

Cover description:

Landsat thematic mapper mosaic of the Middle Rio Grande Basin. The four scenes used in the image were acquired in September 1993. Bands 1, 4, and 7 are displayed through blue, green, and red filters, respectively. The image has been output at 30-meter resolution by cubic convolution resampling to fit the North American Datum of 1983 (NAD83) in a Universal Transverse Mercator (UTM) projection. A terrain correction was included in the processing using USGS 1:24,000-scale Digital Elevation Model (DEM) data. Image compiled by the USGS Astrogeology Program, Flagstaff Field Center. See Mullins and Hare (1999) for a more complete description of the image.

Mullins, K.F., and Hare, T.M., 1999, Calibration, processing, and production of a Landsat thematic mapper mosaic of the Middle Rio Grande Basin Study area, *in* Bartolino, J.R., ed., U.S. Geological Survey Middle Rio Grande Basin Study—Proceedings of the Third Annual Workshop, Albuquerque, New Mexico, February 24–25, 1999: U.S. Geological Survey Open-File Report 99–203, p. 15–17.

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GROUND-WATER RESOURCES OF THE MIDDLE RIO GRANDE BASIN

By

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Foreword

In 1995, the agency primarily responsible for managing water resources in New Mexico, the Office of the State Engineer, declared the Middle Rio Grande Basin a “critical basin”; that is, a ground-water basin faced with rapid economic and population growth for which there is less than adequate technical information about the available water supply. This declaration was largely the result of studies of the ground-water resources of the Middle Rio Grande Basin by the New Mexico Bureau of Geology and Mineral Resources (formerly the New Mexico Bureau of Mines and Mineral Resources) and U.S. Geological Survey (USGS) in cooperation with the City of Albuquerque that showed conclusively that many aspects of the popular understanding of water resources of the basin were incorrect. The two most important conclusions of these studies were that there is significantly less ground water available for supply than previously thought and that the Rio Grande contributes less water to the Santa Fe Group aquifer system than was previously believed. Both conclusions have had and will continue to have major impacts on how water is used, allocated, and managed in the basin. However, these studies also revealed gaps in the understanding of the water resources of the basin. In an effort to fill some of these gaps, the USGS and other agencies began the Middle Rio Grande Basin Study, a 6-year effort to improve the understanding of the hydrology, geology, and land-surface characteristics of the Middle Rio Grande Basin.

An important aspect of the USGS mission is to provide information that describes the Earth, its resources, and the processes that govern the availability and quality of those resources. With reports such as this Circular, the USGS seeks to broaden public understanding of water resources and the processes that affect those resources. Our hope is that this improved understanding will contribute to another goal of the USGS: the use of this scientific information to enhance and protect our quality of life.

This Circular presents an overview of our current understanding of the water resources of the Middle Rio Grande Basin, with an emphasis on ground water. This report is written for a wide audience of people interested or involved in the use of water resources in the Middle Rio Grande Basin. It is intended to serve as a general educational document rather than a report of new scientific findings, though much of the information it contains is the result of new studies performed as part of the Middle Rio Grande Basin Study. This Circular, coupled with ongoing data collection and research, is the USGS contribution toward a sound scientific basis for water managers and policy makers to make informed decisions about the water resources of the basin with the goal of meeting current needs and assuring a sustainable supply for future generations.

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Director, U.S. Geological Survey

Acknowledgments

This report is not only the culmination of the 6-year Middle Rio Grande Basin Study, but also of the work of many preceding scientists and engineers. Some of the most notable scientists in the fields of geology and hydrology have worked in the Middle Rio Grande Basin at some point in their careers, including Kirk Bryan and C.V. Theis. The authors wish to acknowledge the contribution of all those who have contributed to the current understanding of the hydrogeology of the basin. The oft-quoted remark of Lucan (Marcus Annaeus Lucanus, A.D. 39–65) applies: “Pigmies placed on the shoulders of giants see more than the giants themselves.”

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In addition to the U.S. Geological Survey, many other Federal, State, and local governments and agencies contributed resources to or cooperated in the characterization of the water resources, geology, and land surface of the Middle Rio Grande Basin. These governments and agencies include the City of Albuquerque, New Mexico Office of the State Engineer, New Mexico Bureau of Geology and Mineral Resources, Albuquerque Metropolitan Arroyo Flood Control Authority, Middle Rio Grande Council of Governments, Middle Rio Grande Conservancy District, Bureau of Reclamation, Pueblo of Cochiti, Pueblo of Isleta, Pueblo of Jemez, Pueblo of Laguna, Pueblo of San Felipe, Pueblo of Sandia, Pueblo of Santa Ana, Pueblo of Santo Domingo, Pueblo of Zia, City of Santa Fe, Village of Los Lunas, Bernalillo County, Santa Fe County, New Mexico Environment Department, Sandia National Laboratories, Los Alamos National Laboratory, U.S. Environmental Protection Agency, and the U.S. Army Corps of Engineers.

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Contents

Executive Summary 1

- Characteristics of the Middle Rio Grande Basin 1
- Geology 1
- Surface Water 2
- Ground Water 3
- Ground-Water Chemistry 3
- Ground-Water-Flow Modeling 4

Chapter 1: Common questions about water resources in the Middle Rio Grande Basin 5

- How much water do we have? 5
- How much water do we use? 5
- How long will our supplies last? 6
- How effective are water conservation efforts in the area? 6
- How rapidly are ground-water levels declining? 6
- Is municipal and(or) industrial pumping lowering ground-water levels outside major metropolitan areas? 7
- Have ground-water-level declines triggered land subsidence? 7
- How will water chemistry affect the use of ground water? 7
- How much water in the basin is appropriated? 7
- How much water can be pumped from the aquifer system using the present infrastructure? 8
- How interrelated are the ground-water and surface-water systems? 8

Chapter 2: The Middle Rio Grande Basin 9

- Physical characteristics 9
- Climate 9
- Major vegetation types 14
- Human activities and water resources 16

Chapter 3: Geology of the Santa Fe Group aquifer system 23

- The Rio Grande Rift 23
- Geologic processes that shaped the aquifer system 29
- How the basin has changed over geologic time 31
- Three-dimensional form of the aquifer system today 33
- Effect of faults on the aquifer system 34
- Contribution of geophysical data to understanding the aquifer system 35
- How the geologic model represents current interpretation of basin structure and stratigraphy 40

Chapter 4: The hydrologic system of the Middle Rio Grande Basin 41

- Surface-water system 41
 - Surface-water quantity 44
- Ground-water system 47
 - Ground-water-level declines 47
 - Aquifer productivity 58
 - Ground-water quantity 60
- Water use in the basin 60
- Water budgets 63
- Major legal and institutional controls on water in the basin 65
 - Rio Grande Compact 66
 - San Juan-Chama Transmountain Diversion Project 67
 - Endangered species 67
- Water appropriation 69

Chapter 5: How water moves through the aquifer system	71
Recharge and underflow—How ground water enters the aquifer system	71
Mountain-front recharge	71
Tributary recharge	73
Rio Grande and inner-valley recharge	76
Subsurface recharge or underflow	77
Flow paths—How ground water moves through the aquifer system	80
Discharge—How ground water leaves the aquifer system	81
Pumpage	81
Seepage to drains and the Rio Grande and springs	81
Evapotranspiration	84
Underflow	85
Effects of ground-water withdrawals	85
Deterioration of water quality	85
Water-well problems	86
Subsidence	86
Chapter 6: Chemical characteristics of water in the aquifer system	91
General quality of ground water and what it reveals about the ground-water system	91
Naturally occurring substances that limit the use of ground water	94
Contaminants of human origin and ground water	99
Chapter 7: Computer simulations of the aquifer system	101
Ground-water-flow model of the basin	101
Information used in the ground-water-flow model	106
What the ground-water-flow model tells us about the hydrologic system of the basin	110
What the ground-water-flow model tells us about future conditions	114
Chapter 8: Important questions that remain about water resources of the Middle Rio Grande Basin	115
How much water is pumped where and by whom?	115
What are the availability and quality of water in deeper parts of the aquifer?	115
How much water does vegetation in the bosque use?	116
How is the aquifer responding to pumping over the long term?	116
Is septic-system effluent contaminating ground water?	116
How will the more stringent arsenic standard affect water supplies?	116
Are pharmaceuticals present in ground or surface water?	117
Chapter 9: Key points regarding water resources of the Middle Rio Grande Basin	119
References Cited	121
Abbreviations and Chemical Notation	132
Prefixes for Abbreviations for Multiples and Submultiples	133

FIGURES

- 2.1–2.3. Maps showing:
- 2.1. Major physiographic features of the Middle Rio Grande Basin **10**
 - 2.2. Average monthly temperatures for selected National Weather Service stations in and near the Middle Rio Grande Basin **12**
 - 2.3. Average monthly precipitation for selected National Weather Service stations in and near the Middle Rio Grande Basin **13**
- 2.4. Photographs looking west across the Rio Grande toward the Albuquerque volcanoes **15**
- 2.5–3.2. Maps showing:
- 2.5. Generalized land use and land cover in the Middle Rio Grande Basin in the early 1980's **19**
 - 3.1. Location of the Middle Rio Grande Basin and the Rio Grande Rift **28**
 - 3.2. Simplified structural features of the Middle Rio Grande Basin **29**
- 3.3. Section showing east-west geologic section through the Calabacillas subbasin illustrating general relation of faults and sedimentary units **30**
- 3.4. Graph showing variation of oxygen isotope composition of shells from bottom-dwelling micro-organisms in the Pacific and Atlantic Oceans during the last 25 million years **32**
- 4.1. Map showing major surface-water features of the Middle Rio Grande Basin **42**
- 4.2. Diagram of the inner valley irrigation network in the Middle Rio Grande Basin **43**
- 4.3–4.7. Maps showing:
- 4.3. Current and discontinued streamflow-gaging stations in and adjacent to the Middle Rio Grande Basin **45**
 - 4.4. Ground-water levels that represent predevelopment conditions in the Santa Fe Group aquifer system in the Middle Rio Grande Basin **50**
 - 4.5. Ground-water levels that represent 1960–61 conditions in the Santa Fe Group aquifer system in the Middle Rio Grande Basin **51**
 - 4.6. Ground-water levels that represent winter 1994–95 conditions in the Santa Fe Group aquifer system in the Middle Rio Grande Basin **52**
 - 4.7. Location of selected wells in the Middle Rio Grande Basin **53**
- 4.8. Graphs showing water levels in selected wells in the Middle Rio Grande Basin **55**
- 4.9. Map showing distribution of east-west horizontal hydraulic conductivity in the upper part of the Santa Fe Group aquifer system in the ground-water-flow model of McAda and Barroll (2002) **59**
- 4.10. Diagram showing water withdrawal estimates by category for surface and ground water during 1995 for counties in the Middle Rio Grande Basin. See table 4.2 for the data by county **62**
- 4.11–6.1. Maps showing:
- 4.11. Middle Rio Grande water budget for the reach from the Otowi stream-gaging station to Elephant Butte Dam as prepared by the Action Committee of the Middle Rio Grande Water Assembly **64**
 - 4.12. Diversion dams and tunnels of the San Juan-Chama Transmountain Diversion Project **68**
- 6.1. Hydrochemical regions of the Middle Rio Grande Basin **95**
- 7.1. Section showing generalized configuration of ground-water-flow model layers used by McAda and Barroll (2002) along model row 80 **104**
- 7.2. Map showing active cells in the ground-water-flow model grid (layer 1) of McAda and Barroll (2002) **105**

TABLES

- 2.1. National Weather Service weather stations in the Middle Rio Grande Basin and Sandia Crest station **11**
- 2.2. Population in New Mexico, Albuquerque, and the Middle Rio Grande Basin, 1900–2000 **18**
- 4.1. Mean annual surface-water inflows into and outflows from the Middle Rio Grande Basin **46**
- 4.2. Water withdrawal estimates during 1995 for counties in the Middle Rio Grande Basin **61**
- 6.1. Median values of selected parameters of the 13 hydrochemical zones delineated for the Santa Fe Group aquifer system of the Middle Rio Grande Basin **96**
- 6.2. Current drinking-water standards and significance of constituents commonly found in ground water in the Middle Rio Grande Basin **97**
- 7.1. Simulated annual water budget for the ground-water-flow model of McAda and Barroll (2002) **111**

Boxes

- A** Landscape change modeling 20
- B** Structural, sedimentologic, and climatic effects on the Middle Rio Grande Basin aquifer system 24
- C** How well information is used to understand the hydrogeology of the basin 26
- D** How geophysical methods have been used to understand the subsurface 36
- E** Knowledge gained from the 98th Street well core 38
- F** Ground-water-level maps and how they are used to understand the aquifer 48
- G** How mountain-front recharge is studied 74
- H** How ground-water/surface-water interaction of the Rio Grande has been studied 78
- I** Environmental tracers and how they are used to understand the aquifer 82
- J** Land subsidence and how it is being studied in the basin 88
- K** How ground-water chemistry helps us understand the aquifer 92
- L** Ground-water-flow models and how they are used to study the basin 102
- M** How the geologic framework is translated into a ground-water-flow model 108
- N** How carbon-14 data were used to improve the ground-water-flow model 112

FIGURES

- A.1.** Graph showing changes in urban characteristics for Albuquerque, 1940–2050 20
- A.2.** Diagram showing urban area in the vicinity of Albuquerque in 1935, 1991, and 2050 projected using the SLEUTH model 21
- B.1.** Generalized section showing substantial thickening of the Atrisco silt- and clay-rich beds in the downthrown fault block east of the 98th Street well location and index map 24
- B.2.** Oblique aerial photograph of outcrops in the upper Santa Fe Group sediment adjacent to the Zia fault in the northern Calabacillas subbasin. The prominent whitish zone is a buried calcareous soil that was buried by yellowish, windblown silt deposited following downdropping on the Zia fault 25
- C.1.** Section showing hypothetical responses of various borehole geophysical tools to alluvial deposits of contrasting texture and saturation and to volcanic rock units 26
- C.2.** Graph showing correlation of electrical conductivity logs among Albuquerque well fields west of the Rio Grande 27
- D.1.** Map showing gravity data for the entire Middle Rio Grande Basin and surrounding area 36
- D.2.** Map showing area south of Albuquerque and simplified map of important hydrogeologic features 37
- E.1.** Graph showing lithology and geophysical logs of the 98th Street well 39
- F.1.** Map showing information needed to determine water-table elevations and to calculate hydraulic gradients 48
- F.2.** Section showing hypothetical well locations, water-table elevations, water-table contours, and approximate directions of ground-water flow 48
- F.3.** Diagram showing examples of water-table contours and directions of ground-water flow in the vicinity of losing and gaining streams 49
- G.1.** Map showing locations of study sites for mountain-front recharge and water temperature in the Middle Rio Grande Basin 74
- G.2.** Diagram showing temperature compared to time at two depths in an ephemeral streambed during periods of no flow and flow 75

<i>H.1.</i>	Map showing locations of study sites on the Rio Grande for water temperature and flood pulses	78
<i>H.2.</i>	Graph showing thermographs from Paseo del Norte section showing Rio Grande temperature and ground-water temperatures measured in wells P06, P07, and P08	79
<i>I.1.</i>	Graph showing concentrations of tritium (³ H) in precipitation, chlorofluorocarbons (CFC-11, CFC-12, and CFC-113) in air, and sulfur hexafluoride (SF ₆) in air over North America, 1940–97	82
<i>J.1.</i>	Photograph showing surface instrumentation of the Montaña extensometer	89
<i>J.2.</i>	Map showing Interferometric Synthetic Aperture Radar (InSAR) image of the Albuquerque area, July 2, 1993–September 3, 1995	89
<i>L.1–L.3.</i>	Diagrams showing:	
<i>L.1.</i>	Part of a hypothetical basin-fill ground-water system	102
<i>L.2.</i>	Part of a hypothetical basin-fill ground-water system with some model cells shown superimposed	103
<i>L.3.</i>	Subset of the model cells that represent an aquifer, indicating that flow is calculated between adjacent cells	103
<i>M.1.</i>	Section showing representation of an aquifer in a finite-difference ground-water-flow model	108
<i>M.2.</i>	Section showing representation of ground-water flow-model cells related to sedimentary deposits	109
<i>N.1.</i>	Map showing traveltimes and ground-water flow paths predicted by a preliminary version of the current revision of the ground-water-flow model of the Middle Rio Grande Basin	113

TABLES

<i>A.1.</i>	Urban growth in Albuquerque, 1935–2050. Projections for 2050 are based on SLEUTH model output	20
<i>D.1.</i>	Brief description of the geophysical methods used and the hydrogeologic features delineated by each	37

Conversions

This Circular uses both inch/pound (U.S. customary) and International System of Units (SI metric) units. The conversion factors listed below are provided to convert between inch/pound and SI metric units, or different units in the same systems.

Measurement	Multiply	By	To Obtain
Length	inch	25.4	millimeter (mm)
	foot (ft)	0.3048	meter (m)
	mile (mi)	1.609	kilometer (km)
Area	square mile (mi ²)	2.590	square kilometer (km ²)
	acre (acre)	0.4047	hectare (ha)
Volume	acre-foot (acre-ft)	1,233	cubic meter (m ³)
	gallon	0.003785	cubic meter (m ³)
	cubic foot (ft ³)	0.02832	cubic meter (m ³)
Flow rate	cubic foot per second (ft ³ /s)	0.2832	cubic meter per second (m ³ /s)
	cubic foot per second (ft ³ /s)	723.97	acre-foot per year (acre-ft/yr)
	cubic foot per second (ft ³ /s)	448.83	gallon per minute (gal/min)
Hydraulic conductivity	foot per day (ft/d)	0.3048	meter per day (m/d)
Temperature	degree Fahrenheit (°F)	(°F-32)/1.8	degree Celsius (°C)
Tritium activity	tritium unit (TU)	3.24	picocuries per liter (pCi/L)
Magnetism	Tesla (T)	1	weber per square meter (Wb/m ²)
Gravity	gal (Gal)	1	centimeter per second squared (cm/s ²)

Electrical conductivity units are given in siemens (S), which is the preferred unit name under the International System of Units. It is numerically equivalent to the older term mhos.

Electrical resistivity can be converted to electrical conductivity (siemens per meter) by taking its inverse.

Vertical Datum

In this report, “sea level” refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)—a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

Base Credits

All maps of the Middle Rio Grande Basin in this report are in Lambert Conformal Conic projection with standard parallels 33°00' and 45°00' north latitude, and central meridian 106°00' west longitude. The base for figure 3.1 was compiled from U.S. Department of Commerce, Bureau of Census TIGER/line Precensus Files, 1990, scale 1:100,000.

The base for the maps of the Middle Rio Grande Basin was compiled from several sources. The hydrography is from 1977–78 U.S. Geological Survey digital data, scale 1:100,000. Cultural features are from 1992 City of Albuquerque digital data, scale 1:2,400, and digitized from 1977–78 U.S. Geological Survey maps, scale 1:100,000. Other sources are noted on the maps themselves.

