GEOLOGIC MAPS AND REPORTS AVAILABLE FOR YOUR REVIEW
NOVEMBER 2006

The following is a list of available geologic documents that you might want to review during the trip. Some are very technical and scientific. You are welcome to use them. Enjoy the trip!
Bob B.

SEVEN MAPS WITH EXLANATIONS OF GEOLOGIC UNITS ALONG TRIP ROUTES -- Titled "Geologic Atlas' of Texas" borrowed from the UT Bureau of Economic Geology (UT BEG). Includes the Austin, Llano, Sonora, Fort Stockton, Emory Peak – Presidio, Marfa and Pecos Sheets.

TWO MAPS TITLED "GEOLOGICAL HIGHWAY MAPS OF TEXAS," H. B. Renfro Memorial Additions. They have geologic time scales which give approximate ages of geologic units in millions of years.

TWO BOOKS TITLED "ROADSIDE GEOLOGY OF TEXAS" By Darwin Spearing.

A REFERENCE BOOK TITLED "ROCKS & MINERALS" published by Simon & Shuster.

A REFERENCE BOOK TITLED "CAMBRIDGE GUIDE TO MINERALS, ROCKS AND FOSSILS" by A. C. Bishop, Et Al.

A BOOK TITLED "DICTIONARY OF GEOLOGICAL TERMS" prepared by the American Geological Institute.

A BOOK TITLED "THE BIG BEND OF THE RIO GRANDE" by Ross Maxwell, UT BEG Guidebook 7. The author is the person from which the Park's "Ross Maxwell Scenic Drive" got its name.

A BOOK TITLED "GEOLOGY OF THE BIG BEND RANCH STATE PARK, TEXAS" By Christopher D. Henry, UT BEG Guidebook 27.

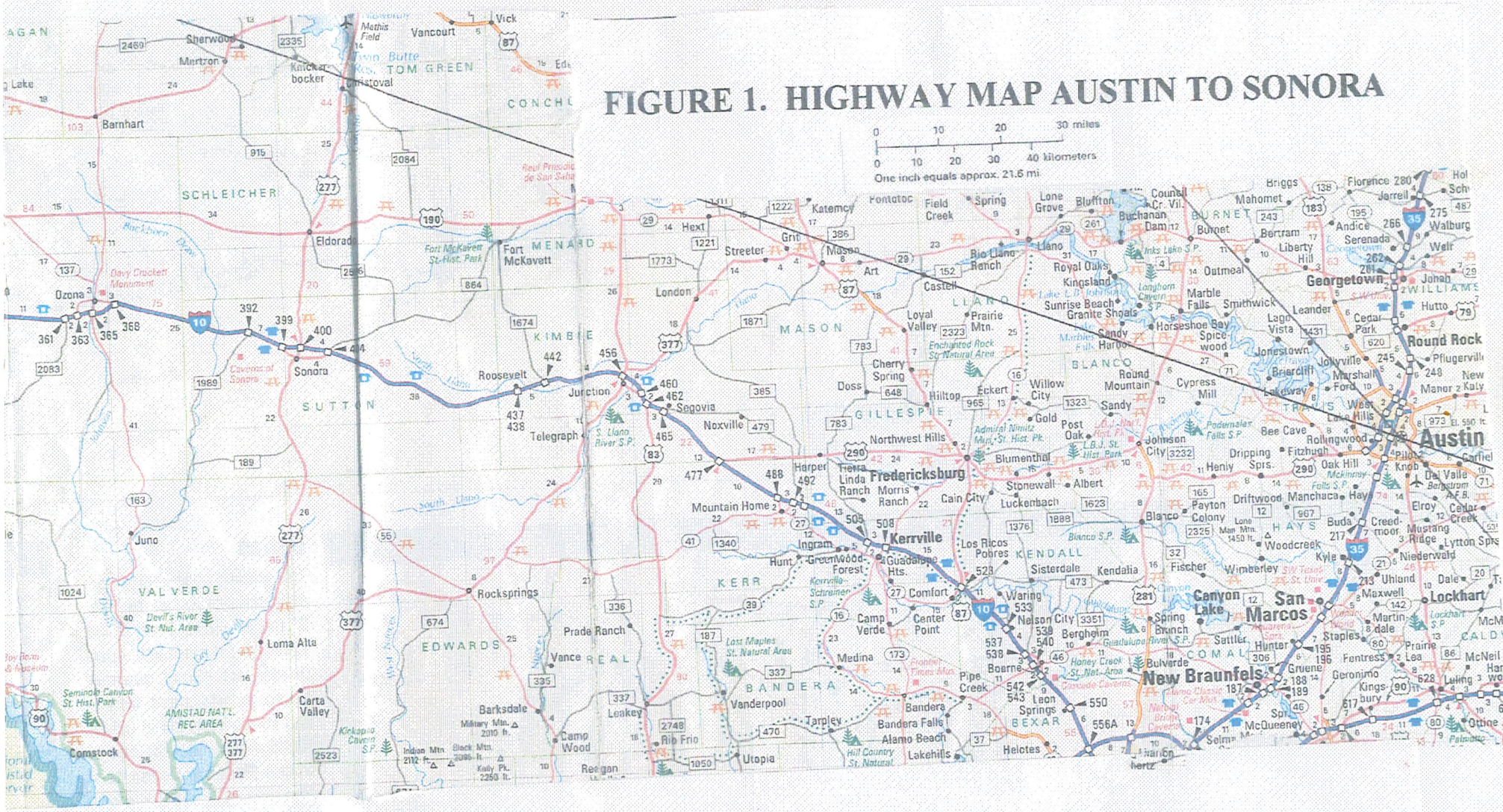
A BOOK TITLED "CENOZOIC GEOLOGY OF THE TRANS-PECOS VOLCANIC FIELD OF TEXAS" Editors Walton & Henry, UT BEG Guidebook 19.

A BOOK TITLED "AQUIFERS OF WEST TEXAS" Edited by Robert Mace, Et Al., Texas Water Development Board Report 356.

A BOOK TITLED "GEOLOGIC WONDERS OF WEST TEXAS" By Donald P. McGookey.

A COLORFUL BROCHURE TITLED "TEXAS ROCKS & FOSSILS" Published by the Texas Department of Transportation. Actually a fold-out for a wall hanging.

FIGURE 1. HIGHWAY MAP AUSTIN TO SONORA



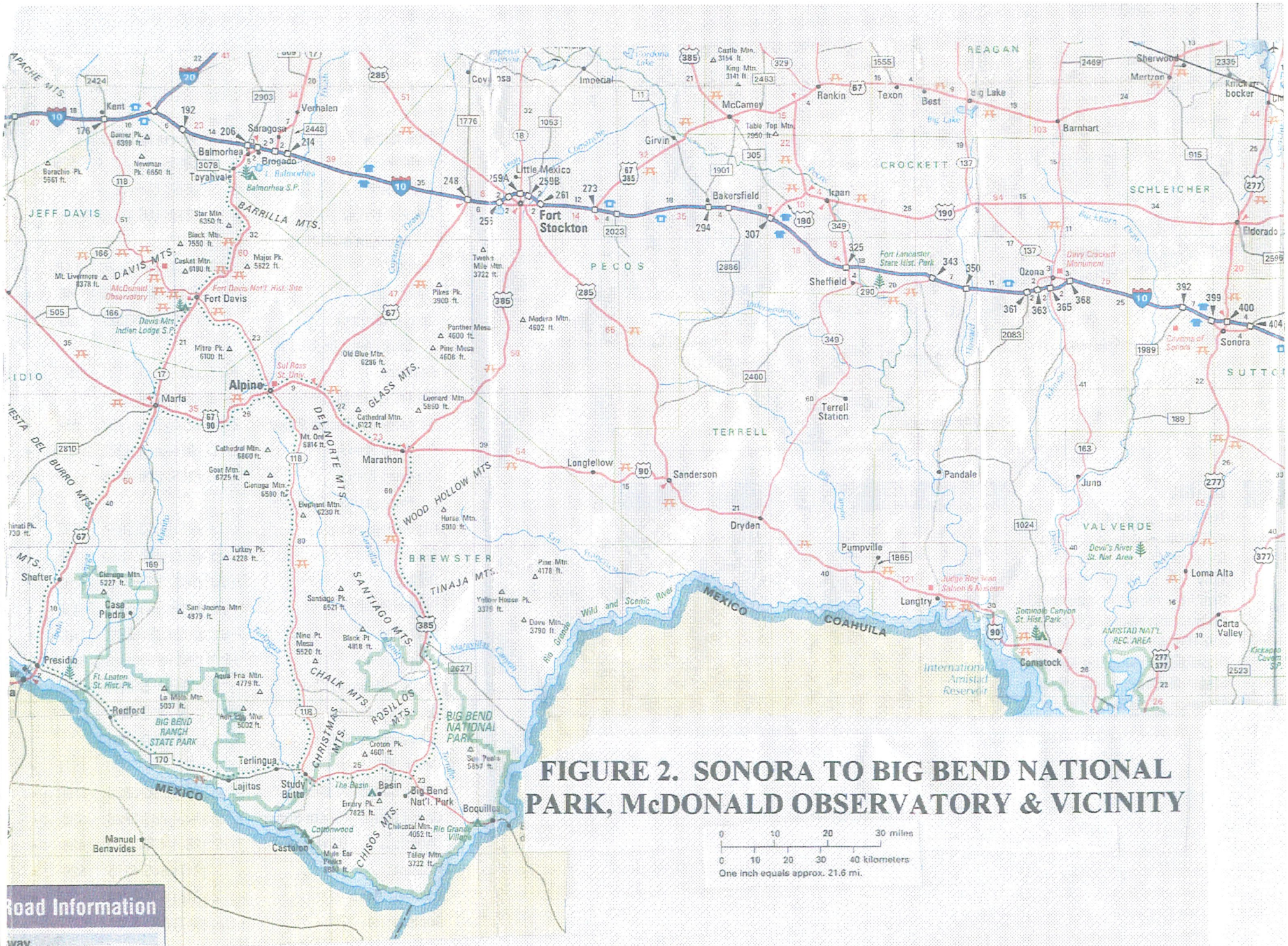


FIGURE 2. SONORA TO BIG BEND NATIONAL PARK, McDONALD OBSERVATORY & VICINITY

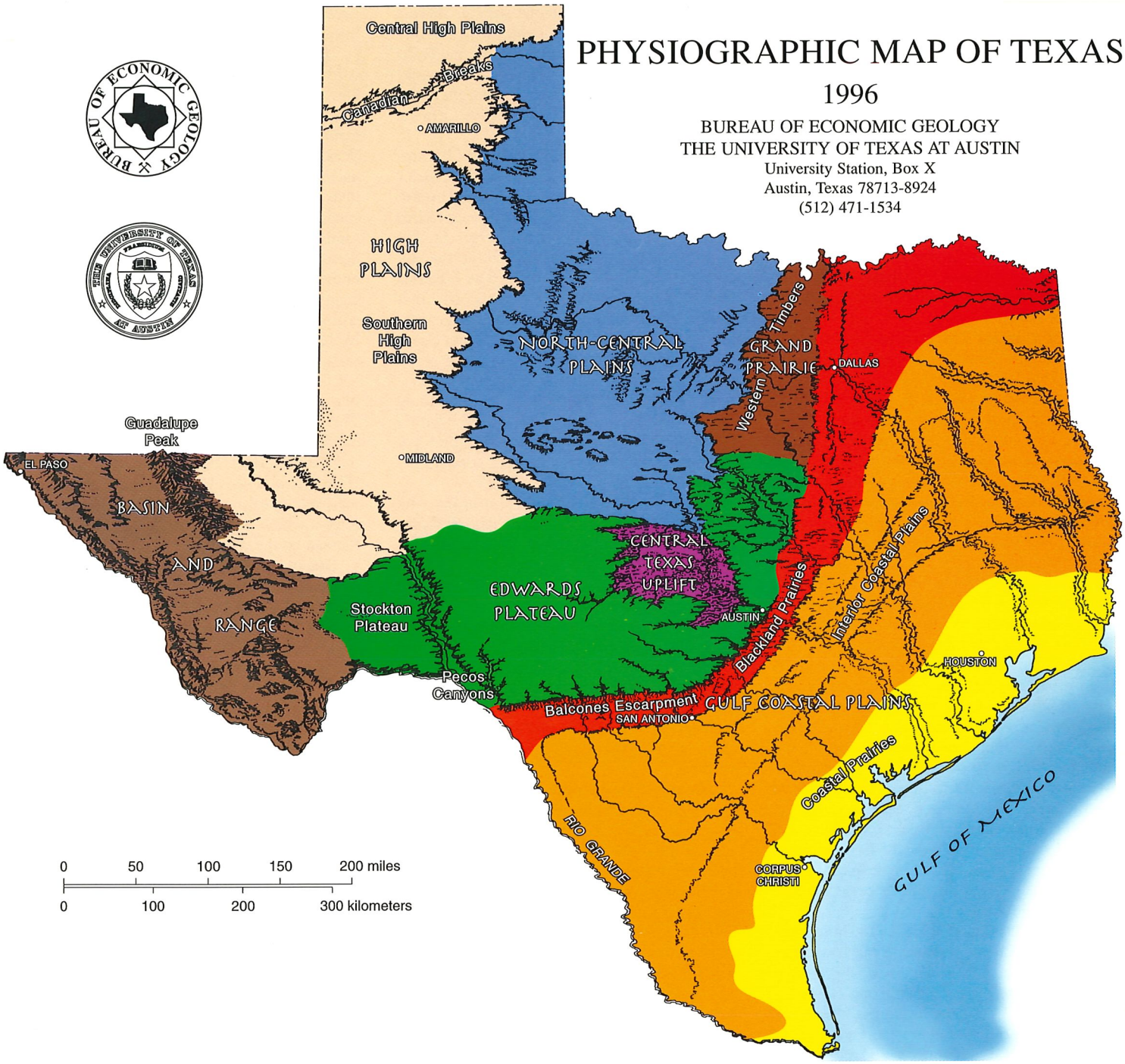
0 10 20 30 miles
0 10 20 30 40 kilometers
One inch equals approx. 21.6 mi.

Road Information

PHYSIOGRAPHIC MAP OF TEXAS

1996

BUREAU OF ECONOMIC GEOLOGY
THE UNIVERSITY OF TEXAS AT AUSTIN
University Station, Box X
Austin, Texas 78713-8924
(512) 471-1534



PROVINCE	MAX. ELEV. (ft)	MIN. ELEV. (ft)	TOPOGRAPHY	GEOLOGIC STRUCTURE	BEDROCK TYPES
Gulf Coastal Plains					
Coastal Prairies	300	0	Nearly flat prairie, <1 ft/mi to Gulf	Nearly flat strata	Deltaic sands and muds
Interior Coastal Plains	800	300	Parallel ridges (questas) and valleys	Beds tilted toward Gulf	Unconsolidated sands and muds
Blackland Prairies	1000	450	Low rolling terrain	Beds tilted south and east	Chalks and marls
Grand Prairie	1250	450	Low stairstep hills west; plains east	Strata dip east	Calcareous east; sandy west
Edwards Plateau					
Principal	3000	450	Flat upper surface with box canyons	Beds dip south; normal faulted	Limestones and dolomites
Pecos Canyons	2000	1200	Steep-walled canyons		Limestones and dolomites
Stockton Plateau	4200	1700	Mesa-formed terrain; highs to west	Unfaulted, near-horizontal beds	Carbonates and alluvial sediments
Central Texas Uplift	2000	800	Knobby plain; surrounded by questas	Centripetal dips, strongly faulted	Granites; metamorphics; sediments
North-Central Plains	3000	900	Low north-south ridges (questas)	West dip; minor faults	Limestones; sandstones; shales
High Plains					
Central	4750	2900	Flat prairies slope east and south	Slight dips east and south	Eolian silts and fine sands
Canadian Breaks	3800	2350	Highly dissected; local solution valleys		
Southern	3800	2200	Flat; many playas; local dune fields		
Basin and Range	8750	1700	North-south mountains and basins	Some complex folding and faulting	Igneous; metamorphics; sediments

Physiography of Texas

Geologists study the natural scenery of Texas and sort its variations into distinctive physiographic provinces. Each province or landscape reflects a unified geological history of depositional and erosional processes. Each physiographic province is distinguished by characteristic geologic structure, rock and soil types, vegetation, and climate. The elevations and shapes of its landforms contrast significantly with those of landforms in adjacent regions. The *Physiographic Map of Texas* displays seven physiographic provinces and their principal subdivisions; the accompanying table describes their major physical differences. The following descriptions selectively emphasize those characteristics that distinguish provinces and their subdivisions.

Gulf Coastal Plains. The Gulf Coastal Plains include three subprovinces named the Coastal Prairies, the Interior Coastal Plains, and the Blackland Prairies. The Coastal Prairies begin at the Gulf of Mexico shoreline. Young deltaic sands, silts, and clays erode to nearly flat grasslands that form almost imperceptible slopes to the southeast. Trees are uncommon except locally along streams and in oak mottes, growing on coarser underlying sediments of ancient streams. Minor steeper slopes, from 1 foot to as much as 9 feet high, result from subsidence of deltaic sediments along faults. Between Corpus Christi and Brownsville, broad sand sheets pocked by low dunes and blowouts forming ponds dominate the landscape.

The Interior Coastal Plains comprise alternating belts of resistant uncemented sands among weaker shales that erode into long, sandy ridges. At least two major down-to-the-coast fault systems trend nearly parallel to the coastline. Clusters of faults also concentrate over salt domes in East Texas. That region is characterized by pine and hardwood forests and numerous permanent streams. West and south, tree density continuously declines, pines disappear in Central Texas, and chaparral brush and sparse grasses dominate between San Antonio and Laredo.

On the Blackland Prairies of the innermost Gulf Coastal Plains, chalks and marls weather to deep, black, fertile clay soils, in contrast with the thin red and tan sandy and clay soils of the Interior Gulf Coastal Plains. The blacklands have a gentle undulating surface, cleared of most natural vegetation and cultivated for crops.

From sea level at the Gulf of Mexico, the elevation of the Gulf Coastal Plains increases northward and westward. In the Austin–San Antonio area, the average elevation is about 800 feet. South of Del Rio, the western end of the Gulf Coastal Plains has an elevation of about 1,000 feet.

Grand Prairie. The eastern Grand Prairie developed on limestones; weathering and erosion have left thin rocky soils. North and west of Fort Worth, the plateaulike surface is well exposed, and numerous streams dissect land that is mostly flat or that gently slopes southeastward. There, silver bluestem–Texas wintergrass grassland is the flora. Primarily sandstones underlie the western margin of the Grand Prairie, where post oak woods form the Western Cross Timbers.

Edwards Plateau. The Balcones Escarpment, superposed on a curved band of major normal faults, bounds the eastern and southern Edwards Plateau. Its principal area includes the Hill Country and a broad plateau. Stream erosion of the fault escarpment sculpts the Hill Country from Waco to Del Rio. The Edwards Plateau is capped by hard Cretaceous limestones. Local streams entrench the plateau as much as 1,800 feet in 15 miles. The upper drainages of streams are waterless draws that open into box canyons where springs provide permanently flowing water. Sinkholes commonly dot the limestone terrane and connect with a network of caverns. Alternating hard and soft marly limestones form a stairstep topography in the central interior of the province.

The Edwards Plateau includes the Stockton Plateau, mesalike land that is the highest part of this subdivision. With westward-decreasing rainfall, the vegetation grades from mesquite–juniper brush westward into creosote bush–tarbush shrubs.

The Pecos River erodes a canyon as deep as 1,000 feet between the Edwards and Stockton Plateaus. Its side streams become draws forming narrow blind canyons with nearly vertical walls. The Pecos Canyons include the major river and its side streams. Vegetation is sparse, even near springs and streams.

Central Texas Uplift. The most characteristic feature of this province is a central basin having a rolling floor studded with rounded granite hills 400 to 600 feet high. Enchanted Rock State Park is typical of this terrain. Rocks forming both basin floor and hills are among the oldest in Texas. A rim of resistant lower Paleozoic formations (see the *Geology of Texas* map) surrounds the basin. Beyond the Paleozoic rim is a second ridge formed of limestones like those of the Edwards Plateau. Central live oak–mesquite parks are surrounded by live oak–ashe juniper parks.

North-Central Plains. An erosional surface that developed on upper Paleozoic formations forms the North-Central Plains. Where shale bedrock prevails, meandering rivers traverse stretches of local prairie. In areas of harder bedrock, hills and rolling plains dominate. Local areas of hard sandstones and limestones cap steep slopes severely dissected near rivers. Lengthy dip slopes of strongly fractured limestones display extensive rectangular patterns. Western rocks and soils are oxidized red or gray where gypsum dominates, whereas eastern rocks and soils weather tan to buff. Live oak–ashe juniper parks grade westward into mesquite–lotebush brush.

High Plains. The High Plains of Texas form a nearly flat plateau with an average elevation approximating 3,000 feet. Extensive stream-laid sand and gravel deposits, which contain the Ogallala aquifer, underlie the plains. Windblown sands and silts form thick, rich soils and caliche locally. Havard shin oak–mesquite brush dominates the silty soils, whereas sandsage–Havard shin oak brush occupies the sand sheets. Numerous playa lakes scatter randomly over the treeless plains. The eastern boundary is a westward-retreating escarpment capped by a hard caliche. Headwaters of major rivers deeply notch the caprock, as exemplified by Palo Duro Canyon and Caprock Canyons State Parks.

On the High Plains, widespread small, intermittent streams dominate the drainage. The Canadian River cuts across the province, creating the Canadian Breaks and separating the Central High Plains from the Southern High Plains. Pecos River drainage erodes the west-facing escarpment of the Southern High Plains, which terminates against the Edwards Plateau on the south.

Basin and Range. The Basin and Range province contains eight mountain peaks that are higher than 8,000 feet. At 8,749 feet, Guadalupe Peak is the highest point in Texas. Mountain ranges generally trend nearly north-south and rise abruptly from barren rocky plains.

Plateaus in which the rocks are nearly horizontal and less deformed commonly flank the mountains. Cores of strongly folded and faulted sedimentary and volcanic rocks or of granite rocks compose the interiors of mountain ranges. Volcanic rocks form many peaks. Large flows of volcanic ash and thick deposits of volcanic debris flank the slopes of most former volcanoes. Ancient volcanic activity of the Texas Basin and Range province was mostly explosive in nature, like Mount Saint Helens. Volcanoes that poured successive lava flows are uncommon. Eroded craters, where the cores of volcanoes collapsed and subsided, are abundant.

Gray oak–pinyon pine–alligator juniper parks drape the highest elevations. Creosote bush and lechuguilla shrubs sparsely populate plateaus and intermediate elevations. Tobosa–black grama grassland occupies the low basins.

The *Physiographic Map of Texas* is a useful guide to appreciate statewide travel. Texas abounds with vistas of mountains, plateaus, plains, hills, and valleys in which many rock types and geologic structures are exposed. A variety of vegetation grows, depending on local climate.

—Text by E. G. Wermund

Bureau of Economic Geology

The **Bureau of Economic Geology,** established in 1909, is a research entity of The University of Texas at Austin and also functions as the State Geological Survey. The Bureau conducts basic and applied research projects in energy and mineral resources, coastal and environmental studies, land resources, and geologic mapping. Reports and maps published by the Bureau are available for a nominal price. A list of publications is available on request.

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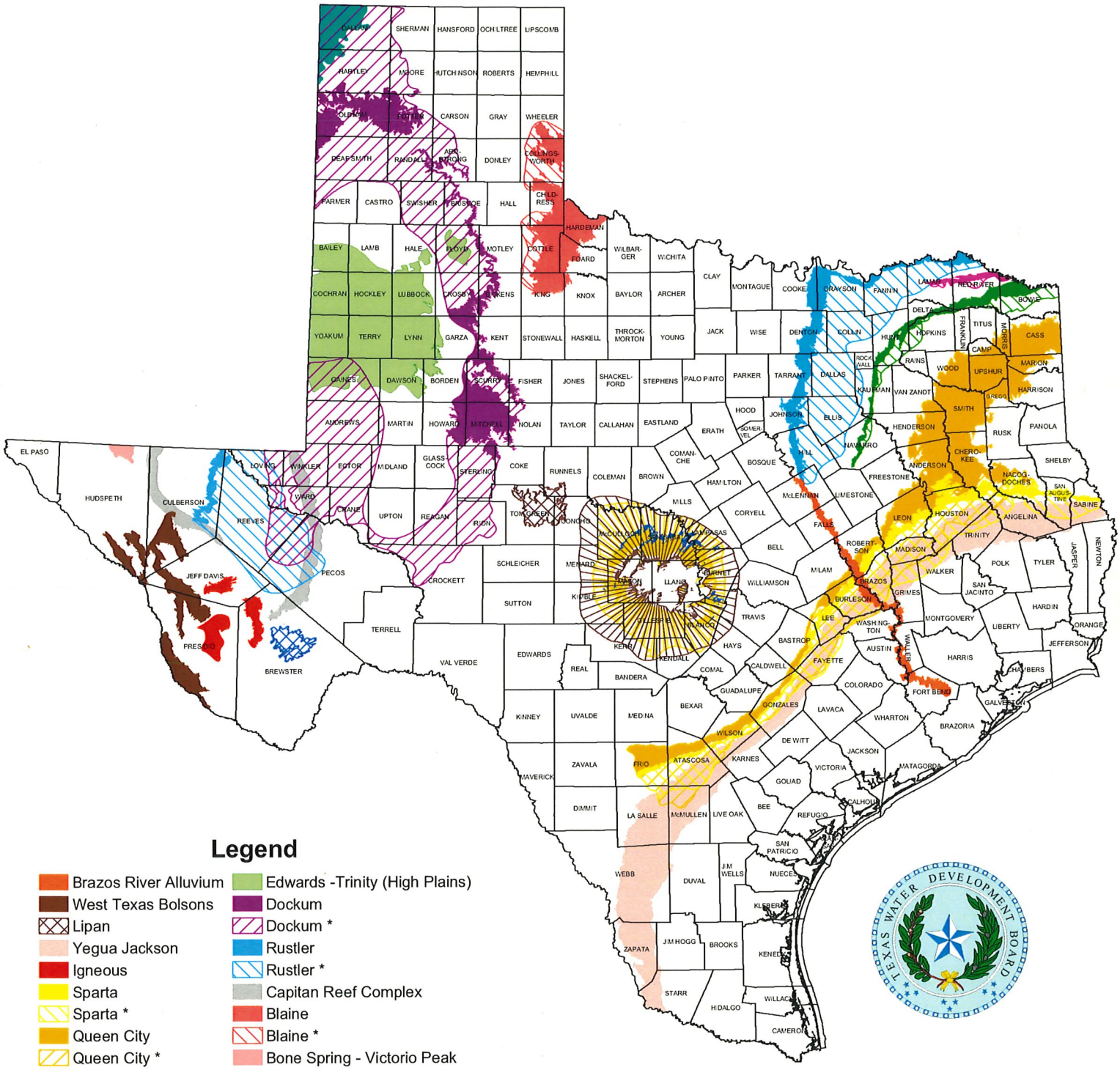
Minor Aquifers of Texas



Legend

- Brazos River Alluvium
- West Texas Bolsons
- Lipan
- Yegua Jackson
- Igneous
- Sparta
- Sparta *
- Queen City
- Queen City *
- Nacatoch
- Nacatoch *
- Blossom
- Blossom *
- Woodbine
- Woodbine *
- Rita Blanca
- Edwards -Trinity (High Plains)
- Dockum
- Dockum *
- Rustler
- Rustler *
- Capitan Reef Complex
- Blaine
- Blaine *
- Bone Spring - Victorio Peak
- Marble Falls
- Marathon
- Ellenburger - San Saba
- Ellenburger - San Saba *
- Hickory
- Hickory *

NOTE: Chronology by Geologic age.

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 lies or dips below other rock layers)

N
W E
S

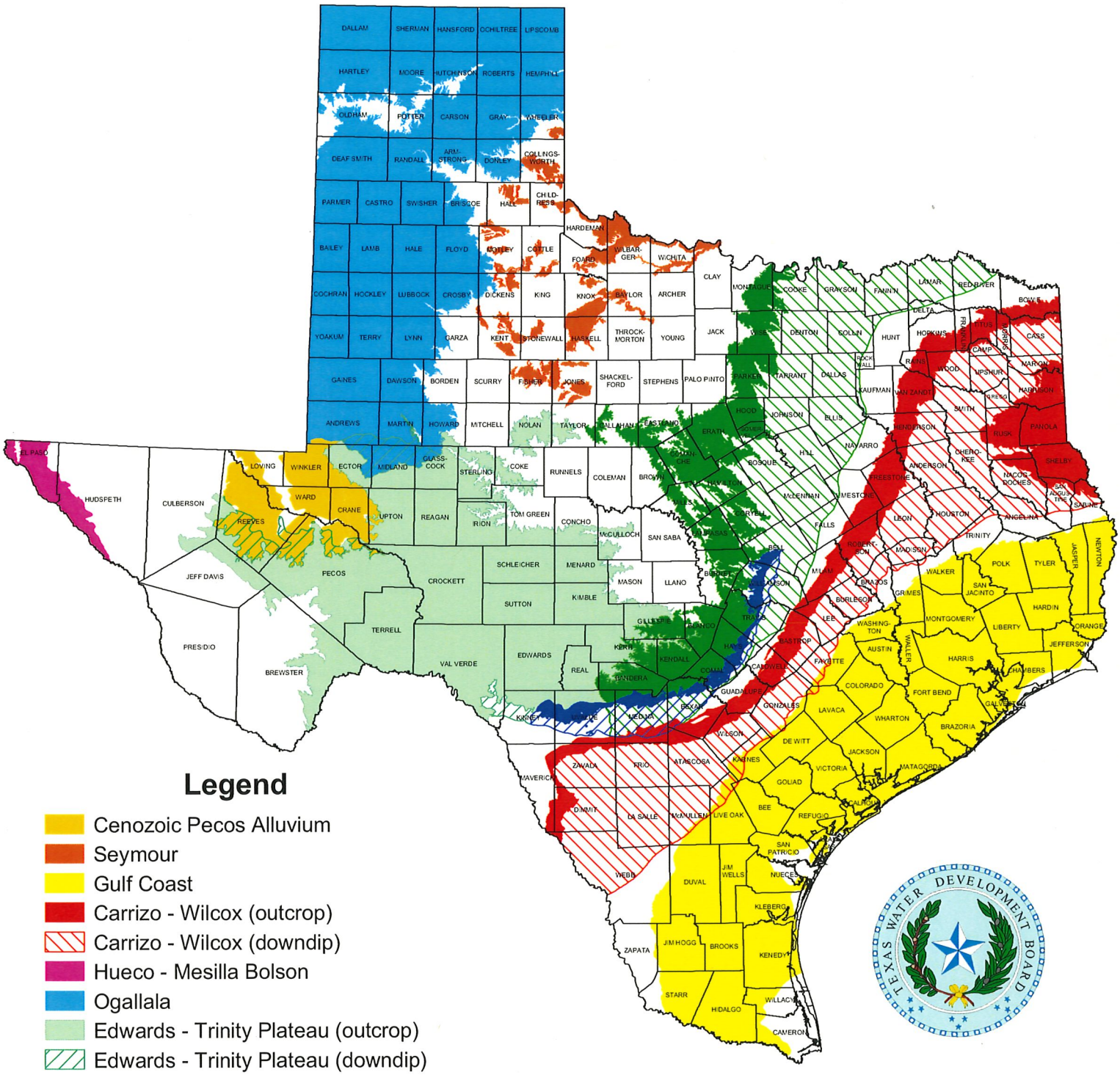
0 15 30 60 90 120 Miles

TEXAS WATER DEVELOPMENT BOARD

DISCLAIMER
This map was generated by the Texas Water Development Board using GIS (Geographic Information Systems) software. No claims are made to the accuracy or completeness of the information shown herein nor to its suitability for a particular use. The scale and location of all mapped data are approximate.

Map created by Mark Hayes, Mapping Coordinator

Major Aquifers of Texas



Legend

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

NOTE: Chronology by Geologic age.

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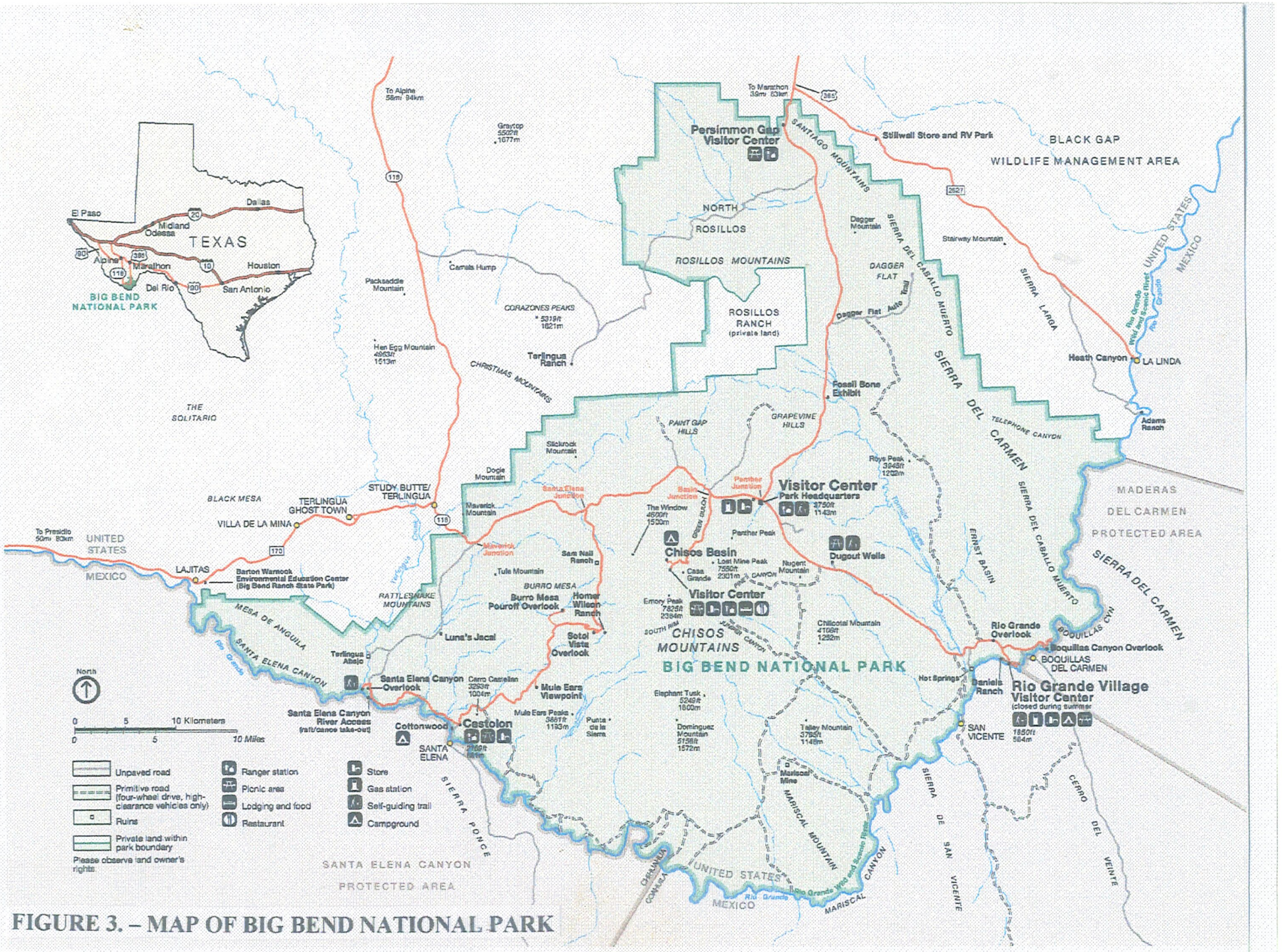

FIGURE 3. – MAP OF BIG BEND NATIONAL PARK