A grayscale map of North America, showing the outlines of the United States and Mexico. The map is positioned in the background, with the title text overlaid on it.

TRANSBOUNDARY AQUIFERS BETWEEN MEXICO AND THE US

Identification, Classification and Priorization

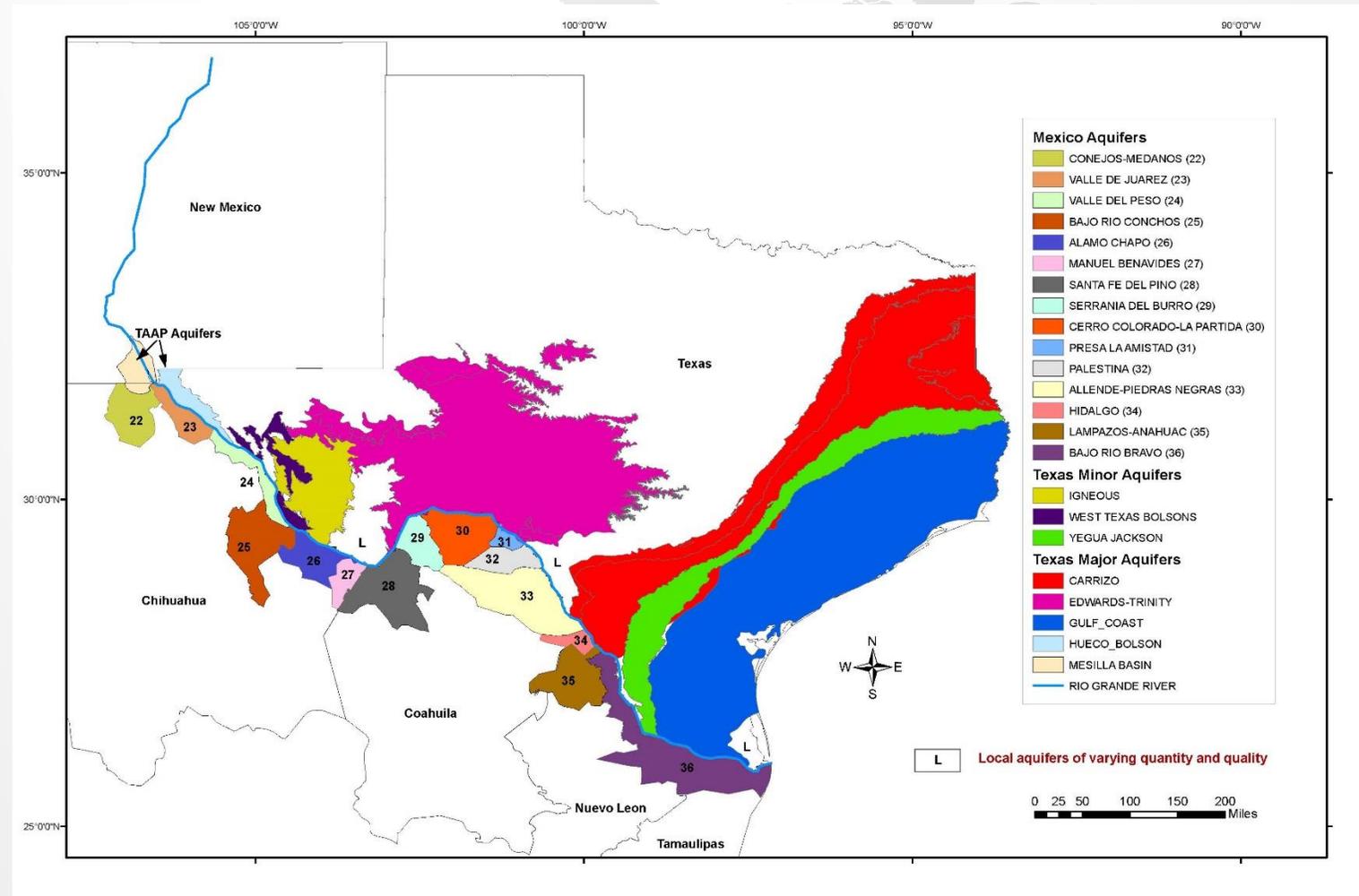
Rosario Sanchez & Laura Rodriguez
Texas Water Resources Institute, Texas A&M University

Acknowledgement: UGSG TAAP, Texas Agrilife Research, Texas A&M University

CURRENT RESEARCH

1. Identification
2. Delineation
3. Classification
4. Priorization

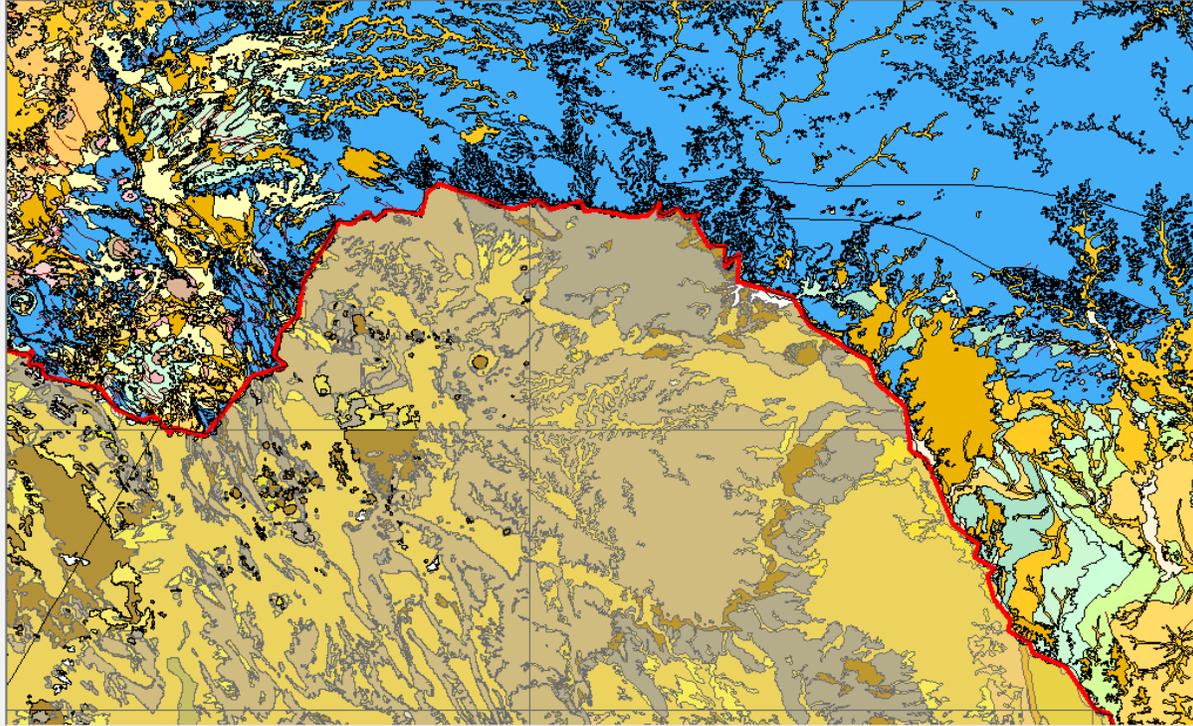
Of transboundary aquifers



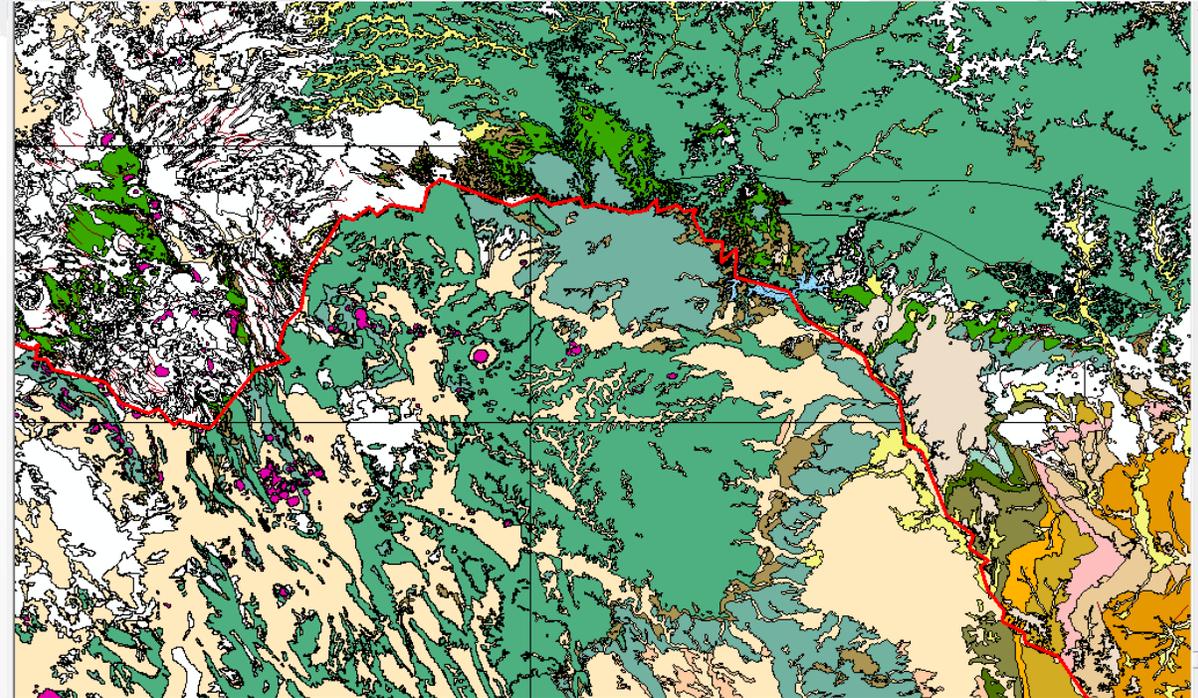
Current Research

Transboundary Aquifers between Mexico and Texas

Before...



After

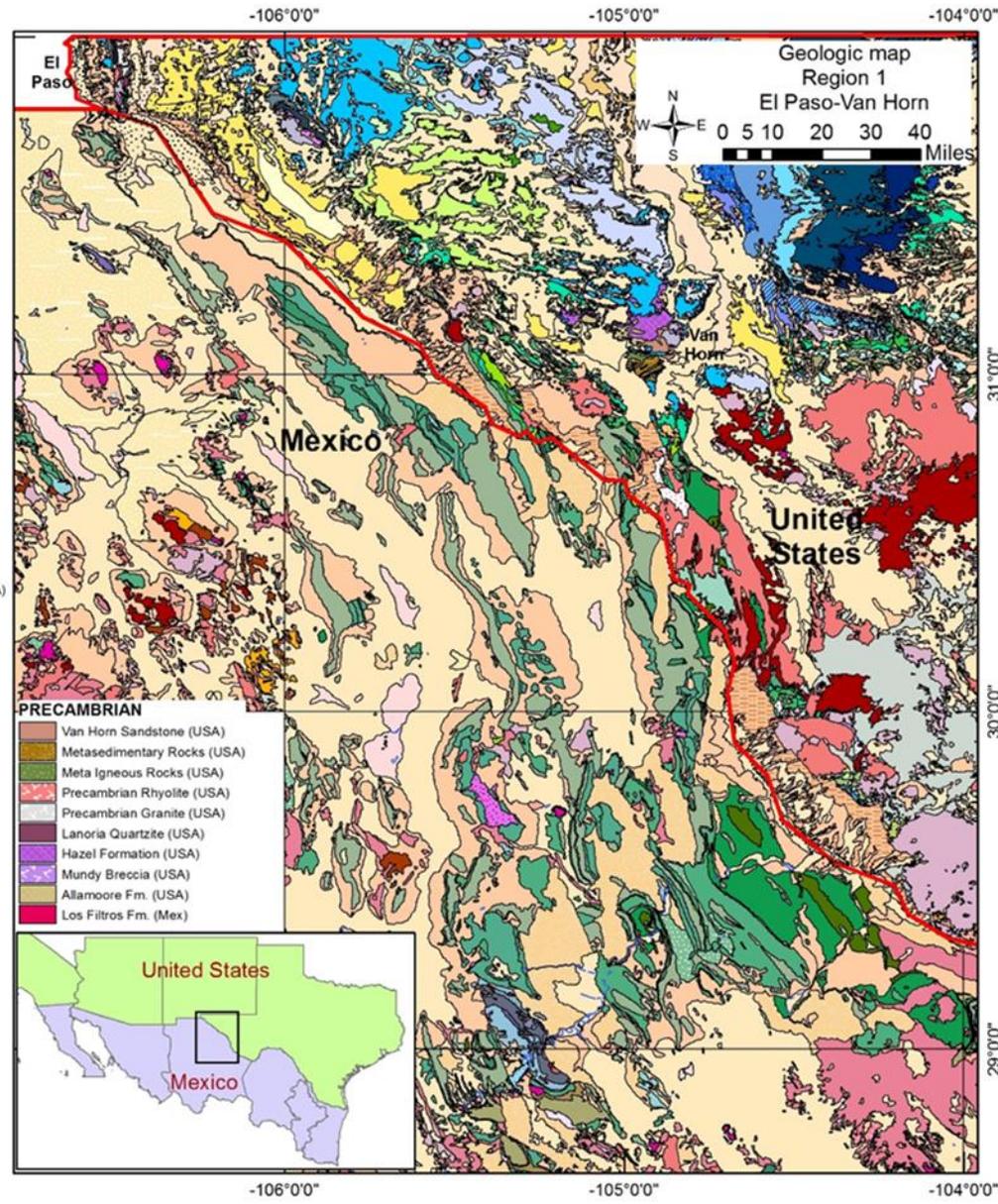


GEOLOGICAL CORRELATION

Mexico/USA Geologic Units

- Water
- Country Boundary
- CENOZOIC**
- Sand dunes/Sand Dunes
- Sand Sheet/Sand Sheet
- Qt Alluvium/Qt Alluvium
- Qt Lacustrine/Qt Lacustrine
- Qt Colluvium/Qt Colluvium
- Qt Eolic/Qt Eolic
- Qt Conglomerates/Qt Conglomerates
- Playa Deposits (USA)
- Quaternary Clay and Mud (USA)
- Gatuna Fm. (USA)
- Toy Limestone (USA)
- Qt to Tertiary Clay and Mud (USA)
- Neogene Conglomerate (Mex)
- Tertiary igneous Rocks/
Tertiary igneous Rocks
- Extrusive Igneous Rocks (USA)
- Dacitic Porphyry (Mex)
- Tertiary Basalts/Tertiary Basalts
- Ash Flow Tuff/Ash Flow Tuff
- Rhyodacite-Rhyodacitic Tuff (Mex)
- Rhyolitic Breccia (Mex)
- Rhyolitic Porphyry/Rhyolitic Porphyry
- Rhyolitic Tuff (Mex)
- Andesitic Porphyry (Mex)
- Trachyte/Trachyte
- Tonalite (Mex)
- Tarantula Gravel (USA)
- Perdiz Conglomerate (USA)
- Chisos Fm. (USA)
- Hogeve Tuff (USA)
- El Uno Formation (Mex)
- MESOZOIC**
- Cretaceous Rocks Undivided (USA)
- Formation not assigned (Mex)
- Cretaceous Conglomerate (Mex)
- Navarrete Fm. (Mex)
- Picacho Fm./Picacho Fm.
- San Carlos Fm./San Carlos Sandstone
- Aguja Fm./Aguja Fm.
- Pen Fm./Pen Fm.
- Upper Tamaulipas Fm. (Mex)
- Georgetown Fm./Georgetown Fm.
- Benigno Fm. (Mex)
- Cuchillo Fm. (Mex)
- Boquillas Fm./Boquillas Fm.
- Eagle Ford Fm./Eagle Ford Group
- Ojinaga Fm./Ojinaga Fm.
- Boracho Limestone (USA)
- Benevides Fm./Benevides Fm.
- Loma de Plata Fm./Espy Limestone
- Buda-Del Rio Fm./
Buda Limestone-Del Rio Clay
- Buda and San Martine Undivided (USA)
- Washita Group/Washita Group
- Sta Elena Fm./Sta Elena Limestone
- Del Carmen Fm./Del Carmen Limestone

- Del Canyon-Telephone Canyon Fm. (USA)
- West Nueces Fm./West Nueces Fm.
- Kiamichi Fm./Kiamichi Fm.
- Edwards Fm./Edwards Fm.
- Finlay Formation (USA)
- Cox Sandstone (USA)
- Yearwood Fm. (USA)
- Bluff Mesa Fm. (USA)
- Campagrande Fm. (USA)
- La Pena Fm./Yucca Fm.
- Shafter Fm. (USA)
- Presidio Fm. (USA)
- Etholen Fm. (USA)
- Torcer Formation (USA)
- Aurora Fm./Glen Rose Fm.
- Cupido-Las Vigas Fm. (Mex)
- Malone Formation (USA)
- La Casita Fm. (Mex)
- Triassic-Jurassic conglomerate (Mex)
- PALEOZOIC**
- Pastor Fm. (Mex)
- Plomosas Fm. (Mex)
- Verde Fm. (Mex)
- Monillas Fm. (Mex)
- Dewey Lake Fm. (USA)
- Rustler-Castile Fm. Undivided (USA)
- Rustler Fm. (USA)
- Castile Fm. (USA)
- Bell Canyon-Brushy Canyon Undivided (USA)
- Brusky Creek Fm. (USA)
- Carlsbad Group (USA)
- Capitan Limestone (USA)
- Bell Canyon Fm. (USA)
- Cherry Canyon Fm. (USA)
- Word Fm. (USA)
- Yates Fm. (USA)
- Goat Seep Limestone (USA)
- Munn Fm. (USA)
- Briggs Fm. (USA)
- Cutoff Shale (USA)
- Mina Grande Fm. (USA)
- Seven Rivers Fm. (USA)
- Ross Mine Fm. (USA)
- Pinto Canyon Fm. (USA)
- Victorio Peak Fm. (USA)
- Bone Spring Limestone (USA)
- Leonardian Rocks Undivided (USA)
- Hueco Limestone (USA)
- Alta Fm. (USA)
- Magdalena Fm. (USA)
- Mississippian and Devonian Rocks/
Mississippian and Devonian Rocks
- Fusselman Dolomite (USA)
- Paleozoic Rocks Undivided (USA)
- Sostenes Fm./Montoya Dolomite
- Cieneguita Fm. (USA)
- Ordovician Undivided (USA)
- Marathon-Dagger Flat Fm. (USA)
- Cambrian-Carboniferous Rocks (Mex)

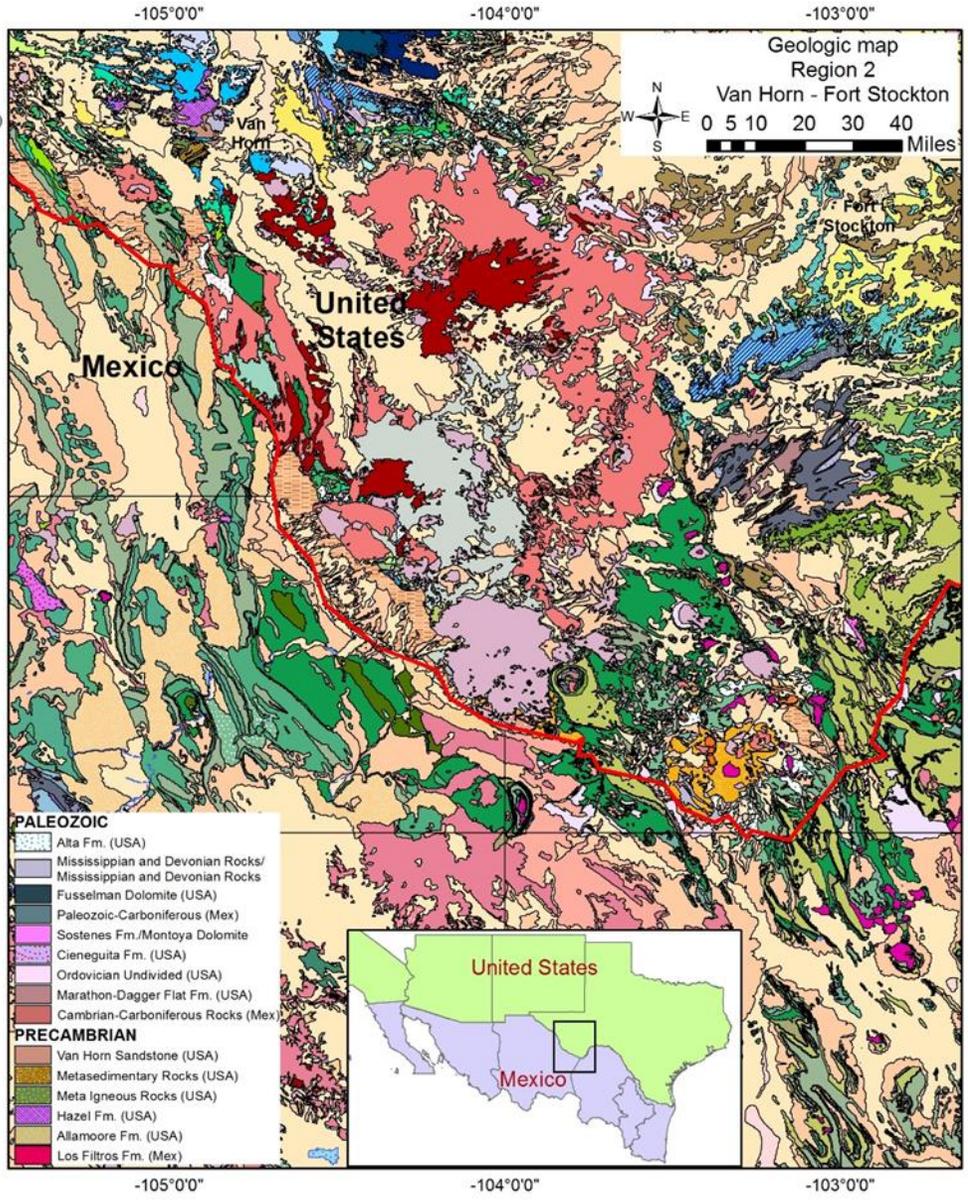


GEOLOGICAL CORRELATION

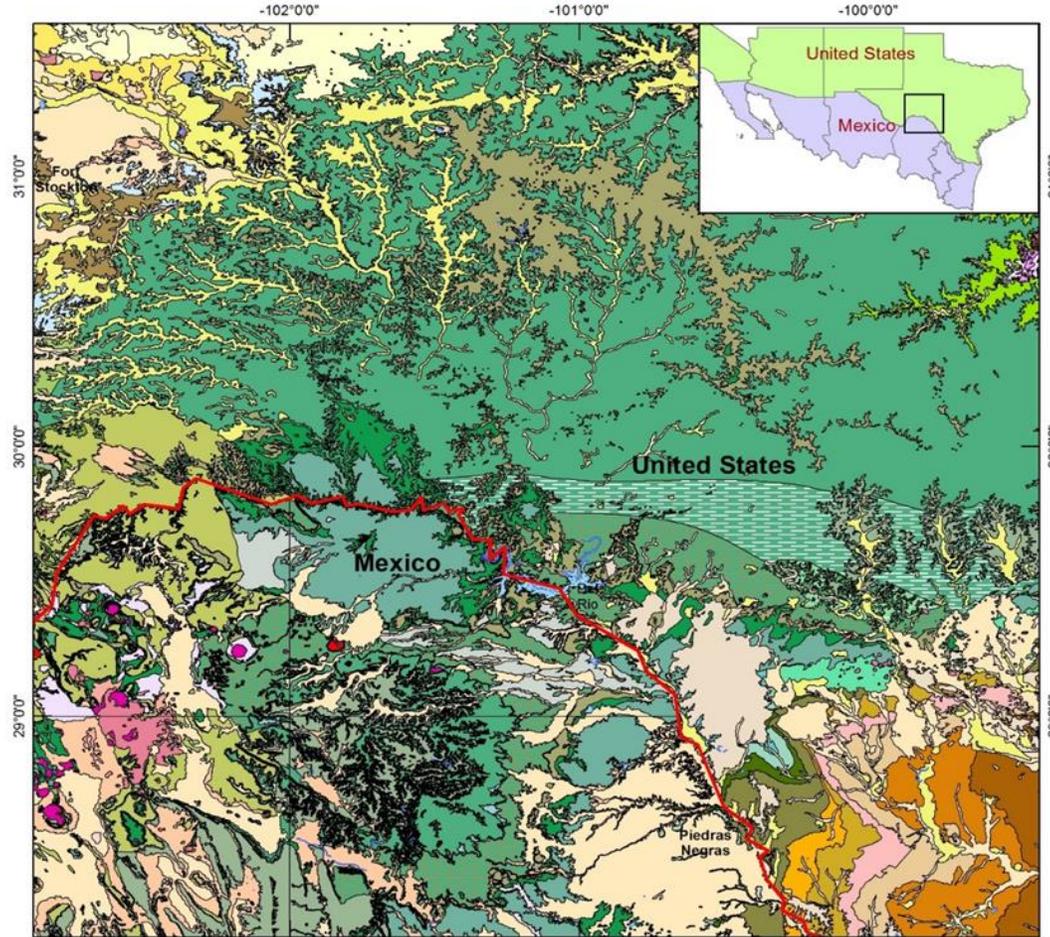
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- Sand dunes/Sand Dunes
- Sand Sheet/Sand Sheet
- Qt Alluvium/Qt Alluvium
- Qt Lacustrine/Qt Lacustrine
- Qt Colluvium/Qt Colluvium
- Qt Conglomerates/Qt Conglomerates
- Playa Deposits (USA)
- Quaternary Clay and Mud (USA)
- Evaporites (USA)
- Gypsite (USA)
- Tahoka Fm. (USA)
- Gatuna Fm. (USA)
- Toy Limestone (USA)
- Qt to Tertiary Clay and Mud (USA)
- Neogene Conglomerate (Mex)
- Tertiary Igneous Rocks/ Tertiary Igneous Rocks**
- Extrusive Igneous Rocks (USA)
- Dacitic Porphyry (Mex)
- Tertiary Basalts/Tertiary Basalts**
- Ash Flow Tuff/Ash Flow Tuff
- Rhyodacite-Rhyodacitic Tuff (Mex)
- Rhyolitic Breccia (Mex)
- Rhyolitic Porphyry/Rhyolitic Porphyry
- Rhyolitic Tuff (Mex)
- Andesitic Porphyry (Mex)
- Trachyte/Trachyte
- Quartzmonzonite (Mex)
- Fingers Fm. (USA)
- Tarantula Gravel (USA)
- Perdiz Conglomerate (USA)
- Chisos Fm. (USA)
- Hogeys Tuff (USA)
- Hannold Hill Fm. (USA)
- Black Peaks Fm. (USA)
- MESOZOIC**
- Javelina Fm. (USA)
- Cretaceous Rocks Undivided (USA)
- Formation not assigned (Mex)
- Cretaceous Conglomerate (Mex)
- Navarrete Fm. (Mex)
- Picacho Fm./Picacho Fm.
- San Carlos Fm./San Carlos Sandstone
- Aguja Fm./Aguja Fm.
- Pen Fm./Pen Fm.
- Austin Fm./Austin Chalk
- Upper Tamaulipas Fm. (Mex)
- Georgetown Fm./Georgetown Fm.
- Benigno Fm. (Mex)
- Cuchillo Fm. (Mex)
- Boquillas Fm./Boquillas Fm.
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- Benevides Fm./Benevides Fm.
- Loma de Plata Fm./Espy Limestone

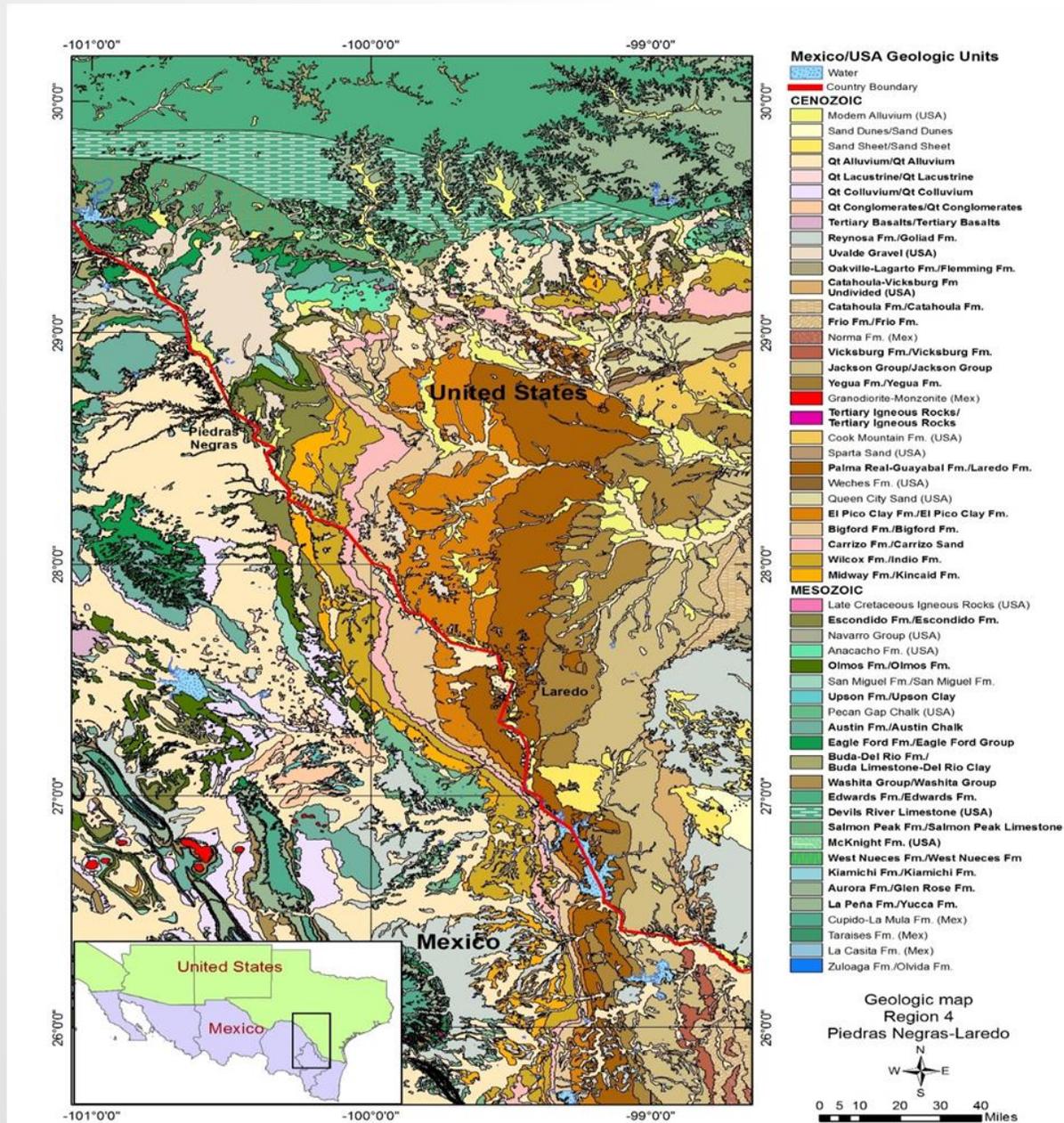
- Buda-Del Rio Fm./ Buda Limestone-Del Rio Clay
- Buda and San Martine Undivided (USA)
- Washita Group/Washita Group
- Sta Elena Fm./Sta Elena Limestone
- Del Carmen Fm./Del Carmen Limestone
- Del Canyon-Telephone Canyon Fm. (USA)
- West Nueces Fm./West Nueces Fm.
- Salmon Peak Fm./ Salmon Peak Limestone
- Kiamichi Fm./Kiamichi Fm.
- Edwards Fm./Edwards Fm.
- Finlay Formation (USA)
- Fredericksburg Group (USA)
- Fort Terret Member (USA)
- Puerto Rico Fm. (Mex)
- Cox Sandstone (USA)
- Yearwood Fm. (USA)
- Bluff Mesa Fm. (USA)
- Campgrande Fm. (USA)
- La Pena Fm./Yucca Fm.
- Shafter Fm. (USA)
- Presidio Fm. (USA)
- Aholen Fm. (USA)
- Aurora Fm./Glen Rose Fm.
- Trinity Group Undivided (USA)
- Bissett Conglomerate (USA)
- Cupido-Las Vigas Fm. (Mex)
- La Casita Fm. (Mex)
- Dockum Group Undivided (Mex)
- PALEOZOIC**
- Pastor Fm. (Mex)
- Plomosas Fm. (Mex)
- Verde Fm. (Mex)
- Monillas Fm. (Mex)
- Dewey Lake Fm. (USA)
- Skinner Ranch Fm. (USA)
- Rustler Fm. (USA)
- Castile Fm. (USA)
- Capitan Limestone (USA)
- Bell Canyon Fm. (USA)
- Cherry Canyon Fm. (USA)
- Tansill Fm. (USA)
- Tessey Limestone (USA)
- Word Fm. (USA)
- Yates Fm. (USA)
- Cathedral Mountain Fm. (USA)
- Nealranch Fm. (USA)
- Gaptank Fm. (USA)
- Haymond Fm. (USA)
- Dimple Limestone (USA)
- Tesnus Fm. (USA)
- Munn Fm. (USA)
- Cutoff Shale (USA)
- Mina Grande Fm. (USA)
- Seven Rivers Fm. (USA)
- Ross Mine Fm. (USA)
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- Fusselman Dolomite (USA)
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- Cieneguita Fm. (USA)
- Ordovician Undivided (USA)
- Marathon-Dagger Flat Fm. (USA)
- Cambrian-Carboniferous Rocks (Mex)
- PRECAMBRIAN**
- Van Horn Sandstone (USA)
- Metasedimentary Rocks (USA)
- Meta Igneous Rocks (USA)
- Hazel Fm. (USA)
- Allamore Fm. (USA)
- Los Filtros Fm. (Mex)



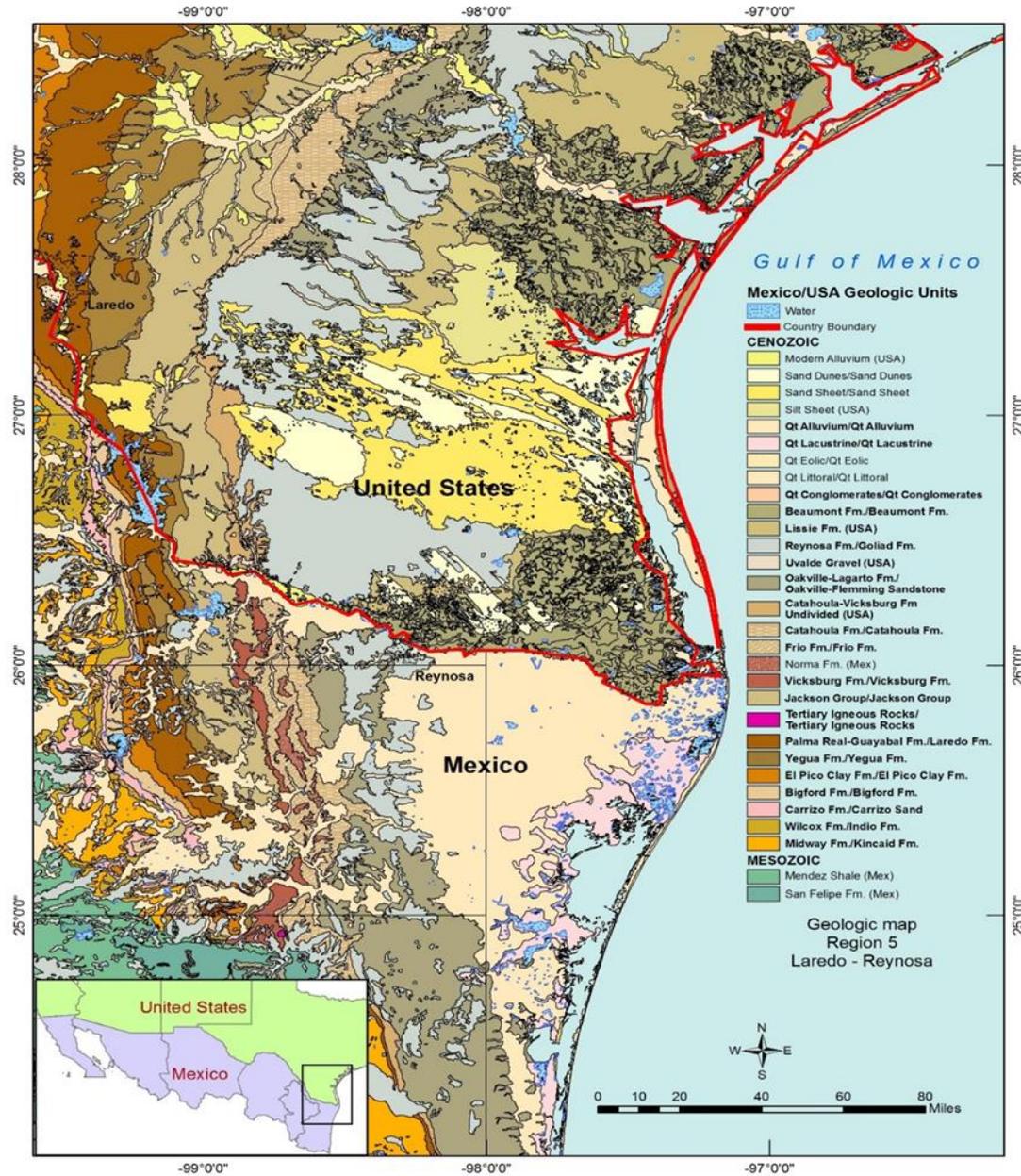
GEOLOGICAL CORRELATION



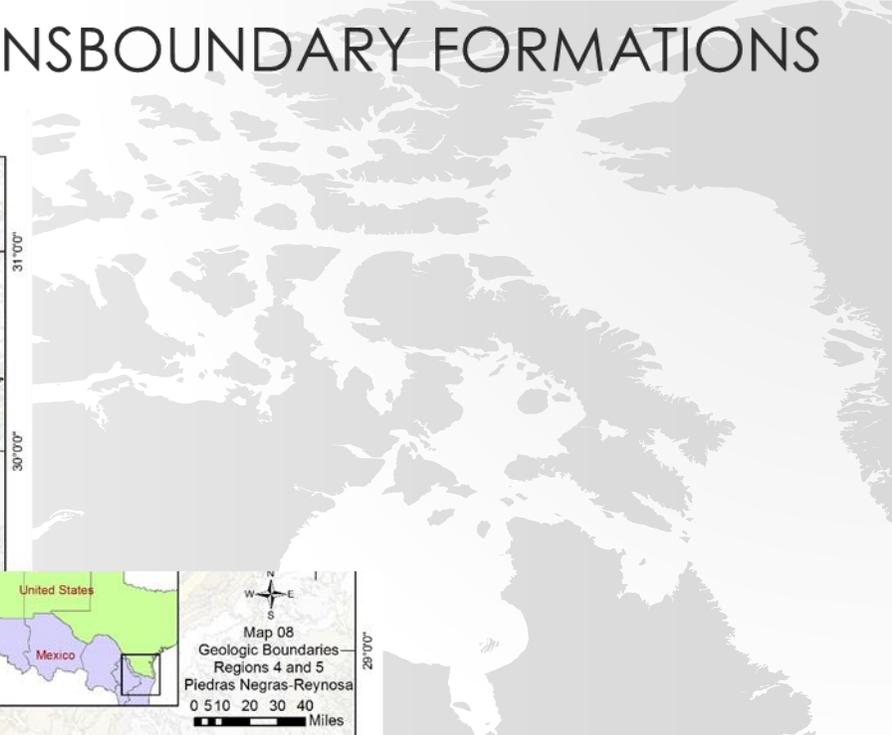
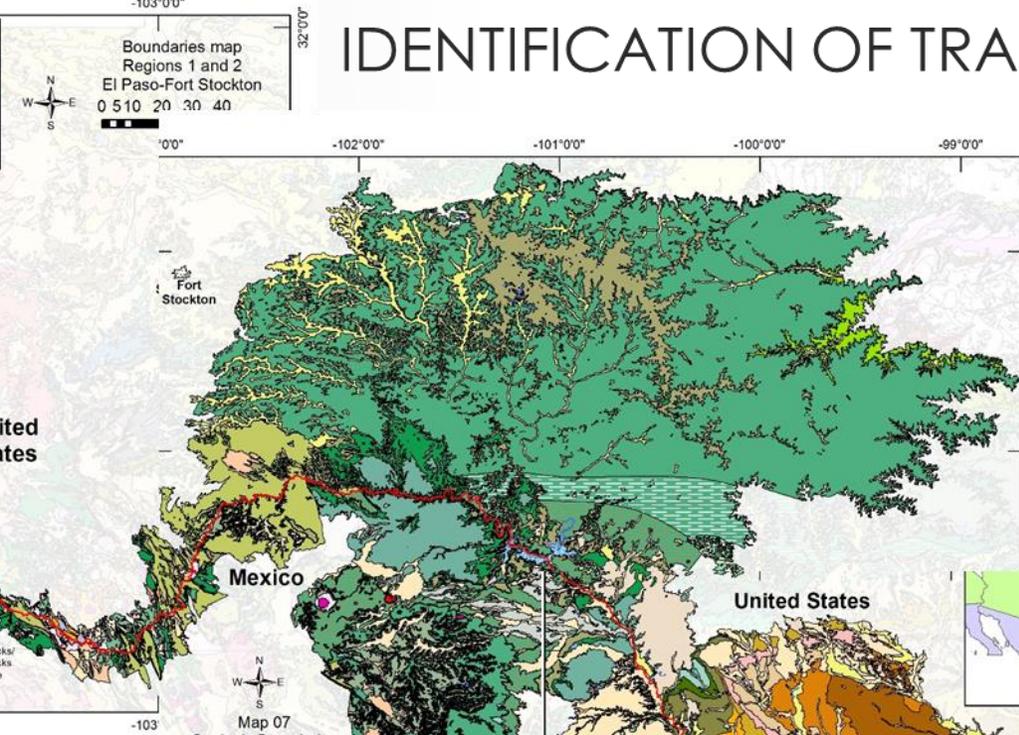
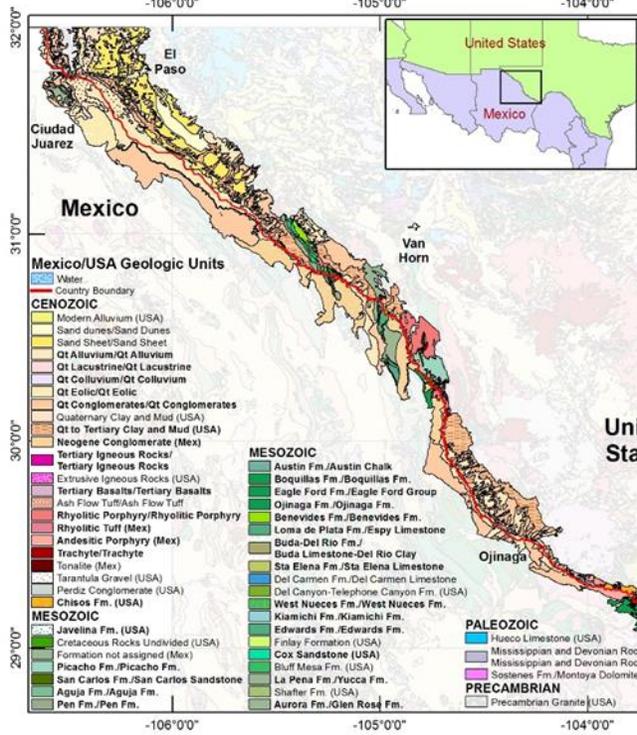
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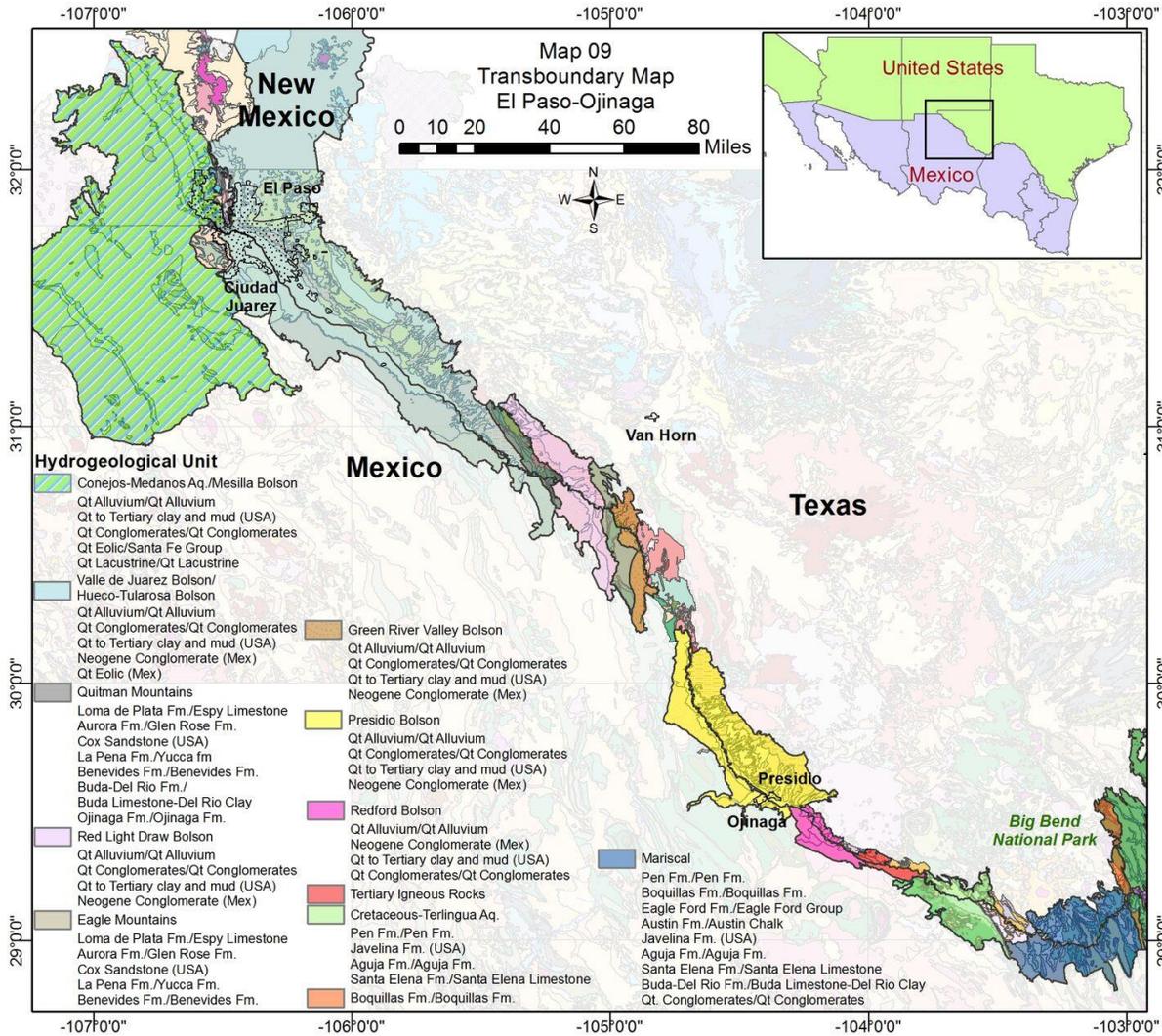
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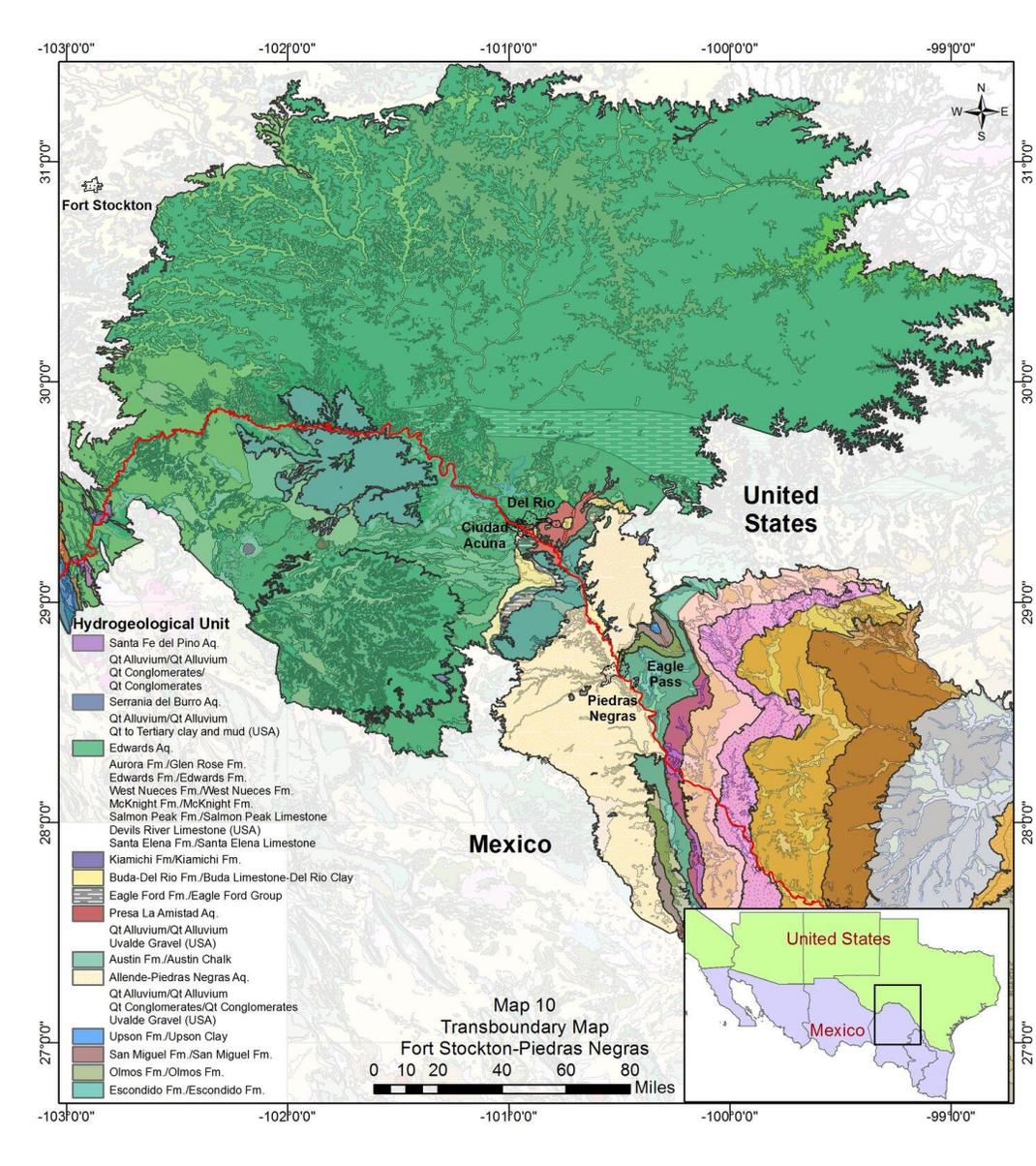
IDENTIFICATION OF TRANSBOUNDARY FORMATIONS



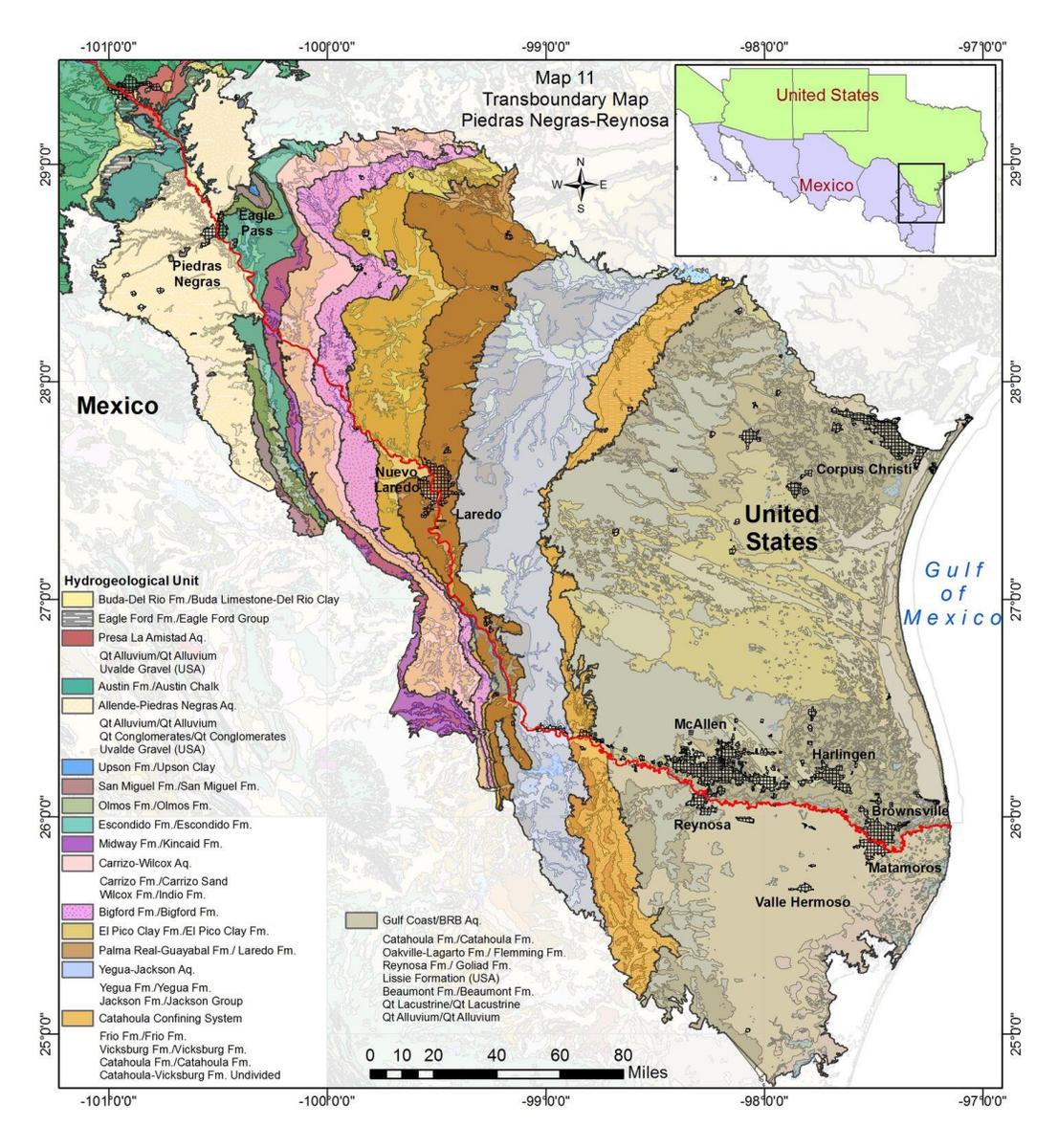
IDENTIFICATION OF HYDROGEOLOGICAL UNITS



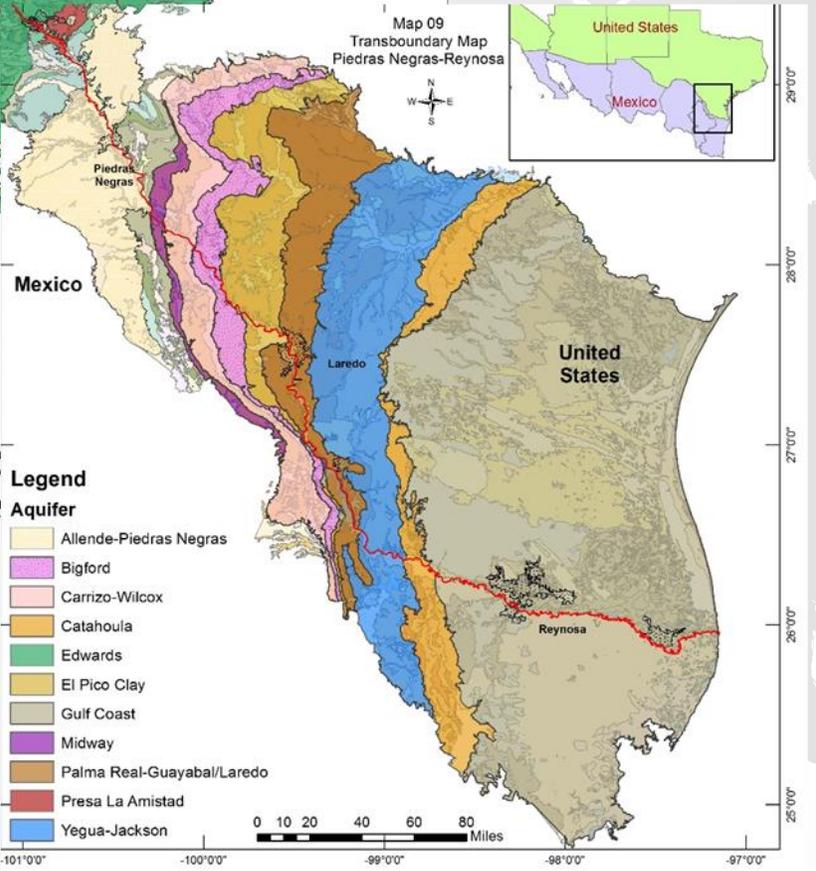
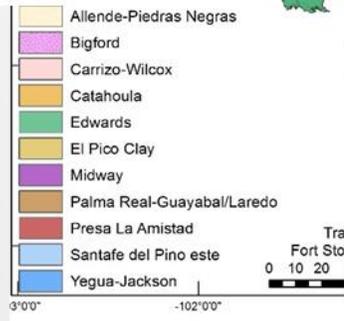
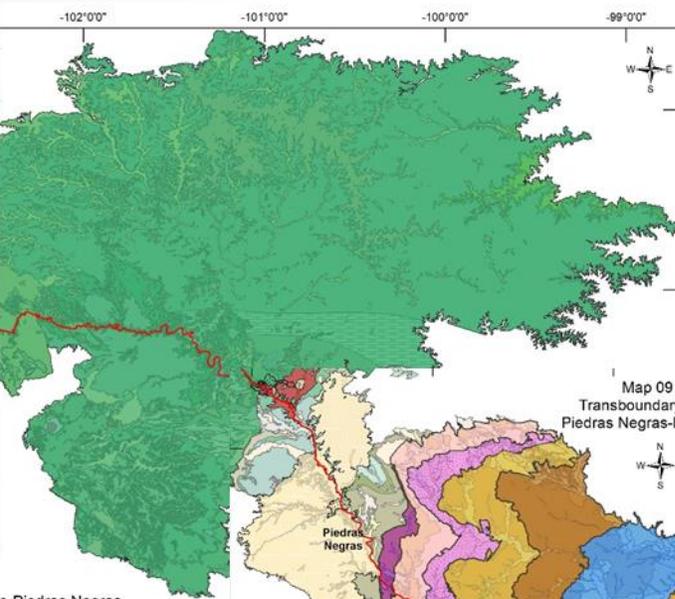
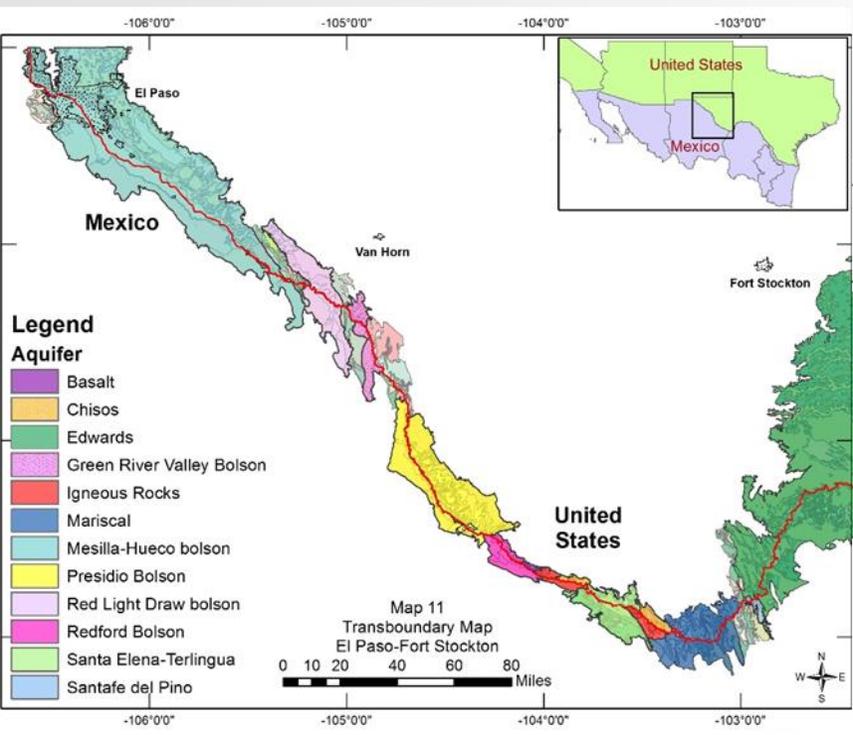
IDENTIFICATION OF HYDROGEOLOGICAL UNITS



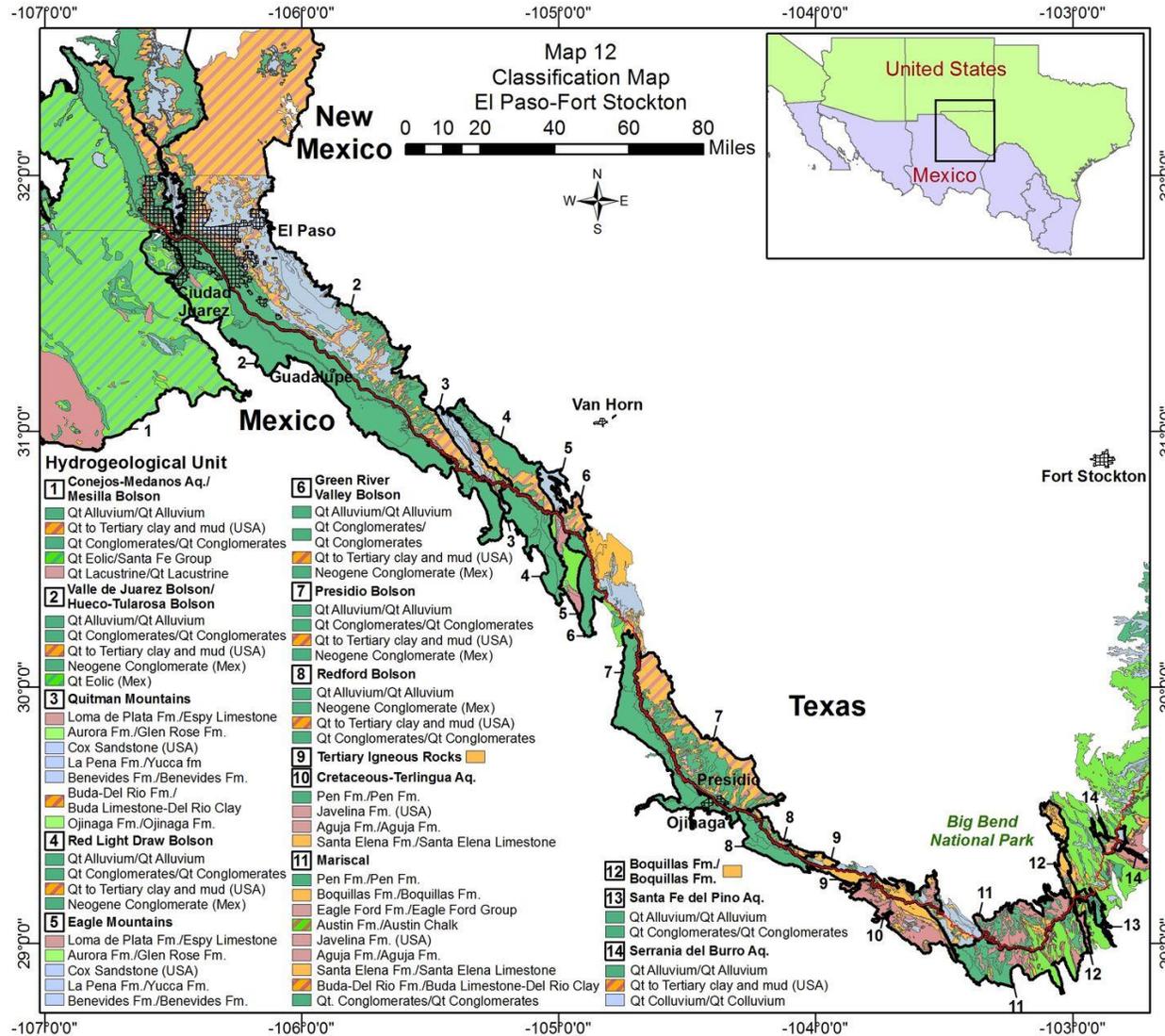
IDENTIFICATION OF HYDROGEOLOGICAL UNITS



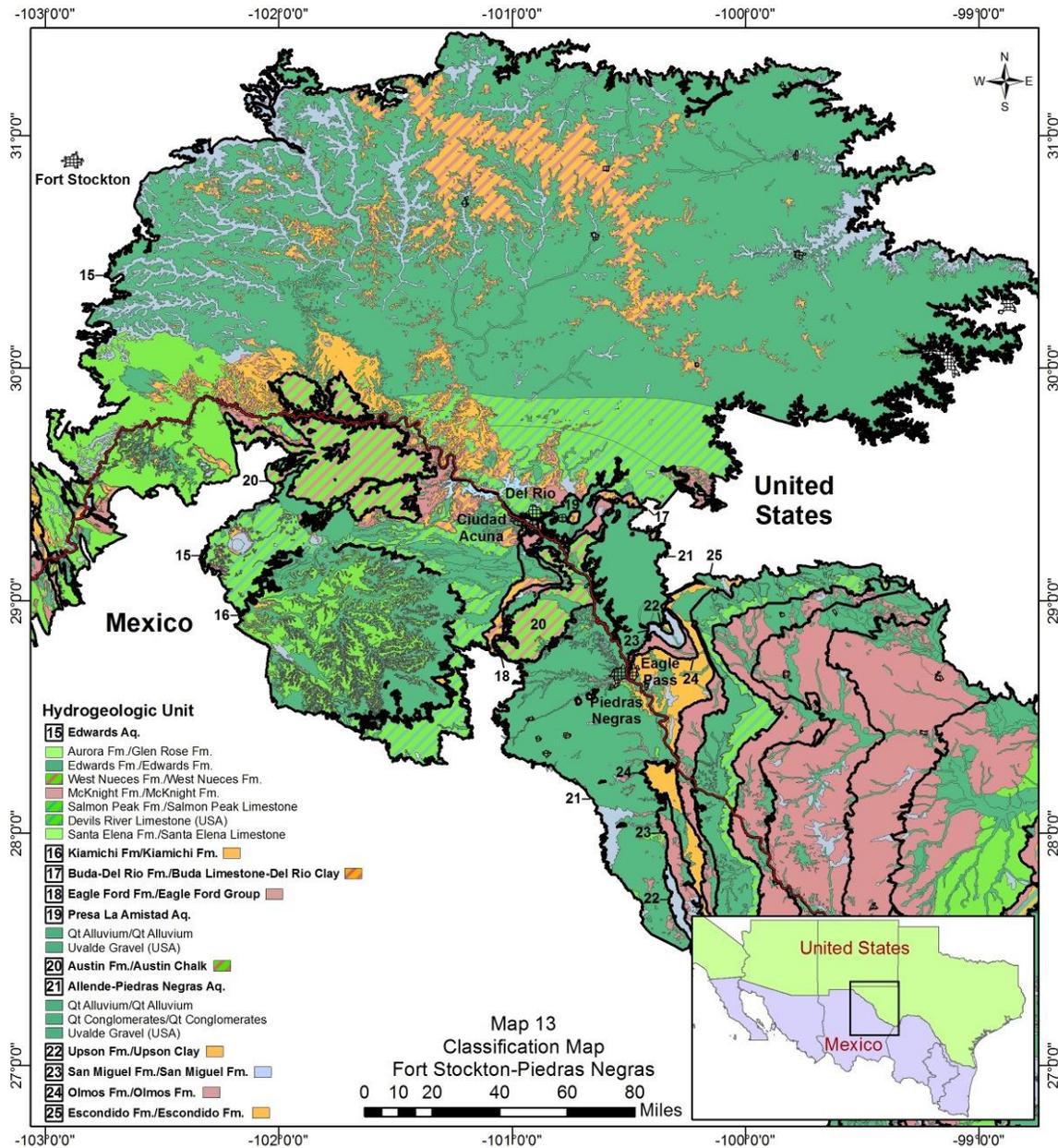
IDENTIFICATION OF HYDROGEOLOGICAL UNITS



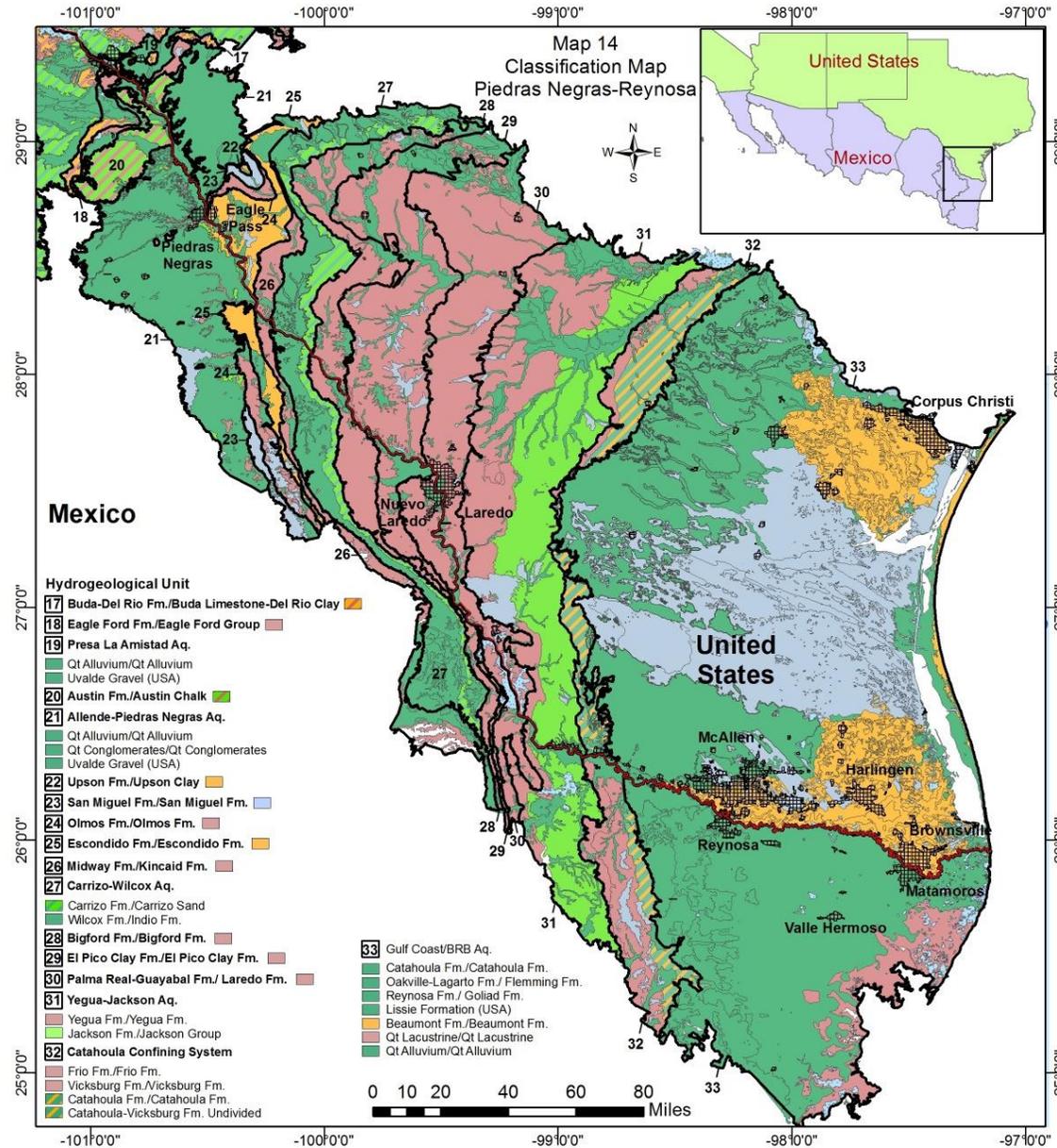
CLASSIFICATION OF HYDROGEOLOGICAL UNITS



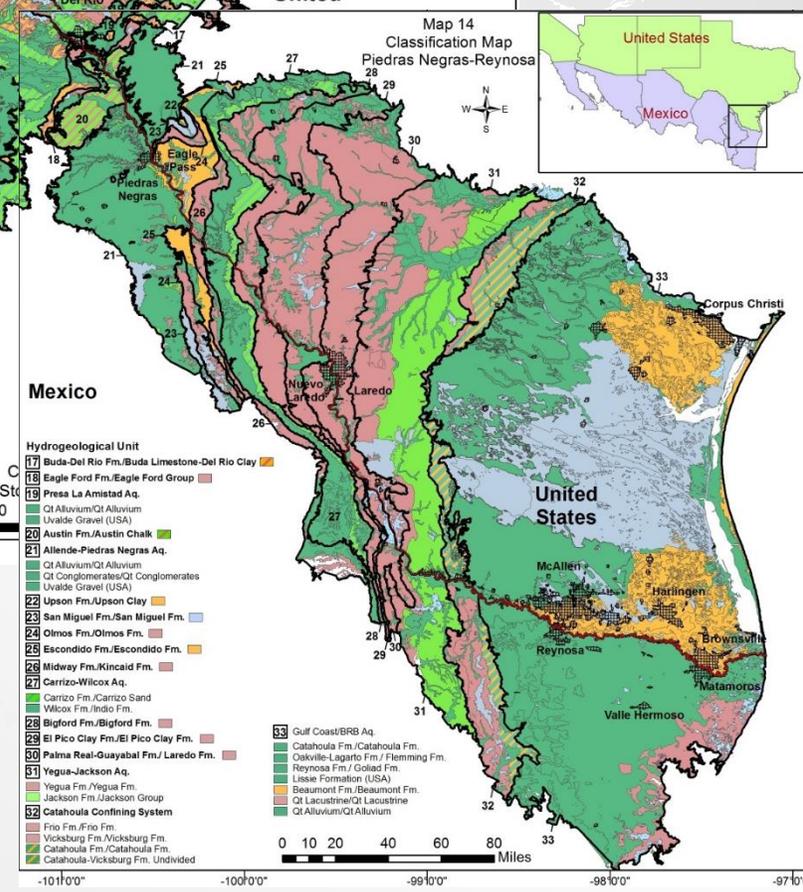
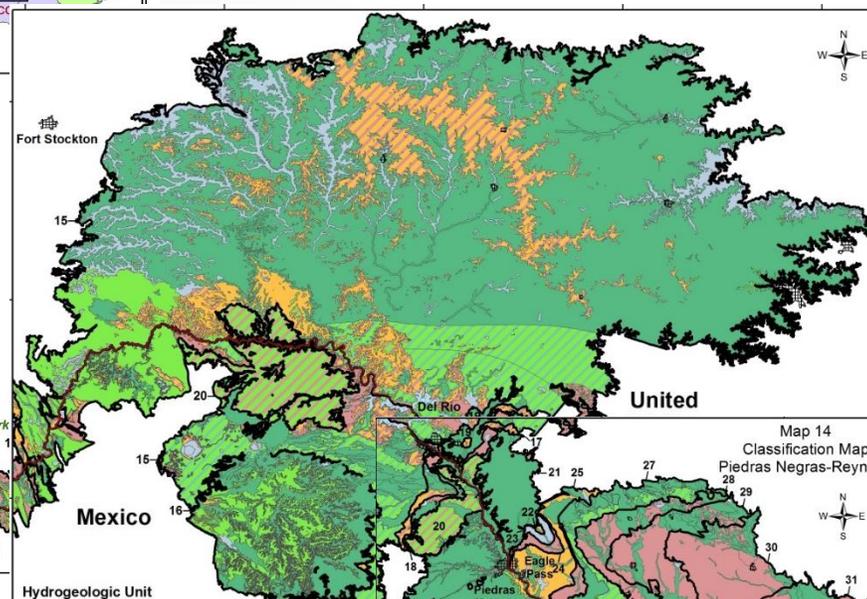
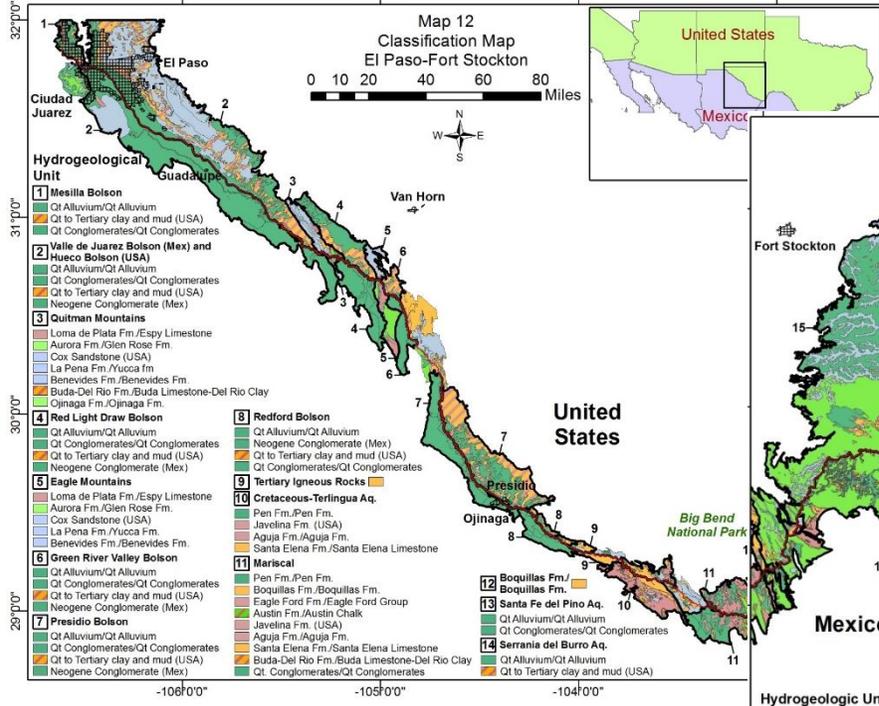
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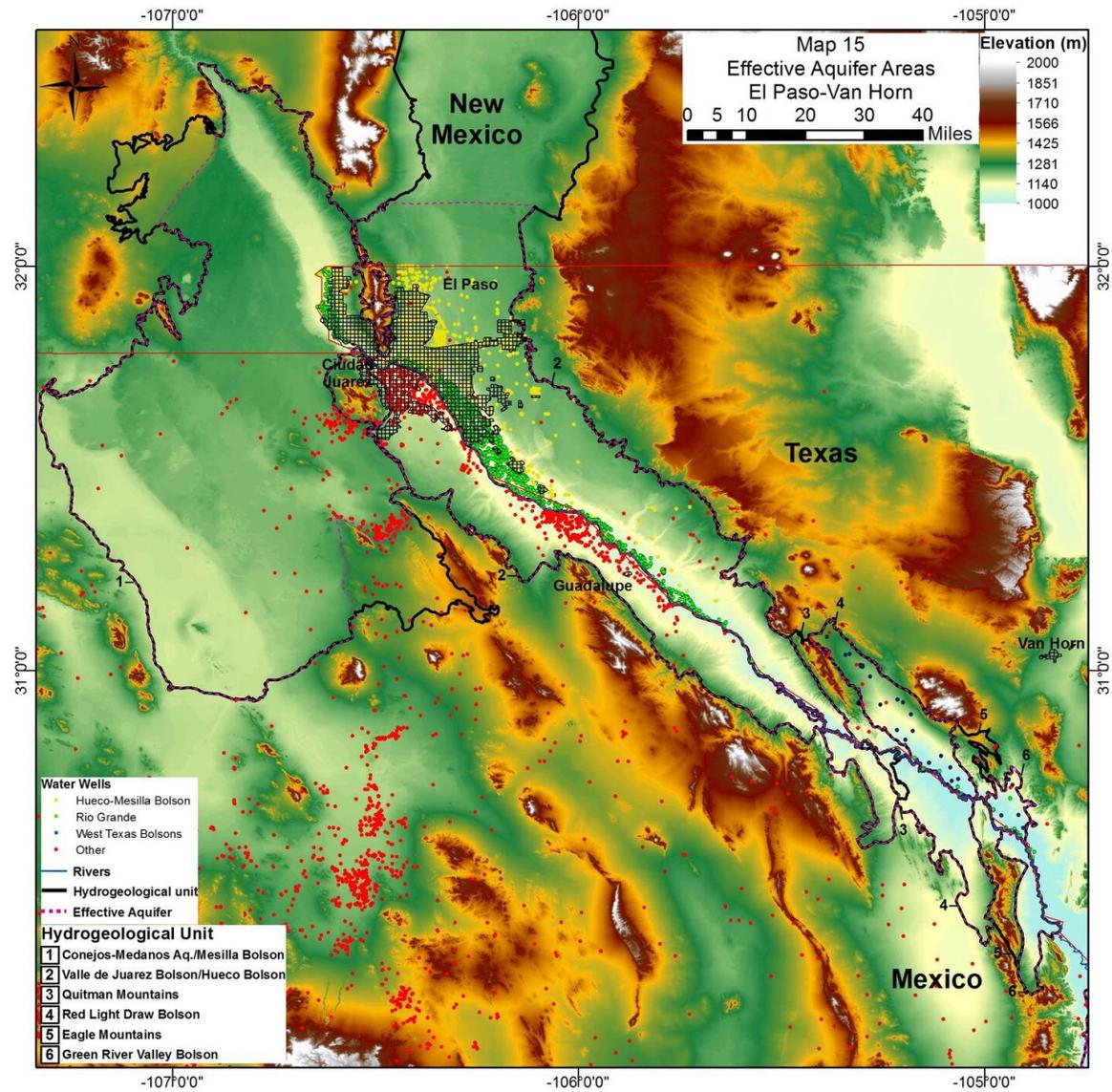


CLASSIFICATION OF HYDROGEOLOGICAL UNITS

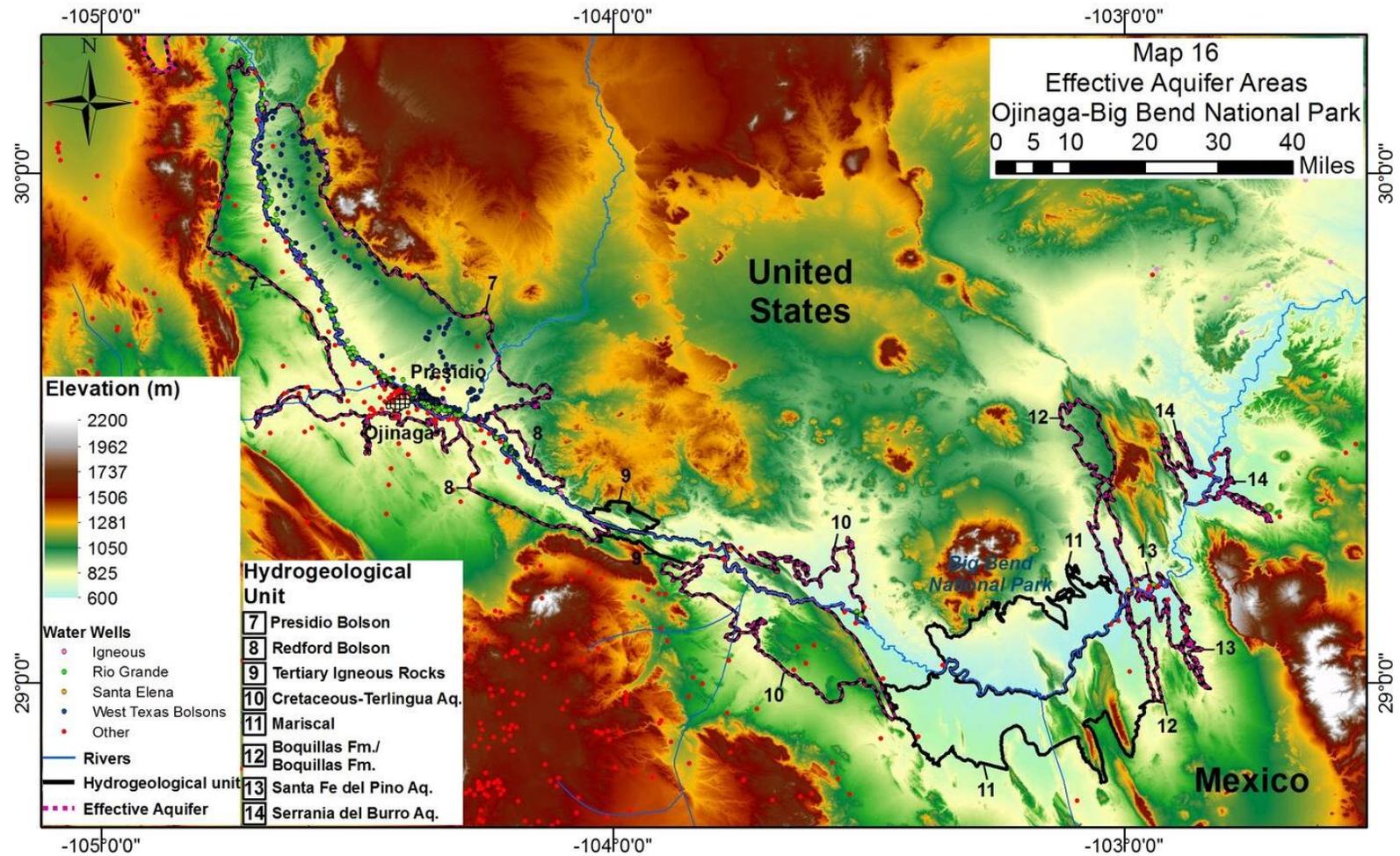


Formation Classification		Water Quality				
		Good	Regular	Poor	No Info	
Aquifer Potential	Good	A	A1	A2	A3	A4
	Middle	B	B1	B2	B3	B4
	Poor	C	C1	C2	C3	C4
	Aquitard	D	D1	D2	D3	D4
	No Info	E	E1	E2	E3	E4

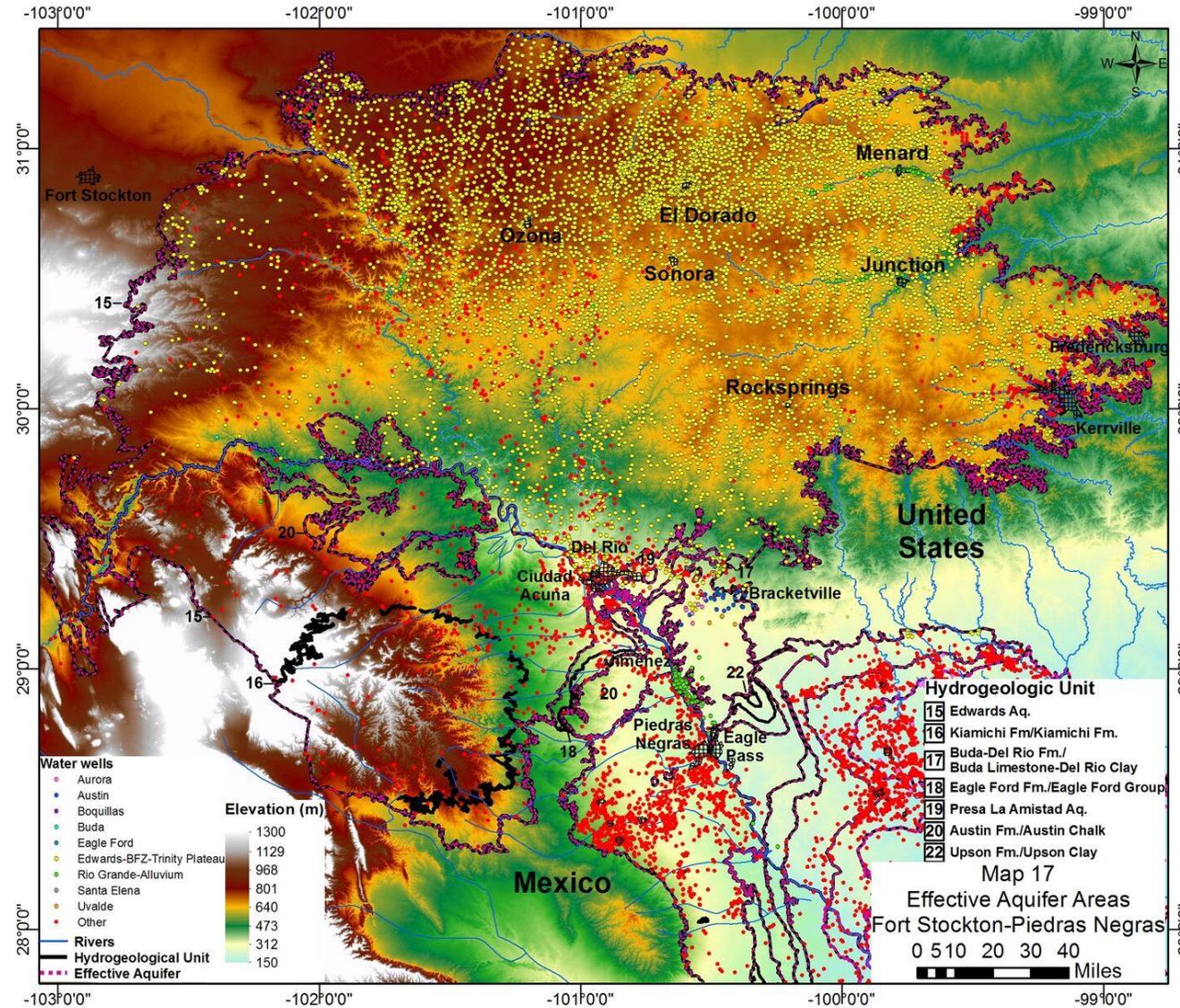
EFFECTIVE AQUIFER AREAS



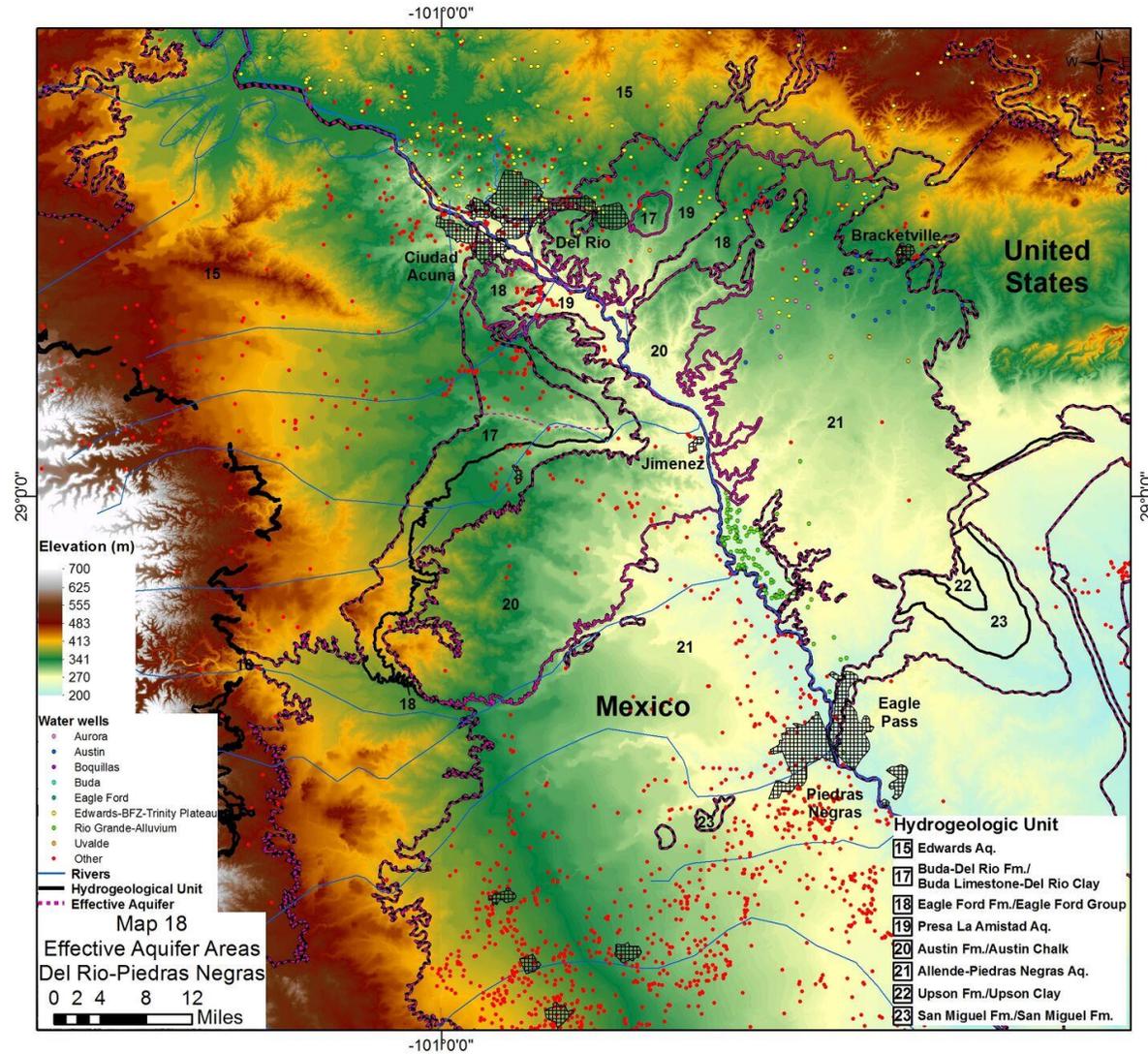
EFFECTIVE AQUIFER AREAS

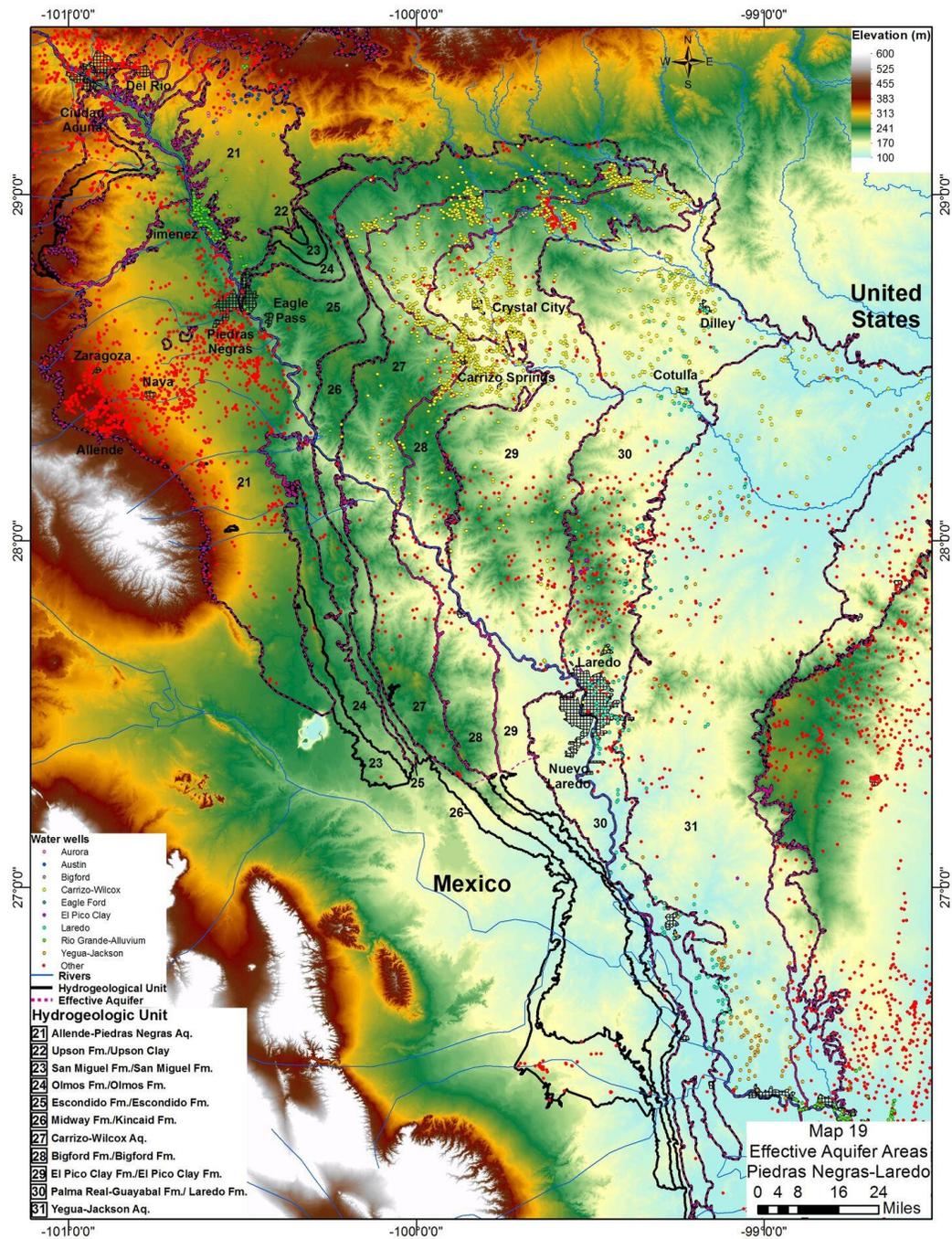


EFFECTIVE AQUIFER AREAS



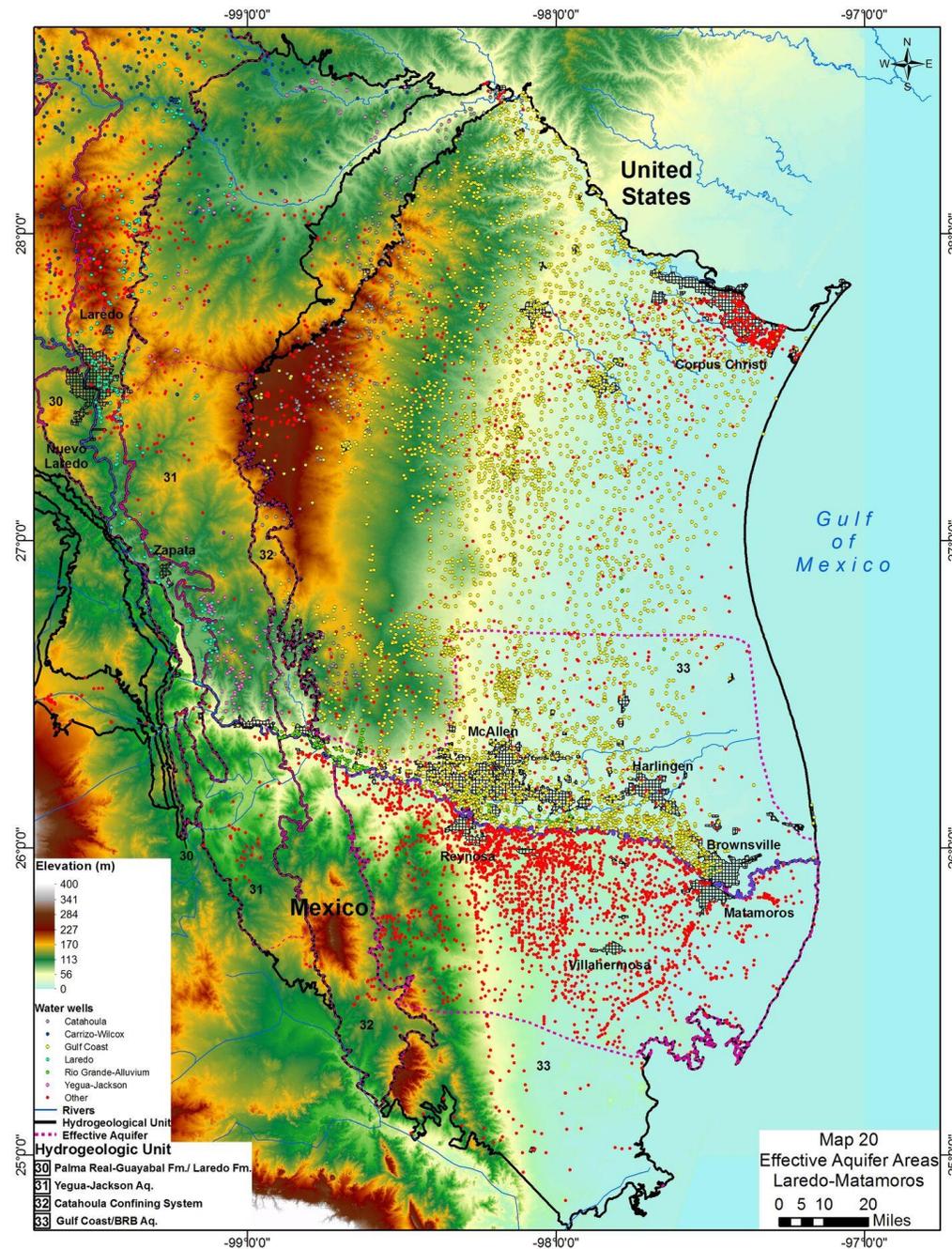
EFFECTIVE AQUIFER AREAS





EFFECTIVE AQUIFER AREAS

EFFECTIVE AQUIFER AREAS



THE TRANSBOUNDARY NATURE OF AQUIFERS or TRANSBOUNDARINESS

*“**The extent** to which aquifer riparians **prioritize** a particular aquifer over another and recognize **its value in the context** of economic, environmental, social, cultural, and legal institutional criteria”.*

*“A **function of the attention** that aquifer riparians give to a particular border aquifer **rather than a simple geographic or hydrologic exercise**”.*

*“The transboundary **elements related** to the aquifer drive and **extend its limits in different dimensions and at different scales**”.*

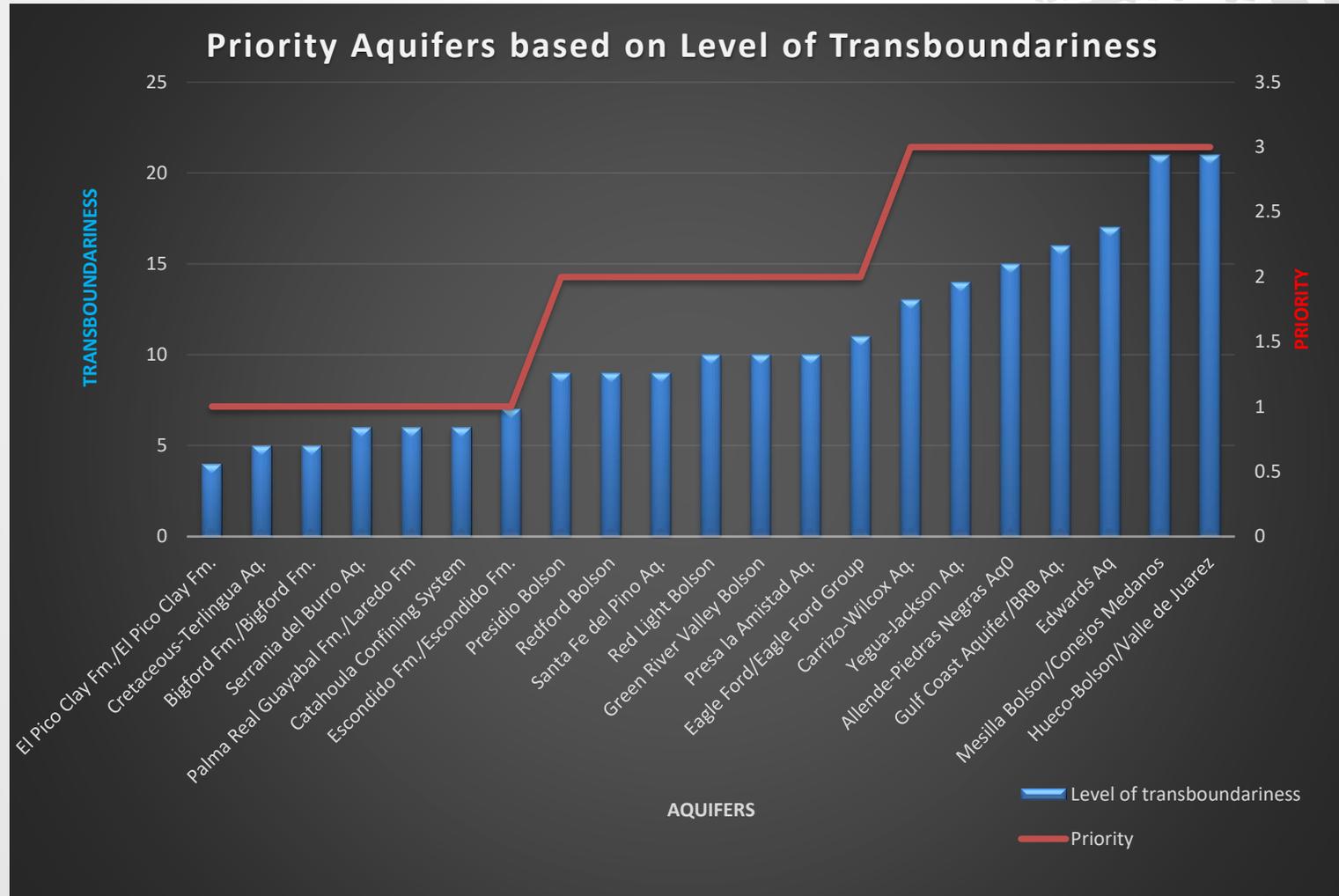
*“A **measure of the implications** of having and identifying and **aquifer that happen to be shared** by two or more countries”. (Sanchez & Eckstein, 2017)*

CRITERIA TO MEASURE THE LEVEL OF AQUIFER TRANSBOUNDARINESS

Score: 3 (high), 2 (med), 1 (low)

Aquifer										CRITERIA											
AQUIFER /UNIT	Population			GW Dependency (by any use)			Water Quantity/Quality Challenges			Data/Research Availability			Political Recognition (as transboundary)			Cooperation Efforts			Other Issues Governing the Agenda		
	High >400,000	Med around 200,000	Low < 100,000	High >70%	Med ÷ 40-60%	Low < 30%	High Deficit salinity contamination vulnerability	Med Deficit signs of contamination starting to appear	Low Not reported yet	Reasonable	Some or only on one side	Limited	Both countries	Partial, one country or part of another system	None	High binational and local level	Some local	Limited/ none	Highly visible	Some partial on one country	Limited

AQUIFER TRANSBOUNDARINESS



WHAT DOES THIS MEAN?

- New approach for aquifer identification, delineation and categorization
- New transboundary management alternatives
- Improve groundwater research on the border
- Improve transboundary water relationships between Texas and Mexico
- Promote cooperation & data exchange

A light gray map of North America, showing the outlines of the United States, Canada, and Mexico. The map is positioned in the background of the slide.

TRANSBOUNDARY AQUIFERS BETWEEN MEXICO AND THE US

Research update

Rosario Sanchez & Laura Rodriguez
Texas Water Resources Institute, Texas A&M University

Acknowledgement: USGS TAAP, Texas Agrilife Research, Texas A&M University