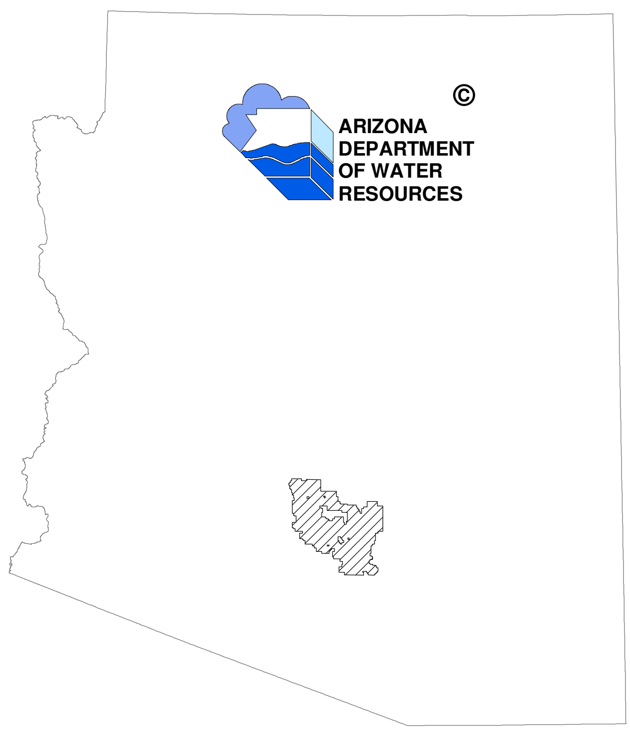
ARIZONA DEPARTMENT OF WATER RESOURCES

REGIONAL GROUNDWATER FLOW MODEL OF THE PINAL ACTIVE MANAGEMENT AREA PROVISIONAL REPORT GEOLOGY UPDATE



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HYDROLOGY DIVISION

MODELING REPORT NO. 20

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LIST OF ACRONYMS

ADWR	Arizona Department of Water Resources
AMA	Active Management Area
AMSL	Above Mean Sea Level
AZGS	Arizona Geological Survey
BLS	Below Land Surface
CAM	Central Arizona Model
GRIC	Gila River Indian Community
HBU	Hydrologic Bedrock Unit
LCU	Lower Conglomerate Unit
MSCU	Middle Silt and Clay Unit
OGCC	Oil and Gas Conservation Commission
SRV	Salt River Valley
UAU	Upper Alluvial Unit

ABSTRACT

The investigation of the geology in a model area is an important step in the development of any groundwater model because it is the basis for defining the geologic framework of the model and parameters such as hydraulic conductivity, storage and transmissivity.

The last time the Pinal model geology had been reviewed was in the Pinal Active Management Area Regional Groundwater Flow Model Phase One report published in 1989 and the Phase Two report published in 1990. Since that time the amount of geology information from wells drilled in the area has increased, but the overall quality of logs did not.

Many sources, besides driller logs, were reviewed to increase our understanding of the geology in this area and many changes were made as a result. Although the original hydrogeologic units (Upper Alluvial Unit, Middle Silt and Clay Unit, Lower Conglomerate Unit) were also represented in this geology update, a thin model Layer 2 was used in areas where the Middle Silt and Clay unit was absent in order to conform with model code requirements. Due to the absence of this unit in many areas of the model domain, the original version of the geology from 1990 combined the Middle Silt and Clay Unit with the Lower Conglomerate Unit to create a continuous layer for the groundwater model.

Some areas in the model domain had little data available, such as the Gila River Indian Reservation, the Ak-Chin Reservation, the Tohono O'odham Reservation, the Florence Gap area between the Pinal and SRV model areas, the area between the Pinal and Tucson model areas, and the model edges adjacent to bedrock.

The review included thousands of logs, consisting of driller logs, particle size logs, geologist logs, and geophysical logs. Out of all the logs reviewed, 1,993 of those logs were used and 1,882 of those logs were driller logs. The final representation of the geology for the Pinal groundwater model is very dependant on the quality of data used. Out of the 1,993 logs that were reviewed, 1,923 of the logs reviewed had very few intervals defined, very basic sample descriptions, and no geophysical logs or logs prepared by geologists to verify the information in the log submitted by the driller.

According to criteria established for the SRV geology which were also used during this review, such logs are of fair or poor quality.

The review resulted in a three layer representation of the geology in the Pinal model area, as well as a modified version of the geology which will be used in the Pinal regional groundwater model update.

1.0 Introduction

The process of updating the Pinal model geology was begun in 2007, and had not been addressed since Modeling Report No. 2 (Corkhill and Hill, 1990). The purpose of this provisional report is to document the data collection activities and findings of the hydrogeologic framework of the study area. This report will be finalized after the Pinal Active Management Area (AMA) Regional Groundwater Flow Model report which documents the update and recalibration of the groundwater flow model in Pinal County have been completed.

2.0 General Regional Setting

The Pinal AMA is located in south-central Arizona, and is further divided into five sub-basins; Aguirre Valley, Eloy, Maricopa-Stanfield, Santa Rosa Valley, and Vekol Valley (**Figure 1**). The Pinal AMA regional groundwater flow model area covers the Eloy and Maricopa-Stanfield sub-basins, because the greatest percentage of agricultural and urban groundwater withdrawals occurs within those sub-basins.

The Pinal model area also covers a portion or all of three Indian Reservations; the Tohono O'odham (formerly the Papago Indian Reservation) to the south, the Gila River Indian Reservation to the north, and the Ak-Chin Indian Reservation near the town of Maricopa (**Figure 2**).

The Pinal AMA is located within the Basin and Range Physiographic Province of Arizona, which was formed during the Cenozoic. During the Oligocene Epoch a period of intense tectonic activity began. This period of intense tectonic activity has been called the "Mid-Tertiary Orogeny" (Nations and Stump, 1996). During this orogeny, the landscape changed from one of a flat lying relatively stable landscape, to that of a tectonically active area characterized by basaltic volcanism, crustal melting, low-angle gravity-induced faulting, the formation of metamorphic core complexes, and the deposition of thick sequences of sediments in basins. Crustal extension caused a series of steeply-dipping normal faults. The subsiding fault-blocks formed grabens (or deep basins) and the stable blocks formed horsts (or mountain ranges) (Nations and Stump, 1996).

Metamorphic core complexes including South Mountain northeast of the Estrella Mountains and the Picacho Mountains east of Interstate 10 bound the model area to the northwest and southeast, respectively. The metamorphic core complexes exhibit a northeast orientation, unlike the fault block mountains which have a more northerly orientation. These mountain ranges are believed to be caused by thermal upwellings (Nations and Stump, 1996).

2.1 Geologic Overview

Four major hydrogeologic units were recognized in the Phase One report for the Pinal AMA Regional Groundwater Flow Model (Wickham and Corkhill, 1989) and were also used in this study. These units include the Upper Alluvial Unit (UAU), the Middle Silt and Clay Unit (MSCU), the Lower Conglomerate Unit (LCU), and the Hydrologic Bedrock Unit (HBU).

2.1.1 Depositional History of the Alluvial Units

As stated above, during the Mid-Tertiary Orogeny the area in the vicinity of the Lower Santa Cruz Basin was experiencing a period of tectonic activity which produced many of the features we see today in the landscape. Extensional forces resulted in the formation of grabens (basins) and horsts (mountains) which were separated by high-angle normal faults. Basaltic volcanism was also occurring during this time (Wickham and Corkhill, 1989).

Following faulting the basins slowly filled with alluvium from mass wasting of mountain material and from nearby streams and sheet erosion. Coarse materials were deposited close to the mountains and fine material settled towards the basin centers. Over time this material became consolidated due to physical and chemical processes associated with diagenesis. During this period of deposition the LCU was formed (Wickham and Corkhill, 1989).

After the LCU was deposited another period of tectonism occurred and an uplifted area (now referred to as the Casa Grande Ridge) became a sub-surface bedrock high which separated the area into two distinct depositional sub-basins: the Maricopa-Stanfield sub-basin to the west and the Eloy sub-basin to the east. The ridge trended north to south from the Sacaton Mountains to the Silver Reef Mountains. Rivers which flowed through the area were captured, which resulted in a low-energy lacustrine environment in the Eloy sub-basin. The same process was occurring in the Maricopa-Stanfield sub-basin. Over millions of years silt, clay, and evaporites (in the Eloy sub-basin) were deposited in these basins. During this period of deposition the MSCU was formed (Wickham and Corkhill, 1989). Since the Casa Grande Ridge was elevated above the basin floors at that time, no MSCU was deposited on the ridge and the exposed LCU was eroded over a period of several million years.

Once the deposition of silts and clays were sufficient for stream flow to be renewed between the basins, the deposition of the upper sand and gravel unit (or UAU) began and has continued to present day (Hardt and Cattany, 1965).

2.1.2 Sources of Geology Information

Many sources were reviewed during the geology update in an attempt to get the most accurate estimate possible for the thicknesses of the UAU, MSCU, and the LCU. Sources included the following:

- The SRV regional model geology (Freihoefer et. al., 2009) in the Florence Gap area,
- The Tucson regional model geology (Mason and Bota, 2006) where the Pinal model intersects the Tucson model in the south-east corner,
- ADWR imaged records (Fortis) for driller logs of registered 55 wells and Land Department registered 35 wells,
- *The Hydrologic History of the Gila River Indian Reservation* (Gookin Engineers,

Ltd., 2000) which helped with some background information on alluvial thickness in the Casa Grande Ridge area,

- The Arizona Geological Survey (AZGS) modification to the Oppenheimer, and Sumner. 1980. Depth to Bedrock Map (Richard, S.M, et al., 2007) for depth to bedrock in the deepest parts of the Eloy and Maricopa-Stanfield sub-basins (from 3,200 feet depth to bedrock to 9,600 feet depth to bedrock),
- *The Underground Waters of Gila Valley, Arizona* (Lee, 1904) which indicated that the Salt River, which currently flows on the north side of South Mountain, used to flow south of the east side of South Mountain and join up with the Gila River at that point. This fact assisted with the interpretation in the Gila River Indian Community (GRIC) area,
- The calibrated transmissivity from Plate 2 of *Predevelopment Hydrology of the Gila River Indian Reservation, South-Central Arizona* (Thomsen and Eychaner, 1991) assisted with the interpretation in the GRIC area,
- *Description and Analysis of the Geohydrologic System in Western Pinal County, Arizona* (Hardt and Cattany, 1965) which gave some geological background in the Casa Grande Ridge area and confirmed that there was little to no LCU on the ridge,
- Logs used by the USGS to produce *Hydrogeology of Picacho Basin, south-central Arizona* (Pool et. al., 2001) which provided some data we did not have west of the Picacho Mountains in the Eloy sub-basin,
- Various Oil and Gas Conservation Commission (OGCC) records from wells drilled for natural resources purposes,
- Reports submitted to ADWR for the Recharge or Assured Water Supply Programs.

2.2 Description of Hydrogeologic Units

The definitions of the UAU, MSCU, and LCU used in this study were based on descriptions provided in the Phase One report for the Pinal AMA Regional Groundwater Flow Model (Wickham and Corkhill, 1989). The descriptions are generalized here, but more detailed information on how these units were defined can be found in the Phase One report. The units are described in order from land surface to the top of bedrock.

2.2.1 Upper Alluvial Unit (UAU)

The UAU consists mainly of unconsolidated to slightly consolidated interbedded sands and gravels with some finer grained materials existing as lenses (Wickham and Corkhill, 1989). In some areas the lower part of the UAU has a transition zone, in which relatively coarse UAU material is interbedded with finer alluvial material which is typical of the MSCU.

2.2.2 Middle Silt and Clay Unit (MSCU)

The MSCU is a fine grained unit and consists predominantly of silt, clays and sands (Wickham and Corkhill, 1989). The MSCU is thickest in the basin centers and decreases in thickness towards the edges of the Casa Grande Ridge and area mountain ranges. In the Eloy sub-basin the MSCU also contains a sub-unit of evaporite deposits, mainly anhydrite. The MSCU is absent in the Casa Grande Ridge area.

2.2.3 Lower Conglomerate Unit (LCU)

The LCU is characterized by semi-consolidated to consolidated coarse sediments consisting of granite fragments, cobbles, boulders, sands and gravels (Wickham and Corkhill, 1989). This unit is the lower most water bearing unit in the model area and generally overlies impermeable bedrock.

2.3 Modifications to the Hydrogeologic Units in the Pinal Model Area

During this geology review, several interpretation changes or other area modifications were applied to the geological units. One modification was implemented due to the plan to include subsidence simulation capabilities into the Pinal regional groundwater model, and the others were implemented in the Casa Grande Ridge area which had depths to fractured bedrock as shallow as 50 feet.

2.3.1 UAU 2009 Interpretation Changes

During this geology review one change was made to the previous ADWR interpretation of the UAU. The transition zone between the UAU and MSCU, which had been included in the UAU according to the Phase One report for the Pinal AMA Regional Groundwater Flow Model (Wickham and Corkhill, 1989), was moved to the MSCU. The reason for this decision will be discussed further in the next section.

A change was also made on the ridge between the Eloy and Maricopa-Stanfield sub-basins, but the change did not involve the definition of the UAU. A decision was made to make the UAU in this ridge area no less than 150 feet thick.

Figures produced based on the new UAU interpretation includes: depth to the bottom of the UAU (**Figure 3**) and the UAU bottom elevation (**Figure 4**) (the UAU thickness is the same as the depth to the bottom of the UAU so no figure was produced).

2.3.2 MSCU 2009 Interpretation Changes

During this geology review one change was made to the interpretation of the MSCU. The logs reviewed indicated there was a transition zone between the UAU and the MSCU, which had been included within the UAU in the Phase One report for the Pinal AMA Regional Groundwater Flow Model (Wickham and Corkhill, 1989). This transition zone consisted of thick fine grained zones followed by thick sand and gravel zones. However, because the incorporation of subsidence was being considered for the Pinal regional model it made more sense to include the transition zone in the MSCU. By lumping the fine grained zones together as a single hydrogeologic unit, only three layers would be needed for the subsidence package. Based on my log review, five layers could be defined if attempting to incorporate subsidence due to this transition zone. However, then five layers would be needed throughout the entire model area and the transition zone was only evident in the Eloy sub-basin.

The interpretive methodology employed for the Pinal model geology update was consistent with how the middle alluvial unit in the SRV regional model area was defined (Dubas and Davis, 2006), which will make the process of joining the SRV and Pinal model areas at some time in the future much easier.

Figures produced based on the new MSCU interpretation includes: depth to the bottom of the MSCU (**Figure 5**), MSCU bottom elevation (**Figure 6**), and thickness of the MSCU (**Figure 7**).

2.3.3 LCU 2009 Interpretation Changes

The definition of the LCU in the 2009 Pinal regional model differed only in the Casa Grande Ridge area. During the review of the ridge area it was concluded that there was little to no LCU over a portion of the ridge area, which was also noted in Hardt and Cattany (1965). **Figure 8** depicts the locations of wells where no evidence of an LCU was found in the driller logs. Also note that, as shown in **Figure 2**, the southern part of the Casa Grande Ridge area (north of the Tat Momoli Mountains) is part of the Tohono O'odham Reservation and therefore there were no logs to verify the lack of LCU continued into this area. Even though there was no LCU in this area, there was evidence of thick fractured bedrock which was recognized as an important source of water in the area. Therefore a decision was made to include 200 feet of the fractured bedrock in the LCU in those areas.

Figures produced based on the new LCU interpretation include: depth to the bottom of the LCU (**Figure 9**), LCU bottom elevation (**Figure 10**), and thickness of the LCU (**Figure 11**).

2.4 Geologic Cross-Section Maps

The cross-sections in **Figure 12** through **Figure 14** were produced using the interpreted and smoothed per-node geology from the model and not the geology encountered at any particular well. Per node refers to the data for a particular cell, spatially located at the center of the cell. The per-node geology represents an approximation based on all the logs reviewed in the model area.

Cross-section A-A' (**Figure 12**) begins at the western boundary of the model area and ends at the eastern boundary of the model area. The cross-section clearly indicates the presence of the Maricopa-Stanfield sub-basin west of the ridge, the Casa Grande Ridge, and the Eloy sub-basin east of the ridge.

Cross-section B-B' (**Figure 13**) begins in the northwest corner of the model area where the Santa Cruz Wash meets the Gila River. The cross-section indicates the presence of a bedrock outcrop southeast of that point, which is Pima Butte. From Pima Butte the cross-section crosses the Ak-Chin Indian Reservation (which as shown is within the deepest part of the Maricopa-Stanfield sub-basin) before ending at bedrock at the southern part of the model area.

Cross-section C-C' (**Figure 14**) begins in the northeast corner of the model area where the SRV model joins with the Pinal model (Florence Gap area). The cross-section goes through Florence before the basin sediments begin to thicken towards Coolidge. The basin reaches the thickest point in the Eloy area before thinning out again in the southeast corner of the model area where the Pinal model joins with the Tucson model.

2.5 Uncertainty Associated with Geology Interpretation

2.5.1 Areas with Little to No Data

Although there was a lot of growth in the Pinal area since the late 1980's, few new high capacity wells were drilled during that period. Many of the wells associated with new developments are old agriculture wells that have been converted to municipal wells, so very little new data was available in the Pinal area. Some areas have had very few wells drilled, or the wells were not drilled deep enough to define the UAU, MSCU, and the LCU. **Figure 15**, **Figure 16**, and **Figure 17** indicate where some of the areas of limited data are located (such as the Indian Reservations, the Florence Gap area, and the Tucson join area which are discussed below), as well as the locations of wells that had geologic contact depth estimations for that Layer. Areas with few to no wells indicate little to no data was available for that location.

Not all of the geological contact estimates match the Departments geological interpretation for the model area. There were various explanations for the contact estimates not matching the final interpretations, including; data from one log may not have matched data from other logs in the area, some logs may have indicated possible localized faulting which in some cases would have been difficult to incorporate into the regional interpretation of a groundwater model, and based on area research some logs were considered to be inaccurate. At the completion of the project a calculation which compared the estimated contacts from the log review with the Departments interpreted values assigned to each model cell indicated which wells had estimated contacts that were within 15% (plus or minus) of the pre-model final geology value at that location. If a well location in **Figure 15** through **Figure 17** is indicated in red then the estimated contact is within 15% as indicated above.

2.5.1.1 Indian Reservations

Approximately 31% of the Pinal active model domain is covered by Indian Reservations **(Figure 2)**. The Ak-Chin Reservation is entirely encompassed by the active model domain and is approximately 2% of the total domain area. The northeast corner of the Tohono O'odham Reservation is in the active model domain and is just over 3% of the total model area. The Gila River Indian Reservation which is in the northwest part of the active model domain is approximately 25% of the total model area.

The Pinal active model domain was expanded in the 2009 update to cover a larger portion of the GRIC than the original model. The GRIC area included in the original

Pinal model is only 6.8% of the total model active area. Although data from GRIC was obtained during the SRV geology data collection process, most of the data was of fair to poor quality and scattered throughout the Reservation. The Modeling Unit attempted to acquire new data for the Gila River Indian Community and from the Tohono O'odham Nation, however, the attempts were unsuccessful. The data obtained for the SRV model geology for the GRIC area was obtained in 2004 so none of the data in this model represents any drilling beyond that date.

Only 5 logs were found within the Tohono O'odham Reservation that had recognizable contacts between the hydrogeologic units and 17 logs had recognizable contacts within the Ak-Chin Reservation.

2.5.1.2 Florence Gap

The area in the north-east corner of the model area, north of Florence and where the Pinal model domain connects with the SRV model domain, is informally called the "Florence Gap" by the Department. Very few wells have been drilled in that area, and a clearly recognizable fine-grained unit (such as the MSCU) is generally absent in the log descriptions that are available. In this area the sediments are generally more coarse-grained and the contact between the UAU and LCU is difficult to discern. However, there is clearly a recognizable MSCU just north of the Florence area in the SRV model area.

2.5.1.3 Tucson Join Area

There are a number of wells in the area between Picacho Peak and the Silver Bell Mountains close to the Silver Bell Mountains, but very few had driller's logs. However, based on the logs that are available the MSCU pinches out in this area and is absent at the south-east boundary of the Pinal model domain where it intersects the Tucson model domain. Similar to the Florence area, the sediments are generally more coarse-grained and the contact between the UAU and MSCU is difficult to discern.

2.5.1.4 Model Edges

The outer boundary of the model domain (in particular areas close to bedrock) typically has fewer logs than the main portions of the basins. In the logs that are available for these areas there is normally no description of the MSCU, therefore making the UAU difficult to distinguish from the LCU. Along the hardrock areas the depth to basement can change radically in a relatively short distance. The lack of data makes it impractical to attempt to capture that fine of a resolution in the regional model and the geology was based on factors such as; average depths seen in the area, bedrock contours from AZGS (Richard, S.M, et al., 2007), or thickness limits imposed by the Modeling Unit (for example no thickness less than 100 ft).

2.5.1.5 Basin Centers

Data is lacking within the deepest parts of the Eloy and Maricopa-Stanfield sub-basins on the bottom of the MSCU and for the depth to bedrock because the deepest parts of the basins are over a mile deep and very few wells are ever drilled to that depth. The exception would be any drilling done for the assessment of petroleum, geothermal, or mineral resources and more recently for evaluation of salt bodies as potential localities for solution mining and natural gas storage.

2.5.2 Quality of Source Data

The final interpretation of the geology used in the Pinal groundwater model was dependant on the quality of the data reviewed. During this review 1,993 well logs were used (many more were examined but were unusable). Each log used during the review was evaluated for quality. Factors used to establish the quality of a log include the following:

- Sample frequency – a log with one description for a 1,200 feet well was considered to be of lower quality than one with more numerous intervals described by the driller or geologist for the same depth well;

- Sample description – a log with the description “rocks” would be of poor quality, while a description which includes size and coarseness of grains; percentages of fine versus coarse grained material as well as the types of materials encountered would be of good quality. Other descriptions which could give the log a “poor” quality would be limestone, shells, and sandstone which are not found in this area;

- Log suite agreement – if the driller log, geologist log, particle size log and/or geophysical log for a particular well showed lithologic agreement between the different logs the quality increased, whereas if the lithology in the log suite did not agree, the quality decreased;

During this review there were 367 poor logs, 1,556 fair logs, 48 good logs, and 20 excellent logs identified. The reason most of the logs were considered fair or poor was that out of 1,993 wells, 1,882 of those wells only had driller logs associated with them. According to the criteria established for the SRV geology (Dubas and Davis, 2006) driller logs are generally not considered to be better than “fair” in quality because sample descriptions are very general and if no other types of logs are available there is nothing to confirm the lithologic interpretation. Only 74 geologist logs and 51 geophysical logs were available for this study.

3.0 Relationship Between Geologic Units and Model Layers

Once the final interpretation of the geology was completed some changes were made before the geology was used in the groundwater model. Many of these changes were made so that the model would have three continuous layers because the groundwater modeling software MODFLOW (Harbaugh, et. al., 2000) requires a layer to be laterally continuous across the model domain.

Another change involved the truncation of the total thickness of the model (Layer 1 + Layer 2 + Layer 3) at a depth of 3,000 feet below land surface (BLS). In the 1990 Pinal model report a maximum thickness of 4,000 feet was used. During this revision the decision was made to be consistent with the SRV model (Freihoefer et. al., 2009) and the total simulated thickness of hydrogeologic units was truncated at a depth of 3,000 feet BLS. This was done because eventually the Pinal model and the SRV model will be joined (with the Hassayampa model) to form the Central Arizona Model (CAM).

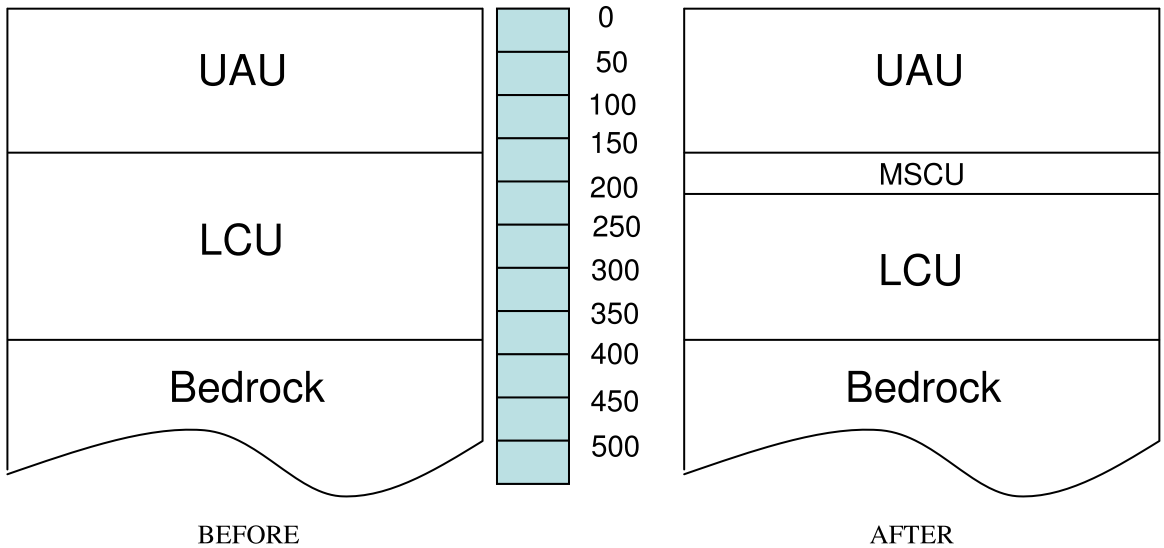
After the changes were made the new thicknesses represented the Layer thickness as opposed to the unit thickness.

3.1 Upper Alluvial Unit – Model Layer 1

No additional changes were made to the UAU to create model Layer 1.

3.2 Middle Silt and Clay Unit – Model Layer 2

Two changes were made to the MSCU to create model Layer 2. The decision was made to give any cell where the MSCU was less than 50 feet (or absent) a thickness of 50 feet **(Figure 18)** because as stated above MODFLOW requires a layer to be laterally continuous across the model domain. This thickness was taken from the top of the LCU (see below). To compensate for the fact that an artificial MSCU had been created, the areas where the MSCU was absent were assigned the same hydraulic properties as the LCU in that location.



In the centers of the deep groundwater sub-basins, where a thick MSCU is present, the bottom of the MSCU was truncated at a depth of 2,800 feet so that an additional 200 feet would be available for the LCU (Layer Three). The cells affected by the truncation of the MSCU are shown in **Figure 19**.

3.3 Lower Conglomerate Unit – Model Layer 3

Only one change was made to the LCU to create model Layer 3. The LCU was truncated so that the total simulated thickness of hydrogeologic units was no greater than 3,000 feet BLS. The cells affected by the truncation of the LCU are shown in **Figure 20**.

4.0 Limitations

The geologic interpretations presented in this provisional report are regional in scope and may not be suitable for site-specific applications. Cell-size limitations, the lack of localized data, and the regional scale of the analysis make it difficult to accurately represent all areas within the model domain. If the geology presented in this report is to be used for a site-specific application the interpretation should be amended with site specific geology information if availalbe. For example, a localized study in a heavily faulted area would be generalized in this representation of the geology because in a regional scale model localized faulting may be irrelevant. In addition, a comparison of local geology data close to the edges of the model domain may not be comparable because thicknesses of units were increased or decreased based on the regional scale of the Pinal model.

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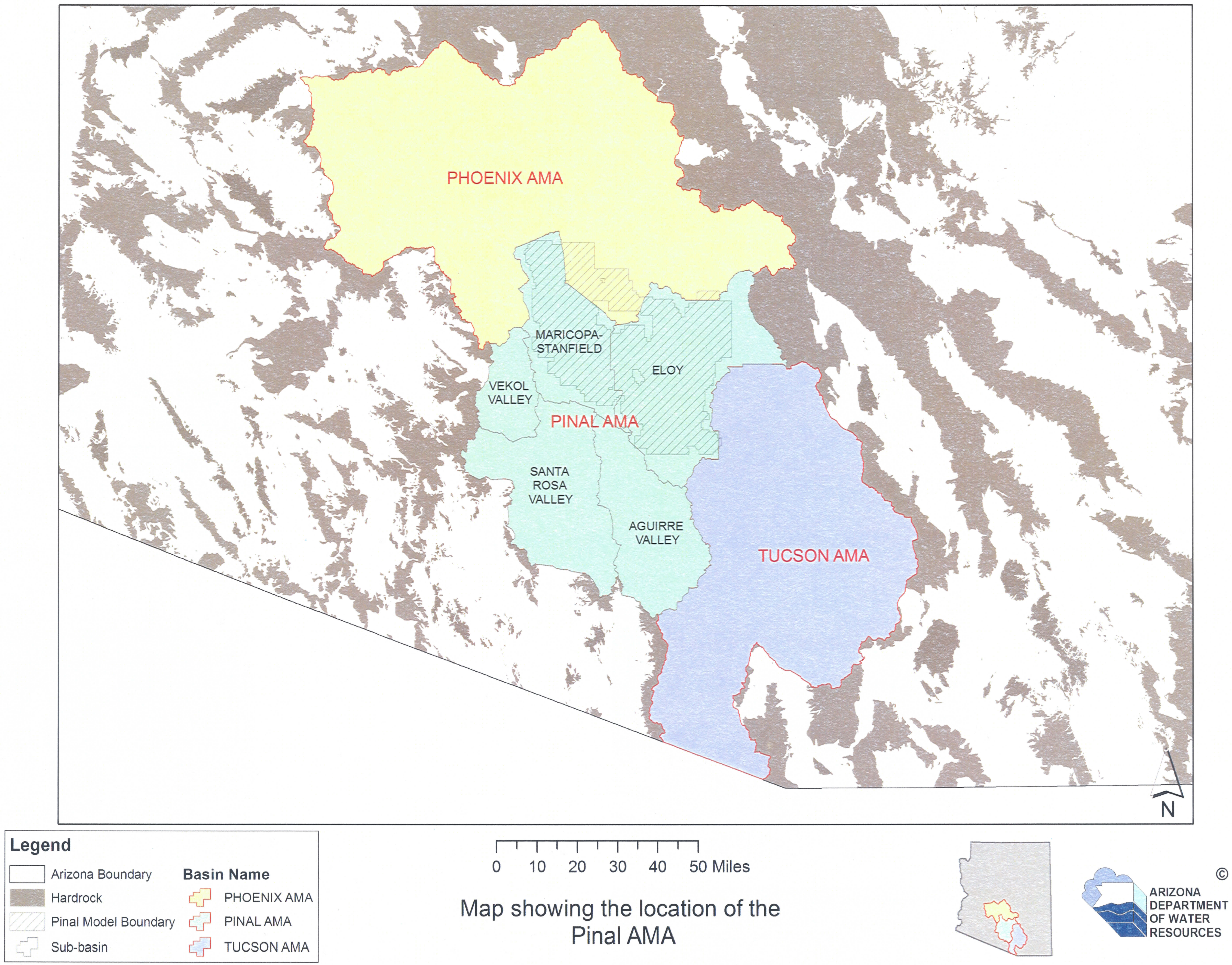
Figures

Figure 1



PHOENIX AMA
MARICOPA-STANFIELD
ELOY
VEKOL VALLEY
PINAL AMA
SANTA ROSA VALLEY
AGUIRRE VALLEY
TUCSON AMA
N
Legend
Arizona Boundary
Hardrock
Pinal Model Boundary
Sub-basin
Basin Name
PHOENIX AMA
PINAL AMA
TUCSON AMA
0 10 20 30 40 50 Miles
Map showing the location of the Pinal AMA
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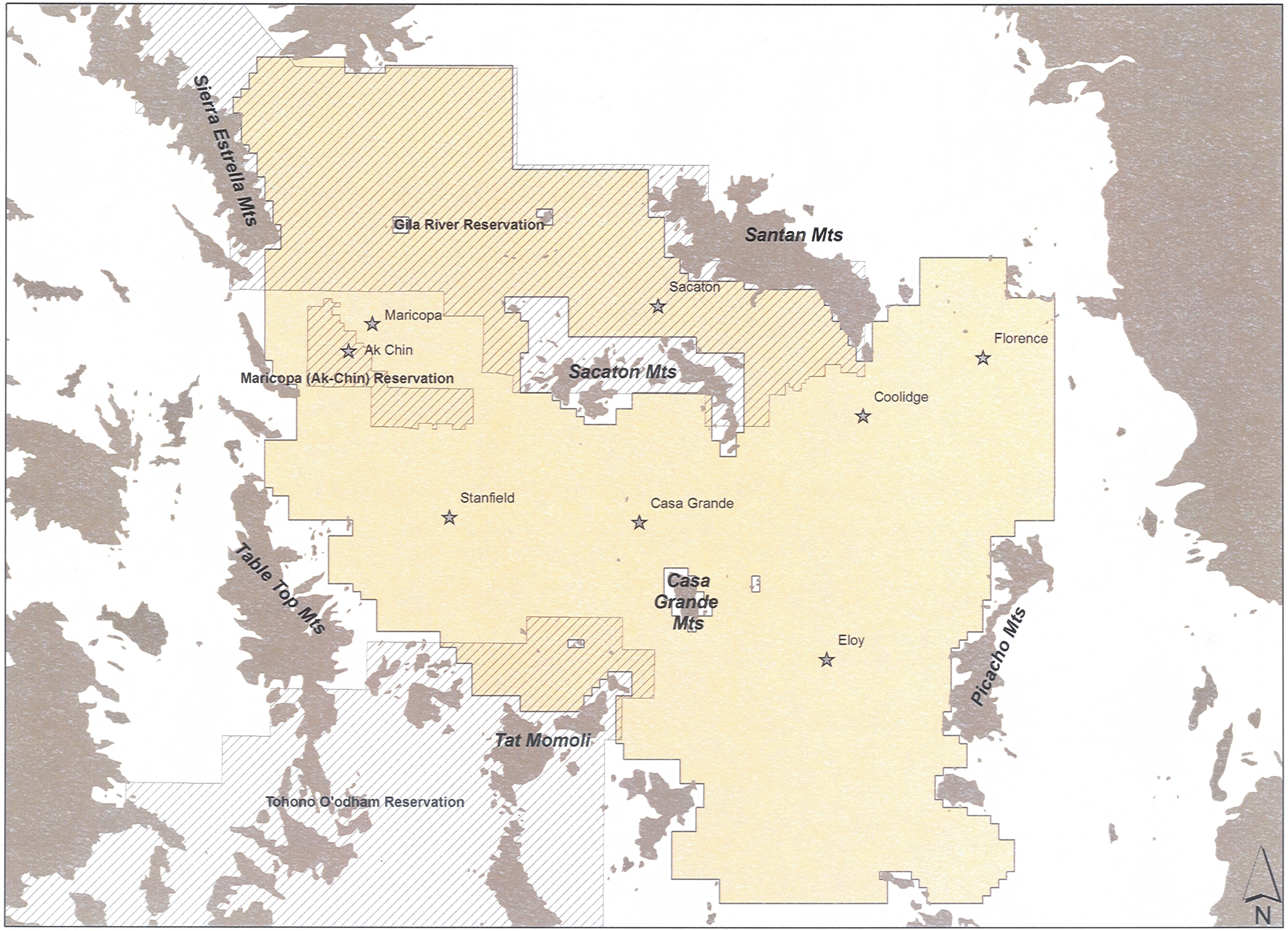
©

Figure 2



Legend

- ☆ City Location
- Hardrock
- Pinal Model Boundary
- Indian Reservation

0 2 4 6 8 10 Miles

Map showing the location of Indian Reservations within the Pinal model area

ARIZONA DEPARTMENT OF WATER RESOURCES ©

Figure 3

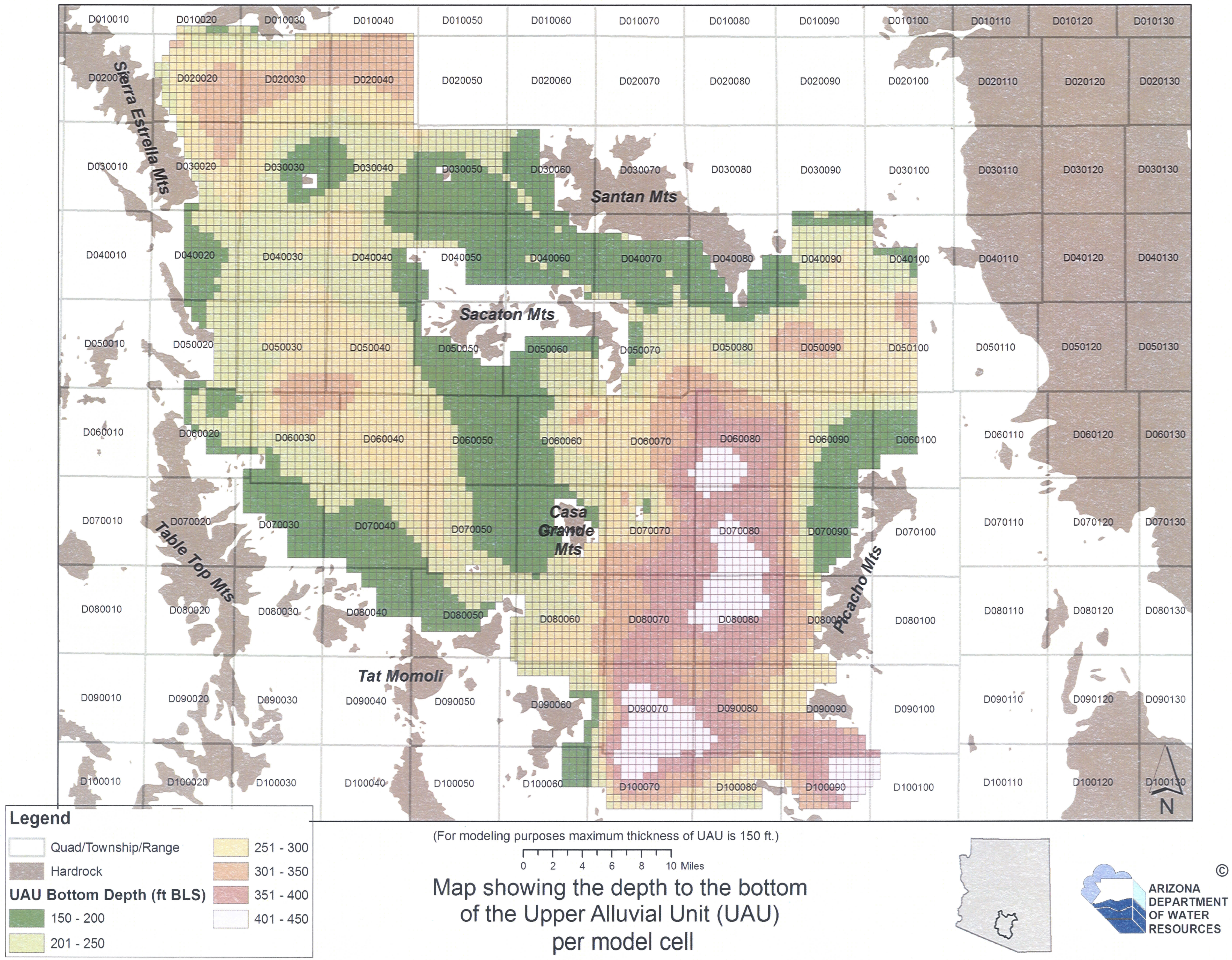

Sierra Estrella Mts
Santan Mts
Sacaton Mts
Casa Grande Mts
Table Top Mts
Picacho Mts
Tat Momoli
N
Legend
Quad/Township/Range
Hardrock
UAU Bottom Depth (ft BLS)
150 - 200
201 - 250
251 - 300
301 - 350
351 - 400
401 - 450
(For modeling purposes maximum thickness of UAU is 150 ft.)
0 2 4 6 8 10 Miles
Map showing the depth to the bottom of the Upper Alluvial Unit (UAU) per model cell
ARIZONA DEPARTMENT OF WATER RESOURCES
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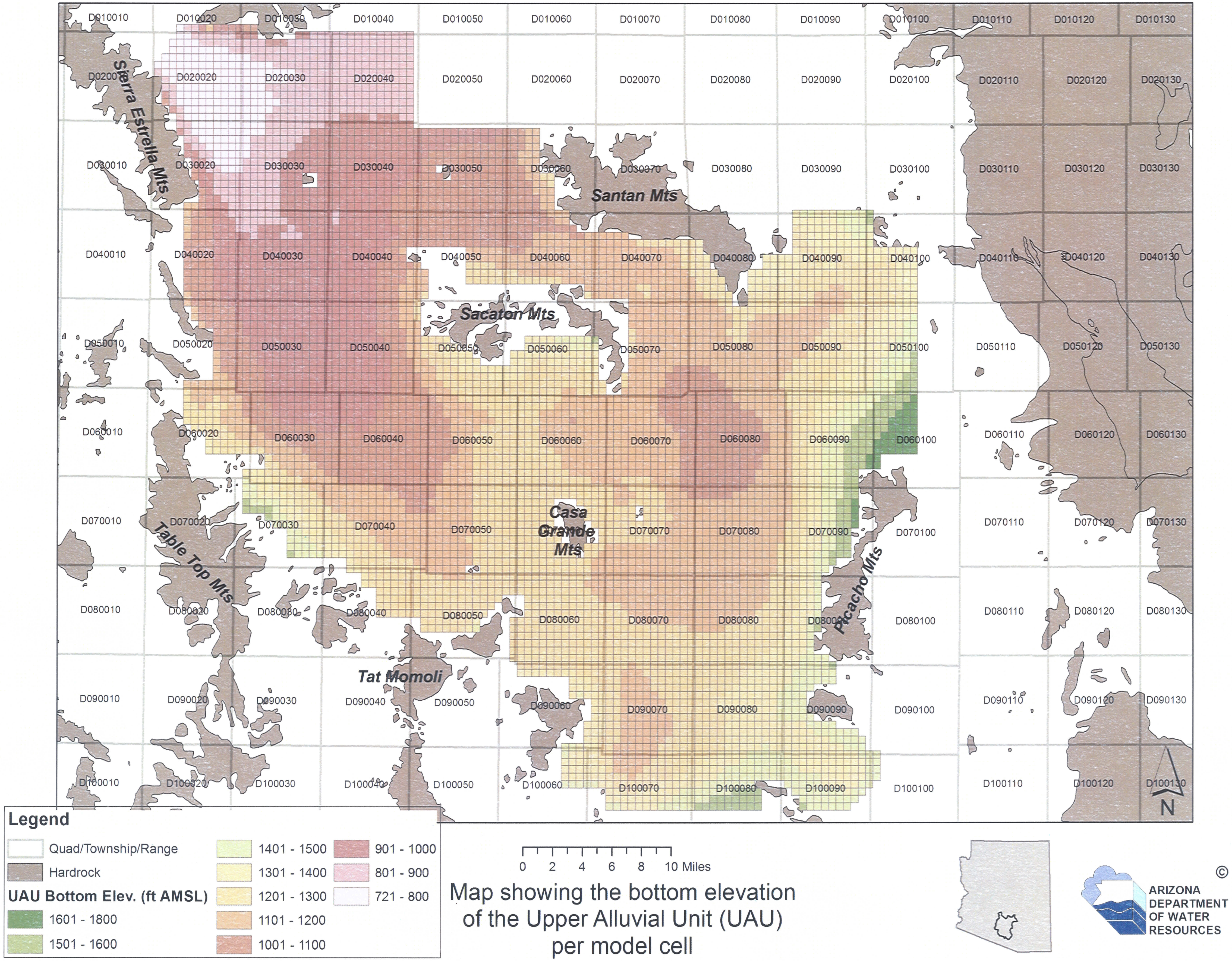
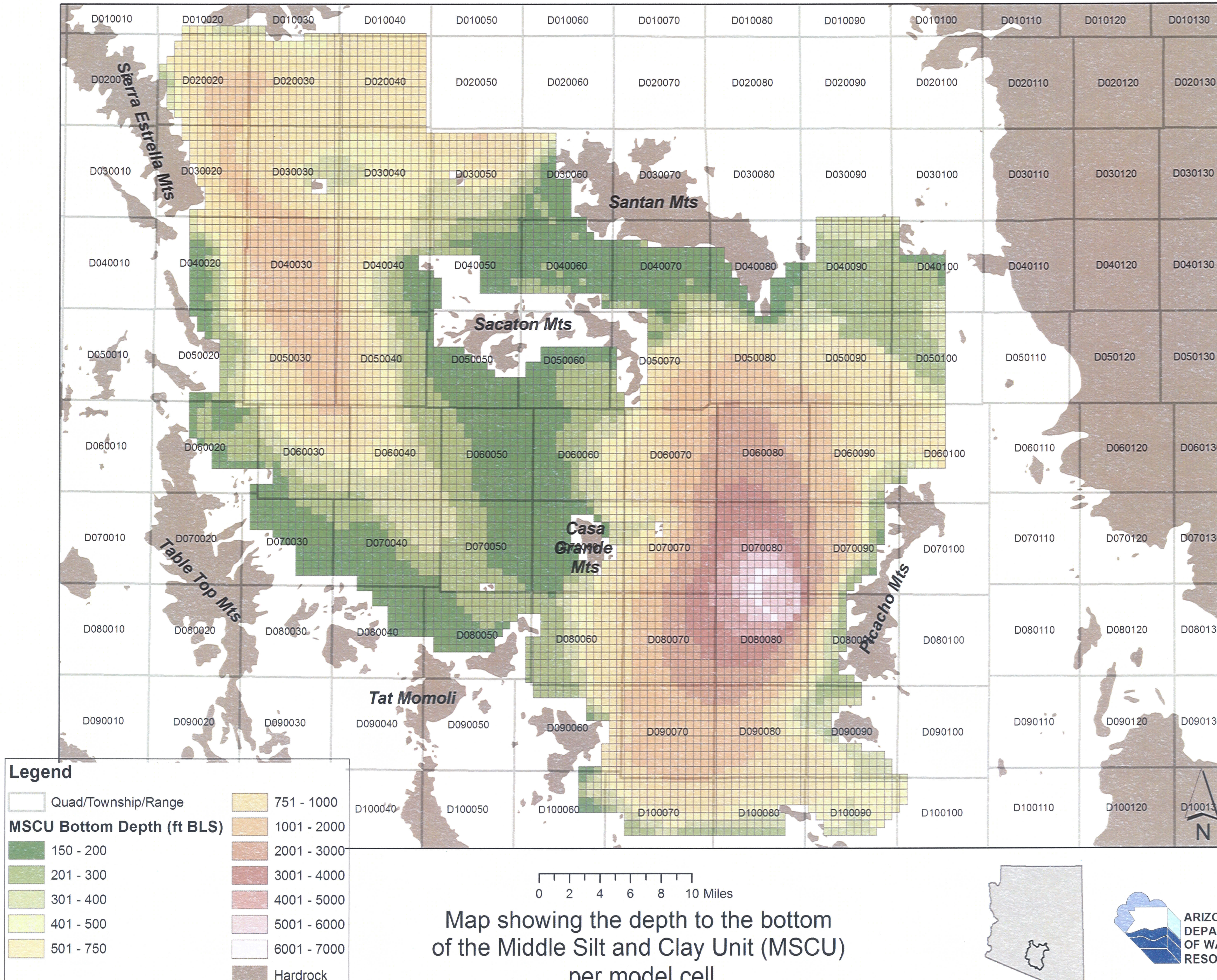
Figure 4



Map showing the bottom elevation of the Upper Alluvial Unit (UAU) per model cell

Figure 5



Map showing the depth to the bottom of the Middle Silt and Clay Unit (MSCU) per model cell

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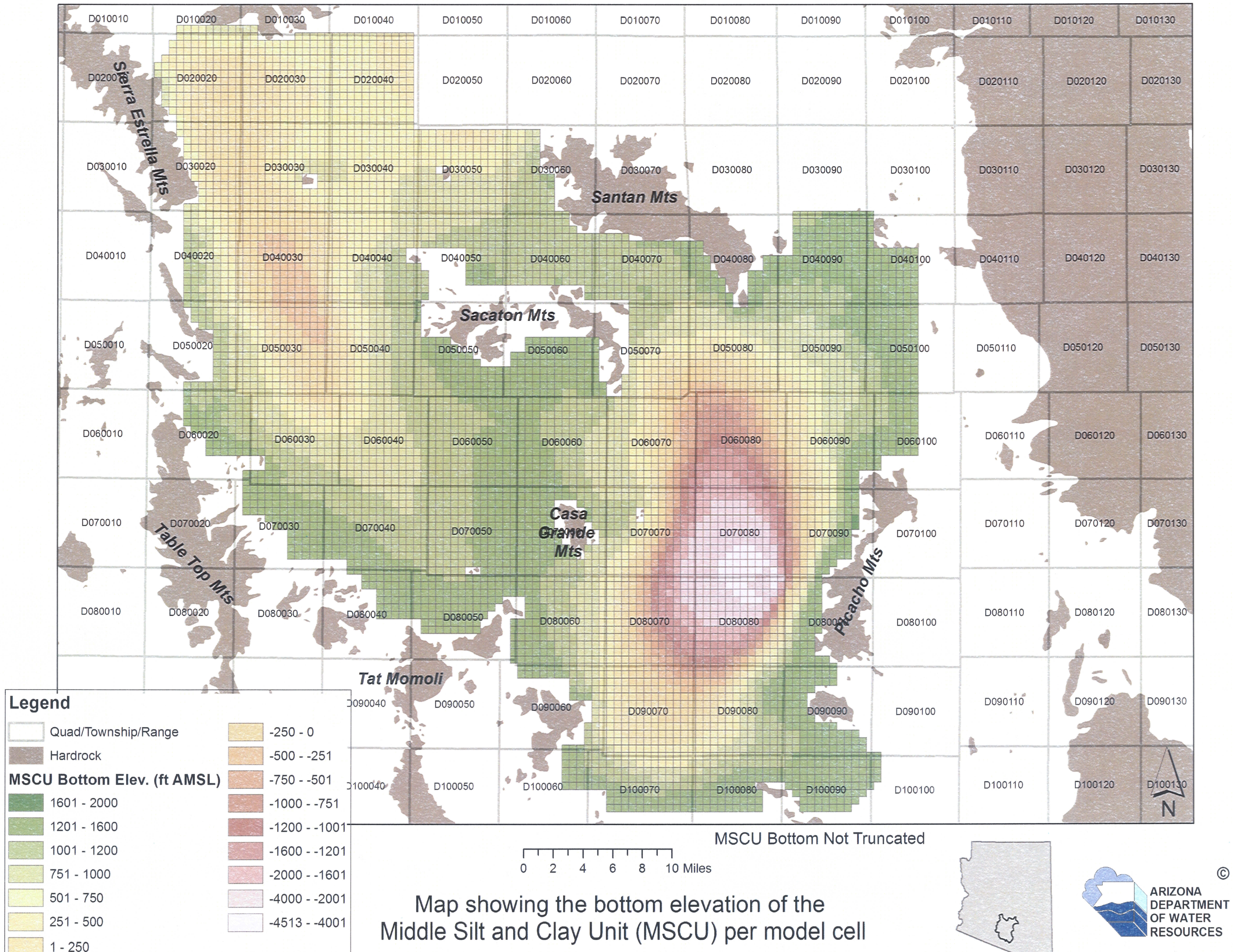
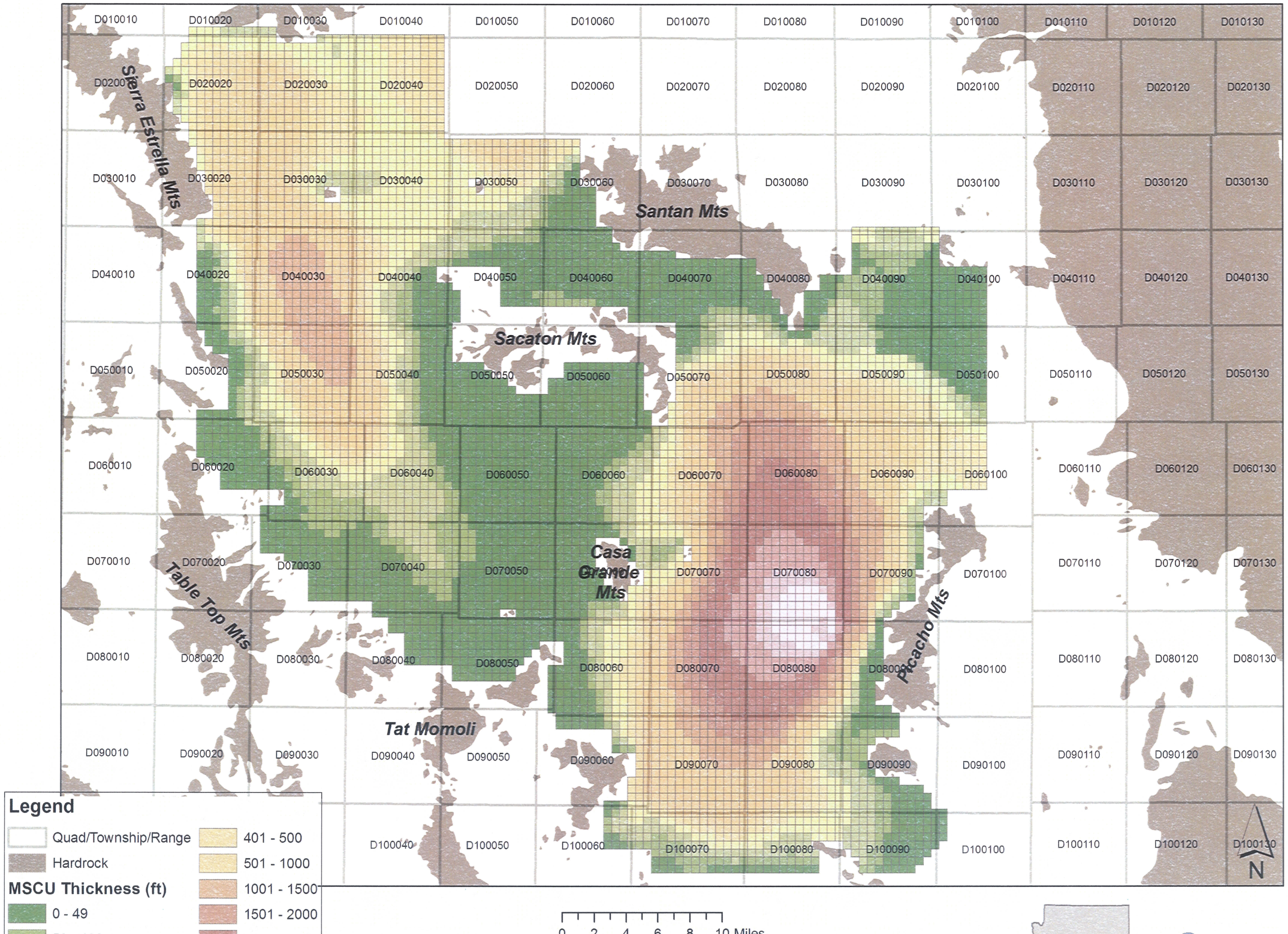
Figure 6



Map showing the bottom elevation of the Middle Silt and Clay Unit (MSCU) per model cell

Figure 7



Isopach Map showing the thickness of the Middle Silt and Clay Unit (MSCU) per model cell

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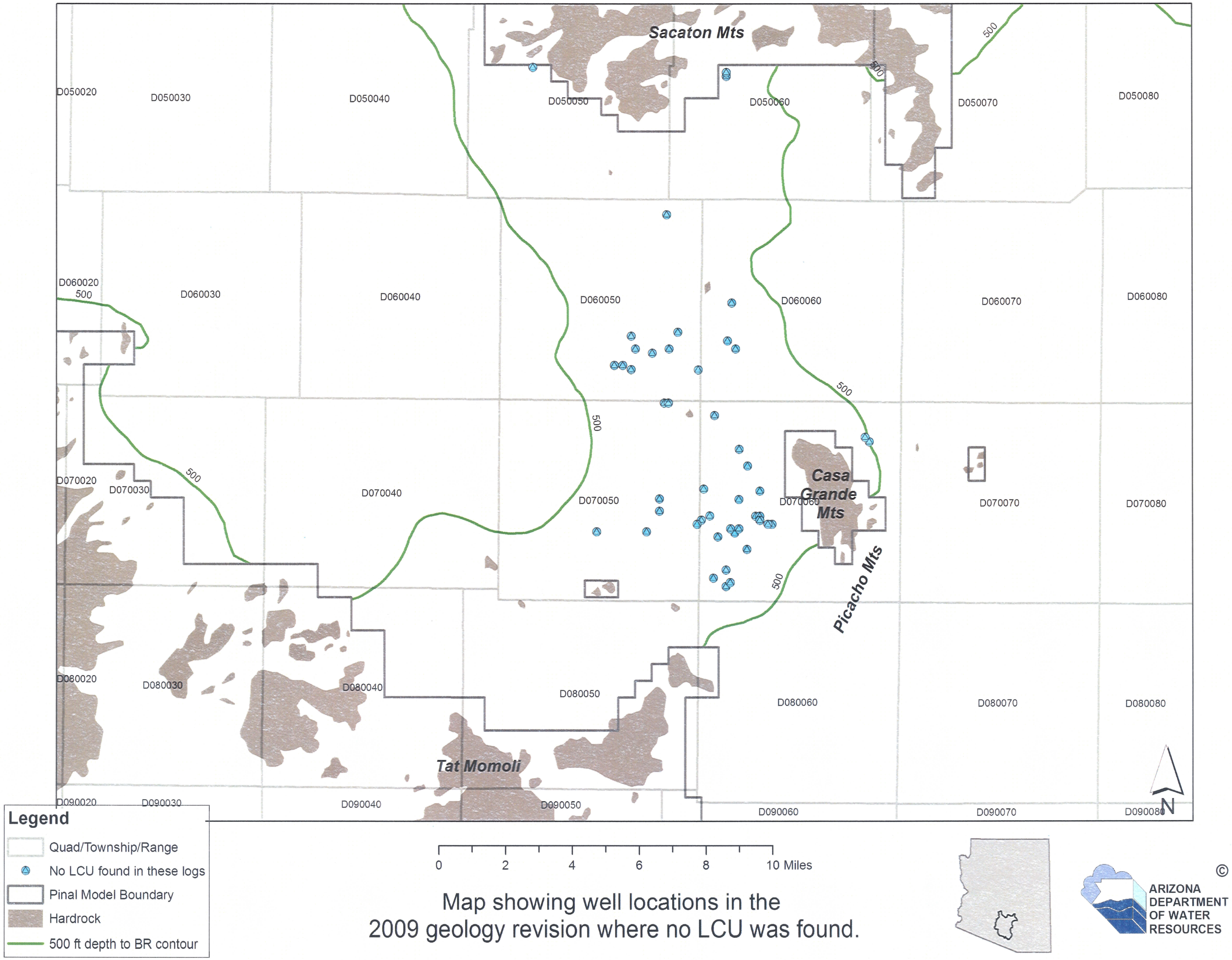
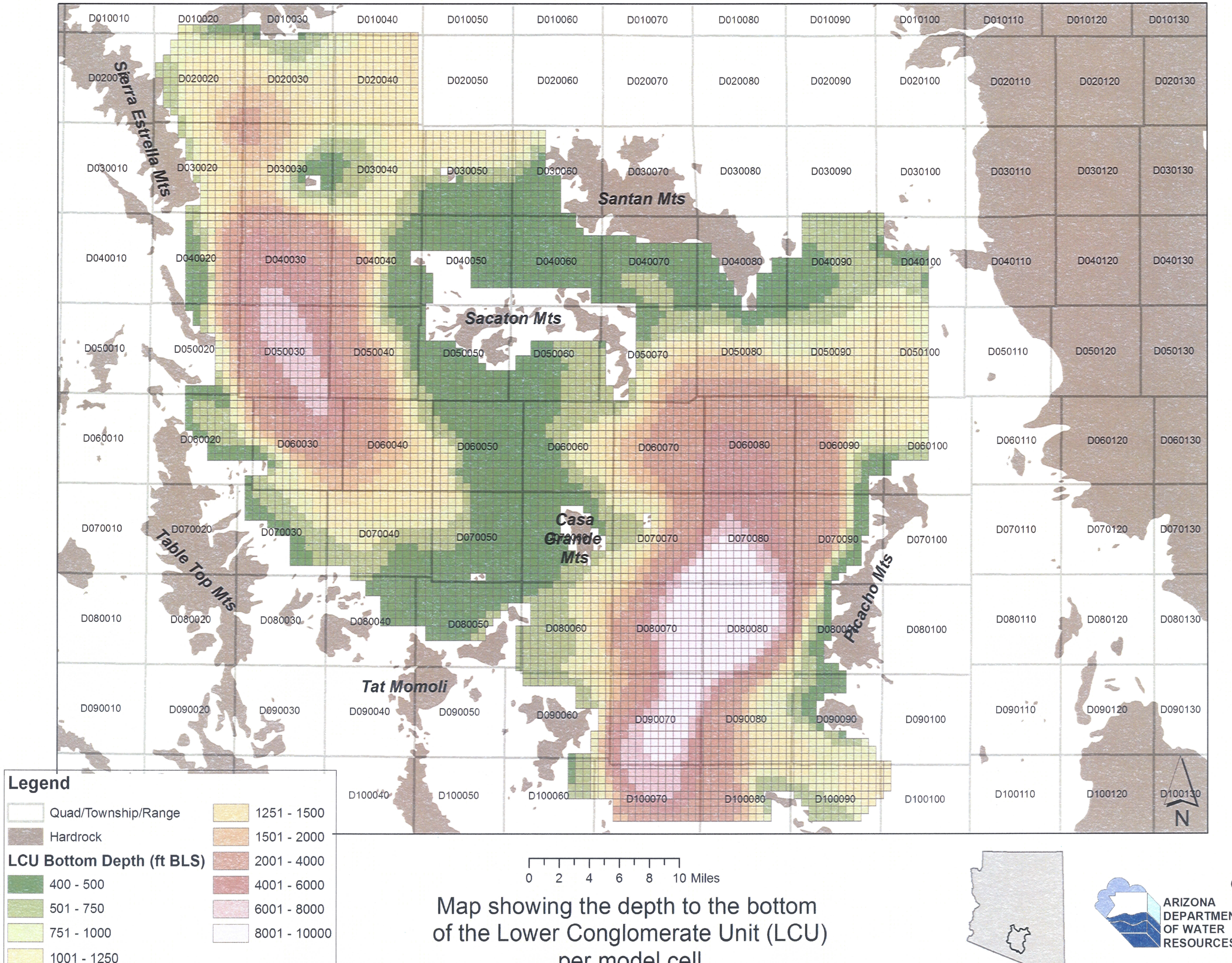
Figure 8



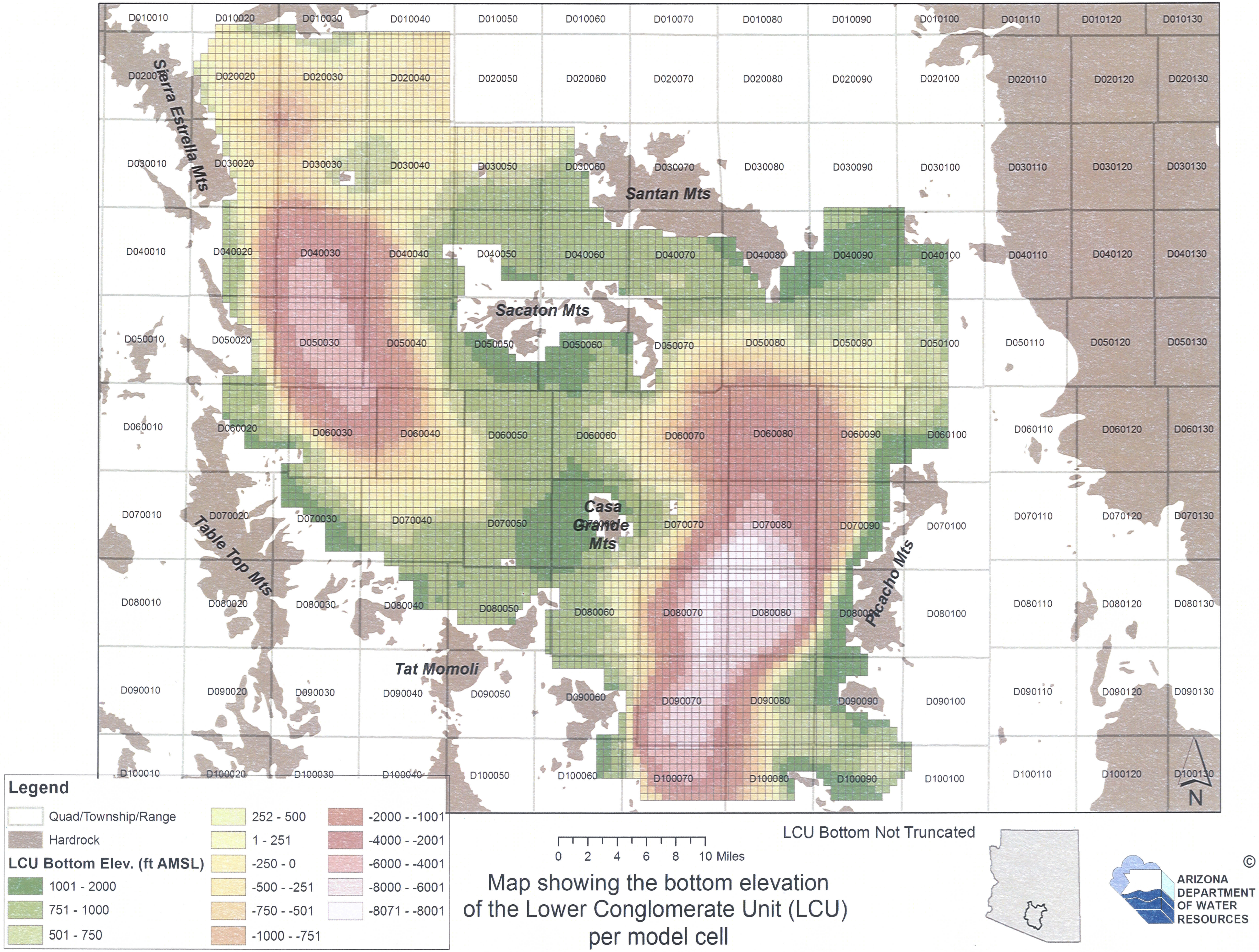
Map showing well locations in the 2009 geology revision where no LCU was found.

Figure 9



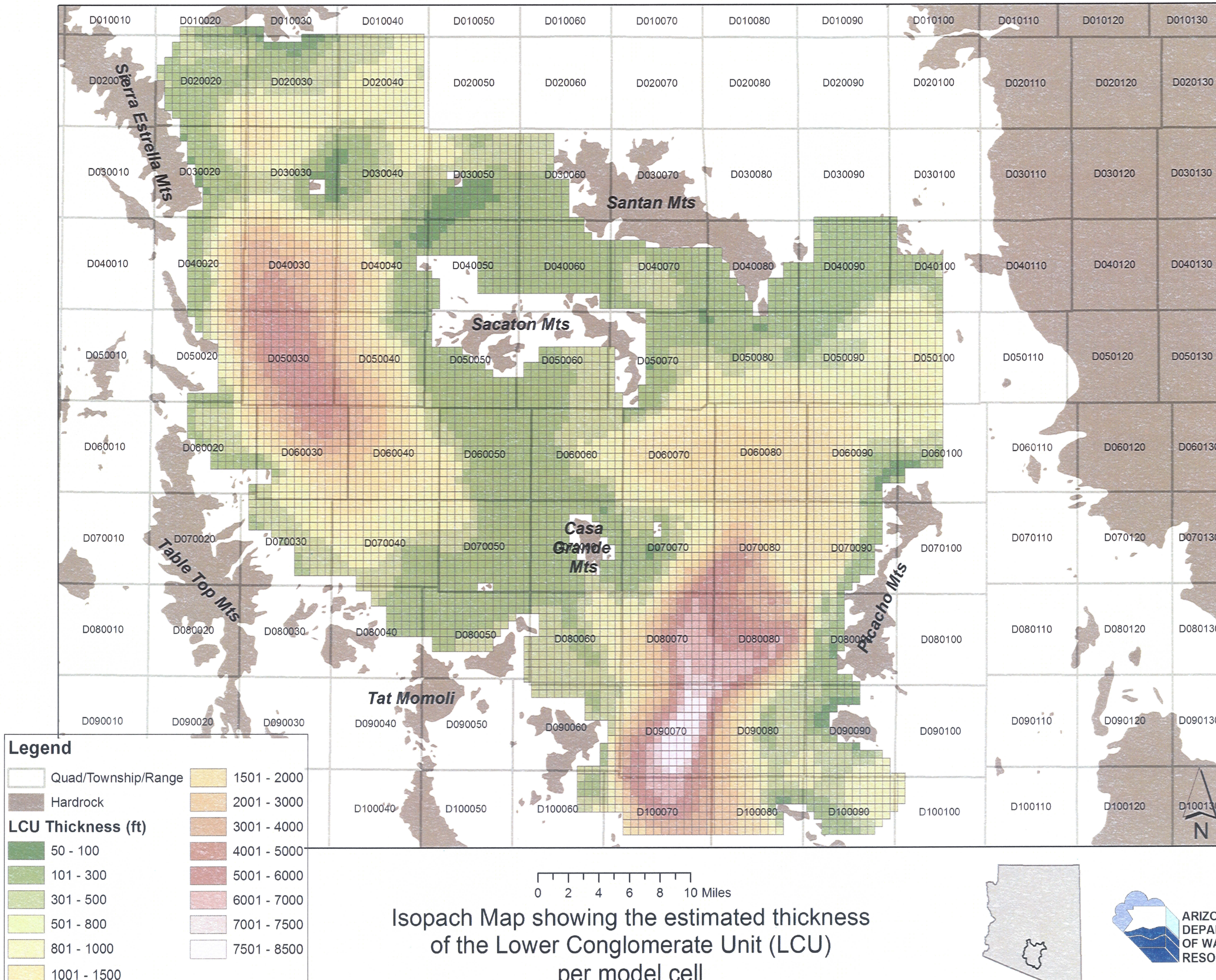
Map showing the depth to the bottom of the Lower Conglomerate Unit (LCU) per model cell

Figure 10



Map showing the bottom elevation of the Lower Conglomerate Unit (LCU) per model cell

Figure 11



Isopach Map showing the estimated thickness of the Lower Conglomerate Unit (LCU) per model cell

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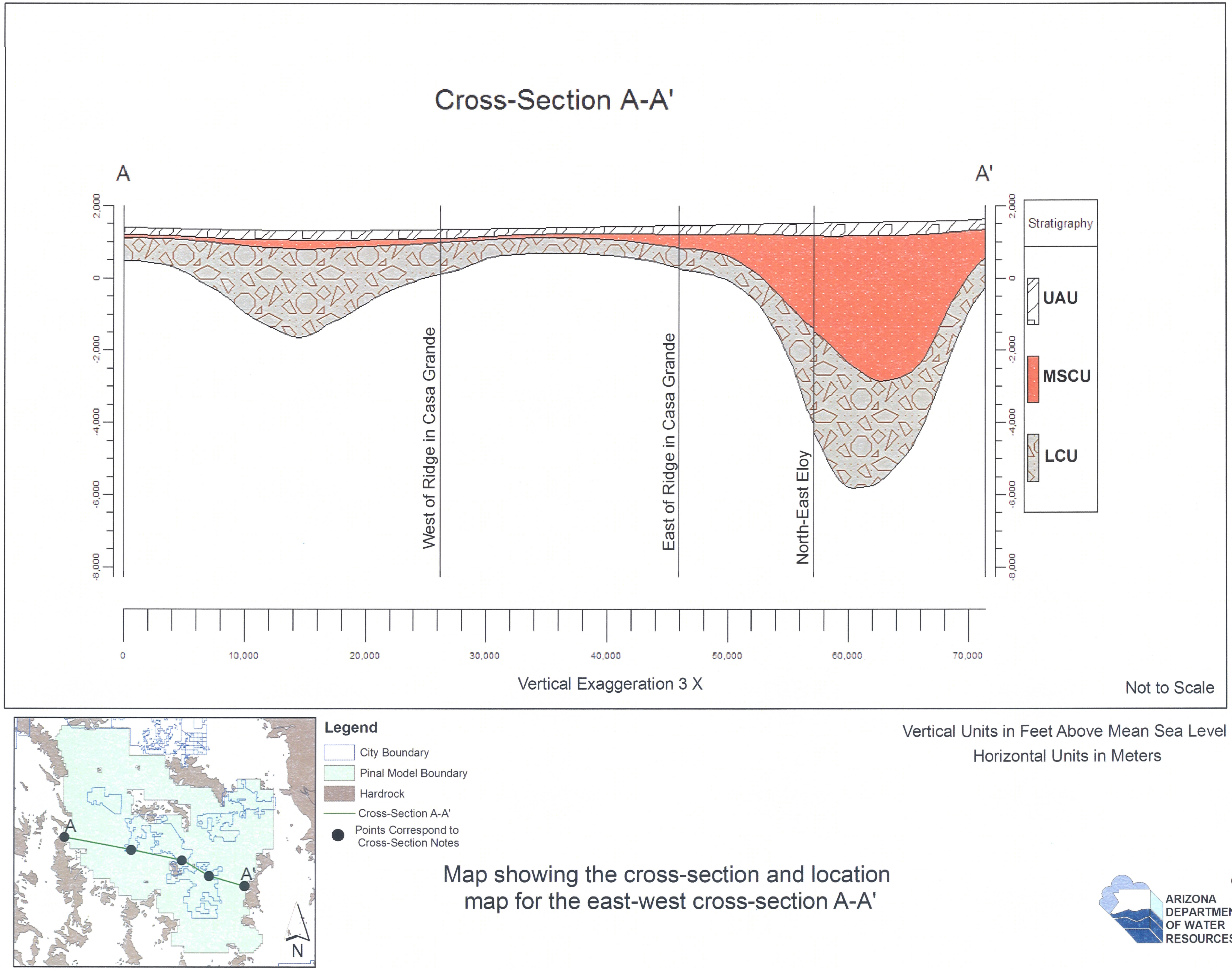
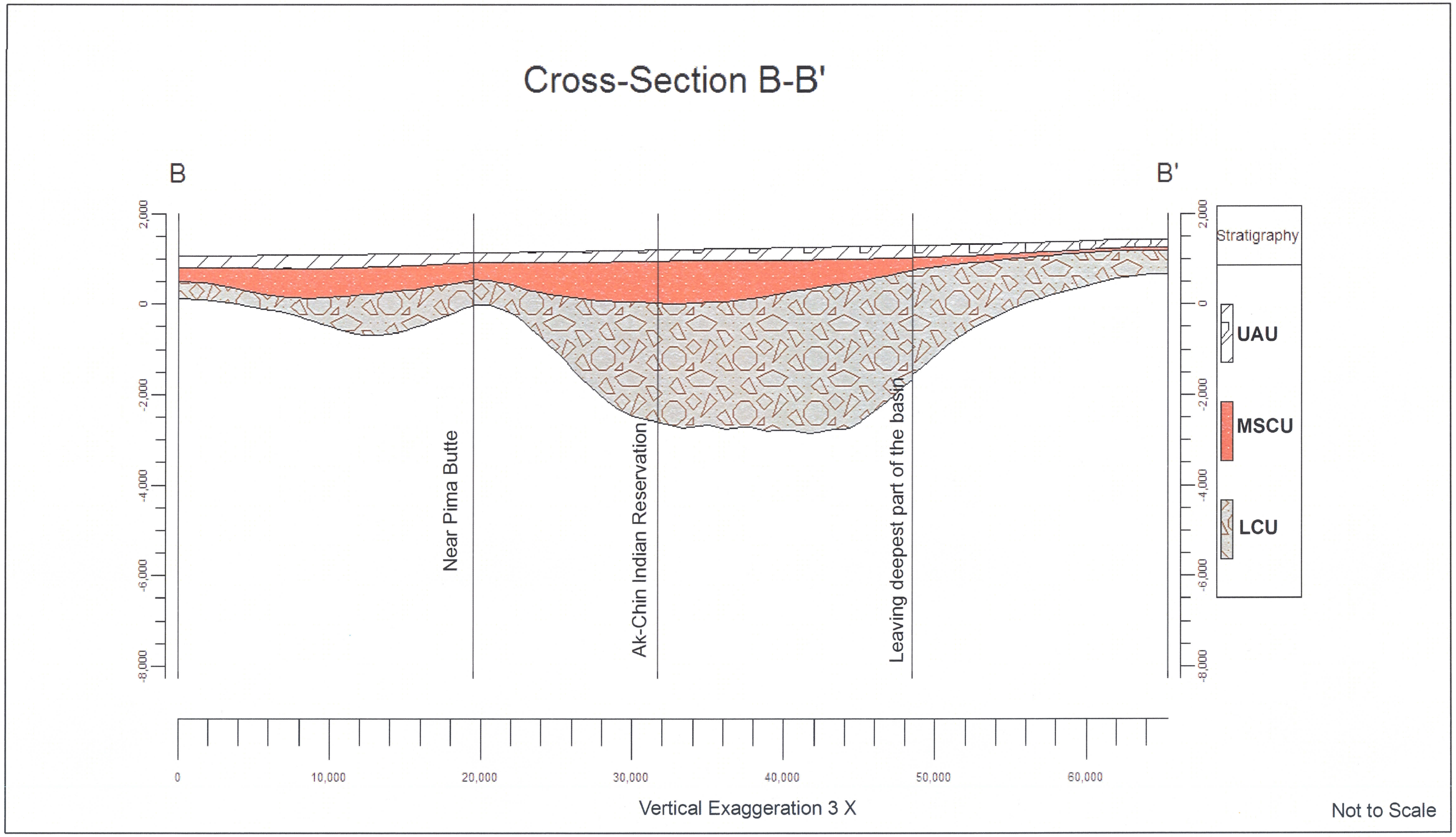
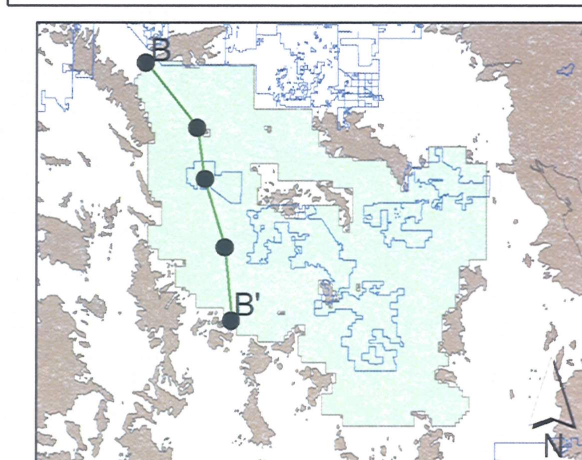
Figure 12



Map showing the cross-section and location map for the east-west cross-section A-A'

Figure 13





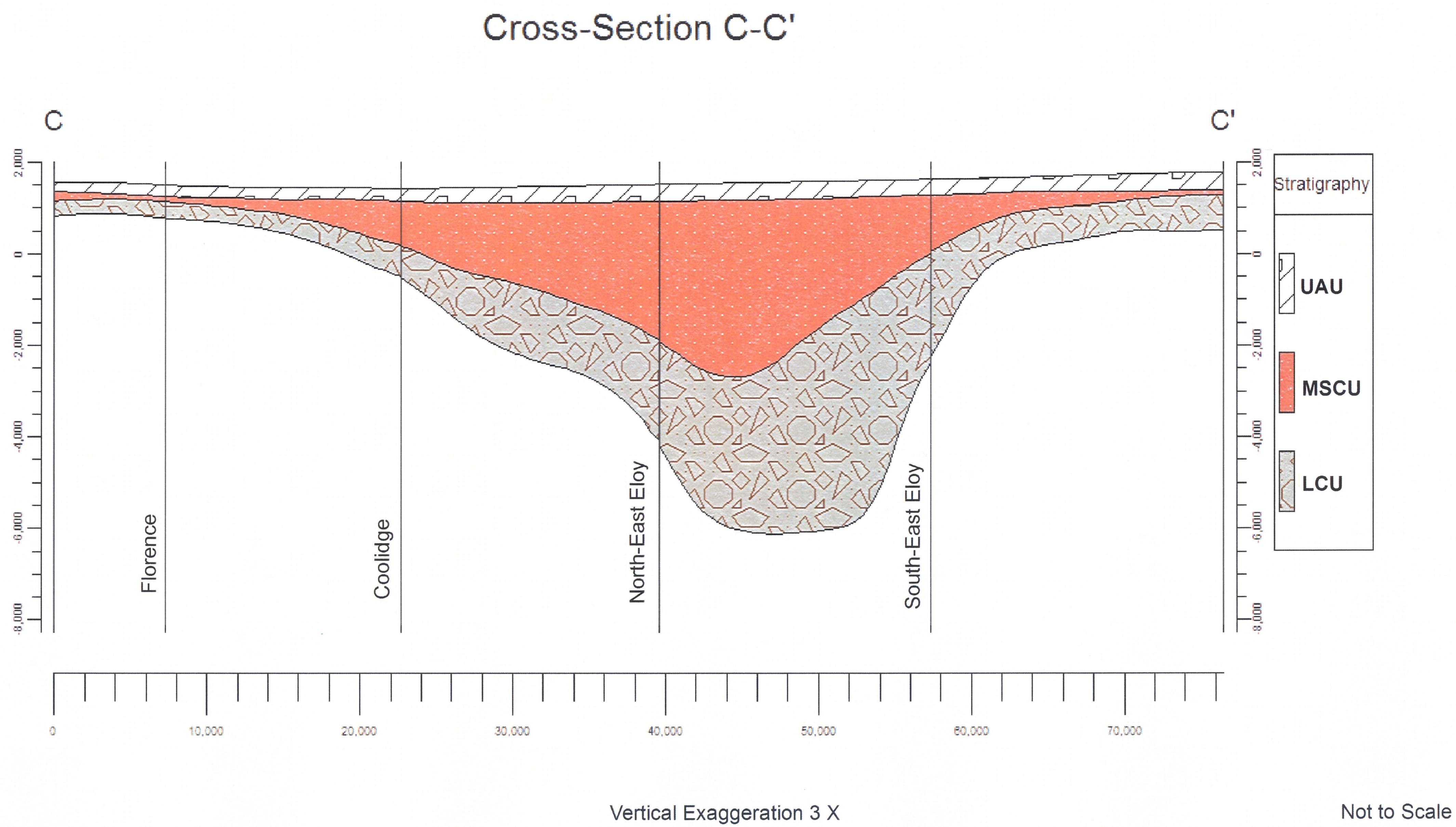
Legend

- City Boundary
- Pinal Model Boundary
- Hardrock
- Cross-Section B-B'
- Points Correspond to Cross-Section Notes

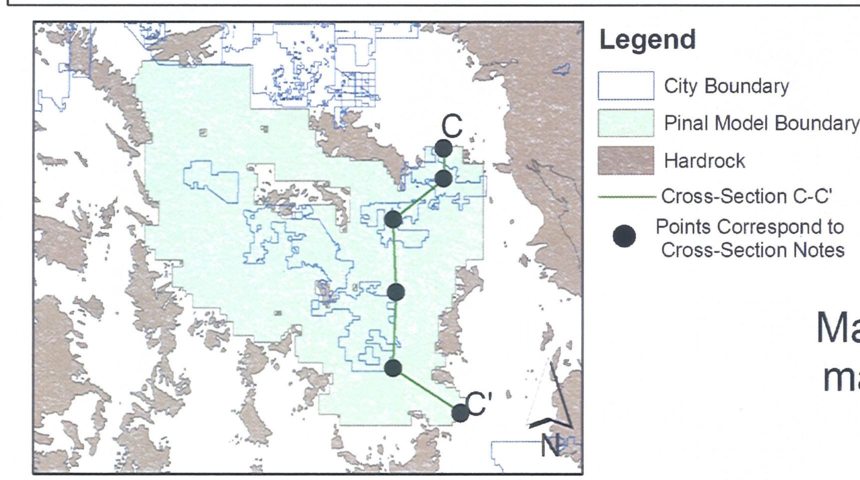
Vertical Units in Feet Above Mean Sea Level
Horizontal Units in Meters

Map showing the cross-section and location map for the north-south cross-section B-B' through the Maricopa-Stanfield sub-basin

Figure 14



Vertical Units in Feet Above Mean Sea Level
Horizontal Units in Meters



Map showing the cross-section and location map for the north-south cross-section C-C' through the Eloy sub-basin

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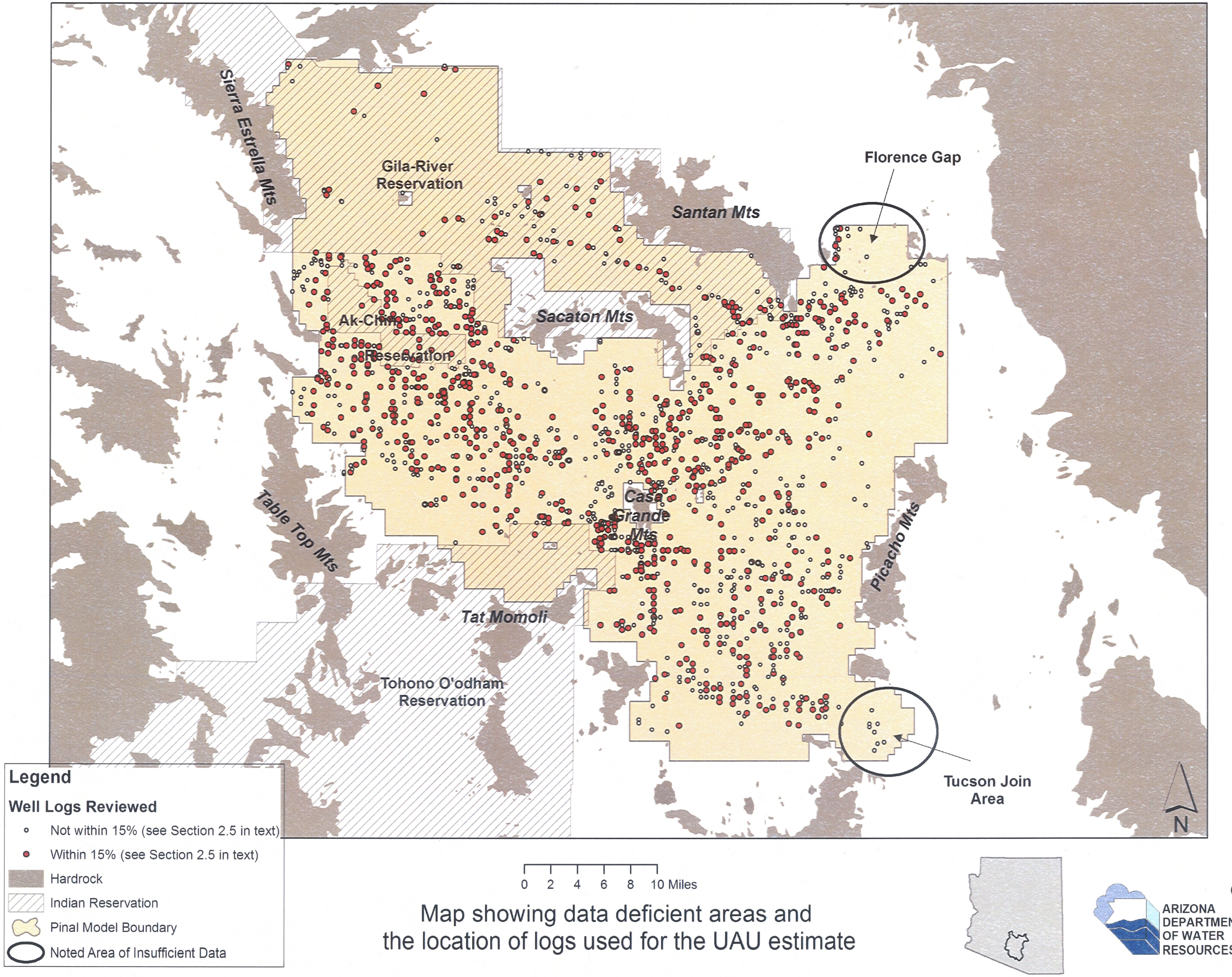
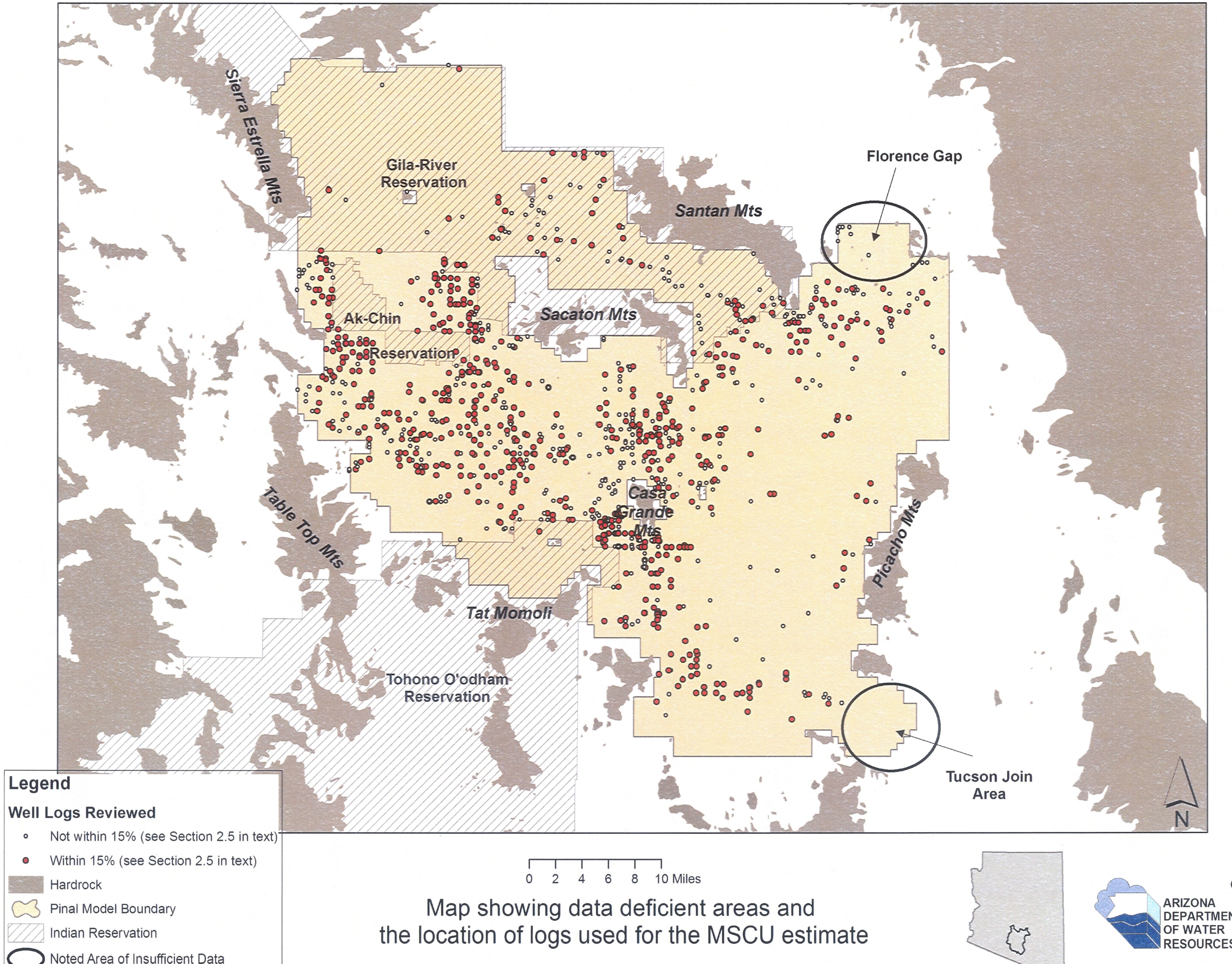
Figure 15



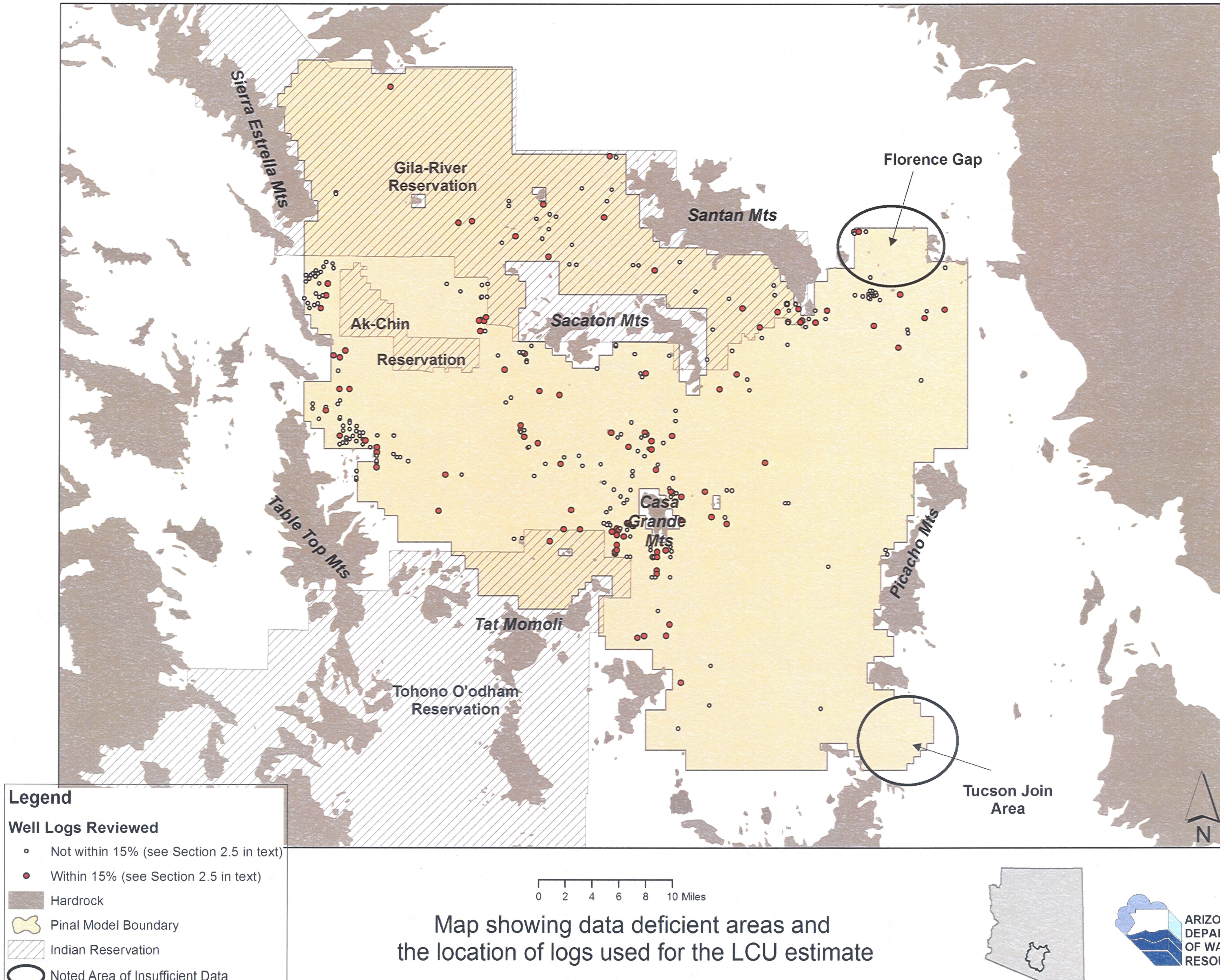
Map showing data deficient areas and the location of logs used for the UAU estimate

Figure 16



Map showing data deficient areas and the location of logs used for the MSCU estimate

Figure 17



Map showing data deficient areas and the location of logs used for the LCU estimate

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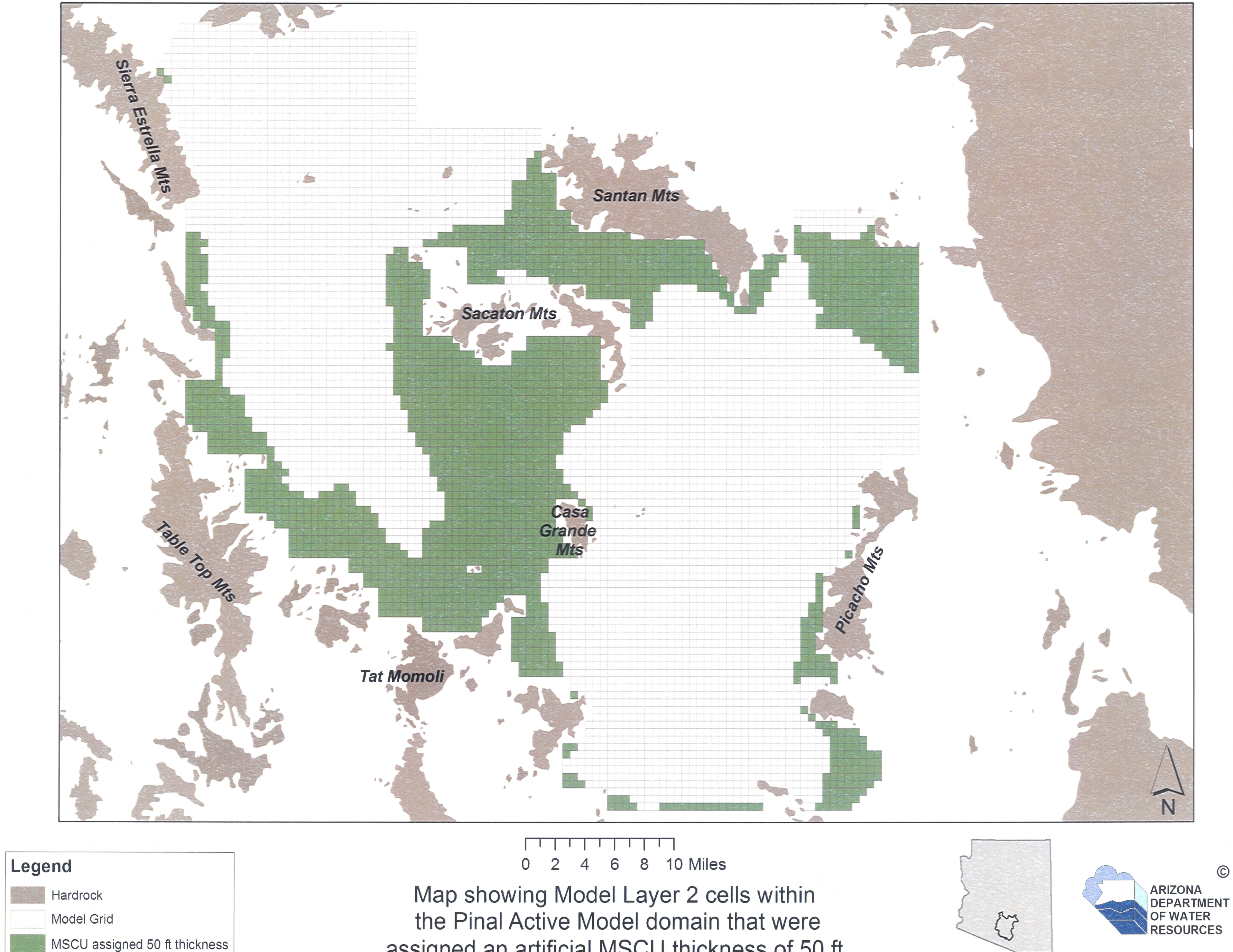
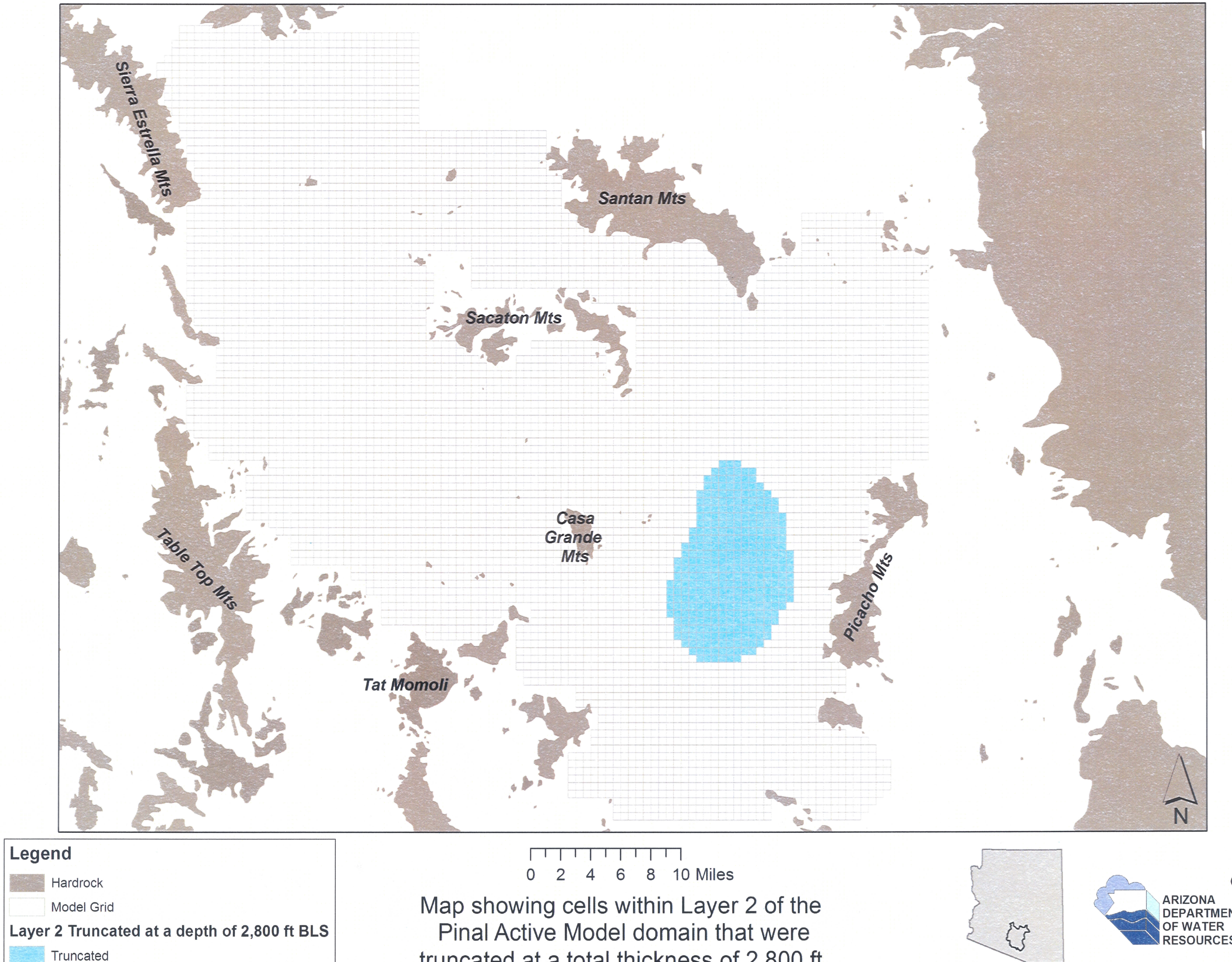
Figure 18



Map showing Model Layer 2 cells within the Pinal Active Model domain that were assigned an artificial MSCU thickness of 50 ft.

Figure 19



Map showing cells within Layer 2 of the Pinal Active Model domain that were truncated at a total thickness of 2,800 ft.

Figure 20

Map showing cells within Layer 3 of the Pinal Active Model domain that were truncated at a total thickness of 3,000 ft.