<u>Middle Pecos GCD Exhibit 1</u>

Middle Pecos GCD Board of Directors' Resolution

RESOLUTION
OF THE BOARD OF DIRECTORS OF THE
MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT
MEETING HELD JANUARY 21, 2025

A RESOLUTION REGARDING PETITION FOR INQUIRY

WHEREAS, the Board of Directors of the Middle Pecos Groundwater Conservation District (the "District"), upon proper notice, was briefed and took public comment under Agenda Item XII on its agenda, and understands that Cockrell Investment Partners, L.P. ("Cockrell") filed a Petition for Inquiry pursuant to Texas Water Code § 36.3011, complaining that the District has failed to adopt rules, and that any rules that may have been adopted are not designed to achieve desired future conditions and do not adequately protect groundwater in the management areas;

WHEREAS, the statutory relief sought by Cockrell is comprehensive, as set forth in Texas Water Code §§ 36.3011 and 36.303:

(1) TCEQ orders the District to take certain actions or refrain from taking certain actions;
(2) TCEQ dissolves the District's Board and calls an election to elect a new Board;
(3) TCEQ requests the Texas Attorney General to appoint a receiver to collect the District's assets and carry on its business;
(4) TCEQ dissolves the District; or
(5) TCEQ recommends that the Texas Legislature take action to accomplish comprehensive management in the District.

WHEREAS, the District's Board was further briefed that all districts within Groundwater Management Areas 3 and 7 received statutorily required notice of this petition, and that dozens of representatives of districts across the state, Texas Commission on Environmental Quality, Texas Water Development Board, and Texas Department of Licensing and Regulation, and legislative, hydrogeological, and legal professionals were made aware of Cockrell's petition during Texas Alliance of Groundwater Districts' Winter Speaker Series and Business Meeting held last week, January 15-16, 2025;

WHEREAS, the District's Board deliberated in public session and observed that Cockrell's petition was unwarranted and clearly an intent to collaterally attack Fort Stockton Holdings, L.P.'s permit and contractual arrangement with the Cities of Abilene, Midland and San Angelo, and to reurge its three petitions for rulemaking that the Board had substantial basis for denying;

WHEREAS, the District's Board recognized the gravity of the allegations and request for relief in the petition, and took action to direct its Board President and Vice President and General Manager to prepare a substantive response, and to memorialize the Board's strong support in opposition to the petition, by this resolution.

NOW THEREFORE BE IT RESOLVED THAT:

(1) The above recitals are true and correctly reflect the Board's position on Cockrell's petition.
(2) The Board's officers, General Manager, and legal counsel are further authorized to take any and all action necessary to implement this resolution.

AND IT IS SO ORDERED.

Upon motion duly made by Director Alvaro Mandujano, Jr., and seconded by Director Puja Boinpally, and upon discussion, the Board voted 8 in favor and — opposed, — abstained, and 3 absent, and the motion thereby PASSED on this 21st day of January, 2025.

MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT

by: Jerry McGuairt

Jerry McGuairt, Board President

ATTEST:

by: Janet Groth

Janet Groth, Board Vice President

<u>Middle Pecos GCD Exhibit 2</u>

Middle Pecos GCD General Manager Ty Edwards' Affidavit

TCEQ DOCKET NO. 2025-0373-MIS

RESTATED PETITION FOR INQUIRY SUBMITTED BY COCKRELL INVESTMENT PARTNERS, L.P. FOR REVIEW OF MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT	§ § § § § § § §	**BEFORE THE TEXAS COMMISSION ON ENVIRONMENTAL QUALITY**

MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT GENERAL MANAGER TY EDWARDS' AFFIDAVIT

BEFORE ME, the undersigned authority, on this day personally appeared Ty Edwards, who, being by me duly sworn, deposed as follows:

1. "My name is Ty Edwards. I am over the age of eighteen (18) years, have never been convicted of a felony or a crime of moral turpitude, and am of sound mind and competent to make this affidavit. I have personal knowledge of the facts contained herein, and the facts are true and correct. Where certain facts and representations are of a highly technical nature, I understand and agree with them, and have relied on the expert opinions of licensed hydrogeologists and engineers who are engaged by the Middle Pecos Groundwater Conservation District—what I'll call the District—they work with me on a daily basis and contribute to my work.

2. I am the General Manager of the District, a position I have held for over eight years, since January 2017. I was first hired by the District over 11 years ago in mid-December, 2013. I was initially hired by the former General Manager, Paul Weatherby, to serve as Assistant General Manager – there was an understanding that I had an opportunity to be trained and mentored and to step in to the General Manager position when Mr. Weatherby retired. Once he retired effective December 31, 2017, the Board took action to promote me to General Manager. I was born and raised on a ranch in Pecos County. Prior to my work at the District, I worked for several years with a local water well drilling company and became very experienced with the geology and aquifers within Pecos County, with Texas Department of Licensing and Regulation standards for well drilling, and with the role of the District.

3. I'm personally very involved with regional water planning and have been serving for several years as an appointed representative and voting member of the 32-county Region F Regional Water Planning Group. The work we do at Region F's group is related to the work by the designated representatives and

voting members within the Groundwater Management Areas – or GMAs. I am very familiar with both processes and involved with leadership in not only Region F, but both GMAs 3 and 7 that cover my District's boundaries. I make all meetings of Region F's planning group. We adopted the fifth 5-year plan in late 2020 and, as required by Senate Bills 1 and 2, are busy in this sixth cycle and our about to conduct a hearing on our next 5-year plan so that we can timely approve and submit it to the Texas Water Development Board.

4. In GMA 3, I serve as the Administrator and designated voting District Representative for my District. In this role, I take the lead with responsibility for coordinating, providing notices for, and running our GMA 3 joint planning meetings, and work closely with our consultant, Dr. Bill Hutchison, P.E., P.G. Our GMA 3 covers portions of six counties and the boundaries of two groundwater districts – including the southwest and north central portion of my District's boundaries. The remaining portion of our District is in GMA 7, which covers portions of 33 counties and the boundaries of 20 groundwater districts. I am the designated voting District Representative for my District in GMA 7, and coordinate closely with the Administrator and Dr. Hutchison who is also the lead consultant in that GMA. I attend all the GMA 3 and 7 meetings. Like with the regional planning groups, GMAs run in five-year cycles—we're in our fourth round of joint planning and on target in both GMAs 3 and 7 to meet our statutory deadlines of May 2026 for proposed DFCs and January 2027 for final DFCs.

5. There are several documents attached to my affidavit. I would like to confirm that they are authentic, and by this affidavit am doing so: I am familiar with the manner in which those records are created and maintained at the District given my duties and responsibilities as the District's General Manager. The attached business records were either created by the District or have been filed with or otherwise submitted to the District – we consider these documents to be public information and records of the District. It is the regular practice of the District to make these types of records at or near the time of each act, event, condition, or opinion set forth in each record, and it is the regular practice of the District for these types of records to be made by, or from information transmitted by, persons with knowledge of the matters set forth in them. These business records have been kept by the District in the regular course of business, in accordance with the Texas Public Information Act and the Local Government Records Act, and are attached to my affidavit as exact duplicates of the original."

Further affiant sayeth not.

SIGNED on this 7th day of April, 2025.

Ty Edwards, General Manager
Middle Pecos Groundwater
Conservation District

STATE OF TEXAS §
§
COUNTY OF PECOS §

SUBSCRIBED AND SWORN TO BEFORE ME on this 7th day of April, 2025.

GAIL REEVES
NOTARY PUBLIC
STATE OF TEXAS
NOTARY ID 13167190-2
MY COMM. EXP. 08-06-2026

Notary Public, State of Texas

Middle Pecos GCD Exhibit 3

Middle Pecos GCD Bylaws and Rules (September 27, 2000)

BY-LAWS AND RULES
OF THE
MIDDLE PECOS RIVER
UNDERGROUND WATER DISTRICT

In accordance with the Legislative Act, S.B. 1911, Article XVI, Section 59, of the Texas Constitution the following on the 27th day of September, 2000, were ratified and adopted. These are guides to be used with discretion and were adopted for the purpose of simplifying procedures and facilitating the administration of the District.

ESTABLISHMENT OF THE DISTRICT

Definitions:

(1) The "Board" shall mean the Board of Directors of the Middle Pecos River Underground Water District consisting of the temporary directors appointed by the Commissioners' Court of Pecos County; subsequent boards shall consist of equal representation from each precinct in the county plus one director from the City of Iraan, one from the City of Fort Stockton, and one at-large director not to exceed a total of 11 directors.

(2) The "District" shall mean the Middle Pecos River Underground Water District maintaining its office in Fort Stockton, Texas; where registrations, reports, and other papers are required to be filed with or sent to the District. The area includes the County lines.

(3) "Water" shall mean underground water.

(4) "Owner" shall mean and include any person, firm, partnership or corporation that has the right to produce water from the land either by ownership, contract, lease, easement, or any other estate in the land.

(5) "Person" shall mean any individual, partnership, firm, or corporation.

(6) The word "Waste" as used shall have the same meaning as defined by the Legislature.

REQUIREMENTS FOR THE BOARD AND PROCEDURES FOR MEETINGS

Candidates:
A person is qualified to serve on the Board who has filed an application with the secretary of the Board. It must be signed by the applicant or by at least 10 qualified electors of the District and filed 20 days prior to the election. In addition, a person must be a resident of the District for at least one year; at least 21 years of age; and not otherwise disqualified by Section 50.026, of the Texas Water Code, as amended.

Elections:
An election shall be held on the 1st Saturday in May (as dictated by Section 41.001. Uniform election dates, of the Texas Election Laws, as amended), every second year to elect the appropriate number of Directors to the Board.

Meetings:
The Board shall hold meetings as necessary to conduct the business of the District at the call of the Chairman or at the request of at least (2) of the Directors of the Board.
—a quorum is the majority of the Directors.
—the Board may elect its own officers yearly.

—meetings will be pre-announced and held in a suitable location.
—the Board will follow the Roberts Rules of Parliamentary Procedures.
—the Board may also act as a hearing Board concerning any disputes concerning the Rules and operations of the District.

POWER AND DUTIES OF THE DISTRICT

The District may exercise the powers, rights, privileges, and functions permitted by Chapters 51 and 52 of the Water Code, as amended, including authority to:

(1) make and enforce rules to provide for conserving, preserving, protecting, recharging, and preventing waste of water from the underground water reservoirs that may be enforced by injunction, mandatory injunction, or other appropriate remedies in a court of competent jurisdiction, or;
(2) require permits for the drilling, equipping, and completion of wells in the underground water reservoirs and issue permits subject to terms and provisions with reference to the drilling, equipping, and completion of the wells as may be necessary to prevent waste or conserve and protect the underground water;
(3) provide for the spacing of wells producing from the underground reservoirs and regulate the production from those wells to minimize as far as practicable the drawdown of the water table or reduction of the artesian pressure, provided, the owner of the land, his heirs, assigns and lessees are not denied a permit to drill a well on their land and the right to produce underground water from that well subject to rules adopted under this act;
(4) require records to be kept and reports to be made of the drilling, equipping, and completion of wells into any underground water reservoirs and the taking and use of underground water from those wells and a copy of those logs and of any electric logs that may be made of the wells to be filed with the District;
(5) acquire land for the erection of dams and for the purpose of draining lakes, draws and depressions, and construct dams, drain lakes, depressions, draws, and creeks and install pumps and other equipment necessary to recharge any underground water reservoirs;
(6) have made by registered professional engineers, surveys of the underground water of any underground water reservoir and of the facilities for the development, production and use of the underground water, determine the quantity of the underground water available for production and use and the improvements, developments, and recharges needed for those underground water reservoirs;
(7) develop comprehensive plans for the most efficient use of the underground water of any underground water reservoir and for the control and prevention of waste of that underground water, with the plans to specify in the amount of detail that may be practicable, the acts, procedures performance, and avoidance that are or may be necessary to effect those plans, including specifications;
(8) carry out research projects, develop information, and determine limitations, if any that should be made on the withdrawal of underground water from any underground water reservoir;
(9) collect and preserve information regarding the use of the underground water and the practicability of recharge of any underground water reservoir;
(10) publish plans and information. Bring them to the notice and attention of the users of the underground water within the District, and encourage their adoption and execution.

ADMINISTRATIVE PROCEDURES

Administrator and Employees:
The Board may employ a manager and set his salary. The Board may delegate any of its powers and duties (except those of adopting rules, a dissolution resolution, a dissolution order, and those relating to hearings, taxation and bonds) to the manager who may carry out the powers and duties delegated to him by the Board. Employment of personnel is subject to the general law on nepotism. The manager with the approval of the Board may employ employees of the Board and set their salaries, and hire legal counsel for the Board.
The manager, with approval of the Board, may develop a plan of work for the district, act as official liaison for the Board between the public and governmental agencies, and prepare budgets.
The manager's position shall be reviewed yearly at the beginning of the fiscal year.

AMENDMENT TO BY-LAWS

These By-Laws may be altered or amended or the same may be repealed by new By-Laws adopted at any regular or special meeting of the Board of Directors of the District, provided that no such action shall be taken at a regular or special meeting unless ten (10) days notice of the proposed alteration, amendment or repeal and a copy of proposed new By-Laws is submitted in writing to each of the Directors of the District with the Notice of such meeting. No such alteration, amendment or repeal of the By-Laws or the adoption of new By-Laws shall be valid unless the same shall be by the affirmative vote of at least a majority of all the Directors of the District.

DISSOLUTION OF THE DISTRICT

Chapter 52 of the Water Code, as amended, applies to dissolution of the District.

Glenn Honaker

Glenn Honaker, Chairman

Mike Jernigan

Mike Jernigan, Vice-Chairman

Lee Harris

Lee Harris, Secretary/Treasurer

John Dorris

John Dorris, Director

Len Bennett

Len Bennett, Director

Middle Pecos GCD Exhibit 4

Minutes of March 27, 2000 Pecos County Commissioners Court Meeting

MINUTES OF THE COMMISSIONERS' COURT

On this the 27th day of March 2000 and the time posted for a Regular Session of the Commissioners' Court of Pecos County, Texas in the Courtroom of the Pecos County Courthouse, Fort Stockton, Texas with the following members present, to-wit:

Hon. Delmon Hodges	County Judge
Gregg McKenzie	Commissioner Pct. 1
Tony Villarreal	Commissioner Pct. 2
Linda Webb	Commissioner Pct. 3
Paul Valenzuela	Commissioner Pct. 4
Kriste Burnett	County Attorney
Trish King	Deputy Clerk

Upon motion by Commissioner Valenzuela, seconded by Commissioner Webb, and carried, it was ordered to approve the minutes of the previous meeting as presented by the County Clerk.

Upon motion by Commissioner Webb, seconded by Commissioner Villarreal, and carried, it was ordered to approve the payment of overtime as submitted by the County Treasurer.

Upon motion by Commissioner Webb, seconded by Commissioner Villarreal, and carried, it was ordered to approve the Financial Report presented by the County Treasurer.

Upon motion by Commissioner Villarreal, seconded by Commissioner Valenzuela, and carried, it was ordered to approve the Line Item Transfers as presented by the County Auditor and shown on Page 671.

Upon motion by Commissioner Valenzuela, seconded by Commissioner Webb, and carried, it was ordered to approve the County Auditor's Report of various offices as shown on Page 673.

Upon motion by Commissioner Valenzuela, seconded by Commissioner McKenzie, and carried, it was ordered to approve the Financial Report presented by the County Auditor.

Upon motion by Commissioner McKenzie, seconded by Commissioner Valenzuela, and carried, it was ordered to approve all accounts presented to the Court. Commissioner Villarreal abstained from any bills pertaining to Carlson Wagonlit Travel.

Upon motion by Commissioner McKenzie, seconded by Commissioner Webb, and carried, it was ordered to table any action regarding the presentation of West Texas Internet Services until a later date.

Upon motion by Commissioner Webb, seconded by Commissioner Valenzuela, and carried, it was ordered to approve the service agreement with Iraan/Sheffield Little League Association, shown on Page ________.

Upon motion by Commissioner Valenzuela, seconded by Commissioner Webb, and carried, it was ordered to table awarding the bids submitted for materials for CDBG Project #719641 in Precinct #4 until the next session.

Bids submitted are as follows:

Morrison Supply Co. Odessa, Texas	$233,799.65
Western Industrial Supply Odessa, Texas	$231,672.05
Sims Plastics Inc. Odessa, Texas	$256,749.82

Upon motion by Commissioner Valenzuela, seconded by Commissioner Villarreal, and carried, it was ordered to approve the request of Pecos County Water Improvement District #1 to submit application for year 2001 Community Development Block Grant Program (CDBG) funds for water improvement.

Upon motion by Commissioner Valenzuela, seconded by Commissioner McKenzie, and carried, it was ordered to appoint temporary members to the Board of the Middle Pecos River Underground Water District as follows:

Lee Harris	Glenn Honaker	John Dorris	Len Bennett
Randy Peterson	Mike Jerigan	Ben Webb	

Upon motion by Commissioner Webb, seconded by Commissioner McKenzie, and carried, it was ordered to allow the County Judge to send correspondence to Duncan Disposal regarding a 3% increase in their contract, which the Commissioner's would not approve.

Middle Pecos GCD Exhibit 5

Minutes of February 19, 2013 Middle Pecos GCD Board of Directors Meeting

Middle Pecos Groundwater Conservation District
Minutes of February 19, 2013

On this the 19th day of February, 2013, public hearings and a regular board meeting was held by the Middle Pecos Groundwater Conservation District in the office located at 405 North Spring Drive, Fort Stockton, Texas, with the following members present, to-wit:

Glenn Honaker	President, Precinct 1
John Dorris	Vice President, Precinct 3
M. R. Gonzalez	Secretary/Treasurer, Precinct 2
Janet Groth	Precinct 1
Merrell Daggett	Precinct 2
Weldon Blackwelder	Precinct 3
Alvaro Mandujano, Jr.	Precinct 4
Ronald Cooper	Precinct 4
Vanessa Cardwell	Fort Stockton, City of
Evans Turpin	Iraan, City of
Terry Whigham	At Large

Quorum Present.

Others present: Paul Weatherby, Allan Standen, Melissa Mills, Harvey Gray, Yaraniz Lujan, Craig Pearson, Rocky Rives, Randy Braden, Zach Brady, Ed McCarthy, Jeff Williams, Brock Thompson, Gary Drgac, , Alan Murphy, Raul Rodriguez, Stefan Schuster, Joe Shuster, Schuyler Wight, Bill Lannom, Joe Grimes, Rodger Bowers, Jerry McGuairt and Shawn Yorks.

REGULAR BOARD MEETING AGENDA

I Call to order at 1:02 p.m. by President Glenn Honaker

II Consider and act on letter of **resignation from Glenn Honaker**
Glenn Honaker presented a letter of resignation to the Board. Reason: Moving out of Precinct 1. Weldon Blackwelder made a motion to accept the resignation of Glenn Honaker, seconded by Alvaro Mandujano, Jr. Motion carried.

Note: At this time, Glenn Honaker joined the audience, and Vice President John Dorris lead the meeting.

III Consider and act to **fill Board vacancy** in Precinct 1
Jerry McGuairt was present as a candidate for appointment to the open position for the Precinct 1 director. The term of the appointment will expire at the regular election for Directors in November 2014.

Merrell Daggett made a motion to appoint Jerry McGuairt to the position for Precinct 1 director; seconded by Evans Turpin; motion carried with one abstention.

Jerry McGuairt completed the *Statement of Officer*, and the *Oath of Office* was administered by John Dorris and notarized by Melissa Mills.

IV Consider and act on repealing and/or amending **District's bylaws**

Alvaro Mandujano, Jr. made a motion to table this agenda item until the next regular meeting. Seconded by Terry Whigham. Motion carried.

V Consider and act on **Board Officer positions** for 2013

Vanessa Cardwell made a motion to table this agenda item until the next regular meeting. Seconded by Merrell Daggett. Motion carried.

Note: Agenda Items are *Out of Sequence.* The minutes reflect the order in which they were addressed by the Board.

VII Presentation of **District auditor's report on financials for Fiscal Year 10-01-2011 through 09-30-2012 and act to approve auditor's report**

Rocky Rives with Smith and Rives, PC Certified Public Accountants presented the audit to the Board and answered all questions. The opinion rendered is the financial statements present fairly, in all material respects, the respective financial position of the governmental activities, the major fund, and the aggregate remaining fund information of the MPGCD, as of September 30, 2012, and the respective changes in financial position thereof for the year then ended in conformity with accounting principles generally accepted in the United States of America. There are no findings that require disclosure or corrective action in the audit report. Mr. Rives recommended a depository contract be made with our bank.

Merrell Daggett made a motion to approve the Audit for Fiscal Year 10-01-2011 through 9-30-2012 as presented. Seconded by Weldon Blackwelder. Motion carried.

VI Consider and act upon **Randy Braden's Motion for Rehearing**

Mr. Braden requested a rehearing on the Board's decision issued on January 15, 2013, and requested reconsideration of the conditions imposed on the permit. Mr. Braden is represented by Zach Brady of Brady and Hamilton, LLP.

M. R. Gonzalez made a motion to grant the rehearing. Seconded by Alvaro Mandujano, Jr. Vote: Ayes: 9 Nays: 2 Motion carried.

VIII Recess from Regular Board Meeting to conduct public hearings

AT 1:35 PM the Board recessed from the regular meeting, and moved into the Public Hearings.

POSSIBLE REHEARING ON PRODUCTION PERMIT APPLICATION
FILED BY RANDY BRADEN

I Call to Order at 1:36 PM by John Dorris, Vice President

II Public Hearing on **Randy Braden's Production Permit Application**

Parties Representing Mr. Braden: Mr. Randy Braden and Mr. Zach Brady

Mr. Zach Brady, Randy Braden's lawyer, was given the floor. He was sworn in by John Dorris, Vice President.

Three issues with the conditions imposed on the permit on January 15, 2013.
Issue One: He is seeking relief from the permit condition requiring an Insta-Flow meter on each producing well prior to commencing irrigation in 2013. Mr. Braden currently has existing meters on his drip irrigation system to accurately measure the groundwater produced. He agrees to report his monthly usage to the District.
Issue Two: The permit condition that requires plugging of "Abandoned" wells. There are several older wells on the property. They are equipped with a pump, functional casing, and pump column. The wells are not deteriorated and not abandoned. Mr. Braden requests that the District allow these wells to be capped in accordance with TDLR standards when they are not in active use. The two wells are SW1 and SW2.

Issue Three: Mr. Braden requests the ability to produce 940 acre-feet for his crops, as he originally applied for. The Board decision granted 800 acre-feet on January 15, 2013.

Allan Standen, MPGCD hydrogeologist, stated that we would be unable to differentiate between the aquifers to determine which aquifer was being pumped from. Stratigraphy shows Pecos Valley and Edwards/Trinity dual aquifers in his location. The screened interval covers both aquifers and the waters comingle.

Other statements were made by: Randy Braden, Gary Drgac and Dr. David Pearson

III Adjourn Janet Groth made a motion to adjourn the hearing. Seconded by Merrell Daggett. Motion carried and the hearing adjourned at 2:20 PM.

SHOW CAUSE HEARING ON ALLEGED VIOLATION OF DISTRICT'S RULES BY ACOSTA DRILLING

I Call to Order at 2:25 PM by John Dorris, Vice President

II Show Cause Hearing on alleged violations of District's Rules by Acosta Drilling

Party representing Acosta Drilling: No one in attendance.

On January 16, 2013 Victor M. Acosta, Jr. with Acosta Drilling out of Lamesa, Texas was sent via Priority Mail of the U.S. Postal Service with Delivery Confirmation by Return Receipt Requested, a notice of alleged violation of the rules of the Middle Pecos Groundwater Conservation District. Note: The notice was returned to MPGCD unclaimed.

BASIS OF VIOLATION: The District has reason to believe that Acosta Drilling has drilled one or more wells without authority and without complying with drilling and reporting requirements of District Rules 11.1 and 13.1. The District has no record of receiving the required drilling approval form or the required well log report. **If** this information is correct, then Acosta Drilling is in violation of these rules. Rule 11.1(a) states that "no person may drill, operate, equip, complete, or alter the size of a well or well pump without first obtaining a permit (nonexempt wells) or approved pre-registration (exempt wells)." Rule 13.1(b) states that "the driller of any exempt or nonexempt well shall file with the District the well log required by Section 1901.251, Texas Occupations Code, and, if available, the geophysical log and electric log." Acosta Drilling has failed to respond to informal requests by the District dated 11-30-2012, 12-11-2012, and 01-02-2013.

Paul Weatherby: The only response from Acosta Drilling was on 01-31-2013,and that is when we were sent two drilling reports on Randy Braden.

III Adjourn Merrell Daggett made a motion to adjourn the hearing. Seconded by Ronald Cooper. Motion carried and the hearing adjourned at 2:35 PM.

HEARING ON PRODUCTION PERMIT APPLICATION FILED BY SCHUYLER WIGHT

I Call to Order at 2:32 PM by John Dorris, Vice President

II Public Hearing on **Schuyler Wight's Production Permit Application**

Mr. Schuyler Wight submitted an application for a production permit on 10/15/2012. He is requesting 999 acre feet annually from the Edwards/Trinity aquifer. The three wells are located on Survey T&PRR, Block 48, TSP 10, Section 21 N/2. The use is for irrigation on his farm.

Mr. Wight was present. There were no questions or comments from the public or the board.

III Adjourn Ronald Cooper made a motion to adjourn the hearing. Seconded by Weldon Blackwelder. Motion carried and the hearing adjourned at 2:35 PM.

HEARING ON RESUBMITTED DRILLING PERMIT APPLICATION FILED BY CITY OF FORT STOCKTON

I Call to Order at 2:36 PM by John Dorris, Vice President

II Public Hearing on **City of Fort Stockton's Resubmitted Drilling Permit Application**

Party representing City of Fort Stockton: Raul Rodriguez & Stefan Schuster

Paul Weatherby: This is a resubmission of the original drilling application. The resubmission was received and posted on 02-08-2013. The bid package is unchanged.

Raul Rodriguez and Stefan Schuster were sworn in by John Dorris.

Question: Why so many changes?

Stefan Schuster: We have cooperation from Fort Stockton Holdings, and feel more secure hitting the aquifer in section 112, which is better for spending one million dollars to drill a test well. There is potential for a monitor well on Fort Stockton Holdings' section 111 right on the property line near the SE corner of 112.

III Adjourn Vanessa Cardwell made a motion to adjourn the hearing. Seconded by Merrell Daggett. Motion carried and the hearing adjourned at 2:46 PM.

The Board recessed at 2:46 PM.

IX Reconvene meeting at 3:02 PM.

Paul Weatherby introduced Shawn Yorks, he is new to the staff of the Fort Stockton Pioneer newspaper.

XII Consider and act upon **Randy Braden's Permit Application**

After lengthy discussions, Vanessa Cardwell made a motion to grant the production for the original 940 acre feet as requested. We will monitor the 2 meters with monthly reporting with the existing meters. Wells SW1 and SW2 are to be plugged according to TDLR standards within 6 months, with a report to Paul Weatherby on the status of the plugging within 4 months. The motion was seconded by Merrell Daggett. Jerry McGuairt abstained. Motion carried.
Vote: <u>10 For</u>, <u>1 Abstain</u>

Note: Terry Whigham left the meeting at 3:47 PM.

XVI Consider and act upon **Schuyler Wight's Production Permit Application**
Evans Turpin made a motion to approve the production permit for 999 acre feet annually from the Edwards/Trinity aquifer. The three wells are located on Survey T&PRR, Block 48, TSP 10, Section 21 N/2. The use is for irrigation. Seconded by Merrell Daggett. Janet Groth and Jerry McGuairt abstained.
Vote: <u>8 For</u>, <u>2 Abstain</u>, <u>1 Absent</u>. Motion carried.

XVII Consider and act upon **City of Fort Stockton's Drilling Permit Application**
Merrell Daggett made a motion to approve the drilling of the test well on section on 112 as originally presented. The permit granted on 01-19-2013 for section 71 is now void. Seconded by Alvaro Mandujano, Jr. Jerry McGuairt abstained.
Vote: <u>9 For</u>, <u>1 Abstain</u>, <u>1 Absent</u>. Motion carried.

X Comments from **public and media** (limit 5 minutes per person) None

XV Consider and act on **alleged violations by Acosta Drilling**, and consider and act on appropriate penalty or other enforcement remedy to be imposed or pursued in court

Merrell Daggett made a motion to levy a $5,000 fine for 2 violations with a 30 day time limit. Violation of District rule 11.1a. Seconded by Vanessa Cardwell. Motion carried unanimously.

XIII **Executive/Closed Session** to address personnel matters and to consult with legal counsel

Vice President Dorris called an executive session at 4:09 PM for the purposes authorized under the Texas Open Meetings Act, V.T.C.A., Government Code, Chapter 551.071 to consult with attorney and Chapter 551.074 personnel matters.

Note: Alvaro Mandujano, Jr. left the meeting @ 5:00 PM. A quorum remained.

The meeting reconvened into open meeting at 5:05 PM and Mr. Dorris stated that no decisions were made in executive session

XIV Consider and take action on **personnel and staffing matters discussed during Executive Session**
Tabled

XI Consider and act on **Minutes of** December 18, 2012, and January 15, 2013

Merrell Daggett made a motion to approve the minutes of December 18, 2012. Seconded by Weldon Blackwelder. Motion carried.

Merrell Daggett made a motion to approve the minutes of January 15, 2013. Seconded by Janet Groth. Motion carried.

XVIII Update on **developments with Groundwater Management Area 3** (recent meeting, future work and meetings)

Tabled

XIX Consider and act on Texas Commission on Environmental Quality's work and report on **Priority Groundwater Management Areas**

Tabled.

XX Review developments regarding potential formation of groundwater conservation districts or expansion of boundaries of existing groundwater conservation districts within Groundwater Management Areas 3 and 7

Tabled.

XXI Discuss and review **US Fish and Wildlife Service's proposed rule regarding the listing of six west Texas aquatic invertebrate species as endangered species** and recent Federal Register notice and issuance of draft economic assessment

The U. S. Fish and Wildlife Service will have a public hearing on February 21, 2013, at the Balmorhea State Park in Toyahvale, Texas, to discuss a draft economic analysis for the proposed critical habitat for the Phantom Cave snail, Phantom springsnail, diminutive amphipod, Diamond Y Spring snail, Gonzales springsnail and Pecos amphipod. The draft economic analysis provides estimated costs of the foreseeable potential economic impacts of the proposed critical habitat designation for the six west Texas invertebrates over the next 20 years.

MPGCD attorney Mike Gershon prepared a statement to be read into the record at the public hearing on February 21st. A summary of the comments:

- MPGCD opposes listing the Diamond Y Spring Snail, the Gonzales Spring Snail and the Pecos Amphipod.
- MPGCD points out that USFWS is uncertain and applies presumptions and assumptions in reaching its conclusions.
- MPGCD recognizes that USFWS relies heavily on Radu Boghici at TWDB. We believe that Radu can clarify his comments to USFWS and help us figure out the problem in a better way.
- MPGCD emphasizes that there is an “adequate regulatory mechanism” in place – our DFCs, and our Management Plan. Although they criticize the current DFCs and MP, they don’t criticize the process. We invite them to engage in our GMA process and MP hearings. So far, they have not done so. That process works, and MPGCD has a lot of authority over groundwater regulation.

MPGCD hydrogeologist Allan Standen has reviewed two thesis on the Diamond Y Springs and believes we can claim and present a case that the Rustler is not the only aquifer contributing to the Diamond Y Springs.

A representative of the MPGCD will go and submit the comments for the record.

XXII Consider and act upon **Accounts Payable and Treasurer’s Report and Line Item Transfers for the Months Ending 12-31-2012 and 01-31-2013**

Ronald Cooper made a motion to approve the accounts payable and treasurer’s report for 12-31-2012. Seconded by M. R. Gonzalez. Motion carried.

Janet Groth made a motion to approve the accounts payable and treasurer’s report for 01-31-2013. Seconded by Merrell Daggett. Motion carried.

XXIII Consider and act upon **Depository Contract with Pecos County State Bank and approve Directors on Signature Card**

Ronald Cooper motioned that MPGCD set policy and strategy to invest District funds in Demand Deposit accounts, Certificates of Deposit and other interest-bearing bank accounts at Pecos County State Bank in compliance with the Public Funds Investment Act for the next 12 months.

No action on a director for the signature on the accounts.

XXIV Consider and act upon **Progress Reports: Well Registrations, Production Permits, Drilling Permits, Data Loggers, ongoing Water Quality Analysis and Legislative Update**

Tabled

XXV **Consider and act upon General Manager's 2012 Annual Report**

Tabled

XXVI **General Manager's Correspondence and Report**

Tabled

XXVII **Directors' comments**

None

XXVIII Consider and/or act upon **agenda for next meeting**

- Executive session on personnel
- Acosta Drilling
- All of today's tabled items.

XXIX **Adjourn** Merrell Daggett made a motion to adjourn, seconded by Janet Groth. The motion carried, and the meeting adjourned at 5:29 PM.

____________________________ ____________________________

Secretary/Treasurer President

Date Approved ____________________

Middle Pecos GCD Exhibit 6

Minutes of May 19, 2020 and June 16, 2020 Middle Pecos GCD Board of Directors Meeting

MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT

P.O Box 1644 Fort Stockton, TX 79735 Phone (432)336-0698 Fax (432)336-3407
405 North Spring Drive Fort Stockton, Texas 79735
Email: mpgcd@mpgcd.org Website: www.middlepecosgcd.org

MINUTES OF REGULAR BOARD MEETING
HELD BY VIDEOCONFERENCE AND TELECONFERENCE

May 19, 2020

In accordance with Governor Abbott's declaration of the COVID-19 public health threat and action to temporarily suspend certain provisions of the Texas Open Meetings Act, a quorum of the District's Board of Directors held its regular Board meeting by videoconference call. The public was invited to join this meeting by way of videoconference. Members of the public wishing to make public comment during the meeting were able to register by emailing mpgcd@mpgcd.org prior to 9:30 a.m. on May 19, 2020. A copy of the agenda packet was made available on the District's website at the time of the meeting.

On this the 19th of May, 2020, a Regular Board Meeting was held by the Middle Pecos Groundwater Conservation District with the following members' present:

Jerry McGuairt	President, Precinct 1
M. R. Gonzalez	Prec. 2, Secretary/Treasurer
Allan Childs	At Large
Janet Groth	Vice President, Precinct 1
Puja Boinpally	Precinct 2
Weldon Blackwelder	Precinct 3
Vanessa Cardwell	City of Fort Stockton
Jeff Sims	City of Iraan (Joined in at Executive Session)

Quorum Present.

Members Absent: Larry Drgac, Ronnie Cooper, and Alvaro Mandujano, Jr.

District employees participating: Ty Edwards, Anthony Bodnar, and Melissa Mills.

Others attending via Videoconference: Mike Gershon, Geoff Pike, Buck Benson, Glenn Honaker, Ryan Reed, Kaveh Khorzad, Jeff Williams, Ed

McCarthy, Jr, Brock Thompson, Gary Bryant, Mel Riggs, Mark Tisdale, Darrell Peckham, Zachary Swick, Kirby Warnock, Jason Hill, Jim Cravens, James Craven, Carl Craigo, Collin Wood, Scott Hibbs, Allison Strube, Mark Harral, and someone showing up as PCWC3.

REGULAR BOARD MEETING

I Call to order regular Board meeting at 10:04 a.m. by President Jerry McGuairt.

II Comments from **public and media**: None at this time—Kirby Warnock allowed to make comment under Agenda Item VI.

III Consider and/or act upon **Minutes of Regular Meeting on March 24, 2020**. Allan Childs made a motion to approve the minutes of March 24, 2020, as presented. Motion seconded by M. R. Gonzalez. Motion carried.
Vote: 8 For. -0- Against. 3 Absent.

IV Consider and/or act upon **Treasurer's Report for the Month Ending March 31, 2020.**

Janet Groth made a motion to approve the Treasurer's Report for the month ending March 31, 2020 as presented. Motion seconded by Allan Childs. Motion carried. Vote: 8 For. -0- Against. 3 Absent.

V Consider and/or act upon **Treasurer's Report for the Month Ending April 30, 2020.**

Allan Childs made a motion to approve the Treasurer's Report for the month ending April 30, 2020 as presented. Motion seconded by Janet Groth. Motion carried. Vote: 8 For. -0- Against. 3 Absent.

VI Briefing and take action as necessary regarding **7D area and continued Kent and Luna permit hearings.**

No substantial update. Mr. Luna has moved in a 'poly tank' and hauls water to the tank for his domestic use. Mr. Kent has hooked up to one of Jerry Gordon's wells for his water.

Pecos County WCID#1 update from Kristen Fancher is that the title insurance company out of Florida has hired a Texas title attorney.

Public Comment: Kirby Warnock voiced concern about 40 to 50 more requests for water well drilling in this same area that could possibly be submitted.

Note: The following agenda items (IX and X) were taken up in an order different than what was posted. The items in the minutes appear in the order in which they were considered.

IX Consider and/or act upon participation in the **Groundwater Management Area 7 donation to the 4-H Ambassador Program of $250.**

The 4-H Water Ambassadors gain advance knowledge and develop leadership skills related to the science, technology, engineering and management of water in Texas. 4-H Water Ambassadors accept the responsibility of educating youth and adults in their communities and beyond. They are committed to advancing their understanding of water throughout their term of service.

Our contribution of $250 will be combined with 22 other Groundwater Conservation Districts in Groundwater Management Area 7 for a combined $5,000 sponsorship level.

Janet Groth made a motion to approve the participation in the Groundwater Management Area 7 donation to the 4-H Water Ambassadors Program in the amount of $250. Motion seconded by Puja Boinpally.
Motion carried. Vote: 8 For. -0- Against. 3 Absent.

X **Progress Reports: Well Registrations, Production Permits, Drilling Permits, Data Loggers, Drought Monitor Map, Water Quality Analysis and General Manager's Correspondence.**

* Pecos County Tax Appraisals: Even with the recent downturn in the oil and gas industry, our estimated tax valuations will remain about the same as last year. The downturn may not be reflected until next year's valuations. On a positive note, in next year's valuations there will be 2 or 3 more solar facilities on-line.
* Drought Monitor: The drought monitor report is submitted in Board Information. Pecos County is currently out of drought.
* Water Quality Analysis: Water analysis samples are being pulled during pump tests.
* 2020 Texas Groundwater Summit: MPGCD will reserve 5 rooms for the upcoming Summit.
* Texas Governor's Disaster Proclamation: On May 12, 2020 Texas Governor Greg Abbott issued a proclamation renewing the declaration stating that the novel CoronaVirus (COVID-19) poses an imminent threat of disaster for all counties in Texas. For MPGCD this means we have another 30 days for remote meetings.

* June 2020 Board Meeting: The June meeting will be an in-person meeting hopefully. Several meetings will take place in the day(s) before and after the June meeting.
* Klose upcoming permit: Mr. Klose owns 3 sections in Coyanosa. There are over 20 existing water wells. The land is currently being used for the oil & gas industry, but will soon be covered with solar facilities. Mr. Wood has leased this property and will come in and apply for industrial permits.
* City of Fort Stockton: In the area of 7-D Road and Moody Road, the City of Fort Stockton will be opening a new landfill. While working the area and clearing brush, a well was found. This large irrigation well was drilled after the springs quit flowing. The well is not registered or permitted. We ran a camera down the well and found holes in the pipe, and as a result I am going to require them to concrete that in just behind the casing to make sure nothing is running into the well bore due to the fact that the well is at a landfill. They have agreed to this. The permit request will be 20 acre feet or less.
* RigData Report: The report shows 5 rigs in Pecos County.

NOTE: Returning to Agenda Items VII and VIII (addressed together), then Executive Session, and back to VII and VIII, followed by agenda items XI and XII

VII Briefing, discussion and act if necessary on guidance to General Manager on his authority under District Rule 11.8 regarding **Fort Stockton Holdings, L.P.'s application for permit renewal.**

VIII Briefing and take action as necessary on **Cockrell Investment Partners, L.P. v. Middle Pecos Groundwater Conservation District,** Cause No. P-12176-112-CV (Pecos County District Court).

<u>Briefing from Mike Gershon, MPGCD attorney</u>:

With respect to Agenda Item VII, explained District Rule 11.8 on renewal and applicable statute, including General Manager's decision and notice to permit holder, opportunity for permit holder to object to General Manager's decision, General Manager's notice to Board of Directors, and Board's opportunity to act on renewal. Based on timeline, General Manager ought to issue decision by late May with item on Board's June agenda. FSH's permit term expires in mid-July 2020.

With respect to Agenda Item VIII, a pretrial conference is set in Pecos County District Court in July regarding Cockrell Investment Partners, L.P. v. Middle Pecos Groundwater Conservation District, Cause No. P-12176-112-CV, at the request of Judge Gomez as a matter of Court policy when addressing the Court's dismissal docket on dormant cases. Lawsuit has been abated to allow the parties to attempt settlement. On May 11, 2020 Cockrell Investment Partners, L. P.

attorneys suggested continuation of the abatement for more settlement discussion and sent a draft motion to push out what they are proposing and a discovery and trial schedule.

Ty Edwards, MPGCD General Manager, reported that Fort Stockton Holdings, L.P. had filed the permit renewal request on 04-02-2020.

Comments from Ed McCarthy, Jr., attorney for Fort Stockton Holdings, L.P.(FSH): Earlier this year we filed a letter request with the District stating that FSH would like to renew the permit as it was issued 3 years ago with the same permit conditions and terms as are in the permit as issued. We are not seeking any amendments to the permit.

Comments from Ryan Reed, attorney for Cockrell Investment Partners, L.P. (Cockrell):
Regarding agenda item VIII, we have spoken to the District Court and because of the situation with COVID-19 (CoronaVirus), the Court is pushing off hearings and deadlines for a period of time, several months at least, until their docket is manageable. For this reason, I do not have any comment on the continuance of the abatement.

Cockrell is interested in continuing a dialogue with FSH and the District in the interest of a settlement. Regarding agenda item VII, Cockrell's position is that the District needs to implement rules for management zone 1 that are protective of the historic lows that the aquifer has seen. If we are to surpass and test the aquifer to see its capacity and the water quality below historic lows, there needs to be a framework implemented where the District is gathering data and testing the limits on the aquifer in a controlled fashion. Cockrell relies on the aquifer for the pecan orchard, and if the water is not available during the summer months when needed to irrigate, that will have devastating consequences on both the crop and Belding Farms. We are interested in seeing rules being implemented that collect additional data, and protect the water in the summer months. We are in discussions with FSH about proposals and rule amendments.

Ryan Reed presented a PowerPoint presentation to aid in his discussion about Agenda item VII comments.

FSH's Permit and Supply Contract:

- Issued pursuant to Settlement Agreement between MPGCD and FSH (April 28, 2017)
- Permit effective as of July 18, 2017
- Permit Term: Three Years as provided for in Texas Water Code section 36.122(i)(1)

- TWC 36.122(i)(1): "The period specified shall be…at least three years if construction of a conveyance system has not been initiated prior to the issuance of the permit."
- Location of Use: Within TWDB's State Water Plan "Region F"
- City of Midland Groundwater Supply Agreement and related Interlocal Agreement contemplate:
    - City will design, construct, operate, measure and maintain infrastructure to produce, deliver, treat, and supply water
    - Water will be supplied to Abilene ("Region G")

Some of these recent developments do no tract the original permit.
Renewal of a Production and Export Permit:

- The conditions of TWC 36.122(i) have not been satisfied.
    - No construction of a conveyance system.
    - Groundwater Supply Agreement demonstrates this is exclusively Midland's obligation.
- TWC 36.122(i)(1) Permits have a statutory renewal mechanism.
    - Construction of a conveyance system.
    - TWC 36.122(i)(1) does not cite back to TWC 36.1145 (renewal statute).
- TWC 36.122(i)(2) Permits have a statutory renewal mechanism.
    - TWC 36.122(i)(2) cites back to TWC 36.1145 (renewal statute).
- TWC 36.1145 governs production permits and TWC 36.122(i)(2) permits only.
- MPGCD can renew the production permit under TWC 36.1145, but cannot renew the export component under TWC 36.122(i)(1). FSH must reapply for a TWC 36.122(i)(1) permit and consideration must be given to the TWC 36.122(f) factors.

Bottom line: Cockrell's position is that the application to renew the permit is not the proper vehicle to do so. A new application needs to be filed relating to the export. As water is to be exported and used out of the District, it is incredibly important that rules are implemented that protect the aquifer and protect all parties so they can use their permitted water. If we exceed and test the capacity of the aquifer, we should do so in a conservation-minded manner that protects the rights of all users.

<u>Comments from Ed McCarthy, Jr., attorney for Fort Stockton Holdings, L.P.(FSH):</u>
Mr. McCarthy stated that he believes that Mr. Reed is misinterpreting the law. On May 12, 2020, FSH did enter into agreements with the City of Midland with respect to the water. Midland has a separate interlocal with the cities in the West

Texas Water Partnership Group, and with Abilene to the extent that there is an addition in the event that it is needed at some point in the future. If you bring water to Abilene, that will be addressed separately from this renewal application. FSH has everything in order that we need for the renewal authorization and export authorization. He believes renewal is an administrative matter and that there will not be a hearing on the application.

Mike Gershon, MPGCD attorney: Last night just before midnight we received a filing from Cockrell titled "Request for Party Status". Mr. Reed filed this claiming a justiciable interest in the event that there is a hearing.

An Executive Session was called at 11:04 a.m. by Presiding Officer Jerry McGuairt pursuant to the Texas Open Meetings Act, Sections 551.071 of the Texas Government Code, to consult with attorney.

Note: Jeff Sims joined the meeting at this time.

The Executive Session ended at 12:49 p.m. President McGuairt stated that no action was taken in executive session.

Regular session reconvened at 12:52 p.m.

Continue with Agenda item VII:

Mike Gershon, MPGCD attorney: It is not critical that action be taken. The Board has discretion to share with the General Manager what their view is on our permit renewal rule and the statute that our rule is implementing. But, there is no action required. Our rules don't indicate that the Board takes action at this juncture. The Board will receive notice on the General Manager's decision before the next Board Meeting. At the June meeting the Board will have discretion to address the General Manager's decision and overrule it to make changes if they so choose.

VIII Briefing and take action as necessary on **Cockrell Investment Partners, L.P. v. Middle Pecos Groundwater Conservation District,** Cause No. P-12176-112-CV (Pecos County District Court).

Briefing from Mike Gershon, MPGCD attorney: As noted earlier this morning, a pretrial conference is set in July. The lawsuit has been abated since initially filed in 2017. On May 11, 2020 Cockrell's attorney requested to continue the abatement and sent a draft motion to push out what they are proposing and a discovery and trial schedule.

The July hearing and date were set at the Judge's request. We hear from Cockrell that due to COVID-19 (CoronaVirus) the July hearing date may not be realistic. At that hearing we would let the Court know that we would like to have a hearing on our pending plea to the jurisdiction. FSH has made public that they would like to intervene and would need time to submit their filings.

Ed McCarthy, Jr., attorney for Fort Stockton Holdings, L.P. (FSH): FSH offered comment about its participation whether or not there is abatement.

Jeff Sims made a motion to not abate the pending litigation with Cockrell Investment Partners, and to pursue the case and pursue a hearing on our pending plea to the jurisdiction. Janet Groth seconded the motion.
Motion carried. Vote: **6** For. **2** Against. **3** Absent.

XI **Directors' Comments** and consider and/or act upon **agenda for next meeting**.
The June meeting will hopefully be an in-person meeting. We will try and reserve the Pecos County Courthouse second floor for the meeting. There may be 2 permit hearings ready, and the FSH permit renewal will be on the agenda, and Dr. Bill Hutchison will be here to give an update on his model. There will be an agenda item to call for the November election.

XII **Adjourn** Board meeting.
Allan Childs, Jr. made a motion to adjourn the meeting. Motion seconded by M. R. Gonzalez. Motion carried unanimously. Meeting adjourned at 1:12 p.m.

M. R. Gonzalez

M. R. Gonzalez, Secretary/Treasurer

Jerry McGuairt

Jerry McGuairt, President

Date Approved 06-16-2020

MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT
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Email: mpgcd@mpgcd.orgWebsite: www.middlepecosgcd.org

June 16, 2020

MINUTES OF REGULAR BOARD MEETING AND PERMIT HEARING

On this the 16th of June, 2020, a Regular Board Meeting and Permit Hearing were held by the Middle Pecos Groundwater Conservation District in the Pecos County Courthouse on the 2nd Floor located at 103 W. Callaghan, Fort Stockton, Texas, with the following members' present, to-wit:

Jerry McGuairt	President, Precinct 1
Janet Groth	Vice President, Precinct 1
M. R. Gonzalez	Prec. 2, Secretary/Treasurer
Puja Boinpally	Precinct 2
Weldon Blackwelder	Precinct 3
Larry Drgac	Precinct 3
Alvaro Mandujano, Jr.	Precinct 4
Vanessa Cardwell	City of Fort Stockton
Jeff Sims	City of Iraan

Quorum Present.
Members Absent: Ronnie Cooper and Allan Childs

Others present: Ty Edwards, Mike Gershon, Allan Standen, Bill Hutchison, Michelle Sutherland, Melissa Mills, Anthony Bodnar, Paula McGuairt, Geoff Pike, Ryan Reed, Buck Benson, Tommy Soriero, Zack Swick, Glenn Honaker, Kaveh Khorzad, Jeff and Erin Williams, Ed McCarthy, Jr., Brock Thompson, Gary Bryant, Mel Riggs, Mark Tisdale, Mike Thornhill, Gary Klose, Reed Klose, Collin Wood, Gil Van Deventer, Kirby Warnock, Andres Madrid, and Jesse Gonzales.

REGULAR BOARD MEETING

I Call to order regular Board meeting at 10:01 a.m. by President Jerry McGuairt.

II Comments from **public and media**:

Andres Madrid made public comment: He is a resident of the "Little Mexico" area and is unable to obtain water service from Pecos County WCID#1 at this time because they are not setting new taps at this time. He owns less than 10 acres and would like to request permission to drill a water well.

Mr. Madrid was advised to fill out an application for a production permit and expect a hearing would likely be called on a complete application.

PUBLIC HEARING ON PRODUCTION PERMIT APPLICATION FOR GARY KLOSE AND HIS ASSOCIATE COLLIN WOOD

I Call to order at 10:04 a.m. the Public Hearing on **Application for a Production Permit for Gary Klose and Collin Wood**.

Party representing application: Collin Wood and Gary Klose

Protestant to application: None.

Public Comment: None.

Jerry McGuairt declared the application uncontested.

Collin Wood was sworn in for testimony for Mr. Klose:

Mr. Wood/Efficient Recycling Solutions, LLC, and Mr. and Mrs. Gary Klose/Klose Land, Inc. have entered an agreement for Water Development. Since 1960s to 1990s the Kloses have owned and farmed Section 22 and Section 27, Block C-2, PSL Survey, and Section 4, Block 48. The water is being requested for construction of a Solar Facility on the property, and for a future water station on Tipton Road for oil field use. The solar facility needs 70-80 acre feet and possibly more, and 320 acre feet which would only be about 6 frac jobs which is a low estimate.

Manager Ty Edwards presented the production permit application to the Board. Gary Klose and his associate Collin Wood have made application for a Production Permit for 3 wells located on the following described lands: Section 22, Block C-2, PSL Survey, A-5066, Section 27, Block C-2, PSL Survey, A-9443, All of the N/2 and SW/4, A-8120 and SE/4, A-5539 of Section 4, Block 48, Township 8 South, T&P RR, Co. Survey, in Pecos County. The application requests authorization to produce 400 acre-feet/year for Industrial Use from the Pecos Valley Aquifer.

The Klose Farm has 6,860 acre feet of *Historical and Existing Use* permits for Irrigation for the 24 wells on the property from the Pecos Valley Aquifer. The solar farm is expected to need the water for the 18-month construction period and will also use the water for oil-and-gas purposes. The solar facility is expected to use half of the property, and it would not be practical for farming any longer.

Allan Standen, MPGCD Hydrogeologist, was sworn in for testimony and advised of his opinion that after a review of the specific capacity pump tests for the 3 wells in the application, along with two MPGCD monitor wells in the area, there were no expected unreasonable effects.

II Adjourn Hearing and Consider and/or Act on **Application for a Production Permit for Gary Klose and Collin Wood**.

President Jerry McGuairt adjourned the hearing at 10:24 a.m.

The Board and Applicant showed interest in exploring the possibility of reducing the *Historical and Existing Use* permits and applying for a new production permit if a beneficial need is proven.

Alvaro Mandujano, Jr. made a motion to grant 200 acre feet for Industrial Use from the Pecos Valley aquifer. Motion seconded by Janet Groth.
Motion passed unanimously. Vote: 9 FOR. -0- Oppose. 2 Absent.

Reconvened the Regular meeting at 10:30 a.m.

REGULAR BOARD MEETING – CONTINUED

Director Vanessa Cardwell stepped out of the meeting for a few minutes.

III Consider and/or act on **Minutes of Regular Meeting on May 19, 2020**.

Janet Groth made a motion to approve the minutes of May 19, 2020 as presented.
Motion seconded by Jeff Sims. Motion carried unanimously.
Vote: 8 FOR. -0- Oppose. 3 Absent (Cardwell/Childs/Cooper).

IV Consider and/or act on **Treasurer's Report for the Month Ending May 31, 2020**.

Puja Boinpally made a motion to approve the Treasurer's Report for the Month Ending May 31, 2020. Motion seconded by Alvaro Mandujano, Jr.
Motion passed unanimously.
Vote: 8 FOR. -0- Oppose. 3 Absent (Cardwell/Childs/Cooper).

V Consider and/or act on **Tax Abatement Policy and Guidelines**.

Vanessa Cardwell returned to the meeting.

There were no changes proposed to the tax abatement policy and guidelines.

A Few Tax Abatement Highlights: All applications requesting tax abatement from the District shall be considered on an individual basis with regard to both the applicant's qualification for abatement and the amount of the abatement. The

District has set a limitation value of Fifty Million Dollars ($50,000,000) on all projects to be considered for a tax abatement; meaning that only that value exceeding the limitation value will be considered as eligible for a tax abatement. The decisions of other taxing units, including the County, to grant or deny tax abatement do not bind the District, and the District shall evaluate all requests within the context of the District's management plan, rules, and statutory mandate, and the adopted policy. A nonrefundable payment to the Middle Pecos Groundwater Conservation District of Five Thousand and no/100 Dollars ($5,000) must accompany the application at the time of submission. Sunset Provision and Agreement Modification: Pursuant to Texas Property Tax Code, Chapter 312, these guidelines and criteria are effective upon the date of their adoption and will remain in effect for two (2) years.

Janet Groth made a motion to approve the Tax Abatement Policy and Guidelines. Motion seconded by Weldon Blackwelder. Motion carried unanimously.
Vote: 9 FOR. -0- Oppose. 2 Absent (Childs/Cooper).

VI Briefing and take action as necessary regarding **7D area and continued Kent and Luna permit hearings**.
No new updates.

VII Consider and/or act on an **Engagement Letter with Smith & Rives, PC for the Audit for the Year Ending September 30, 2020**.

Vanessa Cardwell made a motion to approve the engagement letter with Smith & Rives, P.C. for the Audit for the Year Ending September 30, 2020. Motion seconded by M. R. Gonzalez. Motion carried Unanimously.
Vote: 9 FOR. -0- Oppose. 2 Absent (Childs/Cooper).

VIII Consider and/or act on **Joint Study Agreement** required by April 2017 agreement with Fort Stockton Holdings, LP.

Mike Gershon, MPGCD attorney, recounted the past event(s) that led us to today's consideration of a Joint Study Agreement. The Joint Study Agreement with Fort Stockton Holdings, LP (FSH) was contemplated by the permit conditions that were associated with the production permit that was issued in 2017. One of the permit conditions required the parties (which were MPGCD and FSH) to enter an agreement providing for the scope and the funding for a Joint Study. The Joint Study is referenced in 'special permit condition' #13 and #14.

For Reference: Special Permit Conditions attached to the Amended Application for Production Permit with Export Authorization that was approved on 07-18-2017:
#13. The attached schedule entitled "Monitor Well Thresholds and Cutback" applies to the permit until a Joint Study can be conducted and until such time as the Board determines relaxing

the restrictions in Table 6 are justified by the results of the Joint Study. Any cutback in Table 6 shall go into effect April 1st of each year and remain in effect through March 31st of the immediately following year.
14. The Study scope, project management, and responsibility for funding shall be agreed to between FSH and District within 6 months. The study shall commence shortly after an agreement is reached on the scope.

By agreement between FSH and the District in the 2017 timeframe, the parties held off and abated that 6-month timeframe. The permit term is up in July 2020, and on 04-02-2020 FSH filed an application to renew the permit as approved on 07-18-2017. Discussions and briefings were held at last month's Board Meeting regarding MPGCD General Manager, Ty Edwards, decision regarding the permit renewal. Mr. Edwards decision on renewal is conditioned on FSH's satisfying the special permit conditions. Two of the conditions relate to the Joint Study.

Over the last several weeks, MPGCD hydrogeologists Dr. Bill Hutchison, Allan Standen, Vince Clause and Michelle Sutherland have been working with FSH's hydrogeologist Mike Thornhill to prepare a scope of work. Both parties had different agendas for conducting the studies. MPGCD's interest was to collect additional data and analysis for assurance of our aquifer level thresholds and cutbacks that were incorporated into the FSH permit. FSH had an interest in seeing if they could produce even more water that they were currently entitled to under the permit and have less restrictions. Cockrell Investment Partners expressed concern about uncertainty of future aquifer conditions based on possible pumping from FSH. In discussions between MPGCD and FSH on Monday, June 15th, FSH indicated that export will most likely not be in the next 2 to 3 years, but will be sooner than 10 years.

<u>Dr. Bill Hutchison</u>, MPGCD Hydrogeologist, explained that his focus has been on the special conditions relating to the 11 threshold monitoring wells. Attached to the threshold levels were the anticipated or potential for pumping reductions if some of those thresholds were met. There were also summer thresholds that would require analysis and action needed if the thresholds were exceeded. There was an additional special condition which is the Joint Study. Dr. Hutchison presented a PowerPoint presentation titled: FSH/MPGCD Joint Study Plan June 16, 2020.

Summary of the PowerPoint presentation:

- ✓ The proposed Joint Study is a 3-Phased approach
- ✓ Management Zone 1 is the focus of the Joint Study. We want to get additional data in place in terms of elevation and conductivity before pumping increases for exportation and develop a baseline.

- ✓ This is an early warning system and we need a comprehensive data set to address what we can anticipate in terms of interpretive issues. The foundation of this endeavor is to not let the water levels drop below the historic minimum levels.
- ✓ Rustler aquifer: The Rustler aquifer underlies the Edwards-Trinity Plateau. There is a potential for upward leakage of the Rustler water into the Edwards-Trinity. The monitoring data is necessary to determine the potential for upward leakage, and can help determine the water quality impacts of upward leakage, and to answer question of why something is changing.
- ✓ **<u>3-Phases of the Joint Study:</u>**

  <u>Phase "0" (initial/preliminary work):</u> Now to September 2020. Finalize the scope and budget.

  <u>Phase 1:</u> October 2020 to September 2021. Identify and begin instrumentation of new monitoring wells (possibly including Rustler wells) with temperature and conductivity probes to provide continuous water quality monitoring. Convert the existing 11 threshold wells with instrumentation to provide additional baseline information such as elevation and conductivity. Process the collected data and prepare initial monitoring report to be discussed at an annual meeting of Management Zone 1 stakeholders.

  <u>Phase 2:</u> Continue to monitor and process data, continue to expand instrumentation of existing wells, add new monitoring wells as budget allows. Process the collected data and prepare monitoring report to be discussed at an annual meeting of Management Zone 1 stakeholders.

  <u>Phase 3:</u> Begins after export pumping starts. Continue to monitor, process data, and prepare annual report, and add new monitor wells. Process the collected data and prepare monitoring report to be discussed at an annual meeting of Management Zone 1 stakeholders. Post audit model/develop recommendations for model update.

  Key Elements of Phases:
- ✓ In time, data will be available to evaluate thresholds which addresses FSH's underlying objective of modifying thresholds/more pumping.
- ✓ Addresses water quality issues raised by MPGCD and Cockrell Investment Partners.
- ✓ Groundwater elevation and water quality data collection efforts equal or exceed those additional data collection efforts proposed by Cockrell Investments Partners.
- ✓ Annual meeting of all Management Zone 1 stakeholders is responsive to Cockrell's proposal to convene more frequent meetings.

Ed McCarthy, Fort Stockton Holdings, LP attorney:
Summary of FSH offer to MPGCD: A lump sum one-time payment of $250,000 will be offered and dedicated for the sole purpose of funding the Joint Study for Phases 1 and 2. A Rustler well that is currently used periodically for irrigation and is not part of the export permit, has been offered as a monitoring well. In addition, Fort Stockton Holdings LP agreed to fund 100% of the cost of a new Rustler monitoring well based on the final bids and the contracts that the District completes, if it is determined by District that such a well is needed.

Summary of Comments made to the Board:
FSH believes that the Edwards-Trinity aquifer could withstand greater pumping as it did in the past, which was their basis for agreeing to the threshold limits and criteria and curtailments imposed in the 2017 permit. They advocate that additional science and data should be collected and developed over the years to assess FSH's ability to develop greater pumping levels from the Edwards-Trinity. FSH is of the position that the Rustler aquifer was never a point of discussion in 2017, and only recently became a point of discussion. FSH supports the concept of learning more about the Rustler just as we support all science related to the aquifers within the District.

Ryan Reed, attorney for Cockrell Investments Partners, L.P.
Although Cockrell has not been involved with the Joint Study talks, we are pleasantly surprised to hear about the concept of the study—the science and intent to get a better understanding of the data are great concepts. We are pleased to hear about the funding for these issues. Cockrell Investments is actively using our Rustler wells, two of which were recently drilled. Once we have data, we are happy to discuss it.

We have presented a set of proposed rules that are a supplement to Dr. Hutchison's rules, which will be discussed later today. The proposed rules go hand-in-hand with the Joint Study issues being discussed.

Mike Gershon's guidance to the Board: The Board can act to approve the agreement that will delegate authority to the President and Vice President to get the agreement in order subject to terms that will be laid out in the motion or the Board can wait until next month to vote on the agreement that will be drafted, and you will have the draft in advance of the meeting to review before the vote.

Alvaro Mandujano, Jr., made a motion to approve the Joint Study Agreement with Fort Stockton Holdings LP, as required by FSH's production permit special permit conditions, to implement Phase 1 and Phase 2 of the current proposal to

which FSH is committing $250,000 to be dedicated to be spent to do Phase 1 and Phase 2 with payment due by September 1, 2020. One of the first steps will be the installation of the new transducers in the wells given the priority of improving upon the database. This database will include the use of an existing FSH Rustler well which was offered to MPGCD as a monitoring well. Also, the commitment that at such time the District determines a new Rustler monitoring well is necessary, that FSH will fund 100% of the cost of the Rustler well based on the final bid(s) and the contract(s) that the District enters. Authority to oversee completion and execution of the Joint Study Agreement shall be delegated to President Jerry McGuairt and to Vice President Janet Groth, with the guidance of Mike Gershon. The motion was seconded by Larry Drgac. The motion passed unanimously.
Vote: 9 FOR. -0- Oppose. 2 Absent (Childs/Cooper).

IX Consider and/or act on **proposed rule amendments intended to (1) change Management Zone 1 boundaries and operating conditions to recognize hydrogeological differences between South Coyanosa and Belding areas and (2) establish (A) acceptable aquifer level fluctuations and (B) thresholds for pro rata cutbacks when aquifer level declines in certain monitoring wells**, which have been subject to public rulemaking hearing and based on public comment.

Director Puja Boinpally recused herself, and completed the Disclosure Affidavit.

(1) change Management Zone 1 boundaries and operating conditions to recognize hydrogeological differences between South Coyanosa and Belding areas.
General Manager, Ty Edwards, reported that there have been several rulemaking hearings over the years. In 2017 the District had several rulemaking hearings and took public comment. The purpose of the proposed rule changes was to modify the boundaries of Management Zone 1 to better incorporate the science in the Management Zone 1 area. We have that set out in the proposed rules.

Gershon: The applicable statute - 36.101 of the Texas Water Code and our rules provide that after hearing and public comment, which has occurred, and appropriate notice was published, then you can act on these proposed rules. The way that we've defined the management zone in the current rules, we have essentially a picture, a visualization of that management zone, and there is some text in Rule 10.5(a) that describes what you see in our rules. Based on the visualization and reference to GAM grid cells, and latitude and longitude and coordinates, there is an easier way to describe that and an easier way probably for the public to deal with that by using the District's Excel files and other records within the District.

Vanessa Cardwell made a motion to approve the proposed rule amendments to change Management Zone 1 boundaries as presented. Also to approve a nonsubstantive change in the language that describes Management Zone 1 boundaries as shown in Rule 10.5(a). The nonsubstantive changes include removing the coordinate values and changing it to reference the District's records (referencing Excel file—see note below). Motion seconded by Janet Groth.

Note: The District Excel file is located at: \\Mpgcd-server\data\1.M.P.G.C.D\5. Rules & by-laws& chap 36\001.Adopted Rules\06-16-2020_Rule 10-5-a_MPGCD_MZ1_ModelGridCentroilds.xlsx

Public Comment from Ryan Reed, Attorney for Cockrell Investment Partners, L.P. We do not object to changing the boundaries of Management Zone 1. Procedurally however, Cockrell believes that it is unclear if we are currently in a rulemaking hearing or if the previous (2017) rulemaking hearings were ever concluded. It appears the previous rulemaking hearings were never concluded, and that this one hasn't been noticed. This is relevant because there are additional issues we believe should be considered as part of the rulemaking hearings. Specifically, Cockrell provided the District with a set of proposed rules that we believe should supplement what Dr. Hutchison's previously prepared. We do think that it is appropriate when considering the change to the management zone that we also consider Dr. Hutchison's rules as well as Cockrell's proposed supplemental rules.

There was discussion by Mike Gershon and others about the 1st and 2nd rulemaking hearings in 2017 and whether they were properly noticed and adjourned.

Ryan Reed again took the floor and said he stands corrected, and that the record reflects that the meetings were adjourned.

President McGuairt called for the vote on the motion on the floor. Motion passed. Vote: 8 FOR. -0- Oppose. 2 Absent (Childs/Cooper). 1 Abstention/Boinpally.

2nd Part of Agenda Item:
(2) establish (A) acceptable aquifer level fluctuations and (B) thresholds for pro rata cutbacks when aquifer level declines in certain monitoring wells, which have been subject to public rulemaking hearing and based on public comment.

Mike Gershon: We have received concepts from Cockrell Investment Partners, LP, and have talked concepts with Fort Stockton Holdings, LP, and proposed rules have been published and considered at a hearing in 2017. There appears to be more work to be done. Typically Board workshops have proven useful for rules development prior to issuing notice for a formal hearing. Note that the settlement agreement with Fort Stockton Holdings, LP, required us to consider whether to address these rules, but did not require us to take any particular action on the rules. We have been working for 3 years on this since the settlement agreement was entered. No action is necessary.

President Jerry McGuairt declared that No Action was taken.

X Briefing and take action if necessary on General Manager's decisions on **renewal/nonrenewal of production permit of Pyote Water Systems, III and production permits authorizing export of Alpha Water Resources, LLC and Fort Stockton Holdings, LP.**

Pyote Water Systems, III: Canceled permit via nonrenewal. This was a permit for a small industrial permit for one well. The company is no longer an entity and is closed.

Alpha Water Resources, LLC: Alpha Water Resources, LLC was known at one time as STW. Mr. Allan Murphy never fully complied with the permit condition by submitting the bond as required before drilling, and never drilled any of the monitor wells. They were given multiple extensions. This permit has been cancelled. We have not heard from Mr. Allan Murphy regarding the notice of cancellation letter.

Fort Stockton Holdings, LP: General Manager, Ty Edwards, has sent a letter to FSH renewing the 3-year permit. FSH did not challenge the decision.

Mike Gershon informed the Board that they could overrule the renewal. The Board deliberated and appeared to agree with the renewal with no motions offered to overrule the General Manager's decision.

Note: Alvaro Mandujano, Jr. left the meeting at 2:20 p.m. A quorum remained.

Public Comment from Ryan Reed, Attorney for Cockrell Investment Partners, L.P.: He does not believe that this Board or Mr. Edwards has the authority under the Texas Water Code to renew the export component of the FSH permit. Texas Water Code 36.1145 does not govern the automatic renewal of the FSH permit. In his opinion, Texas Water Code 36.122 (i)(1) provides that for the export permit to be renewed there must be commencement of construction of a conveyance system. FSH has not commenced construction of the conveyance system. The deal that FSH reached with the City of Midland expressly provides that the City of Midland is going to be responsible for the entire construction of the conveyance system, which has not yet commenced. The renewal of the export permit is void and inconsistent with the statute.

Mike Gershon: The District received Cockrell Investment Partners' written briefing, which requests party status and a hearing. To be clear, we are not having a hearing today on the renewal. Our interpretation of the statute is that we are not supposed to have a hearing unless we are going to initiate changes to the permit or there is another reason for nonrenewal. The only action item for the Board is to overrule the General Manager's renewal if the Board believes that to be appropriate.

Ryan Reed: We are not contesting the renewal of the production component, but simply requesting that they file an application to export the water and all of the factors of 36.122 (f) – or address the contemplated hearing.

Ed McCarthy summarized FSH's filing with the District and position on the applicability of Texas Water Code Sections related to renewal and export authorization. There was substantial discussion among Mr. McCarthy, Mr. Reed, and Mr. Gershon, and the Board and General Manager.

President Jerry McGuairt declared that No Action was taken.

XI Briefing and take action as necessary on **Cockrell Investment Partners, L.P. v.Middle Pecos Groundwater Conservation District,** Cause No. P-12176-112-CV (Pecos County District Court).

Mike Gershon: Our plan at the present time is to appear before Judge Gomez for a pretrial conference in late July either by zoom call as the Judge has been doing for some proceedings or in person. The scope of that hearing is guided by a rule of procedure that allows us to address preliminary matters. The scope doesn't include the District's pending plea to the jurisdiction. At the July hearing, we will make the Judge aware that the District would like to set a hearing on the pending plea to the jurisdiction. We have a joint staff support that Ryan and his colleagues and I are working through to make sure that Judge Gomez is aware of the issues that he will be looking at and how much time we need. We'll know more about the procedural approach to this case after the hearing.

Ryan Reed: I think that is a fair assessment of where we are. We do owe the Court a joint status report. A written report that has been circulated between Mr. Gershon, myself and Mr. Cruz. That will be filed as soon as we hammer out the details. And as Mr. Gershon said, we will appear before the Court however the Court sees fit, and assuming that the July 27th date holds. We will continue down the path of determining whether we should have party status, or should have had party status on the application from 2009 that was then converted into whatever it was converted into. The issues are very much like what we are talking about today: whether we should have had party status or not and whether something is or is not contemplated by the statute.

No action taken.

XII **Progress Reports: Well Registrations, Drilling Permits, Production Permits, Data Loggers, Drought Monitor Map, Water Quality Analysis, Railroad Commission Well Plugging Fund, Texas Alliance of Groundwater Districts' committee work, Groundwater Management Area 7, and General Manager's Correspondence.**

* Pecos County Tax Appraisals: Even with the recent downturn in the oil and gas industry, our estimated tax valuations will remain about the same as last year.
* Drought Monitor: The drought monitor report is submitted in Board Information. Pecos County is currently out of drought, but getting drier.
* 2020 Texas Groundwater Summit: MPGCD will reserve 5 rooms for the upcoming Summit.
* Clayton Mill Project: Drilled a 3" X 8' hold and installed a grounding rod.
* Crabb Capitan Well: The Capitan well on the Crabb Estate is free-flowing. In was bulldozed over the well head in the 1970s. We have sent them a letter

informing them of the serious public safety and environmental hazard the well poses. Informed them that the flowing well needs to reworked or plugged.

* Groundwater Management Area #7: There is a meeting on August 6, 2020 in San Angelo, TX.
* Texas Alliance of Groundwater Districts (TAGD): The legislative subcommittees for TAGD are set, and Ty Edwards is on 1) Produced Water Subcommittee and the 2) Brackish Subcommittee.
* November 3, 2020 Election: The period for candidates to file applications for a place on the ballot this year runs from Saturday, July 18 to Monday, August 17, 2020. We will call for the election at the July meeting.
* Well Registrations: Since 06-12-2020 our total registrations 3,277. 963 of those are Non-Exempt Wells and 2,314 Exempt wells.
* RigData Report: The report shows 1 rig in Pecos County.

XIII **Directors' Comments** and consider and/or act on **agenda for next meeting**.

The July meeting will be moved to July 14th due to conflicts. This is the 2nd Tuesday.

XIV **Adjourn** Board meeting.
Weldon Blackwelder made a motion to adjourn the meeting. Motion seconded by Larry Drgac. Motion carried unanimously. Meeting adjourned at 2:59 p.m.

M.R. Gonzalez

M. R. Gonzalez, Secretary/Treasurer

Date Approved 7-14-20

Jerry McGuairt

Jerry McGuairt, President

Middle Pecos GCD Exhibit 7

Middle Pecos GCD Order Adopting Written Findings of Fact and Conclusions (July 8, 2011)

Bickerstaff Heath Delgado Acosta LLP

3711 S. Mopac Expressway Building One, Suite 3 Austin, Texas 78746 (512) 472-8021 Fax (512) 320-5638 http://www.bickerstaff.com

MEMORANDUM

TO: Persons on attached Mailing List

FROM: Bill Dugat BD

RE: Order Adopting Findings and Conclusions

DATE: July 11, 2011

Attached is duplicate original of the July 8, 2011 Order of the Middle Pecos Groundwater Conservation District adopting findings and conclusions, which has been certified by the Board Secretary.

CERTIFICATE OF SERVICE

By my signature below, I hereby certify that on this 11th day of July, 2011, a true and complete copy of the foregoing Memorandum was sent to the following via e-mail, facsimile, and/or certified mail:

Ed McCarthy 711 West 7th Street Austin, TX 78701 512-225-5606 512-225-5565 (fax) Email: emccarthy@jacksonsjoberg.com	representing Applicant Fort Stockton Holdings, L.P.
Mike Gershon 816 Congress Avenue, Suite 1900 Austin, TX 78701 512-322-5872 512-472-0532 (fax) Email: mgershon@lglawfirm.com	representing the General Manager of the Middle Pecos Groundwater Conservation District
Russ Johnson 600 Congress Avenue, Suite 2100 Austin, TX 78701 512-495-6074 512-495-6093 (fax) Email: rjohnson@mcginnislaw.com	representing City of Fort Stockton
Tom Beard P.O. Box 668 Alpine, TX 79831-0668 432-364-2244 432-225-1080 (fax) Email: tombeard@leoncita.com	
Harvey Gray P.O. Box 696 Fort Stockton, TX 79735 432-336-3977 432-336-3052 (fax) Email: pcwcid1@sbcglobal.net	Board President, Pecos County WCID #1

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Bill Dugat III

William D. Dugat III

APPLICATION OF FORT STOCKTON HOLDINGS L.P. FOR PRODUCTION PERMIT AND TRANSPORT AUTHORIZATION	§ § § § §	**BEFORE THE MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT**

ORDER
ADOPTING WRITTEN FINDINGS AND CONCLUSIONS

WHEREAS, on May 4, 5, 10, 11 and 12, 2011 the Board of Directors ("Board") of the Middle Pecos Groundwater Conservation District conducted contested case hearings in connection with an application filed by Fort Stockton Holdings, L.P.("FSH"); and

WHEREAS, on June 10, 2009, the Board voted 11-0 to deny the application; and

WHEREAS, on June 13, 2011, FSH requested the Board make written findings and conclusions in connection with its decision; and

WHEREAS, Texas Water Code section 36.412 provides that a party to a contested case may request written findings and conclusions not later than the 20th day after the date of the board's decision; and

WHEREAS, the Board shall make written findings and conclusions regarding a decision on a permit on receipt of a timely request.

NOW, THEREFORE, BE IT RESOLVED that:

(1) The Board adopts the Findings of Fact and Conclusions of Law attached as Exhibit A and incorporated herein for all purposes.

(2) By his signature, the Board Secretary attests and certifies this resolution and the findings of fact and conclusions of law as official documents of the District.

DULY PASSED AND ADOPTED BY THE BOARD OF DIRECTORS BY A VOTE OF 7 FOR AND 1 AGAINST ON THE 8th DAY OF JULY, 2011.

3 absent

MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT

Glenn Honaker
President and Presiding Officer

ATTEST:

M.R. Gonzalez, Board Secretary

EXHIBIT "A"

APPLICATION OF FORT STOCKTON HOLDINGS, L.P. FOR PRODUCTION PERMIT AND TRANSPORT AUTHORIZATION	§ § § §	**BEFORE THE MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT**

MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT'S
FINDINGS OF FACT AND CONCLUSIONS OF LAW

FINDINGS OF FACT

1. The Middle Pecos Groundwater Conservation District ("District") is a political subdivision of the State of Texas organized and existing under and by virtue of Article XVI, Section 59, of the Texas Constitution, and a groundwater conservation district acting under Chapter 36, Water Code, and the District's enabling act, Act of May 26, 1999, 76^{th} Leg., R.S., ch. 1331, 1999 Tex. Gen. Laws 4536 (Senate Bill 1911), as amended.

2. On July 13, 2009, Fort Stockton Holdings, L.P. ("FSH") submitted to the District its Production Permit Application with transport authorization (the "Application") to produce and transport 49,000 acre feet of groundwater per year from 46 wells.

3. FSH supplemented its Application on July 30, 2009, to provide technical data required by the District's Hydrogeologic Report requirements.

4. On August 6, 2009, FSH supplemented its Application by filing Attachments "F," "G," "H," and "I" to its Application.

5. FSH supplemented its Application on September 24, 2009, which included an amendment to its Application to produce 47,418 acre feet of groundwater per year rather than the 49,000 acre feet per year originally requested in the materials submitted on July 13, 2009.

6. FSH and District representatives met on September 3, 2009, and September 21, 2009, to discuss development of FSH's Application, including technical information required in the Hydrogeologic Report. The District's General Manager sent FSH a letter on September 26, 2009, memorializing the agreement reached between the parties with regard to the technical information required to be submitted with the Application.

7. FSH's consultant, the Thornhill Group, sent a letter to the District's General Manager on October 7, 2009, seeking clarification of the well testing protocols associated with the Hydrogeologic Report.

8. The District General Manager conducted a review of the information submitted to be included as FSH's Application and sent a letter to FSH on October 8, 2009, listing deficiencies with FSH's Application.

9. FSH supplemented its Application to provide technical information associated with the Hydrogeologic Report on November 12, 2009.

10. The District General Manager sent a subsequent letter to FSH on January 15, 2010, listing deficiencies with the Application.

11. On January 19, 2010, the District Board of Directors (the "Board") voted to approve the District General Manager's interpretation and application of District rules as memorialized in his list of deficiencies cited in his January 15, 2010 letter to FSH.

12. District representatives met with FSH representatives to resolve administrative completeness issues associated with FSH's Application on February 10, 2010. FSH also filed a supplement to its Application on February 10, 2010.

13. FSH filed additional supplements to its Application on March 9, 2010.

14. On March 16, 2010, the Board declared FSH's Application administratively complete under the qualification that FSH would submit certain technical information identified by the District General Manager and which FSH had agreed to submit.

15. On December 1, 2010, FSH filed a supplement to its Hydrogeological Report and informed the District that additional technical data would be sent to the District by mail.

16. The District General Manager and hydrogeologist conducted a technical review of FSH's supplemented Hydrogeological Report and sent a letter to FSH on February 9, 2011, indicating that FSH's technical information required in the Hydrogeological Report was considered to be complete.

17. The District issued notice of the hearing on FSH's Application in accordance with Section 36.404, Water Code, on April 10, 2010, by posting notice in a place readily accessible to the public at the District office, providing notice to the County Clerk in Pecos County, providing notice by regular mail to applicant FSH, and providing notice to all persons who had requested notice.

18. The District Board held a preliminary hearing on FSH's Application on April 20, 2010, within the statutory timeframe required after the District's determination that FSH's Application was administratively complete, to consider preliminary motions, admit jurisdictional evidence, receive public comment, determine party status, and establish a

procedural schedule for the hearing on the merits. The Board continued the hearing in accordance with Section 36.409, Water Code.

19. The District Board President, Glenn Honaker, was designated at the April 20, 2010 preliminary hearing as the Presiding Officer for the hearing on FSH's Application.

20. As required by Section 36.1071, Water Code, the District amended its Management Plan and developed rules implementing its Management Plan. The Texas Water Development Board approved the District's Management Plan on December 8, 2010. The rules implementing the District's Management Plan were adopted to be effective on February 15, 2011.

21. The City of Fort Stockton ("City"), Brewster County Groundwater Conservation District ("BCGCD"), Gregg McKenzie, L.B. Ryan, Mark Bradley Davis, Pecos County Water Control and Improvement District No. 1 ("Pecos County WCID No. 1"), Tom Beard, Dan Pearcy, and Pecos County ("County") each filed requests for party status under District Rule 11.11.4 and were admitted as parties to the hearing on FSH's Application. Dan Pearcy later withdrew as a party to the hearing and the Presiding Officer issued an Order acknowledging the withdrawal of Dan Pearcy on December 17, 2010.

22. The Presiding Officer issued multiple orders designating the procedural schedule for the hearing and providing deadlines for disclosure of party contentions, discovery, and depositions.

23. One acre-foot of water is equal to 325,851.4 gallons.

24. The Presiding Officer's June 1, 2010, Order provided for limited discovery to determine the parties' respective contentions/issues and to inspect and obtain information and materials that were reasonably likely to be offered as evidence at the hearing.

25. The District coordinated with each of the parties to continue the hearing on FSH's application to May 4, 5, 10, and 11, 2011. To afford all of the parties the amount of time needed for their direct cases, cross examination of witnesses, and rebuttal testimony, the hearing was continued to May 12, 2011.

26. FSH supplemented its Application with its *Geotechnical Report Shallow Soil Permeability Assessment Mesa and Stockton Farms Ft. Stockton, Texas* on March 8, 2011.

27. FSH supplemented its Application with a Summary Groundwater Availability Assessment, a letter of interest from Midland County Freshwater Supply District No. 1, and documents that reduced the number of wells associated with the application from 46 to 25 on March 16, 2011.

28. After a review of the supplemental materials filed by FSH on March 16, 2011, the District General Manager on March 29, 2011, sent a letter to FSH indicating that the March 16, 2011 supplement that reduced the number of wells from 46 to 25 rendered information in FSH's Application obsolete. FSH filed a response to the District General Manager's letter on April 15, 2011.

29. FSH filed a supplement to its Application on April 15, 2011, to include its Groundwater Availability Assessment Report.

30. FSH sent a file transfer to the District on April 16, 2011, containing portions of its 2011 regional groundwater study and associated model files.

31. The hearing held on April 20, 2010 and continued to May 4, 5, 10, 11, and 12 was transcribed by a court reporter.

32. The parties were given the following time limits to present direct testimony and for cross-examination: eight hours for FSH; the City and the County split eight hours; two hours for Pecos County WCID No. 1; two hours for Tom Beard; two hours for L.B. Ryan; two hours for Gregg McKenzie; two hours for Mark Bradley Davis; two hours for BCGCD; and eight hours for the General Manager of the District. The Presiding Officer allowed the parties to share time.

33. All fact and expert witnesses that testified at the hearing were sworn in by the Presiding Officer.

34. The Presiding Officer gave FSH the opportunity to have up to six hours of rebuttal testimony, and FSH chose not to use any time for rebuttal at the close of the direct testimony on May 12, 2011.

35. District Rule 11.10.1 requires FSH to provide the following information in its Application:

    (1) the name and mailing address of the applicant and the owner of the land on which the well will be located;

    (2) if the applicant is other than the owner of the property, documentation establishing the applicable authority to construct and operate a well for the proposed use;

    (3) the location of each well and the estimated rate at which water will be withdrawn;

    (4) the date the permit is to expire if the well(s) is/are not drilled or if the existing well(s) is/are not properly completed to meet all statutory and regulatory requirements for the intended purpose of use;

(5) a statement of the nature and purpose of the proposed use and the amount of water to be used for each purpose, and documentation evidencing the amount and purpose of water to be used during the permit term;

(6) a requirement that the water withdrawn under the permit be put to beneficial use at all times;

(7) the location of the use of the water from the well;

(8) the conditions and restrictions, if any, placed on the rate and amount of withdrawal;

(9) a declaration that the applicant will comply with the District's Rules and all groundwater use permits and plans promulgated pursuant to the District's Rules;

(10) a declaration that the applicant will comply with the district's management plan;

(11) a drought contingency plan;

(12) a declaration that the applicant will comply with all District well plugging and capping guidelines and report closure to the commission;

(13) the duration the permit is proposed to be in effect, if greater than one year; and

(14) if groundwater is proposed to be transferred out of the District, the applicant shall describe the following issues and provide documents relevant to these issues:

(i) the availability of water in the District and in the proposed receiving area during the period for which the water supply is requested;

(ii) the projected effect of the proposed transfer on aquifer conditions, depletion, subsidence, or effects on existing permit holders or other groundwater users within the District; and

(iii) how the proposed transfer is consistent with the approved regional water plan and certified district management plan.

36. District Rule 11.10.2 requires FSH to provide the following information in its Application:

(a) A location map of all existing wells within a half (1/2) mile radius of the proposed well or the existing well to be modified;

(b) A map or other document from the Pecos County Tax Appraisal District indicating the ownership and location of the subject property;

(c) A document indicating the location of the proposed well or the existing well to be modified, the subject property, and adjacent owners' physical and mailing addresses;

(d) Notice of any application to the Texas Commission on Environmental Quality to obtain or modify a Certificate of Convenience and Necessity to provide water or wastewater service with water obtained pursuant to the requested permit;

(e) A statement of the nature and purpose of the proposed use and the amount of water to be used for each purpose; and

(f) A hydrogeological report shall be attached to applications meeting the following conditions:

(1) Requests to operate a nonexempt well with an annual maximum permitted use of at least 1,000 acre feet; and

(2) Requests to amend and increase by at least 250 acre feet the annual maximum permitted use of a Production Permit.

(g) An applicant subject to subsection (f) of this section shall agree to conduct pumping test for each well for which a production permit is being requested, and to submit the results of the pumping test to the District within 30 days of the well coming on-line and beginning to produce groundwater for beneficial use.

37. FSH's Application is certified and signed by Mr. Paul Latham, the Vice President of FSH at the time the Application was filed. FSH later provided information substituting Mr. Brock Thompson as the authorized representative for FSH in his new capacity as Vice President of FSH.

38. FSH's Application provides that the proposed production would be from the Edwards-Trinity aquifer.

39. FSH's Application provides that the total amount of groundwater applied for is 47,418 acre feet per year, less the volume of water produced under its Existing and Historic Use Permits for the same wells during the same calendar year.

40. FSH's Application requests the following special permit condition be tied to a Production Permit granted by the District:

> This application is not requesting any increase in the total volume of groundwater production already approved by the District, because the production allowed under this proposed permit would be limited to the amount of groundwater production not used under applicant's Existing and Historic Use Permits in a given year for the same wells. As explained in greater detail elsewhere in the Application, the maximum annual volume of water Applicant will be entitled to produce during any calendar year, whether

allocated to Public Supply or Industrial purposes, shall never exceed 47,418 ac-ft/yr. Moreover, in combination with Applicant's separate Existing and Historic Use permits issued by the District, which authorize total production of 47,418 ac-ft/yr, Applicant has requested inclusion of a Special Condition in its Production Permit to be issued pursuant to this Application which would limit Applicant's total annual production pursuant to its new Production Permit and its Existing and Historic Use Permits to a combined maximum production volume of 47,418 ac-ft/yr. Applicant understands that water produced under this permit for Public Supply and/or Industrial purposes will be subject to the District's rules relating to new permits, and of the rules which remain applicable to its Existing and Historic Use Permits.

41. The 47,418 acre feet of water requested in FSH's Application is the same amount of water for which FSH has the authority to produce under its Historic and Existing Use Permits issued by the District.

42. FSH's Application provides that the purpose of use of the water would be 47,418 acre feet per year for Public Supply and/or Industrial uses. FSH's Application indicated that the water would be supplied to municipal water purveyors and/or manufacturing, electric generation, oil and gas, etc...in terms of the types of industries.

43. FSH's Application alleges that the total number of acres of land contiguous in ownership with the land where the well(s) are located is 18,510.61 acres. Evidence presented by FSH shows that the actual number is 17,856.78 acres, with 3,665.70 being leased acres.

44. FSH's Application requests that the duration of the permit term be five years subject to an automatic extension to 50 years under certain circumstances.

45. FSH's Application asserts that the proposed location of use may be within 22 counties located within the Texas Water Development Board's State Water Plan "Region F" Planning Area.

46. Through its Application and special condition, FSH is attempting to change the purpose and location of use of its 47,418 acre feet of current pumping rights (for irrigation use) under its Historic and Existing Use permits to a new purpose (municipal and/or industrial) and a new location (an unspecified area outside of the boundaries of the District).

47. As part of its February 10, 2010 application supplement, FSH submitted a Williams Farms Desalination Study conducted by Black and Veatch. The study recommended that reverse osmosis be used as the treatment process for water produced from FSH property and that the recommended disposal method for the discharge of the concentrate flows that would result from treatment of the water is through deep well injection. The study provides that additional investigations would be needed to determine the feasibility of the deep well injection disposal method and the associated costs. The study also indicates that surface water discharge is also a possibility to dispose of the waste, but that this

alternative would need to be investigated further with the Texas Commission on Environmental Quality to determine feasibility.

48. Black and Veatch found that high concentrations of iron and manganese contribute to high average and maximum values in some of the FSH wells. Suspended constituents of concern for making reverse osmosis a viable option include turbidity, colloidal material and oxidized forms of metal and oxides such as iron and manganese.

49. The dissolved solids from the water proposed to be withdrawn and transferred is approximately 1,900 milligrams per liter and that FSH would have to remove 900 milligrams per liter in order to sell the water for municipal purposes through the reverse osmosis process.

50. According to the testimony of FSH witness Mr. Jeff Williams, the Historic and Existing Use Permits in question were granted upon maximum production of these wells in many different years and not from any one year.

51. FSH's current and recent water usage is well below its Historic and Existing Use permitted amount of 47,418 acre feet per year for agricultural purposes. Production from FSH's Historic and Existing Use Permits was approximately 22,000 to 25,000 acre feet per year between 2003 and 2009. Production from FSH's Historic and Existing Use Permits was approximately 30,000 acre feet per year in 2010.

52. FSH's Historic and Existing Use Permits authorize production of groundwater only for agricultural irrigation purposes.

53. FSH consultants participated in discussions with two different utilities directors for the City of Midland. These discussions indicated that while the City of Midland may be interested in FSH's potential water source, there are certain factors that the City of Midland will consider before contracting to buy water from FSH or the Midland County Fresh Water Supply District No. 1, including the cost of the water and whether Midland would be able to remove deposits from their pipes so the pipes do not leak.

54. FSH has had preliminary contacts and discussions with parties that are, at best, *possible* or *potential* purchasers of water. Such potential customers have options besides FSH, including those that are identified in the approved Region F Regional Water Plan.

55. It is not inevitable that the City of Midland, some not-yet-created or confirmed utility district in Midland County, or anyone else, will purchase water to be pumped pursuant to the permit requested by FSH.

56. The Raw Water Supply Contract between FSH and the Midland County Freshwater Supply District No. 1 does not reflect a firm commitment to do anything except to coordinate efforts.

57. As of the date of the hearing on the merits of FSH's Application, FSH did not provide any evidence that either FSH or Midland County Fresh Water Supply District No. 1 has a customer, demand, need, or a confirmed destination for the water that it requested in its Application.

58. Dr. James Duke testified that in order for FSH's project to be feasible, FSH would need the full 47,418 acre feet requested in FSH's Application.

59. Dr. James Duke testified that he estimates that there would be about 10 to 15 percent loss because of the reverse osmosis treatment process, leaving approximately 40,304 acre feet to be sold for municipal or industrial purposes. The Black and Veatch report submitted by FSH indicates that the loss from reverse osmosis is in the range of 15 to 25 percent.

60. The City loses approximately 23 percent of its water from reverse osmosis.

61. High levels of magnesium, manganese and iron were detected in the groundwater in the Leon-Belding area which can make the water unsuitable for reverse osmosis treatment.

62. Despite the fact that some of the requested 47,418 acre feet of water would be lost in the reverse osmosis process, FSH entered into a Raw Water Supply Contract with Midland County Fresh Water Supply District No. 1 for the delivery of up to 47,418 acre feet of groundwater.

63. The County owns wells that could be adversely affected by the granting of the Application.

64. The City operates a public water supply system, providing potable water to customers from groundwater wells located in the Leon-Belding area in Pecos County.

65. The City owns and operates four wells in the Leon-Belding area, which serve as the exclusive supply of water for the City's public water supply system.

66. The City's wells are adjacent to FSH's proposed well field, within one-half mile of some of FSH's proposed production wells.

67. The City's Leon-Belding area wells are completed in the Edwards-Trinity aquifer.

68. The City's Leon-Belding area wells were connected to the municipal water system in the early 1960s, after the City's municipal wells near Comanche Springs failed.

69. Groundwater in the Leon-Belding area has elevated levels of total dissolved solids, which requires the City to operate a reverse osmosis treatment plant to bring the water within state secondary drinking water standards.

70. The City has Historic and Existing Use Permits from the District to operate its wells and produce up to 8,081.3 acre feet per year.

71. The City uses on average approximately 3,500 acre feet per year.

72. Evidence provided by and testimony from the City's expert provided that production from the Leon-Belding area at historically high levels from the 1940s to 1970s resulted in an apparent water quality decline in the area.

73. The City's expert testified that FSH's Application, if granted, has the potential to further degrade water quality in the Leon-Belding well field, which would increase water treatment costs for the City, for instance, by increasing the use and frequency of replacement for filter medias and treatment chemicals.

74. The treatment of the water requested by FSH will create approximately 3.75 billion gallons of waste per year.

75. The City's reverse osmosis system is designed to handle water with total dissolved solids up to 3,000 mg/L. If the quality of water declines and total dissolved solids exceeds 3,000 mg/L, the reverse osmosis system will have to be redesigned.

76. The City spent $5,409,000.00 during the past five fiscal years 2005 to 2010, on its reverse osmosis plant.

77. The City has other potential groundwater resources, but all are cost prohibitive options for its public water supply system.

78. The City public water system is already strained financially, with the City having to meet its obligations through certificate of obligation bonds rather than revenue.

79. The City's public water supply system is vulnerable and sensitive to any decrease in water levels or degradation in water quality.

80. The County, City, Gregg McKenzie, Pecos County WCID No. 1 and the General Manager provided evidence and testimony that the groundwater availability model prepared by FSH consultants and submitted to the District on April 15, 2011, could likely underestimate the effects of FSH's proposed pumping on adjacent well owners and the aquifer due to inaccuracies with some of the model's input parameters.

81. As of the final date of the hearing on FSH's Application, FSH had only received letters of interest from retail water suppliers. These letters of interest only describe an interest to discuss FSH's potential project, and do not commit to using FSH water if the permit were granted by the District.

82. Substantial withdrawals of groundwater during the 1950s and 1960s rendered the City's wells unusable, and as a result, the City had to relocate its municipal well field to a new location in the Leon-Belding area.

83. Clayton Williams Farms is the general partner of FSH, Clayton Williams Farms, Inc., is a partner of FSH, and members of the Williams family are partners in FSH.

84. Evidence was presented that FSH created or assisted in the creation of the Midland County Fresh Water Supply District No. 1 in an effort to show that FSH has a customer for the water that they requested in their Application.

85. FSH's witnesses testified that FSH has identified potential customer bases, but has not secured any customers.

86. FSH witnesses testified that FSH has no intent of abandoning its current Historic and Existing Use permits issued by the District.

87. FSH representatives provided information at public meetings in Midland that FSH is requesting a change in the purpose and location of use of the water that has been produced historically under FSH's Historic and Existing Use permits.

88. The environmental impact statement prepared by the Department of Energy for the Texas Clean Energy Project (Summit Power Group) prioritizes water supply options for Summit Power Group's project, and listed FSH as the third of three water supply options.

89. There were no representatives from the Cities of Midland, Odessa, San Angelo, or any other entity or potential customer within the 22 counties identified as the location of use within the Region F Regional Water Planning Group area to testify on their water supply needs, the sources identified to meet those needs, or whether FSH is being considered as a potential water source.

90. The City of Fort Stockton is limited to using local groundwater resources as its source of supply while the Cities of Midland, Odessa, and San Angelo have multiple sources of supply currently available or available for development.

91. Mr. Brock Thompson stated that there are many variables that exist with regard to FSH's proposed project and use of the water requested in its Application, including construction costs, reverse osmosis plants, and pipeline routes, all of which have not been fully developed or explored yet.

92. FSH has not developed a written business plan or other type of plan that lays out the objectives for the FSH project. In addition, Mr. Thompson testified that FSH has not yet developed any pro formas or other accounting documents to determine the financial feasibility of the project.

93. FSH included property that is leased under a 99-year contract with the acreage associated with its Application and that the terms of the leases limit the use of water to agricultural use only.

94. FSH does not have authority from the lessors who have leased property associated with the Application to commit the permits associated with lessors' property and groundwater under the lessors' property for use under their requested permit.

95. Historically, FSH has put into irrigated agricultural production about 12,000 acres total, and only about 6,200 acres at any one time since the 1980s.

96. FSH's March 16, 2011 amended application does not delete all wells on leased property or on the property lines of the leased property.

97. FSH narrowed its application to produce from 25 wells, which wells are permitted to produce 29,931 acre feet per year under FSH's Historic and Existing Use Permits. FSH's original Application requested authority to produce from all 46 wells associated with FSH's Historic and Existing Use Permits.

98. The City presented evidence and testimony that FSH is only authorized to produce 29,931 acre feet from the 25 wells under its Historic and Existing Use Permits, but that FSH asks to preserve the right to produce all 47,418 acre feet per year from fewer wells and smaller acreage.

99. Acreage associated with FSH's Application is divided into four parts: (1) Caramba Farms North, (2) Caramba Farms South, (3) Stockton Farms, and (4) Mesa Farms.

100. The leased tracts are on the Mesa Farms and Stockton Farms portions of the property associated with FSH's Application.

101. FSH owns the right to produce groundwater while the surface acreage is either owned by Clayton Williams Farms, Inc., or those persons or entities from whom the acreage has been leased.

102. Testimony provided by Mr. Robert Rendall, a real estate attorney for certain Clayton Williams companies, including FSH, indicated that a mistake had been made in the original Application filed by FSH because property that was not owned by one of Clayton Williams' entities, Clajon Production Corporation, was mistakenly conveyed as if Clajon Production Corporation owned the property even though the property was owned by Mr. L.B. Ryan and Mr. Gregg McKenzie.

103. FSH did not rectify the false claim of ownership to the leased lands until Mr. L.B. Ryan and Mr. Gregg McKenzie became parties to hearing of FSH's Application and brought it to FSH's attention.

104. Dr. James Duke testified that one factor to consider in determining project feasibility is whether there is sufficient capacity in the transmission lines to provide electricity to FSH's project site in the Leon-Belding area. Dr. James Duke indicated that a consultant, Mr. Charlie Adams, represented that there would be enough capacity in the transmission

lines, but that FSH's Application does not contain any documentation that reflects this opinion.

105. FSH's project to transport water from Pecos County to other areas in Region F is not listed in the Region F Regional Water Plan.

106. The Midland County Freshwater Supply District No. 1 would likely be responsible for the financing of FSH's project.

107. Dr. James Duke testified that it was not inevitable that one or more entities would purchase, lease or otherwise receive water from FSH if the permit were granted.

108. FSH's consultants developed a five-well test plan in coordination with the District and that the five-well test plan verified the Thornhill Group's prior analyses provided in its 2008 Report submitted to the District.

109. Darrell Peckham, P.G., testified that where there is more heterogeneity in an aquifer, such as in the area of FSH's proposed pumping, that there must be more control on the use of a model for simulations, which requires more modeling expertise.

110. FSH used approximately 30 pump tests from 17 wells to determine aquifer characteristics in the 2008 Report submitted to the District, and some of those 17 wells are no longer included in FSH's Application. FSH's 2008 Report providing information on the pump tests conducted on the 17 wells did not include any wells from Caramba Farms because the Caramba property had not been purchased at the time the study was conducted to prepare the Report.

111. The range of transmissivity values from the 2008 Report prepared by Thornhill Group was 60,000 gallons per day per foot to 1,250,000 gallons per day per foot.

112. The range of transmissivity values in the 2010 addendum to the Hydrogeologic Report was between 388,985 and 1,214,998 gallons per day per foot.

113. Transmissivity values reflect the ability of the water to be transmitted through material in the aquifer.

114. Mike Keester, P.G., testified that an aquifer model is an application of a mathematical formula to simulate aquifer conditions.

115. The Edwards Trinity Aquifer in the area of Pecos County is considered to be a mature karst aquifer.

116. The testimony and expert report of Dr. Al Blair provide that the model described in the 2011 Report submitted by FSH significantly overestimates recharge from Glass Mountains, significantly overestimates historical use, and underestimates return flows.

117. The testimony and expert report of Dr. Al Blair provide that the problems with the inputs to and outputs from FSH's model described in the 2011 Report submitted by FSH, and problems with the model's calibration, affect the model's efficacy, and that based on these problems and on recent measurements of aquifer levels, the model is not capable of reliably predicting the effects of granting FSH's permit application on the aquifer and on nearby users.

118. Dr. Al Blair testified that he disagrees with the conclusion of FSH's experts as set forth in FSH's 2011 Report, that if pumping continues at current levels, aquifer levels will not decline and will remain constant. Dr. Al Blair testified that if pumping continues at its current levels, aquifer levels will continue to decline at a rate of approximately 3.2 feet.

119. Taken together, the expert testimony and technical evidence on the effect of granting FSH's permit on the aquifer and nearby users shows that there is considerable uncertainty regarding how severe the drawdown on the aquifer will be in the coming years.

120. FSH did not provide evidence or testimony as to the exact judgments or calibrations that were used to create the model to develop the 2011 Report.

121. The transmissivity values calculated by Charles R. Williams, P.G., and admitted into evidence at the hearing were lower than the values calculated by FSH's hydrogeologists.

122. Evidence and testimony provided by the City's, the County's, and the General Manager's experts demonstrates that FSH's model inputs could be inaccurate and that such inaccurate model inputs could likely results in inaccurate predictions of drawdown.

123. David Dunn, P.E., testified that only those recommended strategies identified in the 2011 Region F Regional Water Plan are considered to be the strategies recognized to meet the needs identified in the Region F Regional Water Plan and that FSH's project is not a recommended strategy cited in the 2011 Region F Regional Water Plan.

124. The General Manager's expert, David Dunn, P.E. provided certain testimony related to Section 36.122(f)(3) of the Texas Water Code for the purpose of allowing the Board to consider this criteria for determining whether to limit FSH's amount of production if the permit were granted.

125. FSH essentially seeks an amendment to its Historic and Existing Use permits to allow FSH to convert the location and purpose of use of groundwater under those permits to new purposes and to a new (as of yet undetermined) place of use while preserving its rights to the same *amount* of production.

126. FSH's experts and the City's expert predict there will be adverse impacts in the form of drawdown of the aquifer if FSH's Application is granted.

127. The City's expert Mr. Stefan Schuster, P.E., predicts drawdown greater than that predicted by FSH's experts.

128. The City's expert estimates potential drawdown of up to 90 feet.

129. The City's expert estimates a 25 percent error in the overall historical irrigation estimates by FSH's expert for the Leon-Belding area. If historical pumping was actually less, predicted drawdown in the aquifer would be greater.

130. The City's expert provided an expert report and testimony that the absence of technical data strains the accuracy of all expert predictions in this case, leading to uncertainty of the predictions.

131. The City's expert testified that production under FSH's Application will cause aquifer water levels to decline perhaps by as much as 90 feet, which could require the City to rework its wells to lower the well pumps, and would therefore increase costs to the City.

132. Since the 1980s, District-wide production has been substantially less than the amounts permitted for production by the District.

133. Establishing a precedent of authorizing new permits for Historic and Existing Permit amounts will result in production amounts with serious negative impacts on all permit holders and users in the District.

134. Testimony was presented that water quality in the Edwards-Trinity system is quite variable, fluctuating for some minerals by more than 100%. Certain mineral concentrations increase during the irrigation season, suggesting that increased drawdown and longer-term pumping of the aquifer causes more water to be pumped from the Trinity Sands portion of the aquifer.

135. Increased contribution from the finer sands aquifer of the Trinity, due to drawdown, could significantly degrade water quality.

136. Nitrate fluctuations and lower magnesium/calcium rations suggest localized recharge and/or return flows from local irrigation use.

137. The possible impacts associated with granting FSH's Application include aquifer water level drawdown, water quality degradation, and, in a worst case scenario, loss of the City's current municipal water supply absent massive capital investment. All of these potential impacts would increase costs to the City.

138. The City's expert testified that granting the permit as requested by FSH will, if exercised, result in a permanent loss of spring flow at Comanche Springs.

139. Mr. Tom Beard, on behalf of Leoncita Land Company, testified that the springs on his property are weakened by FSH's current production.

140. The Region F plan details the T Bar Well field, availability of water from the Colorado River Municipal Water District (CRMWD), the groundwater well field from Luminant Generation company in Ward County, and a water reclamation plant in Big Springs, Texas, among other groundwater and surface water sources.

141. The City's gross water usage will increase with the increase of total dissolved solids in the aquifer, since a higher percentage is lost through the reverse osmosis process.

142. Evidence and testimony presented at the hearing on FSH's Application provided that long term pumping locally increases upward flow from underlying formations with higher total dissolved solids resulting in degradation of groundwater quality.

143. Evidence and testimony presented at the hearing provided that FSH's proposed sustained pumping conditions will limit seasonal aquifer recovery traditionally experienced by the fluctuations in water use from the irrigation season.

144. Testimony provided by Mr. Jeff Williams provided that FSH does not meter its total water usage and FSH's Historic and Existing Use Permits were based on estimates relating to the types of crops FSH reports having planted during the Historic and Existing Use period.

145. Evidence and testimony provided at the hearing on FSH's Application provided that FSH's proposed permit would decrease the recharge of the aquifer by as much as 15 to 30 percent since there would be no return flow to the area.

146. Neither the City of Midland's nor the City of Fort Stockton's existing reverse osmosis plants are equipped or capable of handling the waste generated from the 47,418 acre feet of production requested by FSH in its Application.

147. FSH expert Dr. James Duke testified that a pipeline as large as 54 inches in diameter could be used to transport water from the Leon-Belding area.

148. Evidence and testimony was presented that a 54-inch inside diameter pipeline could store as much as 66 million gallons of water and transport as much as 115 million gallons of water per day.

149. Evidence and testimony presented at the hearing on FSH's Application provided that much of the proposed receiving area is a member of the Colorado River Municipal Water District (CRMWD), which has alternative plans to meet future water needs.

150. Pecos County WCID No. 1 historically provided water from the Comanche Springs to residents of Fort Stockton and farmers and ranchers North and East of the Comanche Springs.

151. Pecos County WCID No. 1 currently produces groundwater from the Edwards-Trinity aquifer for potable water supply to approximately 4,000 customers.

152. Pecos County WCID No. 1 has had to relocate its water supply in the past due to historic withdrawal of groundwater.

153. FSH did not conduct specific studies or address the impacts of the proposed pumping of 47,418 acre feet on Pecos County WCID No. 1, Mr. Tom Beard (Leoncita Land Company), Mr. Gregg McKenzie, Mr. L.B. Ryan, the County, or on any other existing user other than the City.

154. Over pumping by FSH in the Leon-Belding area will adversely affect other permit holders including the City who would have to rework wells and increase pumping costs.

155. Evidence and testimony presented at the hearing on FSH's Application reflects that if the full amount allocated under FSH's Historic and Existing Use Permits were exercised by FSH, the impacts to permit holders, the aquifer, and water quality could be substantially greater than under current pumping conditions.

156. The issues of water contamination and water quality degradation raised by the protesting parties were not addressed by FSH at the hearing on FSH's Application.

157. FSH's witnesses frequently stated that certain questions were best suited for another witness or that other witnesses that were not made available to testify were best suited to answer the questions of the parties to the hearing.

158. FSH's witnesses were not able to answer very general questions concerning the mathematics and/or science of modeling.

159. Neither FSH nor any other party presented evidence at the hearing on FSH's application of the possible effects on the aquifer and nearby users of the issuance of a new permit for 47,418 acre feet per year for new uses while leaving the existing authorization for 47,418 acre feet per year in place.

CONCLUSIONS OF LAW

1. Pursuant to Section 36.0015, Water Code, and the District's enabling legislation, the District is charged with conserving, protecting, preserving, recharging, and preventing waste of the groundwater resources of Pecos County through rules developed and adopted under Chapter 36, Water Code.

2. The hearing on FSH's Application was properly noticed in accordance with District Rule 11.11.2 and Section 36.404, Water Code.

3. The hearing on FSH's Application held on April 10, 2010, and continued to May 4, 5, 10, 11, and 12, 2011, was conducted in accordance with Section 11 of the District's Rules and Chapter 36, Water Code.

4. The hearing on FSH's Application was continued in accordance with Section 36.409, Water Code.

5. The Presiding Officer issued multiple orders designating the procedural schedule for the hearing and providing deadlines for disclosure of party contentions, discovery, and depositions, in accordance with Sections 36.406(d) and 36.415, Water Code, and District Rule 11.11.3.

6. The hearing conducted on FSH's Application was conducted by a quorum of the Board in accordance with Section 36.406, Water Code.

7. The Board is able to make determinations on the credibility and forthrightness of witnesses called to testify on permit applications before the Board and is able to determine how much weight to give to testimony before the Board.

8. FSH was required to submit a Hydrogeological Report meeting the requirements of District Rule 11.10.3.

9. Section 36.415, Water Code, requires the District to adopt procedural rules to implement Subchapter M, Chapter 36, Water Code, related to Permit and Permit Amendment Applications. The procedural rules adopted by the District related to the processing and conduct of hearings on a permit application were adopted in accordance with Chapter 36, Water Code, and governed the process of the hearing on the FSH's Application.

10. FSH had the burden of proof to show that it met all of the elements required of permit applications in Chapter 36, Water Code, and the District's Rules.

11. Section 36.113(d), Water Code, and District Rule 11.11.10 require the Board, before granting or denying a permit application, to consider whether:

    (1) the application contains accurate information and conforms to the requirements prescribed by Chapter 36, Texas Water Code;

(2) the water well(s) complies with spacing and production limitations identified in these rules;

(3) the proposed use of water does or does not unreasonably affect existing groundwater and surface water resources or existing permit holders;

(4) the proposed use of water is dedicated to a beneficial use;

(5) the proposed use of water is consistent with the District's water management plan;

(6) the applicant agrees to avoid waste and achieve water conservation; and

(7) the applicant has agreed that reasonable diligence will be used to protect groundwater quality and that the applicant will follow well plugging guidelines at the time of well closure.

12. Sec. 36.1131 (b), Water Code provides the District may require the following in a permit:

(1) the name and address of the person to whom the permit is issued;

(2) the location of the well;

(3) the date the permit is to expire if no well is drilled;

(4) a statement of the purpose for which the well is to be used;

(5) a requirement that the water withdrawn under the permit be put to beneficial use at all times;

(6) the location of the use of the water from the well;

(7) a water well closure plan or a declaration that the applicant will comply with well plugging guidelines and report closure to the commission;

(8) the conditions and restrictions, if any, placed on the rate and amount of withdrawal;

(9) any conservation-oriented methods of drilling and operating prescribed by the district;

(10) a drought contingency plan prescribed by the district; and

(11) other terms and conditions as provided by Section 36.113.

13. In *Guitar Holding Company, L.P. v. Hudspeth County Groundwater Conservation District No. 1.*, 263 S.W.3d 910, 918 (Tex. 2008), the Texas Supreme Court invalidated a district's rule that allowed owners of historic and existing use permits to maintain historic use protections while converting the water use to a new purpose and location.

14. *Guitar* established that when an applicant seeks to convert its historic and existing use to a new use—for instance, by seeking to transfer water out of the district for municipal and industrial purposes—the protected use ends, as does any justification for protecting it. *Guitar* provides that when an applicant seeks to convert historic and existing use to a new use, the district may not give preference to the amount and purpose of the new use—all new uses must be treated equally.

15. As in *Guitar*, because FSH seeks to convert its historic irrigation production to a new purpose and location, there is no justification for continuing to protect that amount of production.

16. The holding in *Guitar* prohibits the District from granting FSH's Application.

17. The permit requested by FSH would allow FSH to change the location and purpose of use of water that it is currently authorized by the District to pump under its Historic and Existing Use permits if FSH can sell that water.

18. In the *Guitar case,* the Texas Supreme Court held that a groundwater district may not allow persons who hold permits based on historic or existing use of groundwater to change the purpose and location of use (*e.g.*, from irrigation within the district to municipal or industrial use outside of the district), while preserving their right to pump an amount of groundwater related to their historic or existing use.

19. The *Guitar* case stands for the proposition that in permitting transport or other new uses, a groundwater district may not "grandfather" an existing or historical user with respect to *amount*, and that with regard to new uses, a historical or existing user must stand on the same footing as all other landowners.

20. Because FSH seeks to preserve its Historic and Existing Use Permit amount through its special permit condition, and has refused to reduce that amount or disassociate its Application from its Historic and Existing Use Permit, granting FSH's Application as requested would violate the Texas Supreme Court's opinion in *Guitar*.

21. The adoption of a special permit condition proposed by FSH, providing that for each acre foot of groundwater pumped under the Production Permit, the amount that FSH is authorized to pump under its Historic and Existing Use Permits shall be reduced, will result in an illegal change in the place and purpose of use of the water, as prohibited by *Guitar*. FSH's Application is based upon the adoption of their proposed special permit condition.

22. Section 36.122(f), Water Code, requires the District to consider whether:

(1) the availability of water in the district and in the proposed receiving area;

(2) the projected effect of the transfer on aquifer conditions, depletion, subsidence, or on existing permit holders or other groundwater users in the district; and

(3) the approved regional water plan and certified district management plan.

23. Section 36.122(g), Water Code, provides that the District may not deny a permit based on the fact the applicant seeks to transfer groundwater outside of the District but may limit a permit issued if conditions under Section 36.122(f) warrant the limitation. In accordance with Section 36.122(g), the Board did not base its decision to deny FSH's Application on the fact that FSH sought to transfer groundwater, and based its decision on FSH's failure to meet the criteria expressly required of permit applications and of permits in the District's Rules and Sections 36.113(a), (c), and (d), and 36.1131(b), Water Code.

24. Section 36.101, Water Code, authorizes the District to make and enforce rules to provide for conserving, protecting, and recharging of the groundwater resources and to prevent the degradation of water quality.

25. The consideration of the effect on existing permit holders in Section 36.113(d)(3), Water Code, includes whether the proposed use of water will affect the water quality of the groundwater resources in the area.

26. Section 36.113(c), Water Code, allows the District to require that the following be included in permit applications:

(1) The name and mailing address of the applicant and the owner of the land on which the well will be located;

(2) If the applicant is other than the owner of the property, documentation establishing the applicable authority to construct and operate a well for the proposed used;

(3) A statement of the nature and purpose of the proposed use and the amount of water to be used for each purpose;

(4) A water conservation plan or a declaration that the applicant will comply with the district's management plan;

(5) The location of each well and the estimated rate at which water will be withdrawn;

(6) A water well closure plan or a declaration that the applicant will comply with well plugging guidelines and report closure to the Texas Commission on Environmental Quality; and

(7) A drought contingency plan.

27. District Rule 11.10.1 requires applicants to provide the information set forth in Section 36.113(c), Water Code.

28. FSH does not have the applicable authority to operate a well for the proposed use of groundwater from leased lands that FSH used to calculate acreage associated with its Application, as required by District Rule 11.10.1(a)(2) and authorized by Section 36.113(c)(2), Water Code. Such evidence and testimony provided that the leases associated with FSH's Application prohibit the use of water associated with the leased lands for any use other than agricultural irrigation.

29. The possible adverse impacts of FSH's Application on water quality are unreasonable, particularly given the potential impact on the City's permitted municipal water supply.

30. Evidence and testimony presented at the hearing on FSH's Application demonstrates that FSH did not meet the criteria in District Rule 11.11.10(d) and Section 36.113(d)(3) and 36.1131(b)(5), Water Code, related to beneficial use because FSH does not know the purpose of the use of the water and whether any of the requested amount of water will be used at all.

31. Evidence and testimony presented at the hearing on FSH's Application demonstrates that FSH did not meet the criteria in District Rule 11.11.10(a)(5) and authorized by Sections 36.113(c)(3) and 36.1131(b)(4), Water Code, because FSH did not prove the nature and purpose of the proposed use and the amount of water to be used for each purpose, and did not provide sufficient documentation evidencing the amount and purpose of water to be used during the initial permit term.

32. Evidence and testimony presented at the hearing on FSH's Application demonstrates that FSH did not meet the criteria in District Rule 11.10.1(a)(3) and authorized by Sections 36.113(c)(5) and 36.1131(b)(6), Water Code, because FSH did not provide sufficient information on the location of use of the water from each well, and the rate and amount of withdrawal from each well.

33. Evidence and testimony presented at the hearing on FSH's Application demonstrates that FSH did not meet the criteria in District Rule 11.11.10(c) and Section 36.113(d)(2) because FSH did not show that there will not be unreasonable effects on existing groundwater and surface water resources or existing permit holders.

34. FSH's Application did not meet certain criteria under Sections 36.113(a), (c), and (d), Water Code, and District Rules 11.1.1, 11.8.2, 11.10.1, and 11.11.10.

35. FSH did not show that the amount of available groundwater under its land was equal to or greater than the amount of groundwater requested in its application.

36. Evidence and testimony presented at the hearing on FSH's Application demonstrates that FSH's Application is speculative in nature because there is no certainty as to whether the water will be put to beneficial use, how the water will be put to beneficial use, when the water will be put to beneficial use, or where the water will be put to beneficial use.

37. *Texas Rivers Protection Ass'n v. Texas Natural Resource Conservation Commission*, 912 S.W.2d 147 (Tex. App.–Austin 1995, writ denied), is a case related to surface water permitting that FSH has relied upon for the proposition that the District cannot require the existence of contracts as a condition precedent to receiving a permit. The court in *Texas Rivers Protection Ass'n* weighed certain factors to determine whether an application is speculative, including whether it is inevitable that the water from the permit will be put to beneficial use, whether the infrastructure is in place to deliver the water, and whether there is a firm customer or demand for the water. Based on testimony and evidence provided at the hearing on FSH's Application, it is not inevitable that FSH's water will be put to beneficial use under a new Production Permit, FSH has not developed any infrastructure and has yet to fully evaluate and make a decision on the facilities, method, and costs associated with delivering the water, and does not have any firm customer or demand at this time.

38. The rules in effect on February 15, 2011, apply to the application; provided, however, that the Board considered all versions of its rules in effect from the time the Application was declared administratively complete and declared technically complete, and is of the position that it would have adopted the same findings and conclusions of law under any version of the rules.

39. At the conclusion of the testimony and evidence presented during the five-day hearing on FSH's Application, the Board accepted written closing arguments. After reviewing and considering the testimony and evidence in the record on FSH's Application, the Board met with a quorum, and upon a Motion and a second, voted unanimously on a 11-0 vote to deny the application.

* * *

Middle Pecos GCD Exhibit 8

Notice of April 28, 2009 House Natural Resources Committee Hearing on HB 4805 (81R)

HOUSE OF REPRESENTATIVES
NOTICE OF PUBLIC HEARING

COMMITTEE: Natural Resources

TIME & DATE: 8:00 AM, Tuesday, April 28, 2009

PLACE: E2.010

CHAIR: Rep. Allan Ritter

HB 1295 Aycock

Relating to notification of an application related to a certificate of public convenience and necessity for water or sewer service.

HB 1981 Rodriguez

Relating to the regulation of stormwater management by certain counties.

HB 2602 Kleinschmidt

Relating to the powers and duties of the Bastrop County Water Control and Improvement District No. 2; providing authority to impose a tax and issue bonds.

HB 4212 Callegari

Relating to the enforcement of rules by a groundwater conservation district or subsidence district.

HB 4719 Aycock

Relating to the creation of the Burnet County Municipal Utility District No. 3; providing authority to impose a tax and issue bonds; granting the power of eminent domain.

HB 4756 Howard, Donna

Relating to the Lower Colorado River Authority.

HB 4763 Crownover

Relating to the creation of the Denton County Municipal Utility District No. 8; providing authority to impose a tax and issue bonds; granting a limited power of eminent domain.

HB 4780 Heflin

Relating to election and qualifications of members of the board of directors of the Santa Rita Underground Water Conservation District.

HB 4784 Fletcher

Relating to the creation of the Harris County Municipal Utility District No. 524; providing authority to impose a tax and issue bonds; granting a limited power of eminent domain.

HB 4785 Weber

Relating to the powers and financing of the Brazoria County Groundwater Conservation District.

HB 4786 Weber

Relating to the creation of the Brazoria County Municipal Utility District No. 63; providing authority to impose a tax and issue bonds; granting a limited power of eminent domain.

HB 4790 Phillips

Relating to the creation of the Brown's Ranch Municipal Utility District No. 1 of Grayson County; providing authority to impose a tax and issue bonds; granting a limited power of eminent domain.

HB 4791 Zerwas

Relating to the powers of the North Fort Bend Water Authority.

HB 4792 Callegari

Relating to the powers of the West Harris County Regional Water Authority.

HB 4796 Rose

Relating to a study of the availability and sustainability of groundwater in the Hays Trinity Groundwater Conservation District; providing funds for the study.

HB 4799 Gattis | et al.

Relating to the creation of the Seven Oaks Ranch Municipal Utility District; providing authority to impose a tax and issue bonds; granting the power of eminent domain.

HB 4800 Gattis

Relating to the creation of the San Gabriel Municipal Utility District No. 1; providing authority to impose a tax and issue bonds; granting a limited power of eminent domain.

HB 4802 Otto

Relating to the creation of the Liberty County Municipal Utility District No. 6; providing authority to impose a tax and issue bonds; granting a limited power of eminent domain.

HB 4803 Maldonado

Relating to the creation of the South Fork Ranch Municipal Utility District; providing authority to impose a tax and issue bonds; granting a limited power of eminent domain.

HB 4805 Craddick

Relating to the creation of the West Texas Water Supply District; providing authority to impose a tax and issue bonds; granting the power of eminent domain.

HB 4807 Gallego

Relating to the board of directors of the Red Bluff Water Power Control District.

HB 4810 Miller, Doug

Relating to the creation of the Comal County Water Control and Improvement District No. 5; providing authority to impose a tax and issue bonds; granting a limited power of eminent domain.

HB 4811 Miller, Doug

Relating to the creation of the Comal County Water Control and Improvement District No. 6; providing authority to impose a tax and issue bonds; granting a limited power of eminent domain.

SB 794 Fraser

Relating to the composition of the board of directors of the Central Colorado River Authority.

HB 2166 Rose

Relating to increased oversight, openness, transparency, and accountability for water supply or sewer service corporations.

HB 2313 Gattis

Relating to the repeal of the designation of the Little River reservoir and the Little River off-channel reservoir as sites of unique value for the construction of a reservoir.

HB 3379 Miller, Doug

Relating to the eligibility of certain entities to receive money from the water infrastructure fund.

HB 3603 Paxton

Relating to a study of fire flow service by water supply corporations in semi-urban areas.

HB 3609 Miller, Doug | et al.

Relating to a requirement to provide sufficient water pressure for fire suppression in certain special utility districts.

HB 4153 Rose

Relating to an exemption from permitting requirements of the Edwards Aquifer Authority for certain wells owned by a charitable organization.

HB 4218 Turner, Sylvester

Relating to representation in a court proceeding involving a retail public utility providing water or sewer service.

HB 4318 Callegari

Relating to allowing certain landowners to request that land be decertified from the service area of a holder of a certificate of public convenience and necessity.

HB 4667 Merritt

Relating to the amount and use of the coastal protection fee.

SB 724 Hegar

Relating to the qualification of supervisors of a fresh water supply district.

SB 1047 Lucio

Relating to the procurement methods authorized for public projects by a combined municipally owned electric, water, and wastewater utility situated in an economically distressed area within 30 miles of the Lower Texas Gulf Coast.

SB 1238 Ogden

Relating to a study regarding the Carrizo-Wilcox aquifer.

SB 1386 Seliger

Relating to priority groundwater management areas.

SB 1414 Williams

Relating to the regulation of certain aggregate production operations by the Texas Commission on Environmental Quality; providing penalties.

<u>Middle Pecos GCD Exhibit 9</u>

Notice of September 20, 2016 House Natural Resources Subcommittee on Special Water Districts Hearing in Fort Stockton

** REVISION **

HOUSE OF REPRESENTATIVES

NOTICE OF PUBLIC HEARING

COMMITTEE:	Natural Resources-S/C on Special Water Districts
TIME & DATE:	11:00 AM, Tuesday, September 20, 2016
PLACE:	Fort Stockton, TX (Please see below)
CHAIR:	Rep. Lyle Larson

****Please note time change****

The hearing will be held at:

Fort Stockton ISD
Board Room, Administration Building
101 West Division Street
Fort Stockton, TX 79735

The Committee will meet to address Interim Charge 6: Evaluate the status of legislation to encourage joint groundwater planning, including HB 200 (84R), and monitor ongoing legal developments concerning ownership access to groundwater and the impact of these developments on property rights and groundwater management.

The Committee will hear invited and public testimony.

** See Committee Coordinator for previous versions of the schedule, if applicable. **

NOTICE OF ASSISTANCE AT PUBLIC MEETINGS

Persons with disabilities who plan to attend this meeting and who may need assistance, such as a sign language interpreter, are requested to contact Stacey Nicchio at (512) 463-0850, 72 hours prior to the meeting so that appropriate arrangements can be made.

Middle Pecos GCD Exhibit 10

Notice of and Minutes of April 3, 2017 public forum in Fort Stockton and April 6, 2017 Public forum in Iraan

MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT

P.O Box 1644 Fort Stockton, TX 79735 Phone (432)336-0698 Fax#432-336-3407
405 North Spring Drive Fort Stockton, Texas 79735
Email: mpgcd@mpgcd.org Website: www.mpgcd.org

NOTICE OF PUBLIC INFORMATIONAL MEETING AND SPECIAL-CALLED BOARD MEETING[1]

April 3, 2017, 7:00 p.m.
Pecos County Civic Center
1674 Airport Drive, Fort Stockton, Texas

During the meeting, a quorum of the Board may enter executive session under the Texas Open Meetings Act, § 551.071 of the Texas Government Code, for any item on this agenda or as otherwise authorized by law, and the Board may change the order in which one or more agenda items are considered.

PUBLIC INFORMATIONAL MEETING[2]

I Introduction by District's Board President.

II Presentation by District's General Manager on District's statutory purpose, priorities and groundwater studies, and recent developments with pending lawsuits filed against District, legislation that affects the District, and settlement proposal by Fort Stockton Holdings, Clayton Williams Farms and Republic Water Company.

III Public input on General Manager's presentation (limit 3 minutes per person).[3]

IV Closing remarks by District's Board Member(s) and General Manager.

V Adjourn public informational meeting.

MEETING AGENDA

I Establish quorum and call to order meeting.

II Comments from **public and media** (limit 3 minutes per person). Members of the public may address the Board for a limited time concerning any subject whether or not it is on the agenda.[3]

III Consider and/or act on matters involving Fort Stockton Holdings, LP (FSHLP), Republic Water Co. of Texas, LLC (Republic LLC) and Clayton Williams Farms,

Inc.'s draft settlement proposal received on March 18, 2017, related to following pending lawsuits and contested hearing:

- **Republic LLC's state-court lawsuit**, Court of Appeals Case No. 08-17-00001-CV
- **FSHLP v. Pecos County, MPGCD, et al.**, Court of Appeals Case No. 08-15-00382-CV
- **In re the Application of Republic LLC**, State Office of Administrative Hearings Docket No. 959-17-3195

Board action may include response to settlement proposal.

IV Briefing and take action as necessary on **matters regarding 85th Texas Legislative Session** that affect District, including passage of one or more resolutions to reflect Board's position on legislation.

V **Directors' comments.**[4]

VI Consider and/or act upon **agenda for next** meeting.

VII **Adjourn Board meeting.**

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[1] This facility is wheelchair/parking accessible. Requests for accommodations must be made 48 hours prior to this meeting by contacting Ty Edwards at 432-336-0698.
[2] The purpose of the Public Informational Meeting is to inform the public and receive public input on the matters listed. This segment of the meeting may not include a quorum of the District's Board of Directors; this notice is posted in the event that a quorum attends.
[3] The Board is not allowed to take action on any subject presented that is not on the agenda, nor is the Board required to provide a response; any substantive consideration and action by the Board on a matter presented by the public that is not on today's agenda will be conducted under a specific item on a future agenda.
[4] No action will be taken on these agenda items. These items are on the agenda to provide the District's General Manager and Directors an opportunity to bring to the public's and each other's attention important issues pertinent to groundwater management within the District. Any substantive deliberation and formal action on any of these issues will be conducted under a specific item on a future agenda.

MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT
P.O Box 1644 Fort Stockton, TX 79735 Phone (432)336-0698 Fax#432-336-3407
405 North Spring Drive Fort Stockton, Texas 79735
Email: mpgcd@mpgcd.org Website: www.mpgcd.org

Minutes of April 3, 2017

On this the 3rd of April, 2017, a Special Called board meeting and Public Informational Meeting was held by the Middle Pecos Groundwater Conservation District at the Pecos County Civic Center located at 1674 Airport Drive, Fort Stockton, Texas, with the following members present, to-wit:

Jerry McGuairt	President, Precinct 1
John Dorris	Vice President, Precinct 3
M. R. Gonzalez	Secretary/Treasurer, Precinct 2
Janet Groth	Precinct 1
Weldon Blackwelder	Precinct 3
Alvaro Mandujano, Jr.	Precinct 4
Vanessa Cardwell	City of Fort Stockton
Allan Childs, Jr.	At Large

Quorum Present.
Board members absent: Ronald Cooper and Jeff Sims
Note: Precinct 2/ Open Position

Others present: Ty Edwards, Mike Gershon, Gail Reeves, Melissa Mills, Gerald D. Lyda, Gene Lyda, Trey Gerfers, Kay Nowell, Jim Hatcher, Ronnie Brandenburg, Leven Porter, Lane Porter, Bob Hayter, Kathy Sconiers, Joe Sconiers, Tom Chapman, Santiago Cantu, Jr., Wynona Riggs, Gary and Donna Bryant, Frank Velasco, Jr., Frank L. Hoelscher, Marjorie Hoelscher, Larry Hoelscher, Ray and Kay Griffith, Babs and Don Kneupper, Zan Matthies, Billy Jackson, Sandra Sconeirs, Lupe Dominguez, Robert and Reba Preston, Jeff Williams, Brock Thompson, Ed McCarthy, Paula McGuairt, George and Stacy Hansard, Leesa Granado, Delmon Hodges, Georgia and Robert Jamison, Howard McKissack, Aggie Oldfield, Shirley Elmore, Frances and Dean Tedford, Al Haney, Martha Subia, Nancy and Rex Carpenter, Debra Ezell, Carol Adams, Roger Harrison, Gretta and Dudley McKissack, Houston McKenzie, Dan Frank, Todd and Jill Suter, Worth Kincaid, Angie and Dr. Jim Miles, Gladys Dorris, Donald and Loraine Lannom, Oscar Hernandez, James Cravens, Chris Alexander, Glenn and Karen Honaker, Frank Rodriguez, Joe Schuster, Arlie Weatherman, Ruben Houston, Gary Cardwell, Aku Rodriguez/CBS 7, and Bob Beal/Fort Stockton Pioneer.

I Call to order regular Board meeting at 7:00 p.m. by President Jerry McGuairt.

PUBLIC INFORMATIONAL MEETING

I Introduction by District's Board President.

II Presentation by District's General Manager on District's statutory purpose, priorities and groundwater studies, and recent developments with pending lawsuits filed against District, legislation that affects the District, and settlement proposal by Fort Stockton Holdings, Clayton Williams Farms and Republic Water Company.

Power Point Presentation given by Ty Edwards. He gave a brief history of the District, and our current monitoring and analysis schedule for Pecos County. He also talked about 1) the Aquifer Studies that have been completed in Pecos County, and 2) the export permits that have been granted in the past, and 3) the management zones and the purpose for having them, and 4) the 85th Legislature and bills associated with water, and 5) the permit application and settlement offer received from Fort Stockton Holdings LP/Clayton Williams Farms, Inc./Republic Water Company of Texas, LLC., and 6) historic and current water levels in Fort Stockton and in Management Zone 1.

III Public input on General Manager's presentation.
(Comments have been very condensed.)

Jim Hatcher: The Sunset Review bill would require a lot of tax payer money, and is ludicrous. The House Bill(s) are an attempt to impugn the integrity of the MPGCD Board. The City of Fort Stockton City Council and the MPGCD Board need to get along.

Zan Matthies: Mr. Matthies has been with the District since its inception. He believes that the District should be ran on the "good word" of individuals, and don't need lawyers and law suits. Our goal was to not pit neighbor against neighbor, nor brother against brother with water wars. We felt like permits for "Historic and Existing Use" would best benefit Pecos County and keep us out of lawsuits. We were also told you could use the water for whatever reason as long as it was a beneficial use.

Debra Ezell: Her family has ties to Pecos County ranch land since the 1800's. They have witnessed the drying up of Comanche Springs and other Pecos County Springs and would like to have water for future generations. She strongly opposes House Bill 4235.

Leesa Granado: She agrees with Debra Ezell and Jim Hatcher.

Gretta McKissack: Please consider tabling this matter so that we may think it over more. And, the current strategy seems to be to divide and conquer, so the City and MPGCD need to work together.

Bob Beal: He would like to know what Fort Stockton Holdings is seeking to accomplish by means of the settlement offer. And, how the offer relates to Republic Water Co. Of Texas.

There were no explanations or answers to Mr. Beal's questions.

Dudley McKissack: He asked if a production permit could have multiple uses on a single permit. (Ty Edwards answered "Yes".) Another thing, is 8 – 10 years ago there was a hearing at 1 p.m., and nobody could show up. There have been two court cases that have been thrown out. You need to keep plugging along. The Sunset Bill will die. Finally, I strongly urge you to consider what you are doing, because once you let one person start it – there's no end.

IV Closing remarks by Board Member(s) and General Manager.

Jerry McGuairt thanked everyone for coming to the public forum, and for their remarks and their support.

V Adjourn public informational meeting.
Jerry McGuairt adjourned the public informational meeting at 7:45 p.m.

MEETING AGENDA

I Call to order Special Called Meeting at 7:45 p.m. by President Jerry McGuairt.

II Comments from **public and media**

Trey Gerfers: He is with the Big Bend Conservation Alliance, and a resident of Marfa. He invited everyone to a West Texas Water Symposium on April 22nd at the Granada Theater in Alpine, Texas from 8 am to 5 pm.

Ronnie Brandenburg: He has Section 20 in Coyanosa. Pearl Resources (an Oil Company) drilled a horizontal well and didn't set surface casing. They drilled into the Capitan Reef and 2,000 gallons per minute along with H_2S Gas came to the surface. Mr. Brandenburg wanted to know why we haven't fined them.

General Manager Ty Edwards reported that the Railroad Commission is investigating and the insurance company hired an environmental team to do impact studies. The water quality analysis show that the H_2S Gas has dissipated, and there were no more water quality concerns. The Texas Railroad Commission is the regulatory agency responsible for the investigations and fines.

Dudley McKissack: Shared a quote worth remembering:
Sell your water – Sell your soul.

Zan Matthies: Regarding Historic and Existing Use permits: Water users were allowed to look at a 15 year period to determine the one year with the highest usage, and they were given a permit for the highest usage year. There is no way the Historic and Existing Use permits can harm the aquifer. Next, after the cutoff date of granting Historic and Existing Use permits – people could apply for a production permit. If granted, they can drill the well and if the aquifer drops to a bad level – they would be the first ones to be cut off. Second, you are selling your water any way you look at it. It is either going out in hay or cotton or cows. Water is leaving here.

III Consider and/or act on matters involving Fort Stockton Holdings, LP (FSHLP), Republic Water Co. of Texas, LLC (Republic LLC) and Clayton Williams Farms, Inc.'s draft settlement proposal received on March 17 ~~18~~, 2017, related to following pending lawsuits and contested hearing:

- **Republic LLC's state-court lawsuit**, Court of Appeals Case No. 08-17-00001-CV
- **FSHLP v. Pecos County, MPGCD, et al.**, Court of Appeals Case No. 08-15-00382-CV
- **In re the Application of Republic LLC**, State Office of Administrative Hearings Docket No. 959-17-3195

Board action may include response to settlement proposal.

An Executive Session was called at 7:58 p.m. by Presiding Officer Jerry McGuairt pursuant to the Texas Open Meetings Act, Sections 551.071 of the Texas Government Code, to consult with attorney.

The Executive Session ended at 9:07 p.m. President McGuairt stated that no decisions or votes were made in executive session.

John Dorris made a motion to table this item until after the Iraan Public Meeting on Thursday at 7 p.m. Seconded by Janet Groth. Motion carried unanimously.

IV Briefing and take action as necessary on **matters regarding 85th Texas Legislative Session** that affect District, including passage of one or more resolutions to reflect Board's position on legislation.

Tabled.

V **Directors' comments.** No comments

VI Consider and/or act upon **agenda for next** meeting. No comments.

VII **Adjourn Board meeting.**
Weldon Blackwelder made a motion to adjourn the meeting. Seconded by Allan Childs. Motion carried unanimously. The meeting adjourned at 9:12 p.m.

M R Gonzalez

M. R. Gonzalez, Secretary/Treasurer

Date Approved 4-18-17

Jerry McGuairt

Jerry McGuairt, President

Minutes prepared by Melissa Mills

FILED
MAR 30 2017
1:25pm
LIZ CHAPMAN
CLERK COUNTY COURT, PECOS CO., TEXAS
By: ____ Deputy

MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT
P.O Box 1644 Fort Stockton, TX 79735 Phone (432)336-0698 Fax#432-336-3407
405 North Spring Drive Fort Stockton, Texas 79735
Email: mpgcd@mpgcd.org Website: www.mpgcd.org

NOTICE OF PUBLIC INFORMATIONAL MEETING AND SPECIAL-CALLED BOARD MEETING[1]

April 6, 2017, 7:00 p.m.
Iraan Civic Center
Alley Oop Lane / 624 Parkside Street
Iraan, Texas

During the meeting, a quorum of the Board may enter executive session under the Texas Open Meetings Act, § 551.071 of the Texas Government Code, for any item on this agenda or as otherwise authorized by law, and the Board may change the order in which one or more agenda items are considered.

PUBLIC INFORMATIONAL MEETING[2]

I Introduction by District's Board Officer.

II Presentation by District's General Manager on District's statutory purpose, priorities and groundwater studies, and recent developments with pending lawsuits filed against District, legislation that affects the District, and settlement proposal by Fort Stockton Holdings, Clayton Williams Farms and Republic Water Company.

III Public input on General Manager's presentation (limit 3 minutes per person).[3]

IV Closing remarks by District's Board Member(s) and General Manager.

V Adjourn public informational meeting.

MEETING AGENDA

I Establish quorum and call to order meeting.

II Comments from **public and media** (limit 3 minutes per person). Members of the public may address the Board for a limited time concerning any subject whether or not it is on the agenda.[3]

III Consider and/or act on matters involving Fort Stockton Holdings, LP (FSHLP), Republic Water Co. of Texas, LLC (Republic LLC) and Clayton Williams Farms,

Inc.'s draft settlement proposal received on March 18, 2017, related to following pending lawsuits and contested hearing:

- **Republic LLC's state-court lawsuit**, Court of Appeals Case No. 08-17-00001-CV
- **FSHLP v. Pecos County, MPGCD, et al.**, Court of Appeals Case No. 08-15-00382-CV
- **In re the Application of Republic LLC**, State Office of Administrative Hearings Docket No. 959-17-3195

Board action may include response to settlement proposal.

IV **Directors' comments.**[4]

V Consider and/or act upon **agenda for next** meeting.

VI **Adjourn Board meeting.**

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[1] This facility is wheelchair/parking accessible. Requests for accommodations must be made 48 hours prior to this meeting by contacting Ty Edwards at 432-336-0698.
[2] The purpose of the Public Informational Meeting is to inform the public and receive public input on the matters listed. This segment of the meeting may not include a quorum of the District's Board of Directors; this notice is posted in the event that a quorum attends.
[3] The Board is not allowed to take action on any subject presented that is not on the agenda, nor is the Board required to provide a response; any substantive consideration and action by the Board on a matter presented by the public that is not on today's agenda will be conducted under a specific item on a future agenda.
[4] No action will be taken on these agenda items. These items are on the agenda to provide the District's General Manager and Directors an opportunity to bring to the public's and each other's attention important issues pertinent to groundwater management within the District. Any substantive deliberation and formal action on any of these issues will be conducted under a specific item on a future agenda.

MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT
P.O Box 1644 Fort Stockton, TX 79735 Phone (432)336-0698 Fax#432-336-3407
405 North Spring Drive Fort Stockton, Texas 79735
Email: mpgcd@mpgcd.org Website: www.mpgcd.org

Minutes of April 6, 2017

On this the 6th of April, 2017, a Special Called board meeting and Public Informational Meeting was held by the Middle Pecos Groundwater Conservation District at the Iraan Civic Center, Alley Oop Lane, 624 Parkside Street, Iraan, Texas, with the following members present, to-wit:

Jerry McGuairt	President, Precinct 1
John Dorris	Vice President, Precinct 3
M. R. Gonzalez	Secretary/Treasurer, Precinct 2
Janet Groth	Precinct 1
Weldon Blackwelder	Precinct 3
Alvaro Mandujano, Jr.	Precinct 4
Vanessa Cardwell	City of Fort Stockton
Jeff Sims	City of Iraan
Allan Childs, Jr.	At Large

Quorum Present.
Board members absent: Ronald Cooper
Note: Precinct 2/ Open Position

Others present: Ty Edwards, Mike Gershon, Gail Reeves, Melissa Mills, T. J. Holmes, Margaret Holmes, Evans Turpin, Gladys Dorris, Jeff Williams, Ed McCarthy, Brock Thompson, Scott Mitchell, Rita Childs, Paula McGuairt, John Evridge, Eddie Sweeten, Gary Drgac, Ira Yates, Don, and Bob Beal/Fort Stockton Pioneer.

Call to order at 7:00 p.m. by President Jerry McGuairt.

PUBLIC INFORMATIONAL MEETING

I Introduction by District's Board President.

II Presentation by District's General Manager on District's statutory purpose, priorities and groundwater studies, and recent developments with pending lawsuits filed against District, legislation that affects the District, and settlement proposal by Fort Stockton Holdings, Clayton Williams Farms and Republic Water Company.

Power Point Presentation given by Ty Edwards. He gave a brief history of the District, and our current monitoring and analysis schedule for Pecos County. He also talked about 1) the Aquifer Studies that have been completed in Pecos County, and 2) the export permits that have been granted in the past, and 3) the management zones and the purpose for having them, and 4) the 85th Legislature and bills associated with water, and 5) the permit application and settlement offer received from Fort Stockton Holdings LP/Clayton Williams Farms, Inc./Republic Water Company of Texas, LLC., and 6) historic and current water levels in Fort Stockton and in Management Zone 1.

III Public input on General Manager's presentation.

No Public Comment

IV Closing remarks by District's Board Member(s) and General Manager.
No Comments,

V Adjourn public informational meeting.
Jerry McGuairt adjourned the public informational meeting at 7:36 p.m.

SPECIAL CALLED MEETING CONTINUED

I Call to order Special Called Meeting at 7:36 p.m. by President Jerry McGuairt.

II Comments from **public and media**

Ty Edwards was asked why House Bill 4235 was filed.

Ty Edwards: I don't know why Larson would file it.

Jerry McGuairt said that people in the bigger cities need the water and they have more votes than we do out here.

III Consider and/or act on matters involving Fort Stockton Holdings, LP (FSHLP), Republic Water Co. of Texas, LLC (Republic LLC) and Clayton Williams Farms, Inc.'s draft settlement proposal received on March 17 ~~18~~, 2017, related to following pending lawsuits and contested hearing:

- **Republic LLC's state-court lawsuit**, Court of Appeals Case No. 08-17-00001-CV
- **FSHLP v. Pecos County, MPGCD, et al.**, Court of Appeals Case No. 08-15-00382-CV
- **In re the Application of Republic LLC**, State Office of Administrative Hearings Docket No. 959-17-3195

Board action may include response to settlement proposal.

An Executive Session was called at 7:44 p.m. by Presiding Officer Jerry McGuairt pursuant to the Texas Open Meetings Act, Sections 551.071 of the Texas Government Code, to consult with attorney.

The Executive Session ended at 8:16 p.m. President McGuairt stated that no decisions or votes were made in executive session.

John Dorris made a motion to respond to Fort Stockton Holdings, LP (FSHLP), Republic Water Co. of Texas, LLC (Republic LLC) and Clayton Williams Farms, Inc.'s March 17th proposal by authorizing our Board President and Secretary to execute the copies vetted by our settlement committee and drafted by our legal counsel that is before us today. Motion seconded by Alvaro Mandujano, Jr. No additional comments. Vote: **For:** 8 - Dorris, McGuairt, Gonzalez, Mandujano, Cardwell, Groth, Sims, Blackwelder. **Against:** 1 - Allan Childs. **Absent:** 1- Ronnie Cooper. **Vacant Position:** 1 – Precinct 2.

(Two duplicate originals of the MPGCD Counterproposal 4/6/17 were signed. MPGCD kept one and one was handed to Mr. Ed McCarthy.)

IV **Directors' comments**. No comments

V Consider and/or act upon **agenda for next** meeting. No comments.

VI **Adjourn Board meeting**.
Weldon Blackwelder made a motion to adjourn the meeting. Seconded by John Dorris. Motion carried unanimously. The meeting adjourned at 8:23 p.m.

M. R. Gonzalez

M. R. Gonzalez, Secretary/Treasurer

Jerry McGuairt

Jerry McGuairt, President

Date Approved 4-18-17

Minutes prepared by Melissa Mills

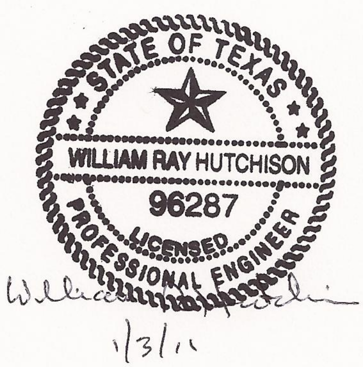
Middle Pecos GCD Exhibit 11

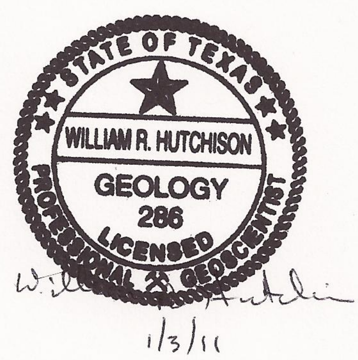
Texas Water Development Board GAM Task 10-033 (January 2011)

GAM Task 10-033

by William R. Hutchison, Ph.D, P.E., P.G.
Texas Water Development Board
Groundwater Resources Division
(512) 463-5067
January 3, 2011

The seal appearing on this document was authorized by William R. Hutchison, P.E. 96287, P.G. 286 on January 3, 2011





EXECUTIVE SUMMARY:

Middle Pecos Groundwater Conservation District is considering the designation of three management zones within the district, and requested that average drawdown associated with the desired future conditions in for each of these zones be estimated based on Scenarios 10 and 11 of GAM Run 09-035, Version 2 (Hutchison, 2010).

REQUESTOR:

Randy Williams of Bar-W Groundwater Exploration on behalf of the Middle Pecos Groundwater Conservation District requested the drawdown summary for the three proposed management zones.

DESCRIPTION OF REQUEST:

Middle Pecos Groundwater Conservation District is considering the designation of three management zones within the district, and requested that average drawdown associated with the desired future conditions in for each of these zones be estimated based on Scenarios 10 and 11 of GAM Run 09-035, Version 2 (Hutchison, 2010). As described in GAM Run 09-035, Version 2, the adopted desired future condition for the for the Edwards-Trinity (Plateau) and Pecos Valley aquifers in Groundwater Management Area 7 were based on Scenario 10, and the desired future condition for the Edwards-Trinity (Plateau) and Pecos Valley aquifers in Groundwater Management Area 3 were based on Scenario 11. Because proposed management zones 1 and 2 are wholly located in Groundwater Management Area 7, results from Scenario 10 were used to estimate average drawdown in each zone. Because proposed management zone 3 is wholly located in Groundwater Management Area 3, results from Scenario 11 were used to estimate average drawdown in this zone.

METHODS:

Mr. Randy Williams of Bar-W Groundwater Exploration on behalf of the Middle Pecos Groundwater Conservation District provided Excel files with the model row and column number for cells within each zone. The file named Zone1_Grids_Export_10182010.xls contained the cells within Zone 1. The file named Zone2_Grids_Export_10182010.xls contained the cells within Zone 2. The file named Zone3_Grids_Export_10182010.xls contained the cells within Zone 3. These files were then combined to a single file that contained the 700 model grid cells that constituted the three zones.

A FORTRAN code (*getmpzndd.for*) was written to read the management zone file and head output files from Scenarios 10 and 11, calculate annual average drawdown in each of the three zones, and write a file that summarized average annual drawdown for each of the three zones.

PARAMETERS AND ASSUMPTIONS:

- The recently modified and calibrated groundwater flow model of the Edwards Trinity (Plateau) and Pecos Valley aquifers (Hutchison and Jones, 2010) was used for these simulations. The model was calibrated based on groundwater elevation data from 1930 to 2005. Scenarios 1 to 10 used the calibrated model. As discussed in Hutchison (2010), specific storage values were modified in Crane, Ward, and Winkler counties for Scenario 11.

- The model has one layer which represents the Pecos Valley Aquifer in the northwest portion of the model area, the Edwards-Trinity (Plateau) Aquifer in the southeast portion of the model area, and a lumped representation of both aquifers in the relatively narrow area where the Pecos Valley Aquifer overlies the Edwards-Trinity (Plateau) Aquifer.

- As further detailed in the model report (Hutchison and Jones, 2010), model calibration statistics for the entire model domain for groundwater elevation is summarized below. Note that the calibrated model statistics are presented as well as the statistics for the modified model used in Scenario 11.

Statistic	Calibrated Model Used in Scenarios 1 to 10	Modified Model Used in Scenario 11
Average residual	-1.3 feet	-2.9 feet
Standard deviation	70 feet	70 feet
Range of measurements	3058 feet	3058 feet
Standard deviation divided by range	0.02	0.02

- Eleven different pumping scenarios were used as described in Hutchison (2010).

- Each simulation consisted of 55 annual stress periods. Pumping for the first five stress periods (2006 to 2010) was set equal to pumping estimated during model calibration for 2005. Pumping in stress periods 6 to 55 (2011 to 2060) was set equal to the values previously presented in Tables 1, 2 and 3, based on the scenario.

- Drawdown for each proposed management zone was calculated based on the difference between an initial condition at the end of 2010 (stress period 5) and the end of each stress period (2011 to 2060).

- Recharge in each stress period was assumed to be equal to average recharge during the calibration period (1930 to 2005).

- Other model inputs were based on average recharge conditions and did not vary during the simulations.
- The model was run with MODFLOW-2000 (Harbaugh and others, 2000).

RESULTS:

Average annual drawdown for each zone is summarized in Table 1.

Table 1: Average annual drawdown from 2010 conditions for each proposed management zone. Drawdown values in feet and rounded to the nearest foot.

Year	Drawdown (feet) from 2010		
	Zone 1	Zone 2	Zone 3
2011	1	0	0
2012	1	1	1
2013	2	1	1
2014	3	1	2
2015	3	1	2
2016	4	1	2
2017	5	1	3
2018	6	1	3
2019	6	2	4
2020	7	2	4
2021	8	2	4
2022	8	2	4
2023	9	2	5
2024	10	2	5
2025	10	2	5
2026	11	2	6
2027	11	2	6
2028	12	2	6
2029	13	2	6
2030	13	2	7
2031	14	2	7
2032	15	2	7
2033	15	2	8
2034	16	2	8
2035	17	2	8

Year	Drawdown (feet) from 2010		
	Zone 1	Zone 2	Zone 3
2036	17	2	8
2037	18	3	9
2038	19	3	9
2039	19	3	9
2040	20	3	9
2041	20	3	10
2042	21	3	10
2043	22	3	10
2044	22	3	11
2045	23	3	11
2046	24	3	11
2047	24	3	11
2048	25	3	12
2049	25	3	12
2050	26	3	12
2051	27	3	12
2052	27	3	13
2053	28	3	13
2054	29	3	13
2055	29	3	13
2056	30	3	14
2057	30	3	14
2058	31	3	14
2059	32	3	14
2060	32	3	15

REFERENCES:

Harbaugh, A.W., Banta, E.R., Hill, M.C., and McDonald, M.G., 2000, MODFLOW-2000, The U.S. Geological Survey modular ground-water model-user guide to modularization concepts and the ground-water flow process: U.S. Geological Survey Open-File Report 00-92, 121 p.

Hutchison, William R. (2010). GAM Run 09-035, Version 2, Model Run Report. Texas Water Development Board, August 7, 2010, 10p.

Hutchison, William R., and Jones, Ian, 2010 (in preparation). Evaluation of Groundwater Flow in Groundwater Management Areas 3 and 7 Using a MODFLOW-2000 Model. Texas Water Development Board Unpublished Report.

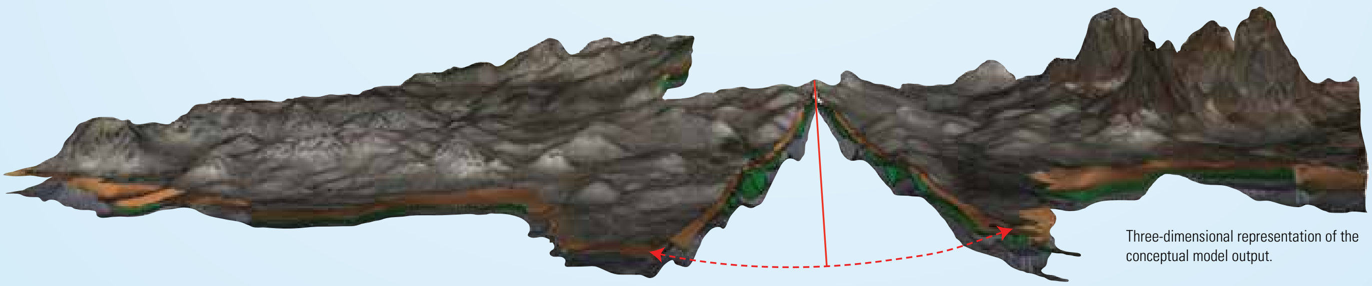
Middle Pecos GCD Exhibit 12

U.S. Geological Survey, A Conceptual Hydrogeologic Model for the Hydrogeologic Framework, Geochemistry, and Groundwater- Flow System of the Edwards- Trinity and Related Aquifers in the Pecos County Region, Texas (May 2013)

Prepared in cooperation with the Middle Pecos Groundwater Conservation District, Pecos County, City of Fort Stockton, Brewster County, and Pecos County Water Control and Improvement District No. 1

A Conceptual Hydrogeologic Model

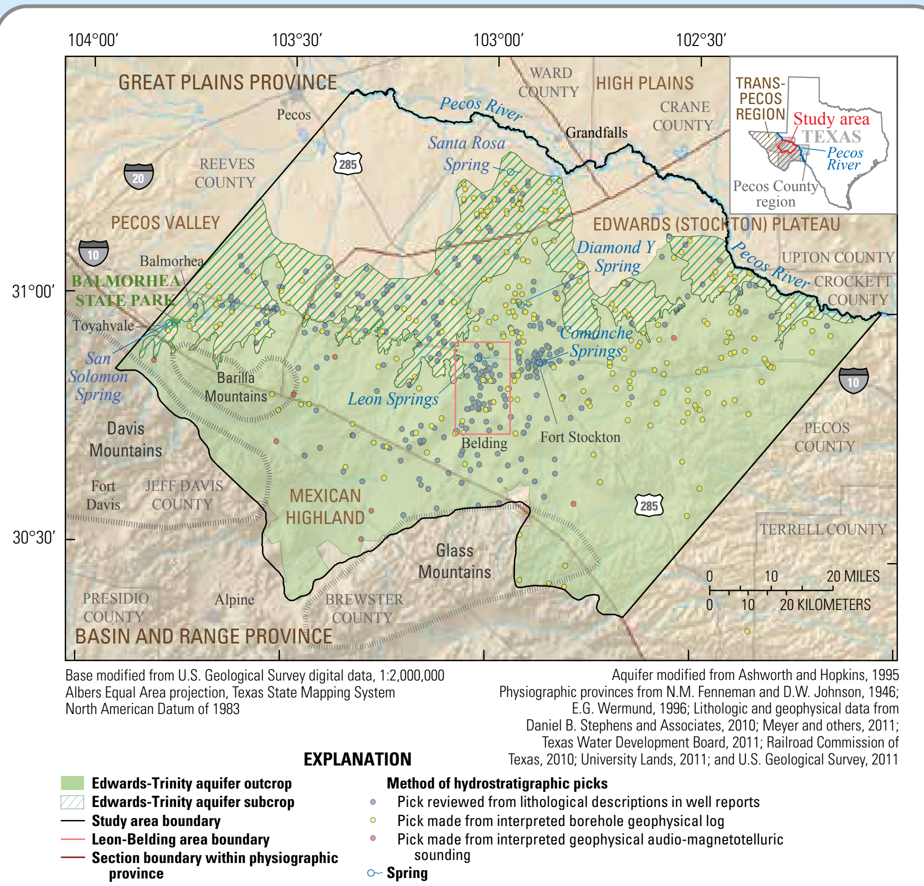
for the Hydrogeologic Framework, Geochemistry, and Groundwater-Flow System of the Edwards-Trinity and Related Aquifers in the Pecos County Region, Texas



Three-dimensional representation of the conceptual model output.

The Edwards-Trinity aquifer is a vital groundwater resource for agricultural, industrial, and municipal uses in the Trans-Pecos region of west Texas. A conceptual model of the hydrogeologic framework, geochemistry, and groundwater-flow system in the 4,700 square-mile (mi^2) study area was developed by the U.S. Geological Survey (USGS) in cooperation with the Middle Pecos Groundwater Conservation District, Pecos County, City of Fort Stockton, Brewster County, and Pecos County Water Control and Improvement District No. 1. The model was developed to gain a better understanding of the groundwater system and to establish a scientific foundation for resource-management decisions. Data and information were collected or obtained from various sources to develop the model. Lithologic information obtained from well reports and geophysical data were used to describe the hydrostratigraphy and structural features of the groundwater system, and aquifer-test data were used to estimate aquifer hydraulic properties. Groundwater-quality data were used to evaluate groundwater-flow paths, water and rock interaction, aquifer interaction, and the mixing of water from different sources. Groundwater-level data also were used to evaluate aquifer interaction as well as to develop a potentiometric-surface map, delineate regional groundwater divides, and describe regional groundwater-flow paths.

Several previous studies have been done to compile or collect physical and chemical data, describe the hydrogeologic processes, and develop conceptual and numerical groundwater-flow models of the Edwards-Trinity aquifer in the Trans-Pecos region. Documented methods were used to compile and collect groundwater, surface-water, geochemical, geophysical, and geologic information that subsequently were used to develop this conceptual model.



Location of study area and hydrostratigraphic data used to identify tops and bases (picks) of the hydrostratigraphic contacts in the Pecos County region, Texas.

Hydrogeologic Framework

Hydrostratigraphy

Well reports, borehole geophysical logs, and surface geophysical soundings were evaluated to determine the lithologies, hydrostratigraphic units, and the tops and bases of the hydrostratigraphic units (commonly referred to as the "hydrostratigraphic picks"). The resulting datasets were used to characterize vertical and lateral hydrostratigraphic extents. More than 2,000 data records for wells in or near the study area were obtained from various sources and evaluated for applicability to the study. A total of 662 records were found to contain pertinent data of applicable vertical extent within the study area. Stratigraphic and lithologic descriptions and borehole geophysical logs were obtained from existing reports and were assessed and interpreted to identify the vertical extents of hydrostratigraphic units. After the existing data were compiled, a geospatial analysis was done to identify data gaps and areas of concern. To enhance compiled data and fill in data gaps, where possible, 44 additional borehole geophysical logs, 4 time-domain electromagnetic (TDEM) soundings, and 13 audio-magnetotelluric (AMT) soundings were collected at the site. Three-dimensional surfaces were interpolated to represent the tops and bases of applicable hydrostratigraphic units. These three-dimensional surfaces were then used to assess all hydrostratigraphic contacts and refine contacts as needed.

U.S. Geological Survey borehole geophysical logging truck.

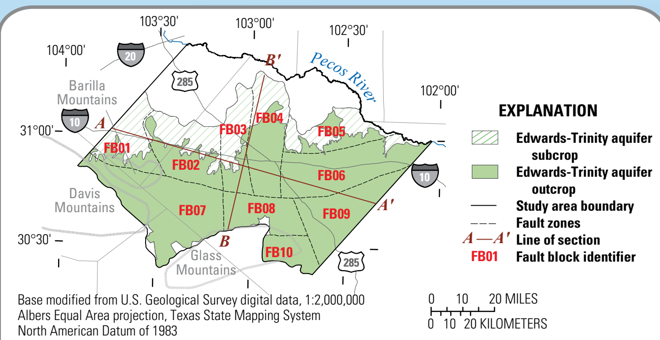
Borehole Geophysics

Borehole geophysical data such as natural gamma, formation resistivity, and caliper are commonly used to identify and characterize stratigraphic units; these data exist for many wells in the study area and were collected during previous scientific investigations and petroleum explorations. A total of 230 borehole geophysical logs—28 from University Lands (2011), 23 from USGS, 51 from the Railroad Commission of Texas, and 128 from Texas Water Development Board (Meyer and others, 2011)—were identified to contain relevant data for the project and were used to generate hydrostratigraphic contacts.

Surface Geophysics

Of the TDEM and AMT soundings collected in the study area, all of the TDEM soundings and four of the AMT soundings were near wells from which borehole geophysical logs were collected by the USGS. These locations were used to verify results between well data and surface geophysical soundings. Hydrostratigraphic contacts (picks) from surface soundings were used to supplement and enhance the compiled data set. Surface geophysical inverse modeling results were interpreted with layered-earth electrical scenarios in which each layer represents a separate electrical layer. These electrical layers then were associated with geologic layers. The layered-earth electrical scenarios for the AMT soundings were interpreted based on electrical changes in the modeling results.

Time-domain electromagnetic surface geophysical sounding collection.



Location of fault zones and fault blocks within the study area delineated based on the interpretation of multiple cross sections of interpolated hydrostratigraphic contacts.

Fault Interpretation

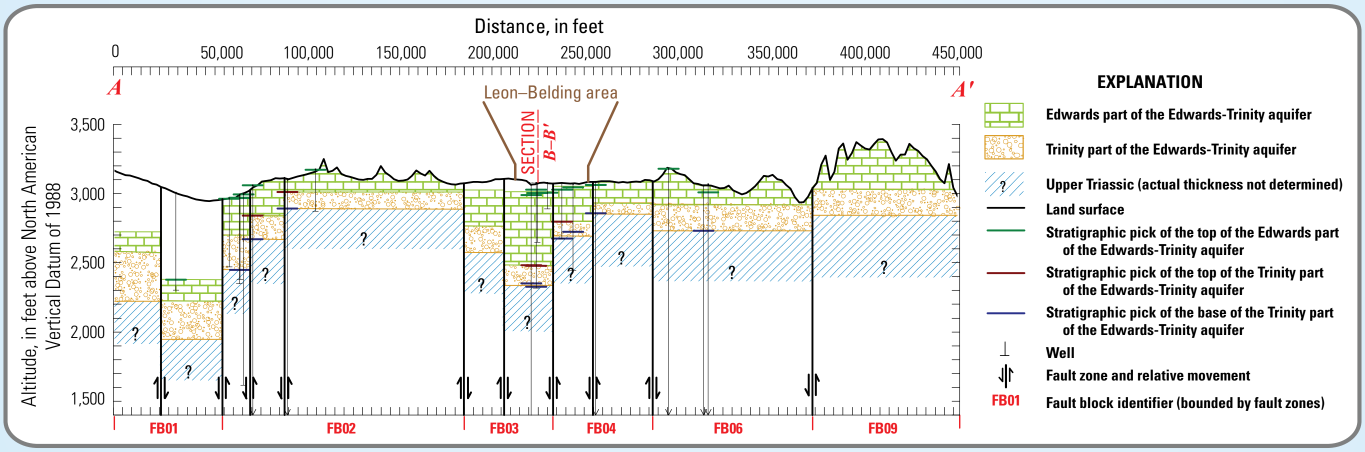
Faults in the study area likely formed as growth and collapse features as sediments were deposited along the margins of more resistant rocks and structures, such as the Glass Mountains, and as sediments collapsed into the voids created by the dissolution of Permian-age evaporite deposits. Fault zones were delineated based on the interpretation of cross sections of the interpolated top and base surfaces of the Edwards-Trinity aquifer units and are similar to faults delineated previously for the underlying Rustler aquifer (INTERRA Incorporated, 2011). Each fault zone represents a series of parallel and transverse faults that result in an overall displacement between two adjacent fault blocks.

Stratigraphic Surface Construction

After the geophysical logs and soundings were compiled and interpreted and the tops and bases of hydrostratigraphic units (picks) were determined, grids were created for each surface using kriging interpolation techniques. Modeling software was used to create the three-dimensional hydrostratigraphic surfaces. Preliminary grids were then used to identify outliers and areas requiring review. Throughout the process, the identified tops and bases of hydrostratigraphic units were reviewed and revised as needed to better conform to the available data.

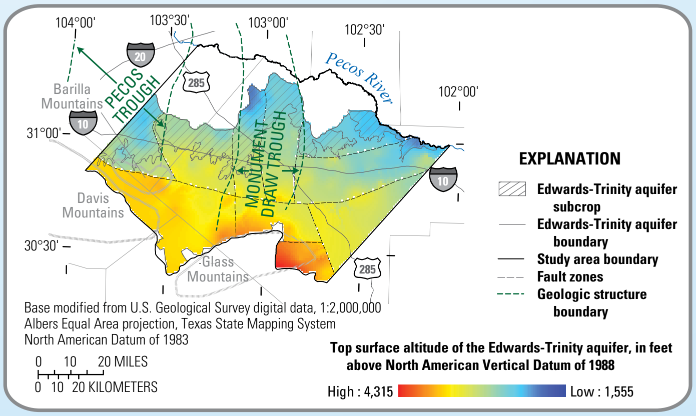
Hydrostratigraphic Layers

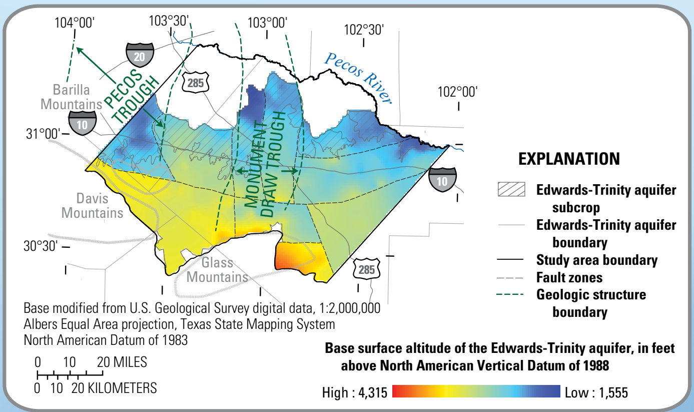
Cross Sections



Top of the Edwards-Trinity Aquifer

The altitude of the top of the Edwards-Trinity aquifer, which is, in general, the top of the Edwards part of the aquifer (upper Cretaceous), closely matched those of the land-surface altitudes throughout most of the study area. The altitude of the top surface of the Edwards-Trinity aquifer was highest in the southern part of the study area near the Glass Mountains (about 4,310 feet). The altitude decreased to the northeast, and the lowest altitude near the northeastern edge of the study area at the Pecos River was about 2,250 feet. The Edwards-Trinity aquifer dipped more sharply than the slope of the land surface in two locations, Monument Draw trough and the Pecos trough. All altitudes were measured in feet above North American Vertical Datum of 1988.



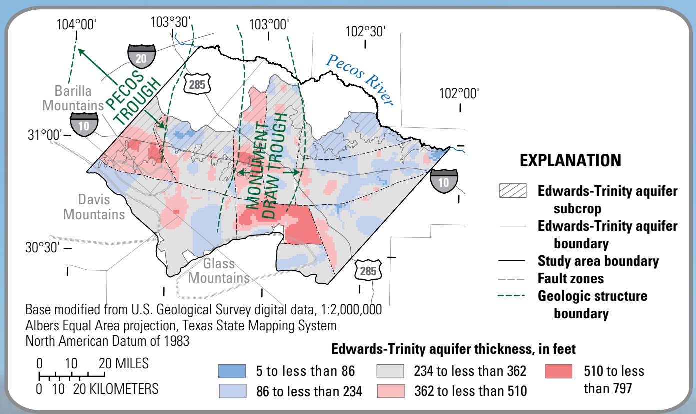


Base of the Edwards-Trinity Aquifer

The spatial trends observed for the base surface of the Edwards-Trinity aquifer were similar to those observed for the top of the Edwards-Trinity aquifer. The highest altitude of the base of the Edwards-Trinity aquifer was in the southern part of the study area near the Glass Mountains (about 4,110 feet). Similar to the top of the Edwards-Trinity aquifer, the altitude of the base of the Edwards-Trinity aquifer decreased to the northeast, which is consistent with findings by Barker and Ardis (1992). The lowest altitude for the base of the Edwards-Trinity aquifer was in the north-central part of the study area in the Monument Draw trough (about 1,550 feet).

Thickness of the Edwards-Trinity Aquifer

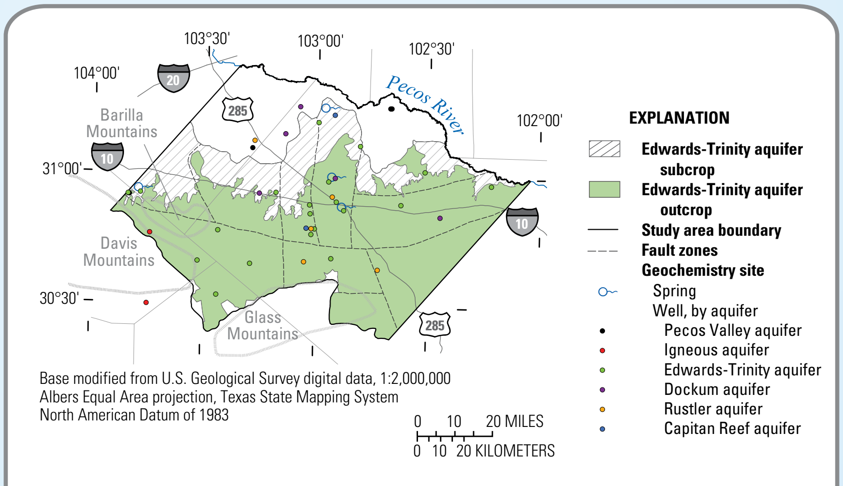
Thickness of the Edwards-Trinity aquifer in the study area was calculated as the difference in altitudes between its top and base. About 50 percent of the aquifer was between 234 and 362 feet thick, about 25 percent was less than 234 feet thick, and about 25 percent was more than 362 feet thick. The minimum thickness was 5 feet and the maximum thickness was about 797 feet. Some of the thinnest sections of the Edwards-Trinity aquifer were in the eastern part of the study area, near the northwestern slope of the Glass Mountains, and near the northeastern slope of the Davis Mountains. It was determined that the aquifer was often thickest in the central part of the study area in the Monument Draw trough and at the western edge of the study area in the Pecos trough.



Geochemistry

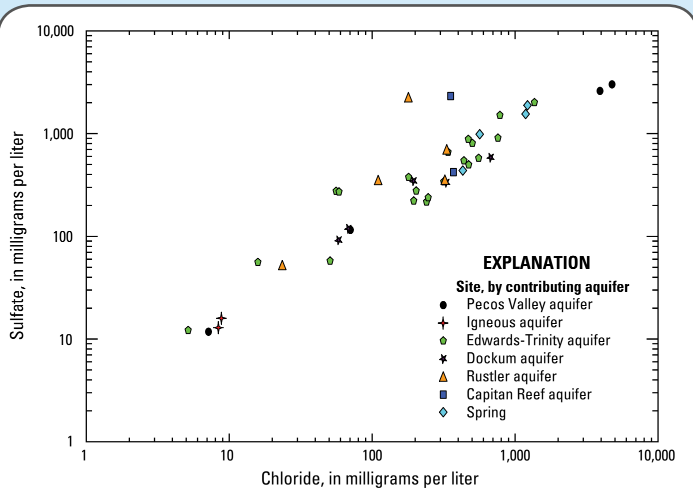
Geochemical Results

Analyses of geochemical and isotopic samples provided insights into the chemical characteristics of water from different sources and different aquifers. Chemical characteristics of water from different sources were used to qualitatively asses the aquifer interaction, groundwater-flow paths, water-rock interaction, mixing of water from different sources, and to identify likely source waters and geochemical endmembers. Geochemical properties that were evaluated included specific conductance, hydrochemical facies, sulfate and chloride concentrations, silica concentrations, stable isotopes of oxygen and hydrogen, strontium isotopes, environmental tracers, and concentrations of organic compounds and nutrients.



Location of groundwater-well and spring sites for geochemical data collection.

Geochemical and isotopic results indicate groundwater in the system likely is dominated by mineralized, regional groundwater flow that probably recharged during the cooler, wetter climates of the Pleistocene with variable contributions of recent, local recharge. The mixing of water from multiple sources combined with water-rock interaction with various rock types, including siliciclastic, carbonate, evaporite, and igneous rocks, contributed to a groundwater chemistry that was complex between and within aquifer units.



Relation between sulfate concentrations to chloride concentrations for samples collected from groundwater and spring sites.

Water-quality sampling by the U.S. Geological Survey, San Solomon Springs, Texas.

Geochemical Endmembers

Four endmembers were identified to use as part of the qualitative groundwater-flow and mixing analysis. The endmembers represented: (1) mineralized groundwater that likely recharged northwest of the study area during the Pleistocene and is flowing through the Edwards-Trinity aquifer along regional groundwater-flow paths; (2) dilute, recent recharge from the Barilla and Davis Mountains with a composition indicative of interaction with igneous rocks; (3) dilute, recent recharge from the Glass Mountains with a composition indicative of interaction with carbonate rocks; and (4) mineralized water that is likely a mixture of recharge under recent and Pleistocene climatic conditions and is flowing through the Edwards-Trinity aquifer along regional groundwater-flow paths east of the Monument Draw trough.

Groundwater-Flow System

Groundwater Recharge

Four principal sources of recharge to the Edwards-Trinity aquifer were identified: (1) regional groundwater flow in the Edwards-Trinity aquifer that originated as recharge northwest of the study area and enters the study area near the western corner; (2) runoff from the Barilla, Davis, and Glass Mountains that percolates through underlying rocks and into the gravels along the slopes of the mountains; (3) return flow from irrigation; and (4) upwelling from deeper aquifers. Although some of the groundwater appears to have recharged under conditions similar to the current climate, the only samples collected from the Edwards-Trinity aquifer that likely recharged during the last 60 years were collected from wells in mountain recharge areas and in areas receiving agricultural return flow.

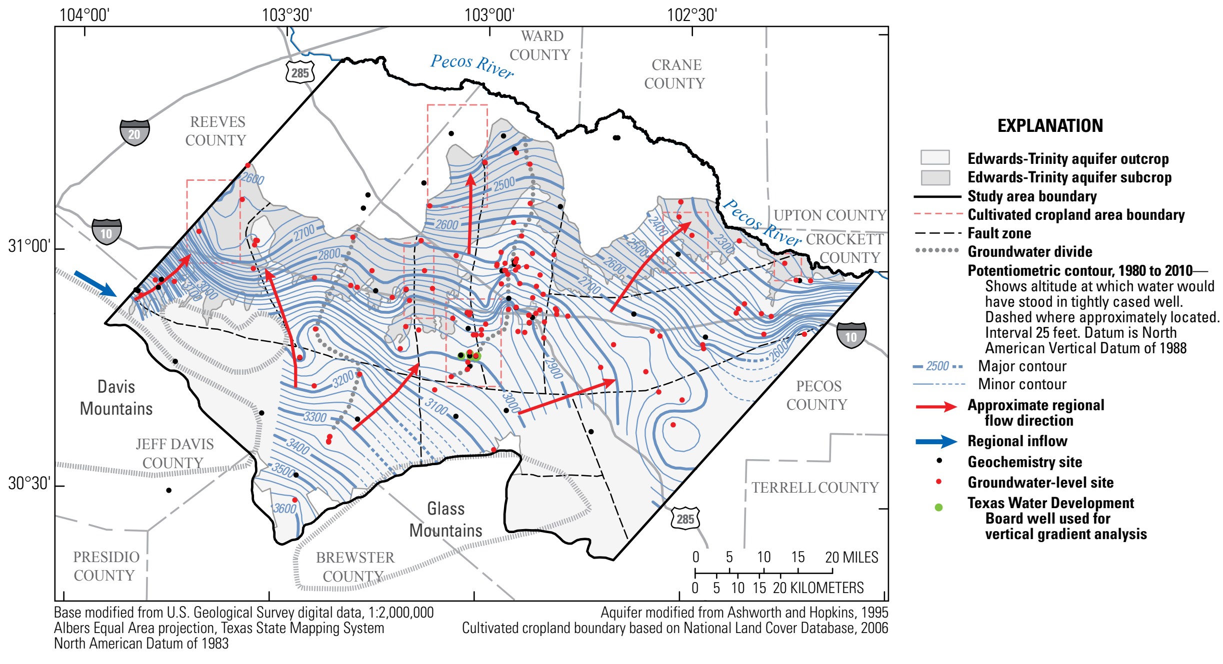
Transmissivity

Transmissivity values calculated and estimated from historical aquifer-test data ranged from 1,500 to 1,216,000 gallons per day per foot. The highest transmissivity values were measured in the Monument Draw trough area, which is also one of the thickest parts of the Edwards-Trinity aquifer and is in a faulted area. The lowest values were measured in the eastern part of the study area, near some of the thinnest parts of the aquifer. Hydraulic conductivity values generally showed the same trends as the transmissivity values.

U.S. Geological Survey pump hoist truck and water-quality trailer.

Groundwater Flow

Groundwater-level altitudes (which were used to generate a potentiometric-surface map of the Edwards-Trinity aquifer) ranged from about 2,300 to about 3,300 feet and generally decreased from southwest to northeast. Regional groundwater flow is from areas of recharge in the south and southwest to the north and northeast. Groundwater generally flows north into the down-dip extent of the Edwards-Trinity aquifer or east out of the study area. Regional groundwater flow entering the study area from the northwest naturally discharges from springs or turns northward to flow into the Pecos trough where it discharges into the Pecos Valley or Dockum aquifers at the down-dip extent of the Edwards-Trinity aquifer. Recharge from the Barilla and Davis Mountains also predominantly flows toward the Pecos trough and most likely naturally discharges to other aquifers in the groundwater system. Groundwater flow in the Edwards-Trinity aquifer in the Monument Draw trough originated as recharge in the Glass Mountains, agricultural return flow, or upwelling groundwater from lower units. Edwards-Trinity aquifer water generally flows north and northeast in the Monument Draw trough and naturally discharges from springs or to other aquifers in the groundwater system at the down-dip extent. Groundwater in the eastern part of the study area likely originated in the Glass Mountains, generally flows northeast, and flows out of the study area to the east or naturally discharges from springs or to other aquifers in the groundwater system at the down-dip extent or to the Pecos River.



Groundwater flow and potentiometric-surface map of the Edwards-Trinity aquifer developed using geochemical data and the average winter (November through April) groundwater-level data for 1980–2010.

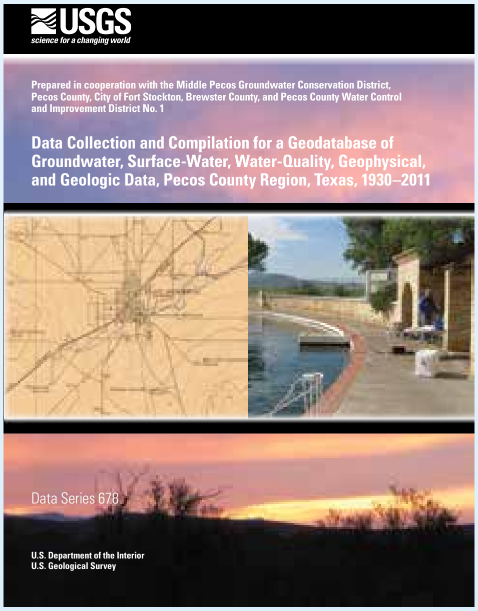
This fact sheet is based on the following USGS reports:

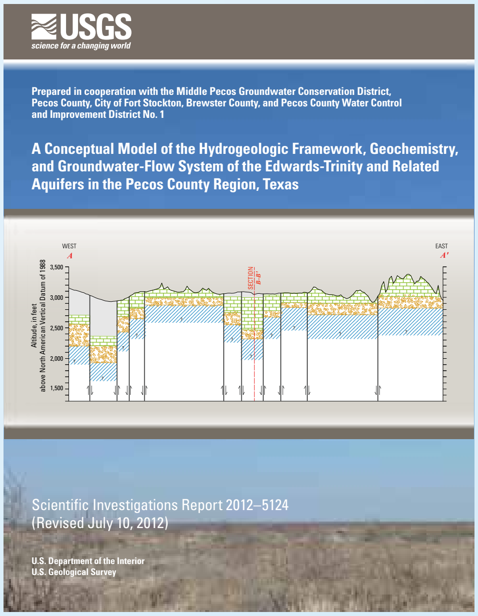
Pearson, D.K., Bumgarner, J.R., Houston, N.A., Stanton, G.P., Teeple, A.P., and Thomas, J.V., 2012, Data collection and compilation for a geodatabase of groundwater, surface-water, water-quality, geophysical, and geologic data, Pecos County region, Texas, 1930–2011; U.S. Geological Survey Data Series 678, 67 p.

http://pubs.er.usgs.gov/publication/ds678

Bumgarner, J.R., Stanton, G.P., Teeple, A.P., Thomas, J.V., Houston, N.A., Payne, J.D., and Musgrove, MaryLynn, 2012, A conceptual model of the hydrogeologic framework, geochemistry, and groundwater-flow system of the Edwards-Trinity and related aquifers in the Pecos County region, Texas: U.S. Geological Survey Scientific Investigations Report 2012–5124, 74 p.

http://pubs.er.usgs.gov/publication/sir20125124





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Barker, R.A., and Ardis, A.F., 1992, Configuration of the base of the Edwards-Trinity aquifer and hydrogeology of the underlying pre-Cretaceous rocks, west-central Texas: U.S. Geological Survey Water-Resources Investigations Report 91–4071, 25 p., 1 pl.

Daniel B. Stephens and Associates, 2010, City of Fort Stockton groundwater availability analysis—Evaluation of pumping on city wells: Prepared for the City of Fort Stockton, 79 p.

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Meyer, J.E., Wise, M.R., and Kalaswad, Sanjeev, 2011, Pecos Valley aquifer, west Texas: Structure and brackish groundwater: Texas Water Development Board Brackish Resources Aquifer Characterization System (BRACS), 92 p.

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University Lands, 2011, Well and production data collection: The University of Texas System, Well Library, accessed July 1, 2011, at http://www.utlands.utsystem.edu/techdata.aspx.

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Director, USGS Texas Water Science Center
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gs-w-txpublic-info@usgs.gov

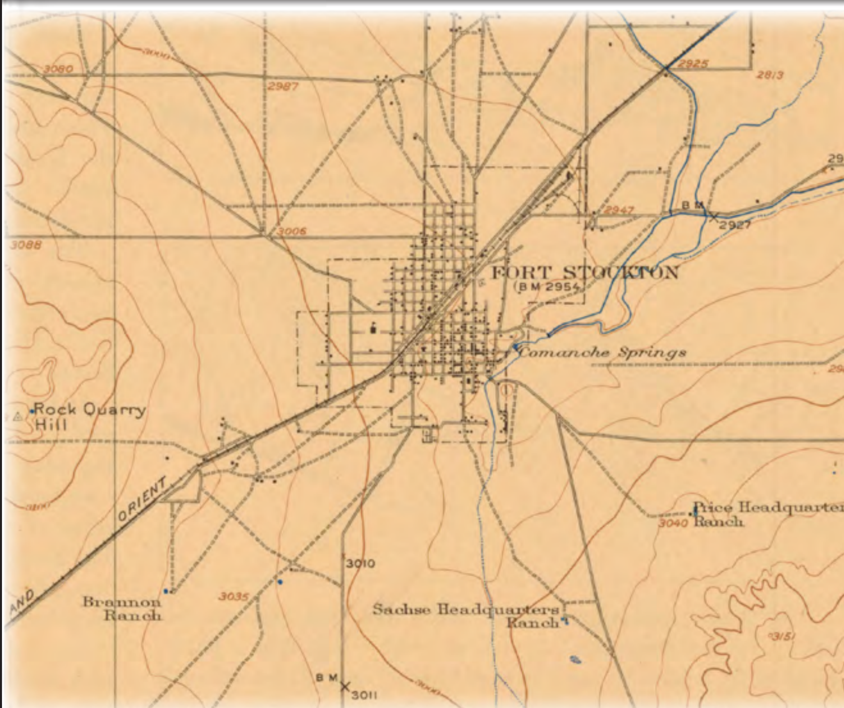
Publishing support provided by
Lafayette Publishing Service Center

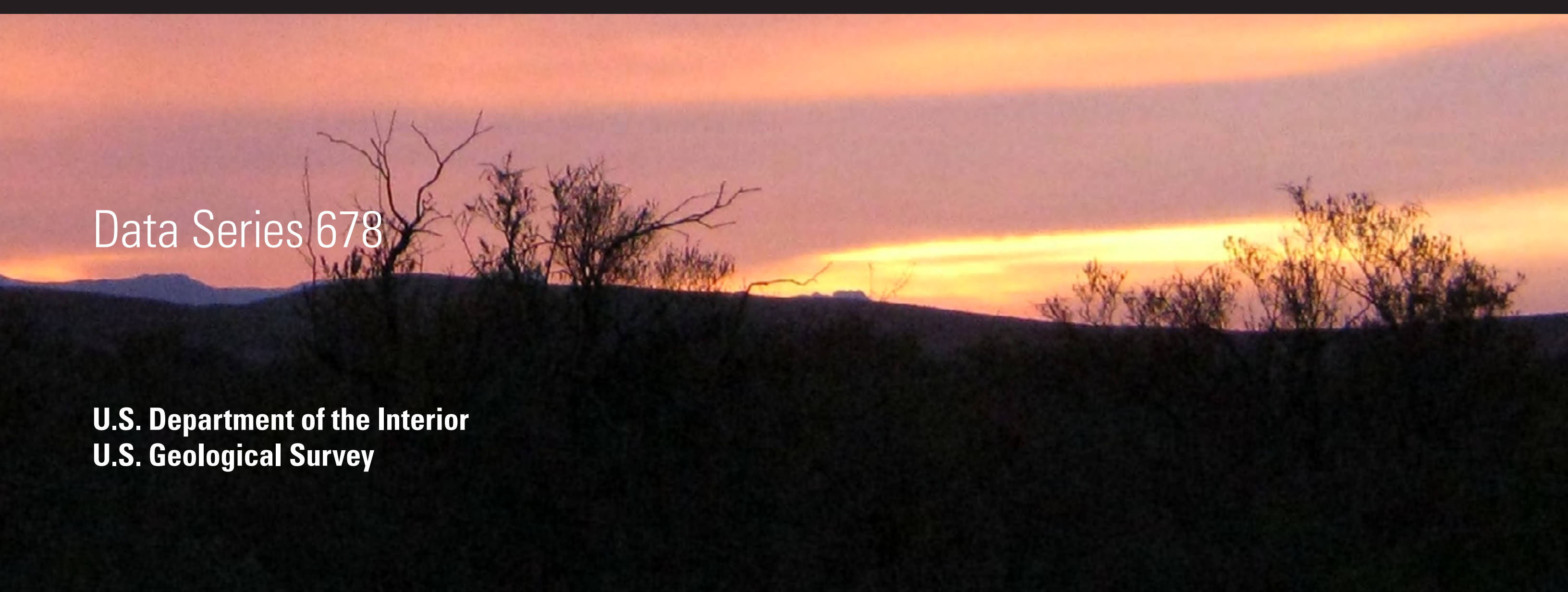
Middle Pecos GCD Exhibit 13

U.S. Geological Survey, Data Collection and Compilation for a Geodatabase of Groundwater, Surface-Water, Water- Quality, Geophysical and Geologic Data, Pecos County Region, Texas, 1930-2011 (2011)

Prepared in cooperation with the Middle Pecos Groundwater Conservation District, Pecos County, City of Fort Stockton, Brewster County, and Pecos County Water Control and Improvement District No. 1

Data Collection and Compilation for a Geodatabase of Groundwater, Surface-Water, Water-Quality, Geophysical, and Geologic Data, Pecos County Region, Texas, 1930–2011





Data Series 678

U.S. Department of the Interior
U.S. Geological Survey

Cover left. The historical topographic map is a closeup of the City of Fort Stockton, Pecos County, Texas, Fort Stockton quadrangle (U.S. Geological Survey, 1923, scale 1:62,500). The map also shows Comanche Springs, which is one of the sampling sites in this study.

Cover right. Water-quality sampling by U.S. Geological Survey, San Solomon Springs, Balmorhea, Texas (photograph by T. L. Sample, U.S. Geological Survey).

Data Collection and Compilation for a Geodatabase of Groundwater, Surface-Water, Water-Quality, Geophysical, and Geologic Data, Pecos County Region, Texas, 1930–2011

By Daniel K. Pearson, Johnathan R. Bumgarner, Natalie A. Houston, Gregory P. Stanton, Andrew P. Teeple, and Jonathan V. Thomas

Prepared in cooperation with the Middle Pecos Groundwater Conservation District, Pecos County, City of Fort Stockton, Brewster County, and Pecos County Water Control and Improvement District No. 1

Data Series 678

U.S. Department of the Interior
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Suggested citation:
Pearson, D.K., Bumgarner, J.R., Houston, N.A., Stanton, G.P., Teeple, A.P. and Thomas, J.V., 2012, Data collection and compilation for a geodatabase of groundwater, surface-water, water-quality, geophysical, and geologic data, Pecos County region, Texas, 1930–2011: U.S. Geological Survey Data Series 678, 67 p.

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Conversion Factors

Inch/Pound to SI

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
square mile (mi^2)	2.590	square kilometer (km^2)
	Flow rate	
foot per second (ft/s)	0.3048	meter per second (m/s)
gallon per minute (gal/min)	0.06309	liter per second (L/s)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$°F=(1.8\times°C)+32$$

Horizontal coordinate information is referenced to North American Datum of 1983 (NAD 83)

Concentrations of chemical constituents in water are given either in milligrams per liter (mg/L) or micrograms per liter (µg/L).

Data Collection and Compilation for a Geodatabase of Groundwater, Surface-Water, Water-Quality, Geophysical, and Geologic Data, Pecos County Region, Texas, 1930–2011

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Abstract

The U.S. Geological Survey, in cooperation with Middle Pecos Groundwater Conservation District, Pecos County, City of Fort Stockton, Brewster County, and Pecos County Water Control and Improvement District No. 1, compiled groundwater, surface-water, water-quality, geophysical, and geologic data for site locations in the Pecos County region, Texas, and developed a geodatabase to facilitate use of this information. Data were compiled for an approximately 4,700 square mile area of the Pecos County region, Texas. The geodatabase contains data from 8,242 sampling locations; it was designed to organize and store field-collected geochemical and geophysical data, as well as digital database resources from the U.S. Geological Survey, Middle Pecos Groundwater Conservation District, Texas Water Development Board, Texas Commission on Environmental Quality, and numerous other State and local databases. The geodatabase combines these disparate database resources into a simple data model. Site locations are geospatially enabled and stored in a geodatabase feature class for cartographic visualization and spatial analysis within a Geographic Information System. The sampling locations are related to hydrogeologic information through the use of geodatabase relationship classes. The geodatabase relationship classes provide the ability to perform complex spatial and data-driven queries to explore data stored in the geodatabase.

Introduction

The U.S. Geological Survey (USGS), in cooperation with the Middle Pecos Groundwater Conservation District (MPGCD), Pecos County, City of Fort Stockton (COFS), Brewster County, and Pecos County Water Control and Improvement District No. 1, developed a geodatabase of available groundwater, surface-water, water-quality, geophysical, and geologic data for site locations in the Pecos County region, Texas (fig. 1). Digital data resources from existing databases and previous publications were identified and assessed for inclusion into the geodatabase based on data quality and completeness. Data were gathered from various Federal, State, and local databases including USGS, MPGCD, COFS, Texas Water Development Board (TWDB), Texas Commission on Environmental Quality (TCEQ), Texas Railroad Commission (TXRRC), U.S Environmental Protection Agency (USEPA), and the University of Texas Land System (UTLD). In addition to downloadable data sources, geochemical and geophysical data collected by the USGS during 2009–11 were included into the geodatabase. The geodatabase contains data from 8,242 sampling locations (sites) in the study area. Data from groundwater, surface-water, and water-quality sampling sites are included. Geophysical data and driller log files were compiled for 626 of the groundwater sites, along with the geologic data associated with those logs.

Purpose and Scope

This report documents data collection, compilation, and geodatabase design for a geodatabase of groundwater, surface-water, water-quality, geophysical, and geologic data collected from more than 8,000 sampling locations in the Pecos County region, Texas. Data were compiled from existing digital databases, previously published reports, and USGS field-collected data. The geodatabase compiled for this report will be used by the cooperating agencies as a data clearinghouse for obtaining groundwater, surface-water, water-quality, geophysical, and geologic data. Following a description of the study area, the methodologies used for field-collected data acquisition and the compilation of existing digital database resources and previously published reports in the geodatabase are described. The geodatabase compilation processes section includes an explanation of the geodatabase design, data input steps, and quality-assurance controls. The geodatabase provides detailed information regarding site locations and associated groundwater, surface-water, water-quality, geophysical, and geologic information.

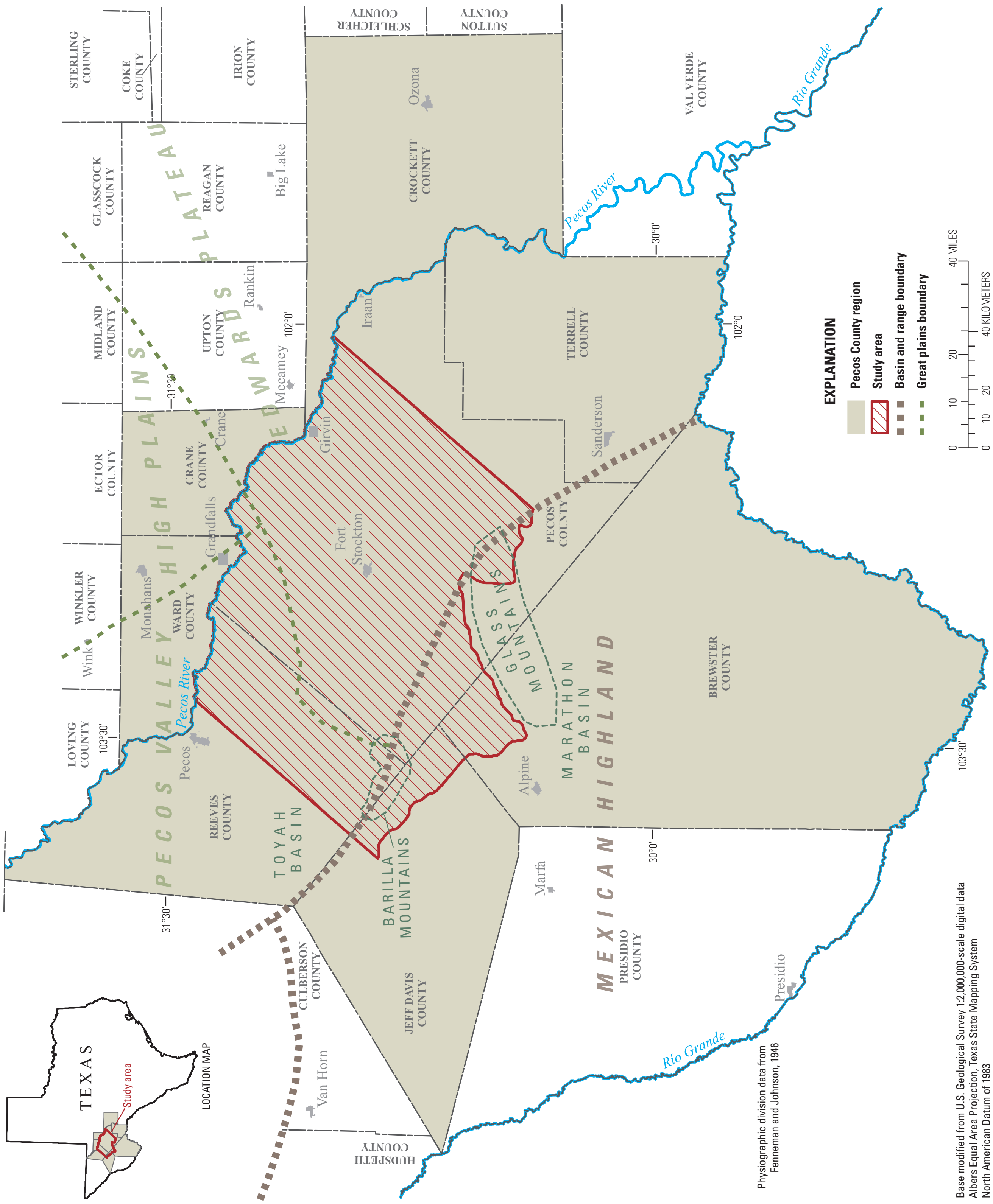

Figure 1. Location of study area and Pecos County region, Texas, 2011.

Description of Study Area

The study area (fig. 1) includes the western part of the MPGCD management area (Pecos County) and extends beyond Pecos County to include the extent of the field-collected data gathered for this project. The study area was modified from the TWDB Groundwater Availability Model (GAM) of the Edwards-Trinity and Pecos Valley aquifers extent (Anaya and Jones, 2009). The northeastern boundary of the project study area was set at the Pecos River, while the southeastern and northwestern boundaries were aligned to the data cells of the GAM model and set to the extent of the geodatabase contents. The southwestern boundary was modified using the “active” part of the GAM model as a template for editing the final study area boundary. Geospatial data were compiled for the Pecos County region of West Texas including parts of Pecos, Reeves, Jeff Davis, Brewster, Terrell, Crane, Ward and Crockett Counties.

The study area is located in the Pecos Valley, Edwards Plateau, and High Plains sections of the Great Plains Physiographic Province and the Mexican Highland section of the Basin and Range Province (Fenneman and Johnson, 1946; fig. 1). West of the Pecos River, the Edwards Plateau section of the Great Plains Physiographic Province (Fenneman and Johnson, 1946) is defined by the boundary of the major geographic features in the area: (1) the Pecos River; (2) the Toyah Basin; (3) the Marathon Basin, characterized by ridges and isolated buttes and mesas; (4) the Glass Mountains; and (5) the Barilla Mountains (Small and Ozuna, 1993, fig. 1).

Hydrogeologic Setting

The geologic setting contributed to the formation of two major and four minor aquifers in the study area. The major aquifers include the Pecos Valley and the Edwards-Trinity, and the minor aquifers include the Igneous, the Dockum, the Rustler, and the Capitan Reef Complex (also called the Capitan Reef) aquifers (table 1, fig. 2). The Pecos Valley aquifer is composed of Cenozoic-age alluvium consisting of unconsolidated silt, sand, gravel and clay (Small and Ozuna, 1993). In the northern part of the study area the Pecos Valley aquifer uncomformably overlies the Cretaceous-age Edwards-Trinity aquifers, Triassic-age Dockum aquifer, and Permian-age Rustler aquifer. The Igneous aquifer is a minor aquifer that is composed of Tertiary-age volcanic and volcaniclastic rocks. Located southwest of the study area, the Igneous aquifer uncomformably overlies the Cretaceous-age Edwards-Trinity aquifer. The Edwards-Trinity aquifer is composed of lower Cretaceous-age rocks of limestone, marl, and clay of the Washita Group; limestone of the Fredericksburg Group; and sand, limestone, and shale of the Trinity group (table 1). The Edwards part of the aquifer is composed of rocks of the Washita and Fredericksburg Groups, which locally are referred to as the Edwards and Sixshooter Groups (Brand and DeFord, 1958; Small and Ozuna, 1993; Smith and others, 2000). The Fort Lancaster Formation, the Burt Ranch Member, and the Fort Terrett Formation make up the Edwards Group and occur in the eastern part of the study area (Rose, 1972; Smith and Brown, 1983; Small and Ozuna, 1993). The Boracho Formation, the University Mesa Marl, which is a facies change equivalent of the Boracho Formation, and the Finlay Formation make up the Sixshooter Group and occur in the western part of Pecos County (Brand and DeFord, 1958; Small and Ozuna, 1993; Smith and others, 2000). The Buda Limestone, which overlies the Boracho Formation, is present east of Fort Stockton. Regionally, the Buda Limestone, the Fort Lancaster Formation, and the Burt Ranch Member form the Washita Group. The Fort Terrett Formation forms the Fredericksburg Group. The Trinity group is composed of the Maxon Sand, the Glen Rose Formation, and the Basal Cretaceous Sand (Anaya and Jones, 2009). The individual formations in the Trinity Group are not separated for the purposes of this report. Locally the Trinity Group is known as the Trinity Sands (Small and Ozuna, 1993; Rees and Buckner, 1980).

The Dockum aquifer is a minor aquifer and is composed of Triassic-age rocks of shale, sand, sandstone, and conglomerate of the Dockum Group (Bradley and Kalaswad, 2003). The stratigraphic nomenclature of the Dockum Group has been updated and regionalized in the literature as better information became available (Lehman, 1994a,b; Bradley and Kalaswad, 2003). In Pecos County, a sand unit within the Dockum aquifer is recognizable in some geophysical logs, but the individual formations of the Dockum Group are not separated for the purposes of this report. Locally, the Dockum aquifer is also known as the Santa Rosa aquifer (Small and Ozuna, 1993).

The Rustler and Capitan Reef aquifers are minor aquifers composed of Permian-age rocks. The Rustler aquifer is composed of mostly dolomite, anhydrite, and some limestone of the Rustler Formation. A basal unit consists of sand, conglomerate, and some shale (Small and Ozuna, 1993; LBG-Guyton, 2003). The Capitan Reef aquifer consists of reef, fore-reef, and back-reef facies of dolomite and limestone of the older Capitan Limestone.

Table 1. Hydrostratigraphic section in the Pecos County region, Texas.

[Water-yielding properties: yields (gallons per minutes) - small less than 50, moderate 50 to 500, large is more than 500; Classification of water dissolved-solids concentration (milligrams per liter) - fresh less than 1,000, slightly saline 1,000 to 3,000, moderately saline 3,000 to 10,000]

Era	System	Series or group		Stratigraphic unit			Approximate maximum thickness (feet)		
Cenozoic	Quaternary and Tertiary			Alluvium			1,150		
	Tertiary			Volcanic Rocks, Undivided			1,000+		
Mesozoic	Cretaceous	Gulfian Series	Terlingua Group	Boquillas Formation			250		
							Western Pecos County	Eastern Pecos County	
		Comanchean Series	Washita Group	Western Pecos County	Eastern Pecos County				
				Sixshooter Group*: Buda Limestone	Buda Limestone		100	200	
				Sixshooter Group*: Boracho Formation*	Edwards Group**: Fort Lancaster Formation***		410	350	
				Sixshooter Group*: University Mesa Marl***	Edwards Group**: Burt Ranch Member**				
			Fredericksburg Group	Sixshooter Group*: Finlay Formation*	Edwards Group**: Fort Terrett Formation**		165	200	
			Trinity Group	Trinity Sands	Maxon Sands****		300****		
				Trinity Sands	Glen Rose Formation****		200+****		
				Trinity Sands	“Basal” Sand****		100****		
	Triassic	Dockum Group		Middle			600		
				Lower			70		
Paleozoic	Permian	Ochoan Series		Dewey Lake Red Beds			600		
				Southern Pecos County	Northern Pecos County		Southern Pecos County	Northern Pecos County	
				Tessey Limestone	Rustler Formation		1,050	450	
					Salado Formation			2,200	
					Castile Formation			2,300	
		Guadalupian Series	Whitehorse Group	Gilliam Limestone	Capitan Limestone	Guadalupian Formations; undivided	870	1,650	1,900
				Lower Guadalupian Formations; undivided			2,000		
				Lower Permian Formations; undivided			10,000		
	Pennsylvanian			Pennsylvanian Formations; undivided			6,000		

* — Brand and DeFord, 1968

** — Rose, 1972

*** — Smith and Brown, 1983

**** — Rees and Buckner, 1980

<table>
<tr><th colspan="3">Character of rocks</th><th colspan="2">Water yielding properties</th><th>Hydrostratigrphic unit</th></tr>
<tr><td colspan="3">Unconsolidated silt, sand, gravel, clay, boulders, caliche, gypsum, and conglomerate</td><td colspan="2">Yields range from small to large quantities of fresh to moderately saline water</td><td>Pecos Valley</td></tr>
<tr><td colspan="3">Lavas, pyroclastic tuffs, volcanic ash, tuff breccias, fragmental breccias, agglomerates; few thin beds of conglomerates, sandstones, and freshwater limestones</td><td colspan="2">Yields small quantities of freshwater</td><td>Igneous</td></tr>
<tr><td colspan="3">Brown to red flaggy limestone interbedded with shale</td><td colspan="2">Not known to yield water</td><td></td></tr>
<tr><td colspan="3">Soft nodular limestone, marl, and thin-bedded hard granular limesone</td><td colspan="2">Does not yield water in most of the study area; however, may yield small quantities in Reeves County</td><td rowspan="5">Edwards-Trinity</td></tr>
<tr><td colspan="3">Hard massive limestone, thin-bedded limestone, and soft nodular limestone with some clay</td><td colspan="2">Yields small quantities of water</td></tr>
<tr><td colspan="3">Soft nodular limestone, marl, and hard massive ledge-forming limestone</td><td colspan="2">Yields small quantities of water</td></tr>
<tr><td colspan="3">Massive ledge-forming limestone and soft nodular limestone</td><td colspan="2">Yields small quantities of fresh to moderately saline water</td></tr>
<tr><td colspan="3">Crossbedded, fine- to coarse-grained, poorly to well-cemented quartz sand with some silt, shale, and limestone</td><td colspan="2">Yields small to moderate quantities of fresh to slightly saline water</td></tr>
<tr><td colspan="3">Reddish-brown to gray coarse-grained sandstone</td><td colspan="2">Yields small to moderate quantities of fresh to slightly saline water</td><td>Dockum</td></tr>
<tr><td colspan="3">Red shale and siltstone</td><td colspan="2">Not known to yield water</td><td rowspan="3"></td></tr>
<tr><td colspan="3">Sand, shale, gypsum, and anhydrite</td><td colspan="2">Not known to yield water</td></tr>
<tr><td colspan="2">Southern Pecos County</td><td>Northern Pecos County</td><td>Southern Pecos County</td><td>Northern Pecos County</td></tr>
<tr><td colspan="2" rowspan="3">Limestone and dolomite</td><td>Red shale, sandstone, anhydrite, dolomite, limestone, conglomerate, and halite</td><td rowspan="3">Not known to yield water</td><td>Yields small to large quantities of slightly to moderately saline water</td><td>Rustler</td></tr>
<tr><td>Mostly halite, with anhydrite and some dolomite</td><td>Not known to yield water</td><td rowspan="2"></td></tr>
<tr><td>Mostly calcareous anhydrite, with halite and associated salts and some limestone</td><td>Not known to yield water</td></tr>
<tr><td>Limestone , dolomite, and sand-stone</td><td>Limestone, dolomite, and reef talus</td><td>Dolomite, limestone, anhydrite, shale, and sand-stone</td><td>Yields freshwater to a few wells in the Glass Moutains</td><td>Yields moderate to large quantities of moderately saline water</td><td>Capitan Reef</td></tr>
<tr><td colspan="3">Dolomite, dolomitic limestone, limestone, and siliceous shale</td><td colspan="2">Yields small to large quantities of moderately saline water</td><td rowspan="3"></td></tr>
<tr><td colspan="3">Shale, siliceous shale, limestone, dolomitic limestone, sandstone, and basal conglomerate</td><td colspan="2">Yields small quantities of water</td></tr>
<tr><td colspan="3">Limestone, sand, sandstone, shale chert, and conglomerate</td><td colspan="2">Yields small quantities of water</td></tr>
</table>

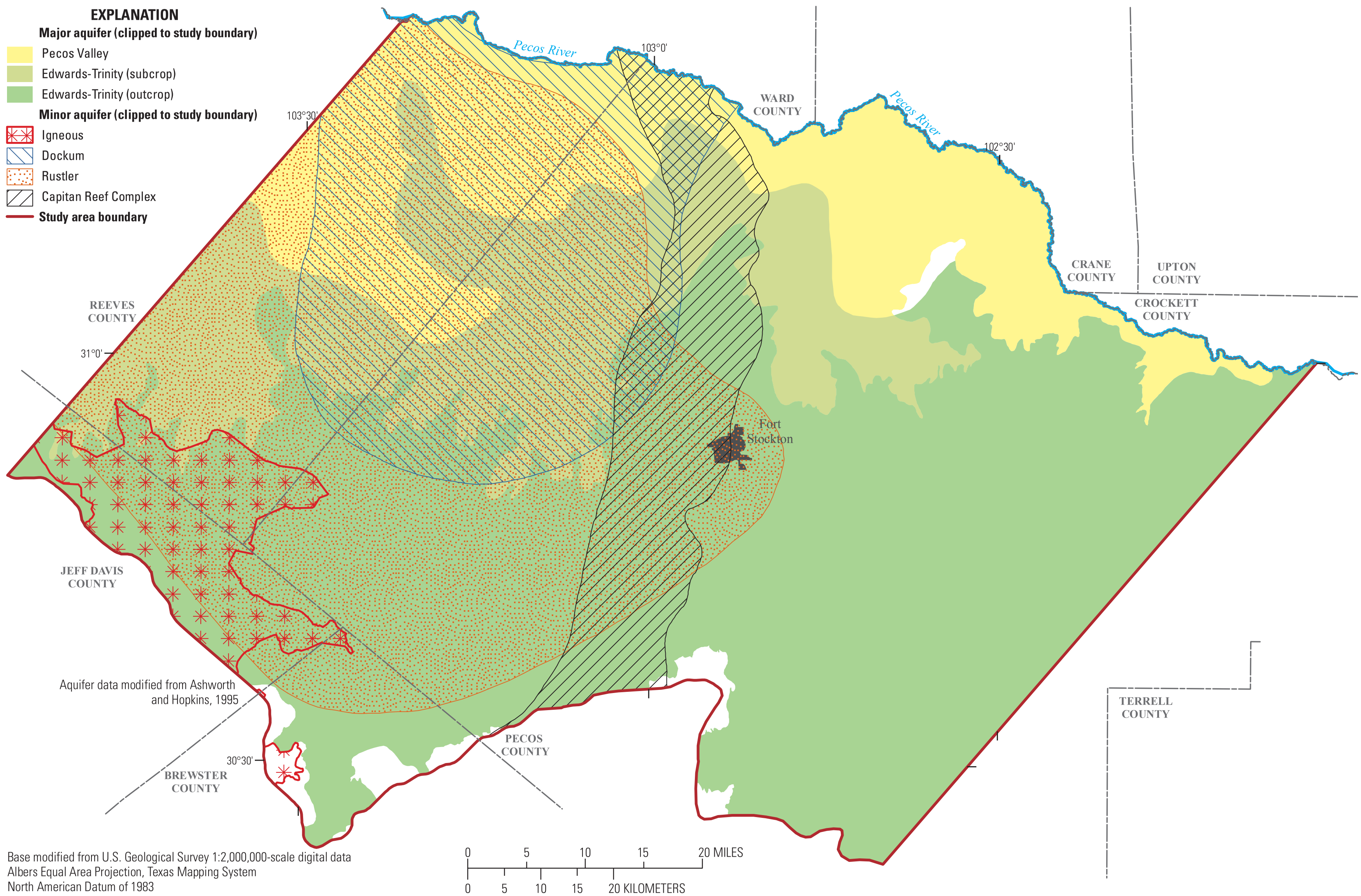

Figure 2. Extent of the major aquifers (Pecos Valley, Edwards-Trinity [subcrop], and Edwards-Trinity [outcrop]) and minor aquifers (Igneous, Dockum, Rustler, and Capitan Reef Complex), Pecos County region, Texas, 2011.

Methods

The geodatabase contains data gathered in support of this project using two different data collection strategies. First, new (data collected during the study period) geochemical and geophysical data were collected in the field in 2009, 2010, and 2011 by USGS. Second, existing data from Federal, State and local agencies that manage and store groundwater, surface-water, water-quality, geophysical, and geology information were gathered and compiled into the geodatabase. These data were downloaded using internet portal, through direct connect with the native database using secured access, or gathered from published reports or other hardcopy sources.

Water-Quality Methods

Geochemical data were collected in 2010 and 2011 at 44 data-collection sites (fig. 3, table 2). Final results were reviewed for completeness and accuracy and, with the exception of data for one constituent, uploaded to the USGS National Water Information System (NWIS) for warehousing (U.S. Geological Survey, 2011a). Helium–4 (^{4}He) data were the only data collected that are not available from NWIS; these data are presented in table 3.

Water-Quality Sample Collection

Geochemical samples were collected in 2010–11 from 38 wells screened in the Pecos Valley, Edwards-Trinity, Dockum, Rustler, and Capitan Reef aquifers, from 4 springs, and from 2 Pecos River surface-water sites (fig. 3, table 2) (Wilde and others, variously dated). Almost all of the data can be accessed using the USGS NWIS at http://waterdata.usgs.gov (U.S. Geological Survey, 2011a). Those data that were not uploaded to the USGS NWIS web are included herein. Physicochemical properties (water temperature, dissolved oxygen, specific conductance, pH, turbidity, and alkalinity), barometric pressure, and depth to water were measured in the field at the time of sample collection. All samples were analyzed for major ions, nutrients, trace elements, and isotopes (hydrogen [hydrogen–2/hydrogen–1 (^{2}H/^{1}H)], oxygen [oxygen–18/oxygen–16 (^{18}O/^{16}O)], and strontium [strontium–87/strontium–86 (^{87}Sr/^{86}Sr)]). Samples collected from select sites were analyzed for pesticide compounds, tritium (^{3}H), dissolved gases, and ^{4}He.

Groundwater Sampling

Groundwater samples were collected using procedures described in the USGS National Field Manual for the Collection of Water-Quality Data (U.S. Geological Survey, variously dated), the USGS Chlorofluorocarbon Laboratory, Reston, Virginia (U.S. Geological Survey, 2011b), and the USGS Stable Isotope Laboratory in Reston, Va. (U.S. Geological Survey, 2011c). Groundwater-quality samples, physicochemical properties, and water-level data were collected once from each site (fig. 3) during 2010–11. Water levels in wells were measured manually at the time of sampling, when possible, by using an electric tape or steel tape.

Observation wells were pumped using an electric, portable, submersible, positive displacement pump (Grundfos Redi–flo2, Redi–flo–3) constructed of stainless steel and Teflon. Water was pumped from domestic and municipal wells using existing pumps, and samples were collected at the wellhead prior to installation of any pressure tanks or filtering or other treatment devices. Prior to any treatment, a connection was made for purging and sampling by using a brass connector with compression fitting to refrigeration-grade copper tubing.

Prior to sample collection, one to three casing volumes were purged from the well, depending on well type, either observation or supply. For wells that are continuously pumped (or pumped regularly every few hours) such as those used for public supply, domestic supply, or industrial purposes, purging less than three casing volumes is permissible (U.S. Geological Survey, variously dated, chapter A4). The purge procedure removes stagnant water in the well, reduces chemical artifacts of well installation or well construction materials, or mitigates effects of infrequent pumping. After purging was complete, the physicochemical properties dissolved oxygen, pH, specific conductance, and water temperature were measured until readings were stable (Wilde, variously dated). Once readings stabilized, water samples were collected through Teflon tubing in new, precleaned bottles. Water samples were collected and processed onsite to minimize changes to the water-sample chemistry or contamination from the atmosphere. To prevent degradation of water samples and maintain the initial concentration of compounds between the time of sample collection and laboratory analyses, samples were preserved with the appropriate acid (when required) or chilled to 4 degrees Celsius (^{o}C) according to the laboratory protocols and shipped overnight to the analyzing laboratories.

At each site after sample completion, sampling equipment was cleaned according to established protocols prior to use at the next site (Wilde, 2004). All samples were stored on ice in coolers following collection and during shipping. Samples were shipped overnight to the analyzing laboratories.

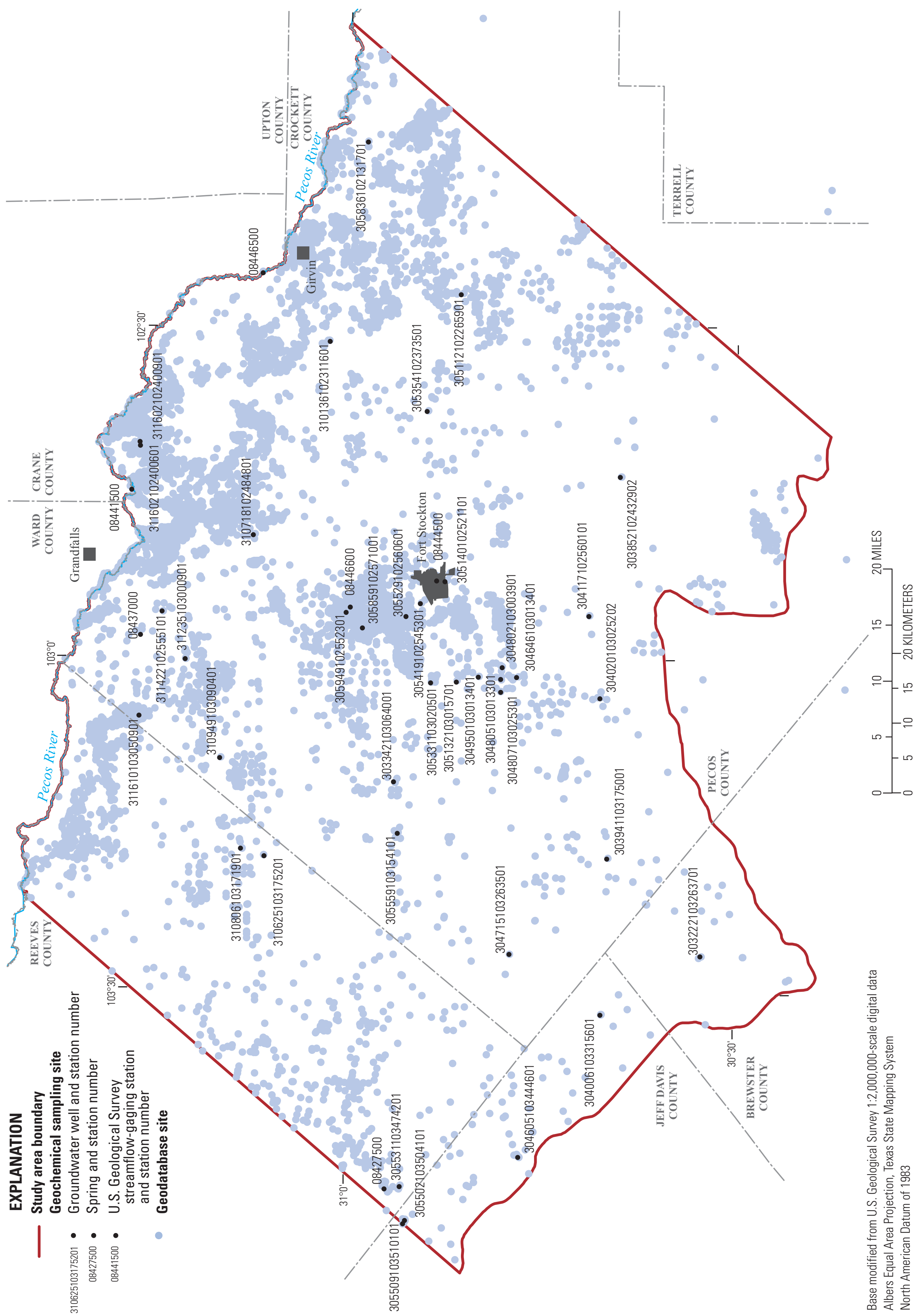

Figure 3. Site locations of field-collected geochemical data, Pecos County region, Texas, 2010–11.

Table 2. Geochemical data-collection sites in the Pecos County region, Texas, 2010–11.

[USGS, U.S. Geological Survey; dd, decimal degrees; --, not applicable]

USGS station number	Station name or State well number	Latitude (dd)	Longitude (dd)	Site type	Contributing aquifer
08427500	San Solomon Springs	30.94292	-103.78824	Spring	--
08437000	Santa Rosa Spring	31.26743	-102.95828	Spring	--
08441500	Pecos River below Grandfalls, Tex.	31.28348	-102.74265	Stream	--
08444500	Comanche Springs	30.88628	-102.87495	Spring	--
08446500	Pecos River near Girvin, Tex.	31.11320	-102.41764	Stream	--
08446600	Diamond Y Springs	31.00190	-102.92358	Spring	--
302955103451101	PS-52-34-303	30.49860	-103.75300	Well	Igneous
303222103263701	BK-52-29-8xx (Brewster County ET Well)	30.53950	-103.44346	Well	Edwards-Trinity
303342103064001	US-52-07-502	30.93779	-103.18711	Well	Edwards-Trinity
303852102432902	US-53-19-7xx (PC QW)	30.64799	-102.72470	Well	Rustler
303941103175001	US-52-22-8xx (Farm Well 3)	30.66139	-103.29720	Well	Edwards-Trinity
304006103315601	PS-52-20-601	30.66827	-103.53216	Well	Edwards-Trinity
304020103025202	US-52-24-501	30.67295	-103.05601	Well	Rustler
304117102560101	US-53-17-501	30.68806	-102.93361	Well	Edwards-Trinity
304605103444601	PS-52-11-702	30.77100	-103.74800	Well	Igneous
304646103013401	US-52-16-910	30.77931	-103.02615	Well	Edwards-Trinity
304715103263501	US-52-13-801	30.78740	-103.44343	Well	Edwards-Trinity
304802103003901	US-52-16-611	30.80088	-103.01110	Well	Edwards-Trinity
304805103013301	US-52-16-609	30.80129	-103.02618	Well	Rustler
304807103025301	US-52-16-504	30.80241	-103.04844	Well	Capitan Reef
305112102265901	US-53-13-208	30.85341	-102.44965	Well	Dockum
305132103015701	US-52-16-3xx (S-21)	30.85899	-103.03244	Well	Edwards-Trinity
305140102521101	US-53-09-306	30.87393	-102.88229	Well	Edwards-Trinity
305331103020501	US-52-08-909	30.89210	-103.03516	Well	Edwards-Trinity
305354102373501	US-53-03-9xx	30.89825	-102.62647	Well	Edwards-Trinity
305419102545301	US-53-01-907	30.90560	-102.91610	Well	Edwards-Trinity
305502103504101	PS-52-02-404	30.91737	-103.84518	Well	Pecos Valley
305509103510101	PS-52-02-4xx (Balmerea)	30.91911	-103.85027	Well	Edwards-Trinity
305529102560601	US-53-01-5xx (Apache 3)	30.92470	-102.93490	Well	Rustler
305531103474201	WD-52-02-507	30.92539	-103.79511	Well	Edwards-Trinity
305559103154101	US-52-06-603	30.93305	-103.26194	Well	Dockum
305836102131701	US-53-07-105	30.97667	-102.22139	Well	Edwards-Trinity
305859102571001	US-53-01-210	30.98293	-102.95271	Well	Edwards-Trinity
305949102552301	US-53-01-208	30.99718	-102.92291	Well	Dockum
310136102311601	US-45-60-903	31.02670	-102.52102	Well	Edwards-Trinity
310625103175201	WD-46-62-201	31.10685	-103.29777	Well	Pecos Valley
310718102484801	US-45-58-2xx	31.12162	-102.81354	Well	Edwards-Trinity
310806103171901	WD-46-54-901	31.13502	-103.28796	Well	Rustler
310949103090401	US-46-55-9xx (Weatherby Ranch)	31.16341	-103.15103	Well	Dockum
311235103000901	US-46-56-309	31.20974	-103.00262	Well	Edwards-Trinity
311422102555101	US-45-49-203	31.23974	-102.93097	Well	Capitan Reef
311602102400601	US-45-43-807	31.26942	-102.67609	Well	Pecos Valley
311602102400901	US-45-43-8xx (PA 1)	31.26934	-102.68214	Well	Pecos Valley
311610103050901	US-46-48-701	31.26959	-103.08683	Well	Dockum

Table 3. Helium-4 measured in groundwater samples collected in the Pecos County region, Texas, 2010–11.

[USGS, U.S. Geological Survey; cc/g, cubic centimeter per gram; H_2O, water; STP, standard temperature and pressure]

USGS station number	Date	Sample start time	Helium-4 (cc/g of H_2O at STP x 10^{-9})
305509103510101	9/1/2010	16:00	81
311602102400901	8/17/2010	21:00	164
302955103451101	9/2/2010	11:00	55
304715103263501	8/28/2010	14:00	230
305140102521101	8/10/2010	17:00	261
305502103504101	8/15/2010	19:00	53
304006103315601	6/23/2011	11:00	3,877
305531103474201	6/22/2011	11:00	573
304605103444601	6/22/2011	14:00	68

Surface-Water Sampling

Streamflow velocities at the Pecos River surface-water sites were below 1.5 feet per second (ft/s) and, therefore, samples were collected using the multi-vertical grab sampling method (U.S. Geological Survey, variously dated). A sample was collected at each site using a 1-liter Teflon bottle with a 5/16- inch (in.) nozzle. The grab sample was then composited in a Teflon churn and dispensed into appropriate containers.

At each site after sample completion, sampling equipment was cleaned according to established protocols prior to use at the next site (Wilde, 2004). All samples were stored on ice in coolers following collection and during shipping. Samples were shipped overnight to the analyzing laboratories.

Spring Sampling

Spring water was sampled as close to a spring orifice as possible. Otherwise, spring water was sampled from the bottom of the pool or nearest to the primary discharge location based on anecdotal evidence. Spring-water samples were collected using a peristaltic pump and flexible Teflon diaphragm head by immersing Teflon tubing below the water surface into or near the spring orifice, avoiding contact with the atmosphere and standing surface water. San Solomon Springs (8427500) was sampled from the main discharge point. Comanche Springs (08444500) was sampled at the Government Spring discharge point, which is the primary discharge orifice of the springs. A spring orifice could not be located at the Diamond Y Springs (08446600) or Santa Rosa Spring (08437000) sites, so the samples were taken from the spring pools.

At each site after sample completion, sampling equipment was cleaned according to established protocols prior to use at the next site (Wilde, 2004). All samples were stored on ice in coolers following collection and during shipping. Samples were shipped overnight to the analyzing laboratories.

Analytical Methods

Samples collected and analyzed for major ions, nutrients, trace elements, and pesticide compounds were analyzed by the USGS National Water Quality Laboratory (NWQL), Denver, Colorado, using published methods. Methods for major ions are published in Fishman and Friedman (1989), Fishman (1993), and American Public Health Association (1998). Nutrients methods are published in Patton and Kryskalla (2003) and Fishman (1993). Trace element methods are published in Fishman and Friedman (1989), Garbarino and others (2006), and Garbarino (1999). Pesticide compound methods are published in Zaugg and others (1995), Lindley and others (1996), Madsen and others, (2003), and Sandstrom and others (2001). Samples for analysis of oxygen and hydrogen isotopes were analyzed at the USGS Stable Isotope Laboratory in Reston, Va. $^{18}O/^{16}O$ analytical methods are described in Révész and Coplen (2008a) and $^{2}H/^{1}H$ methods are described in Révész and Coplen (2008b). Samples for analysis of strontium isotopes were analyzed at the Menlo Park Isotope Laboratory in Menlo Park, California. Samples for the analysis of tritium were shipped to the Menlo Park Tritium Laboratory in Menlo Park, Calif. Analytical methods for ^{3}H are documented in Ostlund and Warner (1962) and Thatcher and others (1977). Samples for the analysis of dissolved gases and 4–helium were shipped to the USGS Dissolved Gas Laboratory in Reston, Va., and analyzed by methods described in Busenberg and others (1993) and Busenberg and others (2001). Samples for the analysis of 3–helium were analyzed by the Noble Gas Laboratory of

Lamont-Doherty Earth Observatory of Columbia University, Palisades, New York, using methods described in Schlosser and others (1988).

The USGS uses two reporting conventions for the analytical data from the National Water Quality Laboratory, the laboratory reporting level (LRL) and the long-term method detection level (LT-MDL). The LRL is two times the LT-MDL, and concentrations measured between the LRL and LT-MDL are reported as estimated concentrations (Childress and others, 1999).

Geochemical Quality Assurance

Quality-control data were collected to assess the precision and accuracy of sample-collection procedures and laboratory analyses (U.S. Geological Survey, variously dated). Quality-control samples consisted of two equipment blank samples, four field blank samples, four sequential replicate samples, and environmental matrix-spike samples.

Equipment blanks were collected annually in a controlled environment to determine if the cleaning procedures for sample containers and the equipment for sample collection and sample processing were sufficient to produce contaminant-free samples. Field blank samples were collected and processed at a sampling site prior to environmental samples to ensure equipment cleaning conducted in the field between sites was adequate, and that the collection, processing, or transporting procedures in the field did not contaminate the samples.

Equipment blank results indicate the sampling equipment did not introduce appreciable amounts of the constituents of interest to the samples and, with a few exceptions, equipment blank results were less than the reporting limits (table 4). Field blank results indicate the sample collection and handling procedures did not introduce appreciable contamination of the constituents of interest to the environmental samples, with a few exceptions, and provided another indication that representative samples were collected. Analytes detected in the field blanks included ammonia, barium, calcium, chloride, cobalt, copper, fluoride, lead, magnesium, manganese, molybdenum, nickel, sodium, strontium, sulfate, thallium, total nitrogen, and zinc (table 4). Because most of the concentrations measured in the field blanks were low, with a few exceptions, the environmental results do not show a bias except for some of the metal concentrations measured in the field blank samples collected on August 28, 2010, and the lead concentrations in some of the blank samples. The detected copper concentration of 1.5 μg/L was greater than the measured copper concentrations in 23 of the environmental samples. The detected filtered lead concentrations of 0.24 μg/L and 0.23 μg/L were greater than the measured lead concentrations in 21 of the environmental samples. The detected molybdenum concentration of 0.77 μg/L was greater than the measured molybdenum concentrations in five of the environmental samples. The detected nickel concentration of 0.48 μg/L was greater than the measured nickel concentrations in 19 of the environmental samples. The detected zinc concentration of 3.8 μg/L was greater than the measured zinc concentrations in 11 of the environmental samples. All of these detections of concern were measured in the field blank collected on August 28, 2010, except the lead concentration of 0.24 μg/L, which was measured in the field blank collected on August 12, 2010, and the filtered ammonia concentration of 0.011, which was measured in the field blank collected on June 22, 2011.

The cause of the low-level contamination of several metals in the field blank collected on August 28, 2010, and the detected concentrations of lead in three of the field blanks collected on August 12, 18, and 28, 2010, is currently (February 2012) unknown. The corresponding metals data from samples associated with these blanks were censored in the database.

Sequential replicate samples were collected to measure the variation in results originating from sampling and analytical methods. Sequential replicate sample results are included in table 5. Inorganic constituent replicates were collected with a new, preconditioned capsule filter. Capsule filters were replaced prior to collecting the sequential replicate in case of filter loading, which might reduce the effective pore size of the filter (Horowitz and others, 1996).

Replicate samples were compared with associated environmental samples to assess the variability of the measured concentrations by computing the relative percent difference (RPD) for each constituent with equation 1:

$$RPD = |C1 - C2|/((C1 + C2)/2) \times 100, \qquad (1)$$

where

C1 is constituent concentration, in milligrams per liter, from the environmental sample; and

C2 is constituent concentration, in milligrams per liter, from the replicate sample.

RPDs of 10 percent or less indicate good agreement between the paired results if the concentrations are sufficiently large compared to their associated LRL (Oden and others, 2011). An RPD was not computed for a replicated constituent if the paired results were censored as estimated or less than their associated LRL.

There was generally good agreement between the environmental and replicate samples with a few exceptions. Several of the replicate metal concentrations measured on January 25, 2011, and June 23, 2011, were greater than 10 percent different (table 5). All but one of these samples with greater than 10 percent differences were detected at or near the detection limit so that small variability in the analysis caused large RPDs. The one exception was the detected lead concentration in the June 23, 2011, sample and, because of issues with lead concentrations in the blanks, these were already censored. The causes of the greater than 10 percent differences between some of the environmental and replicate samples are unknown.

Table 4. Results of major ion, trace element, and nutrient analyses from equipment blanks and field blanks collected in association with geochemical samples collected in the Pecos County region, Texas, 2010–11.

[USGS, U.S. Geological Survey; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; E, estimated; M, presence verified but not quantified; U, analyzed for but not detected at a concentration equal to or greater than the long-term method detection level]

USGS station number	Station name or State well number	Date	Sample start time	Sample type	Calcium, water, filtered (mg/L)	Magnesium, water, filtered (mg/L)	Potassium, water, filtered (mg/L)	Sodium, water, filtered (mg/L)	Bromide, water, filtered (mg/L)	Chloride, water, filtered (mg/L)	Fluoride, water, filtered (mg/L)	Hydrogen sulfide, water, unfiltered (mg/L)
302009097405901	Austin Field Headquarters	03-15-2010	14:00	Equipment blank	<0.04	<0.016	<0.06	<0.10	<0.02	<0.12	<0.08	--
302009097405901	Austin Field Headquarters	04-05-2010	12:30	Equipment blank	--	--	--	--	--	--	--	--
311610103050901	US-46-48-701	08-12-2010	10:05	Field blank	<.04	<.016	<.06	<.10	<.02	<.12	<.08	--
304805103013301	US-52-16-609	08-18-2010	15:05	Field blank	<.04	<.016	<.06	<.10	<.02	<.12	<.08	--
304715103263501	US-52-13-801	08-28-2010	13:05	Field blank	.11	.026	<.06	E.10	<.02	.14	E.05	U
305531103474201	WD-52-02-507	06-22-2011	10:00	Field blank	.03	<.008	<.02	<.06	<.01	<.06	<.04	--

USGS station number	Station name or State well number	Date	Sample start time	Sample type	Silica, water, filtered as SiO_2 (mg/L)	Sulfate, water, filtered (mg/L)	Ammonia plus organic nitrogen, water, filtered as nitrogen (mg/L)	Ammonia plus organic nitrogen, water, unfiltered as nitrogen (mg/L)	Ammonia, water, filtered as NH_4 (mg/L)	Ammonia, water, filtered as nitrogen (mg/L)	Ammonia, water, unfiltered as NH_4 (mg/L)	Ammonia, water, unfiltered as nitrogen (mg/L)
302009097405901	Austin Field Headquarters	03-15-2010	14:00	Equipment blank	<0.06	<0.18	<0.10	--	--	--	<0.052	<0.04
302009097405901	Austin Field Headquarters	04-05-2010	12:30	Equipment blank	--	--	--	E0.07	--	--	<.052	<.04
311610103050901	US-46-48-701	08-12-2010	10:05	Field blank	<.06	<.18	--	--	<0.026	<0.020	--	--
304805103013301	US-52-16-609	08-18-2010	15:05	Field blank	<.06	<.18	--	--	<.026	<.020	--	--
304715103263501	US-52-13-801	08-28-2010	13:05	Field blank	<.06	E.12	--	--	<.026	<.020	--	--
305531103474201	WD-52-02-507	06-22-2011	10:00	Field blank	<.03	<.09	--	--	.014	.011	--	--

UUSGS station number	Station name or State well number	Date	Sample start time	Sample type	Nitrate plus nitrite, water, filtered as nitrogen (mg/L)	Nitrate, water, filtered (mg/L)	Nitrate, water, filtered as nitrogen (mg/L)	Nitrite, water, filtered (mg/L)	Nitrite, water, filtered (mg/L) as nitrogen	Organic nitrogen, water, filtered (mg/L)	Organic nitrogen, water, unfiltered (mg/L)	Orthophosphate, water, filtered (mg/L)
302009097405901	Austin Field Headquarters	03-15-2010	14:00	Equipment blank	<0.04	--	--	--	--	--	--	<0.025
302009097405901	Austin Field Headquarters	04-05-2010	12:30	Equipment blank	<.04	<0.177	<0.040	<0.007	<0.002	--	<0.07	.080
311610103050901	US-46-48-701	08-12-2010	10:05	Field blank	<.04	<.177	<.040	<.007	<.002	<0.10	--	<.025
304805103013301	US-52-16-609	08-18-2010	15:05	Field blank	<.04	<.177	<.040	<.007	<.002	<.10	--	<.025
304715103263501	US-52-13-801	08-28-2010	13:05	Field blank	<.04	<.177	<.040	<.007	<.002	<.10	--	<.025
305531103474201	WD-52-02-507	06-22-2011	10:00	Field blank	<.02	<.089	<.020	<.003	<.001	<.04	--	<.012

USGS station number	Station name or State well number	Date	Sample start time	Sample type	Orthophos-phate, water, filtered as phosphorus (mg/L)	Phosphorus, water, filtered as phosphorus (mg/L)	Phosphorus, water, unfiltered as phosphorus (mg/L)	Total nitrogen (nitrate + nitrite + ammonia + organic-N), water, filtered, analytically determined (mg/L)	Total nitrogen, water, filtered (mg/L)	Total nitrogen, water, unfiltered (mg/L)	Aluminum, water, filtered (µg/L)	Barium, water, filtered (µg/L)
302009097405901	Austin Field Headquarters	03-15-2010	14:00	Equipment blank	<0.008	<0.006	--	--	<0.14	--	<3.4	<0.14
302009097405901	Austin Field Headquarters	04-05-2010	12:30	Equipment blank	.026	E.03	E0.03	--	--	<0.11	--	--
311610103050901	US-46-48-701	08-12-2010	10:05	Field blank	<.008	--	--	<0.10	--	--	<3.4	<.14
304805103013301	US-52-16-609	08-18-2010	15:05	Field blank	<.008	--	--	<.10	--	--	<3.4	<.14
304715103263501	US-52-13-801	08-28-2010	13:05	Field blank	<.008	--	--	E.10	--	--	<3.4	M
305531103474201	WD-52-02-507	06-22-2011	10:00	Field blank	<.004	--	--	<.05	--	--	339	<.07

Table 4. Results of major ion, trace element, and nutrient analyses from equipment blanks and field blanks collected in association with geochemical samples collected in the Pecos County region, Texas, 2010–11.—Continued

[USGS, U.S. Geological Survey; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; E, estimated; M, presence verified but not quantified; U, analyzed for but not detected at a concentration equal to or greater than the long-term method detection level]

USGS station number	Station name or State well number	Date	Sample start time	Sample type	Beryllium, water, filtered (µg/L)	Cadmium, water, filtered (µg/L)	Chromium, water, filtered (µg/L)	Cobalt, water, filtered (µg/L)	Copper, water, filtered (µg/L)	Copper, water, unfiltered, recoverable (µg/L)	Iron, water, filtered (µg/L)	Lead, water, filtered (µg/L)
302009097405901	Austin Field Headquarters	03-15-2010	14:00	Equipment blank	--	<0.02	<0.12	--	<1.0	--	<6	<0.03
302009097405901	Austin Field Headquarters	04-05-2010	12:30	Equipment blank	--	--	--	--	--	<1.4	--	--
311610103050901	US-46-48-701	08-12-2010	10:05	Field blank	<0.01	<.02	<.12	<0.01	<1.0	--	<6	.24
304805103013301	US-52-16-609	08-18-2010	15:05	Field blank	<.01	<.02	<.12	<.01	E.92	--	<6	.10
304715103263501	US-52-13-801	08-28-2010	13:05	Field blank	<.01	<.02	<.12	.02	1.5	--	<6	.23
305531103474201	WD-52-02-507	06-22-2011	10:00	Field blank	<.01	<.02	<.06	.35	<.50	--	<3	.05

USGS station number	Station name or State well number	Date	Sample start time	Sample type	Lead, water, unfiltered, recoverable (µg/L)	Lithium, water, filtered (µg/L)	Manganese, water, filtered (µg/L)	Molybdenum, water, filtered (µg/L)	Nickel, water, filtered (µg/L)	Silver, water, filtered (µg/L)	Strontium, water, filtered (µg/L)	Thallium, water, filtered (µg/L)
302009097405901	Austin Field Headquarters	03-15-2010	14:00	Equipment blank	--	--	<0.3	--	<0.12	<0.01	<0.40	--
302009097405901	Austin Field Headquarters	04-05-2010	12:30	Equipment blank	<0.06	--	--	--	--	--	--	--
311610103050901	US-46-48-701	08-12-2010	10:05	Field blank	--	<0.4	<.3	<0.03	<.12	<.01	<.40	E0.02
304805103013301	US-52-16-609	08-18-2010	15:05	Field blank	--	<.4	<.3	.05	E.08	<.01	<.40	<.02
304715103263501	US-52-13-801	08-28-2010	13:05	Field blank	--	<.4	E.2	.77	.48	<.01	.53	<.02
305531103474201	WD-52-02-507	06-22-2011	10:00	Field blank	--	<.2	.7	<.01	<.09	<.01	<.20	<.01

USGS station number	Station name or State well number	Date	Sample start time	Sample type	Vanadium, water, filtered (µg/L)	Zinc, water, filtered (µg/L)	Zinc, water, unfiltered, recoverable (µg/L)	Antimony, water, filtered (µg/L)	Arsenic, water, filtered (µg/L)	Boron, water, filtered (µg/L)	Selenium, water, filtered (µg/L)	1-Naphthol, water, filtered (0.7 micron glass fiber filter), recoverable (µg/L)
302009097405901	Austin Field Headquarters	03-15-2010	14:00	Equipment blank	--	<2.8	--	--	<0.04	<3	--	--
302009097405901	Austin Field Headquarters	04-05-2010	12:30	Equipment blank	--	--	<2.0	--	--	--	--	--
311610103050901	US-46-48-701	08-12-2010	10:05	Field blank	<0.16	<2.8	--	<0.05	<.04	<3	<0.04	--
304805103013301	US-52-16-609	08-18-2010	15:05	Field blank	<.16	<2.8	--	<.05	<.04	<3	<.04	--
304715103263501	US-52-13-801	08-28-2010	13:05	Field blank	<.16	3.8	--	<.05	<.04	<3	<.04	--
305531103474201	WD-52-02-507	06-22-2011	10:00	Field blank	<.08	<1.4	--	.03	<.02	<3	<.03	<0.036

USGS station number	Station name or State well number	Date	Sample start time	Sample type	2,6-Diethylaniline, water, filtered (0.7 micron glass fiber filter), recoverable (µg/L)	2-Chloro-2′, 6′-diethylacetanilide, water, filtered, recoverable (µg/L)	2-Chloro-4-isopropylamino-6-amino-s-triazine, water, filtered, recoverable (µg/L)	2-Ethyl-6-methylaniline, water, filtered, recoverable (µg/L)	3,4-Dichloroaniline, water, filtered, recoverable (µg/L)	3,5-Dichloroaniline, water, filtered, recoverable (µg/L)	4-Chloro-2-methylphenol, water, filtered, recoverable (µg/L)	Acetochlor, water, filtered, recoverable (µg/L)
302009097405901	Austin Field Headquarters	03-15-2010	14:00	Equipment blank	--	--	--	--	--	--	--	--
302009097405901	Austin Field Headquarters	04-05-2010	12:30	Equipment blank	--	--	--	--	--	--	--	--
311610103050901	US-46-48-701	08-12-2010	10:05	Field blank	--	--	--	--	--	--	--	--
304805103013301	US-52-16-609	08-18-2010	15:05	Field blank	--	--	--	--	--	--	--	--
304715103263501	US-52-13-801	08-28-2010	13:05	Field blank	--	--	--	--	--	--	--	--
305531103474201	WD-52-02-507	06-22-2011	10:00	Field blank	<0.006	<0.010	<0.006	<0.010	<0.004	<0.004	<0.005	<0.010

Table 4. Results of major ion, trace element, and nutrient analyses from equipment blanks and field blanks collected in association with geochemical samples collected in the Pecos County region, Texas, 2010–11.—Continued

[USGS, U.S. Geological Survey; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; E, estimated; M, presence verified but not quantified; U, analyzed for but not detected at a concentration equal to or greater than the long-term method detection level]

USGS station number	Station name or State well number	Date	Sample start time	Sample type	Alachlor, water, filtered, recoverable (µg/L)	alpha-Endosulfan, water, filtered, recoverable (µg/L)	Atrazine, water, filtered, recoverable (µg/L)	Azinphos-methyl oxygen analog, water, filtered, recoverable (µg/L)	Azinphos-methyl, water, filtered (0.7 micron glass fiber filter), recoverable (µg/L)	Benfluralin, water, filtered (0.7 micron glass fiber filter), recoverable (µg/L)	Carbaryl, water, filtered (0.7 micron glass fiber filter), recoverable (µg/L)	Carbofuran, water, filtered (0.7 micron glass fiber filter), recoverable (µg/L)
302009097405901	Austin Field Headquarters	03-15-2010	14:00	Equipment blank	--	--	--	--	--	--	--	--
302009097405901	Austin Field Headquarters	04-05-2010	12:30	Equipment blank	--	--	--	--	--	--	--	--
311610103050901	US-46-48-701	08-12-2010	10:05	Field blank	--	--	--	--	--	--	--	--
304805103013301	US-52-16-609	08-18-2010	15:05	Field blank	--	--	--	--	--	--	--	--
304715103263501	US-52-13-801	08-28-2010	13:05	Field blank	--	--	--	--	--	--	--	--
305531103474201	WD-52-02-507	06-22-2011	10:00	Field blank	<0.008	<0.006	<0.008	<0.04	<0.120	<0.014	<0.060	<0.060

USGS station number	Station name or State well number	Date	Sample start time	Sample type	Chlorpyrifos oxygen analog, water, filtered, recoverable (µg/L)	Chlorpyrifos, water, filtered, recoverable (µg/L)	cis-Permethrin, water, filtered (0.7 micron glass fiber filter), recoverable (µg/L)	cis-Propiconazole, water, filtered, recoverable (µg/L)	Cyanazine, water, filtered, recoverable (µg/L)	Cyfluthrin, water, filtered, recoverable (µg/L)	Cypermethrin, water, filtered, recoverable (µg/L)	DCPA, water, filtered (0.7 micron glass fiber filter), recoverable (µg/L)
302009097405901	Austin Field Headquarters	03-15-2010	14:00	Equipment blank	--	--	--	--	--	--	--	--
302009097405901	Austin Field Headquarters	04-05-2010	12:30	Equipment blank	--	--	--	--	--	--	--	--
311610103050901	US-46-48-701	08-12-2010	10:05	Field blank	--	--	--	--	--	--	--	--
304805103013301	US-52-16-609	08-18-2010	15:05	Field blank	--	--	--	--	--	--	--	--
304715103263501	US-52-13-801	08-28-2010	13:05	Field blank	--	--	--	--	--	--	--	--
305531103474201	WD-52-02-507	06-22-2011	10:00	Field blank	<0.06	<0.004	<0.010	<0.008	<0.022	<0.016	<0.020	<0.008

USGS station number	Station name or State well number	Date	Sample start time	Sample type	Desulfinylfipronil amide, water, filtered, recoverable (µg/L)	Desulfinylfipronil, water, filtered, recoverable (µg/L)	Diazinon, water, filtered, recoverable (µg/L)	Dichlorvos, water, filtered, recoverable (µg/L)	Dicrotophos, water, filtered, recoverable (µg/L)	Dieldrin, water, filtered, recoverable (µg/L)	Dimethoate, water, filtered (0.7 micron glass fiber filter), recoverable (µg/L)	Disulfoton sulfone, water, filtered, recoverable (µg/L)
302009097405901	Austin Field Headquarters	03-15-2010	14:00	Equipment blank	--	--	--	--	--	--	--	--
302009097405901	Austin Field Headquarters	04-05-2010	12:30	Equipment blank	--	--	--	--	--	--	--	--
311610103050901	US-46-48-701	08-12-2010	10:05	Field blank	--	--	--	--	--	--	--	--
304805103013301	US-52-16-609	08-18-2010	15:05	Field blank	--	--	--	--	--	--	--	--
304715103263501	US-52-13-801	08-28-2010	13:05	Field blank	--	--	--	--	--	--	--	--
305531103474201	WD-52-02-507	06-22-2011	10:00	Field blank	<0.029	<0.012	<0.006	<0.04	<0.08	<0.008	<0.006	<0.01

Table 4. Results of major ion, trace element, and nutrient analyses from equipment blanks and field blanks collected in association with geochemical samples collected in the Pecos County region, Texas, 2010–11.—Continued

[USGS, U.S. Geological Survey; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; E, estimated; M, presence verified but not quantified; U, analyzed for but not detected at a concentration equal to or greater than the long-term method detection level]

USGS station number	Station name or State well number	Date	Sample start time	Sample type	Disulfoton, water, filtered (0.7 micron glass fiber filter), recoverable (µg/L)	Endosulfan sulfate, water, filtered, recoverable (µg/L)	EPTC, water, filtered (0.7 micron glass fiber filter), recoverable (µg/L)	Ethion monoxon, water, filtered, recoverable (µg/L)	Ethion, water, filtered, recoverable (µg/L)	Ethoprop, water, filtered (0.7 micron glass fiber filter), recoverable (µg/L)	Fenamiphos sulfone, water, filtered, recoverable (µg/L)	Fenamiphos sulfoxide, water, filtered, recoverable (µg/L)
302009097405901	Austin Field Headquarters	03-15-2010	14:00	Equipment blank	--	--	--	--	--	--	--	--
302009097405901	Austin Field Headquarters	04-05-2010	12:30	Equipment blank	--	--	--	--	--	--	--	--
311610103050901	US-46-48-701	08-12-2010	10:05	Field blank	--	--	--	--	--	--	--	--
304805103013301	US-52-16-609	08-18-2010	15:05	Field blank	--	--	--	--	--	--	--	--
304715103263501	US-52-13-801	08-28-2010	13:05	Field blank	--	--	--	--	--	--	--	--
305531103474201	WD-52-02-507	06-22-2011	10:00	Field blank	<0.04	<0.016	<0.006	<0.02	<0.008	<0.016	<0.054	<0.08

USGS station number	Station name or State well number	Date	Sample start time	Sample type	Fenamiphos, water, filtered, recoverable (µg/L)	Fipronil sulfide, water, filtered, recoverable (µg/L)	Fipronil sulfone, water, filtered, recoverable (µg/L)	Fipronil, water, filtered, recoverable (µg/L)	Fonofos, water, filtered, recoverable (µg/L)	Hexazinone, water, filtered, recoverable (µg/L)	Iprodione, water, filtered, recoverable (µg/L)	Isofenphos, water, filtered, recoverable (µg/L)
302009097405901	Austin Field Headquarters	03-15-2010	14:00	Equipment blank	--	--	--	--	--	--	--	--
302009097405901	Austin Field Headquarters	04-05-2010	12:30	Equipment blank	--	--	--	--	--	--	--	--
311610103050901	US-46-48-701	08-12-2010	10:05	Field blank	--	--	--	--	--	--	--	--
304805103013301	US-52-16-609	08-18-2010	15:05	Field blank	--	--	--	--	--	--	--	--
304715103263501	US-52-13-801	08-28-2010	13:05	Field blank	--	--	--	--	--	--	--	--
305531103474201	WD-52-02-507	06-22-2011	10:00	Field blank	<0.03	<0.012	<0.024	<0.018	<0.005	<0.008	<0.014	<0.006

USGS station number	Station name or State well number	Date	Sample start time	Sample type	lambda-Cyhalothrin, water, filtered, recoverable (µg/L)	Malaoxon, water, filtered, recoverable (µg/L)	Malathion, water, filtered, recoverable (µg/L)	Metalaxyl, water, filtered, recoverable (µg/L)	Methidathion, water, filtered, recoverable (µg/L)	Methyl paraoxon, water, filtered, recoverable (µg/L)	Methyl parathion, water, filtered (0.7 micron glass fiber filter), recoverable (µg/L)	Metolachlor, water, filtered, recoverable (µg/L)
302009097405901	Austin Field Headquarters	03-15-2010	14:00	Equipment blank	--	--	--	--	--	--	--	--
302009097405901	Austin Field Headquarters	04-05-2010	12:30	Equipment blank	--	--	--	--	--	--	--	--
311610103050901	US-46-48-701	08-12-2010	10:05	Field blank	--	--	--	--	--	--	--	--
304805103013301	US-52-16-609	08-18-2010	15:05	Field blank	--	--	--	--	--	--	--	--
304715103263501	US-52-13-801	08-28-2010	13:05	Field blank	--	--	--	--	--	--	--	--
305531103474201	WD-52-02-507	06-22-2011	10:00	Field blank	<0.010	<0.022	<0.016	<0.014	<0.012	<0.01	<0.008	<0.020

USGS station number	Station name or State well number	Date	Sample start time	Sample type	Metribuzin, water, filtered, recoverable (µg/L)	Molinate, water, filtered (0.7 micron glass fiber filter), recoverable (µg/L)	Myclobutanil, water, filtered, recoverable (µg/L)	Oxyfluorfen, water, filtered, recoverable (µg/L)	Pendimethalin, water, filtered (0.7 micron glass fiber filter), recoverable (µg/L)	Phorate oxygen analog, water, filtered, recoverable (µg/L)	Phorate, water, filtered (0.7 micron glass fiber filter), recoverable (µg/L)	Phosmet oxygen analog, water, filtered, recoverable (µg/L)
302009097405901	Austin Field Headquarters	03-15-2010	14:00	Equipment blank	--	--	--	--	--	--	--	--
302009097405901	Austin Field Headquarters	04-05-2010	12:30	Equipment blank	--	--	--	--	--	--	--	--
311610103050901	US-46-48-701	08-12-2010	10:05	Field blank	--	--	--	--	--	--	--	--
304805103013301	US-52-16-609	08-18-2010	15:05	Field blank	--	--	--	--	--	--	--	--
304715103263501	US-52-13-801	08-28-2010	13:05	Field blank	--	--	--	--	--	--	--	--
305531103474201	WD-52-02-507	06-22-2011	10:00	Field blank	<0.012	<0.004	<0.010	<0.006	<0.012	<0.03	<0.020	<0.05

Table 4. Results of major ion, trace element, and nutrient analyses from equipment blanks and field blanks collected in association with geochemical samples collected in the Pecos County region, Texas, 2010–11.—Continued

[USGS, U.S. Geological Survey; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data; <, less than; E, estimated; M, presence verified but not quantified; U, analyzed for but not detected at a concentration equal to or greater than the long-term method detection level]

USGS station number	Station name or State well number	Date	Sample start time	Sample type	Phosmet, water, filtered, recoverable (µg/L)	Prometon, water, filtered, recoverable (µg/L)	Prometryn, water, filtered, recoverable (µg/L)	Propanil, water, filtered (0.7 micron glass fiber filter), recoverable (µg/L)	Propargite, water, filtered (0.7 micron glass fiber filter), recoverable (µg/L)	Simazine, water, filtered, recoverable (µg/L)	Tebuthiuron, water, filtered (0.7 micron glass fiber filter), recoverable (µg/L)	Tefluthrin, water, filtered, recoverable (µg/L)
302009097405901	Austin Field Headquarters	03-15-2010	14:00	Equipment blank	--	--	--	--	--	--	--	--
302009097405901	Austin Field Headquarters	04-05-2010	12:30	Equipment blank	--	--	--	--	--	--	--	--
311610103050901	US-46-48-701	08-12-2010	10:05	Field blank	--	--	--	--	--	--	--	--
304805103013301	US-52-16-609	08-18-2010	15:05	Field blank	--	--	--	--	--	--	--	--
304715103263501	US-52-13-801	08-28-2010	13:05	Field blank	--	--	--	--	--	--	--	--
305531103474201	WD-52-02-507	06-22-2011	10:00	Field blank	<0.140	<0.012	<0.006	<0.010	<0.02	<0.006	<0.03	<0.010

USGS station number	Station name or State well number	Date	Sample start time	Sample type	Terbufos oxygen analog sulfone, water, filtered, recoverable (µg/L)	Terbufos, water, filtered (0.7 micron glass fiber filter), recoverable (µg/L)	Terbuthylazine, water, filtered, recoverable (µg/L)	Thiobencarb, water, filtered (0.7 micron glass fiber filter), recoverable (µg/L)	trans-Propiconazole, water, filtered, recoverable (µg/L)	Tribuphos, water, filtered, recoverable (µg/L)	Trifluralin, water, filtered (0.7 micron glass fiber filter), recoverable (µg/L)	Organic carbon, water, unfiltered (mg/L)
302009097405901	Austin Field Headquarters	03-15-2010	14:00	Equipment blank	--	--	--	--	--	--	--	E0.3
302009097405901	Austin Field Headquarters	04-05-2010	12:30	Equipment blank	--	--	--	--	--	--	--	<.6
311610103050901	US-46-48-701	08-12-2010	10:05	Field blank	--	--	--	--	--	--	--	--
304805103013301	US-52-16-609	08-18-2010	15:05	Field blank	--	--	--	--	--	--	--	--
304715103263501	US-52-13-801	08-28-2010	13:05	Field blank	--	--	--	--	--	--	--	--
305531103474201	WD-52-02-507	06-22-2011	10:00	Field blank	<0.04	<0.02	<0.01	<0.016	<0.01	<0.018	<0.018	--

USGS station number	Station name or State well number	Date	Sample start time	Sample type	Uranium (natural), water, filtered (µg/L)
302009097405901	Austin Field Headquarters	03-15-2010	14:00	Equipment blank	--
302009097405901	Austin Field Headquarters	04-05-2010	12:30	Equipment blank	--
311610103050901	US-46-48-701	08-12-2010	10:05	Field blank	<0.01
304805103013301	US-52-16-609	08-18-2010	15:05	Field blank	<.01
304715103263501	US-52-13-801	08-28-2010	13:05	Field blank	<.01
305531103474201	WD-52-02-507	06-22-2011	10:00	Field blank	<.004

Table 5. Relative percent differences between sequential replicate and environmental samples analyzed for major ions, trace elements, and elemental isotopes collected in the Pecos County region, Texas, 2010–11.

[USGS, U.S. Geological Survey; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; NTRU, Nephelometric Turbidity Ratio Unit; <, concentration was less than laboratory reporting level; --, RPD not calculated because the concentration for one or both samples in the pair was less than the laboratory reporting level]

USGS station number	Date	Constituent	Sequential replicate result	Environmental result	Relative percent differences
08437000	1/25/2011	Alkalinity, water, filtered inflection-point titration method (incremental titration method), field (mg/L as calcium carbonate)	254.0	232.0	9.05
08437000	1/25/2011	Aluminum, water, filtered (µg/L)	5.6	<5.1	--
08437000	1/25/2011	Ammonia, water, filtered (µg/L)	.057	.060	5.13
08437000	1/25/2011	Arsenic, water, filtered (µg/L)	1.7	1.7	0
08437000	1/25/2011	Barium, water, filtered (µg/L)	20	20	0
08437000	1/25/2011	Beryllium, water, filtered (µg/L)	.04	.04	0
08437000	1/25/2011	Bicarbonate, water, filtered, inflection-point titration method (incremental titration method), field (mg/L)	309	283	8.78
08437000	1/25/2011	Boron, water, filtered (µg/L)	1,010	1,020	0.99
08437000	1/25/2011	Bromide, water, filtered (mg/L)	2.33	2.37	1.70
08437000	1/25/2011	Cadmium, water, filtered (µg/L)	.10	.05	66.67
08437000	1/25/2011	Calcium, water, filtered (mg/L)	447	462	3.30
08437000	1/25/2011	Carbonate, water, filtered, inflection-point titration method (incremental titration method), field (mg/L)	.3	.2	40.00
08437000	1/25/2011	Chloride, water, filtered (mg/L)	1,180	1,180	0
08437000	1/25/2011	Chromium, water, filtered (µg/L)	.40	.43	7.23
08437000	1/25/2011	Cobalt, water, filtered (µg/L)	.46	.36	24.39
08437000	1/25/2011	Delta deuterium, water, unfiltered (per mil)	-46.70	-47.00	-0.64
08437000	1/25/2011	Delta oxygen-18, water, unfiltered (per mil)	-6.57	-6.56	-0.15
08437000	1/25/2011	Dissolved solids dried at 180 degrees Celsius, water, filtered (mg/L)	4,530	4,520	0.22
08437000	1/25/2011	Fluoride, water, filtered (mg/L)	1.70	1.72	1.17
08437000	1/25/2011	Iron, water, filtered (µg/L)	15	<13	--
08437000	1/25/2011	Lead, water, filtered (µg/L)	0.11	<0.04	--
08437000	1/25/2011	Lithium, water, filtered (µg/L)	280	279	0.36
08437000	1/25/2011	Magnesium, water, filtered (mg/L)	176	180	2.25
08437000	1/25/2011	Manganese, water, filtered (µg/L)	12.8	12.5	2.37
08437000	1/25/2011	Molybdenum, water, filtered (µg/L)	13.7	13.7	0
08437000	1/25/2011	Nickel, water, filtered (µg/L)	2.0	1.9	5.13
08437000	1/25/2011	Nitrite, water, filtered (µg/L)	.02	.02	0
08437000	1/25/2011	Nitrate plus Nitrite, water, filtered (mg/L)	2.97	2.95	0.68
08437000	1/25/2011	Orthophosphate, water, filtered (mg/L as phosphorus)	.02	.02	0
08437000	1/25/2011	Potassium, water, filtered (mg/L)	21.1	21.6	2.34
08437000	1/25/2011	Selenium, water, filtered (µg/L)	5.4	5.6	3.64
08437000	1/25/2011	Silica, water, filtered (mg/L as SiO_2)	32.4	32.8	1.23
08437000	1/25/2011	Silver, water, filtered (µg/L)	<.01	.02	--
08437000	1/25/2011	Sodium, water, filtered (mg/L)	688	696	1.16
08437000	1/25/2011	Strontium, water, filtered (µg/L)	8,760	9,060	3.37
08437000	1/25/2011	Sulfate, water, filtered (mg/L)	1,550	1,550	0

Table 5. Relative percent differences between sequential replicate and environmental samples analyzed for major ions, trace elements, and elemental isotopes collected in the Pecos County region, Texas, 2010–11.—Continued

[USGS, U.S. Geological Survey; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; NTRU, Nephelometric Turbidity Ratio Unit; <, concentration was less than laboratory reporting level; --, RPD not calculated because the concentration for one or both samples in the pair was less than the laboratory reporting level]

USGS station number	Date	Constituent	Sequential replicate result	Environmental result	Relative percent differences
08437000	1/25/2011	Thallium, water, filtered (µg/L)	0.28	0.26	7.41
08437000	1/25/2011	Total nitrogen, water, filtered (mg/L)	3.09	3.16	2.24
08437000	1/25/2011	Tritium, water, unfiltered (pCi/L)	1.9	1.8	5.41
08437000	1/25/2011	Uranium (natural), water, filtered (µg/L)	21.0	21.1	0.48
08437000	1/25/2011	Vanadium, water, filtered (µg/L)	6.3	6.5	3.13
304006103315601	6/23/2011	Alkalinity, water, filtered inflection-point titration method (incremental titration method), field (mg/L as calcium carbonate)	330	336	1.80
304006103315601	6/23/2011	Ammonia, water, filtered (µg/L)	.781	.780	0.13
304006103315601	6/23/2011	Antimony, water, filtered (µg/L)	<.03	.13	--
304006103315601	6/23/2011	Arsenic, water, filtered (µg/L)	3.1	3.0	3.28
304006103315601	6/23/2011	Barium, water, filtered (µg/L)	40	40	0
304006103315601	6/23/2011	Beryllium, water, filtered (µg/L)	.02	.02	0
304006103315601	6/23/2011	Bicarbonate, water, filtered, inflection-point titration method (incremental titration method), field (mg/L)	401	409	1.98
304006103315601	6/23/2011	Boron, water, filtered (µg/L)	1,120	1,110	0.90
304006103315601	6/23/2011	Cadmium, water, filtered (µg/L)	.03	.03	0
304006103315601	6/23/2011	Calcium, water, filtered (mg/L)	26.8	27.0	0.74
304006103315601	6/23/2011	Carbonate, water, filtered, inflection-point titration method (incremental titration method), field (mg/L)	.7	.6	15.38
304006103315601	6/23/2011	Chloride, water, filtered (mg/L)	57.1	58.6	2.59
304006103315601	6/23/2011	Cobalt, water, filtered (µg/L)	.07	<0.02	--
304006103315601	6/23/2011	Dissolved solids dried at 180 degrees Celsius, water, filtered (mg/L)	869	859	1.16
304006103315601	6/23/2011	Fluoride, water, filtered (mg/L)	1.22	1.23	0.82
304006103315601	6/23/2011	Iron, water, filtered (µg/L)	66	65	1.53
304006103315601	6/23/2011	Lead, water, filtered (µg/L)	.02	1.21	193.50
304006103315601	6/23/2011	Lithium, water, filtered (µg/L)	198	199	0.50
304006103315601	6/23/2011	Magnesium, water, filtered (mg/L)	4.39	4.38	0.23
304006103315601	6/23/2011	Manganese, water, filtered (µg/L)	15.9	16.1	1.25
304006103315601	6/23/2011	Molybdenum, water, filtered (µg/L)	12.5	12.5	0
304006103315601	6/23/2011	Orthophosphate, water, filtered (mg/L as phosphorus)	.019	.019	0
304006103315601	6/23/2011	Potassium, water, filtered (mg/L)	7.25	7.43	2.45
304006103315601	6/23/2011	Selenium, water, filtered (µg/L)	.06	.06	0
304006103315601	6/23/2011	Silica, water, filtered (mg/L as SiO_2)	20.7	21.1	1.91
304006103315601	6/23/2011	Sodium, water, filtered (mg/L)	266	265	0.38
304006103315601	6/23/2011	Strontium, water, filtered (µg/L)	1,020	1,030	0.98
304006103315601	6/23/2011	Sulfate, water, filtered (mg/L)	271	271	0
304006103315601	6/23/2011	Total nitrogen, water, filtered (mg/L)	.85	.86	1.17
304006103315601	6/23/2011	Uranium (natural), water, filtered (µg/L)	22.4	22.4	0
304006103315601	6/23/2011	Vanadium, water, filtered (µg/L)	.19	.21	10.00

Table 5. Relative percent differences between sequential replicate and environmental samples analyzed for major ions, trace elements, and elemental isotopes collected in the Pecos County region, Texas, 2010–11.—Continued

[USGS, U.S. Geological Survey; mg/L, milligrams per liter; µg/L, micrograms per liter; pCi/L, picocuries per liter; NTRU, Nephelometric Turbidity Ratio Unit; <, concentration was less than laboratory reporting level; --, RPD not calculated because the concentration for one or both samples in the pair was less than the laboratory reporting level]

USGS station number	Date	Constituent	Sequential replicate result	Environmental result	Relative percent differences
304006103315601	6/23/2011	Zinc, water, filtered (µg/L)	2.6	3.0	14.29
305331103020501	8/17/2010	Alkalinity, water, filtered inflection-point titration method (incremental titration method), field (mg/L as calcium carbonate)	230	235	2.15
305331103020501	8/17/2010	Arsenic, water, filtered (µg/L)	.60	.56	6.90
305331103020501	8/17/2010	Barium, water, filtered (µg/L)	15	16	6.45
305331103020501	8/17/2010	Bicarbonate, water, filtered, inflection-point titration method (incremental titration method), field (mg/L)	280	286	2.12
305331103020501	8/17/2010	Boron, water, filtered (µg/L)	388.8	396.4	1.94
305331103020501	8/17/2010	Bromide, water, filtered (mg/L)	1.06	1.05	0.95
305331103020501	8/17/2010	Calcium, water, filtered (mg/L)	275	278	1.08
305331103020501	8/17/2010	Carbonate, water, filtered, inflection-point titration method (incremental titration method), field (mg/L)	.2	.2	0
305331103020501	8/17/2010	Chloride, water, filtered (mg/L)	760	758	0.26
305331103020501	8/17/2010	Cobalt, water, filtered (µg/L)	.11	.11	0
305331103020501	8/17/2010	Delta deuterium, water, unfiltered (per mil)	-50.50	-52.30	-3.50
305331103020501	8/17/2010	Delta oxygen-18, water, unfiltered (per mil)	-7.41	-7.47	-0.81
305331103020501	8/17/2010	Dissolved solids dried at 180 degrees Celsius, water, filtered (mg/L)	2,770	2,770	0
305331103020501	8/17/2010	Fluoride, water, filtered (mg/L)	1.31	1.30	0.77
305331103020501	8/17/2010	Lead, water, filtered (µg/L)	.19	.19	0
305331103020501	8/17/2010	Lithium, water, filtered (µg/L)	130	133	2.28
305331103020501	8/17/2010	Magnesium, water, filtered (mg/L)	107	109	1.85
305331103020501	8/17/2010	Molybdenum, water, filtered (µg/L)	14.2	14.5	2.09
305331103020501	8/17/2010	Nickel, water, filtered (µg/L)	.88	.83	5.85
305331103020501	8/17/2010	Nitrate plus Nitrite, water, filtered (mg/L)	1.63	1.61	1.23
305331103020501	8/17/2010	Orthophosphate, water, filtered (mg/L as phosphorus)	.016	.018	11.76
305331103020501	8/17/2010	Potassium, water, filtered (mg/L)	15.0	15.2	1.32
305331103020501	8/17/2010	Selenium, water, filtered (µg/L)	3.6	3.7	2.74
305331103020501	8/17/2010	Silica, water, filtered (mg/L as SiO_2)	23.4	23.3	0.43
305331103020501	8/17/2010	Sodium, water, filtered (mg/L)	418	421	0.72
305331103020501	8/17/2010	Strontium, water, filtered (µg/L)	5,490	5,330	2.96
305331103020501	8/17/2010	Sulfate, water, filtered (mg/L)	912	908	0.44
305331103020501	8/17/2010	Thallium, water, filtered (µg/L)	.87	.87	0
305331103020501	8/17/2010	Total nitrogen, water, filtered (mg/L)	1.61	1.61	0
305331103020501	8/17/2010	Tritium, water, unfiltered (pCi/L)	1.5	1.3	14.29
305331103020501	8/17/2010	Uranium (natural), water, filtered (µg/L)	8.76	8.90	1.59
305331103020501	8/17/2010	Vanadium, water, filtered (µg/L)	1.8	1.9	5.41
305509103510101	9/1/2010	Delta deuterium, water, unfiltered (per mil)	-11.70	-11.50	-1.72
305509103510101	9/1/2010	Delta oxygen-18, water, unfiltered (per mil)	-0.52	-0.61	-15.93

Field spikes are used to assess bias and variability from degradation of organic constituent concentrations during sample processing, storage, and analysis. Field spikes are environmental replicate samples into which a known volume and concentration of target analytes are added. Analytical recoveries of the spiked target compounds are expressed as percentages of expected (theoretical) concentrations. Computed field-spike recoveries (equation 2) are compared to theoretical and laboratory recoveries to evaluate matrix interferences or degradation of organic compounds:

$$\text{Recovery} = [(C_{spiked} - C_{unspiked}) \div C_{expected}] \times 100, \quad (2)$$

where

C_{spiked} is the measured concentration of analyte in the spiked environmental sample, in micrograms per liter;

$C_{unspiked}$ is the measured concentration of analyte in the unspiked environmental sample, in micrograms per liter;

$C_{expected}$ is the theoretical concentration of analyte in the spiked environmental sample, in micrograms per liter, and is computed as

$$C_{expected} = C_{solution} \times V_{spike} \div V_{sample}, \quad (3)$$

where

$C_{solution}$ is concentration of analyte in spiked environmental solution, in micrograms per liter;

V_{spike} is volume of spike added to environmental sample, in milliliters; and

V_{sample} is volume of environmental sample, in liters.

A mixture of target analytes was added to a replicate environmental sample (site 305419102545301 collected on August 6, 2010). The calculated spike recoveries in this report were compared to time-series graph of groundwater spike recoveries in appendix 3 of Martin and Eberle (2011). In 2010, the spike recoveries in this report are within the range of spike recoveries shown by Martin and Eberle, indicating no bias in the results. For target analytes not included, the spiked recoveries of reagent water by the NWQL were reviewed for method performance, with methods appearing to be operating normally (U.S. Geological Survey, 2012).

Geophysical Methods

Surface and borehole geophysical data were collected throughout the study area from 2009 to 2011 to supplement compiled historical data and to minimize data gaps. Time-domain electromagnetic (TDEM) soundings were collected at 4 locations (fig. 4, table 6) and audio-magnetotelluric (AMT) soundings were collected at 13 locations (fig. 4, table 7) and borehole geophysical logs were collected at 44 locations (fig. 4, table 8). Site locations and associated information can be accessed using the USGS NWIS (U.S. Geological Survey, 2011a) and archived geophysical database.

Surface Geophysical Methods

Surface geophysical resistivity methods can be used to detect changes in the electrical properties of the subsurface (Zohdy and others, 1974). The electrical properties of soil and rock are determined by water content, porosity, clay content and mineralogy, and conductivity (or reciprocal of electrical resistivity) of the pore water (Lucius and others, 2007). Resistivity measurements can be used to construct graphical images of the spatial distribution of electrical properties of the subsurface which, in turn, can be used to identify stratigraphic units and describe subsurface hydrogeology. The two surface geophysical methods used to evaluate the subsurface stratigraphy and hydrogeology in the study area were TDEM and AMT. Comprehensive descriptions of the theory and application of surface geophysical resistivity methods, as well as tables of the electrical properties of earth materials, are presented in Keller and Frischknecht (1966) and Lucius and others (2007).

Time-Domain Electromagnetic Soundings

Four TDEM soundings were collected at four different sites using the Geonics Protem 47 and 57 systems (Geonics Limited, 2006a,b). Each of the locations were near wells that had borehole geophysical logs collected by the USGS. Locations were selected so that the TDEM could be compared to the borehole geophysical logs to determine if this geophysical method would yield information to fill in data gaps associated with these sites.

The Geonics Protem 47 and 57 systems (hereinafter referred to as Protem 47 and 57, respectively) were used to collect TDEM soundings at each site. The Protem 47 and 57 use a multiturn receiver (Rx) coil to measure electromagnetic fields in the center of the transmitter (Tx) loop. The effective area of the receiver relates to the sensitivity of the Rx coil. The 100 square meter (m^2) Rx coil of the Protem 57 is able to measure smaller voltages than the 31.4-m^2 coil of the Protem 47. At each sounding, an integration time of 15 seconds (s) was used to measure six different data sets (the compilation of these data sets is referred to as a stack). The mean value of all the soundings collected over the integration time is stored. The values stored in the stack are averaged to ensure data quality and repeatability, and averaging is done prior to the inversion step, which is explained in the inverse modeling section of this report.

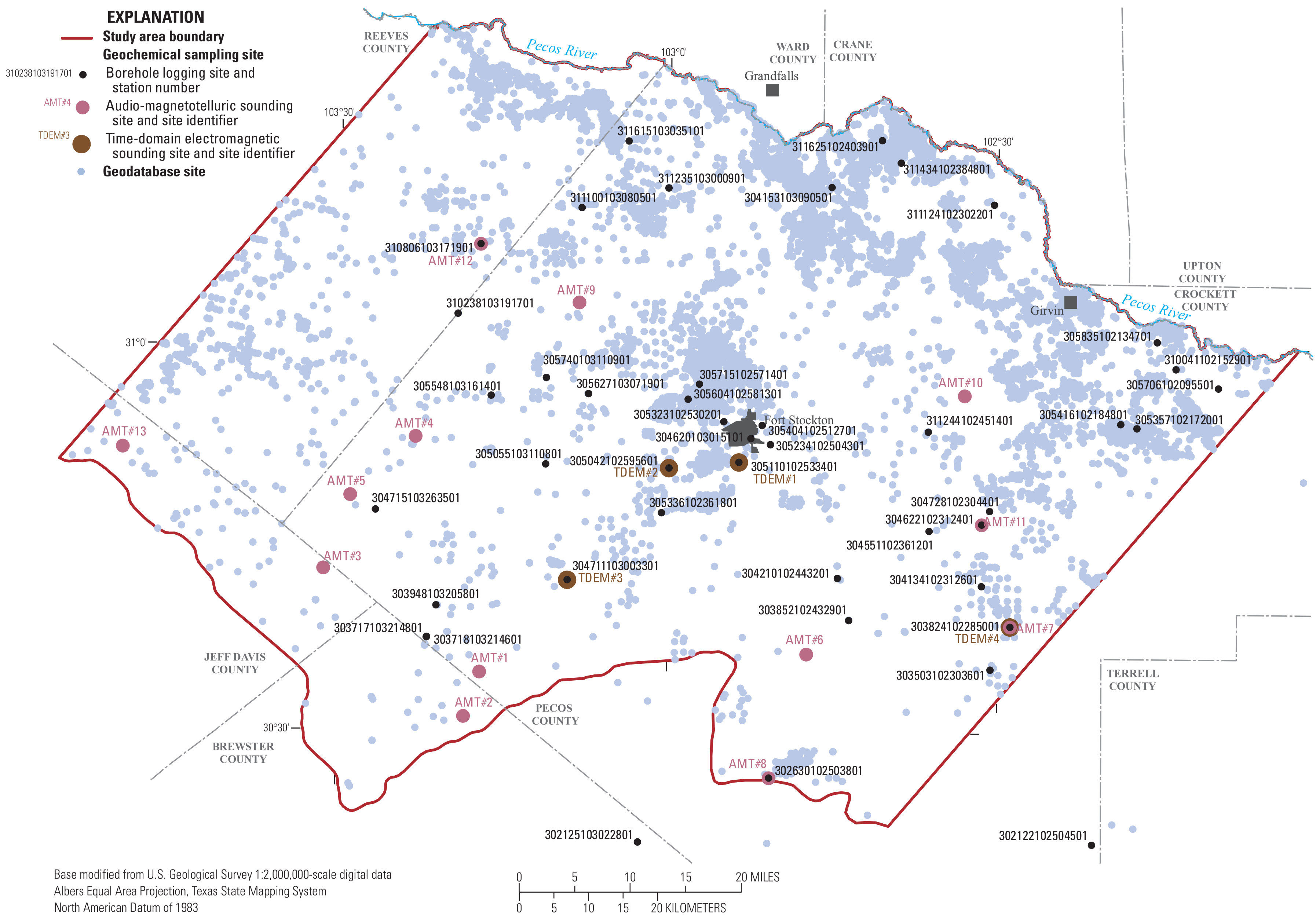

Figure 4. Site locations of field-collected geophysical data, including borehole logging and surface geophysical sites, Pecos County region, Texas, 2009–11.

Table 6. Time-domain electromagnetic geophysical sounding sites, Pecos County region, Texas, 2009-11

[TDEM, time-domain electromagnetic; USGS, U.S. Geological Survey; dd, decimal degrees]

Sounding identification number	USGS station number	State well number	Latitude (dd)	Longitude (dd)
TDEM#1	305110102533401	US-53-09-301	30.85286	-102.89278
TDEM#2	305042102595601	US-53-09-106	30.84509	-102.99899
TDEM#3	304711103003301	US-52-16-909	30.69795	-103.15138
TDEM#4	303824102285001	US-53-21-703	30.64000	-102.48052

Table 7. Audio magnetotelluric geophysical sounding sites, Pecos County region, Texas, 2009-11.

[AMT, audio magnetotelluric; USGS, U.S.Geological Survey; dd, decimal degrees; --, sounding not collected at/near well site]

Sounding identification number	USGS station number	State well number	Latitude (dd)	Longitude (dd)
AMT#1	--	--	30.57745	-103.28333
AMT#2	--	--	30.51932	-103.30687
AMT#3	--	--	30.71023	-103.52157
AMT#4	--	--	30.88350	-103.38389
AMT#5	--	--	30.80659	-103.48194
AMT#6	--	--	30.60335	-102.78842
AMT#7	303824102285001	US-53-21-703	30.64000	-102.48052
AMT#8	302630102503801	US-53-34-401	30.44176	-102.84396
AMT#9	--	--	31.06002	-103.13731
AMT#10	--	--	30.94134	-102.55057
AMT#11	304622102312401	US-53-12-901	30.77304	-102.52379
AMT#12	310806103171901	WD-46-54-901	31.13502	-103.28796
AMT#13	--	--	30.86516	-103.82792

Table 8. Borehole geophysical data-collection sites, Pecos County region, Texas, 2009-11.

[USGS, U.S. Geological Survey; dd, decimal degrees]

USGS station number	State well number	Latitude (dd)	Longitude (dd)
302122102504501	US-53-42-101	30.356	-102.8458611
302125103022801	BK-52-48-301	30.357	-103.0411306
302630102503801	US-53-34-401	30.4417611	-102.8439611
303503102303601	US-53-28-303	30.5842111	-102.5100694
303717103214801	US-52-30-107	30.62143889	-103.3638306
303718103214601	US-52-30-108	30.62181944	-103.3632389
303824102285001	US-53-21-703	30.64	-102.4805194
303852102432901	US-53-19-701	30.6479	-102.7247111
303948103205801	52-22-7xx	30.66344444	-103.3494444
304134102312601	US-53-20-603	30.69278889	-102.5239889
304153103090501	US-52-23-604	30.69795	-103.1513806
304210102443201	53-19-4xx	30.70269444	-102.7422778
304551102361201	US-53-12-701	30.76448056	-102.6038694
304620103015101	US-53-02-7xx (COFS 6)	30.7721	-103.0308
304622102312401	US-53-12-901	30.77303889	-102.5237889
304711103003301	US-52-16-909	30.78641944	-103.0093194
304715103263501	US-52-13-801	30.7874	-103.4434306
304728102304401	US-53-12-902	30.79098056	-102.5121611
305042102595601	US-53-09-106	30.84508889	-102.9989889
305055103110801	52-15-2xx	30.84863889	-103.1856667
305110102533401	US-53-09-301	30.8528611	-102.8927806
305234102504301	US-53-02-708	30.87618056	-102.8452111
305323102530201	US-53-01-908	30.88951944	-102.8839694
305336102361801	US-53-04-701	30.89363889	-102.6054
305357102172001	US-53-06-901	30.89923056	-102.2891194
305404102512701	US-53-02-710	30.9012	-102.8577
305416102184801	US-53-06-803	30.90458056	-102.3132694
305548103161401	US-52-06-604	30.9302	-103.2706
305604102581301	US-53-01-4xx (Apache 4)	30.93455	-102.9703
305627103071901	US-52-08-402	30.94075	-103.122
305706102095501	US-53-07-601	30.95175	-102.1653611
305715102571401	US-53-01-503	30.9542611	-102.9538194
305740103110901	US-52-07-201	30.9612	-103.1860806
305835102134701	US-53-07-106	30.9765	-102.2297694
310041102152901	US-45-62-901	31.0115611	-102.25855
310238103191701	US-46-62-801	31.0440111	-103.3213889
310806103171901	WD-46-54-901	31.13501944	-103.2879611
311100103080501	US-46-55-603	31.1834611	-103.1347389
311124102302201	US-45-52-602	31.19008056	-102.5065389
311235103000901	US-46-56-309	31.20973889	-103.0026194
311244102451401	US-45-50-302	31.21208889	-102.7539694
311434102384801	US-45-51-306	31.24468056	-102.6493
311615103035101	US-46-48-805	31.2708111	-103.0641611
311625102403901	US-45-43-806	31.27378889	-102.6778389

For each TDEM sounding collected, the voltages measured from the eddy currents were averaged and evaluated statistically by using preprocessing scripts (Joe Vrabel, U.S. Geological Survey, written commun., 2010). These scripts use the raw field data (voltage data) to calculate the uncertainty of each time gate (measured voltage values at discreet intervals of time increasing after shutoff of the current) independently. After calculating the standard deviation of the voltage, the user can specify limits to trim the data set (remove outliers prior to inverse modeling). For this study, the data were initially filtered by using the mean of the six stacks collected. Outliers were evaluated by the program and any data that were more than 10 percent above or below other data points were removed. The averages of each time gate were saved as processed data files to be used in the inversion software (Interpex Limited, 1996).

Audiomagnetotelluric Soundings

A total of 13 AMT soundings was collected and processed within the study area using the Stratagem EH4 electrical conductivity imaging system developed by Geometrics, Inc. and Electromagnetic Instruments, Inc. (Geometrics, 2012), and in accordance with techniques described by Asch and Sweetkind (2010). Of the 13 soundings collected, 4 of these soundings were collected near wells that had borehole geophysical logs collected by the USGS. These locations were selected so that the AMT soundings could be compared to the borehole geophysical logs, which aid in the interpretation of the AMT soundings. The remaining nine sounding locations were selected in areas where little or no other compiled data were located.

The Stratagem EH4 system was used to collect AMT data for each sounding location. The Stratagem EH4 system measures perpendicular arrays of electrical and magnetic fields labeled as X and Y directions within a range of 10 hertz (Hz) to 100 kilohertz (kHz) (Asch and Sweetkind, 2010). The electric field was measured by four stainless-steel electrodes placed into the earth with a 25-meter dipole (two electrodes separated by 25 meters) in the X direction and a 25-meter dipole in the Y direction. A fifth electrode was used as a ground. The ambient magnetic field was measured with two induction magnetometer coils that were placed more than 3 meters away from the electrode dipoles and are placed level in a small trench and then covered with dirt to ensure there is no movement of the coil. The controlled source transmitter was a 400-watt transmitter to supplement the received electromagnetic signal in the frequency range from 900 Hz to 23,000 Hz. The X and Y directions were chosen on a site by site basis with the X and Y directions being approximately 45 degrees from visible anthropogenic sources (Geometrics, 2007).

Time-series datasets were analyzed and selected based on the optimal signal-to-noise ratio before calculations were performed on the datasets. The measured AMT time-series datasets at each location were converted to the frequency domain and processed to determine a two-dimensional (2D) impedance tensor of apparent resistivity and phase (Asch and Sweetkind, 2010). Poor quality (noisy) data were filtered out in the time-series datasets before the conversion was made and in the spectral and resistivity datasets after conversion. Apparent resistivity is the approximate ratio of the magnitude of the electric field to the magnitude of the magnetic field for a given frequency (Asch and Sweetkind, 2010). The impedance tensor was rotated to an angle that closely represented a 2D earth at each sounding location. This allows for the separation of the TE and TM modes, which can be used to identify lateral variation across the sounding site.

Data were exported from Imagem, the Stratagem data acquisition program, into two files: a cross-power data file, which contained spectral conversion of the data and a magnetotelluric (MT) impedance data file, which contained the apparent resistivity and phase conversion of the data (Geometrics, 2007). These files were used during the 2D inversion modeling process.

Inverse Modeling of Surface Geophysical Results

Apparent resistivity represents the resistivity of a completely uniform (homogenous and isotropic) subsurface (Keller and Frischknecht, 1966). Inverse modeling is the process of creating an estimate of the true distribution of subsurface resistivity (derived from the actual heterogeneous, anisotropic rocks) from the measured apparent resistivity (modeled as homogeneous, isotropic rocks). To estimate the resistivity of nonuniform earth material, inverse modeling software is used. The IX1Dv3 program, developed by Interpex Limited (1996), was used for inverse modeling of the TDEM soundings. The AMT sounding data were inverted using selected inversion algorithms within the Geotools MT software package used to process AMT and MT data (Geotools, 1998).

For this report, root mean square errors (RMSE) of 10 percent or less were generally considered acceptable, and RMSEs of 5 percent were generally considered good. The inverse modeling results of the TDEM data collected throughout the area had RMSEs of less than 4 percent for all soundings collected (appendix 1). The TDEM results were not able to resolve the depths needed to make geologic picks, so AMT was used to obtain deeper information.

The inverse modeling results of the AMT data collected throughout the area had acceptable errors between the measured field data and the calculated model data (appendix 2). There were two locations (AMT07 and AMT13, fig. 4) where anthropogenic noise distorted the signal sufficiently such that a poor inversion result was obtained. Four of the AMT soundings were located near wells from which geophysical logs were obtained, allowing the data quality to be assessed using borehole geophysical results.

Borehole Geophysical Methods

Borehole geophysical data such as natural gamma, formation resistivity, and caliper are commonly used to characterize and identify stratigraphic units (Keys, 1997). Many of these data had been collected in some wells in the study area as parts of previous studies and petroleum exploration (Small, and Ozuna, 1993; Smith and others, 2000). Conventional borehole geophysical log data such as natural gamma, formation resistivity, fluid resistivity, temperature, and caliper were collected in 44 wells where additional geophysical data were most critical to supplement existing data. In addition to the conventional borehole geophysical methods, advanced borehole geophysical measurements of vertical flow (magnitude and direction), in the borehole were collected in six representative wells using the Electromagnetic (EM) flowmeter. These data can be evaluated to determine the relation of flow to the hydrostratigraphic units in each well. All borehole geophysical data were collected using a Century Geophysical Corporation System VI logging system conveyed by a 0.25-in. diameter 4-conductor wireline or a Mount Sopris Instruments Matrix logging system conveyed by a 0.1875-in. diameter single conductor wireline. Limitations, calibration procedures, and algorithms of the geophysical probes are available from the manufacturers (Century Geophysical Corporation, 2012; Mount Sopris Instruments, 2012).

Electromagnetic Induction Logs

Electromagnetic induction probes measure conductivity in air- or water-filled holes and perform well in open holes or polyvinyl chloride (PVC) cased holes. The measurement of conductivity commonly is reciprocated to provide logs with curves of resistivity and conductivity (Keys, 1997). Conductivity is affected by the salinity of borehole and formation fluids and the type of lithology encountered. Generally, pure carbonates, sands, and gravels have lower conductivity, thus higher resistivity, than clays or shales (Keys, 1997). A Century Geophysical Corporation 9510 or a Geonics EM39 induction conductivity probe was calibrated and was used to the manufacturer's specifications (Century Geophysical Corporation, written commun., 2011; Mount Sopris Instruments, written commun., 2011). The EM induction conductivity measurements (commonly sensitive to metallic conductive objects) were affected at depths corresponding with metal objects such as centralizers and stainless steel screens.

Natural Gamma Logs

Natural gamma logs provide a record of gamma radiation detected at depth in a borehole. Fine-grained sediments that contain abundant clay tend to be more radioactive than quartz-grain sandstones or carbonates (Keys, 1997). The natural gamma log was run in conjunction with the fluid resistivity log and was recorded in natural gamma counts per second simultaneously as the induction log was recorded in both cased and open boreholes. A Century Geophysical Corporation 8044 multiparameter probe or a Mount Sopris Instruments 2PGA–1000 natural gamma probe with a sodium iodide detector was calibrated and was used to the manufacturer's specifications. The natural gamma and induction logs collectively can be useful in identifying lithologies and contact depths of the strata penetrated in the borehole.

Electric Logs

Electric logs use a series of electrodes mounted on the downhole probe and a surface electrode in the ground to measure potential (or voltage) that varies with the electrical properties of fluids and rock materials. Electric logs require an uncased, fluid-filled hole to allow the current to flow into the formation. Electric logs include the following electrical methods measured in boreholes: normal resistivity, lateral resistivity, spontaneous potential, and single-point resistance. A Century Geophysical Corporation model 8044 multiparameter E-log probe was used to measure normal resistivity, lateral resistivity, spontaneous potential, and single-point resistance. These geophysical methods are explained in detail in Keys (1990, 1997).

Caliper Logs

Caliper logs provide a measurement of the diameter of the borehole and are useful in determining changes in borehole diameter that can be related to drilling techniques, cavernous formations, lithology, and well construction. The Century Geophysical Corporation model 7074 and the Mount Sopris Instruments 2PCA–1000, three-arm caliper probes were used in this study and recorded an average diameter measured by the three arms. The Century Geophysical Corporation 7074 probe was run in the short or long arm configurations (depending on hole diameter) for boreholes from 2 to 24 and 2 to 36 inches in diameter, respectively (Century Geophysical Corporation, 2012). The Mount Sopris Instruments 2PCA–1000 can be used in boreholes from 2 to 17 inches in diameter (Mount Sopris Instruments, 2012). Other limitations and algorithms of the geophysical probes can be found at Century Geophysical Corporation (2012) and Mount Sopris Instruments (2012). The caliper logs were collected using the Century Geophysical Corporation System IV or Mount Sopris Instruments Matrix logging systems. The caliper was calibrated by performing a two-point calibration on short sections of pipe (rings) where diameters were larger and smaller than the borehole sizes that were expected to be encountered.

Fluid Resistivity and Temperature Logs

Fluid resistivity logs provide a record of the capacity of the borehole fluid to conduct electrical current (Keys, 1990). Changes in fluid resistivity are measured by ring electrodes inside a housing that allows borehole fluid to flow through it. When feasible, fluid resistivity logs were run as the first logging run to record the ambient conditions before other probes have passed through the borehole and have vertically mixed the borehole fluid. Curve deflections on the fluid resistivity log can indicate horizontal or vertical flow, stratification of borehole fluid, or screened intervals in cased wells. The fluid resistivity values also can be used in calculations with other logs. Fluid resistivity and the reciprocal (fluid conductivity) are shown on the logs in this study for comparison to specific-conductance values collected at springs (appendix 1).

The fluid conductivity values contained in the logs for this study are the values recorded at the ambient borehole temperature and are not corrected to a standard temperature. A Century Geophysical Corporation model 8044 multiparameter E-log probe or a Mount Sopris Instruments model 2PFA–1000 probe was used to log fluid resistivity in uncased (open) boreholes and cased wells. Calibration of the fluid resistivity logging probes was done with solutions of known conductivity in a two-point calibration. Temperature logs record the temperature of the borehole fluid that the logging probe passes through as it is raised or lowered in the borehole. A Century Geophysical Corporation model 8044 multiparameter E-log probe or a Mount Sopris Instruments model 2PFA–1000 probe was used to log fluid temperature in uncased (open) boreholes and cased wells. All temperature logs were collected as the probe was lowered in the borehole to maximize the flow into the sensor housing at the bottom of the Century Geophysical Corporation model 8044 logging probe. Temperature logs can provide useful information on the movement of water through a water-well borehole, including the location of depth intervals that produce or accept water (Keys, 1990).

Optical Borehole Imaging

The optical borehole imager (OBI) is an oriented logging device that can provide a high-resolution, 360-degree image or “cylindrical picture” of the circumference of the borehole that can be used to evaluate secondary porosity features such as fractures and solution openings. The OBI uses a digital scanning camera and conical mirror, which records a 360-degree image of the borehole wall showing the texture, color, and fractures in air-filled or clear fluid-filled boreholes (Hearst and others, 2000). A cylindrical light ring between the camera and mirror illuminates the part of the borehole wall being imaged. An Advanced Logic Technology optical borehole imager or OBI40 was used to collect optical images of the surface wall of open and cased wells in both air and clear water (Advanced Logic Technology, 2012). The utility and analytical methods of optical imaging are explained in Keys (1997) and Hearst and others (2000).

Acoustic Borehole Imaging

The acoustic borehole imager (ABI) is an oriented logging device that can provide a high-resolution, 360-degree image or cylindrical acoustic image of the circumference of the borehole that can be used to evaluate secondary porosity features such as fractures and solution openings. Acoustic borehole imaging tools generate an image of the borehole wall by transmitting ultrasonic pulses from a rotating sensor and recording the amplitude and traveltime of the signals reflected at the interface between the borehole fluid and borehole wall. Because of the need for sound waves to be transmitted to and from the borehole wall and rock formation, ABI tools can only be used in fluid-filled holes. An Advanced Logic Technology acoustic borehole imager or ABI40 was used to collect acoustic borehole images. These are multiecho systems that measure multiple echoes of amplitude and traveltime. The ABI image shows the borehole-fracture intersection by scattering acoustic energy and enabling the defined orientation and fracture aperture to be used to calculate the strike and dip of planar features such as fractures and bedding planes (Hearst and others, 2000; Keys, 1997; Paillet, 1991).

Electromagnetic Flowmeter

The EM flowmeter measures the vertical flow rate and direction in a borehole using the principal of Faraday’s Law of EM Induction (Century Geophysical Corporation, written commun., 2006). The EM flowmeter probe consists of an electromagnet and two electrodes 180 degrees apart and oriented 90 degrees to the magnetic field inside a hollow cylinder or tube. The voltage induced by a conductor moving at right angles through the magnetic field is directly proportional to the velocity of the conductor (water) through the field (Century Geophysical Corporation, written commun., 2006). Generally, when using the tool to measure low-velocity flow, rubber diverters direct the water flow through the tube, which is open at both ends, instead of around the tool. Because the diameter of the tube and voltage response is calibrated, the volume of flow is instantaneously recorded. The direction of water flow is determined by the polarity of the response; upward flow is positive and downward flow is negative. If there are vertical hydraulic head gradients within the aquifer adjacent to the borehole, then the ambient flow profile is subtracted from the flow profile during steady pumping to yield the estimated relative interval transmissivity (Paillet, 2001).

Geophysical Data Quality Assurance and Formats

All logs collected during 2009–11 were collected according to the American Society of Testing and Materials (ASTM) borehole geophysical standard procedures: (1) ASTM Standard Guide for Planning and Conducting Borehole Geophysical Logging - D5753-05 (American Society of Testing and Materials, 2010), (2) ASTM Standard Guide for Conducting Borehole Geophysical Logging Mechanical Caliper - D6167 – 97 (American Society of Testing and Materials, 2004), and (3) ASTM Standard Guide for Conducting Borehole Geophysical Logging Electromagnetic Induction - D6726 – 01 (American Society of Testing and Materials, 2007). All logs were collected in digital format and were recorded in the proprietary format of the data acquisition equipment used to collect the logs. These proprietary data formats were converted to and stored as Log American Standard Code for Information Interchange (ASCII) Standard (Canadian Well Logging Society, 2011) tabular data and presented as chart logs in a portable document format (PDF) file (appendix 2). All surface geophysical data were collected in accordance with ASTM Standard Guide for Selecting Surface Geophysical Methods - D6429 (American Society of Testing and Materials, 1999).

Geodatabase Compilation

Groundwater, surface-water, water-quality, geophysical, and geologic information were downloaded from existing database resources hosted by various Federal, State, and local agencies. The geodatabase comprises data accessed and downloaded from enterprise database resources that warehouse environmental data, such as USGS NWIS, USEPA Modernized Storage and Retrieval Repository (STORET), TWDB Groundwater Database, TCEQ Surface Water Quality Information System (SWQMIS), and others.

The USGS groundwater, surface-water, and water-quality data were obtained from NWIS and include measurements taken as part of routine sampling and project-specific sampling in the Texas Water Science Centers (U.S. Geological Survey, 2011a). In addition, field-collected geochemical and geophysical data reported in the sections above were included with the downloaded data obtained from NWIS. The USEPA data were obtained from the Modern STORET and include mostly surface water-quality data supplied by State and local agencies (U.S. Environmental Protection Agency, 2011). Data from the TWDB Groundwater Database include well information, water quality, and water levels reported to TWDB from Federal, State, and local entities (Texas Water Development Board, 2011). The TCEQ SWQMIS data were obtained using direct connection with the database (Texas Commission on Environmental Quality, 2011). This information includes mostly surface-water information focused on water quality for sites throughout Texas. Local database resources were used from the City of Fort Stockton and Middle Pecos Groundwater Conservation District. Additional data were mined from published reports and other hardcopy data resources in the geodatabase. In most cases, these data were acquired directly from the source agency and accessed through the publishing agency's website or online libraries. Appendix 3 provides detail about the database resources used in the final geodatabase product.

Many of the data resources compiled into the geodatabase came from databases or other digital files with vastly different file formats, contents, structure, and function. The compilation process included a qualitative and quantitative analysis of each individual data source to identify relevant, authoritative data to include in the geodatabase. Data were extracted from the native data source using custom queries and export functions, and then loaded into the geodatabase using import functions and structured query language (SQL) code. This process incorporates data from many disparate databases into a single compilation and may result in duplicate records in the geodatabase because of redundant data reported between unique databases.

The first step of this process was to compile all geographic site locations from independent database resources into a single master site file for the geodatabase. Site locations were provided in a compatible geospatial data format (geodatabase feature class or shapefile format) or latitude/longitude coordinates were identified in the tabular information. The final master site file was then related to the groundwater, surface-water, water-quality, geophysical, and geologic data stored in data tables in the geodatabase. Groundwater levels and geologic data were combined into a single table for all available sources, while groundwater, surface-water, and water-quality data were stored in separate tables in the geodatabase and organized by source agency.

Geodatabase Design

A geodatabase is a spatially enabled database that contains spatial and tabular data and allows users to associate tabular data with physical and spatial components (Shah and Houston, 2007). It is capable of handling volumes of data efficiently through the use of a relational database management system. The geodatabase can be explored interactively using a GIS or accessed through traditional database queries. Using a GIS, the spatial data can be viewed in combination with other relevant geospatial data layers (aerial imagery, surface geology, administrative boundaries, and so forth) to analyze distribution patterns, data gaps, spatial relationships, and to create cartographic representations of the geodatabase contents.

The geodatabase is comprised of database objects: feature classes, relationship classes, and attribute tables. Feature classes store geospatial data objects of similar geometry type (point, line, or polygon). A collection of feature classes are stored and managed in a feature dataset, which uses a single, defined geographic or projected coordinate system for all data stored within the database object. Relationship classes link geospatial data stored in the feature classes with related tabular information stored in attribute tables. Relationship classes allow the end user to query data by establishing connections between geospatial data stored in the feature classes with related tabular information stored within the geodatabase attribute tables (Zeiler, 1999). The geodatabase designed for this study was based on an Environmental Systems Research Institute (ESRI) ArcGIS 10.0 personal geodatabase platform. ArcGIS personal geodatabases store database information as Microsoft Access (97–2003) files (Zeiler, 1999).

Figure 5 shows the simplified geodatabase model used for this project. Figure elements are shaded to highlight the distinction between data sources, data elements used to store geographic information and those used to store related tabular information. Compiling data, entering data into the geodatabase, ensuring data quality, and documenting the associated metadata were the primary steps in creating the geodatabase.

Data Input

Digital data were imported and select hardcopy data were entered manually into the geodatabase. Data were extracted from the native data resources using custom queries and basic data export functions and then were loaded into the geodatabase using import functions and SQL code within Microsoft Access. Whenever possible, SQL code was used to automate the creation of tables within the geodatabase and to load data into specified database elements within the geodatabase. Traditional geodatabase import/export functions within ArcGIS were used for the final compilation for geospatial components. The Microsoft Access table and query design wizards also were used for data input. In addition, ESRI ArcCatalog was used to create tables and upload data into the geodatabase attribute tables using the "Simple Data Loader." This efficient tool allows the end-user to load both spatial and tabular data, stored in various native data formats, into a geodatabase feature class or attribute table.

Geodatabase Data Quality Assurance

Database schemas and data formats from the various source agencies are incongruent, so the final database schema was simplified to capture only essential information needed for the geodatabase. Using database imports functions and SQL code, the disparate data were loaded into the generalized schema for geographic locations (sitefile) and attribute tables that store water-level and water-quality data. Simple cross-checks were performed to ensure the number of records from the native data resources were consistent with the number of records imported into the geodatabase after loading.

In some cases, data from one source agency were reported in one or more of the unique database sources used in this project. For example, some of water-level altitudes collected by the USGS and stored in NWIS were also stored in the TWDB Groundwater Database. Based on the design of the geodatabase, native database resources uploaded into the geodatabase reside in independent attribute tables and are linked to the sitefile through relationship classes linked by the unique identifier for each record. The design of the geodatabase operates under the assumption that data might be duplicated between source agencies.

Additional quality assurance methods can be applied after querying the geodatabase to ensure a higher level of data quality. This may include a search for duplicate geographic site locations using a tolerance established by the end-user. Shah and Maltby (2010) used a 30-meter horizontal buffer to identify site locations near each other and then used additional fields (for example, source agency) to eliminate duplicate information where possible. Additionally, tabular information can be reviewed post-query using a combination of key fields, such as source agency, date/time, site type, parameter name or result values, to help identify potential duplicates. While these steps can help eliminate duplicate data, the possibility that duplicate data exist in the post-query results is still high based on the inability to precisely identify all duplicate data because of data rounding, incongruent database schemas, and other data handling errors present in each database resource.

Metadata

Federal Geographic Data Committee (FGDC) compliant metadata were created for each spatial data layer in the geodatabase. Metadata describe the "who, what, when, where, why, and how" for each spatial data layer. FGDC metadata include data categories such as title, abstract, publication date, and sourcing information. In addition, the metadata record describes the geographic setting for each spatial data layer, including the geographic or projected coordinate system and vertical/horizontal datum. Lastly, the metadata record describes the attribute label definitions and domain values for fields in the attribute table of the spatial data layer. A detailed listing of metadata contents can be found at *http://www.fgdc.gov/metadata* (Federal Geographic Data Committee, 2012). The metadata record for the sitefile feature class can be found in appendix 4.

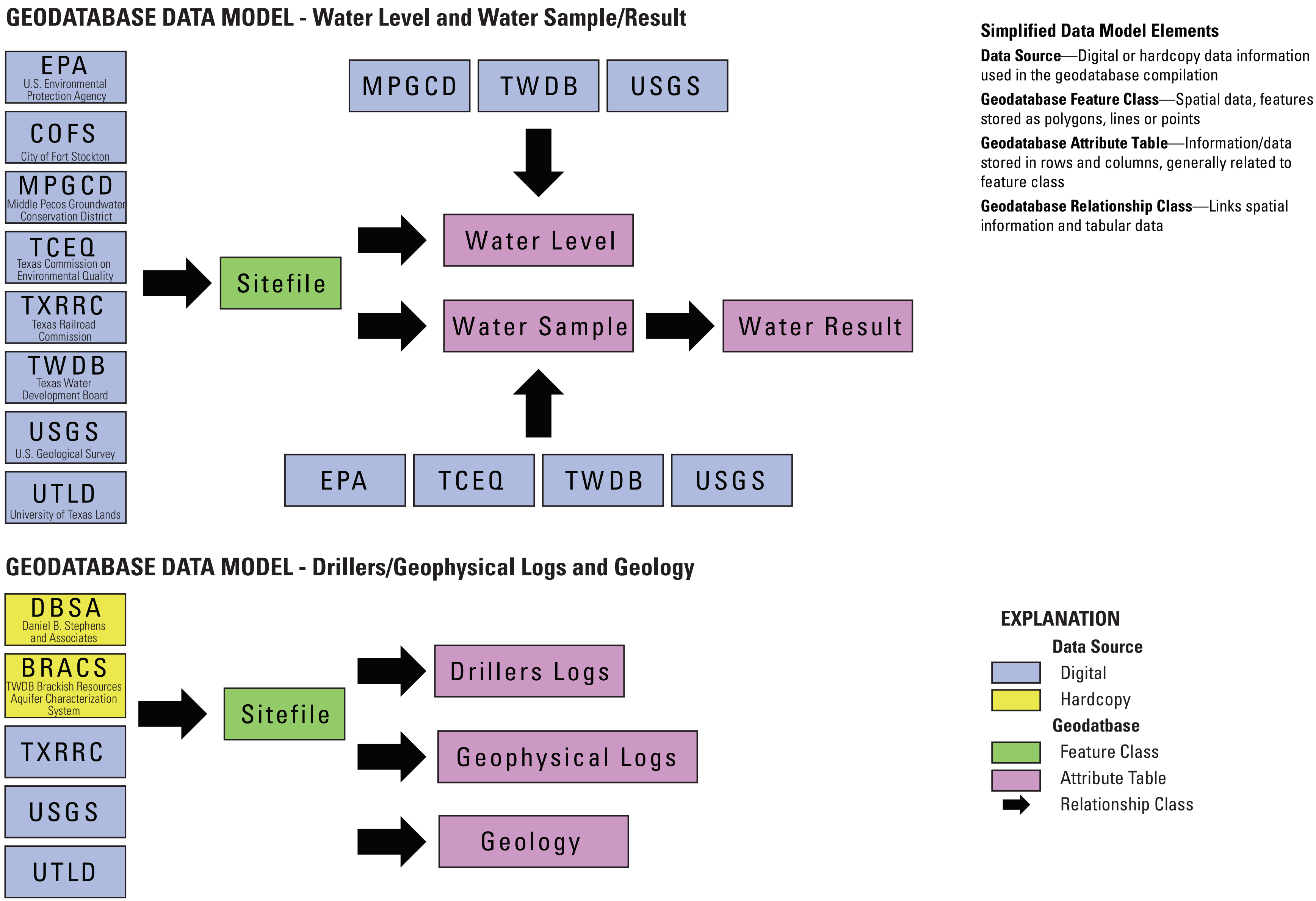

Figure 5. Simplified geodatabase data model for hydrogeologic data for the Pecos County region, Texas, 2011.

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Glossary

Acronyms and terms used throughout the report

ABI	acoustic borehole imager
AMT	audio-magnetotelluric
ASCII	American Standard Code for Information Interchange
ASTM	American Society of Testing and Materials
COFS	City of Fort Stockton
EM	electromagnetic
ESRI	Environmental Systems Research Institute
FGDC	Federal Geographic Data Committee
GAM	groundwater availability model
GIS	geographic information system
LRL	laboratory reporting level
MPGCD	Middle Pecos Groundwater Conservation District
MT	magnetotelluric
NWIS	National Water Information System
OBI	optical borehole imager
Ohm	Unit of measure of electrical resistance (International System)
Ohm-meters	Unit by which resistivity is measured; it is derived from the following equation:

$$R = rA/L$$

where

R is resistivity, in ohm-meters;

r is resistance measured, in ohms;

A is cross-sectional area, in meters squared; and

L is length of the resistor, in meters.

PDF	Portable Document Format
RMSE	root mean square error
RPD	relative percent difference
SQL	Structured Query Language
STORET	Storage and Retrieval Repository
SWQMIS	Surface Water Quality Monitoring Information System
TCEQ	Texas Commission on Environmental Quality
TDEM	time-domain electromagnetic
TE	transverse electric
TM	transverse magnetic
TWDB	Texas Water Development Board
TXRRC	Texas Railroad Commission
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
UTLD	University of Texas System Lands

Appendix 1. Time-Domain Electromagnetic Resistivity from Field Measurements as a Function of Time and Inverse Modeling Results (Smooth and Layered-Earth Models)

Measured apparent resistivity data as a function of time are presented in appendix 1. Apparent resistivity values are calculated from the raw voltage values measured for each sounding, When plotted in time, these apparent resistivity values yield a decay curve representing the subsurface electrical stratigraphy. Data points that deviated appreciably (in the judgment of the authors) from the decay curve (and, therefore, represented suspect data) were deleted before inverse modeling. Appendix 1 includes the decay curve for each sounding as well as the inverse modeling results calculated from the curve.

A smooth inverse model (a multilayered model that holds the depth values fixed and allows the resistivities to vary during inversion) was then fit to the data using Occam's inversion principle (Constable and others, 1987). The inversion process uses a series of iterations to create a model that closely fits the data. Iterations were continued until the root mean square error (RMSE) between measured and calculated apparent resistivity changed less than 0.1 percent between iterations. To better represent the electrical stratigraphy of each sounding, layered-earth models were then generated. The layered-earth models are simplified to represent geologic units with depth. Throughout the area, the layered-earth models range from 4 to 6 layers, depending on observed inflections in the apparent resistivity decay curve and smooth model inversions. Graphs of the smooth and layered-earth models for each sounding site are in appendix 1. The graphs show the raw apparent resistivity data and the inversion results. The smooth (green line), layered-earth (red line), and error or bounds of layered equivalent models (grey shaded area around depth profiles) are shown in the plots.

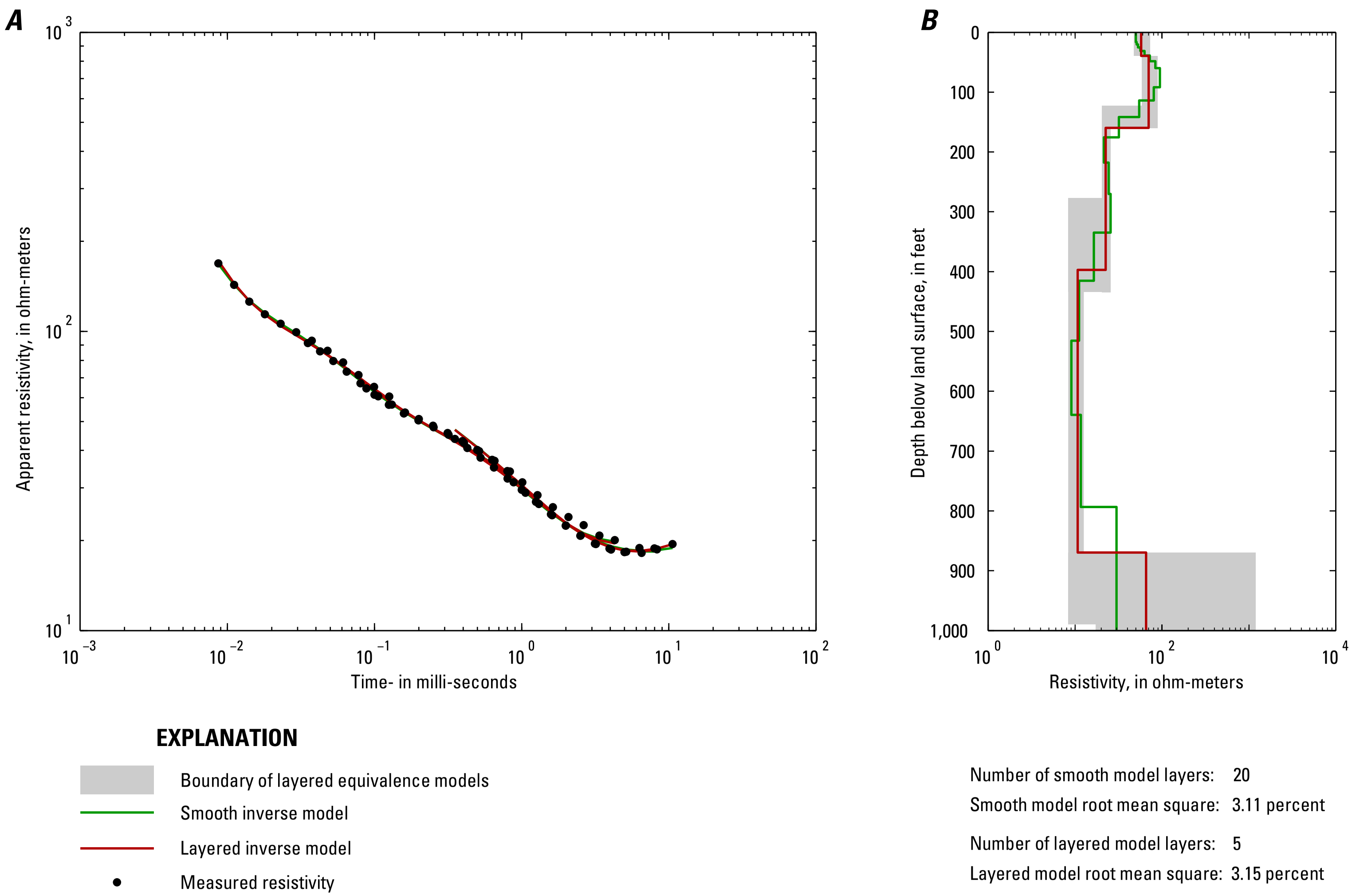

Figure 1.1 Sounding site TDEM#1, Pecos County, Texas. *A*, 80-meter time-domain electromagnetic sounding data (apparent resistivity from field measurements) as a function of time. *B*, 80-meter layered and equivalent inverse modeling results (models of true resistivity as a function of depth).

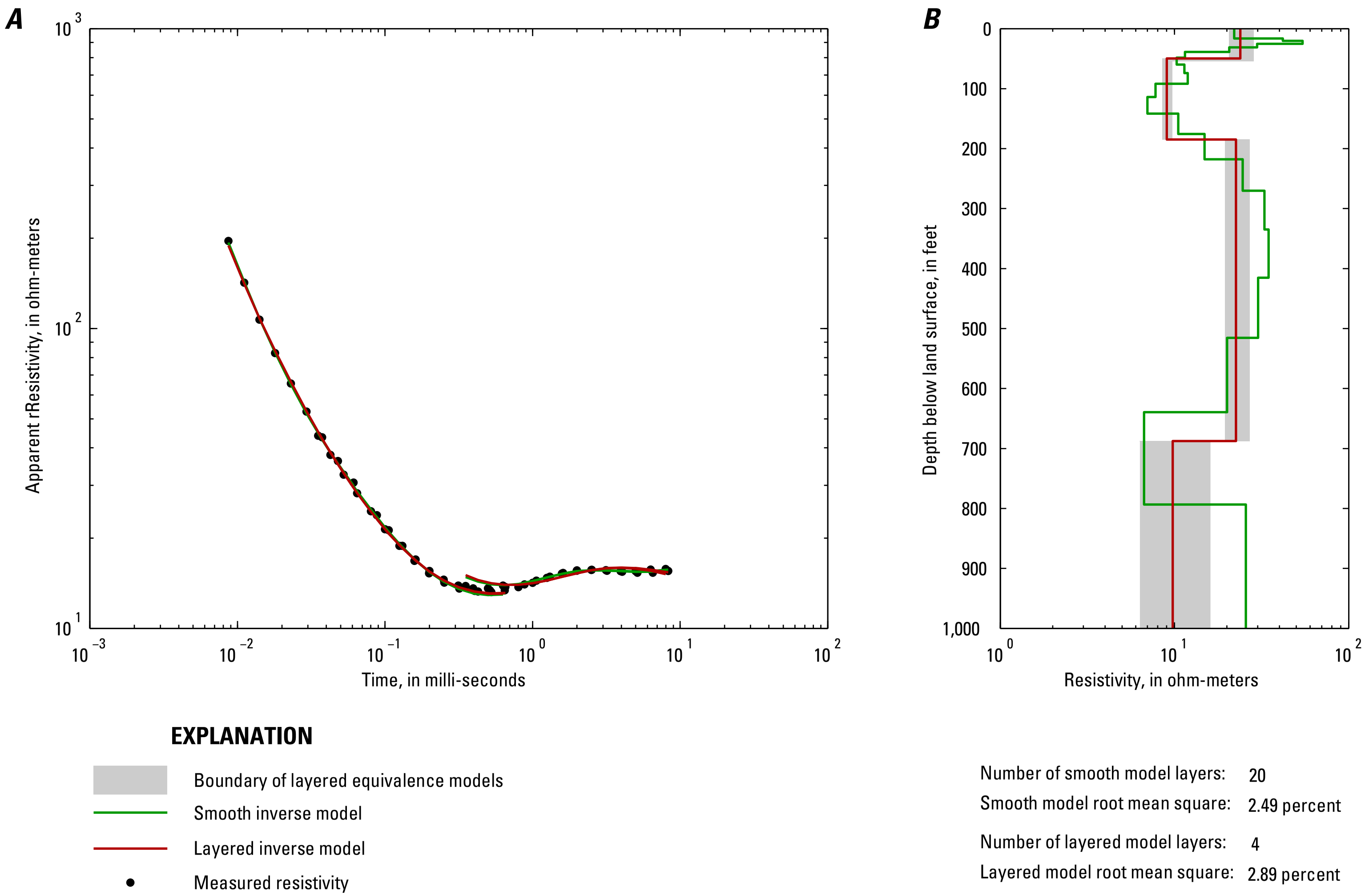

Figure 1.2 Sounding site TDEM#2, Pecos County, Texas. *A*, 80-meter time-domain electromagnetic sounding data (apparent resistivity from field measurements) as a function of time. *B*, 80-meter layered and equivalent inverse modeling results (models of true resistivity as a function of depth).

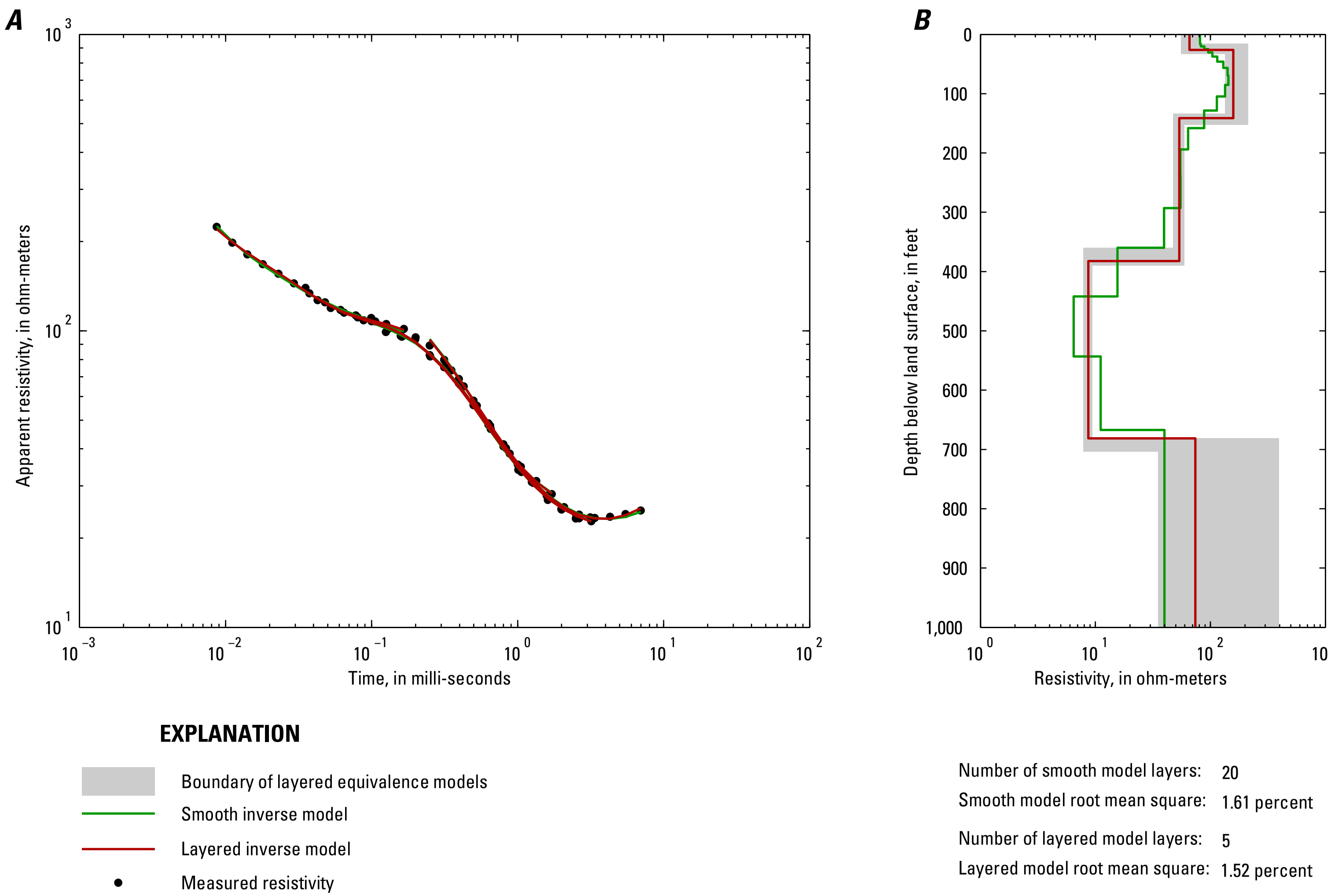

Figure 1.3 Sounding site TDEM#3, Pecos County, Texas. *A*, 80-meter time-domain electromagnetic sounding data (apparent resistivity from field measurements) as a function of time. *B*, 80-meter layered and equivalent inverse modeling results (models of true resistivity as a function of depth).

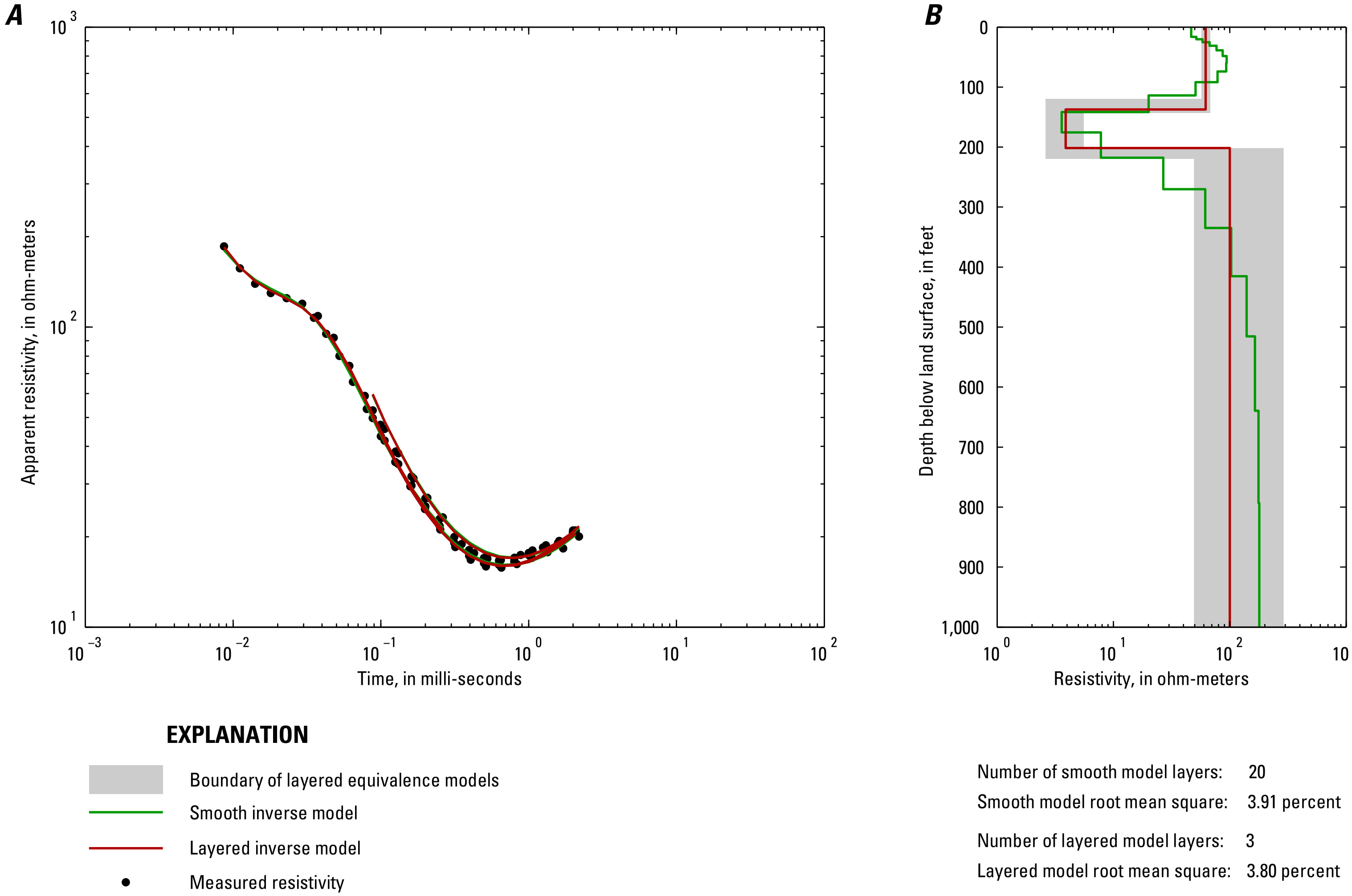

Figure 1.4 Sounding site TDEM#4, Pecos County, Texas. *A*, 80-meter time-domain electromagnetic sounding data (apparent resistivity from field measurements) as a function of time. *B*, 80-meter layered and equivalent inverse modeling results (models of true resistivity as a function of depth).

Appendix 2. Inverse Modeling Results of Audio-Magnetotelluric Soundings as a Function of Resistivity and Depth

Inverse modeling of the best fit for the transverse magnetic (TM) curve for the audio-magnetotelluric (AMT) sounding data is the best choice when approximating a three-dimensional structure beneath a centrally located point as demonstrated by Wannamaker and others (1984). However, the depths to the base of electrical units in the model may not be well constrained because TM data are relatively insensitive to the depth extent of a subsurface body (Eberhart-Phillips and others, 1995). Using a mixed mode analysis (modeling the mixed mode analysis of transverse magnetic and transverse electric response [TMTE] mode) can aid in the interpretation of elongated geologic structures from the modeling results.

The AMT sounding data were inverted using the computer algorithm RLM2DI (Mackie and others, 1997; Rodi and Mackie, 2001) from Geotools MT (Geotools, 1998). The forward modeling computer algorithm PW2D (Wannamaker and others, 1987) then used the inversion results from RLM2DI as the initial input model to perform a sensitivity analysis on the conductive units. The RLM2DI algorithm uses Maxwell's equations governing magnetotellurics within a finite-difference network to calculate the forward model and minimizes the objective function using a nonlinear conjugate gradient optimization approach for the inverse modeling results (Asch and Sweetkind, 2010). The PW2D algorithm simulates transverse electric and magnetic fields using a linear basis for each finite element. RLM2DI ran approximately 25 iterations in order to reduce the root mean square error (RMSE) to a reasonable value between the measured field data and the calculated data. PW2D ran the necessary number of iterations of forward modeling for a sensitivity analysis of conductive units based on how complex the inversion results were from RLM2DI. Graphs of the AMT inversion results for each sounding site (figs. 2.1–2.13) show modeled resistivity with warmer colors (red, orange, and yellow) representing higher values and cooler colors (green, blue, and violet) representing lower values measured in ohm-meters. The graphs show the inversion results for the TMTE mode for all sounding locations. For sites where there appeared to be a three-dimensional change, the TM and transverse electric (TE) modes were separated in order to get a better understanding of what is present at that site.

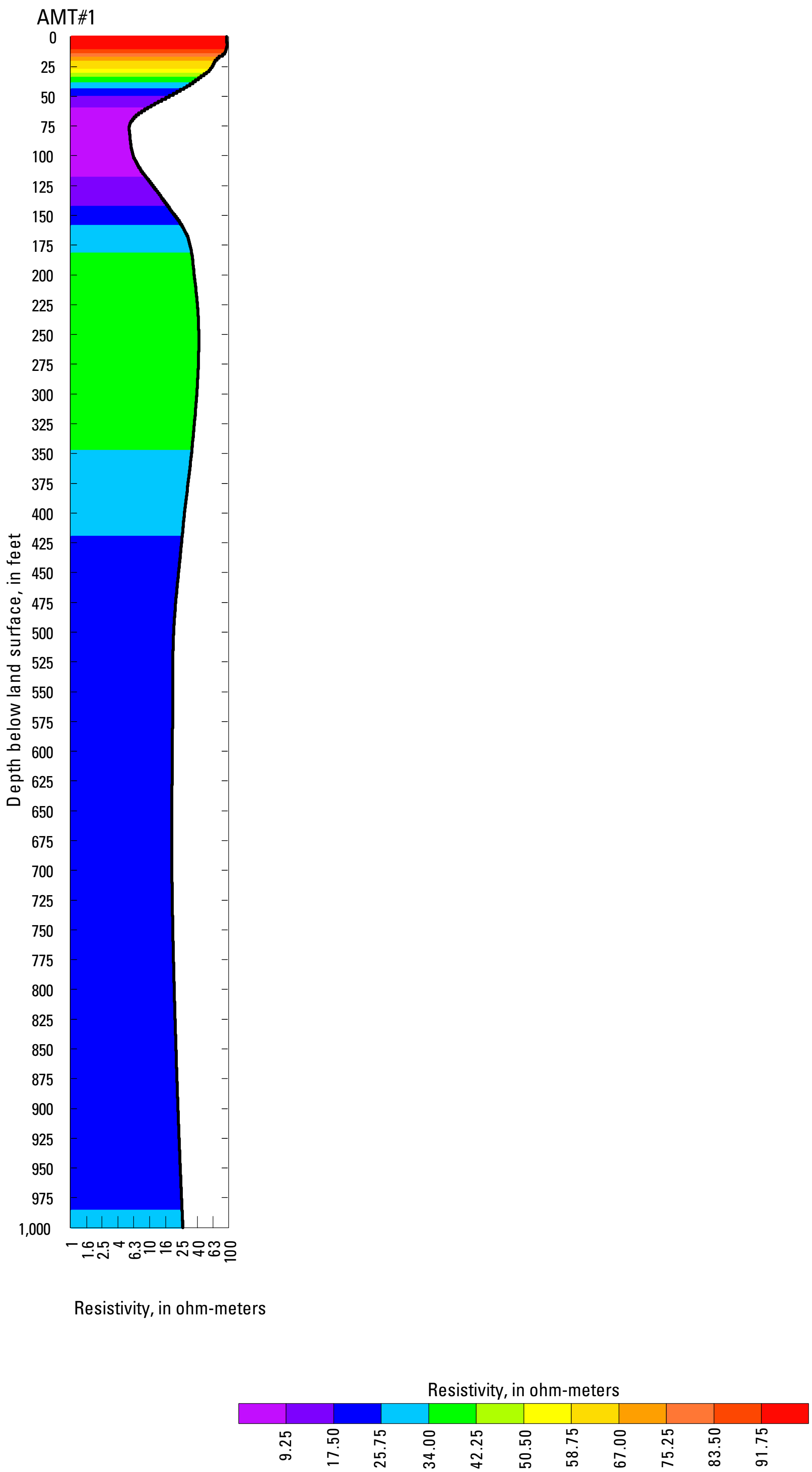

Figure 2.1 Sounding site AMT#1, Pecos County, Texas. Resistivity of mixed mode transverse magnetic and transverse electric responses.

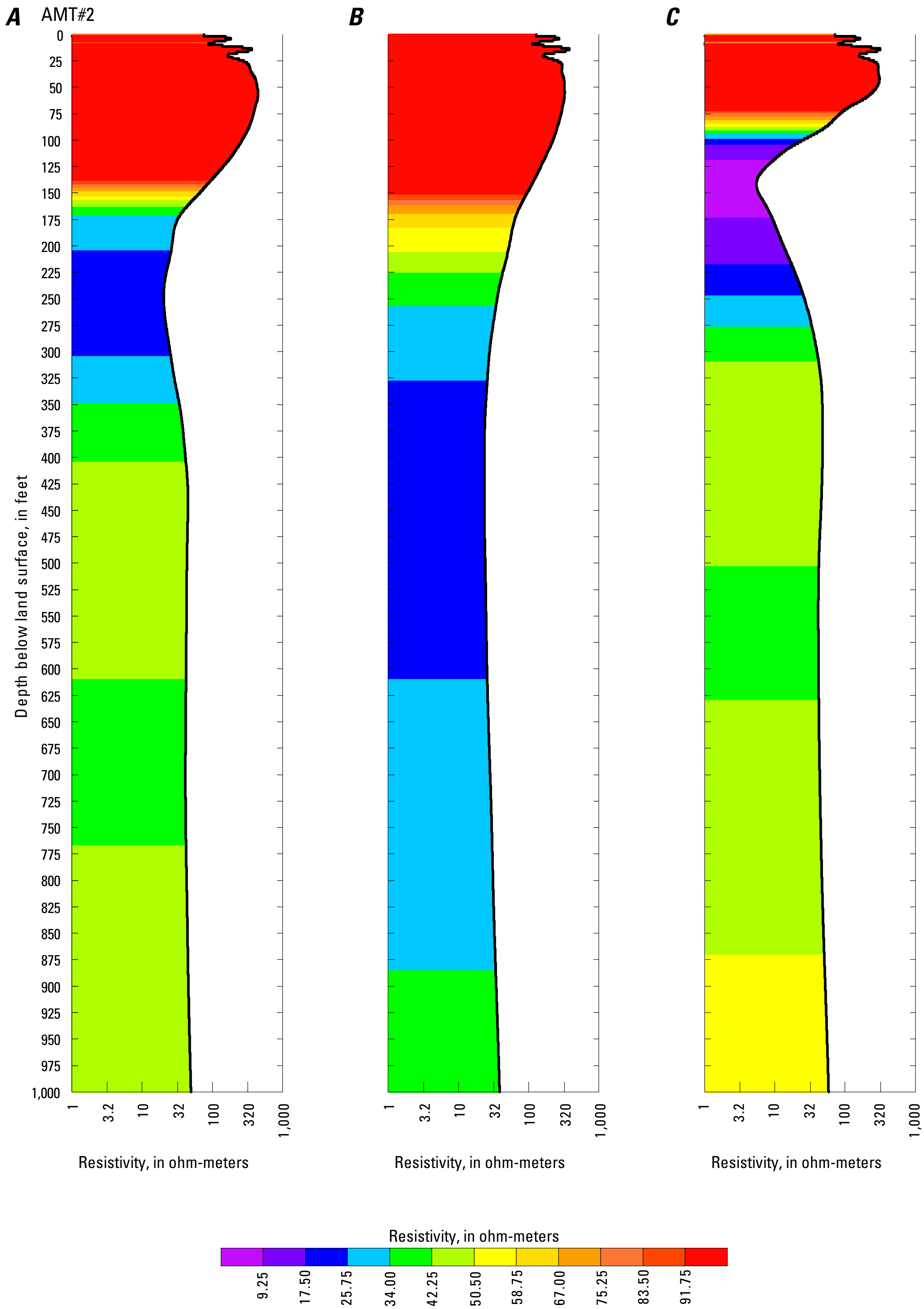

Figure 2.2 Sounding site AMT#2, Brewster County, Texas. *A*, Resistivity of mixed mode transverse magnetic and transverse electric responses. *B*, Resistivity of transverse electric response. *C*, Resistivity of transverse magnetic response.

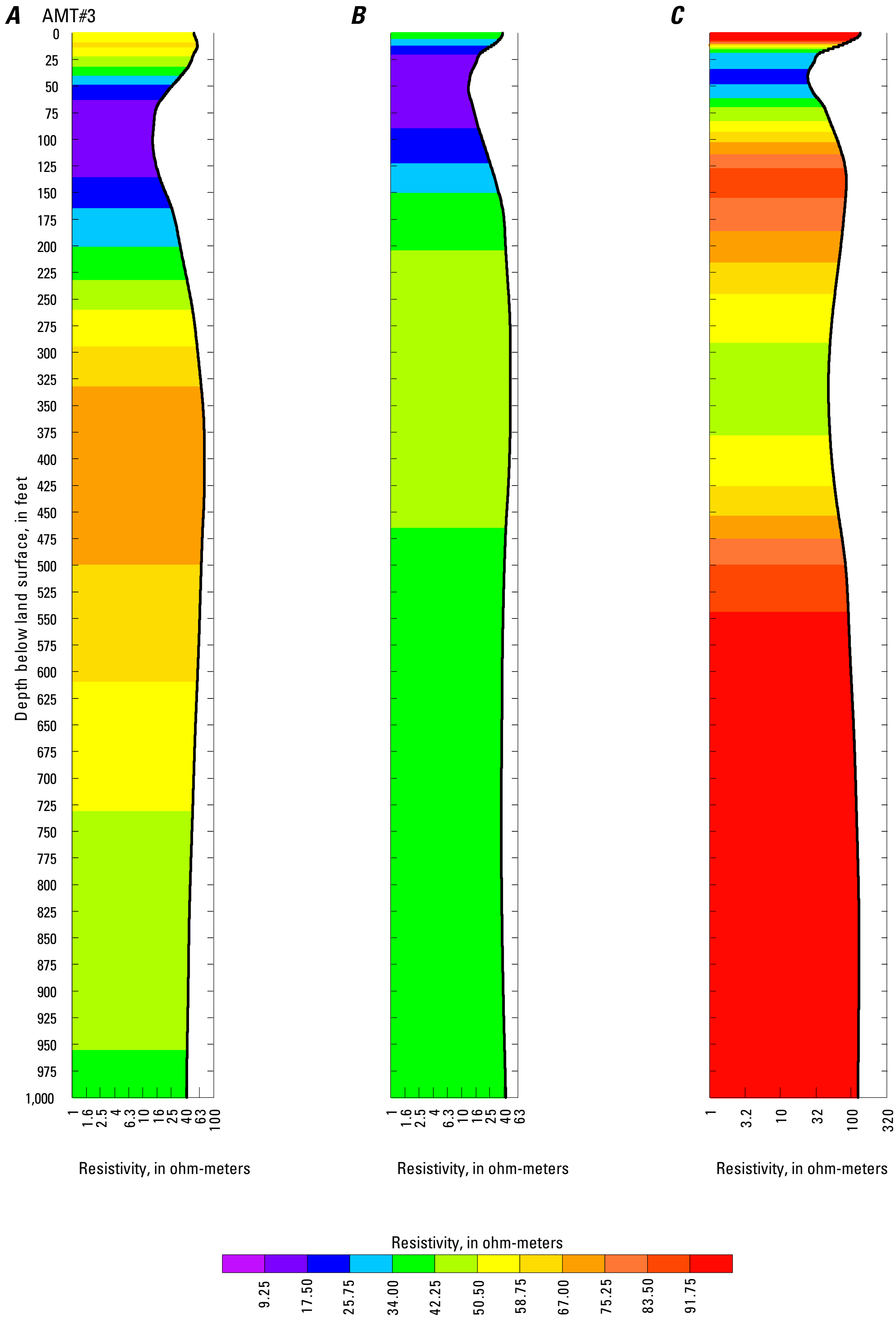

Figure 2.3 Sounding site AMT#3, Jeff Davis County, Texas. *A*, Resistivity of mixed mode transverse magnetic and transverse electric responses. *B*, Resistivity of transverse electric response. *C*, Resistivity of transverse magnetic response.

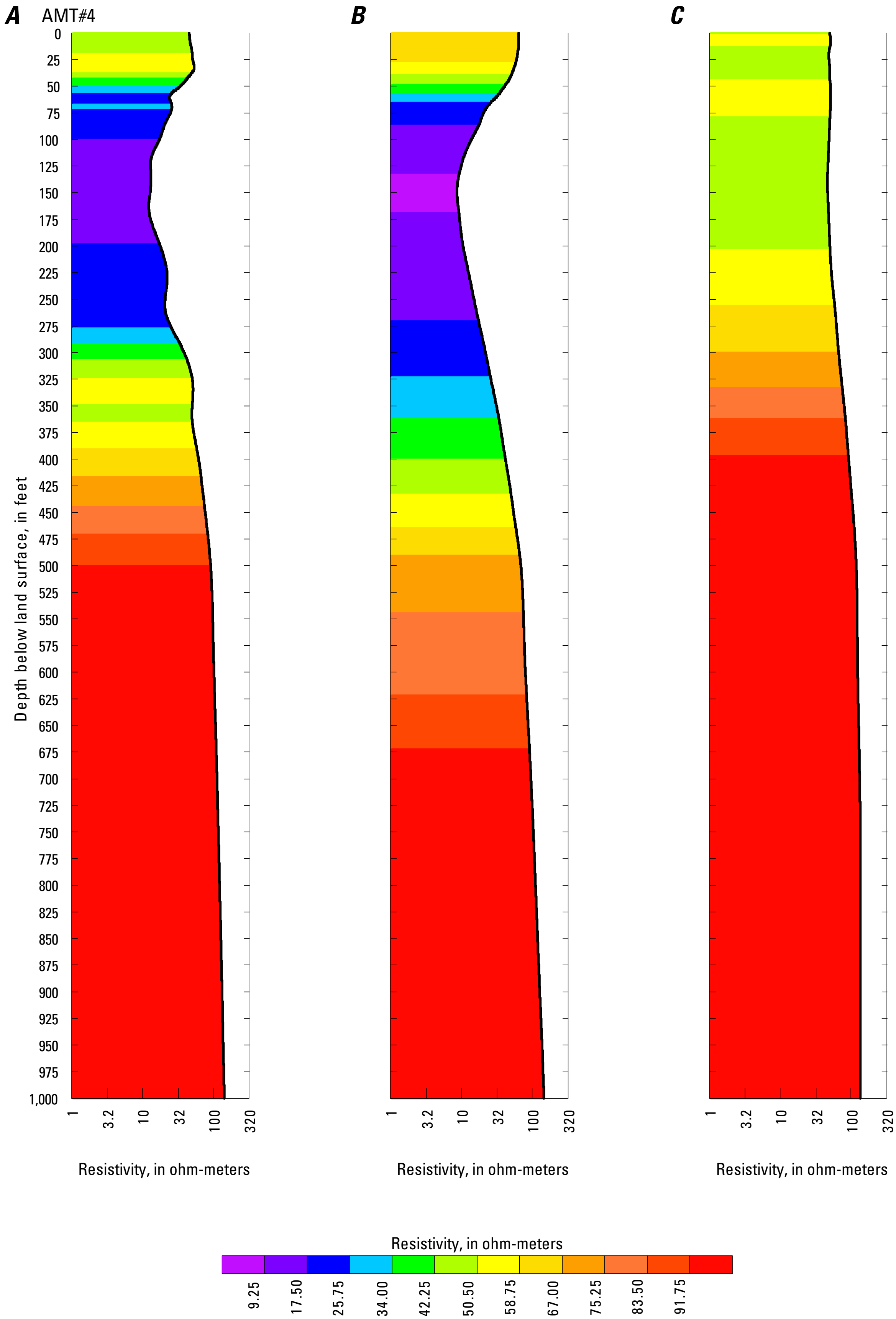

Figure 2.4 Sounding site AMT#4, Pecos County, Texas. *A*, Resistivity of mixed mode transverse magnetic and transverse electric responses. *B*, Resistivity of transverse electric response. *C*, Resistivity of transverse magnetic response.

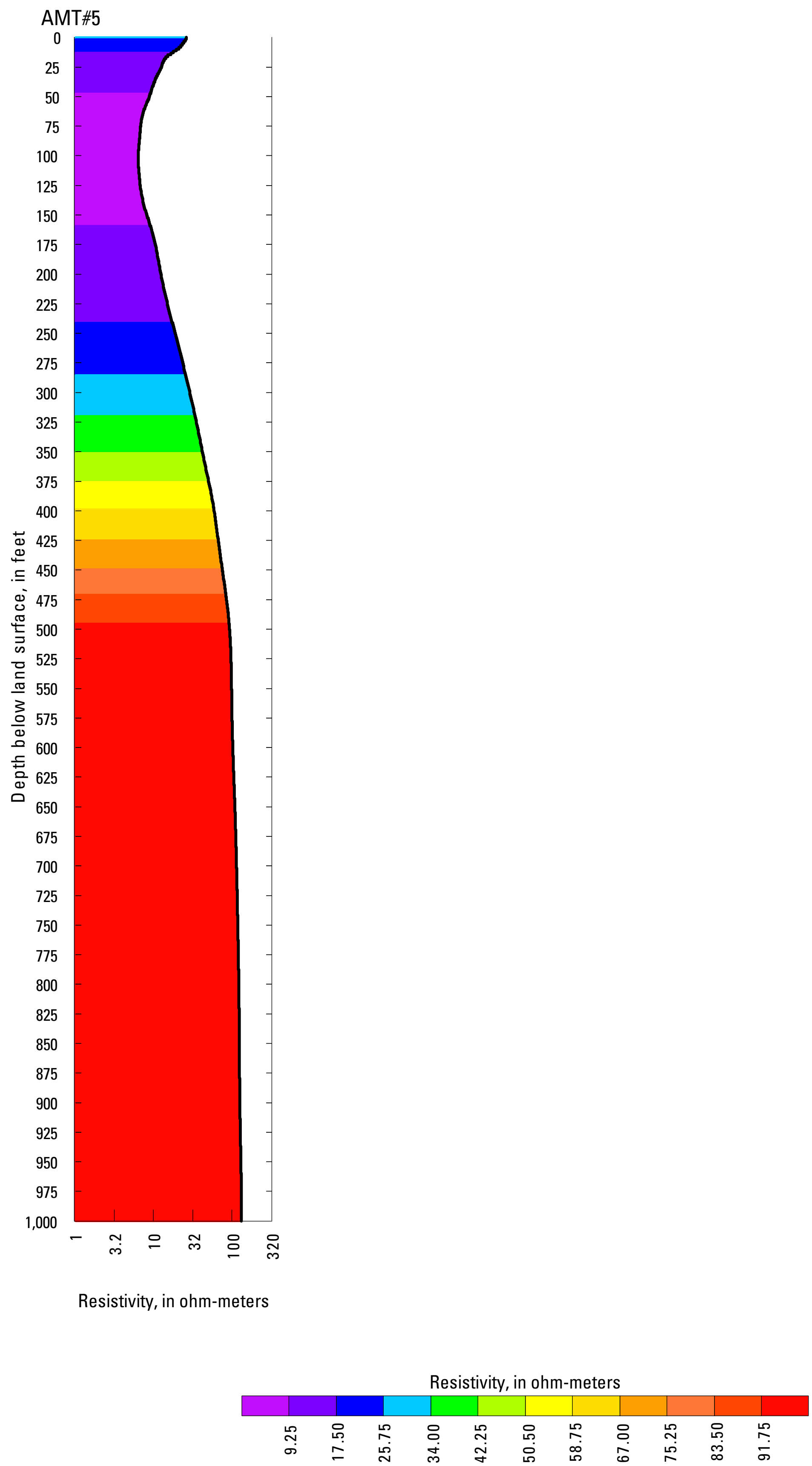

Figure 2.5 Sounding site AMT#5, Pecos County, Texas. Resistivity of mixed mode transverse magnetic and transverse electric responses.

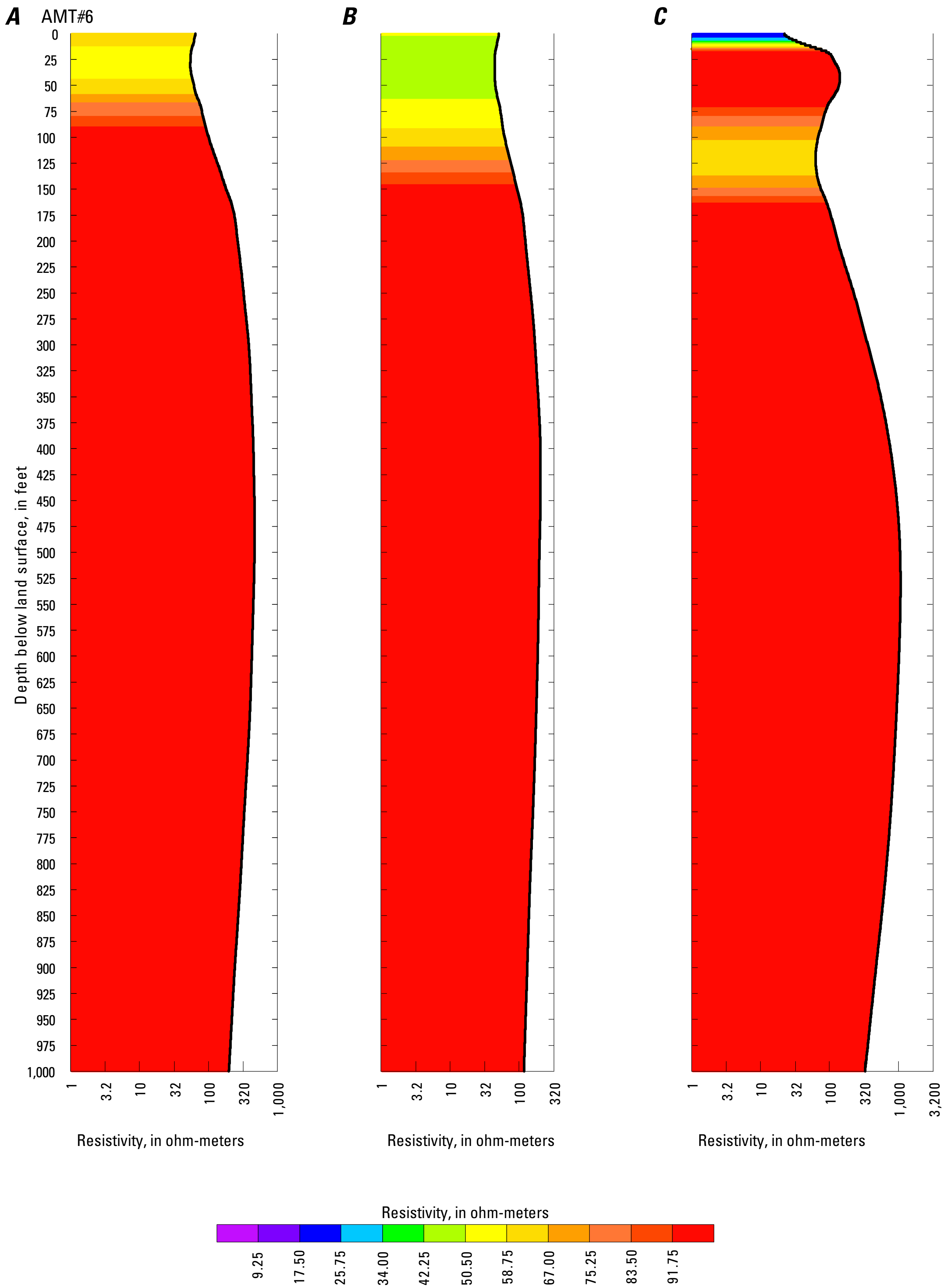

Figure 2.6 Sounding site AMT#6, Pecos County, Texas. *A*, Resistivity of mixed mode transverse magnetic and transverse electric responses. *B*, Resistivity of transverse electric response. *C*, Resistivity of transverse magnetic response.

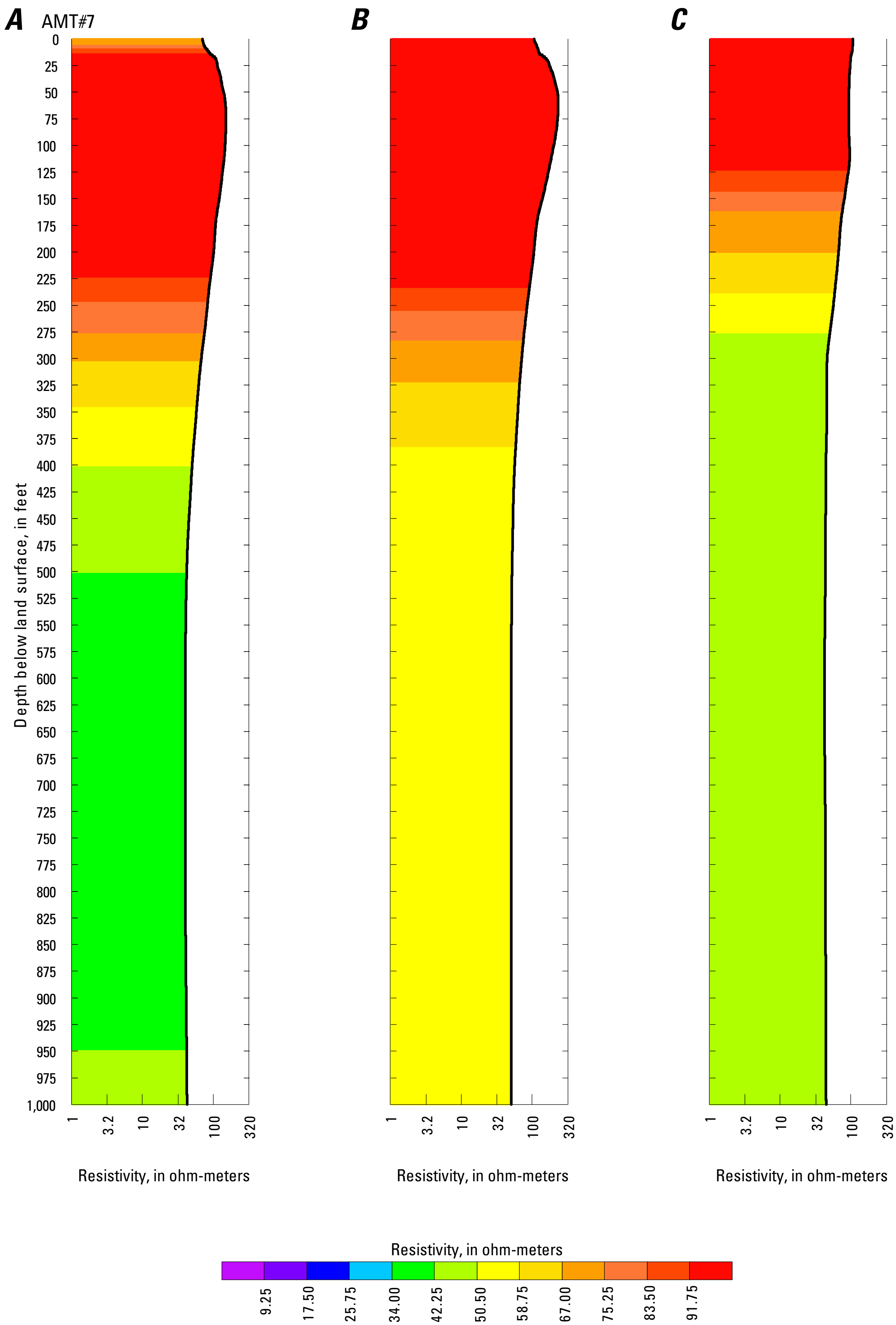

Figure 2.7 Sounding site AMT#7, Pecos County, Texas. *A*, Resistivity of mixed mode transverse magnetic and transverse electric responses. *B*, Resistivity of transverse electric response. *C*, Resistivity of transverse magnetic response.

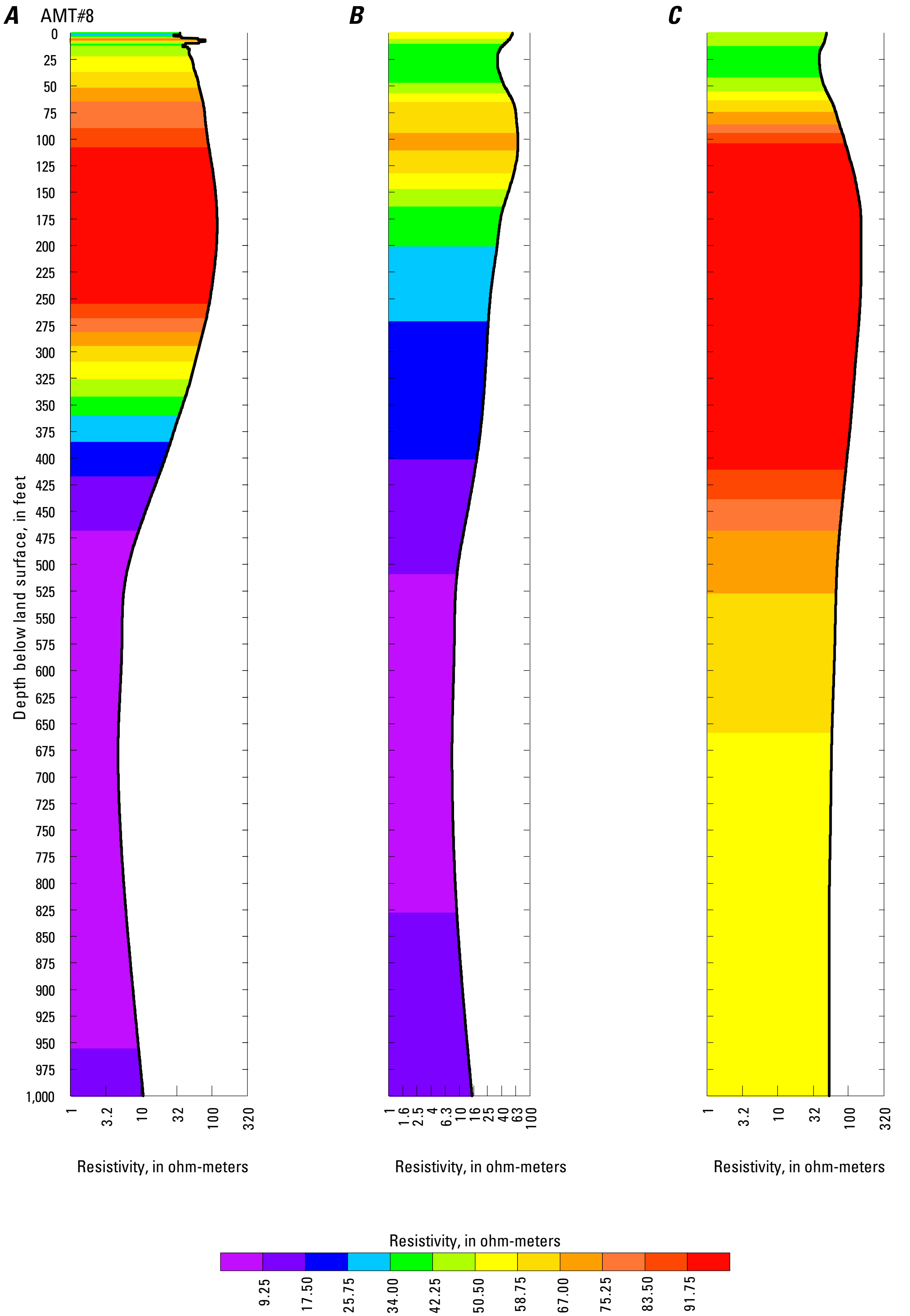

Figure 2.8 Sounding site AMT#8, Pecos County, Texas. *A*, Resistivity of mixed mode transverse magnetic and transverse electric responses. *B*, Resistivity of transverse electric response. *C*, Resistivity of transverse magnetic response.

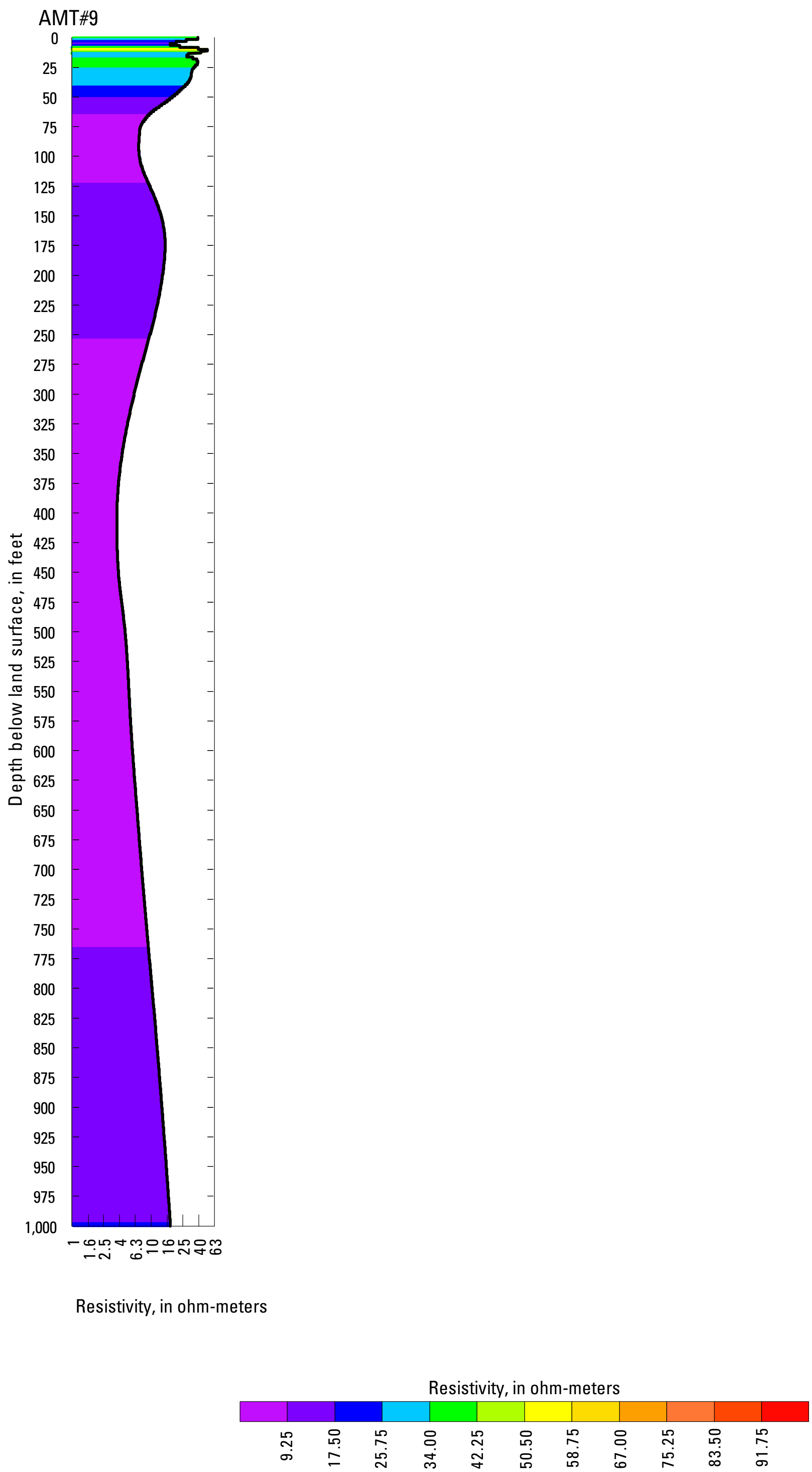

Figure 2.9 Sounding site AMT#9, Pecos County, Texas. Resistivity of mixed mode transverse magnetic and transverse electric responses.

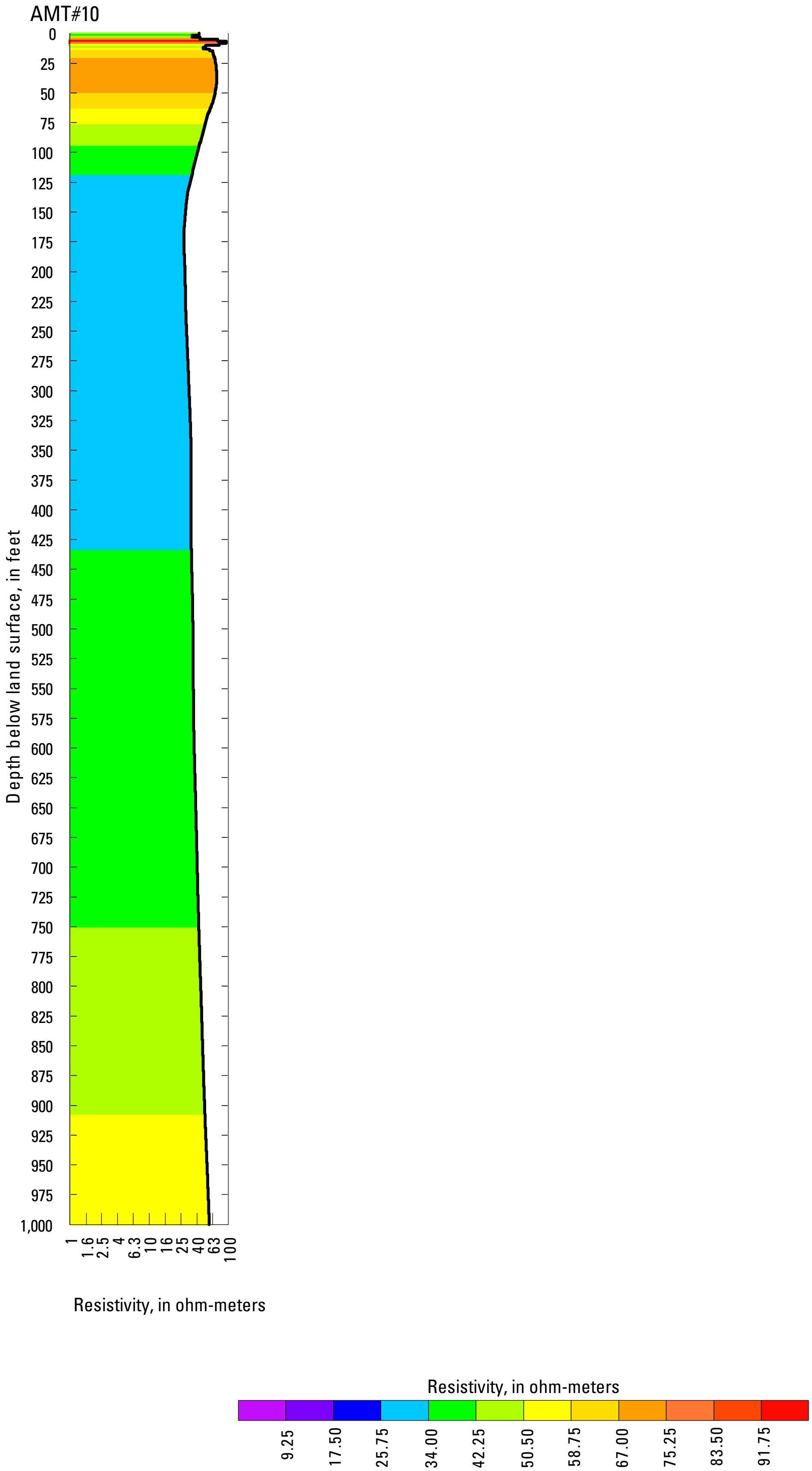

Figure 2.10 Sounding site AMT#10, Pecos County, Texas. Resistivity of mixed mode transverse magnetic and transverse electric responses.

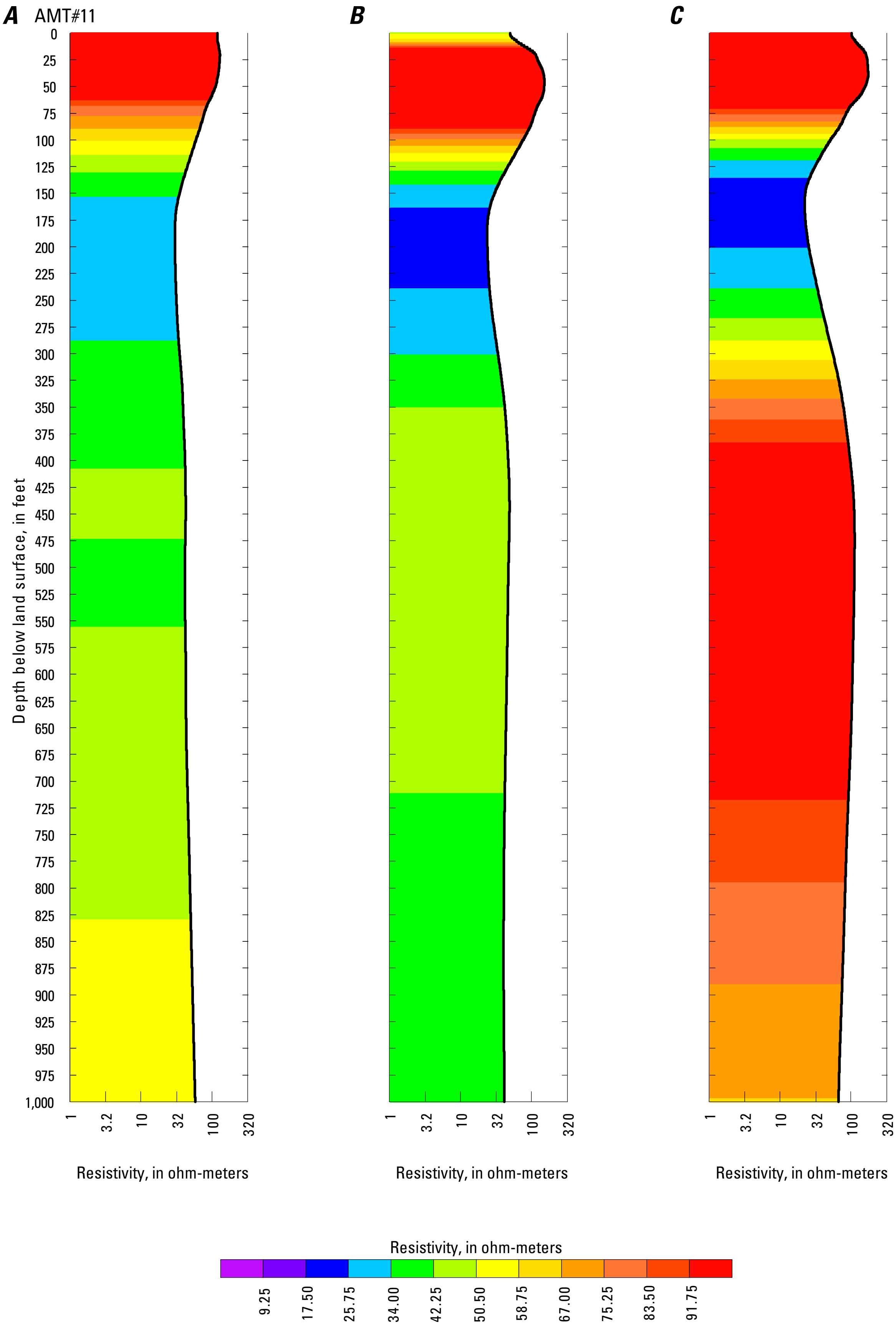

Figure 2.11 Sounding site AMT#11, Pecos County, Texas. *A*, Resistivity of mixed mode transverse magnetic and transverse electric responses. *B*, Resistivity of transverse electric response. *C*, Resistivity of transverse magnetic response.

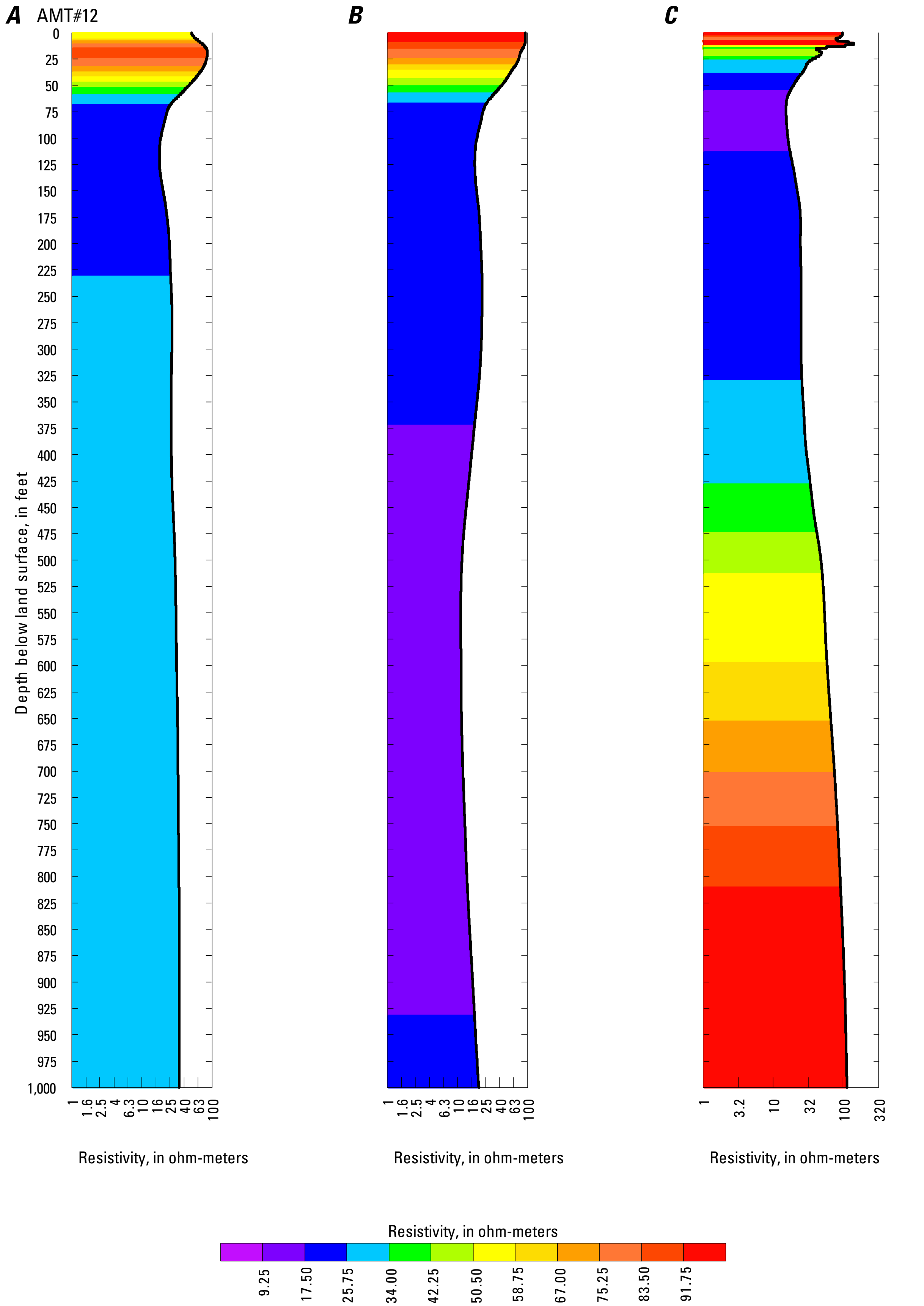

Figure 2.12 Sounding site AMT#12, Reeves County, Texas. *A*, Resistivity of mixed mode transverse magnetic and transverse electric responses. *B*, Resistivity of transverse electric response. *C*, Resistivity of transverse magnetic response.

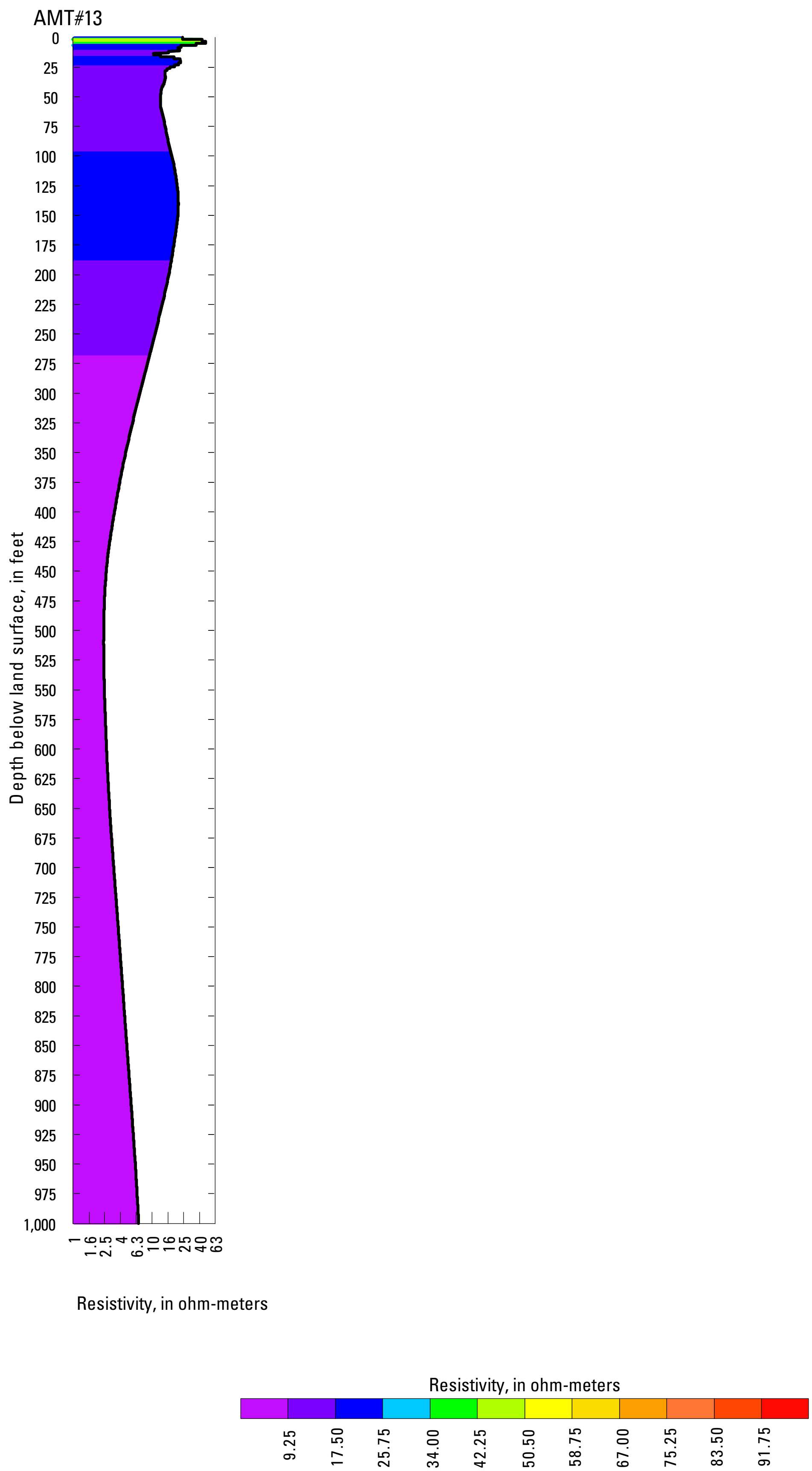

Figure 2.13 Sounding site AMT#13, Jeff Davis County, Texas. Resistivity of mixed mode transverse magnetic and transverse elctric responses.

Appendix 3. Digital Database Resources

Source: U.S. Environmental Protection Agency STORET Modern
Processing: Created sample table. Created unique site identifier by prefixing site_id assigned by sourcing agency with site_abv.
Data Origination: Downloadable data- http://www.epa.gov/storet/
Water-Quality Date Range: 8/15/1996 – 6/15/2011
Number of sites: 7

Source: Middle Pecos Groundwater Conservation District
Processing: Created unique site identifier by prefixing site_id assigned by sourcing agency with site_abv.
Data Origination: File transfer protocol or other direct access
Water-Quality Date Range: no data available
Number of Sites: 33

Source: Texas Commission on Environmental Quality , Surface Water Quality Information System
Processing: Created sample table. Created unique site identifier by prefixing site_id assigned by sourcing agency with site_abv.
Data Origination: File transfer protocol or other direct access
Water-Quality Date Range: 9/5/1968 – 8/24/1992
Number of Sites: 13

Source: Texas Railroad Commission
Processing: Created unique site identifier by prefixing site_id assigned by sourcing agency with site_abv.
Data Origination: Downloadable data- http://www.rrc.state.tx.us/data/online/oilgasrecords.php
(Texas Railroad Commission, 2011)
Water-Quality Date Range: no data available
Number of Sites: 6220

Source: Texas Water Development Board Groundwater Database (GWDB)
Processing: Created sample table. Created unique site identifier by prefixing site_id assigned by sourcing agency with site_abv.
Data Origination: Downloadable data- http://www.twdb.state.tx.us/groundwater/data/gwdbrpt.asp
Water-Quality Date Range: 10/2/1930–4/30/2009
Number of Sites: 1065

Source: U.S. Geological Survey, National Water Information System
Processing: Created unique site identifier by prefixing site_id assigned by sourcing agency with site_abv.
Data Origination: File transfer protocol or other direct access
Water-Quality Date Range: 4/7/1932–6/23/2011
Number of Sites: 81

Source: University of Texas System Lands
Processing: Created unique site identifier by prefixing site_id assigned by sourcing agency with site_abv.
Data Origination: Downloadable data- http://www.utlands.utsystem.edu/WellSearchInfo.aspx
(University of Texas System Lands, 2011)
Water-Quality Date Range: no data available
Number of Sites: 823

Source: City of Fort Stockton Well Locations (Domestic and Municipal)
Processing: Created unique site identifier by prefixing site_id assigned by sourcing agency with site_abv.
Data Origination: File transfer protocol or other direct access
Water-Quality Date Range: no data available
Number of Sites: 281

Source: Daniel B. Stephens and Associates (Capitan Reef Study)
Processing: Data compiled from digital media included previously published geologic formation picks
Data Origination: File transfer protocol or other direct access
Water-Quality Date Range: no data available
Number of Sites: 153

Source: Texas Water Development Board Brackish Resources Aquifer Characterization System
Processing: Data compiled from digital media included previously published geologic formation picks
Data Origination: File transfer protocol or other direct access (Meyer and others, 2011)
Water-Quality Date Range: no data available
Number of Sites: 153

Appendix 4. Federal Geographic Data Committee-Compliant Metadata Record

Identification_Information
Citation:
Citation_Information:
Originator: U.S. Geological Survey
Publication_Date: 20111101
Title: Data Collection and Compilation for a Geodatabase, Pecos County Region, Texas, 1930–2011
Region, Texas, 2011
Geospatial_Data_Presentation_Form: vector digital data

Description:
Abstract: The U.S. Geological Survey, in cooperation with the Middle Pecos Groundwater Conservation District, Pecos County, City of Fort Stockton, Brewster County, and Pecos County Water Control and Improvement District No. 1, developed a geodatabase of available groundwater, surface-water, water-quality, geophysical, and geology data for site locations in the Pecos County region, Texas. Data were compiled for an approximately 4,700 square mile area of the Pecos County region, Texas. The geodatabase, designed to warehouse field-collected geochemical and geophysical data, as well as digital database resources from the U.S. Geological Survey, Middle Pecos Groundwater Conservation District, Texas Water Development Board, Texas Commission on Environmental Quality, and numerous other State and local databases, contains 8,242 unique sampling locations. The geodatabase was used to combine these disparate database resources into a simple data model. Site locations are geospatially-enabled and stored in a geodatabase feature class for general mapping purposes and more rigorous spatial analysis. The sampling locations are related to the hydrogeologic information through the use of geodatabase relationship classes. The geodatabase relationship classes provide the ability to perform complex spatial and data-driven queries to explore data stored in the geodatabase.
Purpose: The purpose of this report is to provide information on data acquisition and geodatabase compilation of hydrogeologic data, Pecos County region, Texas. Groundwater, surface-water, water-quality, geophysical, and geologic information for more than 8,000 sampling locations were compiled from various digital data sources in the study area. Digital data sources were gathered from existing databases, previously published reports, and field-collected data.

Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 2011
Currentness_Reference: 1930–2011
Status:
Progress: On-going
Maintenance_and_Update_Frequency: None Planned
Spatial_Domain:
Bounding_Coordinate:
West_Bounding_Coordinate: -103.903888
East_Bounding_Coordinate: -101.816520
North_Bounding_Coordinate: 31.420552
South_Bounding_Coordinate: 30.356220

Keywords:
Theme:
Theme_Keyword: hydrogeology
Theme_Keyword: groundwater
Theme_Keyword: surface water
Theme_Keyword: water quality
Theme_Keyword: geology
Place:
Place_Keyword: Pecos County region
Place_Keyword: Trans-Pecos
Place_Keyword: Pecos County
Place_Keyword: Reeves County
Place_Keyword: Jeff Davis County
Place_Keyword: Brewster County
Place_Keyword: Terrell County
Place_Keyword: Crane County
Place_Keyword: Ward County
Place_Keyword: Crockett County

Use_Constraints: These data are for informational purposes only. These data have not received Bureau approval and as such are provisional and subject to revision. The data are released on the condition that neither the U.S. Geological Survey, its cooperators, nor the U.S. Government may be held liable for any damages resulting from its authorized or unauthorized use. Although these data have been processed successfully on a computer system at the U.S. Geological Survey, no warranty expressed or implied is made regarding the accuracy or utility of the data on any other system or for general or scientific purposes, nor shall the act of distribution constitute any such warranty.
Native_Data_Set_Environment: Microsoft Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 3; ESRI ArcGIS 10.0.0.2414

Data_Quality_Information:
Lineage:
Process_Step:
Process_Description: Geographic locations of groundwater well sites, oil/gas well sites and surface-water sites were gathered from various Federal, State, and local databases. These data were compiled into a simplified feature class that maintains information related to: source agency, site identifier, unique identifier, site code (type), and site name.
Process_Date: 20111101

Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: Entity point
Point_and_Vector_Object_Count: 8242

Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Geographic:
Latitude_Resolution: 0.000000
Longitude_Resolution: 0.000000
Geographic_Coordinate_Units: Decimal degrees

Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1983
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137.000000
Denominator_of_Flattening_Ratio: 298.257222

Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: sitefile
Attribute:
Attribute_Label: OBJECTID
Attribute_Definition: Internal feature number.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Sequential unique whole numbers that are automatically generated.
Attribute:
Attribute_Label: SHAPE
Attribute_Definition: Feature geometry.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Coordinates defining the features.
Attribute:
Attribute_Label: source_nm
Attribute_Definition: Source name.
Attribute:
Attribute_Label: source_abv
Attribute_Definition: Source abbreviation.
Attribute:
Attribute_Label: site_id
Attribute_Definition: Native source identifier.
Attribute:
Attribute_Label: unique_id
Attribute_Definition: Unique identifier is combination of source_abv and site_id fields.
Attribute:
Attribute_Label: site_cd
Attribute_Definition: Site code.

Attribute:
Attribute_Label: site_nm
Attribute_Definition: Site name.

Distribution_Information:
Resource_Description: Downloadable Data
Metadata_Reference_Information:
Metadata_Date: 20111101
Metadata_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: U.S. Geological Survey
Contact_Person: Public Information Officer
Contact_Address:
Address_Type: mailing and physical address
Address: 1505 Ferguson Lane
City: Austin
State_or_Province: Texas
Postal_Code: 78754
Country: USA
Contact_Voice_Telephone: 512–927–3500
Contact_Facsimile_Telephone: 512–927–3590
Contact_Electronic_Mail_Address: gs-w-txpublic-info@usgs.gov
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC–STD–001–1998
Metadata_Time_Convention: local time
Metadata_Extensions:
Profile_Name: ESRI Metadata Profile

Prepared by the USGS Lafayette Publishing Service Center

Pearson and others—**Data Collection and Compilation for a Geodatabase, Pecos County Region, Texas, 1930–2011**—Data Series 678

ISBN 978-1-4113-3373-4

9 781411 333734

Printed on recycled paper

<u>Middle Pecos GCD Exhibit 14</u>

Fort Stockton Holdings, L.P.'s Amended Application for a Production Permit and Authorizing Export

MIDDLE PECOS
Groundwater Conservation District
Drawer 1644, Fort Stockton, Texas 79735
Phone: 432/336-0698 Fax: 432/336-3407

"AMENDED" APPLICATION FOR A PRODUCTION PERMIT AND AUTHORIZING EXPORT

General Instructions: A Production Permit is required by the District for operating or producing groundwater from any non-exempt well for which a Historic and Existing Use Permit or amendment thereto to include the well has not been issued by the District or timely applied for and awaiting District action. An application for a Production Permit shall contain all the information requested in Rule 11.9. An applicant may file a Production Permit Application for more than one well and also, if the wells are part of a well system as defined by the District's Rules.

Applicant(s) Information: Provide the information requested below. If the Applicant is more than one individual with different residences, attach a separate sheet with a description of their respective interests in the well(s), listing their names and addresses, and designating a contact person. If the Applicant is a corporation, partnership, limited partnership or other business association, state its name and address below and attach written documentation that the Authorized Representative, whose name is provided below, is authorized to represent the well owner. If the applicant is other than the owner of the property, attach documentation establishing the applicable authority to construct and operate a well(s) subject to this application.

Please Print or Type

Applicant: Fort Stockton Holdings, L.P. Phone: (432) 688-3038 Fax: (432) 688-3247

Mailing Address: 6 Desta Drive, Suite 6500 City Midland ST TX Zip 78705

Physical Address: Same E-Mail: platham@claytonwilliams.com

Contact/Authorized Representative: ~~Paul Latham, Vice President~~ ~~**(See Attachments "A" and "B")**~~ See **Appendix A**

Relationship to Owner/Applicant ~~Vice President, Clayton Williams Farms, Inc., general partner, Fort Stockton Holdings, L.P.~~ See **Appendix A**

Phone: ~~Same~~ Fax: ~~Same~~ E-mail: ~~Same~~

Mailing Address: ~~Same~~ City ~~Same~~ ST Zip ~~Same~~

Aquifer: This application is for a Production Permit from the following Aquifer: Edwards-Trinity

Proposed Groundwater Withdrawal Amount: Total amount of groundwater applied for in this application in acre-feet per year (1 acre-foot equals 325,851 gallons): ~~47,41849,000 ac-ft/year, *less* the volume of water produced under Applicant's Existing and Historic Use Permits for the same wells during the same calendar year.*~~ **28,400** acre-feet per year

List the requested amount of groundwater withdrawal for each purpose in acre-feet per year (1 acre-foot is 325,851 gallons), the duration required for each use (if perpetual, mark as such, otherwise, provide a date for the last withdrawal) and describe in detail each proposed use:

Domestic Amount: ~~N/A 0.0 ac-ft/yr~~ Duration of Use: ~~N/A0.0 ac-ft/yr~~

Livestock Amount: ~~N/A0.0 ac-ft/yr~~ Duration of Use: ~~N/A0.0 ac-ft/yr~~

Proposed Use (Number and type of livestock): ~~N/A0.0 ac-ft/yr~~

28,400 ac-ft/yr for **Agricultural** use, less the volume produced for other authorized uses of **municipal** and **industrial**.

Irrigation Amount: ~~N/A0.0 ac-ft/yr~~ Duration of Use: ~~N/A0.0 ac-ft/yr~~

Proposed Use (Type and acreage of crops, type of irrigation (spray, drip, etc.)): ~~N/A0.0 ac-ft/yr~~

Public Supply Amount: ~~N/A 47,418 ac-ft/yr, *less* the volume of water produced under Applicant's Existing and Historic Use Permits for the same wells during the same calendar year, and less the volume of water produced for Industrial use pursuant to this permit during the same calendar year.*~~ **28,400 ac-ft/yr**, less the volume produced for other authorized uses of **agricultural** and **industrial.**

Duration of Use: ~~5 years minimum/50 years contingent, as further described in the attached Permit Supplement D(1), and renewable thereafter. Applicant intends to apply for renewals.~~

See **Special Permit Condition 2** (attached)

Proposed Use (location, number of people, provide copy of contract): Supply wholesale water to municipal water purveyors within the Texas Water Development Board's State Water Plan "Region F" Planning Area (31 TAC) as described in the attached Permit Supplement.

Industrial Amount: ~~N/A 47,418 ac-ft/yr, *less* the volume of water produced under Applicant's Existing and Historic Use Permits for the same wells during the same calendar year, and less the volume of water produced for Public Supply use pursuant to this permit during the same calendar year.*~~ **28,400 ac-ft/yr**, less the volume produced for other authorized uses of **agricultural** and **municipal.**

Duration of Use: ~~5 years minimum/50 years contingent, as further described in the attached Permit Supplement D(1), and renewable thereafter. Applicant intends to apply for renewals.~~ See **Special Permit Condition 2** (attached)

Proposed Use (type of industry): e.g. manufacturing, electric generation, Oil & Gas, etc.

Other Amount: ~~49,000 acre-feet/year~~0.0 ac-ft/yr Duration of Use: ~~perpetual~~0.0 ac-ft/yr

Proposed Use: ~~Multiple uses for Public Supply, Industrial, Irrigation, and Livestock purposes~~0.0 ac-ft/yr

~~* This application is not requesting any increase in the total volume of groundwater production already approved by the District, because the production allowed under this proposed permit would be limited to the amount of groundwater production not used under applicant's Existing and Historic Use Permits in a given year for the same wells. As explained in greater detail elsewhere in the Application, the maximum annual volume of water Applicant will be entitled to produce during any calendar year, whether allocated to Public Supply or Industrial purposes, shall never exceed 47,418 ac-ft/yr. Moreover, in combination with Applicant's separate Existing and Historic Use Permits issued by the District, which authorize total production of 47,418 ac-ft/yr, Applicant has requested inclusion of a Special Condition in its Production Permit to be issued pursuant to this Application which would limit Applicant's total annual production pursuant to its new Production Permit and its Existing and Historic Use Permits to a combined maximum production volume of 47,418 ac-ft/yr. Applicant understands that water produced under this permit for Public Supply and/or Industrial purposes will be subject to the District's rules relating to new permits, and not the rules which remain applicable to its Existing and Historic Use Permits.~~

Rate of Production for each well subject to this application (in gallons per minute): **~~(See Attachment "C")~~** See **Appendix B-1**
Estimated Rate of withdrawal per year: **~~(See Attachment "C")~~** See **Appendix B-1**
Maximum Rate of withdrawal per year: **~~(See Attachment "C")~~** See **Appendix B-1**

Location of Use: Please describe the location of use: Within Texas Water Development Board's State Water Plan "Region F" Planning Area (31 TAC) as described in the attached Supplement. **~~(See Attachment "D")~~**

If the proposed location of use is outside Pecos County, attach a separate sheet that addresses the three issues set forth in District Rule 11.9.1(a)~~(7).~~ **See Attached ~~Supplement~~ Special Permit Conditions**

Land ownership: Total number of acres of land contiguous in ownership with the land where the well(s) are located: ~~18,510.61~~ **~~acres.~~** 14,191.08 acres

Provide well owner's identification name for each well relied upon to support this application: See **Appendix C**

Well Owner's Name:

~~Fort Stockton Holdings, L.P.~~

Same

Same

Well Reference in Applicant's Registration

~~See Attachment "C"~~

SEE SUPPLEMENT ATTACHED

DECLARATION: I agree that the water withdrawn from the well(s) will be put to beneficial, nonwasteful use at all times. I agree that reasonable diligence will be used to protect groundwater quality. I agree to abide by the rules of the Middle Pecos Groundwater Conservation District, the District Management Plan, and orders of the District's Board of Directors. I agree to comply with the District's well capping and plugging guidelines and report any well closure to the District. Furthermore, I agree not to exceed the production allowance of the Production Permit. **I understand and agree that my withdrawal and beneficial use of groundwater authorized by a Production Permit issued by the District may be limited if the District determines that reductions are necessary pursuant to the aquifer-based production limit, proportional adjustment, or permit limit rules of the District (District Rules 10.3, 10.4, and 10.5).**

Although Applicant understands this permit will be subject to the District's rules, and Applicant agrees to abide by such rules, nothing in this application should be construed as a waiver of Applicant's right to obtain compensation for a taking of its vested property rights in the event that the application of the District's rules to Applicant's groundwater rights results in a taking of vested property rights in any given year. Furthermore, nothing in this application should be construed as a waiver of Applicant's right to appeal or challenge the validity of any of the District's rules either administratively or in a court of competent jurisdiction.

I hereby certify that the information contained herein is true and correct to the best of my knowledge and belief.

Signature of Applicant: ______________________ Date: July 8, 2009

L. Paul Latham, Vice President

AFFIDAVIT

STATE OF TEXAS §
§
COUNTY OF TRAVIS §

Before me, the undersigned authority, on this day personally appeared L. Paul Latham, acting in his capacity as Vice President, Clayton Williams Farms, Inc., a Delaware corporation, as the sole General Partner of Fort Stockton Holdings, L.P., a Texas limited partnership, the Applicant in Application filed with the Middle Pecos Groundwater Conservation District on July 13, 2009, who after being by me duly sworn, upon oath deposes and says that he has read the statements and information in the foregoing letter providing amendatory and supplemental/clarifying language in connection with said July 13th Application and that the same are true and correct to the best of his knowledge.

L. Paul Latham for the Applicant

Subscribed and Sworn to before me this 24th day of September, 2009.

McRAE M. BIGGAR
Notary Public
State of Texas
Comm. Expires 10-10-2010

McRae M. Biggar
Signature of Notary

McRae M. Biggar
Printed Name of Notary

10-10-2010
Date of Expiration

Approval or denial of this application is subject to the rules of the District.

For District Use Only:

Date Application Received: 9/28/09 Mapped: ____________

Field Inspection: ____________

District Well Nos. ____________

Paul Weatherly
Signature

General Manager 9/28/09
Title Date

Middle Pecos GCD Exhibit 15

Notice of April 3, 2017 public forum in Fort Stockton and April 6, 2017 Public forum in Iraan.

FILED
MAR 30 2017
1-25pm
LIZ CHAPMAN
[illegible]UNTY COURT, PECOS CO., TEXAS
By: mm Deputy

MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT

P.O Box 1644 Fort Stockton, TX 79735 Phone (432)336-0698 Fax#432[illegible]
405 North Spring Drive Fort Stockton, Texas 79735
Email: mpgcd@mpgcd.org Website: www.mpgcd.org

NOTICE OF PUBLIC INFORMATIONAL MEETING AND SPECIAL-CALLED BOARD MEETING[1]

April 3, 2017, 7:00 p.m.
Pecos County Civic Center
1674 Airport Drive, Fort Stockton, Texas

During the meeting, a quorum of the Board may enter executive session under the Texas Open Meetings Act, § 551.071 of the Texas Government Code, for any item on this agenda or as otherwise authorized by law, and the Board may change the order in which one or more agenda items are considered.

PUBLIC INFORMATIONAL MEETING[2]

I Introduction by District's Board President.

II Presentation by District's General Manager on District's statutory purpose, priorities and groundwater studies, and recent developments with pending lawsuits filed against District, legislation that affects the District, and settlement proposal by Fort Stockton Holdings, Clayton Williams Farms and Republic Water Company.

III Public input on General Manager's presentation (limit 3 minutes per person).[3]

IV Closing remarks by District's Board Member(s) and General Manager.

V Adjourn public informational meeting.

MEETING AGENDA

I Establish quorum and call to order meeting.

II Comments from **public and media** (limit 3 minutes per person). Members of the public may address the Board for a limited time concerning any subject whether or not it is on the agenda.[3]

III Consider and/or act on matters involving Fort Stockton Holdings, LP (FSHLP), Republic Water Co. of Texas, LLC (Republic LLC) and Clayton Williams Farms,

Inc.'s draft settlement proposal received on March 18, 2017, related to following pending lawsuits and contested hearing:

- **Republic LLC's state-court lawsuit**, Court of Appeals Case No. 08-17-00001-CV
- **FSHLP v. Pecos County, MPGCD, et al.**, Court of Appeals Case No. 08-15-00382-CV
- **In re the Application of Republic LLC**, State Office of Administrative Hearings Docket No. 959-17-3195

Board action may include response to settlement proposal.

IV Briefing and take action as necessary on **matters regarding 85th Texas Legislative Session** that affect District, including passage of one or more resolutions to reflect Board's position on legislation.

V **Directors' comments.**[4]

VI Consider and/or act upon **agenda for next** meeting.

VII **Adjourn Board meeting.**

---

[1] This facility is wheelchair/parking accessible. Requests for accommodations must be made 48 hours prior to this meeting by contacting Ty Edwards at 432-336-0698.
[2] The purpose of the Public Informational Meeting is to inform the public and receive public input on the matters listed. This segment of the meeting may not include a quorum of the District's Board of Directors; this notice is posted in the event that a quorum attends.
[3] The Board is not allowed to take action on any subject presented that is not on the agenda, nor is the Board required to provide a response; any substantive consideration and action by the Board on a matter presented by the public that is not on today's agenda will be conducted under a specific item on a future agenda.
[4] No action will be taken on these agenda items. These items are on the agenda to provide the District's General Manager and Directors an opportunity to bring to the public's and each other's attention important issues pertinent to groundwater management within the District. Any substantive deliberation and formal action on any of these issues will be conducted under a specific item on a future agenda.

FILED
MAR 30 2017
1:25pm
LIZ CHAPMAN
CLERK COUNTY COURT, PECOS CO., TEXAS
By: [signature] Deputy

MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT

P.O Box 1644 Fort Stockton, TX 79735 Phone (432)336-0698 Fax#432-336-3407
405 North Spring Drive Fort Stockton, Texas 79735
Email: mpgcd@mpgcd.org Website: www.mpgcd.org

NOTICE OF PUBLIC INFORMATIONAL MEETING AND SPECIAL-CALLED BOARD MEETING[1]

April 6, 2017, 7:00 p.m.
Iraan Civic Center
Alley Oop Lane / 624 Parkside Street
Iraan, Texas

During the meeting, a quorum of the Board may enter executive session under the Texas Open Meetings Act, § 551.071 of the Texas Government Code, for any item on this agenda or as otherwise authorized by law, and the Board may change the order in which one or more agenda items are considered.

PUBLIC INFORMATIONAL MEETING[2]

I Introduction by District's Board Officer.

II Presentation by District's General Manager on District's statutory purpose, priorities and groundwater studies, and recent developments with pending lawsuits filed against District, legislation that affects the District, and settlement proposal by Fort Stockton Holdings, Clayton Williams Farms and Republic Water Company.

III Public input on General Manager's presentation (limit 3 minutes per person).[3]

IV Closing remarks by District's Board Member(s) and General Manager.

V Adjourn public informational meeting.

MEETING AGENDA

I Establish quorum and call to order meeting.

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III Consider and/or act on matters involving Fort Stockton Holdings, LP (FSHLP), Republic Water Co. of Texas, LLC (Republic LLC) and Clayton Williams Farms,

Inc.'s draft settlement proposal received on March 18, 2017, related to following pending lawsuits and contested hearing:

- **Republic LLC's state-court lawsuit**, Court of Appeals Case No. 08-17-00001-CV
- **FSHLP v. Pecos County, MPGCD, et al.**, Court of Appeals Case No. 08-15-00382-CV
- **In re the Application of Republic LLC**, State Office of Administrative Hearings Docket No. 959-17-3195

Board action may include response to settlement proposal.

IV **Directors' comments.**[4]

V Consider and/or act upon **agenda for next** meeting.

VI **Adjourn Board meeting.**

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[1] This facility is wheelchair/parking accessible. Requests for accommodations must be made 48 hours prior to this meeting by contacting Ty Edwards at 432-336-0698.

[2] The purpose of the Public Informational Meeting is to inform the public and receive public input on the matters listed. This segment of the meeting may not include a quorum of the District's Board of Directors; this notice is posted in the event that a quorum attends.

[3] The Board is not allowed to take action on any subject presented that is not on the agenda, nor is the Board required to provide a response; any substantive consideration and action by the Board on a matter presented by the public that is not on today's agenda will be conducted under a specific item on a future agenda.

[4] No action will be taken on these agenda items. These items are on the agenda to provide the District's General Manager and Directors an opportunity to bring to the public's and each other's attention important issues pertinent to groundwater management within the District. Any substantive deliberation and formal action on any of these issues will be conducted under a specific item on a future agenda.

Middle Pecos GCD Exhibit 16

Minutes from the April 3, 2017
public forum in Fort Stockton

MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT
P.O Box 1644 Fort Stockton, TX 79735 Phone (432)336-0698 Fax#432-336-3407
405 North Spring Drive Fort Stockton, Texas 79735
Email: mpgcd@mpgcd.org Website: www.mpgcd.org

Minutes of April 3, 2017

On this the 3rd of April, 2017, a Special Called board meeting and Public Informational Meeting was held by the Middle Pecos Groundwater Conservation District at the Pecos County Civic Center located at 1674 Airport Drive, Fort Stockton, Texas, with the following members present, to-wit:

Jerry McGuairt	President, Precinct 1
John Dorris	Vice President, Precinct 3
M. R. Gonzalez	Secretary/Treasurer, Precinct 2
Janet Groth	Precinct 1
Weldon Blackwelder	Precinct 3
Alvaro Mandujano, Jr.	Precinct 4
Vanessa Cardwell	City of Fort Stockton
Allan Childs, Jr.	At Large

Quorum Present.
Board members absent: Ronald Cooper and Jeff Sims
Note: Precinct 2/ Open Position

Others present: Ty Edwards, Mike Gershon, Gail Reeves, Melissa Mills, Gerald D. Lyda, Gene Lyda, Trey Gerfers, Kay Nowell, Jim Hatcher, Ronnie Brandenburg, Leven Porter, Lane Porter, Bob Hayter, Kathy Sconiers, Joe Sconiers, Tom Chapman, Santiago Cantu, Jr., Wynona Riggs, Gary and Donna Bryant, Frank Velasco, Jr., Frank L. Hoelscher, Marjorie Hoelscher, Larry Hoelscher, Ray and Kay Griffith, Babs and Don Kneupper, Zan Matthies, Billy Jackson, Sandra Sconeirs, Lupe Dominguez, Robert and Reba Preston, Jeff Williams, Brock Thompson, Ed McCarthy, Paula McGuairt, George and Stacy Hansard, Leesa Granado, Delmon Hodges, Georgia and Robert Jamison, Howard McKissack, Aggie Oldfield, Shirley Elmore, Frances and Dean Tedford, Al Haney, Martha Subia, Nancy and Rex Carpenter, Debra Ezell, Carol Adams, Roger Harrison, Gretta and Dudley McKissack, Houston McKenzie, Dan Frank, Todd and Jill Suter, Worth Kincaid, Angie and Dr. Jim Miles, Gladys Dorris, Donald and Loraine Lannom, Oscar Hernandez, James Cravens, Chris Alexander, Glenn and Karen Honaker, Frank Rodriguez, Joe Schuster, Arlie Weatherman, Ruben Houston, Gary Cardwell, Aku Rodriguez/CBS 7, and Bob Beal/Fort Stockton Pioneer.

I Call to order regular Board meeting at 7:00 p.m. by President Jerry McGuairt.

PUBLIC INFORMATIONAL MEETING

I Introduction by District's Board President.

II Presentation by District's General Manager on District's statutory purpose, priorities and groundwater studies, and recent developments with pending lawsuits filed against District, legislation that affects the District, and settlement proposal by Fort Stockton Holdings, Clayton Williams Farms and Republic Water Company.

Power Point Presentation given by Ty Edwards. He gave a brief history of the District, and our current monitoring and analysis schedule for Pecos County. He also talked about 1) the Aquifer Studies that have been completed in Pecos County, and 2) the export permits that have been granted in the past, and 3) the management zones and the purpose for having them, and 4) the 85th Legislature and bills associated with water, and 5) the permit application and settlement offer received from Fort Stockton Holdings LP/Clayton Williams Farms, Inc./Republic Water Company of Texas, LLC., and 6) historic and current water levels in Fort Stockton and in Management Zone 1.

III Public input on General Manager's presentation.
(Comments have been very condensed.)

Jim Hatcher: The Sunset Review bill would require a lot of tax payer money, and is ludicrous. The House Bill(s) are an attempt to impugn the integrity of the MPGCD Board. The City of Fort Stockton City Council and the MPGCD Board need to get along.

Zan Matthies: Mr. Matthies has been with the District since its inception. He believes that the District should be ran on the "good word" of individuals, and don't need lawyers and law suits. Our goal was to not pit neighbor against neighbor, nor brother against brother with water wars. We felt like permits for "Historic and Existing Use" would best benefit Pecos County and keep us out of lawsuits. We were also told you could use the water for whatever reason as long as it was a beneficial use.

Debra Ezell: Her family has ties to Pecos County ranch land since the 1800's. They have witnessed the drying up of Comanche Springs and other Pecos County Springs and would like to have water for future generations. She strongly opposes House Bill 4235.

Leesa Granado: She agrees with Debra Ezell and Jim Hatcher.

Gretta McKissack: Please consider tabling this matter so that we may think it over more. And, the current strategy seems to be to divide and conquer, so the City and MPGCD need to work together.

Bob Beal: He would like to know what Fort Stockton Holdings is seeking to accomplish by means of the settlement offer. And, how the offer relates to Republic Water Co. Of Texas.

There were no explanations or answers to Mr. Beal's questions.

Dudley McKissack: He asked if a production permit could have multiple uses on a single permit. (Ty Edwards answered "Yes".) Another thing, is 8 – 10 years ago there was a hearing at 1 p.m., and nobody could show up. There have been two court cases that have been thrown out. You need to keep plugging along. The Sunset Bill will die. Finally, I strongly urge you to consider what you are doing, because once you let one person start it – there's no end.

IV Closing remarks by Board Member(s) and General Manager.

Jerry McGuairt thanked everyone for coming to the public forum, and for their remarks and their support.

V Adjourn public informational meeting.
Jerry McGuairt adjourned the public informational meeting at 7:45 p.m.

MEETING AGENDA

I Call to order Special Called Meeting at 7:45 p.m. by President Jerry McGuairt.

II Comments from **public and media**

Trey Gerfers: He is with the Big Bend Conservation Alliance, and a resident of Marfa. He invited everyone to a West Texas Water Symposium on April 22nd at the Granada Theater in Alpine, Texas from 8 am to 5 pm.

Ronnie Brandenburg: He has Section 20 in Coyanosa. Pearl Resources (an Oil Company) drilled a horizontal well and didn't set surface casing. They drilled into the Capitan Reef and 2,000 gallons per minute along with H_2S Gas came to the surface. Mr. Brandenburg wanted to know why we haven't fined them.

General Manager Ty Edwards reported that the Railroad Commission is investigating and the insurance company hired an environmental team to do impact studies. The water quality analysis show that the H_2S Gas has dissipated, and there were no more water quality concerns. The Texas Railroad Commission is the regulatory agency responsible for the investigations and fines.

<u>Dudley McKissack:</u> Shared a quote worth remembering:
Sell your water – Sell your soul.

<u>Zan Matthies</u>: Regarding Historic and Existing Use permits: Water users were allowed to look at a 15 year period to determine the one year with the highest usage, and they were given a permit for the highest usage year. There is no way the Historic and Existing Use permits can harm the aquifer. Next, after the cutoff date of granting Historic and Existing Use permits – people could apply for a production permit. If granted, they can drill the well and if the aquifer drops to a bad level – they would be the first ones to be cut off. Second, you are selling your water any way you look at it. It is either going out in hay or cotton or cows. Water is leaving here.

III Consider and/or act on matters involving Fort Stockton Holdings, LP (FSHLP), Republic Water Co. of Texas, LLC (Republic LLC) and Clayton Williams Farms, Inc.'s draft settlement proposal received on March 17 ~~18~~, 2017, related to following pending lawsuits and contested hearing:

- **Republic LLC's state-court lawsuit**, Court of Appeals Case No. 08-17-00001-CV
- **FSHLP v. Pecos County, MPGCD, et al.**, Court of Appeals Case No. 08-15-00382-CV
- **In re the Application of Republic LLC**, State Office of Administrative Hearings Docket No. 959-17-3195

Board action may include response to settlement proposal.

An Executive Session was called at 7:58 p.m. by Presiding Officer Jerry McGuairt pursuant to the Texas Open Meetings Act, Sections 551.071 of the Texas Government Code, to consult with attorney.

The Executive Session ended at 9:07 p.m. President McGuairt stated that no decisions or votes were made in executive session.

John Dorris made a motion to table this item until after the Iraan Public Meeting on Thursday at 7 p.m. Seconded by Janet Groth. Motion carried unanimously.

IV Briefing and take action as necessary on **matters regarding 85th Texas Legislative Session** that affect District, including passage of one or more resolutions to reflect Board's position on legislation.

Tabled.

V **Directors' comments.** No comments

VI Consider and/or act upon **agenda for next** meeting. No comments.

VII **Adjourn Board meeting.**
Weldon Blackwelder made a motion to adjourn the meeting. Seconded by Allan Childs. Motion carried unanimously. The meeting adjourned at 9:12 p.m.

M. R. Gonzalez, Secretary/Treasurer

Jerry McGuairt, President

Date Approved 4-18-17

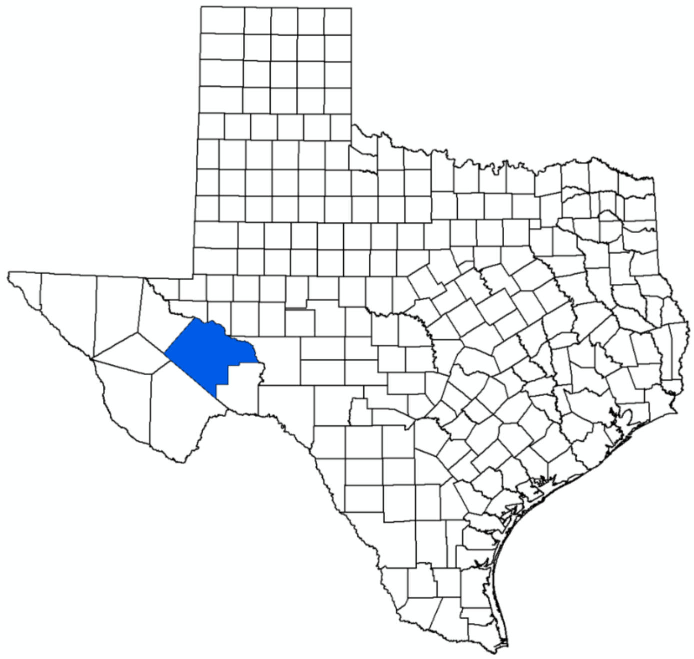
Minutes prepared by Melissa Mills

Middle Pecos GCD Exhibit 17

Overview of Technical Memoranda, prepared by William R. Hutchison, Ph.D., P.E., P.G. and Michelle A. Sutherland, P.E, dated May 3, 2024

Draft Technical Memorandum 1 v3

Overview of Technical Memoranda



Prepared for:
Ty Edwards, General Manager
Middle Pecos Groundwater Conservation District
PO Box 1644
Fort Stockton, TX 79735

Prepared by:
William R. Hutchison, Ph.D., P.E., P.G.
Independent Groundwater Consultant
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Michelle A. Sutherland, P.E.
Envision Water
10400 W. Overland Road, Suite #194
Boise, ID 83709
949-702-3622
msutherland@envisionwater.com

May 3, 2024

Draft Technical Memorandum 1 v2

Professional Engineer and Professional Geoscientist Seals

Draft Report

Stamps will be added when finalized

Table of Contents

List of Tables

1.0 Overview

1.1 MPGCD Aquifers and Existing Groundwater Models

The Middle Pecos GCD covers all of Pecos County, and there are six named aquifers within the District boundaries (listed from youngest to oldest):

- Pecos Valley Aquifer
- Igneous Aquifer
- Edwards-Trinity (Plateau) Aquifer
- Dockum Aquifer
- Rustler Aquifer
- Capitan Reef Complex Aquifer

The Texas Water Development Board (TWDB) has developed the following Groundwater Availability Models (GAMs), or regional numerical groundwater flow models, that cover the named aquifers within the District:

- Edwards-Trinity (Plateau) and Pecos Valley Aquifers (completed in 2004)
- Edwards-Trinity (Plateau) and Pecos Valley Aquifers (PEST update in 2009)
- Edwards-Trinity (Plateau) and Pecos Valley Aquifers (one-layer alternative model completed in 2010)
- Edwards-Trinity (Plateau) and Pecos Valley Aquifers (update to 20024 and 2009 model in progress, scheduled completion in 2024 or 2025)
- Parts of the West Texas Bolsons (Wild Horse Flat, Michigan Flat, Ryan Flat, and Lobo Flat) Aquifer and Igneous Aquifer (completed in 2004)
- Dockum Aquifer (completed in 2008)
- Dockum Aquifer (alternative model completed in 2010)
- High Plains Aquifer System (includes Dockum Aquifer, completed in 2015)
- Rustler Aquifer (completed in 2012)
- Capitan Reed Complex Aquifer (completed in 2016)

In addition to the TWDB Groundwater Availability Models, the following models that cover Pecos County groundwater resources have also been developed:

- Western Pecos County Groundwater Model (completed in 2011 by R.W. Harden & Associates, LBG-Guyton Associates, and Thornhill Group, Inc.)
- Edwards-Trinity and Related Aquifers (completed in 2014 by USGS)

John Shomaker & Associates have also completed a model of the Capitan Reef Complex Aquifer for a private landowner. MPGCD has been provided a copy of the model files and the report.

During Joint Groundwater Planning activities with other groundwater conservation districts in GMA 3 and GMA 7, MPGCD is required to work with the most recent TWDB model when developing desired future conditions because these are used by TWDB in developing modeled available groundwater values. Thus, MPGCD routinely works with the following models during Joint Planning:

- Edwards-Trinity (Plateau) and Pecos Valley Aquifers (one-layer alternative model completed in 2010)
- High Plains Aquifer System (includes Dockum Aquifer, completed in 2015)
- Rustler Aquifer (completed in 2012)
- Capitan Reed Complex Aquifer (completed in 2016)

Please note that the Igneous Aquifer does not have a large footprint in Pecos County, and, therefore, has been classified as not relevant for the purposes of Joint Planning in Pecos County.

The various limitations of these models are documented in the various technical memoranda that were developed as part of the Joint Planning process. The fact that the District is required to work with four separate models that were developed and calibrated for different time periods, and that have different capabilities and limitations, presents challenges to the District.

In addition, MPGCD desires to have a single tool that would be useful to provide quantitative data and information for permitting decisions. At one time, MPGCD required the use of the USGS model as part of its permit review process. However, a review of the model found that it was unreliable for that purpose.

A review of the Western Pecos Model, however, demonstrated that it was useful for some aspects of permit review, but lacked the ability to assess management options on a sub annual time scale. A model with a sub annual time discretization is desirable to better understand the relationship between pumping and spring flow at Comanche Spring.

1.2 MPGCD Groundwater Model

Allan Standen has recently completed an updated geologic model of Pecos County. This geologic model provides the basic framework for this groundwater model. MODFLOW 6 is the code used for the groundwater model. As developed in the technical memoranda, much of the basic information and data from the existing models were used to develop a single groundwater flow model for the District that covers all aquifers. New data is also used and documented in the technical memoranda.

This improved model includes more District-centric objectives and better aligns with the boundaries of the District for all aquifers. In simple terms, the objective is to develop a tool that would assist the District in groundwater management. Specific objectives/uses that are contemplated include:

- DFC development without the need to use regional GAMs
- Provide a quantitative basis for future updates to the district's rules that sets a threshold well size/pumping amount for requiring permit applicants to prepare hydrologic reports
- Provide a tool that can be used to review permit applications by quantifying the potential impacts of new pumping for any formation/aquifer in the District on a regional scale

- Assess the relationship between groundwater pumping and spring flow at Comanche Springs on a sub annual time scale

2.0 Technical Memoranda

Documentation of the model development, calibration, and application will be via a summary model report and a series of technical memoranda that will be released in draft form as model development progresses. The release of the draft technical memoranda provides MPGCD and others to review progress of model development. The technical memoranda include details of conceptualization, assumptions, and input data associated with different aspects of the model.

Table 1 summarizes the technical memoranda:

Table 1. Summary of Technical Memoranda

Tech Memo Number	Subject
1	Overview of Technical Memoranda
2	Model Grid
3	Grid Implementation (BAS and DISU)
4	Existing Groundwater Pumping Estimates
5	Groundwater Pumping (WEL)
6	Recharge (WEL)
7	Aquifer Parameters (LPF)
8	Boundary Flows (GHB)
9	Springs (DRN)
10	Surface Water (RIV)
11	Groundwater Evapotranspiration (EVT)
12	Model Run Specifications (NAM, OC, Solver)
13	Model Calibration Datasets
14	Model Calibration
15	Groundwater Budgets
16	Model Sensitivity

Middle Pecos GCD Exhibit 18

Technical Memoranda status report (February 13, 2025)

MPGCD Model - Technical Memoranda

2/13/2025 version 08

Tech Memo Number	Subject	Draft 1 Completion Date	Most Recent Draft and Completion Date	Notes
1	Overview of Technical Memoranda	11/30/2020	5/3/2024 (v3)	**v2**: Updated text (JSA Capitan model files), updated list of TMs, **v3**: updates associated with updated model gird
2	Model Grid	11/30/2020	5/3/2024 (v2)	Need reference for Allan Standen's geologic model **v2**: updated model grid
3	Grid Implementation (DISU)	12/1/2020	5/3/2024 (v2)	**v2**: updated model grid
4	Existing Groundwater Pumping Data	12/27/2021	2/4/2022 (v4)	**v2**: Corrected typo. **v3**: Updated and corrected JSAI model interpretation . **v4**: Corrected a reported error in MPGCD database for one well in 2020, revised affected figures in main report and in Appendix C.
5	Groundwater Pumping (WEL)			Completed: Databaase download of historic metered pumping.
6	Recharge (WEL or RCH)			Completed: Characterized focused and upland recharge cells. Developed basic algorithm to estimate recharge based on rainfall and cell size based on karstic landscape.
7	Aquifer Parameters (NPF)			Completed: Analysis of 187 specific capacity tests using 8 methods for each test to obtain transmissivity estimates. Summarized min, avg, max for each cell to aid calibration.
8	Boundary Flows (GHB)			Completed: Identified boundary cells for GHB cells
9	Springs (DRN)			Completed: Identifed locations of relevant springs
10	Surface Water (RIV)			Completed: Developed algorithm to be updated during calibration on RIV cells based on cell size
11	Groundwater Evapotranspiration (EVT)			Preliminary evaluation completed related to need for this package. May be better suited for DRN and/or RIV package.
12	Model Run Specifications (NAM, OC, TDIS, IC, Solver)			Routine "bookeeping" packages for model execution
13	Model Calibration Datasets			Completed: Processed TWDB, MPGCD, and Belding data. Worked to identify and correct reference point elevation errors in source data and confirmed consistentcy with model grid top elevations.
14	Model Calibration			Initiate once model is up and running
15	Groundwater Budgets			Complete once model is calibrated
16	Model Sensitivity			Complete once model is calibrated

Middle Pecos GCD Exhibit 19

Letter proposal dated June 12, 2019

William R. Hutchison, Ph.D., P.E., P.G.
9305 Jamaica Beach
Jamaica Beach, TX 77554
512-745-0599
billhutch@texasgw.com

June 12, 2019

Mr. Ty Edwards, General Manager
Middle Pecos Groundwater Conservation District
PO Box 1644
Fort Stockton, TX 79735

RE: Proposal to Provide Professional Services: Groundwater Model

Dear Mr. Edwards:

As a follow-up to recent discussions, this letter presents a proposed scope of work, cost, and schedule to complete Phase 1 of the development of a groundwater flow model. This letter also provides an overview of the overall effort to complete the model.

Background

The Middle Pecos GCD covers all of Pecos County, and there are six named aquifers within the District boundaries (listed from youngest to oldest):

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- Parts of the West Texas Bolsons (Wild Horse Flat, Michigan Flat, Ryan Flat, and Lobo Flat) Aquifer and Igneous Aquifer (completed in 2004)
- Dockum Aquifer (completed in 2008)
- Dockum Aquifer (alternative model completed in 2010)

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In addition to the TWDB Groundwater Availability Models, the following models that cover Pecos County groundwater resources have also been developed:

- Western Pecos County Groundwater Model (completed in 2011 by R.W. Harden & Associates, LBG-Guyton Associates, and Thornhill Group, Inc.)
- Edwards-Trinity and Related Aquifers (completed in 2014 by USGS)

John Shomaker & Associates have also completed a model of the Capitan Reef Complex Aquifer for a private landowner. To date, MPGCD has not been provided a copy of the model files or the report.

During Joint Groundwater Planning activities with other groundwater conservation districts in GMA 3 and GMA 7, MPGCD is required to work with the most recent TWDB model when developing desired future conditions because these are used by TWDB in developing modeled available groundwater values. Thus, MPGCD routinely works with the following models during Joint Planning:

- Edwards-Trinity (Plateau) and Pecos Valley Aquifers (one-layer alternative model completed in 2010)
- High Plains Aquifer System (includes Dockum Aquifer, completed in 2015)
- Rustler Aquifer (completed in 2012)
- Capitan Reed Complex Aquifer (completed in 2016)

Please note that the Igneous Aquifer does not have a large footprint in Pecos County, and, therefore, has been classified as not relevant for the purposes of Joint Planning in Pecos County.

The various limitations of these models are documented in the various technical memoranda that were developed as part of the Joint Planning process. The fact that the District is required to work with four separate models that were developed and calibrated for different time periods, and that have different capabilities and limitations, presents challenges to the District.

In addition, MPGCD desires to have a single tool that would be useful to provide quantitative data and information for permitting decisions. At one time, MPGCD required the use of the USGS model as part of its permit review process. However, a review of the model found that it was unreliable for that purpose.

A review of the Western Pecos Model, however, demonstrated that it was useful for some aspects of permit review, but lacked the ability to assess management options on a monthly time scale. A model with a monthly time discretization is desirable to better understand the relationship between pumping and spring flow at Comanche Spring.

Model Objectives

As we have discussed, there have been recent developments and advancements in the MODFLOW suite of groundwater modeling codes. These improvements provide an opportunity to use the basic information and data from these various GAMs to develop a single groundwater flow model for the District that covers all aquifers. This combined model can also include the results of the recently completed effort by Alan Standen to update the geologic framework of Pecos County.

This improved model would be developed with a more District-centric set of objectives and would better align with the boundaries of the District for all aquifers. In simple terms, the objective is to develop a tool that would assist the District in groundwater management. Specific uses that are contemplated include:

- DFC development without the need to use regional GAMs
- Provide a quantitative basis for future updates to the district's rules that sets a threshold well size/pumping amount for requiring permit applicants to prepare hydrologic reports
- Provide a tool that can be used to review permit applications by quantifying the potential impacts of new pumping for any formation/aquifer in the District on a regional scale
- Assess the relationship between groundwater pumping and spring flow at Comanche Springs on a monthly time scale

Proposed Phases of Model Development and Application

We have discussed a general approach to the work where an initial phase would be completed in the current fiscal year which ends September 30, 2019 that recognizes the constraints of your current budget. Specifically, Phase 1 would be completed by the end of September 2019. Completion of the entire modeling effort by October 31, 2020 will also result in the opportunity of having the model available for simulations during the next round of joint planning. The next statutory deadline for proposed desired future conditions is May 1, 2021.

The following phasing is recommended:

- Phase 1: Update and extend the geologic framework recently completed by Alan Standen and incorporate updated geologic framework into a new model grid
- Phase 2: Model development
- Phase 3: Model calibration
- Phase 4: Initial simulations

For the current fiscal year, Phase 1 is proposed to be completed by September 30, 2019 with a budget of $25,000. If authorized, Phases 2 to 4 would be completed by October 31, 2020.

For the entire effort, total costs should be between $70,000 to $100,000 as follows:

- Phase 1: $25,000
- Phase 2: $25,000
- Phase 3: $10,000 to $25,000
- Phase 4: $10,000 to $25,000

The range in Phase 3 is due to the uncertainty of the time required to complete the calibration without having a full appreciation of the available data for calibration and the interactions between the aquifers. As we have discussed, the Rustler GAM, the USGS model, and the Capitan Reef Complex GAM have severe limitations because of the way inter-aquifer flows are treated. Because these previous attempts have essentially failed, it may take some additional time to calibrate the model to achieve a reasonable degree of connection between the aquifers.

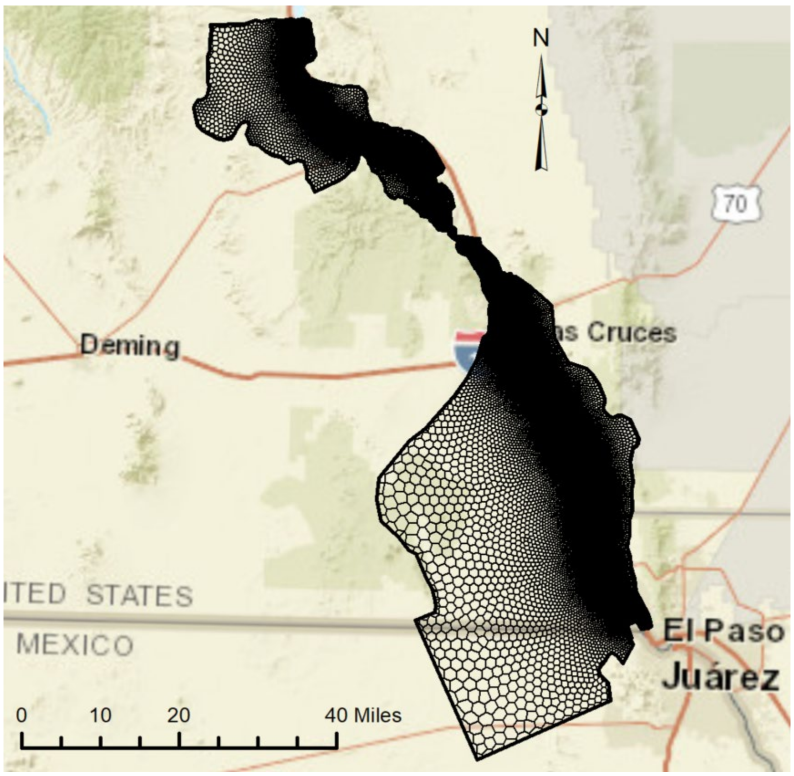
The range in Phase 4 is due to the uncertainty of how many simulations need to be completed and how thoroughly they need to be documented. Some of this effort is directly tied to the activities of GMA 3 and GMA 7, and we should refine the scope and budget of this phase once the model is completed.

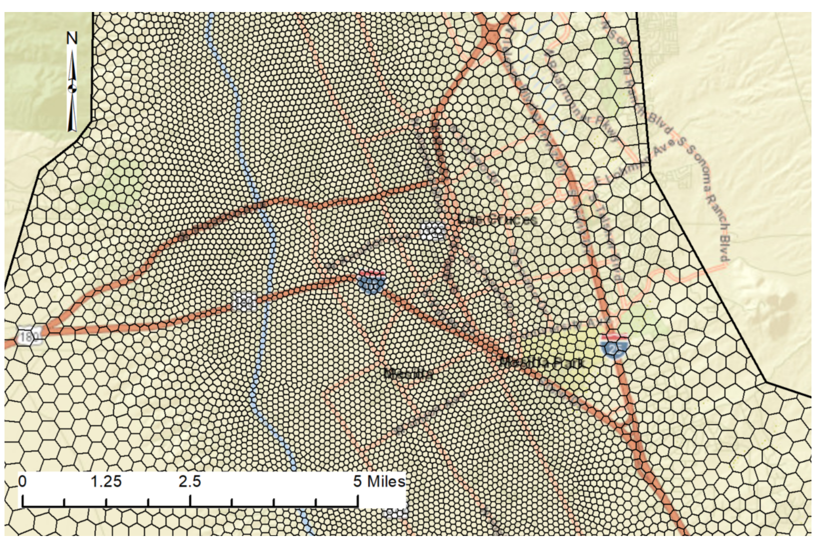
The specific cost and schedule of Phases 2 to 4 would be developed on a phase by phase basis after consultation and discussion with you. Specifically, I would present the results of each phase to you and/or your Board with recommendations for scope, cost, and schedule for the subsequent phase. This letter proposal focuses on Phase 1.

Phase 1: Geologic Framework Update and Grid Development

Alan Standen has completed an update of the geologic framework of Pecos County. The results of his work include the top and bottom elevation of all aquifer units in all areas of Pecos County. This work needs to be expanded to include extrapolations of the top and bottom elevations in the areas just outside of Pecos County because the model boundaries need to extent past the boundary of Pecos County in order to properly simulate subsurface inflows and outflow to and from Pecos County.

Once the geologic framework is completed, a model grid will be developed and the top and bottom elevations for each cell and each model layer will be developed using Leapfrog software. The development of a grid using Voronoi cells will be accomplished using the commercial software package AlgoMesh. The Voronoi cells will have varying sizes that could include small cell size near the streams and gradually larger cells away from the streams can be used to better follow geologic boundaries (outcrop areas) and hydrologic boundaries (rivers and streams). We may also refine the grid in the Leon-Belding area and the area of Comanche Springs. The use of an "unstructured grid" is a major advancement in MODFLOW and can be used to improve the model. An example of a grid of Voronoi cells is presented below. The example is from a model that I have recently completed in the El Paso-Las Cruces area. The upper image is the entire model area, and the lower image is an enlarged view of the Las Cruces area.





Michelle Sutherland is proposed as a subcontractor on this project. She worked with Alan Standen on the geologic update previously mentioned and is in an excellent position to provide knowledge and support on this overall effort.

General Scope of Work for Subsequent Phases

Phase 2: At this time, the model will be developed with either MODFLOW-USG or MODFLOW 6. MODFLOW-USG was released by the USGS in 2013. MODFLOW 6 is a more recent code released in 2017. Both codes will handle the proposed Voronoi grid. I have experience with both codes. A final decision will be made at the completion of Phase 1. Model development will include inclusion of detailed pumping data from the District files. This will be a significant improvement in comparison with the existing regional model that have been developed in the past.

Phase 3. Model calibration will rely on existing and available groundwater elevation data from the TWDB groundwater database, the MPGCD database, and the Belding Farms database which we received in 2018. In addition, we will use any spring flow and stream flow data that may be available.

Phase 4: At a minimum, the initial simulations will include mimicking the existing model runs that are the bases for the desired future conditions and evaluating their results in the context of the next round of joint planning. A more comprehensive list of simulations will be developed in consultation with you as Phase 3 is being completed. Please note that one of the objectives of these initial simulations is to test the usability of the model for future simulations to evaluate permit applications. As with any model, this model will have limitations, and understanding those limitations in the context of evaluation of permit evaluations will be one of the primary objectives of this phase.

Michelle Sutherland and I appreciate the opportunity to assist the District in this effort. If you have any questions or wish to discuss this proposal, please call me at 512-745-0599 or email me at billhutch@texasgw.com.

Sincerely,

William R Hutchison

William R. Hutchison, Ph.D., P.E., P.G.

Middle Pecos GCD Exhibit 20

Agenda for June 18, 2019 Middle Pecos GCD Board of Directors Meeting

MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT
P.O Box 1644 Fort Stockton, TX 79735 Phone (432)336-0698 Fax (432)336-3407
405 North Spring Drive Fort Stockton, Texas 79735
Email: mpgcd@mpgcd.org Website: www.middlepecosgcd.org

NOTICE OF REGULAR BOARD MEETING AND PERMIT HEARINGS[1]

June 18, 2019
Call to Order at 10:00 a.m.
405 North Spring Drive, Fort Stockton, Texas

During the meeting and hearings, the Board reserves the right to go into executive session for any of the purposes authorized under the Texas Open Meetings Act, Chapter 551 of the Texas Government Code, for any item on this agenda or as otherwise authorized by law.

The meeting and hearings may be recessed for lunch to allow the Board to address all the agenda items on this date and the Board may change the order in which one or more of the meeting or hearing items are considered.

REGULAR BOARD MEETING

I Call to order regular Board meeting.

II Comments from **public and media** (limit 5 minutes per person). Members of the public may address the Board for a limited time concerning any subject whether or not it is on the agenda.[2]

PUBLIC HEARING ON APPLICATION TO AMEND AN EXISTING PRODUCTION PERMIT FOR LEE BAKER[3]

I Call to order at 10:00 a.m. the Public Hearing on **Application to Amend an Existing Production Permit for Lee Baker.**

II Adjourn Hearing and Consider and/or Act on **Application to Amend an Existing Production Permit for Lee Baker.**

FILED
JUN 14 2019
LIZ CHAPMAN
CLERK COUNTY COURT, PECOS CO., TEXAS
By: ______ Deputy

PUBLIC HEARING ON A DRILLING PERMIT
FOR CLARENCE STEPHAN[3]

I Call to order at 10:05 a.m. the Public Hearing on **Application for a Drilling Permit for Clarence Stephan.**

II Adjourn Hearing and Consider and/or Act on **Application for a Drilling Permit for Clarence Stephan.**

PUBLIC HEARING ON PRODUCTION PERMIT
FOR SPRINT KARNES COUNTY DISPOSAL, LLC.[3]

I Call to order at 10:10 a.m. the Public Hearing on **Application for a Production Permit for Sprint Karnes County Disposal, LLC.**

II Adjourn Hearing and Consider and/or Act on **Application for a Production Permit for Sprint Karnes County Disposal, LLC.**

REGULAR BOARD MEETING – CONTINUED

III Consider and/or act upon **the Minutes of Regular Meeting for May 21, 2019.**

IV Consider and/or act upon **Accounts Payable, Treasurer's Report and Line Item Transfers for the Month Ending May 31, 2019**.

V Briefing on **Cockrell Interests LLC's Estimation of Year-Around Thresholds in Belding Farms Wells Report by Nick Martin, P.G., P.H. and Ronald Green, Ph.D., P.G. Earth Science Section Southwest Research Institute.**

VI Consider and/or act upon approving **Bill Hutchison to move forward with Phase 1 of the development of a Groundwater Flow Model for Pecos County. The potential uses of the model include: 1) alternative DFC development and evaluation, 2) management zone delineation, 3) assessment of groundwater monitoring results, 4) provision of quantitative support of rulemaking decisions, and 5) assistance in the review of permit applications.**

VII Consider and/or act upon **Edge 1 Water Holdings Corporation's Notice of Intent to Drill an Exempt Well into the San Andres Formation and consider approving drilling plan/well schematic and performance bond.**

VIII **Progress Reports: Well Registrations, Production Permits, Drilling Permits, Data Loggers, Drought Monitor Map and ongoing Water Quality Analysis.[4]**

IX Consider and/or act upon **General Manager's Correspondence.**

X **Directors' Comments**[4] and consider and/or act upon **agenda for next meeting.**

XI **Adjourn** Board meeting.

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[1] The Board may break for lunch and commence or continue the Board meeting and hearings immediately after lunch. This facility is wheelchair/parking accessible. Requests for accommodations must be made 48 hours prior to this meeting by contacting Ty Edwards at 432-336-0698.

[2] The Board is not allowed to take action on any subject presented that is not on the agenda, nor is the Board required to provide a response; any substantive consideration and action by the Board will be conducted under a specific item on a future agenda.

[3] Additional more detailed notice of the public hearings required by state law and the District's rules was separately issued by the District.

[4] No action will be taken on these agenda items. These items are on the agenda to provide the District's General Manager and Directors an opportunity to bring to the public's and each other's attention important issues pertinent to groundwater management within the District such that any substantive deliberation and formal action on any of these issues will be conducted under a specific item on a future agenda.

Middle Pecos GCD Exhibit 21

Texas Water Development Board, A Conceptual Model of Groundwater Flow in the Pecos Valley and Edwards-Trinity (Plateau) Regional Aquifers (August 2022)

A Conceptual Model of Groundwater Flow in the Pecos Valley and Edwards-Trinity (Plateau) Regional Aquifers

By Ki Cha, Ph.D.,
Jevon Harding, P.G.,
Grayson Dowlearn, P.G.,
Ian Jones, Ph.D., P.G., and
Roberto Anaya, P.G.
Texas Water Development Board
August 2022

Geoscientist Seals

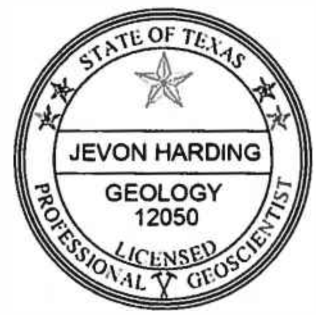
The following professional geoscientists contributed to this conceptual model report and associated data compilation and analyses:

Jevon Harding, P.G.

Ms. Harding was responsible for creating structural frameworks, compiling hydraulic properties, and reviewing the final project report. She was the primary author of the structural framework and hydraulic properties sections.

Signature

8-11-22
Date

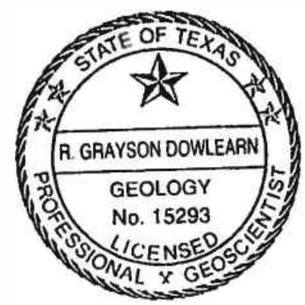


Grayson Dowlearn, P.G.

Mr. Dowlearn was responsible for compiling groundwater water levels. He was the primary author of the sections related to water levels.

Signature

8/11/2022
Date



Ian Jones, P.G.

Dr. Jones was responsible for compiling water quality data. He was the primary author of the water quality section.

Signature

08/11/2022
Date

Roberto Anaya, P.G.

Mr. Anaya was responsible for compiling the stratigraphic framework. He reviewed the sections related to geologic setting, hydrostratigraphy, and hydrostratigraphic framework.

Signature

08/11/2022
Date

STATE OF TEXAS
Roberto Anaya
Geology
No. 480
LICENSED
PROFESSIONAL GEOSCIENTIST

Other Contributor

Ki Cha, Ph.D.

Dr. Cha was the project manager and oversight the project. He was the primary author of the sections not covered by the co-authors of this report. He was responsible for compiling, reviewing, and QA/QC the final report.

Ki Cha   08 – 11 – 22

Signature   Date

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A Conceptual Model of Groundwater Flow in the Pecos Valley and Edwards-Trinity (Plateau) Regional Aquifers

By Ki Cha, Ph.D.,
Jevon Harding, P.G.,
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Ian Jones, Ph.D., P.G., and
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Texas Water Development Board
August 2022

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EXECUTIVE SUMMARY

The conceptual model for the Pecos Valley and Edwards-Trinity (Plateau) regional aquifers includes the Pecos Valley Aquifer, the Edwards-Trinity (Plateau) Aquifer, a small portions of the southern tip of the Ogallala Aquifer, the San Antonio and the Barton Springs segments of Edwards (Balcones Fault Zone) Aquifer, and the Southern portion of the Trinity Aquifer. A conceptual model is a generalized representation of a groundwater flow system based on hydrogeologic information (Anderson and Woessner, 1992), and is a keystone to building a reliable groundwater availability model by consolidating real-world data. This report discusses geologic, hydrologic, and hydrogeologic information of the study area and presents the conceptual model developed based on that information.

The current modeling effort primarily focuses on the Pecos Valley Aquifer and Edwards-Trinity (Plateau) Aquifer. While other aquifers in the study area will be included in the model, it is only with the goal of helping better define the boundary conditions of the primary modeling targets. Note that the current model does not have an objective to update the models of the Trinity Aquifer or the Edwards (Balcones Fault Zone) aquifers, as these will be updated in later TWDB modeling efforts. This report is intended to be an update of the previous TWDB model of the Pecos Valley and Edwards-Trinity (Plateau) Aquifers (Anaya and Jones, 2009). Including these other non-primary aquifers in the current model is one of the major updates from previous work and will improve our understanding of the interconnected flow between the aquifers in this region. The aquifers in the study area occupy 49,000 square miles of West and Central Texas and supply springflow and baseflow to numerous intermittent and perennial streams. Also, these aquifers are the primary source of freshwater for irrigation, livestock, manufacturing, mining, municipal, and domestic use in the region. In recent decades, the water availability of these aquifers has been a challenge as droughts decrease recharge to the aquifer and result in an increase in groundwater pumping. To better estimate the groundwater availability and provide a tool for regional water planning in this region, the Texas Water Development Board (TWDB) is developing a revised and updated groundwater availability model for these aquifers as part of the Groundwater Modeling Program. For the first phase of the model development, we have updated the conceptual model that describes the aquifer flow system and summarizes the hydrogeologic system. This report documents the conceptual model development work for the Pecos Valley Aquifer and the Edwards-Trinity (Plateau) Aquifer regional model. The second phase of the process will be to build and calibrate a numerical groundwater model based on this conceptual model.

Most of the study area is a plateau (Figure ES-1). The elevation of the study area is highest in the northwest and slopes gradually to the southeast. The greatest relief occurs on the west margin of the study area along the Trans-Pecos Basin and Range of West Texas and the Eastern Sierra Madre Mountains in Mexico and on the southeast margin along the Balcones Fault Zone (Lindgren and others, 2004). Most streams in the study area are intermittent or ephemeral. Perennial streams are more common on the northern, eastern,

and southern margins of the Edwards Plateau along the spring-fed headwater tributaries (Anaya and Jones, 2009). Climate, surface geology, topographic slope, soil, and vegetation cover all affect recharge in the study area. Average annual precipitation in the study area decreases from 34 inches (east) to 12 inches (west). Average annual temperature increases from 60 degrees Fahrenheit in the north to 70 degrees Fahrenheit in the south. Land use change determines the water consumption, and the most prominent urbanization happens in the eastern part of the study area (San Antonio and Austin), where the Edwards (Balcones Fault Zone) Aquifer occurs. The Edwards Plateau and Hill Country areas have poor soil development, while the Pecos Valley and Edwards (Balcones Fault Zone) areas have slightly better.

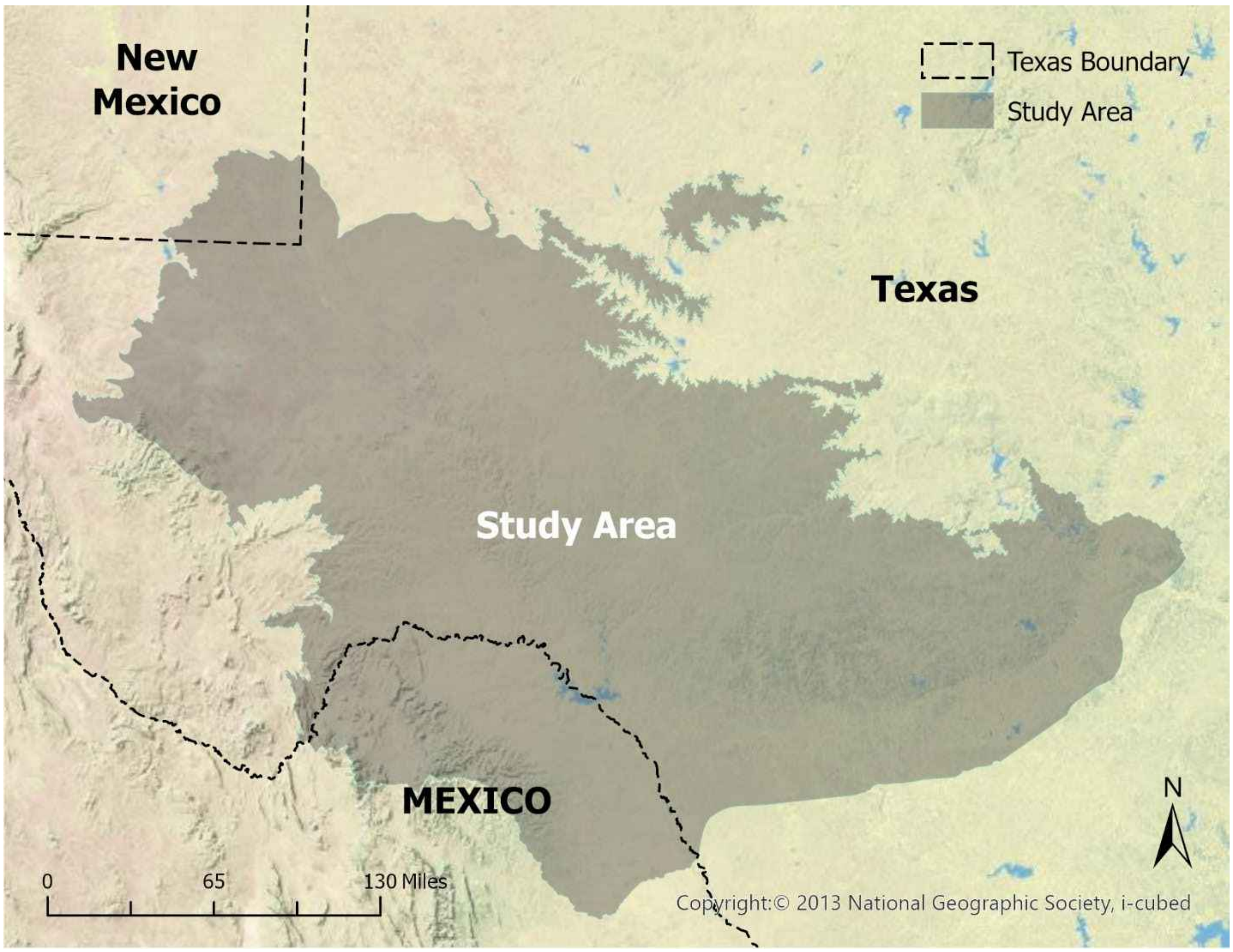


Figure ES-1. Map of study area.

The Edwards-Trinity aquifer system includes the Edwards-Trinity (Plateau), Edwards (Balcones Fault Zone), and the Trinity aquifers within the study area. The Edwards-Trinity aquifer system consists of Lower Cretaceous shallow marine rock sediments belonging to the Lower Washita, Fredericksburg, and Trinity groups. The Trinity Group sediments form the bottom unit of the Edwards-Trinity aquifer system. The Lower Washita and

Fredericksburg sediments form the Edwards Group on the top of the Trinity Group or the top unit of the Edwards-Trinity aquifer system. The Pecos Valley Aquifer consists of Cenozoic terrigenous rock sediments.

For modeling purposes, we have condensed the geology of the study area into three simplified layers. The top layer (Layer 1) represents younger units that overlie the Edwards and Trinity hydrostratigraphic units and includes the Pecos Valley Aquifer and other shallow units. The middle layer (Layer 2) represents the Edwards hydrostratigraphic unit and consists of the Edwards (Balcones Fault Zone) Aquifer and the Edwards portion of the Edwards-Trinity (Plateau) Aquifer. The bottom layer (Layer 3) represents the Trinity hydrostratigraphic unit (the southern portion of the Trinity Aquifer and the Trinity portion of the Edwards-Trinity (Plateau) Aquifer).

We compiled and analyzed well data, including water level data and aquifer test information, to determine the regional groundwater flow patterns and aquifer characteristics. The water level analysis shows that groundwater flows from northwest to southeast and generally follows the regional topography. Potentiometric surfaces were created with water level contours for 1950, 1980, 2000, and 2015, in addition to several hydrographs, to show water level changes over time. We also compared water levels from paired wells (neighboring wells drilled to different formations) to show potential vertical connections between hydrostratigraphic units. Aquifer tests provided information about the capacity of groundwater flow, referred to as storage and transmissivity. We compiled data from long-term and short-term aquifer tests to calculate the hydraulic conductivity, which measures the ease of groundwater flow through an aquifer. The median hydraulic conductivity of each region will be used as an initial calibration value for the numerical model. The median value of the hydraulic conductivity was 6.0 and 4.0 feet per day for the Pecos Valley Aquifer north and south of the Pecos River, respectively, and 4.1 feet per day for the Edwards hydrostratigraphic unit. For the Trinity hydrostratigraphic unit, the median hydraulic conductivity is 7.0 feet per day in the Northern Plateau region (where Glen Rose Formation is absent), 1.6 feet per day in the Southern Plateau region (where Glen Rose Formation is present), and 0.2 feet per day in the Hill Country and Balcones Fault Zone regions. During the calibration process of the model, these initial values will be adjusted within reasonable bounds to coincide with lithology standards. The storativity, which shows the availability of aquifer water storage, varies from 1.8×10^{-4} to 7.5×10^{-4} across the study area.

The water quality analysis of the Pecos Valley and Edwards-Trinity (Plateua) regional aquifers examined the salinity, relative age, recharge condition, and general groundwater flow direction in the study area. In terms of salinity, the Pecos River defines the groundwater quality divide in the Pecos Valley Aquifer, with fresh groundwater occuring north of the Pecos River, and slight to very saline groundwater occuring south of the Pecos River. In the Edwards-Trinity (Plateau) Aquifer, most groundwater is fresh. Only the western portion of the aquifer contains saline groundwater due to the interaction of underlying saline aquifers. In the Hill Country portion of the Trinity Aquifer, groundwater is fresh to moderately saline, and the salinity varies by depth rather than spatial location. In the Edwards (Balcones Fault Zone) Aquifer, groundwater is fresh, with very saline groundwater occurring in the down-dip portion of the units beyond the official boundary of the aquifer. From the groundwater isotopic composition analysis, we were able to identify the general locations where recharge occurs and the relative ages of groundwater. In general, the Edwards (Balcones Fault Zone) Aquifer and the Hill Country portion of Trinity Aquifer, both located in the eastern portion of the study area, undergo frequent recharge events and have relatively younger aged groundwater than the groundwater in the west, such as the Pecos Valley Aquifer.

Two studies are underway to develop the recharge and discharge analyses for the current conceptual model. These studies are estimating the recharge with consideration of surface water-groundwater interaction and developing a method for estimating pumping discharge from the Pecos Valley and Edwards-Trinity (Plateau) regional aquifers. The conceptualization of recharge to and discharge from aquifers in the study area for this model will be based on the findings from those two studies.

Figure ES-2 shows a block diagram of the proposed numerical groundwater model design based on the conceptual model presented in this report. This diagram is meant to represent the simplified layers and boundary conditions to be implemented in the numerical groundwater model. Please review this report in its entirety for further details into the data analysis and decision-making used to develop this simplified model.

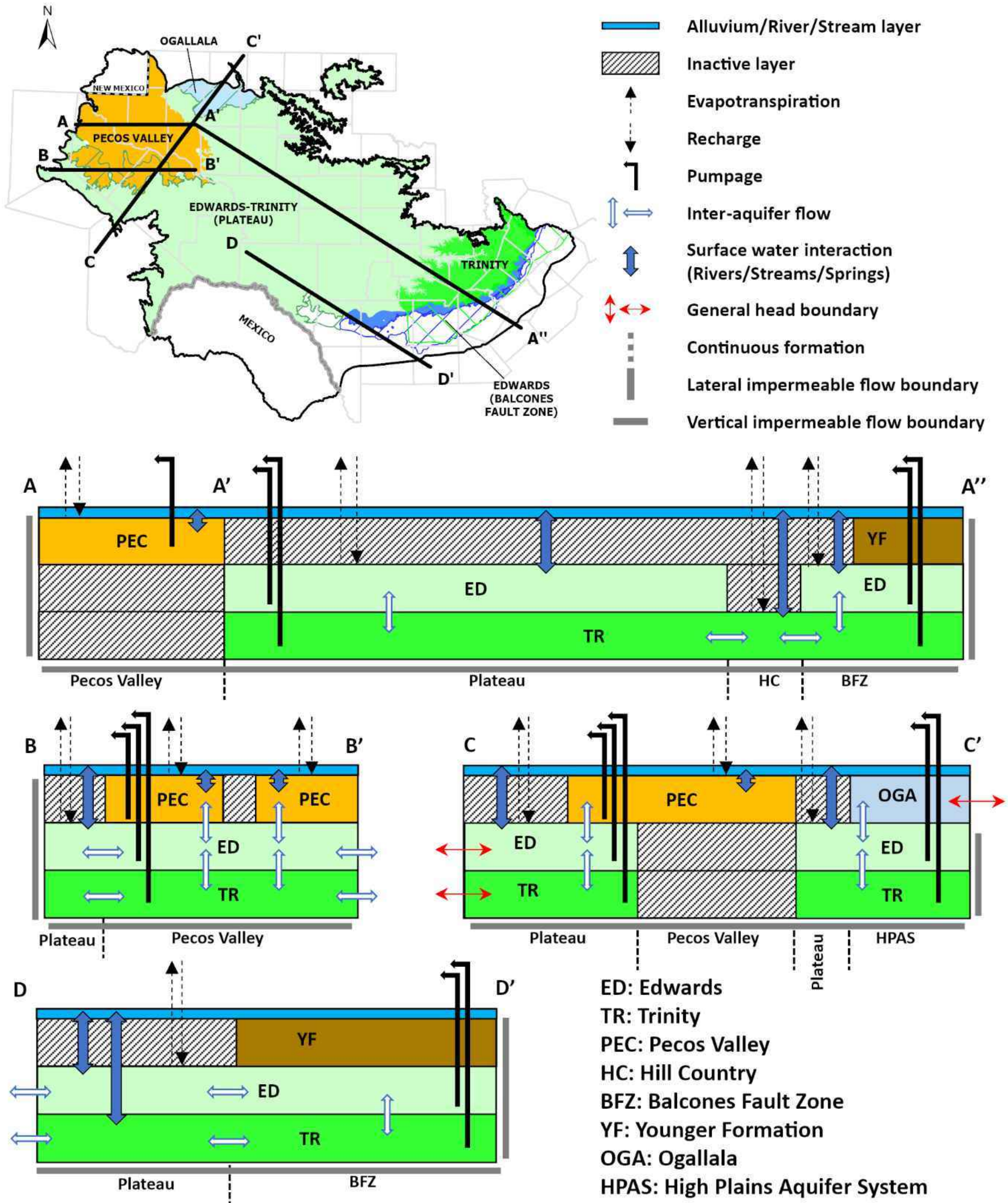


Figure ES-2. Block diagram of the conceptual model of study area.

INTRODUCTION

A groundwater conceptual model is a simplified representation of a complex real-world aquifer system. It provides the foundation for developing a numerical groundwater availability model that simulates and estimates the groundwater flow and volume within an aquifer. The current study develops the conceptual model for the Pecos Valley and Edwards-Trinity (Plateau) regional aquifers and will later be used to develop the numerical groundwater availability model of the study area.

The study area includes five major aquifers in West and Central Texas: the Pecos Valley Aquifer, the Ogallala Aquifer, the Edwards-Trinity (Plateau) Aquifer, the San Antonio and the Barton Springs segments of the Edwards (Balcones Fault Zone) Aquifer, and the Southern portion of the Trinity Aquifer. This report primarily focuses on the Pecos Valley Aquifer and Edwards-Trinity (Plateau) Aquifer. Even though they are not the focus of this modeling effort, this report also includes some analysis on the other aquifers, including the Trinity Aquifer and the Edwards (Balcones Fault Zone) Aquifer, that fall within the study area boundaries. These aquifers will be included in the eventual numerical model to help better define boundary conditions for the Pecos Valley Aquifer and Edwards-Trinity (Plateau) Aquifer. Previous models in the study area had smaller extents or did not fully model the interconnection between aquifers, so the inclusion of these additional aquifers represents a major update to the modeling of groundwater flow in the region.

The aquifers in the study area are the primary source of freshwater for irrigation, livestock, manufacturing, mining, municipal, and domestic use in the region. These aquifers also supply springflow and baseflow to numerous intermittent and perennial streams. Baseflow is streamflow without contributions from rainfall events. This semiarid/arid region already experiences extreme variations in precipitation, which will likely be exacerbated by future climate variability. As droughts decrease recharge to and increase pumping demands from these aquifers, groundwater levels, flows in springs and streams in a region containing several rapidly expanding population centers will likely become issues of public concern.

To better understand groundwater flow and provide a tool for regional water planning in this region, the Texas Water Development Board (TWDB) is revising and updating the groundwater availability model for these aquifers as part of the Groundwater Modeling Program. Historically, the TWDB published models for the Pecos Valley and the Edwards-Trinity (Plateau) Aquifers (Anaya and Jones, 2009; Hutchison and others, 2011), for the Hill Country portion of the Trinity Aquifer (Jones and others, 2011), and for the San Antonio and the Barton Springs segments of the Edwards (Balcones Fault Zone) Aquifer (Scanlon and other, 2001; Lindgren and others, 2004; Hutchison and Hill, 2011). The goal of the Groundwater Modeling Program is to provide a tool to estimate groundwater availability for the citizens of Texas by producing standardized and publicly available groundwater flow models with data and documentation (TWDB, 2013). A groundwater availability model is a quantitative tool to estimate the amount of water available in an aquifer by implementing simplified real-world geologic and hydrogeologic conditions into a computer program. Also, it is possible to evaluate the effect of pumping, drought, and different water management scenarios on the groundwater flow system in the study area on a regional scale. To construct the groundwater availability model, a conceptual model must first be developed that describes the aquifer flow system and organizes the hydrogeologic data that controls groundwater flow. The conceptual model includes: 1) introduction of the study area, 2) review of previous studies, and 3) hydrogeologic setting in the study area.

This conceptual model report is organized into several sections that describe the various components of conceptual models. First, Section 2 addresses the physical features that can impact aquifer conditions, such as topography, surface geology, stream locations, soil development, land cover and landuse, vegetation, climate, and the geologic history of the study area. Then, Section 3 describes the previous studies conducted for the current study area. Section 4 presents the hydrologic setting, or the characteristics that impact groundwater behavior and flow, based on data collected and analyzed for this report. The hydrologic setting section covers the hydrostratigraphy and structural framework of the aquifer, groundwater levels, groundwater flow directions, recharge to and discharge from the aquifer, surface water, evapotranspiration, hydraulic properties, and water quality. Section 5 introduces the conceptual model developed based on information presented in previous sections (Section 2 through 4). Finally, Section 6 includes brief introductions of ongoing studies related with the current study area and suggestions to improve the model, if possible, in the next update.

2 STUDY AREA

The study area covers over 49,000 square miles of West and Central Texas from 97°W to 105°W in longitude and between 28°N to 33°N in latitude (Figure 2.0-1). This region includes five major Texas aquifers, from southeast to northwest: the San Antonio and Barton Springs segments of the Edwards (Balcones Fault Zone) Aquifer, the Southern portion of the Trinity Aquifer, the Edwards-Trinity (Plateau) Aquifer, the Ogallala Aquifer, and the Pecos Valley Aquifer (Figure 2.0-2). The Edwards-Trinity (Plateau) Aquifer occupies much of the study area, encompassing about 35,000 square miles. The southern portion of the Trinity Aquifer and the Pecos Valley Aquifer each cover nearly 7,000 square miles, the Edwards (Balcones Fault Zone) Aquifer covers an area of 3,500 square miles and the Ogallala Aquifer covers an area of 1,100 square miles. For the current study, the Pecos Valley Aquifer and Edwards-Trinity (Plateau) Aquifer are the primary interest of the groundwater availability model and the rest of the aquifers will define the boundary conditions of the model.

The northern boundary of the study area coincides with the northern extent of the Pecos Valley Aquifer, the Edwards-Trinity (Plateau) Aquifer, and the Hill Country portion of the Trinity Aquifer. Along the northeastern boundary in Burnet County, we extended the study area beyond the previous TWDB model (Anaya and Jones, 2009) to include the surface water divide between the Brazos and the Colorado River basins. Along the southeastern boundary, we extended the study area to incorporate the San Antonio and the Barton Springs segments of Edwards (Balcones Fault Zone) Aquifer and the confined part of the Trinity Aquifer. This is a major update from the previous TWDB model (Anaya and Jones, 2009) meant to help account for flow between the Edwards-Trinity (Plateau) Aquifer and the Edwards (Balcones Fault Zone) Aquifer and to incorporate and extend westward to the Rio Grande the confined parts of the Trinity Aquifer in the study area. In this region, the study area boundary coincides with the boundary of a U.S. Geological Survey model that simulates the water quality of the San Antonio and Barton Springs segments of the Edwards (Balcones Fault Zone) Aquifer (Brakefield and others, 2015). The southeastern boundary continues southwest to the the surface water divide in the Sierra Madre Oriental in Mexico, southwest of the Rio Grande. This portion of Mexico was included in the study area to better account for potential groundwater flow towards the Rio Grande, as described in Boghici (2002). The western boundary of the study area coincides with the western boundaries of the Edwards-Trinity (Plateau) and Pecos Valley aquifers. In New Mexico, the western boundary coincides with the watershed boundary, as defined by National Hydrography Dataset 12-digit hydrologic unit (HUC) codes.

Figure 2.0-1. Location of study area.

Figure 2.0-2 shows cities in the study area with a population higher than 10,000 based on the 2010 Census. As shown, most of the study area is rural and over 70 percent of the region's cities have a population of less than 50,000 (white dots in the figure). However, rapid urbanization is occurring along the Interstate-35 corridor between San Antonio and Austin, with each of those metropolitan areas supporting a population of over 750,000 people and still growing. Population growth is highest in the southeastern portion of the study area, where these rapidly growing urban centers overlap the Hill Country portion of the Trinity Aquifer and the Edwards (Balcones Fault Zone) Aquifer.

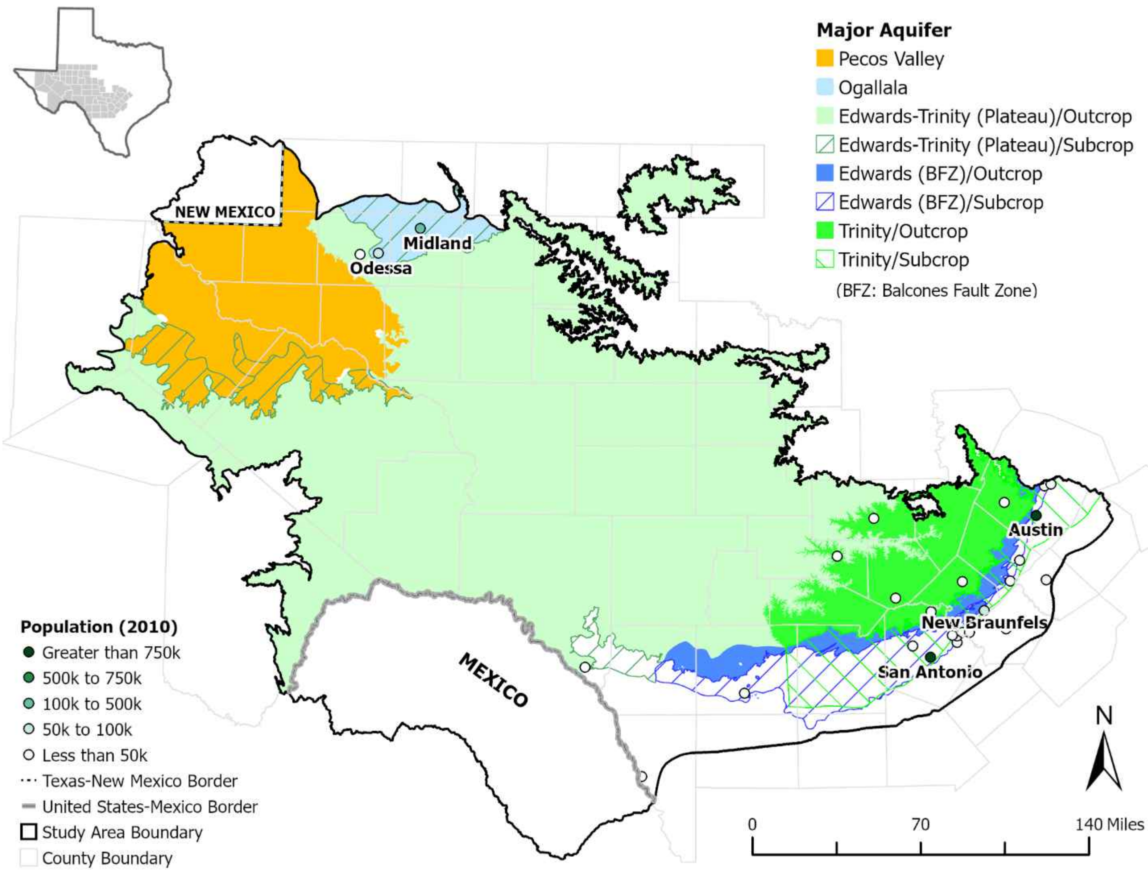


Figure 2.0-2. Major aquifers in Texas and major cities with population over 10,000 within the study area.

There are several administrative divisions in Texas for water resources planning and management. Figure 2.0-3 shows the regional water planning groups in the study area. Regional water planning groups develop a regional water plan for each planning area by identifying water needs and recommending water management strategies to meet future water needs. These regional plans are the basis for the Texas State Water Plan. The study area intersects seven regional water planning groups: Far West Texas (Region E), Region F, Region G, Plateau (Region J), Lower Colorado (Region K), South Central Texas (Region L), and Rio Grande (Region M). Of these, Regions F, J, and L cover the majority of the study area. Groundwater management areas were created based on Texas Water Code 35.001 to conserve, preserve, protect, recharge, and prevent the waste of groundwater resources. The study area includes nine groundwater management areas (2, 3, 4, 7, 8, 9, 10, 12, and 13) (Figure 2.0-4), and four of them (3, 7, 9, and 10) cover the majority of the study area. The most localized government unit for groundwater management is the groundwater conservation district, and there are 43 groundwater conservation districts within the study area (Figure 2.0-5).

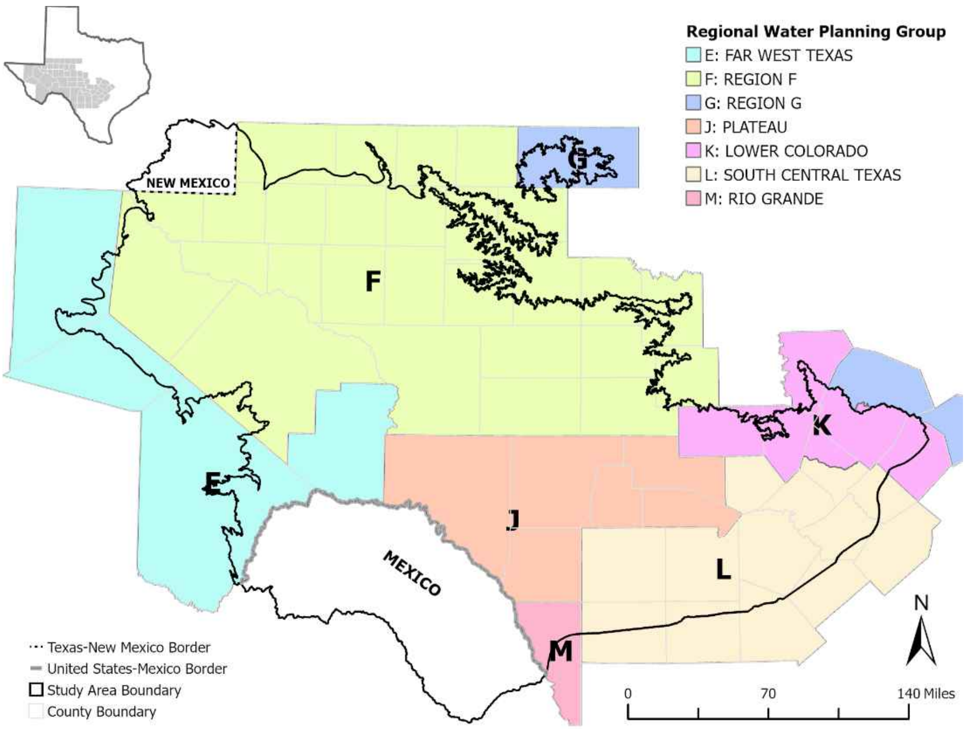


Figure 2.0-3. Regional water planning groups (RWPG) in the study area.

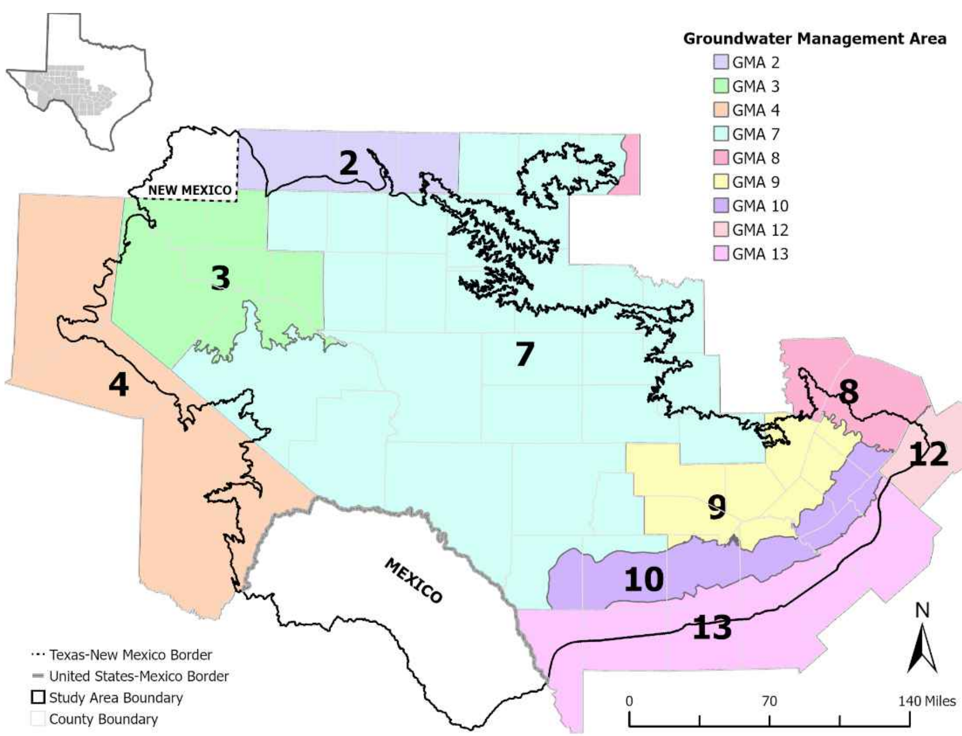


Figure 2.0-4. Groundwater management areas (GMAs) in the study area.

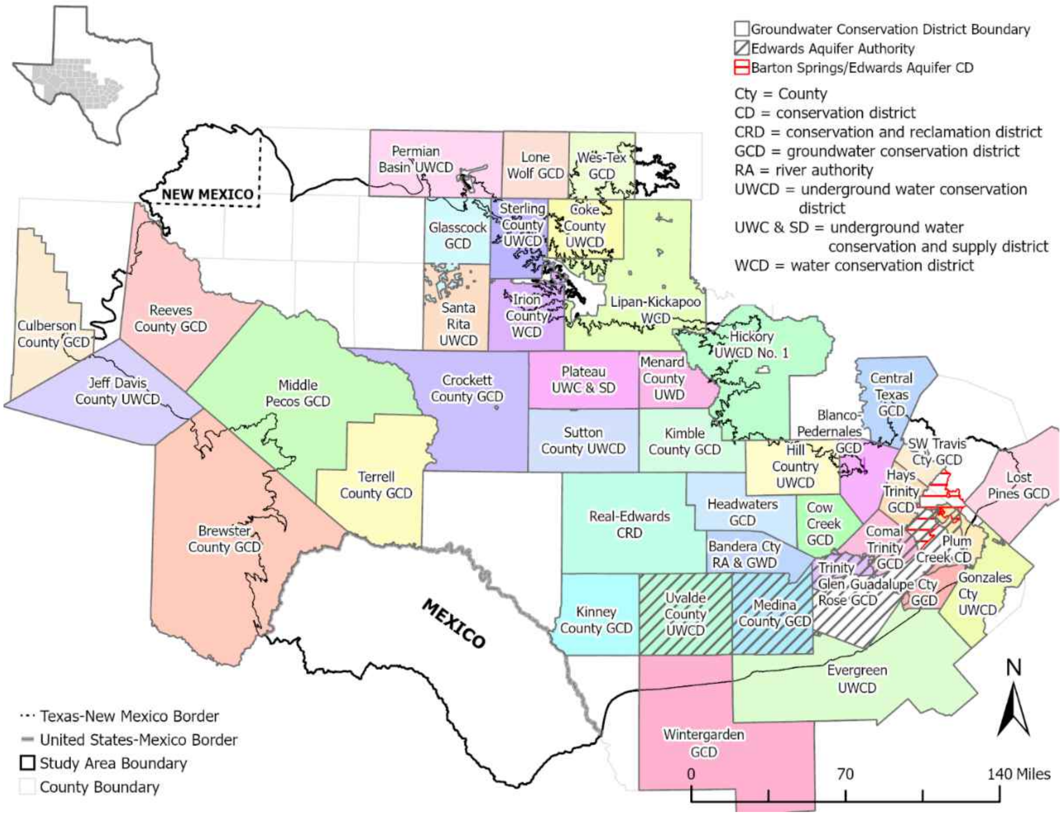


Figure 2.0-5. Groundwater conservation districts (GCDs) in the study area (As of July 2019).

2.1 Physiography

The term physiography is a contraction of the words "physical geography" and refers to the natural features of a landscape or geomorphology, as shaped by the local climate and underlying geology. Surface drainage (streams), soil development, vegetation, and land use can also influence the physical characteristics of a region. A physiographic province defines a geographic region with similar physiography. Figure 2.1-1 shows the landform and physiographic provinces and sub-provinces in the study area. The study area intersects the Edwards Plateau, High Plains, Gulf Coastal Plains, and Basin and Range physiographic provinces (Figure 2.1-2), as defined by Wermund (1996).

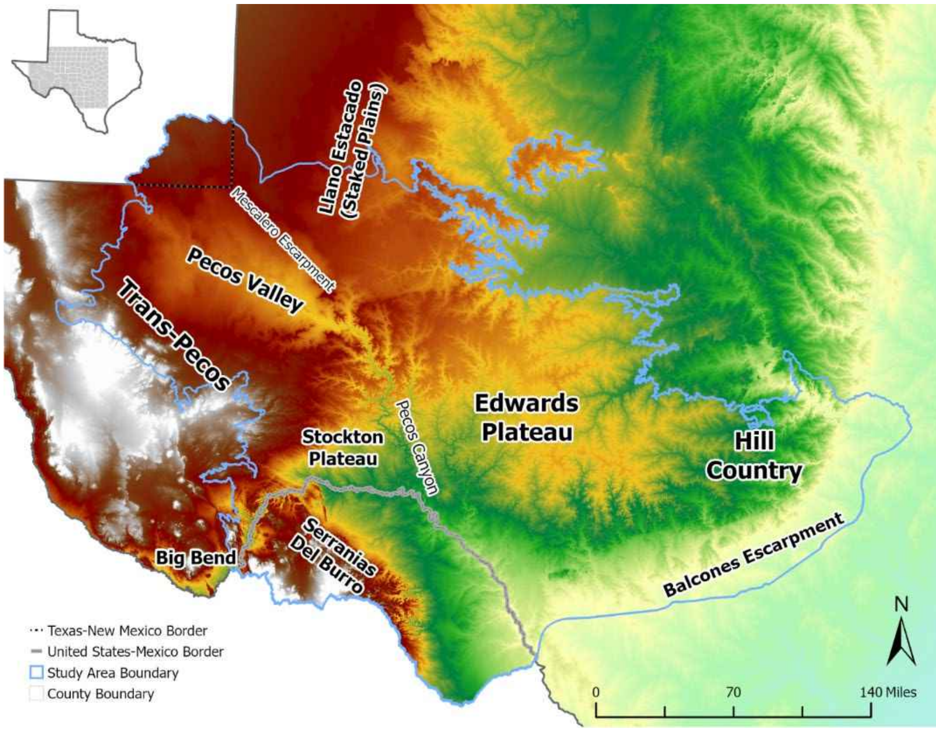


Figure 2.1-1. Landforms of study area with adjacent landscape (U.S. Geological Survey, 2014).

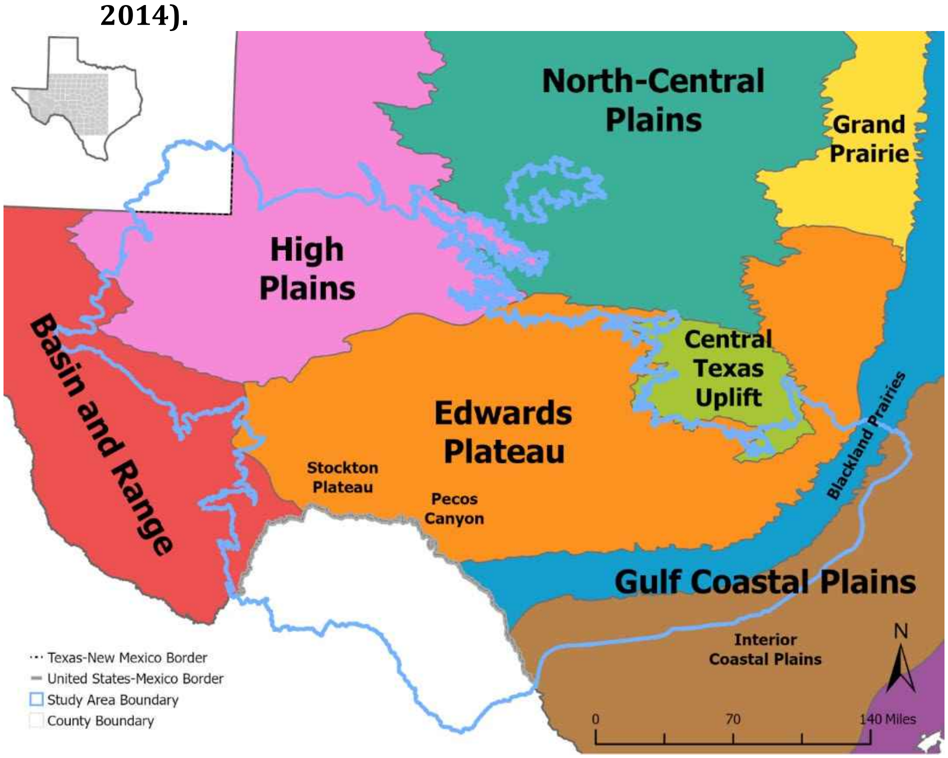


Figure 2.1-2. Physiographic provinces and sub-provinces of study area with (Wermund, 1996).

The Edwards Plateau province includes the extents of the Edwards-Trinity (Plateau) Aquifer and Hill Country portion of the Trinity Aquifer. This is the dominant physiographic province in the region, covering about two-thirds of the study area. In the southwest, the Edwards Plateau province includes the Stockton Plateau, a dry, high-elevation area, the Pecos Canyon, which has steep-walled canyons, and the Pecos River and its tributaries. A thick layer of Cretaceous limestone caps much of the Edwards Plateau province and forms a suitable environment for karst features. The Edwards Plateau province has experienced erosion since ancient Cretaceous seas retreated to the current Gulf of Mexico. The Balcones Fault Zone exists in the region of the Balcones Escarpment that separates the Gulf Coastal Plains and Edwards Plateau provinces along the southeastern margin of the Edwards Plateau province.

The Southern High Plains, a sub-province of the High Plains physiographic province, includes the Pecos Valley and Llano Estacado regions. The Llano Estacado section of the Southern High Plains is a flat area with many playa lakes and ends against the Mescalero Escarpment. On the south side of the Mescalero Escarpment, the Pecos Valley section of the Southern High Plains consists of a thick accumulation of alluvium capping the underlying Cretaceous and Paleozoic rocks. The Pecos River flows from northwest to southeast along the Pecos Valley. To the northeast, the Pecos Valley section slopes gently towards the Mescalero Escarpment. To the southwest, the Pecos Valley section slopes steeply towards the mountains of the Trans-Pecos section of the Basin and Range physiographic province.

The Basin and Range physiographic province occurs along the western boundary of the study area. It stretches from the south High Plains toward the United States and Mexico border. This area contains the highest elevations in Texas and has eight mountain peaks higher than 8,000 feet elevation. These mountain ranges are north-south oriented with complex folding and faulting. The province contains a large number of volcanic rocks due to a history of volcanic activity. Volcanic rocks of the Davis Mountains overlie a small portion of the Edwards-Trinity (Plateau) Aquifer in the study area.

The Gulf Coastal Plains province includes the southern extent of the Edwards (Balcones Fault Zone) Aquifer. The Balcones Fault Zone area contains a system of northeast to southwest oriented faults along the southeast side of the study area. As a result of faulting along the Balcones Fault Zone, the Balcones Escarpment formed, resulting in an elevated Hill Country juxtaposed against the low-lying Gulf Coastal Plains. An abrupt increase of elevation at the Balcones Escarpment affects regional weather (Caran and Baker, 1986) and stream drainage patterns. Caves and sinkholes are common in the exposed Cretaceous limestone on the elevated Balcones Escarpment (Maclay, 1995).

Figure 2.1-3 shows the geologic ages of surface rocks of the study area. Most of the study area exhibits post-Cretaceous rock units on the surface. In the western part of the study area, Quaternary, the younger unit, covers the top surface and creates the Pecos Valley Aquifer and the Edwards-Trinity (Plateau) Aquifer caps. The Cretaceous rock is on the surface of the central part of the study area. It extends from the down streams of the Pecos

Valley to the Edwards (Balcones Fault Zone) region, and its coverage is like the Edwards Plateau province in Figure 2.1-2. On the eastern boundary of the study area, Quaternary and Tertiary aged materials are present on the top surface and cap the Edwards (Balcones Fault Zone) Aquifer.

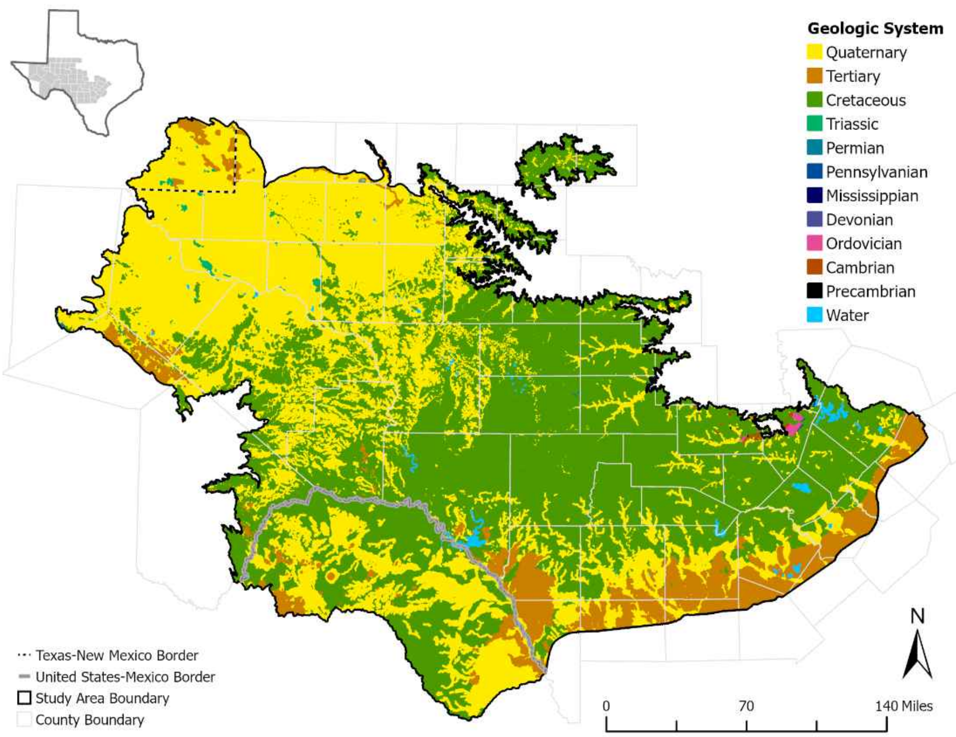


Figure 2.1-3. Geologic ages of the surface rocks in the study area (Bureau of Economic Geology, 2014).

2.1.1 Topography and Land surface elevation

Topography (or land surface elevation) can affect several aspects of groundwater behavior. The steepness of the land surface can determine the degree to which precipitation runs off into surface drainages versus percolating to recharge groundwater. Groundwater elevation in unconfined aquifers is typically assumed to be a subdued replica of land surface elevation, so topography can also help approximate groundwater levels. Figure 2.1-4 shows land surface elevation inside of the study area. The landform of the Edwards Plateau can be described as a tableland, and the elevation gradually declines from the northwest to the southeast until the Balcones Fault Zone. Then, elevation suddenly drops a hundred to several hundred feet at the Balcones Escarpment (Lindgren and others, 2004). Another steep elevation change occurs on the margin of the Basin and Range physiographic province in the west and along the Eastern Sierra Madre Mountains in Mexico. Here, the elevation drops over 4,000 feet from the mountains to the plateau over only 20 miles.

In the context of regional groundwater modeling, steep elevation changes can introduce an error for calculating water budgets in the numerical groundwater model unless the model grid optimization refines the grid. However, the model grid optimization increases the computational cost tremendously. During model construction, we will consider either excluding these areas from the model or smoothing the land surface elevation by refining the model grid in these areas. This can be a reasonable approach if no significant groundwater flow is expected in these areas or if including these areas significantly worsens groundwater flow results elsewhere.

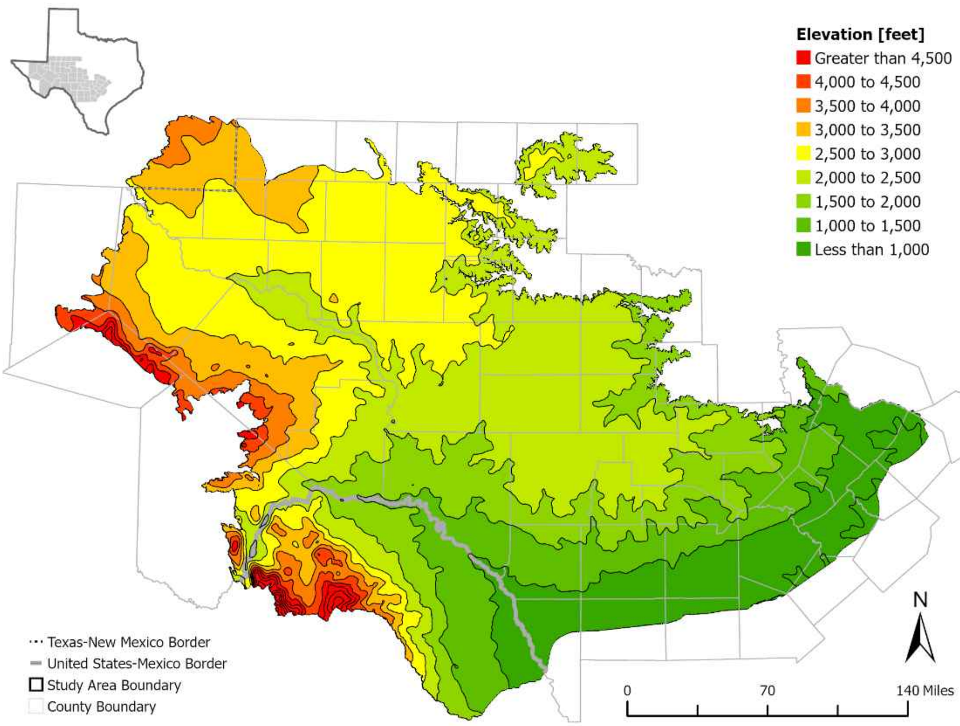


Figure 2.1-4. Land surface elevation (U.S. Geological Survey, 2014).

2.1.2 Surface drainage

The distribution of surface drainage can affect several aspects of groundwater behavior. Erosion from streams can remove sediments of permeable aquifer material, altering the direction of groundwater flow. Where streams intersect the groundwater table, they supply locations for discharge from the aquifer. Where a stream is above the groundwater table but connected through permeable sediments, it can provide locations of recharge to the aquifer. Figure 2.1-5 shows the surface drainage within the study area. The Edwards Plateau area has high stream density with well-developed stream channels, but very few perennial streams flow year-round. Most streams are intermittent or ephemeral and only flow during or shortly after precipitation events. Perennial streams are more common on the northern, eastern, and southern margins of the Edwards Plateau along the spring-fed headwater tributaries (Anaya and Jones, 2009). Higher average annual precipitation (Walker, 1979) and the discharge of the Edwards-Trinity (Plateau) Aquifer from springs at the southern and southeastern margin of Edwards Plateau likely contribute to this higher perennial stream coverage. As streams cross the Balcones Fault Zone they can often percolate down along the many faults in this area, disrupting flow along small tributaries. Besides the Pecos River, streams in the Pecos Valley are typically intermittent or ephemeral due to geologic characteristics and dry climate conditions. Streams are especially poorly developed north of the Pecos River, where the alluvium is overlain by windblown sand deposited in dunes. Precipitation quickly infiltrates into the dune sand without runoff, preventing the formation of streams (Garza and Wesselman, 1959; Ogilbee and others, 1962; Jones 2001, 2004).

2.1.3 Soil Development

Soil development, especially soil thickness and soil type, can also affect groundwater conditions. Thin soils or soils with low permeability can reduce how much precipitation percolates down to recharge groundwater. Soil types also control the amount and type of vegetation that can grow in a region, which in turn affects how much water is lost to evapotranspiration rather than recharging groundwater. Soil development in the Edwards Plateau and Hill Country is generally poor, with shallow soils and limited vegetation types, but is slightly better in the Pecos Valley and Balcones Fault Zone (Figure 2.1-6). Most of the Edwards Plateau and Hill Country areas have less than 1 foot of soil thickness, while the Pecos Valley and Edwards Balcones Fault Zone areas have 2 to 5 feet of soil cover.

Soil available water storage refers to the quantity of water that the soil can store. This parameter is important as it helps farmers choose which crops to plant and how to design irrigation systems. Soil available water storage in the study area ranges from 0.25 to 12 inches in the top 150 centimeters (about 5 feet) of soil (Figure 2.1-7).

The soils in the Edwards Plateau and Hill Country are typically Mollisols (Figure 2.1-8) that drain quickly and develop under subhumid to semiarid climates (U.S. Department of Agriculture, 1999). Aridisols occur from the northwestern Edwards Plateau across the Pecos Valley. Aridisols develop under arid conditions and contain sandy and loamy soils with limited soil moisture availability to sustain plant growth (U.S. Department of Agriculture, 1999). Vertisols and Alfisols cover most of the Edwards (Balcones Fault Zone) Aquifer. Those soils are generally silty to clayey loams with a brownish color and have a fair soil moisture regime (Baker and others, 1986; U.S. Department of Agriculture,1999).

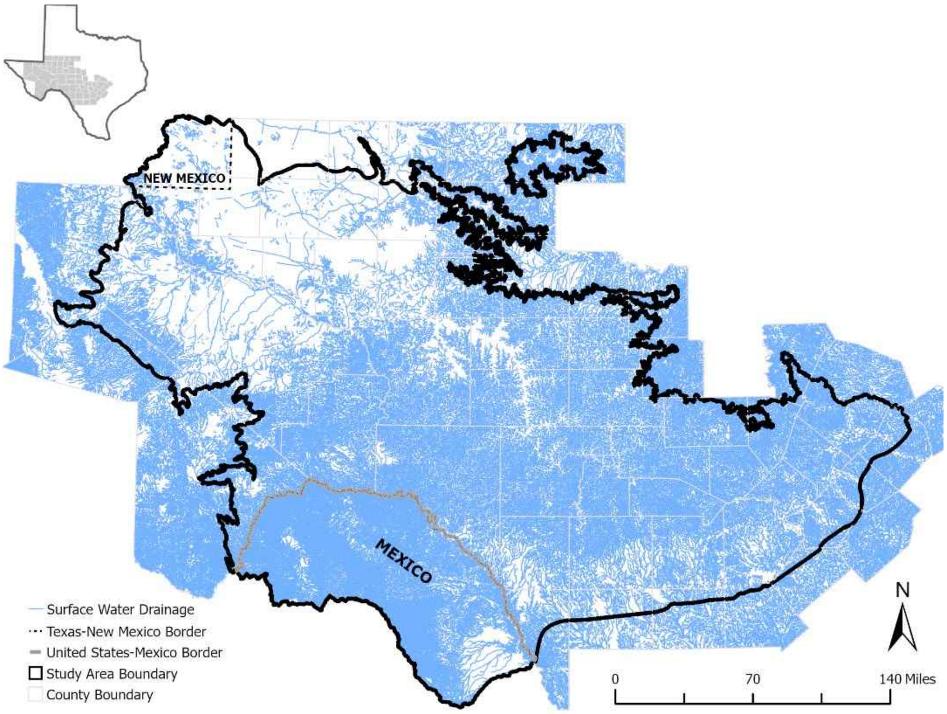


Figure 2.1-5. Surface water drainage in the study area (U.S. Geological Survey, 2021a).

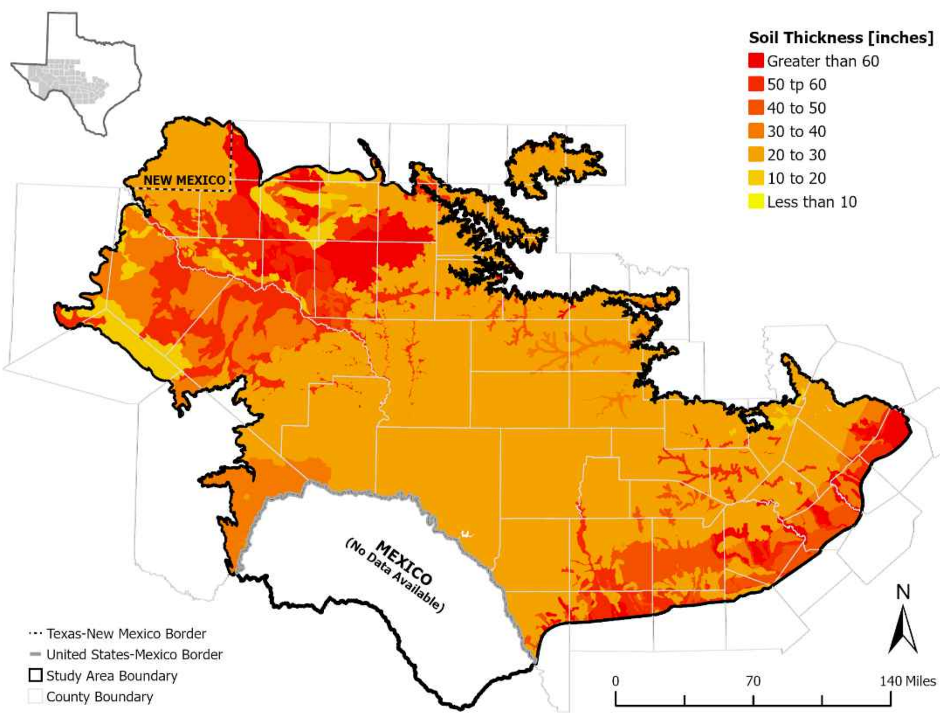


Figure 2.1-6. Soil thickness as an indication of soil development (Natural Resources Convervation Service, 2016).

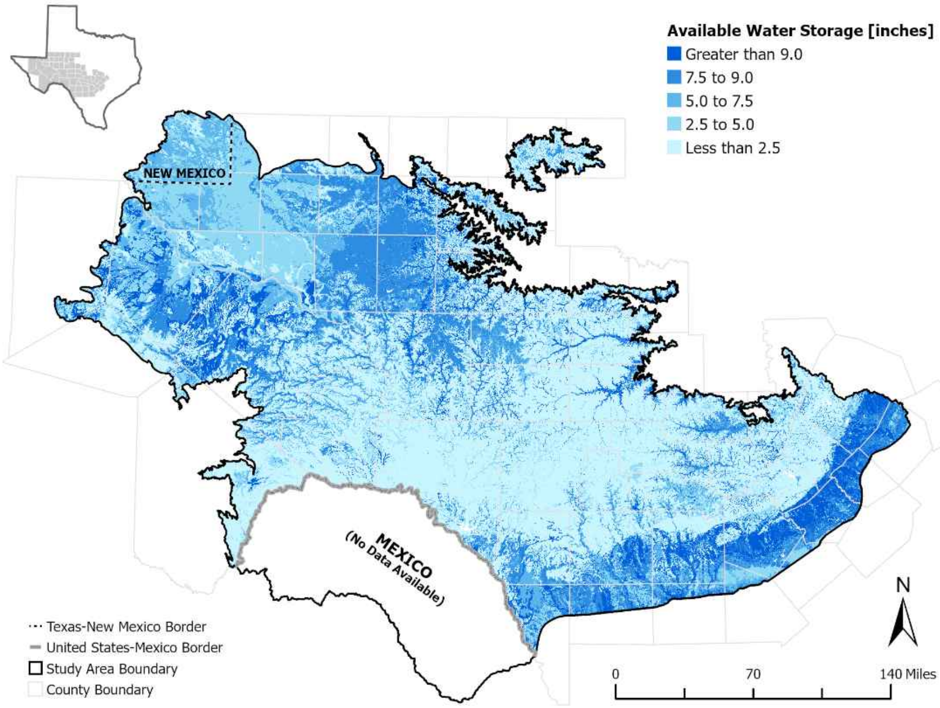


Figure 2.1-7. Soil available water storage in study area (Natural Resources Convervation Service, 2016).

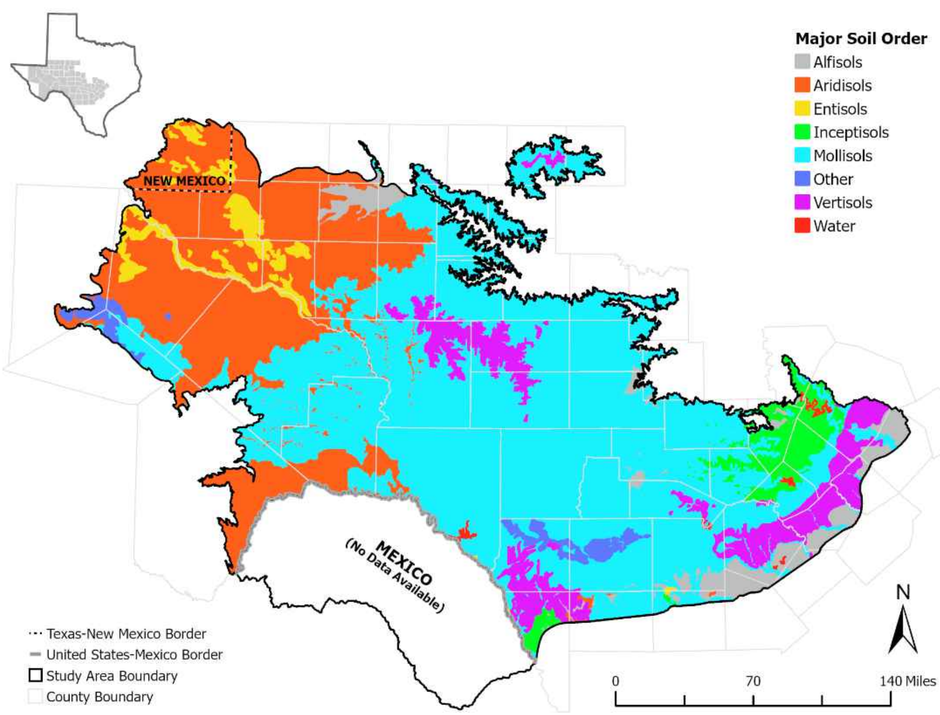


Figure 2.1-8. Soil order types (Natural Resources Convervation Service, 2016).

2.1.4 Vegetation and Land Use

Like soil development, vegetation and land use have a significant impact on recharge to the aquifer. The amount and type of vegetation affects how much water is lost to evapotranspiration rather than recharging groundwater. Figure 2.1-9 shows the vegetation types regrouped into the general categories from the ecological maps of Texas Parks and Wildlife (Elliott and others, 2014). The western and central Edwards Plateau and the Pecos region can be classified as mosaics of semi-open grassland, grassland-shrubland, or shrubland (Riskind and Diamond, 1988). Mid- and short-grass species dominate here along with woody vegetation such as juniper, white shin oak, plateau live oak, and mesquite (Riskind and Diamond, 1988; Anaya and Jones, 2009; Elliott and others, 2014). The eastern Edwards Plateau, the Hill Country area, is dominated primarily by forest and woodland vegetation. Species such as Texas Oak, Plateau Live Oak, Ashe Juniper, and Texas Ash occur with higher density than they do in the central Edwards Plateau (Riskind and Diamond, 1988; Elliott and others, 2014). In recent years, it was observed that urban development in the Balcones Fault Zone has been replacing natural vegetation types primarily consisting of grassland and shrubland.

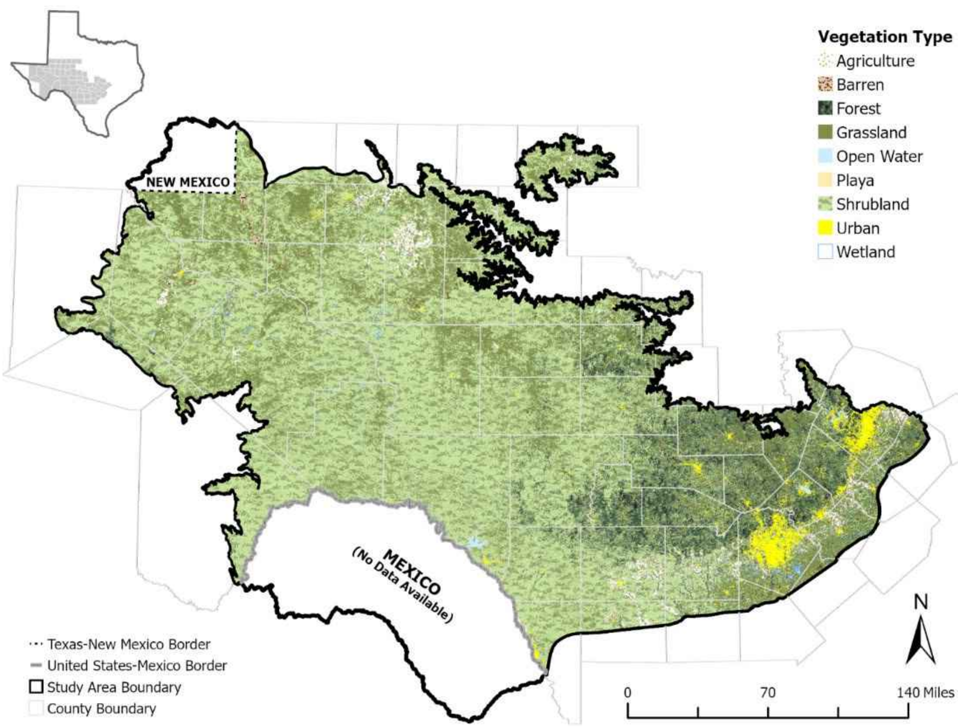


Figure 2.1-9. Vegetation types (modified from Elliott and others, 2014).

Land use can impact how much water runs off to surface drainages versus percolating down to recharge groundwater. Land use changing from natural vegetation to more paved and impermeable urban areas can both decrease groundwater recharge and increase surface runoff, leading to soil erosion and flooding. Figure 2.1-10 shows where land use in the region changed to urban use from other use types between 2001 and 2019. The change was mapped using land-cover datasets from the National Land Cover Database (https://www.mrlc.gov/data). Many spots on the northwestern Edwards Plateau and the Balcones Fault Zone areas show conversion to urban land use. The most prominent urbanization has happened in the San Antonio and Austin areas over the Edwards (Balcones Fault Zone) Aquifer.

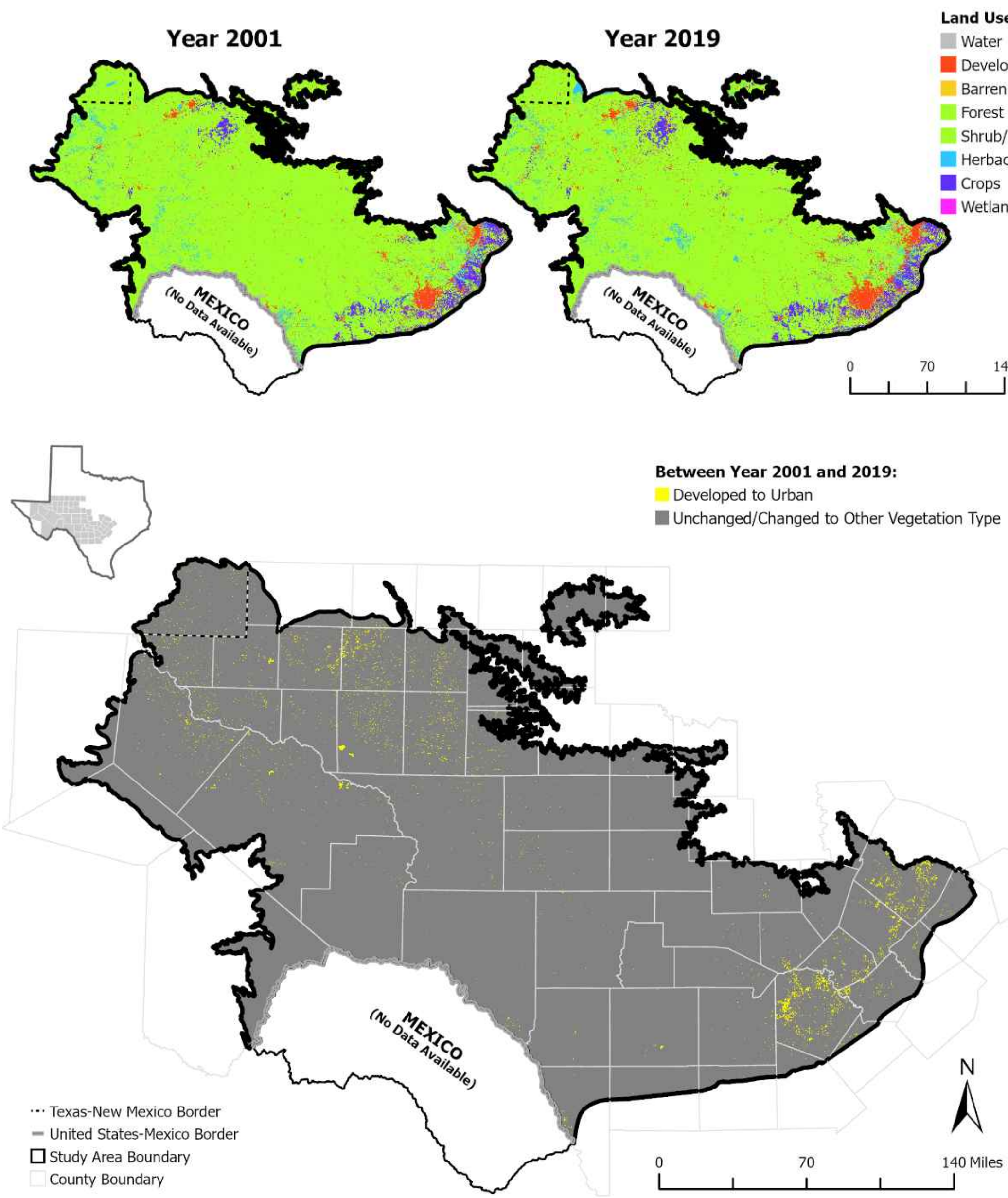


Figure 2.1-10. Land use in year 2001 (top left) and year 2019 (top right) and Land use change from 2001 to 2019 (bottom) (National Land Cover Database, 2021).

2.2 Climate

Climate is an essential consideration in water resources management because it determines the amount and distribution of precipitation, evaporation, and drought conditions, all of which can affect surface water flow and groundwater availability. Climate refers to spatial and temporal statistical interpretations of precipitation, temperature, evaporation, and drought observations. Most of the study area can be classified as a subtropical climate, characterized by hot summers and mild winters (Figure 2.2-1). The eastern study area, closest to the Gulf of Mexico, has the highest humidity and is classified as subhumid. Humidity drops with distance from the Gulf of Mexico, so that the central and western section of the study area is steppe (semi-arid to arid), and the Pecos Valley and Trans-Pecos regions are arid (Bomar, 1983; Larkin and Bomar, 1983). A small portion of the study area in the Llano Estacado region, is described as a continental-steppe climate in Larkin and Bomar (1983), rather than subtropical climate. The continental-steppe climate type is characterized by extreme temperature ranges, low humidity, and minimal rainfall.

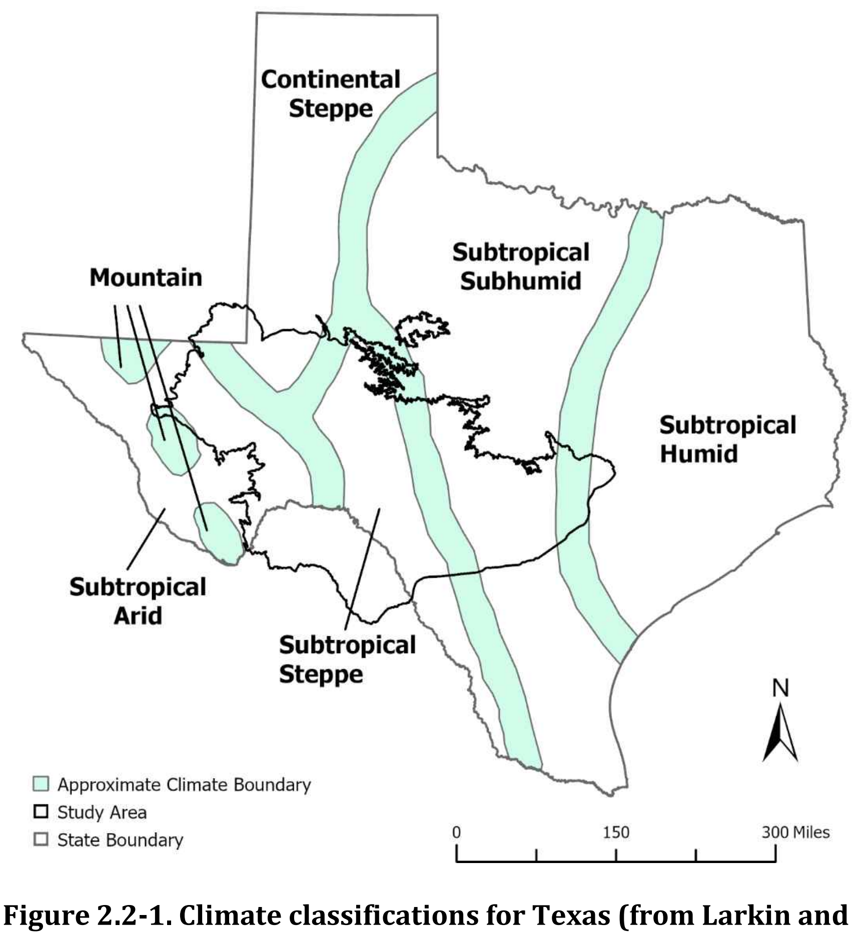


Figure 2.2-1. Climate classifications for Texas (from Larkin and Bomar, 1983).

The study area intersects six climate divisions, as defined by the National Climatic Data Center (NCDC, 2021). Divisions 5 (Trans-Pecos), 6 (Edwards Plateau), and 7 (Post Oak Savanna) cover most of the study area, while Divisions 1 (High Plains), 2 (Low Rolling Plains), and 9 (Southern) cover only a small section of the study area (Figure 2.2-2). The following sections discuss the climate conditions for these divisions.

Figure 2.2-3 shows the monthly average precipitation and temperature measured at 14 weather stations across the study area. This figure includes at least one station from each climate division. Each station had a minimum of 50 years of measurements although the measurement years vary for each station. Precipitation (blue bars in figure) follows one of two distinct annual precipitation patterns depending on the location of the stations. Precipitation in the eastern two-thirds of the study area is higher, with an average of 1 to 5 inches per month, and peaks twice, once in early summer and once in fall. Precipitation at western stations is lower, about 0 to 2 inches per month of precipitation, and only peaks once in late summer or early fall during monsoon season. The precipitation pattern is related to the distance from the Gulf of Mexico, with rain decreasing from east to west. The annual temperature pattern is similar at all 14 stations, with highest temperatures in the summer and lowest temperatures in the winter. Generally, monthly average temperatures are hotter in the southern section of the study area and decrease moving north. The hottest monthly average temperature (83 degrees Fahrenheit) was calculated for August at the Eagle Pass 3N station in Maverick County (Climate Division 9), and the lowest monthly average temperature (43 degrees Fahrenheit) was calculated for January at the Roscoe station in Sterling County (Climate Division 6).

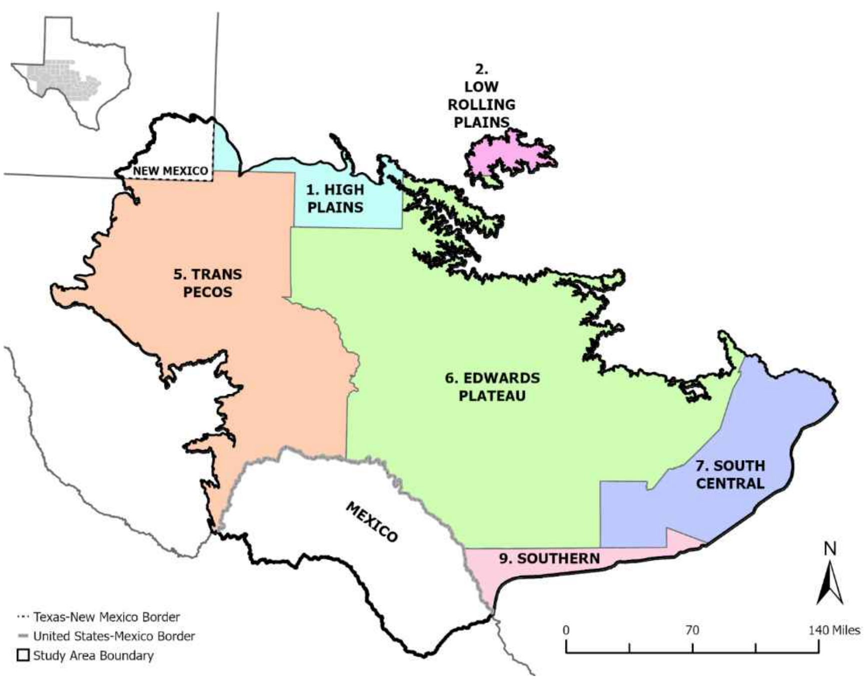


Figure 2.2-2. Climate division for Texas (National Climate Data Center, 2021).

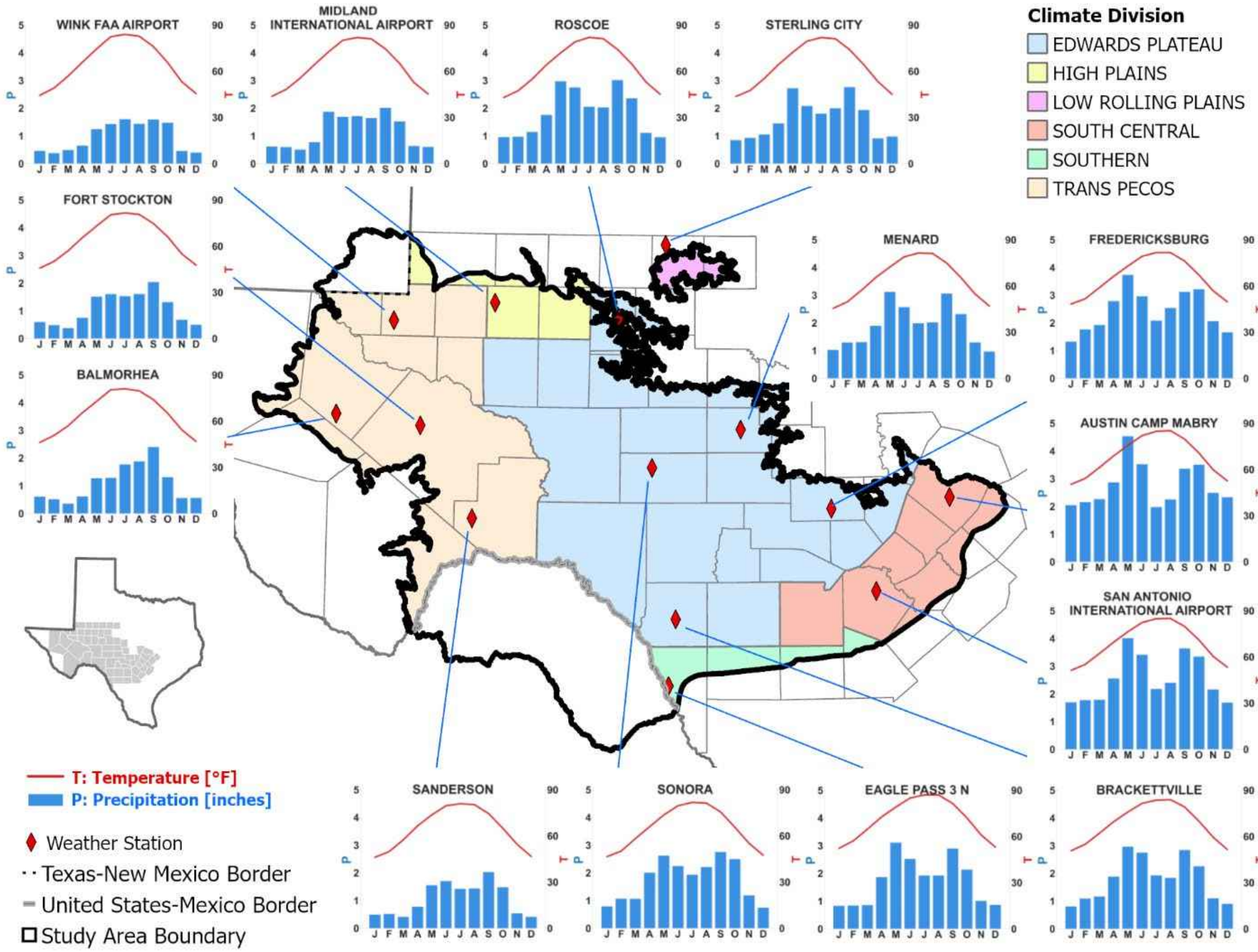


Figure 2.2-3. Monthly precipitation and temperature at weather station (National Climate Data Center, 2021).

2.2.1 Precipitation

Precipitation refers to the water falling to the ground as rain and snow. Figure 2.2-4 shows the contour map of average annual precipitation created using PRISM (PRISM, 2021) data from 1900 to 2019. As shown, precipitation decreases from 34 inches per year to 12 inches per year westward from the Gulf of Mexico. This pattern is consistent with the trends observed at individual stations, shown in Figure 2.2-3.. The difference in precipitation patterns between the eastern and western regions is likely due to differences in precipitation development. In general, precipitation in the eastern part of the study area occurs when humid air from the Gulf Coast meets cold air from the north, whereas precipitation in the western part is dominated by sporadic thunderstorms occurring during the summer period.

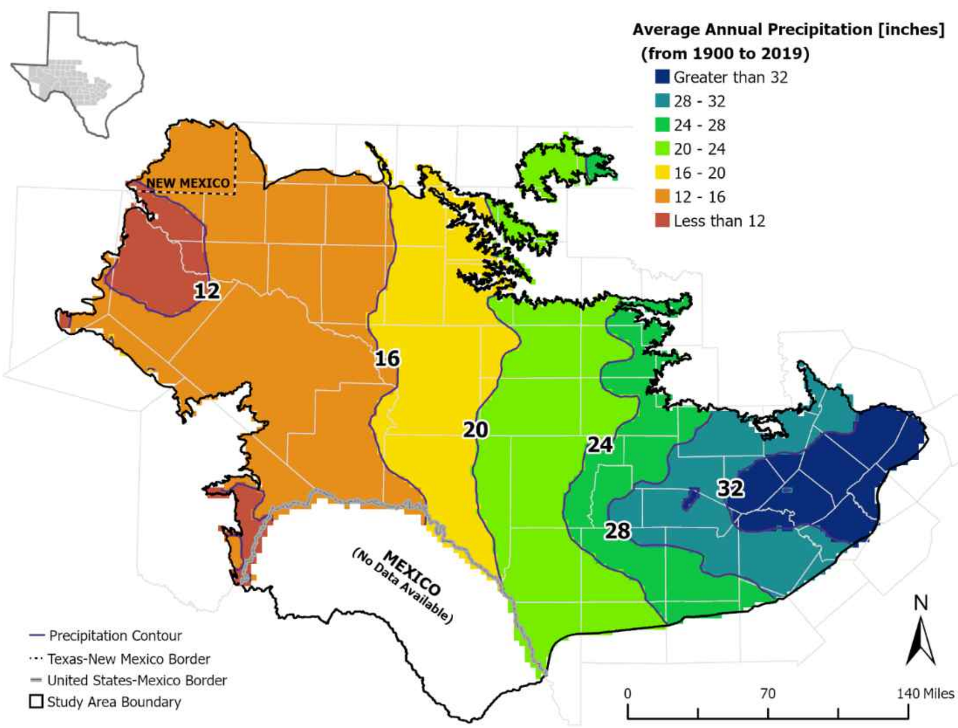


Figure 2.2-4. Average annual precipitation from 1900 to 2019 (PRISM, 2021).

2.2.2 Temperature

Figure 2.2-5 shows a contour map of the annual mean temperature in degrees Fahrenheit created using PRISM (PRISM, 2021) data from 1900 to 2019. Overall, temperatures in the southern portion of the study area are about 10 degrees Fahrenheit higher than in the northern area. The mean annual temperature in the northern portion of the study area is around 60 degrees Fahrenheit and gradually increases to 70 degrees Fahrenheit toward the south. Variations in the temperature map follow topographic trends. For instance, the downstream area of the Pecos River valley has a slightly higher average temperature than the surrounding area due to the lower elevations in the valley. The lowest mean annual temperature in the study area is in the mountains of the Trans-Pecos region in the west.

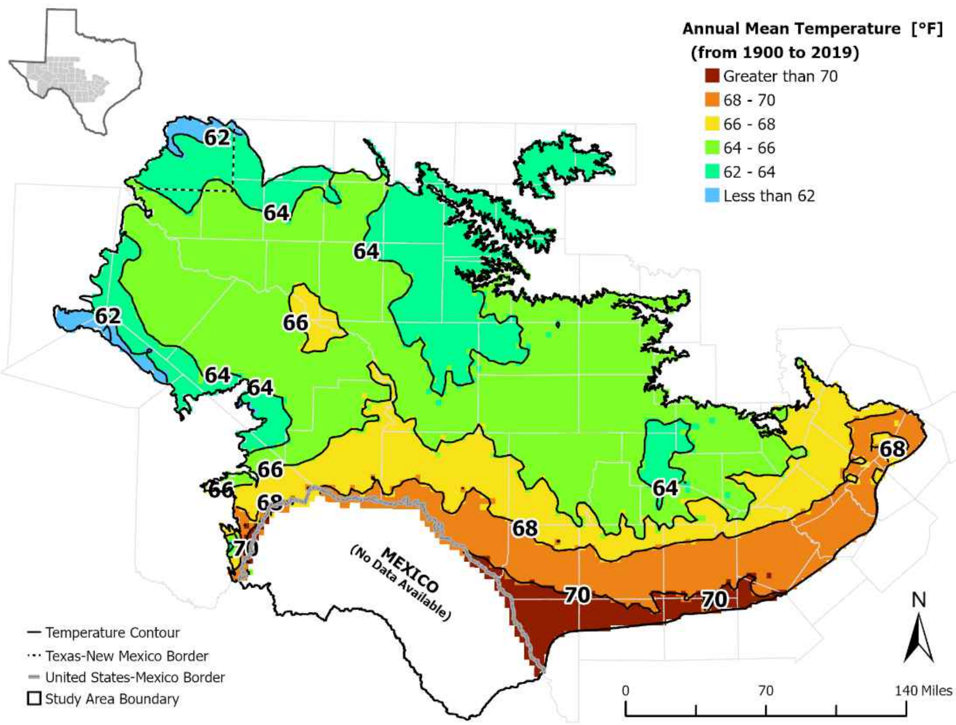


Figure 2.2-5. Annual mean temperatures for the study area from 1900 to 2019 (PRISM, 2021).

2.2.3 Evaporation

Evaporation is the amount of water that escapes from the Earth's surface due to the heat of solar energy. It is critical to know evaporation since it determines how much precipitation remains to either run off to surface water or percolate down to recharge groundwater. However, it is highly challenging to measure evaporation directly from the surface soil. The typical estimation method is based on lake evaporation data. TWDB provides the lake evaporation data based on one-degree latitude by one-degree longitude quadrangles for the entire state of Texas (TWDB, 2021a). Figure 2.2-6 shows a contour map created using the TWDB lake evaporation data by quadrangle for the 30 years from 1971 to 2000. The evaporation estimates range from 52 to 72 inches per year over the study area. Generally, evaporation rates are higher in the central Edwards Plateau area and get lower towards the mountains in the west or towards the Hill Country area in the east.

Another method for estimating evaporation is using a model. This approach helps to utilize other data, such as climate data, which have a more extended measurement history with higher spatial density. Narasimhan and others (2005) modeled evaporation data using limited climate data, including maximum, minimum, and dew point temperatures from 1971 to 2000. Figure 2.2-7 shows a contour map created using the evaporation data from Narasimhan and others (2005). These modeled evaporation trends are similar to the measured evaporation trends shown previously in Figure 2.2-6. The modeled evaporation values range from 48 to 82 inches per year, with the highest evaporation values in the Edwards Plateau region and lower towards the mountains in the west and towards the Hill Country area in the east.

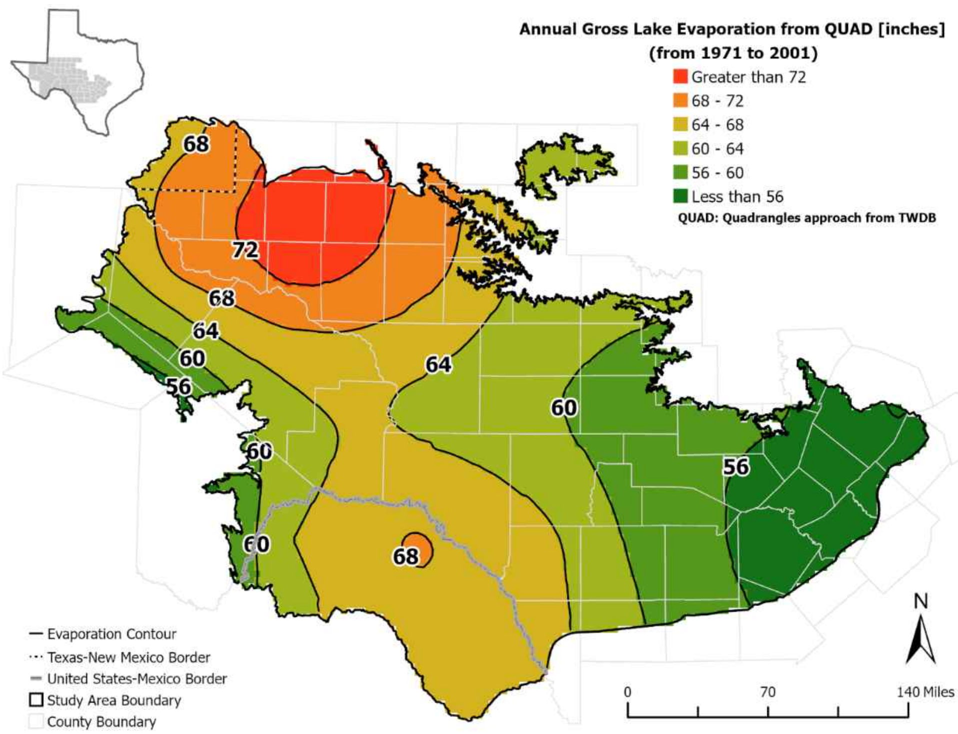


Figure 2.2-6. Gross lake evaporation for the study area from TWDB Quad approach from 1971 to 2001 (TWDB, 2021a).

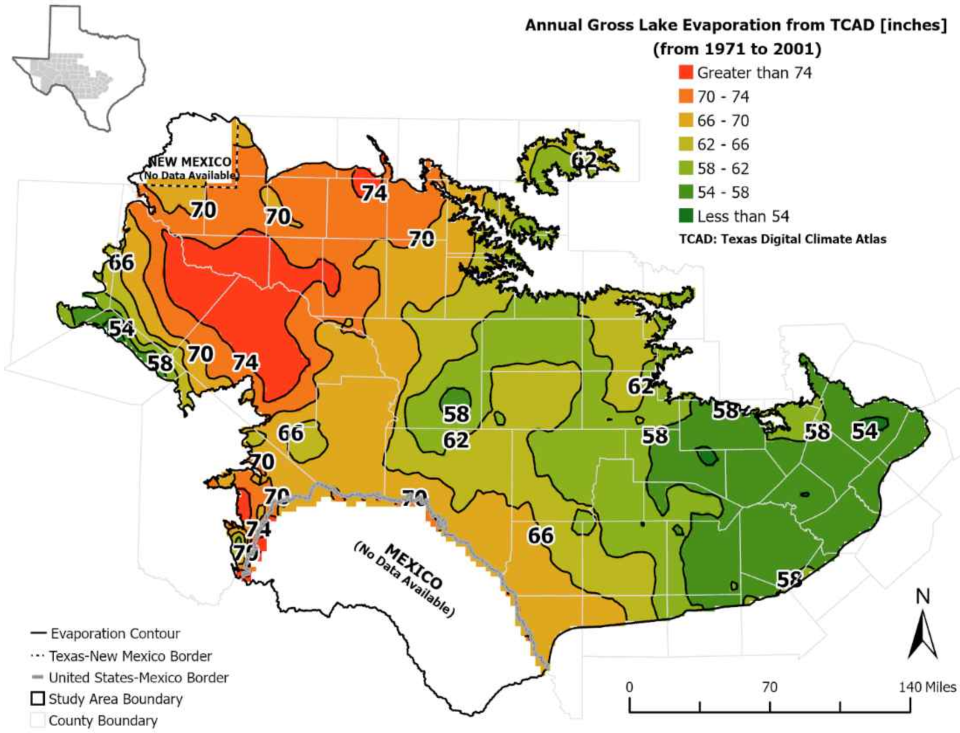


Figure 2.2-7. Gross lake evaporation for the study area from Texas Digital Climate Atlas from 1971 to 2001 (Narasimhan and others, 2005).

2.2.4 Drought Index (Palmer Hydrologic Drought Index)

The Palmer Hydrologic Drought Index is a scaled value used to represent abnormally wet, average, and abnormally dry conditions. Drought conditions can have a profound impact on groundwater resources. Lower precipitation and higher temperatures reduce the amount of water available to recharge the aquifer. In addition, as the severity of drought increases, surface water availability decreases, typically resulting in increased groundwater extraction. Thus, drought conditions not only reduce recharge of the groundwater but increases the amount of groundwater pumped for use.

Figure 2.2-8 and Figure 2.2-9 show the annual precipitation (top) and the Palmer Hydrologic drought indices (bottom) from 1895 to 2020 for climate divisions 5, 6, 7 and 9 (National Oceanic and Atmospheric Administration, 2021). A positive drought index indicates wetter than normal conditions and vice versa. The most severe drought (the drought of record), with respect to duration and intensity, occurred between 1950 and 1957 (Bradley and Malstaff, 2004). The most recent severe drought happened between 2011 and 2014. The comparison of temporal trends in the precipitation graphs versus the drought index graphs, shows a clear positive correlation between the drought index and precipitation. One of the purposes of regional groundwater modeling is to help better plan for droughts in Texas. During construction of the regional groundwater model, we will consider how best to implement drought conditions in the historical time period and in future simulations in order to best estimate the effects of droughts on groundwater resources.

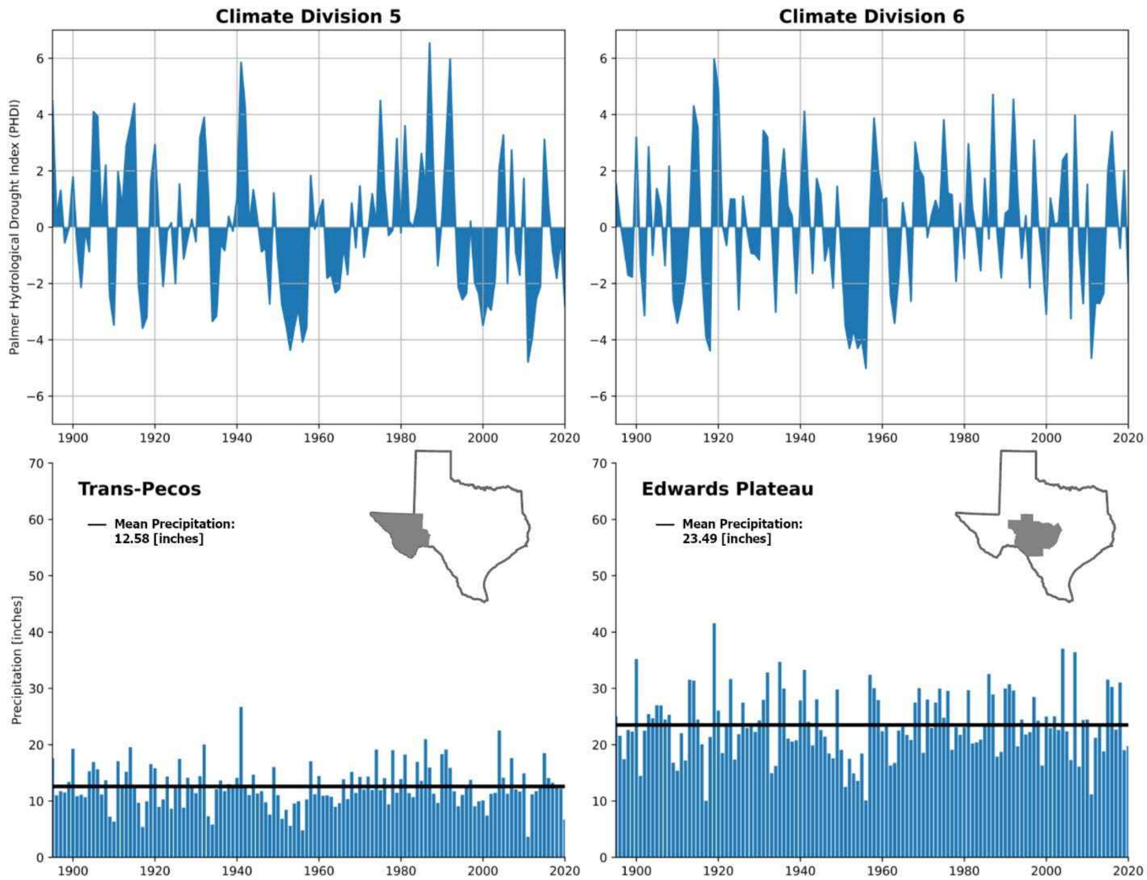


Figure 2.2-8. Annual Palmer Hydrological Drought Index (PHDI) and annual precipitation at Climate Division 5 and 6 for the period of 1895 to 2020. Black bar in the precipitation bar chart shows mean precipitation over the period (National Oceanic and Atmospheric Administration, 2021).

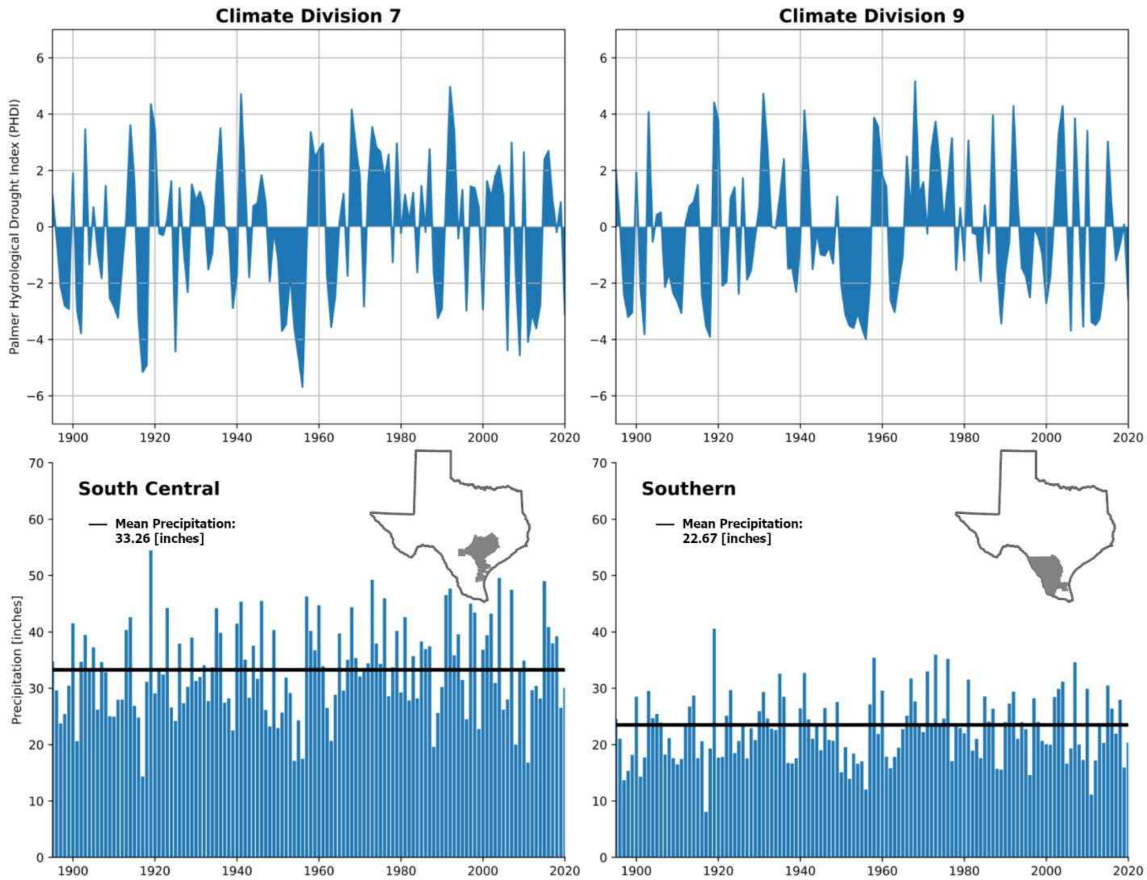


Figure 2.2-9. Annual Palmer Hydrological Drought Index (PHDI) and annual precipitation at Climate Division 7 and 9 for the period of 1895 to 2020. Black bar in the precipitation bar chart shows mean precipitation over the period (National Oceanic and Atmospheric Administration, 2021).

2.3 Geologic Setting

The current study area encompasses the entirety of the Pecos Valley Aquifer and the Edwards-Trinity aquifer system, which includes the Edwards-Trinity (Plateau) and Edwards (Balcones Fault Zone) aquifers as well as the Southern portion of the Trinity Aquifer. This section briefly summarizes the geologic history relevant to the component units of these aquifers.

The Edwards-Trinity aquifer system consists of Early Cretaceous shallow marine rock sediments belonging to the Lower Washita, Fredericksburg, and Trinity groups. The Lower Washita and Fredericksburg sediments form the Edwards Group, the top unit of the Edwards-Trinity aquifer system. The Trinity Group sediments form the bottom unit of the Edwards-Trinity aquifer system. In the eastern third of the study area (Central Edwards Plateau and Balcones Fault Zone), these Cretaceous units rest on top of Early to Late Paleozoic sediments. In the western portion of the study area, the Cretaceous units rest on

Triassic units (including the Dockum Aquifer) and Permian units (including the Rustler and Capitan Reef Complex aquifers). The unconformity, a contact between rock units representing a break in the time record, between the Cretaceous Edwards-Trinity aquifer system and underlying pre-Cretaceous units indicates a major shift in the geologic evolution of the study area. The gap between Late Triassic and Early Cretaceous rocks spans about 60 million years and was characterized by crustal warping and erosion (Barker and Ardis, 1992; Barker and other 1994). In general, the thin to medium-bedded Cretaceous strata of the Edwards-Trinity aquifer system are nearly flat-lying and typically dip southeastward on top of Triassic and Paleozoic units which generally dip westward. The Pecos Valley Aquifer consists of Cenozoic terrigenous rock sediments (Anaya and Jones, 2009) and overlies a portion of the Cretaceous Edwards-Trinity (Plateau) Aquifer. Where the Edwards-Trinity (Plateau) Aquifer is not present, the Pecos Valley Aquifer overlies Triassic units (including the Dockum Aquifer) and Permian units (including the Rustler and Capitan Reef Complex aquifers).

2.3.1 Pre-Cretaceous Period

In the context of the current study, the Pre-Cretaceous period refers to the the older units underlying the Pecos Valley Aquifer and the Edwards-Trinity aquifer system. During the Paleozoic Era, the geologic history of west-central Texas was dominated by activity related to the Ouachita geosyncline. The Ouachita geosyncline enters Texas from southeastern Oklahoma and extends around the southeastern and southern margins of the Llano uplift, then curves westward against the south edge of the Devils River uplifts and continues to the southeastern and eastern margins of the Marathon-Solitario uplifts (Barker and Ardis, 1992). Fine-grained materials were deposited in the foreland area until Late Permian time. The thickness of the deposits was more than 20,000 feet (Barker and Ardis, 1992). Intermittent periods of tectonic uplift and volcanic activity occurred along the cratonic margins of the geosyncline creating a subsiding trough (Barker and Ardis, 1996). The Ouachita orogeny climaxed between Late Pennsylvanian and Early Permian, with significant uplifting, thrust faulting, and intensive folding. Various degrees of metamorphism occurred in the interior sediments of the geosyncline. A very complex structure of foreland facies created petroleum traps and some of the world's most productive oil and gas reservoirs (Barker and Ardis, 1996). The Permian basin developed in west Texas as the Ouachita orogeny progressively phased out. During the middle to end of Late Permian, the Permian Basin repeatedly connected to the open ocean until the end of the Paleozoic, when the sea withdrew as West Texas was uplifted (Barker and Ardis, 1996).

The end of the Ouachita orogeny was followed by long periods of nondeposition, crustal warping, and erosion of the Paleozoic sediment during the Early and Middle Triassic (Baker and Ardis, 1996). Uplifting of the Llano area and the erosion of the central basin continued. Deposition of eroded materials from Paleozoic rocks in the low-lying fluvial, deltaic, and lacustrine environments formed the Dockum Group (McGowen and others, 1979). During the Jurassic, the landscape of the study area was tilted toward the southeast, and the surface drainage was reversed from northwestward flow toward the inland sea to southeastward flow toward the Cretaceous sea (Sellards, 1933). The Ouachita Mountains began to erode across central Texas and the Gulf of Mexico started to open.

2.3.2 Cretaceous Period

In the context of the current study, the Cretaceous period refers to the age of the units of the Edwards-Trinity aquifer system. The development of the Gulf of Mexico continued into the Cretaceous Period (Wood and Walper, 1974). The Cretaceous seas advanced from the southeast and began to form a broad continental shelf known as the Comanche Shelf (Figure 2.3-1). During the Trinitian time, the Llano Uplift provided a prominent structural shelf for the deposition of Trinity Group sediments. The Trinity rock record indicates that three shoreline advance and retreat cycles occurred during deposition of Trinity Group sediments (Barker and Ardis, 1996). Trinity rocks have a wedge-like shape from less than 150 ft thick near the Llano uplift to more than 1,000 ft thick in the Balcones Fault Zone (Barker and Ardis, 1996). The southeast section of the Llano Uplift, the current Hill Country area, experienced several depositional periods with the transgressions and regressions of the Cretaceous seas. The basal Cretaceous sand was deposited as braided stream deposits on top of the pre-Cretaceous rocks in the western section of the Llano Uplift (Barker and Ardis 1992). The Glen Rose Limestone accumulated to the southwest and south of the Llano Uplift. Due to the significant subsidence rate during the middle to late Trinitian time, the Glen Rose Limestone is more than three times thicker in southern Kinney County as it is in central Sutton County (Barker and Ardis 1996). The sea withdrew further down south and east during the late Trinitian. The southwestern part of Glen Rose Limestone was replaced by the Maxon Sandstone (King, 1980). The shoreline receded continually slightly to the north of the Balcones Fault Zone at the end of Trinitian time.

In early Fredericksburgian time (the age of the Edwards Group), the Stuart City Reef Trend began to form from and extended from northern Mexico across nearly 500 miles of southeastern Texas. The reef sheltered depositional environments on the Comanche Shelf from storm waves and deep ocean currents (Barker and Ardis 1996). Figure 2.3-1 shows other structural elements around the Comanche Shelf that controlled depositional environments:

- The Central Texas Platform that was an elongated mound on the Comanche Shelf which extended from the Austin and San Antonio areas northwest to the San Angelo area;
- The San Marcos Platform that extended southeast of the Llano Uplift to the Stuart City Reef Trend;
- The Maverick basin that was a semicircular depression along the southern margin of the Comanche shelf straddling the Texas – Mexico border;
- The Devils River Reef Trend that developed around the eastern, northern, and western rim of the Maverick basin and surrounded the Maverick basin; and
- The Fort Stockton basin which extended from northern Mexico across the northwestern part of the Comanche shelf.

Those structural elements helped isolate the Comanche Shelf from open seas. Various formations were deposited depending on the relative sea levels and climatic conditions. Before the deposition of the Upper Cretaceous, much of the Central Texas Platform was subaerially exposed (Figure 2.3-2) and both erosion and karstification of the Lower Cretaceous carbonate sediments occurred, likely the origin of many of the caverns in today's Edwards Plateau area (Barker and Ardis, 1996). During the Late Cretaceous, deposition and subaerial erosion repeatedly occurred, forming the Del Rio Clay, Buda Limestone, Boquillas Formation, and Austin Group sediments over the study area.

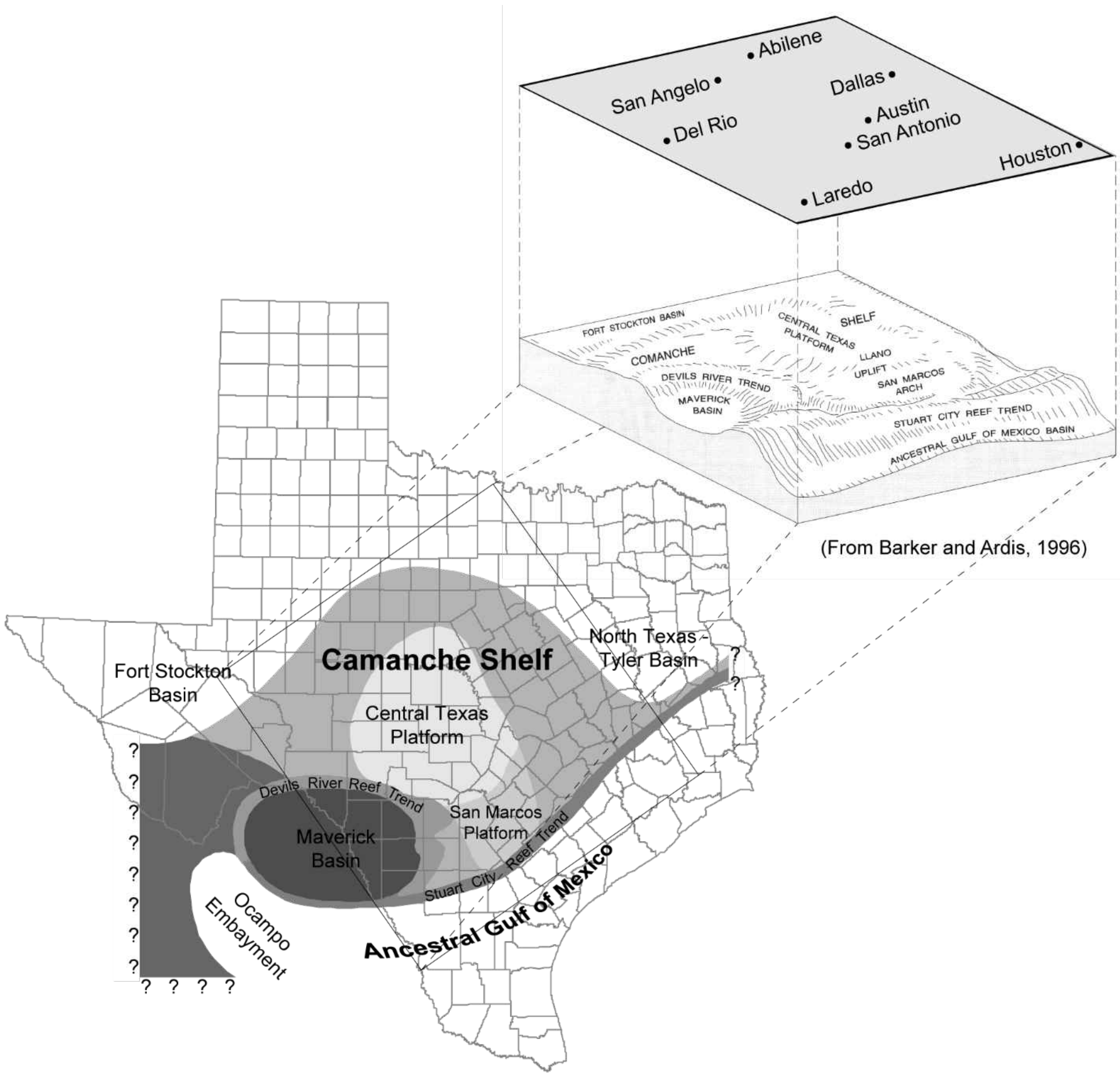


Figure 2.3-1. Paleogeographic elements affecting the depositional environments of the Edwards Group sediments (from Anaya and Jones, 2009).

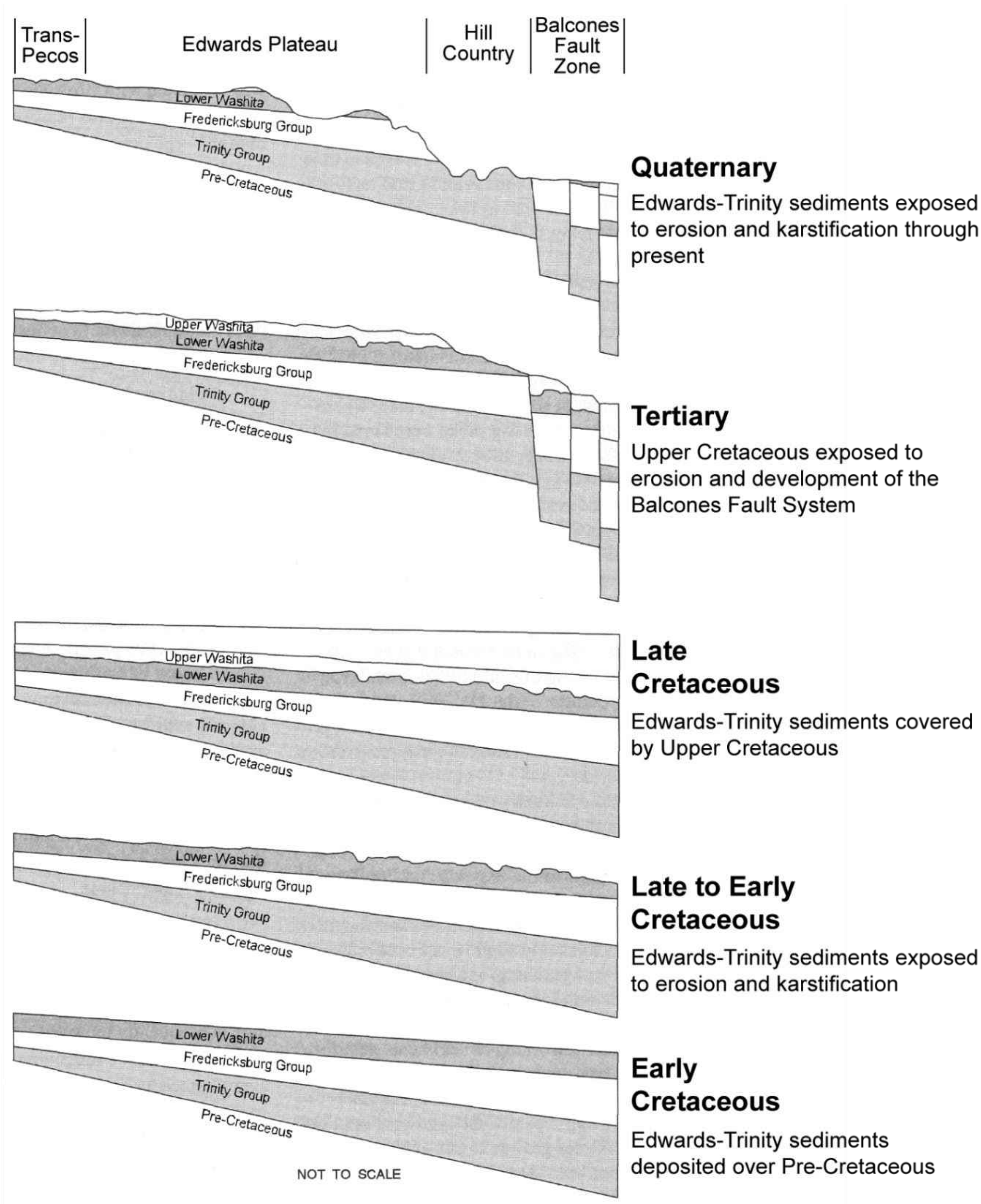


Figure 2.3-2. Evolutionary development of the Edwards-Trinity (Plateau) and Edwards (Balcones Fault Zone) aquifers system (modified from Barker and Ardis, 1996).

2.3.3 Post-Cretaceous Period

In the context of the current study, the Post-Cretaceous period refers to the ages of the Pecos Valley Aquifer and the younger units overlying the Edwards-Trinity aquifer system. The post-Cretaceous geologic history is dominated by uplift and erosion over west-central Texas and deposition and subsidence in the Gulf of Mexico. As the Laramide orogenic cycle began, Paleozoic sediments in the Delaware basin were uplifted, Upper Permian deposits were dissolved and deformed, and the overlying Triassic and Cretaceous sediments collapsed and eroded (Barker and Ardis, 1996; Anaya and Jones 2009). During the Tertiary and Quaternary, more than 1,500 feet of talus and alluvial fill accumulated in troughs in the current day Pecos Valley Aquifer (previously, Cenozoic Pecos Alluvium), and the Basin and Range tectonic cycle enhanced the deposition. On the southeastern side of the study area, sediments accumulated in the Gulf of Mexico and increased the tensile stress along the ancient hinge-line of the Ouachita Fold Belt. The Balcones Fault Zone formed afterwards, with mostly down-to-the-southeast normal faults. The vertical displacement across the Balcones Fault zone is about 900 to 1,200 feet (Barker and Ardis 1996). The Balcones Fault Zone’s stair-stepped shape down toward the Texas Gulf Coast significantly impacted surface and subsurface hydrogeologic feature development. Groundwater flow speed, direction and volume, spring location, and stream movement and discharge were all influenced by the disrupted lateral continuity of Cretaceous strata.

3 PREVIOUS WORK

Numerous studies have been conducted for the study area, and there are many reports published accordingly. The study topics include geology (Fisher and Rodda, 1969; Smith, 1974), hydrogeology (Barker and others 1994; Barker and Ardis, 1996; Kuniansky and Ardis, 2004), ecology (Elliott and others, 2014), springs (Brune, 1975; 1981), climate (Larkin and Bomar, 1983), and well records.

Over the study area, the Texas Department of Water Resources conducted a regional groundwater study to discuss the Trans-Pecos (Rees and Buckner, 1980) and the Edwards Plateau (Walker, 1979). The TWDB published reports that describe groundwater resources for the Edwards (Balcones Fault Zone) (Klemt and others 1975) and the current Pecos Valley Aquifer (Ashworth, 1990).

In the late 1970s, the U.S. Geological Survey began the Regional Aquifer Systems Analysis (RASA) program to improve the hydrogeologic information of the major aquifer systems in the United States. A study covering the Edwards-Trinity (Plateau) Aquifer system and adjacent hydraulically connected units was completed under this program. Multiple comprehensive reports were published, including Barker and others (1994) and Barker and Ardis (1992; 1996), which describe the geologic history and hydrogeologic framework of the Edwards-Trinity aquifer system, and Kuniansky and Ardis (2004), which describes the hydrogeology, groundwater use, and groundwater flow in the study area.

Several numerical models have been developed, along with hydrogeological studies, to understand the groundwater flow systems better. The U.S. Geological Survey developed finite-element groundwater flow models for the Edwards-Trinity Aquifer system with a single layer (Kuniansky and Holligan, 1994) and multiple layers (Kuniansky, 1994; 1995). The single-layered model assumed a greatly simplified aquifer system and only simulated major springs in the study area. Kuniansky and Ardis (2004) developed two finite-element groundwater flow models with two different scales. The larger-scale model was a two-dimensional, single-layer model to simulate the entire Edwards-Trinity Aquifer system. The small-scale model was a three-dimensional, multilayer model. The smaller-scale model simulates a relatively localized area known for complex flow patterns: the Hill Country area and Balcones Fault Zone as well as part of the Edwards Plateau.

The TWDB and its subcontractors have produced several groundwater availability models in the study area as part the TWDB Groundwater Modeling Program. The TWDB developed two finite-difference numerical groundwater flow models to simulate three-dimensional steady-state and transient flow for the Edwards-Trinity (Plateau) and Pecos Valley Aquifer (Anaya and Jones, 2009) and the Hill Country portion of the Trinity Aquifer (Jones and others, 2011). Later, Hutchison and others (2011a) updated the model from Anaya and Jones (2009) by improving the calibration with model layer reduction and input parameters adjustment. Toll and others (2018) updated the conceptual model for the Hill Country portion of the Trinity Aquifer. For the Edwards (Balcones Fault Zone) Aquifer, Lindgren and others (2004) and Scanlon and others (2001) developed the models for the San Antonio and the Barton Springs segments, respectively. The Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer model was updated by Hutchison and Hill (2011) by re-calibrating to an extended period that included the historic drought-of-record.

In recent years, several studies updated these previous models or developed new models for relatively localized regions or specific purposes. A groundwater model was developed for the Pecos River watershed (Green and others, 2016) and coupled surface-water/groundwater model for the Devils River watershed (Toll and others, 2017), with a focus on surface water/groundwater interaction. For Kinney County and Val Verde County, two local groundwater models were created to fill a gap between other regional groundwater models (Hutchison and others, 2011b; Hutchison and Burton, 2014). In the Pecos County region, Bumgarner and others (2012) created a conceptual model while Clark and others (2014) created a numerical model of the Edwards-Trinity (Plateau) Aquifer. In the San Antonio segment of the Edwards (Balcones Fault Zone) Aquifer, several studies have updated the TWDB groundwater availability model to better simulate the conduit flow (Lindgren, 2006) or to assess the uncertainty from variable climate conditions (Brakefield and others, 2015; Foster and others, 2021). Fratesi and others (2015) developed an independent model for the San Antonio segment of the Edwards (Balcones Fault Zone) Aquifer and compared the prediction simulation with the TWDB groundwater availability model (Lindgren and others, 2004).

In the Hill Country and adjacent areas, many studies focused on geologic and hydrogeologic conditions. Smith and others (2018) and Watson and others (2018) discussed the karst geologic characteristics of the Trinity Group. The U.S. Geological Survey published several maps and reports regarding the geologic framework and hydrogeologic conditions at the county scale (Clark and Morris, 2011, 2015, 2017; Clark and others, 2016a, 2016b, 2018, 2020). Several studies discussed hydrogeologic features, cross-formational flow, and surface-water/groundwater interaction of this region including Wong and others, (2014), Hunt and others (2017), Smith and others (2018), Watson and others (2018), Martin and others (2019). Hydrogeologic atlases of the Hill Country portion of the Trinity Aquifer and the southwest Travis County were completed by Wierman and others (2010) and Hunt and others (2020), respectively. These hydrogeologic atlases compiled existing data, newly collected data, and identified data gaps within the study area.

Several reports provide water quality data, water quality analysis, or water budget analysis. Ashworth (2010) discussed aquifer data analysis (including water chemistry) in Edwards, Kinney, and Val Verde counties, whileKreitler and others (2013) examined the hydrochemical and isotope data analysis in Groundwater Management Areas 3 and 7. Water quality analysis studies on the San Antonio segment of the Edwards Aquifer were completed by Opsahl and others (2018, 2020). Green and Bertetti (2012) presented a quantitative water budget analysis as an alternative to the regional model to construct the desired future condition of eight counties in Southwest Texas.

Recently, Sharp and others (2019) published a memoir about the Edwards Aquifer that includes discussions on the history, characteristics, environment, biology, and ecology of the aquifer and identified emerging issues which threaten these water resources.

4 HYDROLOGIC SETTING

The hydrologic setting describes the aquifer characteristics and groundwater conditions that contribute to the groundwater hydrology of the aquifer system. Elements of the hydrologic setting include the layering of the geologic units comprising the aquifer system (hydrostratigraphy), groundwater levels and regional groundwater flow patterns, physical characteristics of the aquifer that impact groundwater flow (hydraulic properties), inflows to and outflows from the groundwater system, and groundwater chemistry (quality). Inflows include recharge from precipitation and leakage from surface water features such as streams, rivers, and reservoirs. Outflows include discharge to springs and surface water features, water loss from evapotranspiration, and groundwater pumping.

4.1 Hydrostratigraphy and Hydrostratigraphic Framework

Stratigraphy refers to the vertical and lateral organization of the geologic units, typically based on a hierarchical classification system of stratigraphic units. Stratigraphic units represent simplified groupings of geologic units and are typically chosen by correlating lithostratigraphic units (groups with similar rock characteristics) with chronostratigraphic units (groups with similar rock ages) and/or geochronologic units (groups with similar geologic time). Figure 4.1-1 provides a stratigraphic column, or a simplified representation of the geology, for the study area.

Hydrostratigraphy refers to the further organization of these geologic units into groups based on similar aquifer characteristics. We have condensed the stratigraphic units in Figure 4.1-1 into three simplified hydrostratigraphic units based on similar aquifer characteristics. The top hydrostratigraphic unit represents younger units that overlie the Edwards and Trinity hydrostratigraphic units and includes the Pecos Valley Aquifer and other shallow units. The middle hydrostratigraphic unit represents the Edwards hydrostratigraphic unit and includes the Edwards (Balcones Fault Zone) Aquifer and the Edwards Group equivalent units of the Edwards-Trinity (Plateau) Aquifer. The bottom hydrostratigraphic unit represents the Trinity hydrostratigraphic unit and includes the Southern portion of the Trinity Aquifer and the Trinity Group equivalent units of the Edwards-Trinity (Plateau) Aquifer. These hydrostratigraphic units are complex and can represent different geologic formations and aquifers depending on their location within the study area. To simplify our hydrostratigraphic discussion, we have split the study area into distinct geographic regions, as shown in Figure 4.1-2. The following sections provide individual hydrostratigraphic descriptions for each of these regions. For each region, we provide a stratigraphic column, with geologic units grouped into their corresponding hydrostratigraphic units.

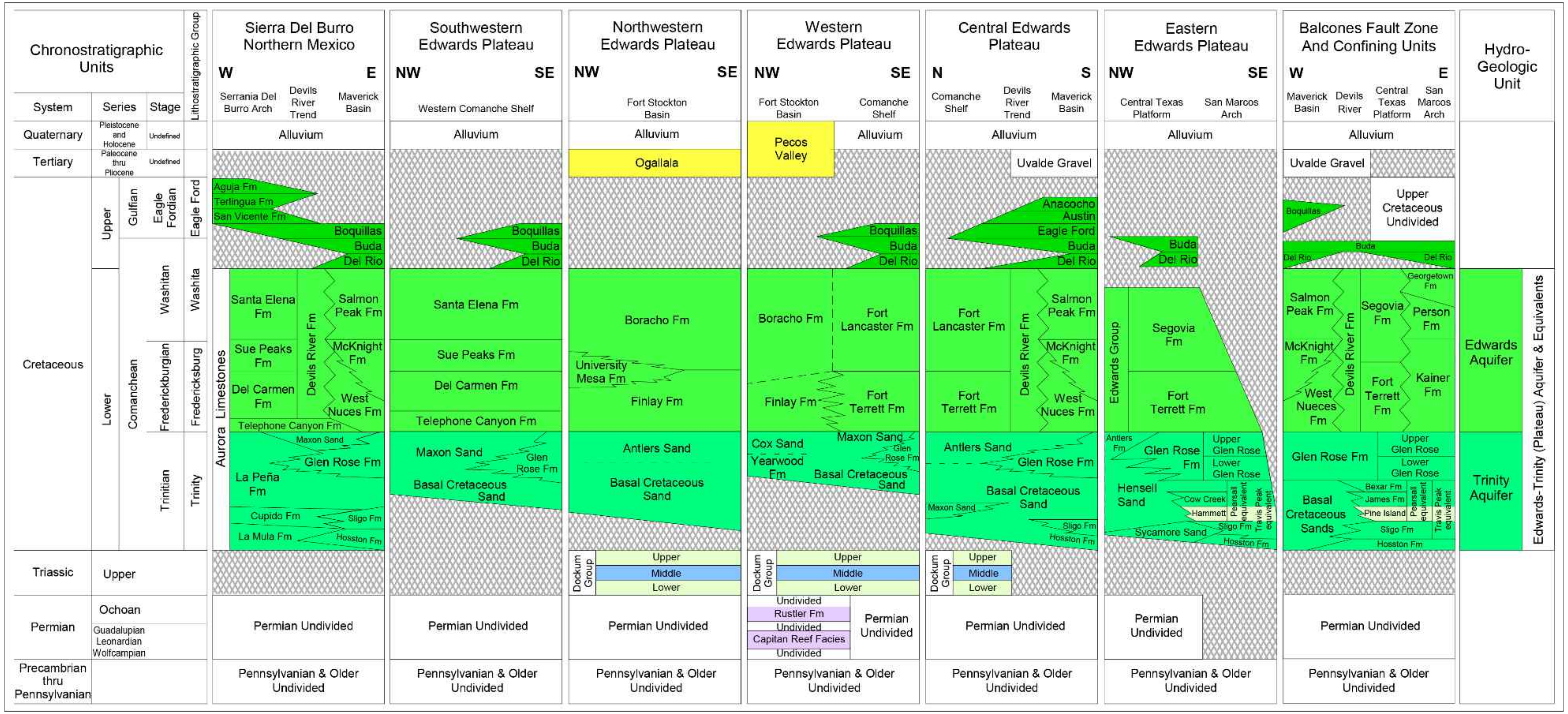


Figure 4.1-1. Stratigraphic correlation chart for the Edwards-Trinity (Plateau) and Pecos Valley aquifers regional Groundwater Availabilty Model.

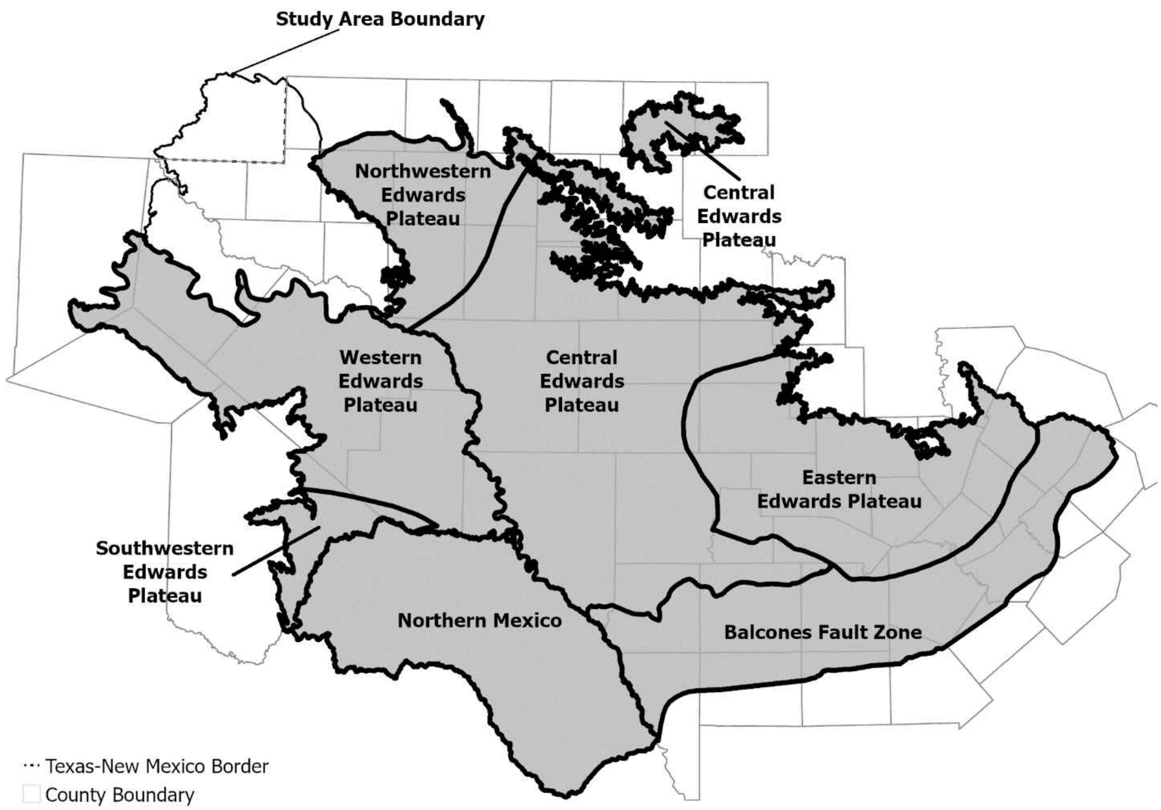


Figure 4.1-2. Stratigraphic regions delineated for the Edwards-Trinity (Plateau) and Pecos Valley aquifers regional Groundwater Availabilty Model.

4.1.1 Balcones Fault Zone and Younger Confining Units

In the Balcones Fault Zone, all three hydrostratigraphic units are present (Figure 4.1-3). The youngest hydrostratigraphic unit represents Late Washita to Gulfian sediments, including the Del Rio Clay, Buda Limestone, and Boquillas Formation. These units create a confining unit over about 70 percent of the Balcones Fault Zone (Barker and others, 1994). In the southeastern section of this region, where these Upper Cretaceous units dip down into the subcrop, the youngest hydrostratigraphic unit also includes any overlying units from the top of the Upper Cretaceous to land surface, such as the Eagle Ford, Austin, Taylor, and Navarro groups (shown in the stratigraphic column as Upper Cretaceous undivided).

The Edwards hydrostratigraphic unit represents the Edwards (Balcones Fault Zone) Aquifer and equivalent downdip units in the east and the Edwards portion of the Edwards-Trinity (Plateau) Aquifer in the west. This includes the lower part of the Washita Group and the entire Fredericksburg Group. In the northeastern Balcones Fault Zone (San Marcos Arch area), the Edwards hydrostratigraphic unit comprises the Kainer and the Person formations overlain by the Georgetown Formation. West of the San Marcos Arch, the

Segovia and Fort Terrett formations comprise the Edwards hydrostratigraphic unit. In the western Balcones Fault Zone (Devils River Trend area), the Edwards hydrostratigraphic unit represents the Devils River Formation. In the southwestern Balcones Fault Zone (Maverick Basin area), the Edwards hydrostratigraphic unit comprises the West Nueces, McKnight, and Salmon Peak formations.

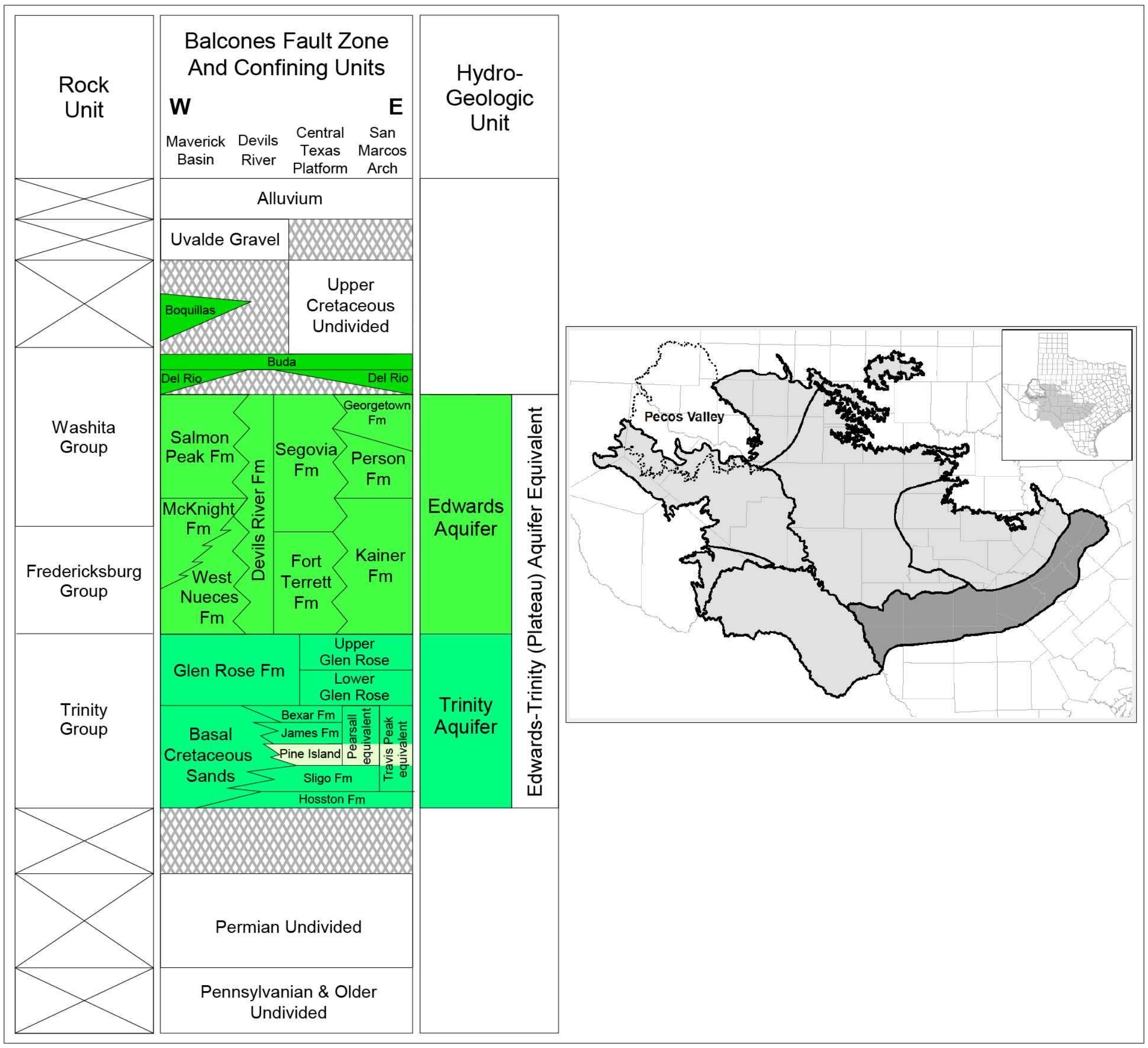


Figure 4.1-3. Hydrostratigraphy for the Balcones Fault Zone and younger confining units region.

The Trinity hydrostratigraphic unit represents the subcrop of the Hill Country portion of the Trinity Aquifer and equivalent downdip units in the east and the subcrop of the Trinity portion of the Edwards-Trinity (Plateau) Aquifer in the west. In the eastern section of the Balcones Fault Zone region, the Hosston and Sligo formations comprise the lower member of Trinity hydrostratigraphic unit. The Pearsall Formation, which contains the Pine Island Shale, James Formation, and Bexar Shale members, overlies the Sligo Formation and extends to the south-central part of the Edwards Plateau. The Pine Island Shale Member stretches eastward from the Balcones Fault Zone and is a persistent Lower Cretaceous unit in east Texas (Barker and others, 1994). The Bexar Shale Member is present between the James Formation and the Glen Rose Limestone in the Balcones Fault Zone (Barker and others, 1994). The Pearsall Formation and the underlying Sligo and Hosston formations grade into undifferentiated basal Cretaceous sands towards the Maverick Basin in the west. The Glen Rose Limestone overlies the Pearsall Formation in the east and the undifferentiated basal Cretaceous sands in the west. The base of the Edwards-Trinity aquifer system in the Balcones Fault Zone generally descends steeply towards the Gulf of Mexico.

In this region, the Edwards hydrostratigraphic unit is the major water-producing unit, as the Edwards (Balcones Fault Zone) Aquifer is one of the most productive aquifers in the world (Barker and Ardis, 1996). The Trinity hydrostratigraphic unit also produces water, but is deeper, less permeable and more saline than the overlying Edwards unit. Based on multiport wells south of Austin, Texas, Smith and Hunt (2020) found some connectivity between the Edwards hydrostratigraphic and the upper portion of the Trinity hydrostratigraphic unit, but little to no connection between the Edwards and lower units of the Trinity hydrostratigraphic unit. Relatively impermeable Paleozoic rocks underlie the Trinity hydrostratigraphic unit, precluding significant hydraulic connection between the Trinity unit and underlying units. It should be noted that this region is highly faulted, which can greatly alter the direction of or impede groundwater flow. The vertical fault displacement in the Cretaceous rocks ranges typically from 900 feet in Austin to 1,200 feet in San Antonio. The displacement within the overlying pre-Cretaceous rocks is unknown (Barker and Ardis, 1992).

4.1.2 Eastern Edwards Plateau (Hill Country and Llano Uplift)

In the Eastern Edwards Plateau region, only the bottom two hydrostratigraphic units are present (Figure 4.1-4). In the western portion of this region, the Upper Cretaceous sediments such as the Del Rio Clay and the Buda Limestone occur but are thin, discontinuous, and largely unsaturated, and therefore not considered a separate hydrostratigraphic unit in this region. The Edwards hydrostratigraphic unit represents the Edwards units of the Edwards-Trinity (Plateau) Aquifer, comprising the Fort Terret and the Segovia Formation of the Fredericksburg and Washita Group, respectively. The boundary between the Edwards-Trinity (Plateau) Aquifer and the Hill Country portion of the Trinity Aquifer marks where erosion removed most of the Fredericksburg and Washita groups and younger units in the Hill Country. East of this boundary, the remaining non-eroded portions of the Edwards units cap the higher ridges of the Hill Country, but since these are thin, discontinuous, and largely unsaturated, we do not include these discontinuous pieces overlying the Trinity Aquifer into the Edwards hydrostratigraphic unit extent.

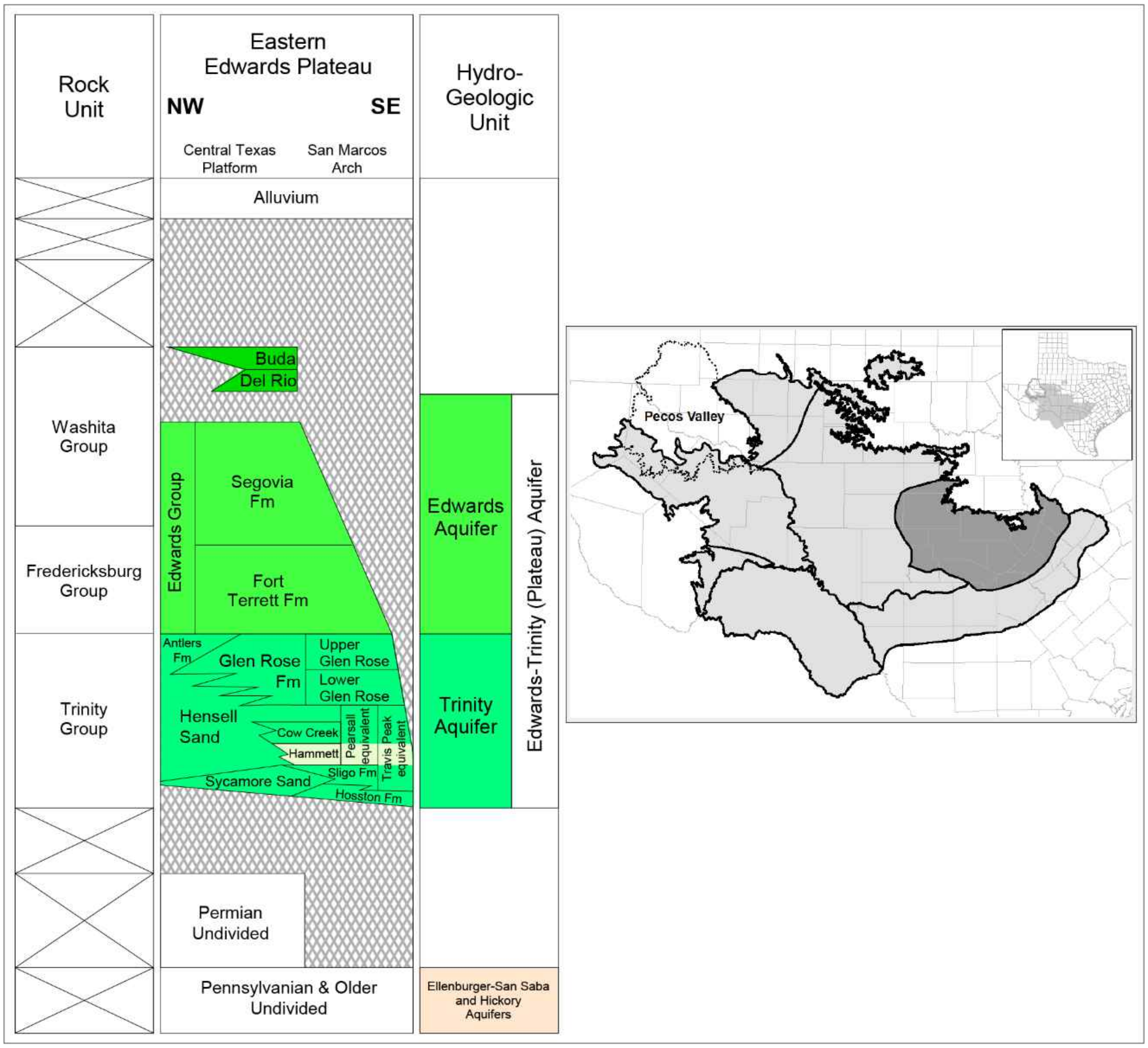


Figure 4.1-4. Hydrostratigraphy for the Eastern Edwards Plateau and Hill Country region.

The Trinity hydrostratigraphic unit can be subdivided into the Lower, Middle, and Upper Trinity productive subunits on the southeastern side of this region (Ashworth, 1983). The Lower Trinity productive unit consists of the Hosston Formation and Sycamore Sand and overlying Sligo Formation. The Lower Trinity unit extends northward from the Balcones Fault Zone. The Hammett Shale is a confining (impermeable) unit between the Lower and Middle Trinity units that separates the vertical flow between these two Trinity subunits. The Middle Trinity subunit comprises the Cow Creek Limestone, Hensell Sand, and the lower member of Glen Rose Limestone. The Upper Trinity subunit consists of the upper member of the Glen Rose Limestone (Ashworth, 1983; Mace and others, 2000). Unlike the

Balcones Fault Zone region, the Glen Rose Limestone in the southeastern portion of this region, is separated into upper and lower members by hydraulically tight sediments (Barker and others, 1994). As the Trinity Group extends west and northwest away from the Hill Country region, some formations start to pinch out. Unlike the Hill Country region, the separation between the Upper, Middle, and Lower Trinity subunits is less clear. The units of the Middle and Lower Trinity pinch out and grade into the Hensell Sand and Antlers Sand formations. The differentiation of the Lower and Upper Glen Rose formations also disappears as these blend into undifferentiated Glen Rose Formation further to the west and northwest.

In the Hill Country portion of this region, the Middle Trinity subunit of the Trinity hydrostratigraphic unit is generally the major water-producing unit, with smaller amounts produced from the Upper and Lower Trinity subunits. However, for the purposes of this study, we combined the Upper, Middle, and Lower Trinity into one Trinity hydrostratigraphic unit which presumes hydraulic connection between all component units. In the rest of the region, the major water-producing unit is the Edwards-Trinity (Plateau) Aquifer, a combination of the Edwards and Trinity hydrostratigraphic units. Since these two hydrostratigraphic units comprise one aquifer in this region, we assume hydraulic connection between them.

In most of this region, underlying Paleozoic rocks provide a relatively impermeable boundary at the base of the Trinity hydrostratigraphic unit (Barker and Ardis, 1992), so hydraulic connection is unlikely between the Trinity unit and underlying units. The exception is along the northeastern margin of this region, where several minor aquifers of the Llano Uplift, including the Precambrian Hickory Aquifer, and the Paleozoic Ellenburger-San Saba and Marble Falls aquifers, underlie and are likely hydraulically connected to the Trinity hydrostratigraphic unit. However, the study assumes cross-formational flow with these aquifers is likely minor.

4.1.3 Central Edwards Plateau (Plateau)

In the Central Plateau region, all three hydrostratigraphic units are present (Figure 4.1-5). The younger hydrostratigraphic unit is only present in the very southeastern section of this region in Val Verde and Kinney counties along the Devils River Trend and Maverick Basin. Here, it represents Late Washita to Gulfian sediments, including the Del Rio Clay, Buda Limestone, Eagle Ford Group, Austin Group, and Anacocho Limestone. In general, these Upper Cretaceous rocks act as confining units to the Edwards hydrostratigraphic unit of the Edwards-Trinity (Plateau) Aquifer. While Upper Washita sediments such as the Del Rio Clay and the Buda Limestone occur elsewhere in the region, they are thin, discontinuous, and largely unsaturated, and therefore not considered a part of the confining hydrostratigraphic unit in this study.

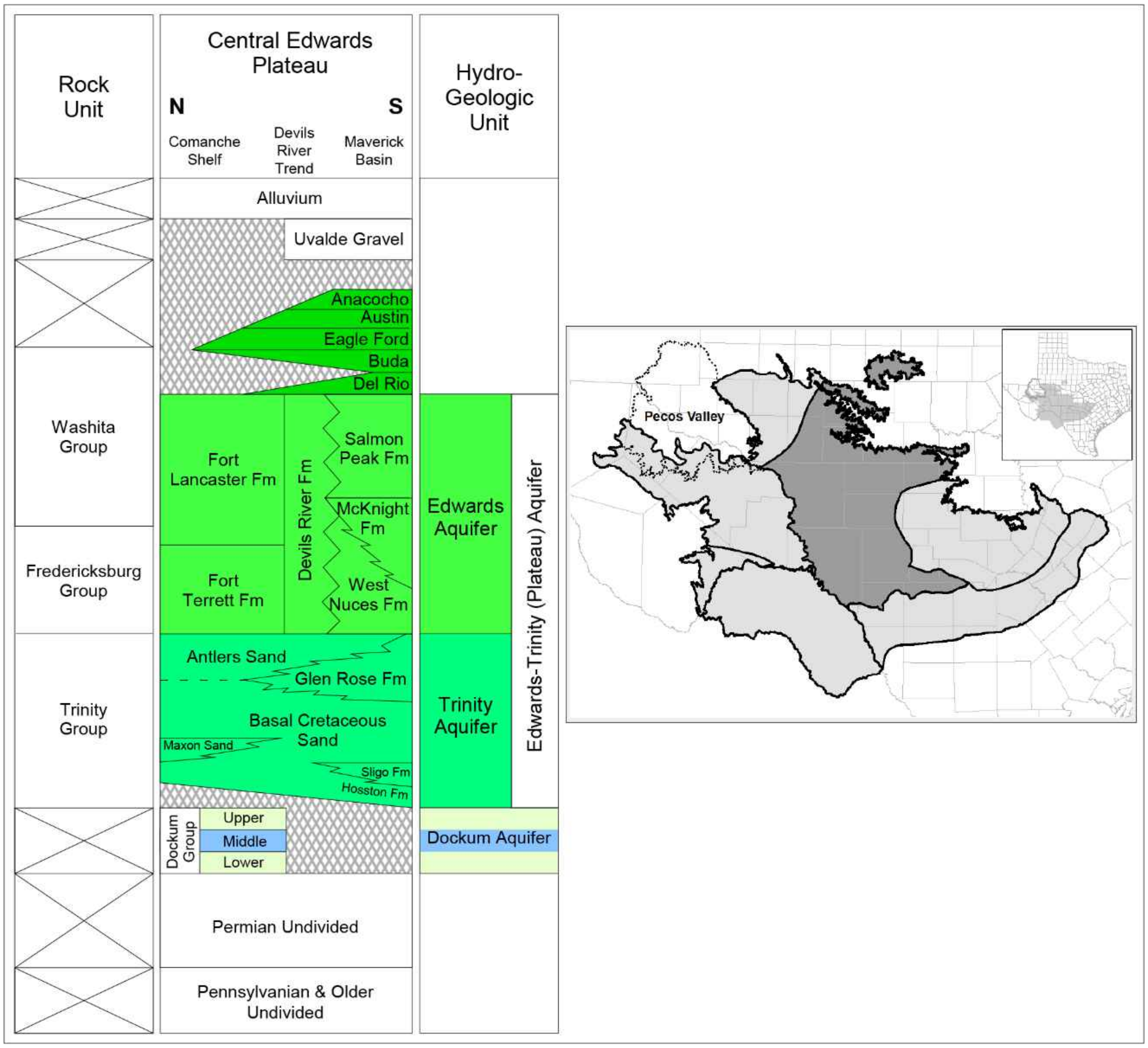


Figure 4.1-5. Hydrostratigraphy for the central Edwards Plateau region.

The Edwards hydrostratigraphic unit represents different formations of the Fredericksburg and Lower Washita groups depending on the location. In the Maverick Basin, this includes the West Nueces Formation (Fredericksburg), the McKnight Formation (Fredericksburg and Lower Washita), and the Salmon Peak Formation (Lower Washita). Within the Devils River Reef Trend, this includes the Devils River Formation (Fredericksburg and Lower Washita). On the Comanche Shelf, this includes the Fort Terrett Formation (Fredericksburg) and the Fort Lancaster Formation (Fredericksburg and Lower Washita). Rose (1972) refers to these combined units as the Edwards Group Limestones.

The Trinity hydrostratigraphic unit represents Trinity Group rocks, including a portion of the Sligo and Hosston formations, undifferentiated basal Cretaceous sands, the Glen Rose Limestone, the Maxon Sandstone and the Antlers Sand. The Sligo and Hosston formations pinch out in the south and grade into undifferentiated basal Cretaceous sands. The undifferentiated basal Cretaceous sands and the Maxon Sandstone are sometimes indistinguishable and are laterally equivalent to the Antlers Sand in the northern plateau (Anaya and Jones, 2009).

In this region, the major water-producing unit is the Edwards-Trinity (Plateau) Aquifer, a combination of the Edwards and Trinity hydrostratigraphic units. Since these two hydrostratigraphic units have a hydraulic connection, we comprise these units into one aquifer in this region for this study. Where present, the younger Upper Cretaceous hydrostratigraphic unit acts as confining unit for the Edwards hydrostratigraphic unit. Underlying Paleozoic rocks provide a relatively impermeable layer at the base of the Trinity hydrostratigraphic unit in the central section of the Edwards Plateau (Barker and Ardis, 1992), so hydraulic connection is unlikely between the Trinity unit and underlying units. In the northern section of this region, the Trinity hydrostratigraphic unit overlies the Late Triassic Dockum Group, including the Santa Rosa, Tecovas, Trujillo, and Cooper Canyon formations. The Dockum Aquifer and the Trinity hydrostratigraphic unit have insignificant hydraulic connection except where the Trinity Group directly overlies the Santa Rosa Formation (Walker, 1979).

4.1.4 Northwestern Edwards Plateau (Llano Estacado)

In the Llano Estacado of the Northwestern Edwards Plateau region, all three hydrostratigraphic units are present (Figure 4.1-6.). The younger hydrostratigraphic unit represents the Late Tertiary Ogallala Formation, or Ogallala Aquifer. This formation overlies the Edwards hydrostratigraphic unit and portions of the Trinity hydrostratigraphic unit where Edwards Group sediments have been eroded away.

The Edwards hydrostratigraphic unit represents the Finlay Formation (Fredericksburg), University Mesa Formation (Fredericksburg), and Boracho Formation (Fredericksburg and Washita). These units comprise the Edwards portion of the Edwards-Trinity (Plateau) Aquifer. In certain portions of this region, the Edwards Group rocks have been eroded away along old stream drainages, or paleochannels.

The Trinity hydrostratigraphic unit represents undifferentiated basal Cretaceous sands and the Antlers Sand of the Trinity Group, collectively referred to as the Trinity Sand. These units comprise the Trinity portion of the Edwards-Trinity (Plateau) Aquifer.

The major water-producing unit in this region is the Ogallala Aquifer, followed by the Edwards-Trinity (Plateau) Aquifer, a combination of the Edwards and Trinity hydrostratigraphic units. Since the Edwards and Trinity hydrostratigraphic units comprise one aquifer in this region, we assume hydraulic connection between the two hydrostratigraphic units. We also assume hydraulic connection between the Ogallala Aquifer and underlying Edwards and Trinity hydrostratigraphic units (Anaya and Jones, 2009). The Late Triassic Dockum Group, including the Santa Rosa, Tecovas, Trujillo, and Cooper Canyon formations, underlies the Trinity hydrostratigraphic unit in this region. The

Dockum Aquifer and the Trinity hydrostratigraphic unit have an insignificant hydraulic connection except where the Trinity Group directly overlies the Santa Rosa Formation (Walker, 1979).

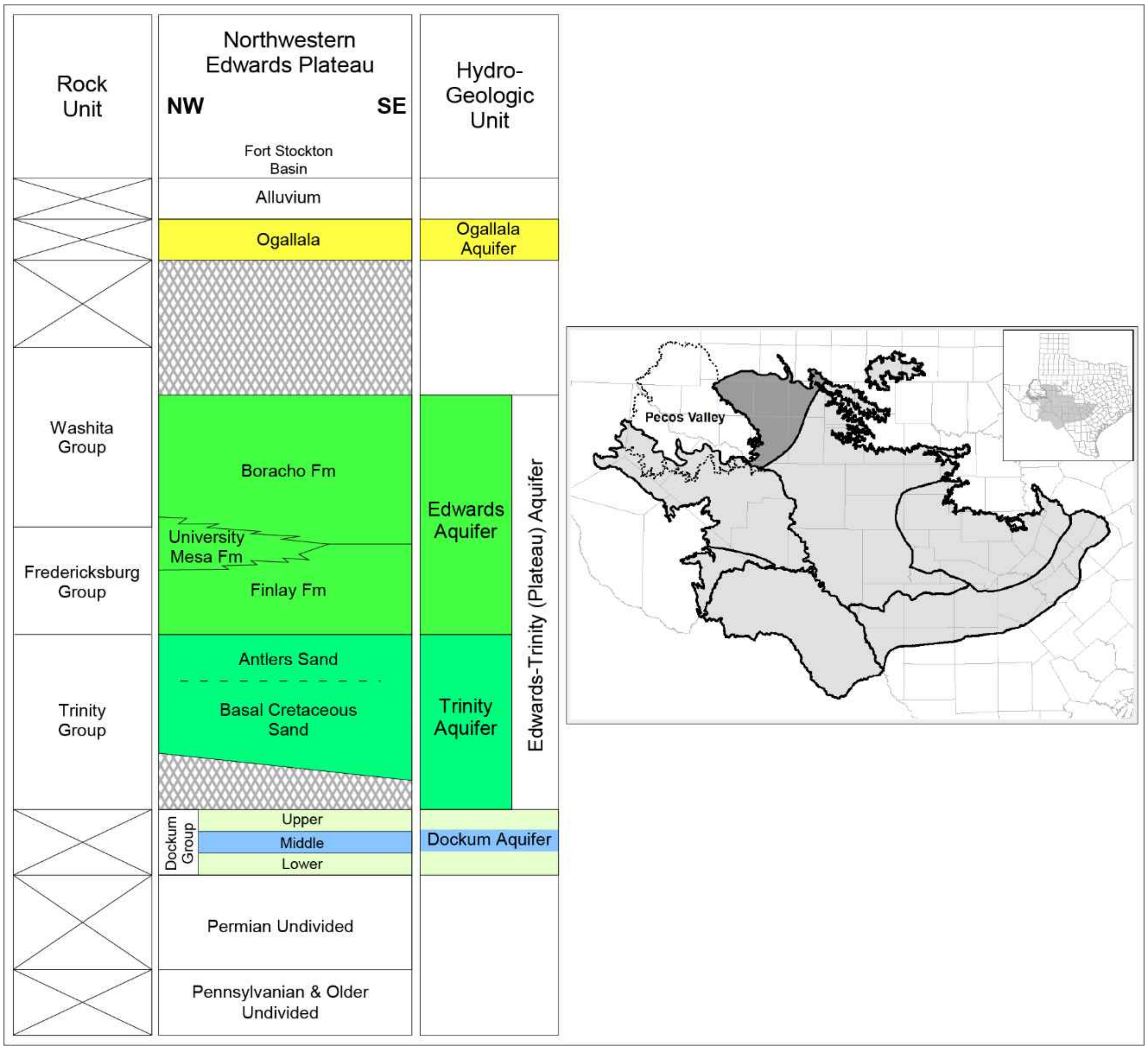


Figure 4.1-6. Hydrostratigraphy for the northwestern Edwards Plateau and Llano Estacado region.

4.1.5 Western Edwards Plateau (Trans-Pecos)

In the Trans-Pecos region, all three hydrostratigraphic units are present (Figure 4.1-7.). The younger hydrostratigraphic unit represents the Pecos Valley Aquifer. The Pecos Valley Aquifer consists of Tertiary and Quaternary age sediments that accumulated in the Pecos Valley, including the Tahoka, the Gatuna, the Judkins, and the Monahans formations. These units comprise a variety of discontinuous alluvium, lacustrine, eolian, and valley fill deposits, but act as one hydrostratigraphic unit despite their different origins and ages

(Anaya and Jones, 2009). The Pecos Valley Aquifer is only present in the northeastern section of this region. Elsewhere, the Del Rio Clay, Buda Limestone and the Boquillas Formation of the Upper Cretaceous do exist but are thin, discontinuous, and largely unsaturated. We do not consider them part of this hydrostratigraphic unit for this study.

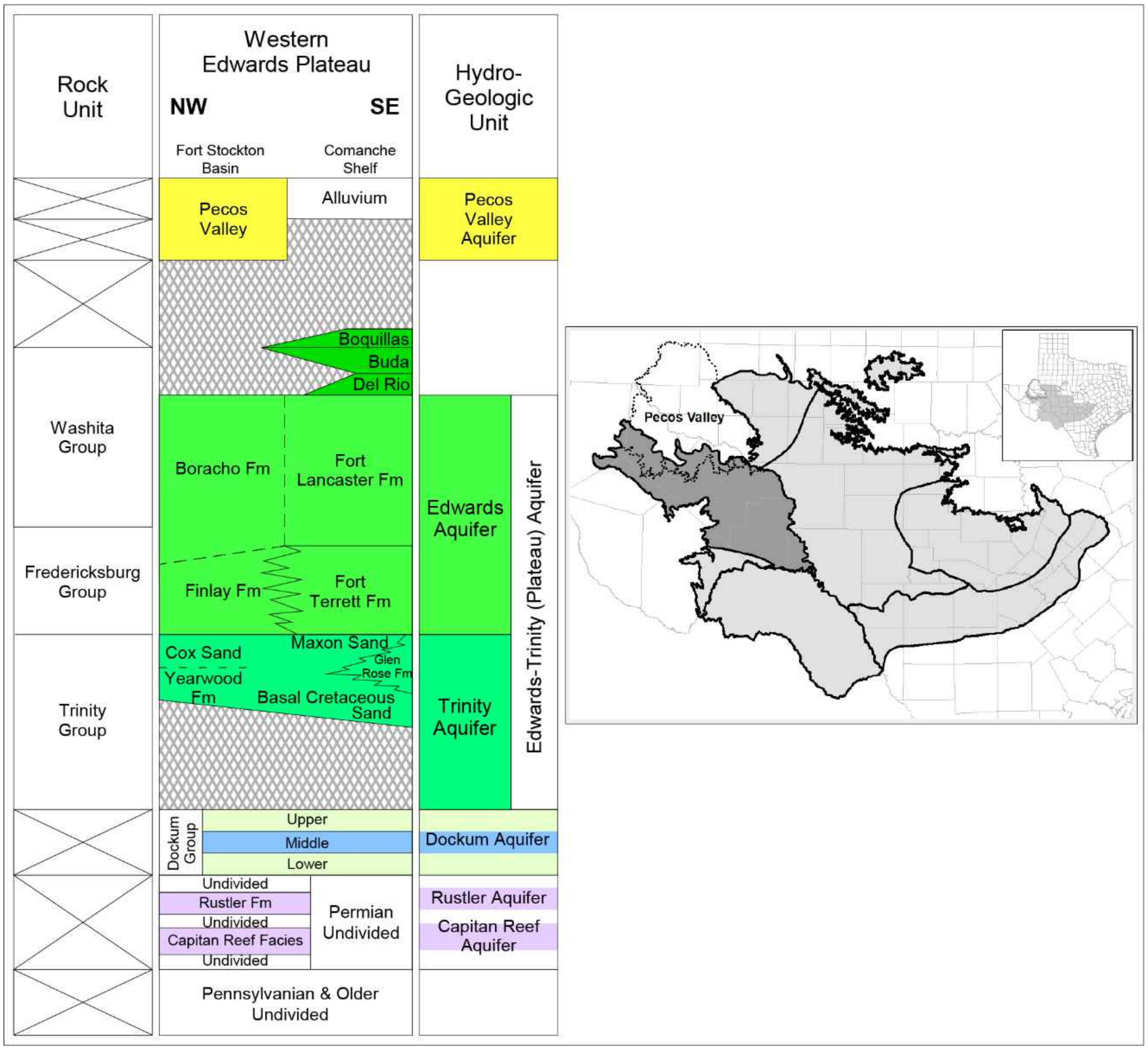


Figure 4.1-7. Hydrostratigraphy for the western Edwards Plateau and Trans-Pecos region.

The Edwards hydrostratigraphic unit represents the Fort Terrett, Fort Lancaster Finlay, and Boracho formations of the Edwards Group. The Fort Terrett Formation and the Fort Lancaster Formation formed within the Comanche Shelf environment, and the Finlay Formation and the Boracho Formation formed within the Fort Stockton Basin depositional environment. Locally, these four units, in a group, are referred to as Edwards Group Limestone, and they compose the Edwards portion of the Edwards-Trinity (Plateau) Aquifer.

The Trinity hydrostratigraphic unit represents Trinity Group rocks, including undifferentiated basal Cretaceous sands, the Glen Rose Formation, and the Maxon Sandstone. In the far northwestern Trans-Pecos region, this unit also includes the Yearwood Formation and the Cox Sandstone of the Trinity Group. Together, these units form the Trinity portion of the Edwards-Trinity (Plateau) Aquifer.

In this region, the Pecos Valley Aquifer is the major water-producing unit, followed by the Edwards-Trinity (Plateau) Aquifer, a combination of the Edwards and Trinity hydrostratigraphic units. Since the Edwards and Trinity hydrostratigraphic units comprise one aquifer in this region, we assume hydraulic connection between the two hydrostratigraphic units. At its southern edge, the Pecos Valley Aquifer overlies and is in hydraulic connection with the Edwards hydrostratigraphic unit. Elsewhere, it overlies the Triassic Dockum Aquifer and the Permian Capitan Reef Complex and Rustler aquifers. The difference in permeability between these units makes hydraulic connection unlikely. The Trinity hydrostratigraphic unit also overlies the Permian Capitan Reef Complex and Rustler aquifers and the Triassic Dockum Aquifer. Anaya and Jones (2009) assumed no significant hydraulic connection with these underlying units. However, Walker (1979) notes that the Dockum Aquifer and the Trinity hydrostratigraphic unit can be hydraulically connected where the Trinity Group directly overlies the Santa Rosa Formation of the Dockum Group (Walker, 1979).

4.1.6 Southwestern Edwards Plateau

In the Big Bend area of the Southwestern Edwards Plateau region, only the bottom two hydrostratigraphic units are present (Figure 4.1-8.). The Upper Cretaceous sediments, such as the Del Rio Clay, the Buda Limestone, and the Boquillas Formation are present but are discontinuous and largely unsaturated, so we do not consider them to be a separate hydrostratigraphic unit in this region.

The Edwards hydrostratigraphic unit represents the Telephone Canyon Formation (Fredericksburg), the Del Carmen Formation (Fredericksburg), Sue Peaks Formation (Frederickburg and Washita) and Santa Elena Formation (Lower Washita). Together, these units form the Edwards portion of the Edwards-Trinity (Plateau) Aquifer.

The Trinity hydrostratigraphic unit represents the Trinity Group rocks, including undifferentiated basal Cretaceous sands, Glen Rose Formation, and Maxon Sandstone. The

Glen Rose Formation pinches out in the southern portion of the region. Together, these units form the Trinity portion of the Edwards-Trinity (Plateau) Aquifer.

In this region, the major water-producing unit is the Edwards-Trinity (Plateau) Aquifer, a combination of the Edwards and Trinity hydrostratigraphic units. Since these two hydrostratigraphic units comprise one aquifer in this region, we assume hydraulic connection between them. The underlying Paleozoic rocks provide a relatively impermeable base for the Trinity hydrostratigraphic unit (Barker and Ardis, 1992), making hydraulic connection unlikely between the Trinity and underlying units.

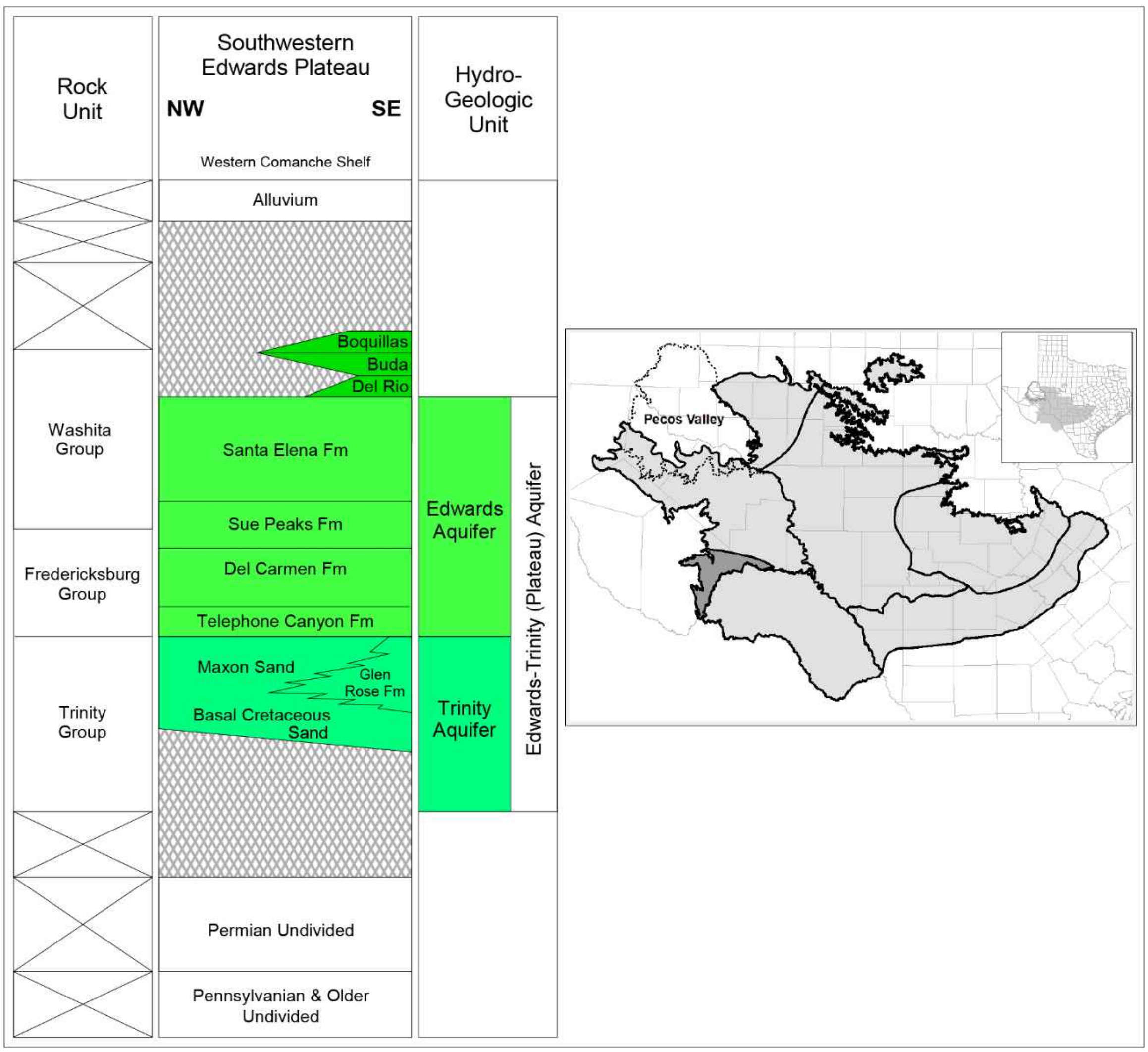


Figure 4.1-8. Hydrostratigraphy for the southewestern Edwards Plateau and Big Bend region.

4.1.7 Transboundary Edwards Plateau (Mexico)

In the Transboundary Edwards Plateau region, all three hydrostratigraphic units are present (Figure 4.1-9..) The geology is similar to the Central Edwards Plateau and Balcones regions, but with slightly different geologic names in Mexico. The younger hydrostratigraphic unit represents Upper Cretaceous ("Cretácico superior") units in the southeastern portion of the region, including the Del Rio Clay, Buda Limestone, and Boquillas Formation in the southeastern portion of the region, the San Vicente, Terlingua, and Aguja formations in the western portion of the region. In the southeastern section of this region, where these Upper Cretaceous units dip down into the subcrop, the youngest hydrostratigraphic unit also includes any overlying units from the top of the Upper Cretaceous to land surface, such as the Eagle Ford, Austin, Taylor, and Navarro groups (not shown in the stratigraphic column). Together, these act as a confining unit for the underlying Edwards hydrostratigraphic unit. In the west, Upper Cretaceous units can exist in isolated pods, but since these pieces are disconnected and largely unsaturated, we do not include them in the confining younger hydrostratigraphic unit.

The Edwards hydrostratigraphic unit represents Edwards facies similar to the Central Edwards Plateau region and the southwestern Edwards Plateau region. In the Maverick Basin area, this includes the West Nueces Formation (Fredericksburg), the McKnight Formation (Fredericksburg and Lower Washita), and the Salmon Peak Formation (Lower Washita). Within the Devils River Reef Trend, this includes the Devils River Formation (Fredericksburg and Lower Washita). In the Serrania Del Burro Arch area, this also includes the Telephone Canyon Formation (Fredericksburg), the Del Carmen Formation (Fredericksburg), the Sue Peaks Formation (upper Fredericksburg and Lower Washita) and Santa Elena Formation (Washita).

The Trinity hydrostratigraphic unit represents the Hosston Formation and its Mexican equivalent the La Mula Formation, the Sligo Formation and its Mexican equivalent the Cupido Formation, and the La Peña Formation (equivalent to the Pearsall Formation in Texas). The Glen Rose Limestone and overlying Maxon Sand are present in the Maverick Basin section in the east but grade into the La Peña Formation towards the west.

There is little available information about hydrogeology, water production and aquifer use in Mexico, so we assume it is similar to the Central Edwards Plateau region across the border. In this case, the younger hydrostratigraphic unit is assumed to act as a confining unit where it is present. Hydraulic connection between the Edwards and Trinity hydrostratigraphic units is also assumed. Underlying Paleozoic rocks provide a relatively impermeable base for the Trinity hydrostratigraphic unit, making hydraulic connection unlikely between the Trinity and underlying units.

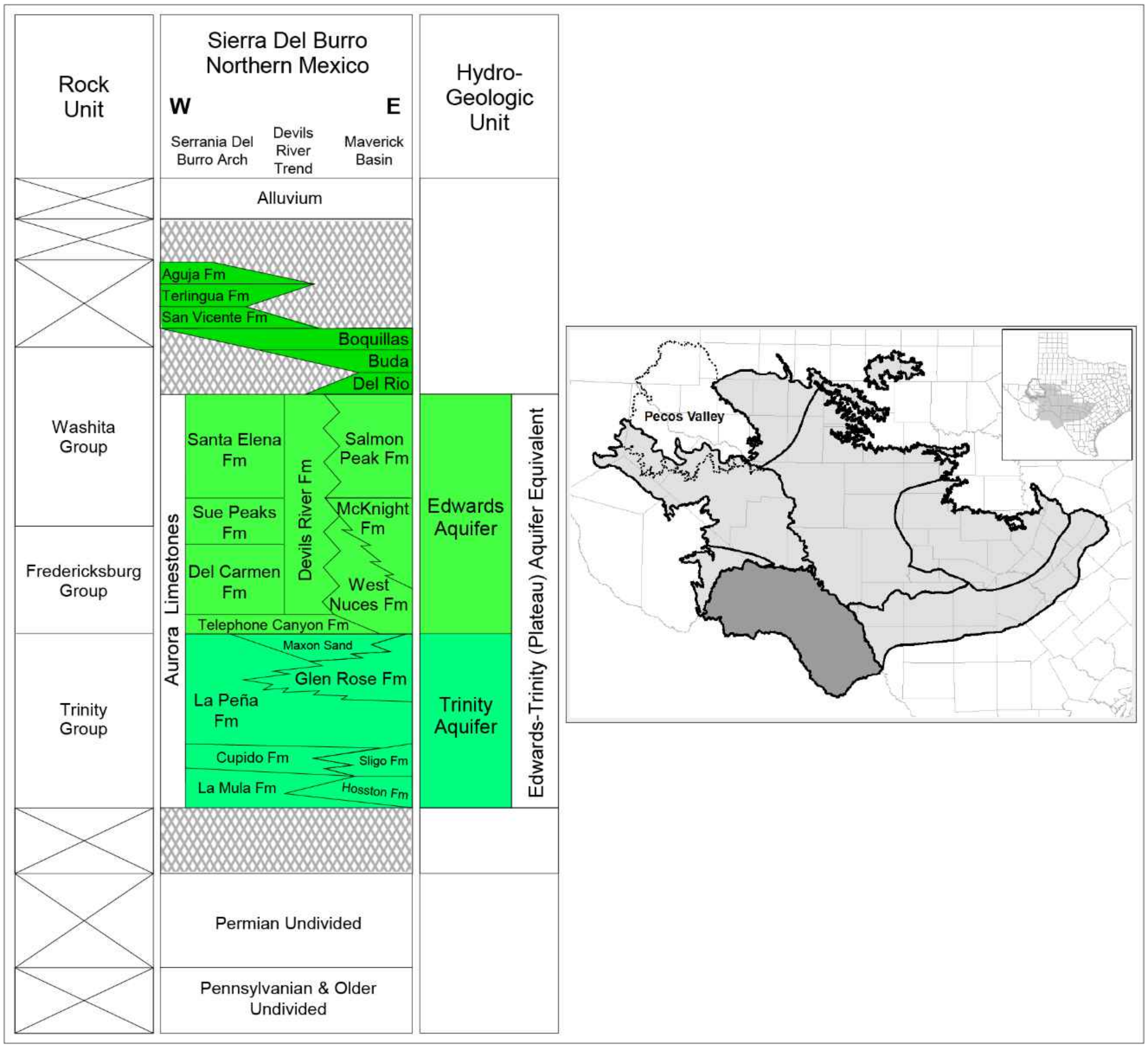


Figure 4.1-9. Hydrostratigraphy for the transboundary Edwards Plateau equivalent units within Mexico region.

4.2 Structural Framework

We have condensed the geology discussed in the previous section into three simplified layers. The following subsections discuss how we defined these layers, created elevation surfaces, and calculated thicknesses.

4.2.1 Pecos Valley Aquifer and other shallow units

The top layer (Layer 1) represents different geologic formations in different areas of the study area. In the northwestern portion of the study area, Layer 1 represents the Pecos Valley Aquifer and the Ogallala Aquifer. In the southeastern portion of the study area, Layer 1 represents younger shallow geologic formations that overlie the Edwards and Trinity formations and is conceptualized to act as a confining unit. Layer 1 does not exist in the rest of the study area, as these areas correspond either with outcrops where older rocks like the Edwards or Trinity formations are at land surface or with areas where overlying shallow formations are not conceptualized to act as a confining unit.

The top of Layer 1 is equivalent to land surface as defined by the National Elevation Dataset (U.S. Geological Survey, 2014) 30-meter resolution Digital Elevation Model (Figure 4.2-1). In the area corresponding to the spatial extent of the Pecos Valley Aquifer, the bottom of Layer 1 (Figure 4.2-2) is based on the Pecos Valley Aquifer surfaces created by the TWDB's Brackish Resources Aquifer Characterization System (BRACS) program (Meyer and others, 2012). The bottom of Layer 1 in this area is equal to the Meyers and others (2012) Pecos Valley Aquifer thickness raster subtracted from the top of Layer 1 (land surface). Any gaps were filled between the official extents of the Pecos Valley and Edwards-Trinity (Plateau) aquifers by extrapolating the Meyer and others (2012) surface using the *Topo to Raster* tool in ArcGIS Pro.

In the area corresponding to the spatial extent of the Ogallala Aquifer, the bottom of Layer 1 (Figure 4.2-2) is based on the Ogallala surfaces created as part of the High Plains Aquifer System Groundwater Availability Model (Deeds and others, 2015). The bottom of Layer 1 in this area is equal to the Deeds and others (2015) Ogallala thickness raster subtracted from the top of Layer 1 (land surface).

In the southeastern portion of the study area, Layer 1 represents Upper Cretaceous and other younger units such as the Del Rio Clay, Buda Limestone, Eagle Ford Group, Austin Group, and Anacocho Limestone that overlie the Edwards and Trinity hydrostratigraphic units. These units were conceptualized to potentially act as a confining unit for the underlying Edwards and Trinity hydrostratigraphic units. In Texas, Layer 1 extends from the southern edge of the Edwards (Balcones Fault Zone) Aquifer outcrop and the Edwards-Trinity (Plateau) Aquifer outcrop to the southeastern boundary of the study area. In Mexico, Layer 1 extends from the approximate western edge of the Upper Cretaceous outcrop provided by the Instituto Nacional de Estadistica y Geografia geologic maps (1982a; 1982b; 1982c; 1982d) to the southeastern boundary of the study area. The bottom of Layer 1 (Figure 4.2-2) in the southeastern portion of the study area is equivalent to the top of Layer 2, as defined in the following section.

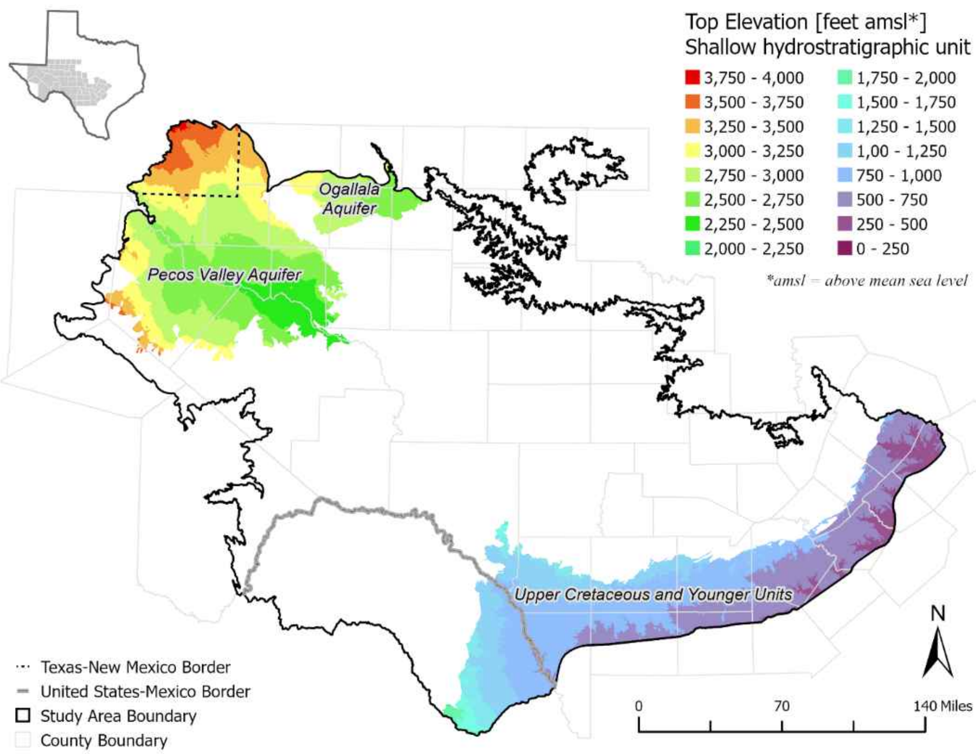


Figure 4.2-1. Elevation of the top of the shallow hydrostratigraphic unit (Layer 1).

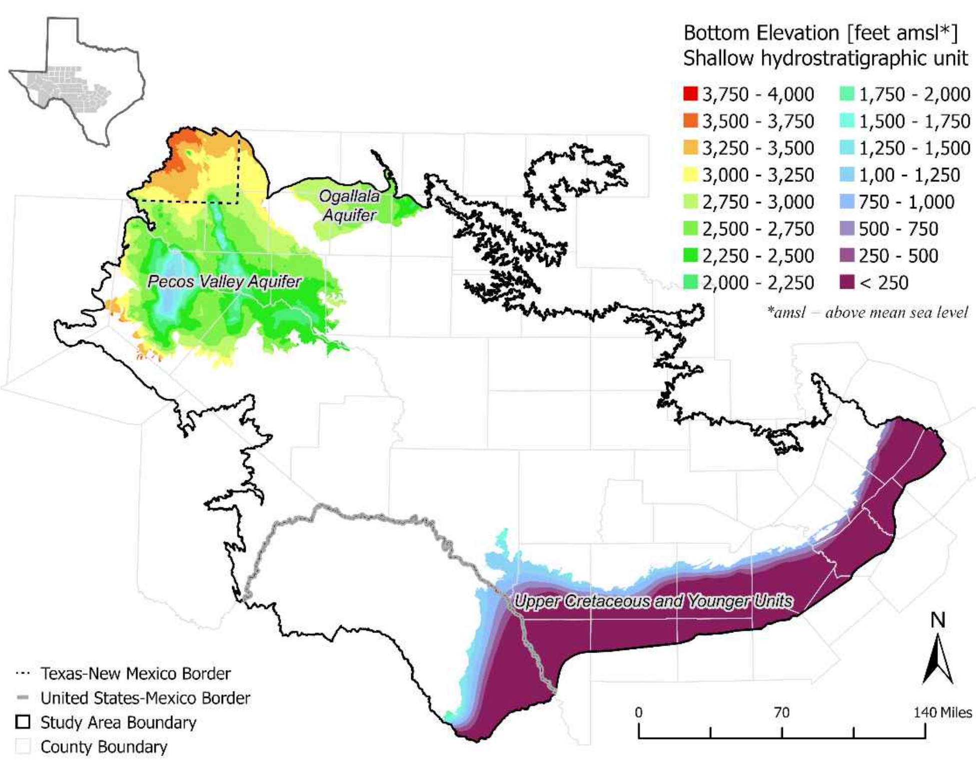


Figure 4.2-2. Elevation of the bottom of the shallow hydrostratigraphic unit (Layer 1).

Thickness

Figure 4.2-3 shows the thickness of Layer 1. In the area representing the Pecos Valley and Ogallala Aquifers, the thickness is equivalent to the thickness rasters in the source datasets described above. In the subcrop area in the southeastern portion of the study area, the thickness is equal to the top of Layer 2 (defined in Section 4.2.2 following section) subtracted from the top of Layer 1 (land surface).

In the portion of Layer 1 representing the Pecos Valley Aquifer, the median thickness is 119 feet. The largest thickness values (over 1,500 feet) occur in the center of two basins known as the Pecos Trough in Pecos and Loving counties and the Monument Draw Trough in Winkler and Ward counties. The smallest thickness values (near zero) occur along the edges of the aquifer and along a ridge of Dockum Formation that separates the Pecos and Monument Draw troughs. In the portion of Layer 1 representing the Ogallala Aquifer, thickness ranges from near zero to over 400 feet, with a median thickness of about 100 feet. In the portion of Layer 1 representing Upper Cretaceous and younger units, thickness ranges from near zero to over 4,500 feet with a median thickness of about 1,400 feet. Thickness increases consistently with distance from the boundary with the Edwards hydrostratigraphic unit towards the southeast boundary of the study area.

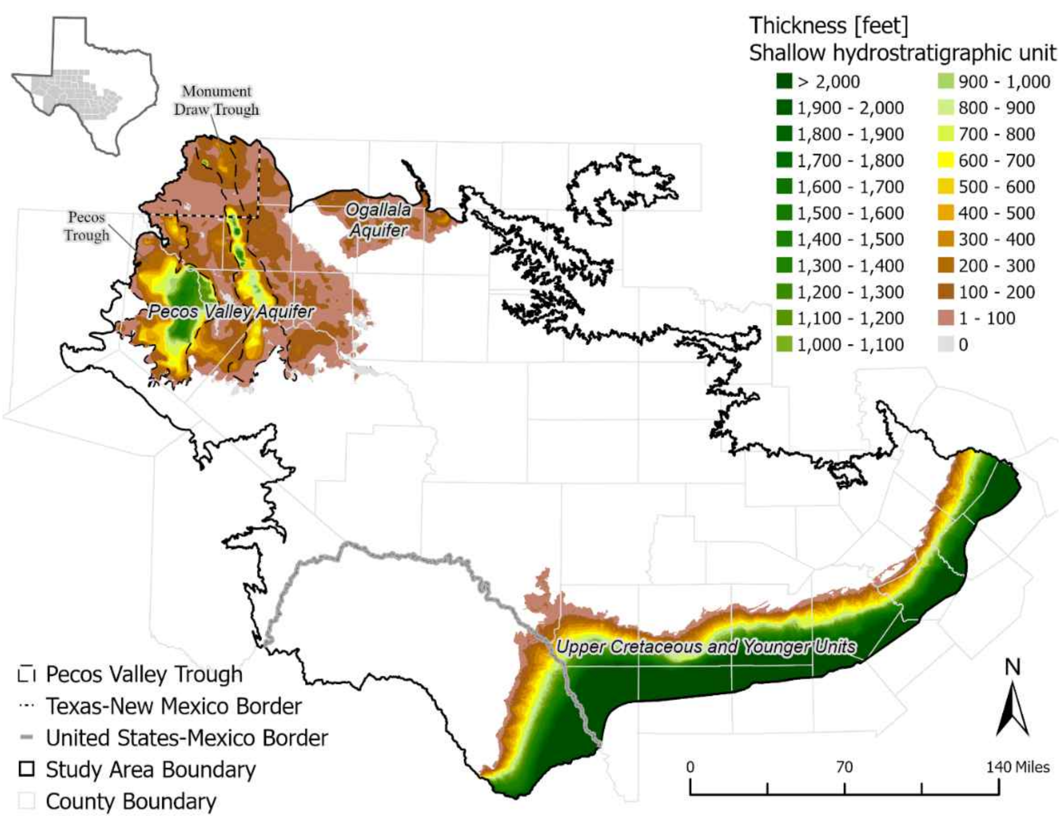


Figure 4.2-3. Thickness of the shallow hydrostratigraphic unit (Layer 1).

4.2.2 Edwards hydrostratigraphic unit

The middle layer (Layer 2) represents the Edwards hydrostratigraphic unit. In the southeastern portion of the study area, Layer 2 represents the Edwards (Balcones Fault Zone) Aquifer and equivalent downdip units. In the remainder of the study area, the layer represents the Edwards hydrostratigraphic unit within the Edwards-Trinity (Plateau) Aquifer in Texas and the equivalent units in Mexico.

Extent of Outcrop

In the area corresponding to the Edwards (Balcones Fault Zone) Aquifer, the outcrop of Layer 2 coincides with the extent of the Edwards (Balcones Fault Zone) Aquifer outcrop. In the remainder of the study area in Texas, the outcrop of Layer 2 is equivalent to the Edwards-Trinity (Plateau) Aquifer outcrop except where Layer 2 does not exist (where Layer 3 outcrops instead, as defined in Section 4.2.3). In the portion of the study area within Mexico, the outcrop of Layer 2 is equivalent to the extent of the study area except where Layer 2 does not exist (where Layer 3 outcrops instead, as defined in Section 4.2.3). Figure 4.2-4 shows the comparison between the surface geology and the simplified extent of the Edwards hydrostratigraphic unit outcrop.

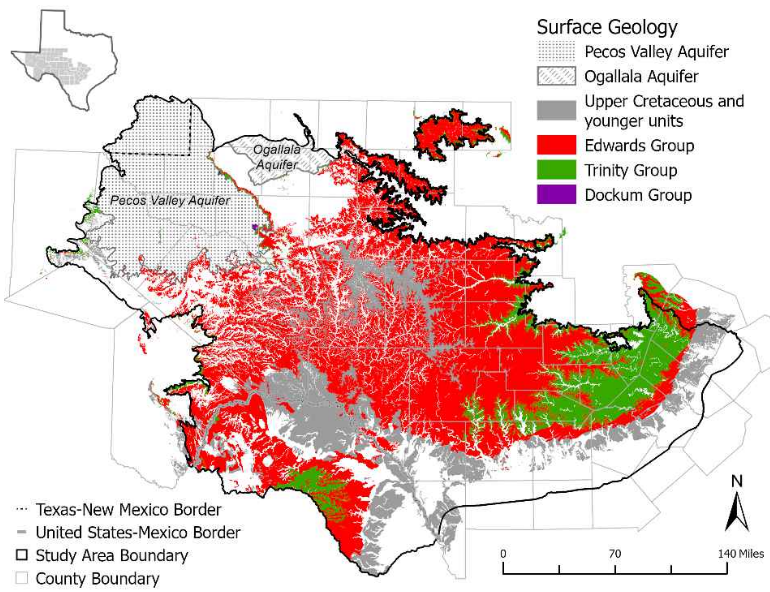
Within the extent of the Edwards-Trinity (Plateau) Aquifer, several Upper Cretaceous units exist as erosional remnants capping formations of the Edwards and Trinity Groups. Since these remnants are discontinuous, thin, and largely unsaturated, we did not include these formations as a separate layer but combined them into the simplified Layer 2. For this reason, please note that the *Edwards* hydrostratigraphic unit (Layer 2) referred to in this report can actually include some *non-Edwards* geologic units, as shown in Figure 4.2-4. This is consistent with the current mapping of the Edwards-Trinity (Plateau) Aquifer as well as with the approach used in the previous groundwater availability model (Anaya and Jones, 2009). In Mexico, all units were included from the top of the Edwards Group geologic units to land surface into Layer 2. As in Texas, this includes several Upper Cretaceous ("Cretácico superior") outcrops that exist as erosional remnants capping Edwards and Trinity units but also includes several large alluvial units. We considered this an acceptable simplification for the current analysis, as the study does not intend to use this model to provide comprehensive groundwater flow information in Mexico. However, readers interested in groundwater flow conditions in Mexico should be aware of these simplifications and interpret the current analysis accordingly.

Extent of Subcrop

In the area underneath the Pecos Valley Aquifer, the extent of the Layer 2 subcrop is equivalent to the extent of the Edwards-Trinity (Plateau) Aquifer created by the TWDB's Brackish Resources Aquifer Characterization System program (Meyer and others, 2012), though we did remove some discontinuous remnants or "islands". Please note that while this extent does not coincide with the official extent of the subcrop of the Edwards-Trinity (Plateau) Aquifer (see Figure 4.2-4), it does represent the most up-to-date TWDB interpretation of the extent of this unit.

In the area underneath the Ogallala Aquifer, the extent of the Layer 2 subcrop is equivalent to the extent of the Ogallala Aquifer. In the southeastern section of the model, the extent of the Layer 2 subcrop coincides with the extent of Layer 1 as described in the previous section.

(A)



(B)

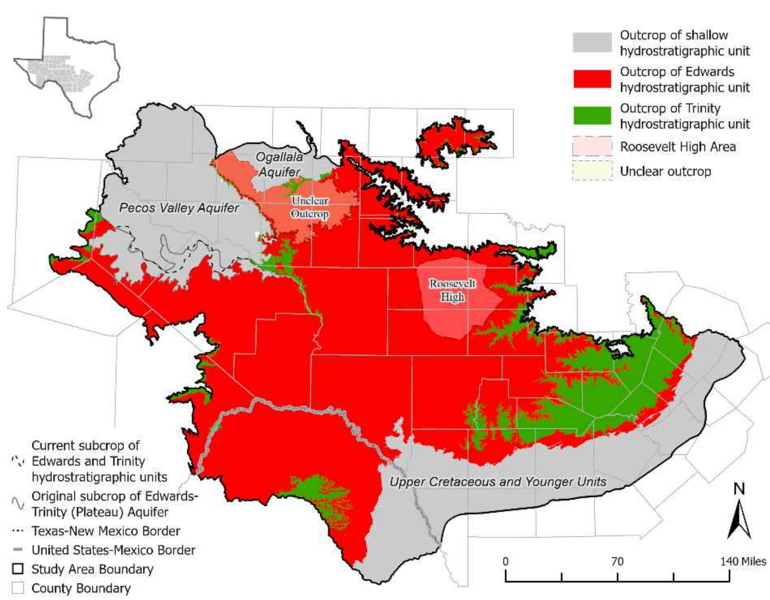


Figure 4.2-4. (A) Surface geology and (B) extents of corresponding hydrostratigraphic units.

Top Elevation

Figure 4.2-5 provides the top elevation of Layer 2. In the outcrop area of Layer 2, the top of Layer 2 is equivalent to land surface as defined by the National Elevation Dataset 30-meter resolution Digital Elevation Model. In the subcrop areas underlying the Pecos Valley and Ogallala aquifers, the top of Layer 2 is equivalent to the bottom of Layer 1, as defined in the previous section. These surfaces are represented by contour lines in Figure 4.2-5. In the subcrop area in the southeastern portion of the study area, we compiled a set of control points for the top of Layer 2, shown as dark gray dots (*Edwards Top Control Point*) in Figure 4.2-5. The Layer 2 top control points include:

- Stratigraphic picks representing the top of the Georgetown Formation from the Barton Springs Edwards Aquifer Conservation District, (Barton Springs/Edwards Aquifer Conservation District, 2020);
- Contours representing the top of the Georgetown Formation, derived from a United States Geological Survey model of the Edwards Aquifer (Brakefield and others, 2015); and
- Stratigraphic picks representing either the top of the Georgetown Formation or the bottom of the Del Rio Clay from the TWDB Brackish Resources Aquifer Characterization System database (TWDB, 2021b).

Additional control points were also used to enforce boundaries, provide control in areas of sparse to no data, and to smooth the transitions at boundaries between the outcrop at land surface and the interpolated subcrop surface. These boundary control points, shown as white squares (*Boundary Control Point*) in Figure 4.2-5, include:

- Points along the southern boundary of the Edwards (Balcones Fault Zone) Aquifer outcrop with an elevation equal to the National Elevation Dataset 30-meter resolution Digital Elevation Model (to avoid elevation jumps at the edge of the outcrop); and
- Contours representing the depositional shape of Buda Limestone in Mexico, georeferenced from Smith and others (2000) and set equal to estimated elevation values for the top of Layer 2 (to enforce drainage to the Rio Grande from Layer 2 in Mexico).

The Layer 2 control points and the boundary control points were interpolated using the *Topo To Raster* tool in ArcGIS Pro. Faults are from the TWDB Brackish Resources Aquifer Characterization System map of the Hill Country portion of the Trinity Aquifer (Robinson and others, in review) and implemented as "Cliffs" in the interpolation tool. The final Layer 2 surface is equivalent to this interpolated surface, with the following corrections to avoid inversions: in the outcrop, the Layer 2 surface is corrected to the National Elevation Dataset 30-meter resolution Digital Elevation Model values; in the subcrop under the Pecos Valley and Ogallala aquifers, the Layer 2 surface is corrected to the values of the bottom of Layer 1 (defined in Section 4.2.1).

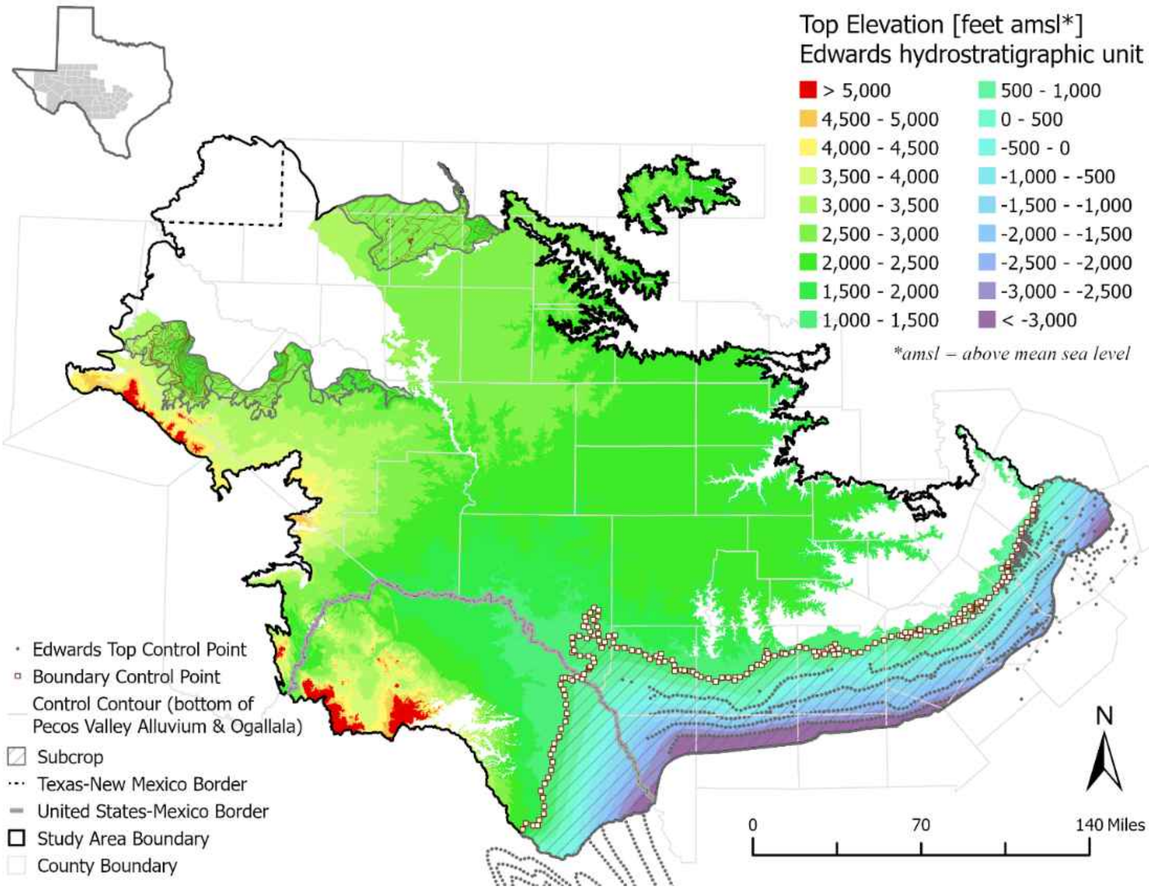


Figure 4.2-5. Elevation of the top of the Edwards hydrostratigraphic unit (Layer 2).

Thickness

Figure 4.2-6 shows the thickness of Layer 2. Thickness was calculated by subtracting the top of Layer 3 (defined in Section 4.2.3) from the top of Layer 2. In the portion of Layer 2 representing the Edwards-Trinity (Plateau) Aquifer and equivalent units in Mexico, thickness ranges from near zero to over 5,500 feet with a median thickness of 346 feet. The thickest portions correspond to mountainous areas along the western boundary of the study area and in Mexico. Combining overlying sediments into Layer 2 resulted in large thickness values in these areas. The thickness also consistently increases downdip from the Rio Grande towards the southernmost boundary of the study area in Mexico. In the subcrop underneath the Ogallala Aquifer, there is a section of zero thickness that we assumed represents an area where the Edwards hydrostratigraphic unit has been eroded away. In the portion of Layer 2 representing the Edwards (Balcones Fault Zone) Aquifer, thickness ranges from near zero to over 1,800 feet with a median thickness of 610 feet. Due to the highly faulted nature of this region, there is not a consistent trend downdip from the outcrop towards the southeast boundary of the study area.

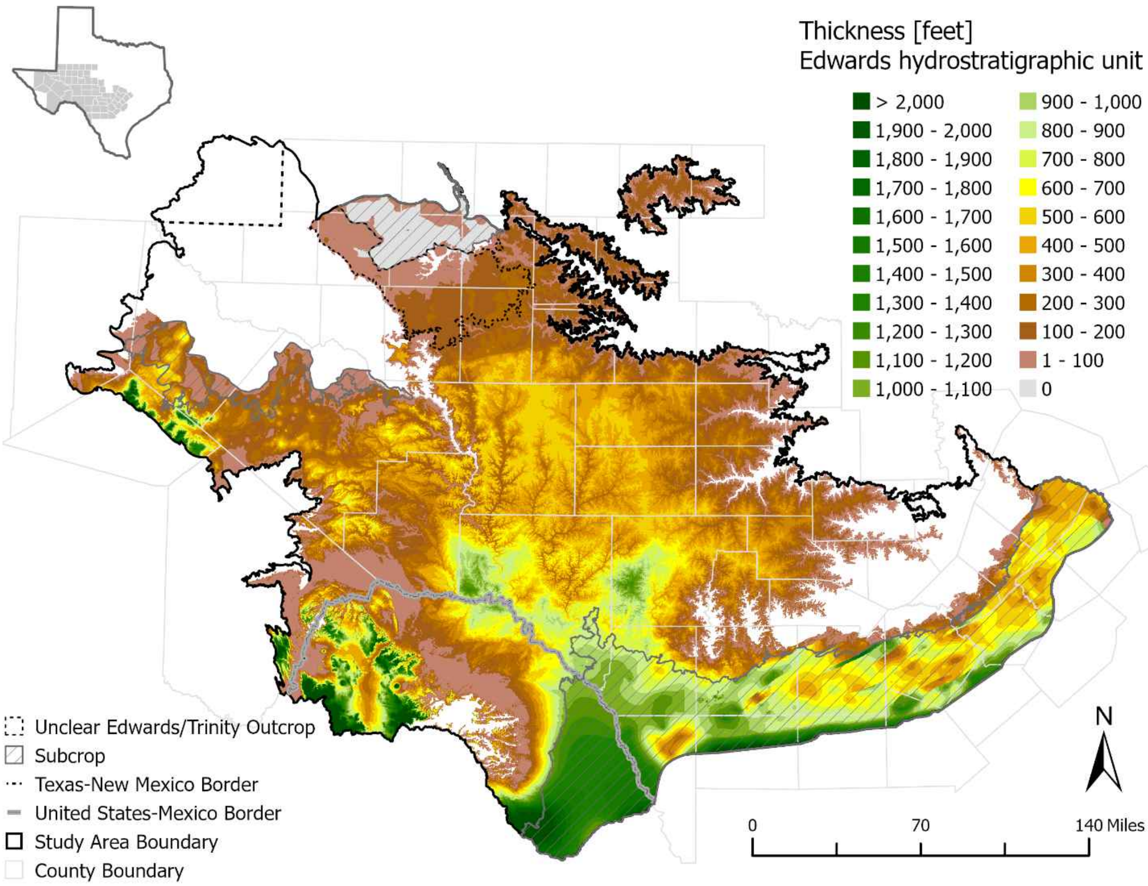


Figure 4.2-6. Thickness of the Edwards hydrostratigraphic unit (Layer 2).

4.2.3 Trinity hydrostratigraphic unit

The bottom layer (Layer 3) represents the Trinity hydrostratigraphic unit. In the eastern portion of the study area, Layer 3 represents the Hill Country portion of the Trinity Aquifer and equivalent downdip units. In the remainder of the study area, the layer represents the Trinity hydrostratigraphic unit within the Edwards-Trinity (Plateau) Aquifer in Texas and the equivalent units in Mexico.

Extent of outcrop

In the area corresponding to the Hill Country portion of the Trinity Aquifer, the extent of the Layer 3 outcrop is equivalent to the outcrop of the Hill Country portion of the Trinity Aquifer. In the remainder of the study area in Texas, the extent of the Layer 3 outcrop is equivalent to the extent of the Trinity surface outcrops in the Geologic Atlas of Texas. In Mexico, the extent of the Layer 3 outcrop is equivalent to the extent of the Glen Rose Formation outcrop, georeferenced from Smith (1970). Figure 4.2-4 shows the comparison between the surface geology and the simplified extent of the Trinity hydrostratigraphic unit outcrop.

Extent of Subcrop

The extent of the Layer 3 subcrop is equivalent to the extent of Layer 2. The exception is a small area in eastern Schleicher, western Menard, northeastern Sutton, and northwestern Kimble counties, where the Layer 3 does not exist. These gaps are consistent with gaps in the "Roosevelt High" area of the Trinity hydrostratigraphic unit in Anaya and Jones (2009). In this area, a Permian ridge creates a localized structural high that creates an extremely thin or nonexistent Trinity hydrostratigraphic unit. Figure 4.2-4(B) shows this area as a dashed line.

Top Elevation

Figure 4.2-7 provides the top elevation of Layer 3. In the outcrop area, the top of Layer 3 is equivalent to land surface as defined by the National Elevation Dataset 30-meter resolution Digital Elevation Model. In the subcrop area elsewhere in the study area, we compiled a set of control points for the top of Layer 3, shown as dark gray dots (*Trinity Top Control Point*) in Figure 4.2-7. The Layer 3 top control points include:

- Stratigraphic picks representing the top of the Trinity Group, from the Barton Springs Edwards Aquifer Conservation District, (Barton Springs/Edwards Aquifer Conservation District, 2020);
- Stratigraphic picks representing the top of the Glen Rose Formation, from the Hill Country Underground Water Conservation District, (Hill Country Underground Water Conservation District, 2020);
- Stratigraphic picks representing the top of the Trinity Group, from the TWDB Brackish Resources Aquifer Characterization System database (TWDB, 2021b);
- Stratigraphic picks representing the top of the "Trinity layer" from the U.S. Geological Survey model of the Edwards-Trinity Aquifer in Pecos County (Bumgarner and others, 2012);
- Stratigraphic picks representing the top of the Trinity group, from TWDB Brackish Resources Aquifer Characterization System project mapping the Hill Country portion of the Trinity Aquifer (Robinson and others, in review);
- Stratigraphic picks representing the top of the Trinity Group, from Walker (1979);
- Contours representing "the top of the Trinity strata and base of Fredericksburg strata," georeferenced from Barker and Ardis (1996); and
- Contours representing the land surface elevation in the outcrop of the Glen Rose Formation in Mexico, georeferenced from Smith (1970).

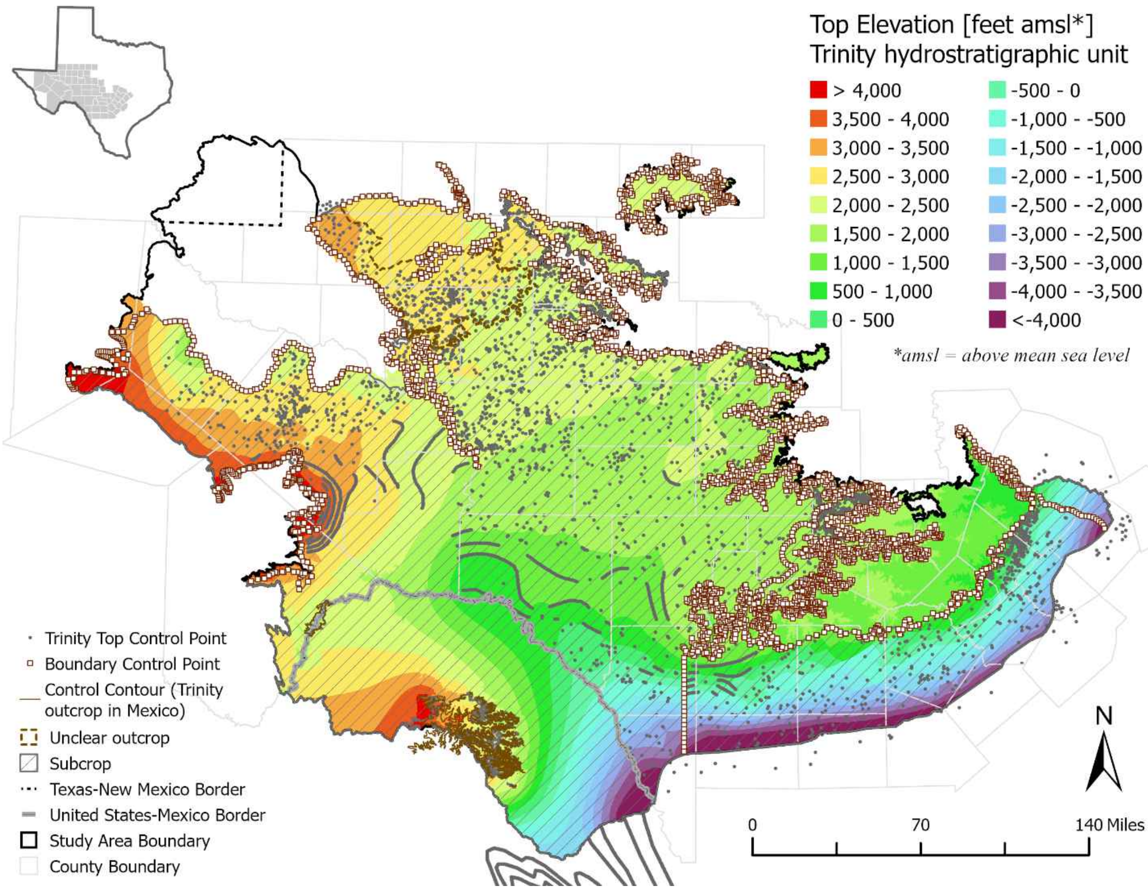


Figure 4.2-7 Elevation of the top of the Trinity hydrostratigraphic unit (Layer 3).

Additional control points were also used to enforce boundaries, provide control in areas of sparse to no data, and to smooth the transitions at boundaries between different regions. These boundary control points, shown as white squares (*Boundary Control Point*) in Figure 4.2-7, include:

- Points along the northern boundary of the Edwards-Trinity (Plateau) Aquifer subcrop under the Pecos Valley Aquifer, set equal to 10 feet below the bottom elevation of Layer 1 (to enforce a pinch-out at the aquifer boundary);
- Points along the northern boundary of the Edwards-Trinity (Plateau) Aquifer subcrop under the Ogallala Aquifer, set equal to 10 feet below the bottom elevation of Layer 1 (to enforce a pinch-out at the aquifer boundary);
- Points along the boundary between the outcrop of Layer 2 and the outcrop of Layer 3 and between the outcrop of Layer 1 (in the Ogallala Aquifer area) and the outcrop of Layer 3, set to the National Elevation Dataset 30-meter resolution Digital Elevation Model (to smooth the transition from outcrop to subcrop);
- Points along the western boundary corresponding to outcrops of older Pennsylvanian and Permian-age units, as defined by the Geologic Atlas of Texas, set

equal to 10 feet below the National Elevation Dataset 30-meter resolution Digital Elevation Model (to enforce a pinch-out at the aquifer boundary);

- Points along the Robinson and others (in review) boundary of the Hill Country portion of the Trinity Aquifer (to smooth the transition between Plateau and Hill Country region); and
- Contours representing the depositional shape of Buda Limestone in Mexico, georeferenced from Smith and others (2000) and set equal to estimated elevation values for the top of Layer 3 (to enforce drainage to the Rio Grande from Layer 3 in Mexico).

The Layer 3 top control points and the boundary control points were interpolated using the *Topo To Raster* tool in ArcGIS Pro. Faults are from the TWDB Brackish Resources Aquifer Characterization System map of the Hill Country portion of the Trinity Aquifer (Robinson and others, in review) and implemented as "Cliffs" in the interpolation tool. The final Layer 3 top surface is equivalent to this interpolated surface, with the following corrections to avoid inversions. In the outcrop, the surface is corrected to the values of the National Elevation Dataset 30-meter resolution Digital Elevation Model. In the area corresponding to the Robinson and others (in review) extent, the surface is corrected to the topmost elevation of all combined Trinity subunit surfaces provided in that report.

In the majority of the study area, if the top of Layer 3 was higher than Layer 2, we corrected these inversions by assigning them a value of 10 feet below the top elevation of Layer 2. However, as shown by the Trinity outcrop along the southern edge of the Ogallala Aquifer, there are areas where streams have eroded the Edwards hydrostratigraphic unit away, exposing the Trinity hydrostratigraphic unit. In these areas, enforcing a minimum Edwards thickness is inappropriate. Unfortunately, the surface geology in this area is unhelpful for distinguishing eroded areas since the Edwards-Trinity (Plateau) Aquifer is covered by either the Ogallala Aquifer or thin eolian sediments just south of the Ogallala Aquifer. This area has been marked with a dotted line in Figure 4.2-6. Since it is unclear whether this area represents an outcrop of the Edwards or the Trinity hydrostratigraphic unit, Layer 3 inversions with Layer 2 were not corrected by enforcing a minimum thickness in this area. Instead, it was assumed that these inversions represented areas where the Edwards hydrostratigraphic unit was eroded away, so a thickness of zero was used.

Bottom Elevation

Figure 4.2-8 provides the bottom elevation of Layer 3. We compiled a set of control points for the bottom of Layer 3, shown as dark gray dots (*Trinity Bottom Control Point*) in Figure 4.2-8. The Layer 3 bottom control points include:

- Stratigraphic picks representing the base of the Trinity Group, from the Barton Springs Edwards Aquifer Conservation District, (Barton Springs/Edwards Aquifer Conservation District, 2020);

- Stratigraphic picks representing the base of the Trinity Group, from the TWDB Brackish Resources Aquifer Characterization System database (TWDB, 2021b);
- Stratigraphic picks representing the base of the "Trinity layer" from the U.S. Geological Survey model of the Edwards-Trinity Aquifer in Pecos County (Bumgarner and others, 2012);
- Stratigraphic picks representing the top of the Lipan Aquifer below the Edwards-Trinity (Plateau) Aquifer, from TWDB Brackish Resources Aquifer Characterization System project mapping the Lipan Aquifer (Robinson and others, 2018);
- Stratigraphic picks representing the base of the Trinity Group, from the TWDB Brackish Resources Aquifer Characterization System mapping project for the Hill Country portion of the Trinity Aquifer (Robinson and others, in review);
- Stratigraphic picks representing the bottom of the Edwards-Trinity (Plateau) Aquifer, from the groundwater availability model for the High Plains Aquifer System (Deeds and others, 2015);
- Stratigraphic picks representing the base of "Cretaceous aquifers," from the groundwater availability model for the minor aquifers of the Llano Uplift region (Shi and others, 2016); and
- Contours representing "base of the Edwards-Trinity Aquifer," georeferenced from Barker and Ardis (1992).

Additional control points were used to enforce boundaries, provide control in areas of sparse to no data, and to smooth the transitions at boundaries between different regions. These boundary control points, shown as white squares (*Boundary Control Point*) in Figure 4.2-8, include:

- Points along the northern boundary of the Edwards-Trinity (Plateau) Aquifer subcrop under the Pecos Valley Aquifer, set equal to 20 feet below the bottom elevation of Layer 1 (to enforce a pinch-out at the aquifer boundary);
- Points along the northern boundary of the Edwards-Trinity (Plateau) Aquifer subcrop under the Ogallala Aquifer, set equal to 20 feet below the bottom elevation of Layer 1 (to enforce a pinch-out at the aquifer boundary);
- Points along the western boundary corresponding to outcrops of older Pennsylvanian and Permian-age units, as mapped by the Geologic Atlas of Texas, set equal to 20 feet below the National Elevation Dataset 30-meter resolution Digital Elevation Model (to enforce a pinch-out at the aquifer boundary);
- Points along the Robinson and others (in review) boundary of the Hill Country portion of the Trinity Aquifer (to smooth the transition between Plateau and Hill Country region);
- Contours representing the depositional shape of Buda Limestone in Mexico, georeferenced from Smith and others (2000) and set equal to estimated elevation values for the bottom of Layer 3 (to enforce drainage to the Rio Grande from Layer 3 in Mexico); and

- Contours representing the land surface elevation in the outcrop of the Glen Rose Formation in Mexico minus 1,500 feet, georeferenced from Smith (1970) (to enforce a reasonable thickness at the model's southern boundary).

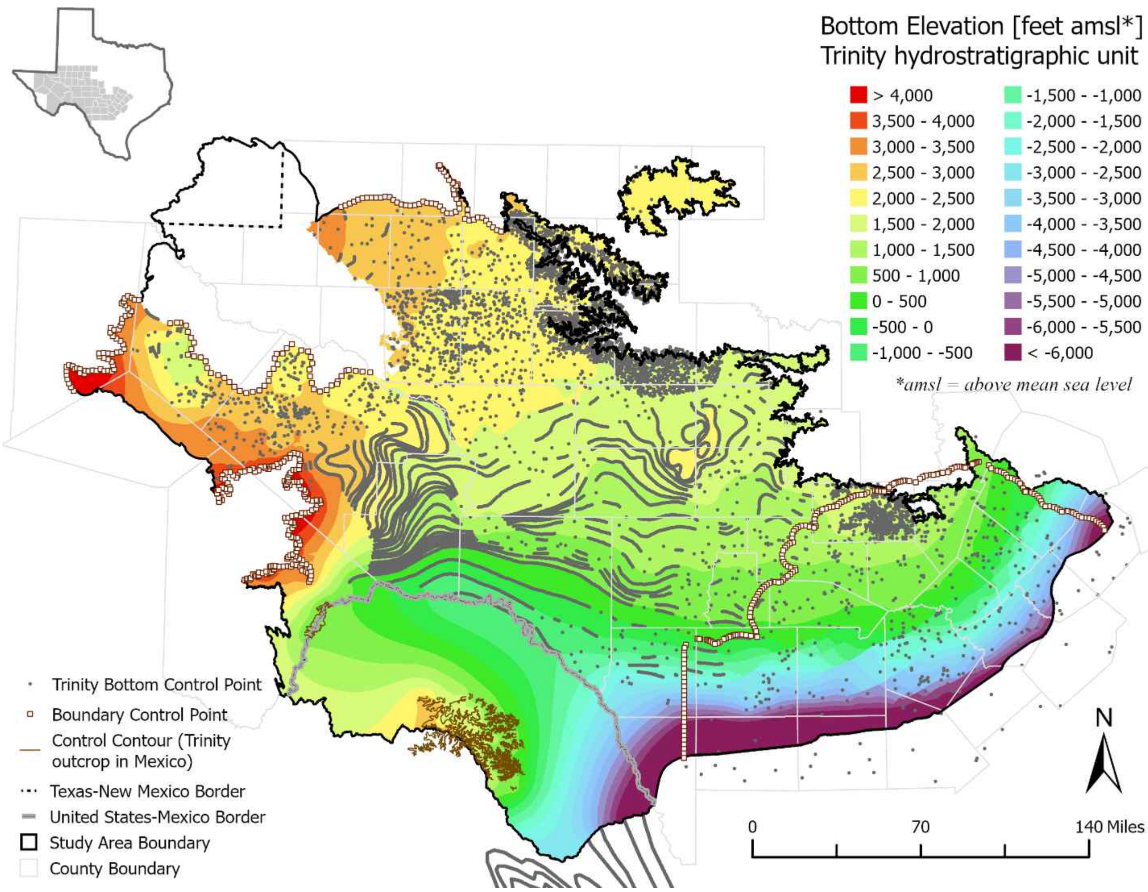


Figure 4.2-8. Elevation of the bottom of the Trinity hydrostratigraphic unit (Layer 3).

The Layer 3 bottom control points and the boundary control points were interpolated using the *Topo To Raster* tool in ArcGIS Pro. Faults are from the TWDB Brackish Resources Aquifer Characterization System map of the Hill Country portion of the Trinity Aquifer (Robinson and others, in review) and implemented as "Cliffs" in the interpolation tool. The final Layer 3 bottom surface is equivalent to this interpolated surface, with the following corrections to avoid inversions. In the area corresponding to the Robinson and others (in review) extent, the Layer 3 bottom surface is corrected to the base of Trinity raster from that report.

In the majority of the study area, if the bottom of Layer 3 was higher than the top of Layer 3, we corrected these inversions by assigning them a value of 10 feet below the top elevation of Layer 3. However, as noted earlier, the Trinity hydrostratigraphic unit is extremely thin to nonexistent in the "Roosevelt High" area in the central Plateau region.

Enforcing a minimum Trinity thickness in that area is not reasonable. We have marked this area with a dashed line in Figure 4.2-9. In this area, inversions were not corrected by enforcing a minimum thickness between the bottom and top of Layer 3. Instead, we assumed that these inversions represented areas where the Trinity hydrostratigraphic unit was absent and enforced a thickness of zero.

Thickness

Figure 4.2-9 shows the thickness of Layer 3. The thickness is equivalent to the bottom surface of Layer 3 subtracted from the top surface of Layer 3. In the portion of Layer 3 representing the Edwards-Trinity (Plateau) Aquifer and equivalent units in Mexico, the thickness ranges from near zero to over 4,700 feet with a median thickness of about 450 feet. Thickness generally increases from north to south. In the portion of Layer 3 representing the outcrop of the Hill Country portion of the Trinity Aquifer, thickness ranges from near zero to over 2,500 feet with a median thickness of about 730 feet. The thinnest sections correspond with eroded river valleys. In the portion of Layer 3 representing the subcrop of the Southern portion of the Trinity Aquifer, thickness ranges from about 75 feet to over 4,200 feet with a median thickness of about 2,040 feet. Thickness generally increases consistently with distance from the outcrop towards the southeastern boundary of the current model, with some variation in this trend due to faulting.

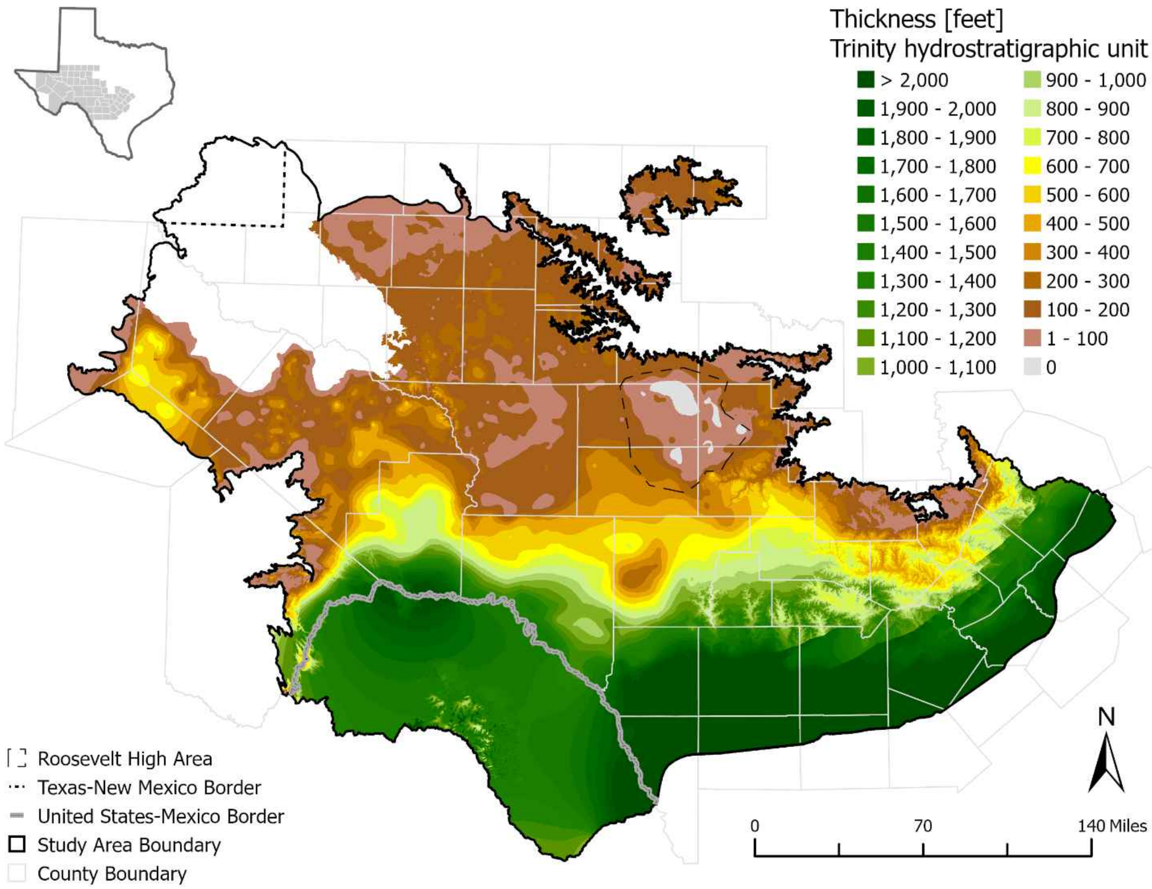


Figure 4.2-9. Thickness of the Trinity hydrostratigraphic unit (Layer 3).

4.2.4 Discussion

The surfaces described in the previous sections are meant to provide a structural framework for a regional groundwater model. Assumptions and simplifications were made while creating these surfaces, based on the goals of this proposed groundwater model. The primary focus of the proposed groundwater model is groundwater flow in the Pecos Valley and Edwards-Trinity (Plateau) aquifers. Therefore, the surfaces in those areas are the least simplified and closest to actual geology. To a lesser extent, the proposed groundwater model will include groundwater flow in the Southern portion of the Trinity Aquifer and the Edwards (Balcones Fault Zone) Aquifer. However, the focus in these areas will be groundwater communication between these units and the Edwards-Trinity (Plateau) Aquifer. For this reason, there were some significant simplifications made to these units. Most notably, we have combined the component units of the Southern portion of the Trinity Aquifer (Upper, Middle, and Lower Trinity) into one unit.

It is not the intention of this study to model groundwater flow conditions in younger units like the Ogallala Aquifer, Upper Cretaceous units, alluvial units, or the Carrizo-Wilcox Aquifer. Therefore, we drastically simplified the surfaces of these units and only include them in the context of “placeholder” units. For readers interested in groundwater flow conditions in these other aquifers, other TWDB groundwater availability models focused on those particular aquifers are recommended.

As noted previously, the interpretation of the Edwards and Trinity hydrostratigraphic units in Mexico were simplified as it is not the intention to use this model to provide comprehensive groundwater flow information in Mexico. We only include this region to account for additional flow to the Rio Grande and recharge to underlying aquifers. It is not recommended the current study to readers interested in groundwater flow conditions in Mexico.

The TWDB Brackish Resources Aquifer Characterization System team is concurrently working on an updated map of the Edwards-Trinity (Plateau) Aquifer. However, this data is still in preliminary stages and could not be incorporated into the current study. If additional data are available in time for the numerical model, we will consider updating our surfaces to incorporate new findings from that project.

4.3 Water Levels and Regional Groundwater Flow

Spatial and temporal trends in groundwater levels can help determine historical behavior of regional groundwater flow and cross-formational flow across the study area. This section discusses the sources of water-level data, estimates of historical groundwater-level contours, and analysis of cross-formational flow. We present the results of analysis by hydrostratigraphic unit (as defined in Section 4.1). The younger hydrostratigraphic unit (Layer 1), represents the Pecos Valley Aquifer, Ogallala Aquifer, and Upper Cretaceous confining units. The Edwards hydrostratigraphic unit (Layer 2) represents the Edwards (Balcones Fault Zone) Aquifer and the Edwards units within the Edwards-Trinity (Plateau) Aquifer. The Trinity hydrostratigraphic unit (Layer 3) represents the Hill Country portion of the Trinity Aquifer,the Trinity Aquifer below the Edwards (Balcones Fault Zone) Aquifer, and the Trinity units of the Edwards-Trinity (Plateau) Aquifer.

4.3.1 Assignment of hydrostratigraphic units to wells

We assigned wells to hydrostratigraphic units based on the structural framework developed in Section 4.2 and well construction information. We used well depth and screen information to determine aquifer assignments, according to the process summarized in Figure 4.3-1. Data sources for wells often use different nomenclature even for the same formations and aquifers, the standardization was necessary. In addition, the structural framework developed for this report is different from the structural framework used in previous studies of the Edwards-Trinity regional aquifer system and possibly has different aquifer surfaces used in those reports. For this reason, water-level elevations data were re-analyzed if wells had depth, screen, or open interval information available.

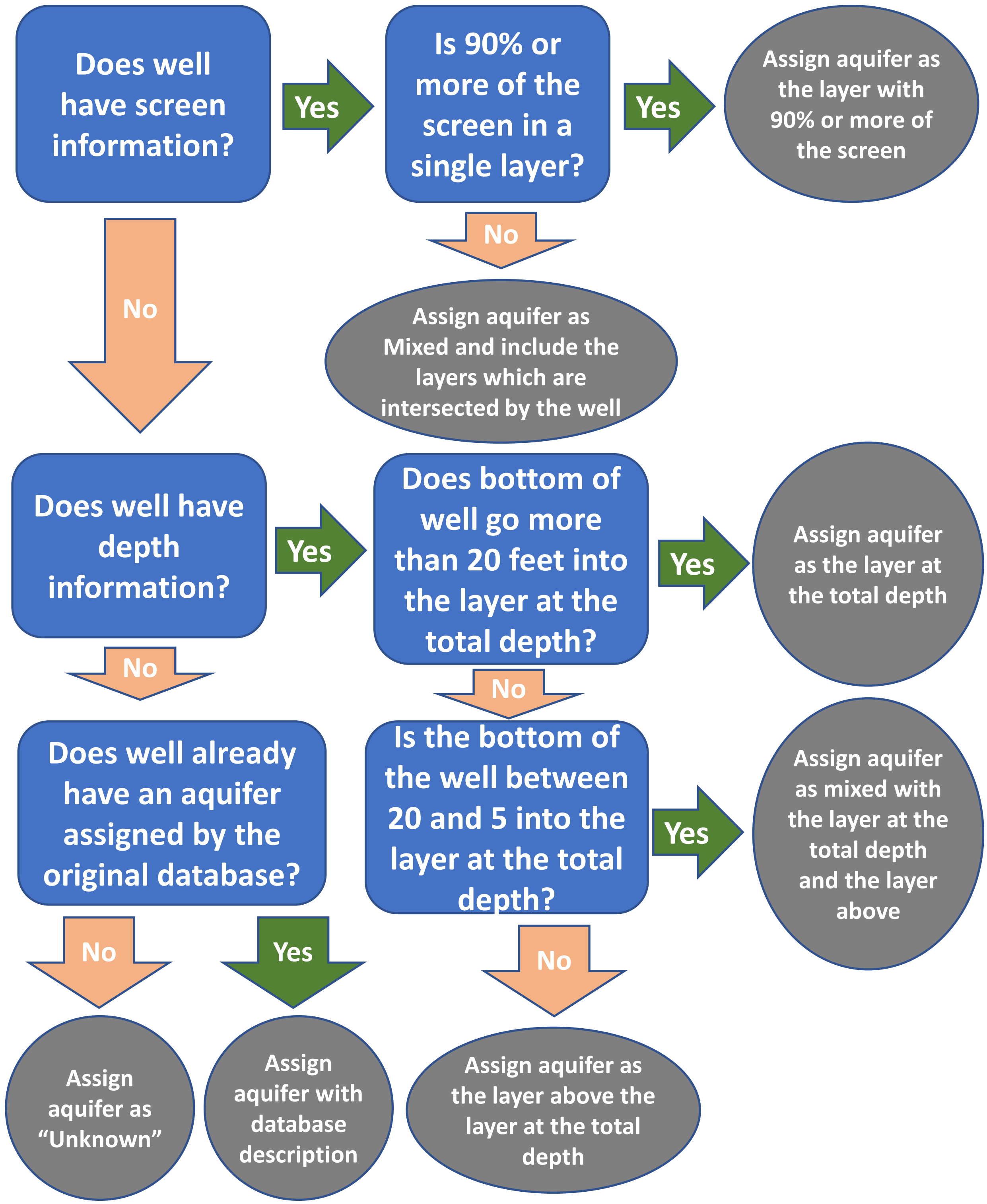


Figure 4.3-1. Aquifer assignment decision flow chart to determine which aquifer was contributing water levels to a well.

4.3.2 Water level data collection and analysis

Multiple sources for water level data were queried in the current study area. Data sources for water level measurements included:

- The “WaterLevelsMajor”, “WaterLevelsMinor”, “WaterLevelsCombination” and “WaterLevelsOtherUnassigned" tables in the TWDB groundwater database (TWDB, 2021c);
- The “*WellLevels*” table in the TWDB submitted drillers’ report database (TWDB, 2021d);
- The “*tblBRACS_SWL*” table in the TWDB Brackish Resources Aquifer Characterization System database (TWDB, 2021b);
- The U. S. Geological Survey National Water Information System *“Historical Data”*, *“Field Measurements”*, and *“Daily Data”* databases (U.S. Geological Survey, 2021b)
- The database for the conceptual model for the Hill Country portion of the Trinity Aquifer (Toll and others, 2018);
- Water level data submitted by Barton Springs/Edwards Aquifer Conservation District (Barton Springs/Edwards Aquifer Conservation District, 2020);
- Water levels collected from groundwater resource maps in Mexico (Instituto Nacional de Estadistica y Geografia, 1982c; 1982d);
- Open data from Conagua Comision Nacional del Agua Data Abiertos (Conagua, 2021);
- The Public Water Supply database (Texas Commission of Environmental Quality, 2021); and
- Water levels used in previous models (Brakefield and others, 2015; Clark and others, 2014).

These datasets were compiled into one water level database for the current study. We only included water levels from the TWDB Groundwater Database which were assigned a “Publishable” status. There were many duplicate data points between the various data sources. The TWDB Groundwater Database was the primary source if there were conflicts or information discrepancies for the same well between different data sources. The compiled database contains sufficient information to support both the creation of the potentiometric surface maps and hydrographs shown in this report, as well as tasks that might require additional filtering in the future, such as the selection of calibration targets in the future numerical groundwater model. We also divided water level measurements into two seasons, either “Summer” or “Winter”. The "Summer" is for water levels measured between the beginning of March and the end of October and “Winter” is for the measurement between the beginning of November to the end of February. In the interest of preserving all data that might be useful for developing the numerical groundwater model, the compiled database includes water levels that are not used in the analyses described below.

Potentiometric surfaces and water level elevation contours were created in all three hydrostratigraphic units for the years 1950, 1980, 2000, and 2015. We utilized the *Topo To Raster* tool in ESRI ArcMap to interpolate water level elevation data. We only used "Winter" water levels as we assumed these best represented static aquifer conditions with minimal influence from agricultural pumping. The average of the winter water levels from November 1945 through February 1955 represents the 1950 average water level surface for each hydrostratigraphic unit. As in the previous groundwater availability model of the Edwards-Trinity (Plateau) and Pecos Valley Aquifer model (Anaya and Jones, 2009), it was assumed that the year 1980 approximately represents steady-state conditions for the current study area. The average of the winter water levels from November 1975 through February 1985 represents the 1980 average water level surface for each hydrostratigraphic unit. The average of the winter water levels from November 1997 through February 2003 represents the 2000 average water level surface for each hydrostratigraphic unit . The average of the winter water levels from November 2013 to February 2017 represents the 2015 average water level surface for each hydrostratigraphic unit. We used a larger time span to average water levels in the 1950 and 1980 water level analysis to fill in some of the spatial gaps due to fewer water level measurements available for those time periods. There were enough data points available for the later water level analyses where a time span of only four winter cycles can improve spatial coverage for the 2000 and 2015 water level analyses. It should be noted that our interpolation method extends the potentiometric surface maps and contours beyond the control points to cover the entire study area for each hydrostratigraphic unit. As such, the areas closest to observed water level control points have less uncertainty and are more reliable than the areas far from the observed water level control points. Due to the difference in the spatial distribution of observed water level control points for each year, locations of less uncertainty vary by year and hydrostratigraphic unit.

Hydrographs show water level variations at a specific location through time. They are helpful for illustrating water level trends at the location of the well and surrounding area and for identifying erroneous measurements that don't represent static regional aquifer conditions—a spike caused by nearby pumping, for example. We generated representative hydrographs for each hydrostratigraphic unit using average winter water levels by year. Only the hydrographs which had a long enough history and high enough measurement frequency were considered as representative of regional water level trends.

4.3.3 Pecos Valley Aquifer and other shallow units water levels, regional flow, and trends

The Pecos Valley Aquifer, in the northwestern portion of the study area, consists of many layers of sand, silt and some coarse grained materials which accumulated during the Quaternary and Tertiary periods. These layers are exposed at the surface and the aquifer is entirely unconfined. The Pecos River divides the aquifer into two regions. Aeolian soils dominate the region north of the river while alluvium sediments dominate the region south of the river. The aquifer is thickest along two major troughs, the Monument Draw Trough and the Pecos Trough, north and south of the river, respectively.

Figure 4.3-2 through Figure 4.3-5 provide the interpolated water levels in the Pecos Valley hydrostratigraphic unit for the years 1950, 1980, 2000, and 2015 and Figure 4.3-6 provides representative hydrographs. In general, the regional groundwater flow pattern is from northwest to southeast following topography but is also strongly influenced by the Pecos River, with groundwater flowing toward the river on a local scale. High pumping rates in condensed areas can cause isolated water level drops, which are called cones of depression. Figure 4.3-3 shows cones of depression in the Pecos Trough in Reeves County and the Monument Draw Trough in Pecos County which were observed from 1960 (Jones, 2001; 2004; 2008). As of 2015, measured water levels range from a maximum of approximately 3,620 feet above mean sea level in the northernmost part of the aquifer in New Mexico to a minimum of approximately 2,290 feet above mean sea level at the intersection of Reeves, Pecos, and Ward counties (Figure 4.3-5). Hydrographs shown in Figure 4.3-6, display both shared and unique trends within the Pecos Valley Aquifer. Shared trends can be seen south of the Pecos River in Figure 4.3-6(A, F, and H) where water levels decline between the late 1950s to around the 1970s and then begin to rise sometime between the late 1960s to the late 1970s. These water-level fluctuations reflect irrigation pumping patterns in the Pecos Trough portion of the Pecos Valley Aquifer which peaked in the 1970s. On the north and west sides of the Pecos Valley Aquifer, Figure 4.3-6(C) shows that water levels remain steady or as Figure 4.3-6(B, D, and E) shows that water levels maintain a slow and steady decline. Figure 4.3-6(G) shows a steady water level from the 1960s to the mid-1970s followed by a sharp decline in the late 1970s to mid-1980s and then followed by steady water levels from the late 1980s until the late 2010s. Water level fluctuations tend to be greater south of the Pecos River and within the Pecos Trough. Water levels north of the Pecos River tend to have smaller fluctuations and are more stable as shown in Figure 4.3-6(B and C).

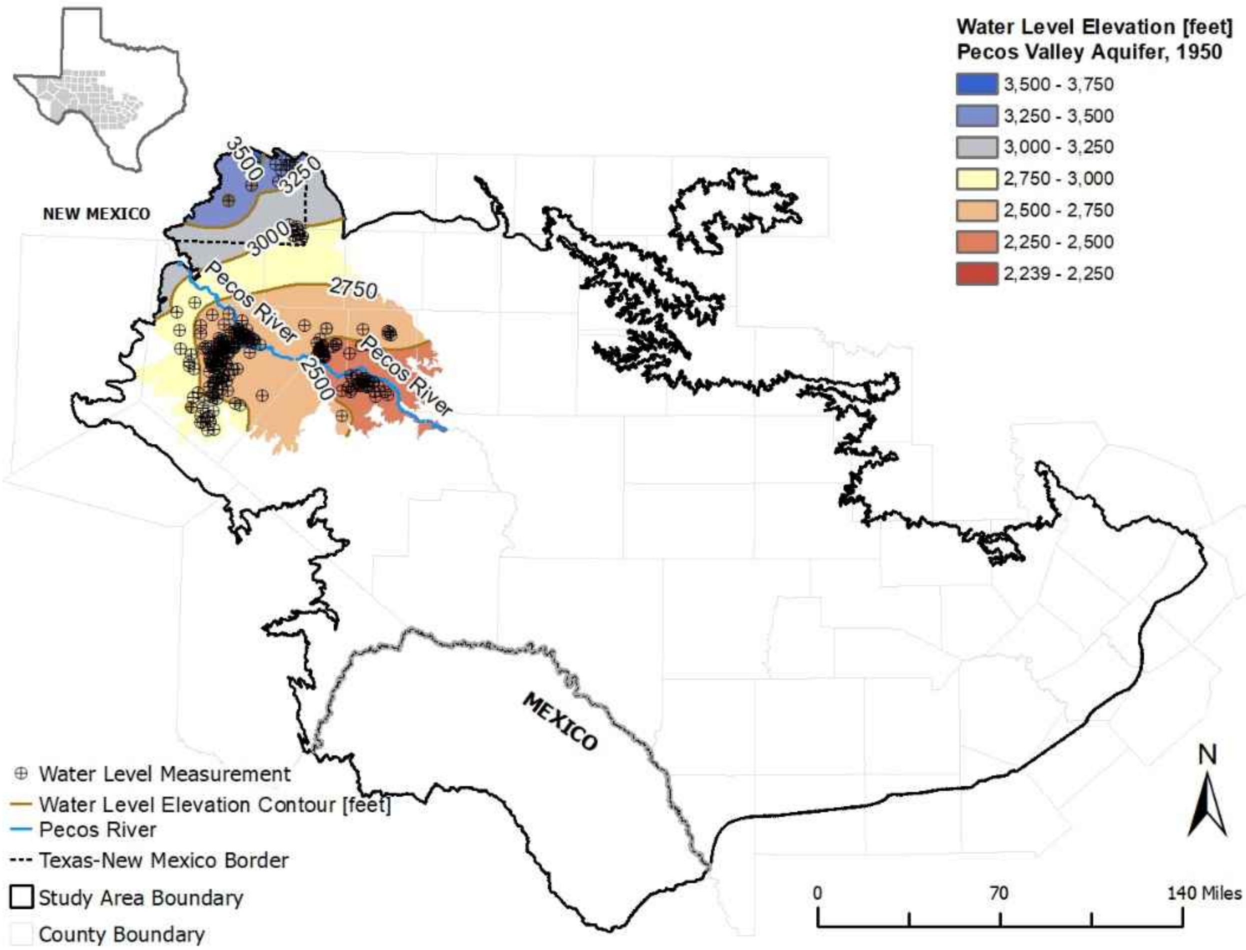


Figure 4.3-2. Interpolated potentiometric surface with contours of the Pecos Valley Aquifer for the year 1950. All elevations are reported in feet above mean sea level.

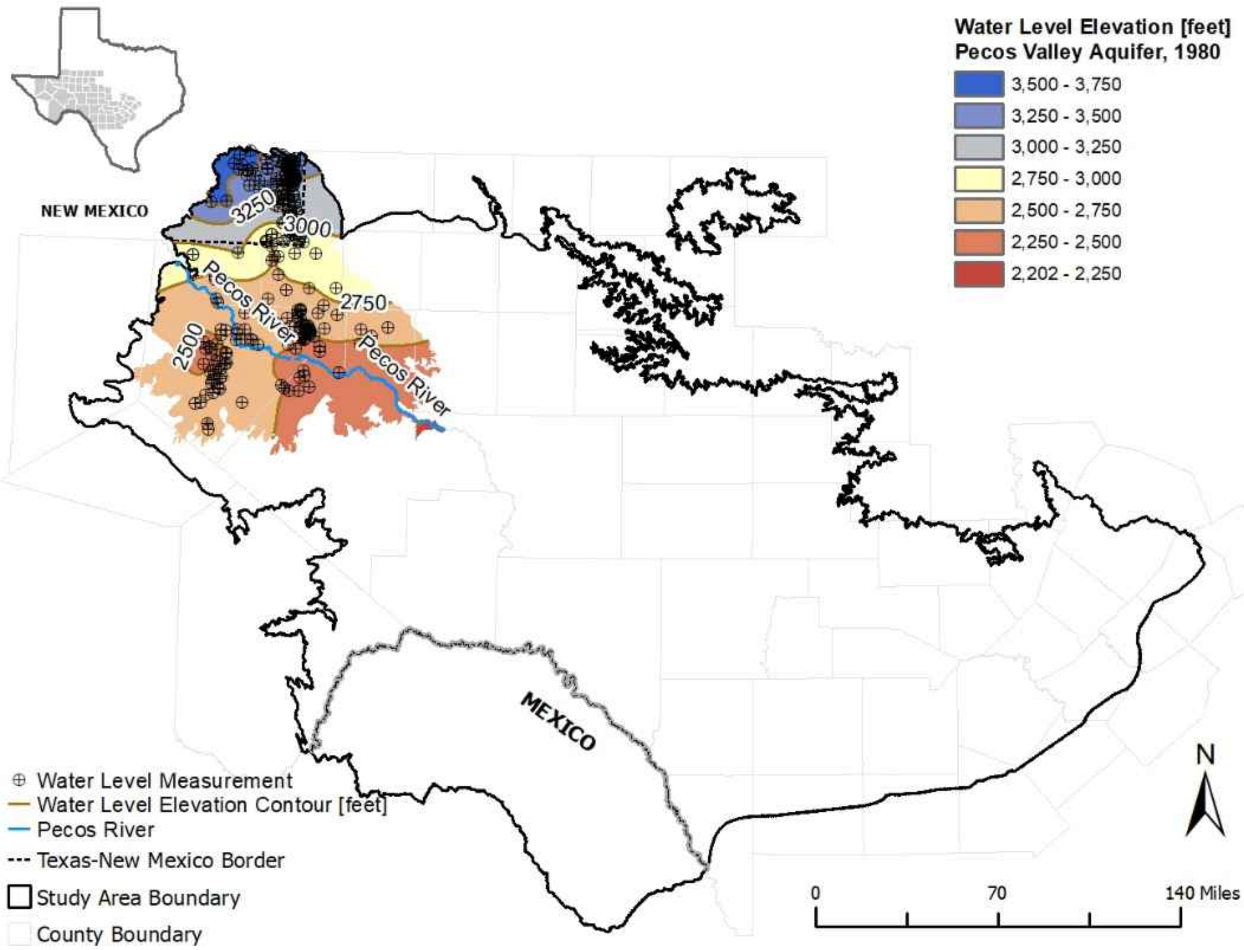


Figure 4.3-3. Interpolated potentiometric surface with contours of the Pecos Valley Aquifer for the year 1980. All elevations are reported in feet above mean sea level.

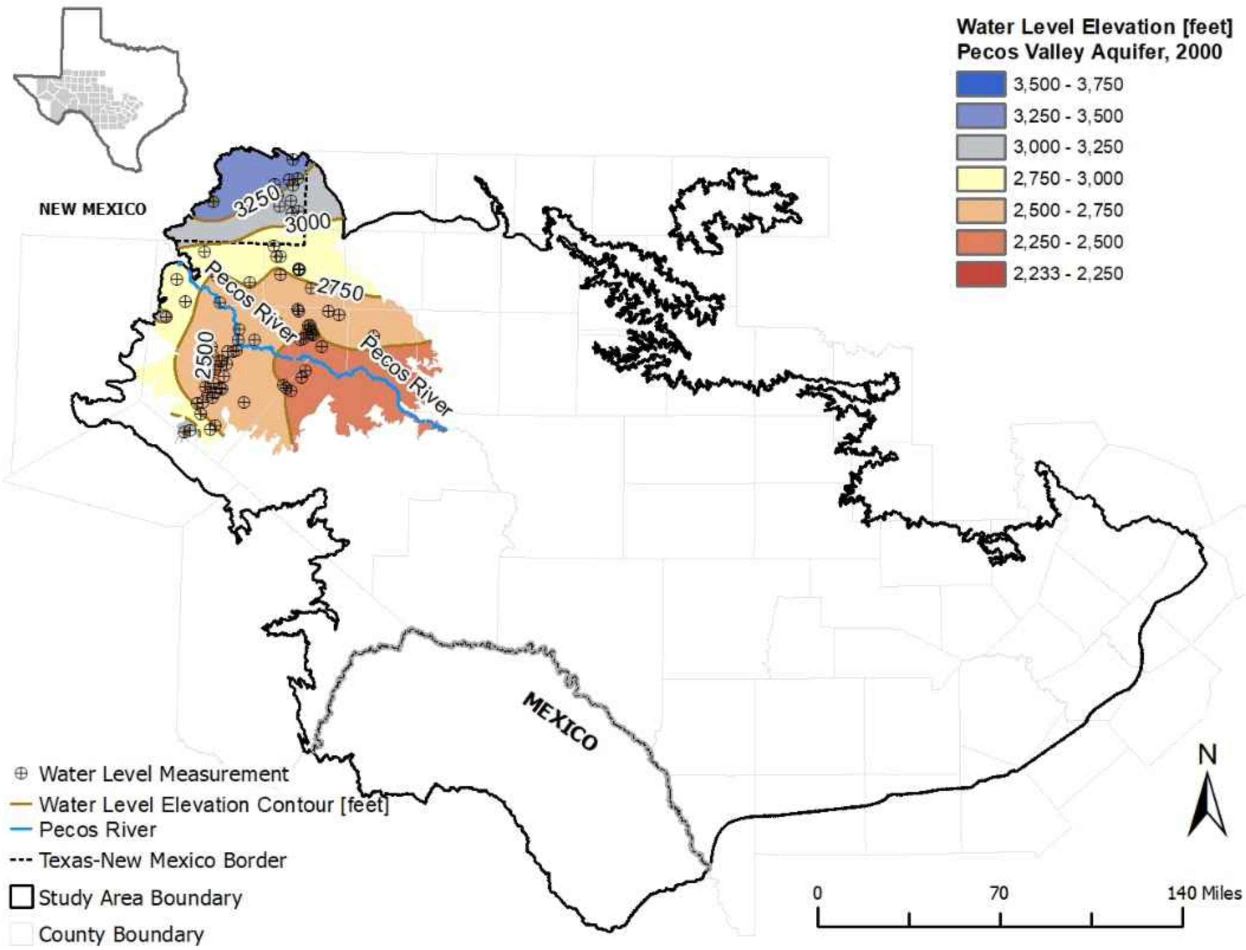


Figure 4.3-4. Interpolated potentiometric surface with contours of the Pecos Valley Aquifer for the year 2000. All elevations are reported in feet above mean sea level.

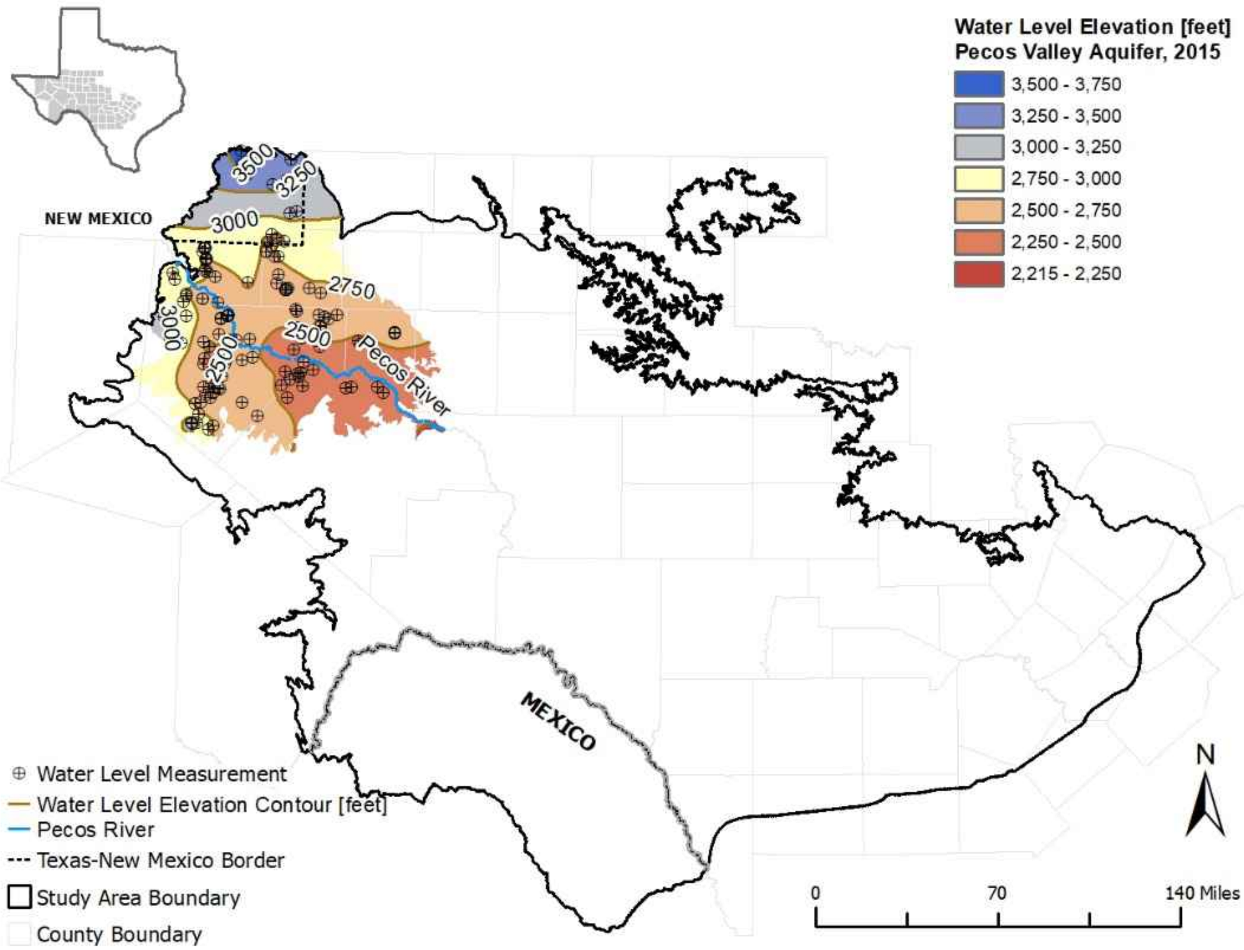


Figure 4.3-5. Interpolated potentiometric surface with contours of the Pecos Valley Aquifer for the year 2015. All elevations are reported in feet above mean sea level.

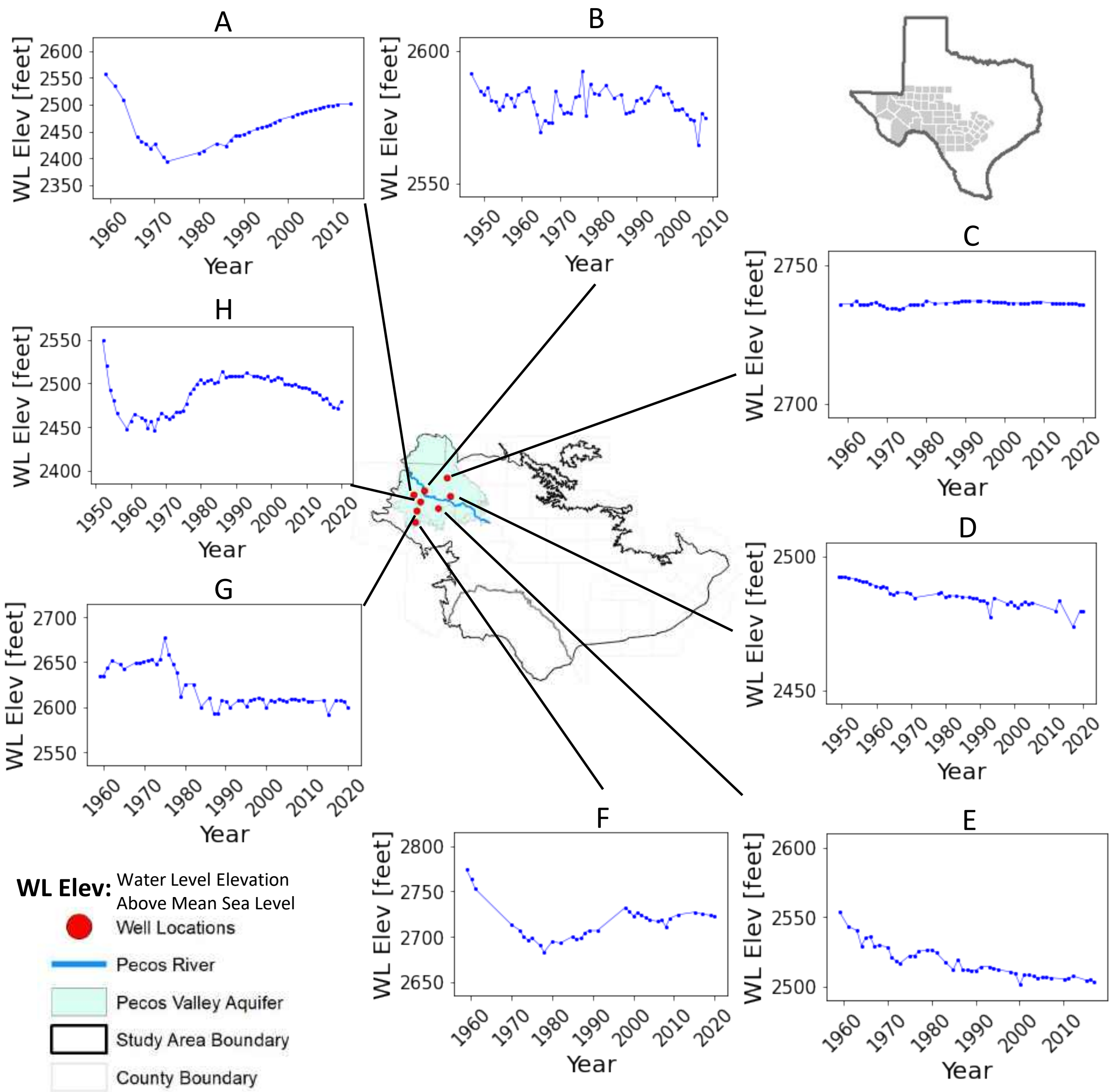


Figure 4.3-6. Representative hydrographs of the Pecos Valley Aquifer. All elevations are reported in feet above mean sea level. The Pecos Valley Aquifer is displayed as light green.

4.3.4 Edwards hydrostratigraphic unit water levels, regional flow, and trends

The Edwards hydrostratigraphic unit is exposed at surface throughout the Edwards Plateau region and largely unconfined with the exception of small areas where it underlies the Pecos Valley and Ogallala aquifers. The Edwards hydostratigraphic unit can be dry along the western and northwestern margins of the study area (Anaya and Jones, 2009). In the Balcones Fault Zone in the southeastern portion of the study area, the Edwards hydrostratigraphic unit is unconfined in the outcrop but confined downdip, where it underlies less permeable and continuous Upper Cretaceous units. When aquifers are confined by rock units which restrict flow upwards, they can become pressurized and contain water levels above the physical location of the aquifer. These portions are called artesian and can even have water levels which rise above the land surface. Water level measurements in the confined downdip Edwards Aquifer along the Balcones Fault Zone are artesian and several wells from the TWDB Groundwater Database record water levels above land surface.

Figure 4.3-7 through Figure 4.3-10 display the interpolated water levels in the Edwards hydrostratigraphic unit for the years 1950, 1980, 2000, and 2015 and Figure 4.3-11 provides representative hydrographs. In general, the regional groundwater flow pattern tends to follow the regional topography shaped by rivers and streams, especially the Pecos River and Rio Grande. In the Balcones Fault Zone, faults can also influence groundwater flow patterns (Hunt and Others, 2015). According to hydrographs and the interpolated potentiometric surfaces, water levels in the Edwards hydrostratigraphic unit have been mostly stable since the 1950s across the entire study area with some declines and rebounds in the west. As of 2015, water levels range from a maximum of approximately 3,480 feet above mean sea level in Jeff Davis County on the west side of the study area to a minimum of approximately 430 feet above mean sea level in central Travis County on the east side of the study area (Figure 4.3-10). Hydrographs tend to show the stability, but with significant fluctuations, of the Edwards hydrostratigraphic unit. In the Balcones Fault Zone, Figure 4.3-11(D and E) show large fluctuations on a small time scale but have a long term stable water level. In the eastern and central Edwards Plateau, Figure 4.3-11(C, F, and H) show similar trends to the hydrographs in the Balcones Fault Zone with stable long term trends but have smaller fluctuations. In the western and northern portions of the study area, Figure 4.3-11(A and B) shows large declines between the 1950s and 1960s but then recoveries beginning in the 1970s. A hydrograph in Val Verde County, Figure 4.3-11(G), shows a sharp rise in water levels in the late 1960 followed by stable water levels from the mid-1970s to the early 1990s before water levels declined into the 2000s. The Edwards hydrostratigraphic unit has a large recharge zone across the study area and is a karst aquifer with many dissolution features which allow for high rates of groundwater recharge. We assume that these characteristics help the Edwards hydrostratigraphic unit to maintain the relatively stable water levels displayed in the hydrographs.

The potentiometric surface map for the year 2015 (Figure 4.3-10) shows a groundwater divide in Kinney County approximately coinciding with the boundary between the Edwards

(Balcones Fault Zone) Aquifer and the Edwards-Trinity Aquifer. A groundwater divide represents a change in groundwater flow so that the direction of flow is different on either side of this feature.

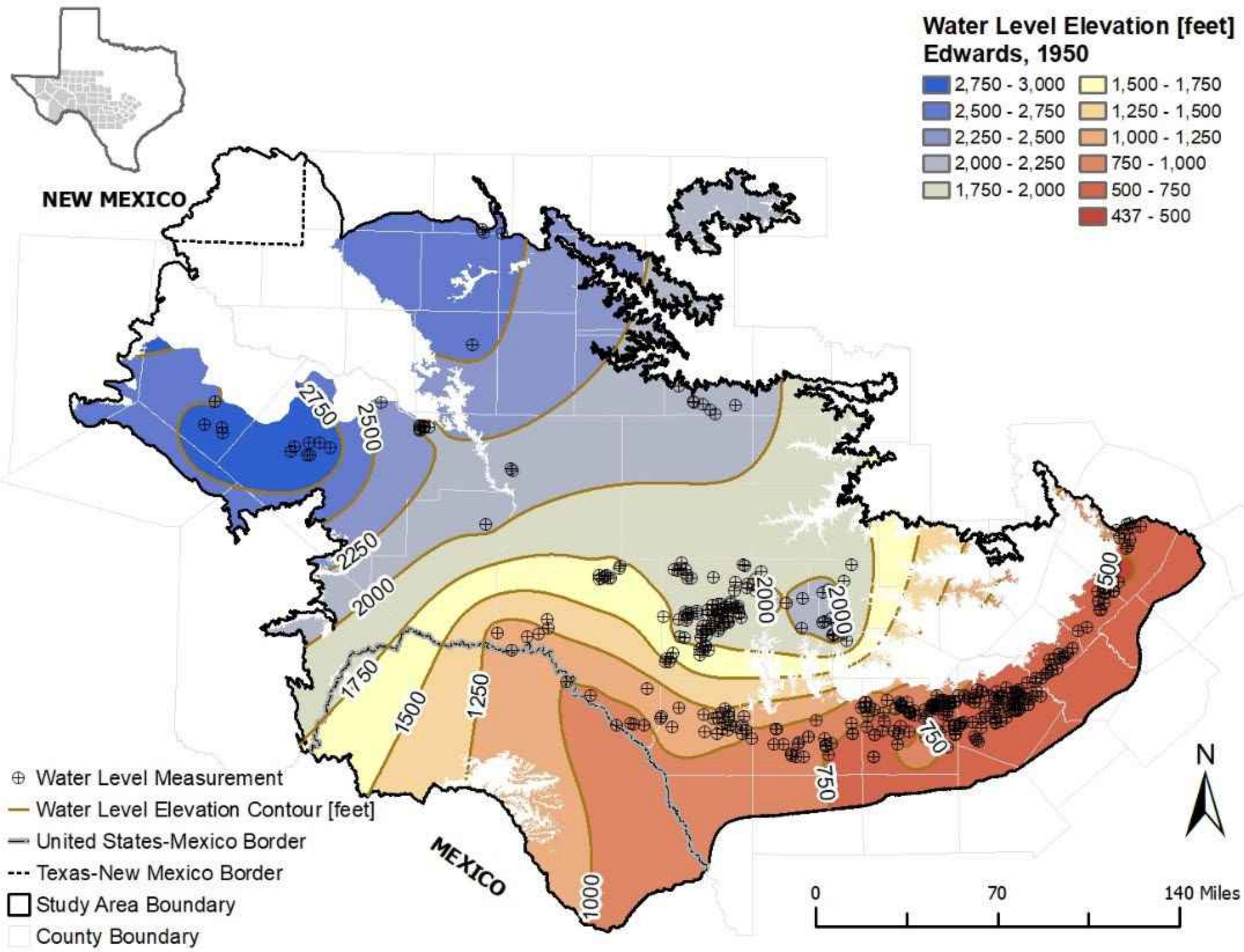


Figure 4.3-7. Interpolated potentiometric surface with contours of the Edwards hydrostratigraphic unit for the year 1950. All elevations are reported in feet above mean sea level.

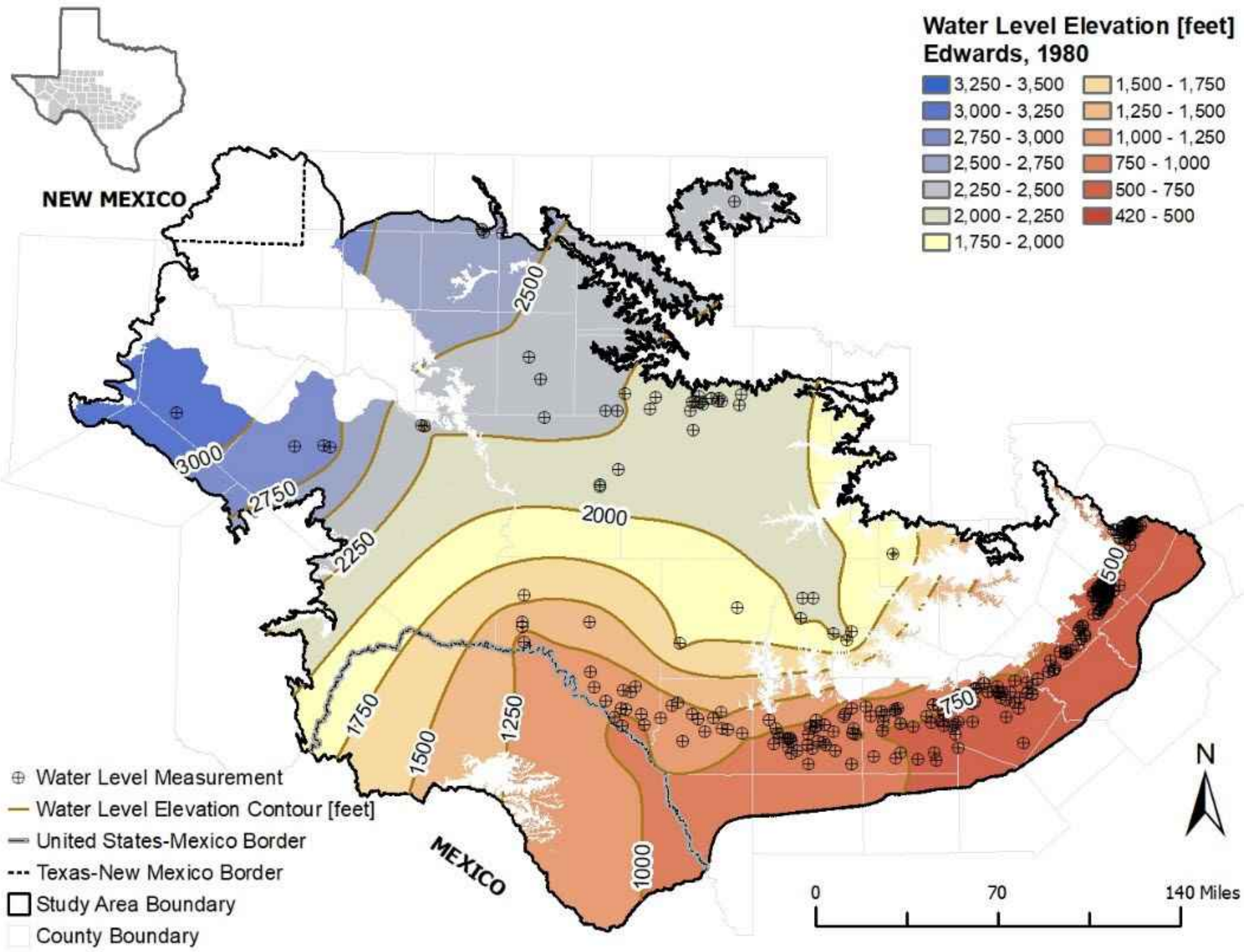


Figure 4.3-8. Interpolated potentiometric surface with contours of the Edwards hydrostratigraphic unit for the year 1980. All elevations are reported in feet above mean sea level.

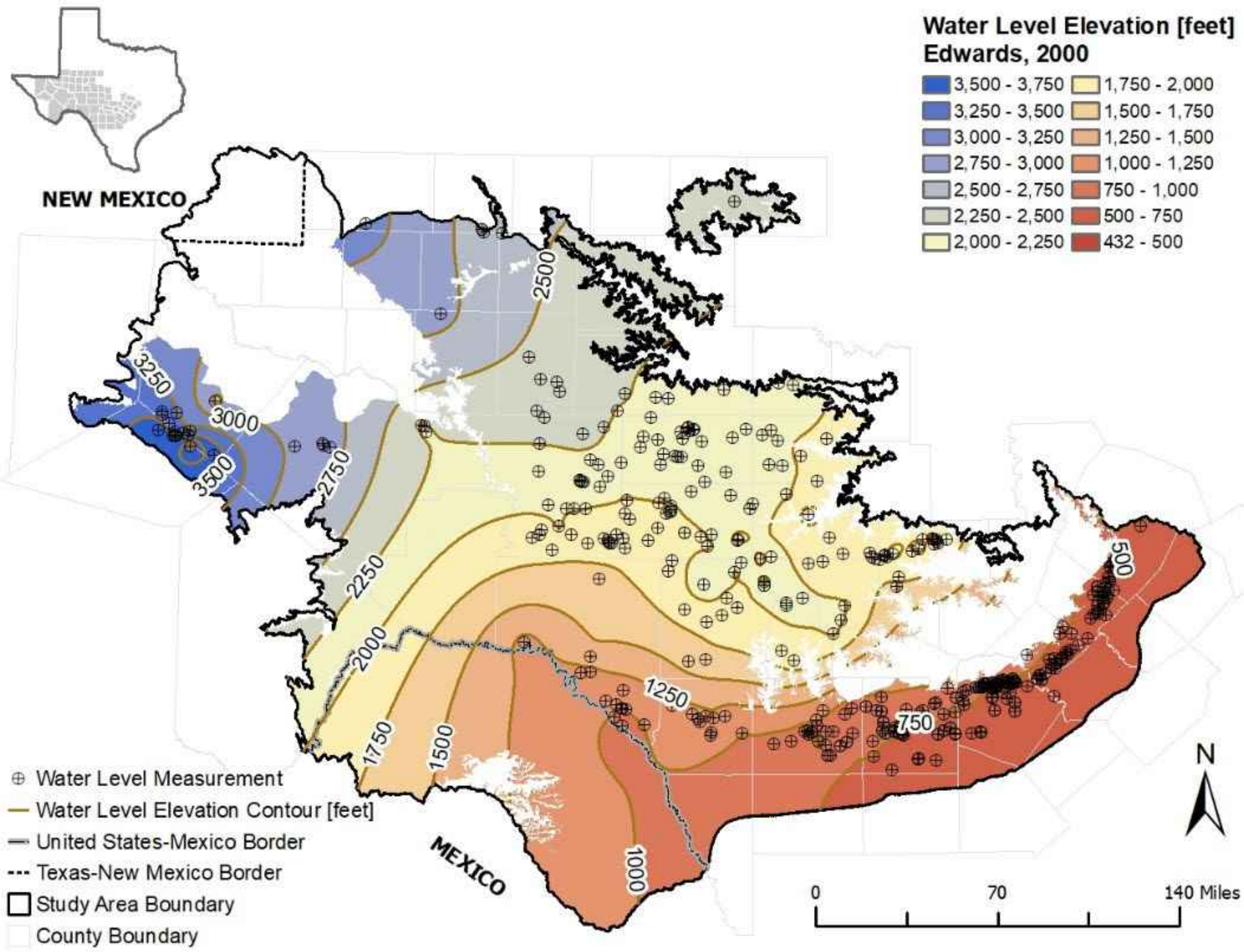


Figure 4.3-9. Interpolated potentiometric surface with contours of the Edwards hydrostratigraphic unit for the year 2000. All elevations are reported in feet above mean sea level.

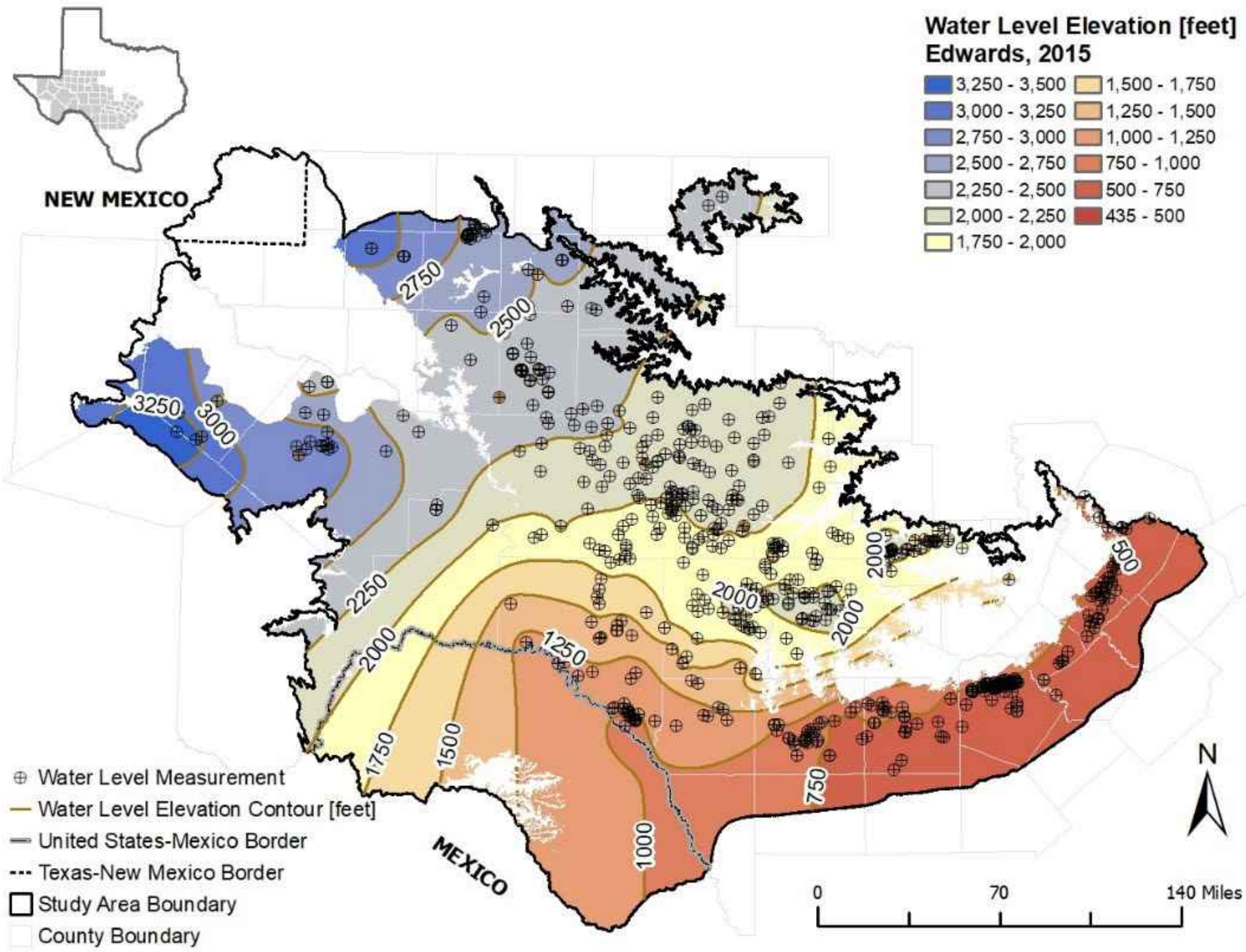


Figure 4.3-10. Interpolated potentiometric surface with contours of the Edwards hydrostratigraphic unit for the year 2015. All elevations are reported in feet above mean sea level.

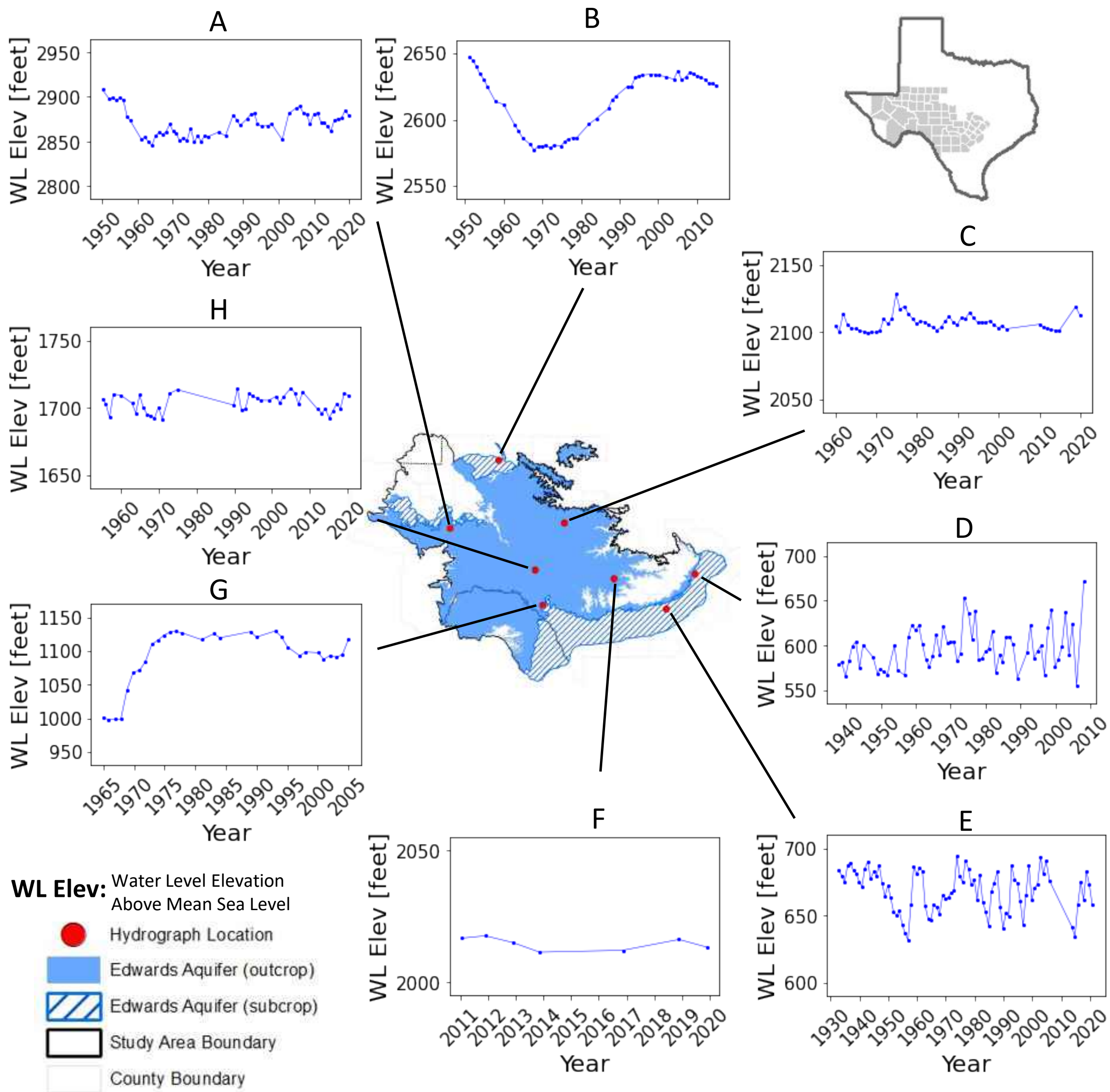


Figure 4.3-11. Representative hydrographs of the Edwards hydrostratigraphic unit. All elevations are reported in feet above mean sea level. The unconfined portion of the Edwards hydrostratigraphic unit is displayed in solid blue and the confined portion of the Edwards hydrostratigraphic unit is displayed in blue hatch pattern.

4.3.5 Trinity hydrostratigraphic unit water levels, regional flow, and trends

The Trinity hydrostratigraphic unit covers the largest portion of the study area. The majority of the Trinity hydrostratigraphic unit underlies the Edwards hydrostratigraphic unit and exists in the subcrop. The exception occurs in the Hill Country area, where the Edwards has been eroded away, leaving the Trinity exposed in the outcrop (see Figure 2.0-2). Where the Edwards hydrostratigraphic unit exists, the relatively impermeable sediments of the overlying basal member of the Edwards Group act as a confining or semi-confining unit to the Trinity hydrostratigraphic unit (Anaya and Jones, 2009). Otherwise, the Trinity hydrostratigraphic unit is unconfined where it crops out at the surface.

Figure 4.3-12 through Figure 4.3-15 provide the interpolated water levels in the Trinity hydrostratigraphic unit for the years 1950, 1980, 2000, and 2015 and Figure 4.3-16 provides representative hydrographs. In general, the regional groundwater flow pattern tends to follow the regional topography, which is shaped by rivers and streams. The Trinity groundwater flow patterns follow trends similar to those of the overlying Edwards hydrostratigraphic unit. According to the hydrographs and potentiometric surface maps, both regional groundwater trends and individual water levels in the Trinity hydrostratigraphic unit have fluctuated since the 1950s. As of 2015, measured water levels range from a maximum of around 3,430 feet above mean sea level in the far western portion of the study area in Jeff Davis County to a minimum of about 210 feet above mean sea level in the center of Travis County on the far east side of the study area (Figure 4.3-15). Figure 4.3-16(A, C, E, and H) shows that water levels in the Trinity hydrostratigraphic unit appear to have remained constant or slightly risen near the Pecos Valley Aquifer and eastward across the Edwards Plateau, even with one well within the heavily-developed area around San Antonio in Bexar County. However, in Figure 4.3-16(B, D, F, and G) water levels have fallen in the Hill Country area, from Real County to the Hays-Travis County boundary, as well as in the northernmost Edwards Plateau in Glasscock County. The declines in the Trinity hydrostratigraphic unit appear to be more recent, mostly after the 1980s. Some water level declines have been gradual and consistent since the 1950s while others were sudden but have since leveled out. The hydrographs show that there have been periods of water level decline followed by water level rise in Pecos County in the western portion of the study area. Local trends in water level hydrographs do not always match the regional groundwater trends seen in the water level maps.

The groundwater divide in the Trinity hydrostratigraphic unit occurs in the same area as the divide between the Edwards (Balcones Fault Zone) Aquifer and the Edwards-Trinity (Plateau) Aquifer. The potentiometric surface for the year 2015 shows a ridge of higher groundwater levels in Kinney County, which could indicate a groundwater divide.

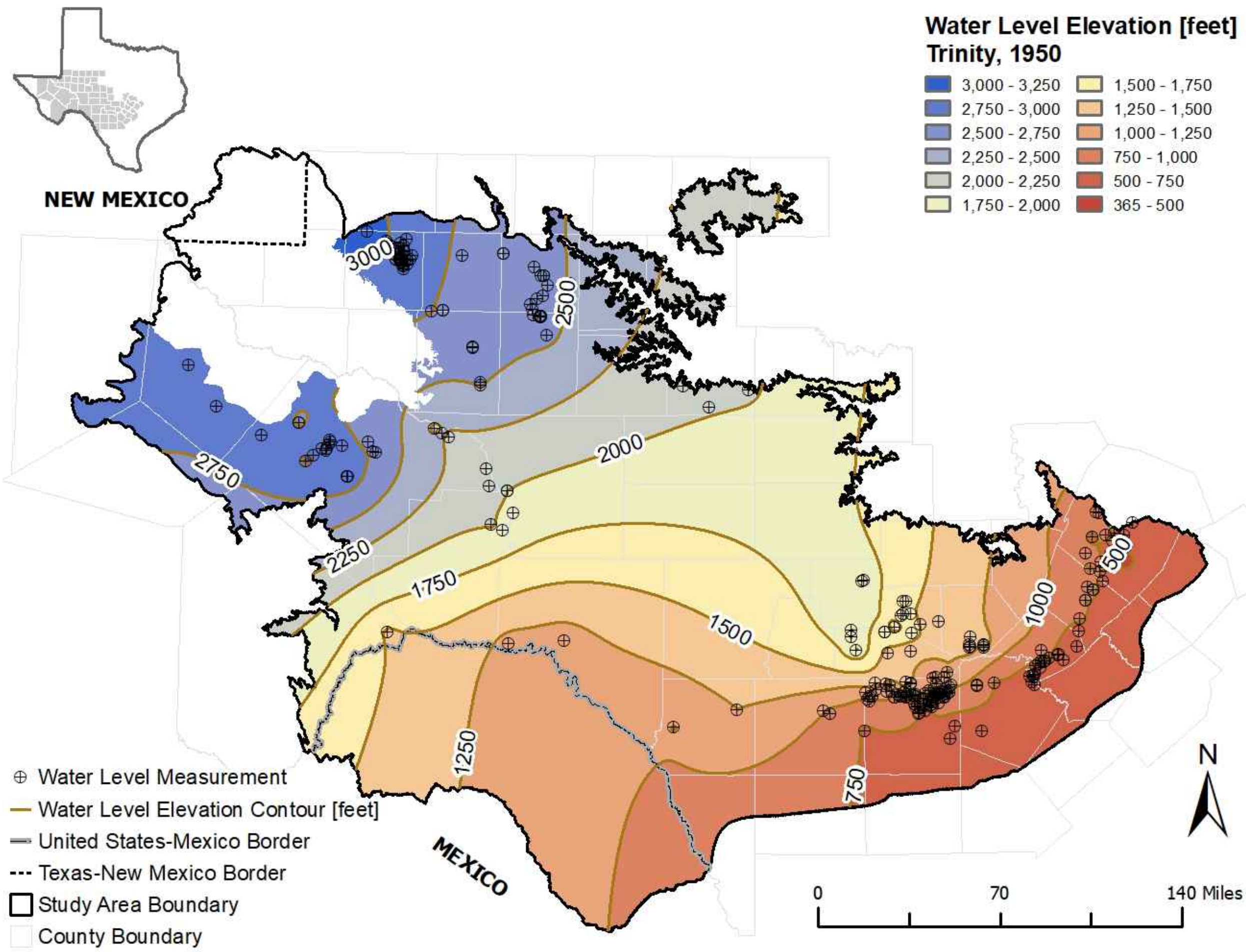


Figure 4.3-12. Interpolated potentiometric surface with contours of the Trinity hydrostratigraphic unit for the year 1950. All elevations are reported in feet above mean sea level.

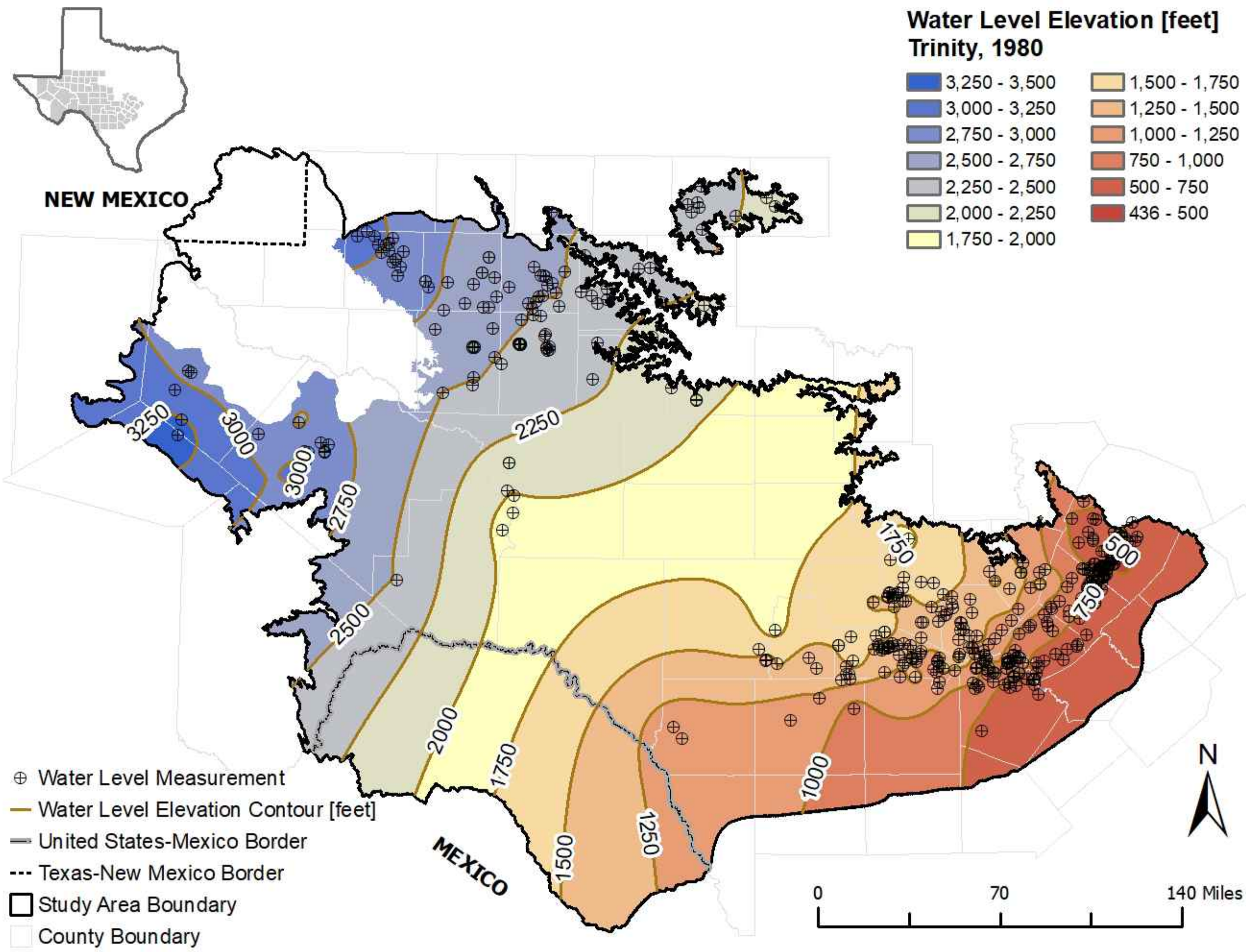


Figure 4.3-13. Interpolated potentiometric surface with contours of the Trinity hydrostratigraphic unit for the year 1980. All elevations are reported in feet above mean sea level.

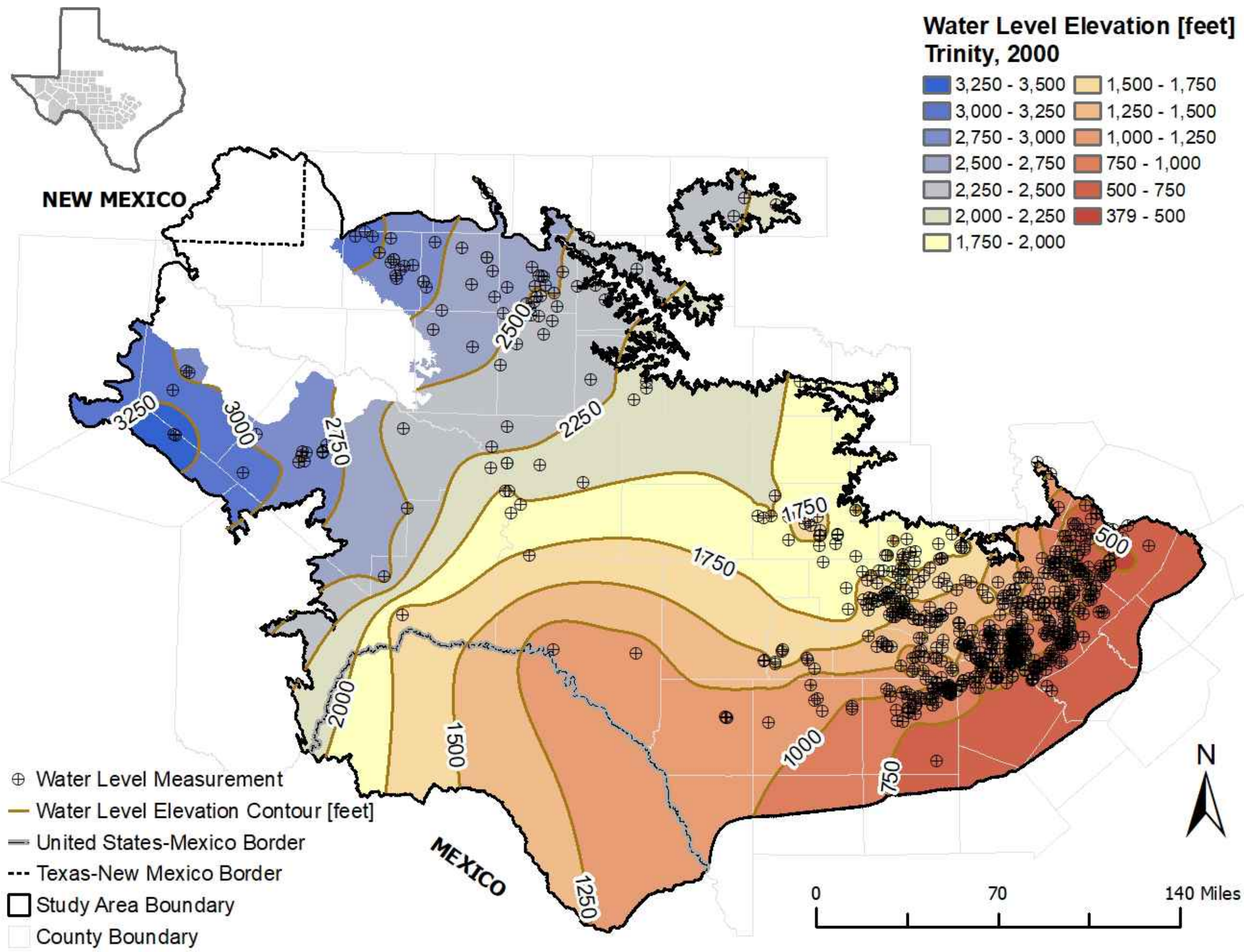


Figure 4.3-14. Interpolated potentiometric surface with contours of the Trinity hydrostratigraphic unit for the year 2000. All elevations are reported in feet above mean sea level.

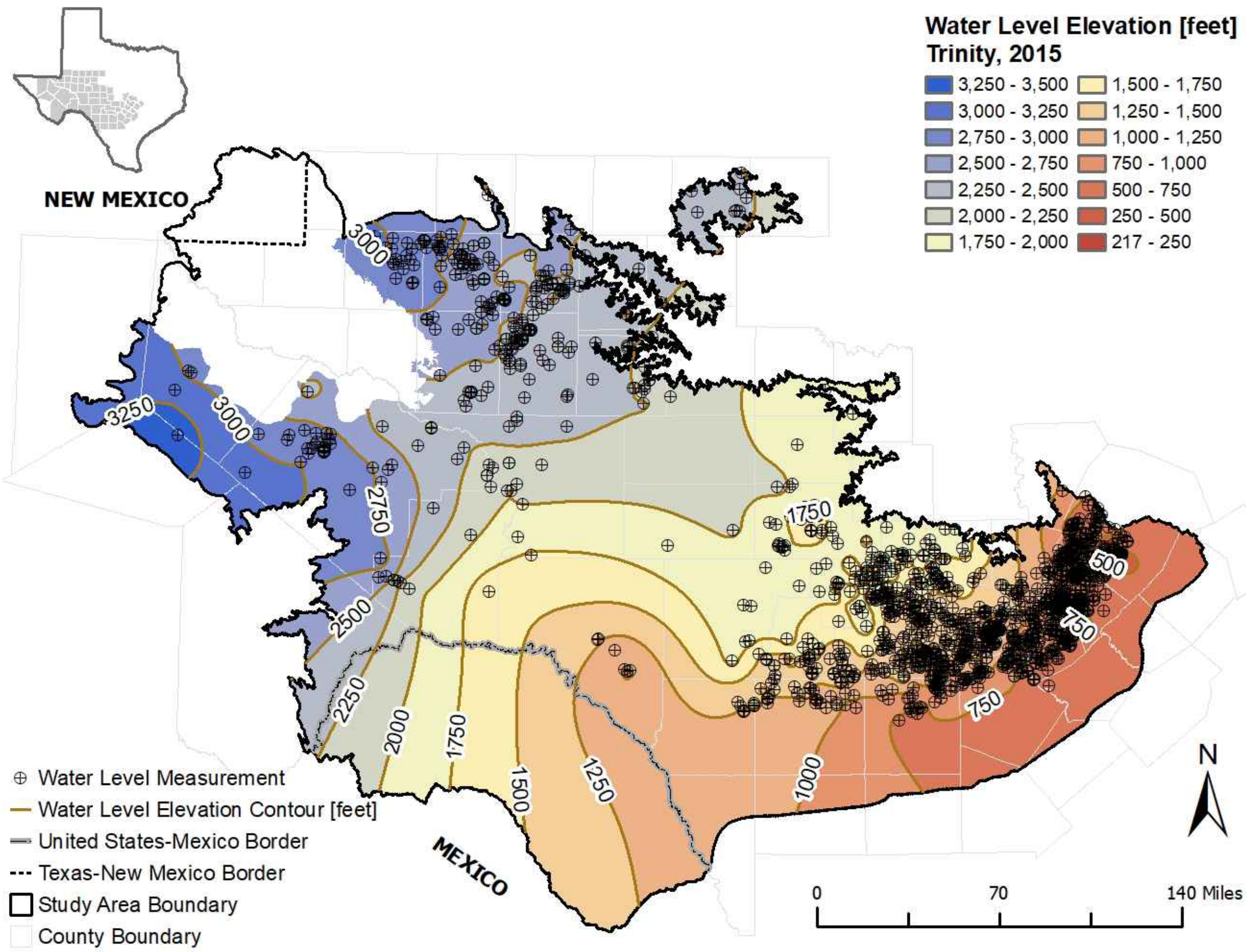


Figure 4.3-15. Interpolated potentiometric surface with contours of the Trinity hydrostratigraphic unit for the year 2015. All elevations are reported in feet above mean sea level.

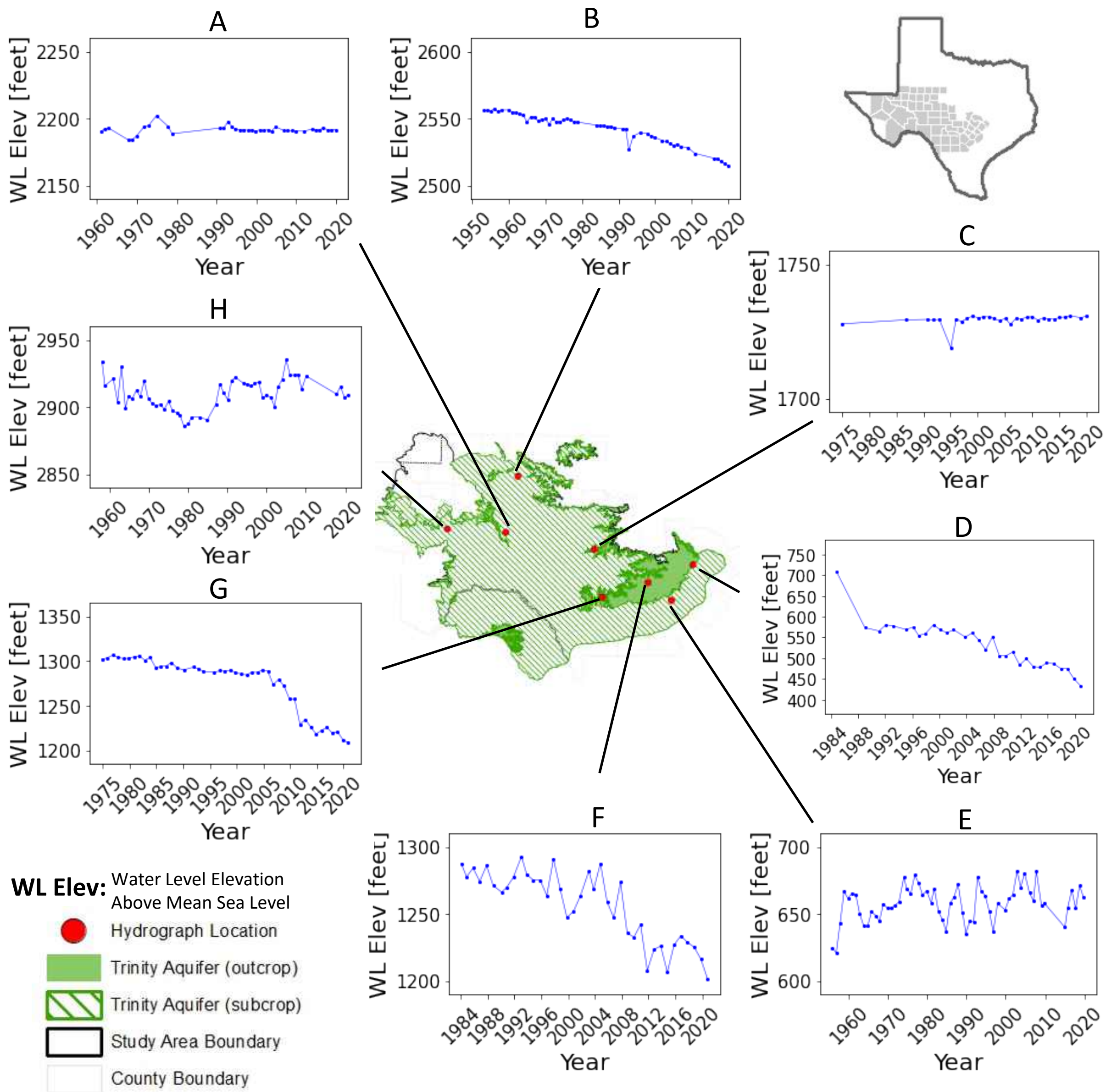


Figure 4.3-16. Representative hydrographs of the Trinity hydrostratigraphic unit. All elevations are reported in feet above mean sea level. The unconfined portion of the Trinity hydrostratigraphic unit is displayed in solid green and the confined portion of the Trinity hydrostratigraphic unit is displayed in green hatch pattern.

4.3.6 Regional groundwater flow paths

Figure 4.3-17 shows the schematic regional groundwater flow paths in the study area. In the Pecos Valley Aquifer, groundwater generally flows towards the Pecos River. In the Trans-Pecos region in the west, groundwater in the Edwards and Trinity hydrostratigraphic units flows toward the Pecos River and the Rio Grande, with potentiometric maps suggesting a steep gradient towards these surface water drainages. In the Central Edwards Plateau region, groundwater generally flows from northwest to southeast towards the Edwards Balcones Fault Zone. A regional groundwater divide in this area, coinciding with the surface water divide, separates groundwater flow toward the Colorado River in the north and toward the Pecos River and the Rio Grande in the south. A groundwater divide near Kerr and Real counties separates groundwater flow toward the Rio Grande in the south and groundwater flow toward the Balcones Fault Zone and into the Guadalupe, San Antonio, and Nueces river basins (Anaya and Jones 2009). This groundwater divide represents the boundary between the Edwards-Trinity (Plateau) Aquifer and the Hill Country portion of the Trinity Aquifer. As groundwater flows into the Balcones Fault Zone, groundwater flow direction shifts toward the northeast in response to faults in the area that block southeastward groundwater flow path. In general, the flow path in this region is parallel to the strike of the fault zone.

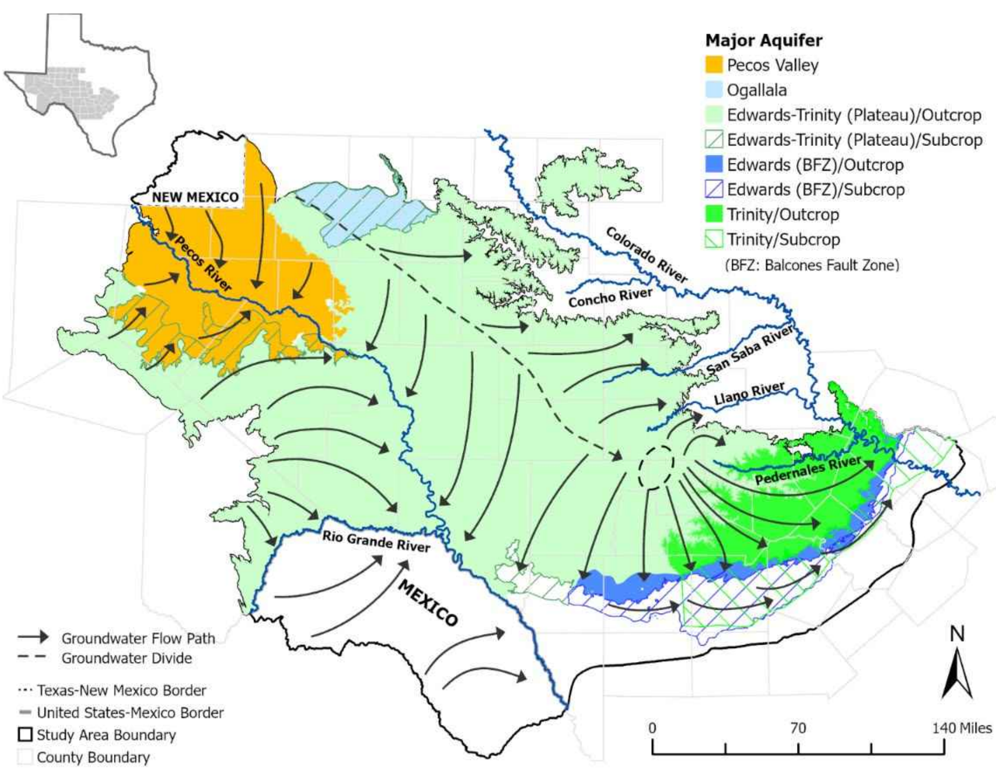


Figure 4.3-17. Generalized regional groundwater flow path for the Pecos Valley and Edwards-Trinity (Plateau) Region (modified from Anaya and Jones, 2009; Edwards Aquifer Authority, 2021).

4.3.7 Cross-formational flow

We analyzed cross-formational flow using hydrographs of neighboring well pairs completed in different hydrostratigraphic units. Figure 4.3-18 shows representative hydrograph comparisons for well pairs located within one mile of each other. In general, overlap in water levels or similar parallel trends between the paired hydrographs is assumed to indicate possible connection between hydrostratigraphic units while separation and lack of similar trends indicates that the hydrostratigraphic units are not locally connected. Figure 4.3-18 (A and B) shows that cross-formational flow might occur between the Trinity hydrostratigraphic unit and the underlying Pre-Cretaceous rocks (Paleozoic) in the northern and central portions of the Edwards Plateau in Reagan and Kerr counties. In Figure 4.3-18 (A), water levels overlap and have similar temporal trends, indicating a strong connection. The water levels do not overlap in Figure 4.3-18 (B), but they do rise and fall parallel to each other over the same time frame indicating some connection between these two units. This connection is less clear in the east, as shown in Figure 4.3-18 (C), where the Trinity and the underlying Pre-Cretaceous rocks (Paleozoic) in Blanco County do briefly overlap but do not have similar water level trends, indicating little to no connection.

The Edwards and the Trinity Hydrostratigraphic units appear to be connected in the Balcones Fault Zone based on the overlapping water levels with similar temporal trends from a well pair in Travis County, shown in Figure 4.3-18 (D). This strong connection is consistent with the findings of Smith and Hunt (2020) which found that the top portion of the Trinity hydrostratigraphic unit in Hays and Travis counties is connected to the Edwards hydrostratigraphic unit while the lower portions of the Trinity hydrostratigraphic unit are disconnected from the Edwards hydrostratigraphic unit. Smith and Hunt (2020) also conclude that, locally, lateral flow is much greater than cross-formational flow between the Edwards and Trinity hydrostratigraphic units in the highly faulted and karst Balcones Fault Zone. Unlike the Balcones Fault Zone, the connection between the Edwards and Trinity hydrostratigraphic units is not as strong in the Edwards-Trinity (Plateau) region. Figure 4.3-18 (F) shows water levels for these units in Kerr County that do not overlap and do not seem to share common trends over time. However, the cross-formational connection reappears further west in Pecos County, where the water levels of the Edwards and Trinity hydrostratigraphic units overlap and indicate strong connection, as shown in Figure 4.3-18 (G).

Figure 4.3-18 (E) shows the comparison between the overlying Upper Cretaceous confining units and the Edwards hydrostratigraphic unit in the Balcones Fault Zone. These do not appear to be connected, as the water levels do not overlap and do not show similar temporal trends. Figure 4.3-18 (H) shows that the Pecos Valley Aquifer and the underlying Pre-Cretaceous rocks (lower Mesozoic to Paleozoic rocks) appear to be connected because of overlapping water levels and similar temporal trends.

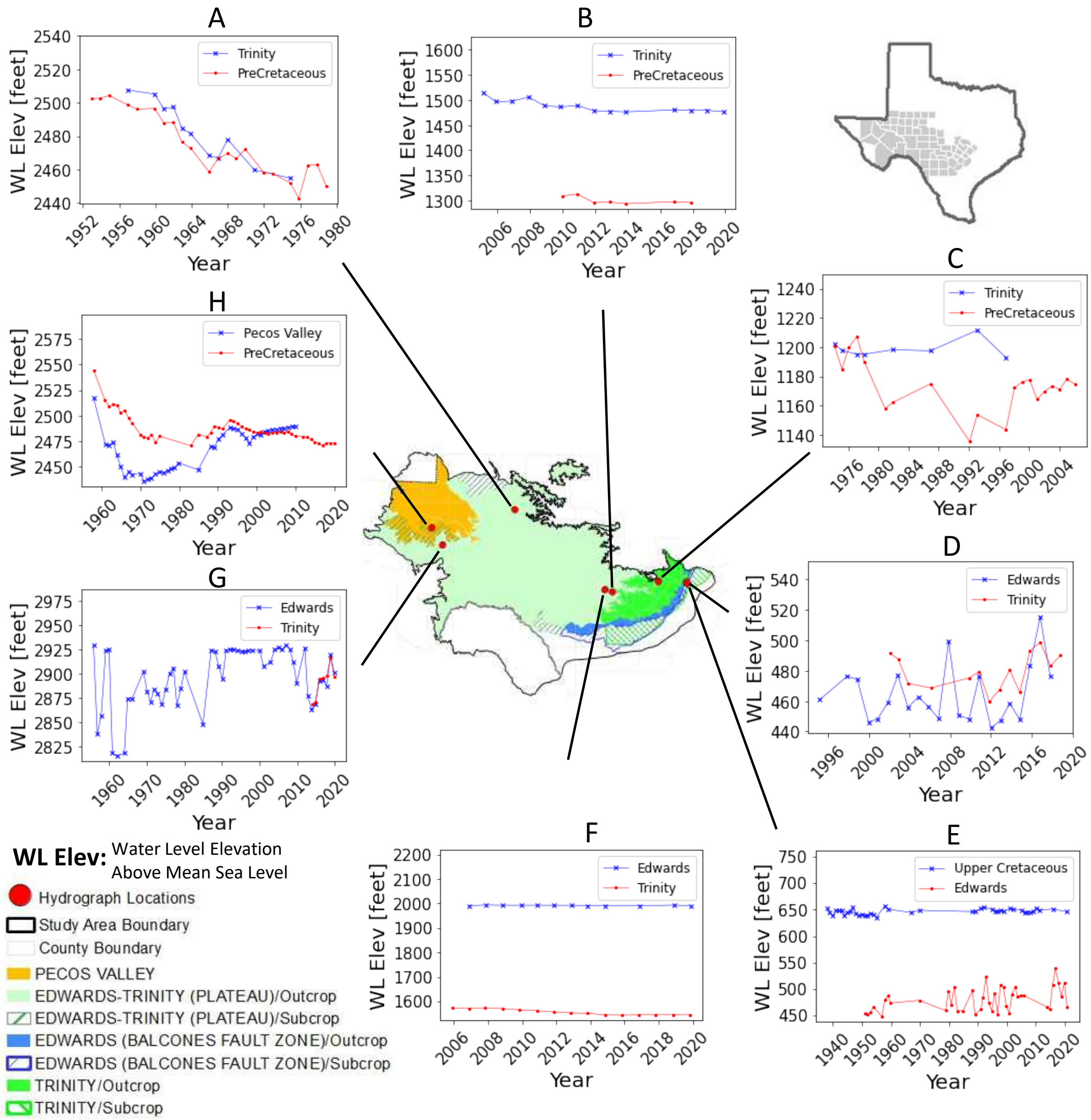


Figure 4.3-18. Selected hydrographs showing water level trends between different hydrostratigraphic units across the study area. All elevations are reported in feet above mean sea level. The Pecos Valley Aquifer is displayed as solid orange, the Edwards-Trinity Plateau Aquifer is displayed as light green, the Trinity Aquifer is displayed as lime green, and the Edwards (Balcones Fault Zone) Aquifer is displayed as blue.

4.4 Recharge

Groundwater recharge is the hydrologic process by which water travels downwards, reaches the water table, and becomes part of the groundwater flow system (Anderson and Woessner, 1992). It is the only natural hydrologic process that can increase the amount of groundwater. Potential sources for recharge include infiltration of precipitation, return flow from irrigation, and leakage from surface water. Factors that influence recharge include the amount and frequency of rainfall, topography, land use and vegetation type, outcrop extent, and the infiltration characteristics of both the upper soil layer and the aquifer (McLaurin, 1988).

However, measuring the amount of recharge to the aquifer directly is not available. Instead, it must be estimated using other measurable parameters. For instance, the sum of runoff, plant uptake, and evaporation from measured precipitation can be subtracted to calculate the infiltration from precipitation (or irrigation return flow). Streamflow analysis can also be used to estimate the recharge to the groundwater from streams.

A TWDB subcontractor (WSP USA) is concurrently developing recharge estimates for the Pecos Valley and Edwards-Trinity (Plateau) regional aquifers model study area based on several estimation methods. The draft report will be publicly available at the same time as the current report. That report will provide final recharge estimates and discuss the various approaches and techniques used to convert measurable data into recharge values in the study area. The recharge distribution in the final numerical groundwater model will be based on the findings of this study.

4.5 Rivers, Streams, Springs, and Lakes

Interaction between surface water and groundwater occurs in areas where surface water is in contact with the outcrop of aquifer rock units. Depending on the flow direction, these interactions can create surface water features including rivers, streams, springs, and lakes, or recharge the aquifer. The aquifer's water level relative to the surface elevation determines the direction of flow between the aquifer and the surface water bodies. In the study area, surface water features occur in the northern, eastern, and southern margins of the Edwards Plateau. Figure 4.5-1 and Figure 4.5-2 show the location of surface water features with river basins and major aquifers in the study area.

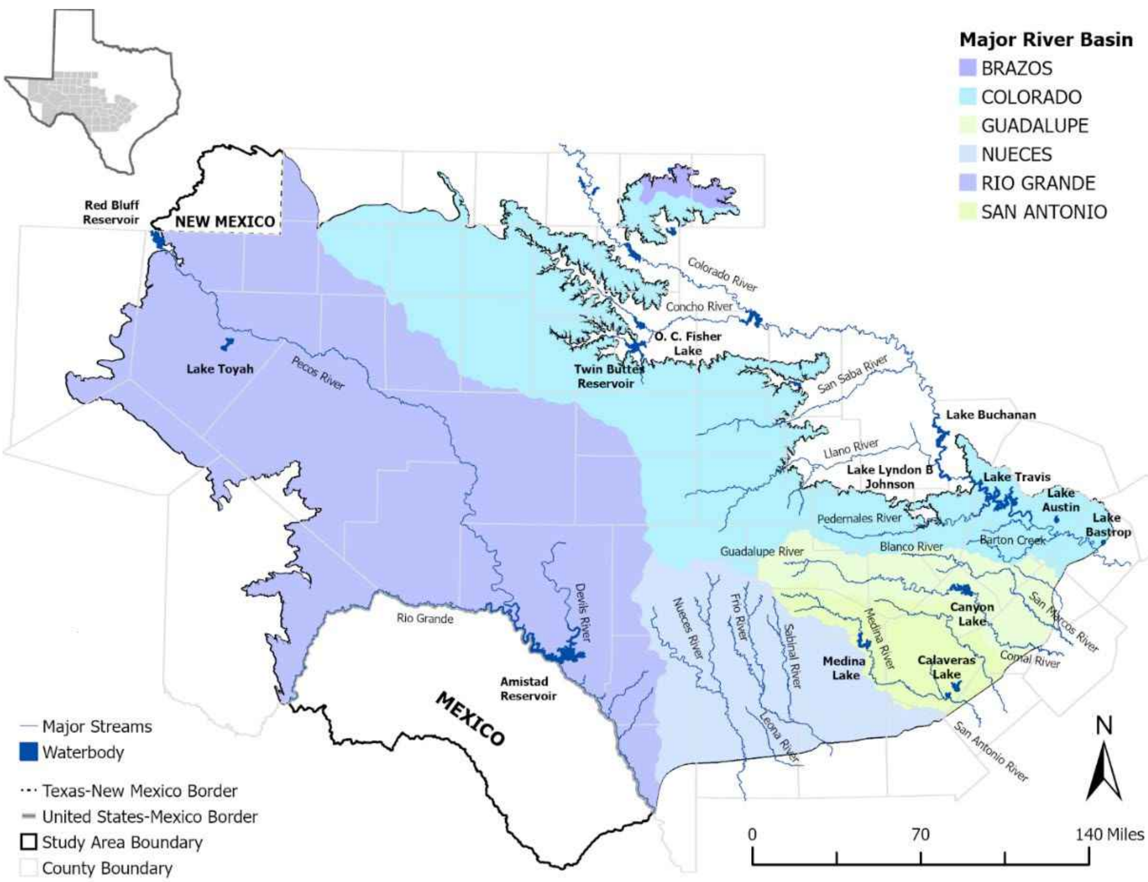


Figure 4.5-1. Major streams and drainage basins of the study area.

Figure 4.5-1 shows river basin, rivers, and reservoirs in the study area. There are six major river basins within the study area: the Brazos, Colorado, Guadalupe, Nueces, Rio Grande, and San Antonio river basins. Although the Brazos River does not flow within the study area, the Brazos River Basin intersects the northern tip of the study area in Nolan and Taylor counties. The major rivers generally flow from northwest to southeast following topography toward the Gulf of Mexico. The Pecos River and Devils River are major tributaries to the Rio Grande and drain the southwestern part of the study area, intersecting the outcrop of the Edwards-Trinity (Plateau) Aquifer. The Pecos River also intersects the Pecos Valley Aquifer in its upstream reaches. The Nueces, Frio, Sabinal, Medina, Guadalupe, and Blanco rivers are located in the southeastern river basins and drain the southeastern and southern portions of the plateau, intersecting the outcrops of the Hill Country portion of the Trinity Aquifer and the Edwards (Balcones Fault Zone) Aquifer. The Concho, San Saba, Llano, and Pedernales rivers are the tributary streams of the Colorado River and drain the northeastern part of Edwards Plateau, intersecting the outcrops of the Edwards-Trinity (Plateau) Aquifer in the west and the Hill Country portion of the Trinity Aquifer in the east.

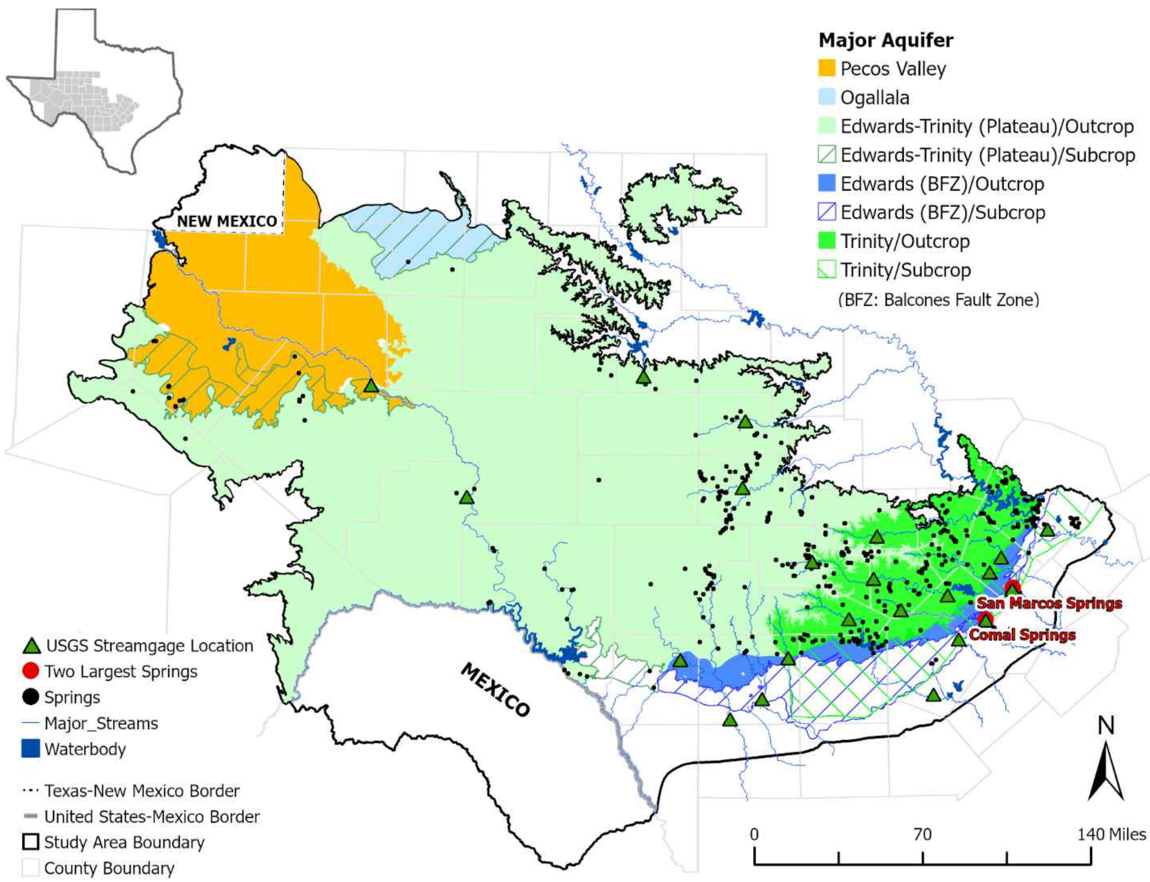


Figure 4.5-2. Stream gage and spring locations in the study area.

Building a dam creates reservoirs and the pressure head generated by the reservoir can artificially sustain groundwater levels higher than the regional aquifer. Weinberg and French (2018) reported higher groundwater level near the Amistad Reservoir along the Rio Grande in Val Verde County than the regional aquifer system. We will consider the potential effects of nearby reservoirs when choosing water level measurements to use during model calibration. Other noteworthy water bodies in the study area include Red Bluff Reservoir just west of the study area on the Pecos River in Loving County, Medina Lake on the Medina River in Medina County, Canyon Lake on the Guadalupe River in Comal County, and Lake Travis and Lake Austin both on the Colorado River in Travis County.

Springs represent locations where groundwater discharges from the aquifer to surface water. As such, springs with significant flow will be implemented in the numerical model, as possible and appropriate, to help better model groundwater/surface water interaction. Figure 4.5-2 shows springs within the study area. In the Edwards-Trinity (Plateau) Aquifer area, most springs fall along major streamlines in the south and southeast portion of the aquifer, although some springs also occur in the Trans-Pecos region. Within the Edwards (Balcones Fault Zone) Aquifer area, larger springs occur at the northern side of the aquifer, where the groundwater flows along fault lines and discharges when the water level is higher than the ground surface.

The two largest springs in the study area are in the Edwards (Balcones Fault Zone) area. Figure 4.5-3 shows the monthly discharge from Comal Springs and San Marcos Springs. From the 1930s to the present day, Comal Springs has discharged a monthly average of about 300 cubic feet per second. The significant drop observed during the several month period during the 1950s drought of record represents the only time that the springs ceased to flow. San Marcos Spring has produced a monthly average flow of about 175 cubic feet per second since the 1950s and has never ceased flowing.

Table 4.5-1 includes other significant springs in the study area. Within the Edwards (Balcones Fault Zones) Aquifer extent, these include Barton Springs in Travis County, San Felipe Springs in Val Verde County, Las Moras Springs in Kinney County, and San Antonio Springs in Bexar County. Barton Springs and San Felipe Springs have a monthly flow average higher than 60 cubic feet per second, while Las Moras Springs and San Antonio Springs have lower flow volumes (around 20 cubic feet per second). In addition, San Antonio Springs flows only in the wet season (data not shown).

In the Edwards-Trinity (Plateau) Aquifer extent, significant springs include San Solomon Springs and Giffin Springs in Reeves County, Phantom Lake Spring in Jeff Davis County, and Comanche Springs in Pecos County. When flowing, San Solomon Springs and Comanche Springs produce more than 25 cubic feet per second on average. Giffin Springs has relatively low rates (around 4 cubic feet per second), and Phantom Lake Spring has intermediate flow rates (around 12 cubic feet per second).

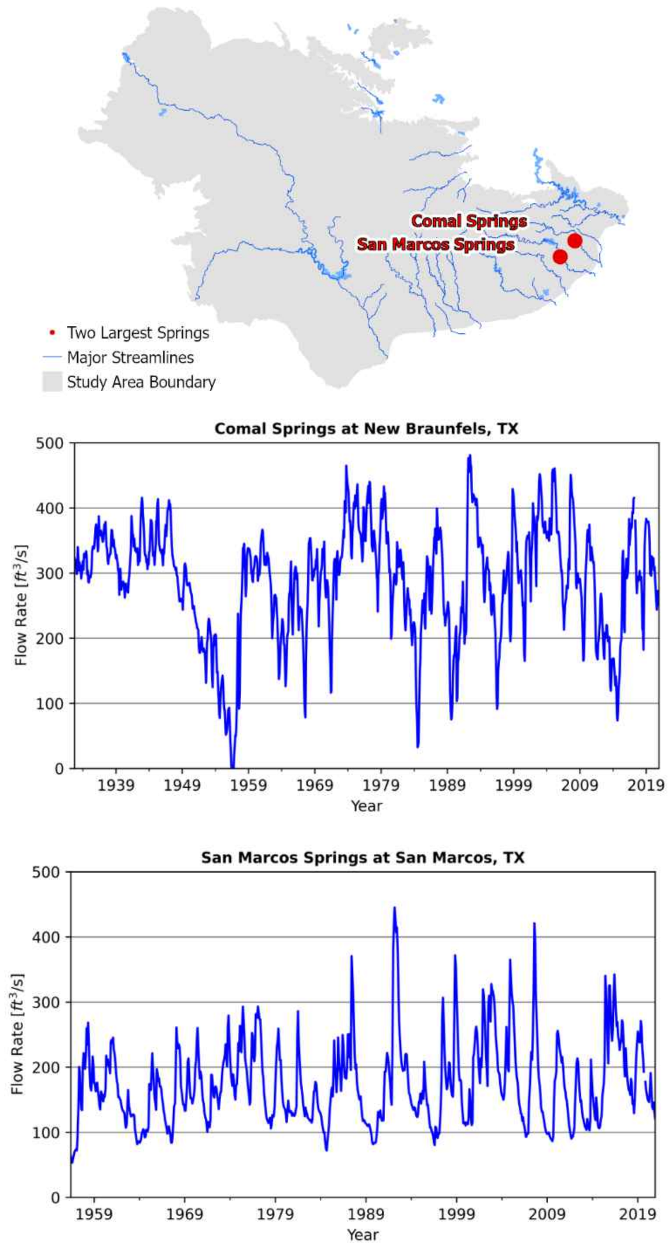


Figure 4.5-3. Hydrographs for the two largest springs (Comal Springs and San Marcos Springs) in the study area.

Table 4.5-1. List of Springs in each aquifer of the study area with the monthly average flow and county location.

Aquifer	Spring Name	Monthly average springflow (cubic feet per second)	County
Edwards (Balcones Fault Zone)	Barton Springs	64.7	Travis
	San Felipe Springs	100.5	Val Verde
	Las Moras Springs	20.7	Kinney
	San Antonio Springs	19.4	Bexar
Edwards-Trinity (Plateau)	San Solomon Springs	32.8	Reeves
	Giffin Spring	4.1	
	Phantom Lake Spring	12.4	Jeff Davis
	Comanche Springs	25.4	Pecos

Since springs are a strong indicator of groundwater availability and aquifer health, recently there has been increasing interest in the springs of the current study area. In 2020, the TWDB initiated the Springs Monitoring Program as part of the TWDB Groundwater Monitoring program. This effort aims to consistently collect discharge and water quality data at springs where data was previously only collected sporadically, often on a case-by-case basis. Springs were chosen for initial monitoring based on factors including cultural significance and sensitivity due to aquifer decline or the presence of endangered species. Most of the chosen springs discharge from the Edwards-Trinity (Plateau) Aquifer or the Hill Country portion of the Trinity Aquifer within the current study area. In the western portion of the study area, a recent study by the Meadows Center for Water and the Environment at Texas State University (Mace and others, 2020) focused on Comanche Springs, once the largest springs in West Texas. Comanche Springs stopped flowing in the 1960s due to significant groundwater pumping, but recently it has begun flowing again in winter months when the aquifer has rebounded from irrigation. Follow-up efforts, including the establishment of a water-market (Texas Water Trade) continue to focus on restoring perpetual flow at Comanche Springs. Since these efforts are still brand new, the current model will not be able to fully incorporate results generated by either the new TWDB program or the Comanche Springs program. However, these efforts do highlight the importance of springflow in the current study area.

Figure 4.5-2 also presents the U.S. Geological Survey streamflow gages in the study area. Figure 4.5-4. shows the streamflow hydrographs of the major streams in the study area.

These hydrographs represent a subset of streamflow gages with a long period of measurement, in locations likely to represent the aquifer behavior. The graphs present the monthly flow rate in cubic feet per second from 1980 to the most recent measurement date measured at the stream gage stations. Breaks in the graphs represent times when no measurements are available for that gage. The U.S. Geological Survey calculated monthly flow rate by averaging their higher frequency measurement data. Spikes in the hydrograph represent stormflow events. If the hydrograph remains constantly above zero, this indicates perennial, or yearlong, flow conditions. If the hydrograph has periods where flow is zero, this indicates intermittent flow conditions.

Streamflow hydrographs can be used as calibration targets to constrain surface water-groundwater interaction in a regional groundwater model. In addition, analyses of streamflow hydrographs can provide estimates of flow from the aquifer to the stream, and vice versa. These analyses separate hydrographs into the portions contributed by surface runoff versus baseflow and the portion that contributes to groundwater recharge in a basin.

A TWDB subcontractor (WSP USA) is concurrently developing baseflow and recharge estimates for the Pecos Valley and Edwards-Trinity (Plateau) regional aquifers model study area, based on several hydrograph separation techniques. The draft report will be publicly available at the same time as the current report. That report will provide final baseflow estimates for streams and rivers in the study area. The implementation of surface water – groundwater interaction in the final numerical groundwater model will be based on the findings of this study.

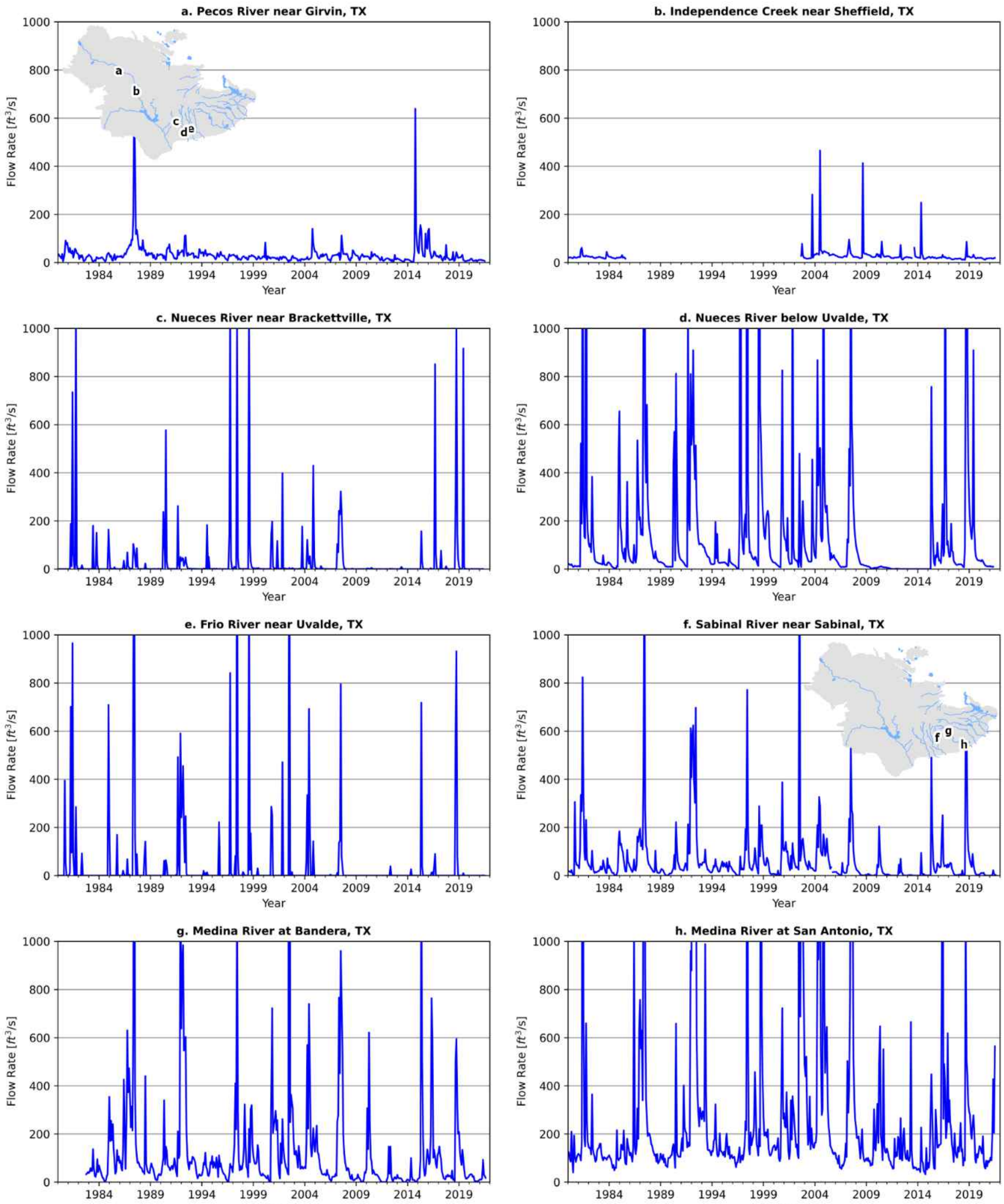


Figure 4.5-4. Streamflow hydrographs for major streams over the study area.

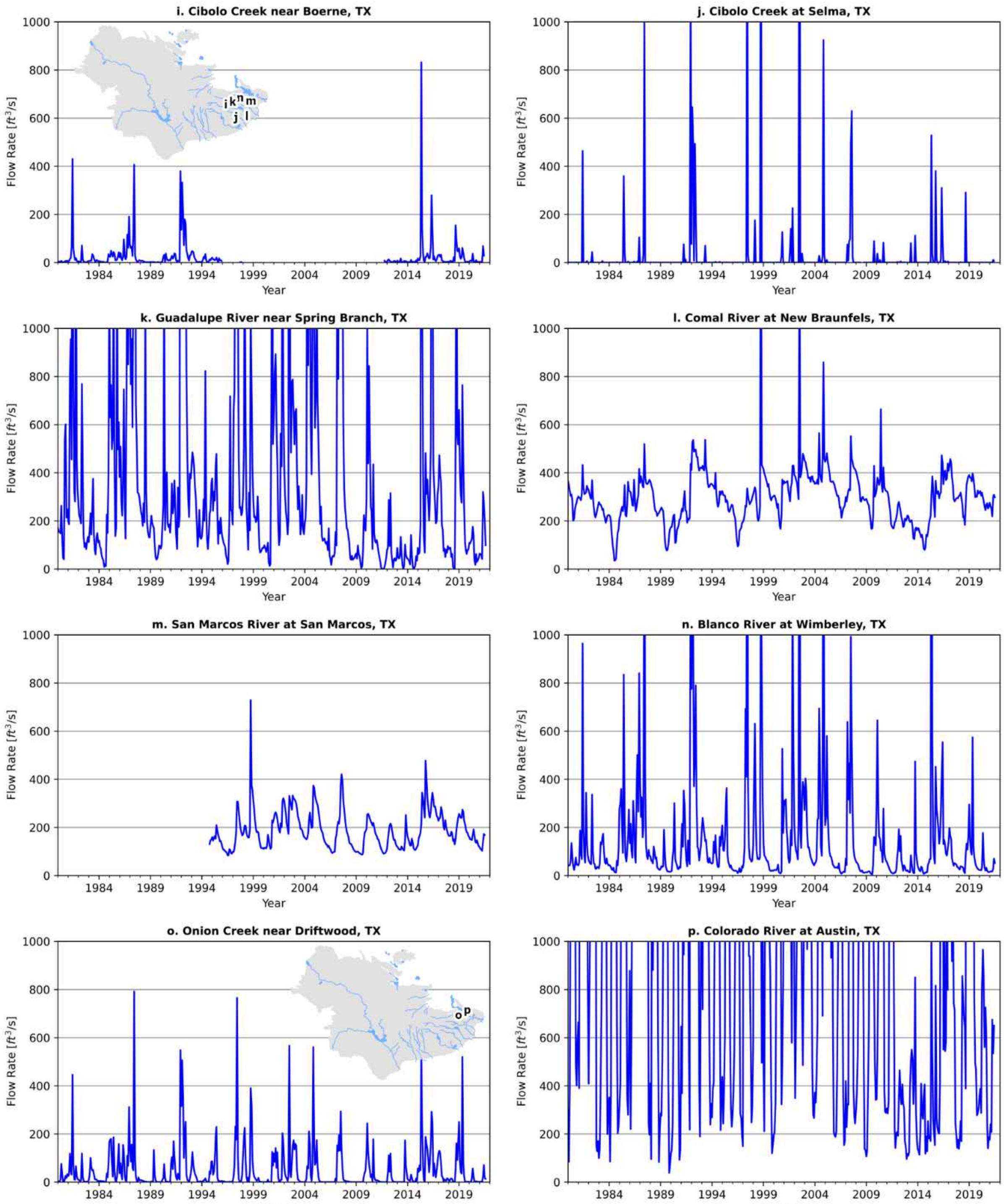


Figure 4.5-4 (continued)

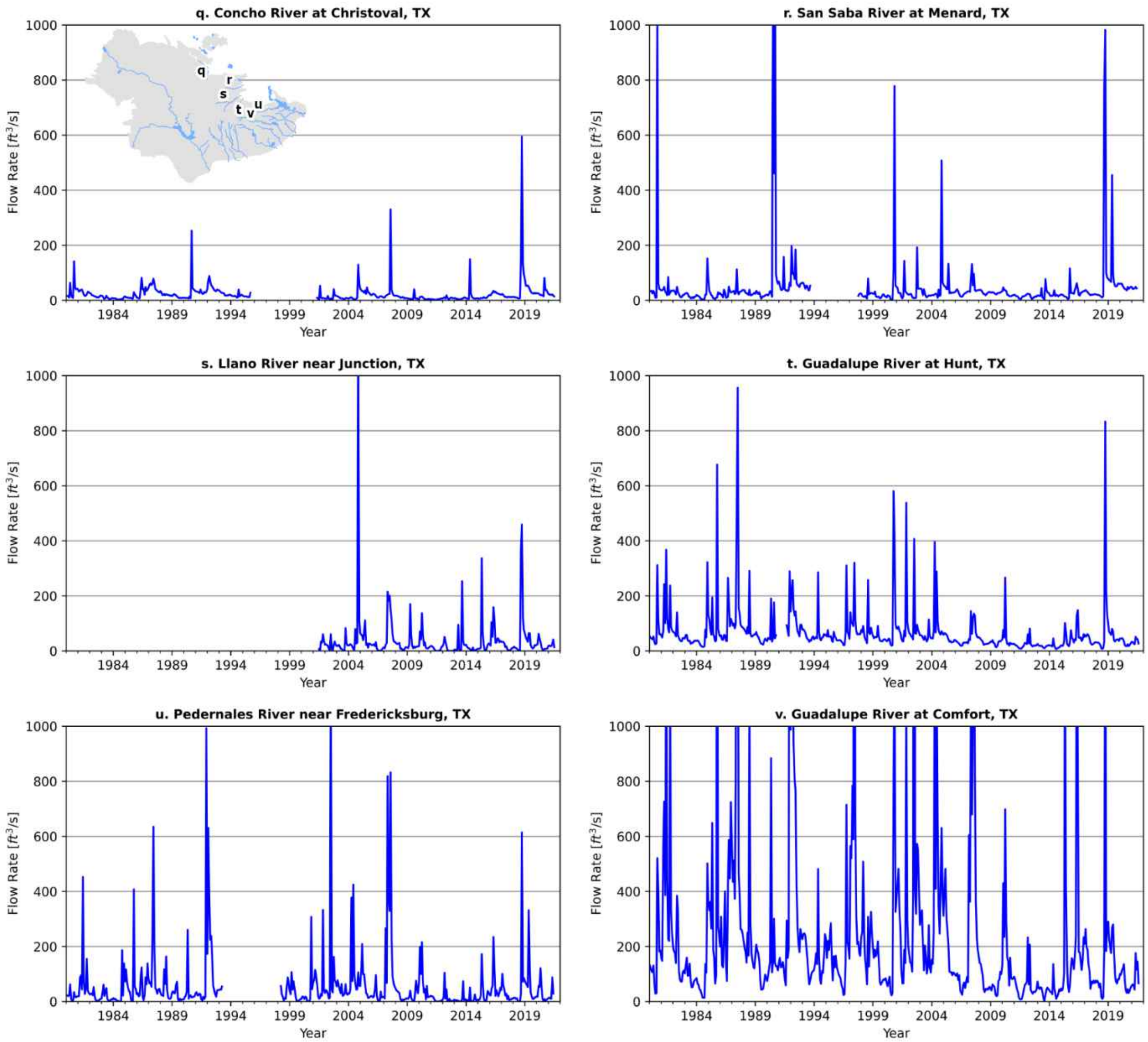


Figure 4.5-4 (continued)

4.6 Hydraulic Properties

The ability of an aquifer to transmit groundwater is influenced by aquifer lithology, fracturing, karstification, structural deformation, and proximity to surface water bodies. Several hydraulic parameters are used to describe aquifer properties, including hydraulic conductivity, transmissivity, specific yield, storativity, and specific capacity. Each of these terms is briefly described below.

Hydraulic Conductivity (K) is a parameter representing how easily groundwater can flow through an aquifer. A higher hydraulic conductivity value means that the groundwater can flow through the aquifer more easily than an aquifer with lower hydraulic conductivity. Hydraulic conductivity may be expressed in feet per day.

Transmissivity (T) is the product of the hydraulic conductivity and the saturated aquifer thickness. Transmissivity is a measure of groundwater flow through the saturated thickness of an aquifer. An aquifer with a higher transmissivity tends to transmit more water than an aquifer with lower transmissivity. Transmissivity may be expressed in square feet per day.

Specific Yield (Sy), also called drainable porosity, is the volume of water released per unit volume of aquifer under the force of gravity. It approximates the effective porosity when the voids in the aquifer are large and well connected. For aquifers with finer materials, the specific yield is usually less than the effective porosity. Specific yield is unitless.

Storativity (S), also called the storage coefficient, is the volume of water released per unit area of aquifer when the water level in the aquifer is lowered by a unit of length. In a confined (or artesian) aquifer, storativity can be used to calculate aquifer specific storage by dividing the aquifer thickness. In an unconfined (water table) aquifer, storativity is essentially equal to the specific yield. The storativity of a confined aquifer is often lower than the specific yield of an unconfined aquifer; given both aquifers contain the same materials. As a result, for the same aquifer, the outcrop area yields more water than downdip portion with the same head loss or drawdown. Storativity is dimensionless. In a confined (or artesian) aquifer, storativity can be used to calculate aquifer specific storage by dividing the aquifer thickness. Specific storage is expressed as one over length such as 1/foot or $foot^{-1}$.

Specific Capacity (S_c), the discharge of a well divided by the drawdown, is a measure of well yield. Specific capacity depends on aquifer properties, well construction, and pumping rate. Specific capacity increases with increasing aquifer transmissivity and well diameter. Well specific capacity is often hindered by poor well design and construction as well as increasing pumping rate, which reduces well efficiency. Specific capacity may be expressed in gallons per minute per foot of drawdown in the well.

Aquifer hydraulic properties are important parameters typically adjusted during model calibration. For this reason, we focused on determining appropriate initial values and ranges of hydraulic properties for use in the model calibration process. Values for hydraulic properties were calculated based on observed data and also compiled values provided in previous studies. The following subsections discuss the data, calculations, and analysis of hydraulic properties for the Pecos Valley Aquifer, the Edwards hydrostratigraphic unit of the Edwards-Trinity (Plateau) Aquifer and the Edwards (Balcones Fault Zone) Aquifer, and the Trinity hydrostratigraphic unit of the Edwards-Trinity (Plateau) Aquifer, the Hill Country portion of the Trinity Aquifer, and the Balcones Falut Zone portion of the Trinity Aquifer within the study area.

4.6.1 Data Sources for Transmissivity Measurements

Aquifer performance tests provide field measurements of transmissivity and storage. Multi-hour to multi-day aquifer pumping tests provide the most reliable estimates of aquifer properties for regional groundwater models as these long tests have a large radius of influence and thus can provide information for a large portion of the aquifer. Unfortunately, conducting and analyzing the results of long-term aquifer tests is expensive and labor-intensive, so long-term aquifer tests are fairly uncommon. Multiple sources for long-term pump test data were queried in the current study area. Data sources for point measurements included:

- TWDB compilations of pumping test analyses (Myers, 1969; Christian and Wuerch, 2012);
- A compilation of pumping tests from county groundwater availability studies (Daniel B. Stephens and Associates, 2006);
- Pumping test data from groundwater conservation districts in the study area, including a compilation of aquifer tests from Barton Springs Edwards Aquifer Conservation District (Hunt and others, 2010) and individual records received and compiled by Toll and others (2018);
- Aquifer pump test data included in the TWDB Brackish Resources Aquifer Characterization System database (TWDB, 2021b);
- The source geodatabase for the Edwards-Trinity (Plateau) Aquifer groundwater availability model (Anaya and Jones, 2009);
- Aquifer pump test data included in the "*Remarks*" section of the TWDB Groundwater Database (TWDB, 2021c); and
- Scanned well documents available from the TWDB Groundwater Data Viewer accessible at https://www3.twdb.texas.gov/apps/WaterDataInteractive/GroundWaterDataViewer.

Two TWDB publications (Myers, 1969; Christian and Wuerch, 2012) provide compilations and analyses of aquifer test data contained in TWDB records. The current study area includes 103 tests from the Myers (1969) dataset and 52 tests from the Christian and Wuerch (2012) dataset.

Daniel B. Stephens and Associates (2006) provides a compilation of pumping tests conducted during the development of housing subdivisions, mostly from counties that require Groundwater Availability Studies as part of the subdivision platting process. This dataset included 10 counties that fall wholly or partially within the current study area, so we were able to use 57 aquifer tests from this dataset.

A Barton Springs Edwards Aquifer Conservation District report (Hunt and others, 2010) provides a compilation of aquifer test data in Hays and Trinity counties, collected from County Water Availability Studies, district hydrogeologic reports, and the TWDB Groundwater Database. After removing tests that are duplicates of previously mentioned datasets, we included 60 tests from this dataset. During the development of the Hill Country portion of the Trinity Aquifer conceptual model (Toll and others, 2018), Barton Springs Edwards Aquifer Conservation District and Blanco-Pedernales Groundwater Conservation District provided several recent documents for individual aquifer tests. We included 23 of these aquifer tests, which are available in the source geodatabase for Toll and others (2018).

The TWDB Brackish Resources Aquifer Characterization System database (TWDB, 2021b) contains aquifer test data collected as part of various TWDB brackish resources reports. Many of these are duplicates of other data sources, particularly Myers (1969) and Christian and Wuerch (2012). After removing duplicates, we included 49 tests from this dataset.

The Edwards-Trinity (Plateau) Aquifer Groundwater Availability Model (Anaya and Jones, 2009) database provides a compilation of aquifer test data from various sources. The majority of these wells are duplicates of wells in the Christian and Wuerch (2012) dataset, which was in progress at the time of that model's publication. After removing duplicates, we included 19 values from the Anaya and Jones (2009) dataset.

The "*Remarks*" field in the "*WellMain*" table of the TWDB Groundwater Database (TWDB, 2021c) includes text containing aquifer test data for several wells. We included 4 wells from this dataset. The "*OtherDataAvailable*" field of the TWDB Groundwater Database "*WellMain*" table also indicates when additional scanned well documents are available for a particular well. We filtered this for wells marked as having "Aquifer Test" data available. Many of these wells are already included in other data sources, including Myers (1969) and Christian and Wuerch (2012). After removing duplicates, we digitized available aquifer test data from the "Scanned Documents" accessible by State Well Number from the interactive interface of the TWDB Groundwater Database at https://www3.twdb.texas.gov/apps/WaterDataInteractive/GroundWaterDataViewer. We included 35 tests from this dataset. Because digitizing scanned documents is a labor-intensive process, focus was given only on areas with few to no aquifer tests available from other datasets and did not include all wells flagged as having available "Aquifer Test" data.

It should also be noted that some wells flagged as having available "Aquifer Test" data are mismarked or have illegible scans, so we did not include these tests in our hydraulic properties database.

We assigned these wells to the current report's hydrostratigraphic units based on their well depth and screen information, according to the methodology described in Section 4.3.1. In the interest of preserving as much long-term aquifer test data as possible, the aquifer assignment provided in the source dataset for wells with no screen or well depth information available were used. This allowed the study to include several additional wells from the Myers (1969), Christian and Wuerch (2012), Daniel B. Stephens and Associates (2006), and Anaya and Jones (2009) datasets.

The left-hand side of Figure 4.6-1 shows the spatial distribution of transmissivity values from long-term aquifer tests by hydrostratigraphic unit. As shown, long-term aquifer tests are sparse in much of the study area. The hydraulic conductivity was calculated by dividing the transmissivity by the unit thickness at these locations. The left-hand side of Figure 4.6-2 shows the spatial distribution of hydraulic conductivity values from long-term aquifer tests by hydrostratigraphic unit. Table 4.6-1 provides the median transmissivity and hydraulic conductivity values from long-term aquifer tests for each hydrostratigraphic unit.

Table 4.6-1. Hydraulic Properties by Hydrostratigraphic Unit (values represent median of compiled measured values)

Hydrostratigraphic Unit	Transmissivity (square feet per day)			Hydraulic Conductivity (feet per day)			Storativity
	Long-term aquifer tests	Specific capacity tests	Combined long-term + specific capacity tests	Long-term aquifer tests	Specific capacity tests	Combined long-term + specific capacity tests	Long-term aquifer tests
Pecos Valley Alluvium	4,939	3,274	3,702	6.0	5.8	5.8	2.5×10^{-4}
North	4,545	3,293	3,309	8.1	5.9	6.0	3.0×10^{-4}
South	5,079	2,794	4,137	4.5	3.9	4.0	2.0×10^{-4}
Edwards	2,818	1,543	1,543	6.9	4.1	4.1	7.5×10^{-4}
Trinity	213	654	654	0.4	1.4	1.4	3.0×10^{-4}
North Plateau	325	1,037	973	1.8	7.2	7.0	6.0×10^{-4}
South Plateau	231	1,850	1,716	0.3	1.6	1.6	4.9×10^{-4}
Hill Country	164	135	135	0.2	0.2	0.2	1.8×10^{-4}

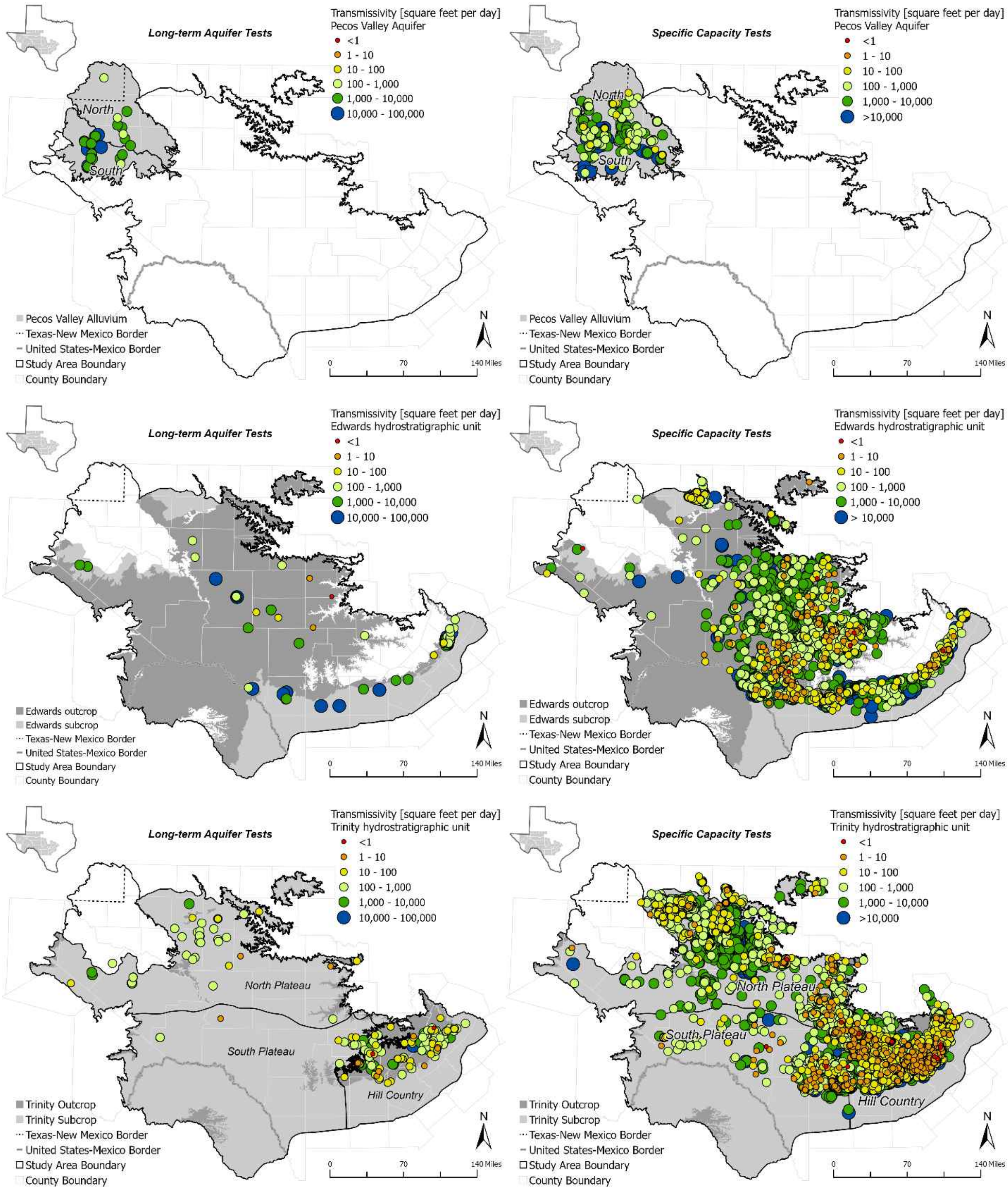


Figure 4.6-1. Transmissivity values by hydrostratigraphic unit estimated from long-term aquifer tests (left-hand side) and specific capacity tests (right-hand side).

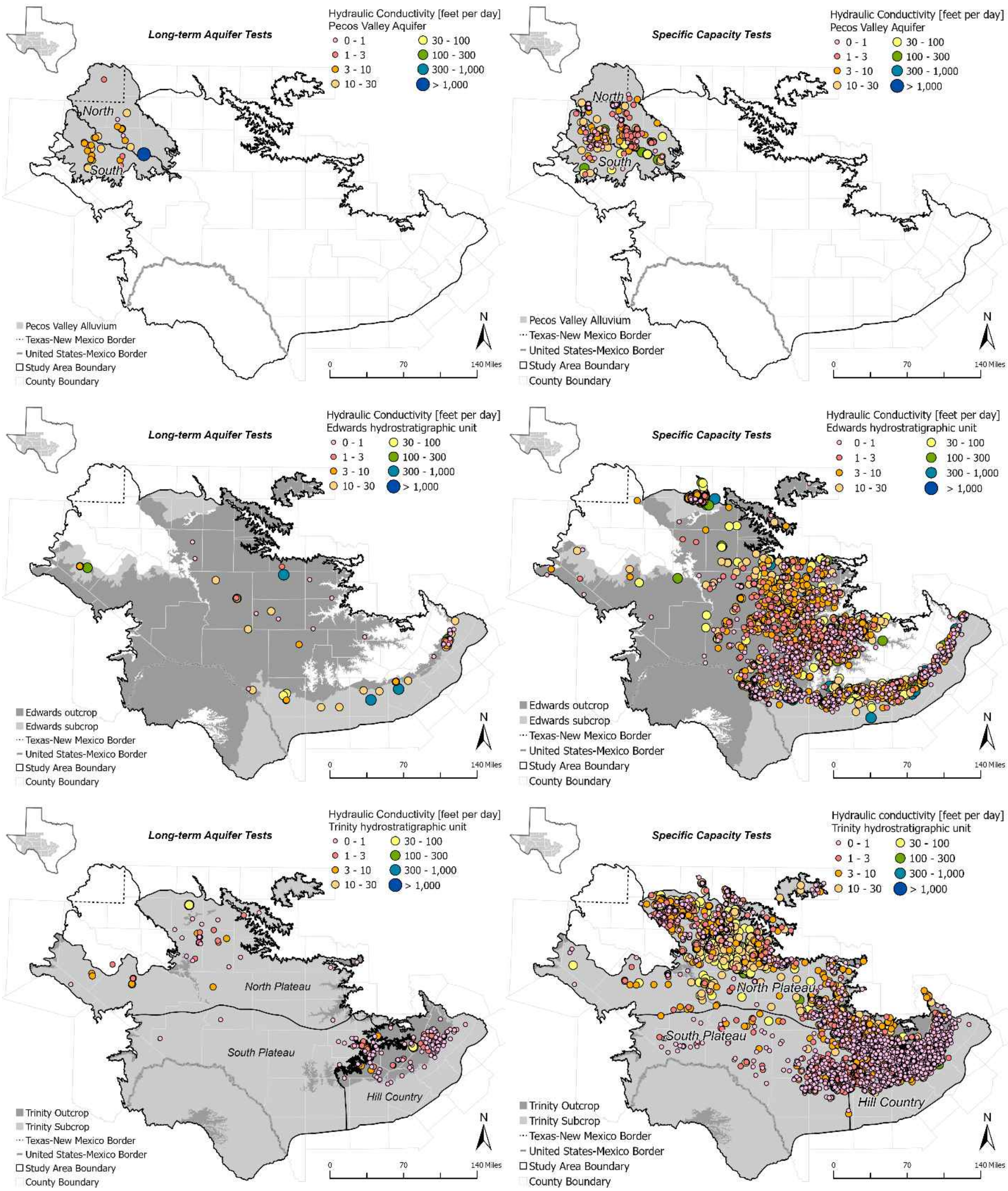


Figure 4.6-2. Hydraulic conductivity values by hydrostratigraphic unit estimated from long-term aquifer tests (left-hand side) and specific capacity tests (right-hand side).

4.6.2 Data Sources for Specific Capacity Tests

Conducting and analyzing the results of long-term aquifer tests is expensive and labor-intensive, so long-term aquifer tests are not well distributed throughout the study area. Specific capacity tests, on the other hand, are simple, short, and commonly available for most wells. Specific capacity, or the pumping rate divided by drawdown, is an important parameter for determining the expected performance of a drilled well. Specific capacity tests stress a smaller portion of the aquifer than long-term aquifer tests and represent near-well aquifer conditions. However, specific capacity tests are useful for filling gaps in areas where long-term aquifer tests are sparse. Multiple sources of specific capacity measurement data were queried in the current study area. Data sources for point measurements of specific capacity included:

- Drawdown, yield, and duration data for specific capacity tests from the "*WellTest*" table in the TWDB groundwater database (TWDB, 2021c);
- Specific capacity data from remarks in the "*WellMain*" table in the TWDB groundwater database (TWDB, 2021c);
- Drawdown, yield, and duration data for specific capacity tests from the "*WellTest*" table in the TWDB submitted drillers' report database (TWDB, 2021d); and
- Specific capacity and duration data for specific capacity tests from the "*tblBRACS_AquiferTestInformation*" table in the TWDB Brackish Resources Aquifer Characterization System database (TWDB, 2021b).

The "*WellTest*" table of the TWDB groundwater database (TWDB, 2021c) includes yield, drawdown, and duration data from specific capacity tests. We calculated specific capacity values by dividing yield by drawdown. Based on recommendations in Mace (2001), wells with a test type of "Bailed" and with a test duration of zero were ignored. Mace (2001) also noted that ignoring wells with zero reported drawdown can introduce a bias towards lower transmissivity values. For this reason, we assumed wells with zero reported drawdown to have a drawdown of 1 foot, a standard value used in previous reports mentioned in Mace (2001). This assumption allowed the study to calculate a specific capacity value for these wells instead of ignoring them. Altogether, we included 648 values from the "*WellTest*" table. The "*Remarks*" field in the "*WellMain*" table of the TWDB groundwater database (TWDB, 2021c) includes text containing specific capacity test results by well. We compiled the specific capacity and test duration values included in the text remarks. Based on recommendations in Mace (2001), wells with a test duration of zero were ignored. After removing duplicates from the "*WellTest*" table, we included 891 wells from this dataset.

The "*WellTest*" table in the TWDB submitted drillers' report database (TWDB, 2021d) includes a spreadsheet of yield, drawdown and duration data from specific capacity tests. This dataset has minor overlap with the TWDB groundwater database (TWDB, 2021c). After removing duplicates, we included 16,050 values from this dataset in the current study area. We used the same assumptions for calculating specific capacity values as we did for the "*WellTest*" table of the TWDB groundwater database (TWDB, 2021c).

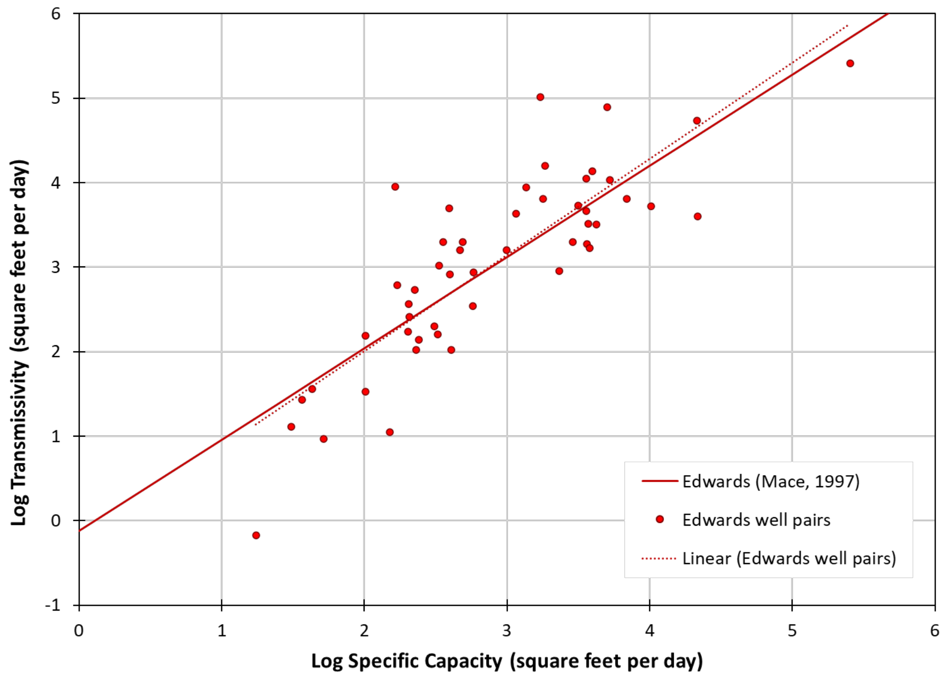
The "*tblBRACS_AquiferTestInformation"* table in the TWDB Brackish Resources Aquifer Characterization System database (TWDB, 2021b) contains aquifer test data collected as part of various TWDB brackish resources reports. We compiled specific capacity and test duration values included in the spreadsheet. Based on recommendations in Mace (2001), wells with a test duration of zero were ignored. This database has significant overlap with other datasets, especially the TWDB groundwater database (TWDB, 2021c). After removing duplicates, we included 1,802 values from this dataset.

These wells were assigned to the current report's hydrostratigraphic units based on their well depth and screen information. Note that for brevity, "screen" in this analysis refers to both screened and open intervals. Wells without sufficient depth or screen information were ignored to satisfactorily assign them to the current report's hydrostratigraphic units.

4.6.3 Calculation of Transmissivity from Specific Capacity Tests

There are several methods available for estimating transmissivity using specific-capacity data. A commonly used analytical method from Driscoll (1986) uses a simplified version of the Cooper and Jacob (1946) equation and estimates transmissivity by multiplying specific capacity (in gallons per day per foot) by 2,000 in confined aquifers and by 1,500 in unconfined aquifers. This simplification makes assumptions that are not necessarily appropriate for this study area, so we did not use this method in the current analysis.

One empirical method described in Mace (2001) develops an aquifer-specific relationship between transmissivity and specific capacity using pairs of transmissivity and specific capacity measurements taken at the same wells. Mace (2001) provides a table of aquifer-specific empirical relationships that includes several Texas aquifers within the current study area. From the long-term aquifer test data, we compiled well pairs that had both a transmissivity value and specific capacity value reported and compared this data to the empirical relationships provided in Mace (2001). As shown in Figure 4.6-3, the Trinity well pairs from long-term aquifer test data most closely match the Mace (2001) relationship developed for the Glen Rose and Cow Creek formations while the Edwards well pairs most closely match the Mace (1997) relationship for the Edwards Aquifer.



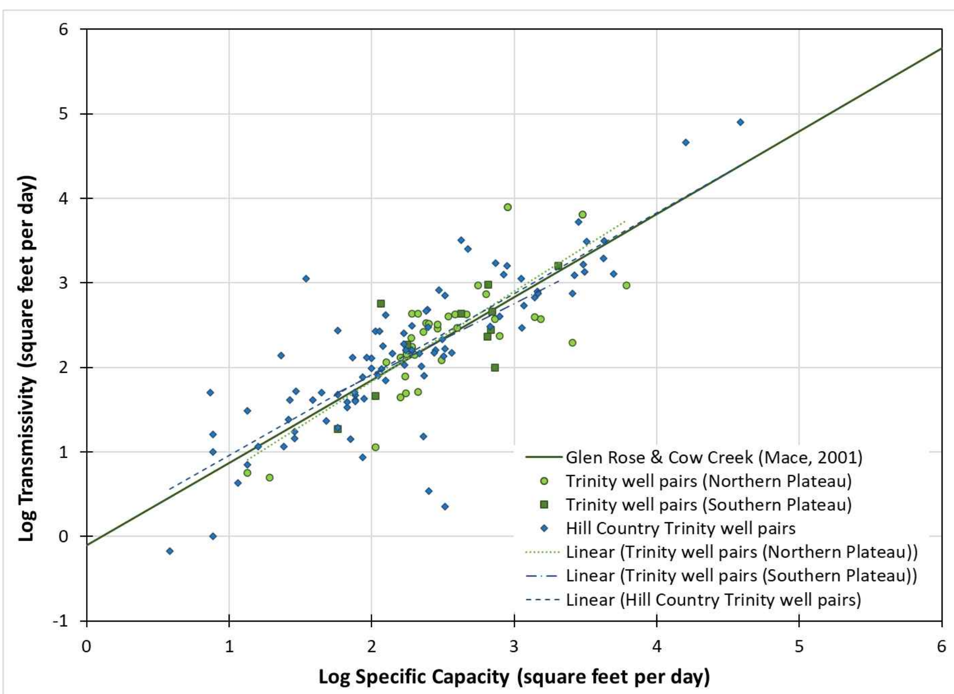


Figure 4.6-3. Comparison of transmissivity and specific capacity measurement pairs to aquifer-specific relationships in the literature.

Because the Edwards and Trinity well pairs closely matched the Mace (2001) empirical relationships, we used these relationships to calculate transmissivity from specific capacity for the Edwards and Trinity hydrostratigraphic units. However, the Pecos Valley Alluvium well pairs (data not shown) did not closely match any empirical relationships provided in Mace (2001). Since no relationships were established with confidence using empirical methods, an analytical method for calculating transmissivity values from specific-capacity data was used instead. According to Mace (2001), the preferred analytical approach for establishing a relationship between specific capacity and transmissivity is based on the Theis non-equilibrium equation (Theis and others, 1963):

$$S_c = \frac{4\pi T}{\left[\ln\left(\frac{2.25Tt}{r^2S}\right)\right]} \qquad (Equation\ 4.1)$$

where:

S_c= specific capacity,
T = aquifer transmissivity,
t = pumping time,
r = well radius, and
S = aquifer storativity.

Since Equation 4.1 cannot be solved directly for transmissivity, Microsoft Excel was used to solve it iteratively, according to the method provided in Mace (2001). For wells with available screen information, we used the average screen radius. For wells with no screen information, we used an assumed well radius of 4 inches. This value is based on the average radius of wells assigned to the Edwards-Trinity Plateau in the TWDB groundwater database (TWDB, 2021c). The aquifer storativity for the calculation was assumed to be 1.0 x 10^{-4}, which is slightly low but reasonable based on measured storativity values (Section 4.6.6). Based on the recommendation from Mace (2001), the data was ignored where the specific capacity test type is “bailed” and where the pumping duration of the test is not recorded.

It should be noted that this dataset may contain wells whose screens do not cover a large percentage of the aquifer. For these “partially penetrating” wells, the transmissivity value calculated from Equation 4.1 will not be representative of the entire aquifer thickness (Mace, 2001). We did not attempt to correct for this through filtering or mathematical methods, as most wells in the dataset lacked sufficient screen information to confidently make these corrections.

The right-hand side of Figure 4.6-1 shows the spatial distribution of the transmissivity estimates derived from specific capacity data by hydrostratigraphic unit. The right-hand side of Figure 4.6-2 show the spatial distribution of hydraulic conductivity derived from specific capacity data by hydrostratigraphic unit. The hydraulic conductivity was calculated by dividing the transmissivity by the unit thickness at these locations. Table 4.6-1 summarizes the median transmissivity and hydraulic conductivity values calculated from specific capacity data for each hydrostratigraphic unit.

4.6.4 Transmissivity and Horizontal Hydraulic Conductivity Discussion

For this conceptual model, we focused on determining appropriate initial values and ranges of hydraulic properties for use in the model calibration process. As with all field data, the compiled hydraulic property measurements described above have some uncertainty. The assumptions in the methodology for assigning aquifers and calculating transmissivity from specific capacity introduce more uncertainty. Since interpolating over the current large study area might inadvertently emphasize misleading anomalies caused by these assumptions, we did not attempt to interpolate either the transmissivity or hydraulic conductivity distribution. Instead, the study depends on the calculated range and statistical distribution of these compiled values to determine representative hydraulic property values over the coarse of geologically similar spatial zones, as shown in Figure 4.6-1 and Figure 4.6-2. Table 4.6-1provides the median hydraulic property values calculated from the long-term aquifer tests and specific capacity tests as well as the median value of all tests combined. Figure 4.6-4 provides histograms of transmissivity values by hydrostratigraphic unit based on the combined data gathered from both long-term aquifer tests and specific capacity tests. Figure 4.6-5 provides histograms of hydraulic conductivity values by hydrostratigraphic unit.

Pecos Valley Aquifer

In the shallow hydrostratigraphic unit, we only considered hydraulic property data for the Pecos Valley Aquifer. In the Pecos Valley Aquifer, a median hydraulic conductivity of 5.8 feet per day was derived based on all well test data. The area north of the Pecos River has a slightly higher median hydraulic conductivity (5.9 feet per day) than the area south of the Pecos River (3.9 feet per day). During model calibration, it will be determined whether it makes sense to separate these areas into different zones. The previous TWDB groundwater availability model for the Edwards-Trinity (Plateau) Aquifer (Anaya and Jones, 2009) used a hydraulic conductivity value of 9 feet per day for the Pecos Valley Aquifer. An alternate version of this model using a different calibration method (Young and others, 2010) found a calibrated median hydraulic conductivity value of 7.1 feet per day.

The calculated hydraulic conductivity value for the Pecos Valley Aquifer is slightly lower than the values from previous models but seems reasonable as an initial value for calibration. Since the full aquifer thickness was used in the calculation of hydraulic conductivity rather than saturated thickness, it makes sense that the values skew lower. During calibration, we will consider increasing the hydraulic conductivity value to closer match the previous modeled values.

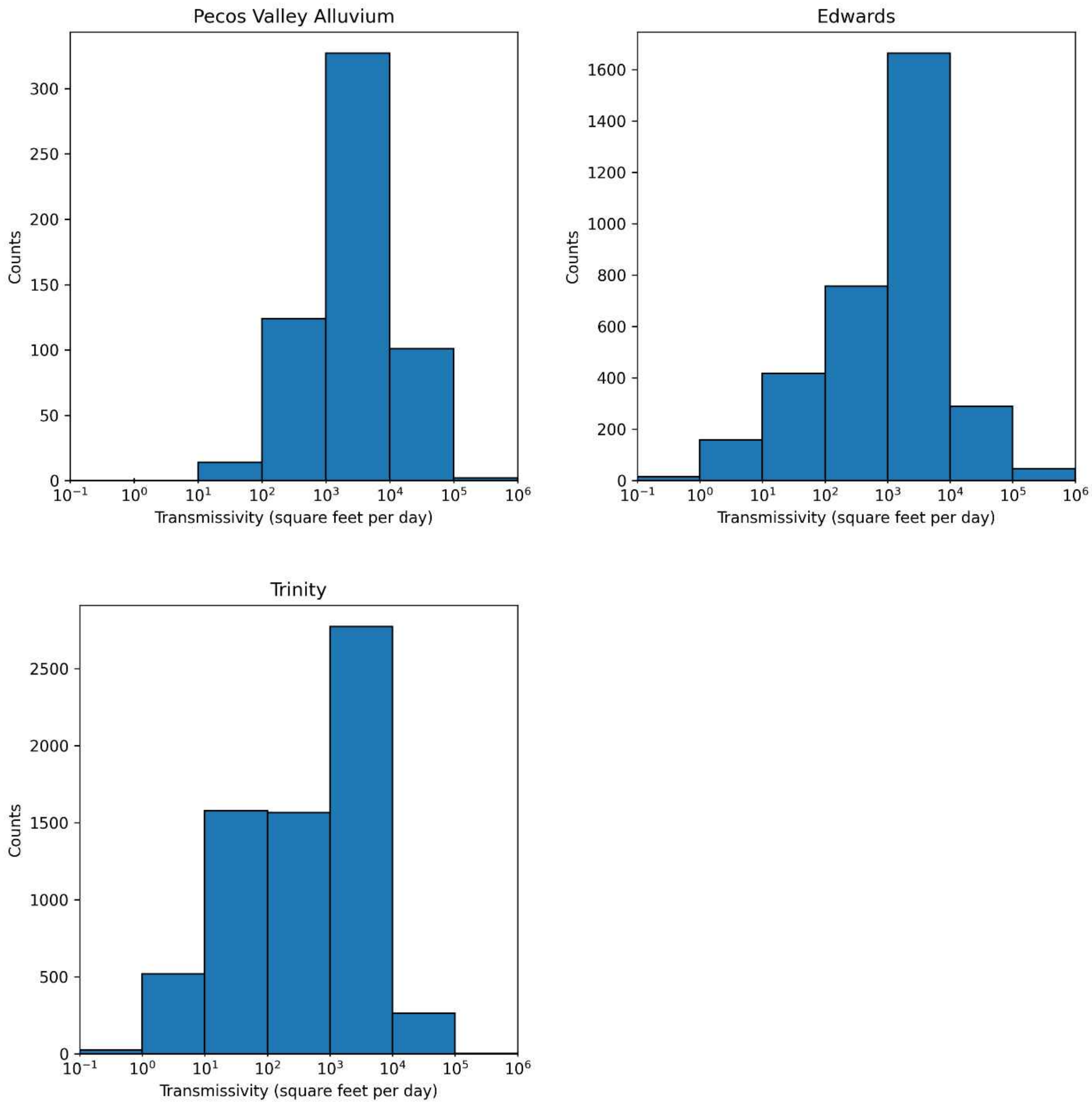


Figure 4.6-4. Histograms of Transmissivity estimates by hydrographic unit.

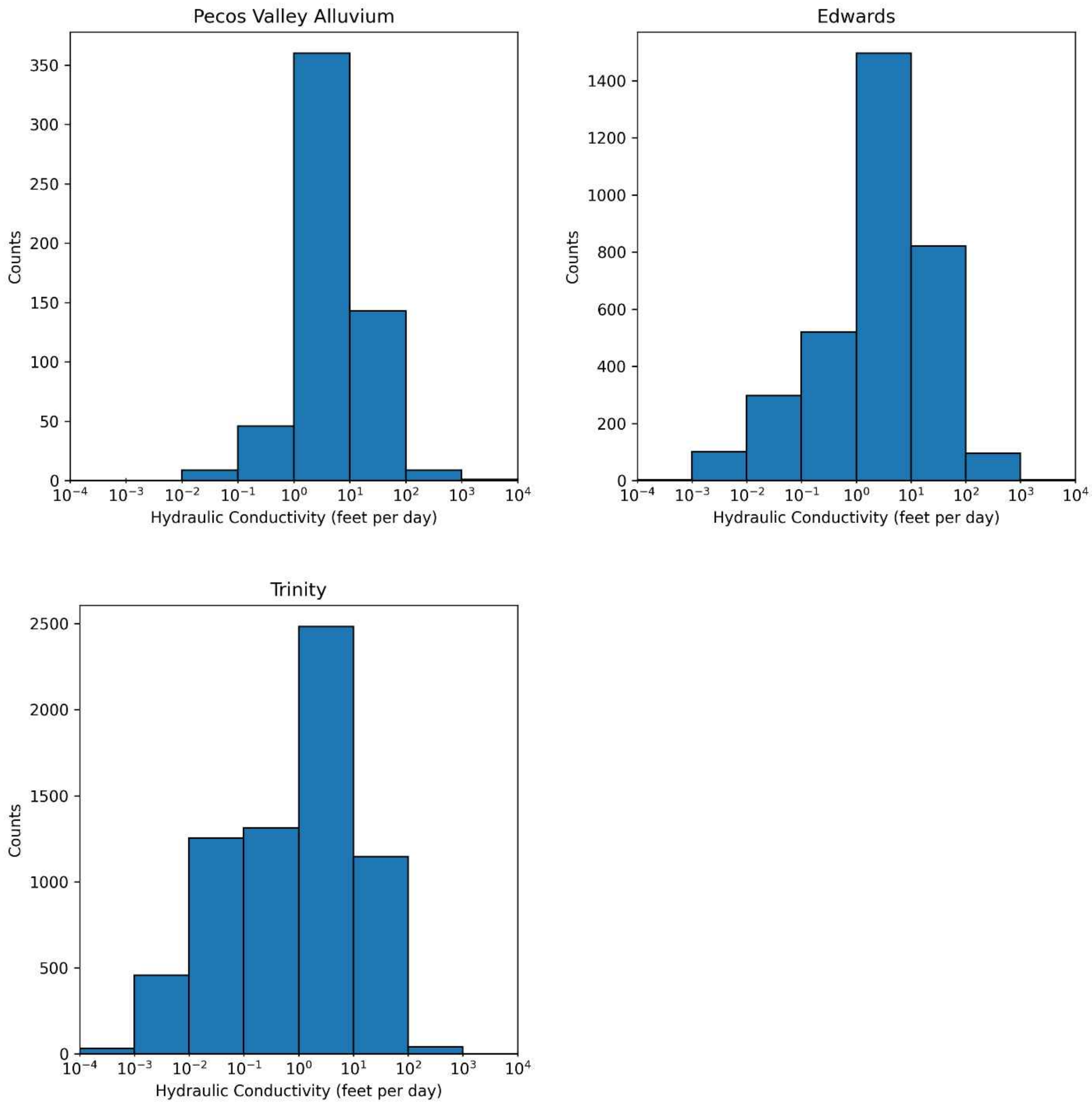


Figure 4.6-5. Histograms of hydraulic conductivity estimates by hydrographic unit.

Edwards hydrostratigraphic unit

In the Edwards hydrostratigraphic unit, a median hydraulic conductivity of 4.1 feet per day was derived based on all well data. The previous TWDB groundwater availability model for the Edwards-Trinity (Plateau) Aquifer (Anaya and Jones, 2009) used a hydraulic conductivity value of 6.65 feet per day for this unit. An alternate version of this model using a different calibration method (Young and others, 2010) found a calibrated median hydraulic conductivity value of 8 feet per day. The previous TWDB model for the Hill Country portion of the Trinity Aquifer (Jones and others, 2011) found a calibrated hydraulic conductivity value of 11 feet per day for the Edwards Group.

The calculated hydraulic conductivity value for the Edwards hydrostratigraphic unit is slightly lower than the values from previous models but generally seems reasonable as an initial value for calibration. The exception is in the highly-productive Edwards (Balcones Fault Zone) Aquifer, where this hydraulic conductivity value may be too low. During calibration, it will be determined whether it makes sense to either increase hydraulic conductivity or to separate this highly-faulted area into a different zone than the rest of the study area (where the Edwards hydrostratigraphic unit is largely intact). However, a compilation of aquifer tests in this region (Hunt and others, 2010) found a median Edwards hydraulic conductivity of 5.71 feet per day, which implies that the calculated value for this study may not be unreasonable. A model of the Edwards-Trinity aquifer system in the Hill Country area (Kuniansky and Ardis, 2004) also showed that the faults in this region can severely constrict flow perpendicular to the faults, which may also cause lower hydraulic conductivity values.

Trinity hydrostratigraphic unit

For discussion purposes, the Trinity hydrostratigraphic unit was split into several zones, labeled in Figure 4.6-1 and Figure 4.6-2. The “Hill Country” region refers to the area of the Trinity hydrostratigraphic unit representing the Hill Country portion of the Trinity Aquifer. The “North Plateau” region refers to those western portions of the Trinity hydrostratigraphic unit in the Edwards-Trinity (Plateau) Aquifer where the Glen Rose Formation is absent and the “South Plateau” region refers to where the Glen Rose Formation is present. This boundary of the Glen Rose Formation was georeferenced from Barker and others (1994). The “Nolan Island” region refers to the isolated portion of the Edwards-Trinity (Plateau) Aquifer occurring mostly in Nolan and Taylor counties. For this analysis, we have included this area into the “North Plateau” region, but during calibration, considerations will be made as to whether it makes sense to treat this area separately.

In the North Plateau region of the Trinity hydrostratigraphic unit, the median hydraulic conductivity derived from all well data is 7.0 feet per day. The previous TWDB groundwater availability model for the Edwards-Trinity (Plateau) Aquifer (Anaya and Jones, 2009) used a hydraulic conductivity value of 15 feet per day for this region. A re-calibrated version of the Edwards-Trinity (Plateau) Aquifer model (Young and others, 2010), found a calibrated median hydraulic conductivity value of 3.7 feet per day. The calculated hydraulic conductivity value for the North Plateau region of the Trinity hydrostratigraphic unit falls between the values from previous models and seems reasonable as an initial value for calibration.

In the South Plateau region of the Trinity hydrostratigraphic unit, the median hydraulic conductivity derived from compiled well data is 1.6 feet per day. The previous TWDB groundwater availability model for the Edwards-Trinity (Plateau) Aquifer (Anaya and Jones, 2009) used a hydraulic conductivity value of 2.5 feet per day for this region. An alternate version of this model using a different calibration method (Young and others, 2010) found a calibrated median hydraulic conductivity value of 2.1 feet per day. The calculated hydraulic conductivity value for the South Plateau region of the Trinity hydrostratigraphic unit is slightly lower than the values from previous models but seems reasonable as an initial value for calibration.

In the Hill Country region of the Trinity hydrostratigraphic unit, the median hydraulic conductivity derived from compiled well data is 0.2 feet per day. The previous TWDB groundwater availability model for the Edwards-Trinity (Plateau) Aquifer (Anaya and Jones, 2009) used a hydraulic conductivity value of 2.5 feet per day. An alternate version of this model using a different calibration method (Young and others, 2010) found a calibrated median hydraulic conductivity value of 2.1 feet per day. The calculated hydraulic conductivity value for the Hill Country region of the Trinity hydrostratigraphic unit in this study is lower than the values from previous models. Since the calculated value includes all subunits of the Trinity hydrostratigraphic unit, even the very low permeability portions, the lower calculated value might be over-representing lower permeability subunits. Since these subunits will not be implemented individually in the model, it may not be reasonable to use the lower value to represent the combined Trinity hydrostratigraphic unit in this area. During calibration of the numerical model, we will consider using higher values, more similar to past models, for hydraulic conductivity in this region.

4.6.5 Vertical Hydraulic Conductivity

In the context of regional groundwater planning, vertical hydraulic conductivity is largely considered for its impact on leakage between hydrostratigraphic units and into hydrostratigraphic units from springs and streams. A vertical leakage coefficient is the vertical hydraulic conductivity of a unit divided by the thickness of the unit. In most sedimentary aquifers, we assume that vertical hydraulic conductivity is lower than horizontal hydraulic conductivity. In other words, water flows more easily along the horizontal plane of the geologic layer than vertically through the layer. A common assumption is that horizontal hydraulic conductivity is 10 times greater than vertical hydraulic conductivity. However, the actual difference between vertical hydraulic conductivity and horizontal hydraulic conductivity, often expressed as a vertical anisotropy ratio, depends on local geologic conditions. In the Hill Country area, low-permeability confining units like the Hammett Shale, Bexar Shale, and the clays and marls of upper member of the Glen Rose Limestone create high vertical anisotropy ratios within the Trinity Aquifer. A study by W.E. Simpson Company and William F. Guyton Associates (1993) in northern Bexar County estimated vertical hydraulic conductivity in these confining units is only around 1.0×10^{-4} to 0.003 feet per day. These confining units are not present further west in the study area. So, as noted in Anaya and Jones (2009), the thinner, but more homogenous Trinity Sands in the northwest portion of the Edwards-Trinity (Plateau) Aquifer have less vertical anisotropy than the shale, sand, and limestone transgressive-regressive sequence in the Hill Country portion of the Trinity Aquifer. For this reason, we will consider the Hill Country region separately from the Plateau regions during calibration.

Since measured vertical hydraulic conductivity values are rare, vertical hydraulic conductivity is usually a calibrated model parameter. In fact, standard modeling procedures provided by Anderson and Woessner (1992) recommend using groundwater models for estimating vertical hydraulic conductivity at a regional scale. The previous TWDB model for the Edwards-Trinity (Plateau) Aquifer (Anaya and Jones, 2009) assumed an initial vertical hydraulic conductivity value equal to 10 percent of the horizontal hydraulic conductivity. Within the model layer representing the Edwards hydrostratigraphic unit, the calibrated vertical hydraulic conductivity value was 1.0×10^{-4} feet per day in areas overlying those portions of the Trinity hydrostratigraphic unit that represented the Glen Rose Formation and 1.0×10^{-5} feet per day in areas where Glen Rose Formation was absent. Within the model layers representing the Edwards and Trinity hydrostratigraphic units, little to no cross-formational flow was found to or from the underlying Dockum, Capitan Reef Complex, Rustler, and Hickory aquifers. The previous TWDB model for the Hill Country portion of the Trinity Aquifer (Jones and others, 2011) assumed an initial vertical hydraulic conductivity value equal to 10 percent of the horizontal hydraulic conductivity, with the and the vertical leakance ranging from 1.0×10^{-6} to 0.8 per day.

4.6.6 Storage Properties

Storativity, or storage coefficient, is the volume of water released per unit area of aquifer when the water level in the aquifer is lowered by one unit of length. In a confined (or artesian) aquifer, aquifer specific storage can be calculated by dividing storativity by the aquifer thickness. In an unconfined (water table) aquifer, storativity is essentially equal to the specific yield, or drainable porosity. The following sections discuss our estimates for these storage properties.

Storativity and Specific Storage Values

As with transmissivity, analyses of long-term pump tests provide the most reliable estimates for storativity. We queried multiple sources for long-term aquifer test data, as discussed in Section 4.6.1. The queries found 145 measurements of storativity values from long-term aquifer test data in the current study area. We ignored values marked as literature values since these were not calculated using aquifer test data or marked as unreliable or out-of-range. Table 4.6-1 provides the median values of measured storativity values by hydrostratigraphic unit. Figure 4.6-6 shows the spatial distribution of these point measurements by hydrostratigraphic unit. Figure 4.6-7 shows the histograms of storativity by hydrostratigraphic unit. The median storativity value is 2.5×10^{-4} for the Pecos Valley Aquifer, 7.5×10^{-4} for the Edwards hydrostratigraphic unit, and 3.0×10^{-4} for the Trinity hydrostratigraphic unit. Within the Trinity hydrostratigraphic unit, storativity is lower in the the Hill Country portion of the Trinity Aquifer (1.8×10^{-4}) than in the northern portion of the Edwards-Trinity Plateau (6.0×10^{-4}) and the southern portion of the Edwards-Trinity Plateau (4.9×10^{-4}).

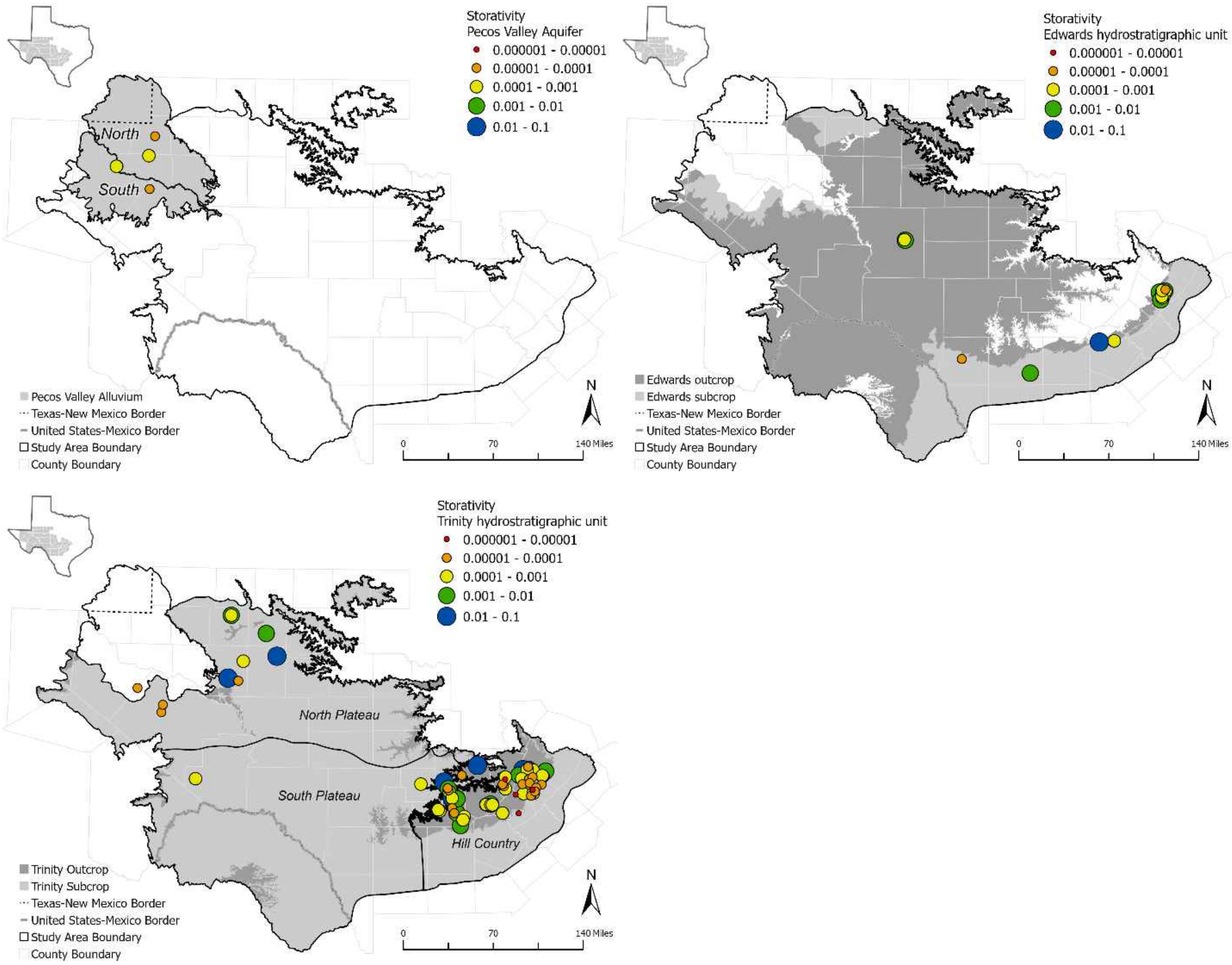


Figure 4.6-6. Measured storativity values derived from long-term aquifer tests by hydrostratigraphic unit.

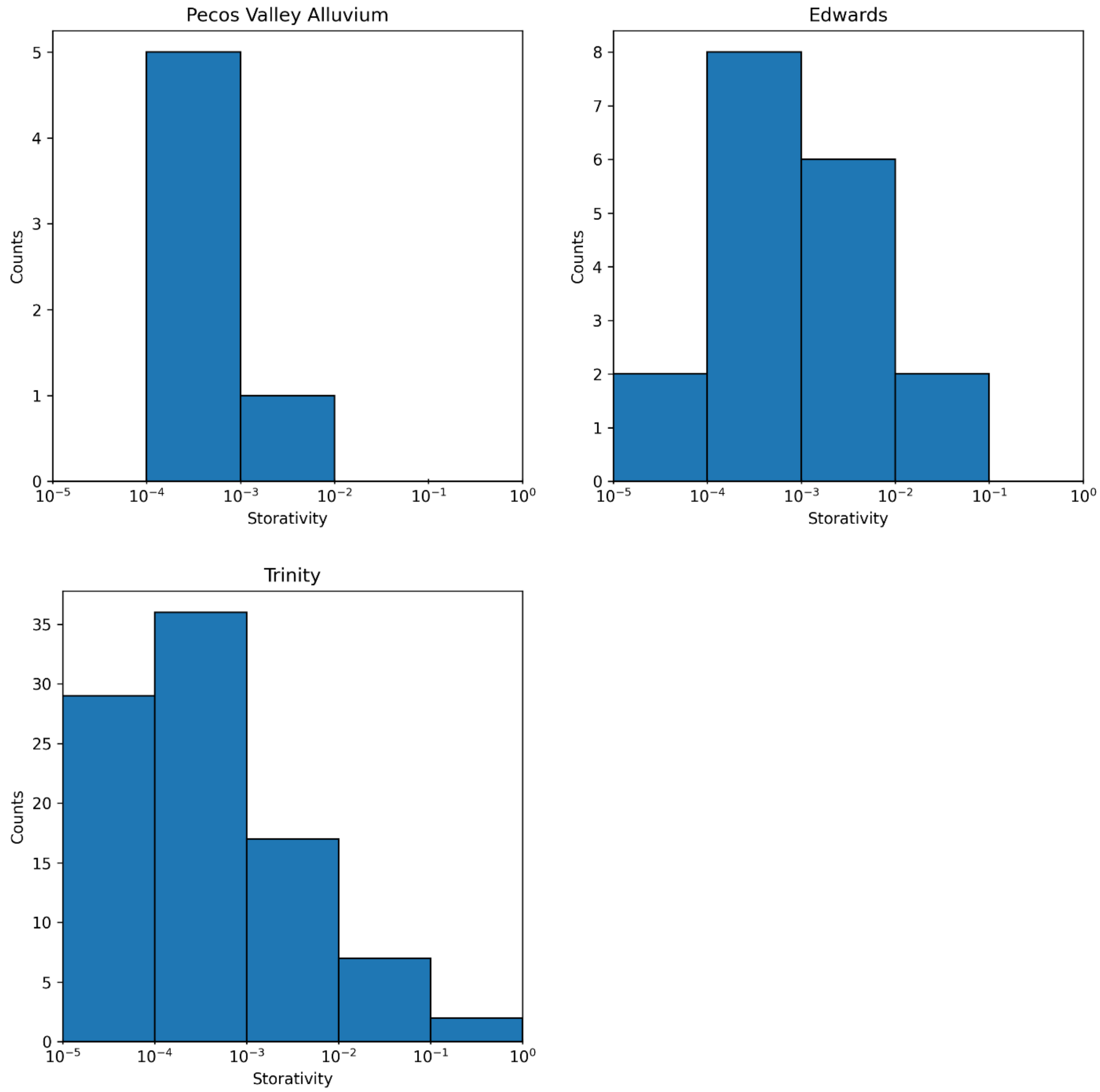


Figure 4.6-7. Range of measured storativity values by hydrostratigraphic unit.

In addition to measured data, we also considered literature values for storage properties. Walker (1979) provides a compilation of aquifer tests for the "Lower Cretaceous Aquifer" in the Edwards-Trinity (Plateau) region. This dataset includes several wells falling within the current model's Trinity hydrostratigraphic unit, including a Gillespie County well in the Hensell Formation with a storativity value of 7.0×10^{-5} and five Kerrville wells in the Hosston and Sligo formations with storativity values ranging from 2.0×10^{-5} to 5.0×10^{-5}. Ashworth (1983) compiled storativity values from Walker (1979) and an additional well completed in Cow Creek, Sligo and Hosston formations with a storage coefficient of 7.4×10^{-4}.

Specific storage refers to the storage coefficient divided by the thickness of the aquifer. In the previous TWDB groundwater availability model for the Edwards-Trinity (Plateau) Aquifer (Anaya and Jones, 2009), the calibrated specific storage value was 2.0×10^{-4} per foot for the modeled unit representing the current Pecos Valley Aquifer. For the modeled unit representing the current Edwards hydrostratigraphic unit, the calibrated specific storage value ranged from 5.0×10^{-7} to 5.0×10^{-6} per foot. For the modeled unit representing the current Trinity hydrostratigraphic unit, the calibrated specific storage value ranged from 1.0×10^{-7} to 1.0×10^{-5} per foot. An alternate version of this model using a different calibration method (Young and others, 2010) found that the calibrated median specific storage value was 4.1×10^{-5} per foot in the modeled unit representing the Pecos Valley Aquifer and 1.1×10^{-5} per foot in the modeled unit representing the current Edwards hydrostratigraphic unit. For the modeled unit representing the current Trinity hydrostratigraphic unit, the calibrated specific storage value was 9.2×10^{-6} per foot in the Southern Plateau and Hill Country regions, 9.4×10^{-6} per foot in the Northern Plateau region and 1.0×10^{-5} per foot in the Nolan Island region.

Specific Yield Values

As discussed earlier, the storativity is essentially equal to the specific yield for unconfined aquifers and tends to be higher in unconfined aquifers than in confined aquifers. The median storativity values in Table 4.6-1 seem lower than typical specific yield values and therefore likely represent confined storativity values rather than specific yield values. For comparison, representative specific yield values in the literature for unconsolidated gravels and sands similar to the Pecos Valley Aquifer range from 0.21 to 0.33 (Morris and Johnson, 1967) or from 0.19 to 0.22 (Heath,1983). These literature values are similar to the calibrated specific yield values in previous models. In the previous TWDB groundwater availability model for the Edwards-Trinity (Plateau) Aquifer (Anaya and Jones, 2009), the calibrated specific yield value was 0.2 for the modeled unit representing the current Pecos Valley Aquifer. An alternate version of this model using a different calibration method (Young and others, 2010) found that the calibrated median specific yield value was 0.1 in the modeled unit representing the current Pecos Valley Aquifer. Since the calculated storativity values are too low to consider them representative of unconfined specific yield in the Pecos Valley Aquifer, we will instead use a higher value during calibration, more similar to previous models and the literature values.

The specific yield of consolidated materials, like the limestone and sandstone present in the Edwards and Trinity hydrostratigraphic units, are typically lower than in unconsolidated materials like the alluvium of the Pecos Valley Aquifer. However, representative specific yield values for these materials in the literature are still much higher than the storativity values in Table 4.6-1. For instance, typical limestone values range from 0.14 (Morris and Johnson, 1967) to 0.18 (Heath, 1983) and sandstone ranges from 0.06 (Heath, 1983) to 0.27 (Morris and Johnson, 1967). In the previous TWDB groundwater availability model for the Edwards-Trinity (Plateau) Aquifer (Anaya and Jones, 2009), the calibrated specific yield value ranged from 5.0×10^{-4} to 0.05 for the modeled unit representing the current

Edwards hydrostratigraphic unit. For the modeled unit representing the current Trinity hydrostratigraphic unit, the calibrated specific yield value ranged from 0.003 to 0.03 throughout most of the Edwards-Trinity Plateau region, and down to 3.0×10^{-4} in the southern confined part of the Hill Country region. An alternate version of this model using a different calibration method (Young and others, 2010) found that the calibrated median specific yield value was 0.009 in the modeled unit representing the current Edwards hydrostratigraphic unit, and 0.08 in the modeled unit representing the current Trinity hydrostratigraphic unit. Since the calculated storativity values for this study are too low to consider them representative of unconfined specific yield in the Edwards and Trinity hydrostratigraphic units, we will instead use a higher value during calibration, more similar to previous models. As those models indicate that the Edwards and Trinity hydrostratigraphic units act as confined aquifers through much of their extent, specific yield will be a less important parameter for these units compared to the fully unconfined Pecos Valley Aquifer.

4.7 Discharge

Discharge is the process by which water leaves an aquifer. There are two types of discharge: natural and anthropogenic. The natural discharge process can include outflow to streams or springs, evapotranspiration, and cross-formational flow. Pumping from wells is an example of anthropogenic discharge from aquifers.

4.7.1 Natural Aquifer Discharge

Groundwater discharges naturally through springs or stream baseflow in areas where the water level intersects ground surface. As discussed in Section 4.5, discharge to springs and streams mostly occurs in the southern and southeastern portion of the study area, particularly in the Edwards Balcones Fault Zone area and along the eastern margin of the Edwards Plateau area. Detailed discussion about groundwater discharges to surface water bodies within the study area can be found in Section 4.5.

Natural groundwater discharge can also take the form of cross-formational flow between hydraulically contiguous major and minor aquifers of the Edwards-Trinity aquifer system. Cross-formational flow in the study area occurs between the Hill Country portion of the Trinity Aquifer and the Edwards (Balcones Fault Zone) Aquifer. However, the actual rate of cross-formational flow is difficult to measure. While several studies (Kuniansky and Holligan, 1994; Mace and others, 2000; Anaya and Jones, 2009) provide evidence for the existence of this cross-formation flow and provide estimates of the volume of flow, there is no consensus on the actual amount of flow. Another location for cross-formational flow is near the eastern flanks of the Trans-Pecos mountains, where some groundwater flows from the Edwards-Trinity (Plateau) Aquifer into the Pecos Valley Aquifer (Anaya and Jones, 2009).

Evapotranspiration refers to the net water extraction due to evaporation from bare soil, open water surfaces, and transpiration from plants. If the water table is shallow or phreatophytes are abundant, groundwater evapotranspiration can be significant for aquifers (Scanlon and others, 2005). Phreatophytes, which are deep-rooted and obtain most of their water from the saturated zone of an aquifer, occur along major stream valleys and can greatly increase evapotranspiration rates. Anaya and Jones (2009) noted that high evapotranspiration rates occur along the Pecos River in the Trans-Pecos region. Scanlon and others (2005) completed the evapotranspiration study over Texas as shown in Figure 4.7-1.

A TWDB subcontractor (WSP USA) is concurrently developing discharge estimates for the Pecos Valley and Edwards-Trinity (Plateau) regional aquifers model study area based on several estimation methods, including an evapotranspiration analysis based on remote-sensing and TexMesonet data. The draft report will be publicly available at the same time as the current report. That report will provide estimates for evapotranspiration values in the study area. The evapotranspiration rates in the final numerical groundwater model will be based on the findings of that study.

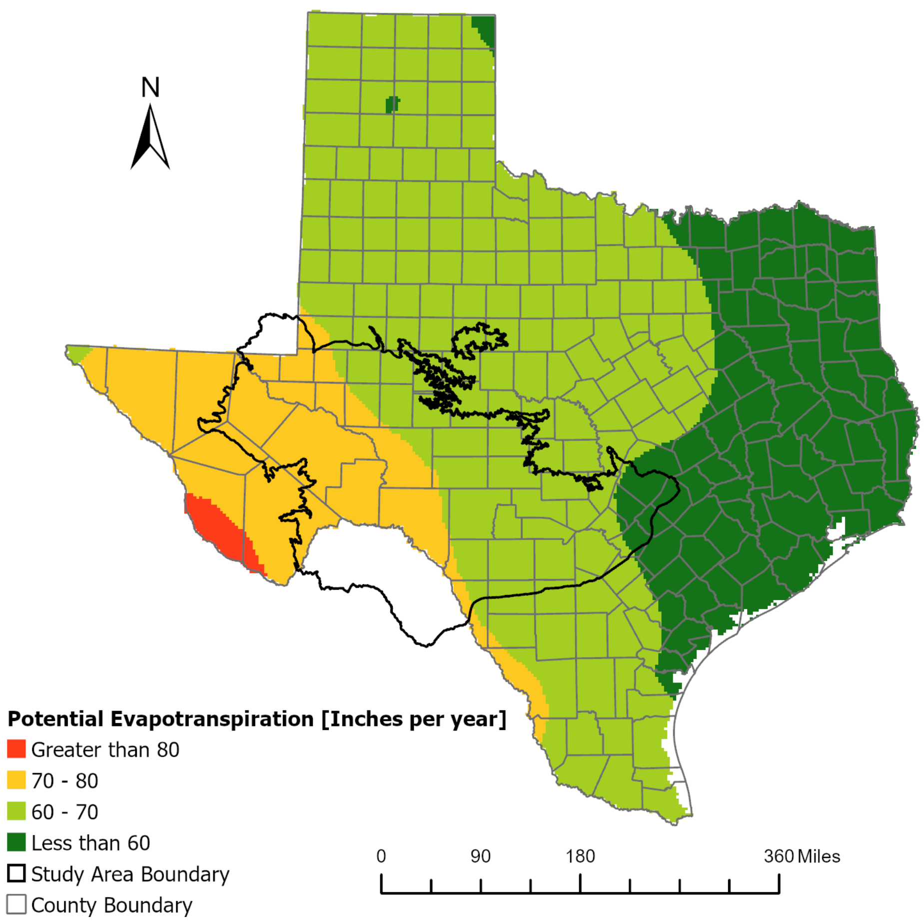


Figure 4.7-1. Potential Evapotranspiration for Texas (Scanlon and others, 2005).

4.7.2 Aquifer Discharge through Pumping

Pumping-or anthropogenic extraction of groundwater from an aquifer-often makes up a significant portion of groundwater discharge. Groundwater pumping in the study area provides water for irrigation, livestock, manufacturing, mining, municipal, and domestic use. TWDB collects pumping data from industrial and municipal users through the Water Use Survey, as mandated by the Texas Water Code. TWDB provides the compiled results by year and by county in the historical groundwater pumpage dataset. This dataset provides an invaluable starting point for developing a pumping dataset in the study area. However, this dataset requires substantial understanding to provide a complete picture of pumping in the study area. For instance, in addition to surveyed water use, this dataset contains the non-surveyed water use, which estimates the county-level water use based on the methodologies and assumptions developed by TWDB staff for the area where no water use survey data is collected. Understanding the assumptions and methodologies behind the data is essential. In addition, changes in data collection, survey distribution, and survey response rates can introduce inconsistencies or even data gaps to this dataset.

A TWDB subcontractor (LRE Water LLC.) is concurrently developing pumping estimates for the Pecos Valley and Edwards-Trinity (Plateau) regional aquifers model study area meant to fill the data gaps in the TWDB historical groundwater pumpage dataset. The draft report will be publicly available at the same time as the current report. That report will provide estimates for pumping values and spatial distribution of pumping in the study area. The pumping rates in the final numerical groundwater model will be based on the findings of this study.

4.8 Water Quality

We will be developing a regional groundwater flow model instead of a contaminant transport (water quality) model or a seawater intrusion model. As such, water quality variations will not be directly incorporated into the numerical model. However, water quality analysis can still provide insight into the overall conceptualization of groundwater flow in the study area. The following groundwater quality analysis was used to evaluate groundwater's salinity levels, recharge conditions, approximate and relative ages, and the general flow direction. We conducted the water quality analysis with the "*WaterQualityMajor"* table in the TWDB groundwater database (TWDB, 2021c). Water quality analysis includes 7,635 wells data from the Pecos Valley, Edwards-Trinity (Plateau), and Edwards (Balcones Fault Zone) aquifers and the Hill Country portion of the Trinity Aquifer (Figure 4.8-1). We used the aquifer classification assigned within the TWDB groundwater database since water quality analysis provides a general groundwater trend rather than the numerical model's specific data. This section discusses the major element and isotopic compositions of groundwater in the aquifers within our study area with implications for determination of groundwater flow through and recharge to the respective aquifers.

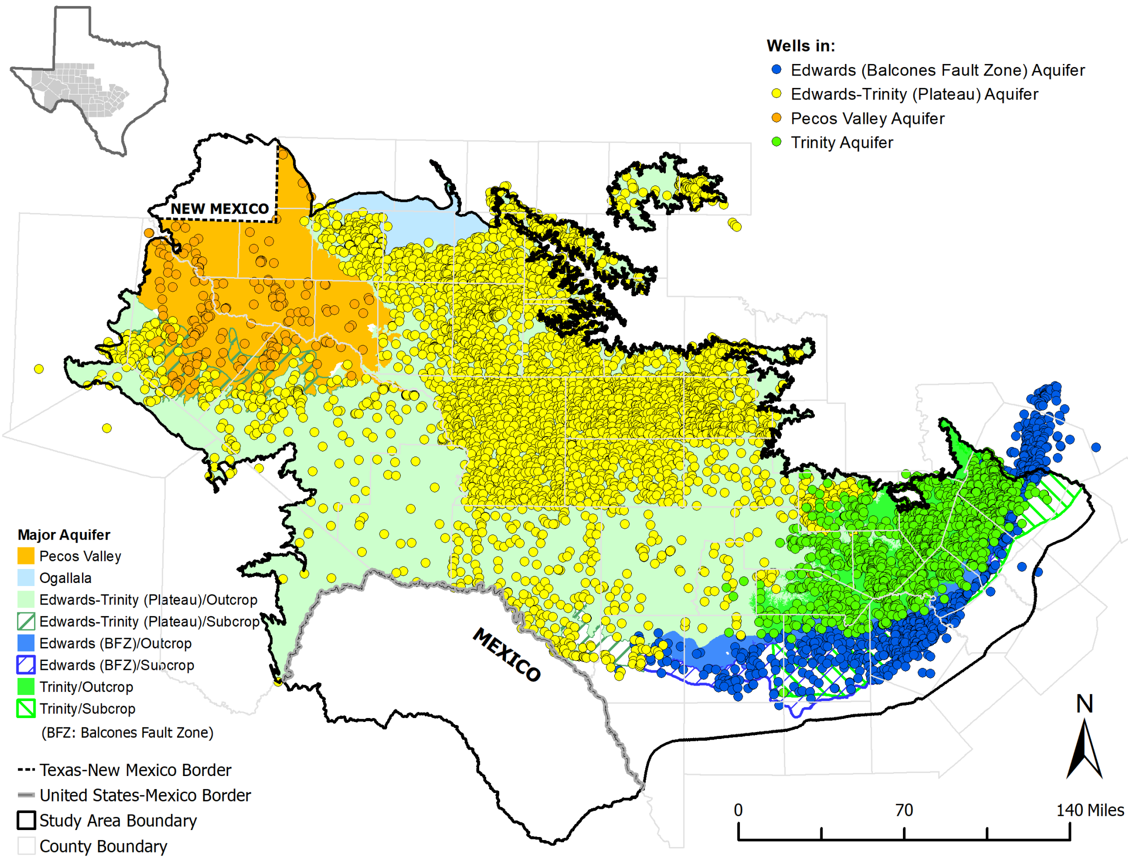


Figure 4.8-1. Location of Water Quality Samples (TWDB, 2021c).

4.8.1 Major Elements

Groundwater total dissolved solids and major elements concentrations can provide information about groundwater hydrology. In general, lower concentrations can represent areas with freshwater inflow- often recharge from precipitation- or areas where the groundwater has not extensively interacted with the rock formations of the aquifer due to either the young age of water or the insolubility of the aquifer matrix. Higher concentrations can indicate deeper areas with less recent recharge or areas where water has extensively interacted with the rock formations of the aquifer due to either the older age of the water or the solubility of the aquifer matrix. Areas of anomalously high salinity can also help pinpoint the locations of features like salt domes and evaporite beds or, near the coast, the extent of seawater intrusion. Some major elements are of concern due to their deleterious effects on human health and need to be measured against drinking water standards. In some parts of the study area, total dissolved solids and chloride and sulfate concentrations exceed applicable water quality standards. High concentrations of these constituents occur in the Pecos Valley and Trinity aquifers, north-central parts of the Edwards-Trinity (Plateau) Aquifer, and downdip portions of the Edwards (Balcones Fault Zone) Aquifer.

Figure 4.8-2 shows total dissolved solids in Pecos Valley Aquifer groundwater. Fresh groundwater—total dissolved solids less than 1,000 milligrams per liter—primarily occurs in the Monument Draw portion of the aquifer that extends through Winkler County and parts of Ward and Pecos counties (Jones, 2008). Fresh groundwater also occurs in parts of Crane and Reeves counties. Generally, most fresh groundwater in the aquifer occurs north of the Pecos River. Slightly to very saline groundwater—total dissolved solids of 1,000 milligrams per liter to less than 35,000 milligrams per liter—occurs throughout the remainder of the aquifer, especially south and west of the Pecos River. Jones (2008) attributes this moderate to very saline groundwater either to 1) the recharge of surface runoff derived from the evaporitic outcrops of the Rustler Formation west of the Pecos Valley Aquifer, or 2) upward influxes of saline groundwater from the underlying Rustler, Dockum and Capitan Reef Complex aquifers. While the bottom of the Pecos Valley Aquifer over these deeper aquifers is currently conceptualized as a no-flow boundary, the potential for upward flow based on these observed salinity fluxes will be considered during development of the numerical model, if appropriate.

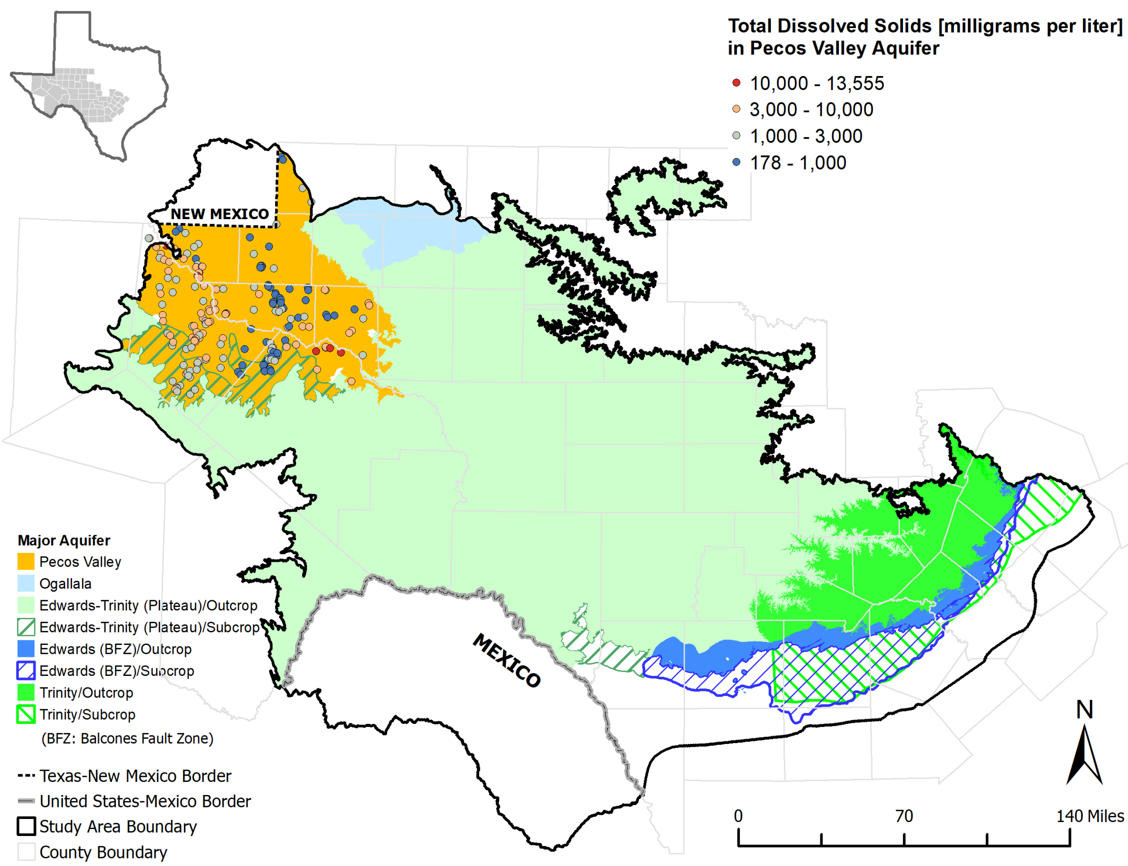


Figure 4.8-2. Map of average total dissolved solids (in milligrams per liter) for the Pecos Valley Aquifer (TWDB, 2021c).

In the Edwards-Trinity (Plateau) Aquifer, most groundwater is fresh (Figure 4.8-3). Slightly to very saline groundwater occurs mostly in the western half of the aquifer. The saline groundwater occurs along the boundary between the Edwards-Trinity (Plateau) and Pecos Valley aquifers where the two aquifers overlap and overlie saline aquifers such as the Rustler and Dockum aquifers. While the bottom of the Edwards-Trinity (Plateau) Aquifer over these deeper aquifers is currently conceptualized as a no-flow boundary, the potential for upward flow based on these observed salinity fluxes will be considered during development of the numerical model, if appropriate. Saline groundwater in the Edwards-Trinity (Plateau) Aquifer also occurs in the central portion of the aquifer, associated with the Antlers Sand and overlying Edwards Limestone (Nance, 2010).

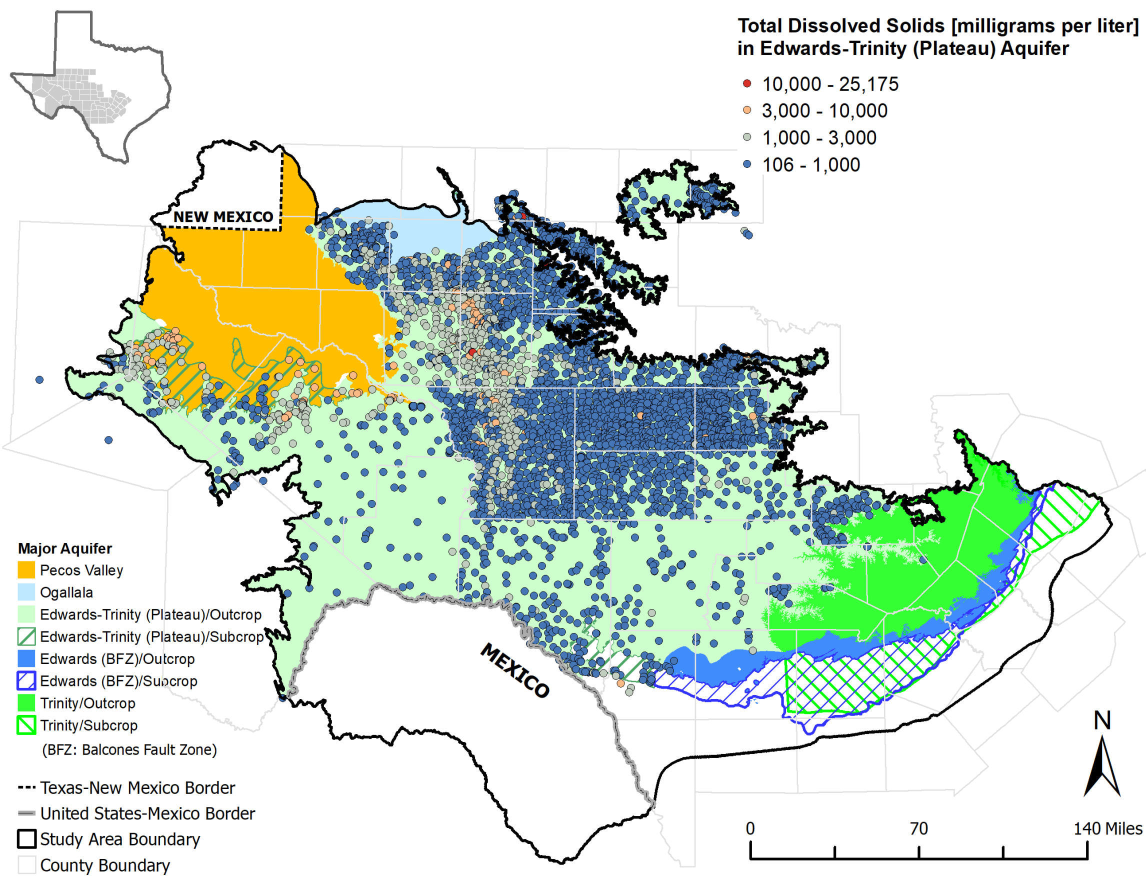


Figure 4.8-3. Map of average total dissolved solids (in milligrams per liter) for the Edwards-Trinity (Plateau) Aquifer (TWDB, 2021c).

In the Hill Country portion of the Trinity Aquifer, groundwater is fresh to moderately saline (Figure 4.8-4). There are no apparent spatial trends in the distribution of groundwater salinity. However, there is some vertical variation in groundwater salinity. In general, Trinity Aquifer groundwater is more saline in the upper member of the Glen Rose Formation (Upper Trinity) and in the Sligo and Hosston formations (Lower Trinity) than in the lower member of the Glen Rose Formation, Hensell Formation and Cow Creek Formation (Middle Trinity). However, these salinity differences have little impact on the current conceptualization of groundwater flow in this area as the numerical model will not distinguish between component formations of the Trinity Aquifer.

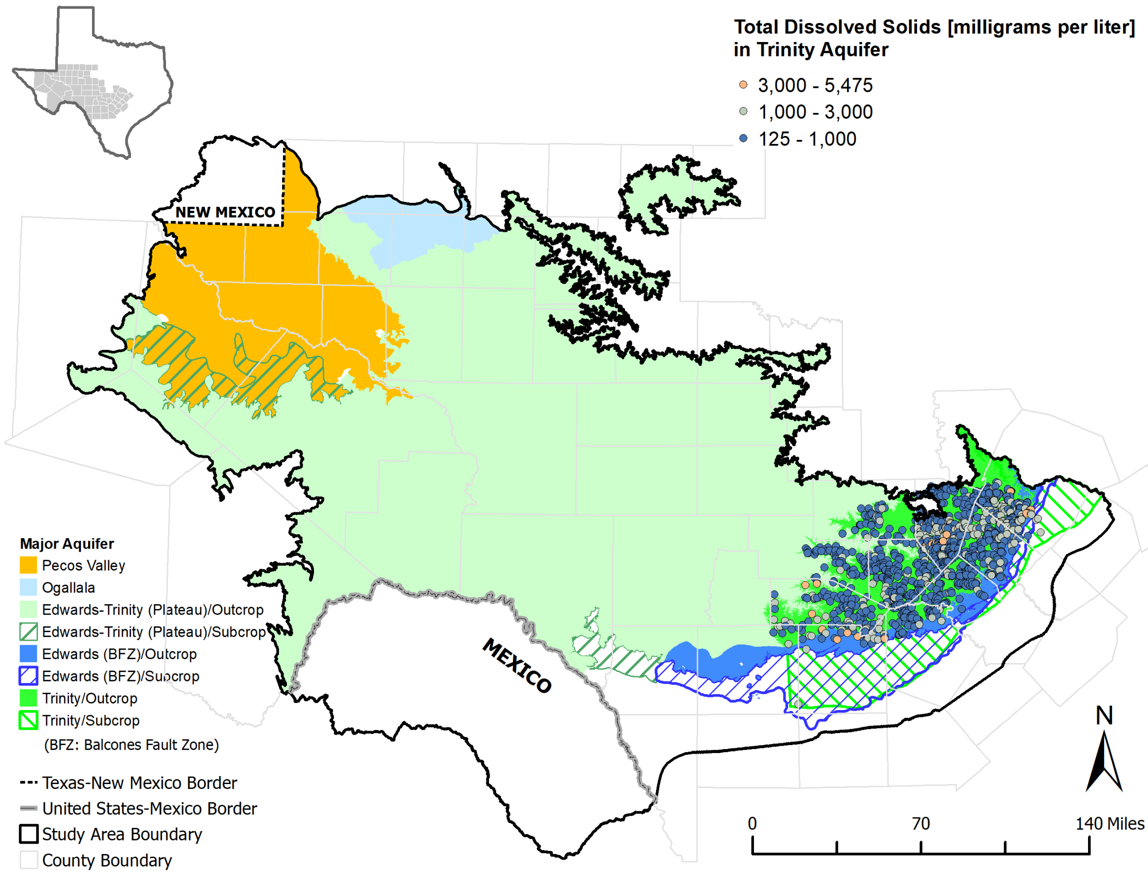


Figure 4.8-4. Map of average total dissolved solids (in milligrams per liter) for the Hill Country portion of the Trinity Aquifer (TWDB, 2021c).

In the Edwards (Balcones Fault Zone) Aquifer, groundwater is fresh to very saline (Figure 4.8-5). Groundwater is fresh throughout most of the aquifer. The slightly to very saline groundwater occurs in the down-dip portions of the aquifer beyond the official boundary of the aquifer, also called the “Bad Water Line”. As the current model is not intended to model groundwater availability in the Edwards (Balcones Fault Zone) Aquifer, with the Edwards Group included only to provide a boundary condition, the entirety of the Edwards Group will be included in the numerical model regardless of salinity.

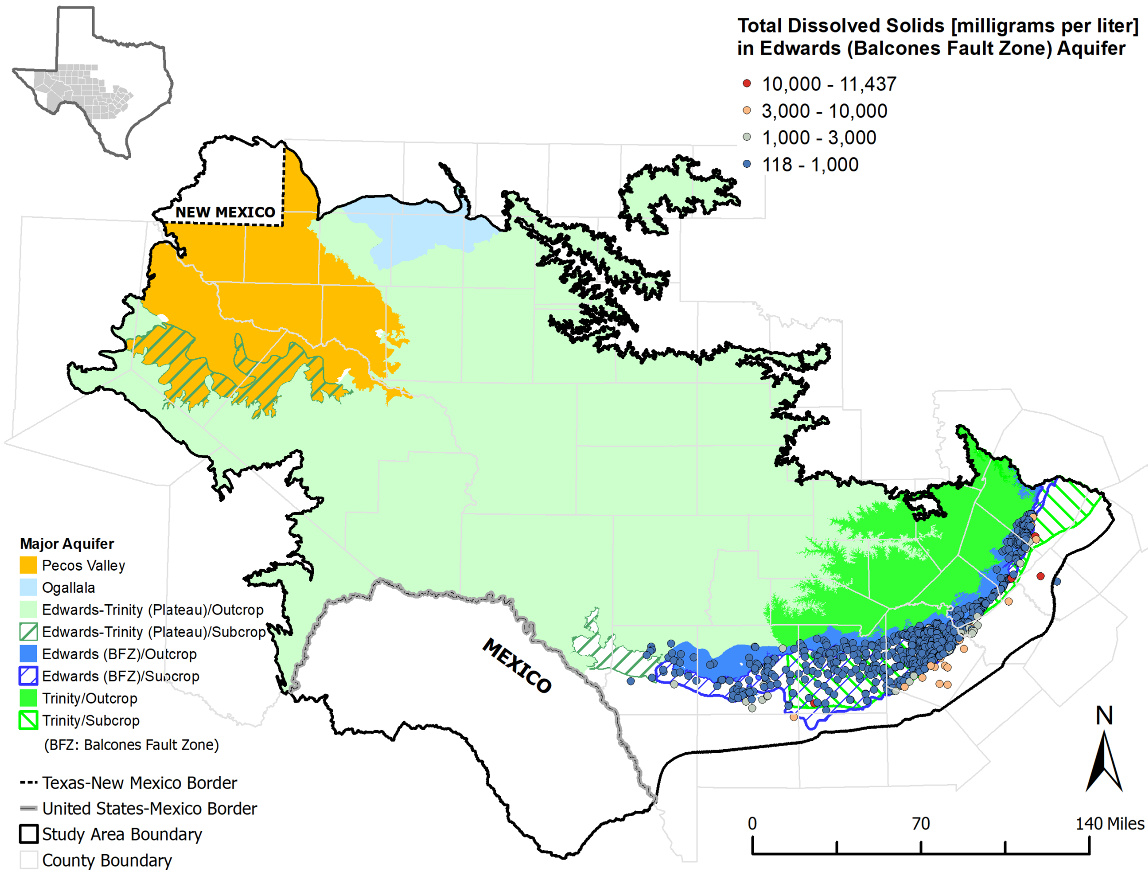


Figure 4.8-5. Map of average total dissolved solids (in milligrams per liter) for the Edwards (Balcones Fault Zone) Aquifer (TWDB, 2021c).

Groundwater within our study area displays a wide range of geochemical compositions (Figure 4.8-6). Groundwater compositions range from calcium-magnesium to sodium compositions and bicarbonate to sulfate and chloride compositions. These compositional differences represent the effects of varying geochemical processes that take place as the groundwater flows through and interacts with aquifer rock and mixes with groundwater inflows from surrounding stratigraphic units. These compositions indicate groundwater interaction with calcite, dolomite, halite, and gypsum—minerals that occur within the various aquifers and adjacent stratigraphic units. Groundwater interaction with dolomite and calcite produces calcium-magnesium-bicarbonate compositions, gypsum produces calcium-sulfate compositions, and upward migration of groundwater from deep evaporite units that contain halite produces sodium-chloride groundwater compositions. In the carbonate Edwards-Trinity (Plateau), Trinity, and Edwards (Balcones Fault Zone) aquifers, groundwater compositions change from calcium to calcium-magnesium and bicarbonate compositions in up-dip parts of the aquifer, becoming increasingly sodium-rich with depth. These changes in groundwater compositions tend to be accompanied by increases in total dissolved solids. The Pecos Valley Aquifer tends to have the lowest magnesium and bicarbonate groundwater compositions of all the aquifers in the study area.

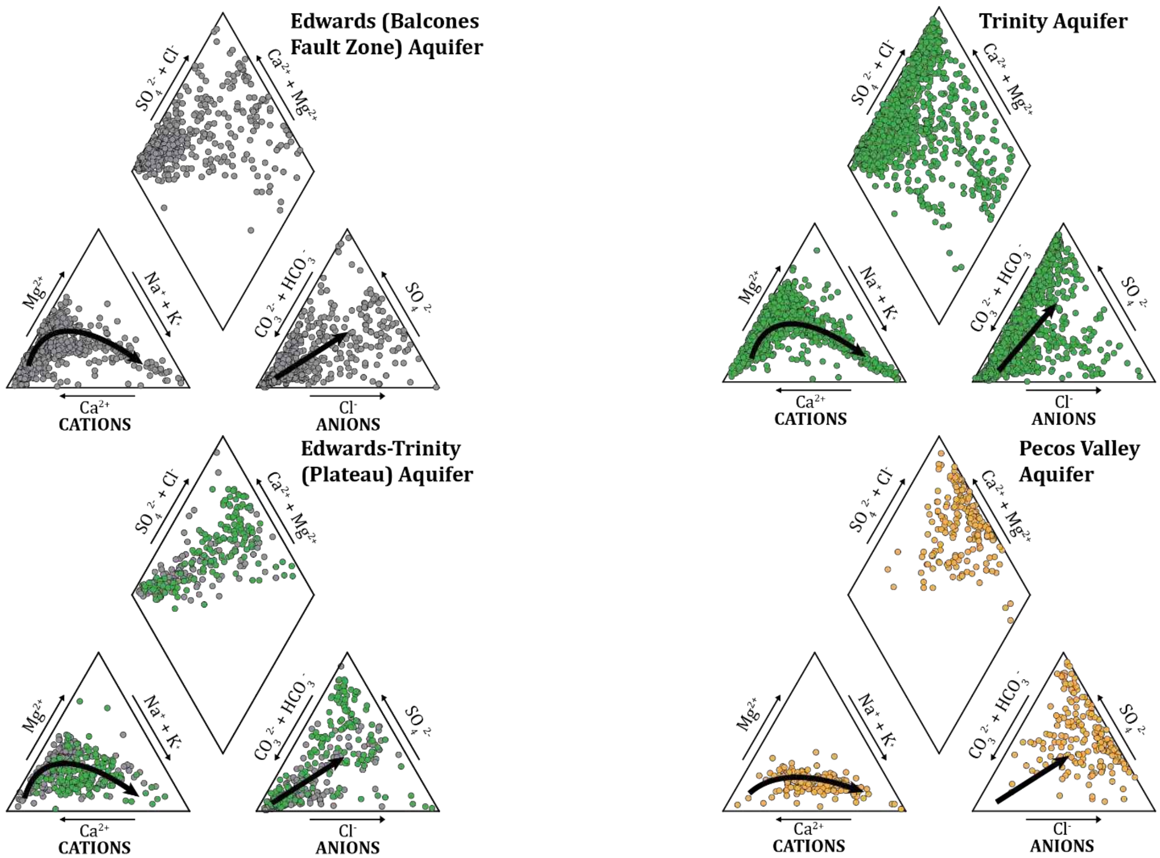


Figure 4.8-6. Piper diagrams showing the range of groundwater compositions in the Edwards (Balcones Fault Zone), Trinity, Edwards-Trinity (Plateau), and Pecos Valley aquifers. The arrows indicate compositional changes along flow paths.

The Barton Springs/Edwards Aquifer Conservation District drilled five Westbay Multiport wells located in Travis and Hays counties (Figure 4.8-7). These wells penetrate the Edwards (Balcones Fault Zone) and Trinity aquifers. Their multiple ports facilitate collection of groundwater samples from selected intervals in the respective aquifers and evaluation of geochemical variation along vertical transects through the adjacent aquifers. Figure 4.8-8 shows groundwater compositions in the Edwards (Balcones Fault Zone) Aquifer and Upper, Middle and Lower portions of the Trinity Aquifer in the Antioch, Driftwood, Ruby Ranch, West Travis County, and Saline Edwards multiport wells. These data sets show that groundwater from the Edwards (Balcones Fault Zone) and Trinity aquifers has a calcium-magnesium composition. Groundwater in the Lower Trinity unit tends to have more sodium, falling along a trend between calcium-magnesium and sodium compositions. Edwards (Balcones Fault Zone) Aquifer groundwater compositions are mostly bicarbonate but may overlap with the Trinity Aquifer compositions near contacts between the aquifers. The Trinity Aquifer groundwater has a wide range of compositions, mostly ranging from bicarbonate-sulfate to sulfate compositions. One of the multiport wells ("Saline Edwards") is located in the saline zone down-dip of the Edwards (Balcones Fault Zone) Aquifer. In this area, groundwater composition is sodium-chloride instead of the calcium-bicarbonate composition found in the freshwater portions of the aquifer.

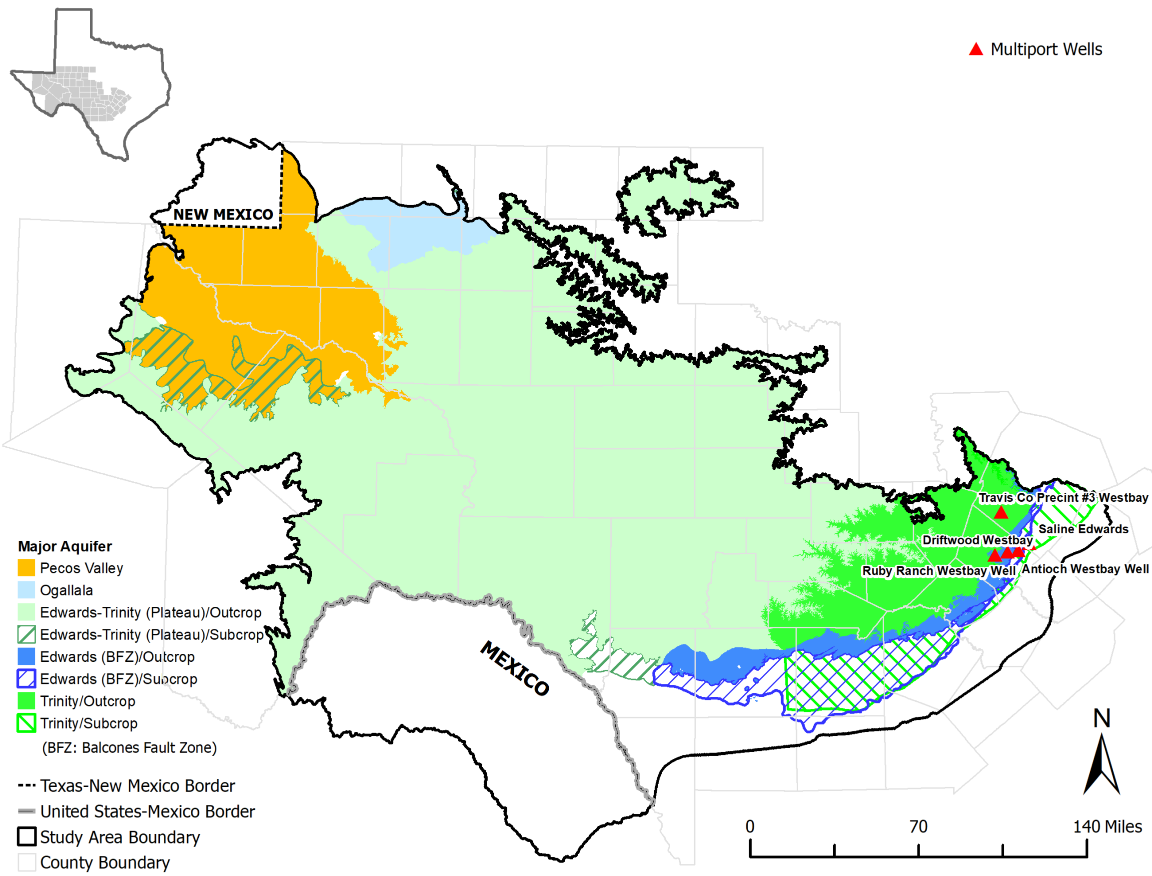


Figure 4.8-7. Locations of multi-port wells that penetrate the Edwards (Balcones Fault Zone) and Trinity aquifers.

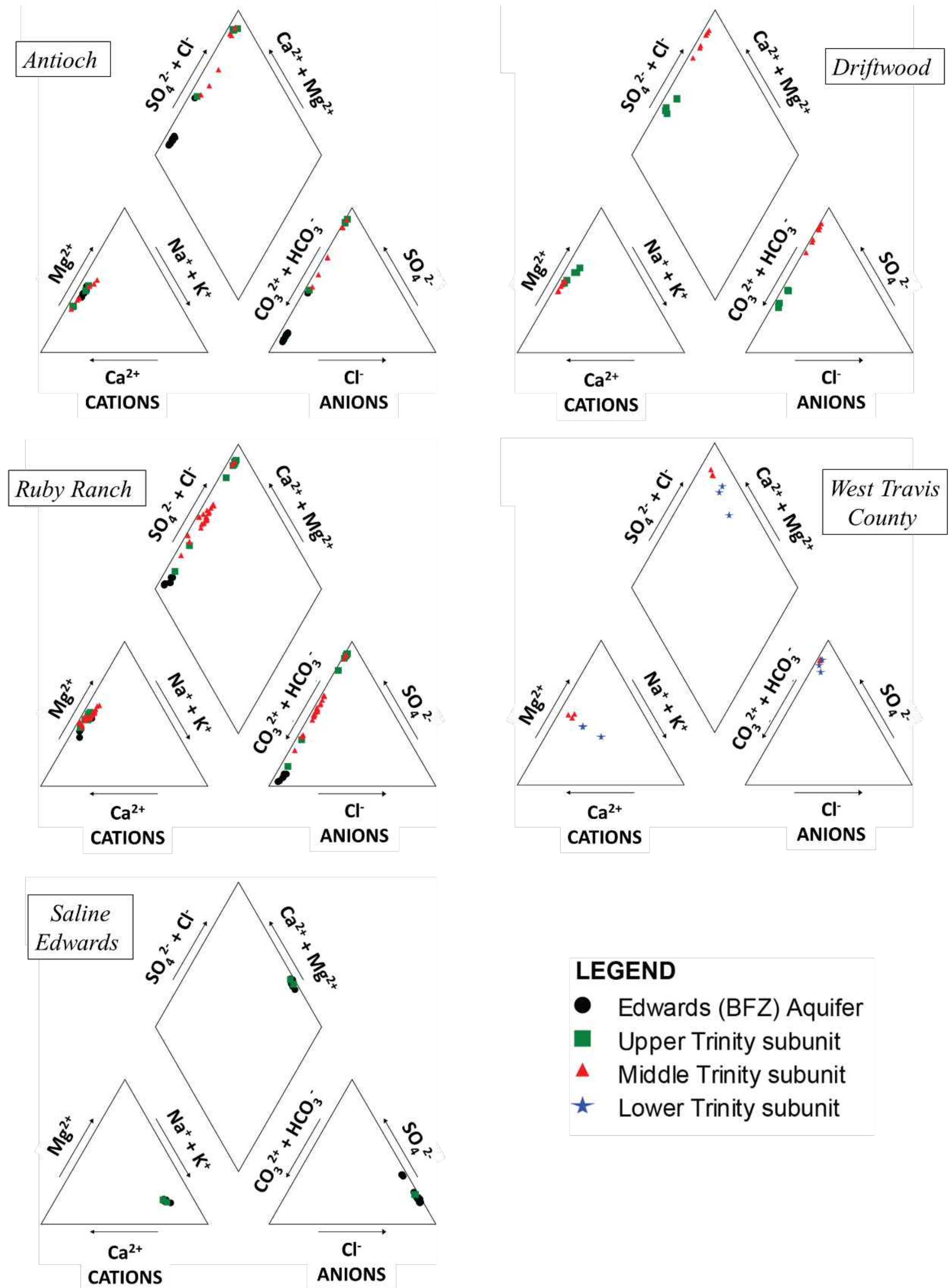


Figure 4.8-8. Piper diagrams showing the groundwater compositions measured in the Barton Springs and Edwards Aquifer Groundwater Conservation District multiport wells.

In general, these observed groundwater types are consistent with the compositions expected from groundwater interactions with dolomite and calcite (calcium-magnesium-bicarbonate) and gypsum (calcium-sulfate) in the shallower sections and with deep evaporite (sodium-chloride) in the deeper sections. The compositions of the Edwards (Balcones Fault Zone) and Trinity aquifer samples from the multiport wells are similar (calcium-magnesium). This suggests the potential for cross-formational flow between these two aquifers in this area, which is consistent with results from water level analyses (see Section 4.3.7).

4.8.2 Isotopes

Groundwater isotopic compositions can provide information about groundwater hydrology. Concentrations or ratios of different isotopes often change in response to processes such as evaporation, water-rock interaction, recharge processes, and the time elapsed since recharge.

Groundwater carbon-13 ($\delta^{13}C$) isotopic compositions represent the ratios of stable carbon isotopes—^{12}C and ^{13}C—in groundwater relative to the composition of the standard Peedee Belemnite calcite (Clark and Fritz, 1997). These isotope ratios are expressed as the relative difference in per mil, meaning parts per thousand. Groundwater carbon-13 isotopic compositions often reflect relative carbon inputs from interaction with soil and aquifer rock. Recently recharged groundwater near recharge zones tends to have more negative carbon-13 compositions reflecting recent contact with the soil. As the groundwater flows through the aquifer and away from the recharge zone, water-rock interaction results in the groundwater taking on more positive carbon-13 isotopic compositions, reflecting those of the aquifer rock. These trends are apparent in the aquifers of the Edwards-Trinity region where groundwater carbon-13 compositions vary from -20 indicative of soil to +10 indicative of limestone rock (Figure 4.8-9). Groundwater carbon-13 compositions of about -20 to -10 per mil indicate recent recharge while compositions of about 0 to +10 per mil indicate groundwater with long residence time in the aquifer.

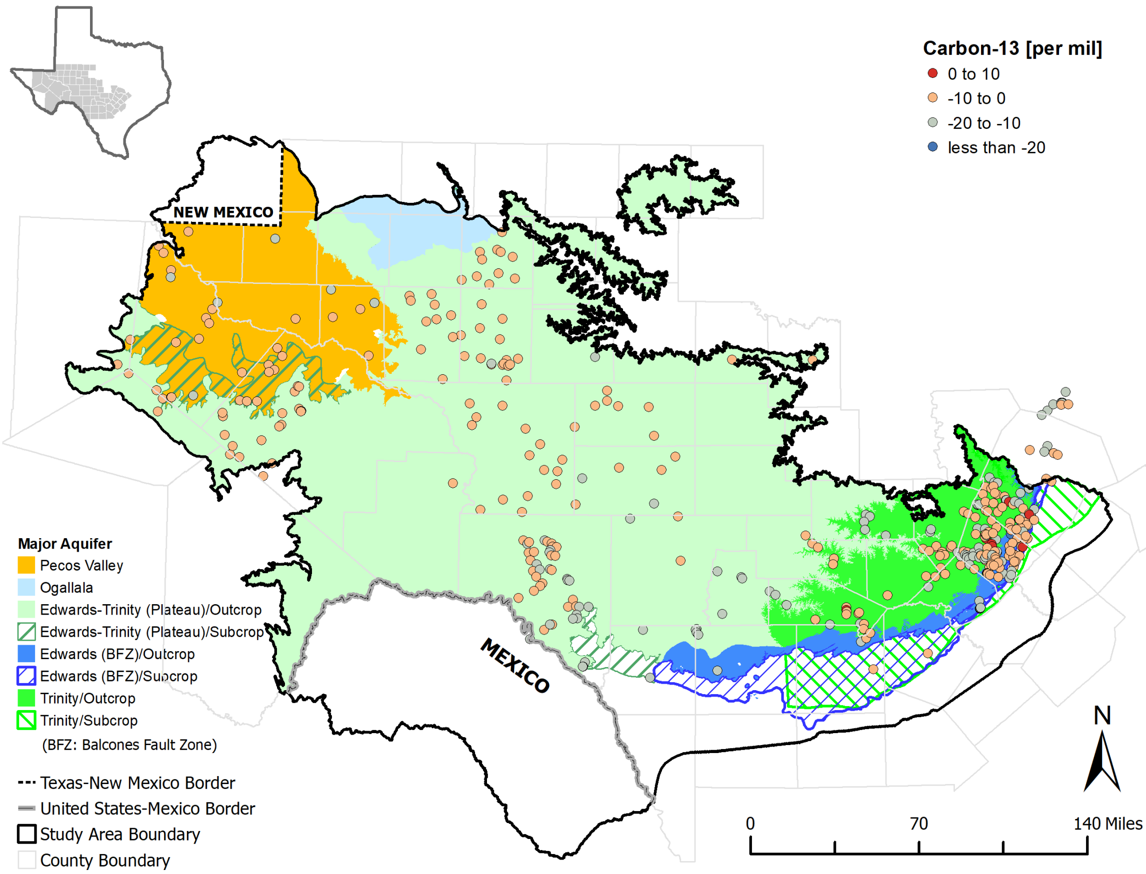


Figure 4.8-9. Groundwater Carbon-13 isotopes (in per mil) in the aquifers of the Edwards-Trinity region.

Carbon-14 is a radiogenic isotope that can help determine the relative age of groundwater. Carbon-14 measurements are expressed as a fraction of modern carbon. Without a continuous influx of carbon-14 from recharge, carbon-14 decays over time in an aquifer. As a result, groundwater carbon-14 activity is typically higher in shallower parts of an aquifer where recharge is occurring. In the study area, carbon-14 fractions range from 0 to about 1.1 and are highest within and immediately adjacent to aquifer outcrops where recharge occurs and lowest where there is no local recharge and almost all of the groundwater carbon-14 has decayed (Figure 4.8-10).

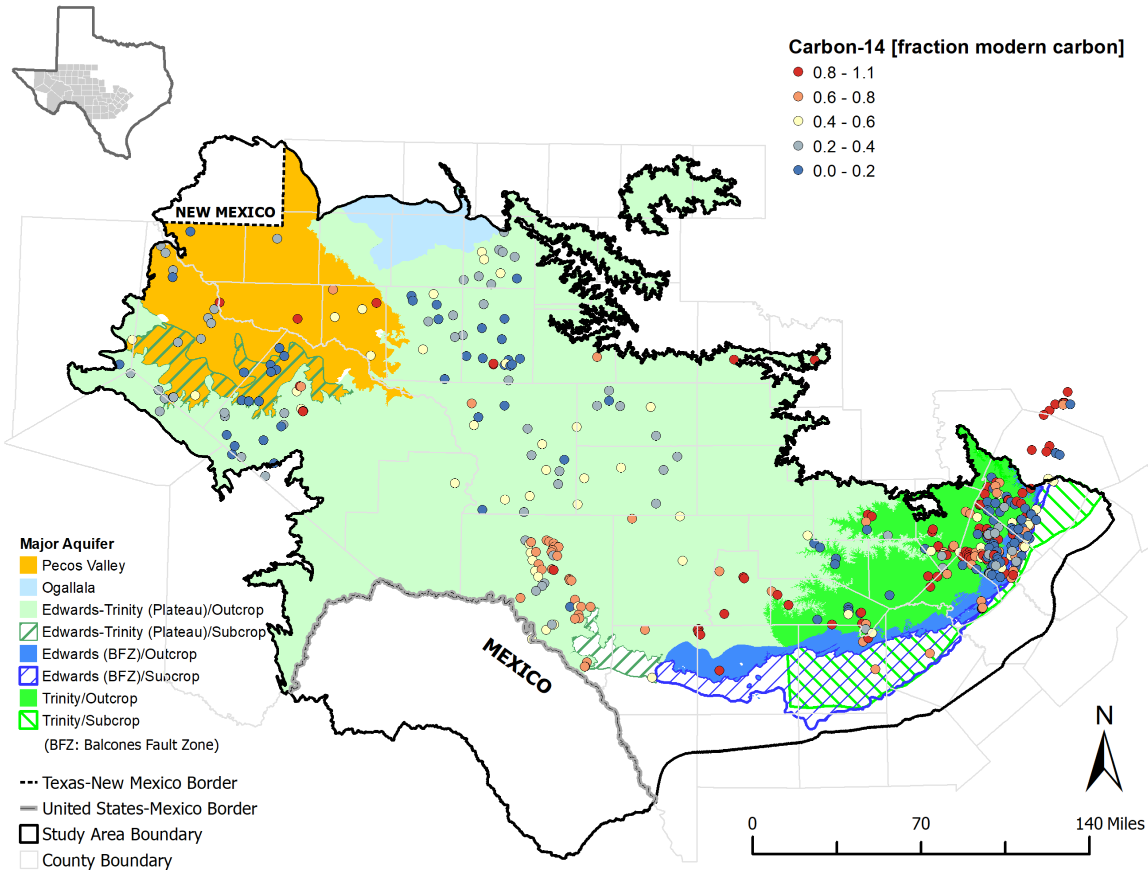


Figure 4.8-10. Groundwater Carbon-14 (in fraction modern carbon) in the aquifers of the Edwards-Trinity region.

Tritium, a radiogenic isotope of hydrogen, can also help determine the age of groundwater. Groundwater tritium behaves like carbon-14. The difference is that tritium has a faster decay rate with a half-life of 12.3 years compared to 5,730 years for carbon-14 (Clark and Fritz, 1997). High tritium activity indicates the most recent recharge. In the study area, the groundwater tritium activity ranges between 0 and 6 Tritium Units (one Tritium Unit = 3.22 picocuries) as shown in Figure 4.8-11. The highest groundwater tritium activity indicates recent recharge while tritium activity near or below detection indicates groundwater that is very old.

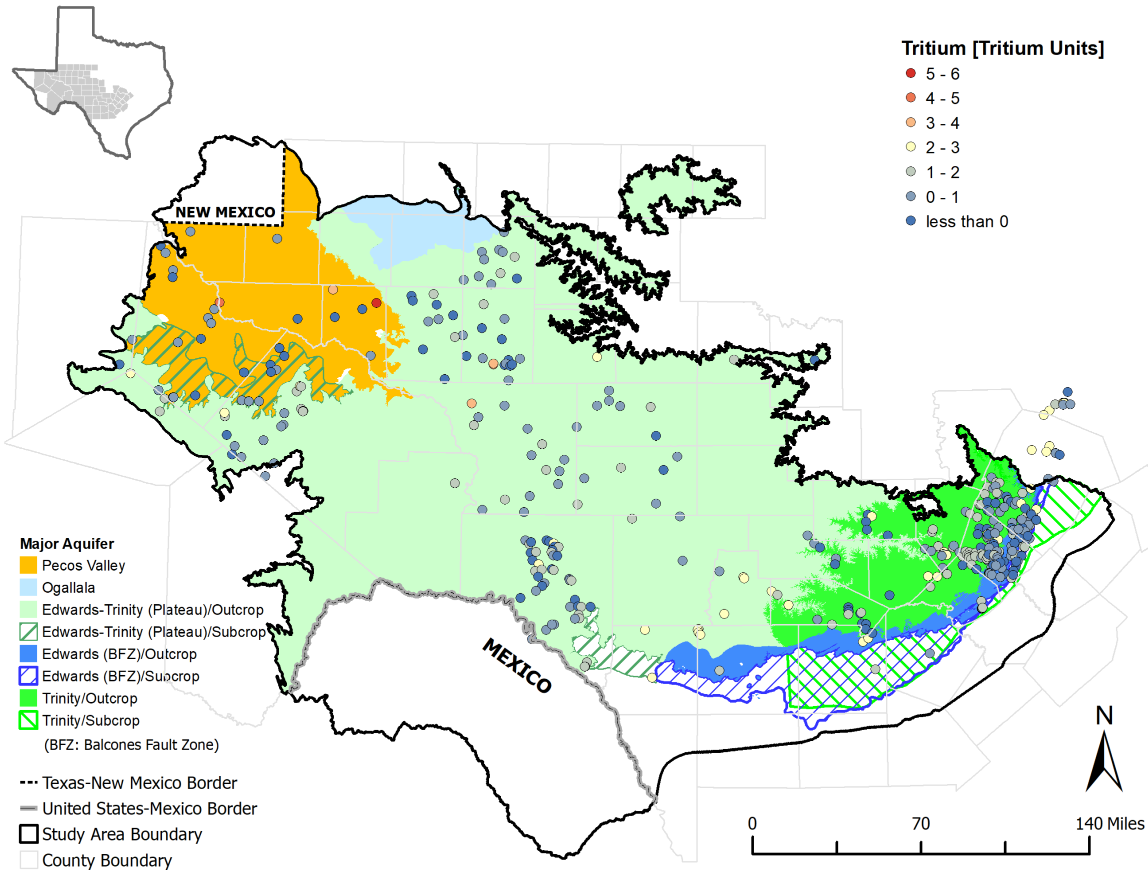


Figure 4.8-11. Groundwater tritium (in Tritium Units) in the aquifers of the Edwards-Trinity region.

Figure 4.8-12 and Figure 4.8-13 show the relationships between groundwater isotopic compositions in the respective aquifers within the study area. All the aquifers have the same range of carbon-14 compositions between 0 and 1.1 where close to 1.1 indicates recent recharge and 0 indicates groundwater that recharge more than 20,000 years ago (Figure 4.8-12). This range indicates that all of the aquifers in the study area are active, receiving modern recharge water. Because both carbon-14 and tritium undergo radioactive decay, both will decline over time. Recently recharged groundwater appears to the top-right of the graph and becomes progressively older to the bottom-left. Figure 4.8-13 shows the relationship between radioactive carbon-14 and stable carbon-13 isotopes and the arrow for the general compositional trend over time. As carbon-14 decreases due to decay, water-rock interaction gradually changes groundwater carbon-13 compositions from soil-influenced recharge water to rock-influenced ancient groundwater.

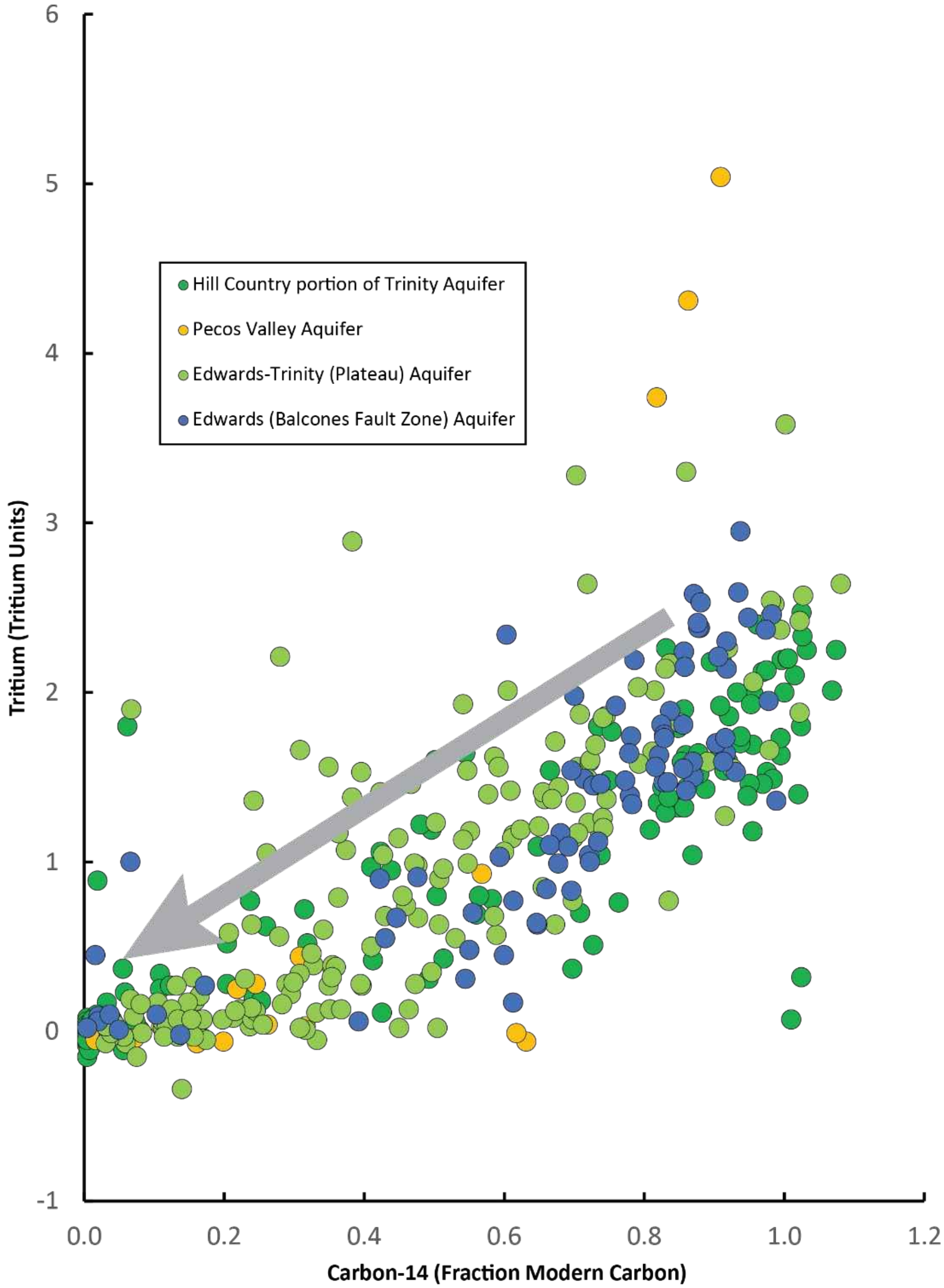


Figure 4.8-12. Groundwater tritium and carbon-14 isotopes in the aquifers of the Edwards-Trinity region. The arrow indicates the trend of groundwater compositions from younger to older groundwater.

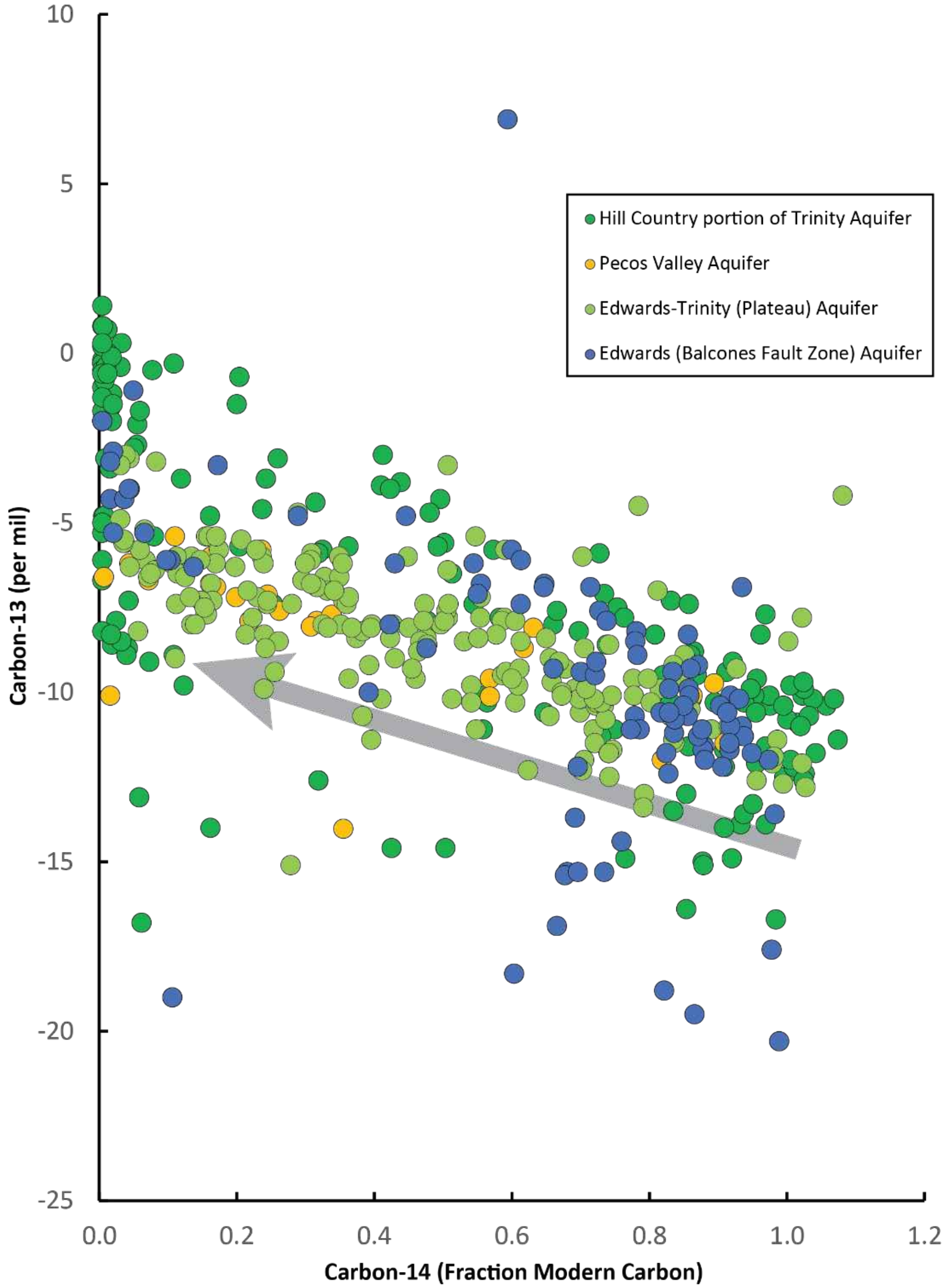


Figure 4.8-13. Groundwater carbon-13 and carbon-14 isotopes in the aquifers of the Edwards-Trinity region. The arrow indicates trends from younger to older groundwater compositions.

In general, this analysis of radiogenic isotopes supports our current conceptualization of recharge from recent precipitation over most of the study area. As expected, areas where the carbon-13, carbon-14, or tritium compositions indicate higher ages correspond to deeper portions of the aquifer that are not expected to be heavily influenced by recharge. Within the outcrop and near-crop areas where radiogenic isotopes indicate young groundwater ages from recent recharge, there is still some slight variation in calculated ages. The spatial distributions shown in Figure 4.8-9 through Figure 4.8-11 could thus be used to adjust recharge zoning in the numerical model, if necessary.

Figure 4.8-14 shows the groundwater carbon-14 and carbon-13 isotopes in the Edwards (Balcones Fault Zone) and Trinity aquifers measured at the Barton Springs/Edwards Aquifer Conservation District multiport wells. This evaluation shows the same general trends observed at the aquifer scale in Figure 4.8-13. The carbon isotopes in the multiport wells indicate that on average Edwards (Balcones Fault Zone) Aquifer groundwater is younger and more likely to have soil-influenced carbon-13 compositions than groundwater in the Trinity Aquifer. The groundwater compositions in the upper member of the Glen Rose Limestone (Upper Trinity) are similar to the oldest Edwards (Balcones Fault Zone) Aquifer groundwater. Groundwater compositions in the lower member of the Glen Rose Limestone, Hensell Sand, and Cow Creek Limestone (Middle Trinity) are older and more rock-influenced than the overlying hydrostratigraphic units. The oldest and most rock-influenced groundwater in the multiport wells occurs in the down-dip saline Edwards hydrostratigraphic unit, located beyond the “Bad Water Line” boundary of the Edwards (Balcones Fault Zone) Aquifer. This groundwater is ancient and highly saline—total dissolved solids are greater than 8,000 milligrams per liter, increasing with depth. The carbon-14 in the down-dip saline Edwards unit is below detection and therefore the groundwater is highly unlikely to have detectable tritium. The apparent groundwater age of this unit is greater than 45,000 years based on the half-life of carbon-14.

Groundwater stable hydrogen (δ^2H) and oxygen ($\delta^{18}O$) isotopic compositions represent the ratios of stable hydrogen isotopes (H and ^2H) and stable oxygen isotopes (^{16}O and ^{18}O) in groundwater relative to the composition of Standard Mean Ocean Water (Clark and Fritz, 1997). These isotope ratios are expressed as the relative difference in per mil, meaning parts per thousand. Groundwater stable hydrogen and oxygen isotopic compositions reflect the composition of the precipitation that recharged the aquifer, which may vary spatially or temporally in response to factors such as elevation, temperature, and amount of precipitation (Dansgaard, 1964; Fontes and Olivry, 1977; Fontes, 1980; Gonfiantini, 1985; Scholl and others, 1996). Consequently, the hydrogen and oxygen isotopic compositions of groundwater can be used as an indicator of the conditions under which recharge to the aquifer occurred.

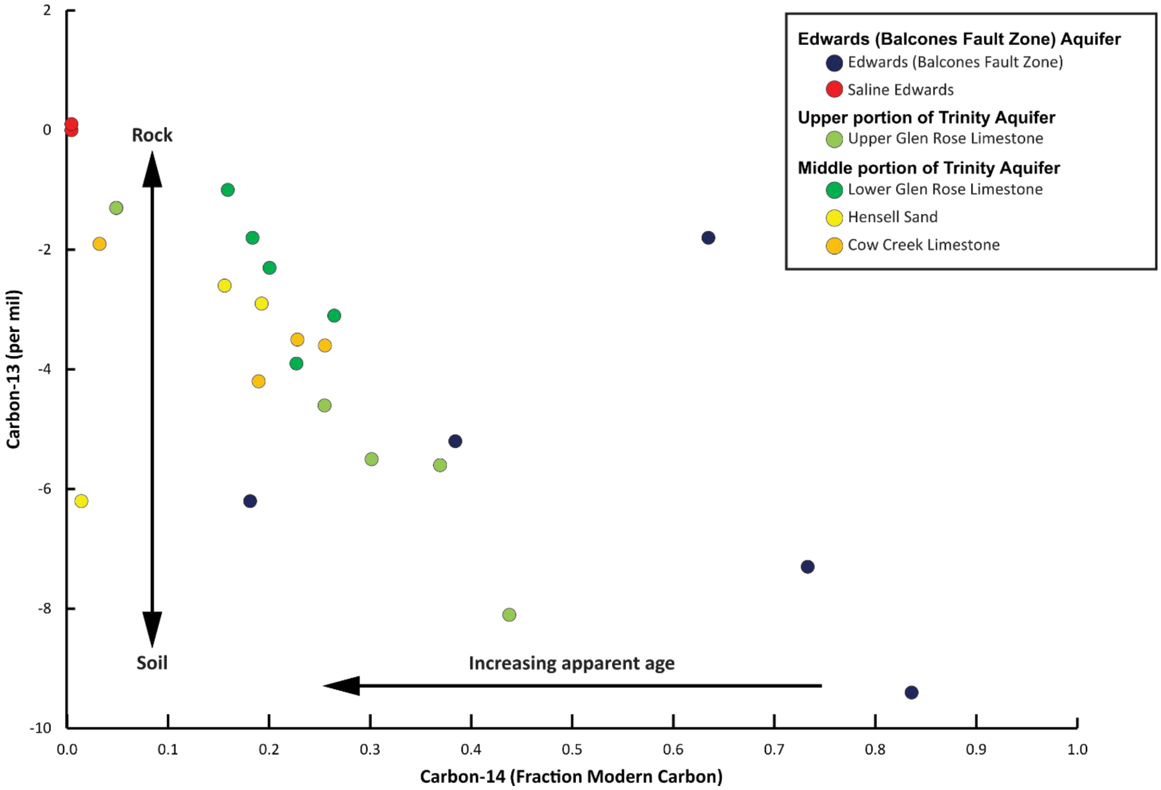


Figure 4.8-14. Groundwater carbon-13 and carbon-14 isotopes showing the range of groundwater compositions in the stratigraphic units of the Edwards (Balcones Fault Zone) Aquifer, and the Upper and Middle portions of the Trinity Aquifer in the Multiport Wells in the Barton Springs/Edwards Aquifer Conservation District.

Figure 4.8-15 and Figure 4.8-16 show groundwater hydrogen and oxygen isotopic compositions in the study area. Figure 4.8-15 show that the most negative groundwater oxygen isotopic compositions occur in the western parts of the study area and become progressively more positive towards the east, which reflects changes in precipitation isotopic composition across the study area. Figure 4.8-16 shows groundwater stable hydrogen and oxygen isotopic compositions relative to the Global Meteoric Water Line. Groundwater stable hydrogen and oxygen isotopic compositions in the study area lie in the ranges -73 to -13 per mil and -10 to -1 per mil, respectively. Stable hydrogen and oxygen isotope compositions generally lie along the Global Meteoric Water Line, which represents the average relationship between stable hydrogen and oxygen isotopic compositions in precipitation around the world (Craig, 1961). Hydrogen and oxygen isotopic compositions in the respective aquifers vary widely due to interannual or spatial variation of recharge conditions. Hydrogen and oxygen isotopic compositions in the Edwards (Balcones Fault Zone) and Trinity aquifers fall within a relatively narrow range of values compared to the Pecos Valley and Edwards-Trinity (Plateau) aquifers. The median hydrogen (-25.1 per mil) and oxygen (-4.3 per mil) isotopic compositions of groundwater in the Edwards (Balcones Fault Zone) and Trinity aquifers in the study area are almost identical and higher than the

Pecos Valley and Edwards-Trinity (Plateau) aquifers (inset graph in Figure 4.8-16). This trend can be attributed to climatic variation across the study area. The climate in the study area becomes progressively more arid from east to west. The result of this climatic trend is that overall stable hydrogen and oxygen isotopic compositions of recharging precipitation water would migrate down the Global Meteoric Water Line from east to west.

Surface evaporation from rivers and reservoirs, mixing with connate water/seawater, or extensive rock-water interaction can cause isotopic compositions to deviate from the Global Meteoric Water Line. However, since the hydrogen and oxygen isotopic composition of all aquifers in the study area closely match the Global Meteoric Water Line, this supports the current conceptualization that the majority of inflow to these aquifers is from modern precipitation.

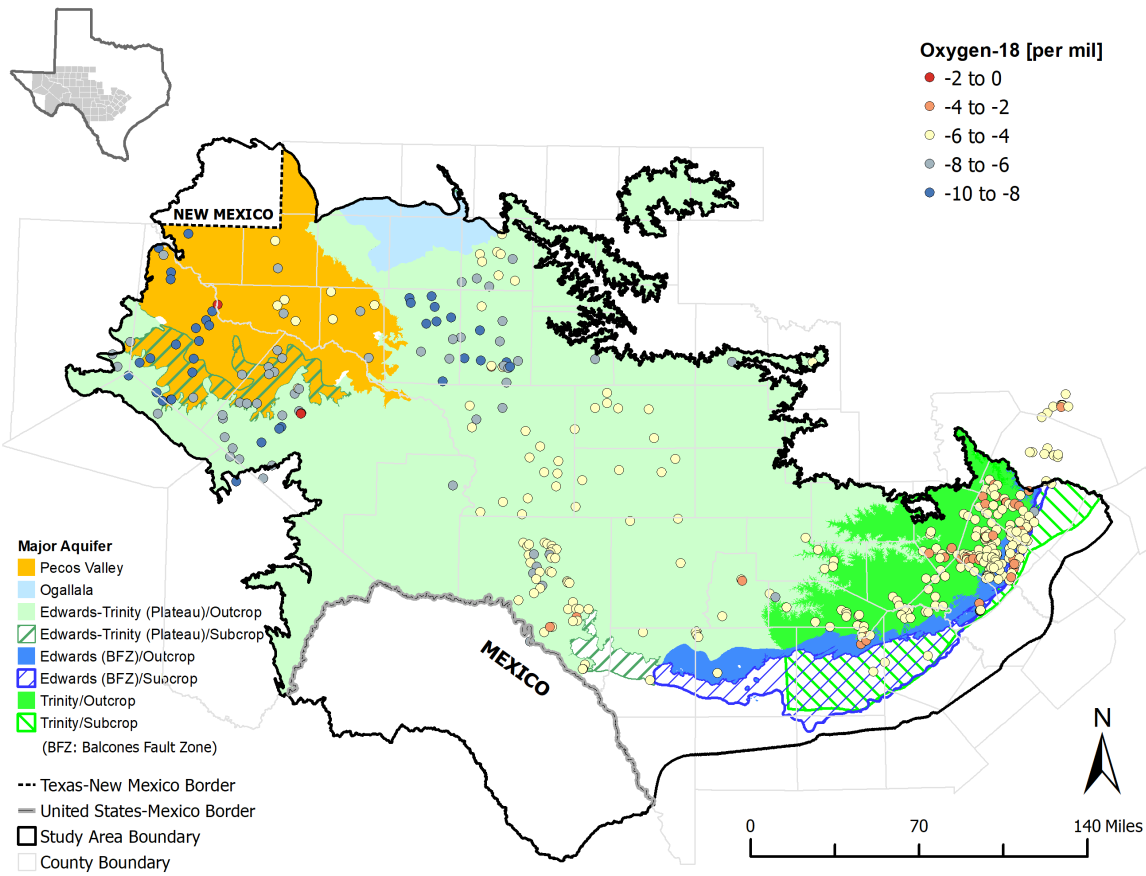


Figure 4.8-15. Groundwater stable oxygen isotopes ($\delta^{18}O$, in per mil) in the aquifers of the Edwards-Trinity region.

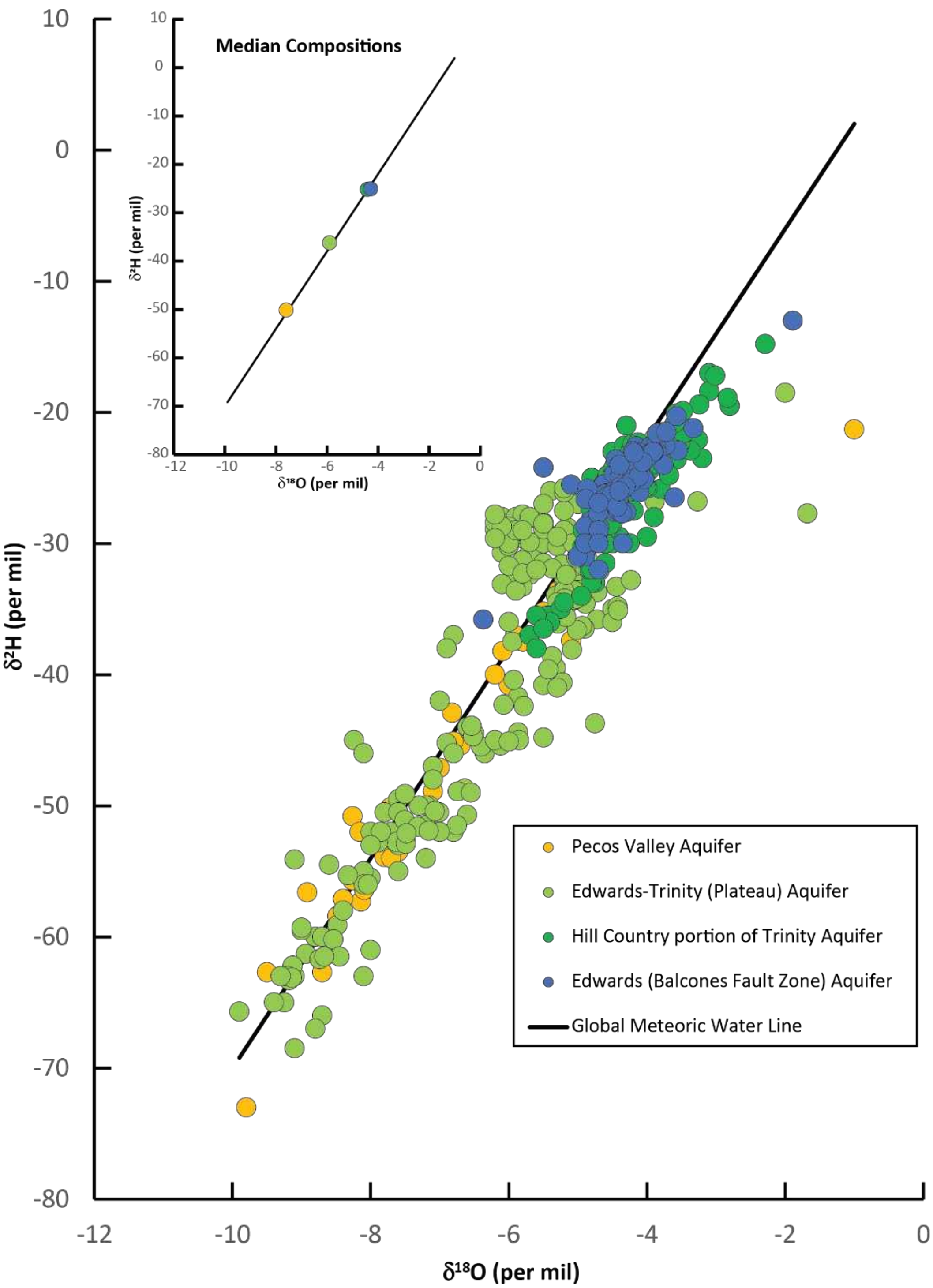


Figure 4.8-16. Groundwater stable oxygen isotopes (δ¹⁸O, in per mil) and stable hydrogen isotopes (δ²H, in per mil) in the aquifers of the Edwards-Trinity region. The inset graph shows the median values for each aquifer.

5 CONCEPTUAL MODEL

A conceptual model is a generalized representation of a groundwater flow system based on the hydrogeologic setting (Anderson and Woessner, 1992). The primary purpose of the conceptual model is to consolidate relevant real-world data into a simplified aquifer flow system that can be approximated using a mathematical groundwater model. In this report, we have developed a conceptual model by defining the hydrostratigraphic framework and aquifer boundaries, calculating approximate values for hydrologic parameters and climatic conditions, and identifying locations and pathways for discharge and recharge.

Figure 5.0-1 provides a summary of the conceptual model, represented as a simplified geologic cross-section with inflows and outflows marked with arrows. Figure 5.0-2 illustrates the conceptual model as a block diagram, meant to represent the aquifer system approximated by a numerical groundwater model. The structural framework for the Edwards-Trinity (Regional) aquifers system comprises three basic hydrostratigraphic units that represent: 1) the Pecos Valley Aquifer and other surficial younger units, 2) the units of the Edwards Group, and 3) the units of the Trinity Group (see discussion in Sections 4.1 and 4.2). For modeling purposes, we will add an additional layer on the top of these units to represent the river or stream channels in the study area. The extra layer does not have structural hydrogeologic meaning, but it simulates streamflow that overlies the aquifer system and has a hydraulic connection to the aquifer system. This additional layer is meant to improve the model simulation of surface water – groundwater interaction.

The first layer below the river layer, or the younger hydrostratigraphic unit (Layer 1 in Section 4.2), represents the Pecos Valley Aquifer and other younger units that overlie the Edwards and Trinity formations. The Pecos Valley Aquifer receives recharge from precipitation over the aquifer and cross-formational flow from the adjacent Edwards-Trinity (Plateau) Aquifer. Groundwater leaves the Pecos Valley Aquifer through evapotranspiration, as baseflow to the Pecos River, and by pumpage from irrigation wells. Evapotranspiration outflow also occurs around the riparian reaches of the Pecos River, where the water table is shallow.

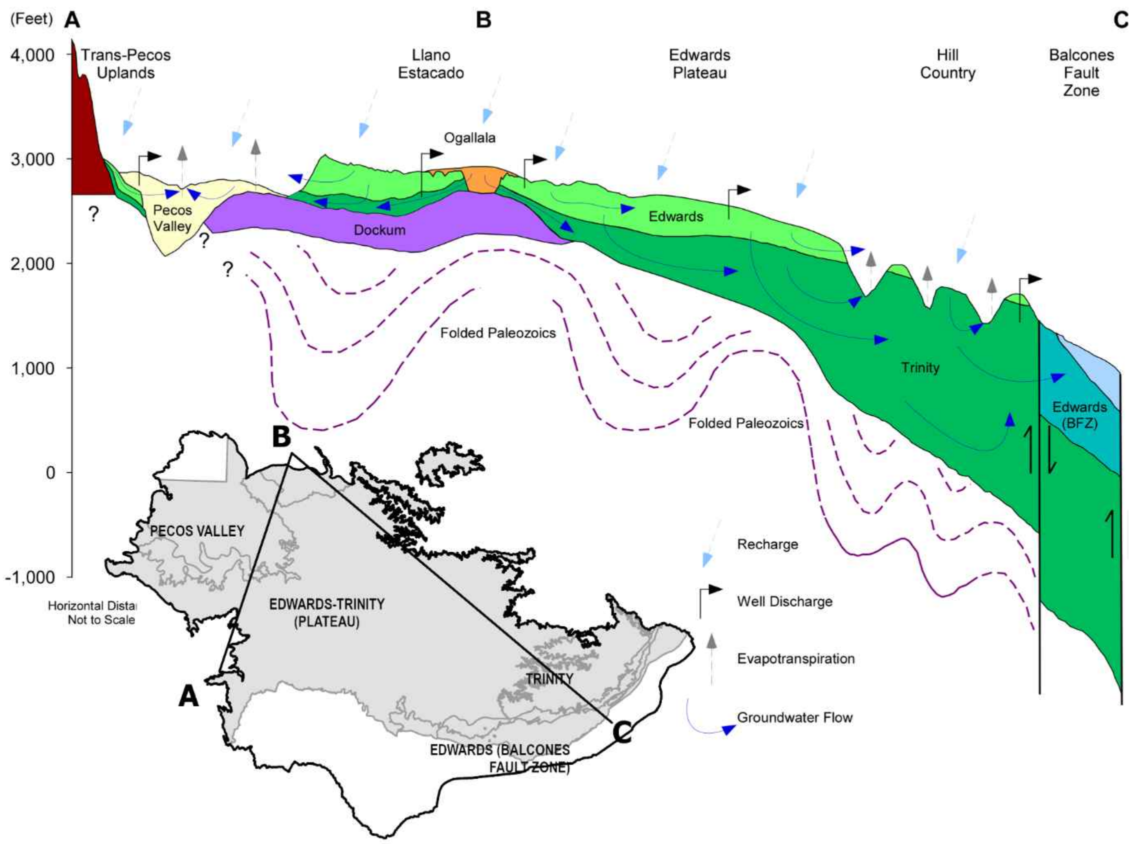


Figure 5.0-1. Conceptual model of the Edwards-Trinity (Plateau), Trinity (Hill Country), Edwards (Balcones Fault Zone) and Pecos Valley aquifers (modified from Anaya and Jones, 2009).

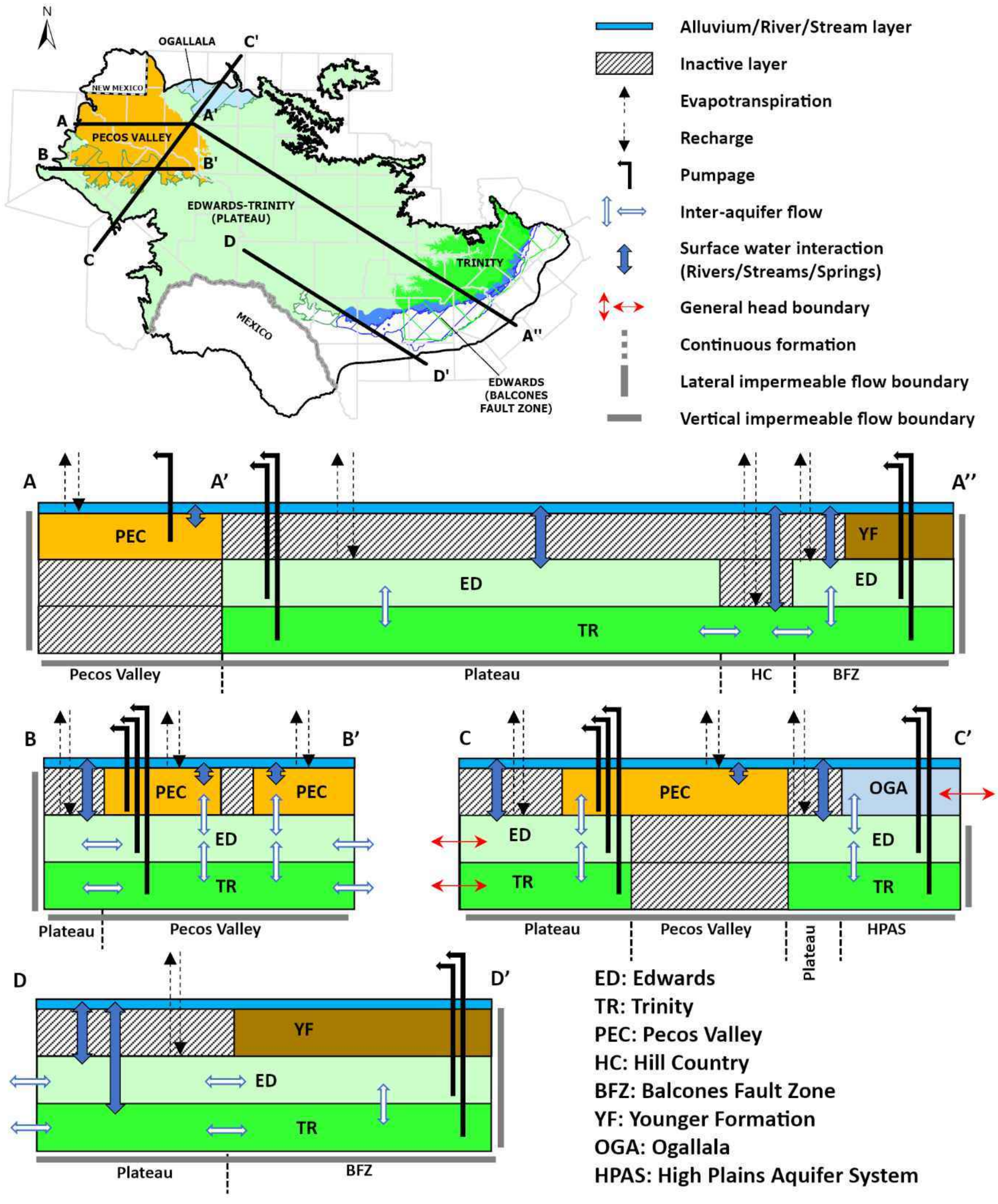


Figure 5.0-2. Block diagram of the Edwards-Trinity (Plateau), Trinity (Hill Country), Edwards (Balcones Fault Zone) and Pecos Valley aquifers.

The Edwards hydrostratigraphic unit (Layer 2 in Section 4.2), represents the Edwards (Balcones Fault Zone) Aquifer and the Edwards unit of the Edwards-Trinity (Plateau) Aquifer. Recharge from precipitation provides the primary inflow for the Edwards hydrostratigraphic unit. However, only a small amount (0 to 10 percent) of the annual precipitation actually recharges the aquifer, either directly through the aquifer outcrops or through the losing streams that overlie the aquifer outcrops. The rest of the precipitation leaves the study area by evapotranspiration or runoff and does not contribute to the aquifer's recharge. The previous TWDB model (Anaya and Jones, 2009) indicates that up to 10.9 percent of precipitation recharges the Edwards unit of the Edwards-Trinity (Plateau) aquifer. For the Edwards (Balcones Fault Zone) Aquifer, recharge from infiltration of rainfall was about 15 to 40 percent of total recharge (Scanlon and others, 2001; Maclay and Land, 1988). The Edwards hydrostratigraphic unit loses water through evapotranspiration, springs, streams, and pumpage. Evapotranspiration occurs where vegetation can tap into the water table, usually in riparian areas where the water table is shallow. Losses due to spring discharge and gaining streams occur at the south and southeastern margin of the Edwards Plateau, as discussed in Section 4.5. Losses from pumpage occur over the entire study area, but most aggressively in the eastern part of the study area, due to increasing demand from rapidly growing urban centers.

The Trinity hydrostratigraphic unit (Layer 3 in Section 4.2), represents the Hill Country portion of the Trinity Aquifer and the Trinity unit of the Edwards-Trinity (Plateau) Aquifer. The Trinity hydrostratigraphic unit has a restricted outcrop area, and as a result, recharge from precipitation is limited. Consequently, much of its recharge comes from the overlying Edwards hydrostratigraphic unit. Only the Hill Country area has exposed outcrops, and the previous study (Anaya and Jones, 2009) indicates about 4 to 6 percent of precipitation contributes to the recharge of the Trinity hydrostratigraphic unit in this area. Groundwater leaves the Trinity hydrostratigraphic unit through the springs and streams of the Hill Country and by pumping across the entire study area. Losses to gaining streams occur along the major streams in the Hill Country area.

Groundwater can move between the different layers as cross-formational flow. For example, at the boundary between the Edwards-Trinity (Plateau) and Edwards (Balcones Fault Zone), the Trinity hydrostratigraphic unit discharges groundwater to the Edwards hydrostratigraphic unit. In the west of the study area, both the Edwards and Trinity hydrostratigraphic units have a hydraulic connection to the Pecos Valley and Ogallala aquifers. But the amount of groundwater flow from the Ogallala Aquifer is relatively small, about 3,000 acre-feet per year (Blandford and Blazer, 2004; Deeds and Jigmond, 2015). Several underlying minor aquifers, including the Dockum, Capitan Reef Complex, Rustler, Hickory, Ellenburger-San Saba, Marble Falls, and Lipan aquifers, are hydraulically connected with the Edwards-Trinity (Plateau) Aquifer. However, we assume the groundwater flow between those aquifers is insignificant and did not implement in the conceptual model. While the Pecos Valley Aquifer is hydraulically connected to underlying minor aquifers, including the Dockum, Capitan Reef Complex, and Rustler aquifers, we assume the groundwater flow from those aquifers is insignificant and did not implement this flow in the conceptual model.

The current conceptual model incorporates several major updates compared to the previous TWDB groundwater availability model (Anaya and Jones, 2009). First, the extent of the model is much larger than the previous model and extends to the south and southeast to include northeastern Mexico and the Balcones Fault Zone. The portion in Mexico was included to improve our conceptualization of groundwater flow to the Rio Grande River while the Balcones Fault Zone region was included to better account for cross-formational flow between the Edwards-Trinity (Plateau) and Edwards (Balcones Fault Zone) aquifers, as well as the Hill Country portion of the Trinity Aquifer. Another update to the current model is the separation of the Pecos Valley Aquifer from the Edwards-Trinity (Plateau) Aquifer. The previous model conceptualized the Pecos Valley Aquifer blending into the Edwards hydrostratigraphic unit and modeled these two units as one contiguous layer. The current model separates these aquifers into two distinct layers with the aim to better understand the differences in groundwater flow as well as the connections between these two aquifers. Updates to modeling feature and software made since the previous model allow higher resolution and more detail near surface water features. With this in mind, the current conceptualization includes an additional layer for streams and rivers, which is intended to improve our understanding of surface water - groundwater interaction. Besides the updates described in the current report, the contracted studies for pumping estimates (LRE) and recharge analysis (WSP) in the study area represent major updates in their own right. These in-depth studies provide previously unavailable data on a regional scale for two parameters that have a significant impact on groundwater availability modeling. The results of these original studies will provide tremendous insight into developing the groundwater availability model of the Pecos Valley and Edwards-Trinity (Plateau) Regional Aquifers that was not available during the development of the previous model.

6 FUTURE IMPROVEMENTS

The structural framework is the foundation for developing the groundwater availability model. The current structural framework was created using the most current data available in the literature. The data collected from previous studies include the TWDB's Groundwater Availability Modeling Program (Walker, 1979; Anaya and Jones, 2009; Deed and others, 2015), the TWDB's Brackish Resources Aquifer Characterization System (BRACS) program (Meyer and others, 2012; Robinson and others, in review), the United States Geological Survey (Barker and Ardis, 1996; Bumgarner and others, 2012; Brakefield and others, 2015), and the Bureau of Economic Geology at the University of Texas, Austin (Smith, 1970; Smith and others, 2000). In addition, some groundwater conservation districts provided geologic data for the framework development.

There are currently two separate studies in development which will provide additional geologic data to improve the geologic framework in the future. The TWDB Brackish Resource Aquifer Characterization System is currently conducting a study of brackish groundwater in the Edwards-Trinity (Plateau) Aquifer. The study is reanalyzing geophysical logs and will develop a new framework of its own for the Edwards-Trinity (Plateau) which could fill data gaps for this conceptual model. The Texas Railroad Commission also recently presented preliminary results for a geologic study in Maverick County which could expand the freshwater extent of the Trinity Aquifer and provide insight into transboundary groundwater flow. If additional data is available in time for the numerical model, we will consider updating our framework and model extent to incorporate new findings from these projects.

Surface water and groundwater interactions have demanded more attention as climate uncertainty intensifies and population continues to grow. Accordingly, there is a greater need to implement more comprehensive modeling of surface water and groundwater interaction in groundwater availability models. The current software used in groundwater availability modeling is not optimized to simulate these interactions, particularly at the regional scale of the current model. It is costly to perform such comprehensive modeling at such a large scale. In addition to the lack of computing resources, insufficient data for calibrating the surface water and groundwater interactions presents a challenge for developing these models.

However, as computational resources increase and the software and computation techniques to solve these complex problems improves, a comprehensive model that simulates the entire hydrologic cycle could be possible at a reasonable cost in the future. TWDB is currently collecting field data and investigating surface water/groundwater interaction elswhere in the study area. These efforts include a study to establish quantitative relationships between groundwater elevations and river baseflow in the South Llano River basin and a study to collect spring/stream flow and produce a potentiometric map using LIDAR (Light Detection and Ranging) in Val Verde County. If additional data is available in time, we will consider incorporating new findings from these projects into the numerical model.

Independently of the TWDB GAM program, various stakeholders are developing a localized coupled surface water-groundwater model in the Hill Country portion of the Trinity Aquifer, but it is not scheduled to be completed in time to provide new insights for the current model. However, this study will be helpful for developing the localized model of the Hill Country portion of the Trinity Aquifer that TWDB plans to create as a future improvement to the current regional model.

Another method for addressing the limitations of regional scale groundwater modeling is to develop nested local scale models. The TWDB Groundwater Modeling Program plans to develop local scale models for the Hill Country portion of the Trinity Aquifer and the Edwards-Trinity (Plateau) Aquifer within "Nolan Island," the isolated portion of the aquifer located in Nolan and Taylor counties. These localized models will improve simulations of smaller scale groundwater flow without the need for additional computing resources or new software. Importantly, the local scale model in the Hill Country portion of the Trinity Aquifer will implement subunits of the Trinity Aquifer, which will help identify, manage, and plan the available groundwater resources in that area.

New data for water levels, hydraulic properties, and other parameters are constantly being collected by TWDB and other stakeholders, including groundwater conservation districts. Of particular interest, the new TWDB springs monitoring program has begun providing additional data of surface water and groundwater interaction (aquifer discharges) through the springs in Texas. As new data could potentially improve on our current conceptualization, these findings will need to be incorporated into future work.

7 ACKNOWLEDGEMENTS

The authors want to acknowledge all of those who showed great interest in this project by attending stakeholder advisory forums, making requests, asking questions, and even providing data to support in the development of this project. We want to thank Barton Springs/Edwards Aquifer Conservation District, the Trinity Glen Rose Groundwater Conservation District, the Hill Country Underground Water Conservation District, the Oklahoma-Texas Water Science Center of the United States Geological Survey and the Texas Commission of Environmental Quality for sharing their data with us for this project. We are grateful to all of the TWDB staff who also contributed: Stephen Bond and Daryn Hardwick for their work on the framework development, Cindy Ridgeway, Larry French, Radu Boghici, and Kayla Shearhart for providing technical and editorial review, comments, and guidance to the project, Mark Robinson for sharing the draft structural framework of the Hill Country Trinity, Evan Strickland for reviewing our Edwards-Trinity (Plateau) structural framework, Natalie Ballew for moderating stakeholder advisory forums, and finally Donald Karr for providing the cover picture of this report.

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<u>Middle Pecos GCD Exhibit 22</u>

Minutes of June 16, 2020 meeting at Agenda Item VIII

MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT
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June 16, 2020

MINUTES OF REGULAR BOARD MEETING AND PERMIT HEARING

On this the 16th of June, 2020, a Regular Board Meeting and Permit Hearing were held by the Middle Pecos Groundwater Conservation District in the Pecos County Courthouse on the 2nd Floor located at 103 W. Callaghan, Fort Stockton, Texas, with the following members' present, to-wit:

Jerry McGuairt	President, Precinct 1
Janet Groth	Vice President, Precinct 1
M. R. Gonzalez	Prec. 2, Secretary/Treasurer
Puja Boinpally	Precinct 2
Weldon Blackwelder	Precinct 3
Larry Drgac	Precinct 3
Alvaro Mandujano, Jr.	Precinct 4
Vanessa Cardwell	City of Fort Stockton
Jeff Sims	City of Iraan

Quorum Present.
Members Absent: Ronnie Cooper and Allan Childs

Others present: Ty Edwards, Mike Gershon, Allan Standen, Bill Hutchison, Michelle Sutherland, Melissa Mills, Anthony Bodnar, Paula McGuairt, Geoff Pike, Ryan Reed, Buck Benson, Tommy Soriero, Zack Swick, Glenn Honaker, Kaveh Khorzad, Jeff and Erin Williams, Ed McCarthy, Jr., Brock Thompson, Gary Bryant, Mel Riggs, Mark Tisdale, Mike Thornhill, Gary Klose, Reed Klose, Collin Wood, Gil Van Deventer, Kirby Warnock, Andres Madrid, and Jesse Gonzales.

REGULAR BOARD MEETING

I Call to order regular Board meeting at 10:01 a.m. by President Jerry McGuairt.

II Comments from **public and media**:

Andres Madrid made public comment: He is a resident of the "Little Mexico" area and is unable to obtain water service from Pecos County WCID#1 at this time because they are not setting new taps at this time. He owns less than 10 acres and would like to request permission to drill a water well.

Mr. Madrid was advised to fill out an application for a production permit and expect a hearing would likely be called on a complete application.

PUBLIC HEARING ON PRODUCTION PERMIT APPLICATION FOR GARY KLOSE AND HIS ASSOCIATE COLLIN WOOD

I Call to order at 10:04 a.m. the Public Hearing on **Application for a Production Permit for Gary Klose and Collin Wood**.

Party representing application: Collin Wood and Gary Klose

Protestant to application: None.

Public Comment: None.

Jerry McGuairt declared the application uncontested.

Collin Wood was sworn in for testimony for Mr. Klose:

Mr. Wood/Efficient Recycling Solutions, LLC, and Mr. and Mrs. Gary Klose/Klose Land, Inc. have entered an agreement for Water Development. Since 1960s to 1990s the Kloses have owned and farmed Section 22 and Section 27, Block C-2, PSL Survey, and Section 4, Block 48. The water is being requested for construction of a Solar Facility on the property, and for a future water station on Tipton Road for oil field use. The solar facility needs 70-80 acre feet and possibly more, and 320 acre feet which would only be about 6 frac jobs which is a low estimate.

Manager Ty Edwards presented the production permit application to the Board. Gary Klose and his associate Collin Wood have made application for a Production Permit for 3 wells located on the following described lands: Section 22, Block C-2, PSL Survey, A-5066, Section 27, Block C-2, PSL Survey, A-9443, All of the N/2 and SW/4, A-8120 and SE/4, A-5539 of Section 4, Block 48, Township 8 South, T&P RR, Co. Survey, in Pecos County. The application requests authorization to produce 400 acre-feet/year for Industrial Use from the Pecos Valley Aquifer.

The Klose Farm has 6,860 acre feet of *Historical and Existing Use* permits for Irrigation for the 24 wells on the property from the Pecos Valley Aquifer. The solar farm is expected to need the water for the 18-month construction period and will also use the water for oil-and-gas purposes. The solar facility is expected to use half of the property, and it would not be practical for farming any longer.

Allan Standen, MPGCD Hydrogeologist, was sworn in for testimony and advised of his opinion that after a review of the specific capacity pump tests for the 3 wells in the application, along with two MPGCD monitor wells in the area, there were no expected unreasonable effects.

II Adjourn Hearing and Consider and/or Act on **Application for a Production Permit for Gary Klose and Collin Wood**.

President Jerry McGuairt adjourned the hearing at 10:24 a.m.

The Board and Applicant showed interest in exploring the possibility of reducing the *Historical and Existing Use* permits and applying for a new production permit if a beneficial need is proven.

Alvaro Mandujano, Jr. made a motion to grant 200 acre feet for Industrial Use from the Pecos Valley aquifer. Motion seconded by Janet Groth.
Motion passed unanimously. Vote: 9 FOR. -0- Oppose. 2 Absent.

Reconvened the Regular meeting at 10:30 a.m.

REGULAR BOARD MEETING – CONTINUED

Director Vanessa Cardwell stepped out of the meeting for a few minutes.

III Consider and/or act on **Minutes of Regular Meeting on May 19, 2020**.

Janet Groth made a motion to approve the minutes of May 19, 2020 as presented.
Motion seconded by Jeff Sims. Motion carried unanimously.
Vote: 8 FOR. -0- Oppose. 3 Absent (Cardwell/Childs/Cooper).

IV Consider and/or act on **Treasurer's Report for the Month Ending May 31, 2020**.

Puja Boinpally made a motion to approve the Treasurer's Report for the Month Ending May 31, 2020. Motion seconded by Alvaro Mandujano, Jr.
Motion passed unanimously.
Vote: 8 FOR. -0- Oppose. 3 Absent (Cardwell/Childs/Cooper).

V Consider and/or act on **Tax Abatement Policy and Guidelines**.

Vanessa Cardwell returned to the meeting.

There were no changes proposed to the tax abatement policy and guidelines.

A Few Tax Abatement Highlights: All applications requesting tax abatement from the District shall be considered on an individual basis with regard to both the applicant's qualification for abatement and the amount of the abatement. The

District has set a limitation value of Fifty Million Dollars ($50,000,000) on all projects to be considered for a tax abatement; meaning that only that value exceeding the limitation value will be considered as eligible for a tax abatement. The decisions of other taxing units, including the County, to grant or deny tax abatement do not bind the District, and the District shall evaluate all requests within the context of the District's management plan, rules, and statutory mandate, and the adopted policy. A nonrefundable payment to the Middle Pecos Groundwater Conservation District of Five Thousand and no/100 Dollars ($5,000) must accompany the application at the time of submission. Sunset Provision and Agreement Modification: Pursuant to Texas Property Tax Code, Chapter 312, these guidelines and criteria are effective upon the date of their adoption and will remain in effect for two (2) years.

Janet Groth made a motion to approve the Tax Abatement Policy and Guidelines. Motion seconded by Weldon Blackwelder. Motion carried unanimously.
Vote: 9 FOR. -0- Oppose. 2 Absent (Childs/Cooper).

VI Briefing and take action as necessary regarding **7D area and continued Kent and Luna permit hearings**.
No new updates.

VII Consider and/or act on an **Engagement Letter with Smith & Rives, PC for the Audit for the Year Ending September 30, 2020**.

Vanessa Cardwell made a motion to approve the engagement letter with Smith & Rives, P.C. for the Audit for the Year Ending September 30, 2020. Motion seconded by M. R. Gonzalez. Motion carried Unanimously.
Vote: 9 FOR. -0- Oppose. 2 Absent (Childs/Cooper).

VIII Consider and/or act on **Joint Study Agreement** required by April 2017 agreement with Fort Stockton Holdings, LP.

Mike Gershon, MPGCD attorney, recounted the past event(s) that led us to today's consideration of a Joint Study Agreement. The Joint Study Agreement with Fort Stockton Holdings, LP (FSH) was contemplated by the permit conditions that were associated with the production permit that was issued in 2017. One of the permit conditions required the parties (which were MPGCD and FSH) to enter an agreement providing for the scope and the funding for a Joint Study. The Joint Study is referenced in 'special permit condition' #13 and #14.

For Reference: Special Permit Conditions attached to the Amended Application for Production Permit with Export Authorization that was approved on 07-18-2017:
#13. The attached schedule entitled "Monitor Well Thresholds and Cutback" applies to the permit until a Joint Study can be conducted and until such time as the Board determines relaxing

the restrictions in Table 6 are justified by the results of the Joint Study. Any cutback in Table 6 shall go into effect April 1st of each year and remain in effect through March 31st of the immediately following year.

14. The Study scope, project management, and responsibility for funding shall be agreed to between FSH and District within 6 months. The study shall commence shortly after an agreement is reached on the scope.

By agreement between FSH and the District in the 2017 timeframe, the parties held off and abated that 6-month timeframe. The permit term is up in July 2020, and on 04-02-2020 FSH filed an application to renew the permit as approved on 07-18-2017. Discussions and briefings were held at last month's Board Meeting regarding MPGCD General Manager, Ty Edwards, decision regarding the permit renewal. Mr. Edwards decision on renewal is conditioned on FSH's satisfying the special permit conditions. Two of the conditions relate to the Joint Study.

Over the last several weeks, MPGCD hydrogeologists Dr. Bill Hutchison, Allan Standen, Vince Clause and Michelle Sutherland have been working with FSH's hydrogeologist Mike Thornhill to prepare a scope of work. Both parties had different agendas for conducting the studies. MPGCD's interest was to collect additional data and analysis for assurance of our aquifer level thresholds and cutbacks that were incorporated into the FSH permit. FSH had an interest in seeing if they could produce even more water that they were currently entitled to under the permit and have less restrictions. Cockrell Investment Partners expressed concern about uncertainty of future aquifer conditions based on possible pumping from FSH. In discussions between MPGCD and FSH on Monday, June 15th, FSH indicated that export will most likely not be in the next 2 to 3 years, but will be sooner than 10 years.

Dr. Bill Hutchison, MPGCD Hydrogeologist, explained that his focus has been on the special conditions relating to the 11 threshold monitoring wells. Attached to the threshold levels were the anticipated or potential for pumping reductions if some of those thresholds were met. There were also summer thresholds that would require analysis and action needed if the thresholds were exceeded. There was an additional special condition which is the Joint Study. Dr. Hutchison presented a PowerPoint presentation titled: FSH/MPGCD Joint Study Plan June 16, 2020.

Summary of the PowerPoint presentation:

- ✓ The proposed Joint Study is a 3-Phased approach
- ✓ Management Zone 1 is the focus of the Joint Study. We want to get additional data in place in terms of elevation and conductivity before pumping increases for exportation and develop a baseline.

- ✓ This is an early warning system and we need a comprehensive data set to address what we can anticipate in terms of interpretive issues. The foundation of this endeavor is to not let the water levels drop below the historic minimum levels.
- ✓ Rustler aquifer: The Rustler aquifer underlies the Edwards-Trinity Plateau. There is a potential for upward leakage of the Rustler water into the Edwards-Trinity. The monitoring data is necessary to determine the potential for upward leakage, and can help determine the water quality impacts of upward leakage, and to answer question of why something is changing.
- ✓ **<u>3-Phases of the Joint Study:</u>**
  <u>Phase "0" (initial/preliminary work):</u> Now to September 2020. Finalize the scope and budget.
  <u>Phase 1:</u> October 2020 to September 2021. Identify and begin instrumentation of new monitoring wells (possibly including Rustler wells) with temperature and conductivity probes to provide continuous water quality monitoring. Convert the existing 11 threshold wells with instrumentation to provide additional baseline information such as elevation and conductivity. Process the collected data and prepare initial monitoring report to be discussed at an annual meeting of Management Zone 1 stakeholders.
  <u>Phase 2:</u> Continue to monitor and process data, continue to expand instrumentation of existing wells, add new monitoring wells as budget allows. Process the collected data and prepare monitoring report to be discussed at an annual meeting of Management Zone 1 stakeholders.
  <u>Phase 3:</u> Begins after export pumping starts. Continue to monitor, process data, and prepare annual report, and add new monitor wells. Process the collected data and prepare monitoring report to be discussed at an annual meeting of Management Zone 1 stakeholders. Post audit model/develop recommendations for model update.

  Key Elements of Phases:
- ✓ In time, data will be available to evaluate thresholds which addresses FSH's underlying objective of modifying thresholds/more pumping.
- ✓ Addresses water quality issues raised by MPGCD and Cockrell Investment Partners.
- ✓ Groundwater elevation and water quality data collection efforts equal or exceed those additional data collection efforts proposed by Cockrell Investments Partners.
- ✓ Annual meeting of all Management Zone 1 stakeholders is responsive to Cockrell's proposal to convene more frequent meetings.

Ed McCarthy, Fort Stockton Holdings, LP attorney:
Summary of FSH offer to MPGCD: A lump sum one-time payment of $250,000 will be offered and dedicated for the sole purpose of funding the Joint Study for Phases 1 and 2. A Rustler well that is currently used periodically for irrigation and is not part of the export permit, has been offered as a monitoring well. In addition, Fort Stockton Holdings LP agreed to fund 100% of the cost of a new Rustler monitoring well based on the final bids and the contracts that the District completes, if it is determined by District that such a well is needed.

Summary of Comments made to the Board:
FSH believes that the Edwards-Trinity aquifer could withstand greater pumping as it did in the past, which was their basis for agreeing to the threshold limits and criteria and curtailments imposed in the 2017 permit. They advocate that additional science and data should be collected and developed over the years to assess FSH's ability to develop greater pumping levels from the Edwards-Trinity. FSH is of the position that the Rustler aquifer was never a point of discussion in 2017, and only recently became a point of discussion. FSH supports the concept of learning more about the Rustler just as we support all science related to the aquifers within the District.

Ryan Reed, attorney for Cockrell Investments Partners, L.P.
Although Cockrell has not been involved with the Joint Study talks, we are pleasantly surprised to hear about the concept of the study—the science and intent to get a better understanding of the data are great concepts. We are pleased to hear about the funding for these issues. Cockrell Investments is actively using our Rustler wells, two of which were recently drilled. Once we have data, we are happy to discuss it.

We have presented a set of proposed rules that are a supplement to Dr. Hutchison's rules, which will be discussed later today. The proposed rules go hand-in-hand with the Joint Study issues being discussed.

Mike Gershon's guidance to the Board: The Board can act to approve the agreement that will delegate authority to the President and Vice President to get the agreement in order subject to terms that will be laid out in the motion or the Board can wait until next month to vote on the agreement that will be drafted, and you will have the draft in advance of the meeting to review before the vote.

Alvaro Mandujano, Jr., made a motion to approve the Joint Study Agreement with Fort Stockton Holdings LP, as required by FSH's production permit special permit conditions, to implement Phase 1 and Phase 2 of the current proposal to

which FSH is committing $250,000 to be dedicated to be spent to do Phase 1 and Phase 2 with payment due by September 1, 2020. One of the first steps will be the installation of the new transducers in the wells given the priority of improving upon the database. This database will include the use of an existing FSH Rustler well which was offered to MPGCD as a monitoring well. Also, the commitment that at such time the District determines a new Rustler monitoring well is necessary, that FSH will fund 100% of the cost of the Rustler well based on the final bid(s) and the contract(s) that the District enters. Authority to oversee completion and execution of the Joint Study Agreement shall be delegated to President Jerry McGuairt and to Vice President Janet Groth, with the guidance of Mike Gershon. The motion was seconded by Larry Drgac. The motion passed unanimously.
Vote: 9 FOR. -0- Oppose. 2 Absent (Childs/Cooper).

IX Consider and/or act on **proposed rule amendments intended to (1) change Management Zone 1 boundaries and operating conditions to recognize hydrogeological differences between South Coyanosa and Belding areas and (2) establish (A) acceptable aquifer level fluctuations and (B) thresholds for pro rata cutbacks when aquifer level declines in certain monitoring wells**, which have been subject to public rulemaking hearing and based on public comment.

Director Puja Boinpally recused herself, and completed the Disclosure Affidavit.

(1) change Management Zone 1 boundaries and operating conditions to recognize hydrogeological differences between South Coyanosa and Belding areas.
General Manager, Ty Edwards, reported that there have been several rulemaking hearings over the years. In 2017 the District had several rulemaking hearings and took public comment. The purpose of the proposed rule changes was to modify the boundaries of Management Zone 1 to better incorporate the science in the Management Zone 1 area. We have that set out in the proposed rules.

Gershon: The applicable statute - 36.101 of the Texas Water Code and our rules provide that after hearing and public comment, which has occurred, and appropriate notice was published, then you can act on these proposed rules. The way that we've defined the management zone in the current rules, we have essentially a picture, a visualization of that management zone, and there is some text in Rule 10.5(a) that describes what you see in our rules. Based on the visualization and reference to GAM grid cells, and latitude and longitude and coordinates, there is an easier way to describe that and an easier way probably for the public to deal with that by using the District's Excel files and other records within the District.

Vanessa Cardwell made a motion to approve the proposed rule amendments to change Management Zone 1 boundaries as presented. Also to approve a nonsubstantive change in the language that describes Management Zone 1 boundaries as shown in Rule 10.5(a). The nonsubstantive changes include removing the coordinate values and changing it to reference the District's records (referencing Excel file—see note below). Motion seconded by Janet Groth.

Note: The District Excel file is located at: \\Mpgcd-server\data\1.M.P.G.C.D\5. Rules & by-laws& chap 36\001.Adopted Rules\06-16-2020_Rule 10-5-a_MPGCD_MZ1_ModelGridCentroilds.xlsx

Public Comment from Ryan Reed, Attorney for Cockrell Investment Partners, L.P. We do not object to changing the boundaries of Management Zone 1. Procedurally however, Cockrell believes that it is unclear if we are currently in a rulemaking hearing or if the previous (2017) rulemaking hearings were ever concluded. It appears the previous rulemaking hearings were never concluded, and that this one hasn't been noticed. This is relevant because there are additional issues we believe should be considered as part of the rulemaking hearings. Specifically, Cockrell provided the District with a set of proposed rules that we believe should supplement what Dr. Hutchison's previously prepared. We do think that it is appropriate when considering the change to the management zone that we also consider Dr. Hutchison's rules as well as Cockrell's proposed supplemental rules.

There was discussion by Mike Gershon and others about the 1st and 2nd rulemaking hearings in 2017 and whether they were properly noticed and adjourned.

Ryan Reed again took the floor and said he stands corrected, and that the record reflects that the meetings were adjourned.

President McGuairt called for the vote on the motion on the floor. Motion passed. Vote: 8 FOR. -0- Oppose. 2 Absent (Childs/Cooper). 1 Abstention/Boinpally.

2nd Part of Agenda Item:
(2) establish (A) acceptable aquifer level fluctuations and (B) thresholds for pro rata cutbacks when aquifer level declines in certain monitoring wells, which have been subject to public rulemaking hearing and based on public comment.

Mike Gershon: We have received concepts from Cockrell Investment Partners, LP, and have talked concepts with Fort Stockton Holdings, LP, and proposed rules have been published and considered at a hearing in 2017. There appears to be more work to be done. Typically Board workshops have proven useful for rules development prior to issuing notice for a formal hearing. Note that the settlement agreement with Fort Stockton Holdings, LP, required us to consider whether to address these rules, but did not require us to take any particular action on the rules. We have been working for 3 years on this since the settlement agreement was entered. No action is necessary.

President Jerry McGuairt declared that No Action was taken.

X Briefing and take action if necessary on General Manager's decisions on **renewal/nonrenewal of production permit of Pyote Water Systems, III and production permits authorizing export of Alpha Water Resources, LLC and Fort Stockton Holdings, LP.**

Pyote Water Systems, III: Canceled permit via nonrenewal. This was a permit for a small industrial permit for one well. The company is no longer an entity and is closed.

Alpha Water Resources, LLC: Alpha Water Resources, LLC was known at one time as STW. Mr. Allan Murphy never fully complied with the permit condition by submitting the bond as required before drilling, and never drilled any of the monitor wells. They were given multiple extensions. This permit has been cancelled. We have not heard from Mr. Allan Murphy regarding the notice of cancellation letter.

Fort Stockton Holdings, LP: General Manager, Ty Edwards, has sent a letter to FSH renewing the 3-year permit. FSH did not challenge the decision.

Mike Gershon informed the Board that they could overrule the renewal. The Board deliberated and appeared to agree with the renewal with no motions offered to overrule the General Manager's decision.

Note: Alvaro Mandujano, Jr. left the meeting at 2:20 p.m. A quorum remained.

Public Comment from Ryan Reed, Attorney for Cockrell Investment Partners, L.P.: He does not believe that this Board or Mr. Edwards has the authority under the Texas Water Code to renew the export component of the FSH permit. Texas Water Code 36.1145 does not govern the automatic renewal of the FSH permit. In his opinion, Texas Water Code 36.122 (i)(1) provides that for the export permit to be renewed there must be commencement of construction of a conveyance system. FSH has not commenced construction of the conveyance system. The deal that FSH reached with the City of Midland expressly provides that the City of Midland is going to be responsible for the entire construction of the conveyance system, which has not yet commenced. The renewal of the export permit is void and inconsistent with the statute.

Mike Gershon: The District received Cockrell Investment Partners' written briefing, which requests party status and a hearing. To be clear, we are not having a hearing today on the renewal. Our interpretation of the statute is that we are not supposed to have a hearing unless we are going to initiate changes to the permit or there is another reason for nonrenewal. The only action item for the Board is to overrule the General Manager's renewal if the Board believes that to be appropriate.

Ryan Reed: We are not contesting the renewal of the production component, but simply requesting that they file an application to export the water and all of the factors of 36.122 (f) – or address the contemplated hearing.

Ed McCarthy summarized FSH's filing with the District and position on the applicability of Texas Water Code Sections related to renewal and export authorization. There was substantial discussion among Mr. McCarthy, Mr. Reed, and Mr. Gershon, and the Board and General Manager.

President Jerry McGuairt declared that No Action was taken.

XI Briefing and take action as necessary on **Cockrell Investment Partners, L.P. v.Middle Pecos Groundwater Conservation District,** Cause No. P-12176-112-CV (Pecos County District Court).

Mike Gershon: Our plan at the present time is to appear before Judge Gomez for a pretrial conference in late July either by zoom call as the Judge has been doing for some proceedings or in person. The scope of that hearing is guided by a rule of procedure that allows us to address preliminary matters. The scope doesn't include the District's pending plea to the jurisdiction. At the July hearing, we will make the Judge aware that the District would like to set a hearing on the pending plea to the jurisdiction. We have a joint staff support that Ryan and his colleagues and I are working through to make sure that Judge Gomez is aware of the issues that he will be looking at and how much time we need. We'll know more about the procedural approach to this case after the hearing.

Ryan Reed: I think that is a fair assessment of where we are. We do owe the Court a joint status report. A written report that has been circulated between Mr. Gershon, myself and Mr. Cruz. That will be filed as soon as we hammer out the details. And as Mr. Gershon said, we will appear before the Court however the Court sees fit, and assuming that the July 27th date holds. We will continue down the path of determining whether we should have party status, or should have had party status on the application from 2009 that was then converted into whatever it was converted into. The issues are very much like what we are talking about today: whether we should have had party status or not and whether something is or is not contemplated by the statute.

No action taken.

XII **Progress Reports: Well Registrations, Drilling Permits, Production Permits, Data Loggers, Drought Monitor Map, Water Quality Analysis, Railroad Commission Well Plugging Fund, Texas Alliance of Groundwater Districts' committee work, Groundwater Management Area 7, and General Manager's Correspondence.**

* Pecos County Tax Appraisals: Even with the recent downturn in the oil and gas industry, our estimated tax valuations will remain about the same as last year.
* Drought Monitor: The drought monitor report is submitted in Board Information. Pecos County is currently out of drought, but getting drier.
* 2020 Texas Groundwater Summit: MPGCD will reserve 5 rooms for the upcoming Summit.
* Clayton Mill Project: Drilled a 3" X 8' hold and installed a grounding rod.
* Crabb Capitan Well: The Capitan well on the Crabb Estate is free-flowing. In was bulldozed over the well head in the 1970s. We have sent them a letter

informing them of the serious public safety and environmental hazard the well poses. Informed them that the flowing well needs to reworked or plugged.

* Groundwater Management Area #7: There is a meeting on August 6, 2020 in San Angelo, TX.
* Texas Alliance of Groundwater Districts (TAGD): The legislative subcommittees for TAGD are set, and Ty Edwards is on 1) Produced Water Subcommittee and the 2) Brackish Subcommittee.
* November 3, 2020 Election: The period for candidates to file applications for a place on the ballot this year runs from Saturday, July 18 to Monday, August 17, 2020. We will call for the election at the July meeting.
* Well Registrations: Since 06-12-2020 our total registrations 3,277. 963 of those are Non-Exempt Wells and 2,314 Exempt wells.
* RigData Report: The report shows 1 rig in Pecos County.

XIII **Directors' Comments** and consider and/or act on **agenda for next meeting**.

The July meeting will be moved to July 14^{th} due to conflicts. This is the 2^{nd} Tuesday.

XIV **Adjourn** Board meeting.
Weldon Blackwelder made a motion to adjourn the meeting. Motion seconded by Larry Drgac. Motion carried unanimously. Meeting adjourned at 2:59 p.m.

M.R. Gonzalez

M. R. Gonzalez, Secretary/Treasurer

Date Approved 7-14-20

Jerry McGuaird

Jerry McGuairt, President

Middle Pecos GCD Exhibit 23

Order on Pleas to the Jurisdiction, Cause No. P-12176-112-CV,
112th Judicial District, Pecos County, Texas (Cockrell 1)

CAUSE NO. P-12176-112-CV

COCKRELL INVESTMENT PARTNERS, L.P., Plaintiff,	§	IN THE DISTRICT COURT
v.	§	112th JUDICIAL DISTRICT
MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT AND ITS BOARD PRESIDENT JERRY MCGUAIRT, AND REPUBLIC WATER COMPANY OF TEXAS, LLC Defendants,	§	PECOS COUNTY, TEXAS
and	§	
FORT STOCKTON HOLDINGS, L.P., Intervenor-Defendant.	§	

ORDER ON PLEAS TO THE JURISDICTION

On the 17th day of December, 2020, came on for consideration before the Court those pleas to the jurisdiction on file in this cause that were pending at the time of this hearing. Upon considering these pleas to the jurisdiction, Plaintiff's responses thereto, all replies to Plaintiff's responses, the pleadings and papers on file in this cause, and arguments of counsel, the Court believes that good cause exists to grant the pleas to the jurisdiction. The Court is aware that defendant Republic Water Company of Texas, LLC (Republic) filed its answer and plea to the jurisdiction on December 18, 2020, and recognizes that Plaintiff's claims implicating Republic are moot as a result of this Court's ruling on the other defendants' pleas to the jurisdiction.

Accordingly, the Court is of the opinion and hereby decrees that the pleas to the jurisdiction heard on December 17, 2020 shall be granted, and that all of Plaintiff's claims against all the defendants shall be dismissed.

The Court will address the District and its Board President's request for recovery of its costs and attorneys' fees in accordance with Texas Water Code § 36.066(g) and (h) in a final judgment after Plaintiff, the District and its Board President file an agreed-upon award or, if agreement is not reached, at a subsequent hearing.

AND IT IS SO ORDERED.

Signed this 28 day of December, 2020.

STEPHEN B. ABLES, JUDGE PRESIDING

APPROVED AS TO FORM AND SUBSTANCE AND ENTRY REQUESTED:

/s/ Michael A. Gershon
Michael A. Gershon
C. Cole Ruiz
Lloyd Gosselink Rochelle & Townsend, PC
816 Congress Avenue, Suite 1900
Austin, Texas 78701
Attorneys for Middle Pecos Groundwater Conservation District and
Jerry McGuairt, President

/s/ Edmond R. McCarthy, Jr.
Edmond R. McCarthy, Jr.
Edmond R. McCarthy, III
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Austin, Texas 78701
Attorneys for Fort Stockton Holdings, LP

/s/ Stacey V. Reese
Stacey V. Reese
Stacey V. Reese Law, PLLC
910 West Avenue, Suite 15
Austin, Texas 78701
Attorneys For Republic Water Company Of Texas, LLC

APPROVED AS TO FORM ONLY:

Mr. Sam W. Cruse III
Gibbs & Bruns, LLP
1100 Louisiana Street, Suite 5300
Houston, Texas 77002
Attorneys for Cockrell Investment Partners LP

Middle Pecos GCD Exhibit 24

Final Judgment, Cause No. P-8277-83-CV, 83rd Judicial District, Pecos County, Texas (Cockrell 2)

CAUSE NO. P-8277-83-CV

COCKRELL INVESTMENT PARTNERS, L.P.,	§	
Plaintiff,	§	IN THE DISTRICT COURT
v.	§	83rd JUDICIAL DISTRICT
MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT AND ITS GENERAL MANAGER TY EDWARDS AND FORT STOCKTON HOLDINGS, L.P.,	§	PECOS COUNTY, TEXAS
Defendants.	§	

FINAL JUDGMENT

On the 31st day of March, 2021, came on for consideration during a hearing before the Court cross-motions for traditional and partial summary judgment filed by Fort Stockton Holdings, L.P. (FSH), the Middle Pecos Groundwater Conservation District and its General Manager (collectively, the District), and Cockrell Investment Partners, L.P. (Cockrell). Upon consideration of the parties' respective motions and responses thereto, the pleadings, evidence and other papers on file in this cause, the Court is of the opinion that FSH's traditional motion for summary judgment and the District's motion for partial summary judgment should be granted, and that Cockrell's motion for partial summary judgment should be denied.

Subsequent to the hearing on summary judgment, the Court was advised that the District and Cockrell reached agreement on the amount of attorneys' fees and court costs incurred by the District to be awarded pursuant to Section 36.066 of the Texas Water Code, which is agreed upon without waiving Cockrell's right to challenge the trial court's ruling on the motions for summary judgment, which amount is indicated below in this judgment. The Court is of the opinion that rendition of this final judgment is appropriate.

IT IS THEREFORE ORDERED, ADJUDGED and DECREED as follows:

1. FSH's traditional motion for summary judgment is GRANTED.

2. The District's motion for partial summary judgment is GRANTED.

3. Cockrell's motion for partial summary judgment is DENIED.

4. The District's claim for attorneys' fees and other costs incurred in the 83rd Judicial District Court pursuant to Section 36.066 of the Texas Water Code is GRANTED in the amount of $53,970.30, which amount Cockrell is directed to remit to the District within 35 calendar days of the date of this judgment; provided, however, if Cockrell appeals this judgment, Cockrell is directed to remit this award to the Court registry until appeals have been exhausted.

5. Contingent appellate costs and fees incurred by the District are likewise GRANTED under Section 36.066 if on appeal of this judgment the District shall substantially prevail before the Court of Appeals, and the District is awarded and shall have and recover judgment from against Cockrell, for costs and fees incurred in responding to such appeal in the amount of $45,740.00 dollars, which amount Cockrell is directed to remit to the District within 20 (twenty) days of full and final disposition of the appeal.

6. Contingent appellate costs and fees incurred by the District before the Texas Supreme Court are likewise GRANTED under Section 36.066 if on appeal the District shall substantially prevail before the Texas Supreme Court, and the District is awarded and shall have and recover judgment from against Cockrell, for costs and fees incurred in responding to such appeal in the amount of $37,835.00 dollars, which amount Cockrell is directed to remit to the District within 20 (twenty) days of full and final disposition of the appeal.

7. All other relief requested by any party that is not granted in this judgment is hereby DENIED.

8. This judgment disposes of all parties and claims and is FINAL and APPEALABLE.

AND IT IS SO ORDERED, ADJUDGED AND DECREED.

Signed this 20th day of October, 2021.

St B. Able / BH

Honorable Stephen B. Ables
Judge Presiding

APPROVED AS TO FORM:

Michael A. Gershon
Attorney for Middle Pecos
Groundwater Conservation District and
Its General Manager Ty Edwards

Ryan C. Reed
Attorney for Cockrell Investment
Partners, L.P.

Edmond R. McCarthy, Jr.
Attorney for Fort Stockton Holdings, L.P.

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Associated Case Party: Cockrell investment Partners, L.P.

Name	BarNumber	Email	TimestampSubmitted	Status
Ryan Reed		rreed@pulmanlaw.com	10/26/2021 11:50:40 AM	SENT
Ryan C.Reed		rreed@pulmanlaw.com	10/26/2021 11:50:40 AM	SENT
Dana VanOutryve		dvanoutryve@pulmanlaw.com	10/26/2021 11:50:40 AM	SENT

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<u>Middle Pecos GCD Exhibit 25</u>

Excerpt of Middle Pecos GCD Rules, effective May 18, 2005

MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT RULES

Procedural Rules Initial Effective Date: January 7, 2004;
Amended August 18, 2004, and September 20, 2004

Substantive Rules Initial Effective Date: August 18, 2004;
Amended October 20, 2004, December 15, 2004, January 19, 2005, and May 18, 2005

PECOS COUNTY, TEXAS

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INTRODUCTION

BACKGROUND AND PURPOSE

Texas faces a difficult challenge to develop water policies that serve county, state, and regional interests. The Texas Constitution authorizes the creation of groundwater conservation districts to plan, develop, and regulate the use of water. The Groundwater Conservation District is a local unit of government authorized by the Texas Legislature and ratified at the local level to manage and protect groundwater.

The MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT was created in the 76th Legislature, 1999 by S. B. 1911 and ratified in the 77th Legislature, 2001 by HB. 1258. The district was confirmed by qualified voters of Pecos County in November of 2001.

The boundaries of the MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT are coextensive with the boundaries of Pecos County, Texas. Aquifers underlying Pecos County are the Edwards-Trinity, the Cenozoic Pecos Alluvium, the Dockum, the Capitan Reef Complex, and the Rustler.

The District is governed by a board of eleven directors elected as follows:

1) One director shall be elected by the qualified voters of the entire district.

2) Two directors shall be elected from each of the four counties commissioner's precincts by the qualified voters of that precinct;

3) One director shall be elected from the city of Iraan by the qualified voters of that city; and

4) One director shall be elected from the city of Fort Stockton by the qualified voters of that city.

The district has the rights, powers, privileges, authority, functions, and the duties provided by the general law of the State, Chapter 36 of the Water Code, and the district's enabling legislation, H.B. 1258 and S.B. 1911.

The substantive rules of the Middle Pecos Groundwater Conservation District were initially adopted by the Board of Directors on August 18, 2004, at a duly posted public meeting in compliance with the Texas Open Meetings Act and following notice and hearing in accordance with Section 36.101 of the Texas Water Code. The District's rules are hereby adopted as the rules of this District in accordance with Section 59 of Article XVI of the Texas Constitution, Chapter 36 of the Texas Water Code, and the District's enabling act [Acts 1999, 76th Leg., R.S., Ch. 1331 (Senate Bill 1911), and Acts 2001, 77th Leg., R.S., Ch. 1299 (House Bill 1258)]. The procedural rules which initially took effect on January 7, 2004, were subsequently amended on August 18, 2004, and October 20, 2004. The substantive rules which initially took effect August 18, 2004 were subsequently amended October 20, 2004, December 6, 2004, January 19, 2005 and April 13, 2005, and May 18, 2005. The effective date of the Historic and Existing Use Rules is September 1, 2004.

The District's rules are and have been adopted to simplify procedures, avoid delays, and facilitate the administration of the water laws of the State of the Texas. These rules are to be construed to attain those objectives. These rules may be used as guides in the exercise of discretion, where discretion is vested. However, these rules shall not be construed as a limitation or restriction upon the exercise of discretion conferred by law, nor shall they be construed to deprive the District or the Board of any powers, duties, or jurisdiction provided by law. These rules will not limit or restrict the amount and accuracy of data or information that may be required for the proper administration of the law.

PURPOSE OF THE DISTRICT

Groundwater Conservation districts provide to a local board the authority and responsibility to develop and implement comprehensive management plans to conserve, protect, and manage groundwater resources. The district board will strive to maintain a balance between protecting the rights of private landowners and the responsibility of protecting the water resources by directing their efforts toward preventing waste, collecting data, educating people about water conservation, and preventing irreparable harm to the aquifers. The Groundwater Conservation District accomplishes these goals by performing certain duties as described in Chapter 36 of the Texas Water Code.

MISSION STATEMENT

Develop and implement an efficient, economical and environmentally sound groundwater management program to protect, and maintain historical aquifer levels and enhance the water resources of the district, and to communicate and administer to the needs and concerns of the citizens of Pecos County.

SECTION 1. DEFINITIONS, PURPOSE, AND CONCEPTS OF THE RULES AND BYLAWS

RULE 1.1 DEFINITIONS OF TERMS

In the administration of its duties the District defines terms as set forth in Chapter 36 of the Texas Water Code unless otherwise modified or defined herein as necessary to apply to unique attributes of the District. The specific terms hereinafter defined shall have the following meaning in these rules.

"Abandoned Well" – a well that has not been used for a beneficial purpose for at least one year and/or a well not registered with the District. A well is considered to be in use in the following cases:

1. A non-deteriorated well which contains the casing, pump and pump column in good condition; or

<u>Middle Pecos GCD Exhibit 26</u>

Middle Pecos GCD District Rules, effective December 1, 2023

MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT

RULES

Effective December 1, 2023

PECOS COUNTY, TEXAS

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INTRODUCTION

BACKGROUND AND PURPOSE

Texas faces a difficult challenge to develop water policies that serve county, state, regional, and individual Texans' interests. The Texas Constitution authorizes the creation of groundwater conservation districts to plan for, develop, and regulate the use of groundwater. A groundwater conservation district is a local unit of government authorized by the Texas Legislature and ratified by local election of the district's constituents to manage and protect groundwater.

The MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT (the "District") was created in the 76th Legislature, 1999 by Senate Bill 1911, and ratified in the 77th Legislature, 2001 by House Bill 1258. The District was confirmed by qualified voters of Pecos County in November of 2002.

The boundaries of the District are coextensive with the boundaries of Pecos County, Texas. Aquifers and other recognized groundwater formations underlying Pecos County include the Capitan Reef, Dockum, Edwards-Trinity, Pecos Valley, Rustler, and San Andres.

The District is governed by a board of eleven directors elected as follows:

(1) One director shall be elected by the qualified voters of the entire district;

(2) Two directors shall be elected from each of the four Pecos County Commissioners' precincts by the qualified voters of each respective precinct;

(3) One director shall be elected from the City of Iraan by the qualified voters of that city; and

(4) One director shall be elected from the City of Fort Stockton by the qualified voters of that city.

The District has the rights, powers, privileges, authority, functions, and the duties provided by the general law of the State, Chapter 36 of the Texas Water Code, and the District Act.

The substantive rules of the District were initially adopted by the District's Board of Directors on August 18, 2004, at a duly posted public meeting in compliance with the Texas Open Meetings Act and following notice and hearing in accordance with Section 36.101 of the Texas Water Code. The District's rules are hereby adopted as the rules of this District in accordance with Section 59 of Article XVI of the Texas Constitution, Chapter 36 of the Texas Water Code, and the District Act.

The District's rules are and have been adopted to simplify procedures, avoid delays, and facilitate the administration of the water laws of the State of Texas. These rules are to be construed to attain those objectives. These rules may be used as guides in the exercise of discretion, where discretion is vested. However, these rules shall not be construed as a limitation or restriction upon the exercise of discretion conferred by law, nor shall they be construed to deprive the District or the District's Board of any powers, duties, or jurisdiction provided by law. These rules will not limit or restrict the amount and accuracy of data or information that may be required for the proper administration of the law.

Nothing in these rules or Chapter 36 of the Texas Water Code shall be construed as granting the authority to deprive or divest a landowner, including a landowner's lessees, heirs, or assigns, of the groundwater ownership and rights described by Section 36.002 of the Texas Water Code, recognizing, however, that Section 36.002 does not prohibit the District from limiting or prohibiting the drilling of a well for failure or inability to comply with minimum well spacing or tract size requirements adopted by the District; affect the ability of the District to regulate groundwater production as authorized under Section 36.113, 36.116, or 36.122 or otherwise under Chapter 36, Texas Water Code, or a special law governing the District; or require that a rule adopted by the District allocate to each landowner a proportionate share of available groundwater for production from the aquifer based on the number of acres owned by the landowner.

PURPOSE OF THE DISTRICT

By statutory enactment and declaration by the Texas Supreme Court, groundwater management by groundwater conservation districts is the state's preferred method of groundwater management in order to protect property rights, balance the conservation and development of groundwater to meet the needs of this state, and use the best available science in the conservation and development of groundwater. The District's locally elected board of directors and staff accomplish this purpose by performing certain duties set forth in the general law of the State, Chapter 36 of the Texas Water Code, and the District Act, and implemented in accordance with these rules.

MISSION STATEMENT

Develop and implement an efficient, economical and environmentally sound groundwater management program to protect, maintain and enhance the groundwater resources of the District, and to communicate and administer to the needs and concerns of the citizens of Pecos County associated with these groundwater resources.

SECTION 1. DEFINITIONS, PURPOSE, AND CONCEPTS OF THE RULES

RULE 1.1 DEFINITIONS OF TERMS

In the administration of its duties the District defines terms as set forth in Chapter 36 of the Texas Water Code unless otherwise modified or defined herein as necessary to apply to unique attributes of the District. The specific terms hereinafter defined shall have the following meaning in these rules, the District's Management Plan, forms, and other documents of the District:

"Abandoned Well" means a well that has not been used for a beneficial purpose for at least one year and/or a well not registered with the District. A well is considered to be in use in the following cases:

(a) a non-deteriorated well which contains the casing, pump and pump column in good condition; or
(b) a non-deteriorated well which has been capped.

“Affected Person” means, with respect to a Groundwater Management Area:

(1) an owner of land in the Groundwater Management Area;

(2) a district in or adjacent to the Groundwater Management Area;

(3) a regional water planning group with a water management strategy in the Groundwater Management Area;

(4) a person who holds or is applying for a permit from a district in the Groundwater Management Area;

(5) a person who has groundwater rights in the Groundwater Management Area;

(6) or any other person defined as affected by a TCEQ rule.

“Animal Feeding Operation” means a lot or facility (other than an aquatic animal production facility) where animals have been, are, or will be stabled or confined and fed or maintained for a total of 45 (forty-five) calendar days or more in any 12-month period, and the animal confinement areas do not sustain crops, vegetation, forage growth, or postharvest residues in the normal growing season over any portion of the lot or facility.

“Aquifer” means a geologic formation that will yield water to a well in sufficient quantities to make the production of water from this formation feasible for beneficial use. When the term “Aquifer” is used in these rules, it shall also mean the Aquifer’s subdivisions.

“Aquifer Storage and Recovery Project” or “ASR Project” means a project involving the injection of water into a geologic formation for the purpose of subsequent recovery and beneficial use by the Project Operator.

“ASR” means aquifer storage and recovery.

“ASR Injection Well” means a Class V injection well used for the injection of water into a geologic formation as part of an ASR Project.

“ASR Recovery Well” means a well used for the recovery of water from a geologic formation as part of an ASR Project.

“Beneficial Use” means “use for a beneficial purpose,” which means use for:

(a) agricultural, gardening, domestic, stock raising, municipal, mining, manufacturing, industrial, commercial, recreational, or pleasure purposes;

(b) exploring for, producing, handling, or treating oil, gas, sulphur, or other minerals; or

(c) any other purpose that is useful and beneficial to the user.

“Best available science” means conclusions that are logically and reasonably derived using statistical or quantitative data, techniques, analyses, and studies that are publicly available to reviewing scientists and can be employed to address a specific scientific question.

“Board” means the Board of Directors of the District.

“Capitan Limestone Aquifer” means the Capitan Reef Complex consists of the Capitan Reef and associated reefs and limestones which were deposited around the perimeter of the Delaware Basin during Permian time. The reef complex is composed of approximately 2,000 feet of massive, vuggy to cavernous limestone and dolomite, bedded limestone, and reef talus. In the study area, (located in the northern part of the Trans-Pecos region of West Texas, which is in the Great Plains physiographic province, and falls within the Rio Grande basin), the reef occurs in a 6 to 10 mile wide, south-southeast trending belt, extending from New Mexico through western Winkler, central Ward, and western Pecos Counties. Depth to the top of the reef ranges from 2,400 to 3,600 feet (Guyton and Associates, 1958). The Capitan Reef Complex yields small to large quantities of moderately to very saline water to wells in the study area that primarily have been used for secondary recovery of oil in Ward and Winkler Counties(Richey and others, 1985).

“Capping” means equipping a well with a securely affixed, removable device that will prevent the entrance of surface pollutants into the well in compliance with regulations of the Texas Department of Licensing and Regulations.

“Casing” means a tubular structure installed in the excavated or drilled borehole to maintain the well opening.

“Concentrated Animal Feeding Operation” (“CAFO”) means any animal feeding operation with the number of animals established in TCEQ’s rules, including at least 37,500 chickens (other than laying hens), or that has been designated by the TCEQ’s Executive Director as a CAFO because it is a significant contributor of pollutants into or adjacent to water in the state.

“Conservation” refers to those water saving practices, techniques, and technologies that will reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of waste, or increase the recycling and reuse of water so that a water supply is made available for future or alternative uses.

“Desired Future Condition” means a quantitative description, adopted in accordance with Section 36.108, Texas Water Code, of the desired condition of the groundwater resources in a Groundwater Management Area at one or more specified future times.

“Dewatering Well” means a well used to remove groundwater from a construction site or excavation, or to relieve hydrostatic uplift on permanent structures.

“Director” means an elected or appointed member of the Board of Directors of the District.

“Discharge” means the volume of water that passes a given point within a given period of time.

“District” means the Middle Pecos Groundwater Conservation District.

"District Act" means the District's enabling legislation to be codified in Chapter 8851 of the Texas Special District Local Laws effective on April 1, 2013, and originally enacted by Act of the 76th Legislature, 1999, Regular Session, Chapter 1331 (Senate Bill 1911), as amended by Act of the 77th Legislature, 2001, Regular Session, Chapter 1299 (House Bill 1258), and Act of the 82nd Legislature, 2011, Regular Session, Chapter 199 (Senate Bill 564).

"District Management Plan" or **"Management Plan"** means the plan promulgated and adopted by the District, as may be amended and revised by the Board from time to time, pursuant to Sections 36.1071-36.1073 of the Texas Water Code.

"Dockum Group Aquifer" – The Dockum Group of Triassic age consists of upper and lower shaley units and a middle water-bearing sandstone unit often referred to as the "Santa Rosa." Small to moderate quantities of fresh to moderately saline water are produced from the sandstone in Winkler, Ward, eastern Loving, and eastern Reeves Counties, primarily where the aquifer is relatively shallow. In parts of Pecos, Reeves, Ward, and Winkler Counties, where the sandstone is hydraulically connected to the Pecos Valley Aquifer, the combination has been referred to as the Allurosa aquifer.

"District Office" means the principal office of the District at such location as may be established by the Board.

"Domestic Use" means water used by and connected to a household for personal needs or for household purposes such as drinking, bathing, heating, cooking, sanitation or cleaning, and landscape irrigation. Ancillary use may include watering of domestic animals.

"Domestic Well" means a well providing groundwater for domestic use.

"Drill" means drilling, equipping, completing wells, or modifying the size of wells or well pumps/motors (resulting in an increase in pumpage volume) whereby a drilling or service rig must be on location to perform the activity.

"Edwards-Trinity (Plateau) Aquifer" – The Edwards-Trinity (Plateau) aquifer underlies the Pecos Valley Aquifer in the study area, (located in the northern part of the Trans-Pecos region of West Texas, which is in the Great Plains physiographic province, and falls within the Rio Grande basin), in the southwest half of Reeves County and a portion of the Coyanosa area in northwest Pecos County. The aquifer is composed of water-bearing lower Cretaceous sands and limestones that are hydraulically connected to the overlying alluvium. Wells completed in the aquifer produce small to moderate quantities of fresh to moderately saline water, which is generally similar to that of the overlying alluvium. The poorest quality water is the aquifer, with dissolved solids in excess of 3,000 milligrams per liter (mg/l), occurs in the southwestern part of Reeves County where the aquifer receives recharge from the sulfate-rich Rustler aquifer. Water from the Edwards-Trinity(Plateau) aquifer is mostly used for irrigation, with a lesser amount used for industrial purposes in western Reeves County.

"Evidence of Historic or Existing Use" means evidence that is material and relevant to a determination of the amount of groundwater beneficially used without waste by a permit applicant during the relevant time period set by District rule that regulates groundwater based on historic use. Evidence in the form of oral or written testimony shall be subject to cross-examination. The Texas Rules of Evidence govern the admissibility and introduction of evidence of historic or existing use, except that evidence not admissible under the Texas Rules of Evidence may be admitted if it is of the type commonly relied upon by reasonably prudent persons in the conduct of their affairs.

"Exempt Well" means a well that is exempt pursuant to District Rule 11.3.

"Existing Well" means any well in the District that was drilled on or before the effective date of these rules.

"Export of Groundwater" means pumping, transferring, or transporting groundwater out of the District. The terms "transfer," "transport," or "export" of groundwater are used interchangeably within Chapter 36 of the Texas Water Code and these rules.

"Fees" means charges imposed by the District pursuant to these rules.

"Groundwater Management Area" means an area designated and delineated by the TWDB as suitable for the management of groundwater resources.

"Groundwater Reservoir" means a specific subsurface water-bearing reservoir having ascertainable boundaries and containing groundwater.

"Historic and Existing Use Period" means the period September 1, 1989, through the effective date of the rules adopting "Historic and Existing Use" rules, September 1, 2004; provided, however, that this period shall extend an additional consecutive 12-month period dating from September 1 - August 30 ("12-month period" or "year") for each such year during which the applicant demonstrates continued beneficial use of water in that year and demonstrates continued beneficial use in each and every year between September 1, 1989, and September 1, 2004, up to an additional, consecutive fifteen years extending to September 1, 1974.

"Hydrogeological Report" means a report that identifies the availability of groundwater in a particular area and formation, and which also addresses the issues of quantity and quality of that water and the impacts of pumping that water on the surrounding environment including impacts to nearby or adjacent wells.

"Irrigation Use" means the application of water, not associated with agricultural irrigation use, to plants or land in order to promote growth of plants, turf, or trees. Irrigation use includes but is not limited to athletic fields, parks, golf courses, and landscape irrigation not tied to domestic use.

"Irrigation Well" means a well providing groundwater for irrigation use (a nonexempt well).

"Leachate Well" means a well used to remove contamination from soil or groundwater.

"Livestock" means domesticated horses, cattle, goats, sheep, swine, poultry, ostriches, emus, rheas, deer and antelope, and other similar animals involved in farming or ranching operations on land, recorded and taxed in the County as an agricultural land use. Dogs, cats, birds, fish, reptiles, small mammals, potbellied pigs, and other animals typically kept as pets are not considered livestock. Livestock-type animals kept as pets or in a pet-like environment are not considered livestock.

“Managed Available Groundwater” refers to the term used by the TWDB in some of its models and associated reports, model runs, and other written documents, and which was defined by statutory law in existence prior to the 2011 legislative session, during which the 82nd Legislature replaced the concept of Managed Available Groundwater with Modeled Available Groundwater.

“Management Zone” means a geographic area delineated under District Rule 10.5 and in accordance with Section 36.116(d), Texas Water Code, and is sometimes referred to as a “management zone”.

“Maximum Historic and Existing Use” means the quantity of water put to beneficial use during the single 12-month period (September 1 – August 30) of maximum beneficial use during the Historic and Existing Use Period.

“Modeled Available Groundwater” means the amount of water that the Executive Administrator of the TWDB determines may be produced on an average annual basis to achieve the Desired Future Conditions established for the Aquifers in the District.

“Modify” means to alter the physical or mechanical characteristics of a well, its equipment, or production capabilities. This does not include repair of equipment, well houses or enclosures, or replacement with comparable equipment.

“Monitoring Well” means a well installed exclusively to measure some property of the groundwater or an aquifer that it penetrates, that does not produce more than 5,000 gallons per year.

“New Well” means any well that is not an existing well, or any existing well, which has been modified to increase water production after the effective date of these Rules.

“Office” means the State Office of Administrative Hearings.

“Pecos Valley Aquifer” – During the Cenozoic Era, a thick sequence of alluvial deposits accumulated in two large slumpage depressions. These depressions are herein referred to as the Monument Draw Trough, which developed along the eastern margin of the Delaware Basin, and the Pecos Trough, which occupies the south-central part of the Basin. The troughs were formed by dissolution and removal of evaporates in the underlying Ochoan Series, which resulted in the collapse of the Rustler Formation and younger rocks into the voids (Maley and Huffington, 1953). Water saturated alluvial fill in these troughs is classified as the Pecos Valley Aquifer.

“Permit Amendment” means a minor or major change in a permit.

“Person” includes a corporation, individual, organization, cooperative, government or governmental subdivision or agency, business trust, estate, trust, partnership, association, or any other legal entity.

“Personal Justiciable Interest” means an interest related to a legal right, duty, privilege, power, or economic interest affected by a permit or permit amendment application. A justiciable interest is an interest beyond that shared by the general public.

“Plugging” means the permanent closure of a well in accordance with approved District standards.

"Pollution" means the alteration of the physical, thermal, chemical, or biological quality of, or the contamination or degradation of, any groundwater within the District that renders the groundwater harmful, detrimental, or injurious to humans, animal life, vegetation, or property or to public health, safety, or impairs the usefulness or the public or private use or enjoyment of the water for any lawful or reasonable purpose.

"Presiding Officer" means the Board President or, in the Board President's absence, a Director delegated authority by the Board to preside over a hearing.

"Production Permit" is synonymous with "Operating Permit," both terms which mean the type of a permit that authorizes the operation and production from a water well.

"Project Operator" means a person holding an authorization under this subchapter to undertake an ASR Project.

"Retail Public Utility" means any person, corporation, public utility, water supply or sewer service corporation, municipality, political subdivision or agency operating, maintaining, or controlling in this state, facilities (such as a public water supply well) for providing potable water service for compensation.

"Rustler Aquifer" – The Rustler Formation underlies the entire study area, (located in the northern part of the Trans-Pecos region of West Texas, which is in the Great Plains physiographic province, and falls within the Rio Grande basin), and consists of 200 to 500 feet of anhydrite and dolomite with a basal zone of sandstone and shale. Slightly to moderately saline water occurs in the formation in most of Reeves and western Loving, Ward, and Pecos Counties and has mostly been used for irrigation and livestock supply. Elsewhere, the formation produces very saline to brine quality water that is used primarily for secondary oil recovery. Water in the aquifer occurs under artesian conditions, except in the out crop in the Rustler Hills to the west and in collapsed zones in the two troughs.

"Rules" means the standards and regulations promulgated by the District, as they may be amended from time to time, and are often referred to generally as "rules" or the District's rules.

"Seal" means the impermeable material, such as cement grout, bentonite, or puddling clay, placed in the annular space between the borehole wall and the casing to prevent the downhole movement of surface water or the vertical mixing of groundwater.

"SOAH" means the State Office of Administrative Hearings.

"Special Provisions" means the conditions or requirements added to a permit, which may be more or less restrictive than the Rules as a result of circumstances unique to a particular situation.

"Spring" means a point(s) of natural discharge from an aquifer.

"Static Water Level" means the water level in a well that has not been affected by withdrawal of groundwater.

"Stratum" means a layer of rock having a similar composition throughout.

“Subsidence” means the lowering in elevation of the land surface caused by withdrawal of groundwater.

“Surface Completion” means sealing off access of undesirable water, surface material, or other potential sources of contamination to the wellbore by proper casing and/or cementing procedures.

“TCEQ” means the Texas Commission on Environmental Quality, and its predecessor and any successor agencies.

“TWDB” means the Texas Water Development Board.

“User” means a person who produces, distributes, or uses water from any Aquifer within the District.

“Waste” shall have the meaning provided for in District Rule 14.1.

“Water Table” means the upper boundary of the saturated zone in an unconfined aquifer.

“Water Tight Seal” means a seal that prohibits the entrance of liquids or solutions, including water, which may enter through the wellhead and potentially, contaminate the well.

“Water Well” means any drilled or excavated facility, device, or method used to withdraw groundwater from the groundwater supply.

“Well” means any artificial excavation or borehole constructed for the purposes of exploring for or producing groundwater, or for injection, monitoring, or dewatering purposes.

“Well Registration” means the creation of a record of the well by use and a well identification number for purposes of registering the well as to its geographic location and for notification to the well owner in cases of spills or accidents, data collection, recordkeeping and for future planning purposes. (See Section 9 of the District’s rules).

“Well System” means two or more wells owned, operated, or otherwise under the control of the same person and that are held under the same permit.

“Withdraw or Withdrawal” means the act of extracting groundwater by pumping or any other method other than the discharge of natural springs.

RULE 1.2 PURPOSE OF RULES

The rules of the District are promulgated and adopted under the District’s statutory authority to achieve the following purposes and objectives: to provide for conserving, preserving, protecting, and recharging of groundwater or of a groundwater reservoir or its subdivisions, in order to control subsidence, or prevent waste of groundwater. The District’s orders rules, requirements, resolutions, policies, guidelines or similar measures have been implemented to fulfill these objectives.

RULE 1.3 USE AND EFFECT OF RULES

These rules are used by the District as guides in the exercise of the powers conferred by law and in the accomplishment of the purposes of the District Act and Chapter 36 of the Texas Water Code. They shall not be construed as a limitation or restriction on the exercise of any discretion, where it exists, nor shall they be construed to deprive the District or Board of the exercise of any powers, duties or jurisdiction conferred by law; nor shall they be construed to limit or restrict the amount and character of data or information that may be required to be collected for the proper administration of the District Act or Chapter 36.

RULE 1.4 AMENDING OF RULES

The Board may, following notice and hearing, amend or repeal these rules or adopt new rules from time to time, following the procedure set forth in the Rulemaking Section of these rules, and applicable law.

RULE 1.5 HEADINGS AND CAPTIONS

The section and other headings and captions contained in these rules are for reference purposes only and do not affect in any way the meaning or interpretation of these rules.

RULE 1.6 CONSTRUCTION

A reference to a title or chapter without further identification is a reference to a title or chapter of the Texas Water Code, unless the context of usage clearly implies otherwise. A reference to a section or rule without further identification is a reference to a section or rule in these rules, unless the context of usage clearly implies otherwise. Construction of words and phrases is governed by the Code Construction Act, Subchapter B, Chapter 311, Texas Government Code. The singular includes the plural, and the plural includes the singular. The words "and" and "or" are interchangeable and shall be interpreted to mean and/or.

RULE 1.7 SEVERABILITY

In case any one or more of the provisions contained in these rules shall for any reason be held to be invalid, illegal, or unenforceable in any respect, such invalidity, illegality, or unenforceability shall not affect any other rules or provisions hereof, and these rules shall be construed as if such invalid, illegal, or unenforceable rule or provision had never been contained herein.

RULE 1.8 SEVERABILITY CLAUSE

If any section, sentence, paragraph, clause, or part of these rules should be held or declared invalid for any reason by a final judgment of the courts of this state or of the United States, such decision or holding shall not affect the validity of the remaining portions of these rules, and the Board does hereby declare that it would have adopted and promulgated such remaining portions irrespective or the fact that any other sentence, section, paragraph, clause, or part thereof may be declared invalid.

RULE 1.9 COMPLIANCE

All permit holders and registrants of the District shall comply with all applicable rules and regulations of other governmental entities. Where the District's rules and regulations are more stringent than those of other governmental entities, the District's rules and regulations shall control.

RULE 1.10 VERB USAGE

The verbs may, can, might, should, or could are used when an action is optional or may not apply in every case. The verbs will, shall, or must are used when an action is required. The verb cannot is used when an action is not allowed or is not achievable. Unless otherwise expressly provided for in these rules, the past, present, and future tense shall include each other.

SECTION 2. BOARD AND DISTRICT STAFF

RULE 2.1 MEETINGS

The Board shall meet at least once each quarter and may meet more frequently as the Board may establish from time to time. At the request of the Board President, or by written request of at least three members, the Board may hold special meetings. All Board meetings will be held and conducted according to the Texas Open Meetings Act, Chapter 551, Texas Government Code. Directors shall not knowingly conspire to meet in numbers less than a quorum for the purpose of secret deliberations.

RULE 2.2 COMMITTEES

The Board President may establish committees for formulation of policy recommendations to the Board, and appoint the chair and membership of the committees. Committee members serve at the pleasure of the Board President.

RULE 2.3 ASSISTANT SECRETARY

A Director or member of the District staff may be appointed by the Board as Assistant Secretary to the Board to assist in meeting the responsibilities of the Board Secretary, if desired by the Board.

RULE 2.4 GENERAL MANAGER

The Board may employ or contract with a person to manage the District, and title this person "General Manager". The General Manager shall have full authority to manage and operate the affairs of the District, subject only to Board orders. The Board will review the compensation and/or contract of the General Manager each year at the beginning of the third quarter of every fiscal year. The General Manager, with approval of the Board, may employ all persons necessary for the proper handling of business and operation of the District, and their compensation will be set by the Board.

SECTION 3. BOARD

RULE 3.1 PURPOSE OF BOARD

The Board was created to determine policy and regulate the withdrawal of groundwater within the boundaries of the District for conserving, preserving, protecting and recharging the groundwater and aquifers within the District, and to exercise its rights, powers, and duties in a way that will effectively and expeditiously accomplish the purposes of the District Act. The Board's responsibilities include, but are not limited to, the adoption, implementation, and enforcement of the District's rules and orders.

RULE 3.2 BOARD STRUCTURE, OFFICERS

The Board may elect officers annually, but must elect officers at the first meeting following the November elections of each even-numbered year. Directors and officers serve until their successors are elected or appointed and sworn in accordance with the District Act and these rules, and qualified under applicable State law. If there is a vacancy on the Board, the remaining Directors shall appoint a Director to serve the remainder of the term. If at any time there are fewer than three qualified Directors, the Pecos County Commissioners Court shall appoint the necessary number of persons to fill all the vacancies on the Board. The appointed Director's term shall end on qualification of the Director elected at that election.

RULE 3.3 EX PARTE COMMUNICATIONS

Directors may not communicate, directly or indirectly, about any issue of fact or law in any contested hearing before the Board, with any agency, person, party or their representatives, except on notice and opportunity for all parties to participate. This rule does not apply to a Director who abstains from voting on any matter in which ex parte communications have occurred or to communications between the Board and the staff, professional, or consultants of the District.

SECTION 4. GENERAL PROCEDURAL PROVISIONS

RULE 4.1 DISTRICT ADDRESS

The District's mailing address is P.O. Box 1644, Fort Stockton, Texas, 79735, and its physical address shall be established by the Board and posted on the District's Internet site, if the District has a functioning Internet site.

RULE 4.2 COMPUTING TIME

In computing any period of time specified by these rules, by a Presiding Officer, by the Board, or by law, the period shall begin on the day after the act, event, or default in question, and shall conclude on the last day of that designated period, unless the last day is a Saturday, Sunday, or legal holiday on which the District Office is closed, in which case the period runs until the end of the next day which is neither a Saturday, Sunday, nor legal holiday on which the District Office is closed.

RULE 4.3 FILING OF DOCUMENTS AND TIME LIMIT

Applications, requests, or other papers or documents shall be filed either by hand delivery, mail, or telephonic document transfer to the District Office. The document shall be considered filed as of the date received by the District for a hand delivery; as of the date reflected by the official United States Postal Service postmark if mailed; and, for telephonic document transfers, as of the date on which the telephonic document transfer is complete, except that any transfer occurring after 5:00 p.m. will be deemed complete on the following business day. If a person files a document by facsimile, he or she must file a copy by mail within three (3) calendar days. A document may be filed by electronic mail ("email") only if the Board or Presiding Officer has expressly authorized filing by email for that particular type of document and expressly established the appropriate date and time deadline, email address, and any other appropriate filing instructions.

RULE 4.4 METHODS OF SERVICE UNDER THE RULES

Except as otherwise provided for in these rules, and notice or document required by these rules to be served or delivered may be delivered to the recipient, or the recipient's authorized representative, in person, by agent, by courier-receipted delivery, by certified or registered mail sent to recipient's last known address, by email to the recipient's email address on file with the District if written consent is granted by the recipient, or by facsimile to the recipient's current facsimile number and shall be accomplished by 5:00 o'clock p.m. (as shown by the clock in the recipient's office) of the date on which it is due. Service by mail is complete upon deposit in a post office or other official depository of the United States Postal Service. Service by facsimile is complete upon transfer, except that any transfer commencing after 5:00 o'clock p.m. (as shown by the clock in the recipient's office) shall be deemed complete the following business day. If service or delivery is by mail, and the recipient has the right to perform some act or is required to perform some act within a prescribed period of time after service, three (3) calendar days will be added to the prescribed period. Where service by other methods has proved unsuccessful, the service shall be complete by such other method as may be approved by the Board. The person or person's attorney shall certify compliance with this rule in writing over signature and on the filed document. A certificate by a person or the person's attorney of record, or the return of an officer, or the affidavit of any person showing service of a document, shall be prima facie evidence of the fact of service.

RULE 4.5 USE OF FORMS

The General Manager will furnish forms and instructions for the preparation of any application, declaration, registration or other document that is required to be filed with the District on a form prepared by the District. The use of such forms is mandatory. Supplements may be attached if there is insufficient space on the form. If supplements are used, the data and information entered therein shall be separated into sections that are numbered to correspond with the numbers of the printed form.

RULE 4.6 MINUTES AND RECORDS OF THE DISTRICT

All official documents, reports, records, and minutes of the District will be available for public inspection and copying in accordance with the Texas Public Information Act.

RULE 4.7 APPLICABILITY; PROCEDURES NOT OTHERWISE PROVIDED FOR

This Section 4 shall apply to all types of hearings conducted by the District to the extent this Section is not inconsistent with any other section of these rules that applies to the type of hearing at issue. If, in connection with any hearing, the Board determines that there are no statutes or other applicable rules resolving particular procedural questions then before the Board, the Board will direct the parties to follow procedures consistent with the purpose of these rules, the District Act, and Chapter 36 of the Texas Water Code.

RULE 4.8 CONTINUANCE

Unless provided otherwise in these Rules, any meeting, workshop, or hearing may be continued from time to time and date to date without published notice after the initial notice, in conformity with the Texas Open Meetings Act.

RULE 4.9 REQUEST FOR RECONSIDERATION

To appeal a decision of the District, including any determinations made by the Board or General Manager, concerning any matter not covered under any other section of these rules, a request for reconsideration may be filed with the District within 20 (twenty) calendar days of the date of the decision. Such request for reconsideration must be in writing and must state clear and concise grounds for the request. The Board will make a decision on the request for reconsideration within 45 (forty-five) calendar days thereafter. The failure of the Board to grant or deny the request for reconsideration within 45 (forty-five) calendar days of the date of filing shall constitute a denial of the request. This rule is not intended to be a prerequisite for a person to exhaust administrative remedies prior to filing suit in court.

SECTION 5. HEARINGS GENERALLY

RULE 5.1 APPLICABILITY

(a) Rulemaking hearings are governed by Section 6 of the District’s rules.

(b) Hearings on the District Management Plan are governed by Section 8 of the District’s rules.

(c) Permit-related hearings and hearings on applications for well-spacing exceptions are governed by Section 11 of the District’s rules.

(d) Hearings to prevent waste, pollution, or degradation of the quality of groundwater under Section 14 of the District’s rules may be conducted under Rule 14.4.

(e) Enforcement hearings are governed by Section 15 of the District’s rules.

(f) Hearings on the Desired Future Conditions, including the appeal process of Desired Future Conditions, are governed by Section 17 of the District’s rules.

(g) All other hearings not described in this rule are governed by Rule 5.2.

RULE 5.2 HEARINGS ON OTHER MATTERS

A public hearing may be held on any matter beyond rulemaking, the District Management Plan, enforcement, and permitting, within the jurisdiction of the District, if the Board deems a hearing to be in the public interest or necessary to effectively carry out the duties and responsibilities of the District. Not less than ten (10) calendar days prior to the date of a public hearing, the Board shall publish notice of the subject matter of the hearing, the time, date, and place of the hearing, in a newspaper of general circulation in the District, in addition to posting the notice in the manner provided by the Texas Open Meetings Act.

SECTION 6. RULEMAKING HEARINGS

RULE 6.1 GENERAL

A rulemaking hearing involves matters of general applicability that implement, interpret, or prescribe the law or District's policy, or that describe the procedure or practice requirements of the District. The District will update its rules to implement the Desired Future Conditions before the first anniversary of the date that the TWDB approves the District Management Plan that has been updated to reflect the adopted Desired Future Conditions.

RULE 6.2 NOTICE AND SCHEDULING OF HEARINGS

(a) For all rulemaking hearings, the notice shall include a brief explanation of the subject matter of the hearing, the time, date, and place of the hearing, location, or Internet site at which a copy of the proposed rules may be reviewed or copied, if the District has a functioning Internet site, and any other information deemed relevant by the General Manager or the Board.

(b) Not less than 20 (twenty) calendar days prior to the date of the hearing, and subject to the notice requirements of the Texas Open Meetings Act the General Manager shall:

  (1) post notice in a place readily accessible to the public at the District Office;

  (2) provide notice to the County Clerk of Pecos County;

  (3) publish notice in one or more newspapers of general circulation in the District;

  (4) provide notice by mail, fax, or email to any person who has requested notice under Subsection (c); and

  (5) make available a copy of all proposed rules at a place accessible to the public during normal business hours, and post an electronic copy on the District's Internet site, if the District has a functioning Internet site.

(c) A person may submit to the District a written request for notice of a rulemaking hearing. A request is effective for the remainder of the calendar year in which the request is received by the District. To receive notice of a rulemaking hearing in a later year, a person must submit a new request. An affidavit of an officer or employee of the District establishing attempted service by first class mail, fax, or email to the person in accordance with the information provided by the person is proof that notice was provided by the District.

(d) Failure to provide notice under Subsection (c) does not invalidate an action taken by the District at a rulemaking hearing.

(e) Any hearing may or may not be scheduled during the District's regular business hours, Monday through Friday of each week, except District holidays. Any hearing may be continued from time to time and date to date without published notice after the initial published notice in conformity with the Texas Open Meetings Act. The District must conduct at least one hearing prior to adopting amendments to the District's rules.

RULE 6.3 RULEMAKING HEARINGS PROCEDURES

(a) General Procedures: The Presiding Officer will conduct the rulemaking hearing in the manner the Presiding Officer deems most appropriate to obtain all relevant information pertaining to the subject of the hearing as conveniently, inexpensively, and expeditiously as possible. In conducting a rulemaking hearing, the Presiding Officer may elect to utilize procedures set forth in these Rules for permit hearings to the extent that and in the manner that the Presiding Officer deems most appropriate for the particular rulemaking hearing. The Presiding Officer will prepare and keep a record of the rulemaking hearing in the form of an audio or video recording or a court reporter transcription at his or her discretion.

(b) Submission of Documents: Any interested person may submit written statements, protests, or comments, briefs, affidavits, exhibits, technical reports, or other documents relating to the subject of the hearing. Such documents must be submitted no later than the time of the hearing, as stated in the notice of hearing; provided, however, the Presiding Officer may grant additional time for the submission of documents.

(c) Oral Presentations: Any person desiring to testify on the subject of the hearing must so indicate on the registration form provided at the hearing. The Presiding Officer establishes the order of testimony and may limit the number of times a person may speak, the time period for oral presentations, and the time period for raising questions. In addition, the Presiding Officer may limit or exclude cumulative, irrelevant, or unduly repetitious presentations.

(d) Conclusion of the hearing: At the conclusion of the hearing, the Board may take action on the subject matter of the hearing, take no action, or postpone action until a future meeting or hearing of the Board. When adopting, amending, or repealing any rule, the District shall:

(1) consider all groundwater uses and needs;
(2) develop rules that are fair and impartial;
(3) consider the groundwater ownership and rights described by Section 36.002, Texas Water Code;
(4) consider the public interest in conservation, preservation, protection, recharging, and prevention of waste of groundwater, and of groundwater reservoirs or their subdivisions, and in controlling subsidence caused by withdrawal of groundwater

reservoirs or their subdivision, consistent with the objectives of Section 59, Article XVI, Texas Constitution;

(5) consider the goals developed as part of the District Management Plan under Section 36.1071, Texas Water Code; and

(6) not discriminate between land that is irrigated for production and land that was irrigated for production and enrolled or participating in a federal conservation program.

(e) Hearing Registration Form: A person participating in a rulemaking hearing shall complete a hearing registration form stating the person's name, address, and whom the person represents, if applicable.

RULE 6.4 CONDUCT AND DECORUM

Every person, party, representative, witness, and other participant in a proceeding must conform to ethical standards of conduct and must exhibit courtesy and respect for all other participants. No person may engage in any activity during a proceeding that interferes with the orderly conduct of District business. If in the judgment of the Presiding Officer, a person is acting in violation of this provision, the Presiding Officer will first warn the person to refrain from engaging in such conduct. Upon further violation by the same person, the Presiding Officer may exclude that person from the proceeding for such time and under such conditions as the Presiding Officer deems necessary.

RULE 6.5 PETITION TO MODIFY OR ADOPT DISTRICT RULE

(a) A person with a real property interest in groundwater located within the District's jurisdictional boundaries may file a petition with the District to request the adoption or modification of a rule.

(b) Petitions under this rule must be submitted in writing on the Petition to Adopt or Modify Rules Form appended to these rules to the District office and must comply with the following requirements:

(1) A separate petition must be filed for each general topic proposed to be addressed by a rule modification or change;

(2) Each petition must be signed and state the full name of each person signing the petition and the person's contact information, including phone number, physical address, mailing address, and email address, if any;

(3) Each petition must include:

(A) proof that the person submitting the petition has a real property interest in groundwater located within the District's jurisdictional boundaries;

(B) a written explanation of the proposed rule or rule modification's intended purpose;

(C) the text of the proposed rule prepared in a manner to indicate the words to be added or deleted from the text of the current rule, if any; and

(D) an allegation of injury or inequity that could result from the failure to adopt the proposed rule.

(c) If a person is unable to comply with any procedures required under this rule, then the person must submit to the District, on the same day that the person submits a petition under this rule, a written explanation as to why compliance with the required procedure(s) is not possible and must submit a written request that the Board waive the specific procedure(s) at issue. Upon receipt of a written explanation and request as described herein, the Board may, at its sole discretion, waive any procedure set forth under this rule. A petition may be denied for failure to comply with the requirements under this rule.

(d) The District will provide notice of the Board's consideration of and action on a petition in accordance with District Rule 6.2 at least 20 (twenty) calendar days prior to the date of the hearing.

(e) Any person with a real property interest in groundwater located within the District may provide written public comment on the petition to the District. It is strongly encouraged that written comment be provided at least seven (7) calendar days before the petition is to be considered at a publicly noticed Board meeting.

(f) Notice of the Board's consideration of and action on a petition shall be included on a Board agenda with three (3) calendar days' notice compliant with the Texas Open Meetings Act.

(g) Any person desiring to testify on a petition during a hearing must so indicate on the registration form provided at the hearing. The presiding officer establishes the order of testimony and may limit the number of times a person may speak, and the time period for oral presentations. In addition, the Presiding Officer may limit or exclude questions and cumulative, irrelevant, or unduly repetitious presentations.

(h) Within 90 (ninety) calendar days after submission of a petition that complies with this rule, the Board shall consider the petition at a Board meeting and either:

(1) grant the petition in part or in its entirety and initiate rulemaking proceedings on the subject matter identified in the granted petition in accordance with the rulemaking procedure set forth in these rules; or

(2) deny the petition in part or in its entirety and provide an explanation for denial in the minutes of the Board meeting or in a separate written statement to be kept in the District's records.

(i) Nothing in this rule may be construed to create a private cause of action for a decision to accept or deny a petition filed under this rule.

SECTION 7. EMERGENCY RULES AND ORDERS

RULE 7.1 EMERGENCY RULES

The Board may adopt an emergency rule without prior notice and/or hearing if the Board finds that a substantial likelihood of imminent peril to the public health, safety, or welfare, or a requirement of state or federal law, requires adoption of a rule on less than 20 (twenty) calendar days' notice. The Board shall prepare a written statement of the reasons for this finding. An emergency rule adopted shall be effective for not more than 90 (ninety) calendar days after its adoption by the Board. The Board may extend the 90-day period for an additional 90 (ninety) calendar days if notice of a hearing on the final rule is given not later than the 90th calendar day after the date the rules is adopted. An emergency rule adopted without notice and/or a hearing must be adopted at a meeting conducted under Chapter 551, Texas Government Code.

RULE 7.2 EMERGENCY ORDER AUTHORIZING TEMPORARY PRODUCTION FOR DEMONSTRATED EMERGENCY NEED

(a) A person can request in writing that the District issue an emergency order authorizing the production of groundwater for a beneficial use without a permit for a temporary period of time during which the person can submit a Production Permit application. This request must be in writing and include sufficient factual detail of the emergency situation; the quantity of groundwater needed (in gallons or acre feet); the proposed source of the groundwater (identify the aquifer); the specific location of the well from which the groundwater will be produced; and the period of time proposed for the requested emergency authorization. This request must be submitted to the District's office by any means that ensures receipt by the District.

(b) Upon receipt and consideration of the written request for an emergency order under this rule, the District's Board President or General Manager may issue an emergency order partially or fully granting the request. An order issued under this rule will provide a time limit during which it is effective, which may not exceed 75 (seventy-five) calendar days.

(c) Upon issuance of an order under this rule, the requestor is not required to hold a permit but must use its best efforts to prepare and submit a Production Permit application. The beneficiary of the emergency order authorization must submit a Production Permit application to the District within 20 (twenty) calendar days of issuance of the emergency order. If a Production Permit application is timely submitted under this subsection, then it is within the discretion of the District's Board President or General Manager to extend the 75-day timeframe of the emergency order while the application is pending.

(d) If neither the District's Board President nor General Manager issues an order under this rule after reviewing the request, the requestor's remedy is to submit a Production Permit application.

(e) If an emergency order is issued, the District's Board must be notified of the circumstances and relief granted at the District's next Board meeting.

RULE 7.3 EMERGENCY PERMIT AMENDMENT

If an emergency water need is demonstrated to the Board, the Board may amend a Production Permit or Historic or Existing Use Permit to authorize production from one or more additional wells owned or operated by the permit holder to provide flexibility to the entity with the emergency water need as long as the amendment is consistent with Rule 11.1(b). A hearing is not required under this rule. The Board may take action under this rule at a meeting for which notice has been provided in accordance with the Texas Open Meetings Act.

SECTION 8. DISTRICT MANAGEMENT PLAN

RULE 8.1 ADOPTION OF A MANAGEMENT PLAN

The Board shall adopt a Management Plan that specifies the acts, procedures, performance and avoidance necessary to minimize as far as practicable the drawdown of the water table or the reduction of artesian pressure, to prevent interference between wells, to prevent degradation of water quality, to prevent waste, and to avoid impairment of Desired Future Conditions. The District shall use the District's rules to implement the Management Plan.

RULE 8.2 AMENDMENT

The Board will review and readopt or amend the plan at least every fifth year after its last approval by TWDB. The District will amend its plan to address goals and objectives consistent with achieving the Desired Future Conditions within two years of the adoption of the Desired Future Conditions by the Groundwater Management Area.

RULE 8.3 EFFECTIVE DATE

The Management Plan and any amendments thereto take effect on approval by the TWDB's Executive Administrator or, if appealed, on approval by the TWDB. Approval of the Management Plan remains in effect until the District fails to timely readopt a Management Plan, the District fails to timely submit the District's readopted Management Plan to the TWDB's Executive Administrator, or the TWDB's Executive Administrator determines that the readopted Management Plan does not meet the requirements for approval, and the District has exhausted all appeals to the TWDB or appropriate court.

RULE 8.4 NOTICE

(a) The notice of a hearing on any adoption or amendment of the Management Plan shall include the time, date, and place of the hearing, location or Internet site at which a copy of the proposed plan may be reviewed or copied, if the District has a functioning Internet site, and any other information deemed relevant by the General Manager or the Board.

(b) Not less than ten (10) calendar days prior to the date of the hearing, and subject to the notice requirements of the Texas Open Meetings Act, the General Manager shall:

(1) post notice in a place readily accessible to the public at the District Office;
(2) provide notice to the county clerk of Pecos County; and
(3) make available a copy of the proposed plan at a place accessible to the public during normal business hours, and post an electronic copy on the District's Internet site, if the District has a functioning Internet site.

(c) Any hearing may or may not be scheduled during the District's regular business hours, Monday through Friday of each week, except District holidays. Any hearing may be continued from time to time and date to date without notice after the initial notice, in compliance with the Texas Open Meetings Act. The District must conduct at least one hearing prior to adopting the plan or any amendments to the plan.

RULE 8.5 HEARING PROCEDURES

(a) General Procedures: The Presiding Officer will conduct the hearing in the manner the Presiding Officer deems most appropriate to obtain all relevant information pertaining to the subject of the hearing as conveniently, inexpensively, and expeditiously as possible. The Presiding Officer will prepare and keep a record of the hearing in the form of an audio or video recording or a court reporter transcription at his or her discretion.

(b) Submission of Documents: Any interested person may submit written statements, protests, or comments, briefs, affidavits, exhibits, technical reports, or other documents relating to the subject of the hearing. Such documents must be submitted no later than the time of the hearing, as stated in the notice of hearing; provided, however, the Presiding Officer may grant additional time for the submission of documents.

(c) Oral Presentations: Any person desiring to testify on the subject of the hearing must so indicate on the registration form provided at the hearing. The Presiding Officer establishes the order of testimony and may limit the number of times a person may speak, the time period for oral presentations, and the time period for raising questions. In addition, the Presiding Officer may limit or exclude cumulative, irrelevant, or unduly repetitious presentations.

(d) Conclusion of the hearing: At the conclusion of the hearing, the Board may take action on the subject matter of the hearing, take no action, or postpone action until a future meeting or hearing of the Board. When adopting, amending, or repealing the Management Plan, the District shall:

(1) use the District's best available data and groundwater availability modeling information provided by the TWDB's Executive Administrator together with any available site-specific information that has been provided by the District to the TWDB's Executive Administrator for review and comment before being used in the plan;
(2) address the management goals set forth in Section 36.1071, Texas Water Code; and
(3) use and address objectives consistent with achieving the Desired Future Conditions as adopted during the joint planning process.

(e) Hearing Registration Form: A person participating in a hearing on the Management Plan shall complete a hearing registration form stating the person's name, address, and whom the person represents, if applicable.

SECTION 9. WATER WELL REGISTRATION

RULE 9.1 REGISTRATION

All water wells, existing and new, exempt and nonexempt, must be registered with the District and are required to comply with the District's registration requirements in these rules.

RULE 9.2 GENERAL REGISTRATION POLICIES AND PROCEDURES

9.2.1 Each person who intends to drill, equip, modify, complete, operate, change type of use, plug, abandon, or alter the size of a well within the District must complete and submit to the District the District's Notice of Intent to Drill a New Well (Notice of Intent), registration or permit application form, as applicable, even though the well may be exempt from the requirement of a permit under District Rule 11.3.

9.2.2 Pre-registration: For all proposed new exempt and nonexempt wells, the owner of the proposed new well, or the well operator or any other person acting on behalf of the owner of the proposed new well must file a Notice of Intent prior to drilling the proposed new well. If it is believed by the person filing the Notice of Intent that the proposed new well will be exempt under District Rule 11.3, then the Notice of Intent must reflect the basis for the exemption, and must be approved by the District prior to drilling the new well. Within five (5) calendar days from receipt of a Notice of Intent, the District's General Manager shall (1) determine whether the well is exempt under the District's rules, (2) complete the District Use Only section at the end of the Notice of Intent indicating whether the well is exempt, and (3) return a copy of the completed Notice of Intent by facsimile or mail to the address(es) and facsimile number(s) set forth in the Notice of Intent. If the District's determination is that the well is exempt, drilling may begin immediately upon receiving the approved Notice of Intent. The drilling of a new exempt well is subject to the rules of the District. Upon completion of the new exempt well, a registration form must be completed and filed. If the District's determination is that the well is nonexempt, a Drilling Permit application must be filed and approved by the District before drilling may begin.

9.2.3 Registration: All wells must be registered. Existing nonexempt and exempt wells shall be registered immediately. New nonexempt wells shall be registered immediately upon completion pursuant to a Drilling Permit. New exempt wells shall be registered immediately upon completion pursuant to an approved pre-registration.

9.2.4 Re-registration: If the owner or operator of a registered well plans to change the type of use of the groundwater, increase the withdrawal rate, or substantially alter the size of the well or well pump in a manner that does not require a permit, the well must be re-registered on a new registration form.

9.2.5 In the event of an emergency during the drilling of a new exempt well or with an existing well, as defined by the well driller or well service operator, as applicable, an exempt well may be reworked prior to re-registration. The registration requirement will be waived for a 48-hour period.

9.2.6 Term: A registration certificate is perpetual in nature, subject to cancellation for violation of these Rules.

9.2.7 Transfer of Registration: Upon submission to the District of written notice of transfer of ownership or control of any water right or water well covered by a registration and documents evidencing the transfer, the District's General Manager will amend the well registration to reflect the new owner(s).

SECTION 10. PRODUCTION LIMITATIONS

RULE 10.1 HISTORIC AND EXISTING USE PERMITS

The District shall designate the quantity of groundwater that may be produced on an annual basis in each Historic and Existing Use Permit issued by the District, and each permit shall be subject to the conditions of the District Act, Chapter 36 of the Texas Water Code, and these rules, provided, however, that the quantity that may be withdrawn shall not exceed the Maximum Historic and Existing Use demonstrated by the applicant, and determined by the Board, except as that designated quantity of groundwater may be reduced if the District imposes restrictions under these rules and/or permit conditions, or consistent with a Demand Management Plan developed under Rule 10.3(b).

RULE 10.2 PRODUCTION PERMITS

The District shall designate the quantity of groundwater that may be produced on an annual basis under a Production Permit pursuant to the conditions of the District Act, Chapter 36 of the Texas Water Code, and these rules, provided, however, that the quantity shall not exceed an amount demonstrated by the applicant and determined by the Board to be necessary for beneficial use throughout the permit term, except as may be reduced if the District imposes restrictions under these rules and/or permit conditions, or consistent with a Demand Management Plan developed under Rule 10.3(b).

RULE 10.3 AQUIFER-BASED PRODUCTION LIMITS

(a) The District may limit the total amount of authorized annual production and maximum annual rate of groundwater withdrawal for any aquifer within the District as the District determines to be necessary based upon the best available hydrogeologic, geographic, and other relevant scientific data, including but not limited to noted changes in the water levels, water quality, groundwater withdrawals, annual recharge, or the loss of stored water in the aquifer, to avoid impairment of any Desired Future Condition. The District may also develop, utilize, and/or adopt groundwater availability models in support of the District's management of the groundwater within its jurisdiction. The District may establish a series of index or monitoring wells to aid in this determination.

(b) The District will continue to study what aquifer conditions may indicate that proportional adjustment reductions to the amount of permitted production of groundwater are necessary to avoid impairment of the Desired Future Conditions of any of the various aquifers within the District. The District will also continue to study what quantity of proportional adjustment reductions to the amount of permitted production of groundwater are necessary to avoid impairment of the Desired Future Conditions of any of the various aquifers within the District. The Board will consider the findings of the District regarding actions necessary to avoid impairment of the Desired Future Conditions of any of the various aquifers within the District, and may adopt, after appropriate rulemaking notice and hearing, an aquifer-specific Demand Management Plan setting forth a schedule of the actions that may be necessary to avoid impairment of the Desired Future Conditions of any of the various aquifers within the District.

(c) The Board has the right to modify a permit if data from monitoring wells within the source aquifer or other evidence reflects conditions such as but not limited to an unacceptable level of decline in water quality of the aquifer, or as may be necessary to prevent waste and achieve water conservation, minimize as far as practicable the drawdown of the water table or the reduction of artesian pressure, lessen interference between wells, or control and prevent subsidence, or to avoid impairment of the Desired Future Conditions of any of the various aquifers within the District. If the Board has an interest in modifying a permit under this rule, it must provide notice and an opportunity for hearing pursuant to Section 11 of the District's rules.

(d) Upon adoption of Desired Future Conditions and setting of the Modeled Available Groundwater numbers for any aquifer or its subdivisions in the District, the District shall, to the extent possible, issue permits up to the point that the total volume of exempt and permitted groundwater production will achieve an applicable Desired Future Condition for each such aquifer or its subdivision in the District. If the total amount of production within an aquifer, or its subdivision, as applicable, is less than the total volume of exempt and permitted groundwater production that will achieve an applicable Desired Future Condition for that aquifer, production amounts authorized under Historic and Existing Use and Production Permits may remain the same or be increased, as set forth under these rules. As determined by the District, if the total amount of production within an aquifer exceeds the Modeled Available Groundwater set for an aquifer, production amounts may be decreased proportionally among all permit holders producing from that aquifer, if necessary to avoid impairment of the Desired Future Condition. Any necessary reductions will first be applied to Production Permits, and, subsequently, if production still exceeds the Modeled Available Groundwater set for an aquifer after reducing Production Permits in their entirety, to Historic and Existing Use Permits, as set forth under Rule 10.4.

RULE 10.4 PROPORTIONAL ADJUSTMENT

(a) When establishing proportional adjustment restrictions, the Board shall first set aside an amount of groundwater equal to an estimate of total exempt use.

(b) After setting aside an amount of groundwater for exempt use, to the extent of remaining groundwater availability, the Board shall allocate groundwater to Historic and Existing Use Permits according to the permitted Maximum Historic and Existing Use in each. If there is insufficient groundwater availability to allow withdrawal under all Historic and Existing Use Permits, the Board shall allocate the groundwater availability first to the Historic and Existing Permits in an amount up to the Eligible Recharge Credit, on a pro rata basis relative to all other Historic and Existing Permits. The Eligible Recharge Credit shall mean 30% of the permitted Maximum Historic and Existing Use that is designated for and previously put to irrigation use in each Historic and Existing Use Permit. The groundwater authorized for withdrawal pursuant to an Eligible Recharge Credit must be withdrawn from the same aquifer that has been recharged with groundwater allocated under the respective permit or application. The remaining groundwater availability shall then be allocated among the Historic and Existing Use Permits up to an amount authorized under each permit on an equal percentage basis until total authorized production equals groundwater availability for a particular aquifer district-wide or within a management zone, if applicable. The Eligible Recharge Credit shall be applied in such a manner that the irrigation user's Existing and Historic Use Permit shall not be proportionally reduced to the extent of the Eligible Recharge Credit. The only basis for proportionately reducing the Eligible Recharge Credit shall be in the event that 100% of the non-recharge credit portion of the Historic and Existing Use Permit allotments has been reduced. If it can be demonstrated and the Board takes official action to determine that the irrigation recharge is more or less than 30%, then the Eligible Recharge Credit may be adjusted by subsequent rulemaking. No groundwater shall be authorized for production under Production Permits if there is insufficient water availability to satisfy all Historic and Existing Use Permits and exempt use, subject to Subsection (e) of this rule. The Eligible Recharge Credit for irrigation use under a Production Permit shall not be applied where there is equal to or less than enough groundwater to satisfy all Historic and Existing Use Permits and exempt use.

(c) If there is sufficient groundwater to satisfy all Historic and Existing Use Permits and exempt use, the Board shall then allocate remaining water availability first to the existing Production Permit holders in an amount equal to their Eligible Recharge Credit, on a pro rata basis relative to all other Production Permits. The Eligible Recharge Credit shall mean 30% of the groundwater allocated under each Production Permit that is designated for and previously put to irrigation use. The groundwater authorized for withdrawal pursuant to an Eligible Recharge Credit must be withdrawn from the same aquifer that has been recharged with groundwater allocated under the respective Production Permit. The remaining groundwater availability shall then be allocated among the Production Permits up to an amount authorized under each permit on an equal percentage basis until total authorized production equals groundwater availability for a particular aquifer district-wide or within a management zone, if applicable. The recharge credit shall be applied in such a manner that the irrigation user's Production Permit shall not be proportionally reduced to the extent of the recharge credit. The only occasion for proportionately reducing the Eligible Recharge Credit shall be in the event that 100% of the non-recharge credit portion of the Production Permit allotments has been reduced, and there is only sufficient groundwater availability to supply exempt use and Historic and Existing Use. If it can be demonstrated and the Board takes official action to determine that the irrigation recharge is more or less than 30%, then the recharge credit shall be adjusted accordingly. No groundwater may be authorized for production under new Production Permits if there is insufficient groundwater availability to satisfy all existing Production Permits, subject to Subsection (e) of this rule.

(d) If there is sufficient groundwater to satisfy all Historic and Existing Use Permits, exempt use, and existing Production Permits, the Board may then allocate remaining groundwater availability to applications for new or amended Production Permits approved by the District.

(e) When establishing proportional adjustment restrictions that contemplate the reduction of authorized production or a prohibition on authorization for new or increased production, the Board may also choose to proportionately reduce any existing Production Permits on a pro rata basis, excluding the authorized Eligible Recharge Credit, in order to make groundwater available for new applications for Production Permits and may allocate to each surface acre a designated amount of groundwater. In doing so, the Board may elect to allocate more water to surface acreage recognized under existing Production Permits than to surface acreage associated with applications for new Production Permits.

RULE 10.5 MANAGEMENT ZONES

(a) As set forth in the District Management Plan and illustrated in Figures 1 through 4 below, and in furtherance of the purposes set forth in Section 36.116(d) of the Texas Water Code, the following management zones are established within the principal areas of irrigation and other beneficial uses of groundwater and pertinent surrounding areas of Pecos County:

(1) Management Zone 1 – Leon-Belding Irrigation Area and Vicinity of City of Fort Stockton to include outlets of Comanche Springs;

(2) Management Zone 2 – Bakersfield Irrigation Area; and

(3) Management Zone 3 – Coyanosa Irrigation Area.

The delineation of each Management Zone is based upon relevant model grid cells and associated data on file with the District and accessible to the public.

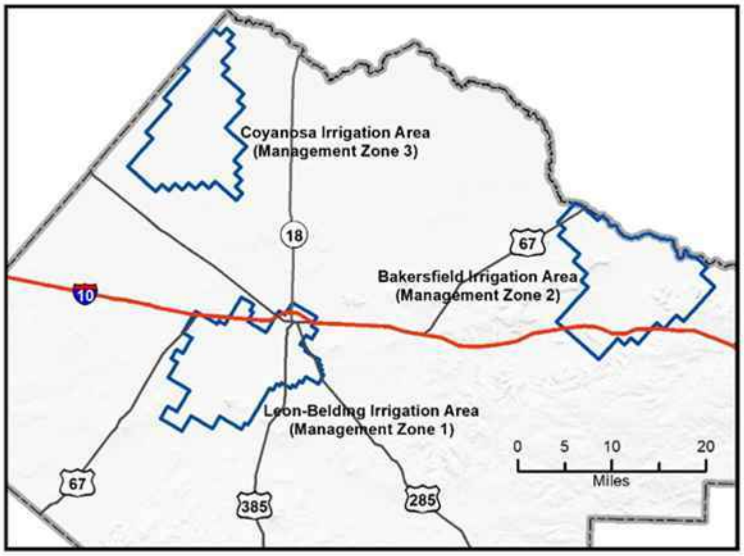

Figure 1, District Designated Management Zones

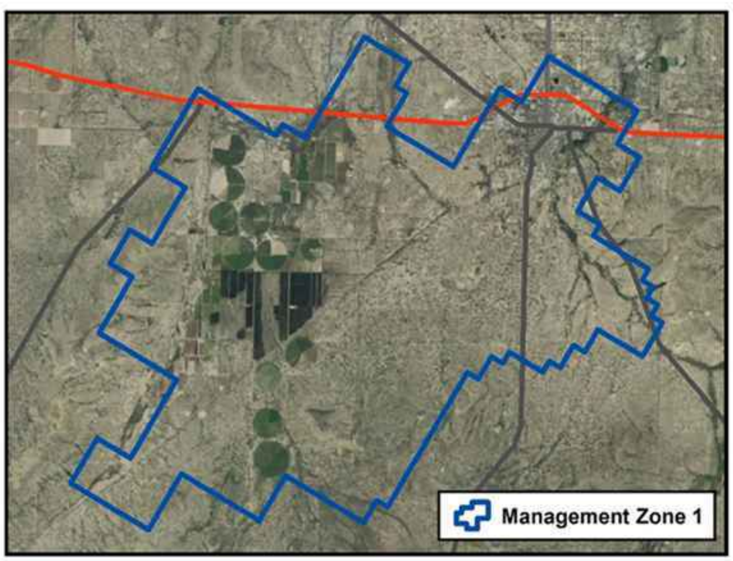

Figure 2, District Management Zone 1

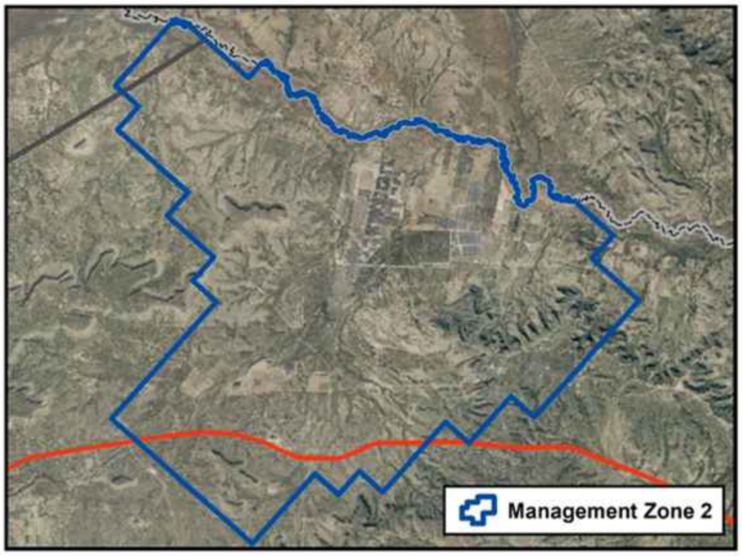

Figure 3, District Management Zone 2

Figure 4, District Management Zone 3

(b) The District shall establish benchmarks of sustainable groundwater use over time to avoid impairment of the Desired Future Condition of each of the aquifers within each management zone, and will re-establish benchmarks from time to time as necessary to be consistent with such Desired Future Conditions. The benchmarks of sustainable groundwater use are threshold amounts of acceptable drawdown over time. The threshold amounts of acceptable drawdown are the average predicted drawdown values over time for each management zone predicted in Scenarios 10 and 11 of TWDB GAM-Run 09-35, Version 2, used to establish the DFCs for the Edwards-Trinity (Plateau) and Pecos Valley aquifers in the District. The predicted drawdown values over time for Management Zones 1 and 2, located in the GMA-7 portion of the District, are from Scenario 10. The predicted drawdown values over time for Management Zone 3, located in the GMA-3 portion of the

District, are from Scenario 11. The threshold amounts of acceptable drawdown over time for each management zone are as presented in TWDB GAM Task Report 10-033, which presents more detailed information on Pecos County than otherwise available in but consistent with Scenarios 10 and 11 of TWDB GAM-Run 09-35. The threshold amounts of acceptable drawdown over time for each management zone are as follows:

Year	Management Zone-1 Average Draw-Down (in feet, rounded to nearest foot)	Management Zone-2 Average Draw-Down (in feet, rounded to nearest foot)	Management Zone-3 Average Draw-Down (in feet, rounded to nearest foot)
2015	3	1	2
2020	7	2	4
2025	10	2	5
2030	13	2	7
2035	17	2	8
2040	20	3	9
2045	23	3	11
2050	26	3	12
2055	29	3	13
2060	32	3	15

Table 1, Example Predictive Average Drawdown Values over Time in Edwards-Trinity (Plateau) and Pecos Valley Aquifers for MPGCD Management Zones from TWDB GAM Task Report 10-033.

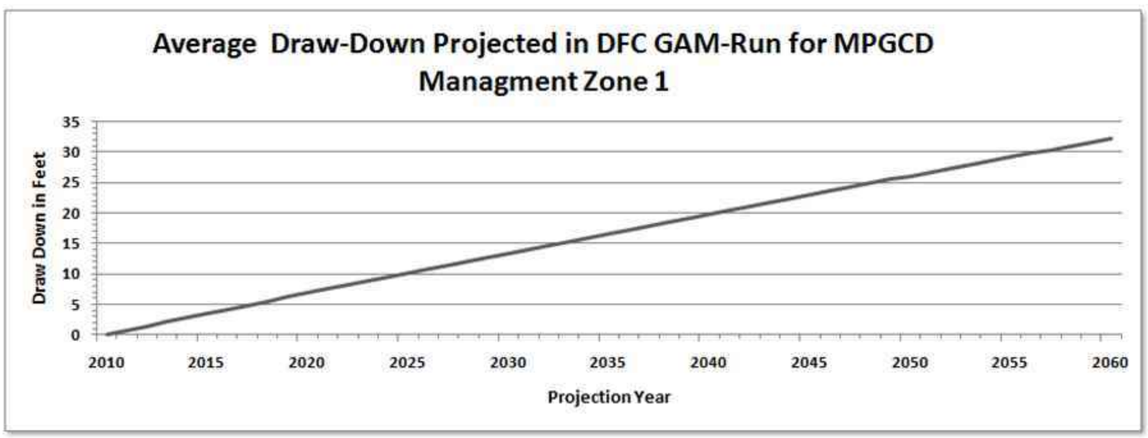

Figure 5, Chart of Predictive Average Drawdown Values over Time in Edwards-Trinity (Plateau) and Pecos Valley Aquifers for MPGCD Management Zone 1 from TWDB GAM Task Report 10-033.

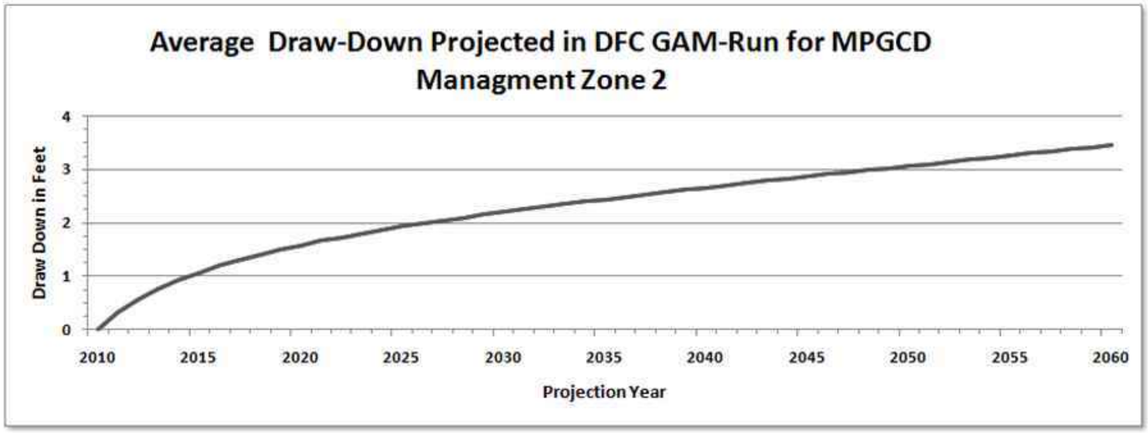

Figure 6, Chart of Predictive Average Drawdown Values over Time in Edwards-Trinity (Plateau) and Pecos Valley Aquifers for MPGCD Management Zone 2 from TWDB GAM Task Report 10-033.

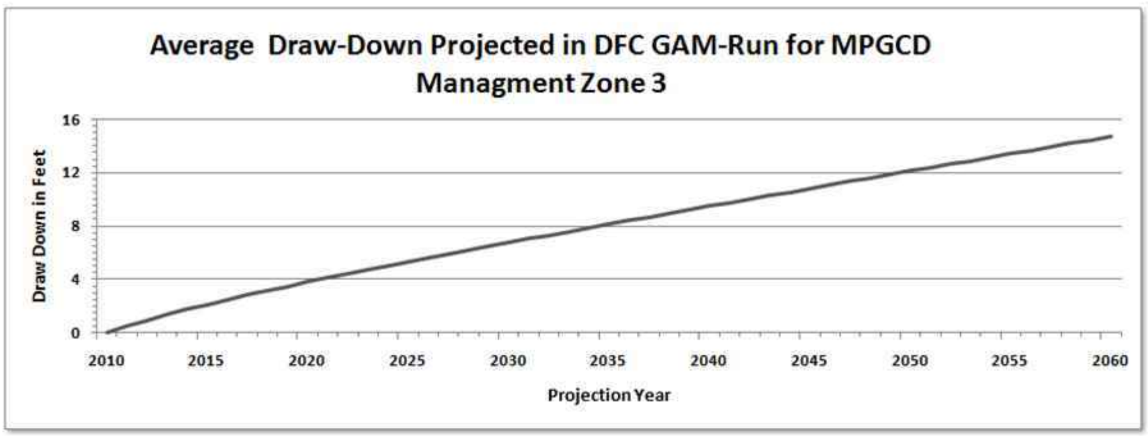

Figure 7, Chart of Predictive Average Drawdown Values over Time in Edwards-Trinity (Plateau) and Pecos Valley Aquifers for MPGCD Management Zone 3 from TWDB GAM Task Report 10-033.

(c) At least every five years, the District will assess the amount of average drawdown realized in each of the management Zones established by the District. The District will compare the amount of realized drawdown in each Management Zone to the time-appropriate threshold of acceptable drawdown in order to determine whether the amount of groundwater use occurring in the Management Zone appears likely to impair the DFC. The District may elect to assess the aquifer drawdown realized in any Management Zone and compare the realized drawdown to the time-appropriate threshold of acceptable drawdown as often as necessary to effectively manage groundwater use and insure the aquifer DFCs are not impaired. The Board may authorize the General Manager to determine whether a comparison of realized drawdown to the threshold of acceptable drawdown is needed for any Management Zone.

(d) The District recognizes that, as of the date of these Rules, the majority of groundwater used the Management Zones is for agricultural irrigation involving widespread intensive seasonal use of groundwater followed by a general cessation of use by the majority of users in the Management Zones. The District further recognizes that after the general cessation of use the aquifer recovers from the effects of the previous intensive seasonal use to reach a point of maximum water-level recovery prior to initiation of the succeeding intensive-use season. The District also recognizes that the threshold of acceptable drawdown values generally represent the year-end maximum recovered water level of the aquifer in the Management Zones for the referenced year. However, the actual date of the maximum recovery of the aquifer water levels in the Management Zone may occur anytime from the month of November of a given calendar year through the month of February of the following year.

(e) To facilitate the comparison of realized drawdown to the thresholds of acceptable drawdown over time in the Management Zones the District will use the following procedures or actions:

(1) Establish several monitor wells in and around each Management Zone for the purpose of observing and quantifying the amount of aquifer drawdown realized over time in each Management Zone;
(2) Develop maps of maximum water-level recovery conditions for year 2010 following procedures in this subsection below;
(3) On or before February 25, 2013, adopt after notice and hearing, the maps of 2010 Management Zone water levels as the 2010 benchmarks for future comparisons of water levels under these rules;
(4) Observe the recovery of aquifer water levels as represented by the monitor wells after the intensive-use season to determine the apparent point of maximum water-level recovery in the Management Zone;
(5) In observing the recovering water levels in the monitor wells of a Management Zone, the District may determine that the apparent point of maximum water-level recovery from the season of intensive use in any given year occurs on a date through the month of February of the succeeding year;
(6) Compile the water-level data, of the Management Zone for the year in which the comparison is to be made;
(7) Determine the water-level drawdown from the established year 2010 conditions for the centroid of each grid-cell of the TWDB Edwards-Trinity (Plateau) / Pecos Valley Aquifer GAM located in the Management Zone area from the water-level contour map;
(8) Calculate the average drawdown of aquifer water levels for the year in which the comparison is to be made in each Management Zone using the set of GAM grid-cell centroid drawdown values for that year;
(9) Compare the calculated average water-level drawdown value for the Management Zone to the DFC-based threshold of acceptable drawdown for the year in which the comparison is to be made, taking into consideration how the distribution of monitoring wells and the amount of pumping known or estimated to be occurring within a Management Zone may affect comparison with the results of TWDB GAM Task Report 10-033 used to establish the thresholds of acceptable drawdown; and
(10) Adopt, after notice and hearing, maps of water levels of all the aquifers, which were not addressed in subsection (3) above, as benchmarks for future comparisons of water levels under these rules.

(f) The Board may, after appropriate rulemaking notice and hearing, establish proportional adjustment reductions based upon the availability of groundwater, benchmarks of sustainable groundwater use over time, and/or degradation of water quality that could result from declining water levels if the Board determines reductions are required to conform with these rules. Upon adoption of a Desired Future Condition and setting of Modeled Available Groundwater for an aquifer within the District, the District shall ensure that the groundwater available for production within a management zone or among management zones designated for that aquifer does not impair the Desired Future Condition and is consistent with the Modeled Available Groundwater for that aquifer within the District. Restrictions within a certain management zone will be uniformly applied within that management zone.

(g) As determined by the District, if the total amount of production within a management zone causes the benchmark of sustainable use within the management zone to be impaired, production amounts authorized under Historic and Existing Use and Production Permits may be decreased within a management zone.

RULE 10.6 LIMIT SPECIFIED IN PERMIT

The maximum annual quantity of groundwater that may be withdrawn under a Historic and Existing Use Permit or Production Permit issued by the District shall be no greater than the amount specified in the permit or the amended permit unless the District makes a determination under Section 10 to increase or decrease the authorized amount of withdrawal. Permits may be issued subject to conditions and restrictions placed on the rate and amount of withdrawal pursuant to the District's rules and permit terms necessary to prevent waste and achieve water conservation, minimize as far as practicable the drawdown of the water table or the reduction of artesian pressure, lessen interference between wells, or control and prevent subsidence. The permit holder, by accepting the permit, agrees to abide by any and all groundwater withdrawal regulations established by the District that are currently in place, as well as any and all regulations established by the District in the future. Acceptance of the permit by the person to whom it is issued constitutes acknowledgment of and agreement to comply with all of the terms, provisions, conditions, limitations, and restrictions.

In addition to any special provisions or other requirements incorporated into the permit, each permit is subject to the following standard permit provisions:

(a) This permit is granted in accordance with the provisions of the rules of the District, and acceptance of this permit constitutes an acknowledgment and agreement that the permit holder will comply with the rules of the District.

(b) The permit terms may be modified or amended pursuant to the provisions of the District's rules or to comply with statutory requirements.

(c) The operation of the well for the authorized withdrawal must be conducted in a non-wasteful manner.

(d) Withdrawals from all nonexempt wells must be accurately measured either by meter or District-approved alternative measuring method, in accordance with the District's rules. The owner or operator of all permitted wells must file an annual pumpage report with the District.

If the well is metered, the meter readings must be attached to the annual pumpage report filed with the District. Wells that are drilled, completed, or equipped so that they are incapable of producing more than 25,000 gallons per day are not required to have a meter or report annual production if used for domestic purposes or for watering livestock or poultry.

(e) The General Manager or Board may, after notice and hearing consistent with permitting hearings governed by Section 11, reduce the quantity of groundwater authorized under a production permit if the applicant has not demonstrated that the water allocated has been withdrawn and put to beneficial use for the purpose and in the amount described in the permit for at least one calendar year during the first three full calendar years following issuance of the permit. The applicant has the burden of proof to demonstrate that the groundwater allocated has been withdrawn and put to beneficial use for the purpose and in the amount described in the permit. No parties other than the permit holder and General Manager may be named as parties in the hearing. The District shall provide written notice of this hearing by certified mail (return receipt requested), hand delivery, first class mail, fax, email, FedEx, UPS, or any other type of public or private courier or delivery service. If the District is unable to provide notice to the permit holder by any of these forms of notice, the District may tape the notice on the door of the permit holder's office or home, or post notice in the newspaper of general circulation in the District and within the county in which the alleged violator resides or in which the alleged violator's office is located.

(f) The well site must be accessible to District representatives for inspection, and the permit holder agrees to cooperate fully in any reasonable inspection of the well and well site by the District representatives.

(g) The application pursuant to which this permit has been issued is incorporated in the permit, and the permit is granted on the basis of, and contingent upon, the accuracy of the information supplied in that application. A finding that false information has been supplied is grounds for immediate revocation of the permit.

(h) Violation of a permit's terms, conditions, requirements, or special provisions is punishable by civil penalties as provided by the District's rules.

(i) The permit may also contain provisions relating to the means and methods of export outside the District of groundwater produced within the District.

RULE 10.7 MEASURING AND REPORTING GROUNDWATER WITHDRAWALS

(a) Nonexempt wells: Every owner or operator of a nonexempt Water Well is responsible for measuring withdrawals from each Water Well either by a District-approved meter or alternative measuring method. Meters must be selected and installed in accordance with the District General Manager's specifications and approval, at the well owner's cost. Meters are not required to be installed on nonexempt wells that are drilled, completed, or equipped so that they are incapable of producing more than 25,000 gallons per day, as long as an alternative measuring method approved by the District is used to record and report groundwater production from this type of well.

(b) Alternative measuring method: The District may authorize the use of an alternative measuring method in lieu of a meter if it can be demonstrated by the well owner that the alternative measuring method is capable of accurate measurement of groundwater withdrawal. The owner of a nonexempt well must secure the District General Manager's approval of an alternative measuring method of determining the amount of groundwater withdrawn. The District General Manager may authorize the alternative measuring method if the applicant well owner demonstrates that the alternative measuring method can accurately measure the groundwater withdrawn. Reporting shall still be required by an owner or operator of a well who is using a District-approved alternative measuring method. A report reflecting annual withdrawals, on a calendar-year basis, shall be provided by any means approved by the General Manager, or more frequently, if requested by the General Manager.

(c) Exempt wells:

(1) An entity holding a permit issued by the Railroad Commission of Texas under Chapter 134, Texas Natural Resources Code, that authorizes the drilling of a water well, shall report monthly to the District:

(A) the total amount of water withdrawn during the month;
(B) the quantity of water necessary for mining activities; and
(C) the quantity of water withdrawn for other purposes.

(2) A report reflecting the total amount of water withdrawn each month from a well exempt under District Rule 11.3(a)(2) must be submitted to the District by the owner or operator. The owner and the operator of such a well may coordinate to determine the amount of monthly withdrawals and to submit this report. However, both the owner and operator of such a well are responsible for ensuring that the withdrawals are determined and that the report is submitted to the District.

(3) The groundwater production from wells subject to reporting under this Subsection (c) must be measured by meter or alternative measuring method approved under this Rule 10.7.

(d) A meter shall be read and the meter reading monthly recorded to reflect the actual amount of pumpage throughout each calendar year. A report reflecting the annual withdrawals and annual system water loss, on a calendar-year basis, shall be provided by any means approved by the General Manager, or more frequently, if requested by the General Manager. The permit holder subject to this reporting requirement shall keep accurate records of the amount of groundwater withdrawn and the purpose of the withdrawal, and such records shall be available for inspection by the District or its representatives. Where wells are permitted in the aggregate, metering and reporting are required on a well-by-well basis.

(e) Immediate written notice shall be given to the District in the event a withdrawal exceeds or is anticipated to exceed the quantity authorized by a permit issued by the District.

(f) Meter accuracy to be tested. The District may require a well owner or operator, at the well owner's or operator's expense, to test the accuracy of the meter and submit a certificate of the test results. The District also has the authority to test a meter. If a test reveals that a meter is not registering within an accuracy of 95%-105% of actual flow, or is not properly recording the total flow of groundwater withdrawn from the well or Well System, the well owner or operator must take appropriate steps to remedy the problem, and to retest the meter within 90 (ninety) calendar days from the date the problem is discovered.

(g) Violation of Metering and Reporting Requirements: False reporting or logging of meter readings, intentionally tampering with or disabling a meter, or similar actions to avoid accurate reporting of groundwater use and pumpage shall constitute a violation of these rules and shall subject the person performing the action, as well as the well owner, and/or the primary operator who authorizes or allows that action, to such remedies as provided in the District Act and these rules.

(h) Recordkeeping Required until Installation of Meter: In the event that a well owner or operator is not measuring withdrawals by District-approved meter or alternative measuring method, the well owner or operator shall be required to keep an accurate log of dates of operation of each well, the duration of such operation, and the purpose and place of use of the water produced until such time as the well owner or operator installs a District-approved meter or secures an alternate measuring method. Such metering log shall be submitted to the District in writing and sworn to within ten (10) calendar days of the installation of the meter or approval of an alternate measuring method, whichever is earlier. Failure to provide the metering log as required by this rule or the provision of false information therein shall be a violation of these rules and grounds for permit denial or revocation.

(i) Meter Maintenance: Costs of meter maintenance shall be borne by the well owner or operator.

(j) Water Use Reporting: Pursuant to Texas Water Code Sections 36.109 and 36.111, if the Board or General Manager deems it useful or otherwise necessary for the District to secure monthly groundwater use data, the General Manager may notify any user of groundwater that monthly groundwater use must be reported to the District.

SECTION 11. GENERAL PERMITTING POLICIES AND PROCEDURES

RULE 11.1 REQUIREMENT FOR PERMIT TO DRILL, OPERATE, OR ALTER THE SIZE OF A WELL OR WELL PUMP; PERMIT AMENDMENT

(a) Permits Required: No person may drill, operate, equip, complete, or alter the size of a well or well pump without first obtaining a permit or approved pre-registration, as applicable, from the District as provided by statutory law and these rules.

(b) Permit Amendment Required: A permit amendment is required prior to any deviation from the permit terms regarding the maximum amount of groundwater to be produced from a well, the location of a proposed well, the purpose of use of the groundwater, the location of use of the groundwater, or the drilling and operation of additional wells, even if aggregate withdrawals remain the same. A Historic and Existing Use Permit may not be amended to modify the purpose of use for which the Historic and Existing Use Permit was originally granted, but may be amended to modify the place of use to a place inside or outside the district. The District may authorize a permit holder to lease or otherwise transfer ownership of a Historic and Existing Use Permit or the amount of groundwater production authorized under such a permit, as long as the purpose of use does not change and as long as the withdrawal is made from the same aquifer and within the same management zone, if applicable, and such transfers are subject to the Rule 11.9.1 and Rule 11.10.10.

(c) Absent an express reservation of rights in the transferor, the transfer of ownership of the well(s) designated by a permit is presumed to transfer ownership of the permit, and the transfer of the land and well site on which the well is located is presumed to transfer ownership of the well. The ownership of a permit may be transferred separately from the ownership of water rights and a well and land and well site on which the well is located, subject to these Rules and permit conditions, with sufficient documentation of an ownership or contractual right to hold the permit. If a transferor retains any interest in the permit, the District may issue a second permit to the transferee that contains the benefits severed and transferred. The District may thereafter amend the permit of the transferor accordingly, along with any appropriate conditions relevant to the transfer imposed by the District. The District shall limit the amount of production authorized in the transfer of a permit to a different location of use to the amount of water produced and beneficially used by the transferor under the original permit.

(d) If the production authorized for two or more wells that have been aggregated to function as part of a Well System under Rule 11.2 and one or more wells under the Well System will be transferred, the District may allocate a pro rata share of the total authorized production to each well transferred unless the conveyance documents transferring the well(s) clearly provides for a different method of allocation.

(e) Upon submission to the District of written notice of transfer of ownership or control of any water right or water well covered by a permit and documents evidencing the transfer, the District's General Manager will amend the permit to reflect the new owner(s).

RULE 11.2 AGGREGATION OF WITHDRAWAL AMONG MULTIPLE WELLS

A Drilling Permit application must be filed for each well that requires permitting. However, one application shall be filed for a Production Permit, or for renewal thereof, which consolidates two or more wells that will function as part of a Well System.

RULE 11.3 PERMIT EXCLUSIONS AND EXEMPTIONS

(a) The District's permit requirements in these rules do not apply to:

(1) drilling or operating a well used solely for domestic use or for providing water for livestock or poultry if the well is located or to be located on a tract of land larger than 10 acres and drilled, completed, or equipped so that it is incapable of producing more than 25,000 gallons of groundwater a day; provided, however, that this exemption shall also apply after the effective date of this rule to a well to be drilled, completed, or equipped on a tract of land equal to or less than 10 acres in size only if:

(A) the well is to be used solely for domestic use or for providing water for livestock or poultry on the tract;

(B) such tract was equal to or less than 10 acres in size prior to the effective date of this rule; and

(C) such tract is not further subdivided into smaller tracts of land after the effective date of this rule and prior to the drilling, completion, or equipping of the well.

i. A well qualifying for exemption under this subsection must observe a minimum distance of 50 feet from the property line and 50 feet from other wells.

ii. For purposes of an exemption under this subsection, the terms "livestock use" and "poultry use" do not include livestock or poultry operations that fall under the definition of "Animal Feeding Operation" or "Concentrated Animal Feeding Operation" set forth in District Rule 1.1.

(2) drilling a water well used solely to supply water for a rig that is actively engaged in drilling or exploration operations for an oil or gas well permitted by the Railroad Commission of Texas provided that the person holding the permit is responsible for drilling and operating the water well and the water well is located on the same lease or field associated with the drilling rig.

(3) drilling a water well authorized under a permit issued by the Railroad Commission of Texas under Chapter 134, Texas Natural Resources Code, or for production from the well to the extent the withdrawals are required for mining activities regardless of any subsequent use of the water.

(4) drilling a water well for temporary use to supply water to a rig that is actively engaged in drilling a groundwater production well permitted by the District except that this exemption may not exceed 180 (one hundred eighty) calendar days but may be extended until the groundwater production well is complete.

(5) an injection water source well permitted by the Railroad Commission of Texas for secondary or enhanced oil or gas recovery.

(6) a well used for an ASR Project, except as provided under District Rule 18.1.

(7) monitoring wells.

(8) leachate wells.

(9) dewatering wells.

(b) A well exempted under Subsections (a)(2), (3), (4), and (5) above loses its exemption and must be permitted and comply with all the District's rules in order to be operated if:

(1) the groundwater withdrawals that were exempted under Subsection (a)(2) are no longer used solely to supply water for a rig that is actively engaged in drilling or exploration operations for an oil or gas well permitted by the Railroad Commission of Texas;

(2) the groundwater withdrawals that were exempted under Subsection (a)(3) are no longer necessary for mining activities or are greater than the amount necessary for mining activities specified in the permit issued by the Railroad Commission of Texas under Chapter 134, Texas Natural Resources Code;

(3) the groundwater withdrawals that were exempted under Subsection (a)(4) are no longer used solely to supply water for secondary or enhanced oil recovery pursuant to the terms of the permit issued by the Railroad Commission of Texas; or

(4) the groundwater withdrawals that were exempted under Subsection (a)(5) exceed the amount specified in the permit issued by TCEQ.

(c) A water well exempted under Section (a) above shall:

(1) be pre-registered and registered in accordance with rules promulgated by the District; and

(2) be equipped and maintained so as to conform to the District's rules requiring installation of casing, pipe, and fittings to prevent the escape of groundwater from a groundwater reservoir to any reservoir not containing groundwater and to prevent the pollution of harmful alteration of the character of the water in any groundwater reservoir.

(d) Registered wells observe exemptions that were in place at the time of filing the registration.

(e) A well exempt under this section will lose its exempt status if the well is subsequently used for a purpose or in a manner that is not exempt.

RULE 11.4 HISTORIC AND EXISTING USE PERMITS

The District recognizes the validity of Historic and Existing Use Permits granted under the District's rules and will continue to recognize the rules and procedures applicable to a Historic and Existing Use permit existing at the time the permit was granted. The District no longer accepts applications for Historic and Existing Use Permits because the deadline has passed, and the application procedures and the Historic and Existing Use Permit permitting process are now obsolete. Historic and Existing Use Permits are subject to the transfer, renewal, and permit amendment provisions set forth in these rules.

RULE 11.5 PERMITS REQUIRED TO DRILL A NEW WELL

(a) Every person who drills a water well after the initial effective date of these rules must file the Notice of Intent provided for in Rule 9.2. Every person who drills a nonexempt well must file a permit application on a form approved by the District.

(b) Drilling Permit Requirement: The well owner, well operator, or any other person acting on behalf of the well owner must obtain a Drilling Permit from the District prior to drilling a new water well, perforating an existing well or increasing the size of a well pump therein so that the well could reasonably be expected to produce 25,000 gallons per day or more, unless the well is an exempt well under District Rule 11.3.

RULE 11.6 PERMITS REQUIRED TO OPERATE A NEW WELL OR FOR INCREASED WITHDRAWAL AND BENEFICIAL USE FROM AN EXISTING WELL

Prior to and no later than 21 (twenty-one) calendar days after completion of a new water well, or reworking or re-equipping an existing water well, the well owner or well operator must file a completed Production Permit application on a form approved by the District. A Production Permit may only be issued if the well from which water is proposed to be withdrawn has been drilled or if the Production Permit is subject to the well being drilled in accordance with the terms of a Drilling Permit. If the Drilling Permit expires without a well being drilled, any associated Production Permit shall expire at the same time the Drilling Permit expires.

RULE 11.7 PERMIT TERM

(a) Drilling Permit Term: Unless specified otherwise by the Board or these rules, Drilling Permits are effective for a term ending 120 (one hundred twenty) calendar days after the date the permit is issued by the District, which may be extended by the General Manager with good cause shown.

(b) Historic and Existing Use Permit and Production Permit Terms: Unless specified otherwise by the Board or these rules, Historic and Existing Use Permits and Production Permits are effective until the end of the calendar year in which they are issued. If renewed, such permits shall thereafter be effective for one-year terms from the initial expiration date unless specified otherwise by the Board. The permit term will be shown on the permit. A permit applicant requesting a permit term longer than one year must substantiate its reason for the longer term and its need to put groundwater to beneficial use throughout the proposed permit term.

RULE 11.8 PERMIT RENEWAL

(a) Permit Renewal: Renewal applications shall be provided by the District prior to expiration of the permit term, and shall be filed with the District no later than January 15th of the new year for which the permit renewal is requested. Production Permits will not be renewed unless the well has been drilled at the time of the renewal application.

(b) Renewal Application Requirements: The District will timely provide a form for an application for renewal prior to expiration of the permit term. The renewal application will be a streamlined application and will not include all of the elements required for an original application.

(c) The District shall, without a hearing, renew or approve an application to renew a Production Permit before the date on which the permit expires, provided that:

(1) the application is submitted in a timely manner; and

(2) the permit holder is not requesting a change related to the renewal that would require a permit amendment under the District's rules.

(d) The District is not required to renew a permit under District Rule 11.8(c) if the applicant:

(1) is delinquent in paying a fee required by the District;

(2) is subject to a pending enforcement action for a substantive violation of a District permit, order, or rule that has not been settled by agreement with the District or a final adjudication; or

(3) has not paid a civil penalty or has otherwise failed to comply with an order resulting from a final adjudication of a violation of a District permit, order, or District rule.

(e) If the District is not required to renew a permit under District Rule 11.8(d), the permit remains in effect until the final settlement or adjudication on the matter of the substantive violation.

(f) Any permit holder seeking renewal may appeal the General Manager's ruling by filing, within ten (10) calendar days of notice of the General Manager's ruling, a written request for a hearing before the Board. The Board will hear the applicant's appeal at the next available regular Board meeting. The General Manager shall inform the Board of any renewal applications granted or denied. On the motion of any Board member, and a majority concurrence in the motion, the Board may overrule the action of the General Manager. The General Manager may authorize an applicant for a permit renewal to continue operating under the conditions of the prior permit, subject to any changes necessary under proportional adjustment regulations or these rules, for any period in which the renewal application is the subject of a hearing.

(g) If the holder of a Production Permit, in connection with the renewal of a permit or otherwise, requests a change that requires an amendment to the permit under District Rule 11.1, the permit as it existed before the permit amendment process remains in effect until the later of:

(1) the conclusion of the permit amendment or renewal process, as applicable; or

(2) a final settlement or adjudication on the matter of whether the change to the permit requires a permit amendment.

(h) If the permit amendment process results in the denial of an amendment, the permit as it existed before the permit amendment process shall be renewed under District Rule 11.8(c) without penalty, unless subsection (d) of District Rule 11.8 applies to the applicant.

(i) The District may initiate an amendment to a Production Permit, in connection with the renewal of a permit or otherwise, for the purpose of achieving a Desired Future Condition or another statutory purpose of the District. Any amendment initiated by the District shall be processed in accordance with Section 11 of the District's rules. If the District initiates an amendment to a Production Permit, the permit as it existed before the permit amendment process shall remain in effect until the conclusion of the permit amendment or renewal process, as applicable.

RULE 11.9 PERMIT APPLICATIONS

11.9.1 Requirements for All Permit Applications:

(a) Each application for a water well Drilling Permit, Production Permit, and permit amendment requires the filing of a separate application. The application must be completed on the District's form and may be supplemented. Each application for a permit shall be in writing and sworn to, and shall include the name, mailing address, phone number, and email address of the applicant and the owner of the land on which the well or Well System is or will be located.

(b) In addition to the information required of all permit applications in Rule 11.9.1(a), an application for a Drilling Permit or to amend a Drilling Permit must include the following information:

(1) if the applicant does not own the well site(s) and proposed well(s), documentation establishing the applicable authority to construct, drill, and complete each well on each proposed well site;

(2) the location of each well and the estimated rate at which water will be withdrawn;

(3) the conditions and restrictions, if any, placed on the rate and amount of withdrawal;

(4) the date the permit is to expire if each well is not drilled or if each existing well is not properly completed to meet all statutory and regulatory requirements for the intended purpose of use;

(5) a declaration that the applicant will comply with all District well plugging and capping guidelines and report closure to the Commission;

(6) a location map of all existing wells within a one half (1/2) mile radius of the proposed well or Well System or the existing well or wells to be modified;

(7) a map or other document from the Pecos County Tax Appraisal District indicating the ownership and location of the subject property;

(8) a document indicating the location of each proposed well or each existing well to be modified, the subject property, and adjacent owners' physical and mailing addresses;

(9) notice of any application to TCEQ to obtain or modify a Certificate of Convenience and Necessity to provide water and wastewater service with water obtained pursuant to the requested permit; and

(10) a statement of the nature and purpose of the proposed use and the amount of water to be used for each purpose.

(c) In addition to the information required of all permit applications in Rule 11.9.1(a), an application for a production permit or to amend a production permit must include the following information:

(1) if the applicant does not own the well site(s), proposed well(s), and groundwater, documentation establishing the applicable authority to operate each well and produce and beneficially use the groundwater from each well;

(2) the annual amount of groundwater claimed to be necessary for beneficial use during each year of the proposed permit term with information supporting the annual amount of use requested for each proposed purpose of use;

(3) a requirement that the water withdrawn under the permit be put to beneficial use at all times;

(4) the location of the use of the water from the well or Well System;

(5) the conditions and restrictions, if any, placed on the rate and amount of withdrawal;

(6) a declaration that the applicant will comply with the District's rules and all groundwater use permits and plans promulgated pursuant to the District's rules;

(7) a declaration that the applicant will comply with the District Management Plan;

(8) a drought contingency plan;

(9) a declaration that the applicant will comply with all District well plugging and capping guidelines and report closure to the Commission;

(10) the duration the permit is proposed to be in effect, if greater than one year;

(11) a written statement addressing each of the applicable criteria in Rules 10.2 and 11.10.10(a), (b), and (c) and substantiating why the applicant believes the Board should consider each of these applicable criteria in a manner favorable to the applicant; and

(12) if groundwater is proposed to be exported out of the District, the applicant shall describe the following issues and provide documents relevant to these issues:

(A) the availability of water in the District and in the proposed receiving area during the period for which the water supply is requested;

(B) the projected effect of the proposed export on aquifer conditions, depletion, subsidence, or effects on existing permit holders or other groundwater users within the District; and

(C) how the proposed export is consistent with the approved regional water plan and certified District Management Plan.

(13) a hydrogeological report shall be attached to an application that:

(A) requests a new Production Permit for 1,000 acre feet or more per year from one or more wells or an associated Well System;

(B) requests a new Production Permit or amendment to an existing Production Permit in an amount that when combined with the amount of an existing Production or Historic and Existing Use permit or permits associated with the same well or wells or Well System is at least 1, 000 acre feet per year; or

(C) requests to amend and increase by at least 250 acre feet the annual maximum permitted use of a Production Permit for a well or Well System.

This report must address the area of influence of the well(s) and any associated Well System for which a permit is being requested and a description of the aquifer that will supply water to each well, and be complete in a manner that complies with the requirements adopted in Rule 11.9.3.

(14) the hydrogeological report required in Subsection (13) shall be updated for each and every permit amendment application that requests an increase in production of at least 1,000 acre feet per year from one or more wells or an associated Well System authorized under an existing Production or Historic and Existing Use Permit or Permits that currently authorize at least 1,000 acre feet per year.

(15) the results of a pump test for each well for which a production permit or amendment to a production permit is being requested depends upon the following thresholds:

(A) If the annual amount of groundwater withdrawal from one or more wells or an associated Well System in any calendar year during the permit term is more than 20 acre feet and less than 1,000 acre feet, the pump test(s) and results must meet the requirements of Rule 11.9.2(a);

(B) If an application is subject to the hydrogeological report requirements in Subsection (13) of this rule, the pump test(s) and results must meet the requirements of Rule 11.9.2(b).

(d) The General Manager or Board may waive one or more of the informational requirements for an application to amend a production permit depending on the nature of the amendment provided that the Board has sufficient, relevant information to consider the application at the hearing.

(e) The applicant must provide the District with the information relevant to the type of application that is required in this Rule 11.9 for the District to declare that the application is administratively complete. If the District provides a written list of application deficiencies, the applicant shall have 60 (sixty) calendar days to fully respond to the General Manager's satisfaction, after which a deficient application expires. The applicant may request an extension of this 60-day period or a ruling on the administrative completeness of its application by filing a written request with the District. The District will set an applicant's request under this rule on its next regularly scheduled Board meeting agenda, with three (3) calendar days' notice compliant with the Texas Open Meetings Act. The Board will consider and take action on an applicant's request under this rule at this meeting.

11.9.2 Specific Capacity Pump Test and Pump Test Report Requirements

(a) Specific Capacity Pump Test and Pump Test Report Requirements required by Rule 11.9.1(c)(15)(A)(for one or more nonexempt wells or an associated Well System proposed to be authorized to annually withdraw less than 1,000 acre feet): The specific capacity pump test will provide the District with site-specific aquifer properties and well-yield information necessary to better evaluate a production permit application. The District is aware that a pump test to obtain aquifer specific capacity information requires site preparation, specialized monitoring equipment, monitoring during the test and pump test data analysis which can be time consuming and somewhat costly. The District will assist the production permit applicant with site preparation, provide the required water level monitoring equipment and conduct the technical analysis of the specific capacity pump test.

As part of its consideration of the relevant permitting factors in Rules 11.10.10, the MPGCD Board will consider the specific capacity pump test analysis results provided by the applicant along with input on these results from MPGCD's General Manager and professionals and, if there is a contested hearing, input on these results from any parties admitted into the contested hearing.

The dedicated pump must have the production capacity to meet the permit applicant's requested groundwater demand. The District must be notified at least 14 days in advance of any specific capacity pump test. A specific capacity pump test conducted without prior approval from the District will be deemed noncompliant with MPGCD permit requirements.

If the specific capacity pump test activity is found to be flawed or not acceptable by the District's General Manager, the District's General Manager may require the specific capacity pump test to be repeated.

The District Manager has the authority to exempt a permit applicant from this requirement provided the permit applicant provides good cause why other information submitted with the application is sufficient to describe the type of site-specific aquifer properties and well-yield information that would be obtained from the pump test and associated analysis.

(1) Specific Capacity Pump Test Site Preparation

(A) Availability of local monitor wells: The District is working to expand its understanding of the groundwater resources within the District to ensure the best available science is considered during the permitting process. If a well located within 1,000 feet of and completed within the same aquifer as the permit applicant's specific capacity pump test well is available to be monitored during the pump test, the General Manager may require that it be monitored during the test. This monitor well would provide additional, important aquifer properties. A monitor well(s) may not be actively pumping during the pump test.

(B) Installation of Water-level Transducers and the Determination of Static Water Levels

i. The District staff will assist in the installation of District's own water-level transducers into the permit applicant's well to be pump tested and additional transducers into any monitor wells identified for the specific capacity pump test.

ii. The District staff will determine the depth from the static water level of the well to the top of the pump intake (pump test water column thickness) prior to a pump test to understand at what water level depth the water level will drop below the water level transducer or below the pump intake. It is recommended that the water level transducer depth should be located at least 10 feet above the pump intake.

iii. Prior to a specific capacity pump test, static water levels of the pump test well and any associated monitor wells must be measured by transducers for at least 24 hours prior to the pump test.

iv. The District's staff will make sure that the transducers are time synchronized if there is more than one transducer. The transducers will be programmed to collect water levels every 15 minutes during the entire pump test event which includes: 24 hours before pumping commences, during pumping (8 or 12 hours), and for at least 8 hours after pumping concludes (well recovery measurements).

(2) Determination of Specific Capacity Pump Test Discharge Rate: The specific capacity pump test discharge rate should be representative of the production needed to meet the permit applicant's requested instantaneous production rate (expressed in gallons per minute) and annual quantity of production (expressed in gallons or acre-feet per year). The District's General Manager will provide guidance to the permit applicant on a recommended pump test discharge rate.

(3) Monitoring of Specific Capacity Pump Test Discharge Rate: During a specific capacity pump test, the water level within the well usually declines and, as it does, the well discharge rate will also decrease. The permit applicant needs to provide a flow meter or a method to accurately estimate (within 10% of the actual rate) the pump test discharge rate during the specific capacity pump test. The pump test discharge monitoring method must be pre-approved by the District's General Manager before the pump test begins.

There should be allowance for increasing the pump rpm to maintain a constant discharge rate during the specific capacity pump test or, with the District General Manager's approval, the average discharge rate during the pump test could be used to calculate the well's specific capacity.

(4) Specific Capacity Pump Test Time Period: The specific capacity pump test time period will vary depending on the aquifer and will be confirmed by the District's General Manager in the following ranges:

(A) At least an 8-hour specific capacity pump test for the Edwards-Trinity, Pecos Alluvium and Dockum aquifers.

(B) At least a 12-hour specific capacity pump test for the Rustler, Capitan, San Andres and Igneous aquifers.

(5) Specific Capacity Pump Test

(A) The District staff will help initiate the pump test at an agreed-upon time determined by the District General Manager and the permit applicant. The District will verify that the water-level transducers are active and collecting water level data.

(B) Using a conductivity meter provided by the District measure the discharge water conductivity at 5 to 10 minutes after the pump test has started, mid-way through the pump test and at the end of the pump test. The District's staff will collect the first and last conductivity measurements.

(C) The permit applicant is responsible for monitoring and recording the pumping well's discharge rate changes during the pump test and the mid-pump test water quality conductivity measurement.

(D) Upon completion of the required time for the pump test, the District's staff will shut down the pump test and confirm that the water-level transducers are still active and collecting water level data.

(6) Post Specific Capacity Pump Test: After the completion of the water level recovery measurements, the District's staff will:

(A) Remove transducers from all the wells, and collect pump test information from the permit applicant (variation in pump test discharge rates or the time which permit applicant adjusted pump rate to fixed discharge rate and mid-pump test water quality measurement).

(B) The District's staff will download all the water level transducer data into an Excel spreadsheet with notations on the variations of pump discharge rates with time.

(C) District's groundwater consultant (PG or PE) will take pump test data provided by the District and calculate specific capacity and determine aquifer properties for the monitor wells (if available).

(D) District's groundwater consultant will prepare a brief report to provide to the District's Board and the permit applicant.

(b) Pump Test and Pump Test Report Requirements Associated with Hydrogeological Report required by Rule 11.9.1(c)(14) and (15)(B) (for one or more nonexempt wells or an associated Well System proposed to be authorized to annually withdraw at least 1,000 acre feet): The American Society of Testing and Materials (ASTM) documents D4043 (Selection of Aquifer Test Method) and D4050 (Field Procedure, Pump Tests) provide guidance for designing and implementation of pump tests, and D4105 (Confined Aquifer Pump Test Analysis) or D4106 (Unconfined Aquifer Pump Test Analysis) provide guidance to determine aquifer properties. A permit applicant can purchase these documents at http://global.ihs.com/standards.cfm?publisher=ASTM&RID=Z06&MID=5280 and is strongly encouraged to review these documents prior to designing and conducting any pump tests.

(1) Pump Tests:

Pump tests conducted without prior approval from the District may be deemed noncompliant with the District's Production Permit requirements. The District must be notified at least 48 hours in advance of any pump test conducted as part of the hydrogeological investigation.

Texas registered geoscientists (P.G.) and/or engineers (P.E.) with five years or more of groundwater experience will be required to oversee the design and implementation of each pump test and associated monitor wells and will evaluate the pump test results to determine aquifer properties. Aquifer properties to be determined from the pump tests include specific capacity, transmissivity, hydraulic conductivity, and possibly storage coefficient or storativity values.

(2) Pump Test Monitor Wells:

Monitor wells are required for applicant well fields with multiple wells. Monitor wells selected by the applicant for the pump test must comply with the District's monitor well requirements and the monitor well selection must be pre-approved by the District's General Manager. Monitor wells may not be actively pumping during the pump test. The use of existing private wells within two miles of the pumping wells and within the same groundwater producing formation is acceptable if the well meets the District's monitor well requirements.

A monitor well selected for the pump test is required to monitor only the applicant's aquifer and exhibit a connection with the pumping wells indicated by a minimum of 0.2 feet of drawdown during the pump test. For confined aquifers, the District may also require a monitor well in an overlying aquifer to monitor potential water level fluctuations and to determine whether there is communication between the applicant's aquifer and overlying aquifers.

(3) Pump Test Requirements:

(A) If possible, the District and/or the applicant will meet with any adjacent landowners with large operating wells (>250 gpm) within a two-mile radius of the pump test pumping wells prior to the pump test. The District and/or the applicant will inform the landowners of the date of the pump test, and, if possible, determine whether the landowners' wells will be active during the scheduled pump test. If the landowners' wells are going to be active during the pump test, the District will request that the landowners do not vary the pumping rates during the pump test.

(B) The designed pump test results must be able to be used to mimic the well field's impact of the applicant's requested acre feet per year pumpage.

(C) Static water levels of each pump test pumping and monitor wells should be measured every 12 hours for a total of 36 hours for the Pecos Valley Alluvium, Edwards-Trinity Plateau, and Dockum clastic aquifers and for a total of 72 hours for the Rustler and Capitan Reef Complex karstic aquifers and the San Andres karstic formation prior to the beginning of the pump test.

(D) Flow meters will be used to monitor each pumping well's groundwater production.

(E) Measure water levels and pump test discharge rates and times during pump test at acceptable frequency according to ASTM 4050.

(F) A metered pump test of not less than a continuous 36 hours for the dominantly clastic aquifers, including the Pecos Valley Alluvium (clastic), Edwards-Trinity Plateau (carbonate karst and clastic), and Dockum (clastic).

(G) The documentation of times of field activities, weather changes, and pump test adjustments and/or problems will be recorded.

(H) A recovery phase of a period sufficient for a 95 percent recovery of beginning water levels of each pumping well and 90 percent recovery for each monitor well, not to exceed time period of pumping activity. Water level measurements during recovery should be measured at the same frequency as during the pumping phase (frequent at beginning and decreasing frequency with time).

(I) Water quality parameters (pH, temperature, and conductivity) of the pump test wells' discharged water will be measured at the beginning of the pump test and every 12 hours during the pump test.

(J) Water quality analysis will include TDS, SO4, Cl, Ca, Mg, Na, HCO3, F, Br, and NO3 from each pumping well and will be collected twice—prior to and at the end of each pump test.

The applicant may request that the District's General Manager consider a variation of the above pump test requirements. The District's General Manager has 30 days to review and approve or disapprove the variance request.

(4) Pump Test Report Requirements:

(A) A discussion about the general characteristics of the aquifer, including, but not limited to: confined or unconfined, clastic or karstic, variation in aquifer thickness, and interpreted degree of karst development. Discuss whether the production wells are partially or fully penetrating and the impact on monitor well selection.

(B) For each pump test and monitor well, tables listing water level changes with times, initial water levels at the start of pump test (for pumping and monitor wells), pump test date, start time, end time, changes during and final pumping rates, and water quality parameters measured during the pump test, as a report appendix.

(C) For each pump test and monitor well, a table listing the water level recovery measurements with times as a report appendix.

(D) Copies of field notes collected during the pump test as a report appendix.

(E) A discussion of the reasoning for the selection of the pump test analysis method used to estimate the aquifer properties for each pumping and monitor well in the pump test.

(F) A table listing final estimated aquifer properties for each pumping and monitor well in the pump test.

(G) A table of the pumping wells water quality parameters collected during the pump test.

(H) A discussion of any observed groundwater quality changes (if any) that occurred during the pump test.

If the pump test activity or analysis is found to be flawed or not acceptable by the District's General Manager, the District's General Manager may require that the pump test or analysis be repeated in an acceptable manner before the groundwater Production Permit application may be considered.

11.9.3 Hydrogeological Report Requirements for Production Permits for >1,000 Or More Acre-Feet Per Year: Planning and implementation of all hydrogeological reports required for a Production Permit application should be coordinated with the District to minimize technical issues and to expedite the review process of the application. The District may exercise discretion in the application of the guidelines on an individual and site-specific basis in order to allow a practicable application of the guidelines while ensuring a result yielding the information needed by the District to manage groundwater resources.

The hydrogeological report is intended to provide information to the District on:

(1) the geologic setting of the applicant's proposed production well field;

(2) well construction information of production and monitor wells;

(3) local aquifer characterization of aquifer properties by pump tests; and

(4) an evaluation of whether the proposed use of water unreasonably affects existing groundwater resources or existing permit holders.

(a) Geologic Setting of Applicant's Proposed Production Well Field: The report shall include a discussion of the surface and subsurface geology of the applicant's tract of land on which each proposed production well or wells are located and will include a brief description of the local geology and the selected aquifer within a two-mile radius of each of Applicant's proposed wells. The description will include:

(1) A table that illustrates the stratigraphic column of geological formations overlying and underlying the applicant's identified producing aquifer.

(2) The following figures will be required for the hydrogeological report based on available subsurface well data. The aerial extent of the following figures will include the applicant's proposed production well field and a two-mile buffer zone, reflected by concentric circles with a radius of two miles from each of the applicant's proposed wells.

(A) A figure illustrating the location of the applicant's proposed production and monitor wells, property boundary, and each existing water well located within a two-mile radius of the applicant's proposed production wells. This figure will include the name of each adjacent landowner whose property adjoins the applicant's, the locations of existing water wells, and the names of local streets and/or roads.

(B) A figure illustrating the contoured top depth of the producing aquifer. (This is not required for the Pecos Valley Alluvium or Edwards-Trinity Plateau aquifers.)

(C) A figure illustrating the most recent available water level measurements of the applicant's and adjacent landowners' existing water wells within a two-mile radius of the proposed well field.

(b) Required Well Construction Information: The hydrogeological report will include well construction information for each of the applicant's existing groundwater production and monitor well(s) to be used in the proposed well field. New, proposed production and monitor wells will need a well construction schematic, based on available information. Well construction information for each production and monitor well should include the following:

(1) the identification of the aquifer to be produced from;

(2) the total depths, diameters, and expected screen or production intervals of each of the applicant's existing and proposed production and monitor wells;

(3) each production well's proposed maximum pumping rate; and

(4) a water well driller's report and/or driller's log (if available) for existing wells.

(c) Local Aquifer Characterization: The District may require a pump test to determine local aquifer characterization of the applicant's proposed well field and to evaluate the potential impact of the requested production on existing wells and the District's DFCs. Production from all confined aquifers will require pump tests. The District may exempt the applicant from conducting pump tests on unconfined aquifers if:

(1) the proposed well field (multiple production wells) is in an unconfined aquifer and each proposed well is more than two miles from the applicant's property lines;

(2) the proposed well field involves a single production well in an unconfined aquifer and is more than one mile from the applicant's property lines; or

(3) there are no other landowners' production wells using the applicant's designated unconfined aquifer within two miles of the applicant's property lines.

If the District grants an exemption to the applicant for a pump test, local aquifer properties from available groundwater models (TWDB, USGS, or available reviewed consultant's groundwater models with the District's prior approval) will be used to estimate the potential for unreasonable effects on existing wells by the proposed pumping, including, but not limited to, identifying water level declines within a two-mile radius from each of the applicant's proposed wells.

The applicant may appeal the District's General Manager's decision to require pump tests by filing with the District a request for reconsideration identifying all the reasons why the applicant believes a pump test is unnecessary. The District's General Manager has 30 days to review the appeal and decide whether to support or repeal the pump test requirement. The applicant may appeal the General Manager's decision on the request for reconsideration by filing with the District a written appeal to the District's Board identifying all the reasons why the applicant believes a pump test is unnecessary.

*Pump test and pump test report guidance is provided in Rule 11.9.2.

(d) Potential of Unreasonable Effects from Proposed Production on Existing Wells and Groundwater Resources: The applicant is required to estimate the potential water level impacts caused by the proposed pumping to wells located within a two-mile radius of the applicant's well field applying the assumptions and otherwise meeting the requirements enumerated below in this section. This analysis must mimic the applicant's expected full production operations.

(1) The time periods for water level decline analyses are 30, 180, 365, and 730 days.

(2) The water level impact for the above time periods must be estimated for each well within a two-mile radius from each of the applicant's proposed wells; or a figure illustrating calculated water level decline contours at one quarter (1/4) mile intervals up to two miles (eight contour intervals) for each time period is acceptable.

(3) The water level impact information should also be summarized in a report table.

The applicant has two options on how to evaluate the potential of water level impacts:

Option 1: The applicant can have the District's consultant hydrogeologist assist in completing Section (d) of the applicant's hydrogeological report. If the applicant chooses this option, the applicant realizes that having the District's hydrogeologist complete the hydrogeological report does not guarantee that the District's Board will approve the application, just that the hydrogeological report will be administratively and technically complete. The hydrogeological analysis of the provided pump test results may be favorable or unfavorable for the applicant. The District's hydrogeologist will make a recommendation to the District's Board based on his or her professional opinion of the hydrogeological information provided and compiled in the report.

The applicant will provide the completed hydrogeological report (Sections (a), (b), and (c)) and the pump test results (in an Excel format) to the District's hydrogeologist. If a Production Permit application requests 10,000 acre feet per year or less, then the District's hydrogeologist will use the applicant's pump test derived aquifer properties and estimate water level declines for all the report required wells using pump test simulation software.

If a Production Permit application requests more than 10,000 acre feet per year, then an existing groundwater availability model will be run to estimate the water level declines and potential DFC impacts. The groundwater availability model used for this analysis will be selected by the District's hydrogeologist after discussions with the applicant's groundwater consultants. In the case of the San Andres formation (for which no groundwater availability models exist), a detailed analysis using pump test simulation software will be completed.

If no pump test was required from the applicant for the hydrogeological report, the local aquifer properties will be obtained from the District's hydrogeologist's selected groundwater availability model (USGS, TWDB, or consultant's groundwater model) to determine the water level impact analyses. After running the pump test simulation software (<10,000 acre feet) or groundwater models (>10,000 acre feet), the District's hydrogeologist will generate all the required well level change text, figures, and charts necessary to complete the applicant's hydrogeological report.

The District will charge the applicant the District's hydrogeologist's hourly fee for this service.

Option 2: The applicant may use their own consultant and/or groundwater model (groundwater model must be reviewed and accepted by the District's hydrogeologist prior to model runs) to complete the water level impact analyses. The applicant's consultant will provide text, figures, and tables to meet the above-stated District requirements for the water level impact analyses.

RULE 11.10 PERMIT HEARINGS

11.10.1 All hearings shall be held before a quorum of the Board, a hearings examiner delegated in writing the responsibility to preside over the hearing, or SOAH in accordance with Rule 11.10.4.

11.10.2 Notice and Scheduling of Hearing: Once the District has received an administratively complete application for a water well Drilling Permit, Production Permit, or a permit amendment, or if the Board desires to modify an existing permit, the General Manager will issue a written notice of the hearing on the application in accordance with these rules.

(a) Notices of all hearings of the District shall be prepared by the General Manager and shall, at a minimum, state the following information:

(1) the name and address of the applicant or permit holder;

(2) the name or names of the owner or owners of the land if different from the applicant or permit holder;

(3) the time, date, and location of the hearing;

(4) the address or approximate proposed location of the well or Well System, if different than the address of the applicant or permit holder;

(5) a brief explanation of the proposed permit or permit amendment, including any requested amount of groundwater, the purpose of the proposed use, and any change in use, or if the Board desires to modify an existing permit, a brief explanation of the proposed permit modification and the basis for the proposed modification; and

(6) any other information the Board or General Manager deems appropriate to include in the notice.

(b) Not less than ten (10) calendar days prior to the date of the hearing, notice shall be:

(1) posted by the General Manager at a place readily accessible to the public in the District office;

(2) provided by the General Manager to the County Clerk of Pecos County, whereupon the County Clerk shall post the notice on a bulletin board at a place convenient to the public in the county courthouse; and

(3) provided to the applicant by regular mail.

Not less than ten (10) calendar days prior to the date of the hearing, notice may be provided by regular mail to landowners who, in the discretion of the General Manager, may be affected by the application.

(c) A person may request notice from the district of a hearing on a permit or a permit amendment application. The request shall be memorialized in writing and is effective for the remainder of the calendar year in which the request is received by the District. To receive notice of a hearing in a later year, a person must submit a new request. An affidavit of an officer or employee of the District establishing attempted service by first class mail, fax, or email to the person in accordance with the information provided by the person is proof that notice was provided by the District.

(d) Failure to provide notice under Subsection (c) does not invalidate an action taken by the District at the hearing.

(e) The Board shall conduct an evidentiary hearing on a permit or permit amendment application if a party appears to protest that application or if the General Manager proposes to deny that application in whole or in part, unless the applicant or other party in a contested hearing requests the District to contract with SOAH to conduct the evidentiary hearing. If no one appears at the initial, preliminary hearing and the General Manager proposes to grant the application, the permit or permit amendment application is considered uncontested, and the Board may act on the permit application after considering the permitting criteria in these rules. Unless one of the parties in a contested hearing requests a continuance and demonstrates good cause for the continuance, the Board may conduct the preliminary and evidentiary hearings on the same date.

(f) Any hearing may or may not be scheduled during the District's regular business hours, Monday through Friday of each week, except District holidays. All hearings shall be held at the location set forth in the notice.

(g) The General Manager shall set an initial, preliminary hearing date within 60 (sixty) calendar days after the date the administratively complete application is submitted. The initial, preliminary hearing shall be held within 35 (thirty-five) calendar days after the setting of the date. Within this same time frame, the General Manager shall post notice and set a hearing on the application before the District Board. The General Manager may schedule as many applications at one hearing as the General Manager deems necessary.

11.10.3 Authority of Presiding Officer: The Presiding Officer may conduct preliminary and evidentiary hearings or other proceedings in the manner the Presiding Officer deems most appropriate for the particular hearing. The Presiding Officer has the authority to:

(a) set hearing dates, other than the initial, preliminary hearing date for permit matters;

(b) convene the hearing at the time and place specified in the notice for public hearing;

(c) rule on motions;

(d) permit the receipt of and rule on the admissibility of evidence consistent with Subchapter D, Chapter 2001, Texas Government Code;

(e) establish the order for presentation of evidence;

(f) administer oaths to all persons presenting testimony;

(g) examine and allow cross-examination of witnesses;

(h) ensure that information and testimony are introduced as conveniently and expeditiously as possible, without prejudicing the rights of any party to the proceeding;

(i) conduct public hearings in an orderly manner in accordance with these rules;

(j) recess any hearing from time to time and place to place;

(k) issue subpoenas, require depositions, or order other discovery consistent with Subchapter D, Chapter 2001, Texas Government Code;

(l) exercise any other appropriate powers necessary or convenient to effectively carry out the responsibilities of Presiding Officer; and

(m) determine how to apportion among the parties the costs related to a contract for the services of a Presiding Officer and the preparation of the official hearing record.

11.10.4 Appearance; Presentation; Time for Presentation; Ability to Supplement; Conduct and Decorum; Written Testimony; Hearing before SOAH:

(a) Appearance: Protestants and non-protestant interested persons may present evidence, exhibits, or testimony, or make an oral presentation as allowed by the Presiding Officer. A person appearing in a representative capacity may be required to prove proper authority. Each person attending and participating in a hearing of the District must submit on a form provided by the District, prior to or at the commencement of the initial, preliminary hearing, the following information: the person's name and address, who the person represents if other than himself, whether the person wishes to testify, whether the person is protesting the application, and any other information relevant to the hearing.

(1) Protestants: To protest an application for a permit or permit amendment, a potential party must attend the permit hearing prepared to articulate his or her justiciable interest related to a legal right, duty, privilege, power, or economic interest that is within the District's regulatory authority and how that justiciable interest would be adversely affected by the permit proposed by the application. This potential party must attend the initial, preliminary hearing and be prepared to address and respond to inquiry and any cross-examination regarding their alleged justiciable interest. A justiciable interest does not include persons who have only an interest common to

members of the general public. It is recommended that a person desiring to protest an application for a permit or permit amendment file with the District a notice of protest setting forth the protestant's justiciable interest related to a legal right, duty, privilege, power, or economic interest that is within the District's regulatory authority and how that justiciable interest would be adversely affected by the permit proposed by the application. It is recommended that the notice of protest be submitted so that it is received by the District at least two business days before the permit hearing. The Board may take testimony and shall deliberate and take official action at the hearing to determine whether the protestant has sufficiently demonstrated their justiciable interest and how that justiciable interest would be adversely affected by the permit proposed by the application. If the Board finds that a protestant does not adequately establish that its justiciable interest is affected by the proposed permit, then the protestant shall not be allowed to participate in the hearing.

(2) Non-protestant interested persons: A person may appear at an initial, preliminary hearing in person or by representative provided the representative is fully authorized, in writing, to speak and act for the principal. Any person appearing and offering any evidence pursuant to this subsection shall be subject to cross-examination.

(3) Request for SOAH Hearing: If an application is contested, any party to the hearing may request that the District contract with SOAH to conduct further proceedings in the hearing. A request for a SOAH hearing under this rule must be made to the Board at the initial, preliminary hearing and is untimely if submitted after the conclusion of the preliminary hearing.

(b) After the Presiding Officer calls a hearing to order, the Presiding Officer shall announce the subject matter of the hearing and the order and procedure for presentations.

(c) The Presiding Officer may prescribe reasonable time limits for the presentation of evidence and oral argument at the preliminary and evidentiary hearings.

(d) If requested with good cause shown and if allowed in the sole discretion of the Presiding Officer, any person who appears at a hearing and makes a presentation before the Board may supplement that presentation by filing additional written evidence with the Board within ten (10) calendar days after the date of conclusion of the hearing. Cumulative, repetitive, and unduly burdensome evidence filed under this subsection will not be considered by the Board. A person who files additional written material with the presiding officer under this subsection must also provide the material, not later than the 10th calendar day after the date of the hearing, to any person who provided comments on an uncontested application or any party to a contested hearing. A person who receives additional written material under this subsection may file a response to the material with the presiding officer not later than the 10th day after the date the material was received.

(e) Every person, party, representative, witness, and other participant in a proceeding must conform to ethical standards of conduct and must exhibit courtesy and respect for all other participants. No person may engage in any activity during a proceeding that interferes with the orderly conduct of District business. If in the judgment of the Presiding Officer, a person is acting in violation of this provision, the Presiding Officer will first warn the person to refrain from engaging in such conduct. Upon further violation by the same person, the Presiding Officer may exclude that person from the proceeding for such time and under such conditions as the Presiding Officer deems necessary.

(f) Written Testimony: When the Presiding Officer determines that a proceeding will be expedited and the interest of the parties will not be prejudiced substantially, the Presiding Officer may allow testimony to be received in written form, which testimony shall be subject to cross-examination. If the Presiding Officer allows written testimony, the written testimony of a witness, either in narrative or question and answer form, may be admitted into evidence upon the witness being sworn and identifying the testimony as a true and accurate record of what the testimony would be if given orally.

(g) SOAH Hearing:

(1) Deadline, Location: If timely requested by the applicant or other party to a contested hearing, the District shall contract with SOAH to conduct the hearing on the application. The Board shall determine whether the SOAH hearing will be held in Travis County or at the District Office or other regular meeting place of the Board, after considering the interests and convenience of the parties, and the expense of a SOAH contract.

(2) Costs, Deposit: The party requesting that the hearing be conducted by SOAH shall pay all costs associated with the contract for the hearing and shall make a deposit with the District in an amount that is sufficient to pay the estimated SOAH contract amount before the hearing begins. If the total cost for the contract exceeds the amount deposited by the paying party at the conclusion of the hearing, the party that requested the hearing shall pay the remaining amount due to pay the final price of the contract. If there are unused funds remaining from the deposit at the conclusion of the hearing, the unused funds shall be refunded to the paying party.

(3) Referral: Upon execution of a contract with SOAH and receipt of the deposit from the appropriate party or parties, the District's Presiding Officer shall refer the application to SOAH. The Presiding Officer's referral to SOAH shall be in writing and shall include procedures established by the Presiding Officer under Subsection (g)(4) below; a copy of the permit application, all evidence admitted at the preliminary hearing, the District's rules and other relevant policies and precedents, the District Management Plan, and the District Act; and guidance and the District's interpretation regarding its regulations, permitting criteria, and other relevant law to be addressed in a Proposal for Decision and Findings of Fact and Conclusions of Law to be prepared by SOAH. The District or Presiding Officer may not attempt to influence the Finding of Facts or the Administrative Law Judge's application of the law in a contested case except by proper evidence and legal argument. SOAH may certify one or more questions to the District's Board seeking the District Board's guidance on District precedent or the District Board's interpretation of its regulations or other relevant law, in which case the District's Board shall reply to SOAH in writing.

(4) Procedure before SOAH: A hearing conducted by SOAH is governed by SOAH's procedural rules; Subchapters C, D, and F, Chapter 2001, Texas Government Code; and, to the extent, not inconsistent with these provisions, any procedures established by the Presiding Officer under District Rule 11.10.3.

(5) District's Receipt of SOAH's Proposal for Decision and Findings of Fact and Conclusions of Law: The District's Board shall conduct a hearing within 45 (forty-five) days of receipt of SOAH's Proposal for Decision and Findings of Fact and Conclusions of Law, and shall act on the application at this hearing or not later than 60 days after the date that the Board's final hearing on the application is concluded in a manner consistent with Section 2001.058, Texas Government Code. At least ten (10) calendar days prior to this hearing, the Presiding Officer shall provide written notice to the parties of the time and place of the Board's hearing under this subsection by mail and fax, for each party with a fax number. The Presiding Officer shall exercise his or her authority under Rule 11.10.3 in conducting this hearing.

(6) The Board may (i) remand an issue germane to the application or the proposed findings of fact and conclusions of law, (ii) change a finding of fact or conclusion of law made by the Administrative Law Judge, or (iii) vacate or modify an order issued by the Administrative Law Judge, only if the Board determines:

(A) that the Administrative Law Judge did not properly apply or interpret applicable law, District rules, written policies, or prior administrative decisions;

(B) that a prior administrative decision on which the Administrative Law Judge relied is incorrect or should be changed; or

(C) that a technical error in a finding of fact should be changed.

(7) A final decision issued by the Board must be in writing and must either adopt the findings of fact and conclusions of law as proposed by the Administrative Law Judge or include revised findings of fact and conclusions of law consistent with Rule 11.10.4(g)(6).

(8) Notwithstanding any other rule, for hearings conducted by the State Office of Administrative Hearings, the Board shall issue a final decision not later than the 180th calendar day after the date of receipt of the final proposal for decision from State Office of Administrative Hearings. The deadline may be extended if all parties agree to the extension.

(9) Notwithstanding any other rule, if a motion for rehearing is filed and granted by the Board under Section 36.412 of the Texas Water Code, the Board shall make a final decision on the application not later than the 90th calendar day after the date of the decision by the Board that was subject to the motion for rehearing.

(10) Notwithstanding any other rule, the Board is considered to have adopted the final proposed for decision of the Administrative Law Judge as a final order on the 181st

calendar day after the date the Administrative Law Judge issued the final proposed for decision if the Board has not issued a final decision by:

(A) adopting the findings of fact and conclusions of law as proposed by the Administrative Law Judge; or

(B) issuing revised findings of fact and conclusion of law as set forth in this rule and the Texas Water Code.

(11) A proposed final decision adopted under Rule 11.10.4(g)(10) is final, immediately appealable, and not subject to a request for rehearing.

11.10.5 Recording

(a) Contested Hearings: Contested Hearings: A record of the hearing in the form of an audio or video recording or a court reporter transcription shall be kept in a contested hearing. The Presiding Officer shall have the hearing transcribed by a court reporter upon a request by a party to a contested hearing. Court reporter transcription costs may be assessed against the party requesting the transcription or among the parties to the hearing. In assessing reporting and transcription costs, the Presiding Officer must consider the following factors:

(1) the party who requested the transcript;
(2) the financial ability of the requesting party to pay the costs;
(3) the extent to which the requesting party participated in the hearing;
(4) the relative benefits to the various parties of having a transcript;
(5) the budgetary constraints of a governmental entity participating in the proceeding; and
(6) any other factor that is relevant to a just and reasonable assessment of costs.

(b) Uncontested Hearings: In an uncontested hearing, the Presiding Officer may substitute meeting minutes or the report required under Rule 11.10.9 for a method of recording the hearing.

11.10.6 Evidence; Broadening the Issues

(a) The Presiding Officer shall admit evidence if it is relevant to an issue at the hearing.

(b) The Presiding Officer may exclude evidence that is irrelevant, immaterial, or unduly repetitious.

(c) No person will be allowed to appear in any hearing whose appearance, in the opinion of the Presiding Officer, is for the sole purpose of unduly broadening the issues to be considered in the hearing.

11.10.7 Continuance: The Presiding Officer may continue hearings or other proceedings from time to time and from place to place without the necessity of publishing, serving, mailing, or otherwise issuing a new notice. If a hearing or other proceeding is continued and a time and place for the hearing or other proceeding to reconvene are not publicly announced at the hearing or other proceeding by the Presiding Officer before it is recessed, a notice of any further setting of the hearing or other proceeding which shall include the date, hour, place and subject of the meeting will be provided by regular mail at a reasonable time to the parties and any other person the Presiding Officer deems appropriate, but it is not necessary to post or publish a notice of the new setting, except as required by the Texas Open Meetings Act. A continuance may not exceed the time limit for the issuance of a final decision under Section 36.4165 of the Texas Water Code. This rule applies only to permit hearings.

11.10.8 Uncontested Hearings: If no persons timely protest the application and the General Manager proposes to grant the application, the application shall be considered uncontested and the General Manager may act on the application without subjecting the application to a permit hearing before the Board.

(a) The Board may take action on any uncontested application at a properly noticed public meeting held at any time after the public hearing at which the application is scheduled to be heard. The Board may issue a written order to:

(1) grant the application;

(2) grant the application with special conditions; or

(3) deny the application.

(b) An applicant may, not later than the 20th day after the date the Board issues an order granting the application, demand a contested case hearing if the order:

(1) includes special conditions that were not part of the application as finally submitted; or

(2) grants a maximum amount of groundwater production that is less than the amount requested in the application.

(c) If, during a contested case hearing, all interested persons contesting the application withdraw their protests or are found by the Board not to have a justiciable interest affected by the application, or the parties reach a negotiated or agreed settlement which, in the judgment of the Board, settles the facts or issues in controversy, the proceeding will be considered an uncontested hearing and the Board may take any action authorized under District Rule 11.10.8(a).

11.10.9 Proposal for Decision: If the hearing was conducted by a quorum of the Board and if the Presiding Officer prepared a record of the hearing as provided by Rule 11.10.5(a), the Presiding Officer shall determine whether to prepare and submit a Proposal for Decision ("PFD") to the Board under this rule. If a PFD is required, the Presiding Officer shall submit a PFD to the Board within 30 days after the date the hearing is finally concluded. The PFD must include a summary of the subject matter of the hearing, the evidence or public comments received, and the Presiding Officer's recommendations for Board action on the subject matter of the hearing. A copy of the PFD shall be provided to the applicant and each designated party. The applicant and any designated party may submit to the Board written exceptions to the PFD. The Presiding Officer may direct the General

Manager or another District representative to prepare the PFD and recommendations required by this Rule. The Board shall consider the PFD at a final hearing. Additional evidence may not be presented during this final hearing, however the parties may present oral argument to summarize the evidence, present legal argument, or argue an exception to the PFD. A final hearing may be continued in accordance with Rule 11.10.7 and Section 36.409, Texas Water Code.

11.10.10 Board Action: Either on the final hearing date or no later than 60 (sixty) calendar days after the final hearing date is concluded, the Board must take action on the subject matter of the hearing.

(a) In deciding whether or not to issue or amend a Drilling Permit, Production Permit, or Historic and Existing Use Permit, and in setting the permitted volume and other terms of a permit, the Board must consider whether:

(1) the application contains accurate information and conforms to the requirements prescribed by Chapter 36, Texas Water Code;

(2) the water well(s) complies with spacing and production limitations identified in these rules;

(3) the proposed use of water does or does not unreasonably affect existing groundwater and surface water resources or existing permit holders;

(4) the proposed use of water is dedicated to a beneficial use;

(5) the proposed use of water is consistent with the District Management Plan;

(6) the applicant agrees to avoid waste and achieve water conservation;

(7) the applicant has agreed that reasonable diligence will be used to protect groundwater quality and that the applicant will follow well plugging guidelines at the time of well closure; and

(8) for those hearings conducted by SOAH under Rule 11.10.4, the Board shall consider the Proposal for Decision and Findings of Fact and Conclusions of Law issued by SOAH.

(b) In deciding whether or not to modify a permit, and in setting the modified permitted volume and other terms of a permit, the Board must consider whether the data from monitoring wells within the source aquifer or other evidence reflects:

(1) an unacceptable level of decline in water quality of the aquifer;

(2) that modification of the permit is necessary to prevent waste and achieve water conservation;

(3) that modification of the permit will minimize as far as practicable the drawdown of the water table or the reduction of artesian pressure;

(4) that modification of the permit will lessen interference between wells;

(5) that modification of the permit will control and prevent subsidence; and

(6) that modification of the permit is necessary to avoid impairment of Desired Future Conditions.

(c) The Board shall consider the relevant criteria and observe the relevant restrictions and may exercise the authority set forth in Sections 36.113, 36.1131, and 36.122 of the Texas Water Code. In issuing permits, the District shall manage total groundwater production on a long-term basis to achieve an applicable Desired Future Condition and consider:

(1) the Modeled Available Groundwater;

(2) the TWDB Executive Administrator's estimate of the current and projected amount of groundwater produced under exemptions granted by District Rule 11.3 and Section 36.117, Texas Water Code;

(3) the amount of groundwater authorized under permits previously issued by the District;

(4) a reasonable estimate of the amount of groundwater that is actually produced under permits issued by the District; and

(5) yearly precipitation and production patterns.

(d) The District may not impose any restrictions on the production of groundwater for use outside of the District other than imposed upon production for in-district use, and shall be fair, impartial, and nondiscriminatory.

11.10.11 Request for Rehearing and Appeal:

(a) An applicant in a contested or uncontested hearing on an application or a party to a contested hearing may administratively appeal a decision of the Board on a permit or permit amendment application by requesting written findings of fact and conclusions of law from the Board not later than the 20th calendar day after the date of the decision.

(b) On receipt of a timely written request, the Board shall make written findings and conclusions regarding a decision of the Board on a permit or permit amendment application. The Board shall provide certified copies of the findings and conclusions to the party who requested them, and to each designated party, not later than the 35th calendar day after the date the Board receives the request. A party to the contested case hearing may request a rehearing before the Board not later than the 20th calendar day after the date the Board issues the findings and conclusions. A party to a contested hearing must first make a request for written findings and conclusions under District Rule 11.10.11(a) before a party to the contested case may submit a request for rehearing under this rule.

(c) A request for rehearing must be filed in the District office and must state clear and concise grounds for the request. The person requesting a rehearing must provide copies of the request to all parties to the hearing.

(d) If the Board grants a request for rehearing, the Board shall, after proper notice, schedule the rehearing not later than the 45th calendar day after the date the request is granted.

(e) The failure of the Board to grant or deny a request for rehearing before the 91st calendar day after the date the request is submitted is a denial of the request.

(f) A decision by the Board on a permit or permit amendment application is final:

(1) if a request for rehearing is not filed on time, on the expiration of the period for filing a request for rehearing;

(2) if a request for rehearing is filed on time and the Board denies the request for rehearing, on the date the Board denies the request for rehearing; or

(3) if a request for rehearing is filed on time and the Board grants the request for rehearing:

(A) on the final date of the rehearing if the Board does not take further action;

(B) if the Board takes further action after rehearing, on the expiration of the period for filing a request for rehearing on the Board's modified decision if a request for rehearing is not timely filed; or

(C) if the Board takes further action after rehearing and another request for rehearing on this Board action is timely filed, then Subsections 3(A) and (C) of this rule shall govern the finality of the Board's decision.

(g) The applicant or party to a contested case hearing must exhaust all administrative remedies with the District prior to seeking judicial relief from a District decision on a permit or permit amendment application. After all administrative remedies are exhausted with the District, an applicant or a party to a contested case hearing must file suit in a court of competent jurisdiction in Pecos County to appeal the District's decision on a permit or permit amendment application within 60 (sixty) calendar days after the date the District's decision is final. An applicant or party to a contested case hearing is prohibited from filing suit to appeal a District's permitting decision if a request for rehearing was not timely filed.

(h) The Board shall consolidate requests for rehearing filed by multiple parties to the contested case hearing but only one rehearing may be considered per matter.

SECTION 12. REWORKING AND REPLACING A WELL

RULE 12.1 REWORKING AND REPLACING A WELL

(a) An existing well may be reworked or re-equipped in a manner that will not change the existing well status.

(b) A permit must be applied for and granted by the Board if a party wishes to replace an existing well with a replacement well.

(c) A replacement well, in order to be considered such, must be drilled within a reasonable distance of the existing well as long as it meets the District's spacing requirements.

(d) In the event the application meets spacing and production requirements, the General Manager may grant such application without further notice.

SECTION 13. WELL LOCATION AND COMPLETION

RULE 13.1 RESPONSIBILITY

(a) After an application for a well Drilling Permit has been granted, the well or wells, if drilled, must be drilled within a reasonable distance of the location specified in the Drilling Permit, and not elsewhere, provided, however, that spacing restrictions be met. If the well or wells are drilled at a different location, the drilling or operation of such well may be enjoined by the Board pursuant to Chapter 36, Texas Water Code.

(b) As described in the Texas Water Well Drillers' Rules, all well drillers and persons having any exempt or nonexempt well drilled, deepened, or otherwise altered shall adhere to the provisions of the rule prescribing the location of wells and proper completion. Each and every exempt and nonexempt well shall be completed in accordance with all statutory and regulatory requirements applicable to the type of well required for the purpose of use authorized under the permit. The driller of any exempt or nonexempt well shall file with the District the well log required by Section 1901.251, Texas Occupations Code, and, if available, the geophysical log and electric log.

RULE 13.2 LOCATION OF DOMESTIC, INDUSTRIAL, INJECTION, IRRIGATION WELLS

Location of wells should be as specified in *16 Texas Administrative Code, Chapter 76.1000*.

RULE 13.3 STANDARDS OF COMPLETION FOR DOMESTIC, INDUSTRIAL, INJECTION, AND IRRIGATION WELLS

Standards of completion shall be as specified in *16 Texas Administrative Code, Chapter 76.1000.*

RULE 13.4 RE-COMPLETIONS

Standards shall be as specified in *16 Texas Administrative Code, Chapter 76.1003*.

RULE 13.5 SPACING REQUIREMENTS

(a) Spacing and Location of Existing Wells: Wells drilled prior to the Effective Date of these rules are not subject to spacing requirements of this rule except that these existing wells shall have been drilled in accordance with state law in effect, if any, on the date such drilling commenced.

(b) Spacing and Location of New Wells: All new permitted wells must comply with the spacing and location requirements set forth under the Texas Water Well Drillers and Pump Installers Administrative Rules, Title 16, Part 4, Chapter 76, Texas Administrative Code, except that wells shall not be located within 50 (fifty) feet from a property line or any existing well. Water well drillers shall indicate the method of completion performed on the Well Report (Texas Department of Licensing and Regulation Form #001 WWD, Section 10, Surface Completion). The District does not impose any additional requirements, but shall consider evidence submitted at the hearing on the permit application that demonstrates that the proposed new well(s) adversely impact and interfere with neighboring wells.

(c) Exceptions to Spacing Requirements:

(1) The Board may grant exceptions to the spacing requirements of the District if the requirements of this section are met.

(2) If an exception to the spacing requirements of the District is desired, the person seeking the exception shall submit an application to the Board and provide written notice of the application to all owners of adjacent property and owners of registered wells located on adjacent property. In the application, the applicant must explain the circumstances justifying an exception to the spacing requirements of the District. The application must include a plat or sketch, drawn to scale, one inch equaling 200 feet. The application and plat must be certified by some person actually acquainted with the facts who shall state that the facts contained in the application and plat are true and correct, and that notice was sent to each of the appropriate property and well owners.

(3) The Board shall conduct a hearing within 65 (sixty-five) calendar days after the application is administratively complete, and no sooner than 20 (twenty) calendar days after the applicant’s notice was sent to each of the appropriate property and well owners. The District shall post notice and conduct the public hearing in accordance with Section 11 of the District’s rules. Provided, however, if all owners of adjacent property and owners of registered wells execute a waiver in writing, stating that they do not object to the granting of the exception, the Board may proceed, upon notice to the applicant only and without hearing, and determine the outcome of the application. The applicant may waive notice or hearing or both.

(4) If the applicant presents waivers signed by all landowners and well owners whose property or permitted wells would be located within the applicable minimum distance established under these Rules from the proposed well site stating that they have no objection to the proposed location of the well site, the Board, upon the General Manager’s recommendation, may waive certain spacing requirements for the proposed well location.

SECTION 14. WASTE AND BENEFICIAL USE

RULE 14.1 DEFINITION OF WASTE

“Waste” means any one or more of the following:

(a) withdrawal of groundwater from a groundwater reservoir at a rate and in an amount that causes or threatens to cause intrusion into the reservoir of water unsuitable for municipal, industrial, agricultural, gardening, domestic, or stock raising purposes;

(b) the flowing or producing of wells from a groundwater reservoir if the water produced is not used for a beneficial purpose, or is not used for such purposes with a reasonable degree of efficiency. Includes line losses in excess of those determined to be unavoidable.

(c) escape of groundwater from a groundwater reservoir to any other reservoir or geologic strata that does not contain groundwater;

(d) pollution or harmful alteration of groundwater in a groundwater reservoir by saltwater or by other deleterious matter admitted from another stratum or from the surface of the ground;

(e) willfully or negligently causing, suffering, or allowing groundwater to escape into any river, creek, natural watercourse, depression, lake, reservoir, drain, sewer, street, highway, road, or road ditch, or onto any land other than that of the owner of the well other than the natural flow of natural springs unless such discharge is authorized by permit, rule, or order issued by TCEQ under Chapter 26 of the Texas Water Code, *Water Quality Control*;

(f) groundwater pumped for irrigation that escapes as irrigation tailwater onto land other than that of the owner of the well unless permission has been granted by the occupant of the land receiving the discharge;

(g) groundwater used for heating or cooling that is allowed to drain on the land surface as tailwater and not re-circulated back to the aquifer;

(h) the loss of groundwater in the distribution system and/or storage facilities of the water supply system which should not exceed acceptable "system water losses" as defined by the American Water Works Association standard; or

(i) Pursuant to Section 11.205 of the Texas Water Code, unless the water from an artesian well is used for a purpose and in a manner in which it may be lawfully used on the owner's land, it is waste and unlawful to willfully cause or knowingly permit the water to run off the owner's land or to percolate through the stratum above which the water is found.

RULE 14.2 WASTEFUL USE OR PRODUCTION

(a) No person shall intentionally or negligently commit waste.

(b) Underground water shall not be produced within, or used within or without the District in such a manner as to constitute waste.

(c) Any person producing or using groundwater shall use every possible precaution, in accordance with the most approved methods, to stop and prevent waste of water.

RULE 14.3 POLLUTION OR DEGRADATION OF QUALITY OF GROUNDWATER

(a) No person shall cause pollution or harmfully alter the character of the underground water of the District by means of salt water or other deleterious matter admitted from another stratum or strata or from the surface of the ground, or from the operation of a well.

(b) No person shall cause pollution or harmfully alter the character of the underground water of the District by activities on the surface of the ground which cause or allow pollutants to enter the groundwater through recharge features, whether natural or manmade.

(c) No person shall cause degradation of the quality of groundwater.

RULE 14.4 ORDERS TO PREVENT WASTE, POLLUTION, OR DEGRADATION OF QUALITY OF GROUNDWATER

After providing 15 (fifteen) calendar days' notice to affected parties and an opportunity for a hearing, the Board may adopt orders to prohibit or prevent waste, pollution, or degradation of the quality of groundwater. If the factual basis for the order is disputed, the Board shall direct that an evidentiary hearing be conducted prior to consideration and decision on the entry of such an order. If the Board President or his or her designee determines that an emergency exists requiring the immediate entry of an order to prohibit waste or pollution and protect the public health, safety, and welfare, he or she may enter a temporary order without notice and hearing provided, however, the temporary order shall continue in effect for the lesser of 15 (fifteen) calendar days or until a hearing can be conducted. In such an emergency, the Board President or his or her designee is also authorized, without notice or hearing to pursue a temporary restraining order, injunctive, and other appropriate relief in a court of competent jurisdiction.

RULE 14.5 REQUIRED EQUIPMENT ON WELLS FOR THE PROTECTION OF GROUNDWATER QUALITY

14.5.1 EQUIPMENT REQUIRED. The following equipment must be installed on all wells having a chemical injection, chemigation or foreign substance unit in the water delivery system: an in-line, automatic quick-closing check valve capable of preventing pollution or harmful alteration of the groundwater. Such equipment must be installed on all new wells at the time of completion. Such equipment shall be installed on all existing wells the next time the wells are serviced.

14.5.2 CHECK VALVES. The type of check valve installed shall meet the following specifications:

(a) Check valves must be equipped with a TCEQ-approved hazardous materials backflow device, and installed in a manner approved by Texas Department of Licensing and Regulation ("TDLR").

(b) A vacuum-relief device shall be installed between the pump discharge and the check valve in such a position and in such a manner that insects, animals, floodwater, or other pollutants cannot enter the well though the vacuum-relief device. The vacuum-relief device may be mounted on the inspection port as long as it does not interfere with the inspection of other anti-pollution devices.

SECTION 15. INVESTIGATIONS AND ENFORCEMENT

RULE 15.1 NOTICE AND ACCESS TO PROPERTY

Board Members and District agents and employees are entitled to access to all property within the District to carry out technical and other investigations necessary to the implementation of the District's rules. Prior to entering upon property for the purpose of conducting an investigation, the person seeking access must give notice in writing or in person or by telephone to the owner, lessee, or operator, agent, or employee of the well owner or lessee, as determined by information contained in the application or other information on file with the District. Notice is not required if prior permission is granted to enter without notice. Inhibiting or prohibiting access to any Board Member or District agents or employees who are attempting to conduct an investigation under the District's rules constitutes a violation and subjects the person who is inhibiting or prohibiting access, as well as any other person who authorizes or allows such action, to the penalties set forth in Texas Water Code Chapter 36.

RULE 15.2 CONDUCT OF INVESTIGATION

Investigations or inspections by the District that require entrance upon property must be conducted at reasonable times, and must be consistent with the establishment's rules and regulations concerning safety, internal security, and fire protection. The District representative or representatives conducting such investigations must identify themselves and present credentials upon request of the owner, lessee, operator, or person in charge of the well or property.

RULE 15.3 RULE ENFORCEMENT; ENFORCEMENT HEARING

15.3.1 If it appears that a person has violated or is violating any provision of the District's rules, the District may employ any of the following means, or a combination thereof, in providing notice of the violation:

(a) Informal Notice: The officers, staff or agents of the District acting on behalf of the District or the Board may inform the person of the violation via telephone by informing, or attempting to inform, the appropriate person to explain the violation and the steps necessary to cure the violation. The information received by the District through this informal notice concerning the violation and the date and time of the telephone call will be documented and will remain in the District's files. Nothing in this subsection shall limit the authority of the District to take action, including emergency actions or any other appropriate enforcement action, without prior notice provided under this subsection.

(b) Written Notice of Violation: The District may inform the person of the violation through written notice of violation. Each notice of violation issued herein shall explain the basis of the violation, identify the rule or order that has been violated or is currently being violated, and list specific required actions that must be satisfactorily completed to cure a past or present violation to address each violation raised, and may include the payment of applicable civil penalties. Notice of a violation issued herein shall be provided through a delivery method in compliance with these Rules. Nothing in this Subsection shall limit the authority of the District to take action, including emergency actions or any other appropriate enforcement action, without prior notice provided under this subsection.

(c) Compliance Meeting: The District may hold a meeting with any person whom the District believes to have violated, or to be violating, a District rule or order to discuss each such violation and the steps necessary to satisfactorily remedy each such violation. The General Manager may conduct a compliance meeting without the Board, unless otherwise determined by the Board or General Manager. The information received in any meeting conducted pursuant to this subsection concerning the violation will be documented, along with the date and time of the meeting, and will be kept on file with the District. Nothing in this subsection shall limit the authority of the District to take action, including emergency actions or any other appropriate enforcement action, without prior notice provided under this subsection.

15.3.2 Show Cause Hearing.

(a) Upon recommendation of the General Manager to the Board or upon the Board's own motion, the Board may order any person that it believes has violated or is violating any provision of the District's rules a District order to appear before the Board at a public meeting, held in accordance with the Texas Open Meetings Act, and called for such purpose and to show cause of the reasons an enforcement action, including the assessment of civil penalties and initiation of a suit in a court of competent jurisdiction in Pecos County, should not be pursued against the person made the subject of the show cause hearing. The Presiding Officer may employ the procedural rules in Section 11 of the District's rules.

(b) No show cause hearing under subsection (a) of this Rule may be conducted unless the District serves, on each person made the subject of the show cause hearing, a written notice ten (10) calendar days prior to the date of the hearing. Such notice shall include all of the following information:

(1) the time, date, and place for the hearing; and
(2) the basis of each asserted violation; and
(3) the rule or order that the District believes has been violated or is currently being violated; and
(4) a request that the person duly appear and show cause of the reasons an enforcement action should not be pursued.

(c) The District may pursue immediate enforcement action against the person cited to appear in any show cause order issued by the District where the person cited fails to appear and show cause of the reasons an enforcement action should not be pursued.

(d) Nothing in this rule shall constrain the authority of the District to take action, including emergency actions or any other enforcement action, against a person at any time, regardless of whether the District decides to hold a hearing under this Section.

15.3.3 Remedies

(a) The Board shall consider the appropriate remedies to pursue against an alleged violator during the show cause hearing, including assessment of a civil penalty, injunctive relief, or assessment of a civil penalty and injunctive relief. In assessing civil penalties, the Board may determine that each day that a violation continues shall be considered a separate violation. The civil penalty for a violation of any District rule is hereby set at the lower of $10,000.00 per violation or a lesser amount determined after consideration, during the enforcement hearing, of the criteria in subsection (b) of this rule.

(b) In determining the amount of a civil penalty, the Board of Directors shall consider the following factors:

(1) compliance history;
(2) efforts to correct the violation and whether the violator makes a good faith effort to cooperate with the District;
(3) the penalty amount necessary to ensure future compliance and deter future noncompliance;
(4) any enforcement costs related to the violation; and
(5) any other matters deemed necessary by the Board.

15.3.4 The District shall collect all past due fees and civil penalties accrued that the District is entitled to collect under the District's rules. The District shall provide written notice of the alleged violation and show cause hearing by certified mail, return receipt requested, hand delivery, first class mail, facsimile, email, FedEx, UPS, or any other type of public or private courier or delivery service. If the District is unable to provide notice to the alleged violator by any of these forms of notice, the District may tape the notice on the door of the alleged violator's office or home, or post notice in the newspaper of general circulation in the District and within the county in which the alleged violator resides or in which the alleged violator's office is located. Any person or entity in violation of these rules is subject to all past due fees and civil penalties along with all fees and penalties occurring as a result of any violations that ensue after the District provides written notice of a violation. Failure to pay required fees will result in a violation of the District's rules and such failure is subject to civil penalties.

15.3.5 The District may afford an opportunity to the alleged violator to cure a violation through coordination and negotiation with the District.

15.3.6 After conclusion of the show cause hearing, the District may commence suit. Any suit shall be filed in a court of competent jurisdiction in Pecos County. If the District prevails in a suit brought under this Section, the District may seek and the court shall grant, in the interests of justice and as provided by Subsection 36.066(h), Texas Water Code, in the same action, recovery of attorney's fees, costs for expert witnesses, and other costs incurred by the District before the court.

RULE 15.4 SEALING OF WELLS

Following notice to the well owner and operator and upon resolution by the Board, the District may seal wells that are prohibited from withdrawing groundwater within the District to ensure that such wells are not operated in violation of the District's rules. A well may be sealed when: (1) no application has been made for a permit to drill a new water well which is not excluded or exempted; or (2) no application has been made for a Production permit to withdraw groundwater from an existing well that is not excluded or exempted from the requirement that a permit be obtained in order to lawfully withdraw groundwater; or (3) the Board has denied, canceled or revoked a Drilling Permit or a Production permit.

The well may be sealed by physical means, and tagged to indicate that the well has been sealed by the District, and other appropriate action may be taken as necessary to preclude operation of the well or to identify unauthorized operation of the well.

Tampering with, altering, damaging, or removing the seal of a sealed well, or in any other way violating the integrity of the seal, or pumping of groundwater from a well that has been sealed constitutes a violation of these rules and subjects the person performing that action, as well as any well owner or primary operator who authorizes or allows that action, to such penalties as provided by the District's rules.

RULE 15.5 CAPPING AND PLUGGING OF WELLS

(a) The District may require a well to be capped to prevent waste, prevent pollution, or prevent further deterioration of a well casing. The well must remain capped until such time as the conditions that led to the capping requirement are eliminated. If well pump equipment is removed from a well and the well will be re-equipped at a later date, the well must be capped, provided however that the casing is not in a deteriorated condition that would permit co-mingling of water strata, in which case the well must be plugged. The cap must be capable of sustaining a weight of at least four hundred (400) pounds and must be constructed with a water tight seal to prevent entrance of surface pollutants into the well itself, either through the well bore or well casing.

(b) A deteriorated or abandoned well must be plugged in accordance with the Texas Department of License and Regulation, Water Well Drillers and Pump Installers Rules (16 TAC Chapter 76). It is the responsibility of the landowner to see that such a well is plugged to prevent pollution of the underground water and to prevent injury to persons and animals. Registration of the well is required prior to, or in conjunction with, well plugging.

Any person that plugs a well in the District must submit a copy of the plugging report to the District and the Texas Department of License and Regulation within 30 (thirty) calendar days of plugging completion.

(c) If the owner or lessee fails or refuses to plug or cap the well in compliance with this rule and District standards within 30 (thirty) calendar days after being requested to do so in writing by an officer, agent, or employee of the District, then, upon Board approval, any person, firm, or corporation employed by the District may go on the land and plug or cap the well safely and securely, pursuant to TWC Chapter 36.118.

Reasonable expenses incurred by the District in plugging or capping a well constitutes a lien on the land on which the well is located.

The District shall perfect the lien by filing in the deed records an affidavit, executed by any person conversant with the facts, stating the following:

(1) the existence of the well;
(2) the legal description of the property on which the well is located;
(3) the approximate location of the well on the property;
(4) the failure or refusal of the owner or lessee, after notification, to close the well within 30 (thirty) calendar days after the notification;
(5) the closing of the well by the District, or by an authorized agent, representative, or employee of the District; and
(6) the expense incurred by the District in closing the well.

SECTION 16. FEES

RULE 16.1 GROUNDWATER EXPORT FEE

(a) The District may impose an export fee or surcharge, established by Board resolution, for export of groundwater out of the District using one of the following methods:

(1) a fee negotiated between the District and the exporter; or

(2) a rate not to exceed 20 (twenty) cents for each thousand gallons of water exported from the District.

If a production fee is assessed, this export fee shall not exceed 10 percent of the amount of the fee assessed for the production of water for use within the District.

(b) Payment of the Groundwater Export Fee shall be made at a time negotiated under 16.1(a)(1) or no later than the payment deadline established by the General Manager.

(c) Effective January 1, 2024, the maximum allowable rate the District may impose for an export fee under Rule 16.1(a)(2) shall increase each calendar year in accordance with Section 36.122(e-1) of the Texas Water Code. An increase in the export fee is not valid unless it is approved by the Board after a public hearing. The District may only use funds obtained from the rate increase under this subsection for costs related to assessing and addressing impacts associated with groundwater development as provided by Section 36.207 of the Texas Water Code Section, including:

(A) maintaining operability of wells significantly affected by groundwater development;

(B) developing or distributing alternative water supplies; and

(C) conducting aquifer monitoring, data collection, and aquifer science.

RULE 16.2 RETURNED CHECK FEE

Any person who tenders to the District a check that is returned to the District for insufficient funds, account closed, signature missing, or any other reason shall immediately remit funds to the District in the amount of the check that was returned and reimburse the District for any expenses associated with the returned check that were incurred by the District.

SECTION 17. PROPOSED DESIRED FUTURE CONDITIONS; PUBLIC COMMENT, HEARING, AND BOARD ADOPTION; APPEAL OF DESIRED FUTURE CONDITIONS

RULE 17.1 PUBLIC COMMENT

Upon receipt of proposed Desired Future Conditions from the Groundwater Management Area's district representatives, a public comment period of 90 (ninety) calendar days commences, during which the District will receive written public comments and conduct at least one hearing to allow public comment on the proposed Desired Future Conditions relevant to the District. The District will make available at the Distriict Office a copy of the proposed Desired Future Conditions and any supporting materials, such as the documentation of factors considered under Subsection 36.108(d) and groundwater availability model run results.

RULE 17.2 NOTICES OF HEARING AND MEETING

(a) At least ten (10) calendar days before a hearing or meeting under this Section, the Board must post notice that includes:

    (1) the proposed Desired Future Conditions and a list of any other agenda items;
    (2) the date, time, and location of the hearing;
    (3) the name, telephone number, and address of the person to whom questions or requests for additional information may be submitted;
    (4) the names of the other districts in the District's management area; and
    (5) information on how the public may submit comments.

(b) Except as provided by Subsection (a), the hearing and meeting notice must be provided in the manner prescribed for a rulemaking hearing under Rule 6.2(b) and Subsection 36.101(d), Texas Water Code.

RULE 17.3 HEARING

The District shall hold a public hearing to accept public comments using procedures prescribed in Section 6 of these rules.

RULE 17.4 DISTRICT'S REPORT ON PUBLIC COMMENTS AND SUGGESTED REVISIONS

After the public hearing, the District shall compile for consideration at the next joint planning meeting a summary of relevant comments received, any suggested revisions to the proposed Desired Future Conditions, and the basis for any suggested revisions.

RULE 17.5 BOARD ADOPTION OF DESIRED FUTURE CONDITIONS

As soon as possible after the District receives the Desired Future Conditions resolution and explanatory report from the Groundwater Management Area's district representatives pursuant to Subsection 36.108(d-3), the Board shall adopt the Desired Future Conditions in the resolution and explanatory report that apply to the District. The Board shall issue notice of its meeting at which it will take action on the Desired Future Conditions in accordance with Rule 17.2(a) and (b).

RULE 17.6 APPEAL OF DESIRED FUTURE CONDITIONS

(a) Not later than 120 (one hundred twenty) calendar days after the date on which the District adopts a Desired Future Condition under Subsection 36.108(d-4), Texas Water Code, a person determined by the District to be an affected person may file a petition appealing the reasonableness of a Desired Future Condition. The petition must include:

  (1) evidence that the petitioner is an affected person;

  (2) a request that the District contract with SOAH to conduct a hearing on the petitioner's appeal of the reasonableness of the Desired Future Condition;

  (3) evidence that the districts did not establish a reasonable Desired Future Condition of the groundwater resources within the relevant Groundwater Management Area.

(b) Not later than ten (10) calendar days after receiving a petition described by Subsection (a), the District's Presiding Officer shall determine whether the petition was timely filed and meets the requirements of Rule 17.6(a) and, if so, shall submit a copy of the petition to the TWDB. If the petition was untimely or did not meet the requirements of Rule 17.6(a), the District's Presiding Officer shall return the petition to the petitioner advising of the defectiveness of the petition. Not later than 60 (sixty) calendar days after receiving a petition under Rule 17.6(a), the District shall:

  (1) contract with SOAH to conduct the requested hearing; and

  (2) submit to SOAH a copy of any petitions related to the hearing requested under Rule 17.6(a) and received by the District.

(c) A hearing under District Rule 17.6 must be held:

  (1) at the District office or Pecos County Courthouse unless the District's Board provides for a different location; and

  (2) in accordance with Chapter 2001, Texas Government Code, and SOAH's rules.

  Not less than ten (10) calendar days prior to the date of the hearing, notice may be provided by regular mail to landowners who, in the discretion of the General Manager, may be affected by the application.

(d) Not less than ten (10) calendar days prior to the date of the SOAH hearing under this rule, notice shall be issued by the District and meet the following requirements:

(1) state the subject matter, time, date, and location of the hearing;

(2) be posted at a place readily accessible to the public at the District's office;

(3) be provided to the County Clerk of Pecos County, whereupon the County Clerk shall post the notice on a bulletin board at a place convenient to the public in the County Courthouse; and

(4) be sent by certified mail, return receipt requested; hand delivery; first class mail; fax; email; FedEx; UPS; or any other type of public or private courier or delivery service to:

(A) the petitioner;

(B) any person who has requested notice in writing to the District;

(C) each nonparty district and regional water planning group located within the same Groundwater Management Area as a district named in the petition;

(D) TWDB's Executive Administrator; and

(E) TCEQ's Executive Director.

If the District is unable to provide notice by any of these forms of notice, the District may tape the notice on the door of the individual's or entity's office or home, or post notice in the newspaper of general circulation in the District and within the county in which the person or entity resides or in which the person's or entity's office is located.

(e) Before a hearing is conducted under this rule, SOAH shall hold a prehearing conference to determine preliminary matters, including:

(1) whether the petition should be dismissed for failure to state a claim on which relief can be granted;

(2) whether a person seeking to participate in the hearing is an affected person who is eligible to participate; and

(3) each affected person that shall be named as a party to the hearing.

(f) The petitioner shall pay the costs associated with the contract for the hearing conducted by SOAH under this rule. The petitioner shall deposit with the District an amount sufficient to pay the contract amount before the hearing begins. After the hearing, SOAH may assess costs to one or more of the parties participating in the hearing and the District shall refund any money exceeding actual hearing costs to the petitioner. SOAH shall consider the following in apportioning costs of the hearing:

(1) the party who requested the hearing;

(2) the party who prevailed in the hearing;

(3) the financial ability of the party to pay the costs;

(4) the extent to which the party participated in the hearing; and

(5) any other factor relevant to a just and reasonable assessment of costs.

(g) On receipt of the SOAH Administrative Law Judge's findings of fact and conclusions of law in a proposal for decision, which may include a dismissal of a petition, the District shall issue a final order stating the District's decision on the contested matter and the District's findings of fact and conclusions of law. The District may change a finding of fact or conclusion of law made by the Administrative Law Judge, or may vacate or modify an order issued by the Administrative Law Judge, as provided by Section 2001.058(e), Texas Government Code.

(h) If the District vacates or modifies the proposal for decision, the District shall issue a report describing in detail the District's reasons for disagreement with the Administrative Law Judge's findings of fact and conclusions of law. The report shall provide the policy, scientific, and technical justifications for the District's decision.

(i) If the District in its final order finds that a Desired Future Condition is unreasonable, not later than the 60th calendar day after the date of the final order, the District shall coordinate with the districts in the Groundwater Management Area at issue to reconvene in a joint planning meeting for the purpose of revising the Desired Future Condition found to be unreasonable in accordance with the procedures in Section 36.108, Texas Water Code.

(j) The Administrative Law Judge may consolidate hearings requested under this rule that affect two or more districts. The Administrative Law Judge shall prepare separate findings of fact and conclusions of law for each district included as a party in a multidistrict hearing.

SECTION 18. AQUIFER STORAGE AND RECOVERY (ASR)

RULE 18.1 APPLICABILITY OF DISTRICT'S RULES TO ASR PROJECTS

(a) As a general matter, TCEQ has exclusive jurisdiction over the regulation and permitting of ASR Injection Wells. However, the District has concurrent jurisdiction over an ASR Injection Well that also functions as an ASR Recovery Well. The District is entitled to notice of and may seek to participate in an ASR permitting matter pending at TCEQ and, if the District qualifies as a party, in a contested hearing on an ASR application.

(b) The provisions of District Rule 18.1 apply to an ASR Recovery Well that also functions as an ASR Injection Well.

(c) A Project Operator shall:

(1) register an ASR Injection Well and ASR Recovery Well associated with the ASR Project if a well is located in the District;

(2) submit to the District the monthly report required to be provided to TCEQ under Section 27.155, Texas Water Code, at the same time the report is submitted to TCEQ; and

(3) submit to the District the annual report required to be provided to TCEQ under Section 27.156, Texas Water Code, at the same time the report is submitted to TCEQ.

(d) If an ASR Project recovers an amount of groundwater that exceeds the volume authorized by TCEQ to be recovered under the project, the Project Operator shall report to the District the volume of groundwater recovered that exceeds the volume authorized to be recovered in addition to providing the report required by District Rule 18.1(c)(2).

(e) Except as provided by District Rule 18.1(f), the District may not require a permit for the drilling, equipping, operation, or completion of an ASR Injection Well or an ASR Recovery Well that is authorized by TCEQ.

(f) Each ASR Recovery Well that is associated with an ASR Project is subject to the permitting, spacing, and production requirements of the District if the amount of groundwater recovered from the wells will exceed the volume authorized by TCEQ to be recovered under the project. The requirements of the District apply only to the portion of the volume of groundwater recovered from the ASR Recovery Well that exceeds the volume authorized by TCEQ to be recovered.

(g) A Project Operator may not recover groundwater from an ASR Project in an amount that exceeds the volume authorized by TCEQ to be recovered under the project unless the Project Operator complies with the applicable requirements of the District as described by this rule.

(h) The District may not assess a production fee or export fee or surcharge for groundwater recovered from an ASR Recovery Well, except to the extent that the amount of groundwater recovered under the ASR Project exceeds the volume authorized by TCEQ to be recovered.

(i) The District may consider hydrogeologic conditions related to the injection and recovery of groundwater as part of an ASR Project in the planning for and monitoring of the achievement of a Desired Future Condition for the aquifer in which the wells associated with the project are located.

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MIDDLE PECOS
Groundwater Conservation District
P. O. Box 1644, Fort Stockton, Texas 79735
Phone: 432/336-0698; Fax: 432/336-3407
Email: mpgcd@mpgcd.org

PETITION TO ADOPT OR MODIFY A DISTRICT RULE

Instructions: This Petition to Adopt or Modify a District Rule form must be completed as required by District Rule 6.5 and filed at the District office. Each rule adoption or modification requested must be submitted on a separate Petition to Adopt or Modify a District Rule form.

A person unable to comply with any procedures under District Rule 6.5, or to provide the information required by this form, may file a written explanation as to why compliance with the required procedure(s) is not possible along with a written request that the District waive the specific procedure(s). The written explanation and written request must be submitted to the District Office at the same time as this Form.

Additional information may be attached to this form.

1. **Text of Proposed Rule or Rule Modification** (underline words proposed to be added to the text of the current rules and strike through words proposed to be deleted from the text of the current rules):

2. **Written Explanation of the Intended Purpose of the Proposed Rule or Rule Modification:**

3. **Allegation of Injury or Inequity that could Result from Failure to Adopt Proposed Rule or to Modify Current Rule:**

4. **Description of Petitioner(s) Real Property Interest in Groundwater in the District** (attach proof of real property interest in groundwater located within the District for each petitioner):

<u>Petitioner(s) Information</u> (Please include information for additional petitioners as appropriate).

Petitioner #1:

First Name	Last Name	Phone Number	Email Address	
Physical Address		City	State	Zip code
Mailing Address		City	State	Zip code

Signature *Date*

Petitioner #2:

First Name	Last Name	Phone Number	Email Address	
Physical Address		City	State	Zip code
Mailing Address		City	State	Zip code

Signature *Date*

Petitioner #3:

First Name	Last Name	Phone Number	Email Address	
Physical Address		City	State	Zip code
Mailing Address		City	State	Zip code

Signature *Date*

Additional information may be attached to this form.

Middle Pecos GCD Exhibit 27

Middle Pecos GCD Management Plan, approved July 16, 2020

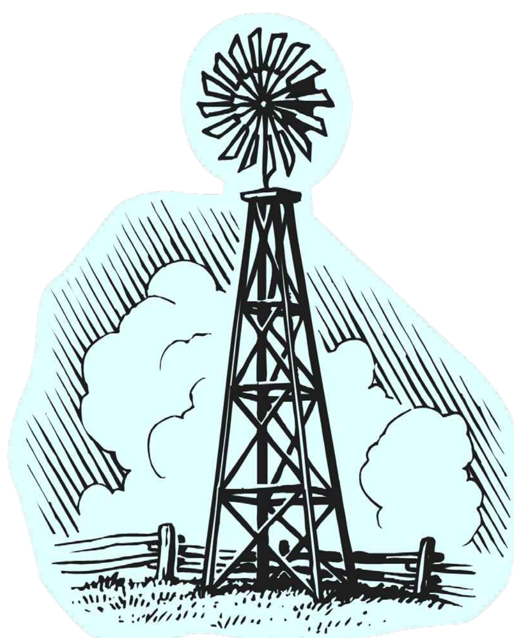
Groundwater Management Plan

Pecos County

Prepared by:

Middle Pecos
Groundwater Conservation District
Fort Stockton, Texas

Ty Edwards
General Manager



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Middle Pecos Groundwater Conservation District
Groundwater Management Plan

July 16, 2020 (Final Approved Plan)

1.0 District Mission

The Middle Pecos Groundwater Conservation District (the District) is committed to manage and protect the groundwater resources of The District. The District was created to help maintain a sustainable, adequate, reliable, cost effective and high-quality source of groundwater to promote the vitality, economy, and environment of the District. The District will work with and for the citizens of the District and cooperate with other local, regional, and State agencies involved in the study and management of groundwater resources.

2.0 Purpose of Management Plan

In 1997 the 75th Texas Legislature established a statewide comprehensive regional water planning initiative with the enactment of Senate Bill 1 (SB1). Among the provisions of SB1 were amendments to Chapter 36 of the Texas Water Code requiring groundwater conservation districts to develop a groundwater management plan that shall be submitted to the Texas Water Development Board (TWDB) for approval. The groundwater management plan was specified to contain estimates on the availability of groundwater in the district, details of how the district would manage groundwater, and management goals for the district. In 2001 the 77th Texas Legislature further clarified the water planning and management provisions of SB1 with the enactment of Senate Bill 2 (SB2).

The requirements of the Chapter 36 Texas Water Code provisions for groundwater management plan development are specified in 31 Texas Administrative Code Chapter 356 of the TWDB Rules. This plan fulfills all requirements for groundwater management plans in SB1, SB2, Chapter 36 Texas Water Code, and TWDB rules.

3.0 Time Period of Management Plan

This plan shall be in effect for a period of five years from the date of approval by TWDB, unless a new or amended management plan is adopted by the District Board of Directors and approved by TWDB. The management plan will be readopted with or without changes by the District Board and submitted to TWDB for approval at least every five years.

4.0 Middle Pecos Groundwater Conservation District

The District was created in 1999. The creation of the District is recorded in Chapter 1331 of the Acts of the 76th Texas Legislature (SB 1911). This act enabled the District to function in a limited capacity until the creation of the District was fully validated in the 77th Legislature. The validation of the District is recorded in Chapter 1299 of the Acts of the 77th Texas Legislature (HB 1258). The District was confirmed by local election held in Pecos County on November 5, 2002.

The District boundaries are coterminous with the boundaries of Pecos County, Texas. The District is bounded by Reeves, Ward, Crane, Crockett, Terrell, Brewster, and Jeff Davis counties. As of the plan date, groundwater conservation districts (GCDs) that bound the District are in Reeves, Jeff Davis, Brewster, and Crockett Counties. The GCDs neighboring the District are Brewster County GCD, Jeff Davis County Underground Water Conservation District (UWCD), Terrell County GCD, and Crockett County GCD.

Most of the District is in Groundwater Management Area (GMA) 7, with the northern part of the District in GMA 3. Chapter 36 of the Texas Water Code authorizes the District to co-ordinate its management of groundwater with other GCDs in both GMA 7 and GMA 3. GMA 3 consists of Middle Pecos GCD and Reeves County GCD. The other GCDs that are located in GMA 7 are: Crockett County GCD, Santa Rita UWCD (Reagan), Irion County Water Conservation District (WCD), Glasscock GCD, Sterling County UWCD, Lone Wolf GCD (Mitchell), Terrell GCD, Wes-Tex GCD (Nolan), Coke County UWCD, Lipan-Kickapoo WCD (Tom Green, Concho, and Runnels), Hickory UWCD No. 1 (McCulloch, San Saba, and Mason), Menard County UWD, Hill Country UWCD (Gillespie), Kimble County GCD, Plateau Underground Water Conservation and Supply District (Schleicher), Sutton County UWCD, Real-Edwards Conservation and Reclamation District, Uvalde County UWCD, and Kinney County GCD.

The District Board of Directors is composed of eleven members elected to staggered four-year terms. Two directors are elected from each of the four county precincts, one director is elected at-large, one director is elected from the City of Iraan and one director is elected from the City of Fort Stockton. The Board of Directors holds regular meetings, at least quarterly. Meetings of the Board of Directors are public meetings noticed and held in accordance with public meeting requirements.

4.1 Authority of the District

The District derives its authority to manage groundwater use within the District by virtue of the powers granted and authorized in the District enabling act HB 1258 of the 77th Texas Legislature. The District, acting under authority of the enabling legislation, assumes all the rights and responsibilities of a groundwater conservation district specified in Chapter 36 of the Texas Water Code. The District has developed rules specifying the bounds of due process governing District actions.

4.2 Groundwater Resources of the District

There are six sources of groundwater recognized by TWDB in the District. Two of these sources; the Edwards-Trinity (Plateau) Aquifer and the Pecos Valley Aquifer are classified as major aquifers by TWDB. (Fig. 3) The other four sources of groundwater; the Rustler Aquifer, the Dockum Aquifer, the Igneous Aquifer and the Capitan Reef Complex Aquifer are classified as minor aquifers by TWDB. A major aquifer produces large amounts of water over larger areas and a minor aquifer produces minor amounts of water over large areas or large amounts of water over small areas.

The groundwater sources in the District may produce both fresh and moderately saline (brackish) water. The geologic origins of the groundwater sources of the District cover a broad range of geologic time. Listed in ascending order by geologic age, these sources and their ages are: Rustler Formation and Capitan Reef Complex (Permian), Dockum aquifer (Triassic), Edwards-Trinity (Plateau) aquifer (Cretaceous), and Pecos Valley (Quaternary). The geologic age of the various sources of groundwater in the District and the geologic history of Pecos County have a bearing on the structure of the groundwater sources of the District and their relationships.

4.3 Management Zones

The District has established groundwater management zones in the principal areas of irrigation (or other groundwater demand) and pertinent surrounding areas of Pecos County, as described below:

1) The Leon-Belding Irrigation Area and the vicinity of the City of Fort Stockton to include the outlets of Comanche Springs.
2) The Bakersfield Irrigation Area.
3) The Coyanosa Irrigation Area.

A map that shows the boundaries of the management zones is presented in Figure 1. The District recognizes that groundwater use in the areas of principal groundwater demand in the District has the potential to result in localized aquifer draw down sufficient to possibly impair the DFCs of the aquifer in District as a whole (within each GMA). Please note that the management zone map is an updated version as compared to the current rules. An update to the rules to implement these management zone changes is expected in the next several weeks.

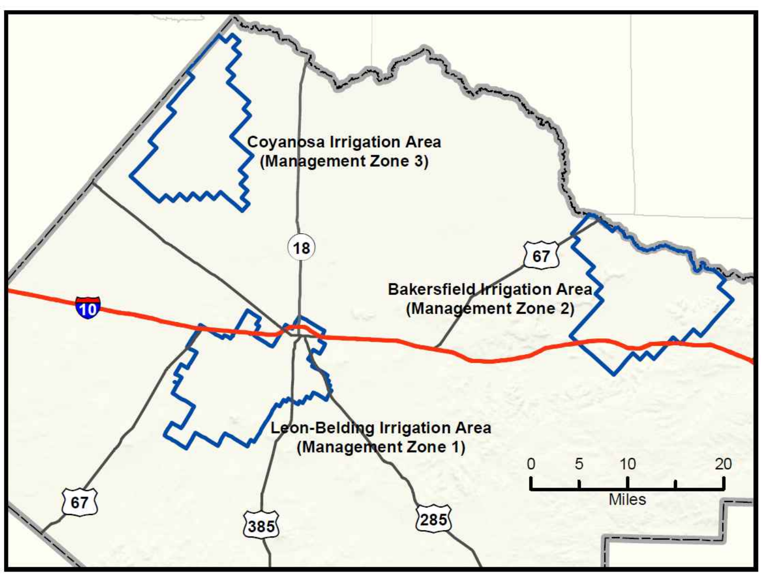

Figure 1. Groundwater Management Zones in MPGCD

5.0 Technical Information Required by Texas Administrative Code

The information in this section is provided pursuant to statutes and rules as summarized in the TWDB Groundwater Conservation District Management Plan Checklist, effective December 6, 2012. The information is organized according to the order in the checklist.

5.1 Estimate of the Modeled Available Groundwater in the District

Modeled available groundwater is defined in TWC §36.001 as "the amount of water that the executive administrator determines may be produced on an average annual basis to achieve a desired future condition established under Section 36.108." The District is within the boundaries of two Groundwater Management Areas (GMAs): GMA 3 and GMA 7.

The Texas Water Development Board website has summaries of desired future conditions and modeled available groundwater estimates for each Groundwater Management Area, including tabulations for each groundwater conservation district in GMAs 3 and 7. These summaries are available at:

http://www.twdb.texas.gov/groundwater/dfc/2016jointplanning.asp

The desired future conditions for Middle Pecos Groundwater Conservation District are presented in Table 1. The modeled available groundwater estimates for Middle Pecos Groundwater Conservation District are presented in Table 2.

Table 1. Summary of Desired Future Conditions for MPGCD

Aquifer	Groundwater Management Area	Desired Future Condition (DFC)	Date DFC Adopted
Capitan Reef Complex	3	Total net drawdown not to exceed 4 feet in Pecos County (Middle Pecos GCD) in 2070 as compared with aquifer levels in 2006	10/20/2016
Capitan Reef Complex	7	Total net drawdown of the Capitan Reef Aquifer not to exceed 56 feet in Pecos County (Middle Pecos GCD) in 2070 as compared with 2006 aquifer levels.	3/23/2017
Dockum	3	Total net drawdown not to exceed 52 feet in 2070, as compared with aquifer levels in 2012	10/20/2016
Dockum	7	Total net drawdown of the Dockum Aquifer not to exceed 52 feet in Pecos County (Middle Pecos GCD) in 2070, as compared with 2012 aquifer levels.	9/22/2016
Edwards-Trinity (Plateau) and Pecos Valley	3	Total net drawdown not to exceed 14 feet in 2070, as compared with aquifer levels in 2010	10/20/2016, revised on 12/13/2017
Edwards-Trinity (Plateau) and Pecos Valley	7	Average drawdown not to exceed 14 feet of drawdown from 2010 to 2070	3/22/2018
Rustler	3	Total net drawdown not to exceed 69 feet in 2070, as compared with aquifer levels in 2009	10/20/2016
Rustler	7	Total net drawdown of the Rustler Aquifer in Pecos County (Middle Pecos GCD) in 2070 not to exceed 94 feet as compared with 2009 aquifer levels	9/22/2016

Table 2. Summary of Modeled Available Groundwater for MPGCD

Aquifer	Groundwater Management Area	Modeled Available Groundwater (AF/yr) 2020	2030	2040	2050	2060	2070	TWDB Report
Capitan Reef Complex	3	4	4	4	4	4	4	GR 16-027 MAG
Capitan Reef Complex	7	26,164	26,164	26,164	26,164	26,164	26,164	GR 16-026 MAG v.2.
Dockum	3	6,142	6,142	6,142	6,142	6,142	6,142	GR 16-027 MAG
Dockum	7	2,022	2,022	2,022	2,022	2,022	2,022	GR 16-026 MAG v.2.
Edwards-Trinity (Plateau) and Pecos Valley	3	122,899	122,899	122,899	122,899	122,899	122,899	GR 16-027 MAG
Edwards-Trinity (Plateau) and Pecos Valley	7	117,309	117,309	117,309	117,309	117,309	117,309	GR 16-026 MAG v.2.
Rustler	3	3	3	3	3	3	3	GR 16-027 MAG
Rustler	7	7,040	7,040	7,040	7,040	7,040	7,040	GR 16-026 MAG v.2.

5.2 Estimate of the Amount of Groundwater Being Used within the District on an Annual Basis

Please refer to Appendix A: Estimated Historical Water Use and 2017 State Water Plan Datasets: Middle Pecos Groundwater Conservation District.

5.3 Estimate of the Annual Amount of Recharge from Precipitation

Please refer to Appendix B: GAM Run 19-021: Middle Pecos Groundwater Conservation District Management Plan, dated February 18, 2020.

5.4 Estimate of the Annual Volume of Water That Discharges to Springs and Surface Water Bodies

Please refer to Appendix B: GAM Run 19-021: Middle Pecos Groundwater Conservation District Management Plan, dated February 18, 2020.

5.5 Estimate of the Annual Volume of flow into the District, out of the District, and between Aquifers

Please refer to Appendix B: GAM Run 19-021: Middle Pecos Groundwater Conservation District Management Plan, dated February 18, 2020.

5.6 Estimate of the Projected Surface Water Supply within the District

Please refer to Appendix A: Estimated Historical Water Use and 2017 State Water Plan Datasets: Middle Pecos Groundwater Conservation District.

5.7 Estimate of the Projected Total Demand for Water within the District

Please refer to Appendix A: Estimated Historical Water Use and 2017 State Water Plan Datasets: Middle Pecos Groundwater Conservation District.

5.8 Water Supply Needs

Please refer to Appendix A: Estimated Historical Water Use and 2017 State Water Plan Datasets: Middle Pecos Groundwater Conservation District. There are no water supply needs for the District.

5.9 Water Management Strategies

Please refer to Appendix A: Estimated Historical Water Use and 2017 State Water Plan Datasets: Middle Pecos Groundwater Conservation District.

Page 7 of Appendix A includes five specific water conservation strategies (i.e. demand reduction strategies), one weather modification strategy that will yield additional 264 AF/yr of supply, and one groundwater development project that would yield an additional 250 AF/yr of supply for Pecos County WCID #1.

These specific water management strategies were considered and included in the overall preparation of this management plan.

5.10 How the District Will Manage Groundwater Supplies

The Texas Legislature established that groundwater conservation districts are the preferred method of groundwater management in Section 36.0015 of the Texas Water Code. The District will cooperate with the other Groundwater Conservation Districts in the Groundwater Management Areas which Pecos County is located.

The District will manage the supply of groundwater within the District to conserve the resource while seeking to maintain the economic viability of all resource user groups, public and private. The District seeks to manage the groundwater resources of the District as practicably as possible in a sustainable manner through the development of the Desired Future Conditions of Aquifers within the District.

The District will protect the existing and historical use of groundwater that occurred in the District prior to the effective date of the rules establishing the claims process. To obtain a historic use permit, an existing or historic user had to prove the maximum annual amount of groundwater that the user put towards a beneficial use during an existing and historic use period established in the District rules. The protection extended to historic use permit holders is achieved by imposing more restrictive permit conditions on new permit applications. In extending this protection to historic use permit holders the District established limitations that:

a) Apply to all subsequent new applications for the permitted use of groundwater and applications for the increased use of groundwater by holders of historic user permits regardless of the type or location of use
b) Bear a reasonable relationship to the District's management plan
c) Are reasonably necessary to protect existing use and maintain established Desired Future Conditions of aquifers, aquifer subdivisions or management established by the District.

In consideration of the economic and cultural activities occurring within the District, the District will identify and engage in such activities and practices, that if implemented may result in the conservation of groundwater in the District. The District will manage groundwater resources through rules developed and implemented in accordance with Chapter 36 of the Texas Water Code and the provisions of the District Enabling Act recorded in Chapter 1299 of the Acts of the 77th Texas Legislature (HB 1258).

The District will require that any well that is constructed as an exempt well under activities regulated by the Texas Railroad Commission (TRC) and later converted to another use not regulated by the TRC will be required to seek a permit for the use of groundwater in the District if the converted use of the well is otherwise not exempted from permitting under the Texas Water Code or Rules of the District.

In each Management Zone, the District seeks to avoid impairment of the adopted DFCs for the District as a whole (within the portions of the District in each of GMAs 3 and 7) by establishing benchmarks of sustainable groundwater use over time in the District Rules. The assessment of the change in average draw-down values over time will be indexed to year 2010 water levels to be consistent with the adopted DFCs of the Edwards-Trinity (Plateau) and Pecos Valley aquifers. By managing the change in aquifer water levels over time in the management zones, the District can provide for the sustainability of the aquifers and avoid impairment of the aquifer DFCs established by the GMAs.

An example of this management activity is when special permit conditions were adopted in Management Zone 1. The thresholds were established based on avoiding groundwater elevations dropping below historic minima. This will be accomplished by routine monitoring of groundwater elevations in 11 wells and requiring non-historic use pumping reductions if certain thresholds are exceeded (i.e. groundwater elevations drop below the threshold value set for each well). When developing the thresholds, a comparison was made to evaluate the consistency with the adopted desired future condition. Figure 2 shows the results of the comparison.

Please note that the blue data points represent the groundwater elevation where pumping cutbacks begin for each well. The red dots represent the groundwater elevation where a shut-down in non-historic groundwater pumping would be required, thus providing an opportunity for groundwater elevation recovery. The black line represents one-to-one line between the DFC depth to water at each well and the threshold depth to water in each well. The data points generally fall just above or just below the black line demonstrating that the thresholds are consistent with the DFC.

The District may employ technical resources at its disposal, as needed, to evaluate the resources available within the District and to determine the effectiveness of regulatory or conservation measures. In consideration of individual, localized or District-wide conditions the District may allow the production in a management zone to exceed the sustainable amount for a period considered necessary by the District. The exercise of this discretion by the District shall not be construed as limiting the authority of the District in any other matter. A public or private user may appeal to the Board for discretion in enforcement of the provisions of a reduction in the permitted use of groundwater on grounds of adverse economic hardship or unique local conditions. The exercise of said discretion by the Board shall not be construed as limiting the power of the Board.

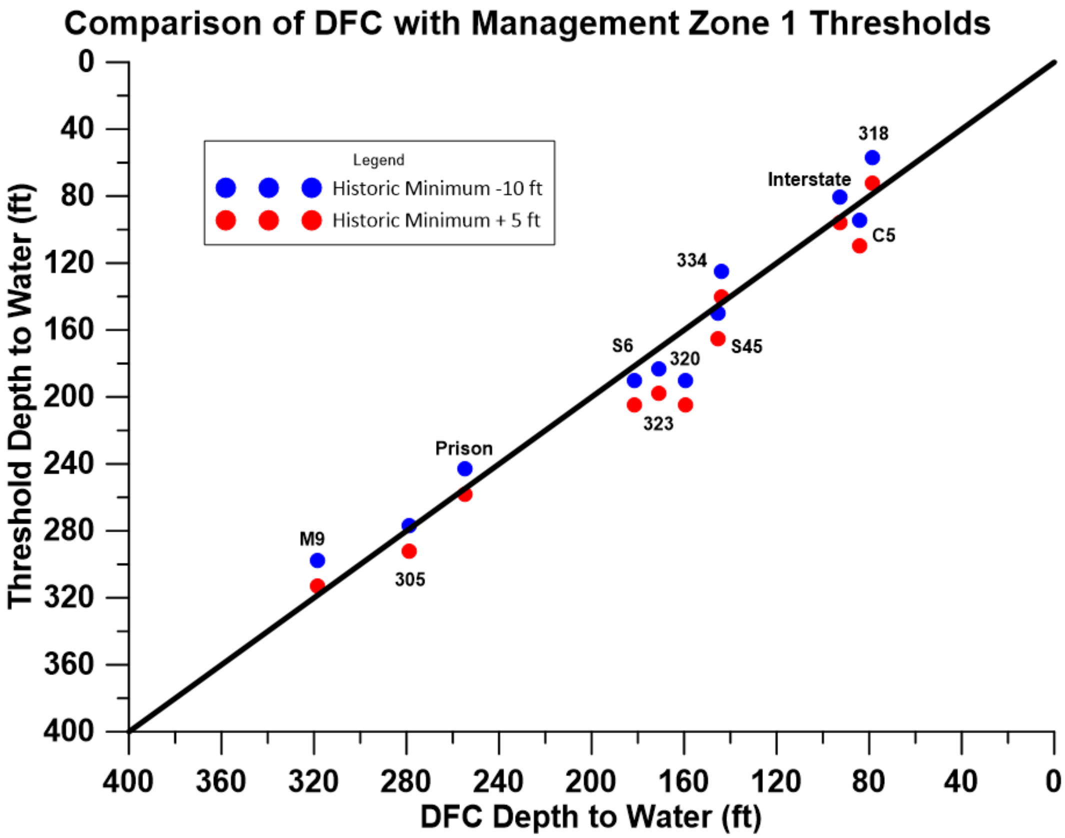

Figure 2. Comparison of DFC with Management Zone 1 Thresholds

5.11 Actions, Procedures, Performance, and Avoidance Necessary to Effectuate the Management Plan

The District will implement the goals and provisions of this Management Plan and will utilize the objectives of this Management Plan as a guideline in its decision-making to be consistent with the provisions of this plan.

The District has adopted rules, in accordance with Chapter 36 of the Texas Water Code, that implement the Management Plan. The current version of the rules is dated June 19, 2018, and is attached as Appendix C. The rules are also available at:

https://www.middlepecosgcd.org/pdf/rules/2018/MPGCD%20Rules%20adopted%20June%2019%202018.pdf?_t=1536326104

All rules will be followed and enforced. The District will amend the District rules as necessary to comply with changes to Chapter 36 of the Texas Water Code and to ensure the best management of the groundwater within the District. The development and enforcement of the rules of the District will be based on the best scientific and technical evidence available to the District. If, at any point, it appears the District will not be able to achieve the adopted Desired Future Conditions the Board of Directors will amend the rules as necessary to ensure the Desired Future Conditions will be achieved.

The District may deny a well construction permit or limit groundwater withdrawals in accordance with the guidelines stated in the rules of the District. In making a determination to deny a permit or reduce the amount of groundwater withdrawals authorized in an existing permit, the District will weigh the public benefit in managing the aquifer to be derived from the denial of a groundwater withdrawal permit or the reduction of the amount of authorized groundwater withdrawals against the individual hardship imposed by the permit denial or authorization reduction.

The relevant factors to be considered in deciding to deny a permit or limit groundwater withdrawals may include:

- The rules of the District
- The distribution of groundwater resources in the aquifers or aquifer subdivisions of the District or any management zones established by the District
- The economic hardship resulting from grant or denial of a permit or the terms prescribed by the permit

In pursuit of the District's mission of protecting the resource, the District may require reduction of groundwater withdrawals. To achieve this purpose, the District may, at the Boards discretion amend or revoke any permits after notice and hearing. The determination to seek the amendment, reduction, or revocation of a permit by the District will be based on aquifer conditions observed by the District. The District will, when necessary, enforce the terms and conditions of permits and the rules of the District by enjoining the permit holder in a court of competent jurisdiction as provided for in Texas Water Code Chapter 36.102.

The District will establish rules for the proportional reduction of the permitted use of groundwater in the District that will recognize the following priorities of use:

- Exempt users with consideration to livestock and domestic use
- Holders of historic use of groundwater permits
- Holders of non-historic groundwater use permits

The General Manager of the District will prepare and submit an annual report (Annual Report) to the District Board of Directors. The Annual Report will include an update on the District's performance in achieving the management goals contained in this plan. The general manager will present the Annual Report to the Board of Directors within one hundred twenty (120) days following the completion of the District's Fiscal Year, currently the District fiscal year ends on September 30 of each calendar year. A copy of the annual audit of District financial records will be included in the Annual Report. The District will maintain a copy of the Annual Report on file for public inspection at the District offices, upon adoption by the Board of Directors.

5.12 Evidence that the Plan was Adopted after Notice and Hearing

The notice for the public hearing was posted with the Pecos County Clerk on June 29, 2020, and the management plan was posted on the District's website on June 30, 2020. The public hearing was held at the Middle Pecos Groundwater Conservation District during the regular Board meeting on July 14. 2020. There were no comments during the public hearing. The Board approved the plan on July 14, 2020 after the close of the public hearing.

Please refer to Appendix D for copies of the notice, agenda, and Board resolution for the public hearing.

5.13 Evidence that District Coordinated with Regional Surface Water Management Entities Following Notice and Hearing

Please refer to Appendix E.

5.14 Site-Specific Information

Not Applicable

6.0 Management Goals

6.1 Providing for the Most Efficient Use of Groundwater in the District

Objective – Each year, the District will require all new exempt or permitted wells that are constructed within the boundaries of the District to be registered with the District in accordance with the District rules.

Performance Standard – Each Year the number of exempt and permitted wells registered by the District for the year will be incorporated into the Annual Report submitted to the Board of Directors of the District.

6.2 Controlling and Preventing the Waste of Groundwater in the District

Objective – Each year, the District will provide information to the public on eliminating and reducing wasteful practices in the use of groundwater either by a page on groundwater waste reduction or a link to information on groundwater waste reduction on the District's website or by providing an article on eliminating and reducing wasteful practices to a newspaper of general circulation in the District for potential publication.

Performance Standard – Submit an article annually regarding the elimination of wasteful practices to a local publication for distribution in Pecos County. A copy of the information provided on groundwater waste reduction will be included in the District's Annual Report to be given to the District Board of Directors.

6.3. Controlling and Preventing Subsidence

The subsidence tool developed by the Texas Water Development Board was used to assess the potential for subsidence in the five aquifers in the District using the default values provided. The tool can be accessed at:

http://www.twdb.texas.gov/groundwater/models/research/subsidence/subsidence.asp

The tool provides a numeric total weighted risk factor that ranges from 0 (low risk) to 10 (high risk). The results of applying the default values from the tool yield the following scores:

- Capitan Reef Complex Aquifer: 2.66
- Dockum Aquifer: 3.75
- Edwards-Trinity (Plateau) Aquifer: 2.97
- Pecos Valley Aquifer: 5.78
- Rustler Aquifer: 3.59

Based on applying the tool, this management goal is not applicable to the District due to the low risk of subsidence in Pecos County.

6.4. Addressing Conjunctive Surface Water Management Issues

Objective – Each year, the District will participate in the regional planning process by being represented at the Region F Regional Water Planning Group meetings.

Performance Standard – The attendance of a District representative to at least 50 percent of the Region F Regional Water Planning Group meetings will be noted in the Annual Report presented to the District Board of Directors.

6.5 Addressing Natural Resource Issues That Affect the Use and Availability of Groundwater and which are Impacted by the Use of Groundwater

Objective – Each year the District will monitor the discharge of Comanche and related springs or acquire the monitoring data on spring discharge developed by others.

Performance Standard – Each year, a summary of the collected or gathered spring data will be included in the Annual Report submitted to the District Board of Directors.

Objective - By attending GMA 3 and GMA 7 meetings, there is the opportunity to participate in discussions, planning and education concerning the interrelationship of groundwater with other natural resource issues. The MPGCD designated representative will attend 50% of the GMA 3 and GMA 7 meetings annually.

Performance Standard - The minutes for all attended meetings of GMA 3 and GMA 7 will be maintained in the District for a period of three (3) years from their accepted date. A report of all attended meetings will be given to the Board at the regular meeting.

6.6 Addressing Drought Conditions

Objective – Each month, the District will download available drought information, for the District, from available websites on the internet such as (last accessed on June 4, 2020):

https://droughtmonitor.unl.edu/CurrentMap/StateDroughtMonitor.aspx?TX

Performance Standard – Quarterly, the District will assess the status of drought in the District and prepare a briefing for the Board of Directors. The downloaded maps, reports, and information will be included with copies of the quarterly briefing in the District Annual Report to the Board of Directors.

6.7 Addressing Conservation, Recharge Enhancement, Rainwater Harvesting, Precipitation Enhancement, and Brush Control Where Cost Effective

6.7.1 Addressing Conservation

Objective – The District will submit an article annually, regarding water conservation for publication to at least one newspaper of general circulation in Pecos County.

Performance Standard – A copy of the article submitted by the District for publication to a newspaper of general circulation in Pecos County regarding water conservation will be included in the Annual Report to the Board of Directors.

6.7.2 Recharge Enhancement

This management goal is not applicable to the District due to lack of available surface water of acceptable quality and cost effectiveness.

6.7.3 Rainwater Harvesting

Objective – The District will post an article or a link to an article annually, regarding rainwater harvesting on the District website www.middlepecosgcd.org

Performance Standard – A copy of the article posted on the District website regarding rainwater harvesting will be included in the Annual Report to the Board of Directors.

6.7.4 Precipitation Enhancement

This management goal is not applicable to the District because of the generally low annual precipitation, and is considered not cost effective at this time.

6.7.5 Brush Control

This management goal is not applicable to the District because the objective is not cost effective due to the sparse nature of the vegetation in the District and the fact that much of the recharge to the District's aquifers are outside the boundaries of the District.

6.8 Addressing the Desired Future Conditions

Objective – The desired future conditions for the Captain Reef Complex, Dockum, Edwards-Trinity (Plateau), Pecos Valley Alluvium, and Rustler aquifers were adopted after the review of results from Groundwater Availability Model simulations. The model results include cell-by-cell estimates of groundwater elevations and drawdown for each year of the predictive period (through 2070). To assess the desired future condition in the District, these model results are compared annually to groundwater monitoring data that are available from the TWDB groundwater database.

Performance Standard – Each year, the District will download groundwater data from Pecos County from the Texas Water Development Board groundwater database. The comparison of model results will be on a well-by-well basis for data that are available. The data downloaded from the database will be compared to model results each year and presented at a regular Board meeting in the form of tables and graphs as appropriate. These comparisons will be supplemented by data and information related to drought conditions and permitted pumping data. An example of the analysis completed in 2020 is provided in Appendix F.

Appendix A

Estimated Historical Water Use and 2017 State Water Plan Datasets: Middle Pecos Groundwater Conservation District

Estimated Historical Water Use And 2017 State Water Plan Datasets:

Middle Pecos Groundwater Conservation District

by Stephen Allen
Texas Water Development Board
Groundwater Division
Groundwater Technical Assistance Section
stephen.allen@twdb.texas.gov
(512) 463-7317
April 14, 2020

GROUNDWATER MANAGEMENT PLAN DATA:

This package of water data reports (part 1 of a 2-part package of information) is being provided to groundwater conservation districts to help them meet the requirements for approval of their five-year groundwater management plan. Each report in the package addresses a specific numbered requirement in the Texas Water Development Board's groundwater management plan checklist. The checklist can be viewed and downloaded from this web address:

http://www.twdb.texas.gov/groundwater/docs/GCD/GMPChecklist0113.pdf

The five reports included in this part are:

1. Estimated Historical Water Use (checklist item 2)

   from the TWDB Historical Water Use Survey (WUS)

2. Projected Surface Water Supplies (checklist item 6)
3. Projected Water Demands (checklist item 7)
4. Projected Water Supply Needs (checklist item 8)
5. Projected Water Management Strategies (checklist item 9)

   from the 2017 Texas State Water Plan (SWP)

Part 2 of the 2-part package is the groundwater availability model (GAM) report for the District (checklist items 3 through 5). The District should have received, or will receive, this report from the Groundwater Availability Modeling Section. Questions about the GAM can be directed to Dr. Shirley Wade, shirley.wade@twdb.texas.gov, (512) 936-0883.

DISCLAIMER:

The data presented in this report represents the most up-to-date WUS and 2017 SWP data available as of 4/14/2020. Although it does not happen frequently, either of these datasets are subject to change pending the availability of more accurate WUS data or an amendment to the 2017 SWP. District personnel must review these datasets and correct any discrepancies in order to ensure approval of their groundwater management plan.

The WUS dataset can be verified at this web address:

http://www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/

The 2017 SWP dataset can be verified by contacting Sabrina Anderson (sabrina.anderson@twdb.texas.gov or 512-936-0886).

For additional questions regarding this data, please contact Stephen Allen (stephen.allen@twdb.texas.gov or 512-463-7317).

Estimated Historical Water Use
TWDB Historical Water Use Survey (WUS) Data

Groundwater and surface water historical use estimates are currently unavailable for calendar year 2018. TWDB staff anticipates the calculation and posting of these estimates at a later date.

PECOS COUNTY

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2017	GW	5,268	88	1,003	0	137,334	531	144,224
	SW	0	0	0	0	3,146	28	3,174
2016	GW	5,217	221	247	0	147,893	599	154,177
	SW	0	0	0	0	3,910	32	3,942
2015	GW	5,294	142	189	0	151,876	595	158,096
	SW	0	0	0	0	2,972	31	3,003
2014	GW	5,173	133	89	0	159,501	643	165,539
	SW	0	0	0	0	0	34	34
2013	GW	5,635	137	52	0	139,488	601	145,913
	SW	0	0	0	0	0	32	32
2012	GW	4,174	252	5	0	110,247	619	115,297
	SW	0	0	0	0	0	33	33
2011	GW	6,421	244	2	0	125,090	694	132,451
	SW	0	0	0	0	55,000	37	55,037
2010	GW	4,771	247	182	0	122,675	703	128,578
	SW	0	0	57	0	3,358	37	3,452
2009	GW	4,902	211	263	0	90,845	714	96,935
	SW	0	0	81	0	1,345	38	1,464
2008	GW	5,229	239	342	0	56,914	774	63,498
	SW	0	0	105	0	0	41	146
2007	GW	4,565	231	5	0	54,562	688	60,051
	SW	0	0	0	0	3,348	37	3,385
2006	GW	4,649	184	5	0	61,906	886	67,630
	SW	0	0	0	0	7,150	47	7,197
2005	GW	4,406	195	5	0	41,404	792	46,802
	SW	0	0	0	0	5,199	42	5,241
2004	GW	4,361	178	5	0	42,478	746	47,768
	SW	0	0	0	0	191	39	230
2003	GW	4,818	142	6	0	37,644	743	43,353
	SW	0	0	0	0	0	39	39
2002	GW	4,334	142	7	0	61,255	867	66,605
	SW	0	0	0	0	1,250	46	1,296

Projected Surface Water Supplies
TWDB 2017 State Water Plan Data

PECOS COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
F	IRRIGATION, PECOS	RIO GRANDE	RED BLUFF LAKE/RESERVOIR	1,558	1,559	1,560	1,561	1,562	1,563
F	IRRIGATION, PECOS	RIO GRANDE	RIO GRANDE RUN-OF-RIVER	4,444	4,444	4,444	4,444	4,444	4,444
F	LIVESTOCK, PECOS	RIO GRANDE	RIO GRANDE LIVESTOCK LOCAL SUPPLY	52	52	52	52	52	52
	Sum of Projected Surface Water Supplies (acre-feet)			**6,054**	**6,055**	**6,056**	**6,057**	**6,058**	**6,059**

Projected Water Demands
TWDB 2017 State Water Plan Data

Please note that the demand numbers presented here include the plumbing code savings found in the Regional and State Water Plans.

PECOS COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
F	COUNTY-OTHER, PECOS	RIO GRANDE	415	427	453	478	501	522
F	FORT STOCKTON	RIO GRANDE	4,910	5,230	5,548	5,853	6,138	6,398
F	IRAAN	RIO GRANDE	459	486	513	541	567	591
F	IRRIGATION, PECOS	RIO GRANDE	126,023	126,023	126,023	126,023	126,023	126,023
F	LIVESTOCK, PECOS	RIO GRANDE	932	932	932	932	932	932
F	MANUFACTURING, PECOS	RIO GRANDE	103	103	103	103	103	103
F	MINING, PECOS	RIO GRANDE	690	1,068	1,072	861	672	524
F	PECOS COUNTY WCID #1	RIO GRANDE	439	456	475	496	519	540
		Sum of Projected Water Demands (acre-feet)	**133,971**	**134,725**	**135,119**	**135,287**	**135,455**	**135,633**

Projected Water Supply Needs
TWDB 2017 State Water Plan Data

Negative values (in red) reflect a projected water supply need, positive values a surplus.

PECOS COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
F	COUNTY-OTHER, PECOS	RIO GRANDE	0	0	0	0	0	0
F	FORT STOCKTON	RIO GRANDE	0	0	0	0	0	0
F	IRAAN	RIO GRANDE	0	0	0	0	0	0
F	IRRIGATION, PECOS	RIO GRANDE	5	6	7	8	9	10
F	LIVESTOCK, PECOS	RIO GRANDE	0	0	0	0	0	0
F	MANUFACTURING, PECOS	RIO GRANDE	0	0	0	0	0	0
F	MINING, PECOS	RIO GRANDE	0	0	0	0	0	0
F	PECOS COUNTY WCID #1	RIO GRANDE	0	0	0	0	0	0
	Sum of Projected Water Supply Needs (acre-feet)		**0**	**0**	**0**	**0**	**0**	**0**

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

PECOS COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
FORT STOCKTON, RIO GRANDE (F)							
MUNICIPAL CONSERVATION - FORT STOCKTON	DEMAND REDUCTION [PECOS]	50	53	57	60	63	66
		50	**53**	**57**	**60**	**63**	**66**
IRAAN, RIO GRANDE (F)							
MUNICIPAL CONSERVATION - IRAAN	DEMAND REDUCTION [PECOS]	7	8	8	9	9	10
		7	**8**	**8**	**9**	**9**	**10**
IRRIGATION, PECOS, RIO GRANDE (F)							
IRRIGATION CONSERVATION - PECOS COUNTY	DEMAND REDUCTION [PECOS]	6,301	12,602	18,903	18,903	18,903	18,903
WEATHER MODIFICATION	WEATHER MODIFICATION [ATMOSPHERE]	264	264	264	264	264	264
		6,565	**12,866**	**19,167**	**19,167**	**19,167**	**19,167**
MINING, PECOS, RIO GRANDE (F)							
MINING CONSERVATION - PECOS COUNTY	DEMAND REDUCTION [PECOS]	48	75	75	60	47	37
		48	**75**	**75**	**60**	**47**	**37**
PECOS COUNTY WCID #1, RIO GRANDE (F)							
DEVELOP ADDITIONAL EDWARDS-TRINITY PLATEAU AQUIFER SUPPLIES - PECOS COUNTY WCID #1	EDWARDS-TRINITY-PLATEAU AQUIFER [PECOS]	250	250	250	250	250	250
MUNICIPAL CONSERVATION - PECOS WCID	DEMAND REDUCTION [PECOS]	19	20	22	23	24	25
		269	**270**	**272**	**273**	**274**	**275**
Sum of Projected Water Management Strategies (acre-feet)		**6,939**	**13,272**	**19,579**	**19,569**	**19,560**	**19,555**

Appendix B

GAM Run 19-021: Middle Pecos Groundwater Conservation District Management Plan

Texas Water Development Board

P.O. Box 13231, 1700 N. Congress Ave.
Austin, TX 78711-3231, www.twdb.texas.gov
Phone (512) 463-7847, Fax (512) 475-2053

February 18, 2020

Mr. Ty Edwards
General Manager
Middle Pecos Groundwater Conservation District
P.O. Box 1644
Fort Stockton, TX 79735

Dear Mr. Edwards:

This letter transmits information to you in partial fulfilment of Texas Water Code, Section 36.1071, Subsections (e) and (h), which require that the Executive Administrator of the Texas Water Development Board (TWDB) provide groundwater availability modeling information to a groundwater conservation district for use in developing its groundwater management plan.

The TWDB provides this information to the Middle Pecos Groundwater Conservation District in two parts. Part 1 is the Estimated Historical Water Use/State Water Plan datasets report, which will be provided to you separately from the TWDB Groundwater Technical Assistance Department. The Part 1 water data report includes estimates of historical water use, projected surface water supplies, projected water demands, projected water supply needs, and projected water management strategies for the groundwater conservation district. Please direct questions about the water data report to Mr. Stephen Allen at (512) 463-7317 or Stephen.Allen@twdb.texas.gov. Part 2 is the required groundwater availability modeling information and is provided with this letter. This information includes:

1. the annual amount of recharge from precipitation, if any, to each aquifer within the district;
2. for each aquifer within the district, the annual volume of water that discharges from the aquifer to springs and any surface-water bodies, including lakes, streams, and rivers; and
3. the annual volume of flow into and out of the district within each aquifer and between aquifers in the district.

This model run, GAM Run 19-021, replaces GAM Run 14-010 as the approach used for analyzing model results has been since refined to more accurately delineate flows between hydraulically connected units. In addition, GAM Run 19-021 includes results from the Groundwater Availability Model for the Capitan Reef Complex Aquifer and the Groundwater Availability Model for the High Plains Aquifer System to analyze the Dockum Aquifer. For your convenience, an electronic version of the GAM Run 19-021 report is available to download at http://www.twdb.texas.gov/groundwater/docs/GAMruns/GR19-021.pdf.

The groundwater management plan for the Middle Pecos Groundwater Conservation District should be adopted by the district on or before June 17, 2020 and submitted to the Executive Administrator of the TWDB on or before July 17, 2020. The current management plan for the Middle Pecos Groundwater Conservation District expires on September 15, 2020.

If you have any further questions or concerns about the model run, please feel free to contact Grayson Dowlearn of our Groundwater staff at (512) 475-1552 or Grayson.Dowlearn@twdb.texas.gov , or Cindy Ridgeway of our Groundwater staff at (512) 936-2386 or Cindy.Ridgeway@twdb.texas.gov.

Sincerely,

Jeff Walker
Executive Administrator

Enclosures

c w/o enc.: Cindy Ridgeway, P.G., Groundwater
Stephen Allen, P.G., Groundwater
Grayson Dowlearn, Groundwater

GAM Run 19-021: Middle Pecos Groundwater Conservation District Management Plan

By Grayson Dowlearn
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Department
(512) 475-1552
February 18, 2020

STATE OF TEXAS
CYNTHIA K. RIDGEWAY
GEOLOGY
No. 471
LICENSED
PROFESSIONAL GEOSCIENTIST

Cynthia K Ridgeway

Cynthia K. Ridgeway is the manager of the Groundwater Availability Modeling Department and is responsible for the oversight of work performed by Grayson Dowlearn under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G. 471 on February 18, 2020.

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GAM RUN 19-021: MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT MANAGEMENT PLAN

By Grayson Dowlearn
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Department
(512) 475-1552
February 18, 2020

EXECUTIVE SUMMARY:

Texas State Water Code, Section 36.1071, Subsection (h) (Texas Water Code, 2011), states that, in developing its groundwater management plan, a groundwater conservation district shall use groundwater availability modeling information provided by the Executive Administrator of the Texas Water Development Board (TWDB) in conjunction with any available site-specific information provided by the district for review and comment to the Executive Administrator.

The TWDB provides data and information to the Middle Pecos Groundwater Conservation District in two parts. Part 1 is the Estimated Historical Water Use/State Water Plan dataset report, which will be provided to you separately by the TWDB Groundwater Technical Assistance Department. Please direct questions about the water data report to Mr. Stephen Allen at 512-463-7317 or stephen.allen@twdb.texas.gov. Part 2 is the required groundwater availability modeling information and this information includes:

1. the annual amount of recharge from precipitation, if any, to the groundwater resources within the district;
2. for each aquifer within the district, the annual volume of water that discharges from the aquifer to springs and any surface-water bodies, including lakes, streams, and rivers; and
3. the annual volume of flow into and out of the district within each aquifer and between aquifers in the district.

The groundwater management plan for the Middle Pecos Groundwater Conservation District should be adopted by the district on or before June 17, 2020 and submitted to the executive administrator of the TWDB on or before July 17, 2020. The current management plan for the Middle Pecos Groundwater Conservation District expires on September 15, 2020.

We used four groundwater availability models to estimate the management plan information for the aquifers within the Middle Pecos Groundwater Conservation District. Information for the Pecos Valley and Edwards-Trinity (Plateau) aquifers is from version 1.01 of the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers (Anaya and Jones, 2009). Information for the Dockum Aquifer is from version 1.01 of the groundwater availability model for the High Plains aquifer system (Deeds and Jigmond, 2015 and Deeds and Hamlin, 2015). Information for the Rustler Aquifer is from version 1.01 of the groundwater availability model for the Rustler Aquifer (Ewing and others, 2012). Information for the Capitan Reef Complex Aquifer is from version 1.01 of the groundwater availability model for the Capitan Reef Complex Aquifer (Jones, 2016). While a small portion of the Igneous Aquifer underlies the district at the western tip of Pecos County, the model for the Igneous Aquifer does not extend into Pecos County. For more information concerning this aquifer, please contact Mr. Stephen Allen at 512-463-7317 or stephen.allen@twdb.texas.gov.

This report replaces the results of GAM Run 14-010 (Jones, 2014), as the approach used for analyzing model results has been since refined to more accurately delineate flows between hydraulically connected units and official aquifer boundaries. In addition, this analysis includes results from the groundwater availability model for the Capitan Reef Complex Aquifer and the groundwater availability model for the High Plains Aquifer System, both of which were released since the publication of GAM Run 14-010. Tables 1, 2, 3, 4, and 5 summarize the groundwater availability model data required by statute and Figures 1, 2, 3, 4, and 5 show the area of the models from which the values in the tables were extracted. If, after review of the figures, the Middle Pecos Groundwater Conservation District determines that the district boundaries used in the assessment do not reflect current conditions, please notify the TWDB at your earliest convenience.

METHODS:

In accordance with the provisions of the Texas State Water Code, Section 36.1071, Subsection (h), the groundwater availability models mentioned above were used to estimate information for the Middle Pecos Groundwater Conservation District management plan. Water budgets were extracted for the Edwards-Trinity (Plateau) and Pecos Valley aquifers (1981-2000), Dockum Aquifer (1980-2012), Rustler Aquifer (1980-2008), and

Capitan Reef Complex Aquifer (1980-2005). We used ZONEBUDGET Version 3.01 (Harbaugh, 2009) to extract water budgets from the model results. The average annual water budget values for recharge, surface-water outflow, inflow to the district, outflow from the district, and the flow between aquifers within the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Capitan Reef Complex Aquifer

- We used version 1.01 of the groundwater availability model for the Capitan Reef Complex Aquifer. See Jones (2016) for assumptions and limitations of the groundwater availability model.

- The model has five active layers representing the Edwards-Trinity (Plateau) and Pecos Valley aquifers (Layer 1); Dockum Aquifer and Dewey Lake Formation (Layer 2); Rustler Aquifer (Layer 3); Artesia Group, Salado Formation, and Castile Formation (Layer 4); and Capitan Reef Complex Aquifer, Delaware Basin, and San Andres Formation (Layer 5).

- While the model for the Capitan Reef Complex Aquifer includes the Pecos Valley, Edwards-Trinity (Plateau), Dockum, and Rustler aquifers, the focus of the model run was to extract information for the Capitan Reef Complex Aquifer. Thus, model Layer 5 was used for the management plan analysis.

- Water budget terms were averaged for the period 1980 through 2005 (stress periods 50 through 75).

- The model was run with MODFLOW-2005 (Harbaugh, 2005).

Rustler Aquifer

- We used version 1.01 of the groundwater availability model for the Rustler Aquifer. See Ewing and others (2012) for assumptions and limitations of the groundwater availability model.

- The model has two active layers representing the Dewey Lake Formation and Dockum Aquifer (Layer 1) and the Rustler Aquifer (Layer 2). While the model for the Rustler Aquifer includes the Dockum Aquifer, the focus of the model run was to extract information for the Rustler Aquifer. Therefore, model Layer 2 was used for the management plan analysis.

- Water budget terms were averaged for the period 1980 through 2008 (stress periods 63 through 91).
- The model was run with MODFLOW-2000 (Harbaugh and Others, 2000).

Dockum Aquifer

- We used version 1.01 of the groundwater availability model for the High Plains Aquifer System. See Deeds and Jigmond (2015) for assumptions and limitations of the model for the High Plains Aquifer System.
- The groundwater availability model for the High Plains Aquifer System contains four layers representing the Ogallala Aquifer and the Pecos Valley Aquifer (Layer 1); the Rita Blanca Aquifer, the Edwards-Trinity (High Plains) Aquifer, and the Edwards-Trinity (Plateau) Aquifer (Layer 2); the upper Dockum Group (Layer 3); and the lower Dockum Group (Layer 4). Layers 3 and 4, representing the Dockum Aquifer, were analyzed together. While the Pecos Valley and Edwards-Trinity (Plateau) aquifers are included in this model, they were not the focus of the model. Therefore, we used version 1.01 of the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers for analyzing these aquifers,
- Water budget terms were averaged for the period 1980 through 2012 (stress periods 52 through 84).
- The model was run with MODFLOW-NWT (Niswonger and others, 2011).

Edwards-Trinity (Plateau) and Pecos Valley Aquifers

- We used version 1.01 of the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers. See Anaya and Jones (2009) for assumptions and limitations of the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers.
- The model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers includes two active layers representing the Pecos Valley Aquifer and the Edwards Group and equivalent limestone hydrostratigraphic units (Layer 1) and the undifferentiated Trinity Group hydrostratigraphic units (Layer 2) in the district.
- A portion of the area underlying the district represents both the Pecos Valley and Edwards-Trinity (Plateau) aquifers within Layer 1 of the model. We assumed certain model cells are assigned to the Pecos Valley Aquifer and the remaining cells are assigned to the Edwards-Trinity (Plateau) Aquifer where this condition exists.

- Water budget terms were averaged for the period 1981 through 1999 (stress periods 2 through 21).

- The model was run with MODFLOW-96 (Harbaugh and McDonald, 1996).

RESULTS:

A groundwater budget summarizes the amount of water entering and leaving the aquifer according to the groundwater availability model. Selected groundwater budget components listed below were extracted from the model results for the aquifers located within the district and averaged over the historical calibration periods, as shown in Tables 1, 2, 3, 4 and 5.

1. Precipitation recharge—the areally distributed recharge sourced from precipitation falling on the outcrop areas of the aquifers (where the aquifer is exposed at land surface) within the district.

2. Surface-water outflow—the total water discharging from the aquifer (outflow) to surface-water features such as streams, reservoirs, and springs.

3. Flow into and out of district—the lateral flow within the aquifer between the district and adjacent counties.

4. Flow between aquifers—the net vertical flow between the aquifer and adjacent aquifers or confining units. This flow is controlled by the relative water levels in each aquifer and aquifer properties of each aquifer or confining unit that define the amount of leakage that occurs.

The information needed for the district's management plan is summarized in Tables 1, 2, 3, 4 and 5. It is important to note that sub-regional water budgets are not exact. This is due to the size of the model cells and the approach used to extract data from the model. To avoid double accounting, a model cell that straddles a political boundary, such as a district or county boundary, is assigned to one side of the boundary based on the location of the centroid of the model cell. For example, if a cell contains two counties, the cell is assigned to the county where the centroid of the cell is located.

TABLE 1: SUMMARIZED INFORMATION FOR THE CAPITAN REEF COMPLEX AQUIFER THAT IS NEEDED FOR THE MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Capitan Reef Complex Aquifer	4,860
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers.	Capitan Reef Complex Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Capitan Reef Complex Aquifer	29,953
Estimated annual volume of flow out of the district within each aquifer in the district	Capitan Reef Complex Aquifer	2,823
Estimated net annual volume of flow between each aquifer in the district	From Capitan Reef Complex Aquifer to Artesia Group/Salado Formation/Castile Formation	23,463
	From Capitan Reef Complex Aquifer to Capitan Reef Complex and other units	9,085

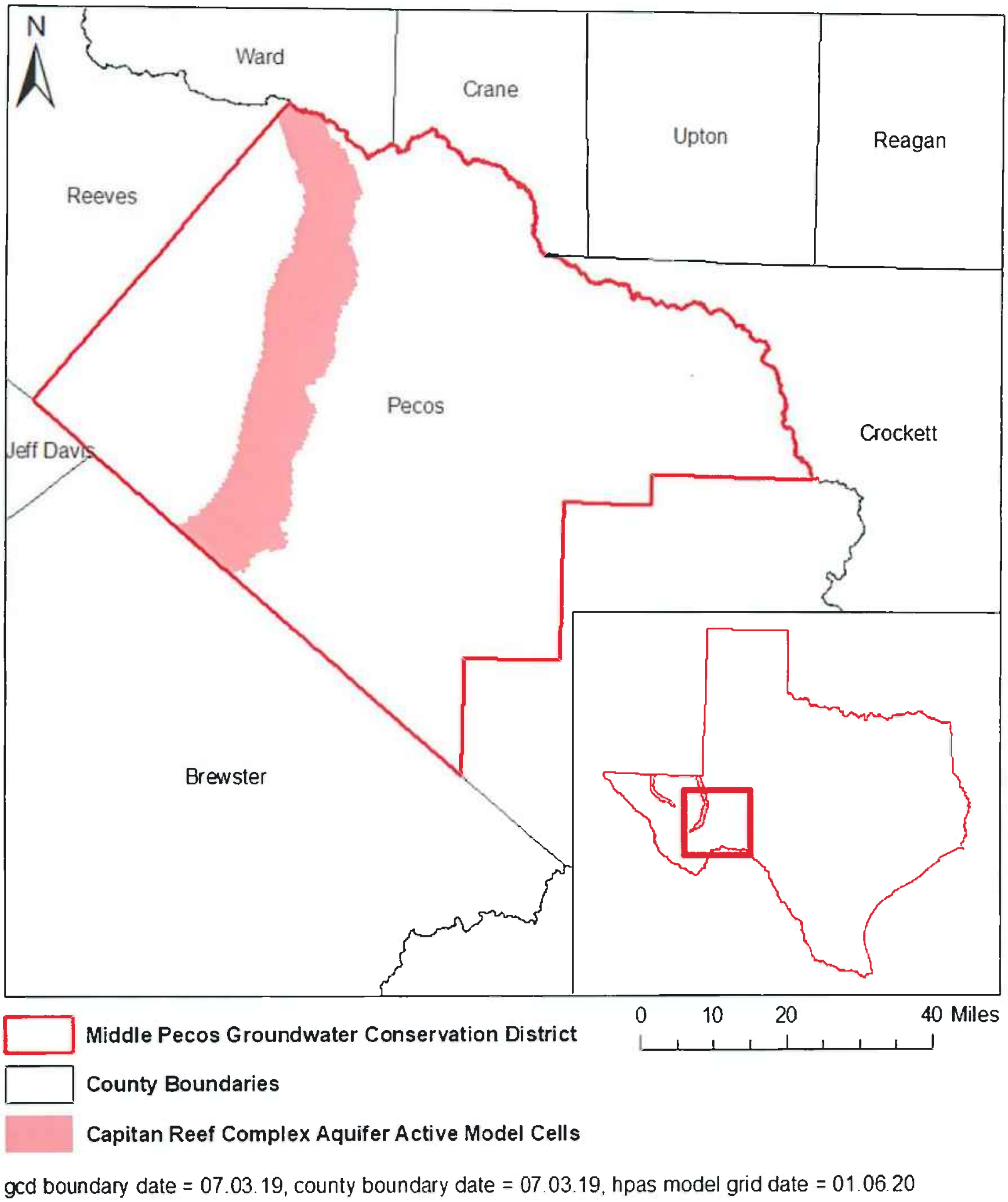

FIGURE 1: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE CAPITAN REEF COMPLEX AQUIFER FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE CAPITAN REEF COMPLEX AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 2: SUMMARIZED INFORMATION FOR THE RUSTLER AQUIFER THAT IS NEEDED FOR THE MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Rustler Aquifer	0
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers.	Rustler Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Rustler Aquifer	539
Estimated annual volume of flow out of the district within each aquifer in the district	Rustler Aquifer	418
Estimated net annual volume of flow between each aquifer in the district	From the Rustler Aquifer to the Dockum Aquifer	856
	To the Rustler Aquifer from other overlying units	342
	To the Rustler Aquifer from Rustler Formation	532

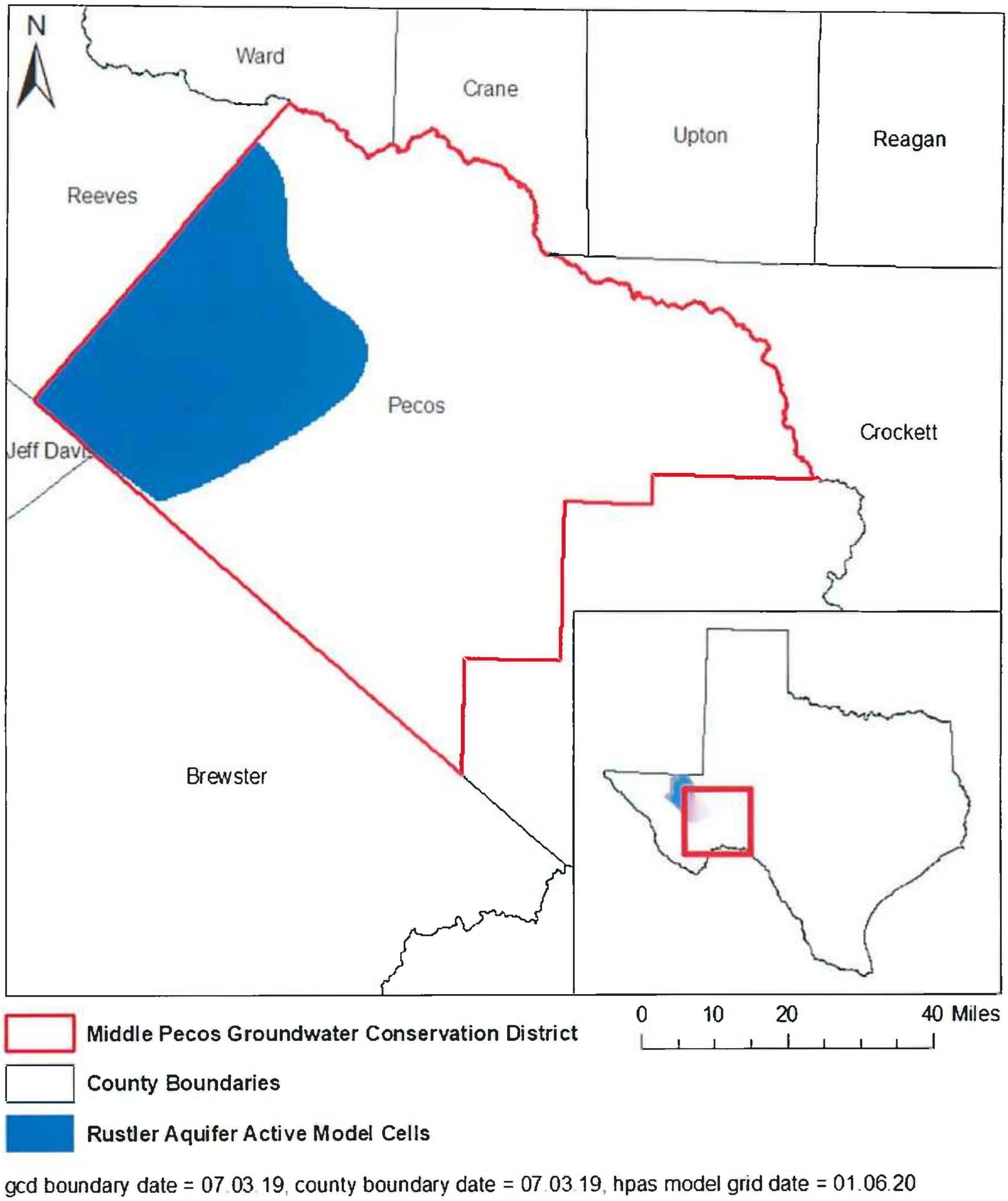

FIGURE 2: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE RUSTLER AQUIFER FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED (THE RUSTLER AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 3: SUMMARIZED INFORMATION FOR THE DOCKUM AQUIFER THAT IS NEEDED FOR THE MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Dockum Aquifer	0
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers.	Dockum Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Dockum Aquifer	511
Estimated annual volume of flow out of the district within each aquifer in the district	Dockum Aquifer	320
Estimated net annual volume of flow between each aquifer in the district	From the Dockum Aquifer to the Pecos Valley Aquifer	118
	To the Dockum Aquifer from the Edwards-Trinity (Plateau) Aquifer	160
	To Dockum Aquifer from Rustler Aquifer	856*
	From Dockum Aquifer to Dockum Formation	87

* Indicates value calculated from the groundwater availability model for the Rustler Aquifer, all other values are from the groundwater availability model for the High Plains Aquifer System.

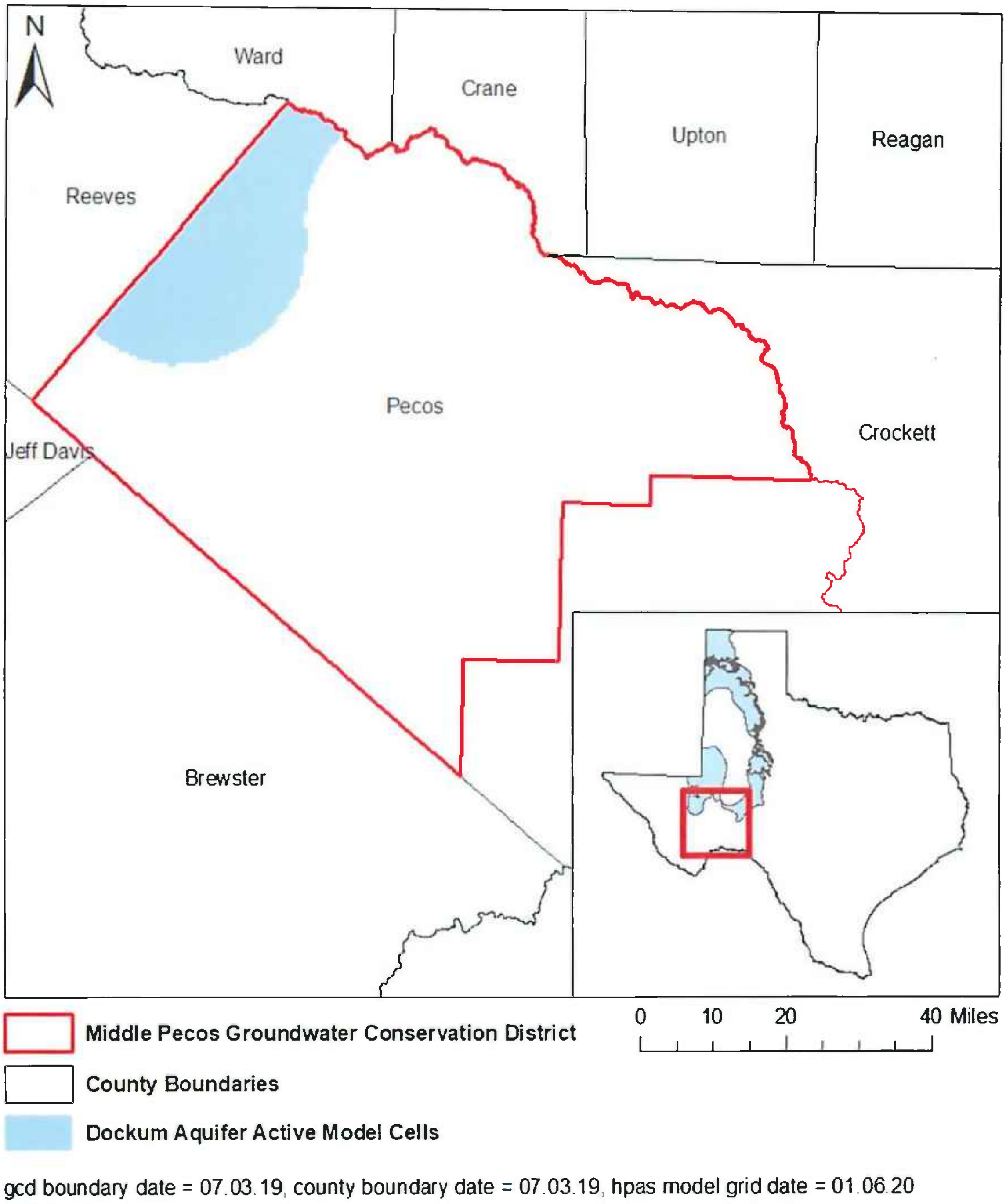

FIGURE 3: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE HIGH PLAINS AQUIFER SYSTEM FROM WHICH THE INFORMATION IN TABLE 3 WAS EXTRACTED (THE DOCKUM AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 4: SUMMARIZED INFORMATION FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER THAT IS NEEDED FOR THE MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Edwards-Trinity (Plateau) Aquifer	141,982
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers.	Edwards-Trinity (Plateau) Aquifer	24,024
Estimated annual volume of flow into the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	32,418
Estimated annual volume of flow out of the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	77,569
Estimated net annual volume of flow between each aquifer in the district	From the Edwards-Trinity (Plateau) Aquifer to the Pecos Valley Aquifer	41,370
	From the Edwards-Trinity (Plateau) Aquifer to the Dockum Aquifer	160*

* Indicates values calculated from the groundwater availability model for the High Plains Aquifer System, all other values are calculated from the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers.

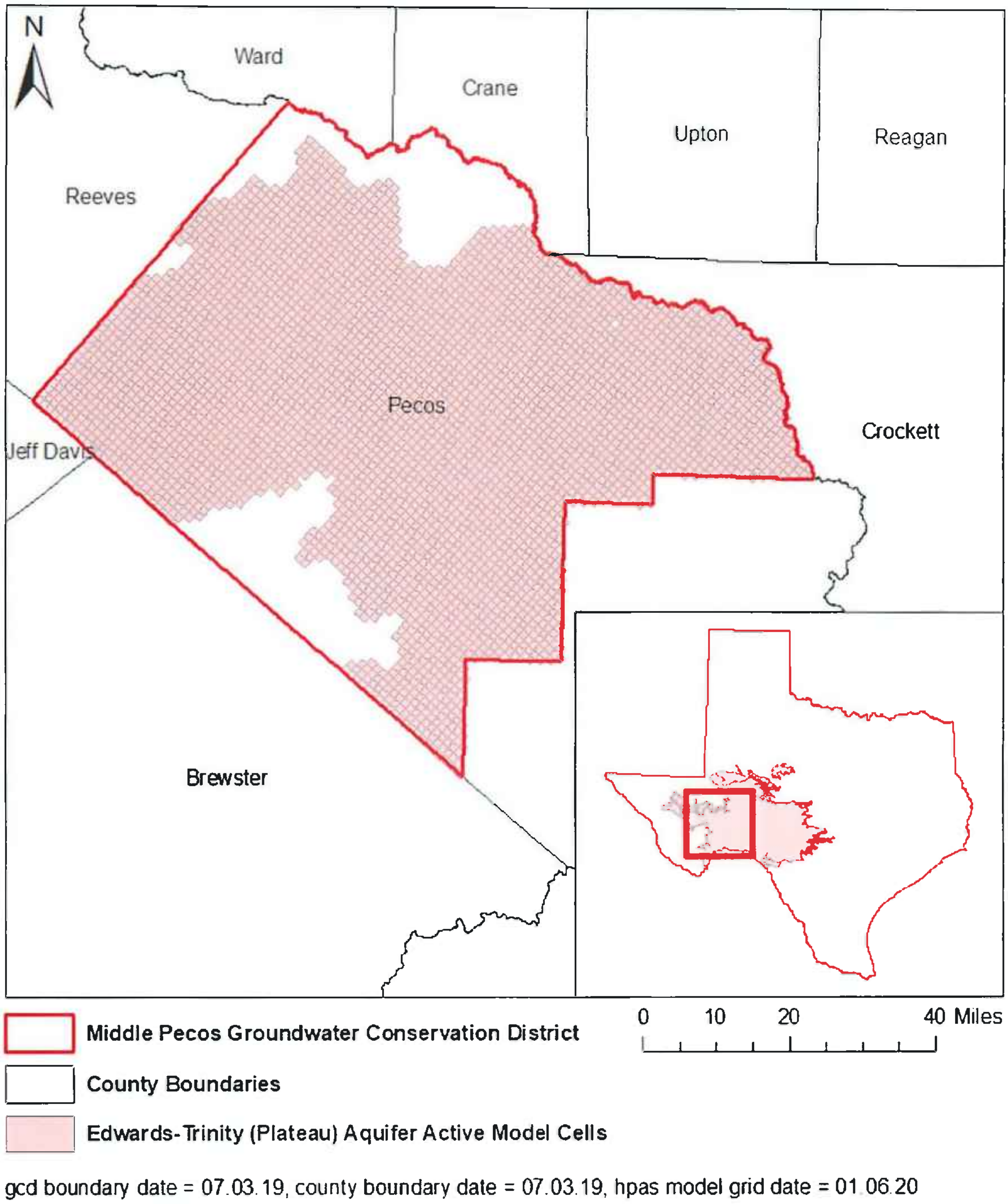

FIGURE 4: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE EDWARDS-TRINITY (PLATEAU) AND PECOS VALLEY AQUIFERS FROM WHICH THE INFORMATION IN TABLE 4 WAS EXTRACTED (THE EDWARDS-TRINITY (PLATEAU) AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 5: SUMMARIZED INFORMATION FOR THE PECOS VALLEY AQUIFER THAT IS NEEDED FOR THE MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Pecos Valley	35,919
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers.	Pecos Valley	23,989
Estimated annual volume of flow into the district within each aquifer in the district	Pecos Valley	3,225
Estimated annual volume of flow out of the district within each aquifer in the district	Pecos Valley	15,118
Estimated net annual volume of flow between each aquifer in the district	To the Pecos Valley Aquifer from the Edwards-Trinity (Plateau) Aquifer	41,370
	To the Pecos Valley Aquifer from the Dockum Aquifer	118*

* Indicates values calculated from the groundwater availability model for the High Plains Aquifer System, all other values are calculated from the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers.

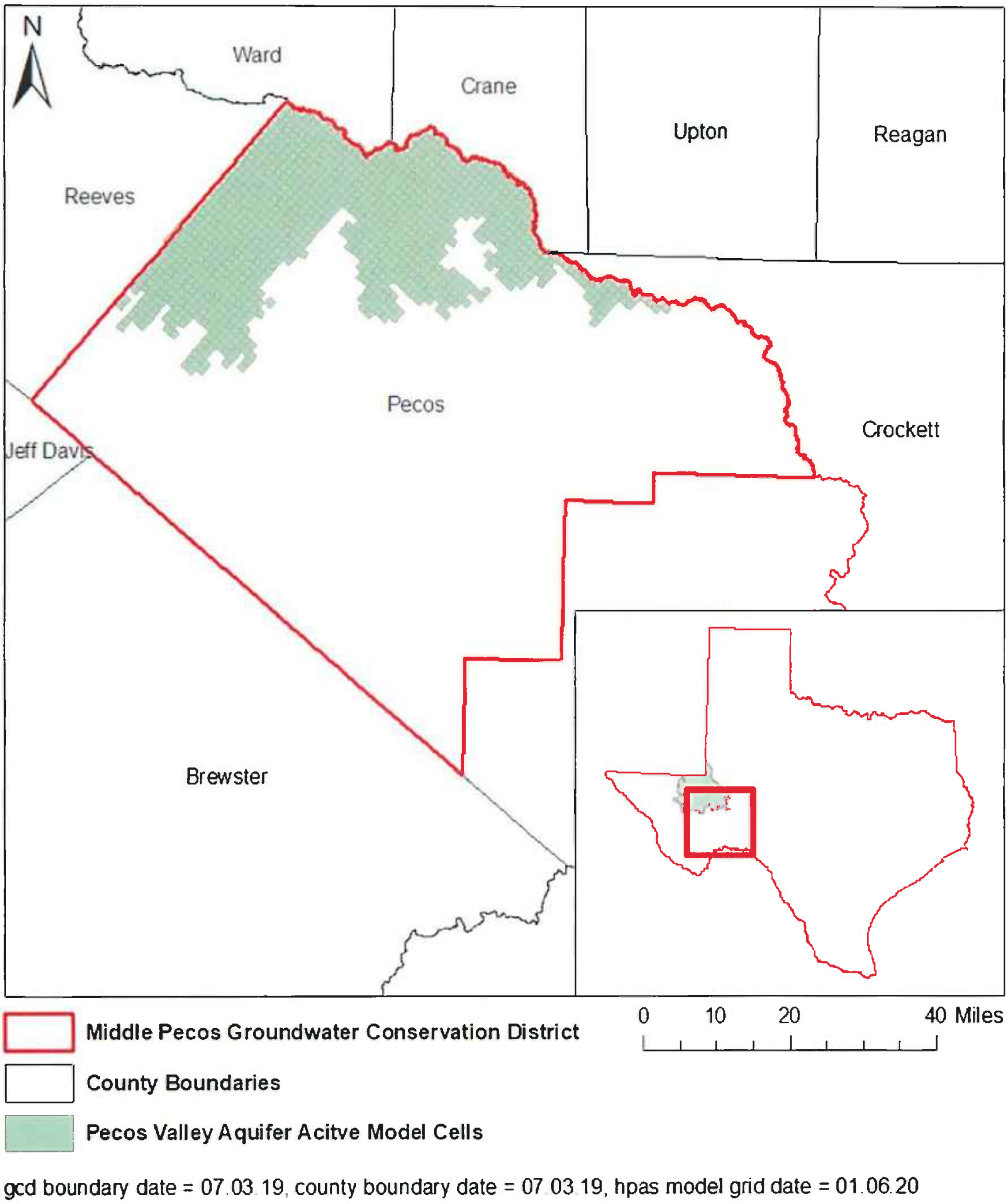

FIGURE 5: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE EDWARDS-TRINITY (PLATEAU) AND PECOS VALLEY AQUIFERS FROM WHICH THE INFORMATION IN TABLE 5 WAS EXTRACTED (THE PECOS VALLEY AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

LIMITATIONS:

The groundwater models used in completing this analysis is the best available scientific tool that can be used to meet the stated objectives. To the extent that this analysis will be used for planning purposes and/or regulatory purposes related to pumping in the past and into the future, it is important to recognize the assumptions and limitations associated with the use of the results. In reviewing the use of models in environmental regulatory decision making, the National Research Council (2007) noted:

> *"Models will always be constrained by computational limitations, assumptions, and knowledge gaps. They can best be viewed as tools to help inform decisions rather than as machines to generate truth or make decisions. Scientific advances will never make it possible to build a perfect model that accounts for every aspect of reality or to prove that a given model is correct in all respects for a particular regulatory application. These characteristics make evaluation of a regulatory model more complex than solely a comparison of measurement data with model results."*

A key aspect of using the groundwater model to evaluate historic groundwater flow conditions includes the assumptions about the location in the aquifer where historic pumping was placed. Understanding the amount and location of historic pumping is as important as evaluating the volume of groundwater flow into and out of the district, between aquifers within the district (as applicable), interactions with surface water (as applicable), recharge to the aquifer system (as applicable), and other metrics that describe the impacts of that pumping. In addition, assumptions regarding precipitation, recharge, and interaction with streams are specific to particular historic time periods.

Because the application of the groundwater models was designed to address regional scale questions, the results are most effective on a regional scale. The TWDB makes no warranties or representations related to the actual conditions of any aquifer at a particular location or at a particular time.

It is important for groundwater conservation districts to monitor groundwater pumping and overall conditions of the aquifer. Because of the limitations of the groundwater model and the assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB to refine this analysis in the future given the reality of how the aquifer responds to the actual amount and location of pumping now and in the future. Historic precipitation patterns also need to be placed in context as future climatic conditions, such as dry and wet year precipitation patterns, may differ and affect groundwater flow conditions.

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Appendix C

Middle Pecos Groundwater Conservation District Effective June 18, 2018

MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT

RULES

Effective June 19, 2018

PECOS COUNTY, TEXAS

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INTRODUCTION

BACKGROUND AND PURPOSE

Texas faces a difficult challenge to develop water policies that serve county, state, regional, and individual Texans' interests. The Texas Constitution authorizes the creation of groundwater conservation districts to plan for, develop, and regulate the use of groundwater. A groundwater conservation district is a local unit of government authorized by the Texas Legislature and ratified by local election of the district's constituents to manage and protect groundwater.

The MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT (the "District") was created in the 76th Legislature, 1999 by Senate Bill 1911, and ratified in the 77th Legislature, 2001 by House Bill 1258. The District was confirmed by qualified voters of Pecos County in November of 2002.

The boundaries of the District are coextensive with the boundaries of Pecos County, Texas. Aquifers and other recognized groundwater formations underlying Pecos County include the Capitan Reef, Dockum, Edwards-Trinity, Pecos Valley, Rustler, and San Andres.

The District is governed by a board of eleven directors elected as follows:

(1) One director shall be elected by the qualified voters of the entire district;

(2) Two directors shall be elected from each of the four Pecos County Commissioners' precincts by the qualified voters of each respective precinct;

(3) One director shall be elected from the City of Iraan by the qualified voters of that city; and

(4) One director shall be elected from the City of Fort Stockton by the qualified voters of that city.

The District has the rights, powers, privileges, authority, functions, and the duties provided by the general law of the State, Chapter 36 of the Texas Water Code, and the District Act.

The substantive rules of the District were initially adopted by the District's Board of Directors on August 18, 2004, at a duly posted public meeting in compliance with the Texas Open Meetings Act and following notice and hearing in accordance with Section 36.101 of the Texas Water Code. The District's rules are hereby adopted as the rules of this District in accordance with Section 59 of Article XVI of the Texas Constitution, Chapter 36 of the Texas Water Code, and the District Act.

The District's rules are and have been adopted to simplify procedures, avoid delays, and facilitate the administration of the water laws of the State of Texas. These rules are to be construed to attain those objectives. These rules may be used as guides in the exercise of discretion, where discretion is vested. However, these rules shall not be construed as a limitation or restriction upon the exercise of discretion conferred by law, nor shall they be construed to deprive the District or the District's Board of any powers, duties, or jurisdiction provided by law.

These rules will not limit or restrict the amount and accuracy of data or information that may be required for the proper administration of the law.

Nothing in these rules or Chapter 36 of the Texas Water Code shall be construed as granting the authority to deprive or divest a landowner, including a landowner's lessees, heirs, or assigns, of the groundwater ownership and rights described by Section 36.002 of the Texas Water Code, recognizing, however, that Section 36.002 does not prohibit the District from limiting or prohibiting the drilling of a well for failure or inability to comply with minimum well spacing or tract size requirements adopted by the District; affect the ability of the District to regulate groundwater production as authorized under Section 36.113, 36.116, or 36.122 or otherwise under Chapter 36, Texas Water Code, or a special law governing the District; or require that a rule adopted by the District allocate to each landowner a proportionate share of available groundwater for production from the aquifer based on the number of acres owned by the landowner.

PURPOSE OF THE DISTRICT

By statutory enactment and declaration by the Texas Supreme Court, groundwater management by groundwater conservation districts is the state's preferred method of groundwater management in order to protect property rights, balance the conservation and development of groundwater to meet the needs of this state, and use the best available science in the conservation and development of groundwater. The District's locally elected board of directors and staff accomplish this purpose by performing certain duties set forth in the general law of the State, Chapter 36 of the Texas Water Code, and the District Act, and implemented in accordance with these rules.

MISSION STATEMENT

Develop and implement an efficient, economical and environmentally sound groundwater management program to protect, maintain and enhance the groundwater resources of the District, and to communicate and administer to the needs and concerns of the citizens of Pecos County associated with these groundwater resources.

SECTION 1. DEFINITIONS, PURPOSE, AND CONCEPTS OF THE RULES

RULE 1.1 DEFINITIONS OF TERMS

In the administration of its duties the District defines terms as set forth in Chapter 36 of the Texas Water Code unless otherwise modified or defined herein as necessary to apply to unique attributes of the District. The specific terms hereinafter defined shall have the following meaning in these rules, the District's Management Plan, forms, and other documents of the District:

"Abandoned Well" means a well that has not been used for a beneficial purpose for at least one year and/or a well not registered with the District. A well is considered to be in use in the following cases:

(a) a non-deteriorated well which contains the casing, pump and pump column in good condition; or

(b) a non-deteriorated well which has been capped.

"Affected Person" means, with respect to a Groundwater Management Area:

(1) an owner of land in the Groundwater Management Area;

(2) a district in or adjacent to the Groundwater Management Area;

(3) a regional water planning group with a water management strategy in the Groundwater Management Area;

(4) a person who holds or is applying for a permit from a district in the Groundwater Management Area;

(5) a person who has groundwater rights in the Groundwater Management Area;

(6) or any other person defined as affected by a TCEQ rule.

"Animal Feeding Operation" means a lot or facility (other than an aquatic animal production facility) where animals have been, are, or will be stabled or confined and fed or maintained for a total of 45 (forty-five) calendar days or more in any 12-month period, and the animal confinement areas do not sustain crops, vegetation, forage growth, or postharvest residues in the normal growing season over any portion of the lot or facility.

"Aquifer" means a geologic formation that will yield water to a well in sufficient quantities to make the production of water from this formation feasible for beneficial use. When the term "Aquifer" is used in these rules, it shall also mean the Aquifer's subdivisions.

"Aquifer Storage and Recovery Project" or "ASR Project" means a project involving the injection of water into a geologic formation for the purpose of subsequent recovery and beneficial use by the Project Operator.

"ASR" means aquifer storage and recovery.

"ASR Injection Well" means a Class V injection well used for the injection of water into a geologic formation as part of an ASR Project.

"ASR Recovery Well" means a well used for the recovery of water from a geologic formation as part of an ASR Project.

"Beneficial Use" means "use for a beneficial purpose," which means use for:

(a) agricultural, gardening, domestic, stock raising, municipal, mining, manufacturing, industrial, commercial, recreational, or pleasure purposes;

(b) exploring for, producing, handling, or treating oil, gas, sulphur, or other minerals; or

(c) any other purpose that is useful and beneficial to the user.

“Best available science” means conclusions that are logically and reasonably derived using statistical or quantitative data, techniques, analyses, and studies that are publicly available to reviewing scientists and can be employed to address a specific scientific question.

“Board” means the Board of Directors of the District.

“Capitan Limestone Aquifer” means the Capitan Reef Complex consists of the Capitan Reef and associated reefs and limestones which were deposited around the perimeter of the Delaware Basin during Permian time. The reef complex is composed of approximately 2,000 feet of massive, vuggy to cavernous limestone and dolomite, bedded limestone, and reef talus. In the study area, (located in the northern part of the Trans-Pecos region of West Texas, which is in the Great Plains physiographic province, and falls within the Rio Grande basin), the reef occurs in a 6 to 10 mile wide, south-southeast trending belt, extending from New Mexico through western Winkler, central Ward, and western Pecos Counties. Depth to the top of the reef ranges from 2,400 to 3,600 feet (Guyton and Associates, 1958). The Capitan Reef Complex yields small to large quantities of moderately to very saline water to wells in the study area that primarily have been used for secondary recovery of oil in Ward and Winkler Counties(Richey and others, 1985).

“Capping” means equipping a well with a securely affixed, removable device that will prevent the entrance of surface pollutants into the well in compliance with regulations of the Texas Department of Licensing and Regulations.

“Casing” means a tubular structure installed in the excavated or drilled borehole to maintain the well opening.

“Concentrated Animal Feeding Operation” (“CAFO”) means any animal feeding operation with the number of animals established in TCEQ’s rules, including at least 37,500 chickens (other than laying hens), or that has been designated by the TCEQ’s Executive Director as a CAFO because it is a significant contributor of pollutants into or adjacent to water in the state.

“Conservation” refers to those water saving practices, techniques, and technologies that will reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of waste, or increase the recycling and reuse of water so that a water supply is made available for future or alternative uses.

“Desired Future Condition” means a quantitative description, adopted in accordance with Section 36.108, Texas Water Code, of the desired condition of the groundwater resources in a Groundwater Management Area at one or more specified future times.

“Dewatering Well” means a well used to remove groundwater from a construction site or excavation, or to relieve hydrostatic uplift on permanent structures.

“Director” means an elected or appointed member of the Board of Directors of the District.

“Discharge” means the volume of water that passes a given point within a given period of time.

“District” means the Middle Pecos Groundwater Conservation District.

"District Act" means the District's enabling legislation to be codified in Chapter 8851 of the Texas Special District Local Laws effective on April 1, 2013, and originally enacted by Act of the 76th Legislature, 1999, Regular Session, Chapter 1331 (Senate Bill 1911), as amended by Act of the 77th Legislature, 2001, Regular Session, Chapter 1299 (House Bill 1258), and Act of the 82nd Legislature, 2011, Regular Session, Chapter 199 (Senate Bill 564).

"District Management Plan" or **"Management Plan"** means the plan promulgated and adopted by the District, as may be amended and revised by the Board from time to time, pursuant to Sections 36.1071-36.1073 of the Texas Water Code.

"Dockum Group Aquifer" – The Dockum Group of Triassic age consists of upper and lower shaley units and a middle water-bearing sandstone unit often referred to as the "Santa Rosa." Small to moderate quantities of fresh to moderately saline water are produced from the sandstone in Winkler, Ward, eastern Loving, and eastern Reeves Counties, primarily where the aquifer is relatively shallow. In parts of Pecos, Reeves, Ward, and Winkler Counties, where the sandstone is hydraulically connected to the Pecos Valley Aquifer, the combination has been referred to as the Allurosa aquifer.

"District Office" means the principal office of the District at such location as may be established by the Board.

"Domestic Use" means water used by and connected to a household for personal needs or for household purposes such as drinking, bathing, heating, cooking, sanitation or cleaning, and landscape irrigation. Ancillary use may include watering of domestic animals.

"Domestic Well" means a well providing groundwater for domestic use.

"Drill" means drilling, equipping, completing wells, or modifying the size of wells or well pumps/motors (resulting in an increase in pumpage volume) whereby a drilling or service rig must be on location to perform the activity.

"Edwards-Trinity (Plateau) Aquifer" – The Edwards-Trinity (Plateau) aquifer underlies the Pecos Valley Aquifer in the study area, (located in the northern part of the Trans-Pecos region of West Texas, which is in the Great Plains physiographic province, and falls within the Rio Grande basin), in the southwest half of Reeves County and a portion of the Coyanosa area in northwest Pecos County. The aquifer is composed of water-bearing lower Cretaceous sands and limestones that are hydraulically connected to the overlying alluvium. Wells completed in the aquifer produce small to moderate quantities of fresh to moderately saline water, which is generally similar to that of the overlying alluvium. The poorest quality water is the aquifer, with dissolved solids in excess of 3,000 milligrams per liter (mg/l), occurs in the southwestern part of Reeves County where the aquifer receives recharge from the sulfate-rich Rustler aquifer. Water from the Edwards-Trinity(Plateau) aquifer is mostly used for irrigation, with a lesser amount used for industrial purposes in western Reeves County.

"Evidence of Historic or Existing Use" means evidence that is material and relevant to a determination of the amount of groundwater beneficially used without waste by a permit applicant during the relevant time period set by District rule that regulates groundwater based on historic use. Evidence in the form of oral or written testimony shall be subject to cross-examination. The Texas Rules of Evidence govern the admissibility and introduction of evidence of historic or existing use, except that evidence not admissible under the Texas Rules of Evidence may be admitted if it is of the type commonly relied upon by reasonably prudent persons in the conduct of their affairs.

“Exempt Well” means a well that is exempt pursuant to District Rule 11.3.

“Existing Well” means any well in the District that was drilled on or before the effective date of these rules.

“Export of Groundwater” means pumping, transferring, or transporting groundwater out of the District. The terms “transfer,” “transport,” or “export” of groundwater are used interchangeably within Chapter 36 of the Texas Water Code and these rules.

“Fees” means charges imposed by the District pursuant to these rules.

“Groundwater Management Area” means an area designated and delineated by the TWDB as suitable for the management of groundwater resources.

“Groundwater Reservoir” means a specific subsurface water-bearing reservoir having ascertainable boundaries and containing groundwater.

“Historic and Existing Use Period” means the period September 1, 1989, through the effective date of the rules adopting “Historic and Existing Use” rules, September 1, 2004; provided, however, that this period shall extend an additional consecutive 12-month period dating from September 1 - August 30 (“12-month period” or “year”) for each such year during which the applicant demonstrates continued beneficial use of water in that year and demonstrates continued beneficial use in each and every year between September 1, 1989, and September 1, 2004, up to an additional, consecutive fifteen years extending to September 1, 1974.

“Hydrogeological Report” means a report that identifies the availability of groundwater in a particular area and formation, and which also addresses the issues of quantity and quality of that water and the impacts of pumping that water on the surrounding environment including impacts to nearby or adjacent wells.

“Irrigation Use” means the application of water, not associated with agricultural irrigation use, to plants or land in order to promote growth of plants, turf, or trees. Irrigation use includes but is not limited to athletic fields, parks, golf courses, and landscape irrigation not tied to domestic use.

“Irrigation Well” means a well providing groundwater for irrigation use (a nonexempt well).

“Leachate Well” means a well used to remove contamination from soil or groundwater.

“Livestock” means domesticated horses, cattle, goats, sheep, swine, poultry, ostriches, emus, rheas, deer and antelope, and other similar animals involved in farming or ranching operations on land, recorded and taxed in the County as an agricultural land use. Dogs, cats, birds, fish, reptiles, small mammals, potbellied pigs, and other animals typically kept as pets are not considered livestock. Livestock-type animals kept as pets or in a pet-like environment are not considered livestock.

"Managed Available Groundwater" refers to the term used by the TWDB in some of its models and associated reports, model runs, and other written documents, and which was defined by statutory law in existence prior to the 2011 legislative session, during which the 82nd Legislature replaced the concept of Managed Available Groundwater with Modeled Available Groundwater.

"Management Zone" means a geographic area delineated under District Rule 10.5 and in accordance with Section 36.116(d), Texas Water Code, and is sometimes referred to as a "management zone".

"Maximum Historic and Existing Use" means the quantity of water put to beneficial use during the single 12-month period (September 1 – August 30) of maximum beneficial use during the Historic and Existing Use Period.

"Modeled Available Groundwater" means the amount of water that the Executive Administrator of the TWDB determines may be produced on an average annual basis to achieve the Desired Future Conditions established for the Aquifers in the District.

"Modify" means to alter the physical or mechanical characteristics of a well, its equipment, or production capabilities. This does not include repair of equipment, well houses or enclosures, or replacement with comparable equipment.

"Monitoring Well" means a well installed exclusively to measure some property of the groundwater or an aquifer that it penetrates, that does not produce more than 5,000 gallons per year.

"New Well" means any well that is not an existing well, or any existing well, which has been modified to increase water production after the effective date of these Rules.

"Office" means the State Office of Administrative Hearings.

"Pecos Valley Aquifer" – During the Cenozoic Era, a thick sequence of alluvial deposits accumulated in two large slumpage depressions. These depressions are herein referred to as the Monument Draw Trough, which developed along the eastern margin of the Delaware Basin, and the Pecos Trough, which occupies the south-central part of the Basin. The troughs were formed by dissolution and removal of evaporates in the underlying Ochoan Series, which resulted in the collapse of the Rustler Formation and younger rocks into the voids (Maley and Huffington, 1953). Water saturated alluvial fill in these troughs is classified as the Pecos Valley Aquifer.

"Permit Amendment" means a minor or major change in a permit.

"Person" includes a corporation, individual, organization, cooperative, government or governmental subdivision or agency, business trust, estate, trust, partnership, association, or any other legal entity.

“Personal Justiciable Interest” means an interest related to a legal right, duty, privilege, power, or economic interest affected by a permit or permit amendment application. A justiciable interest is an interest beyond that shared by the general public.

“Plugging” means the permanent closure of a well in accordance with approved District standards.

“Pollution” means the alteration of the physical, thermal, chemical, or biological quality of, or the contamination or degradation of, any groundwater within the District that renders the groundwater harmful, detrimental, or injurious to humans, animal life, vegetation, or property or to public health, safety, or impairs the usefulness or the public or private use or enjoyment of the water for any lawful or reasonable purpose.

“Presiding Officer” means the Board President or, in the Board President’s absence, a Director delegated authority by the Board to preside over a hearing.

“Production Permit” is synonymous with “Operating Permit,” both terms which mean the type of a permit that authorizes the operation and production from a water well.

“Project Operator” means a person holding an authorization under this subchapter to undertake an ASR Project.

“Retail Public Utility” means any person, corporation, public utility, water supply or sewer service corporation, municipality, political subdivision or agency operating, maintaining, or controlling in this state, facilities (such as a public water supply well) for providing potable water service for compensation.

“Rustler Aquifer” – The Rustler Formation underlies the entire study area, (located in the northern part of the Trans-Pecos region of West Texas, which is in the Great Plains physiographic province, and falls within the Rio Grande basin), and consists of 200 to 500 feet of anhydrite and dolomite with a basal zone of sandstone and shale. Slightly to moderately saline water occurs in the formation in most of Reeves and western Loving, Ward, and Pecos Counties and has mostly been used for irrigation and livestock supply. Elsewhere, the formation produces very saline to brine quality water that is used primarily for secondary oil recovery. Water in the aquifer occurs under artesian conditions, except in the out crop in the Rustler Hills to the west and in collapsed zones in the two troughs.

“Rules” means the standards and regulations promulgated by the District, as they may be amended from time to time, and are often referred to generally as “rules” or the District’s rules.

“Seal” means the impermeable material, such as cement grout, bentonite, or puddling clay, placed in the annular space between the borehole wall and the casing to prevent the downhole movement of surface water or the vertical mixing of groundwater.

“SOAH” means the State Office of Administrative Hearings.

“Special Provisions” means the conditions or requirements added to a permit, which may be more or less restrictive than the Rules as a result of circumstances unique to a particular situation.

“Spring” means a point(s) of natural discharge from an aquifer.

“Static Water Level” means the water level in a well that has not been affected by withdrawal of groundwater.

“Stratum” means a layer of rock having a similar composition throughout.

“Subsidence” means the lowering in elevation of the land surface caused by withdrawal of groundwater.

“Surface Completion” means sealing off access of undesirable water, surface material, or other potential sources of contamination to the wellbore by proper casing and/or cementing procedures.

“TCEQ” means the Texas Commission on Environmental Quality, and its predecessor and any successor agencies.

“TWDB” means the Texas Water Development Board.

“User” means a person who produces, distributes, or uses water from any Aquifer within the District.

“Waste” shall have the meaning provided for in District Rule 14.1.

“Water Table” means the upper boundary of the saturated zone in an unconfined aquifer.

“Water Tight Seal” means a seal that prohibits the entrance of liquids or solutions, including water, which may enter through the wellhead and potentially, contaminate the well.

“Water Well” means any drilled or excavated facility, device, or method used to withdraw groundwater from the groundwater supply.

“Well” means any artificial excavation or borehole constructed for the purposes of exploring for or producing groundwater, or for injection, monitoring, or dewatering purposes.

“Well Registration” means the creation of a record of the well by use and a well identification number for purposes of registering the well as to its geographic location and for notification to the well owner in cases of spills or accidents, data collection, recordkeeping and for future planning purposes. (See Section 9 of the District’s rules).

“Well System” means two or more wells owned, operated, or otherwise under the control of the same person and that are held under the same permit.

“Withdraw or Withdrawal” means the act of extracting groundwater by pumping or any other method other than the discharge of natural springs.

RULE 1.2 PURPOSE OF RULES

The rules of the District are promulgated and adopted under the District's statutory authority to achieve the following purposes and objectives: to provide for conserving, preserving, protecting, and recharging of groundwater or of a groundwater reservoir or its subdivisions, in order to control subsidence, or prevent waste of groundwater. The District's orders rules, requirements, resolutions, policies, guidelines or similar measures have been implemented to fulfill these objectives.

RULE 1.3 USE AND EFFECT OF RULES

These rules are used by the District as guides in the exercise of the powers conferred by law and in the accomplishment of the purposes of the District Act and Chapter 36 of the Texas Water Code. They shall not be construed as a limitation or restriction on the exercise of any discretion, where it exists, nor shall they be construed to deprive the District or Board of the exercise of any powers, duties or jurisdiction conferred by law; nor shall they be construed to limit or restrict the amount and character of data or information that may be required to be collected for the proper administration of the District Act or Chapter 36.

RULE 1.4 AMENDING OF RULES

The Board may, following notice and hearing, amend or repeal these rules or adopt new rules from time to time, following the procedure set forth in the Rulemaking Section of these rules, and applicable law.

RULE 1.5 HEADINGS AND CAPTIONS

The section and other headings and captions contained in these rules are for reference purposes only and do not affect in any way the meaning or interpretation of these rules.

RULE 1.6 CONSTRUCTION

A reference to a title or chapter without further identification is a reference to a title or chapter of the Texas Water Code, unless the context of usage clearly implies otherwise. A reference to a section or rule without further identification is a reference to a section or rule in these rules, unless the context of usage clearly implies otherwise. Construction of words and phrases is governed by the Code Construction Act, Subchapter B, Chapter 311, Texas Government Code. The singular includes the plural, and the plural includes the singular. The words "and" and "or" are interchangeable and shall be interpreted to mean and/or.

RULE 1.7 SEVERABILITY

In case any one or more of the provisions contained in these rules shall for any reason be held to be invalid, illegal, or unenforceable in any respect, such invalidity, illegality, or unenforceability shall not affect any other rules or provisions hereof, and these rules shall be construed as if such invalid, illegal, or unenforceable rule or provision had never been contained herein.

RULE 1.8 SEVERABILITY CLAUSE

If any section, sentence, paragraph, clause, or part of these rules should be held or declared invalid for any reason by a final judgment of the courts of this state or of the United States, such decision or holding shall not affect the validity of the remaining portions of these rules, and the Board does hereby declare that it would have adopted and promulgated such remaining portions irrespective or the fact that any other sentence, section, paragraph, clause, or part thereof may be declared invalid.

RULE 1.9 COMPLIANCE

All permit holders and registrants of the District shall comply with all applicable rules and regulations of other governmental entities. Where the District's rules and regulations are more stringent than those of other governmental entities, the District's rules and regulations shall control.

RULE 1.10 VERB USAGE

The verbs may, can, might, should, or could are used when an action is optional or may not apply in every case. The verbs will, shall, or must are used when an action is required. The verb cannot is used when an action is not allowed or is not achievable. Unless otherwise expressly provided for in these rules, the past, present, and future tense shall include each other.

SECTION 2. BOARD AND DISTRICT STAFF

RULE 2.1 MEETINGS

The Board shall meet at least once each quarter and may meet more frequently as the Board may establish from time to time. At the request of the Board President, or by written request of at least three members, the Board may hold special meetings. All Board meetings will be held and conducted according to the Texas Open Meetings Act, Chapter 551, Texas Government Code. Directors shall not knowingly conspire to meet in numbers less than a quorum for the purpose of secret deliberations.

RULE 2.2 COMMITTEES

The Board President may establish committees for formulation of policy recommendations to the Board, and appoint the chair and membership of the committees. Committee members serve at the pleasure of the Board President.

RULE 2.3 ASSISTANT SECRETARY

A Director or member of the District staff may be appointed by the Board as Assistant Secretary to the Board to assist in meeting the responsibilities of the Board Secretary, if desired by the Board.

RULE 2.4 GENERAL MANAGER

The Board may employ or contract with a person to manage the District, and title this person "General Manager". The General Manager shall have full authority to manage and operate the affairs of the District, subject only to Board orders. The Board will review the compensation and/or contract of the General Manager each year at the beginning of the third quarter of every fiscal year. The General Manager, with approval of the Board, may employ all persons necessary for the proper handling of business and operation of the District, and their compensation will be set by the Board.

SECTION 3. BOARD

RULE 3.1 PURPOSE OF BOARD

The Board was created to determine policy and regulate the withdrawal of groundwater within the boundaries of the District for conserving, preserving, protecting and recharging the groundwater and aquifers within the District, and to exercise its rights, powers, and duties in a way that will effectively and expeditiously accomplish the purposes of the District Act. The Board's responsibilities include, but are not limited to, the adoption, implementation, and enforcement of the District's rules and orders.

RULE 3.2 BOARD STRUCTURE, OFFICERS

The Board may elect officers annually, but must elect officers at the first meeting following the November elections of each even-numbered year. Directors and officers serve until their successors are elected or appointed and sworn in accordance with the District Act and these rules, and qualified under applicable State law. If there is a vacancy on the Board, the remaining Directors shall appoint a Director to serve the remainder of the term. If at any time there are fewer than three qualified Directors, the Pecos County Commissioners Court shall appoint the necessary number of persons to fill all the vacancies on the Board. The appointed Director's term shall end on qualification of the Director elected at that election.

RULE 3.3 EX PARTE COMMUNICATIONS

Directors may not communicate, directly or indirectly, about any issue of fact or law in any contested hearing before the Board, with any agency, person, party or their representatives, except on notice and opportunity for all parties to participate. This rule does not apply to a Director who abstains from voting on any matter in which ex parte communications have occurred or to communications between the Board and the staff, professional, or consultants of the District.

SECTION 4. GENERAL PROCEDURAL PROVISIONS

RULE 4.1 DISTRICT ADDRESS

The District's mailing address is P.O. Box 1644, Fort Stockton, Texas, 79735, and its physical address shall be established by the Board and posted on the District's Internet site, if the District has a functioning Internet site.

RULE 4.2 COMPUTING TIME

In computing any period of time specified by these rules, by a Presiding Officer, by the Board, or by law, the period shall begin on the day after the act, event, or default in question, and shall conclude on the last day of that designated period, unless the last day is a Saturday, Sunday, or legal holiday on which the District Office is closed, in which case the period runs until the end of the next day which is neither a Saturday, Sunday, nor legal holiday on which the District Office is closed.

RULE 4.3 FILING OF DOCUMENTS AND TIME LIMIT

Applications, requests, or other papers or documents shall be filed either by hand delivery, mail, or telephonic document transfer to the District Office. The document shall be considered filed as of the date received by the District for a hand delivery; as of the date reflected by the official United States Postal Service postmark if mailed; and, for telephonic document transfers, as of the date on which the telephonic document transfer is complete, except that any transfer occurring after 5:00 p.m. will be deemed complete on the following business day. If a person files a document by facsimile, he or she must file a copy by mail within three (3) calendar days. A document may be filed by electronic mail ("email") only if the Board or Presiding Officer has expressly authorized filing by email for that particular type of document and expressly established the appropriate date and time deadline, email address, and any other appropriate filing instructions.

RULE 4.4 METHODS OF SERVICE UNDER THE RULES

Except as otherwise provided for in these rules, and notice or document required by these rules to be served or delivered may be delivered to the recipient, or the recipient's authorized representative, in person, by agent, by courier-receipted delivery, by certified or registered mail sent to recipient's last known address, by email to the recipient's email address on file with the District if written consent is granted by the recipient, or by facsimile to the recipient's current facsimile number and shall be accomplished by 5:00 o'clock p.m. (as shown by the clock in the recipient's office) of the date on which it is due. Service by mail is complete upon deposit in a post office or other official depository of the United States Postal Service. Service by facsimile is complete upon transfer, except that any transfer commencing after 5:00 o'clock p.m. (as shown by the clock in the recipient's office) shall be deemed complete the following business day. If service or delivery is by mail, and the recipient has the right to perform some act or is required to perform some act within a prescribed period of time after service, three (3) calendar days will be added to the prescribed period. Where service by other methods has proved unsuccessful, the service shall be complete by such other method as may be approved by the Board. The person or person's attorney shall certify compliance with this rule in writing over signature and on the filed document. A certificate by a person or the person's attorney of record, or the return of an officer, or the affidavit of any person showing service of a document, shall be prima facie evidence of the fact of service.

RULE 4.5 USE OF FORMS

The General Manager will furnish forms and instructions for the preparation of any application, declaration, registration or other document that is required to be filed with the District on a form prepared by the District. The use of such forms is mandatory. Supplements may be attached if there is insufficient space on the form. If supplements are used, the data and information entered therein shall be separated into sections that are numbered to correspond with the numbers of the printed form.

RULE 4.6 MINUTES AND RECORDS OF THE DISTRICT

All official documents, reports, records, and minutes of the District will be available for public inspection and copying in accordance with the Texas Public Information Act.

RULE 4.7 APPLICABILITY; PROCEDURES NOT OTHERWISE PROVIDED FOR

This Section 4 shall apply to all types of hearings conducted by the District to the extent this Section is not inconsistent with any other section of these rules that applies to the type of hearing at issue. If, in connection with any hearing, the Board determines that there are no statutes or other applicable rules resolving particular procedural questions then before the Board, the Board will direct the parties to follow procedures consistent with the purpose of these rules, the District Act, and Chapter 36 of the Texas Water Code.

RULE 4.8 CONTINUANCE

Unless provided otherwise in these Rules, any meeting, workshop, or hearing may be continued from time to time and date to date without published notice after the initial notice, in conformity with the Texas Open Meetings Act.

RULE 4.9 REQUEST FOR RECONSIDERATION

To appeal a decision of the District, including any determinations made by the General Manager, concerning any matter not covered under any other section of these rules, a request for reconsideration may be filed with the District within 20 (twenty) calendar days of the date of the decision. Such request for reconsideration must be in writing and must state clear and concise grounds for the request. The Board will make a decision on the request for reconsideration within 45 (forty-five) calendar days thereafter. The failure of the Board to grant or deny the request for reconsideration within 45 (forty-five) calendar days of the date of filing shall constitute a denial of the request.

SECTION 5. HEARINGS GENERALLY

RULE 5.1 APPLICABILITY

(a) Rulemaking hearings are governed by Section 6 of the District’s rules.

(b) Hearings on the District Management Plan are governed by Section 8 of the District’s rules.

(c) Permit-related hearings and hearings on applications for well-spacing exceptions are governed by Section 11 of the District's rules.

(d) Hearings to prevent waste, pollution, or degradation of the quality of groundwater under Section 14 of the District's rules may be conducted under Rule 14.4.

(e) Enforcement hearings are governed by Section 15 of the District's rules.

(f) Hearings on the Desired Future Conditions, including the appeal process of Desired Future Conditions, are governed by Section 17 of the District's rules.

(g) All other hearings not described in this rule are governed by Rule 5.2.

RULE 5.2 HEARINGS ON OTHER MATTERS

A public hearing may be held on any matter beyond rulemaking, the District Management Plan, enforcement, and permitting, within the jurisdiction of the District, if the Board deems a hearing to be in the public interest or necessary to effectively carry out the duties and responsibilities of the District. Not less than ten (10) calendar days prior to the date of a public hearing, the Board shall publish notice of the subject matter of the hearing, the time, date, and place of the hearing, in a newspaper of general circulation in the District, in addition to posting the notice in the manner provided by the Texas Open Meetings Act.

SECTION 6. RULEMAKING HEARINGS

RULE 6.1 GENERAL

A rulemaking hearing involves matters of general applicability that implement, interpret, or prescribe the law or District's policy, or that describe the procedure or practice requirements of the District. The District will update its rules to implement the Desired Future Conditions before the first anniversary of the date that the TWDB approves the District Management Plan that has been updated to reflect the adopted Desired Future Conditions.

RULE 6.2 NOTICE AND SCHEDULING OF HEARINGS

(a) For all rulemaking hearings, the notice shall include a brief explanation of the subject matter of the hearing, the time, date, and place of the hearing, location, or Internet site at which a copy of the proposed rules may be reviewed or copied, if the District has a functioning Internet site, and any other information deemed relevant by the General Manager or the Board.

(b) Not less than 20 (twenty) calendar days prior to the date of the hearing, and subject to the notice requirements of the Texas Open Meetings Act the General Manager shall:

    (1) post notice in a place readily accessible to the public at the District Office;

    (2) provide notice to the County Clerk of Pecos County;

(3) publish notice in one or more newspapers of general circulation in the District;

(4) provide notice by mail, fax, or email to any person who has requested notice under Subsection (c); and

(5) make available a copy of all proposed rules at a place accessible to the public during normal business hours, and post an electronic copy on the District's Internet site, if the District has a functioning Internet site.

(c) A person may submit to the District a written request for notice of a rulemaking hearing. A request is effective for the remainder of the calendar year in which the request is received by the District. To receive notice of a rulemaking hearing in a later year, a person must submit a new request. An affidavit of an officer or employee of the District establishing attempted service by first class mail, fax, or email to the person in accordance with the information provided by the person is proof that notice was provided by the District.

(d) Failure to provide notice under Subsection (c) does not invalidate an action taken by the District at a rulemaking hearing.

(e) Any hearing may or may not be scheduled during the District's regular business hours, Monday through Friday of each week, except District holidays. Any hearing may be continued from time to time and date to date without published notice after the initial published notice in conformity with the Texas Open Meetings Act. The District must conduct at least one hearing prior to adopting amendments to the District's rules.

RULE 6.3 RULEMAKING HEARINGS PROCEDURES

(a) General Procedures: The Presiding Officer will conduct the rulemaking hearing in the manner the Presiding Officer deems most appropriate to obtain all relevant information pertaining to the subject of the hearing as conveniently, inexpensively, and expeditiously as possible. In conducting a rulemaking hearing, the Presiding Officer may elect to utilize procedures set forth in these Rules for permit hearings to the extent that and in the manner that the Presiding Officer deems most appropriate for the particular rulemaking hearing. The Presiding Officer will prepare and keep a record of the rulemaking hearing in the form of an audio or video recording or a court reporter transcription at his or her discretion.

(b) Submission of Documents: Any interested person may submit written statements, protests, or comments, briefs, affidavits, exhibits, technical reports, or other documents relating to the subject of the hearing. Such documents must be submitted no later than the time of the hearing, as stated in the notice of hearing; provided, however, the Presiding Officer may grant additional time for the submission of documents.

(c) Oral Presentations: Any person desiring to testify on the subject of the hearing must so indicate on the registration form provided at the hearing. The Presiding Officer establishes the order of testimony and may limit the number of times a person may speak, the time period for oral presentations, and the time period for raising questions. In addition, the Presiding Officer may limit or exclude cumulative, irrelevant, or unduly repetitious presentations.

(d) Conclusion of the hearing: At the conclusion of the hearing, the Board may take action on the subject matter of the hearing, take no action, or postpone action until a future meeting or hearing of the Board. When adopting, amending, or repealing any rule, the District shall:

(1) consider all groundwater uses and needs;
(2) develop rules that are fair and impartial;
(3) consider the groundwater ownership and rights described by Section 36.002, Texas Water Code;
(4) consider the public interest in conservation, preservation, protection, recharging, and prevention of waste of groundwater, and of groundwater reservoirs or their subdivisions, and in controlling subsidence caused by withdrawal of groundwater reservoirs or their subdivision, consistent with the objectives of Section 59, Article XVI, Texas Constitution;
(5) consider the goals developed as part of the District Management Plan under Section 36.1071, Texas Water Code; and
(6) not discriminate between land that is irrigated for production and land that was irrigated for production and enrolled or participating in a federal conservation program.

(e) Hearing Registration Form: A person participating in a rulemaking hearing shall complete a hearing registration form stating the person's name, address, and whom the person represents, if applicable.

RULE 6.4 CONDUCT AND DECORUM

Every person, party, representative, witness, and other participant in a proceeding must conform to ethical standards of conduct and must exhibit courtesy and respect for all other participants. No person may engage in any activity during a proceeding that interferes with the orderly conduct of District business. If in the judgment of the Presiding Officer, a person is acting in violation of this provision, the Presiding Officer will first warn the person to refrain from engaging in such conduct. Upon further violation by the same person, the Presiding Officer may exclude that person from the proceeding for such time and under such conditions as the Presiding Officer deems necessary.

SECTION 7. EMERGENCY RULES AND ORDERS

RULE 7.1 EMERGENCY RULES

The Board may adopt an emergency rule without prior notice and/or hearing if the Board finds that a substantial likelihood of imminent peril to the public health, safety, or welfare, or a requirement of state or federal law, requires adoption of a rule on less than 20 (twenty) calendar days' notice. The Board shall prepare a written statement of the reasons for this finding. An emergency rule adopted shall be effective for not more than 90 (ninety) calendar days after its adoption by the Board. The Board may extend the 90-day period for an additional 90 (ninety) calendar days if notice of a hearing on the final rule is given not later than the 90^{th} calendar day after the date the rules is adopted. An emergency rule adopted without notice and/or a hearing must be adopted at a meeting conducted under Chapter 551, Texas Government Code.

RULE 7.2 EMERGENCY ORDER AUTHORIZING TEMPORARY PRODUCTION FOR DEMONSTRATED EMERGENCY NEED

(a) A person can request in writing that the District issue an emergency order authorizing the production of groundwater for a beneficial use without a permit for a temporary period of time during which the person can submit a Production Permit application. This request must be in writing and include sufficient factual detail of the emergency situation; the quantity of groundwater needed (in gallons or acre feet); the proposed source of the groundwater (identify the aquifer); the specific location of the well from which the groundwater will be produced; and the period of time proposed for the requested emergency authorization. This request must be submitted to the District's office by any means that ensures receipt by the District.

(b) Upon receipt and consideration of the written request for an emergency order under this rule, the District's Board President or General Manager may issue an emergency order partially or fully granting the request. An order issued under this rule will provide a time limit during which it is effective, which may not exceed 75 (seventy-five) calendar days.

(c) Upon issuance of an order under this rule, the requestor is not required to hold a permit but must use its best efforts to prepare and submit a Production Permit application. The beneficiary of the emergency order authorization must submit a Production Permit application to the District within 20 (twenty) calendar days of issuance of the emergency order. If a Production Permit application is timely submitted under this subsection, then it is within the discretion of the District's Board President or General Manager to extend the 75-day timeframe of the emergency order while the application is pending.

(d) If neither the District's Board President nor General Manager issues an order under this rule after reviewing the request, the requestor's remedy is to submit a Production Permit application.

(e) If an emergency order is issued, the District's Board must be notified of the circumstances and relief granted at the District's next Board meeting.

RULE 7.3 EMERGENCY PERMIT AMENDMENT

If an emergency water need is demonstrated to the Board, the Board may amend a Production Permit or Historic or Existing Use Permit to authorize production from one or more additional wells owned or operated by the permit holder to provide flexibility to the entity with the emergency water need as long as the amendment is consistent with Rule 11.1(b). A hearing is not required under this rule. The Board may take action under this rule at a meeting for which notice has been provided in accordance with the Texas Open Meetings Act.

SECTION 8. DISTRICT MANAGEMENT PLAN

RULE 8.1 ADOPTION OF A MANAGEMENT PLAN

The Board shall adopt a Management Plan that specifies the acts, procedures, performance and avoidance necessary to minimize as far as practicable the drawdown of the water table or the reduction of artesian pressure, to prevent interference between wells, to prevent degradation of water quality, to prevent waste, and to avoid impairment of Desired Future Conditions. The District shall use the District's rules to implement the Management Plan.

RULE 8.2 AMENDMENT

The Board will review and readopt or amend the plan at least every fifth year after its last approval by TWDB. The District will amend its plan to address goals and objectives consistent with achieving the Desired Future Conditions within two years of the adoption of the Desired Future Conditions by the Groundwater Management Area.

RULE 8.3 EFFECTIVE DATE

The Management Plan and any amendments thereto take effect on approval by the TWDB's Executive Administrator or, if appealed, on approval by the TWDB. Approval of the Management Plan remains in effect until the District fails to timely readopt a Management Plan, the District fails to timely submit the District's readopted Management Plan to the TWDB's Executive Administrator, or the TWDB's Executive Administrator determines that the readopted Management Plan does not meet the requirements for approval, and the District has exhausted all appeals to the TWDB or appropriate court.

RULE 8.4 NOTICE

(a) The notice of a hearing on any adoption or amendment of the Management Plan shall include the time, date, and place of the hearing, location or Internet site at which a copy of the proposed plan may be reviewed or copied, if the District has a functioning Internet site, and any other information deemed relevant by the General Manager or the Board.

(b) Not less than ten (10) calendar days prior to the date of the hearing, and subject to the notice requirements of the Texas Open Meetings Act, the General Manager shall:

(1) post notice in a place readily accessible to the public at the District Office;
(2) provide notice to the county clerk of Pecos County; and
(3) make available a copy of the proposed plan at a place accessible to the public during normal business hours, and post an electronic copy on the District's Internet site, if the District has a functioning Internet site.

(c) Any hearing may or may not be scheduled during the District's regular business hours, Monday through Friday of each week, except District holidays. Any hearing may be continued from time to time and date to date without notice after the initial notice, in compliance with the Texas Open Meetings Act. The District must conduct at least one hearing prior to adopting the plan or any amendments to the plan.

RULE 8.5 HEARING PROCEDURES

(a) General Procedures: The Presiding Officer will conduct the hearing in the manner the Presiding Officer deems most appropriate to obtain all relevant information pertaining to the subject of the hearing as conveniently, inexpensively, and expeditiously as possible. The Presiding Officer will prepare and keep a record of the hearing in the form of an audio or video recording or a court reporter transcription at his or her discretion.

(b) Submission of Documents: Any interested person may submit written statements, protests, or comments, briefs, affidavits, exhibits, technical reports, or other documents relating to the subject of the hearing. Such documents must be submitted no later than the time of the hearing, as stated in the notice of hearing; provided, however, the Presiding Officer may grant additional time for the submission of documents.

(c) Oral Presentations: Any person desiring to testify on the subject of the hearing must so indicate on the registration form provided at the hearing. The Presiding Officer establishes the order of testimony and may limit the number of times a person may speak, the time period for oral presentations, and the time period for raising questions. In addition, the Presiding Officer may limit or exclude cumulative, irrelevant, or unduly repetitious presentations.

(d) Conclusion of the hearing: At the conclusion of the hearing, the Board may take action on the subject matter of the hearing, take no action, or postpone action until a future meeting or hearing of the Board. When adopting, amending, or repealing the Management Plan, the District shall:

(1) use the District's best available data and groundwater availability modeling information provided by the TWDB's Executive Administrator together with any available site-specific information that has been provided by the District to the TWDB's Executive Administrator for review and comment before being used in the plan;
(2) address the management goals set forth in Section 36.1071, Texas Water Code; and
(3) use and address objectives consistent with achieving the Desired Future Conditions as adopted during the joint planning process.

(e) Hearing Registration Form: A person participating in a hearing on the Management Plan shall complete a hearing registration form stating the person's name, address, and whom the person represents, if applicable.

SECTION 9. WATER WELL REGISTRATION

RULE 9.1 REGISTRATION

All water wells, existing and new, exempt and nonexempt, must be registered with the District and are required to comply with the District's registration requirements in these rules.

RULE 9.2 GENERAL REGISTRATION POLICIES AND PROCEDURES

9.2.1 Each person who intends to drill, equip, modify, complete, operate, change type of use, plug, abandon, or alter the size of a well within the District must complete and submit to the District the District's Notice of Intent to Drill a New Well (Notice of Intent), registration or permit application form, as applicable, even though the well may be exempt from the requirement of a permit under District Rule 11.3.

9.2.2 Pre-registration: For all proposed new exempt and nonexempt wells, the owner of the proposed new well, or the well operator or any other person acting on behalf of the owner of the proposed new well must file a Notice of Intent prior to drilling the proposed new well. If it is believed by the person filing the Notice of Intent that the proposed new well will be exempt under District Rule 11.3, then the Notice of Intent must reflect the basis for the exemption, and must be approved by the District prior to drilling the new well. Within five (5) calendar days from receipt of a Notice of Intent, the District's General Manager shall (1) determine whether the well is exempt under the District's rules, (2) complete the District Use Only section at the end of the Notice of Intent indicating whether the well is exempt, and (3) return a copy of the completed Notice of Intent by facsimile or mail to the address(es) and facsimile number(s) set forth in the Notice of Intent. If the District's determination is that the well is exempt, drilling may begin immediately upon receiving the approved Notice of Intent. The drilling of a new exempt well is subject to the rules of the District. Upon completion of the new exempt well, a registration form must be completed and filed. If the District's determination is that the well is nonexempt, a Drilling Permit application must be filed and approved by the District before drilling may begin.

9.2.3 Registration: All wells must be registered. Existing nonexempt and exempt wells shall be registered immediately. New nonexempt wells shall be registered immediately upon completion pursuant to a Drilling Permit. New exempt wells shall be registered immediately upon completion pursuant to an approved pre-registration.

9.2.4 Re-registration: If the owner or operator of a registered well plans to change the type of use of the groundwater, increase the withdrawal rate, or substantially alter the size of the well or well pump in a manner that does not require a permit, the well must be re-registered on a new registration form.

9.2.5 In the event of an emergency during the drilling of a new exempt well or with an existing well, as defined by the well driller or well service operator, as applicable, an exempt well may be reworked prior to re-registration. The registration requirement will be waived for a 48-hour period.

9.2.6 Term: A registration certificate is perpetual in nature, subject to cancellation for violation of these Rules.

9.2.7 Transfer of Registration: Upon submission to the District of written notice of transfer of ownership or control of any water right or water well covered by a registration and documents evidencing the transfer, the District's General Manager will amend the well registration to reflect the new owner(s).

SECTION 10. PRODUCTION LIMITATIONS

RULE 10.1 HISTORIC AND EXISTING USE PERMITS

The District shall designate the quantity of groundwater that may be produced on an annual basis in each Historic and Existing Use Permit issued by the District, and each permit shall be subject to the conditions of the District Act, Chapter 36 of the Texas Water Code, and these rules, provided, however, that the quantity that may be withdrawn shall not exceed the Maximum Historic and Existing Use demonstrated by the applicant, and determined by the Board, except as that designated quantity of groundwater may be reduced if the District imposes restrictions under these rules and/or permit conditions, or consistent with a Demand Management Plan developed under Rule 10.3(b).

RULE 10.2 PRODUCTION PERMITS

The District shall designate the quantity of groundwater that may be produced on an annual basis under a Production Permit pursuant to the conditions of the District Act, Chapter 36 of the Texas Water Code, and these rules, provided, however, that the quantity shall not exceed an amount demonstrated by the applicant and determined by the Board to be necessary for beneficial use throughout the permit term, except as may be reduced if the District imposes restrictions under these rules and/or permit conditions, or consistent with a Demand Management Plan developed under Rule 10.3(b).

RULE 10.3 AQUIFER-BASED PRODUCTION LIMITS

(a) The District may limit the total amount of authorized annual production and maximum annual rate of groundwater withdrawal for any aquifer within the District as the District determines to be necessary based upon the best available hydrogeologic, geographic, and other relevant scientific data, including but not limited to noted changes in the water levels, water quality, groundwater withdrawals, annual recharge, or the loss of stored water in the aquifer, to avoid impairment of any Desired Future Condition. The District may also develop, utilize, and/or adopt groundwater availability models in support of the District's management of the groundwater within its jurisdiction. The District may establish a series of index or monitoring wells to aid in this determination.

(b) The District will continue to study what aquifer conditions may indicate that proportional adjustment reductions to the amount of permitted production of groundwater are necessary to avoid impairment of the Desired Future Conditions of any of the various aquifers within the District. The District will also continue to study what quantity of proportional adjustment reductions to the amount of permitted production of groundwater are necessary to avoid impairment of the Desired Future Conditions of any of the various aquifers within the District. The Board will consider the findings of the District regarding actions necessary to avoid impairment of the Desired Future Conditions of any of the various aquifers within the District, and may adopt, after appropriate rulemaking notice and hearing, an aquifer-specific Demand Management Plan setting forth a schedule of the actions that may be necessary to avoid impairment of the Desired Future Conditions of any of the various aquifers within the District.

(c) The Board has the right to modify a permit if data from monitoring wells within the source aquifer or other evidence reflects conditions such as but not limited to an unacceptable level of decline in water quality of the aquifer, or as may be necessary to prevent waste and achieve water conservation, minimize as far as practicable the drawdown of the water table or the reduction of artesian pressure, lessen interference between wells, or control and prevent subsidence, or to avoid impairment of the Desired Future Conditions of any of the various aquifers within the District. If the Board has an interest in modifying a permit under this rule, it must provide notice and an opportunity for hearing pursuant to Section 11 of the District's rules.

(d) Upon adoption of Desired Future Conditions and setting of the Modeled Available Groundwater numbers for any aquifer or its subdivisions in the District, the District shall, to the extent possible, issue permits up to the point that the total volume of exempt and permitted groundwater production will achieve an applicable Desired Future Condition for each such aquifer or its subdivision in the District. If the total amount of production within an aquifer, or its subdivision, as applicable, is less than the total volume of exempt and permitted groundwater production that will achieve an applicable Desired Future Condition for that aquifer, production amounts authorized under Historic and Existing Use and Production Permits may remain the same or be increased, as set forth under these rules. As determined by the District, if the total amount of production within an aquifer exceeds the Modeled Available Groundwater set for an aquifer, production amounts may be decreased proportionally among all permit holders producing from that aquifer, if necessary to avoid impairment of the Desired Future Condition. Any necessary reductions will first be applied to Production Permits, and, subsequently, if production still exceeds the Modeled Available Groundwater set for an aquifer after reducing Production Permits in their entirety, to Historic and Existing Use Permits, as set forth under Rule 10.4.

RULE 10.4 PROPORTIONAL ADJUSTMENT

(a) When establishing proportional adjustment restrictions, the Board shall first set aside an amount of groundwater equal to an estimate of total exempt use.

(b) After setting aside an amount of groundwater for exempt use, to the extent of remaining groundwater availability, the Board shall allocate groundwater to Historic and Existing Use Permits according to the permitted Maximum Historic and Existing Use in each. If there is insufficient groundwater availability to allow withdrawal under all Historic and Existing Use Permits, the Board shall allocate the groundwater availability first to the Historic and Existing Permits in an amount up to the Eligible Recharge Credit, on a pro rata basis relative to all other Historic and Existing Permits. The Eligible Recharge Credit shall mean 30% of the permitted Maximum Historic and Existing Use that is designated for and previously put to irrigation use in each Historic and Existing Use Permit. The groundwater authorized for withdrawal pursuant to an Eligible Recharge Credit must be withdrawn from the same aquifer that has been recharged with groundwater allocated under the respective permit or application. The remaining groundwater availability shall then be allocated among the Historic and Existing Use Permits up to an amount authorized under each permit on an equal percentage basis until total authorized production equals groundwater availability for a particular aquifer district-wide or within a management zone, if applicable. The Eligible Recharge Credit shall be applied in such a manner that the irrigation user's Existing and Historic Use Permit shall not be proportionally reduced to the extent of the Eligible Recharge Credit. The only basis for proportionately reducing the Eligible Recharge Credit shall be in the event that 100% of the non-recharge credit portion of the Historic and Existing Use Permit allotments has been reduced. If it can be demonstrated and the Board takes official action to determine that the irrigation recharge is more or less than 30%, then the Eligible Recharge Credit may be adjusted by subsequent rulemaking. No groundwater shall be authorized for production under Production Permits if there is insufficient water availability to satisfy all Historic and Existing Use Permits and exempt use, subject to Subsection (e) of this rule. The Eligible Recharge Credit for irrigation use under a Production Permit shall not be applied where there is equal to or less than enough groundwater to satisfy all Historic and Existing Use Permits and exempt use.

(c) If there is sufficient groundwater to satisfy all Historic and Existing Use Permits and exempt use, the Board shall then allocate remaining water availability first to the existing Production Permit holders in an amount equal to their Eligible Recharge Credit, on a pro rata basis relative to all other Production Permits. The Eligible Recharge Credit shall mean 30% of the groundwater allocated under each Production Permit that is designated for and previously put to irrigation use. The groundwater authorized for withdrawal pursuant to an Eligible Recharge Credit must be withdrawn from the same aquifer that has been recharged with groundwater allocated under the respective Production Permit. The remaining groundwater availability shall then be allocated among the Production Permits up to an amount authorized under each permit on an equal percentage basis until total authorized production equals groundwater availability for a particular aquifer district-wide or within a management zone, if applicable. The recharge credit shall be applied in such a manner that the irrigation user's Production Permit shall not be proportionally reduced to the extent of the recharge credit. The only occasion for proportionately reducing the Eligible Recharge Credit shall be in the event that 100% of the non-recharge credit portion of the Production Permit allotments has been reduced, and there is only sufficient groundwater availability to supply exempt use and Historic and Existing Use. If it can be demonstrated and the Board takes official action to determine that the irrigation recharge is more or less than 30%, then the recharge credit shall be adjusted accordingly. No groundwater may be authorized for production under new Production Permits if there is insufficient groundwater availability to satisfy all existing Production Permits, subject to Subsection (e) of this rule.

(d) If there is sufficient groundwater to satisfy all Historic and Existing Use Permits, exempt use, and existing Production Permits, the Board may then allocate remaining groundwater availability to applications for new or amended Production Permits approved by the District.

(e) When establishing proportional adjustment restrictions that contemplate the reduction of authorized production or a prohibition on authorization for new or increased production, the Board may also choose to proportionately reduce any existing Production Permits on a pro rata basis, excluding the authorized Eligible Recharge Credit, in order to make groundwater available for new applications for Production Permits and may allocate to each surface acre a designated amount of groundwater. In doing so, the Board may elect to allocate more water to surface acreage recognized under existing Production Permits than to surface acreage associated with applications for new Production Permits.

RULE 10.5 MANAGEMENT ZONES

(a) As set forth in the District Management Plan and illustrated in Figures 1 through 4 below, the following management zones are established within the principal areas of irrigation and pertinent surrounding areas of Pecos County:

Management Zone 1 – Leon-Belding Irrigation Area and Vicinity of City of Fort Stockton to include outlets of Comanche Springs:

This management zone area is generally bounded by the TWDB Edwards-Trinity (Plateau) / Pecos Valley Aquifer GAM-Grid cells that contain the following sets of latitude and longitude coordinates: (30.90321N, -102.8566 W); (30.85306N, -102.8928 W); (30.69796 N, -10.15137 W). The specific GAM-grid cells composing Management Zone 1 are provided in Appendix G of the District Management Plan.

Management Zone 2 – Bakersfield Irrigation Area:

This management zone area is generally bounded by the TWDB Edwards-Trinity (Plateau) / Pecos Valley Aquifer GAM-Grid cells that contain the following sets of latitude and longitude coordinates: (except where cells are truncated by intersection with the Pecos County-line): (31.05667 N, -102.3717 W); (30.8992 N, -102.28911 W); (30.95167 N, -102.1653 W); (30.96833 N, -102.2169 W). The specific GAM-Grid cells used to compose Management Zone 2 are provided in Appendix G of the District Management Plan.

Management Zone 3 – Coyanosa Irrigation Area:

This management zone area is generally bounded by the TWDB Edwards-Trinity (Plateau) / Pecos Valley Aquifer GAM-Grid cells that contain the following sets of latitude and longitude coordinates (except where cells are truncated by intersection with the Pecos County-line): (31.1805 N, 103.0202 W); (31.3169 N, 103.0511 W); 31.2097 N, 103.0026 W); (31.1105 N, 102.9924 W); (31.1025 N, 103.1022 W); (31.1834 N, 103.1347 W). The specific GAM-Grid cells used to compose Management Zone 3 are provided in Appendix G of the District Management Plan.

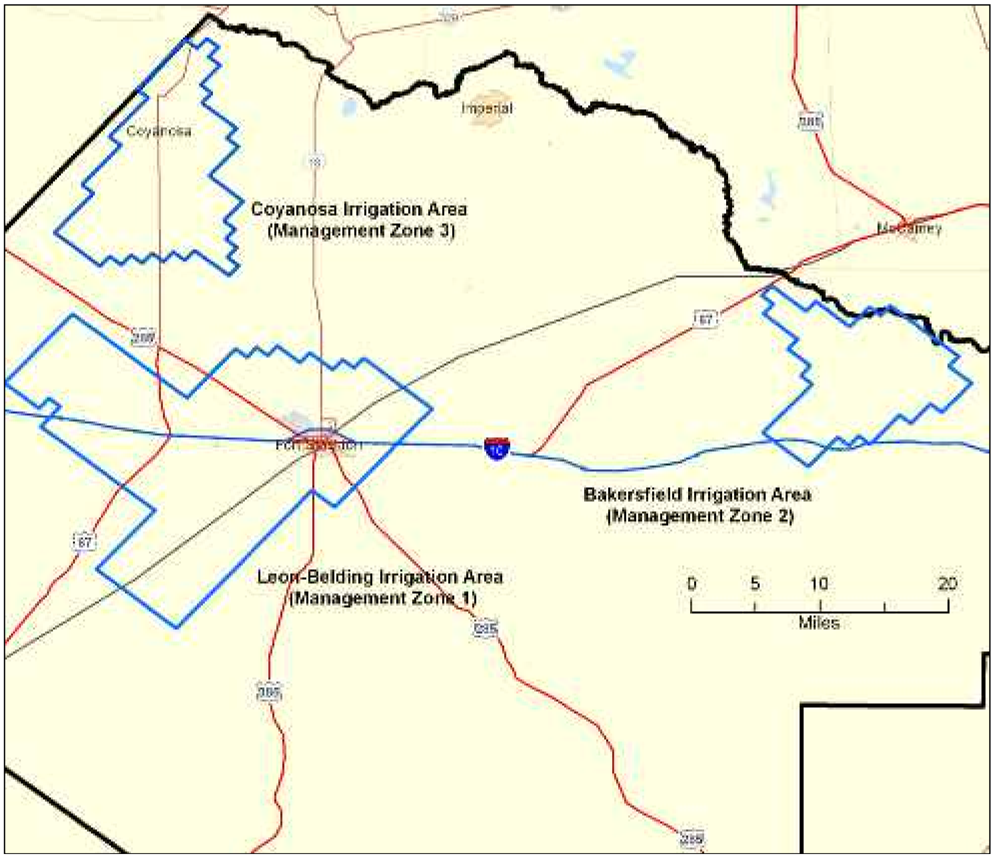

Figure 1, District Designated Management Zones

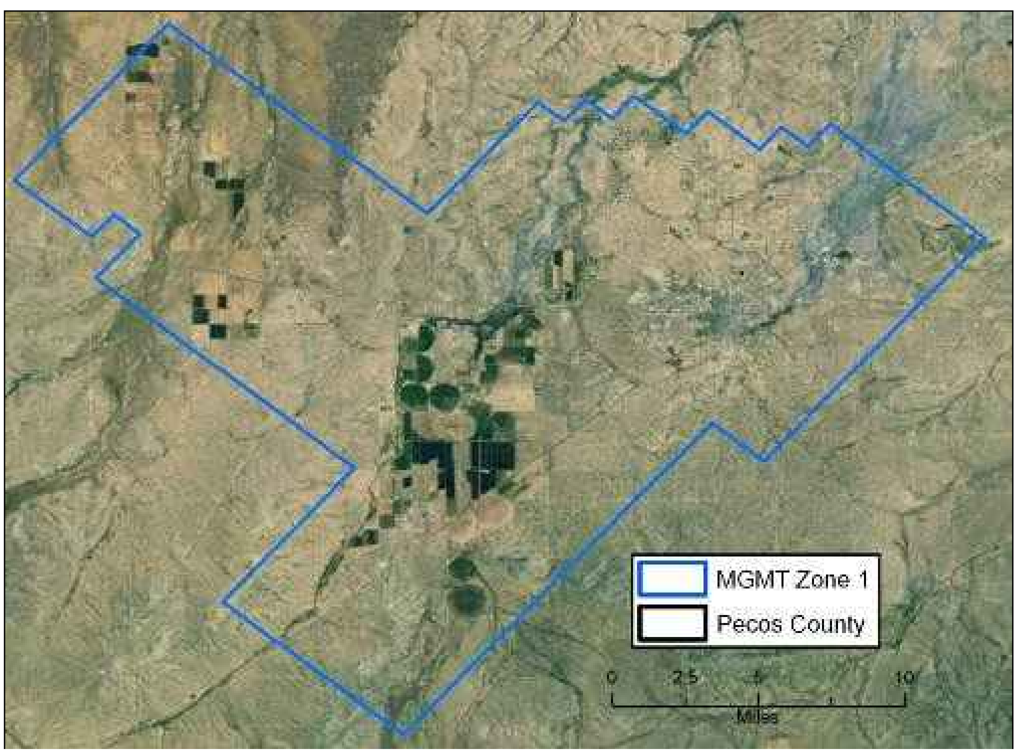

Figure 2, District Management Zone 1

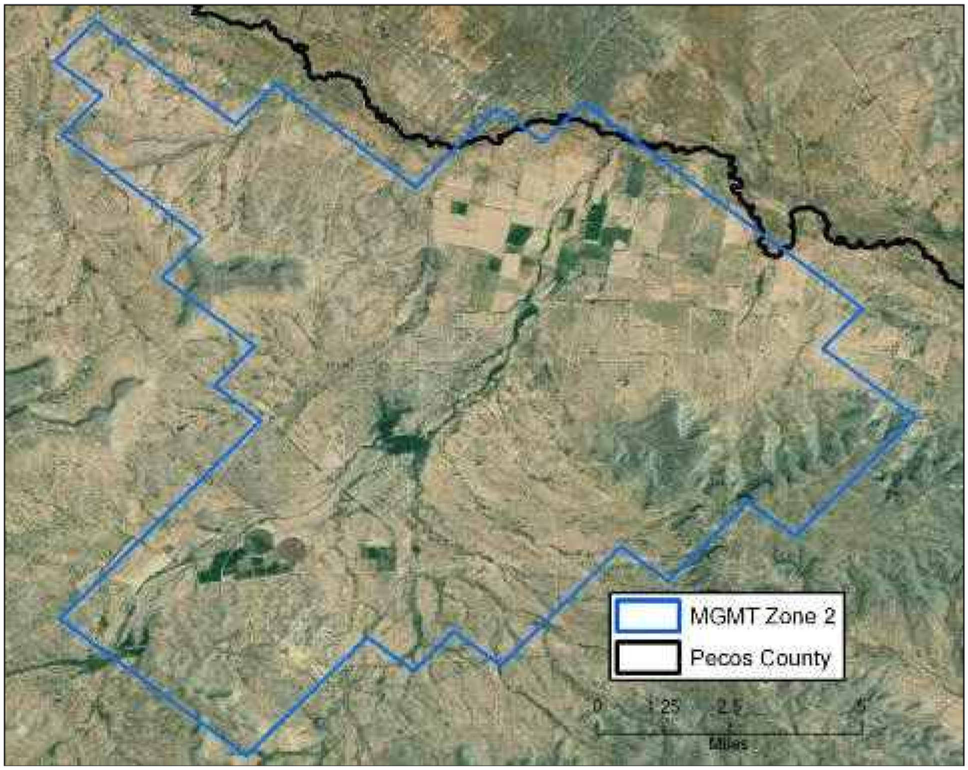

Figure 3, District Management Zone 2

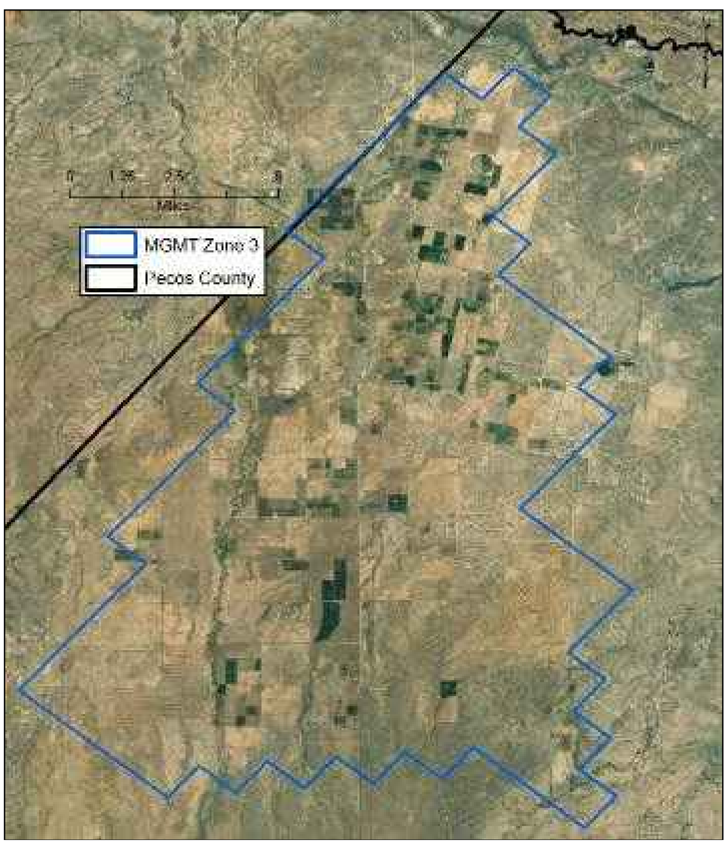

Figure 4, District Management Zone 3

(b) The District shall establish benchmarks of sustainable groundwater use over time to avoid impairment of the Desired Future Condition of each of the aquifers within each management zone, and will re-establish benchmarks from time to time as necessary to be consistent with such Desired Future Conditions. The benchmarks of sustainable groundwater use are threshold amounts of acceptable drawdown over time. The threshold amounts of acceptable drawdown are the average predicted drawdown values over time for each management zone predicted in Scenarios 10 and 11 of TWDB GAM-Run 09-35, Version 2, used to establish the DFCs for the Edwards-Trinity (Plateau) and Pecos Valley aquifers in the District. The predicted drawdown values over time for Management Zones 1 and 2, located in the GMA-7 portion of the District, are from Scenario 10. The predicted drawdown values over time for Management Zone 3, located in the GMA-3 portion of the District, are from Scenario 11. The threshold amounts of acceptable drawdown over time for each management zone are as presented in TWDB GAM Task Report 10-033, which presents more detailed information on Pecos County than otherwise available in but consistent with Scenarios 10 and 11 of TWDB GAM-Run 09-35. The threshold amounts of acceptable drawdown over time for each management zone are as follows:

Year	Management Zone-1 Average Draw-Down (in feet, rounded to nearest foot)	Management Zone-2 Average Draw-Down (in feet, rounded to nearest foot)	Management Zone-3 Average Draw-Down (in feet, rounded to nearest foot)
2015	3	1	2
2020	7	2	4
2025	10	2	5
2030	13	2	7
2035	17	2	8
2040	20	3	9
2045	23	3	11
2050	26	3	12
2055	29	3	13
2060	32	3	15

Table 1, Example Predictive Average Drawdown Values over Time in Edwards-Trinity (Plateau) and Pecos Valley Aquifers for MPGCD Management Zones from TWDB GAM Task Report 10-033.

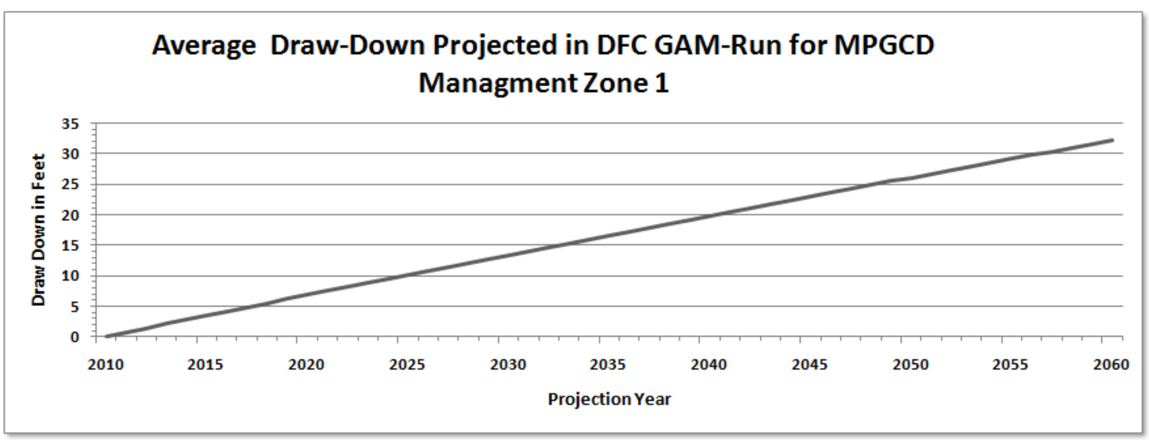

Figure 5, Chart of Predictive Average Drawdown Values over Time in Edwards-Trinity (Plateau) and Pecos Valley Aquifers for MPGCD Management Zone 1 from TWDB GAM Task Report 10-033.

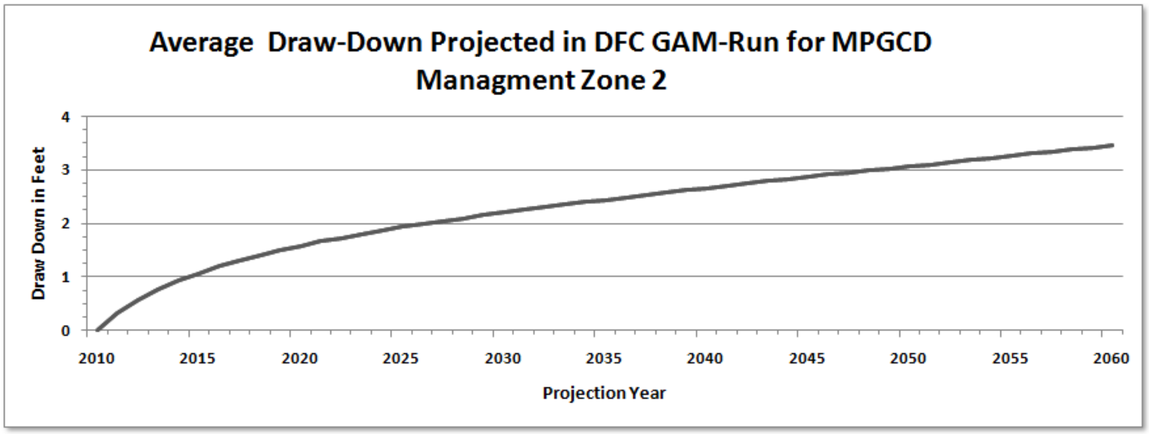

Figure 6, Chart of Predictive Average Drawdown Values over Time in Edwards-Trinity (Plateau) and Pecos Valley Aquifers for MPGCD Management Zone 2 from TWDB GAM Task Report 10-033.

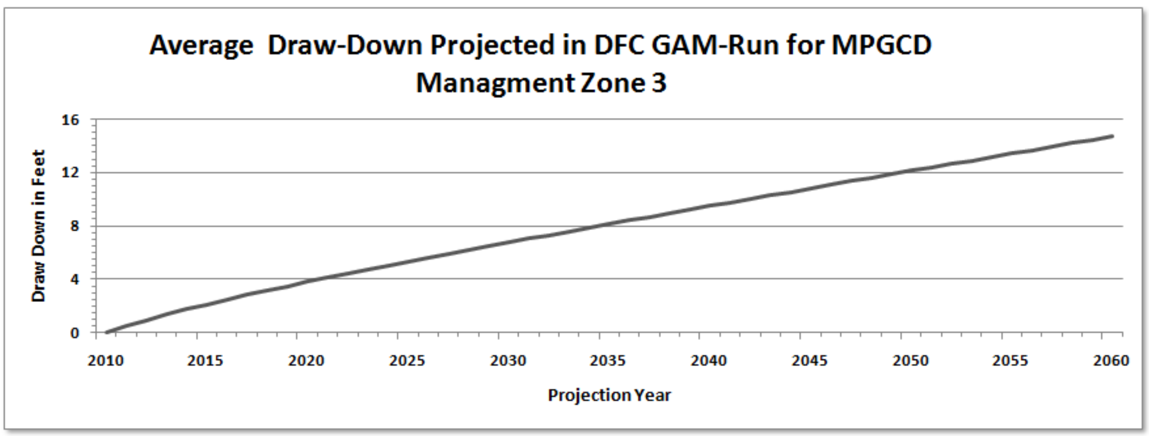

Figure 7, Chart of Predictive Average Drawdown Values over Time in Edwards-Trinity (Plateau) and Pecos Valley Aquifers for MPGCD Management Zone 3 from TWDB GAM Task Report 10-033.

(c) At least every five years, the District will assess the amount of average drawdown realized in each of the management Zones established by the District. The District will compare the amount of realized drawdown in each Management Zone to the time-appropriate threshold of acceptable drawdown in order to determine whether the amount of groundwater use occurring in the Management Zone appears likely to impair the DFC. The District may elect to assess the aquifer drawdown realized in any Management Zone and compare the realized drawdown to the time-appropriate threshold of acceptable drawdown as often as necessary to effectively manage groundwater use and insure the aquifer DFCs are not impaired. The Board may authorize the General Manager to determine whether a comparison of realized drawdown to the threshold of acceptable drawdown is needed for any Management Zone.

(d) The District recognizes that, as of the date of these Rules, the majority of groundwater used the Management Zones is for agricultural irrigation involving widespread intensive seasonal use of groundwater followed by a general cessation of use by the majority of users in the Management Zones. The District further recognizes that after the general cessation of use the aquifer recovers from the effects of the previous intensive seasonal use to reach a point of maximum water-level recovery prior to initiation of the succeeding intensive-use season. The District also recognizes that the threshold of acceptable drawdown values generally represent the year-end maximum recovered water level of the aquifer in the Management Zones for the referenced year. However, the actual date of the maximum recovery of the aquifer water levels in the Management Zone may occur anytime from the month of November of a given calendar year through the month of February of the following year.

(e) To facilitate the comparison of realized drawdown to the thresholds of acceptable drawdown over time in the Management Zones the District will use the following procedures or actions:

(1) Establish several monitor wells in and around each Management Zone for the purpose of observing and quantifying the amount of aquifer drawdown realized over time in each Management Zone;
(2) Develop maps of maximum water-level recovery conditions for year 2010 following procedures in this subsection below;
(3) On or before February 25, 2013, adopt after notice and hearing, the maps of 2010 Management Zone water levels as the 2010 benchmarks for future comparisons of water levels under these rules;
(4) Observe the recovery of aquifer water levels as represented by the monitor wells after the intensive-use season to determine the apparent point of maximum water-level recovery in the Management Zone;
(5) In observing the recovering water levels in the monitor wells of a Management Zone, the District may determine that the apparent point of maximum water-level recovery from the season of intensive use in any given year occurs on a date through the month of February of the succeeding year;
(6) Compile the water-level data, of the Management Zone for the year in which the comparison is to be made;
(7) Determine the water-level drawdown from the established year 2010 conditions for the centroid of each grid-cell of the TWDB Edwards-Trinity (Plateau) / Pecos Valley Aquifer GAM located in the Management Zone area from the water-level contour map;
(8) Calculate the average drawdown of aquifer water levels for the year in which the comparison is to be made in each Management Zone using the set of GAM grid-cell centroid drawdown values for that year;
(9) Compare the calculated average water-level drawdown value for the Management Zone to the DFC-based threshold of acceptable drawdown for the year in which the comparison is to be made, taking into consideration how the distribution of monitoring wells and the amount of pumping known or estimated to be occurring within a Management Zone may affect comparison with the results of TWDB GAM Task Report 10-033 used to establish the thresholds of acceptable drawdown; and
(10) Adopt, after notice and hearing, maps of water levels of all the aquifers, which were not addressed in subsection (3) above, as benchmarks for future comparisons of water levels under these rules.

(f) The Board may, after appropriate rulemaking notice and hearing, establish proportional adjustment reductions based upon the availability of groundwater, benchmarks of sustainable groundwater use over time, and/or degradation of water quality that could result from declining water levels if the Board determines reductions are required to conform with these rules. Upon adoption of a Desired Future Condition and setting of Modeled Available Groundwater for an aquifer within the District, the District shall ensure that the groundwater available for production within a management zone or among management zones designated for that aquifer does not impair the Desired Future Condition and is consistent with the Modeled Available Groundwater for that aquifer within the District. Restrictions within a certain management zone will be uniformly applied within that management zone.

(g) As determined by the District, if the total amount of production within a management zone causes the benchmark of sustainable use within the management zone to be impaired, production amounts authorized under Historic and Existing Use and Production Permits may be decreased within a management zone.

RULE 10.6 LIMIT SPECIFIED IN PERMIT

The maximum annual quantity of groundwater that may be withdrawn under a Historic and Existing Use Permit or Production Permit issued by the District shall be no greater than the amount specified in the permit or the amended permit unless the District makes a determination under Section 10 to increase or decrease the authorized amount of withdrawal. Permits may be issued subject to conditions and restrictions placed on the rate and amount of withdrawal pursuant to the District's rules and permit terms necessary to prevent waste and achieve water conservation, minimize as far as practicable the drawdown of the water table or the reduction of artesian pressure, lessen interference between wells, or control and prevent subsidence. The permit holder, by accepting the permit, agrees to abide by any and all groundwater withdrawal regulations established by the District that are currently in place, as well as any and all regulations established by the District in the future. Acceptance of the permit by the person to whom it is issued constitutes acknowledgment of and agreement to comply with all of the terms, provisions, conditions, limitations, and restrictions.

In addition to any special provisions or other requirements incorporated into the permit, each permit is subject to the following standard permit provisions:

(a) This permit is granted in accordance with the provisions of the rules of the District, and acceptance of this permit constitutes an acknowledgment and agreement that the permit holder will comply with the rules of the District.

(b) The permit terms may be modified or amended pursuant to the provisions of the District's rules or to comply with statutory requirements.

(c) The operation of the well for the authorized withdrawal must be conducted in a non-wasteful manner.

(d) Withdrawals from all nonexempt wells must be accurately measured either by meter or District-approved alternative measuring method, in accordance with the District's rules. The owner or operator of all permitted wells must file an annual pumpage report with the

District. If the well is metered, the meter readings must be attached to the annual pumpage report filed with the District. Wells that are drilled, completed, or equipped so that they are incapable of producing more than 25,000 gallons per day are not required to have a meter or report annual production if used for domestic purposes or for watering livestock or poultry.

(e) The General Manager or Board may, after notice and hearing consistent with permitting hearings governed by Section 11, reduce the quantity of groundwater authorized under a production permit if the applicant has not demonstrated that the water allocated has been withdrawn and put to beneficial use for the purpose and in the amount described in the permit for at least one calendar year during the first three full calendar years following issuance of the permit. The applicant has the burden of proof to demonstrate that the groundwater allocated has been withdrawn and put to beneficial use for the purpose and in the amount described in the permit. No parties other than the permit holder and General Manager may be named as parties in the hearing. The District shall provide written notice of this hearing by certified mail (return receipt requested), hand delivery, first class mail, fax, email, FedEx, UPS, or any other type of public or private courier or delivery service. If the District is unable to provide notice to the permit holder by any of these forms of notice, the District may tape the notice on the door of the permit holder’s office or home, or post notice in the newspaper of general circulation in the District and within the county in which the alleged violator resides or in which the alleged violator’s office is located.

(f) The well site must be accessible to District representatives for inspection, and the permit holder agrees to cooperate fully in any reasonable inspection of the well and well site by the District representatives.

(g) The application pursuant to which this permit has been issued is incorporated in the permit, and the permit is granted on the basis of, and contingent upon, the accuracy of the information supplied in that application. A finding that false information has been supplied is grounds for immediate revocation of the permit.

(h) Violation of a permit’s terms, conditions, requirements, or special provisions is punishable by civil penalties as provided by the District’s rules.

(i) The permit may also contain provisions relating to the means and methods of export outside the District of groundwater produced within the District.

RULE 10.7 MEASURING AND REPORTING GROUNDWATER WITHDRAWALS

(a) Nonexempt wells: Every owner or operator of a nonexempt Water Well is responsible for measuring withdrawals from each Water Well either by a District-approved meter or alternative measuring method. Meters must be selected and installed in accordance with the District General Manager’s specifications and approval, at the well owner’s cost. Meters are not required to be installed on nonexempt wells that are drilled, completed, or equipped so that they are incapable of producing more than 25,000 gallons per day, as long as an alternative measuring method approved by the District is used to record and report groundwater production from this type of well.

(b) Alternative measuring method: The District may authorize the use of an alternative measuring method in lieu of a meter if it can be demonstrated by the well owner that the alternative measuring method is capable of accurate measurement of groundwater withdrawal. The owner of a nonexempt well must secure the District General Manager's approval of an alternative measuring method of determining the amount of groundwater withdrawn. The District General Manager may authorize the alternative measuring method if the applicant well owner demonstrates that the alternative measuring method can accurately measure the groundwater withdrawn. Reporting shall still be required by an owner or operator of a well who is using a District-approved alternative measuring method. A report reflecting annual withdrawals, on a calendar-year basis, shall be provided by any means approved by the General Manager, or more frequently, if requested by the General Manager.

(c) Exempt wells:

(1) An entity holding a permit issued by the Railroad Commission of Texas under Chapter 134, Texas Natural Resources Code, that authorizes the drilling of a water well, shall report monthly to the District:

(A) the total amount of water withdrawn during the month;
(B) the quantity of water necessary for mining activities; and
(C) the quantity of water withdrawn for other purposes.

(2) A report reflecting the total amount of water withdrawn each month from a well exempt under District Rule 11.3(a)(2) must be submitted to the District by the owner or operator. The owner and the operator of such a well may coordinate to determine the amount of monthly withdrawals and to submit this report. However, both the owner and operator of such a well are responsible for ensuring that the withdrawals are determined and that the report is submitted to the District.

(3) The groundwater production from wells subject to reporting under this Subsection (c) must be measured by meter or alternative measuring method approved under this Rule 10.7.

(d) A meter shall be read and the meter reading monthly recorded to reflect the actual amount of pumpage throughout each calendar year. A report reflecting the annual withdrawals and annual system water loss, on a calendar-year basis, shall be provided by any means approved by the General Manager, or more frequently, if requested by the General Manager. The permit holder subject to this reporting requirement shall keep accurate records of the amount of groundwater withdrawn and the purpose of the withdrawal, and such records shall be available for inspection by the District or its representatives. Where wells are permitted in the aggregate, metering and reporting are required on a well-by-well basis.

(e) Immediate written notice shall be given to the District in the event a withdrawal exceeds or is anticipated to exceed the quantity authorized by a permit issued by the District.

(f) Meter accuracy to be tested. The District may require a well owner or operator, at the well owner's or operator's expense, to test the accuracy of the meter and submit a certificate of the test results. The District also has the authority to test a meter. If a test reveals that a meter is not registering within an accuracy of 95%-105% of actual flow, or is not properly recording the total flow of groundwater withdrawn from the well or Well System, the well owner or operator must take appropriate steps to remedy the problem, and to retest the meter within 90 (ninety) calendar days from the date the problem is discovered.

(g) Violation of Metering and Reporting Requirements: False reporting or logging of meter readings, intentionally tampering with or disabling a meter, or similar actions to avoid accurate reporting of groundwater use and pumpage shall constitute a violation of these rules and shall subject the person performing the action, as well as the well owner, and/or the primary operator who authorizes or allows that action, to such remedies as provided in the District Act and these rules.

(h) Recordkeeping Required until Installation of Meter: In the event that a well owner or operator is not measuring withdrawals by District-approved meter or alternative measuring method, the well owner or operator shall be required to keep an accurate log of dates of operation of each well, the duration of such operation, and the purpose and place of use of the water produced until such time as the well owner or operator installs a District-approved meter or secures an alternate measuring method. Such metering log shall be submitted to the District in writing and sworn to within ten (10) calendar days of the installation of the meter or approval of an alternate measuring method, whichever is earlier. Failure to provide the metering log as required by this rule or the provision of false information therein shall be a violation of these rules and grounds for permit denial or revocation.

(i) Meter Maintenance: Costs of meter maintenance shall be borne by the well owner or operator.

(j) Water Use Reporting: Pursuant to Texas Water Code Sections 36.109 and 36.111, if the Board or General Manager deems it useful or otherwise necessary for the District to secure monthly groundwater use data, the General Manager may notify any user of groundwater that monthly groundwater use must be reported to the District.

SECTION 11. GENERAL PERMITTING POLICIES AND PROCEDURES

RULE 11.1 REQUIREMENT FOR PERMIT TO DRILL, OPERATE, OR ALTER THE SIZE OF A WELL OR WELL PUMP; PERMIT AMENDMENT

(a) Permits Required: No person may drill, operate, equip, complete, or alter the size of a well or well pump without first obtaining a permit or approved pre-registration, as applicable, from the District as provided by statutory law and these rules.

(b) Permit Amendment Required: A permit amendment is required prior to any deviation from the permit terms regarding the maximum amount of groundwater to be produced from a well, the location of a proposed well, the purpose of use of the groundwater, the location of use of the groundwater, or the drilling and operation of additional wells, even if aggregate withdrawals remain the same. A Historic and Existing Use Permit may not be amended to modify the purpose of use for which the Historic and Existing Use Permit was originally granted, but may be amended to modify the place of use to a place inside or outside the district. The District may authorize a permit holder to lease or otherwise transfer ownership of a Historic and Existing Use Permit or the amount of groundwater production authorized under such a permit, as long as the purpose of use does not change and as long as the withdrawal is made from the same aquifer and within the same management zone, if applicable, and such transfers are subject to the Rule 11.9.1 and Rule 11.10.10.

(c) Absent an express reservation of rights in the transferor, the transfer of ownership of the well(s) designated by a permit is presumed to transfer ownership of the permit, and the transfer of the land and well site on which the well is located is presumed to transfer ownership of the well. The ownership of a permit may be transferred separately from the ownership of water rights and a well and land and well site on which the well is located, subject to these Rules and permit conditions, with sufficient documentation of an ownership or contractual right to hold the permit. If a transferor retains any interest in the permit, the District may issue a second permit to the transferee that contains the benefits severed and transferred. The District may thereafter amend the permit of the transferor accordingly, along with any appropriate conditions relevant to the transfer imposed by the District. The District shall limit the amount of production authorized in the transfer of a permit to a different location of use to the amount of water produced and beneficially used by the transferor under the original permit.

(d) If the production authorized for two or more wells that have been aggregated to function as part of a Well System under Rule 11.2 and one or more wells under the Well System will be transferred, the District may allocate a pro rata share of the total authorized production to each well transferred unless the conveyance documents transferring the well(s) clearly provides for a different method of allocation.

(e) Upon submission to the District of written notice of transfer of ownership or control of any water right or water well covered by a permit and documents evidencing the transfer, the District's General Manager will amend the permit to reflect the new owner(s).

RULE 11.2 AGGREGATION OF WITHDRAWAL AMONG MULTIPLE WELLS

A Drilling Permit application must be filed for each well that requires permitting. However, one application shall be filed for a Production Permit, or for renewal thereof, which consolidates two or more wells that will function as part of a Well System.

RULE 11.3 PERMIT EXCLUSIONS AND EXEMPTIONS

(a) The District's permit requirements in these rules do not apply to:

(1) drilling or operating a well used solely for domestic use or for providing water for livestock or poultry if the well is located or to be located on a tract of land larger than 10 acres and drilled, completed, or equipped so that it is incapable of producing more than 25,000 gallons of groundwater a day; provided, however, that this exemption shall also apply after the effective date of this rule to a well to be drilled, completed, or equipped on a tract of land equal to or less than 10 acres in size only if:

(A) the well is to be used solely for domestic use or for providing water for livestock or poultry on the tract;

(B) such tract was equal to or less than 10 acres in size prior to the effective date of this rule; and

(C) such tract is not further subdivided into smaller tracts of land after the effective date of this rule and prior to the drilling, completion, or equipping of the well.

i. A well qualifying for exemption under this subsection must observe a minimum distance of 50 feet from the property line and 50 feet from other wells.

ii. For purposes of an exemption under this subsection, the terms "livestock use" and "poultry use" do not include livestock or poultry operations that fall under the definition of "Animal Feeding Operation" or "Concentrated Animal Feeding Operation" set forth in District Rule 1.1.

(2) drilling a water well used solely to supply water for a rig that is actively engaged in drilling or exploration operations for an oil or gas well permitted by the Railroad Commission of Texas provided that the person holding the permit is responsible for drilling and operating the water well and the water well is located on the same lease or field associated with the drilling rig.

(3) drilling a water well authorized under a permit issued by the Railroad Commission of Texas under Chapter 134, Texas Natural Resources Code, or for production from the well to the extent the withdrawals are required for mining activities regardless of any subsequent use of the water.

(4) an injection water source well permitted by the Railroad Commission of Texas for secondary or enhanced oil or gas recovery.

(5) a well used for an ASR Project, except as provided under District Rule 18.1.

(6) monitoring wells.

(7) leachate wells.

(8) dewatering wells.

(b) A well exempted under Subsections (a)(2), (3), (4), and (5) above loses its exemption and must be permitted and comply with all the District's rules in order to be operated if:

(1) the groundwater withdrawals that were exempted under Subsection (a)(2) are no longer used solely to supply water for a rig that is actively engaged in drilling or exploration operations for an oil or gas well permitted by the Railroad Commission of Texas;

(2) the groundwater withdrawals that were exempted under Subsection (a)(3) are no longer necessary for mining activities or are greater than the amount necessary for mining activities specified in the permit issued by the Railroad Commission of Texas under Chapter 134, Texas Natural Resources Code;

(3) the groundwater withdrawals that were exempted under Subsection (a)(4) are no longer used solely to supply water for secondary or enhanced oil recovery pursuant to the terms of the permit issued by the Railroad Commission of Texas; or

(4) the groundwater withdrawals that were exempted under Subsection (a)(5) exceed the amount specified in the permit issued by TCEQ.

(c) A water well exempted under Section (a) above shall:

(1) be pre-registered and registered in accordance with rules promulgated by the District; and

(2) be equipped and maintained so as to conform to the District's rules requiring installation of casing, pipe, and fittings to prevent the escape of groundwater from a groundwater reservoir to any reservoir not containing groundwater and to prevent the pollution of harmful alteration of the character of the water in any groundwater reservoir.

(d) Registered wells observe exemptions that were in place at the time of filing the registration.

(e) A well exempt under this section will lose its exempt status if the well is subsequently used for a purpose or in a manner that is not exempt.

RULE 11.4 HISTORIC AND EXISTING USE PERMITS

The District recognizes the validity of Historic and Existing Use Permits granted under the District's rules and will continue to recognize the rules and procedures applicable to a Historic and Existing Use permit existing at the time the permit was granted. The District no longer accepts applications for Historic and Existing Use Permits because the deadline has passed, and the application procedures and the Historic and Existing Use Permit permitting process are now obsolete. Historic and Existing Use Permits are subject to the transfer, renewal, and permit amendment provisions set forth in these rules.

RULE 11.5 PERMITS REQUIRED TO DRILL A NEW WELL

(a) Every person who drills a water well after the initial effective date of these rules must file the Notice of Intent provided for in Rule 9.2. Every person who drills a nonexempt well must file a permit application on a form approved by the District.

(b) Drilling Permit Requirement: The well owner, well operator, or any other person acting on behalf of the well owner must obtain a Drilling Permit from the District prior to drilling a new water well, perforating an existing well or increasing the size of a well pump therein so that the well could reasonably be expected to produce 25,000 gallons per day or more, unless the well is an exempt well under District Rule 11.3.

RULE 11.6 PERMITS REQUIRED TO OPERATE A NEW WELL OR FOR INCREASED WITHDRAWAL AND BENEFICIAL USE FROM AN EXISTING WELL

Prior to and no later than 21 (twenty-one) calendar days after completion of a new water well, or reworking or re-equipping an existing water well, the well owner or well operator must file a completed Production Permit application on a form approved by the District. A Production Permit may only be issued if the well from which water is proposed to be withdrawn has been drilled or if the Production Permit is subject to the well being drilled in accordance with the terms of a Drilling Permit. If the Drilling Permit expires without a well being drilled, any associated Production Permit shall expire at the same time the Drilling Permit expires.

RULE 11.7 PERMIT TERM

(a) Drilling Permit Term: Unless specified otherwise by the Board or these rules, Drilling Permits are effective for a term ending 120 (one hundred twenty) calendar days after the date the permit is issued by the District, which may be extended by the General Manager with good cause shown.

(b) Historic and Existing Use Permit and Production Permit Terms: Unless specified otherwise by the Board or these rules, Historic and Existing Use Permits and Production Permits are effective until the end of the calendar year in which they are issued. If renewed, such permits shall thereafter be effective for one-year terms from the initial expiration date unless specified otherwise by the Board. The permit term will be shown on the permit. A permit applicant requesting a permit term longer than one year must substantiate its reason for the longer term and its need to put groundwater to beneficial use throughout the proposed permit term.

RULE 11.8 PERMIT RENEWAL

(a) Permit Renewal: Renewal applications shall be provided by the District prior to expiration of the permit term, and shall be filed with the District no later than January 15th of the new year for which the permit renewal is requested. Production Permits will not be renewed unless the well has been drilled at the time of the renewal application.

(b) Renewal Application Requirements: The District will timely provide a form for an application for renewal prior to expiration of the permit term. The renewal application will be a streamlined application and will not include all of the elements required for an original application.

(c) The District shall, without a hearing, renew or approve an application to renew a Production Permit before the date on which the permit expires, provided that:

(1) the application is submitted in a timely manner; and

(2) the permit holder is not requesting a change related to the renewal that would require a permit amendment under the District's rules.

(d) The District is not required to renew a permit under District Rule 11.8(c) if the applicant:

(1) is delinquent in paying a fee required by the District;

(2) is subject to a pending enforcement action for a substantive violation of a District permit, order, or rule that has not been settled by agreement with the District or a final adjudication; or

(3) has not paid a civil penalty or has otherwise failed to comply with an order resulting from a final adjudication of a violation of a District permit, order, or District rule.

(e) If the District is not required to renew a permit under District Rule 11.8(d), the permit remains in effect until the final settlement or adjudication on the matter of the substantive violation.

(f) Any permit holder seeking renewal may appeal the General Manager's ruling by filing, within ten (10) calendar days of notice of the General Manager's ruling, a written request for a hearing before the Board. The Board will hear the applicant's appeal at the next available regular Board meeting. The General Manager shall inform the Board of any renewal applications granted or denied. On the motion of any Board member, and a majority concurrence in the motion, the Board may overrule the action of the General Manager. The General Manager may authorize an applicant for a permit renewal to continue operating under the conditions of the prior permit, subject to any changes necessary under proportional adjustment regulations or these rules, for any period in which the renewal application is the subject of a hearing.

(g) If the holder of a Production Permit, in connection with the renewal of a permit or otherwise, requests a change that requires an amendment to the permit under District Rule 11.1, the permit as it existed before the permit amendment process remains in effect until the later of:

(1) the conclusion of the permit amendment or renewal process, as applicable; or

(2) a final settlement or adjudication on the matter of whether the change to the permit requires a permit amendment.

(h) If the permit amendment process results in the denial of an amendment, the permit as it existed before the permit amendment process shall be renewed under District Rule 11.8(c) without penalty, unless subsection (d) of District Rule 11.8 applies to the applicant.

(i) The District may initiate an amendment to a Production Permit, in connection with the renewal of a permit or otherwise, for the purpose of achieving a Desired Future Condition or another statutory purpose of the District. Any amendment initiated by the District shall be processed in accordance with Section 11 of the District's rules. If the District initiates an amendment to a Production Permit, the permit as it existed before the permit amendment process shall remain in effect until the conclusion of the permit amendment or renewal process, as applicable.

RULE 11.9 PERMIT APPLICATIONS

11.9.1 Requirements for All Permit Applications:

(a) Each application for a water well Drilling Permit, Production Permit, and permit amendment requires the filing of a separate application. The application must be completed on the District's form and may be supplemented. Each application for a permit shall be in writing and sworn to, and shall include the name, mailing address, phone number, and email address of the applicant and the owner of the land on which the well or Well System is or will be located.

(b) In addition to the information required of all permit applications in Rule 11.9.1(a), an application for a Drilling Permit or to amend a Drilling Permit must include the following information:

(1) if the applicant does not own the well site(s) and proposed well(s), documentation establishing the applicable authority to construct, drill, and complete each well on each proposed well site;

(2) the location of each well and the estimated rate at which water will be withdrawn;

(3) the conditions and restrictions, if any, placed on the rate and amount of withdrawal;

(4) the date the permit is to expire if each well is not drilled or if each existing well is not properly completed to meet all statutory and regulatory requirements for the intended purpose of use;

(5) a declaration that the applicant will comply with all District well plugging and capping guidelines and report closure to the Commission;

(6) a location map of all existing wells within a one half (1/2) mile radius of the proposed well or Well System or the existing well or wells to be modified;

(7) a map or other document from the Pecos County Tax Appraisal District indicating the ownership and location of the subject property;

(8) a document indicating the location of each proposed well or each existing well to be modified, the subject property, and adjacent owners' physical and mailing addresses;

(9) notice of any application to TCEQ to obtain or modify a Certificate of Convenience and Necessity to provide water and wastewater service with water obtained pursuant to the requested permit; and

(10) a statement of the nature and purpose of the proposed use and the amount of water to be used for each purpose.

(c) In addition to the information required of all permit applications in Rule 11.9.1(a), an application for a production permit or to amend a production permit must include the following information:

(1) if the applicant does not own the well site(s), proposed well(s), and groundwater, documentation establishing the applicable authority to operate each well and produce and beneficially use the groundwater from each well;

(2) the annual amount of groundwater claimed to be necessary for beneficial use during each year of the proposed permit term with information supporting the annual amount of use requested for each proposed purpose of use;

(3) a requirement that the water withdrawn under the permit be put to beneficial use at all times;

(4) the location of the use of the water from the well or Well System;

(5) the conditions and restrictions, if any, placed on the rate and amount of withdrawal;

(6) a declaration that the applicant will comply with the District's rules and all groundwater use permits and plans promulgated pursuant to the District's rules;

(7) a declaration that the applicant will comply with the District Management Plan;

(8) a drought contingency plan;

(9) a declaration that the applicant will comply with all District well plugging and capping guidelines and report closure to the Commission;

(10) the duration the permit is proposed to be in effect, if greater than one year;

(11) a written statement addressing each of the applicable criteria in Rules 10.2 and 11.10.10(a), (b), and (c) and substantiating why the applicant believes the Board should consider each of these applicable criteria in a manner favorable to the applicant; and

(12) if groundwater is proposed to be exported out of the District, the applicant shall describe the following issues and provide documents relevant to these issues:

(A) the availability of water in the District and in the proposed receiving area during the period for which the water supply is requested;

(B) the projected effect of the proposed export on aquifer conditions, depletion, subsidence, or effects on existing permit holders or other groundwater users within the District; and

(C) how the proposed export is consistent with the approved regional water plan and certified District Management Plan.

(13) a hydrogeological report shall be attached to an application that:

(A) requests a new Production Permit for 1,000 acre feet or more per year from one or more wells or an associated Well System;

(B) requests a new Production Permit or amendment to an existing Production Permit in an amount that when combined with the amount of an existing Production or Historic and Existing Use permit or permits associated with the same well or wells or Well System is at least 1, 000 acre feet per year; or

(C) requests to amend and increase by at least 250 acre feet the annual maximum permitted use of a Production Permit for a well or Well System.

This report must address the area of influence of the well(s) and any associated Well System for which a permit is being requested and a description of the aquifer that will supply water to each well, and be complete in a manner that complies with the requirements adopted in Rule 11.9.3.

(14) the hydrogeological report required in Subsection (13) shall be updated for each and every permit amendment application that requests an increase in production of at least 1,000 acre feet per year from one or more wells or an associated Well System authorized under an existing Production or Historic and Existing Use Permit or Permits that currently authorize at least 1,000 acre feet per year.

(15) the results of a pump test for each well for which a production permit or amendment to a production permit is being requested depends upon the following thresholds:

(A) If the annual amount of groundwater withdrawal from one or more wells or an associated Well System in any calendar year during the permit term is more than 20 acre feet and less than 1,000 acre feet, the pump test(s) and results must meet the requirements of Rule 11.9.2(a);

(B) If an application is subject to the hydrogeological report requirements in Subsection (13) of this rule, the pump test(s) and results must meet the requirements of Rule 11.9.2(b).

(d) The General Manager or Board may waive one or more of the informational requirements for an application to amend a production permit depending on the nature of the amendment provided that the Board has sufficient, relevant information to consider the application at the hearing.

(e) The applicant must provide the District with the information relevant to the type of application that is required in this Rule 11.9 for the District to declare that the application is administratively complete. If the District provides a written list of application deficiencies, the applicant shall have 60 (sixty) calendar days to fully respond to the General Manager's satisfaction, after which a deficient application expires. The applicant may request an extension of this 60-day period or a ruling on the administrative completeness of its application by filing a written request with the District. The District will set an applicant's request under this rule on its next regularly scheduled Board meeting agenda, with three (3) calendar days' notice compliant with the Texas Open Meetings Act. The Board will consider and take action on an applicant's request under this rule at this meeting.

11.9.2 Specific Capacity Pump Test and Pump Test Report Requirements

(a) Specific Capacity Pump Test and Pump Test Report Requirements required by Rule 11.9.1(c)(15)(A)(for one or more nonexempt wells or an associated Well System proposed to be authorized to annually withdraw less than 1,000 acre feet): The specific capacity pump test will provide the District with site-specific aquifer properties and well-yield information necessary to better evaluate a production permit application. The District is aware that a pump test to obtain aquifer specific capacity information requires site preparation, specialized monitoring equipment, monitoring during the test and pump test data analysis which can be time consuming and somewhat costly. The District will assist the production permit applicant with site preparation, provide the required water level monitoring equipment and conduct the technical analysis of the specific capacity pump test.

As part of its consideration of the relevant permitting factors in Rules 11.10.10, the MPGCD Board will consider the specific capacity pump test analysis results provided by the applicant along with input on these results from MPGCD's General Manager and professionals and, if there is a contested hearing, input on these results from any parties admitted into the contested hearing.

The dedicated pump must have the production capacity to meet the permit applicant's requested groundwater demand. The District must be notified at least 14 days in advance of any specific capacity pump test. A specific capacity pump test conducted without prior approval from the District will be deemed noncompliant with MPGCD permit requirements.

If the specific capacity pump test activity is found to be flawed or not acceptable by the District's General Manager, the District's General Manager may require the specific capacity pump test to be repeated.

The District Manager has the authority to exempt a permit applicant from this requirement provided the permit applicant provides good cause why other information submitted with the application is sufficient to describe the type of site-specific aquifer properties and well-yield information that would be obtained from the pump test and associated analysis.

(1) Specific Capacity Pump Test Site Preparation

(A) Availability of local monitor wells: The District is working to expand its understanding of the groundwater resources within the District to ensure the best available science is considered during the permitting process. If a well located within 1,000 feet of and completed within the same aquifer as the permit applicant's specific capacity pump test well is available to be monitored during the pump test, the General Manager may require that it be monitored during the test. This monitor well would provide additional, important aquifer properties. A monitor well(s) may not be actively pumping during the pump test.

(B) Installation of Water-level Transducers and the Determination of Static Water Levels

i. The District staff will assist in the installation of District's own water-level transducers into the permit applicant's well to be pump tested and additional transducers into any monitor wells identified for the specific capacity pump test.

ii. The District staff will determine the depth from the static water level of the well to the top of the pump intake (pump test water column thickness) prior to a pump test to understand at what water level depth the water level will drop below the water level transducer or below the pump intake. It is recommended that the water level transducer depth should be located at least 10 feet above the pump intake.

iii. Prior to a specific capacity pump test, static water levels of the pump test well and any associated monitor wells must be measured by transducers for at least 24 hours prior to the pump test.

iv. The District's staff will make sure that the transducers are time synchronized if there is more than one transducer. The transducers will be programmed to collect water levels every 15 minutes during the entire pump test event which includes: 24 hours before pumping commences, during pumping (8 or 12 hours), and for at least 8 hours after pumping concludes (well recovery measurements).

(2) Determination of Specific Capacity Pump Test Discharge Rate: The specific capacity pump test discharge rate should be representative of the production needed to meet the permit applicant's requested instantaneous production rate (expressed in gallons per minute) and annual quantity of production (expressed in gallons or acre-feet per year). The District's General Manager will provide guidance to the permit applicant on a recommended pump test discharge rate.

(3) Monitoring of Specific Capacity Pump Test Discharge Rate: During a specific capacity pump test, the water level within the well usually declines and, as it does, the well discharge rate will also decrease. The permit applicant needs to provide a flow meter or a method to accurately estimate (within 10% of the actual rate) the pump test discharge rate during the specific capacity pump test. The pump test discharge monitoring method must be pre-approved by the District's General Manager before the pump test begins.

There should be allowance for increasing the pump rpm to maintain a constant discharge rate during the specific capacity pump test or, with the District General Manager's approval, the average discharge rate during the pump test could be used to calculate the well's specific capacity.

(4) Specific Capacity Pump Test Time Period: The specific capacity pump test time period will vary depending on the aquifer and will be confirmed by the District's General Manager in the following ranges:

(A) At least an 8-hour specific capacity pump test for the Edwards-Trinity, Pecos Alluvium and Dockum aquifers.

(B) At least a 12-hour specific capacity pump test for the Rustler, Capitan, San Andres and Igneous aquifers.

(5) Specific Capacity Pump Test

(A) The District staff will help initiate the pump test at an agreed-upon time determined by the District General Manager and the permit applicant. The District will verify that the water-level transducers are active and collecting water level data.

(B) Using a conductivity meter provided by the District measure the discharge water conductivity at 5 to 10 minutes after the pump test has started, mid-way through the pump test and at the end of the pump test. The District's staff will collect the first and last conductivity measurements.

(C) The permit applicant is responsible for monitoring and recording the pumping well's discharge rate changes during the pump test and the mid-pump test water quality conductivity measurement.

(D) Upon completion of the required time for the pump test, the District's staff will shut down the pump test and confirm that the water-level transducers are still active and collecting water level data.

(6) Post Specific Capacity Pump Test: After the completion of the water level recovery measurements, the District's staff will:

(A) Remove transducers from all the wells, and collect pump test information from the permit applicant (variation in pump test discharge rates or the time which permit applicant adjusted pump rate to fixed discharge rate and mid-pump test water quality measurement).

(B) The District's staff will download all the water level transducer data into an Excel spreadsheet with notations on the variations of pump discharge rates with time.

(C) District's groundwater consultant (PG or PE) will take pump test data provided by the District and calculate specific capacity and determine aquifer properties for the monitor wells (if available).

(D) District's groundwater consultant will prepare a brief report to provide to the District's Board and the permit applicant.

(b) Pump Test and Pump Test Report Requirements Associated with Hydrogeological Report required by Rule 11.9.1(c)(14) and (15)(B) (for one or more nonexempt wells or an associated Well System proposed to be authorized to annually withdraw at least 1,000 acre feet): The American Society of Testing and Materials (ASTM) documents D4043 (Selection of Aquifer Test Method) and D4050 (Field Procedure, Pump Tests) provide guidance for designing and implementation of pump tests, and D4105 (Confined Aquifer Pump Test Analysis) or D4106 (Unconfined Aquifer Pump Test Analysis) provide guidance to determine aquifer properties. A permit applicant can purchase these documents at http://global.ihs.com/standards.cfm?publisher=ASTM&RID=Z06&MID=5280 and is strongly encouraged to review these documents prior to designing and conducting any pump tests.

(1) Pump Tests:

Pump tests conducted without prior approval from the District may be deemed noncompliant with the District's Production Permit requirements. The District must be notified at least 48 hours in advance of any pump test conducted as part of the hydrogeological investigation.

Texas registered geoscientists (P.G.) and/or engineers (P.E.) with five years or more of groundwater experience will be required to oversee the design and implementation of each pump test and associated monitor wells and will evaluate the pump test results to determine aquifer properties. Aquifer properties to be determined from the pump tests include specific capacity, transmissivity, hydraulic conductivity, and possibly storage coefficient or storativity values.

(2) Pump Test Monitor Wells:

Monitor wells are required for applicant well fields with multiple wells. Monitor wells selected by the applicant for the pump test must comply with the District's monitor well requirements and the monitor well selection must be pre-approved by the District's General Manager. Monitor wells may not be actively pumping during the pump test. The use of existing private wells within two miles of the pumping wells and within the same groundwater producing formation is acceptable if the well meets the District's monitor well requirements.

A monitor well selected for the pump test is required to monitor only the applicant's aquifer and exhibit a connection with the pumping wells indicated by a minimum of 0.2 feet of drawdown during the pump test. For confined aquifers, the District may also require a monitor well in an overlying aquifer to monitor potential water level fluctuations and to determine whether there is communication between the applicant's aquifer and overlying aquifers.

(3) Pump Test Requirements:

(A) If possible, the District and/or the applicant will meet with any adjacent landowners with large operating wells (>250 gpm) within a two-mile radius of the pump test pumping wells prior to the pump test. The District and/or the applicant will inform the landowners of the date of the pump test, and, if possible, determine whether the landowners' wells will be active during the scheduled pump test. If the landowners' wells are going to be active during the pump test, the District will request that the landowners do not vary the pumping rates during the pump test.

(B) The designed pump test results must be able to be used to mimic the well field's impact of the applicant's requested acre feet per year pumpage.

(C) Static water levels of each pump test pumping and monitor wells should be measured every 12 hours for a total of 36 hours for the Pecos Valley Alluvium, Edwards-Trinity Plateau, and Dockum clastic aquifers and for a total of 72 hours for the Rustler and Capitan Reef Complex karstic aquifers and the San Andres karstic formation prior to the beginning of the pump test.

(D) Flow meters will be used to monitor each pumping well's groundwater production.

(E) Measure water levels and pump test discharge rates and times during pump test at acceptable frequency according to ASTM 4050.

(F) A metered pump test of not less than a continuous 36 hours for the dominantly clastic aquifers, including the Pecos Valley Alluvium (clastic), Edwards-Trinity Plateau (carbonate karst and clastic), and Dockum (clastic).

(G) The documentation of times of field activities, weather changes, and pump test adjustments and/or problems will be recorded.

(H) A recovery phase of a period sufficient for a 95 percent recovery of beginning water levels of each pumping well and 90 percent recovery for each monitor well, not to exceed time period of pumping activity. Water level measurements during recovery should be measured at the same frequency as during the pumping phase (frequent at beginning and decreasing frequency with time).

(I) Water quality parameters (pH, temperature, and conductivity) of the pump test wells' discharged water will be measured at the beginning of the pump test and every 12 hours during the pump test.

(J) Water quality analysis will include TDS, SO4, Cl, Ca, Mg, Na, HCO3, F, Br, and NO3 from each pumping well and will be collected twice—prior to and at the end of each pump test.

The applicant may request that the District's General Manager consider a variation of the above pump test requirements. The District's General Manager has 30 days to review and approve or disapprove the variance request.

(4) Pump Test Report Requirements:

(A) A discussion about the general characteristics of the aquifer, including, but not limited to: confined or unconfined, clastic or karstic, variation in aquifer thickness, and interpreted degree of karst development. Discuss whether the production wells are partially or fully penetrating and the impact on monitor well selection.

(B) For each pump test and monitor well, tables listing water level changes with times, initial water levels at the start of pump test (for pumping and monitor wells), pump test date, start time, end time, changes during and final pumping rates, and water quality parameters measured during the pump test, as a report appendix.

(C) For each pump test and monitor well, a table listing the water level recovery measurements with times as a report appendix.

(D) Copies of field notes collected during the pump test as a report appendix.

(E) A discussion of the reasoning for the selection of the pump test analysis method used to estimate the aquifer properties for each pumping and monitor well in the pump test.

(F) A table listing final estimated aquifer properties for each pumping and monitor well in the pump test.

(G) A table of the pumping wells water quality parameters collected during the pump test.

(H) A discussion of any observed groundwater quality changes (if any) that occurred during the pump test.

If the pump test activity or analysis is found to be flawed or not acceptable by the District's General Manager, the District's General Manager may require that the pump test or analysis be repeated in an acceptable manner before the groundwater Production Permit application may be considered.

11.9.3 Hydrogeological Report Requirements for Production Permits for >1,000 Or More Acre-Feet Per Year: Planning and implementation of all hydrogeological reports required for a Production Permit application should be coordinated with the District to minimize technical issues and to expedite the review process of the application. The District may exercise discretion in the application of the guidelines on an individual and site-specific basis in order to allow a practicable application of the guidelines while ensuring a result yielding the information needed by the District to manage groundwater resources.

The hydrogeological report is intended to provide information to the District on:

(1) the geologic setting of the applicant's proposed production well field;

(2) well construction information of production and monitor wells;

(3) local aquifer characterization of aquifer properties by pump tests; and

(4) an evaluation of whether the proposed use of water unreasonably affects existing groundwater resources or existing permit holders.

(a) Geologic Setting of Applicant's Proposed Production Well Field: The report shall include a discussion of the surface and subsurface geology of the applicant's tract of land on which each proposed production well or wells are located and will include a brief description of the local geology and the selected aquifer within a two-mile radius of each of Applicant's proposed wells. The description will include:

(1) A table that illustrates the stratigraphic column of geological formations overlying and underlying the applicant's identified producing aquifer.

(2) The following figures will be required for the hydrogeological report based on available subsurface well data. The aerial extent of the following figures will include the applicant's proposed production well field and a two-mile buffer zone, reflected by concentric circles with a radius of two miles from each of the applicant's proposed wells.

(A) A figure illustrating the location of the applicant's proposed production and monitor wells, property boundary, and each existing water well located within a two-mile radius of the applicant's proposed production wells. This figure will include the name of each adjacent landowner whose property adjoins the applicant's, the locations of existing water wells, and the names of local streets and/or roads.

(B) A figure illustrating the contoured top depth of the producing aquifer. (This is not required for the Pecos Valley Alluvium or Edwards-Trinity Plateau aquifers.)

(C) A figure illustrating the most recent available water level measurements of the applicant's and adjacent landowners' existing water wells within a two-mile radius of the proposed well field.

(b) Required Well Construction Information: The hydrogeological report will include well construction information for each of the applicant's existing groundwater production and monitor well(s) to be used in the proposed well field. New, proposed production and monitor wells will need a well construction schematic, based on available information. Well construction information for each production and monitor well should include the following:

(1) the identification of the aquifer to be produced from;

(2) the total depths, diameters, and expected screen or production intervals of each of the applicant's existing and proposed production and monitor wells;

(3) each production well's proposed maximum pumping rate; and

(4) a water well driller's report and/or driller's log (if available) for existing wells.

(c) Local Aquifer Characterization: The District may require a pump test to determine local aquifer characterization of the applicant's proposed well field and to evaluate the potential impact of the requested production on existing wells and the District's DFCs. Production from all confined aquifers will require pump tests. The District may exempt the applicant from conducting pump tests on unconfined aquifers if:

(1) the proposed well field (multiple production wells) is in an unconfined aquifer and each proposed well is more than two miles from the applicant's property lines;

(2) the proposed well field involves a single production well in an unconfined aquifer and is more than one mile from the applicant's property lines; or

(3) there are no other landowners' production wells using the applicant's designated unconfined aquifer within two miles of the applicant's property lines.

If the District grants an exemption to the applicant for a pump test, local aquifer properties from available groundwater models (TWDB, USGS, or available reviewed consultant's groundwater models with the District's prior approval) will be used to estimate the potential for unreasonable effects on existing wells by the proposed pumping, including, but not limited to, identifying water level declines within a two-mile radius from each of the applicant's proposed wells.

The applicant may appeal the District's General Manager's decision to require pump tests by filing with the District a request for reconsideration identifying all the reasons why the applicant believes a pump test is unnecessary. The District's General Manager has 30 days to review the appeal and decide whether to support or repeal the pump test requirement. The applicant may appeal the General Manager's decision on the request for reconsideration by filing with the District a written appeal to the District's Board identifying all the reasons why the applicant believes a pump test is unnecessary.

*Pump test and pump test report guidance is provided in Rule 11.9.2.

(d) Potential of Unreasonable Effects from Proposed Production on Existing Wells and Groundwater Resources: The applicant is required to estimate the potential water level impacts caused by the proposed pumping to wells located within a two-mile radius of the applicant's well field applying the assumptions and otherwise meeting the requirements enumerated below in this section. This analysis must mimic the applicant's expected full production operations.

(1) The time periods for water level decline analyses are 30, 180, 365, and 730 days.

(2) The water level impact for the above time periods must be estimated for each well within a two-mile radius from each of the applicant's proposed wells; or a figure illustrating calculated water level decline contours at one quarter (1/4) mile intervals up to two miles (eight contour intervals) for each time period is acceptable.

(3) The water level impact information should also be summarized in a report table.

The applicant has two options on how to evaluate the potential of water level impacts:

Option 1: The applicant can have the District's consultant hydrogeologist assist in completing Section (d) of the applicant's hydrogeological report. If the applicant chooses this option, the applicant realizes that having the District's hydrogeologist complete the hydrogeological report does not guarantee that the District's Board will approve the application, just that the hydrogeological report will be administratively and technically complete. The hydrogeological analysis of the provided pump test results may be favorable or unfavorable for the applicant. The District's hydrogeologist will make a recommendation to the District's Board based on his or her professional opinion of the hydrogeological information provided and compiled in the report.

The applicant will provide the completed hydrogeological report (Sections (a), (b), and (c)) and the pump test results (in an Excel format) to the District's hydrogeologist. If a Production Permit application requests 10,000 acre feet per year or less, then the District's hydrogeologist will use the applicant's pump test derived aquifer properties and estimate water level declines for all the report required wells using pump test simulation software.

If a Production Permit application requests more than 10,000 acre feet per year, then an existing groundwater availability model will be run to estimate the water level declines and potential DFC impacts. The groundwater availability model used for this analysis will be selected by the District's hydrogeologist after discussions with the applicant's groundwater consultants. In the case of the San Andres formation (for which no groundwater availability models exist), a detailed analysis using pump test simulation software will be completed.

If no pump test was required from the applicant for the hydrogeological report, the local aquifer properties will be obtained from the District's hydrogeologist's selected groundwater availability model (USGS, TWDB, or consultant's groundwater model) to determine the water level impact analyses. After running the pump test simulation software (<10,000 acre feet) or groundwater models (>10,000 acre feet), the District's hydrogeologist will generate all the required well level change text, figures, and charts necessary to complete the applicant's hydrogeological report.

The District will charge the applicant the District's hydrogeologist's hourly fee for this service.

Option 2: The applicant may use their own consultant and/or groundwater model (groundwater model must be reviewed and accepted by the District's hydrogeologist prior to model runs) to complete the water level impact analyses. The applicant's consultant will provide text, figures, and tables to meet the above-stated District requirements for the water level impact analyses.

RULE 11.10 PERMIT HEARINGS

11.10.1 All hearings shall be held before a quorum of the Board, a hearings examiner delegated in writing the responsibility to preside over the hearing, or SOAH in accordance with Rule 11.10.4.

11.10.2 Notice and Scheduling of Hearing: Once the District has received an administratively complete application for a water well Drilling Permit, Production Permit, or a permit amendment, or if the Board desires to modify an existing permit, the General Manager will issue a written notice of the hearing on the application in accordance with these rules.

(a) Notices of all hearings of the District shall be prepared by the General Manager and shall, at a minimum, state the following information:

(1) the name and address of the applicant or permit holder;

(2) the name or names of the owner or owners of the land if different from the applicant or permit holder;

(3) the time, date, and location of the hearing;

(4) the address or approximate proposed location of the well or Well System, if different than the address of the applicant or permit holder;

(5) a brief explanation of the proposed permit or permit amendment, including any requested amount of groundwater, the purpose of the proposed use, and any change in use, or if the Board desires to modify an existing permit, a brief explanation of the proposed permit modification and the basis for the proposed

modification; and

(6) any other information the Board or General Manager deems appropriate to include in the notice.

(b) Not less than ten (10) calendar days prior to the date of the hearing, notice shall be:

(1) posted by the General Manager at a place readily accessible to the public in the District office;

(2) provided by the General Manager to the County Clerk of Pecos County, whereupon the County Clerk shall post the notice on a bulletin board at a place convenient to the public in the county courthouse; and

(3) provided to the applicant by regular mail.

Not less than ten (10) calendar days prior to the date of the hearing, notice may be provided by regular mail to landowners who, in the discretion of the General Manager, may be affected by the application.

(c) A person may request notice from the district of a hearing on a permit or a permit amendment application. The request shall be memorialized in writing and is effective for the remainder of the calendar year in which the request is received by the District. To receive notice of a hearing in a later year, a person must submit a new request. An affidavit of an officer or employee of the District establishing attempted service by first class mail, fax, or email to the person in accordance with the information provided by the person is proof that notice was provided by the District.

(d) Failure to provide notice under Subsection (c) does not invalidate an action taken by the District at the hearing.

(e) The Board shall conduct an evidentiary hearing on a permit or permit amendment application if a party appears to protest that application or if the General Manager proposes to deny that application in whole or in part, unless the applicant or other party in a contested hearing requests the District to contract with SOAH to conduct the evidentiary hearing. If no one appears at the initial, preliminary hearing and the General Manager proposes to grant the application, the permit or permit amendment application is considered uncontested, and the Board may act on the permit application after considering the permitting criteria in these rules. Unless one of the parties in a contested hearing requests a continuance and demonstrates good cause for the continuance, the Board may conduct the preliminary and evidentiary hearings on the same date.

(f) Any hearing may or may not be scheduled during the District's regular business hours, Monday through Friday of each week, except District holidays. All hearings shall be held at the location set forth in the notice.

(g) The General Manager shall set an initial, preliminary hearing date within 60 (sixty) calendar days after the date the administratively complete application is submitted. The initial, preliminary hearing shall be held within 35 (thirty-five) calendar days after the setting of the date. Within this same time frame, the General Manager shall post notice and set a hearing on the application before the District Board. The General Manager may schedule as many applications at one hearing as the General Manager deems necessary.

11.10.3 Authority of Presiding Officer: The Presiding Officer may conduct preliminary and evidentiary hearings or other proceedings in the manner the Presiding Officer deems most appropriate for the particular hearing. The Presiding Officer has the authority to:

(a) set hearing dates, other than the initial, preliminary hearing date for permit matters;

(b) convene the hearing at the time and place specified in the notice for public hearing;

(c) rule on motions;

(d) permit the receipt of and rule on the admissibility of evidence consistent with Subchapter D, Chapter 2001, Texas Government Code;

(e) establish the order for presentation of evidence;

(f) administer oaths to all persons presenting testimony;

(g) examine and allow cross-examination of witnesses;

(h) ensure that information and testimony are introduced as conveniently and expeditiously as possible, without prejudicing the rights of any party to the proceeding;

(i) conduct public hearings in an orderly manner in accordance with these rules;

(j) recess any hearing from time to time and place to place;

(k) issue subpoenas, require depositions, or order other discovery consistent with Subchapter D, Chapter 2001, Texas Government Code;

(l) exercise any other appropriate powers necessary or convenient to effectively carry out the responsibilities of Presiding Officer; and

(m) determine how to apportion among the parties the costs related to a contract for the services of a Presiding Officer and the preparation of the official hearing record.

11.10.4 Appearance; Presentation; Time for Presentation; Ability to Supplement; Conduct and Decorum; Written Testimony; Hearing before SOAH:

(a) Appearance: Protestants and non-protestant interested persons may present evidence, exhibits, or testimony, or make an oral presentation as allowed by the Presiding Officer. A person appearing in a representative capacity may be required to prove proper authority. Each person attending and participating in a hearing of the District must submit on a form provided by the District, prior to or at the commencement of the initial, preliminary hearing, the following information: the person's name and address, who the person represents if other than himself, whether the person wishes to testify, whether the person is protesting the application, and any other information relevant to the hearing.

(1) Protestants: To protest an application for a permit or permit amendment, a potential party must attend the permit hearing prepared to articulate his or her justiciable interest related to a legal right, duty, privilege, power, or economic interest that is within the District's regulatory authority and how that justiciable interest would be adversely affected by the permit proposed by the application. This potential party must attend the initial, preliminary hearing and be prepared to address and respond to inquiry and any cross-examination regarding their alleged justiciable interest. A justiciable interest does not include persons who have only an interest common to members of the general public. It is recommended that a person desiring to protest an application for a permit or permit amendment file with the District a notice of protest setting forth the protestant's justiciable interest related to a legal right, duty, privilege, power, or economic interest that is within the District's regulatory authority and how that justiciable interest would be adversely affected by the permit proposed by the application. It is recommended that the notice of protest be submitted so that it is received by the District at least two business days before the permit hearing. The Board may take testimony and shall deliberate and take official action at the hearing to determine whether the protestant has sufficiently demonstrated their justiciable interest and how that justiciable interest would be adversely affected by the permit proposed by the application. If the Board finds that a protestant does not adequately establish that its justiciable interest is affected by the proposed permit, then the protestant shall not be allowed to participate in the hearing.

(2) Non-protestant interested persons: A person may appear at an initial, preliminary hearing in person or by representative provided the representative is fully authorized, in writing, to speak and act for the principal. Any person appearing and offering any evidence pursuant to this subsection shall be subject to cross-examination.

(3) Request for SOAH Hearing: If an application is contested, any party to the hearing may request that the District contract with SOAH to conduct further proceedings in the hearing. A request for a SOAH hearing under this rule must be made to the Board at the initial, preliminary hearing and is untimely if submitted after the conclusion of the preliminary hearing.

(b) After the Presiding Officer calls a hearing to order, the Presiding Officer shall announce the subject matter of the hearing and the order and procedure for presentations.

(c) The Presiding Officer may prescribe reasonable time limits for the presentation of evidence and oral argument at the preliminary and evidentiary hearings.

(d) If requested with good cause shown and if allowed in the sole discretion of the Presiding Officer, any person who appears at a hearing and makes a presentation before the Board may supplement that presentation by filing additional written evidence with the Board within ten (10) calendar days after the date of conclusion of the hearing. Cumulative, repetitive, and unduly burdensome evidence filed under this subsection will not be considered by the Board. A person who files additional written material with the presiding officer under this subsection must also provide the material, not later than the 10th calendar day after the date of the hearing, to any person who provided comments on an uncontested application or any party to a contested hearing. A person who receives additional written material under this subsection may file a response to the material with the presiding officer not later than the 10th day after the date the material was received.

(e) Every person, party, representative, witness, and other participant in a proceeding must conform to ethical standards of conduct and must exhibit courtesy and respect for all other participants. No person may engage in any activity during a proceeding that interferes with the orderly conduct of District business. If in the judgment of the Presiding Officer, a person is acting in violation of this provision, the Presiding Officer will first warn the person to refrain from engaging in such conduct. Upon further violation by the same person, the Presiding Officer may exclude that person from the proceeding for such time and under such conditions as the Presiding Officer deems necessary.

(f) Written Testimony: When the Presiding Officer determines that a proceeding will be expedited and the interest of the parties will not be prejudiced substantially, the Presiding Officer may allow testimony to be received in written form, which testimony shall be subject to cross-examination. If the Presiding Officer allows written testimony, the written testimony of a witness, either in narrative or question and answer form, may be admitted into evidence upon the witness being sworn and identifying the testimony as a true and accurate record of what the testimony would be if given orally.

(g) SOAH Hearing:

(1) Deadline, Location: If timely requested by the applicant or other party to a contested hearing, the District shall contract with SOAH to conduct the hearing on the application. The Board shall determine whether the SOAH hearing will be held in Travis County or at the District Office or other regular meeting place of the Board, after considering the interests and convenience of the parties, and the expense of a SOAH contract.

(2) Costs, Deposit: The party requesting that the hearing be conducted by SOAH shall pay all costs associated with the contract for the hearing and shall make a deposit with the District in an amount that is sufficient to pay the estimated SOAH contract amount before the hearing begins. If the total cost for the contract exceeds the amount deposited by the paying party at the conclusion of the hearing, the party that requested the hearing shall pay the remaining amount due to pay the final price of the contract. If there are unused funds remaining from the deposit at the conclusion of the hearing, the unused funds shall be refunded to the paying party.

(3) Referral: Upon execution of a contract with SOAH and receipt of the deposit from the appropriate party or parties, the District's Presiding Officer shall refer the application to SOAH. The Presiding Officer's referral to SOAH shall be in writing and shall include procedures established by the Presiding Officer under

Subsection (g)(4) below; a copy of the permit application, all evidence admitted at the preliminary hearing, the District's rules and other relevant policies and precedents, the District Management Plan, and the District Act; and guidance and the District's interpretation regarding its regulations, permitting criteria, and other relevant law to be addressed in a Proposal for Decision and Findings of Fact and Conclusions of Law to be prepared by SOAH. The District or Presiding Officer may not attempt to influence the Finding of Facts or the Administrative Law Judge's application of the law in a contested case except by proper evidence and legal argument. SOAH may certify one or more questions to the District's Board seeking the District Board's guidance on District precedent or the District Board's interpretation of its regulations or other relevant law, in which case the District's Board shall reply to SOAH in writing.

(4) Procedure before SOAH: A hearing conducted by SOAH is governed by SOAH's procedural rules; Subchapters C, D, and F, Chapter 2001, Texas Government Code; and, to the extent, not inconsistent with these provisions, any procedures established by the Presiding Officer under District Rule 11.10.3.

(5) District's Receipt of SOAH's Proposal for Decision and Findings of Fact and Conclusions of Law: The District's Board shall conduct a hearing within 45 (forty-five) days of receipt of SOAH's Proposal for Decision and Findings of Fact and Conclusions of Law, and shall act on the application at this hearing or no later than 60 days after the date that the Board's final hearing on the application is concluded in a manner consistent with Section 2001.058, Texas Government Code. At least ten (10) calendar days prior to this hearing, the Presiding Officer shall provide written notice to the parties of the time and place of the Board's hearing under this subsection by mail and fax, for each party with a fax number. The Presiding Officer shall exercise his or her authority under Rule 11.10.3 in conducting this hearing.

(6) The Board may change a finding of fact or conclusion of law made by the Administrative Law Judge, or may vacate or modify an order issued by the Administrative Law Judge, only if the Board determines:

(A) that the Administrative Law Judge did not properly apply or interpret applicable law, District rules, written policies, or prior administrative decisions;

(B) that a prior administrative decision on which the Administrative Law Judge relied is incorrect or should be changed; or

(C) that a technical error in a finding of fact should be changed.

11.10.5 Recording

(a) Contested Hearings: Contested Hearings: A record of the hearing in the form of an audio or video recording or a court reporter transcription shall be kept in a contested hearing. The Presiding Officer shall have the hearing transcribed by a court reporter upon a request by a party to a contested hearing. Court reporter transcription costs may be assessed against the party requesting the transcription or among the parties to the hearing. In assessing reporting and transcription costs, the Presiding Officer must consider the following factors:

(1) the party who requested the transcript;
(2) the financial ability of the requesting party to pay the costs;
(3) the extent to which the requesting party participated in the hearing;
(4) the relative benefits to the various parties of having a transcript;
(5) the budgetary constraints of a governmental entity participating in the proceeding; and
(6) any other factor that is relevant to a just and reasonable assessment of costs.

(b) Uncontested Hearings: In an uncontested hearing, the Presiding Officer may substitute meeting minutes or the report required under Rule 11.10.9 for a method of recording the hearing.

11.10.6 Evidence; Broadening the Issues

(a) The Presiding Officer shall admit evidence if it is relevant to an issue at the hearing.

(b) The Presiding Officer may exclude evidence that is irrelevant, immaterial, or unduly repetitious.

(c) No person will be allowed to appear in any hearing whose appearance, in the opinion of the Presiding Officer, is for the sole purpose of unduly broadening the issues to be considered in the hearing.

11.10.7 Continuance: The Presiding Officer may continue hearings or other proceedings from time to time and from place to place without the necessity of publishing, serving, mailing, or otherwise issuing a new notice. If a hearing or other proceeding is continued and a time and place for the hearing or other proceeding to reconvene are not publicly announced at the hearing or other proceeding by the Presiding Officer before it is recessed, a notice of any further setting of the hearing or other proceeding which shall include the date, hour, place and subject of the meeting will be provided by regular mail at a reasonable time to the parties and any other person the Presiding Officer deems appropriate, but it is not necessary to post or publish a notice of the new setting, except as required by the Texas Open Meetings Act. This rule applies only to permit hearings.

11.10.8 Uncontested Hearings: If no persons timely protest the application and the General Manager proposes to grant the application, the application shall be considered uncontested and the General Manager may act on the application without subjecting the application to a permit hearing before the Board.

(a) The Board may take action on any uncontested application at a properly noticed public meeting held at any time after the public hearing at which the application is scheduled to be heard. The Board may issue a written order to:

(1) grant the application;

(2) grant the application with special conditions; or

(3) deny the application.

(b) An applicant may, not later than the 20th day after the date the Board issues an order granting the application, demand a contested case hearing if the order:

(1) includes special conditions that were not part of the application as finally submitted; or

(2) grants a maximum amount of groundwater production that is less than the amount requested in the application.

(c) If, during a contested case hearing, all interested persons contesting the application withdraw their protests or are found by the Board not to have a justiciable interest affected by the application, or the parties reach a negotiated or agreed settlement which, in the judgment of the Board, settles the facts or issues in controversy, the proceeding will be considered an uncontested hearing and the Board may take any action authorized under District Rule 11.10.8(a).

11.10.9 Proposal for Decision: If the hearing was conducted by a quorum of the Board and if the Presiding Officer prepared a record of the hearing as provided by Rule 11.10.5(a), the Presiding Officer shall determine whether to prepare and submit a Proposal for Decision ("PFD") to the Board under this rule. If a PFD is required, the Presiding Officer shall submit a PFD to the Board within 30 days after the date the hearing is finally concluded. The PFD must include a summary of the subject matter of the hearing, the evidence or public comments received, and the Presiding Officer's recommendations for Board action on the subject matter of the hearing. A copy of the PFD shall be provided to the applicant and each designated party. The applicant and any designated party may submit to the Board written exceptions to the PFD. The Presiding Officer may direct the General Manager or another District representative to prepare the PFD and recommendations required by this Rule. The Board shall consider the PFD at a final hearing. Additional evidence may not be presented during this final hearing, however the parties may present oral argument to summarize the evidence, present legal argument, or argue an exception to the PFD. A final hearing may be continued in accordance with Rule 11.10.7 and Section 36.409, Texas Water Code.

11.10.10 Board Action: Either on the final hearing date or no later than 60 (sixty) calendar days after the final hearing date is concluded, the Board must take action on the subject matter of the hearing.

(a) In deciding whether or not to issue or amend a Drilling Permit, Production Permit, or Historic and Existing Use Permit, and in setting the permitted volume and other terms of a permit, the Board must consider whether:

(1) the application contains accurate information and conforms to the requirements prescribed by Chapter 36, Texas Water Code;

(2) the water well(s) complies with spacing and production limitations identified in these rules;

(3) the proposed use of water does or does not unreasonably affect existing groundwater and surface water resources or existing permit holders;

(4) the proposed use of water is dedicated to a beneficial use;

(5) the proposed use of water is consistent with the District Management Plan;

(6) the applicant agrees to avoid waste and achieve water conservation;

(7) the applicant has agreed that reasonable diligence will be used to protect groundwater quality and that the applicant will follow well plugging guidelines at the time of well closure; and

(8) for those hearings conducted by SOAH under Rule 11.10.4, the Board shall consider the Proposal for Decision and Findings of Fact and Conclusions of Law issued by SOAH.

(b) In deciding whether or not to modify a permit, and in setting the modified permitted volume and other terms of a permit, the Board must consider whether the data from monitoring wells within the source aquifer or other evidence reflects:

(1) an unacceptable level of decline in water quality of the aquifer;

(2) that modification of the permit is necessary to prevent waste and achieve water conservation;

(3) that modification of the permit will minimize as far as practicable the drawdown of the water table or the reduction of artesian pressure;

(4) that modification of the permit will lessen interference between wells;

(5) that modification of the permit will control and prevent subsidence; and

(6) that modification of the permit is necessary to avoid impairment of Desired Future Conditions.

(c) The Board shall consider the relevant criteria and observe the relevant restrictions and may exercise the authority set forth in Sections 36.113, 36.1131, and 36.122 of the Texas Water Code. In issuing permits, the District shall manage total groundwater production on a long-term basis to achieve an applicable Desired Future Condition and consider:

(1) the Modeled Available Groundwater;

(2) the TWDB Executive Administrator's estimate of the current and projected amount of groundwater produced under exemptions granted by District Rule 11.3 and Section 36.117, Texas Water Code;

(3) the amount of groundwater authorized under permits previously issued by the District;

(4) a reasonable estimate of the amount of groundwater that is actually produced under permits issued by the District; and

(5) yearly precipitation and production patterns.

(d) The District may not impose any restrictions on the production of groundwater for use outside of the District other than imposed upon production for in-district use, and shall be fair, impartial, and nondiscriminatory.

11.10.11 Request for Rehearing and Appeal:

(a) An applicant in a contested or uncontested hearing on an application or a party to a contested hearing may administratively appeal a decision of the Board on a permit or permit amendment application by requesting written findings of fact and conclusions of law from the Board not later than the 20th calendar day after the date of the decision.

(b) On receipt of a timely written request, the Board shall make written findings and conclusions regarding a decision of the Board on a permit or permit amendment application. The Board shall provide certified copies of the findings and conclusions to the party who requested them, and to each designated party, not later than the 35th calendar day after the date the Board receives the request. A party to the contested case hearing may request a rehearing before the Board not later than the 20th calendar day after the date the Board issues the findings and conclusions. A party to a contested hearing must first make a request for written findings and conclusions under District Rule 11.10.11(a) before a party to the contested case may submit a request for rehearing under this rule.

(c) A request for rehearing must be filed in the District office and must state clear and concise grounds for the request. The person requesting a rehearing must provide copies of the request to all parties to the hearing.

(d) If the Board grants a request for rehearing, the Board shall, after proper notice, schedule the rehearing not later than the 45th calendar day after the date the request is granted.

(e) The failure of the Board to grant or deny a request for rehearing before the 91st calendar day after the date the request is submitted is a denial of the request.

(f) A decision by the Board on a permit or permit amendment application is final:

(1) if a request for rehearing is not filed on time, on the expiration of the period for filing a request for rehearing;

(2) if a request for rehearing is filed on time and the Board denies the request for rehearing, on the date the Board denies the request for rehearing; or

(3) if a request for rehearing is filed on time and the Board grants the request for rehearing:

(A) on the final date of the rehearing if the Board does not take further action;

(B) if the Board takes further action after rehearing, on the expiration of the period for filing a request for rehearing on the Board's modified decision if a request for rehearing is not timely filed; or

(C) if the Board takes further action after rehearing and another request for rehearing on this Board action is timely filed, then Subsections 3(A) and (C) of this rule shall govern the finality of the Board's decision.

(g) The applicant or party to a contested case hearing must exhaust all administrative remedies with the District prior to seeking judicial relief from a District decision on a permit or permit amendment application. After all administrative remedies are exhausted with the District, an applicant or a party to a contested case hearing must file suit in a court of competent jurisdiction in Pecos County to appeal the District's decision on a permit or permit amendment application within 60 (sixty) calendar days after the date the District's decision is final. An applicant or party to a contested case hearing is prohibited from filing suit to appeal a District's permitting decision if a request for rehearing was not timely filed.

SECTION 12. REWORKING AND REPLACING A WELL

RULE 12.1 REWORKING AND REPLACING A WELL

(a) An existing well may be reworked or re-equipped in a manner that will not change the existing well status.

(b) A permit must be applied for and granted by the Board if a party wishes to replace an existing well with a replacement well.

(c) A replacement well, in order to be considered such, must be drilled within a reasonable distance of the existing well as long as it meets the District's spacing requirements.

(d) In the event the application meets spacing and production requirements, the General Manager may grant such application without further notice.

SECTION 13. WELL LOCATION AND COMPLETION

RULE 13.1 RESPONSIBILITY

(a) After an application for a well Drilling Permit has been granted, the well or wells, if drilled, must be drilled within a reasonable distance of the location specified in the Drilling Permit, and not elsewhere, provided, however, that spacing restrictions be met. If the well or wells are drilled at a different location, the drilling or operation of such well may be enjoined by the Board pursuant to Chapter 36, Texas Water Code.

(b) As described in the Texas Water Well Drillers' Rules, all well drillers and persons having any exempt or nonexempt well drilled, deepened, or otherwise altered shall adhere to the provisions of the rule prescribing the location of wells and proper completion. Each and every exempt and nonexempt well shall be completed in accordance with all statutory and regulatory requirements applicable to the type of well required for the purpose of use authorized under the permit. The driller of any exempt or nonexempt well shall file with the District the well log required by Section 1901.251, Texas Occupations Code, and, if available, the geophysical log and electric log.

RULE 13.2 LOCATION OF DOMESTIC, INDUSTRIAL, INJECTION, IRRIGATION WELLS

Location of wells should be as specified in *16 Texas Administrative Code, Chapter 76.1000*.

RULE 13.3 STANDARDS OF COMPLETION FOR DOMESTIC, INDUSTRIAL, INJECTION, AND IRRIGATION WELLS

Standards of completion shall be as specified in *16 Texas Administrative Code, Chapter 76.1000*.

RULE 13.4 RE-COMPLETIONS

Standards shall be as specified in *16 Texas Administrative Code, Chapter 76.1003*.

RULE 13.5 SPACING REQUIREMENTS

(a) Spacing and Location of Existing Wells: Wells drilled prior to the Effective Date of these rules are not subject to spacing requirements of this rule except that these existing wells shall have been drilled in accordance with state law in effect, if any, on the date such drilling commenced.

(b) Spacing and Location of New Wells: All new permitted wells must comply with the spacing and location requirements set forth under the Texas Water Well Drillers and Pump Installers Administrative Rules, Title 16, Part 4, Chapter 76, Texas Administrative Code, except that wells shall not be located within 50 (fifty) feet from a property line or any existing well. Water well drillers shall indicate the method of completion performed on the Well Report (Texas Department of Licensing and Regulation Form #001 WWD, Section 10, Surface Completion). The District does not impose any additional requirements, but shall consider evidence submitted at the hearing on the permit application that demonstrates that the proposed new well(s) adversely impact and interfere with neighboring wells.

(c) Exceptions to Spacing Requirements:

(1) The Board may grant exceptions to the spacing requirements of the District if the requirements of this section are met.

(2) If an exception to the spacing requirements of the District is desired, the person seeking the exception shall submit an application to the Board and provide written notice of the application to all owners of adjacent property and owners of registered wells located on adjacent property. In the application, the applicant must explain the circumstances justifying an exception to the spacing requirements of the District. The application must include a plat or sketch, drawn to scale, one inch equaling 200 feet. The application and plat must be certified by some person actually acquainted with the facts who shall state that the facts contained in the application and plat are true and correct, and that notice was sent to each of the appropriate property and well owners.

(3) The Board shall conduct a hearing within 65 (sixty-five) calendar days after the application is administratively complete, and no sooner than 20 (twenty) calendar days after the applicant's notice was sent to each of the appropriate property and well owners. The District shall post notice and conduct the public hearing in accordance with Section 11 of the District's rules. Provided, however, if all owners of adjacent property and owners of registered wells execute a waiver in writing, stating that they do not object to the granting of the exception, the Board may proceed, upon notice to the applicant only and without hearing, and determine the outcome of the application. The applicant may waive notice or hearing or both.

(4) If the applicant presents waivers signed by all landowners and well owners whose property or permitted wells would be located within the applicable minimum distance established under these Rules from the proposed well site stating that they have no objection to the proposed location of the well site, the Board, upon the General Manager's recommendation, may waive certain spacing requirements for the proposed well location.

SECTION 14. WASTE AND BENEFICIAL USE

RULE 14.1 DEFINITION OF WASTE

"Waste" means any one or more of the following:

(a) withdrawal of groundwater from a groundwater reservoir at a rate and in an amount that causes or threatens to cause intrusion into the reservoir of water unsuitable for municipal, industrial, agricultural, gardening, domestic, or stock raising purposes;

(b) the flowing or producing of wells from a groundwater reservoir if the water produced is not used for a beneficial purpose, or is not used for such purposes with a reasonable degree of efficiency. Includes line losses in excess of those determined to be unavoidable.

(c) escape of groundwater from a groundwater reservoir to any other reservoir or geologic strata that does not contain groundwater;

(d) pollution or harmful alteration of groundwater in a groundwater reservoir by saltwater or by other deleterious matter admitted from another stratum or from the surface of the ground;

(e) willfully or negligently causing, suffering, or allowing groundwater to escape into any river, creek, natural watercourse, depression, lake, reservoir, drain, sewer, street, highway, road, or road ditch, or onto any land other than that of the owner of the well other than the natural flow of natural springs unless such discharge is authorized by permit, rule, or order issued by TCEQ under Chapter 26 of the Texas Water Code, *Water Quality Control*;

(f) groundwater pumped for irrigation that escapes as irrigation tailwater onto land other than that of the owner of the well unless permission has been granted by the occupant of the land receiving the discharge;

(g) groundwater used for heating or cooling that is allowed to drain on the land surface as tailwater and not re-circulated back to the aquifer;

(h) the loss of groundwater in the distribution system and/or storage facilities of the water supply system which should not exceed acceptable "system water losses" as defined by the American Water Works Association standard; or

(i) Pursuant to Section 11.205 of the Texas Water Code, unless the water from an artesian well is used for a purpose and in a manner in which it may be lawfully used on the owner's land, it is waste and unlawful to willfully cause or knowingly permit the water to run off the owner's land or to percolate through the stratum above which the water is found.

RULE 14.2 WASTEFUL USE OR PRODUCTION

(a) No person shall intentionally or negligently commit waste.

(b) Underground water shall not be produced within, or used within or without the District in such a manner as to constitute waste.

(c) Any person producing or using groundwater shall use every possible precaution, in accordance with the most approved methods, to stop and prevent waste of water.

RULE 14.3 POLLUTION OR DEGRADATION OF QUALITY OF GROUNDWATER

(a) No person shall cause pollution or harmfully alter the character of the underground water of the District by means of salt water or other deleterious matter admitted from another stratum or strata or from the surface of the ground, or from the operation of a well.

(b) No person shall cause pollution or harmfully alter the character of the underground water of the District by activities on the surface of the ground which cause or allow pollutants to enter the groundwater through recharge features, whether natural or manmade.

(c) No person shall cause degradation of the quality of groundwater.

RULE 14.4 ORDERS TO PREVENT WASTE, POLLUTION, OR DEGRADATION OF QUALITY OF GROUNDWATER

After providing 15 (fifteen) calendar days' notice to affected parties and an opportunity for a hearing, the Board may adopt orders to prohibit or prevent waste, pollution, or degradation of the quality of groundwater. If the factual basis for the order is disputed, the Board shall direct that an evidentiary hearing be conducted prior to consideration and decision on the entry of such an order. If the Board President or his or her designee determines that an emergency exists requiring the immediate entry of an order to prohibit waste or pollution and protect the public health, safety, and welfare, he or she may enter a temporary order without notice and hearing provided, however, the temporary order shall continue in effect for the lesser of 15 (fifteen) calendar days or until a hearing can be conducted. In such an emergency, the Board President or his or her designee is also authorized, without notice or hearing to pursue a temporary restraining order, injunctive, and other appropriate relief in a court of competent jurisdiction.

RULE 14.5 REQUIRED EQUIPMENT ON WELLS FOR THE PROTECTION OF GROUNDWATER QUALITY

14.5.1 EQUIPMENT REQUIRED. The following equipment must be installed on all wells having a chemical injection, chemigation or foreign substance unit in the water delivery system: an in-line, automatic quick-closing check valve capable of preventing pollution or harmful alteration of the groundwater. Such equipment must be installed on all new wells at the time of completion. Such equipment shall be installed on all existing wells the next time the wells are serviced.

14.5.2 CHECK VALVES. The type of check valve installed shall meet the following specifications:

(a) Check valves must be equipped with a TCEQ-approved hazardous materials backflow device, and installed in a manner approved by Texas Department of Licensing and Regulation (“TDLR”).

(b) A vacuum-relief device shall be installed between the pump discharge and the check valve in such a position and in such a manner that insects, animals, floodwater, or other pollutants cannot enter the well though the vacuum-relief device. The vacuum-relief device may be mounted on the inspection port as long as it does not interfere with the inspection of other anti-pollution devices.

SECTION 15. INVESTIGATIONS AND ENFORCEMENT

RULE 15.1 NOTICE AND ACCESS TO PROPERTY

Board Members and District agents and employees are entitled to access to all property within the District to carry out technical and other investigations necessary to the implementation of the District’s rules. Prior to entering upon property for the purpose of conducting an investigation, the person seeking access must give notice in writing or in person or by telephone to the owner, lessee, or operator, agent, or employee of the well owner or lessee, as determined by information contained in the application or other information on file with the District. Notice is not required if prior permission is granted to enter without notice. Inhibiting or prohibiting access to any Board Member or District agents or employees who are attempting to conduct an investigation under the District’s rules constitutes a violation and subjects the person who is inhibiting or prohibiting access, as well as any other person who authorizes or allows such action, to the penalties set forth in Texas Water Code Chapter 36.

RULE 15.2 CONDUCT OF INVESTIGATION

Investigations or inspections by the District that require entrance upon property must be conducted at reasonable times, and must be consistent with the establishment’s rules and regulations concerning safety, internal security, and fire protection. The District representative or representatives conducting such investigations must identify themselves and present credentials upon request of the owner, lessee, operator, or person in charge of the well or property.

RULE 15.3 RULE ENFORCEMENT; ENFORCEMENT HEARING

15.3.1 If it appears that a person has violated or is violating any provision of the District’s rules, the District may employ any of the following means, or a combination thereof, in providing notice of the violation:

(a) Informal Notice: The officers, staff or agents of the District acting on behalf of the District or the Board may inform the person of the violation via telephone by informing, or attempting to inform, the appropriate person to explain the violation and the steps necessary to cure the violation. The information received by the District through this informal notice concerning the violation and the date and time of the telephone call will be documented and will remain in the District's files. Nothing in this subsection shall limit the authority of the District to take action, including emergency actions or any other appropriate enforcement action, without prior notice provided under this subsection.

(b) Written Notice of Violation: The District may inform the person of the violation through written notice of violation. Each notice of violation issued herein shall explain the basis of the violation, identify the rule or order that has been violated or is currently being violated, and list specific required actions that must be satisfactorily completed to cure a past or present violation to address each violation raised, and may include the payment of applicable civil penalties. Notice of a violation issued herein shall be provided through a delivery method in compliance with these Rules. Nothing in this Subsection shall limit the authority of the District to take action, including emergency actions or any other appropriate enforcement action, without prior notice provided under this subsection.

(c) Compliance Meeting: The District may hold a meeting with any person whom the District believes to have violated, or to be violating, a District rule or order to discuss each such violation and the steps necessary to satisfactorily remedy each such violation. The General Manager may conduct a compliance meeting without the Board, unless otherwise determined by the Board or General Manager. The information received in any meeting conducted pursuant to this subsection concerning the violation will be documented, along with the date and time of the meeting, and will be kept on file with the District. Nothing in this subsection shall limit the authority of the District to take action, including emergency actions or any other appropriate enforcement action, without prior notice provided under this subsection.

15.3.2 Show Cause Hearing.

(a) Upon recommendation of the General Manager to the Board or upon the Board's own motion, the Board may order any person that it believes has violated or is violating any provision of the District's rules a District order to appear before the Board at a public meeting, held in accordance with the Texas Open Meetings Act, and called for such purpose and to show cause of the reasons an enforcement action, including the assessment of civil penalties and initiation of a suit in a court of competent jurisdiction in Pecos County, should not be pursued against the person made the subject of the show cause hearing. The Presiding Officer may employ the procedural rules in Section 11 of the District's rules.

(b) No show cause hearing under subsection (a) of this Rule may be conducted unless the District serves, on each person made the subject of the show cause hearing, a written notice ten (10) calendar days prior to the date of the hearing. Such notice shall include all of the following information:

(1) the time, date, and place for the hearing; and
(2) the basis of each asserted violation; and
(3) the rule or order that the District believes has been violated or is currently being violated; and
(4) a request that the person duly appear and show cause of the reasons an enforcement action should not be pursued.

(c) The District may pursue immediate enforcement action against the person cited to appear in any show cause order issued by the District where the person cited fails to appear and show cause of the reasons an enforcement action should not be pursued.

(d) Nothing in this rule shall constrain the authority of the District to take action, including emergency actions or any other enforcement action, against a person at any time, regardless of whether the District decides to hold a hearing under this Section.

15.3.3 Remedies

(a) The Board shall consider the appropriate remedies to pursue against an alleged violator during the show cause hearing, including assessment of a civil penalty, injunctive relief, or assessment of a civil penalty and injunctive relief. In assessing civil penalties, the Board may determine that each day that a violation continues shall be considered a separate violation. The civil penalty for a violation of any District rule is hereby set at the lower of $10,000.00 per violation or a lesser amount determined after consideration, during the enforcement hearing, of the criteria in subsection (b) of this rule.

(b) In determining the amount of a civil penalty, the Board of Directors shall consider the following factors:

(1) compliance history;
(2) efforts to correct the violation and whether the violator makes a good faith effort to cooperate with the District;
(3) the penalty amount necessary to ensure future compliance and deter future noncompliance;
(4) any enforcement costs related to the violation; and
(5) any other matters deemed necessary by the Board.

15.3.4 The District shall collect all past due fees and civil penalties accrued that the District is entitled to collect under the District's rules. The District shall provide written notice of the alleged violation and show cause hearing by certified mail, return receipt requested, hand delivery, first class mail, facsimile, email, FedEx, UPS, or any other type of public or private courier or delivery service. If the District is unable to provide notice to the alleged violator by any of these forms of notice, the District may tape the notice on the door of the alleged violator's office or home, or post notice in the newspaper of general circulation in the District and within the county in which the alleged violator resides or in which the alleged violator's office is located. Any person or entity in violation of these rules is subject to all past due fees and civil penalties along with all fees and penalties occurring as a result of any violations that ensue after the District provides written notice of a violation. Failure to pay required fees will result in a violation of the District's rules and such failure is subject to civil penalties.

15.3.5 The District may afford an opportunity to the alleged violator to cure a violation through coordination and negotiation with the District.

15.3.6 After conclusion of the show cause hearing, the District may commence suit. Any suit shall be filed in a court of competent jurisdiction in Pecos County. If the District prevails in a suit brought under this Section, the District may seek and the court shall grant, in the interests of justice and as provided by Subsection 36.066(h), Texas Water Code, in the same action, recovery of attorney's fees, costs for expert witnesses, and other costs incurred by the District before the court.

RULE 15.4 SEALING OF WELLS

Following notice to the well owner and operator and upon resolution by the Board, the District may seal wells that are prohibited from withdrawing groundwater within the District to ensure that such wells are not operated in violation of the District's rules. A well may be sealed when: (1) no application has been made for a permit to drill a new water well which is not excluded or exempted; or (2) no application has been made for a Production permit to withdraw groundwater from an existing well that is not excluded or exempted from the requirement that a permit be obtained in order to lawfully withdraw groundwater; or (3) the Board has denied, canceled or revoked a Drilling Permit or a Production permit.

The well may be sealed by physical means, and tagged to indicate that the well has been sealed by the District, and other appropriate action may be taken as necessary to preclude operation of the well or to identify unauthorized operation of the well.

Tampering with, altering, damaging, or removing the seal of a sealed well, or in any other way violating the integrity of the seal, or pumping of groundwater from a well that has been sealed constitutes a violation of these rules and subjects the person performing that action, as well as any well owner or primary operator who authorizes or allows that action, to such penalties as provided by the District's rules.

RULE 15.5 CAPPING AND PLUGGING OF WELLS

(a) The District may require a well to be capped to prevent waste, prevent pollution, or prevent further deterioration of a well casing. The well must remain capped until such time as the conditions that led to the capping requirement are eliminated. If well pump equipment is removed from a well and the well will be re-equipped at a later date, the well must be capped, provided however that the casing is not in a deteriorated condition that would permit co-mingling of water strata, in which case the well must be plugged. The cap must be capable of sustaining a weight of at least four hundred (400) pounds and must be constructed with a water tight seal to prevent entrance of surface pollutants into the well itself, either through the well bore or well casing.

(b) A deteriorated or abandoned well must be plugged in accordance with the Texas Department of License and Regulation, Water Well Drillers and Pump Installers Rules (16 TAC Chapter 76). It is the responsibility of the landowner to see that such a well is plugged to prevent pollution of the underground water and to prevent injury to persons and animals. Registration of the well is required prior to, or in conjunction with, well plugging.

Any person that plugs a well in the District must submit a copy of the plugging report to the District and the Texas Department of License and Regulation within 30 (thirty) calendar days of plugging completion.

(c) If the owner or lessee fails or refuses to plug or cap the well in compliance with this rule and District standards within 30 (thirty) calendar days after being requested to do so in writing by an officer, agent, or employee of the District, then, upon Board approval, any person, firm, or corporation employed by the District may go on the land and plug or cap the well safely and securely, pursuant to TWC Chapter 36.118.

Reasonable expenses incurred by the District in plugging or capping a well constitutes a lien on the land on which the well is located.

The District shall perfect the lien by filing in the deed records an affidavit, executed by any person conversant with the facts, stating the following:

(1) the existence of the well;
(2) the legal description of the property on which the well is located;
(3) the approximate location of the well on the property;
(4) the failure or refusal of the owner or lessee, after notification, to close the well within 30 (thirty) calendar days after the notification;
(5) the closing of the well by the District, or by an authorized agent, representative, or employee of the District; and
(6) the expense incurred by the District in closing the well.

SECTION 16. FEES

RULE 16.1 GROUNDWATER EXPORT FEE

(a) The District may impose an export fee or surcharge, established by Board resolution, for export of groundwater out of the District using one of the following methods:

(1) a fee negotiated between the District and the exporter; or

(2) a rate not to exceed the equivalent of the District’s tax rate per hundred dollars of valuation for each thousand gallons of water exported from the District or 2.5 cents per thousand gallons of water, if the District assesses a tax rate of less than 2.5 cents per hundred dollars of valuation.

If a production fee is assessed, this export fee shall not exceed 10 percent of the amount of the fee assessed for the production of water for use within the District.

(b) Payment of the Groundwater Export Fee shall be made at a time negotiated under 16.1(a)(1) or no later than the payment deadline established by the General Manager.

RULE 16.2 RETURNED CHECK FEE

Any person who tenders to the District a check that is returned to the District for insufficient funds, account closed, signature missing, or any other reason shall immediately remit funds to the District in the amount of the check that was returned and reimburse the District for any expenses associated with the returned check that were incurred by the District.

SECTION 17. PROPOSED DESIRED FUTURE CONDITIONS; PUBLIC COMMENT, HEARING, AND BOARD ADOPTION; APPEAL OF DESIRED FUTURE CONDITIONS

RULE 17.1 PUBLIC COMMENT

Upon receipt of proposed Desired Future Conditions from the Groundwater Management Area's district representatives, a public comment period of 90 (ninety) calendar days commences, during which the District will receive written public comments and conduct at least one hearing to allow public comment on the proposed Desired Future Conditions relevant to the District. The District will make available at the Distriict Office a copy of the proposed Desired Future Conditions and any supporting materials, such as the documentation of factors considered under Subsection 36.108(d) and groundwater availability model run results.

RULE 17.2 NOTICES OF HEARING AND MEETING

(a) At least ten (10) calendar days before a hearing or meeting under this Section, the Board must post notice that includes:

   (1) the proposed Desired Future Conditions and a list of any other agenda items;
   (2) the date, time, and location of the hearing;
   (3) the name, telephone number, and address of the person to whom questions or requests for additional information may be submitted;
   (4) the names of the other districts in the District's management area; and
   (5) information on how the public may submit comments.

(b) Except as provided by Subsection (a), the hearing and meeting notice must be provided in the manner prescribed for a rulemaking hearing under Rule 6.2(b) and Subsection 36.101(d), Texas Water Code.

RULE 17.3 HEARING

The District shall hold a public hearing to accept public comments using procedures prescribed in Section 6 of these rules.

RULE 17.4 DISTRICT'S REPORT ON PUBLIC COMMENTS AND SUGGESTED REVISIONS

After the public hearing, the District shall compile for consideration at the next joint planning meeting a summary of relevant comments received, any suggested revisions to the proposed Desired Future Conditions, and the basis for any suggested revisions.

RULE 17.5 BOARD ADOPTION OF DESIRED FUTURE CONDITIONS

As soon as possible after the District receives the Desired Future Conditions resolution and explanatory report from the Groundwater Management Area's district representatives pursuant to Subsection 36.108(d-3), the Board shall adopt the Desired Future Conditions in the resolution and explanatory report that apply to the District. The Board shall issue notice of its meeting at which it will take action on the Desired Future Conditions in accordance with Rule 17.2(a) and (b).

RULE 17.6 APPEAL OF DESIRED FUTURE CONDITIONS

(a) Not later than 120 (one hundred twenty) calendar days after the date on which the District adopts a Desired Future Condition under Subsection 36.108(d-4), Texas Water Code, a person determined by the District to be an affected person may file a petition appealing the reasonableness of a Desired Future Condition. The petition must include:

(1) evidence that the petitioner is an affected person;

(2) a request that the District contract with SOAH to conduct a hearing on the petitioner's appeal of the reasonableness of the Desired Future Condition;

(3) evidence that the districts did not establish a reasonable Desired Future Condition of the groundwater resources within the relevant Groundwater Management Area.

(b) Not later than ten (10) calendar days after receiving a petition described by Subsection (a), the District's Presiding Officer shall determine whether the petition was timely filed and meets the requirements of Rule 17.6(a) and, if so, shall submit a copy of the petition to the TWDB. If the petition was untimely or did not meet the requirements of Rule 17.6(a), the District's Presiding Officer shall return the petition to the petitioner advising of the defectiveness of the petition. Not later than 60 (sixty) calendar days after receiving a petition under Rule 17.6(a), the District shall:

(1) contract with SOAH to conduct the requested hearing; and

(2) submit to SOAH a copy of any petitions related to the hearing requested under Rule 17.6(a) and received by the District.

(c) A hearing under District Rule 17.6 must be held:

(1) at the District office or Pecos County Courthouse unless the District's Board provides for a different location; and

(2) in accordance with Chapter 2001, Texas Government Code, and SOAH's rules.

Not less than ten (10) calendar days prior to the date of the hearing, notice may be provided by regular mail to landowners who, in the discretion of the General Manager, may be affected by the application.

(d) Not less than ten (10) calendar days prior to the date of the SOAH hearing under this rule, notice shall be issued by the District and meet the following requirements:

(1) state the subject matter, time, date, and location of the hearing;

(2) be posted at a place readily accessible to the public at the District's office;

(3) be provided to the County Clerk of Pecos County, whereupon the County Clerk shall post the notice on a bulletin board at a place convenient to the public in the County Courthouse; and

(4) be sent by certified mail, return receipt requested; hand delivery; first class mail; fax; email; FedEx; UPS; or any other type of public or private courier or delivery service to:

(A) the petitioner;

(B) any person who has requested notice in writing to the District;

(C) each nonparty district and regional water planning group located within the same Groundwater Management Area as a district named in the petition;

(D) TWDB's Executive Administrator; and

(E) TCEQ's Executive Director.

If the District is unable to provide notice by any of these forms of notice, the District may tape the notice on the door of the individual's or entity's office or home, or post notice in the newspaper of general circulation in the District and within the county in which the person or entity resides or in which the person's or entity's office is located.

(e) Before a hearing is conducted under this rule, SOAH shall hold a prehearing conference to determine preliminary matters, including:

(1) whether the petition should be dismissed for failure to state a claim on which relief can be granted;

(2) whether a person seeking to participate in the hearing is an affected person who is eligible to participate; and

(3) each affected person that shall be named as a party to the hearing.

(f) The petitioner shall pay the costs associated with the contract for the hearing conducted by SOAH under this rule. The petitioner shall deposit with the District an amount sufficient to pay the contract amount before the hearing begins. After the hearing, SOAH may assess costs to one or more of the parties participating in the hearing and the District shall refund any money exceeding actual hearing costs to the petitioner. SOAH shall consider the following in apportioning costs of the hearing:

(1) the party who requested the hearing;

(2) the party who prevailed in the hearing;

(3) the financial ability of the party to pay the costs;

(4) the extent to which the party participated in the hearing; and

(5) any other factor relevant to a just and reasonable assessment of costs.

(g) On receipt of the SOAH Administrative Law Judge's findings of fact and conclusions of law in a proposal for decision, which may include a dismissal of a petition, the District shall issue a final order stating the District's decision on the contested matter and the District's findings of fact and conclusions of law. The District may change a finding of fact or conclusion of law made by the Administrative Law Judge, or may vacate or modify an order issued by the Administrative Law Judge, as provided by Section 2001.058(e), Texas Government Code.

(h) If the District vacates or modifies the proposal for decision, the District shall issue a report describing in detail the District's reasons for disagreement with the Administrative Law Judge's findings of fact and conclusions of law. The report shall provide the policy, scientific, and technical justifications for the District's decision.

(i) If the District in its final order finds that a Desired Future Condition is unreasonable, not later than the 60th calendar day after the date of the final order, the District shall coordinate with the districts in the Groundwater Management Area at issue to reconvene in a joint planning meeting for the purpose of revising the Desired Future Condition found to be unreasonable in accordance with the procedures in Section 36.108, Texas Water Code.

(j) The Administrative Law Judge may consolidate hearings requested under this rule that affect two or more districts. The Administrative Law Judge shall prepare separate findings of fact and conclusions of law for each district included as a party in a multidistrict hearing.

SECTION 18. AQUIFER STORAGE AND RECOVERY (ASR)

RULE 18.1 APPLICABILITY OF DISTRICT'S RULES TO ASR PROJECTS

(a) As a general matter, TCEQ has exclusive jurisdiction over the regulation and permitting of ASR Injection Wells. However, the District has concurrent jurisdiction over an ASR Injection Well that also functions as an ASR Recovery Well. The District is entitled to notice of and may seek to participate in an ASR permitting matter pending at TCEQ and, if the District qualifies as a party, in a contested hearing on an ASR application.

(b) The provisions of District Rule 18.1 apply to an ASR Recovery Well that also functions as an ASR Injection Well.

(c) A Project Operator shall:

(1) register an ASR Injection Well and ASR Recovery Well associated with the ASR Project if a well is located in the District;

(2) submit to the District the monthly report required to be provided to TCEQ under Section 27.155, Texas Water Code, at the same time the report is submitted to TCEQ; and

(3) submit to the District the annual report required to be provided to TCEQ under Section 27.156, Texas Water Code, at the same time the report is submitted to TCEQ.

(d) If an ASR Project recovers an amount of groundwater that exceeds the volume authorized by TCEQ to be recovered under the project, the Project Operator shall report to the District the volume of groundwater recovered that exceeds the volume authorized to be recovered in addition to providing the report required by District Rule 18.1(c)(2).

(e) Except as provided by District Rule 18.1(f), the District may not require a permit for the drilling, equipping, operation, or completion of an ASR Injection Well or an ASR Recovery Well that is authorized by TCEQ.

(f) Each ASR Recovery Well that is associated with an ASR Project is subject to the permitting, spacing, and production requirements of the District if the amount of groundwater recovered from the wells will exceed the volume authorized by TCEQ to be recovered under the project. The requirements of the District apply only to the portion of the volume of groundwater recovered from the ASR Recovery Well that exceeds the volume authorized by TCEQ to be recovered.

(g) A Project Operator may not recover groundwater from an ASR Project in an amount that exceeds the volume authorized by TCEQ to be recovered under the project unless the Project Operator complies with the applicable requirements of the District as described by this rule.

(h) The District may not assess a production fee or export fee or surcharge for groundwater recovered from an ASR Recovery Well, except to the extent that the amount of groundwater recovered under the ASR Project exceeds the volume authorized by TCEQ to be recovered.

(i) The District may consider hydrogeologic conditions related to the injection and recovery of groundwater as part of an ASR Project in the planning for and monitoring of the achievement of a Desired Future Condition for the aquifer in which the wells associated with the project are located.

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Appendix D

Evidence of Notice and Hearing

MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT

NOTICE OF PUBLIC HEARING ON AMENDMENTS TO MANAGEMENT PLAN

July 14, 2020 at 10:00 a.m.
District's Office, 405 North Spring Drive
Fort Stockton, Texas 79735

The Middle Pecos Groundwater Conservation District (District) will hold a public hearing on proposed amendments to the District's management plan on July 14, 2020, at 10:00 a.m. at its office at 405 North Spring Drive, Fort Stockton, Texas 79735. All interested parties are invited to attend and are encouraged to provide input, and may do so orally or in written form. Additionally, this public hearing will be accessible via videoconference call in accordance with Governor Abbott's declaration of the COVID-19 public health threat and action to temporarily suspend certain provisions of the Texas Open Meetings Act. Members of the public may listen to and participate in the meeting via the web video link and toll-free call-in number below.

Link:	https://us02web.zoom.us/j/84263436983	Call-in #: 1-888-992-1129
Meeting ID:	842 6343 6983	
Password:	754489	

The proposed amendments to the management plan incorporate the updated Desired Future Conditions and Modeled Available Groundwater information developed from the work of the Texas Water Development Board (TWDB), groundwater conservation districts and other stakeholders within Groundwater Management Areas 3 and 7, and amends certain management objectives and performance standards. Following this hearing, the District will, in coordination with surface water management entities on a regional basis, complete the management plan to address the management goals statutorily required in Section 36.1071 of the Texas Water Code and TWDB's rules.

Copies of the proposed management plan are available for review at the District's office at 405 North Spring Drive, Fort Stockton, Texas 79735, and on the District's webpage at www.middlepecosgcd.org.

The District is committed to compliance with the Americans with Disabilities Act (ADA). If you require special assistance to participate in this hearing, please call (432) 336-0698 at least 24 hours in advance of the meeting to make arrangements. For more information about the management plan or public hearing, please contact the District's General Manager Ty Edwards at (432) 336-0698.

FILED
JUN 29 2020
LIZ CHAPMAN
CLERK COUNTY COURT, PECOS CO., TEXAS
By J. Kurz Deputy
10:35 am

FILED
JUL 1 0 2020
LIZ CHAPMAN
CLERK COUNTY COURT, PECOS CO., TEXAS
By J. Rana Deputy
2:00pm

MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT

P.O Box 1644 Fort Stockton, TX 79735 Phone (432)336-0698 Fax (432)336-3407
405 North Spring Drive Fort Stockton, Texas 79735
Email: mpgcd@mpgcd.org Website: www.middlepecosgcd.org

NOTICE OF REGULAR BOARD MEETING AND PUBLIC HEARING TO BE HELD BY VIDEOCONFERENCE AND TELECONFERENCE[1]

July 14, 2020
Call to Order at 10:00 a.m.

In accordance with Governor Abbott's declaration of the COVID-19 public health threat and action to temporarily suspend certain provisions of the Texas Open Meetings Act, a quorum of the District's Board of Directors will hold its regular Board meeting and hearing by videoconference and teleconference. There will not be an in-person meeting. The public may join this meeting as follows:

Access the videoconference at this link: https://us02web.zoom.us/j/84263436983
Password: 754489 / Meeting ID: 842 6343 6983

Alternatively, call in to this meeting at this toll-free number: 1-888-992-1129

Members of the public wishing to make public comment during the meeting and/or hearing must register by emailing mpgcd@mpgcd.org prior to 9:30 a.m. on July 14, 2020. A copy of the agenda packet will be available on the District's website at the time of the meeting.

During this meeting, the Board reserves the right to go into executive session for any of the purposes authorized under the Texas Open Meetings Act, Chapter 551 of the Texas Government Code, for any item on this agenda or as otherwise authorized by law.

REGULAR BOARD MEETING

I Call to order regular Board meeting and roll call.

II Comments from **public and media** (limit 5 minutes per person cumulative for all items addressed). Members of the public may address the Board for a limited time concerning any subject whether or not it is on the agenda (each person wishing to speak must submit a completed public comment form).[2]

III Consider and/or act upon **Minutes of Regular Meeting on June 16, 2020.**

PUBLIC HEARING ON AMENDMENTS TO MANAGEMENT PLAN[3]

I Call to Order at 10:00 a.m.

II Public hearing to receive public input on proposed Amendments to Management Plan.

III Adjourn.

REGULAR BOARD MEETING – CONTINUED

IV Consider and/or act upon **Treasurer's Report for the Month Ending June 30, 2020.**

V Consider and review **2020-2021 draft budget.**

VI Consider and/or act upon **2020 Amendments to Management Plan.**

VII Consider and/or act on **Cockrell Investment Partners, L.P.'s (Cockrell's) pending motion for contested case hearing and referral to State Office of Administrative Hearings (SOAH) on District's proposed rules** (filed August 10, 2017).

VIII Consider and/or act regarding **rules acted on at June 16, 2020 Board meeting and future workshop(s) and/or hearing(s) on proposed rules.**

IX Consider and/or act on **Cockrell's Request for Reconsideration regarding third-party party status concerning Fort Stockton Holdings, L.P.'s (FSH's) Application for Permit Renewal** (filed July 6, 2020).

X Consider and/or act on **Cockrell's Request for Findings and Conclusions regarding FSH's Application for Permit Renewal** (filed July 6, 2020).

XI Briefing and take action as necessary on **Cockrell Investment Partners, L.P. v. Middle Pecos Groundwater Conservation District,** Cause No. P-12176-112-CV (Pecos County District Court).

XII Consider and/or act upon **Order of General Election for November 3, 2020.**

XIII Consider and/or act regarding compliance with and/or exemption from recently adopted **Texas Commission on Environmental Quality rules regarding recycling** and associated statutory requirements.

XIV **Progress Reports: Well Registrations, Production Permits, Drilling Permits, Data Loggers, Drought Monitor Map, Water Quality Analysis and General Manager's Correspondence.**[4]

XV **Directors' Comments**[4] and consider and/or act upon **agenda for next meeting.**

XVI **Adjourn** Board meeting.

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[1] The Board may break for lunch and commence or continue the Board meeting and/or hearing immediately after lunch. Requests for accommodations under the ADA/Americans with Disabilities Act must be made 48 hours prior to this meeting by contacting Ty Edwards at 432-336-0698.

[2] The Board will apply new statutory law governing public comment. If more than 5 minutes (cumulative) is requested, there must be good cause in the sole discretion of the Presiding Officer. The Board is not allowed to take action on any subject presented that is not on the agenda, nor is the Board required to provide a response; any substantive consideration and action by the Board will be conducted under a specific item on a future agenda.

[3] Additional more detailed notice of this public hearing required by state law and the District's rules was separately issued by the District.

[4] No action will be taken on these agenda items. These items are on the agenda to provide the District's General Manager and Directors an opportunity to bring to the public's and each other's attention important issues pertinent to groundwater management within the District such that any substantive deliberation and formal action on any of these issues will be conducted under a specific item on a future agenda.

RESOLUTION
OF THE BOARD OF DIRECTORS OF THE MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT HEARING HELD JULY 14, 2020

A RESOLUTION ADOPTING THE DISTRICT'S MANAGEMENT PLAN

WHEREAS, the Middle Pecos Groundwater Conservation District (the "District") is a political subdivision of the State of Texas organized and existing under and by virtue of Article XVI, Section 59, of the Texas Constitution, and a groundwater conservation district acting under Chapter 36 of the Texas Water Code and the District's enabling act, Texas Special District Local Laws Code Chapter 8851;

WHEREAS, under the direction of the Board of Directors (the "Board"), and in accordance with Section 36.1071, Texas Water Code; Chapter 356, Title 31, Texas Administrative Code; and Section 8 of the District's rules, the District has revised its Management Plan;

WHEREAS, the District held a properly noticed public hearing to receive and consider public comments on the Management Plan for the District at 405 North Spring Drive (District Office), Fort Stockton, Texas on July 14, 2020;

WHEREAS, on June 29, 2020, more than 10 days prior to its July 14th public hearing, the District made its Management Plan available for public review at the District's office and on the District's webpage;

WHEREAS, the District obtained comments from the Texas Water Development Board ("TWDB") through a preliminary review of the District's Management Plan conducted by TWDB staff, and the District has considered and addressed all such comments in the development of its Management Plan;

WHEREAS, the Board received and considered the advice of the District's legal counsel and consultant on the revisions to the District's Management Plan;

WHEREAS, the Board received public comments on the District's Management Plan, considered and reviewed those comments in preparing revisions to its Management Plan, and completed its five-year review;

WHEREAS, the District has coordinated and will continue to coordinate with the appropriate surface water management entities pursuant to Section 36.1071, Texas Water Code; and

WHEREAS, the Board of Directors finds that the Management Plan meets all of the requirements of Chapter 36, Texas Water Code, and Chapter 356, Title 31, Texas Administrative Code.

NOW THEREFORE BE IT RESOLVED THAT:

1. The above recitals are true and correct.

2. The Management Plan is hereby adopted as the groundwater management plan for the District.

3. The District's Board, General Manager, legal counsel and consultant are further authorized to take any and all action necessary to file the adopted Management Plan with TWDB and to coordinate with TWDB as may be required in furtherance of TWDB's approval pursuant to the provisions of Chapter 36 of the Texas Water Code and other applicable law.

AND IT IS SO ORDERED.

Upon motion duly made by Director Ronald Cooper, and seconded by Director M.R. Gonzalez, and upon discussion, the Board voted 10 in favor, ∅ opposed, ∅ abstained, and 1 absent, and the motion thereby PASSED on this 14th day of July, 2020.

MIDDLE PECOS GROUNDWATER CONSERVATION DISTRICT

By: Jerry McGuaire
Board President

ATTEST:

M.R. Gonzalez
Board Secretary

Appendix E

Coordination with Surface Water Entities

Bill Hutchison

From:	Middle Pecos GCD <mpgcd@mpgcd.org>
Sent:	Wednesday, July 15, 2020 9:46 AM
To:	PCWID2@hotmail.com; Ronnie Cooper; redbluff@windstream.net; Melissa Mills
Subject:	MPGCD 2020 Management Plan
Attachments:	MPGCD Notice of Public Hearing on Amendments to Managment Plan 7-14-2020 (1).pdf; 07-14-2020 mgmt plan resol - executed.pdf

By way of this email The Middle Pecos Groundwater Conservation District is notifying you we have adopted our 2020 Management Plan.

A copy of the 2020 MPGCD Management Plan is available here.

PCWID #2
PCWID2@hotmail.com

PCWID#3
ronniec@valornet.com

Red Bluff Water Power Control District
GM: Robin Prutte
432-448-2818
e-mail: redbluff@windstream.net

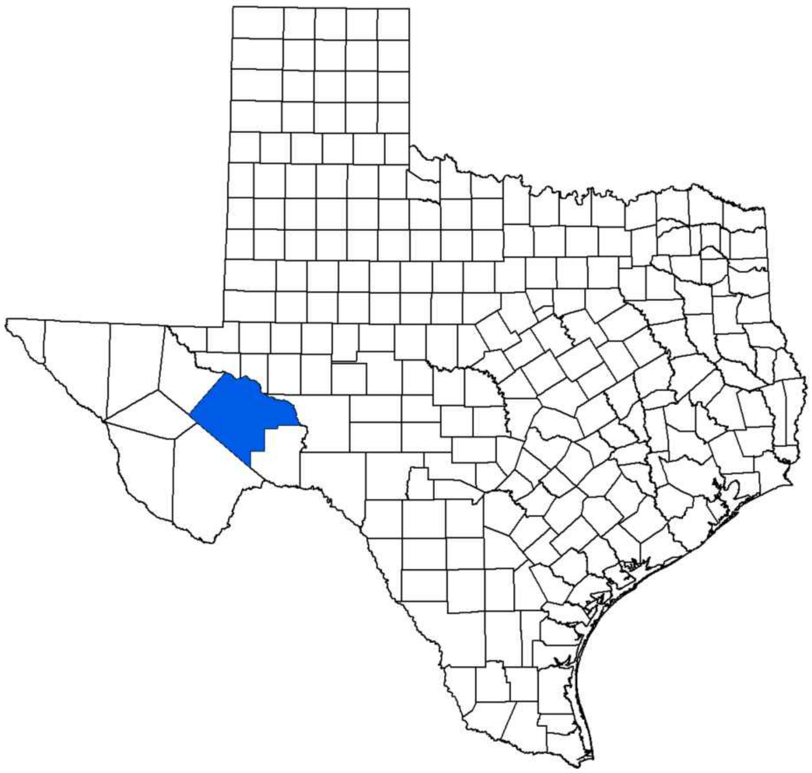
Ty Edwards
General Manager
Middle Pecos GCD
PO Box 1644
405 North Spring Drive
Ft. Stockton Texas 79735
Cell: 432-940-1357
Office: 432-336-0698
www.mpgcd.org

Appendix F

Comparison of Groundwater Elevations and Drawdowns: GAM DFC Simulation and Measured Data from TWDB

Final Report

Comparison of Groundwater Elevations and Drawdowns: GAM DFC Simulation and Measured Data from TWDB



Prepared for:
Middle Pecos Groundwater Conservation District
PO Box 1644
Ft. Stockton, TX 79735
432-336-0698

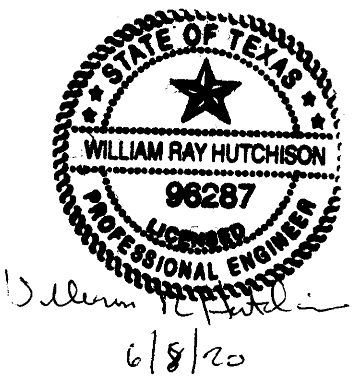
Prepared by:
William R. Hutchison, Ph.D., P.E., P.G.
Independent Groundwater Consultant
9305 Jamaica Beach
Jamaica Beach, TX 77554
512-745-0599
billhutch@texasgw.com

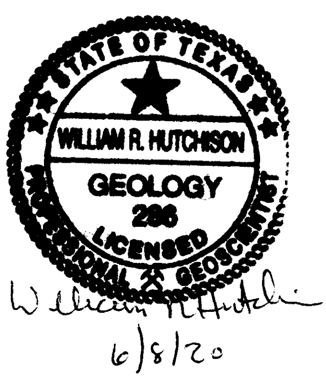
June 8, 2020

Professional Engineer and Professional Geoscientist Seals

This report was prepared by William R. Hutchison, Ph.D., P.E., P.G., who is licensed in the State of Texas as follows:

- Professional Engineer (Geological and Civil) No. 96287
- Engineering Firm Registration No. 14526
- Professional Geoscientist (Geology) No. 286





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1.0 Introduction

One of the required goals (Goal 8) of the Middle Pecos Groundwater Conservation District Management Plan is a how the District addresses the desired future conditions in a quantitative manner. This report:

- Summarizes the available data from the TWDB Groundwater Database
- Describes the analyses that were completed to select monitoring wells for the comparison with the simulations that are the basis for the desired future condition
- Provides a comparison of model simulated groundwater elevations and drawdowns with actual data and provides some context to the results with an analysis of precipitation in the area.

1.1 2020 District Management Plan

The updated 2020 District Management Plan outlines a process where the District downloads groundwater data for Pecos County from the Texas Water Development Board groundwater database and compares the model results on a well-by-well basis for data that are available. As described in the management plan, wells were selected using the following criteria:

1. The well was located within the boundaries of the District
2. The TWDB database included aquifer completion information
3. End-of-the-year groundwater elevation data are available for 2005 which is the starting point of the drawdown calculation of the desired future condition for the Edwards-Trinity (Plateau) and Pecos Valley aquifers.

As developed in this report, data are insufficient to complete this comparison for the Capitan Reef Complex, Dockum, and Rustler aquifers.

1.2 TWDB Database

1.2.1 Groundwater Levels

The groundwater level database for Texas which includes groundwater levels for the major and minor aquifers was downloaded from the TWDB website on May 15, 2020. The files *WaterLevelsMajor.txt* and *WaterLevelsMinor.txt* contain all water level data for Texas. The data for Pecos County were used for this effort.

There was a total of 26,527 groundwater level entries in Pecos County from 564 wells. Of the entries in the database, 25,799 had depth to water data (i.e. 728 had no data entered for a variety of reasons). Of the 25,799 entries that had data, 25,404 from 545 wells were labeled "publishable" (i.e. 395 were labeled "questionable" for a variety of reasons).

The "publishable" data cover the period March 3, 1940 to April 30, 2020. The number of readings in each aquifer (as labeled by TWDB) are as follows:

- Capitan Reef Complex Aquifer: 38
- Dockum Aquifer: 1
- Edwards-Trinity (Plateau) Aquifer: 20,712
- Pecos Valley Aquifer: 4,436
- Rustler Aquifer: 217

The "publishable" groundwater level data were saved in the file *PecosPubWL.xlsx.*

1.2.2 Geographic Coordinates, Well Depths, and Well Use

Geographical coordinates, well depths, and well use for the 545 wells with "publishable" data were extracted from the file *WellMain.txt* from the TWDB groundwater database. These data were combined with the groundwater level data in *PecosPubWL.xlsx* and resulted in adding the well coordinates, depths, and well use to the groundwater level data. These coordinates from the TWDB are expressed in latitude and longitude. The coordinates were converted into x- and y-coordinates (GAM coordinate system) using the commercial software *Surfer*. The results were saved in the file *PecosPubWLCoord.xlsx.*

1.2.3 GAM Row and Column Locations

The x- and y-coordinates of the well locations were used to find the well in terms of the appropriate model grids of the GAMs (Capitan Reef Complex Aquifer, Edwards-Trinity (Plateau)/Pecos Valley aquifers, and Rustler Aquifer). There was only one data point for the Dockum aquifer in the TWDB database and it was taken in 1964 and is not useful for the analysis of comparing simulated drawdowns with actual monitoring data in the context of evaluating consistency with desired future conditions.

FORTRAN programs were written to find the appropriate model grid cell:

- Capitan Reef Complex Aquifer: *capitanrowcol.exe*
- Edwards-Trinity (Plateau) and Pecos Valley aquifers: *etppvrowcol.exe*
- Rustler Aquifer: *rustlerrowcol.exe*

Results were written to the following files:

- Capitan Reef Complex Aquifer: *capitanrowcolwl.dat*
- Edwards-Trinity (Plateau) and Pecos Valley aquifers: *etppvrowcolwl.dat*
- Rustler Aquifer: *rustlerrowcolwl.dat*

1.2.4 End-of-Year Groundwater Elevations

The data files for each aquifer were combined into a file named *allrowcolwl.dat*. A FORTRAN program named *AnnGWData.exe* was written to pick an end-of-year groundwater level that can be used to compare with GAM simulation results. For purposes of this selection, the priority of groundwater levels was as follows:

1. December of the current year
2. January of the next year
3. November of the current year
4. February of the next year

Data from March to October were ignored for purposes of this end-of-year selection. Output from the FORTRAN program includes a file named *annwellcount.dat* that contains the number of annual readings for each well and the earliest and most reading year of data, and a file named *anngwe.dat* that contains the measured end-of-year groundwater elevation. Please note of the 545 wells that had "published" data in the file *allrowcolwl.dat*, only 443 had end-of-year data. The ID number in the first column of *anngwe.dat* was also used to track data in addition to the state well number (as shown in the file *annwellcount.dat*).

1.2.5 Simulated Groundwater Elevations from Groundwater Availability Models

The Capitan Reef Complex Aquifer GAM calibration period was 1931 to 2005 (75 annual stress periods). The predictive scenarios were run for the period 2006 to 2070 (65 annual stress periods). The FORTRAN program *getcaphed.exe* was developed to extract simulated groundwater elevations for both the calibrated model and the simulation that was the basis for the desired future condition (Scenario 4). The simulated groundwater elevations were chosen based on the TWDB groundwater database monitoring points in *anngwe.dat* described in the previous section. Comparisons were limited to the wells identified in the TWDB database as Capitan Reef Complex Aquifer wells. Results were written to the file *caphedcompare.dat.*

The calibration period of the alternative GAM that covers the Edwards-Trinity (Plateau) and Pecos Valley aquifers was 1930 to 2005 (76 annual stress periods). The predictive scenarios were run for the period 2006 to 2070 (65 annual stress periods). The FORTRAN program *getetppvhed.exe* was developed to extract simulated groundwater elevations for both the calibrated model and the simulation that was the basis for the desired future condition (Scenario 2). The simulated groundwater elevations were chosen based on the TWDB groundwater database monitoring points in *anngwe.dat* described in the previous section. Comparisons were limited to wells identified in the TWDB database as Edwards-Trinity (Plateau) or Pecos Valley aquifer wells. Results were written to the file *etppvhedcompare.dat.*

The Rustler Aquifer GAM calibration period was 1918 to 2008 (91 annual stress periods). The predictive scenarios were run for the period 2009 to 2070 (62 annual stress periods). The FORTRAN program *getrustlerhed.exe* was developed to extract simulated groundwater elevations for both the calibrated model and the simulation that was the basis for the desired future condition (Scenario 4). The simulated groundwater elevations were chosen based on the TWDB groundwater database monitoring points in *anngwe.dat* described in the previous section. Comparisons were limited to the wells identified in the TWDB database as Rustler Aquifer wells. Results were written to the file *rustlerhedcompare.dat.*

2.0 Comparison of Measured Data with GAM Results

2.1 Capitan Reef Complex and Rustler Aquifers

The comparison of actual data to GAM results for the Capitan Reef Complex Aquifer yielded only six end-of-year groundwater elevations in five wells have been collected since 2005 (the end of the calibration period of the GAM). The comparison results are contained in the file *caphedcompare.dat*. There is general lack of data and there is a poor match between actual data and GAM results. However, the high pumping anticipated in the predictive run that was the basis for the desired future condition has not started. Thus, any variation in the actual groundwater elevations that may have occurred would be the result of natural variation in recharge and the small amount of pumping from this aquifer. This review suggests that additional monitoring be initiated, or the aquifer should be classified as not relevant for purposes of joint planning. If the aquifer were classified as not relevant for purposes of joint planning, Middle Pecos GCD would still manage groundwater and could still issue permits for production under its rules. However, no desired future condition would be established, no modeled available groundwater would be calculated by TWDB, and groundwater availability for this aquifer would be established by the regional planning group.

The comparison of actual data to GAM results for the Rustler Aquifer yielded only 11 end-of-year groundwater elevations in three wells have been collected since 2009 (the end of the calibration period of the GAM). The comparison results are contained in the file *RustlerHedCompare.xlsx.* There is a general lack of data and there is a poor match between the actual data and GAM results in the one well that has a multi-year record (Well 52-16-202). Actual data from 2010 to 2018 show a decline of about 7 feet. However, the GAM at the location of the well predicts a decline of about 93 feet. This review suggests that additional monitoring be initiated, or the aquifer should be classified as not relevant for purposes of joint planning. If the aquifer were classified as not relevant for purposes of joint planning, Middle Pecos GCD would still manage groundwater and could still issue permits for production under its rules. However, no desired future condition would be established, no modeled available groundwater would be calculated by TWDB, and groundwater availability for this aquifer would be established by the regional planning group.

2.2 Edwards-Trinity (Plateau) and Pecos Valley Aquifers

The comparison of actual data to GAM results for the Edwards-Trinity (Plateau) and Pecos Valley aquifers yielded 3,313 end-of-year groundwater elevations for both the calibration period and predictive period of the GAM runs. These data were further divided into readings through 2005 (calibration period) and after 2005 (predictive period). The file *ETPPVHeadcompare.xlsx* includes a sheet named "All" with all the data, a sheet named "Calibration" that contains 2,395 end-of-year groundwater elevations through 2005, and a sheet named "Prediction" that contains 882 end-of-year groundwater elevations from 2006 to 2019.

2.2.1 Overall Evaluation of Model Calibration

The GAM was calibrated to achieve a reasonable fit throughout the regional aquifer. This analysis involves evaluating the calibration specifically in Pecos County. Model calibration for Pecos County was evaluated graphically and with summary statistics. Figure 1 presents a cross plot of measured groundwater elevations vs. simulated groundwater elevation.

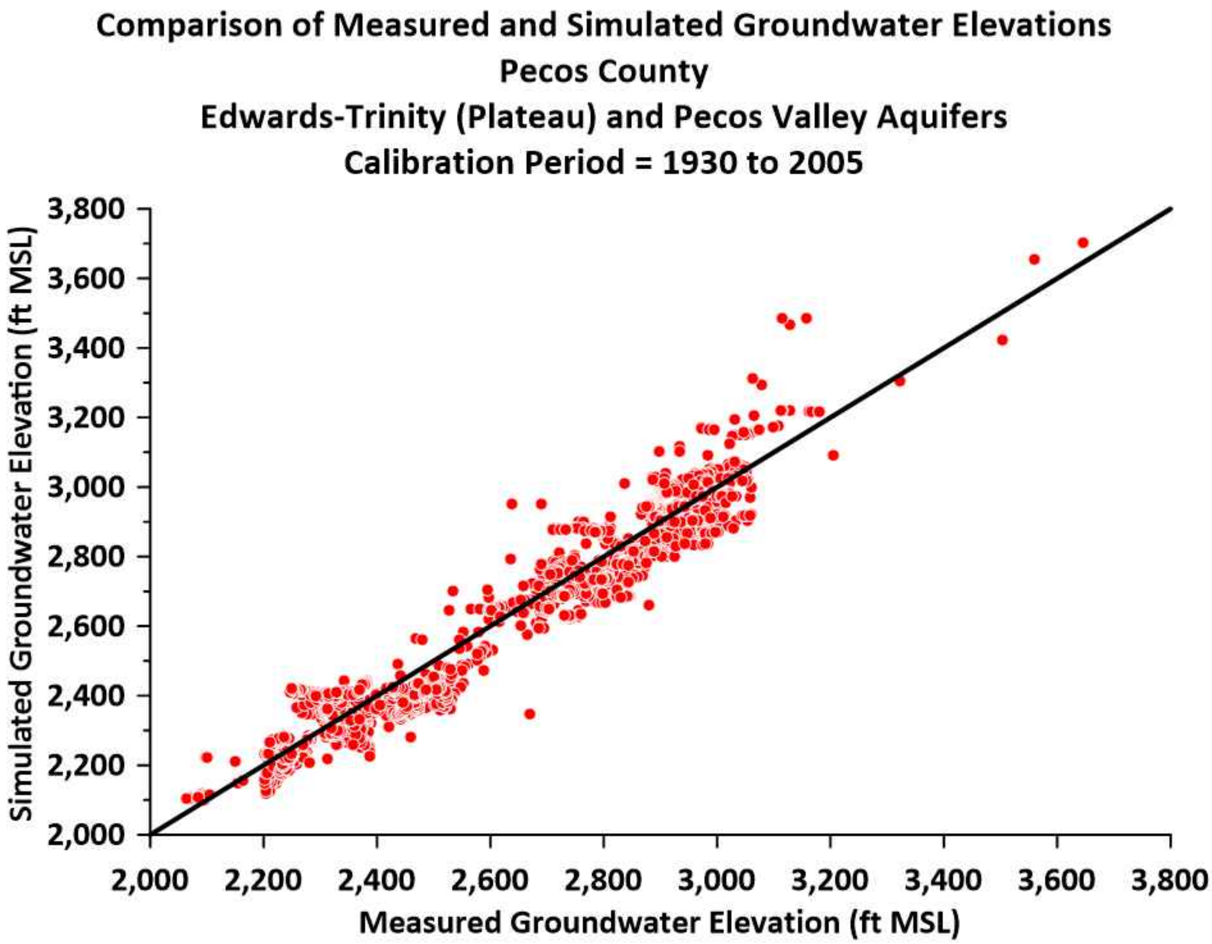


Figure 1. Comparison of Groundwater Elevations - Calibration Period

Each red data point shows the relationship between the measured groundwater elevation and the simulated groundwater elevation. An ideal match lies on the black 1 to 1 line. Points that lie below or to the right of the black line are instances where the simulated groundwater elevation is less than the measured groundwater elevation. Points that lie above or to the left of the black line are instances where the simulated groundwater elevation is higher than the measured groundwater elevation.

Table 1 summarizes the calibration statistics in Pecos County. The residual is calculated as the measured groundwater elevation minus the simulated groundwater elevation. The mean of the residual (23.20 feet), therefore, reflects that the average simulated groundwater elevation is 23.20 feet below the average measured groundwater elevation. A measure to assess the overall calibration is the scaled residual standard deviation (the residual standard deviation divided by the range in measurements). Typically, a value of less than 0.1 is considered acceptable. Please note that the calculated value for this analysis is 0.04.

Table 1. Pecos County Calibration Statistics

Statistic	Value
Residual Mean	23.20
Absolute Residual Mean	55.25
Residual Standard Deviation	64.21
Sum of Squared Residuals	11,160,002
Root Mean Square Error	68.26
Minimum Residual	-372.34
Maximum Residual	323.05
Number of Observations	2,395
Range in Observations	1,581.77
Scaled Residual Standard Deviation	0.0406
Scaled Absolute Residual Mean	0.0349
Scaled Root Mean Square Error	0.0432
Scaled Residual Mean	0.0147

Based on this analysis, the calibration is considered generally acceptable, but with some limitations due to the relatively large residual mean and root mean square error. Limitations to the calibration were considered when evaluating the comparison of the predictive simulation (i.e. the basis for the desired future condition) and actual monitoring data from 2006 to present.

2.2.2 Overall Comparison of Predictive Simulation

A cross plot of the overall comparison between measured groundwater elevations in Pecos County from 2006 to 2019 vs. simulated groundwater elevation at each point for the same period under the predictive simulation that was the basis for the desired future condition is presented in Figure 2. The associated statistics of this comparison are presented in Table 2.

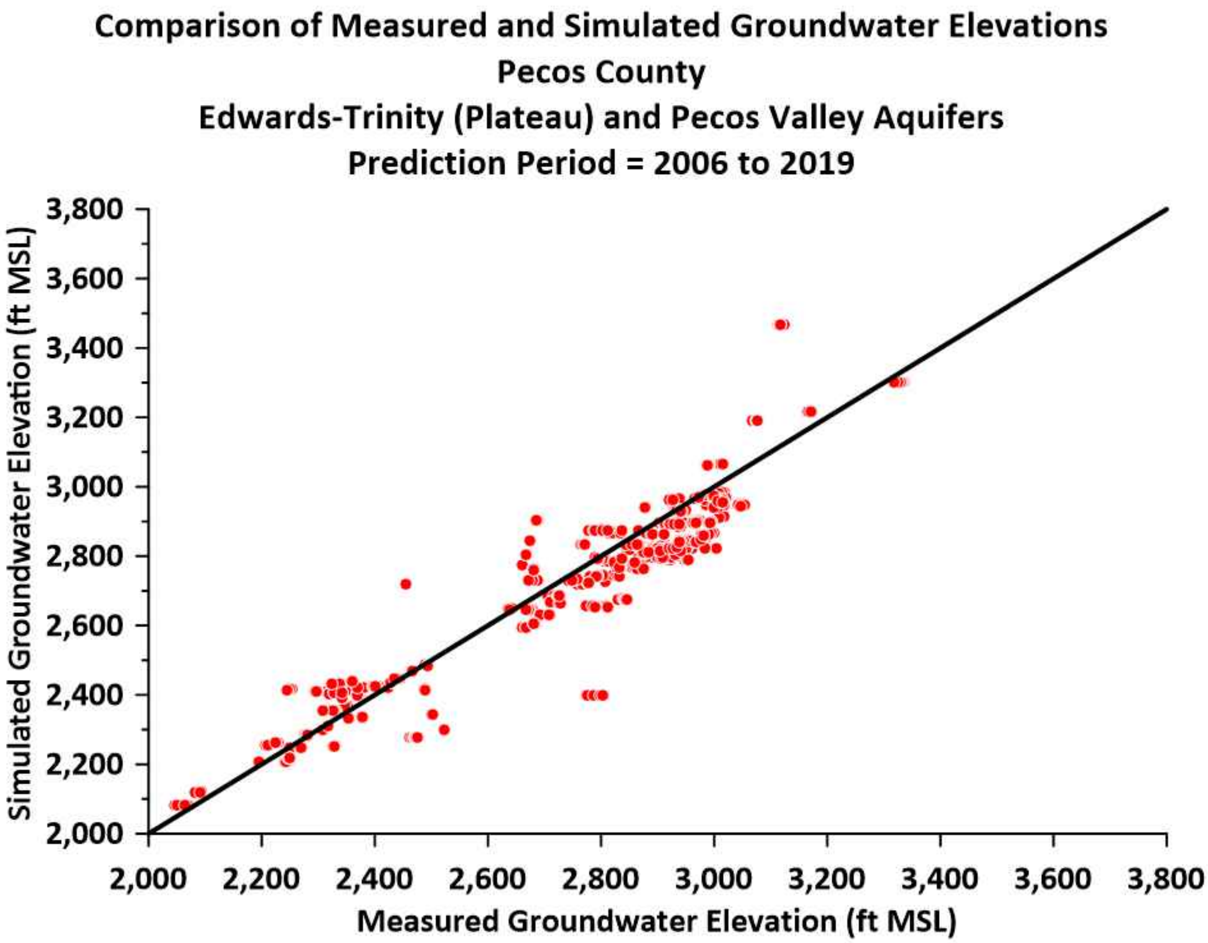


Figure 2. Comparison of Groundwater Elevations - Predictive Period

The predictive simulation assumed average rainfall and recharge conditions for each year from 2006 to 2070. Therefore, the only variation in simulated groundwater elevations is due to changes in groundwater pumping. However, the variation in measured groundwater elevations is due to a combination of changes in pumping and variations in rainfall and recharge. Thus, a more detailed comparison between measured groundwater elevations and simulated groundwater elevations is necessary as described below.

Table 2. Pecos County Predictive Simulation Comparison Statistics

Statistic	Value
Residual Mean	15.40
Absolute Residual Mean	71.00
Residual Standard Deviation	96.08
Sum of Squared Residuals	8,342,707
Root Mean Square Error	97.26
Minimum Residual	-354.28
Maximum Residual	405.97
Number of Observations	882
Range in Observations	1,289.82
Scaled Residual Standard Deviation	0.0745
Scaled Absolute Residual Mean	0.0550
Scaled Root Mean Square Error	0.0754
Scaled Residual Mean	0.0119

3.0 Drawdown Comparison

3.1 Well Selection

The desired future condition for the Edwards-Trinity (Plateau) and Pecos Valley aquifers as adopted by the groundwater conservation districts of Groundwater Management Area 7 for Pecos County is average drawdown not to exceed 14 feet from 2010 to 2070. This average drawdown was calculated based on a model run that was completed from 2006 to 2070 since the calibration period ended in 2005.

Inspection of the available measured data in 2005 yields 28 wells with a measured groundwater elevation at the end of 2005. The inspection also yields that there were 15 wells with end-of-year measurements in 2010. Thus, comparison of the predictive run using 2005 as a basis for the comparison will yield almost twice the number of the comparisons as a comparison based on 2010. As a result of the more comprehensive comparison, all drawdown calculations and comparisons will be based on 2005 measurements as a starting point.

The 28 wells with data in 2005 are summarized in Table 3 and the locations of these wells are presented in Figure 3.

Table 3. Summary of 28 Wells Used in Comparison

Well ID	State Well Number	Aquifer	GAM Row	GAM Column	2005 End-of-Year Measured Groundwater Elevation (ft MSL)
102	4562402	ETP	169	141	2,459.00
103	4562901	PV	167	148	2,249.70
105	4563701	ETP	166	150	2,244.74
113	4648604	PV	182	100	2,249.51
114	4648801	PV	184	101	2,327.96
127	4656306	ETP	184	105	2,369.81
130	4656401	PV	191	102	2,486.30
167	5206501	ETP	212	104	2,874.43
180	5207302	ETP	203	110	2,795.13
184	5207502	ETP	207	110	2,872.89
190	5207901	ETP	208	114	2,943.59
196	5208302	ETP	199	116	2,875.00
199	5208801	ETP	205	118	2,955.50
226	5216302	ETP	205	121	2,997.89
239	5216505	PV	207	120	3,015.00
252	5216802	ETP	209	123	3,027.20
263	5221301	ETP	226	109	3,179.15
320	5301707	ETP	200	120	2,942.92
326	5301902	ETP	197	126	2,924.36
360	5302708	ETP	197	128	2,889.32
370	5303901	ETP	189	137	2,730.61
385	5306501	ETP	173	149	2,311.42
399	5307202	ETP	166	153	2,268.60
400	5307203	ETP	166	154	2,211.60
421	5309105	ETP	204	122	2,979.63
425	5309301	ETP	200	127	2,923.96
430	5309306	ETP	198	126	2,927.00
448	5312702	ETP	192	144	2,757.00

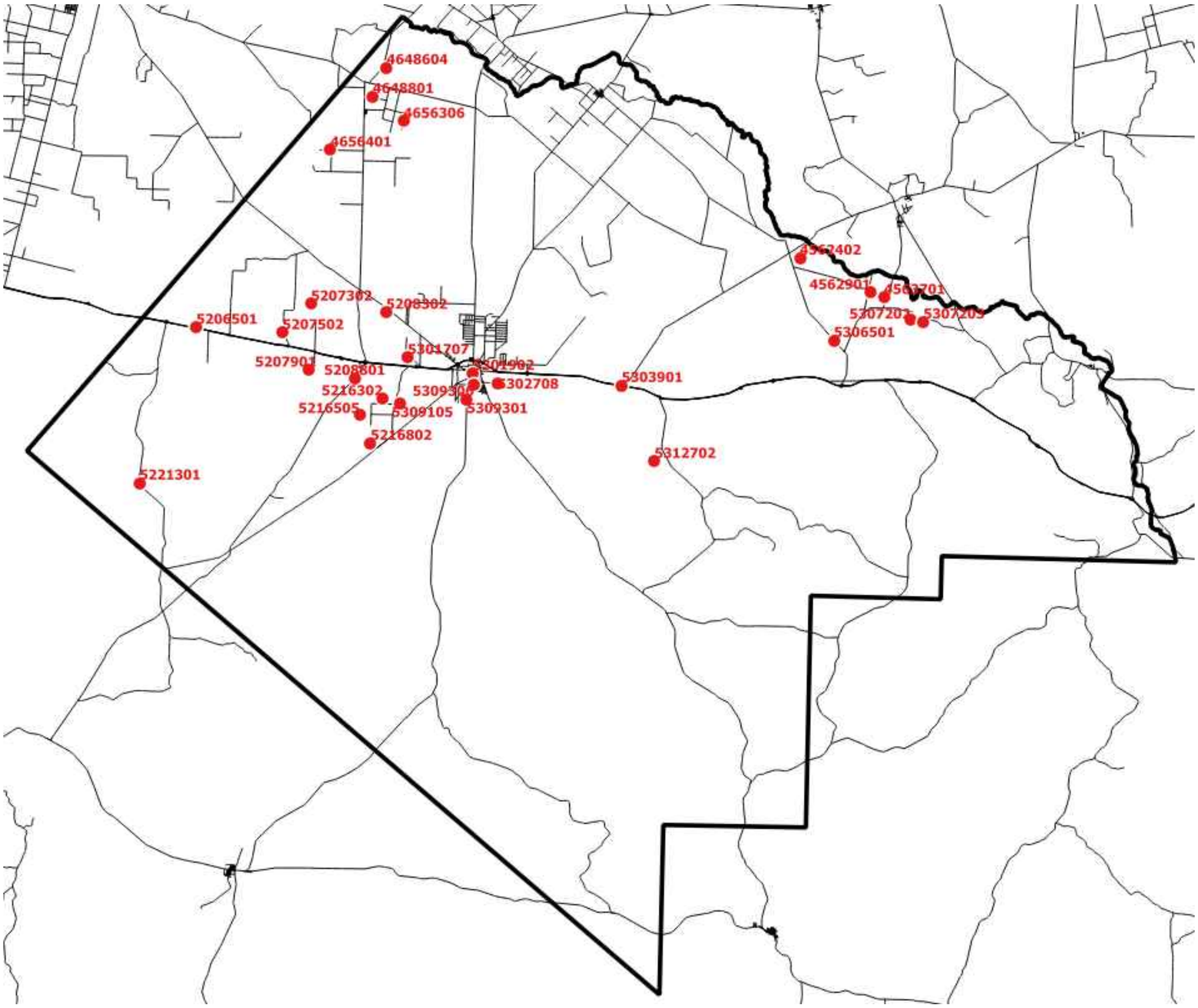


Figure 3. Location of Edwards-Trinity (Plateau) and Pecos Valley Aquifer Wells with 2005 Data

3.2 Drawdown Calculation

The FORTRAN program *getDFCdd.exe* was written to complete the drawdown calculations. The program reads the binary output files of the calibrated model (*etppv4.hds*) and the predictive run (*pred.hds*). The program then reads the list of the 28 wells used for the analysis (*2005ActGWE.csv*) that includes the id number, the state well number, the aquifer designation, the model row and column, the actual measured groundwater elevation at the end of 2005 and the simulated groundwater elevation at the end of 2005 from the calibrated model.

The file with the actual data for all wells (*etppvhedcompare.dat*) is read. Actual drawdown for the 28 wells is then calculated as the groundwater elevation in 2005 minus the actual groundwater elevation of the data point for each well. Simulated drawdown is calculated for the 28 wells.

Two output files are written, one with a summary of all drawdown comparisons (a total of 910), and two files are written for each of the 28 wells: one file with actual drawdown and one file with simulated drawdown. The individual files were used to construct hydrographs of drawdown that are presented in Appendix A.

The 910 drawdown comparisons were saved as an Excel spreadsheet (*PrePost2005Compare.xlsx*). The tab labeled "All" contains all 910 comparisons. The tab labeled "Pre2005" contains 640 comparisons before 2005 (1946 to 2004). These are useful to assess the calibration of the model in terms of drawdown. The tab labeled "Post2005" contains 242 comparisons after 2005 (2006 to 2019).

A summary tab is included as is reproduced as Table 4, which includes the number of wells for each year of the comparison, the average measured drawdown, and the average simulated drawdown from those wells with measured data. Please note that 2019 only had a single measured drawdown. The average drawdown data from 2006 to 2018 are presented in Figure 4. Each measured drawdown point in Figure 4 includes the annual precipitation in inches during that year. Average rainfall was 13.48 inches from 1940 to 2019.

Table 4. Summary of Average Drawdown 2006 to 2019

Year	Number of Wells	Average Measured Drawdown (ft from 2005)	Average Simulated Drawdown (ft from 2005)
2006	17	1.47	2.20
2007	17	0.23	3.72
2008	14	5.52	4.04
2009	21	0.55	4.76
2010	15	4.49	5.40
2011	19	10.85	5.68
2012	21	12.51	6.06
2013	21	17.87	6.55
2014	21	13.78	7.02
2015	21	3.68	7.49
2016	21	4.24	7.94
2017	16	6.18	8.90
2018	17	2.78	9.31
2019	1	13.11	17.07

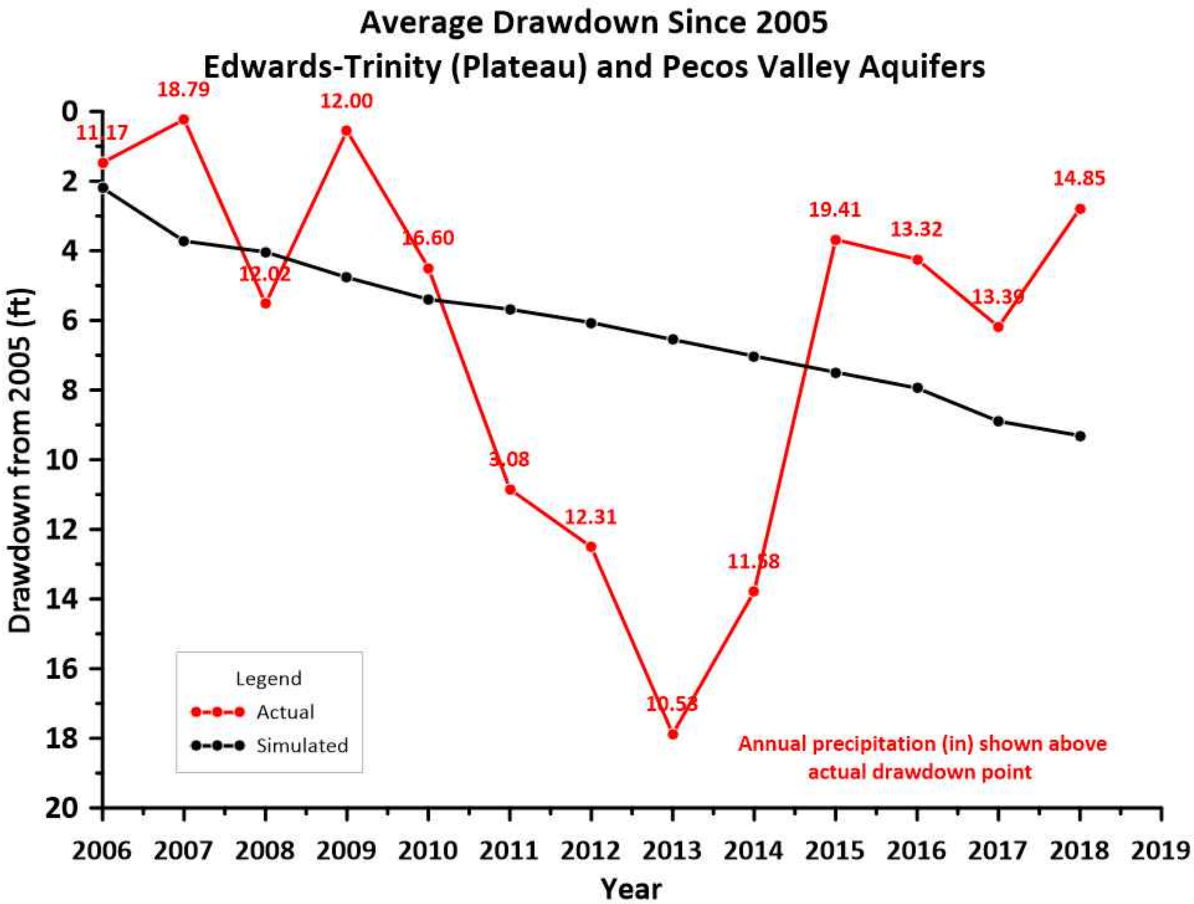


Figure 4. Average Drawdown (2005 to 2018)

Please note that the simulated drawdown is declining from 2006 to 2018 with only slight variations from a linear trend. The linear trend is expected because the simulation assumed constant and average rainfall and recharge conditions. The slight variation is expected because the specific wells used in the calculation change from year to year depending on data availability (i.e. not all wells have an end-of-year groundwater elevation measurement).

The actual drawdown, in contrast, exhibits larger variation than the simulated drawdown. To further assess the variation in the actual drawdown, an analysis of rainfall in the region was completed.

4.0 Precipitation Evaluation

Precipitation data were downloaded from the TWDB website (*https://waterdatafortexas.org/lake-evaporation-rainfall*). As seen in Figure 6, Pecos County is in parts of four quadrangles (604, 605, 704,and 705).

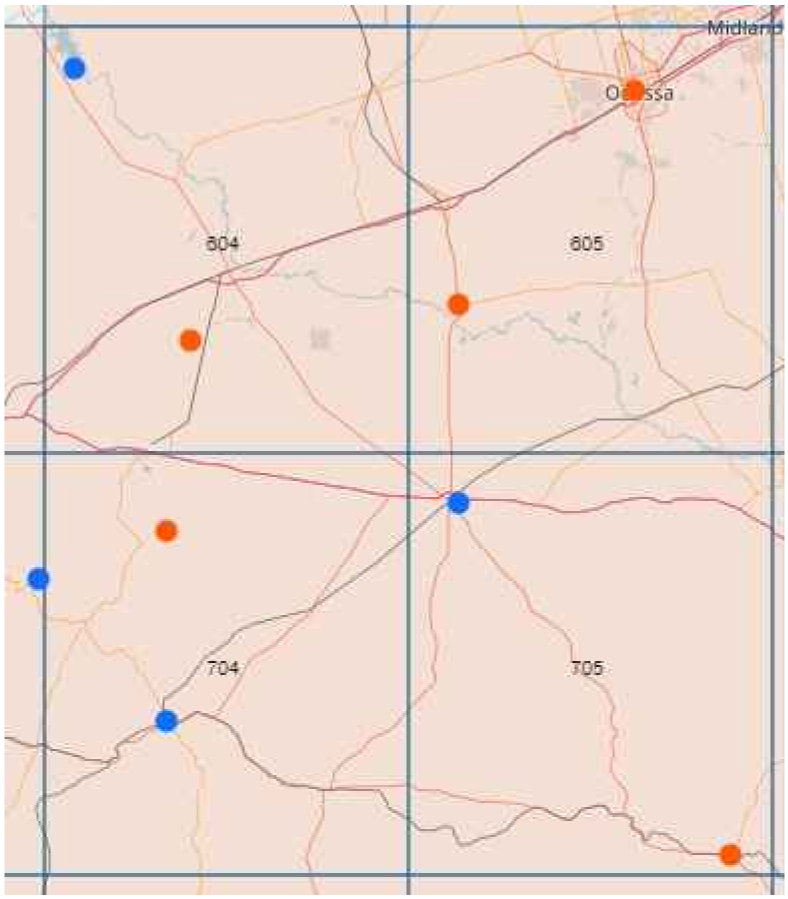


Figure 5. Location of Precipitation Quads

3.1 Annual Precipitation

The available data for the four quadrangles include monthly totals of precipitation from 1940 to 2019. These data were saved to the file *PecosPrecip.xlsx* in the tab labeled "All". The monthly data were averaged across all four quadrangles, the annual totals for each year were summed and presented in Column J. The annual rainfall was also expressed in terms of a percent average for the entire period in Column K. Average rainfall from 1940 to 2019 was 13.48 inches. Annual departures from the average are presented in Column L, and the cumulative departures from the average are presented in Column M. The pertinent data for the years of interest (2006 to 2019) are summarized in Table 6.

Table 5. Precipitation (in/yr) for Quadrangles 604, 605, 704, and 705: 2006 to 2019

Year	Annual Precipitation (in)	Annual Precipitation (% of Average)	Annual Departure from Average (in)	Cumulative Departure from Average Since 1940 (in)
2006	11.17	82.82	-2.32	3.08
2007	18.79	139.38	5.31	8.39
2008	12.02	89.17	-1.46	6.93
2009	12.00	89.00	-1.48	5.45
2010	16.60	123.13	3.12	8.57
2011	3.08	22.86	-10.40	-1.83
2012	12.32	91.34	-1.17	-3.00
2013	10.53	78.08	-2.96	-5.96
2014	11.58	85.90	-1.90	-7.86
2015	19.41	143.97	5.93	-1.93
2016	13.32	98.79	-0.16	-2.09
2017	13.39	99.33	-0.09	-2.18
2018	14.85	110.12	1.36	-0.82
2019	14.30	106.06	0.82	0.00

The annual totals for the average of the four Quadrangles for all years were plotted and are presented in Figure 6. The plot shows the significance of 2011 in the context of the entire record as the driest year.

Although 2011 was the driest year in the record (3.08 in), it must be placed in context of persistent periods of less than average precipitation as shown in Figure 7, the dry period around 2010 was about the same as the dry period in the early 2000s. However, a persistent dry period started in the 1950s and extended through the late 1970s when a series of wet years were observed. The driest period coincides with the period of lowest recorded groundwater elevations in the 1970s, which appear to be due to a combination of high groundwater pumping and persistent drought conditions.

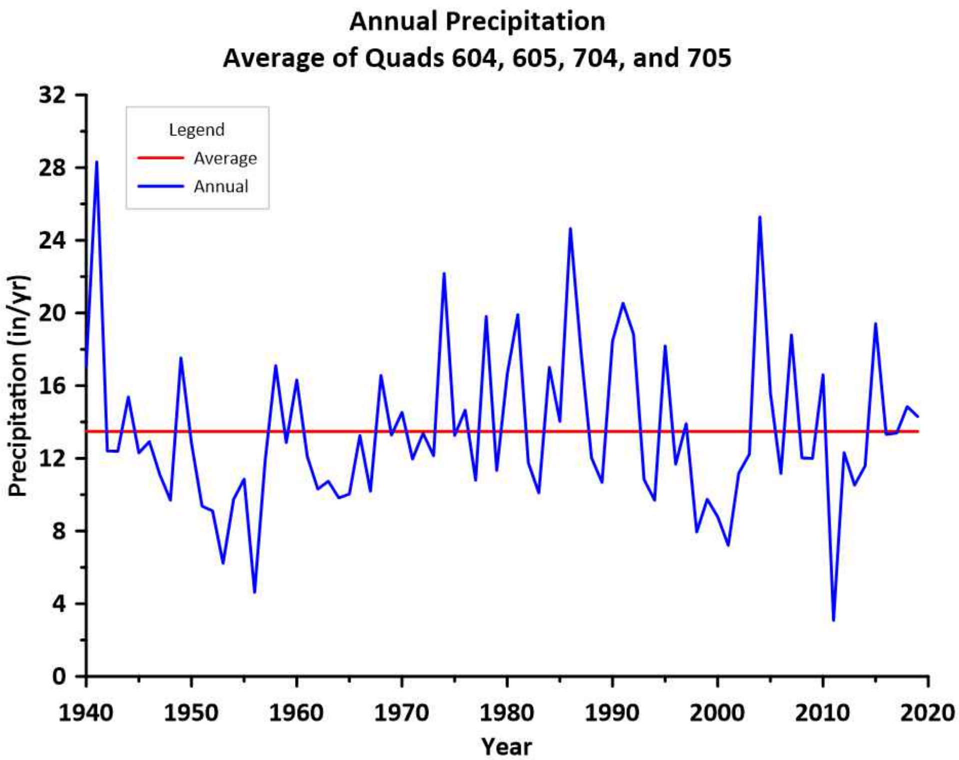


Figure 6. Annual Precipitation in Pecos County Area

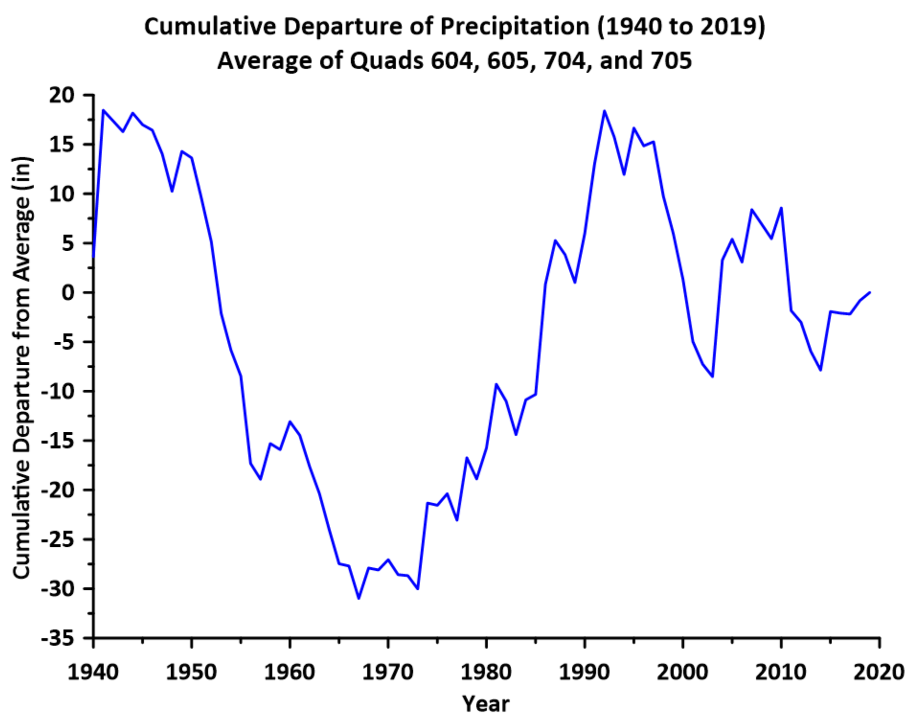


Figure 7. Cumulative Departure from Average Precipitation

Figure 8 presents a plot of annual precipitation vs. measured drawdown, along with the best-fit line based on a linear regression. Please note that the year is also shown on each data point. As expected, the higher the rainfall, the lower the drawdown. However, the plot shows considerable scatter. The 95% confidence of the linear regression is also shown.

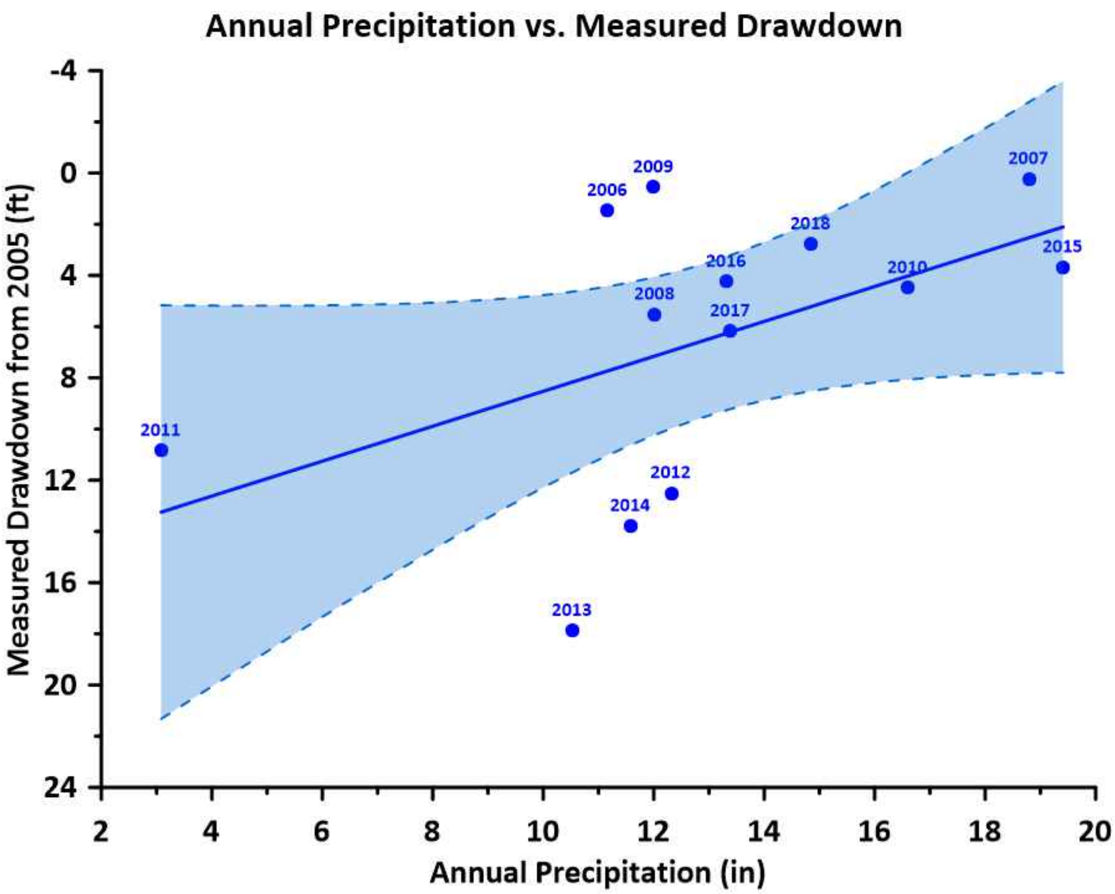


Figure 8. Annual Precipitation vs. Measured Drawdown

5.0 Discussion and Recommendations

The TWDB database was sampled to find wells with groundwater elevation measurements in Pecos County.

The analysis showed that the TWDB database did not have sufficient groundwater elevation data to complete a comparison with simulated drawdowns for the Capitan Reef Complex, Dockum, and Rustler aquifers. It is recommended that monitoring of wells completed in these aquifers be identified and data collection from these wells improved, or the aquifers be classified as not relevant for purposes of joint planning. Such a classification would result in no desired future condition for that aquifer in Pecos County and would result in no modeled available groundwater calculation by the Texas Water Development Board. The Regional Planning Group (Region F) would be responsible for establishing groundwater availability if an aquifer is classified as not relevant for purposes of joint planning.

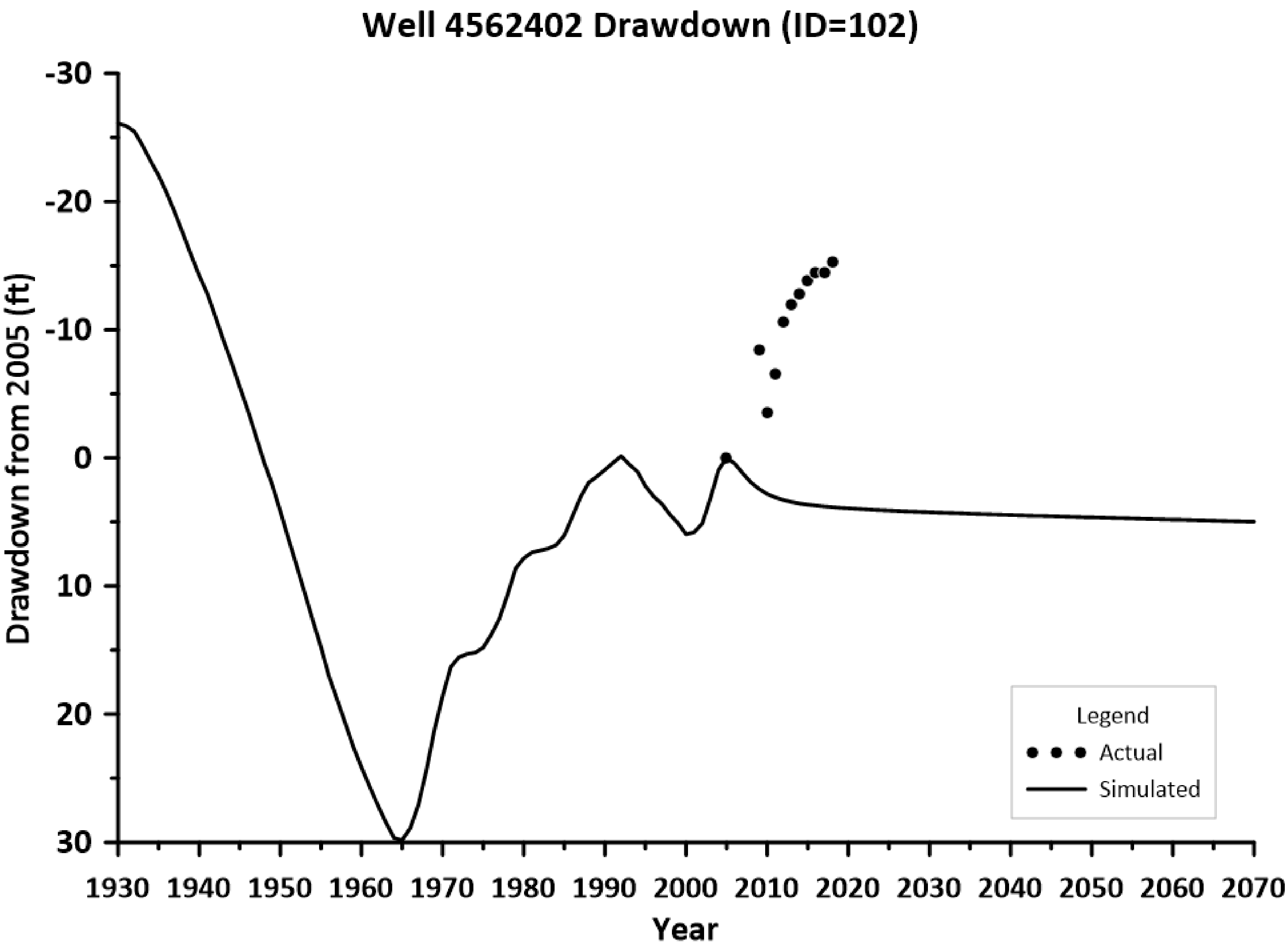
The analysis showed that the TWDB database had sufficient groundwater elevation data to complete a comparison with simulated drawdown for the Edwards-Trinity (Plateau) and Pecos Valley aquifers. The database was sampled to find wells in Pecos County with groundwater elevation measurements in 2005 to compare with simulated drawdowns from the GAM simulation that was the basis for the desired future condition.

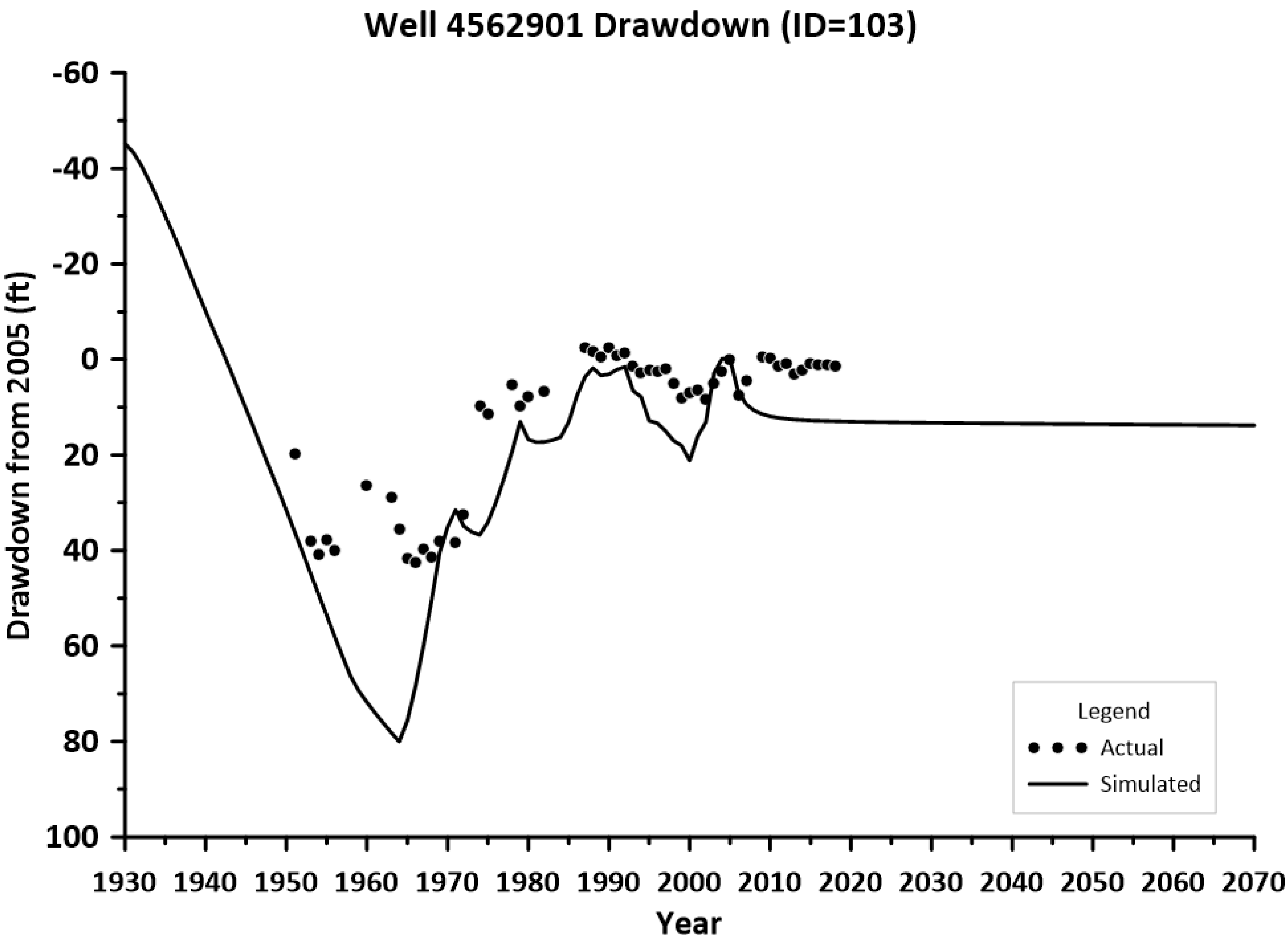
The comparison of measured drawdowns with simulated drawdowns showed that, in general, when annual precipitation is higher than average, measured drawdown is less than simulated drawdown and when annual precipitation is less than average, measured drawdown is higher than simulated drawdown. In general, lower than average precipitation correlates with lower than average recharge and higher than average pumping. However, this relationship is complex and other factors are important. This analysis shows a weak correlation between annual precipitation and measured drawdown, but the analysis also shows that the measured drawdowns are consistent with the simulation that was the basis for the desired future condition.

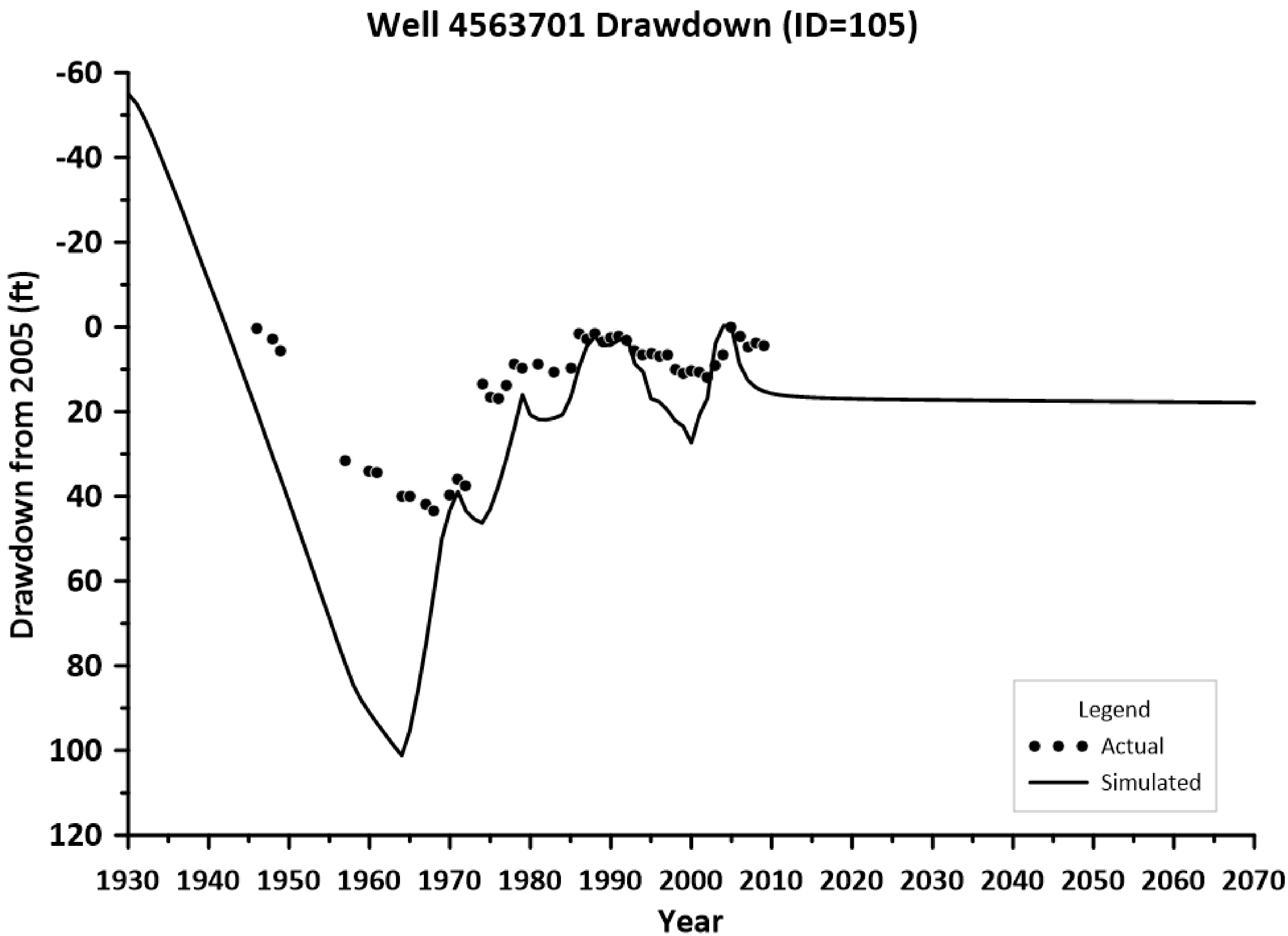
Based on this analysis, it is recommended that the approach used in this analysis should be incorporated into the Middle Pecos GCD management plan to specifically address Goal 8. The current plan also has other elements related to monitoring that are valid and important for other specific groundwater management activities within the District. The comparison of measured data with the desired future condition is a specific activity related to advancing the planning goals of Groundwater Management Areas 3 and 7 and are not necessarily the same as the management activities of other monitoring.

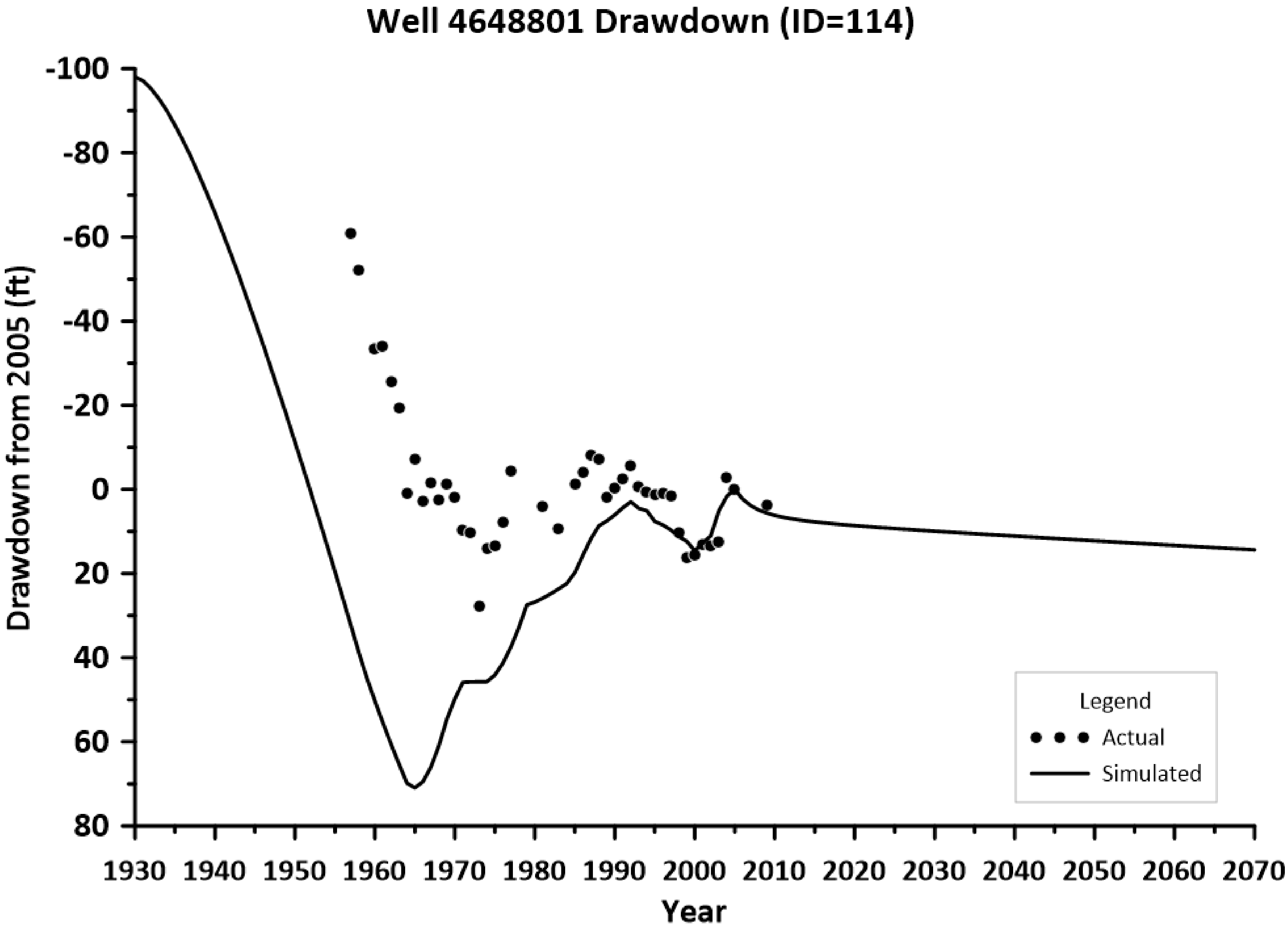
Appendix A

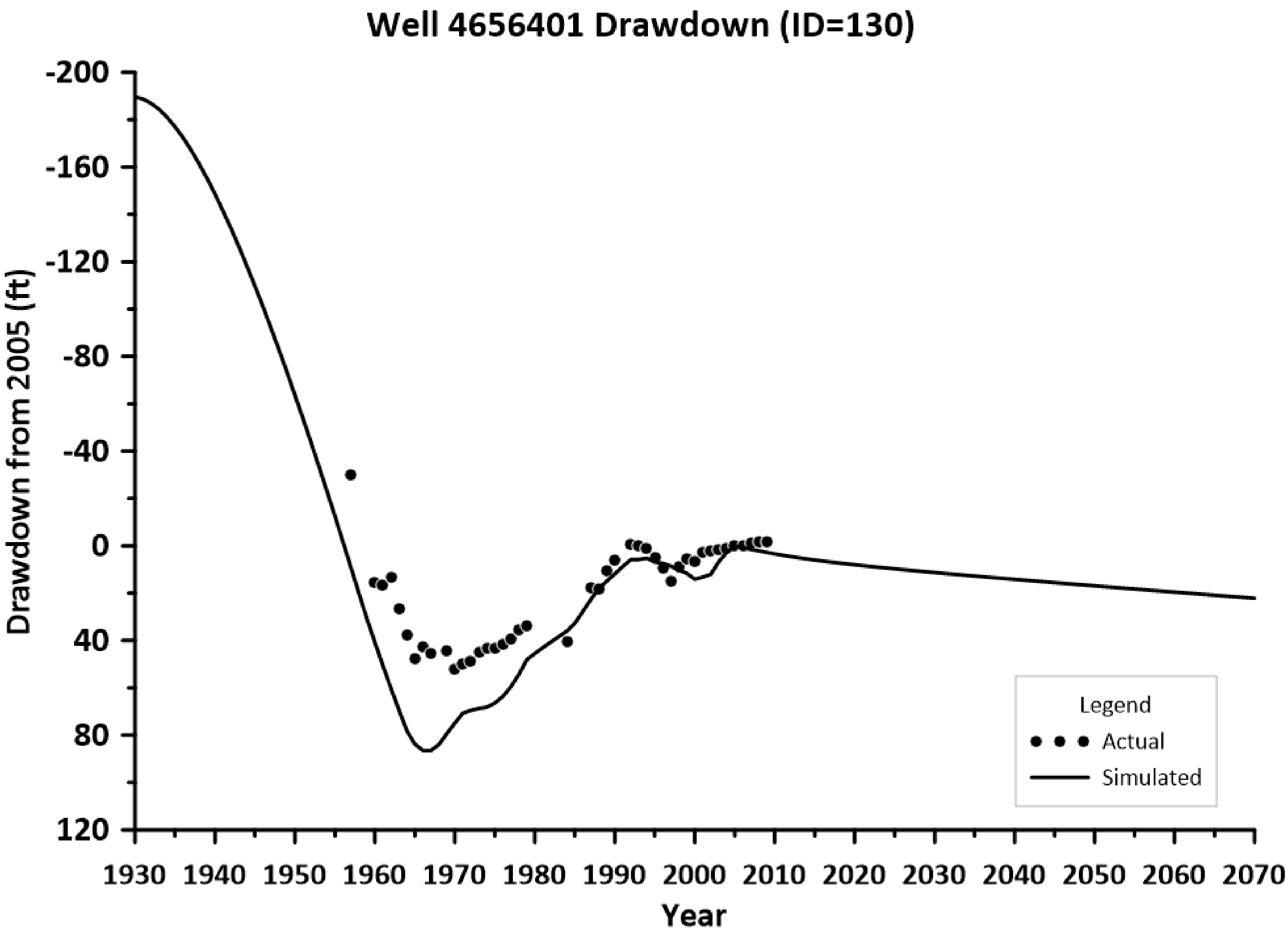
Hydrographs for 28 Monitoring Wells


Well 4562402 Drawdown (ID=102)
Drawdown from 2005 (ft)
-30
-20
-10
0
10
20
30
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
2060
2070
Year
Legend
Actual
Simulated

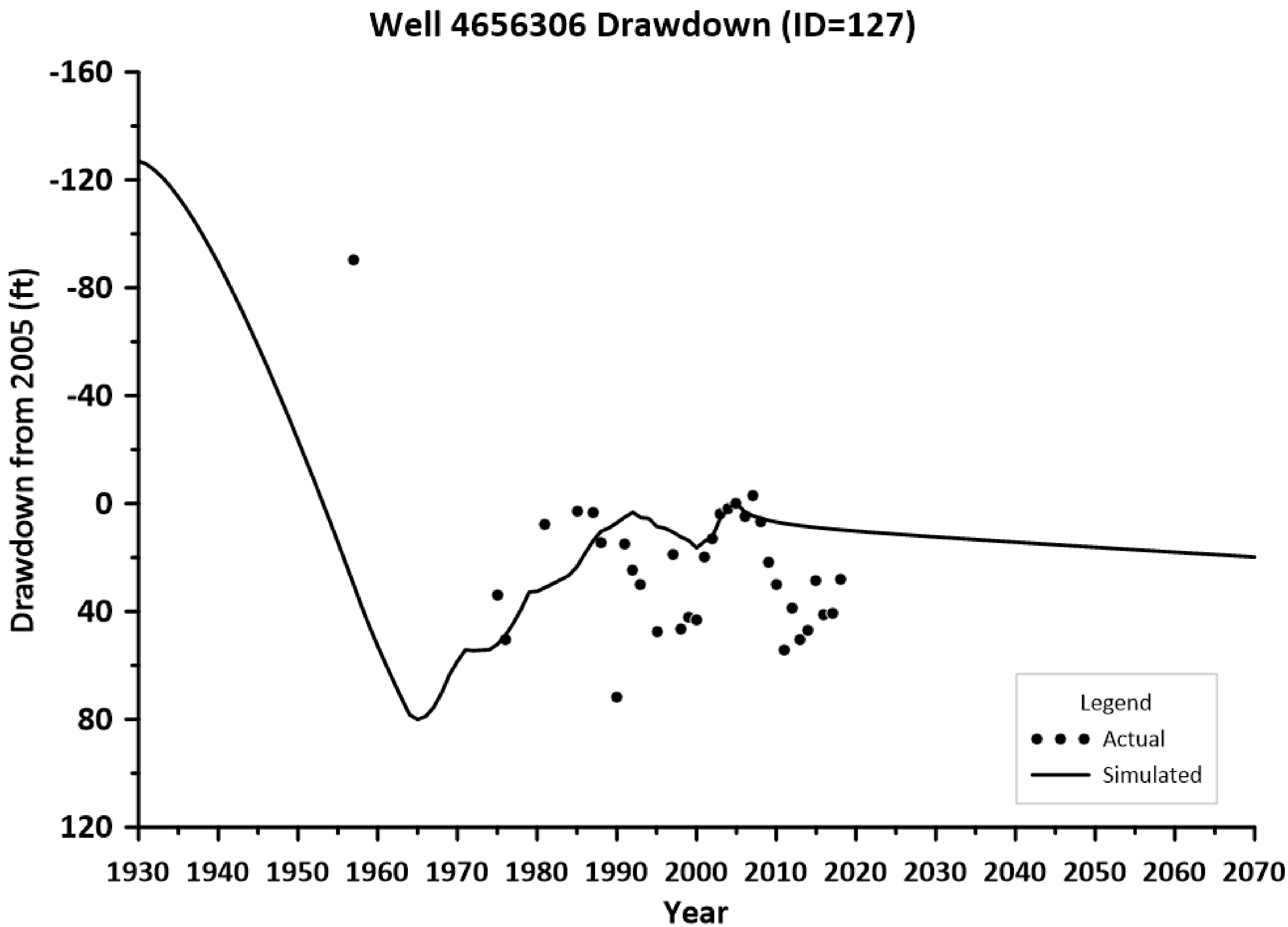

Well 4562901 Drawdown (ID=103)
Drawdown from 2005 (ft)
-60
-40
-20
0
20
40
60
80
100
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
2060
2070
Year
Legend
Actual
Simulated


Well 4563701 Drawdown (ID=105)
Drawdown from 2005 (ft)
-60
-40
-20
0
20
40
60
80
100
120
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
2060
2070
Year
Legend
Actual
Simulated

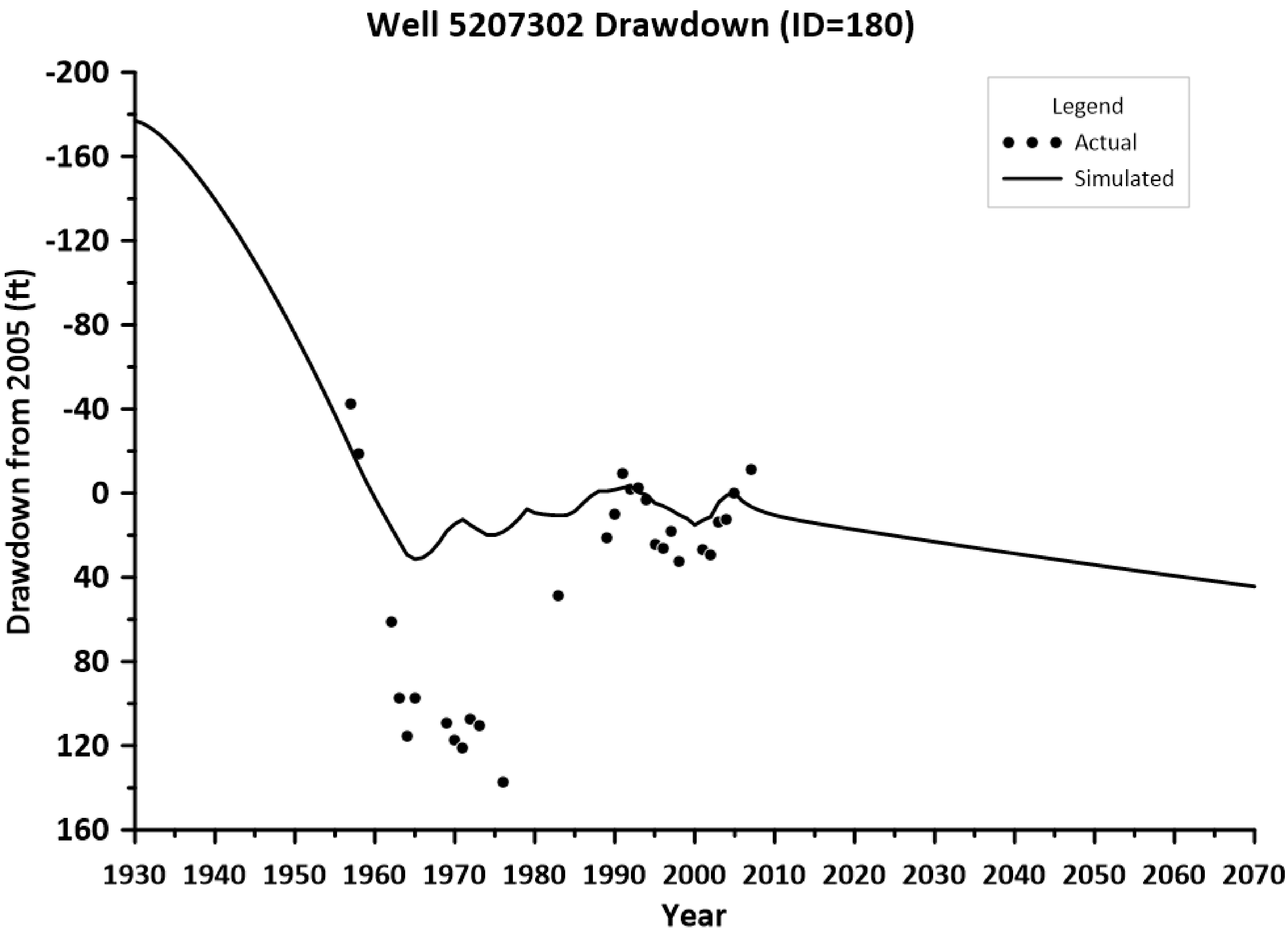

Well 4648801 Drawdown (ID=114)
Drawdown from 2005 (ft)
-100
-80
-60
-40
-20
0
20
40
60
80
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
2060
2070
Year
Legend
Actual
Simulated

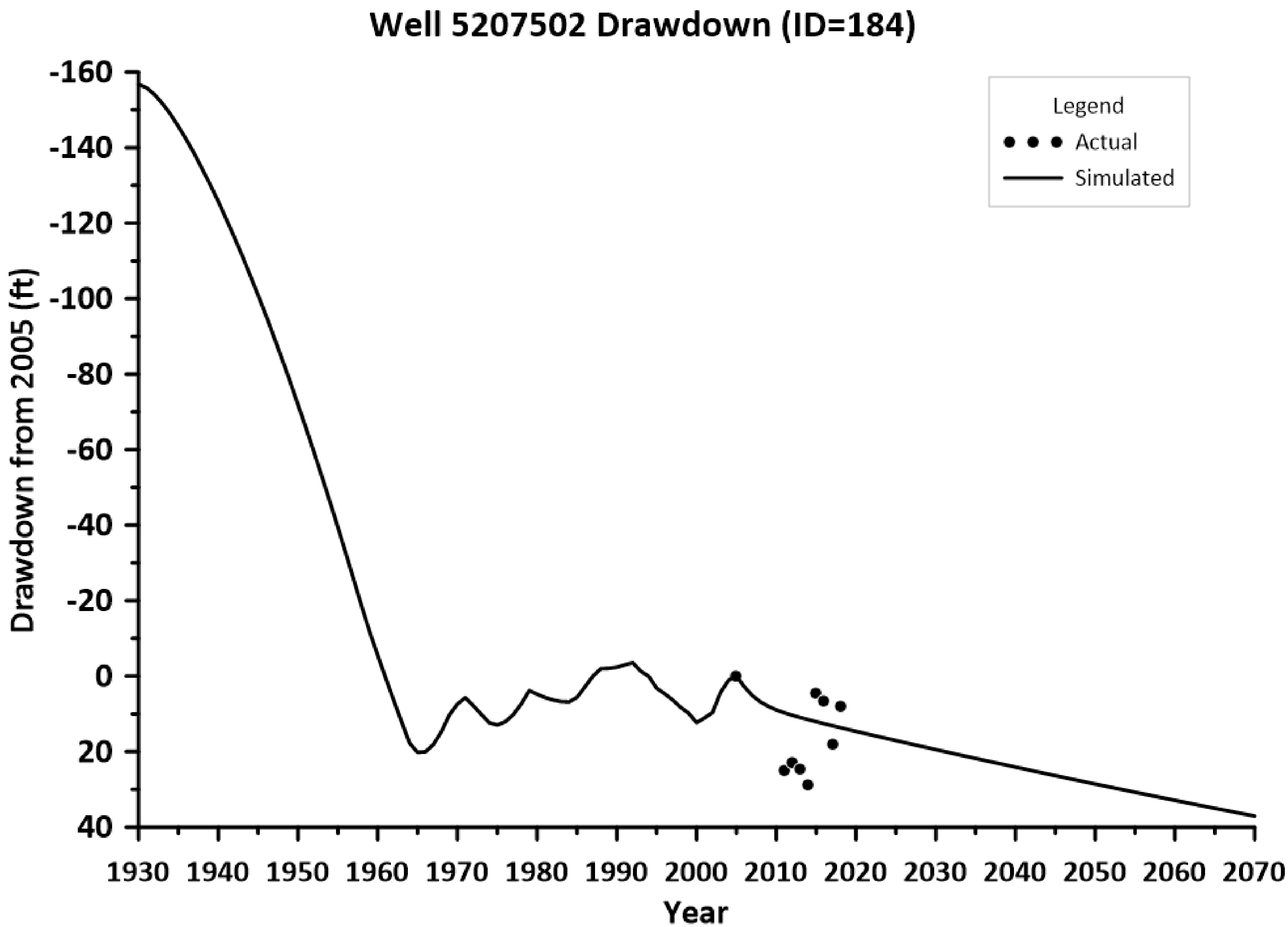


Well 4656401 Drawdown (ID=130)
Drawdown from 2005 (ft)
-200
-160
-120
-80
-40
0
40
80
120
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
2060
2070
Year
Legend
Actual
Simulated



Well 4656306 Drawdown (ID=127)
Drawdown from 2005 (ft)
-160
-120
-80
-40
0
40
80
120
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
2060
2070
Year
Legend
Actual
Simulated


Well 5207302 Drawdown (ID=180)
Legend
Actual
Simulated
Drawdown from 2005 (ft)
-200
-160
-120
-80
-40
0
40
80
120
160
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
2060
2070
Year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Drawdown from 2005 (ft)
-160
-140
-120
-100
-80
-60
-40
-20
0
20
40
1930
1940
1950
1960
1970
1980
1990
2000
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2020
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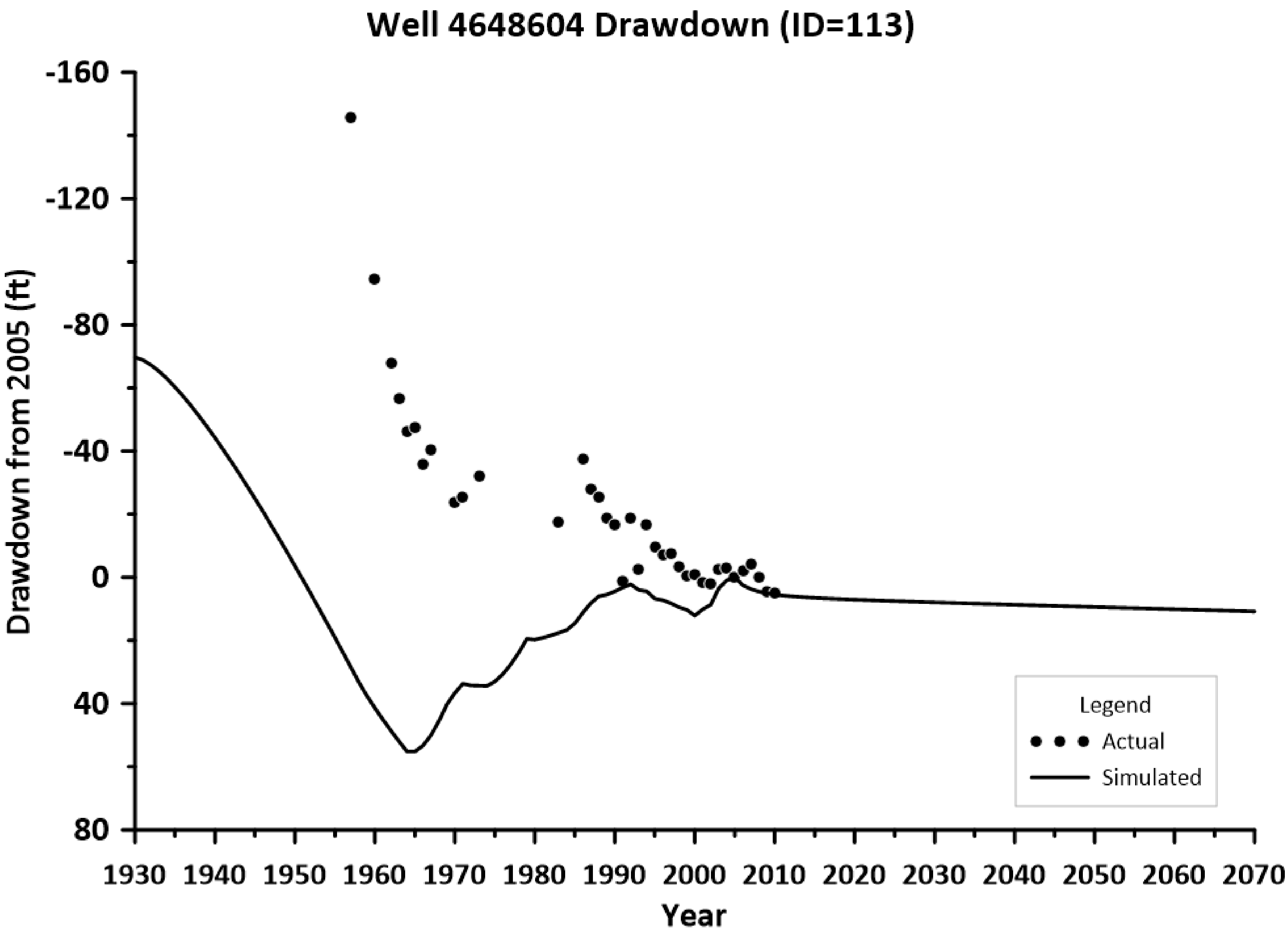
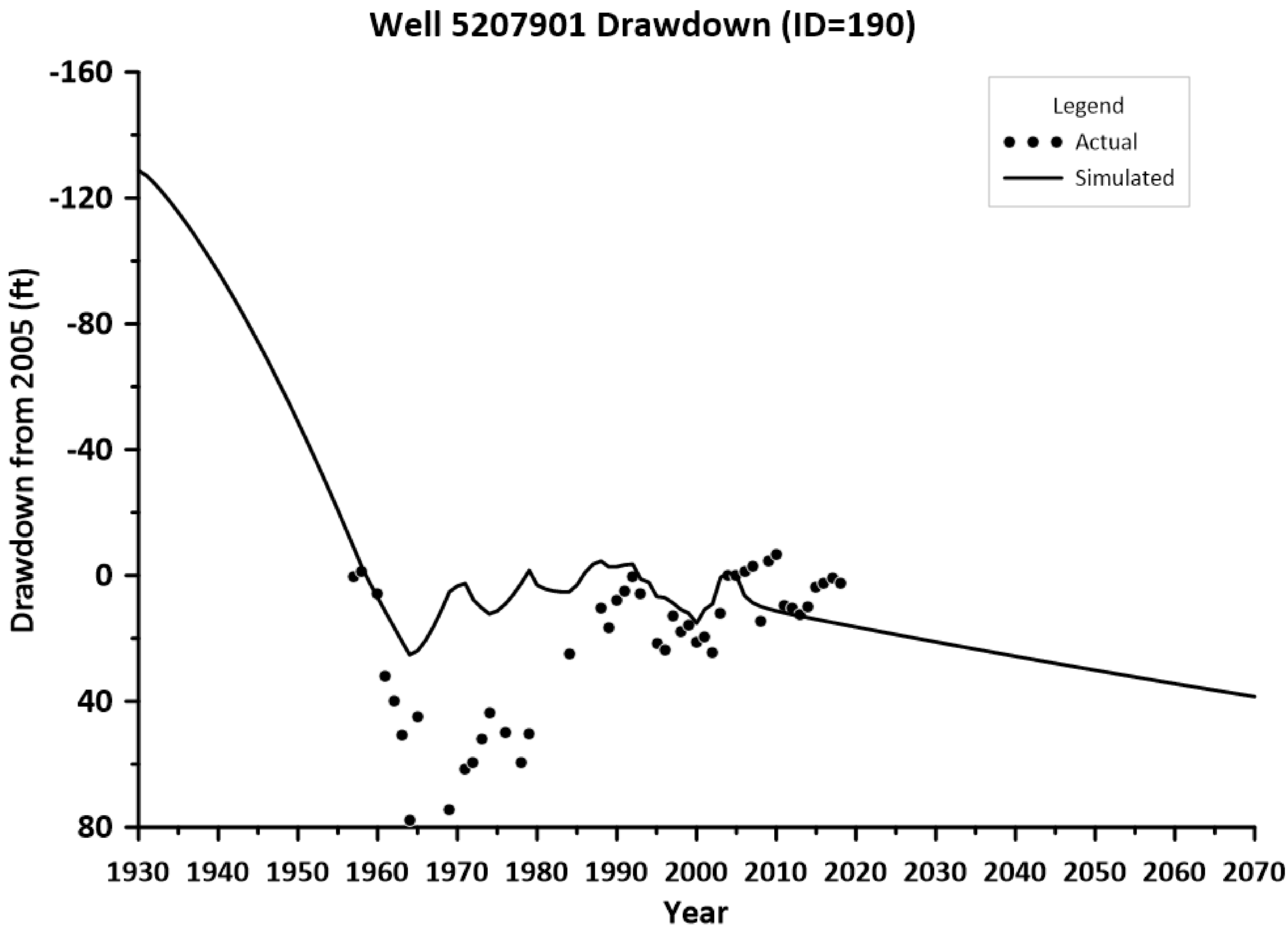
2040
2050
2060
2070
Year
Legend
Actual
Simulated


Well 4648604 Drawdown (ID=113)
-160
-120
-80
-40
0
40
80
Drawdown from 2005 (ft)
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
2060
2070
Year
Legend
Actual
Simulated



Well 5207901 Drawdown (ID=190)
Legend
Actual
Simulated
Drawdown from 2005 (ft)
-160
-120
-80
-40
0
40
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1960
1970
1980
1990
2000
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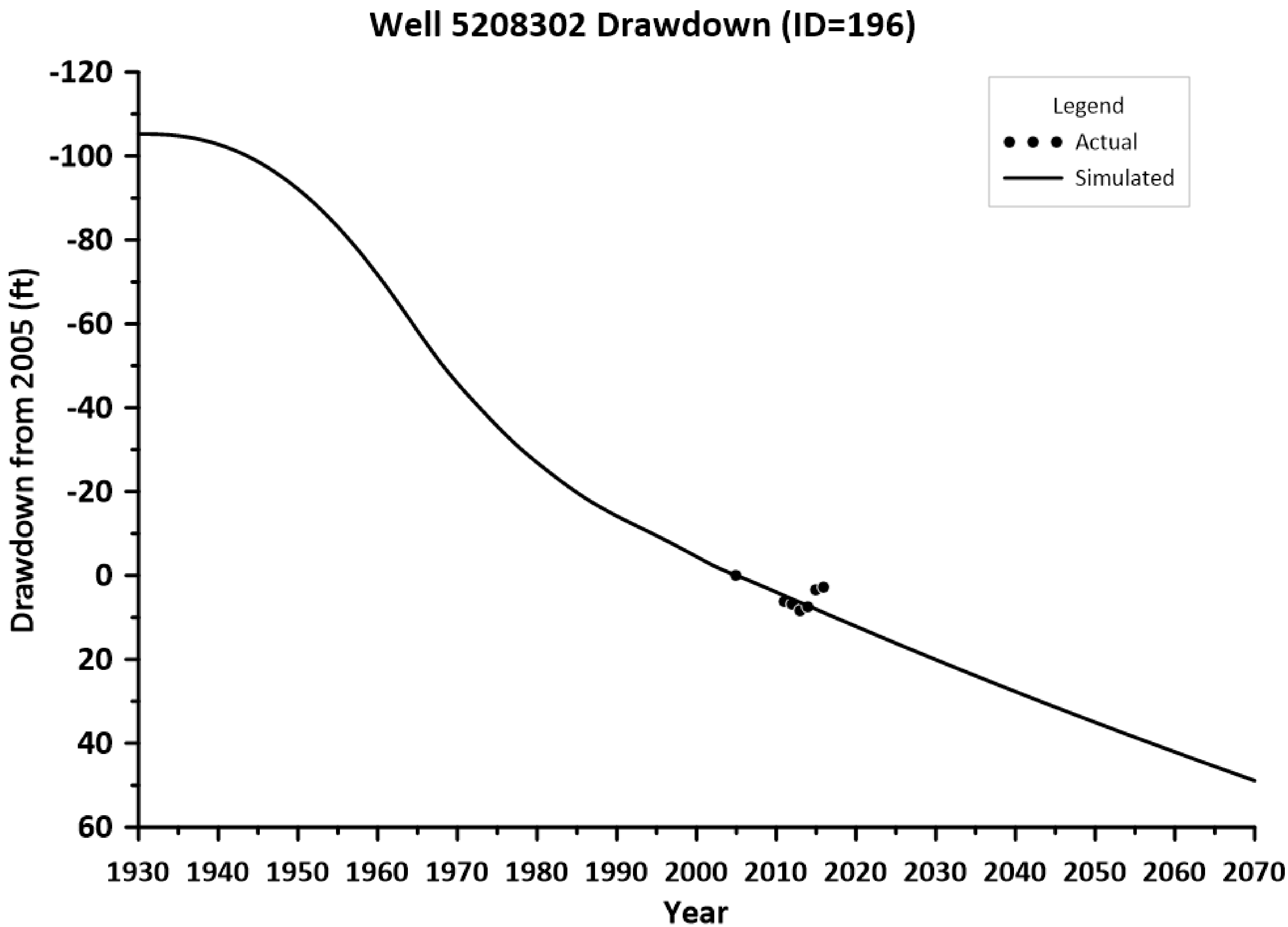
2020
2030
2040
2050
2060
2070
Year



Well 5208302 Drawdown (ID=196)
Legend
Actual
Simulated
Drawdown from 2005 (ft)
-120
-100
-80
-60
-40
-20
0
20
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1940
1950
1960
1970
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2000
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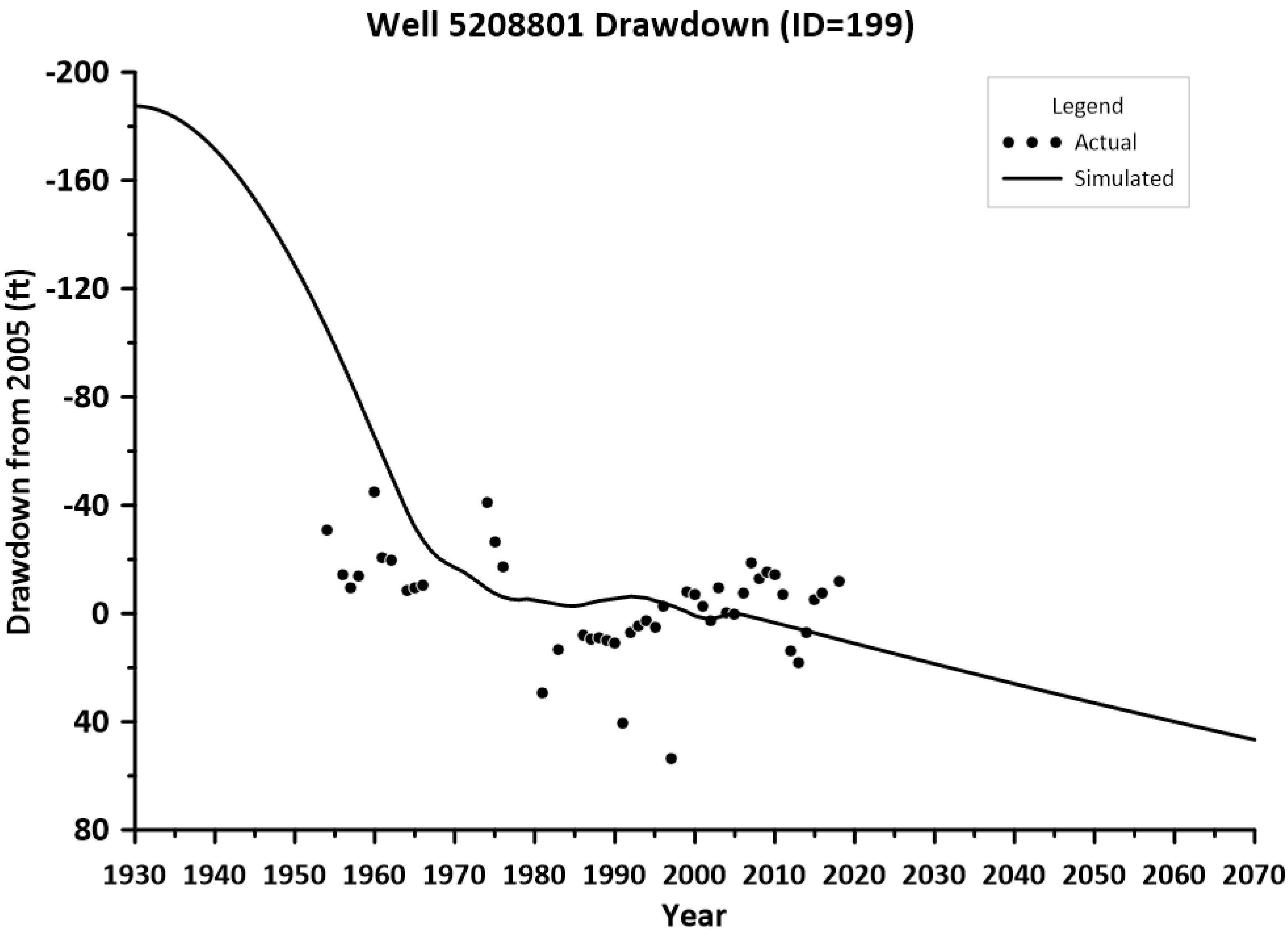
Year



Well 5208801 Drawdown (ID=199)
Legend
Actual
Simulated
Drawdown from 2005 (ft)
-200
-160
-120
-80
-40
0
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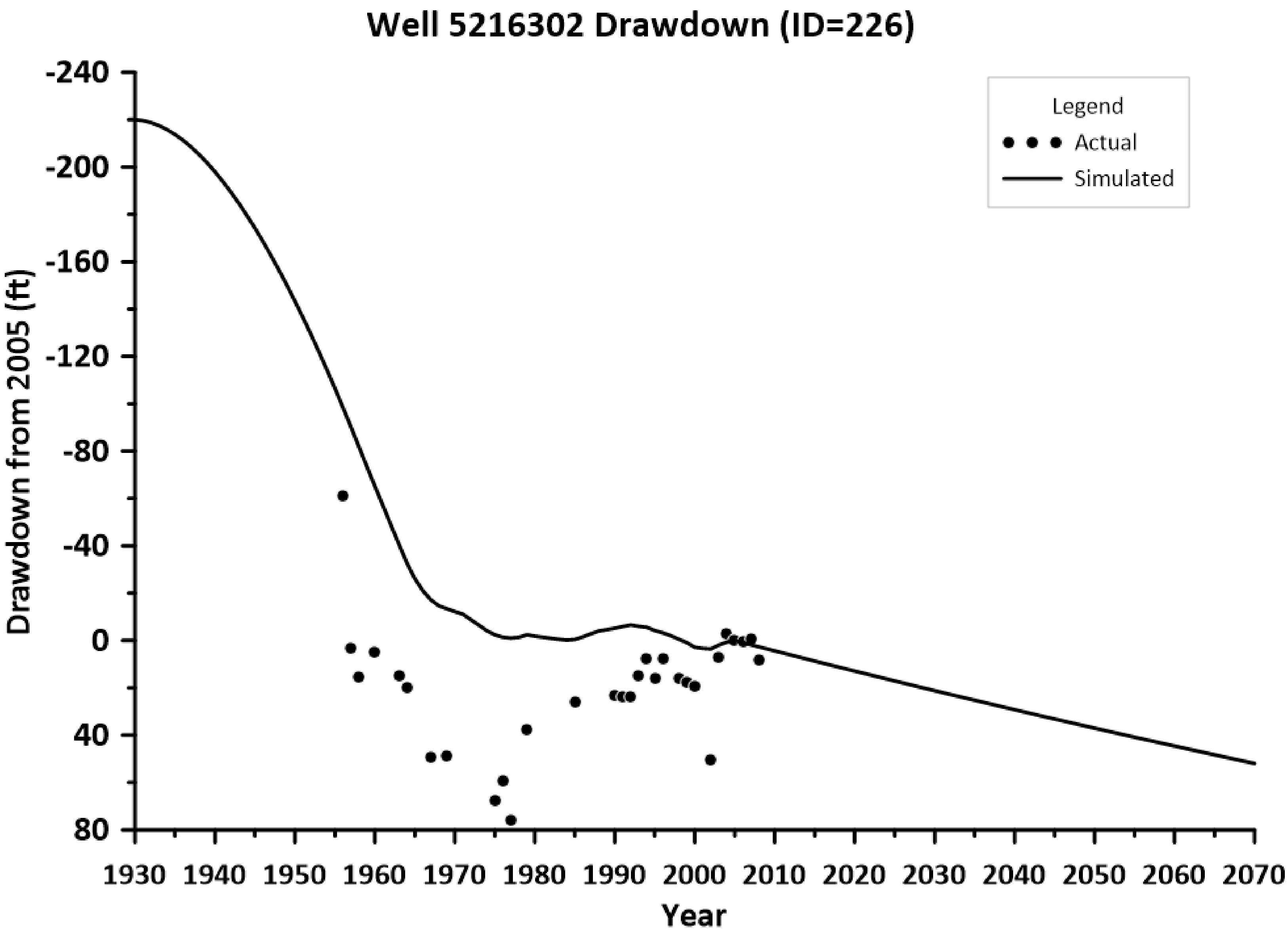
Year


Well 5216302 Drawdown (ID=226)
Legend
Actual
Simulated
Drawdown from 2005 (ft)
-240
-200
-160
-120
-80
-40
0
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1960
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1980
1990
2000
2010
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2030
2040
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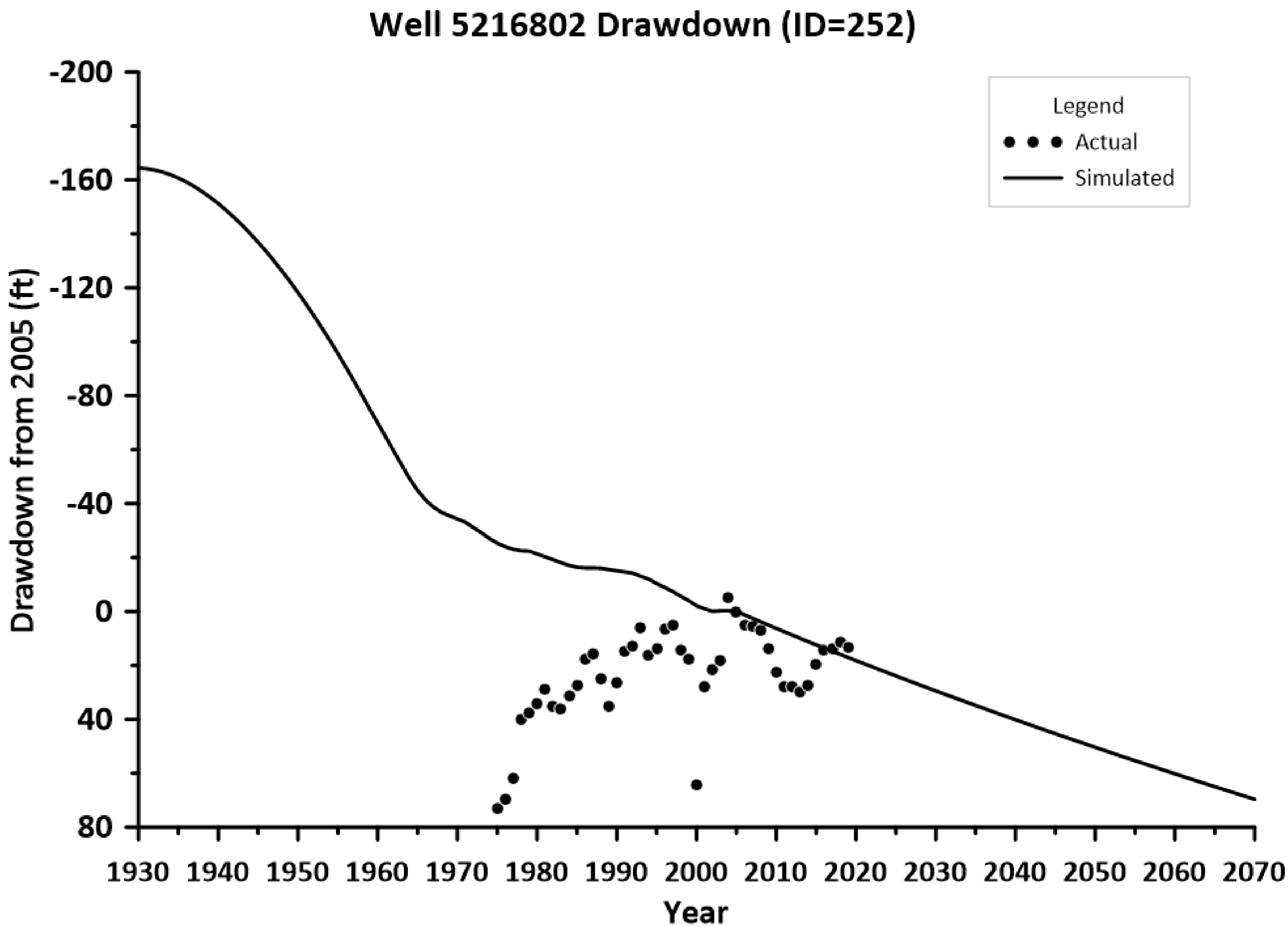
2070
Year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Legend
Actual
Simulated
Drawdown from 2005 (ft)
-200
-160
-120
-80
-40
0
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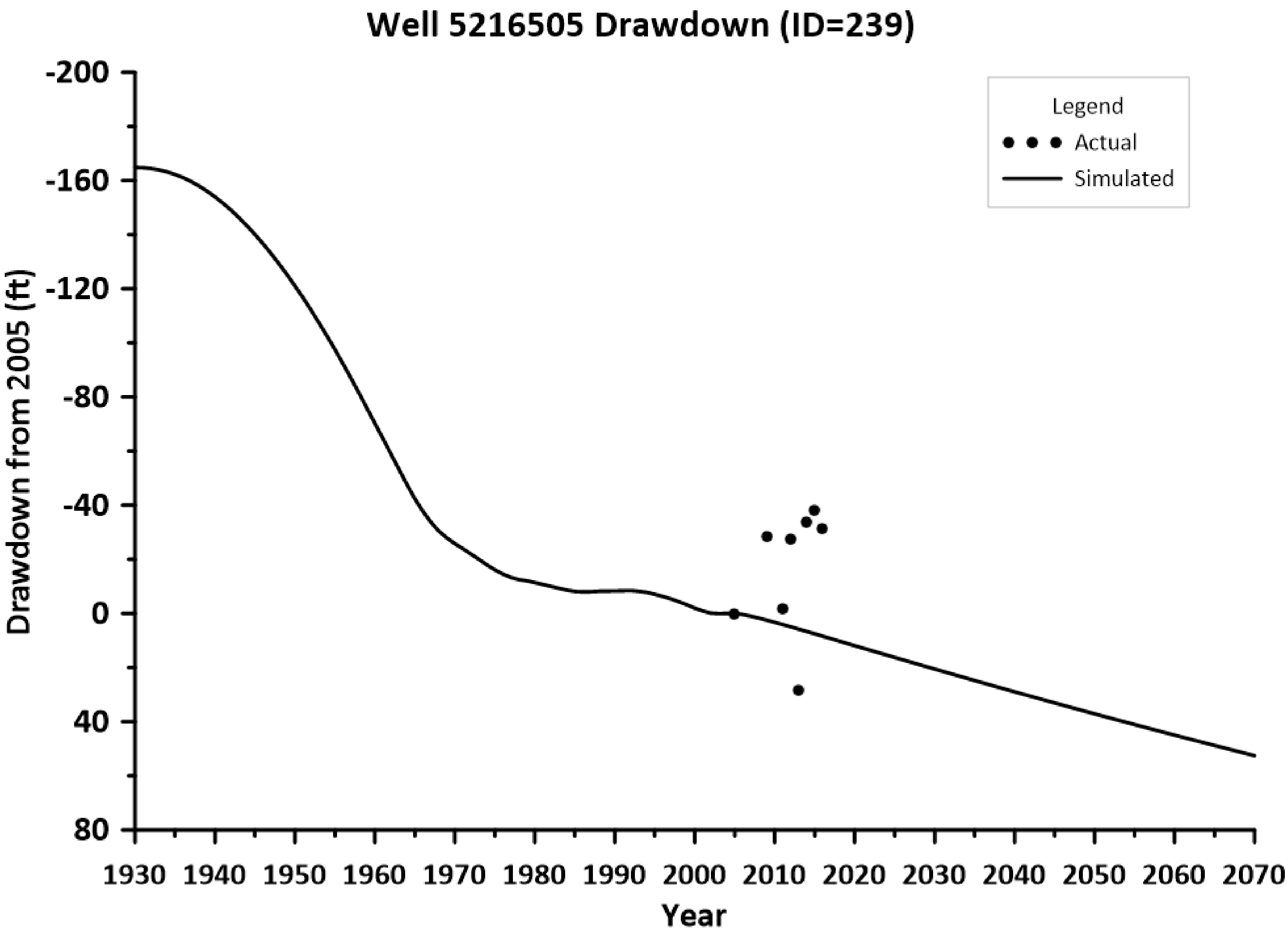
2050
2060
2070
Year



Well 5216505 Drawdown (ID=239)
Legend
Actual
Simulated
Drawdown from 2005 (ft)
-200
-160
-120
-80
-40
0
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1970
1980
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2030
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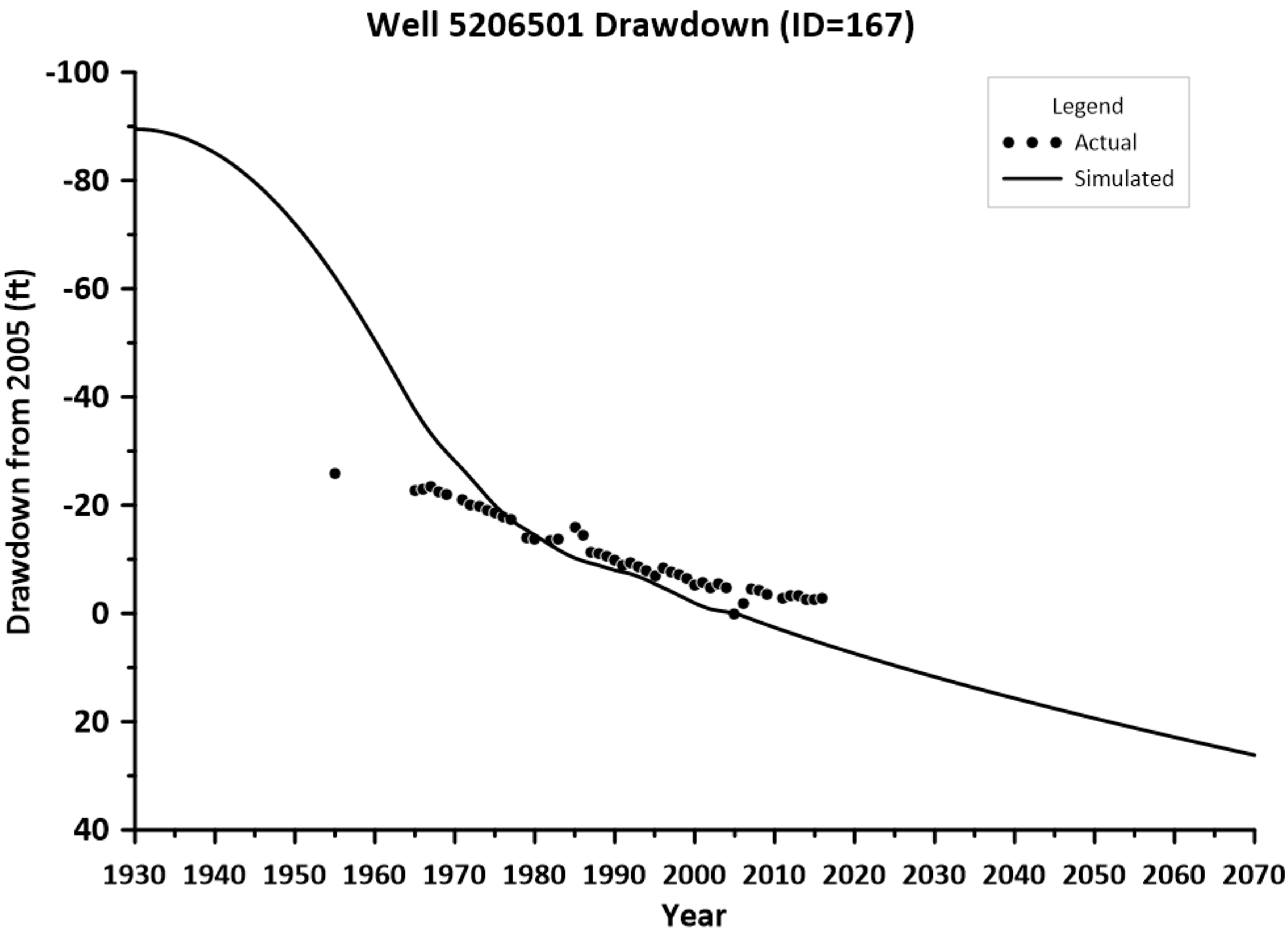
2050
2060
2070
Year



Well 5206501 Drawdown (ID=167)
Legend
Actual
Simulated
Drawdown from 2005 (ft)
-100
-80
-60
-40
-20
0
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40
1930
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1980
1990
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2010
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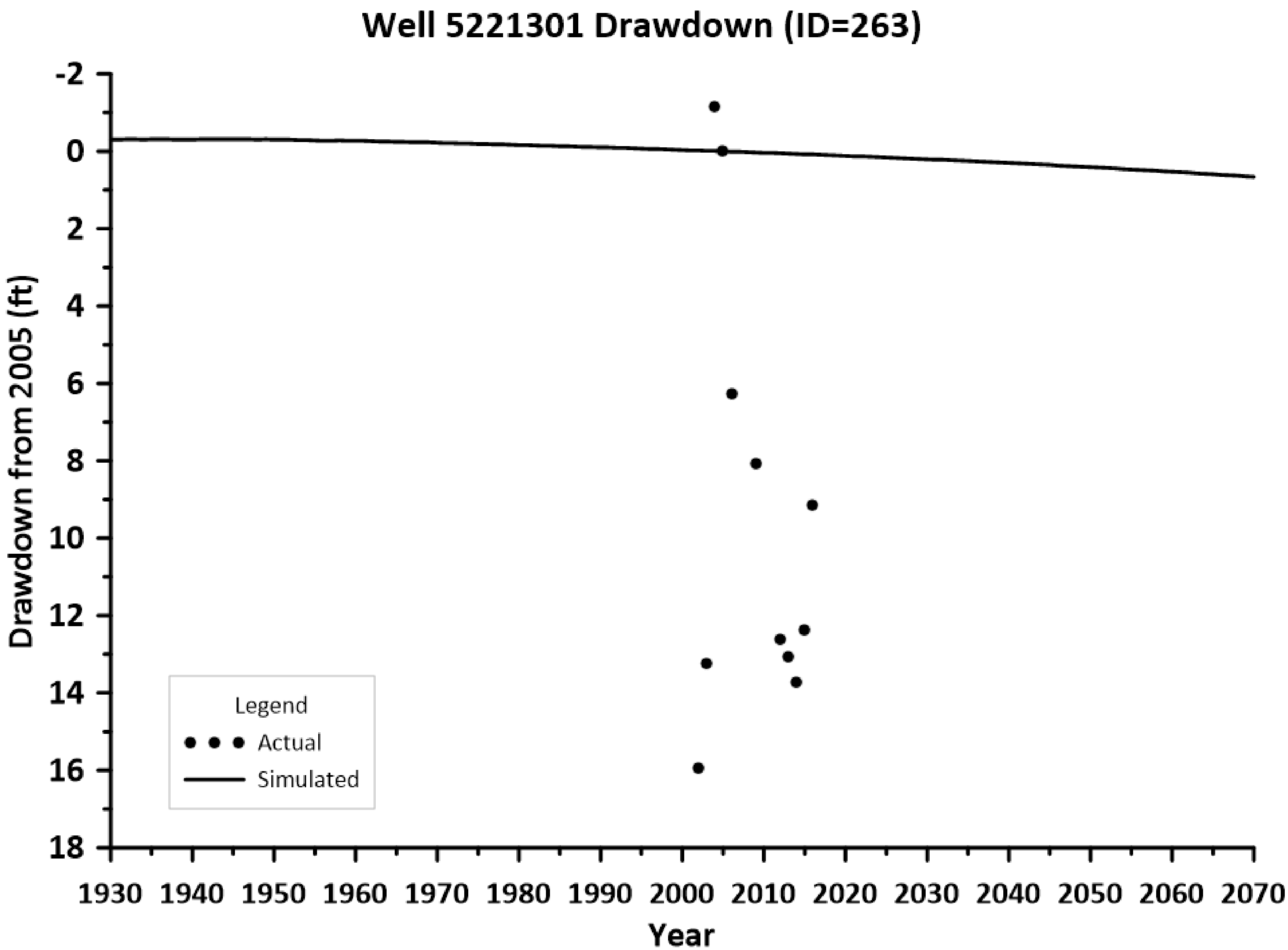
2030
2040
2050
2060
2070
Year


Well 5221301 Drawdown (ID=263)
Drawdown from 2005 (ft)
-2
0
2
4
6
8
10
12
14
16
18
Legend
Actual
Simulated
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
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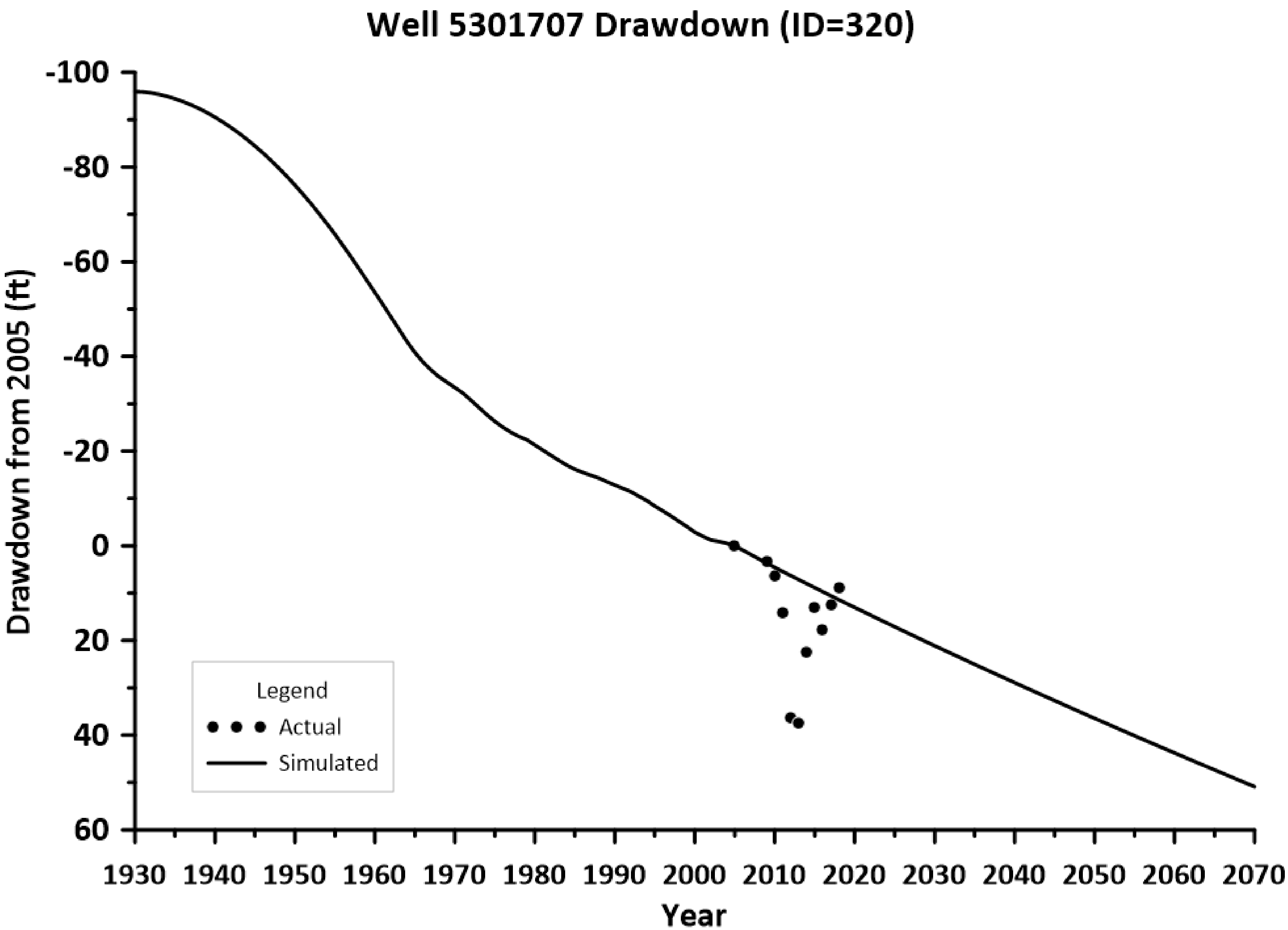
2060
2070
Year


Well 5301707 Drawdown (ID=320)
Drawdown from 2005 (ft)
-100
-80
-60
-40
-20
0
20
40
60
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
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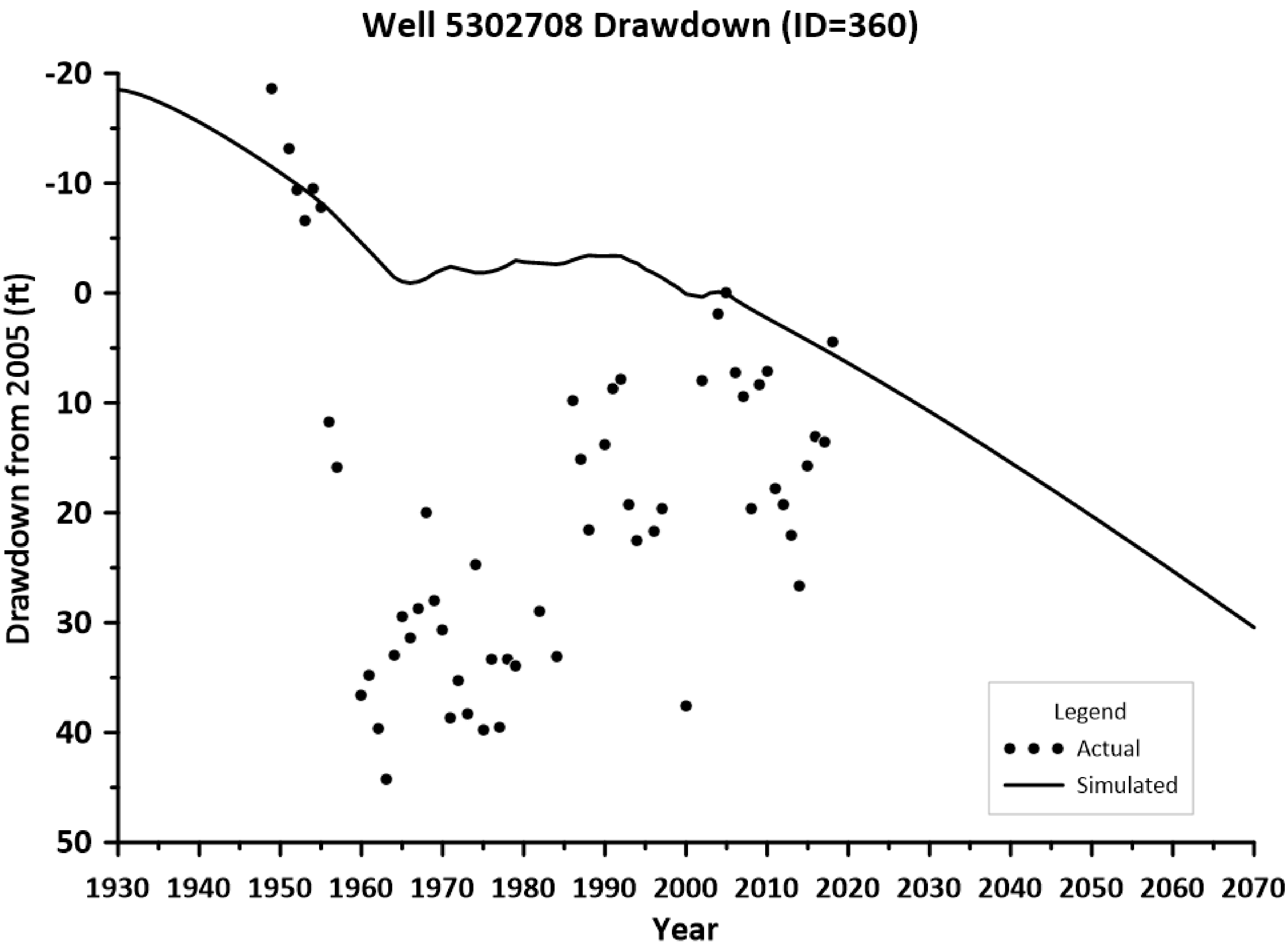
2060
2070
Year
Legend
Actual
Simulated


Well 5302708 Drawdown (ID=360)
Drawdown from 2005 (ft)
-20
-10
0
10
20
30
40
50
1930
1940
1950
1960
1970
1980
1990
2000
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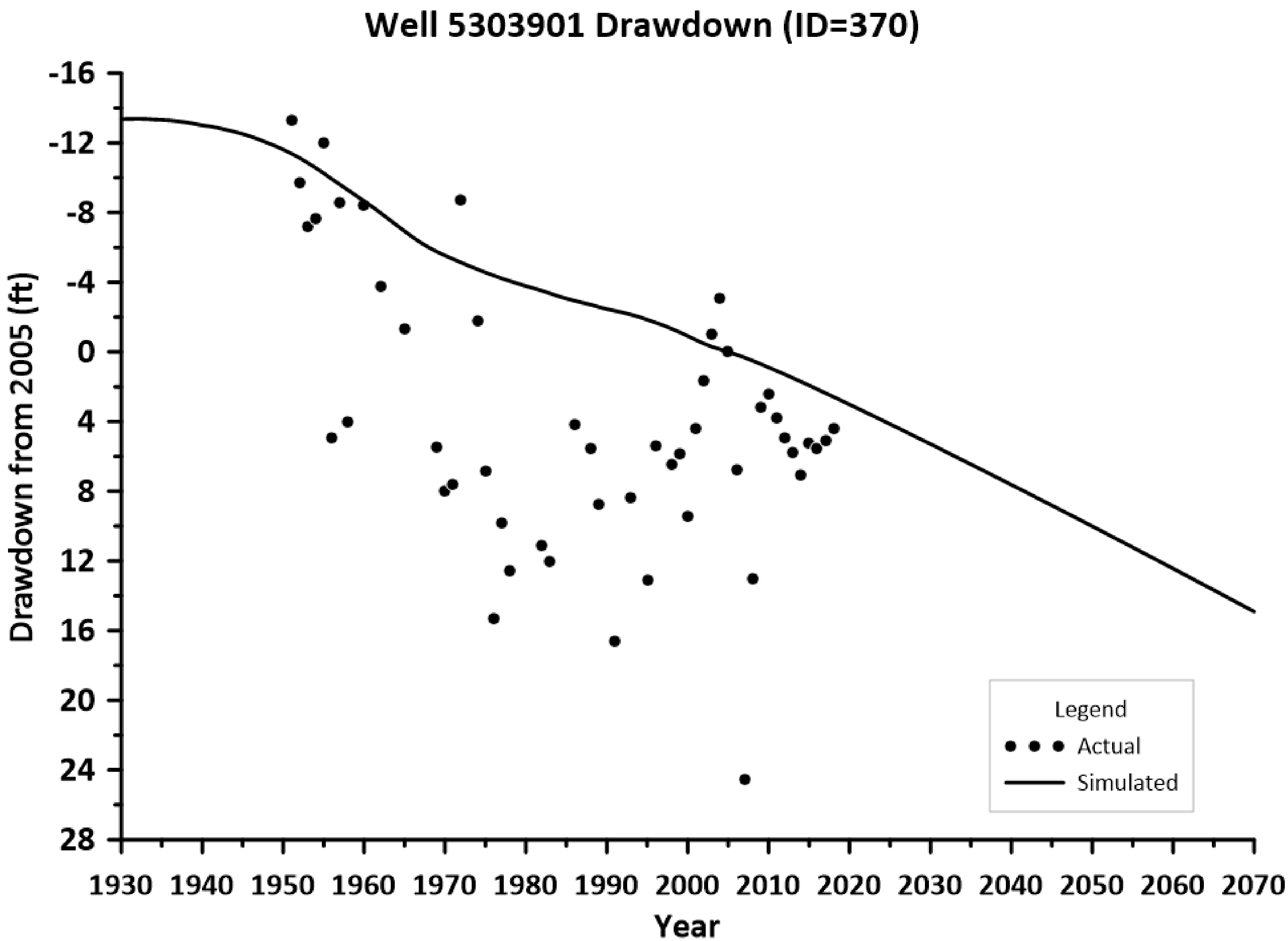
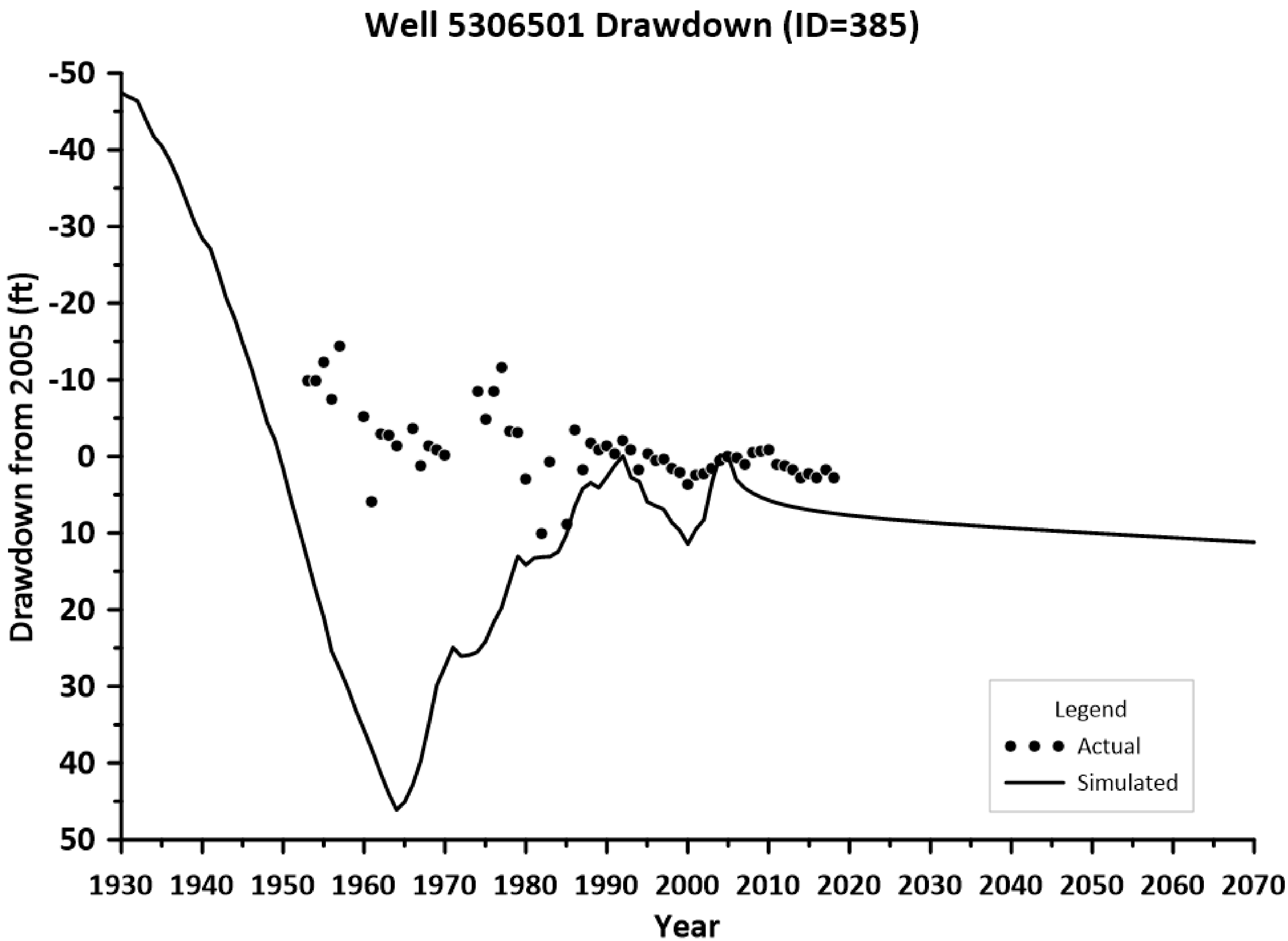
2060
2070
Year
Legend
Actual
Simulated



Well 5303901 Drawdown (ID=370)
Drawdown from 2005 (ft)
-16
-12
-8
-4
0
4
8
12
16
20
24
28
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
2060
2070
Year
Legend
Actual
Simulated



Well 5306501 Drawdown (ID=385)
Drawdown from 2005 (ft)
-50
-40
-30
-20
-10
0
10
20
30
40
50
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
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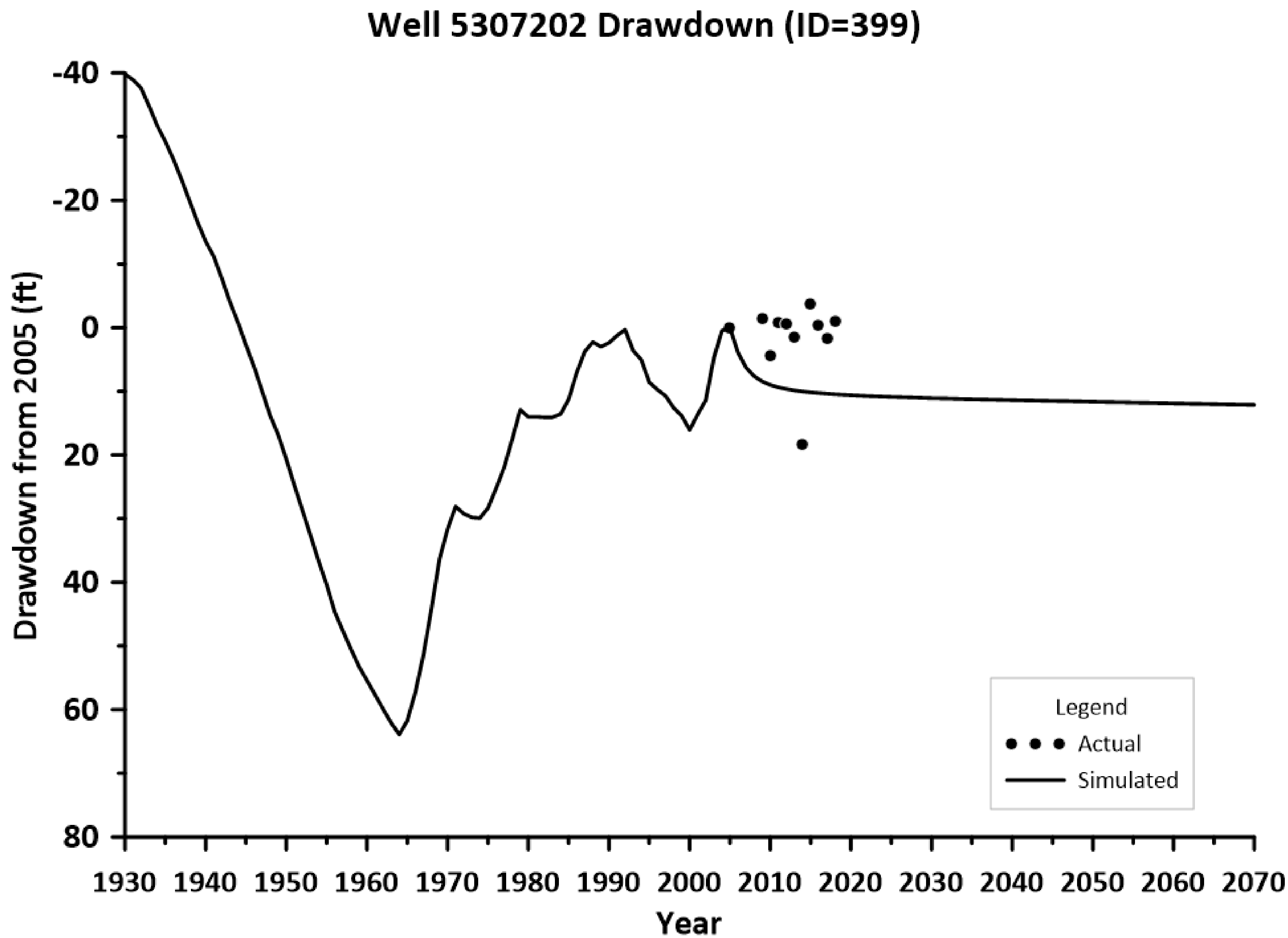
2060
2070
Year
Legend
Actual
Simulated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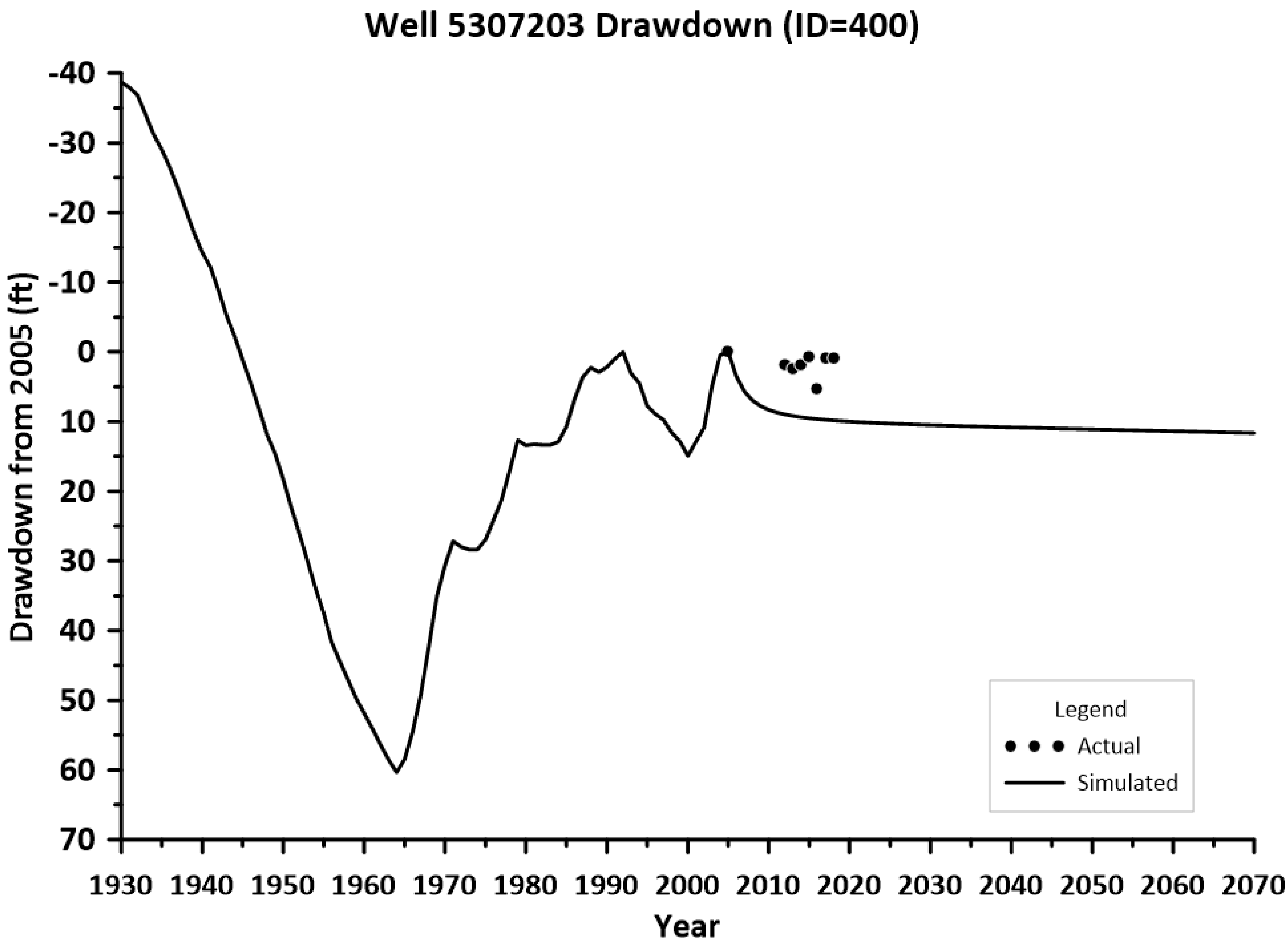
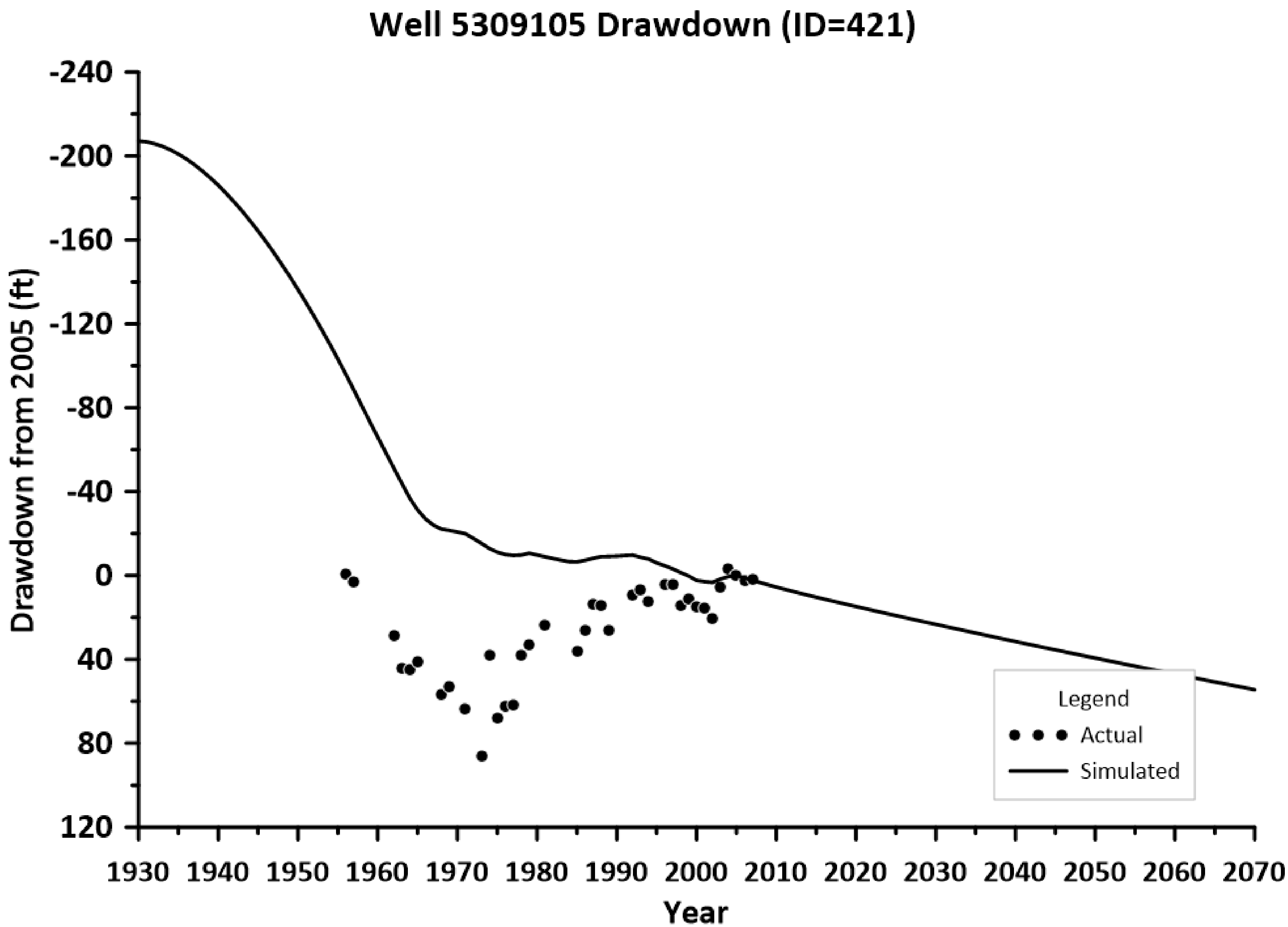
-40
-20
0
20
40
60
80
Drawdown from 2005 (ft)
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
2060
2070
Year
Legend
Actual
Simulated



Well 5307203 Drawdown (ID=400)
-40
-30
-20
-10
0
10
20
30
40
50
60
70
Drawdown from 2005 (ft)
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
2060
2070
Year
Legend
Actual
Simulated



Well 5309105 Drawdown (ID=421)
Drawdown from 2005 (ft)
-240
-200
-160
-120
-80
-40
0
40
80
120
1930
1940
1950
1960
1970
1980
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2030
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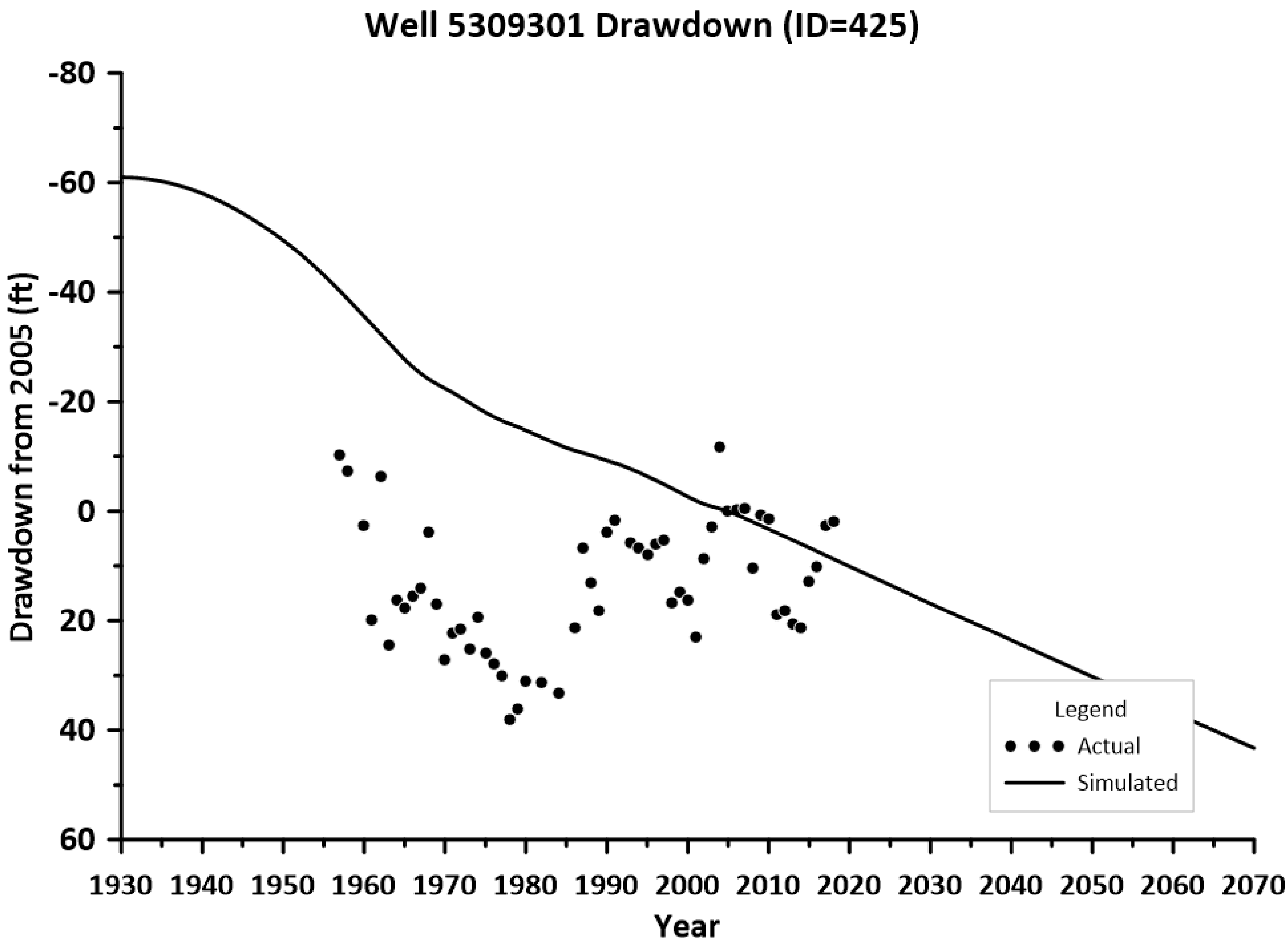
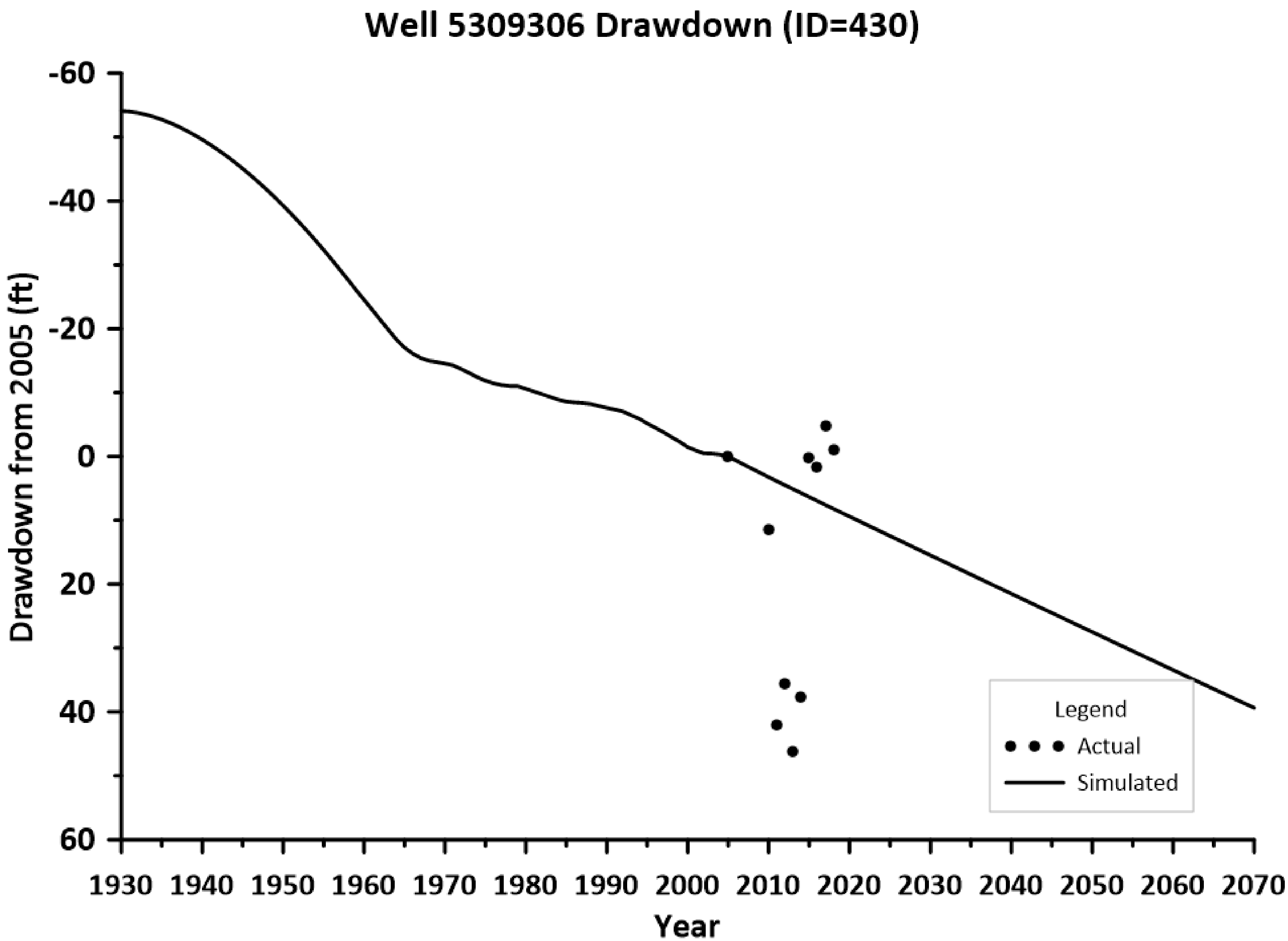
2060
2070
Year
Legend
Actual
Simulated



Well 5309301 Drawdown (ID=425)
Drawdown from 2005 (ft)
-80
-60
-40
-20
0
20
40
60
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
2060
2070
Year
Legend
Actual
Simulated


Well 5309306 Drawdown (ID=430)
-60
-40
-20
0
20
40
60
Drawdown from 2005 (ft)
1930
1940
1950
1960
1970
1980
1990
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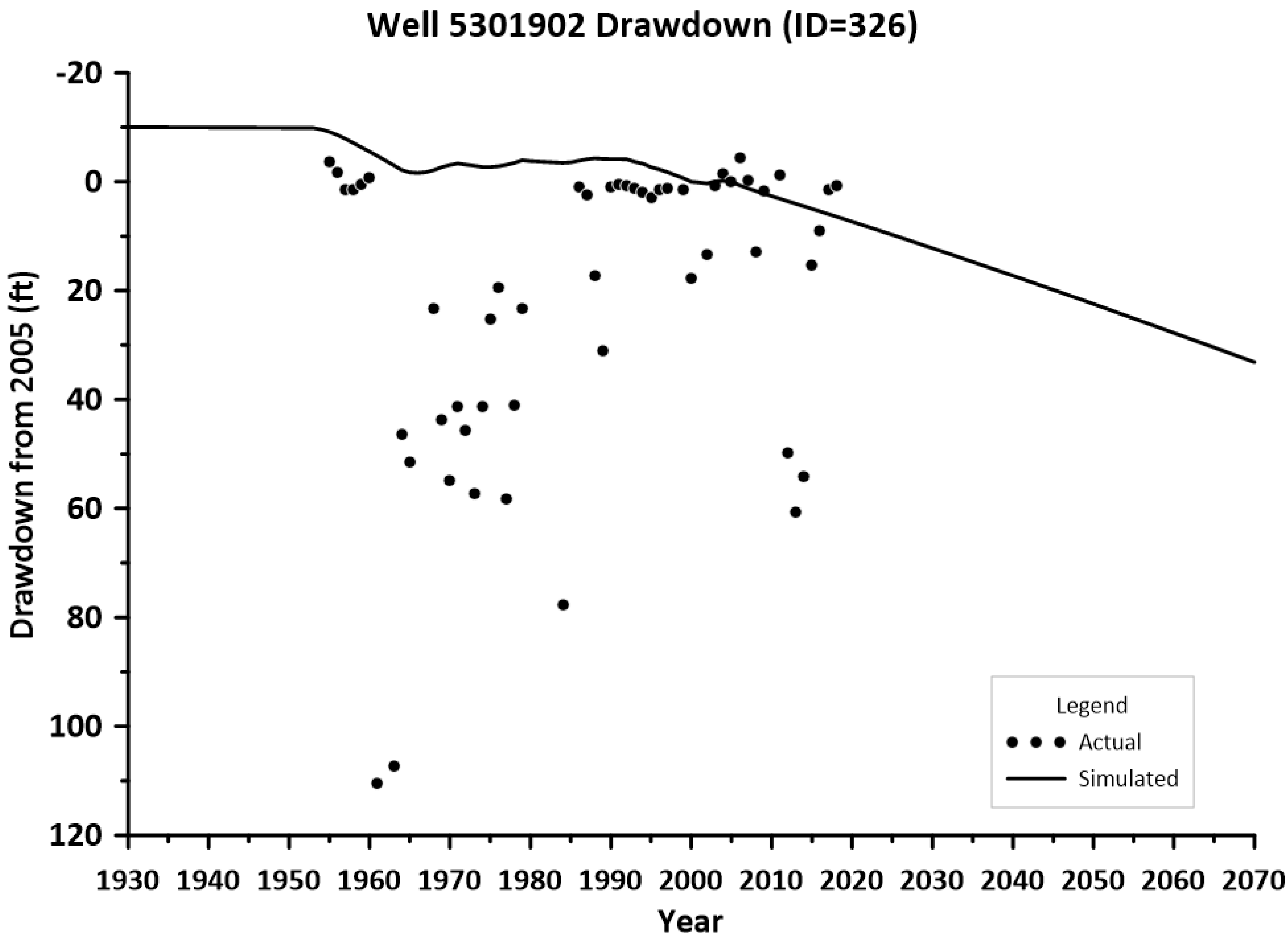
2020
2030
2040
2050
2060
2070
Year
Legend
Actual
Simulated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Drawdown from 2005 (ft)
-20
0
20
40
60
80
100
120
1930
1940
1950
1960
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1980
1990
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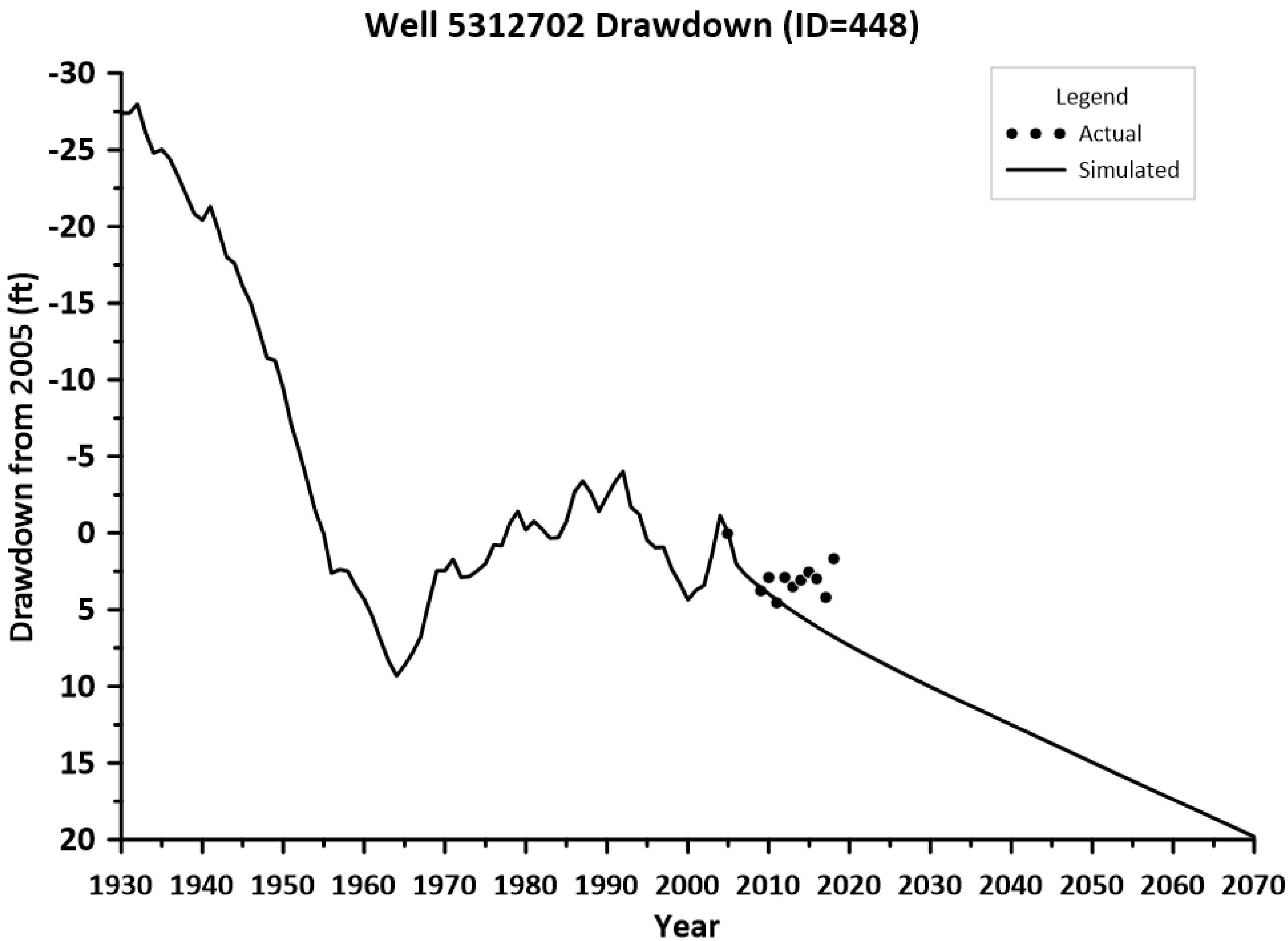
2010
2020
2030
2040
2050
2060
2070
Year
Legend
Actual
Simulated



Well 5312702 Drawdown (ID=448)
Legend
Actual
Simulated
Drawdown from 2005 (ft)
-30
-25
-20
-15
-10
-5
0
5
10
15
20
1930
1940
1950
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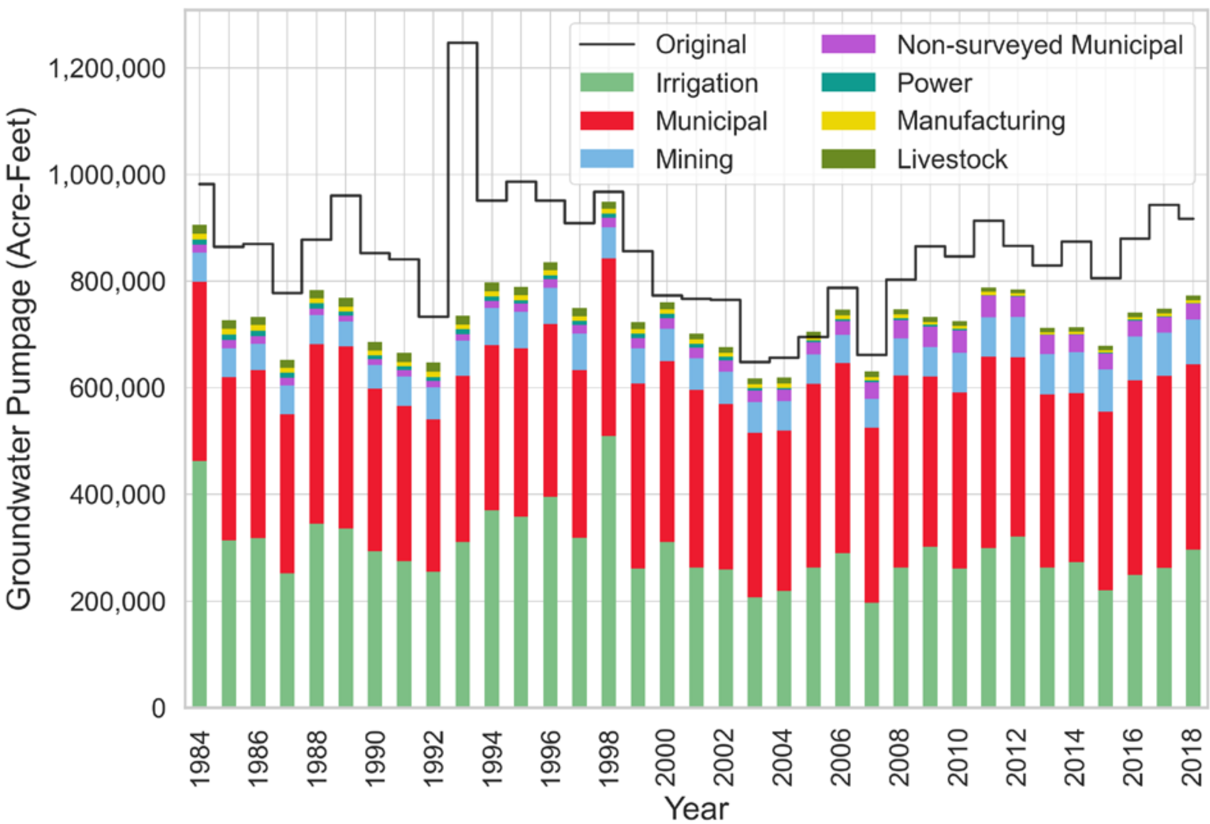
2070
Year

<u>Middle Pecos GCD Exhibit 28</u>

Texas Water Development Board, Final Report: Estimation of Groundwater Pumping Volumes, Location and Aquifers for West Texas (February 28, 2022) (Excerpt)

FINAL

Estimation of Groundwater Pumping Volumes, Locations, and Aquifers for West Texas



Prepared for

Texas Water Development Board
Contract Number 2048302456

February 28, 2022

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Final Report:

Estimation of Groundwater Pumping Volumes, Locations, and Aquifers for West Texas

TWDB Contract Number 2048302456

Prepared By

Jordan Furnans, Ph.D., PE, PG
Michael Keester, PG
Micaela Pedrazas, EIT, GIT
Stephanie S. Wong, Ph.D.
Tucker Fullmer
LRE Water, LLC

Rohit Goswami, Ph.D., PE
Uvashree Janani Mohandass, EIT
WSP USA

Michael Thornhill, PG
Eric Seeger, PG
Thornhill Group, Inc.

Michelle Sutherland, PE
Michelle A. Sutherland, LLC

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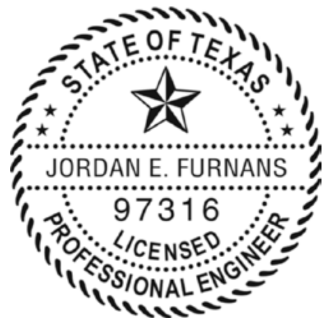
Geoscientist and Engineer Seals

The Texas Water Development Board contracted with LRE Water, LLC, a licensed professional geoscientist firm (Texas License No. 50516) and licensed professional engineering firm (Texas License No. 14368).

This draft report is released to the Texas Water Development Board for review by the following licensed professional geoscientists and licensed professional engineers in the State of Texas:

Jordan Furnans, PhD, PE, PG

Dr. Furnans was the Project Manager for this work, with responsibility for all project tasks.



Signature | 2/28/2022 Date

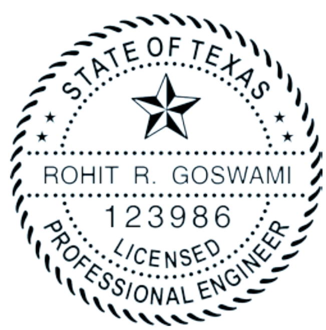
Michael Keester, PG

Mr. Keester was primarily responsible for directing compilation of available data, evaluation of the TWDB Water Use Survey pumping data, and development of a plan to address anomalies in the Water Use Survey data. He was the primary author of the draft Task 1 and Task 2 reports which were the basis for the report sections on these topics.

Signature | 2/28/2022 Date

Rohit Goswami, PhD, PE

Dr. Goswami led the WSP, Inc. team in completing the mining assessment effort, and assisted in developing the municipal-surveyed assessments.



Signature | 2/28/2022 Date

prioritized its use above estimates obtained from other methods. The location of known irrigation wells and crop areas guided the spatial distribution of the irrigation pumping. The vertical distribution of pumping (that is, from which aquifer the groundwater is withdrawn) will correspond to the well's open interval depths (if known) or the well depth. Our proposed methodology also does not exclude dryland farming areas from the estimation of irrigation demand. This may be important for this study area, which does include a significant amount of dryland production.

Irrigation Methodology Test Case

As a test case, we reviewed the irrigation pumping Water Use Survey data for the Edwards-Trinity (Plateau) Aquifer in Pecos County. Farmers in Pecos County have used abundant water supplies for about 150 years to irrigate crops downstream from Leon Springs (in the Leon-Belding Irrigation Area) and from Comanche Springs near the City of Fort Stockton. Comanche Creek and irrigation canals were historically used to distribute water to members of the Pecos County Water Control and Improvement District No. 1. TWDB has noted that:

> "Pecos County is not a fair sample of the study area to test this methodology. It is a best-case scenario because agricultural fields are accurately identified remotely in this arid county and there is a smaller percentage of dryland production." (See TWDB Comment #49 in Appendix).

From the 1940s numerous large capacity water wells were drilled in other parts of Pecos County and six additional irrigation areas were developed. Some of the irrigation areas relied primarily on wells completed in the Pecos Valley Aquifer (formerly called the Cenozoic Pecos Alluvium Aquifer) and some areas relied predominantly on wells completed into the Edwards-Trinity (Plateau) Aquifer. Maximum acreages irrigated and accompanying pumping rates occurred in the 1960s with the highest TWDB reported estimate of approximately 339,000 acre-feet per year in 1964. During the maximum irrigation period of the 1960s, estimates of groundwater production from the Leon-Belding Area (primarily the Edwards-Trinity (Plateau) Aquifer) are up to 120,000 acre-feet per year (Thornhill and others, 2008; Harden and others, 2011; Mace and others, 2020), and more than 177,000 acre-feet per year were pumped from the Coyanosa area which mainly tapped the Pecos Valley Aquifer (Thornhill and others, 2008).

By 1969 irrigation had reportedly decreased to about 180,000 acre-feet per year in the county. Since the mid-1970s, water usage from aquifers in the Trans-Pecos Region has declined substantially, primarily due to economic considerations associated with the oil embargo and other factors, and partly due to increased farming efficiencies. Total pumping for Pecos County from 1985 to 2005 generally remained between 50,000 and 80,000 acre-feet per year. Assessing the distribution of pumping between the Edwards-Trinity (Plateau) Aquifer and the Pecos Valley Aquifer requires an understanding of the historical locations of pumping.

Maintaining historical pumping rights was a primary consideration for the formation of the Middle Pecos Groundwater Conservation District. The establishment of Historic and Existing Use permits provided the primary regulatory framework for the District. Based on a historic period from September 20, 1989 through September 20, 2004, unless an applicant could prove a continuous historical pumping period prior to that period, the District reviewed applications and granted Historic and Existing Use permits. For a few years, the only permits granted by the

District were Historic and Existing Use permits. The District granted these permits with total allocations of 230,813 acre-feet per year which included all the historical irrigation areas. The District granted 117,489.3 acre-feet per year for the Edwards-Trinity (Plateau) Aquifer and 94,759.8 acre-feet per year for the Pecos Valley Aquifer (Thornhill and others, 2008).

The District has since permitted approximately an additional 8,400 acre-feet per year for two non-exempt production permits, although that water was known to have been produced during the Historic and Existing Use production period. Based on the geologic structure of the Edwards-Trinity (Plateau) Aquifer and its relationship to the Pecos Valley Aquifer, it is likely that some of the permits were originally assigned to an incorrect aquifer. The District may have corrected those aquifer assignments based on their three-dimensional modeling efforts.

As reported in Section 3.3.36 and illustrated on Figure 372, since 1984 the reported pumping from the Edwards-Trinity (Plateau) Aquifer for irrigation ranged between 20,000 and 100,000 acre-feet per year. We found several anomalies in the data based on manual review, a year-to-year change analysis, and a standard deviation analysis (see Figure 372).

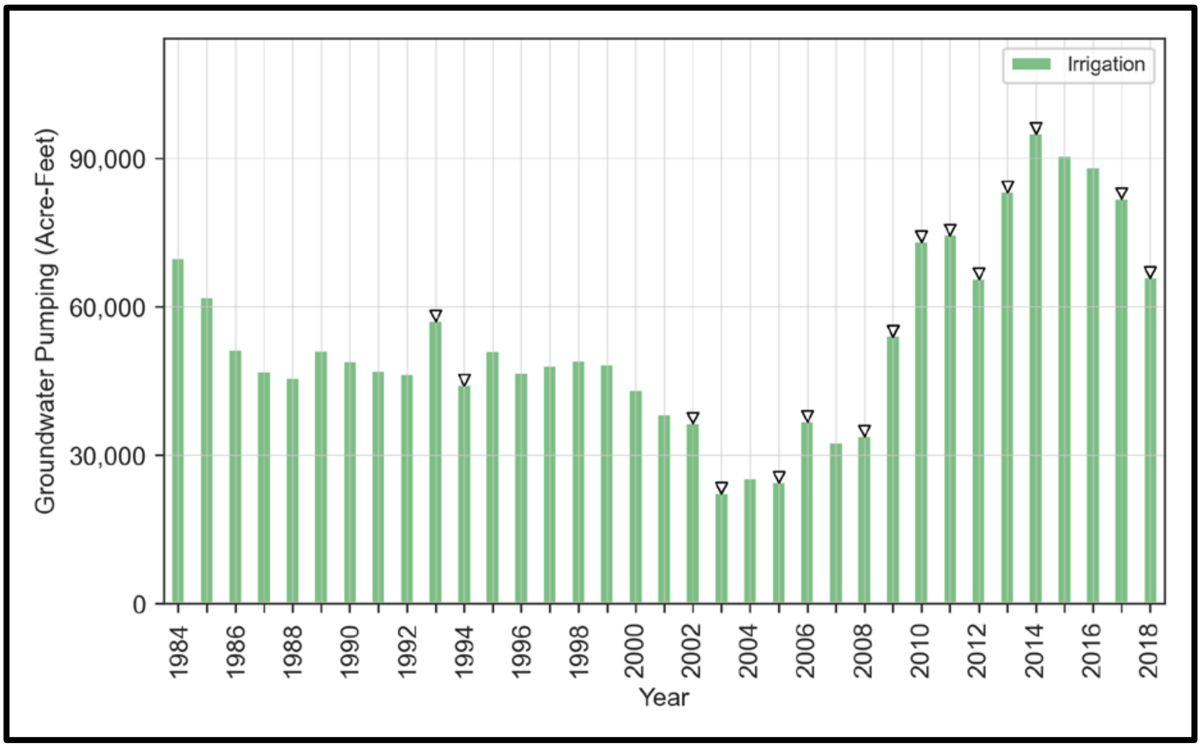


Figure 372. Pecos County Edwards-Trinity (Plateau) Aquifer groundwater pumping for irrigation use as reported in the TWDB Water Use Survey data. Triangles mark years identified as having anomalous data.

Figure 373 illustrates the irrigated crop areas within Pecos County based on the CropScape data analysis that identified the most frequently occurring crop type. The TWDB estimates of the number of acres associated with the crops are available for the entire county (see Figure 374). To determine the irrigated acres associated with each aquifer in Pecos County, we used the delineations of each study area aquifer as shown on Figure 373. Much of the irrigated acreage in

Appendix 5 – Task 3 Draft Report Comments and Responses

The following provides comments from the TWDB on the Task 3 draft report which was revised into this final report.

General comments to be addressed

1. Per Exhibit B, Attachment 1: Please review the text, including the list of authors to correct several spelling and grammatical errors. (IJ)

Comment has been addressed, and all spelling and grammatical errors have been corrected.

2. Please note that a municipality may draw water from a non-adjacent aquifer. Consequently, the assumption that city boundaries must coincide with aquifer boundaries may not be valid. For example, the cities of Odessa and Midland own wells drawing groundwater from the Pecos Valley Aquifer in Ward or Winkler counties. Please review the report to ensure that cities drawing groundwater from a non-adjacent aquifer are included. (IJ)

Comment addressed in section 4.1.1, and we ensured pumpage was properly assigned and located within the project geodatabase.

3. Please propose an explanation for the sudden increase in livestock pumpage starting in 2005 in several counties, for example, Medina, Nolan and Tom Green counties. (IJ)

Comment addressed for all the county revisions in the report by correcting the livestock pumpage subplot in the figure.

4. The first figure in Section 5.2.36 has no caption. Please renumber this figure and all subsequent figures in the report and revise the text accordingly. (IJ)

The figure in question was a duplicate of Figure 584 and therefore deleted.

5. All abbreviations used in figures should be explained in the legend of the figure, examples include BFZ, GCD, UWCD. (CR)

Explanations for abbreviations have been added to figure captions, as suggested in comment 14.

6. Please double-check the figure numbers in the text and revise as appropriate. Several figure numbers are referencing incorrect figures. (KC)

Comment was addressed throughout the document.

49. Section 4.2: Please address the following issues in the text: (AD)

    a. The proposed methodology does not exclude dryland farming from their estimation of irrigation demand. This is important because there is a significant amount of dryland production in the study area.

    b. Pecos county is not a fair sample of the study area to test this methodology it is a best-case scenario because agricultural fields are accurately identified remotely in this arid county and there is a smaller percent of dryland production.

    c. TWDB irrigation estimates are based on crop acreage. Please note that a 100-acre field with two crops in a year would be calculated as 200 acres.

    d. In estimating irrigation demand, runoff and soil moisture availability should not be disregarded. Effective precipitation is a critical factor, precipitation in too large or too small events is lost to runoff or evaporation, respectively, and has little effect on the crops.

    e. The proposed irrigation estimate data should be in agreement with local groundwater conservation district data in order to be defensible and accepted.

Comment is addressed in Section 4.2, in Section 5.2.36, and in Section 6.

50. Section 4.2, Page 468, paragraph 2: The text states “we developed refined estimates of where crops are planted within the study area”. This is the most challenging part of the entire irrigation water use estimating process. Please describe how it was done for each year back to the 1980s. (WSP)

Comment addressed in Section 4.2.

51. Section 4.2, Page 468, Paragraph 3: Please discuss how the method to address Water Use Survey irrigation anomalies factors or does not factor when farmers plant summer and winter crops, discussed on page 470. (CR)

Comment addressed in Section 4.2.

52. Section 4.3, Page 478, paragraph 4: Net generation was used in this methodology. Please describe how you handled negative net generation values. (WSP)

Comment addressed in Section 4.3.

<u>Middle Pecos GCD Exhibit 29</u>

Evaluation of Cockrell's "Anytime" Thresholds, William R. Hutchison, Ph.D., P.E., P.G.
(October 17, 2023)

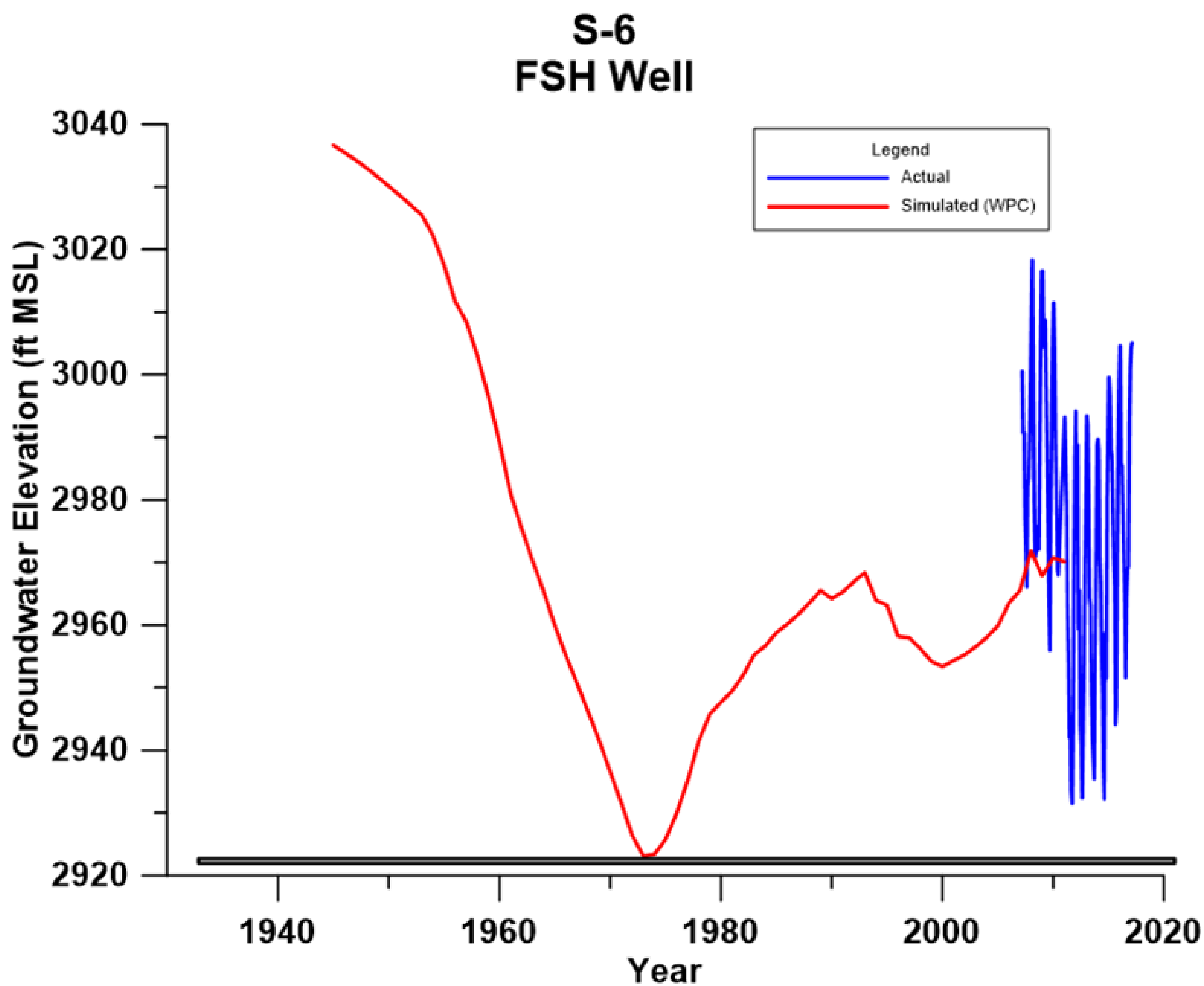
Updated Analysis of Belding Farms Data and Proposed “Anytime” Thresholds

Bill Hutchison

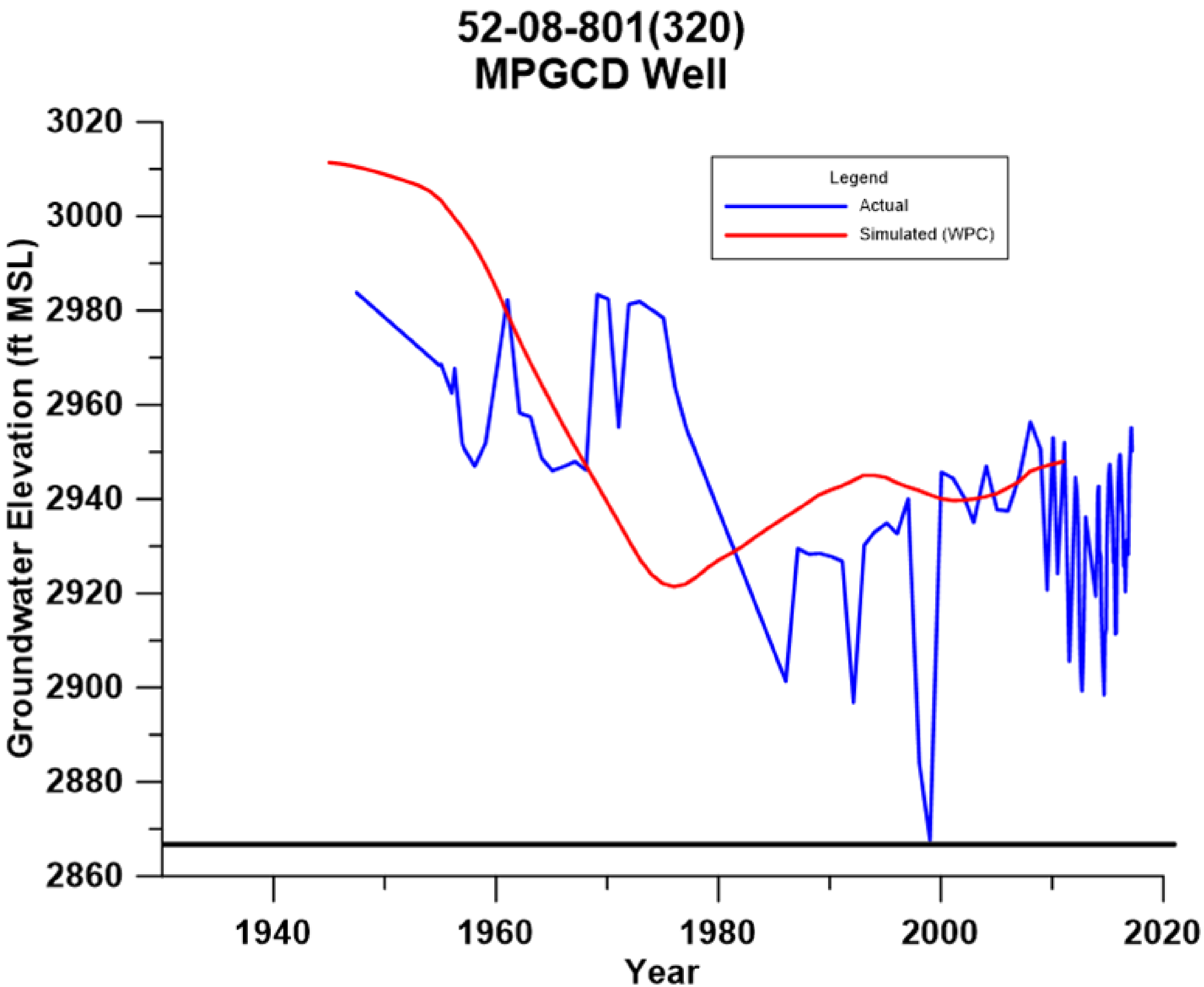
October 17, 2023

Summary of Data Analysis History

- 2017
  - FSH Litigation Settled/Permit Issued
    - FSH and Belding Farms representatives participated in discussions and reviewed/commented on draft thresholds
    - Report (June 16, 2017)
      - Thresholds (4 winter, 1 summer) in 11 wells based on historic minimum groundwater elevations (based on data and model)
    - No Belding Farms data were available when thresholds were established
- 2018
  - Belding Farms data provided to MPGCD
  - Analyses:
    - Report (December 7, 2018)
    - Presentation (December 18, 2018)
- 2019 to 2022
  - No meaningful discussions/analyses
- 2023
  - Cockrell provided and updated set of data (including pump settings)
  - Analyzed in context of rules petition



S-6
FSH Well
Legend
Actual
Simulated (WPC)
Groundwater Elevation (ft MSL)
3040
3020
3000
2980
2960
2940
2920
1940
1960
1980
2000
2020
Year



52-08-801(320)
MPGCD Well
Legend
Actual
Simulated (WPC)
Groundwater Elevation (ft MSL)
Year
3020
3000
2980
2960
2940
2920
2900
2880
2860
1940
1960
1980
2000
2020

2018 Report and Presentation

- One focus was “summer thresholds” (special condition on FSH permit) vs. “anytime thresholds” (Cockrell proposal)
- 2018 analysis evaluated Cockrell proposed “anytime thresholds” in the context of 6 Belding pumping wells
- Belding Farms data did not include pump setting in these 6 pumping wells
    - Without the pump depth data, not possible to fully evaluate

Conclusions from 2018 Analyses

- Groundwater elevations recover in winter (non-irrigation season)
- Drawdown (monthly and annual) is well defined with Belding Farms data
- Groundwater elevations in all MZ1 wells are "connected"
  - Also supported by MPGCD 11 monitoring well data
- Adopted thresholds are conservative and protective of Belding wells (and other MZ1 wells)

Conclusion Related to Cockrell's Ability to Pump

- Belding pumping data from 1960s and 1970s show that Cockrell's actual pumping was above Cockrell's current permit limits (no permit limits in 1960s and 1970s)
- Groundwater levels in 1960s and 1970s were much lower than recent groundwater levels
- Belding Farms data show that Belding Farms pumped as much as 8,000 AF/yr (from ETP Aquifer) when groundwater levels were lower than Cockrell's proposed "anytime" thresholds
- Cockrell's stated concerns about inability to pump are not supported by Belding Farms data

Updated (2023) Analyses

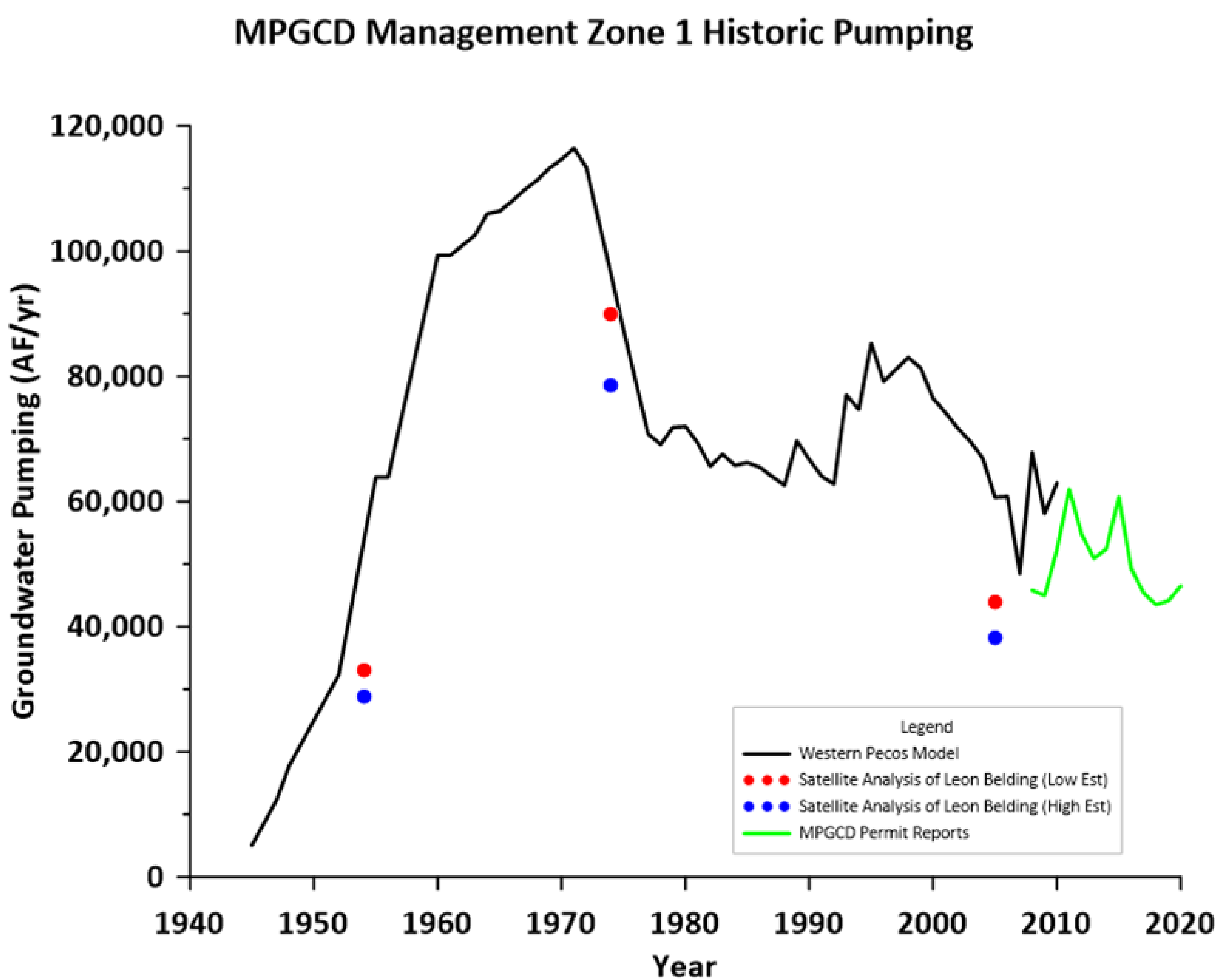
- Objective: Evaluate the proposed thresholds contained in Cockrell's petition/proposed MZ1 rules submitted in September 2023
- Update analysis of historic pumping in MZ1
  - Including Belding Farms pumping
- Focus on evaluation of Belding Farms winter maximum and summer minimum groundwater levels
  - Integrate pump setting data into analysis
- Update analysis of proposed (Cockrell) "anytime" thresholds in the context of Belding Farms pumping wells (Edwards-Trinity Plateau Aquifer)
- Review groundwater quality data evaluated in 2017 during development of settlement
  - Groundwater quality is a component of Cockrell petition/proposed MZ1 rules

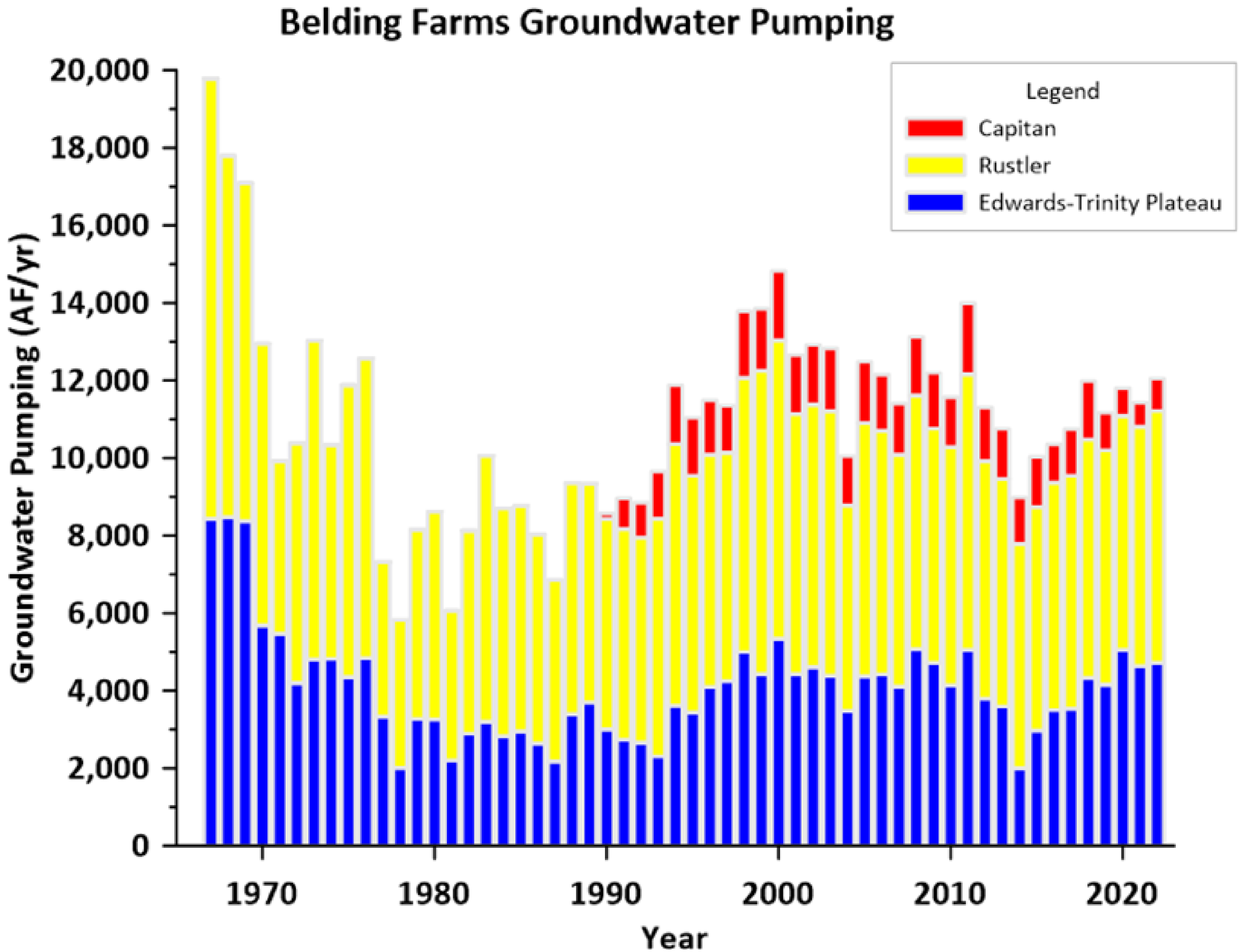
Potential Errors in Belding Farms Data

- Static Water Levels and Pumping Water Levels
  - Depth to Water reported or blank if no data
  - Some cells had a “0”, which were removed (assumed to be no data)
- Surface Elevation of Well 8
  - Listed as 2,132 ft MSL
  - Assumed to be a typo (used 3,132 ft MSL in analyses)

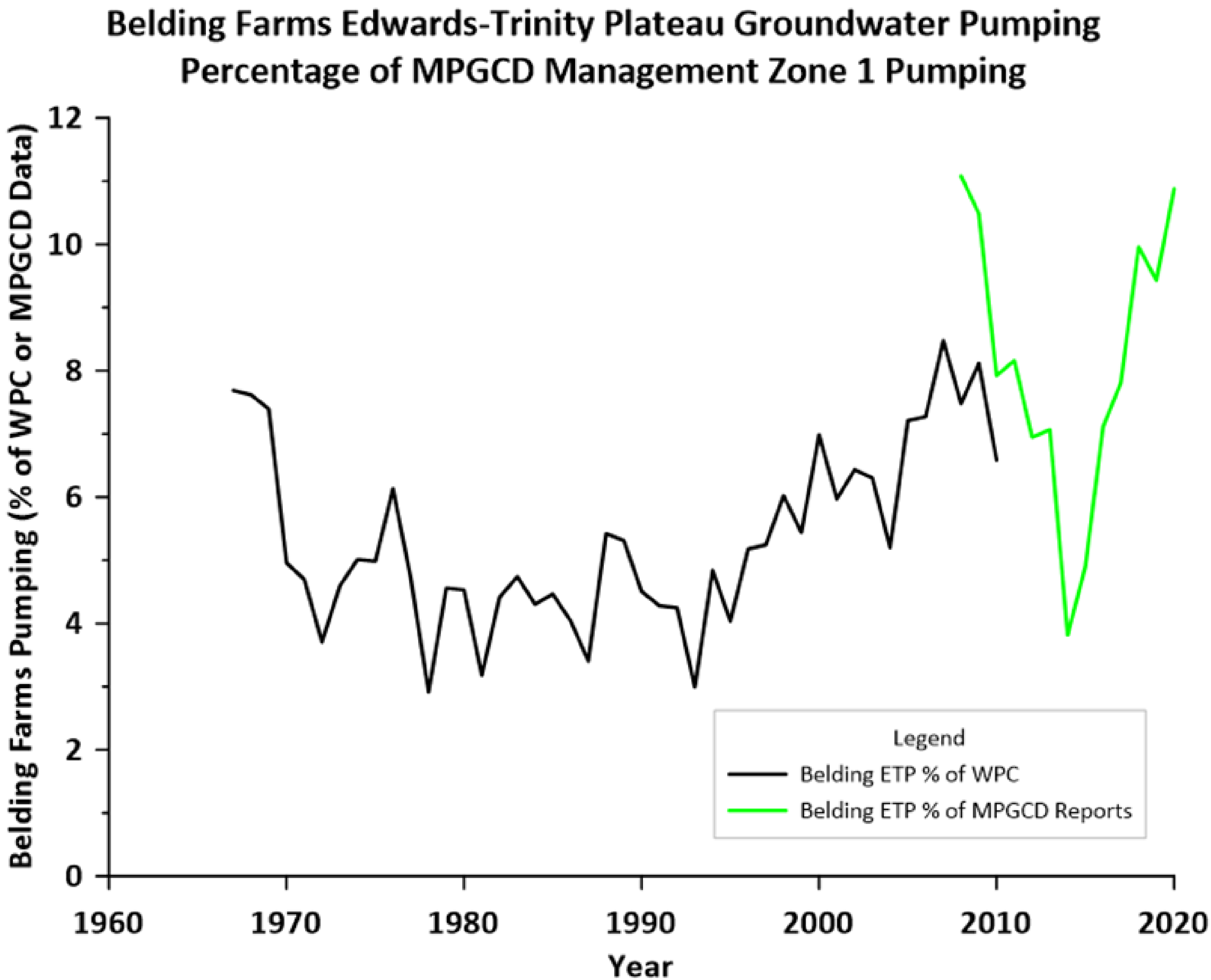
Historic Pumping in MPGCD Management Zone 1

- Western Pecos Model (R.W. Harden & Associates and others, 2011)
  - Pumping estimates in MZ1 from model output
  - Leon-Belding area estimates of pumping based on satellite analysis for three years (1954, 1974, 2005) completed by Resource Analysis and Mapping (RAM) and LBG-Guyton Associates (Appendix B of model report)
- MPGCD Permitted Pumping Data
- Belding Farms Pumping Data


MPGCD Management Zone 1 Historic Pumping
Groundwater Pumping (AF/yr)
120,000
100,000
80,000
60,000
40,000
20,000
0
1940
1950
1960
1970
1980
1990
2000
2010
2020
Year
Legend
Western Pecos Model
Satellite Analysis of Leon Belding (Low Est)
Satellite Analysis of Leon Belding (High Est)
MPGCD Permit Reports



Belding Farms Groundwater Pumping
Legend
Capitan
Rustler
Edwards-Trinity Plateau
Groundwater Pumping (AF/yr)
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
1970
1980
1990
2000
2010
2020
Year



Belding Farms Edwards-Trinity Plateau Groundwater Pumping
Percentage of MPGCD Management Zone 1 Pumping
Belding Farms Pumping (% of WPC or MPGCD Data)
0
2
4
6
8
10
12
1960
1970
1980
1990
2000
2010
2020
Year
Legend
Belding ETP % of WPC
Belding ETP % of MPGCD Reports

Historic Pumping Conclusions

- MZ 1 pumping in 1960s and 1970s was more than recent years
- Based on FSH's retirement of historic and existing use permits, "export" pumping will not result in an increase in pumping above that experienced in the 1960s and 1970s
  - Foundation to special condition thresholds (protect historic minimum groundwater levels)
- Belding Farms pumping from Edwards-Trinity (Plateau) Aquifer (ETP) represents between 22 and 43 percent of total Belding Farms pumping (since 2010)
- Belding Farms ETP pumping has been 3 to 10 percent of MZ1 pumping from ETP

Belding Farms Pumping and Groundwater Levels

- Focused on six ETP production wells
  - 1, 2, 3, 5, 8, 10
- Historic individual well pumping
  - Current permit limit
- Static depth-to-water data for each year:
  - Winter maximum
  - Summer minimum
- Pump depth

Winter Maximum Static Water Level Example

- Belding Well 1 (1974)
    - “Winter” period is November to March
    - Depth to water (from Belding Farms data)
        - November 1973 = 310 ft
        - December 1973 = 310 ft
        - January 1974 = 308 ft
        - February 1974 = 312 ft
        - March 1974 = 312 ft

Winter Maximum Static Water Level Example

- Belding Well 1 (1974)
  - “Winter” period is November to March
  - Depth to water (from Belding Farms data)
    - November 1973 = 310 ft
    - December 1973 = 310 ft
    - January 1974 = 308 ft
    - February 1974 = 312 ft
    - March 1974 = 312 ft

Winter Maximum for 1974 = 308 ft

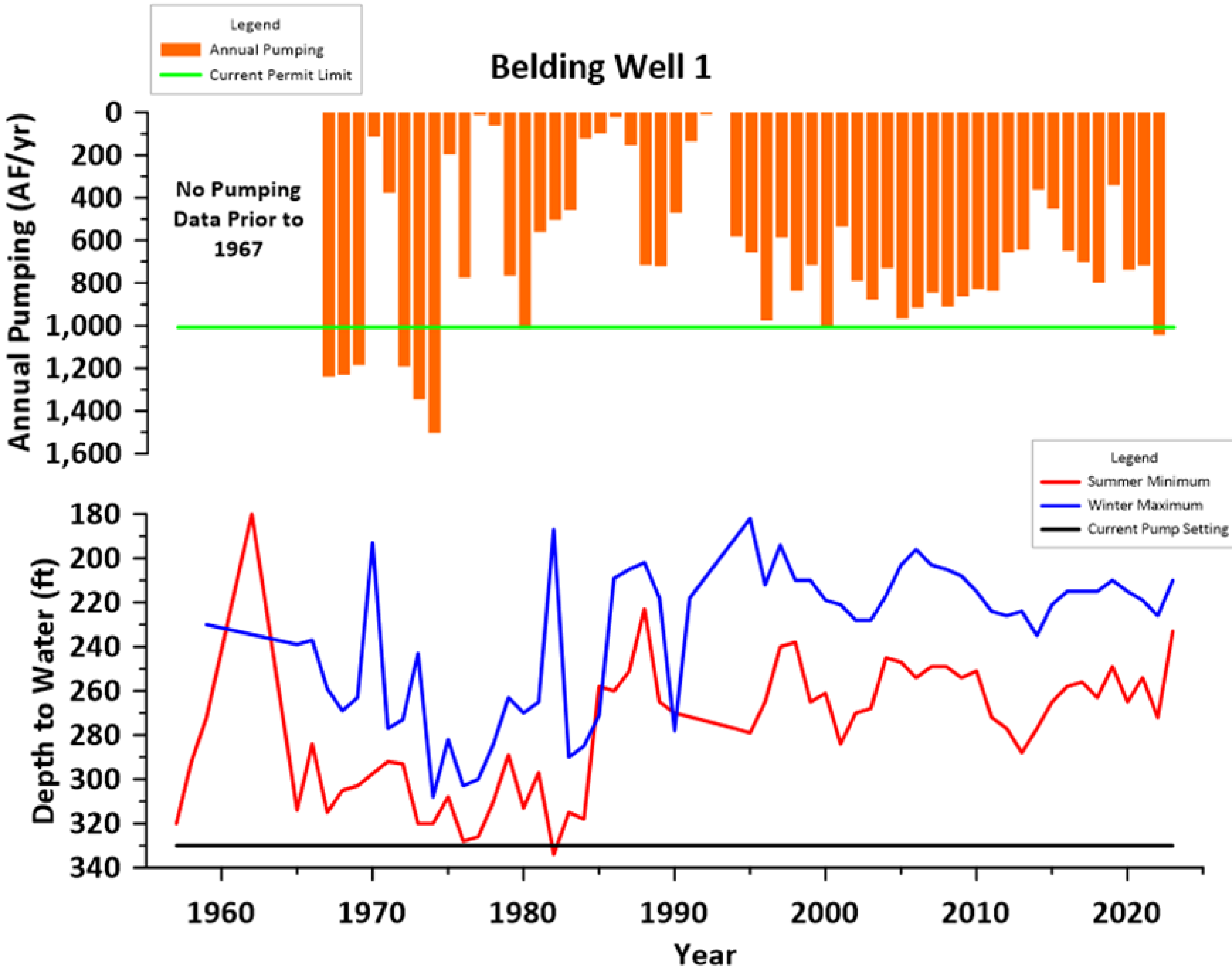
Summer Minimum Static Water Level Example

- Belding Well 1 (1982)
  - “Summer” period is April to October
  - Depth to water (from Belding Farms data)
    - April 1982 = No data
    - May 1982 = 292 ft
    - June 1982 = 304 ft
    - July 1982 = 306 ft
    - August 1982 = No data
    - September 1982 = 334 ft
    - October 1982 = 331 ft

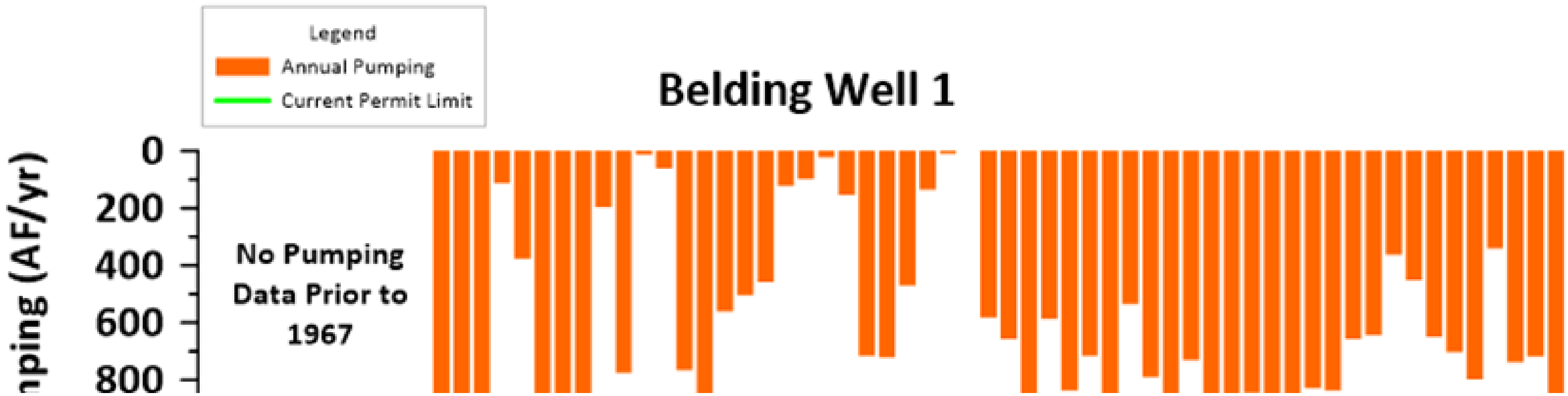
Summer Minimum Static Water Level Example

- Belding Well 1 (1982)
  - “Summer” period is April to October
  - Depth to water (from Belding Farms data)
    - April 1982 = No data
    - May 1982 = 292 ft
    - June 1982 = 304 ft
    - July 1982 = 306 ft
    - August 1982 = No data
    - September 1982 = 334 ft
    - October 1982 = 331 ft

Summer Minimum for 1982 = 334 ft

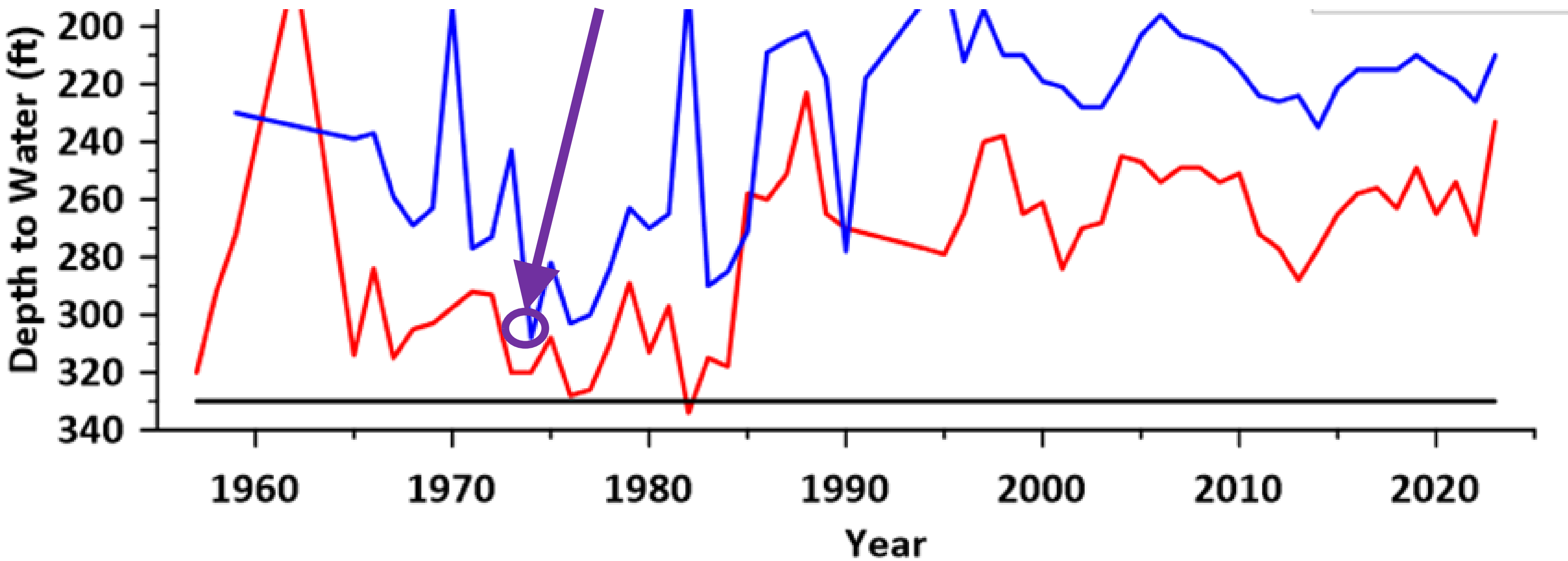


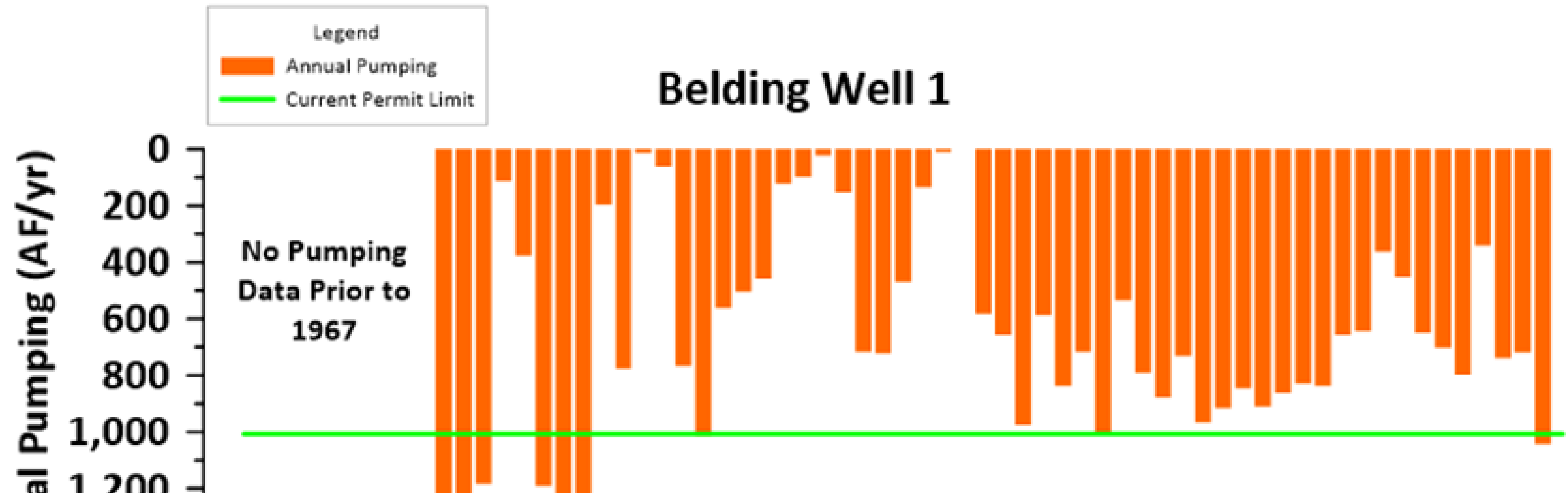
Legend
Annual Pumping
Current Permit Limit
Belding Well 1
Annual Pumping (AF/yr)
0
200
400
600
800
1,000
1,200
1,400
1,600
No Pumping Data Prior to 1967
Legend
Summer Minimum
Winter Maximum
Current Pump Setting
Depth to Water (ft)
180
200
220
240
260
280
300
320
340
1960
1970
1980
1990
2000
2010
2020
Year



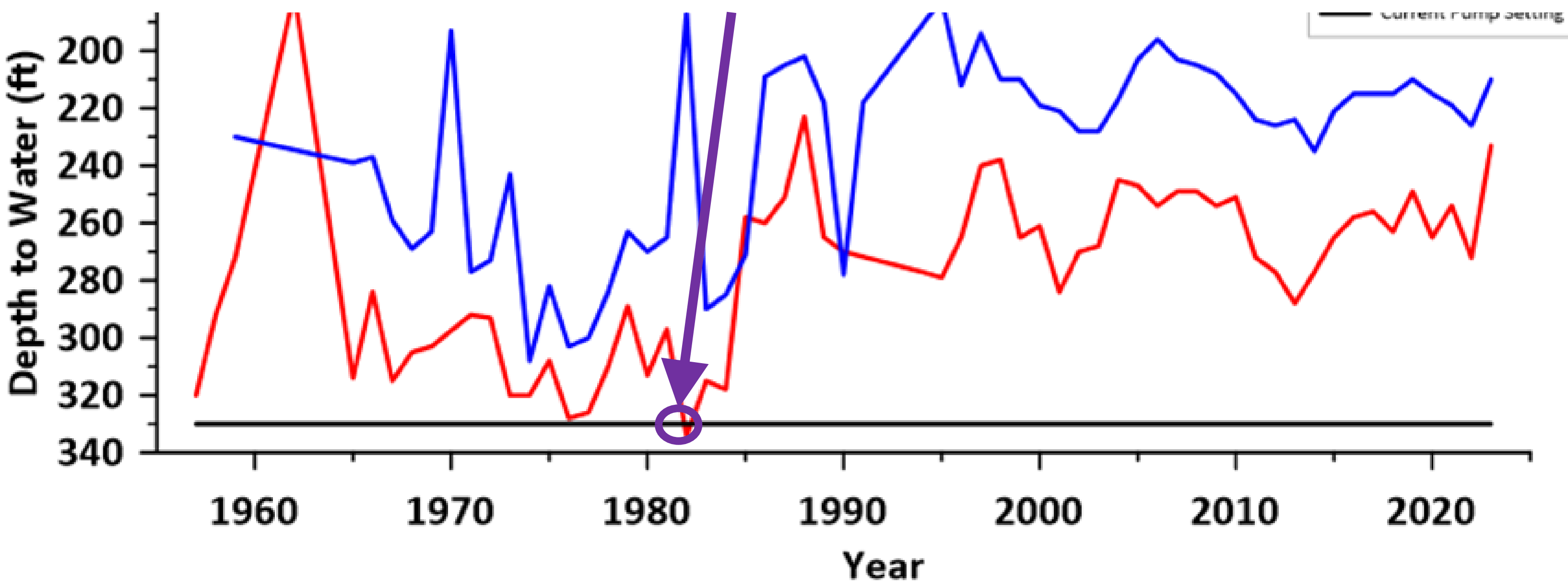
Lowest Winter Maximum in Belding Well 1 observed in 1974 = 308 ft

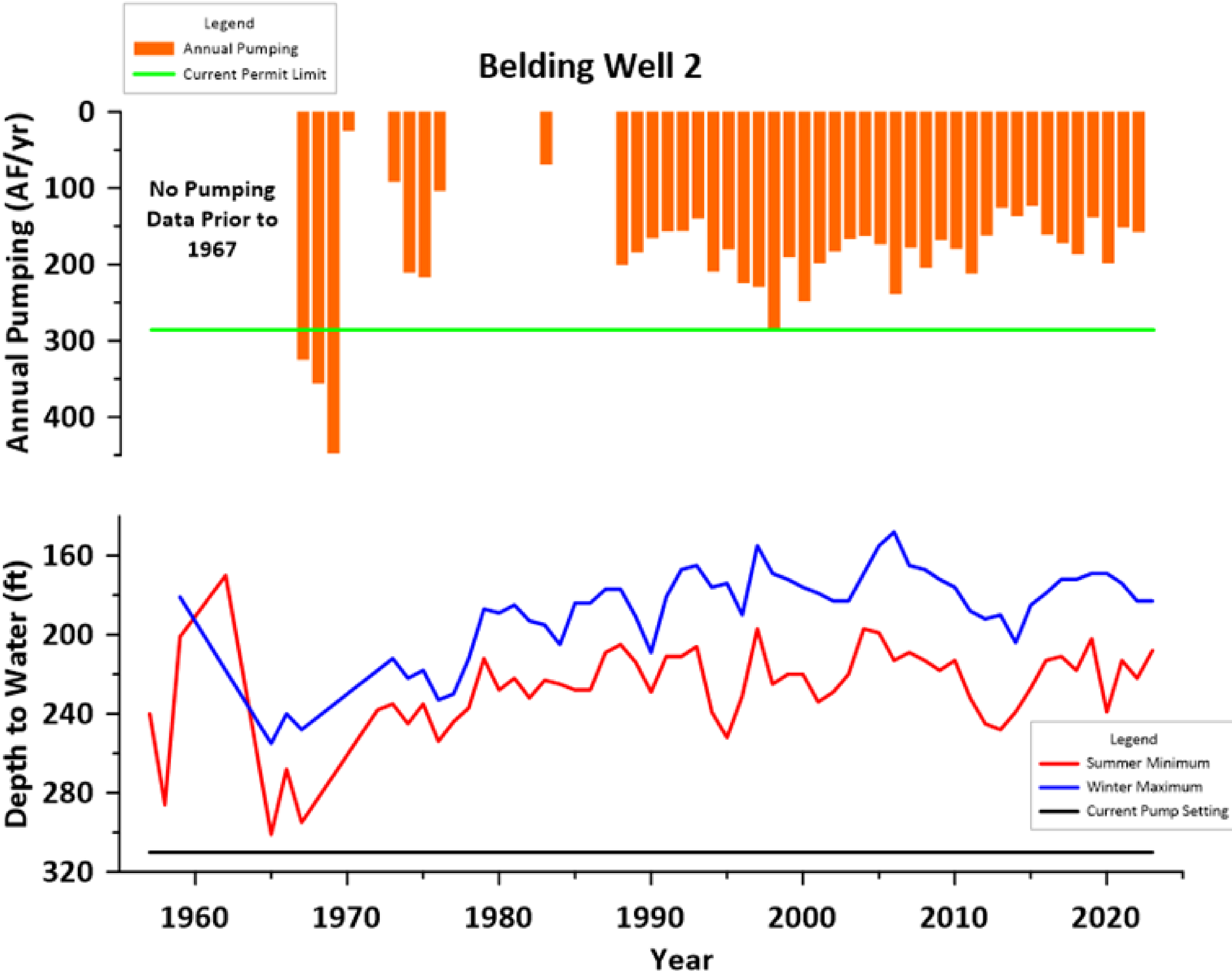
FSH Winter Thresholds are based on the "Lowest Winter Maximum" in each of the 11 monitoring wells

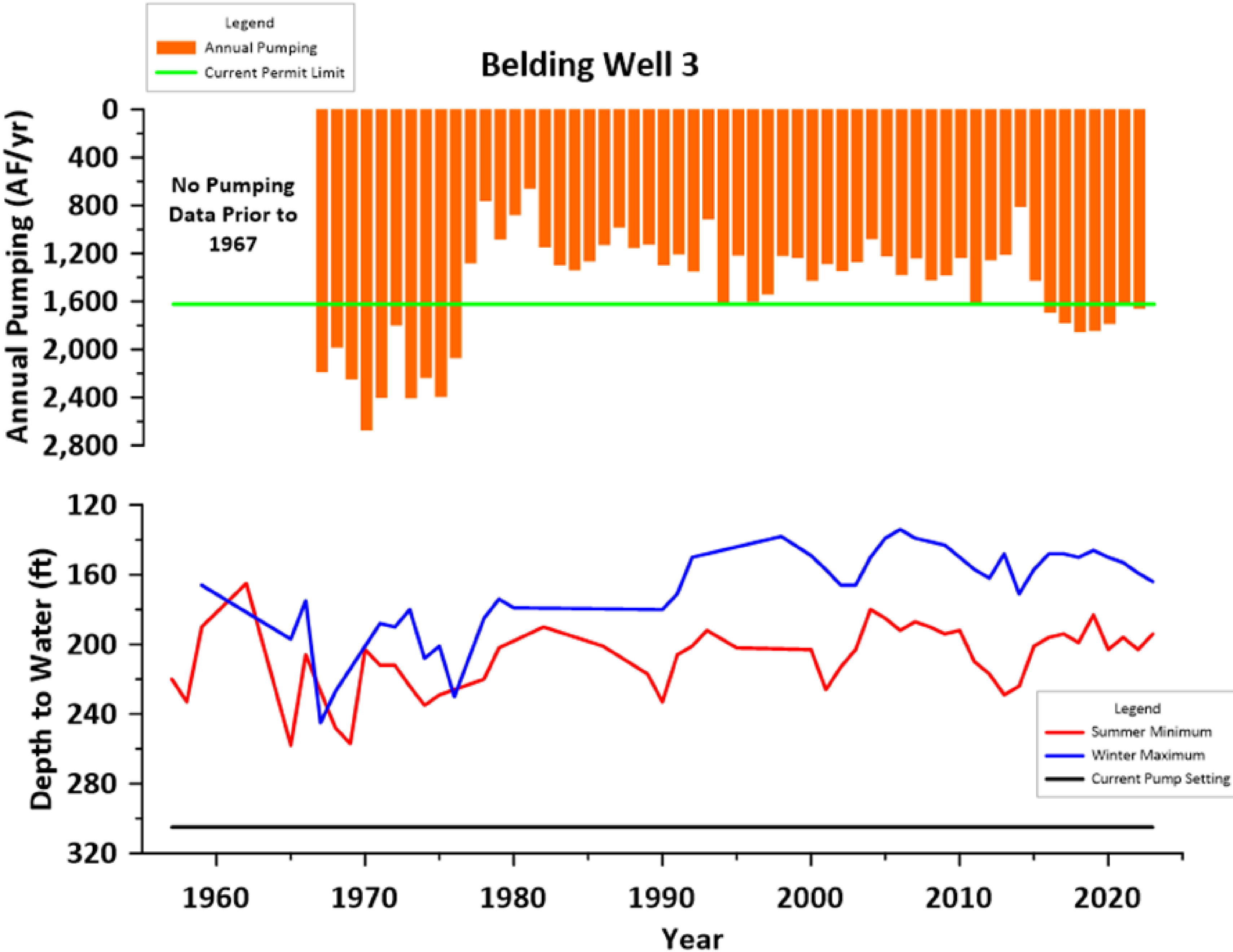




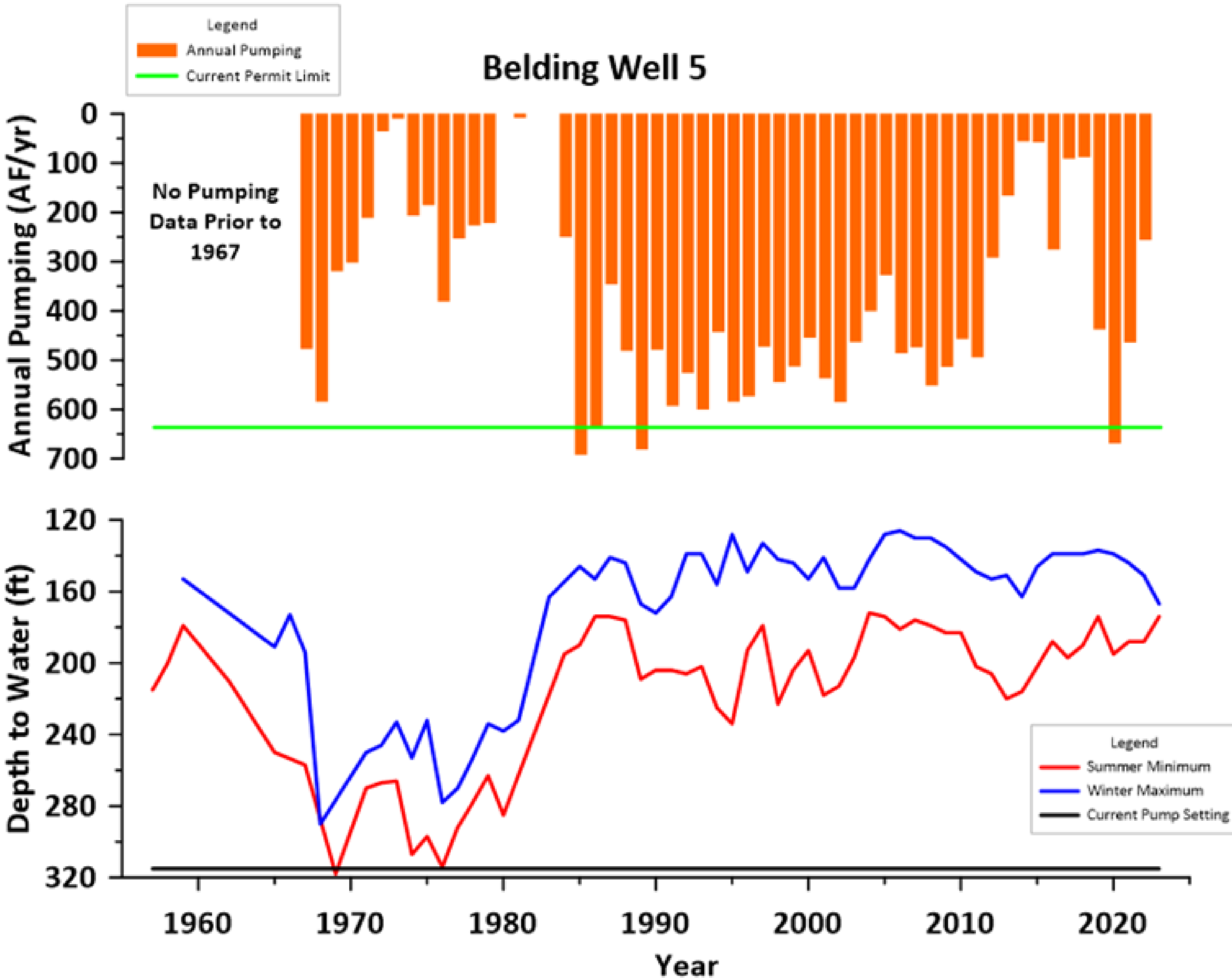
Lowest Summer Minimum in Belding Well 1 observed in 1982 = 334 ft

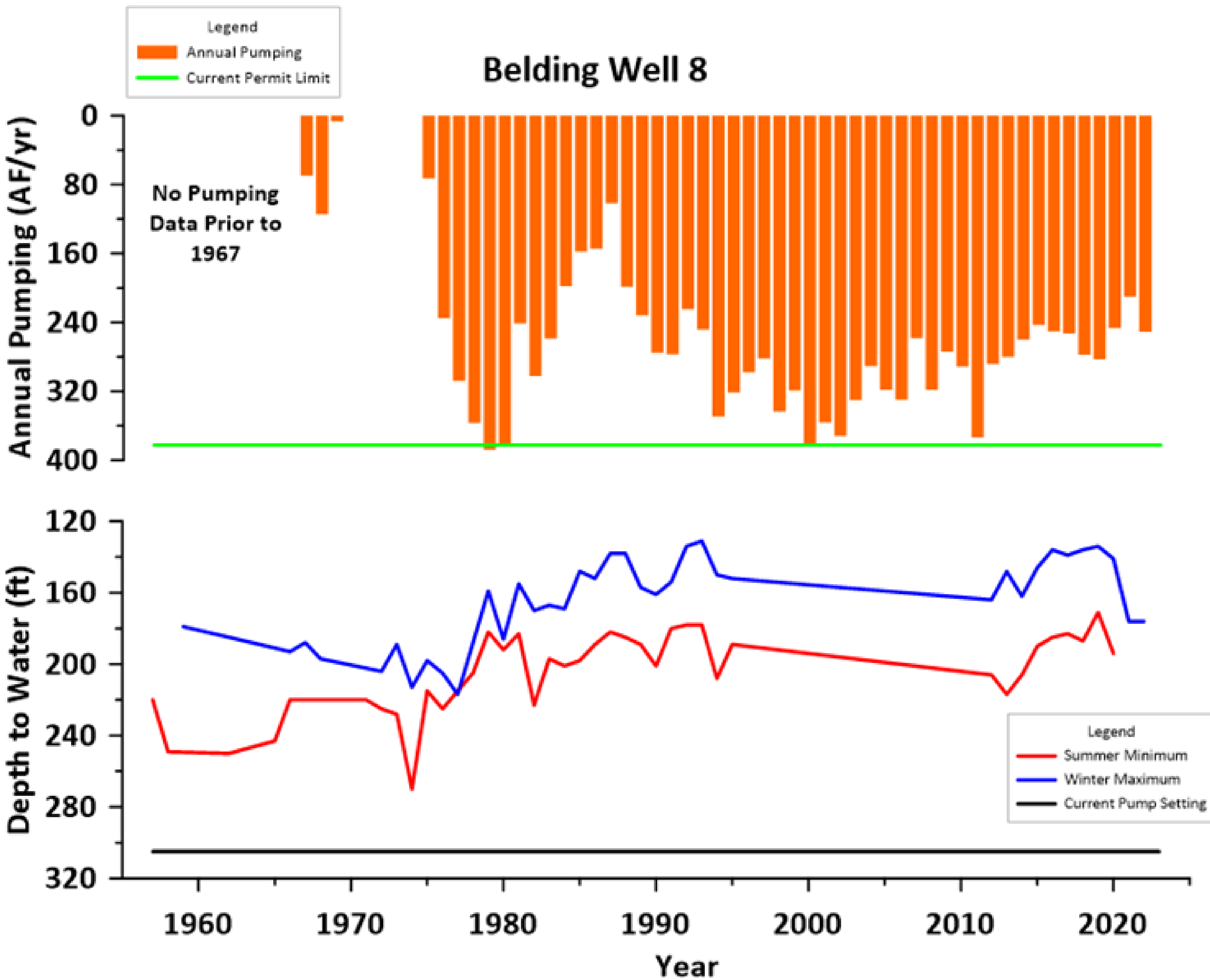


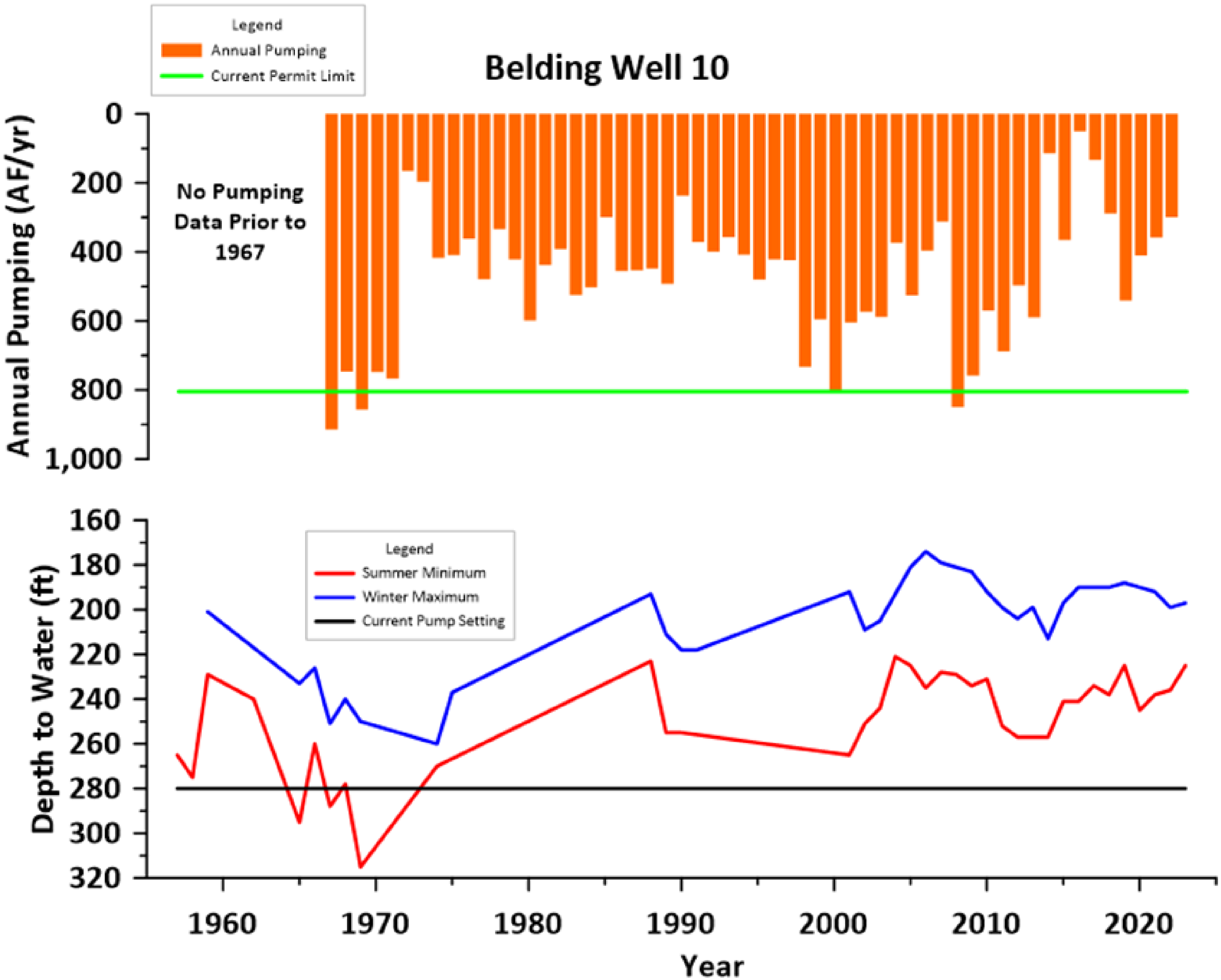

Legend
Annual Pumping
Current Permit Limit
Belding Well 2
Annual Pumping (AF/yr)
0
100
200
300
400
No Pumping Data Prior to 1967
160
200
240
280
320
Depth to Water (ft)
Legend
Summer Minimum
Winter Maximum
Current Pump Setting
1960
1970
1980
1990
2000
2010
2020
Year



Belding Well 3
Legend
Annual Pumping
Current Permit Limit
No Pumping Data Prior to 1967
Annual Pumping (AF/yr)
0
400
800
1,200
1,600
2,000
2,400
2,800
Depth to Water (ft)
120
160
200
240
280
320
Legend
Summer Minimum
Winter Maximum
Current Pump Setting
1960
1970
1980
1990
2000
2010
2020
Year


Legend
Annual Pumping
Current Permit Limit
Belding Well 5
Annual Pumping (AF/yr)
0
100
200
300
400
500
600
700
No Pumping Data Prior to 1967
Depth to Water (ft)
120
160
200
240
280
320
Legend
Summer Minimum
Winter Maximum
Current Pump Setting
1960
1970
1980
1990
2000
2010
2020
Year


Belding Well 8
Legend
Annual Pumping
Current Permit Limit
No Pumping Data Prior to 1967
Annual Pumping (AF/yr)
0
80
160
240
320
400
Depth to Water (ft)
120
160
200
240
280
320
Legend
Summer Minimum
Winter Maximum
Current Pump Setting
1960
1970
1980
1990
2000
2010
2020
Year



Belding Well 10
Legend
Annual Pumping
Current Permit Limit
Annual Pumping (AF/yr)
0
200
400
600
800
1,000
No Pumping Data Prior to 1967
Legend
Summer Minimum
Winter Maximum
Current Pump Setting
Depth to Water (ft)
160
180
200
220
240
260
280
300
320
1960
1970
1980
1990
2000
2010
2020
Year

Historic Pumping Conclusions

- Higher pumping in 1960s and 1970s correlate with lower groundwater levels
- Recent pumping has sometimes exceeded individual well permit limits as reported in Belding Farms database
- Lower groundwater levels in 1960s and 1970s recovered when pumping was reduced
  - Suggests that special condition pumping reductions for FSH wells would result in recovery of groundwater levels if implemented
- No long-term decline in winter groundwater levels in last 30+ years
  - Suggests pumping at current levels is sustainable
    - Not the same as "sustainable management" linked to year-round spring flow
- At least 4 of the 6 Belding Farms production wells analyzed had lower pump settings in 1960s and 1970s when groundwater levels were lower
  - Based on comparison of summer minimum, current pump setting, and historic pumping

Summary of Cockrell Proposed "Anytime" Thresholds

- Four monitoring wells
- Specified MPGCD action if groundwater levels drop below two of the four wells

Table 1. Groundwater elevation trigger levels (ft, msl | depth to water)

Well	Threshold 1		Threshold 2		Threshold 3	
Prison Well	2960	239	2950	249	2900	299
S-6	2935	188	2925	198	2875	248
S-45	2920	147	2910	157	2860	207
MPGCD 320	2900	168	2890	178	2840	228

Proposed Actions/Pumping Reductions

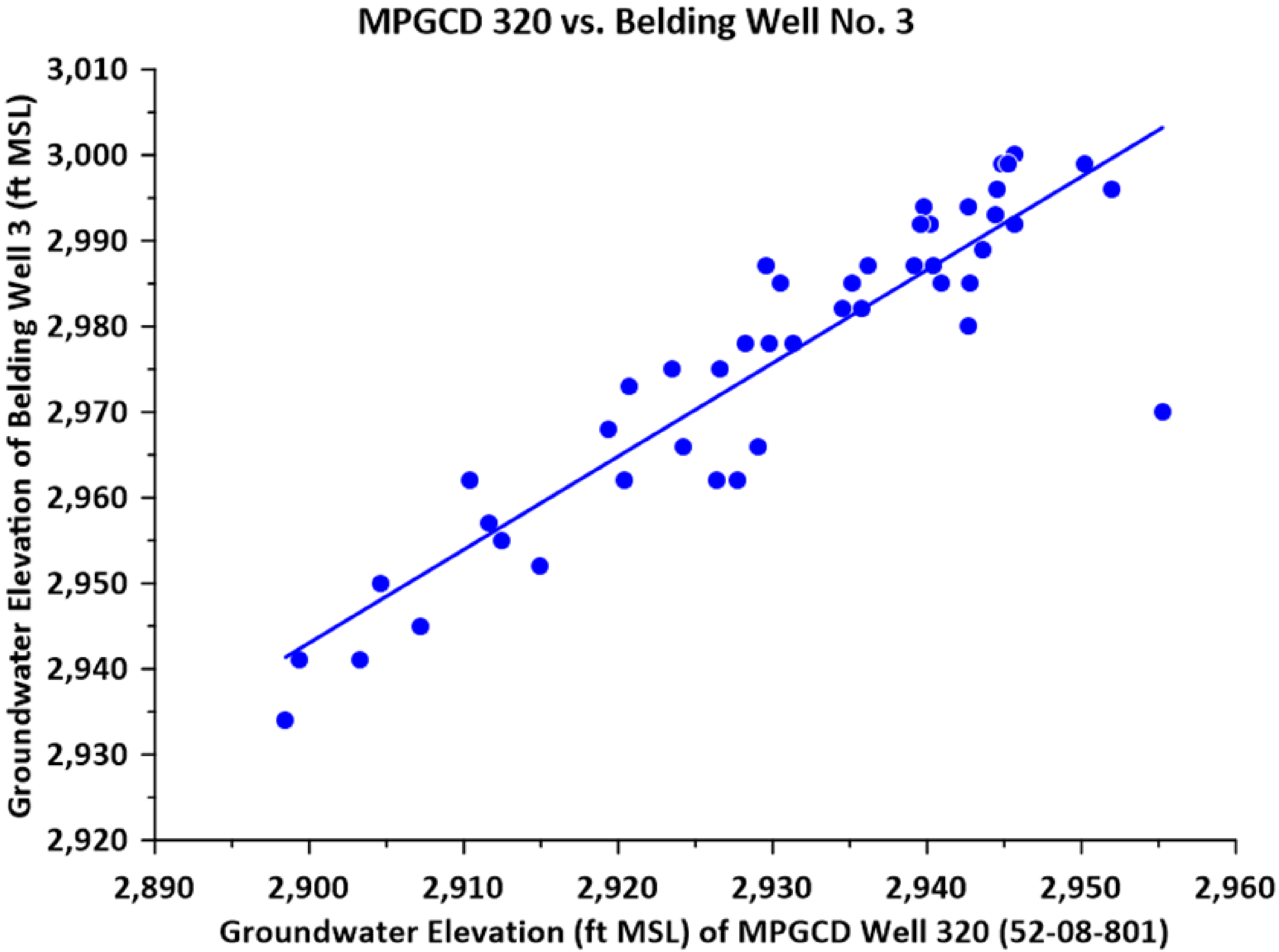
- Threshold 1 actions include several administrative actions including a moratorium on permits, and discussion at Board meeting
  - Lasts 30 days
- Proposed production reductions (all “production permit holders” in MZ1):
  - Threshold 1: None
  - Threshold 2: 50%
  - Threshold 3: 100%

Administration of Proposed Reductions

- Daily reductions in permit limits under Thresholds 2 and 3
- Requires 10 days above threshold limit to resume “normal” permit limits (3 of 4 wells)
- Provisions to adjust Threshold 2 limits after “evidentiary hearing” and analysis of groundwater quality data
  - Essentially demonstrating that there was “no adverse impact to the aquifer” if Threshold 2 was triggered
  - Caveat: if FSH Winter Threshold 1 is invoked, no changes can be made

Analyses of Proposed “Anytime” Thresholds

- 2018 report and presentation included correlation analysis of groundwater elevations
  - Belding Farms wells
  - 11 MPGCD monitoring wells in FSH special permit conditions
- Provided data at the time did not include pump settings
- Updated the analysis
  - Calculated the range of groundwater levels in 6 Belding Farms wells based on proposed thresholds for 4 MPGCD monitoring wells
  - Compared to static water levels in 6 Belding Farms production wells (1,2,3,5,8,10)
    - Winter maximum
    - Summer minimum



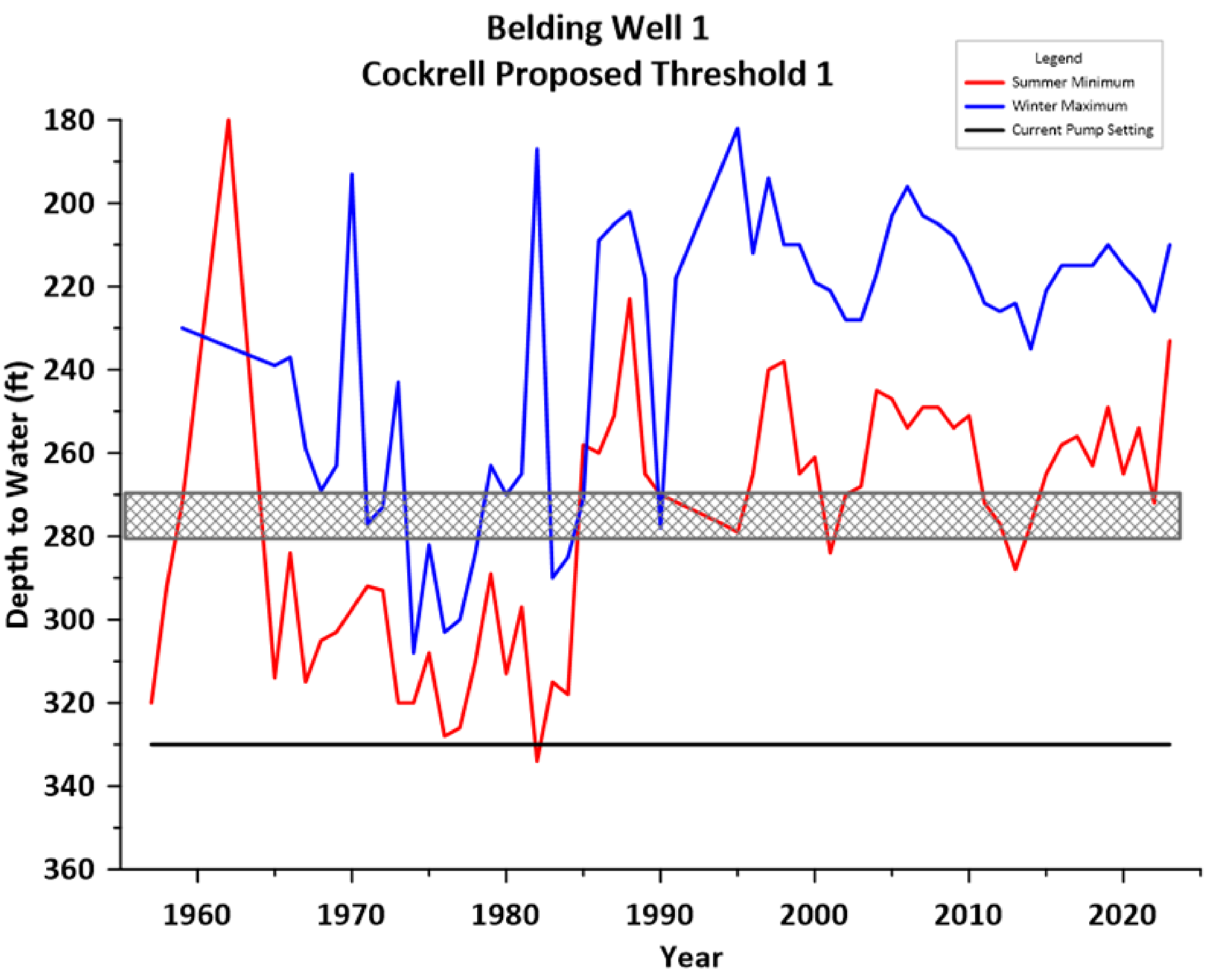
MPGCD 320 vs. Belding Well No. 3
Groundwater Elevation of Belding Well 3 (ft MSL)
3,010
3,000
2,990
2,980
2,970
2,960
2,950
2,940
2,930
2,920
2,890
2,900
2,910
2,920
2,930
2,940
2,950
2,960
Groundwater Elevation (ft MSL) of MPGCD Well 320 (52-08-801)

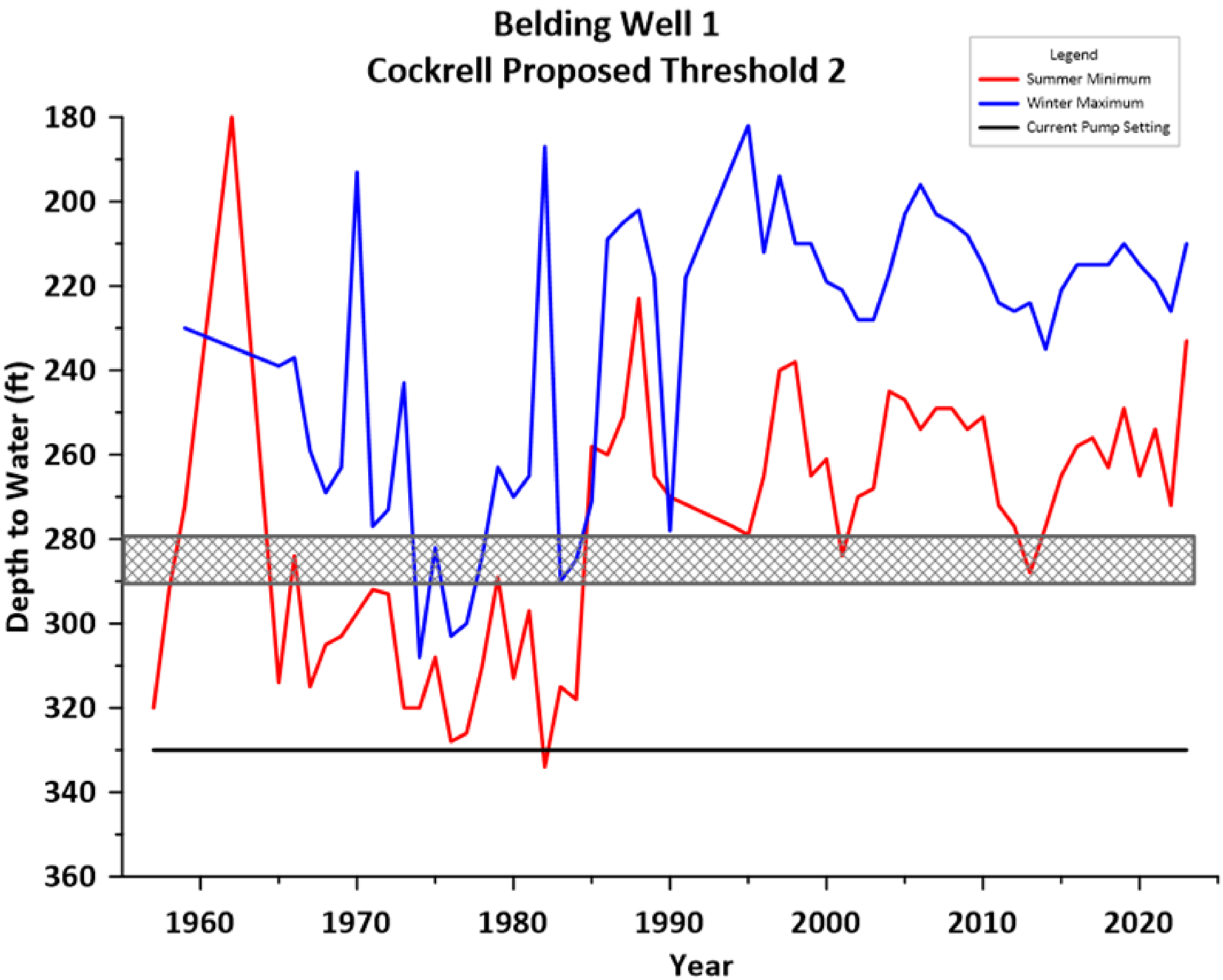
Proposed “Anytime” Threshold Hydrographs

- Six Belding Farms production wells
  - 1, 2, 3, 5, 8, 10
- Three proposed “anytime” thresholds in those six wells
  - Range based on correlation with four wells with proposed thresholds
  - Winter maximum and summer minimum depth to water data
  - Pump setting
- Total of 18 hydrographs (6 wells x 3 thresholds)

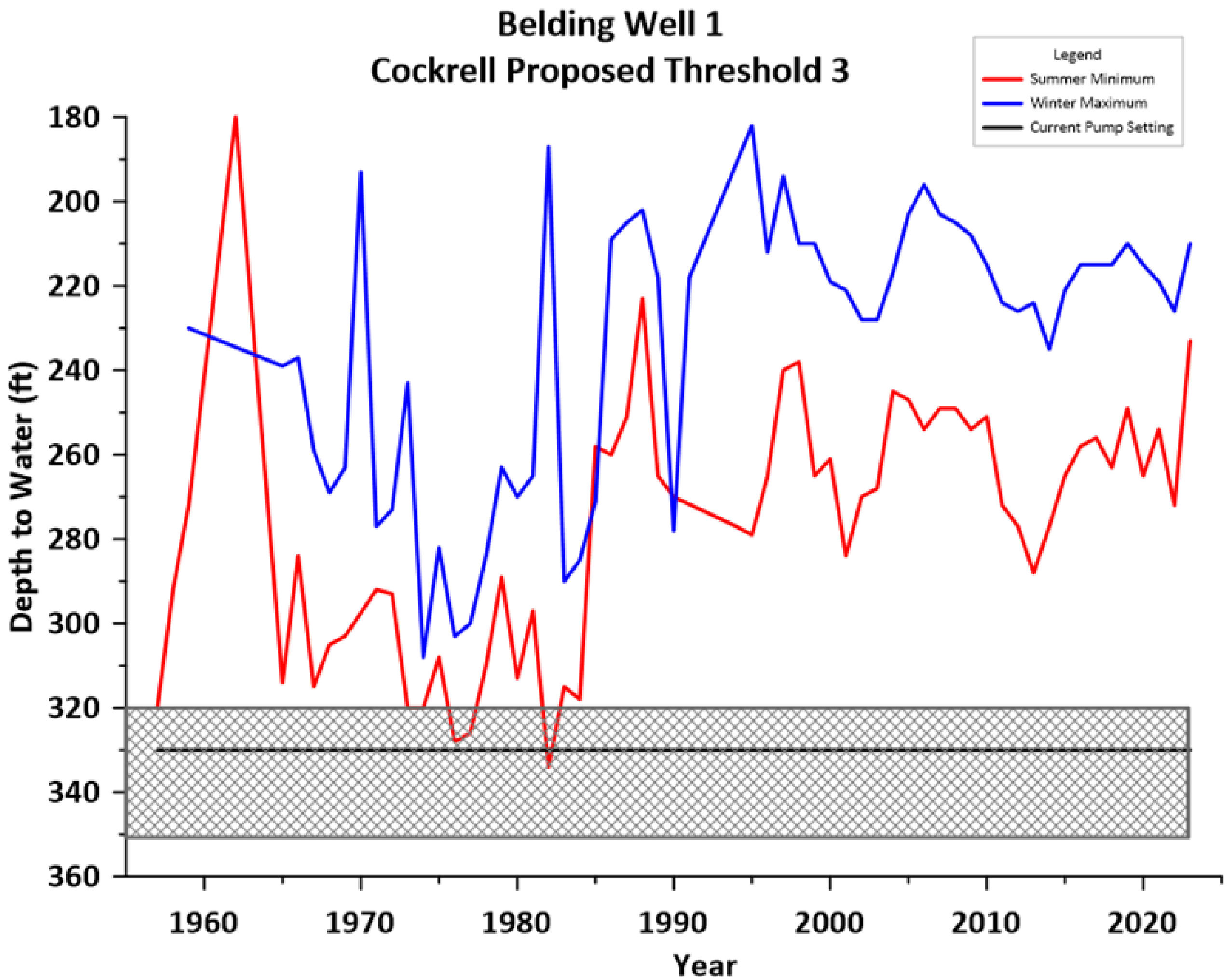
Belding Well 1

- Well Depth = 586 ft
- Pump Setting = 330 ft
- Average Pumping
  - 1967 to 1974 = 1,023 AF/yr
  - 2010 to 2022 = 675 AF/yr


Belding Well 1
Cockrell Proposed Threshold 1
Legend
Summer Minimum
Winter Maximum
Current Pump Setting
Depth to Water (ft)
180
200
220
240
260
280
300
320
340
360
1960
1970
1980
1990
2000
2010
2020
Year

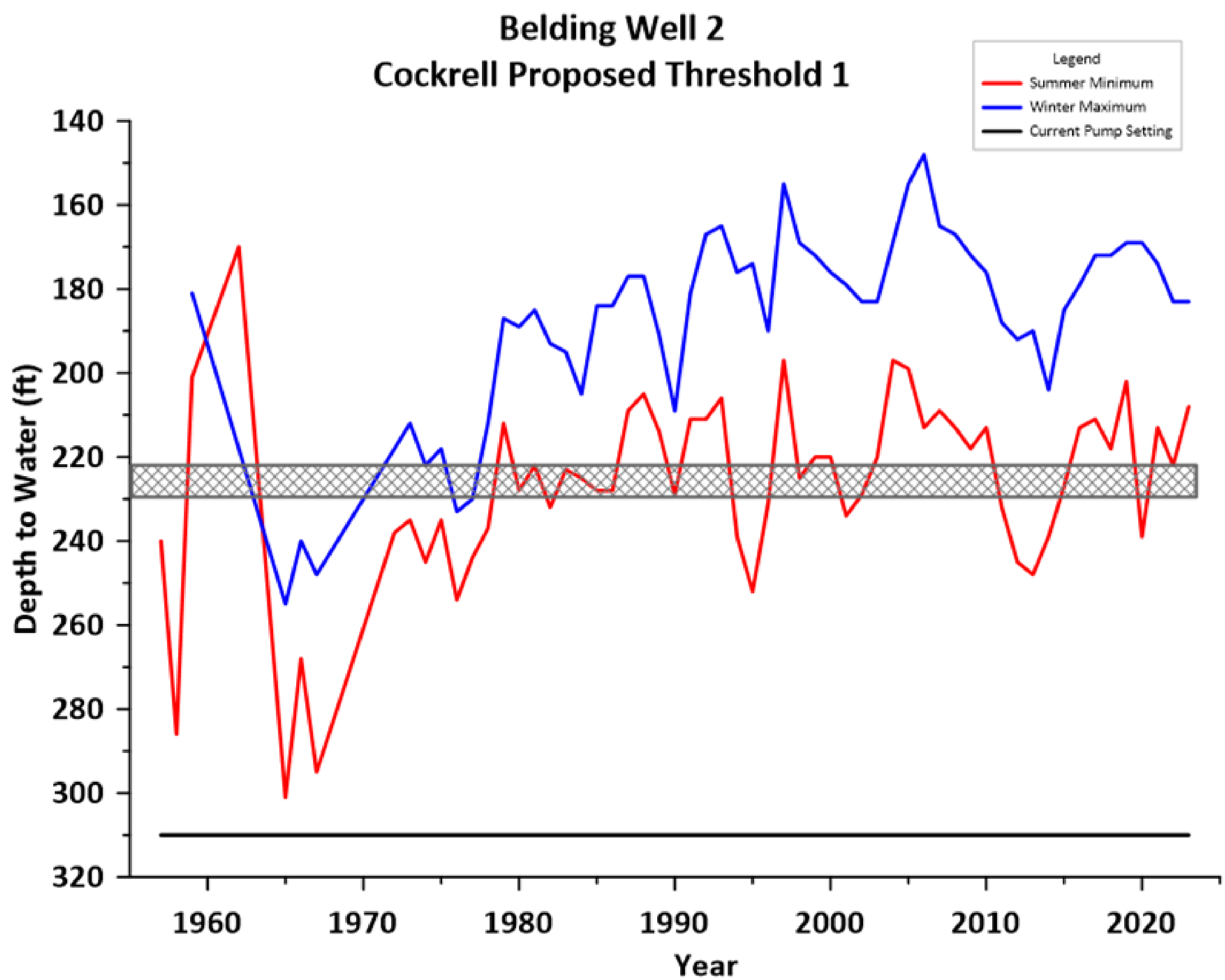


Belding Well 1
Cockrell Proposed Threshold 2
Legend
Summer Minimum
Winter Maximum
Current Pump Setting
Depth to Water (ft)
180
200
220
240
260
280
300
320
340
360
1960
1970
1980
1990
2000
2010
2020
Year

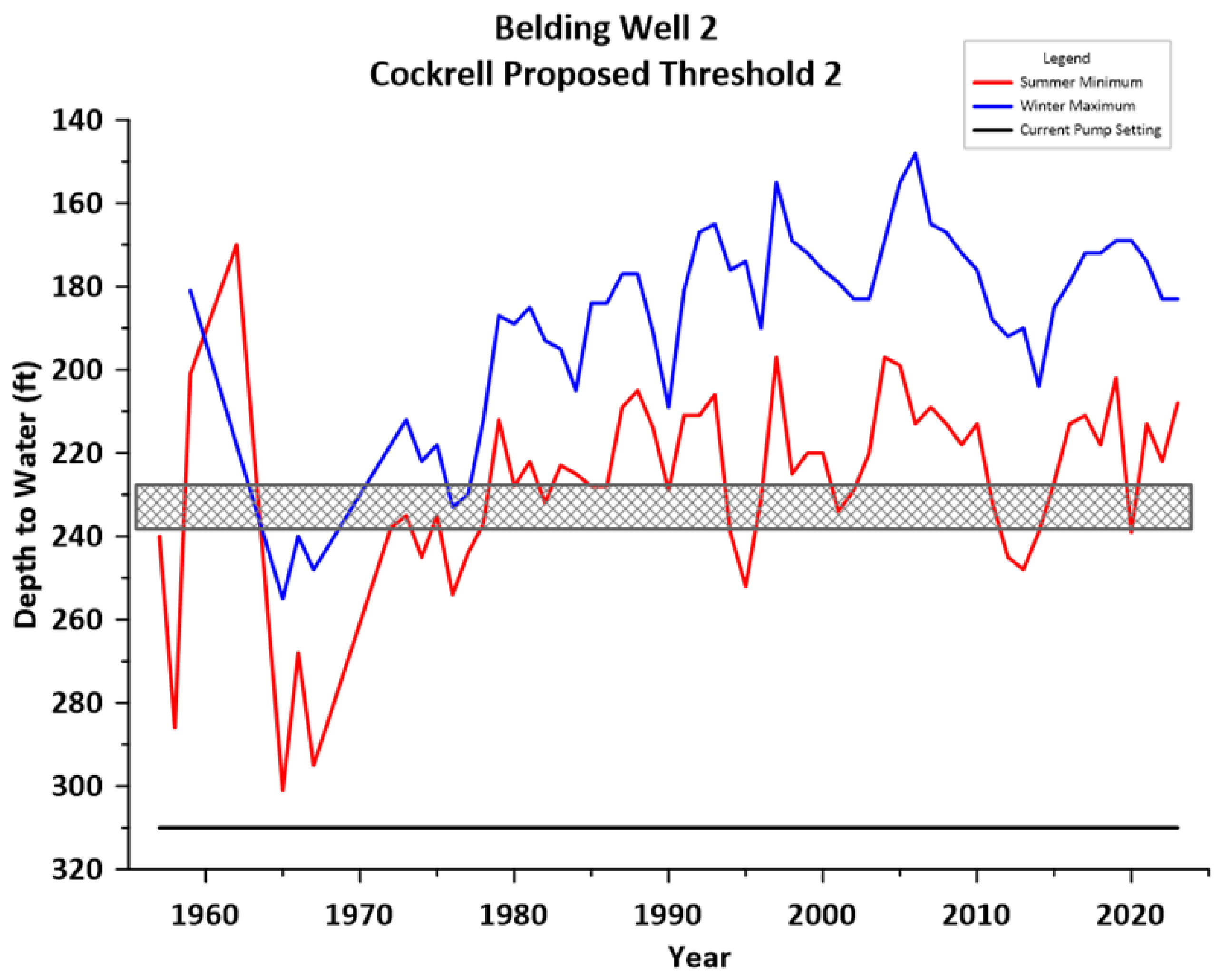

Belding Well 1
Cockrell Proposed Threshold 3
Legend
Summer Minimum
Winter Maximum
Current Pump Setting
Depth to Water (ft)
180
200
220
240
260
280
300
320
340
360
1960
1970
1980
1990
2000
2010
2020
Year

Belding Well 2

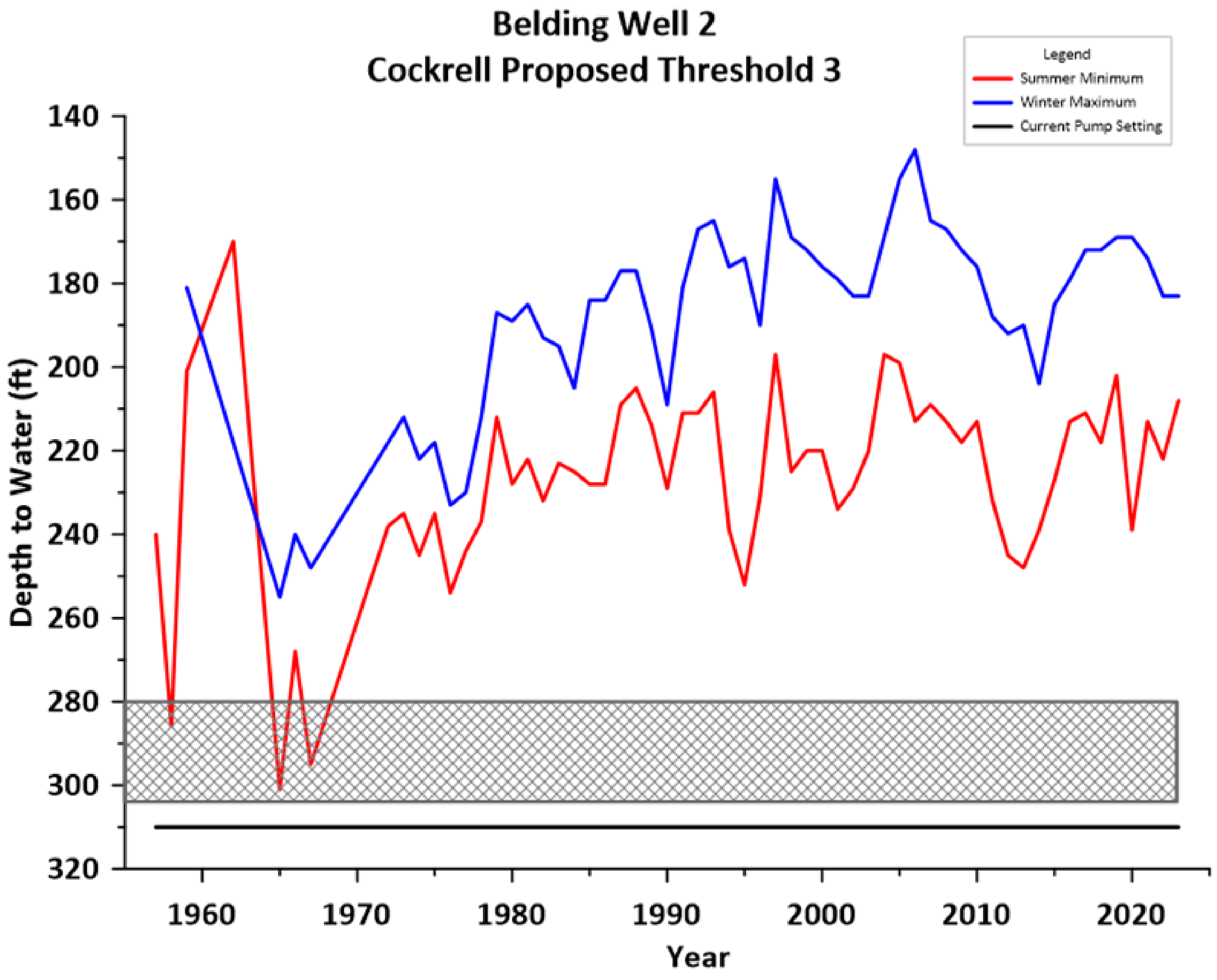
- Well Depth = 420 ft
- Pump Setting = 310 ft
- Average Pumping
  - 1967 to 1974 = 182 AF/yr
  - 2010 to 2022 = 162 AF/yr



Belding Well 2
Cockrell Proposed Threshold 1
Legend
Summer Minimum
Winter Maximum
Current Pump Setting
Depth to Water (ft)
140
160
180
200
220
240
260
280
300
320
1960
1970
1980
1990
2000
2010
2020
Year



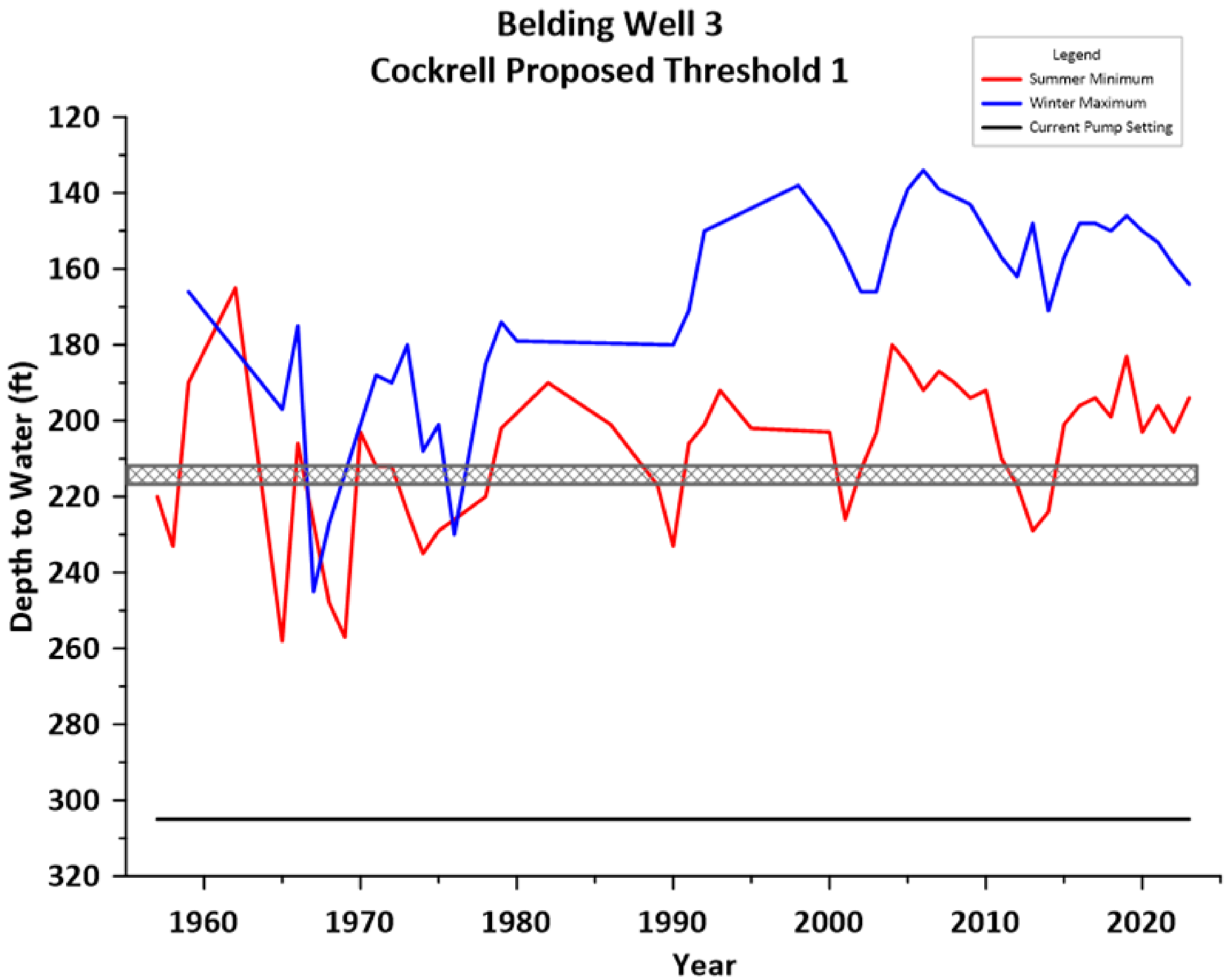
Belding Well 2
Cockrell Proposed Threshold 2
Legend
Summer Minimum
Winter Maximum
Current Pump Setting
Depth to Water (ft)
140
160
180
200
220
240
260
280
300
320
1960
1970
1980
1990
2000
2010
2020
Year

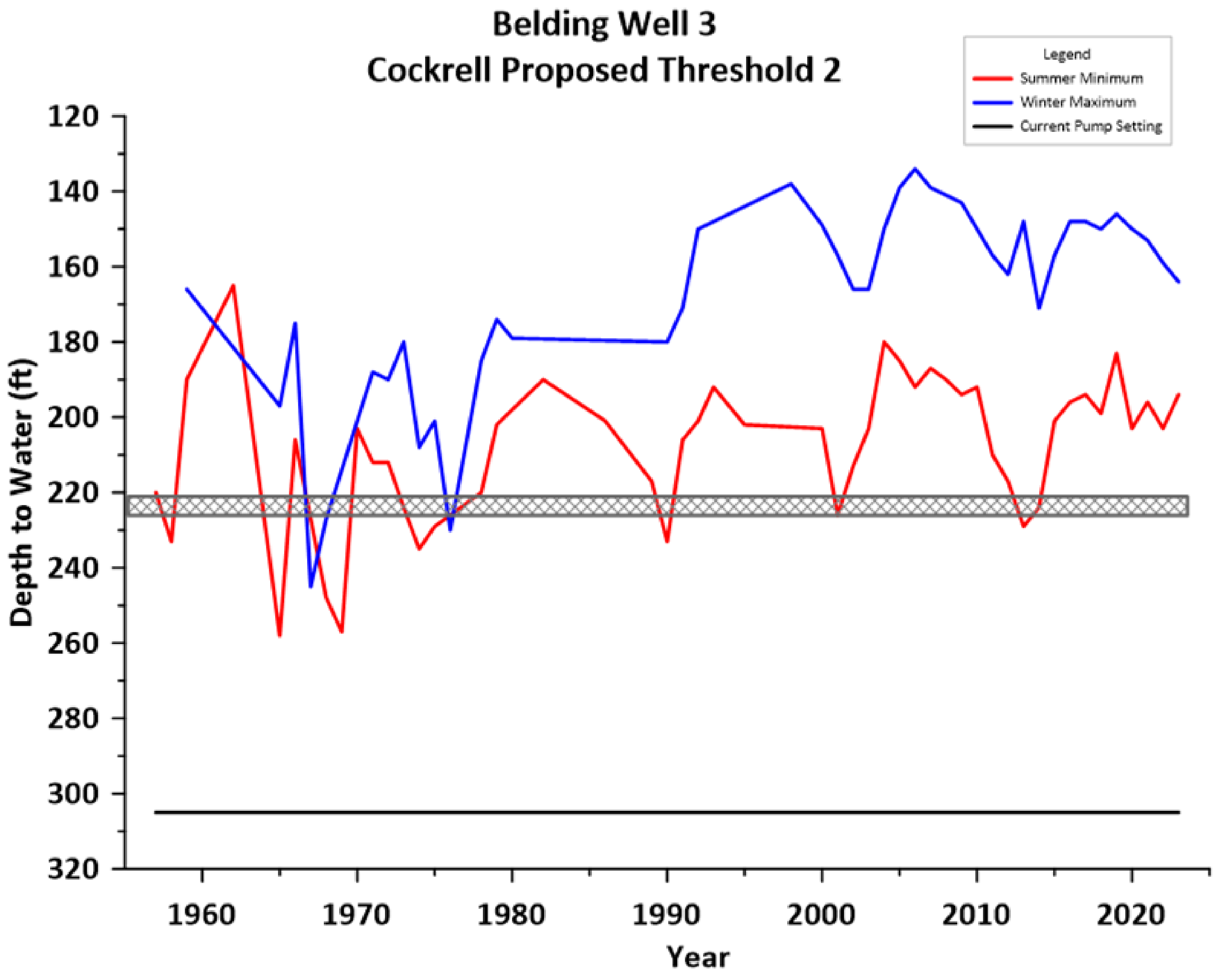


Belding Well 2
Cockrell Proposed Threshold 3
Legend
Summer Minimum
Winter Maximum
Current Pump Setting
Depth to Water (ft)
140
160
180
200
220
240
260
280
300
320
1960
1970
1980
1990
2000
2010
2020
Year

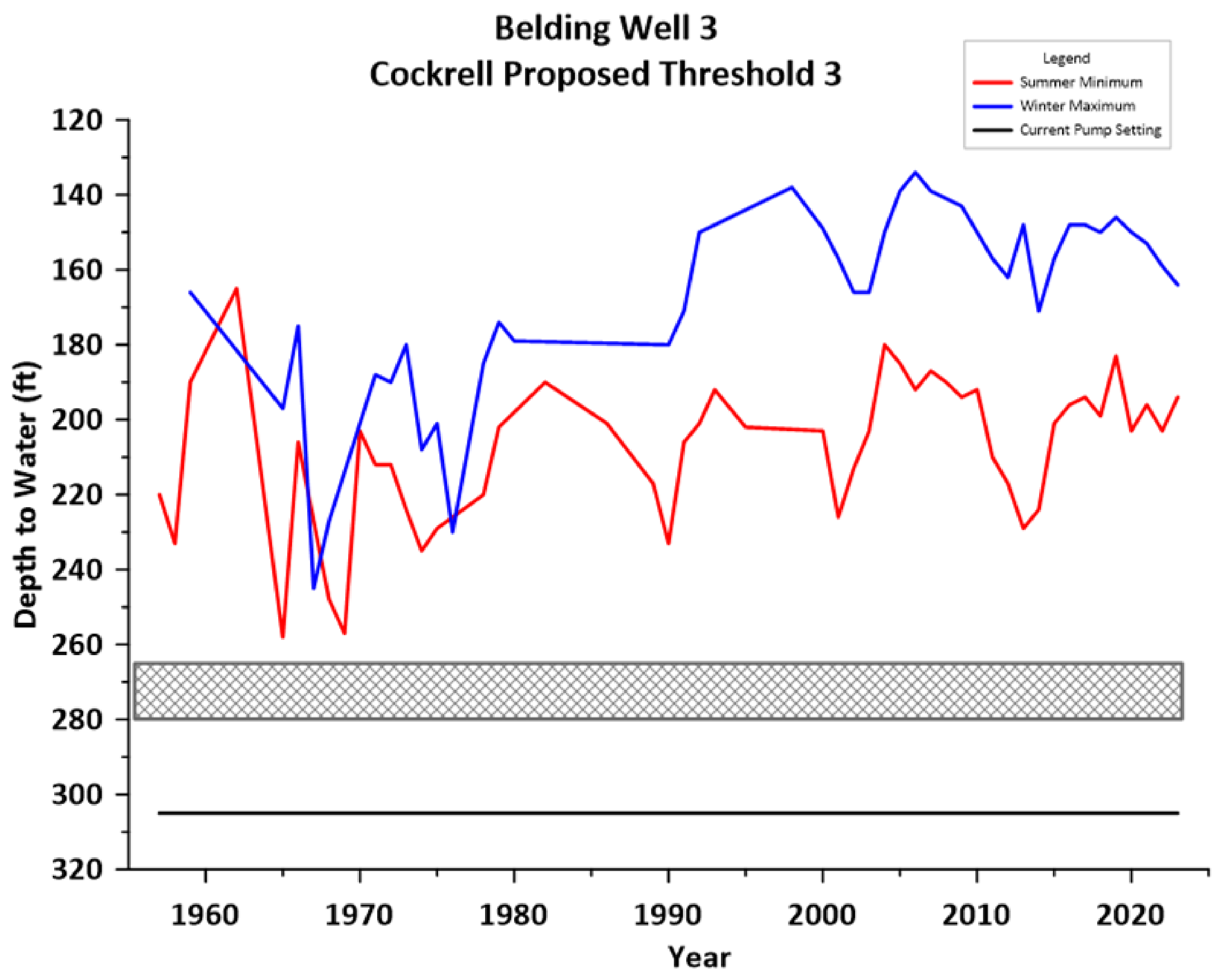
Belding Well 3

- Well Depth = 519 ft
- Pump Setting = 305 ft
- Average Pumping
  - 1967 to 1974 = 2,244 AF/yr
  - 2010 to 2022 = 1,524 AF/yr


Belding Well 3
Cockrell Proposed Threshold 1
Legend
Summer Minimum
Winter Maximum
Current Pump Setting
Depth to Water (ft)
120
140
160
180
200
220
240
260
280
300
320
1960
1970
1980
1990
2000
2010
2020
Year



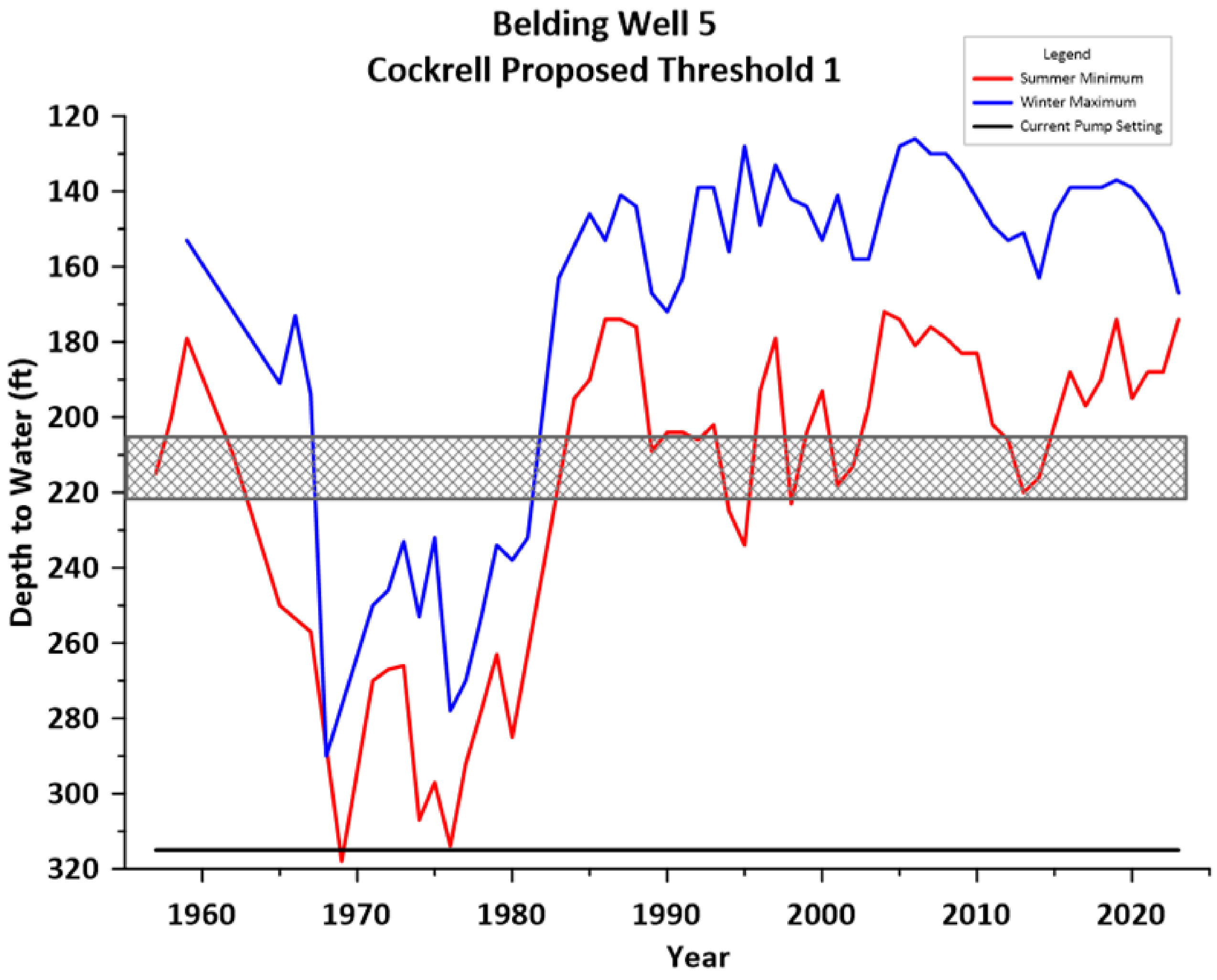
Belding Well 3
Cockrell Proposed Threshold 2
Legend
Summer Minimum
Winter Maximum
Current Pump Setting
Depth to Water (ft)
120
140
160
180
200
220
240
260
280
300
320
1960
1970
1980
1990
2000
2010
2020
Year



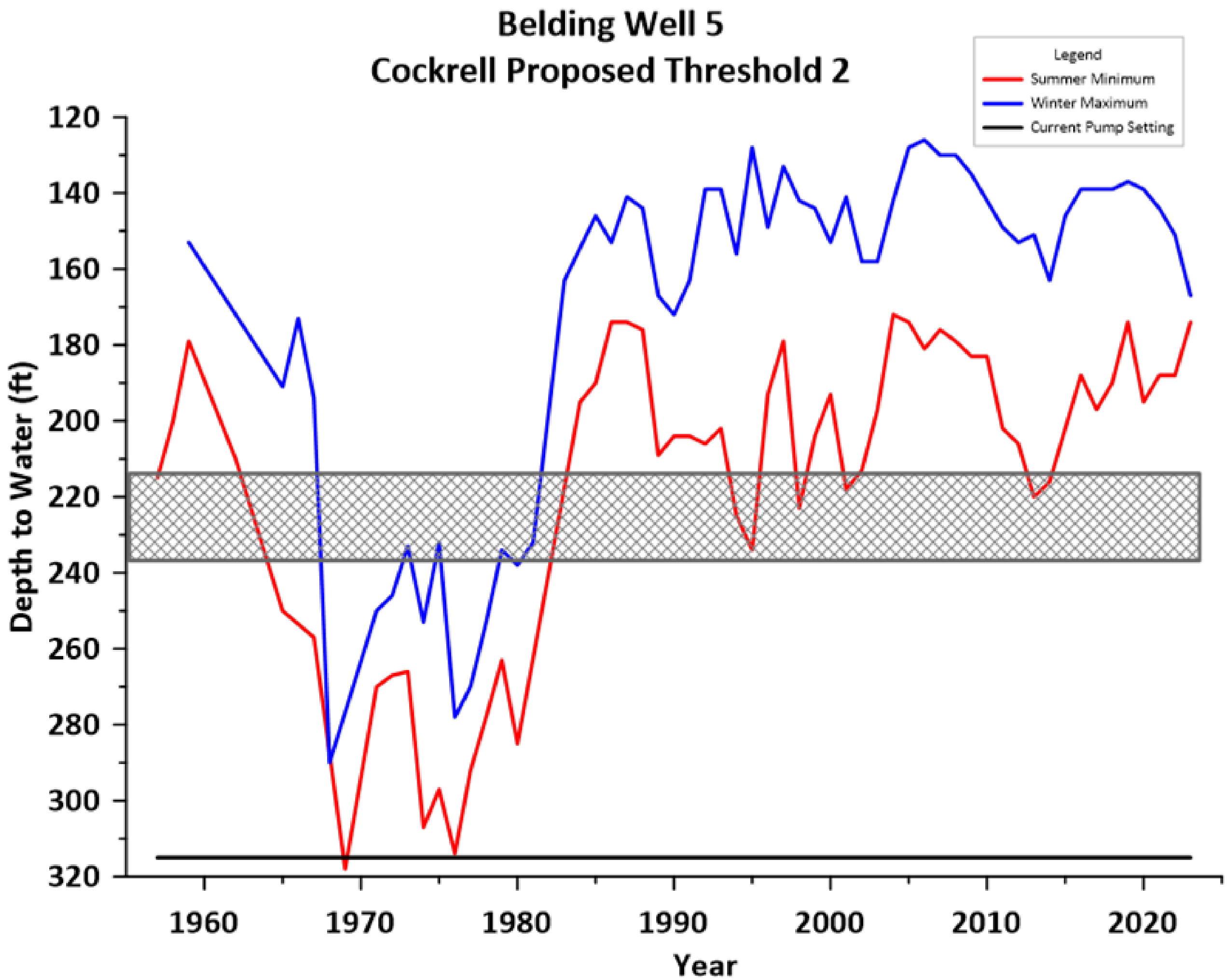
Belding Well 3
Cockrell Proposed Threshold 3
Legend
Summer Minimum
Winter Maximum
Current Pump Setting
Depth to Water (ft)
120
140
160
180
200
220
240
260
280
300
320
1960
1970
1980
1990
2000
2010
2020
Year

Belding Well 5

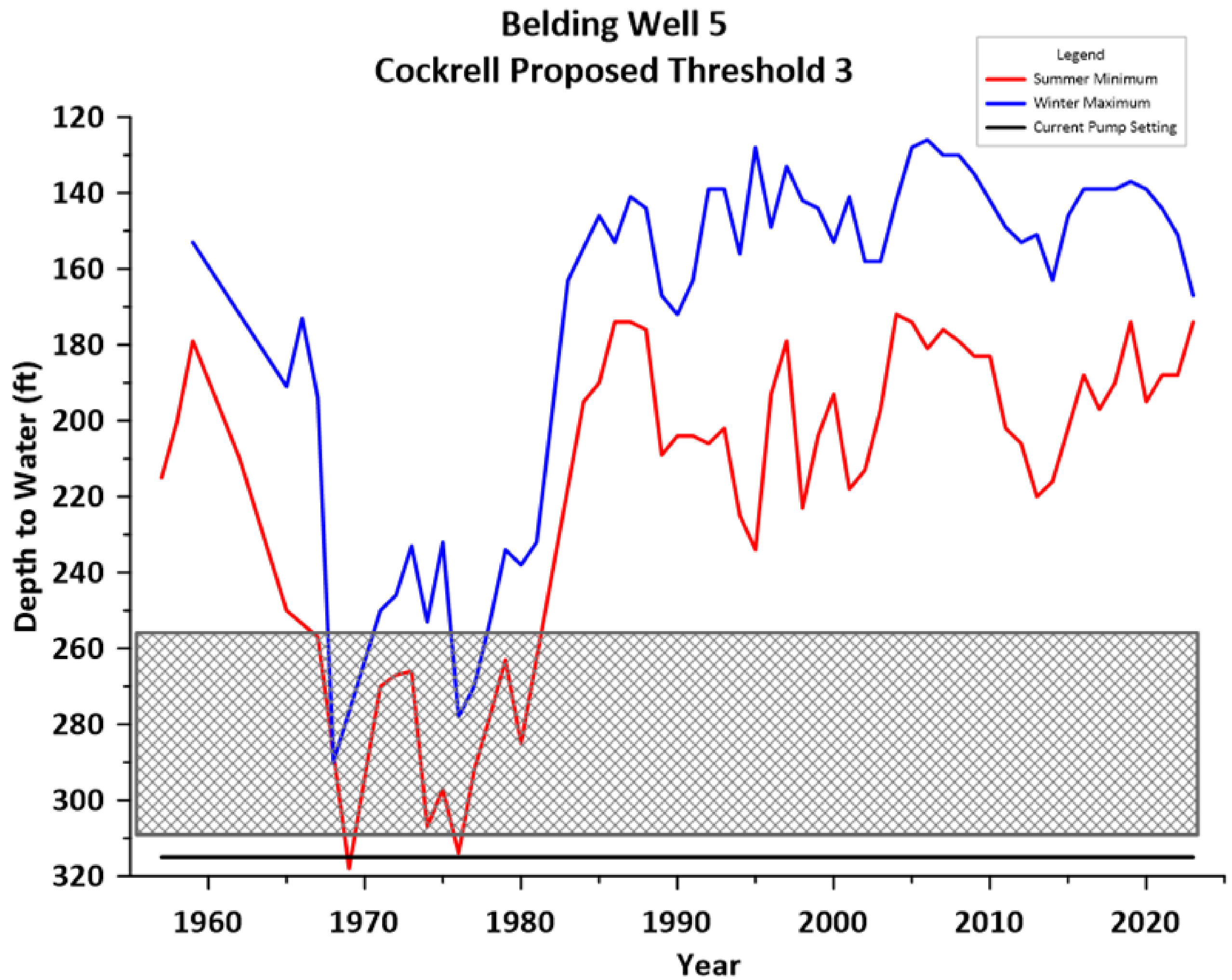
- Well Depth = 415 ft
- Pump Setting = 315 ft
- Average Pumping
  - 1967 to 1974 = 268 AF/yr
  - 2010 to 2022 = 293 AF/yr



Belding Well 5
Cockrell Proposed Threshold 1
Legend
Summer Minimum
Winter Maximum
Current Pump Setting
Depth to Water (ft)
120
140
160
180
200
220
240
260
280
300
320
1960
1970
1980
1990
2000
2010
2020
Year



Belding Well 5
Cockrell Proposed Threshold 2
Legend
Summer Minimum
Winter Maximum
Current Pump Setting
Depth to Water (ft)
120
140
160
180
200
220
240
260
280
300
320
1960
1970
1980
1990
2000
2010
2020
Year

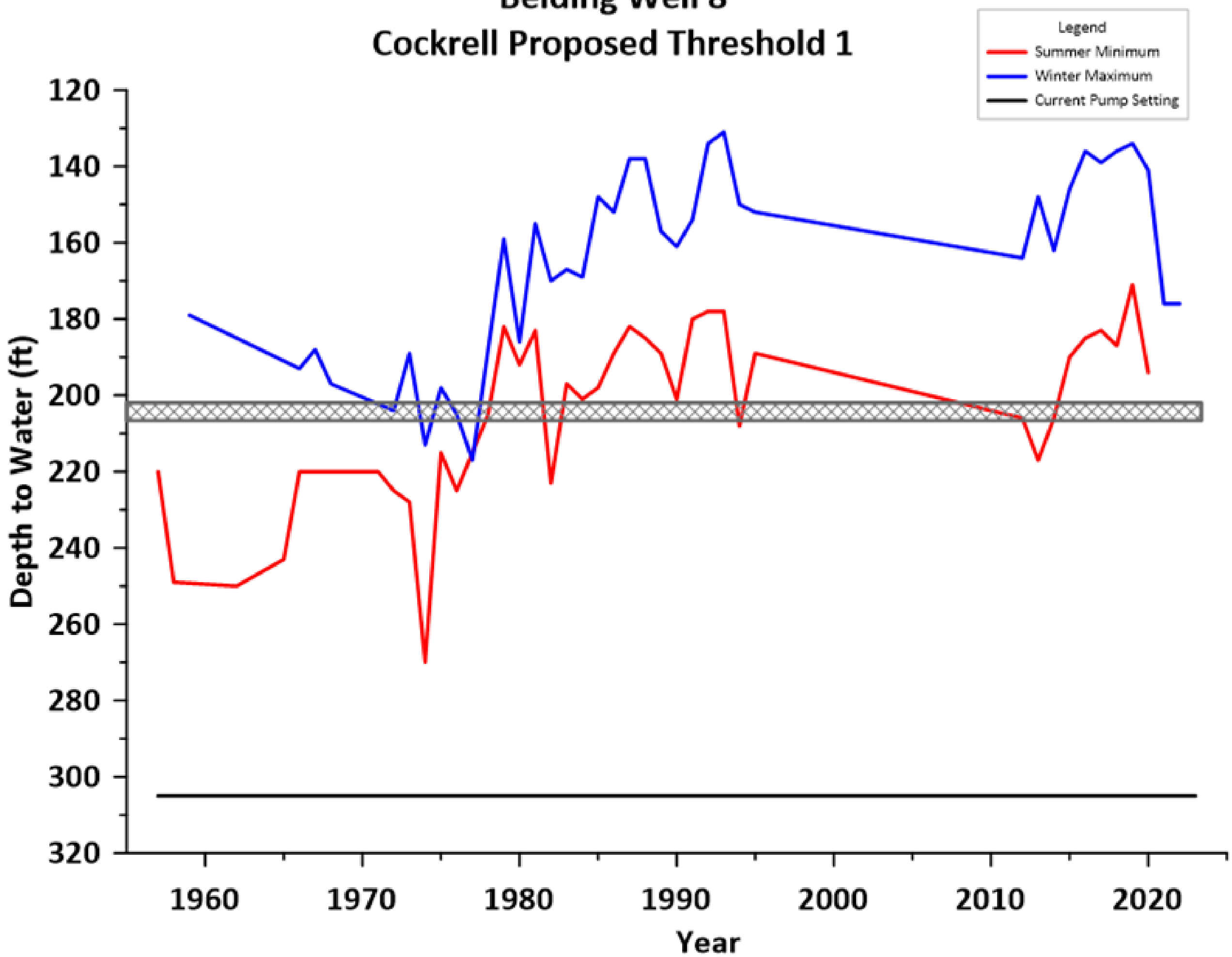


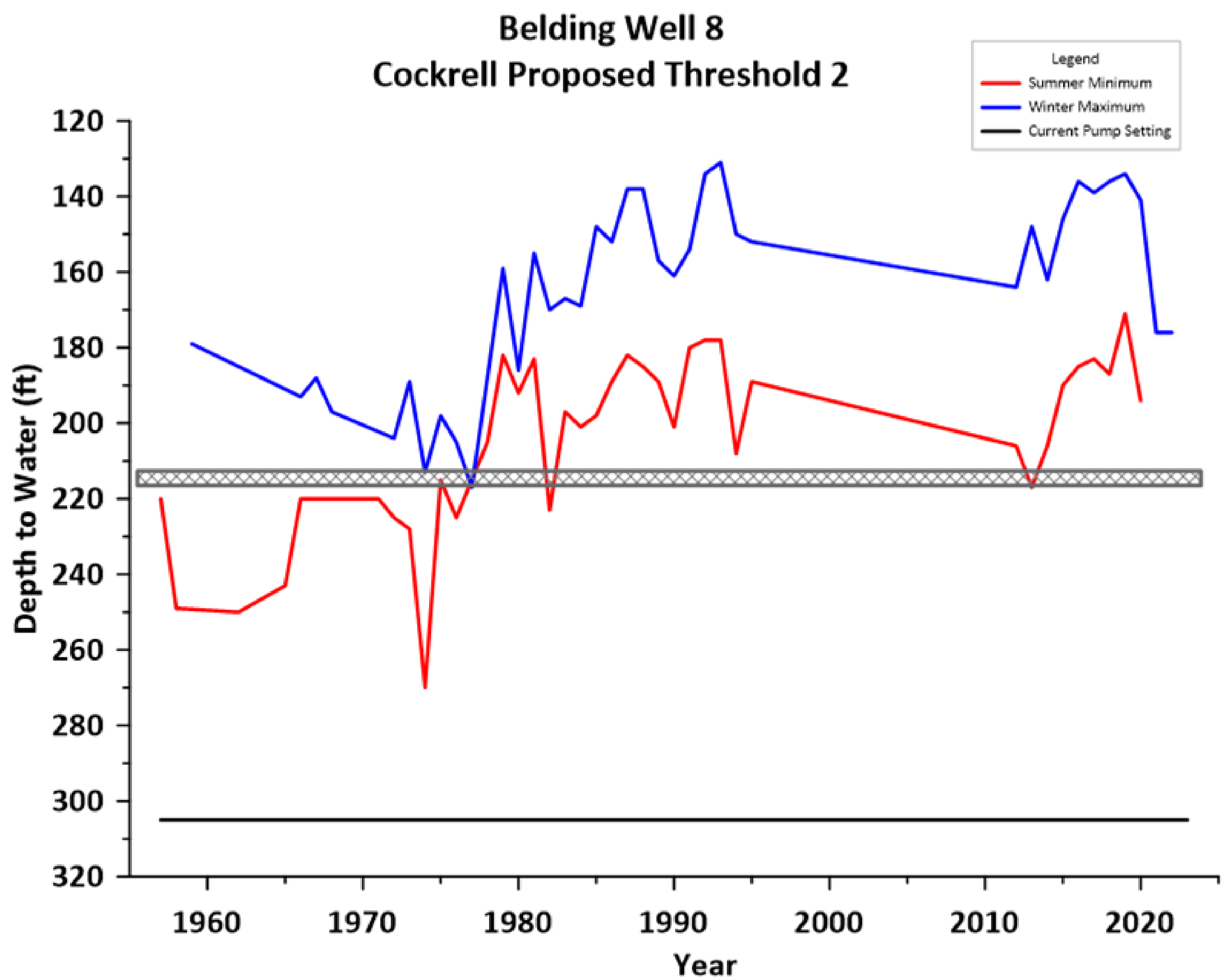
Belding Well 5
Cockrell Proposed Threshold 3
Legend
Summer Minimum
Winter Maximum
Current Pump Setting
Depth to Water (ft)
120
140
160
180
200
220
240
260
280
300
320
1960
1970
1980
1990
2000
2010
2020
Year

Belding Well 8

- Well Depth = 575 ft
- Pump Setting = 305 ft
- Average Pumping
  - 1967 to 1974 =   24 AF/yr
  - 2010 to 2022 = 270 AF/yr

Belding Well 8
Cockrell Proposed Threshold 1





Belding Well 8
Cockrell Proposed Threshold 2
Legend
Summer Minimum
Winter Maximum
Current Pump Setting
Depth to Water (ft)
120
140
160
180
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260
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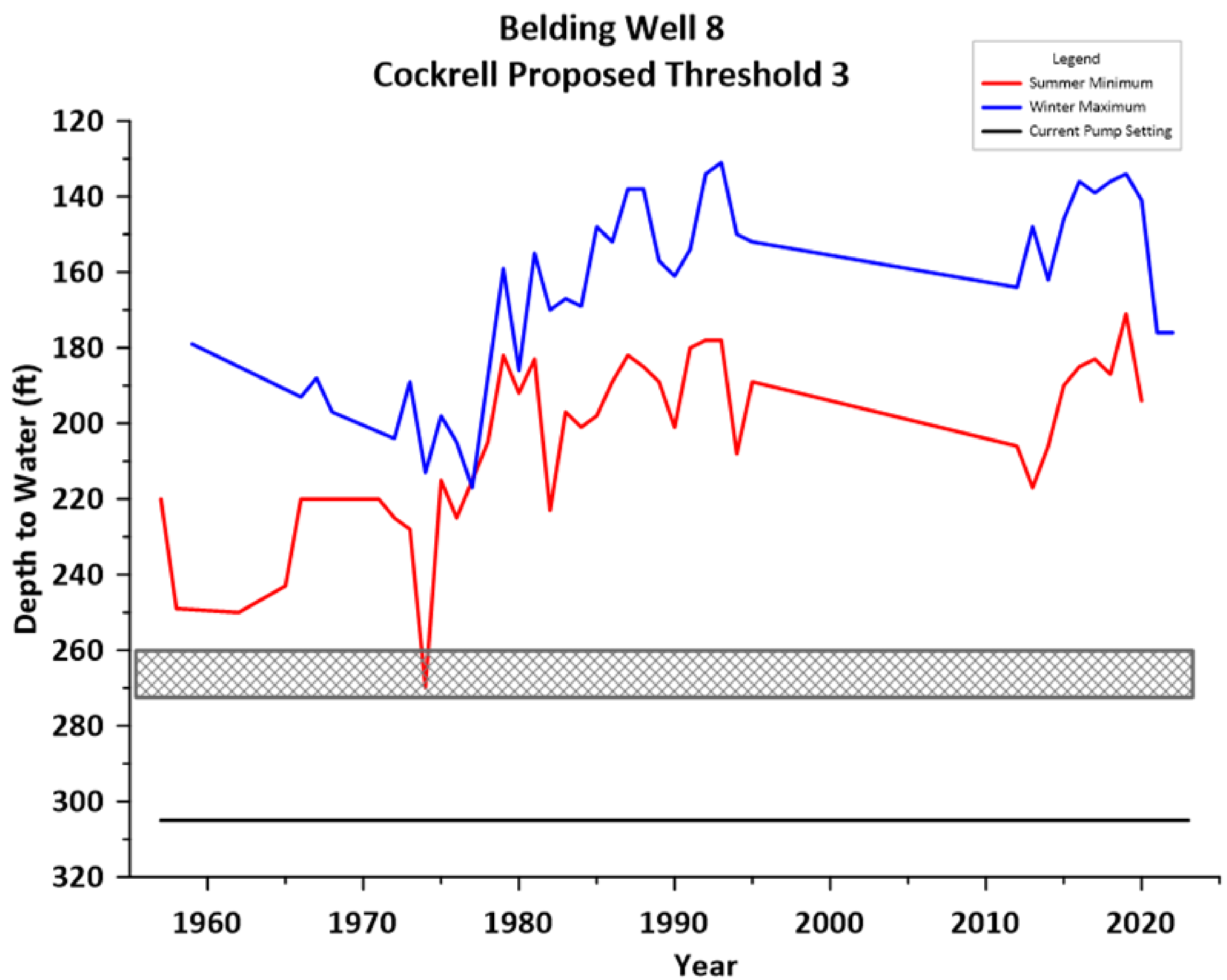
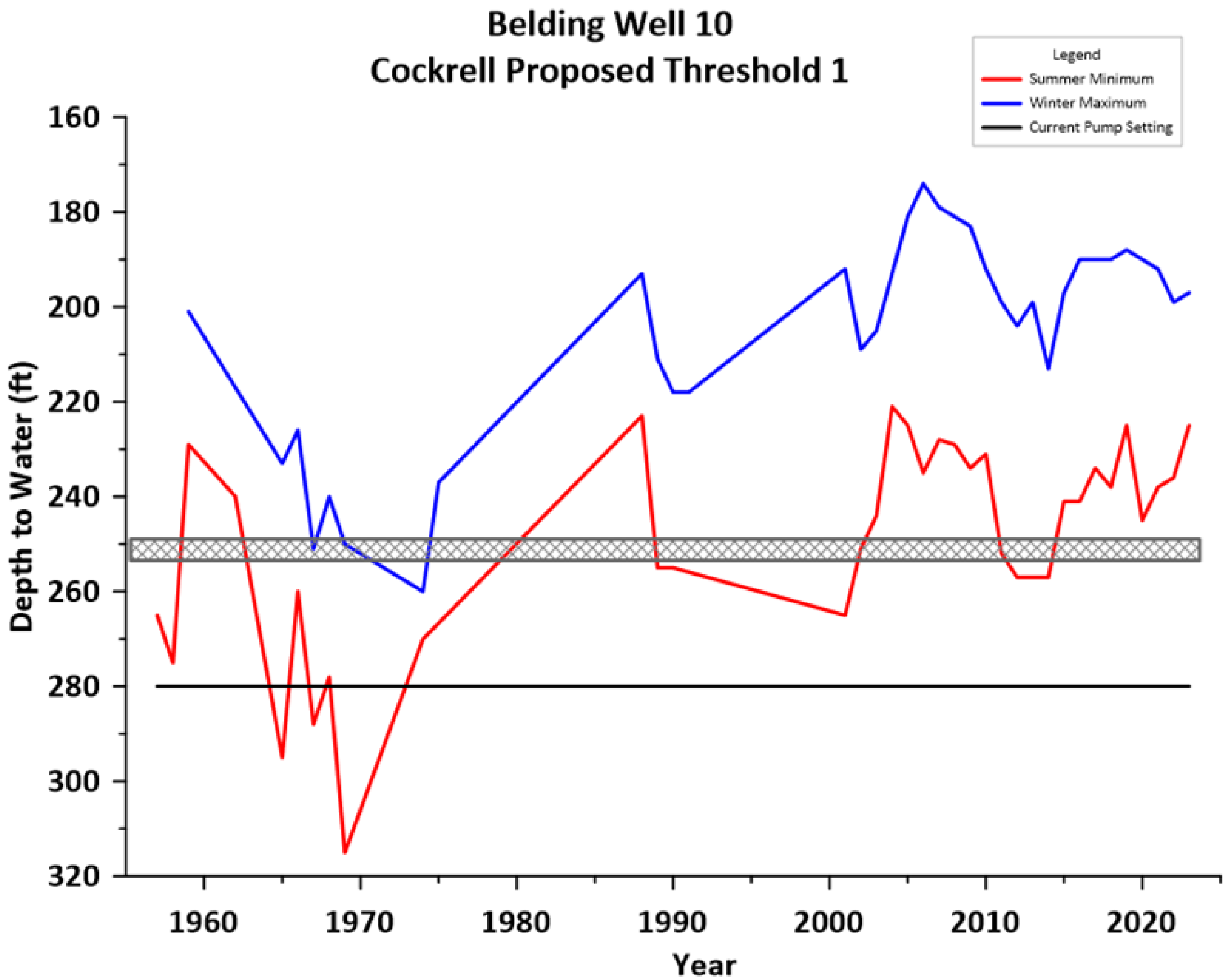
300
320
1960
1970
1980
1990
2000
2010
2020
Year



Belding Well 8
Cockrell Proposed Threshold 3
Legend
Summer Minimum
Winter Maximum
Current Pump Setting
Depth to Water (ft)
120
140
160
180
200
220
240
260
280
300
320
1960
1970
1980
1990
2000
2010
2020
Year

Belding Well 10

- Well Depth = 480 ft
- Pump Setting = 280 ft
- Average Pumping
  - 1967 to 1974 = 602 AF/yr
  - 2010 to 2022 = 377 AF/yr


Belding Well 10
Cockrell Proposed Threshold 1
Legend
Summer Minimum
Winter Maximum
Current Pump Setting
160
180
200
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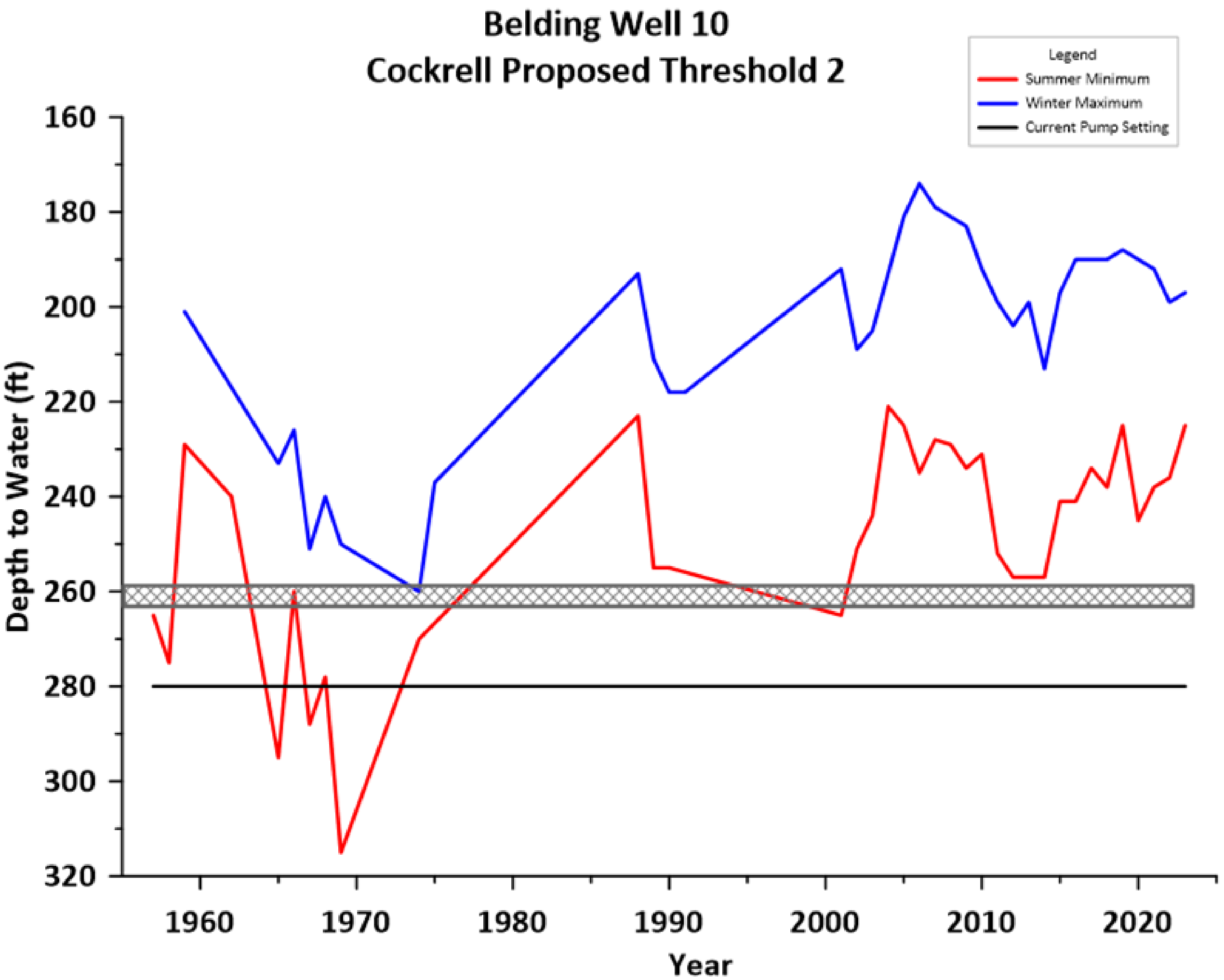
240
260
280
300
320
Depth to Water (ft)
1960
1970
1980
1990
2000
2010
2020
Year



Belding Well 10
Cockrell Proposed Threshold 2
Legend
Summer Minimum
Winter Maximum
Current Pump Setting
Depth to Water (ft)
160
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300
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1960
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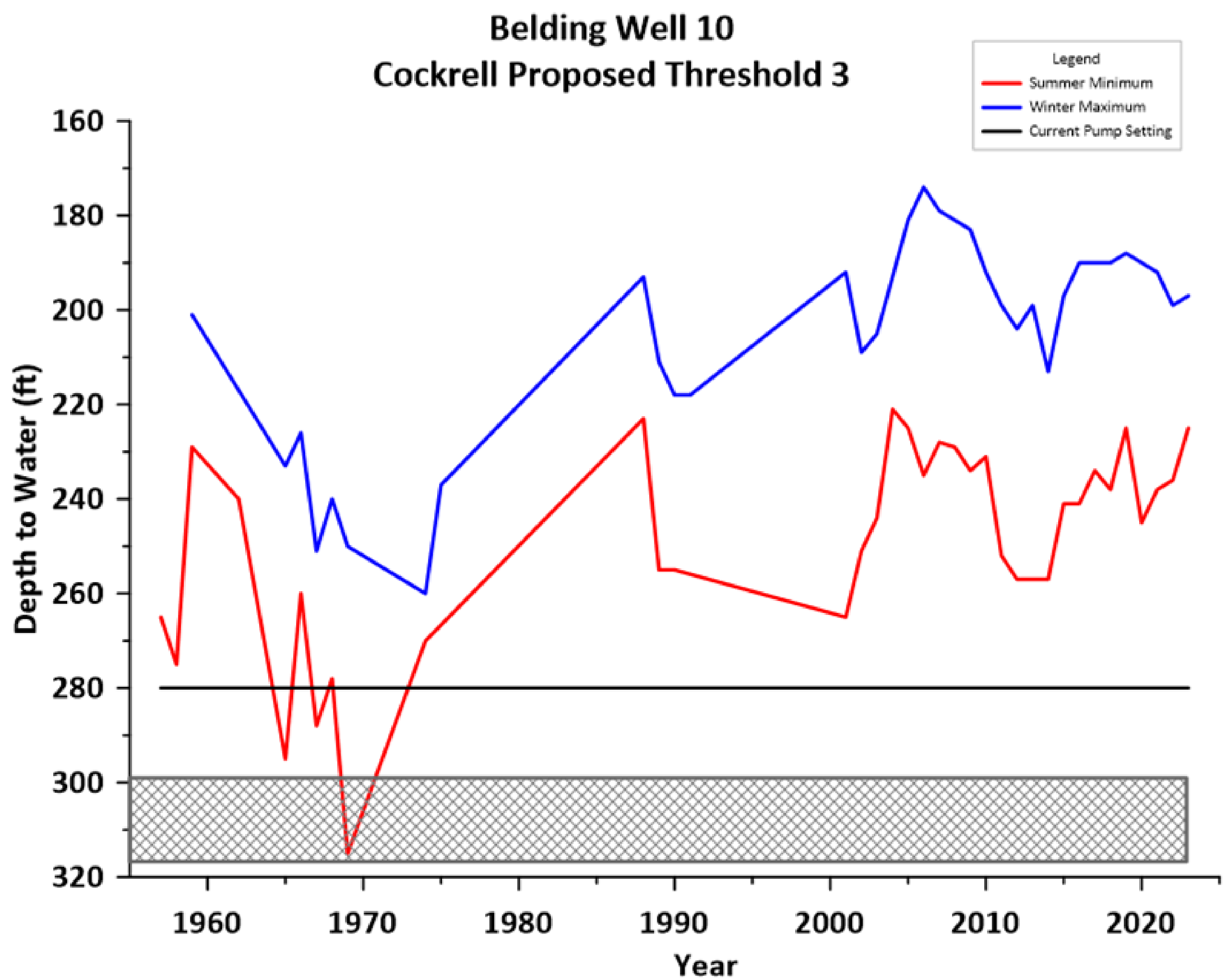
2010
2020
Year



Belding Well 10
Cockrell Proposed Threshold 3
Legend
Summer Minimum
Winter Maximum
Current Pump Setting
Depth to Water (ft)
160
180
200
220
240
260
280
300
320
1960
1970
1980
1990
2000
2010
2020
Year

Analysis of Current FSH Thresholds in the Context of Belding Farms Wells

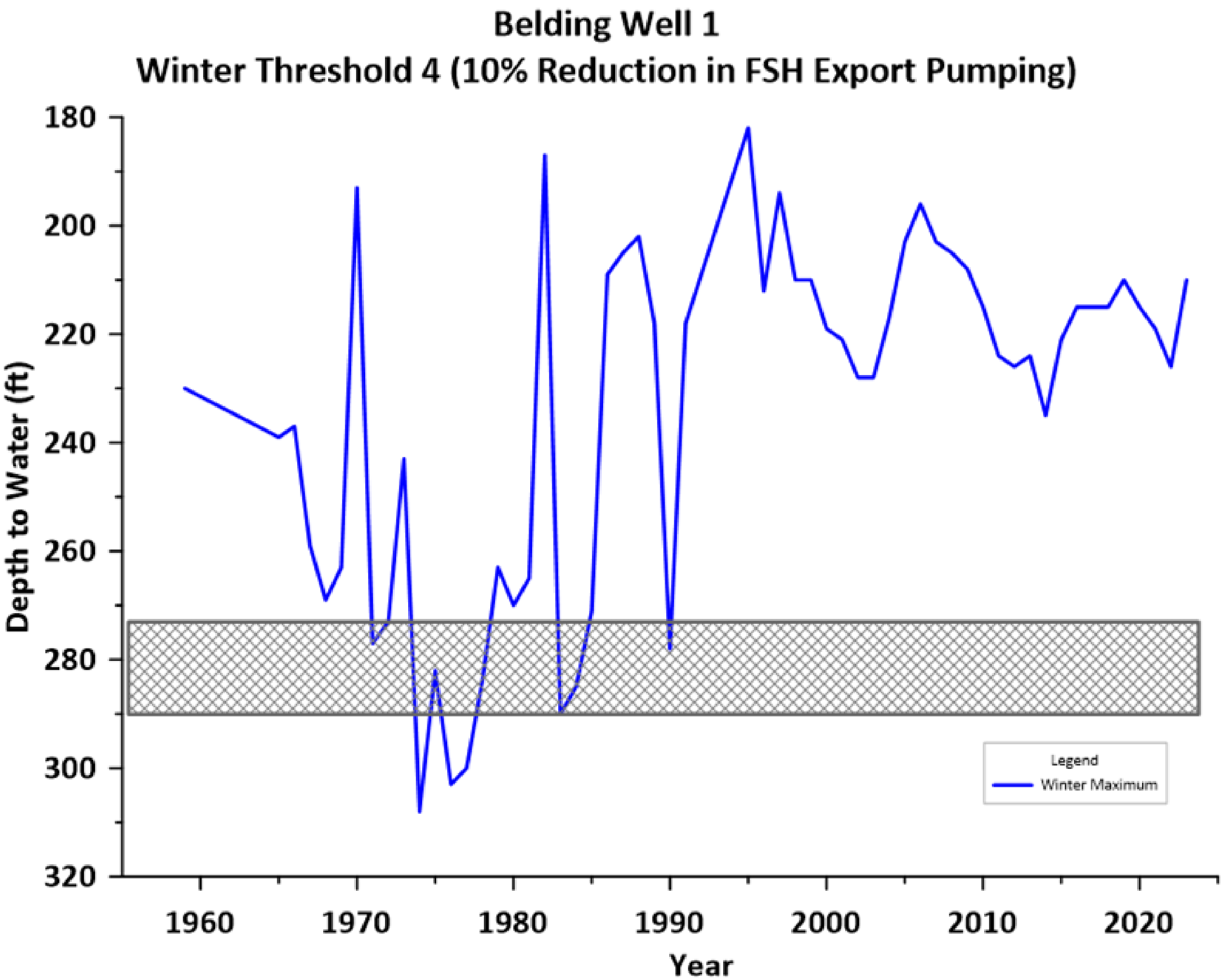
- Belding Farms data were not available in 2017 when thresholds were developed
- 2018 data analysis concluded that the winter thresholds are conservative in protecting groundwater levels in MZ1 wells
  - If Belding Farms data had been available in 2017, winter thresholds would have been set lower
  - FSH chose to not request (or initiate) revisions based on the 2018 data analysis of Belding Farms data
    - Awaiting results of additional studies and monitoring results
- Discussion of 2018 Belding Farms data analysis included recognition that summer thresholds could be revised
  - Requested pump setting data to include as a criterion to revise summer thresholds

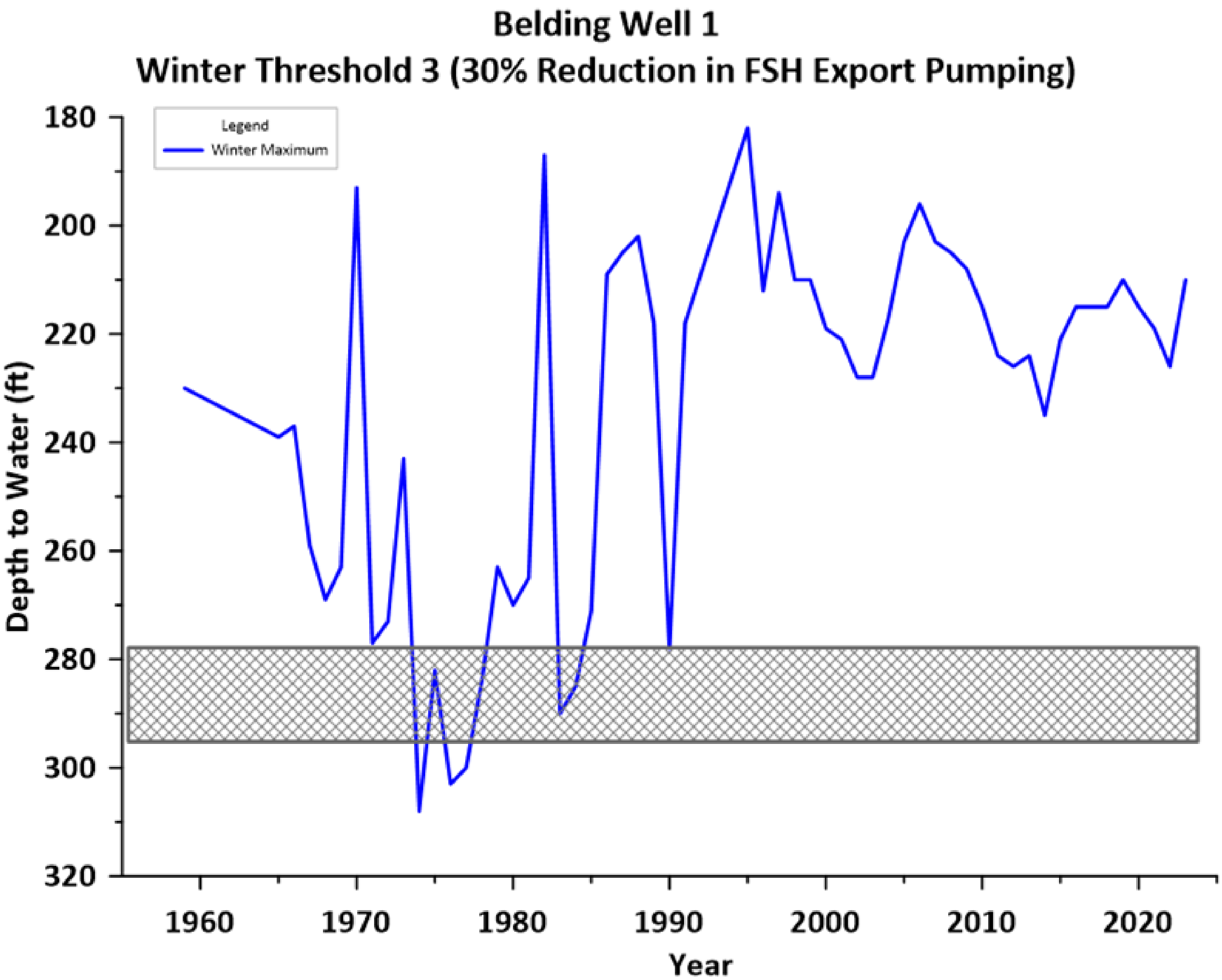
Winter Threshold Hydrographs

- Six Belding Farms production wells
  - 1, 2, 3, 5, 8, 10
- Four FSH winter thresholds in those six wells
  - Range based on correlation with four wells from Cockrell proposal
  - Winter maximum depth to water data
- Total of 24 hydrographs (6 wells x 4 thresholds)
  - Winter 4 = 10% FSH export pumping reduction
  - Winter 3 = 30% FSH export pumping reduction
  - Winter 2 = 50% FSH export pumping reduction
  - Winter 1 = 100% FSH export pumping reduction

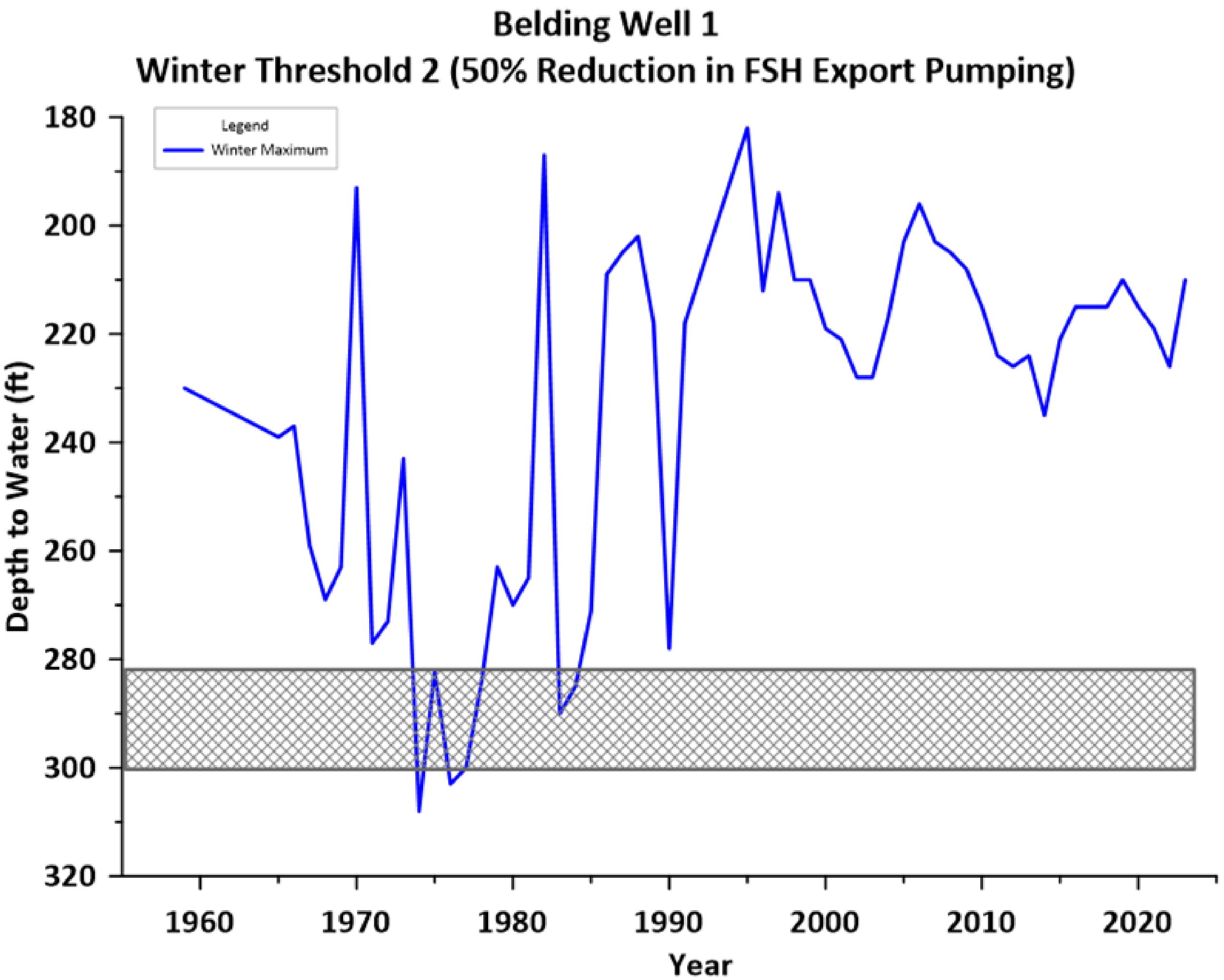
Belding Well 1

- Well Depth = 586 ft
- Pump Setting = 330 ft
- Average Pumping
  - 1967 to 1974 = 1,023 AF/yr
  - 2010 to 2022 = 675 AF/yr


Belding Well 1
Winter Threshold 4 (10% Reduction in FSH Export Pumping)
Depth to Water (ft)
180
200
220
240
260
280
300
320
1960
1970
1980
1990
2000
2010
2020
Year
Legend
Winter Maximum



Belding Well 1
Winter Threshold 3 (30% Reduction in FSH Export Pumping)
Legend
Winter Maximum
Depth to Water (ft)
180
200
220
240
260
280
300
320
1960
1970
1980
1990
2000
2010
2020
Year



Belding Well 1
Winter Threshold 2 (50% Reduction in FSH Export Pumping)
Legend
Winter Maximum
Depth to Water (ft)
180
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1960
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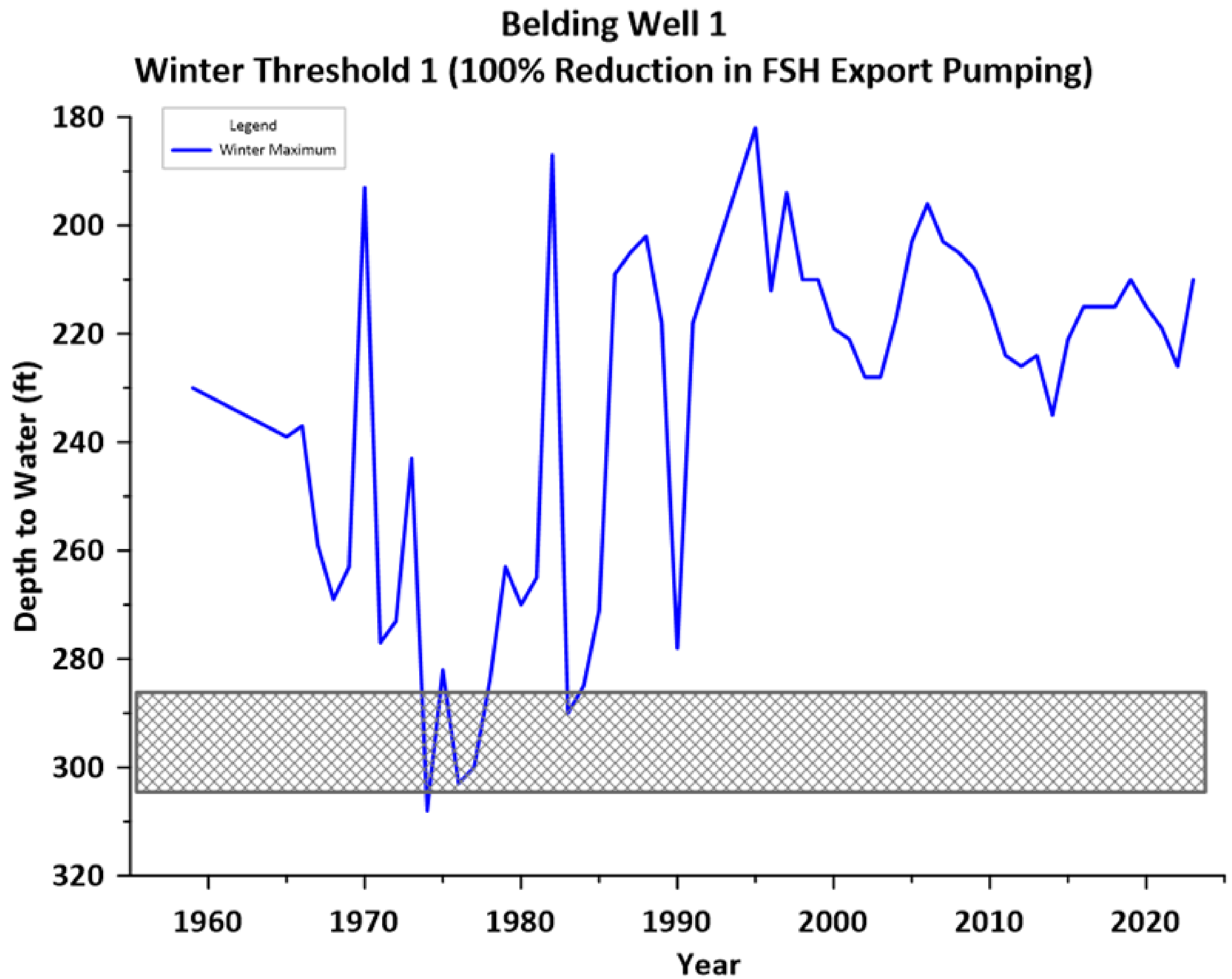
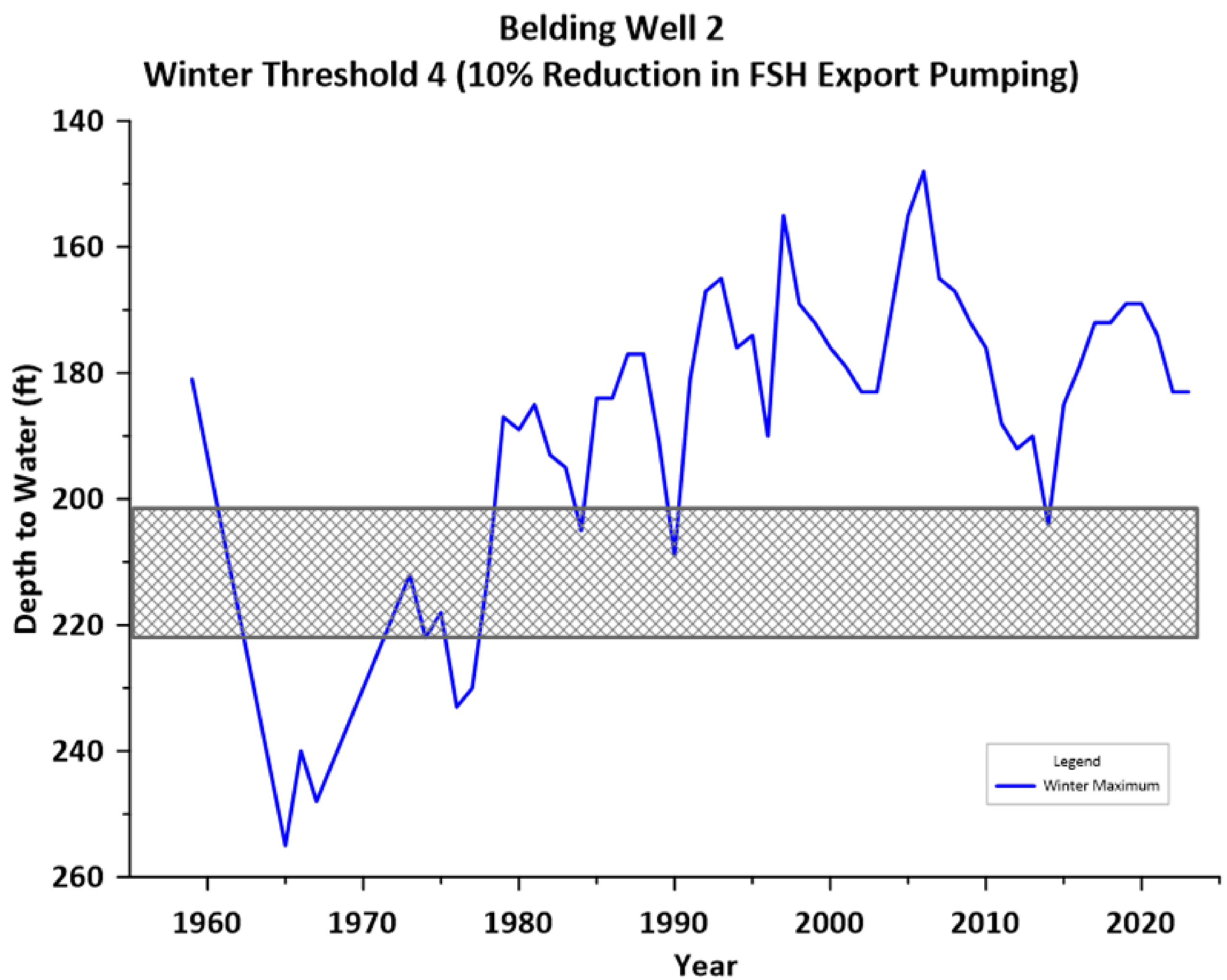
2010
2020
Year


Belding Well 1
Winter Threshold 1 (100% Reduction in FSH Export Pumping)
Legend
Winter Maximum
Depth to Water (ft)
180
200
220
240
260
280
300
320
1960
1970
1980
1990
2000
2010
2020
Year

Belding Well 2

- Well Depth = 420 ft
- Pump Setting = 310 ft
- Average Pumping
  - 1967 to 1974 = 182 AF/yr
  - 2010 to 2022 = 162 AF/yr


Belding Well 2
Winter Threshold 4 (10% Reduction in FSH Export Pumping)
140
160
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240
260
Depth to Water (ft)
1960
1970
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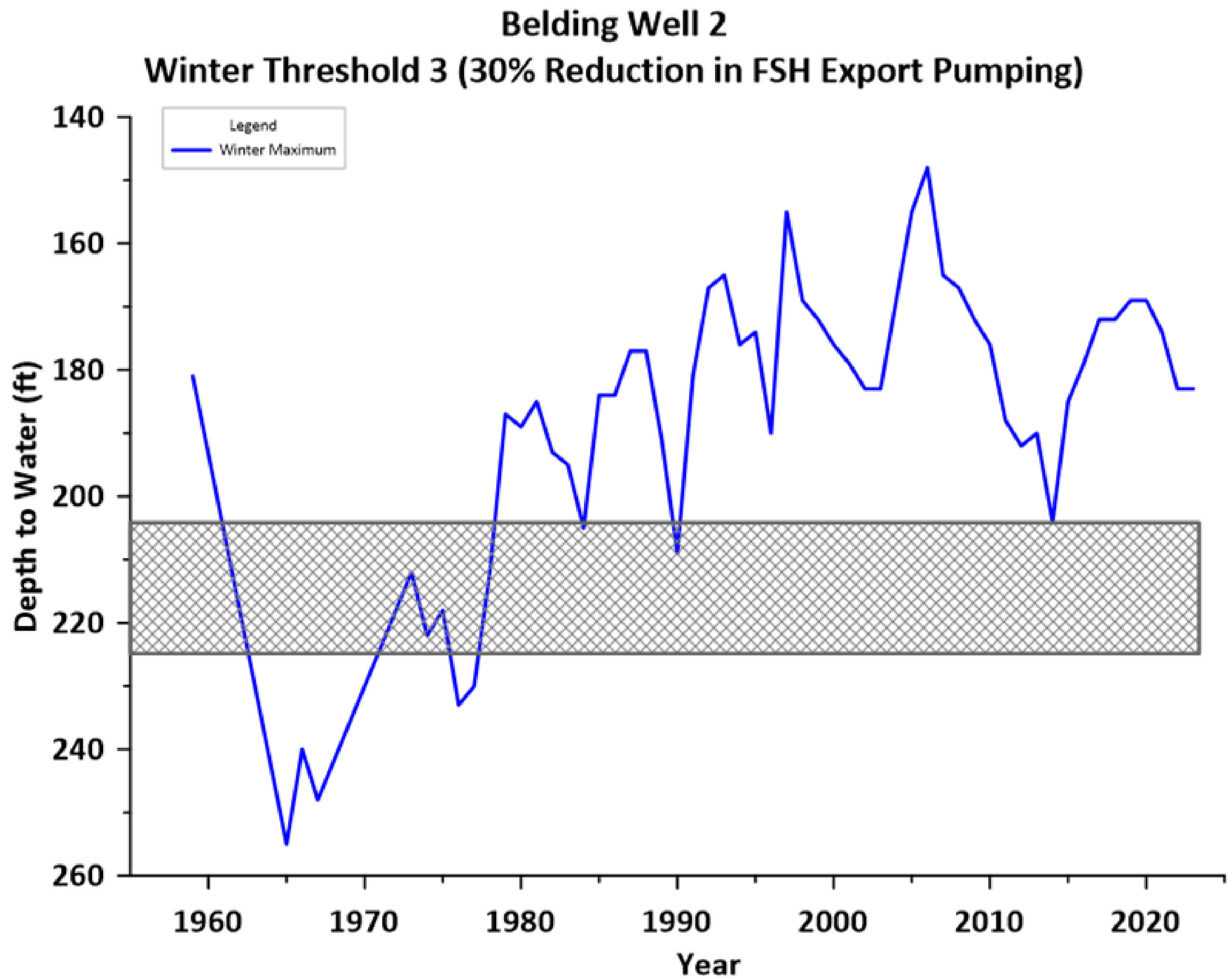
2000
2010
2020
Year
Legend
Winter Maximum


Belding Well 2
Winter Threshold 3 (30% Reduction in FSH Export Pumping)
Legend
Winter Maximum
Depth to Water (ft)
140
160
180
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240
260
1960
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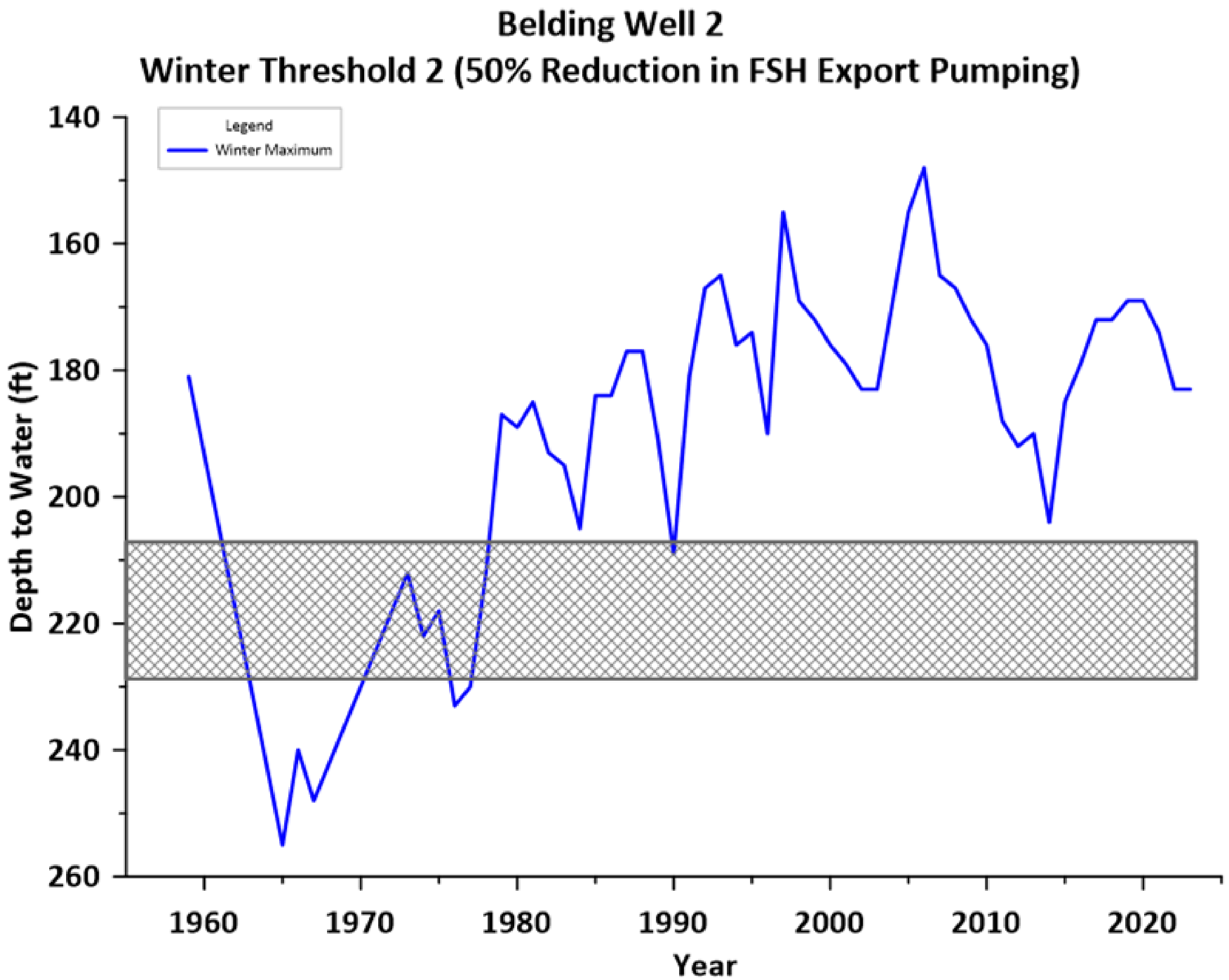
1990
2000
2010
2020
Year


Belding Well 2
Winter Threshold 2 (50% Reduction in FSH Export Pumping)
Legend
Winter Maximum
Depth to Water (ft)
140
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260
1960
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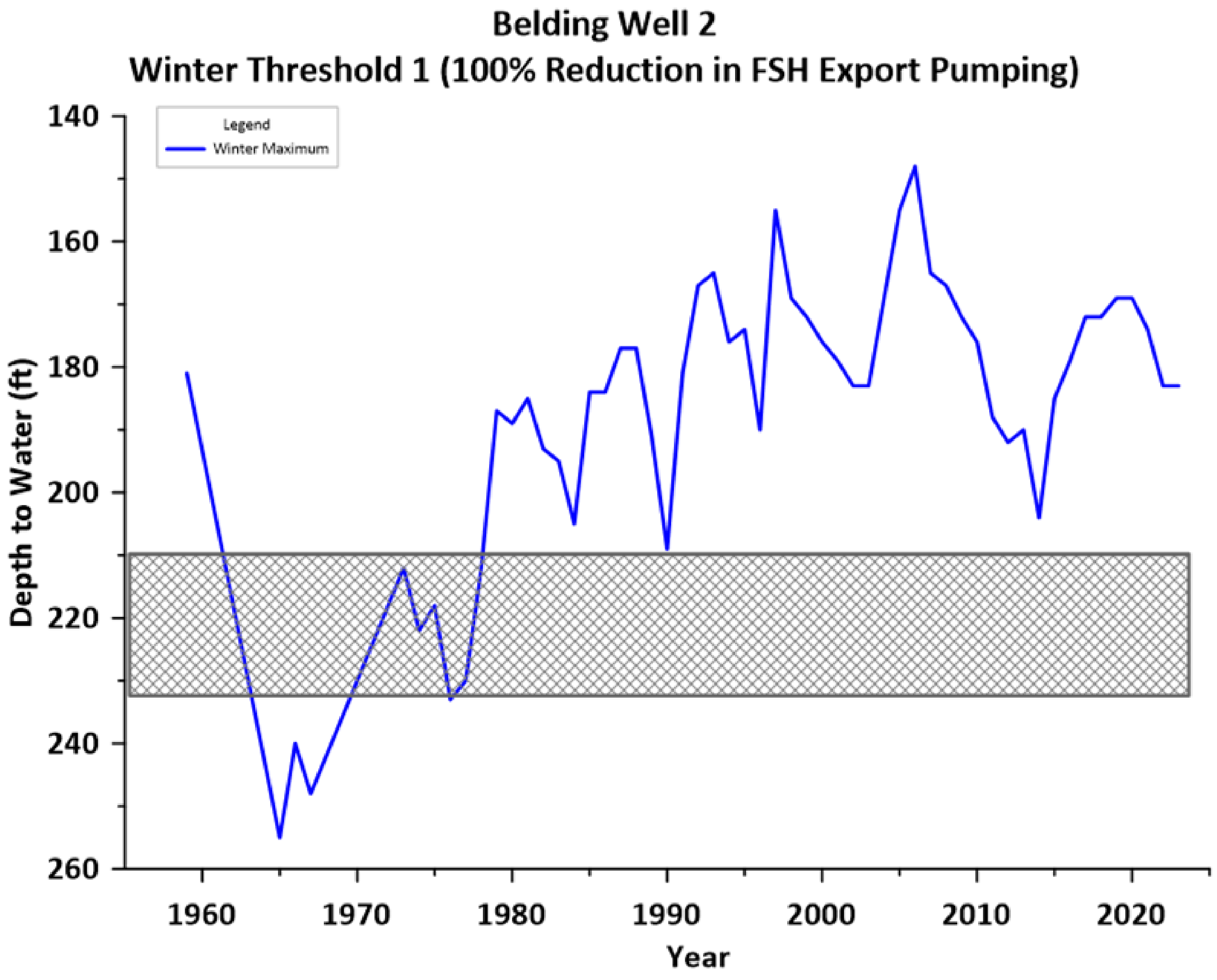
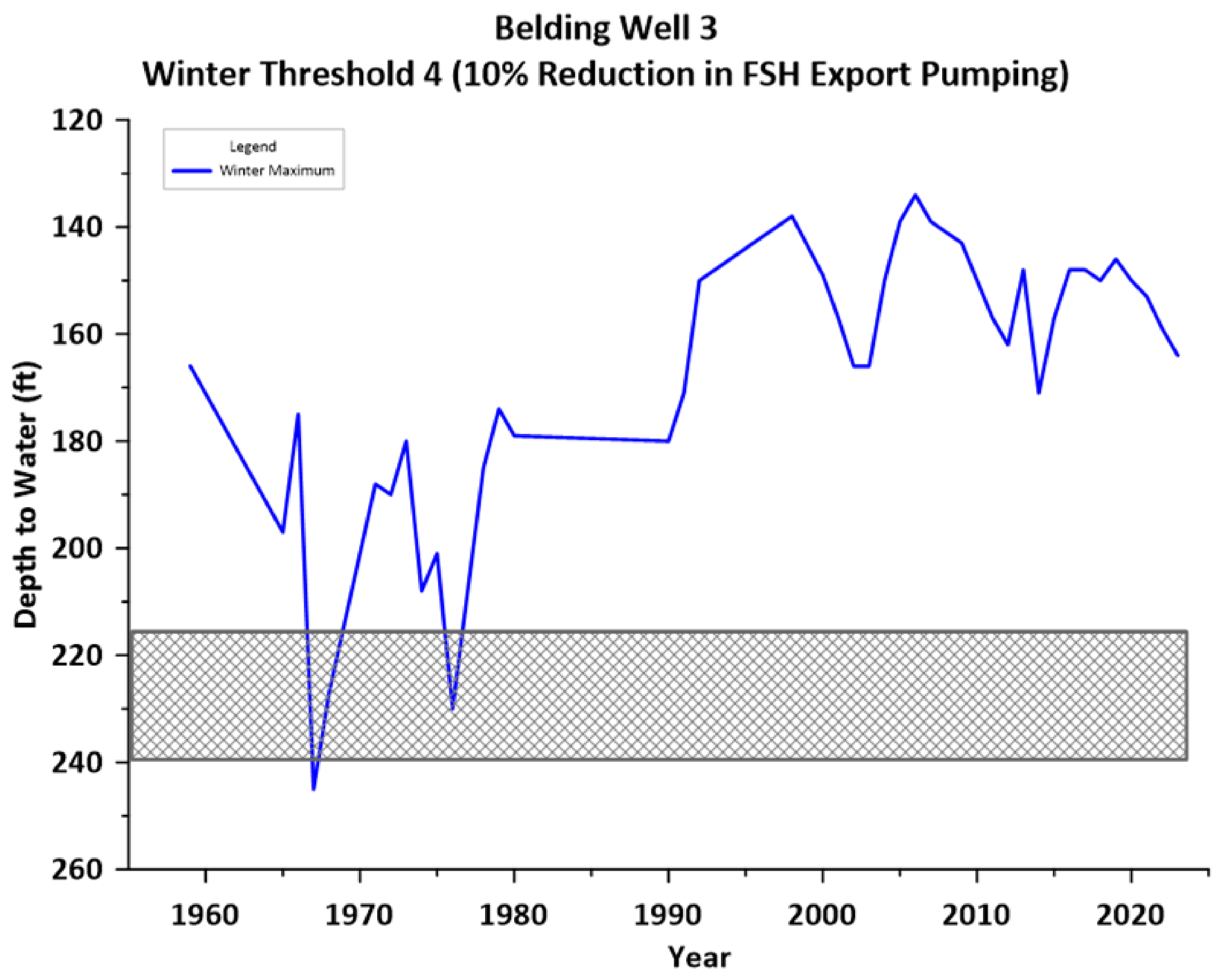
2010
2020
Year


Belding Well 2
Winter Threshold 1 (100% Reduction in FSH Export Pumping)
Legend
Winter Maximum
Depth to Water (ft)
140
160
180
200
220
240
260
1960
1970
1980
1990
2000
2010
2020
Year

Belding Well 3

- Well Depth = 519 ft
- Pump Setting = 305 ft
- Average Pumping
  - 1967 to 1974 = 2,244 AF/yr
  - 2010 to 2022 = 1,524 AF/yr



Belding Well 3
Winter Threshold 4 (10% Reduction in FSH Export Pumping)
Legend
Winter Maximum
Depth to Water (ft)
120
140
160
180
200
220
240
260
1960
1970
1980
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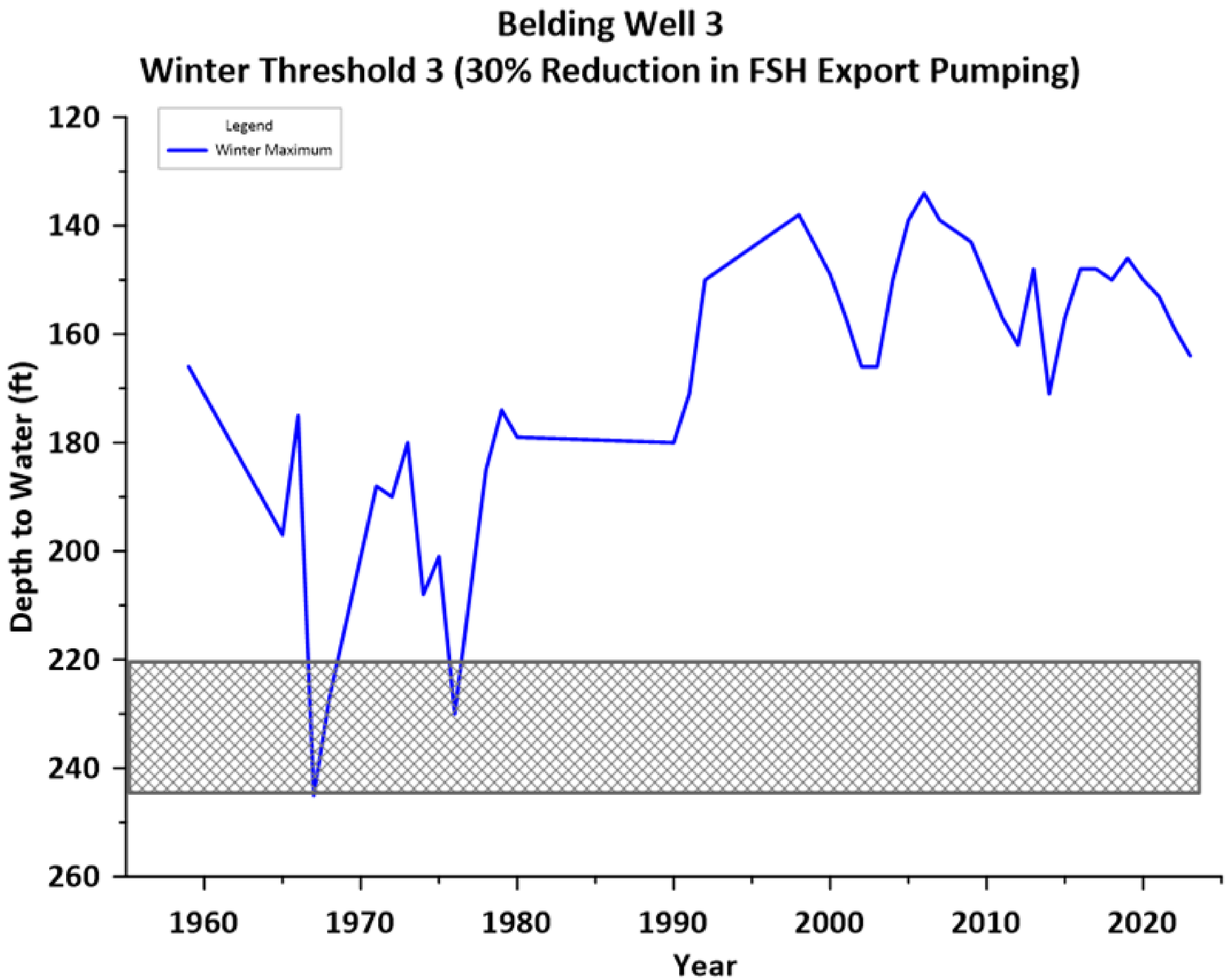
2000
2010
2020
Year


Belding Well 3
Winter Threshold 3 (30% Reduction in FSH Export Pumping)
Legend
Winter Maximum
Depth to Water (ft)
120
140
160
180
200
220
240
260
1960
1970
1980
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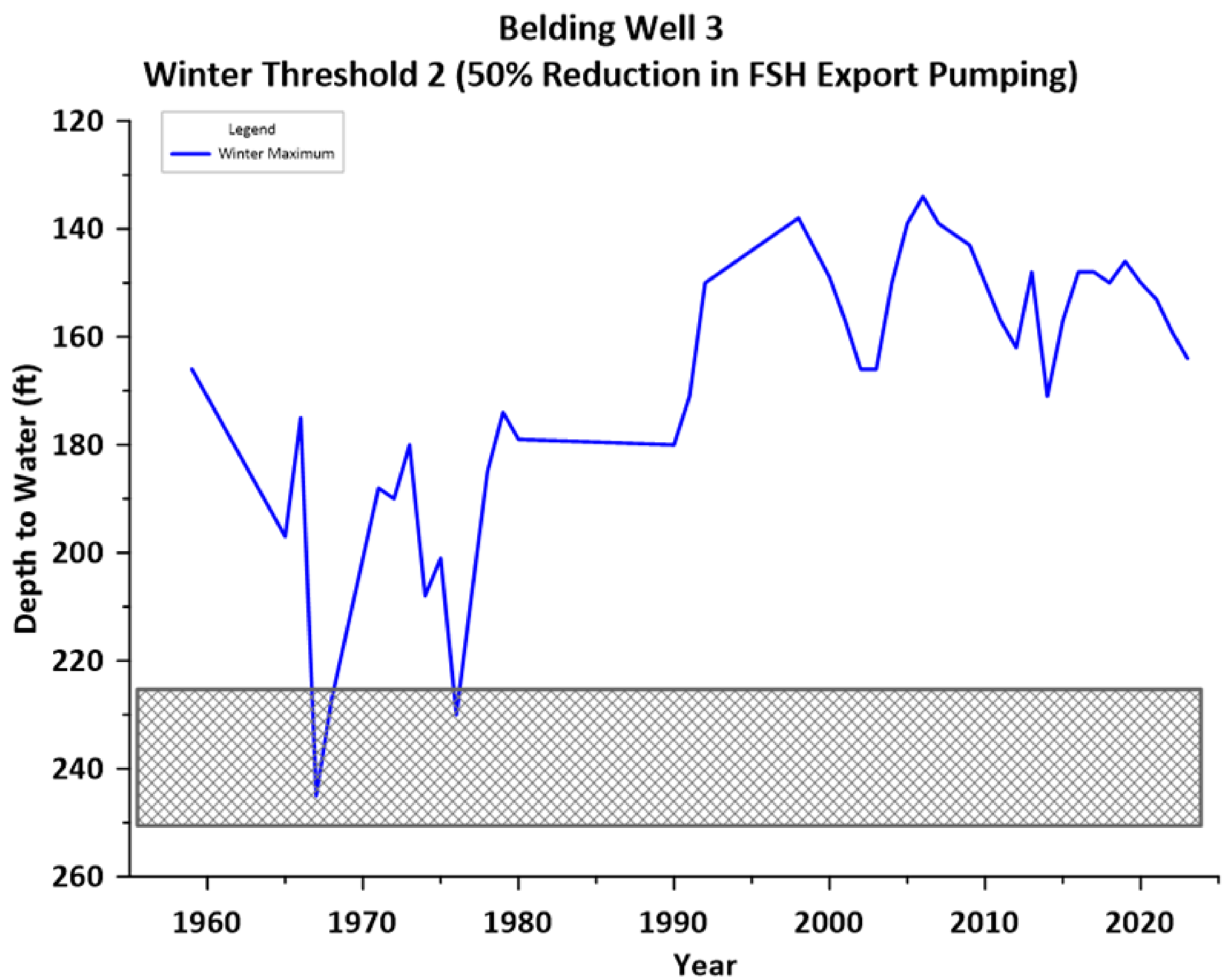
2000
2010
2020
Year



Belding Well 3
Winter Threshold 2 (50% Reduction in FSH Export Pumping)
Legend
Winter Maximum
Depth to Water (ft)
120
140
160
180
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240
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1960
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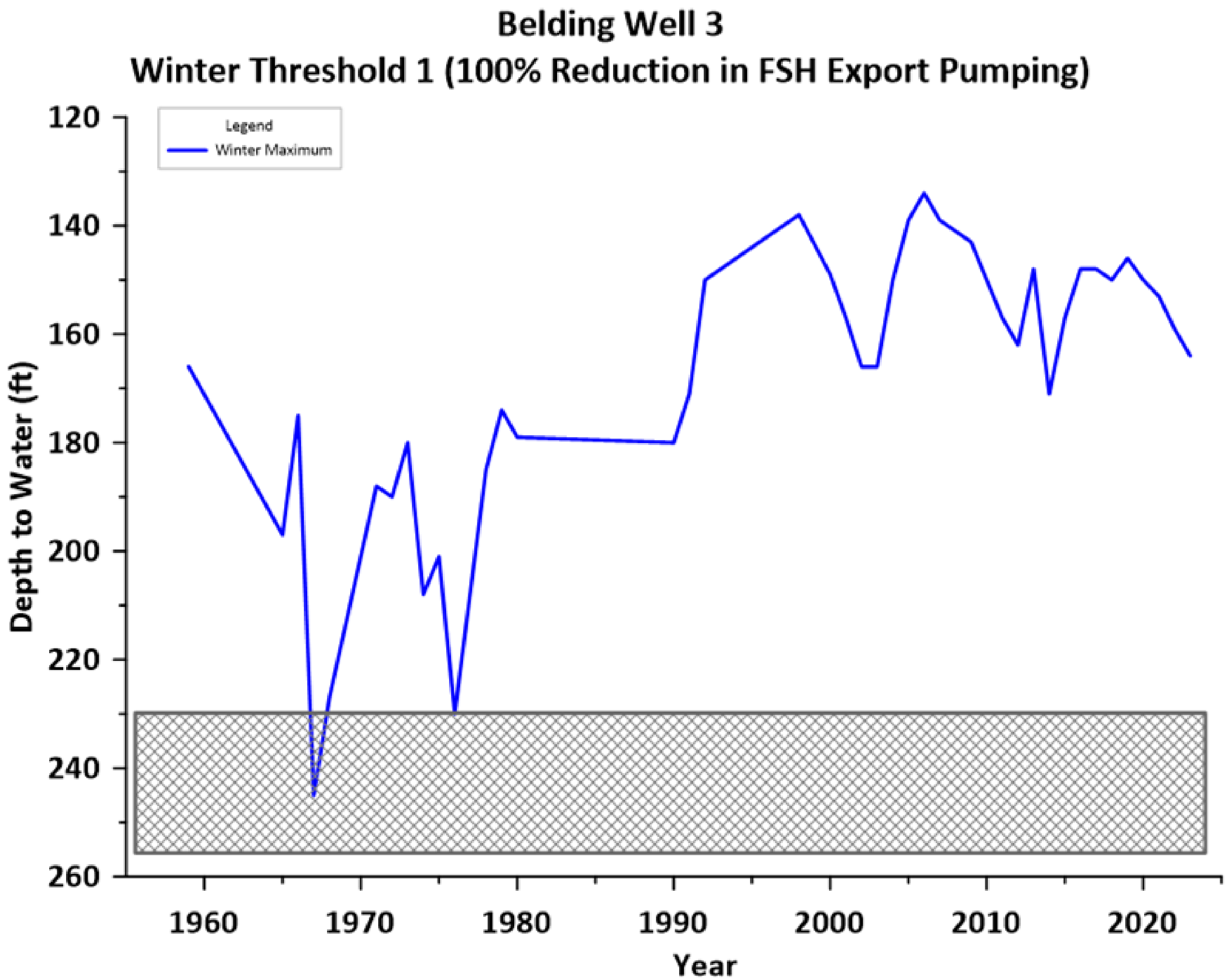
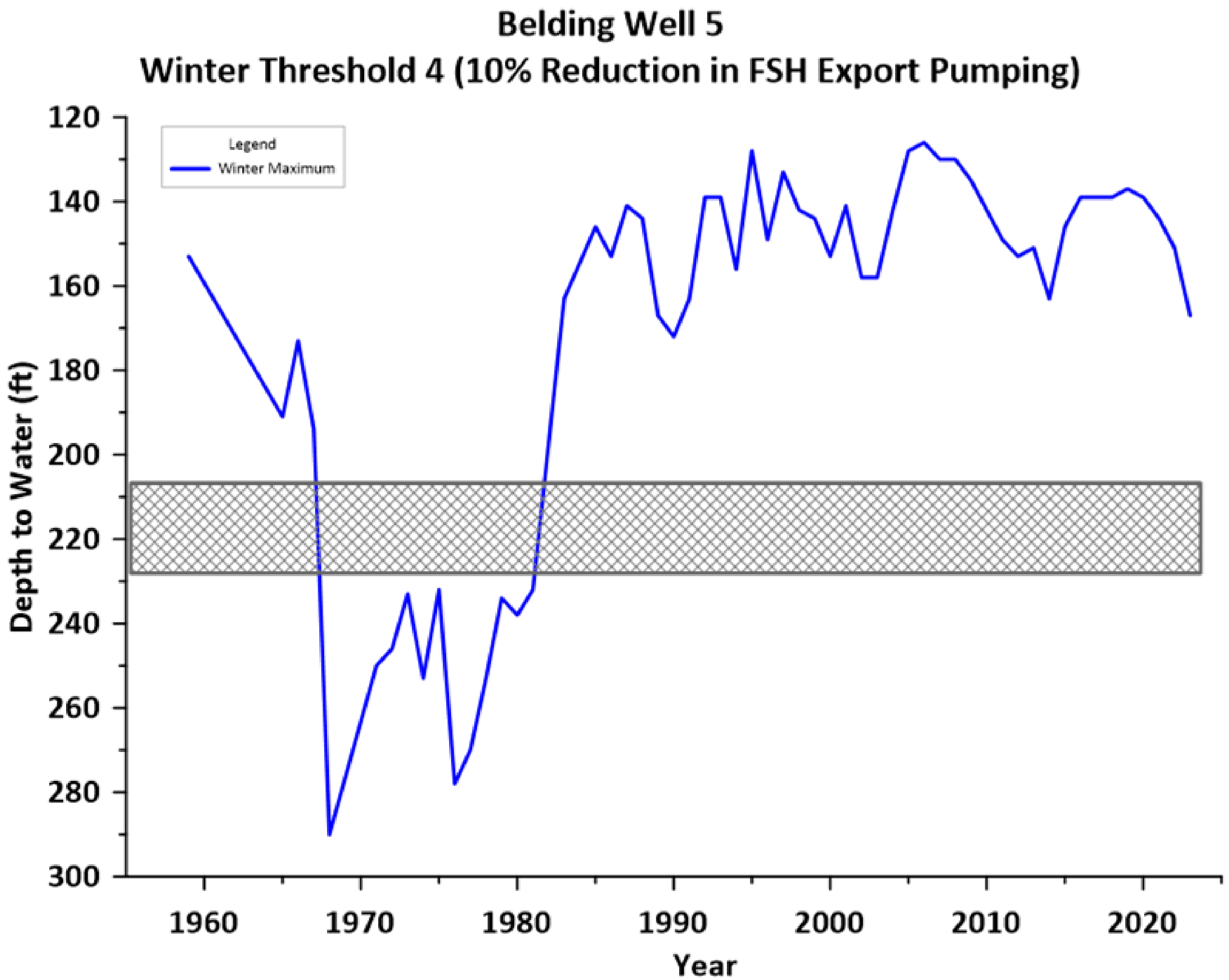
2000
2010
2020
Year



Belding Well 3
Winter Threshold 1 (100% Reduction in FSH Export Pumping)
Legend
Winter Maximum
Depth to Water (ft)
120
140
160
180
200
220
240
260
1960
1970
1980
1990
2000
2010
2020
Year

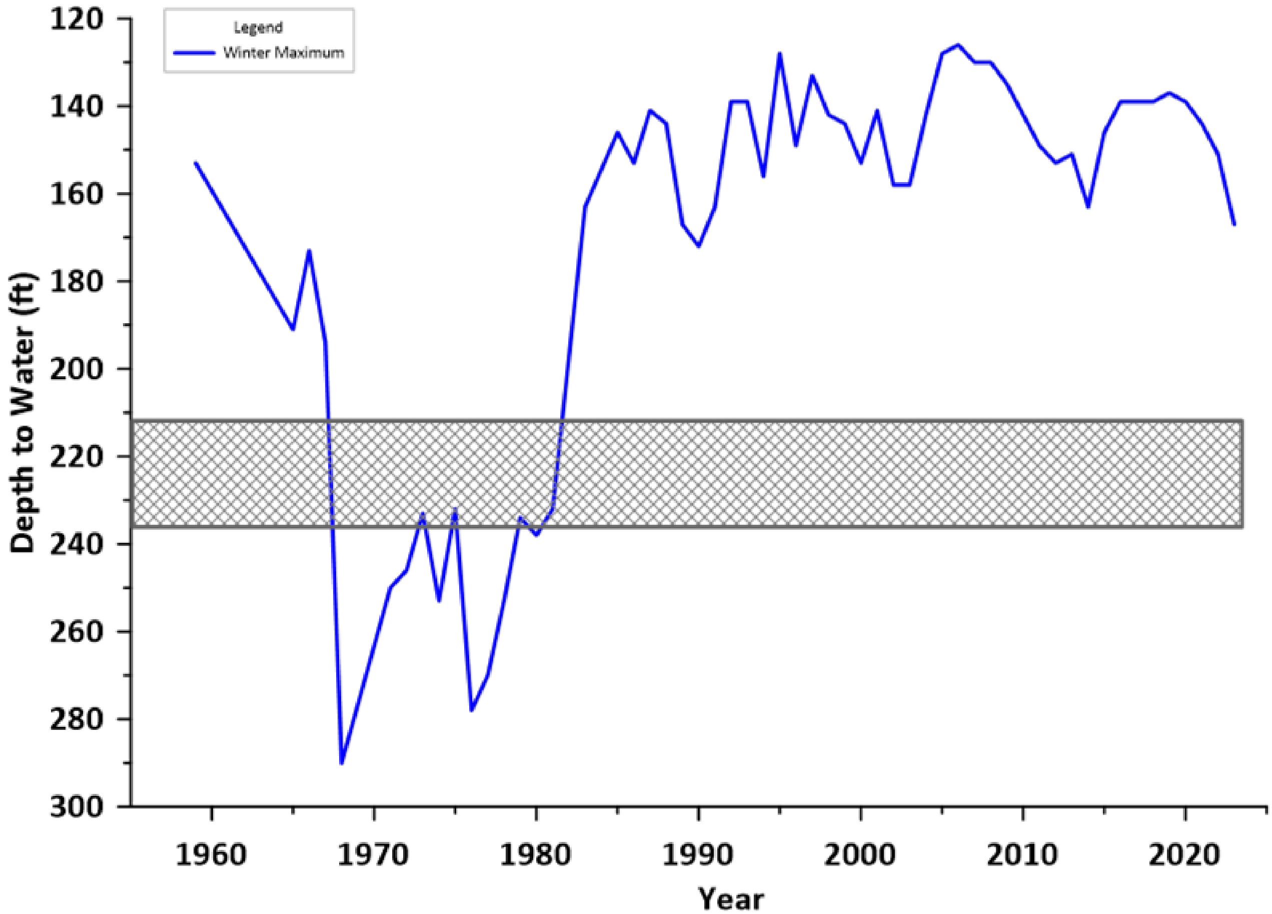
Belding Well 5

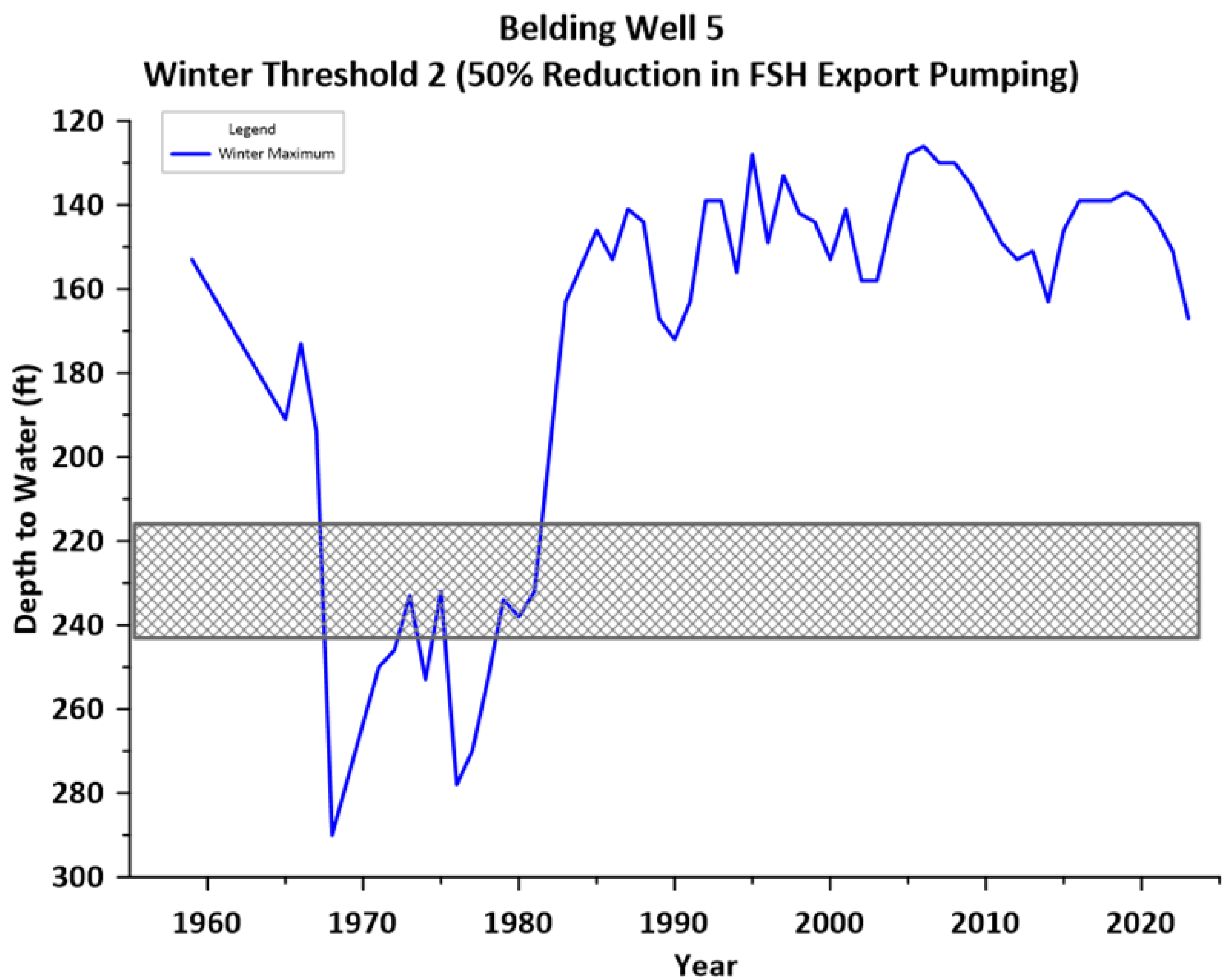
- Well Depth = 415 ft
- Pump Setting = 315 ft
- Average Pumping
    - 1967 to 1974 = 268 AF/yr
    - 2010 to 2022 = 293 AF/yr



Belding Well 5
Winter Threshold 4 (10% Reduction in FSH Export Pumping)
Legend
Winter Maximum
Depth to Water (ft)
120
140
160
180
200
220
240
260
280
300
1960
1970
1980
1990
2000
2010
2020
Year

Belding Well 5
Winter Threshold 3 (30% Reduction in FSH Export Pumping)




Belding Well 5
Winter Threshold 2 (50% Reduction in FSH Export Pumping)
Legend
Winter Maximum
Depth to Water (ft)
120
140
160
180
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240
260
280
300
1960
1970
1980
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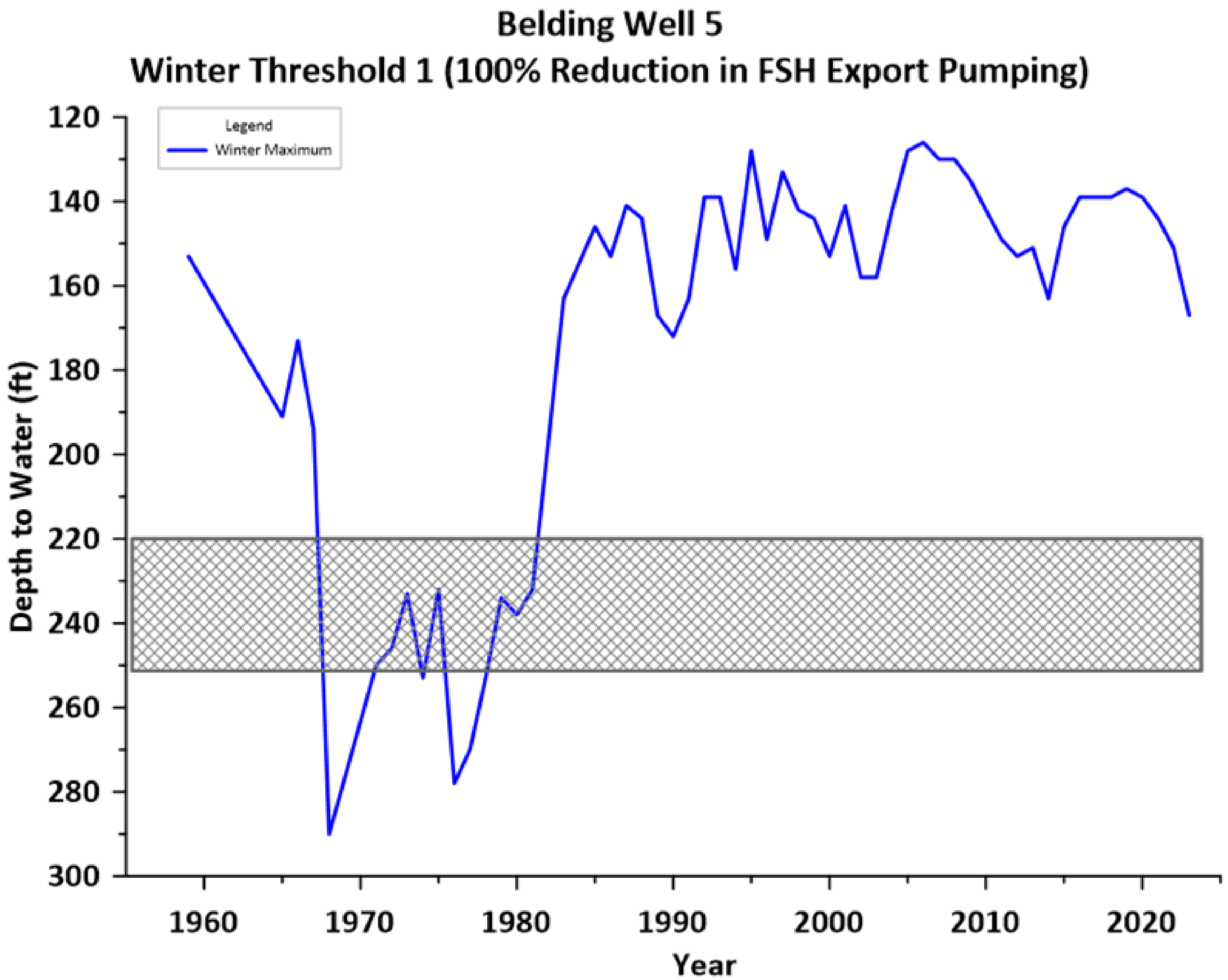
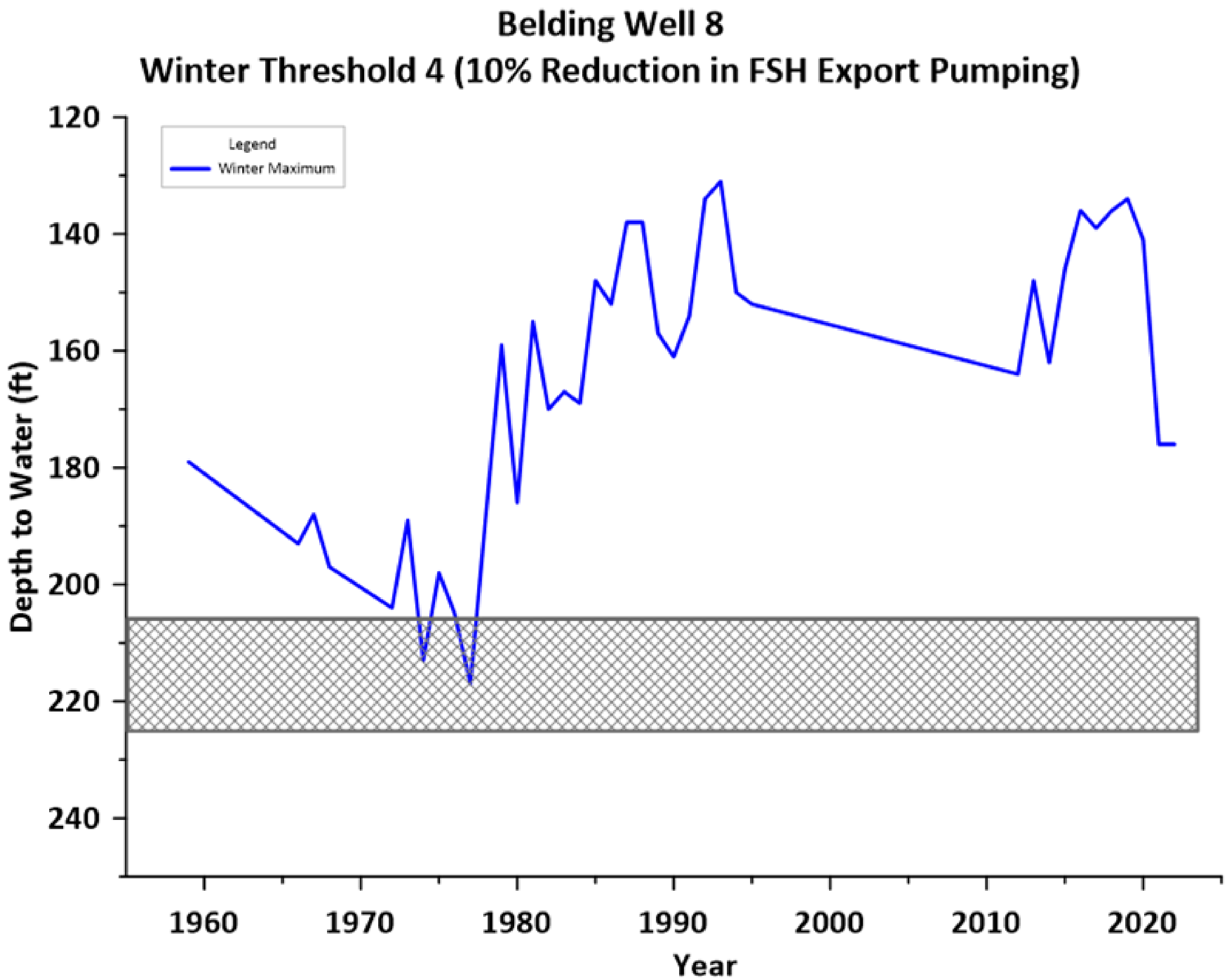
2010
2020
Year



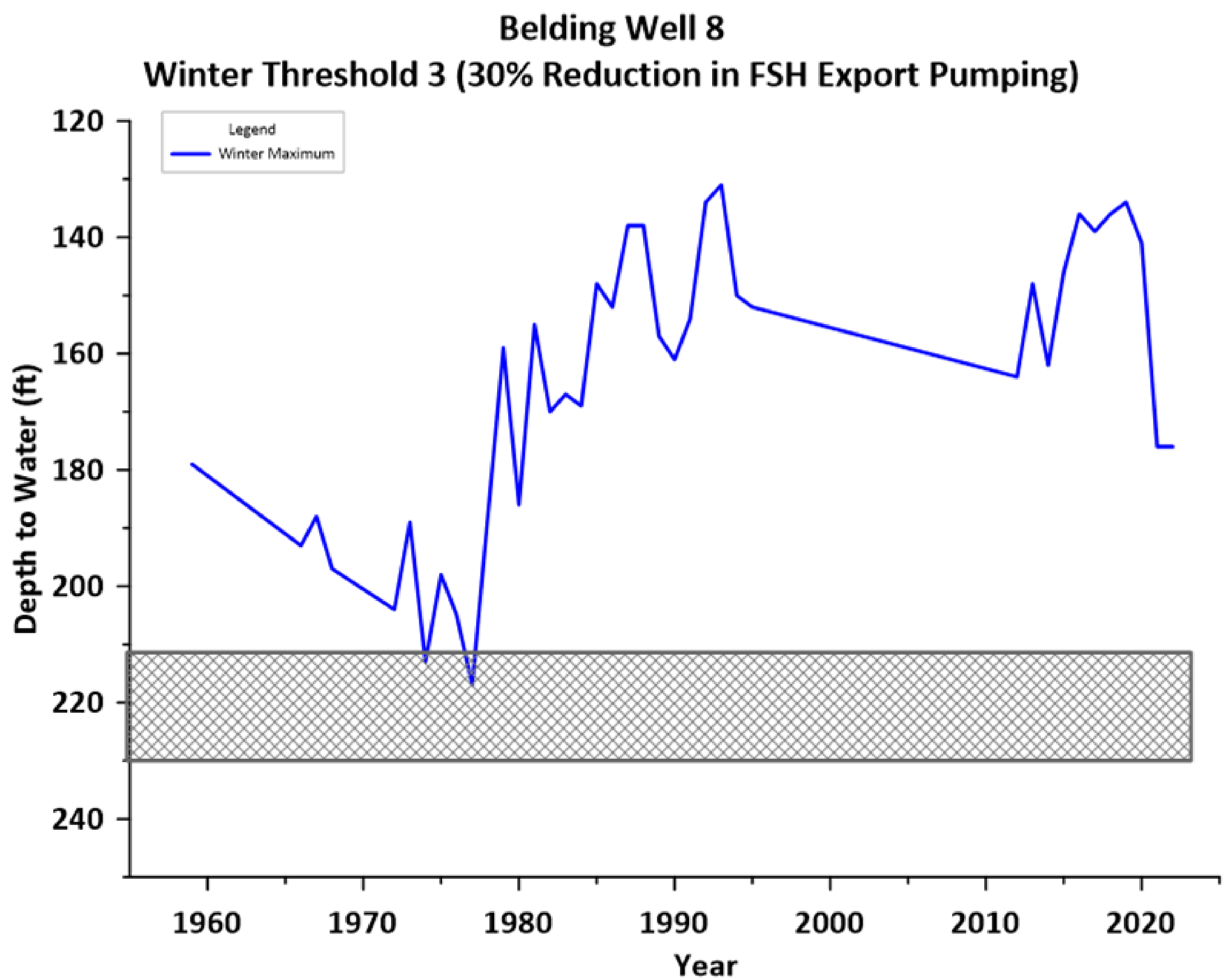
Belding Well 5
Winter Threshold 1 (100% Reduction in FSH Export Pumping)
Legend
Winter Maximum
Depth to Water (ft)
120
140
160
180
200
220
240
260
280
300
1960
1970
1980
1990
2000
2010
2020
Year

Belding Well 8

- Well Depth = 575 ft
- Pump Setting = 305 ft
- Average Pumping
  - 1967 to 1974 = 24 AF/yr
  - 2010 to 2022 = 270 AF/yr



Belding Well 8
Winter Threshold 4 (10% Reduction in FSH Export Pumping)
Legend
Winter Maximum
Depth to Water (ft)
120
140
160
180
200
220
240
1960
1970
1980
1990
2000
2010
2020
Year


Belding Well 8
Winter Threshold 3 (30% Reduction in FSH Export Pumping)
Legend
Winter Maximum
Depth to Water (ft)
120
140
160
180
200
220
240
1960
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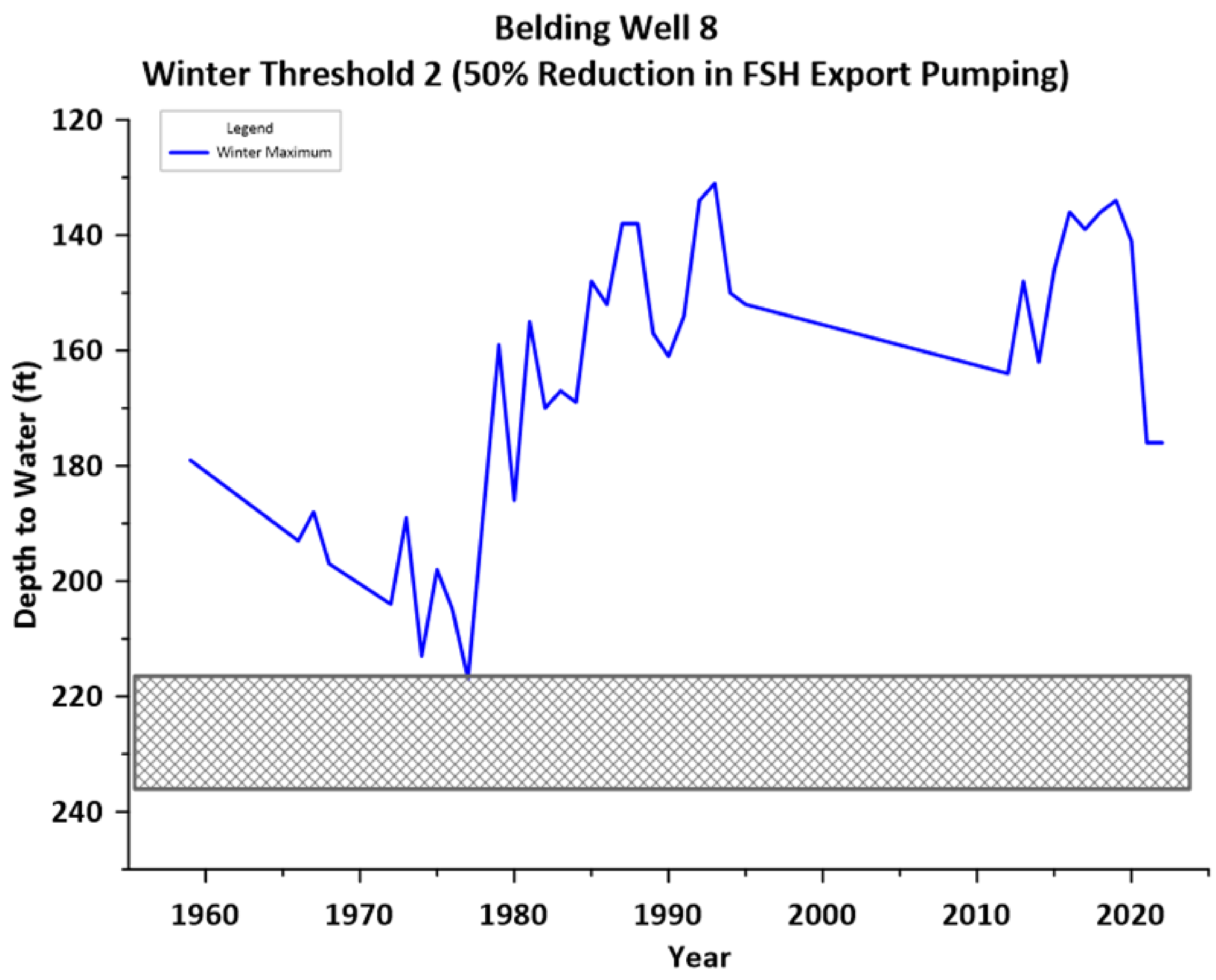
2000
2010
2020
Year


Belding Well 8
Winter Threshold 2 (50% Reduction in FSH Export Pumping)
Legend
Winter Maximum
Depth to Water (ft)
120
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1960
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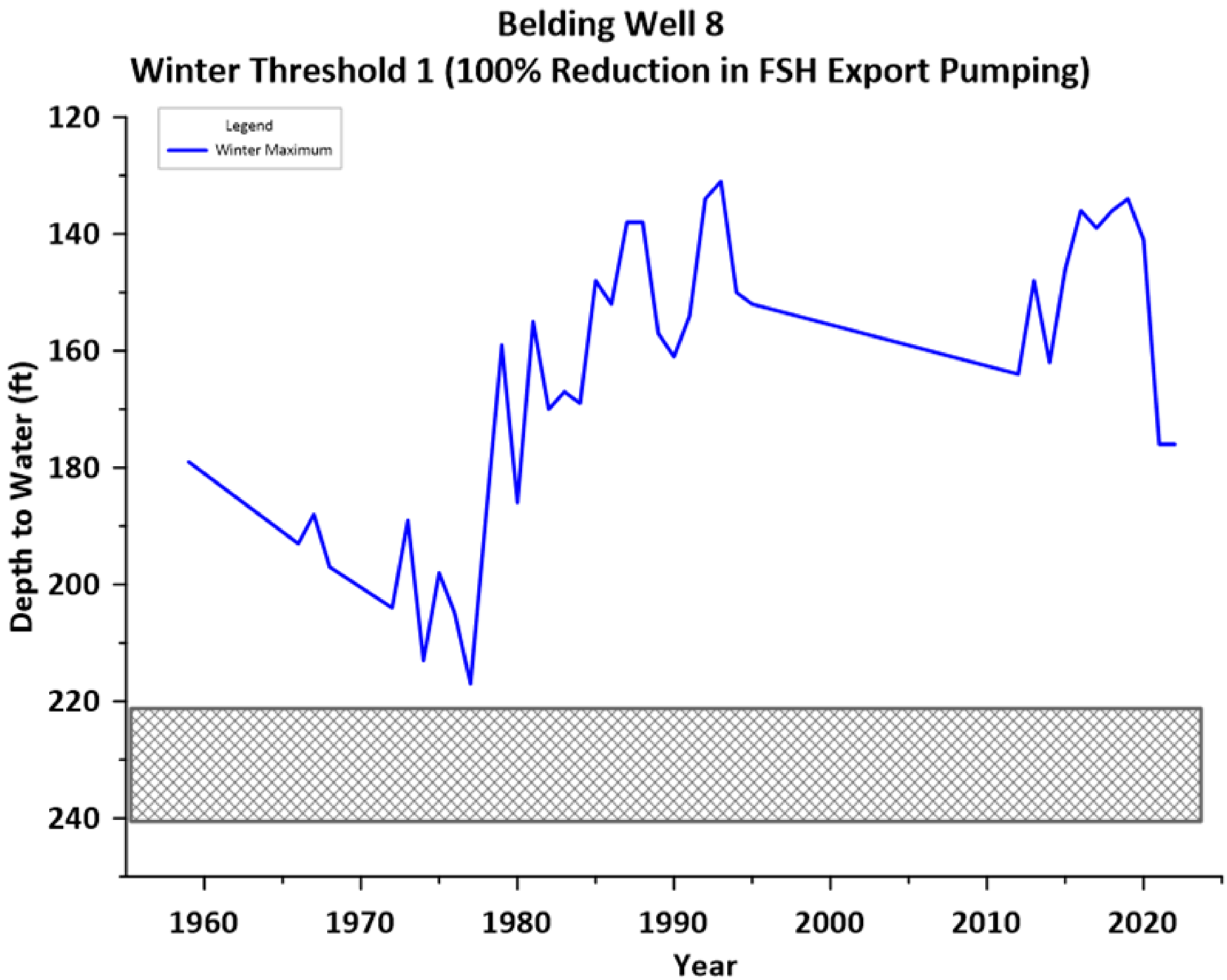
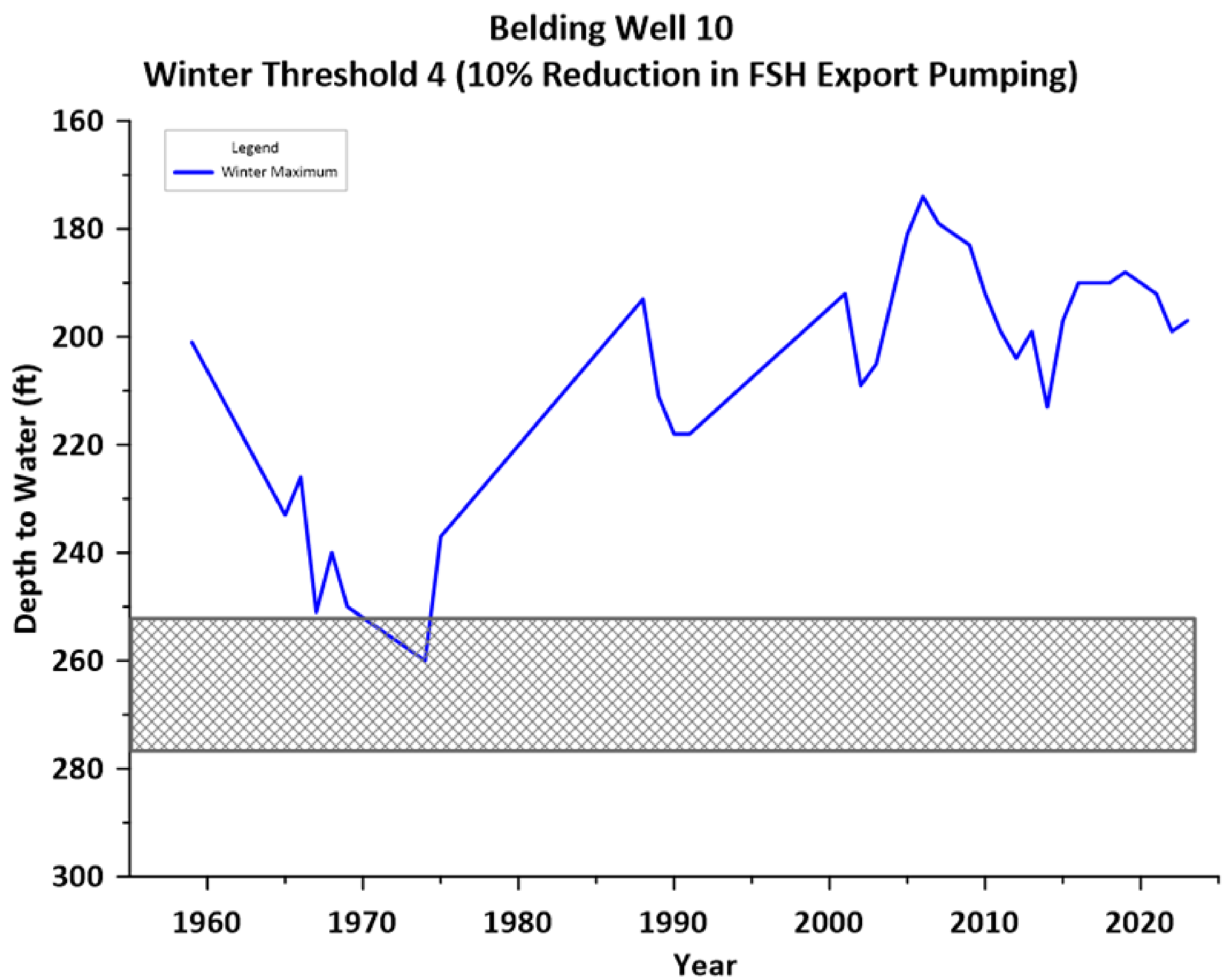
Year


Belding Well 8
Winter Threshold 1 (100% Reduction in FSH Export Pumping)
Legend
Winter Maximum
Depth to Water (ft)
120
140
160
180
200
220
240
1960
1970
1980
1990
2000
2010
2020
Year

Belding Well 10

- Well Depth = 480 ft
- Pump Setting = 280 ft
- Average Pumping
  - 1967 to 1974 = 602 AF/yr
  - 2010 to 2022 = 377 AF/yr



Belding Well 10
Winter Threshold 4 (10% Reduction in FSH Export Pumping)
Legend
Winter Maximum
Depth to Water (ft)
160
180
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280
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1960
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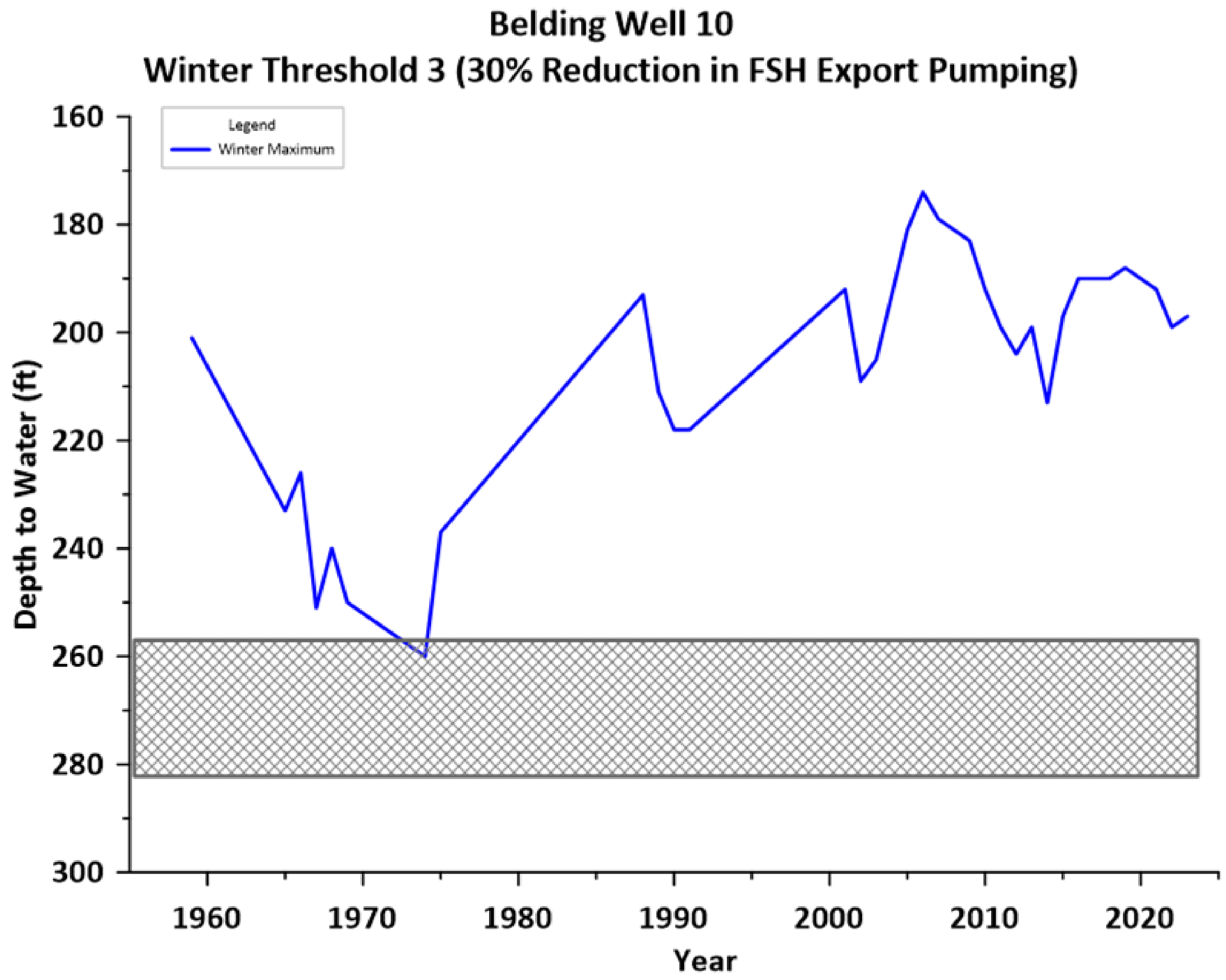
2010
2020
Year



Belding Well 10
Winter Threshold 3 (30% Reduction in FSH Export Pumping)
Legend
Winter Maximum
Depth to Water (ft)
160
180
200
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240
260
280
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1960
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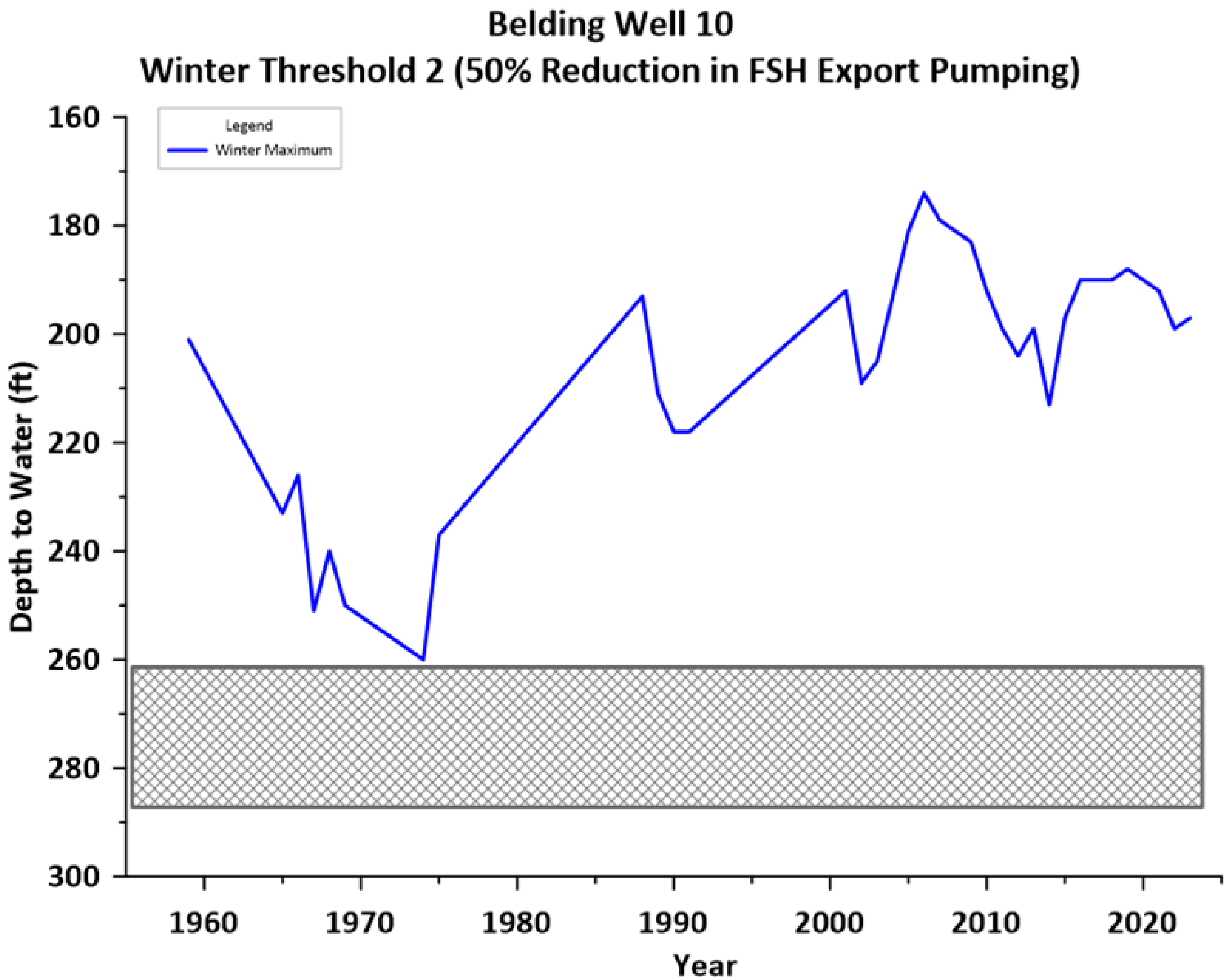
2020
Year


Belding Well 10
Winter Threshold 2 (50% Reduction in FSH Export Pumping)
Legend
Winter Maximum
Depth to Water (ft)
160
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1960
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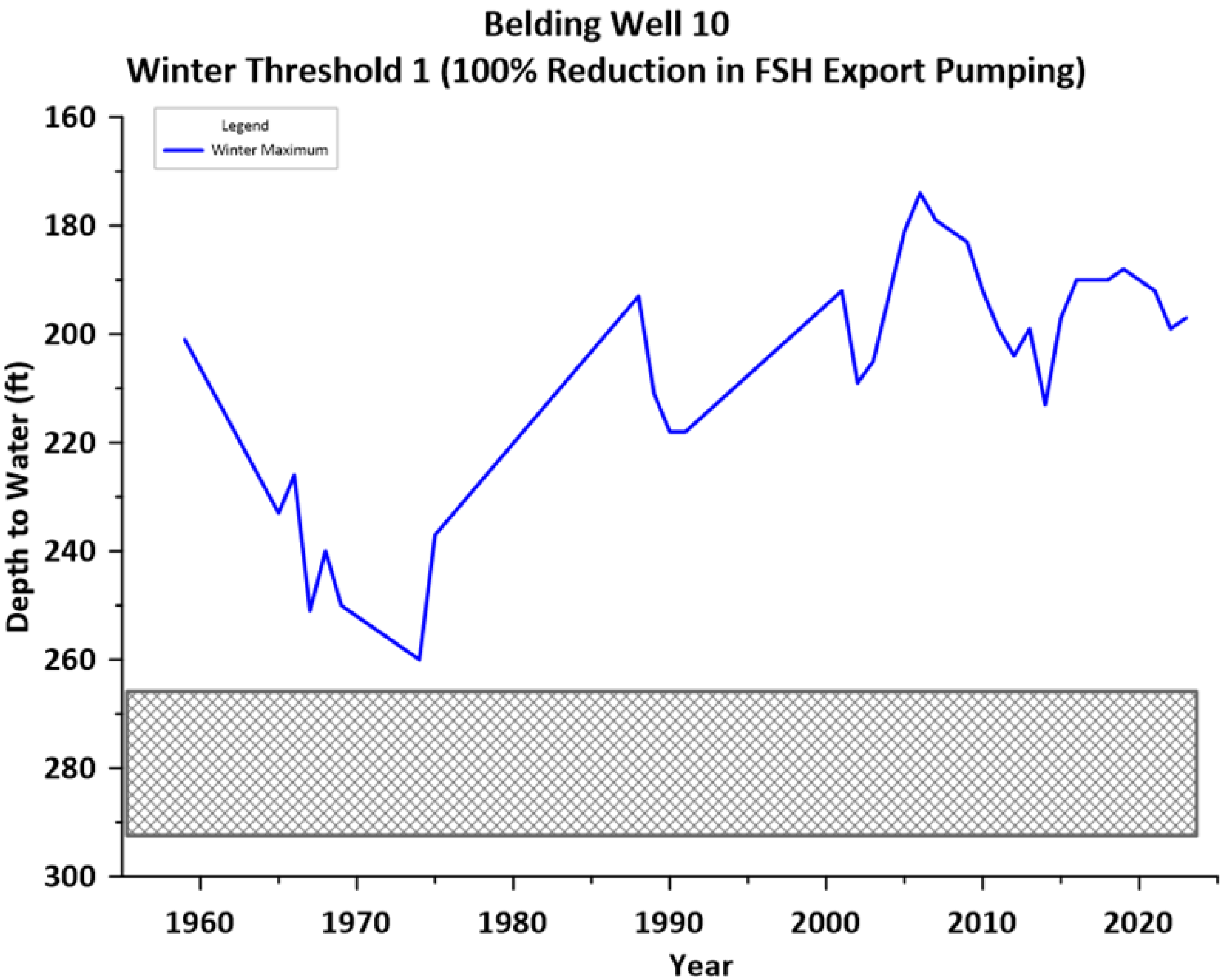
2020
Year



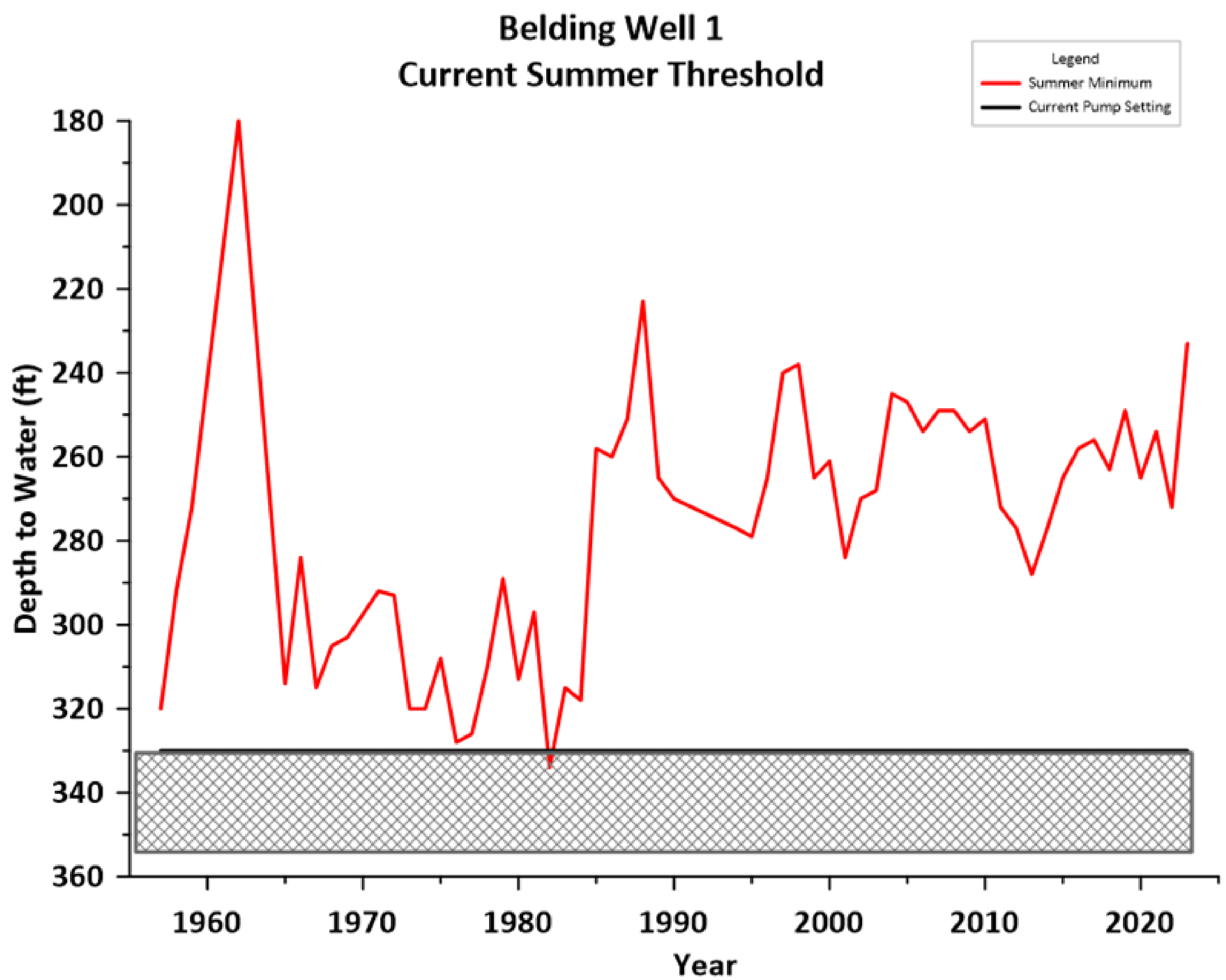
Belding Well 10
Winter Threshold 1 (100% Reduction in FSH Export Pumping)
Legend
Winter Maximum
Depth to Water (ft)
160
180
200
220
240
260
280
300
1960
1970
1980
1990
2000
2010
2020
Year

Winter Threshold Conclusions

- Conservative based on Belding data not available in 2017 when thresholds were set
- 10% and 30% reductions will result in groundwater level recovery
- Completion of additional studies and monitoring data could lead to modifications of winter thresholds in future

Existing Summer Threshold Hydrographs

- In 2017, summer thresholds were developed with limited summer data
  - Based on recent drawdown data
- Belding Farms data are a more robust dataset to set summer thresholds
  - Discussed in 2018, but lack of pump depth limited our ability to complete analysis
- 2023 data update provides pump depth
- Plots summer threshold range from four wells in rules petition (see previous slides) to six Belding Farms wells
- Conclusion: minor adjustments (upward or shallower thresholds) are warranted
  - No change from 2018 conclusion


Belding Well 1
Current Summer Threshold
Legend
Summer Minimum
Current Pump Setting
Depth to Water (ft)
180
200
220
240
260
280
300
320
340
360
1960
1970
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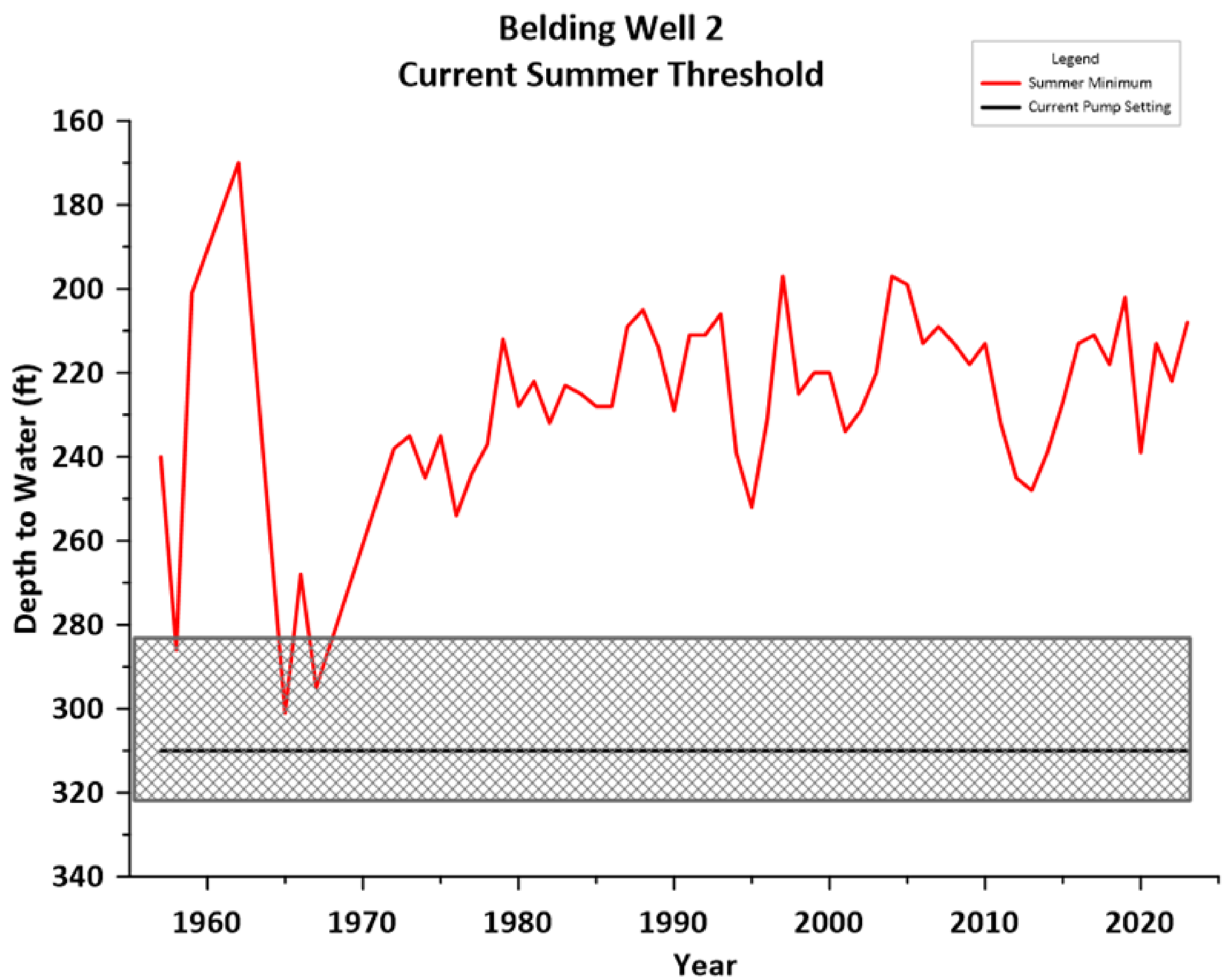
2000
2010
2020
Year



Belding Well 2
Current Summer Threshold
Legend
Summer Minimum
Current Pump Setting
160
180
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240
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280
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320
340
Depth to Water (ft)
1960
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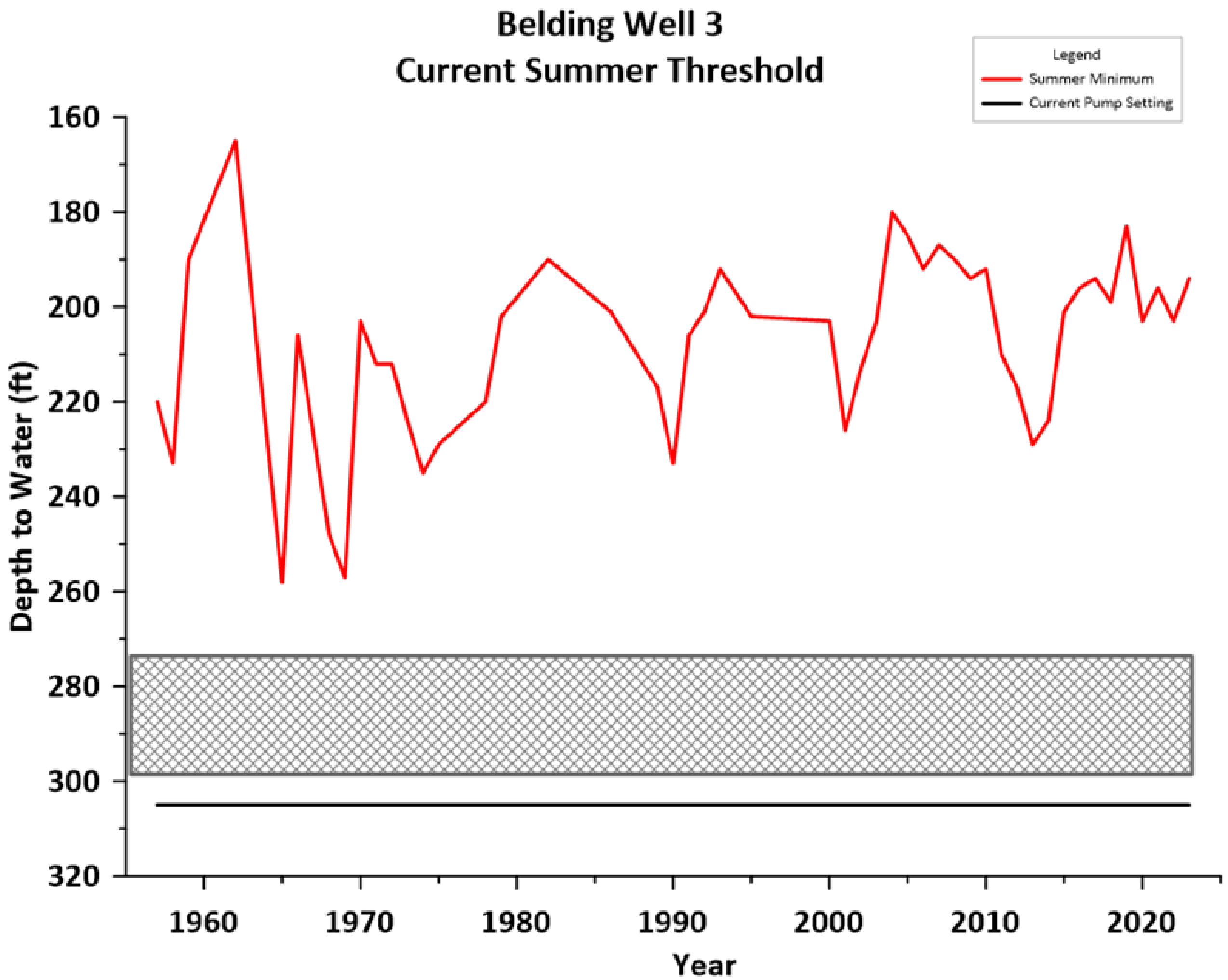
2000
2010
2020
Year


Belding Well 3
Current Summer Threshold
Legend
Summer Minimum
Current Pump Setting
Depth to Water (ft)
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320
1960
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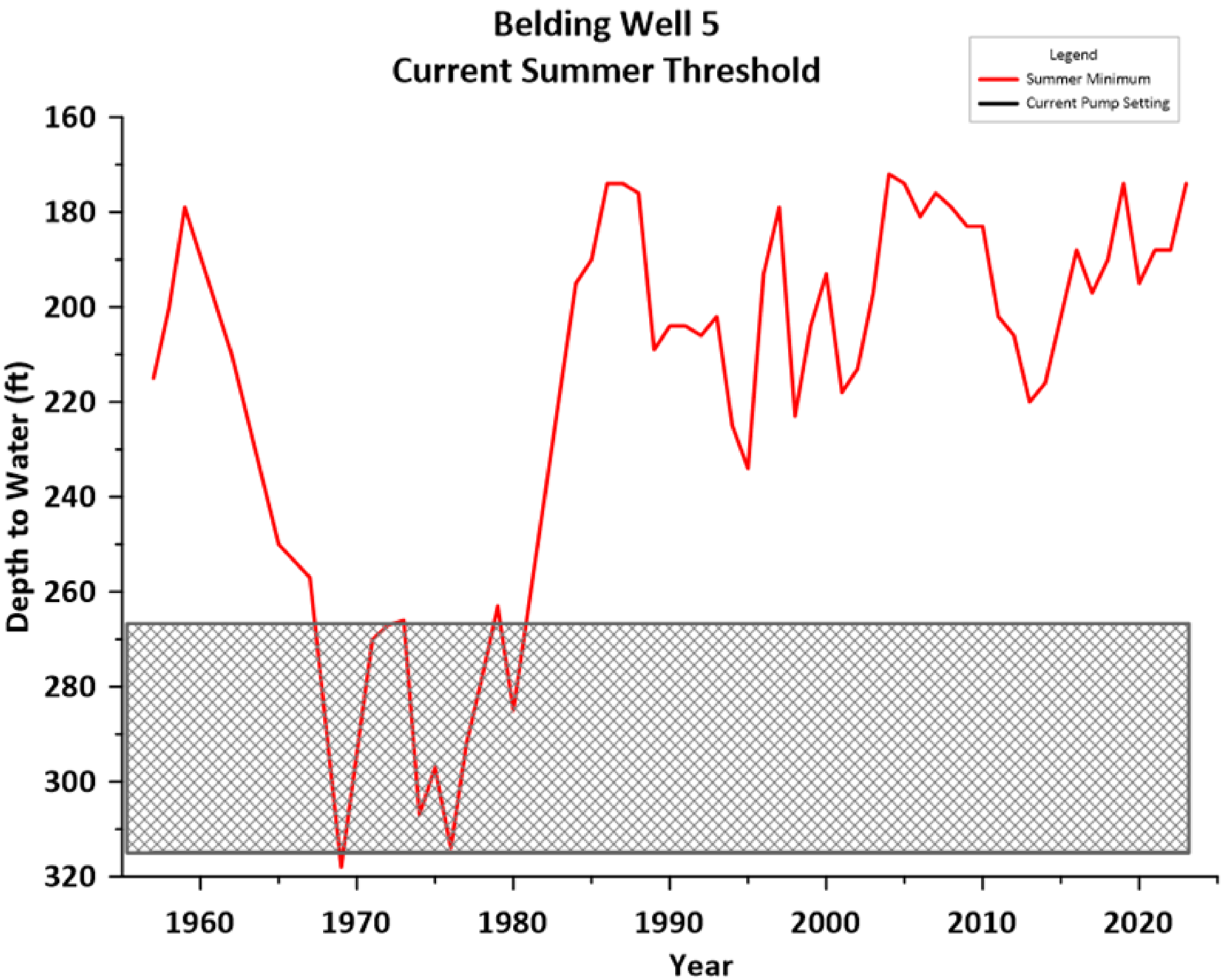
2000
2010
2020
Year



Belding Well 5
Current Summer Threshold
Legend
Summer Minimum
Current Pump Setting
Depth to Water (ft)
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180
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240
260
280
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320
1960
1970
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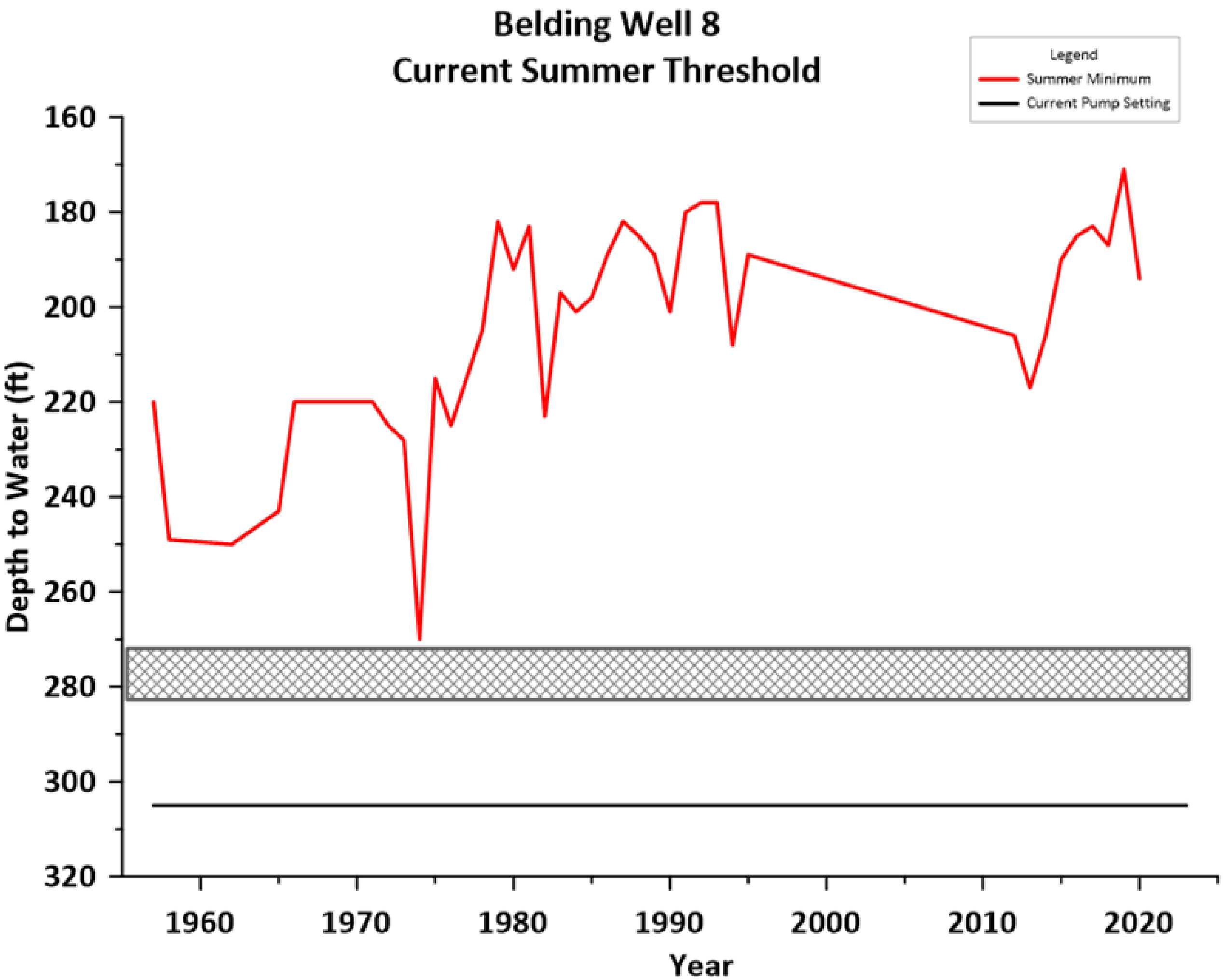
2000
2010
2020
Year



Belding Well 8
Current Summer Threshold
Legend
Summer Minimum
Current Pump Setting
Depth to Water (ft)
160
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1960
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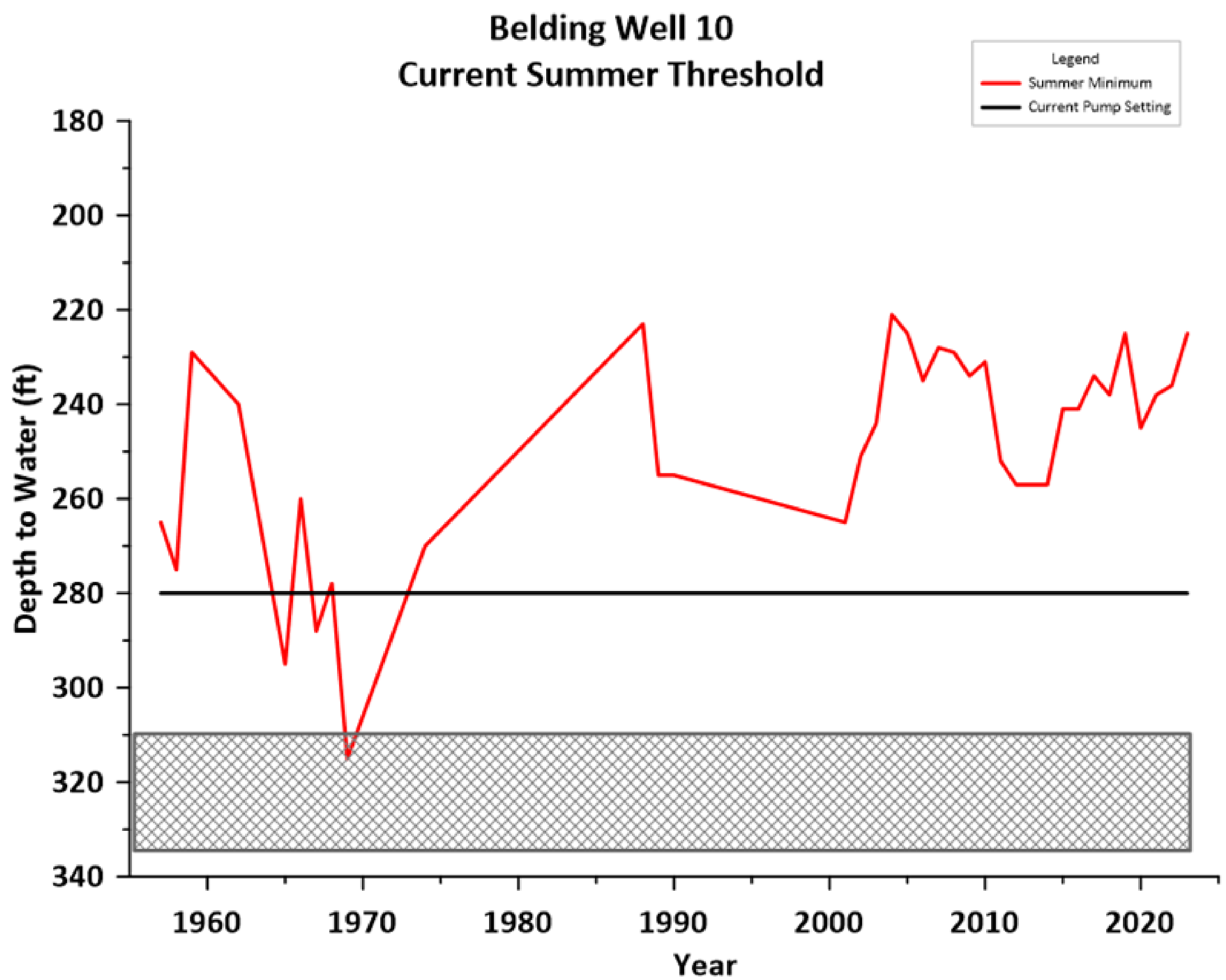
Year

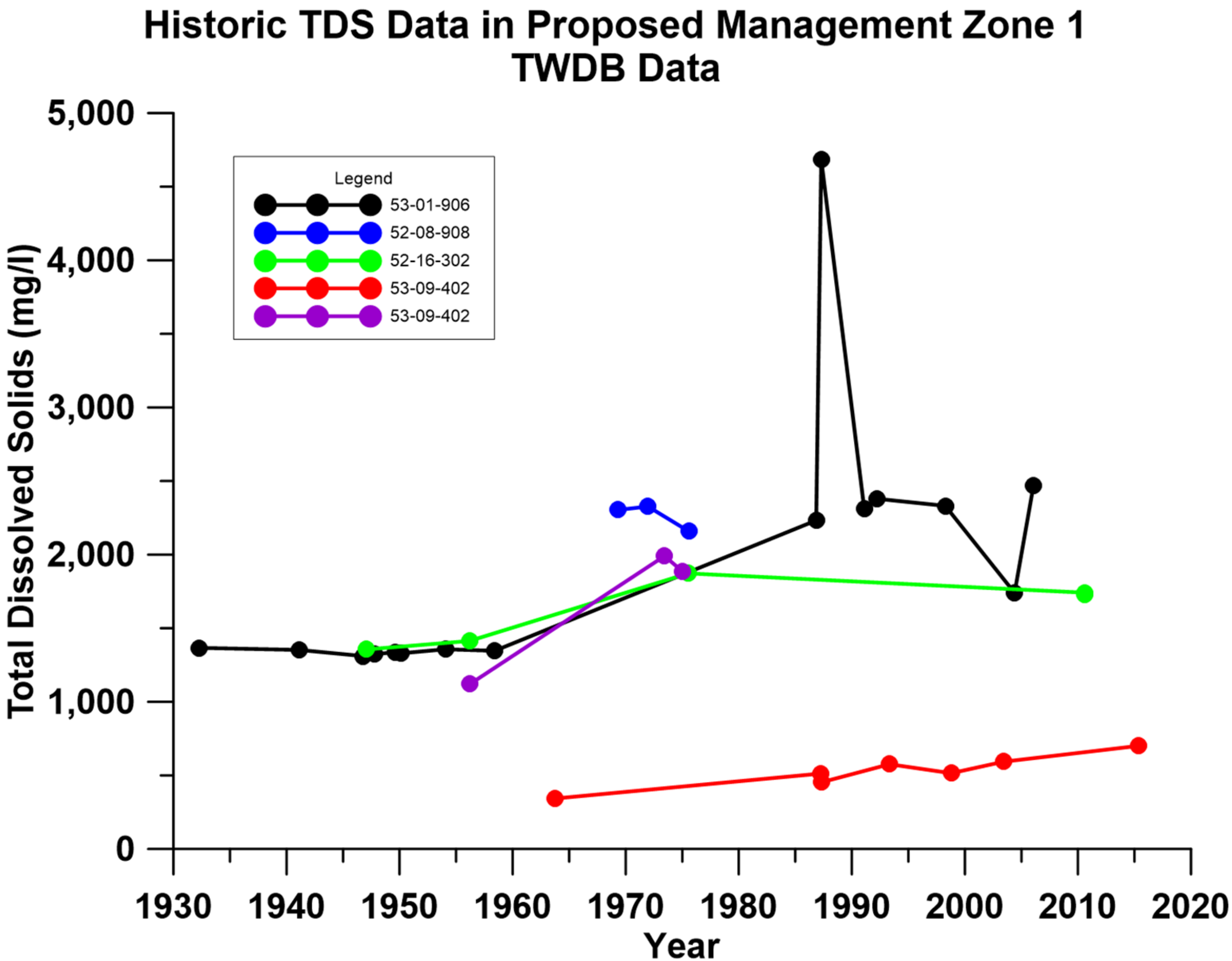


Belding Well 10
Current Summer Threshold
Legend
Summer Minimum
Current Pump Setting
Depth to Water (ft)
180
200
220
240
260
280
300
320
340
1960
1970
1980
1990
2000
2010
2020
Year

Groundwater Quality

- 2017 report that documented threshold development for FSH special permit conditions did not cover groundwater quality
  - Meetings in 2017: groundwater quality was discussed in general
  - No reported groundwater quality degradation associated with high pumping in 1960s and 1970s
    - Pumping reduction after 1970s due to change in economic conditions
- Available data evaluated in 2017
  - 5 wells
  - 34 data points
  - Date range: 1932 to 2010

Presented and Discussed
July 18, 2017



Proposed MZ1 Rules – Groundwater Quality

- Important component of demonstrating “no adverse impact on the aquifer”
- Relies on baseline of 2017 to 2023
  - No data provided to support use of this baseline
  - Silent on well-by-well analysis or lump all data together to form a baseline
- Three of the “tests” to demonstrate “no adverse impact on the aquifer”: less than 5% increase in:
  - Total dissolved solids (TDS)
  - Sodium
  - Calcium

Impact Analysis Process

- Three-part test
  - Measurable
  - Attributable
  - Significant
- Is a 5% increase in TDS measurable?
  - Yes, if there is a sufficient baseline of data
- Is a 5% increase in TDS attributable to FSH pumping?
  - Can't say without good baseline
  - 5% could be "noise" in the data
- Is 5% increase in TDS significant with respect to the "aquifer"?
  - Need to consider use of water and reversibility of increase with groundwater level recovery

Overall Conclusions and Recommendations

- Submitted thresholds in proposed MZ 1 rules:
  - Inconsistent with foundation of settlement (avoid dropping below historic minimum groundwater levels)
  - Would result in Threshold 1 actions for months at a time
    - Permit moratorium
    - Meetings to discuss data
  - Would result in Threshold 2 actions for months at a time
    - 50% reduction in FSH export pumping
    - No benefit to Belding Farms
  - Would result in Threshold 3 actions during drought conditions (high irrigation pumping)
    - 100% reduction in FSH export pumping
    - No benefit to Belding Farms