Texas Water Development Board

Report 345

Aquifers of Texas

by
John B. Ashworth, Geologist
and
Janie Hopkins, Geologist

November 1995

Texas Water Development Board

Craig D. Pedersen, Executive Administrator

Published and Distributed
by the
Texas Water Development Board
P.O. Box 13231
Austin, Texas 787 1 l-323 1

Table of Contents

Page

Figures

Table

INTRODUCTION

Water is one of the state's most precious natural resources and basic economic commodities. It interrelates with and affects almost every aspect of human and natural existence. The purpose of this report is to provide a general overview of this resource in Texas and the aquifers in which it resides.

Ground-water sources supplied 56 percent of the 13.5 million acre-feet of water used in the state in 1992. Figure 1 illustrates the level of ground-water pumpage by county in 1992. More than 75 percent of the 7.6 million acre-feet of ground-water pumpage was for irrigated agriculture, with municipal use accounting for almost 17 percent of the total pumpage (Fig. 2). Due to its widespread availability and relatively low cost, ground water accounts for about 69 percent of the total water used for irrigation and about 41 percent of the water used for municipal needs (Fig. 3).

The Texas Water Development Board (TWDB) has identified and characterized nine major and 20 minor aquifers in the state based on the quantity of water supplied by each. A major aquifer is generally defined as supplying large quantities of water in large areas of the state. Minor aquifers typically supply large quantities of water in small areas or relatively small quantities in large areas. The major and minor aquifers, as presently defined, underlie approximately 81 percent of the state. Lesser quantities of water may also be found in the remainder of the state.

The surface extent, or outcrop, of each aquifer is the area in which the host formations are exposed at the land surface. This area corresponds to the principal recharge zone for the aquifers. Ground water encountered within this area is normally under unconfined, water-table conditions and is most susceptible to contamination.

Some water-bearing formations dip below the surface and are covered by other formations. Aquifers with this characteristic are common, although not exclusive, east and south of Interstate Highway 35. Aquifers covered by less permeable formations, such as clay, are confined under artesian pressure. Delineations of the downdip boundaries of such aquifers as the Edwards (BFZ), Trinity, and Carrizo-Wilcox are based on chemical quality criteria.

Aquifer water quality is described in terms of dissolved-solids concentrations expressed in milligrams per liter (mg/l) and is classified as fresh (less than 1,000 mg/l), slightly saline (1,000 - 3,000 mg/l), moderately saline (3,000 - 10,000 mg/l), and very saline (10,000 - 35,000 mg/l). Aquifer downdip boundaries shown on the maps delineate extents of the aquifers that contain ground water with dissolved-solids concentrations that meet the needs of the aquifers' primary uses. The quality limit for most aquifers is 3,000 mg/l dissolved solids, which meets most agricultural and industrial needs. However, the limit for the Edwards (BFZ) is 1,000 mg/l for public water supply use. The limit for the Dockum and Rustler is 5,000 mg/l, and10,000 mg/l for the Blaine for specific irrigation and industrial uses. Some aquifers, such as the Hueco Bolson and Lipan, have depth limitations at which water of acceptable quality can be obtained.

The following descriptions provide general information pertaining to location, geology, quality, yield, common use, and specific problems of the aquifers throughout their Texas extents. Geologic ages of the aquifers are summarized in Table 1. The aquifers are organized in the order of their magnitude of annual withdrawals, with the aquifer experiencing the largest amount of pumpage listed first. A more thorough understanding of each aquifer may be gained by referring to the suggested reports following each aquifer description.

The characterization of the state's ground-water resources and the development of the maps depicting these aquifers have been accomplished by many staff members of the TWDB over many years. The aquifer maps and reports undergo continual revision to reflect the latest information available. Individual aquifer maps accompanying each description are shown at different scales, but are configured from the same map projection as the major and minor aquifer maps.

The authors gratefully acknowledge all who provided input into this report and specifically thank Phil Nordstrom, Richard Preston, and David Thorkildsen for their valuable contributions. Mark Hayes and Steve Gifford also gave significantly of their time and talents in producing the illustrations.

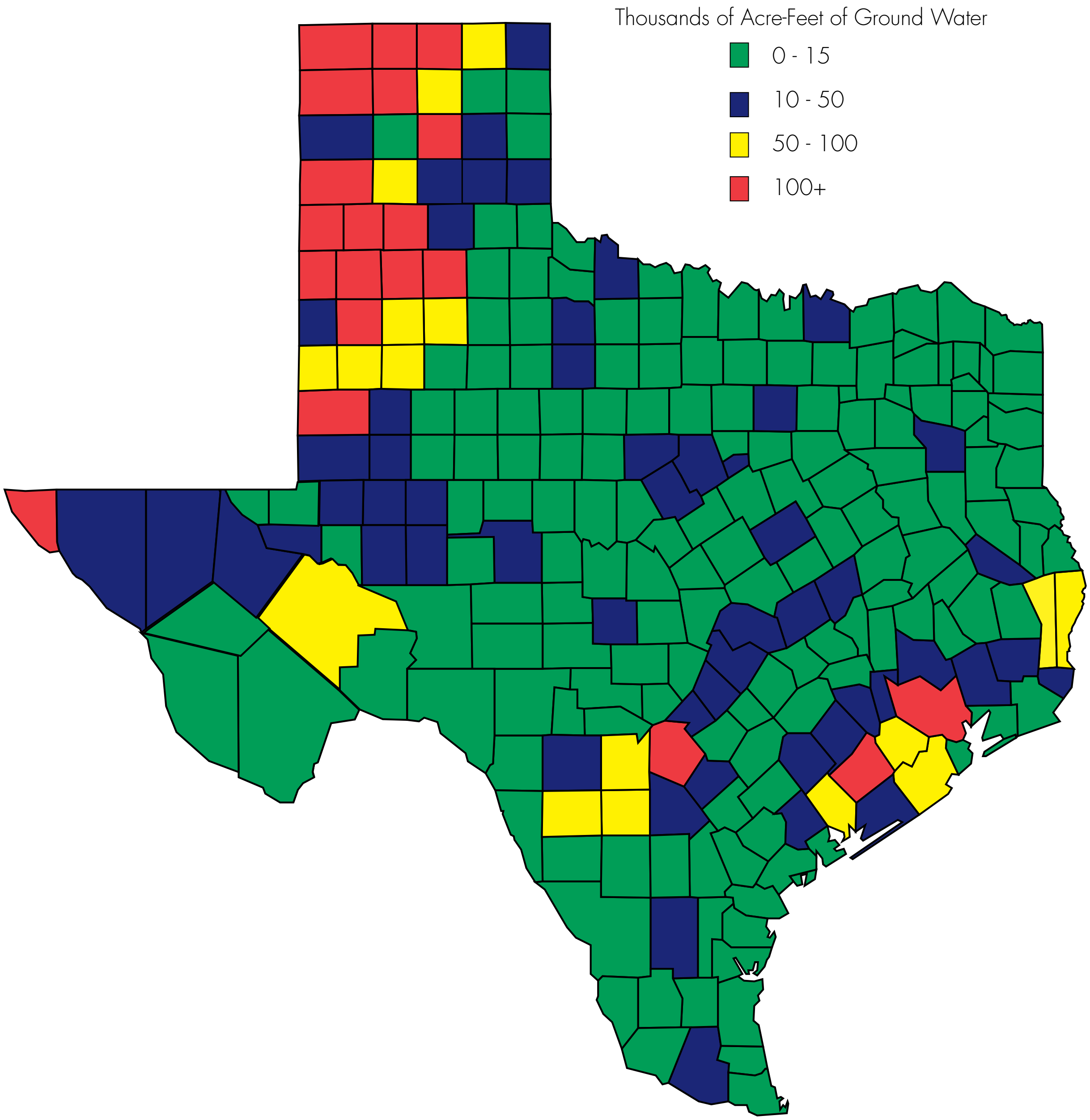


Figure 1. 1992 Ground-Water Pumpage

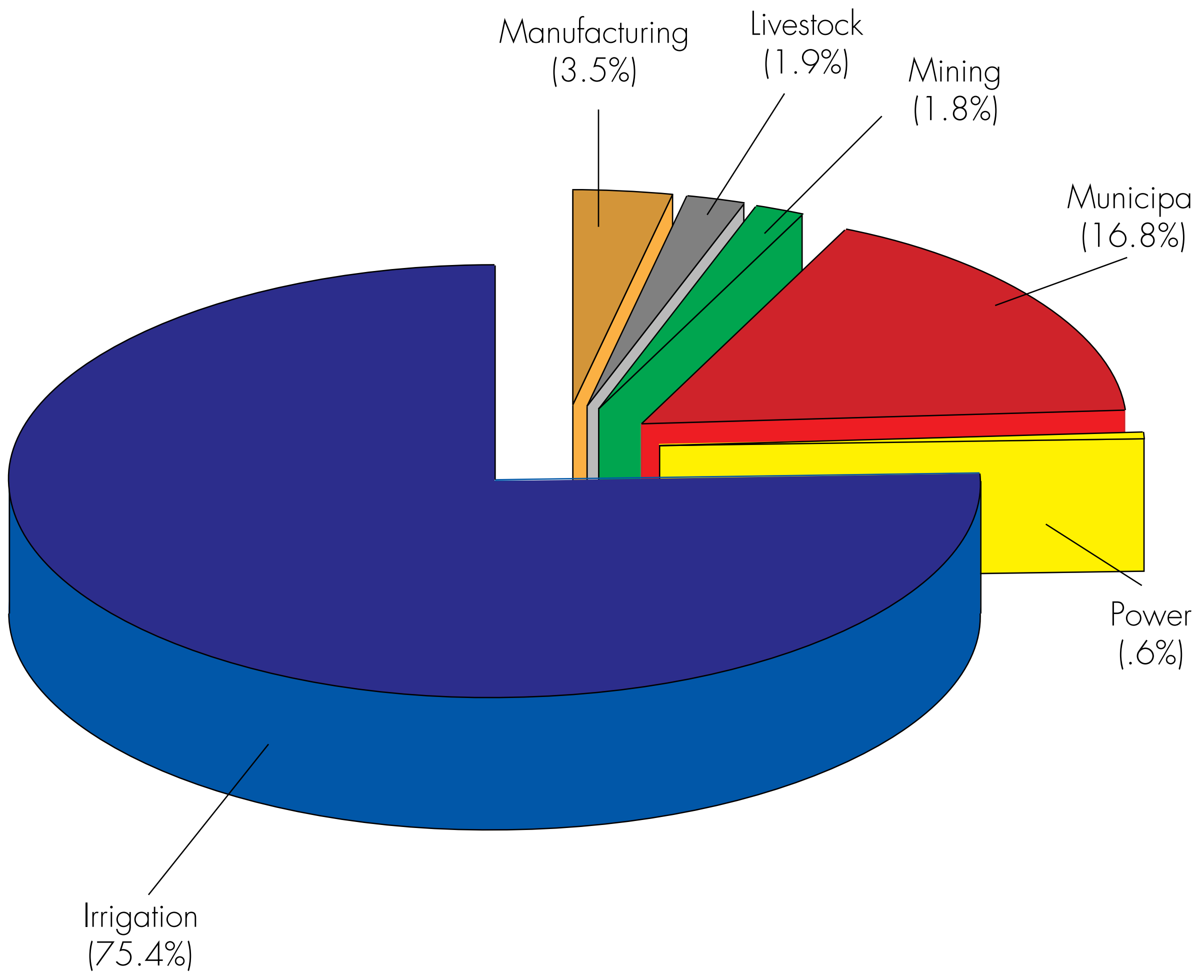


Figure 2. 1992 Ground-Water Use

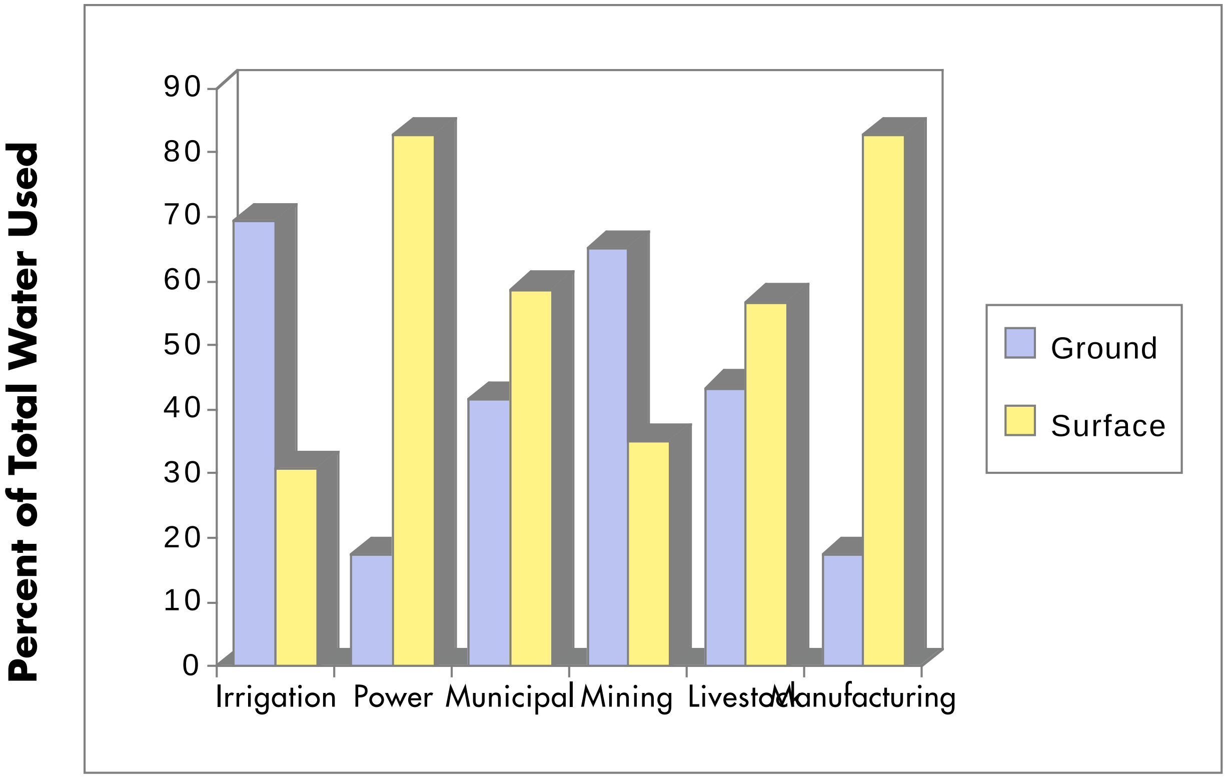


Figure 3. 1992 Water Use by Type

Table 1. Geologic Ages of Aquifers in Texas

Era	Period	Aquifer
Cenozoic	Quaternary	Cenozoic Pecos Alluvium Brazos River Alluvium West Texas Bolsons Seymour Lipan
	Tertiary	Gulf Coast Carrizo-Wilcox Hueco-Mesilla Bolson Ogallala Sparta Igneous Queen City
Mesozoic	Cretaceous	Woodbine Edwards-Trinity (Plateau) Edwards-Trinity (High Plains) Edwards (BFZ) Trinity Nacatoch Blossom Rita Blanca
	Jurassic	Rita Blanca
	Triassic	Dockum
Paleozoic	Permian	Blaine Bone Spring-Victorio Peak Capitan Reef Complex Rustler Lipan
	Pennsylvanian	Marble Falls Marathon
	Mississippian	Marathon
	Devonian	Marathon
	Silurian	Marathon
	Ordovician	Ellenburger-San Saba Marathon
	Cambrian	Ellenburger-San Saba Hickory
Precambrian		

GENERAL GROUND-WATER PRINCIPLES

Vast quantities of water percolate underground through geologic formations known as *aquifers*. The occurrence of water within the formations takes different forms. In sedimentary rocks, such as those composed of sand and gravel, water is contained in the spaces between grains. Some of the largest aquifers in Texas, including the Ogallala, Gulf Coast, and Carrizo-Wilcox, hold water in this fashion. Limestone formations, such as the Edwards, contain water in crevices and caverns caused in part by dissolution of the limestone by ground water. A third occurrence of ground water is within the cracks, fractures, and joints developed in harder formations such as granite and volcanic rock.

Two rock characteristics of fundamental importance related to the occurrence of ground water are *porosity,* which is the amount of open space contained in the rock, and *permeability,* the ability of the porous material to allow fluids to move through it. In sedimentary rocks consisting of sandstone, gravel, clay, and silt, the porosity is a function of the size, shape, sorting, and degree of cementation of the grains. In limestone and other harder rock, the porosity is a function of openings such as cracks, crevices, and caverns. Fine-grained sediments, such as clay and silt, usually have high porosity. However, due to the small size of the voids in these sediments, the permeability is low, and these formations do not readily yield or transmit water. For a geologic formation to be an aquifer, it must be porous, permeable, and yield water in sufficient quantities to provide a usable supply.

Recharge is the addition of water to an aquifer. This water may be absorbed from precipitation, streams, and lakes either directly into a formation or indirectly by way of leakage from another formation. Generally, only a small portion of the total precipitation seeps down through the soil cover to reach the water table. Among the factors that influence the amount of recharge to an aquifer are the amount and frequency of precipitation; the areal extent of the outcrop or intake area; the topography, type and amount of vegetation, and condition of soil cover in the outcrop area; and the ability of the aquifer to accept recharge and transmit it to areas of discharge.

Ground water is said to occur under either *water-table* or *artesian* conditions. Ground water in the outcrop of many aquifers is unconfined and under water-table conditions. Water under these conditions is under atmospheric pressure and will rise or fall in response to changes in the volume of water stored. In most places, the configuration of the water table approximates the topography of the land surface. In a well penetrating an unconfined aquifer, water will rise to the level of the water table.

Away from the outcrop, ground water in the aquifer may occur beneath a relatively impermeable bed. Here, water is under artesian, or confined, conditions, and the impermeable bed confines the water under a pressure greater than atmospheric. In a well penetrating an artesian aquifer, water will rise above the confining bed. If the pressure head is large enough to cause the water in the well to rise above the land surface, the well will flow.

Ground water moves from areas of recharge to areas of discharge, or from points of higher water level to points of lower water level. Under normal artesian conditions, movement of ground water usually is in the direction of the aquifer's regional dip. Under water-table conditions, the slope of the water table, and consequently the direction of ground-water movement, are usually closely related to the slope of the land surface. However, in the case of both artesian and water-table conditions, local anomalies develop in which some water moves toward pumpage areas. The rate of ground-water movement in an aquifer is normally very slow, or in the magnitude of a few feet to a few hundred feet per year.

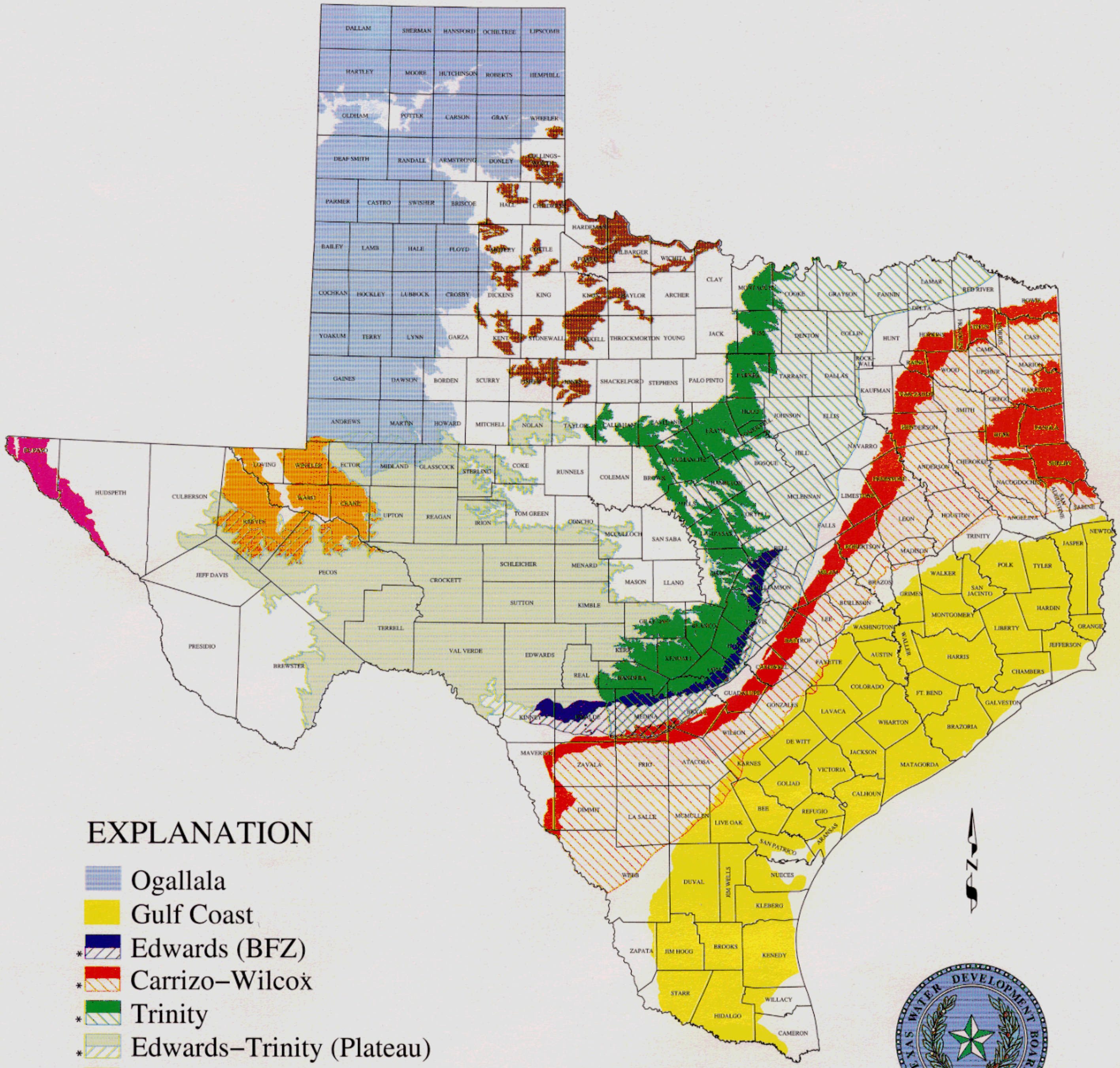
Discharge is the loss of water from an aquifer by either artificial or natural means. Artificial discharge takes place from flowing and pumped water wells, and from drainage ditches, gravel pits, or other excavations that intersect the water table. Natural discharge occurs as springs, evaporation, transpiration, and leakage between formations.

Changes in water levels indicate a change in the ground-water storage in an aquifer. These changes can be due to many causes, with some regionally significant and others confined to more local areas. In short, water-level fluctuations are caused by changes in recharge and discharge.

When recharge is reduced, as in the case of a drought, or when pumpage is greater than recharge, some of the water discharged from the aquifer must be withdrawn from storage, resulting in a decline of water levels. If water levels are lowered excessively, springs and shallow wells may go dry. However, when sufficient precipitation resumes or pumpage is reduced, the volume of water drained from storage may be replaced and water levels will rise accordingly. Changes in water levels in water-table aquifers are generally less pronounced than in artesian aquifers.

When a water well is pumped, water levels in the vicinity are drawn down in the shape of an inverted cone with its apex at the pumped well. The development of these *cones of depression* depends on the aquifer's ability to store and move water and on the rate of pumping. If the cone of one well overlaps the cone of another, additional lowering of water levels will occur as the wells compete for the same water.

MAJOR AQUIFERS OF TEXAS



EXPLANATION

- Ogallala
- Gulf Coast
- * Edwards (BFZ)
- * Carrizo–Wilcox
- * Trinity
- * Edwards–Trinity (Plateau)
- Seymour
- Hueco–Mesilla Bolson
- Cenozoic Pecos Alluvium

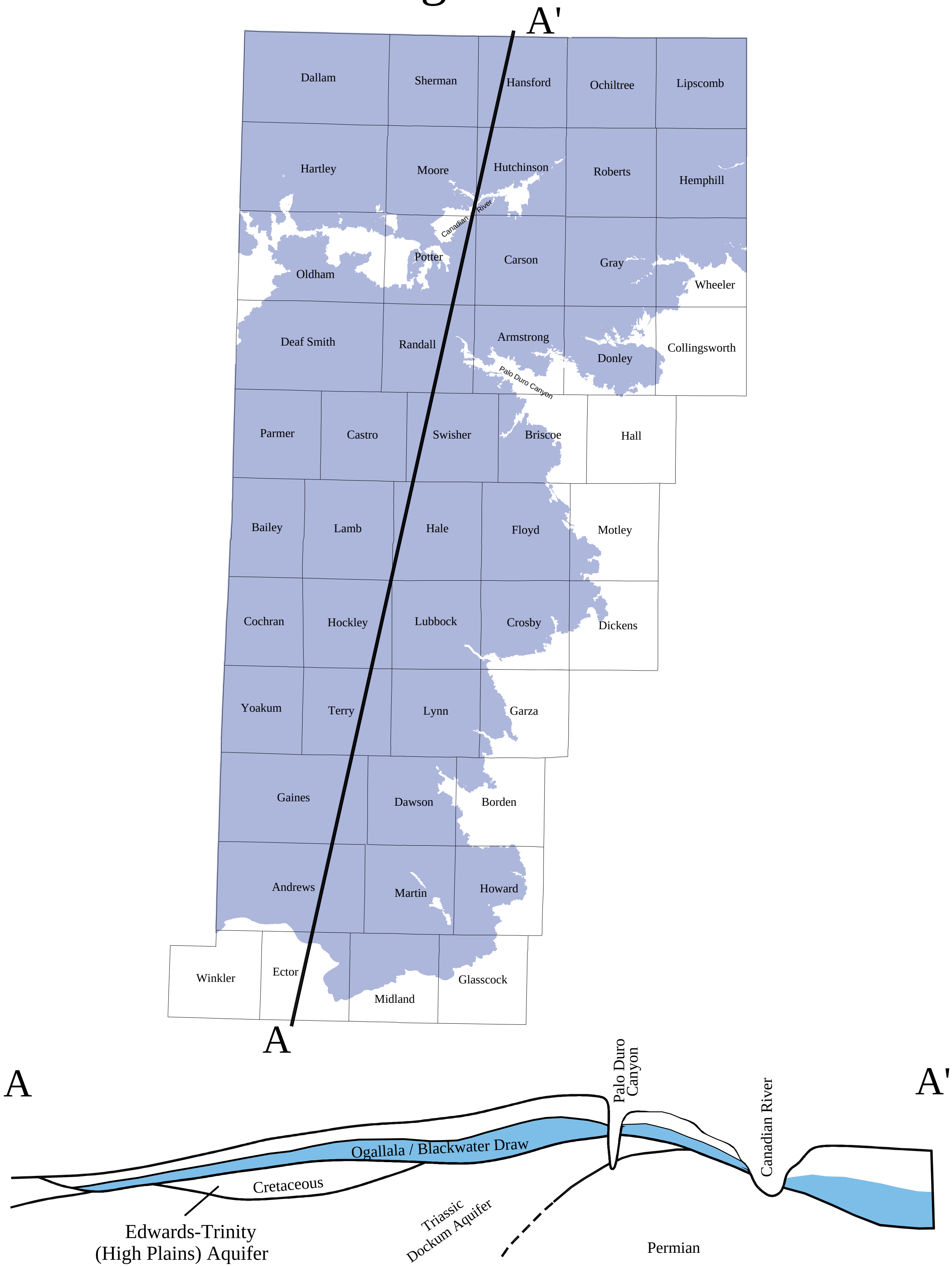
OUTCROP (That part of a water-bearing rock layer which appears at the land surface.)

* DOWNDIP (That part of a water-bearing rock layer which dips below other rock layers.)

Miles
0 25 50 75 100

January 1994

Ogallala



A'
Dallam
Sherman
Hansford
Ochiltree
Lipscomb
Hartley
Moore
Hutchinson
Roberts
Hemphill
Canadian River
Oldham
Potter
Carson
Gray
Wheeler
Deaf Smith
Randall
Armstrong
Donley
Collingsworth
Palo Duro Canyon
Parmer
Castro
Swisher
Briscoe
Hall
Bailey
Lamb
Hale
Floyd
Motley
Cochran
Hockley
Lubbock
Crosby
Dickens
Yoakum
Terry
Lynn
Garza
Gaines
Dawson
Borden
Andrews
Martin
Howard
Winkler
Ector
Midland
Glasscock
A
A
A'
Palo Duro Canyon
Canadian River
Ogallala / Blackwater Draw
Cretaceous
Edwards-Trinity (High Plains) Aquifer
Triassic Dockum Aquifer
Permian

Ogallala Aquifer

The Ogallala aquifer, the major water-bearing unit in the High Plains of Texas, provides water to all or parts of 46 counties. Water-bearing areas of the Ogallala are laterally connected except where the Canadian River has eroded through the formation, thereby forming the boundary between two separate flow systems referred to as the Northern and Southern High Plains. Vertical hydrologic communication also occurs between the Ogallala and the underlying Cretaceous, Jurassic, and Triassic formations in many areas and between the overlying Quaternary Blackwater Draw Formation where present. Although many communities use the Ogallala aquifer as their sole source of drinking water, approximately 95 percent of the water is used for irrigation.

The Ogallala is composed primarily of sand, gravel, clay, and silt deposited during the Tertiary Period. Ground water, under water-table conditions, moves slowly through the Ogallala Formation in a southeastward direction toward the caprock edge or eastern escarpment of the High Plains. Saturated thickness of the aquifer is generally greater in the northern part of the region and thinner in the southern part where the formation overlaps Cretaceous rocks. The saturated thickness, greatest where sediments have filled previously eroded drainage channels, ranges up to approximately 600 feet. Coarse-grained sediments in these channels also have the greatest permeability and supply water to wells with yields of up to 2,000 gal/min. Average yield of Ogallala wells is approximately 500 gal/min.

The chemical quality of the water in the aquifer is generally fresh; however, both dissolved-solids and chloride concentrations increase from north to south. In the Northern High Plains, dissolved solids are usually less than 400 mg/l. Dissolved-solids concentrations typically exceed 400 mg/l in the Southern High Plains, where extensive areas with concentrations exceeding 1,000 mg/l are common, especially in the vicinity of alkali lakes. The chemical quality in the south is probably influenced by upward leakage and subsequent mixing of water from the underlying Cretaceous aquifers. Fluoride content is commonly high, and selenium concentrations locally are in excess of drinking water standards.

Recharge to the Ogallala occurs principally by infiltration of precipitation on the surface and, to a lesser extent, by upward leakage from underlying formations. Only about one inch of the precipitation actually reaches the water table annually because rainfall is minimal, the evaporation rate is high, and the infiltration rate is slow. The highest recharge infiltration rates occur in areas overlain by sandy soils and in playa-lake basins.

Since the expansion of irrigated agriculture in the mid-1940s, greater amounts of water have been pumped from the aquifer than have been recharged. As a result, some areas have experienced water-level declines in excess of 100 feet from predevelopment to 1990. Reduced pumpage in some areas of the High Plains has resulted in a reduction in the rate of water-level decline.

References

Ashworth, J.B., Christian, P., and Waterreus, T.C., 1991, Evaluation of ground-water resources in the Southern High Plains of Texas: TWDB Rept. 330, 39 p.

Cronin, J.G., 1961, A summary of the occurrence and development of ground water in the Southern High Plains of Texas: TBWE Bull. 6107, 104 p.

______, 1969, Ground water in the Ogallala Formation in the Southern High Plains of Texas and New Mexico: U.S. Geological Survey Hydrologic Inv. Atlas HA-330, 9 p., 4 sheets.

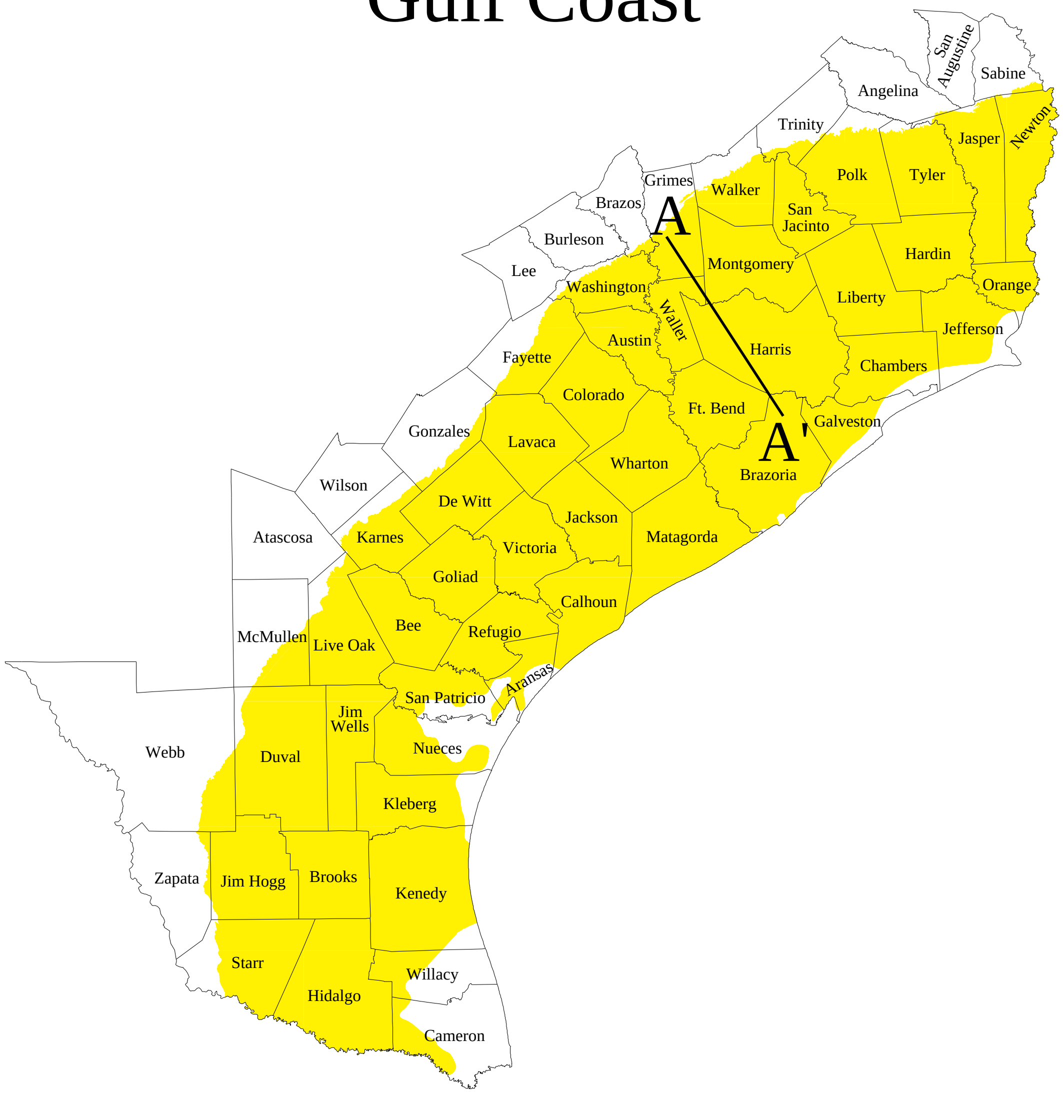
Hopkins, J., 1993, Ground-water quality in the Ogallala aquifer, Texas: TWDB Rept. 342, 41 p.

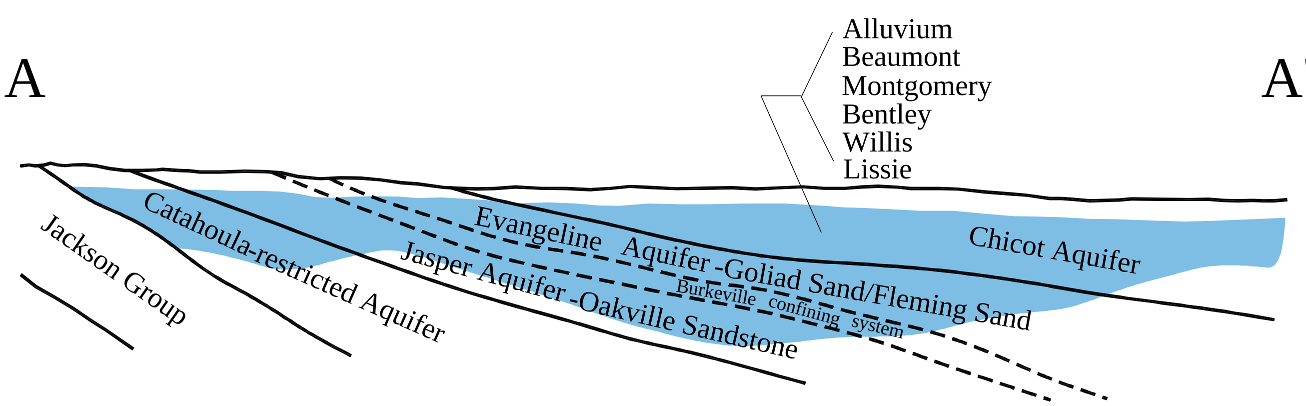
Knowles, T., Nordstrom, P., and Klemt, W.B., 1984, Evaluating the ground-water resources of the High Plains of Texas: TDWR Rept. 288, 4 vols.

Nativ, R., 1988, Hydrogeology and hydrochemistry of the Ogallala aquifer, Southern High Plains, Texas Panhandle and eastern New Mexico: Univ. of Texas, Bureau of Economic Geology Rept. of Inv. No. 177, 64 p.

Peckham, D.S., and Ashworth, J.B., 1993, The High Plains aquifer system of Texas, 1980 to 1990, overview and projections: TWDB Rept. 341, 34 p.

Gulf Coast





Modified from Baker, 1979

Gulf Coast Aquifer

The Gulf Coast aquifer forms a wide belt along the Gulf of Mexico from Florida to Mexico. In Texas, the aquifer provides water to all or parts of 54 counties and extends from the Rio Grande northeastward to the Louisiana-Texas border. Municipal and irrigation uses account for 90 percent of the total pumpage from the aquifer. The Greater Houston metropolitan area is the largest municipal user, where well yields average about 1,600 gal/min.

The aquifer consists of complex interbedded clays, silts, sands, and gravels of Cenozoic age, which are hydrologically connected to form a large, leaky artesian aquifer system. This system comprises four major components consisting of the following generally recognized water-producing formations. The deepest is the Catahoula, which contains ground water near the outcrop in relatively restricted sand layers. Above the Catahoula is the Jasper aquifer, primarily contained within the Oakville Sandstone. The Burkeville confining layer separates the Jasper from the overlying Evangeline aquifer, which is contained within the Fleming and Goliad sands. The Chicot aquifer, or upper component of the Gulf Coast aquifer system, consists of the Lissie, Willis, Bentley, Montgomery, and Beaumont formations, and overlying alluvial deposits. Not all formations are present throughout the system, and nomenclature often differs from one end of the system to the other. Maximum total sand thickness ranges from 700 feet in the south to 1,300 feet in the northern extent.

Water quality is generally good in the shallower portion of the aquifer. Ground water containing less than 500 mg/l dissolved solids is usually encountered to a maximum depth of 3,200 feet in the aquifer from the San Antonio River Basin northeastward to Louisiana. From the San Antonio River Basin southwestward to Mexico, quality deterioration is evident in the form of increased chloride concentration and saltwater encroachment along the coast. Little of this ground water is suitable for prolonged irrigation due to either high salinity or alkalinity, or both. In several areas at or near the coast, including Galveston Island and the central and southern parts of Orange County, heavy municipal or industrial pumpage had previously caused an updip migration, or saltwater intrusion, of poor-quality water into the aquifer. Recent reductions in pumpage here have resulted in a stabilization and, in some cases, even improvement of ground-water quality.

Years of heavy pumpage for municipal and manufacturing use in portions of the aquifer have resulted in areas of significant water-level decline. Declines of 200 feet to 300 feet have been measured in some areas of eastern and southeastern Harris and northern Galveston counties. Other areas of significant water-level declines include the Kingsville area in Kleberg County and portions of Jefferson, Orange, and Wharton counties. Some of these declines have resulted in compaction of dewatered clays and significant land surface subsidence. Subsidence is generally less than 0.5 foot over most of the Texas coast, but has been as much as nine feet in Harris and surrounding counties. As a result, structural damage and flooding have occurred in many low-lying areas along Galveston Bay in Baytown, Texas City, and Houston. Conversion to surface-water use in many of the problem areas has reversed the decline trend.

References

Baker, E.T., Jr., 1979, Stratigraphic and hydrogeologic framework of part of the Coastal Plain of Texas: TDWR Rept. 236, 43 p.

Guyton, W.F., and Associates, 1972, Ground-water conditions in Anderson, Cherokee, Freestone, and Henderson counties, Texas: TWDB Rept. 150, 80 p.

McCoy, T.W., 1990, Evaluation of ground-water resources in the Lower Rio Grande Valley, Texas: TWDB Rept. 316, 48 p.

Muller, D.A., and Price, R.D., 1979, Ground-water availability in Texas, estimates and projections through 2030: TDWR Rept. 238, 77 p.

Sandeen, W.M., and Wesselman, J.B., 1973, Ground-water resources of Brazoria County, Texas: TWDB Rept. 163, 205 p.

Shafer, G.H., 1968, Ground-water resources of Nueces and San Patricio counties, Texas: TWDB Rept. 73, 137 p.

____, 1970, Ground-water resources of Aransas County, Texas: TWDB Rept. 124, 83 p.

Shafer, G.H., and Baker, E.T., Jr., 1973, Ground-water resources of Kleberg, Kenedy, and southern Jim Wells counties, Texas: TWDB Rept. 173, 69 p.

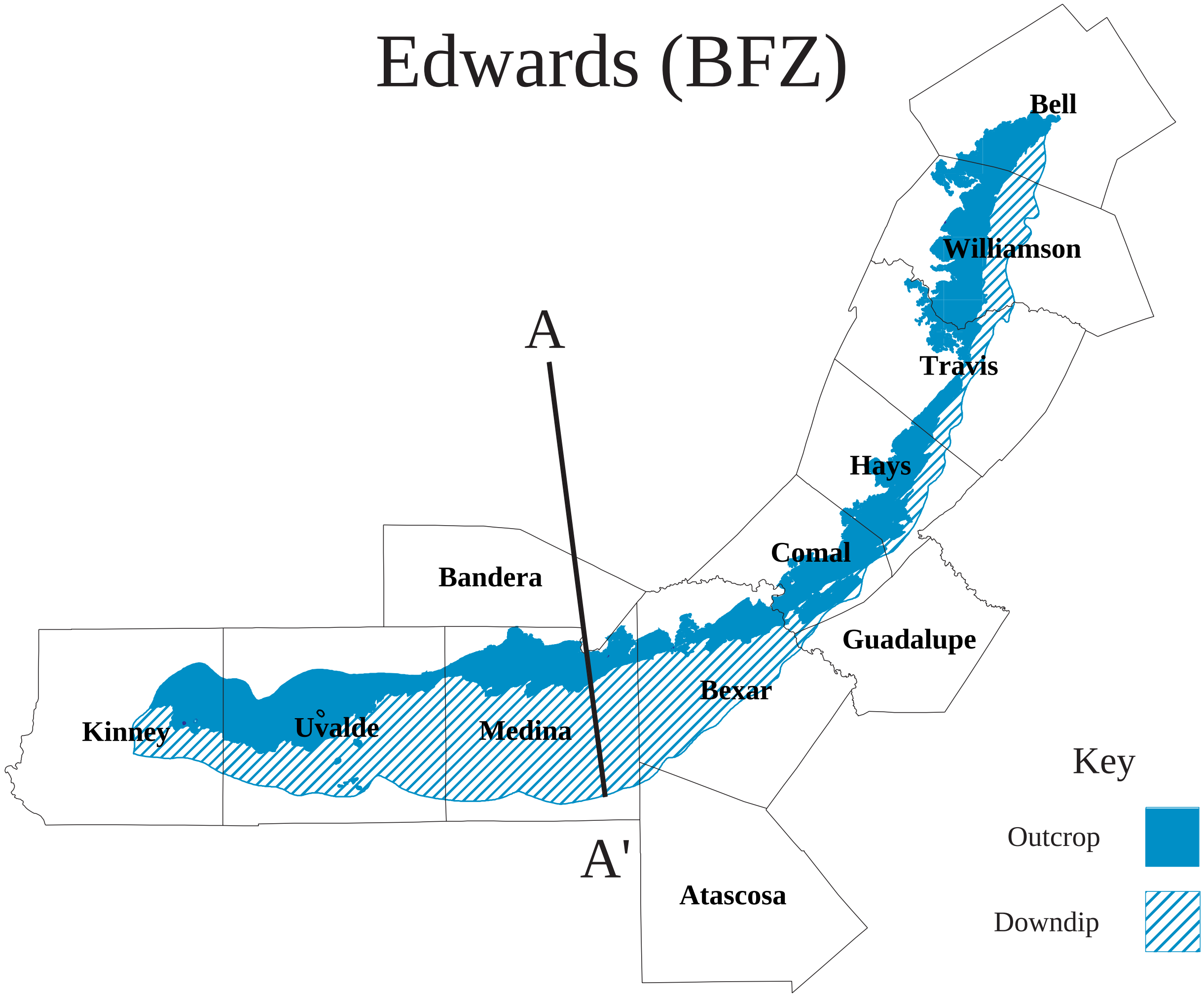
Thorkildsen, D., 1990, Evaluation of water resources of Fort Bend County, Texas: TWDB Rept. 321, 21 p.

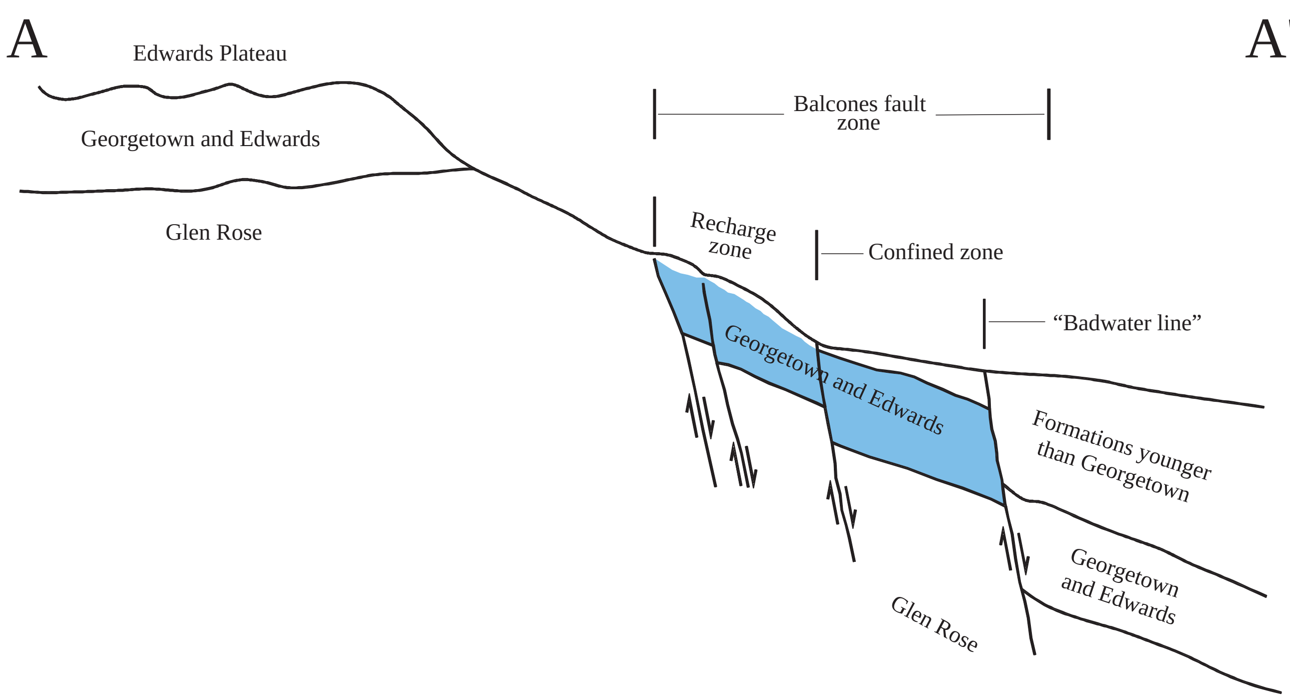
Thorkildsen, D., and Quincy, R., 1990, Evaluation of water resources of Orange and eastern Jefferson counties, Texas: TWDB Rept. 320, 34 p.

Wesselman, J.B., 1967, Ground-water resources of Jasper and Newton counties, Texas: TWDB Rept. 59, 167 p.

Wesselman, J.B., and Aronow, S., 1971, Ground-water resources of Chambers and Jefferson counties, Texas: TWDB Rept. 133, 183 p.

Edwards (BFZ)





Modified from Maclay and Small, 1986

Edwards (Balcones Fault Zone)

The Edwards (Balcones Fault Zone, or BFZ) aquifer covers approximately 4,350 square miles in parts of 11 counties. The aquifer forms a narrow belt extending from a ground-water divide in Kinney County through the San Antonio area northeastward to the Leon River in Bell County. A poorly defined ground-water divide near Kyle in Hays County hydrologically separates the aquifer into the San Antonio and Austin regions. The name Edwards (BFZ) distinguishes this aquifer from the Edwards-Trinity (Plateau) and the Edwards-Trinity (High Plains) aquifers.

Water from the aquifer is primarily used for municipal, irrigation, and recreational purposes; approximately 54 percent is used for municipal supply. San Antonio, which obtains its entire municipal water supply from the Edwards aquifer, is one of the largest cities in the world to rely solely on a single ground-water source. The aquifer feeds several well-known recreational springs and underlies some of the most environmentally sensitive areas in the state.

The aquifer, composed predominantly of limestone formed during the early Cretaceous Period, exists under water-table conditions in the outcrop and under artesian conditions where it is confined below the overlying Del Rio Clay. The Edwards aquifer consists of the Georgetown Limestone, formations of the Edwards Group (the primary water-bearing unit) and their equivalents, and the Comanche Peak Limestone where it exists. Thickness ranges from 200 feet to 600 feet.

Recharge to the aquifer occurs primarily by the downward percolation of surface water from streams draining off the Edwards Plateau to the north and west and by direct infiltration of precipitation on the outcrop. This recharge reaches the aquifer through crevices, faults, and sinkholes in the unsaturated zone. Unknown amounts of ground water enter the aquifer as lateral underflow from the Glen Rose Formation. Water in the aquifer generally moves from the recharge zone toward natural discharge points such as Comal, San Marcos, Barton, and Salado springs. Water is also discharged artificially from hundreds of pumping wells, particularly municipal supply wells in the San Antonio region and irrigation wells in the western extent.

In the updip portion, ground water moving through the aquifer system has dissolved large amounts of rock to create highly permeable solution zones and channels that facilitate rapid flow and relatively high storage capacity within the aquifer. Highly fractured strata in fault zones have also been preferentially dissolved to form conduits capable of transmitting large amounts of water. Due to its extensive honeycombed and cavernous character, the aquifer yields moderate to large quantities of water. Some wells yield in excess of 16,000 gal/min, and one well drilled in Bexar County flowed 24,000 gal/min from a 30-inch diameter well. The aquifer is significantly less permeable farther downdip where the concentration of dissolved solids in the water exceeds 1,000 mg/l.

The chemical quality of water in the aquifer is typically fresh, although hard, with dissolved-solids concentrations averaging less than 500 mg/l. The downdip interface between fresh and slightly saline water represents the extent of water containing less than 1,000 mg/l. Within a short distance downgradient of this “bad water line,” the ground water becomes increasingly mineralized.

Due to its highly permeable nature in the fresh-water zone, the Edwards aquifer responds quickly to changes and extremes of stress placed on the system. This is indicated by rapid water-level fluctuations during relatively short periods of time. During times of adequate rainfall and recharge, the Edwards aquifer is able to supply sufficient amounts of water for all demands as well as sustain spring flows at many locations throughout its extent. However, under conditions of below-average rainfall or drought when discharge exceeds recharge, spring flows may be reduced to environmentally detrimental levels, and mandatory rationing may be established.

References

Baker, E.T., Jr., Slade, R.M., Jr., Dorsey, M.E., Ruiz, L.M., and Duffin, G.L., 1986, Geohydrology of the Edwards aquifer in the Austin area, Texas: TWDB Rept. 293, 217 p.

Brune, Gunnar, and Duffin, G.L., 1983, Occurrence, availability, and quality of ground water in Travis County, Texas: TDWR Rept. 276, 231 p.

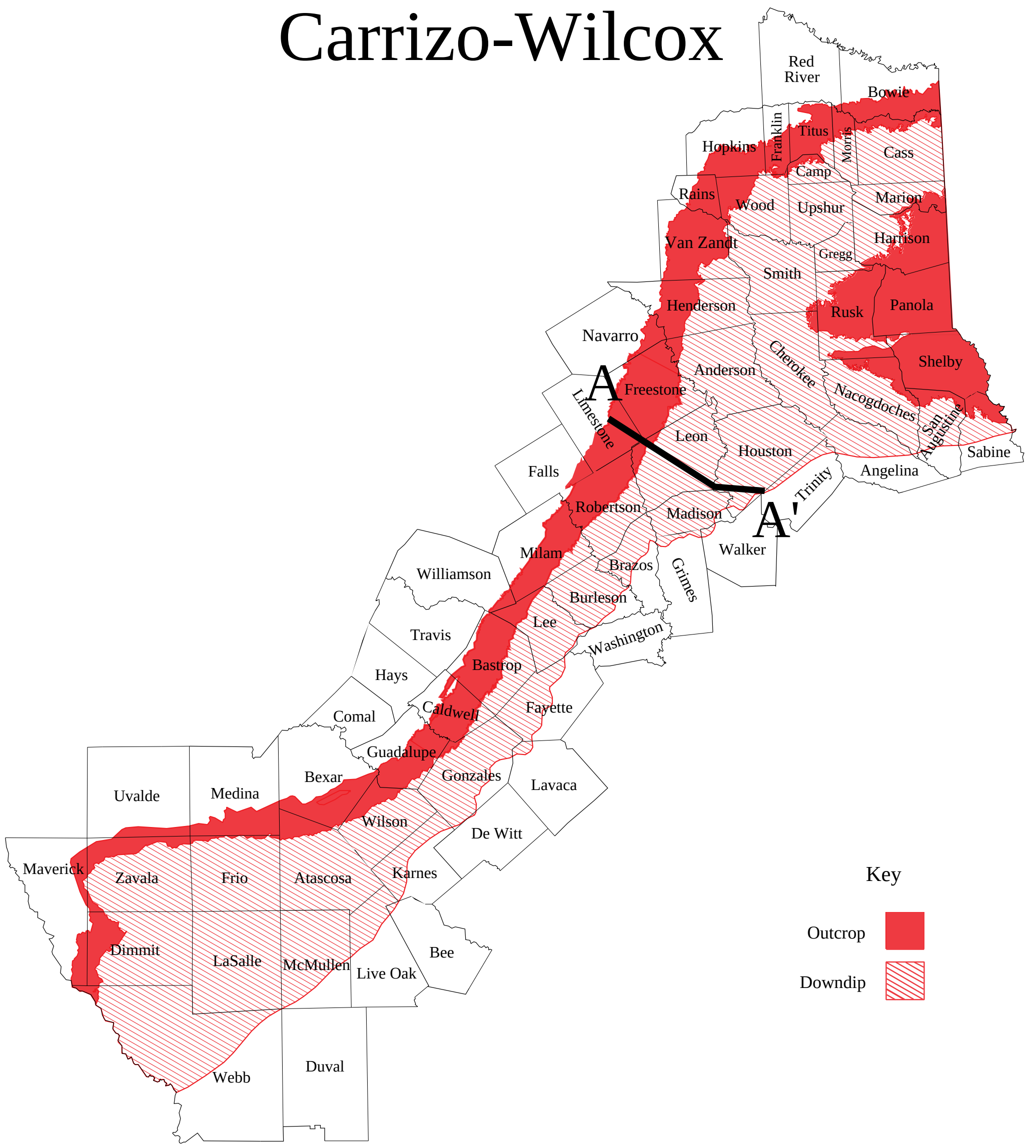
Duffin, G.L., and Musick, S.P., 1991, Evaluation of water resources in Bell, Burnet, Travis, Williamson, and parts of adjacent counties, Texas: TWDB Rept. 326, 105 p.

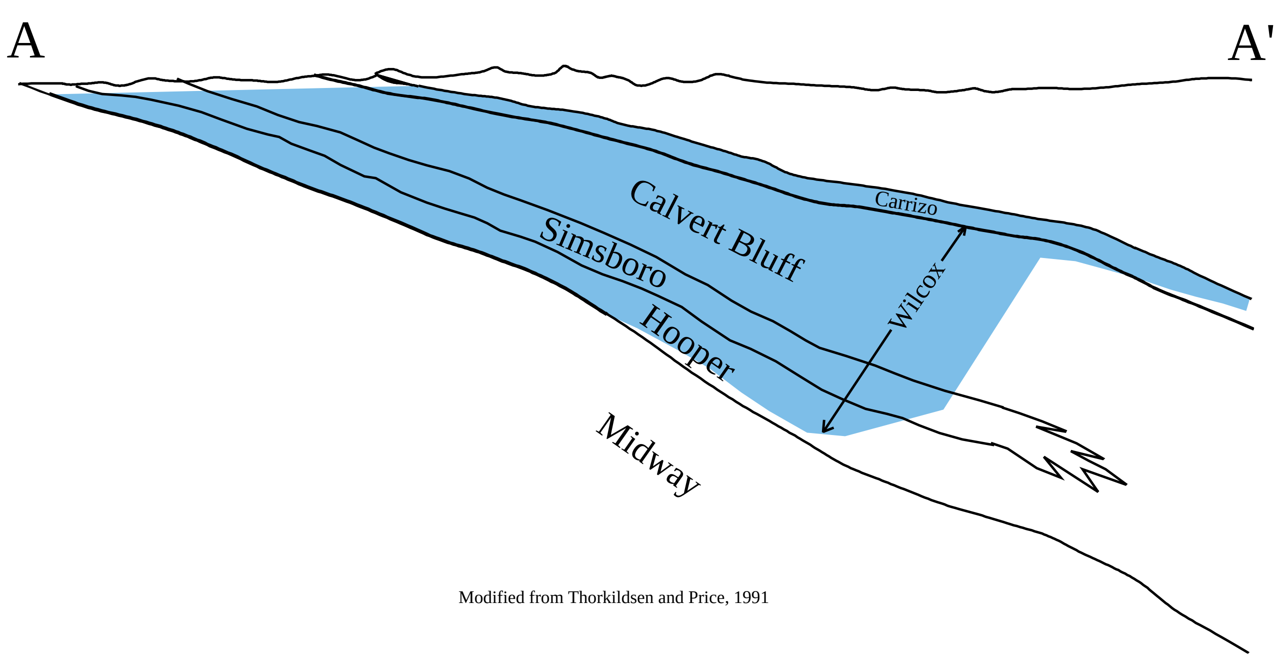
Kreitler, C.W., Senger, R.K., and Collins, E.W., 1987, Geology and hydrology of the northern segment of the Edwards aquifer with an emphasis on the recharge zone in the Georgetown, Texas, area: Prepared for the Texas Water Development Board, IAC (86-67)-1046; Univ. of Texas, Bureau of Economic Geology, 115 p.

Maclay, R.W., and Small, T.A., 1986, Carbonate geology and hydrology of the Edwards aquifer in the San Antonio area, Texas: TWDB Rept. 296, 90 p.

Slagle, D.L., Ardis, A.F., and Slade, R.M., Jr., 1986, Recharge zone of the Edwards aquifer hydrologically associated with Barton Springs in the Austin area, Texas: U.S. Geological Survey Water-Resources Inv. Rept. 86-4062, map.

Carrizo-Wilcox





Modified from Thorkildsen and Price, 1991

Carrizo-Wilcox Aquifer

The Wilcox Group and the overlying Carrizo Formation of the Claiborne Group form a hydrologically connected system known as the Carrizo-Wilcox aquifer. This aquifer extends from the Rio Grande in South Texas northeastward into Arkansas and Louisiana, providing water to all or parts of 60 counties. The Carrizo Sand and Wilcox Group crop out along a narrow band that parallels the Gulf Coast and dips beneath the land surface toward the coast, except in the East Texas structural basin adjacent to the Sabine Uplift, where the formations form a trough.

Municipal and irrigation pumpage account for about 35 percent and 51 percent, respectively, of total pumpage. The largest metropolitan areas dependent on ground water from the Carrizo-Wilcox aquifer are Bryan-College Station, Lufkin-Nacogdoches, and Tyler. Irrigation is the predominant use in the Winter Garden region of South Texas.

The Carrizo-Wilcox aquifer is predominantly composed of sand locally interbedded with gravel, silt, clay, and lignite deposited during the Tertiary Period. South of the Trinity River and north of the Colorado River, the Wilcox Group is divided into three distinct formations: the Hooper, Simsboro, and Calvert Bluff. Of the three, the Simsboro typically contains the most massive water-bearing sands. This division cannot be made south of the Colorado River or north of the Trinity River due to the absence of the Simsboro as a distinct unit. Aquifer thickness in the downdip artesian portion ranges from less than 200 feet to more than 3,000 feet.

Well yields are commonly 500 gal/min, and some may reach 3,000 gal/min downdip where the aquifer is under artesian conditions. Some of the greatest yields (more than 1,000 gal/min) are produced from the Carrizo Sand in the southern, or Winter Garden, area of the aquifer. Yields of greater than 500 gal/min are also obtained from the Carrizo and Simsboro formations in the central region.

Regionally, water from the Carrizo-Wilcox aquifer is fresh to slightly saline. In the outcrop, the water is hard, yet usually low in dissolved solids. Downdip, the water is softer, has a higher temperature, and contains more dissolved solids. Hydrogen sulfide and methane may occur locally. Excessively corrosive water with a high iron content is common throughout much of the northeastern part of the aquifer. Localized contamination of the aquifer in the Winter Garden area is attributed to direct infiltration of oil field brines on the surface and to downward leakage of saline water to the overlying Bigford Formation.

Significant water-level declines have developed in the semiarid Winter Garden portion of the Carrizo aquifer, as the region is heavily dependent on ground water for irrigation. Since 1920, water levels have declined as much as 100 feet in much of the area and more than 250 feet in the Crystal City area of Zavala County. Significant water-level declines resulting from extensive municipal and industrial pumpage also have occurred in Northeast Texas. Tyler and the Lufkin-Nacogdoches area have experienced declines in excess of 400 feet, and in a few wells, as much as 500 feet since the 1940s. In this area, conversion to surface-water use is slowing the rate of water-level decline. The northeast outcrop area has been dewatered in the vicinity of lignite surface-mining operations, and the Simsboro Sand Formation of the Wilcox Group has been affected by water-level declines in parts of Robertson and Milam counties.

References

Anders, R.B., 1967, Ground-water resources of Sabine and San Augustine counties, Texas: TWDB Rept. 37, 54 p.

Broom, M.E., 1969, Ground-water resources of Gregg and Upshur counties, Texas: TWDB Rept. 101, 44 p.

Broom, M.E., Alexander, W.H., Jr., and Myers, B.N., 1965, Ground-water resources of Camp, Franklin, Morris, and Titus counties, Texas: TWC Bull. 6517, 56 p.

Dillard, J.W., 1963, Availability and quality of ground water in Smith County, Texas: TWC Bull. 6302, 35 p.

Guyton, W.F., and Associates, 1970, Ground-water conditions in Angelina and Nacogdoches counties, Texas: TWDB Rept. 110, 60 p.

____, 1972, Ground-water conditions in Anderson, Cherokee, Freestone, and Henderson counties, Texas: TWDB Rept. 150, 80 p.

Klemt, W.B., Duffin, G.L., and Elder, G.R., 1976, Ground-water resources of the Carrizo aquifer in the Winter Garden area of Texas: TWDB Rept. 210, 2 vols.

McCoy, T.W., 1991, Evaluation of the ground-water resources of the western portion of the Winter Garden area, Texas: TWDB Rept. 334, 64 p.

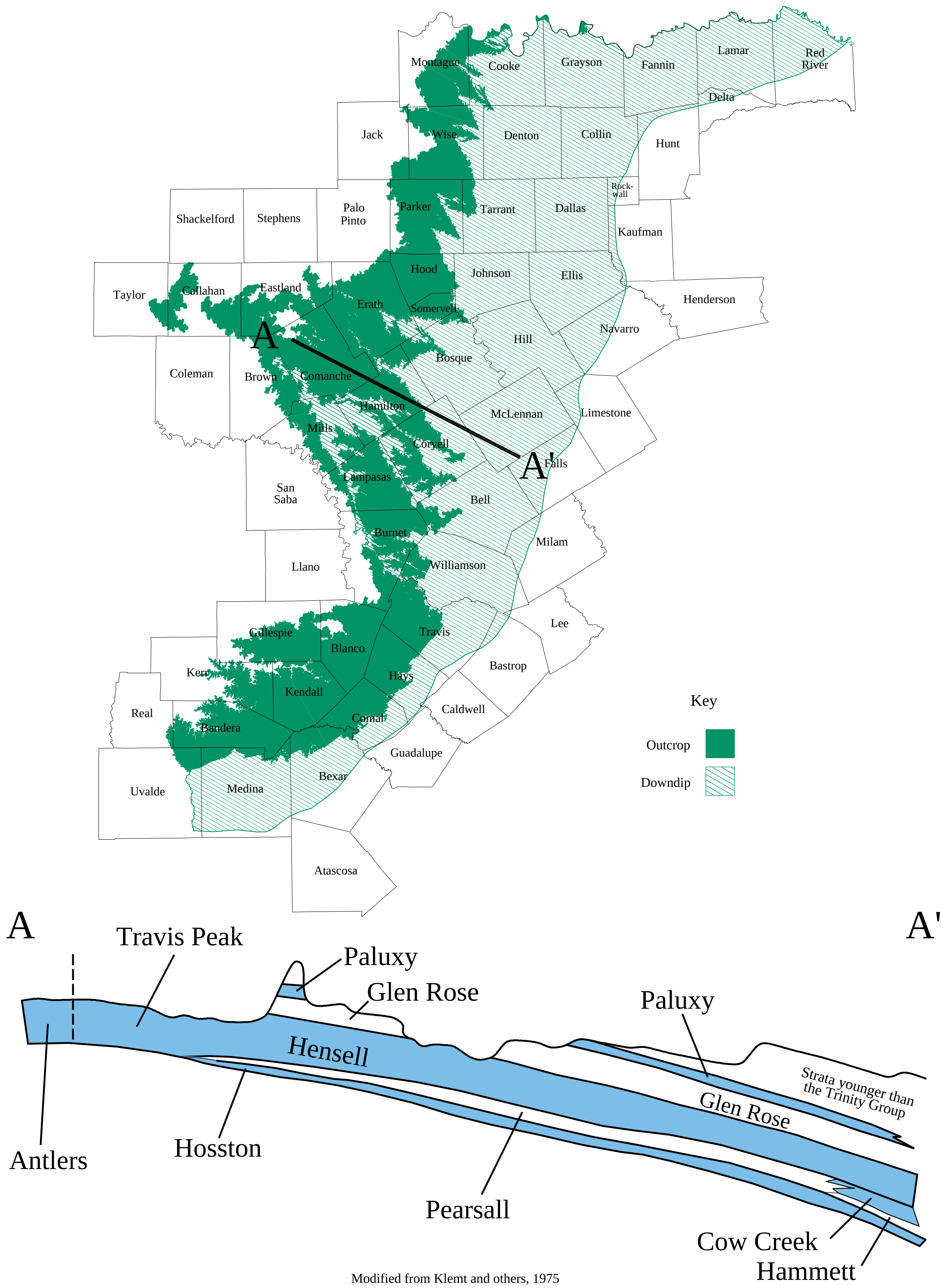
Preston, R.D., and Moore, S.W., 1991, Evaluation of ground-water resources in the vicinity of the cities of Henderson, Jacksonville, Kilgore, Lufkin, Nacogdoches, Rusk, and Tyler in East Texas: TWDB Rept. 327, 51 p.

Rettman, P.L., 1987, Ground-water resources of Limestone County, Texas: TWDB Rept. 299, 97 p.

Sandeen, W.M., 1987, Ground-water resources of Rusk County, Texas: TWDB Rept. 297, 121 p.

Thorkildsen, D., and Price, R.D., 1991, Ground-water resources of the Carrizo-Wilcox aquifer in the Central Texas region: TWDB Rept. 332, 73 p.

Trinity



Modified from Klemt and others, 1975

Trinity Aquifer

The Trinity aquifer consists of early Cretaceous age formations of the Trinity Group where they occur in a band extending through the central part of the state in all or parts of 55 counties, from the Red River in North Texas to the Hill Country of South-Central Texas. Trinity Group deposits also occur in the Panhandle and Edwards Plateau regions where they are included as part of the Edwards-Trinity (High Plains and Plateau) aquifers.

Formations comprising the Trinity Group are (from youngest to oldest) the Paluxy, Glen Rose, and Twin Mountains-Travis Peak. Updip, where the Glen Rose thins or is missing, the Paluxy and Twin Mountains coalesce to form the Antlers Formation. The Antlers consists of up to 900 feet of sand and gravel, with clay beds in the middle section. Water from the Antlers is mainly used for irrigation in the outcrop area of North and Central Texas.

Forming the upper unit of the Trinity Group, the Paluxy Formation consists of up to 400 feet of predominantly fine- to coarse-grained sand interbedded with clay and shale. The formation pinches out downdip and does not occur south of the Colorado River.

Underlying the Paluxy, the Glen Rose Formation forms a gulfward-thickening wedge of marine carbonates consisting primarily of limestone. South of the Colorado River, the Glen Rose is the upper unit of the Trinity Group and is divisible into an upper and lower member. In the north, the downdip portion of the aquifer becomes highly mineralized and is a source of contamination to wells that are drilled into the underlying Twin Mountains.

The basal unit of the Trinity Group consists of the Twin Mountains and Travis Peak formations, which are laterally separated by a facies change. To the north, the Twin Mountains Formation consists mainly of medium- to coarse-grained sands, silty clays, and conglomerates. The Twin Mountains is the most prolific of the Trinity aquifers in North-Central Texas; however, the quality of the water is generally not as good as that from the Paluxy or Antlers Formations. To the south, the Travis Peak Formation contains calcareous sands and silts, conglomerates, and limestones. The formation is subdivided into the following members in descending order: Hensell, Pearsall, Cow Creek, Hammett, Sligo, Hosston, and Sycamore.

Extensive development of the Trinity aquifer has occurred in the Fort Worth-Dallas region where water levels have historically dropped as much as 550 feet. Since the mid-1970s, many public supply wells have been abandoned in favor of a surface-water supply, and water levels have responded with slight rises. Water-level declines of as much as 100 feet are still occurring in Denton and Johnson counties. The Trinity aquifer is most extensively developed from the Hensell and Hosston members in the Waco area, where the water level has declined by as much as 400 feet.

References

Ashworth, J.B., 1983, Ground-water availability of the lower Cretaceous formations in the Hill Country of South-Central Texas: TDWR Rept. 273, 65 p.

Baker, B., Duffin, G., Flores, R., and Lynch, T., 1990, Evaluation of water resources in part of Central Texas: TWDB Rept. 319, 65 p.

____ , 1990, Evaluation of water resources in part of North-Central Texas: TWDB Rept. 318, 67 p.

Brune, G., and Duffin, G.L., 1983, Occurrence, availability, and quality of ground water in Travis County, Texas: TDWR Rept. 276, 231 p.

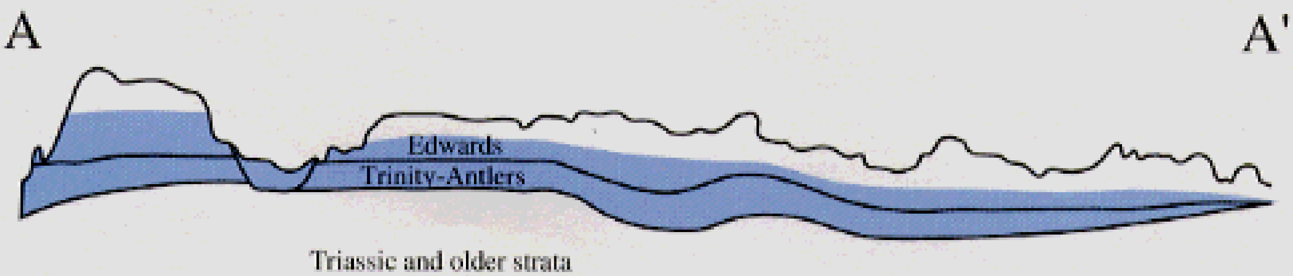
Duffin, G., and Musick, S.P., 1991, Evaluation of water resources in Bell, Burnet, Travis, Williamson, and parts of adjacent counties, Texas: TWDB Rept. 326, 105 p.

Klemt, W.B., Perkins, R.D., and Alvarez, H.J., 1975, Ground-water resources of part of Central Texas, with emphasis on the Antlers and Travis Peak formations: TWDB Rept. 195, 2 vols.

Nordstrom, P.L., 1982, Occurrence, availability, and chemical quality of ground water in the Cretaceous aquifers of North-Central Texas: TDWR Rept. 269, 2 vols.

____ , 1987, Ground-water resources of the Antlers and Travis Peak formations in the outcrop area of North-Central Texas: TWDB Rept. 298, 297 p.

Edwards-Trinity (Plateau)



Modified from Walker, 1979

Edwards-Trinity (Plateau) Aquifer

The Edwards-Trinity (Plateau) aquifer underlies the Edwards Plateau east of the Pecos River and the Stockton Plateau west of the Pecos River, providing water to all or parts of 38 counties. The aquifer extends from the Hill Country of Central Texas to the Trans-Pecos region of West Texas. Irrigation accounts for 70 percent of the total pumpage, whereas municipal use accounts for 15 percent.

The aquifer consists of saturated sediments of lower Cretaceous age Trinity Group formations and overlying limestones and dolomites of the Comanche Peak, Edwards, and Georgetown formations. The Glen Rose Limestone is the primary unit of the Trinity in the southern part of the plateau and is replaced by the Antlers Sand north of the Glen Rose pinchout. The Maxon Sand is present in the western Stockton Plateau region. Maximum saturated thickness of the aquifer is greater than 800 feet.

The aquifer generally exists under water-table conditions; however, where the Trinity is fully saturated and a zone of low permeability occurs near the base of the overlying Edwards aquifer, artesian conditions may exist in the Trinity. Reported well yields commonly range from less than 50 gal/min, where saturated thickness is thin, to more than 1,000 gal/min, where large-capacity wells are completed in jointed and cavernous limestone.

Chemical quality of Edwards-Trinity (Plateau) water ranges from fresh to slightly saline. The water is typically hard and may vary widely in concentrations of dissolved solids made up mostly of calcium and bicarbonate. The salinity of the ground water tends to increase toward the west. Certain areas have unacceptable levels of fluoride.

There is little pumpage from the aquifer over most of its extent, and water levels have remained constant or have fluctuated only with seasonal precipitation. In some instances, water levels have declined as a result of increased pumpage. Although historical declines have occurred in the northwestern part of the aquifer in Reagan, Upton, Midland, and Glasscock counties as a result of irrigation, none of the areas has experienced declines greater than 20 feet since 1980.

References

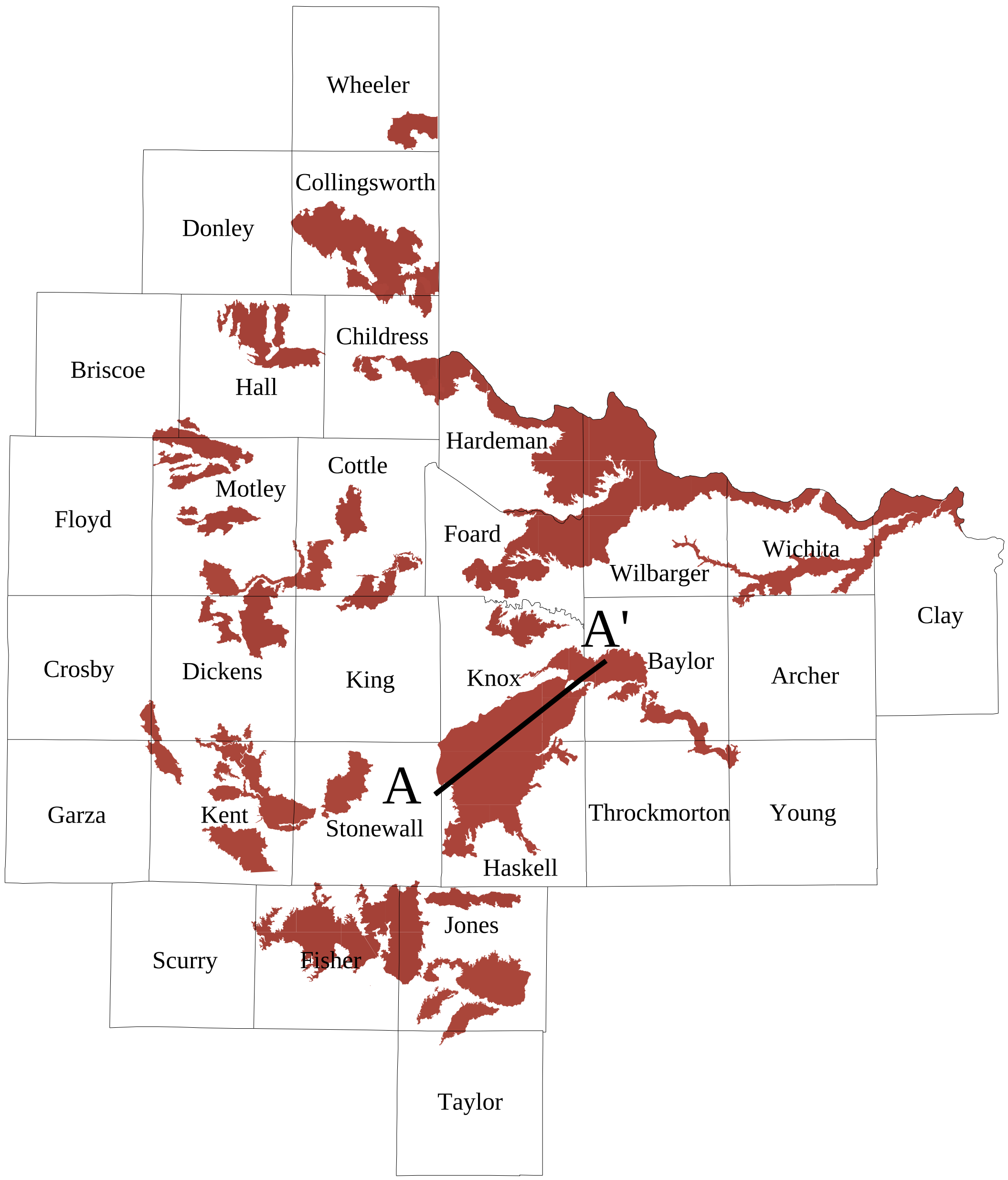
Ashworth, J.B., and Christian, PC., 1989, Evaluation of ground-water resources in parts of Midland, Reagan, and Upton counties, Texas: TWDB Rept. 3 12, 52 p.

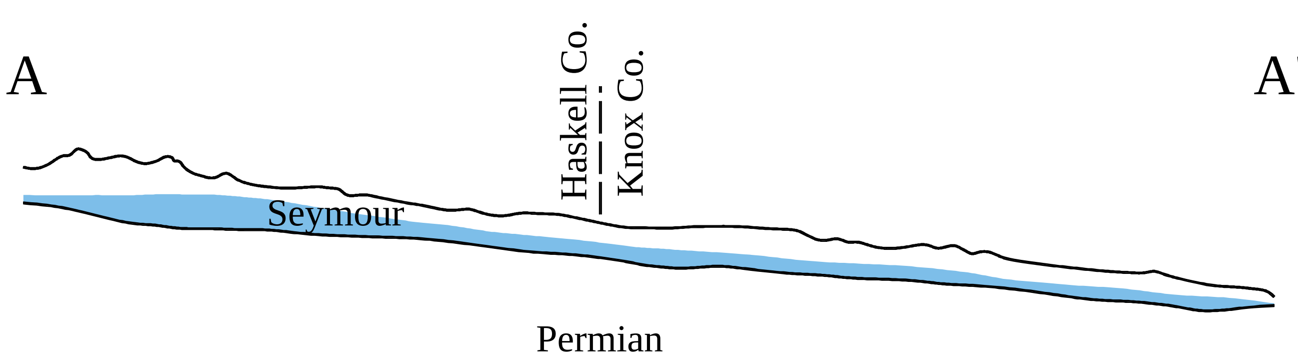
Rees, R., and Buckner, A.W., 1980, Occurrence and quality of ground water in the Edwards-Trinity (Plateau) aquifer in the Trans-Pecos region of Texas: TDWR Rept. 255, 41 p.

Taylor, H.D., 1978, Occurrence, quantity, and quality of ground water in Taylor County, Texas: TDWR Rept. 224, 136 p.

Walker, L.E., 1979, Occurrence, availability, and chemical quality of ground water in the Edwards Plateau region of Texas: TDWR Rept. 235, 114 p.

Seymour





Modified from R.W. Harden and Assoc., 1978

Seymour Aquifer

The Seymour Formation consists of isolated areas of alluvium found in parts of 23 north-central and Panhandle counties. Approximately 90 percent of the water pumped from the aquifer is used for irrigation. Municipal pumpage, primarily for the communities of Vernon, Burkburnett, and Electra, accounts for eight percent.

The Seymour aquifer consists of discontinuous beds of poorly sorted gravel, conglomerate, sand, and silty clay deposited during the Quaternary Period by eastward-flowing streams. Individual accumulations vary greatly in thickness, although most of the Seymour is less than 100 feet thick. In isolated northern parts of the aquifer, the formation may be as thick as 360 feet.

The aquifer exists under water-table conditions throughout much of its extent, but artesian conditions may occur where the water-bearing zone is overlain by clay. The lower, more permeable part of the aquifer produces the greatest amount of ground water. Yields of wells range from less than 100 gal/min to as much as 1,300 gal/min, depending on saturated thickness, and average about 300 gal/min. No significant water-level declines have occurred in the aquifer.

Water quality in these alluvial remnants generally ranges from fresh to slightly saline; however, higher salinity problems occur. The salinity has increased in many heavily pumped areas to the point where the water has become unsuitable for domestic and municipal uses. Natural salt pollution in the upper reaches of the Red and Brazos river basins precludes the full utilization of these water resources. Brine pollution from earlier oil field activities has resulted in localized contamination of fresh ground- and surface-water supplies. High nitrate concentrations in excess of drinking water standards in Seymour ground water are widespread.

References

Duffin, G.L., and Beynon, B.E., 1992, Evaluation of water resources in parts of the Rolling Prairies region of North-Central Texas: TWDB Rept. 337, 93 p.

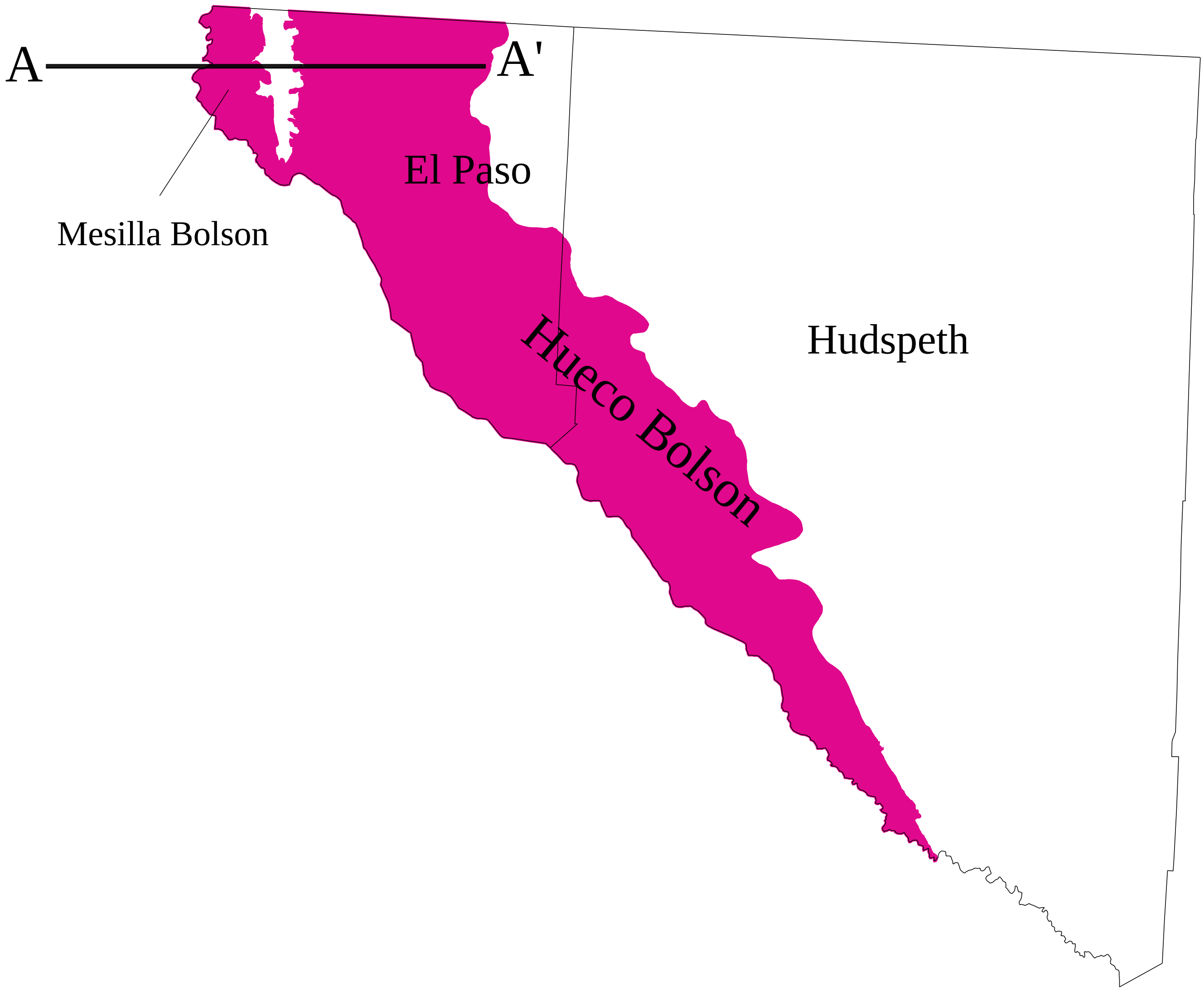
Harden, R.W., and Associates, 1978, The Seymour aquifer, ground-water quality and availability in Haskell and Knox counties, Texas: TDWR Rept. 226, 2 vols.

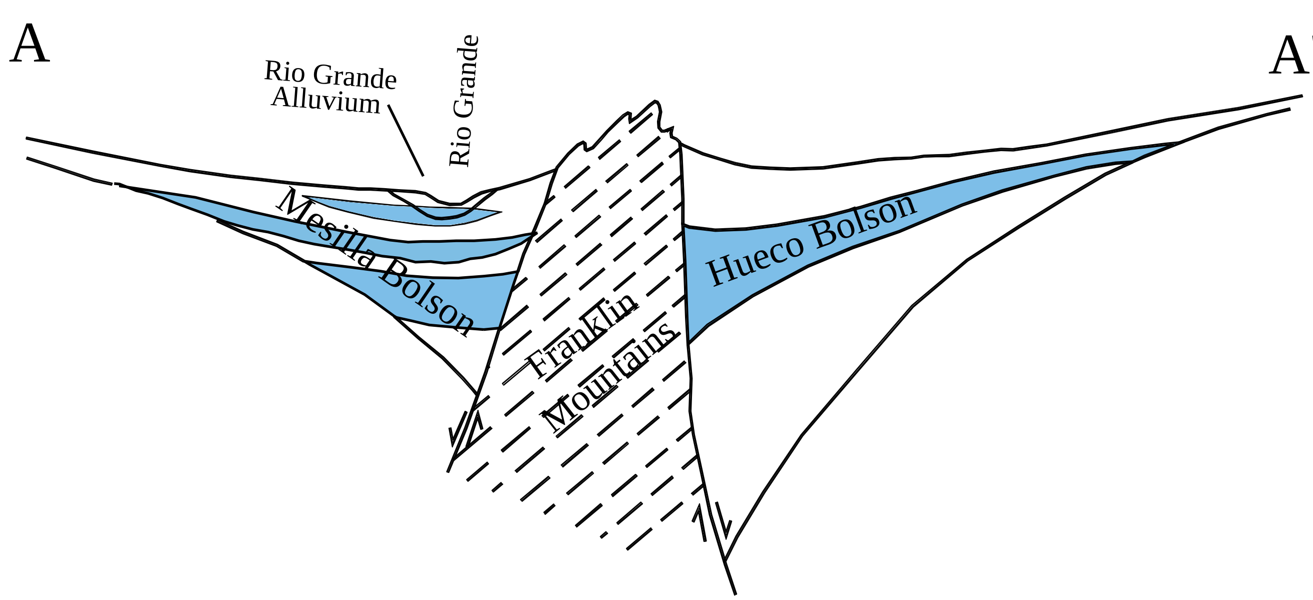
Preston, R.D., 1978, Occurrence and quality of ground water in Baylor County, Texas: TDWR Rept. 218, 118 p.

Price, R.D., 1978, Occurrence, quality, and availability of ground water in Jones County, Texas: TDWR Rept. 215, 105 p.

____ , 1979, Occurrence, quality, and quantity of ground water in Wilbarger County, Texas: TDWR Rept. 240, 222 p.

Hueco-Mesilla Bolson





Hueco-Mesilla Bolson Aquifers

The Hueco and Mesilla Bolson aquifers are located in El Paso and Hudspeth counties in the far western tip of Texas. The aquifers are composed of Tertiary and Quaternary basin-fill (bolson) deposits that extend northward into New Mexico and westward into Mexico. The Hueco Bolson, east of the Franklin Mountains, is the principal aquifer in the El Paso area; to the west is the Mesilla Bolson. Eighty-seven percent of the water pumped from the aquifers is used for municipal supply, primarily for the city of El Paso. Across the international border, water for Ciudad Juarez is supplied from the Hueco Bolson.

The Hueco Bolson, approximately 9,000 feet in total thickness, consists of silt, sand, and gravel in the upper part, and clay and silt in the lower part. Only the upper several hundred feet of the bolson contain fresh to slightly saline water. The majority of the Hueco water in Texas occurs in the El Paso metropolitan area; very little occurs in Hudspeth County.

The Mesilla Bolson consists of approximately 2,000 feet of clay, silt, sand, and gravel. Three water-bearing zones in the Mesilla (shallow, intermediate, and deep) have been identified based on water levels and quality. The shallow water-bearing zone includes the overlying Rio Grande Alluvium.

The chemical quality of the ground water in the Hueco Bolson differs according to its location and depth. Dissolved-solids concentrations in the upper, fresher part of the aquifer range from less than 500 mg/l to more than 1,500 mg/l and average about 640 mg/l. Quality of Hueco Bolson water in Mexico is slightly poorer.

Chemical quality of ground water in the Mesilla Bolson ranges from fresh to saline, with salinity generally increasing to the south along the valley. The water is commonly freshest in the deep zone of the aquifer and contains progressively higher concentrations of dissolved solids in the shallower zones. Increasing deterioration of quality of these aquifers is the result of large-scale ground-water withdrawals, which are depleting the aquifers of the freshest water.

Historical large-scale ground-water withdrawals, especially from municipal well fields in the downtown areas of El Paso and Ciudad Juarez, have caused major water-level declines. These declines, in turn, have significantly changed the direction of flow, rate of flow, and chemical quality of ground water in the aquifers. Declining water levels have also resulted in a minor amount of land-surface subsidence.

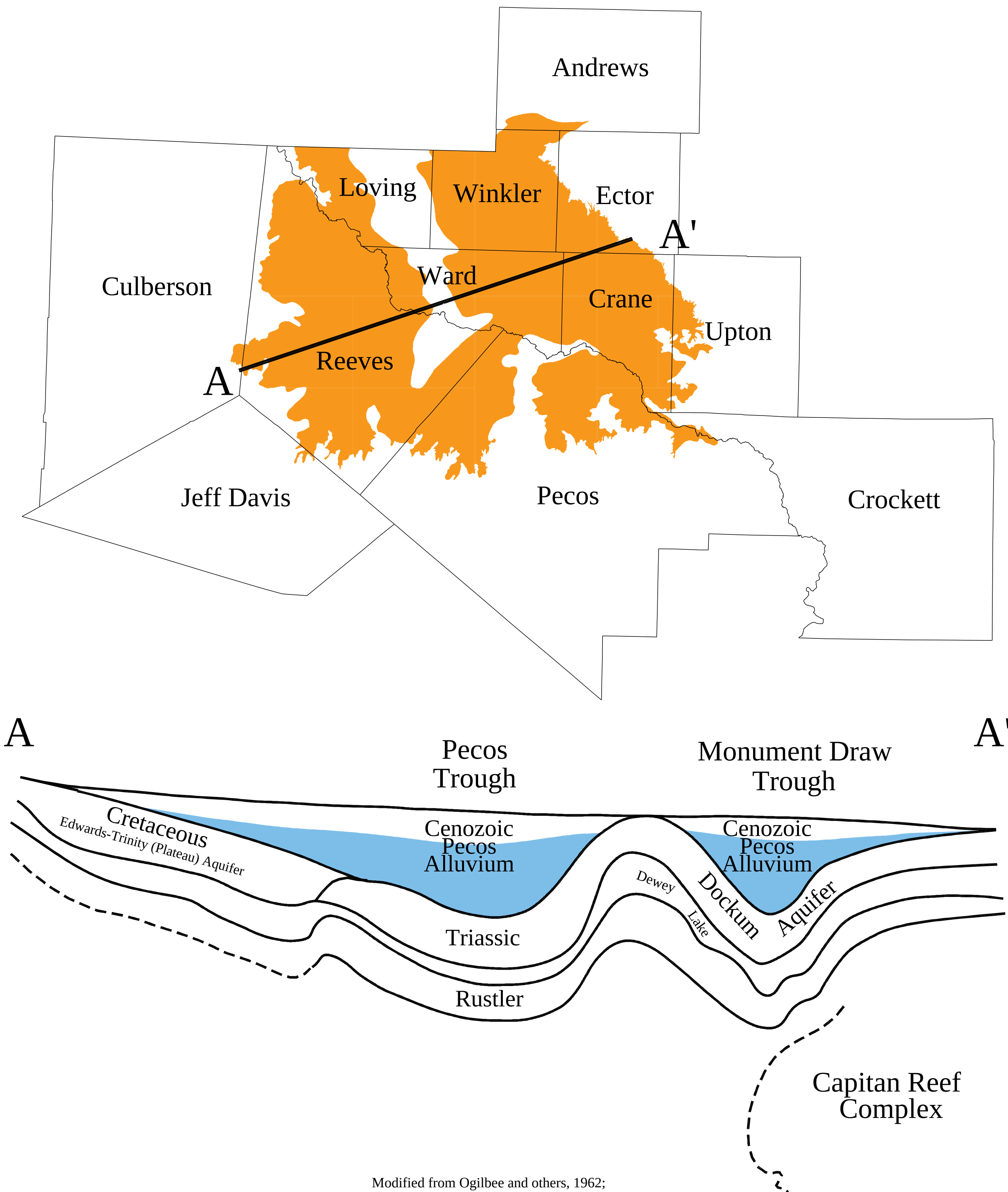
References

Alvarez, H.J., and Buckner, A.W., 1980, Ground-water development in the El Paso region, Texas, with emphasis on the lower El Paso Valley: TDWR Rept. 246, 349 p.

Ashworth, J.B., 1990, Evaluation of ground-water resources in El Paso County, Texas: TWDB Rept. 324, 25 p.

White, D.E., 1987, Summary of hydrologic information in the El Paso, Texas, area, with emphasis on ground-water studies, 1903-80: TWDB Rept. 300, 75 p.

Cenozoic Pecos Alluvium



Modified from Ogilbee and others, 1962;
and Ashworth, 1990

Cenozoic Pecos Alluvium Aquifer

The Cenozoic Pecos Alluvium aquifer, located in the upper part of the Pecos River Valley of West Texas, provides water to parts of Andrews, Crane, Ector, Loving, Pecos, Reeves, Upton, Ward, and Winkler counties. The aquifer is the principal source of water for irrigation in Reeves and northwestern Pecos counties, and for industrial, power generation, and public supply uses elsewhere. A significant amount of water is exported to cities east of the area. Approximately 81 percent of the water pumped from the aquifer is used for irrigation.

The Cenozoic Pecos Alluvium of Quaternary age consists of up to 1,500 feet of alluvial fill and occupies two hydrologically separate basins: the Pecos Trough in the west and the Monument Draw Trough in the east. The aquifer is hydrologically connected to underlying water-bearing strata, including the Edwards-Trinity in Pecos and Reeves counties and the Triassic Dockum in Ward and Winkler counties.

Ground water in the Cenozoic Pecos Alluvium aquifer occurs under semiconfined or unconfined (water-table) conditions, although confining clay beds may create localized artesian conditions. Moderate to large yields can generally be expected from wells completed in this aquifer.

The chemical quality of water in the aquifer is highly variable, differing naturally with location and depth, and is generally better in the Monument Draw Trough. Water from the aquifer is typically hard and contains dissolved-solids concentrations ranging from less than 300 mg/l to more than 5,000 mg/l. Sulfate and chloride are the two predominant constituents. A natural deterioration of quality occurs with increasing depth of the water-bearing strata. Some quality deterioration has resulted from past petroleum industry activities in Loving, Ward, and Winkler counties, and from irrigation in Pecos, Reeves, and Ward counties.

Water-level declines in excess of 200 feet historically have occurred in south-central Reeves and northwest Pecos counties, but have moderated since the mid-1970s with the decrease in irrigation pumpage. Ground water that once rose to the surface and flowed into the Pecos River, now flows in the subsurface toward areas of heavy pumpage. As a consequence, baseflow to the Pecos River has declined. Elsewhere, only moderate water-level declines have occurred as a result of less intense pumpage for industrial and public supply uses in Ward and Winkler counties.

References

Armstrong, C.A., and McMillion, L.G., 1961, Geology and ground-water resources of Pecos County, Texas: TBWE Bull. 6106, 2 vols.

Ashworth, J.B., 1990, Evaluation of ground-water resources in parts of Loving, Pecos, Reeves, Ward, and Winkler counties, Texas: TWDB Rept. 317, 51 p.

Garza, S., and Wesselman, J.B., 1959, Geology and ground-water resources of Winkler County, Texas: TBWE Bull. 5916, 215 p.

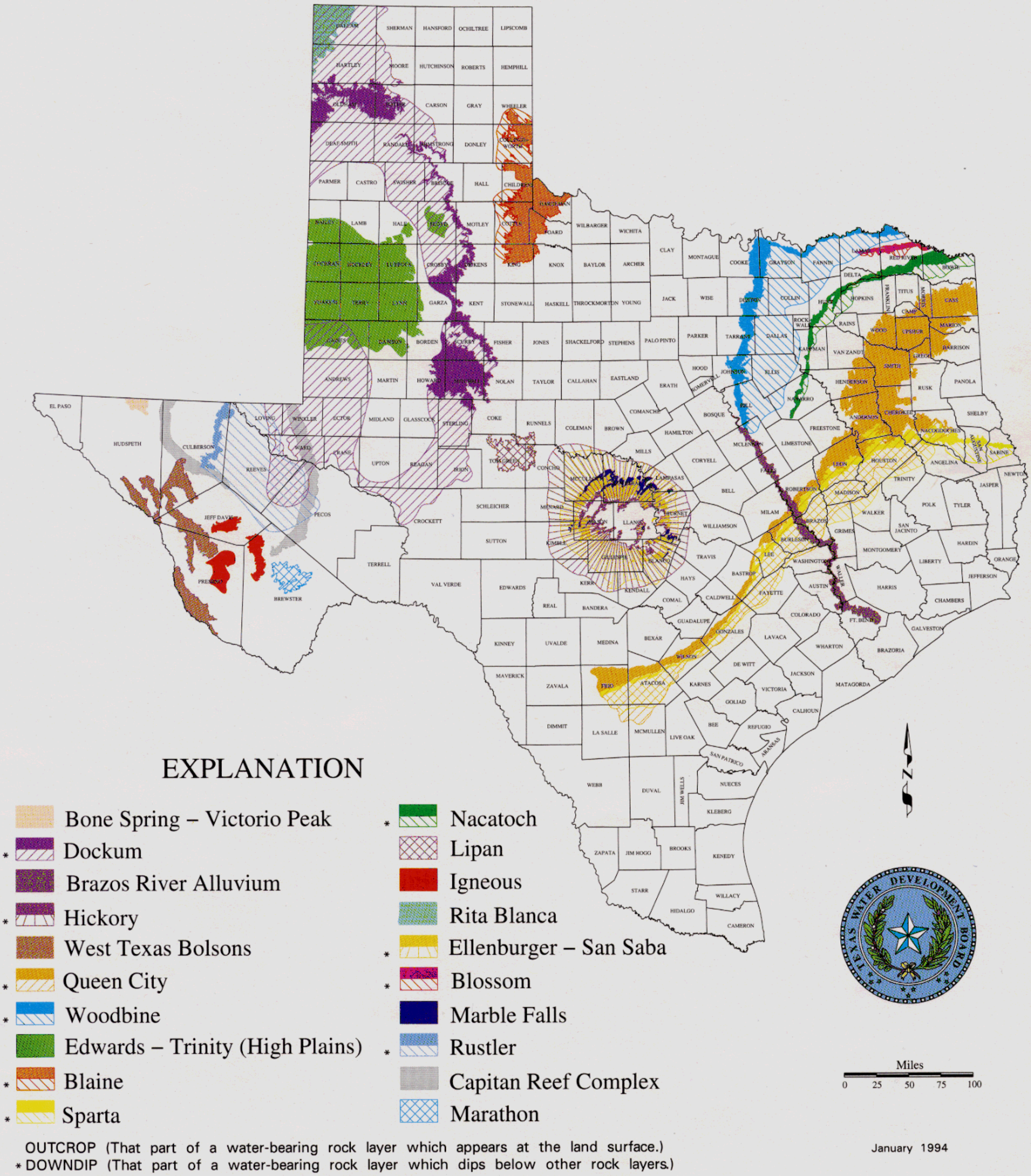
Maley, V.C., and Huffington, R.M., 1953, Cenozoic fill and evaporite solution in the Delaware Basin, Texas and New Mexico: Geological Society of America Bull. Vol. 64, No. 5, pp. 539 - 546.

Ogilbee, W., Wesselman, J.B., and Ireland, B., 1962, Geology and ground-water resources of Reeves County, Texas: TWC Bull. 6214, 2 vols.

Perkins, R.D., Buckner, W.A., and Henry, J.M., 1972, Availability and quality of ground water in the Cenozoic Alluvium aquifer in Reeves, Pecos, Loving, and Ward counties, Texas: TWDB Open File Rept., 28 p.

White, D.E., 1971, Water resources of Ward County, Texas: TWDB Rept. 125, 235 p.

MINOR AQUIFERS OF TEXAS



Bone Spring - Victorio Peak

Bone Spring-Victorio Peak Aquifer

The Bone Spring-Victorio Peak aquifer occupies the eastern edge of the Diablo Plateau west of the Guadalupe Mountains in northeast Hudspeth County and extends northward into the Crow Flats area of New Mexico. The Bone Spring and Victorio Peak formations are composed of as much as 2,000 feet of early Permian age limestone beds and contain ground water in joints, fractures, and solution cavities. Permeability of the limestones is highly variable, and well yields differ widely from about 150 gal/min to more than 2,000 gal/min.

The aquifer is used almost exclusively for irrigation. Dell City is the only community that withdraws water from the aquifer for public supply. Water levels have declined in the aquifer since pre-irrigation times; however, the levels have remained relatively constant since the late 1970s.

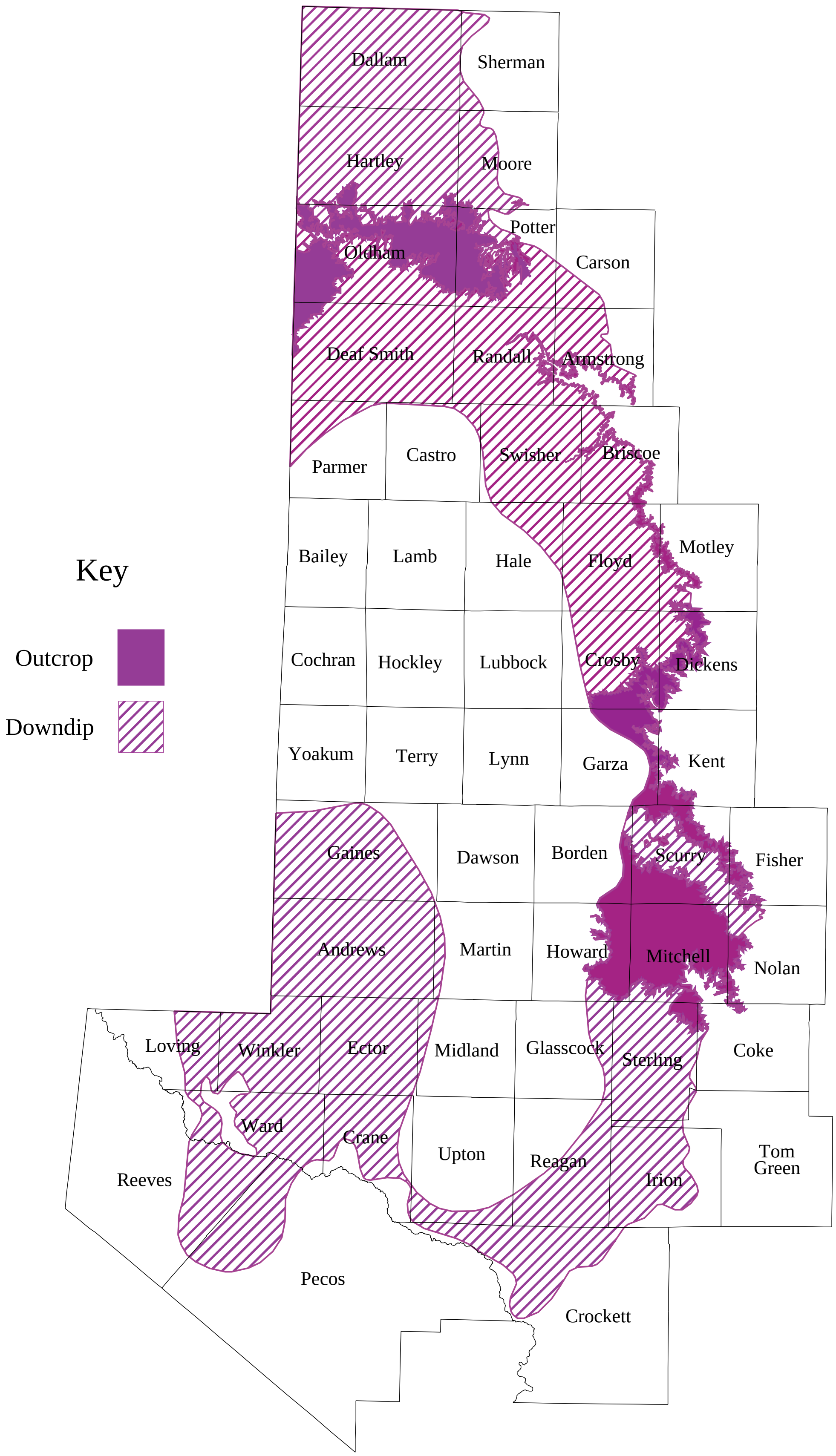
Ground water withdrawn from the aquifer commonly contains between 2,000 mg/l and 6,000 mg/l dissolved solids, but is acceptable for irrigation because the high permeability of the soil alleviates soil salinity. Because the water does not meet drinking water standards, the community of Dell City must use a demineralization process. The quality of the ground water has deteriorated somewhat as salts, leached from surface soils by irrigation return flow, percolate downward to the aquifer.

References

Ashworth, J.B., 1994, Ground-water resources of the Bone Spring-Victorio Peak aquifer in the Dell Valley area, Texas: TWDB Rept. 344, 42 p.

Bjorklund, L.J., 1957, Reconnaissance of ground-water conditions in the Crow Flats area Otero County, New Mexico: State of New Mexico, State Engineer Office Technical Rept. No. 8, 26 p.

Dockum


Key
Outcrop
Downdip
Dallam
Sherman
Hartley
Moore
Potter
Oldham
Carson
Deaf Smith
Randall
Armstrong
Parmer
Castro
Swisher
Briscoe
Bailey
Lamb
Hale
Floyd
Motley
Cochran
Hockley
Lubbock
Crosby
Dickens
Yoakum
Terry
Lynn
Garza
Kent
Gaines
Dawson
Borden
Scurry
Fisher
Andrews
Martin
Howard
Mitchell
Nolan
Loving
Winkler
Ector
Midland
Glasscock
Sterling
Coke
Ward
Crane
Upton
Reagan
Irion
Tom Green
Reeves
Pecos
Crockett

Dockum Aquifer

The Dockum Group of Triassic age underlies much of the Ogallala Formation of the High Plains area of Texas and New Mexico, the northern part of the Edwards Plateau, and the eastern part of the Cenozoic Pecos Alluvium. Where exposed east of the High Plains caprock and in the Canadian River Basin, the land surface takes on a reddish color. In the subsurface, the Dockum is commonly referred to as the “red bed.” The primary water-bearing zone in the formation, the Santa Rosa, consists of up to 700 feet of sand and conglomerate interbedded with layers of silt and shale.

Ground water from the Dockum aquifer is used for irrigation in the eastern outcrop area of Scurry and Mitchell counties, and for municipal water supply in the central part of the High Plains where marginally acceptable quality conditions prevail. Elsewhere, the aquifer is used extensively for oil field water-flooding operations, particularly in the southern part of the High Plains.

Concentrations of dissolved solids in the ground water range from less than 1,000 mg/l near the eastern outcrop to more than 20,000 mg/l in the deeper parts of the aquifer to the west. Relatively high sodium concentrations pose a salinity hazard for soils, thereby limiting regional long-term use of the water for irrigation. The extent of the aquifer as delineated includes the area in which the Dockum ground water contains less than 5,000 mg/l dissolved solids.

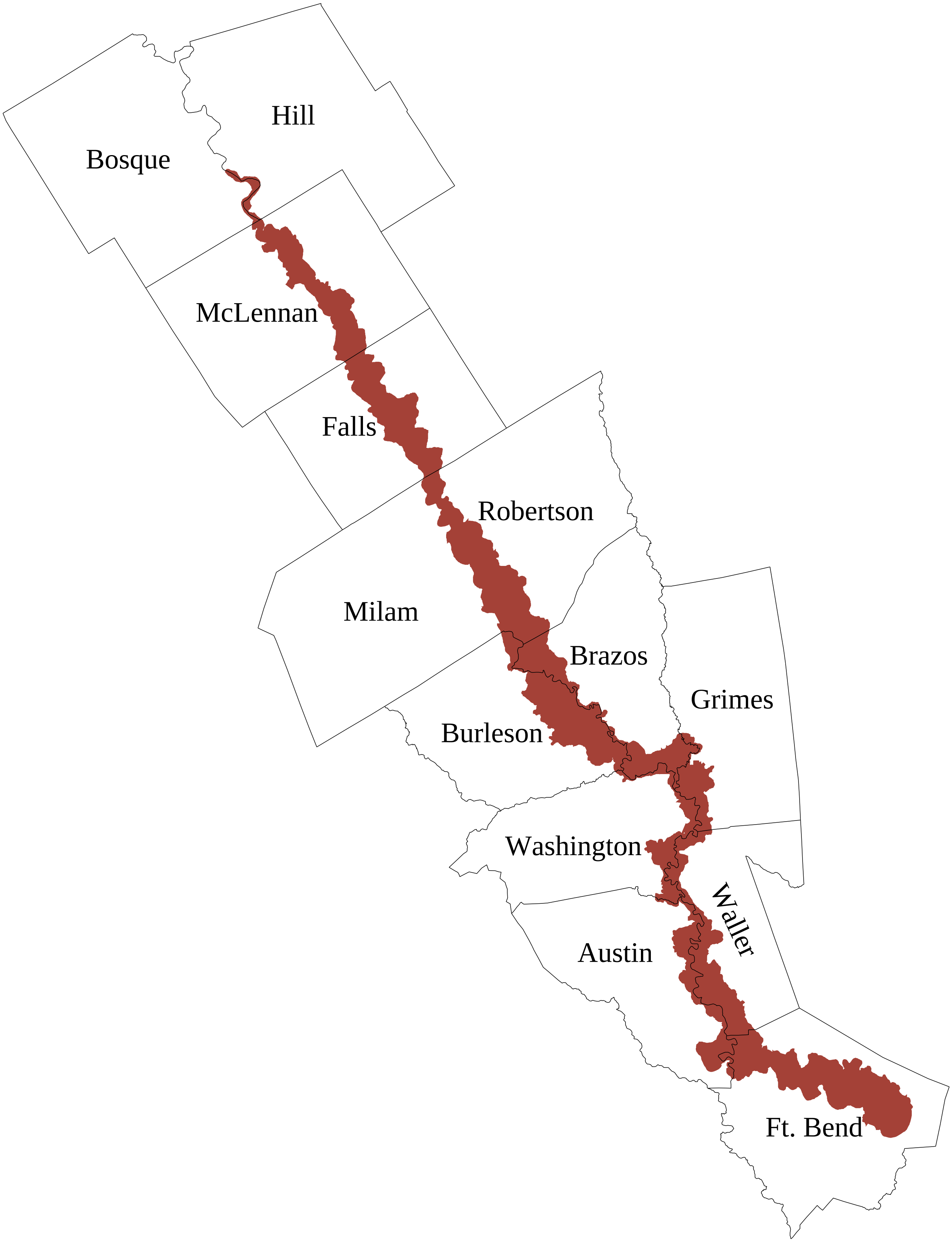
References

Dutton, A.R., and Simpkins, W.W., 1986, Hydrochemistry and water resources of the Triassic Lower Dockum Group in the Texas Panhandle and eastern New Mexico: Univ. of Texas, Bureau of Economic Geology Rept. of Inv. No. 161, 51 p.

McGowen, J.H., Granata, G.E., and Seni, S.J., 1979, Depositional framework of the Lower Dockum Group (Triassic), Texas Panhandle: Univ. of Texas, Bureau of Economic Geology Rept. of Inv. No. 97, 60 p.

Shamburger, V.M., Jr., 1967, Ground-water resources of Mitchell and western Nolan counties, Texas: TWDB Rept. 50, 175 p.

Brazos River Alluvium



Brazos River Alluvium Aquifer

Water-bearing alluvial sediments occur in floodplain and terrace deposits of the Brazos River of southeast Texas. The Brazos River Alluvium aquifer, up to seven miles wide, stretches for 350 miles along the sinuous course of the river between southern Hill and Bosque counties and eastern Fort Bend County. Irrigation accounts for almost all of the pumpage from the aquifer.

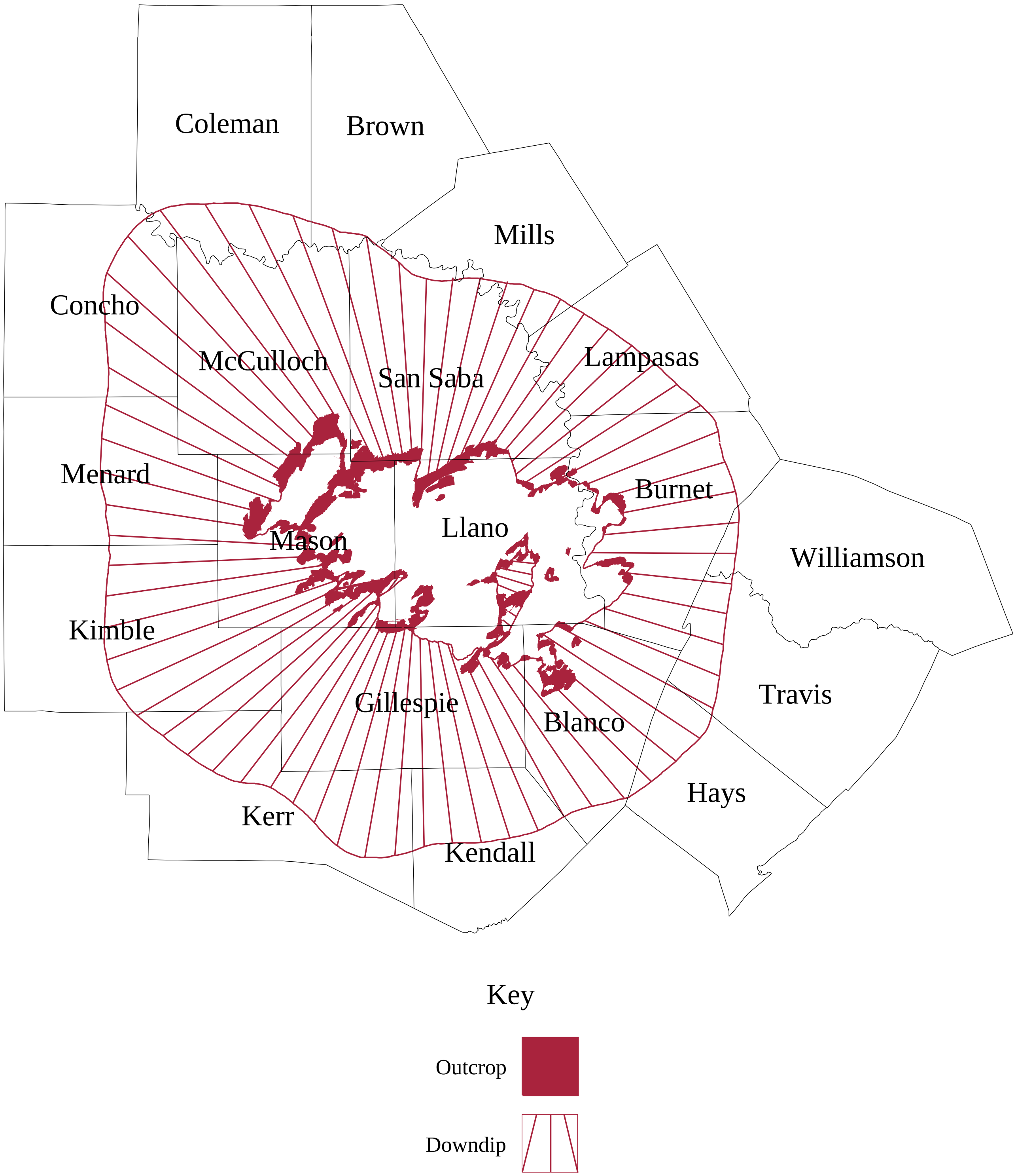
The Quaternary alluvial sediments consist of clay, silt, sand, and gravel, and generally are coarsest in the lower part of the accumulations. Saturated thickness of the alluvium is as much as 85 feet or more, with maximum thickness occurring in the central and southeastern parts of the aquifer. Some wells yield up to 1,000 gal/min, but the majority yield between 250 gal/min and 500 gal/min.

The chemical quality of the ground water varies widely. In many areas, concentrations of dissolved solids exceed 1,000 mg/l. Most of the Brazos River Valley irrigated with this ground water contains soils sufficiently permeable to alleviate any soil salinity problems. In some places, the water from the aquifer is fresh enough to meet drinking water standards.

References

Cronin, J.G., and Wilson, C.A., 1967, Ground water in the flood-plain alluvium of the Brazos River, Whitney Dam to vicinity of Richmond, Texas: TWDB Rept. 41, 206 p.

Hickory



Coleman
Brown
Mills
Concho
McCulloch
San Saba
Lampasas
Menard
Burnet
Llano
Mason
Williamson
Kimble
Travis
Gillespie
Blanco
Hays
Kerr
Kendall
Key
Outcrop
Downdip

Hickory Aquifer

The Hickory aquifer occurs in parts of 19 counties in the Llano Uplift region of Central Texas. Discontinuous outcrops of the Hickory Sandstone overlie and flank exposed Precambrian rocks that form the central core of the uplift. The downdip artesian portion of the aquifer encircles the uplift and extends to maximum depths approaching 4,500 feet. Most of the water pumped from the aquifer is used for irrigation. The largest capacity wells, however, have been completed for municipal water-supply purposes at Brady, Mason, and Fredericksburg.

The Hickory Sandstone Member of the Cambrian Riley Formation is composed of some of the oldest sedimentary rocks found in Texas. In most of the northern and western portions of the aquifer, the Hickory can be differentiated into lower, middle, and upper units, which reach a maximum thickness of 480 feet in southwestern McCulloch County. In the southern and eastern extents of the aquifer, the Hickory consists of only two units. Block faulting has compartmentalized the Hickory aquifer, thus restricting flow.

Ground water from the aquifer is generally fresh. However, locally, the aquifer produces water with excessive alpha particles and total radium concentrations in excess of drinking water standards. The water can also contain radon gas. The upper unit of the Hickory produces ground water containing concentrations of iron in excess of drinking water standards.

References

Bluntzer, R.L., 1992, Evaluation of the ground-water resources of the Paleozoic and Cretaceous aquifers in the Hill Country of Central Texas: TWDB Rept. 339, 130 p.

Mason, C.C., 1961, Ground-water geology of the Hickory Sandstone Member of the Riley Formation, McCulloch County, Texas: TBWE Bull. 6017, 85 p.

West Texas Bolsons

West Texas Bolsons Aquifer

In the western part of the Trans-Pecos region of Texas, several deep basins filled with erosional material of Quaternary age, contain significant quantities of ground water. These filled basins, or bolsons, are the Red Light Draw, Eagle Flat, Green River Valley, Presidio-Redford, and Salt Basin. The Salt Basin can be subdivided into the Wild Horse, Michigan, Lobo, and Ryan flats. The upper part of the Salt Basin extending north of Wild Horse Flat contains ground water with dissolved solids well in excess of 3,000 mg/l and is, therefore, not included as part of the designated aquifer. These bolsons provide variable amounts of water mainly for irrigation and municipal water supplies in parts of Culberson, Hudspeth, Jeff Davis, and Presidio counties. The communities of Presidio, Sierra Blanca, Valentine, and Van Horn use these aquifers for municipal water supplies.

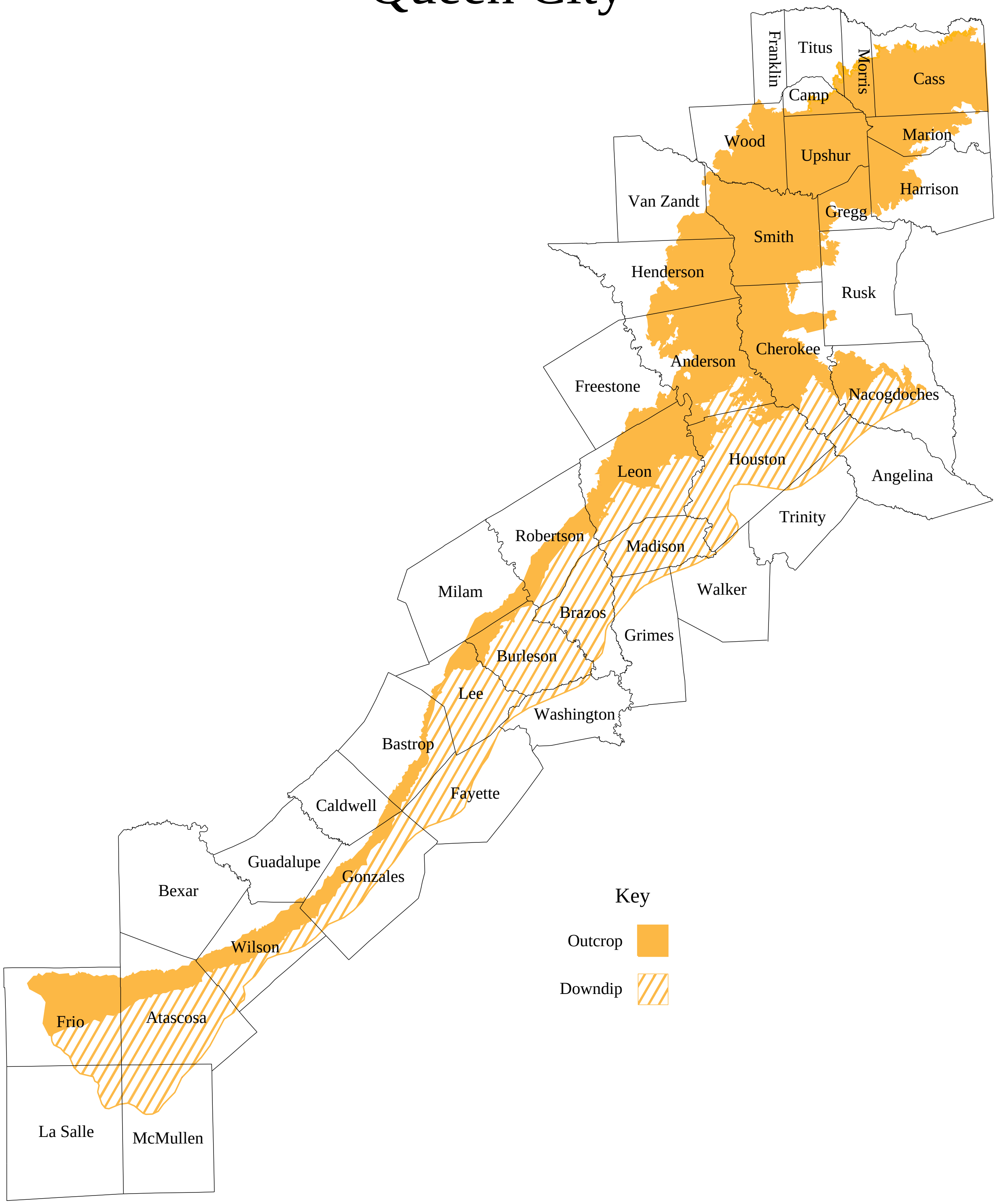
Bolson deposits in each of these basins differ according to the type of rock material that was eroded from the adjacent uplands and the manner in which this material was deposited. Sediments range from coarse-grained volcanics and limestones redeposited as alluvial fans to fine-grained silt and clay lake deposits. Yields of some wells exceed 3,000 gal/min, but most wells produce less than 1,000 gal/min. Water quality differs from basin to basin, ranging from fresh to slightly saline. Recharge is minimal in this region due to low annual rainfall and high evaporation rates.

References

Gates, J.S., White, D.E., Stanley, W.D., and Ackermann, H.D., 1980, Availability of fresh and slightly saline ground water in the basins of westernmost Texas: TDWR Rept. 256, 108 p.

White, D.E., Gates, J.S., Smith, J.T., and Fry, B.J., 1980, Ground-water data for the Salt Basin, Eagle Flat, Red Light Draw, Green River Valley, and Presidio Bolson in westernmost Texas: TDWR Rept. 259, 97 p.

Queen City



Franklin
Titus
Morris
Cass
Camp
Wood
Upshur
Marion
Harrison
Van Zandt
Gregg
Smith
Henderson
Rusk
Cherokee
Anderson
Freestone
Nacogdoches
Houston
Leon
Angelina
Trinity
Robertson
Madison
Milam
Walker
Brazos
Grimes
Burleson
Lee
Washington
Bastrop
Fayette
Caldwell
Guadalupe
Gonzales
Bexar
Wilson
Frio
Atascosa
La Salle
McMullen
Key
Outcrop
Downdip

Queen City Aquifer

The Queen City aquifer extends across Texas from the Frio River in South Texas northeastward into Louisiana. The aquifer provides water for domestic and livestock purposes throughout most of its extent, significant amounts of water for municipal and industrial supplies in Northeast Texas, and water for irrigation in Wilson County. Yields of individual wells are commonly low, but a few exceed 400 gal/min.

Sand, loosely cemented sandstone, and interbedded clay units of the Queen City Formation of the Tertiary Claiborne Group make up the aquifer. These beds fill the East Texas structural basin adjacent to the Sabine Uplift and then dip gently to the south and southeast toward the Gulf Coast. Although total aquifer thickness is usually less than 500 feet, it can approach 700 feet in some areas of Northeast Texas.

Water of excellent quality is generally found within the outcrop and for a few miles downdip, but water quality deteriorates with depth in the downdip direction. In some areas, water of acceptable quality may occur at depths of approximately 2,000 feet. The water may be acidic in much of Northeast Texas and relatively high in iron concentrations in some locations.

References

Alexander, W.H., Jr., and White, D.E., 1966, Ground-water resources of Atascosa and Frio counties, Texas: TWDB Rept. 32, 211 p.

Anders, R.B., 1957, Ground-water geology of Wilson County, Texas: TBWE Bull. 5710, 66 p.

Baker, E.T., Jr., Follett, C.R., McAdoo, G.D., and Bonnet, C.W., 1974, Ground-water resources of Grimes County, Texas: TWDB Rept. 186, 34 p.

Follett, C.R., 1974, Ground-water resources of Brazos and Burleson counties, Texas: TWDB Rept. 185, 62 p.

Guyton, W.F., and Associates, 1972, Ground-water conditions in Anderson, Cherokee, Freestone, and Henderson counties, Texas: TWDB Rept. 150, 80 p.

Harris, H.B., 1965, Ground-water resources of La Salle and McMullen counties, Texas: TWC Bull. 6520, 96 p.

Klemt, W.B., Duffin, G.L., and Elder, G.R., 1976, Ground-water resources of the Carrizo aquifer in the Winter Garden area of Texas: TWDB Rept. 210, 2 vols.

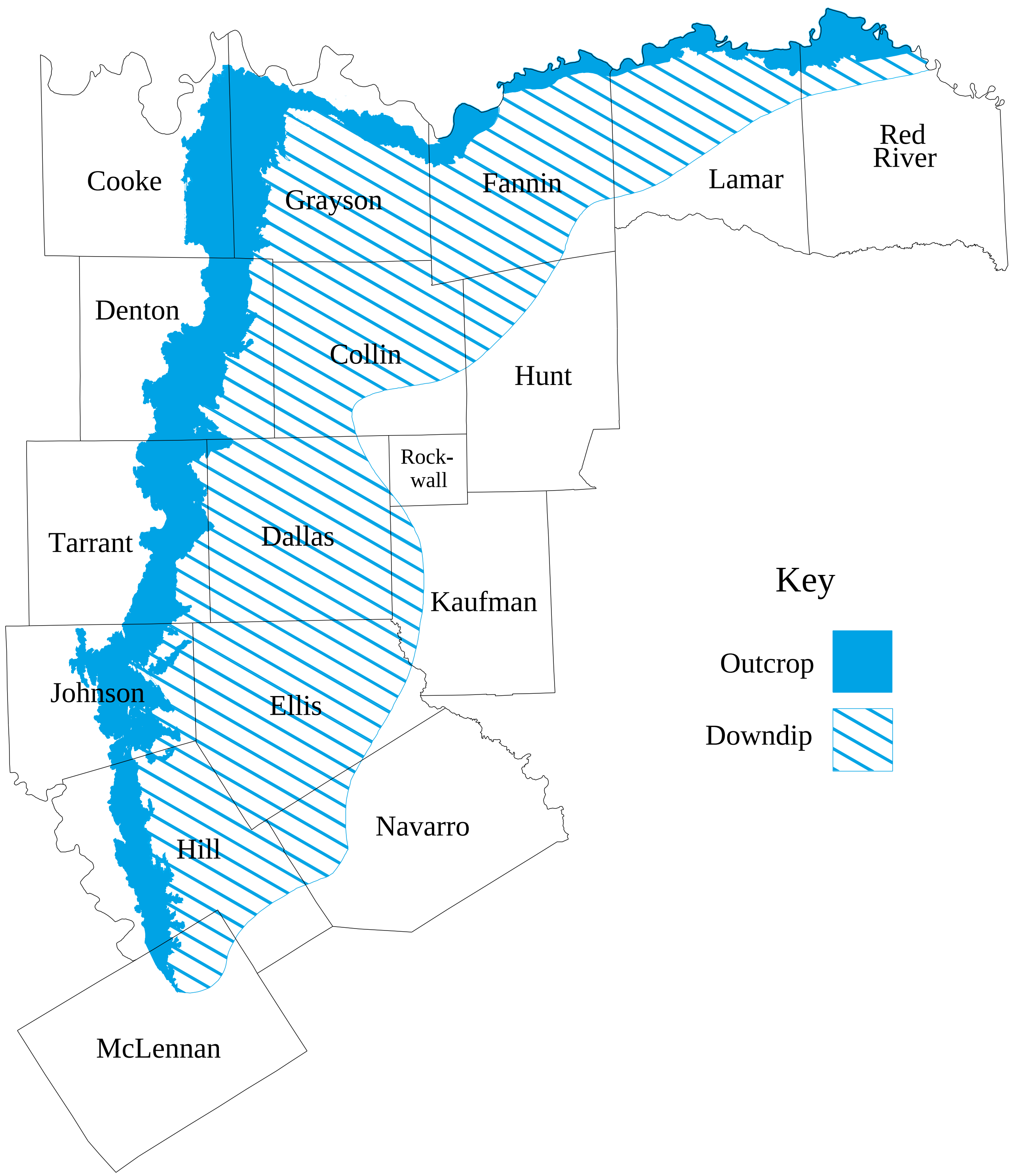
McCoy, T.W., 1991, Evaluation of the ground-water resources of the western portion of the Winter Garden area, Texas: TWDB Rept. 334, 64 p.

Rodgers, L.T., 1967, Availability and quality of ground water in Fayette County, Texas: TWDB Rept. 56, 56 p.

Shafer, G.H., 1965, Ground-water resources of Gonzales County, Texas: TWDB Rept. 4, 89 p.

Thompson, G.L., 1966, Ground-water resources of Lee County, Texas: TWDB Rept. 20, 62 p.

Woodbine


Cooke
Grayson
Fannin
Lamar
Red River
Denton
Collin
Hunt
Rock-wall
Tarrant
Dallas
Kaufman
Johnson
Ellis
Navarro
Hill
McLennan
Key
Outcrop
Downdip

Woodbine Aquifer

The Woodbine aquifer extends from McLennan County in North-Central Texas northward to Cooke County and eastward to Red River County, paralleling the Red River. Water produced from the aquifer furnishes municipal, industrial, domestic, livestock, and small irrigation supplies throughout its North Texas extent.

The Woodbine Formation of Cretaceous age is composed of water-bearing sandstone beds interbedded with shale and clay. The aquifer dips eastward into the subsurface where it reaches a maximum depth of 2,500 feet below land surface and a maximum thickness of approximately 700 feet. The Woodbine aquifer is divided into three water-bearing zones that differ considerably in productivity and quality. Only the lower two zones of the aquifer are developed to supply water for domestic and municipal uses. Heavy municipal and industrial pumpage has contributed to water-level declines in excess of 100 feet in the Sherman-Denison area of Grayson and surrounding counties.

Chemical quality deteriorates rapidly in well depths below 1,500 feet. In areas between the outcrop and this depth, quality is considered good overall as long as ground water from the upper Woodbine is sealed off. The upper Woodbine contains water of extremely poor quality in downdip locales and contains excessive iron concentrations along the outcrop.

References

Hart, D.L., Jr., 1974, Reconnaissance of the water resources of the Ardmore and Sherman quadrangles, Southern Oklahoma: Oklahoma Geological Survey Hydrologic Atlas No. 3, 4 sheets.

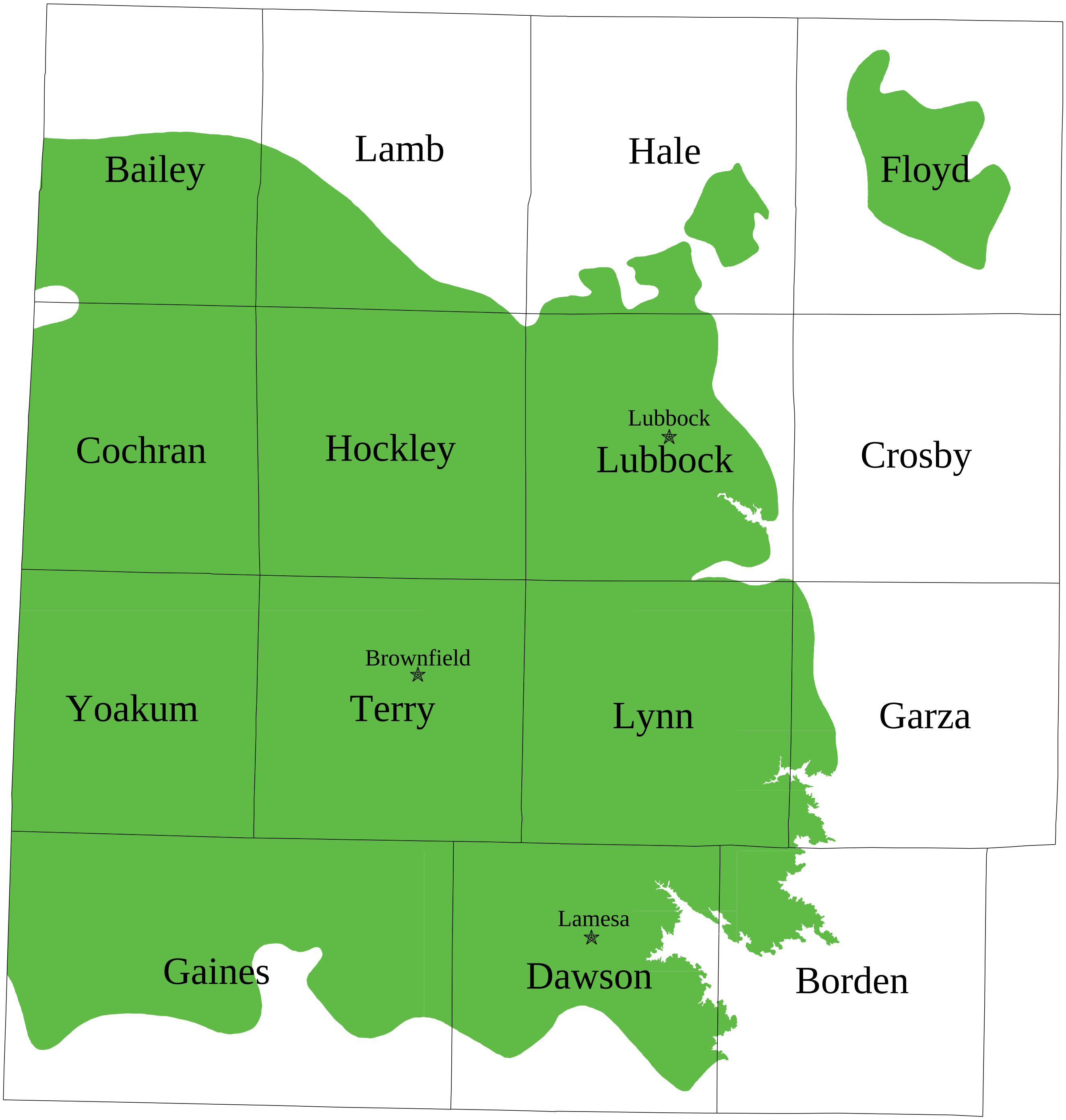
Klemt, W.B., Perkins, R.D., and Alvarez, H.J., 1975, Ground-water resources of part of Central Texas, with emphasis on the Antlers and Travis Peak formations: TWDB Rept. 195, 2 vols.

Marcher, M.V., and Bergman, D.L., 1983, Reconnaissance of the water resources of the McAlester and Texarkana quadrangles, Southeastern Oklahoma: Oklahoma Geological Survey Hydrologic Atlas 9, 4 sheets.

Nordstrom, P.L., 1982, Occurrence, availability, and chemical quality of ground water in the Cretaceous aquifers of North-Central Texas: TDWR Rept. 269, 2 vols.

Plummer, F.B., and Sargent, E.C., 1931, Underground waters and subsurface temperatures of the Woodbine Sand in Northeast Texas: Univ. of Texas, Bureau of Economic Geology Bull. 3138, 175 p.

Edwards-Trinity (High Plains)



Edwards-Trinity (High Plains) Aquifer

The Edwards-Trinity (High Plains) aquifer includes Cretaceous age water-bearing formations of the Fredericksburg and Trinity Groups. These formations underlie the Ogallala Formation in the south-central part of the Texas High Plains and extend westward into New Mexico. The majority of the wells completed in the aquifer provide water for irrigation and yield 50 gal/min to 200 gal/min.

Two distinct ground-water zones occur in the aquifer. One occurs in the basal sand and sandstone deposits of the Antlers Formation (Trinity Group) and is usually under artesian pressure. The other water-bearing zone occurs primarily in joints, solution cavities, and bedding planes in limestones of the Comanche Peak and Edwards formations. In much of the area, this zone is hydrologically connected to the overlying Ogallala aquifer. Recharge to the aquifer occurs directly from the bounding Ogallala Formation along northern and western parts of the subcrop and by downward percolation from overlying units at other locations. Upward movement of ground water from the Triassic Dockum into the Edwards-Trinity is also believed to occur in Lynn County.

Ground-water movement is generally to the southeast. In many places, the ground-water potentiometric surface in the Edwards-Trinity aquifer is higher than in the Ogallala aquifer, resulting in the upward migration of water from the Edwards-Trinity. In these areas, the Edwards-Trinity has a significant impact on the water level and quality of the Ogallala. Wells drilled into the Edwards-Trinity are usually completed also in the overlying Ogallala. Water-level declines of up to 30 feet have occurred in such wells in western Gaines County.

Water in the aquifer is typically fresh to slightly saline and is generally poorer in quality than water in the overlying Ogallala aquifer. Water quality deteriorates in areas where these formations are overlain by saline lakes and the gypsiferous Tahoka and Double Lakes formations.

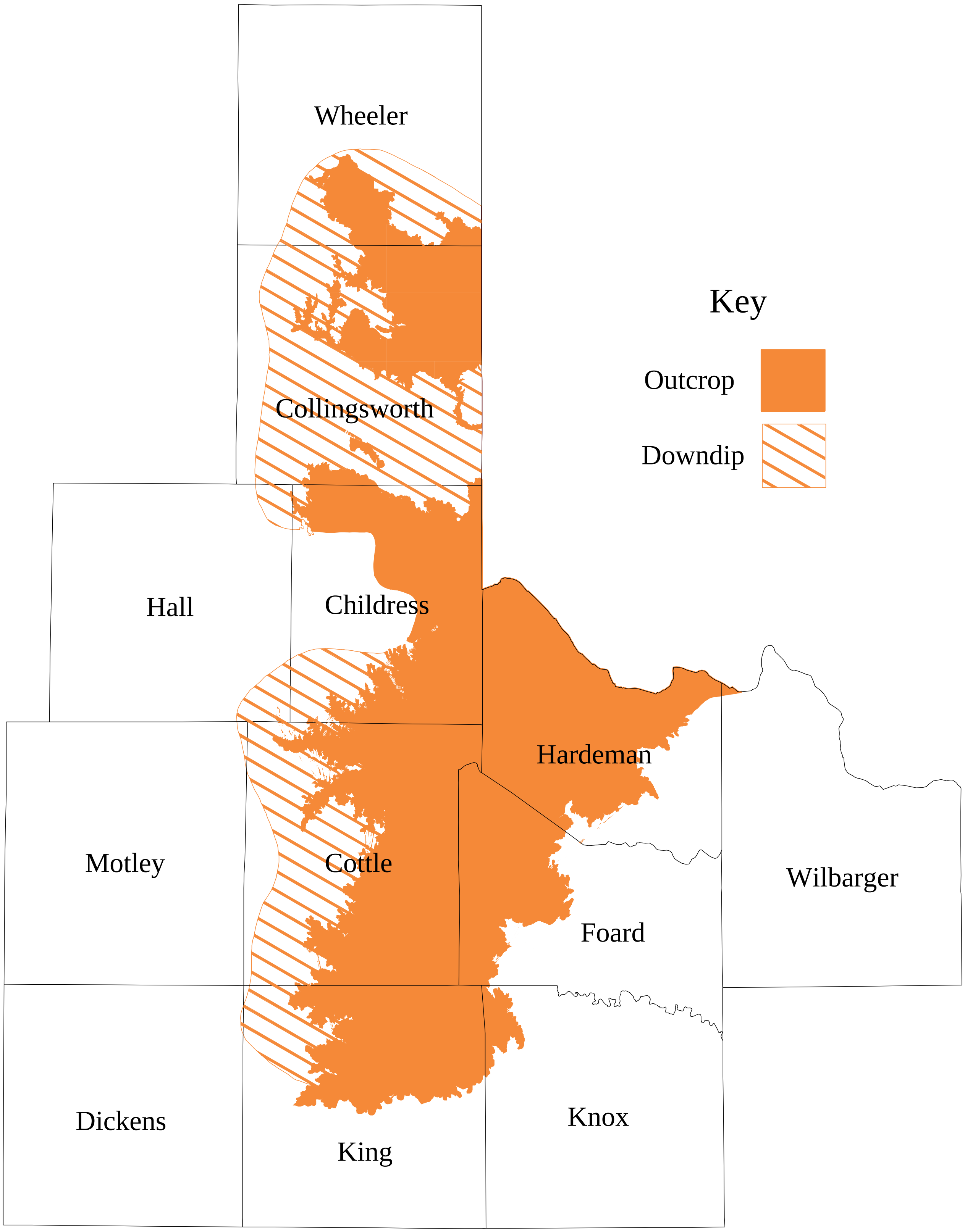
References

Fallin, J.A., 1989, Hydrogeology of Lower Cretaceous strata under the Southern High Plains of Texas and New Mexico: TWDB Rept. 314, 39 p.

Knowles, T., Nordstrom, P., and Klemt, W.B., 1984, Evaluating the ground-water resources of the High Plains of Texas: TDWR Rept. 288, 4 vols.

Nativ, R., and Gutierrez, G.N., 1988, Hydrogeology and hydrochemistry of Cretaceous aquifers, Texas Panhandle and Eastern New Mexico: Univ. of Texas, Bureau of Economic Geology Geological Circular 88-3, 32 p.

Blaine



Wheeler
Key
Outcrop
Downdip
Collingsworth
Hall
Childress
Hardeman
Motley
Cottle
Wilbarger
Foard
Dickens
Knox
King

Blaine Aquifer

The Blaine aquifer provides water in nine counties in West-Central Texas from Wheeler County to King County, extending eastward in the subsurface to adjacent counties. Although the formation is present farther south, the limited use of its water does not justify its inclusion as a minor aquifer in that area. Saturated thickness of the aquifer approaches 300 feet in its northern extent. The Blaine Formation, of Permian age, contains water primarily in numerous solution channels.

Water recharged to the aquifer moves along solution channels in the formation dissolving evaporite deposits of anhydrite and halite, which, in turn, contribute to its overall poor quality. Dissolved-solids concentrations in the Blaine increases with depth of the aquifer and in natural discharge areas along surface drainages. The extent of the aquifer, based on usage, includes water containing less than 10,000 mg/l dissolved solids.

The primary use of Blaine ground water is for irrigation of highly salt-tolerant crops. Well yields vary from a few gallons per minute to more than 1,500 gal/min. Seasonal water-level declines are limited to those areas dependent on ground water for irrigation.

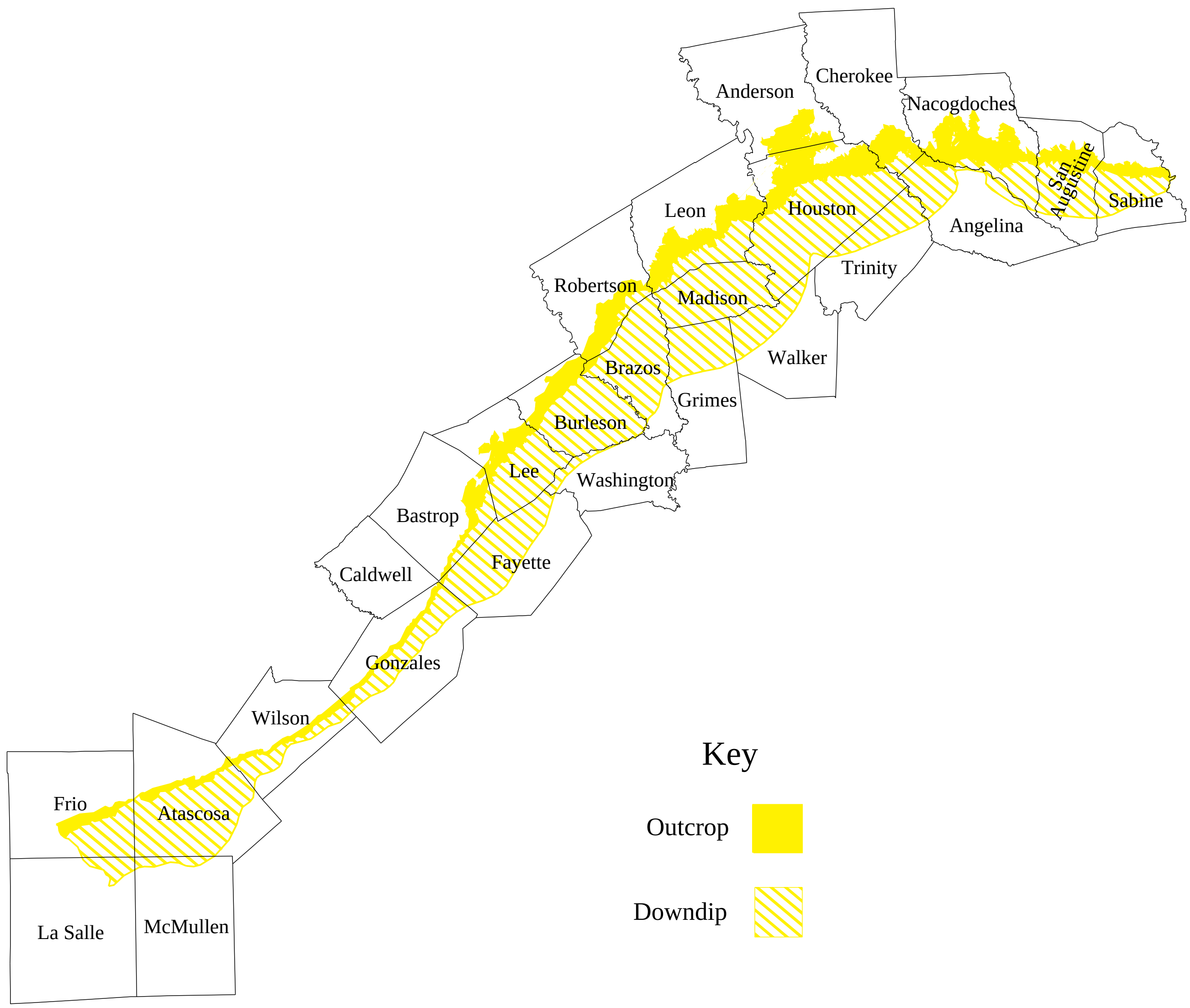
References

Maderak, M.L., 1972, Ground-water resources of Hardeman County, Texas: TWDB Rept. 161, 45 p.

Richter, B.C., and Kreitler, C.W., 1986, Geochemistry of salt-spring and shallow subsurface brines in the Rolling Plains of Texas and Southwestern Oklahoma: Univ. of Texas, Bureau of Economic Geology Rept. of Inv. No. 155, 47 p.

Smith, J.T., 1970, Ground-water resources of Collingsworth County, Texas: TWDB Rept. 119, 115 p.

Sparta


Anderson
Cherokee
Nacogdoches
San Augustine
Sabine
Leon
Houston
Angelina
Trinity
Robertson
Madison
Walker
Brazos
Grimes
Burleson
Lee
Washington
Bastrop
Caldwell
Fayette
Gonzales
Wilson
Frio
Atascosa
La Salle
McMullen
Key
Outcrop
Downdip

Sparta Aquifer

The Sparta aquifer extends in a narrow band from the Frio River in South Texas northeastward to the Louisiana border in Sabine County. The Sparta provides water for domestic and livestock supplies throughout its extent, and water for municipal, industrial, and irrigation purposes in much of the region. Yields of individual wells are generally less than 100 gal/min, although most high-capacity wells average 400 gal/min to 500 gal/min. A few wells produce as much as 1,200 gal/min.

The Sparta Formation, part of the Claiborne Group deposited during the Tertiary, consists of sand and interbedded clay with massive sand beds in the basal section. These beds dip gently to the south and southeast toward the Gulf Coast and reach a total thickness of up to 300 feet.

Water of excellent quality is commonly found within the outcrop and for a few miles downdip, but it deteriorates with depth in the downdip direction. Locally, water within the aquifer may contain iron concentrations in excess of drinking water standards.

References

Alexander, W.H., Jr., and White, D.E., 1966, Ground-water resources of Atascosa and Frio counties, Texas: TWDB Rept. 32, 211 p.

Anders, R.B., 1957, Ground-water geology of Wilson County, Texas: TBWE Bull. 5710, 66 p.

Baker, E.T., Jr., Follett, C.D., McAdoo, G.D., and Bonnet, C.W., 1974, Ground-water resources of Grimes County, Texas: TWDB Rept. 186, 34 p.

Guyton, W.F., and Associates, 1972, Ground-water conditions in Anderson, Cherokee, Freestone, and Henderson counties, Texas: TWDB Rept. 150, 80 p.

Harris, H.B., 1965, Ground-water resources of La Salle and McMullen counties, Texas: TWC Bull. 6520, 96 p.

Klemt, W.B., Duffin, G.L., and Elder, G.R., 1976, Ground-water resources of the Carrizo aquifer in the Winter Garden area of Texas: TWDB Rept. 210, 2 vols.

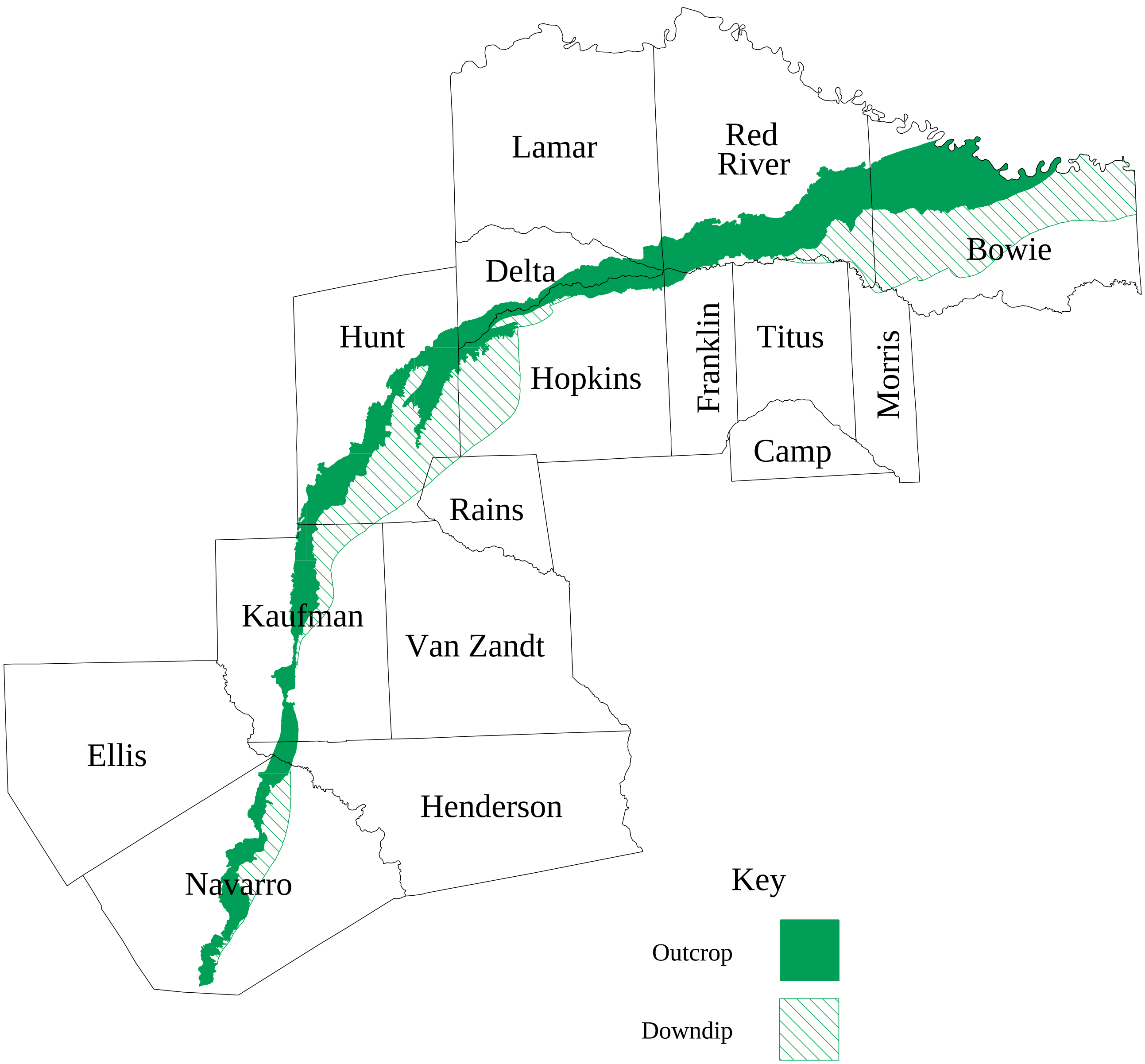
McCoy, T.W., 1991, Evaluation of the ground-water resources of the western portion of the Winter Garden area, Texas: TWDB Rept. 334, 64 p.

Rodgers, L.T., 1967, Availability and quality of ground water in Fayette County, Texas: TWDB Rept. 56, 56 p.

Shafer, G.H., 1965, Ground-water resources of Gonzales County, Texas: TWDB Rept. 4, 89 p.

Thompson, G.L., 1966, Ground-water resources of Lee County, Texas: TWDB Rept. 20, 62 p.

Nacatoch


Lamar
Red River
Delta
Hunt
Hopkins
Franklin
Titus
Morris
Bowie
Camp
Rains
Kaufman
Van Zandt
Ellis
Henderson
Navarro
Key
Outcrop
Downdip

Nacatoch Aquifer

The Nacatoch aquifer occurs in a narrow band in Northeast Texas and extends eastward into Arkansas and Louisiana. The Nacatoch Formation, composed of one to three sequences of sand beds separated by impermeable layers of mudstone or clay, was deposited in the East Texas Basin during the Cretaceous Period. A hydrologically connected mantle of alluvium up to 80 feet thick covers the Nacatoch along major drainageways. The south and east basinward dip of the formation is interrupted by the Mexia-Talco fault zone, which alters the normal flow direction and adversely affects the chemical quality of the ground water.

The quality of ground water in the aquifer is generally alkaline, high in sodium bicarbonate, soft, and increases in dissolved-solids concentrations in the downdip portion of the aquifer. The downdip limit of usable water (less than 3,000 mg/l), especially in the northern region, is controlled by the Mexia-Talco fault system. In areas where the Nacatoch occurs as multiple sand layers, the upper layer contains the best-quality water.

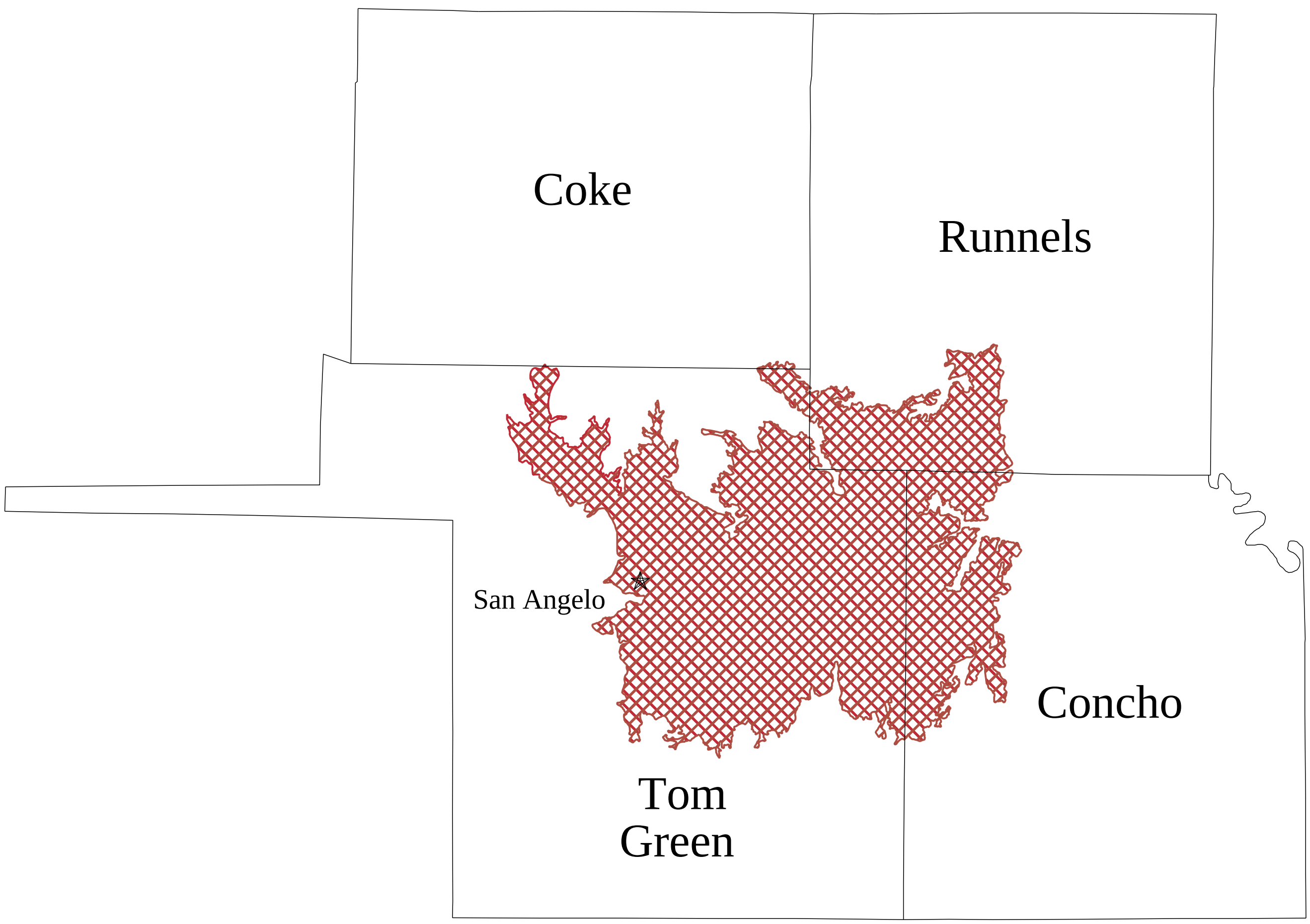
Water from the aquifer is extensively used for rural domestic and livestock purposes; however, the town of Commerce has historically pumped the greatest amount from the aquifer. Declining water levels that had developed around Commerce in Delta and Hunt counties have begun to stabilize as a result of conversion to surface water.

References

Ashworth, J.B., 1988, Ground-water resources of the Nacatoch aquifer: TWDB Rept. 305, 50 p.

McGowen M.K., and Lopez, C.M., 1983, Depositional systems in the Nacatoch Formation (upper Cretaceous), Northeast Texas and Southwest Arkansas: Univ. of Texas, Bureau of Economic Geology Rept. of Inv. No. 137, 59 p.

Lipan



Lipan Aquifer

The Lipan aquifer is located in the Lipan Flats area of eastern Tom Green, western Concho, and southern Runnels counties. The water is principally used for irrigation, with limited amounts used for rural domestic and livestock purposes.

The aquifer comprises up to 125 feet of saturated alluvial deposits of the Leona Formation of Quaternary age. Also included in the aquifer are the updip portions of the underlying Choza Formation and Bullwagon Dolomite of Permian age that are hydrologically continuous with the Leona and contain fresh to slightly saline water.

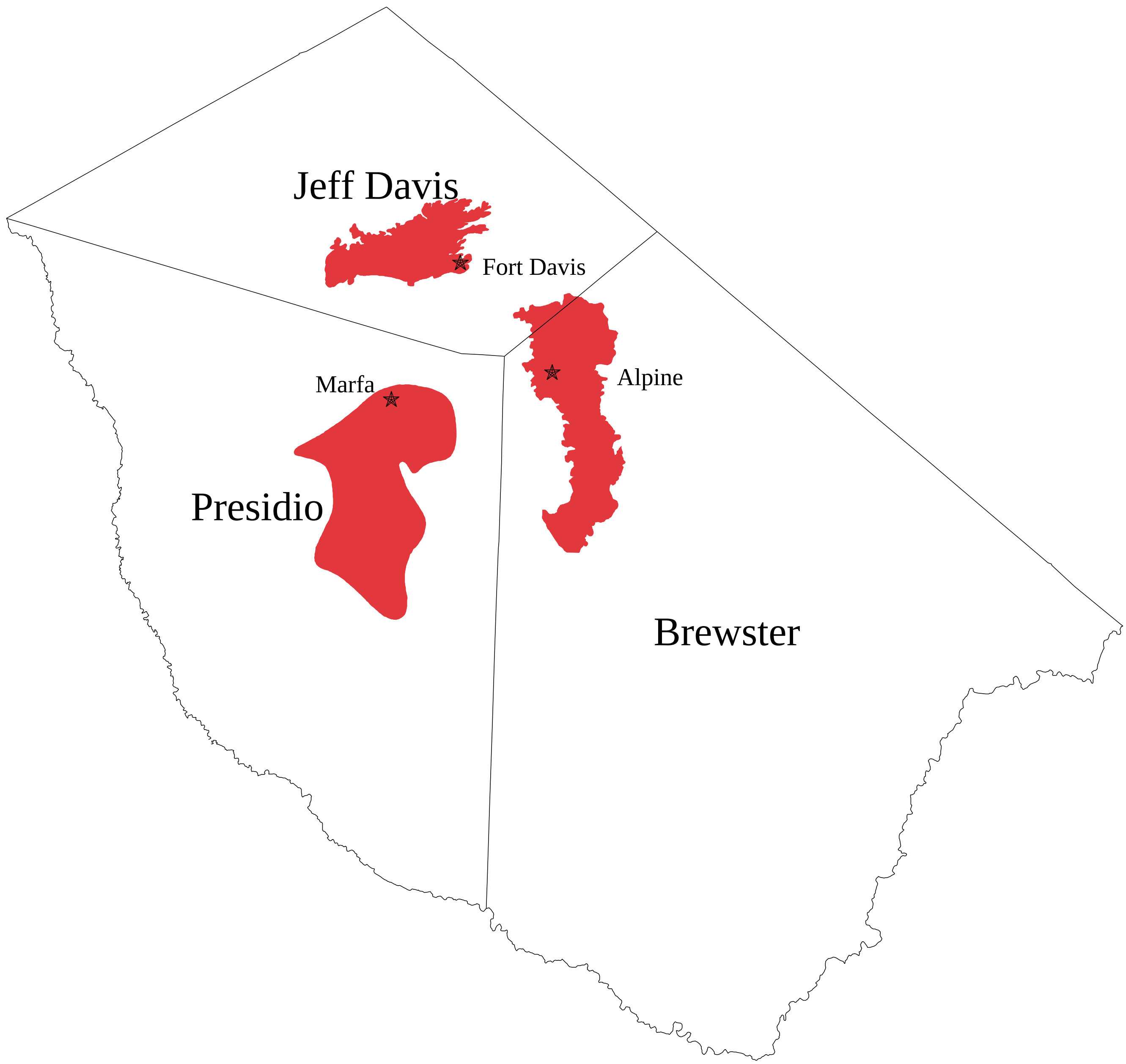
Ground water in the Lipan aquifer naturally discharges by seepage to the Concho River and by evapotranspiration in areas where the water table is at or near land surface. Well yields commonly range from 100 gal/min to more than 1,000 gal/min.

Ground water in the Leona Formation ranges from fresh to slightly saline and is very hard. Water in the underlying updip portions of the Choza and Bullwagon tends to be slightly saline. The chemical quality of ground water in the Lipan aquifer often does not meet drinking water standards; however, it is generally suitable for irrigation.

References

Lee, J.N., 1986, Shallow ground-water conditions, Tom Green County, Texas: U.S. Geological Survey Water-Resources Inv. Rept. 86-4177, 41 p.

Igneous



Igneous Aquifer

The Igneous aquifer occurs in three separate areas in the arid Trans-Pecos region of West Texas within Brewster, Presidio, and Jeff Davis counties. Ground water occurs in fissures and fractures of lava flows, tuffs, and related intrusive and extrusive igneous rocks of Tertiary age. These rocks reach an average thickness of 900 feet to 1,000 feet. The cities of Alpine, Fort Davis, and Marfa use water for municipal supply from the aquifer.

The aquifer in the Alpine area includes the Cottonwood Springs Basalt, Sheep Canyon Basalt, Crossen Trachyte, and associated alluvium; of these, the principal water-bearing unit of the aquifer is the Crossen Trachyte. The aquifer in the Marfa area includes parts of the Petan Basalt and the Tascotal Formation. The Davis Mountains aquifer includes the Barrel Springs Formation and associated alluvium.

Well yields are moderate to large in the Marfa area, and small to moderate in the Alpine and Fort Davis areas. Yields of wells in the Igneous aquifer vary widely because the basalts have a wide range in permeability; lower permeabilities generally occur in the lower sections, and moderately high permeabilities occur in the faulted and fractured upper layers. Water quality is good for municipal and domestic uses. Elevated levels of silica and fluoride have been found in water from some wells, reflecting the igneous origin of the rock.

References

Davis, M.E., 1961, Ground-water reconnaissance of the Marfa area, Presidio County, Texas: TBWE Bull. 6110, 23 p.

Littleton, R.T., and Audsley, G.L., 1957, Ground-water geology of the Alpine area, Brewster, Jeff Davis, and Presidio counties, Texas: TBWE Bull. 5712, 37 p.

Rita Blanca

Rita Blanca Aquifer

The Rita Blanca aquifer underlies the Ogallala Formation in western Dallam and Hartley counties in the northwest corner of the Texas Panhandle and is a small part of a large aquifer that extends into Oklahoma, Colorado, and New Mexico. Irrigation accounts for most of the ground-water use from this aquifer, with Texline being the only community that uses the aquifer for municipal water supply.

Ground water occurs in coarse-grained Cretaceous age sands and gravels of the Lytle and Dakota formations. Ground water also occurs in the Exeter Sandstone and the Morrison Formation of Jurassic age. Highest yields of 600 gal/min to 800 gal/min are obtained from wells completed in the Lytle and Dakota sandstones.

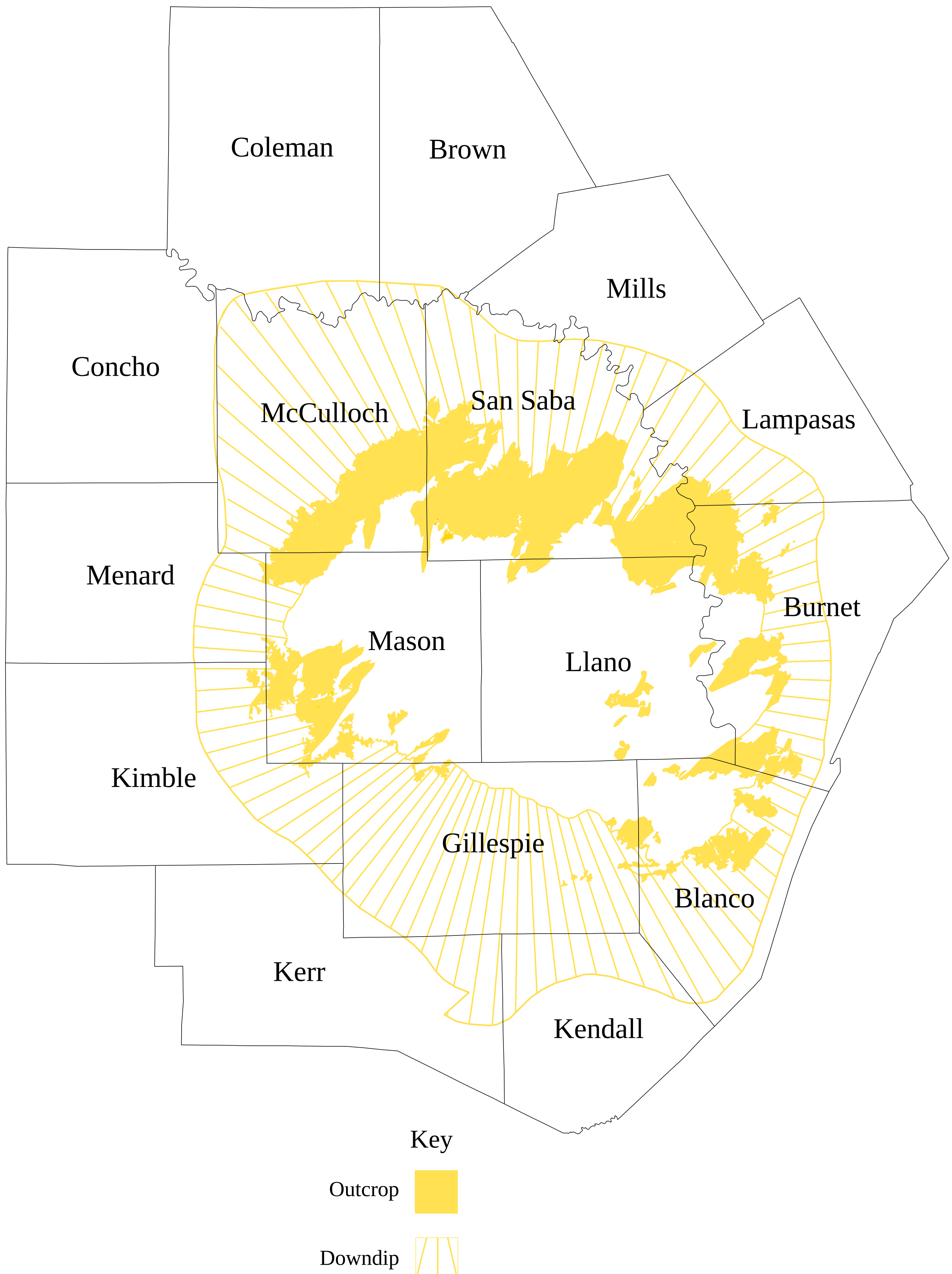
Water quality in the aquifer is usually fresh, but very hard. Some formations, however, produce water that is slightly saline, which is unsuitable for irrigating most crops grown in the region. Water-level declines have developed in excess of 50 feet in some irrigated areas. As a result, many springs in the northern part of Dallam County have disappeared that once contributed to the constant flow in creeks.

References

Christian, P., 1989, Evaluation of ground-water resources in Dallam County, Texas: TWDB Rept. 315, 27 p.

Knowles, T., Nordstrom, P., and Klemt, W.B., 1984, Evaluating the ground-water resources of the High Plains of Texas: TDWR Rept. 288, 4 vols.

Ellenburger-San Saba



Ellenburger-San Saba Aquifer

The Ellenburger-San Saba aquifer occurs in parts of 15 counties in the Llano Uplift area of Central Texas. Discontinuous outcrops of the aquifer encircle older rocks in the core of the uplift, and the remaining downdip portion extends to depths of approximately 3,000 feet below land surface. Regional block faulting has significantly compartmentalized the aquifer.

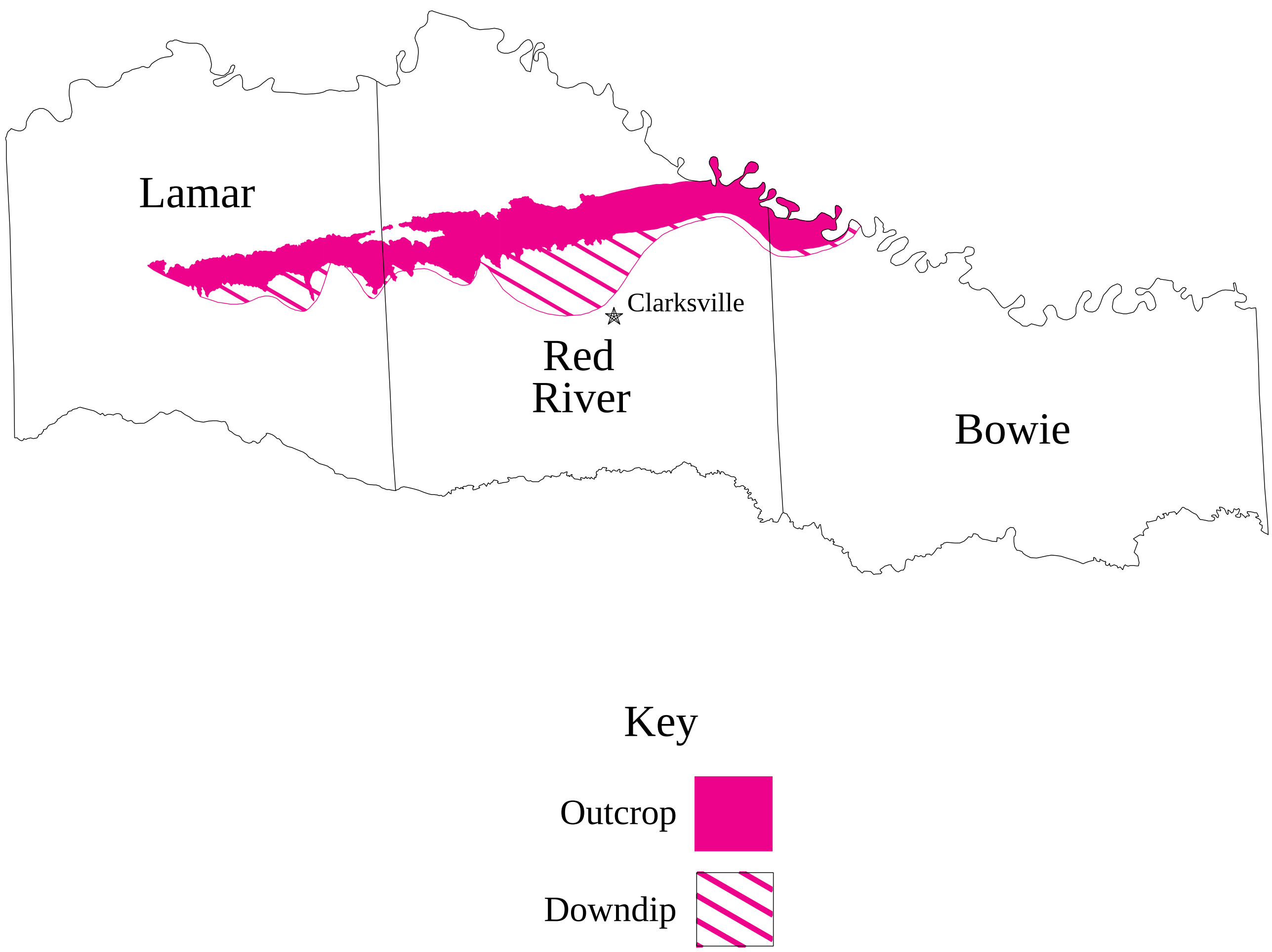
Three-fourths of the water pumped from the aquifer is used for municipal water supplies at Fredericksburg, Johnson City, Bertram, and Richland Springs. Also, a large portion of water flowing from San Saba Springs, which is the water supply for the city of San Saba, is believed to be from the Ellenburger-San Saba and Marble Falls aquifers.

The aquifer occurs in limestone and dolomite facies in the San Saba Member of the Wilberns Formation of late Cambrian age, and in the Honeycut, Gorman, and Tanyard formations of the Ellenburger Group of early Ordovician age. Water in the aquifer primarily occurs in solution cavities formed along faults and related fractures. The Ellenburger-San Saba aquifer in some areas may be hydrologically connected to the Marble Falls aquifer. Water produced from the aquifer is inherently hard and usually has less than 1,000 mg/l dissolved solids.

References

Bluntzer, R.L., 1992, Evaluation of the ground-water resources of the Paleozoic and Cretaceous aquifers in the Hill Country of Central Texas: TWDB Rept. 339, 139 p.

Blossom



Blossom Aquifer

The Blossom aquifer occupies a narrow east-west band in parts of Bowie, Red River, and Lamar counties in the northeast corner of Texas. The Blossom Sand Formation consists of alternating sequences of sand and clay deposited during the Cretaceous Period. In places, the formation attains a thickness of 400 feet, although no more than 29 percent of this thickness consists of water-bearing sand.

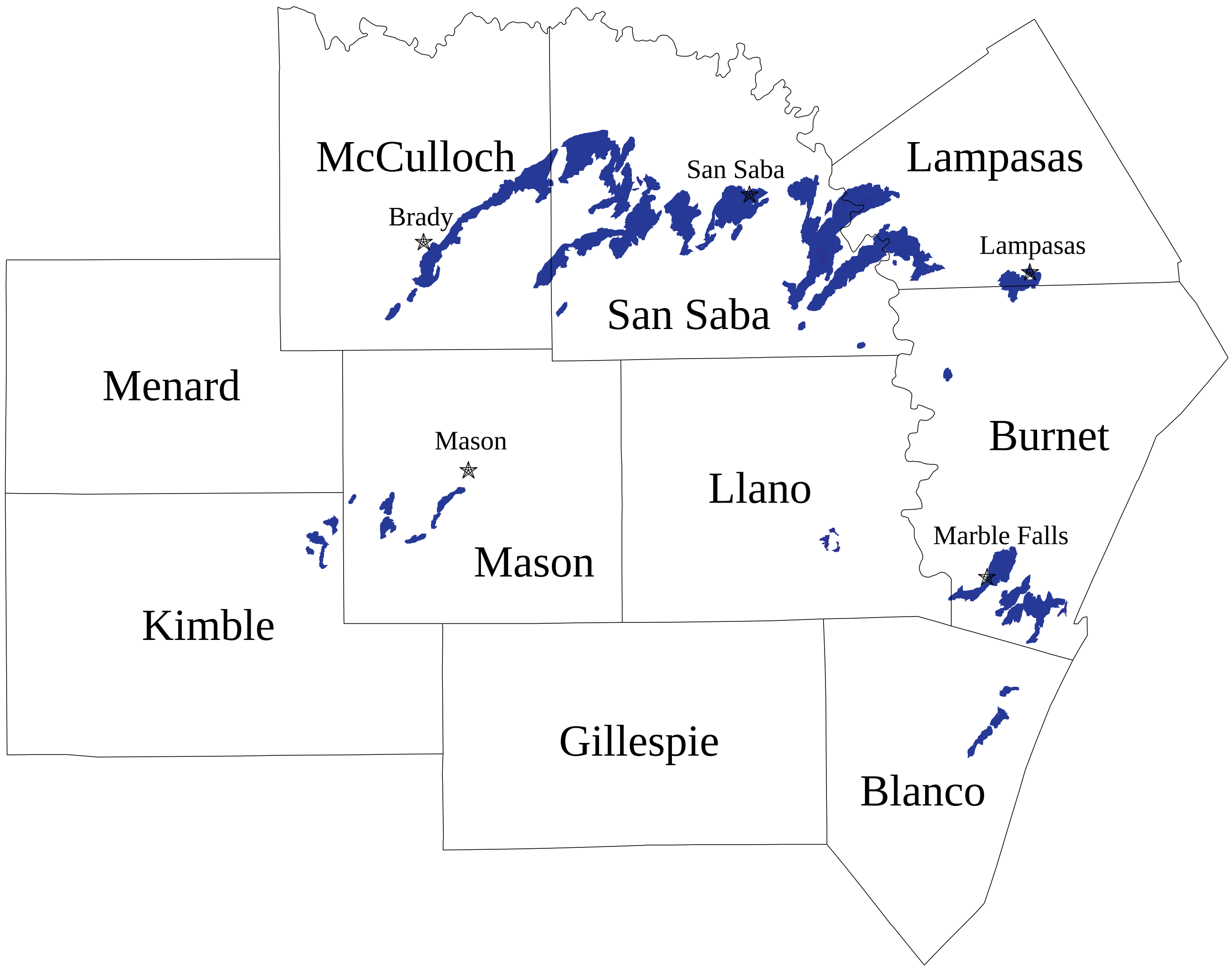
Ground water from the Blossom aquifer is generally soft, slightly alkaline, and, in some areas, high in sodium, bicarbonate, and iron. Water quality, although not acceptable for irrigation due to its high sodium adsorption ratio (SAR) and residual sodium carbonate (RSC) values, is generally acceptable for most nonindustrial uses.

The Blossom aquifer yields water in small to moderate amounts over a limited area on and south of the outcrop, with the largest well yields of 650 gal/min occurring in Red River County. Production decreases in the western half of the aquifer, where yields of 35 gal/min to 85 gal/min are more typical. Historically, Clarksville and the Red River Water Supply Corporation in Red River County have pumped the greatest amounts from the aquifer, which resulted in a water-level deline; however, in recent years, the rate of decline has slowed or even stabilized in some wells as a result of more surface-water use in the area.

References

McLaurin, C., 1988, Occurrence, availability, and chemical quality of ground water in the Blossom Sand aquifer: TWDB Rept. 307, 32 p.

Marble Falls



Marble Falls Aquifer

The Marble Falls aquifer occurs in several separated outcrops, primarily along the northern and eastern flanks of the Llano Uplift. It provides water to parts of Blanco, Burnet, Lampasas, McCulloch, and San Saba counties, and to even smaller parts of Kimble, Llano, and Mason counties in Central Texas. San Saba and Rochelle are the two largest communities that withdraw water from the aquifer for public supply use. Wells have been reported to yield as much as 2,000 gal/min; however, most wells produce substantially less.

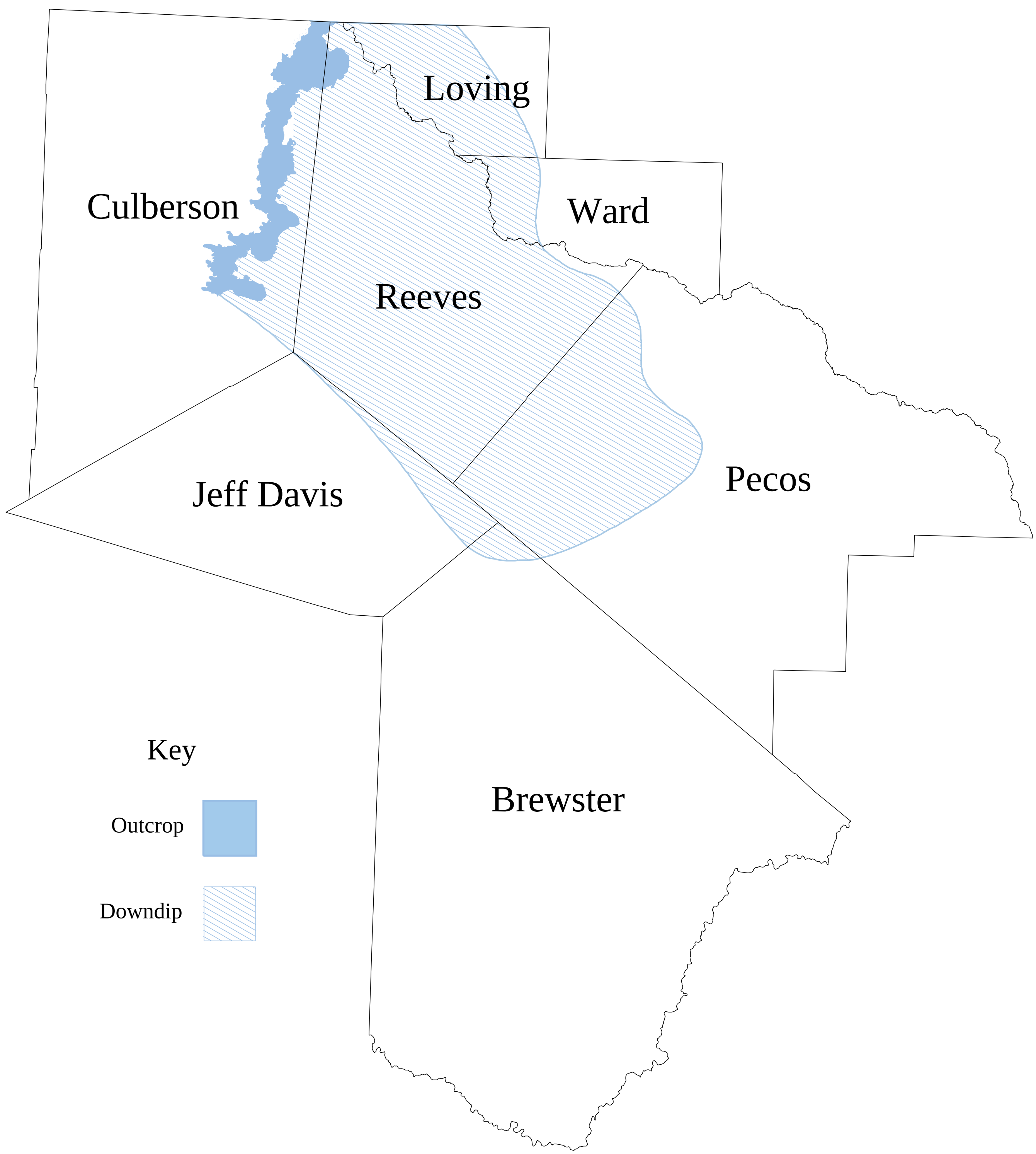
Ground water occurs in fractures, solution cavities, and channels in the limestone of the Marble Falls Formation of the Pennsylvanian Bend Group. Maximum thickness of the formation is 600 feet. Where underlying beds are thin or absent, the Marble Falls and Ellenburger-San Saba aquifers may be hydrologically connected. Numerous large springs issue from the aquifer and provide a significant part of the baseflow to the San Saba River in McCulloch and San Saba counties, and to the Colorado River in San Saba and Lampasas counties.

The quality of water produced from the aquifer is suitable for most purposes. The downdip artesian portion in most areas is not extensive and becomes significantly mineralized within relatively short distances from the outcrop recharge area.

References

Bluntzer, R.L., 1992, Evaluation of the ground-water resources of the Paleozoic and Cretaceous aquifers in the Hill Country of Central Texas: TWDB Rept. 339, 130 p.

Rustler


Loving
Culberson
Ward
Reeves
Pecos
Jeff Davis
Brewster
Key
Outcrop
Downdip

Rustler Aquifer

The Rustler Formation of Permian age crops out in eastern Culberson County in the Trans-Pecos region of Texas and extends eastward into the subsurface of the Delaware Basin. The aquifer is principally located in Loving, Pecos, Reeves, and Ward counties where it yields water for irrigation, livestock, and water-flooding operations in oil-producing areas. High dissolved-solids concentrations render the water unsuitable for human consumption.

Water occurs in highly permeable solution zones that have developed in dolomite, limestone, and gypsum beds of the Rustler Formation. The dissolved-solids concentrations of the water increase downgradient, eastward into the basin, with a shift from sulfate to chloride as the predominant anion.

References

Armstrong, C.A., and McMillion, L.G., 1961, Geology and ground-water resources of Pecos County, Texas: TBWE Bull. 6106, 2 vols.

Maley, V.C., and Huffington, R.M., 1953, Cenozoic fill and evaporite solution in the Delaware Basin, Texas and New Mexico: Geological Society of America Bull. Vol. 64, No. 5, pp. 539-546.

Rickey, S.F., Wells, J.G., and Stephens, K.T., 1985, Geohydrology of the Delaware Basin and vicinity, Texas and New Mexico: U.S. Geological Survey Water-Resources Inv. 84-4077, 99 p.

Capitan Reef Complex

Capitan Reef Complex Aquifer

The Capitan Reef formed along the margins of the Delaware Basin, an embayment covered by a shallow Permian sea. In Texas, two arcuate strips of the reef, 10 to 14 miles wide, are exposed in the Guadalupe, Apache, and Glass mountains; elsewhere, the reef is in the subsurface. The reef extends northward into New Mexico where it provides abundant fresh water to the city of Carlsbad.

Most of the ground water pumped from the aquifer in Texas is used for oil reservoir water-flooding operations in Ward and Winkler counties. A small amount is used for irrigation of salt-tolerant crops in Pecos and Culberson counties.

In Texas, the aquifer is composed of up to 2,360 feet of dolomite and limestone deposited as reef, fore-reef, and back-reef facies. Water-bearing formations include the Capitan Limestone, Goat Seep Limestone, and most of the Carlsbad facies of the Artesia Group—including the Grayburg, Queen, Seven Rivers, Yates, and Tansill formations.

The aquifer generally contains water of poor quality and yields small to large quantities of moderately saline to brine water. Water of the freshest quality is located on and near areas of recharge where the reef is exposed at the surface in the three mountain ranges.

References

Hiss, W.L., 1975, Stratigraphy and ground-water hydrology of the Capitan aquifer, Southeastern New Mexico and Western Texas: U.S. Geological Survey and New Mexico State Engineer Open-File Rept., 396 p.

Rickey, S.F., Wells, J.G., and Stephens, K.T., 1985, Geohydrology of the Delaware Basin and vicinity, Texas and New Mexico: U.S. Geological Survey Water-Resources Inv. 84-4077, 99 p.

Marathon

Marathon Aquifer

The Marathon aquifer occurs entirely within north-central Brewster County. Ground water is used primarily for municipal water supply by the city of Marathon and for domestic and livestock purposes. Water from the aquifer is typically of good quality but hard, with dissolved solids usually ranging from 500 mg/l to 1,000 mg/l.

The Marathon aquifer is contained within the Gaptank, Dimple, Tesnus, Caballos, Maraviallas, Fort Pena, and Marathon Limestone formations; of these, the Marathon Limestone Formation is the most productive unit. These Early Paleozoic (Pennsylvanian through Ordovician) formations occur in a region of complex folding and faulting within the Marathon Uplift.

Water in the Marathon aquifer occurs in numerous crevices, joints, and cavities, and extends to depths ranging from 350 feet to about 900 feet. The depth of most wells is less than 250 feet, and well yields range from less than 10 gal/min to more than 300 gal/min. Many of the shallow wells in the region actually produce water from alluvial deposits that cover portions of the rock formations.

References

DeCook, K.J., 1961, A reconnaissance of the ground-water resources of the Marathon area, Brewster County, Texas: TBWE Bull. 6111, 51 p.