09/12/2006	979435.498	979701.829	247.177	89.670	0.568	0.946	-109.202
S922	411	09/12/2006	979430.903	979703.039	254.988	92.504	0.661	0.969	-109.960
S923	411	09/12/2006	979426.147	979703.029	266.920	96.833	0.703	1.002	-107.094
S924	411	09/12/2006	979430.538	979701.810	257.543	93.431	0.603	0.976	-107.533
S925	411	09/12/2006	979416.341	979703.035	280.043	101.593	0.731	1.038	-108.551
S926	411	09/12/2006	979418.231	979701.770	281.459	102.107	0.617	1.042	-104.612

Station	Meter	Obs Date	Gobs(mgal)	Gn(mgal)	FAC(mgal)	BC(mgal)	TTC(mgal)	CC(mgal)	CBA(mgal)
S927	411	09/12/2006	979418.525	979700.447	282.822	102.601	0.577	1.045	-102.169
S928	411	09/12/2006	979415.335	979701.509	287.142	104.169	0.692	1.057	-103.566
S929	411	09/12/2006	979410.990	979702.739	290.736	105.472	0.709	1.066	-106.842
S930	411	09/12/2006	979403.063	979703.940	301.732	109.461	0.902	1.094	-108.799
S931	411	09/12/2006	979400.806	979703.949	303.262	110.016	0.855	1.098	-110.141
S932	411	09/12/2006	979419.981	979705.491	275.296	99.871	0.914	1.025	-110.196
S933	411	09/12/2006	979429.278	979705.489	261.789	94.971	0.828	0.988	-109.554
S934	411	09/12/2006	979414.623	979706.729	283.078	102.694	1.063	1.046	-111.705
S935	Both	Various	979426.787	979711.417	270.997	98.312	1.123	1.013	-111.835
S936	411	09/12/2006	979437.093	979710.409	253.141	91.834	0.912	0.963	-112.060
S937	411	09/12/2006	979461.222	979710.405	214.437	77.793	0.672	0.847	-112.713
S938	411	09/12/2006	979457.805	979709.174	217.672	78.967	0.666	0.857	-112.855
S939	411	09/12/2006	979438.659	979709.172	247.191	89.675	0.836	0.946	-113.107
S940	411	09/12/2006	979442.746	979707.946	236.998	85.978	0.750	0.916	-114.345