# SIMULATED CHANGES IN GROUND-WATER LEVELS RELATED TO PROPOSED DEVELOPMENT OF FEDERAL COAL LEASES, SAN JUAN BASIN, NEW MEXICO

by Peter F. Frenzel

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WILLIAM P. CLARK, Secretary

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Dallas L. Peck, Director

For additional information
Write to:

District Chief
U.S. Geological Survey
Water Resources Division
505 Marquette NW, Room 720
Albuquerque, New Mexico 87102

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[In back pocket]



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## CONVERSION FACTORS

Measurements in this report are given in inch-pound units only. The following table contains factors for converting these units to metric units.

| Multiply inch-pound unit | By | To obtain metric unit |
|---|---|---|
| foot | 0.3048 | meter |
| foot per second | 0.3048 | meter per second |
| foot squared per day | 0.09290 | meter squared per day |
| cubic foot per second | 0.02832 | cubic meter second |
| acre | 4047 | square meter |
| mile | 1.609 | kilometer |

National Geodetic Vertical Datum of 1929 (NGVD of 1929): A geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called mean sea level. NGVD of 1929 is referred to as sea level in this report.

# SIMULATED CHANGES IN GROUND-WATER LEVELS RELATED TO PROPOSED DEVELOPMENT OF FEDERAL COAL LEASES, SAN JUAN BASIN, NEW MEXICO

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## ABSTRACT

The effects of coal-related ground-water withdrawals on potentiometric surfaces of aquifers in the San Juan Basin, New Mexico, were estimated. A previously published steady-state finite-difference digital model was converted to a transient-state model by changing boundary conditions and adding storage coefficients. No calibration of the transient-state model was attempted. A critical assumption is that the transient behavior of a complex aquifer system can be simulated adequately without a transient calibration. Predicted drawdowns with a minimum amount of coal development combined with other kinds of development were as great as 2,000 feet. As much as 300 feet of additional drawdown were simulated for the maximum amount of coal development. Drawdowns near pumping wells are not predicted. Varying storage and horizontal hydraulic conductivity values within reasonable ranges generally changed the predicted drawdowns by a factor ranging from 0.5 to 2. All results are preliminary.

## INTRODUCTION

The San Juan Basin of New Mexico (fig. 1) is rich in coal resources. The U.S. Bureau of Land Management is preparing environmental impact analyses for the development of federally owned coal in the San Juan Basin. The Bureau of Land Management requested the U.S. Geological Survey to assist by estimating the effects of specified withdrawals on the potentiometric surfaces of the major artesian aquifers that underlie the coal-producing areas.

A transient model analysis was used to simulate changes in the potentiometric surfaces of the major aquifers resulting from the proposed ground-water development. The transient model was based on a calibrated steady-state model (Frenzel and Lyford, 1982) with the following changes: assumed storage coefficients were added and the model boundaries were changed from constant-head to constant-flux in certain areas.

Transient calibration was not done because it would have required time-dependent data to be collected and analyzed, which was beyond the scope of

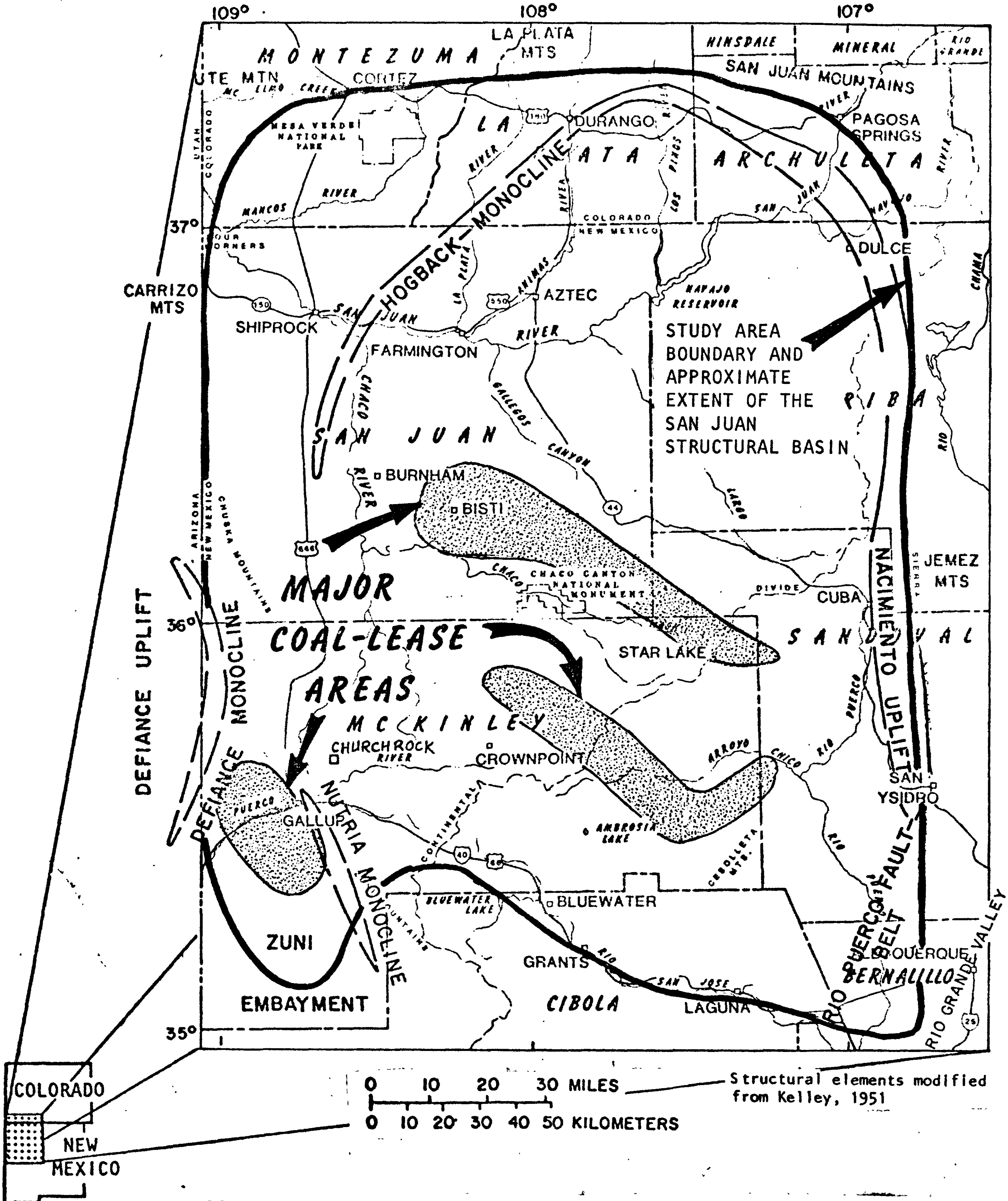



Figure 1.--Location of the study area and major coal-lease areas.

this project. Thus, a critical assumption was that the transient behavior of a complex aquifer system can be adequately simulated by simply adding storage values and modifying the boundary conditions of a steady-state model.

## Acknowledgments

The assistance of Messrs. Steven Todd and Walter Beyeler, U.S. Geological Survey, with creating and checking model input and with creating figures from model output was necessary and much appreciated.

# HYDROGEOLOGIC SETTING

Hydrogeology is discussed here only insofar as it directly applies to this model application. Any further discussion would be beyond the scope of this project. Lyford (1979) gives a good brief overview of the hydrogeology of the San Juan Basin. A much more detailed description is given by Stone and others (1983). Both studies contain references to many other works.

A generalized geologic section of the basin is shown in figure 2. The younger rocks generally crop out in the center of the basin and overlie successively older rocks, which in turn crop out in roughly concentric rings. Thus, the oldest rocks crop out near the periphery. The major aquifers are sandstone, which are separated primarily by shales and siltstones. Except in outcrop areas, the water is under artesian pressure. In the Chuska Mountains on the west side of the basin, most of the Jurassic and Cretaceous aquifers (except for the upper part of the Mesaverde Group) underlie the Chuska Sandstone, a relatively permeable unit of Tertiary age; the flat-lying Chuska Sandstone is deposited on more steeply dipping older beds.

The general direction of ground-water flow in the Jurassic and Cretaceous rocks is along arcuate paths from the highlands along the periphery of the basin toward streams that exit the basin in the northwest, southwest, and southeast. Most of the flow probably follows the bedding, but some leakage occurs from one aquifer to another, generally downward in recharge areas and upward in discharge areas.

The perennial streams in the area are the San Juan River and its southward flowing tributaries in the north and the Rio Chama (tributary of the Rio Grande) in the east. The Rio Puerco (tributary of the Rio Grande) and the Rio San Jose (tributary of the Rio Puerco) in the southeast generally are intermittent but locally have perennial flow in the study area. Numerous springs near the Chuska Mountains sustain perennial surface flows in a limited area along the west side of the basin. In the southwest, the Puerco River (a

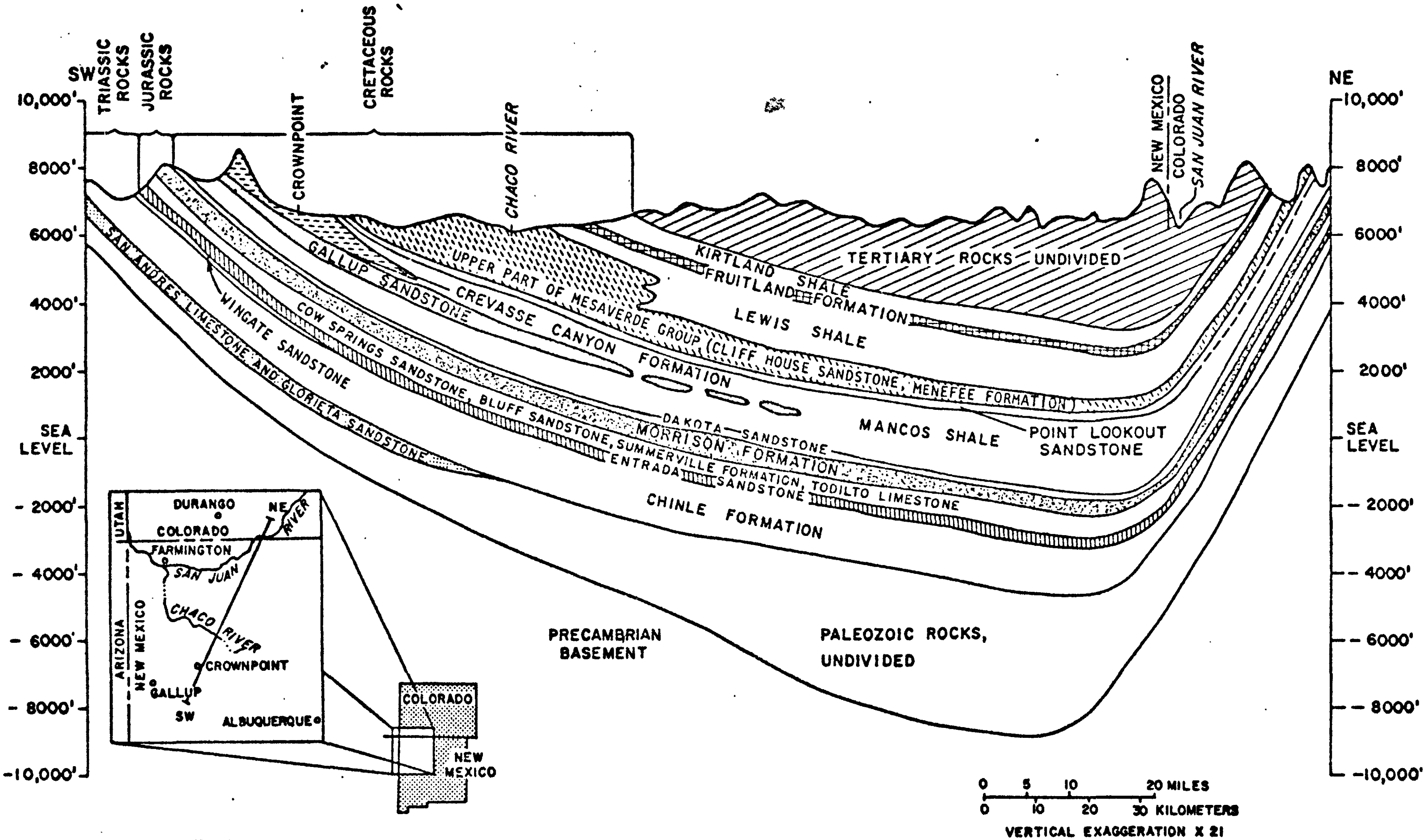



Figure 2.--Generalized geologic section of the San Juan Basin.

tributary of the Little Colorado River, not to be confused with the Rio Puerco) has had perennial flow since uranium-mine dewatering began northeast of Gallup in the 1960's. Most of the land south of the San Juan River is drained by ephemeral streams.

## DESCRIPTION OF THE HYDROLOGIC MODEL

### Steady-state model

A brief description of the steady-state model of Frenzel and Lyford (1982) is given below. Except for the addition of storage and the necessary changes in boundary conditions, the same model was used in this study for transient conditions.

The digital model program computes hydraulic head in time and space in an aquifer system. The model program utilizes a finite-difference method in which differential equations of ground-water flow are solved numerically. The equations require that hydraulic properties, boundaries, and stresses be defined for the area modeled. The digital-model program for three-dimensional flow used in this study is described by Posson and others (1980).

A 22,000 square mile area of northwestern New Mexico and southwestern Colorado was subdivided into a square finite-difference grid within which the model area was defined. Each block of the grid was 6 miles on a side. In the vertical direction were seven layers, ranging in thickness from 300 to 1,500 feet. The node at the center point of each three-dimensional block is designated by its layer, row, and column numbers in the following discussion.

Within the gridded area, model boundaries were selected to coincide with geologic outcrops (where each model layer represents certain geologic layers). Two types of boundaries were used: constant flux and constant head (Posson and others, 1980). A constant flux may be positive, negative, or zero (no-flow). In the steady-state model, only constant-head and no-flow boundaries were used.

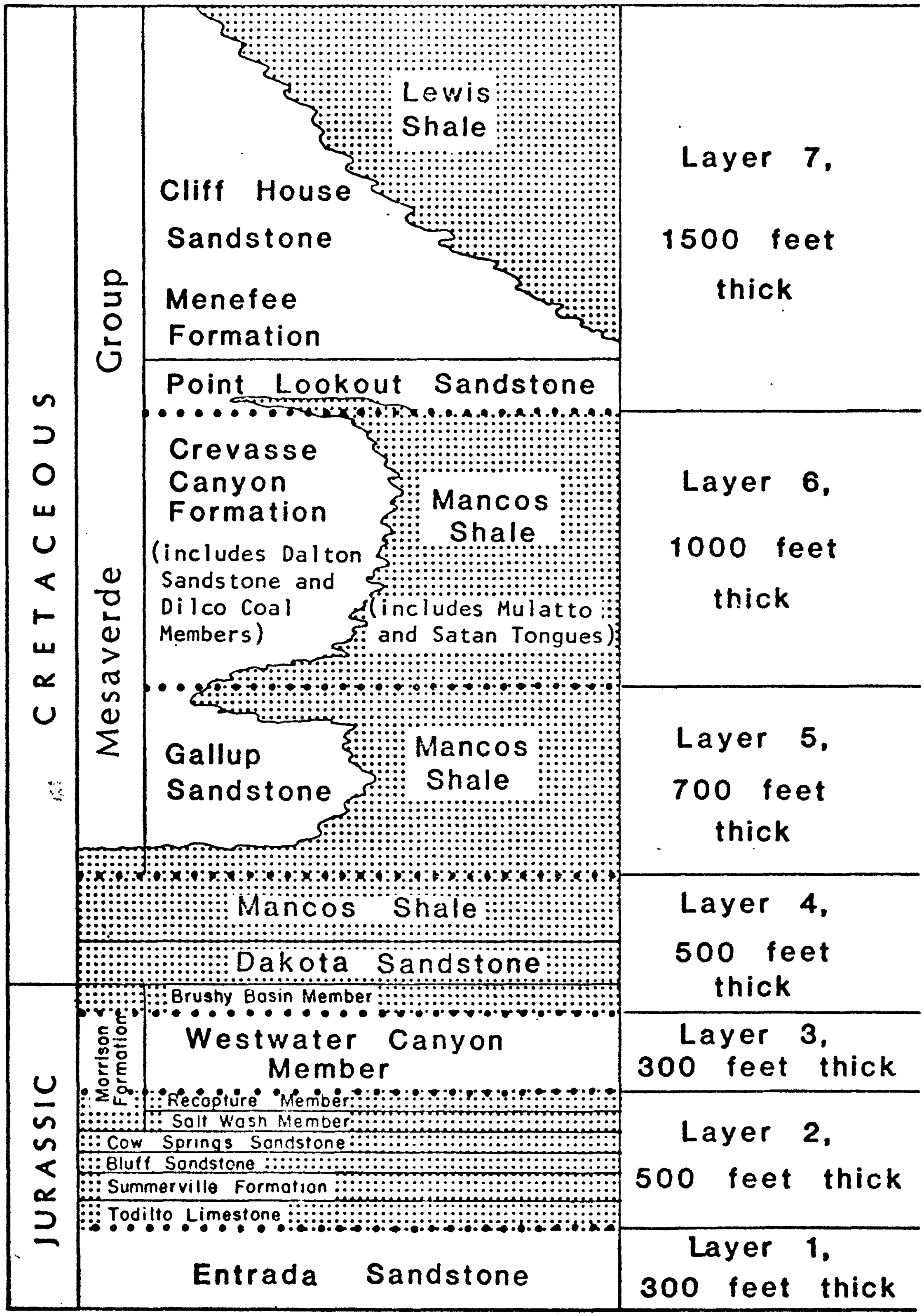
A no-flow boundary was assigned to all nodes in a given layer that lie outside the outcrop of the geologic units represented by that layer. Also, flow was not allowed to cross the lower side of the lowermost layer nor the upper side of the uppermost layer.

Within the no-flow boundaries, the steady-state model approximated flow into and out of the system by constant-head nodes along the outcrops. The values of the constant heads were assigned such that they roughly defined the water table near the land surface. Thus, ground-water recharge was simulated where the land surface was high and discharge was simulated where it was low.

The layers of the steady-state model (fig. 3) generally followed the geologic layering (fig. 2). Layer 1 represented the Entrada Sandstone of Jurassic age. It is potentially a major aquifer, although it is largely unexplored. Layer 2 represented the Todilto Limestone, Summerville Formation, Bluff Sandstone, Cow Springs Sandstone, and the lower part of the Morrison Formation, all of Jurassic age. These units are simulated in the model as a confining layer. Layer 3 represented the Westwater Canyon Member of the Morrison Formation of Jurassic age, a major aquifer. Layer 4 represented the upper part of the Morrison Formation of Jurassic age, and the Dakota Sandstone and lower part of the Mancos Shale, both of Cretaceous age. These units are simulated in the model as a confining layer. Rocks represented by layers 5-7 are all of Cretaceous age. Layer 5 represented the Gallup Sandstone (of the Mesaverde Group), which is a major aquifer in the southwestern part of the basin, and the middle part of the Mancos Shale, which is a confining bed. Layer 6 represented the sandstone aquifers in the middle part of the Mesaverde Group to the south, but elsewhere layer 6 represented the upper part of the Mancos Shale, a confining bed. Layer 7 represented most of the sandstones in the upper part of the Mesaverde Group and part of the Lewis Shale. The sandstones in the middle and upper parts of the Mesaverde Group (excluding the Gallup Sandstone) are important aquifers locally, but most are not continuous over the entire region. The main role of layer 7 was to serve as the upper boundary of the steady-state model.

Of course, no model exactly represents the hydrologic system. Major limitations of this steady-state model stem from the effects of scale, the existence of nearly impermeable beds and dipping beds, unknown density effects, and the sparcity of hydrologic data. The limitations from scale effects are discussed below in the section on appraisal of results. The existence of nearly impermeable beds could, in conjunction with highly ionized water, produce osmotic potentials of unknown magnitude; osmotic potentials are not considered. All beds are treated as if they were flat-lying, giving rise to errors in the vicinity of monoclines that generally bound the basin on the west, north, and east. The potential effects of dense fluids in the deepest part of the basin are not considered. And, the sparcity of calibration data could allow errors to exist undetected in the steady-state model. Additional discussion of limitations and sources of error may be found in Frenzel and Lyford (1982).

The hydraulic characteristics assigned to each node of the steady-state model are shown, layer by layer, in figures 4-10. Also shown are the model-derived flow rates at the constant-head nodes.




NOTE: Shaded areas are defined as confining beds in the model.

Figure 3.--Relation between geologic units and model layers.

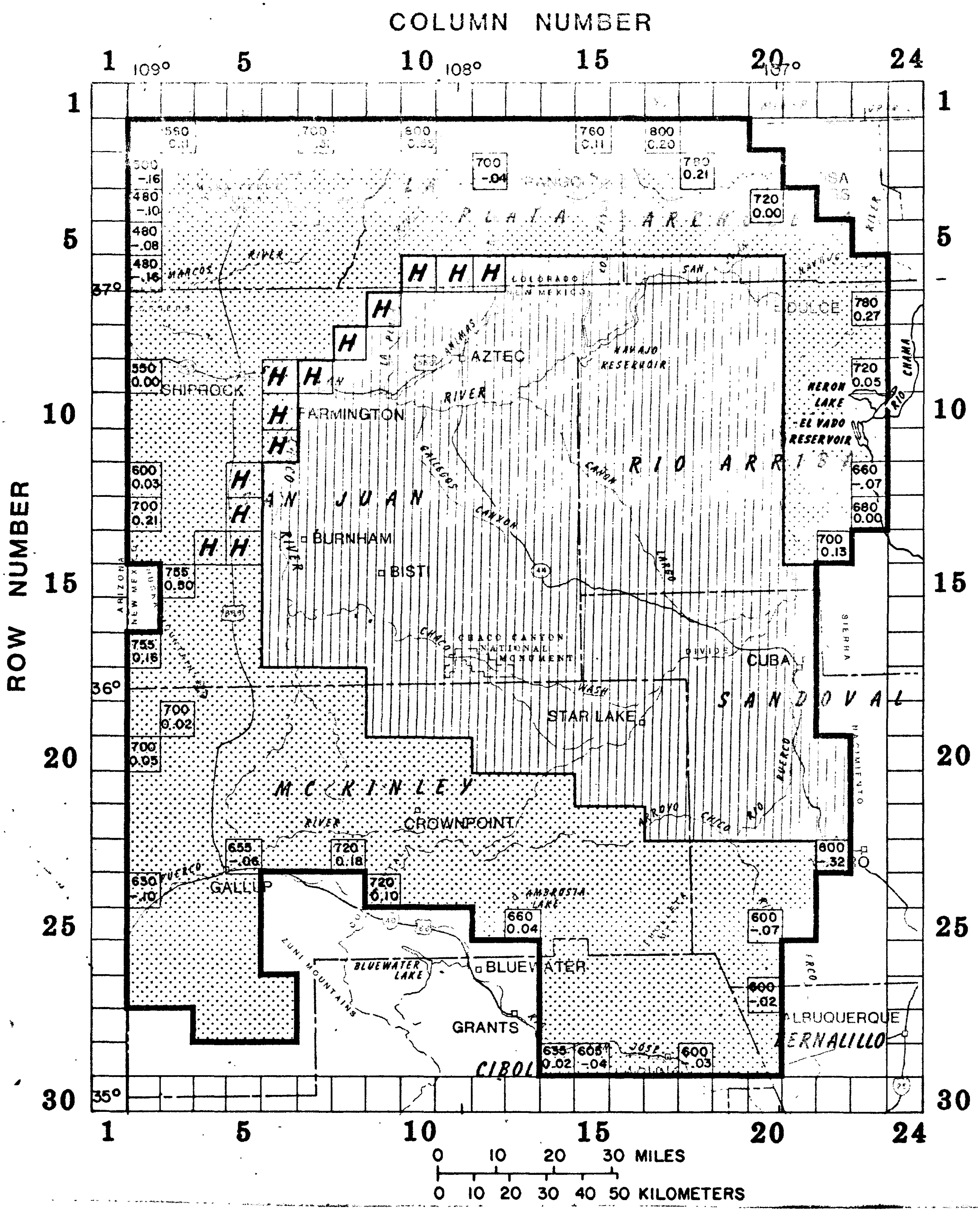



Figure 4.--Hydraulic characteristics of the steady-state model and model-derived flow rates at constant-head nodes for layer 1 (Entrada Sandstone).

## EXPLANATION FOR FIGURE 4

**LAYER THICKNESS IS 300 FEET**

NO-FLOW BOUNDARY--Extent of layer

H — NODE WITH Kz = $5 \times 10^{-9}$, NEAR HOGBACK MONOCLINE

780 / 0.27 — CONSTANT-HEAD NODE--Top number is altitude, in feet, divided by 10; bottom number is flow rate, in cubic feet per second, positive value indicates inflow; negative, outflow

**HYDROLOGIC CHARACTERISTICS**

(dotted pattern) T = 20, Kxy = $7.7 \times 10^{-7}$, Kz = $1.5 \times 10^{-10}$

(vertical-line pattern) T = 150, Kxy = $5.8 \times 10^{-6}$, Kz = $1.2 \times 10^{-9}$

where: T = Transmissivity, in feet squared per day

Kxy = Horizontal hydraulic conductivity, in feet per second

Kz = Vertical hydraulic conductivity, in feet per second

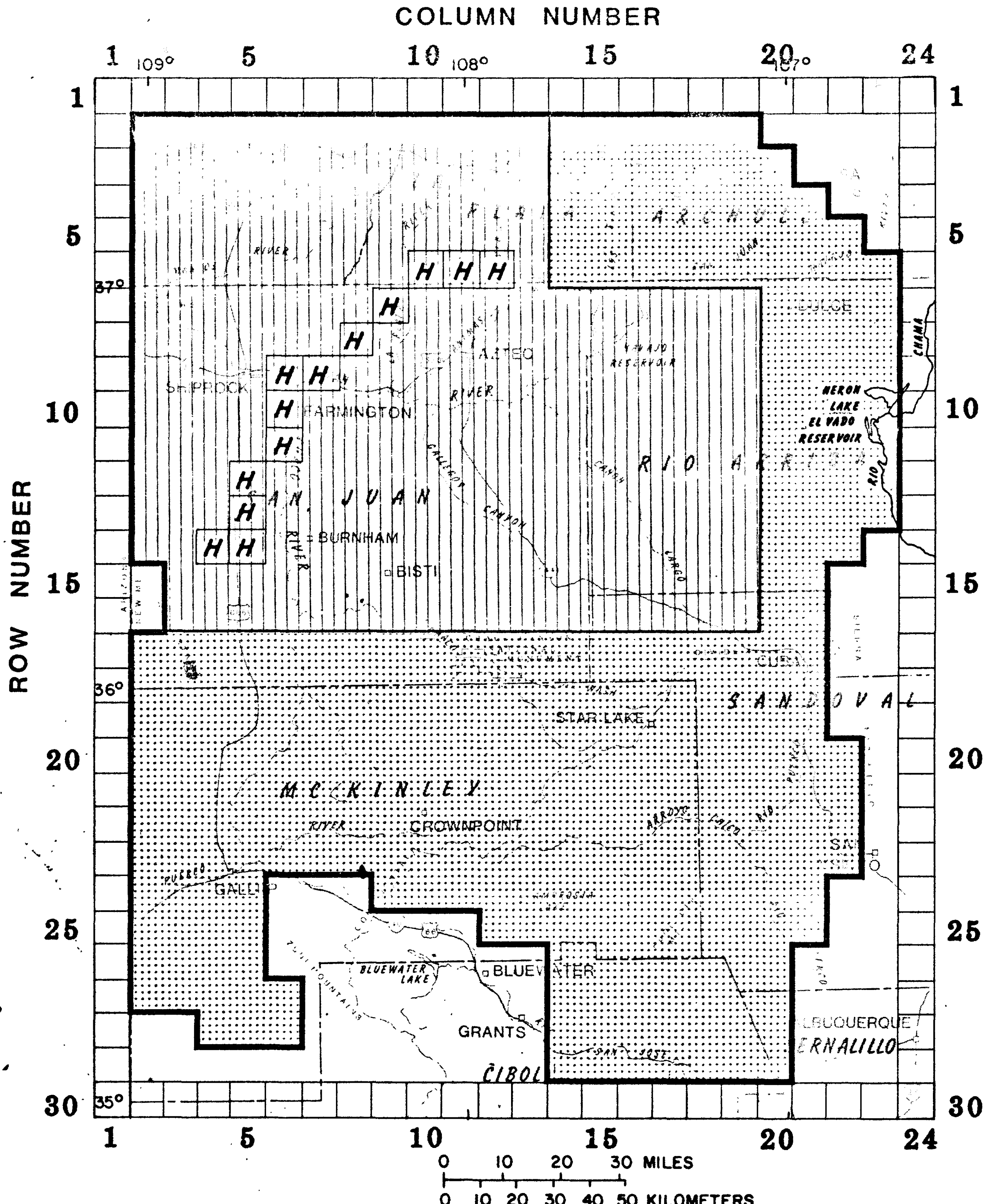



Figure 5.--Hydraulic characteristics of the steady-state model for layer 2 (confining beds).

## EXPLANATION FOR FIGURE 5

LAYER THICKNESS IS 500 FEET

NO-FLOW BOUNDARY--Extent of layer

H NODE WITH Kz = $5 \times 10^{-9}$, NEAR HOGBACK MONOCLINE

HYDROLOGIC CHARACTERISTICS

T = 0.43, Kxy = $1 \times 10^{-8}$, Kz = $1 \times 10^{-12}$

T = 4.3, Kxy = $1 \times 10^{-7}$, Kz = $1 \times 10^{-11}$

where: T = Transmissivity, in feet squared per day

Kxy = Horizontal hydraulic conductivity, in feet per second

Kz = Vertical hydraulic conductivity, in feet per second

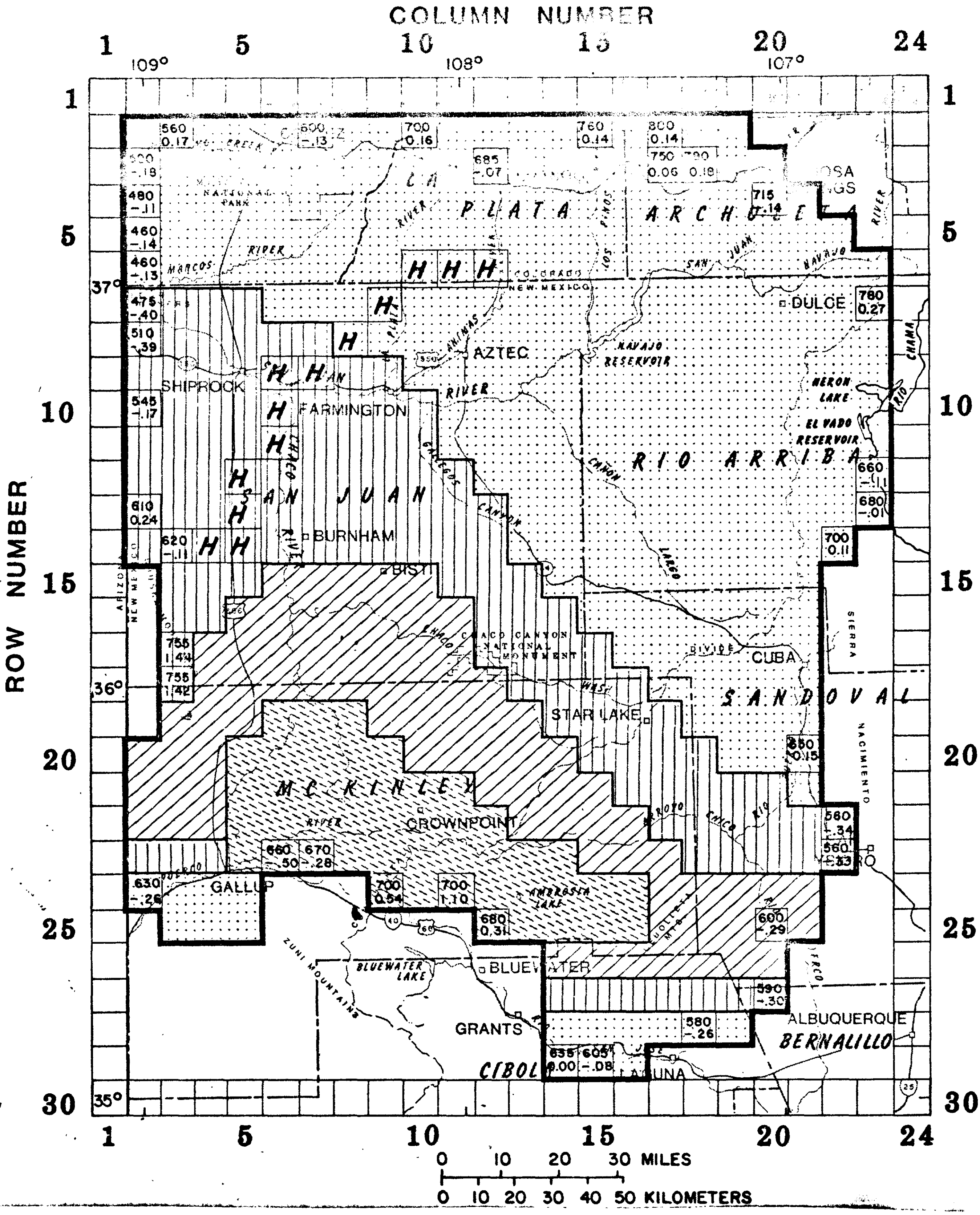



Figure 6.--Hydraulic characteristics of the steady-state model and model-derived flow rates at constant-head nodes for layer 3 (Westwater Canyon Member of the Morrison Formation).

## EXPLANATION FOR FIGURE 6

**LAYER THICKNESS IS 300 FEET**

NO-FLOW BOUNDARY--Extent of layer

H — NODE WITH Kz = $5 \times 10^{-9}$, NEAR HOGBACK MONOCLINE

630 / −.20 — CONSTANT-HEAD NODE--Top number is altitude, in feet, divided by 10; bottom number is flow rate, in cubic feet per second, positive value indicates inflow; negative, outflow

**HYDROLOGIC CHARACTERISTICS**

T = 25, Kxy = $9.6 \times 10^{-7}$, Kz = $9.6 \times 10^{-11}$

T = 100, Kxy = $3.9 \times 10^{-6}$, Kz = $3.9 \times 10^{-10}$

T = 200, Kxy = $7.7 \times 10^{-6}$, Kz = $7.7 \times 10^{-10}$

T = 250, Kxy = $9.6 \times 10^{-6}$, Kz = $9.6 \times 10^{-10}$

where: T = Transmissivity, in feet squared per day

Kxy = Horizontal hydraulic conductivity, in feet per second

Kz = Vertical hydraulic conductivity, in feet per second

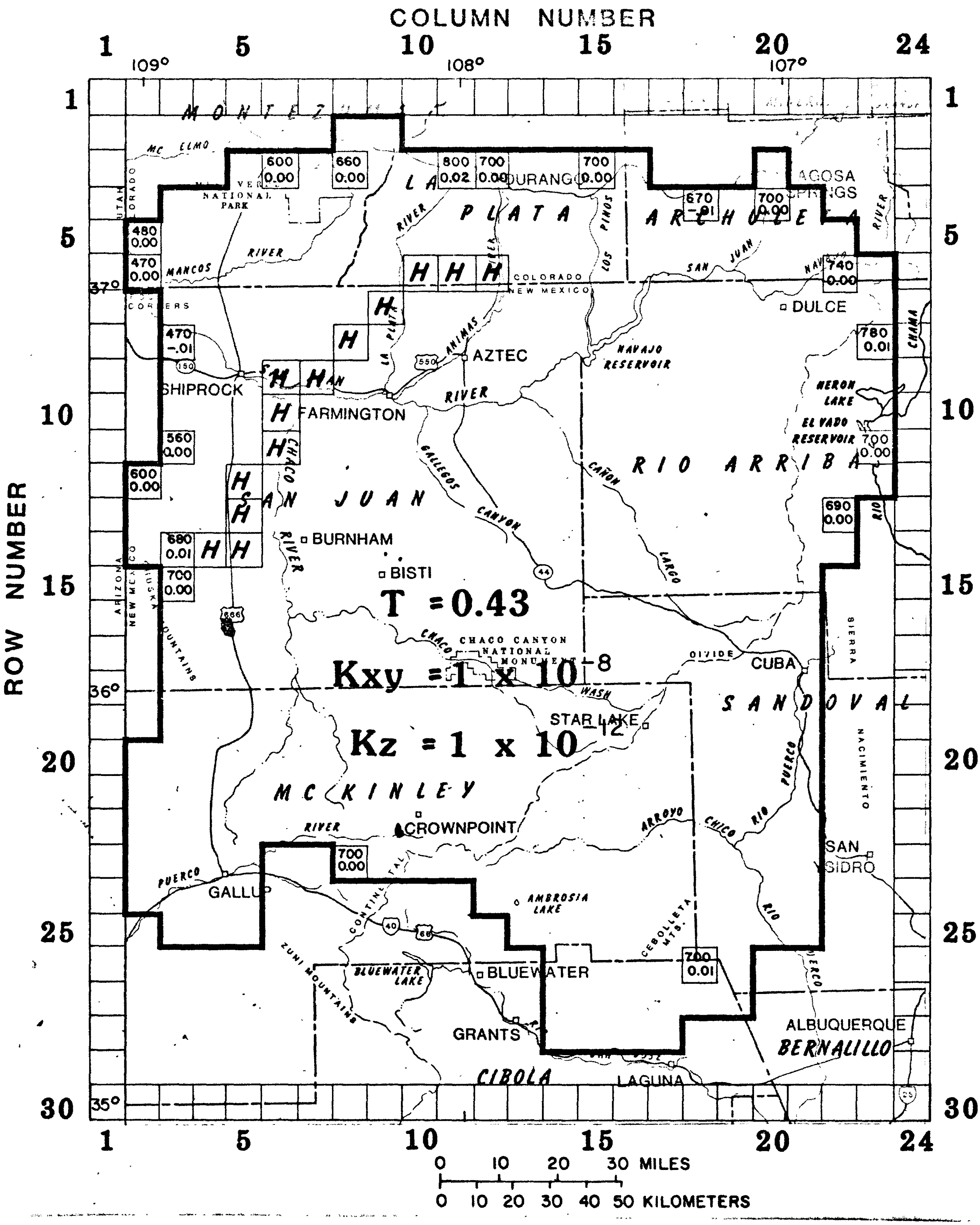



Figure 7.--Hydraulic characteristics of the steady-state model and model-derived flow rates at constant-head nodes for layer 4 (confining beds).

## EXPLANATION FOR FIGURE 7

LAYER THICKNESS IS 500 FEET

NO-FLOW BOUNDARY--Extent of layer

H — NODE WITH Kz = $5 \times 10^{-9}$, NEAR HOGBACK MONOCLINE

780 / 0.01 — CONSTANT-HEAD NODE--Top number is altitude, in feet, divided by 10; bottom number is flow rate, in cubic feet per second, positive value indicates inflow; negative, outflow

HYDROLOGIC CHARACTERISTICS

T = Transmissivity, in feet squared per day

Kxy = Horizontal hydraulic conductivity, in feet per second

Kz = Vertical hydraulic conductivity, in feet per second

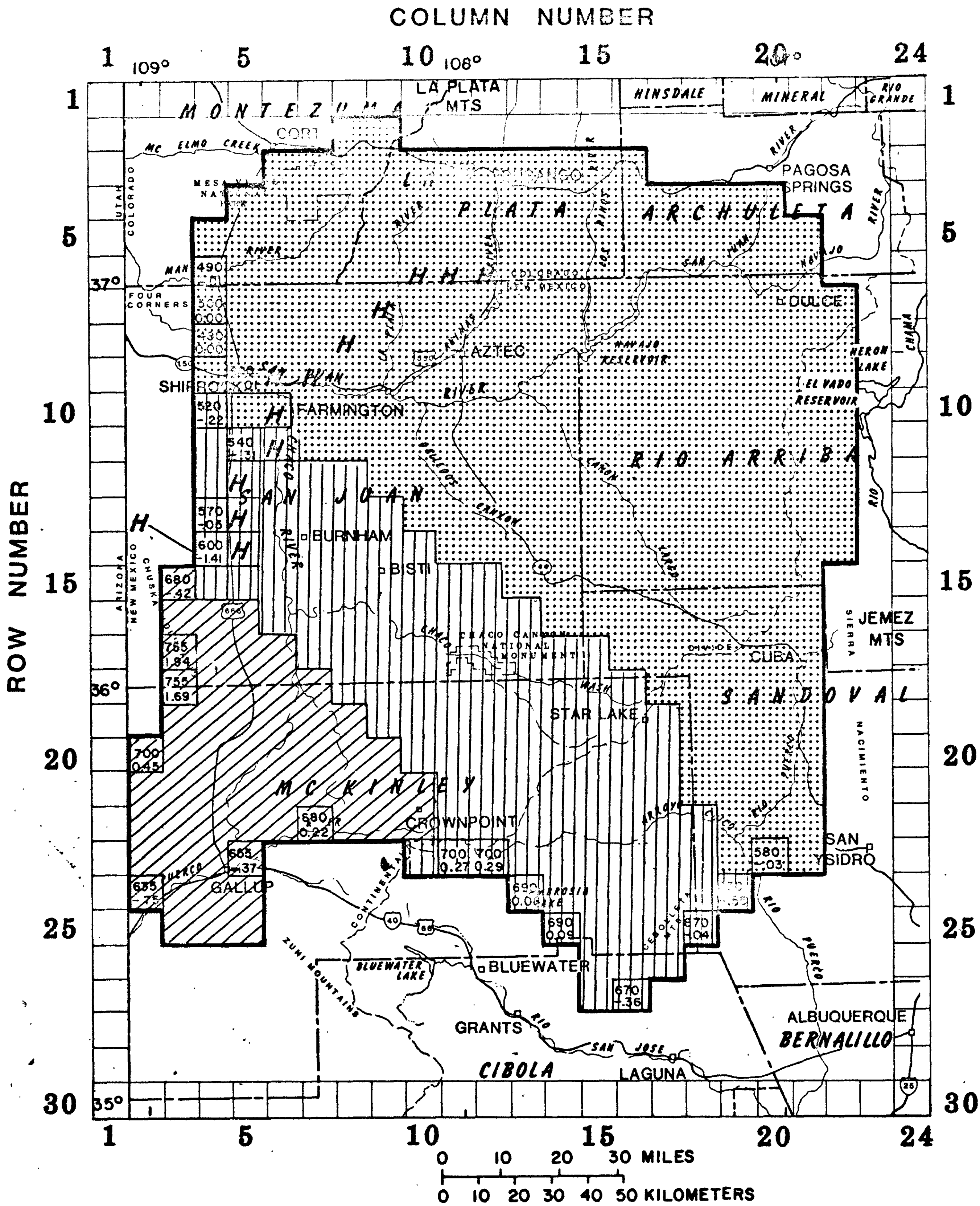



Figure 8.--Hydraulic characteristics of the steady-state model and model-derived flow rates at constant-head nodes for layer 5 (Gallup Sandstone and Mancos Shale).

# EXPLANATION FOR FIGURE 8

LAYER THICKNESS IS 700 FEET

NO-FLOW BOUNDARY--Extent of layer

H — NODE WITH $Kz = 5 \times 10^{-9}$, NEAR HOGBACK MONOCLINE

490 / -.01 — CONSTANT-HEAD NODE--Top number is altitude, in feet, divided by 10; bottom number is flow rate, in cubic feet per second, positive value indicates inflow; negative, outflow

HYDROLOGIC CHARACTERISTICS

$T = 0.26$, $Kxy = 1 \times 10^{-8}$, $Kx = 1 \times 10^{-12}$

$T = 100$, $Kxy = 1.6 \times 10^{-6}$, $Kz = 1.6 \times 10^{-10}$

$T = 200$, $Kxy = 3.3 \times 10^{-6}$, $Kz = 3.3 \times 10^{-10}$

where: T = Transmissivity, in feet squared per day

Kxy = Horizontal hydraulic conductivity, in feet per second

Kz = Vertical hydraulic conductivity, in feet per second

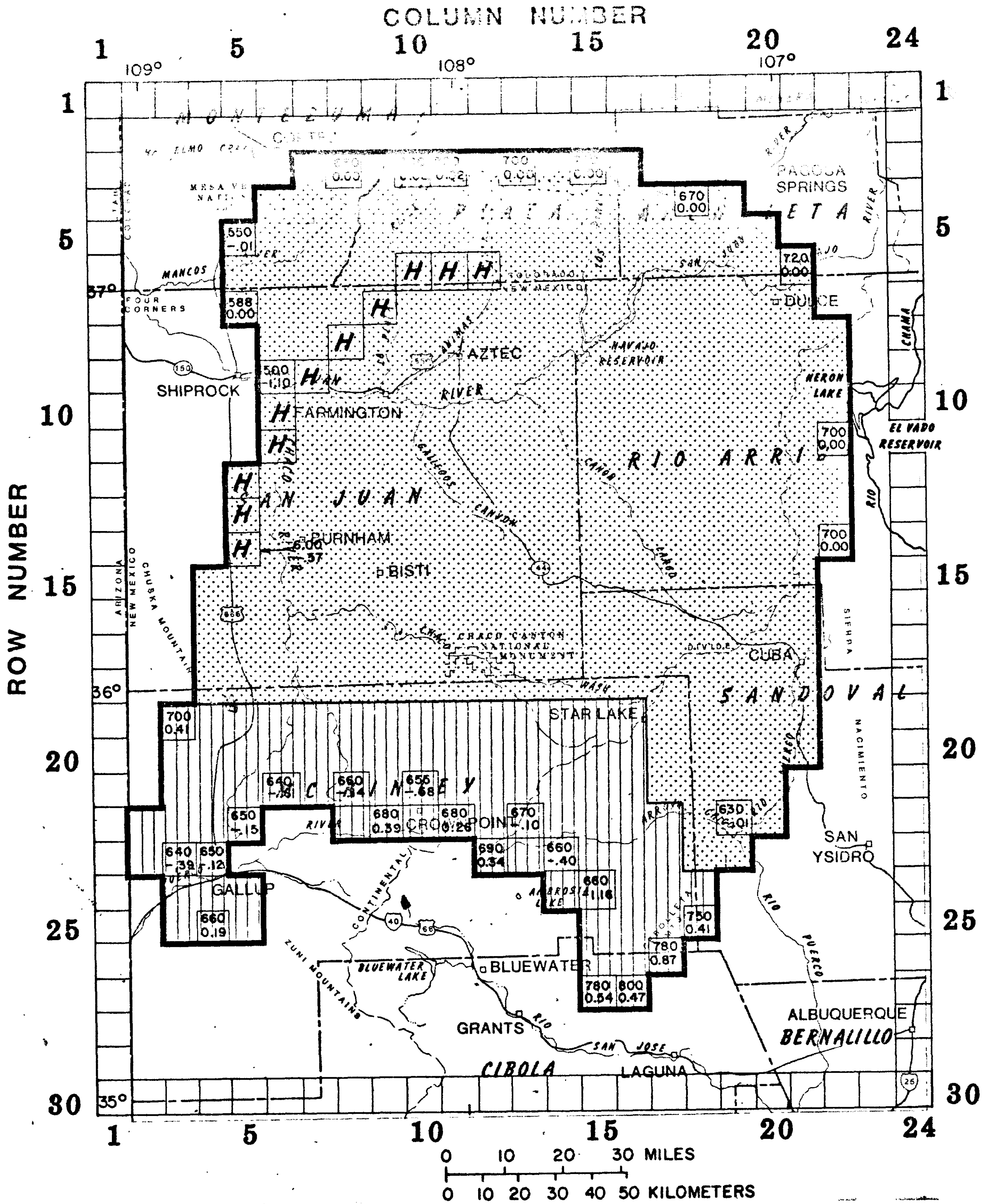


Figure 9.--Hydraulic characteristics of the steady-state model and model-derived flow rates at constant-head nodes for layer 6 (aquifers and confining beds in the middle part of the Mesaverde Group).

## EXPLANATION FOR FIGURE 9

LAYER THICKNESS IS 1000 FEET

NO-FLOW BOUNDARY--Extent of layer

H — NODE WITH Kz = $5 \times 10^{-9}$, NEAR HOGBACK MONOCLINE

720
0.00 — CONSTANT-HEAD NODE--Top number is altitude, in feet, divided by 10; bottom number is flow rate, in cubic feet per second, positive value indicates inflow; negative, outflow

HYDROLOGIC CHARACTERISTICS

T = 0.86, Kxy = $1 \times 10^{-8}$, Kz = $1 \times 10^{-12}$

T = 130, Kxy = $1.2 \times 10^{-6}$, Kz = $1.2 \times 10^{-10}$

where: T = Transmissivity, in feet squared per day

Kxy = Horizontal hydraulic conductivity, in feet per second

Kz = Vertical hydraulic conductivity, in feet per second

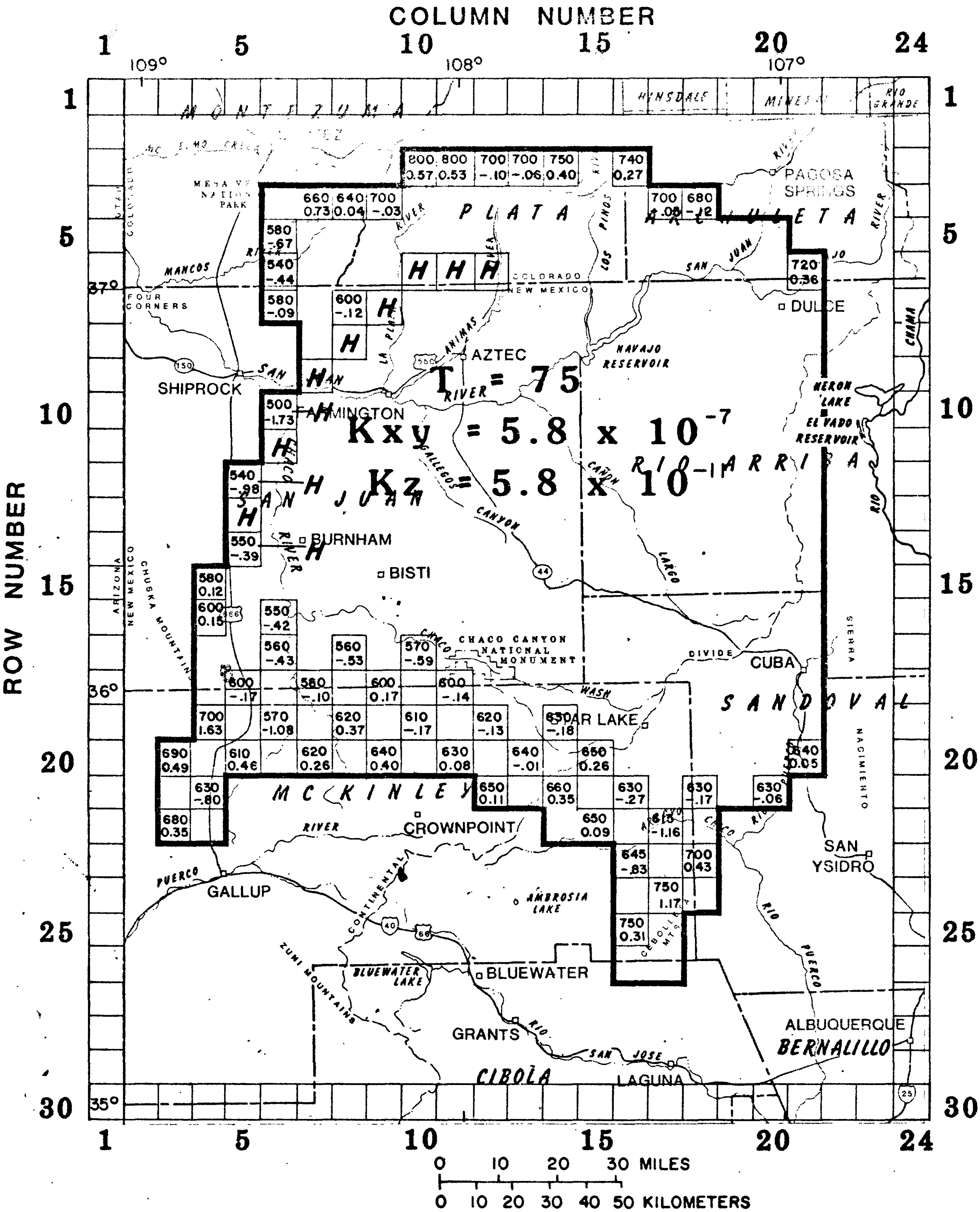



Figure 10.--Hydraulic characteristics of the steady-state model and model-derived flow rates at constant-head nodes for layer 7 (aquifers and confining beds in the upper part of the Mesaverde Group).

## EXPLANATION FOR FIGURE 10

LAYER THICKNESS IS 1500 FEET

NO-FLOW BOUNDARY--Extent of layer

H — NODE WITH Kz = $5 \times 10^{-9}$, NEAR HOGBACK MONOCLINE

720 / 0.36 — CONSTANT-HEAD NODE--Top number is altitude, in feet, divided by 10; bottom number is flow rate, in cubic feet per second, positive value indicates inflow; negative, outflow

HYDROLOGIC CHARACTERISTICS

T = Transmissivity, in feet squared per day

Kxy = Horizontal hydraulic conductivity, in feet per second

Kz = Vertical hydraulic conductivity, in feet per second

## Transient model

The transient model used the hydraulic characteristics of the steady-state model with boundary changes and the addition of specific storage to estimate the effects of possible pumpage by the coal industry on the potentiometric surfaces of the aquifers. The assumption that the transient behavior of a complex aquifer system can be adequately simulated in this way is critical, but this assumption has been used to provide satisfactory results elsewhere (Wilson, 1977).

### Boundaries

The constant-head boundary of the steady-state model was changed to a constant-flux condition where (1) inflow was simulated (recharge) and (2) it was assumed that any lowering of the water table would not result in increased ground-water inflow. This assumption was made for most of the New Mexico part of the model. The values of flux (recharge) specified for each node were those calculated by the steady-state model. However, for the San Juan River, Rio Chama, Rio San Jose, and the Chuska Mountain area, the assumption was made based on the existence of perennial flow that recharge could be increased and that the constant-head condition would be appropriate.

The constant-head nodes that simulated ground-water outflow in the steady-state model were unchanged for the transient model, until, as the transient simulation progressed they began to simulate inflow. After that time in the simulation, inflow rates were monitored and a judgment was made as to whether or not the simulated inflow was reasonable. The flow changed direction from outflow to inflow at 10 constant-head nodes. Their locations, maximum discharges, and the judgment made on the inflow are given in table 1. All other boundaries in the transient model were the same as in the steady-state model.

Table 1.--Maximum ground-water inflow rates at constant-head nodes where the direction of flow changed from outflow to inflow during the transient simulations

| Location (layer. row. column) | Alter-native1/ | Year of maximum inflow | Rate of inflow (cubic feet per second) | Remarks |
|---|---|---|---|---|
| 6.23.4 | 5 | 2000 | 0.065 | On the Puerco River upstream from Gallup. |
| 5.23.5 | 5 | 2000 | 1.93 | On the Puerco River upstream from Gallup. |
| 3.14.3 | 4-5 | 2040 | 0.005 | Assumed to be less than or equal to a reasonable amount of recharge for the area. |
| 3.23.6 | 3-5 | 2010 | 2.70 | On the Puerco River upstream from Gallup. |
| 3.23.7 | -- | 1980 | - | Constant-head condition removed in 1981. |
| 3.25.20 | 4-5 | 2010 | 1.67 | On the Rio Puerco, which is assumed to be perennial due to uranium-mine discharge. |
| 3.27.20 | 5 | 2015 | 0.38 | Do. |
| 3.28.18 | 3-5 | 2015 | 0.22 | Assumed to be less than or equal to a reasonable amount of recharge for the area |
| 3.29.14 | 2-5 | 2040 | 0.037 | On the Rio San Jose, a perennial stream. |
| 3.29.15 | 4-5 | 2015 | 0.035 | Do. |

1/Where more than one alternative is shown, the maximum rate was within 0.01 cubic foot per second for the alternatives shown. The different alternatives are explained in the section on "Ground-water withdrawals and time periods."

2/An adequate flow in the Puerco River was assumed to exist due to the uranium-mine discharges in the Church Rock area. Constant-head condition was removed when simulation of uranium discharges ceased in 2010.

3/The constant-head condition remained throughout the simulation for the reason shown.

## Storage

All layers were treated as if they were under artesian conditions, even in outcrop areas, due to model code limitations. In actual artesian areas, specific storage was assumed to be 5 x $10^{-7}$ per foot of layer thickness throughout the model (figs. 11-17). This value allows for the compressibility of water as well as the matrix, where porosity is assumed to be 0.2.

Although a water table was not explicitly simulated, the values of specific storage were selected so as to simulate specific yield in and near outcrop areas. The specific yield under water-table conditions was assumed to be 0.1 where rocks are predominantly sandstone and 0.01 (Johnson, 1967) where rocks are predominantly shale or siltstone. The storage coefficient was assumed to be approximately equal to the specific yield: specific storage was set equal to the storage coefficient divided by model layer thickness. Where outcrops are narrower than 6 miles, the specific storage was adjusted by a factor that included dip angle, block width, and layer thickness based on the assumption that water tables are horizontal.

The formula that was used is:

$$S_s = \frac{S}{b} \; \frac{b/\sin a}{31{,}680}$$

where

$S_s$ = specific storage (1/foot)
$S$ = storage coefficient
$b$ = model layer thickness (feet)
$a$ = dip angle; and
31,680 = model block width (feet).

Layer thickness cancels out of the equation and block width is constant, so specific storage varies with storage coefficient and dip angle.

Another way of estimating areas under water-table conditions would be to assume that they correspond to outcrop areas (Lyford and others, 1980). However, sandstone units tend to form steeper slopes in outcrop areas than do shale units, so sandstones have narrower outcrops relative to thickness than do shale units. Thus, using only outcrop width, the area under water-table conditions in sand units would be underestimated relative to the area under water-table conditions in shale units.

Considering the highly complex geometry of rocks that control storage in outcrop areas where water-table conditions prevail, it was judged that the use of two dip angles would be realistic. Steeply dipping beds were given a dip angle (a) of 20 degrees and less steeply dipping beds were given a dip angle of 2 degrees. These angles were taken from a structure-contour map of the base of the Dakota Sandstone (Silver, 1950, fig. 6). Specific storage in water-table areas are shown in figures 11-17.

The effect of the storage coefficient and dip adjustments above is to produce additional error in projected water levels near boundaries. Such errors should diminish as distance from boundaries increases.

## Ground-water withdrawals and time periods

Ground-water withdrawal rates specified by the Bureau of Land Management are shown in table 2 at the end of the report. They included significant withdrawals associated with other developments, such as uranium mining, as well as coal development. Historic withdrawals were assumed to begin in 1941 and continue through 1980. (Until 1941 the model-derived steady-state conditions of Frenzel and Lyford, 1982, were assumed to exist.) Alternative 1 represented a minimum of coal development. Alternatives 2-5 in turn each represented increased coal development. Alternative 4 was the "target" alternative. Ground-water withdrawals for each of Alternatives 1 through 5 were simulated for 1981 to 2040, each beginning with the simulated conditions of 1980.

The entire period from 1941 to 2040 was arbitrarily divided into 5-year increments except for the 1980's. The 1980's were divided into a 7-year period (1981-1987) and a 3-year period (1988-1990) to better accommodate and be consistent with other parts of Bureau of Land Management's environmental studies.

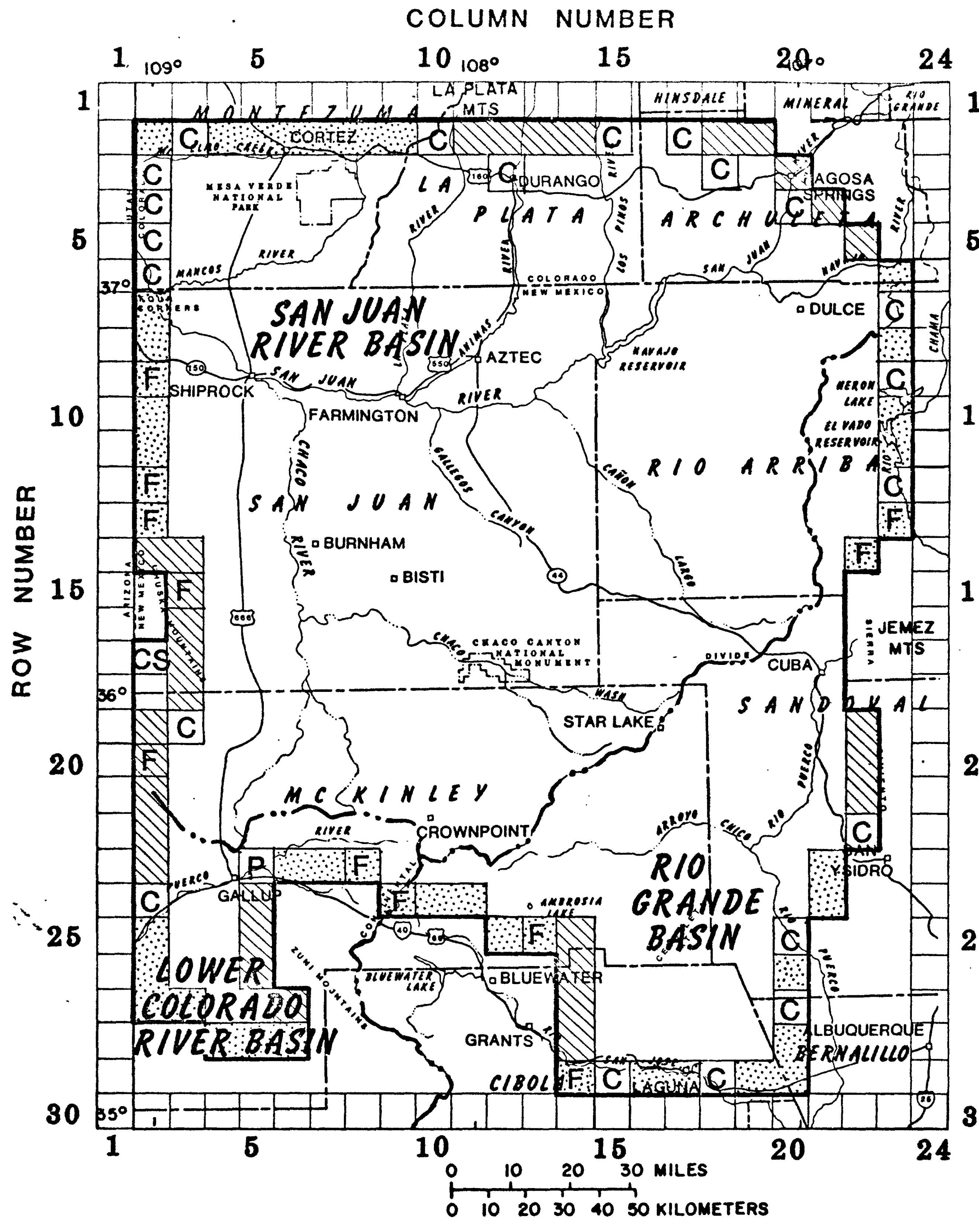



Figure 11.--Specific storage and locations of constant-head and constant-flux nodes for layer 1.

## EXPLANATION FOR FIGURE 11

LAYER THICKNESS IS 300 FEET

NO-FLOW BOUNDARY- Extent of layer

**F** CONSTANT-FLUX NODE

**C** CONSTANT-HEAD NODE

**P** CONSTANT-HEAD NODE ON PUERCO RIVER UPSTREAM FROM GALLUP

**CS** CONSTANT-HEAD NODE APPROXIMATING RECHARGE FROM CHUSKA SANDSTONE

SPECIFIC STORAGE = $10^{-5}$ per foot

SPECIFIC STORAGE = $10^{-4}$ per foot

NOTE: Specific storage = $5 \times 10^{-7}$ per foot except in constant-head nodes and patterned areas

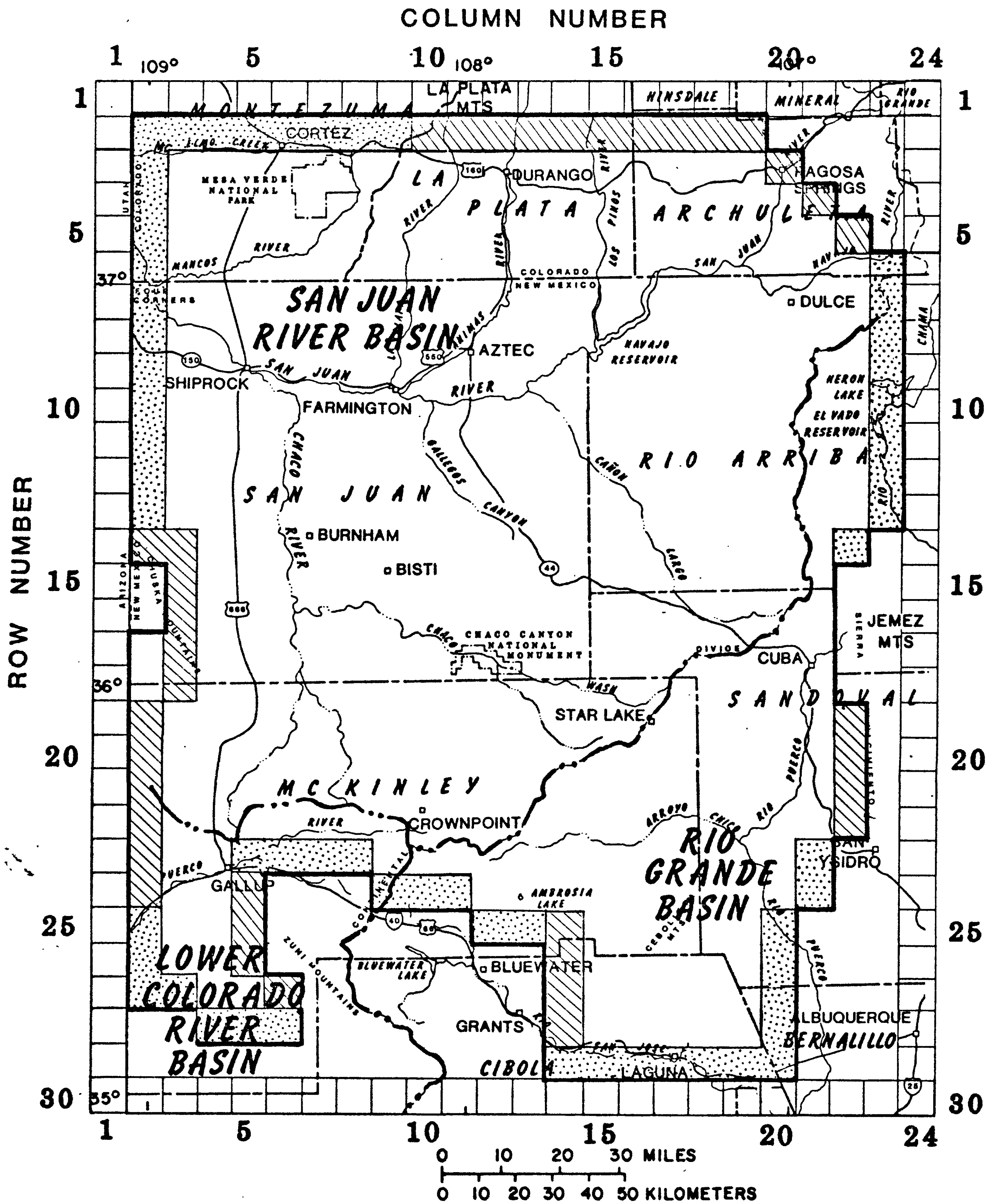



Figure 12.--Specific storage for layer 2.

## EXPLANATION FOR FIGURE 12

LAYER THICKNESS IS 500 FEET

NO FLOW BOUNDARY--Extent of layer

SPECIFIC STORAGE = $10^{-5}$ per foot

SPECIFIC STORAGE = $10^{-4}$ per foot

NOTE: Specific storage = $5 \times 10^{-7}$ per foot except in constant-head nodes and patterned areas

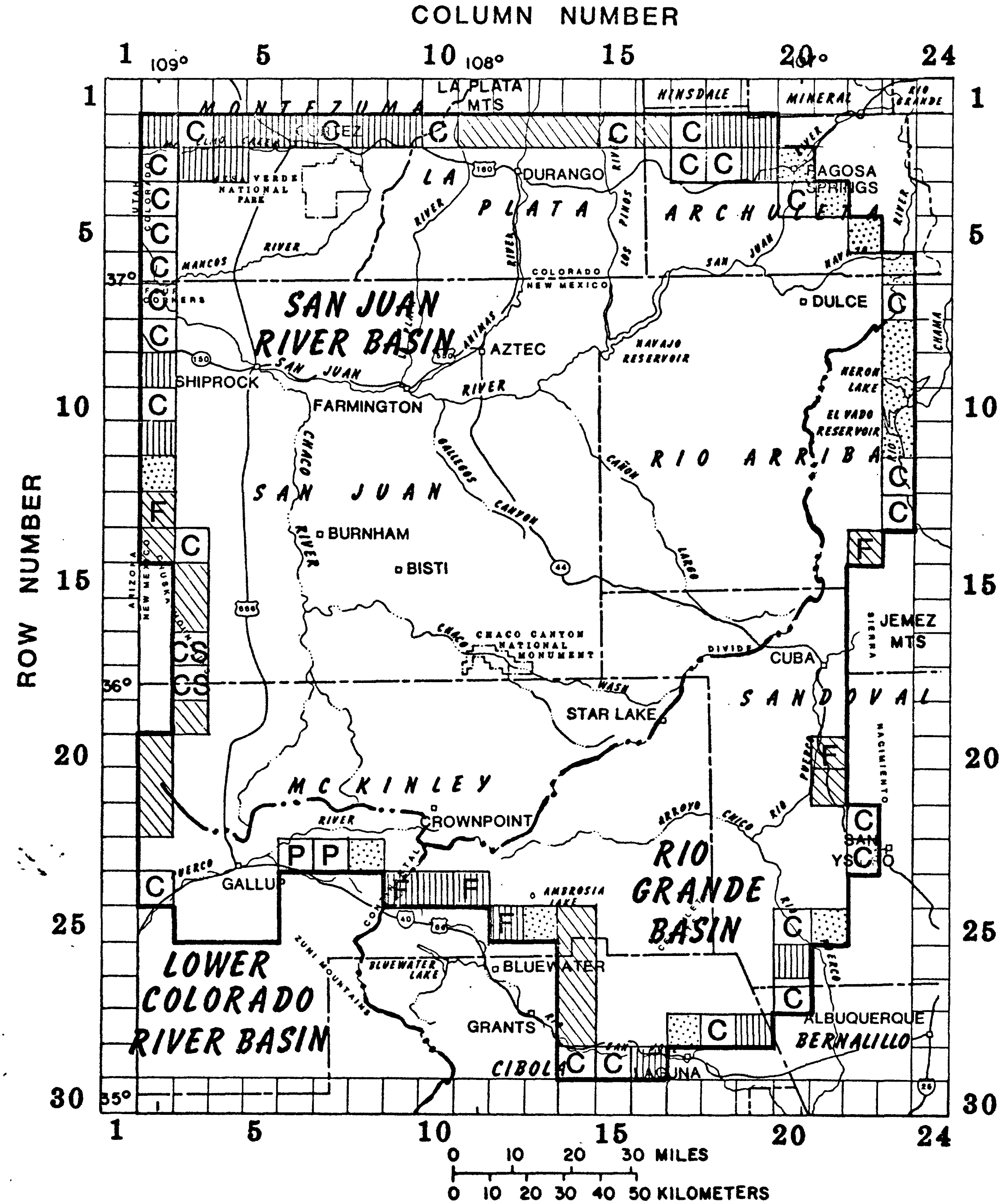



Figure 13.--Specific storage and location of constant-head and constant-flux nodes for layer 3.

## EXPLANATION FOR FIGURE 13

LAYER THICKNESS IS 300 FEET

NO-FLOW BOUNDARY--Extent of layer

F CONSTANT-FLUX NODE

C CONSTANT-HEAD NODE

P CONSTANT-HEAD NODE ON PUERCO RIVER UPSTREAM FROM GALLUP

CS CONSTANT-HEAD NODE APPROXIMATING RECHARGE FROM CHUSKA SANDSTONE

SPECIFIC STORAGE = $10^{-5}$ per foot

SPECIFIC STORAGE = $10^{-4}$ per foot

SPECIFIC STORAGE = $3.3 \times 10^{-4}$ per foot

NOTE: Specific storage = $5 \times 10^{-7}$ per foot except in constant-head nodes and patterned areas

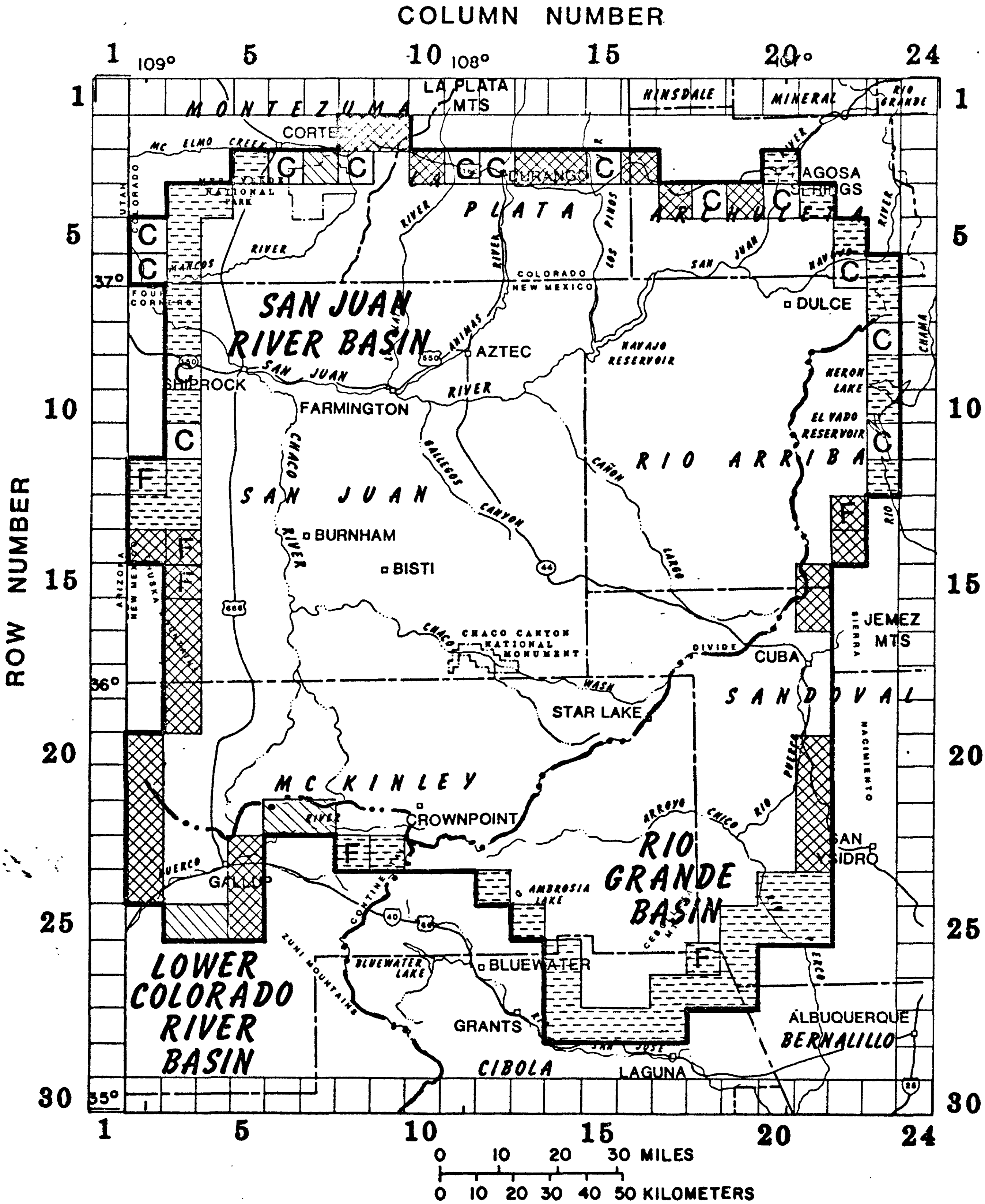



Figure 14.--Specific storage and location of constant-head and constant-flux nodes for layer 4.

## EXPLANATION FOR FIGURE 14

LAYER THICKNESS IS 500 FEET

NO-FLOW BOUNDARY--Extent of layer

F CONSTANT-FLUX NODE

C CONSTANT-HEAD NODE

SPECIFIC STORAGE = $10^{-6}$ per foot

SPECIFIC STORAGE = $10^{-5}$ per foot

SPECIFIC STORAGE = 2 X $10^{-5}$ per foot

NOTE: Specific storage = 5 X $10^{-7}$ per foot except where C or a pattern is shown

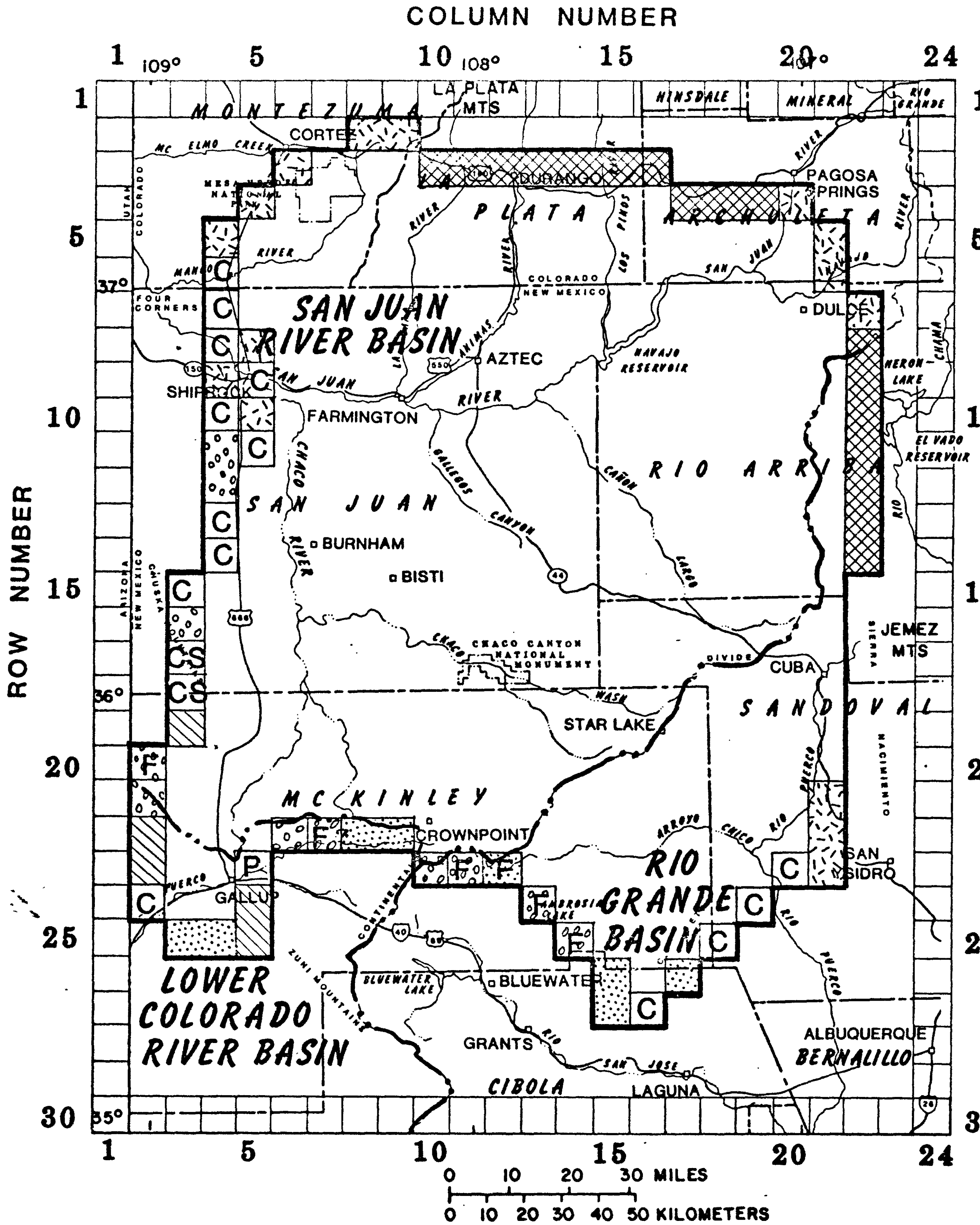



Figure 15.--Specific storage and location of constant-head and constant-flux nodes for layer 5.

## EXPLANATION FOR FIGURE 15

LAYER THICKNESS IS 700 FEET

NO-FLOW BOUNDARY--Extent of layer

F CONSTANT-FLUX NODE

C CONSTANT-HEAD NODE

P CONSTANT-HEAD NODE ON PUERCO RIVER UPSTREAM FROM GALLUP

CS CONSTANT-HEAD NODE APPROXIMATING RECHARGE FROM CHUSKA SANDSTONE

SPECIFIC STORAGE = $10^{-6}$ per foot

SPECIFIC STORAGE = $10^{-5}$ per foot

SPECIFIC STORAGE = $10^{-4}$ per foot

SPECIFIC STORAGE = $1.4 \times 10^{-4}$ per foot

SPECIFIC STORAGE = $1.4 \times 10^{-5}$ per foot

NOTE: Specific storage = $5 \times 10^{-7}$ per foot except in constant-head nodes and patterned areas.

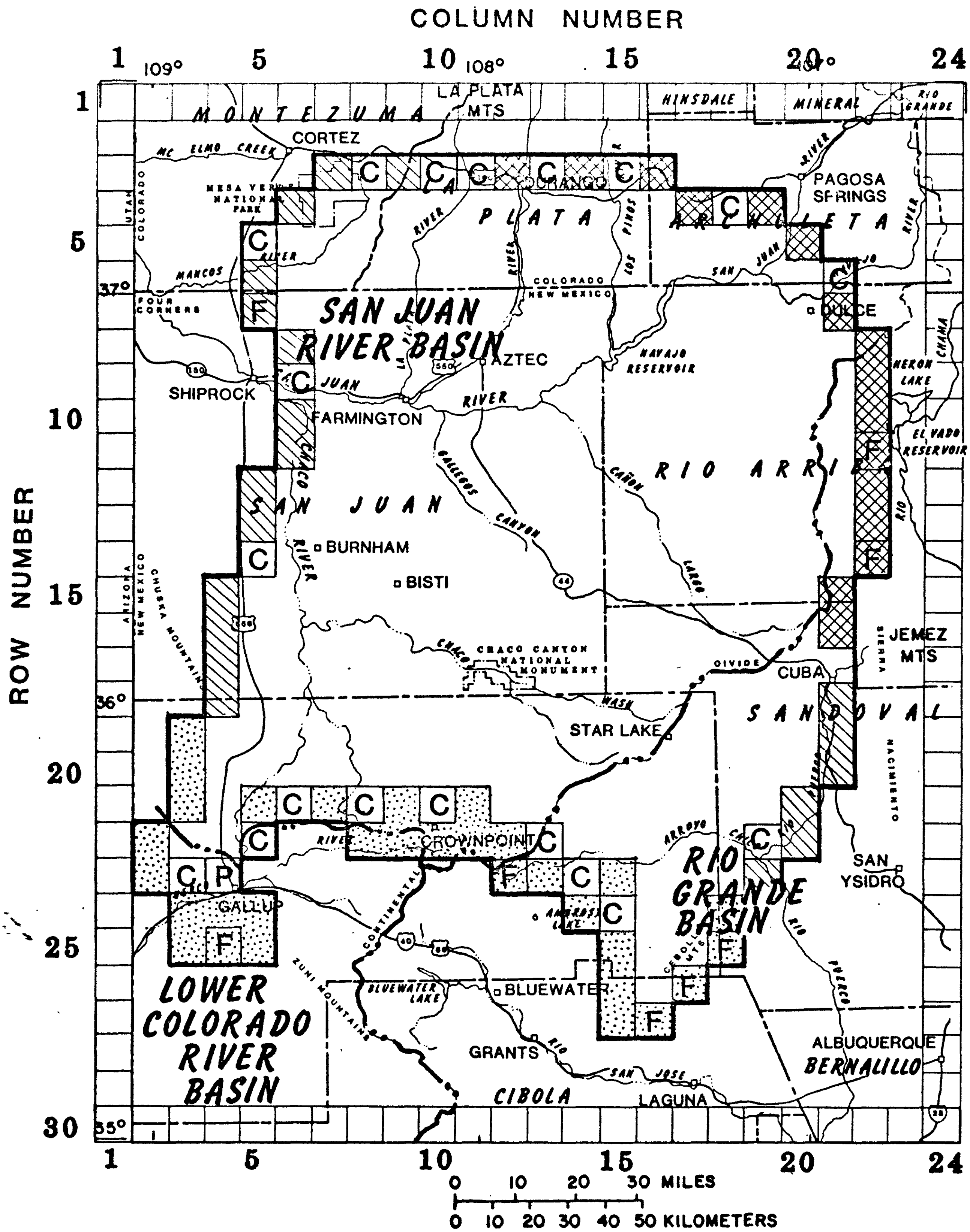



Figure 16.--Specific storage and location of constant-head and constant-flux nodes for layer 6.

## EXPLANATION FOR FIGURE 16

LAYER THICKNESS IS 1000 FEET

NO-FLOW BOUNDARY--Extent of layer

F CONSTANT-FLUX NODE

C CONSTANT-HEAD NODE

P CONSTANT HEAD NODE ON PUERCO RIVER UPSTREAM FROM GALLUP

SPECIFIC STORAGE = $10^{-6}$ per foot

SPECIFIC STORAGE = $10^{-5}$ per foot

SPECIFIC STORAGE = $10^{-4}$ per foot

NOTE: Specific storage = 5 X $10^{-7}$ per foot except where C or a pattern is shown

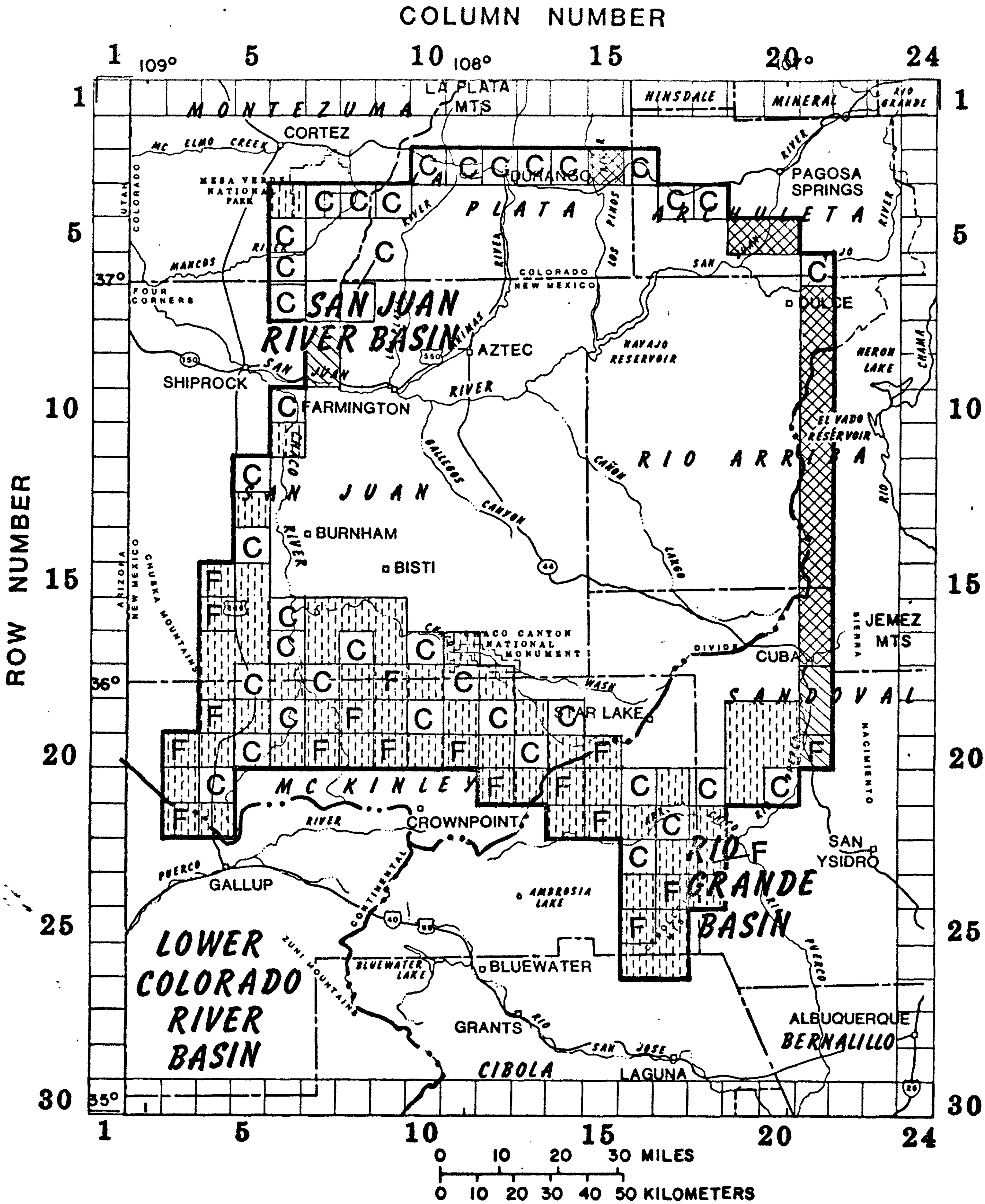



Figure 17.--Specific storage and location of constant-head and constant-flux nodes for layer 7.

## EXPLANATION FOR FIGURE 17

LAYER THICKNESS IS 1500 FEET

NO-FLOW BOUNDARY

F CONSTANT-FLUX NODE

C CONSTANT-HEAD NODE

SPECIFIC STORAGE = $10^{-6}$ per foot

SPECIFIC STORAGE = $10^{-5}$ per foot

SPECIFIC STORAGE = 6.6 X $10^{-5}$ per foot

NOTE: Specific storage = 5 X $10^{-7}$ per foot
except where C or a pattern is shown

## MODEL RESULTS

The results of the model are expressed in terms of drawdown and changes in the mass balance. Drawdowns are reported as the differences between transient-state heads and steady-state heads. That is, the projected drawdowns include the model-derived drawdown for 1980. Drawdowns derived by the model for 1980 are shown in figure 18 for layers 3 and 5. For other layers, the 1980 model-derived drawdowns were less than 10 feet and probably are not significant. (Further information is contained in the "Appraisal of results" section.)

Projected drawdowns for Alternative 1 (minimum coal development) are shown on plate 1. Maps for each aquifer layer (layers 1, 3, 5, 6, and 7) show drawdowns for 1987, 2000, 2020, and 2040. Drawdowns in layer 7 for 1987 are not shown because they were less than 10 feet. The greatest drawdowns (2,000 feet) are shown for layer 3 in 2020. The layer 3 map for 2040 indicates a repressuring of the aquifer (inward movement of the lines of equal drawdown) in the middle of the cone of depression and continued depressuring (outward movement of the lines of equal drawdown) near the periphery.

Drawdowns for Alternatives 2 through 5 (not shown) were not distinguishable from those shown on plate 1, with the exception of layer 5 for 2020 and 2040. Maps for layer 5 under Alternative 4 (target alternative) for 2020 and 2040 are shown in figure 19. There were no discernible differences between the drawdowns for layer 5 under Alternative 5 for 2020 and 2040 and those shown in figure 19.

In order to make the drawdowns of Alternatives 2 through 5 distinguishable from the drawdowns of Alternative 1, the drawdowns projected for Alternative 1 were subtracted from those projected for each of Alternatives 2 through 5. The increased drawdown associated with the additional ground-water withdrawals of each alternative (in excess of the ground-water withdrawals of Alternative 1) is shown on plate 2. In order to reduce the number of maps, only the maximum drawdowns (as much as 300 feet) obtained throughout the period of simulation (1980-2040) are shown. The time periods during which each maximum occurred within the simulation period also are shown on plate 2.

Maps for layers 6 and 7 are not included on plate 2 because the maximum increases in drawdown were 10 feet or less. The very small drawdowns in layers 6 and 7 probably are an artifact of the model. See "Appraisal of results."

The results of the model in terms of mass balance are shown in table 3 and figure 20. In table 3, "sources" are ground-water inflow at constant-head and constant-flux nodes and water taken from storage. "Discharges" are ground-water outflow and withdrawals. Sources and discharges must be equal. In a steady-state condition, by definition, no water comes from or goes into storage. This condition was assumed to exist before 1941, as a starting point. Between 1941 and 1980 most ground-water withdrawals came from storage with minor increases in ground-water inflow and minor decreases in ground-water outflow (table 3). The pattern continues until 2030 for the simulation of future ground-water withdrawals under Alternative 4. At the end of the simulation, ground-water inflow at constant-head nodes was increased by less than 3 cubic feet per second from the 1941 rate and discharges at constant-head nodes were decreased by less than 4 cubic feet per second. Ultimately, constant-head areas may contribute water to storage.

Whereas table 3 shows a summation of inflow at constant-head nodes on the left and outflow at constant-head nodes on the right for the entire model, figure 20 shows inflow (positive and outflow (negative) summed for different areas. The resulting net flow may be positive or negative.

On the left side of figure 20, the entire modeled area is divided into three drainage basins. (Drainage basins are shown in fig. 11-17.) All flow rates at constant-head nodes in the Lower Colorado River drainage basin were summed at the end of each future pumping period and the resulting net flow rates are shown in figure 20A. The abrupt reduction in flow shown as a discontinuity in the graph between 2010 and 2015 reflects the discontinuance of constant-head nodes on the Puerco River upstream from Gallup. A reference line (dashed) corresponding to steady-state flow (1940) is drawn to show the relationship to steady-state conditions. The inflow increased by as much as 7 1/4 cubic feet per second (left side of figure 20A). The net flow rates for Alternatives 1 and 4 are indistinguishable, which is true for most the graphs in figure 20. The net flow rate for all constant-head nodes in the Rio Grande drainage basin is shown in figure 20B. The net steady-state flow rate was negative 7 3/4 cubic feet per second. The negative flow rates indicate net ground-water outflow. (Ground-water inflow generally was treated as constant flux, which is not shown in figure 20.) The greatest reduction of ground-water outflow from the steady-state flow rate was about 3 3/4 cubic feet per second for 2015. Similarly, in the San Juan River drainage basin (fig. 20C), the greatest reduction of ground-water outflow from the steady-state flow rate was about 1 1/2 cubic feet per second for 2020 and beyond.

Net flow rates for the State of New Mexico are shown on the right side of figure 20. New Mexico was divided into three areas. The constant-head nodes on the Puerco River upstream from Gallup (fig. 20E) account for a major part (5 3/4 cubic feet per second) of the difference between steady-state and transient-state flow rates in New Mexico. The constant-head nodes in the Chuska area give an approximation of the flow that may be induced from the Chuska Sandstone as a result of drawdowns in the aquifers of layers 1, 3, and 5. The greatest increase from steady-state ground-water inflow in the Chuska area constant-head nodes was about 2 cubic feet per second (fig. 20F). The greatest decrease in ground-water outflow at constant-head nodes in the State of New Mexico, excluding those in the Puerco upstream from Gallup or Chuska areas, was about 5 1/2 cubic feet per second (fig. 20D).

The greatest change from steady state in the total flow rate at constant-head nodes in Colorado (not shown) was about 0.005 cubic foot per second, which was projected for the end of the period of simulation (2040). Greater changes probably would occur after that date as the effects of withdrawals spread farther from the pumping sites (plate 1).

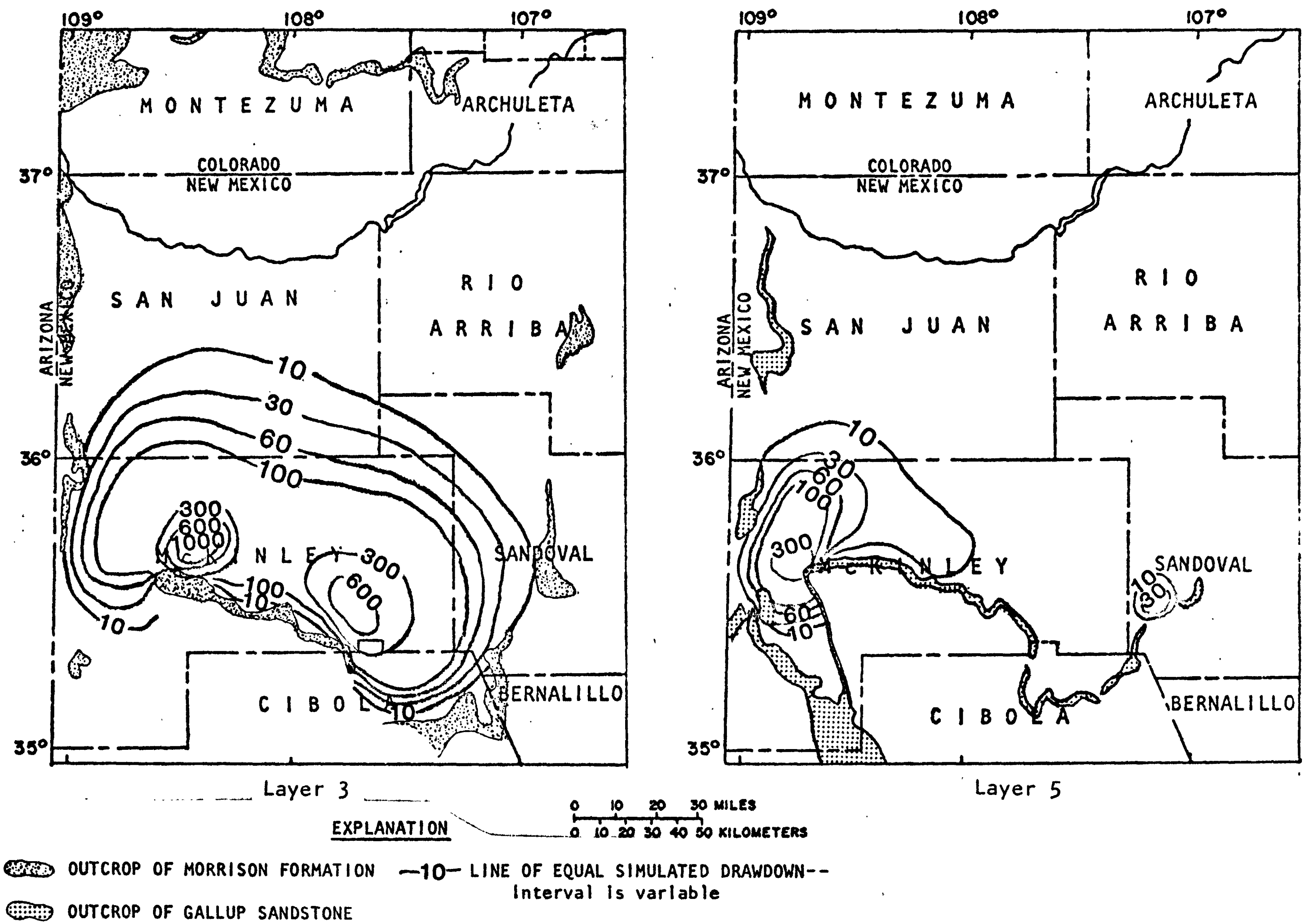



Figure 18.--Model-derived drawdowns for layers 3 and 5 in 1980.

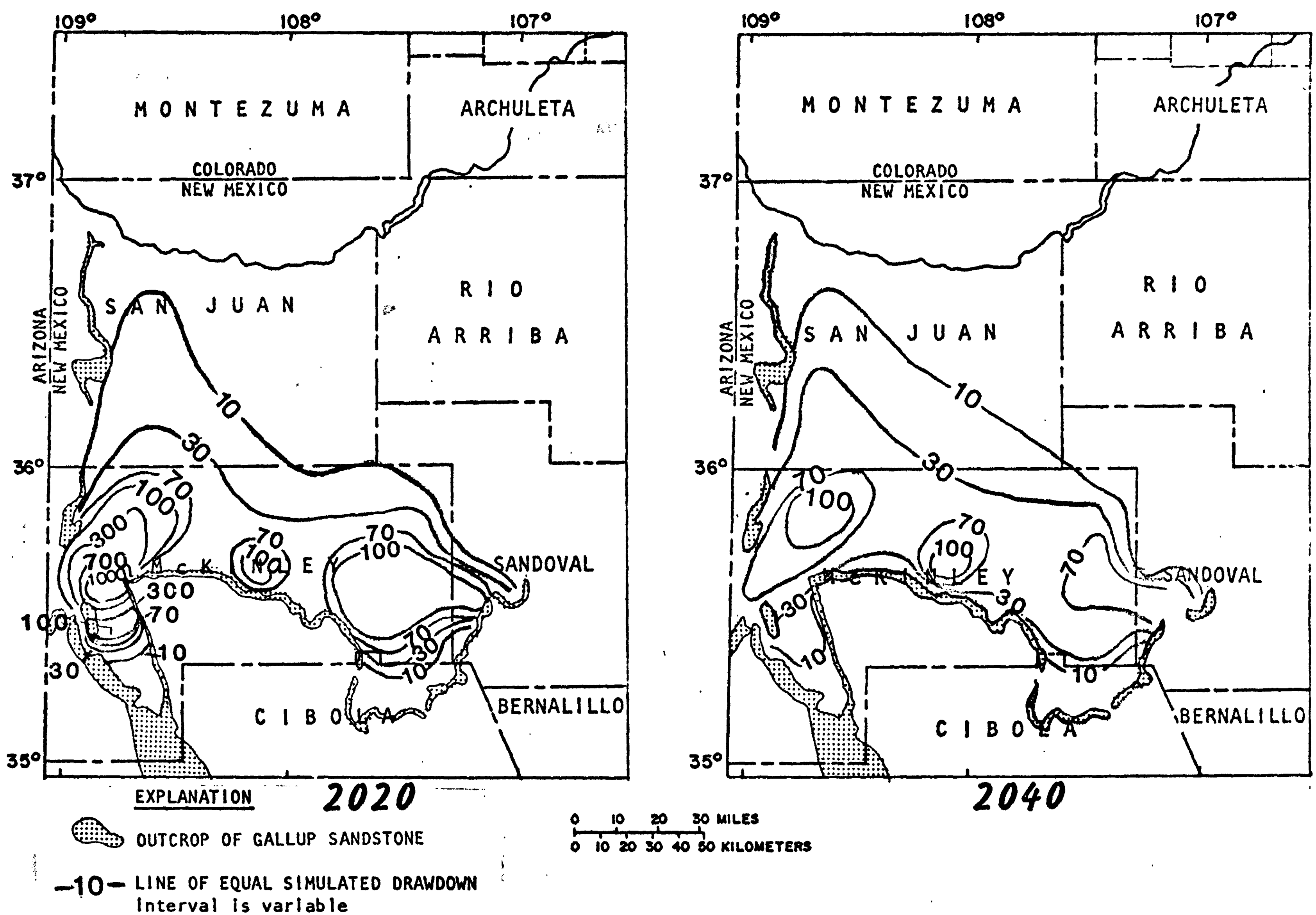
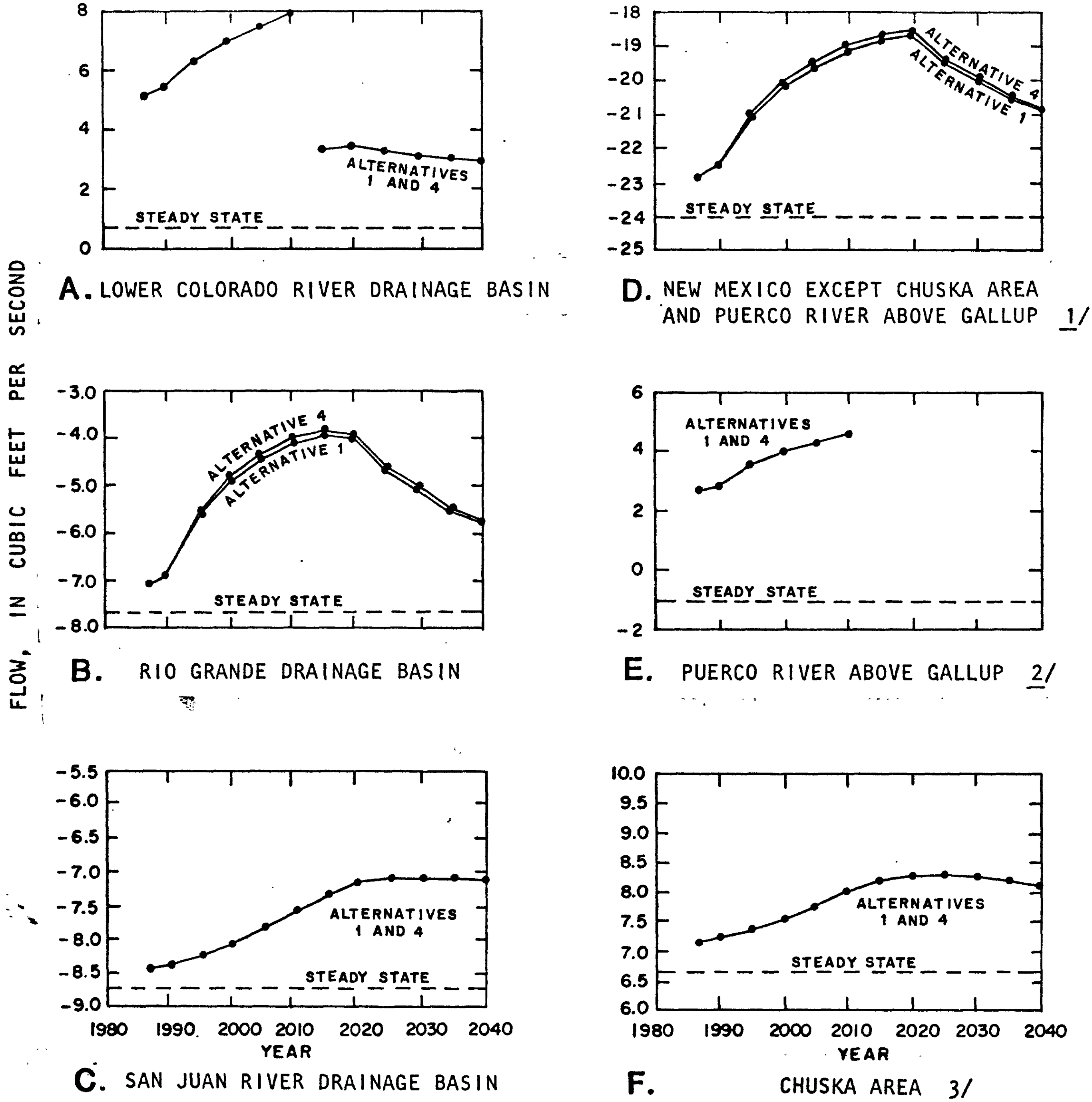



Figure 19.--Model-derived drawdowns for layer 5 in 2020 and 2040 under Alternative 4.




NOTE: The dashed line represents the flow rate under steady-state conditions for the same nodes.

Flow is the sum of the flow rates at all constant-head nodes
(1) in the designated area.
(2) in row 23, columns 4-6, and layers 1,3,5, and 6.
(3) in rows 17 and 18, columns 2 and 3, and layers 1, 3, and 5.

Figure 20.--Constant-head flow rates plotted against time for Alternatives 1 and 4.

Table 3.--Mass balance

| Year | Sources, in cubic feet per second | | | Discharges in cubic feet per second | |
|---|---|---|---|---|---|
| | Contant heads | Constant fluxes | Storage | Constant heads | Ground water withdrawals |
| | | | Steady state | | |
| 1940 | 15.8 | 16.1 | 0.0 | 31.9 | 0.0 |
| | | | Historic simulation | | |
| 1945 | 15.8 | 16.1 | 0.6 | 31.8 | 0.7 |
| 1950 | 15.9 | 16.1 | .6 | 31.8 | .8 |
| 1955 | 15.9 | 16.1 | .7 | 31.8 | 1.0 |
| 1960 | 16.2 | 16.1 | 17.8 | 31.6 | 18.6 |
| 1965 | 16.5 | 16.1 | 29.0 | 31.2 | 30.4 |
| 1970 | 16.6 | 16.1 | 23.1 | 31.2 | 24.7 |
| 1975 | 21.3 | 16.1 | 26.6 | 30.6 | 33.6 |
| 1980 | 22.5 | 16.1 | 26.3 | 30.3 | 34.8 |
| | | | Alternative 4 simulation | | |
| 1987 | 19.4 | 16.1 | 46.0 | 29.8 | 51.7 |
| 1990 | 19.8 | 16.1 | 61.6 | 29.6 | 67.9 |
| 1995 | 21.7 | 16.1 | 89.9 | 29.3 | 98.5 |
| 2000 | 23.1 | 16.1 | 85.4 | 29.0 | 95.6 |
| 2005 | 23.9 | 16.1 | 87.4 | 28.7 | 98.6 |
| 2010 | 24.6 | 16.1 | 71.4 | 28.5 | 83.7 |
| 2015 | 20.1 | 16.1 | 47.2 | 28.1 | 55.3 |
| 2020 | 20.2 | 16.1 | 38.2 | 28.0 | 46.6 |
| 2025 | 19.4 | 16.1 | 14.6 | 28.0 | 22.2 |
| 2030 | 19.0 | 16.1 | 12.9 | 28.2 | 19.8 |
| 2035 | 18.5 | 16.1 | 2.1 | 28.2 | 8.5 |
| 2040 | 18.2 | 16.1 | 2.0 | 28.3 | 8.0 |

## APPRAISAL OF RESULTS

The model and simulation results described in this report represent a preliminary step in a continuing effort to understand the response of the hydrogeologic system in the San Juan structural basin to changes in pumping stress. A number of problem areas remain.

The scale of the model affects the predictions, especially in the vicinity of the outcrop boundary. Features such as the shape of the water table in the vicinity of an outcrop area or a drawdown cone near a well are not well represented by the relatively coarse finite-difference grid. (As previously stated, model blocks are 6 miles on a side and from 300 to 1,500 feet thick.) For example, a model block may cover several mountains and valleys, and the simulated water level can, at best, only be considered to be an average for the area. Similarly, drawdowns at individual withdrawal wells would be significantly greater than the model predicts. Effects of scale are magnified where both of these situations occur, such as in the case of wells that penetrate only a part of the aquifers and confining beds that are combined into the 1,500-foot-thick layer 7 or the 1,000-foot-thick layer 6 in outcrop areas. In this case, deep confined water-bearing beds are combined with water-table beds, possibly causing drawdowns to be underestimated in the confined beds. The predictions can only be valid with respect to the broad, regional picture, and, for the most part, only in the lower five layers of the model.

Projected drawdowns for the Westwater Canyon Member of the Morrison Formation are greater than the distance from the steady-state potentiometric surface to the top of the aquifer in an area between Church Rock and Laguna. If drawdowns approaching such magnitudes were to take place, the confined aquifer in the area (plate 1, layer 3) may be converted to an unconfined aquifer and the effective storage coefficient would increase by about a thousand-fold, greatly reducing the rate of further drawdown. This conversion was not simulated, so the projected drawdowns (based on the lower storage value) are probably too great in this area.

A series of tests was done to estimate how different hydraulic characteristics might affect the results of the model. (This is often referred to as "sensitivity" testing.) The simulation of the Alternative 4 schedule of ground-water withdrawals was repeated using first a high value and then a low value of each of the three hydraulic characteristics for a total of six simulations. The hydraulic characteristics and values used are in table 4. The ranges of values were judged reasonable for the limited purpose of this study but are somewhat questionable and need further investigation.

The tests yielded drawdowns that were generally within the range of 0.5 to 2 times the values shown on plate 1 and figure 19. However, the higher value of specific storage for confined areas generally yielded drawdowns of 0.1 to 0.8 times the predicted drawdowns. Different values of specific storage in water-table areas generally only affected drawdowns within a distance of 2-3 nodes from the boundary during the period simulation (1940-2040). Flow at constant-head nodes generally was within 0.5 to 1.5 times the values shown in figure 20.

The vertical hydraulic conductivity of confining beds could be 10 times as large, but less than 100 times as large, as the value used in the model (Frenzel and Lyford, 1982). The effect of such large vertical hydraulic conductivities was not tested during the sensitivity tests. Qualitatively, the effect would be to simulate less drawdown in layers 3 and 5 and somewhat greater drawdown in layer 1.

The way in which the model treats transient flow from storage in confining beds may be a source of error, but has not been fully investigated. The error may be of a similar magnitude to that indicated in the sensitivity tests where storage was investigated, so it could be compensated for by errors in the estimate of specific storage.

All of these factors contribute to uncertainties in the reliability of the projected drawdowns. The findings should be viewed as preliminary, although they are probably reasonable approximations, within a factor of 2, of water-level changes that would result from the specified alternative plans of coal development. The results are presented primarily to provide timely support to efforts aimed at evaluating the hydrologic effects of coal mining.

Table 4.--Values of hydraulic characteristics used in sensitivity tests.

| Hydraulic characteristic | High value | Low value |
|---|---|---|
| Specific storage (per foot) in confined areas. | $2 \times 10^{-6}$ | $3 \times 10^{-7}$ |
| Specific storage (per foot) in water-table areas. | 2 times the values shown in figures 11-17. | 0.5 times the values shown in figures 11-17. |
| Hydraulic conductivity (feet per second). | 2 times the values shown in figures 4-10. | 0.5 times the values shown in figures 4-10. |

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## GLOSSARY

The following technical terms are used in this report:

**Confining bed**--A confining bed is a body of "impermeable" material stratigraphically adjacent to one or more aquifers. In nature, however, the hydraulic conductivity of confining beds may range from nearly zero to some value distinctly less than that of the aquifer.

**Drawdown (L)**--Drawdown is the lowering of the water table or potentiometric surface caused by ground-water withdrawal.

**Hydraulic head (L)**--The hydraulic head is the height above a standard datum of the surface of a column of water that can be supported by the static pressure at a given point. The standard datum in this report is sea level. Hydraulic head is referred to as head in this report.

**Hydraulic conductivity ($LT^{-1}$)**--Hydraulic conductivity is the characteristic of a medium that allows it to transmit in unit time a unit volume of ground water at the prevailing viscosity through a cross section of unit area, measured at right angles to the direction of flow, under a hydraulic gradient of unit change in head through unit length of flow.

**Potentiometric surface**--The potentiometric surface, which replaces the term "piezometric surface", is a surface which represents the head. As related to an aquifer, it is defined by the levels to which water will rise in tightly cased wells. Where the head varies appreciably with depth in the aquifer, a potentiometric surface is meaningful only if it describes the head along a particular specified surface or stratum in that aquifer. More than one potentiometric surface is then required to describe the distribution of head. The water table is a particular potentiometric surface.

**Sea level**--Sea level is the term used in this report for the National Geodetic Vertical Datum of 1929, a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called mean sea level.

**Specific yield (dimensionless)**--The specific yield of a rock or soil is the ratio of (1) the volume of water which the rock or soil, after being saturated, will yield by gravity to (2) the volume of the rock or soil. The definition implies that gravity drainage is complete.

In the natural environment, specific yield is generally observed as the change that occurs in the amount of water in storage per unit area of unconfined aquifer as the result of a unit change in head. Such a change in storage is produced by the draining or filling of pore space and is therefore dependent upon particle size, rate of change of the water table, time, and other variables. Hence, specific yield is only an approximate measure of the relation between storage and head in unconfined aquifers.

**Storage, specific** ($L^{-1}$)--In problems of three-dimensional transient flow in a compressible ground-water body, it is necessary to consider the amount of water released from or taken into storage per unit volume of the porous medium. The specific storage is the volume of water released from or taken into storage per unit volume of the porous medium per unit change in head.

**Storage coefficient (dimensionless)**--The storage coefficient is the volume of water an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in head.

In a confined aquifer the water derived from storage with decline in head comes from expansion of the water and compression of the aquifer; similarly, water added to storage with a rise in head is accommodated partly by compression of the water and partly by expansion of the aquifer. In an unconfined water body, the amount of water derived from or added to the aquifer by these processes generally is negligible compared to that involved in gravity drainage or filling of pores; hence, in an unconfined aquifer, the storage coefficient is virtually equal to the specific yield.

**Transmissivity** ($L^2/T$)--The transmissivity of an aquifer is the rate at which water of the prevailing viscosity is transmitted through a unit width of the aquifer under a unit hydraulic gradient. It is equal to the thickness of the aquifer multiplied by the hydraulic conductivity. (Conversely, the horizontal hydraulic conductivity in a model layer is the transmissivity of the aquifer that is represented divided by the thickness of the layer.)

**Water table**--The water table is that surface in an unconfined aquifer at which the pressure is atmospheric. It is defined by the levels at which water stands in wells that penetrate the aquifer just far enough to hold standing water. In wells which penetrate to greater depths, the water level will stand above or below the water table if an upward or downward component of ground-water flow exists.

Table 2--Ground-water withdrawal rates, in cubic feet per second.

| Location in model | | | Historic ground-water withdrawals | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Layer | Row | Column | 1941 TO 1945 | 1946 TO 1950 | 1951 TO 1955 | 1956 TO 1960 | 1961 TO 1965 | 1966 TO 1970 | 1971 TO 1975 | 1976 TO 1980 |
| 3 | 20 | 5 | | | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 3 | 22 | 6 | | | | | 0.36 | | | |
| 3 | 22 | 7 | | | | | | | 10.40 | 11.46 |
| 3 | 23 | 9 | | | | | | | | 0.42 |
| 3 | 24 | 13 | | | | 3.78 | 8.58 | 6.73 | 5.79 | 5.35 |
| 3 | 25 | 13 | | | | 7.28 | 8.58 | 6.73 | 5.79 | 5.35 |
| 3 | 25 | 14 | | | | 3.78 | 8.58 | 6.73 | 5.79 | 5.35 |
| 3 | 28 | 17 | | | | | | | | 0.19 |
| 5 | 20 | 5 | | | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 5 | 22 | 4 | | | | | | | 0.86 | 1.79 |
| 5 | 22 | 10 | 0.24 | 0.25 | 0.25 | 0.26 | 0.26 | 0.27 | 0.27 | 0.28 |
| 5 | 23 | 4 | 0.48 | 0.61 | 0.83 | 1.50 | 2.04 | 2.30 | 2.70 | 2.54 |
| 5 | 23 | 19 | | | | | | | | 0.06 |

Table 2--Ground-water withdrawal rates, in cubic feet per second. -- Continued

| Location in model | | | Alternative 1 ground-water withdrawals | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Layer | Row | Column | 1981 TO 1987 | 1988 TO 1990 | 1991 TO 1995 | 1996 TO 2000 | 2001 TO 2005 | 2006 TO 2010 | 2011 TO 2015 | 2016 TO 2020 | 2021 TO 2025 | 2026 TO 2030 | 2031 TO 2035 | 2036 TO 2040 |
| 1 | 15 | 9 | | | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | | | | | |
| 1 | 16 | 10 | | 1.12 | 1.12 | 1.12 | 1.12 | 1.12 | 1.12 | 1.12 | 1.12 | 1.12 | | |
| 1 | 16 | 11 | | | 2.28 | 2.28 | 2.28 | 2.28 | 2.28 | 2.28 | | | | |
| 1 | 16 | 12 | | 1.12 | 1.12 | 1.12 | 1.12 | 1.12 | 1.12 | 1.12 | 1.12 | 1.12 | | |
| 1 | 19 | 16 | | | | | 1.66 | 1.66 | 1.66 | 1.66 | 1.66 | 1.66 | | |
| 1 | 19 | 17 | | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | | | | | | |
| 3 | 14 | 7 | 0.50 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | | | | |
| 3 | 15 | 9 | | 0.45 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 |
| 3 | 16 | 10 | | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | | |
| 3 | 16 | 11 | | | 4.63 | 4.63 | 4.63 | 4.63 | 4.63 | 4.63 | | | | |
| 3 | 16 | 12 | | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | | |
| 3 | 17 | 13 | | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | | | |
| 3 | 19 | 16 | | | | | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | | |
| 3 | 20 | 5 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 3 | 20 | 11 | 4.00 | | 7.80 | 7.80 | 7.80 | | | | | | | |
| 3 | 21 | 9 | | | | 1.47 | 3.29 | 3.85 | 3.78 | 2.10 | | | | |
| 3 | 21 | 10 | | | 10.36 | 10.36 | 10.36 | 10.36 | | | | | | |
| 3 | 22 | 6 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | | | | | | |
| 3 | 22 | 7 | 11.13 | 11.13 | 11.13 | 11.13 | 11.13 | 11.13 | | | | | | |
| 3 | 22 | 10 | | | | 0.17 | 0.38 | 0.45 | 0.45 | 0.25 | | | | |
| 3 | 22 | 12 | 1.60 | 3.65 | 2.10 | 2.10 | 4.93 | 4.93 | 4.88 | 4.88 | 4.63 | 4.63 | 4.63 | 4.63 |
| 3 | 22 | 13 | 0.50 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | | | | | |
| 3 | 23 | 12 | | 3.65 | 2.10 | 2.10 | 0.31 | 0.31 | 0.25 | 0.25 | | | | |
| 3 | 24 | 12 | 0.40 | 0.40 | 0.20 | | | | | | | | | |
| 3 | 24 | 13 | 6.17 | 6.17 | 5.97 | 0.23 | 0.23 | | | | | | | |
| 3 | 25 | 13 | 1.10 | | | | | | | | | | | |
| 3 | 25 | 14 | 7.79 | 8.79 | 9.37 | 9.37 | 9.37 | 3.58 | 3.58 | | | | | |
| 3 | 25 | 15 | 8.91 | 8.91 | 8.91 | 8.91 | 8.91 | 8.91 | | | | | | |
| 3 | 26 | 18 | | | 3.56 | 3.56 | 3.56 | 3.56 | 3.56 | 3.56 | | | | |
| 3 | 26 | 19 | | | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | | |
| 3 | 27 | 18 | | | 0.42 | 0.42 | 0.42 | 0.42 | 0.42 | 0.20 | | | | |
| 5 | 20 | 5 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 5 | 22 | 4 | 2.50 | 2.50 | 3.47 | 3.47 | 3.47 | 3.47 | 5.26 | 5.26 | | | | |
| 5 | 22 | 10 | 0.34 | 0.44 | 0.54 | 0.64 | 0.74 | 0.84 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 |
| 5 | 23 | 3 | 0.97 | 0.97 | 0.97 | 0.97 | | | | | | | | |
| 5 | 23 | 4 | 2.49 | 2.49 | 3.46 | 3.46 | 3.46 | 3.46 | 5.26 | 5.26 | | | | |
| 5 | 23 | 15 | 0.64 | 1.55 | 1.55 | 1.55 | 1.55 | 1.55 | 1.55 | | | | | |
| 5 | 23 | 19 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 |
| 6 | 23 | 15 | 0.09 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | | | | | |
| 7 | 17 | 13 | | 1.38 | 1.38 | 1.38 | 1.38 | 1.38 | 1.38 | 1.38 | 1.38 | | | |
| 7 | 19 | 20 | | | | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | | |
| 7 | 23 | 15 | 0.06 | 0.21 | 0.21 | 0.21 | 0.21 | 0.21 | 0.21 | | | | | |
| 7 | 25 | 15 | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | | | | | | |

Table 2--Ground-water withdrawal rates in cubic feet per second -- Continued

| Location in model | | | Alternative 2 ground-water withdrawals | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LAYER | ROW | COLUMN | 1981 TO 1987 | 1988 TO 1990 | 1991 TO 1995 | 1996 TO 2000 | 2001 TO 2005 | 2006 TO 2010 | 2011 TO 2015 | 2016 TO 2020 | 2021 TO 2025 | 2026 TO 2030 | 2031 TO 2035 | 2036 TO 2040 |
| 1 | 7 | 9 | | 0.01 | | | | | | | | | | |
| 1 | 15 | 9 | | 0.02 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | | | | | |
| 1 | 16 | 10 | | 1.14 | 1.14 | 1.14 | 1.12 | 1.12 | 1.12 | 1.12 | 1.12 | 1.12 | | |
| 1 | 16 | 11 | | | 2.28 | 2.28 | 2.28 | 2.28 | 2.28 | 2.28 | | | | |
| 1 | 16 | 12 | | 1.12 | 1.12 | 1.12 | 1.13 | 1.13 | 1.13 | 1.12 | 1.12 | 1.12 | | |
| 1 | 17 | 15 | | | | 0.07 | | | | | | | | |
| 1 | 18 | 16 | | | | | 0.05 | 0.05 | 0.05 | | | | | |
| 1 | 19 | 16 | | | | | 1.66 | 1.66 | 1.66 | 1.66 | 1.66 | 1.66 | | |
| 1 | 19 | 17 | | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | | | | | | |
| 1 | 22 | 13 | | | | | | | 0.04 | 0.04 | 0.04 | 0.04 | | |
| 3 | 7 | 9 | | 0.03 | | | | | | | | | | |
| 3 | 14 | 7 | 0.50 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | | | | |
| 3 | 15 | 9 | | 0.48 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 |
| 3 | 16 | 10 | | 2.35 | 2.35 | 2.35 | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | | |
| 3 | 16 | 11 | | | 4.63 | 4.63 | 4.63 | 4.63 | 4.63 | 4.63 | | | | |
| 3 | 16 | 12 | | 2.32 | 2.32 | 2.32 | 2.34 | 2.34 | 2.34 | 2.32 | 2.32 | 2.32 | | |
| 3 | 17 | 13 | | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | | | |
| 3 | 17 | 15 | | | | 0.05 | | | | | | | | |
| 3 | 18 | 16 | | | | | 0.03 | 0.03 | 0.03 | | | | | |
| 3 | 19 | 16 | | | | | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | | |
| 3 | 20 | 5 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 3 | 20 | 11 | 4.00 | | 7.80 | 7.80 | 7.80 | | | | | | | |
| 3 | 21 | 9 | | | | 1.47 | 3.29 | 3.85 | 3.78 | 2.10 | | | | |
| 3 | 21 | 10 | | | 10.36 | 10.36 | 10.36 | 10.36 | | | | | | |
| 3 | 22 | 6 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | | | | | | |
| 3 | 22 | 7 | 11.13 | 11.13 | 11.13 | 11.13 | 11.13 | 11.13 | | | | | | |
| 3 | 22 | 10 | | | | 0.17 | 0.38 | 0.45 | 0.45 | 0.25 | | | | |
| 3 | 22 | 12 | 1.60 | 3.65 | 2.10 | 2.10 | 4.93 | 4.93 | 4.88 | 4.88 | 4.63 | 4.63 | 4.63 | 4.63 |
| 3 | 22 | 13 | 0.50 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.93 | 0.03 | 0.03 | 0.03 | | |
| 3 | 23 | 12 | | 3.65 | 2.10 | 2.10 | 0.31 | 0.31 | 0.25 | 0.25 | | | | |
| 3 | 24 | 12 | 0.40 | 0.40 | 0.20 | | | | | | | | | |
| 3 | 24 | 13 | 6.17 | 6.17 | 5.97 | 0.23 | 0.23 | | | | | | | |
| 3 | 25 | 13 | 1.10 | | | | | | | | | | | |
| 3 | 25 | 14 | 7.79 | 8.79 | 9.37 | 9.37 | 9.37 | 3.58 | 3.58 | | | | | |
| 3 | 25 | 15 | 8.91 | 8.91 | 8.91 | 8.91 | 8.91 | 8.91 | | | | | | |
| 3 | 26 | 18 | | | 3.56 | 3.56 | 3.56 | 3.56 | 3.56 | 3.56 | | | | |
| 3 | 26 | 19 | | | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | | |
| 3 | 27 | 18 | | | 0.42 | 0.42 | 0.42 | 0.42 | 0.42 | 0.20 | | | | |

Table 2--Ground-water withdrawal rates in cubic feet per second -- Continued

| Location in model | | | Alternative 2 ground-water withdrawals - concluded | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LAYER | ROW | COLUMN | 1981 TO 1987 | 1988 TO 1990 | 1991 TO 1995 | 1996 TO 2000 | 2001 TO 2005 | 2006 TO 2010 | 2011 TO 2015 | 2016 TO 2020 | 2021 TO 2025 | 2026 TO 2030 | 2031 TO 2035 | 2036 TO 2040 |
| 5 | 20 | 5 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 5 | 22 | 4 | 2.50 | 2.50 | 3.47 | 3.47 | 3.47 | 3.47 | 5.26 | 5.26 | | | | |
| 5 | 22 | 10 | 0.34 | 0.44 | 0.54 | 0.64 | 0.74 | 0.84 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 |
| 5 | 23 | 3 | 0.97 | 1.01 | 1.01 | 1.01 | | | | | | | | |
| 5 | 23 | 4 | 2.49 | 2.49 | 3.46 | 3.46 | 3.46 | 3.46 | 5.26 | 5.26 | | | | |
| 5 | 23 | 15 | 0.64 | 1.55 | 1.55 | 1.55 | 1.55 | 1.55 | 1.55 | | | | | |
| 5 | 23 | 19 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 |
| 6 | 23 | 15 | 0.09 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | | | | | |
| 7 | 17 | 13 | | 1.38 | 1.38 | 1.38 | 1.38 | 1.38 | 1.38 | 1.38 | 1.38 | | | |
| 7 | 17 | 15 | | | | 0.02 | | | | | | | | |
| 7 | 18 | 16 | | | | | 0.01 | 0.01 | 0.01 | | | | | |
| 7 | 19 | 20 | | | | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | | |
| 7 | 22 | 13 | | | | | | | 0.01 | 0.01 | 0.01 | 0.01 | | |
| 7 | 23 | 15 | 0.06 | 0.21 | 0.21 | 0.21 | 0.21 | 0.21 | 0.21 | | | | | |
| 7 | 25 | 15 | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | | | | | | |

Table 2--Ground-water withdrawal rates in cubic feet per second -- Continued

| Location in model | | | Alternative 3 ground-water withdrawals | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LAYER | ROW | COLUMN | 1981 TO 1987 | 1988 TO 1990 | 1991 TO 1995 | 1996 TO 2000 | 2001 TO 2005 | 2006 TO 2010 | 2011 TO 2015 | 2016 TO 2020 | 2021 TO 2025 | 2026 TO 2030 | 2031 TO 2035 | 2036 TO 2040 |
| 1 | 7 | 9 | | 0.01 | | 0.02 | | | | | | | | |
| 1 | 15 | 9 | | | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | | | | | |
| 1 | 15 | 10 | | 0.05 | 0.05 | 0.05 | | | | | | | | |
| 1 | 16 | 10 | | 1.12 | 1.12 | 1.12 | 1.12 | 1.12 | 1.12 | 1.12 | 1.12 | 1.12 | | |
| 1 | 16 | 11 | | | 2.28 | 2.28 | 2.28 | 2.28 | 2.28 | 2.28 | | | | |
| 1 | 16 | 12 | | 1.12 | 1.12 | 1.15 | 1.16 | 1.13 | 1.13 | 1.12 | 1.12 | 1.12 | | |
| 1 | 17 | 14 | | | | | | | | 0.05 | 0.05 | | | |
| 1 | 19 | 16 | | | | | 1.66 | 1.66 | 1.66 | 1.66 | 1.66 | 1.66 | | |
| 1 | 19 | 17 | | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | | | | | | |
| 1 | 22 | 13 | | | | | | | | | 0.03 | 0.03 | 0.03 | |
| 3 | 7 | 9 | | 0.03 | | 0.03 | | | | | | | | |
| 3 | 14 | 7 | 0.50 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | | | | |
| 3 | 15 | 9 | | 0.45 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 |
| 3 | 15 | 10 | | 0.10 | 0.10 | 0.10 | | | | | | | | |
| 3 | 16 | 10 | | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | | |
| 3 | 16 | 11 | | | 4.63 | 4.63 | 4.63 | 4.63 | 4.63 | 4.63 | | | | |
| 3 | 16 | 12 | | 2.32 | 2.32 | 2.99 | 3.01 | 2.34 | 2.34 | 2.32 | 2.32 | 2.32 | | |
| 3 | 17 | 13 | | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | | | |
| 3 | 17 | 14 | | | | | | | | 0.03 | 0.03 | | | |
| 3 | 19 | 16 | | | | | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | | |
| 3 | 20 | 5 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 3 | 20 | 11 | 4.00 | | 7.80 | 7.80 | 7.80 | | | | | | | |
| 3 | 21 | 9 | | | | 1.47 | 3.29 | 3.85 | 3.78 | 2.10 | | | | |
| 3 | 21 | 10 | | | 10.36 | 10.36 | 10.36 | 10.36 | | | | | | |
| 3 | 22 | 6 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | | | | | | |
| 3 | 22 | 7 | 11.13 | 11.13 | 11.13 | 11.13 | 11.13 | 11.13 | | | | | | |
| 3 | 22 | 10 | | | | 0.17 | 0.38 | 0.45 | 0.45 | 0.25 | | | | |
| 3 | 22 | 12 | 1.60 | 3.65 | 2.10 | 2.10 | 4.93 | 4.93 | 4.88 | 4.88 | 4.63 | 4.63 | 4.63 | 4.63 |
| 3 | 22 | 13 | 0.50 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | | 0.02 | 0.02 | 0.02 | |
| 3 | 23 | 12 | | 3.65 | 2.10 | 2.10 | 0.31 | 0.31 | 0.25 | 0.25 | | | | |
| 3 | 24 | 12 | 0.40 | 0.40 | 0.20 | | | | | | | | | |
| 3 | 24 | 13 | 6.17 | 6.17 | 5.97 | 0.23 | 0.23 | | | | | | | |
| 3 | 25 | 13 | 1.10 | | | | | | | | | | | |
| 3 | 25 | 14 | 7.79 | 8.79 | 9.37 | 9.37 | 9.37 | 3.58 | 3.58 | | | | | |
| 3 | 25 | 15 | 8.91 | 8.91 | 8.91 | 8.91 | 8.91 | 8.91 | | | | | | |
| 3 | 26 | 18 | | | 3.56 | 3.56 | 3.56 | 3.56 | 3.56 | 3.56 | | | | |
| 3 | 26 | 19 | | | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | | |
| 3 | 27 | 18 | | | 0.42 | 0.42 | 0.42 | 0.42 | 0.42 | 0.20 | | | | |

Table 2--Ground-water withdrawal rates in cubic feet per second -- Continued

| Location in model | | | Alternative 3 ground-water withdrawals - concluded | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LAYER | ROW | COLUMN | 1981 TO 1987 | 1988 TO 1990 | 1991 TO 1995 | 1996 TO 2000 | 2001 TO 2005 | 2006 TO 2010 | 2011 TO 2015 | 2016 TO 2020 | 2021 TO 2025 | 2026 TO 2030 | 2031 TO 2035 | 2036 TO 2040 |
| 5 | 20 | 5 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 5 | 22 | 4 | 2.50 | 2.50 | 3.47 | 3.47 | 3.47 | 3.47 | 5.26 | 5.26 | | | | |
| 5 | 22 | 10 | 0.34 | 0.44 | 0.54 | 0.64 | 0.74 | 0.84 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 |
| 5 | 23 | 3 | 0.97 | 0.97 | 0.97 | 0.97 | | | | | | | | |
| 5 | 23 | 4 | 2.49 | 2.49 | 3.46 | 3.46 | 3.46 | 3.46 | 5.26 | 5.26 | | | | |
| 5 | 23 | 13 | | | | 0.05 | 0.05 | | | | | | | |
| 5 | 23 | 14 | | 1.05 | 1.05 | 1.05 | | | | | | | | |
| 5 | 23 | 15 | 0.64 | 1.55 | 1.55 | 1.60 | 1.60 | 1.55 | 1.55 | | | | | |
| 5 | 23 | 19 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 |
| 5 | 24 | 15 | | | 1.05 | 1.05 | 1.05 | | | | | | | |
| 6 | 23 | 13 | | | | 0.01 | 0.01 | | | | | | | |
| 6 | 23 | 14 | | 0.21 | 0.21 | 0.21 | | | | | | | | |
| 6 | 23 | 15 | 0.09 | 0.31 | 0.31 | 0.32 | 0.32 | 0.31 | 0.31 | | | | | |
| 6 | 24 | 15 | | | 0.21 | 0.21 | 0.21 | | | | | | | |
| 7 | 17 | 13 | | 1.38 | 1.38 | 1.38 | 1.38 | 1.38 | 1.38 | 1.38 | 1.38 | | | |
| 7 | 17 | 14 | | | | | | | | 0.01 | 0.01 | | | |
| 7 | 19 | 20 | | | | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | | |
| 7 | 22 | 13 | | | | | | | | | 0.01 | 0.01 | 0.01 | |
| 7 | 23 | 13 | | | | 0.01 | 0.01 | | | | | | | |
| 7 | 23 | 14 | | 0.14 | 0.14 | 0.14 | | | | | | | | |
| 7 | 23 | 15 | 0.06 | 0.21 | 0.21 | 0.22 | 0.22 | 0.21 | 0.21 | | | | | |
| 7 | 24 | 15 | | | 0.14 | 0.14 | 0.14 | | | | | | | |
| 7 | 25 | 15 | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | | | | | | |

Table 2--Ground-water withdrawal rates in cubic feet per second -- Continued

| Location in model | | | Alternative 4 ground-water withdrawals | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LAYER | ROW | COLUMN | 1981 TO 1987 | 1988 TO 1990 | 1991 TO 1995 | 1996 TO 2000 | 2001 TO 2005 | 2006 TO 2010 | 2011 TO 2015 | 2016 TO 2020 | 2021 TO 2025 | 2026 TO 2030 | 2031 TO 2035 | 2036 TO 2040 |
| 1 | 7 | 9 | | 0.01 | | 0.02 | | | | | | | | |
| 1 | 15 | 9 | | 0.02 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | | | | | |
| 1 | 15 | 10 | | 0.14 | 0.14 | 0.14 | | | | | | | | |
| 1 | 16 | 9 | | 0.01 | 0.01 | 0.01 | | | | | | | | |
| 1 | 16 | 10 | | 1.14 | 1.14 | 1.14 | 1.12 | 1.12 | 1.12 | 1.12 | 1.12 | 1.12 | | |
| 1 | 16 | 11 | | | 2.28 | 2.28 | 2.28 | 2.28 | 2.28 | 2.28 | | | | |
| 1 | 16 | 12 | | 1.12 | 1.12 | 1.15 | 1.16 | 1.13 | 1.13 | 1.12 | 1.12 | 1.12 | | |
| 1 | 17 | 14 | | | | | | | | 0.05 | 0.05 | | | |
| 1 | 17 | 15 | | | | 0.07 | | | | | | | | |
| 1 | 18 | 16 | | | | | 0.05 | 0.05 | 0.05 | | | | | |
| 1 | 18 | 17 | | 0.14 | 0.14 | 0.14 | | | | | | | | |
| 1 | 19 | 16 | | | | | 1.66 | 1.66 | 1.66 | 1.66 | 1.66 | 1.66 | | |
| 1 | 19 | 17 | | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | | | | | | |
| 1 | 19 | 18 | | 0.02 | 0.02 | 0.02 | | | | | | | | |
| 1 | 22 | 13 | | | | | | | 0.04 | 0.04 | 0.07 | 0.07 | 0.03 | 0.00 |
| 3 | 7 | 9 | | 0.03 | | 0.03 | | | | | | | | |
| 3 | 14 | 7 | 0.50 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | | | | |
| 3 | 15 | 9 | | 0.48 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 |
| 3 | 15 | 10 | | 0.29 | 0.29 | 0.29 | | | | | | | | |
| 3 | 16 | 9 | | 0.02 | 0.02 | 0.02 | | | | | | | | |
| 3 | 16 | 10 | | 2.35 | 2.35 | 2.35 | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | | |
| 3 | 16 | 11 | | | 4.63 | 4.63 | 4.63 | 4.63 | 4.63 | 4.63 | | | | |
| 3 | 16 | 12 | | 2.32 | 2.32 | 2.99 | 3.01 | 2.34 | 2.34 | 2.32 | 2.32 | 2.32 | | |
| 3 | 17 | 13 | | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | | | |
| 3 | 17 | 14 | | | | | | | | 0.03 | 0.03 | | | |
| 3 | 17 | 15 | | | | 0.05 | | | | | | | | |
| 3 | 18 | 16 | | | | | 0.03 | 0.03 | 0.03 | | | | | |
| 3 | 19 | 16 | | | | | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | | |
| 3 | 19 | 18 | | 0.03 | 0.03 | 0.03 | | | | | | | | |
| 3 | 20 | 5 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 3 | 20 | 11 | 4.00 | | 7.80 | 7.80 | 7.80 | | | | | | | |
| 3 | 21 | 9 | | | | 1.47 | 3.29 | 3.85 | 3.78 | 2.10 | | | | |
| 3 | 21 | 10 | | | 10.36 | 10.36 | 10.36 | 10.36 | | | | | | |
| 3 | 22 | 6 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | | | | | | |
| 3 | 22 | 7 | 11.13 | 11.13 | 11.13 | 11.13 | 11.13 | 11.13 | | | | | | |
| 3 | 22 | 10 | | | | 0.17 | 0.38 | 0.45 | 0.45 | 0.25 | | | | |
| 3 | 22 | 12 | 1.60 | 3.65 | 2.10 | 2.10 | 4.93 | 4.93 | 4.88 | 4.88 | 4.63 | 4.63 | 4.63 | 4.63 |
| 3 | 22 | 13 | 0.50 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.93 | 0.03 | 0.05 | 0.05 | 0.02 | 0.00 |
| 3 | 23 | 12 | | 3.65 | 2.10 | 2.10 | 0.31 | 0.31 | 0.25 | 0.25 | | | | |
| 3 | 24 | 12 | 0.40 | 0.40 | 0.20 | | | | | | | | | |

Table 2--Ground-water withdrawal rates in cubic feet per second -- Continued

| Location in model | | | Alternative 4 ground-water withdrawals - concluded | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LAYER | ROW | COLUMN | 1981 TO 1987 | 1988 TO 1990 | 1991 TO 1995 | 1996 TO 2000 | 2001 TO 2005 | 2006 TO 2010 | 2011 TO 2015 | 2016 TO 2020 | 2021 TO 2025 | 2026 TO 2030 | 2031 TO 2035 | 2036 TO 2040 |
| 3 | 24 | 13 | 6.17 | 6.17 | 5.97 | 0.23 | 0.23 | | | | | | | |
| 3 | 25 | 13 | 1.10 | | | | | | | | | | | |
| 3 | 25 | 14 | 7.79 | 8.79 | 9.37 | 9.37 | 9.37 | 3.58 | 3.58 | | | | | |
| 3 | 25 | 15 | 8.91 | 8.91 | 8.91 | 8.91 | 8.91 | 8.91 | | | | | | |
| 3 | 26 | 18 | | | 3.56 | 3.56 | 3.56 | 3.56 | 3.56 | 3.56 | | | | |
| 3 | 26 | 19 | | | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | | |
| 3 | 27 | 18 | | | 0.42 | 0.42 | 0.42 | 0.42 | 0.42 | 0.20 | | | | |
| 5 | 20 | 5 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 5 | 21 | 10 | | | | | | | 0.13 | 0.13 | 0.13 | 0.13 | | |
| 5 | 21 | 11 | | | | | | | | | 0.31 | 0.31 | 0.31 | |
| 5 | 22 | 4 | 2.50 | 2.50 | 3.47 | 3.47 | 3.47 | 3.47 | 5.26 | 5.26 | | | | |
| 5 | 22 | 10 | 0.34 | 0.44 | 0.54 | 0.64 | 0.74 | 0.84 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 |
| 5 | 23 | 3 | 0.97 | 1.08 | 1.08 | 1.08 | 0.07 | | | | | | | |
| 5 | 23 | 4 | 2.49 | 2.49 | 3.46 | 3.46 | 3.46 | 3.46 | 5.26 | 5.26 | | | | |
| 5 | 23 | 13 | | | | 0.05 | 0.05 | | | | | | | |
| 5 | 23 | 14 | | 1.05 | 1.05 | 1.05 | | | | | | | | |
| 5 | 23 | 15 | 0.64 | 1.55 | 1.55 | 1.60 | 1.60 | 1.55 | 1.55 | | | | | |
| 5 | 23 | 19 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 |
| 5 | 24 | 5 | | 0.02 | 0.07 | 0.02 | 0.00 | 0.00 | | | | | | |
| 5 | 24 | 15 | | | 1.05 | 1.05 | 1.05 | | | | | | | |
| 6 | 21 | 10 | | | | | | | 0.03 | 0.03 | 0.03 | 0.03 | | |
| 6 | 21 | 11 | | | | | | | | | 0.06 | 0.06 | 0.06 | 0.00 |
| 6 | 23 | 13 | | | | 0.01 | 0.01 | | | | | | | |
| 6 | 23 | 14 | | 0.21 | 0.21 | 0.21 | | | | | | | | |
| 6 | 23 | 15 | 0.09 | 0.31 | 0.31 | 0.32 | 0.32 | 0.31 | 0.31 | | | | | |
| 6 | 24 | 15 | | | 0.21 | 0.21 | 0.21 | | | | | | | |
| 7 | 17 | 13 | | 1.38 | 1.38 | 1.38 | 1.38 | 1.38 | 1.38 | 1.38 | 1.38 | | | |
| 7 | 17 | 14 | | | | | | | | 0.01 | 0.01 | | | |
| 7 | 17 | 15 | | | | 0.02 | | | | | | | | |
| 7 | 18 | 16 | | | | | 0.01 | 0.01 | 0.01 | | | | | |
| 7 | 19 | 20 | | | | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | | |
| 7 | 21 | 10 | | | | | | | 0.01 | 0.01 | 0.01 | 0.01 | | |
| 7 | 21 | 11 | | | | | | | | | 0.04 | 0.04 | 0.04 | 0.00 |
| 7 | 22 | 13 | | | | | | | 0.01 | 0.01 | 0.02 | 0.02 | 0.01 | |
| 7 | 23 | 13 | | | | 0.01 | 0.01 | | | | | | | |
| 7 | 23 | 14 | | 0.14 | 0.14 | 0.14 | | | | | | | | |
| 7 | 23 | 15 | 0.06 | 0.21 | 0.21 | 0.22 | 0.22 | 0.21 | 0.21 | | | | | |
| 7 | 24 | 15 | | | 0.14 | 0.14 | 0.14 | | | | | | | |
| 7 | 25 | 15 | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | | | | | | |

Table 2--Ground-water withdrawal rates in cubic feet per second -- Continued

| Location in model | | | Alternative 5 ground-water withdrawals | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LAYER | ROW | COLUMN | 1981 TO 1987 | 1988 TO 1990 | 1991 TO 1995 | 1996 TO 2000 | 2001 TO 2005 | 2006 TO 2010 | 2011 TO 2015 | 2016 TO 2020 | 2021 TO 2025 | 2026 TO 2030 | 2031 TO 2035 | 2036 TO 2040 |
| 1 | 7 | 9 | | 0.06 | 0.05 | 0.08 | 0.02 | 0.02 | | | | | | |
| 1 | 15 | 9 | | 0.02 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | | | | | |
| 1 | 15 | 10 | | 0.14 | 0.14 | 0.14 | | | | | | | | |
| 1 | 16 | 9 | | 0.01 | 0.01 | 0.01 | | | | | | | | |
| 1 | 16 | 10 | | 1.14 | 1.14 | 1.14 | 1.12 | 1.12 | 1.12 | 1.12 | 1.12 | 1.12 | | |
| 1 | 16 | 11 | | | 2.28 | 2.28 | 2.28 | 2.28 | 2.28 | 2.28 | | | | |
| 1 | 16 | 12 | | 1.12 | 1.12 | 1.15 | 1.16 | 1.13 | 1.13 | 1.12 | 1.12 | 1.12 | | |
| 1 | 17 | 14 | | | | | | | | 0.05 | 0.05 | | | |
| 1 | 17 | 15 | | | | 0.07 | | | | | | | | |
| 1 | 18 | 16 | | | | | 0.05 | 0.05 | 0.05 | | | | | |
| 1 | 18 | 17 | | 0.14 | 0.14 | 0.24 | 0.10 | | | | | | | |
| 1 | 19 | 16 | | | | | 1.66 | 1.66 | 1.66 | 1.66 | 1.66 | 1.66 | | |
| 1 | 19 | 17 | | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | | | | | | |
| 1 | 19 | 18 | | 0.02 | 0.02 | 0.02 | | | | | | | | |
| 1 | 22 | 13 | | | | | | | 0.04 | 0.04 | 0.07 | 0.07 | 0.03 | 0.00 |
| 3 | 7 | 9 | | 0.12 | 0.09 | 0.16 | 0.03 | 0.03 | | | | | | |
| 3 | 14 | 7 | 0.50 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | | | | |
| 3 | 15 | 9 | | 0.48 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 |
| 3 | 15 | 10 | | 0.29 | 0.29 | 0.29 | | | | | | | | |
| 3 | 16 | 9 | | 0.02 | 0.02 | 0.02 | | | | | | | | |
| 3 | 16 | 10 | | 2.35 | 2.35 | 2.35 | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | | |
| 3 | 16 | 11 | | | 4.63 | 4.63 | 4.63 | 4.63 | 4.63 | 4.63 | | | | |
| 3 | 16 | 12 | | 2.32 | 2.32 | 2.99 | 3.01 | 2.34 | 2.34 | 2.32 | 2.32 | 2.32 | | |
| 3 | 17 | 13 | | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | | | |
| 3 | 17 | 14 | | | | | | | | 0.03 | 0.03 | | | |
| 3 | 17 | 15 | | | | 0.05 | | | | | | | | |
| 3 | 18 | 16 | | | | | 0.03 | 0.03 | 0.03 | | | | | |
| 3 | 19 | 16 | | | | | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | | |
| 3 | 19 | 18 | | 0.03 | 0.03 | 0.03 | | | | | | | | |
| 3 | 20 | 5 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 3 | 20 | 11 | 4.00 | | 7.80 | 7.80 | 7.80 | | | | | | | |
| 3 | 21 | 9 | | | | 1.47 | 3.29 | 3.85 | 3.78 | 2.10 | | | | |
| 3 | 21 | 10 | | | 10.36 | 10.36 | 10.36 | 10.36 | | | | | | |
| 3 | 22 | 6 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | | | | | | |
| 3 | 22 | 7 | 11.13 | 11.13 | 11.13 | 11.13 | 11.13 | 11.13 | | | | | | |
| 3 | 22 | 10 | | | | 0.17 | 0.38 | 0.45 | 0.45 | 0.25 | | | | |
| 3 | 22 | 12 | 1.60 | 3.65 | 2.10 | 2.10 | 4.93 | 4.93 | 4.88 | 4.88 | 4.63 | 4.63 | 4.63 | 4.63 |
| 3 | 22 | 13 | 0.50 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.93 | 0.03 | 0.05 | 0.05 | 0.02 | 0.00 |
| 3 | 23 | 12 | | 3.65 | 2.10 | 2.10 | 0.31 | 0.31 | 0.25 | 0.25 | | | | |
| 3 | 24 | 12 | 0.40 | 0.40 | 0.20 | | | | | | | | | |
| 3 | 24 | 13 | 6.17 | 6.17 | 5.97 | 0.23 | 0.23 | | | | | | | |

Table 2--Ground-water withdrawal rates in cubic feet per second -- Continued

| Location in model | | | Alternative 5 ground-water withdrawals - concluded | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LAYER | ROW | COLUMN | 1981 TO 1987 | 1988 TO 1990 | 1991 TO 1995 | 1996 TO 2000 | 2001 TO 2005 | 2006 TO 2010 | 2011 TO 2015 | 2016 TO 2020 | 2021 TO 2025 | 2026 TO 2030 | 2031 TO 2035 | 2036 TO 2040 |
| 3 | 25 | 13 | 1.10 | | | | | | | | | | | |
| 3 | 25 | 14 | 7.79 | 8.79 | 9.37 | 9.37 | 9.37 | 3.58 | 3.58 | | | | | |
| 3 | 25 | 15 | 8.91 | 8.91 | 8.91 | 8.91 | 8.91 | 8.91 | | | | | | |
| 3 | 26 | 18 | | | 3.56 | 3.56 | 3.56 | 3.56 | 3.56 | 3.56 | | | | |
| 3 | 26 | 19 | | | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | | |
| 3 | 27 | 18 | | | 0.42 | 0.42 | 0.42 | 0.42 | 0.42 | 0.20 | | | | |
| 5 | 20 | 5 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 5 | 21 | 10 | | | | | | | 0.13 | 0.13 | 0.13 | 0.13 | | |
| 5 | 21 | 11 | | | | | | | | | 0.31 | 0.31 | 0.31 | |
| 5 | 22 | 4 | 2.50 | 2.50 | 3.47 | 3.47 | 3.47 | 3.47 | 5.26 | 5.26 | | | | |
| 5 | 22 | 10 | 0.34 | 0.44 | 0.54 | 0.64 | 0.74 | 0.84 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 |
| 5 | 22 | 17 | | 0.51 | 0.51 | 0.51 | | | | | | | | |
| 5 | 23 | 3 | 0.97 | 1.12 | 1.12 | 1.28 | 0.23 | 0.08 | 0.08 | | | | | |
| 5 | 23 | 4 | 2.49 | 2.49 | 3.46 | 3.46 | 3.46 | 3.46 | 5.26 | 5.26 | | | | |
| 5 | 23 | 13 | | | | 0.05 | 0.05 | | | | | | | |
| 5 | 23 | 14 | | 1.05 | 1.05 | 1.05 | | | | | | | | |
| 5 | 23 | 15 | 0.64 | 1.55 | 1.55 | 1.60 | 1.60 | 1.55 | 1.55 | | | | | |
| 5 | 23 | 19 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 |
| 5 | 24 | 3 | | 0.23 | 0.23 | 0.23 | | | | | | | | |
| 5 | 24 | 5 | | 0.08 | 0.13 | 0.13 | 0.05 | | 0.04 | 0.04 | | | | |
| 5 | 24 | 15 | | | 1.05 | 1.05 | 1.05 | | | | | | | |
| 5 | 25 | 5 | | | | 0.03 | 0.03 | | | | | | | |
| 5 | 26 | 5 | | | | 0.05 | 0.05 | | | | | | | |
| 6 | 21 | 10 | | | | | | | 0.03 | 0.03 | 0.03 | 0.03 | | |
| 6 | 21 | 11 | | | | | | | | | 0.06 | 0.06 | 0.06 | 0.00 |
| 6 | 23 | 13 | | | | 0.01 | 0.01 | | | | | | | |
| 6 | 23 | 14 | | 0.21 | 0.21 | 0.21 | | | | | | | | |
| 6 | 23 | 15 | 0.09 | 0.31 | 0.31 | 0.32 | 0.32 | 0.31 | 0.31 | | | | | |
| 6 | 24 | 15 | | | 0.21 | 0.21 | 0.21 | | | | | | | |
| 7 | 17 | 13 | | 1.38 | 1.38 | 1.38 | 1.38 | 1.38 | 1.38 | 1.38 | 1.38 | | | |
| 7 | 17 | 14 | | | | | | | | 0.01 | 0.01 | | | |
| 7 | 17 | 15 | | | | 0.02 | | | | | | | | |
| 7 | 18 | 16 | | | | | 0.01 | 0.01 | 0.01 | | | | | |
| 7 | 19 | 20 | | | | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | | |
| 7 | 21 | 10 | | | | | | | 0.01 | 0.01 | 0.01 | 0.01 | | |
| 7 | 21 | 11 | | | | | | | | | 0.04 | 0.04 | 0.04 | 0.00 |
| 7 | 22 | 13 | | | | | | | 0.01 | 0.01 | 0.02 | 0.02 | 0.01 | |
| 7 | 22 | 17 | | 0.06 | 0.06 | 0.06 | | | | | | | | |
| 7 | 23 | 13 | | | | 0.01 | 0.01 | | | | | | | |
| 7 | 23 | 14 | | 0.14 | 0.14 | 0.14 | | | | | | | | |
| 7 | 23 | 15 | 0.06 | 0.21 | 0.21 | 0.22 | 0.22 | 0.21 | 0.21 | | | | | |
| 7 | 24 | 15 | | | 0.14 | 0.14 | 0.14 | | | | | | | |
| 7 | 25 | 15 | 2.32 | 2.32 | 2.32 | 2.32 | 2.32 | | | | | | | |

Table 2.--Ground-water withdrawal rates, in cubic feet per second - Concluded

SUMMARY BY LAYER
Historic ground-water withdrawals

| LAYER NUMBER | 1941 TO 1945 | 1946 TO 1950 | 1951 TO 1955 | 1956 TO 1960 | 1961 TO 1965 | 1966 TO 1970 | 1971 TO 1975 | 1976 TO 1980 |
|---|---|---|---|---|---|---|---|---|
| 3 | | | | 15.84 | 27.10 | 21.19 | 28.77 | 29.12 |
| 5 | 0.72 | 0.86 | 1.08 | 2.76 | 3.30 | 3.57 | 4.83 | 5.67 |

PROJECTIONS

| LAYER NUMBER | 1981 TO 1987 | 1988 TO 1990 | 1991 TO 1995 | 1996 TO 2000 | 2001 TO 2005 | 2006 TO 2010 | 2011 TO 2015 | 2016 TO 2020 | 2021 TO 2025 | 2026 TO 2030 | 2031 TO 2035 | 2036 TO 2040 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | ALTERNATIVE 1 | | | | | | | |
| 1 | | 3.34 | 5.71 | 5.71 | 7.37 | 7.37 | 6.27 | 6.18 | 3.90 | 3.90 | | |
| 3 | 43.60 | 51.84 | 77.08 | 72.78 | 76.95 | 63.76 | 32.68 | 25.91 | 13.92 | 13.02 | 6.08 | 6.08 |
| 5 | 8.06 | 9.07 | 11.11 | 11.21 | 10.34 | 10.44 | 14.07 | 12.52 | 2.00 | 2.00 | 2.00 | 2.00 |
| 6 | 0.09 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | | | | | |
| 7 | 2.38 | 3.91 | 3.91 | 4.22 | 4.22 | 4.22 | 1.90 | 1.69 | 1.69 | 0.31 | | |
| | | | | | ALTERNATIVE 2 | | | | | | | |
| 1 | | 3.39 | 5.73 | 5.80 | 7.43 | 7.43 | 6.37 | 6.22 | 3.94 | 3.94 | | |
| 3 | 43.60 | 51.93 | 77.11 | 72.86 | 77.00 | 63.81 | 32.76 | 25.94 | 13.95 | 13.05 | 6.09 | 6.08 |
| 5 | 8.06 | 9.11 | 11.15 | 11.25 | 10.34 | 10.44 | 14.07 | 12.52 | 2.00 | 2.00 | 2.00 | 2.00 |
| 6 | 0.09 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | | | | | |
| 7 | 2.38 | 3.91 | 3.91 | 4.24 | 4.23 | 4.23 | 1.92 | 1.70 | 1.70 | 0.32 | | |
| | | | | | ALTERNATIVE 3 | | | | | | | |
| 1 | | 3.40 | 5.76 | 5.81 | 7.41 | 7.38 | 6.28 | 6.23 | 3.98 | 3.93 | 0.03 | |
| 3 | 43.60 | 51.97 | 77.18 | 73.58 | 77.64 | 63.78 | 32.70 | 25.94 | 13.97 | 13.04 | 6.10 | 6.08 |
| 5 | 8.06 | 10.12 | 13.21 | 13.41 | 11.49 | 10.44 | 14.07 | 12.52 | 2.00 | 2.00 | 2.00 | 2.00 |
| 6 | 0.09 | 0.52 | 0.73 | 0.75 | 0.54 | 0.31 | 0.31 | | | | | |
| 7 | 2.38 | 4.05 | 4.19 | 4.52 | 4.38 | 4.22 | 1.90 | 1.70 | 1.71 | 0.32 | 0.01 | |
| | | | | | ALTERNATIVE 4 | | | | | | | |
| 1 | | 3.70 | 6.04 | 6.16 | 7.46 | 7.43 | 6.37 | 6.27 | 4.02 | 3.97 | 0.03 | |
| 3 | 43.60 | 52.27 | 77.45 | 73.90 | 77.67 | 63.81 | 32.76 | 25.97 | 14.00 | 13.07 | 6.10 | 6.08 |
| 5 | 8.06 | 10.25 | 13.39 | 13.54 | 11.56 | 10.44 | 14.20 | 12.65 | 2.44 | 2.44 | 2.31 | 2.00 |
| 6 | 0.09 | 0.52 | 0.73 | 0.75 | 0.54 | 0.31 | 0.34 | 0.03 | 0.09 | 0.09 | 0.06 | |
| 7 | 2.38 | 4.05 | 4.19 | 4.54 | 4.39 | 4.23 | 1.93 | 1.72 | 1.77 | 0.38 | 0.05 | |
| | | | | | ALTERNATIVE 5 | | | | | | | |
| 1 | 0.00 | 3.75 | 6.09 | 6.32 | 7.58 | 7.45 | 6.37 | 6.27 | 4.02 | 3.97 | 0.03 | 0.00 |
| 3 | 43.60 | 52.36 | 77.54 | 74.03 | 77.70 | 63.84 | 32.76 | 25.97 | 14.00 | 13.07 | 6.10 | 6.08 |
| 5 | 8.06 | 11.09 | 14.23 | 14.67 | 11.85 | 10.52 | 14.32 | 12.69 | 2.44 | 2.44 | 2.31 | 2.00 |
| 6 | 0.09 | 0.52 | 0.73 | 0.75 | 0.54 | 0.31 | 0.34 | 0.03 | 0.09 | 0.09 | 0.06 | 0.00 |
| 7 | 2.38 | 4.11 | 4.25 | 4.60 | 4.39 | 4.23 | 1.93 | 1.72 | 1.77 | 0.38 | 0.05 | 0.00 |