Modification and Recalibration of the Groundwater Availability Model of the Dockum Aquifer

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Texas Water Development Board

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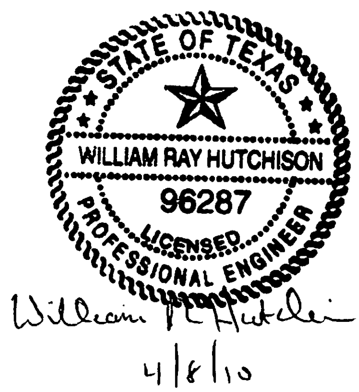

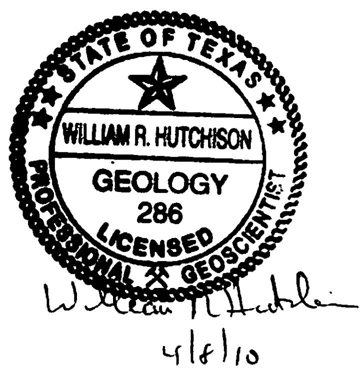

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EXECUTIVE SUMMARY

The Texas Water Development Board uses groundwater availability models to quantify historical conditions in aquifers around the state and to simulate future conditions in the aquifers. A recently completed groundwater availability model for the Dockum Aquifer, which met accepted standards for calibration to historical conditions, was found to be ineffective for use in predictive simulations. This original model for the Dockum Aquifer could not appropriately perform predictive simulations because it 1) used a layer to represent units overlying the Dockum Aquifer that was controlled by general-head boundary conditions, which inhibited translation of inactive cells in the models representing the overlying units to the Dockum Aquifer model, and 2) contained discrepancies in the layer elevations between the Dockum Aquifer model and the models representing the overlying units, which made using head elevations in predictive simulations a challenge.

The purpose of this report is to document a modified and recalibrated groundwater model of the Dockum Aquifer which is better suited to simulate future conditions related to development of desired future conditions. The changes made include removal of the overlying layer representing younger units, transfer of the general-head boundary conditions directly to the top of the Dockum Aquifer cells, use of historical saturated thickness from the northern and southern Ogallala Aquifer groundwater availability models (as opposed to water-level elevation), shortening the historical period of the model to only the calibration period, and recalibration of the model using a parameter estimation procedure (PEST) and trial-and-error.

The result of these changes to the design of the model and the subsequent recalibration is that the modified model more closely matches observed water-level elevations than the original model. The standard deviation of residuals for the upper and lower portions of the Dockum Aquifer are 50 and 70 feet, respectively. The root mean squared errors for these same portions of the aquifer are 48 and 70 feet, respectively. Taking into account the range of measured water levels for these units, these errors are well within accepted standards for groundwater model calibration.

As a result of these modifications, the model transitions smoothly from the historical period into the predictive period and responds more appropriately to changes in the overlying younger units, which was the key objective of this effort.

All groundwater models are simplifications of reality and have limitations. As a regional-scale model with one square mile grid cells, results from this model may differ significantly from observations at a local-scale. For this reason, reporting of model results should be as broad-scale as possible.

Though not every aspect of the model was reassessed, this model is an improvement over the original with respect to the match to water-level observations and is now capable of performing reasonable predictive simulations.

1.0 INTRODUCTION AND PURPOSE OF THE MODEL

The groundwater availability modeling section of the Texas Water Development Board (TWDB) develops, maintains and runs groundwater availability models (GAMs) of the major and minor aquifers around the state in order to provide reliable, timely data on groundwater availability to the citizens of Texas to ensure adequacy of supplies or recognition of inadequacy of supplies throughout the 50 year planning horizon. In pursuit of this mission, it is sometimes necessary to modify a groundwater availability model when new data becomes available or when issues are identified with a model that make it inappropriate for use as a tool for determining groundwater availability. The latter of these two is the case for the groundwater availability model of the Dockum Aquifer, a minor aquifer in Texas as defined in Ashworth and Hopkins (1995). The location of the Dockum Aquifer along with nearby rivers and towns is shown in Figure 1. This report documents the modifications made to this model for it to perform appropriately in predictive simulations of groundwater availability.

The original groundwater availability model for the Dockum Aquifer is described in Ewing and others (2008). This original model was developed for MODFLOW-2000 (Harbaugh and others, 2000). It contains three layers which represent 1) younger units overlying the Dockum Aquifer, 2) the upper portion of the Dockum Aquifer, where present, and a thin section of the lower portion of the Dockum Aquifer elsewhere, and 3) the lower portion of the Dockum Aquifer. The MODFLOW general-head boundary package was applied to the younger units in Layer 1 with a high conductance in order to quickly add or remove water from this layer to mimic water levels in these units. Transient head values for the general-head boundary package were taken from the historical portion of the groundwater availability model for the southern portion of the Ogallala Aquifer, documented in Blandford and others (2003). In a later model revision submitted by INTERA, Inc. to TWDB, transient heads for the general-head boundary package derived from the northern portion of the Ogallala Aquifer model were added (Dutton, 2004). Outside of these areas, general-head boundary head values were held constant at values estimated from land surface elevation.

This implementation of the general-head boundary package in conjunction with the layering scheme is the primary reason for the modifications documented in this report. It should be noted that the original version of the model for the Dockum Aquifer met the Groundwater Availability Modeling Program specifications for calibration to historical water levels. However, as shown in the sensitivity analysis in Ewing and others (2008), the Dockum Aquifer is very sensitive to changes in the overlying younger units, primarily the Ogallala Aquifer. Since significant declines in the northern and southern portions of the Ogallala Aquifer are likely over the next 50 years (for example, Oliver, 2010 and Smith, 2009), it is important that these water level declines be effectively incorporated into predictive simulations of the Dockum Aquifer.

The original version and later revised versions of the model were found not to be appropriate tools for predictive simulations because 1) the inclusion of a layer for younger units controlled by a general-head boundary does not allow for effective modeling of cells that go inactive in predictive simulations of the Ogallala Aquifer, and 2) some discrepancies exist in the layer tops and bottoms between the models for the Dockum and Ogallala aquifers, which inhibits direct translation of head values to the general-head boundaries. Running the existing Dockum model for predictive simulations with general-head boundary values from the northern and southern Ogallala models results in a very large spike in outflow from the general head boundaries as the model tries to remove large amounts of water from Layer 1. This spike at the transition between the historical and predictive simulations is also translated into the underlying Dockum Aquifer layers as changes in the vertical flow between model layers.

The changes to the model documented in this report were made to more appropriately reflect the flow dynamics in the Dockum Aquifer and, more importantly, allow realistic predictive simulations to be made. These changes include removal of the overlying layer representing younger units, transfer of the general-head boundary directly to the top of the Dockum Aquifer cells, use of historical saturated thickness from the northern and southern Ogallala Aquifer models to calculate general-head boundary head values, shortening of the historical period of the model to include only the time period over which it is calibrated, and recalibration of the model.

Figure 1. Location map of the Dockum Aquifer

2.0 MODEL OVERVIEW AND PACKAGES

The original model and the revised model by INTERA, Inc. for the Dockum Aquifer and the modified model documented here use MODFLOW-2000 as the code to simulate groundwater flow (Harbaugh and others, 2000). MODFLOW uses different packages to define the aspects that control groundwater flow. This modified model uses the Basic, Discretization, Layer-Property Flow, Well, Drain, General-Head Boundary, Recharge, and Stream packages along with the Geometric Multigrid solver (Wilson and Naff, 2004). Each of these packages and the changes made, if any, during the model redesign and recalibration process are discussed below.

The MODFLOW-2000 input packages and their filenames used in the modified groundwater model for the Dockum Aquifer are shown in Table 1. The output files generated by the model and their associated filenames are shown in Table 2.

Table 1. Summary of model input packages and filenames

MODFLOW-2000	Input Filename
Basic (BAS6)*	Dockum_Modified_03-10.bas
Name (NAM)	Dockum_Modified_03-10.nam
Discretization (DIS)	Dockum_Modified_03-10.dis
Layer-Property Flow (LPF)*	Dockum_Modified_03-10.lpf
Well (WEL)	Dockum_Modified_03-10.wel
Drain (DRN)	Dockum_Modified_03-10.drn
General-Head Boundary (GHB)	Dockum_Modified_03-10.ghb
Recharge (RCH)	Dockum_Modified_03-10.rch
Stream (STR)	Dockum_Modified_03-10.str
Output Control (OC)	Dockum_Modified_03-10.oc
Geometric Multigrid Solver (GMG)	Dockum_Modified_03-10.gmg

* The BAS6 and LPF packages call additional files which contain initial head and aquifer property information, respectively.

Table 2. Summary of model output files and filenames

MODFLOW-2000	Input Filename
List (LST)	Dockum_Modified_03-10.lst
Global (GLO)	Dockum_Modified_03-10.glo
Heads (HDS)	Dockum_Modified_03-10.hds
Drawdown (DDN)	Dockum_Modified_03-10.ddn
Cell-by-cell Budgets (CBB)	Dockum_Modified_03-10.cbb

2.1 Basic Package

The Basic package is the standard MODFLOW package which contains the status of each cell (active or inactive), the head value assigned to inactive cells (-9999), and calls out the file which contains the starting heads for the model run (oDockum_Modified_03-10.hds).

Two significant changes were made to the Basic package for the modified model. The first is that all cells in Layer 1, which represented overlying younger units in the original model, were inactivated. This was done to better simulate the dynamics of inflow from the overlying Ogallala Aquifer based on results from the northern and southern Ogallala Aquifer groundwater availability models. As described for the General-Head Boundary package below, the general-head boundaries were moved down to interact directly with the Dockum Aquifer and turned off when the corresponding cell from the Ogallala Aquifer model became inactive.

The second change to the Basic package is that the cells in Layer 2 which represented the lower portion of the Dockum Aquifer were inactivated. Each of these cells was 1-foot thick and present only for the purpose of allowing communication between the overlying Layer 1 and the lower portion of the Dockum Aquifer in Layer 3 as described in Ewing and others (2008). The small thickness of this layer was added to the top of Layer 3 in the Discretization package below to maintain an identical structure to the original model.

Figure 2 shows the cells which are active in Layer 2 in the modified model. All active cells in Layer 2 represent the upper portion of the Dockum Aquifer. Figure 3 shows the cells which are active in Layer 3. All active cells in Layer 3 represent the lower portion of the Dockum Aquifer. Note that all active cells do not fall within the official boundary of the Dockum Aquifer defined in Ashworth and Hopkins (1995) and shown in Figure 1.

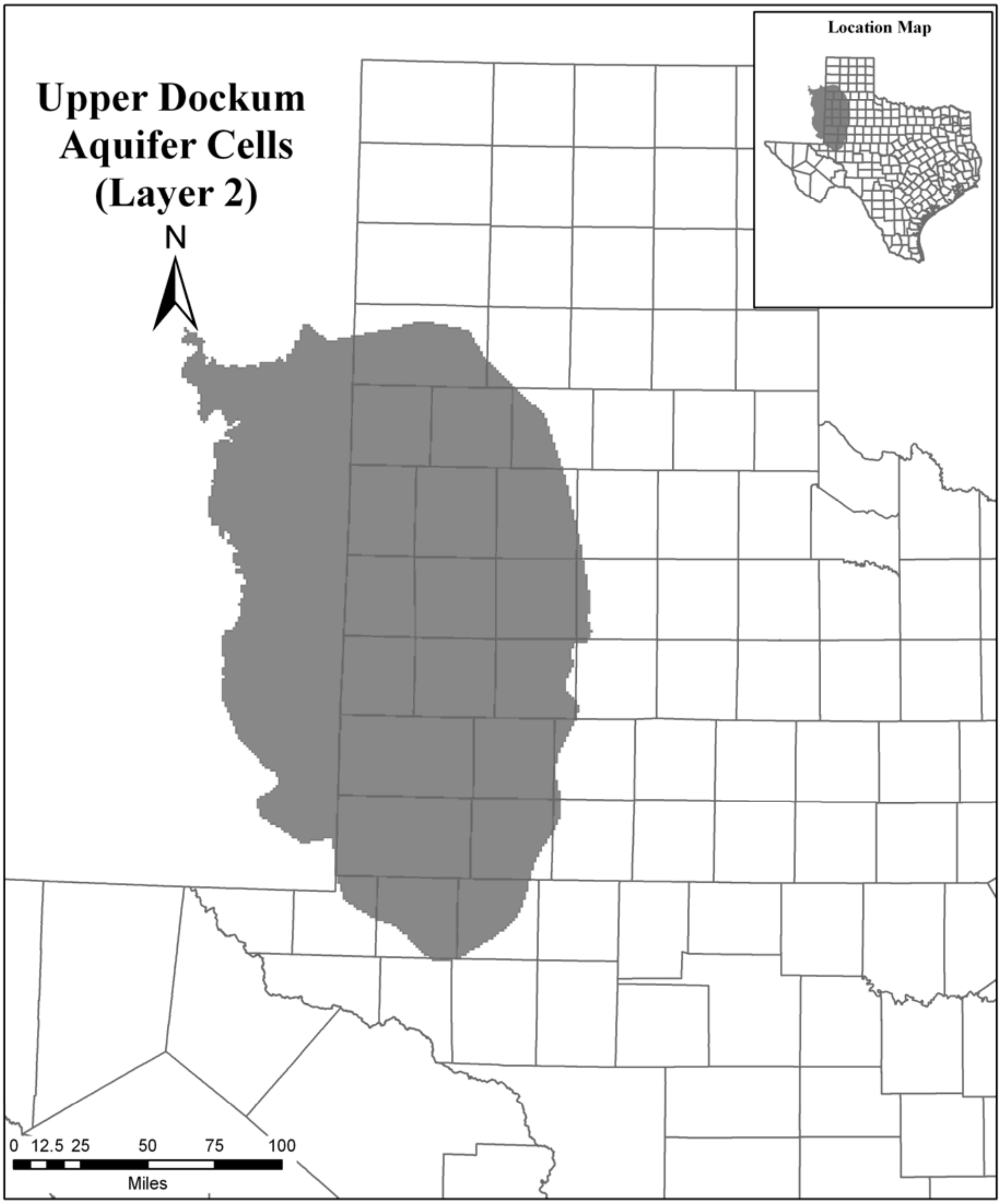


Figure 2. Active cells in the upper portion of the Dockum Aquifer (Layer 2)

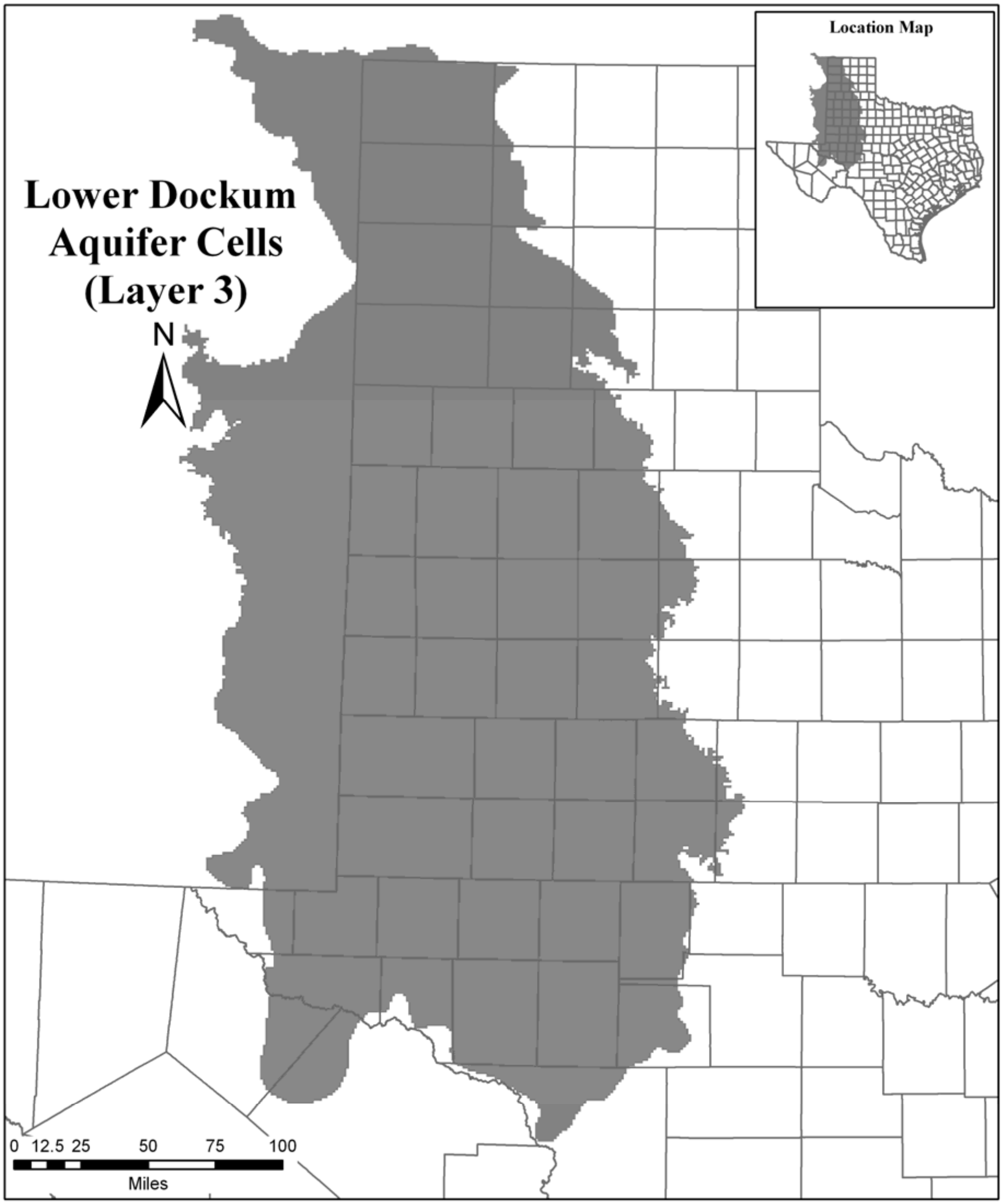


Figure 3. Active cells in the lower portion of the Dockum Aquifer (Layer 3)

2.2 Name File

The MODFLOW name file is a standard file that contains every input and output filename, the package it is associated with, and the unit number. The only changes made to the name file were to reference the new files necessary due to the changes made to the other MODFLOW input packages.

2.3 Discretization Package

The Discretization package is used to define the top and bottom of each model layer, the cell size, and the number of layers, rows, columns, and stress periods in the model.

The first significant change to the Discretization package is that the number of stress periods was reduced from 27 to 19. Specifically, the stress periods that represented periods before the calibration portion of the model (1980 to 1997) were removed and the steady-state stress period was set directly before 1980. The stress periods in the modified model are shown in Table 3.

The stress periods before the calibration portion of the model were removed because inspection of water budgets through time showed that conditions in the pre-development steady-state portion of the model may have been having unrealistic long-term effects on the water levels in the calibration period. These intermediate stress periods were removed and a small amount of pumping was added to the steady-state to achieve a smooth transition between the steady-state and calibration portions of the model. Therefore, the steady-state portion of the modified model no longer represents pre-development conditions and more closely reflects a “quasi” steady state after pumping was introduced to the groundwater flow system. The changes in pumping are discussed in the Well Package section below.

The top and bottom elevation of some model cells were changed to reflect that the portions of the lower Dockum in Layer 2 in the original model were consolidated into Layer 3. As described above for the Basic package, this change was made because the original purpose of the 1-foot thick lower Dockum cells in Layer 2 – to allow communication between layers 1 and 3 – no longer applies since the general-head boundary package is applied directly to the uppermost active Dockum Aquifer cells. The end result of this change is that the thicknesses of the combined upper and lower portions of the Dockum Aquifer are the same as in the original model. In the modified model, all active model cells in Layer 2 represent the upper portion of the Dockum Aquifer and all active model cells in Layer 3 represent the lower portion of the Dockum Aquifer.

Table 3. The length and time period represented by each stress period in the modified groundwater model.

Stress Period	Length (days)	Time Period
1	N/A	Steady-State
2	366	1980
3	365	1981
4	365	1982
5	365	1983
6	366	1984
7	365	1985
8	365	1986
9	365	1987
10	366	1988
11	365	1989
12	365	1990
13	365	1991
14	366	1992
15	365	1993
16	365	1994
17	365	1995
18	366	1996
19	365	1997

2.4 Layer-Property Flow Package

The Layer-Property Flow (LPF) package specifies the properties of the aquifer that control groundwater flow. Specifically, it contains values for hydraulic conductivity (vertically, horizontally along rows, and horizontally along columns), specific storage, and specific yield for each cell in the model.

The LPF package replaces the Block-Centered Flow (BCF) package used in the original model because it allows the option of specifying horizontal anisotropy for every cell. Horizontal anisotropy is the difference in hydraulic conductivity between flow along rows and along columns. The original model, using the BCF package, was horizontally isotropic (that is, the horizontal hydraulic conductivity was the same within a cell for flow along rows and columns). While this assumption is often made for modeling purposes, it is frequently not an accurate representation of the aquifer.

The aquifer properties specified in the LPF package were determined through calibration. Specific details about the calibration are provided in the Model Calibration and Results section below. However, it is important to note here that during calibration the aquifer was divided into 19 zones based primarily on areas of similar hydraulic conductivity in the original model. See Figure 4 for the locations of each of these zones. In this modified model the aquifer properties within each zone are uniform. This is a change from the original model in which hydraulic properties varied cell-by-cell. The average values of each of the hydraulic properties in each zone in the original model are shown in Table 4. The corresponding values for hydraulic properties in the modified model are shown in Table 5.

The LPF package reads several files which each contain values for different aquifer properties. The aquifer property and filename for each of these is shown in Table 6.

Table 4. Average hydraulic conductivity (K, feet/day), specific storage (1/feet), and specific yield (unitless) for each calibration zone in the original model.

Zone	Layer 2				
	K(rows)	K(columns)	K(vertical)	Specific Storage	Specific Yield
1	0.32	0.32	4.31E-04	7.00E-06	0.15
2	0.72	0.72	4.47E-04	6.33E-02	0.15
3	0.30	0.30	4.25E-04	5.20E-01	0.15
4	0.64	0.64	4.11E-04	8.52E-01	0.15
5	0.66	0.66	3.98E-04	4.06E-02	0.15
6	1.24	1.24	4.46E-04	7.52E-02	0.15
7	0.62	0.62	4.38E-04	1.73E-01	0.15
8	2.23	2.23	5.32E-04	5.96E-01	0.15
9	0.60	0.60	4.35E-04	9.23E-02	0.15
10	0.14	0.14	5.24E-04	4.72E-01	0.15
11	0.34	0.34	4.32E-04	9.98E-01	0.15
12	0.46	0.46	3.09E-03	6.83E-06	0.15
13	0.90	0.90	3.34E-03	6.99E-06	0.15
14	0.31	0.31	1.02E-03	6.02E-06	0.15
15	1.41	1.41	8.89E-04	6.00E-06	0.15
16	0.39	0.39	1.47E-03	6.83E-06	0.15
17	0.21	0.21	5.40E-04	3.39E-05	0.15
18	0.27	0.27	5.07E-04	1.49E-05	0.15
19	0.16	0.16	5.87E-04	2.61E-05	0.15

Zone	Layer 3				
	K(rows)	K(columns)	K(vertical)	Specific Storage	Specific Yield
1	0.32	0.32	3.46E-04	6.26E-06	0.15
2	0.72	0.72	3.34E-04	1.21E-04	0.15
3	0.30	0.30	3.04E-04	1.18E-03	0.15
4	0.64	0.64	3.58E-04	1.09E-03	0.15
5	0.66	0.66	3.24E-04	6.69E-05	0.15
6	1.24	1.24	3.99E-04	1.40E-04	0.15
7	0.62	0.62	3.88E-04	4.91E-04	0.15
8	2.23	2.23	3.93E-04	3.29E-03	0.15
9	0.60	0.60	3.56E-04	1.94E-04	0.15
10	0.14	0.14	3.33E-04	6.50E-04	0.15
11	0.34	0.34	3.47E-04	2.79E-03	0.15
12	0.46	0.46	6.24E-04	5.10E-06	0.15
13	0.90	0.90	1.21E-03	4.16E-06	0.15
14	0.31	0.31	5.46E-04	5.48E-06	0.15
15	1.41	1.41	4.64E-04	5.55E-06	0.15
16	0.39	0.39	4.42E-04	5.81E-06	0.15
17	0.11	0.11	3.51E-04	7.74E-06	0.15
18	0.14	0.14	3.20E-04	6.64E-06	0.15
19	0.47	0.47	3.60E-04	6.63E-06	0.15

Table 5. Hydraulic conductivity (K, feet/day), specific storage (1/feet), and specific yield (unitless) for each calibration zone in the modified model. Only those zones which are active in the model are displayed.

Zone	Layer 2				
	K(rows)	K(columns)	K(vertical)	Specific Storage	Specific Yield
17	0.07	0.53	1.00E-04	2.19E-08	0.15
18	0.14	0.27	1.00E-04	9.27E-09	0.15
19	0.28	0.63	1.00E-04	1.58E-08	0.17
Zone	**Layer 3**				
	K(rows)	**K(columns)**	**K(vertical)**	**Specific Storage**	**Specific Yield**
1	0.20	0.22		3.45E-07	0.15
2	2.88	2.75		3.00E-07	0.15
3	0.61	0.61		3.60E-07	0.15
4	0.32	0.32		6.24E-06	0.15
5	1.32	0.47		4.96E-07	0.15
6	0.31	2.82		1.83E-06	0.15
7	0.28	1.76		3.99E-07	0.15
8	1.05	5.95		8.01E-07	0.12
9	0.24	0.15		3.12E-06	0.15
10	5.00	5.00		2.32E-10	0.18
11	7.00	7.00		4.14E-08	0.2
12	0.46	0.11		6.78E-07	0.15
13	1.44	3.60		6.90E-07	0.15
14	0.80	0.31		2.41E-07	0.15
15	2.46	5.63		7.65E-07	0.15
16	0.94	1.56		8.09E-07	0.2
17	0.53	0.13	0.13	2.78E-06	0.15
18	0.07	0.07	0.07	5.39E-07	0.15
19	0.27	0.53	0.13	1.20E-06	0.16

Table 6. Aquifer properties defined in the Layer-Property Flow package and the filenames containing a matrix of each property value

Aquifer Property in LPF Package	Filename
Horizontal Hydraulic Conductivity (Layer 2)	hc2.dat
Horizontal Hydraulic Conductivity (Layer 3)	hc3.dat
Horizontal Anisotropy Factor (Layer 2)	anis2.dat
Horizontal Anisotropy Factor (Layer 3)	anis3.dat
Vertical Hydraulic Conductivity (Layer 2)	vhc2.dat
Vertical Hydraulic Conductivity (Layer 3)	vhc3.dat
Specific Storage (Layer 2)	ss2.dat
Specific Storage (Layer 3)	ss3.dat
Specific Yield (Layer 2)	sy2.dat
Specific Yield (Layer 3)	sy3.dat

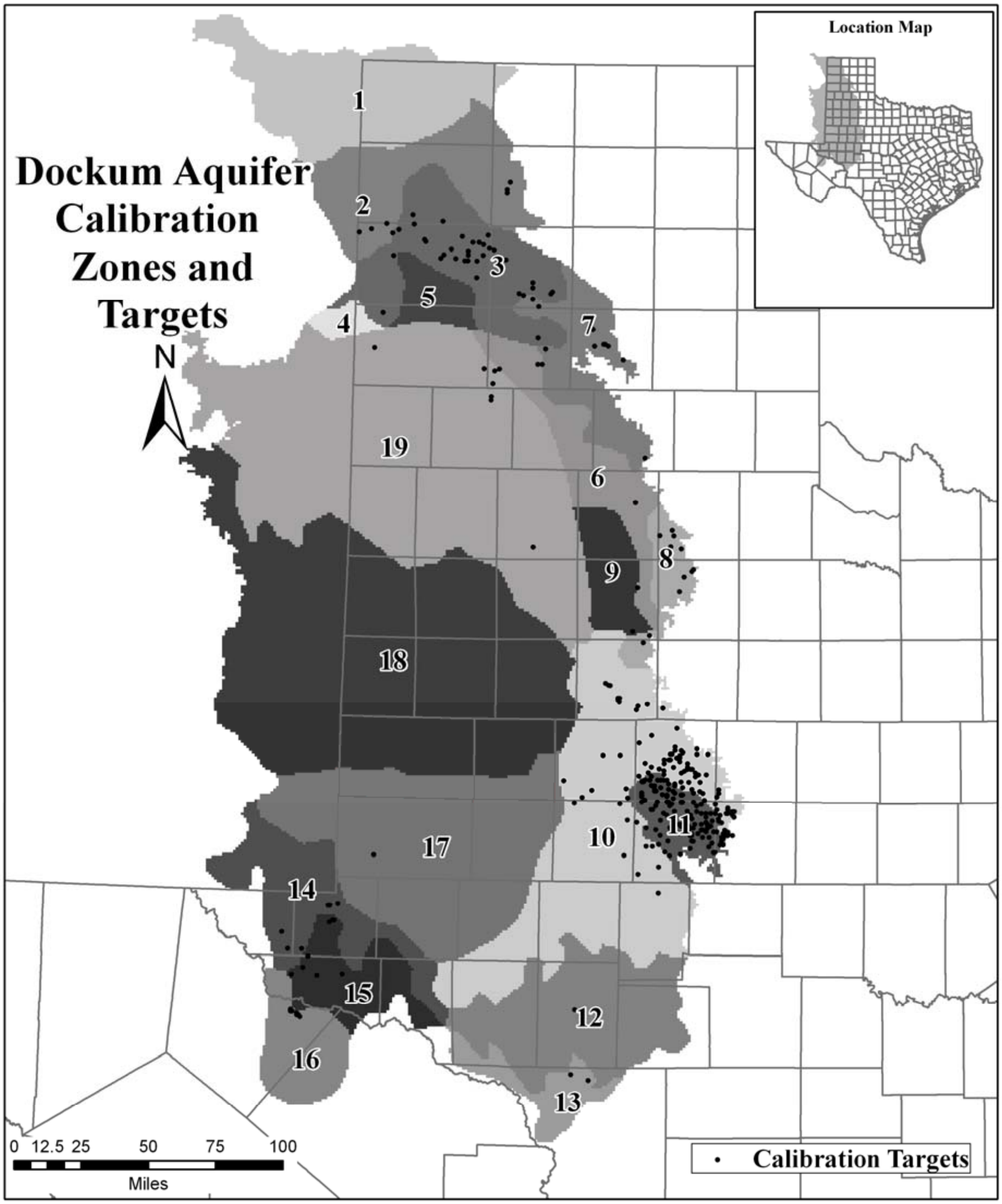


Figure 4. Calibration zones and targets used in the modified Dockum Aquifer groundwater model

2.5 Well Package

The MODFLOW Well package is used in both the original and modified models to simulate pumping from the Dockum Aquifer for municipal, manufacturing, power generation, mining, livestock, irrigation, and rural domestic uses. See Ewing and others (2008) for the procedures used to generate the spatial and temporal distribution of pumping in the model.

Two changes were made to the Well package as a result of the reduction in the number of stress periods. First, the stress periods that were removed from the Discretization package above were also removed from the Well package. Second, since the steady-state period of the model (stress period 1) is directly before the historical transient portion of the model, it was necessary to add a small amount of pumping to the steady-state period to produce water levels at the end of the steady-state that transition smoothly into the historical period. Using an iterative process and examining water budgets through time it was determined that pumping at 20 percent of the 1979 distribution from the original model best achieves this desired smooth transition.

Pumping output from the model through time is shown in the Model Calibration and Results section below.

2.6 Drain Package

As described in Ewing and others (2008), the MODFLOW Drain package was used to simulate outflow to springs as well as evapotranspiration (ET). Drain cells are defined as either representing evapotranspiration or a spring in Ewing and others (2008). The only change made to the drain package in the modified model was the removal of the eight stress periods described in the Discretization package above. The steady-state period of the modified model contains drain values from 1979 in the original model.

2.7 General-Head Boundary Package

The General-Head Boundary (GHB) package is used to allow flow into or out of a model based on the difference between the head value in a cell and the specified GHB head value and the hydraulic properties of the boundary. The upper portion of Figure 5 shows how the General-Head Boundary package was implemented into the overall conceptualization of the original model.

As described above, the GHB head values specified in the original model were taken from the groundwater availability model for the southern portion of the Ogallala Aquifer, where present. In areas outside of the southern portion of the Ogallala Aquifer, GHB head values were set at constant values estimated from land surface topography. This was later revised by INTERA to include heads from both the northern and southern portions of the Ogallala Aquifer models. These general-head boundary conditions were applied to Layer 1, which represented younger units overlying the Dockum Aquifer. Since Layer 1 was an active layer in the original model, the conductance of the general-head boundary was set to a relatively high value (1000 $feet^2/day$) to allow the water level in Layer 1 to more quickly respond to and mimic the head value of the general-head boundary. Another consequence of Layer 1 being active in the original model was that, for interaction to occur between the younger units in Layer 1 and the lower portion of the Dockum Aquifer in Layer 3, Layer 2 must be active. Figure 5 shows that in areas where the upper portion of the Dockum was not present, a 1-foot thick segment of the lower portion of the Dockum Aquifer was placed in Layer 2 to allow flow from the overlying younger units.

The conceptualization of the original model limited predictive simulations in situations where the overlying Ogallala models contained inactive cells. A cell becomes inactive when the water level in the cell falls below the base of the cell, which is a common occurrence in Ogallala Aquifer simulations of managed depletion. In the original model, if a cell becomes inactive in an Ogallala Aquifer model, the corresponding cell in Layer 1 cannot be inactivated. If the general-head boundary condition at the cell in Layer 1 is removed, the cell remains active and will continue to serve as a source of water to the underlying Dockum Aquifer.

Finally, some discrepancies exist in the elevations between the groundwater availability models for the Ogallala Aquifer and the Dockum Aquifer. Specifically, in some areas the base of the Ogallala Aquifer and/or the Edwards-Trinity (High Plains) Aquifer is below the top of the Dockum Aquifer. Outside of the conceptual problem this poses, it means that head values in these areas cannot be directly translated into general head boundary values since they will not always be above the top of the Dockum Aquifer.

The lower portion of Figure 5 depicts important changes for the modified model to address the problems discussed above. As mentioned for the Basic and Discretization packages, Layer 1 was inactivated in the modified model and the general-head boundary was applied directly to the uppermost portion of the Dockum Aquifer. Additionally, the lower portion of the Dockum Aquifer in Layer 2 was grouped into Layer 3 since there was no longer a need for interaction with Layer 1 to occur.

Two additional changes were made to the General-Head Boundary packages that are not shown in Figure 5. First, transient general-head boundary conditions were taken from both the southern and northern Ogallala groundwater availability models. This enabled the northern portion of the Dockum Aquifer to be calibrated to the changing heads in the Ogallala Aquifer through the historical period and transition smoothly into the predictive period. Areas that are not overlain by the Ogallala Aquifer groundwater availability models retained the constant general-head boundary values that existed in the original model.

The second change relates to the elevation discrepancies discussed above. The best way to address this issue would be to revisit and correct the elevations of the layers in the Dockum and/or Ogallala Aquifer models so they are consistent. However, this would be a significant undertaking that is not within the scope of this model modification effort. To address the problem for the modified model, the saturated thickness for each cell and stress period of the groundwater availability models for the Ogallala Aquifer was first calculated and then added to the elevation of the top of the Dockum Aquifer for each corresponding cell and stress period. Where present, the Edwards-Trinity (High Plains) Aquifer base was used in the saturated thickness calculation. Elsewhere, the base of the Ogallala Aquifer was used. Using this method, the GHB head elevation was set to always be above the elevation of the top of the Dockum Aquifer. Additionally, when a cell becomes inactive in one of the Ogallala Aquifer groundwater availability models, the corresponding general-head boundary condition is removed and flow can no longer occur.

The application of the General-Head Boundary package in the modified model requires that the general-head boundary conductance, a term that describes how easily water can flow across the boundary, be revised. As described in Harbaugh and others (2000), the general-head boundary conductance that defines vertical flow from an overlying aquifer comes from Darcy's Law:

$$Q = \frac{K_v A(h_2 - h_1)}{L} = C(h_2 - h_1)$$

where

Q is the volumetric flow across a general-head boundary;
K_v is the vertical hydraulic conductivity;
A is the cross-sectional area of the cell;
(h_2-h_1) is the difference between the head in the cell and the specified head of the general-head boundary;
L is the length over which the flow occurs; and
C is the general-head boundary conductance.

The general-head boundary conductance is, therefore, the product of the vertical hydraulic conductivity and the area of the cell divided by the length over which the flow occurs. Vertical hydraulic conductivity is a parameter that can vary over several orders of magnitude depending on the composition of the aquifer (Freeze and Cherry, 1979). The composition of the Dockum Aquifer ranges from sandstone with a relatively high hydraulic conductivity to siltstone and mudstone with lower hydraulic conductivities (Bradley and Kalaswad, 2003). If, for instance, it is assumed that the average length over which vertical flow occurs between the Ogallala and Dockum Aquifers is 500 feet, conductance values range from less than 0.1 $feet^2$/day to over 1000 $feet^2$/day using the normal ranges for vertical hydraulic conductivity of the different units of the Dockum Aquifer (Freeze and Cherry, 1979).

For this reason, general-head boundary conductance was a calibrated parameter in this modified model. The calibrated general-head boundary conductance values that achieved the best match to measured water levels, while also producing reasonable flow volumes, ranged between 1 and 50 $feet^2$/day and are shown in Table 7. Details on the calibration process are given in the Model Calibration and Results section below.

Table 7. Calibrated general-head boundary conductance values for the modified groundwater model of the Dockum Aquifer.

Zone	General-Head Boundary Conductance (ft^2/day)
1	7
2	16
3	50
4	50
5	1
6	4
7	8
8	5
9	16
10	5
11	5
12	1
13	1
14	10
15	50
16	50
17	50
18	50
19	50

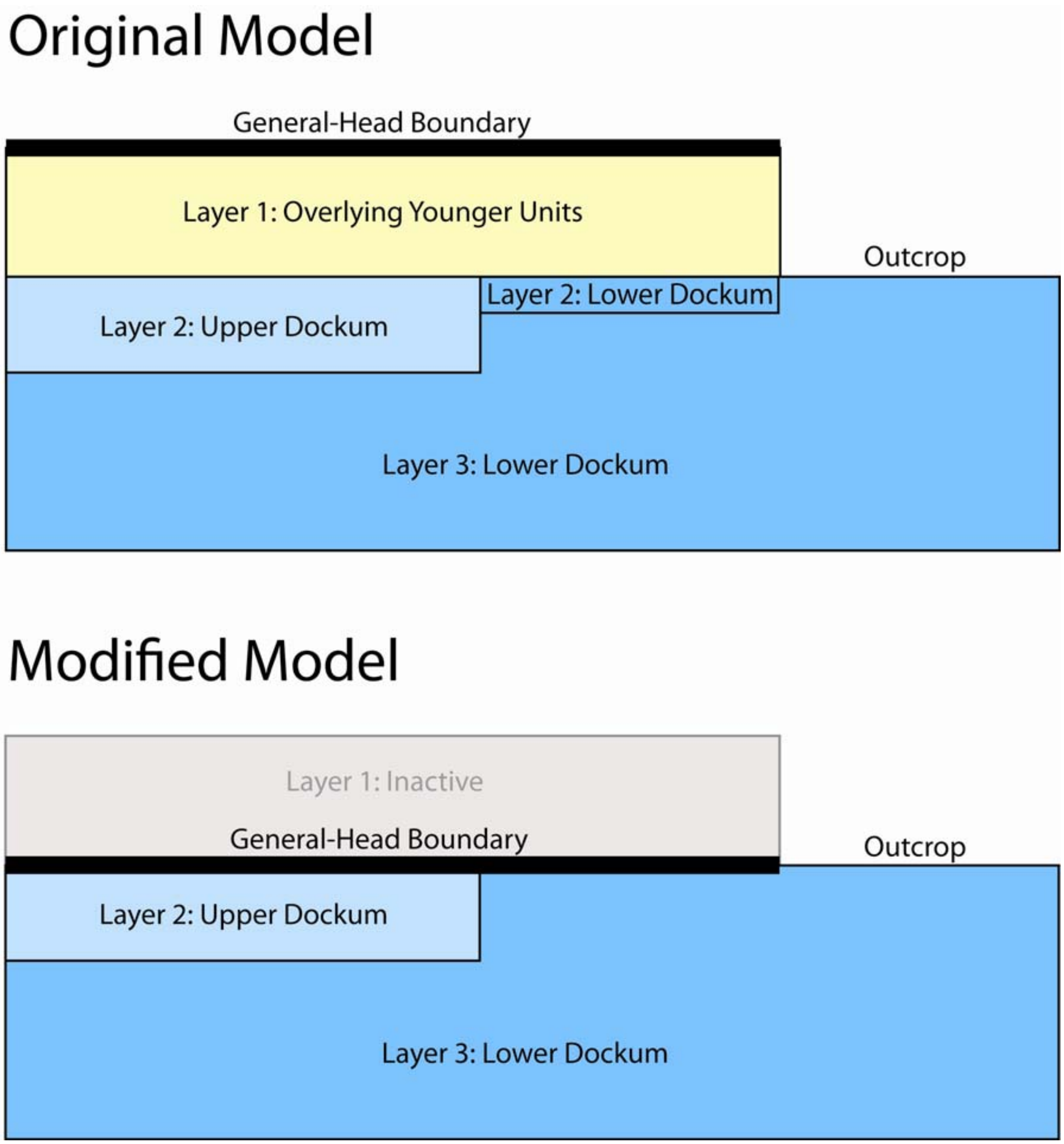


Figure 5. Difference in design of the groundwater models for the Dockum aquifer between the original model (Ewing and others, 2008) and the modified model.

2.8 Recharge Package

The Recharge package is used to simulate inflow to the aquifer from direct precipitation on the outcrop areas of the aquifer. As described in Ewing and others (2008), recharge values for each model cell were determined as a function of topography and accounted for additional recharge due to land use changes in the Colorado River outcrop. Other than removing stress periods that no longer applied, recharge in the modified model remains unchanged from the recharge specified in the original model.

2.9 Stream Package

The Stream package was used to simulate interaction of the aquifer with streams and rivers within the outcrops of the upper and lower portions of the Dockum Aquifer. Other than removing stress periods that no longer applied, the stream package remains unchanged from the original model.

2.10 Output Control File

The MODFLOW-2000 Output Control (OC) file specifies when to save head, drawdown, and budget output during the model run. It is a standard file required for all MODFLOW models. The Output Control file for the modified model is set up to output head, drawdown, and budget information at the end of each stress period.

2.11 Geometric Multigrid (GMG) Solver

MODFLOW requires the use of a solver to solve the finite difference equations that govern groundwater flow in the aquifer. Both the original model for the Dockum Aquifer and this modified model use the Geometric Multigrid (GMG) solver, documented in Wilson and Naff (2004). The solver uses 0.01 foot head change and 0.01 feet^3/day residual convergence criteria, which is unchanged from the original model.

3.0 MODEL CALIBRATION AND RESULTS

3.1 Calibration Procedure

The calibration of a groundwater model refers to the adjustment of certain parameters, within a reasonable range, to improve how closely the model matches observed values. Due to the significant changes made to the model through this model modification, it was necessary to perform a recalibration. Specifically, general-head boundary conductance, hydraulic conductivity along rows, hydraulic conductivity along columns, vertical hydraulic conductivity, specific storage, and specific yield were adjusted for each of the calibration zones previously presented in Figure 4.

The primary targets for the calibration were water levels measured in wells. Secondarily, water budgets were also checked to make sure that flow volumes were reasonable. The well locations used as targets for the calibration are shown in Figure 4. With two exceptions, these wells are the same targets used to calibrate the original model documented in Ewing and others (2008). The first exception is well 908301 (with eight measurements) located in the upper portion of the Dockum Aquifer, which at one point during the calibration became inactive and was subsequently removed so the calibration process could proceed. The second exception is well 1016102 (with two measurements). In the original model the cell this well was located in was within the boundary of the upper portion of the Dockum Aquifer. However, the structure of the cell indicated that it was part of the 1-foot thick lower portion of the Dockum Aquifer in Layer 2. Since the lower portion of the Dockum Aquifer in Layer 2 was moved to Layer 3 during the model modification (described in the Basic Package section above), the two measurement associated with this well were removed. The calibration of the modified model included 1,308 water level measurements from 346 wells. The vast majority of these measurements are in the lower portion of the Dockum Aquifer near the outcrop areas.

Calibration of this modified model was performed using a combination of PEST – an automated calibration software package (Watermark Numerical Computing, 2004) – and trial-and-error. Where possible, the six parameters above were adjusted using PEST, within a reasonable range, to achieve the best possible match to measured water levels. The parameter values and model results achieved through PEST runs were then inspected to determine if they were reasonable. In cases where unreasonable results were found, a trial-and-error approach was used to determine a more appropriate range of possible parameter values for a particular zone to produce more reasonable results. This process was then repeated until flow volumes and parameter values reasonably matched the conceptualization of flow within the Dockum Aquifer while also achieving an appropriate match to measured water levels.

3.2 Calibration Results

There are a number of ways to characterize and convey the quality of a calibration. Each of them, however, is based on the difference between observed values and the corresponding model simulated values, also known as the residuals. A positive residual indicates that the observed value is higher than the simulated value (that is, the model estimate is too low). A negative residual indicates that the observed value is lower than the simulated value (that is, the model estimate is too high). The calibration targets, or observations, used to calibrate both the original and modified versions of the Dockum Aquifer groundwater models are water level measurements.

Statistical measures are often used to quantify the quality of the calibration of a model. Table 8 shows some common calibration statistics for both the original model and this modified model for the upper and lower portions of the Dockum Aquifer for the period between 1980 and 1997. The mean error (ME) is the mean of all of the residuals. For both the original and modified models the mean error is significantly less than the other calculations of error because negative residuals are averaged with positive residuals, which produces an offsetting effect. The mean absolute error (MAE) is the mean of the absolute value of each residual. The standard deviation is the standard deviation of all of the residuals. The root mean square error (RMSE) is another measure of the error which more highly weights large (highly positive or negative) residuals than small residuals.

As can be seen in Table 8, the calibration statistics for the modified model show an improvement over the original model. It should be noted that some of the values for the original model do not exactly match the values presented in Ewing and others (2008). This is because the values in Table 8 for the original model were calculated using the same calibration targets as for the modified model to allow a more direct comparison. Additionally, the range of measured water levels in Ewing and others (2008) could not be verified. Therefore, the range of measured water levels in the target dataset was used to define the range shown in Table 8. According to Anderson and Woessner (2008), the error in water level measurements should be less than 10 percent of the range of measured water levels. As shown in Table 8, the Adjusted Standard

Deviation, the standard deviation divided by the range of measured water levels, for both the original and modified models meets this requirement.

Figure 6 shows a crossplot of observed versus simulated water levels and a plot of observed water levels versus residuals for the upper portion of the Dockum Aquifer. As shown in Figure 6, the observed water levels in the upper portion of the Dockum Aquifer closely match the simulated water levels based on their proximity to the one-to-one line. Additionally, residuals do not appear overly biased toward higher or lower elevations as can be seen in the second plot in Figure 6. Though higher elevations generally had positive residuals while the lower elevations had negative residuals, this is not considered significant due to the lack of data available for the upper portion of the Dockum Aquifer.

Figure 7 shows these same plots for the lower portion of the Dockum Aquifer. As for the upper portion of the Dockum Aquifer, the simulated water levels in the lower portion of the Dockum Aquifer closely follow the corresponding observed values. Additionally, the residuals do not appear biased toward high or low elevations.

Figure 8 shows a histogram of residuals for both the upper and lower portions of the Dockum Aquifer divided into 20 foot increments. Ideally, the residuals will produce a normal distribution with the highest number of residuals close to zero and decreasing residuals in the positive and negative directions.

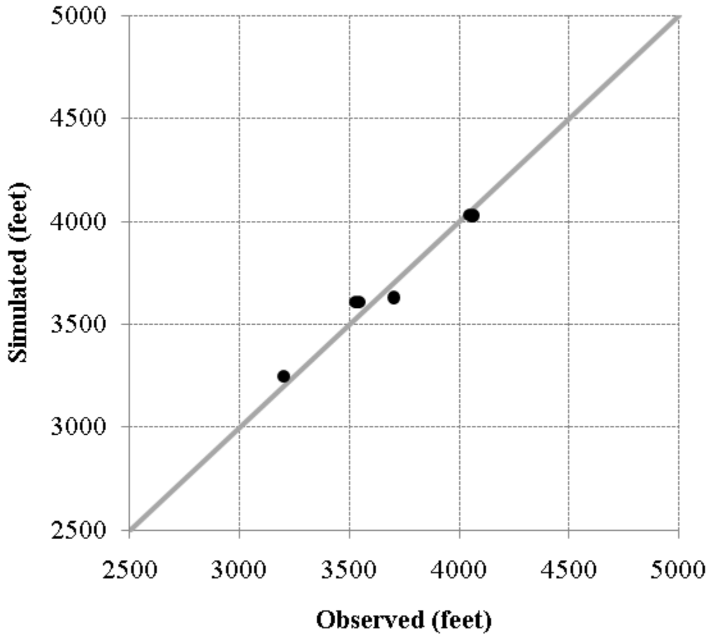
As can be seen in Figure 8, the residuals for the upper portion of the Dockum Aquifer are not normally distributed. This is not considered significant, however, because there were only 15 water-level measurements available for this portion of the aquifer. The histogram of residuals for the lower portion of the Dockum Aquifer in Figure 8 more closely resembles a normal distribution. The main deviation from the normal distribution is for residuals between 80 and 100 feet. Of the approximately 120 residuals in this range, 52 are from a single well (state well 4646211).

A hydrograph for the above well, as well as hydrographs for many additional wells, is shown in Appendix 1. A hydrograph is the representation of water levels through time. The hydrographs in Appendix 1 show observed water levels compared to simulated water levels in both this modified model and in the original model. The wells on which the hydrographs are based are the same wells presented as hydrographs in Ewing and others (2008) except that only those wells with multiple water level measurements were used.

In some cases the modified model more closely matches the observed water levels while in others the opposite is true. Where possible, the y-axes on the hydrographs in Appendix 1 represent 200 feet of water level change. In some cases it was necessary to use a wider range. Note, however, that the gridlines are always at 20-foot intervals.

Table 8. Calibration statistics for the original (Ewing and others, 2008) and modified groundwater models for the Dockum Aquifer

	Modified Model			Original Model		
	Upper	Lower	Model	Upper	Lower	Model
Number of Targets	15	1293	1308	17	1293	1308
Mean Error (ME)	-2.5	4.7	4.6	-88.3	-6.2	-7.1
Mean Absolute Error (MAE)	42.5	52.7	52.6	96.3	69.6	70.0
Root Mean Squared Error (RMSE)	48.0	70.2	70.0	104.9	98.2	98.3
Standard Deviation	49.6	70.1	69.9	58.6	98.0	98.0
Range of Measured Water Levels (feet)	860	2128	2128	860	2128	2128
Adjusted Standard Deviation	0.058	0.033	0.033	0.068	0.046	0.046



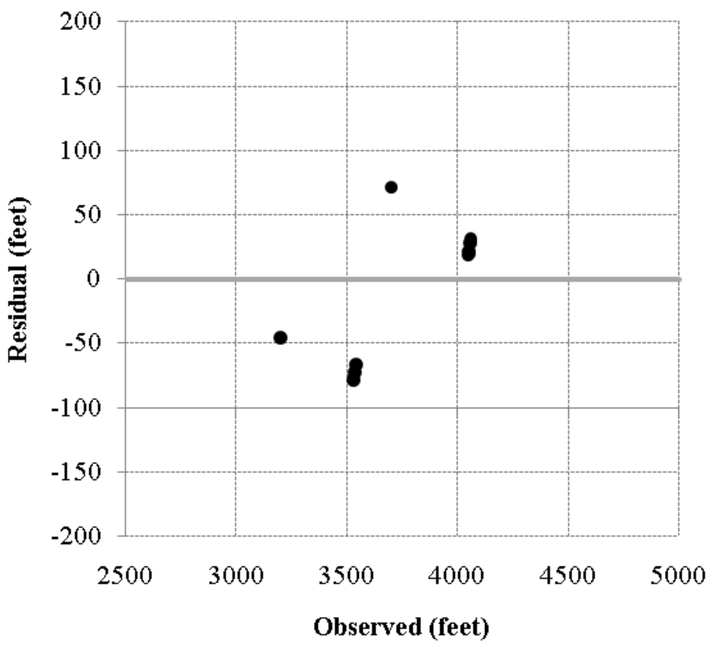


Figure 6. For Layer 2 representing the upper portion of the Dockum Aquifer, plots of (a) simulated versus observed heads, and (b) observed heads versus head residuals.

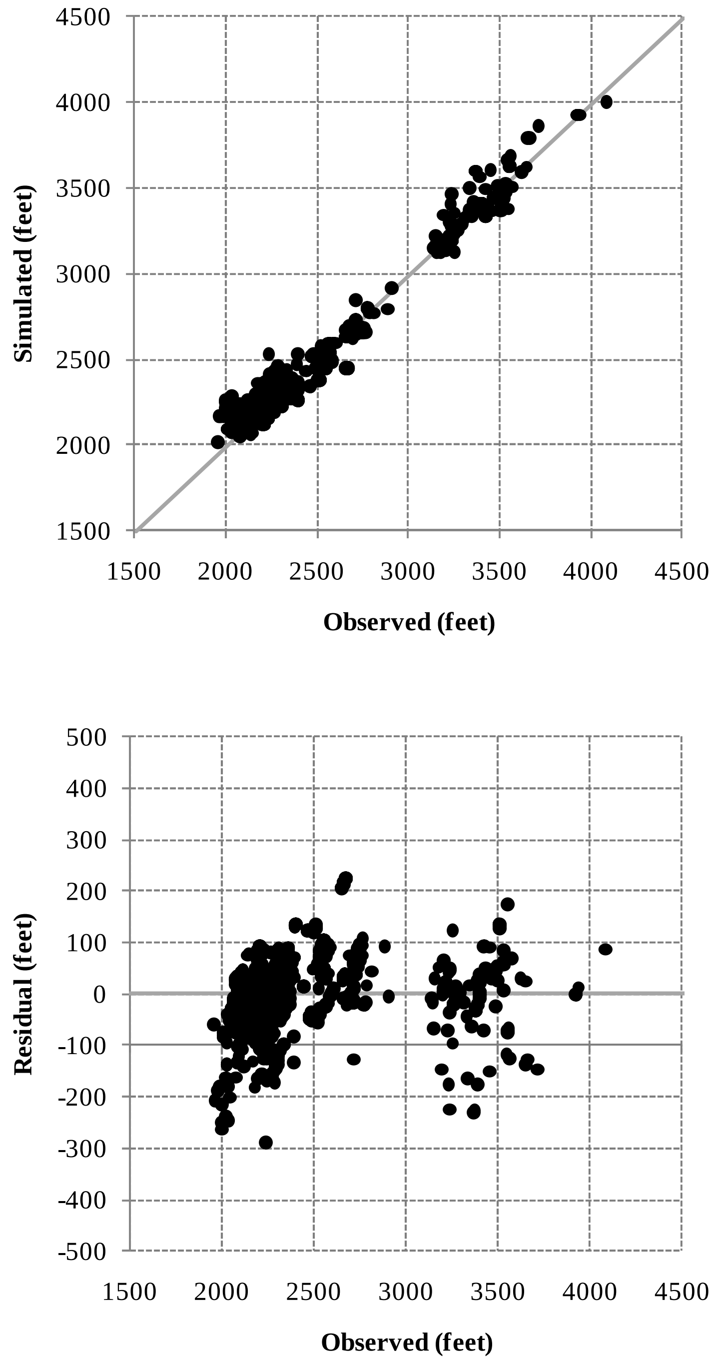
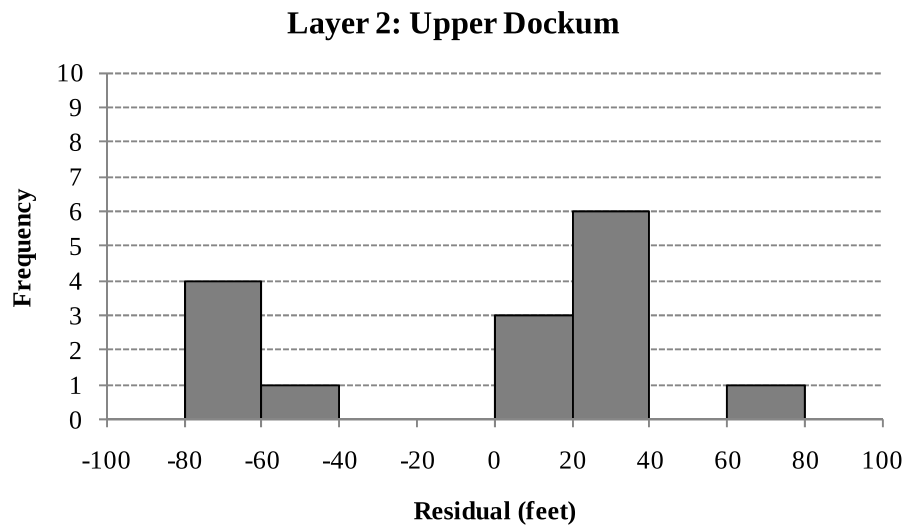


Figure 7. For Layer 3 representing the lower portion of the Dockum Aquifer, plots of (a) simulated versus observed heads, and (b) observed heads versus head residuals.



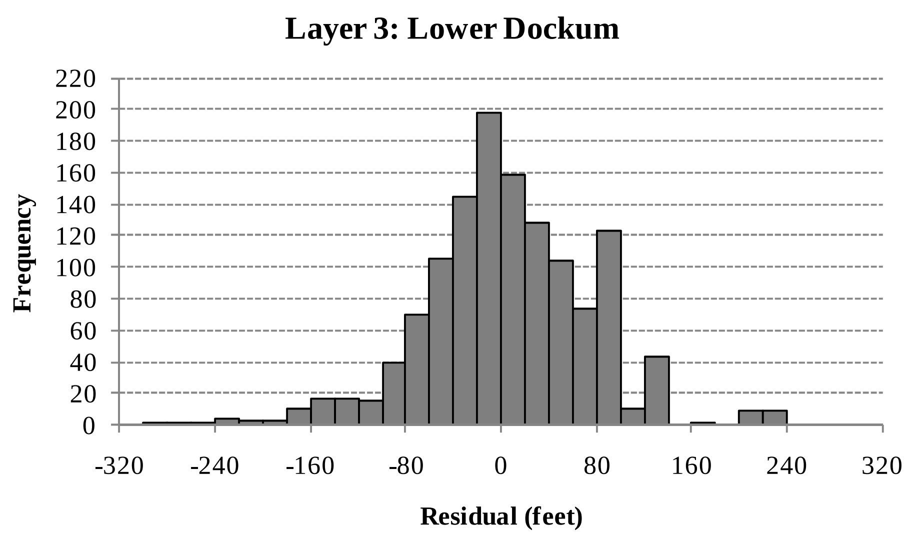


Figure 8. Histograms of the frequency of residuals for the upper and lower portions of the Dockum Aquifer. Each bar represents a range of residuals of 20 feet.

3.3 Flow Direction

Figures 9 and 10 show the direction of flow for the last year of the model (1997) in the upper and lower portions of the Dockum Aquifer, respectively. For both areas, flow is generally from the northwest to the southeast, with some local variations in flow direction primarily due to the presence of rivers. For instance, in the Canadian River outcrop area in Oldham and Potter counties, the arrows indicating flow direction point toward each other and slightly downstream as water in the Dockum Aquifer flows toward the river. A similar pattern can be seen for the Red, Colorado and Pecos rivers. The flow directions shown in figures 9 and 10 are consistent with the original model documented in Ewing and others (2008).

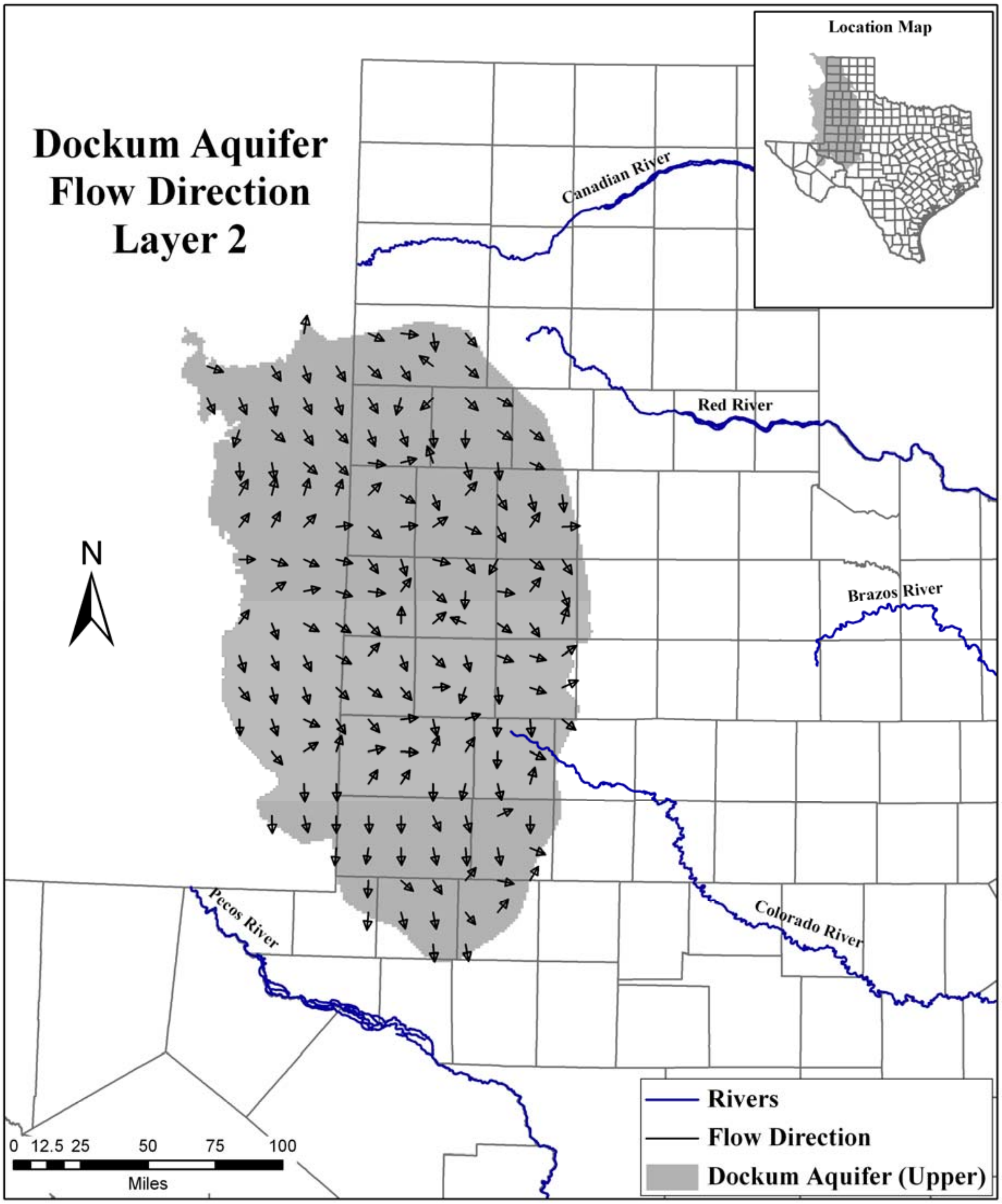


Figure 9. Flow direction for the last year of the model run (1997) for the upper portion of the Dockum Aquifer.

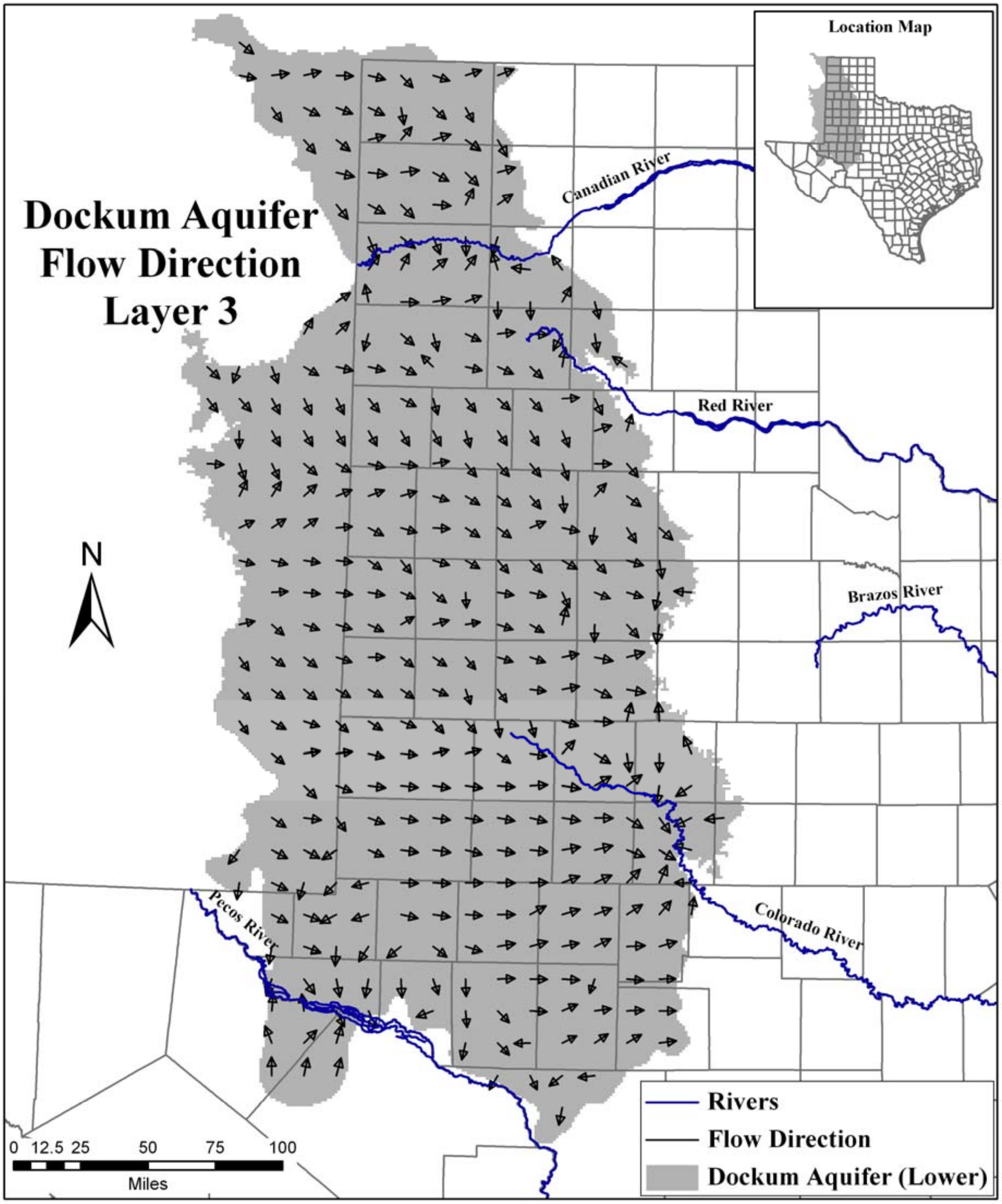


Figure 10. Flow direction for the last year of the model run (1997) for the upper portion of the Dockum Aquifer.

3.4 Water Budgets

Figures 11 through 16 summarize water budget components through time for the modified groundwater model of the Dockum Aquifer. Recharge, depicted in Figure 11, is constant through time and, as described above, is unchanged from the original version of the model. Pumping, shown in Figure 12, is also unchanged from the original model between 1980 and 1997. During this time period, pumping over the whole model declines from approximately 50,000 acre-feet per year in 1980 to approximately 35,000 acre-feet per year in 1988. It then generally increases through 1997. The net amount of water removed from storage in the aquifer each year follows a similar, but mirrored, trend as the pumping, as shown in Figure 13. In general, the higher the pumping, the higher the volume of water removed from storage.

Outflow to springs and by evapotranspiration was simulated together using the MODFLOW Drain package and is shown in Figure 14. The net outflow to streams from the Dockum Aquifer is shown in Figure 15. The volumes for each of these parameters in the modified model are higher than the corresponding parameters in Ewing and others (2008). As described above, these parameters were not changed during the calibration of the modified model. The increased flows appear to be the result of generally higher groundwater levels in these areas.

Figure 16 shows the net volume of flow from younger units overlying the Dockum Aquifer as modeled using the MODFLOW General-Head Boundary package. Through the historical period (1980 through 1997) the net volume of inflow from the younger units into the Dockum Aquifer is decreasing, which is consistent with the declining groundwater levels in the Ogallala Aquifer.

In addition to the figures described above, Appendix 2 contains tables of individual water budget parameters by county, groundwater conservation district, and model layer for the steady-state, 1980, 1990, and 1997 periods of the model.

One of the major improvements in the modified model is that each of the water budget terms shown in figures 11 through 16 can now transition smoothly from the historical to the predictive periods. This is especially important for the General-Head Boundary package, which is the tool through which changes in the overlying aquifers (specifically the Ogallala Aquifer) impact the Dockum Aquifer.

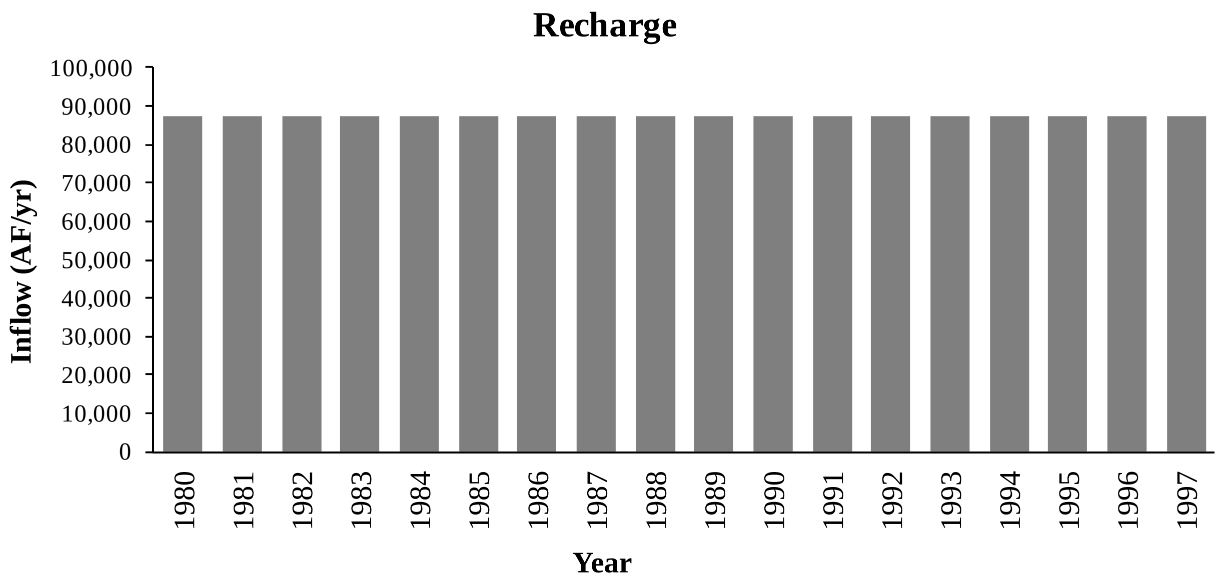


Figure 11. Recharge through time for the historical portion of the modified groundwater model of the Dockum Aquifer. Flow volumes are in acre-feet per year and represent the entire model.

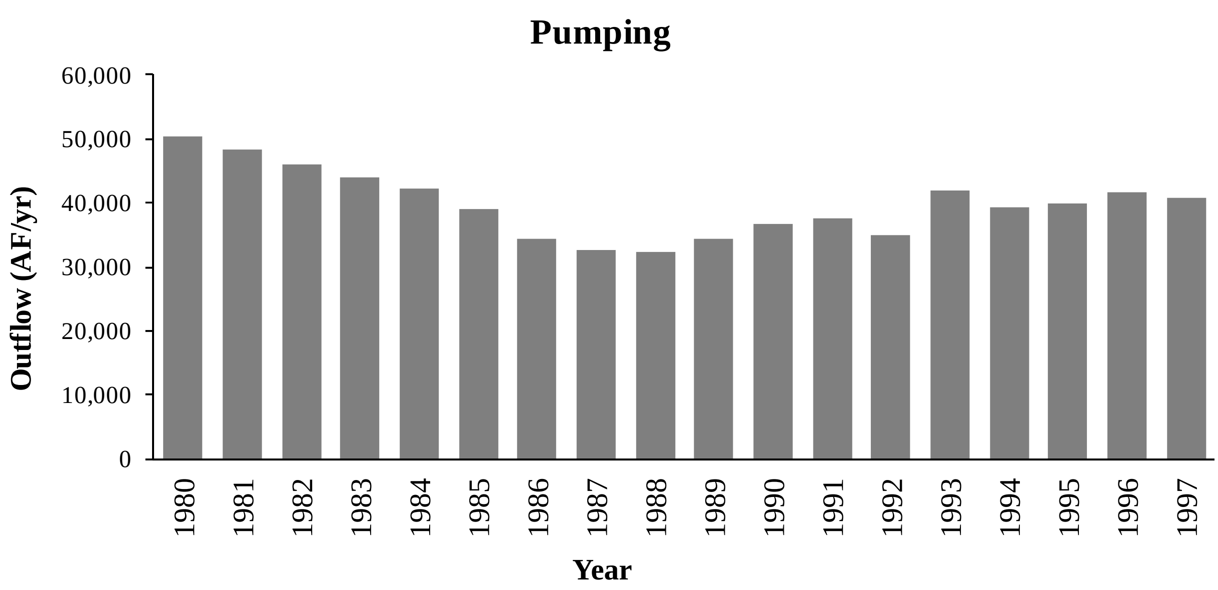


Figure 12. Pumping through time for the historical portion of the modified groundwater model of the Dockum Aquifer. Flow volumes are in acre-feet per year and represent the entire model.

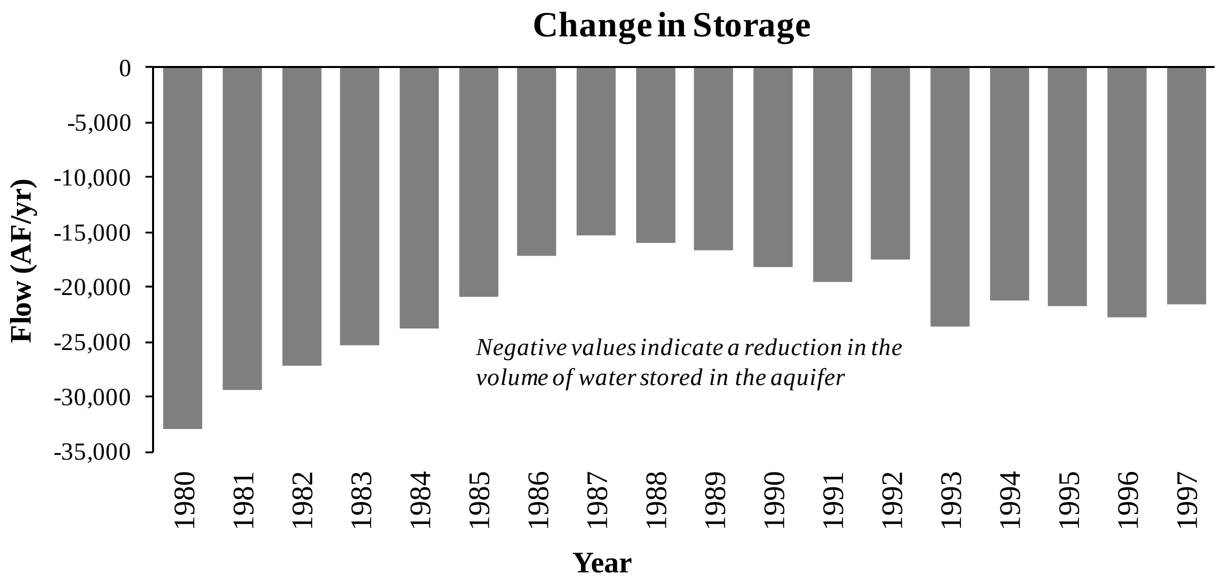


Figure 13. Change in the volume of water stored in the Dockum Aquifer through time for the historical portion of the modified groundwater model. Flow volumes are in acre-feet per year and represent the entire model.

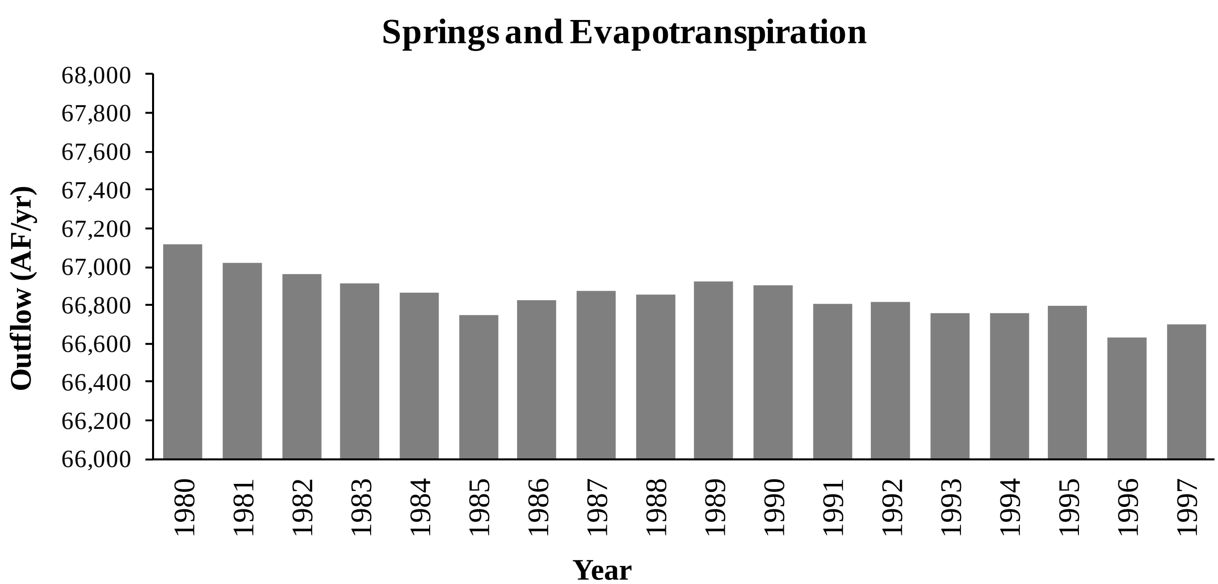


Figure 14. Outflow to springs and by evapotranspiration from the Dockum Aquifer through time for the historical portion of the modified groundwater model. Flow volumes are in acre-feet per year and represent the entire model. Springs and Evapotranspiration are shown together because they were modeled together using the MODFLOW drain package as described above and in Ewing and others (2008).

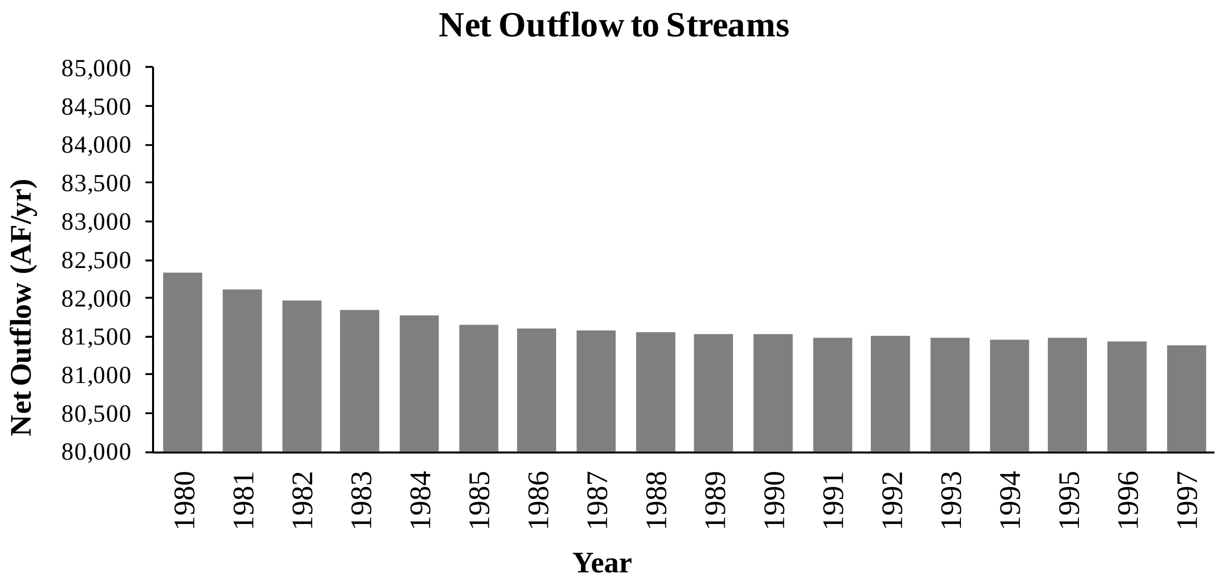


Figure 15. Net outflow to streams from the Dockum Aquifer through time for the historical portion of the modified groundwater model. Flow volumes are in acre-feet per year and represent the entire model.

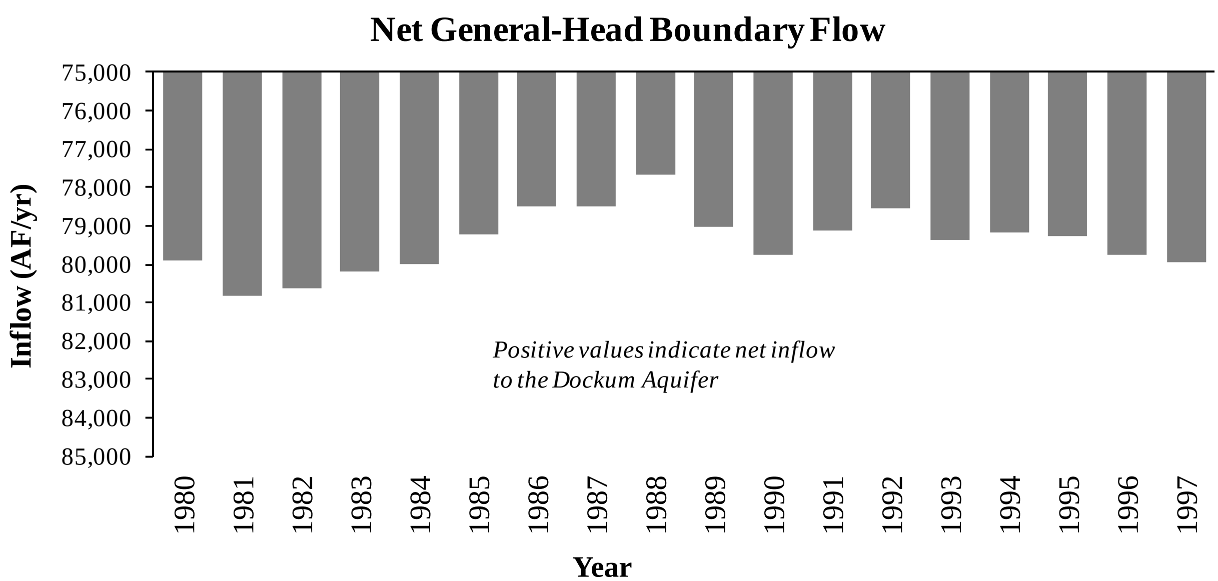


Figure 16. Net inflow into the Dockum Aquifer from younger units above the Dockum Aquifer through time for the historical portion of the modified groundwater model. Flow volumes are in acre-feet per year and represent the entire model.

4.0 MODEL LIMITATIONS

The primary purpose of these model modifications is to allow the model to be used for predictive simulations. Due to this more limited objective, some improvements to the model that could be made – and may be made in the future – were not pursued. For instance, the discrepancy in the layer elevations between the Ogallala and Dockum Aquifer models. Ideally a final determination would be made about the appropriate elevations for each of the layers. The aquifers could then be merged into a single model. This would facilitate directly modeling the relationship between the various aquifers in the model area. It also bypasses the need to determine less intuitive parameters such as general-head boundary conductance since these would no longer be needed.

Additionally, as mentioned above, the volume of outflow by evapotranspiration and to springs and streams is larger than in the original model documented in Ewing and others (2008). While we do not consider the flow volumes in the original model for these parameters to be perfect, we acknowledge that the flow volumes for these parameters in this modified model may not be an improvement since it was not a primary focus area. With more time for further study, a more precise determination of the appropriate volumes for each of these parameters would further improve the model.

As with any regional-scale groundwater model, there can be significant differences between observed and simulated water-levels at a given location. This is because many assumptions and simplifications of the complex conditions in the aquifer must be made in order to effectively model the aquifer system as a whole. Because of this, it is much more appropriate to evaluate model results at a regional scale than at a local scale.

5.0 SUMMARY AND CONCLUSIONS

As discussed above, the primary purpose of these model modifications was to correct issues with the original groundwater availability model which made it inappropriate for use in predictive model runs. The changes discussed above, especially inactivating Layer 1 which represented overlying younger units and updating the General-Head Boundary package, allow model simulations to transition smoothly into predictive model runs. These predictive runs can now effectively incorporate the changing conditions in overlying aquifers which impact the Dockum Aquifer.

Additionally, the recalibration of certain model parameters, which was necessary due to the significant changes in the model, improved the match between observed and simulated water levels.

The modified model is a simpler representation of the Dockum Aquifer than the original model documented in Ewing and others (2008). The stress periods are limited to a steady-state period and a calibration period of 1980 to 1997. The upper and lower portions of the Dockum Aquifer are also now wholly represented by layers 2 and 3, respectively. These improvements should make both modeling easier for the hydrogeologist and interpretation of model results more straight-forward for the decision-maker.

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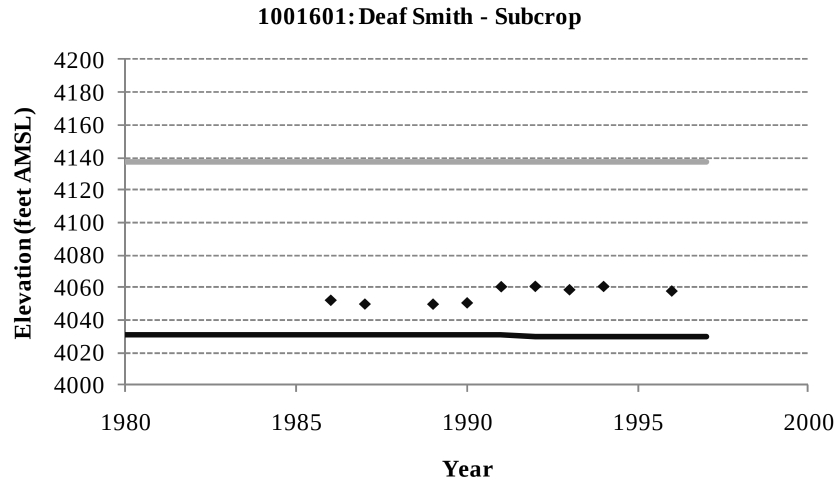
Appendix A

Selected Hydrographs



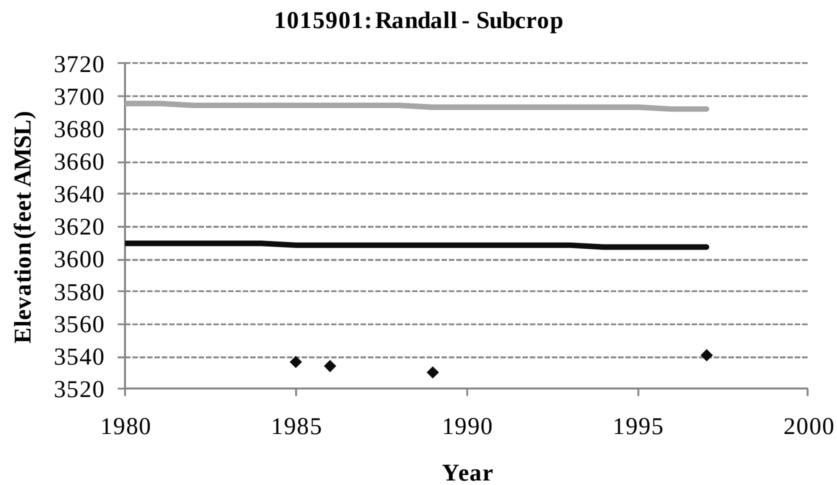
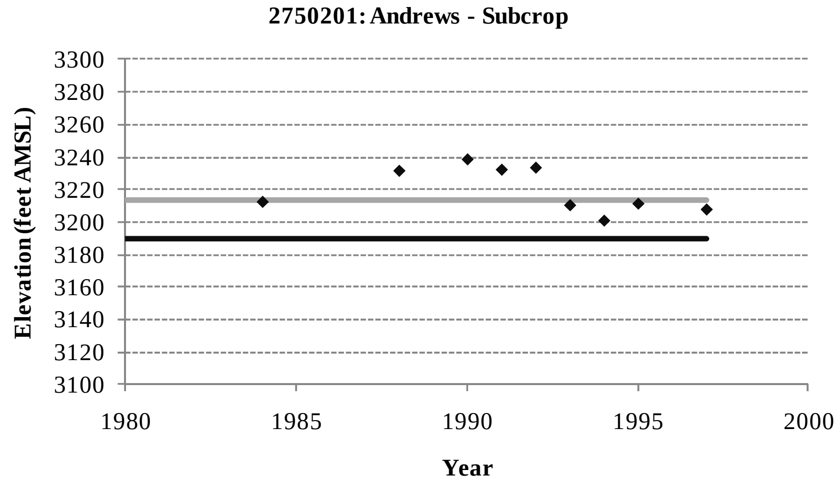


Figure A.1. Simulated and observed water levels for selected wells in the upper portion of the Dockum Aquifer. Dots represent observed values. The black solid line represents simulated water levels in the modified model. The gray solid line represents simulated water levels in the original model (Ewing and others, 2008). All elevations are in feet above mean sea-level.



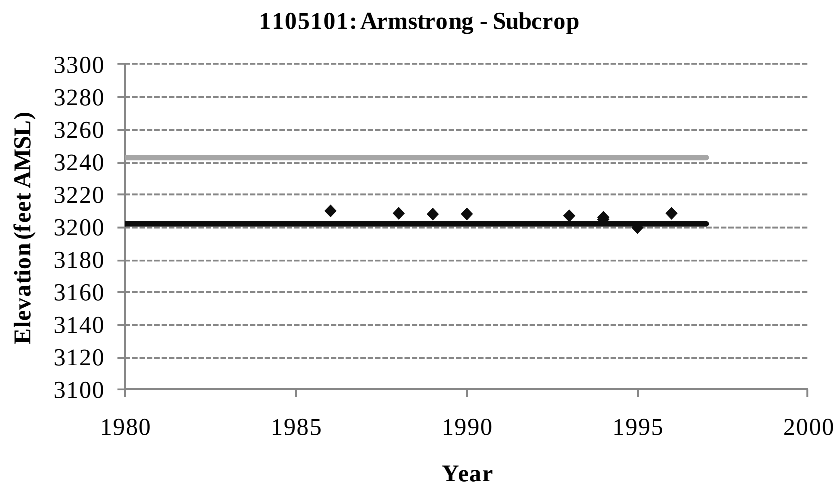
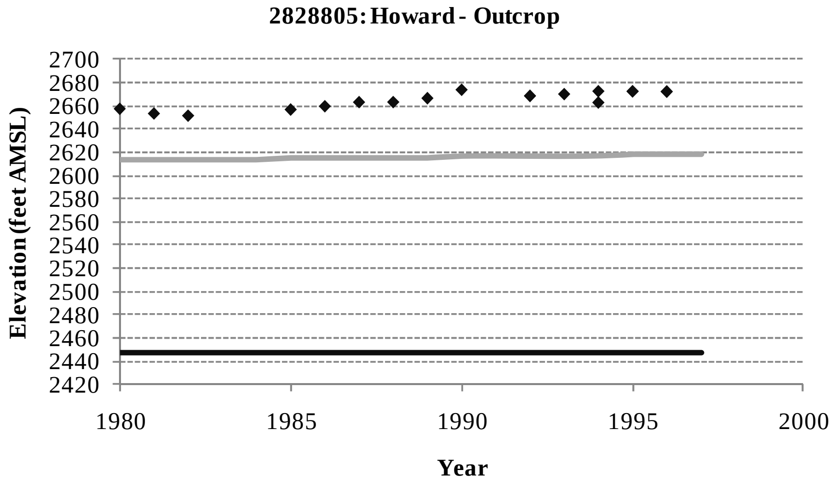
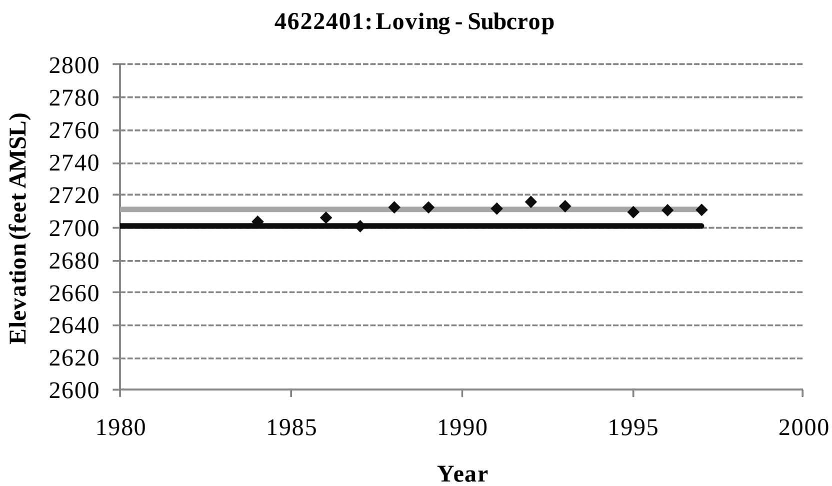
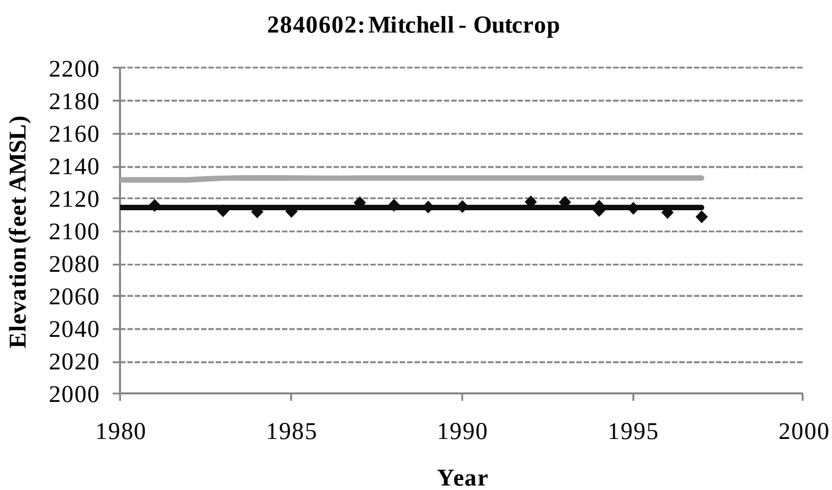


Figure A.2. Simulated and observed water levels for selected wells in the lower portion of the Dockum Aquifer. Dots represent observed values. The black solid line represents simulated water levels in the modified model. The gray solid line represents simulated water levels in the original model (Ewing and others, 2008). All elevations are in feet above mean sea-level.







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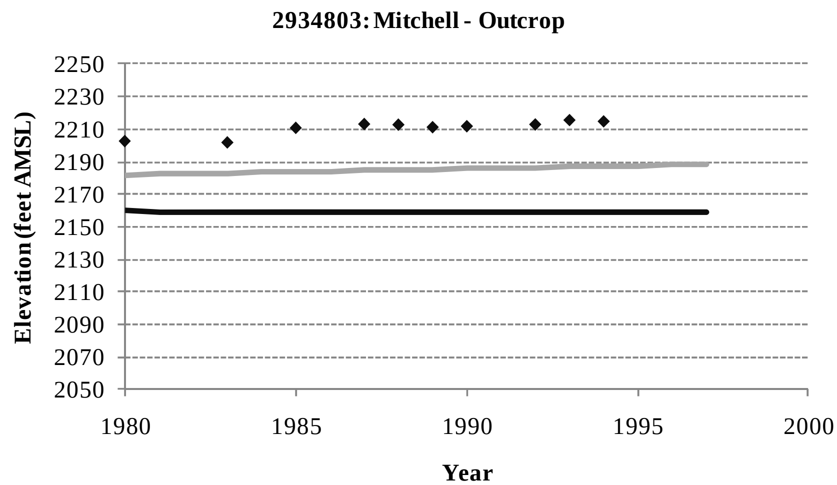

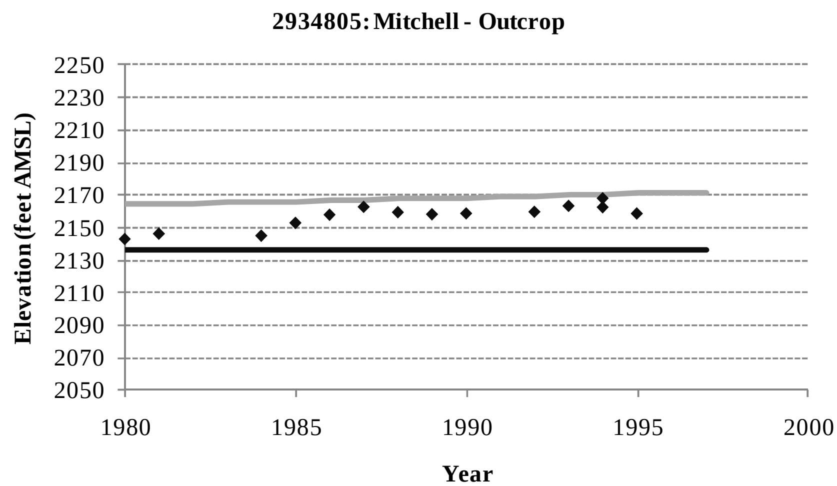

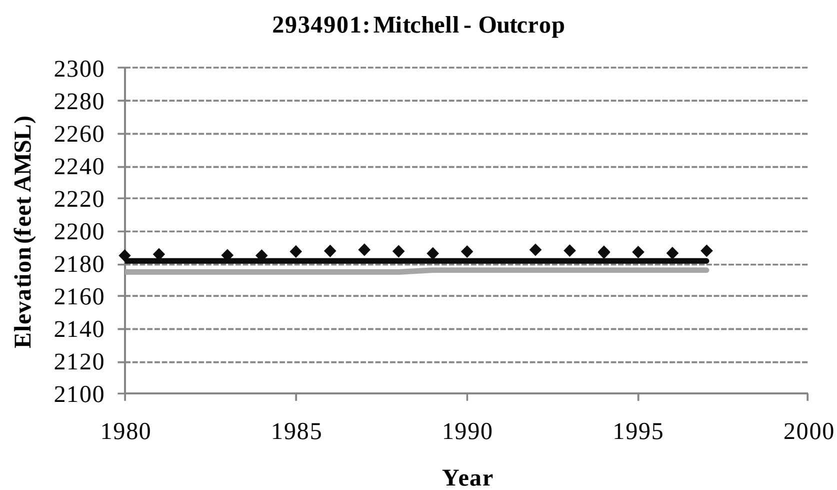

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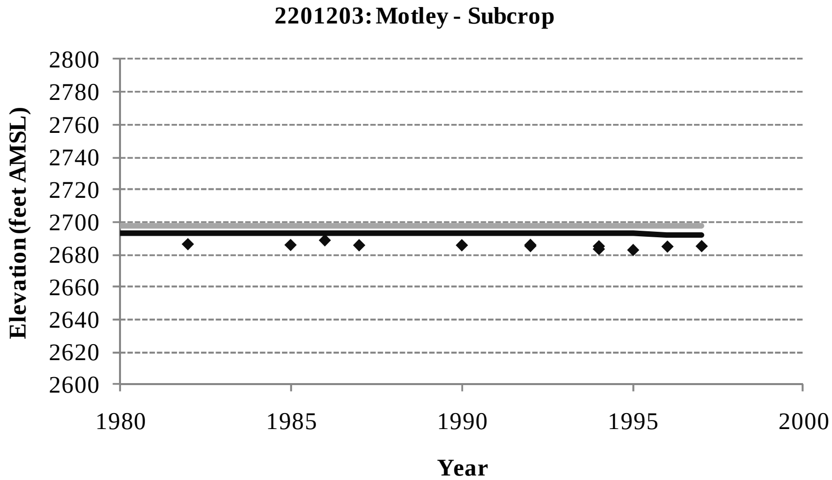
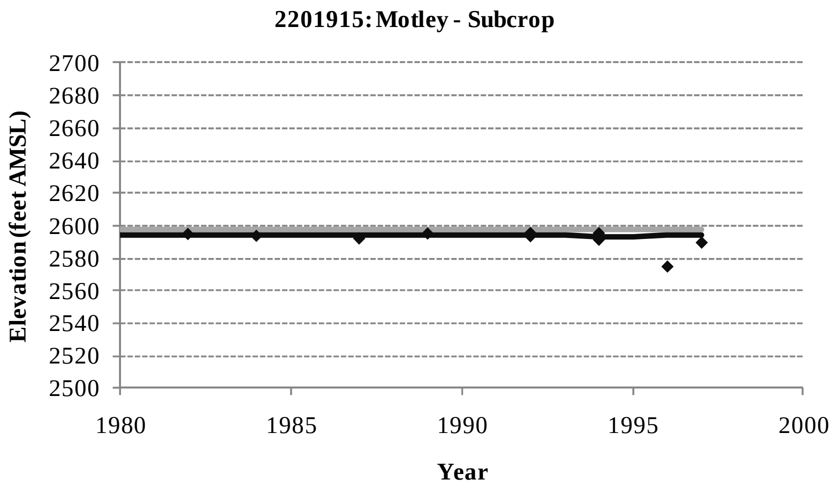




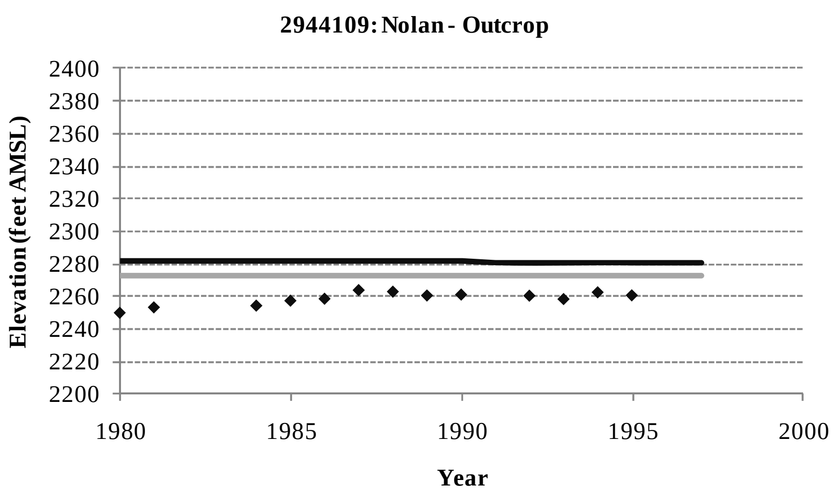
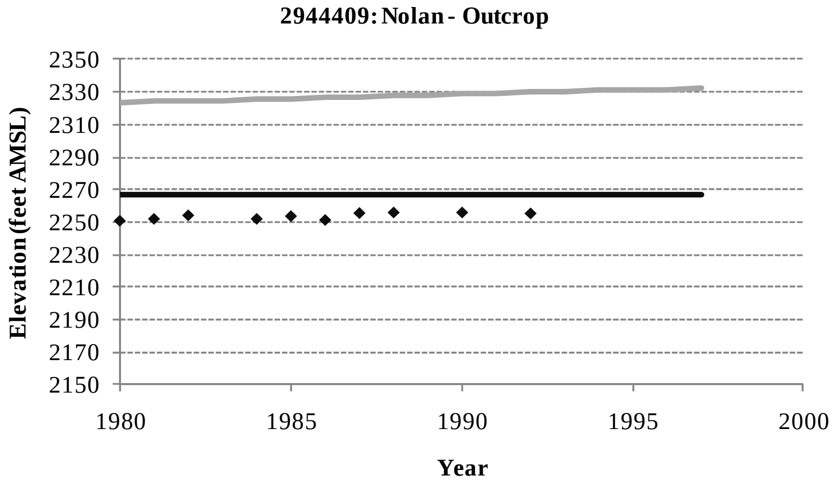
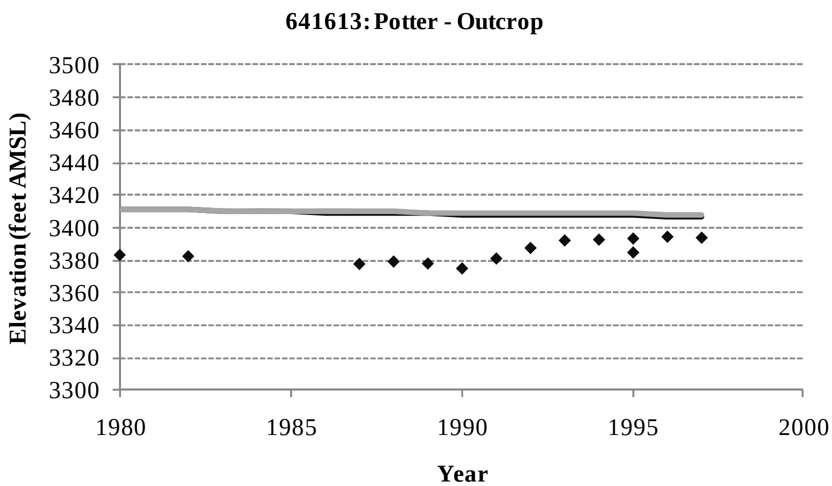


Figure A.2. continued.





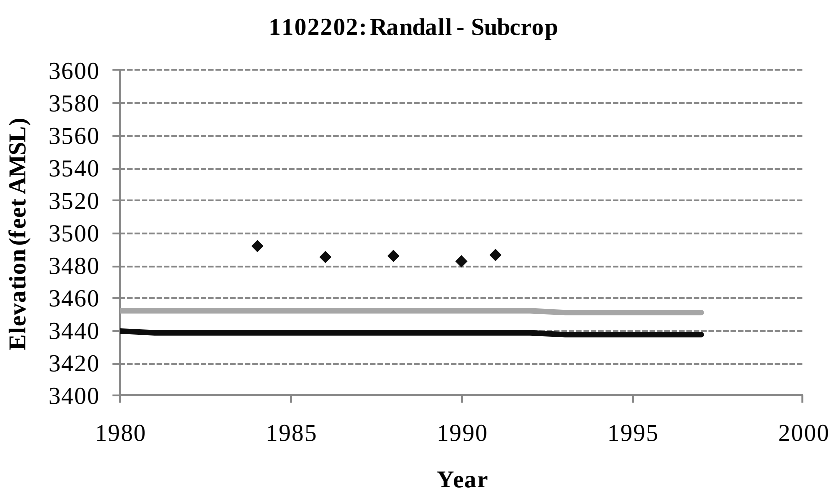
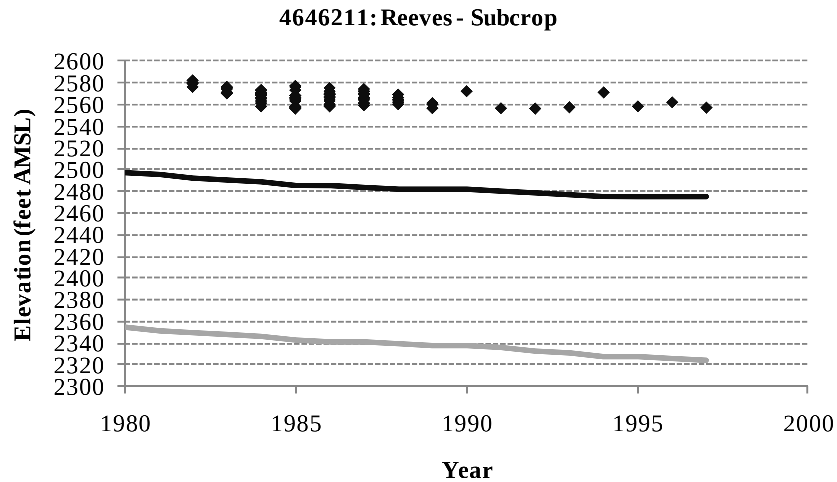
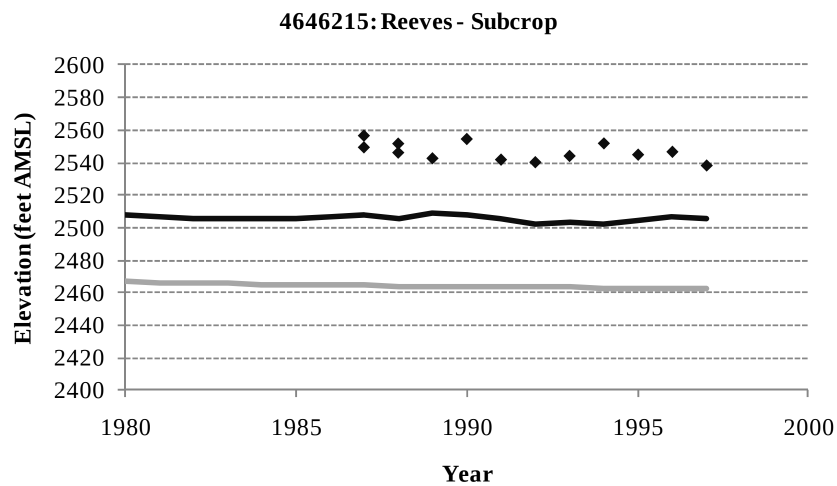


Figure A.2. continued.





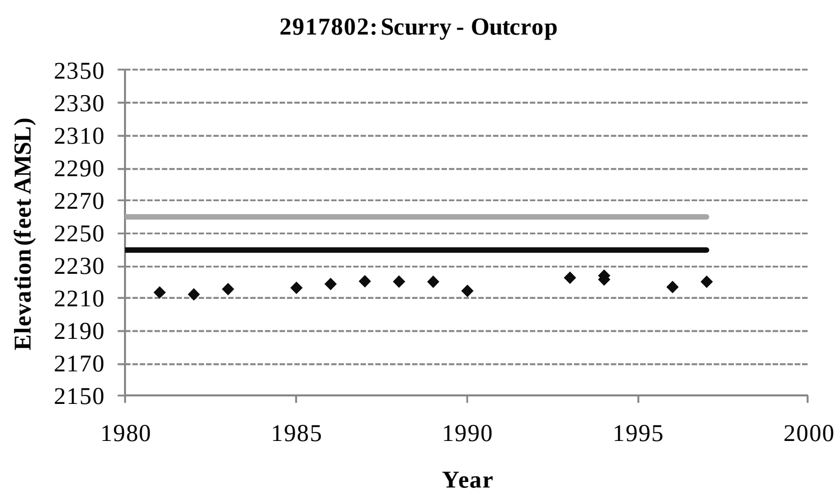
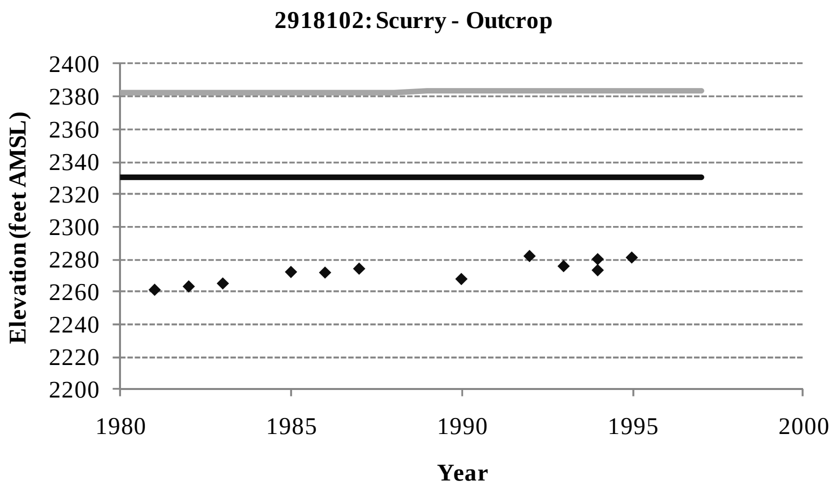
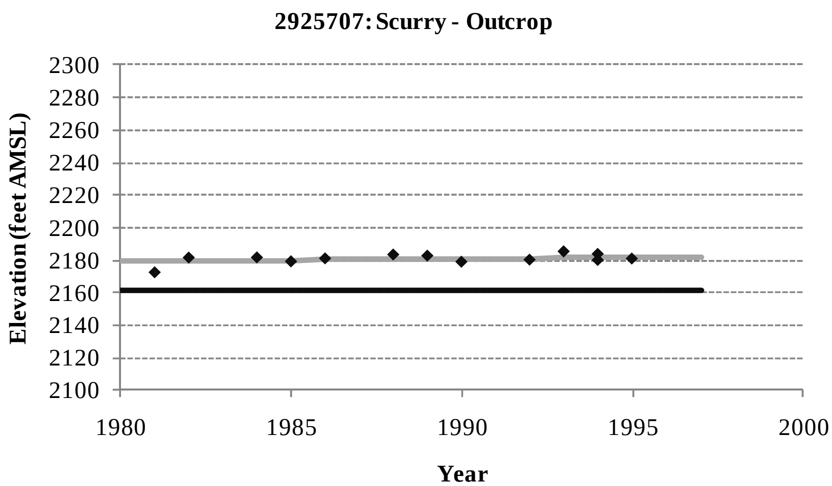


Figure A.2. continued.





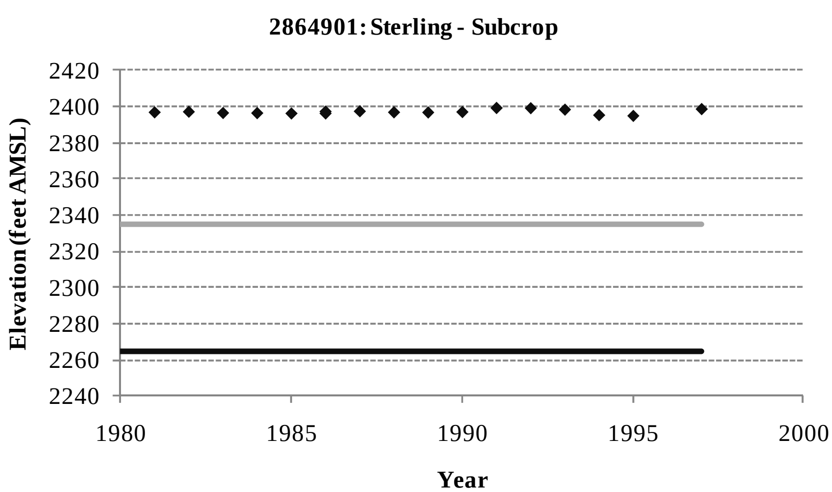
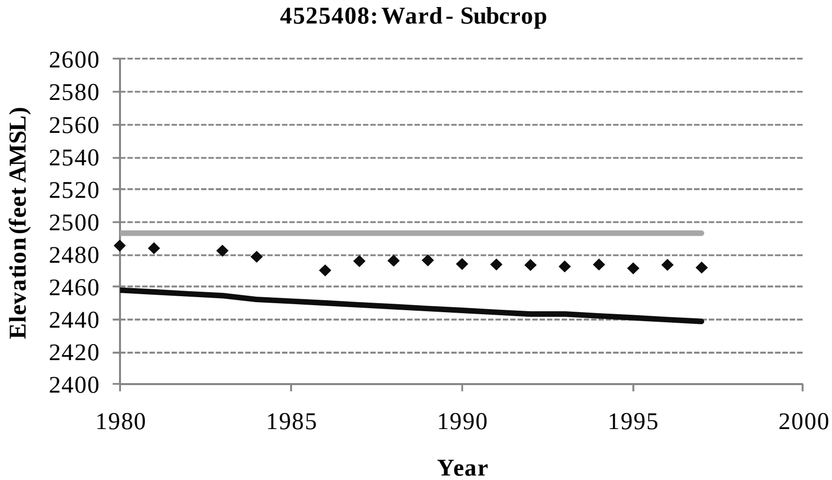
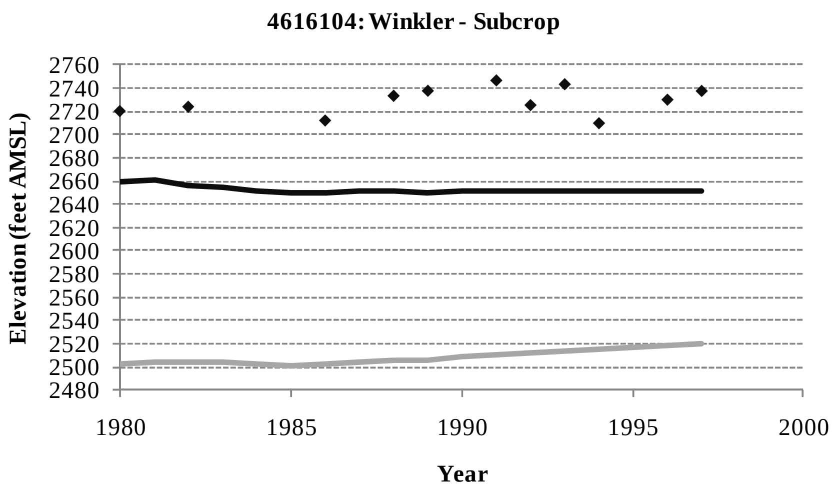


Figure A.2. continued.





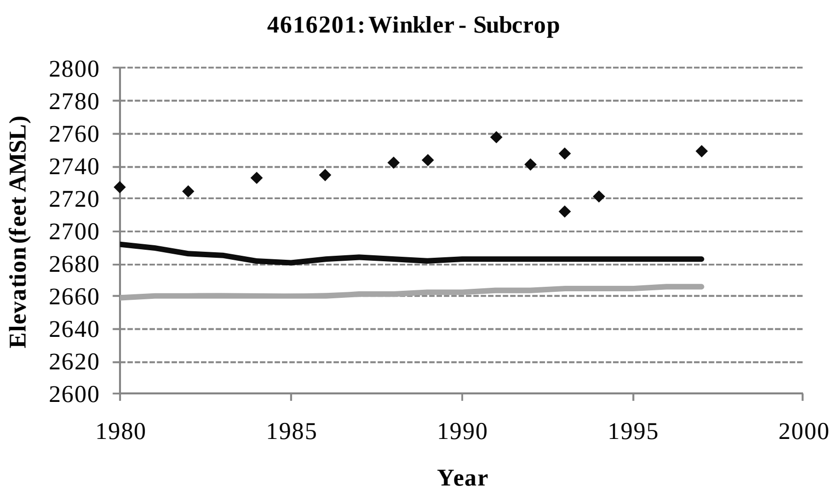


Figure A.2. continued.

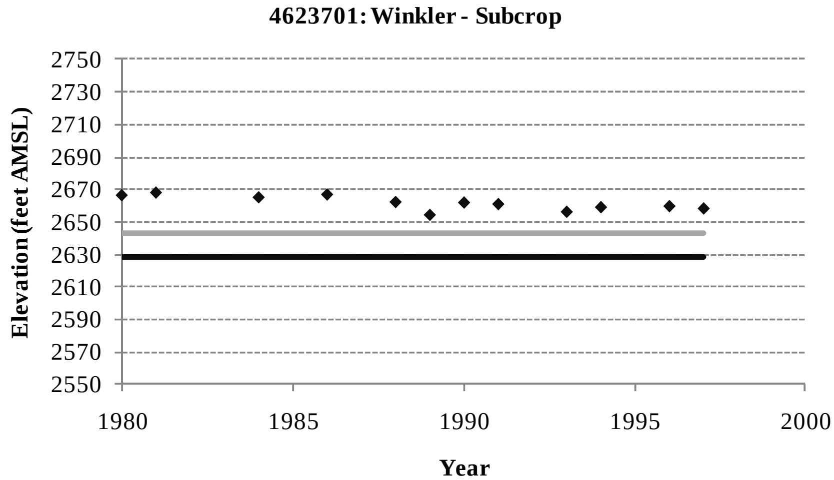


Figure A.2. continued.

Appendix B

Water budgets by county, groundwater conservation district, and model layer for the steady-state, 1980, 1990, and 1997 periods in the modified model

Table B.1. Water budgets by county for the upper and lower portions of the Dockum Aquifer for the steady-state portion of the modified groundwater model. All values are in acre-feet per year.

Stress Period 1	Andrews		Armstrong		Bailey		Borden		Briscoe	
Steady-State	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Inflow										
General-Head Boundary	3,481	0	0	725	3,529	0	1,283	224	0	2,076
Recharge	0	0	0	658	0	0	7	5,573	0	712
Stream Leakage	0	0	0	2	0	0	41	9,346	0	608
Vertical Leakage Upper	0	2,284	0	0	0	544	0	1,394	0	0
Vertical Leakage Lower	880	-	0	-	348	-	0	-	0	-
Lateral Flow	1,053	644	0	272	326	480	68	4,656	0	1,651
Total Inflow	*5,414*	*2,928*	*0*	*1,657*	*4,203*	*1,024*	*1,399*	*21,193*	*0*	*5,047*
Outflow										
Wells	0	4	0	21	0	0	0	16	0	3
Springs and ET	0	0	0	650	0	0	0	8,443	0	1,652
General-Head Boundary	2,883	0	0	199	2,731	0	0	0	0	1
Stream Leakage	0	0	0	262	0	0	0	5,856	0	3,319
Vertical Leakage Upper	0	880	0	0	0	348	0	0	0	0
Vertical Leakage Lower	2,284	-	0	-	544	-	1,394	-	0	-
Lateral Flow	246	2,044	0	525	928	676	4	6,878	0	72
Total Outflow	*5,413*	*2,928*	*0*	*1,657*	*4,203*	*1,024*	*1,398*	*21,193*	*0*	*5,047*
Inflow - Outflow	1	0	0	0	0	0	1	0	0	0
Storage Change	-	-	-	-	-	-	-	-	-	-
Model Error	1	0	0	0	0	0	1	0	0	0
Model Error (percent)	0.02%	0%	0%	0%	0%	0%	0.07%	0%	0%	0%

Table B.1. continued.

Stress Period 1	Carson		Castro		Cochran		Coke		Crane	
Steady-State	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	0	202	3,210	0	1,899	0	0	33	83	1,117
Recharge	0	0	0	0	0	0	0	105	0	0
Stream Leakage	0	0	0	0	0	0	0	0	0	0
Vertical Leakage Upper	0	0	0	1,017	0	140	0	0	0	155
Vertical Leakage Lower	0	-	473	-	394	-	0	-	0	-
Lateral Flow	0	14	251	474	1,030	459	0	50	72	3,978
Total Inflow	*0*	*216*	*3,934*	*1,491*	*3,323*	*599*	*0*	*188*	*155*	*5,250*
Outflow										
Wells	0	56	0	0	0	0	0	0	0	55
Springs and ET	0	0	0	0	0	0	0	0	0	0
General-Head Boundary	0	26	2,439	0	2,832	0	0	2	0	4,532
Stream Leakage	0	0	0	0	0	0	0	0	0	0
Vertical Leakage Upper	0	0	0	473	0	394	0	0	0	0
Vertical Leakage Lower	0	-	1,017	-	140	-	0	-	155	-
Lateral Flow	0	133	478	1,018	351	205	0	186	0	663
Total Outflow	*0*	*215*	*3,934*	*1,491*	*3,323*	*599*	*0*	*188*	*155*	*5,250*
Inflow - Outflow	0	1	0	0	0	0	0	0	0	0
Storage Change	-	-	-	-	-	-	-	-	-	-
Model Error	0	1	0	0	0	0	0	0	0	0
Model Error (percent)	0%	0.46%	0%	0%	0%	0%	0%	0%	0%	0%

Table B.1. continued.

Stress Period 1	Crockett		Crosby		Dallam		Dawson		Deaf Smith	
Steady-State	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	0	171	1,105	2,828	0	1,944	4,084	0	5,007	2,812
Recharge	0	0	1	3,457	0	0	5	11	11	537
Stream Leakage	0	0	0	784	0	0	456	0	0	0
Vertical Leakage Upper	0	0	0	1,112	0	0	0	3,543	0	2,993
Vertical Leakage Lower	0	-	57	-	0	-	193	-	1,430	-
Lateral Flow	0	187	24	2,490	0	2,145	668	761	445	836
Total Inflow	*0*	*358*	*1,187*	*10,671*	*0*	*4,089*	*5,406*	*4,315*	*6,893*	*7,178*
Outflow										
Wells	0	1	0	743	0	500	0	0	0	904
Springs and ET	0	0	0	3,220	0	0	0	1,112	0	1,971
General-Head Boundary	0	354	70	156	0	2,088	1,269	0	3,428	297
Stream Leakage	0	0	0	3,417	0	0	0	0	0	0
Vertical Leakage Upper	0	0	0	57	0	0	0	193	0	1,430
Vertical Leakage Lower	0	-	1,112	-	0	-	3,543	-	2,993	-
Lateral Flow	0	3	5	3,076	0	1,502	594	3,010	473	2,575
Total Outflow	*0*	*358*	*1,187*	*10,669*	*0*	*4,090*	*5,406*	*4,315*	*6,894*	*7,177*
Inflow - Outflow	0	0	0	2	0	-1	0	0	-1	1
Storage Change	-	-	-	-	-	-	-	-	-	-
Model Error	0	0	0	2	0	-1	0	0	-1	1
Model Error (percent)	0%	0%	0%	0.02%	0%	0.02%	0%	0%	0.01%	0.01%

Table B.1. continued.

Stress Period 1	Dickens		Ector		Fisher		Floyd		Gaines	
Steady-State	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	0	286	4,078	2,738	0	0	28	1,618	4,767	0
Recharge	0	4,266	0	0	0	2,095	0	387	0	0
Stream Leakage	0	341	0	0	0	70	0	415	0	0
Vertical Leakage Upper	0	0	0	3,801	0	0	0	26	0	770
Vertical Leakage Lower	0	-	565	-	0	-	9	-	534	-
Lateral Flow	0	156	80	154	0	2,355	1	369	629	661
Total Inflow	*0*	*5,049*	*4,723*	*6,693*	*0*	*4,520*	*38*	*2,815*	*5,930*	*1,431*
Outflow										
Wells	0	4	0	66	0	5	0	273	0	0
Springs and ET	0	2,650	0	0	0	412	0	274	0	0
General-Head Boundary	0	5	825	0	0	0	10	347	3,924	0
Stream Leakage	0	1,017	0	0	0	3,784	0	380	0	0
Vertical Leakage Upper	0	0	0	565	0	0	0	9	0	534
Vertical Leakage Lower	0	-	3,801	-	0	-	26	-	770	-
Lateral Flow	0	1,371	105	6,054	0	318	2	1,532	1,235	898
Total Outflow	*0*	*5,047*	*4,731*	*6,685*	*0*	*4,519*	*38*	*2,815*	*5,929*	*1,432*
Inflow - Outflow	0	2	-8	8	0	1	0	0	1	-1
Storage Change	-	-	-	-	-	-	-	-	-	-
Model Error	0	2	-8	8	0	1	0	0	1	-1
Model Error (percent)	0%	0.04%	0.17%	0.12%	0%	0.02%	0%	0%	0.02%	0.07%

Table B.1. continued.

Stress Period 1	Garza		Glasscock		Hale		Hartley		Hockley	
Steady-State	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	309	1,838	0	3,292	4,383	36	0	7,588	2,489	0
Recharge	0	6,552	0	0	0	0	0	237	0	0
Stream Leakage	0	4,645	0	0	0	0	0	0	0	0
Vertical Leakage Upper	0	349	0	0	0	2,714	0	0	0	391
Vertical Leakage Lower	0	-	0	-	3,152	-	0	-	293	-
Lateral Flow	46	14,021	0	4,530	331	1,211	0	9,549	428	336
Total Inflow	*355*	*27,405*	*0*	*7,822*	*7,866*	*3,961*	*0*	*17,374*	*3,210*	*727*
Outflow										
Wells	0	18	0	0	0	40	0	379	0	177
Springs and ET	0	7,440	0	0	0	0	0	1,678	0	0
General-Head Boundary	0	0	0	5	4,953	23	0	7,622	2,456	0
Stream Leakage	0	19,211	0	0	0	0	0	1,462	0	0
Vertical Leakage Upper	0	0	0	0	0	3,152	0	0	0	293
Vertical Leakage Lower	349	-	0	-	2,714	-	0	-	391	-
Lateral Flow	6	735	0	7,816	199	747	0	6,233	363	258
Total Outflow	*355*	*27,404*	*0*	*7,821*	*7,866*	*3,962*	*0*	*17,374*	*3,210*	*728*
Inflow - Outflow	0	1	0	1	0	-1	0	0	0	-1
Storage Change	-	-	-	-	-	-	-	-	-	-
Model Error	0	1	0	1	0	-1	0	0	0	-1
Model Error (percent)	0%	0%	0%	0.01%	0%	0.03%	0%	0%	0%	0.14%

Table B.1. continued.

Stress Period 1	Howard		Irion		Kent		Lamb		Loving	
Steady-State	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	741	2,855	0	39	0	0	3,758	0	0	423
Recharge	0	4,520	0	0	0	995	0	0	0	0
Stream Leakage	0	3,977	0	0	0	132	0	0	0	0
Vertical Leakage Upper	0	752	0	0	0	0	0	810	0	0
Vertical Leakage Lower	0	-	0	-	0	-	843	-	0	-
Lateral Flow	14	8,875	0	138	0	880	519	756	0	79
Total Inflow	*755*	*20,979*	*0*	*177*	*0*	*2,007*	*5,120*	*1,566*	*0*	*502*
Outflow										
Wells	0	11	0	0	0	1	0	0	0	2
Springs and ET	0	1,108	0	0	0	26	0	0	0	0
General-Head Boundary	0	24	0	172	0	0	3,712	0	0	63
Stream Leakage	0	8,719	0	0	0	1,339	0	0	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	843	0	0
Vertical Leakage Lower	752	-	0	-	0	-	810	-	0	-
Lateral Flow	3	11,118	0	6	0	641	599	723	0	437
Total Outflow	*755*	*20,980*	*0*	*178*	*0*	*2,007*	*5,121*	*1,566*	*0*	*502*
Inflow - Outflow	0	-1	0	-1	0	0	-1	0	0	0
Storage Change	-	-	-	-	-	-	-	-	-	-
Model Error	0	-1	0	-1	0	0	-1	0	0	0
Model Error (percent)	0%	0%	0%	0.56%	0%	0%	0.02%	0%	0%	0%

Table B.1. continued.

Stress Period 1	Lubbock		Lynn		Martin		Midland		Mitchell	
Steady-State	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	4,968	0	5,412	1,045	3,506	237	3,417	850	0	164
Recharge	5	3	0	0	0	0	0	0	0	19,472
Stream Leakage	0	0	2	0	0	0	0	0	0	5,412
Vertical Leakage Upper	0	3,969	0	4,415	0	2,430	0	2,935	0	0
Vertical Leakage Lower	643	-	129	-	606	-	315	-	0	-
Lateral Flow	373	881	210	468	703	2,575	49	2,048	0	21,781
Total Inflow	*5,989*	*4,853*	*5,753*	*5,928*	*4,815*	*5,242*	*3,781*	*5,833*	*0*	*46,829*
Outflow										
Wells	0	1	0	0	0	0	0	0	0	636
Springs and ET	0	3,149	0	0	0	0	0	0	0	13,472
General-Head Boundary	1,900	0	896	0	2,350	5	752	39	0	0
Stream Leakage	0	0	2	0	0	0	0	0	0	32,654
Vertical Leakage Upper	0	643	0	129	0	606	0	315	0	0
Vertical Leakage Lower	3,969	-	4,415	-	2,430	-	2,935	-	0	-
Lateral Flow	119	1,061	440	5,799	34	4,632	94	5,478	0	68
Total Outflow	*5,988*	*4,854*	*5,753*	*5,928*	*4,814*	*5,243*	*3,781*	*5,832*	*0*	*46,830*
Inflow - Outflow	1	-1	0	0	1	-1	0	1	0	-1
Storage Change	-	-	-	-	-	-	-	-	-	-
Model Error	1	-1	0	0	1	-1	0	1	0	-1
Model Error (percent)	0.02%	0.02%	0%	0%	0.02%	0.02%	0%	0.02%	0%	0.00%

Table B.1. continued.

Stress Period 1	Moore		Motley		Nolan		Oldham		Parmer	
Steady-State	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	0	1,953	0	140	0	0	0	5,245	3,567	0
Recharge	0	28	0	619	0	7,135	0	5,399	0	0
Stream Leakage	0	82	0	444	0	169	0	1,466	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	0	0	623
Vertical Leakage Lower	0	-	0	-	0	-	0	-	1,154	-
Lateral Flow	0	1,712	0	1,037	0	69	0	6,687	767	898
Total Inflow	*0*	*3,775*	*0*	*2,240*	*0*	*7,373*	*0*	*18,797*	*5,488*	*1,521*
Outflow										
Wells	0	1,269	0	21	0	214	0	207	0	0
Springs and ET	0	0	0	660	0	719	0	4,481	0	0
General-Head Boundary	0	1,520	0	14	0	0	0	84	4,470	0
Stream Leakage	0	721	0	1,404	0	1,688	0	12,946	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	0	0	1,154
Vertical Leakage Lower	0	-	0	-	0	-	0	-	623	-
Lateral Flow	0	265	0	143	0	4,752	0	1,079	395	367
Total Outflow	*0*	*3,775*	*0*	*2,242*	*0*	*7,373*	*0*	*18,797*	*5,488*	*1,521*
Inflow - Outflow	0	0	0	-2	0	0	0	0	0	0
Storage Change	-	-	-	-	-	-	-	-	-	-
Model Error	0	0	0	-2	0	0	0	0	0	0
Model Error (percent)	0%	0%	0%	0.09%	0%	0%	0%	0%	0%	0%

Table B.1. continued.

Stress Period 1	Pecos		Potter		Randall		Reagan		Reeves	
Steady-State	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	0	2,406	0	1,144	200	4,199	0	343	0	1,762
Recharge	0	0	0	2,298	0	221	0	0	0	0
Stream Leakage	0	0	0	820	0	650	0	0	0	0
Vertical Leakage Upper	0	0	0	0	0	97	0	0	0	0
Vertical Leakage Lower	0	-	0	-	51	-	0	-	0	-
Lateral Flow	0	963	0	1,159	43	1,121	0	392	0	1,869
Total Inflow	*0*	*3,369*	*0*	*5,421*	*294*	*6,288*	*0*	*735*	*0*	*3,631*
Outflow										
Wells	0	211	0	173	0	267	0	364	0	372
Springs and ET	0	0	0	1,679	0	958	0	0	0	0
General-Head Boundary	0	1,944	0	547	189	1,010	0	70	0	2,291
Stream Leakage	0	0	0	2,768	0	3,537	0	0	0	0
Vertical Leakage Upper	0	0	0	0	0	51	0	0	0	0
Vertical Leakage Lower	0	-	0	-	97	-	0	-	0	-
Lateral Flow	0	1,213	0	252	8	465	0	300	0	967
Total Outflow	*0*	*3,368*	*0*	*5,419*	*294*	*6,288*	*0*	*734*	*0*	*3,630*
Inflow - Outflow	0	1	0	2	0	0	0	1	0	1
Storage Change	-	-	-	-	-	-	-	-	-	-
Model Error	0	1	0	2	0	0	0	1	0	1
Model Error (percent)	0%	0.03%	0%	0.04%	0%	0%	0%	0.14%	0%	0.03%

Table B.1. continued.

Stress Period 1	Scurry		Sherman		Sterling		Swisher		Terry	
Steady-State	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	0	0	0	114	0	1,827	759	1,113	1,577	0
Recharge	0	20,229	0	0	0	439	0	9	0	0
Stream Leakage	0	4,389	0	0	0	73	0	296	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	386	0	234
Vertical Leakage Lower	0	-	0	-	0	-	472	-	167	-
Lateral Flow	0	3,857	0	364	0	4,530	154	897	495	215
Total Inflow	*0*	*28,475*	*0*	*478*	*0*	*6,869*	*1,385*	*2,701*	*2,239*	*449*
Outflow										
Wells	0	844	0	124	0	4	0	45	0	1
Springs and ET	0	9,669	0	0	0	0	0	0	0	0
General-Head Boundary	0	0	0	114	0	352	915	70	1,427	0
Stream Leakage	0	10,415	0	0	0	224	0	300	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	472	0	167
Vertical Leakage Lower	0	-	0	-	0	-	386	-	234	-
Lateral Flow	0	7,548	0	239	0	6,290	85	1,814	577	282
Total Outflow	*0*	*28,476*	*0*	*477*	*0*	*6,870*	*1,386*	*2,701*	*2,238*	*450*
Inflow - Outflow	0	-1	0	1	0	-1	-1	0	1	-1
Storage Change	-	-	-	-	-	-	-	-	-	-
Model Error	0	-1	0	1	0	-1	-1	0	1	-1
Model Error (percent)	0%	0%	0%	0.21%	0%	0.01%	0.07%	0%	0.04%	0.22%

Table B.1. continued.

Stress Period 1	Tom Green		Upton		Ward		Winkler		Yoakum	
Steady-State	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	0	6	0	1,472	0	1,306	920	1,778	1,679	0
Recharge	0	0	0	0	0	0	0	0	0	0
Stream Leakage	0	0	0	0	0	0	0	0	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	976	0	198
Vertical Leakage Lower	0	-	0	-	0	-	332	-	199	-
Lateral Flow	0	37	0	879	0	4,253	81	2,008	711	291
Total Inflow	*0*	*43*	*0*	*2,351*	*0*	*5,559*	*1,333*	*4,762*	*2,589*	*489*
Outflow										
Wells	0	0	0	61	0	25	0	745	0	0
Springs and ET	0	0	0	0	0	0	0	0	0	0
General-Head Boundary	0	18	0	166	0	4,645	384	512	1,803	0
Stream Leakage	0	0	0	0	0	0	0	0	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	332	0	199
Vertical Leakage Lower	0	-	0	-	0	-	976	-	198	-
Lateral Flow	0	25	0	2,124	0	889	0	3,146	586	290
Total Outflow	*0*	*43*	*0*	*2,351*	*0*	*5,559*	*1,360*	*4,735*	*2,587*	*489*
Inflow - Outflow	0	0	0	0	0	0	-27	27	2	0
Storage Change	-	-	-	-	-	-	-	-	-	-
Model Error	0	0	0	0	0	0	-27	27	2	0
Model Error (percent)	0%	0%	0%	0%	0%	0%	2.01%	0.57%	0.08%	0%

Table B.2. Water budgets by county for the upper and lower portions of the Dockum Aquifer for 1980 in the modified groundwater model. All values are in acre-feet per year.

Stress Period 2	Andrews		Armstrong		Bailey		Borden		Briscoe	
1980	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	3,479	0	0	772	3,478	0	1,287	224	0	2,067
Recharge	0	0	0	658	0	0	7	5,573	0	712
Stream Leakage	0	0	0	2	0	0	41	9,346	0	608
Vertical Leakage Upper	0	2,282	0	0	0	538	0	1,398	0	0
Vertical Leakage Lower	879	-	0	-	355	-	0	-	0	-
Lateral Flow	1,050	642	0	215	310	472	68	4,656	0	1,611
Total Inflow	*5,408*	*2,924*	*0*	*1,647*	*4,143*	*1,010*	*1,403*	*21,197*	*0*	*4,998*
Outflow										
Wells	0	8	0	103	0	0	0	65	0	17
Springs and ET	0	0	0	649	0	0	0	8,442	0	1,650
General-Head Boundary	2,880	0	0	192	2,659	0	0	0	0	1
Stream Leakage	0	0	0	262	0	0	0	5,856	0	3,319
Vertical Leakage Upper	0	879	0	0	0	355	0	0	0	0
Vertical Leakage Lower	2,282	-	0	-	538	-	1,398	-	0	-
Lateral Flow	246	2,086	0	527	948	677	4	6,901	0	84
Total Outflow	*5,408*	*2,973*	*0*	*1,733*	*4,145*	*1,032*	*1,402*	*21,264*	*0*	*5,071*
Inflow - Outflow	0	-49	0	-86	-2	-22	1	-67	0	-73
Storage Change	0	-49	0	-87	-1	-23	1	-64	0	-71
Model Error	0	0	0	1	-1	1	0	-3	0	-2
Model Error (percent)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Table B.2. continued.

Stress Period 2	Carson		Castro		Cochran		Coke		Crane	
1980	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Inflow										
General-Head Boundary	0	311	3,111	0	1,899	0	0	33	83	1,117
Recharge	0	0	0	0	0	0	0	105	0	0
Stream Leakage	0	0	0	0	0	0	0	0	0	0
Vertical Leakage Upper	0	0	0	902	0	140	0	0	0	155
Vertical Leakage Lower	0	-	578	-	394	-	0	-	0	-
Lateral Flow	0	36	250	438	1,032	457	0	49	72	3,959
Total Inflow	*0*	*347*	*3,939*	*1,340*	*3,325*	*597*	*0*	*187*	*155*	*5,231*
Outflow										
Wells	0	348	0	0	0	0	0	0	0	42
Springs and ET	0	0	0	0	0	0	0	0	0	0
General-Head Boundary	0	2	2,565	0	2,834	0	0	2	0	4,535
Stream Leakage	0	0	0	0	0	0	0	0	0	0
Vertical Leakage Upper	0	0	0	578	0	394	0	0	0	0
Vertical Leakage Lower	0	-	902	-	140	-	0	-	155	-
Lateral Flow	0	69	476	1,020	351	205	0	186	0	665
Total Outflow	*0*	*419*	*3,943*	*1,598*	*3,325*	*599*	*0*	*188*	*155*	*5,242*
Inflow - Outflow	0	-72	-4	-258	0	-2	0	-1	0	-11
Storage Change	0	-73	-4	-258	0	-3	0	0	0	-11
Model Error	0	1	0	0	0	1	0	-1	0	0
Model Error (percent)	0%	0.24%	0%	0%	0%	0%	0%	1%	0%	0%

Table B.2. continued.

Stress Period 2	Crockett		Crosby		Dallam		Dawson		Deaf Smith	
1980	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Inflow										
General-Head Boundary	0	171	1,196	2,987	0	2,235	4,120	0	5,089	2,789
Recharge	0	0	1	3,457	0	0	5	11	11	537
Stream Leakage	0	0	0	784	0	0	456	0	0	0
Vertical Leakage Upper	0	0	0	1,207	0	0	0	3,576	0	3,093
Vertical Leakage Lower	0	-	38	-	0	-	186	-	1,338	-
Lateral Flow	0	170	27	2,611	0	2,248	666	761	441	870
Total Inflow	*0*	*341*	*1,262*	*11,046*	*0*	*4,483*	*5,433*	*4,348*	*6,879*	*7,289*
Outflow										
Wells	0	3	0	3,572	0	1,743	0	1	0	3,384
Springs and ET	0	0	0	3,199	0	0	0	1,111	0	1,953
General-Head Boundary	0	353	50	116	0	1,875	1,254	0	3,325	273
Stream Leakage	0	0	0	3,413	0	0	0	0	0	0
Vertical Leakage Upper	0	0	0	38	0	0	0	186	0	1,338
Vertical Leakage Lower	0	-	1,207	-	0	-	3,576	-	3,093	-
Lateral Flow	0	3	5	3,048	0	1,698	597	3,011	473	2,471
Total Outflow	*0*	*359*	*1,262*	*13,386*	*0*	*5,316*	*5,427*	*4,309*	*6,891*	*9,419*
Inflow - Outflow	0	-18	0	-2,340	0	-833	6	39	-12	-2,130
Storage Change	0	-18	0	-2341	0	-832	6	39	-11	-2131
Model Error	0	0	0	1	0	-1	0	0	-1	1
Model Error (percent)	0%	0%	0%	0.01%	0%	0.02%	0%	0%	0.01%	0.01%

Table B.2. continued.

Stress Period 2 1980	Dickens Upper	Dickens Lower	Ector Upper	Ector Lower	Fisher Upper	Fisher Lower	Floyd Upper	Floyd Lower	Gaines Upper	Gaines Lower
Inflow										
General-Head Boundary	0	291	4,080	2,738	0	0	29	1,659	4,733	0
Recharge	0	4,266	0	0	0	2,095	0	387	0	0
Stream Leakage	0	341	0	0	0	70	0	415	0	0
Vertical Leakage Upper	0	0	0	3,803	0	0	0	27	0	727
Vertical Leakage Lower	0	-	553	-	0	-	9	-	575	-
Lateral Flow	0	137	80	153	0	2,215	1	417	642	654
Total Inflow	*0*	*5,035*	*4,713*	*6,694*	*0*	*4,380*	*39*	*2,905*	*5,950*	*1,381*
Outflow										
Wells	0	22	0	98	0	30	0	1,634	0	0
Springs and ET	0	2,647	0	0	0	410	0	274	0	0
General-Head Boundary	0	5	812	0	0	0	10	345	3,999	0
Stream Leakage	0	1,017	0	0	0	3,784	0	380	0	0
Vertical Leakage Upper	0	0	0	553	0	0	0	9	0	575
Vertical Leakage Lower	0	-	3,803	-	0	-	27	-	727	-
Lateral Flow	0	1,383	105	6,058	0	563	2	1,496	1,230	898
Total Outflow	*0*	*5,074*	*4,720*	*6,709*	*0*	*4,787*	*39*	*4,138*	*5,956*	*1,473*
Inflow - Outflow	0	-39	-7	-15	0	-407	0	-1,233	-6	-92
Storage Change	0	-38	3	-21	0	-407	0	-1231	-7	-92
Model Error	0	-1	-10	6	0	0	0	-2	1	0
Model Error (percent)	0%	0.02%	0.21%	0.09%	0%	0%	0%	0%	0.02%	0%

Table B.2. continued.

Stress Period 2 1980	Garza Upper	Garza Lower	Glasscock Upper	Glasscock Lower	Hale Upper	Hale Lower	Hartley Upper	Hartley Lower	Hockley Upper	Hockley Lower
Inflow										
General-Head Boundary	310	1,839	0	3,297	4,268	35	0	7,930	2,504	0
Recharge	0	6,552	0	0	0	0	0	237	0	0
Stream Leakage	0	4,645	0	0	0	0	0	0	0	0
Vertical Leakage Upper	0	349	0	0	0	2,603	0	0	0	446
Vertical Leakage Lower	0	-	0	-	3,283	-	0	-	289	-
Lateral Flow	46	14,020	0	4,533	327	1,214	0	9,662	423	335
Total Inflow	*356*	*27,405*	*0*	*7,830*	*7,878*	*3,852*	*0*	*17,829*	*3,216*	*781*
Outflow										
Wells	0	79	0	0	0	243	0	1,404	0	559
Springs and ET	0	7,439	0	0	0	0	0	1,675	0	0
General-Head Boundary	0	0	0	5	5,080	24	0	7,140	2,402	0
Stream Leakage	0	19,211	0	0	0	0	0	1,461	0	0
Vertical Leakage Upper	0	0	0	0	0	3,283	0	0	0	289
Vertical Leakage Lower	349	-	0	-	2,603	-	0	-	446	-
Lateral Flow	6	735	0	7,867	197	760	0	7,154	367	258
Total Outflow	*355*	*27,464*	*0*	*7,872*	*7,880*	*4,310*	*0*	*18,834*	*3,215*	*1,106*
Inflow - Outflow	1	-59	0	-42	-2	-458	0	-1,005	1	-325
Storage Change	0	-57	0	-42	-2	-458	0	-1005	-1	-324
Model Error	1	-2	0	0	0	0	0	0	2	-1
Model Error (percent)	0%	0.01%	0%	0%	0%	0%	0%	0%	0%	0.09%

Table B.2. continued.

Stress Period 2	Howard		Irion		Kent		Lamb		Loving	
1980	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	742	2,850	0	39	0	0	3,706	0	0	433
Recharge	0	4,520	0	0	0	995	0	0	0	0
Stream Leakage	0	3,977	0	0	0	132	0	0	0	0
Vertical Leakage Upper	0	762	0	0	0	0	0	749	0	0
Vertical Leakage Lower	0	-	0	-	0	-	916	-	0	-
Lateral Flow	15	8,876	0	137	0	880	520	755	0	72
Total Inflow	*757*	*20,985*	*0*	*176*	*0*	*2,007*	*5,142*	*1,504*	*0*	*505*
Outflow										
Wells	0	27	0	0	0	3	0	0	0	21
Springs and ET	0	1,108	0	0	0	26	0	0	0	0
General-Head Boundary	0	24	0	172	0	0	3,804	0	0	57
Stream Leakage	0	8,719	0	0	0	1,339	0	0	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	916	0	0
Vertical Leakage Lower	762	-	0	-	0	-	749	-	0	-
Lateral Flow	3	11,120	0	6	0	641	595	727	0	447
Total Outflow	*765*	*20,998*	*0*	*178*	*0*	*2,009*	*5,148*	*1,643*	*0*	*525*
Inflow - Outflow	-8	-13	0	-2	0	-2	-6	-139	0	-20
Storage Change	0	-20	0	-1	0	-2	-5	-140	0	-20
Model Error	-8	7	0	-1	0	0	-1	1	0	0
Model Error (percent)	1%	0.03%	0%	0.56%	0%	0%	0.02%	0%	0%	0%

Table B.2. continued.

Stress Period 2	Lubbock		Lynn		Martin		Midland		Mitchell	
1980	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Inflow										
General-Head Boundary	4,973	0	5,442	1,047	3,507	237	3,415	851	0	164
Recharge	5	3	0	0	0	0	0	0	0	19,472
Stream Leakage	0	0	2	0	0	0	0	0	0	5,419
Vertical Leakage Upper	0	3,971	0	4,442	0	2,431	0	2,933	0	0
Vertical Leakage Lower	654	-	125	-	604	-	316	-	0	-
Lateral Flow	371	868	209	467	705	2,575	49	2,034	0	21,462
Total Inflow	*6,003*	*4,842*	*5,778*	*5,956*	*4,816*	*5,243*	*3,780*	*5,818*	*0*	*46,517*
Outflow										
Wells	0	2	0	0	0	0	0	0	0	3,424
Springs and ET	0	3,142	0	0	0	0	0	0	0	13,268
General-Head Boundary	1,910	0	893	0	2,350	5	753	38	0	0
Stream Leakage	0	0	2	0	0	0	0	0	0	32,562
Vertical Leakage Upper	0	654	0	125	0	604	0	316	0	0
Vertical Leakage Lower	3,971	-	4,442	-	2,431	-	2,933	-	0	-
Lateral Flow	122	1,134	440	5,801	34	4,633	94	5,511	0	68
Total Outflow	*6,003*	*4,932*	*5,777*	*5,926*	*4,815*	*5,242*	*3,780*	*5,865*	*0*	*49,322*
Inflow - Outflow	0	-90	1	30	1	1	0	-47	0	-2,805
Storage Change	0	-90	1	30	0	1	0	-48	0	-2807
Model Error	0	0	0	0	1	0	0	1	0	2
Model Error (percent)	0%	0%	0%	0%	0.02%	0%	0%	0.02%	0%	0%

Table B.2. continued.

Stress Period 2 1980	Moore Upper	Moore Lower	Motley Upper	Motley Lower	Nolan Upper	Nolan Lower	Oldham Upper	Oldham Lower	Parmer Upper	Parmer Lower
Inflow										
General-Head Boundary	0	2,669	0	146	0	0	0	5,247	3,452	0
Recharge	0	28	0	619	0	7,135	0	5,399	0	0
Stream Leakage	0	82	0	445	0	170	0	1,556	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	0	0	559
Vertical Leakage Lower	0	-	0	-	0	-	0	-	1,282	-
Lateral Flow	0	2,700	0	1,013	0	63	0	6,626	802	875
Total Inflow	*0*	*5,479*	*0*	*2,223*	*0*	*7,368*	*0*	*18,828*	*5,536*	*1,434*
Outflow										
Wells	0	4,310	0	74	0	820	0	1,193	0	1
Springs and ET	0	0	0	655	0	709	0	4,429	0	0
General-Head Boundary	0	977	0	13	0	0	0	83	4,614	0
Stream Leakage	0	721	0	1,403	0	1,651	0	12,940	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	0	0	1,282
Vertical Leakage Lower	0	-	0	-	0	-	0	-	559	-
Lateral Flow	0	252	0	142	0	4,583	0	1,092	375	385
Total Outflow	*0*	*6,260*	*0*	*2,287*	*0*	*7,763*	*0*	*19,737*	*5,548*	*1,668*
Inflow - Outflow	0	-781	0	-64	0	-395	0	-909	-12	-234
Storage Change	0	-782	0	-65	0	-395	0	-908	-11	-234
Model Error	0	1	0	1	0	0	0	-1	-1	0
Model Error (percent)	0%	0%	0%	0.04%	0%	0%	0%	0%	0%	0%

Table B.2. continued.

Stress Period 2	Pecos		Potter		Randall		Reagan		Reeves	
1980	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	0	2,638	0	1,303	201	4,356	0	356	0	1,910
Recharge	0	0	0	2,298	0	221	0	0	0	0
Stream Leakage	0	0	0	826	0	646	0	0	0	0
Vertical Leakage Upper	0	0	0	0	0	99	0	0	0	0
Vertical Leakage Lower	0	-	0	-	50	-	0	-	0	-
Lateral Flow	0	1,021	0	1,098	44	1,111	0	468	0	1,922
Total Inflow	*0*	*3,659*	*0*	*5,525*	*295*	*6,433*	*0*	*824*	*0*	*3,832*
Outflow										
Wells	0	955	0	717	0	1,075	0	779	0	1,725
Springs and ET	0	0	0	1,665	0	956	0	0	0	0
General-Head Boundary	0	1,750	0	451	188	907	0	69	0	2,048
Stream Leakage	0	0	0	2,762	0	3,517	0	0	0	0
Vertical Leakage Upper	0	0	0	0	0	50	0	0	0	0
Vertical Leakage Lower	0	-	0	-	99	-	0	-	0	-
Lateral Flow	0	1,170	0	296	8	426	0	261	0	1,007
Total Outflow	*0*	*3,875*	*0*	*5,891*	*295*	*6,931*	*0*	*1,109*	*0*	*4,780*
Inflow - Outflow	0	-216	0	-366	0	-498	0	-285	0	-948
Storage Change	0	-215	0	-372	0	-498	0	-284	0	-949
Model Error	0	-1	0	6	0	0	0	-1	0	1
Model Error (percent)	0%	0.03%	0%	0.10%	0%	0%	0%	0.09%	0%	0.02%

Table B.2. continued.

Stress Period 2	Scurry		Sherman		Sterling		Swisher		Terry	
1980	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	0	0	0	280	0	1,829	726	1,108	1,590	0
Recharge	0	20,229	0	0	0	439	0	9	0	0
Stream Leakage	0	4,401	0	0	0	73	0	296	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	359	0	239
Vertical Leakage Lower	0	-	0	-	0	-	516	-	166	-
Lateral Flow	0	4,130	0	548	0	4,531	153	883	493	215
Total Inflow	*0*	*28,760*	*0*	*828*	*0*	*6,872*	*1,395*	*2,655*	*2,249*	*454*
Outflow										
Wells	0	8,906	0	562	0	20	0	219	0	0
Springs and ET	0	9,544	0	0	0	0	0	0	0	0
General-Head Boundary	0	0	0	17	0	350	952	73	1,425	0
Stream Leakage	0	10,352	0	0	0	224	0	300	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	516	0	166
Vertical Leakage Lower	0	-	0	-	0	-	359	-	239	-
Lateral Flow	0	7,256	0	329	0	6,290	85	1,832	584	282
Total Outflow	*0*	*36,058*	*0*	*908*	*0*	*6,884*	*1,396*	*2,940*	*2,248*	*448*
Inflow - Outflow	0	-7,298	0	-80	0	-12	-1	-285	1	6
Storage Change	0	-7295	0	-80	0	-11	0	-285	1	6
Model Error	0	-3	0	0	0	-1	-1	0	0	0
Model Error (percent)	0%	0.01%	0%	0%	0%	0.01%	0.07%	0%	0%	0%

Table B.2. continued.

Stress Period 2 1980	Tom Green Upper	Tom Green Lower	Upton Upper	Upton Lower	Ward Upper	Ward Lower	Winkler Upper	Winkler Lower	Yoakum Upper	Yoakum Lower
Inflow										
General-Head Boundary	0	6	0	1,477	0	1,344	906	2,614	1,688	0
Recharge	0	0	0	0	0	0	0	0	0	0
Stream Leakage	0	0	0	0	0	0	0	0	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	942	0	194
Vertical Leakage Lower	0	-	0	-	0	-	310	-	209	-
Lateral Flow	0	37	0	882	0	4,197	81	2,041	716	285
Total Inflow	*0*	*43*	*0*	*2,359*	*0*	*5,541*	*1,297*	*5,597*	*2,613*	*479*
Outflow										
Wells	0	0	0	252	0	115	0	3,224	0	0
Springs and ET	0	0	0	0	0	0	0	0	0	0
General-Head Boundary	0	18	0	163	0	4,524	355	348	1,836	0
Stream Leakage	0	0	0	0	0	0	0	0	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	310	0	209
Vertical Leakage Lower	0	-	0	-	0	-	942	-	194	-
Lateral Flow	0	25	0	2,120	0	993	0	3,113	584	290
Total Outflow	*0*	*43*	*0*	*2,535*	*0*	*5,632*	*1,297*	*6,995*	*2,614*	*499*
Inflow - Outflow	0	0	0	-176	0	-91	0	-1,398	-1	-20
Storage Change	0	0	0	-176	0	-91	1	-1396	-1	-20
Model Error	0	0	0	0	0	0	-1	-2	0	0
Model Error (percent)	0%	0%	0%	0%	0%	0%	0%	0.03%	0%	0%

Table B.3. Water budgets by county for the upper and lower portions of the Dockum Aquifer for 1990 in the modified groundwater model. All values are in acre-feet per year.

Stress Period 12	Andrews		Armstrong		Bailey		Borden		Briscoe	
1990	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Inflow										
General-Head Boundary	3,465	0	0	789	3,349	0	1,312	225	0	2,006
Recharge	0	0	0	658	0	0	7	5,573	0	712
Stream Leakage	0	0	0	2	0	0	41	9,346	0	608
Vertical Leakage Upper	0	2,277	0	0	0	514	0	1,414	0	0
Vertical Leakage Lower	880	-	0	-	424	-	1	-	0	-
Lateral Flow	1,052	614	0	210	273	421	71	4,681	0	1,571
Total Inflow	*5,397*	*2,891*	*0*	*1,659*	*4,046*	*935*	*1,432*	*21,239*	*0*	*4,897*
Outflow										
Wells	0	38	0	95	0	0	0	58	0	13
Springs and ET	0	0	0	650	0	0	0	8,448	0	1,652
General-Head Boundary	2,875	0	0	189	2,533	0	0	0	0	2
Stream Leakage	0	0	0	262	0	0	0	5,853	0	3,319
Vertical Leakage Upper	0	880	0	0	0	424	0	1	0	0
Vertical Leakage Lower	2,277	-	0	-	514	-	1,414	-	0	-
Lateral Flow	244	2,119	0	533	1,001	700	4	6,908	0	91
Total Outflow	*5,396*	*3,037*	*0*	*1,729*	*4,048*	*1,124*	*1,418*	*21,268*	*0*	*5,077*
Inflow - Outflow	1	-146	0	-70	-2	-189	14	-29	0	-180
Storage Change	2	-146	0	-68	-2	-189	14	-26	0	-175
Model Error	-1	0	0	-2	0	0	0	-3	0	-5
Model Error (percent)	0.02%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Table B.3. continued.

Stress Period 12	Carson		Castro		Cochran		Coke		Crane	
1990	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Inflow										
General-Head Boundary	0	290	2,812	0	1,928	0	0	33	83	1,116
Recharge	0	0	0	0	0	0	0	105	0	0
Stream Leakage	0	0	0	0	0	0	0	0	0	0
Vertical Leakage Upper	0	0	0	631	0	144	0	0	0	155
Vertical Leakage Lower	0	-	1,075	-	404	-	0	-	0	-
Lateral Flow	0	37	286	460	1,045	458	0	49	72	3,961
Total Inflow	*0*	*327*	*4,173*	*1,091*	*3,377*	*602*	*0*	*187*	*155*	*5,232*
Outflow										
Wells	0	279	0	0	0	0	0	0	0	52
Springs and ET	0	0	0	0	0	0	0	0	0	0
General-Head Boundary	0	1	3,117	0	2,883	0	0	2	0	4,530
Stream Leakage	0	0	0	0	0	0	0	0	0	0
Vertical Leakage Upper	0	0	0	1,075	0	404	0	0	0	0
Vertical Leakage Lower	0	-	631	-	144	-	0	-	155	-
Lateral Flow	0	71	429	966	351	211	0	186	0	666
Total Outflow	*0*	*351*	*4,177*	*2,041*	*3,378*	*615*	*0*	*188*	*155*	*5,248*
Inflow - Outflow	0	-24	-4	-950	-1	-13	0	-1	0	-16
Storage Change	0	-24	-4	-951	0	-14	0	0	0	-16
Model Error	0	0	0	1	-1	1	0	-1	0	0
Model Error (percent)	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%

Table B.3. continued.

Stress Period 12	Crockett		Crosby		Dallam		Dawson		Deaf Smith	
1990	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	0	187	1,182	3,150	0	2,472	4,323	0	5,090	2,560
Recharge	0	0	1	3,457	0	0	5	11	11	537
Stream Leakage	0	0	0	784	0	0	454	0	0	0
Vertical Leakage Upper	0	0	0	1,193	0	0	0	3,751	0	3,250
Vertical Leakage Lower	0	-	45	-	0	-	173	-	1,117	-
Lateral Flow	0	126	28	2,654	0	2,588	662	757	410	906
Total Inflow	*0*	*313*	*1,256*	*11,238*	*0*	*5,060*	*5,617*	*4,519*	*6,628*	*7,253*
Outflow										
Wells	0	3	0	2,705	0	1,966	0	2	0	3,241
Springs and ET	0	0	0	3,198	0	0	0	1,118	0	1,933
General-Head Boundary	0	339	57	94	0	1,871	1,191	0	3,030	280
Stream Leakage	0	0	0	3,385	0	0	0	0	0	0
Vertical Leakage Upper	0	0	0	45	0	0	0	173	0	1,117
Vertical Leakage Lower	0	-	1,193	-	0	-	3,751	-	3,250	-
Lateral Flow	0	6	5	3,046	0	1,709	622	3,041	489	2,355
Total Outflow	*0*	*348*	*1,255*	*12,473*	*0*	*5,546*	*5,564*	*4,334*	*6,769*	*8,926*
Inflow - Outflow	0	-35	1	-1,235	0	-486	53	185	-141	-1,673
Storage Change	0	-36	1	-1234	0	-485	53	188	-139	-1673
Model Error	0	1	0	-1	0	-1	0	-3	-2	0
Model Error (percent)	0%	0%	0%	0.01%	0%	0.02%	0%	0%	0.03%	0%

Table B.3. continued.

Stress Period 12	Dickens		Ector		Fisher		Floyd		Gaines	
1990	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Inflow										
General-Head Boundary	0	290	4,033	2,738	0	0	12	1,434	4,614	0
Recharge	0	4,266	0	0	0	2,095	0	387	0	0
Stream Leakage	0	341	0	0	0	70	0	415	0	0
Vertical Leakage Upper	0	0	0	3,749	0	0	0	11	0	577
Vertical Leakage Lower	0	-	560	-	0	-	21	-	733	-
Lateral Flow	0	139	82	155	0	2,275	2	441	753	683
Total Inflow	*0*	*5,036*	*4,675*	*6,642*	*0*	*4,440*	*35*	*2,688*	*6,100*	*1,260*
Outflow										
Wells	0	15	0	61	0	18	0	706	0	0
Springs and ET	0	2,648	0	0	0	398	0	273	0	0
General-Head Boundary	0	5	813	0	0	0	22	504	4,307	0
Stream Leakage	0	1,017	0	0	0	3,765	0	375	0	0
Vertical Leakage Upper	0	0	0	560	0	0	0	21	0	733
Vertical Leakage Lower	0	-	3,749	-	0	-	11	-	577	-
Lateral Flow	0	1,379	105	6,081	0	331	1	1,485	1,221	894
Total Outflow	*0*	*5,064*	*4,667*	*6,702*	*0*	*4,512*	*34*	*3,364*	*6,105*	*1,627*
Inflow - Outflow	0	-28	8	-60	0	-72	1	-676	-5	-367
Storage Change	0	-26	15	-64	0	-72	0	-675	-5	-367
Model Error	0	-2	-7	4	0	0	1	-1	0	0
Model Error (percent)	0%	0.04%	0.15%	0.06%	0%	0%	3%	0%	0%	0%

Table B.3. continued.

Stress Period 12	Garza		Glasscock		Hale		Hartley		Hockley	
1990	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	314	1,864	0	3,329	3,934	24	0	8,209	2,678	0
Recharge	0	6,552	0	0	0	0	0	237	0	0
Stream Leakage	0	4,645	0	0	0	0	0	0	0	0
Vertical Leakage Upper	0	350	0	0	0	2,309	0	0	0	698
Vertical Leakage Lower	0	-	0	-	3,769	-	0	-	261	-
Lateral Flow	46	14,020	0	4,676	302	1,239	0	9,850	411	324
Total Inflow	*360*	*27,431*	*0*	*8,005*	*8,005*	*3,572*	*0*	*18,296*	*3,350*	*1,022*
Outflow										
Wells	0	59	0	0	0	152	0	1,049	0	922
Springs and ET	0	7,440	0	0	0	0	0	1,662	0	0
General-Head Boundary	0	0	0	4	5,511	34	0	7,043	2,253	0
Stream Leakage	0	19,209	0	0	0	0	0	1,446	0	0
Vertical Leakage Upper	0	0	0	0	0	3,769	0	0	0	261
Vertical Leakage Lower	350	-	0	-	2,309	-	0	-	698	-
Lateral Flow	6	736	0	8,175	188	702	0	7,942	400	259
Total Outflow	*356*	*27,444*	*0*	*8,179*	*8,008*	*4,657*	*0*	*19,142*	*3,351*	*1,442*
Inflow - Outflow	4	-13	0	-174	-3	-1,085	0	-846	-1	-420
Storage Change	4	-11	0	-174	-2	-1085	0	-844	-2	-419
Model Error	0	-2	0	0	-1	0	0	-2	1	-1
Model Error (percent)	0%	0.01%	0%	0%	0%	0%	0%	0%	0%	0.07%

Table B.3. continued.

Stress Period 12	Howard		Irion		Kent		Lamb		Loving	
1990	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Inflow										
General-Head Boundary	671	2,842	0	41	0	0	3,565	0	0	434
Recharge	0	4,520	0	0	0	995	0	0	0	0
Stream Leakage	0	3,977	0	0	0	132	0	0	0	0
Vertical Leakage Upper	0	677	0	0	0	0	0	547	0	0
Vertical Leakage Lower	0	-	0	-	0	-	1,293	-	0	-
Lateral Flow	16	8,890	0	127	0	880	530	720	0	70
Total Inflow	*687*	*20,906*	*0*	*168*	*0*	*2,007*	*5,388*	*1,267*	*0*	*504*
Outflow										
Wells	0	56	0	0	0	2	0	0	0	8
Springs and ET	0	1,108	0	0	0	26	0	0	0	0
General-Head Boundary	0	24	0	168	0	0	4,265	0	0	54
Stream Leakage	0	8,717	0	0	0	1,338	0	0	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	1,293	0	0
Vertical Leakage Lower	677	-	0	-	0	-	547	-	0	-
Lateral Flow	3	11,126	0	5	0	641	580	734	0	452
Total Outflow	*680*	*21,031*	*0*	*173*	*0*	*2,007*	*5,392*	*2,027*	*0*	*514*
Inflow - Outflow	7	-125	0	-5	0	0	-4	-760	0	-10
Storage Change	7	-122	0	-6	0	-2	-5	-760	0	-9
Model Error	0	-3	0	1	0	2	1	0	0	-1
Model Error (percent)	0%	0.01%	0%	0.58%	0%	0%	0.02%	0%	0%	0%

Table B.3. continued.

Stress Period 12	Lubbock		Lynn		Martin		Midland		Mitchell	
1990	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Inflow										
General-Head Boundary	4,880	0	5,592	1,063	3,524	235	3,413	858	0	164
Recharge	5	3	0	0	0	0	0	0	0	19,472
Stream Leakage	0	0	6	0	0	0	0	0	0	5,451
Vertical Leakage Upper	0	3,850	0	4,545	0	2,449	0	2,926	0	0
Vertical Leakage Lower	756	-	125	-	607	-	336	-	0	-
Lateral Flow	369	817	200	461	728	2,579	49	2,006	0	21,635
Total Inflow	*6,010*	*4,670*	*5,923*	*6,069*	*4,859*	*5,263*	*3,798*	*5,790*	*0*	*46,722*
Outflow										
Wells	0	3	0	0	0	0	0	0	0	1,791
Springs and ET	0	3,114	0	0	0	0	0	0	0	13,143
General-Head Boundary	2,050	0	917	0	2,377	3	782	36	0	0
Stream Leakage	0	0	6	0	0	0	0	0	0	32,213
Vertical Leakage Upper	0	756	0	125	0	607	0	336	0	0
Vertical Leakage Lower	3,850	-	4,545	-	2,449	-	2,926	-	0	-
Lateral Flow	122	1,163	446	5,810	35	4,648	90	5,675	0	65
Total Outflow	*6,022*	*5,036*	*5,914*	*5,935*	*4,861*	*5,258*	*3,798*	*6,047*	*0*	*47,212*
Inflow - Outflow	-12	-366	9	134	-2	5	0	-257	0	-490
Storage Change	-11	-368	8	135	-1	4	0	-256	0	-495
Model Error	-1	2	1	-1	-1	1	0	-1	0	5
Model Error (percent)	0.02%	0.04%	0%	0%	0.02%	0.02%	0%	0.02%	0%	0.01%

Table B.3. continued.

Stress Period 12	**Moore**		**Motley**		**Nolan**		**Oldham**		**Parmer**	
1990	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	0	3,076	0	146	0	0	0	5,188	3,011	0
Recharge	0	28	0	619	0	7,135	0	5,399	0	0
Stream Leakage	0	82	0	447	0	172	0	1,605	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	0	0	446
Vertical Leakage Lower	0	-	0	-	0	-	0	-	1,589	-
Lateral Flow	0	3,445	0	1,021	0	75	0	6,525	860	904
Total Inflow	*0*	*6,631*	*0*	*2,233*	*0*	*7,382*	*0*	*18,717*	*5,460*	*1,350*
Outflow										
Wells	0	5,569	0	77	0	796	0	510	0	1
Springs and ET	0	0	0	655	0	682	0	4,426	0	0
General-Head Boundary	0	750	0	13	0	0	0	99	4,720	0
Stream Leakage	0	715	0	1,402	0	1,558	0	12,931	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	0	0	1,589
Vertical Leakage Lower	0	-	0	-	0	-	0	-	446	-
Lateral Flow	0	225	0	142	0	4,578	0	1,135	319	365
Total Outflow	*0*	*7,259*	*0*	*2,289*	*0*	*7,614*	*0*	*19,101*	*5,485*	*1,955*
Inflow - Outflow	0	-628	0	-56	0	-232	0	-384	-25	-605
Storage Change	0	-629	0	-55	0	-231	0	-364	-26	-605
Model Error	0	1	0	-1	0	-1	0	-20	1	0
Model Error (percent)	0%	0%	0%	0.04%	0%	0%	0%	0%	0%	0%

Table B.3. continued.

Stress Period 12	Pecos		Potter		Randall		Reagan		Reeves	
1990	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Inflow										
General-Head Boundary	0	2,588	0	1,197	218	4,303	0	491	0	1,943
Recharge	0	0	0	2,298	0	221	0	0	0	0
Stream Leakage	0	0	0	838	0	634	0	0	0	0
Vertical Leakage Upper	0	0	0	0	0	120	0	0	0	0
Vertical Leakage Lower	0	-	0	-	40	-	0	-	0	-
Lateral Flow	0	1,004	0	1,015	46	1,076	0	944	0	1,948
Total Inflow	*0*	*3,592*	*0*	*5,348*	*304*	*6,354*	*0*	*1,435*	*0*	*3,891*
Outflow										
Wells	0	636	0	462	0	882	0	1,657	0	1,050
Springs and ET	0	0	0	1,671	0	958	0	0	0	0
General-Head Boundary	0	1,769	0	518	175	953	0	48	0	2,042
Stream Leakage	0	0	0	2,749	0	3,415	0	0	0	0
Vertical Leakage Upper	0	0	0	0	0	40	0	0	0	0
Vertical Leakage Lower	0	-	0	-	120	-	0	-	0	-
Lateral Flow	0	1,181	0	361	8	411	0	187	0	989
Total Outflow	*0*	*3,586*	*0*	*5,761*	*303*	*6,659*	*0*	*1,892*	*0*	*4,081*
Inflow - Outflow	0	6	0	-413	1	-305	0	-457	0	-190
Storage Change	0	5	0	-407	0	-302	0	-456	0	-190
Model Error	0	1	0	-6	1	-3	0	-1	0	0
Model Error (percent)	0%	0.03%	0%	0.10%	0%	0%	0%	0.05%	0%	0%

Table B.3. continued.

Stress Period 12	Scurry		Sherman		Sterling		Swisher		Terry	
1990	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Inflow										
General-Head Boundary	0	0	0	333	0	1,835	604	1,045	1,630	0
Recharge	0	20,229	0	0	0	439	0	9	0	0
Stream Leakage	0	4,412	0	0	0	73	0	296	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	271	0	229
Vertical Leakage Lower	0	-	0	-	0	-	740	-	199	-
Lateral Flow	0	3,893	0	551	0	4,509	153	924	501	215
Total Inflow	*0*	*28,534*	*0*	*884*	*0*	*6,856*	*1,497*	*2,545*	*2,330*	*444*
Outflow										
Wells	0	1,405	0	442	0	14	0	143	0	1
Springs and ET	0	9,546	0	0	0	0	0	0	0	0
General-Head Boundary	0	0	0	9	0	349	1,155	123	1,495	0
Stream Leakage	0	10,298	0	0	0	224	0	284	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	740	0	199
Vertical Leakage Lower	0	-	0	-	0	-	271	-	229	-
Lateral Flow	0	7,483	0	445	0	6,289	72	1,842	606	286
Total Outflow	*0*	*28,732*	*0*	*896*	*0*	*6,876*	*1,498*	*3,132*	*2,330*	*486*
Inflow - Outflow	0	-198	0	-12	0	-20	-1	-587	0	-42
Storage Change	0	-197	0	-12	0	-19	-1	-587	-1	-42
Model Error	0	-1	0	0	0	-1	0	0	1	0
Model Error (percent)	0%	0%	0%	0%	0%	0.01%	0%	0%	0%	0%

Table B.3. continued.

Stress Period 12	Tom Green		Upton		Ward		Winkler		Yoakum	
1990	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	0	6	0	1,511	0	1,366	940	2,868	1,738	0
Recharge	0	0	0	0	0	0	0	0	0	0
Stream Leakage	0	0	0	0	0	0	0	0	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	981	0	208
Vertical Leakage Lower	0	-	0	-	0	-	262	-	210	-
Lateral Flow	0	34	0	892	0	4,172	82	2,056	735	288
Total Inflow	*0*	*40*	*0*	*2,403*	*0*	*5,538*	*1,284*	*5,905*	*2,683*	*496*
Outflow										
Wells	0	0	0	212	0	80	0	2,352	0	0
Springs and ET	0	0	0	0	0	0	0	0	0	0
General-Head Boundary	0	17	0	154	0	4,495	304	322	1,855	0
Stream Leakage	0	0	0	0	0	0	0	0	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	262	0	210
Vertical Leakage Lower	0	-	0	-	0	-	981	-	208	-
Lateral Flow	0	24	0	2,237	0	1,007	0	3,092	621	298
Total Outflow	*0*	*41*	*0*	*2,603*	*0*	*5,582*	*1,285*	*6,028*	*2,684*	*508*
Inflow - Outflow	0	-1	0	-200	0	-44	-1	-123	-1	-12
Storage Change	0	-1	0	-201	0	-43	-1	-122	0	-12
Model Error	0	0	0	1	0	-1	0	-1	-1	0
Model Error (percent)	0%	0%	0%	0%	0%	0%	0%	0.02%	0.04%	0%

Table B.4. Water budgets by county for the upper and lower portions of the Dockum Aquifer for 1997 in the modified groundwater model. All values are in acre-feet per year.

Stress Period 19	Andrews		Armstrong		Bailey		Borden		Briscoe	
1997	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Inflow										
General-Head Boundary	3,479	0	0	778	3,278	0	1,313	226	0	1,965
Recharge	0	0	0	658	0	0	7	5,573	0	712
Stream Leakage	0	0	0	2	0	0	40	9,346	0	608
Vertical Leakage Upper	0	2,270	0	0	0	516	0	1,416	0	0
Vertical Leakage Lower	880	-	0	-	404	-	2	-	0	-
Lateral Flow	1,029	609	0	228	227	418	80	4,708	0	1,502
Total Inflow	*5,388*	*2,879*	*0*	*1,666*	*3,909*	*934*	*1,442*	*21,269*	*0*	*4,787*
Outflow										
Wells	0	10	0	80	0	0	0	56	0	6
Springs and ET	0	0	0	649	0	0	0	8,454	0	1,652
General-Head Boundary	2,873	0	0	189	2,331	0	0	0	0	3
Stream Leakage	0	0	0	262	0	0	0	5,852	0	3,318
Vertical Leakage Upper	0	880	0	0	0	404	0	2	0	0
Vertical Leakage Lower	2,270	-	0	-	516	-	1,416	-	0	-
Lateral Flow	244	2,130	0	539	1,063	731	5	6,899	0	117
Total Outflow	*5,387*	*3,020*	*0*	*1,719*	*3,910*	*1,135*	*1,421*	*21,263*	*0*	*5,096*
Inflow - Outflow	1	-141	0	-53	-1	-201	21	6	0	-309
Storage Change	2	-142	0	-51	-2	-200	23	8	0	-305
Model Error	-1	1	0	-2	1	-1	-2	-2	0	-4
Model Error (percent)	0.02%	0%	0%	0%	0%	0%	0.14%	0%	0%	0%

Table B.4. continued.

Stress Period 19	Carson		Castro		Cochran		Coke		Crane	
1997	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	0	229	2,805	0	2,023	0	0	33	83	1,122
Recharge	0	0	0	0	0	0	0	105	0	0
Stream Leakage	0	0	0	0	0	0	0	0	0	0
Vertical Leakage Upper	0	0	0	640	0	141	0	0	0	155
Vertical Leakage Lower	0	-	1,165	-	449	-	0	-	0	-
Lateral Flow	0	13	291	480	1,062	462	0	49	72	3,952
Total Inflow	*0*	*242*	*4,261*	*1,120*	*3,534*	*603*	*0*	*187*	*155*	*5,229*
Outflow										
Wells	0	121	0	0	0	0	0	0	0	41
Springs and ET	0	0	0	0	0	0	0	0	0	0
General-Head Boundary	0	6	3,207	0	3,043	0	0	2	0	4,513
Stream Leakage	0	0	0	0	0	0	0	0	0	0
Vertical Leakage Upper	0	0	0	1,165	0	449	0	0	0	0
Vertical Leakage Lower	0	-	640	-	141	-	0	-	155	-
Lateral Flow	0	109	418	946	352	215	0	186	0	665
Total Outflow	*0*	*236*	*4,265*	*2,111*	*3,536*	*664*	*0*	*188*	*155*	*5,219*
Inflow - Outflow	0	6	-4	-991	-2	-61	0	-1	0	10
Storage Change	0	6	-5	-991	-2	-62	0	0	0	11
Model Error	0	0	1	0	0	1	0	-1	0	-1
Model Error (percent)	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%

Table B.4. continued.

Stress Period 19	Crockett		Crosby		Dallam		Dawson		Deaf Smith	
1997	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Inflow										
General-Head Boundary	0	197	1,241	3,378	0	2,713	4,377	0	4,963	2,117
Recharge	0	0	1	3,457	0	0	5	11	11	537
Stream Leakage	0	0	0	783	0	0	452	0	0	0
Vertical Leakage Upper	0	0	0	1,255	0	0	0	3,769	0	3,265
Vertical Leakage Lower	0	-	36	-	0	-	214	-	1,051	-
Lateral Flow	0	112	30	2,754	0	2,894	687	755	391	943
Total Inflow	*0*	*309*	*1,308*	*11,627*	*0*	*5,607*	*5,735*	*4,535*	*6,416*	*6,862*
Outflow										
Wells	0	3	0	3,548	0	2,757	0	2	0	3,869
Springs and ET	0	0	0	3,179	0	0	0	1,121	0	1,861
General-Head Boundary	0	331	48	67	0	1,789	1,254	0	2,909	303
Stream Leakage	0	0	0	3,359	0	0	0	0	0	0
Vertical Leakage Upper	0	0	0	36	0	0	0	214	0	1,051
Vertical Leakage Lower	0	-	1,255	-	0	-	3,769	-	3,265	-
Lateral Flow	0	16	4	3,028	0	1,598	636	3,071	489	2,290
Total Outflow	*0*	*350*	*1,307*	*13,217*	*0*	*6,144*	*5,659*	*4,408*	*6,663*	*9,374*
Inflow - Outflow	0	-41	1	-1,590	0	-537	76	127	-247	-2,512
Storage Change	0	-40	1	-1587	0	-537	76	128	-247	-2512
Model Error	0	-1	0	-3	0	0	0	-1	0	0
Model Error (percent)	0%	0%	0%	0.02%	0%	0%	0%	0%	0%	0%

Table B.4. continued.

Stress Period 19 1997	Dickens Upper	Dickens Lower	Ector Upper	Ector Lower	Fisher Upper	Fisher Lower	Floyd Upper	Floyd Lower	Gaines Upper	Gaines Lower
Inflow										
General-Head Boundary	0	289	3,949	2,739	0	0	13	1,457	4,601	0
Recharge	0	4,266	0	0	0	2,095	0	387	0	0
Stream Leakage	0	341	0	0	0	70	0	415	0	0
Vertical Leakage Upper	0	0	0	3,774	0	0	0	13	0	491
Vertical Leakage Lower	0	-	567	-	0	-	21	-	879	-
Lateral Flow	0	137	83	173	0	2,284	2	529	808	711
Total Inflow	*0*	*5,033*	*4,599*	*6,686*	*0*	*4,449*	*36*	*2,801*	*6,288*	*1,202*
Outflow										
Wells	0	13	0	528	0	12	0	1,091	0	0
Springs and ET	0	2,648	0	0	0	395	0	272	0	0
General-Head Boundary	0	5	768	0	0	0	23	520	4,593	0
Stream Leakage	0	1,017	0	0	0	3,753	0	371	0	0
Vertical Leakage Upper	0	0	0	567	0	0	0	21	0	879
Vertical Leakage Lower	0	-	3,774	-	0	-	13	-	491	-
Lateral Flow	0	1,385	105	6,037	0	319	1	1,415	1,211	887
Total Outflow	*0*	*5,068*	*4,647*	*7,132*	*0*	*4,479*	*37*	*3,690*	*6,295*	*1,766*
Inflow - Outflow	0	-35	-48	-446	0	-30	-1	-889	-7	-564
Storage Change	0	-31	-47	-443	0	-30	0	-888	-7	-564
Model Error	0	-4	-1	-3	0	0	-1	-1	0	0
Model Error (percent)	0%	0.08%	0.02%	0.04%	0%	0%	3%	0%	0%	0%

Table B.4. continued.

Stress Period 19	Garza		Glasscock		Hale		Hartley		Hockley	
1997	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Inflow										
General-Head Boundary	313	1,872	0	3,344	3,811	20	0	8,475	2,808	0
Recharge	0	6,552	0	0	0	0	0	237	0	0
Stream Leakage	0	4,645	0	0	0	0	0	0	0	0
Vertical Leakage Upper	0	350	0	0	0	2,225	0	0	0	593
Vertical Leakage Lower	0	-	0	-	3,907	-	0	-	330	-
Lateral Flow	46	14,025	0	4,753	314	1,309	0	9,938	441	329
Total Inflow	*359*	*27,444*	*0*	*8,097*	*8,032*	*3,554*	*0*	*18,650*	*3,579*	*922*
Outflow										
Wells	0	96	0	0	0	130	0	1,705	0	571
Springs and ET	0	7,438	0	0	0	0	0	1,645	0	0
General-Head Boundary	0	0	0	4	5,617	39	0	6,850	2,603	0
Stream Leakage	0	19,208	0	0	0	0	0	1,434	0	0
Vertical Leakage Upper	0	0	0	0	0	3,907	0	0	0	330
Vertical Leakage Lower	350	-	0	-	2,225	-	0	-	593	-
Lateral Flow	6	736	0	8,337	193	721	0	7,952	386	256
Total Outflow	*356*	*27,478*	*0*	*8,341*	*8,035*	*4,797*	*0*	*19,586*	*3,582*	*1,157*
Inflow - Outflow	3	-34	0	-244	-3	-1,243	0	-936	-3	-235
Storage Change	4	-31	0	-243	-2	-1244	0	-935	-3	-234
Model Error	-1	-3	0	-1	-1	1	0	-1	0	-1
Model Error (percent)	0%	0.01%	0%	0.01%	0%	0.02%	0%	0%	0%	0.09%

Table B.4. continued.

Stress Period 19 1997	Howard Upper	Howard Lower	Irion Upper	Irion Lower	Kent Upper	Kent Lower	Lamb Upper	Lamb Lower	Loving Upper	Loving Lower
Inflow										
General-Head Boundary	676	2,843	0	42	0	0	3,620	0	0	435
Recharge	0	4,520	0	0	0	995	0	0	0	0
Stream Leakage	0	3,977	0	0	0	132	0	0	0	0
Vertical Leakage Upper	0	677	0	0	0	0	0	531	0	0
Vertical Leakage Lower	0	-	0	-	0	-	1,379	-	0	-
Lateral Flow	16	8,900	0	120	0	880	521	716	0	69
Total Inflow	*692*	*20,917*	*0*	*162*	*0*	*2,007*	*5,520*	*1,247*	*0*	*504*
Outflow										
Wells	0	61	0	0	0	2	0	0	0	7
Springs and ET	0	1,107	0	0	0	26	0	0	0	0
General-Head Boundary	0	24	0	164	0	0	4,386	0	0	53
Stream Leakage	0	8,716	0	0	0	1,338	0	0	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	1,379	0	0
Vertical Leakage Lower	677	-	0	-	0	-	531	-	0	-
Lateral Flow	2	11,124	0	4	0	641	607	763	0	452
Total Outflow	*679*	*21,032*	*0*	*168*	*0*	*2,007*	*5,524*	*2,142*	*0*	*512*
Inflow - Outflow	13	-115	0	-6	0	0	-4	-895	0	-8
Storage Change	13	-112	0	-7	0	-2	-5	-895	0	-9
Model Error	0	-3	0	1	0	2	1	0	0	1
Model Error (percent)	0%	0.01%	0%	0.59%	0%	0%	0.02%	0%	0%	0%

Table B.4. continued.

Stress Period 19	Lubbock		Lynn		Martin		Midland		Mitchell	
1997	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	4,768	0	5,692	1,072	3,516	233	3,376	862	0	164
Recharge	5	3	0	0	0	0	0	0	0	19,472
Stream Leakage	0	0	9	0	0	0	0	0	0	5,446
Vertical Leakage Upper	0	3,731	0	4,564	0	2,443	0	2,910	0	0
Vertical Leakage Lower	870	-	146	-	612	-	342	-	0	-
Lateral Flow	381	818	193	455	739	2,587	50	2,008	0	21,648
Total Inflow	*6,024*	*4,552*	*6,040*	*6,091*	*4,867*	*5,263*	*3,768*	*5,780*	*0*	*46,730*
Outflow										
Wells	0	3	0	0	0	0	0	0	0	1,235
Springs and ET	0	3,054	0	0	0	0	0	0	0	13,139
General-Head Boundary	2,206	0	988	0	2,389	3	770	35	0	0
Stream Leakage	0	0	9	0	0	0	0	0	0	32,247
Vertical Leakage Upper	0	870	0	146	0	612	0	342	0	0
Vertical Leakage Lower	3,731	-	4,564	-	2,443	-	2,910	-	0	-
Lateral Flow	123	1,217	466	5,826	36	4,659	88	5,763	0	65
Total Outflow	*6,060*	*5,144*	*6,027*	*5,972*	*4,868*	*5,274*	*3,768*	*6,140*	*0*	*46,686*
Inflow - Outflow	-36	-592	13	119	-1	-11	0	-360	0	44
Storage Change	-37	-592	13	120	-2	-12	-1	-359	0	41
Model Error	1	0	0	-1	1	1	1	-1	0	3
Model Error (percent)	0.02%	0%	0%	0%	0.02%	0.02%	0%	0.02%	0%	0.01%

Table B.4. continued.

Stress Period 19 1997	Moore Upper	Moore Lower	Motley Upper	Motley Lower	Nolan Upper	Nolan Lower	Oldham Upper	Oldham Lower	Parmer Upper	Parmer Lower
Inflow										
General-Head Boundary	0	2,897	0	147	0	0	0	5,144	2,717	0
Recharge	0	28	0	619	0	7,135	0	5,399	0	0
Stream Leakage	0	82	0	449	0	174	0	1,645	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	0	0	406
Vertical Leakage Lower	0	-	0	-	0	-	0	-	1,618	-
Lateral Flow	0	3,264	0	984	0	74	0	6,438	886	952
Total Inflow	*0*	*6,271*	*0*	*2,199*	*0*	*7,383*	*0*	*18,626*	*5,221*	*1,358*
Outflow										
Wells	0	5,033	0	44	0	721	0	1,066	0	1
Springs and ET	0	0	0	657	0	667	0	4,423	0	0
General-Head Boundary	0	814	0	13	0	0	0	60	4,598	0
Stream Leakage	0	707	0	1,401	0	1,540	0	12,923	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	0	0	1,618
Vertical Leakage Lower	0	-	0	-	0	-	0	-	406	-
Lateral Flow	0	209	0	150	0	4,582	0	1,200	263	363
Total Outflow	*0*	*6,763*	*0*	*2,265*	*0*	*7,510*	*0*	*19,672*	*5,267*	*1,982*
Inflow - Outflow	0	-492	0	-66	0	-127	0	-1,046	-46	-624
Storage Change	0	-493	0	-65	0	-127	0	-1026	-45	-624
Model Error	0	1	0	-1	0	0	0	-20	-1	0
Model Error (percent)	0%	0%	0%	0.04%	0%	0%	0%	0%	0%	0%

Table B.4. continued.

Stress Period 19 1997	Pecos Upper	Pecos Lower	Potter Upper	Potter Lower	Randall Upper	Randall Lower	Reagan Upper	Reagan Lower	Reeves Upper	Reeves Lower
Inflow										
General-Head Boundary	0	2,656	0	1,264	232	4,243	0	573	0	1,983
Recharge	0	0	0	2,298	0	221	0	0	0	0
Stream Leakage	0	0	0	841	0	620	0	0	0	0
Vertical Leakage Upper	0	0	0	0	0	137	0	0	0	0
Vertical Leakage Lower	0	-	0	-	32	-	0	-	0	-
Lateral Flow	0	1,009	0	1,004	46	1,075	0	1,208	0	1,970
Total Inflow	*0*	*3,665*	*0*	*5,407*	*310*	*6,296*	*0*	*1,781*	*0*	*3,953*
Outflow										
Wells	0	777	0	769	0	954	0	2,064	0	1,217
Springs and ET	0	0	0	1,668	0	957	0	0	0	0
General-Head Boundary	0	1,708	0	376	166	950	0	37	0	1,961
Stream Leakage	0	0	0	2,747	0	3,375	0	0	0	0
Vertical Leakage Upper	0	0	0	0	0	32	0	0	0	0
Vertical Leakage Lower	0	-	0	-	137	-	0	-	0	-
Lateral Flow	0	1,184	0	377	6	401	0	162	0	989
Total Outflow	*0*	*3,669*	*0*	*5,937*	*309*	*6,669*	*0*	*2,263*	*0*	*4,167*
Inflow - Outflow	0	-4	0	-530	1	-373	0	-482	0	-214
Storage Change	0	-4	0	-525	0	-372	0	-482	0	-213
Model Error	0	0	0	-5	1	-1	0	0	0	-1
Model Error (percent)	0%	0%	0%	0.08%	0%	0%	0%	0%	0%	0.02%

Table B.4. continued.

Stress Period 19 1997	Scurry Upper	Scurry Lower	Sherman Upper	Sherman Lower	Sterling Upper	Sterling Lower	Swisher Upper	Swisher Lower	Terry Upper	Terry Lower
Inflow										
General-Head Boundary	0	0	0	368	0	1,838	623	1,035	1,712	0
Recharge	0	20,229	0	0	0	439	0	9	0	0
Stream Leakage	0	4,414	0	0	0	73	0	296	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	290	0	193
Vertical Leakage Lower	0	-	0	-	0	-	755	-	273	-
Lateral Flow	0	3,873	0	532	0	4,496	152	946	494	212
Total Inflow	*0*	*28,516*	*0*	*900*	*0*	*6,846*	*1,530*	*2,576*	*2,479*	*405*
Outflow										
Wells	0	1,209	0	485	0	11	0	162	0	0
Springs and ET	0	9,547	0	0	0	0	0	0	0	0
General-Head Boundary	0	0	0	5	0	349	1,161	133	1,642	0
Stream Leakage	0	10,298	0	0	0	224	0	266	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	755	0	273
Vertical Leakage Lower	0	-	0	-	0	-	290	-	193	-
Lateral Flow	0	7,501	0	415	0	6,289	79	1,909	647	289
Total Outflow	*0*	*28,555*	*0*	*905*	*0*	*6,873*	*1,530*	*3,225*	*2,482*	*562*
Inflow - Outflow	0	-39	0	-5	0	-27	0	-649	-3	-157
Storage Change	0	-39	0	-6	0	-25	-1	-650	-3	-158
Model Error	0	0	0	1	0	-2	1	1	0	1
Model Error (percent)	0%	0%	0%	0.11%	0%	0.03%	0%	0%	0%	0.18%

Table B.4. continued.

Stress Period 19	Tom Green		Upton		Ward		Winkler		Yoakum	
1997	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	0	7	0	1,535	0	1,370	935	2,837	1,840	0
Recharge	0	0	0	0	0	0	0	0	0	0
Stream Leakage	0	0	0	0	0	0	0	0	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	1,004	0	188
Vertical Leakage Lower	0	-	0	-	0	-	270	-	260	-
Lateral Flow	0	33	0	900	0	4,173	82	1,981	783	290
Total Inflow	*0*	*40*	*0*	*2,435*	*0*	*5,543*	*1,287*	*5,822*	*2,883*	*478*
Outflow										
Wells	0	0	0	220	0	75	0	2,120	0	0
Springs and ET	0	0	0	0	0	0	0	0	0	0
General-Head Boundary	0	17	0	150	0	4,480	314	342	2,081	0
Stream Leakage	0	0	0	0	0	0	0	0	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	270	0	260
Vertical Leakage Lower	0	-	0	-	0	-	1,004	-	188	-
Lateral Flow	0	24	0	2,291	0	1,029	0	3,116	616	306
Total Outflow	*0*	*41*	*0*	*2,661*	*0*	*5,584*	*1,318*	*5,848*	*2,885*	*566*
Inflow - Outflow	0	-1	0	-226	0	-41	-31	-26	-2	-88
Storage Change	0	-2	0	-224	0	-39	-31	-26	-3	-88
Model Error	0	1	0	-2	0	-2	0	0	1	0
Model Error (percent)	0%	2%	0%	0%	0%	0%	0%	0%	0.03%	0%

Table B.5. Water budgets by groundwater conservation district for the upper and lower portions of the Dockum Aquifer for the steady-state portion of the modified groundwater model. All values are in acre-feet per year.

Stress Period 1	Clear Fork GCD		Coke County UWCD		Crockett County GCD		Garza County UWCD		Glasscock GCD	
Steady-State	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	0	0	0	33	0	171	309	1,838	0	3,318
Recharge	0	2,095	0	105	0	0	0	6,552	0	0
Stream Leakage	0	70	0	0	0	0	0	4,645	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	349	0	0
Vertical Leakage Lower	0	-	0	-	0	-	0	-	0	-
Lateral Flow	0	2,355	0	50	0	187	46	14,021	0	5,141
Total Inflow	*0*	*4,520*	*0*	*188*	*0*	*358*	*355*	*27,405*	*0*	*8,459*
Outflow										
Wells	0	5	0	0	0	1	0	18	0	181
Springs and ET	0	412	0	0	0	0	0	7,440	0	0
General-Head Boundary	0	0	0	2	0	354	0	0	0	7
Stream Leakage	0	3,784	0	0	0	0	0	19,211	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	0	0	0
Vertical Leakage Lower	0	-	0	-	0	-	349	-	0	-
Lateral Flow	0	318	0	186	0	3	6	735	0	8,271
Total Outflow	*0*	*4,519*	*0*	*188*	*0*	*358*	*355*	*27,404*	*0*	*8,459*
Inflow - Outflow	0	1	0	0	0	0	0	1	0	0
Storage Change	-	-	-	-	-	-	-	-	-	-
Model Error	0	1	0	0	0	0	0	1	0	0
Model Error (percent)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Table B.5. continued.

Stress Period 1	High Plains UWCD No. 1		Irion County WCD		Llano Estacado UWCD		Lone Wolf GCD		Mesa UWCD	
Steady-State	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	35,746	7,341	0	40	4,767	0	0	164	4,084	0
Recharge	5	419	0	0	0	0	0	19,472	5	11
Stream Leakage	2	459	0	0	0	0	0	5,412	456	0
Vertical Leakage Upper	0	16,752	0	0	0	770	0	0	0	3,543
Vertical Leakage Lower	8,637	-	0	-	534	-	0	-	193	-
Lateral Flow	2,304	6,674	0	150	629	661	0	21,781	668	761
Total Inflow	*46,694*	*31,645*	*0*	*190*	*5,930*	*1,431*	*0*	*46,829*	*5,406*	*4,315*
Outflow										
Wells	0	1,898	0	0	0	0	0	636	0	0
Springs and ET	0	3,566	0	0	0	0	0	13,472	0	1,112
General-Head Boundary	28,477	1,615	0	172	3,924	0	0	0	1,269	0
Stream Leakage	2	232	0	0	0	0	0	32,654	0	0
Vertical Leakage Upper	0	8,637	0	0	0	534	0	0	0	193
Vertical Leakage Lower	16,752	-	0	-	770	-	0	-	3,543	-
Lateral Flow	1,463	15,697	0	18	1,235	898	0	68	594	3,010
Total Outflow	*46,694*	*31,645*	*0*	*190*	*5,929*	*1,432*	*0*	*46,830*	*5,406*	*4,315*
Inflow - Outflow	0	0	0	0	1	-1	0	-1	0	0
Storage Change	-	-	-	-	-	-	-	-	-	-
Model Error	0	0	0	0	1	-1	0	-1	0	0
Model Error (percent)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Table B.5. continued.

Stress Period 1	Middle Pecos GCD		North Plains GCD		Panhandle GCD		Permian Basin UWCD		Sandy Land UWCD	
Steady-State	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	0	2,406	0	7,618	0	1,529	4,247	2,914	1,679	0
Recharge	0	0	0	59	0	2,663	0	4,518	0	0
Stream Leakage	0	0	0	0	0	715	0	3,977	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	3,182	0	198
Vertical Leakage Lower	0	-	0	-	0	-	606	-	199	-
Lateral Flow	0	963	0	10,819	0	2,129	704	12,778	711	291
Total Inflow	*0*	*3,369*	*0*	*18,496*	*0*	*7,036*	*5,557*	*27,369*	*2,589*	*489*
Outflow										
Wells	0	211	0	2,116	0	223	0	11	0	0
Springs and ET	0	0	0	0	0	2,258	0	1,108	0	0
General-Head Boundary	0	1,944	0	10,894	0	597	2,350	28	1,803	0
Stream Leakage	0	0	0	0	0	3,030	0	8,719	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	606	0	199
Vertical Leakage Lower	0	-	0	-	0	-	3,182	-	198	-
Lateral Flow	0	1,213	0	5,486	0	927	25	16,898	586	290
Total Outflow	*0*	*3,368*	*0*	*18,496*	*0*	*7,035*	*5,557*	*27,370*	*2,587*	*489*
Inflow - Outflow	0	1	0	0	0	1	0	-1	2	0
Storage Change	-	-	-	-	-	-	-	-	-	-
Model Error	0	1	0	0	0	1	0	-1	2	0
Model Error (percent)	0%	0%	0%	0%	0%	0.01%	0%	0%	0.08%	0%

Table B.5. continued.

Stress Period 1	Santa Rita UWCD		South Plains UWCD		Sterling County UWCD		Wes-Tex GCD	
Steady-State	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow								
General-Head Boundary	0	316	1,650	0	0	1,827	0	0
Recharge	0	0	0	0	0	439	0	7,135
Stream Leakage	0	0	0	0	0	73	0	169
Vertical Leakage Upper	0	0	0	241	0	0	0	0
Vertical Leakage Lower	0	-	167	-	0	-	0	-
Lateral Flow	0	747	484	221	0	4,531	0	69
Total Inflow	*0*	*1,063*	*2,301*	*462*	*0*	*6,870*	*0*	*7,373*
Outflow								
Wells	0	183	0	1	0	4	0	214
Springs and ET	0	0	0	0	0	0	0	719
General-Head Boundary	0	69	1,427	0	0	355	0	0
Stream Leakage	0	0	0	0	0	224	0	1,688
Vertical Leakage Upper	0	0	0	167	0	0	0	0
Vertical Leakage Lower	0	-	241	-	0	-	0	-
Lateral Flow	0	812	633	294	0	6,288	0	4,752
Total Outflow	*0*	*1,064*	*2,301*	*462*	*0*	*6,871*	*0*	*7,373*
Inflow - Outflow	0	-1	0	0	0	-1	0	0
Storage Change	-	-	-	-	-	-	-	-
Model Error	0	-1	0	0	0	-1	0	0
Model Error (percent)	0%	0.09%	0%	0%	0%	0.01%	0%	0%

Table B.6. Water budgets by groundwater conservation district for the upper and lower portions of the Dockum Aquifer for 1980 in the modified groundwater model. All values are in acre-feet per year.

Stress Period 2	Clear Fork GCD		Coke County UWCD		Crockett County GCD		Garza County UWCD		Glasscock GCD	
1980	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Inflow										
General-Head Boundary	0	0	0	33	0	171	310	1,839	0	3,327
Recharge	0	2,095	0	105	0	0	0	6,552	0	0
Stream Leakage	0	70	0	0	0	0	0	4,645	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	349	0	0
Vertical Leakage Lower	0	-	0	-	0	-	0	-	0	-
Lateral Flow	0	2,215	0	49	0	170	46	14,020	0	5,215
Total Inflow	*0*	*4,380*	*0*	*187*	*0*	*341*	*356*	*27,405*	*0*	*8,542*
Outflow										
Wells	0	30	0	0	0	3	0	79	0	386
Springs and ET	0	410	0	0	0	0	0	7,439	0	0
General-Head Boundary	0	0	0	2	0	353	0	0	0	7
Stream Leakage	0	3,784	0	0	0	0	0	19,211	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	0	0	0
Vertical Leakage Lower	0	-	0	-	0	-	349	-	0	-
Lateral Flow	0	563	0	186	0	3	6	735	0	8,284
Total Outflow	*0*	*4,787*	*0*	*188*	*0*	*359*	*355*	*27,464*	*0*	*8,677*
Inflow - Outflow	0	-407	0	-1	0	-18	1	-59	0	-135
Storage Change	0	-407	0	0	0	-18	0	-57	0	-134
Model Error	0	0	0	-1	0	0	1	-2	0	-1
Model Error (percent)	0%	0%	0%	1%	0%	0%	0.28%	0%	0%	0%

Table B.6. continued.

Stress Period 2	High Plains UWCD No. 1		Irion County WCD		Llano Estacado UWCD		Lone Wolf GCD		Mesa UWCD	
1980	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	35,505	7,659	0	40	4,733	0	0	164	4,120	0
Recharge	5	419	0	0	0	0	0	19,472	5	11
Stream Leakage	2	459	0	0	0	0	0	5,419	456	0
Vertical Leakage Upper	0	16,633	0	0	0	727	0	0	0	3,576
Vertical Leakage Lower	8,995	-	0	-	575	-	0	-	186	-
Lateral Flow	2,316	6,723	0	149	642	654	0	21,462	666	761
Total Inflow	*46,823*	*31,893*	*0*	*189*	*5,950*	*1,381*	*0*	*46,517*	*5,433*	*4,348*
Outflow										
Wells	0	8,721	0	0	0	0	0	3,424	0	1
Springs and ET	0	3,553	0	0	0	0	0	13,268	0	1,111
General-Head Boundary	28,756	1,495	0	172	3,999	0	0	0	1,254	0
Stream Leakage	2	232	0	0	0	0	0	32,562	0	0
Vertical Leakage Upper	0	8,995	0	0	0	575	0	0	0	186
Vertical Leakage Lower	16,633	-	0	-	727	-	0	-	3,576	-
Lateral Flow	1,460	15,410	0	17	1,230	898	0	68	597	3,011
Total Outflow	*46,851*	*38,406*	*0*	*189*	*5,956*	*1,473*	*0*	*49,322*	*5,427*	*4,309*
Inflow - Outflow	-28	-6,513	0	0	-6	-92	0	-2,805	6	39
Storage Change	-27	-6513	0	-1	-7	-92	0	-2807	6	39
Model Error	-1	0	0	1	1	0	0	2	0	0
Model Error (percent)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Table B.6. continued.

Stress Period 2	Middle Pecos GCD		North Plains GCD		Panhandle GCD		Permian Basin UWCD		Sandy Land UWCD	
1980	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	0	2,638	0	8,952	0	1,834	4,248	2,909	1,688	0
Recharge	0	0	0	59	0	2,663	0	4,518	0	0
Stream Leakage	0	0	0	0	0	721	0	3,977	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	3,193	0	194
Vertical Leakage Lower	0	-	0	-	0	-	604	-	209	-
Lateral Flow	0	1,021	0	11,171	0	2,064	707	12,778	716	285
Total Inflow	*0*	*3,659*	*0*	*20,182*	*0*	*7,282*	*5,559*	*27,375*	*2,613*	*479*
Outflow										
Wells	0	955	0	7,478	0	1,031	0	27	0	0
Springs and ET	0	0	0	0	0	2,244	0	1,108	0	0
General-Head Boundary	0	1,750	0	9,615	0	479	2,350	28	1,836	0
Stream Leakage	0	0	0	0	0	3,025	0	8,719	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	604	0	209
Vertical Leakage Lower	0	-	0	-	0	-	3,193	-	194	-
Lateral Flow	0	1,170	0	5,225	0	954	25	16,899	584	290
Total Outflow	*0*	*3,875*	*0*	*22,318*	*0*	*7,733*	*5,568*	*27,385*	*2,614*	*499*
Inflow - Outflow	0	-216	0	-2,136	0	-451	-9	-10	-1	-20
Storage Change	0	-215	0	-2137	0	-455	0	-18	-1	-20
Model Error	0	-1	0	1	0	4	-9	8	0	0
Model Error (percent)	0%	0%	0%	0%	0%	0.05%	0%	0%	0%	0%

Table B.6. continued.

Stress Period 2	Santa Rita UWCD		South Plains UWCD		Sterling County UWCD		Wes-Tex GCD	
1980	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow								
General-Head Boundary	0	326	1,663	0	0	1,829	0	0
Recharge	0	0	0	0	0	439	0	7,135
Stream Leakage	0	0	0	0	0	73	0	170
Vertical Leakage Upper	0	0	0	246	0	0	0	0
Vertical Leakage Lower	0	-	166	-	0	-	0	-
Lateral Flow	0	777	482	221	0	4,532	0	63
Total Inflow	*0*	*1,103*	*2,311*	*467*	*0*	*6,873*	*0*	*7,368*
Outflow								
Wells	0	393	0	0	0	20	0	820
Springs and ET	0	0	0	0	0	0	0	709
General-Head Boundary	0	67	1,425	0	0	353	0	0
Stream Leakage	0	0	0	0	0	224	0	1,651
Vertical Leakage Upper	0	0	0	166	0	0	0	0
Vertical Leakage Lower	0	-	246	-	0	-	0	-
Lateral Flow	0	834	639	294	0	6,288	0	4,583
Total Outflow	*0*	*1,294*	*2,310*	*460*	*0*	*6,885*	*0*	*7,763*
Inflow - Outflow	0	-191	1	7	0	-12	0	-395
Storage Change	0	-193	1	6	0	-11	0	-395
Model Error	0	2	0	1	0	-1	0	0
Model Error (percent)	0%	0.15%	0%	0%	0%	0.01%	0%	0%

Table B.7. Water budgets by groundwater conservation district for the upper and lower portions of the Dockum Aquifer for 1990 in the modified groundwater model. All values are in acre-feet per year.

Stress Period 12	Clear Fork GCD		Coke County UWCD		Crockett County GCD		Garza County UWCD		Glasscock GCD	
1990	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	0	0	0	33	0	187	314	1,864	0	3,389
Recharge	0	2,095	0	105	0	0	0	6,552	0	0
Stream Leakage	0	70	0	0	0	0	0	4,645	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	350	0	0
Vertical Leakage Lower	0	-	0	-	0	-	0	-	0	-
Lateral Flow	0	2,275	0	49	0	126	46	14,020	0	5,773
Total Inflow	*0*	*4,440*	*0*	*187*	*0*	*313*	*360*	*27,431*	*0*	*9,162*
Outflow										
Wells	0	18	0	0	0	3	0	59	0	824
Springs and ET	0	398	0	0	0	0	0	7,440	0	0
General-Head Boundary	0	0	0	2	0	339	0	0	0	5
Stream Leakage	0	3,765	0	0	0	0	0	19,209	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	0	0	0
Vertical Leakage Lower	0	-	0	-	0	-	350	-	0	-
Lateral Flow	0	331	0	186	0	6	6	736	0	8,631
Total Outflow	*0*	*4,512*	*0*	*188*	*0*	*348*	*356*	*27,444*	*0*	*9,460*
Inflow - Outflow	0	-72	0	-1	0	-35	4	-13	0	-298
Storage Change	0	-72	0	0	0	-36	4	-11	0	-297
Model Error	0	0	0	-1	0	1	0	-2	0	-1
Model Error (percent)	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%

Table B.7. continued.

Stress Period 12	High Plains UWCD No. 1		Irion County WCD		Llano Estacado UWCD		Lone Wolf GCD		Mesa UWCD	
1990	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	34,343	7,473	0	42	4,614	0	0	164	4,323	0
Recharge	5	419	0	0	0	0	0	19,472	5	11
Stream Leakage	6	459	0	0	0	0	0	5,451	454	0
Vertical Leakage Upper	0	15,961	0	0	0	577	0	0	0	3,751
Vertical Leakage Lower	10,683	-	0	-	733	-	0	-	173	-
Lateral Flow	2,399	6,855	0	136	753	683	0	21,635	662	757
Total Inflow	*47,436*	*31,167*	*0*	*178*	*6,100*	*1,260*	*0*	*46,722*	*5,617*	*4,519*
Outflow										
Wells	0	6,899	0	0	0	0	0	1,791	0	2
Springs and ET	0	3,525	0	0	0	0	0	13,143	0	1,118
General-Head Boundary	30,095	1,725	0	168	4,307	0	0	0	1,191	0
Stream Leakage	6	232	0	0	0	0	0	32,213	0	0
Vertical Leakage Upper	0	10,683	0	0	0	733	0	0	0	173
Vertical Leakage Lower	15,961	-	0	-	577	-	0	-	3,751	-
Lateral Flow	1,432	15,097	0	15	1,221	894	0	65	622	3,041
Total Outflow	*47,494*	*38,161*	*0*	*183*	*6,105*	*1,627*	*0*	*47,212*	*5,564*	*4,334*
Inflow - Outflow	-58	-6,994	0	-5	-5	-367	0	-490	53	185
Storage Change	-57	-6993	0	-7	-5	-367	0	-495	53	188
Model Error	-1	-1	0	2	0	0	0	5	0	-3
Model Error (percent)	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%

Table B.7. continued.

Stress Period 12	Middle Pecos GCD		North Plains GCD		Panhandle GCD		Permian Basin UWCD		Sandy Land UWCD	
1990	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	0	2,588	0	9,751	0	1,763	4,195	2,900	1,738	0
Recharge	0	0	0	59	0	2,663	0	4,518	0	0
Stream Leakage	0	0	0	0	0	734	0	3,977	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	3,125	0	208
Vertical Leakage Lower	0	-	0	-	0	-	607	-	210	-
Lateral Flow	0	1,004	0	11,873	0	1,995	730	12,781	735	288
Total Inflow	*0*	*3,592*	*0*	*21,683*	*0*	*7,155*	*5,532*	*27,301*	*2,683*	*496*
Outflow										
Wells	0	636	0	8,474	0	780	0	56	0	0
Springs and ET	0	0	0	0	0	2,250	0	1,108	0	0
General-Head Boundary	0	1,769	0	9,303	0	533	2,377	26	1,855	0
Stream Leakage	0	0	0	0	0	3,011	0	8,717	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	607	0	210
Vertical Leakage Lower	0	-	0	-	0	-	3,125	-	208	-
Lateral Flow	0	1,181	0	5,028	0	994	24	16,906	621	298
Total Outflow	*0*	*3,586*	*0*	*22,805*	*0*	*7,568*	*5,526*	*27,420*	*2,684*	*508*
Inflow - Outflow	0	6	0	-1,122	0	-413	6	-119	-1	-12
Storage Change	0	5	0	-1122	0	-405	6	-116	0	-12
Model Error	0	1	0	0	0	-8	0	-3	-1	0
Model Error (percent)	0%	0%	0%	0%	0%	0.11%	0%	0%	0.04%	0%

Table B.7. continued.

Stress Period 12	Santa Rita UWCD		South Plains UWCD		Sterling County UWCD		Wes-Tex GCD	
1990	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow								
General-Head Boundary	0	430	1,707	0	0	1,835	0	0
Recharge	0	0	0	0	0	439	0	7,135
Stream Leakage	0	0	0	0	0	73	0	172
Vertical Leakage Upper	0	0	0	235	0	0	0	0
Vertical Leakage Lower	0	-	199	-	0	-	0	-
Lateral Flow	0	1,262	494	221	0	4,509	0	75
Total Inflow	*0*	*1,692*	*2,400*	*456*	*0*	*6,856*	*0*	*7,382*
Outflow								
Wells	0	832	0	1	0	14	0	796
Springs and ET	0	0	0	0	0	0	0	682
General-Head Boundary	0	48	1,495	0	0	352	0	0
Stream Leakage	0	0	0	0	0	224	0	1,558
Vertical Leakage Upper	0	0	0	199	0	0	0	0
Vertical Leakage Lower	0	-	235	-	0	-	0	-
Lateral Flow	0	1,145	669	300	0	6,286	0	4,578
Total Outflow	*0*	*2,025*	*2,399*	*500*	*0*	*6,876*	*0*	*7,614*
Inflow - Outflow	0	-333	1	-44	0	-20	0	-232
Storage Change	0	-333	-1	-43	0	-19	0	-231
Model Error	0	0	2	-1	0	-1	0	-1
Model Error (percent)	0%	0%	0.08%	0.20%	0%	0.01%	0%	0%

Table B.8. Water budgets by groundwater conservation district for the upper and lower portions of the Dockum Aquifer for 1997 in the modified groundwater model. All values are in acre-feet per year.

Stress Period 19	Clear Fork GCD		Coke County UWCD		Crockett County GCD		Garza County UWCD		Glasscock GCD	
1997	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Inflow										
General-Head Boundary	0	0	0	33	0	197	313	1,872	0	3,422
Recharge	0	2,095	0	105	0	0	0	6,552	0	0
Stream Leakage	0	70	0	0	0	0	0	4,645	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	350	0	0
Vertical Leakage Lower	0	-	0	-	0	-	0	-	0	-
Lateral Flow	0	2,284	0	49	0	112	46	14,025	0	6,097
Total Inflow	*0*	*4,449*	*0*	*187*	*0*	*309*	*359*	*27,444*	*0*	*9,519*
Outflow										
Wells	0	12	0	0	0	3	0	96	0	1,027
Springs and ET	0	395	0	0	0	0	0	7,438	0	0
General-Head Boundary	0	0	0	2	0	331	0	0	0	4
Stream Leakage	0	3,753	0	0	0	0	0	19,208	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	0	0	0
Vertical Leakage Lower	0	-	0	-	0	-	350	-	0	-
Lateral Flow	0	319	0	186	0	16	6	736	0	8,851
Total Outflow	*0*	*4,479*	*0*	*188*	*0*	*350*	*356*	*27,478*	*0*	*9,882*
Inflow - Outflow	0	-30	0	-1	0	-41	3	-34	0	-363
Storage Change	0	-30	0	0	0	-40	4	-31	0	-364
Model Error	0	0	0	-1	0	-1	-1	-3	0	1
Model Error (percent)	0%	0%	0%	1%	0%	0%	0.28%	0%	0%	0%

Table B.8. continued.

Stress Period 19	High Plains UWCD No. 1		Irion County WCD		Llano Estacado UWCD		Lone Wolf GCD		Mesa UWCD	
1997	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	34,005	7,614	0	43	4,601	0	0	164	4,377	0
Recharge	5	419	0	0	0	0	0	19,472	5	11
Stream Leakage	9	459	0	0	0	0	0	5,446	452	0
Vertical Leakage Upper	0	15,634	0	0	0	491	0	0	0	3,769
Vertical Leakage Lower	11,209	-	0	-	879	-	0	-	214	-
Lateral Flow	2,498	7,152	0	128	808	711	0	21,648	687	755
Total Inflow	*47,726*	*31,278*	*0*	*171*	*6,288*	*1,202*	*0*	*46,730*	*5,735*	*4,535*
Outflow										
Wells	0	7,934	0	0	0	0	0	1,235	0	2
Springs and ET	0	3,459	0	0	0	0	0	13,139	0	1,121
General-Head Boundary	30,768	1,677	0	165	4,593	0	0	0	1,254	0
Stream Leakage	9	231	0	0	0	0	0	32,247	0	0
Vertical Leakage Upper	0	11,209	0	0	0	879	0	0	0	214
Vertical Leakage Lower	15,634	-	0	-	491	-	0	-	3,769	-
Lateral Flow	1,435	14,717	0	14	1,211	887	0	65	636	3,071
Total Outflow	*47,846*	*39,227*	*0*	*179*	*6,295*	*1,766*	*0*	*46,686*	*5,659*	*4,408*
Inflow - Outflow	-120	-7,949	0	-8	-7	-564	0	44	76	127
Storage Change	-119	-7949	0	-8	-7	-564	0	41	76	128
Model Error	-1	0	0	0	0	0	0	3	0	-1
Model Error (percent)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Table B.8. continued.

Stress Period 19	Middle Pecos GCD		North Plains GCD		Panhandle GCD		Permian Basin UWCD		Sandy Land UWCD	
1997	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow										
General-Head Boundary	0	2,656	0	9,963	0	1,764	4,192	2,900	1,840	0
Recharge	0	0	0	59	0	2,663	0	4,518	0	0
Stream Leakage	0	0	0	0	0	737	0	3,977	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	3,120	0	188
Vertical Leakage Lower	0	-	0	-	0	-	612	-	260	-
Lateral Flow	0	1,009	0	12,228	0	1,941	741	12,788	783	290
Total Inflow	*0*	*3,665*	*0*	*22,250*	*0*	*7,105*	*5,545*	*27,303*	*2,883*	*478*
Outflow										
Wells	0	777	0	9,165	0	811	0	60	0	0
Springs and ET	0	0	0	0	0	2,246	0	1,107	0	0
General-Head Boundary	0	1,708	0	9,110	0	472	2,389	26	2,081	0
Stream Leakage	0	0	0	0	0	3,010	0	8,716	0	0
Vertical Leakage Upper	0	0	0	0	0	0	0	612	0	260
Vertical Leakage Lower	0	-	0	-	0	-	3,120	-	188	-
Lateral Flow	0	1,184	0	4,931	0	1,002	25	16,904	616	306
Total Outflow	*0*	*3,669*	*0*	*23,206*	*0*	*7,541*	*5,534*	*27,425*	*2,885*	*566*
Inflow - Outflow	0	-4	0	-956	0	-436	11	-122	-2	-88
Storage Change	0	-4	0	-956	0	-427	11	-120	-3	-88
Model Error	0	0	0	0	0	-9	0	-2	1	0
Model Error (percent)	0%	0%	0%	0%	0%	0.12%	0%	0%	0.03%	0%

Table B.8. continued.

Stress Period 19	Santa Rita UWCD		South Plains UWCD		Sterling County UWCD		Wes-Tex GCD	
1997	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
Inflow								
General-Head Boundary	0	496	1,802	0	0	1,838	0	0
Recharge	0	0	0	0	0	439	0	7,135
Stream Leakage	0	0	0	0	0	73	0	174
Vertical Leakage Upper	0	0	0	199	0	0	0	0
Vertical Leakage Lower	0	-	273	-	0	-	0	-
Lateral Flow	0	1,569	490	219	0	4,497	0	74
Total Inflow	*0*	*2,065*	*2,565*	*418*	*0*	*6,847*	*0*	*7,383*
Outflow								
Wells	0	1,037	0	0	0	11	0	721
Springs and ET	0	0	0	0	0	0	0	667
General-Head Boundary	0	37	1,642	0	0	352	0	0
Stream Leakage	0	0	0	0	0	224	0	1,540
Vertical Leakage Upper	0	0	0	273	0	0	0	0
Vertical Leakage Lower	0	-	199	-	0	-	0	-
Lateral Flow	0	1,351	727	306	0	6,286	0	4,582
Total Outflow	*0*	*2,425*	*2,568*	*579*	*0*	*6,873*	*0*	*7,510*
Inflow - Outflow	0	-360	-3	-161	0	-26	0	-127
Storage Change	0	-361	-3	-161	0	-25	0	-127
Model Error	0	1	0	0	0	-1	0	0
Model Error (percent)	0%	0.04%	0%	0%	0%	0.01%	0%	0%

Table B.9. Overall water budgets for the upper and lower portions of the Dockum Aquifer for the steady-state, 1980, 1990, and 1997 portions of the modified groundwater model. All values are in acre-feet per year.

Model-Wide by Layer	Steady-State		1980		1990		1997	
	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Inflow								
General-Head Boundary	102,950	78,496	102,879	82,014	102,284	82,958	102,322	83,328
Recharge	74	87,097	74	87,097	74	87,097	74	87,097
Stream Leakage	499	34,197	499	34,309	500	34,406	501	34,436
Vertical Leakage Upper	0	50,469	0	50,900	0	51,633	0	52,099
Vertical Leakage Lower	18,788	-	19,085	-	20,623	-	21,332	-
Lateral Flow	0	0	0	0	0	0	0	0
Total Inflow	*122,311*	*250,259*	*122,537*	*254,320*	*123,481*	*256,094*	*124,229*	*256,960*
Outflow								
Wells	0	10,963	0	50,521	0	36,805	0	40,668
Springs and ET	0	67,605	0	67,121	0	66,900	0	66,697
General-Head Boundary	71,875	35,489	72,022	32,968	72,772	32,736	73,601	32,106
Stream Leakage	2	117,381	2	117,148	6	116,431	9	116,310
Vertical Leakage Upper	0	18,788	0	19,085	0	20,623	0	21,332
Vertical Leakage Lower	50,469	-	50,900	-	51,633	-	52,099	-
Lateral Flow	0	0	0	0	0	0	0	0
Total Outflow	*122,346*	*250,226*	*122,924*	*286,843*	*124,411*	*273,495*	*125,709*	*277,113*
Inflow - Outflow	-35	33	-387	-32,523	-930	-17,401	-1,480	-20,153
Storage Change	-	-	-360	-32527	-908	-17337	-1464	-20084
Model Error	-35	33	-27	4	-22	-64	-16	-69
Model Error (percent)	0.03%	0%	0.02%	0%	0.02%	0%	0.01%	0%