Refugio Groundwater Conservation District
Meeting Notice and Agenda
(Revised: April 7, 2026)

Notice is hereby given in accordance with the Open Meetings Act, Chapter 551, Government Code and Section 36.064 of the Texas Water Code that the Refugio Groundwater Conservation District Board of Directors will hold a meeting on April 20, 2026, at 6:00 PM at First Baptist Church of Woodsboro Fellowship Hall, 309 Johnson Street, Woodsboro, Texas.

AGENDA

1. Call the meeting to order and welcome guests.
2. Receive public comments.
3. Consideration of and possible action on matters related to groundwater management including the efforts and activities of the District regarding permitting, complaints, investigations, violations, and enforcement cases associated with permitting.
    a. Characterization of Brackish Groundwater Resources from Calhoun, Jackson, Refugio, and Victoria Counties.
    b. Large-scale groundwater production permitting in San Patricio County.
4. Consideration of and possible action on matters related to groundwater protection including complaints, investigations, violations, and enforcement cases related to groundwater contamination and waste.
5. Consideration of and possible action on matters related to groundwater monitoring.
6. Consideration of and possible action on matters related to groundwater conservation.
7. Consideration of and possible action on matters related to groundwater resource planning including Groundwater Management Area 16 Joint Planning, proposed amended desired future conditions, and regional water planning.
8. Consideration of and possible action on matters related to groundwater policy including the Management Plan of the District, the Rules of the District, and draft revisions.
9. Consideration of and possible action on matters related to administration and management including the minutes of previous meetings, amendments to the annual budget of the district, bank accounts, investments, financial reports of the district, bills and invoices of the district, management goals and objectives of the district, administrative policies, staffing, consultant agreements, interlocal cooperation agreements, and support services provided to and from other groundwater conservation districts.
10. Consideration of and possible action on matters related to legal counsel report.
11. Adjourn.

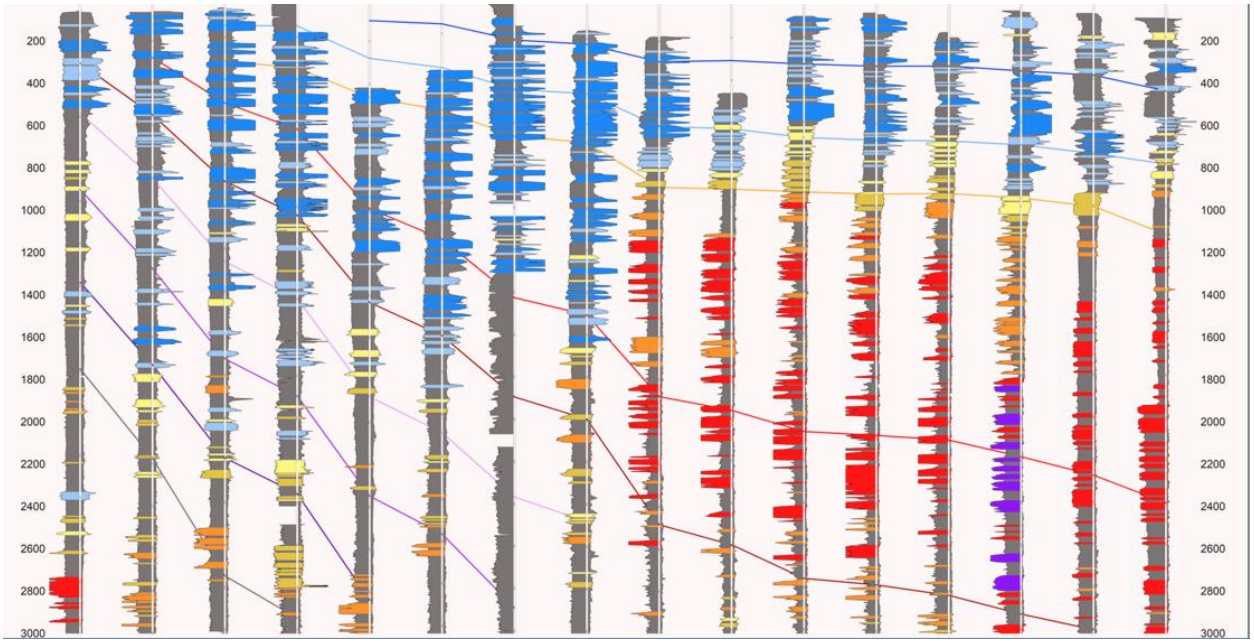
Supplemental Documentation

The Refugio Groundwater Conservation District may close the meeting, if necessary, to conduct private consultation with legal counsel regarding matters protected by the attorney-client privilege pursuant to Section 551.071 of the Government Code or to discuss matters regarding personnel pursuant to Section 551.074 of the Government Code. The Refugio Groundwater Conservation District will return to open meeting, if necessary, to take any action deemed necessary based on discussion in closed meeting pursuant to Section 551.102 of the Government Code.

In Accordance with Title III of the Americans with Disabilities Act, we invite all attendees to advise us of any special accommodations due to disability. Please submit your request as far as possible in advance of event you wish to attend.

FINAL

Characterization of Brackish Groundwater Resources for Calhoun, Jackson, Refugio, and Victoria Counties



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MARCH 2026

FINAL

Characterization of Brackish Groundwater Resources for Calhoun, Jackson, Refugio, and Victoria Counties

Prepared for: Calhoun County Groundwater Conservation District
Texana Groundwater Conservation District
Refugio Groundwater Conservation District
Victoria County Groundwater Conservation District

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MARCH 2026

TABLE OF CONTENTS

1.0 Introduction 1
2.0 Characterization of the Gulf Coast Aquifer System Stratigraphy, Lithology, and Water Quality 4
2.1 Stratigraphy 4
2.2 Geophysical Well Logs 5
2.2.1 Lithology 5
2.2.2 Estimated Sand Percent by Formations 6
2.3 Water Quality 6
2.3.1 Salinity Classification by TDS Concentrations 7
2.3.2 Estimate TDS Concentration from Electrical Resistivity in the Study Area 7
2.3.3 Sections Comprised of Geophysical Logs Showing Lithology and TDS Concentrations 8
2.3.4 Maps of Salinity Zones 9
2.3.5 Cross-sections Showing Wells, Formations, and Salinity Zones 10
3.0 Characterization of the Hydraulic Properites of the Gulf Coast Aquifer System 63
3.1 Hydraulic Conductivity 63
3.1.1 Specific Capacity Tests 63
3.1.2 Aquifer Pumping Tests 70
3.2 Porosity 71
3.3 Specific Storage 73
4.0 Development and Application of a Groundwater Flow Model 86
4.1 Construction of Groundwater Flow Model Grid 86
4.2 Hydraulic Properties in the Groundwater Flow Model 86
4.2.1 Horizontal Hydraulic Conductivity 86
4.2.2 Transmissivity 88
4.2.3 Vertical Hydraulic Conductivity 89
4.2.4 Specific Storage, Specific Yield, and Porosity 90
4.3 Brackish Production Zones 90
4.4 Development of a Steady-state Flow Model 94
4.4.1 Flow Boundary Conditions 95
4.4.2 Selection of Calibration Targets 95
4.4.3 Model Calibration 97
4.5 Applications of Groundwater Flow Model for Drawdown Prediction 112
5.0 References 181

LIST OF FIGURES

Figure 1-1. Comparison of model domains for the Victoria County Groundwater Flow Model (VCGFM) and the Central Gulf Coast Brackish Groundwater Flow (CGCBGWF) Model. 3
Figure 2-1. Locations of the (1) geophysical logs interpreted by Young and others (2016) to characterize the lithology of the Gulf Coast Aquifer System, (2) domain for the groundwater model developed as part of this study, and (3) domain for the Lower Colorado River Basin groundwater flow model. 13
Figure 2-2. Depositional facies map for the Lissie Formation in the southern region of the Texas Gulf Coast Aquifer System (from Young and others, 2010). 14
Figure 2-2. Location of geophysical logs used to characterize the lithology of the Gulf Coast Aquifer System used to develop the CGCBGWF Model. 15
Figure 2-4. Sand percent map for the Beaumont (left) and Lissie (right) formations based on the interpolation of geophysical logs. 16
Figure 2-5. Sand percent map for the Willis (left) and Upper Goliad (right) formations based on the interpolation of geophysical logs. 17
Figure 2-6. Sand percent map for the Lower Goliad (left) and Upper Lagarto (right) formations based on the interpolation of geophysical logs. 18
Figure 2-7. Sand percent map for the Middle Lagarto (left) and Lower Lagarto (right) formations based on the interpolation of geophysical logs. 19
Figure 2-8. Sand percent map for the Oakville Formation based on the interpolation of geophysical logs. 20
Figure 2-9. R_o-TDS graph for the Chicot Aquifer Group (including the Beaumont, Lissie, and Willis formations) based on 164 well-log pairs. Vertical lines show the formation resistivity values for a 1,000 mg/L (blue) and 3,000 mg/L (red) TDS concentration (from Young and others, 2016). 21
Figure 2-10. R_o-TDS graph for the Evangline Aquifer Group (including the Upper Goliad, Lower Goliad, Upper Lagarto, and Middle Lagarto formations) based on 305 well-log pairs. Vertical lines show the formation resistivity values for a 1,000 mg/L (blue) and 3,000 mg/L (red) TDS concentration (from Young and others, 2016). 21
Figure 2-11. R_o-TDS graph for the Jasper/Catahoula Aquifer Group (including the Lower Lagarto, Oakville, and Catahoula formations) based on 117 well-log pairs. Vertical lines show the formation resistivity values for a 1,000 mg/L (blue) and 3,000 mg/L (red) TDS concentration (from Young and others, 2016). 22
Figure 2-12. Location of nine dip cross-sections and three strike cross sections that were constructed using geophysical log information to show vertical profiles of sand and clay sequences and TDS concentrations of groundwater contained in the sand layers. 23
Figure 2-13. Location map showing wells used in dip cross-section D1, with well aliases labeled to correspond to the wells displayed in the cross-section profile. 24
Figure 2-14. Dip cross-section D1 showing formation boundaries and the water quality classification of groundwater in the sand beds identified in 13 logs. 25
Figure 2-15. Location map showing wells used in dip cross-section D2, with well aliases labeled to correspond to the wells displayed in the cross-section profile. 26
Figure 2-16. Dip cross-section D2 showing formation boundaries and the water quality classification of groundwater in the sand beds identified in 16 logs. 27
Figure 2-17. Location map showing wells used in dip cross-section D3, with well aliases labeled to correspond to the wells displayed in the cross-section profile. 28
Figure 2-19. Location map showing wells used in dip cross-section D4, with well aliases labeled to correspond to the wells displayed in the cross-section profile. 30

Figure 2-21. Location map showing wells used in dip cross-section D5, with well aliases labeled to correspond to the wells displayed in the cross-section profile. 32
Figure 2-22. Dip cross-section D5 showing formation boundaries and the water quality classification of groundwater in the sand beds identified in 23 logs. 33
Figure 2-23. Location map showing wells used in dip cross-section D6, with well aliases labeled to correspond to the wells displayed in the cross-section profile. 34
Figure 2-24. Strike cross-section D6 showing formation boundaries and the water quality classification of groundwater in the sand beds identified in 23 logs. 35
Figure 2-25. Location map showing wells used in dip cross-section D7, with well aliases labeled to correspond to the wells displayed in the cross-section profile. 36
Figure 2-27. Location map showing wells used in dip cross-section D8, with well aliases labeled to correspond to the wells displayed in the cross-section profile. 38
Figure 2-28. Strike cross-section D8 showing formation boundaries and the water quality classification of groundwater in the sand beds identified in 15 logs. 39
Figure 2-29. Location map showing wells used in dip cross-section D9, with well aliases labeled to correspond to the wells displayed in the cross-section profile. 40
Figure 2-30. Strike cross-section D9 showing formation boundaries and the water quality classification of groundwater in the sand beds identified in 16 logs. 41
Figure 2-31. Location map showing wells used in strike cross-section A, with well aliases labeled to correspond to the wells displayed in the cross-section profile. 42
Figure 2-32. Strike cross-section A showing formation boundaries and the water quality classification of groundwater in the sand beds identified in 22 logs. 43
Figure 2-33. Location map showing wells used in strike cross-section B, with well aliases labeled to correspond to the wells displayed in the cross-section profile. 44
Figure 2-34. Strike cross-section B showing formation boundaries and the water quality classification of groundwater in the sand beds identified in 29 logs. 45
Figure 2-35. Location map showing wells used in strike cross-section C, with well aliases labeled to correspond to the wells displayed in the cross-section profile. 46
Figure 2-36. Strike cross-section C showing formation boundaries and the water quality classification of groundwater in the sand beds identified in 33 logs. 47
48
Figure 2-37. Location map showing wells used in strike cross-section D, with well aliases labeled to correspond to the wells displayed in the cross-section profile. 48
49
Figure 2-38. Strike cross-section D showing formation boundaries and the water quality classification of groundwater in the sand beds identified in 15 logs. 49
Figure 2-39. Depth to the base of groundwater with a TDS concentration of 1,000 mg/L based on interpretation of geophysical logs. 50
Figure 2-40. Depth to the base of groundwater with a TDS concentration of 3,000 mg/L based on interpretation of geophysical logs. 51
Figure 2-41. Depth to the base of groundwater with a TDS concentration of 10,000 mg/L based on interpretation of geophysical logs. 52
Figure 2-42. Location of nine transects used to create vertical cross-sections A-I that show bottom boundary of formations and groundwater with different TDS concentrations. 53
Figure 2-43. Cross-section A showing the base geological formation, salinity zones, and groundwater wells from the VCGCD database. 54

Figure 2-44. Cross-section B showing the base geological formation, salinity zones, and groundwater wells from the VCGCD database. 55
Figure 2-45. Cross-section C showing the base geological formation, salinity zones, and groundwater wells from the VCGCD database. 56
Figure 2-46. Cross-section D showing the base geological formation, salinity zones, and groundwater wells from the VCGCD database. 57
Figure 2-47. Cross-section E showing the base geological formation, salinity zones, and groundwater wells from the VCGCD database. 58
Figure 2-48. Cross-section F showing the base geological formation, salinity zones, and groundwater wells from the VCGCD database. 59
Figure 2-49. Cross-section G showing the base geological formation, salinity zones, and groundwater wells from the VCGCD database. 60
Figure 2-50. Cross-section H showing the base geological formation, salinity zones, and groundwater wells from the VCGCD database. 61
Figure 2-51. Cross-section I showing the base geological formation, salinity zones, and groundwater wells from the VCGCD database. 62
Figure 3-1. Location of specific capacities calculated from driller logs for wells installed in the Beaumont Formation. 75
Figure 3-2. Location of specific capacities calculated from driller logs for wells installed in the Lissie Formation. 75
Figure 3-3. Location of specific capacities calculated from driller logs for wells installed in the Willis Formation. 76
Figure 3-4. Location of specific capacities calculated from driller logs for wells installed in the Upper Goliad Formation. 76
Figure 3-5. Location of specific capacities calculated from driller logs for wells installed in the Lower Goliad Formation. 77
Figure 3-6. Location of specific capacities calculated from driller logs for wells installed in the Upper Lagarto Formation. 77
Figure 3-7. Location of specific capacities calculated from driller logs for wells installed in the Middle Lagarto Formation. 78
Figure 3-8. Location of specific capacities calculated from driller logs for wells installed in the Lower Lagarto Formation. 78
Figure 3-9. Location of specific capacities calculated from driller logs for wells installed in the Oakville Formation. 79
Figure 3-10. Location of aquifer pumping tests performed in Public Supply Wells in the study area....80
Figure 3-11. Sensitivity of calculated hydraulic conductivity to length of well screen for formations that comprise the Chicot Aquifer in the study area. 81
Figure 3-12. Sensitivity of calculated hydraulic conductivity to length of well screen for formations that comprise the Evangeline Aquifer and the Middle Lagarto Formation in the study area. 82
Figure 3-13. The mean and geometric mean by aquifer calculated from specific capacity tests....83
Figure 3-14. Location of aquifer pumping tests performed in Public Supply Wells in the study area....84
Figure 3-15. Field data for specific storage as a function of depth used to develop a regression for estimating specific storage as a function of depth for the LCRB model (Young and others, 2006). 84
Figure 3-16. Semi-empirical relationship for determining specific storage based on Shestakov (2002) compared to specific storage calculated from aquifer pumping tests (from Young and others, 2016). 85
Figure 4-1. Aerial view of the numerical grid for the groundwater flow model. 115

Figure 4-2. Cross-section AA' (refer to Figure 4-1) of the groundwater flow model grid comprised of 15 layers. 116
Figure 4-3. Relative change in hydraulic conductivity values caused by the temperature dependence of the density and viscosity of water (data from http://www.viscopedia.com/viscosity-tables/substances/water/). 117
Figure 4-4. Observed relationship between porosity in percent and permeability in millidarcies measured in laboratory cores for geological formations in Texas (modified from Loucks and others, 1986). ...118
Figure 4-5. Hydraulic conductivity of Pliocene clays as a function of depth of burial (Neglia, 2004). 119
Figure 4-6 TDS concentrations in groundwater in model layer 1 (Beaumont Formation). 120
Figure 4-7. TDS concentrations in groundwater in model layer 2 (Lissie Formation). 121
Figure 4-8. TDS concentrations in groundwater in model layer 3 (Willis Formation). 122
Figure 4-9. TDS concentrations in groundwater in model layer 4 (Upper Goliad Formation). 123
Figure 4-10. TDS concentrations in groundwater in model layer 5 (Upper Goliad Formation). 124
Figure 4-11. TDS concentrations in groundwater in model layer 6 (Upper Goliad Formation). 125
Figure 4-12. TDS concentrations in groundwater in model layer 7 (Upper Goliad Formation). 126
Figure 4-13. TDS concentrations in groundwater in model layer 8 (Lower Goliad Formation). 127
Figure 4-14. TDS concentrations in groundwater in model layer 9 (Lower Goliad Formation). 128
Figure 4-15. TDS concentrations in groundwater in model layer 10 (Lower Goliad Formation). 129
Figure 4-16. TDS concentrations in groundwater in model layer 11 (Upper Lagarto Formation). 130
Figure 4-17. TDS concentrations in groundwater in model layer 12 (Upper Lagarto Formation). 131
Figure 4-18. TDS concentrations in groundwater in model layer 13 (Middle Lagarto Formation). 132
Figure 4-20. TDS concentrations in groundwater in model layer 15 (Oakville Formation). 134
Figure 4-21. Locations of the Aquifer Pumping Tests whose calculated transmissivity values were used for the model calibration. 135
Figure 4-22. Generation of the single well pumping test model from the CGCBGWF Model. 135
Figure 4-23. Comparison between the observed transmissivity and the simulated transmissivity values for ten aquifer pumping tests used for model calibration. 136
Figure 4-24. Transmissivity values in Model Layer 1 (Beaumont Formation). 137
Figure 4-25. Transmissivity values in Model Layer 2(Lissie Formation). 138
Figure 4-26. Transmissivity values in Model Layer 3(Willis Formation). 139
Figure 4-27. Transmissivity values in Model Layer 4(uppermost quartile of the Upper Goliad Formation). 140
Figure 4-28. Transmissivity values in Model Layer 5(upper quartile of the Upper Goliad formation). 141
Figure 4-29. Transmissivity values in Model Layer 6(lower quartile of the Upper Goliad formation). 142
Figure 4-30. Transmissivity values in Model Layer 7(lowermost quartile of the Upper Goliad formation). 143
Figure 4-31. Transmissivity values in Model Layer 8(upper third of the Lower Goliad formation). 144
Figure 4-32. Transmissivity values in Model Layer 9(middle third of the Lower Goliad formation). 145
Figure 4-33. Transmissivity values in Model Layer 10(lower third of the Lower Goliad formation). 146
Figure 4-34. Transmissivity values in Model Layer 11(upper half of the Upper Lagarto formation). 147
Figure 4-35. Transmissivity values in Model Layer 12(lower half of the Upper Lagarto formation). 148
Figure 4-36. Transmissivity values in Model Layer 13(Middle Lagarto formation). 149
Figure 4-37. Transmissivity values in Model Layer 14(Lower Lagarto formation). 150
Figure 4-38. Transmissivity values in Model Layer 15(Oakville formation). 151
Figure 4-39. Simulated versus observed groundwater levels for 288 wells in the model domain. 152
Figure 4-40. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 1. 153

Figure 4-41. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 2. 154
Figure 4-42. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 3. 155
Figure 4-43. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 4. 156
Figure 4-44. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 5. 157
Figure 4-45. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 6. 158
Figure 4-46. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 7. 159
Figure 4-47. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 8. 160
Figure 4-48. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 9. 161
Figure 4-49. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 10. 162
Figure 4-50. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 11. 163
Figure 4-51. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 12. 164
Figure 4-52. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 13. 165
Figure 4-53. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 14. 166
Figure 4-54. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 15. 167
Figure 4-55. Locations of brackish wellfields where production rates of 15,000 afy and 30,000 afy were simulated using the CGCBGWF Model 168
Figure 4-56. Simulated drawdowns after 5-year pumping at well field #1 at a rate of 15,000 AFY (left) and 30,000 AFY (right). 169
Figure 4-57. Simulated drawdowns after 30-year pumping at well field #1 at a rate of 15,000 AFY (left) and 30,000 AFY (right). 170
Figure 4-58. Simulated drawdowns after 5-year pumping at well field #2 at a rate of 15,000 AFY (left) and 30,000 AFY (right). 171
Figure 4-59. Simulated drawdowns after 30-year pumping at well field #2 at a rate of 15,000 AFY (left) and 30,000 AFY (right). 172
Figure 4-60. Simulated drawdowns after 5-year pumping at well field #3 at a rate of 15,000 AFY (left) and 30,000 AFY (right). 173
Figure 4-61. Simulated drawdowns after 30-year pumping at well field #3 at a rate of 15,000 AFY (left) and 30,000 AFY (right). 174
Figure 4-62. Simulated drawdowns after 5-year pumping at well field #4 at a rate of 15,000 AFY (left) and 30,000 AFY (right). 175
Figure 4-63. Simulated drawdowns after 30-year pumping at well field #4 at a rate of 15,000 AFY (left) and 30,000 AFY (right). 176

Figure 4-64. Simulated drawdowns after 5-year pumping at well field #5 at a rate of 15,000 AFY (left) and 30,000 AFY (right). 177
Figure 4-65. Simulated drawdowns after 30-year pumping at well field #5 at a rate of 15,000 AFY (left) and 30,000 AFY (right). 178
Figure 4-66. Simulated drawdowns after 5-year pumping at well field #6 at a rate of 15,000 AFY (left) and 30,000 AFY (right). 179
Figure 4-67. Simulated drawdowns after 30-year pumping at well field #6 at a rate of 15,000 AFY (left) and 30,000 AFY (right) 180

LIST OF TABLES

Table 2-1. Simplified stratigraphic and hydrogeologic chart of the Gulf Coast Aquifer System (Young and others, 2010). 4
Table 2-2. Groundwater salinity classification based on the criteria established by Winslow and Kister (1956). 7
Table 2-3. Coefficients for Equation 2-1 that predict calculated TDS concentrations from formation resistivity. 8
Table 3-1. Distribution of specific capacity tests by formation in the study area. 65
Table 3-2. Hydraulic conductivities summary by formation and screen length and facies. 66
Table 3-3. Breakpoints used to calculate hydraulic conductivity as a function of sand percent by formation and depositional environment for the LCRB Model. 68
Table 3-4. Breakpoints used to calculate hydraulic conductivity as a function of sand percent by formation and depositional environment for the CGCBGWF Model. 69
Table 3-5. Aquifer Tests in wells with screen intervals greater than 250 feet that primarily intersect coastal deposits comprising the Upper Goliad Formation. 71
Table 3-6. Estimated porosity values for sand, clay, and a deposit consisting of equal mixture of sand and clay as a function of depth. 72
Table 3-7. Parameters used in Equation 3-6 in the LCRB model (Young and others, 2009) to estimate specific storage. 74
Table 4-1. Example calculations illustrating adjustments to horizonal hydraulic conductivity values to account for changes in increases in temperature and decreases in porosity with depth. 88
Table 4-2. Groundwater volumes (in 1,000 acre-feet) in Calhoun County for fresh, slightly saline, moderately saline, and very saline groundwater by model layer and by formation. 91
Table 4-3. Groundwater volumes (in 1,000 acre-feet) in Jackson County for fresh, slightly saline, moderately saline, and very saline groundwater by model layer and by formation. 92
Table 4-4. Groundwater volumes (in 1,000 acre-feet) in Refugio County for fresh, slightly saline, moderately saline, and very saline groundwater by model layer and by formation. 93
Table 4-5. Groundwater volumes (in 1,000 acre-feet) in Victoria County for fresh, slightly saline, moderately saline, and very saline groundwater by model layer and by formation. 94
Table 4-4. Summary of water level calibration targets by county and by hydrogeologic unit. 96
Table 4-5. Aquifer pumping tests for model calibration. 97
Table 4-5. Calibration statistics for hydraulic heads. 99
Table 4-6. Observed values, simulated values, and residuals for 288 groundwater level calibration targets. 99
Table 4-7. Transmissivity from ten aquifer pumping tests. 112
Table 4-8. Locations of brackish well fields. 112

Table 4-9. Simulated drawdown at the six well fields after 5-year and 30-year pumping at 15,000 AFY and 30,000 AFY. 113
Table 4-10. Simulated drawdown from distances to the well fields after 30-year of pumping at 30,000 AFY. 114

Acronyms and Abbreviations

%	percent
°F	degrees Fahrenheit
bgs	below ground surface
BRACS	Brackish Resources Aquifer Characterization System
CCGCD	Calhoun County Groundwater Conservation District
CGCBGW	Central Gulf Coast Brackish Groundwater Flow
CJSL	Coober Jacob straight line method
ft	feet
ft^2/day	square feet per day
GAM	groundwater availability model
GHBC	General Head Boundary Condition
gpm/ft	gallons per minute per foot
INTERA	INTERA Incorporated
LCRA-SAWS	Lower Colorado River Authority-San Antonio Water System
LCRB	Lower Colorado River Basin
MAE	mean absolute error
ME	mean error
mg/L	milligrams per liter
msl	mean sea level
PWS	public water supply
RGCD	Refugio Groundwater Conservation District
RMSE	root mean square error
SP	spontaneous potential
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TDS	Total Dissolved Solids
TGCD	Texana Groundwater Conservation District
TWDB	Texas Water Development Board
USGS	United States Geological Survey
VCGCD	Victoria County Groundwater Conservation District
VCGFM	Victoria County Groundwater Flow Model

Executive Summary

This report documents the work performed by INTERA Incorporated (INTERA) to improve the characterization of brackish groundwater resources and support the development of rules for managing brackish groundwater resources in Calhoun County Groundwater Conservation District (CCGCD), Texana Groundwater Conservation District (TGCD), Refugio Groundwater Conservation District (RGCD), and Victoria County Groundwater Conservation District (VCGCD). The scope of work includes: 1) Characterization of water quality, lithology, and hydraulic properties in Gulf Coast Aquifer System in the VCGCD, RGCD, CCGCD, and TGCD; and 2) Develop and apply a groundwater flow model for the Central Gulf Coast to evaluate the impacts of brackish groundwater development.

Lithology in the Gulf Coast Aquifer System was characterized using 464 geophysical logs with the gamma ray, spontaneous potential, and electrical resistivity signals, which were interpreted into sand and clay sequences in aquifers. Sand percent maps are generated as results of the lithologic characterizations. Water quality in terms of Total Dissolved Solids (TDS) concentrations was estimated using the established relationship between electrical resistivity and TDS concentrations. Salinity zones in aquifers were mapped based on the estimated TDS concentrations, which were used to estimate volumes of brackish groundwater resources. Hydraulic properties in aquifers were estimated based on the analysis of aquifer pumping tests and specific capacity tests.

The Central Gulf Coast Brackish Groundwater Flow Model (CGCBGWF Model), covering 11,730 square miles and portions of 19 counties, was developed by expanding the Victoria County Groundwater Flow Model (Young and Kushnereit, 2018). The CGCBGWF Model is a three-dimensional MODFLOW 6 groundwater flow model that includes fifteen model layers to represent the nine formations that comprise the Gulf Coast Aquifer System. The model was developed based on the conceptual framework that infiltrating rainwater recharges the aquifers and groundwater leaves the aquifers as discharge to either streams or the ocean. The steady-state model was calibrated using 288 water levels and 10 aquifer pumping tests. The CGCBGWF Model was used to predict drawdowns by pumping from six brackish well fields distributed in Jackson, Calhoun, and Refugio counties. Multiple pumping scenarios were simulated to demonstrate the drawdown impacts in both brackish and freshwater zones.

1.0 Introduction

This report documents the work INTERA Incorporated (INTERA) performed to improve the characterization of brackish groundwater resources and support the development of rules for managing brackish groundwater resources in Calhoun County Groundwater Conservation District (CCGCD), Texana Groundwater Conservation District (TGCD), Refugio Groundwater Conservation District (RGCD), and Victoria County Groundwater Conservation District (VCGCD). The objectives of the report are to:

- Improve the characterization of brackish groundwater in Calhoun, Jackson, Refugio, and Victoria counties
- Develop and apply a methodology for predicting impacts to groundwater resources caused by pumping brackish groundwater, and
- Support VCGCD, RGCD, CCGCD, and TGCD with the development of management goals and rules to promote prudent development of brackish groundwater.

The project scope includes expanding and enhancing the Victoria County Groundwater Flow Model (VCGFM) that was developed by Young and Kushnereit (2018). The VCGFM includes an area that extends approximately 50 miles around Victoria County and was built to support the development of rules for VCGCD to incentivize the development of brackish groundwater. The expanded model is referred to herein as the Central Gulf Coast Brackish Groundwater Flow Model (CGCBGWF Model). **Figure 1-1** shows the model domains for the VCGFM and the CGCBGWF Model.

Sections 2 through 4 describe the stratigraphy, lithology, and water quality of the central portion of the Texas Gulf Coast Aquifer System and the development and application of the CGCBGWF Model. A considerable portion of Section 2 focuses on the interpretation of geophysical logs to delineate stratigraphic boundaries, generate sand percent maps, and estimate the Total Dissolved Solids (TDS) concentrations. Section 3 characterizes the hydraulic properties in the study area. The majority of the aquifer hydraulic properties are based on the analysis of aquifer pumping tests and specific capacity tests. The methodologies used to generate hydraulic properties for the aquifer formations is based on those used in studies funded by the Texas Water Development Board (TWDB). Section 3 includes maps of specific capacity. Section 4 describes the development and application of the CGCBGWF Model. The CGCBGWF Model is a three-dimensional MODFLOW-based groundwater flow model that covers 11,730 square miles and includes portions of 19 counties. The CGCBGWF Model includes fifteen model layers to represent nine of the formations that comprise the Gulf Coast Aquifer System.

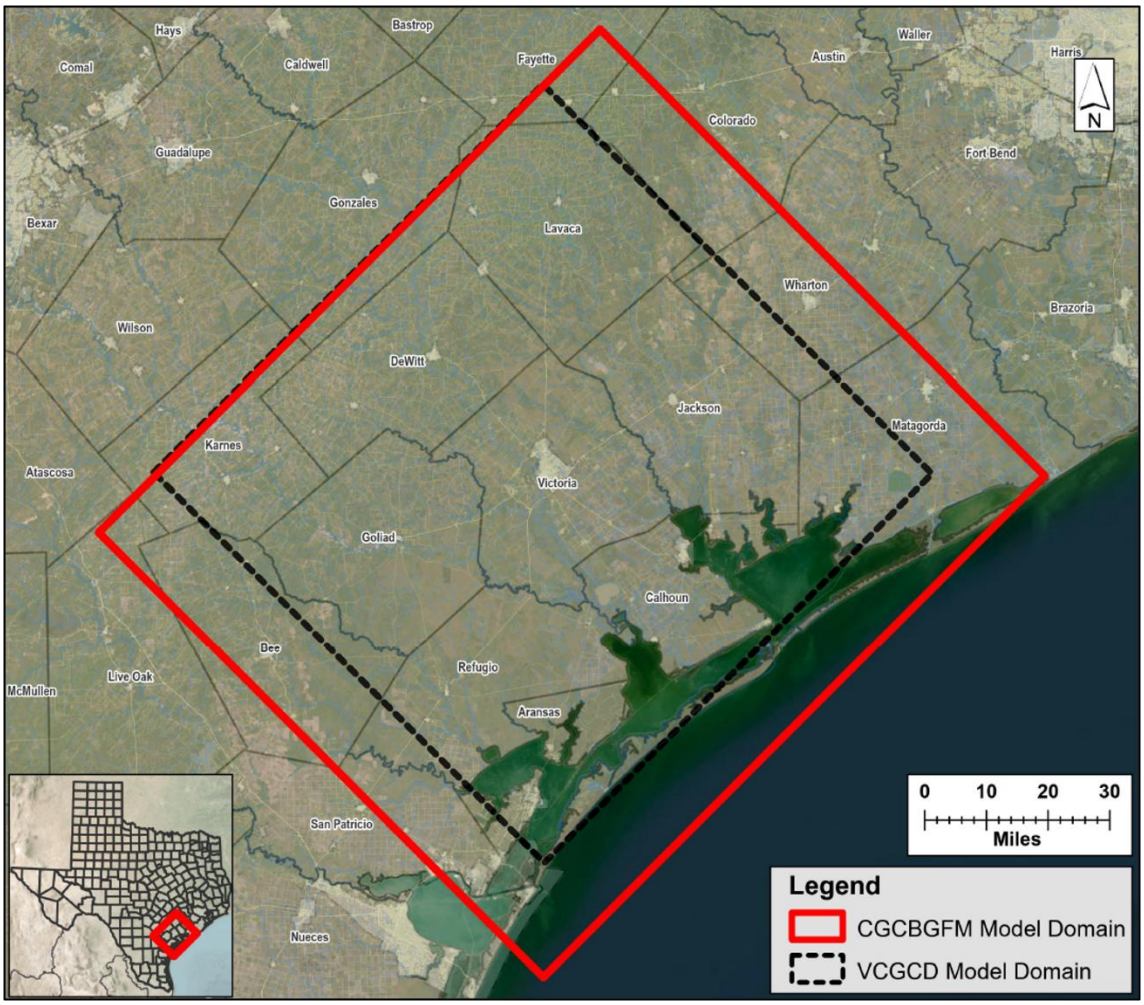


Figure 1-1. Comparison of model domains for the Victoria County Groundwater Flow Model (VCGFM) and the Central Gulf Coast Brackish Groundwater Flow (CGCBGWF) Model.

2.0 Characterization of the Gulf Coast Aquifer System Stratigraphy, Lithology, and Water Quality

This section describes the stratigraphy, lithology, and water quality of the central portion of the Gulf Coast Aquifer System. The majority of the data analyses involved the interpretation of geophysical logs. The foundation of the analyses are the Gulf Coast Aquifer studies funded by the TWDB (Young and others, 2010, 2013, 2016) and the VCGCD (Young and Kushnereit, 2018).

2.1 Stratigraphy

The stratigraphy of the Gulf Coast Aquifer System is based on Young and others (2010, 2012a) and is comprised of, from shallowest to deepest, the Chicot Aquifer, the Evangeline Aquifer, the Burkeville Confining Unit, and the Jasper Aquifer, with parts of the Catahoula Formation acting as the Catahoula Confining System. **Table 2-1** lists the formations associated with the Chicot, Evangeline, and Jasper aquifers. The information from Young and others (2010, 2012a) is well suited for this study because the TWDB performed these studies to support updates to the groundwater availability models (GAMs) for the Gulf Coast Aquifer System.

Table 2-1. Simplified stratigraphic and hydrogeologic chart of the Gulf Coast Aquifer System (Young and others, 2010).

Era	Epoch		Est. Age (M.Y.)	Formation	Hydrogeologic Unit
Cenozoic	Pleistocene		0.7	Beaumont	CHICOT AQUIFER
			1.6	Lissie	
	Pliocene		3.8	Willis	
	Miocene	Late	11.2	Upper Goliad	EVANGELINE AQUIFER
			14.5	Lower Goliad	
			17.8	Upper Lagarto	
		Middle		Middle Lagarto	BURKEVILLE
				Lower Lagarto	JASPER AQUIFER
		Early	24.2	Oakville	
	Oligocene		32	Frio	CATAHOULA
			34	Vicksburg	

The physical and hydraulic properties associated with the formations in Table 2-1 are largely determined by their depositional environment, which can be mapped using depositional facies. Depositional facies account for changes in the environmental factors that affect the composition of a deposit. These environmental factors include, but are not limited to: climate, ocean level, sediment sources, and chemistry. As these factors change over time, the composition of the deposits change, and cycles of repeating sequences of sand and clay occur.

This study adopted the depositional facies maps developed by Young and others (2010). These depositional maps are based on the work of Galloway (2000) that have also been used by Young and Kelley (2006) and Young and others (2010). These facies can be divided into fluvial facies, coastal facies, and shelf facies. Fluvial facies are associated with deposition in rivers and on the floodplains of rivers. Coastal facies are associated with depositions in coastal and shoreline environments. Shelf facies are associated with off-shore environments. Young and others (2010) provide maps of the depositional facies that comprise each of the Gulf Coast formations.

Young and Kelley (2009) effectively used the differences in the hydraulic conductivity values among the fluvial and coastal facies to calibrate a Lower Colorado River Basin (LCRB) groundwater flow model for the Lower Colorado River Authority-San Antonio Water System (LCRA-SAWS) Groundwater for Agriculture Study. The LCRA-SAWS study developed a groundwater flow model to evaluate alternative wellfield designs in Colorado, Wharton, and Matagorda counties to produce an average annual volume of 36,000 acre-feet per year (AFY) of additional groundwater supply from the Lakeside, Garwood, Gulf Coast, and Pierce Ranch Irrigation Divisions in the LCRB. As shown in **Figure 2-1**, the LCRB model extends from Harris County into both Victoria and Calhoun counties. Young and Kelley's (2009) key findings were: (1) fluvial deposits generally are more permeable than coastal deposits and (2) categorizing deposits as either fluvial or coastal was useful in calibrating the LCRB groundwater flow model.

Because of the successful application of depositional facies characterization and modeling of the Gulf Coast Aquifer in the LCRB study, depositional facies will be considered to develop groundwater flow models. **Figure 2-2** shows an example of a depositional map for the Lissie Formation developed by Young and others (2010). For developing the CGCBGWF Model, the fluvial deposits will be associated primarily with the fluvial/meanderbelt facies, and the coastal deposits will be associated primarily with the lower coastal plain fluvial/coastal deposits.

2.2 Geophysical Well Logs

Figure 2-3 shows the locations of the 464 logs that were used in the Study and the location of the 251 logs that were used to develop the CGCBGWF Model. The logs were obtained from the following sources:

- Commercial log libraries;
- Texas Commission on Environmental Quality (TCEQ) files on public water supply wells;
- The Railroad Commission of Texas Collection of "Q" logs;
- TWDB Groundwater Database (GWDB) Brackish Resources Aquifers Characterization System (BRACS) Database.

2.2.1 Lithology

The technical approach used to characterize the lithology of the hydrogeologic units listed in Table 2-1 builds upon the methods established by the TWDB study performed by Young and others (2016). In that study, Young and others (2016) interpreted 609 geophysical logs (Figure 2-3) to construct continuous profiles of sand and clay sequences. The 2018 *Characterization of Brackish Groundwater Resources in Victoria County Report* applied these same interpretation procedures to a subset of 251 geophysical

logs, consisting of 97 logs from the TWDB Brackish Resources Study of the Gulf Coast Aquifer System (Young and others, 2016) and 154 logs acquired and interpreted specifically for that earlier project.

For the current, expanded study, we broadened lithologic control by incorporating an additional 213 geophysical logs (Figure 2-3) into the interpretation workflow. The expanded dataset improved spatial coverage, enhanced the resolution of lithologic characterization across the study area, and allowed for a better delineation of sand and clay sequences, and improved hydrostratigraphic interpretation.

Interpretation of geophysical logs for this study followed a similar approach to Young and others (2016). Sand intervals were delineated based on integrated analysis of the gamma ray (GR) (where available), spontaneous-potential (SP), and resistivity (RES) log signatures. All log interpretations occurred in PETRA, which is a commercial subsurface-interpretation software that enables detailed visualization of geophysical logs and facilitates consistent delineation of sand-body tops and bases through careful, high-resolution manual picking of log responses. For each geophysical log, INTERA also generated a continuous profile of the subsurface lithology based on a binary system of sands and clays. For each model layer, the PETRA analysis results were used to construct sand percent maps and sand thickness maps for each formation and each model layer.

2.2.2 Estimated Sand Percent by Formations

Using the sand intervals identified in the geophysical logs (Figure 2-3), INTERA generated maps of sand percents for the formations that comprise the Gulf Coast Aquifer System. Each map shows the locations of the geophysical logs used to develop estimates of sand percentage. **Figure 2-4** shows maps of sand percents for the Beaumont and Lissie formations. **Figure 2-5** shows maps of sand percents for the Willis and Upper Goliad formations. **Figure 2-6** shows maps of sand percents for the Lower Goliad and Upper Lagarto formations. **Figure 2-7** shows maps of sand percents for the Middle Lagarto and Lower Lagarto formations. **Figure 2-8** shows maps of sand percents for the Oakville Formation.

2.3 Water Quality

Salinity is a measure of the overall quality of groundwater, commonly measured as the TDS concentration, which is typically reported in units of milligrams per liter (mg/L). The primary sources of groundwater to the Gulf Coast Aquifer System consist of relatively fresher meteoric water derived from precipitation recharging the aquifers since their deposition. As groundwater moves through the subsurface, it becomes mineralized, and its salinity increases as the groundwater interacts with the aquifer materials. Among the sources of groundwater salinity in the Texas Gulf Coast Aquifer System are saline connate water trapped in the sediments at the time of deposition, dissolution of salt domes, the upwelling of brine from geothermal zones along growth faults, natural deposits of evaporate minerals, salt water intrusion, sea salt spray, and oil and gas development (Young and others, 2013).

2.3.1 Salinity Classification by TDS Concentrations

For this study, groundwater water quality is classified using the criteria presented in **Table 2-2**. The four criteria were developed by the United States Geological Survey (USGS) (Winslow and Kister, 1956). A complete description of the various groundwater quality classification schemes based upon TDS concentration exists in the USGS Professional Paper 1833 (Stanton and others, 2017).

Table 2-2. Groundwater salinity classification based on the criteria established by Winslow and Kister (1956).

Salinity Classification	TDS Concentration Range (mg/L)
Fresh	Less than 1,000
Slightly Saline*	1,000 to 3,000
Moderately Saline*	3,000 to 10,000
Very Saline	10,000 to 35,000

*Brackish water includes slightly saline and very saline water.

For this study, the definition of TDS is consistent with the Texas Administrative Code (TAC) and the definition provided by the TWDB website. The TAC Title 30 (Environmental Quality), Part 1 (TCEQ) and Chapter 307 (Texas Surface Water Quality Standards) Rule 307.3 (ii) (C) (74) defines TDS as "The amount of material (inorganic salts and small amounts of organic material) dissolved in water and commonly expressed as a concentration in terms of milligrams per liter. The term is equivalent to the term filterable residue, as used in 40 Code of Federal Regulations Part 136 and in previous editions of the publication entitled, *Standard Methods for the Examination of Water and Wastewater*" (TAC, 2016).

The TWDB website describing the groundwater database defines dissolved solids as:

> **"Dissolved Solids:** (sum of constituents) This is calculated based on the values, in mg/L, of the major anions and cations, silica, and 0.4917 of the bicarbonate. Nothing is added into the 'TDS' from the infrequent table. However, some high values that might be considered as contributing to the TDS, while not included in the TWDB's formula, are Fe, Br, B, Ba, and Zn. If a sample is missing one or more major anions or cations so that the analysis is unbalanced, a TDS determined by residue can be entered into the dissolved solids field. However, if all constituents are present, the TDS is calculated and replaces anything else in the field" (TWDB, 2016).

2.3.2 Estimate TDS Concentration from Electrical Resistivity in the Study Area

Young and others (2016) established a regional relationship between temperature-adjusted formation resistivity and TDS for the Gulf Coast Aquifer System. Using 762 geophysical logs and paired values of TDS at nearby wells, they performed a regression analysis to develop coefficients for **Equation 2-1** to show the correlation between the values for the formations in the region (the Chicot, Evangeline, and Jasper/Catahoula hydrogeologic units). Note that the coefficients developed by the regression analysis are regional, and site-specific relationships between TDS and resistivity may differ from those presented by Young and others (2016).

$$In(TDS) = coef2 \times In(R_o) + coef1 \quad \text{(Equation 2-1)}$$

Where:

TDS = total dissolved solids concentration (milligrams per liter)

R_o = formation resistivity (ohm-meters)

Coef1 and Coef2 = coefficients determined by the regression analysis

As stated above, Young and others (2016) developed coefficients for Equation 2-1 (Coef1 and Coef2) to be used regionally for the aquifer systems in the Gulf Coast. These coefficients are listed in **Table 2-3**. Figures 2-9, 2-10, and 2-11 presents the data and the regression used to develop the coefficients for the Chicot Aquifer, the Evangeline Aquifer, and the Jasper/Catahoula Aquifer, respectively. Regional adjustments were developed to account for differences in the types of sands, clays, porosity, and chemical composition of groundwater that accords regionally and locally across the Gulf Coast aquifers.

Table 2-3. Coefficients for Equation 2-1 that predict calculated TDS concentrations from formation resistivity.

Formation Group	Coef1	Coef2
	Young and others (2016)	Young and others (2016)
Chicot Aquifer	9.4	-0.95
Evangeline Aquifer	9.66	-1.03
Jasper/Catahoula Aquifer	9.49	-0.95

To apply Equation 2-1, we made temperature corrections using **Equation 2-2**. We used a site-specific mean annual air temperature of 22 degrees Celsius (Figure 7-7; Young and others, 2016) and a geothermal gradient estimate of 8 degrees Celsius per 1,000 feet (Figure 7-9; Young and others, 2016) to determine the approximate temperature at the depth of each resistivity measurement, which were reported in six-inch increments. Using Equation 2-2, we adjusted resistivity values to 77 degrees Fahrenheit (25 degrees Celsius), which is the standard temperature for reporting specific conductance (the reciprocal of resistivity). A temperature-adjusted resistivity value was determined for each six-inch increment.

$$R_{w^{77}} = R_{w^1} \frac{(T1+6.77)}{77+6.77} \quad \text{(Equation 2-2)}$$

Where:

$R_{w^{77}}$ = sand bed formation resistivity adjusted to 77 degrees Fahrenheit

R_{w^1} = sand bed formation resistivity calculated from the geophysical log

$T1$ = estimated in-situ temperature of groundwater in the sand bed based on the depth of the sand bed.

2.3.3 Sections Comprised of Geophysical Logs Showing Lithology and TDS Concentrations

Figure 2-12 illustrates the spatial arrangement of the 12 geologic cross-sections constructed from the interpreted geophysical log dataset. The cross-section network consists of nine dip-oriented sections (D1 through D9) and three strike-oriented sections (A, B, and C). **Figure 2-13** through **Figure 2-30** present the dip sections, and **Figures 2-31** through **2-38** present the strike sections.

Each cross-section displays the interpreted geophysical logs in a standardized format. All cross-sections share a uniform datum at ground-surface elevation to ensure consistent vertical alignment. The depth track on each section extends from ground surface to 3,000 feet (ft) below ground surface (bgs). For every log trace, the spontaneous-potential (SP) or gamma ray (GR) curve is plotted on the left, and the deep-resistivity (RES) curve is plotted on the right. Where sands have been identified on the geophysical log, the interval between the SP or GR and the RES curve is colored to indicate the salinity of the groundwater as defined in the legend on the upper right of every cross-section. Intervals outside of the sand bodies are rendered in gray to represent clay-rich zones. The alias number for each well or log is shown above its respective trace and can be used for identification on each of the corresponding cross-section base maps. Correlative stratigraphic markers are depicted as solid-colored lines across each cross-section to indicate base of formation boundaries and highlight lateral changes in stratigraphy.

2.3.4 Maps of Salinity Zones

Figures 2-39 through **2-41** are maps of the depth to the base of three groundwater salinity zones within the CGCBGWF Model. These figures depict the base of groundwater with estimated TDS concentrations less than 1,000, 3,000, and 10,000 mg/L, respectively. These maps reflect the base maps presented by Young and others (2016) with minor modifications. The base of each salinity zone was identified by interpreting geophysical logs and marking the deepest occurrence of the applicable TDS threshold. These interpreted depths were then used to contour base-of-salinity surfaces. Geophysical logs used in the development of each surface are shown as black dots on the figures.

Figure 2-39 illustrates the depth to the base of fresh groundwater, defined as groundwater with TDS concentrations less than 1,000 mg/L. Across the expanded model area, the base of fresh groundwater generally occurs at depths ranging from approximately 200 to 1,400 ft bgs. Shallowest depths are present along the southeastern portion of the model area near the coast, whereas greater depths occur inland. The deepest extent of fresh groundwater is observed in the central to northeastern portion of the model area along stratigraphic strike, where depths locally exceed 1,200 feet.

Figure 2-40 shows the depth to the base of useable quality groundwater with TDS concentrations less than 3,000 mg/L. The base of this slightly saline groundwater zone occurs at depths ranging from approximately 500 to 2,250 feet across the model area. Depths generally increase from southeast to northwest, with the shallowest values near the coast and progressively deeper values inland. The deepest portion of the <3,000 mg/L salinity zone is located in the northeastern part of the model area, where depths locally exceed 2,000 feet. The overall trend of the contours is broadly similar to that observed for the base of fresh groundwater, indicating a consistent regional salinity framework with increasing salinity at greater depths.

Figure 2-41 depicts the depth to the base of groundwater with TDS concentrations less than 10,000 mg/L. This surface represents the transition to very saline groundwater and occurs at depths ranging from approximately 1,200 to more than 3,000 ft bgs. As with the shallower salinity zones, the depth to the base of the <10,000 mg/L zone generally increases inland, with the shallowest depths along the coastal margin and the deepest depths in the northern and northeastern portions of the expanded model area.

Collectively, Figures 2-39 through 2-41 demonstrate a consistent regional trend of increasing groundwater salinity with depth and distance from the coast. The expanded model area and increased number of interpreted geophysical logs provide improved spatial resolution and greater confidence in the delineation of salinity-zone boundaries compared to previous studies.

2.3.5 Cross-sections Showing Wells, Formations, and Salinity Zones

Figure 2-42 shows the location of nine transects used to develop cross-sections (**Figures 2-43** through **2-51**) that illustrate the relationship between water well depth, interpreted stratigraphy, and the base of selected salinity zones. The cross-sections are labeled from east to west as Cross-sections A-I. Each cross-section extends across the full width of the expanded model domain and incorporates a five-mile buffer on either side of the transect line to capture nearby water wells for context. Water wells intersecting each buffer are shown as blue vertical lines and represent a compilation of records from the TWDB GWDB, the Submitted Driller's Report Database, and the VCGCD database. These wells are included to illustrate the depth distribution of groundwater development relative to formation geometry and groundwater salinity zones.

The cross-sections display interpreted base of formation contacts for the Beaumont, Lissie, Willis, Upper Goliad, Lower Goliad, Upper Lagarto, Middle Lagarto, Lower Lagarto, and Oakville units, along with contours representing the base of groundwater with TDS concentrations of 1,000, 3,000, and 10,000 mg/L. Together, these sections provide a regional perspective on the vertical and lateral variability of groundwater salinity and its relationship to stratigraphy across the model area.

Figure 2-43 shows Cross-section A, the easternmost transect, extending from Lavaca County southeastward toward the Matagorda County coastline. Most water wells terminate within the Beaumont, Lissie, or Willis formations, with relatively few wells extending into the Evangeline-equivalent units represented by the Upper and Lower Goliad formations. Almost all wells terminate above the base of fresh groundwater (TDS <1,000 mg/L). Along much of the section, the base of fresh groundwater occurs at elevations below approximately −700 feet mean sea level (msl), while the base of slightly saline groundwater (TDS <3,000 mg/L) generally lies below −1,400 to −1,600 ft msl. The bases of the fresh, slightly saline, and moderately saline groundwater zones systematically deepen in the down-dip direction until approximately 10,000 feet from the coastline, at which point the bases of these zones transition abruptly to much shallower depths.

Figure 2-44 shows Cross-section B, which traverses Lavaca, Jackson, and Matagorda counties. The majority of water wells terminate above the base of the Willis Formation, with only a small number extending into the Upper Goliad Formation. Nearly all wells terminate above the base of fresh groundwater, with only isolated wells approaching the fresh-to-slightly saline transition. The Upper Goliad Formation is the thickest unit along the section, locally exceeding 800 feet in thickness. The bases of the fresh, slightly saline, and moderately saline groundwater zones systematically deepen in the down-dip direction until approximately 10,000 feet from the coastline, at which point the bases of these zones transition abruptly to much shallower depths.

Figure 2-45 shows Cross-section C, extending from Gonzales County southeastward into Calhoun County. Most water wells terminate above the base of the Upper Goliad Formation, with only a few deeper wells penetrating into the Lower Goliad Formation. Most wells terminate above the base of

fresh groundwater. The Upper Goliad Formation remains the thickest hydrostratigraphic unit, with a maximum thickness of approximately 800 to 850 feet. Along the down-dip direction, the bases of the fresh, slightly saline, and moderately saline groundwater zones deepen until approximately 10,000 feet from the coastline, at which point the bases of these zones transition abruptly to much shallower depths.

Figure 2-46 shows Cross-section D, which trends from Gonzales County through DeWitt and Victoria counties into Calhoun County. The majority of wells terminate above the base of the Upper Goliad Formation, with a small number of deeper wells extending into the Lower Goliad Formation. All wells terminate above the base of fresh groundwater. The Upper Goliad Formation is again the thickest unit, locally approaching 900 feet in thickness. The bases of the fresh, slightly saline, and moderately saline groundwater zones systematically deepen in the down-dip direction until approximately 10,000 feet from the coastline, at which point the bases of these zones transition abruptly to much shallower depths.

Figure 2-47 shows Cross-section E, which spans Gonzales, DeWitt, Victoria, and Calhoun counties. Water-well completions are generally shallow relative to the deeper hydrostratigraphic units, with most wells terminating within the Beaumont, Lissie, or Willis formations. The bases of the salinity zones exhibit a smooth down-dip deepening trend similar to that observed in adjacent cross-sections. The base of fresh groundwater typically occurs between −600 and −1,100 ft msl, while the base of slightly saline groundwater ranges from approximately −1,400 to −1,800 ft msl. The bases of the fresh, slightly saline, and moderately saline groundwater zones systematically deepen in the down-dip direction until approximately 10,000 feet from the coastline, at which point the bases of these zones transition abruptly to much shallower depths.

Figure 2-48 shows Cross-section F, extending from Karnes County southeastward through Victoria County into Refugio County. The majority of wells terminate above the base of the Willis Formation, with relatively few wells penetrating into the Upper Goliad Formation. The base of fresh groundwater ranges from approximately −500 to −1,100 ft msl, the base of slightly saline groundwater ranges from about −1,300 to −1,700 ft msl, and the base of moderately saline groundwater locally exceeds −2,300 ft msl. The bases of the fresh, slightly saline, and moderately saline groundwater zones systematically deepen in the down-dip direction until approximately 10,000 feet from the coastline, at which point the bases of these zones transition abruptly to much shallower depths.

Figure 2-49 shows Cross-section G, which traverses Karnes, Goliad, Refugio, and Aransas counties. Water-well completions are predominantly shallow and terminate well above the base of fresh groundwater. The base of moderately saline groundwater deepens to elevations approaching −2,700 ft msl in the southeastern portion of the section. The bases of the fresh, slightly saline, and moderately saline groundwater zones systematically deepen in the down-dip direction until approximately 10,000 feet from the coastline, at which point the bases of these zones transition abruptly to much shallower depths.

Figure 2-50 shows Cross-section H, extending from Karnes County southeastward into Aransas County. The section is characterized by relatively shallow well completions compared to the depth of the salinity boundaries. The base of fresh groundwater generally occurs between −600 and −1,000 ft msl, while the base of slightly saline groundwater ranges from approximately −1,400 to −1,800 ft msl. The bases of the

fresh, slightly saline, and moderately saline groundwater zones systematically deepen in the down-dip direction until approximately 10,000 feet from the coastline, at which point the bases of these zones transition abruptly to much shallower depths.

Figure 2-51 shows Cross-section I, the westernmost transect, extending from Karnes County through Bee and Refugio counties into San Patricio County. Most water wells terminate above the base of the Willis Formation, with few wells extending into deeper units. The salinity-zone boundaries exhibit a pronounced down-dip deepening trend, with the base of fresh groundwater generally below −800 ft msl, the base of slightly saline groundwater below −1,600 ft msl, and the base of moderately saline groundwater reaching elevations of approximately −2,700 ft msl toward the southeastern end of the section. The bases of the fresh, slightly saline, and moderately saline groundwater zones systematically deepen in the down-dip direction until approximately 10,000 feet from the coastline, at which point the bases of these zones transition abruptly to much shallower depths.

Collectively, Cross-sections A through I illustrate a consistent regional pattern of increasing groundwater salinity with depth and in the down-dip (southeasterly) direction across the expanded model domain. In all sections, water-well completions are predominantly shallow relative to the depth of the mapped salinity boundaries and generally terminate above the base of fresh groundwater (TDS <1,000 mg/L), particularly within the Beaumont, Lissie, and Willis formations. Penetration of wells into the Upper and Lower Goliad formations is limited and becomes more common toward the central and western portions of the model area. The bases of the fresh, slightly saline (TDS <3,000 mg/L), and moderately saline (TDS <10,000 mg/L) groundwater zones deepen systematically down-dip and broadly parallel the regional stratigraphic dip of the Gulf Coast aquifer system. The deepest occurrences of each salinity zone are consistently observed in the southeastern portions of the cross-sections near the coast, where the thickness of freshwater and slightly saline groundwater is greatest. Lateral continuity of salinity boundaries between adjacent cross-sections indicates a regionally coherent salinity framework, while localized undulations in the surfaces reflect heterogeneity in depositional facies, structural influences, and spatial variability in data density.

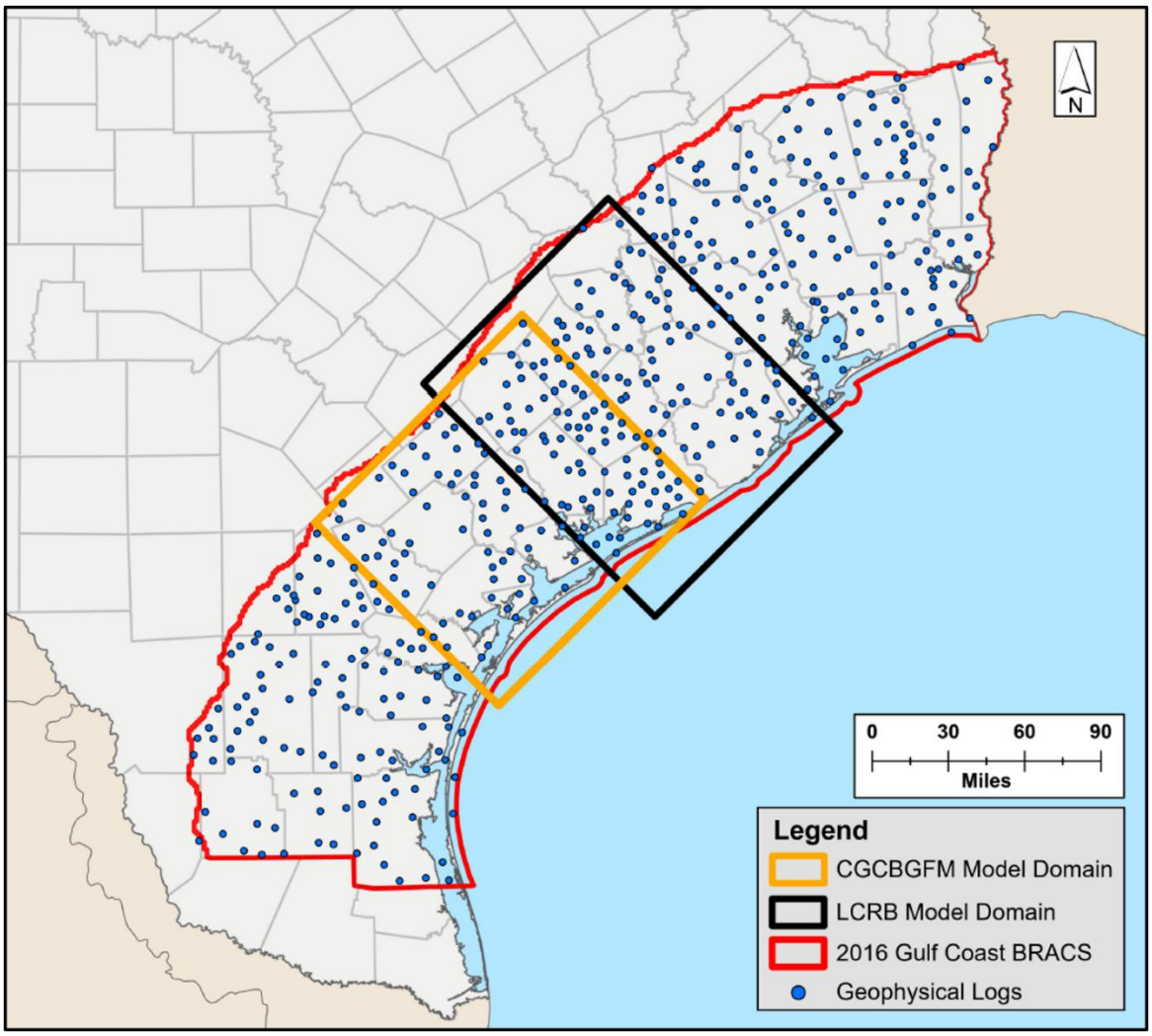


Figure 2-1. Locations of the (1) geophysical logs interpreted by Young and others (2016) to characterize the lithology of the Gulf Coast Aquifer System, (2) domain for the groundwater model developed as part of this study, and (3) domain for the Lower Colorado River Basin groundwater flow model.

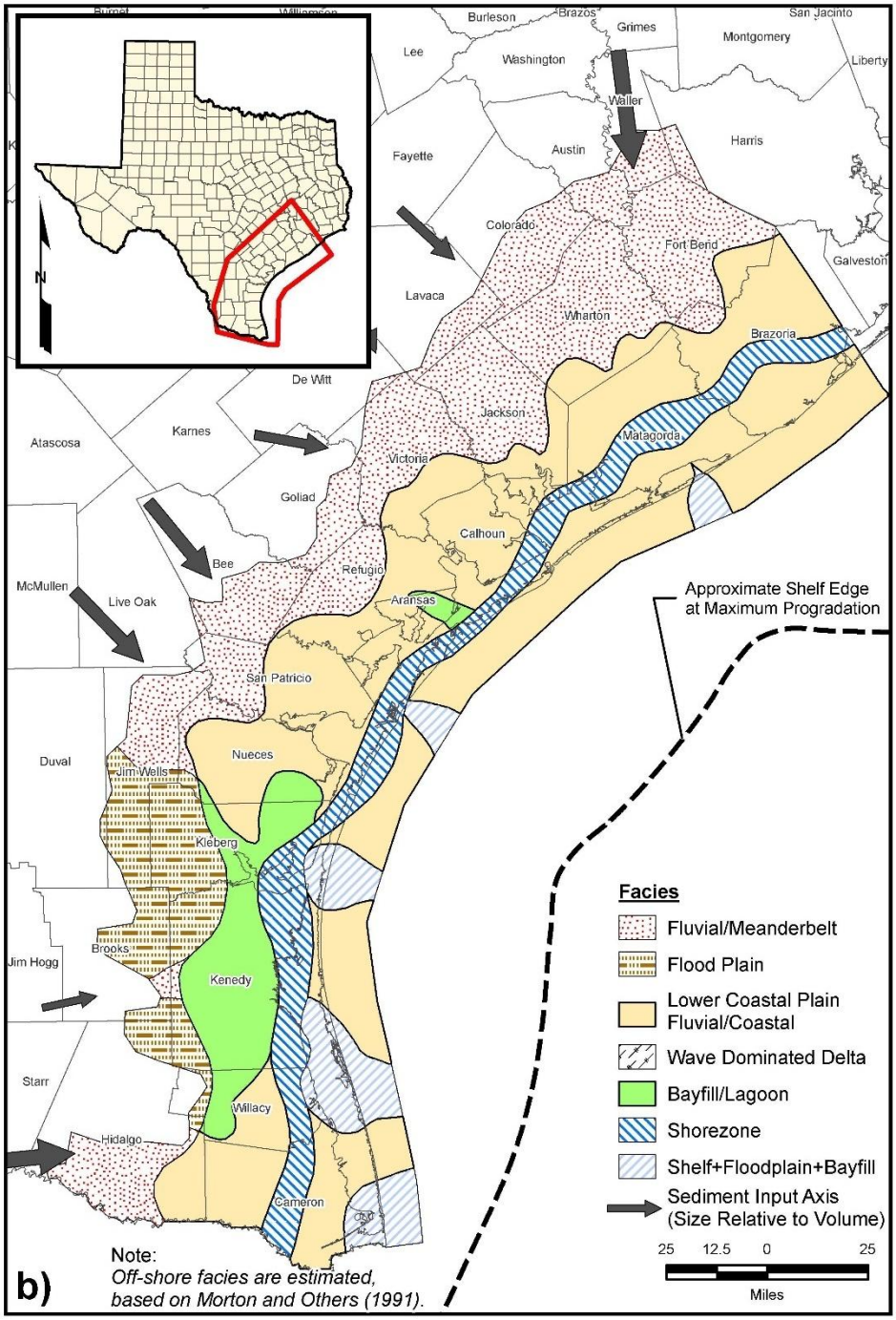


Figure 2-2. Depositional facies map for the Lissie Formation in the southern region of the Texas Gulf Coast Aquifer System (from Young and others, 2010).

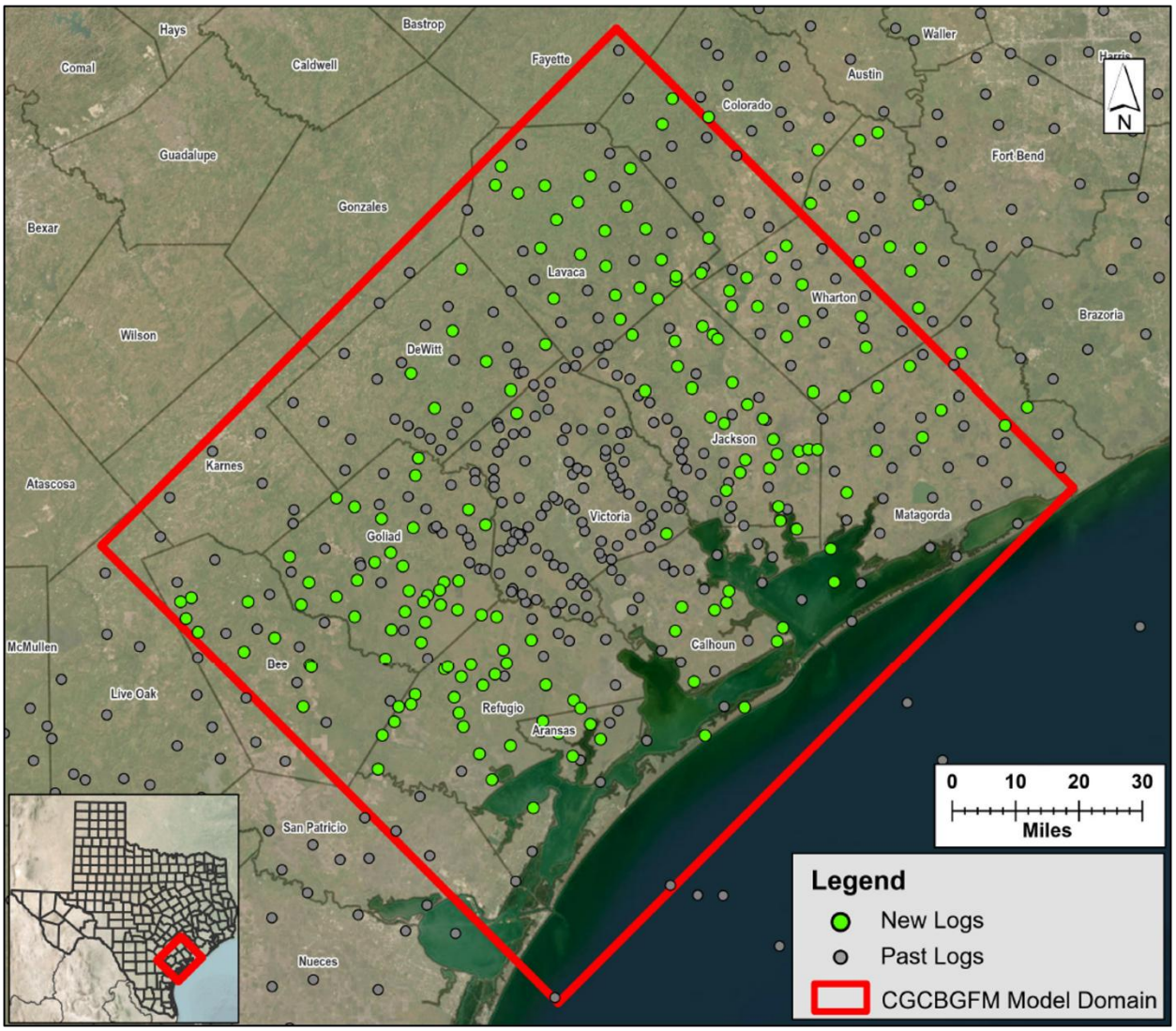


Figure 2-2. Location of geophysical logs used to characterize the lithology of the Gulf Coast Aquifer System used to develop the CGCBGWF Model.

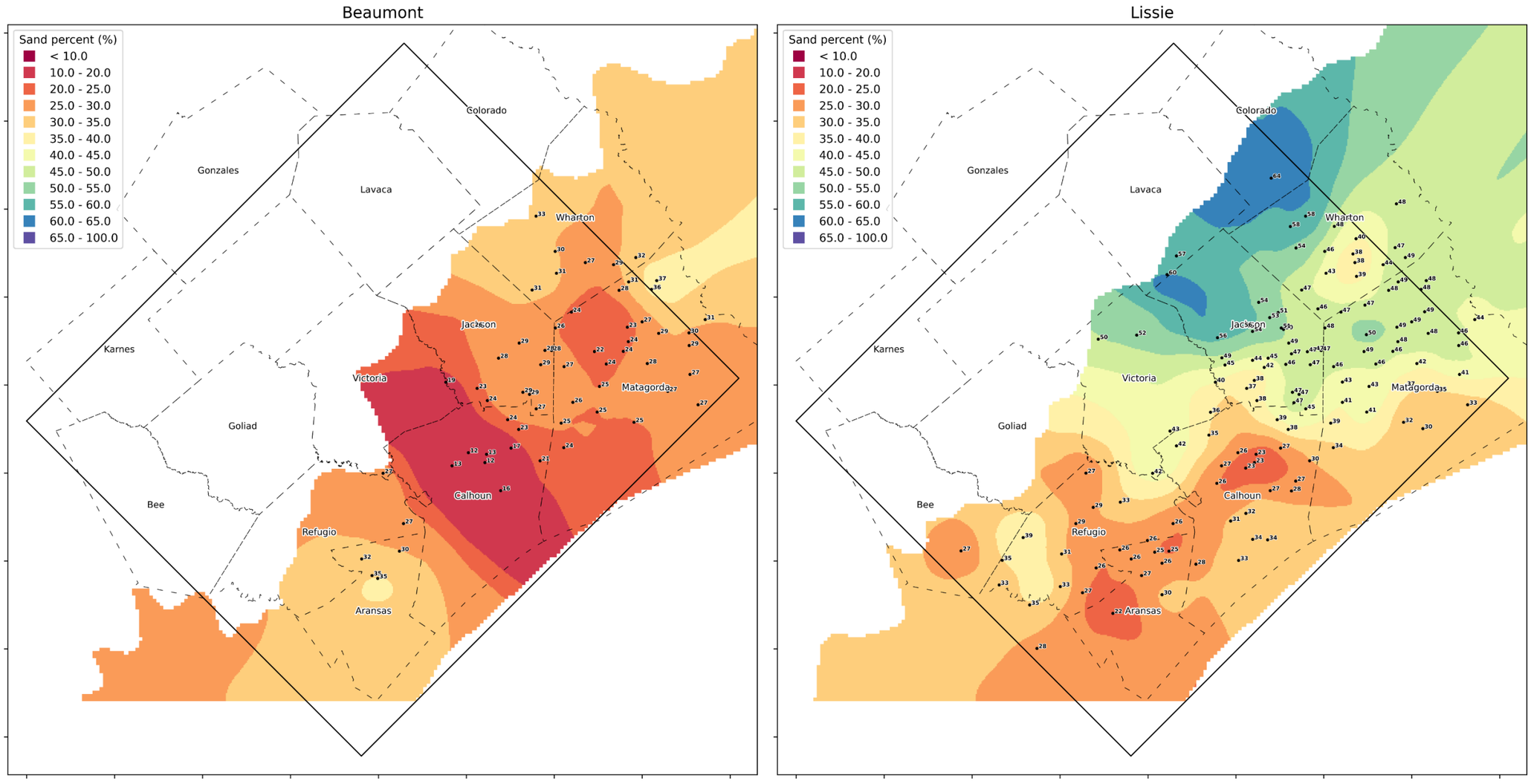


Figure 2-4. Sand percent map for the Beaumont (left) and Lissie (right) formations based on the interpolation of geophysical logs.

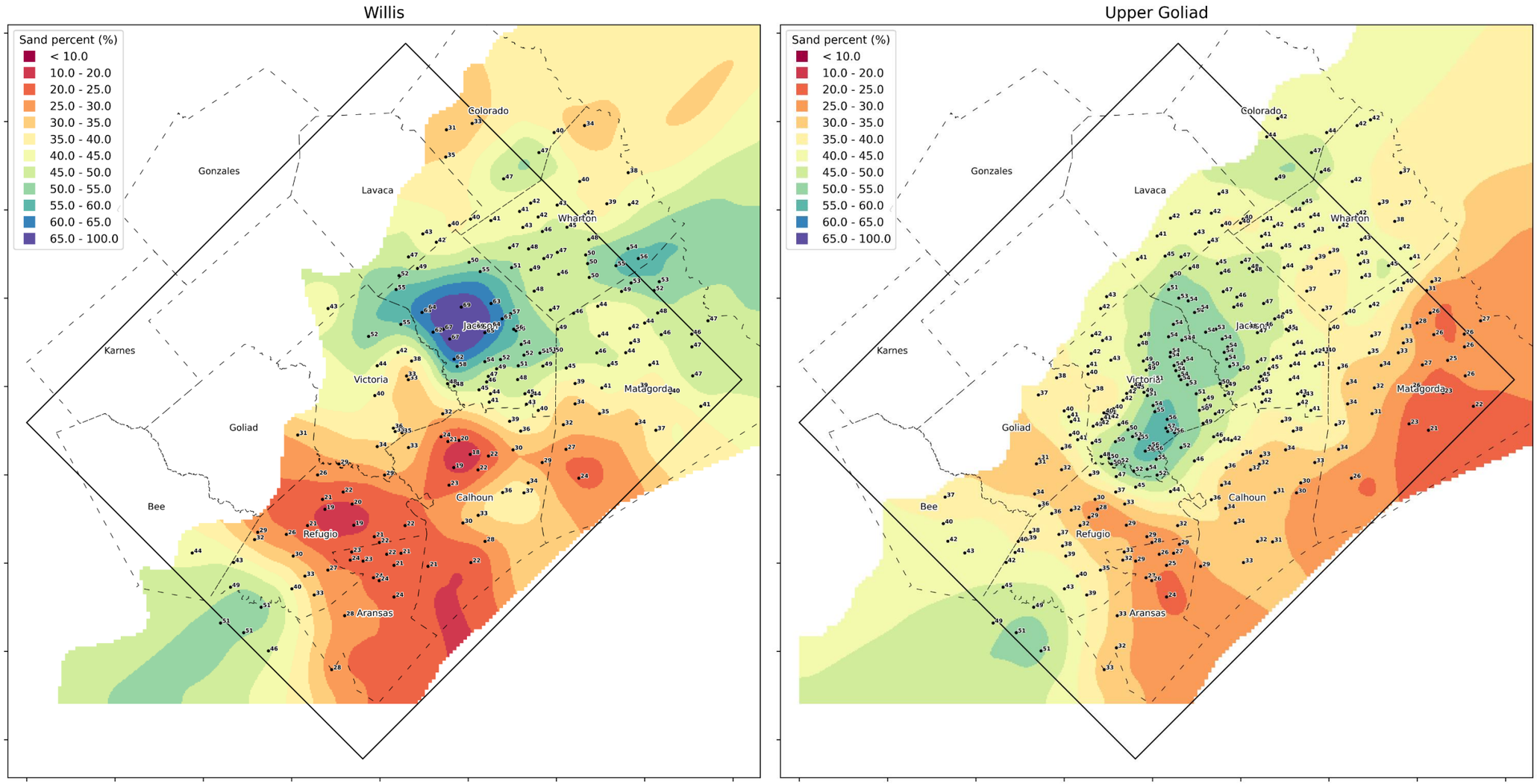


Figure 2-5. Sand percent map for the Willis (left) and Upper Goliad (right) formations based on the interpolation of geophysical logs.

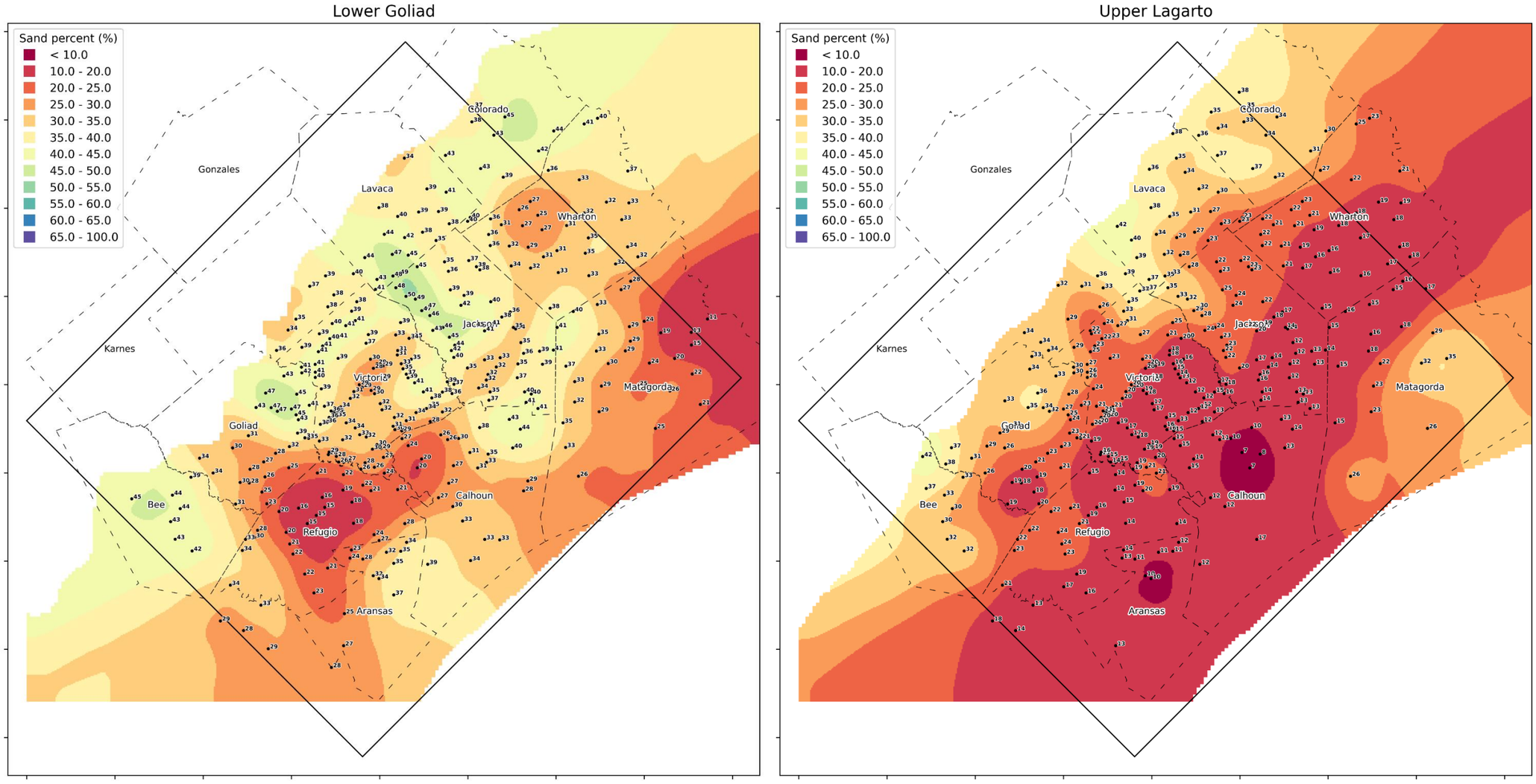


Figure 2-6. Sand percent map for the Lower Goliad (left) and Upper Lagarto (right) formations based on the interpolation of geophysical logs.

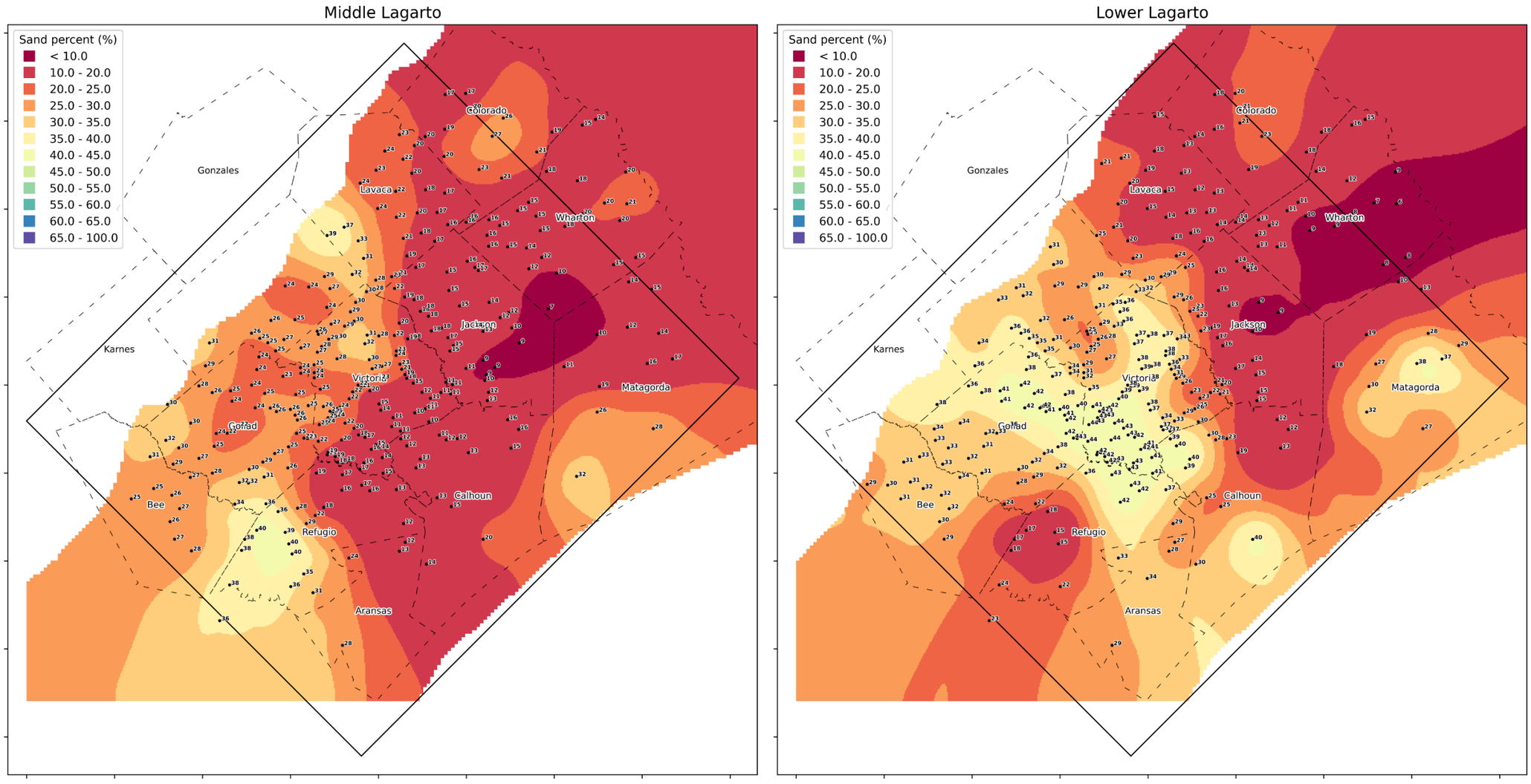


Figure 2-7. Sand percent map for the Middle Lagarto (left) and Lower Lagarto (right) formations based on the interpolation of geophysical logs.

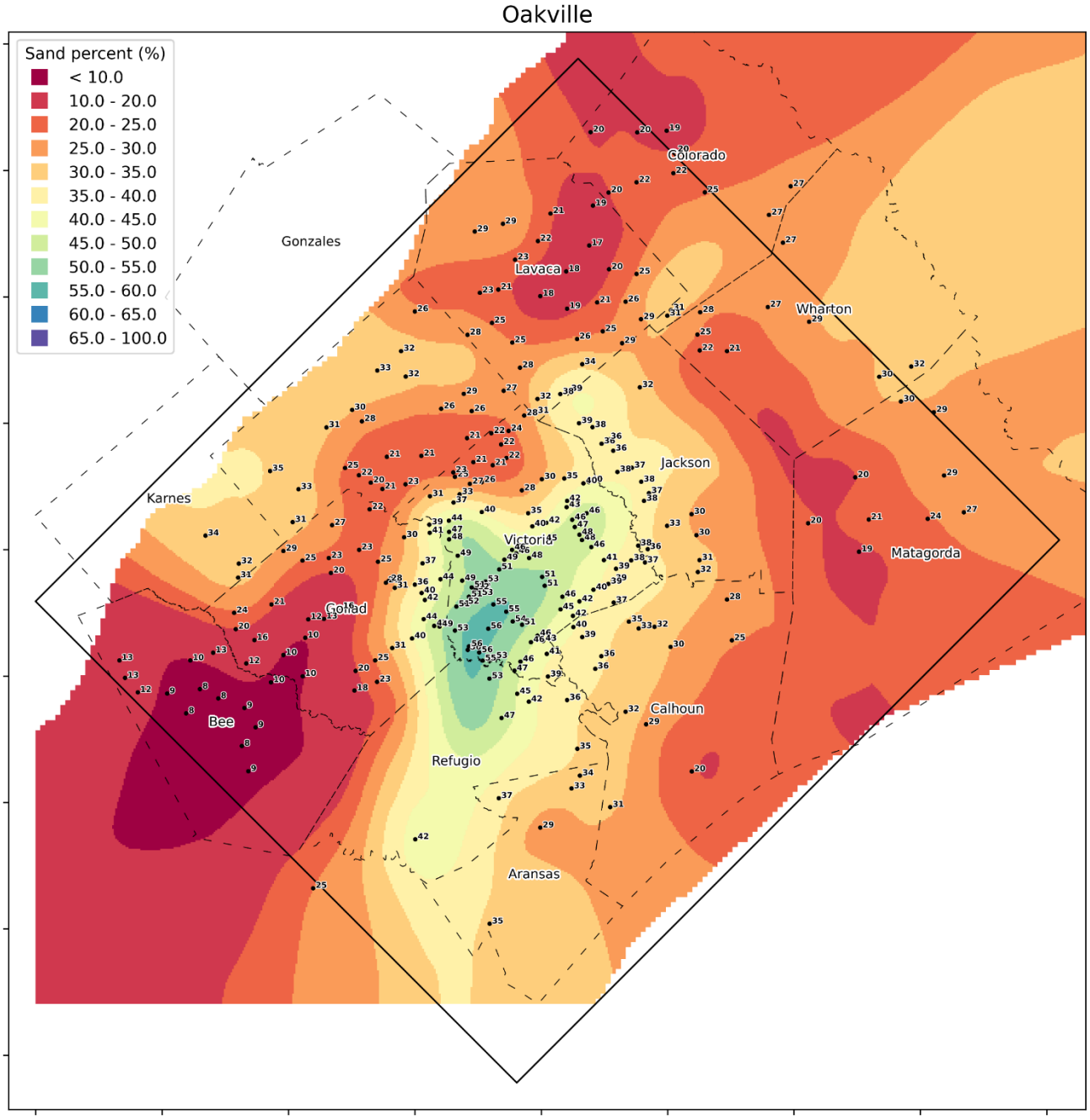


Figure 2-8. Sand percent map for the Oakville Formation based on the interpolation of geophysical logs.

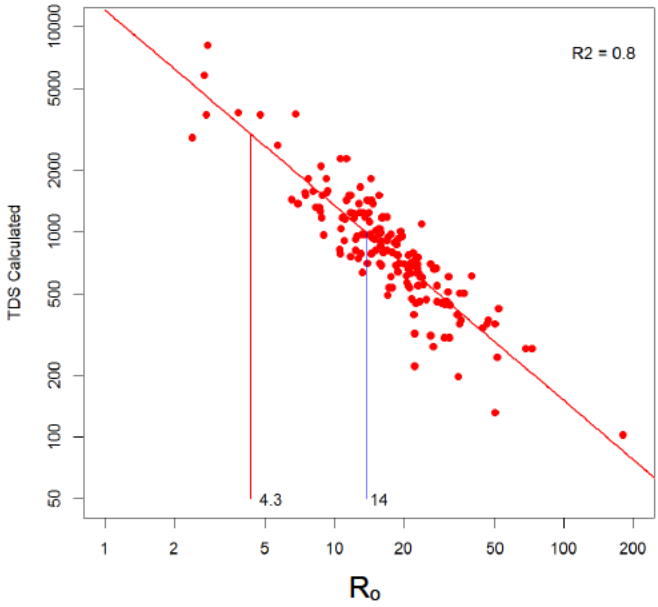


Figure 2-9. R_o-TDS graph for the Chicot Aquifer Group (including the Beaumont, Lissie, and Willis formations) based on 164 well-log pairs. Vertical lines show the formation resistivity values for a 1,000 mg/L (blue) and 3,000 mg/L (red) TDS concentration (from Young and others, 2016).

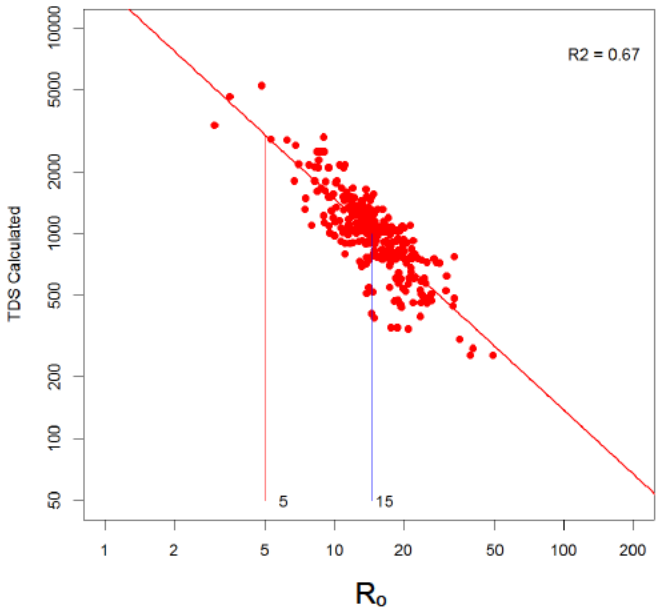


Figure 2-10. R_o-TDS graph for the Evangline Aquifer Group (including the Upper Goliad, Lower Goliad, Upper Lagarto, and Middle Lagarto formations) based on 305 well-log pairs. Vertical lines show the formation resistivity values for a 1,000 mg/L (blue) and 3,000 mg/L (red) TDS concentration (from Young and others, 2016).

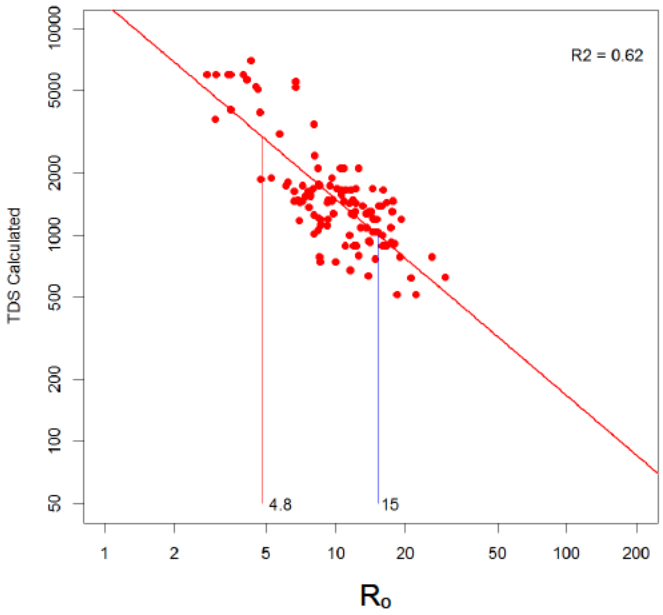


Figure 2-11. R_o-TDS graph for the Jasper/Catahoula Aquifer Group (including the Lower Lagarto, Oakville, and Catahoula formations) based on 117 well-log pairs. Vertical lines show the formation resistivity values for a 1,000 mg/L (blue) and 3,000 mg/L (red) TDS concentration (from Young and others, 2016).

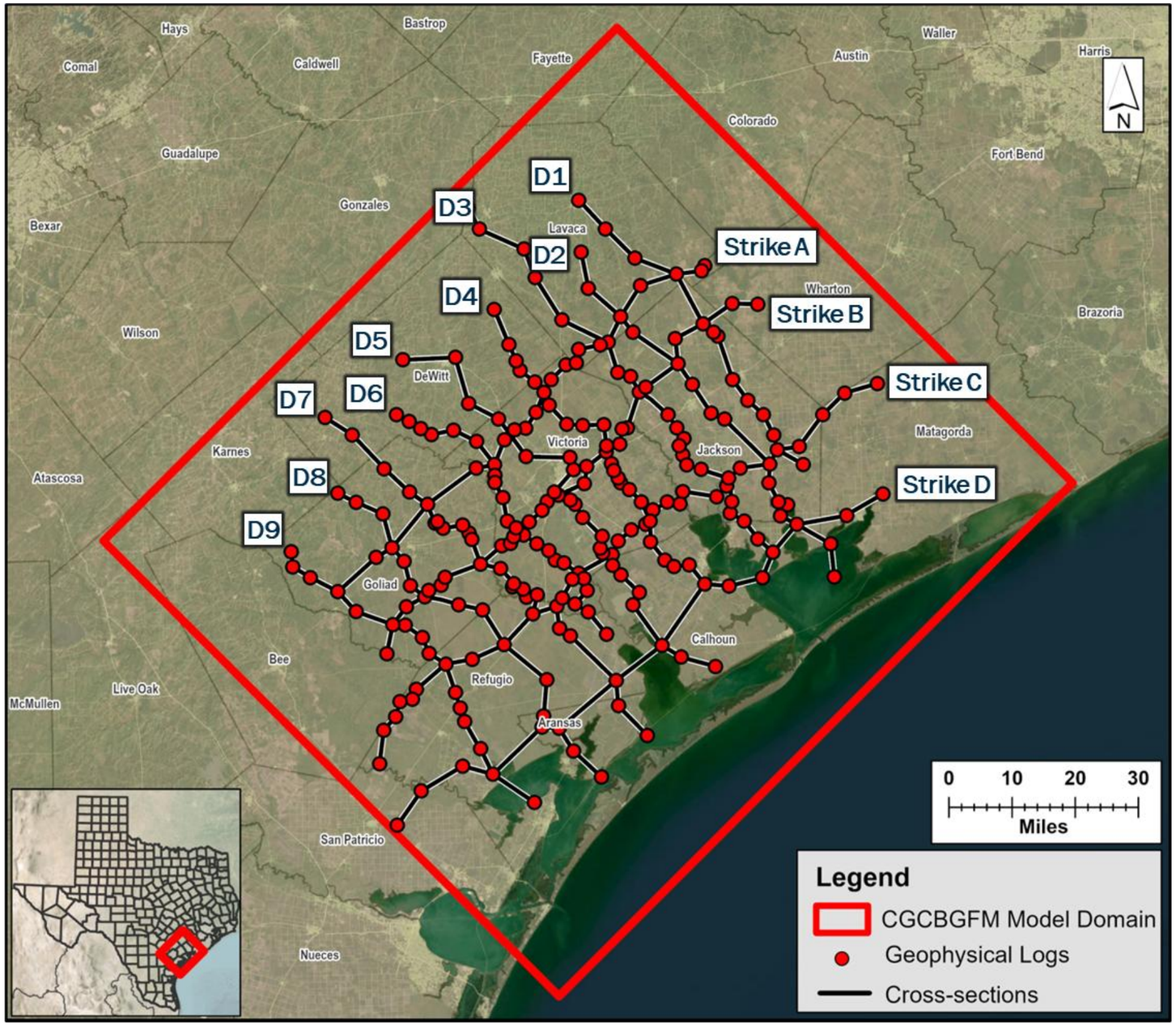


Figure 2-12. Location of nine dip cross-sections and three strike cross sections that were constructed using geophysical log information to show vertical profiles of sand and clay sequences and TDS concentrations of groundwater contained in the sand layers.

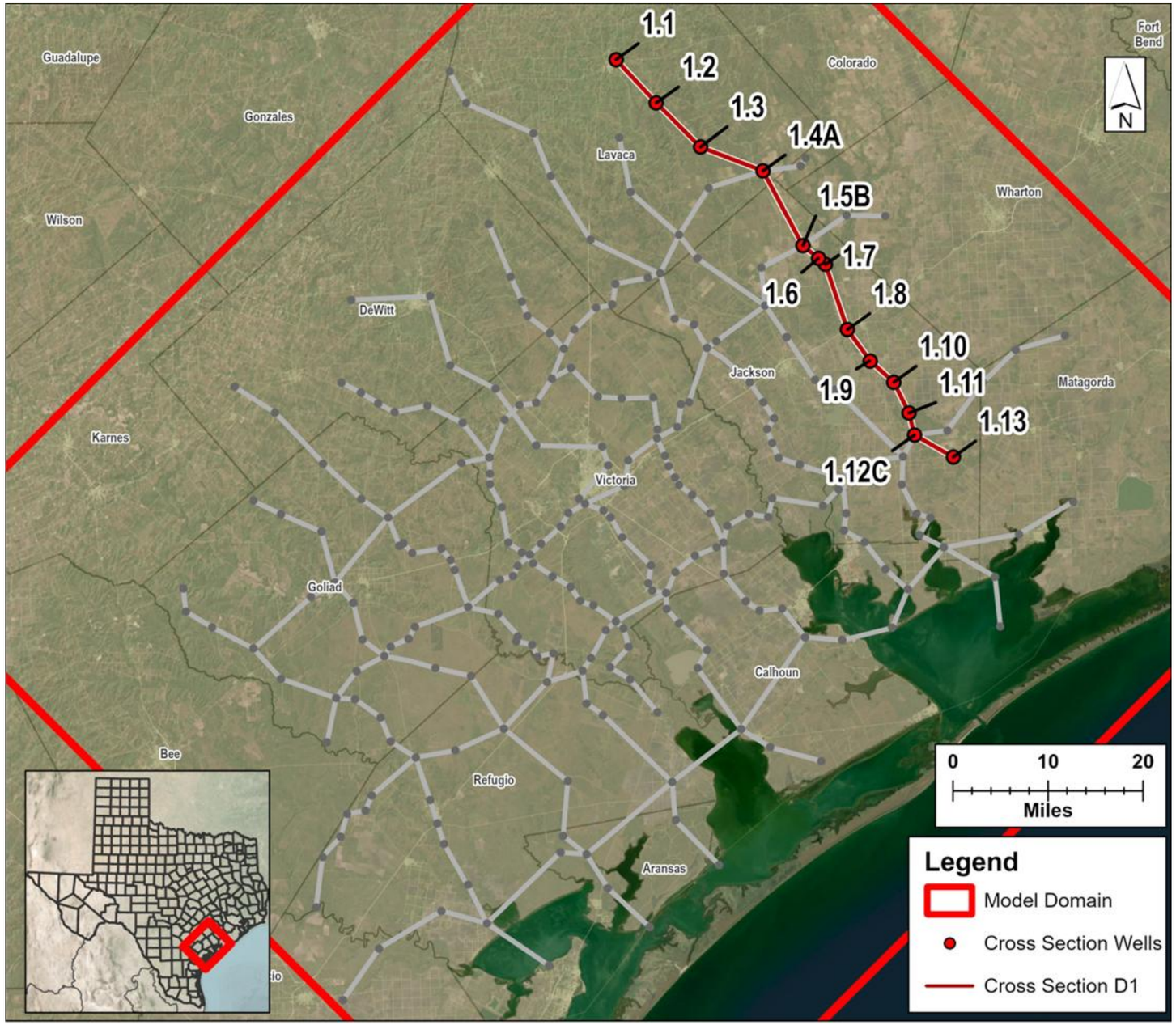


Figure 2-13. Location map showing wells used in dip cross-section D1, with well aliases labeled to correspond to the wells displayed in the cross-section profile.

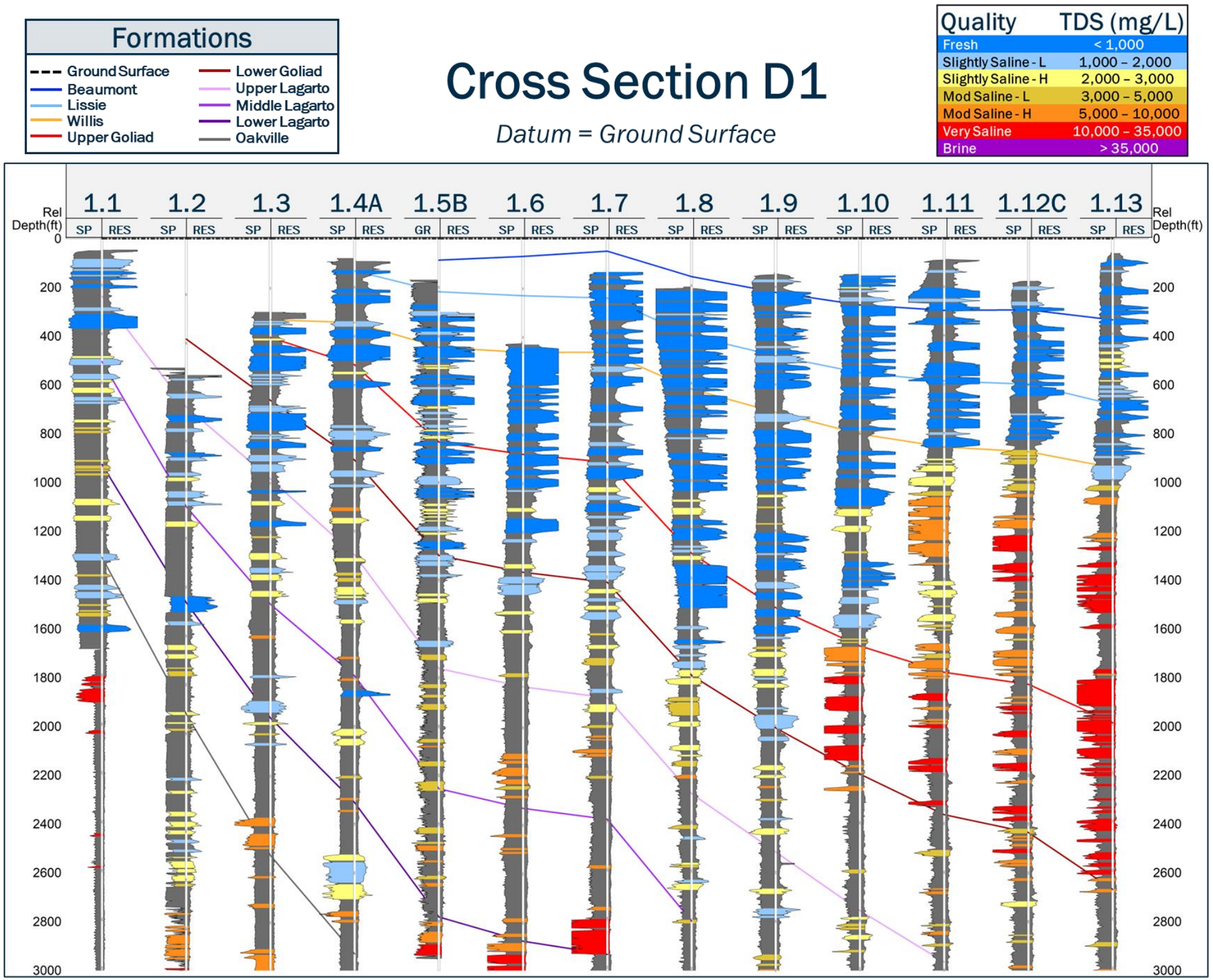


Figure 2-14. Dip cross-section D1 showing formation boundaries and the water quality classification of groundwater in the sand beds identified in 13 logs.

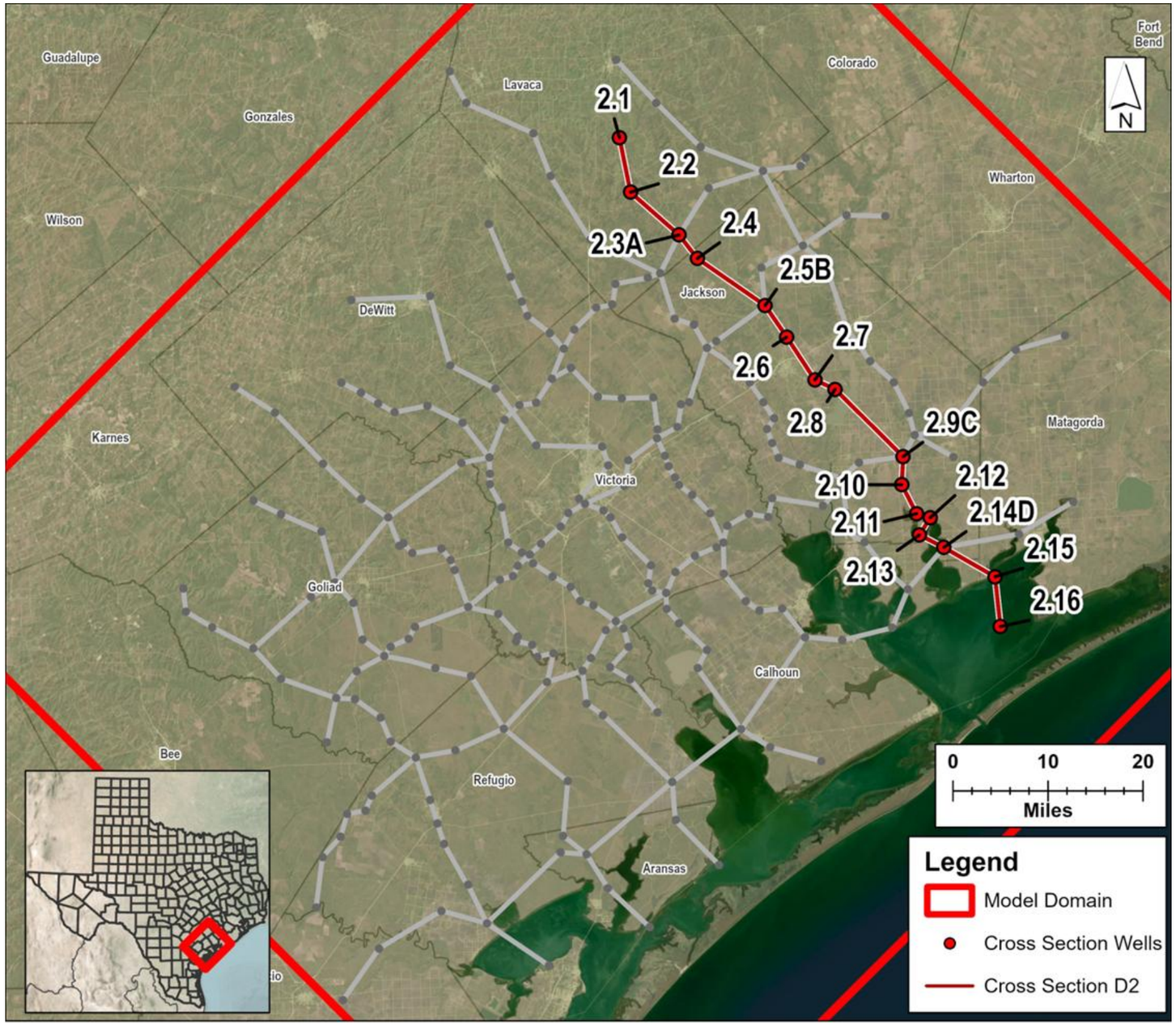


Figure 2-15. Location map showing wells used in dip cross-section D2, with well aliases labeled to correspond to the wells displayed in the cross-section profile.

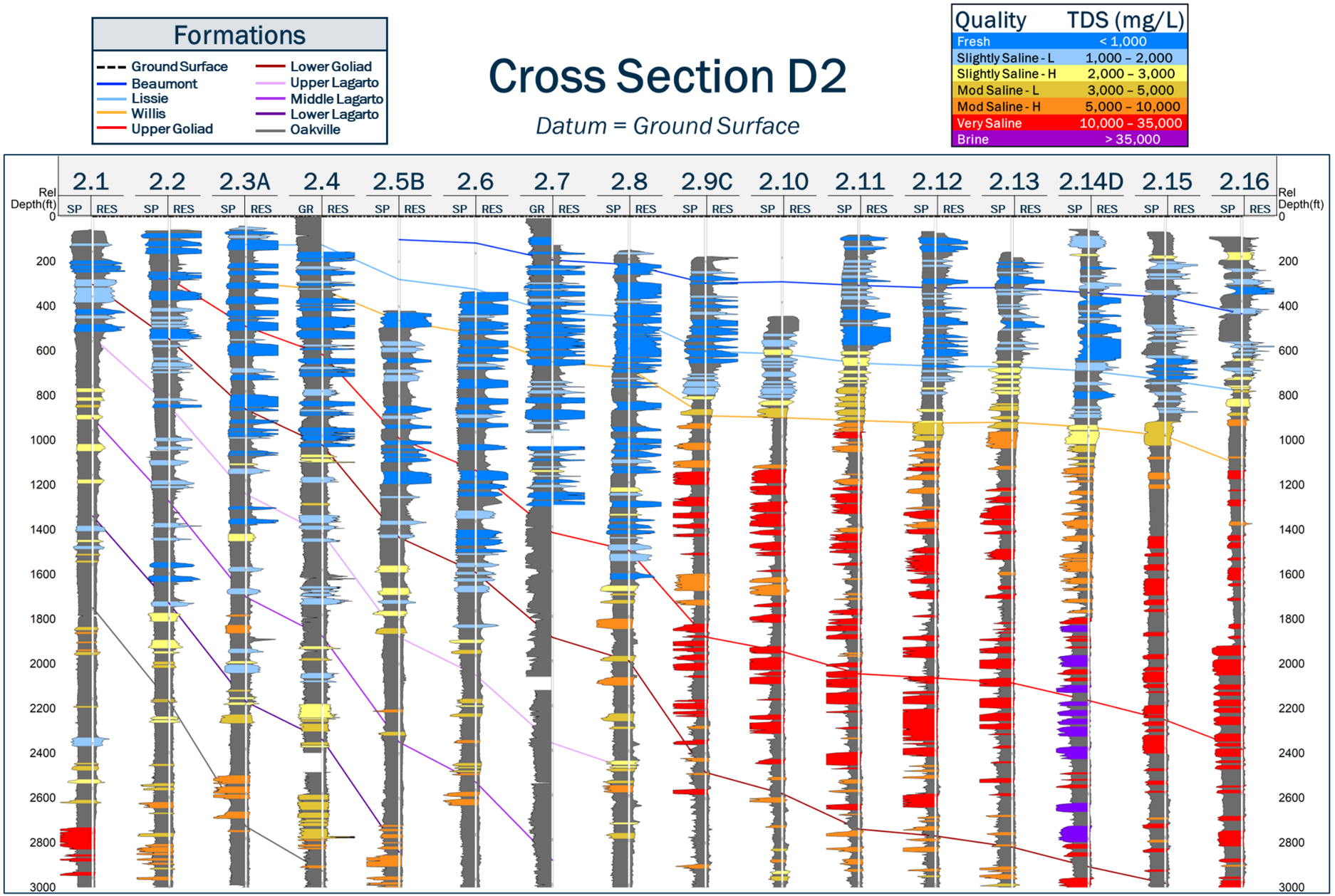


Figure 2-16. Dip cross-section D2 showing formation boundaries and the water quality classification of groundwater in the sand beds identified in 16 logs.

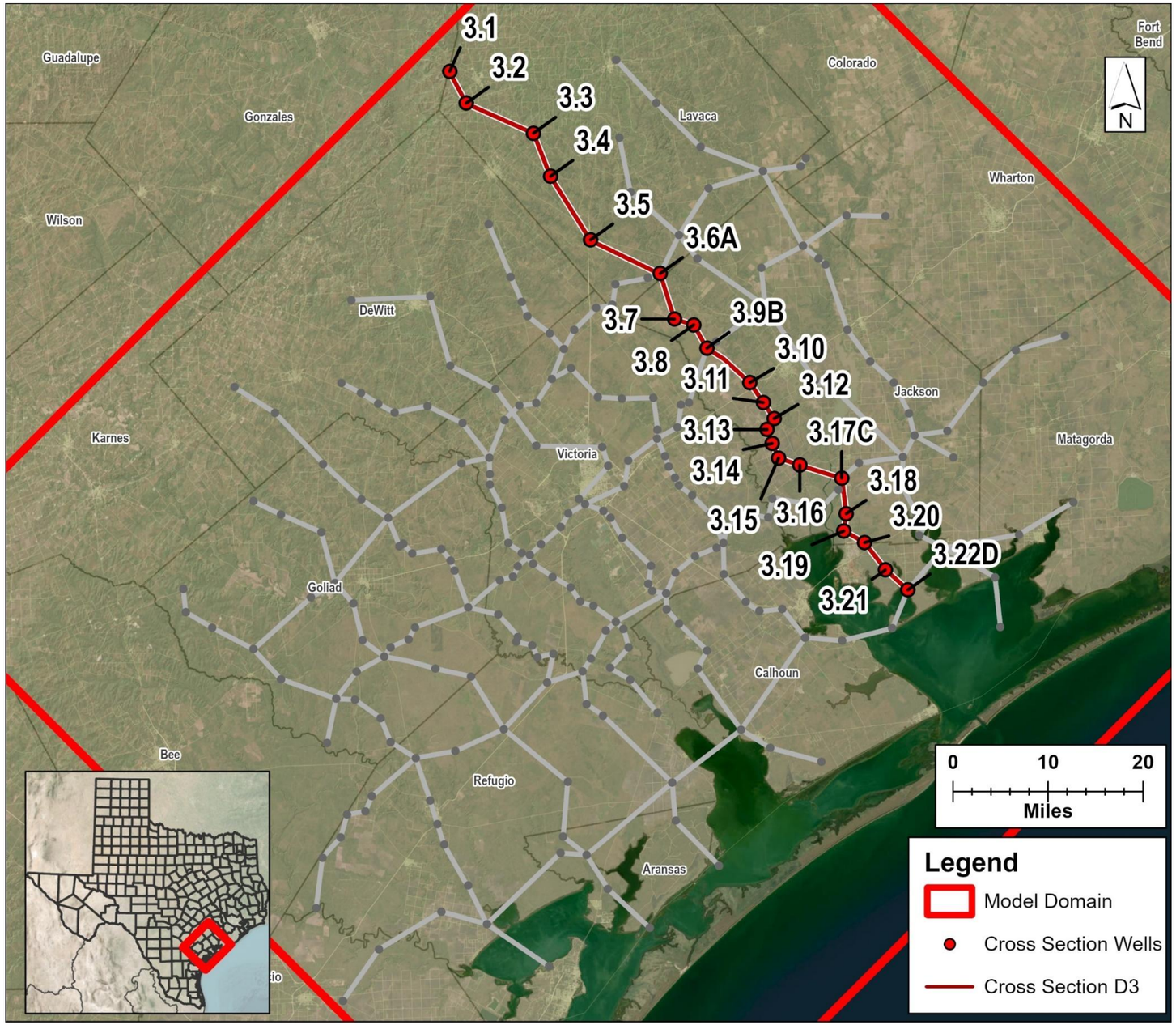


Figure 2-17. Location map showing wells used in dip cross-section D3, with well aliases labeled to correspond to the wells displayed in the cross-section profile.

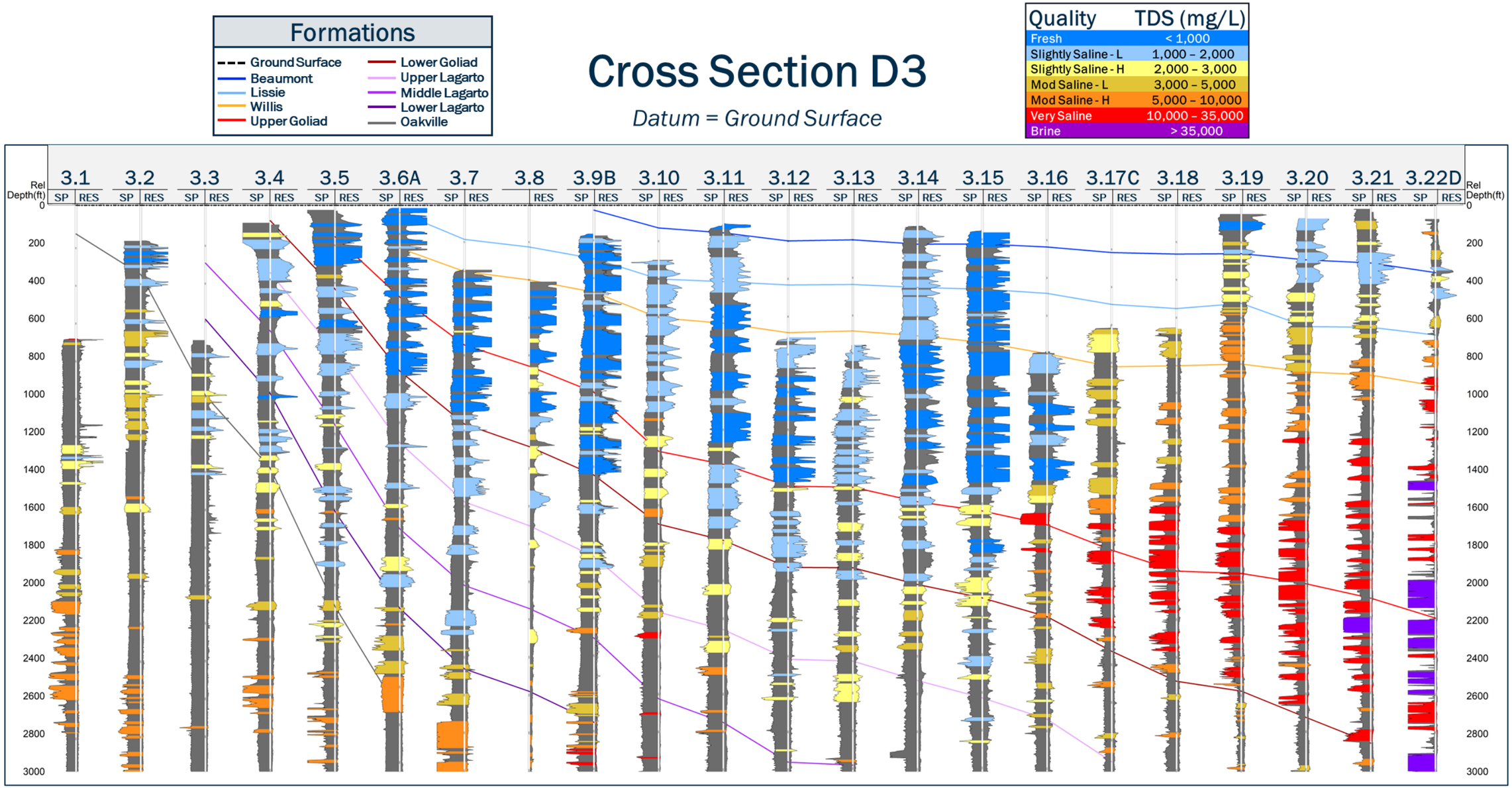


Figure 2-18. Dip cross-section D3 showing formation boundaries and the water quality classification of groundwater in the sand beds identified in 22 logs.

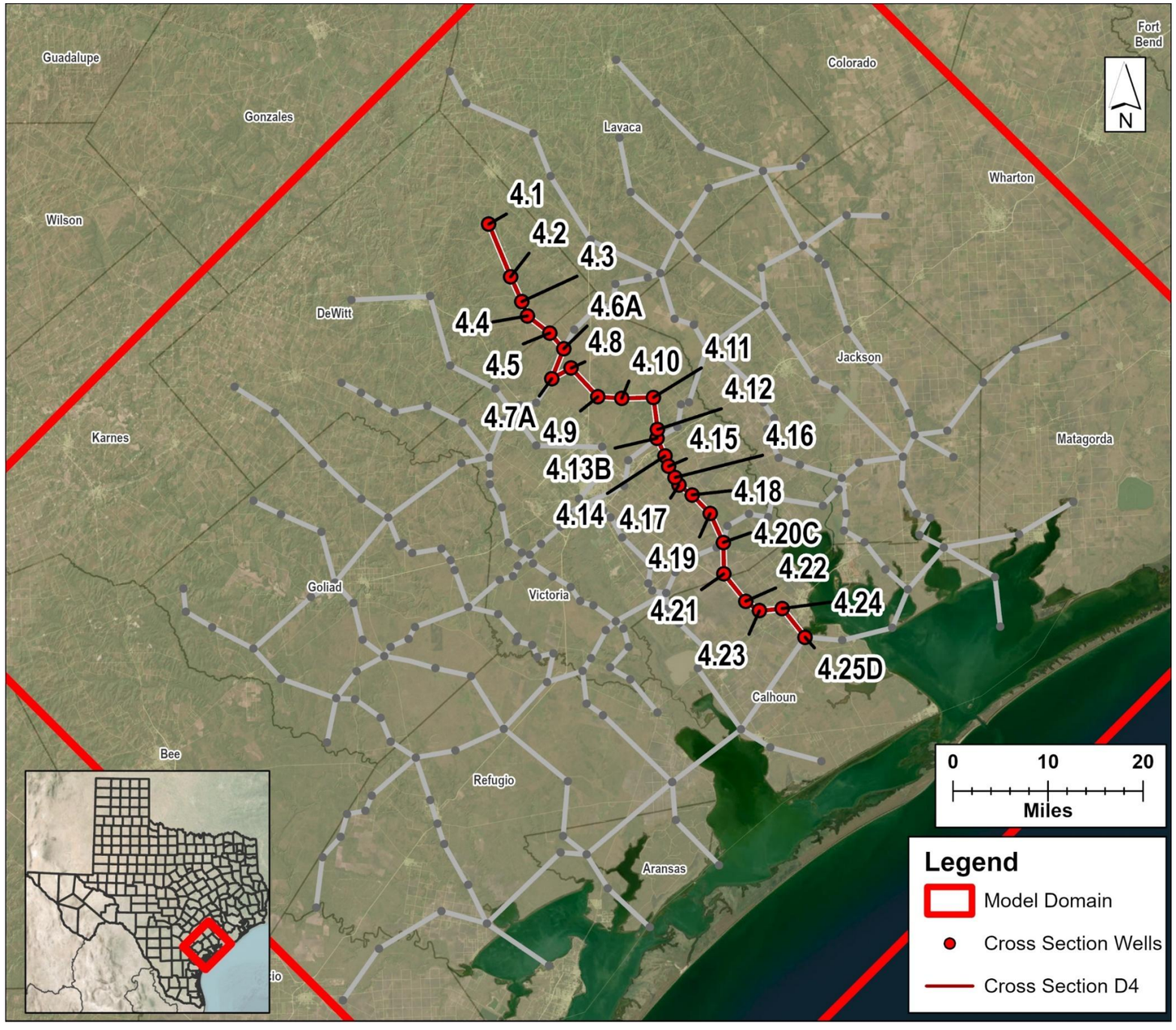


Figure 2-19. Location map showing wells used in dip cross-section D4, with well aliases labeled to correspond to the wells displayed in the cross-section profile.

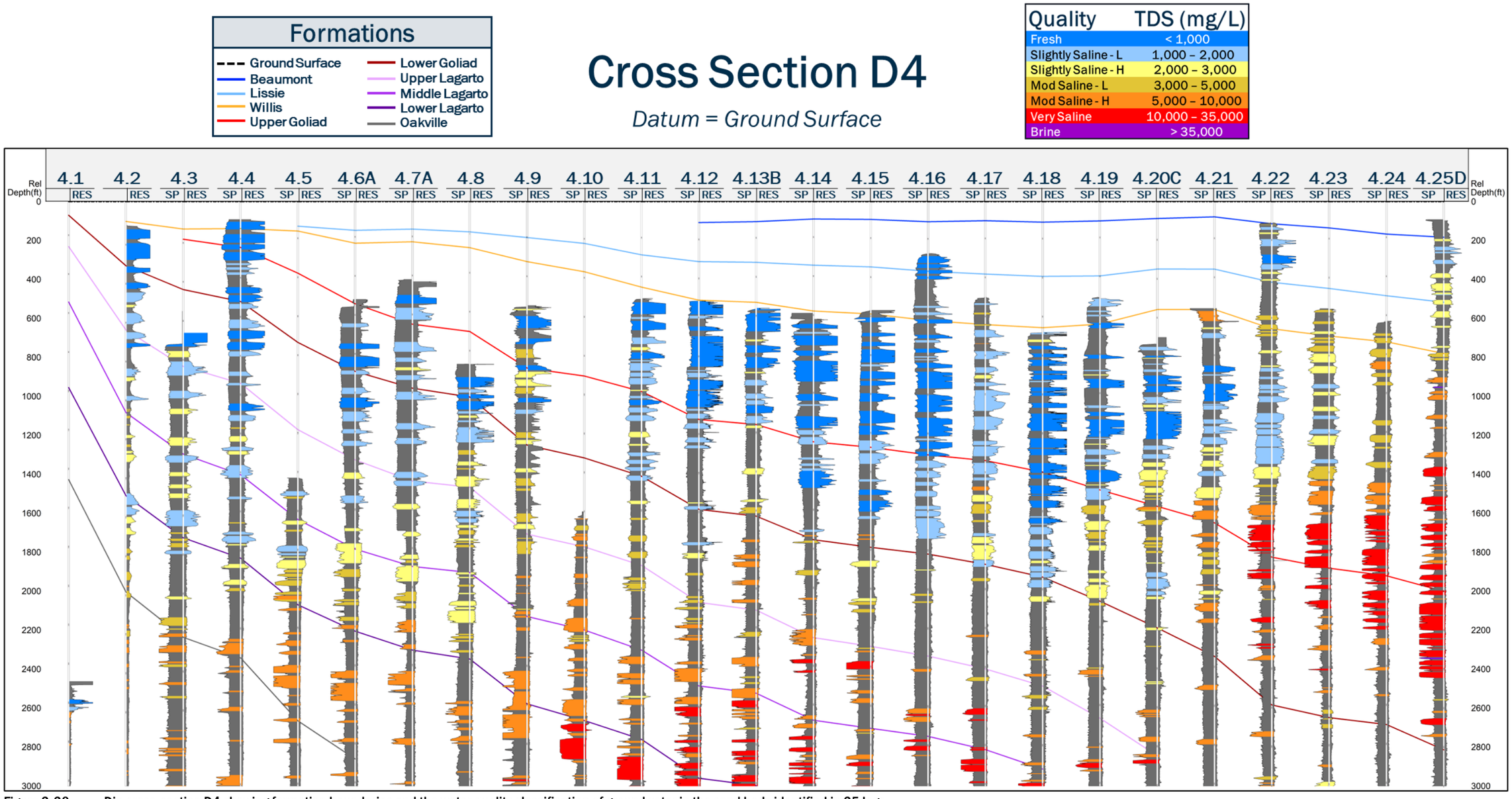


Figure 2-20. Dip cross-section D4 showing formation boundaries and the water quality classification of groundwater in the sand beds identified in 25 logs.

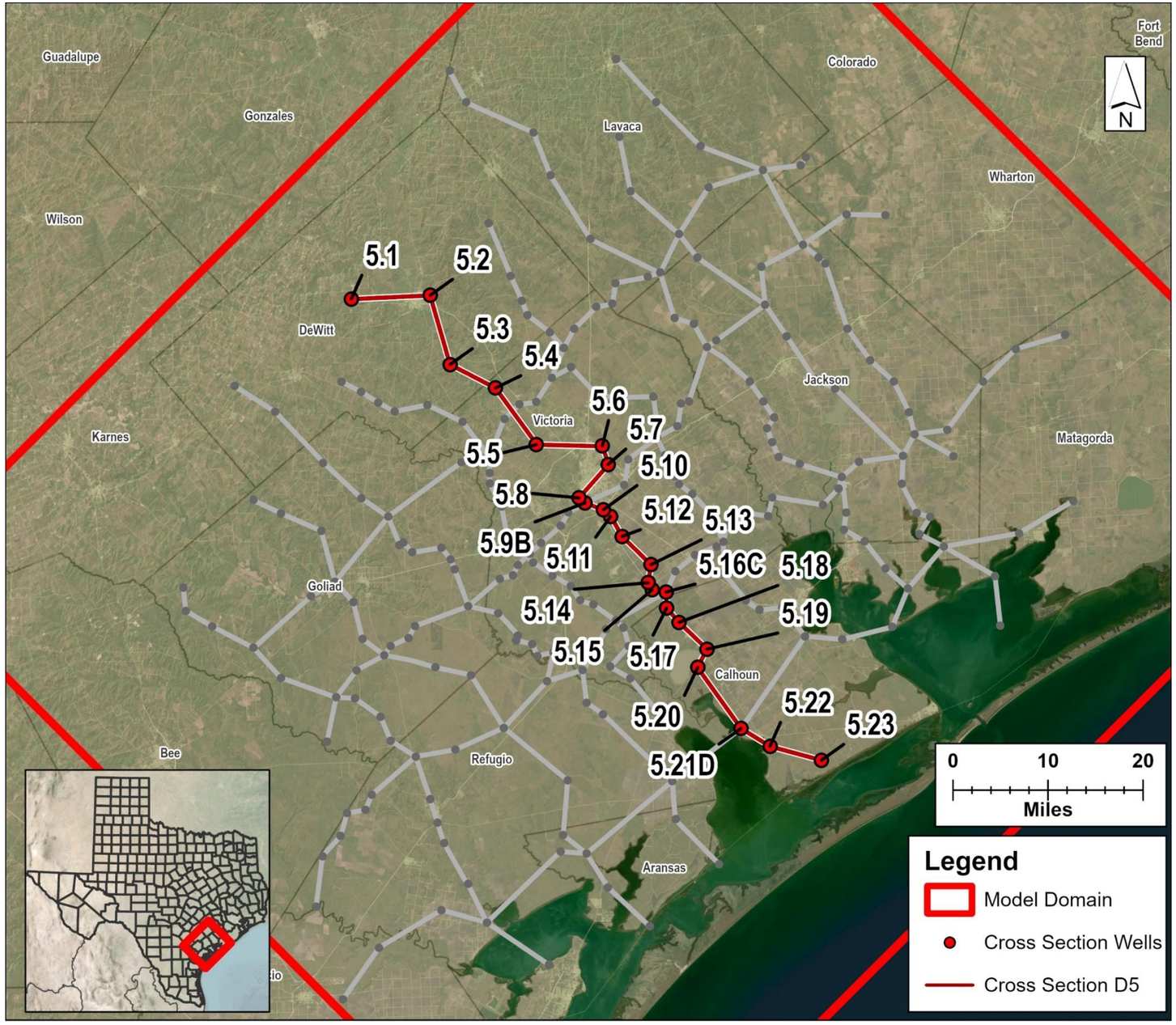


Figure 2-21. Location map showing wells used in dip cross-section D5, with well aliases labeled to correspond to the wells displayed in the cross-section profile.

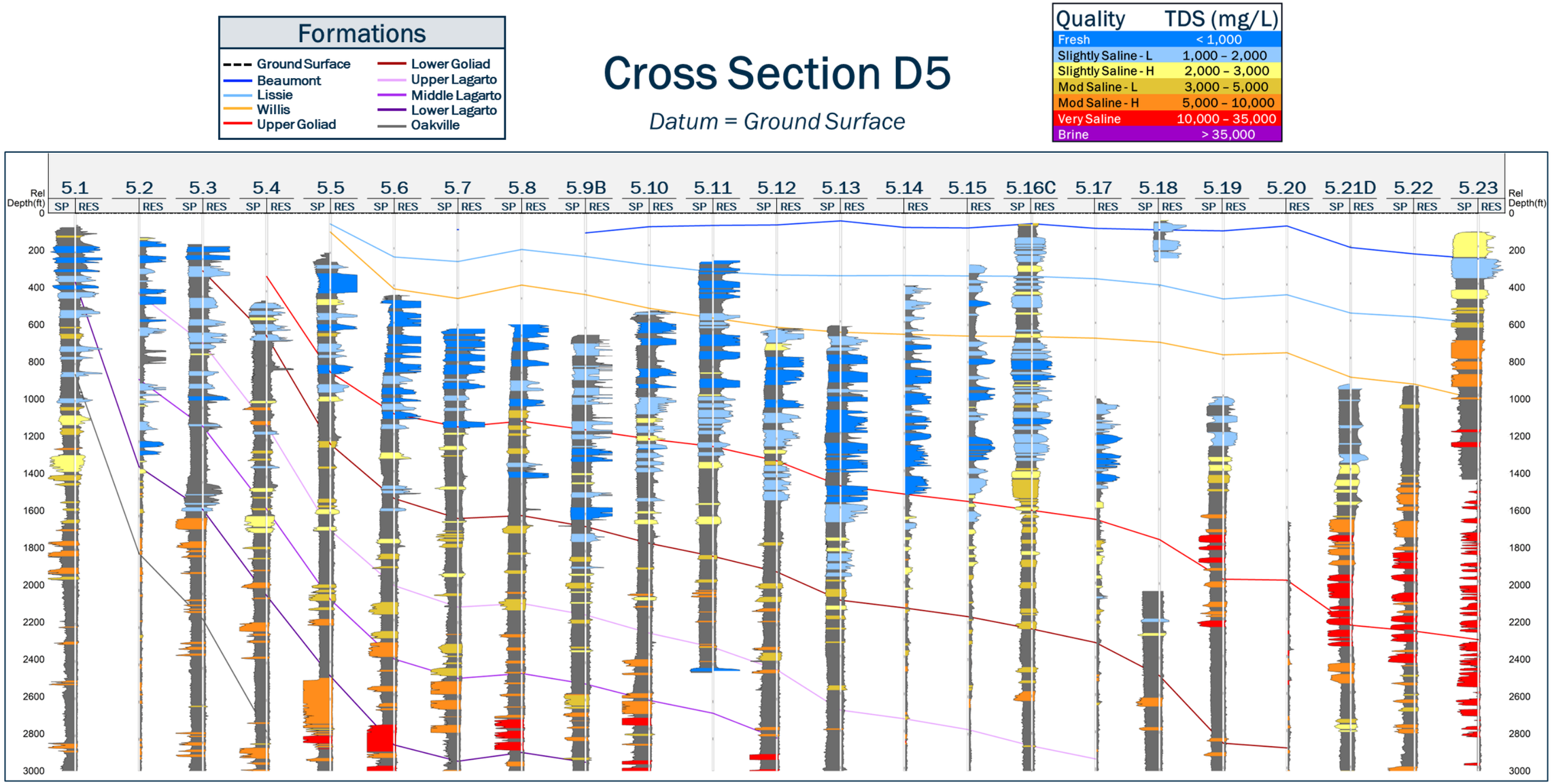


Figure 2-22. Dip cross-section D5 showing formation boundaries and the water quality classification of groundwater in the sand beds identified in 23 logs.

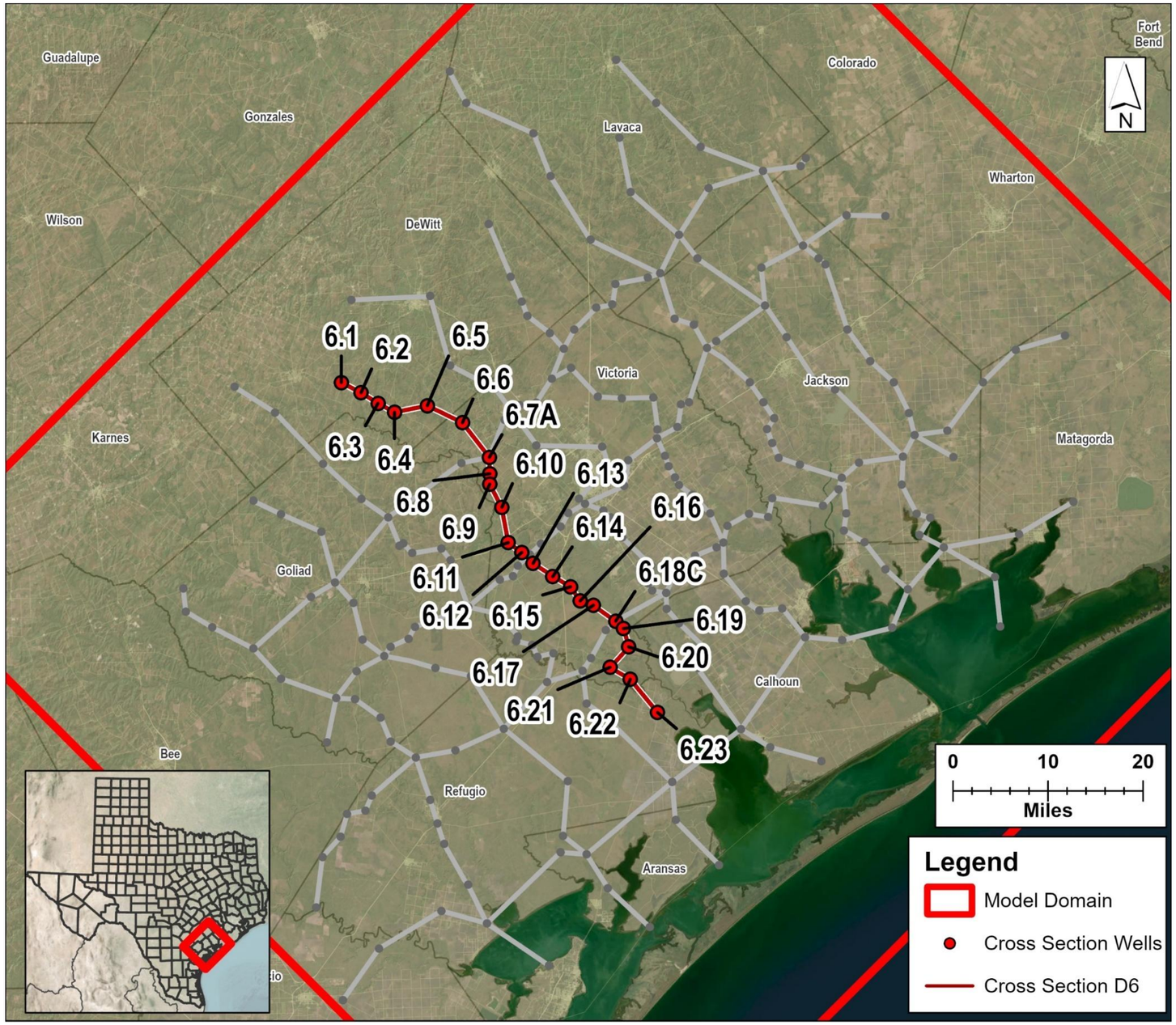


Figure 2-23. Location map showing wells used in dip cross-section D6, with well aliases labeled to correspond to the wells displayed in the cross-section profile.

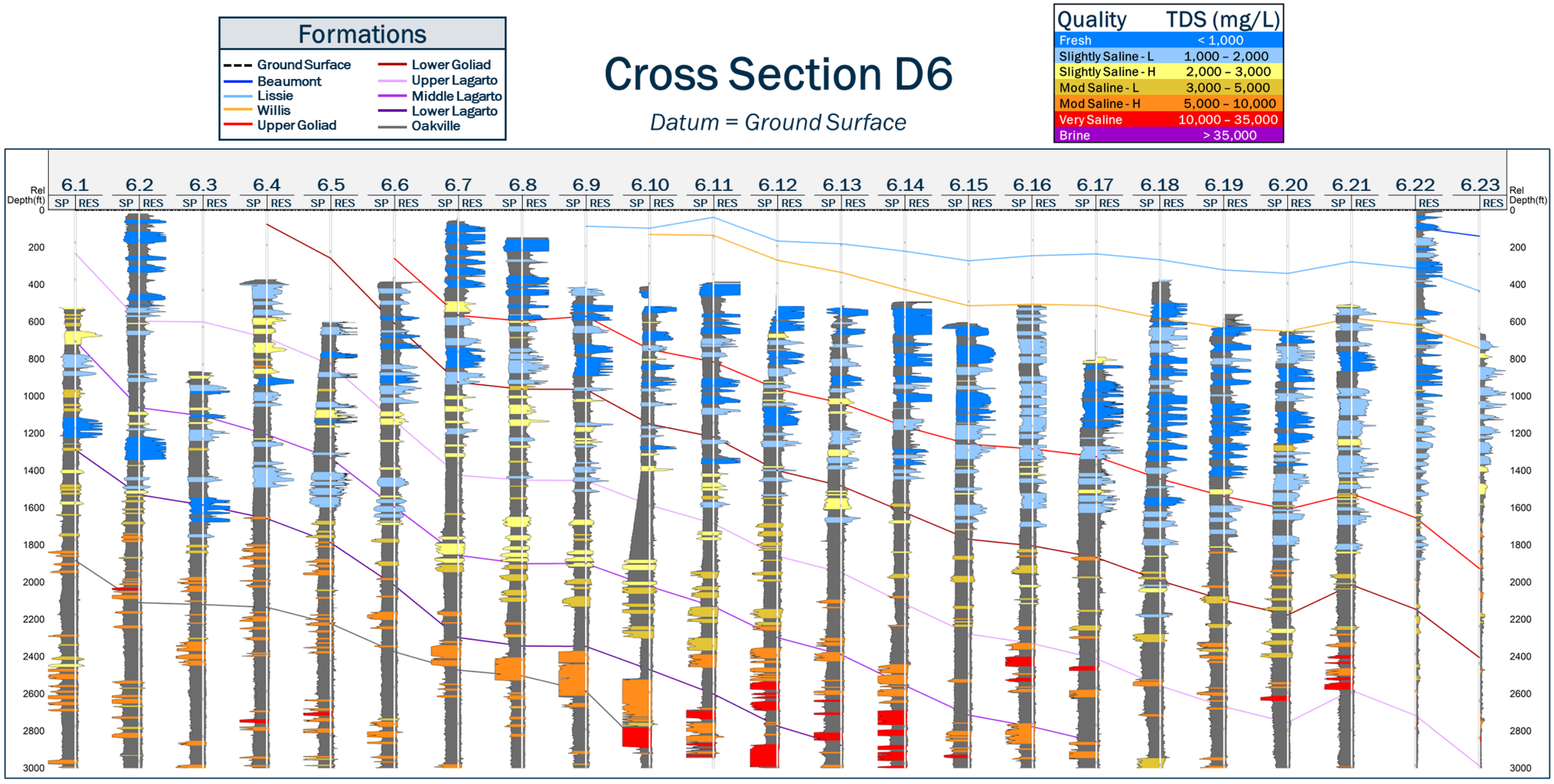


Figure 2-24. Strike cross-section D6 showing formation boundaries and the water quality classification of groundwater in the sand beds identified in 23 logs.

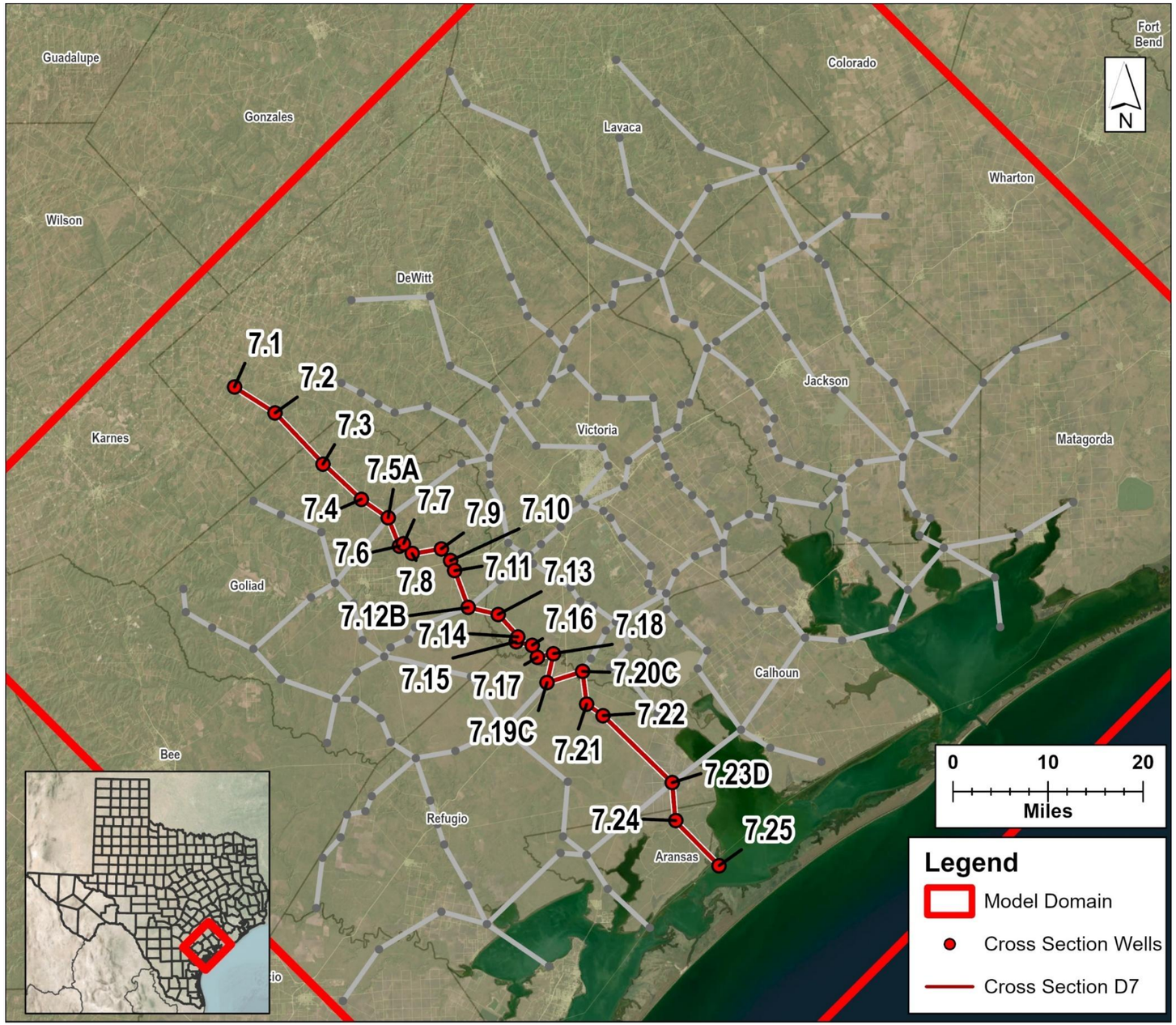


Figure 2-25. Location map showing wells used in dip cross-section D7, with well aliases labeled to correspond to the wells displayed in the cross-section profile.

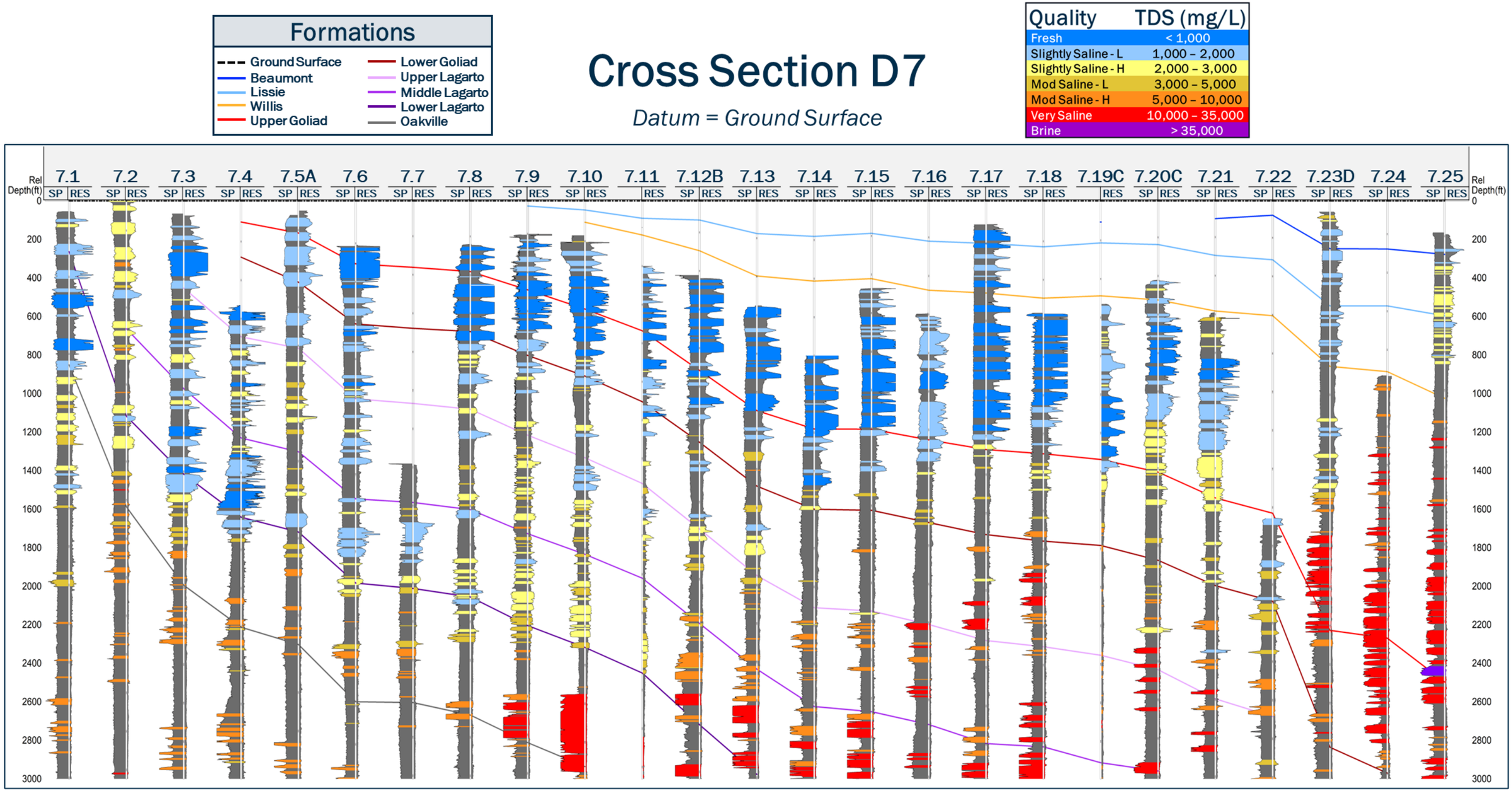


Figure 2-26. Strike cross-section D7 showing formation boundaries and the water quality classification of groundwater in the sand beds identified in 25 logs.

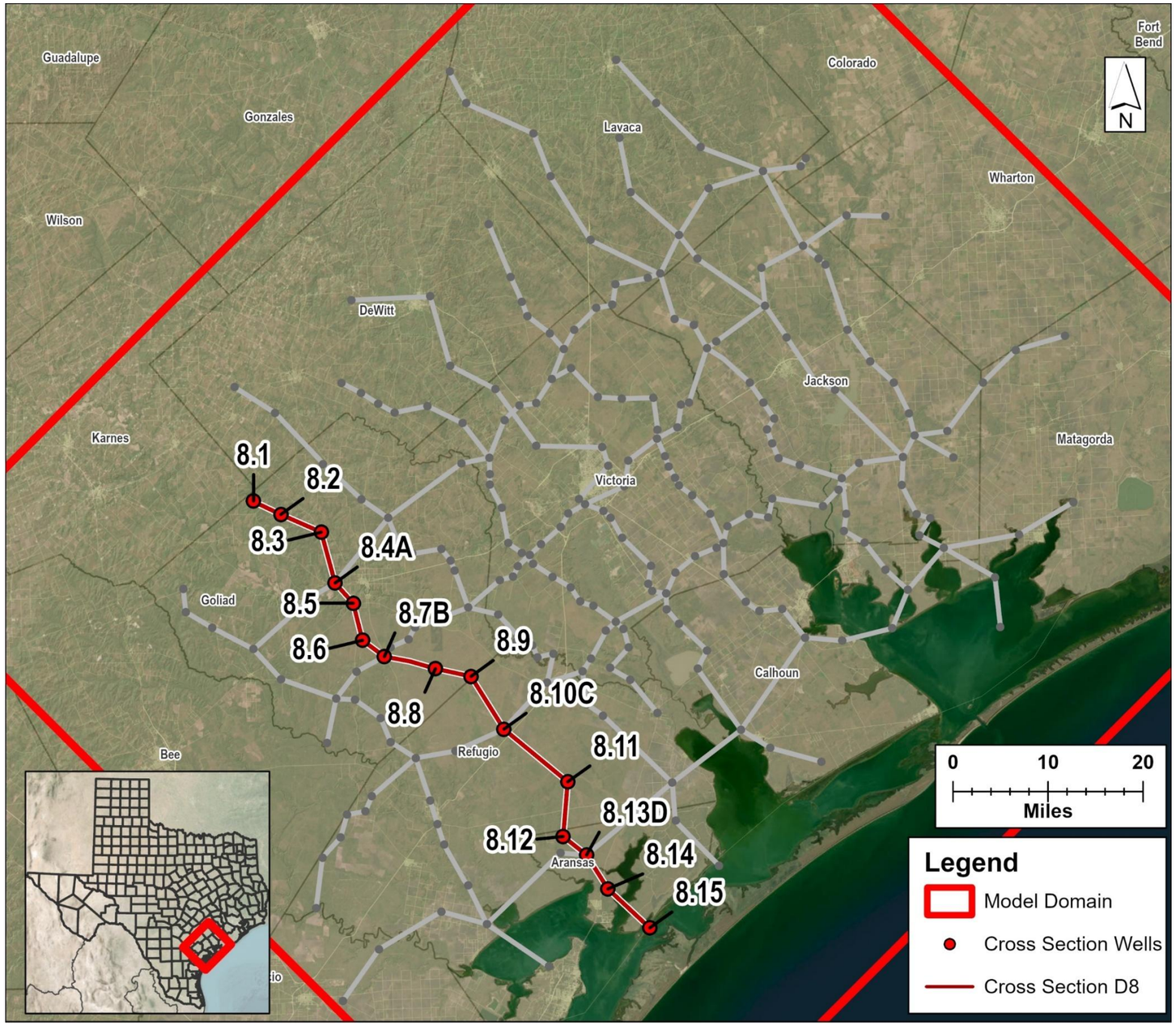


Figure 2-27. Location map showing wells used in dip cross-section D8, with well aliases labeled to correspond to the wells displayed in the cross-section profile.

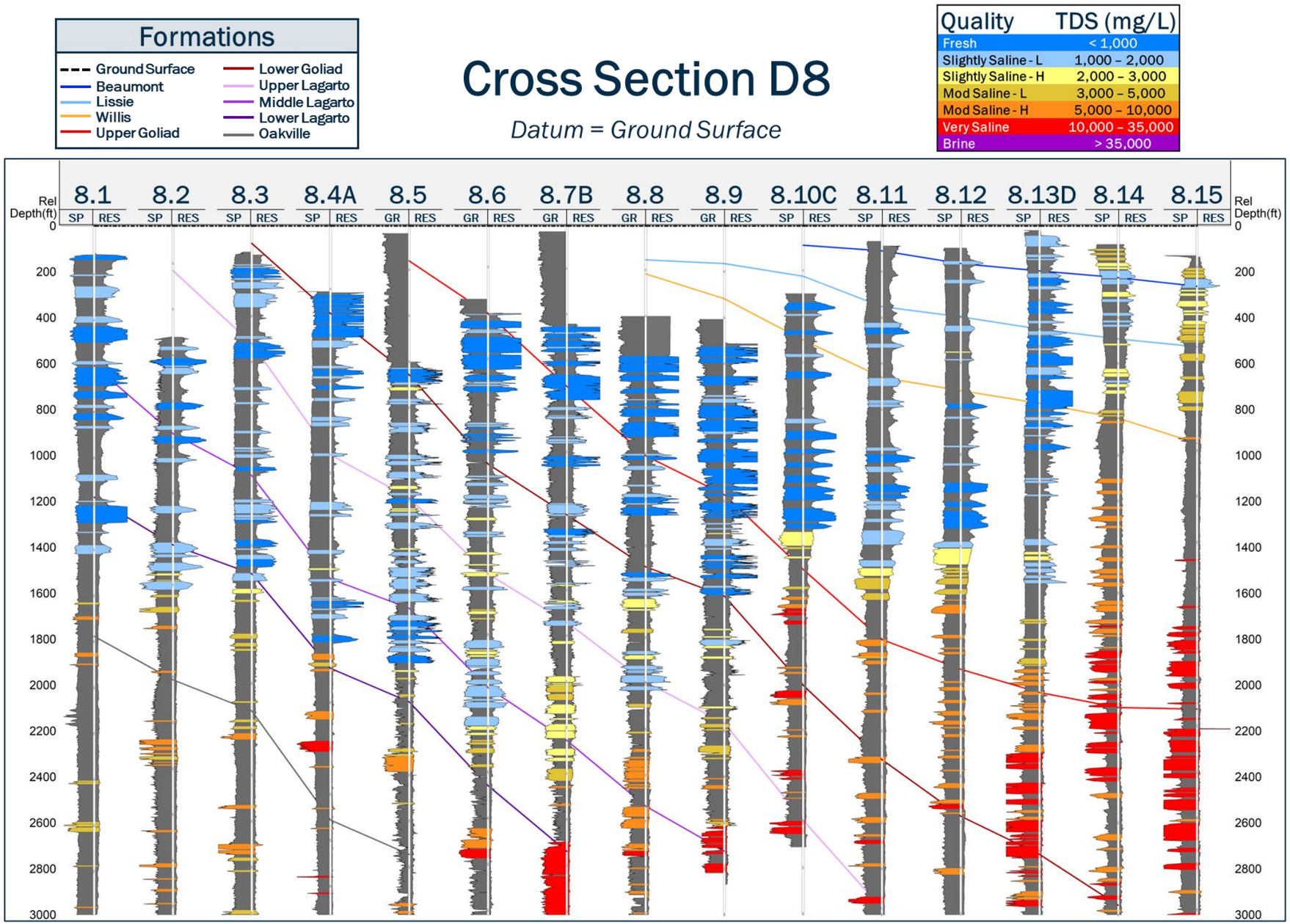


Figure 2-28. Strike cross-section D8 showing formation boundaries and the water quality classification of groundwater in the sand beds identified in 15 logs.

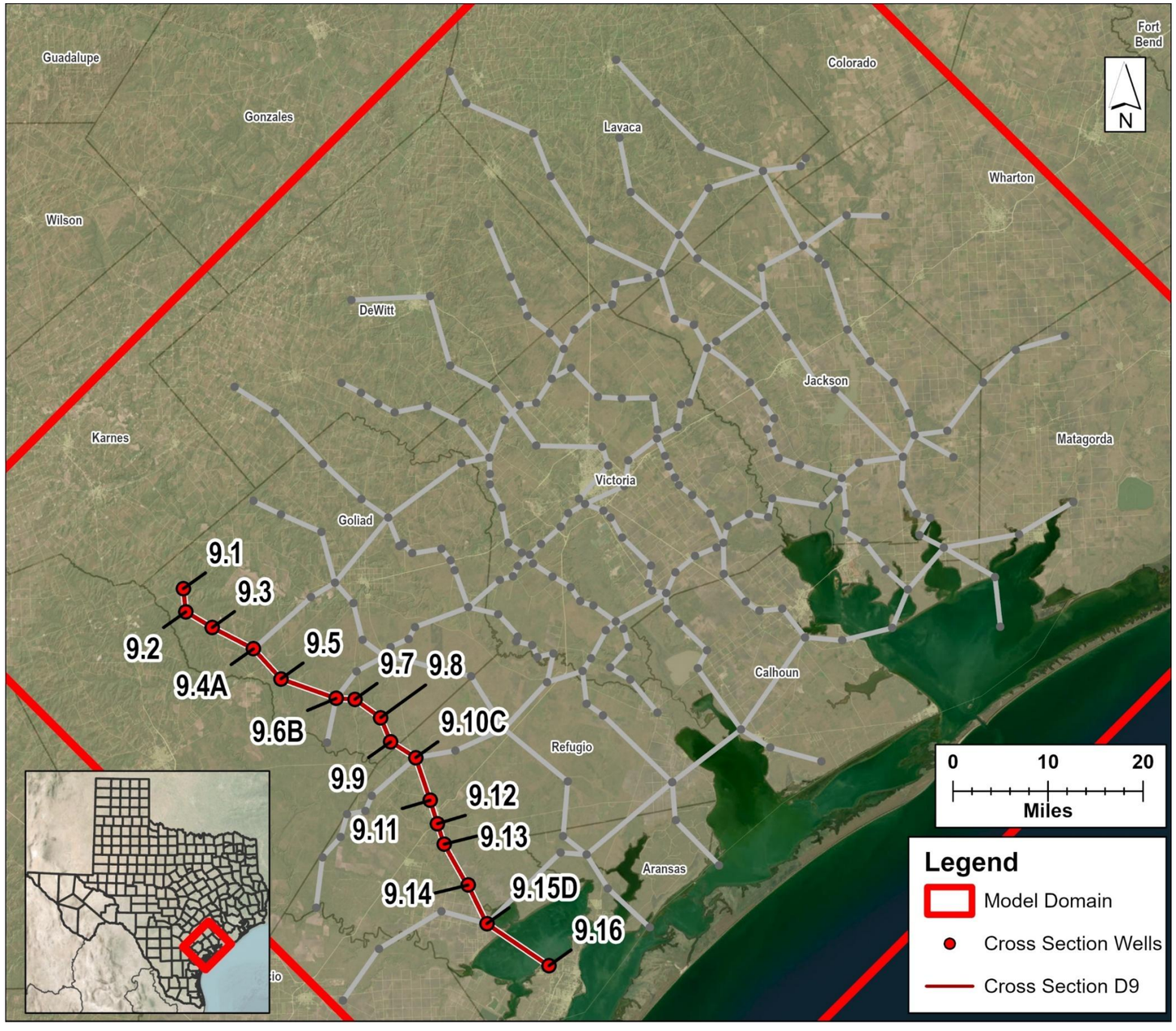


Figure 2-29. Location map showing wells used in dip cross-section D9, with well aliases labeled to correspond to the wells displayed in the cross-section profile.

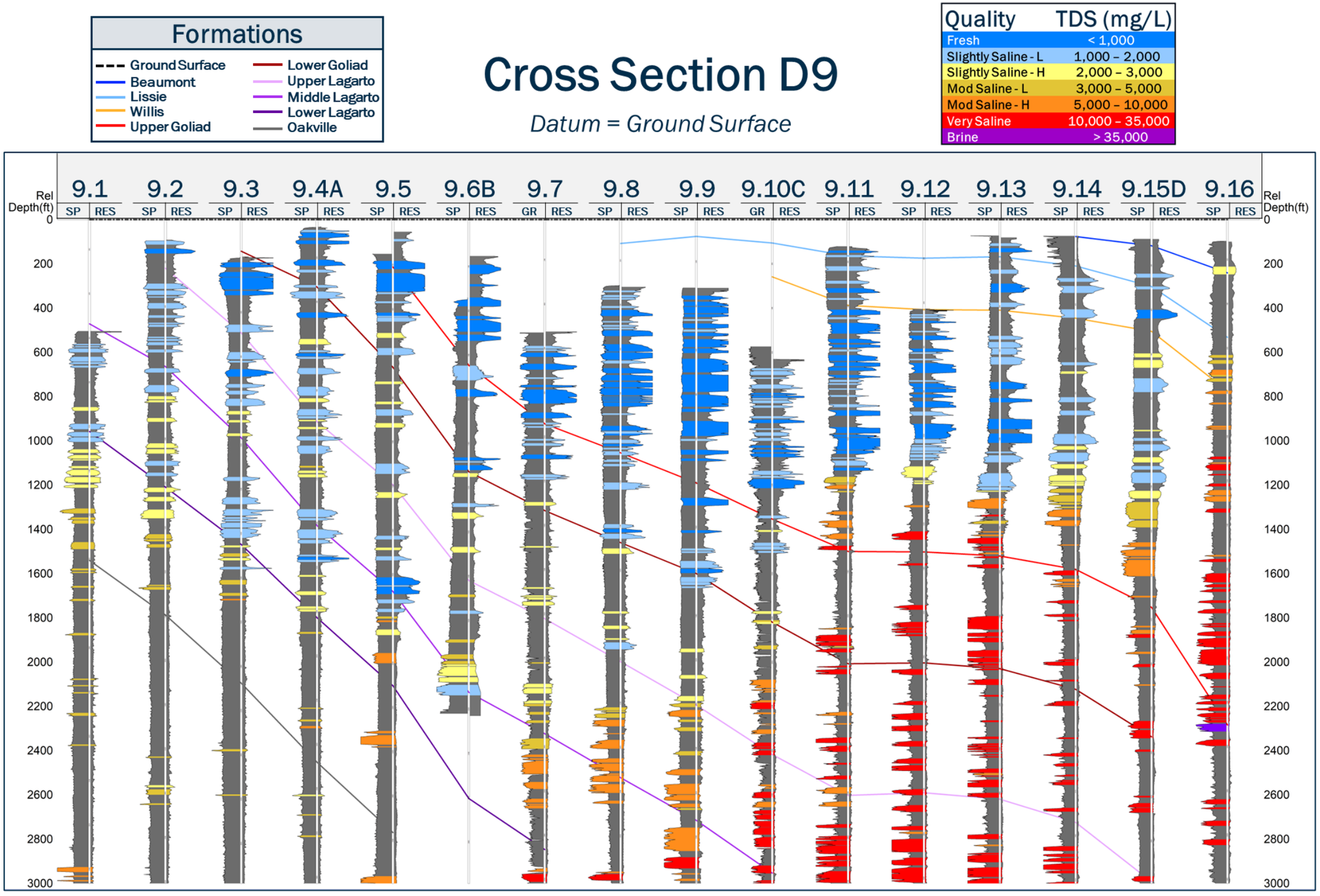


Figure 2-30. Strike cross-section D9 showing formation boundaries and the water quality classification of groundwater in the sand beds identified in 16 logs.

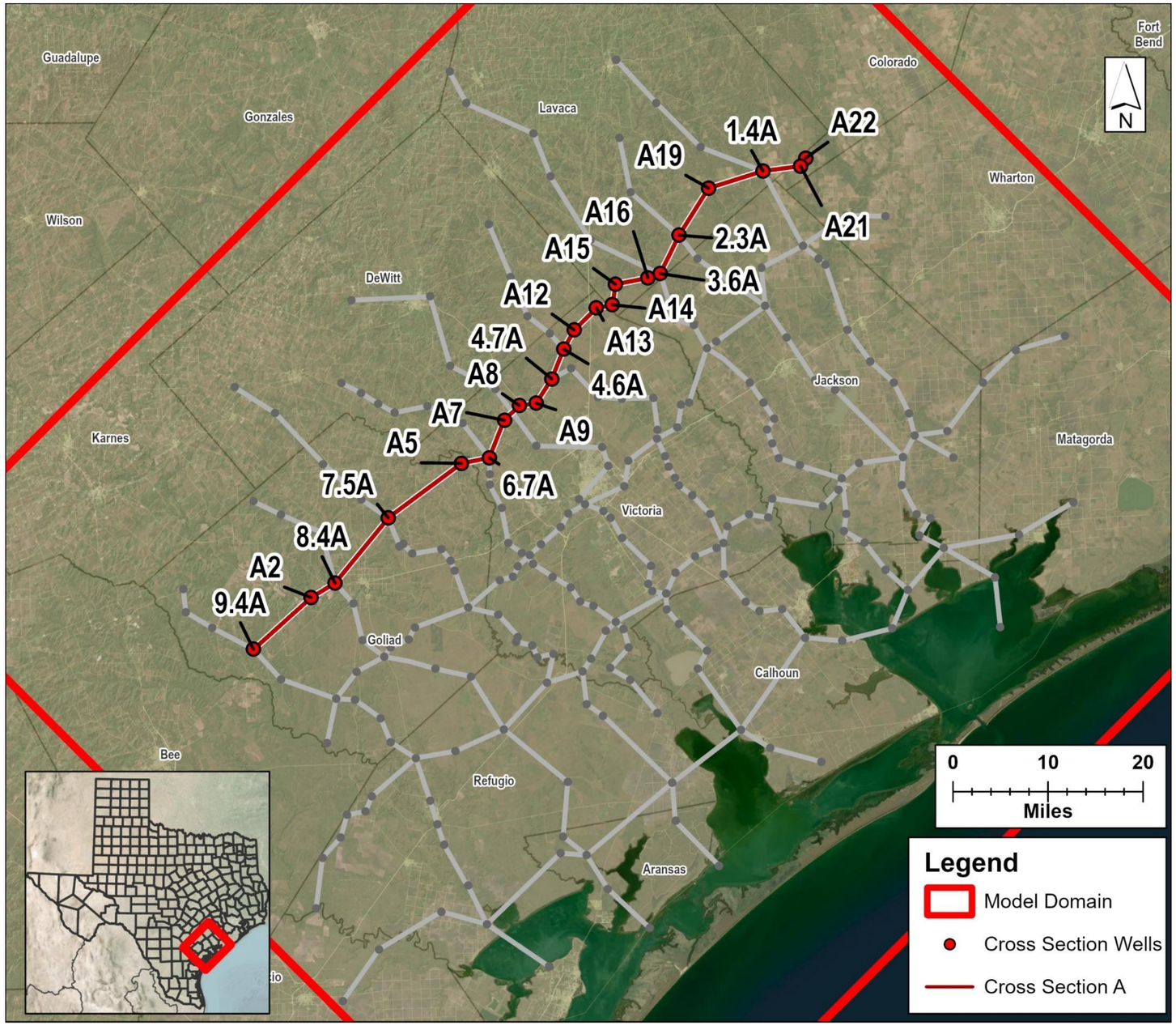


Figure 2-31. Location map showing wells used in strike cross-section A, with well aliases labeled to correspond to the wells displayed in the cross-section profile.

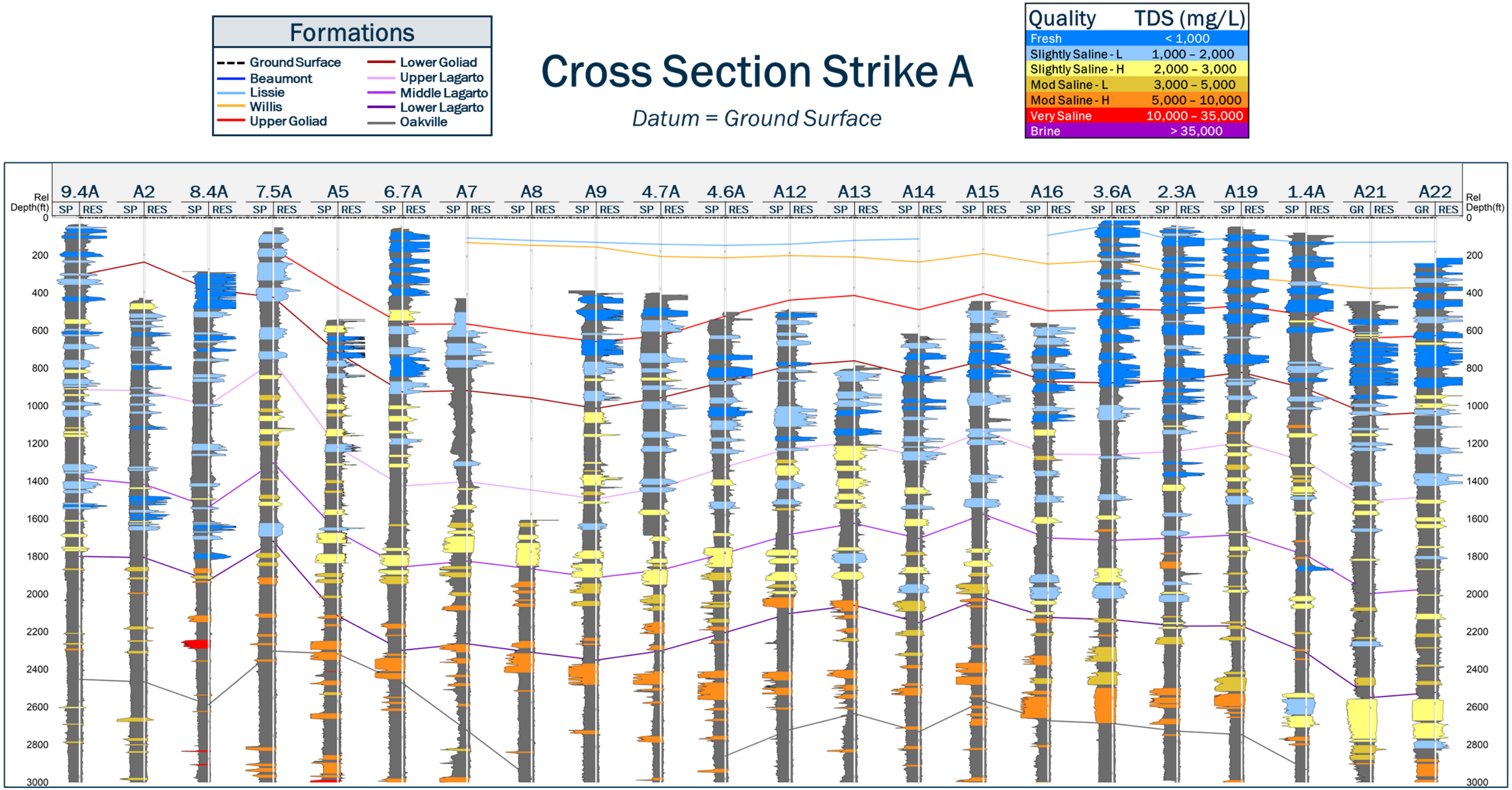


Figure 2-32. Strike cross-section A showing formation boundaries and the water quality classification of groundwater in the sand beds identified in 22 logs.

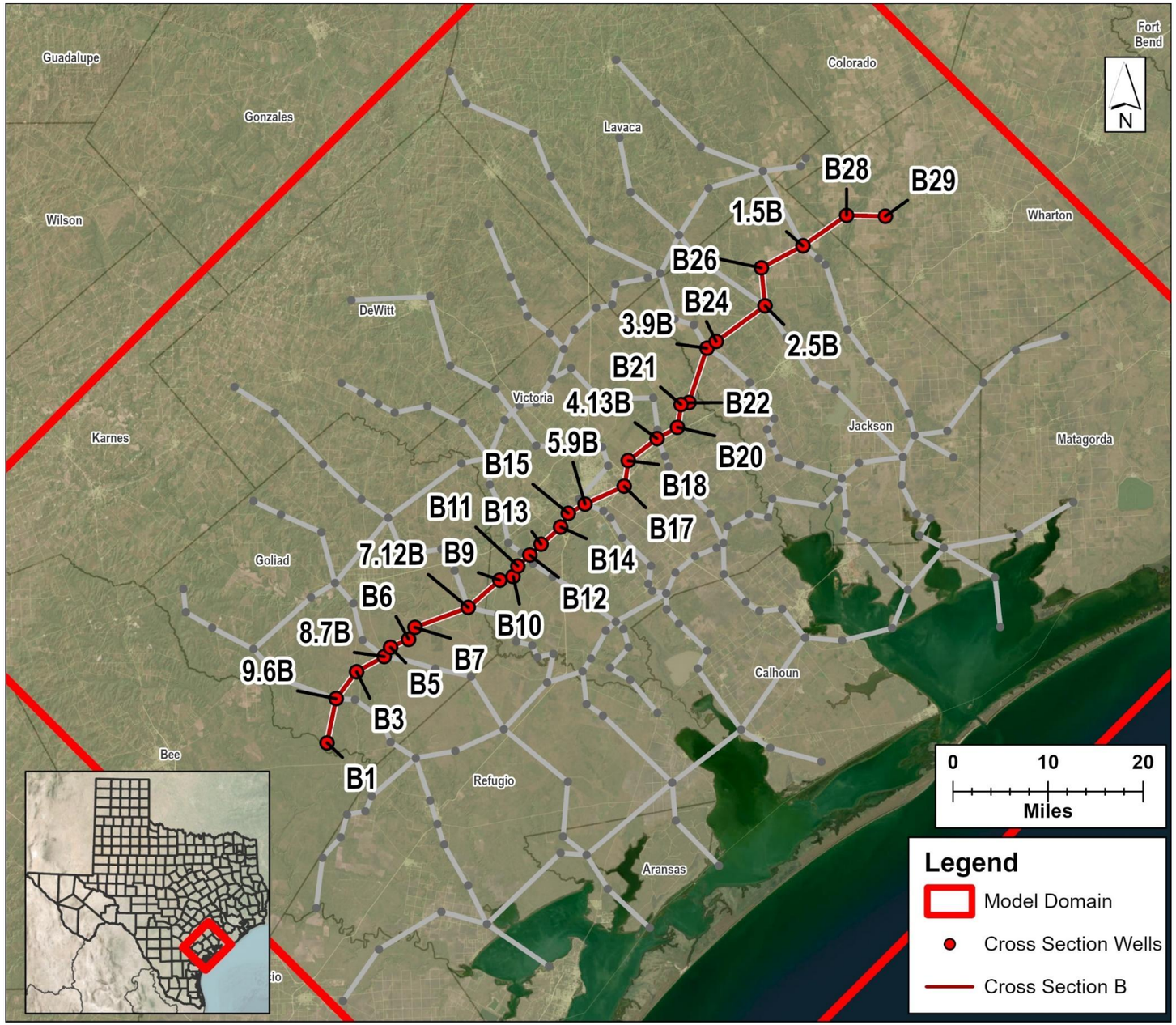


Figure 2-33. Location map showing wells used in strike cross-section B, with well aliases labeled to correspond to the wells displayed in the cross-section profile.

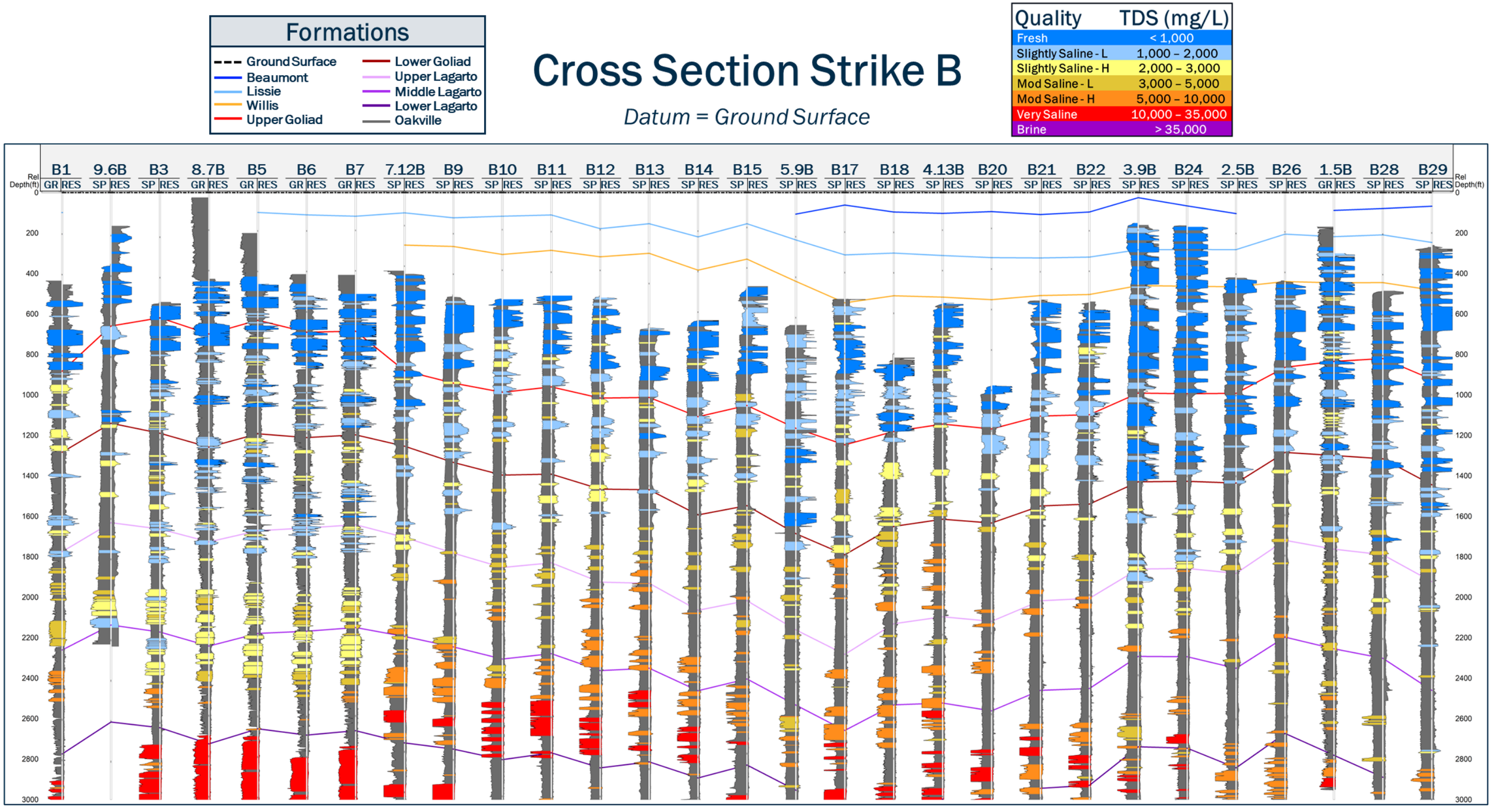


Figure 2-34. Strike cross-section B showing formation boundaries and the water quality classification of groundwater in the sand beds identified in 29 logs.

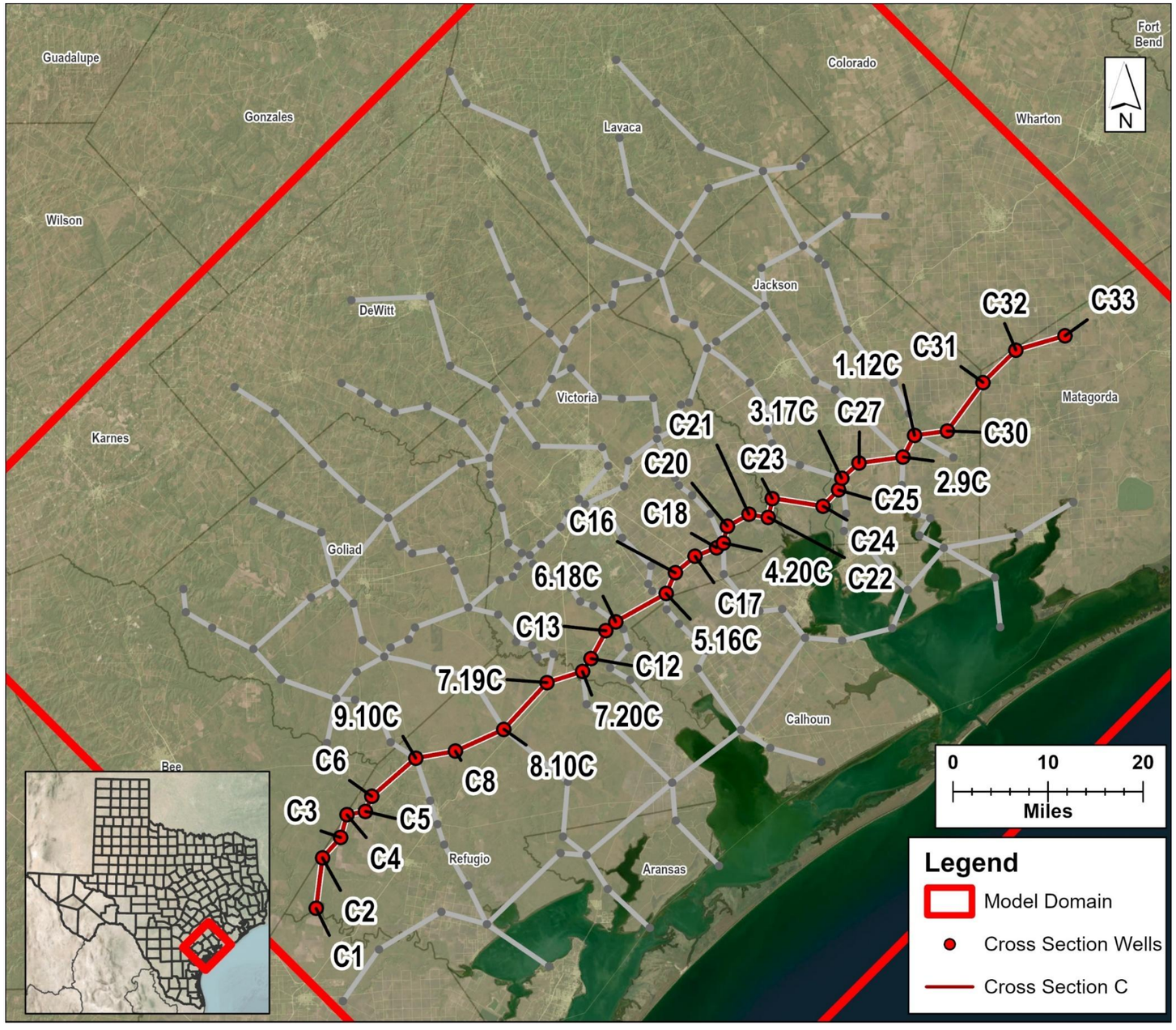


Figure 2-35. Location map showing wells used in strike cross-section C, with well aliases labeled to correspond to the wells displayed in the cross-section profile.

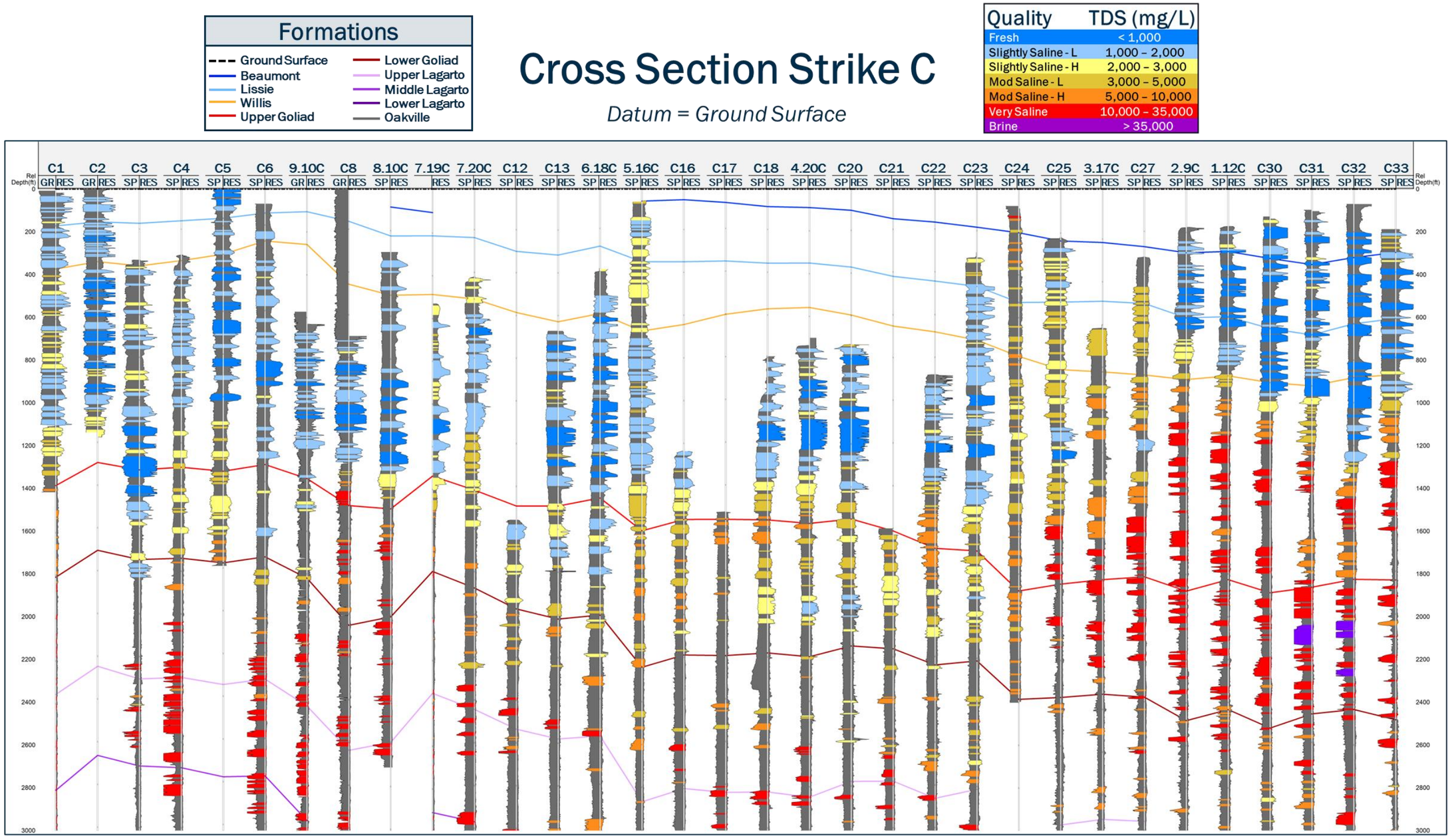


Figure 2-36. Strike cross-section C showing formation boundaries and the water quality classification of groundwater in the sand beds identified in 33 logs.

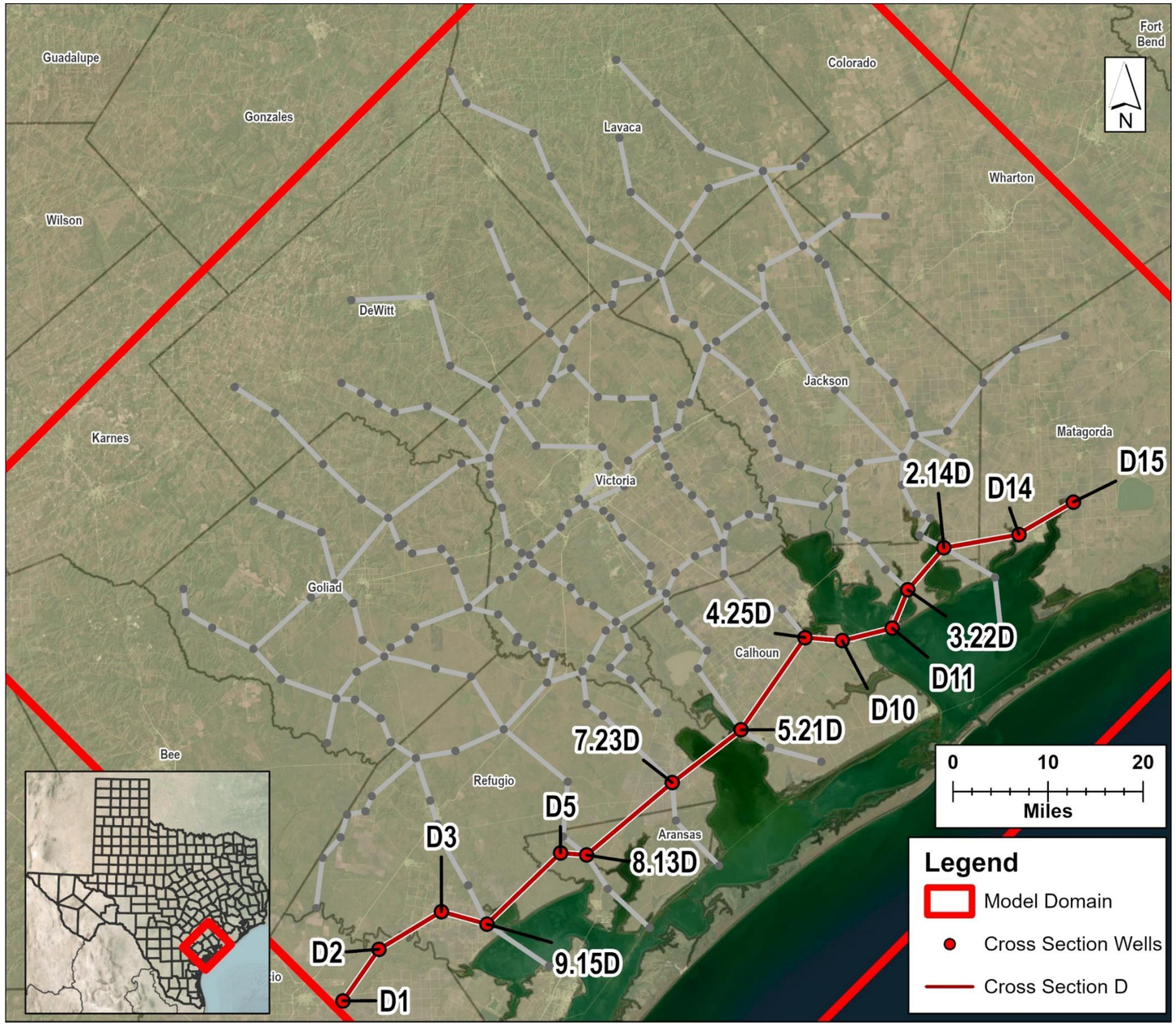


Figure 2-37. Location map showing wells used in strike cross-section D, with well aliases labeled to correspond to the wells displayed in the cross-section profile.

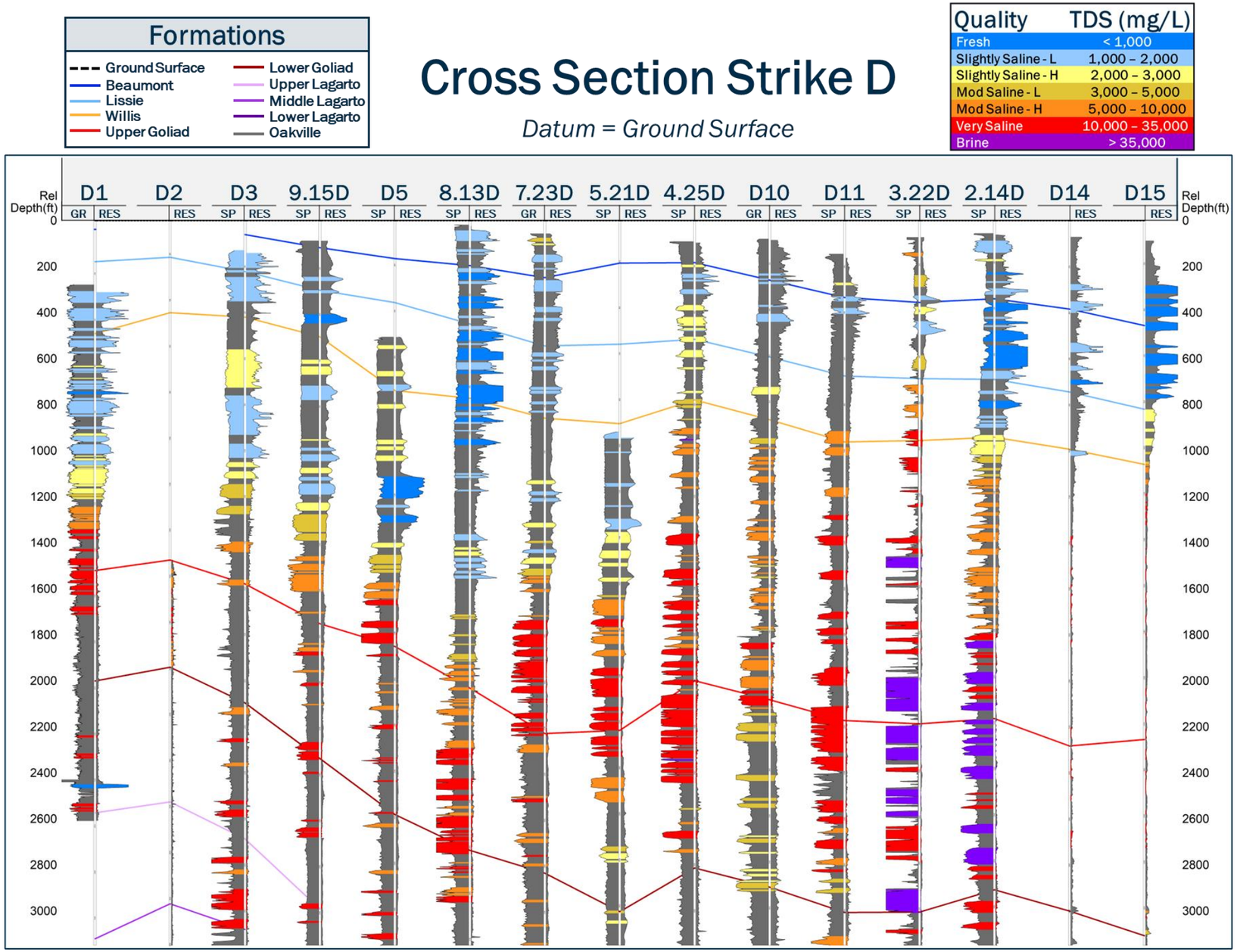


Figure 2-38. Strike cross-section D showing formation boundaries and the water quality classification of groundwater in the sand beds identified in 15 logs.

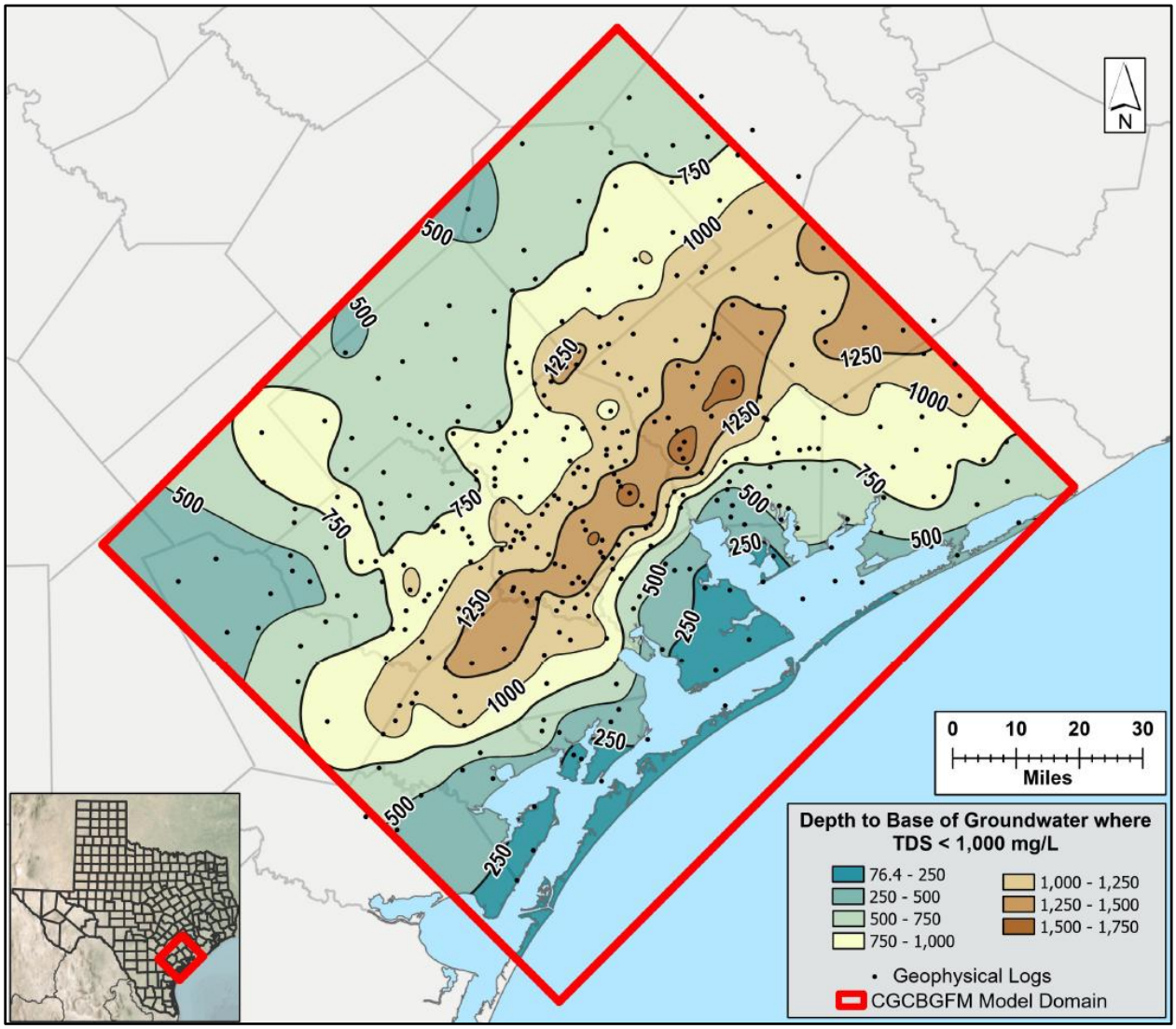


Figure 2-39. Depth to the base of groundwater with a TDS concentration of 1,000 mg/L based on interpretation of geophysical logs.

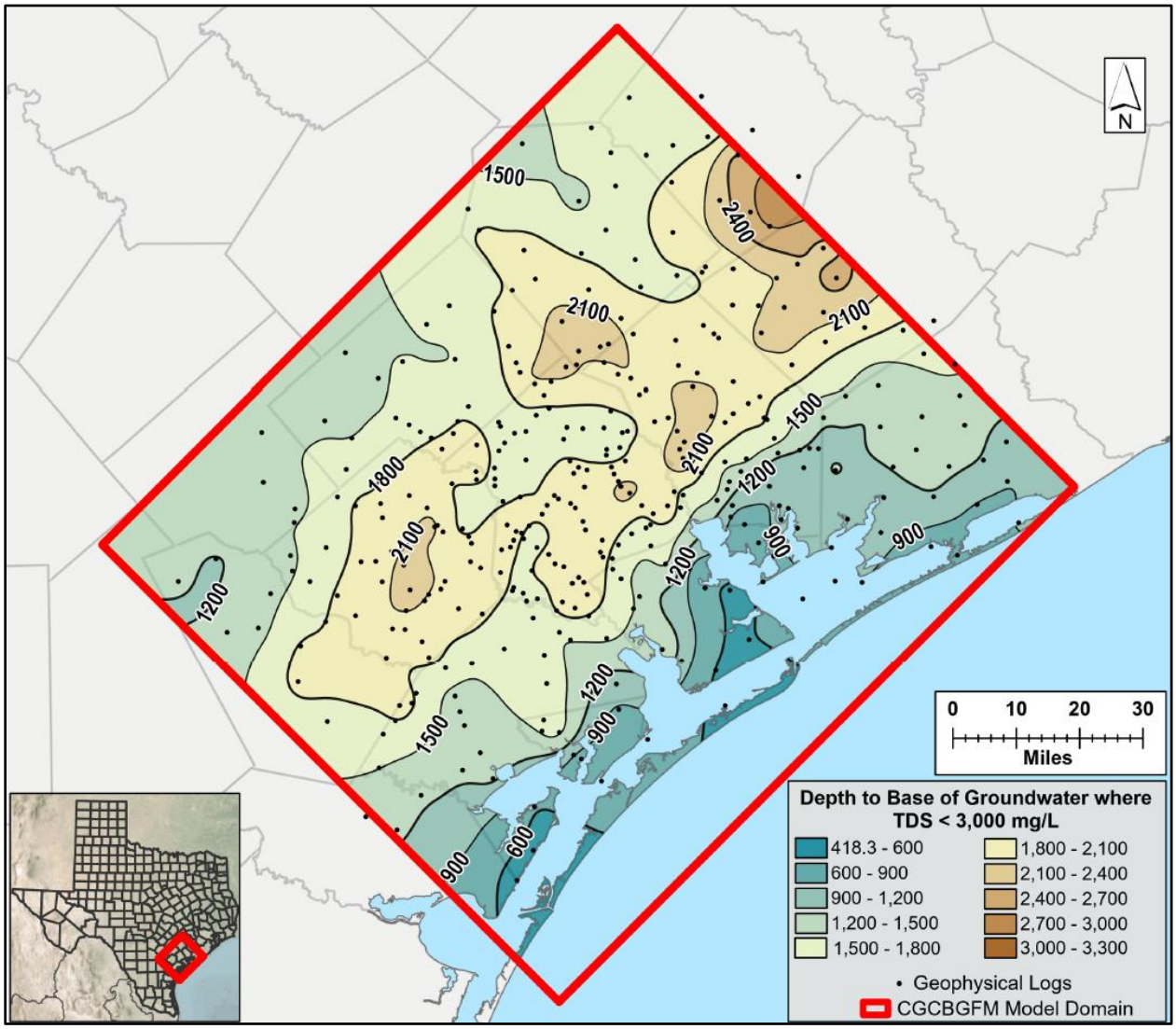


Figure 2-40. Depth to the base of groundwater with a TDS concentration of 3,000 mg/L based on interpretation of geophysical logs.

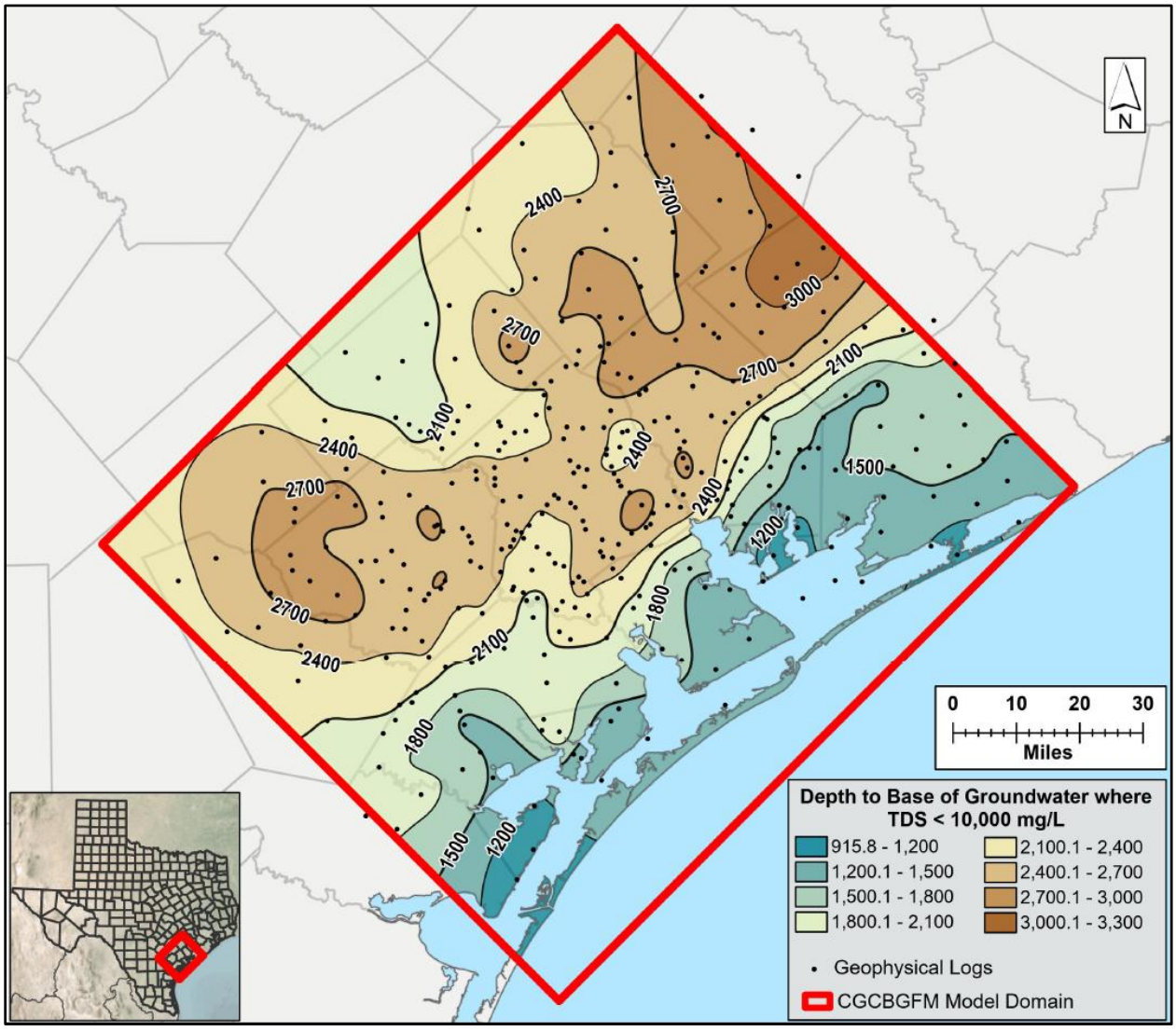


Figure 2-41. Depth to the base of groundwater with a TDS concentration of 10,000 mg/L based on interpretation of geophysical logs.

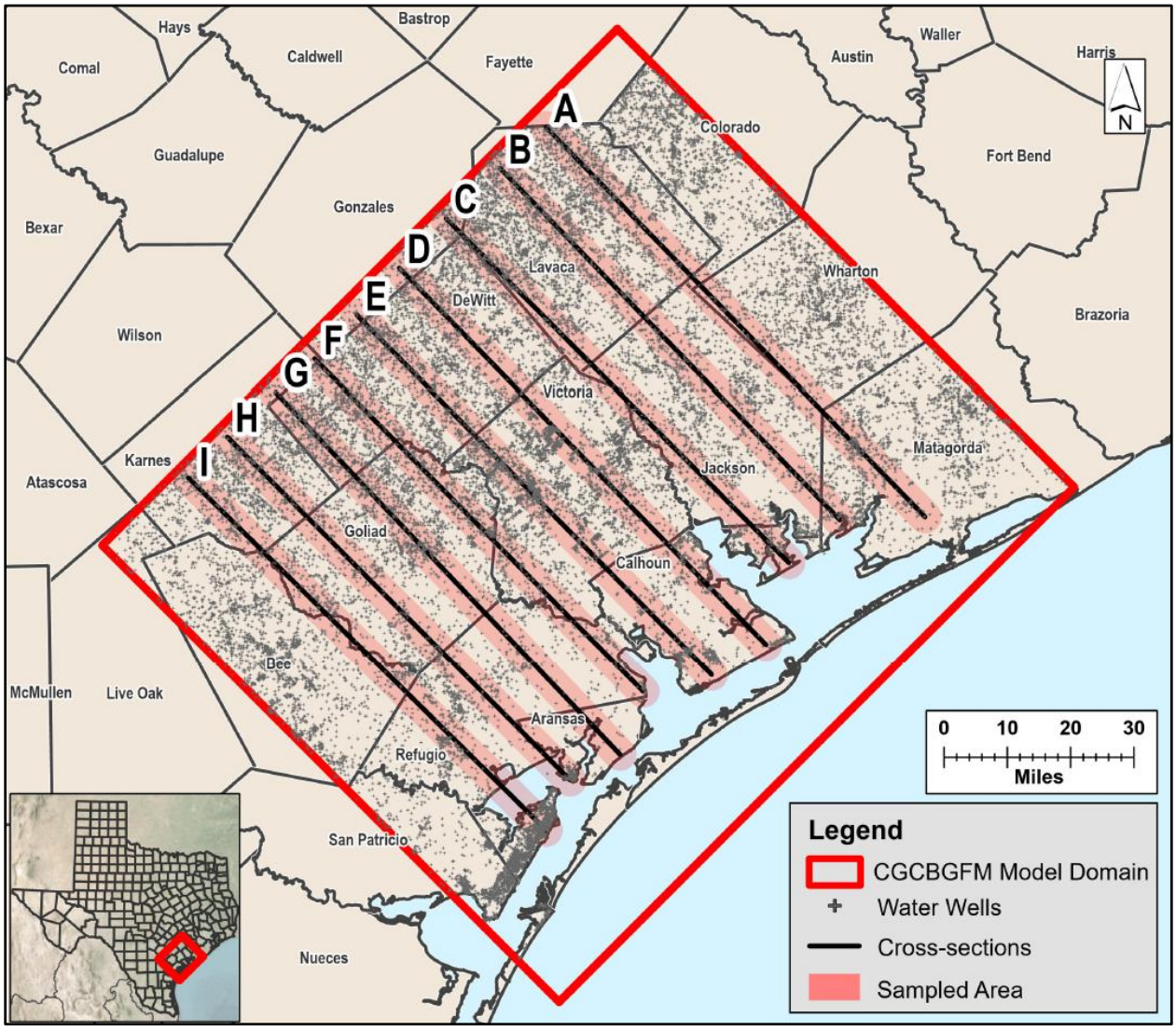


Figure 2-42. Location of nine transects used to create vertical cross-sections A-I that show bottom boundary of formations and groundwater with different TDS concentrations.

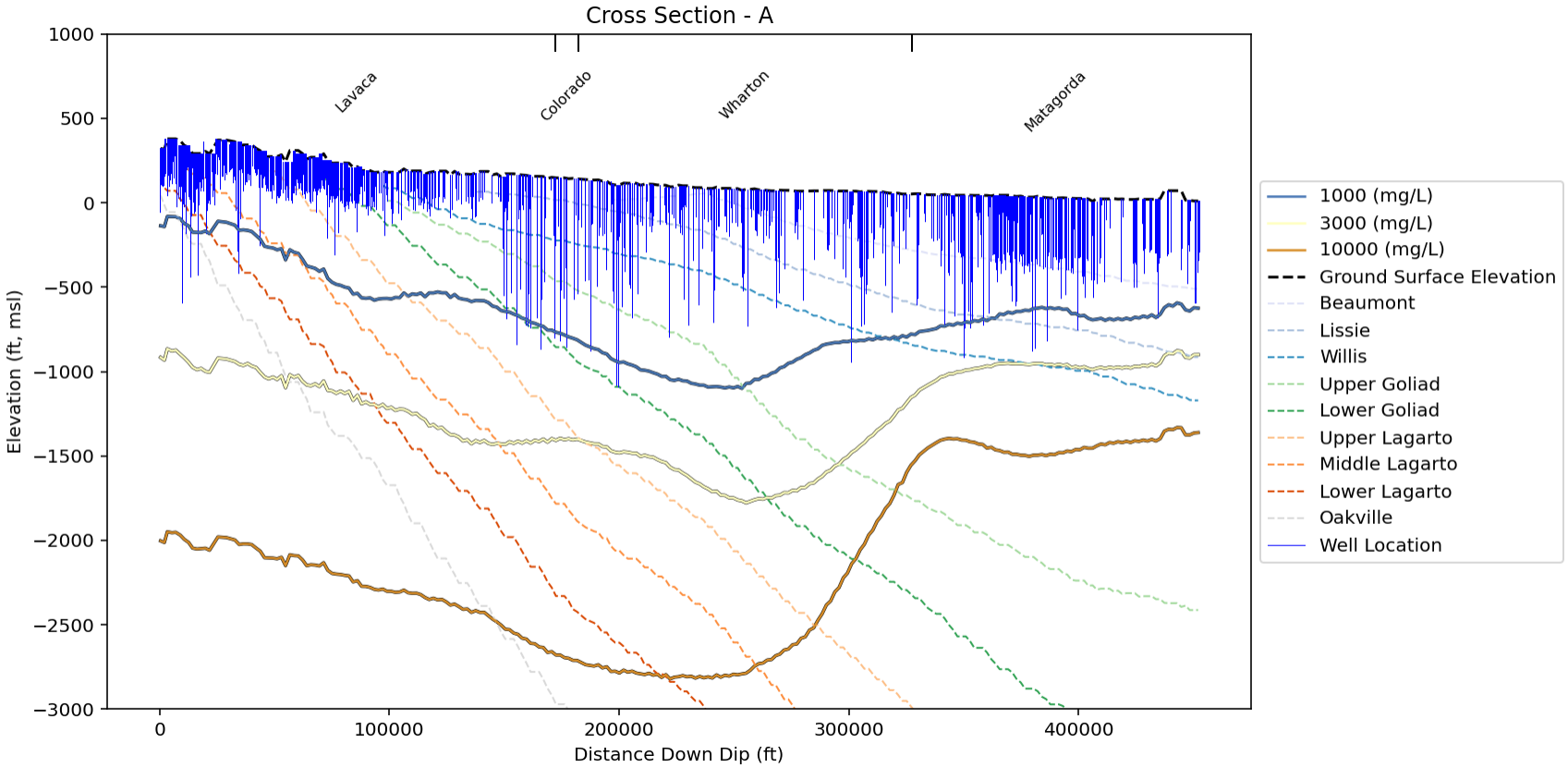


Figure 2-43. Cross-section A showing the base geological formation, salinity zones, and groundwater wells from the VCGCD database.

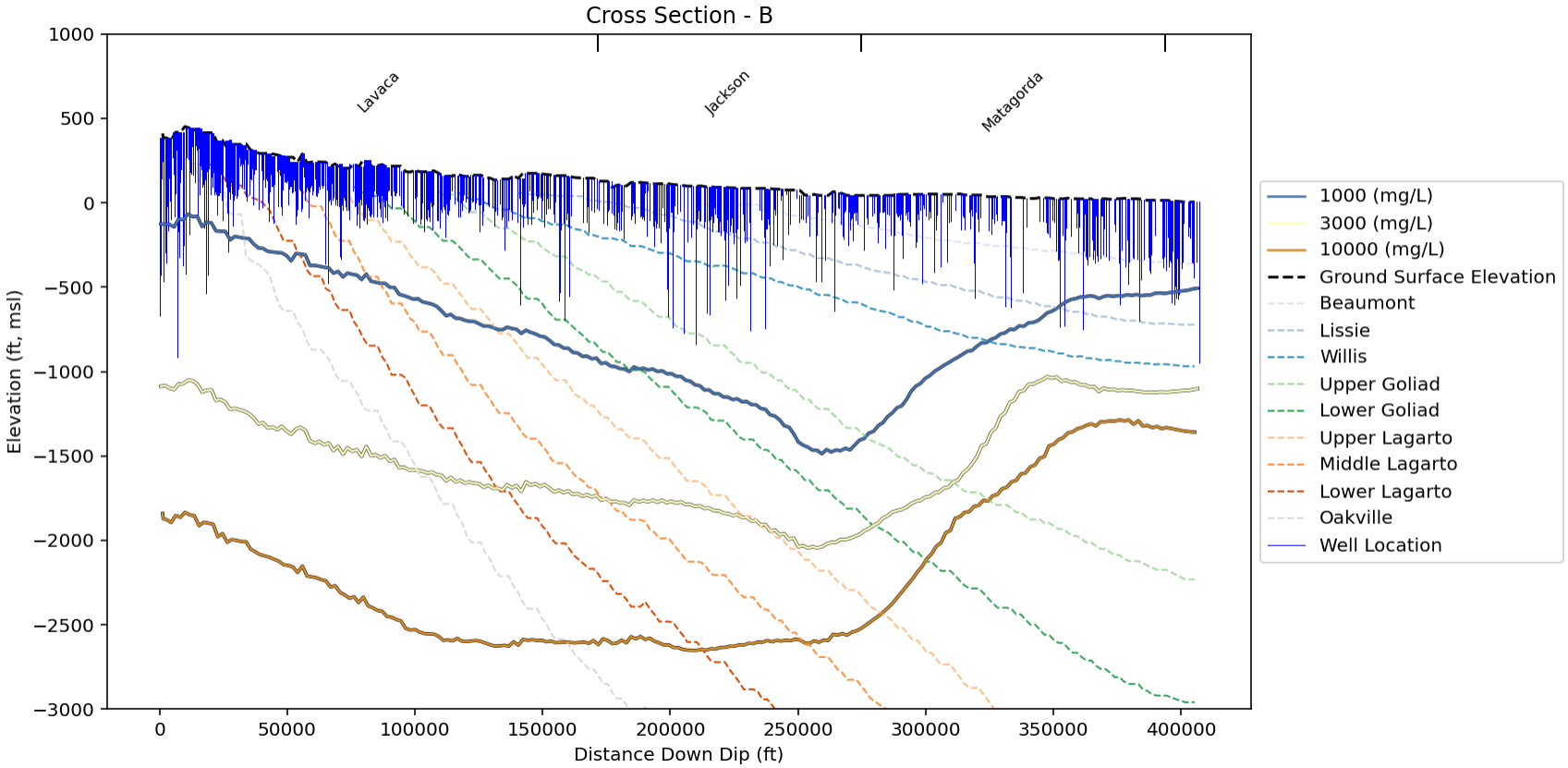


Figure 2-44. Cross-section B showing the base geological formation, salinity zones, and groundwater wells from the VCGCD database.

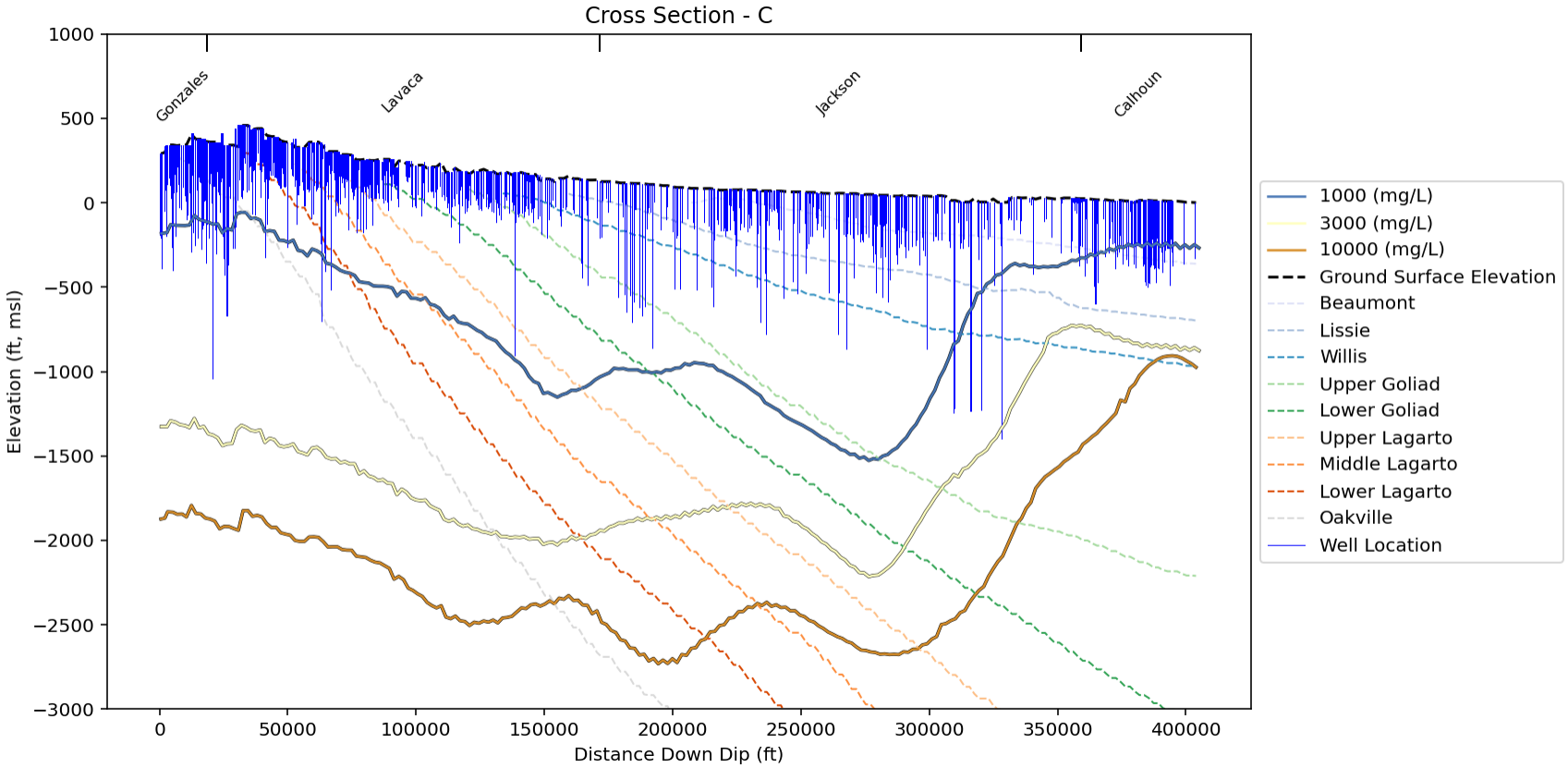


Figure 2-45. Cross-section C showing the base geological formation, salinity zones, and groundwater wells from the VCGCD database.

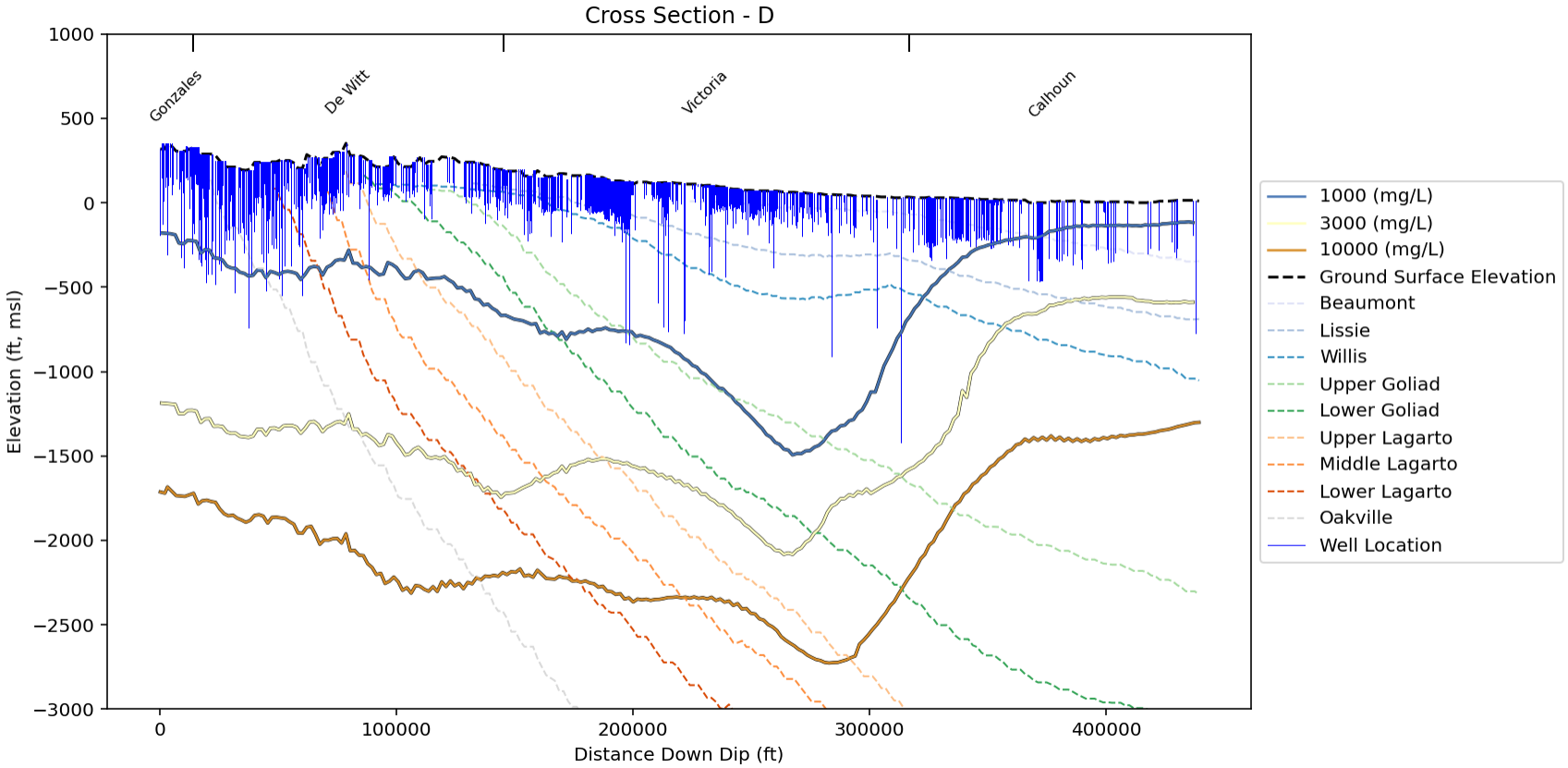


Figure 2-46. Cross-section D showing the base geological formation, salinity zones, and groundwater wells from the VCGCD database.

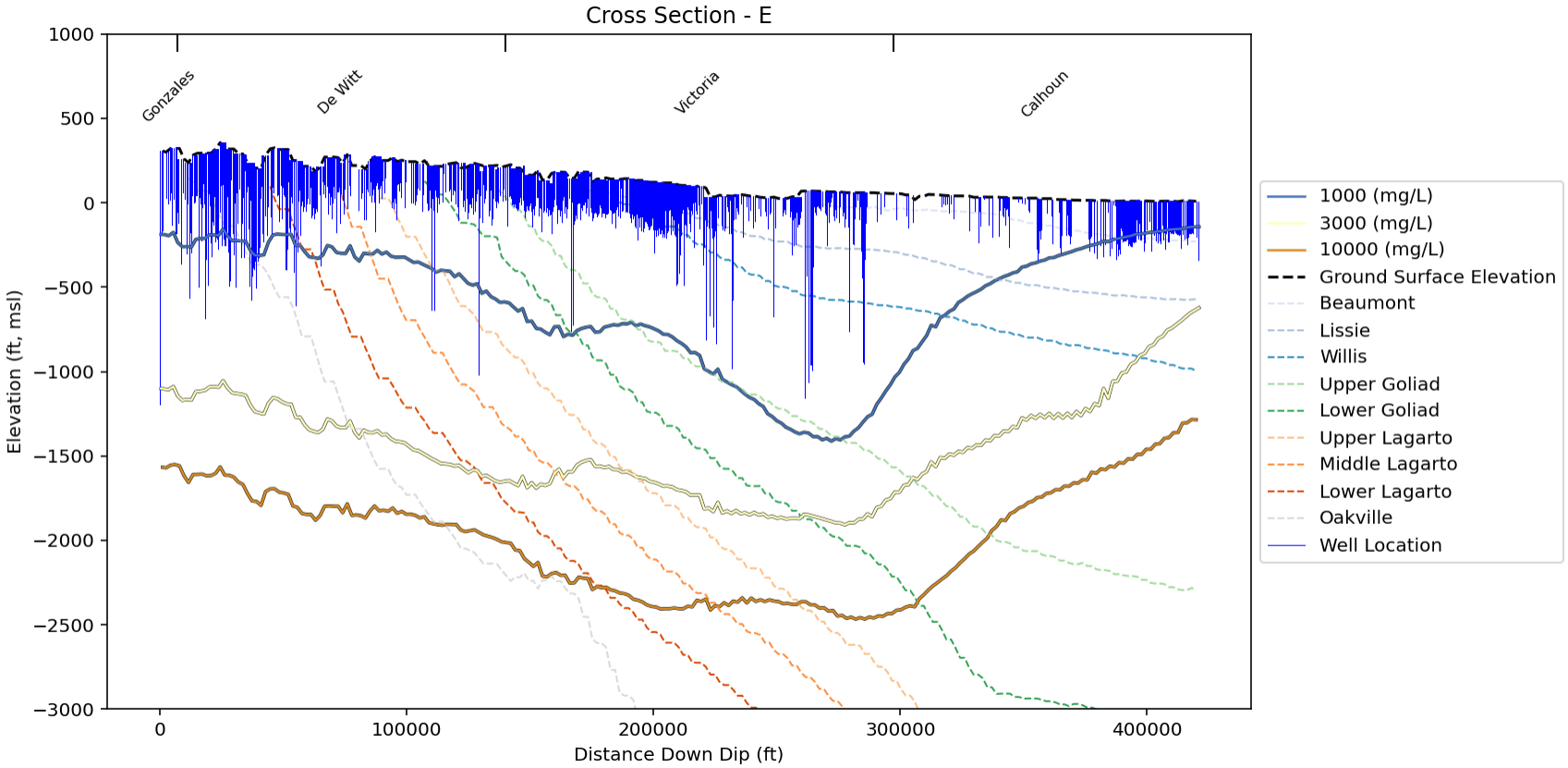


Figure 2-47. Cross-section E showing the base geological formation, salinity zones, and groundwater wells from the VCGCD database.

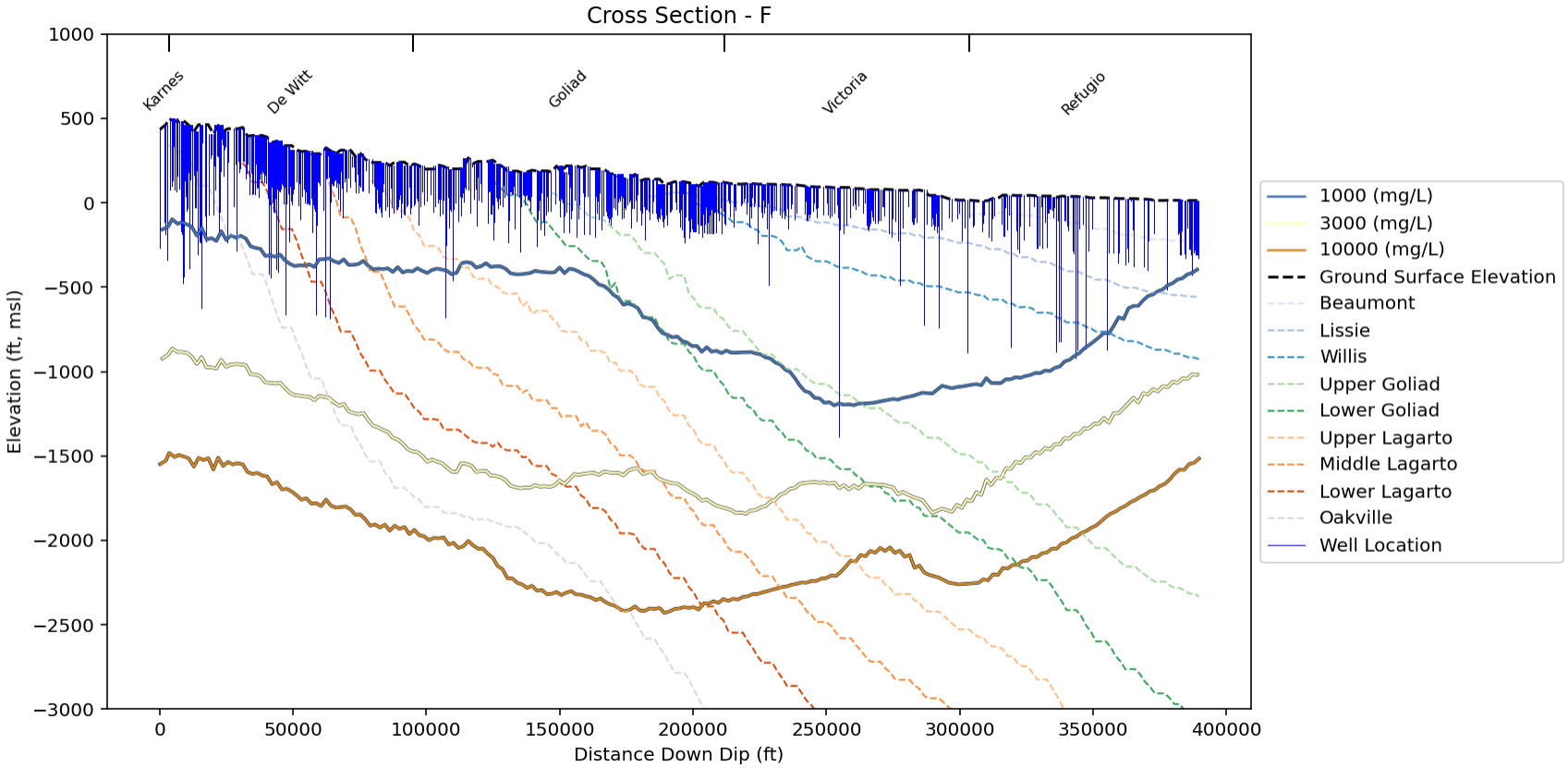


Figure 2-48. Cross-section F showing the base geological formation, salinity zones, and groundwater wells from the VCGCD database.

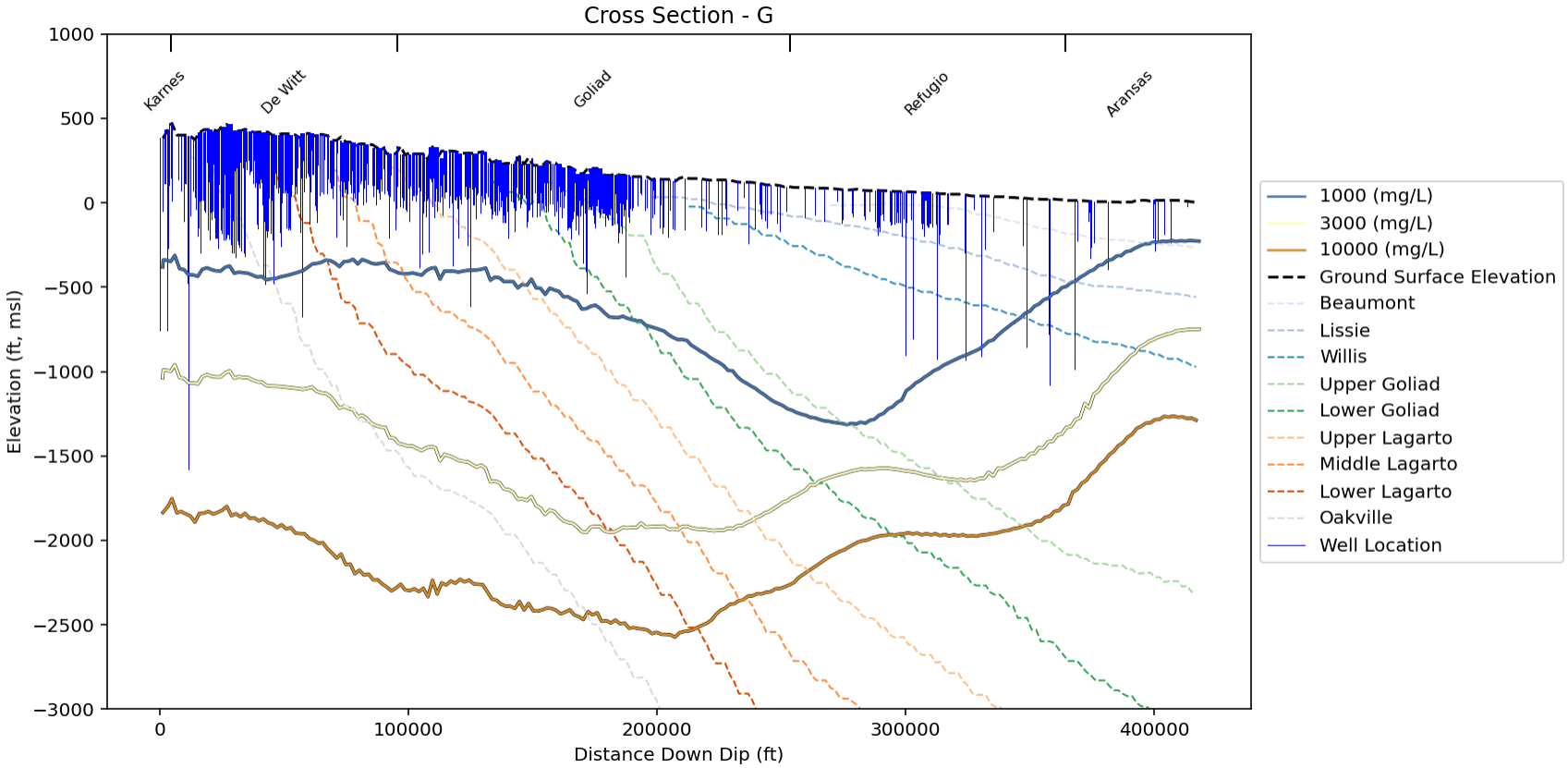


Figure 2-49. Cross-section G showing the base geological formation, salinity zones, and groundwater wells from the VCGCD database.

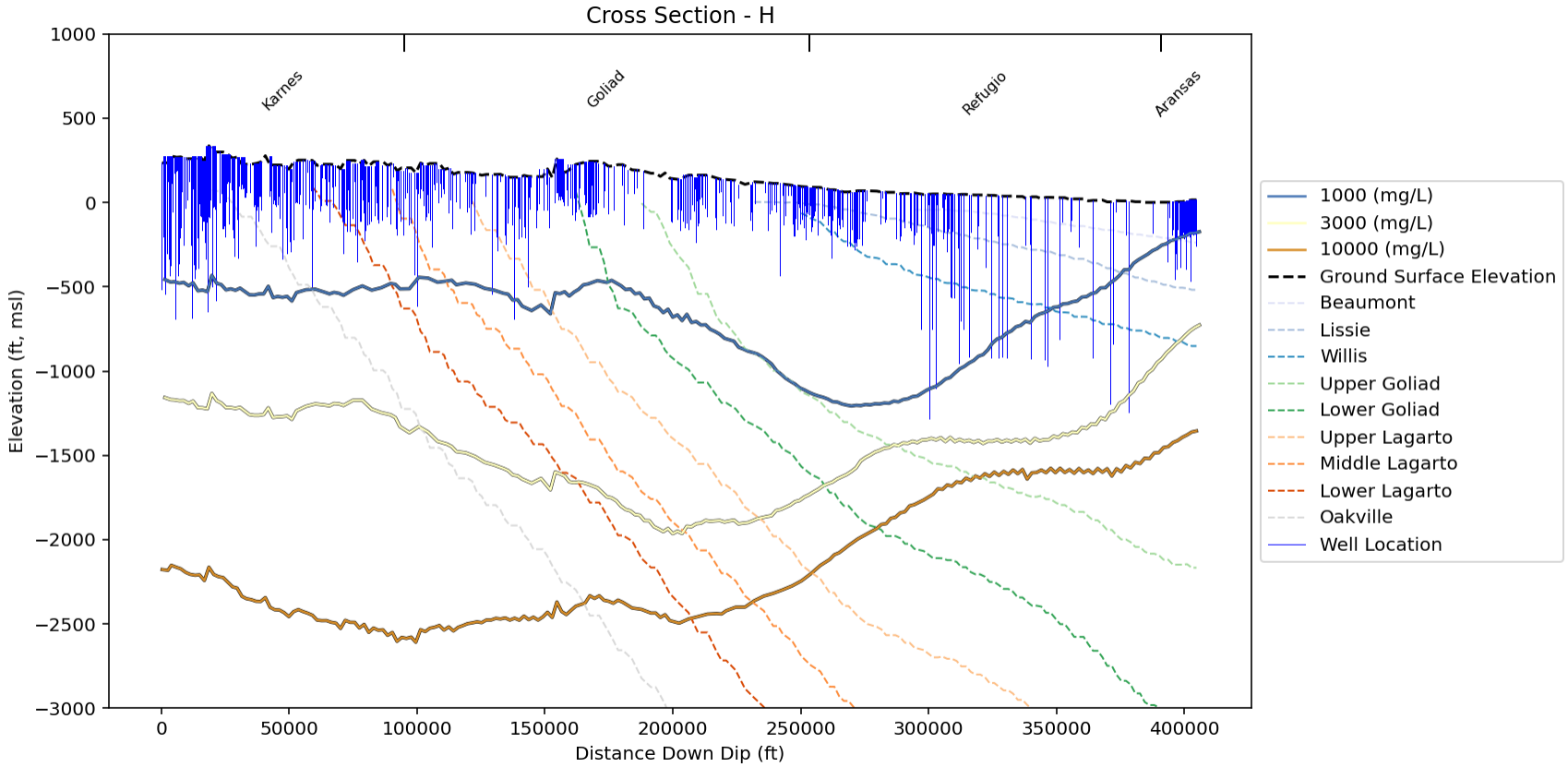


Figure 2-50. Cross-section H showing the base geological formation, salinity zones, and groundwater wells from the VCGCD database.

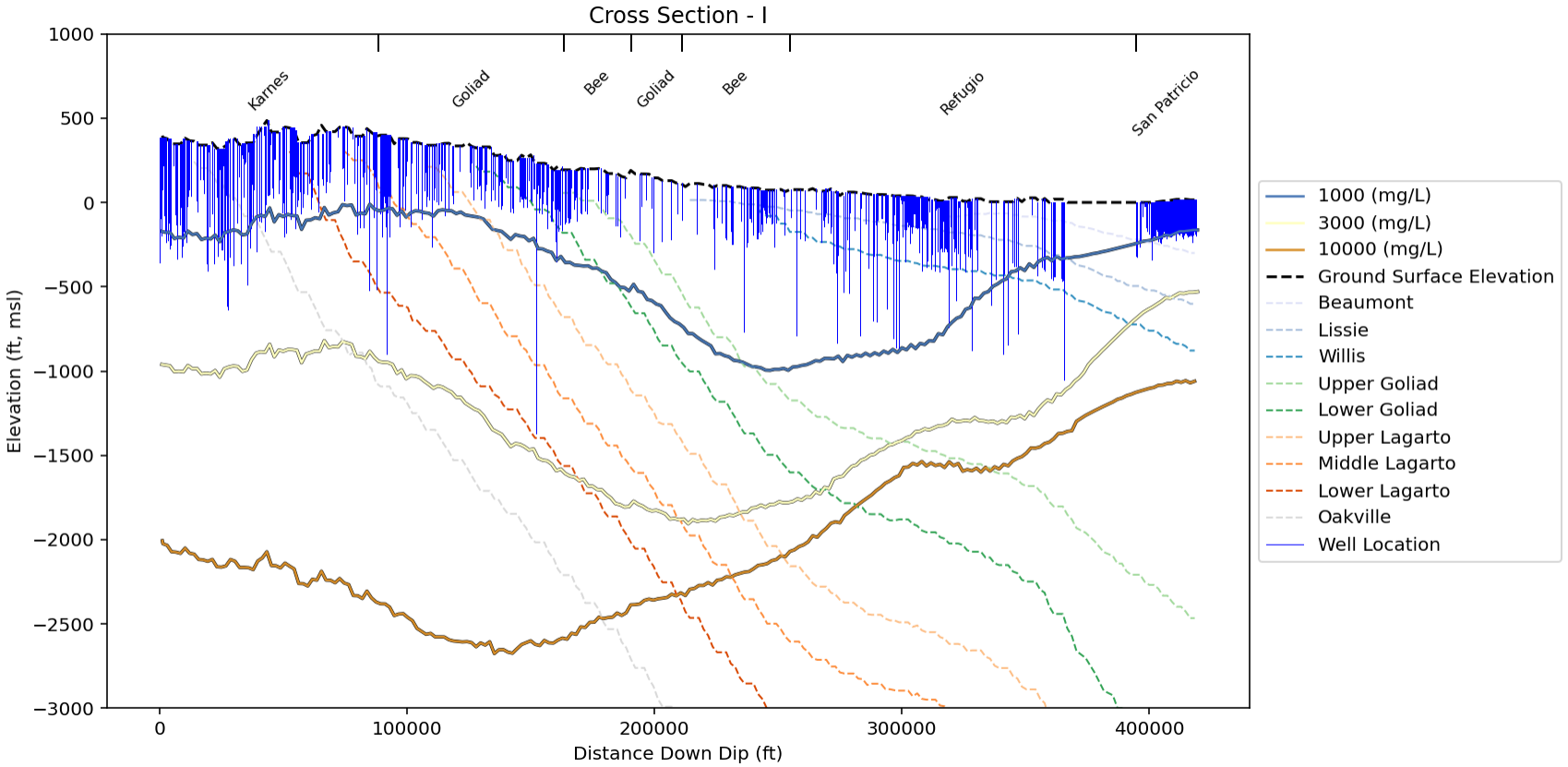


Figure 2-51. Cross-section I showing the base geological formation, salinity zones, and groundwater wells from the VCGCD database.

3.0 Characterization of the Hydraulic Properites of the Gulf Coast Aquifer System

This section describes the methodologies that will be used to characterize the hydraulic conductivity, porosity, and storage properties of the Gulf Coast Aquifer System in the vicinity of Victoria County.

3.1 Hydraulic Conductivity

Hydraulic conductivity, symbolized as K, is an aquifer property that describes the ease with which a fluid (usually water) can move through pore spaces or fractures. Hydraulic conductivity depends on the physical properties of the aquifer deposits, the degree of saturation, and on the density and viscosity of the fluid. Hydraulic conductivity has units with dimensions of length per time (e.g., meters per second or feet per day).

Estimates of hydraulic conductivity are most reliably derived from aquifer pumping tests that measure aquifer response over spatial scales of hundreds to thousands of feet, rather than from laboratory measurements on core samples that represent only a few inches of material. Aquifer pumping tests provide field-scale estimates that are more representative of aquifer heterogeneity and connectivity. The most cost-effective method for estimating aquifer transmissivity is through hydraulic aquifer testing, which involves pumping a well and measuring drawdown in the pumped well or nearby observation wells.

For this study, aquifer hydraulic test data were compiled from driller logs for wells drilled after 2001 and archived in the TWDB's driller log database, as well as from aquifer tests available in the TCEQ Public Water Supply (PWS) database. For both datasets, transmissivity values were calculated from available well test data, and hydraulic conductivity values were subsequently derived from transmissivity estimates. Hydraulic conductivity was calculated using the method described by Myers (1969), in which transmissivity is divided by the length of the well screen.

3.1.1 Specific Capacity Tests

The most widely performed hydraulic tests to estimate aquifer productivity and transmissivity are specific capacity tests. Specific capacity tests involve pumping a well and measuring the pumping rate and drawdown in the well. Once the data are obtained, specific capacity is calculated by dividing the total pumping rate by the drawdown (**Equation 3-1**).

$$SC = Q/s \qquad \text{(Equation 3-1)}$$

Where

SC = specific capacity (volume of water per time/per length)
Q = discharge (volume of water per time)
s = drawdown (length)

Specific capacity is generally reported as gallons per minute per foot (gpm/ft). If the well is pumped at a rate of 100 gpm, and the measured drawdown is 10 ft, then the specific capacity is calculated as 10 gpm/ft. A specific capacity of 10 gpm/ft indicates that, for every foot of drawdown available in a well,

the well will produce 10 gpm. So, if the well is to be pumped at a constant rate of 50 gpm, then the drawdown near the well should be about 5 ft. Specific capacity tests are often performed at a newly installed well to estimate the production capacity of the well.

Several studies have developed relationships between specific capacity and transmissivity for aquifers in Texas (Mace, 2001; Kelley and others, 2004; Young and others, 2009; Prudic, 1991). Mace (2001) provides a thorough discussion of the assumptions and different methods for estimating aquifer transmissivity from a specific capacity value. Factors that affect how to determine transmissivity values from specific capacity values include unconfined conditions, well construction, well development, the amount a well screen interval intersects the aquifer thickness, the degree to which drilling has disturbed the native aquifer material near the well screen, and measurement error.

Most specific capacity tests in the Texas Gulf Coast Aquifer System were performed by drillers during well construction. These tests are often conducted rapidly, under non-ideal conditions, and without rigorous quality control. Additionally, the primary objective of these tests is typically to demonstrate the productive capacity of the well rather than to characterize aquifer transmissivity.

For this study, transmissivity values were determined from specific capacity values using **Equation 3-2**. Equation 3-2 was developed by Prudic (1991) using data from more than 2,500 aquifer pumping tests from the Gulf Coast Aquifer System for which transmissivity values had been calculated. The majority of these aquifer pumping tests were performed in Texas, Louisiana, and Mississippi. In Equation 3-2, specific capacity has the units of square feet per day (ft^2/day). Converting specific capacity from units of gpm/ft to units of ft^2/day requires multiplying by a factor of 192.5 ft^3/(gpm*day).

$$T = 3.89 * SC^{0.896} \quad \text{(Equation 3-2)}$$

Where

T = transmissivity (ft^2/day)
SC = specific capacity (ft^2/day)

Approximately 6,700 specific capacity tests were compiled from driller logs and used to calculate transmissivity values using **Equation 3-2**. **Table 3-1** summarizes the distribution of specific capacity tests by geologic formation. **Figures 3-1** through **3-9** show the locations of wells for which transmissivity values were calculated for the nine formations listed in Table 3-1.

For each formation, hydraulic conductivity values were calculated by dividing transmissivity by the well screen length. The resulting hydraulic conductivity values were then grouped by depositional settings using depositional environment maps developed by Young and others (2010). Two depositional groups were defined: (1) coastal depositional facies and (2) fluvial depositional facies. This classification is consistent with the approach used by Young and others (2016), who demonstrated that the relationship between sand percentage and hydraulic conductivity varies by depositional setting. In general, for equivalent sand percentages, deposits formed in fluvial environments exhibit higher hydraulic conductivity than those formed in coastal environments.

Table 3-1. Distribution of specific capacity tests by formation in the study area.

Formation	Number of Specific Capacity Tests
Beaumont	1,729
Lissie	822
Willis	469
Upper Goliad	703
Lower Goliad	506
Upper Lagarto	526
Middle Lagarto	692
Lower Lagarto	693
Oakville	577
Total	6,717

To estimate an average hydraulic conductivity for each formation, the hydraulic conductivity values were divided by depositional setting (coastal and fluvial) and by well screen. The hydraulic conductivity values were divided into one of four bins based on well screen length. The bin sizes, based on well screen length, were less than 20 ft, between 20 and 40 ft, between 40 and 100 ft, and between 100 and 400 ft. The grouping by well screen was performed to identify a potential bias that was demonstrated by Young and Kelley (2006) to exist in hydraulic tests in the central Texas Gulf Coast Aquifer System.

As discussed by Young and Kelley (2006), bias in hydraulic conductivity estimates arises for two primary reasons. First, short well screens are commonly placed across the most permeable zones encountered during drilling, resulting in preferential sampling of high-permeability materials. Second, pumping from a short screen in a thick aquifer induces convergent flow, causing transmissivity estimates derived from standard methods to reflect a larger effective aquifer thickness than the actual screened interval. An inverse relationship between hydraulic conductivity and well screen length has been documented in the Central Gulf Coast Aquifer System (Young and Kelley, 2006; Young and others, 2009), the Northern Trinity Aquifer (Kelley and others, 2014), and the Yegua-Jackson Aquifer (Deeds and others, 2010).

Figures 3-10 through **3-12** show the sensitivity of average hydraulic conductivity as a function of screen length for formations in the Chicot Aquifer, Evangeline/Burkeville Confining Unit, and Jasper Aquifer. Results for a formation-depositional setting group are only shown where at least three of the four bins have five or more hydraulic conductivity values. **Table 3-2** summarizes the hydraulic conductivity values used to generate Figures 3-10 through 3-12 and provides the basis for subsequent parameterization of the aquifer system. In the three figures, the calculated averages for well screen groups with less than five hydraulic conductivity values are not posted. For each well screen group, with five or more hydraulic conductivity values, the geometric and arithmetic averages of hydraulic conductivity are provided. All the 14 plots of hydraulic conductivity versus screen size support the relationship of decreasing hydraulic conductivity values with increasing screen size.

Figure 3-13 summarizes hydraulic conductivity values by hydrologic unit using only data from wells with screen lengths greater than 100 ft. Based on the results in Figure 3-13, the Chicot Aquifer has the

highest hydraulic conductivity values within the study area, consistent with their lithologic composition and regional hydrogeologic framework.

Table 3-2. Hydraulic conductivities summary by formation and screen length and facies.

Formation	Screen Length	Facies	K Mean	K Geometric Mean	Count
Beaumont	<20 ft	Coastal	29.5	15.0	153
Beaumont	<20 ft	Fluvial	122.2	67.1	132
Beaumont	20–40 ft	Coastal	10.8	7.4	902
Beaumont	20–40 ft	Fluvial	54.2	31.6	177
Beaumont	40–100 ft	Coastal	12.9	6.2	284
Beaumont	40–100 ft	Fluvial	35.8	29.3	53
Beaumont	100–600 ft	Coastal	9.2	4.3	11
Beaumont	100–600 ft	Fluvial	18.4	12.0	17
Lissie	<20 ft	Coastal	63.9	38.2	69
Lissie	<20 ft	Fluvial	97.3	57.2	80
Lissie	20–40 ft	Coastal	52.6	27.9	118
Lissie	20–40 ft	Fluvial	69.6	41.6	325
Lissie	40–100 ft	Coastal	30.2	23.8	58
Lissie	40–100 ft	Fluvial	46.0	22.5	128
Lissie	100–600 ft	Coastal	25.1	17.0	20
Lissie	100–600 ft	Fluvial	24.5	11.7	21
Willis	<20 ft	Coastal	122.0	76.5	9
Willis	<20 ft	Fluvial	70.3	33.6	33
Willis	20–40 ft	Coastal	55.8	39.5	55
Willis	20–40 ft	Fluvial	48.9	23.7	162
Willis	40–100 ft	Coastal	33.8	25.2	64
Willis	40–100 ft	Fluvial	21.1	14.2	119
Willis	100–600 ft	Coastal	26.2	14.6	17
Willis	100–600 ft	Fluvial	8.7	8.1	5
Upper Goliad	<20 ft	Coastal	27.6	20.9	18
Upper Goliad	<20 ft	Fluvial	65.4	32.0	6
Upper Goliad	20–40 ft	Coastal	25.5	20.6	224
Upper Goliad	20–40 ft	Fluvial	39.4	22.1	166
Upper Goliad	40–100 ft	Coastal	23.1	15.9	186
Upper Goliad	40–100 ft	Fluvial	16.1	11.9	82

Formation	Screen Length	Facies	K Mean	K Geometric Mean	Count
Upper Goliad	100–600 ft	Coastal	10.2	8.3	8
Upper Goliad	100–600 ft	Fluvial	14.7	3.1	9
Lower Goliad	<20 ft	Coastal	106.1	70.8	4
Lower Goliad	<20 ft	Fluvial	270.3	159.9	7
Lower Goliad	20–40 ft	Coastal	32.3	22.0	184
Lower Goliad	20–40 ft	Fluvial	97.7	35.0	52
Lower Goliad	40–100 ft	Coastal	17.0	12.6	202
Lower Goliad	40–100 ft	Fluvial	24.8	19.2	48
Lower Goliad	100–600 ft	Coastal	6.9	4.8	7
Lower Goliad	100–600 ft	Fluvial	16.7	16.7	1
Upper Lagarto	<20 ft	Coastal	230.7	79.4	36
Upper Lagarto	20–40 ft	Coastal	45.9	24.7	233
Upper Lagarto	40–100 ft	Coastal	19.5	13.6	242
Upper Lagarto	100–600 ft	Coastal	3.8	3.1	8
Lower Lagarto	<20 ft	Fluvial	155.1	82.4	86
Lower Lagarto	20–40 ft	Coastal	39.0	20.4	10
Lower Lagarto	20–40 ft	Fluvial	91.1	42.7	315
Lower Lagarto	40–100 ft	Coastal	12.5	10.4	38
Lower Lagarto	40–100 ft	Fluvial	18.2	10.7	221
Lower Lagarto	100–600 ft	Coastal	3.4	0.8	4
Lower Lagarto	100–600 ft	Fluvial	3.2	2.4	10
Middle Lagarto	<20 ft	Fluvial	145.2	79.8	103
Middle Lagarto	20–40 ft	Fluvial	69.2	30.0	362
Middle Lagarto	40–100 ft	Fluvial	19.8	12.0	209
Middle Lagarto	100–600 ft	Coastal	4.1	4.1	1
Middle Lagarto	100–600 ft	Fluvial	7.3	3.1	6
Oakville	<20 ft	Coastal	141.6	80.8	27
Oakville	20–40 ft	Coastal	41.7	21.0	204
Oakville	40–100 ft	Coastal	16.5	9.0	313
Oakville	100–600 ft	Coastal	5.7	4.2	33

For well groups with more than ten hydraulic conductivity values, hydraulic conductivity averages for the largest well screen bin (100 to 400 ft) were compared to hydraulic conductivity values obtained from similar analysis performed to support the development of the LCRB model (Young and others, 2009). (Figure 2-2 shows that there is considerable overlap in the domain covering this study area and the study area for the LCRB model.) Because the LCRB model included only model layers for the Beaumont, Lissie, Willis, Upper Goliad, and Lower Goliad formations, only five of the nine well screen groupings could be compared. Based on similar results for these five groups from this study and the LCRB model study (Young and others, 2016), the results from Young and others (2016) were used to guide the relationship between sand percent and-hydraulic conductivity.

Table 3-3 shows the breakpoints used in the LCRB model to estimate hydraulic conductivity assigned to a sand percentage based on a fluvial or a coastal deposition setting. As a rule, the hydraulic conductivity increases with sand percents. The interpolation of the hydraulic conductivity and sand percent is based on minimum and maximum values and values for the 25th, 50th, and 75th percentiles. Interpolation between the five breakpoints is linear. For example, to calculate values for the 37.5th percentile for fluvial deposits in the Beaumont formation, one would take the midpoint between the 25th and the 50th percentiles, which is the 37.5 percentile, and calculate a sand porosity of 57.5% and a formation hydraulic conductivity of 16.5 ft/day.

Table 3-4 shows the breakpoints used in the CGCBGWF to estimate hydraulic conductivity assigned to a sand percentage based on a fluvial or a coastal deposition setting. As a rule, the hydraulic conductivity values increase with increases in sand percents and the hydraulic conductivity values for the CGCBGWF are consistently that the hydraulic conductivity values for the LCRB Model for the same formation and sand percent.

Table 3-3. **Breakpoints used to calculate hydraulic conductivity as a function of sand percent by formation and depositional environment for the LCRB Model.**

Formation	Depositional Environment	Percentile									
		Minimum		25th		50th		75th		Maximum	
		K (ft/d)	Sand Percent (%)	K (ft/d)	Sand Percent (%	K (ft/d)	Sand Percent (%)	K (ft/d)	Sand Percent (%)	K (ft/d)	Sand Percent (%)
Beaumont	Fluvial	5	1	8	36	10	46	13	55	15	70
	Coastal	10	1	24	59	33	70	51	83	75	95
Lissie	Fluvial	7	1	11	52	12	60	20	66	30	88
	Coastal	5	1	14	55	20	66	30	77	50	96
Willis	Fluvial	5	1	8	44	13	58	24	69	35	94
	Coastal	5	1	8	42	13	56	20	66	35	84
Upper Goliad	Fluvial	5	1	9	45	13	55	16	62	20	99
	Coastal	5	1	7	41	11	53	17	59	25	82
Lower Goliad	Fluvial	5	1	8	36	10	45	13	55	15	93

Formation	Depositional Environment	Percentile									
		Minimum		25th		50th		75th		Maximum	
		K (ft/d)	Sand Percent (%)	K (ft/d)	Sand Percent (%	K (ft/d)	Sand Percent (%)	K (ft/d)	Sand Percent (%)	K (ft/d)	Sand Percent (%)
	Coastal	3.25	1	5	41	7	53	11	59	16	82
Upper Lagarto	Fluvial	3.25	1	5	36	7	45	8	55	10	93
	Coastal	2	1	3	41	4	53	7	59	10	82
Middle Lagarto	Fluvial	6	32	10	42	10	47	12	55	14	67
	Coastal	3	14	11	40	14	46	16	51	15	62
Lower Lagarto	Fluvial	3	31	4	35	10	38	13	42	25	50
	Coastal	3	17	5	35	5	41	8	45	12	57
Oakville	Fluvial	2	32	8	36	8	41	8	46	16	51
	Coastal	2	15	6	30	6	36	5	40	6	55

Table 3-4. Breakpoints used to calculate hydraulic conductivity as a function of sand percent by formation and depositional environment for the CGCBGWF Model.

Formation	Depositional Environment	Percentile									
		Minimum		25th		50th		75th		Maximum	
		K (ft/d)	Sand Percent (%)	K (ft/d)	Sand Percent (%	K (ft/d)	Sand Percent (%)	K (ft/d)	Sand Percent (%)	K (ft/d)	Sand Percent (%)
Beaumont	Fluvial	5	15	6	25	12	27	17	30	20	34
	Coastal	2	13	3	19	8	27	10	32	18	37
Lissie	Fluvial	8	20	18	39	25	46	30	55	32	65
	Coastal	3	22	5	29	12	33	14	39	17	50
Willis	Fluvial	6	19	6	31	10	42	18	52	40	69
	Coastal	4	17	8	25	9	33	10	44	24	70
Upper Goliad (Upper Most Portion)	Fluvial	4	30	5	41	6	48	21	51	27	64
	Coastal	2	7	5	24	6	36	10	47	22	67
Upper Goliad (Upper Portion)	Fluvial	4	30	8	37	12	46	17	57	23	70
	Coastal	6	13	6	31	7	44	13	51	18	67
Upper Goliad (Lower Portion)	Fluvial	3	30	4	43	14	47	19	51	28	66
	Coastal	2	19	6	37	5	45	11	53	21	68
	Fluvial	6	32	10	42	9	47	14	55	14	67

Formation	Depositional Environment	Percentile									
		Minimum		25th		50th		75th		Maximum	
		K (ft/d)	Sand Percent (%)	K (ft/d)	Sand Percent (%	K (ft/d)	Sand Percent (%)	K (ft/d)	Sand Percent (%)	K (ft/d)	Sand Percent (%)
Upper Goliad (Lower Most Portion)	Coastal	3	14	10	40	14	46	16	51	15	62
Lower Goliad (Upper Portion)	Fluvial	4	31	3	35	9	38	13	42	25	50
	Coastal	3	17	4	35	6	41	8	45	12	57
Lower Goliad (Middle Portion)	Fluvial	2	32	8	36	7	41	8	46	17	51
	Coastal	2	15	5	30	6	36	5	40	6	55
Lower Goliad (Lower Portion)	Fluvial	4	39	5	44	11	48	12	56	25	62
	Coastal	2	11	7	23	8	30	12	36	13	61
Upper Lagarto (Upper Portion)	Fluvial	2	13	4	19	6	23	10	30	13	34
	Coastal	3	10	6	15	8	18	8	25	9	49
Upper Lagarto (Lower Portion)	Fluvial	3	17	4	21	5	27	10	28	18	35
	Coastal	1	9	4	14	5	19	6	26	7	47
Middle Lagarto	Fluvial	2	16	3	24	3	28	5	36	7	43
	Coastal	1	6	3	14	5	17	5	25	6	43
Lower Lagarto	Fluvial	2	8	4	15	4	20	5	28	5	40
	Coastal	1	6	2	20	3	29	4	35	5	44
Oakville	Coastal	1	7	3	24	3	30	4	36	4	56

3.1.2 Aquifer Pumping Tests

One of the largest sets of existing aquifer pumping test data in the state is managed by the TCEQ PWS program. TCEQ has amassed numerous aquifer pumping tests because a long-term pumping test of about 36 hours is required by TCEQ to demonstrate the production capacity of a PWS well. In 2012, INTERA reviewed these files for five counties in the study area. From this analysis, INTERA (Young, 2012b, c, d, e, f, g, h) calculated 44 transmissivity values based on a Cooper-Jacob straight-line (Cooper and Jacob, 1946) analysis of the time drawdown data. **Figure 3-14** shows the location of these tests. Out of these tests, only the Upper Goliad Formation has ten or more tests with well screen lengths greater than 100 ft. **Table 3-5** lists the transmissivity values calculated for ten wells with well screen intervals greater than 250 ft that primarily intersect the Upper Goliad Formation. The hydraulic conductivity

values were calculated using the method used by Myers (1969). The average and geometric mean of the hydraulic conductivity values are 11.2 and 10.8 ft/day, respectively. Across these ten well screen locations, the estimated average sand percent is about 54%. These two sets of values compare favorably to the tabulated values for the 50th percentile in Table 3-3 for coastal deposits comprising the Upper Goliad Formation, which is a sand percentage of 55% and an average hydraulic conductivity of 13 ft/day. These two sets of values compare favorably to the tabulated values for the 50th percentile in Table 3-4 for coastal deposits comprising the Upper Goliad Formation, which has an average sand percentage of 47% and an average hydraulic conductivity of 11 ft/day.

Table 3-5. Aquifer Tests in wells with screen intervals greater than 250 feet that primarily intersect coastal deposits comprising the Upper Goliad Formation.

Public Well ID	Total Length of Well Screen (ft)	Transmissivity (ft^2/day)	Average Hydraulic Conductivity (ft/day)
G2350002D	368	4,437	12
G2350014B	450	6,337	14
G2350002A	558	6,018	11
G2350002B	585	6,461	11
G2350002I	588	7,480	13
G2350002J	590	10,088	17
G2350002G	614	5,468	9
G2350002F	616	6,712	11
G2350002M	640	3,786	6
G2350002H	644	5,601	9

3.2 Porosity

Porosity is the volume of the void space of a geologic material divided by the total volume of the material. A fully saturated soil or geologic unit is one where all porosity of the material is filled with water. Because of the different minerals and particles that comprise sands and clays, the two lithologies have different porosities and different compressibility properties with increased geostatic pressure.

Estimates for clay porosity are based on laboratory measurements of porosity and compressibility reported by the USGS for three study areas near Houston, Texas (Gabrysch and Bonnet; 1974, 1976a, 1976b). Kelley and others (2018) used consolidometer test data from these USGS study to develop **Equation 3-3** to express porosity a depth of burial for clay. A presumption with the application of Equation 3-3 is that above a depth of 100 ft, the clay porosity is 50%.

$$n = 1.4485D^{-0.233} \qquad \text{(Equation 3-3)}$$

Where:

D = for depth below ground surface greater than 100 ft
n = porosity

Estimates for sand porosity are based on analysis of neutron-density logs from 34 geophysical logs located through the Gulf Coast Aquifer System. At each log, 10 to 20 porosity measurements were made at depths ranging from the surface to almost 8,000 ft, although most measurements were less than 5,000 ft deep. The data show a decrease in porosity with depth that is expressed by **Equation 3-4**, which is identical to Equation 2-4. Equation 3-4 is similar and agrees with several previous studies. Equation 3-4 indicates that porosity decreases about one percent every 1,000 feet of depth. Wallace and others (1972) reported a decrease of 0.95 and 0.85% in porosity every 1,000 ft in the for the Rio Grande and Houston embayment, respectively. Loucks and others (1986) reported a range of 1.28 to 2.05% decrease in porosity for every 1,000 ft of depth for the southern, central, and northern portion of the Frio Formation in the Texas Gulf Coast Aquifer System.

$$\Phi = 36.64 - 0.001 * d \qquad \text{(Equation 3-4)}$$

Where:

Φ = porosity

d = depth (feet)

Table 3-6 tabulates the change in porosity with depth for clays and sands based on Equations 3-2 and 3-4, respectively. **Figure 3-15** illustrates porosity changes with depth. At ground surface, sand and clay have porosities of about 37% and 50%, respectively. At a depth of 385, the sand and clay have the same porosity of 36.2%. For depths greater than 385 ft, sand has a greater porosity than clay. At a depth of 6,000 ft, the porosity of sand and clay are 36.2 and 34.5%, respectively.

Table 3-6. **Estimated porosity values for sand, clay, and a deposit consisting of equal mixture of sand and clay as a function of depth.**

Depth (ft)	Porosity		
	Sand Porosity (%)	Clay Porosity (%)	Porosity_50_Sand% (%)
100	37	50	43
200	36	42	39
400	36	36	36
800	36	31	33
1,200	35	28	32
1,600	35	26	31
2,000	35	25	30
2,500	34	23	29
3,000	34	22	28
3,500	33	22	27
4,000	33	21	27

Depth (ft)	Porosity		
	Sand Porosity (%)	Clay Porosity (%)	Porosity_50_Sand% (%)
4,500	32	20	26
5,000	32	20	26
5,500	31	19	25
6,000	31	19	25

3.3 Specific Storage

Specific storage represents how changes in the hydraulic pressure in a formation affects the volume of space occupied by a certain quantity of groundwater under *confined* conditions. Specific storage and aquifer thickness determine aquifer storativity for confined conditions. Specific storage values were developed using the method of Young and others (2009) for calculating specific storage values for evaluating the impacts of pumping brackish groundwater. This methodology is based on the relationship in **Equation 3-5** (Shestakov, 2002) based on geomechanical considerations.

$$Ss = A / [D + z0] \quad \text{(Equation 3-5)}$$

Where

Ss = specific storage (dimensional analysis is per length)
A = calibrated parameter, which is a function of [1/(1+e)]
D = depth (dimensional analysis is length)
z0 = calibrated parameter

The Shestakov model assumes a power-law relationship between porosity and depth, where the decrease is more pronounced at shallower depth than is allowed by a linear relationship between porosity and depth. The power-law relationship is consistent with the Magara (1978) observation that the rate of porosity decrease is fast at shallow depths and slows down with greater depths of burial. Applications of the Shestakov model for estimating specific storage values include the Northern Trinity and Woodbine GAM (Kelly and others, 2014), the Yegua-Jackson GAM (Deeds and others, 2010), and the LCRB Model (Young and others, 2009; Young and Kelley, 2006).

For this study, **Equation 3-6** is used to estimate specific storage. Equation 3-6 is based on Shestakov's model and was developed for the LCRB model (Young and others, 2009; Young and Kelley, 2006). Equation 3-6 was implemented using the parameters in **Table 3-7**. **Figure 3-16** compares the relationship between specific storage and depth predicted by Equation 3-6 and values of specific storage assembled by Young and Kelly (2006) for the LCRB study area.

$$S_s = S_{s_{min}} + \left\{ \frac{A * [SF + CM * (1 - SF)]}{Z0 + [DM * D^{(DE)}]} \right\} \quad \text{(Equation 3-6)}$$

Where

$S_{s_{min}}$ = minimum value of specific storage
SF = Sand fraction
CM = Clay multiplier
DE = depth exponent
DM = depth multiplier

Table 3-7. Parameters used in Equation 3-6 in the LCRB model (Young and others, 2009) to estimate specific storage.

Parameter	Value
Ss_{min}	0.00000001
A1	0.003
CM	2.0
A2	100
DM	10
DE	0.75

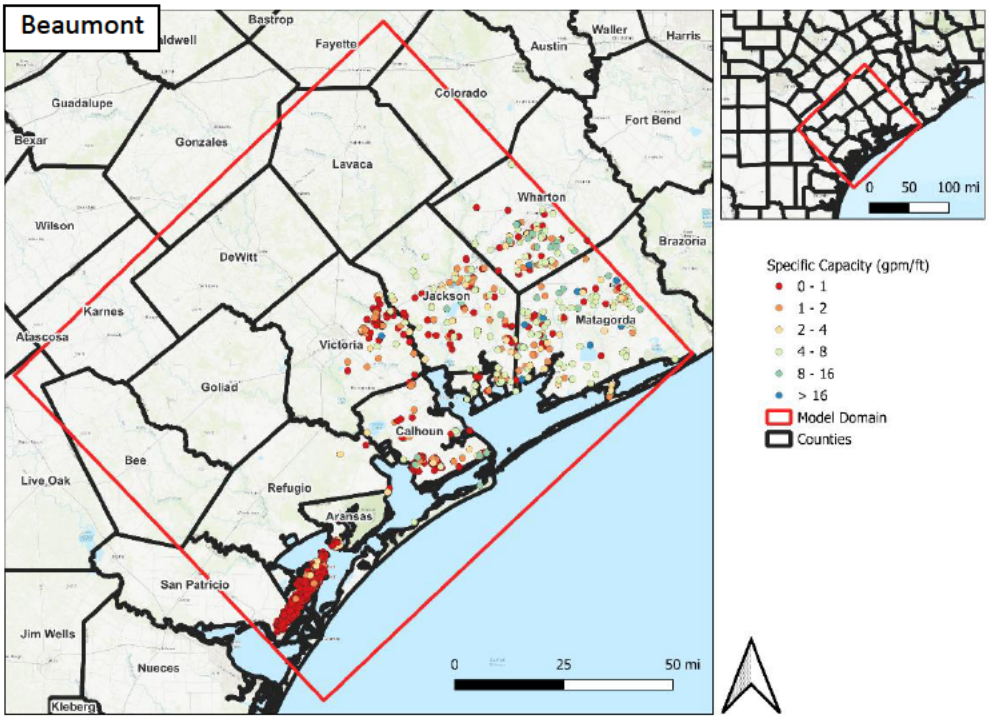


Figure 3-1. Location of specific capacities calculated from driller logs for wells installed in the Beaumont Formation.

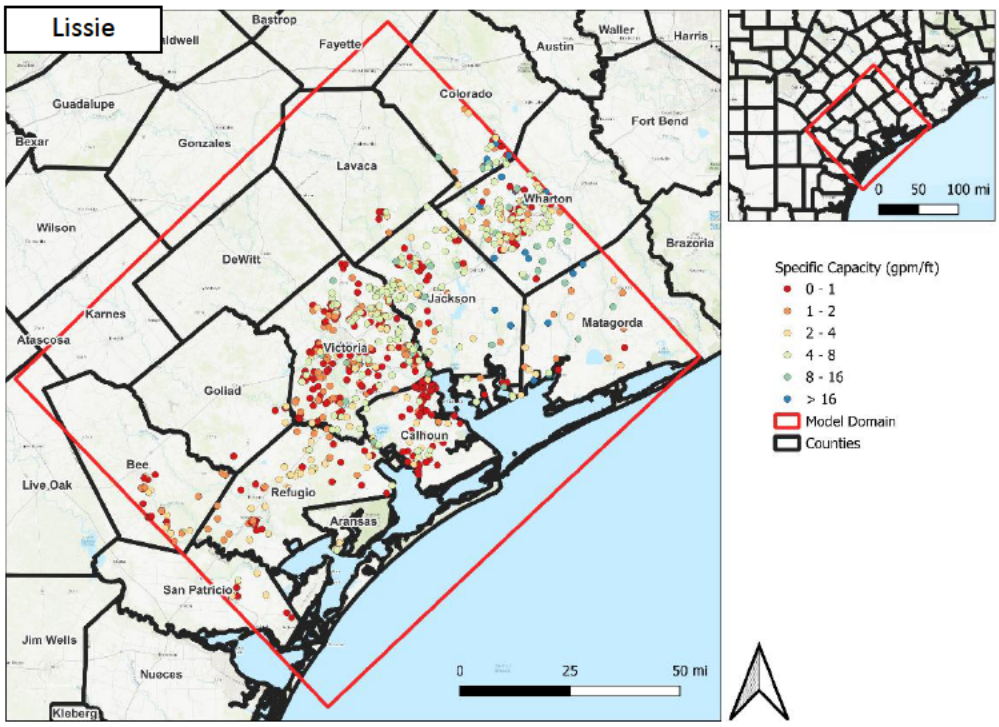


Figure 3-2. Location of specific capacities calculated from driller logs for wells installed in the Lissie Formation.

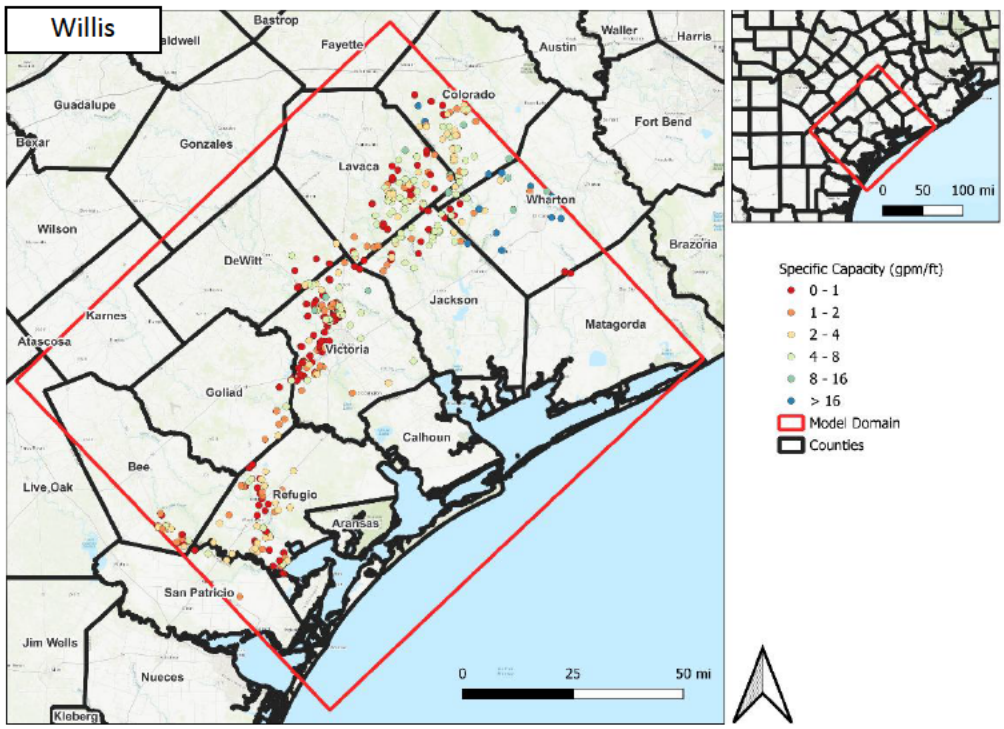


Figure 3-3. Location of specific capacities calculated from driller logs for wells installed in the Willis Formation.

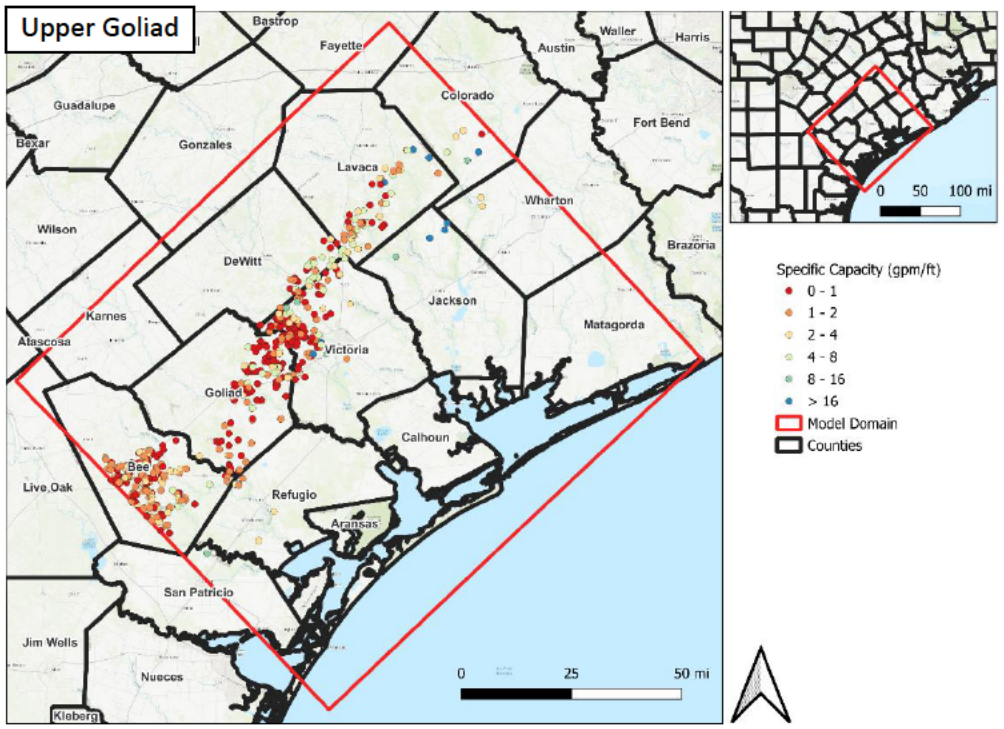


Figure 3-4. Location of specific capacities calculated from driller logs for wells installed in the Upper Goliad Formation.

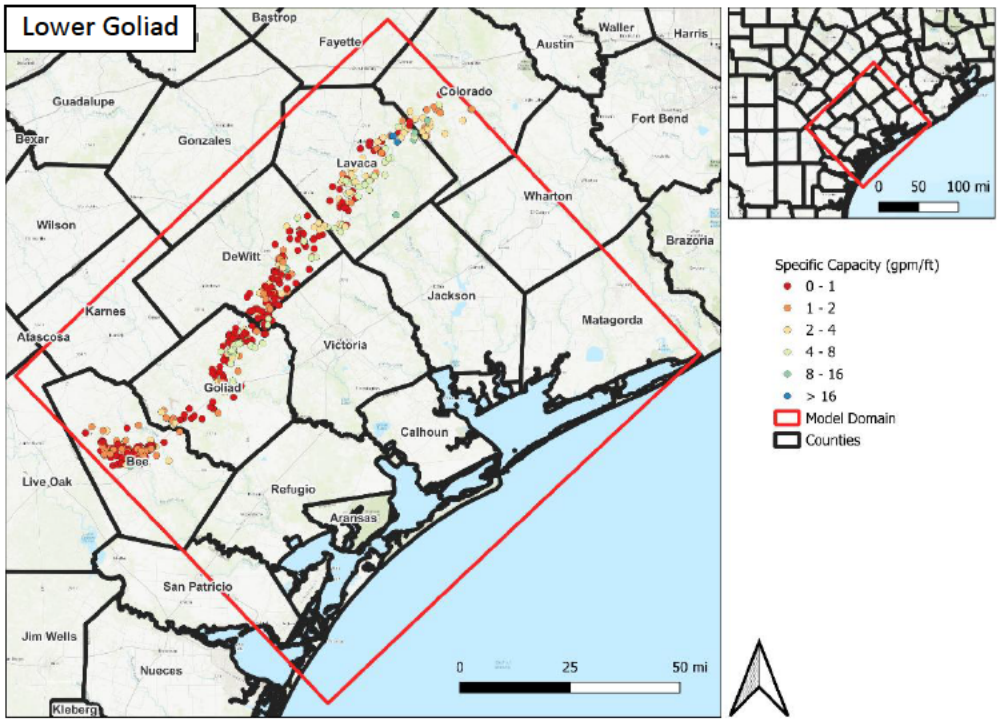


Figure 3-5. Location of specific capacities calculated from driller logs for wells installed in the Lower Goliad Formation.

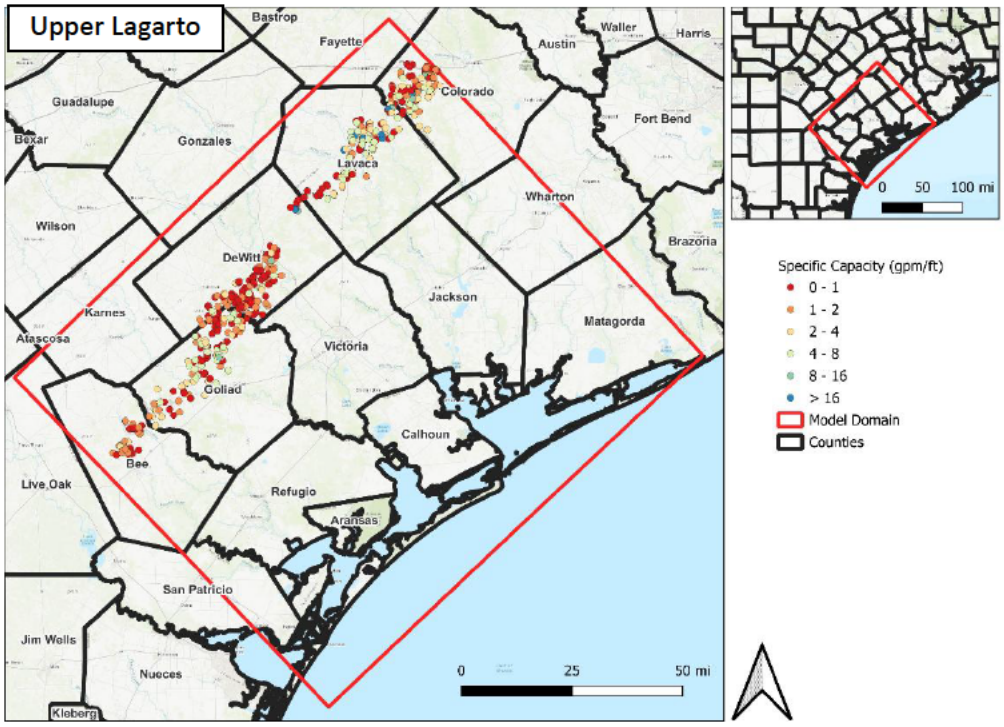


Figure 3-6. Location of specific capacities calculated from driller logs for wells installed in the Upper Lagarto Formation.

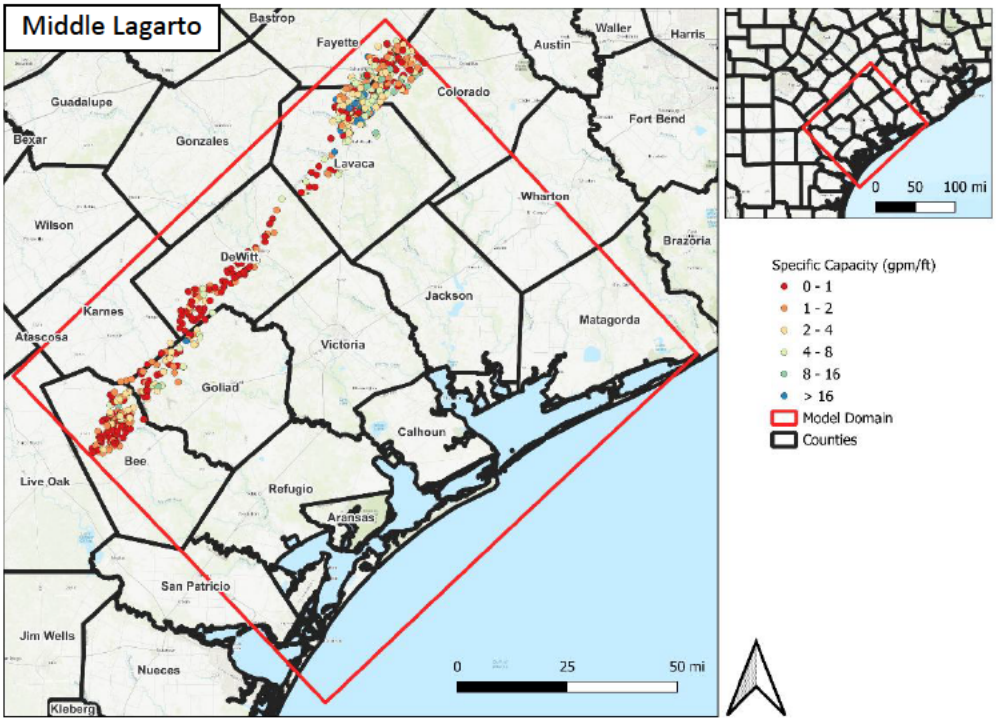


Figure 3-7. Location of specific capacities calculated from driller logs for wells installed in the Middle Lagarto Formation.

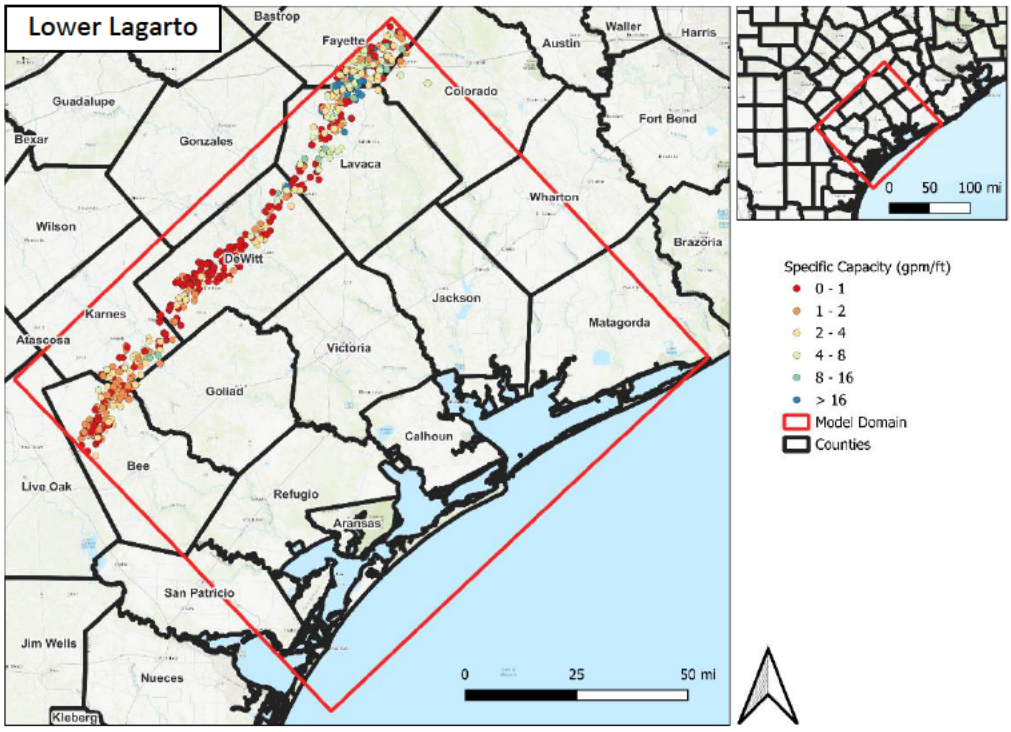


Figure 3-8. Location of specific capacities calculated from driller logs for wells installed in the Lower Lagarto Formation.

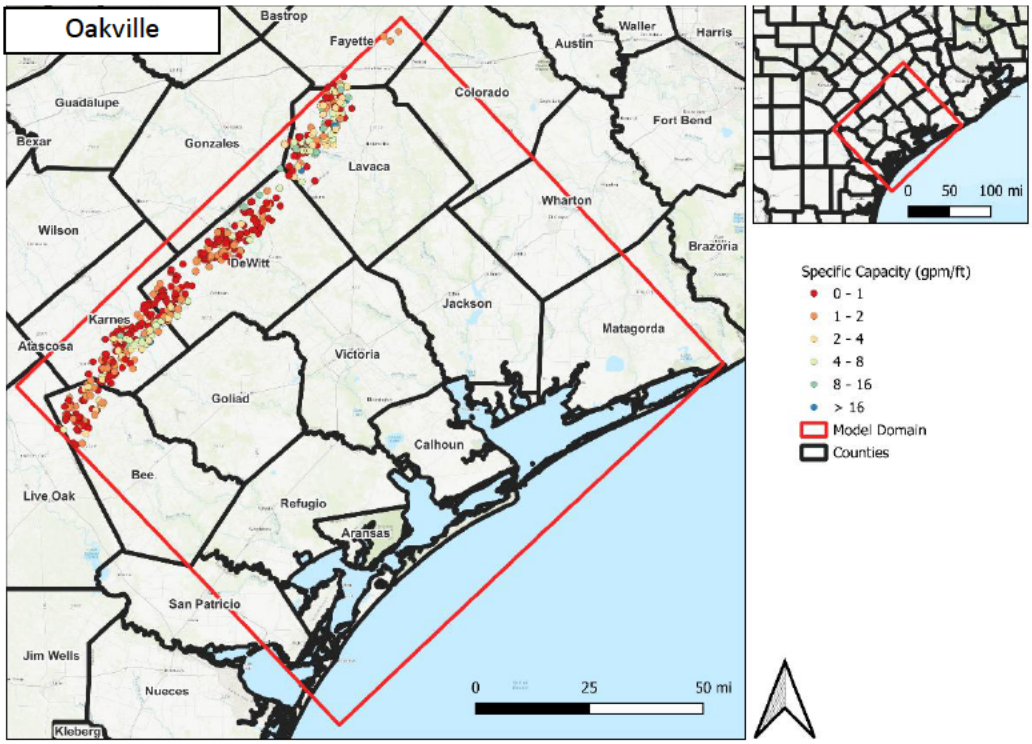


Figure 3-9. **Location of specific capacities calculated from driller logs for wells installed in the Oakville Formation.**

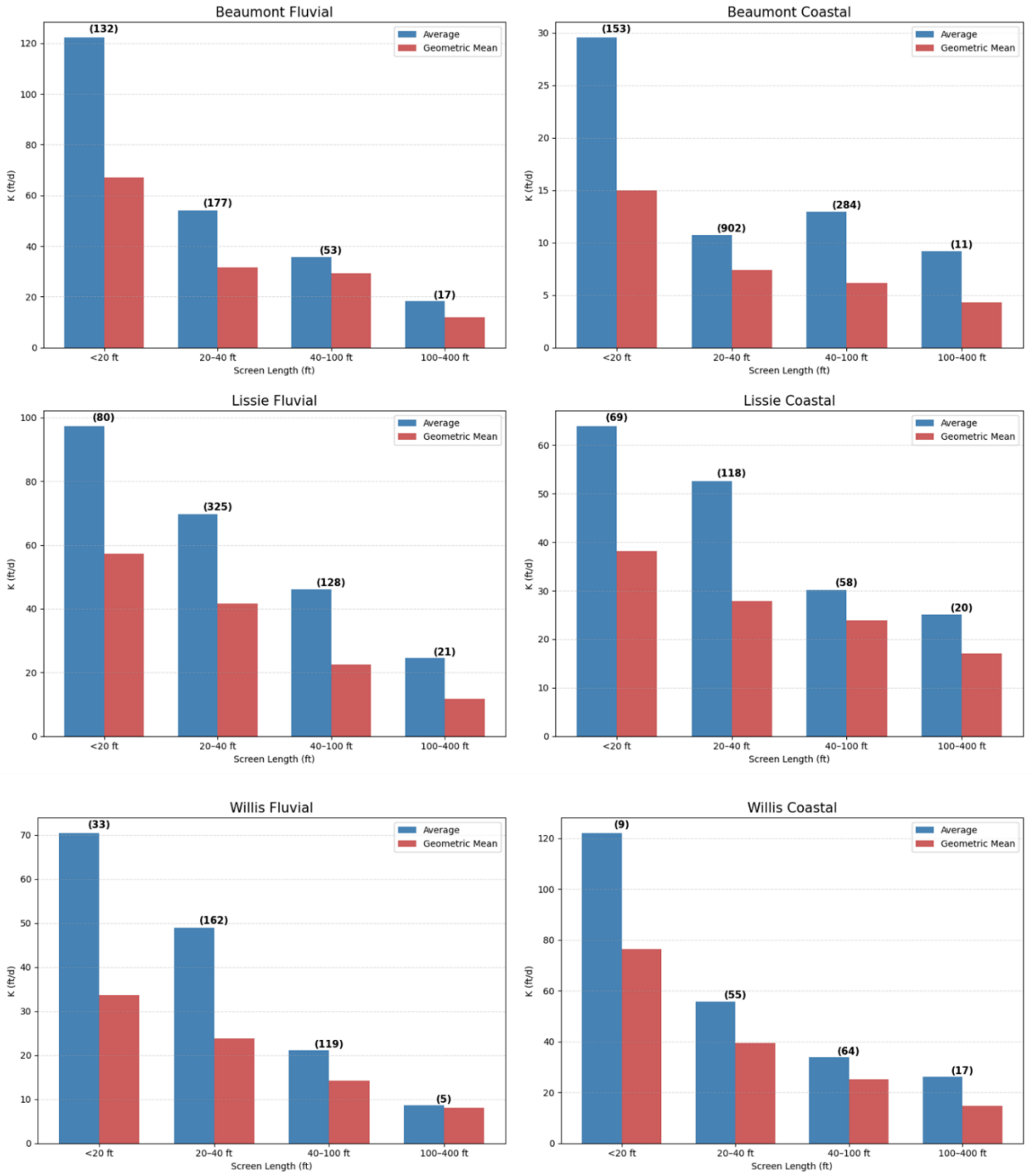


Figure 3-10. Location of aquifer pumping tests performed in Public Supply Wells in the study area.

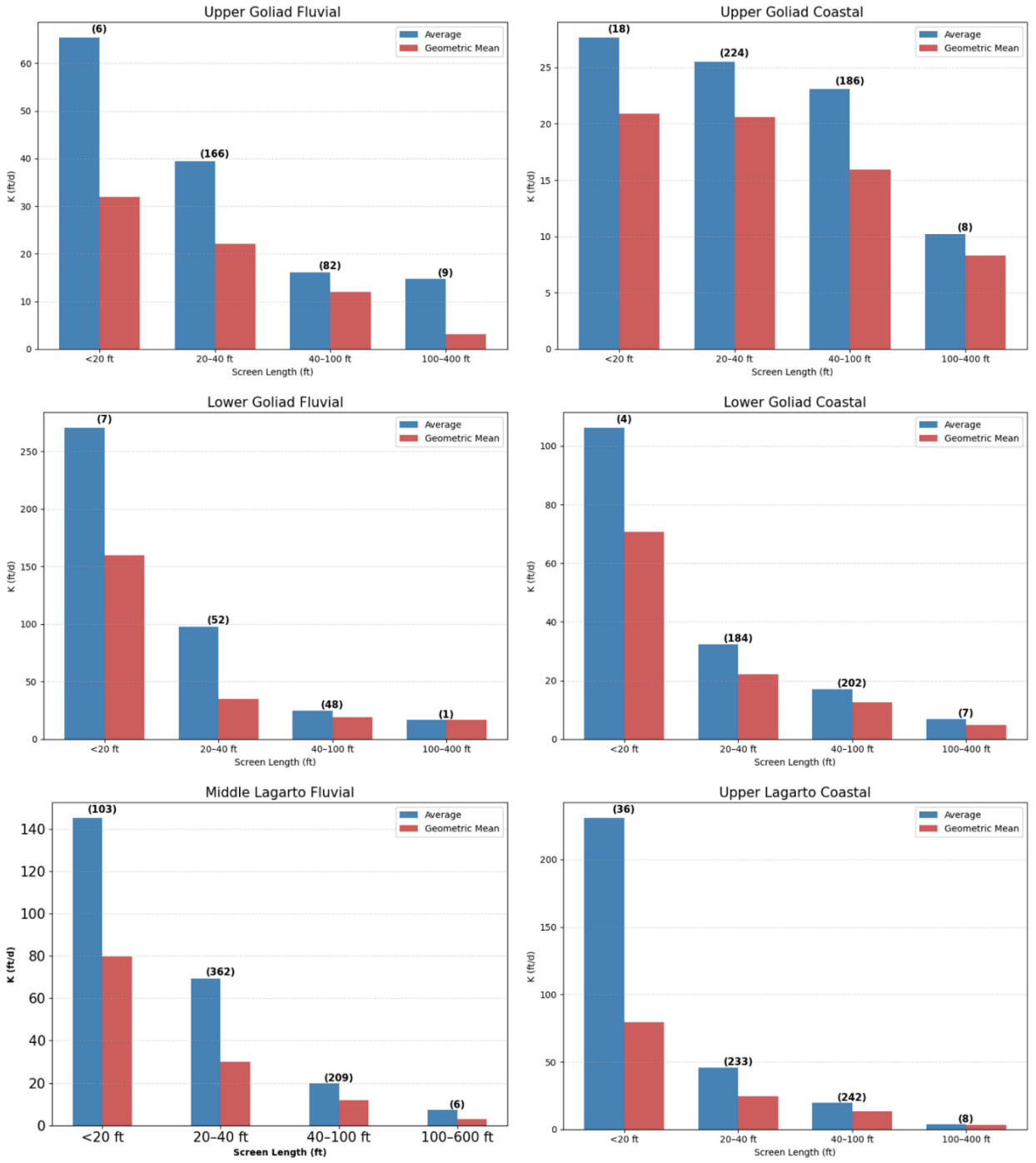


Figure 3-11. Sensitivity of calculated hydraulic conductivity to length of well screen for formations that comprise the Chicot Aquifer in the study area.

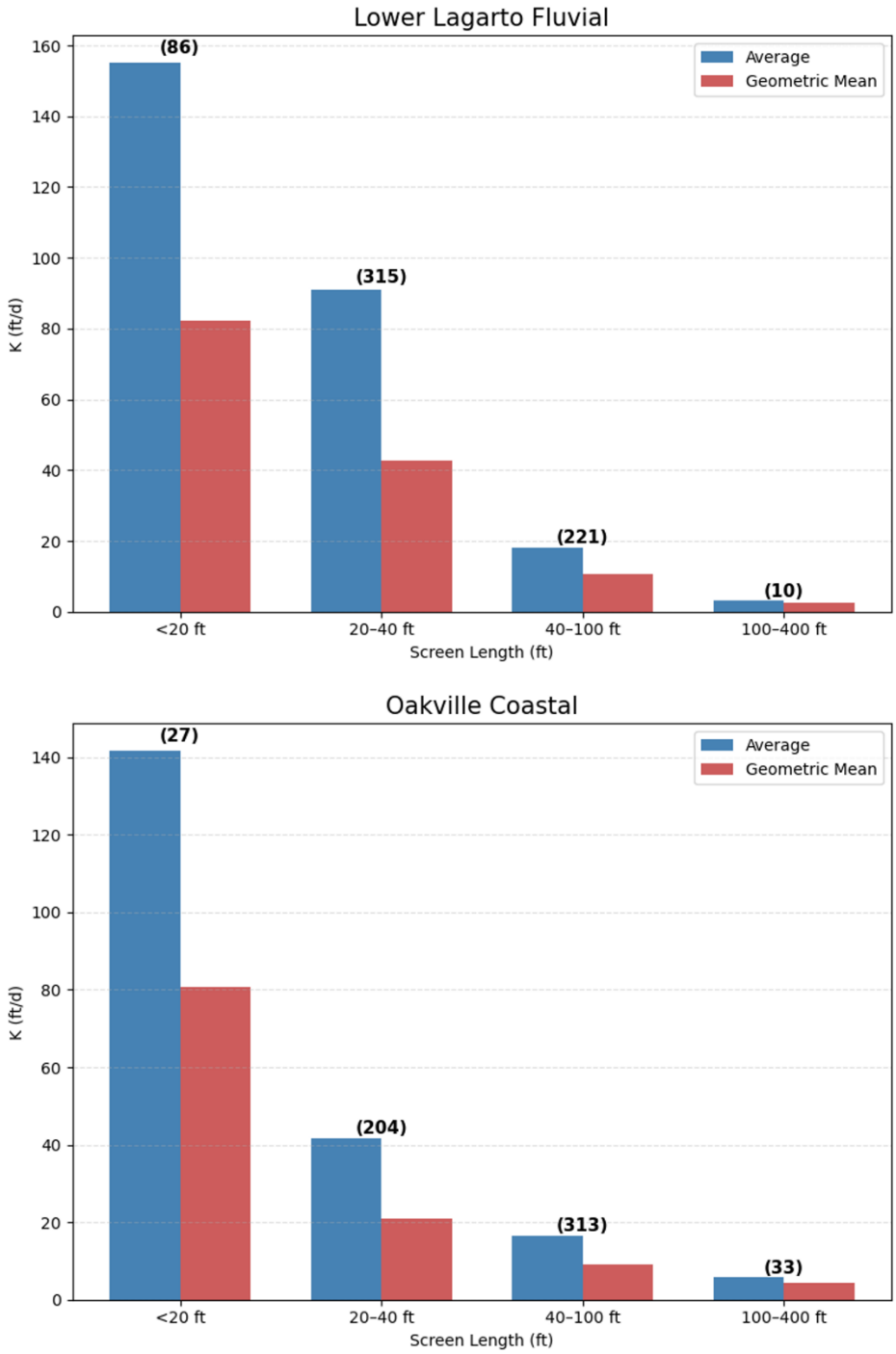


Figure 3-12. Sensitivity of calculated hydraulic conductivity to length of well screen for formations that comprise the Evangeline Aquifer and the Middle Lagarto Formation in the study area.

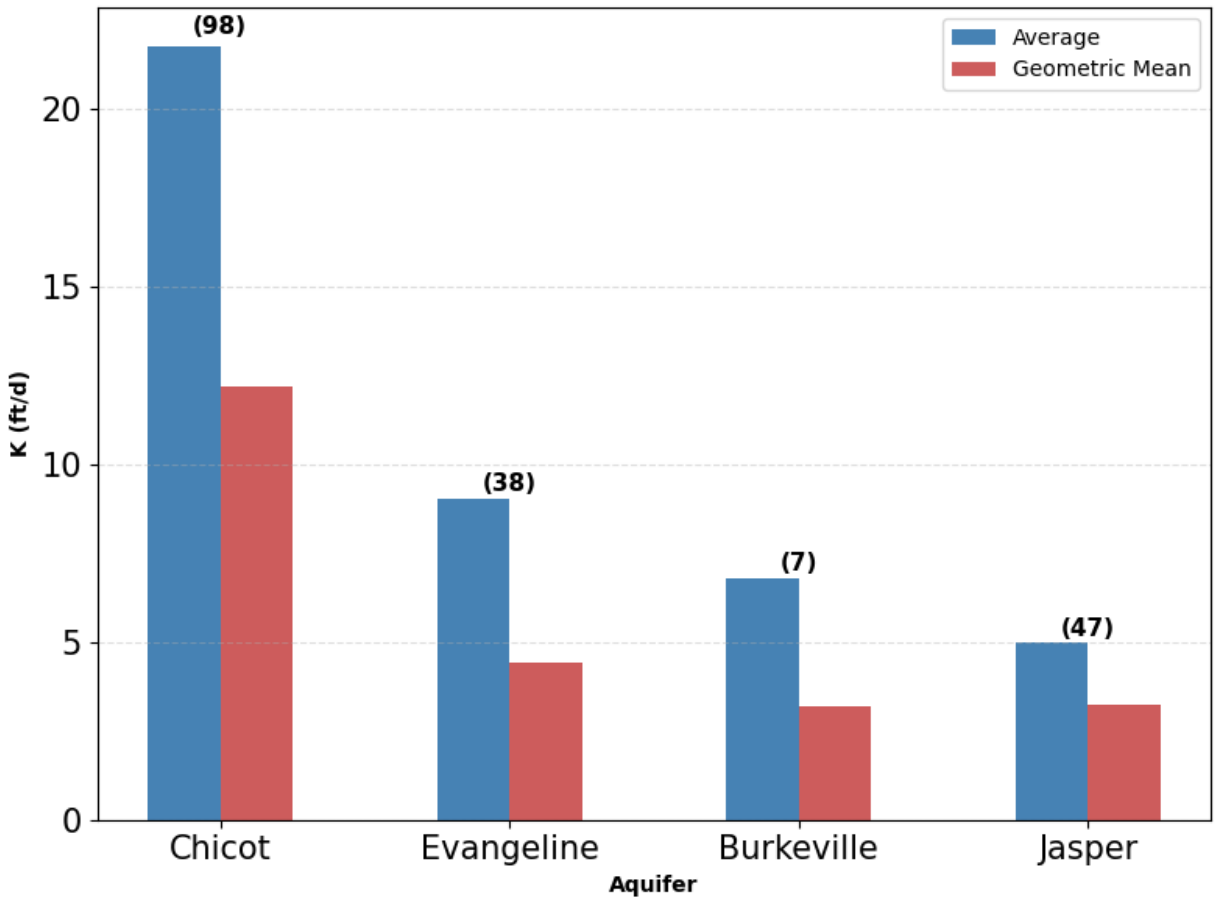


Figure 3-13. The mean and geometric mean by aquifer calculated from specific capacity tests.

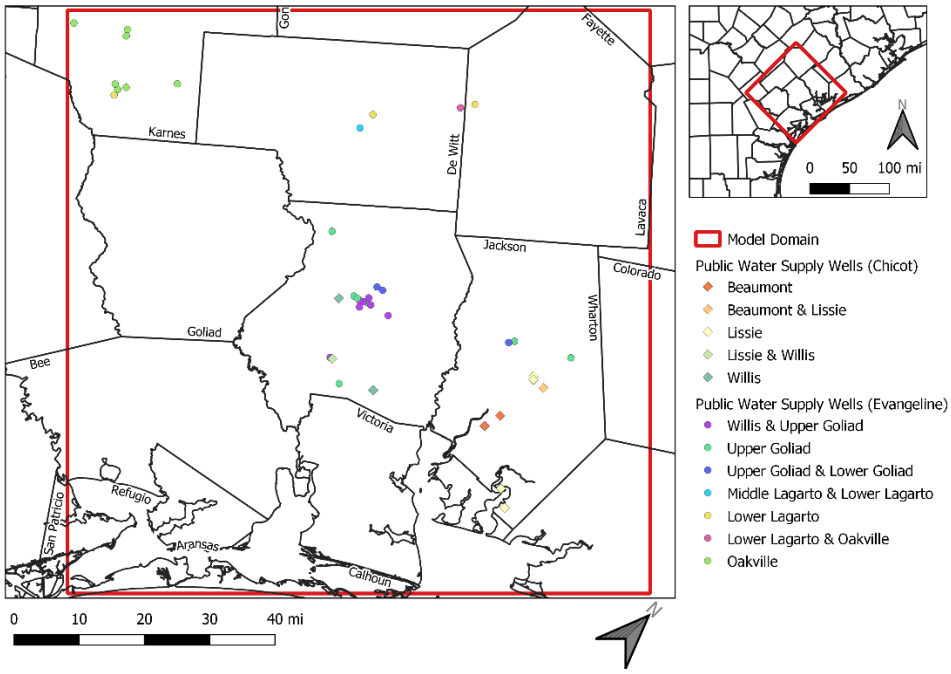


Figure 3-14. Location of aquifer pumping tests performed in Public Supply Wells in the study area.

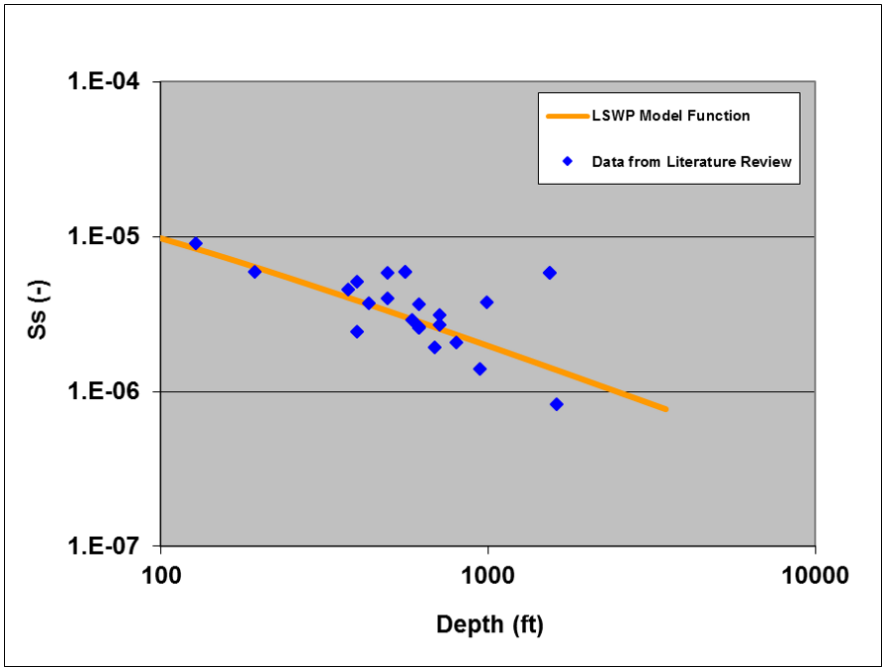


Figure 3-15. Field data for specific storage as a function of depth used to develop a regression for estimating specific storage as a function of depth for the LCRB model (Young and others, 2006).

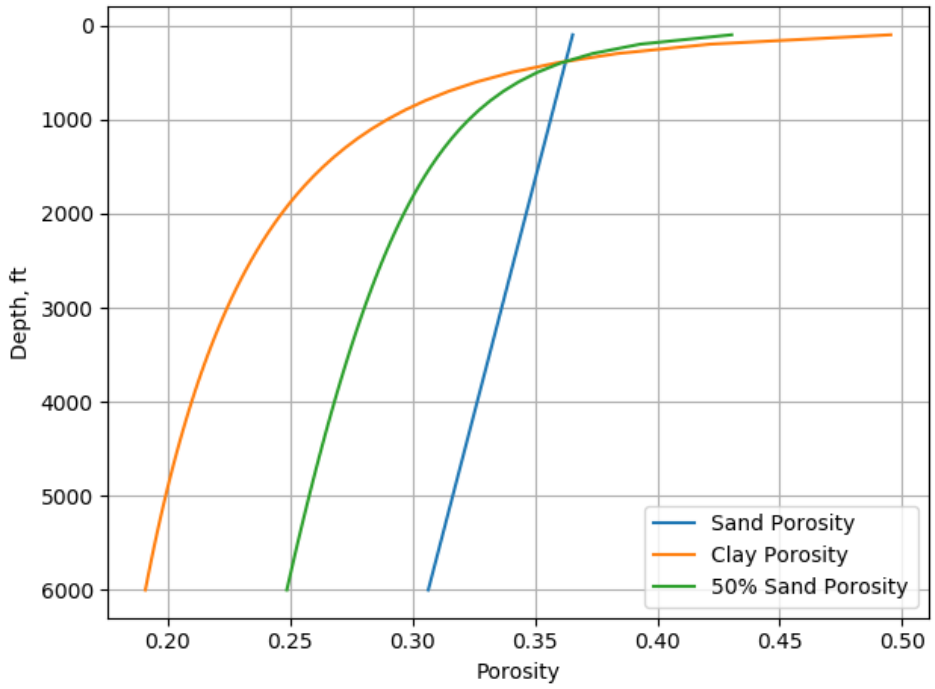


Figure 3-16. Semi-empirical relationship for determining specific storage based on Shestakov (2002) compared to specific storage calculated from aquifer pumping tests (from Young and others, 2016).

4.0 Development and Application of a Groundwater Flow Model

4.1 Construction of Groundwater Flow Model Grid

A three-dimensional groundwater flow model was developed using the MODFLOW 6 code (Hughes and others, 2017). The areal extent and horizontal numerical grid for the model is shown in **Figure 4-1**. The model covers an area of 11,730 square miles and includes a portion of 19 counties. The model domain has been discretized using an unstructured grid consisting of 24,294 cells in a horizontal layer. Across most of the model domain, grid cells are represented by 1-mile by 1-mile squares. In the area of Victoria, Jackson, Refugio, and Calhoun counties, grid cells are represented by 0.5-mile by 0.5-mile squares. The model extends to a depth of about 13,200 feet along the coast and includes the nine formations listed in Table 2-1 that comprise the Chicot Aquifer, Evangeline Aquifer, Burkeville Confining Unit, and the Jasper Aquifer. The model uses 15 layers to represent these nine formations.

Figure 4-2 shows the 15 model layers along a northwest-southeast cross-section through the CGCBGWF Model grid cells. The model layers were constructed using the formation surfaces provided by Young and others (2010). Six of the formations, including Beaumont, Lissie, Willis, Middle Lagarto, Lower Lagarto, and Oakville, are each represented by a single model layer. The Upper Goliad, Lower Goliad, and Upper Lagarto formations are represented by four, three, and two model layers, respectively. Additional model layer resolution was used for these three formations for two reasons. One reason is that most of the brackish groundwater occurs in the Evangeline Aquifer. The second reason is that the formations that comprise the Evangeline Aquifer are significantly thicker than the other formations. The Evangeline formations were subdivided with the goal to obtain model layers with nearly equal thickness.

4.2 Hydraulic Properties in the Groundwater Flow Model

This subsection describes the data and methodologies used to determine the hydraulic properties for the groundwater flow model. The hydraulic properties include horizontal hydraulic conductivity, vertical hydraulic conductivity, transmissivity, specific storage, specific yield, and porosity.

4.2.1 Horizontal Hydraulic Conductivity

The horizontal hydraulic conductivity value for each model grid cell was calculated based on a combination of the methodologies used to generate the hydraulic conductivity values for LCRB groundwater flow model (Young and others, 2009) and groundwater flow models used to simulate the pumping of brackish groundwater in the Texas Gulf Coast (Young and others, 2016). Both of these groundwater models calculate hydraulic conductivity values based on the sand percent of the model grid and adjust the hydraulic conductivity value based on the depth the grid block is below ground surface. The horizontal hydraulic conductivity values for the CGCBGWF Model were calculated using **Equation 4-1**. The depth adjustment for Equation 4-1 is performed in two steps.

$$K_H = K_{sand} * A_{depth} \qquad \text{(Equation 4-1)}$$

where

K_H = horizontal hydraulic conductivity of the grid cell based on the sand percent in the grid cell and application relationship between sand percents and hydraulic conductivity expressed by the values in Table 3-4.

K_{sand} = hydraulic conductivity calculated based on sand percent calculated from relationships determined from Table 3-4

A_{depth} = adjustments to depth of burial accounts for the change in the viscosity and density of water with temperature increases with depth and reduction in porosity caused by increases in consolidation with depth

Equation 4-1 includes a temperature adjustment because hydraulic conductivity is a function of the density and viscosity of water, which are temperature-dependent, and groundwater temperature varies with depth. **Equation 4-2** (Freeze and Cherry, 1979) shows how hydraulic conductivity is dependent on the density and viscosity of water. **Figure 4-3** shows how hydraulic conductivity will increase with increases in temperature from 32 to 180 °F. This increase occurs primarily because the dynamic viscosity of water decreases with increases in temperature. To estimate the change in temperature with depth, we use the same assumptions used by the TWDB report (Young and others, 2016) that model the production of brackish groundwater near Victoria County. For their groundwater model application in Victoria County, Young and others (2016) presume shallow groundwater across the Texas Gulf Coast Aquifer System is 77 °F and a geothermal gradient of about 20 °F per 1,000 ft, or about 100 °F per 5,000 ft. Based on Figure 4-3, the increase in temperature from about 80 to about 180 °F will cause an increase in the hydraulic conductivity of approximately 140%, which translates to approximately 0.028% increase per one foot of depth. This relationship is expressed by Equation 4-2.

$$K = k*\rho*g/\mu \qquad \text{(Equation 4-2)}$$

Where:

K = hydraulic conductivity of media (dimensional analysis is length per time)
k = intrinsic permeability of media (dimensional analysis is length squared)
ρ = density of fluid (dimensional analysis is mass per length cubed)
g = gravitational constant (980.6 square centimeters per second)
μ = dynamic viscosity of fluid (dimensional analysis is mass per length times time)

$$A_{temp} = (1 + D*0.00028) \qquad \text{(Equation 4-3)}$$

Where:

A_{temp} = change in hydraulic conductivity as a function of depth because of a change in temperature of the groundwater

D = depth (dimensional analysis is length)

Equation 4-1 includes a porosity correction because porosity is depth dependent as discussed in Section 3.3. Several comprehensive reviews of field measurements (Nelson, 1994; Magara, 1978; Loucks and others, 1986) provide compelling evidence that the permeability of a formation decreases with decreasing formation porosity. Loucks and others (1984) provide a comprehensive summary of laboratory tests on cores from 253 wells located in the Gulf Coast Aquifer System to demonstrate a general relationship between a decrease in permeability and porosity with depth. Among their findings

is that the sandstone porosity reduction rate remains relatively constant from a depth of a few hundred feet to over 10,000 feet.

Figure 4-4 shows data compiled by Loucks and others (1986) from the Catahoula Formation (also known as the Frio formation) and other aquifers along the Texas Gulf Coast Aquifer System. Figure 4-4 shows that there is a log-linear relationship between the decrease in porosity and decrease in intrinsic permeability. Intrinsic permeability is plotted instead of hydraulic conductivity because intrinsic permeability is invariant with the properties of the liquid. The data in Figure 4-4 represent approximately a reduction in porosity of 10% correspondence to approximately a 30-fold reduction in permeability. The ratio was used to develop **Equation 4-4**, which was used by Young and others (2016) to account for how a reduction in porosity in the Gulf Coast Aquifer System translates into a reduction hydraulic conductivity. **Equation 4-5** shows that the combined adjustment to hydraulic conductivity for A_{depth}, is the product of $A_{porosity}$ and A_{temp}. **Table 4-1** shows provides several example calculations showing the process involved with determining the horizontal hydraulic conductivity for a grid cell.

$$A_{porosity} = 10^{-0.000148*depth} \quad \text{(Equation 4-4)}$$

$$A_{depth} = A_{porosity} * A_{temp} \quad \text{(Equation 4-5)}$$

Where

$A_{porosity}$ = change in hydraulic conductivity as a function of depth because of a change in porosity caused by increases in the geostatic loading

depth = depth in feet

Table 4-1. **Example calculations illustrating adjustments to horizonal hydraulic conductivity values to account for changes in increases in temperature and decreases in porosity with depth.**

Formation	Depostional Setting	Sand percent	Depth of Burial (ft)	Baseline Hydraulic Conductivity (ft/dy)	Adjustments for Changes with Temperature and Porosity			Final Hydraulic Conductivity (ft/dy)
					A_{temp}	$A_{porosity}$	A_{depth}	
Upper Goliad	Coastal	25%	100	10	1.028	0.966	0.994	9.9
Upper Goliad	Coastal	37.5%	500	12	1.140	0.843	0.961	11.5
Upper Goliad	Coastal	50%	1000	14	1.280	0.711	0.910	12.7
Upper Goliad	Coastal	75%	3000	15	1.840	0.360	0.662	9.9

4.2.2 Transmissivity

Transmissivity is calculated by multiplying the saturated thickness of the aquifer by the horizontal hydraulic conductivity (**Equation 4-6**).

$$T = b * K_h \quad \text{(Equation 4-6)}$$

where

T = transmissivity (volume of water per width per time)
b = thickness of the aquifer (length)
K_h = horizontal hydraulic conductivity (volume of water per area per time)

4.2.3 Vertical Hydraulic Conductivity

The physical properties of a deposit that affect the hydraulic conductivity include the size, arrangement, and geometry of the subsurface sediments comprising the deposit as well as the amount of compaction and cementation that the deposit has experienced. Because the arrangement and geometry of the subsurface materials have a directional component, the value of hydraulic conductivity changes with direction. The vertical hydraulic conductivity is measured perpendicular to the direction of horizontal hydraulic conductivity.

In the Gulf Coast Aquifer System, the vertical hydraulic conductivity of groundwater is less than horizontal hydraulic conductivity, meaning that water moves more quickly and easily in the horizontal direction. Vertical anisotropy is usually defined as the ratio of K_h (horizontal hydraulic conductivity) to K_v (vertical hydraulic conductivity), or K_h/K_v. In the Gulf Coast Aquifer System, the vertical hydraulic conductivity of groundwater is less than horizontal hydraulic conductivity, meaning that water moves more quickly and easily in the horizontal direction.

At a much larger scale of several miles and greater, vertical anisotropic ratios can be greater than 100:1 (Maidment, 1992), meaning that horizontal hydraulic conductivity can be greater than 100 times vertical hydraulic conductivity. The GAMs for the Gulf Coast Aquifer System (Hutchison and others, 2011; Kasmarek, 2012; and Chowdhury and others, 2004) have K_h/K_v values for Chicot, Evangeline, and Jasper aquifers that are greater than 1,000. At the scale of aquifers and regional groundwater flow, the differences between the horizontal and vertical hydraulic conductivities are largely controlled by the layering of sediments deposited by different depositional environments. For example, if an aquifer is comprised of alternating layers of relatively permeable sands associated with beach deposits and of relatively impermeable clays associated with lagoon deposits, then the vertical anisotropy across the entire aquifer thickness will be greater than 1,000 because the effective K_h for the aquifer is primarily controlled by the K_h of the sand layers, but the effective K_v for the aquifer is primarily controlled by the K_v of the clay layers.

This method to calculate vertical hydraulic conductivity is given in **Equation 4-7**, **Equation 4-8**, and **Equation 4-9**. The calculation involves sand and clay percentage, vertical hydraulic conductivity of sand and clay deposits, and the depth of the deposit. The three equations use a weighted harmonic mean of vertical conductivity values for sand and clay that are adjusted for depth. The use of an harmonic mean to calculate effective vertical hydraulic conductivity (Freeze and Cherry, 1979) has been used to develop GAMs (Deeds and others, 2003; Dutton and others, 2003) and other regional models funded by the TWDB in the Gulf Coast (Young and others, 2016) and in the Carrizo-Wilcox (Hamlin and others, 2016).

$$K_v = P / [(P_s / K_{vs}) + (P_{c_1\text{-}5ft} / K_{vc_1\text{-}5ft} * 10^{pro_tz * D}) + (P_{c_5ft} / (K_{vc_5ft} * 10^{pro_tz * D}))] \quad \text{(Equation 4-7)}$$

$$P = P_s + P_{c_1\text{-}5ft} + P_{c_5ft} \quad \text{(Equation 4-8)}$$

$$P_{c_1\text{-}5ft} = P_{c_1ft} - P_{c_5ft} \quad \text{(Equation 4-9)}$$

where:

P = percent of a deposit
P_s = percent of sand deposits
P_{c_1ft} = percent of 1-foot clay deposits

P_{c_5ft} = percent of 5-foot clay deposits
$K_{vc_1\text{-}5ft}$ = vertical hydraulic conductivity of clay deposits less than 5 feet thick
K_{vc_5ft} = vertical hydraulic conductivity of clay deposits greater than 5 feet thick
pro_tz = a depth adjustment similar based on Equation 4-4
D = depth
K_v = effective vertical hydraulic conductivity of sand and clay deposit
K_{vs} = vertical hydraulic conductivity of sand

The decrease in the hydraulic conductivity of the clay is based on a linear-log relationship (Neglia, 2004; Kelly and others, 2018) similar to that shown in **Figure 4-5**. Figure 4-5 shows that the hydraulic conductivity of clay decreases by a factor of 10 for every 4,000 ft increase in depth. For our study, we adopt the relationship used by the LCRB model, which is that the hydraulic conductivity of clay reduces 10-fold for every 3,500 ft increase in depth.

4.2.4 Specific Storage, Specific Yield, and Porosity

The specific yield for the aquifers was set to 0.10 based on a review of the specific yield used in the LCRB model and the groundwater availability model for the central Gulf Coast Aquifer System (Chowdhury and others, 2004). The specific storage and porosity values were based on equations that considered difference in sand and clay percentages and the effect of depth of burial. The specific storage values were calculated using Equation 3-6. Porosity values were calculated using Equations 3-3 and 3-4.

4.3 Brackish Production Zones

To help facilitate the placement of potential brackish well fields, the salinity zones in each model layer are provided in **Figures 4-6** through **4-20** The salinity distribution was created by interpolation of the brackish water data discussed in Section 2. **Table 4-2**, **Table 4-3**, **Table 4-4**, and **Table 4-5** tabulate the amount of fresh, slightly saline, moderately saline, and very saline groundwater stored in each model layer and formation for Calhoun, Jackson, Refugio, and Victoria counties, respectively.

The groundwater volumes were calculated by first calculating the volumes between the surfaces of groundwater with TDS concentrations and multiplying the volume by an average porosity, which was assumed to equal 30%. The surfaces used for the base of groundwater with a TDS concentration of 1000, 3000, and 1000 mg/L are shown in Figures 2-37 through 2-39. The base of groundwater with a TDS concentration of 35,000 mg/L was obtained by Young and others (2016).

All four counties have more brackish groundwater than freshwater. Calhoun County has a total groundwater volume of 1.5×10^9 acre-feet of groundwater comprised of approximately 2% and 18%, fresh and brackish groundwater respectively. Jackson County has a total groundwater volume of 7.4×10^8 acre-feet of groundwater comprised of approximately 20% and 31%, fresh and brackish groundwater respectively. Refugio County has a total groundwater volume of 7.4×10^8 acre-feet of groundwater comprised of approximately 16% and 23%, fresh and brackish groundwater respectively. Victoria County has a total groundwater volume of 6.8×10^8 acre-feet of groundwater comprised of approximately 26% and 40%, fresh and brackish groundwater respectively.

Table 4-2. Groundwater volumes (in 1,000 acre-feet) in Calhoun County for fresh, slightly saline, moderately saline, and very saline groundwater by model layer and by formation.

Formation	Model Layer	Fresh	Slightly Saline	Moderately Saline	Very Saline	>35,000 mg/L	Total
		TDS (mg/L)	TDS (mg/L)	TDS (mg/L)	TDS (mg/L)		
		< 1000	1,000 to 3,000	3,000 to 10,000	10,000 to 35,000		
Beaumont	1	27747	27505	0	0	0	55252
Lissie	2	9969	50749	10730	0	0	71448
Willis	3	3570	16087	62152	0	0	81808
Upper_Goliad	4	831	11223	31162	25621	0	68837
Upper_Goliad	5	160	5631	18099	44946	0	68837
Upper_Goliad	6	0	1929	11552	41874	13482	68837
Upper_Goliad	7	0	351	7471	29700	31315	68837
Total (UG)	4-7	991	19134	68284	142142	44797	275346
Lower_Goliad	8	0	67	4046	21769	34774	60657
Lower_Goliad	9	0	0	2369	20353	37936	60657
Lower_Goliad	10	0	0	1080	19034	40543	60657
Total (LG)	8-10	0	67	7495	61156	113254	181971
Upper_Lagarto	11	0	0	304	23718	61635	85657
Upper_Lagarto	12	0	0	0	20617	65040	85657
Total (UL)	11-12	0	0	304	44335	126674	171313
Middle_Lagarto	13	0	0	0	27830	112692	140521
Lower_Lagarto	14	0	0	0	27720	162686	190406
Oakville	15	0	0	0	20895	283604	304499
Total		42277	113541	148964	324077	843706	1472565

Table 4-3. Groundwater volumes (in 1,000 acre-feet) in Jackson County for fresh, slightly saline, moderately saline, and very saline groundwater by model layer and by formation.

Formation	Model Layer	Fresh	Slightly Saline	Moderately Saline	Very Saline	>35,000 mg/L	Total
		TDS (mg/L)	TDS (mg/L)	TDS (mg/L)	TDS (mg/L)		
		< 1000	1,000 to 3,000	3,000 to 10,000	10,000 to 35,000		
Beaumont	1	28747	343	0	0	0	29091
Lissie	2	35552	5224	0	0	0	40776
Willis	3	28190	10057	1418	0	0	39664
Upper_Goliad	4	14982	8046	7826	59	0	30913
Upper_Goliad	5	13088	7190	7826	2808	0	30913
Upper_Goliad	6	11317	6288	7358	4411	1538	30913
Upper_Goliad	7	7812	7284	6921	6344	2552	30913
Total (UG)	4-7	47199	28808	29932	13622	4090	123652
Lower_Goliad	8	6425	7459	5216	6173	2865	28138
Lower_Goliad	9	2013	10668	5232	6640	3586	28138
Lower_Goliad	10	506	10949	5501	6999	4183	28138
Total (LG)	8-10	8944	29075	15950	19812	10634	84414
Upper_Lagarto	11	10	12643	11605	11998	7360	43617
Upper_Lagarto	12	0	5283	16560	13101	8673	43617
Total (UL)	11-12	10	17927	28165	25099	16033	87233
Middle_Lagarto	13	0	3327	33265	32738	20317	89646
Lower_Lagarto	14	0	0	21538	47300	32192	101030
Oakville	15	0	0	6549	54765	82610	143924
Total		148643	94761	136816	193335	165876	739430

Table 4-4. Groundwater volumes (in 1,000 acre-feet) in Refugio County for fresh, slightly saline, moderately saline, and very saline groundwater by model layer and by formation.

Formation	Model Layer	Fresh	Slightly Saline	Moderately Saline	Very Saline	> 35,000 mg/L	Total
		TDS (mg/L)	TDS (mg/L)	TDS (mg/L)	TDS (mg/L)		
		< 1000	1,000 to 3,000	3,000 to 10,000	10,000 to 35,000		
Beaumont	1	12191	0	0	0	0	12191
Lissie	2	29156	600	0	0	0	29756
Willis	3	30999	8069	0	0	0	39068
Upper_Goliad	4	24232	16813	2072	0	0	43116
Upper_Goliad	5	15108	19684	8324	0	0	43116
Upper_Goliad	6	6581	18119	14900	3516	0	43116
Upper_Goliad	7	899	9831	22168	10218	0	43116
Total (UG)	4-7	46821	64446	47463	13735	0	172465
Lower_Goliad	8	0	2938	12439	11781	0	27158
Lower_Goliad	9	0	1152	10469	15537	0	27158
Lower_Goliad	10	0	70	8388	18253	448	27158
Total (LG)	8-10	0	4159	31296	45571	448	81474
Upper_Lagarto	11	0	0	8929	36599	2026	47554
Upper_Lagarto	12	0	0	2059	40956	4540	47554
Total (UL)	11-12	0	0	10988	77555	6566	95108
Middle_Lagarto	13	0	0	0	61990	11106	73096
Lower_Lagarto	14	0	0	0	58361	29713	88074
Oakville	15	0	0	0	32118	114810	146928
Total		119167	77274	89747	289329	162642	738160

Table 4-5. Groundwater volumes (in 1,000 acre-feet) in Victoria County for fresh, slightly saline, moderately saline, and very saline groundwater by model layer and by formation.

Formation	Model Layer	Fresh	Slightly Saline	Moderately Saline	Very Saline	< 35,000 mg/L	Total
		TDS (mg/L)	TDS (mg/L)	TDS (mg/L)	TDS (mg/L)		
		< 1000	1,000 to 3,000	3,000 to 10,000	10,000 to 35,000		
Beaumont	1	5750	0	0	0	0	5750
Lissie	2	33616	0	0	0	0	33616
Willis	3	29940	211	0	0	0	30151
Upper_Goliad	4	27554	1058	0	0	0	28612
Upper_Goliad	5	25431	3181	0	0	0	28612
Upper_Goliad	6	22102	6311	198	0	0	28612
Upper_Goliad	7	7735	19080	1797	0	0	28612
Total (UG)	4-7	82821	29630	1995	0	0	114446
Lower_Goliad	8	4584	18398	3519	0	0	26502
Lower_Goliad	9	3094	16946	6461	0	0	26502
Lower_Goliad	10	1898	11860	12620	124	0	26502
Total (LG)	8-10	9576	47205	22600	124	0	79505
Upper_Lagarto	11	1953	13903	26265	1478	0	43599
Upper_Lagarto	12	297	10065	26364	6874	0	43599
Total (UL)	11-12	2250	23968	52629	8352	0	87199
Middle_Lagarto	13	0	8441	33023	32058	0	73522
Lower_Lagarto	14	0	733	26641	54198	59	81631
Oakville	15	0	0	3666	94211	32287	130164
Total		163954	110187	140554	188942	32346	635983

4.4 Development of a Steady-state Flow Model

The primary objective for the steady-state groundwater flow model is to provide a tool to estimate the impacts of pumping on the water levels in the confined portions of the brackish aquifers. The conceptual framework for the CGCBGWF Model is that infiltrating rainwater recharges the aquifers at the water table and groundwater leaves the aquifers as discharge to either streams or the ocean. To simplify the regional flow system in the fresh water zone, the effects of general head boundary conditions are used to simulate recharge and discharge and impacts of existing pumping on predicted drawdowns can be represented by the principal of superposition.

The steady-state model was constructed using a three-stage process. The first stage was to establish flow boundary conditions for the numerical grid. The second stage was to select water levels and hydraulic properties calibration targets. The third stage was to adjust the hydraulic properties and the flow boundary conditions to obtain an acceptable match between the simulation results and observation data. These three processes are described in the subsections that follow.

4.4.1 Flow Boundary Conditions

General head boundary conditions (aka GHBCs) were used to simulate both aquifer recharge and discharge. GHBCs simulate the exchange of water between the aquifer and external sources using an equation that involves a hydraulic head difference term and a hydraulic conductance term. If the hydraulic head in aquifer is higher than the hydraulic head used by the GHBC, then the GHBC serves as point of discharge. If the hydraulic head in the aquifer is lower than the hydraulic head used by the GHBC, then the GHBC serves as a point of recharge. The flow rate between the simulated groundwater flow system and the GHBCs is controlled by the value of the GHBC hydraulic conductance. In general, an increase in hydraulic conductance will cause an increase in the flow rate.

To simulate recharge into the groundwater model, GHBCs were located in every grid cell on the top of the model that represents aquifer outcrops. For these GHBCs, the hydraulic head was set to an elevation close to land elevation and the hydraulic conductance was initially set to 10 ft^2/day. To simulate discharge out of the groundwater model, GHBCs were located along the major rivers, along the ocean boundary, and across the bay. For the GHBCs representing the ocean boundary, the hydraulic head is set to 0 ft msl, and the hydraulic conductance was set to 1,000 ft^2/day. For the GHBCs representing the major rivers, the hydraulic head is set to be 10 ft bgs, and the conductance was initially set to 15 ft^2/day. The use of GHBCs to represent recharge into the aquifer and discharge into streams and the ocean is similar to the method to develop the GAM for GMA 14 (Kasmarek, 2012). The bottom and the sides of the groundwater model are regarded as no-flow boundaries.

4.4.2 Selection of Calibration Targets

4.4.2.1 Water Levels

There are 288 water levels selected to serve as calibration targets for the steady-state model. The process to select these water levels consisted of the following steps.

- Search the TWDB groundwater database to locate wells with at least three water level measured since 2018.
- Calculate the average water levels for wells and eliminate wells with only one water level measurement or a standard deviation greater than 5 ft.
- Assign each well to a model layer based on an estimate of ground elevation and either the total well depth or the well screen interval. Plot the average water levels by aquifer and eliminate water levels that appear to be depressed because of nearby pumping.

Table 4-6 summarizes the 288 water level wells by county and by hydrogeologic unit. There are 163 water levels assigned to model layers associated with the Chicot Aquifer, 96 water levels assigned to model layers associated with the Evangeline Aquifer, 8 water levels assigned to model layers associated

with the Burkeville Confining Unit, and 10 water levels assigned to model layers associated with the Jasper Aquifer. Eleven of the water levels were assigned to model layers across two hydrogeologic units. The two counties with the most calibration targets are Refugio County and Victoria County with 54 and 52 water levels, respectively.

Table 4-6. Summary of water level calibration targets by county and by hydrogeologic unit.

County	Number of Wells Per Hydrogeologic Unit							Total
	Chicot	Evangeline	Burkeville	Jasper	Chicot & Evangeline	Evangeline & Burkeville	Burkeville & Jasper	
Aransas	2	0	0	0	0	0	0	2
Bee	16	15	0	0	0	0	0	31
Calhoun	7	0	0	0	0	0	0	7
Colorado	0	1	0	0	0	0	1	2
DeWitt	0	6	2	6	0	0	0	14
Goliad	5	42	2	0	1	0	0	50
Jackson	23	0	0	0	1	0	0	24
Lavaca	1	7	4	4	3	1	0	20
Matagorda	1	1	0	0	0	0	0	2
Refugio	49	3	0	0	2	0	0	54
San Patricio	23	1	0	0	0	0	0	24
Victoria	30	20	0	0	2	0	0	52
Wharton	6	0	0	0	0	0	0	6
Total	163	96	8	10	9	1	1	288

4.4.2.2 Aquifer Pumping Tests

Table 4-7 presents ten aquifer pumping tests selected from TCEQ database, distributing in Jackson, Victoria, Refugio, and Calhoun counties. The Cooper Jacob straight-line method (CJSL) (Cooper and Jacob, 1946) was used to calculate the transmissivity using the field time-drawdown data. The transmissivity values vary from 2,112 to 10,294 ft^2/d, which serve as calibration targets for the steady-state model. The goal of calibration is to make the transmissivity calculated from field data to be close to the transmissivity as results of the simulated time-drawdown values. **Figure 4-21** shows the location of the ten aquifer pumping tests.

Table 4-7. Aquifer pumping tests for model calibration.

Well ID	Well Name	County	Latitude	Longitude	Pumping Rate (GPM)	Pumping Test Duration (Hours)	Model Layer	Calculated Transmissivity (ft^2/d)
#1	G1200001A	Jackson	28.98268	-96.64582	1,100	17	6, 7	9,260
#2	G1200002E	Jackson	29.04201	-96.51313	500	36	4, 5	3,116
#3	G1200022C	Jackson	28.72694	-96.42027	521	8	2	4,276
#4	G2350001B	Victoria	28.64738	-96.89516	800	2	4, 5	8,388
#5	G2350002A	Victoria	28.82096	-96.9843	1,360	22	4, 5, 6, 7	6,032
#6	G2350002B	Victoria	28.82075	-96.98759	1,465	24	4, 5, 6, 7	6,477
#7	G2350002I	Victoria	28.81083	-97.01976	1,520	20	4, 5, 6, 7	7,497
#8	WH7931901	Refugio	28.52333	-97.13389	2,770	24	2, 3, 4, 5, 6	10,294
#9	WH7946604	Refugio	28.29833	-97.27222	600	24	4, 5	2,112
#10	G0290065B	Calhoun	28.43278	-96.455	750	36	1, 2, 3	2,571

4.4.3 Model Calibration

The CGCBGWF Model was calibrated using PEST++IES software (White and others, 2020), which is a program that collectively undertakes calibration and uncertainty analysis for environmental and other numerical models. The model calibration involved adjusting model parameters, including horizontal hydraulic conductivity, vertical hydraulic conductivity, and hydraulic conductance associated with the GHBCs, to optimize the agreement between the model and observed data.

Aquifer pumping tests were simulated using a different numerical grid from the CGCBGWF Model. **Figure 4-22** illustrates the generation of the model used to simulate single-well aquifer pumping tests. Each single-well aquifer pumping test model included fifteen model layers with a dimension of 30 miles x 30 miles. The geologic structures of 15-layer model remain the same as the CGCBGWF Model, while the spatial resolution is higher than the CGCBGWF Model. The 15-layer model consisted of 1,336,920 grid cells The smallest grid cells (165 ft x 165 ft) are at the center of the pumping test model where the pumping test well is located, while the largest grid cells (660 ft x 660 ft) were along the model edge. To match the transmissivity informed by the pumping tests, the following steps were applied for each single-well aquifer test simulation in the model calibration:

- Locate the pumping test well at the center of the 15-layer model.
- Transfer all model properties from the CGCBGWF Model to the 15-layer model.
- Simulate steady-state conditions in the 15-layer model.
- Simulate the aquifer pumping test in the 15-layer model.
- Use the simulated time-drawdown data from the pumping well to calculate transmissivity using the CJSL method.

- Compare the transmissivity calculated from the simulated data to the transmissivity calculated from the field test.

Figure 4-23 compares the observed and simulated values for the 10 aquifer pumping tests used to calibrate the model. The average difference between the observed and simulated values is 8.9%. **Figure 4-24** through **Figure 4-38** shows the calibrated transmissivity field for each model layer.

The calibration metrics used to evaluate the model calibration for matching the water levels include residuals, root mean square error (RMSE), mean error (ME), and mean absolute error (MAE) (Anderson and Woessner, 1992). A residual, given in **Equation 4-10**, is defined as the difference between an observed and a simulated value, e.g., hydraulic head.

$$r = h_o - h_s \quad \text{(Equation 4-10)}$$

where:

r = residual,
h_o = observed hydraulic head, and
h_s = simulated hydraulic head.

The RMSE given in **Equation 4-11** is traditionally the basic measure of calibration for hydraulic heads, which is defined as the square root of the average square of the residuals. The ME, given in **Equation 4-12**, is the average of residuals. The MAE, given in **Equation 4-13**, is the average of the absolute value of residuals.

$$RMSE = \sqrt{\frac{1}{n}\sum_{t=1}^{n}(h_o - h_s)_t^2} \quad \text{(Equation 4-11)}$$

$$ME = \frac{1}{n}\sum_{t=1}^{n}(h_o - h_s)_t \quad \text{(Equation 4-12)}$$

$$MAE = \frac{1}{n}\sum_{t=1}^{n}|h_o - h_s|_t \quad \text{(Equation 4-13)}$$

where:

n = number of observations

A typical calibration criterion for groundwater heads is that the RMSE and the MAE are no more than 10% of the range of observed heads in the hydrogeologic units being simulated. **Figure 4-39** shows a comparison of simulated heads versus observed heads. The comparison shows satisfactory match between the two sets of values over the entire range of values, which is from -10.8 to 355.6 ft. **Table 4-8** presents the calibration statistics for the hydraulic heads. All the statistics meet the TWDB standards for groundwater availability models. Both the MAE and the RMSE are less than 5% of the range of the observed hydraulic heads. These statistics demonstrated that the model is well calibrated to the observed hydraulic heads.

Table 4-8. Calibration statistics for hydraulic heads.

Metric	Value (ft)
Number of Points	288
Maximum Head	355.6
Minimum Head	-10.8
Range in Head	366.4
Mean Error (ME)	-5.6
Mean Absolute Error (MAE)	7.9
Root Mean Square Error (RMSE)	9.7

Figures 4-40 through **4-54** shows contours of the simulated steady-state groundwater level for each of the 15 model layers. All the contours show groundwater flow toward the Gulf Coast. In each figure, the residuals of groundwater levels are plotted at observation wells. Most of the residuals for Victoria County are in the Lissie and Upper Goliad formations. **Table 4-9** lists the simulated and observed groundwater levels, and the residuals for the 288 calibration targets.

Since the CGCBGWF Model was created to provide a simplistic representation of the shallow groundwater flow regime, it does not explicitly account for evapotranspiration or groundwater - surface water interactions. In most coastal aquifers, the majority of recharge remain in shallow zones until it exits by evapotranspiration or by discharge to streams. Therefore, in the VCGCD, the recharge rate would be lower than the actual recharge considering the absence of evapotranspiration and stream discharge terms. The average net recharge rate for the CGCBGWF Model is approximately 0.26 inches/year. This rate was determined by adding the recharge from each of the GHBCs and dividing by the total area of the aquifer outcrops.

Table 4-9. Observed values, simulated values, and residuals for 288 groundwater level calibration targets.

State Well Number	County	GAM Coordinates		Formation	Model Layer	Groundwater level (ft)		Residual (ft)
		Easting (ft)	Northing (ft)			Observed	Simulated	
8026501	Calhoun	5,946,726	18,715,821	Lissie	2	8.3	14.6	-6.2
8019503	Calhoun	5,978,894	18,761,232	Lissie	2	9.3	17.6	-8.2
8019506	Calhoun	5,984,925	18,764,198	Lissie	2	6.2	14.5	-8.3
8027601	Calhoun	5,999,861	18,720,143	Lissie	2	-10.8	8.2	-19.0
6761402	DeWitt	5,730,692	18,896,594	Lower Lagarto	14	283.6	285.9	-2.3
7904104	DeWitt	5,689,760	18,862,901	Lower Lagarto	14	275.8	293.3	-17.6
7906101	DeWitt	5,763,688	18,869,847	Middle Lagarto	13	198.0	201.9	-3.9
7906714	DeWitt	5,769,968	18,841,063	Upper Lagarto	11	155.2	161.1	-5.9

State Well Number	County	GAM Coordinates		Formation	Model Layer	Groundwater level (ft)		Residual (ft)
		Easting (ft)	Northing (ft)			Observed	Simulated	
7906306	DeWitt	5,795,316	18,875,269	Lower Goliad	9	154.0	150.4	3.6
7907402	DeWitt	5,805,258	18,857,305	Lower Goliad	9	122.0	134.5	-12.5
6762704	DeWitt	5,759,719	18,880,072	Middle Lagarto	13	216.3	211.7	4.6
7904202	DeWitt	5,694,268	18,867,754	Lower Lagarto	14	281.7	292.5	-10.8
6746606	DeWitt	5,792,479	18,982,761	Lower Lagarto	14	272.9	281.3	-8.3
7906707	DeWitt	5,769,490	18,842,468	Upper Lagarto	11	153.4	165.9	-12.5
7906708	DeWitt	5,770,807	18,843,106	Upper Lagarto	11	155.6	161.1	-5.5
7905606	Goliad	5,748,885	18,846,532	Upper Lagarto	11	181.8	179.8	1.9
7905903	Goliad	5,758,980	18,836,350	Upper Lagarto	11	166.4	170.0	-3.6
7905904	Goliad	5,759,230	18,837,064	Upper Lagarto	11	175.2	170.0	5.3
7905905	Goliad	5,758,086	18,836,632	Upper Lagarto	11, 12	166.4	173.1	-6.7
7905908	Goliad	5,756,473	18,833,458	Upper Lagarto	11	189.7	172.9	16.8
7906706	Goliad	5,764,634	18,833,854	Upper Lagarto	11	165.1	165.7	-0.6
7913111	Goliad	5,728,379	18,819,250	Upper Lagarto	12	184.1	193.5	-9.5
7913223	Goliad	5,744,685	18,817,198	Lower Goliad	10	185.5	184.2	1.3
7913224	Goliad	5,742,448	18,817,854	Lower Goliad	8, 9	218.0	210.7	7.3
7913304	Goliad	5,745,428	18,827,230	Upper Lagarto	12	170.8	181.4	-10.6
7913507	Goliad	5,739,647	18,812,226	Upper Lagarto	11	170.5	181.1	-10.6
7913508	Goliad	5,739,530	18,813,437	Upper Lagarto	11	176.4	185.1	-8.6
7913512	Goliad	5,743,028	18,812,001	Upper Lagarto	11	169.4	181.1	-11.8
7913611	Goliad	5,748,612	18,812,636	Upper Lagarto	11	158.0	175.0	-17.1

State Well Number	County	GAM Coordinates		Formation	Model Layer	Groundwater level (ft)		Residual (ft)
		Easting (ft)	Northing (ft)			Observed	Simulated	
7913803	Goliad	5,740,710	18,789,288	Lower Goliad, Upper Lagarto	10, 11	187.0	171.0	16.0
7913804	Goliad	5,741,489	18,790,217	Upper Lagarto	11	150.3	170.6	-20.3
7913806	Goliad	5,742,411	18,788,822	Upper Lagarto	11	154.0	170.6	-16.6
7913807	Goliad	5,743,393	18,788,643	Upper Lagarto	11	193.1	170.6	22.6
7913808	Goliad	5,743,910	18,789,363	Upper Lagarto	11	152.8	170.6	-17.7
7913809	Goliad	5,742,383	18,790,035	Lower Goliad, Upper Lagarto	10, 11	155.2	171.0	-15.8
7913810	Goliad	5,742,988	18,790,757	Lower Goliad	10	194.2	172.6	21.6
7913811	Goliad	5,740,608	18,789,893	Lower Goliad	10	188.2	172.6	15.6
7914203	Goliad	5,784,394	18,817,538	Upper Lagarto	11	122.8	147.7	-24.9
7922206	Goliad	5,781,273	18,774,066	Upper Goliad	6	109.3	108.4	0.9
7922508	Goliad	5,777,867	18,764,071	Upper Goliad	6, 7	98.5	108.5	-10.0
7928302	Goliad	5,722,140	18,726,055	Lower Goliad	9	133.3	131.7	1.6
7928303	Goliad	5,719,191	18,726,089	Lower Goliad	8	135.3	133.2	2.1
7928304	Goliad	5,719,470	18,728,573	Lower Goliad	10	127.7	141.6	-13.9
7931502	Goliad	5,817,680	18,716,912	Willis	3	69.7	65.3	4.4
7937918	Goliad	5,762,826	18,658,938	Lissie, Upper Goliad	2, 4	54.8	62.7	-7.9
7938202	Goliad	5,784,026	18,682,705	Lissie	2	73.8	64.6	9.2
7938301	Goliad	5,796,292	18,684,420	Lissie	2	66.9	61.6	5.4
7939104	Goliad	5,805,190	18,692,428	Lissie	2	66.4	62.5	3.9
6660205	Jackson	6,023,333	18,921,014	Lissie	2	36.7	55.2	-18.6
6660401	Jackson	5,998,226	18,904,451	Beaumont, Lissie	1, 2	38.3	55.6	-17.3

State Well Number	County	GAM Coordinates		Formation	Model Layer	Groundwater level (ft)		Residual (ft)
		Easting (ft)	Northing (ft)			Observed	Simulated	
6660708	Jackson	5,999,377	18,895,784	Beaumont	1	42.8	52.5	-9.7
8004403	Jackson	6,006,900	18,864,544	Lissie, Willis, Upper Goliad	2, 3, 4	26.0	40.9	-14.9
8004601	Jackson	6,037,802	18,867,025	Beaumont, Lissie	1, 2	32.8	35.0	-2.1
8005102	Jackson	6,042,054	18,878,493	Beaumont, Lissie	1, 2	37.2	38.4	-1.2
8005701	Jackson	6,039,901	18,848,371	Beaumont, Lissie	1, 2	21.4	28.8	-7.4
8011202	Jackson	5,981,678	18,823,508	Beaumont, Lissie, Willis	1, 2, 3	13.0	33.1	-20.1
8011301	Jackson	5,999,963	18,832,964	Beaumont, Lissie	1, 2	9.7	19.1	-9.4
8011502	Jackson	5,981,625	18,819,358	Lissie	2	9.6	31.5	-21.9
8012502	Jackson	6,025,015	18,813,097	Beaumont, Lissie	1, 2	7.5	11.3	-3.8
8011201	Jackson	5,983,003	18,832,653	Beaumont, Lissie, Willis	1, 2, 3	13.3	35.1	-21.8
8004504	Jackson	6,023,005	18,866,155	Lissie	2	18.9	37.1	-18.2
8004101	Jackson	6,004,035	18,876,902	Beaumont, Lissie	1, 2	36.2	45.1	-8.9
6625103	Lavaca	5,885,664	19,096,831	Middle Lagarto	13	264.4	270.7	-6.3
6625203	Lavaca	5,892,575	19,099,469	Middle Lagarto	13	244.8	260.6	-15.7
6634201	Lavaca	5,933,718	19,049,932	Lower Goliad	8	174.7	180.5	-5.8
6634202	Lavaca	5,931,835	19,049,188	Lower Goliad	8	173.3	176.3	-3.0
6634207	Lavaca	5,939,639	19,054,848	Lower Goliad	9	178.9	176.4	2.6
6635901	Lavaca	5,981,361	19,025,694	Willis, Upper Goliad, Lower Goliad, Upper Lagarto	3, 4, 5, 6, 7, 8, 9, 10, 11	143.3	124.6	18.8

State Well Number	County	GAM Coordinates		Formation	Model Layer	Groundwater level (ft)		Residual (ft)
		Easting (ft)	Northing (ft)			Observed	Simulated	
6641203	Lavaca	5,890,037	19,014,342	Lower Goliad	8, 9	177.4	183.4	-6.0
6641703	Lavaca	5,878,641	18,972,448	Lower Goliad	9	154.9	149.5	5.4
6641903	Lavaca	5,909,796	18,973,924	Willis, Upper Goliad, Lower Goliad	3, 6, 7, 8	121.9	131.9	-10.1
6643704	Lavaca	5,967,239	18,980,534	Lissie	2	112.5	101.5	11.0
6644402	Lavaca	5,996,118	18,999,623	Willis, Upper Goliad, Lower Goliad	3, 4, 5, 6, 7, 8, 9, 10	76.9	98.6	-21.7
6649701	Lavaca	5,887,970	18,936,519	Lower Goliad, Upper Lagarto, Middle Lagarto	9, 12, 13	119.3	138.4	-19.1
6649901	Lavaca	5,905,504	18,939,145	Upper Goliad	5	108.6	107.5	1.1
6739306	Lavaca	5,826,828	19,053,044	Okaville	15	355.6	352.9	2.7
6739518	Lavaca	5,821,434	19,040,164	Okaville	15	341.2	337.4	3.8
6739603	Lavaca	5,833,635	19,031,485	Okaville	15	272.6	306.6	-34.0
6740301	Lavaca	5,872,545	19,054,023	Middle Lagarto	13	269.3	269.6	-0.3
6748203	Lavaca	5,854,075	19,001,658	Middle Lagarto	13	196.6	206.2	-9.5
7946601	Refugio	5,792,387	18,629,012	Upper Goliad	4	28.3	43.3	-15.0
7946810	Refugio	5,781,419	18,617,118	Lissie, Willis	2, 3	16.2	42.9	-26.7
8033205	Refugio	5,903,414	18,694,200	Beaumont	1	8.9	5.5	3.4
7931901	Refugio	5,840,658	18,703,644	Upper Goliad	6	49.9	49.8	0.1
7932802	Refugio	5,869,034	18,706,008	Lissie	2	23.4	35.7	-12.3
7907703	Victoria	5,812,855	18,844,648	Upper Goliad	5, 6	111.1	111.7	-0.6
7908406	Victoria	5,847,636	18,848,982	Upper Goliad	4	88.2	90.6	-2.3

State Well Number	County	GAM Coordinates		Formation	Model Layer	Groundwater level (ft)		Residual (ft)
		Easting (ft)	Northing (ft)			Observed	Simulated	
7908903	Victoria	5,872,330	18,835,372	Lissie	2	85.0	74.2	10.8
7915904	Victoria	5,828,746	18,789,311	Upper Goliad	4	72.2	74.0	-1.9
7915905	Victoria	5,834,431	18,789,559	Lissie, Willis	2, 3	77.5	70.9	6.6
7923601	Victoria	5,834,062	18,762,440	Lissie, Willis	2, 3	65.8	63.7	2.1
7924702	Victoria	5,844,556	18,752,495	Lissie	2	53.3	54.8	-1.5
7924802	Victoria	5,864,152	18,745,425	Lissie	2	35.0	43.7	-8.6
8010401	Victoria	5,933,874	18,817,150	Upper Goliad	4	17.0	45.0	-28.0
8017101	Victoria	5,892,357	18,778,758	Upper Goliad	4	26.0	40.0	-14.0
8017602	Victoria	5,909,513	18,760,114	Lissie	2	18.0	27.9	-9.9
8017603	Victoria	5,909,585	18,760,723	Beaumont, Lissie	1, 2	21.0	27.8	-6.8
8017801	Victoria	5,906,671	18,747,087	Lissie	2	10.2	20.7	-10.5
8017905	Victoria	5,915,917	18,750,785	Upper Goliad	4, 5	30.0	29.9	0.1
8018401	Victoria	5,928,573	18,759,740	Lissie, Willis	2, 3	24.6	27.9	-3.3
8019104	Victoria	5,972,175	18,784,375	Lissie	2	10.9	24.4	-13.5
8010502	Victoria	5,943,860	18,806,814	Lissie	2	28.6	38.6	-10.0
8018103	Victoria	5,934,174	18,775,579	Lissie	2	24.1	31.8	-7.7
8017502	Victoria	5,898,363	18,763,672	Upper Goliad	5, 6	35.0	36.9	-1.9
8002804	Victoria	5,944,471	18,844,064	Beaumont	1	32.2	49.3	-17.0
8018402	Victoria	5,932,192	18,760,855	Lissie	2	22.6	27.4	-4.7
7915305	Victoria	5,833,239	18,825,440	Upper Goliad	4	79.0	85.6	-6.6
7907505	Victoria	5,820,505	18,847,573	Upper Goliad	5	98.2	104.4	-6.3
7908404	Victoria	5,848,863	18,849,621	Lissie	2	88.4	91.6	-3.3
7908403	Victoria	5,848,779	18,849,416	Lissie	2	88.1	91.6	-3.6
7916701	Victoria	5,853,411	18,794,908	Upper Goliad	5	57.2	62.5	-5.3
7915903	Victoria	5,834,886	18,789,165	Willis	3	79.7	71.0	8.7
7923303	Victoria	5,835,356	18,777,848	Upper Goliad	4	62.8	68.0	-5.2
7924102	Victoria	5,853,905	18,772,768	Lissie	2	42.1	51.7	-9.7

State Well Number	County	GAM Coordinates		Formation	Model Layer	Groundwater level (ft)		Residual (ft)
		Easting (ft)	Northing (ft)			Observed	Simulated	
7964701	Aransas	5,851,371	18,521,824	Beaumont	1	4.5	0.2	4.2
8049702	Aransas	5,892,008	18,562,939	Beaumont	1	1.9	0.9	1.0
8019507	Calhoun	5,980,281	18,763,041	Lissie	2	3.5	16.9	-13.4
8027302	Calhoun	5,991,910	18,739,719	Beaumont, Lissie	1, 2	-0.1	11.1	-11.2
8036402	Calhoun	6,006,070	18,671,122	Beaumont	1	-6.8	4.1	-10.9
6618601	Colorado	5,941,086	19,135,554	Middle Lagarto, Lower Lagarto	13, 14	228.0	257.1	-29.1
6619904	Colorado	5,980,067	19,120,712	Upper Lagarto	12	194.0	208.3	-14.3
6760904	DeWitt	5,707,574	18,879,783	Lower Lagarto	14	285.7	292.5	-6.8
6755404	DeWitt	5,801,490	18,947,769	Lower Lagarto	14	225.8	226.2	-0.4
6763703	DeWitt	5,807,429	18,886,275	Lower Goliad	8, 9	130.1	138.6	-8.5
7905906	Goliad	5,753,486	18,832,072	Upper Lagarto	11	177.6	177.0	0.7
7905909	Goliad	5,757,737	18,834,115	Upper Lagarto	11	186.3	172.9	13.4
7912305	Goliad	5,716,644	18,819,591	Upper Lagarto	12	213.2	209.3	3.9
7912602	Goliad	5,713,613	18,800,203	Middle Lagarto	13	189.6	198.4	-8.8
7912902	Goliad	5,711,575	18,783,973	Middle Lagarto	13	175.6	190.2	-14.7
7914105	Goliad	5,771,105	18,823,513	Upper Lagarto	11	151.2	160.2	-9.0
7914604	Goliad	5,795,259	18,805,351	Upper Goliad	6	111.2	106.8	4.4
7915401	Goliad	5,806,220	18,808,163	Upper Goliad	5	100.7	98.8	1.9
7915402	Goliad	5,801,193	18,807,886	Upper Goliad, Lower Goliad	7, 8	101.2	105.5	-4.3
7915702	Goliad	5,812,434	18,794,359	Upper Goliad	5	89.7	86.0	3.7
7921307	Goliad	5,761,016	18,776,716	Lower Goliad	9	133.2	138.3	-5.1

State Well Number	County	GAM Coordinates		Formation	Model Layer	Groundwater level (ft)		Residual (ft)
		Easting (ft)	Northing (ft)			Observed	Simulated	
7921607	Goliad	5,757,903	18,757,829	Lower Goliad	8	115.5	124.0	-8.5
7922604	Goliad	5,797,945	18,760,659	Upper Goliad	5, 6	81.2	89.8	-8.6
7923703	Goliad	5,810,802	18,745,729	Upper Goliad	4	75.1	77.9	-2.7
7930301	Goliad	5,802,055	18,732,500	Upper Goliad	4	73.1	77.1	-4.0
7937912	Goliad	5,759,651	18,657,346	Lissie	2	57.9	63.6	-5.7
7938706	Goliad	5,765,835	18,656,279	Upper Goliad	4	50.9	61.7	-10.8
8004614	Jackson	6,033,294	18,860,438	Beaumont	1	36.3	33.8	2.5
8021616	Jackson	6,077,158	18,769,297	Beaumont	1	-7.3	0.7	-8.0
8022406	Jackson	6,087,797	18,771,048	Lissie	2	-2.3	5.8	-8.1
8904607	Jackson	6,042,212	18,878,654	Willis	3	37.0	39.0	-2.0
8904610	Jackson	6,039,906	18,848,271	Lissie	2	21.0	28.9	-7.9
8904611	Jackson	6,025,188	18,813,306	Beaumont, Lissie	1, 2	6.0	11.3	-5.3
8904612	Jackson	6,087,811	18,771,037	Lissie	2	-2.0	5.8	-7.8
8904620	Jackson	6,033,295	18,860,439	Beaumont	1	32.7	33.8	-1.1
8904624	Jackson	6,087,813	18,770,100	Beaumont	1	-7.6	2.3	-10.0
8904627	Jackson	6,077,159	18,769,297	Beaumont	1	-7.9	0.7	-8.5
6633905	Lavaca	5,908,114	19,023,553	Lower Goliad	10	170.5	179.6	-9.1
6732704	Lavaca	5,843,689	19,063,616	Lower Lagarto	14	325.2	327.3	-2.1
8007102	Matagorda	6,121,249	18,880,082	Upper Goliad	4	21.0	31.4	-10.4
8024201	Matagorda	6,180,465	18,784,693	Beaumont	1	-1.0	2.6	-3.6
7932803	Refugio	5,859,117	18,700,081	Beaumont, Lissie	1, 2	43.2	39.3	3.9
8033611	Refugio	5,924,353	18,668,875	Lissie	2	4.6	9.4	-4.8
8034709	Refugio	5,928,361	18,656,773	Lissie	2	2.4	7.7	-5.3
8904631	Refugio	5,859,119	18,700,082	Beaumont, Lissie	1, 2	43.0	39.3	3.7
8904633	Refugio	5,903,505	18,694,203	Beaumont	1	7.0	5.5	1.5
8904636	Refugio	5,924,353	18,668,867	Lissie	2	4.2	9.4	-5.2
8904637	Refugio	5,928,363	18,656,774	Lissie	2	0.5	7.7	-7.1

State Well Number	County	GAM Coordinates		Formation	Model Layer	Groundwater level (ft)		Residual (ft)
		Easting (ft)	Northing (ft)			Observed	Simulated	
7907803	Victoria	5,816,285	18,844,037	Upper Goliad	5, 6	100.4	106.0	-5.6
7915306	Victoria	5,838,323	18,828,100	Upper Goliad	4	79.8	83.3	-3.6
8019105	Victoria	5,973,226	18,778,943	Lissie	2	10.2	22.0	-11.8
8025402	Victoria	5,884,445	18,719,891	Lissie	2	19.1	26.7	-7.6
8904639	Victoria	5,828,608	18,789,060	Lissie, Upper Goliad	2, 4	70.0	73.8	-3.8
8904640	Victoria	5,972,157	18,784,391	Lissie	2	9.0	24.4	-15.4
8904641	Victoria	5,973,246	18,778,916	Lissie	2	9.0	22.0	-13.0
6657406	Victoria	5,882,489	18,902,627	Upper Goliad	4	86.4	92.1	-5.6
7916702	Victoria	5,853,389	18,795,717	Upper Goliad	4, 5	64.6	63.9	0.7
8904646	Victoria	5,853,471	18,794,010	Upper Goliad	4, 5	53.0	62.2	-9.2
7908201	Victoria	5,856,887	18,865,110	Upper Goliad	5	92.2	90.1	2.1
8904647	Victoria	5,834,065	18,762,438	Lissie, Willis	2, 3	63.0	63.7	-0.7
8904648	Victoria	5,844,562	18,752,496	Lissie	2	53.0	54.8	-1.8
8904649	Victoria	5,847,676	18,848,987	Upper Goliad	4	85.0	90.6	-5.6
8904650	Victoria	5,834,444	18,789,537	Lissie, Willis	2, 3	76.0	70.9	5.1
8904651	Victoria	5,922,282	18,786,689	Lissie, Willis, Upper Goliad	2, 3, 4, 5	44.0	37.6	6.4
8904654	Victoria	5,864,154	18,745,426	Lissie	2	35.0	43.7	-8.7
8904656	Victoria	5,838,326	18,828,105	Upper Goliad	4	79.0	83.3	-4.3
8904658	Victoria	5,930,659	18,761,023	Beaumont	1	33.0	27.5	5.5
8904660	Victoria	5,909,556	18,760,687	Beaumont, Lissie	1, 2	19.0	27.8	-8.8
8904661	Victoria	5,834,843	18,789,207	Upper Goliad	4	80.0	71.7	8.3
8904662	Victoria	5,844,574	18,752,493	Lissie	2	52.0	54.8	-2.8
8904663	Victoria	5,932,218	18,774,341	Beaumont, Lissie	1, 2	25.0	31.5	-6.5

State Well Number	County	GAM Coordinates		Formation	Model Layer	Groundwater level (ft)		Residual (ft)
		Easting (ft)	Northing (ft)			Observed	Simulated	
6653503	Wharton	6,058,869	18,948,658	Lissie, Willis	2, 3	46.0	55.8	-9.8
6653804	Wharton	6,051,879	18,929,102	Lissie, Willis	2, 3	43.0	51.0	-8.0
6654108	Wharton	6,088,645	18,961,474	Lissie, Willis	2, 3	54.0	54.3	-0.3
6655412	Wharton	6,122,843	18,958,271	Willis	3	43.0	47.1	-4.1
6661305	Wharton	6,066,475	18,921,679	Beaumont, Lissie, Willis	1, 2, 3	38.0	46.7	-8.7
6662104	Wharton	6,088,852	18,923,121	Beaumont, Lissie	1, 2	34.0	44.7	-10.7
684758	Bee	5,702,026	18,581,631	Willis	3	44.0	56.0	-12.0
682332	San Patricio	5,822,467	18,463,672	Beaumont	1	-5.3	4.6	-10.0
681583	San Patricio	5,829,493	18,493,228	Lissie	2	2.3	7.0	-4.7
679567	Bee	5,694,227	18,565,165	Willis	3	44.0	51.9	-7.9
677401	Bee	5,693,435	18,571,123	Lissie, Willis	2, 3	49.6	53.9	-4.3
674437	Refugio	5,814,041	18,556,431	Willis	3	2.2	15.5	-13.3
668488	San Patricio	5,826,480	18,464,683	Beaumont	1	1.7	3.9	-2.2
666057	San Patricio	5,828,502	18,462,814	Beaumont	1	5.0	3.9	1.1
665606	San Patricio	5,829,132	18,462,729	Beaumont	1	7.7	3.9	3.8
664031	Bee	5,701,026	18,570,540	Willis	3	46.9	51.9	-5.0
654240	San Patricio	5,730,845	18,559,954	Upper Goliad	4	29.3	41.8	-12.5
650844	Refugio	5,812,299	18,547,158	Willis	3	-0.3	13.9	-14.3
649353	Bee	5,661,269	18,607,541	Upper Goliad	4	85.9	83.5	2.4
646286	Bee	5,684,831	18,583,978	Willis	3	60.0	61.3	-1.4
645826	Bee	5,672,001	18,602,913	Upper Goliad	4	69.1	77.1	-8.1
643820	Bee	5,681,504	18,589,403	Willis	3	68.1	64.1	4.0
641612	Bee	5,664,900	18,613,379	Upper Goliad	4	74.5	83.7	-9.1
636982	Refugio	5,821,128	18,558,985	Willis	3	4.2	13.1	-8.8

State Well Number	County	GAM Coordinates		Formation	Model Layer	Groundwater level (ft)		Residual (ft)
		Easting (ft)	Northing (ft)			Observed	Simulated	
636456	Bee	5,677,815	18,606,918	Upper Goliad	4	71.0	74.1	-3.2
636447	San Patricio	5,798,931	18,526,589	Willis	3	5.1	17.6	-12.5
635331	Bee	5,698,800	18,578,235	Willis	3	48.7	56.2	-7.4
627401	Bee	5,694,710	18,599,128	Willis	3	62.3	64.6	-2.3
627193	Bee	5,701,499	18,582,023	Willis	3	50.3	56.0	-5.7
626305	Bee	5,720,319	18,633,037	Upper Goliad	4	58.8	67.6	-8.8
613013	Bee	5,674,475	18,586,082	Upper Goliad	4	64.1	67.4	-3.3
607538	San Patricio	5,711,770	18,562,892	Willis	3	40.7	47.4	-6.6
605560	Bee	5,683,259	18,590,131	Willis	3	66.8	64.1	2.8
591204	Refugio	5,832,350	18,587,689	Lissie, Willis	2, 3	9.2	15.6	-6.3
586723	San Patricio	5,829,597	18,467,393	Beaumont	1	-1.3	3.8	-5.1
575061	Bee	5,691,211	18,617,581	Upper Goliad	4	65.5	74.6	-9.0
563203	Bee	5,681,606	18,608,614	Upper Goliad	4	76.7	74.4	2.3
558080	San Patricio	5,829,200	18,467,460	Beaumont	1	3.7	3.8	-0.1
546444	San Patricio	5,824,645	18,467,315	Beaumont	1	-6.2	4.8	-10.9
544688	Bee	5,688,513	18,615,167	Upper Goliad	4	70.1	74.6	-4.5
540227	Refugio	5,820,090	18,552,066	Willis	3	3.0	11.4	-8.4
540209	Bee	5,707,584	18,590,227	Willis	3	43.9	55.7	-11.8
540091	Refugio	5,791,094	18,575,075	Willis, Upper Goliad	3, 4	19.5	29.1	-9.5
539849	Refugio	5,812,670	18,547,129	Willis	3	4.4	13.6	-9.2
523554	San Patricio	5,739,260	18,530,902	Willis	3	22.9	33.4	-10.5
523552	San Patricio	5,738,998	18,530,593	Willis	3	22.7	33.4	-10.8
520277	San Patricio	5,823,981	18,464,488	Beaumont	1	-2.6	4.6	-7.2
516274	San Patricio	5,822,726	18,464,083	Beaumont	1	-1.3	4.6	-6.0

State Well Number	County	GAM Coordinates		Formation	Model Layer	Groundwater level (ft)		Residual (ft)
		Easting (ft)	Northing (ft)			Observed	Simulated	
508108	Refugio	5,813,114	18,546,642	Willis	3	2.3	13.6	-11.3
508103	Refugio	5,826,336	18,553,444	Willis	3	-4.9	9.5	-14.4
508042	Refugio	5,813,679	18,550,388	Willis	3	2.7	13.3	-10.6
507836	Refugio	5,791,755	18,576,325	Upper Goliad	4	23.0	29.3	-6.4
506421	Bee	5,692,755	18,570,871	Lissie, Willis	2, 3	46.3	53.9	-7.6
504514	San Patricio	5,769,016	18,506,614	Willis	3	13.7	24.5	-10.8
502140	San Patricio	5,827,203	18,468,036	Beaumont	1	4.4	4.8	-0.4
497689	Refugio	5,823,108	18,556,168	Willis	3	7.7	11.8	-4.1
495040	Bee	5,713,205	18,612,122	Lissie, Willis	2, 3	55.0	61.0	-6.0
492490	San Patricio	5,842,820	18,479,382	Beaumont	1	2.6	3.2	-0.7
472129	San Patricio	5,772,725	18,532,674	Willis	3	13.4	27.1	-13.8
472073	San Patricio	5,764,359	18,518,157	Willis	3	21.7	26.8	-5.2
465673	San Patricio	5,828,991	18,475,358	Beaumont	1	-5.9	4.6	-10.4
465058	Refugio	5,824,668	18,552,280	Willis	3	2.1	9.9	-7.8
457303	San Patricio	5,770,391	18,522,095	Lissie, Willis	2, 3	12.4	26.4	-14.0
456041	San Patricio	5,828,929	18,467,171	Beaumont	1	1.0	3.9	-2.9
444822	San Patricio	5,841,226	18,481,028	Beaumont	1	0.4	4.0	-3.6
436354	Refugio	5,826,571	18,585,238	Lissie, Willis	2, 3	4.5	16.2	-11.7
433589	Refugio	5,836,587	18,579,432	Lissie, Willis	2, 3	3.0	11.5	-8.6
433154	Bee	5,691,561	18,578,961	Willis	3	58.1	58.7	-0.6
433153	Bee	5,692,924	18,577,699	Willis	3	56.9	56.3	0.6
429947	Bee	5,710,467	18,583,738	Lissie	2	47.3	53.4	-6.1
428172	Refugio	5,826,938	18,554,025	Willis	3	-3.9	9.5	-13.4
428150	Bee	5,677,933	18,604,066	Upper Goliad	4	78.2	74.1	4.1
684756	Refugio	5,785,053	18,656,397	Willis	3	53.5	55.2	-1.7
674122	Refugio	5,852,555	18,674,769	Lissie	2	35.6	36.4	-0.8

State Well Number	County	GAM Coordinates		Formation	Model Layer	Groundwater level (ft)		Residual (ft)
		Easting (ft)	Northing (ft)			Observed	Simulated	
665743	Refugio	5,779,028	18,666,008	Willis, Upper Goliad	3, 4	56.6	60.7	-4.2
665566	Refugio	5,778,528	18,663,822	Willis	3	49.0	59.0	-10.0
652536	Bee	5,729,207	18,648,885	Upper Goliad	4, 5	58.1	70.6	-12.5
652518	Bee	5,714,882	18,651,970	Upper Goliad	4	81.0	75.8	5.2
649190	Refugio	5,777,572	18,661,859	Willis	3	49.0	58.8	-9.8
638289	Refugio	5,848,938	18,678,857	Lissie	2	38.9	38.6	0.3
626189	Bee	5,729,309	18,645,469	Upper Goliad	5	61.9	70.9	-9.0
577034	Refugio	5,782,576	18,658,496	Willis	3	48.0	56.4	-8.4
528024	Refugio	5,783,223	18,659,709	Willis	3	49.0	56.5	-7.5
523682	Refugio	5,800,753	18,675,596	Lissie, Willis	2, 3	61.3	56.4	4.9
519952	Refugio	5,832,615	18,661,944	Lissie, Willis	2, 3	37.3	40.3	-3.0
519938	Bee	5,737,055	18,657,708	Upper Goliad	4, 5	60.1	70.9	-10.8
517955	Refugio	5,845,691	18,660,222	Lissie	2	28.8	34.8	-6.1
517948	Refugio	5,845,661	18,654,437	Lissie	2	23.2	33.8	-10.6
517938	Refugio	5,841,139	18,655,125	Willis	3	32.2	35.9	-3.7
491082	Bee	5,704,754	18,660,165	Upper Goliad	4	85.5	83.8	1.7
443882	Refugio	5,831,140	18,665,112	Beaumont, Lissie	1, 2	36.3	42.5	-6.2
433561	Refugio	5,831,074	18,665,402	Lissie	2	39.3	42.6	-3.2
674540	Refugio	5,888,141	18,669,090	Lissie	2	15.9	23.0	-7.1
674539	Refugio	5,877,654	18,680,005	Lissie	2	25.8	29.2	-3.4
591582	Refugio	5,951,688	18,638,939	Beaumont, Lissie	1, 2	-3.9	1.4	-5.3
591577	Refugio	5,951,215	18,640,119	Lissie	2	-6.2	3.0	-9.2
560925	Refugio	5,945,596	18,640,653	Beaumont	1	-6.4	2.2	-8.6
531273	Refugio	5,951,382	18,639,463	Lissie	2	-7.2	3.0	-10.1
526539	Refugio	5,951,553	18,639,271	Lissie	2	-5.2	3.0	-8.1
509611	Refugio	5,951,684	18,638,994	Lissie	2	-4.9	3.0	-7.8
437288	Refugio	5,950,921	18,640,713	Lissie	2	-5.2	3.0	-8.2
436956	Refugio	5,943,432	18,634,271	Lissie	2	-4.9	4.3	-9.2
436955	Refugio	5,952,285	18,634,527	Beaumont	1	-6.9	0.9	-7.7

Table 4-10 compares the transmissivity values calculated by the measured data and produced by the groundwater model simulations for the ten aquifer pumping tests. The calibrated groundwater model achieved an acceptable match with the transmissivity values from measured data, with an 8.9 percent difference on average. Incorporating those aquifer pumping tests in model calibration results in reasonable transmissivity fields in the groundwater model, which is essential to reliable groundwater level predictions with production well fields.

Table 4-10. Transmissivity from ten aquifer pumping tests.

Well ID	Well Name	Transmissivity (ft^2/d)		Percent of Difference (%)
		Measured	Model	
#1	G1200001A	9,260	6,279	32.2
#2	G1200002E	3,116	3,082	1.1
#3	G1200022C	4,276	4,318	1.0
#4	G2350001B	8,388	7,158	14.7
#5	G2350002A	6,032	6,301	4.5
#6	G2350002B	6,477	6,693	3.3
#7	G2350002I	7,497	7,534	0.5
#8	WH7931901	10,294	10,373	0.8
#9	WH7946604	2,112	2,316	9.6
#10	G0290065B	2,571	3,118	21.3

4.5 Applications of Groundwater Flow Model for Drawdown Prediction

The CGCBGWF Model was used to predict drawdowns by pumping from the six well fields shown in **Figure 4-55**. At each of the six well fields, the pumping occurred in multiple model layers that contain brackish groundwater with a TDS concentration between 1,300 and 3,000 mg/L. **Table 4-11** lists the model layers, formation, and the layer thickness associated with the well fields.

Table 4-11. Locations of brackish well fields.

Well Field ID	Formation	GAM Coordinates		Model Layers	Model Layer Thickness (ft)	Transmissivity (ft2/d)
		Easting (ft)	Northing (ft)			
1	Upper Goliad, Lower Goliad	6,045,595	18,865,827	7, 8, 9	549	3,568
2	Lissie, Willis, Upper Goliad	5,994,911	18,696,968	2, 3, 4	980	3,621
3	Upper Goliad	5,769,148	18,584,539	6, 7	549	4,486
4	Upper Goliad, Lower Goliad	5,839,489	18,671,026	7, 8	417	2,760
5	Upper Goliad	5,950,274	18,708,201	4, 5	622	5,262
6	Upper Lagarto, Middle Lagarto	5,951,492	18,929,698	11, 12, 13	866	5,384

Two pumping scenarios were performed at each well field using the groundwater model. One scenario involved pumping at 15,000 AFY for 30 years. The other scenario involves pumping at 30,000 AFY for 30 years. **Figure 4-56** through **Figure 4-67** illustrate the simulated drawdown as results of pumping at each well field. For each pumping scenario, drawdown plots are provided for one of the model layers where brackish water is pumped. Drawdown plots are also provided for the first model layer above that contains fresh water. The absence of drawdown contour lines in a plot suggests that the predicted drawdown is less than 10 ft. **Table 4-12** provides simulated drawdown at well fields in interested layers after 5 years and 30 years of pumping.

Table 4-12. Simulated drawdown at the six well fields after 5-year and 30-year pumping at 15,000 AFY and 30,000 AFY.

Well Field ID	Simulated Drawdown in the Pumping Layer						Simulated Drawdown in the Fresh Water Layer					
	Model Layer (Pumped	Depth (ft) to Layer Middle	15,000 AFY		30,000 AFY		Model Layer (Fresh Water)	Depth (ft) to Layer Middle	15,000 AFY		30,000 AFY	
			5-year	30-year	5-year	30-year			5-year	30-year	5-year	30-year
1	8	1,694	148	150	297	303	4	870	15	18	31	37
2	3	703	126	142	251	291	1	99	26	80	49	173
3	7	1,337	133	139	265	277	4	514	18	25	36	50
4	8	1,594	209	212	417	424	6	1,137	80	84	161	168
5	5	1,256	103	106	205	211	1	53	3	12	5	23
6	12	1,427	150	165	307	337	10	1,057	51	62	104	126

At each pumping location, there is a linear relationship between the pumping rate and the simulated drawdown. This relationship is expected since all the pumping occurs in the confined portions of the aquifer. In a confined aquifer, the groundwater flow rate is linearly dependent on the hydraulic gradient. For purposes of planning and permitting, the linear relationship between pumping and drawdown can be used to estimate drawdown for pumping rates in the range from 15,000 to 30,000 AFY.

Table 4-12 shows that the simulated drawdown after 30-year pumping is larger than after 5-year pumping by up to 16 % and 325 % in the pumping layer and the freshwater layer, respectively. After 30-year pumping of 30,000 AFY, the drawdown at the six well fields ranges from 211 to 424 ft in the pumping layer and ranges from 23 to 173 ft in the freshwater layer. A major reason for the difference in drawdown is the difference in the transmissivity of model layers at the well fields. As a general rule, the spatial difference in transmissivity across a formation is primarily controlled by the thickness and extent of sand beds. The high transmissivity is expected to occur where sand beds are thick and clay interbeds are thin in a formation.

Table 4-13 shows simulated drawdown at radial distances from the well fields after 30-year of pumping at 30,000 AFY. At a radial distance of 0.5 mile, the simulated drawdowns are 15% to 27% less than the simulated drawdown at the well fields. At a radial distance of 1 mile, the simulated drawdowns are 28% to 45% less than the simulated drawdown at the well fields. At a radial distance of 3 miles, the simulated drawdowns are 52% to 78% less than the simulated drawdown at the well fields.

Table 4-13. Simulated drawdown from distances to the well fields after 30-year of pumping at 30,000 AFY.

Well Field ID	Model Layer	Simulated Drawdown at Radial Distances in the Pumping Layer							
		Well Field (0 mile)	0.25 mile	0.5 mile	0.75 mile	1 mile	1.5 miles	2 miles	3 miles
1	8	305	267	233	204	179	146	119	87
2	3	296	253	216	180	164	124	98	64
3	7	280	247	220	196	178	146	124	93
4	8	419	390	332	289	254	206	171	119
5	5	213	184	162	143	129	103	86	62
6	12	334	305	284	260	242	215	191	161

Moreover, **Table 4-12** shows that the simulated drawdown in the freshwater layer is up to 97% less than the drawdown in the pumped brackish water layer. The primary reason for drawdown to diminish more rapidly in vertical directions than in horizontal directions is that vertical hydraulic conductivity is typically much smaller than the horizontal hydraulic conductivity. As a general rule, the spatial difference in vertical hydraulic conductivity across a formation is primarily controlled by the thickness and extent of the clay beds. The low vertical hydraulic conductivity is expected to occur where clay beds are thick with minimal sands and fractures.

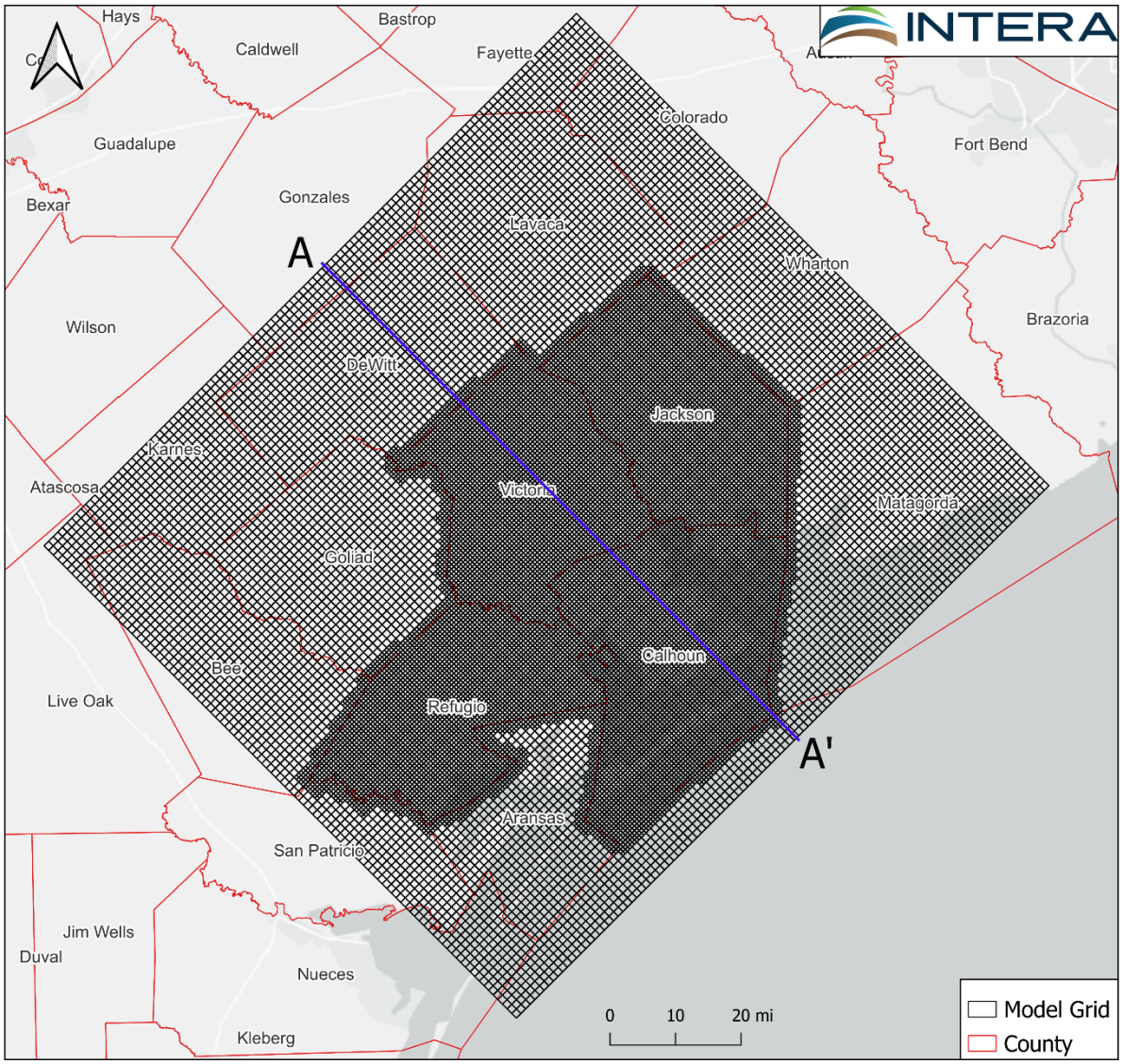


Figure 4-1. Aerial view of the numerical grid for the groundwater flow model.

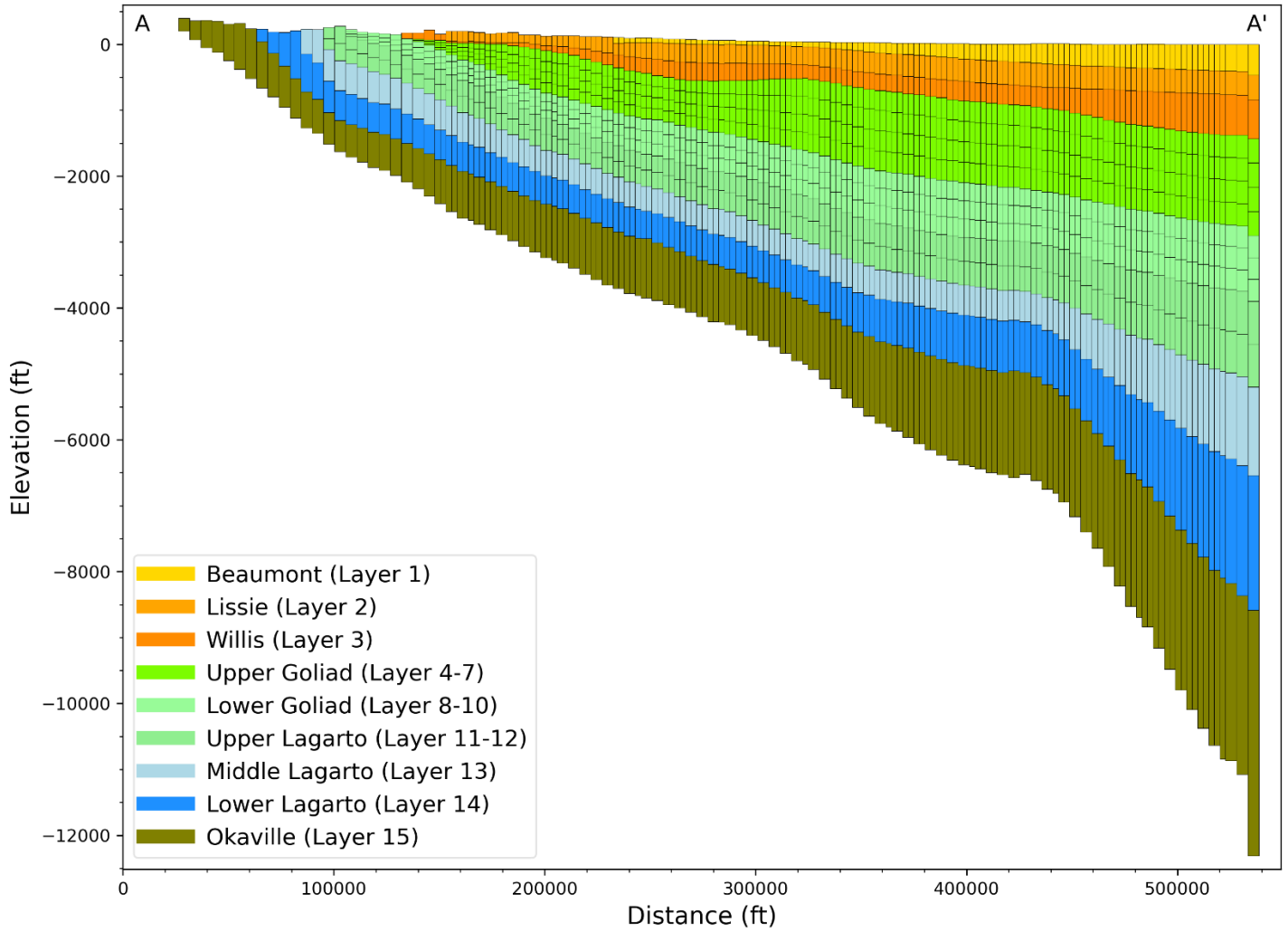
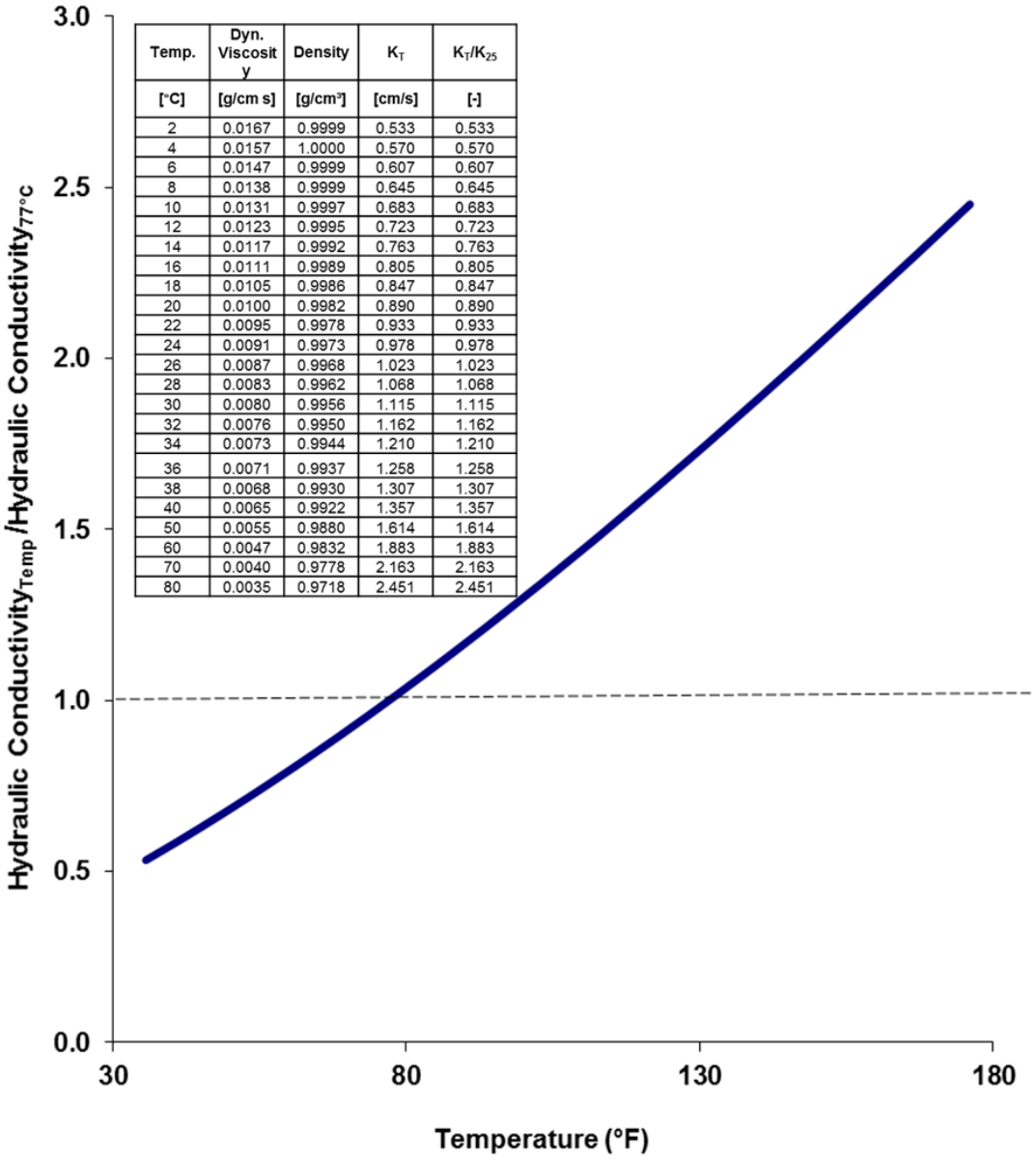


Figure 4-2. Cross-section AA' (refer to Figure 4-1) of the groundwater flow model grid comprised of 15 layers.



Temp.	Dyn. Viscosity	Density	K_T	K_T/K_{25}
[°C]	[g/cm s]	[g/cm³]	[cm/s]	[-]
2	0.0167	0.9999	0.533	0.533
4	0.0157	1.0000	0.570	0.570
6	0.0147	0.9999	0.607	0.607
8	0.0138	0.9999	0.645	0.645
10	0.0131	0.9997	0.683	0.683
12	0.0123	0.9995	0.723	0.723
14	0.0117	0.9992	0.763	0.763
16	0.0111	0.9989	0.805	0.805
18	0.0105	0.9986	0.847	0.847
20	0.0100	0.9982	0.890	0.890
22	0.0095	0.9978	0.933	0.933
24	0.0091	0.9973	0.978	0.978
26	0.0087	0.9968	1.023	1.023
28	0.0083	0.9962	1.068	1.068
30	0.0080	0.9956	1.115	1.115
32	0.0076	0.9950	1.162	1.162
34	0.0073	0.9944	1.210	1.210
36	0.0071	0.9937	1.258	1.258
38	0.0068	0.9930	1.307	1.307
40	0.0065	0.9922	1.357	1.357
50	0.0055	0.9880	1.614	1.614
60	0.0047	0.9832	1.883	1.883
70	0.0040	0.9778	2.163	2.163
80	0.0035	0.9718	2.451	2.451

Figure 4-3. Relative change in hydraulic conductivity values caused by the temperature dependence of the density and viscosity of water (data from http://www.viscopedia.com/viscosity-tables/substances/water/).

Note: °F=degrees Fahrenheit; Hydraulic Conductivity$_{Temp}$=hydraulic conductivity corrected for temperature; Hydraulic Conductivity$_{77°C}$=hydraulic conductivity at 77 degrees Celsius

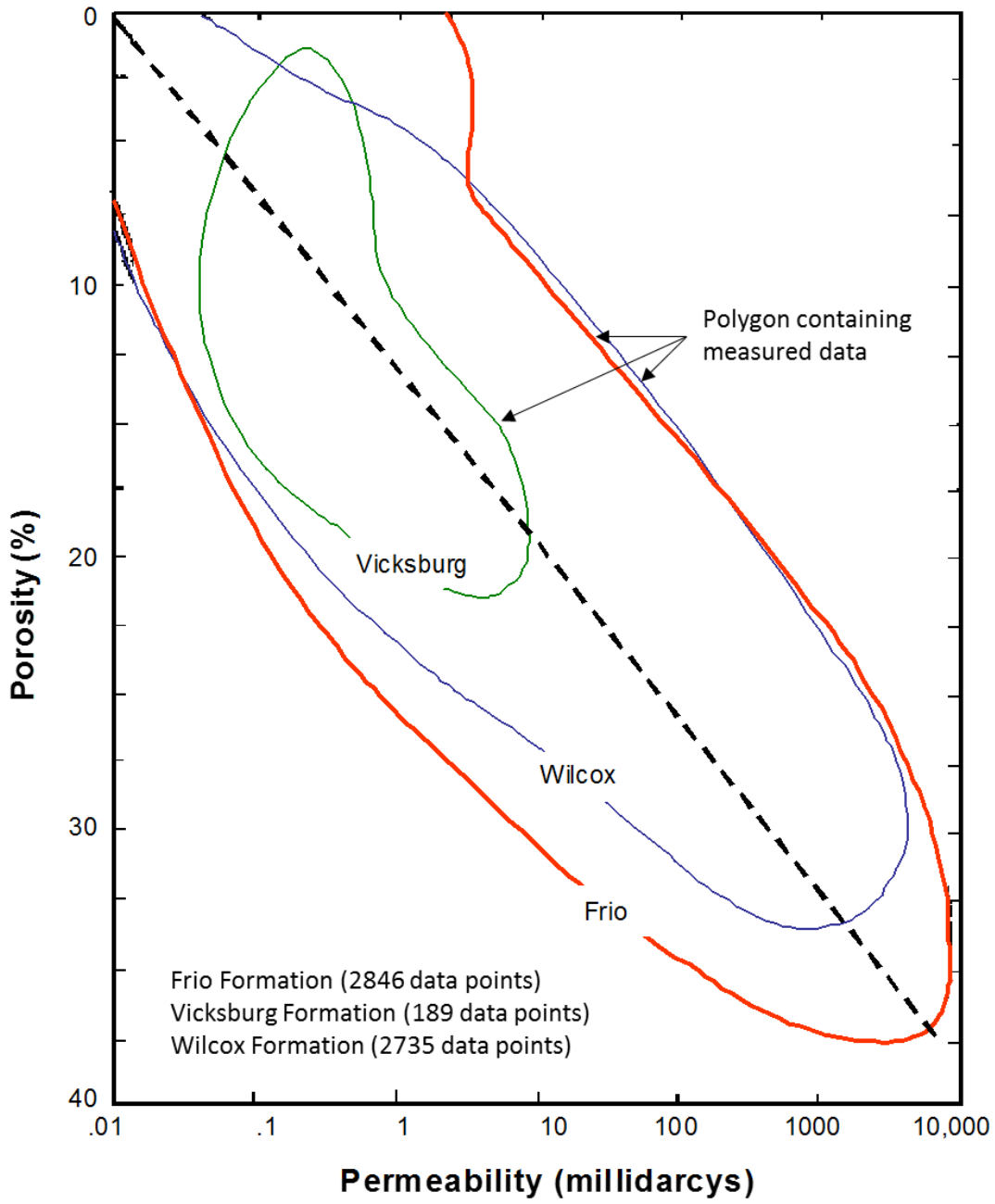


Figure 4-4. Observed relationship between porosity in percent and permeability in millidarcies measured in laboratory cores for geological formations in Texas (modified from Loucks and others, 1986).

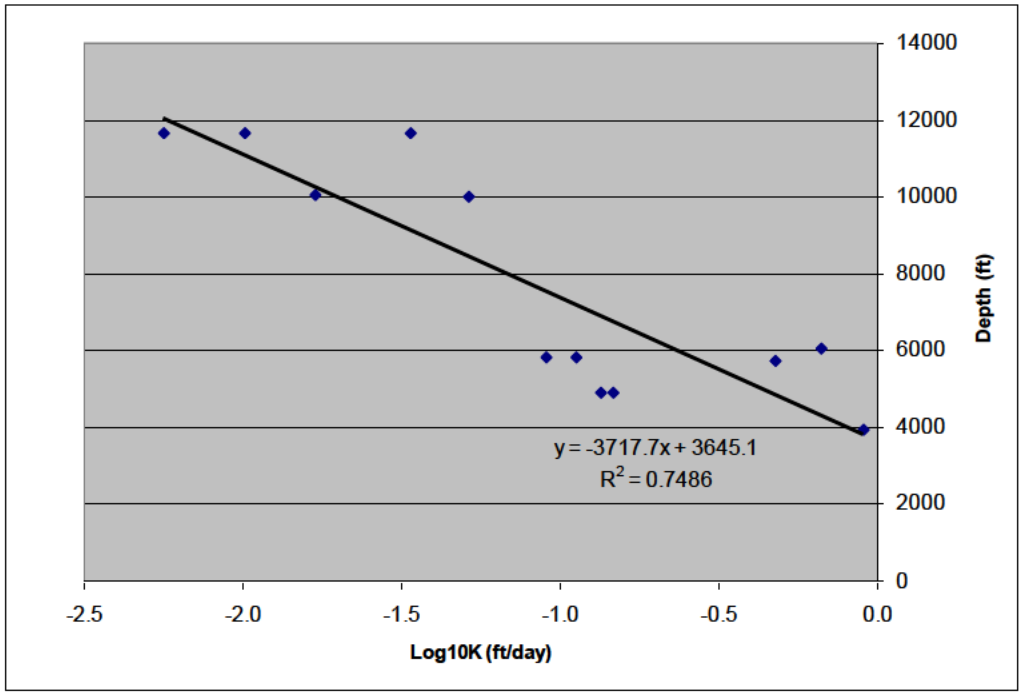


Figure 4-5. Hydraulic conductivity of Pliocene clays as a function of depth of burial (Neglia, 2004).

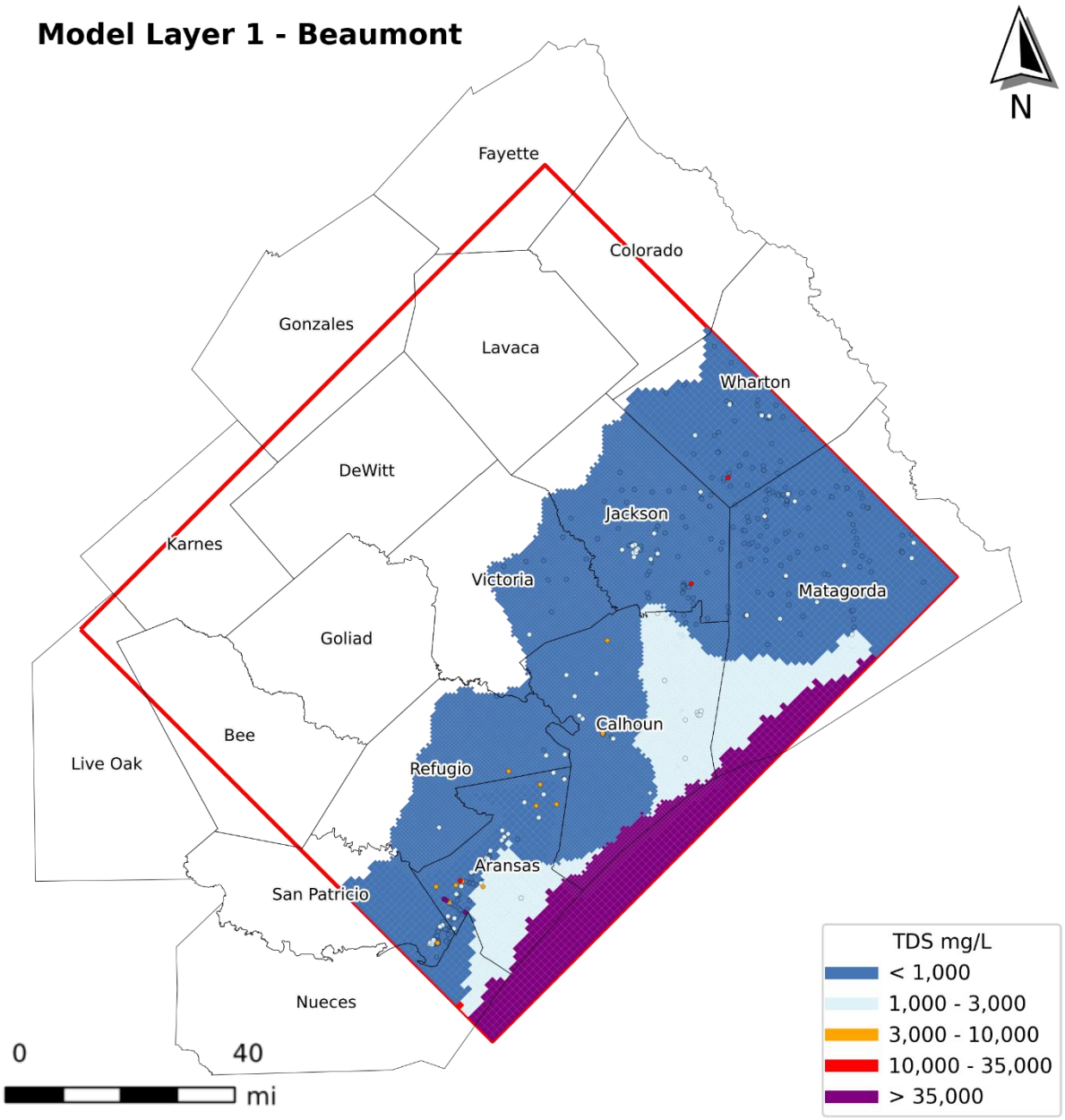


Figure 4-6 TDS concentrations in groundwater in model layer 1 (Beaumont Formation).

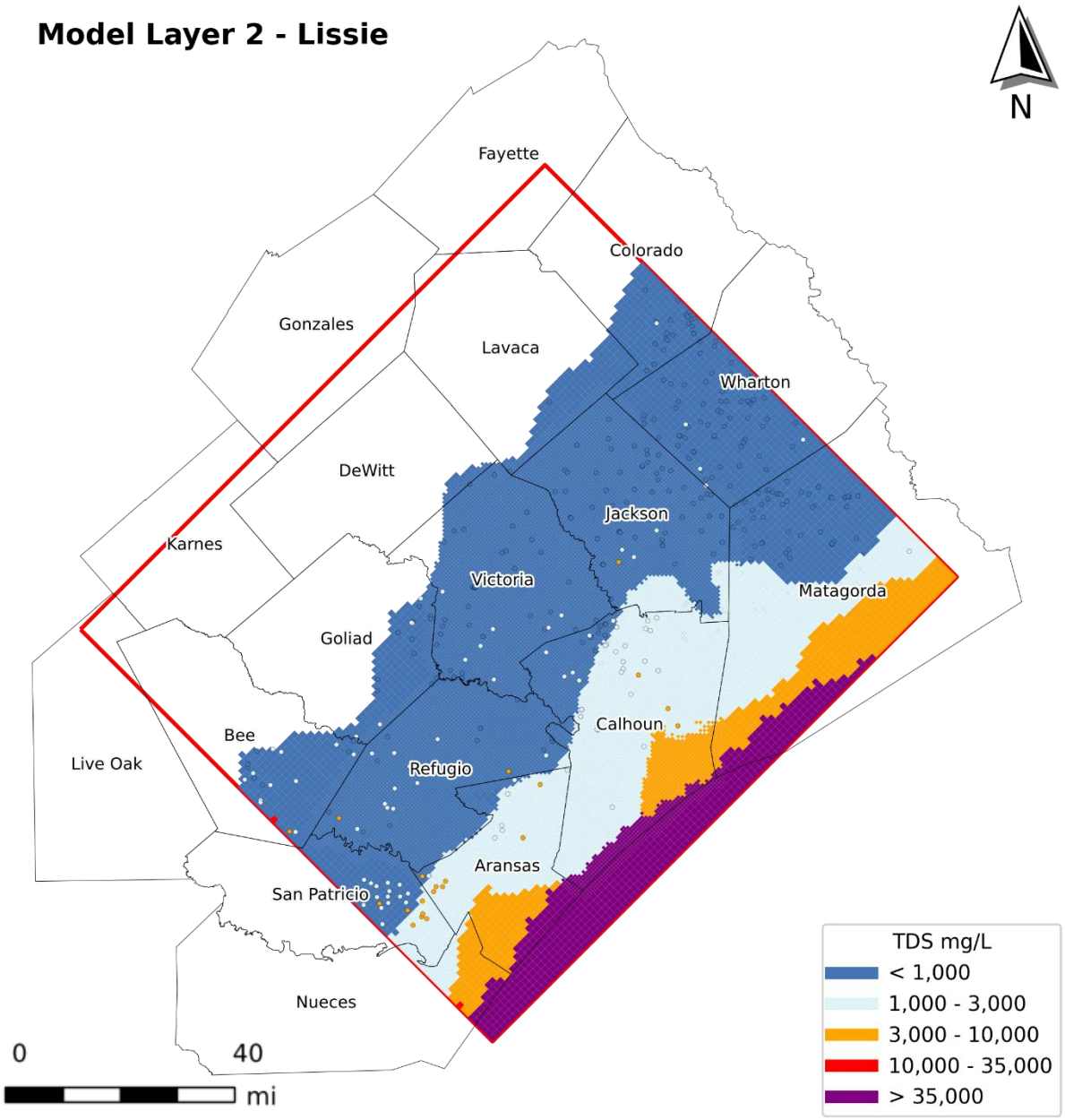


Figure 4-7. TDS concentrations in groundwater in model layer 2 (Lissie Formation).

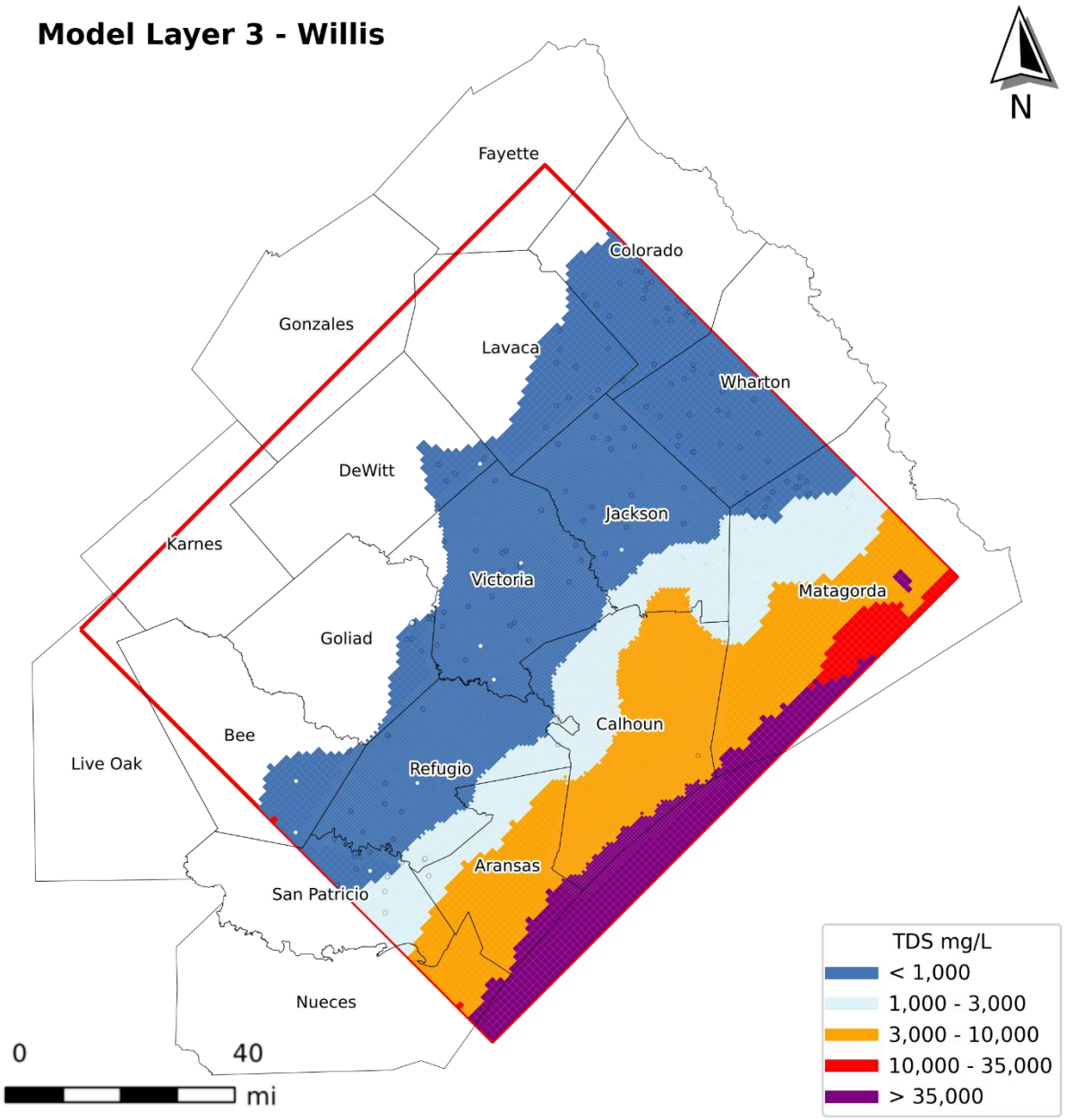


Figure 4-8. TDS concentrations in groundwater in model layer 3 (Willis Formation).

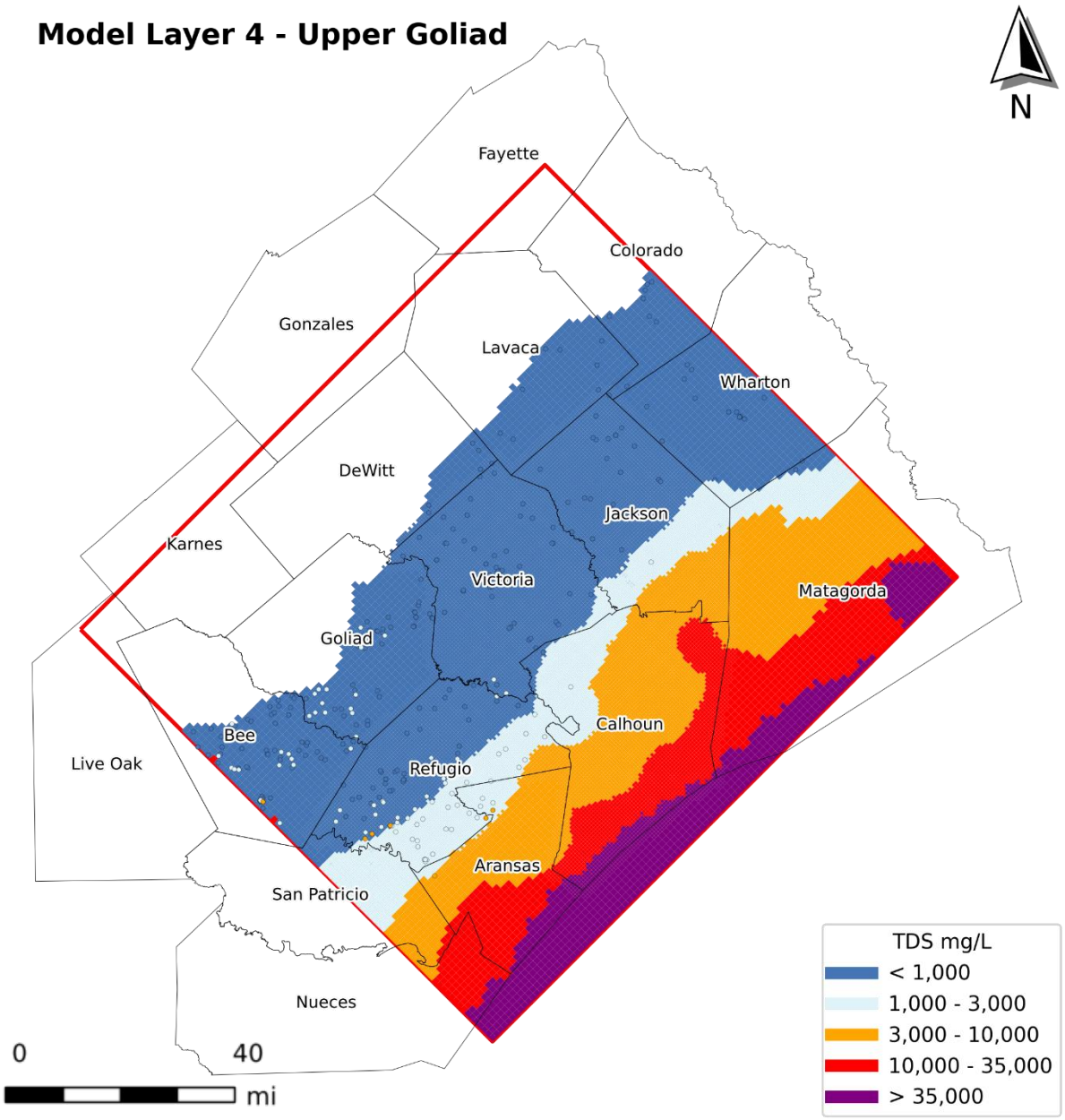


Figure 4-9. TDS concentrations in groundwater in model layer 4 (Upper Goliad Formation).

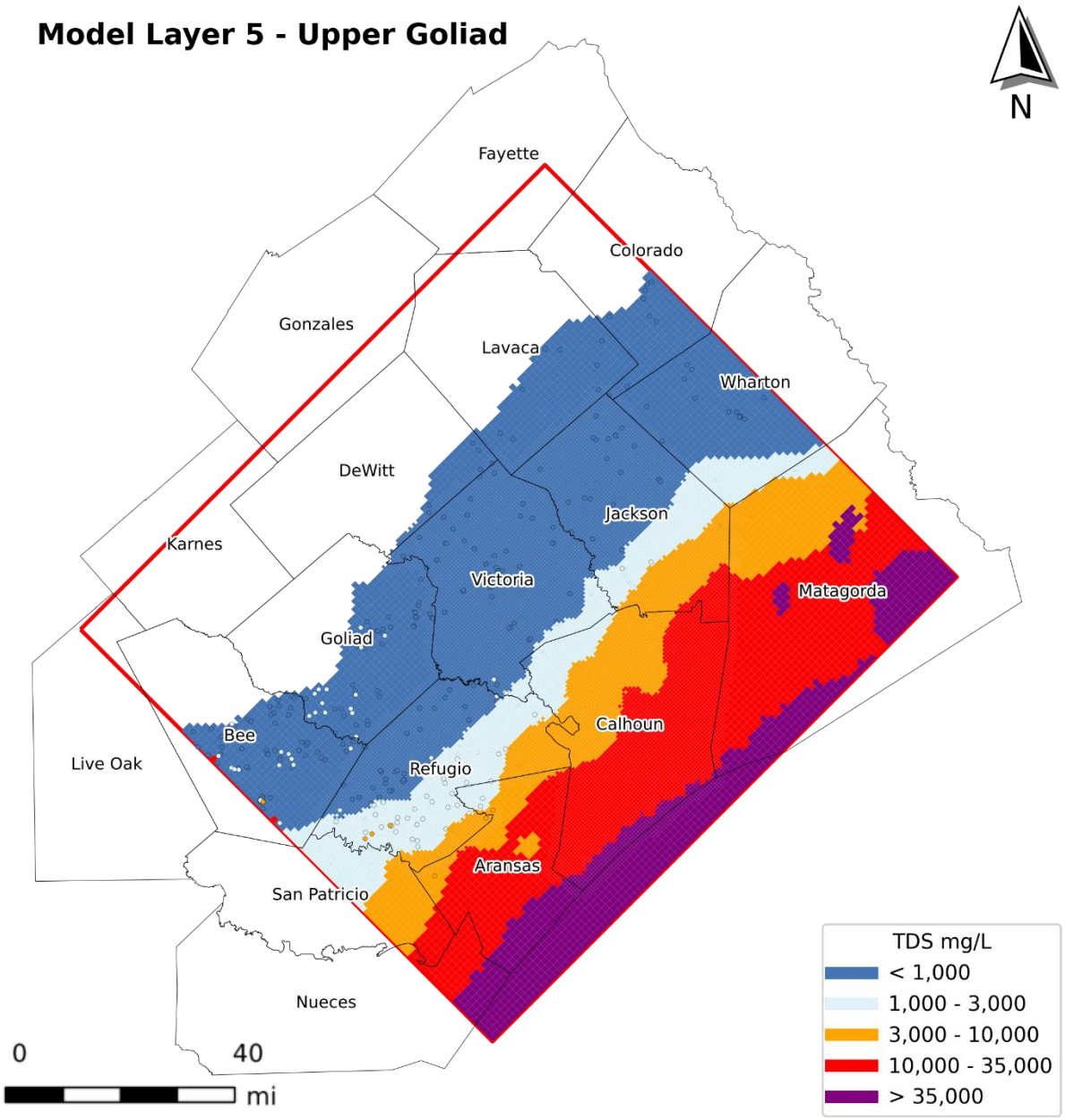


Figure 4-10. TDS concentrations in groundwater in model layer 5 (Upper Goliad Formation).

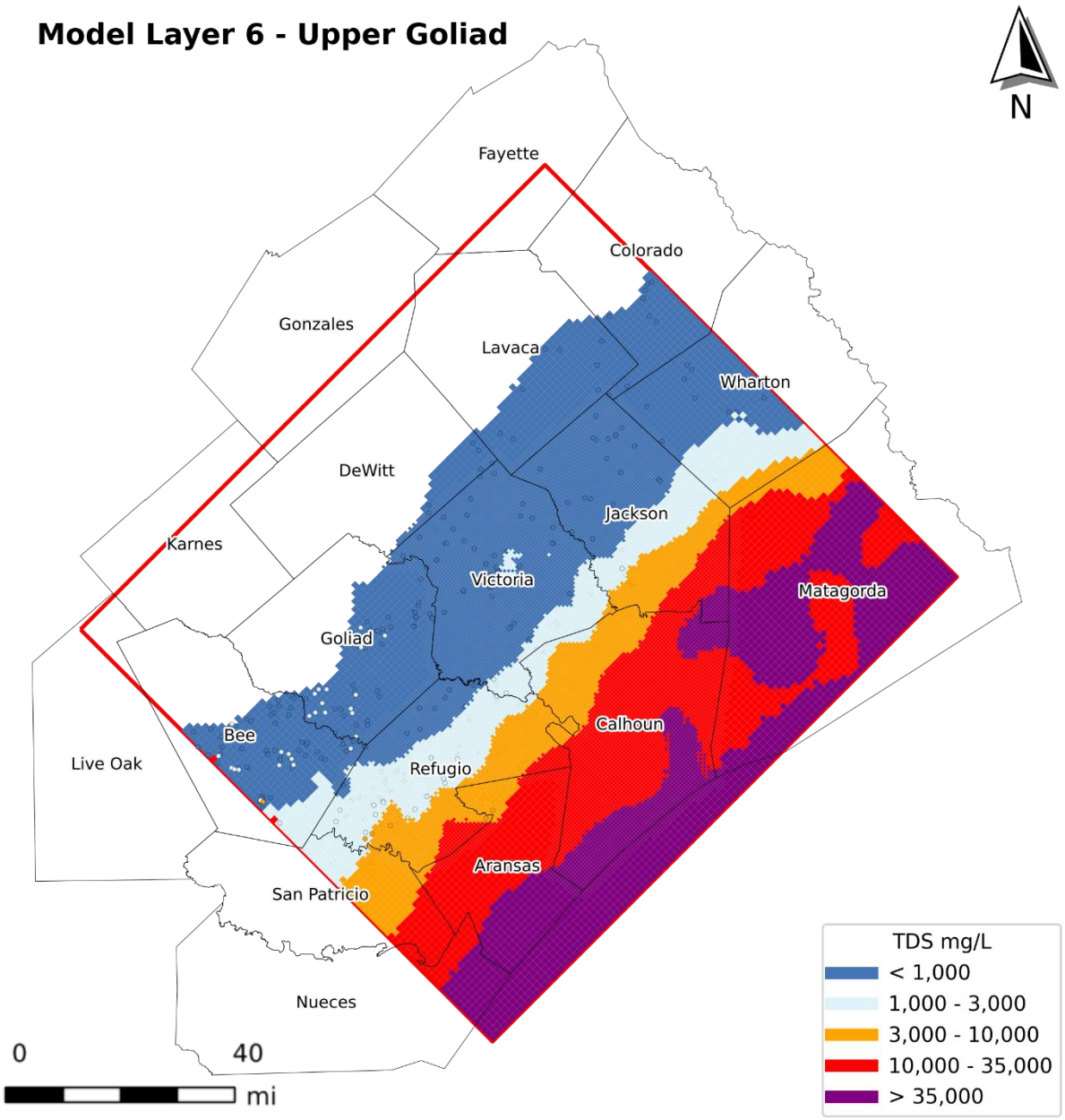


Figure 4-11. TDS concentrations in groundwater in model layer 6 (Upper Goliad Formation).

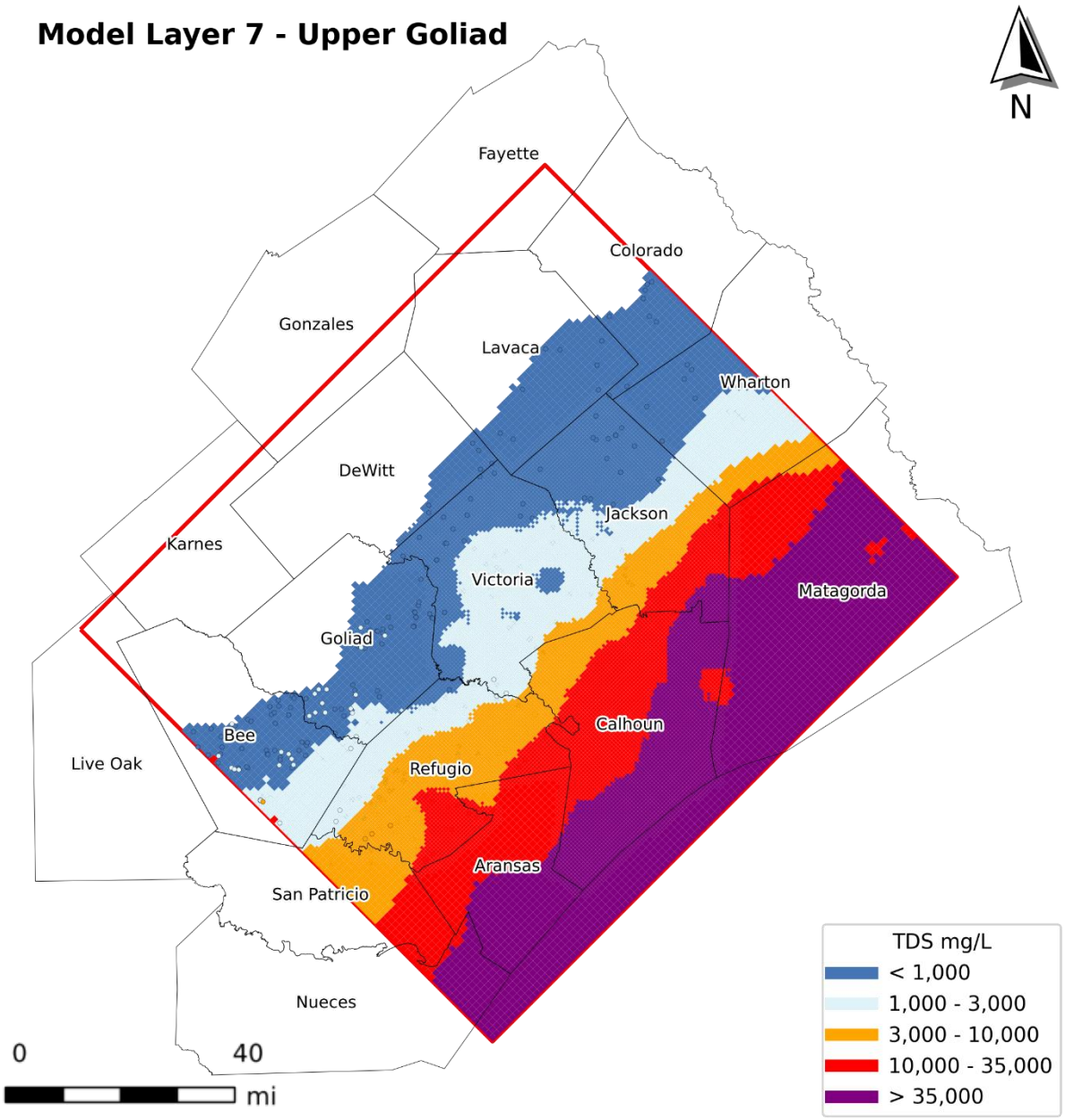


Figure 4-12. TDS concentrations in groundwater in model layer 7 (Upper Goliad Formation).

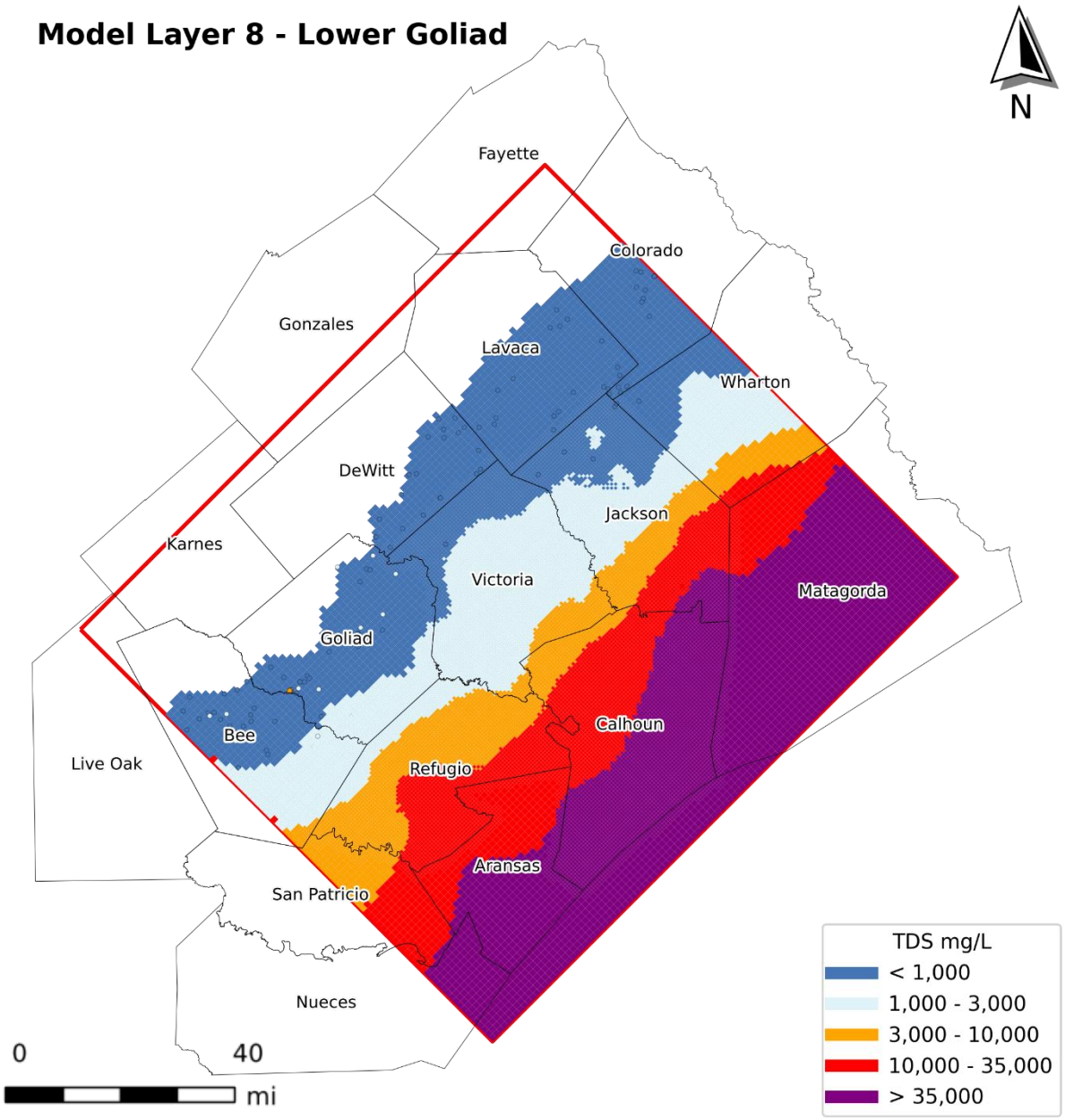


Figure 4-13. TDS concentrations in groundwater in model layer 8 (Lower Goliad Formation).

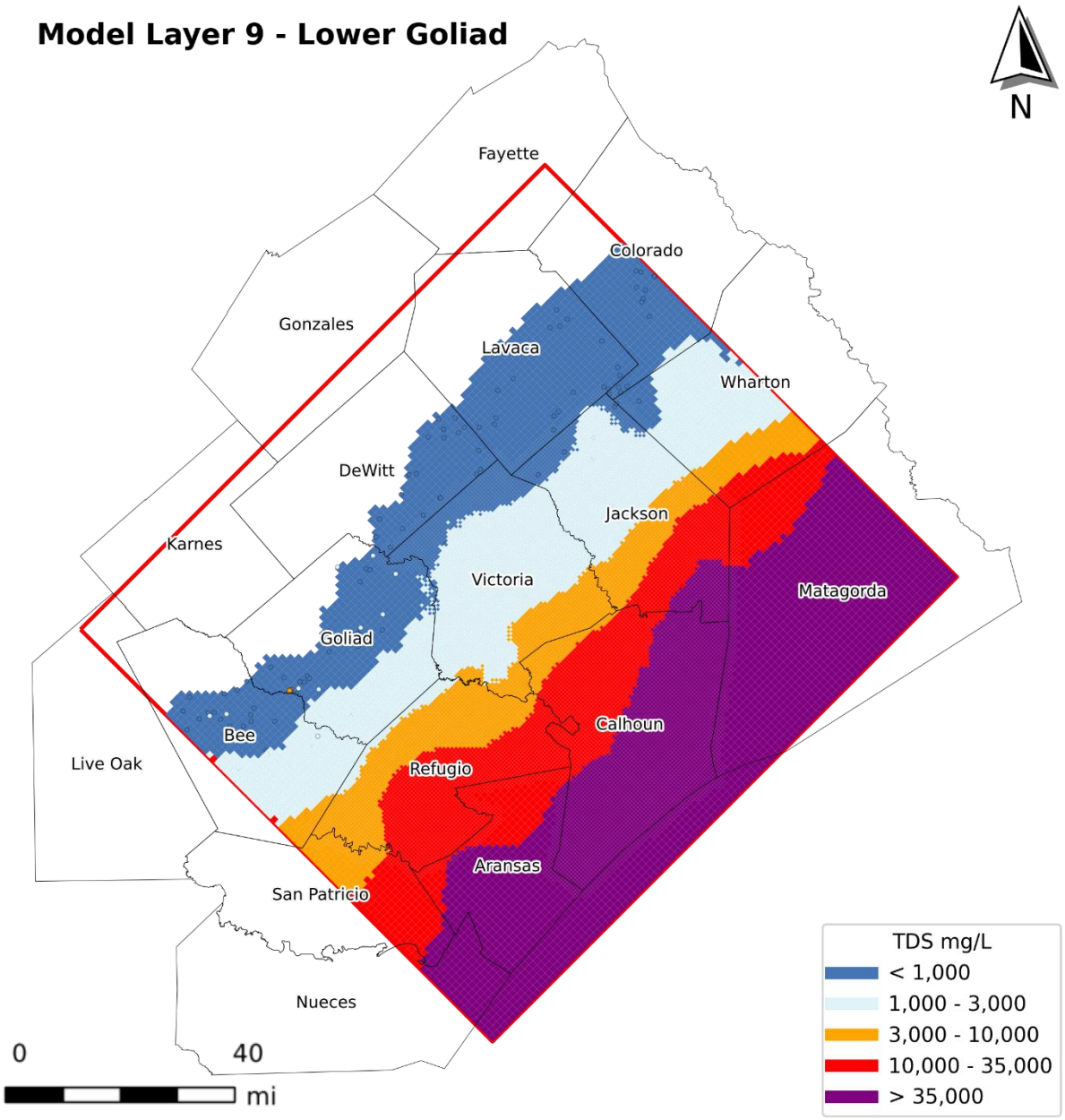


Figure 4-14. TDS concentrations in groundwater in model layer 9 (Lower Goliad Formation).

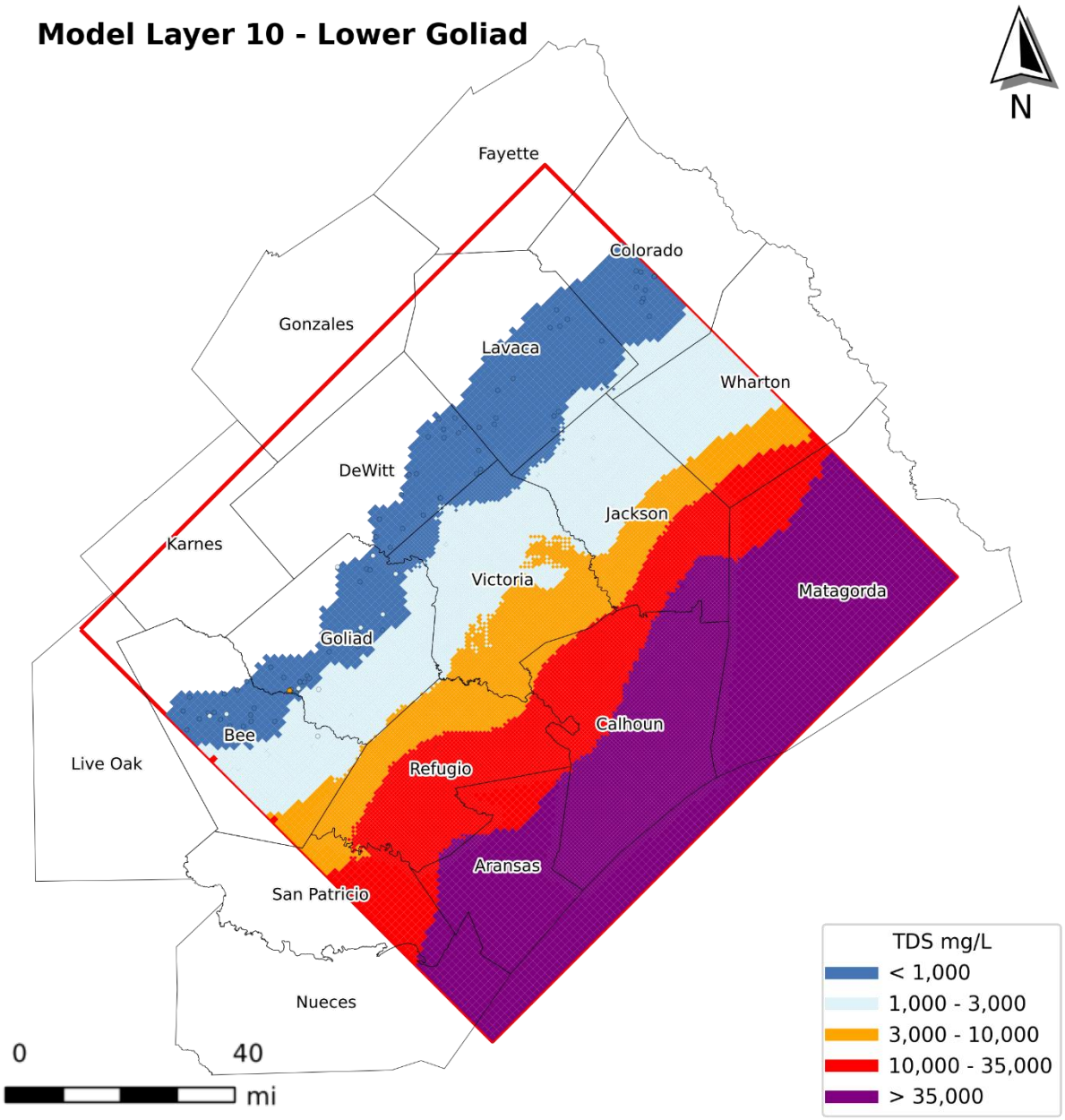


Figure 4-15. TDS concentrations in groundwater in model layer 10 (Lower Goliad Formation).

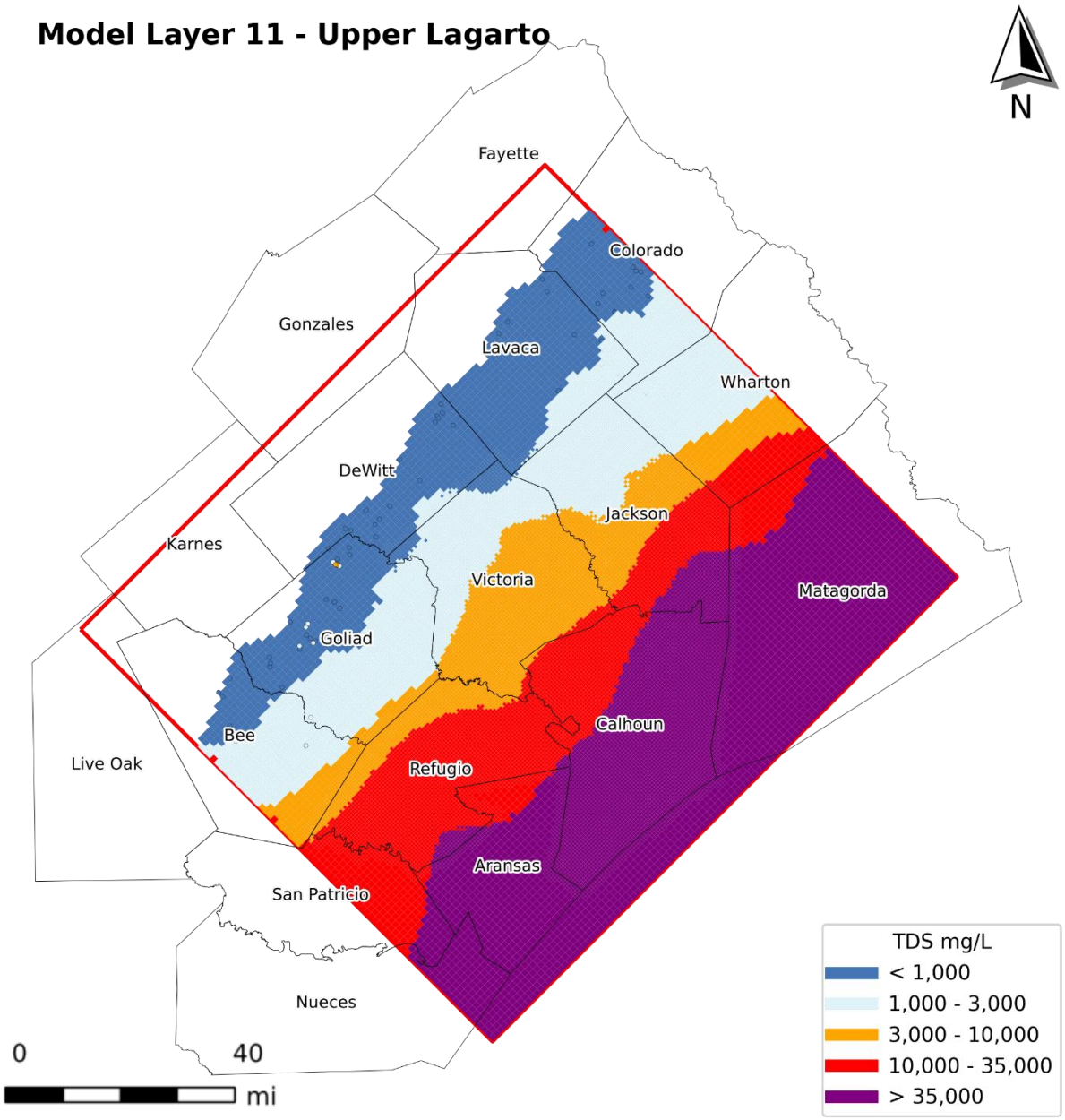


Figure 4-16. TDS concentrations in groundwater in model layer 11 (Upper Lagarto Formation).

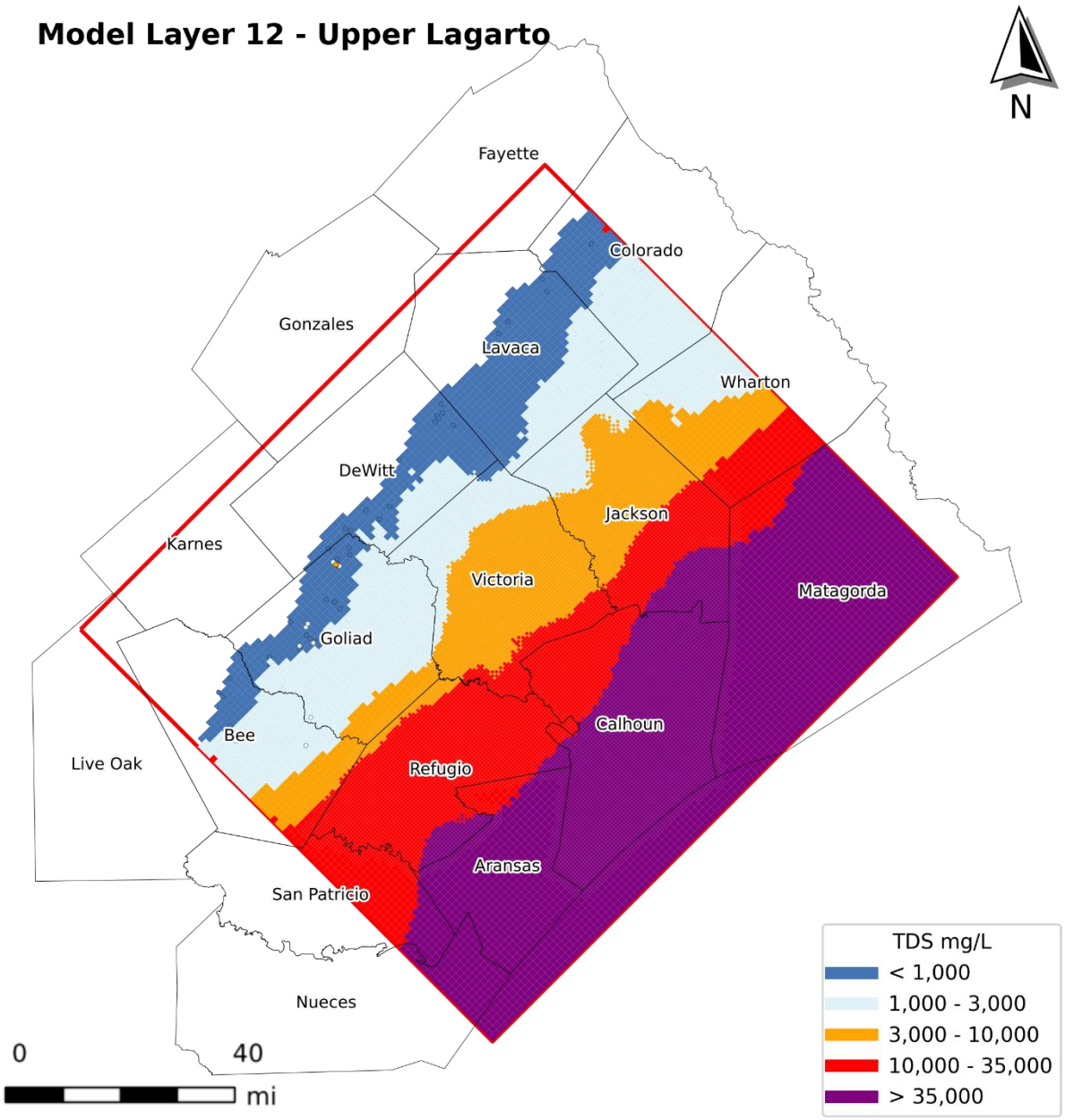


Figure 4-17. TDS concentrations in groundwater in model layer 12 (Upper Lagarto Formation).

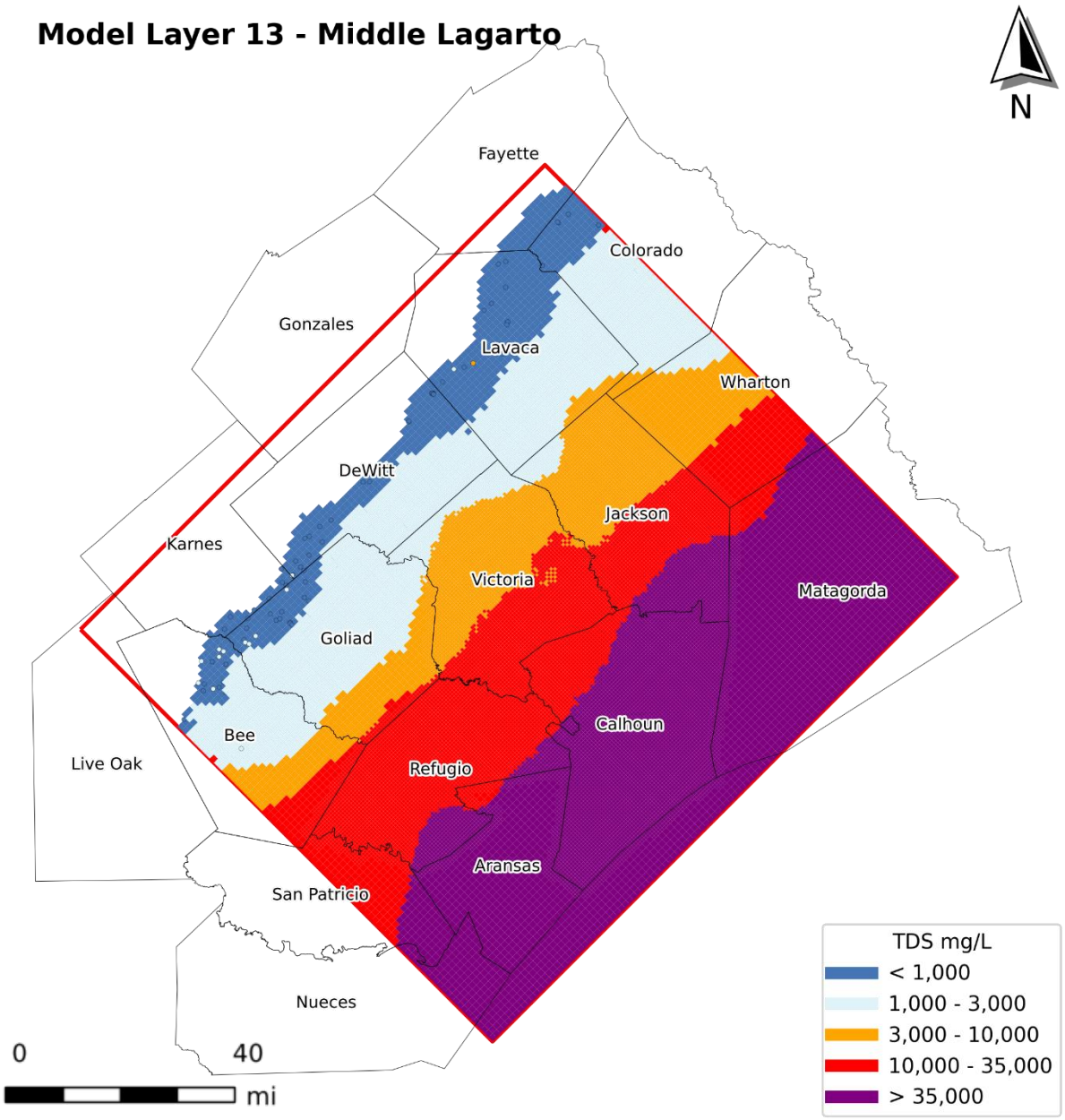


Figure 4-18. TDS concentrations in groundwater in model layer 13 (Middle Lagarto Formation).

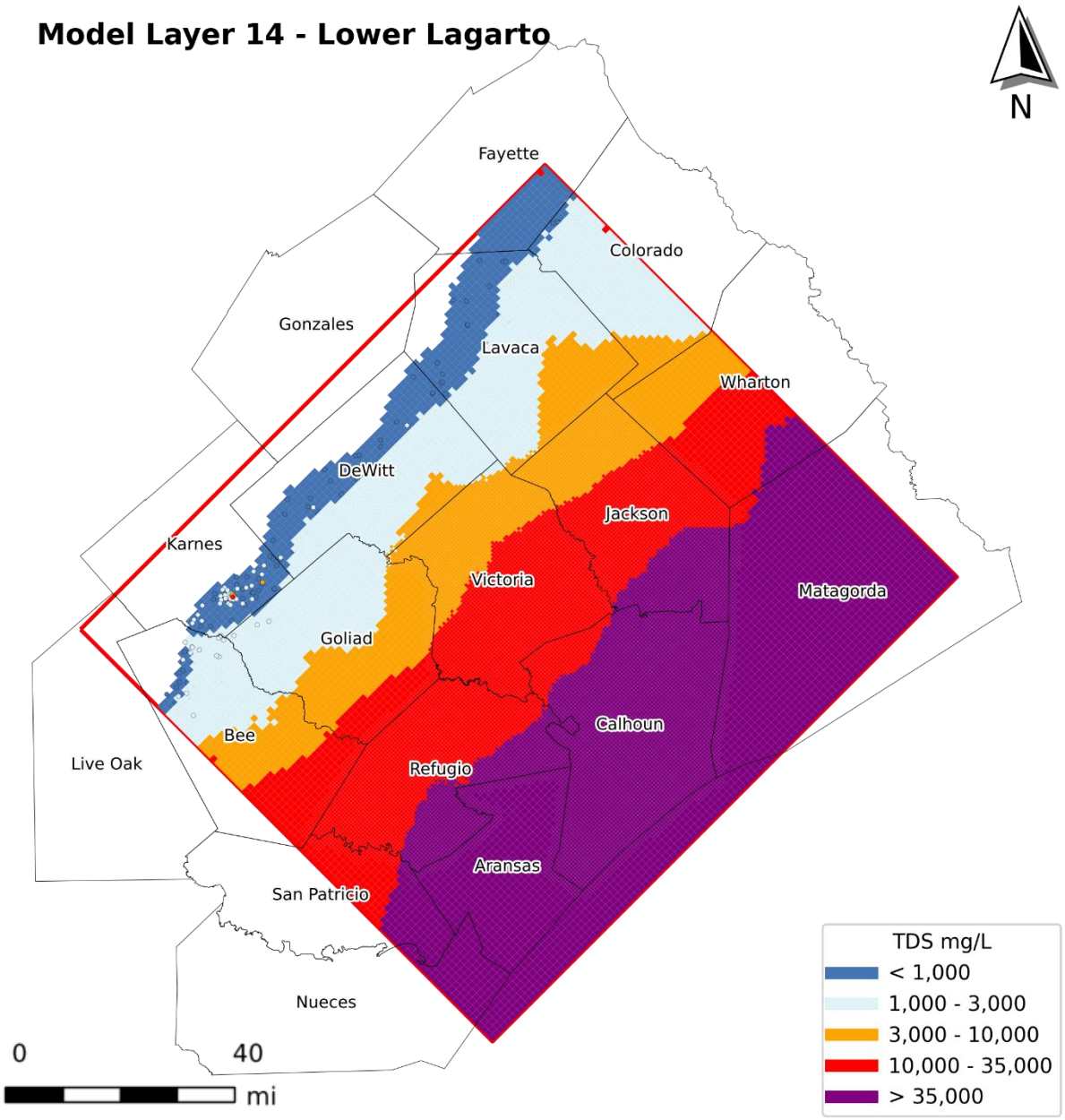


Figure 4-19. TDS concentrations in groundwater in model layer 14 (Lower Lagarto Formation).

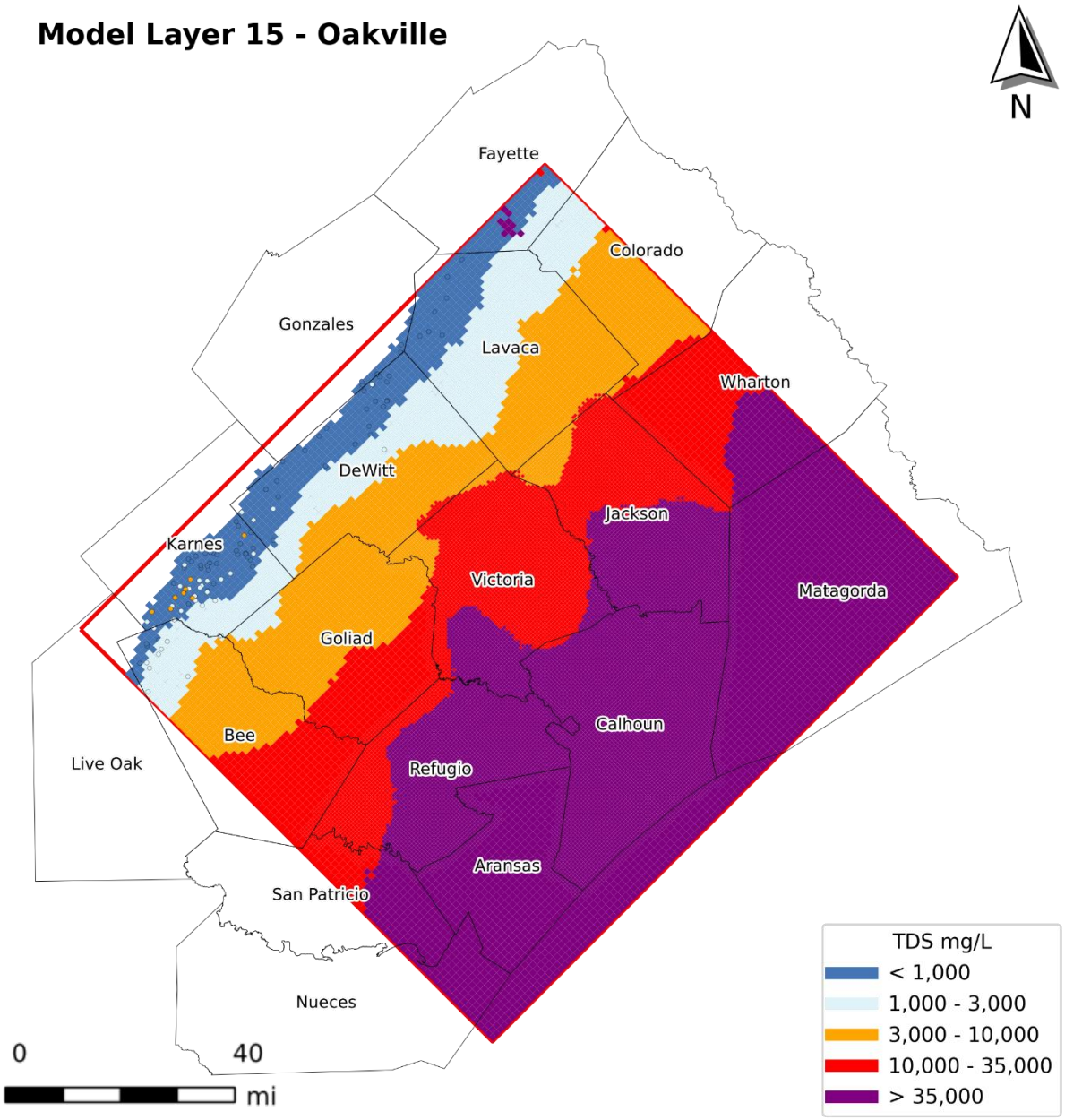


Figure 4-20. TDS concentrations in groundwater in model layer 15 (Oakville Formation).

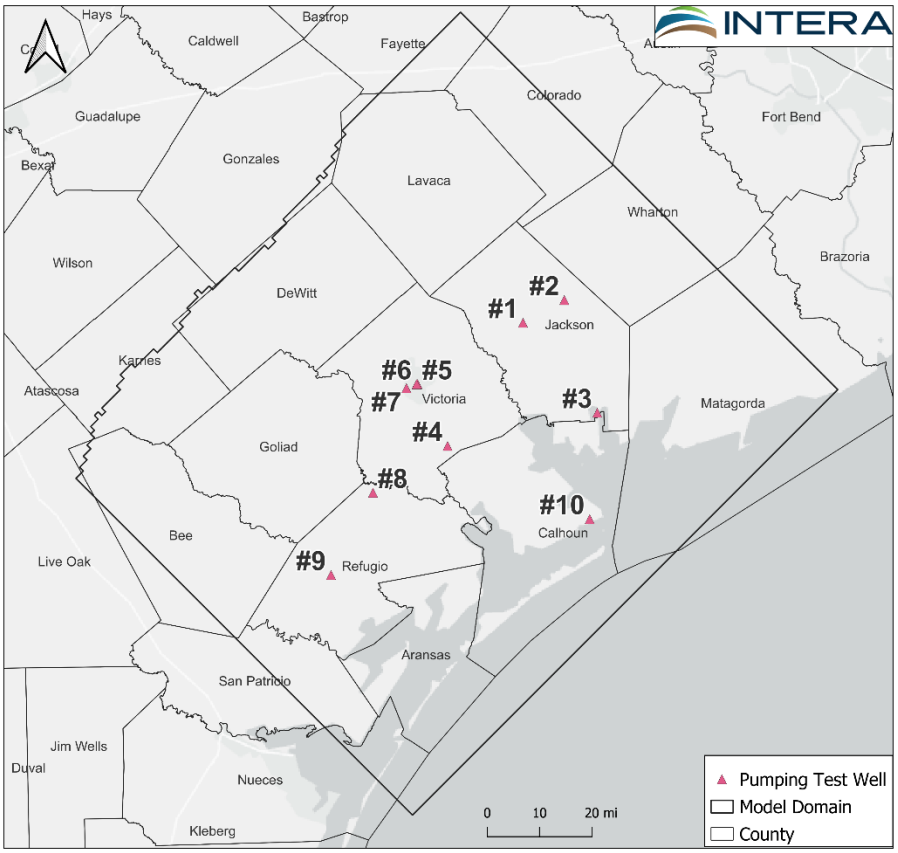


Figure 4-21. Locations of the Aquifer Pumping Tests whose calculated transmissivity values were used for the model calibration.

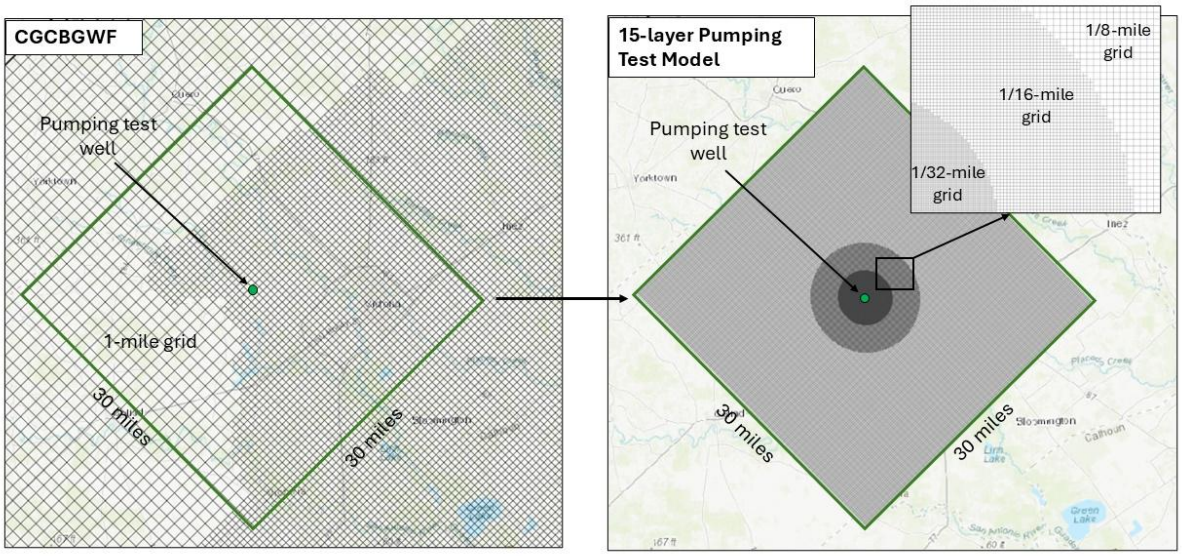


Figure 4-22. Generation of the single well pumping test model from the CGCBGWF Model.

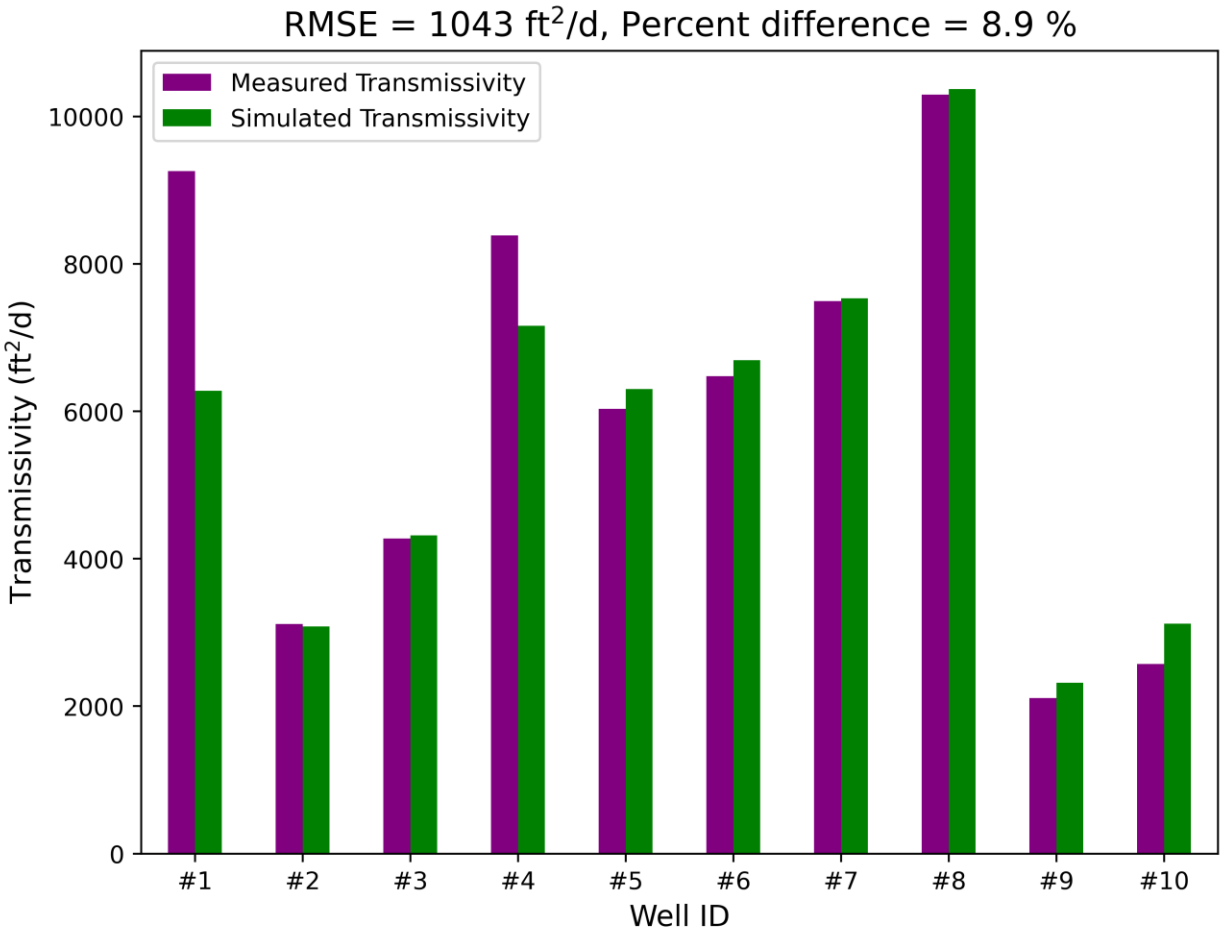


Figure 4-23. Comparison between the observed transmissivity and the simulated transmissivity values for ten aquifer pumping tests used for model calibration.

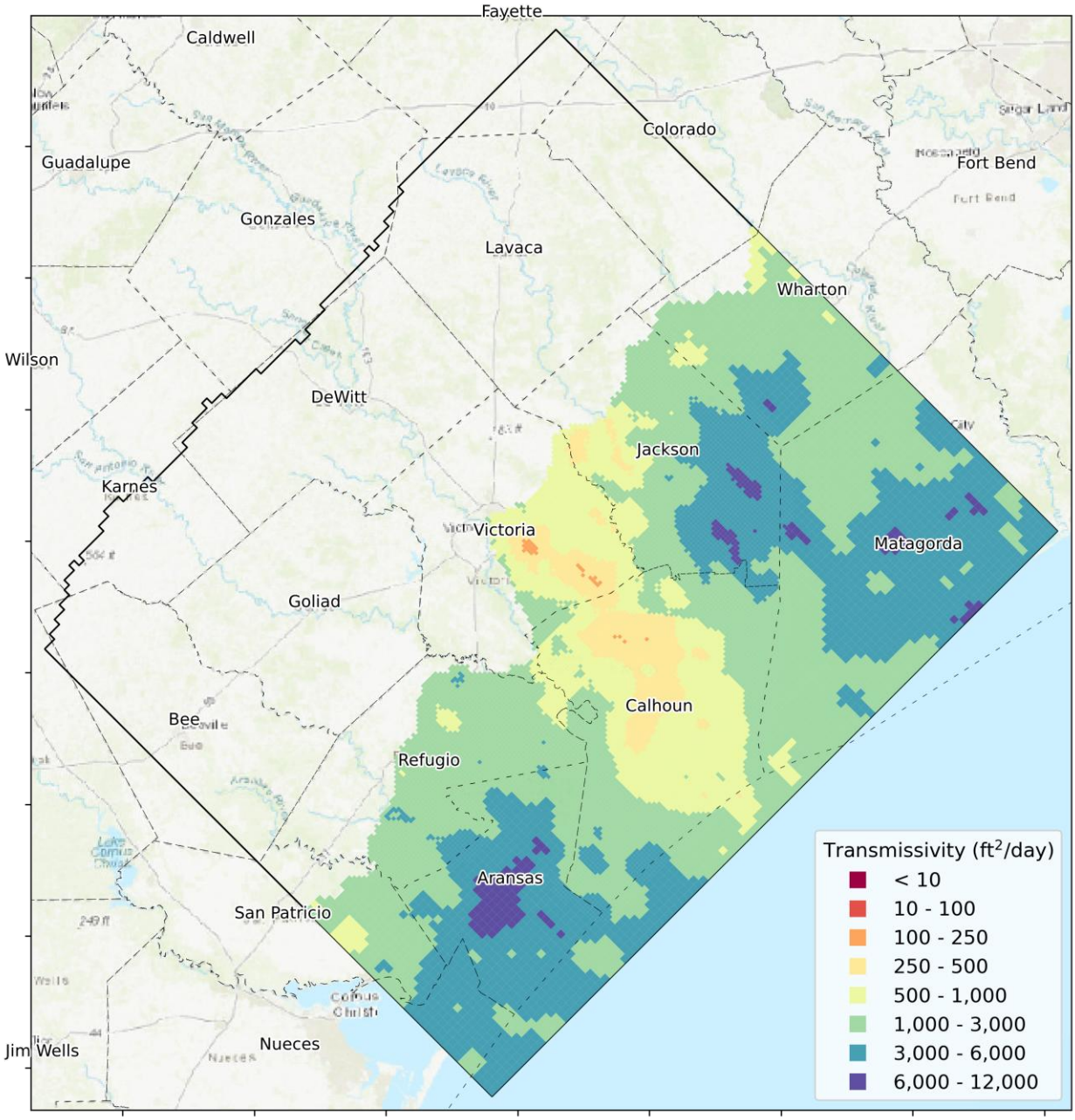


Figure 4-24. Transmissivity values in Model Layer 1 (Beaumont Formation).

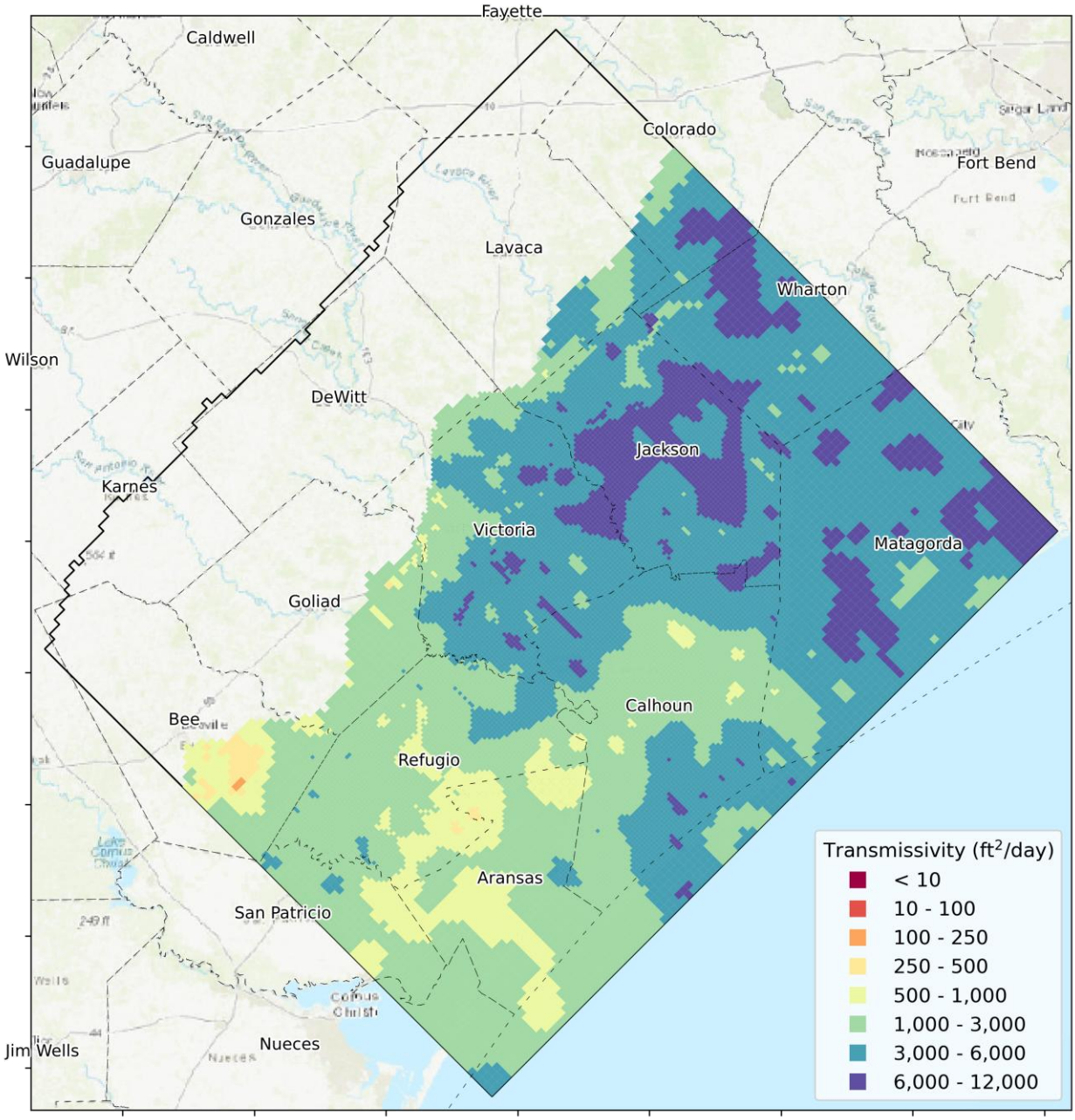


Figure 4-25. Transmissivity values in Model Layer 2 (Lissie Formation).

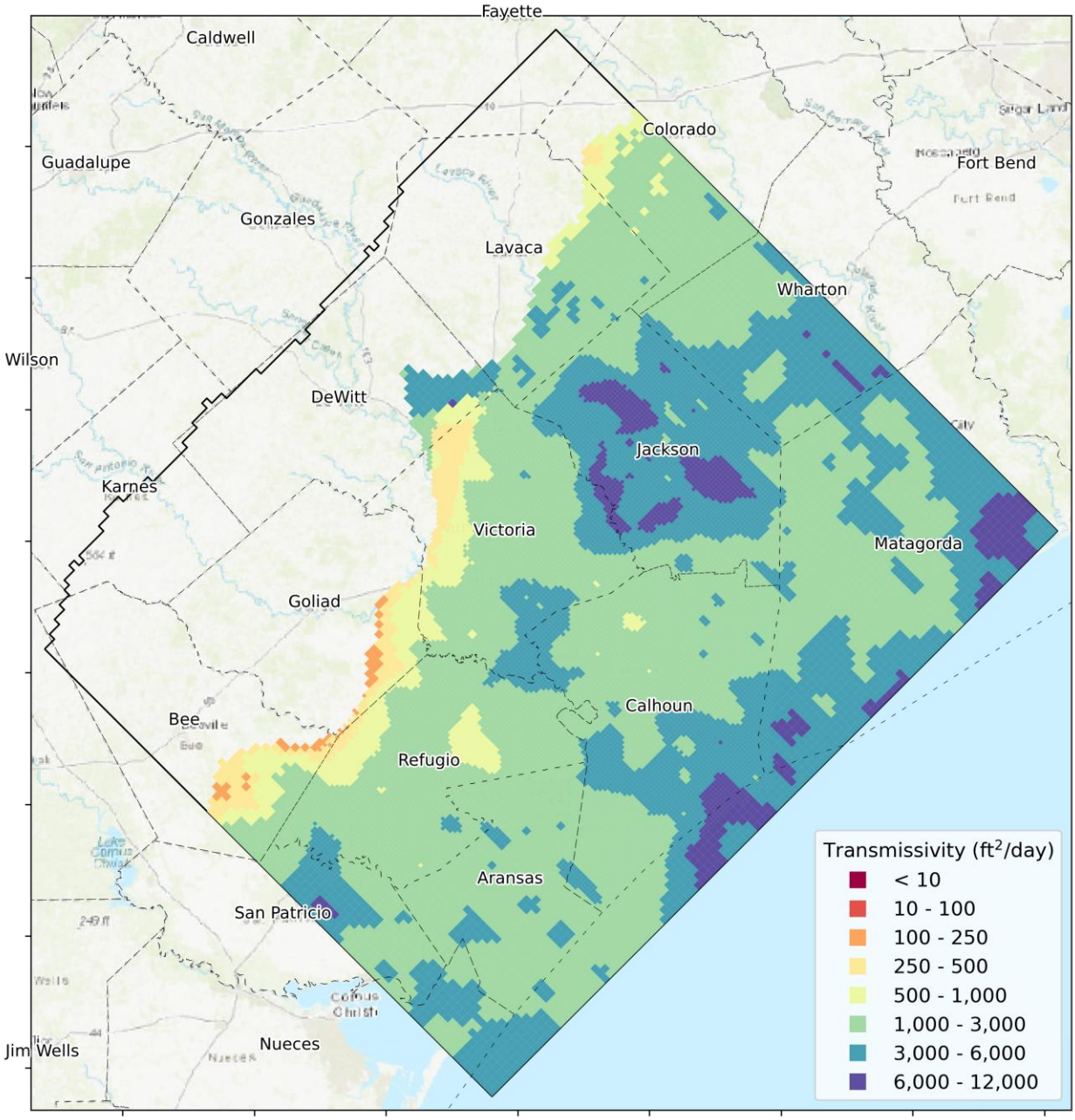


Figure 4-26. Transmissivity values in Model Layer 3 (Willis Formation).

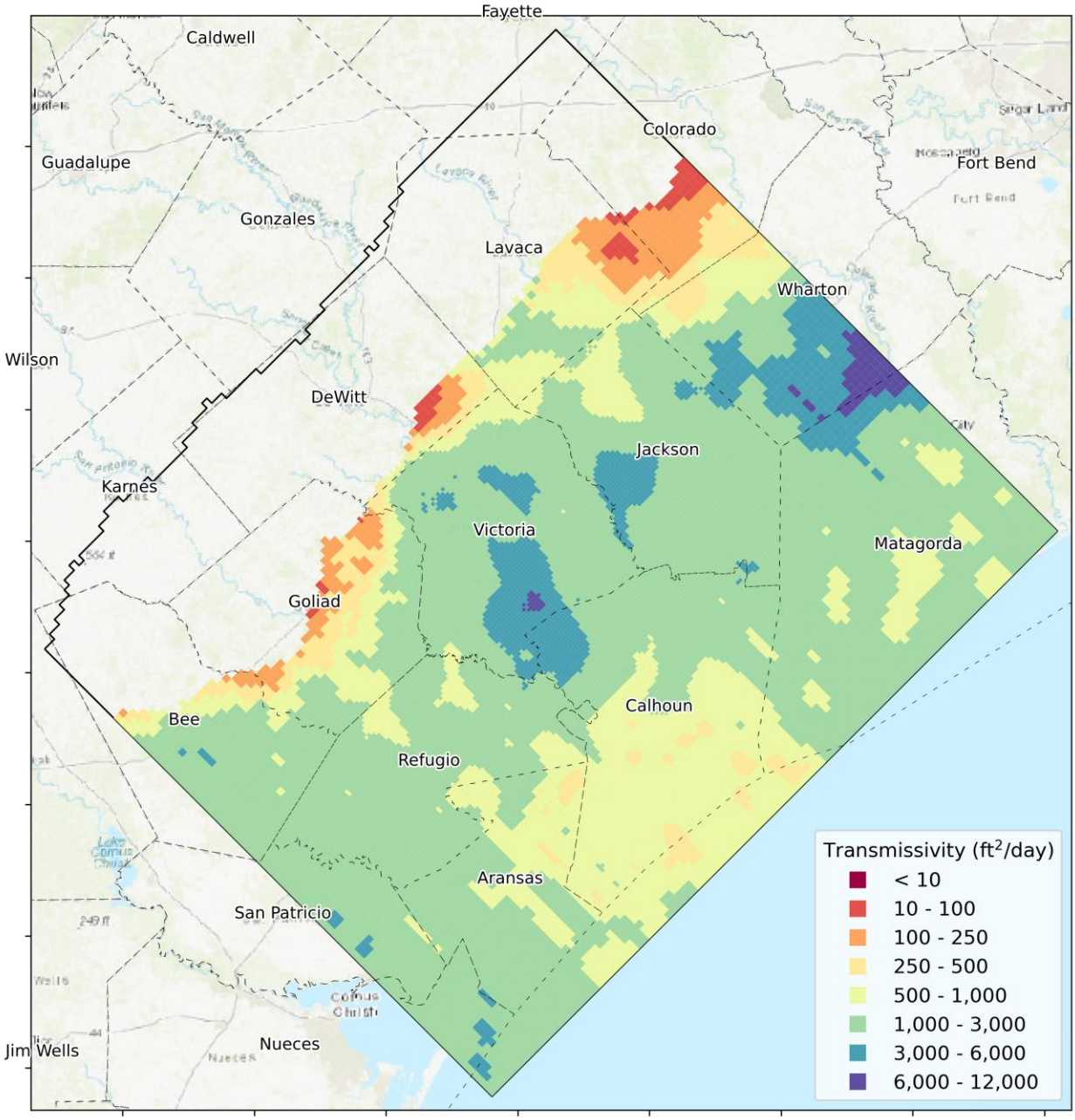


Figure 4-27. Transmissivity values in Model Layer 4 (uppermost quartile of the Upper Goliad Formation).

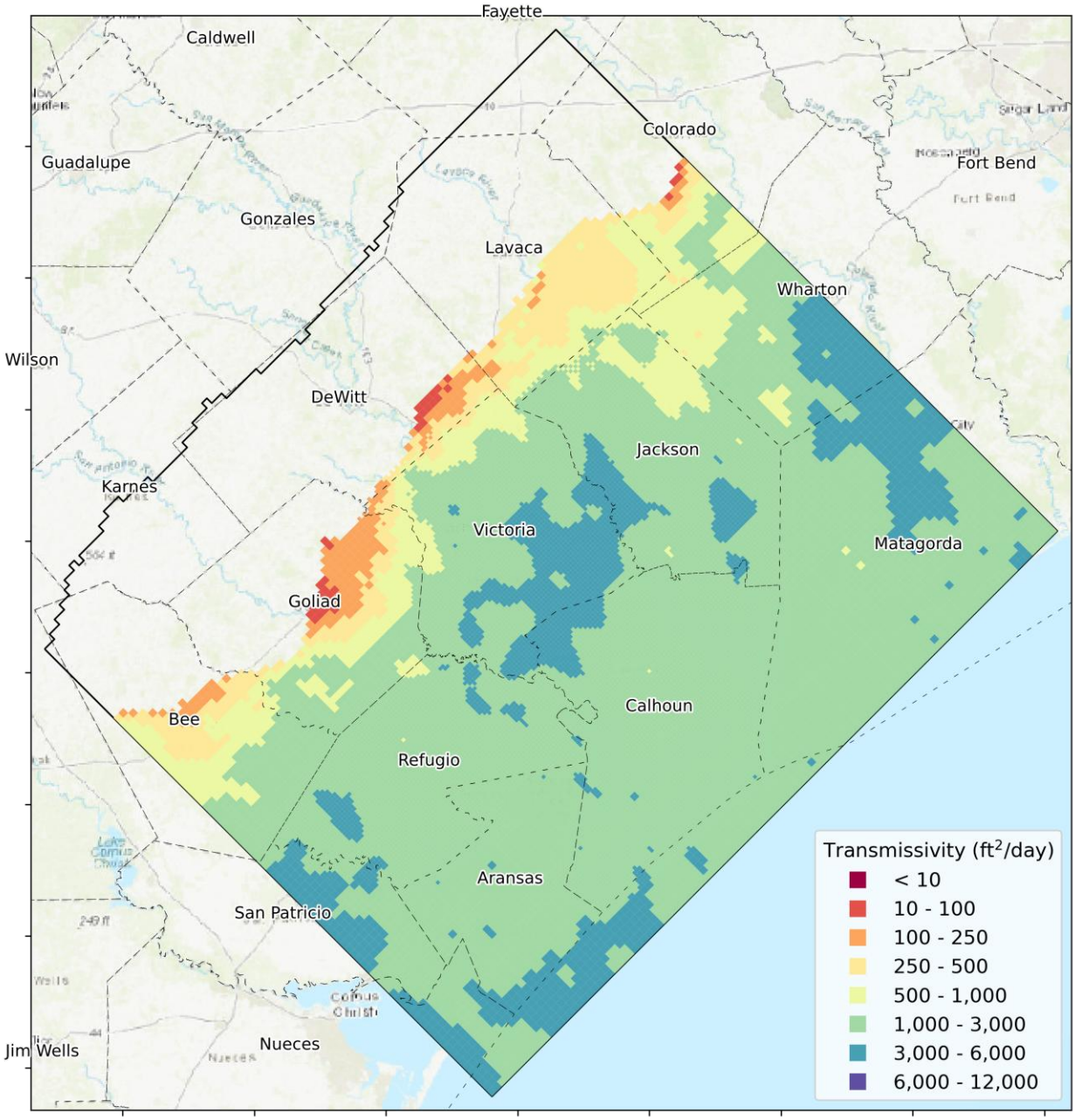


Figure 4-28. Transmissivity values in Model Layer 5 (upper quartile of the Upper Goliad formation).

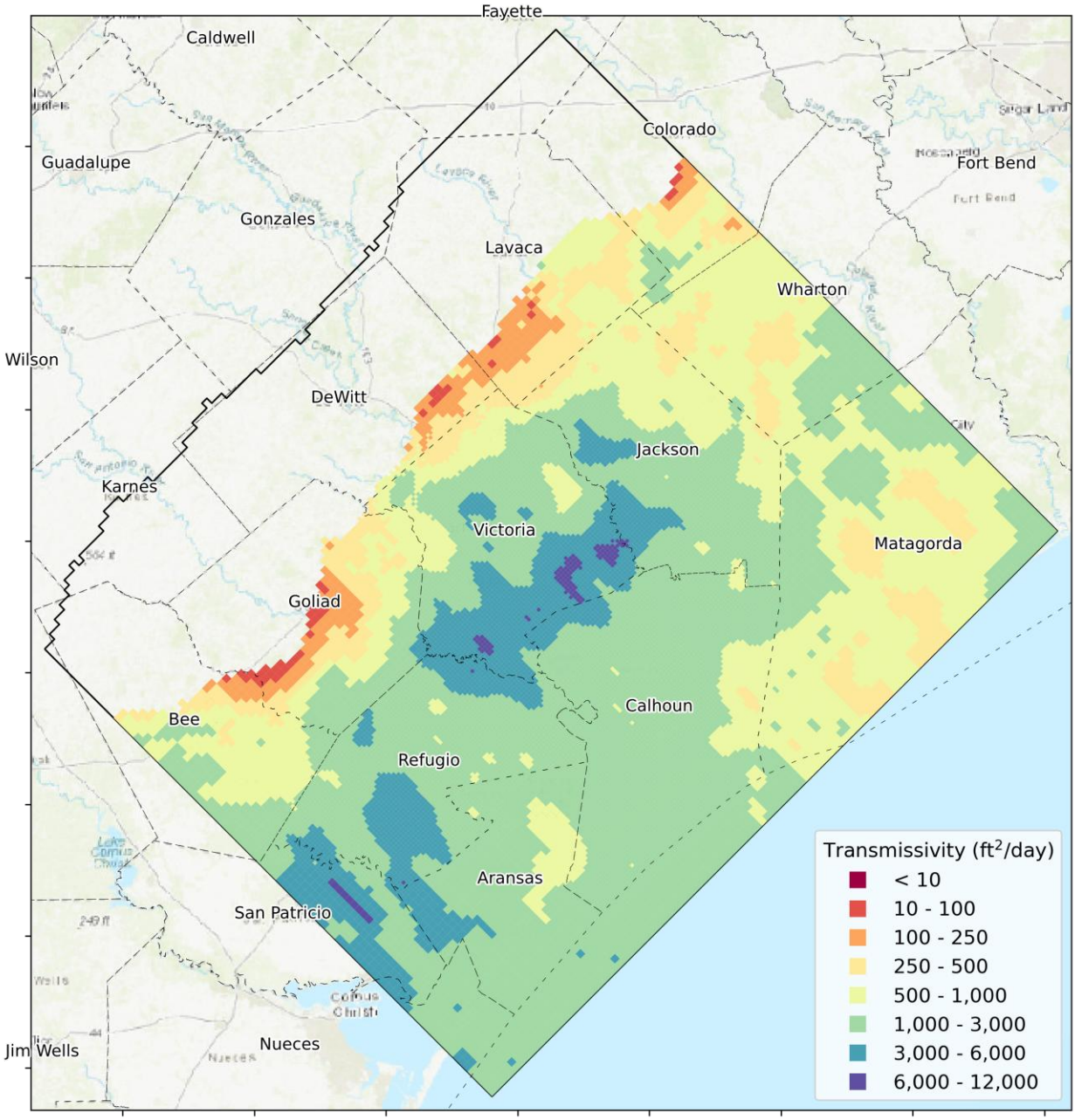


Figure 4-29. Transmissivity values in Model Layer 6 (lower quartile of the Upper Goliad formation).

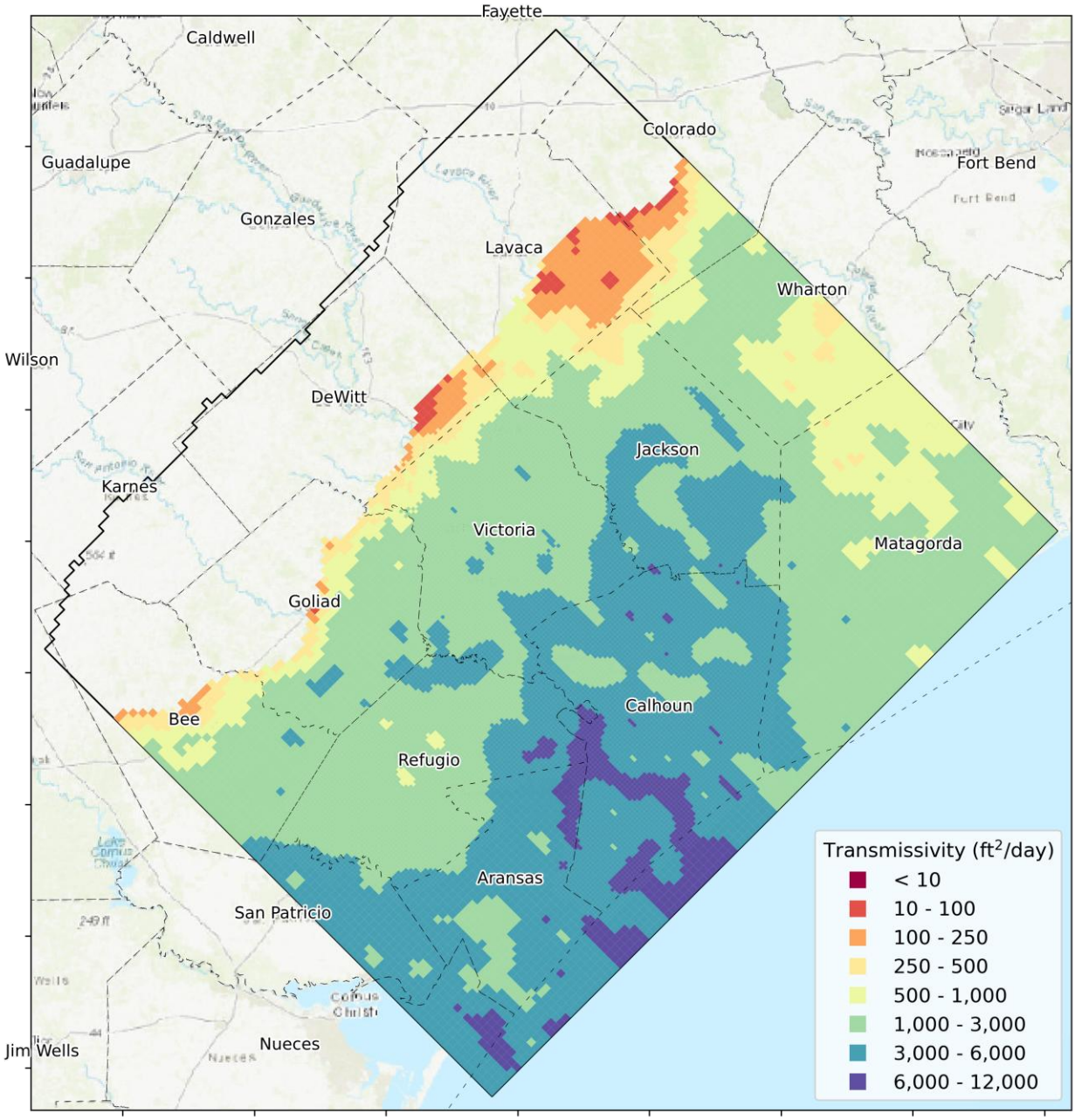


Figure 4-30. Transmissivity values in Model Layer 7 (lowermost quartile of the Upper Goliad formation).

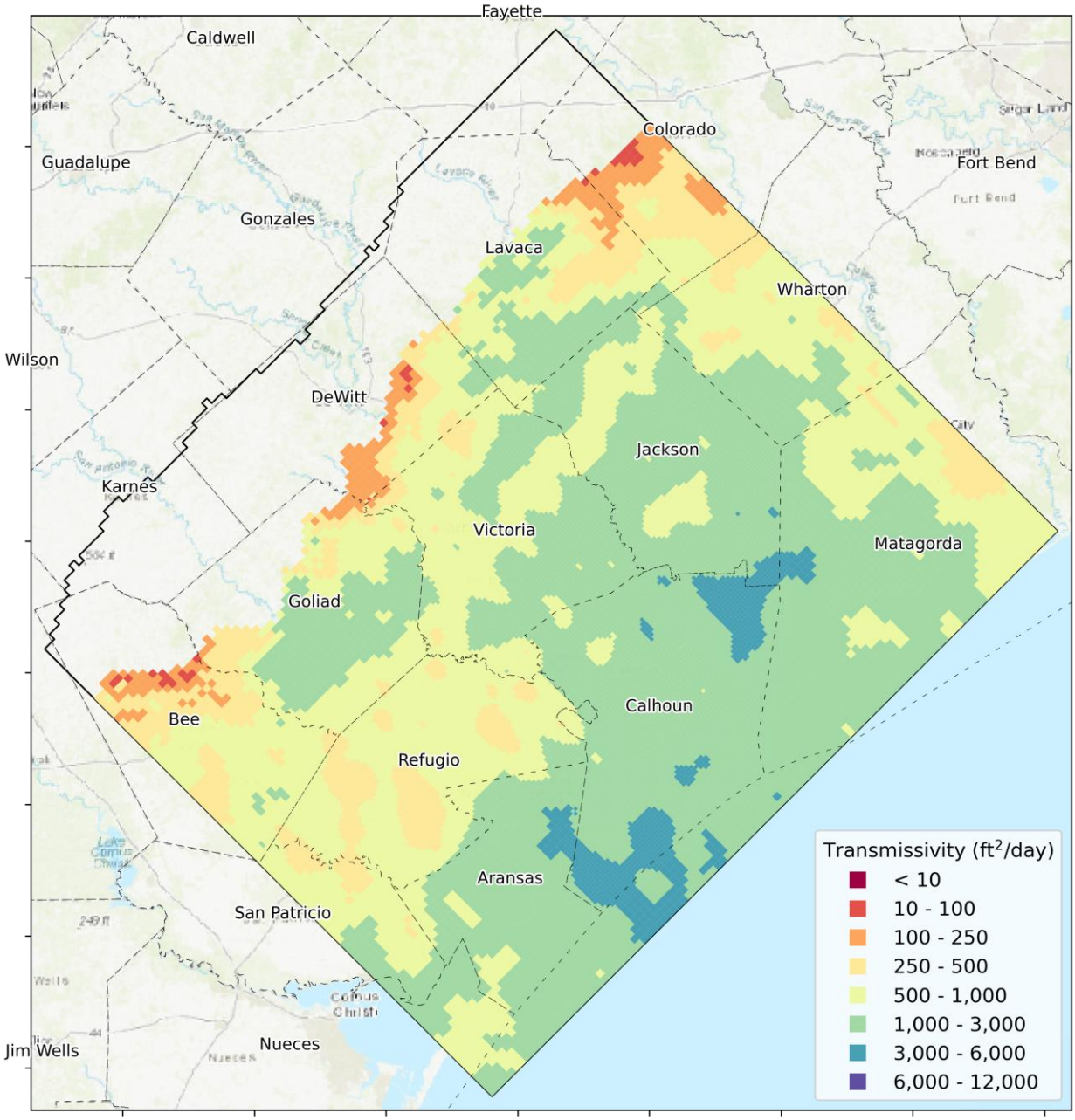


Figure 4-31. Transmissivity values in Model Layer 8 (upper third of the Lower Goliad formation).

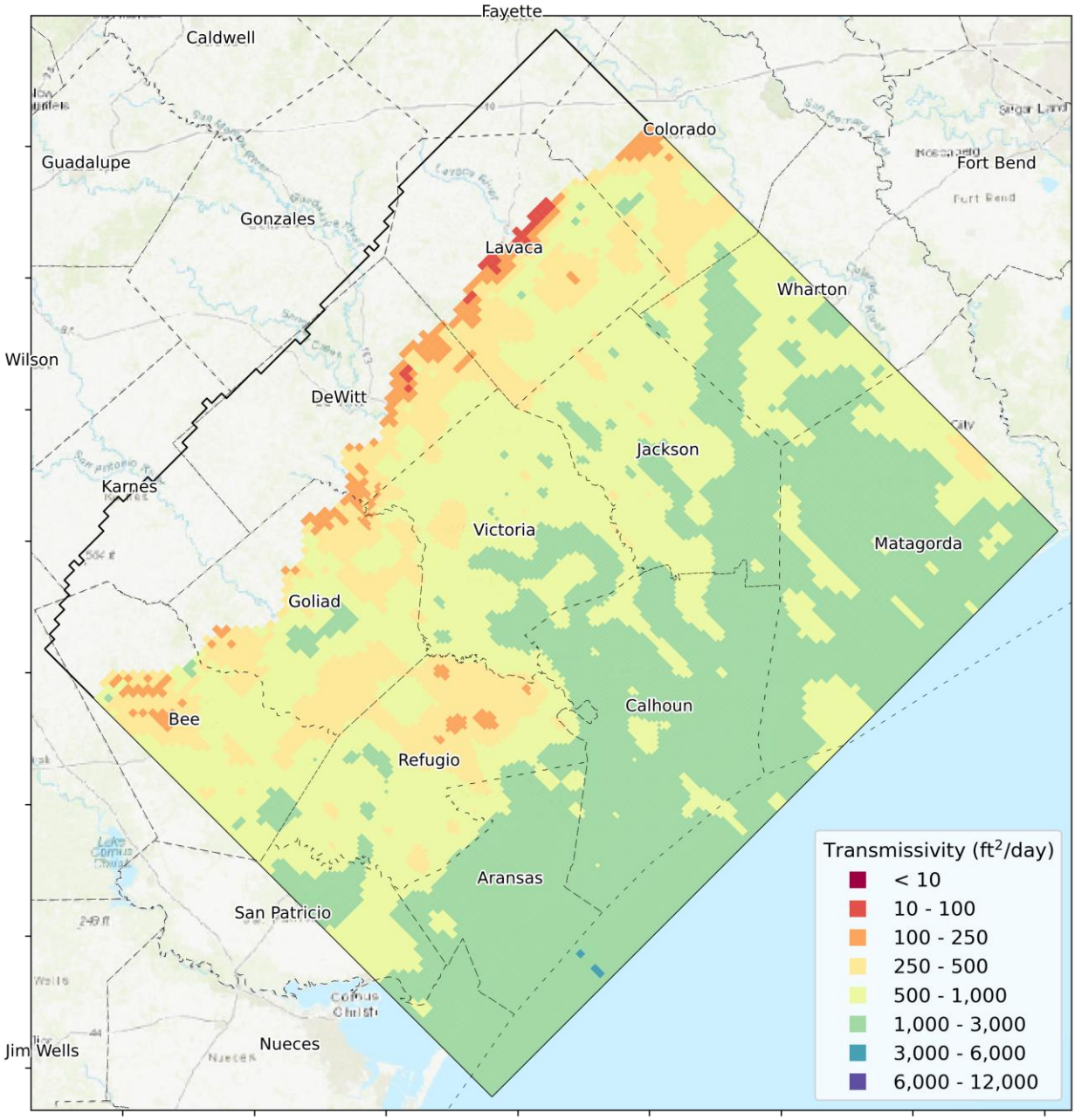


Figure 4-32. Transmissivity values in Model Layer 9 (middle third of the Lower Goliad formation).

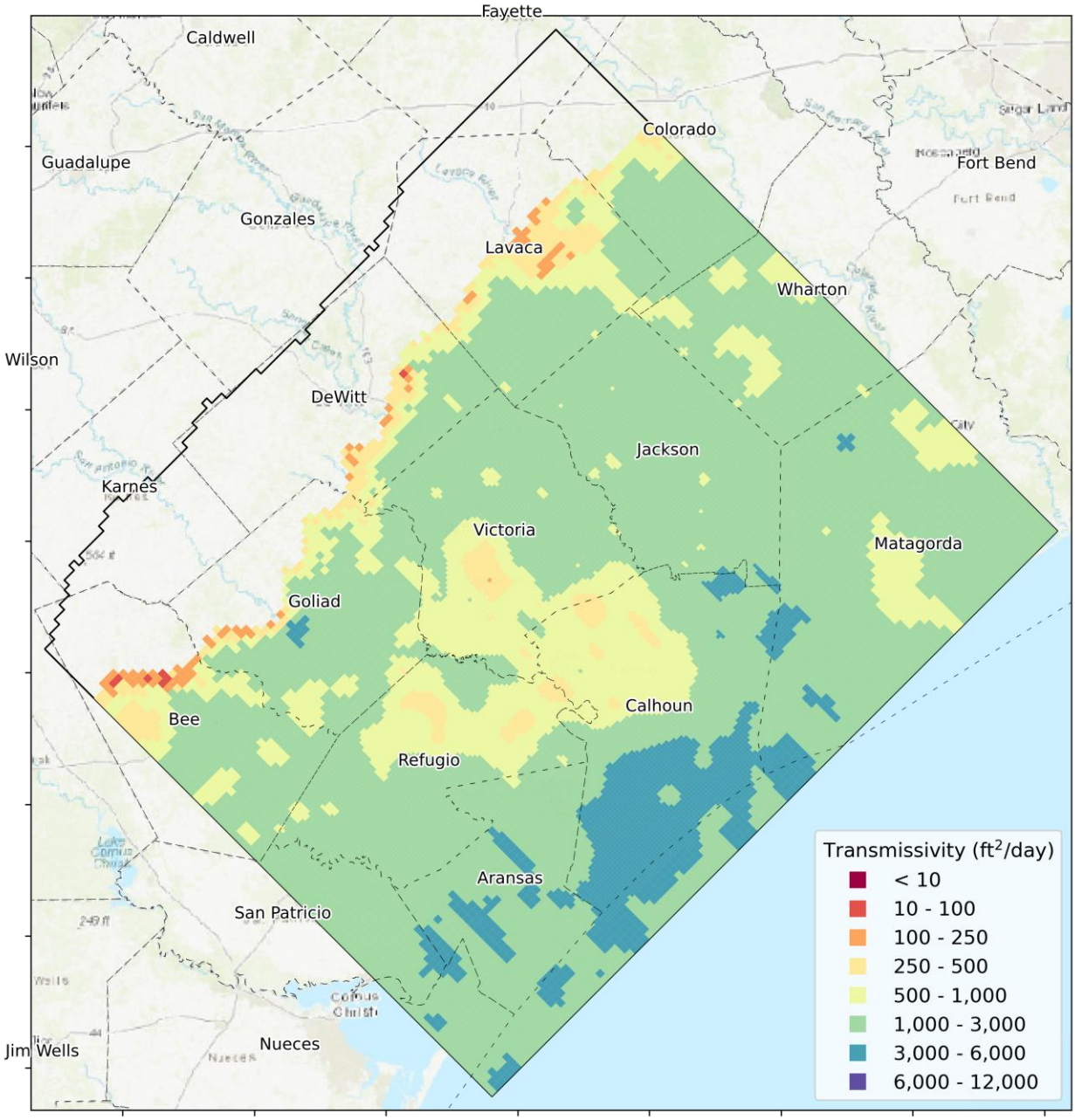


Figure 4-33. Transmissivity values in Model Layer 10 (lower third of the Lower Goliad formation).

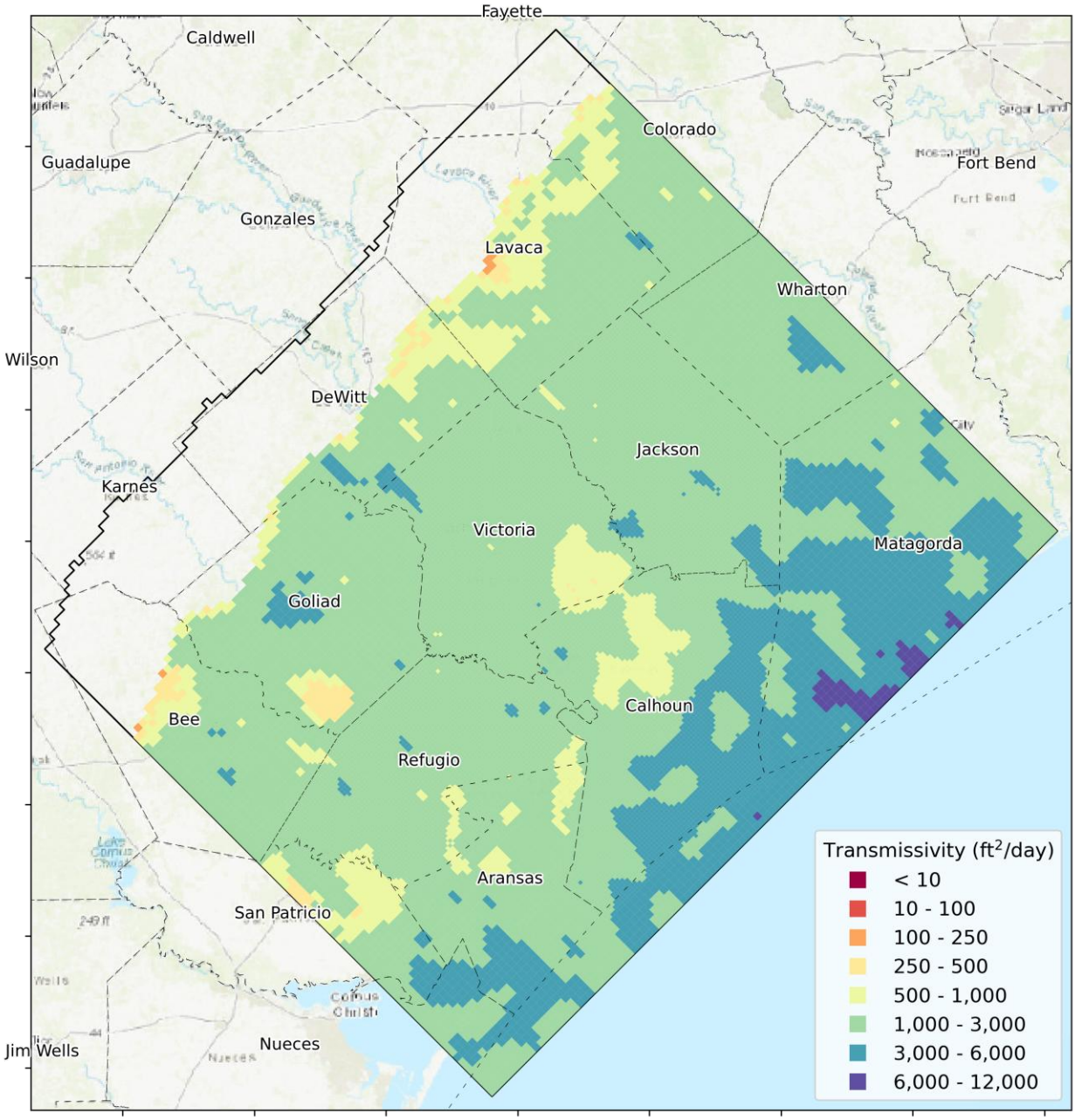


Figure 4-34. Transmissivity values in Model Layer 11 (upper half of the Upper Lagarto formation).

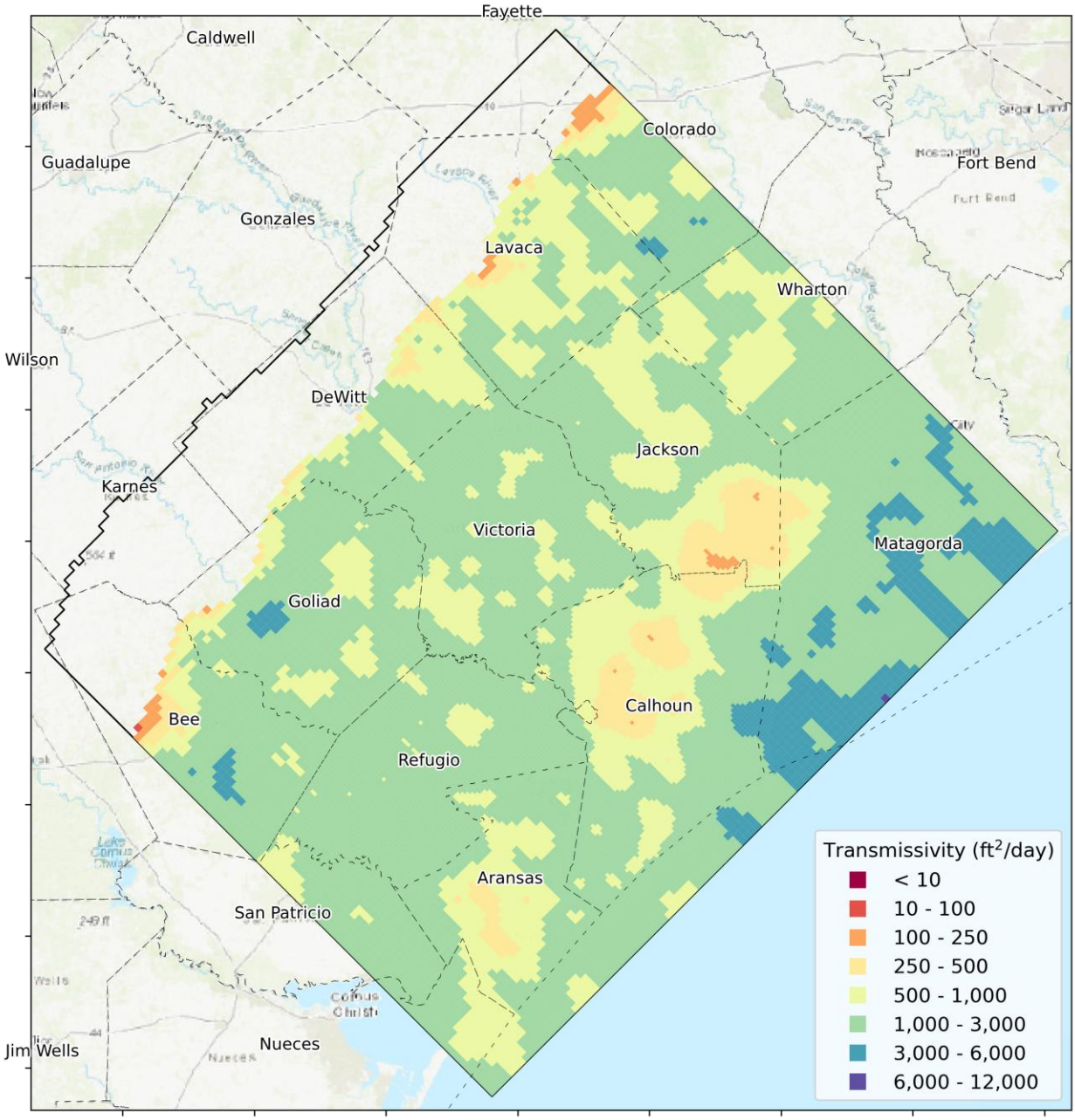


Figure 4-35. Transmissivity values in Model Layer 12 (lower half of the Upper Lagarto formation).

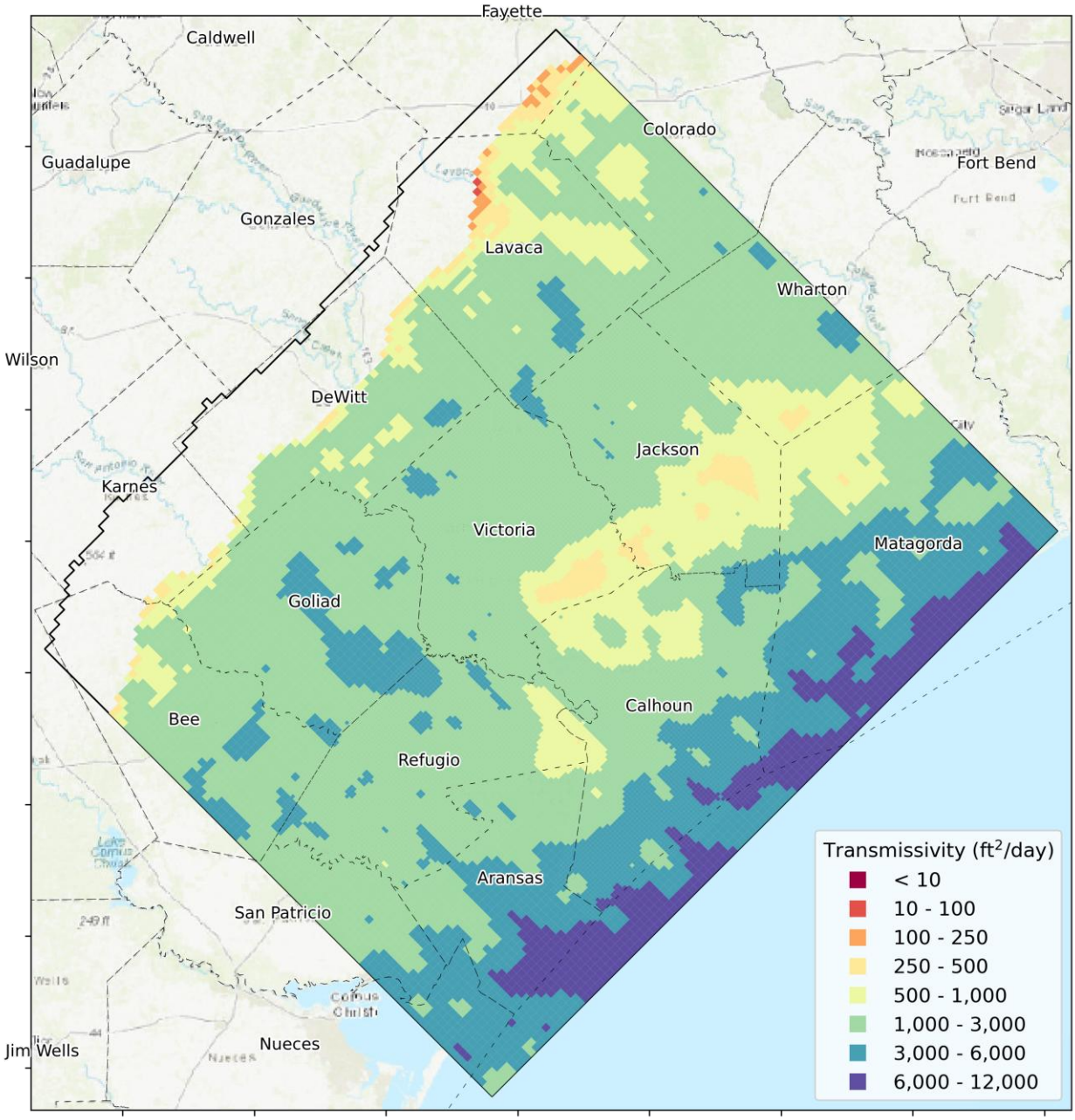


Figure 4-36. Transmissivity values in Model Layer 13 (Middle Lagarto formation).

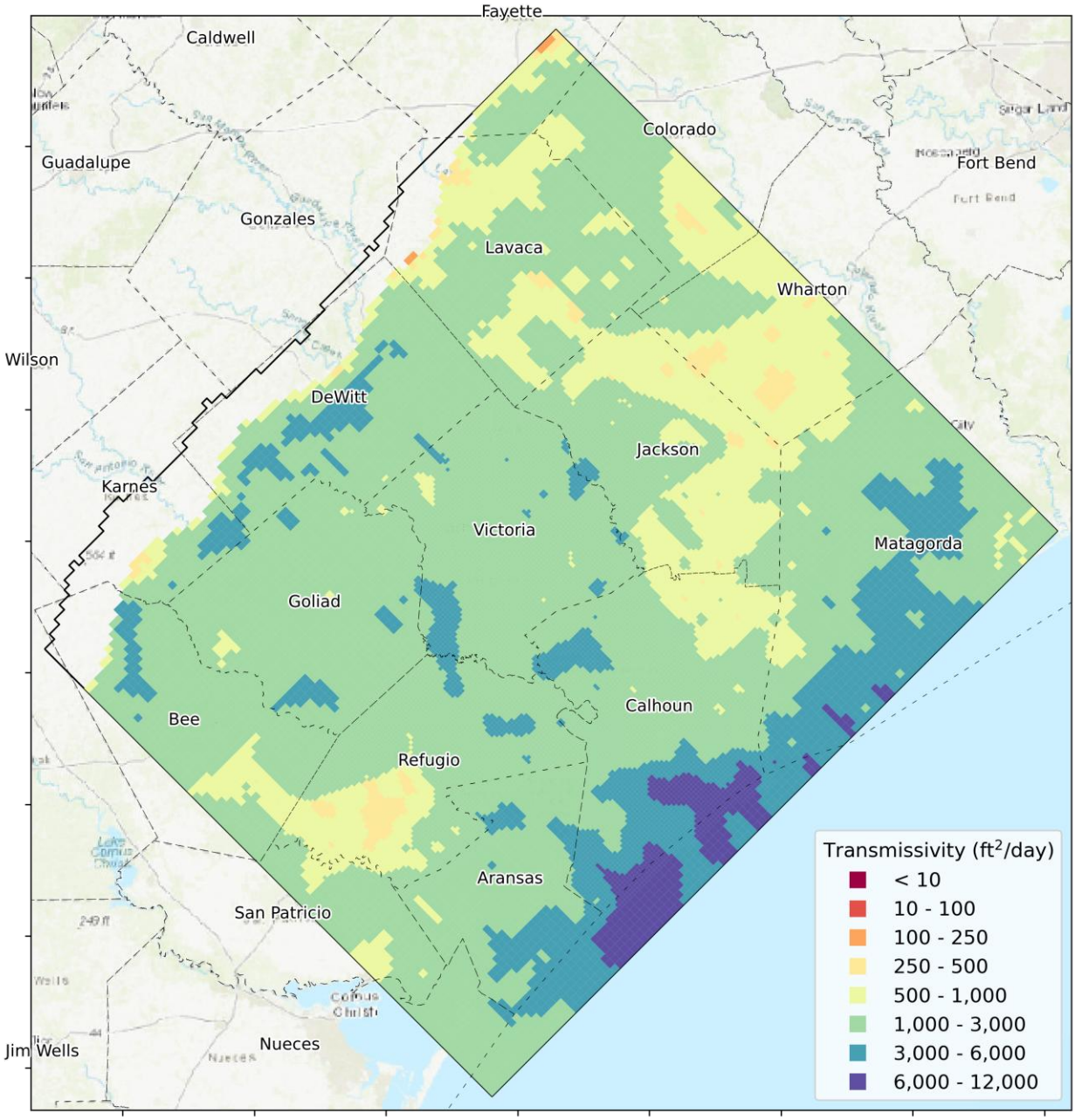


Figure 4-37. Transmissivity values in Model Layer 14 (Lower Lagarto formation).

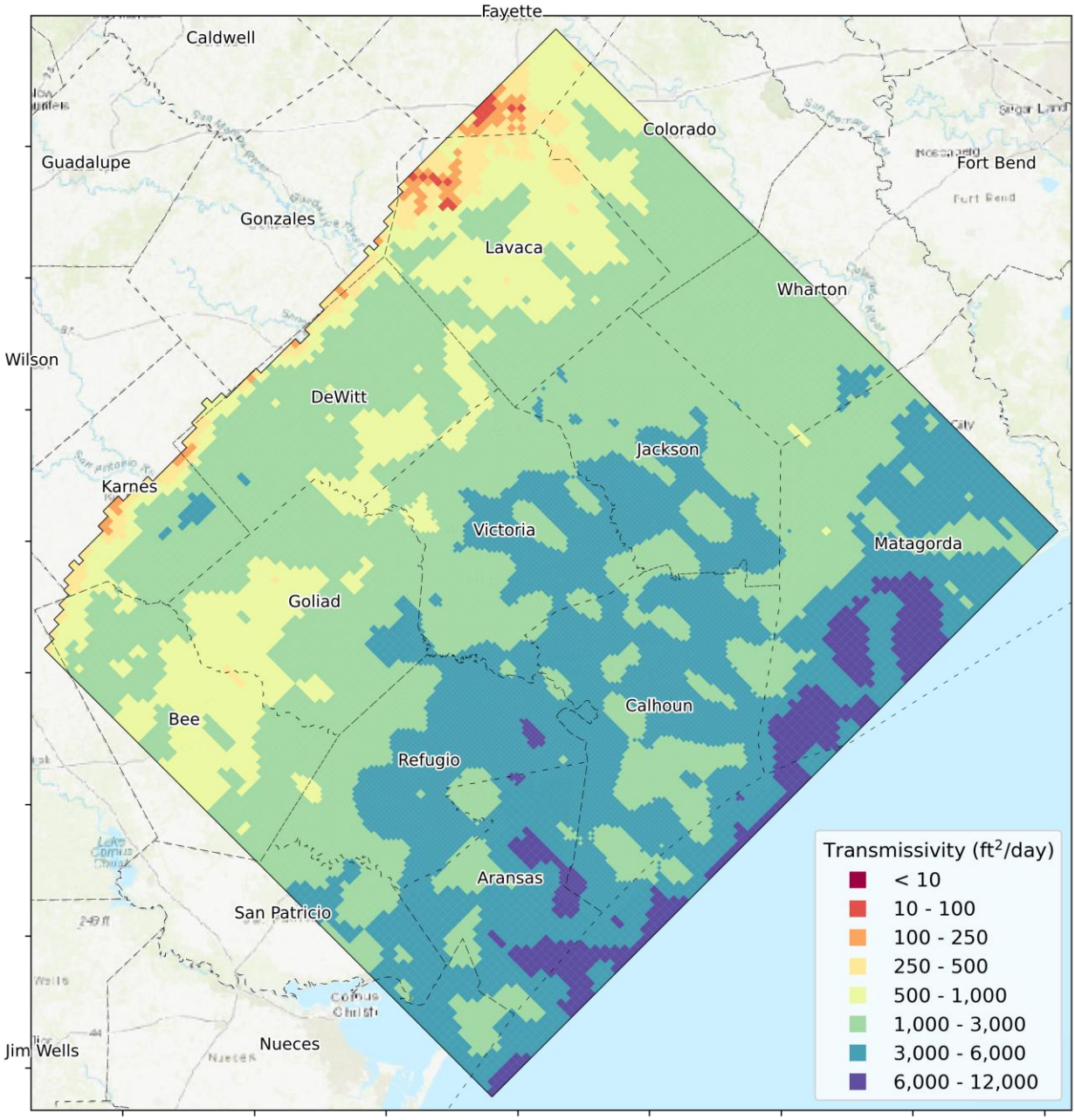


Figure 4-38. Transmissivity values in Model Layer 15 (Oakville formation).

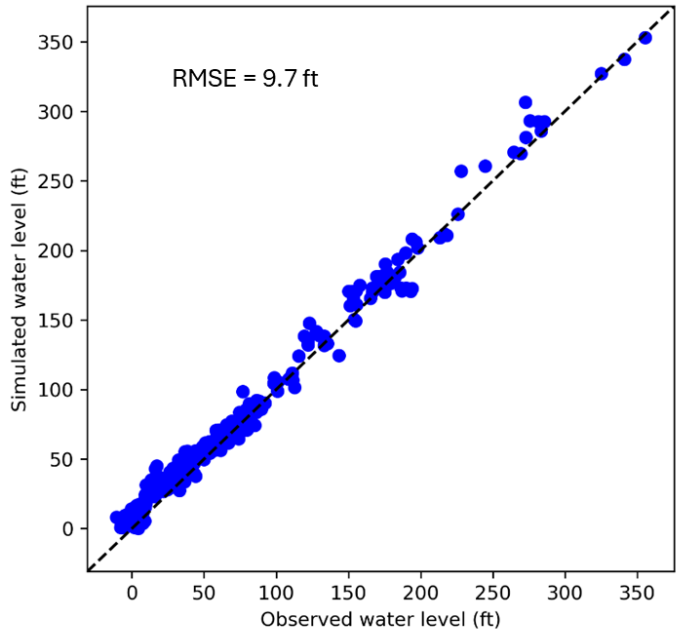


Figure 4-39. Simulated versus observed groundwater levels for 288 wells in the model domain.

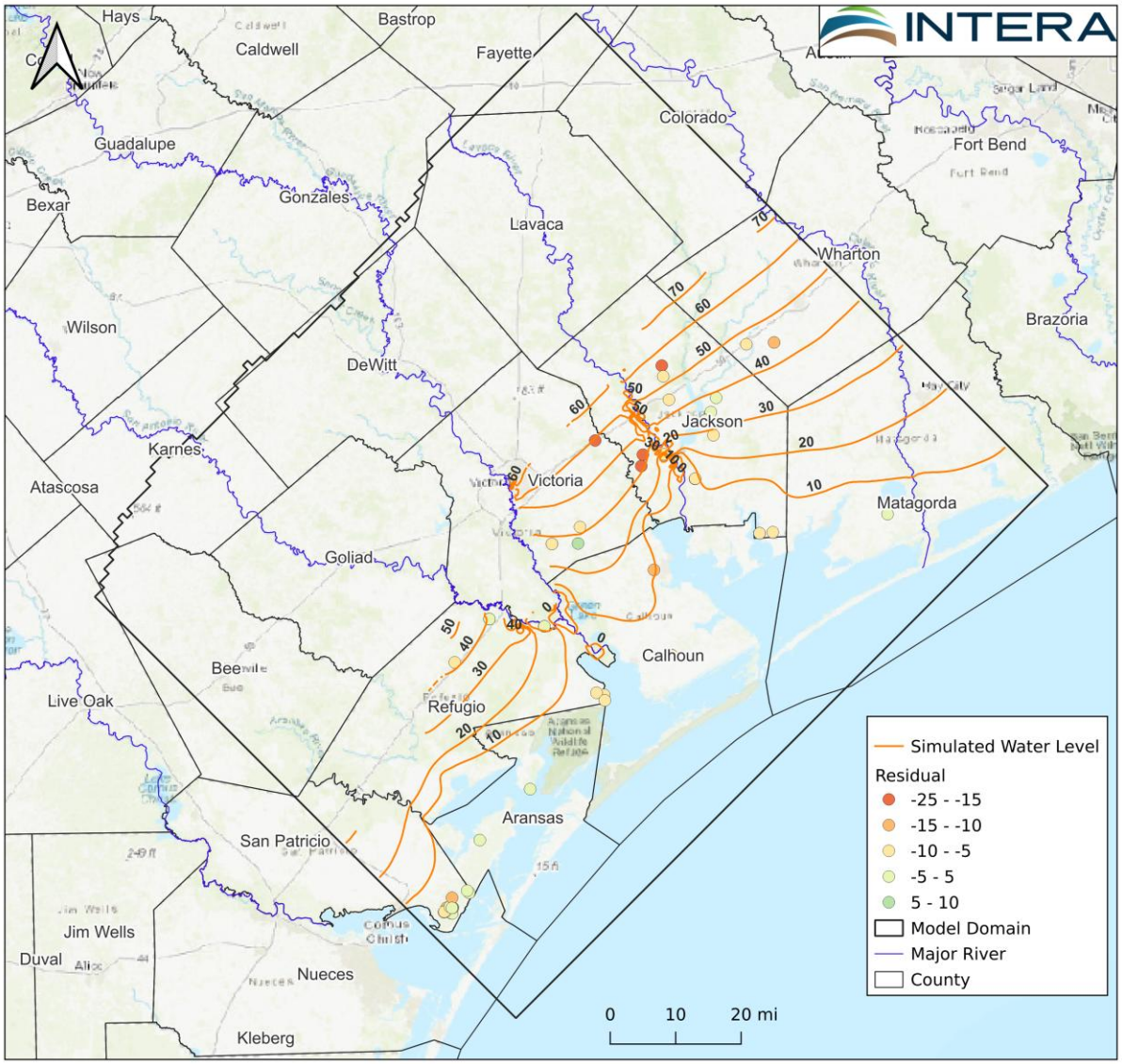


Figure 4-40. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 1.

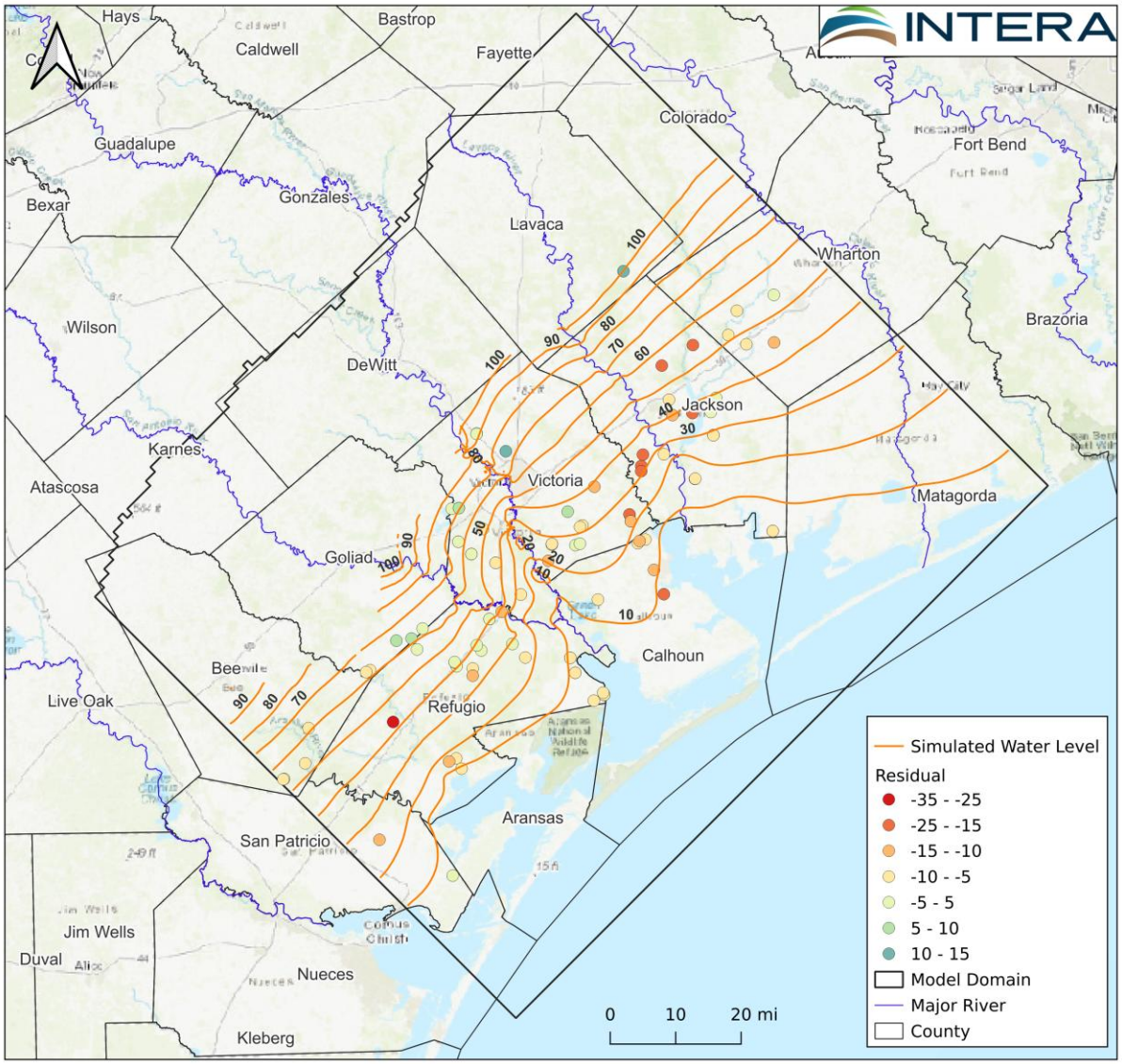


Figure 4-41. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 2.

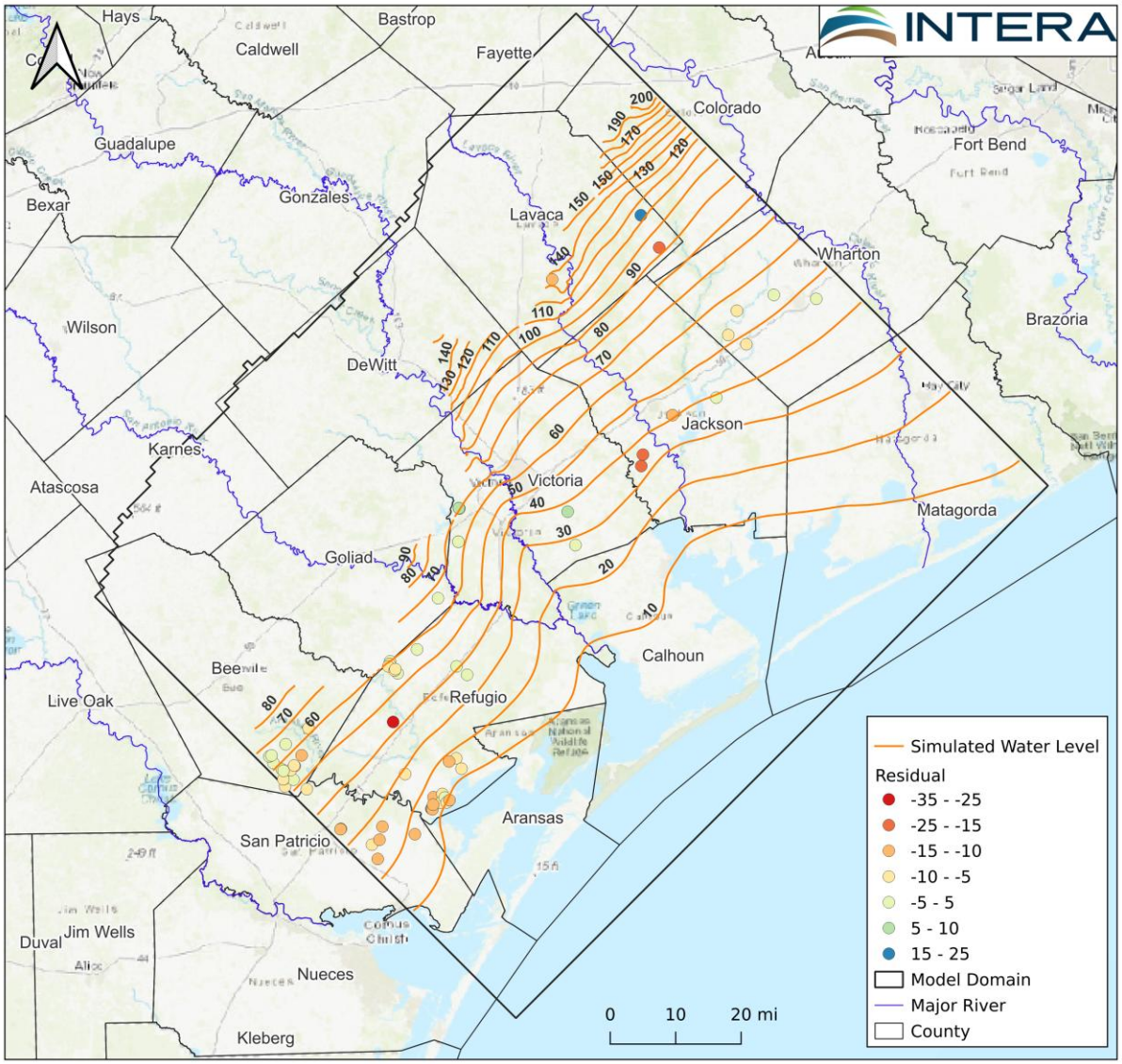


Figure 4-42. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 3.

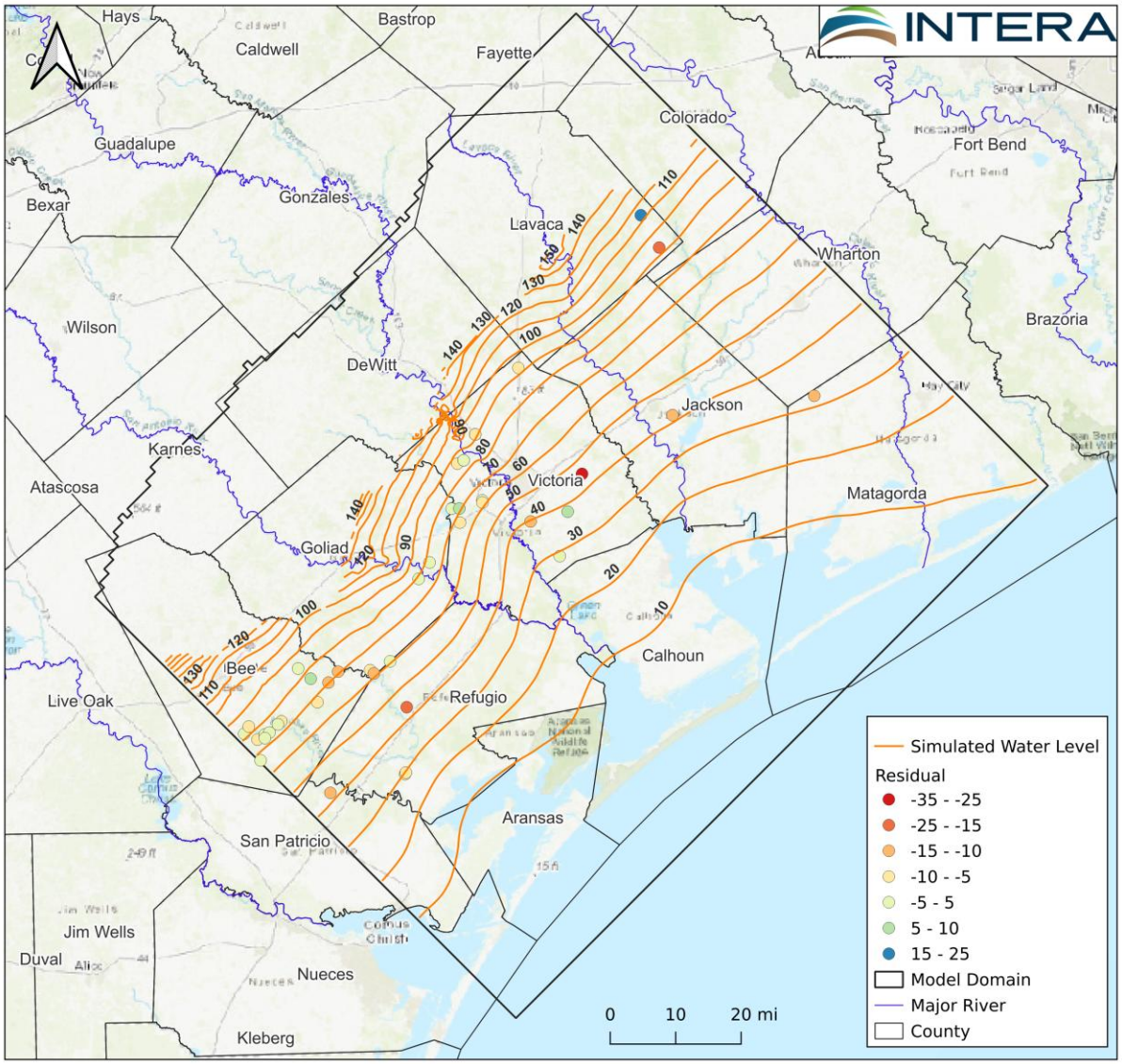


Figure 4-43. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 4.

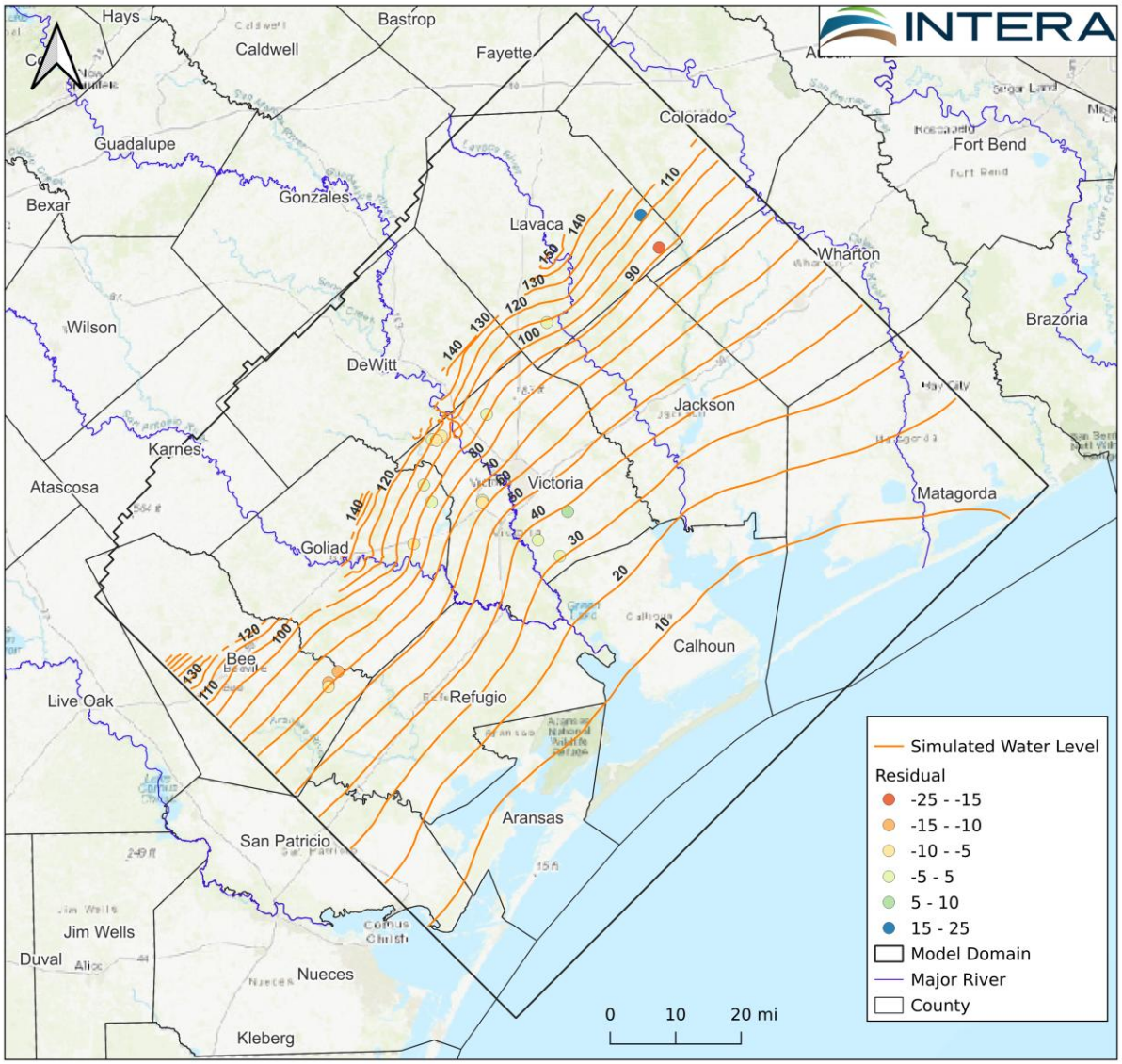


Figure 4-44. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 5.

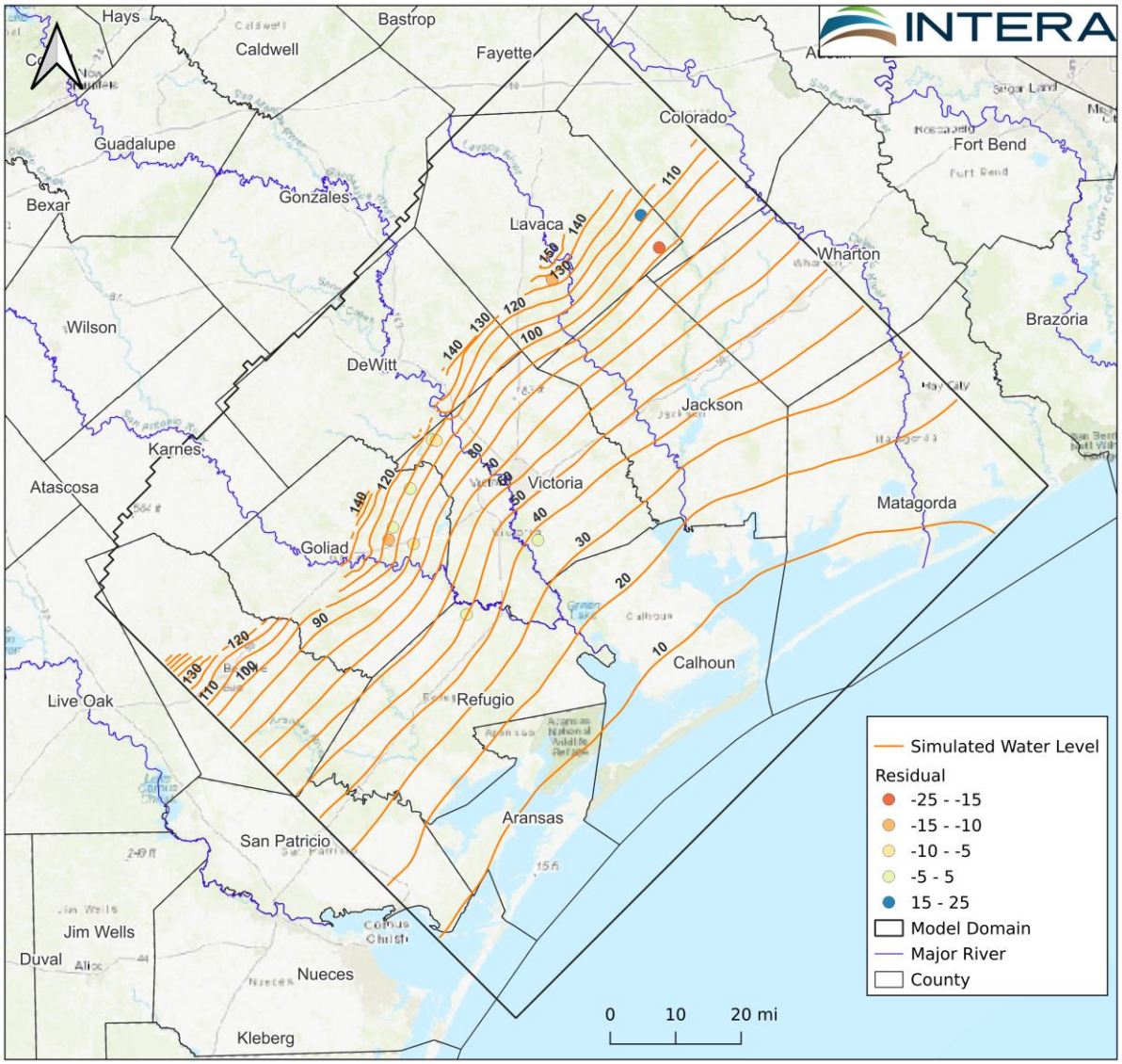


Figure 4-45. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 6.

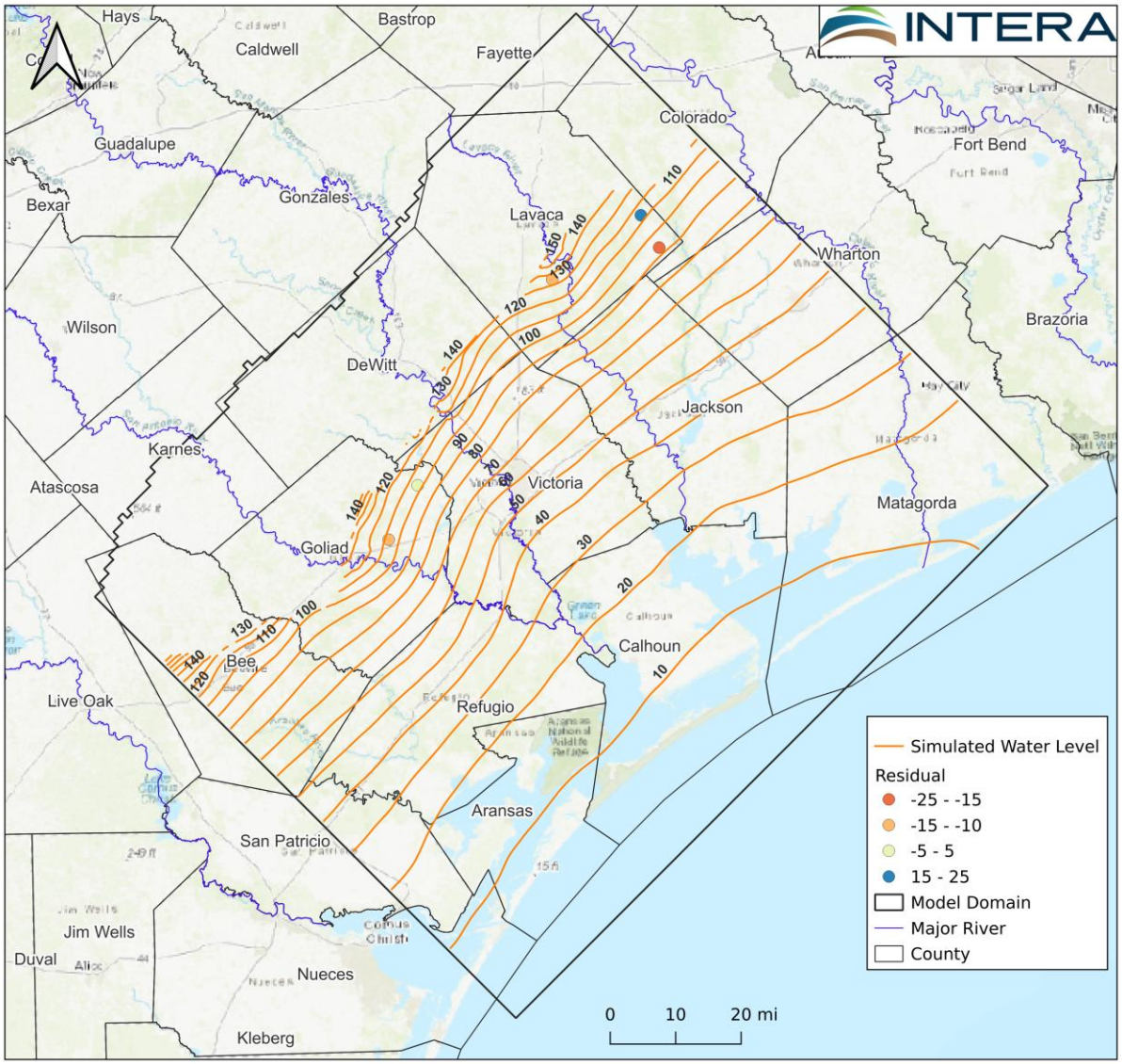


Figure 4-46. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 7.

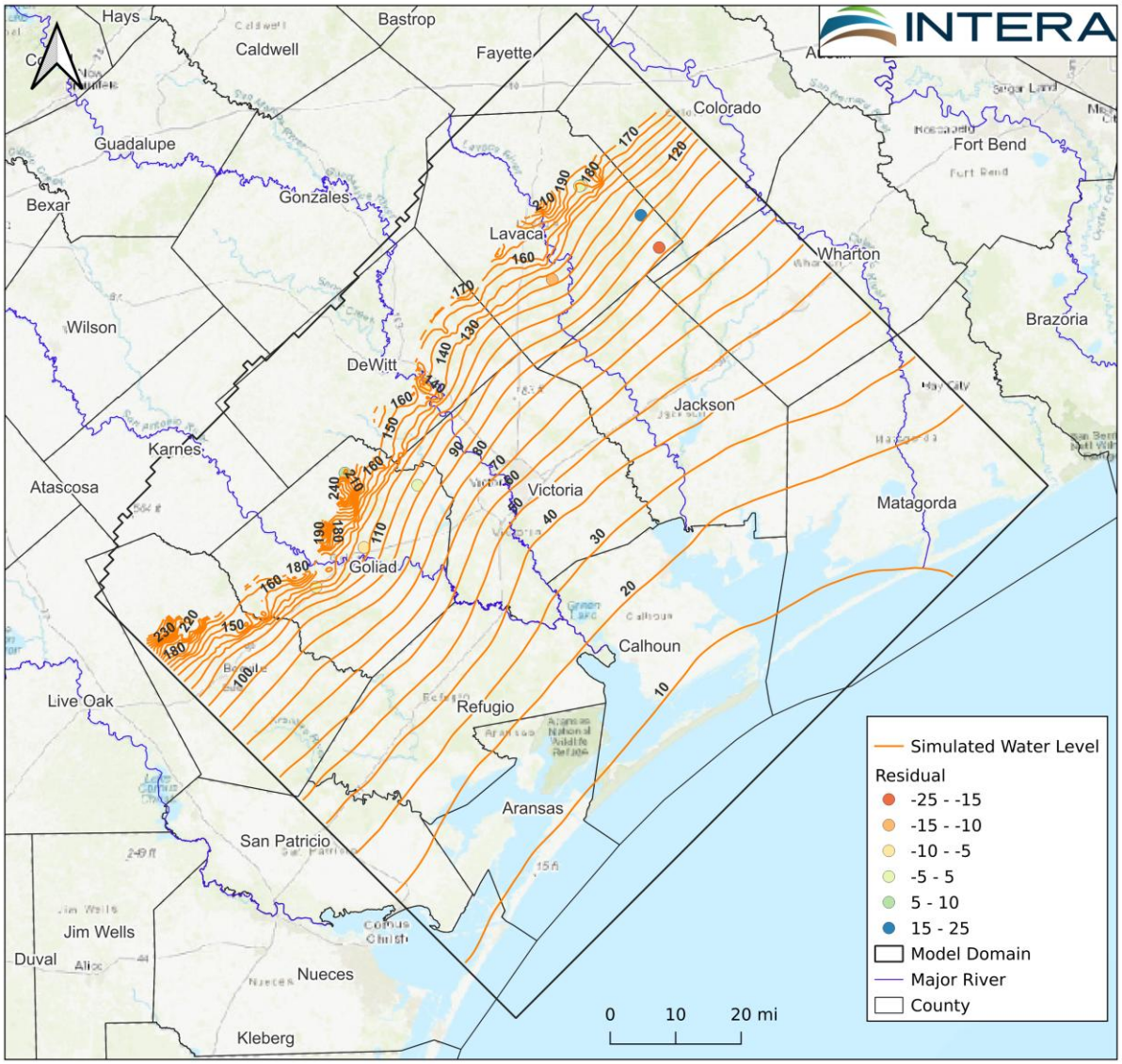


Figure 4-47. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 8.

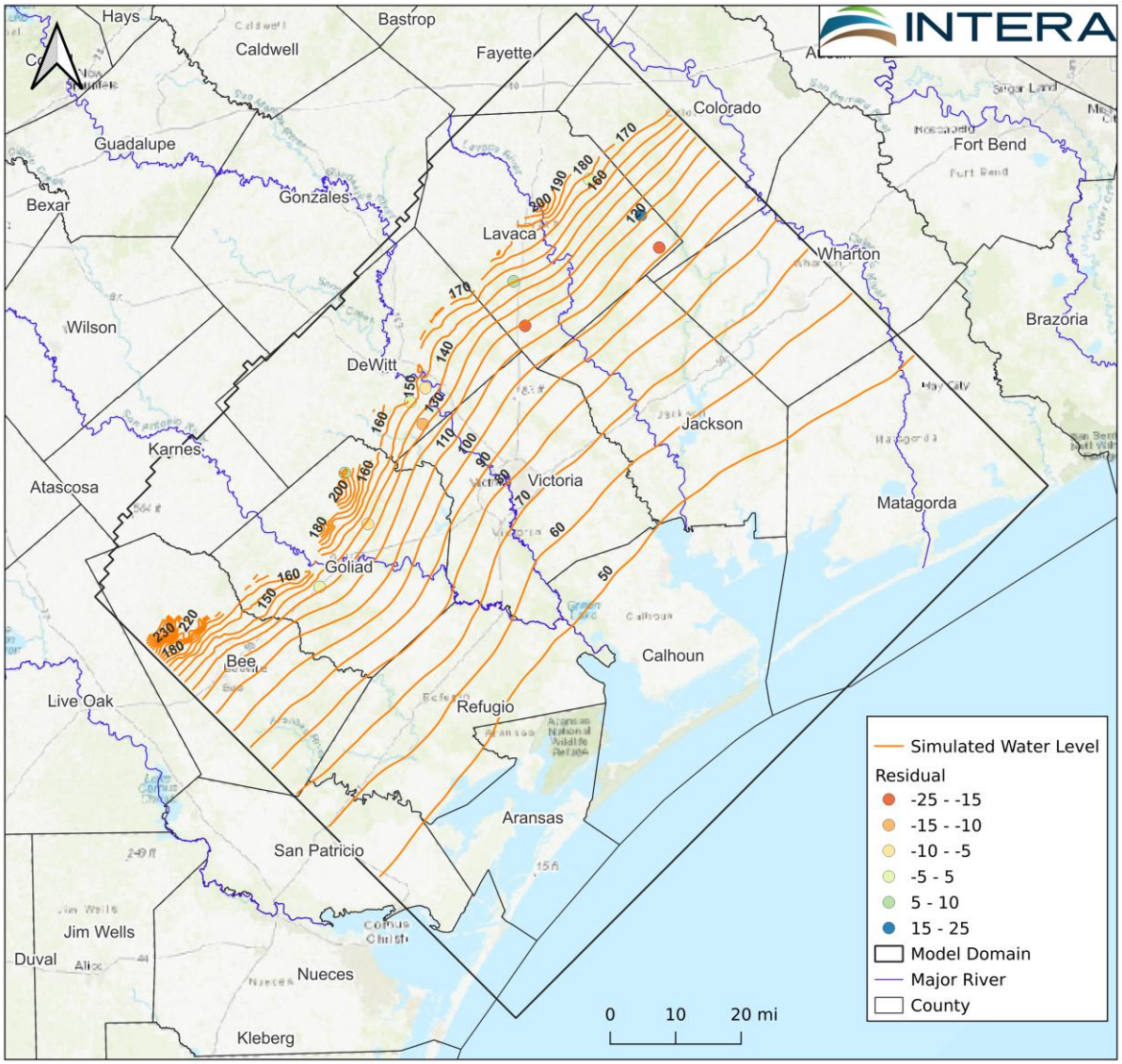


Figure 4-48. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 9.

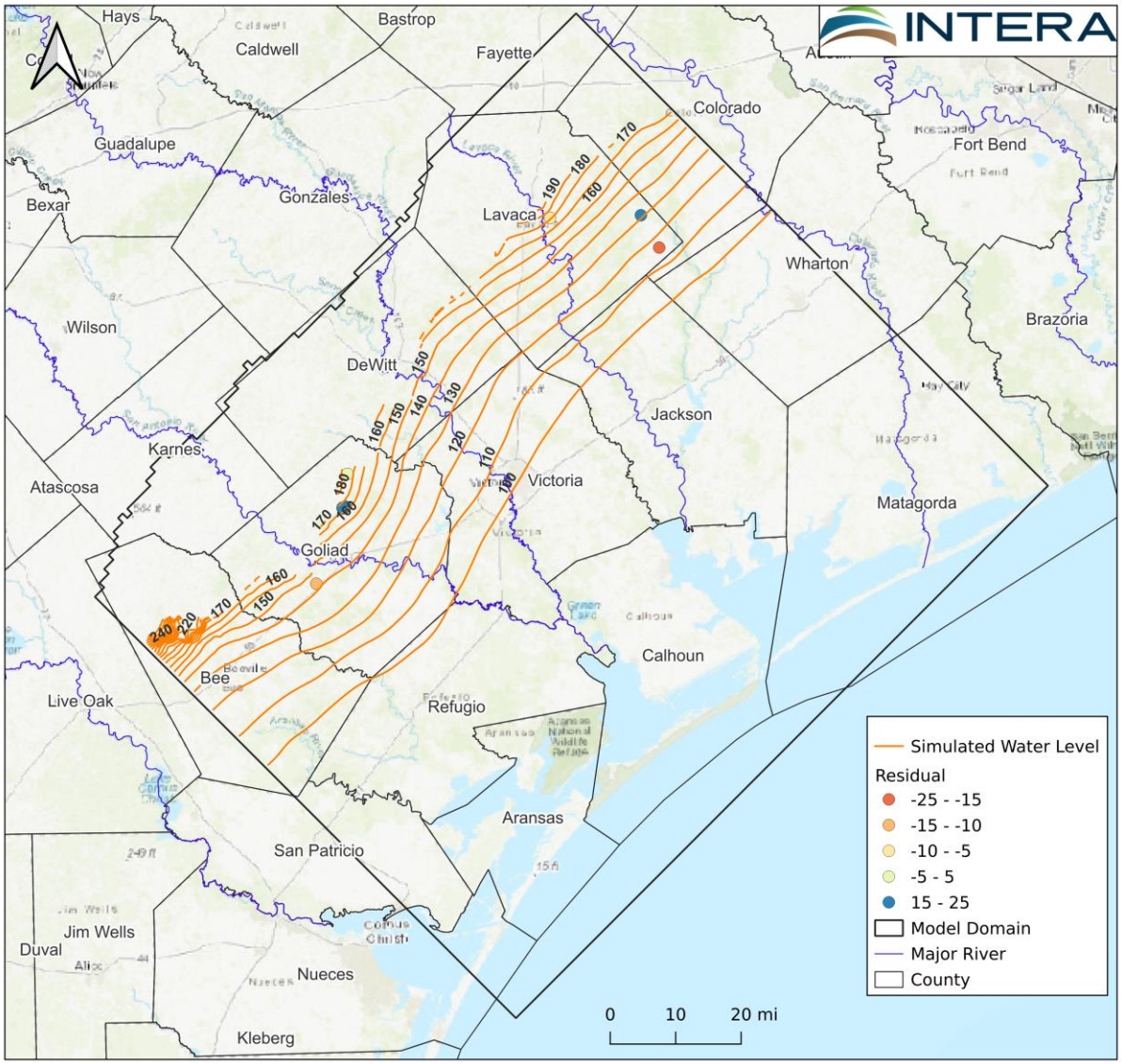


Figure 4-49. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 10.

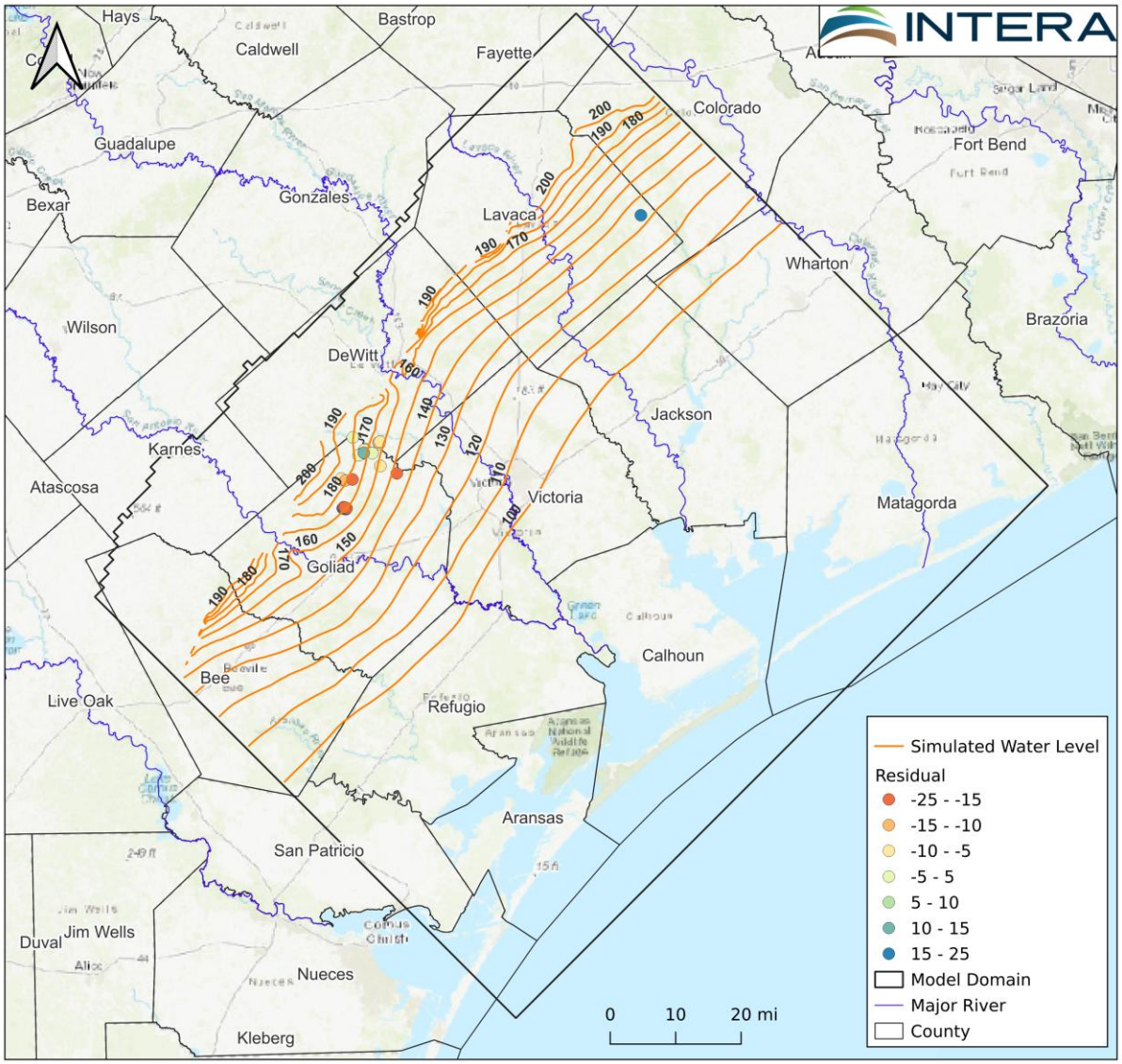


Figure 4-50. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 11.

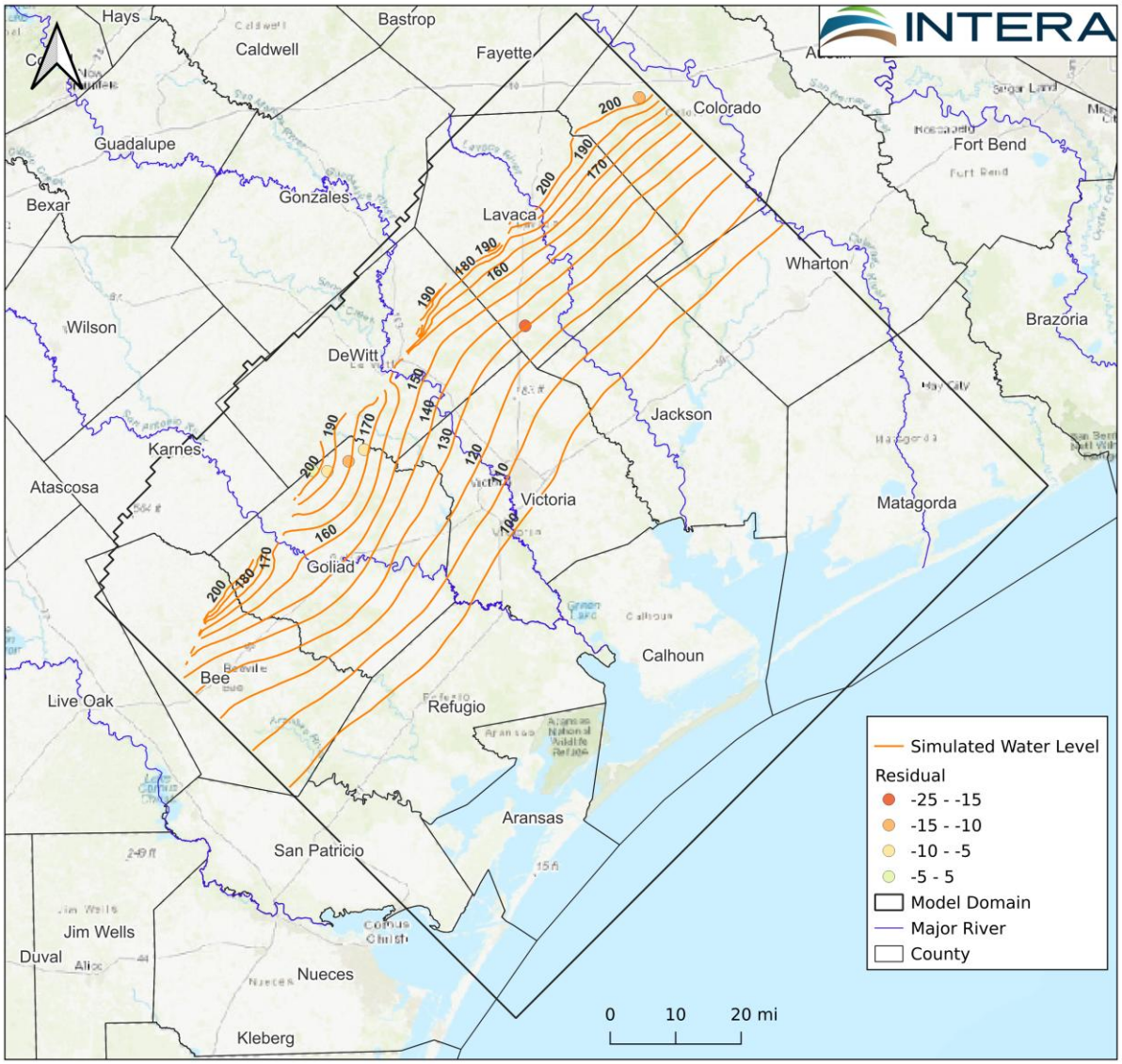


Figure 4-51. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 12.

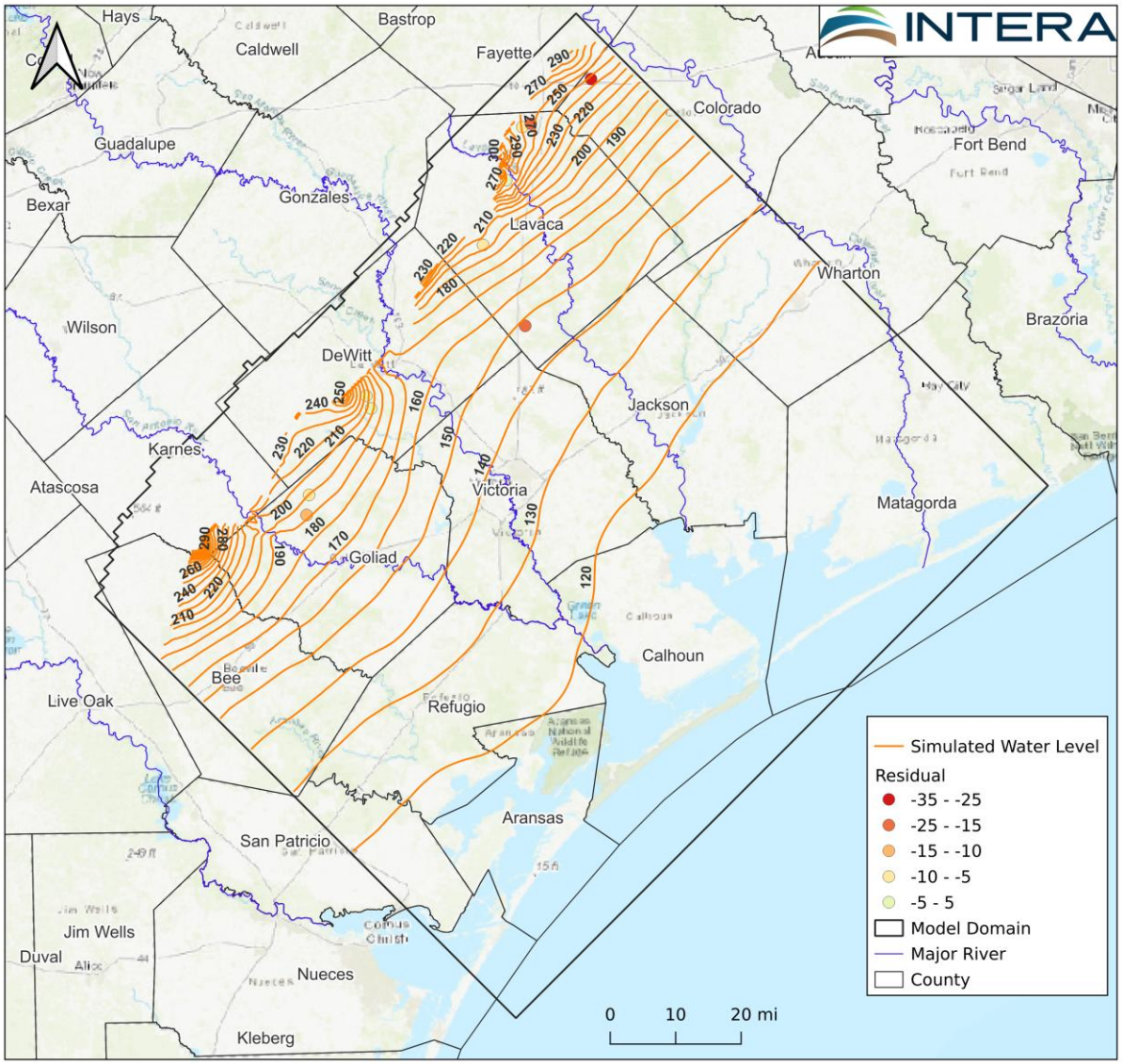


Figure 4-52. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 13.

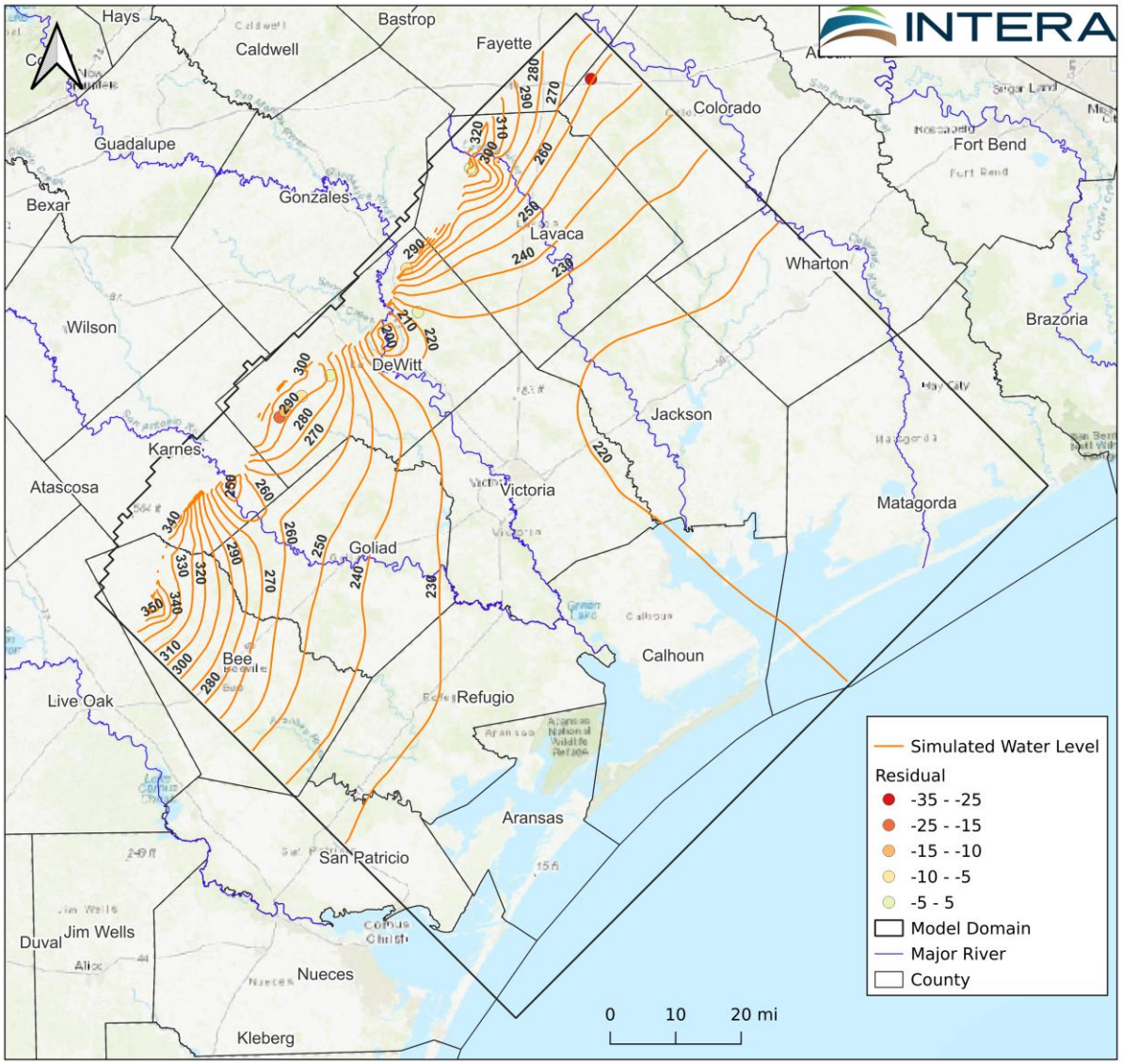


Figure 4-53. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 14.

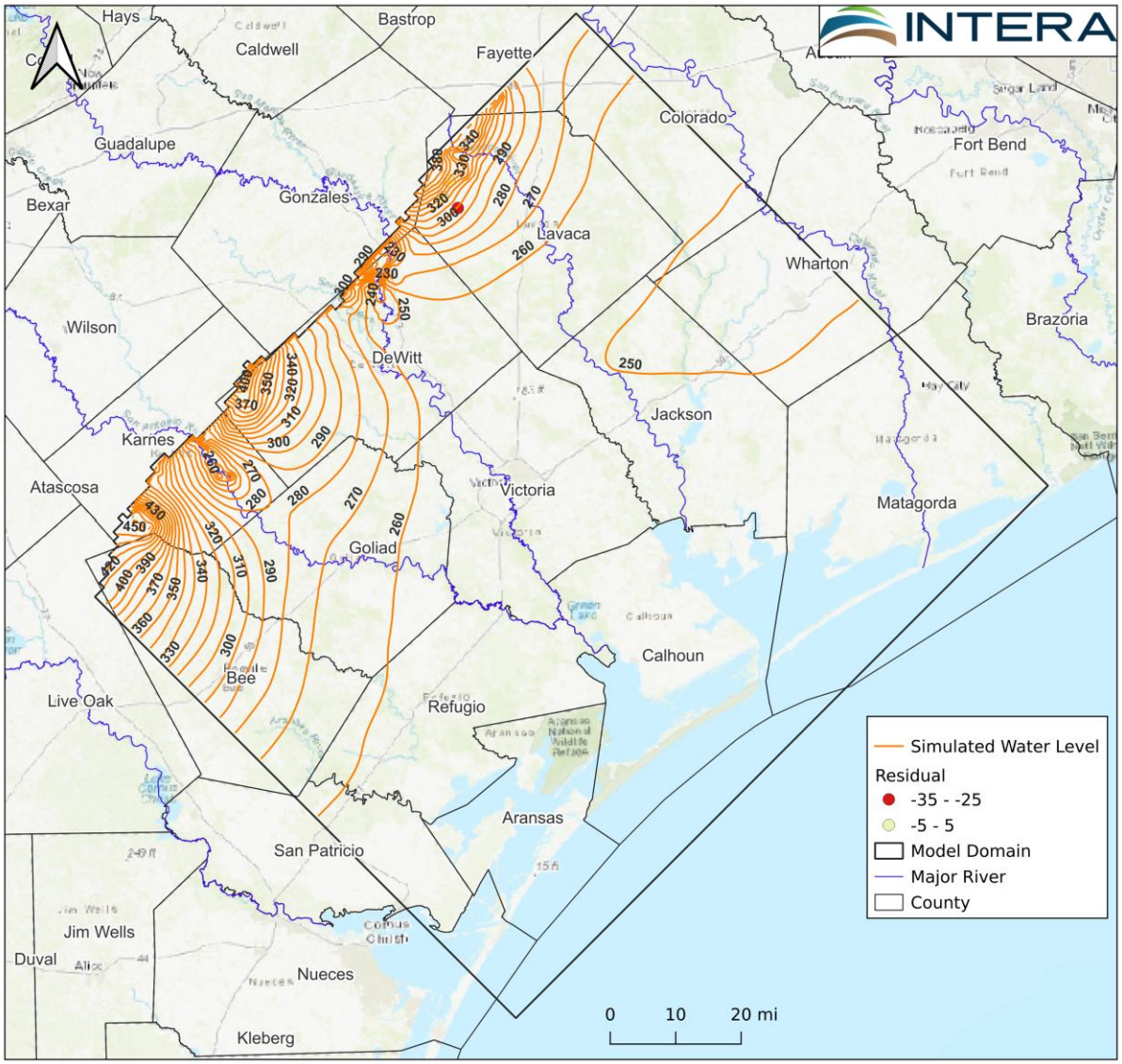


Figure 4-54. Simulated steady-state water levels and residual between observed and simulated groundwater levels for model layer 15.

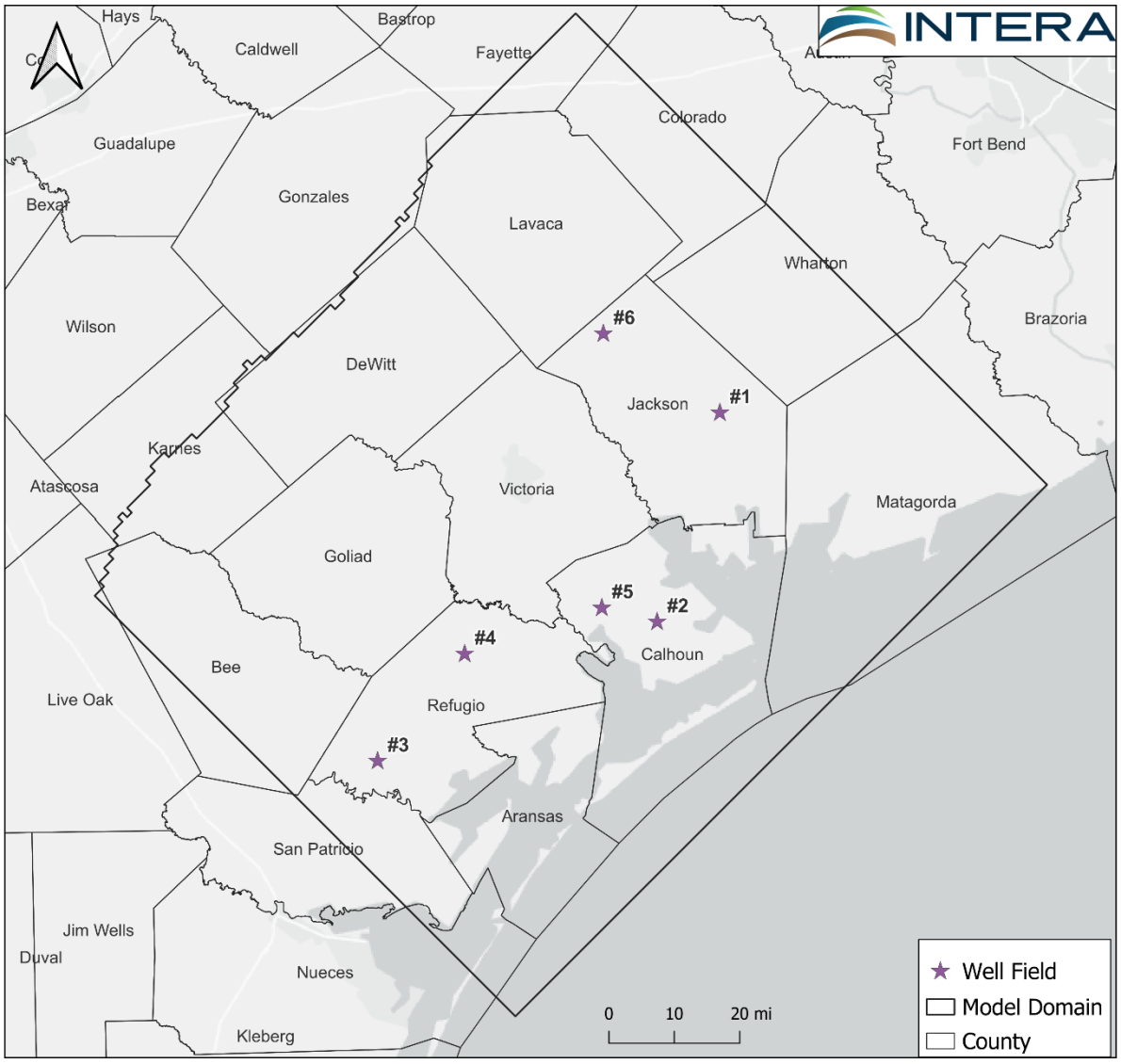


Figure 4-55. Locations of brackish wellfields where production rates of 15,000 afy and 30,000 afy were simulated using the CGCBGWF Model

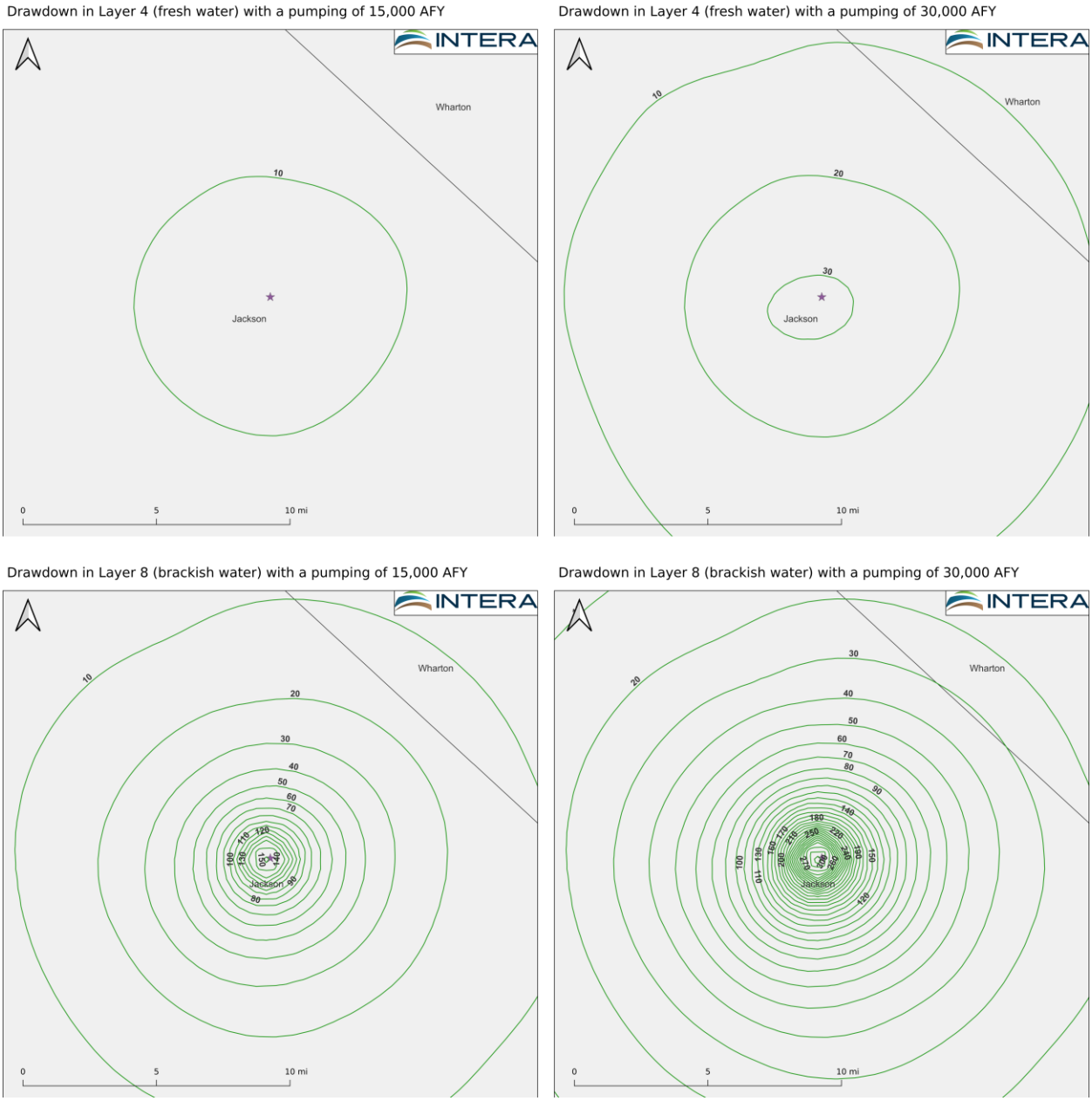


Figure 4-56. Simulated drawdowns after 5-year pumping at well field #1 at a rate of 15,000 AFY (left) and 30,000 AFY (right).

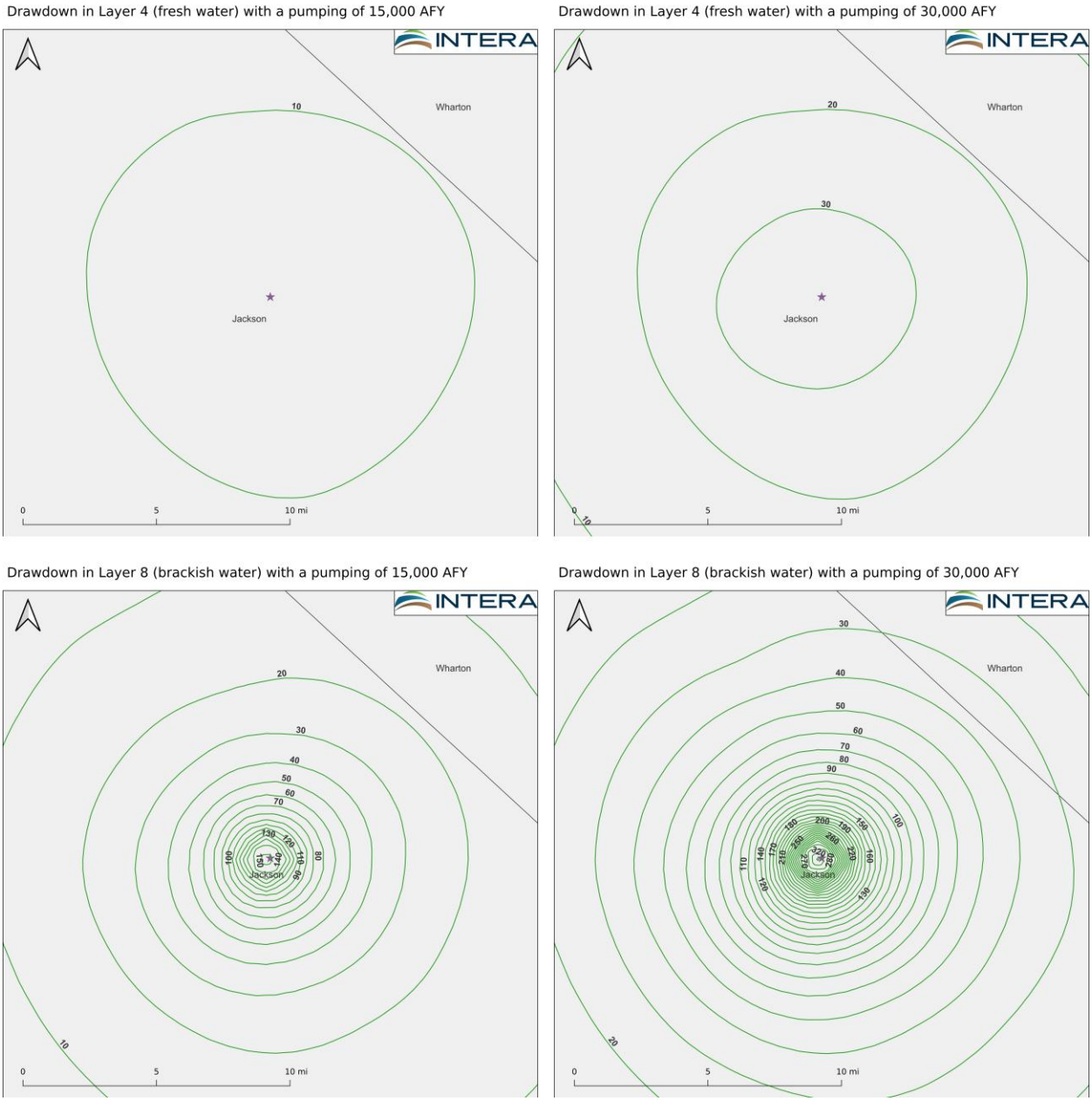


Figure 4-57. Simulated drawdowns after 30-year pumping at well field #1 at a rate of 15,000 AFY (left) and 30,000 AFY (right).

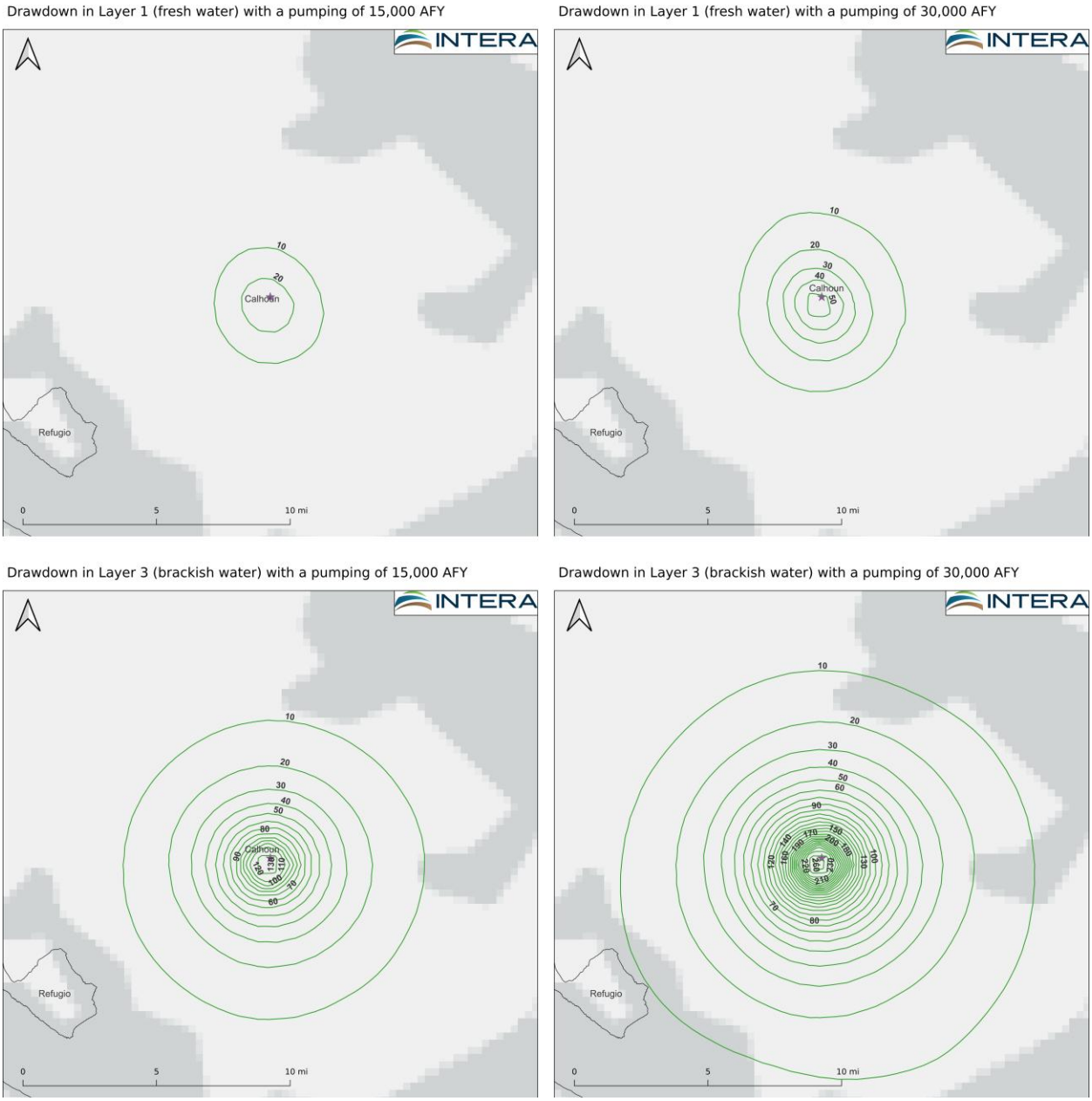


Figure 4-58. Simulated drawdowns after 5-year pumping at well field #2 at a rate of 15,000 AFY (left) and 30,000 AFY (right).

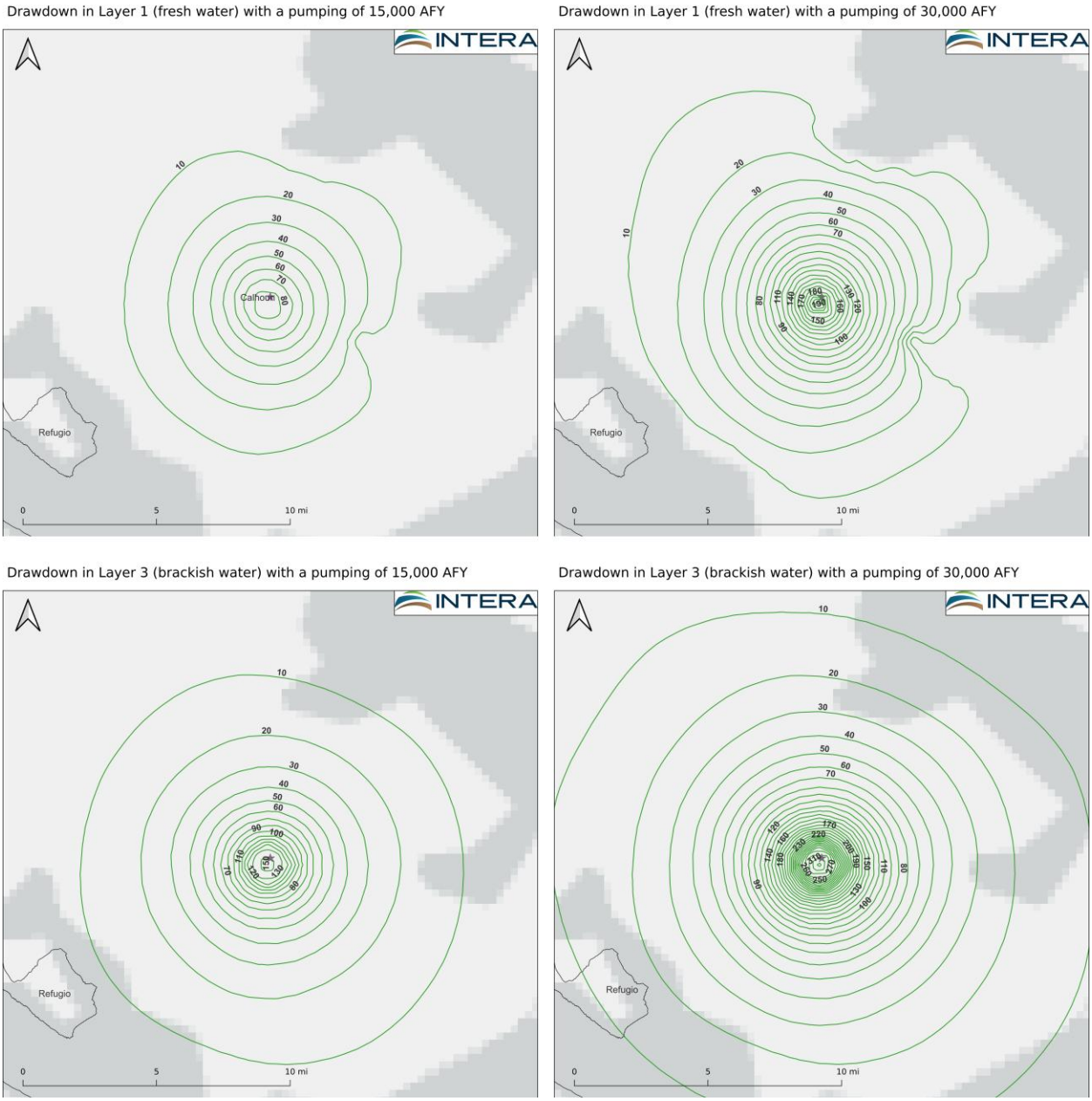


Figure 4-59. Simulated drawdowns after 30-year pumping at well field #2 at a rate of 15,000 AFY (left) and 30,000 AFY (right).

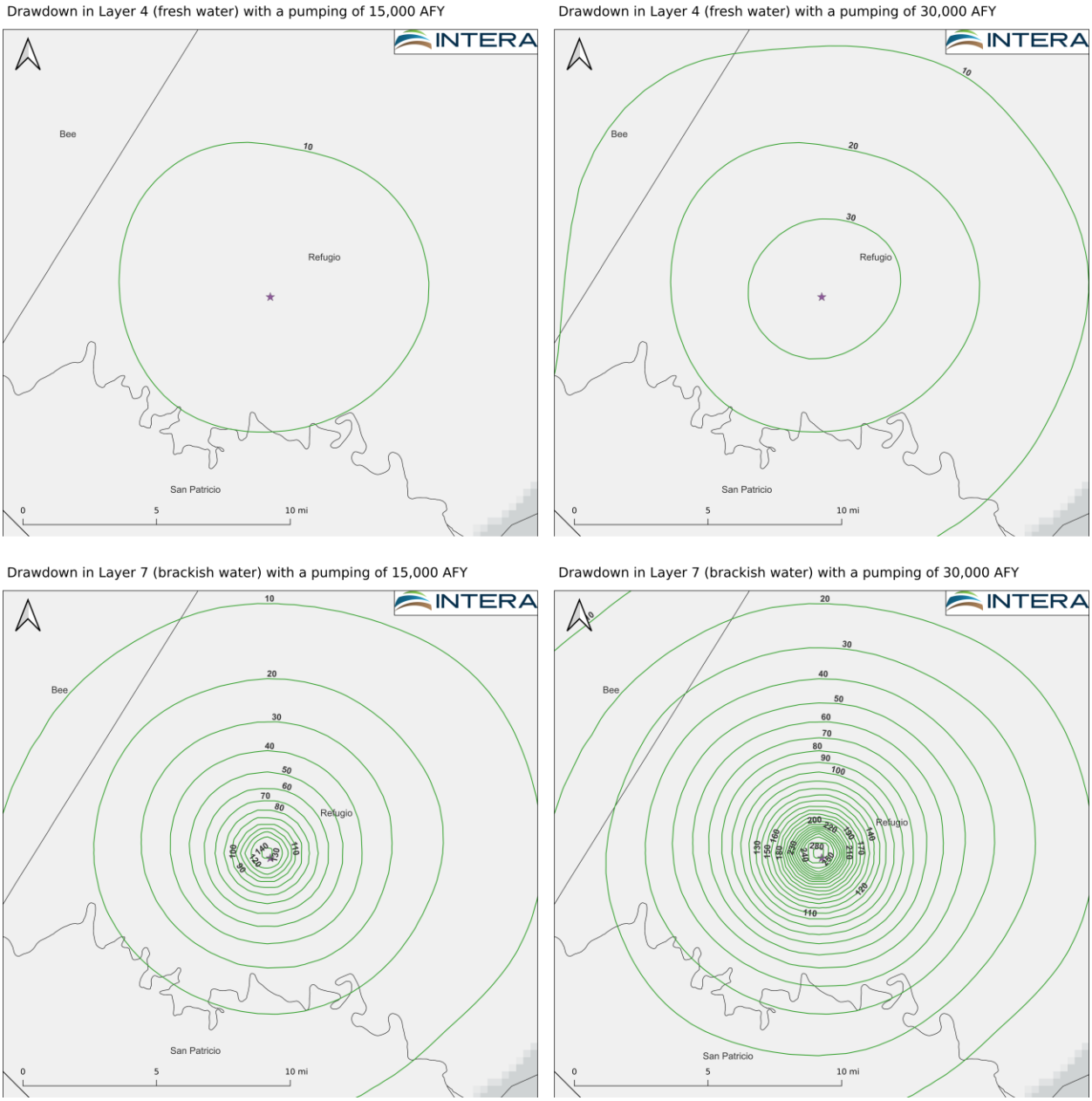


Figure 4-60. Simulated drawdowns after 5-year pumping at well field #3 at a rate of 15,000 AFY (left) and 30,000 AFY (right).

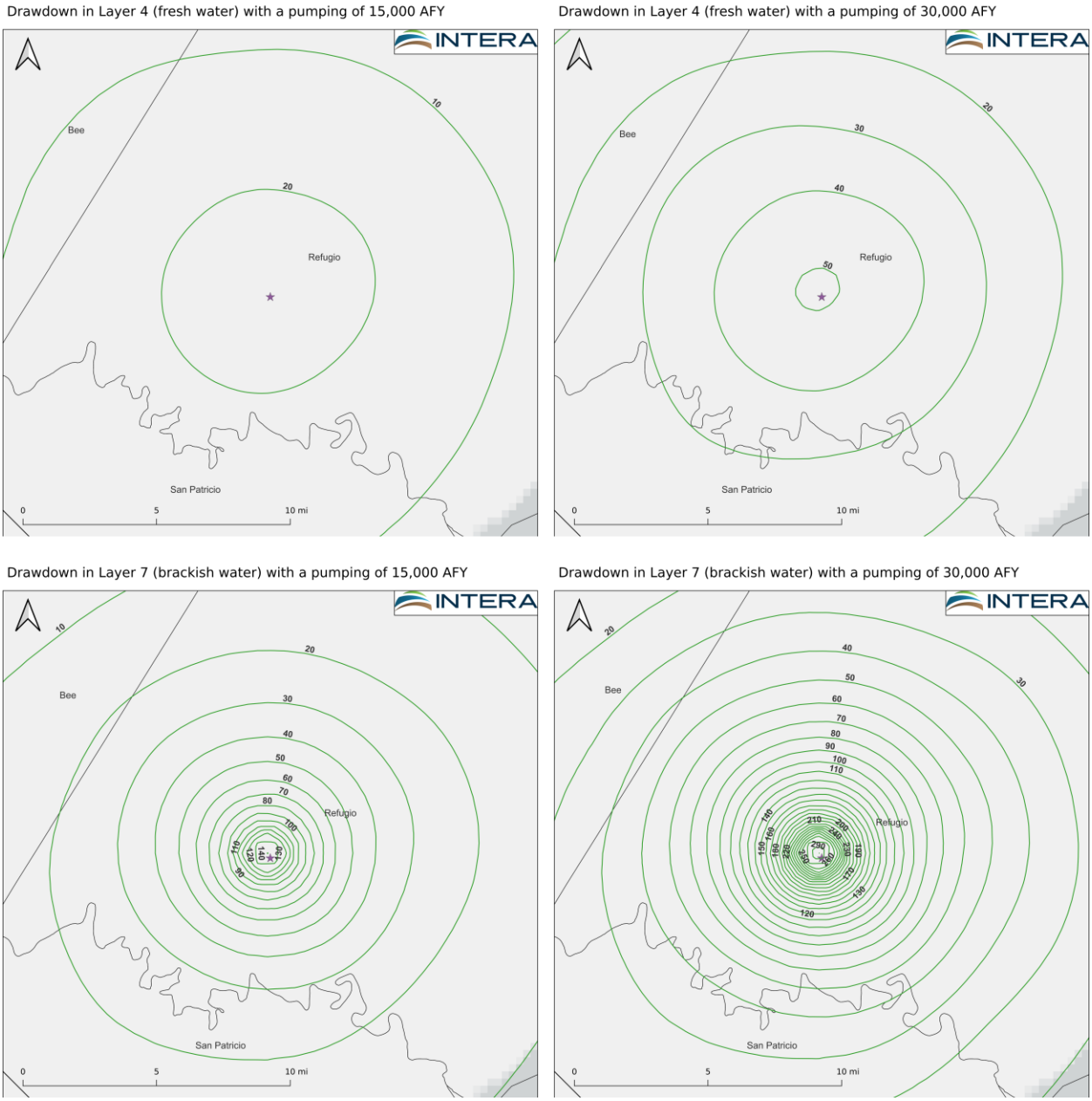


Figure 4-61. Simulated drawdowns after 30-year pumping at well field #3 at a rate of 15,000 AFY (left) and 30,000 AFY (right).

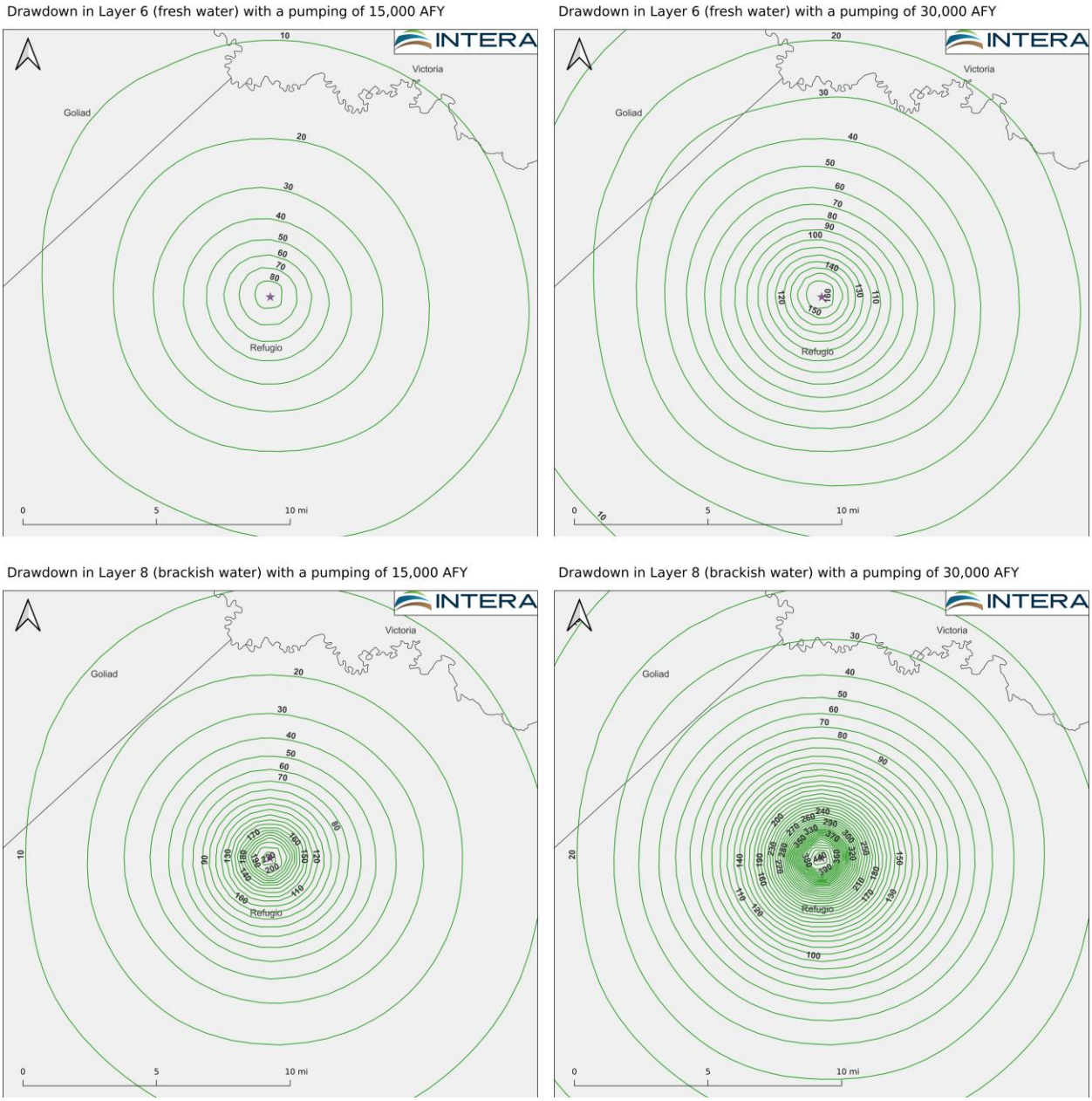


Figure 4-62. Simulated drawdowns after 5-year pumping at well field #4 at a rate of 15,000 AFY (left) and 30,000 AFY (right).

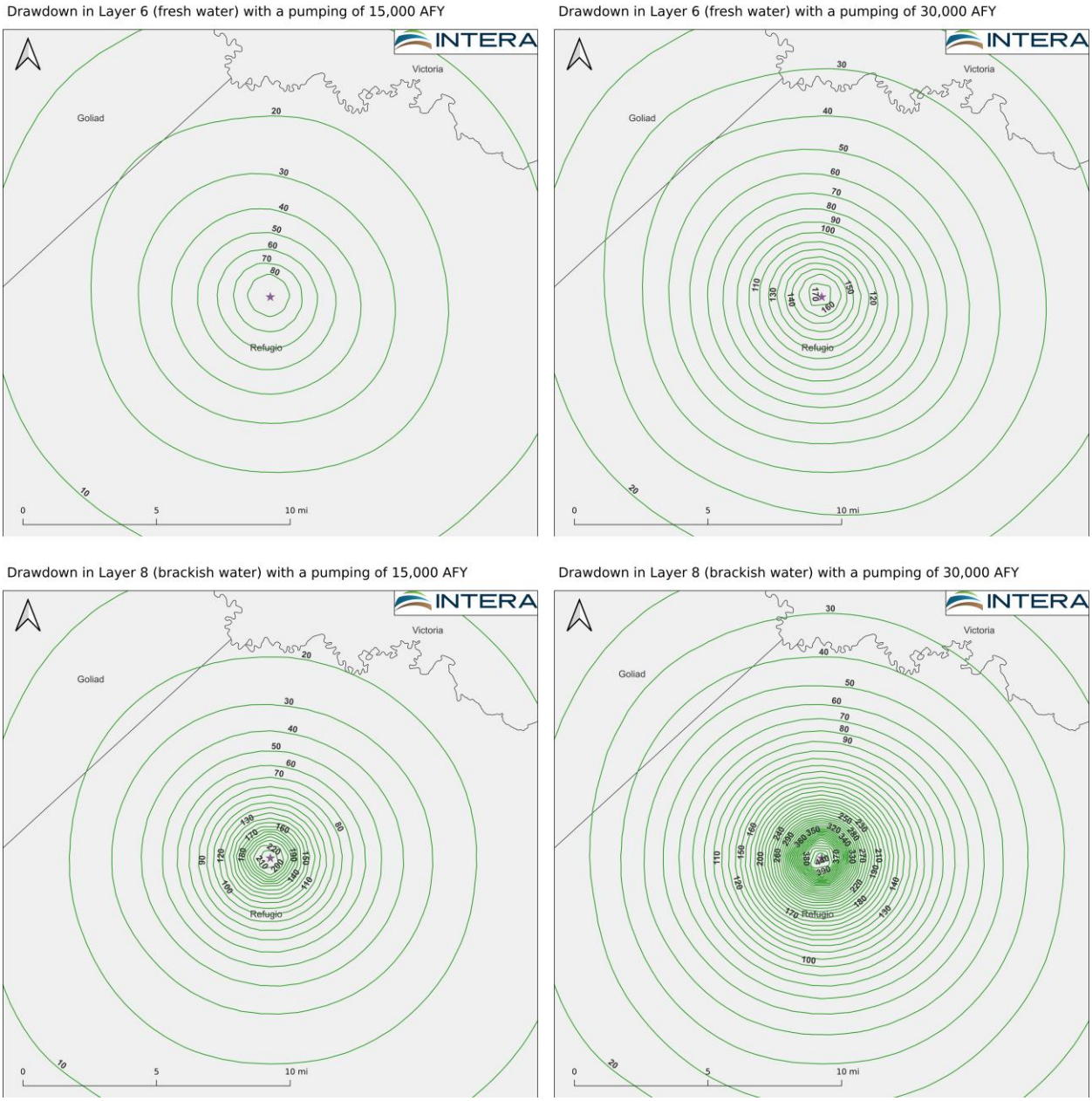


Figure 4-63. Simulated drawdowns after 30-year pumping at well field #4 at a rate of 15,000 AFY (left) and 30,000 AFY (right).

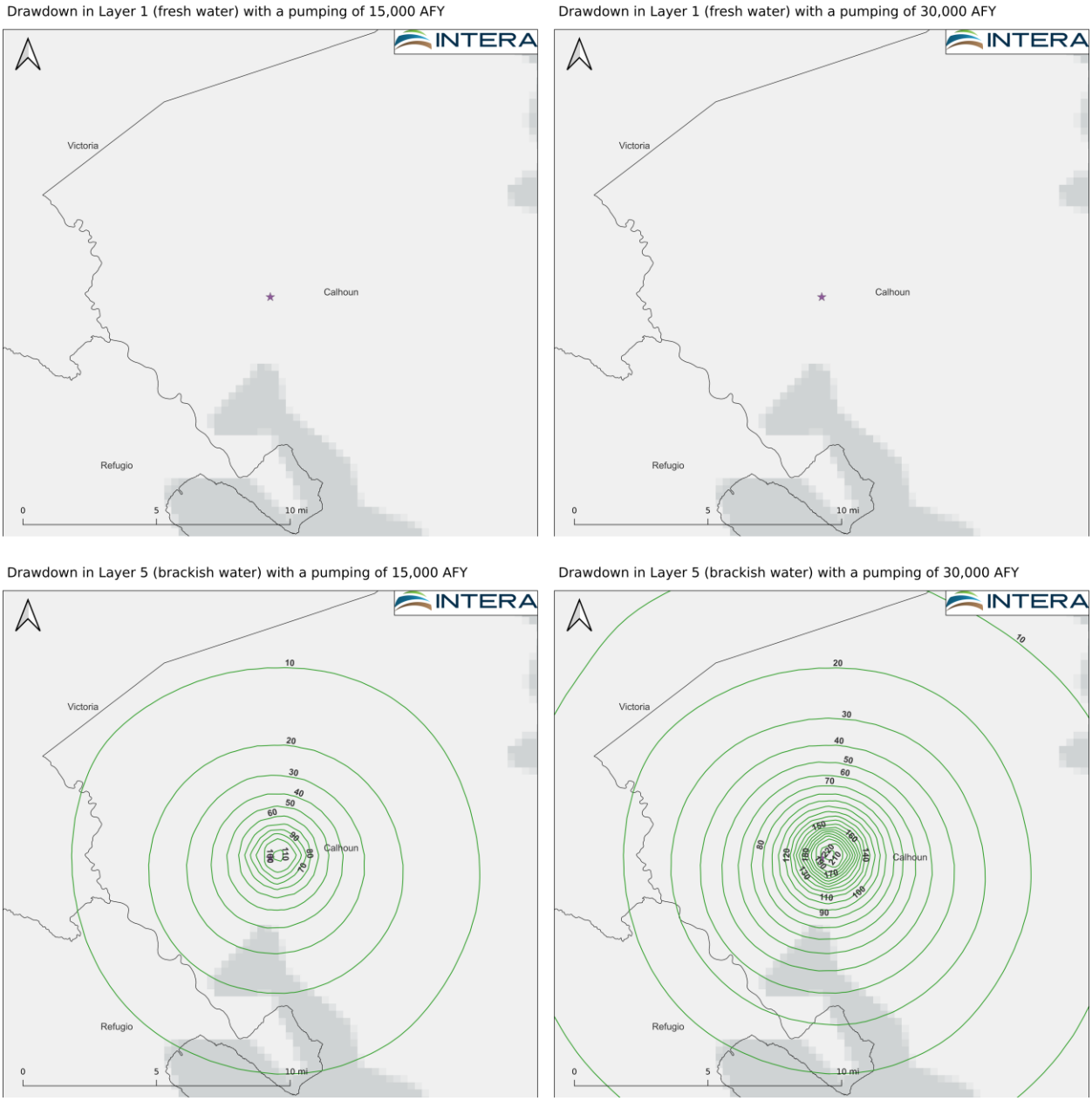


Figure 4-64. Simulated drawdowns after 5-year pumping at well field #5 at a rate of 15,000 AFY (left) and 30,000 AFY (right).

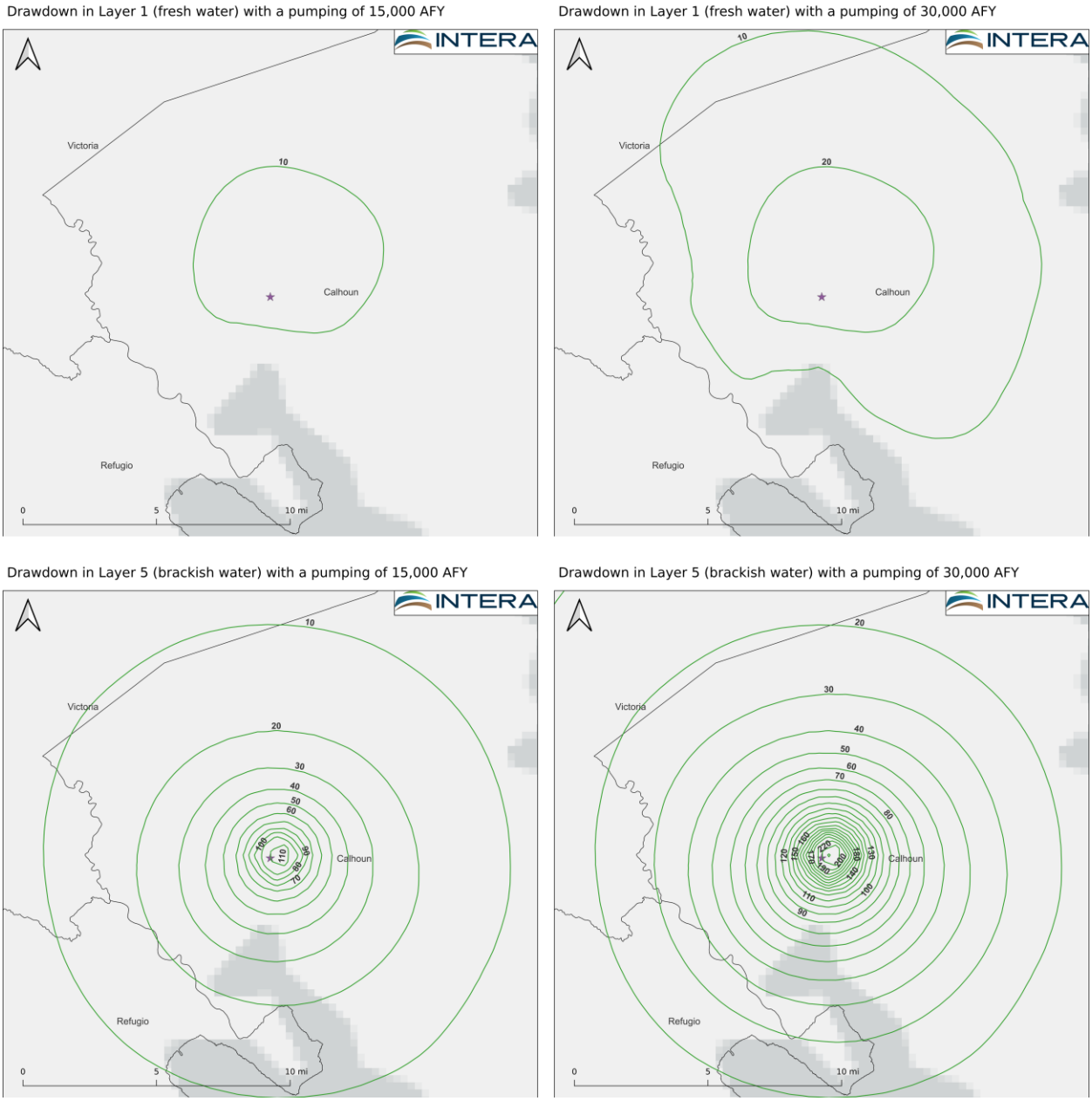


Figure 4-65. Simulated drawdowns after 30-year pumping at well field #5 at a rate of 15,000 AFY (left) and 30,000 AFY (right).

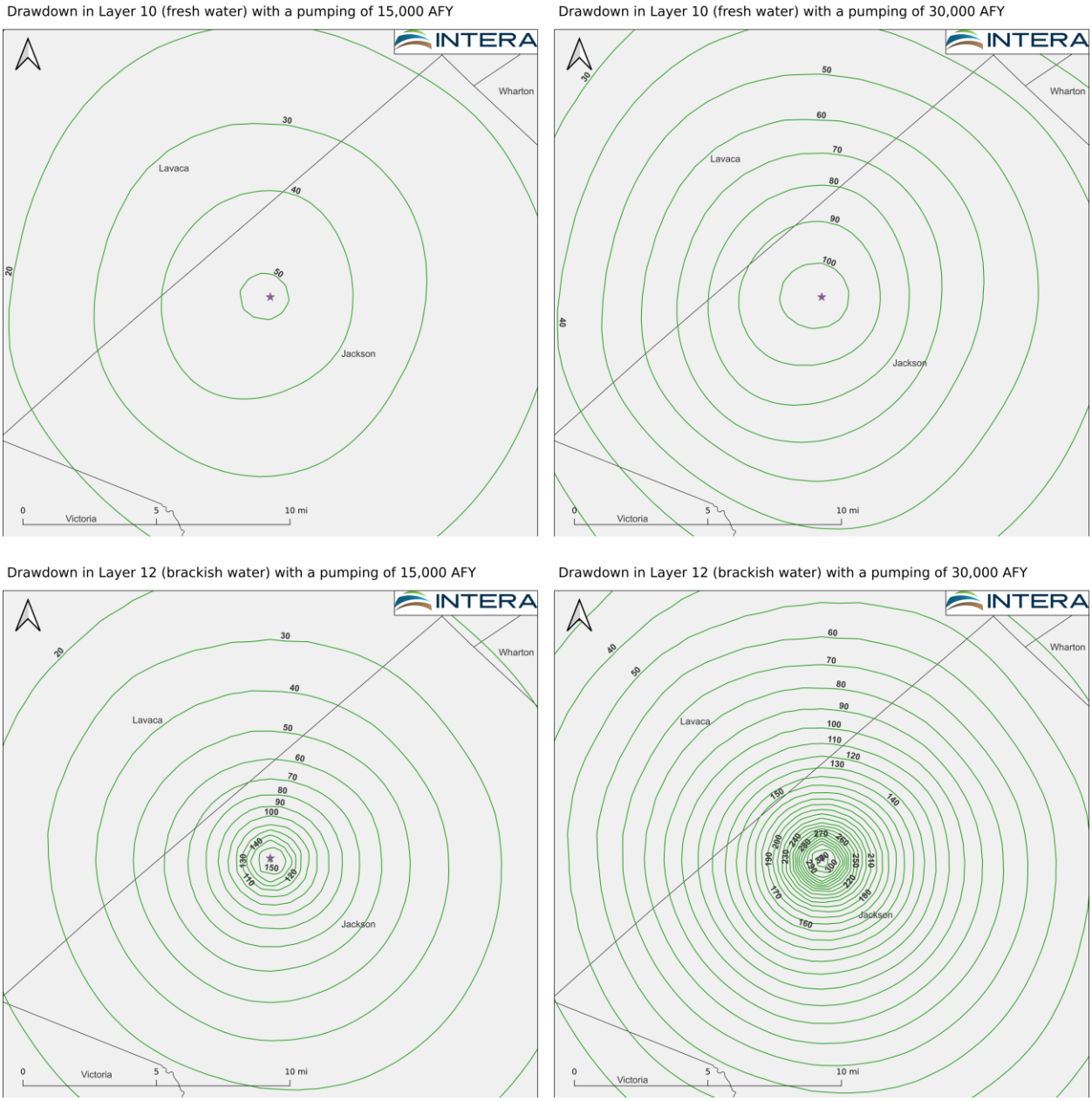


Figure 4-66. Simulated drawdowns after 5-year pumping at well field #6 at a rate of 15,000 AFY (left) and 30,000 AFY (right).

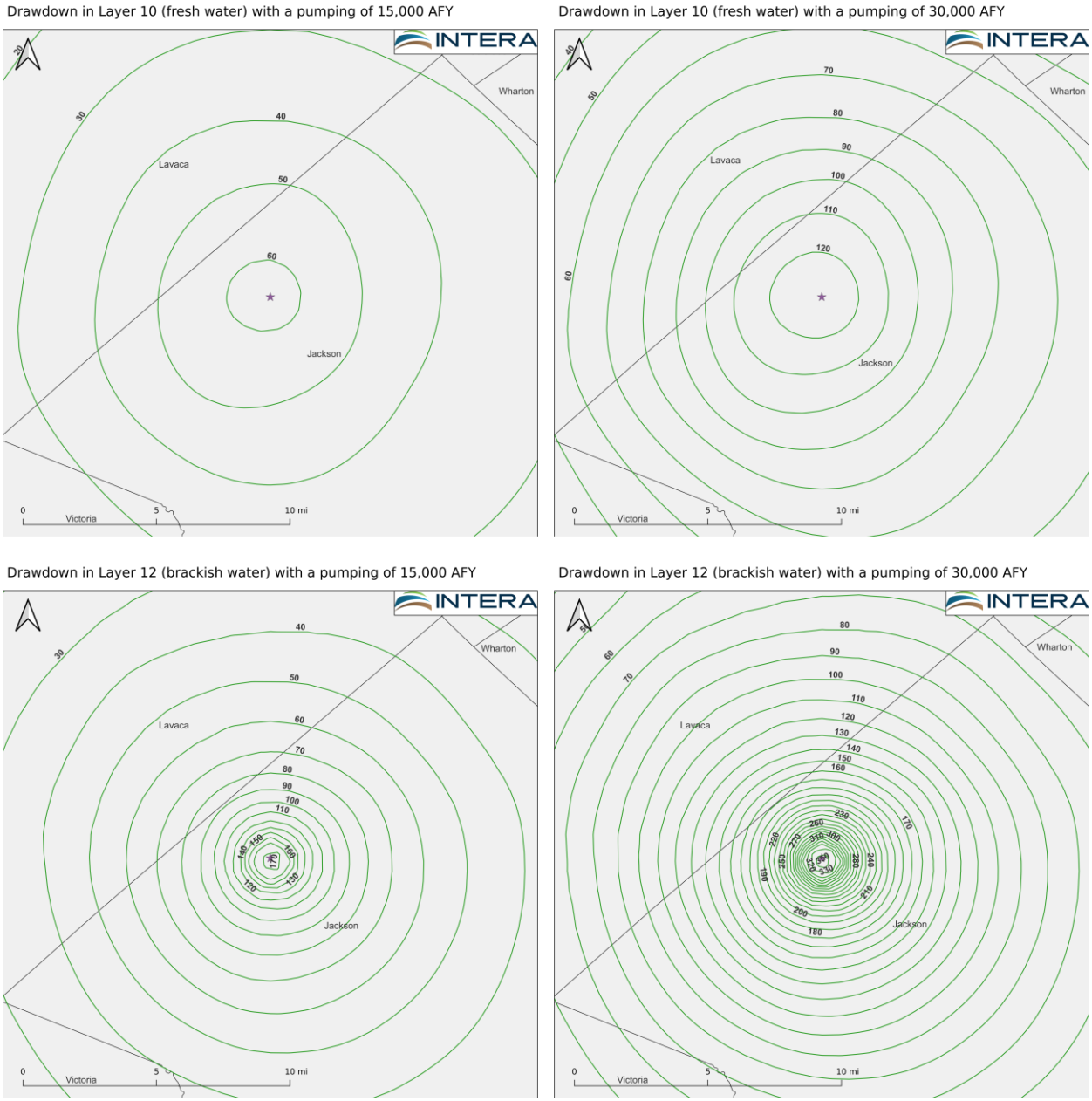


Figure 4-67. Simulated drawdowns after 30-year pumping at well field #6 at a rate of 15,000 AFY (left) and 30,000 AFY (right)

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Young, S., 2012f. Letter Report to Mr. Neil Hudgins, General Manager of Coastal Bend GCD dated June 8, 2015, "Deliverables Associated with Task 1 of Technical Support for Improving the Groundwater Availability Model for GMA 15, prepared by INTERA, Austin Texas

Young, S., 2012g. Letter Report to Ms. Charlotte Krause, General Manager of Pecan Valley GCD dated May 25, 2015, "Deliverables Associated with Task 1 of Technical Support for Improving the Groundwater Availability Model for GMA 15, prepared by INTERA, Austin Texas

Young, S., 2012h. Letter Report to Mr. Russell Labus, General Manager of Evergreen Underground WCD dated May 11, 2015, "Deliverables Associated with Task 1 of Technical Support for Improving the Groundwater Availability Model for GMA 15, prepared by INTERA, Austin Texas

Young, S.C., J. Pinkard, R. Bassett, and A. Chowdhury. 2013. Hydrogeochemical Evaluation of the Texas Gulf Coast Aquifer System and Implications for Developing Groundwater Availability Models, prepared for the Texas Water Development Board, unnumbered report.

Young, S., Jigmond, M., Deeds., N., Blainey, J., Ewing, T., and Banjeri, 2016. Identification of Potential Brackish Groundwater Production Area – Gulf Coast Aquifer System, prepared for the TWDB, unpublished report, September 2016.

Young. S., and R. Kushnereit, 2018. Characterization of Brackish Groundwater Resources in Victoria County, prepared for Victoria County Groundwater Conservation District, prepared by INTERA, Inc. Austin, TX.

INTERA Incorporated
9600 Great Hills Trail, Suite 300W
Austin, TX 78759
+1 (512) 425 2000

April 10, 2026

Mr. Tim Andruss
Victoria County Groundwater Conservation District
1501 Mockingbird Lane
Victoria, TX 77904

RE: Proposal for Additional Simulations Using the Central Gulf Coast Brackish Groundwater Flow Model

Dear Mr. Andruss,

INTERA Incorporated (INTERA) proposes to perform two modeling scenarios and document the results in a report. The proposed work will include the following:

- The modeling scenarios will be run using the recently developed Central Gulf Coast Brackish Groundwater Flow (CGCBGWF) Model
- Modeling Scenario #1 will simulate the production of 30,000 acre-ft/year from the slightly brackish zone that exists in Victoria County GCD, Refugio County GCD, Texana GCD, and Calhoun County GCD. INTERA anticipates that up to four different wellfield configurations will be used to represent Modeling Scenario #1
- Modeling Scenario #2 will simulate the production of 20,000 acre-ft/year from the deeper, moderately brackish zone that exists in Victoria County GCD, Refugio County GCD, Texana GCD, and Calhoun County GCD. INTERA anticipates that up to four different wellfield configurations will be used to represent Modeling Scenario #2.
- Prior to performing any model simulations, INTERA will meet with General Manager Tim Andruss to discuss the well configurations to be modeled for Modeling Scenarios #1 and #2.
- The results for Modeling Scenarios #1 and #2 will be documented in an addendum to the INTERA report that documents the development of the CGCBGWF model

The cost to perform the proposed work is $10,000. The work will be performed under a fixed price contract.

INTERA looks forward to discussing the proposal with you.

Sincerely,

Steven C Young

Steven C Young, PhD, PE, PG
Principal Geoscientist
INTERA, Inc

Cc: Nick Lamkey, INTERA

****

This permit is approved for: 1) operating the above described water well;

2) production of 28,486 gallons or Ac.Ft. of water annually; and

3) a production rate not to exceed 1500 gallons per minute.

4) term of the operating permit 5 years.

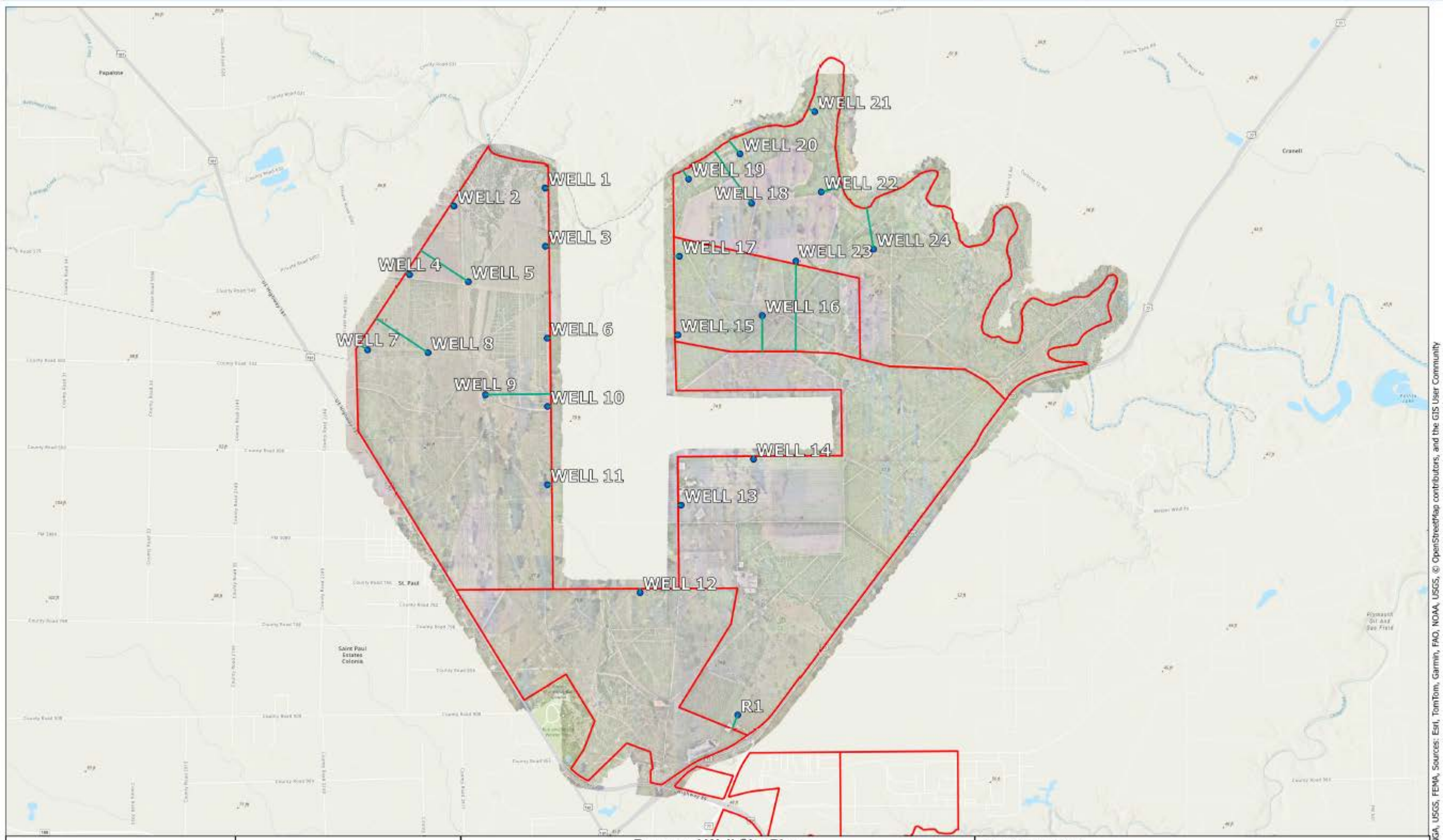
This permit is approved, subject to the rules of the SPCGCD: _____

PRESIDENT SPCGCD OR MANAGER OF SPCGCD

Permit Number: 140

5-16-19

Date



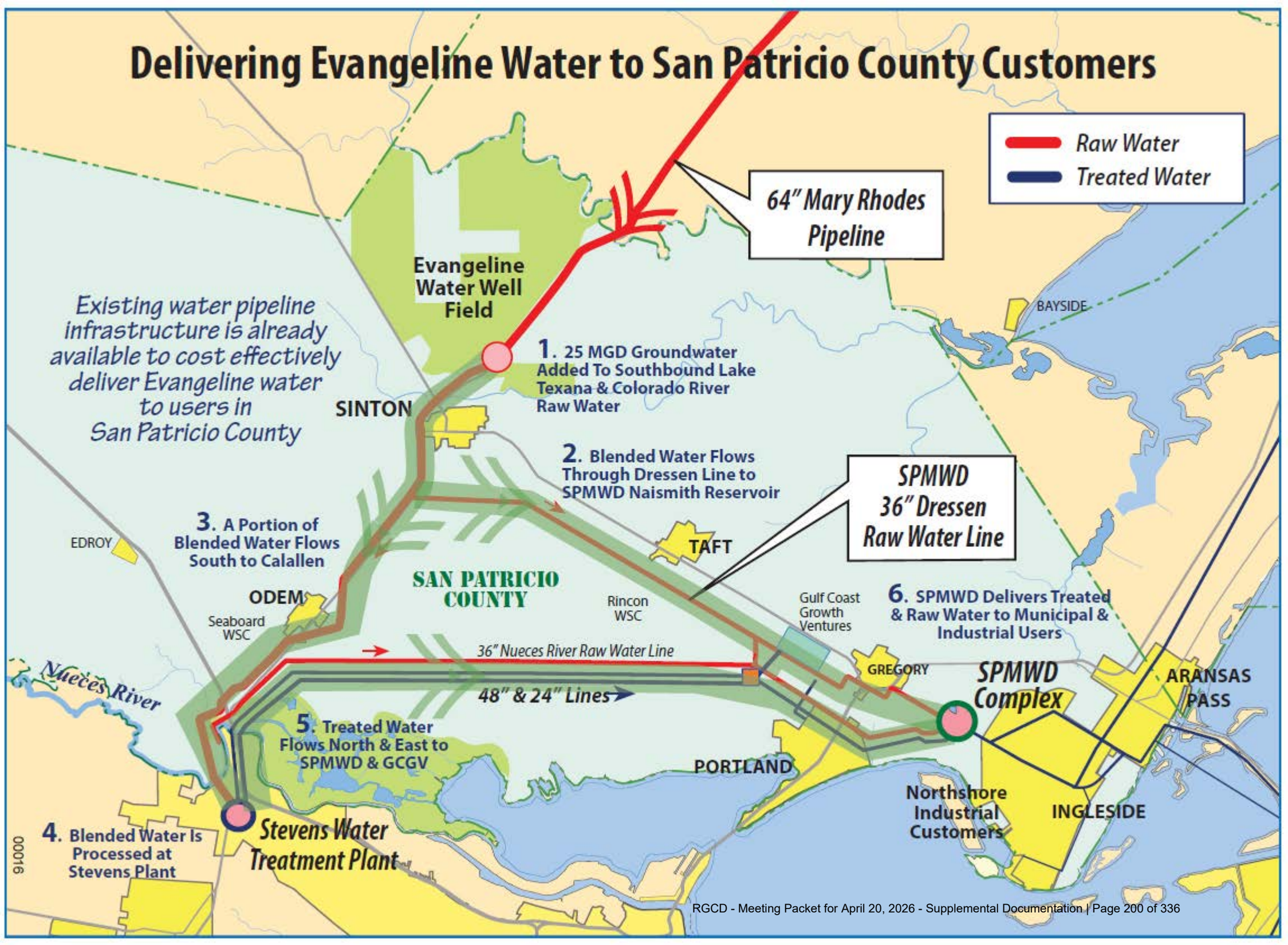
HANSON

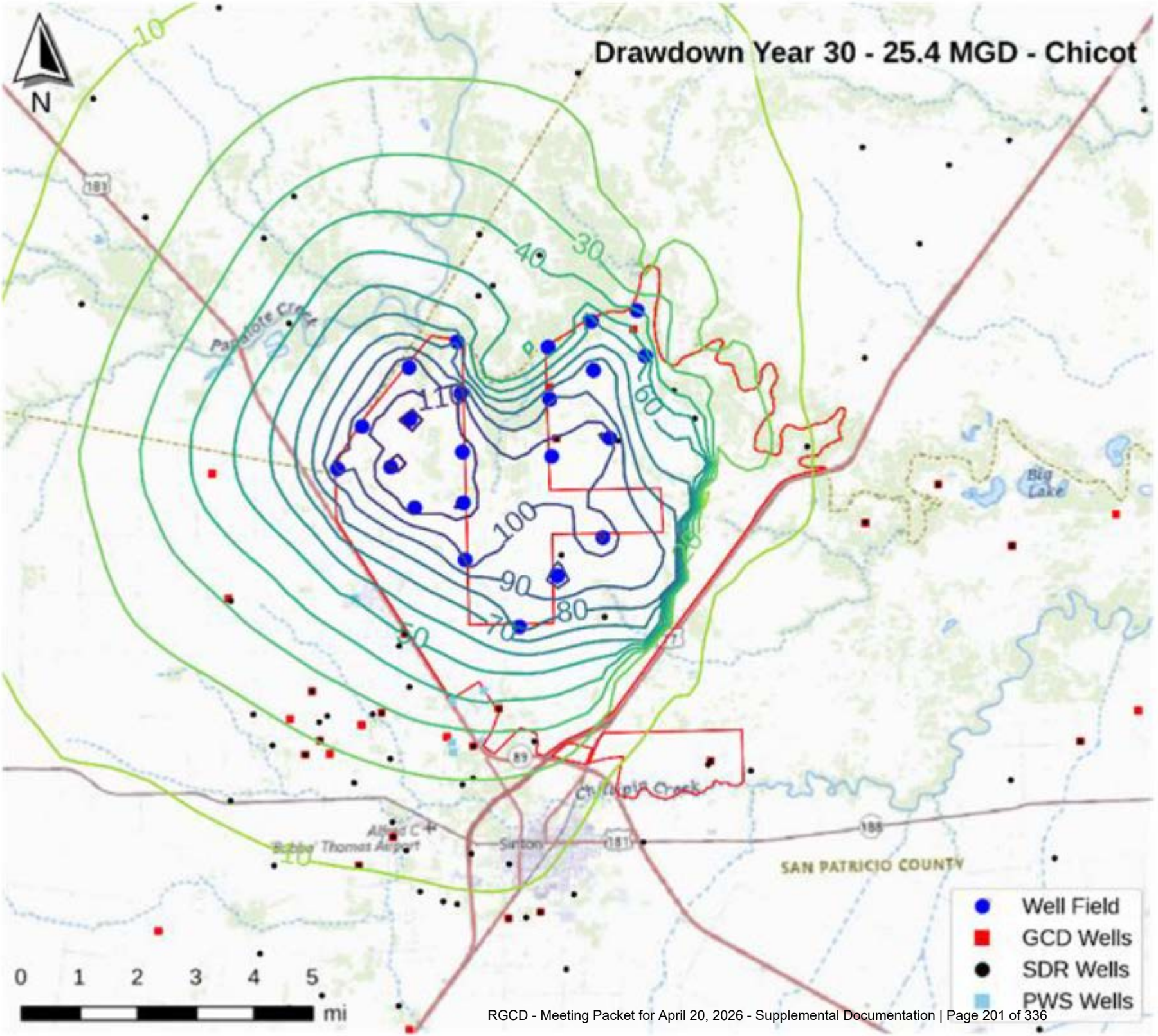
Proposed Well Site Plan

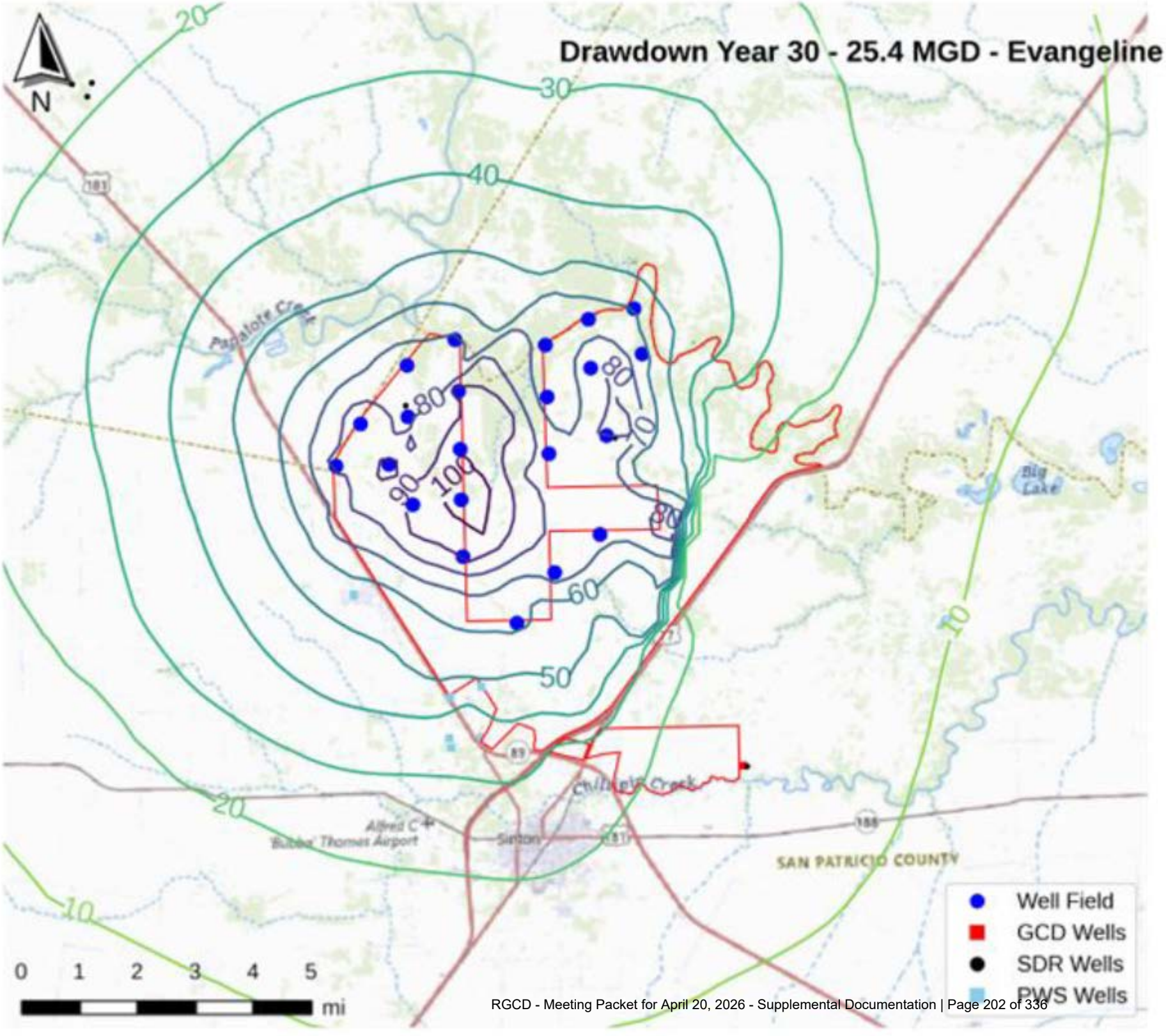
Evangeline Proposed Well Site Plan
San Patricio County, TX

Project #25L0183

Created: 12/9/2025


Delivering Evangeline Water to San Patricio County Customers
Raw Water
Treated Water
64" Mary Rhodes Pipeline
Evangeline Water Well Field
Existing water pipeline infrastructure is already available to cost effectively deliver Evangeline water to users in San Patricio County
1. 25 MGD Groundwater Added To Southbound Lake Texana & Colorado River Raw Water
SINTON
2. Blended Water Flows Through Dressen Line to SPMWD Naismith Reservoir
SPMWD 36" Dressen Raw Water Line
3. A Portion of Blended Water Flows South to Calallen
EDROY
TAFT
SAN PATRICIO COUNTY
ODEM
Seaboard WSC
Rincon WSC
Gulf Coast Growth Ventures
6. SPMWD Delivers Treated & Raw Water to Municipal & Industrial Users
36" Nueces River Raw Water Line
48" & 24" Lines
GREGORY
SPMWD Complex
ARANSAS PASS
Nueces River
5. Treated Water Flows North & East to SPMWD & GCGV
PORTLAND
Northshore Industrial Customers
INGLESIDE
BAYSIDE
4. Blended Water Is Processed at Stevens Plant
Stevens Water Treatment Plant
00016


Drawdown Year 30 - 25.4 MGD - Chicot
N
10
30
40
60
70
80
90
100
110
Papalote Creek
Big Lake
Chiltipin Creek
Alfred C. Thomas Airport
Sinton
SAN PATRICIO COUNTY
Well Field
GCD Wells
SDR Wells
PWS Wells
0 1 2 3 4 5
mi


Drawdown Year 30 - 25.4 MGD - Evangeline
N
20
30
40
80
90
100
60
50
10
Papalote Creek
Big Lake
Chiltipin Creek
Alfred C. "Bubba" Thomas Airport
Sinton
SAN PATRICIO COUNTY
Well Field
GCD Wells
SDR Wells
PWS Wells
0 1 2 3 4 5
mi

Groundwater Research, Science, and Data Collection Grants

Fiscal Year 2026 Application Form

Submit this completed application form and all required attachments by email to GCDGrants@twdb.texas.gov by **March 13, 2026, 2:00pm**. Use the subject: "FY2026 Groundwater Grant Application – <Your District Name>".

Refer to the FY2026 Groundwater Grants Guidelines for deadlines and detailed instructions. All information on this form is required to be considered a complete application. Incomplete applications will not be accepted.

I. Applicant Information

Official name of applicant (groundwater conservation district name)

Victoria County Groundwater Conservation District

Physical address:	1501 E. Mockingbird Lane, Ste 103, Victoria, Texas
Mailing address:	P.O. Box 69, Victoria, Texas 77902

Authorized official (has legal authority to sign a grant agreement)

Name:	Mark Meek
Title:	President of the Board
Phone number:	361-782-8488
Email address:	dmarkmeek@yahoo.com

Designated representative (primary contact for this application)

☐ Same as authorized official

Complete the information below if designated representative is different from the authorized official.

Name:	Tim Andruss
Title:	General Manager
Phone number:	361-579-6863
Email address:	tandruss@vcgcd.org

II. Eligibility Confirmation

Check all that apply

- ✔ Applicant is a groundwater conservation district as defined by Texas Water Code § 36.001(1).
- ✔ Applicant is authorized to accept grants under Texas Water Code § 36.158.
- ✔ Only one application is being submitted by this applicant.

Eligibility documentation

Attach ONE of the following to confirm applicant eligibility, intent, and authorized representatives. *Select which form of documentation is included in this application*:

- ✔ An affidavit from the individual with the authority to act on behalf of the applicant, OR
- ☐ A copy of an adopted resolution, OR
- ☐ Minutes approved by the groundwater conservation district board with the authority to act on behalf of the applicant.

Eligibility documentation must include:

- Amount requested;
- Any local match (not required);
- A statement that grant funds will supplement, not replace, applicant funds;
- Authorization to submit application; AND
- Designation of a representative the TWDB can contact regarding the application.

III. Applicant Financial Information

Annual operating budget (amount)

$248,200 (operating revenue - operating expenses)

For example, $1,250,000

Link to most recent annual operating budget OR enter "file attached" and attach file

file attached

Last financial audit (date):

9/30/2024

Link to most recent financial audit OR enter "file attached" and attach file

file attached

Explain the need for financial assistance

The Victoria County Groundwater Conservation District requires financial assistance to complete the proposed project because its adopted Fiscal Year 2026 operating budget does not include the sufficient allocation of funds to pay for the expenses to be incurred in completing the tasks proposed within the scope of work required to comprehensively assess subsidence in the central portion of the Gulf Coast Aquifer region.

V. Project Information

Project cost

Total project cost

$281,000

Amount requested from the Texas Water Development Board

$231,000

TWDB will only award grants for $50,000 to $300,000

Applicant will provide supplemental funding for this project (local match not required)

Yes ✔ No ☐ To be determined ☐

If yes, amount of supplemental funding and source(s)

$40,000 Cash Contribution - Operating Budget; $10,000 In-Kind Services

Grant Category

Category 1: Groundwater Research and Science

Project title

The Development of the CGCBGF Model for Groundwater Management and Planning

Short project description (brief statement of purpose)

No more than 175 words.

The project will integrate hydrogeologic data, measured subsidence, groundwater production and water levels since 1940 to update the Central Gulf Coast Brackish Groundwater Flow (CGCBGF) Model to support the simulation of subsidence using the MODFLOW 6 CSUB subsidence module. The project will also determine subsidence rates from 2018 to 2025 from satellite-based InSAR data and deformation measurements from NOAA stations for the four counties within the jurisdictions of the cooperating districts. The project will provide the cooperating districts with the information to refine their rules incentivizing the safe development of brackish groundwater, advance the best available science for modeling impacts from brackish production including subsidence, and provide a tool for evaluating the potential impacts of developing brackish groundwater resources. Due to the high risk of subsidence being caused by groundwater production in the Gulf Coast Aquifer, the cooperating districts require the installation of subsidence monitoring stations for high-capacity production permits. To facilitate future brackish projects with these installations, the project includes the installation and operation of a subsidence monitoring station.

Project duration

Months to complete. ***Awarded projects must be completed by May 31, 2028.***

23 months with project completion by May 31, 2028

Category-specific narrative

Complete the prompt that matches your selected category.

For Category 1: Describe how this project furthers best available science[1] in the state and supports the implementation of effective groundwater resource management and planning.

For Category 2: Describe how this project enhances the collection, quality, and availability of groundwater data used by groundwater conservation districts and the TWDB to support effective groundwater resource management and planning within the district and across the state.

No more than 300 words.

This project advances the best available science for groundwater management in Texas by integrating InSAR data, GNSS-based monitoring, historical datasets, and numerical modeling to evaluate subsidence within the Central Gulf Coast Aquifer. Consistent with the definition of best available science under §36.0015, Water Code, the project relies on statistical and quantitative data, analytical methods, and scientific studies that are publicly available and reproducible by the scientific community.

The project provides direct local groundwater management benefits for the cooperating districts by improving the ability to identify, quantify, and evaluate land subsidence associated with groundwater withdrawals. Understanding the relationship among groundwater production, aquifer pressure decline, and land-surface deformation will improve the ability of the cooperating districts and other interested parties to evaluate permit applications, assess potential impacts from pumping, and support joint planning activities.

The project provides statewide benefits by developing improved scientific datasets and modeling tools that can support groundwater availability modeling and subsidence assessment throughout the Texas Gulf Coast region. Estimates of land subsidence from InSAR data, NOAA CORS subsidence monitoring stations, and historical measurements by the National Geodetic Survey will be analyzed to quantify spatial and temporal patterns of subsidence across the study area. These datasets will be integrated with groundwater production histories, water-level records, and compressible clay interbeds within the Gulf Coast Aquifer.

The compiled datasets will be used to refine the CGCBGF Model and apply the MODFLOW-6 CSUB module to simulate land subsidence. The installation of a GNSS-based subsidence monitoring station will provide continuous measurements of land subsidence, supporting long-term monitoring of aquifer response to groundwater development.

The project will deliver subsidence datasets, technical reports, and calibrated modeling tools that improve groundwater science and provide actionable information to support groundwater management, regional water planning, promote the development of brackish groundwater, and sustainable groundwater development in Texas.

[1] See Texas Water Code § 36.0015 for the definition of *best available science.*

Scope of work (attach)
Attach a scope of work that includes:

- ✓ Clearly identified tasks,
- ✓ Clearly defined project team,
- ✓ Estimated completion times for each task (project timeline,
- ✓ Proposed equipment purchases (if applicable, and
- ✓ Deliverables the TWDB will receive through this project (data, reports, or other products).

Note: All deliverables must be provided to the TWDB. Data deliverables must follow data requirements as provided in the grant agreement.

Project budget (attach)
Attach a proposed project budget (using example budget tables in Appendix B of Guidelines) that includes:

- ✓ Total project cost,
- ✓ The cost of each significant element of the project,
- ✓ TWDB costs and local match costs (if applicable; local match not required), and
- ✓ Equipment cost list (if applicable).

VI. Additional Documentation

If you would like to provide any additional information or documentation to support your application, you may attach that to the application. Please list any additional documentation provided with the application:

6.01 - VCGCD - TWDB GRSDC Grant - Addendum 1,
6.02 - VCGCD - TWDB GRSDC Grant - Addendum 2,
6.03 - CCGCD - FY2026 Budget - Adopted 20250825,
6.04 - RGCD - FY2026 Budget - Adopted 20250829,
6.05 - TGCD - FY2026 Budget - Adopted 20250828,
6.06 - CCGCD - Audited Financial Statements - FYE20240930,
6.07 - RGCD - Audited Financial Statements - FYE20240930,
6.08 - TGCD - Audited Financial Statements - FYE20240930,
6.09 - INTERA - Brackish Groundwater Characterization for VCGCD - 20190115,
6.10 - INTERA - Estimates of Subsidence in GMA 15 - 20160203,

****

Before submitting your application, please review all the information provided on this application form carefully, and ensure all required attachments are appended to this PDF or included as email attachments.

Submit this completed application form and all required attachments by email to GCDGrants@twdb.texas.gov by **March 13, 2026, 2:00pm**. Use the subject: "FY2026 Groundwater Grant Application – <Your District Name>".

Scope of Work

The Victoria County Groundwater Conservation District (VCGCD), in cooperation with the Calhoun County Groundwater Conservation District (CCGCD), the Refugio Groundwater Conservation District (RGCD), and the Texana Groundwater Conservation District (TGCD), collectively referred to as the "cooperating districts", is requesting funds from the Texas Water Development Board's (TWDB) Fiscal Year (FY) 2026 Groundwater Research, Science, and Data Collection Grant program to complete a comprehensive subsidence analysis and long-term subsidence monitoring station to support the safe and sustainable development of brackish groundwater resources in the central region of Gulf Coast Aquifer in Texas. The project is referred to as The Development of the CGCBGF Model for Groundwater Management and Planning.

1 – Overall Impact and Value of Project

This project will produce meaningful and measurable outcomes that advance the best available science for groundwater management and planning in Texas. The project will improve the scientific understanding of land subsidence associated with groundwater production within the Central Gulf Coast Aquifer system and provide practical tools that groundwater conservation districts, regional planners, and the Texas Water Development Board (TWDB) can use to evaluate and manage subsidence risks. The project integrates satellite remote sensing, geodetic monitoring, historical groundwater datasets, and numerical groundwater modeling to develop improved datasets and predictive tools for evaluating aquifer compaction and land-surface deformation associated with groundwater withdrawals.

The outcomes of this project will directly support groundwater management decisions within the cooperating districts. Demand for water resources in the central region of Gulf Coast Aquifer continues to increase, particularly for municipal and industrial development. As a result, brackish groundwater resources are increasingly being considered as an important component of future water supply strategies. However, the potential relationship between brackish groundwater production, aquifer pressure decline, and land subsidence remains insufficiently quantified in the central region of Gulf Coast Aquifer in Texas. This project will provide the scientific information and analytical tools necessary for the cooperating districts to evaluate subsidence risks associated with existing and proposed brackish groundwater development and to support science-based groundwater permitting decisions.

The project will also provide important information for the joint planning process of Groundwater Management Area 15. Historically, land subsidence has not been explicitly incorporated into groundwater availability modeling or Desired Future Condition (DFC) evaluations within the management area. By compiling and analyzing satellite-based deformation measurements, groundwater production data, groundwater level trends, and geologic information describing compressible clay interbeds, the project will generate new datasets that can be incorporated into future updates of the Central Gulf Coast Groundwater Availability Model (GAM). These improvements will help ensure that subsidence impacts are considered in future groundwater planning and modeling efforts.

On the state level, the project will support the development of science-based policies and regulatory frameworks governing brackish groundwater production. Recent legislative initiatives in Texas have promoted the development of brackish groundwater resources to meet growing water supply needs. These initiatives promote the development of permitting frameworks and rules that encourage responsible groundwater development while protecting aquifer systems from unacceptable impacts such as land subsidence. The results of this project will provide groundwater conservation districts with the scientific information necessary to evaluate subsidence risks associated with brackish groundwater production and will provide a framework that other districts across Texas can use when developing rules and permitting strategies for brackish groundwater resources.

Land subsidence is particularly important for coastal communities because it compounds the impacts of relative sea-level rise. Previous studies have confirmed that land subsidence is a prominent contributing factor to relative sea-level rise in coastal cities worldwide (Tay et al., 2022). Three of the groundwater conservation districts participating in this project contain significant coastline, with Calhoun County alone containing approximately 570 miles of shoreline. Improved understanding of subsidence patterns in these counties will help local governments, water

planners, and water managers better evaluate long-term risks associated with coastal flooding, infrastructure stability, and ecosystem impacts.

1.1 Key Outcomes of the Project

1. **Advancement of Best Available Science for Groundwater Management**
   - The project will integrate satellite-based Interferometric Synthetic Aperture Radar (InSAR), ground-based Global Navigation Satellite System (GNSS) monitoring, historical groundwater datasets, and MODFLOW-6 CSUB subsidence modeling to create a comprehensive evaluation of subsidence in the Central Gulf Coast Aquifer system. These datasets and modeling tools will improve the scientific understanding of aquifer compaction and subsidence associated with groundwater withdrawals.
2. **Improved Groundwater Management Tools for GCDs and Regional Planning**
   - The project will provide datasets, monitoring infrastructure, and modeling tools that enable groundwater conservation districts to evaluate subsidence risks associated with brackish groundwater development. These tools will support groundwater permitting decisions, joint planning activities in Groundwater Management Area 15, and future updates to groundwater availability models.
3. **Statewide Transferability and Long-Term Monitoring Infrastructure**
   - Installation of a permanent GNSS-based subsidence monitoring station will provide continuous high-precision measurements of vertical land motion within the region. The monitoring data, subsidence datasets, and modeling tools developed through this project will be publicly available and transferable to other regions of Texas where groundwater development and subsidence risks must be evaluated.

Together, these outcomes will improve groundwater science, strengthen groundwater management decisions, and support the safe and sustainable development of groundwater resources throughout the Texas Gulf Coast region and across the state.

2 – Benefits for Groundwater Management

The proposed project will significantly improve groundwater management and planning across the central region of Gulf Coast Aquifer in Texas by expanding the scientific understanding of land subsidence associated with groundwater production and by providing practical tools for evaluating subsidence risks associated with future groundwater development. The project directly supports the safe and sustainable development of groundwater resources, particularly brackish groundwater, while protecting aquifer integrity and minimizing the risk of land-surface subsidence.

2.1 Local Groundwater Management Benefits

The project will provide direct benefits to local groundwater management efforts within the cooperating districts by improving the ability of the districts and permit applicants to evaluate potential subsidence impacts associated with groundwater development projects. In particular, the project will develop scientifically defensible datasets and modeling tools needed to credibly predict subsidence, if any, that may occur as a result of moderate to large-scale brackish groundwater production. The availability of these tools will improve the ability of groundwater conservation districts, permit applicants, and other interested parties to rely on credible scientific information when evaluating proposed groundwater production projects prior to final permitting decisions. In addition, the project will increase certainty that brackish groundwater projects permitted by the cooperating districts can proceed while minimizing the potential for unacceptable subsidence impacts.

The project also directly supports the regulatory framework for managing groundwater production and subsidence of the cooperating districts. The cooperating districts have adopted rules intended to balance the safe development of deep saline groundwater resources with protection against unacceptable land subsidence and/or drawdowns in shallower freshwater zones. These rules include provisions limiting acceptable subsidence impacts, establishing monitoring and reporting requirements for subsidence associated with certain production permits, and potentially requiring curtailment of groundwater production to control or prevent subsidence. See Rule 6.3(1)(1.5), Rule 6.4(4)(4.11), Rule 6.3.2(3), Rule 6.4.3(4)), and Rule 9.1(2) of the Rules of the Victoria County Groundwater Conservation District for more details.

In addition, the cooperating districts have adopted groundwater permitting rules intended to encourage the responsible development of deep-saline groundwater resources. These rules include designation of special groundwater management zones for deep-saline groundwater resources, reduced well spacing requirements for deep-saline production wells, modified well construction requirements, increased production allowances within designated deep-saline groundwater management zones, streamlined permit application requirements, and appropriate permit conditions governing brackish groundwater production. The proposed project will provide the scientific foundation needed to support implementation of these rules and improve the districts' ability to evaluate potential subsidence impacts associated with current and future brackish groundwater development. See Rule 1.1, Rule 2.4(9), Rule 2.3, Rule 6.4(1–2), Rule 6.4(3–4), Rule 6.4.1(1)(1.1–1.3), Rule 6.4.3, and Rule 6.4.4 of the Rules of the Victoria County Groundwater Conservation District for more details.

The project also supports groundwater management planning by providing improved technical information for evaluating Desired Future Conditions (DFCs) during the joint planning process. In particular, the results of the project will help representatives and technical consultants evaluate the factors established under Texas Water Code §36.108, including consideration of the potential impacts of proposed Desired Future Conditions on land subsidence as described in Section 36.108(d)(5). By improving the ability to evaluate the relationship between groundwater withdrawals, aquifer pressure decline, and land-surface deformation, the project will strengthen the scientific basis for groundwater management decisions within the cooperating districts.

2.2 Statewide Benefits and Advancement of Best Available Science

In addition to providing important local benefits, the proposed project will contribute to statewide groundwater science and management efforts by improving the datasets and analytical tools used to evaluate land subsidence across the Texas Gulf Coast region. The project will integrate satellite-based Interferometric Synthetic Aperture Radar (InSAR) measurements, ground-based deformation measurements from NOAA Continuous Operating Reference Stations, historical groundwater production records, groundwater-level data, and geologic information describing compressible clay interbeds within the Gulf Coast Aquifer system. The integration of these datasets will represent a comprehensive evaluation of subsidence in the central region of Gulf Coast Aquifer in Texas.

The project will also refine the Central Gulf Coast Brackish Groundwater Flow Model (CGCBGF Model) and apply the MODFLOW-6 CSUB subsidence module to simulate aquifer compaction and associated land-surface deformation. These modeling tools will improve the ability of groundwater managers and researchers to evaluate the relationship between groundwater withdrawals and subsidence, and they will provide a transferable technical framework that may be applied to other areas of the Texas Gulf Coast where subsidence associated with groundwater development is a concern.

In addition, the installation of a permanent Global Navigation Satellite System (GNSS) subsidence monitoring station will provide continuous high-precision measurements of vertical land motion within the region. These observations will provide independent validation of satellite-based subsidence measurements and support long-term monitoring of aquifer system response to groundwater production. The monitoring data and modeling tools developed through this project will contribute to the body of publicly available scientific information used by groundwater conservation districts, regional water planning groups, and the Texas Water Development Board to support groundwater management, subsidence assessment, and sustainable groundwater development across Texas.

3 – Capacity and Commitment of the Victoria County Groundwater Conservation District

The VCGCD has demonstrated both the administrative capacity and the institutional commitment necessary to successfully manage and complete this project. The project team includes a dedicated grant coordinator who will oversee the administrative and financial responsibilities associated with managing the grant, including documentation, reporting, and compliance with Texas Water Development Board (TWDB) grant requirements. This administrative support ensures the VCGCD has the capability to effectively receive and manage grant funds.

3.1 Victoria County Groundwater Conservation District's Capacity

The organizational structure of the VCGCD is sufficient to manage and administer the proposed project. The operations of the VCGCD are carried out by a staff of seven positions and several consultants who support groundwater management, monitoring, and administrative functions. Management of the VCGCD is provided by Tim Andruss, General Manager, who will serve as the project manager for this project. Administrative support will be provided by Caitlynn Davenport and Lisa Ramirez, Administrative Coordinators, who assist with financial administration, grant documentation, and day-to-day operational support for the VCGCD. Permitting and enforcement activities are supported by Mike Benavides and Corbin Karl, Compliance Specialists, who manage regulatory compliance and permit-related activities within the VCGCD. Field services are provided by Willie Immenhauser, Aquifer Monitoring Technician, along with an additional technician position that supports aquifer monitoring and data collection activities for the VCCGD. This organizational structure provides the personnel and administrative framework necessary to successfully manage project activities, oversee grant administration, and ensure completion of project deliverables.

Project management will be led by Tim Andruss, who has extensive experience overseeing groundwater-related programs and regional water planning initiatives. Mr. Andruss has served as Chair of Groundwater Management Area (GMA) 15 for three joint planning cycles and previously served as Chair of the South Central Regional Water Planning Group Water Planning Group. His experience managing large, multi-agency groundwater initiatives will be instrumental in coordinating the technical team, managing project timelines, and ensuring successful completion of project objectives.

The VCGCD has a strong track record of successfully administering groundwater research projects. One example includes an Aquifer Storage and Recovery (ASR) demonstration study funded through a TWDB groundwater grant of approximately $285,000 over a three-year period. Mr. Andruss and his team successfully managed the financial, administrative, and technical components of that study. In addition, the districts have previously funded regional investigations of historical subsidence and have already developed a regional brackish groundwater flow model to support evaluation of brackish groundwater development.

3.2 Victoria County Groundwater Conservation District's Commitment

The VCGCD has maintained an active groundwater science program for approximately 15 years, demonstrating a long-standing commitment to advancing groundwater research and improving the scientific basis for groundwater management decisions. The proposed project builds directly upon these prior efforts and reflects the cooperating districts' continued investment in understanding subsidence and groundwater resource development.

The cooperating districts have also demonstrated financial commitment to completing the project. District staff will provide approximately $10,000 in in-kind services, and the cooperating districts have budgeted $40,000 in direct funding available to support project implementation. In addition, the districts have sufficient financial resources available to begin work immediately and do not require advance funding from TWDB to initiate project activities.

Importantly, the districts have a clear commitment to using the results of this project to support groundwater management and rulemaking related to brackish groundwater production. The scientific findings generated through this study will help inform the rulemaking process for brackish groundwater development and provide a defensible technical basis for evaluating potential subsidence impacts associated with existing and proposed permits. Ultimately, the districts intend to use the results of this project to support the safe and sustainable development of brackish groundwater resources while protecting aquifer integrity and minimizing the risk of land subsidence.

4 – Technical Approach and Feasibility

The VCGCD proposes a technical approach based on successful projects of a similar nature and has assembled a project team with the expertise and experience to perform their assigned tasks with a high degree of quality and efficiency. The principal investigators of the project team are Steve Young, PhD, PE, PG. of INTERA; Joe Hughes, PhD. of INTERA; Zhong Lu, PhD. of Southern Methodist University; and Guoquan Wang, PhD. of University of Houston.

The Interferometric synthetic aperture radar (InSAR) study to measure land subsidence will be led by Dr. Zhong Lu, who has conducted numerous similar studies along the Texas Gulf Coast, including InSAR investigations for the Harris-Galveston Subsidence District (HGSD) and two groundwater conservation districts (GCDs) in GMA 15.

The development of the CGCBGF Model has been on-going for approximately nine years by INTERA, Inc. INTERA has performed numerous aquifer characterization studies and modeling projects in Texas for the past 20 years. INTERA's experience and expertise in groundwater modeling is strengthened by the recent addition of Dr. Joseph Hughes, who is the principal codeveloper of MODFLOW 6 and the principal developer of the CSUB subsidence package. Dr. Hughes has been working extensively on applying both MODFLOW 6 and CSUB models in the Gulf Coast Aquifer System for the last year and is well positioned to successfully incorporate CSUB into the CGCBGF Model. The approach for calibrating the CSUB module using measured subsidence and water level values is based on similar projects successfully executed by the HGSD in Texas and the California Department of Water Resources.

The construction and operation of the proposed subsidence monitoring station is based on guidelines, instructions, and vendors used by HGSD to develop their successful monitoring network consisting of several hundred stations. To continue that success, INTERA has established communications with all of HGSD major vendors and are planning on using the same vendors to HGSD for the majority of the work.

4.2 Project Tasks

4.2.1 Task 1 – InSAR Study

Interferometric synthetic aperture radar (InSAR), which is a remote sensing technique, has proven to be an effective method for measuring land subsidence in the Northern Gulf Coast (Qu and Lu, 2022). In the northern Gulf Coast region near Houston, InSAR techniques have successfully mapped both groundwater-related subsidence and the locations of geologic faults (Qu and Lu, 2022). As part of this project, InSAR will be used to map land-surface deformation across the four-county study area from 2018 through 2025. The results will also provide an important dataset for evaluating the groundwater-compaction processes that will be simulated in Tasks 2 and 3 of this project.

Land subsidence is particularly of concern for counties with coastlines because of the compounding impact that land subsidence has with sea-level rise on coastal communities. Previous studies have confirmed that land subsidence is a prominent contributing factor of the relative sea level rise in many coastal cities worldwide (Tay et al., 2022). All of the counties within the study area of this project have coastlines with Calhoun County having approximately 570 miles of coastline.

Subtask 1a – Collection and Analysis of InSAR data.

Multiple sets of InSAR data will be collected and analyzed from January 2018 through December 2025 across all of Calhoun, Jackson, Refugio, and Victoria counties. The InSAR data will be collected and analyzed by a team of geophysicists under the supervision of Dr. Zhong Lu, the Shuler-Foscue Endowed Chair Professor of Geophysics in the Huffington Department of Earth Sciences and Professor of Civil Environmental Engineering at Southern Methodist University (SMU). The expected precision of the deformation measurements from the InSAR analysis will be approximately 1 cm/year. Conventional interferometric SAR (InSAR) can be limited by the spatial and temporal decorrelation between radar acquisitions, which can reduce the robustness of deformation estimates (Lu and Dzurisin, 2014). To overcome these limitations, multi-temporal InSAR (MTI) techniques (Ferretti et al., 2001; Berardino et al., 2002; Hooper et al., 2004, Hooper, 2008; Qu et al., 2015, 2019) will be applied. These MTI techniques have been successfully implemented as part of INTERA and SMU joint InSAR studies in Wharton and Matagorda counties (Young et al. 2020a, 2020b).

For each county, time-series of deformation results will be generated from multiple radar scenes (snapshots), supporting the evaluation of changes in land-surface elevation. Multiple scenes will be analyzed each year. Most of the trend analysis will be performed on

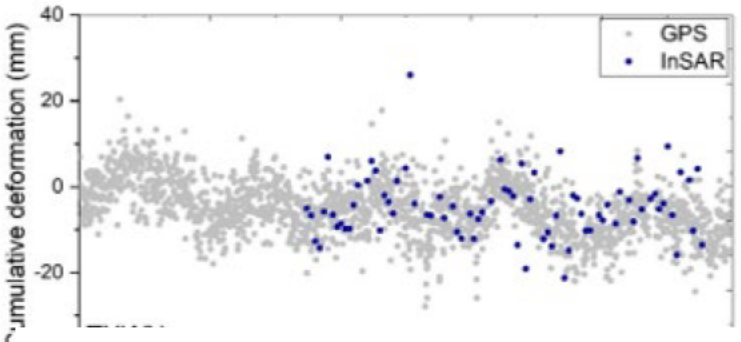


Figure 1- Comparison of InSAR measurements to a Deformation Measured at a Continuous Operating Reference Station (CORS) in Wharton County (Young et al. 2020)

annual average deformation rates. At approximately twenty sites, the results for each scene will be plotted to identify possible seasonality effect as is shown in Figure 1. To verify the accuracy of the InSAR-derived deformation measurements, the results will be compared to the deformation measured at Continuous Operating Reference Station (CORS) operated by the National Oceanic & Atmospheric Agency (NOAA). Relevant stations are located at Victoria, City of Enda, and Port Lavaca in Victoria, Jackson, and Calhoun counties, respectively. Figure 1 presents an example comparison between InSAR-derived deformation measurements and CORS observations from a previous INTERA/SMU InSAR study for Coastal Bend GCD. The comparison demonstrates the consistency between satellite-based deformation measurements and ground-based observations.

Subtask 1b – Prepare Report

INTERA will prepare a technical report documenting methods used for InSAR data collection, processing, and analysis. InSAR measurements can achieve spatial resolutions as fine as approximately 20 meters. However, for reporting and analytical purposes, the spatial datasets will likely be aggregated to grid resolution greater than 100 meters to improve data stability and facilitate interpretation of regional deformation patterns. Temporal averaging will generally be performed on an annual basis to aid in identifying statistically significant trends in land-surface deformation within each county of the project area. The report will include graphical analyses illustrating groundwater level trends and groundwater production over time, along with comparisons to the observed deformation time series derived from the InSAR analysis. These comparisons will be used to evaluate potential correlations between groundwater level declines, pumping patterns, and observed land surface deformation. Where such relationships are identified, the magnitude and statistical significance of the correlations will be quantified. Where appropriate, the maps of the deformation rates will be developed to identify possible locations of geologic faults.

Subtask 1c – Deliverables for Task 1.

Deliverables for Task 1 will include the following:

- GIS-compatible spatial datasets containing processed InSAR deformation measurements for the study area
- time-series deformation datasets derived from the InSAR analysis
- comparison datasets between InSAR-derived deformation and CORS observations
- a technical report prepared by INTERA documenting the methods, datasets, and results of the InSAR analysis

Task 2 – Model Historical Subsidence

From the 1970s through the mid-2000s, most land subsidence investigations in Texas focused almost exclusively on the greater Houston region, particularly studies funded by the Harris–Galveston Subsidence District (HGSD) and the Fort Bend Subsidence District (FBSD). With increased interest and funding associated with the Lower Colorado River Authority–San Antonio Water System Water Project (LSWP), which proposed exporting groundwater from the Lower Colorado River Basin (LCRB) to the City of San Antonio, the geographic focus of subsidence investigations expanded southward to include Wharton, Matagorda, and Jackson counties. These counties have experienced substantial groundwater withdrawals for rice irrigation since the mid-1940s.

Results from previous investigations modeling studies (URS, 2007; Kasmarek, 2012) indicate that notable land subsidence had occurred in these three counties since the 1940s. However, there has yet to be a study to show evidence of measured subsidence. With the possible exception of a TWDB report by Ratzlaff (1982), which compiled a limited amount of land subsidence data in the Gulf Coast, no comprehensive study had documented measured land subsidence across the four counties managed by the Districts had occurred prior to 2015.

In response to growing concerns regarding the potential impacts of subsidence, the cooperating districts joined with three additional groundwater conservation districts within Groundwater Management Area 15 (GMA 15) to fund a regional investigation of land subsidence. This study, conducted by INTERA (Young et al., 2016), concluded that measurable subsidence had occurred in all four counties. The results indicated that sufficient subsidence had already taken place to warrant further evaluation of high-capacity groundwater production wells and their potential to induce additional land subsidence in the region.

Subtask 2a – Literature Search on Historical Subsidence, Production and Water Levels

The objective for Subtask 2a is to assemble information regarding historical subsidence, groundwater production and water levels needed to support the modeling of subsidence in Task 2b. To obtain the historical production and water level data, the project team will query the TWDB groundwater database, the TWDB GAMs for the Central Gulf Coast, and the TWBD county reports. In addition, the project team will query groundwater studies performed by consultants for GCDs and municipalities such as the LWSP (Young and Kelley, 2009). Figure 4-2 shows an example of the type of historical pumping data that can be obtained among the different data sources for Jackson County. We anticipate collecting similar types of data for Calhoun, Refugio, and Victoria counties. For the subject counties, the TWDB has estimates of production since 1988. The most comprehensive source for measured land subsidence will be the aforementioned study by Young et al. (2016). The findings of Young et al. (2016) include:

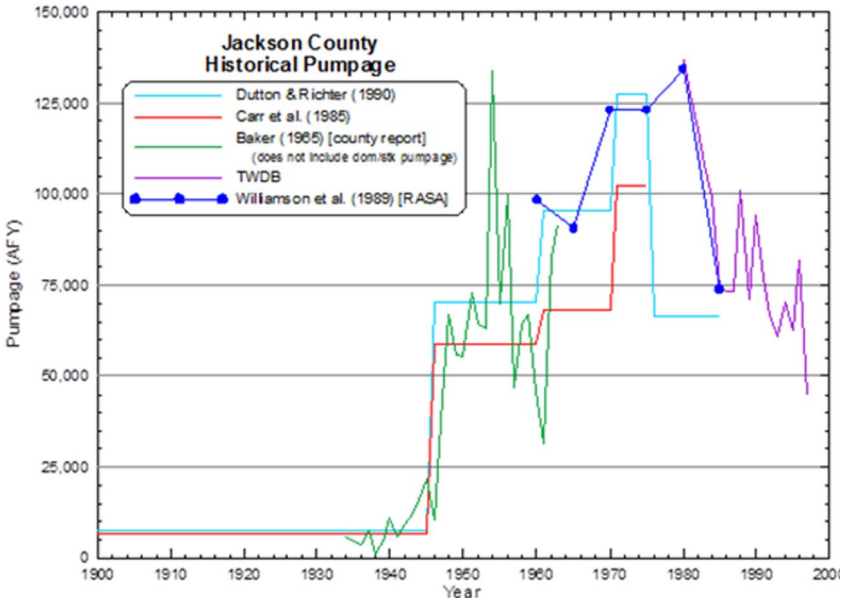


Figure 4-2. Total Groundwater Pumpage in Jackson County between 1900 and 2000 from different information sources

"Estimate historical land subsidence in seven counties in GMA 15. The report presents ground surface elevation data from National Geodectic Survey (NGS) benchmarks called Permanent Identifiers (PIDs), old topographic maps, and LIght and raDAR (LIDAR) data from seven counties in GMA 15. The PID data provide ground surface elevations at 1,700 point locations prior to 1950. The topographic maps cover approximately 2,150 square miles and were constructed between 1950 and 1960. To extract point location data from the topographic maps, the maps were digitized and converted to Geographic Information System (GIS) files. The LIDAR data cover approximately 2,500 square miles and were collected after 2006. The joint analysis of these three data sets support the following conclusions:

- *The LIDAR and PID data indicate that DeWitt, Jackson, Matagorda, Refugio, Victoria, and Wharton counties have experienced at least 2 ft of land subsidence, and Calhoun County has experienced at least 1.5 ft of land subsidence.*
- *The LIDAR and topographic map data indicate that Calhoun, DeWitt, Jackson, Matagorda, Refugio, Victoria, and Wharton counties have experienced at least 2 ft of land subsidence since 1950.*
- *An analysis of the PID data, topographic map data, and LIDAR data indicates that more than two feet of average subsidence has occurred across about 100 square miles covering southwest Wharton, southeast Jackson, and northwest Matagorda counties. (p. 48-49)*

Subtask 2b – Site Selection and Parameterization of Subsidence Model

The most advanced MODFLOW package available for simulating aquifer compaction and land subsidence is the Skeletal Storage, Compaction, and Subsidence (CSUB) package (Hughes et al., 2022). CSUB is a module within the MODFLOW 6 groundwater modeling framework (Hughes et al., 2017) that can be run either as part of an integrated groundwater flow model or as a stand-alone subsidence model. For the purposes of this subtask, CSUB will be implemented as a stand-alone model in which measured groundwater levels are used as inputs to simulate compaction and land-surface deformation. The algorithms in that CSUB package that simulate compaction and land subsidence are similar to those used by PRESS (Espey, Huston, and Associates, Inc. 1982), used by the HGSD since the early 1980s to simulate subsidence. Although both CSUB and PRESS can be used as stand-alone models, only CSUB has the ability to be coupled directly within a groundwater flow model.

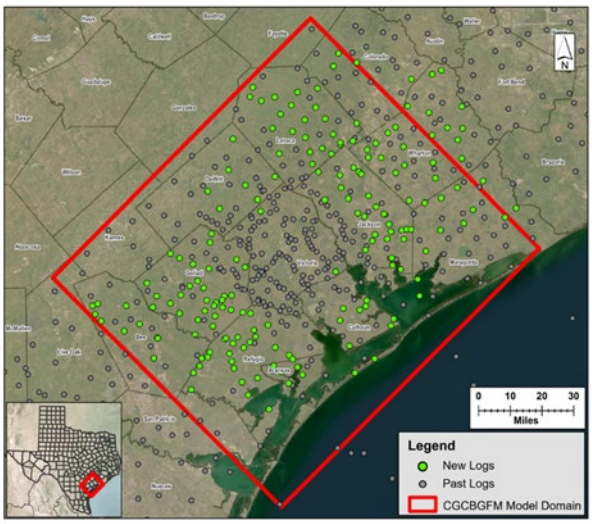


Figure 4-3. Location of 480 geophysical logs in the Central Gulf Coast Brackish Groundwater Flow Model

Both the PRESS and CSUB models simulate land subsidence using Terzaghi's theory of one-dimensional consolidation (Terzaghi, 1925), in which compaction is controlled by changes in groundwater levels (or pore pressure), the geotechnical and hydraulic properties of the clay units, variations in effective stress associated with groundwater level fluctuation, and characterization of the distribution of the clay interbeds within the aquifer system. The characterization of the clay interbeds is typically performed by interpreting individual geophysical logs and interpreting between the logs. When implemented as stand-alone models, both the historical PRESS subsidence models and the CSUB module require groundwater heads to be specified based on measured water levels rather than simulated values from a groundwater flow model which will be achieved with data developed under Subtask 2a.

Land subsidence is primarily controlled by the compaction of fine-grained clay interbeds within the aquifer system. Therefore, accurate representation of the thickness and distribution of clay layers is critical for developing reliable subsidence simulations. For each modeling site, the number and thickness of clay interbeds will be determined through interpolation and interpretation of nearby geophysical logs. Figure 4-3 shows the locations of the approximately 480 geophysical logs that were previously used to construct and calibrate the Central Gulf Coast Brackish Groundwater Flow Model (CGCBGFM) (Yang et al., 2026; Young et al., 2018). These logs provide the stratigraphic framework needed to characterize the distribution of compressible clay units within the aquifer system.

As part of this subtask, CSUB models will be created for at least ten locations. The subsidence history at each site will be developed by integrating deformation estimates from the InSAR analysis described in Subtask 1a with historical groundwater production and water-level datasets compiled in Subtask 2a. Clay interbed properties at each site will be estimated through interpretation of geophysical logs and regional stratigraphic data. The range of geotechnical and hydraulic properties assigned to the clay interbeds will be based on several sources, including results from previously developed PRESS models (Fugro, Inc., 2013), the Gulf Coast Groundwater Availability Model (GAM) developed for GMA 14 (Ellis et al., 2023; Keester et al., 2025), laboratory measurements of clay properties (McClelland Engineering, 1979; Fugro, Inc., 2013), and field measurements of clay compressibility and hydraulic characteristics reported in previous Gulf Coast studies (Gabrysch, 1982).

Subtask 2c– Simulated Historical Subsidence

The CSUB model will be applied in a manner similar to the approach historically used by the HGSD with the PRESS models since the 1980s (Espey, Huston and Associates, Inc., 1982; Fugro, Inc., 2013). HGSD has developed PRESS models for 26 monitoring locations across the greater Houston region. At each site, the PRESS models were calibrated to reproduce the historical subsidence measured at that location. In these models, measured groundwater-levels are entered into PRESS to represent the hydraulic head in the permeable deposits that house the clay interbed. The lowering the pressure in the more permeable deposits leads to a gradual depressurization of compressible clay layers over time, which is a primary cause of land subsidence.

During calibration of the PRESS models, the hydraulic properties (such as hydraulic conductivity) and geotechnical properties (such as the coefficient of compressibility) were adjusted until acceptable agreement between simulated and observed subsidence was achieved. For predictive simulations, the PRESS models were subsequently driven by groundwater-level changes simulated by regional groundwater flow models, while retaining the clay properties determined during the calibration process.

This modeling approach has recently been adopted by the State of California as part of a Best Management Practice (BMP) framework for evaluating and mitigating land subsidence (Ellis et al., 2025; INTERA, 2025). In California's implementation, the CSUB model is used instead of the PRESS model to simulate interbed compaction. Approximately 50 locations were evaluated in California using this approach to reconstruct historical subsidence and support groundwater management planning.

As described in Subtask 2b, at least ten representative sites within the project area will be selected for developing site-specific CSUB models to simulate historical subsidence. The estimated subsidence at each site will be based on comparisons between historical National Geodetic Survey (NGS) benchmark elevations and modern elevation datasets spanning approximately 50 years. Figure 4-4 shows the locations of the NGS benchmarks used in the study by Young (2018), which represent candidate locations for the CSUB simulations.

Site selection will consider several criteria, including the availability of nearby water wells that provide historical groundwater-level records and the presence of geophysical logs that can be used to characterize the thickness and distribution of clay interbeds. In addition, the selection process will consider locations where significant subsidence has already been estimated. Table 4-1 lists locations within the counties shown in Figure 4-4 where more than 1.5 feet of subsidence was calculated by Young (2018) for NGS benchmarks located within two miles of one another.

A report will be prepared by INTERA documenting the development, calibration, and application of the CSUB models used to simulate historical subsidence within the study area.

Table 4-1 Number of Paired PID locations where land subsidence is greater than 1.5 feet and 2.0 ft by county from before 1950 to after 2006 (from Young, 2018)

County	Number of Instances where the calculated land subsidence is greater than 1.5 ft (or 2.0 ft) at NGS benchmarks that are within 2 miles of each other	
	1.5 ft	2 ft
Calhoun	**3**	**0**
DeWitt	14	8
Jackson	**23**	**16**
Matagorda	63	29
Refugio	**16**	**6**
Victoria	**11**	**9**
Wharton	64	38

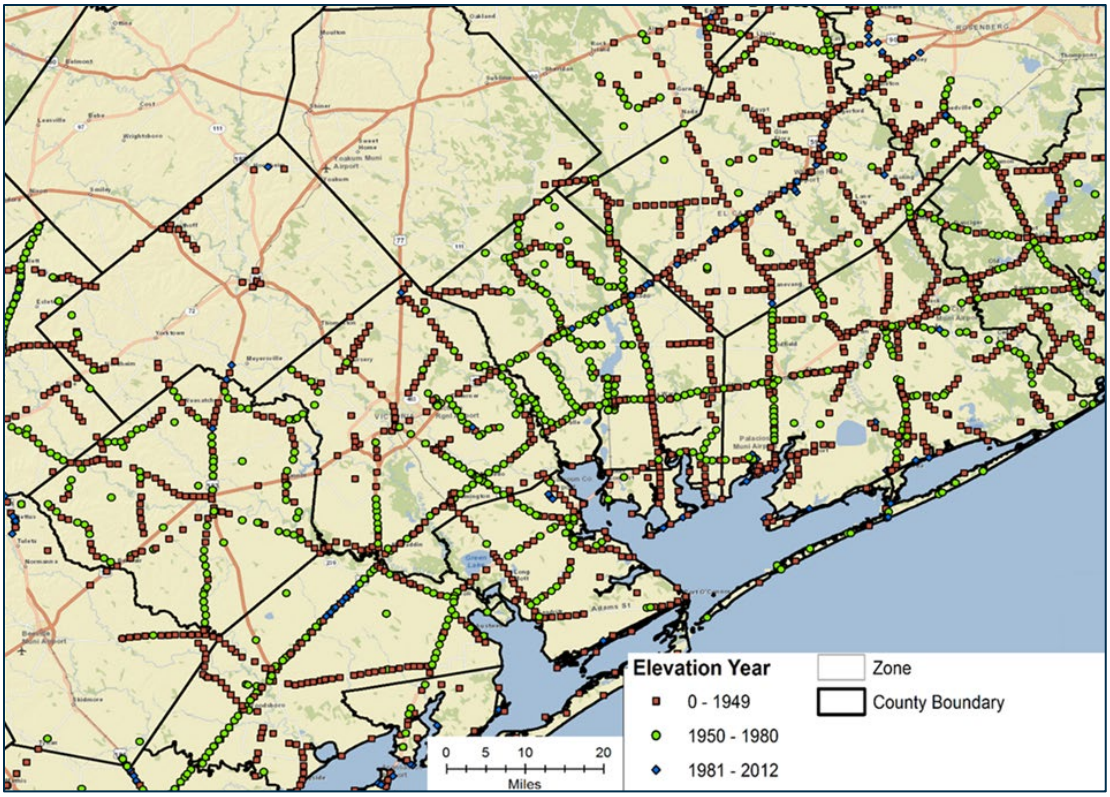


Figure 4-4 The dataset of NGS benchmarks downloaded from http://geodesy.noaa.gov/ and used to determine the amount of land subsidence by comparing their elevations to LIDAR elevations measured after 2006 (from Young, 2018)

Subtask 2d– Deliverables

The deliverables for Task 2 will consist of documentation and modeling files describing the development and application of the CSUB models used to simulate historical land subsidence. These deliverables will include a report that summarizes the data compilation, modeling methodology, calibration procedures, and results of the subsidence simulations conducted for the selected study sites.

The deliverables will also include electronic copies of the CSUB model input and output files developed for the selected locations. These model files will allow the cooperating district, TWDB, and other interested parties to reproduce the subsidence simulations and provide a foundation for incorporating the calibrated subsidence parameters into the regional groundwater flow model described in Task 3.

Task 3 – Model Update the Central Gulf Coast Brackish Groundwater Flow Model (CGCBGF Model)

The CGCBGF model (Yang et al. 2025) is a MODFLOW 6 model that includes all or portions of 19 counties in the Central Gulf Coast of Texas. Figure 4-3 shows the 11,730 square miles covered by the model domain. The cooperating districts developed the CGCBGF Model to help estimate the impacts of brackish water development on fresh groundwater resources and to help develop rules for permitting brackish groundwater production. The CGCBGWF model uses 15 model layers to represent the nine formations that comprise the Chicot, Evangeline, Burkeville, and Jasper hydrogeologic units (Young et al. 2010). The refined three-dimensional structure in the CGCBGWF Model provides for significantly better vertical placement of well screens, of pumping, and of differences in transmissivity than the four-layer structure of the current GAM (Chowdhury et al. 2004).

Subtask 3a – Integrate Subsidence Module into CGCBGWF Model

One of the intended purposes of the CGCBGF Model is to provide a tool for potential permit applicants to use to access the feasibility of developing brackish groundwater. The CCGCD, RGCD, and TGCD are in the process of finalizing the development of rules, similar to those previously completed by the VCGCD, to promote brackish production by providing a significantly higher maximum production allocation per acre than allowed for fresh groundwater. The higher allocation is provided with the requirement that curtailment of production will be enforced if triggers for either drawdown in selected monitoring wells or land subsidence at designated monitoring stations are exceeded. Hence, the permittee has a major incentive to perform an appropriate level of aquifer characterization and groundwater model prior to construction a well field. The cooperating districts offer the CGCBGF Model to permit applicants as a starting point from which to perform site specific analysis and then use the results of the analysis to modify the parameters in the CGCBGWF Model accordingly.

Currently, there are no tools that are well suited for assessing the impacts of brackish production on subsidence for the central portion of the Gulf Coast Aquifer. In order to provide permitting applicants and the cooperating districts with a practical tool for predicting subsidence, CSUB will be integrated into the CGCBGF Model. Dr. Joe Hughes, who is the primary developer of CSUB and a coprincipal developer of MODFLOW 6, will incorporate CSUB into the CGCBGF Model.

Following the successful integration of CSUB, the capabilities of CGCBGF Model to provide reasonable predictions of subsidence will be tested by simulating drawdowns and subsidence for several of the historical subsidence simulation sites modeled in Task 2. The resulting outcomes of these simulations will be documented in a report that will be available to the public.

Subtask 3b – Simulate Future Subsidence for Modeled Available Groundwater (MAG).

The representatives of Groundwater Management Area 15 (GMA 15) have historically adopted drawdown-based Desired Future Conditions (DFC) without the benefit of an assessment of simulated land subsidence. However, representatives have expressed interest in considering potential land subsidence in the development of desired future conditions for relevant aquifers of GMA 15. For this subtask, the CGCBGF Model with CSUB will be used to predict and document the spatial distribution of land subsidence, if any, that will occur through 2080 based on the groundwater pumping scenario used to demonstrate feasibility for the adopted DFC.

Subtask 3c – Deliverables for Task 3.

The deliverables for Task 3 will include the model files for the CGCBGWF Model for simulating the MAG and a report summarizing the land subsidence predictions developed under Subtask 3b.

4.2.4 Task 4 – Install Subsidence Monitoring Station

The installation of a permanent subsidence monitoring station (SMS) represents a critical component of this project. The SMS will provide direct, continuous, and independently verifiable measurements of land-surface elevation change within the District that can be used to evaluate simulated land subsidence impacts and improve the future modifications of the CSUB packet coupled with the CGCBGF Model. While Tasks 1 through 3 focus on the interpretation of remote sensing data (InSAR), historical subsidence, and predictive modeling using the MODFLOW 6 CSUB package, Task 4 establishes the ground-based geodetic measurements that are required to validate relationship between groundwater production and any measurable land surface changes.

Remote sensing methods such as InSAR provide spatially extensive measurements of deformation; however, these techniques benefit from calibration and validation using high-precision ground-based geodetic monuments. The monitoring station installed as part of this project will provide a stable reference point for evaluating deformation trends detected in the InSAR analysis described in Task 1. Additionally, the time-series elevation measurements generated by the station will support evaluation of subsidence predicted by the CSUB simulations described in Task 2 and Task 3.

From a groundwater management perspective, the monitoring station will provide the cooperating districts with continuous and defensible measurements of vertical land motion, allowing the districts to detect early signs of subsidence acceleration associated with brackish groundwater withdrawals. These data will inform future evaluations of groundwater production rules, Desired Future Conditions (DFC) compliance, and long-term aquifer

sustainability assessments. The monitoring station will also provide the districts with an early warning capability, allowing managers and decision-makers to identify areas where groundwater withdrawals may be producing undesirable compaction of aquifer sediments before significant infrastructure damage or irreversible aquifer compaction occurs.

Current and anticipated brackish production rules require that a land subsidence monitoring station be installed at actively permitted brackish wellfields. Installation of this monitoring station provides the cooperating district with meaningful experience to guide and assist in the installation of future stations.

The monitoring station will be designed following engineering practices similar to those used by the HGSD which operates one of the most successful subsidence monitoring networks in the United States. The design will ensure the monument is anchored below the zone of seasonal soil moisture fluctuations and shallow ground movement so that the station measures true land-surface deformation rather than shallow soil movement.

The following subtasks describe the procedures used to identify the optimal station location, construct the monitoring monument, install geodetic instrumentation, and process the resulting deformation measurements.

Subtask 4a– Site Selection, Engineering Design, and Purchase of Equipment

The first step in establishing the monitoring station is to identify an appropriate installation site that maximizes the value of the measurements for groundwater management while ensuring long-term monument stability. Site selection will be conducted through a structured process that integrates hydrogeologic considerations, groundwater production patterns, infrastructure proximity, and monument stability requirements.

Initial candidate locations will be identified through a desktop screening analysis. This screening will evaluate areas where subsidence risk is expected to be greatest based on groundwater production data, aquifer characteristics, and the results of the InSAR analysis described in Task 1. Particular attention will be given to locations associated with high-capacity groundwater production from the Gulf Coast Aquifer system, including brackish groundwater production wells. Three major well fields currently operating or planned in the region provide particularly relevant monitoring targets. One of these wellfields is expected to produce approximately 3,400 acre-feet of brackish groundwater per year (AFY), another wellfield associated with a barge canal project is expected to produce approximately 11,200 AFY of brackish groundwater, and another municipal wellfield is permitted to produce at approximately 11,700 AFY of relatively fresh groundwater. These high-capacity pumping centers represent areas where aquifer compaction and associated subsidence may occur if groundwater withdrawals induce significant declines in pore pressure within compressible sediments.

The desktop analysis will evaluate candidate locations based on several criteria including:

- proximity to major groundwater production centers
- representation of areas identified as potential deformation zones in the InSAR analysis
- availability of stable ground conditions suitable for monument installation
- land ownership and accessibility
- long-term protection from disturbance or vandalism
- proximity to infrastructure that could be impacted by subsidence

Following the desktop screening, the project team will conduct field reconnaissance visits to evaluate the most promising candidate sites. Field investigations will assess ground stability, site security, potential obstructions to satellite reception, solar exposure for the power systems, and logistical considerations for installation and maintenance.

Once a preferred site has been selected, the engineering design for the monument and instrumentation platform will be finalized. All required land access agreements, permits, and permissions will be secured prior to construction.

Dr. Guoquan Wang of the University of Houston has agreed to provide technical guidance on the electronic configuration of the station and the processing of the resulting GNSS data using workflows comparable to those employed by the Harris–Galveston Subsidence District. Vendors for all major equipment components have been contacted, and cost estimates have been obtained in 2026 dollars, ensuring that the equipment procurement portion of the project can be executed efficiently once the site selection process is completed.

Subtask 4b– Construction and QA/QC of Monitoring Station

Following completion of site selection and engineering design, the monitoring station monument will be installed. The monument design is based on the Port-A-Measure (PAMS) stations used by the HGSD and is illustrated in Figure 4-5. While the design will follow this proven configuration, minor modifications may be made to accommodate site-specific conditions encountered during installation.

The monument will consist of a deep-anchored pipe structure designed to isolate geodetic measurements from shallow soil movement. The principal components of the monument include:

- 34 feet total embedment below ground surface
- 4-inch Schedule 40 PVC outer casing
- 2-inch galvanized steel inner pipe
- Concrete plug installed approximately 6 feet from bottom
- Two centering bands to reduce internal movement
- 8 feet of exposed galvanized pole above ground
- 5 x 5 ft Concrete slab with 10-inch tube form to separate pole from slab
- Protective bollards around slab

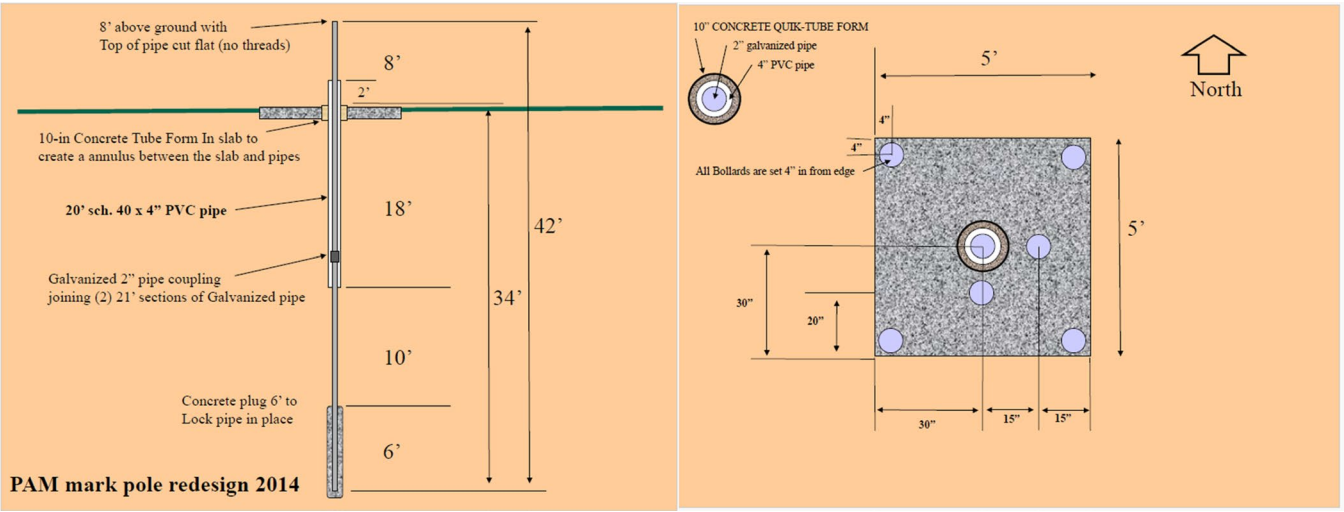


Figure 4-5 Subsidence monitoring station design from HGSD that the proposed subsidence stations is based. Certain measurements and design features will be modified based on information gathered during the site selection process.

The drilling contractor will be responsible for constructing the borehole, installing the outer casing, and setting the inner galvanized pipe. The concrete plug placed near the bottom of the installation locks the inner pipe in place and creates a rigid connection with deeper subsurface materials. This configuration produces a monument that is effectively decoupled from shallow soil deformation, allowing it to accurately measure vertical land motion associated with aquifer compaction.

Centering bands installed between the inner pipe and the outer casing reduce internal movement and ensure the inner pipe remains stable over time. Above ground, the galvanized pipe will extend approximately eight feet above

the ground surface, providing adequate height for installation of GNSS equipment while minimizing risk of vandalism or signal interference.

The concrete slab surrounding the monument will be poured using a tube form that isolates the monument pole from the slab mass. This design prevents expansion or contraction of the slab due to soil moisture variations from influencing the monument's vertical stability. Protective bollards will be installed around the slab to prevent accidental impacts from vehicles or equipment.

Once the monument has been installed, geodetic instrumentation will be mounted and configured. The final station configuration will resemble the example shown in Figure 4-6.

The monitoring station will include the following equipment:

- Trimble Alloy multi-frequency GNSS receiver
- Trimble Zephyr Geodetic 3 antenna
- Precision Machining antenna adapter (pole cap)
- Ameresco Solar 40W solar panel
- Battery and solar regulator
- Weatherproof enclosure and mounts
- Telemetry system (T4D or equivalent)
- DAC SIM card for cellular transmission
- Antenna and power cabling



Figure 4-6 Example of a complete subsidence monitoring station with all geodetic instrumentation and power supply equipment installed.

Following installation, the project team will conduct quality assurance and quality control checks to ensure that the monument and instrumentation are operating correctly. These checks will include verification of satellite signal reception, power system performance, and initial geodetic data acquisition.

Subtask 4c– Process and Record Measured Subsidence

Although monument installation is mechanically straightforward, processing high-precision GNSS data to derive reliable vertical deformation measurements requires specialized expertise and significant computational resources. Because of this complexity, GNSS data processing will be subcontracted to Dr. Guoquan Wang at the University of Houston, who has extensive experience processing geodetic data from subsidence monitoring networks.

Two potential operational configurations are available for acquiring and processing GNSS data from the monitoring station.

Remote Data Configuration

In this configuration the station will operate autonomously and transmit data continuously to a remote processing server. The system will provide:

- continuous GNSS data streaming
- automated data upload through the cellular network

This configuration minimizes the need for field visits and allows the cooperating districts to access deformation measurements soon after they are collected.

Manual Data Retrieval Configuration

Under this alternative configuration, GNSS data would be retrieved manually through periodic site visits. This configuration would involve:

- monthly field visits to download data from the receiver
- local storage and transfer of data files
- manual submission to the processing center

Although the manual configuration is operationally feasible, the remote configuration is expected to be preferred because it minimizes field labor and provides continuous monitoring capability.

Processed data will produce a time-series record of vertical land motion at the monitoring station, typically reported as millimeters or centimeters of vertical displacement relative to a stable geodetic reference frame. These data will be archived and integrated with the deformation datasets developed in Task 1 and the modeling results generated in Tasks 2 and 3.

Subtask 4d– Deliverables

The primary deliverables for Task 4 will consist of the following:

- installation of a fully operational subsidence monitoring station within the project area
- documentation of the station design, installation procedures, and equipment configuration
- processed GNSS datasets representing time-series measurements of vertical land motion

These deliverables will provide the cooperating districts and interested parties with a long-term geodetic monitoring asset that will continue generating subsidence measurements beyond the duration of the grant project. The resulting dataset will complement the remote sensing analyses performed in Task 1 and provide critical ground-truth observations for evaluating the subsidence.

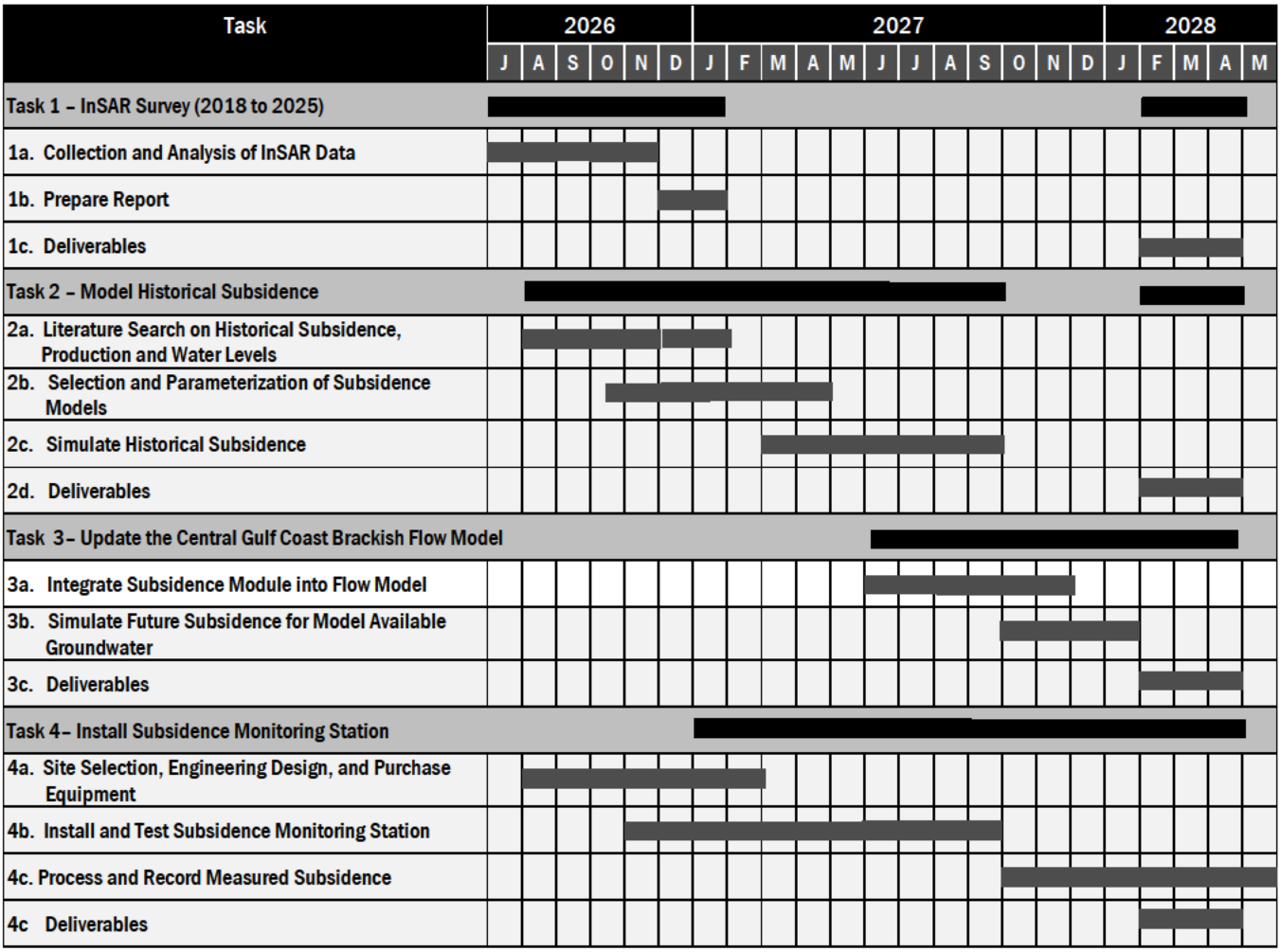
4.3 Equipment Purchases

The project proposes purchasing the following equipment associated with the subsidence monitoring stations under section 4.2.4, subtask 4b - Construction and QA/QC of Monitoring Station. Itemized breakdown of equipment cost included in the budget attachment as part of this application.

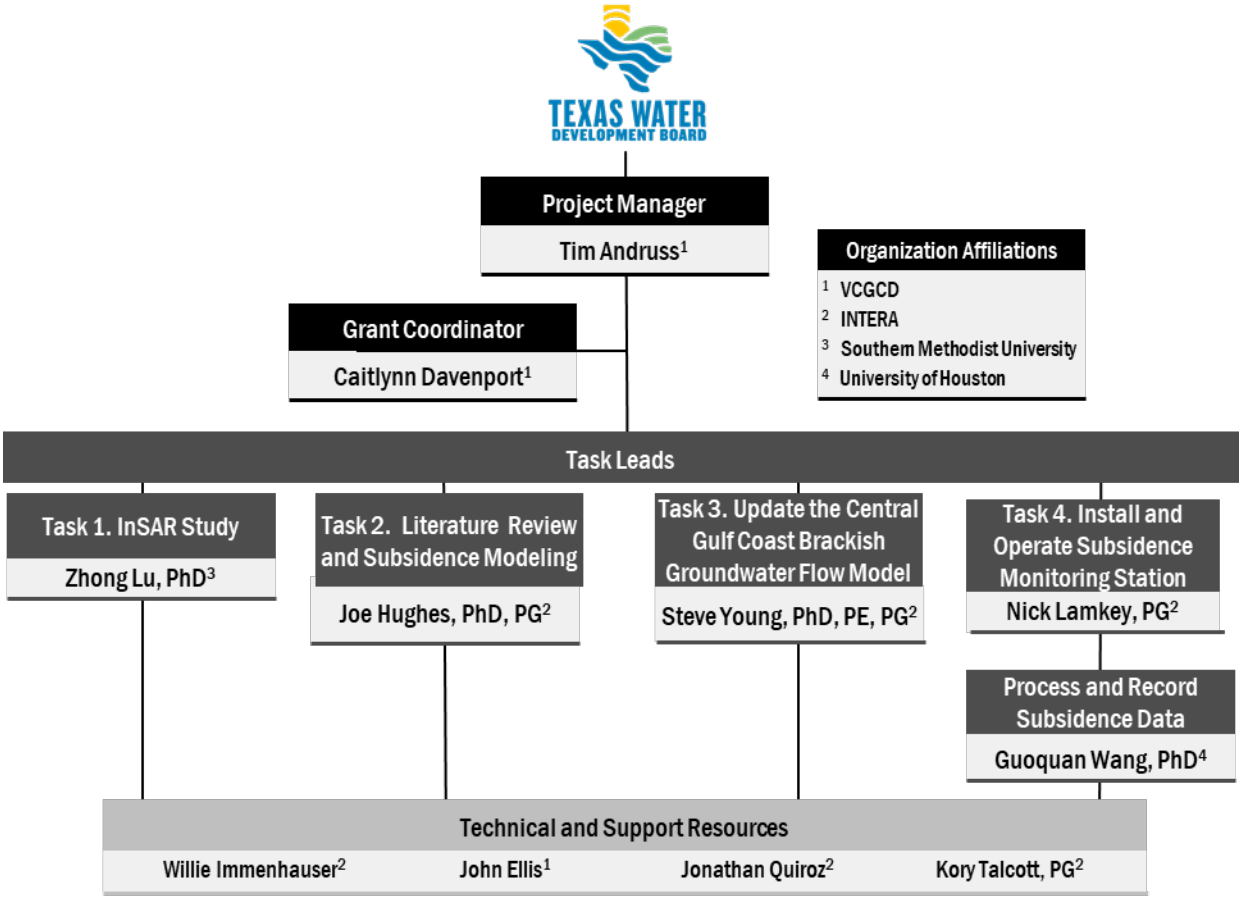
4.4 Deliverables

Deliverables to the TWDB for this project are clearly defined at the end of each task in section 4 of this report in the subheading labeled Deliverables.

4.5 Project Schedule



4.6 Project Team

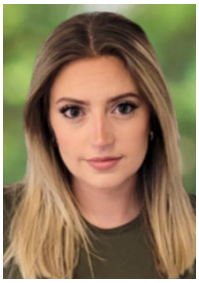




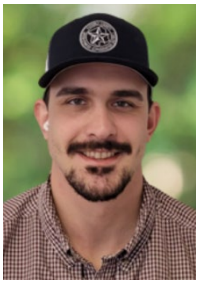
Project Manager – Tim Andruss. Tim Andruss serves as General Manager for the Victoria County Groundwater Conservation District (VCGCD), Calhoun County Groundwater Conservation District (CCGCD), Refugio Groundwater Conservation District (RGCD), and Texana Groundwater Conservation District (TGCD). Tim has worked for the districts since 2007 and holds a BS degree in wildlife and fisheries science, ecology from Texas A&M University. Tim serves as the Chair of GMA 15 and is a representative and past chair of the South Central Texas Regional Water Planning Group (SCTRWPG/Region L). Tim has successfully managed and participated in numerous initiatives and projects, including projects funded by the TWDB, during his tenure as general manager GCDs. Tim will oversee the completion of all tasks and activities undertaken in the proposed project and serve as the primary point of contact for TWDB for this project. Tim's experience and involvement with technical investigations and projects includes technical investigations related to aquifer monitoring and assessment, brackish groundwater resources and associated regulations, subsidence and subsidence monitoring options, aquifer storage and recovery feasibility, groundwater/surface water interactions, evapotranspiration estimation, as well as the installation and automated aquifer monitoring sites.

- **A GIS-based Multi-Criteria Decision Making Approach for Establishing A Regional-Scale Groundwater Monitoring Network (Uddameri, 2011)**
- **A Statistical Power Analysis Approach to Estimate Groundwater Monitoring Network Size in Victoria County Groundwater Conservation District, Texas (Uddameri, 2011)**

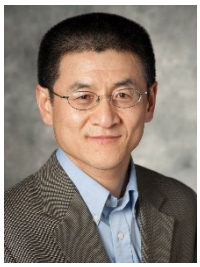
- **Streamflow, Groundwater Hydrology, and Water Quality in the Upper Coleto Creek Watershed in Southeast Texas, 2009-10 (USGS, 2011)**
- **Development of a Regional Plan for Aquifer Storage and Recovery and Off Channel Storage in the Golden Crescent Region of Texas (Arcadis, 2014)**
- **Victoria Aquifer Storage and Recovery Demonstration Project (Arcadis, 2019)**
- **Investigations Regarding the Design and Management of Aquifer Storage and Recovery Operations in Victoria County (INTERA, 2019)**
- **Estimates of Land Subsidence in GMA 15 Based on Ground Surface Elevation Data and Model Results (INTERA, 2016)**
- **Water Level Evaluation - Chicot and Evangeline Aquifers (Golder Associates, 2018-2019)**
- **Characterization of Brackish Groundwater Resources in Victoria County (INTERA, 2018)**
- **Options for Monitoring Land Subsidence Data in Victoria County, Texas (INTERA, 2019)**
- **Effects of Huisache Removal on Rangeland Evapotranspiration in Victoria County, South-Central Texas, 2015–18 (USGS, 2020)**
- **Application of Geostatistical Techniques to Quantify Changes in Water Levels (INTERA, 2021-2023)**



Grant Coordinator – Caitlynn Davenport. Caitlynn Davenport serves as Administrative Coordinator at the Victoria County Groundwater Conservation District, with 11 years of experience managing governmental financial records, coordinating documentation, and supporting organizational operations. Skilled in budgeting, data tracking, compliance processes, and maintaining accurate reporting, she is highly organized with strong attention to detail and has the ability to coordinate multiple deadlines and administrative tasks that will ensure funding compliance, budget revisions and grant coordination. Caitlynn will provide all financial record and information tracking services for this project.



Technical Support, Monitoring Field Technician – Willie Immenhauser. Willie Immenhauser serves as Aquifer Monitoring Technician with the Victoria County Groundwater Conservation District (VCGCD), with four years of experience supporting groundwater resource monitoring and data collection in Calhoun County, De Witt County, Jackson County, Refugio County, and Victoria County, Texas. Willie's expertise includes hands-on groundwater sample collection and processing (e.g., field filtration, preservation, chain-of-custody, and coordination with certified labs per industry standards); field measurement collection and documentation (e.g., manual and automated water level measurements in monitoring wells, aquifer test data, specific conductance, pH, temperature, and flow rates using multiparameter instruments and data loggers, with detailed field logs, photos, and GPS records for data integrity); data entry and processing (e.g., transcription into district databases, QA/QC validation, error checking, and preparation of formatted datasets for model inputs and analysis); equipment calibration and configuration (e.g., routine calibration of water level tapes, water quality handhelds, and loggers; setup and troubleshooting of monitoring equipment to ensure accurate, reliable long-term data); and report drafting (e.g., compiling field summaries, data tables, graphs, and technical narratives for quarterly monitoring reports, aquifer assessments, well assistance program documentation, and support materials).



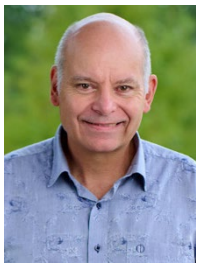
Task Lead, InSAR Study– Zhong Lu, PhD. Zhong Lu is the Shuler-Foscue Endowed Chair Professor of Geophysics in the Huffington Department of Earth Sciences and Professor of Civil Environmental Engineering at Southern Methodist University. He holds a a PhD in Geophysics from the University of Alaska and MS and BS degrees in Geophysics from Peking University. His research interests include advancing InSAR processing methods and applying them to study land subsidence, landslides, volcanoes, earthquakes, coastal processes, and other geophysical phenomena. Zhong has authored or coauthored over 300 peer-reviewed journal articles and book chapters focused on InSAR techniques and applications, and a book, "InSAR Imaging of Aleutian Volcanoes: Monitoring a Volcanic Arc from Space" (Springer, 2014). He served on several NASA science teams, including the NISAR and VenSAR missions, and NASA/JPL OPERA Project. He is a Fellow of the American Geophysical Union (AGU) and the American Association for the Advancement of Science (AAAS), and an SAIC Technical Fellow. Zhong received a Ford Senior Research Fellowship, a Science of Risk Prize, several U.S. Geological Survey Performance Awards, a Leica Geosystems Award from the American Society for Photogrammetry & Remote Sensing, a Science Applications International Corporation Science & Technology Award, and several NASA Group Achievement Awards. Some of his previous positions include serving as a Physical Scientist with the USGS Cascades Volcano Observatory and a Principal Scientist and Technical Fellow with Science Applications International Corporation.



Technical Expert, MODFLOW 6 and Subsidence Modeling – Joe Hughes, PhD, PG. Joe Hughes is a Principal Hydrologist at INTERA with a PhD in hydrogeology, an MS in geochemistry, a BS in geology, and 32 years of research and applied experience in hydrologic software development and modeling and analysis of hydrologic systems, including water availability, water budgets, flow, and transport. He is the co-developer of MODFLOW 6, an internationally recognized software product for simulating groundwater flow and transport. Joe also co-developed FloPy, an internationally recognized software product for pre- and post-processing MODFLOW-based model input and output and analyzing simulated results. He has developed software for simulating natural and managed surface-water flow, subsurface compaction and land subsidance, density-dependent groundwater flow and transport, and integrated surface water/groundwater flow and transport. He also regulary teaches workshops and courses on groundwater flow and transport modeling, MODFLOW 6, and Python programming. Joe has experience in uncertainty and importance analyses as applied to modeling studies and has used numerous uncertainty analysis and optimization codes, such as MODMAN, MODSIM, PEST, PEST++, and UCODE. He has worked on surface water, groundwater, and integrated surface water/groundwater projects throughout the United States and has taken a project management and/or technical lead role in many water resources modeling studies, including integrated surface water/groundwater interaction studies in support of groundwater permit applications. He has served as a technical manager or technical lead quantifying processes such as recharge, hydraulic conductivity, and surface water/groundwater interaction in support of regional and sub-regional groundwater modeling projects. Some of Joe's project and software development experience, particularly relevant to developing the model under this grant from TWDB, includes:

- **Coordination of Hydrologic Software Development Activities, U.S. Geological Survey, Reston, VA. PROJECT MANAGER AND SOFTWARE DEVELOPER**
- **MODFLOW 6 Software Enhancements, U.S. Geological Survey, Reston, VA. PROJECT CO-LEADER**
- **FloPy Development, U.S. Geological Survey, Reston, VA. TEAM LEADER**
- **MODFLOW 6 Development, U.S. Geological Survey, Reston, VA. PROJECT CO-LEADER**
- **Seawater Intrusion Package, U.S. Geological Survey Groundwater Resources Program, Reston, VA. PROJECT MANAGER AND SOFTWARE DEVELOPER**
- **Long Island Sound Compound Flooding Study, New York Water Science Center, Troy, NY. SOFTWARE DEVELOPER AND LEAD MODELER**
- **Evaluation of the Causes of Saltwater Intrusion in Central and South Broward County, Broward County Environmental Planning and Community Resilience Division, Ft. Lauderdale, FL. PROJECT MANAGER**

- **Inundation Changes in Response to Increased Sea Level and Changing Climate Conditions in Broward County, Broward County Environmental Planning and Community Resilience Division, Ft. Lauderdale, FL. PROJECT MANAGER**
- **Quantification of the Effect of Groundwater Pumpage and Increased Sea Level on Canal Leakage and Regional Groundwater Flow in Miami-Dade County, Miami-Dade Water and Sewer Department, Miami, FL. PROJECT MANAGER AND LEAD MODELER**



Task Lead, Hydrogeologic Data Collection & Analysis; Update of the Central Gulf Coast Brackish Groundwater Flow Model – Steve Young, PhD, PE, PG. Dr. Steve Young is a Principal Geoscientist and Engineer at INTERA with a PhD in earth sciences, an MS in environmental engineering, a BS in environmental science, and 44 years of experience in characterizing and solving water supply and groundwater remediation challenges. He has worked on a wide-range of water development issues, including characterizing groundwater resources, developing and applying groundwater models, and designing water supply wellfields. His expertise includes assessing fresh and brackish groundwater resources through the analysis of geophysical logs, aquifer test data, and geochemical data. Working with water management agencies and commercial industry, Steve has evaluated groundwater resources in Texas that include the Gulf Coast Aquifer System, the Northern Trinity Aquifer, and the Carrizo-Wilcox Aquifer. He has managed a wide range of water projects across Texas, working with more than 20 GCDs to help develop management plans, groundwater rules, groundwater databases, and gain a better understanding of groundwater resources. He has participated in joint planning activities with several GMAs and helped with the development of GAMs under TWDB's Groundwater Availability Modeling Program. Some of Steve's project experience, particularly relevant to developing the model under this grant from TWDB, includes:

- **Development and Application of an Operational and Management Groundwater Model for Post Oak Savannah Groundwater Conservation District, Bureau of Reclamation, TX. PROJECT MANAGER AND LEAD HYDROGEOLOGIST**
- **Development and Application of an Operational and Management Groundwater Model for Post Oak Savannah Groundwater Conservation District, Bickerstaff Heath, Delgado, Acosta, LLP, TX. EXPERT WITNESS**
- **Evaluation of Groundwater Resources in Carrizo-Wilcox Aquifer for Long-Term Water Supply, City of Georgetown, TX. PROJECT MANAGER**
- **Evaluation of Land Subsidence in the Woodlands in Montgomery County, San Jacinto River Authority, TX. PROJECT MANAGER**
- **Conversion of Oil and Gas Wells to Water Wells, Post Oak Savannah Groundwater Conservation District, Burleson County, TX. HYDROGEOLOGIST**
- **Development of Groundwater Monitoring Network, Post Oak Savannah Groundwater Conservation District, Milano, TX. HYDROGEOLOGIST AND PROJECT MANAGER**
- **Review of Well Permit Applications, Post Oak Savannah Groundwater Conservation District, Milano, TX. PROJECT MANAGER**
- **Technical Support, Post Oak Savannah Groundwater Conservation District, Milano, TX. PROJECT MANAGER**
- **Characterization of the Carrizo Aquifer and Evaluation of the Groundwater Availability Model for GMA 13, Evergreen Underground Conservation, TX. PROJECT MANAGER AND SENIOR HYDROGEOLOGIST**



Task Lead, Install and Operate Subsidence Monitoring Station – Nick Lamkey, PG. Nick Lamkey is a Hydrogeologist at INTERA with an MS in geology, a BS in geoscience, and eight years of experience in the water resources industry. He specializes in groundwater model development, remote sensing, aquifer test analysis, and data management. His skills include Python programming and GIS. Nick has applied these skills across diverse projects, including developing and updating GAMs, investigating river-aquifer interactions, and assessing nitrate contamination sources in shallow alluvial aquifers. He has also used analytical element models to optimize well spacing for future residential developments. Nick has completed projects for clients that include POSGCD, Central Texas GCD, TWDB, as well as private commercial and investment firms, with work spanning the Carrizo-Wilcox, Edwards, Trinity, and Ogallala aquifers. Some of his project experience, particularly relevant to developing the model under this grant from TWDB, includes:

- **Five-Year Review, Post Oak Savannah Groundwater Conservation District, Central TX. HYDROGEOLOGIST**
- **Trinity Aquifer Sensitivity Study in the Briggs and Oakalla Area, Central Texas Groundwater Conservation District, Burnet, TX. MODELER**
- **Yegua Jackson Groundwater Availability Model Verification, TWDB Austin, TX. LEAD MODELER**
- **Nacatoch Groundwater Availability Model Verification, TWDB, Austin, TX. MODELER**
- **Modeled Available Groundwater Peak Factor Analysis for Brazoria County in Region H, Freese and Nichols, Inc., TX. 2024. MODELER**
- **Fort Cavazos Aquifer Storage and Recovery Well Field Modeling, CDSM, Bell County, TX. 2024. MODELER**
- **Hydrogeologic Assessment of Goodnight Site, Kimley-Horn, Armstrong County, TX. HYDROGEOLOGIST AND MODELER**
- **Groundwater Availability Assessment, Private Investment Firm, Central TX. HYDROGEOLOGIST AND MODELER**
- **Investigation of Water Losses in a Sand Mine Dredge Pond, Private Sand Mining Company, Western TX. PROJECT MANAGER**



Senior Geological Consultant, Process and Record Subsidence Data– Guoquan Wang, PhD. Dr. Guoquan Wang is a Professor in the Department of Earth and Atmospheric Sciences at the University of Houston and serves as Assistant Director of the University of Houston Coastal Center. He is an internationally recognized expert in geodesy, coastal and geological hazards, and natural hazard monitoring, with more than two decades of academic and research experience spanning the United States, Europe, and Asia. Dr. Wang holds a PhD in solid earth geophysics, an MS degree in hydrogeology and engineering geology, and a BS degree in geology. Dr. Wang's research focuses on coastal hazards, land subsidence, sea-level change, faulting, and earthquake-related ground motion, with particular emphasis on the Gulf Coast and Caribbean regions. He is known for advancing the application of GNSS, GPS seismology, LiDAR, InSAR, and numerical modeling techniques to monitor ground deformation, structural health, and geological risk. His work has led to the development of multiple stable geodetic reference frames and long-term monitoring networks used by researchers and practitioners worldwide. A recipient of the NSF CAREER Award and numerous teaching and professional honors, Dr. Wang has authored an extensive body of peer-reviewed publications and has supervised graduate students and postdoctoral researchers, contributing significantly to both scientific advancement and workforce development in geoscience and engineering.



Technical Resource – Jonathan Quiroz. Jonathan Quiroz is a Hydrogeologist at INTERA with an MS in hydrology, a BS in environmental engineering, and 9 years of experience in numerical flow and transport modeling for water resources applications for both surface and groundwater. Mr. Quiroz has developed skills in model planning through utilizing GIS, remote sensing, and map analysis and composition. He has advanced knowledge of applied modeling codes such as MODFLOW, MT3DMS, SEAWAT, SWAT and PRMS. Additionally, he has experience in automated numerical optimization and uncertaty with codes such as PESTP/PEST++. His software experience also includes GIS through software such as QGIS, GRASS-GIS, and ESRI products. His programming languages include Python, Fortran, and SQL, which he applies to a variety of hydrogeologic data for model development. He has worked independently and with teams on a wide range of diverse projects for state, private, and international organizations. Some of Jonathan's project experience, particularly relevant to developing the model under this grant from TWDB, includes:

- **Development of an Operational Model, Post Oak Savannah Groundwater Conservation District, Central TX. HYDROGEOLOGIST**
- **Technical Assistance and Groundwater Modeling to Support the Regulatory Plan Review, Harris-Galveston and Fort Bend Subsidence Districts, Houston, TX. HYDROGEOLOGIST**
- **Well Field Design in the Evangeline/Laguna Groundwater Project, Evangeline/Laguna LP, San Patricio County, TX. HYDROGEOLOGIST**
- **Model Building and Design of a Dewatering System for an Open-Pit in the Las Bambas Mining Project, Hatarilabs / Gidahatari, Apurimac, Peru. HYDROGEOLOGIST**
- **Saline Water Intrusion Analysis in the Chilca Aquifer, Hatarilabs / Gidahatari, Lima, Peru. HYDROGEOLOGIST**
- **Arsenic Transport Modeling from a Tailing Deposit Leaching into the Mantaro river, Hatarilabs / Gidahatari, Junin, Peru. HYDROGEOLOGIST**
- **Groundwater Modeling in the Navidad Mining Project and Particle Travel Time Analysis, Hatarilabs / Gidahatari, Chubut, Argentina. HYDROGEOLOGIST**
- **Development of the Hydrogeologic Model for the Transboundary Aquifer Zarumilla, Hatarilabs / Gidahatari, Peru-Ecuador. HYDROGEOLOGIST**
- **Karst Modeling in the Micro-Basin Tulum, Hatarilabs / Gidahatari, Tulum, Mexico. HYDROGEOLOGIST**

Technical Resource – Kory Talcott, PG. Kory Talcott is a Geologist at INTERA with an MS in geosciences, a BS in petroleum geology, and eight years of combined experience in reservoir characterization and subsurface resource evaluation. His Wolfcamp Formation graduate research advanced understanding of diagenesis and reservoir quality in the Midland Basin. He has planned and geosteered multi-well pads in the Permian and South Texas, developed petrophysical models and regional frameworks that improved development economics and supported strategic business decisions, and critically tested software to implement innovative goals to improve operation metrics and prospect evaluation. Kory has also directed technical support for groundwater protection initiatives, including implementation of the state-funded Leaking Water Well Grant Program, modernization of the State Water Well Report Viewer, and authorship of legislative analyses and Governor's letters. As a licensed Professional Geoscientist in Texas, Kory integrates rigorous academic research, applied exploration and production experience, and regulatory hydrogeology to deliver innovative, data-driven solutions for complex subsurface challenges. Some of Kory's project experience, particularly relevant to developing the model under this grant from TWDB, includes:



- **Leaking Water Well Grant Program, Texas Commission on Environmental Quality, TX. TECHNICAL GEOLOGIST**
- **Water Well Report Viewer Modernization, Texas Commission on Environmental Quality, TX. TECHNICAL GEOLOGIST**

- **Groundwater Protection and Texas Groundwater Protection Committee Support, Texas Commission on Environmental Quality, TX. TECHNICAL GEOLOGIST**
- **Permian & South Texas Operations, SM Energy, TX. LEAD OPERATIONS GEOLOGIST**
- **Permian Asset Development, SM Energy, TX. ASSET DEVELOPMENT GEOLOGIST AND EXECUTIONER**
- **Wolfcamp D Reservoir Evaluation, SM Energy, TX. PROJECT MANAGER AND LEAD GEOLOGIST**
- **South Texas Gulf Coast Business Development, SM Energy, TX. BUSINESS DEVELOPMENT GEOLOGIST**



Technical Resource – John Ellis, PG.. John Ellis is a Principal Hydrogeologist at INTERA with MS degrees in environmental science and hydrogeology, a BS degree in geology, and 18 years of experience in integrated groundwater modeling and uncertainty quantification, land subsidence, data analysis, water resources planning and management, distributed computing networks, and information technology. He also has a background in environmental laws and regulations, site remediation, contaminant transport, and managing teams investigating water quality. He has led several regional scale groundwater availability modeling projects in Texas and Oklahoma to support water resource planning and aquifer management. He is experienced using the MODFLOW-2005, NWT, MODPATH, MT3DMS, and SWB codes and the PEST, PEST++, and PEST-IES calibration codes. He is also experienced in GIS software and performing programmatic workflows and data analysis using Python and VBA. John has more than 15 years of management experience leading multi-disciplinary teams of up to 60 staff, $25 million in assets, and annual project budgets of more than $3 million.

- **Subsidence Technical Services and Extreme Weather Monitoring, California Department of Water Resources, CA. SUBSIDENCE AND MODELING TASK LEAD**
- **Technical Assistance and Groundwater Modeling to Support the Subsidence Regulatory Plan Review, Harris-Galveston and Fort Bend Subsidence Districts, Houston, TX. PROJECT MANAGER**
- **Chicot and Evangeline Geostatistical Study, Harris-Galveston Subsidence District, TX. ASSOCIATE PROJECT MANAGER**
- **Groundwater Science Advisory Committee – Subsidence Investigations, Houston Advanced Research Center, TX. COMMITTEE MEMBER**
- **Northern Texas Gulf Coast Aquifer System – Groundwater Availability Model, Harris-Galveston Subsidence District, TX. PROJECT MANAGER AND TECHNICAL LEAD**
- **Hydrogeologic Assistance for Groundwater Management, Northern Trinity Groundwater Conservation District, TX. PROJECT MANAGER AND PRINCIPAL HYDROGEOLOGIST**

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Project Budget

The Victoria County Groundwater Conservation District (VCGCD), in cooperation with the Calhoun County Groundwater Conservation District (CCGCD), the Refugio Groundwater Conservation District (RGCD), and the Texana Groundwater Conservation District (TGCD), collectively referred to as the "cooperating districts", is requesting funds from the Texas Water Development Board's (TWDB) Fiscal Year (FY) 2026 Groundwater Research, Science, and Data Collection Grant program to complete a comprehensive subsidence analysis and long-term subsidence monitoring station to support the safe and sustainable development of brackish groundwater resources in the central region of Gulf Coast Aquifer in Texas.

Demonstrated Financial Need

The Victoria County Groundwater Conservation District requires financial assistance to complete the proposed project because its adopted Fiscal Year 2026 operating budget does not include sufficient allocation of funds to pay for the expenses to be incurred in completing the tasks proposed within the scope of work required to comprehensively assess subsidence in the central portion of the Gulf Coast Aquifer region.

The VCGCD Board of Directors adopted a budget that allocates no funding to the district's Groundwater Research Program (Program 7000) and only $40,000 to the Groundwater Monitoring Program (Program 4000) for subsidence assessment activities under Project PRJ-20264100.07. These funds alone are insufficient to support the technical analyses, modeling, and monitoring infrastructure required to complete the proposed project.

The VCGCD entered into interlocal cooperation agreements with the CCGCD, RGCD, and TGCD. These agreements establish a cooperative framework through which the cooperating districts share resources and coordinate technical studies that provide mutual benefits to groundwater management in the region.

Under these agreements, the cooperating districts routinely coordinate budget development and cost sharing for projects that address shared groundwater management challenges. For Fiscal Year 2026, each of the cooperating districts included $10,000 in their adopted budgets for subsidence assessment activities. These funds will be made available to partially support the proposed project if TWDB grant funding is awarded.

However, the overall cost of the proposed work significantly exceeds the available local funding resources. Completion of the project—an effort that will provide critical information for the management and long-term planning of groundwater resources in the central portion of the Gulf Coast Aquifer System—can only be achieved if supplemental funding is provided through the TWDB grant program.

Reasonableness of Cost Estimates

The cost estimates used to develop the project budget were prepared by INTERA, Inc., a consulting firm with extensive experience in groundwater modeling, hydrogeologic investigations, and subsidence analysis for groundwater conservation districts and the TWDB.

INTERA has successfully completed numerous technical projects for the cooperating districts and for the TWDB within approved project budgets and schedules. Based on this experience, the cooperating districts are confident that the proposed budget reflects reasonable and appropriate costs for the tasks required to complete the project.

In addition, cost estimates associated with subcontracted services—including drilling and installation of the subsidence monitoring station—were verified by conversations with the Houston-Galveston Subsidence District and using recent quotes and pricing from vendors that regularly provide these services for governmental entities and groundwater monitoring programs in Texas. Likewise, the InSAR study cost estimates were based on previous projects, recent conversations with qualified subcontractors, and updated accordingly for this project.

The project scope was carefully developed to include only those tasks necessary to produce the analyses, monitoring infrastructure, and technical deliverables required to achieve the stated project objectives.

Supplemental Funding

The only supplemental funding source for the project is the local match provided by the cooperating districts through the provision of in-kind services. These services will be used to support field activities and coordination efforts associated with installation of the subsidence monitoring station and the groundwater modeling update.

Documentation of the adopted budgets and associated allocations for subsidence assessment activities by the cooperating districts is included as supporting material for this grant application.

Total Project Cost

The total cost of this project is expected to be $281,000. VCGCD is requesting $231,000 in TWDB funds to complete this project.

Cost of Significant Project Elements and Equipment

Table 1, on the next page, provides costs for the four major project tasks, and associated subtasks. The VCGCD developed the work scope and budget using cost estimates from the subcontractors.

TWDB Costs and Local Match Costs

As shown in Table 1, the VCGCD is requesting $231,000 in grant funds from the TWDB and will contribute an additional $40,000 in matching funds and $10,000 through in-kind services for a total project cost of $281,000. The VCGCD will provide in-kind services that are applied towards groundwater model updates and field work associated with the installation of the subsidence monitoring station.

Equipment Costs

Equipment costs are shown in Table 2. The total cost for equipment is estimated at $30,792.

Table 1. Project Budget

Task	Description	In Kind Services and Funds		
		VCGCD	TWDB	Total Cost
1	InSAR Survey	---	$62,500	$62,500
1a	Collection and Analysis of InSAR Data	---	$30,000	$30,000
1b	Prepare Report	---	$25,000	$25,000
1c	Deliverables	---	$7,500	$7,500
2	Model Historical Subsidence	---	$95,000	$95,000
2a	Literature Search for Historical Subsidence, Production, and Water Levels	---	$15,000	$15,000
2b	Selection and Parameterization of Subsidence Models	---	$20,000	$20,000
2c	Simulate Historical Subsidence	---	$50,000	$50,000
2d	Deliverables	---	$10,000	$10,000
3	Update the Central Gulf Coast Brackish Flow Model	$40,000	$10,000	$50,000
3a	Integrate Subsidence Module into Flow Model	$20,000	$0	$20,000
3b	Simulate Future Subsidence for Modeled Available Groundwater (MAG)	$20,000	$0	$20,000
3c	Deliverables	---	$10,000	$10,000
4	Install and Operate Subsidence Monitoring Station	$10,000	$63,500	$73,500
4a	Site Selection, Engineering Design, and Purchase of Equipment	$5,000	$33,500	$38,500
4b	Construct Monument and Test Equipment	$5,000	$22,000	$27,000
4c	Process and Record Measured Subsidence Data	---	$5,000	$5,000
4d	Deliverables	---	$3,000	$3,000
	PROJECT TOTAL	$50,000	$231,000	$281,000

Table 2. Equipment Costs for Subsidence Monitoring Station

Item	Cost per Unit	Number of Units	District Funds	TWDB Funds	Total Cost
Solar Panel and mount 40W	$338	1	$0.00	$338	$338
Battery	$386	1	$0.00	$386	$386
Solar regulator	$104	1	$0.00	$104	$104
Enclosure box and mounts	$453	1	$0.00	$453	$453
Solar panel cable	$28	1	$0.00	$28	$28
Antenna adapter (pole cap)	$159	1	$0.00	$159	$159
Antenna cable (antenna to receiver)	$138	1	$0.00	$138	$138
Power cable (receiver to regulator)	$414	1	$0.00	$414	$414
Alloy receiver (Newest)	$23,460	1	$0.00	$23,460	$23,460
DAC	$483	1	$0.00	$483	$483
Zephry Geodetic 3 antenna	$4,830	1	$0.00	$4,830	$4,830
Total	$30,792	1	$0.00	$30,792	$30,792

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February 18, 2026

Mr. Tim Andruss
Victoria County Groundwater Conservation District
2805 N. Navarro Street, Suite 210
Victoria, TX 77901

RE: Application of Geostatistical Techniques to Interpret Measured 2024 and 2025 Water Levels

Dear Mr. Andruss,

Attachment A provides INTERA's analysis of the 2024 and 2025 water levels to support an assessment of compliance with GMA 15 DFCs.

Attachment B summarizes all the water levels used for analysis years 2021 through 2025. These data were used to address questions on previous analyses.

As part of the transmission of this letter, INTERA has included separate presentations for Calhoun County GCD, Refugio GCD, Texana GCD and Victoria County GCD that summarize the results of the analysis of the 2024 and 2025 water levels for their respective counties.

Please contact Nick Lamkey or Steve Young if the District has any questions or comments on the final deliverables.

Sincerely,

Nick Lamkey, PG
Hydrogeologist
INTERA, Incorporated
nlamkey@intera.com

Cc: Steven C Young, PhD, PE, PG

Attachment A
Application of Geostatistical Techniques to Interpret Measured 2024 and 2025 Water Levels

Background

In 2021, INTERA completed a regional geostatistical evaluation of groundwater levels (Young and others, 2021) for:

- Calhoun County Groundwater Conservation District
- Refugio Groundwater Conservation District
- Texana Groundwater Conservation District
- Victoria County Groundwater Conservation District

That study accomplished the following:

1. Compiled measured groundwater elevations from GCD records and the Texas Water Development Board (TWDB) Groundwater Database (GWDB) for 2000–2020 into a unified dataset;
2. Applied geostatistical methods to interpolate annual groundwater elevations in the Chicot and Evangeline aquifers from 2000–2020;
3. Evaluated annual water-level change spatially and at selected wells;
4. Provided recommendations for continued monitoring and analysis.

The geostatistical method used to develop the baseline set of results was an application of ordinary kriging. Kriging is a geostatistical interpolation technique that considers both the distance and the degree of variation between known data points when estimating values in unknown areas. Ordinary Kriging provides the best linear unbiased prediction at unsampled locations and reproduces the measured values at all sampled locations exactly. To meet underlying assumptions that were used to develop ordinary Kriging, the measured water levels were detrended prior to the application of ordinary Kriging. The measured water levels were detrended using water levels simulated by the central Gulf Coast Groundwater Availability Model (GAM) that were smoothed using an algorithm described by Young and others (2021). The method was given the acronym SSWL+KR, which stands for smoothed simulated water levels and Kriged residuals.

SSWL+KR was used to interpolate the water level residuals for the years 2000 through 2026 for both the Chicot Aquifer, the Evangeline Aquifer, and the Chicot and Evangeline Aquifer, which is created by combining the Chicot and Evangeline aquifers into single aquifer. The interpolation generated a continuous water level surface using square grid cells with a resolution of 500 ft. Using these surfaces, the average water levels were calculated by county and by year. For the years 2022 through 2024 (Young, 2022; Young, 2023; Young, 2024), water level datasets

corresponding to the periods 2021–2022, 2022–2023, and 2023–2024 were compiled and used to perform the SSWL+KR analysis across the four GCDs.

Analysis of Water Level Data

Two water level datasets were obtained from the TWDB Groundwater Database and the VCGCD. To reconcile any differences in the data from these sources, wells from previous analyses were compiled and used as a reference to identify corresponding wells in both the VCGCD and TWDB GWDB datasets. New wells were subsequently added to this dataset. Water level data for each well from 2023, 2024, 2025 and 2026 was then averaged to determine a representative water level for analysis years 2024 and 2025. One water level per well was used in the SSLW + KR process.

Table 1 lists the water levels. Figures 1 and 2 show the location of the water levels that were used in the geostatistical analyses. Tables 2 through 5 provide the average value for the annual water levels for Calhoun County GCD, Refugio GCD, Texana GCD and Victoria County GCD from 2000 to 2025 for the Chicot Aquifer, the Evangeline Aquifer, and the combination of the Chicot and Evangeline aquifers. In addition, Tables 2 through 5 also provide the difference in the annual water levels for each year between the year 2000 and each analysis year. Hence, the values for water level change in the columns labeled 2025 represent the water level change from 2000 to 2025.

Figures 3 through 5 show water level contours for the Chicot Aquifer generated for the years 2000, 2024, and 2025, respectively. Figures 6 and 7 provide contours at 10-ft intervals that show the change in water levels from 2000 to 2024 and 2025 for the Chicot Aquifer across Victoria, Jackson, Refugio, and Calhoun counties. Across these four GCDs, the contour intervals range between 10 ft (rebound) and -20 ft (decline).

Figures 8 through 10 show water level contours for the Evangeline Aquifer generated for the years 2000, 2024 and 2025, respectively. Figures 11 and 12 provide contours of the change in water levels from 2000 to 2023 for the Evangeline Aquifer. Across these four GCDs, the contour intervals range between 50 ft (rebound) and -20 ft (decline). In Figures 3 through 5 and 8 through 10, the areal extent of the Chicot and Evangeline Aquifers in all four counties is based on the representation of the Evangeline Aquifer in the current Groundwater Availability Model (GAM) for GMA 15 developed by Chowdhury and others (2004).

References

Chowdhury, A. H., S. Wade, R. E. Mace, and C. Ridgeway, 2004, Groundwater Availability Model of the Central Gulf Coast Aquifer System: Numerical Simulations through 1999 Model Report. Texas Water Development Board, 108 p.

Young, S,C., 2022. Memorandum to Tim Andruss Titled: Application of Geostatistical Techniques to Interpret Measured 2021 Water Levels, dated June 29, 2022.

Young, S,C., 2023. Memorandum to Tim Andruss Titled: Application of Geostatistical Techniques to Interpret Measured 2022 Water Levels, dated December 18, 2023.

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Young, S.C., Kushnereit, R., Beal, L., Yan, T., and Pham, H. 2021. Application of Geostatistical Techniques to Quantify Changes in the Water Levels, prepared by INTERA Incorporated, prepared for the Calhoun County GCD, the Refugio GCD, the Texana GCD, and the Victory County GCD, May 2021

Table 1 List of Wells and Water Levels Used to Generate the Water Levels Surfaces for the Chicot and the Evangeline aquifers for the 2024 and 2025 Analysis Years.

GCD Well ID	TWDB Well ID	Land Surface Elevation (ft)	Analysis Year	Assigned Unit	County	Well Depth (ft)	Average Water Level (famsl)
Calhoun County GCD - GW-00001	8027302	16.4	2024	Chicot	Calhoun	175	-6.1
Calhoun County GCD - GW-00003		32.8	2024	Chicot	Calhoun		17.5
Calhoun County GCD - GW-00005		16.4	2024	Chicot	Calhoun		-18.4
Calhoun County GCD - GW-00009		36.1	2024	Chicot	Calhoun		6.9
Calhoun County GCD - GW-00092		16.4	2024	Chicot	Calhoun		-3.2
Calhoun County GCD - NW-00024	8021512	16.4	2024	Chicot	Calhoun	265	-19.8
Refugio GCD - GW-00079		32.8	2024	Chicot	Refugio	331	12.4
Refugio GCD - GW-00152	7932803	75.5	2024	Chicot	Refugio	110	42.6
Refugio GCD - GW-00234	7932802	72.2	2024	Chicot	Refugio	165	24.7
Refugio GCD - GW-00439		19.7	2024	Chicot	Refugio		6.0
Refugio GCD - NW-00539		29.5	2024	Chicot	Refugio	300	3.5
Refugio GCD - NW-00570	8034709	23.0	2024	Chicot	Refugio	320	-0.1
Refugio GCD - NW-00672		68.9	2024	Chicot	Refugio	300	13.6
Refugio GCD - NW-00686		88.6	2024	Chicot	Refugio	140	37.6
Refugio GCD - NW-00690		39.4	2024	Chicot	Refugio	220	4.4
Refugio GCD - NW-00691		82.0	2024	Evangeline	Refugio	160	49.0
Refugio GCD - NW-00692		108.3	2024	Evangeline	Goliad	160	76.3
Refugio GCD - NW-00695		65.6	2024	Chicot	Refugio	225	32.6
Refugio GCD - NW-00696		29.5	2024	Chicot	Refugio	280	-0.5
Refugio GCD - NW-00697		62.3	2024	Chicot	Refugio	210	0.3
	6541401	88.6	2024	Chicot	Wharton	90	51.0
	6541402	82.0	2024	Chicot	Wharton	338	29.8
	6549901	55.8	2024	Chicot	Matagorda	375	20.4
	6557802	49.2	2024	Chicot	Matagorda	315	-15.8
	6612204	315.0	2024	Evangeline	Colorado	140	279.2
	6612603	292.0	2024	Evangeline	Colorado	188	200.6
	6614703	259.2	2024	Chicot	Colorado	71	234.2
	6619804	347.8	2024	Evangeline	Colorado	140	274.9
	6619904	331.4	2024	Evangeline	Colorado	260	187.9
	6621603	232.9	2024	Evangeline	Colorado	812	161.2
	6626202	252.6	2024	Evangeline	Colorado	126	198.7

GCD Well ID	TWDB Well ID	Land Surface Elevation (ft)	Analysis Year	Assigned Unit	County	Well Depth (ft)	Average Water Level (famsl)
	6628702	249.3	2024	Evangeline	Colorado	565	167.4
	6631107	154.2	2024	Chicot	Wharton	450	102.1
	6631504	137.8	2024	Chicot	Wharton	178	91.5
	6632809	118.1	2024	Chicot	Wharton	320	68.9
	6633905	210.0	2024	Evangeline	Lavaca	164	169.0
	6634201	193.6	2024	Evangeline	Lavaca	48	170.1
	6634202	206.7	2024	Evangeline	Lavaca	61	171.4
	6634207	226.4	2024	Evangeline	Lavaca	120	174.8
	6635901	210.0	2024	Evangeline	Lavaca	840	140.4
	6637607	160.8	2024	Chicot	Colorado	318	122.7
	6638202	150.9	2024	Chicot	Wharton	65	114.3
	6638304	150.9	2024	Chicot	Wharton	113	108.1
	6638801	124.7	2024	Chicot	Wharton	116	94.9
	6639801	111.5	2024	Chicot	Wharton	300	67.4
	6640401	111.5	2024	Chicot	Wharton	442	55.6
	6641203	223.1	2024	Evangeline	Lavaca	80	175.5
	6641703	219.8	2024	Evangeline	Lavaca	164	151.2
	6641903	206.7	2024	Evangeline	Lavaca	335	118.2
	6643704	137.8	2024	Chicot	Lavaca	34	109.2
	6643803	150.9	2024	Evangeline	Lavaca	1023	51.2
	6644402	160.8	2024	Evangeline	Lavaca	880	59.2
	6644702	137.8	2024	Evangeline	Colorado	676	31.6
	6645601	141.1	2024	Chicot	Wharton	429	87.3
	6645916	128.0	2024	Chicot	Wharton	125	73.4
	6646201	141.1	2024	Chicot	Wharton	200	91.3
	6646402	131.2	2024	Chicot	Wharton	366	76.6
	6646601	128.0	2024	Chicot	Wharton	186	79.1
	6647101	121.4	2024	Chicot	Wharton	319	68.7
	6647201	114.8	2024	Chicot	Wharton	244	59.5
	6647703	108.3	2024	Chicot	Wharton	242	74.4
	6647904	95.1	2024	Chicot	Wharton	340	31.1
	6648502	91.9	2024	Chicot	Wharton	70	71.5
	6648701	95.1	2024	Chicot	Wharton	90	60.8
	6648802	91.9	2024	Chicot	Wharton	564	50.8
	6648907	88.6	2024	Chicot	Wharton	630	20.7

GCD Well ID	TWDB Well ID	Land Surface Elevation (ft)	Analysis Year	Assigned Unit	County	Well Depth (ft)	Average Water Level (famsl)
	6648908	88.6	2024	Chicot	Wharton	55	61.3
	6648909	88.6	2024	Chicot	Wharton	300	22.5
	6649701	170.6	2024	Evangeline	Lavaca	1082	117.6
	6649901	170.6	2024	Evangeline	Lavaca	272	108.7
	6652603	105.0	2024	Chicot	Wharton	515	38.2
	6653406	98.4	2024	Chicot	Wharton	348	31.5
	6653804	85.3	2024	Chicot	Wharton	495	41.9
	6654108	98.4	2024	Chicot	Wharton	360	47.5
	6654622	98.4	2024	Evangeline	Wharton	1200	20.5
	6654906	88.6	2024	Chicot	Wharton	461	14.9
	6655603	82.0	2024	Chicot	Wharton	100	62.7
	6656302	85.3	2024	Chicot	Wharton	490	6.0
	6656304	88.6	2024	Chicot	Wharton	356	26.6
	6656403	78.7	2024	Chicot	Wharton	275	16.1
	6661302	82.0	2024	Chicot	Wharton	528	26.0
	6661305	78.7	2024	Chicot	Wharton	600	35.1
	6662104	85.3	2024	Chicot	Wharton	371	32.6
	6662307	85.3	2024	Chicot	Wharton	180	58.0
	6662309	82.0	2024	Chicot	Wharton	421	45.2
	6662313	82.0	2024	Chicot	Wharton	480	-0.2
	6663507	68.9	2024	Chicot	Wharton	48	60.1
	6663509	62.3	2024	Chicot	Wharton	688	-27.0
	6663610	68.9	2024	Evangeline	Wharton	857	-25.1
	6664401	68.9	2024	Chicot	Matagorda	1057	-24.3
	6740301	278.9	2024	Evangeline	Lavaca	45	265.3
	6755606	262.5	2024	Evangeline	DeWitt	194	217.1
	6755803	219.8	2024	Evangeline	DeWitt	75	206.9
	6763703	187.0	2024	Evangeline	DeWitt	120	122.6
	7905507	232.9	2024	Evangeline	DeWitt	230	210.6
	7905606	200.1	2024	Evangeline	Goliad	154	176.8
	7905903	216.5	2024	Evangeline	Goliad	280	163.0
	7905904	196.9	2024	Evangeline	Goliad	164	168.8
	7905905	216.5	2024	Evangeline	Goliad	314	162.4
	7905907	232.9	2024	Evangeline	Goliad	261	163.1
	7905908	269.0	2024	Evangeline	Goliad	118	187.3

GCD Well ID	TWDB Well ID	Land Surface Elevation (ft)	Analysis Year	Assigned Unit	County	Well Depth (ft)	Average Water Level (famsl)
	7905909	255.9	2024	Evangeline	Goliad	143	182.8
	7906206	239.5	2024	Evangeline	DeWitt	154	171.9
	7906306	229.7	2024	Evangeline	DeWitt	138	149.6
	7906706	219.8	2024	Evangeline	Goliad	152	165.7
	7906707	200.1	2024	Evangeline	DeWitt	260	151.8
	7906708	216.5	2024	Evangeline	DeWitt	300	151.2
	7906714	200.1	2024	Evangeline	DeWitt	136	153.2
	7906715	239.5	2024	Evangeline	Goliad	150	175.5
	7907402	226.4	2024	Evangeline	DeWitt	217	119.0
	7912305	301.8	2024	Evangeline	Goliad	166	211.5
	7913223	236.2	2024	Evangeline	Goliad	93	181.4
	7913224	232.9	2024	Evangeline	Goliad	24	214.0
	7913225	229.7	2024	Evangeline	Goliad	65	175.9
	7913229	229.7	2024	Evangeline	Goliad	152	167.9
	7913230	249.3	2024	Evangeline	Goliad	282	168.1
	7913231	232.9	2024	Evangeline	Goliad	28	215.3
	7913304	242.8	2024	Evangeline	Goliad	317	166.2
	7913507	282.2	2024	Evangeline	Goliad	250	167.9
	7913510	282.2	2024	Evangeline	Goliad	250	154.6
	7913512	269.0	2024	Evangeline	Goliad	263	165.1
	7913513	292.0	2024	Evangeline	Goliad	230	156.3
	7913515	295.3	2024	Evangeline	Goliad	230	165.3
	7913803	255.9	2024	Evangeline	Goliad	188	186.2
	7913804	242.8	2024	Evangeline	Goliad	291	142.7
	7913805	288.7	2024	Evangeline	Goliad	197	194.2
	7913806	236.2	2024	Evangeline	Goliad	222	147.9
	7913807	269.0	2024	Evangeline	Goliad	222	188.6
	7913808	255.9	2024	Evangeline	Goliad	331	147.8
	7913809	252.6	2024	Evangeline	Goliad	183	150.0
	7913810	265.7	2024	Evangeline	Goliad	186	189.7
	7913811	229.7	2024	Evangeline	Goliad	143	183.0
	7913813	272.3	2024	Evangeline	Goliad	210	189.6
	7914105	187.0	2024	Evangeline	Goliad	209	147.1
	7914203	170.6	2024	Evangeline	Goliad	380	117.9
	7914604	200.1	2024	Evangeline	Goliad	175	108.3

GCD Well ID	TWDB Well ID	Land Surface Elevation (ft)	Analysis Year	Assigned Unit	County	Well Depth (ft)	Average Water Level (famsl)
	7914903	200.1	2024	Evangeline	Goliad	270	124.1
	7915401	177.2	2024	Evangeline	Goliad	145	98.1
	7915402	187.0	2024	Evangeline	Goliad	252	101.2
	7915702	141.1	2024	Evangeline	Goliad	174	86.4
	7916603	62.3	2024	Evangeline	Victoria	612	6.9
	7919511	239.5	2024	Evangeline	Goliad	120	179.4
	7920305	226.4	2024	Evangeline	Goliad	220	150.6
	7921307	206.7	2024	Evangeline	Goliad	284	129.7
	7921503	236.2	2024	Evangeline	Goliad	340	121.6
	7921607	190.3	2024	Evangeline	Goliad	231	114.5
	7921608	196.9	2024	Evangeline	Goliad	84	139.2
	7922508	154.2	2024	Evangeline	Goliad	263	92.1
	7922604	147.6	2024	Evangeline	Goliad	305	78.6
	7923703	114.8	2024	Evangeline	Goliad	350	73.8
	7925506	357.6	2024	Evangeline	Bee	52	315.9
	7927202	305.1	2024	Evangeline	Goliad	150	213.2
	7928302	213.3	2024	Evangeline	Goliad	235	131.9
	7928303	223.1	2024	Evangeline	Goliad	95	131.9
	7928304	236.2	2024	Evangeline	Goliad	320	124.9
	7929302	177.2	2024	Evangeline	Goliad	214	88.9
	7930301	114.8	2024	Evangeline	Goliad	300	69.7
	7931502	108.3	2024	Chicot	Goliad	204	67.8
	7931702	98.4	2024	Chicot	Goliad	218	74.7
	7934202	367.5	2024	Evangeline	Bee	175	227.3
	7934409	337.9	2024	Evangeline	Bee	145	202.7
	7935305	223.1	2024	Evangeline	Bee	150	164.5
	7937911	82.0	2024	Evangeline	Goliad	146	44.9
	7937912	85.3	2024	Chicot	Goliad	61	55.2
	7937918	88.6	2024	Chicot	Goliad	96	45.8
	7937919	85.3	2024	Evangeline	Goliad	160	45.4
	7938201	118.1	2024	Chicot	Goliad	106	81.5
	7938202	101.7	2024	Chicot	Goliad	60	71.7
	7938301	88.6	2024	Chicot	Goliad	62	64.9
	7938303	101.7	2024	Chicot	Goliad	80	75.1
	7938706	75.5	2024	Evangeline	Goliad	325	47.4

GCD Well ID	TWDB Well ID	Land Surface Elevation (ft)	Analysis Year	Assigned Unit	County	Well Depth (ft)	Average Water Level (famsl)
	7939104	88.6	2024	Chicot	Goliad	110	63.1
	7942213	272.3	2024	Evangeline	Bee	185	201.1
	7942703	242.8	2024	Evangeline	Bee	230	176.9
	7943903	134.5	2024	Evangeline	Bee	260	86.3
	7957608	131.2	2024	Evangeline	San Patricio	205	82.6
	7958201	157.5	2024	Evangeline	San Patricio	521	72.5
	7964701	3.3	2024	Chicot	Aransas	130	2.3
	8007102	55.8	2024	Evangeline	Matagorda	1020	14.9
	8007203	52.5	2024	Chicot	Matagorda	453	-42.4
	8008106	49.2	2024	Chicot	Matagorda	64	34.9
	8008504	49.2	2024	Chicot	Matagorda	690	-44.2
	8008505	45.9	2024	Chicot	Matagorda	100	42.4
	8014801	13.1	2024	Chicot	Matagorda	719	-17.6
	8014903	9.8	2024	Chicot	Matagorda	320	-63.4
	8015301	26.2	2024	Chicot	Matagorda	570	-1.2
	8015502	19.7	2024	Chicot	Matagorda	776	-37.3
	8019507	23.0	2024	Chicot	Calhoun	235	3.4
	8024201	6.6	2024	Chicot	Matagorda	490	-5.6
	8024406	3.3	2024	Chicot	Matagorda	360	-37.5
	8024802	3.3	2024	Chicot	Matagorda	380	-34.2
	8049702	6.6	2024	Chicot	Aransas	63	1.7
	8101102	49.2	2024	Chicot	Matagorda	1032	-46.0
	8101205	32.8	2024	Chicot	Matagorda	480	-37.6
	8102404	29.5	2024	Chicot	Matagorda	450	-27.0
	8102605	23.0	2024	Chicot	Matagorda	525	-15.1
	8102901	13.1	2024	Chicot	Matagorda	294	-18.7
	8103406	26.2	2024	Chicot	Matagorda	530	-14.7
	8111901	3.3	2024	Chicot	Matagorda	527	-17.9
	8303506	91.9	2024	Chicot	San Patricio	267	23.7
Texana GCD - GW-00244		59.1	2024	Chicot	Jackson		42.9
Texana GCD - GW-00247		62.3	2024	Chicot	Jackson		37.4
Texana GCD - GW-00278		62.3	2024	Evangeline	Jackson	850	-8.2

GCD Well ID	TWDB Well ID	Land Surface Elevation (ft)	Analysis Year	Assigned Unit	County	Well Depth (ft)	Average Water Level (famsl)
Texana GCD - GW-00291	8004504	49.2	2024	Chicot	Jackson	280	20.5
Texana GCD - GW-00410		55.8	2024	Chicot	Jackson		24.7
Texana GCD - GW-00411		59.1	2024	Chicot	Jackson		24.2
Texana GCD - GW-00444		13.1	2024	Evangeline	Jackson	400	-48.5
Texana GCD - GW-00446		13.1	2024	Chicot	Jackson	110	-49.4
Texana GCD - GW-00566		45.9	2024	Chicot	Jackson	150	33.3
Texana GCD - NW-00310		88.6	2024	Chicot	Jackson	124	47.0
Texana GCD - NW-00451		13.1	2024	Chicot	Jackson	402	-51.0
Texana GCD - NW-00487		9.8	2024	Chicot	Jackson	185	-9.4
Texana GCD - NW-00488		9.8	2024	Chicot	Jackson	330	-60.3
Texana GCD - NW-00489		6.6	2024	Chicot	Jackson	208	-13.3
Texana GCD - NW-00490		6.6	2024	Chicot	Jackson	402	-59.5
Texana GCD - NW-00491		9.8	2024	Chicot	Jackson	204	-9.0
Texana GCD - NW-00492		9.8	2024	Chicot	Jackson	355	-52.6
Texana GCD - NW-00750		29.5	2024	Chicot	Jackson	323	-66.5
Texana GCD - NW-00751		68.9	2024	Chicot	Jackson	310	29.9
Texana GCD - NW-00759		23.0	2024	Chicot	Jackson	383	-47.0
Texana GCD - NW-00760		16.4	2024	Chicot	Jackson	364	-33.6
Texana GCD - NW-00761		124.7	2024	Chicot	Jackson	170	55.7
Texana GCD - NW-00762		13.1	2024	Chicot	Calhoun	296	-46.9
Texana GCD - NW-00785		29.5	2024	Chicot	Jackson	340	-12.5
Texana GCD - NW-00786		59.1	2024	Chicot	Jackson	210	-2.9
Victoria County GCD - GW-000021		124.7	2024	Chicot	Victoria	100	85.6
Victoria County GCD - GW-000138		128.0	2024	Chicot	Victoria		48.4
Victoria County GCD - GW-000158		187.0	2024	Chicot	Victoria		111.5
Victoria County GCD - GW-000159		173.9	2024	Chicot	Victoria		94.3
Victoria County GCD - GW-000192		52.5	2024	Chicot	Victoria		24.4
Victoria County GCD - GW-000227		52.5	2024	Chicot	Victoria		22.5
Victoria County GCD - GW-000271		114.8	2024	Chicot	Victoria		65.9

GCD Well ID	TWDB Well ID	Land Surface Elevation (ft)	Analysis Year	Assigned Unit	County	Well Depth (ft)	Average Water Level (famsl)
Victoria County GCD - GW-000321	8017502	65.6	2024	Evangeline	Victoria	1026	32.1
Victoria County GCD - GW-000366	8002102	91.9	2024	Evangeline	Victoria	791	37.4
Victoria County GCD - GW-000377	8002804	62.3	2024	Chicot	Victoria	92	31.9
Victoria County GCD - GW-000489		55.8	2024	Chicot	Victoria		22.6
Victoria County GCD - GW-000492		52.5	2024	Chicot	Victoria		9.7
Victoria County GCD - GW-000494		173.9	2024	Evangeline	Victoria	190	80.2
Victoria County GCD - GW-000552		160.8	2024	Evangeline	Victoria	112	95.4
Victoria County GCD - GW-000562		82.0	2024	Chicot	Victoria		39.7
Victoria County GCD - GW-000577	7908404	144.4	2024	Evangeline	Victoria	100	88.9
Victoria County GCD - GW-000578	7908403	134.5	2024	Evangeline	Victoria	100	87.1
Victoria County GCD - GW-000583		23.0	2024	Chicot	Victoria		16.7
Victoria County GCD - GW-000587		134.5	2024	Chicot	Victoria		71.5
Victoria County GCD - GW-000589	7908807	108.3	2024	Evangeline	Victoria	215	59.9
Victoria County GCD - GW-000601		101.7	2024	Evangeline	Victoria	588	69.5
Victoria County GCD - GW-000602	7916701	101.7	2024	Evangeline	Victoria	578	53.4
Victoria County GCD - GW-000603		105.0	2024	Evangeline	Victoria	620	49.6
Victoria County GCD - GW-000606		183.7	2024	Chicot	Victoria		91.0
Victoria County GCD - GW-000607		108.3	2024	Chicot	Victoria		59.9
Victoria County GCD - GW-000608	7915903	121.4	2024	Chicot	Victoria	112	76.3

GCD Well ID	TWDB Well ID	Land Surface Elevation (ft)	Analysis Year	Assigned Unit	County	Well Depth (ft)	Average Water Level (famsl)
Victoria County GCD - GW-000609		98.4	2024	Chicot	Victoria	194	63.0
Victoria County GCD - GW-000611		95.1	2024	Chicot	Victoria	100	41.0
Victoria County GCD - GW-000989		55.8	2024	Chicot	Victoria		31.2
Victoria County GCD - NW-000016		170.6	2024	Evangeline	Victoria	250	92.8
Victoria County GCD - NW-000426	7907404	229.7	2024	Evangeline	Victoria	371	100.6
Victoria County GCD - NW-000779	8025402	62.3	2024	Chicot	Victoria	190	16.6
Victoria County GCD - NW-001253		49.2	2024	Chicot	Victoria	52	25.4
Calhoun County GCD - GW-00001	8027302	16.4	2025	Chicot	Calhoun	175	-4.4
Calhoun County GCD - GW-00003		32.8	2025	Chicot	Calhoun		16.3
Calhoun County GCD - GW-00005		16.4	2025	Chicot	Calhoun		-19.4
Calhoun County GCD - GW-00009		36.1	2025	Chicot	Calhoun		1.5
Calhoun County GCD - GW-00092		16.4	2025	Chicot	Calhoun		-3.2
Calhoun County GCD - NW-00024	8021512	16.4	2025	Chicot	Calhoun	265	-19.8
Refugio GCD - GW-00079		32.8	2025	Chicot	Refugio	331	9.9
Refugio GCD - GW-00234	7932802	72.2	2025	Chicot	Refugio	165	14.3
Refugio GCD - GW-00439		19.7	2025	Chicot	Refugio		5.2
Refugio GCD - NW-00474		82.0	2025	Chicot	Refugio		50.7
Refugio GCD - NW-00539		29.5	2025	Chicot	Refugio	300	3.6
Refugio GCD - NW-00570	8034709	23.0	2025	Chicot	Refugio	320	-0.3
	6541401	88.6	2025	Chicot	Wharton	90	53.2
	6541402	82.0	2025	Chicot	Wharton	338	31.6
	6541707	82.0	2025	Chicot	Wharton	499	20.1
	6612204	315.0	2025	Evangeline	Colorado	140	278.8
	6612603	292.0	2025	Evangeline	Colorado	188	200.7
	6614703	259.2	2025	Chicot	Colorado	71	234.1
	6619804	347.8	2025	Evangeline	Colorado	140	277.5
	6619904	331.4	2025	Evangeline	Colorado	260	188.2
	6620602	200.1	2025	Evangeline	Colorado	312	142.9
	6620901	242.8	2025	Evangeline	Colorado	800	171.4

GCD Well ID	TWDB Well ID	Land Surface Elevation (ft)	Analysis Year	Assigned Unit	County	Well Depth (ft)	Average Water Level (famsl)
	6622201	223.1	2025	Evangeline	Colorado	995	180.0
	6628702	249.3	2025	Evangeline	Colorado	565	169.6
	6631107	154.2	2025	Chicot	Wharton	450	104.3
	6631504	137.8	2025	Chicot	Wharton	178	92.0
	6632809	118.1	2025	Chicot	Wharton	320	69.9
	6633905	210.0	2025	Evangeline	Lavaca	164	168.5
	6634201	193.6	2025	Evangeline	Lavaca	48	169.4
	6634202	206.7	2025	Evangeline	Lavaca	61	171.0
	6634207	226.4	2025	Evangeline	Lavaca	120	173.4
	6635901	210.0	2025	Evangeline	Lavaca	840	141.8
	6637607	160.8	2025	Chicot	Colorado	318	122.4
	6638202	150.9	2025	Chicot	Wharton	65	113.5
	6638304	150.9	2025	Chicot	Wharton	113	106.3
	6638801	124.7	2025	Chicot	Wharton	116	94.7
	6639801	111.5	2025	Chicot	Wharton	300	67.1
	6641203	223.1	2025	Evangeline	Lavaca	80	175.3
	6641703	219.8	2025	Evangeline	Lavaca	164	151.4
	6641903	206.7	2025	Evangeline	Lavaca	335	119.7
	6643704	137.8	2025	Chicot	Lavaca	34	109.1
	6643801	150.9	2025	Evangeline	Lavaca	724	64.2
	6643803	150.9	2025	Evangeline	Lavaca	1023	57.7
	6644702	137.8	2025	Evangeline	Colorado	676	42.1
	6645916	128.0	2025	Chicot	Wharton	125	74.0
	6646201	141.1	2025	Chicot	Wharton	200	91.3
	6646402	131.2	2025	Chicot	Wharton	366	77.1
	6646601	128.0	2025	Chicot	Wharton	186	79.4
	6647201	114.8	2025	Chicot	Wharton	244	59.4
	6648802	91.9	2025	Chicot	Wharton	564	51.2
	6648907	88.6	2025	Chicot	Wharton	630	23.0
	6648908	88.6	2025	Chicot	Wharton	55	61.3
	6648909	88.6	2025	Chicot	Wharton	300	24.6
	6649701	170.6	2025	Evangeline	Lavaca	1082	117.6
	6649901	170.6	2025	Evangeline	Lavaca	272	108.7
	6653804	85.3	2025	Chicot	Wharton	495	42.9
	6654108	98.4	2025	Chicot	Wharton	360	47.5

GCD Well ID	TWDB Well ID	Land Surface Elevation (ft)	Analysis Year	Assigned Unit	County	Well Depth (ft)	Average Water Level (famsl)
	6654622	98.4	2025	Evangeline	Wharton	1200	22.8
	6654906	88.6	2025	Chicot	Wharton	461	11.7
	6656302	85.3	2025	Chicot	Wharton	490	15.8
	6661302	82.0	2025	Chicot	Wharton	528	27.1
	6661305	78.7	2025	Chicot	Wharton	600	36.2
	6662104	85.3	2025	Chicot	Wharton	371	32.8
	6662307	85.3	2025	Chicot	Wharton	180	58.2
	6662313	82.0	2025	Chicot	Wharton	480	-1.4
	6663105	78.7	2025	Chicot	Wharton	342	61.4
	6663507	68.9	2025	Chicot	Wharton	48	58.4
	6663509	62.3	2025	Chicot	Wharton	688	-28.9
	6663610	68.9	2025	Evangeline	Wharton	857	-30.4
	6740301	278.9	2025	Evangeline	Lavaca	45	264.4
	6755606	262.5	2025	Evangeline	DeWitt	194	216.9
	6755803	219.8	2025	Evangeline	DeWitt	75	205.1
	6763703	187.0	2025	Evangeline	DeWitt	120	118.8
	7905507	232.9	2025	Evangeline	DeWitt	230	206.4
	7905606	200.1	2025	Evangeline	Goliad	154	178.3
	7905903	216.5	2025	Evangeline	Goliad	280	163.1
	7905904	196.9	2025	Evangeline	Goliad	164	168.5
	7905905	216.5	2025	Evangeline	Goliad	314	162.4
	7905907	232.9	2025	Evangeline	Goliad	261	162.8
	7905909	255.9	2025	Evangeline	Goliad	143	182.3
	7906306	229.7	2025	Evangeline	DeWitt	138	148.3
	7906706	219.8	2025	Evangeline	Goliad	152	159.9
	7906707	200.1	2025	Evangeline	DeWitt	260	148.7
	7906708	216.5	2025	Evangeline	DeWitt	300	149.3
	7912305	301.8	2025	Evangeline	Goliad	166	210.3
	7913223	236.2	2025	Evangeline	Goliad	93	180.0
	7913224	232.9	2025	Evangeline	Goliad	24	212.3
	7913225	229.7	2025	Evangeline	Goliad	65	174.5
	7913229	229.7	2025	Evangeline	Goliad	152	169.0
	7913230	249.3	2025	Evangeline	Goliad	282	167.3
	7913231	232.9	2025	Evangeline	Goliad	28	213.4
	7913304	242.8	2025	Evangeline	Goliad	317	165.9

GCD Well ID	TWDB Well ID	Land Surface Elevation (ft)	Analysis Year	Assigned Unit	County	Well Depth (ft)	Average Water Level (famsl)
	7913507	282.2	2025	Evangeline	Goliad	250	167.6
	7913512	269.0	2025	Evangeline	Goliad	263	163.9
	7913513	292.0	2025	Evangeline	Goliad	230	154.8
	7913803	255.9	2025	Evangeline	Goliad	188	185.9
	7913804	242.8	2025	Evangeline	Goliad	291	143.2
	7913805	288.7	2025	Evangeline	Goliad	197	191.7
	7913806	236.2	2025	Evangeline	Goliad	222	148.0
	7913807	269.0	2025	Evangeline	Goliad	222	186.9
	7913808	255.9	2025	Evangeline	Goliad	331	147.4
	7913809	252.6	2025	Evangeline	Goliad	183	149.9
	7913810	265.7	2025	Evangeline	Goliad	186	187.6
	7913811	229.7	2025	Evangeline	Goliad	143	182.2
	7913813	272.3	2025	Evangeline	Goliad	210	188.0
	7916603	62.3	2025	Evangeline	Victoria	612	13.6
	7922604	147.6	2025	Evangeline	Goliad	305	82.8
	7923703	114.8	2025	Evangeline	Goliad	350	73.8
	7925506	357.6	2025	Evangeline	Bee	52	314.6
	7927202	305.1	2025	Evangeline	Goliad	150	211.8
	7928302	213.3	2025	Evangeline	Goliad	235	131.8
	7928304	236.2	2025	Evangeline	Goliad	320	124.9
	7929302	177.2	2025	Evangeline	Goliad	214	93.2
	7930301	114.8	2025	Evangeline	Goliad	300	70.6
	7931502	108.3	2025	Chicot	Goliad	204	67.8
	7931702	98.4	2025	Chicot	Goliad	218	73.9
	7934409	337.9	2025	Evangeline	Bee	145	202.2
	7935101	259.2	2025	Evangeline	Bee	130	192.1
	7935305	223.1	2025	Evangeline	Bee	150	162.9
	7938201	118.1	2025	Chicot	Goliad	106	81.3
	7938202	101.7	2025	Chicot	Goliad	60	70.2
	7938301	88.6	2025	Chicot	Goliad	62	65.6
	7938303	101.7	2025	Chicot	Goliad	80	75.0
	7939104	88.6	2025	Chicot	Goliad	110	63.5
	7942213	272.3	2025	Evangeline	Bee	185	199.2
	7942703	242.8	2025	Evangeline	Bee	230	176.2
	7944103	150.9	2025	Evangeline	Bee	150	94.2

GCD Well ID	TWDB Well ID	Land Surface Elevation (ft)	Analysis Year	Assigned Unit	County	Well Depth (ft)	Average Water Level (famsl)
	7957608	131.2	2025	Evangeline	San Patricio	205	78.2
	7958201	157.5	2025	Evangeline	San Patricio	521	71.6
	7960104	88.6	2025	Chicot	San Patricio	450	63.0
	7964701	3.3	2025	Chicot	Aransas	130	-2.0
	8007102	55.8	2025	Evangeline	Matagorda	1020	11.3
	8007203	52.5	2025	Chicot	Matagorda	453	-33.8
	8007312	49.2	2025	Chicot	Matagorda	350	-36.2
	8008106	49.2	2025	Chicot	Matagorda	64	33.6
	8008504	49.2	2025	Chicot	Matagorda	690	-43.4
	8008505	45.9	2025	Chicot	Matagorda	100	39.8
	8014801	13.1	2025	Chicot	Matagorda	719	-20.9
	8015405	29.5	2025	Chicot	Matagorda	270	-54.6
	8024201	6.6	2025	Chicot	Matagorda	490	-3.5
	8024406	3.3	2025	Chicot	Matagorda	360	-38.1
	8024601	3.3	2025	Chicot	Matagorda	275	-8.8
	8024802	3.3	2025	Chicot	Matagorda	380	-31.8
	8049702	6.6	2025	Chicot	Aransas	63	1.0
	8102404	29.5	2025	Chicot	Matagorda	450	-27.3
	8102901	13.1	2025	Chicot	Matagorda	294	-17.5
	8103406	26.2	2025	Chicot	Matagorda	530	-13.8
	8111901	3.3	2025	Chicot	Matagorda	527	-24.6
	8117405	3.3	2025	Chicot	Matagorda	472	-21.8
	8303506	91.9	2025	Chicot	San Patricio	267	23.7
Texana GCD - GW-00090		9.8	2025	Chicot	Jackson		-55.8
Texana GCD - GW-00091		9.8	2025	Chicot	Jackson		-57.1
Texana GCD - GW-00244		59.1	2025	Chicot	Jackson		34.4
Texana GCD - GW-00247		62.3	2025	Chicot	Jackson		37.2
Texana GCD - GW-00251		62.3	2025	Chicot	Jackson		33.3
Texana GCD - GW-00278		62.3	2025	Evangeline	Jackson	850	-5.5
Texana GCD - GW-00284	8011502	39.4	2025	Chicot	Jackson	300	10.7
Texana GCD - GW-00291	8004504	49.2	2025	Chicot	Jackson	280	21.1
Texana GCD - GW-00410		55.8	2025	Chicot	Jackson		24.1

GCD Well ID	TWDB Well ID	Land Surface Elevation (ft)	Analysis Year	Assigned Unit	County	Well Depth (ft)	Average Water Level (famsl)
Texana GCD - GW-00411		59.1	2025	Chicot	Jackson		26.3
Texana GCD - GW-00444		13.1	2025	Evangeline	Jackson	400	-55.1
Texana GCD - GW-00566		45.9	2025	Chicot	Jackson	150	30.0
Texana GCD - NW-00075	8022407	9.8	2025	Chicot	Jackson	520	-55.6
Texana GCD - NW-00140		13.1	2025	Chicot	Jackson	520	-52.6
Texana GCD - NW-00310		88.6	2025	Chicot	Jackson	124	48.1
Texana GCD - NW-00487		9.8	2025	Chicot	Jackson	185	-7.4
Texana GCD - NW-00488		9.8	2025	Chicot	Jackson	330	-65.6
Texana GCD - NW-00489		6.6	2025	Chicot	Jackson	208	-10.7
Texana GCD - NW-00490		6.6	2025	Chicot	Jackson	402	-64.1
Texana GCD - NW-00491		9.8	2025	Chicot	Jackson	204	-8.2
Texana GCD - NW-00492		9.8	2025	Chicot	Jackson	355	-54.4
Victoria County GCD - GW-000001		88.6	2025	Chicot	Victoria		50.8
Victoria County GCD - GW-000047		124.7	2025	Evangeline	Victoria	227	68.1
Victoria County GCD - GW-000138		128.0	2025	Chicot	Victoria		46.8
Victoria County GCD - GW-000150		55.8	2025	Chicot	Victoria	140	28.4
Victoria County GCD - GW-000158		187.0	2025	Chicot	Victoria		109.1
Victoria County GCD - GW-000159		173.9	2025	Chicot	Victoria		92.7
Victoria County GCD - GW-000192		52.5	2025	Chicot	Victoria		24.4
Victoria County GCD - GW-000227		52.5	2025	Chicot	Victoria		27.2
Victoria County GCD - GW-000271		114.8	2025	Chicot	Victoria		51.7
Victoria County GCD - GW-000321	8017502	65.6	2025	Evangeline	Victoria	1026	32.0
Victoria County GCD - GW-000366	8002102	91.9	2025	Evangeline	Victoria	791	36.1
Victoria County GCD - GW-000377	8002804	62.3	2025	Chicot	Victoria	92	24.3
Victoria County GCD - GW-000489		55.8	2025	Chicot	Victoria		22.2

GCD Well ID	TWDB Well ID	Land Surface Elevation (ft)	Analysis Year	Assigned Unit	County	Well Depth (ft)	Average Water Level (famsl)
Victoria County GCD - GW-000492		52.5	2025	Chicot	Victoria		8.3
Victoria County GCD - GW-000494		173.9	2025	Evangeline	Victoria	190	67.4
Victoria County GCD - GW-000544		91.9	2025	Chicot	Victoria	853	57.2
Victoria County GCD - GW-000552		160.8	2025	Evangeline	Victoria	112	95.1
Victoria County GCD - GW-000562		82.0	2025	Chicot	Victoria		38.7
Victoria County GCD - GW-000577	7908404	144.4	2025	Evangeline	Victoria	100	87.8
Victoria County GCD - GW-000578	7908403	134.5	2025	Evangeline	Victoria	100	85.1
Victoria County GCD - GW-000587		134.5	2025	Chicot	Victoria		77.5
Victoria County GCD - GW-000588		200.1	2025	Chicot	Victoria		105.2
Victoria County GCD - GW-000602	7916701	101.7	2025	Evangeline	Victoria	578	55.7
Victoria County GCD - GW-000603		105.0	2025	Evangeline	Victoria	620	56.3
Victoria County GCD - GW-000607		108.3	2025	Chicot	Victoria		59.0
Victoria County GCD - GW-000608	7915903	121.4	2025	Chicot	Victoria	112	75.6
Victoria County GCD - GW-000609		98.4	2025	Chicot	Victoria	194	59.3
Victoria County GCD - GW-000614		118.1	2025	Chicot	Victoria		63.6
Victoria County GCD - GW-000735		118.1	2025	Chicot	Victoria		73.7
Victoria County GCD - GW-000989		55.8	2025	Chicot	Victoria		31.1
Victoria County GCD - NW-000016		170.6	2025	Evangeline	Victoria	250	102.7
Victoria County GCD - NW-000779	8025402	62.3	2025	Chicot	Victoria	190	16.1

Table 2 Average annual water level (ft, msl) and change in the average annual water level for Calhoun County for the Chicot Aquifer, the Evangeline Aquifer and the Chicot & Evangeline aquifers

Aquifer	Water Level/ Change	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Chicot	avg. WL (ft)	-7.0	-5.9	-4.9	-0.3	-1.8	1.9	-4.5	-1.0	0.8	-2.6	-2.6	-1.2	-7.6	-5.1	-6.8	-7.7	-7.8	-2.6	-4.2	-2.9	-2.6	-5.0	-1.8	-5.7	-7.6	-7.9
	change (ft)*	0.0	1.1	2.1	6.7	5.2	8.9	2.5	6.1	7.8	4.4	4.4	5.8	-0.6	2.0	0.2	-0.6	-0.8	4.4	2.8	4.1	4.5	2.0	5.2	1.3	-0.6	-0.9
Evangeline	avg. WL (ft)	17.7	11.3	8.1	25.2	13.7	13.3	21.8	28.0	15.1	16.5	18.1	14.6	18.7	10.3	1.2	3.6	3.6	11.6	-8.0	15.2	16.4	9.9	6.6	5.0	-5.5	-6.7
	change (ft)*	0.0	-6.4	-9.6	7.5	-4.0	-4.4	4.1	10.3	-2.6	-1.2	0.4	-3.1	1.0	-7.4	-16.5	-14.2	-14.1	-6.1	-25.8	-2.5	-1.3	-7.8	-11.1	-12.7	-23.2	-24.4
Chicot & Evangeline	avg. WL (ft)	-3.2	-3.7	-3.5	3.7	0.2	3.3	-0.2	3.7	3.1	0.2	0.4	1.0	-3.1	-2.8	-5.7	-6.1	-6.2	-0.4	-5.7	-0.1	0.5	-3.1	-1.3	-4.5	-7.0	-7.6
	change (ft)*	0.0	-0.5	-0.3	7.0	3.4	6.6	3.1	6.9	6.3	3.4	3.6	4.2	0.1	0.4	-2.5	-2.8	-3.0	2.8	-2.5	3.1	3.7	0.1	1.9	-1.3	-3.8	-4.4

* change is measured relative to the year 2000; avg WL is measured relative to mean sea level

Table 3 Average annual water level (ft, msl) and change in the average annual water level for Jackson County for the Chicot Aquifer, the Evangeline Aquifer and the Chicot & Evangeline aquifers

Aquifer	Water Level/ Change	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Chicot	avg. WL (ft)	21.3	19.3	23.4	26.5	26.5	29.3	23.0	29.9	30.7	26.4	27.1	28.1	20.2	23.6	20.3	22.1	20.6	25.9	25.7	26.2	28.0	25.4	29.5	23.6	18.2	23.2
	change (ft)*	0.0	-2.0	2.1	5.2	5.2	8.0	1.7	8.6	9.4	5.1	5.8	6.8	-1.1	2.2	-1.0	0.8	-0.7	4.6	4.4	4.9	6.7	4.1	8.2	2.3	-3.1	1.9
Evangeline	avg. WL (ft)	17.0	19.2	21.8	21.0	22.0	22.0	21.5	32.6	27.5	20.9	17.1	19.6	6.2	20.4	1.7	12.0	21.0	17.4	-3.5	15.4	15.9	12.1	13.0	15.0	0.7	-0.5
	change (ft)*	0.0	2.3	4.9	4.0	5.1	5.1	4.6	15.7	10.6	3.9	0.1	2.6	-10.7	3.4	-15.2	-4.9	4.1	0.4	-20.4	-1.5	-1.0	-4.9	-4.0	-2.0	-16.3	-17.5
Chicot & Evangeline	avg. WL (ft)	19.0	19.1	22.5	23.6	24.2	25.6	22.2	31.2	29.0	23.5	22.0	23.8	13.1	21.9	11.0	16.9	20.7	21.5	11.0	20.8	21.9	18.7	21.1	19.2	9.4	11.3
	change (ft)*	0.0	0.1	3.5	4.6	5.2	6.6	3.1	12.2	10.0	4.5	3.0	4.8	-5.9	2.8	-8.1	-2.1	1.7	2.5	-8.0	1.7	2.9	-0.3	2.1	0.2	-9.6	-7.7

* change is measured relative to the year 2000; avg WL is measured relative to mean sea level

Table 4 Average annual water level (ft, msl) and change in the average annual water level for Refugio County for the Chicot Aquifer, the Evangeline Aquifer and the Chicot & Evangeline aquifers

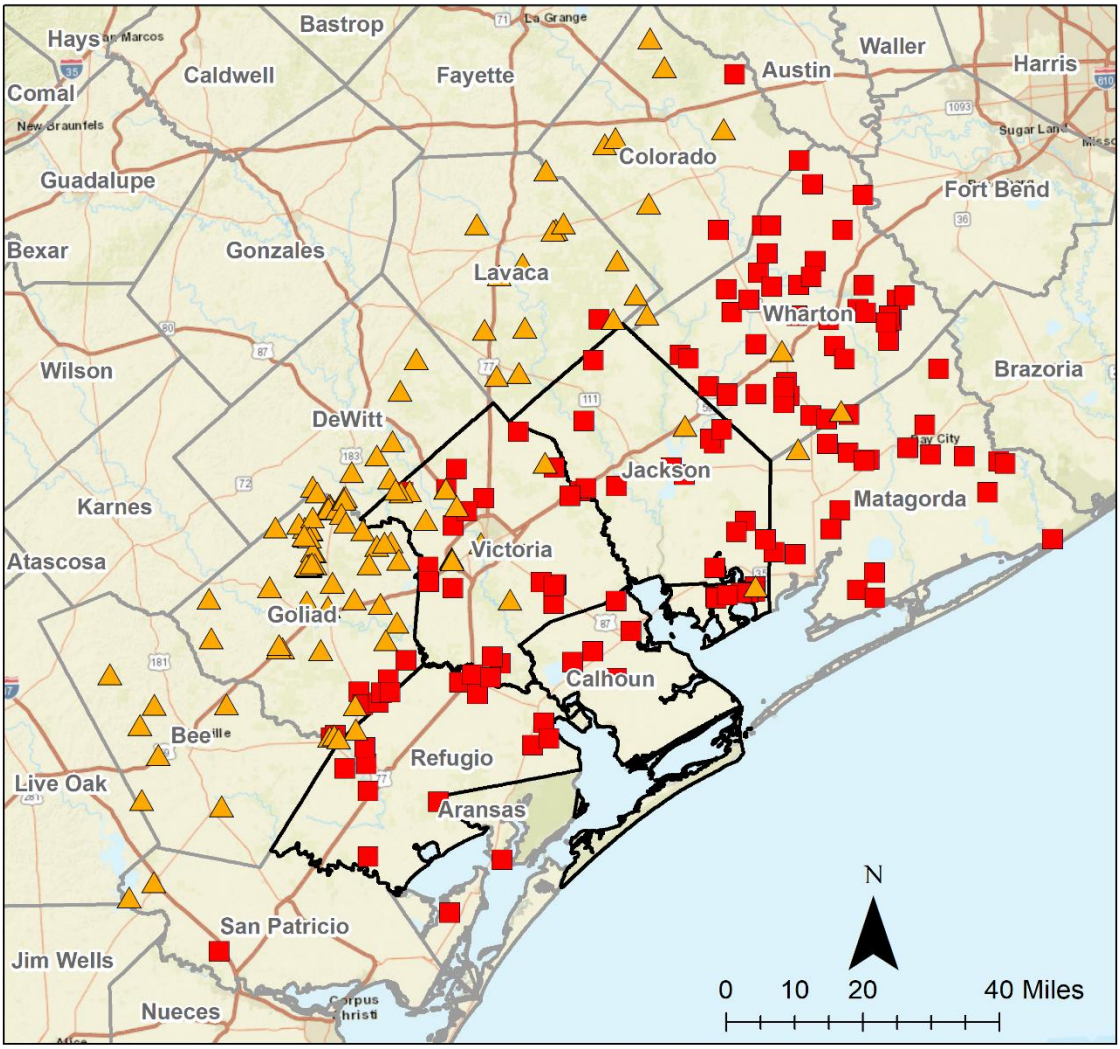
Aquifer	Water Level/ Change	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Chicot	avg. WL (ft)	24.8	23.6	28.3	27.2	24.5	28.3	24.6	27.4	29.0	24.3	22.7	23.5	23.0	19.4	4.5	14.5	19.6	19.2	19.0	20.0	18.4	14.9	19.6	17.3	15.5	18.5
	change (ft)*	0.0	-1.2	3.6	2.5	-0.2	3.5	-0.1	2.6	4.3	-0.5	-2.1	-1.2	-1.8	-5.4	-20.2	-10.3	-5.2	-5.6	-5.8	-4.8	-6.4	-9.9	-5.2	-7.5	-9.3	-6.3
Evangeline	avg. WL (ft)	32.5	31.7	34.2	39.8	37.9	40.7	38.3	35.4	31.2	31.7	21.7	31.6	33.1	27.0	23.9	22.3	24.6	30.4	20.5	28.2	30.9	24.6	28.3	24.1	21.1	27.7
	change (ft)*	0.0	-0.8	1.6	7.2	5.3	8.1	5.8	2.8	-1.3	-0.9	-10.8	-1.0	0.5	-5.5	-8.6	-10.3	-7.9	-2.2	-12.0	-4.3	-1.7	-7.9	-4.2	-8.4	-11.4	-4.8
Chicot & Evangeline	avg. WL (ft)	26.3	25.4	29.1	31.0	28.8	31.8	28.9	29.0	28.5	26.1	20.7	25.6	25.8	21.4	11.9	16.7	20.4	22.8	18.6	22.4	22.6	17.8	22.2	19.0	18.1	22.7
	change (ft)*	0.0	-0.9	2.8	4.7	2.5	5.6	2.6	2.7	2.2	-0.1	-5.5	-0.7	-0.5	-4.9	-14.4	-9.5	-5.8	-3.5	-7.7	-3.9	-3.7	-8.4	-4.1	-7.3	-8.2	-3.6

* change is measured relative to the year 2000; avg WL is measured relative to mean sea level

Table 5 Average annual water level (ft, msl) and change in the average annual water level for Victoria County for the Chicot Aquifer, the Evangeline Aquifer and the Chicot & Evangeline aquifers

Aquifer	Water Level/ Change	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Chicot	avg. WL (ft)	49.8	49.2	47.8	48.8	49.6	52.6	51.8	52.0	52.4	50.9	52.8	48.0	43.5	50.1	45.5	48.2	49.9	51.4	52.0	49.9	47.9	48.6	51	45.6	42.6	42.9
	change (ft)*	0.0	-0.6	-2.0	-1.0	-0.2	2.8	2.0	2.2	2.6	1.1	3.0	-1.7	-6.3	0.3	-4.3	-1.6	0.1	1.6	2.2	0.1	-1.9	-1.2	1.1	-4.2	-7.2	-6.9
Evangeline	avg. WL (ft)	29.8	32.0	40.6	48.8	51.0	48.9	47.6	53.4	53.0	47.7	44.8	41.3	32.4	45.3	40.9	41.4	45.6	46.1	30.6	38.0	39.1	42.7	43.3	44.6	39.2	39.0
	change (ft)*	0.0	2.2	10.8	19.0	21.2	19.1	17.7	23.5	23.1	17.8	15.0	11.5	2.5	15.4	11.0	11.5	15.7	16.3	0.7	8.2	9.3	12.9	13.5	14.8	9.4	9.2
Chicot & Evangeline	avg. WL (ft)	41.3	42.4	46.0	50.6	51.9	52.2	51.2	54.2	54.2	50.7	50.2	46.2	39.3	49.3	44.8	46.3	49.3	50.4	42.7	45.6	45.1	47.4	48.8	46.9	40.8	40.9
	change (ft)*	0.0	1.0	4.6	9.2	10.5	10.9	9.9	12.9	12.9	9.4	8.9	4.9	-2.0	7.9	3.4	5.0	7.9	9.0	1.4	4.2	3.8	6.1	7.5	5.6	-0.5	-0.4

* change is measured relative to the year 2000; avg WL is measured relative to mean sea level



Monitoring Well Network 2024

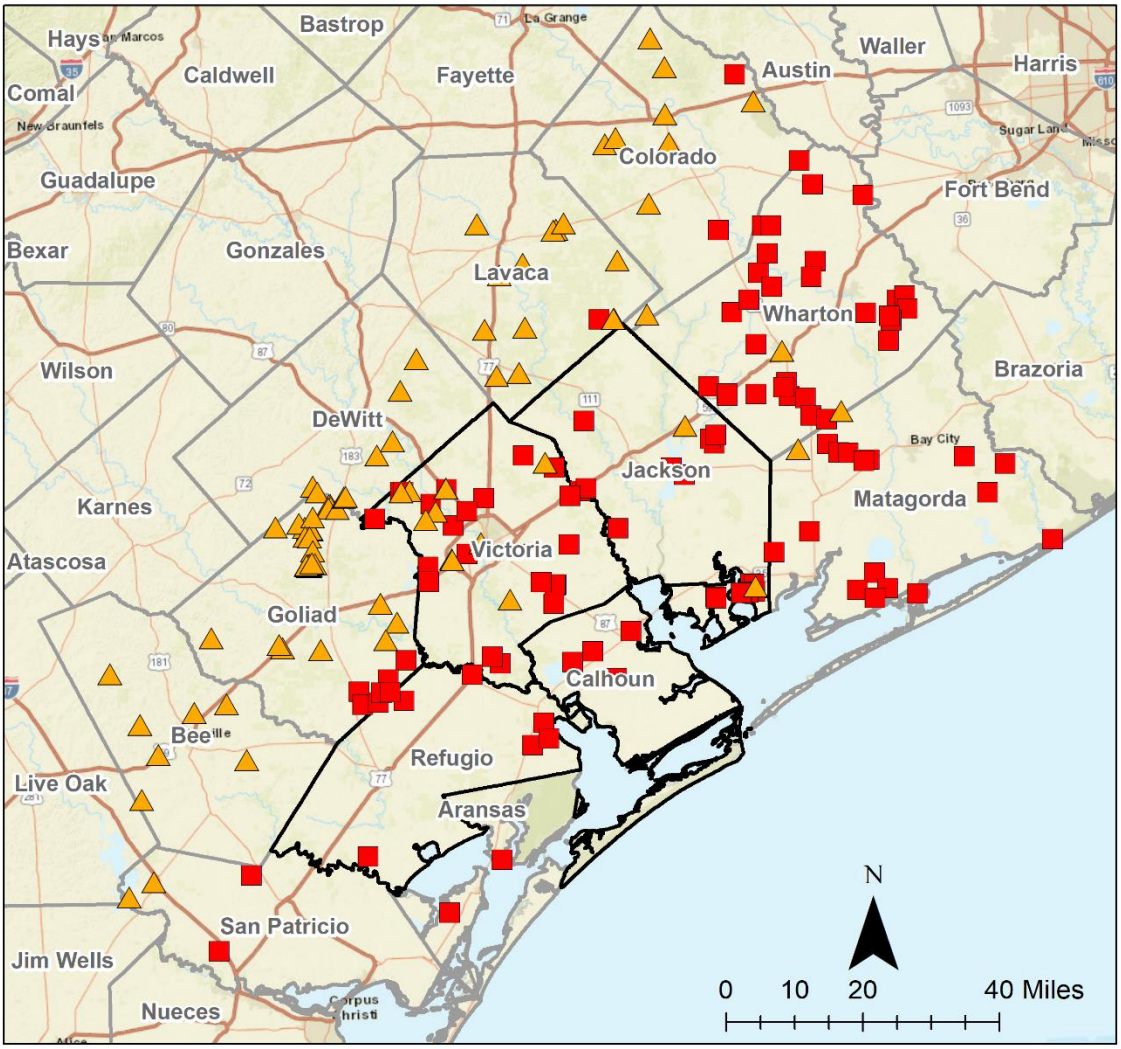
Counties of Interest

Counties

Evangeline Aquifer

Chicot Aquifer

Figure 1 Location of Water Levels that were Interpolated to Generate the Water Levels Surfaces for the Chicot and the Evangeline aquifers analysis year 2024.



Monitoring Well Network 2025

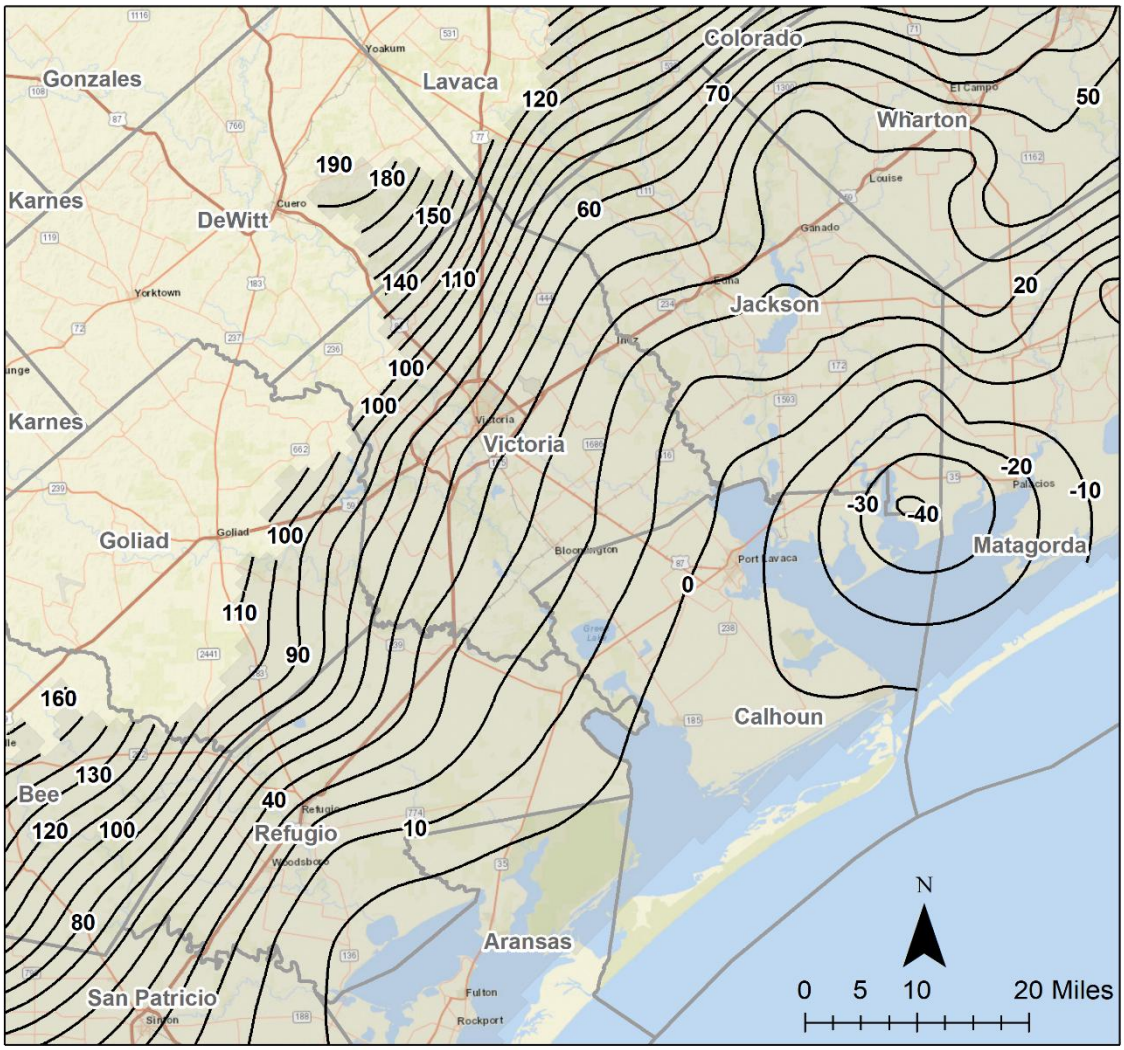
Counties of Interest

Counties

Evangeline Aquifer

Chicot Aquifer

Figure 2 Location of Water Levels that were Interpolated to Generate the Water Levels Surfaces for the Chicot and the Evangeline aquifers analysis year 2025.



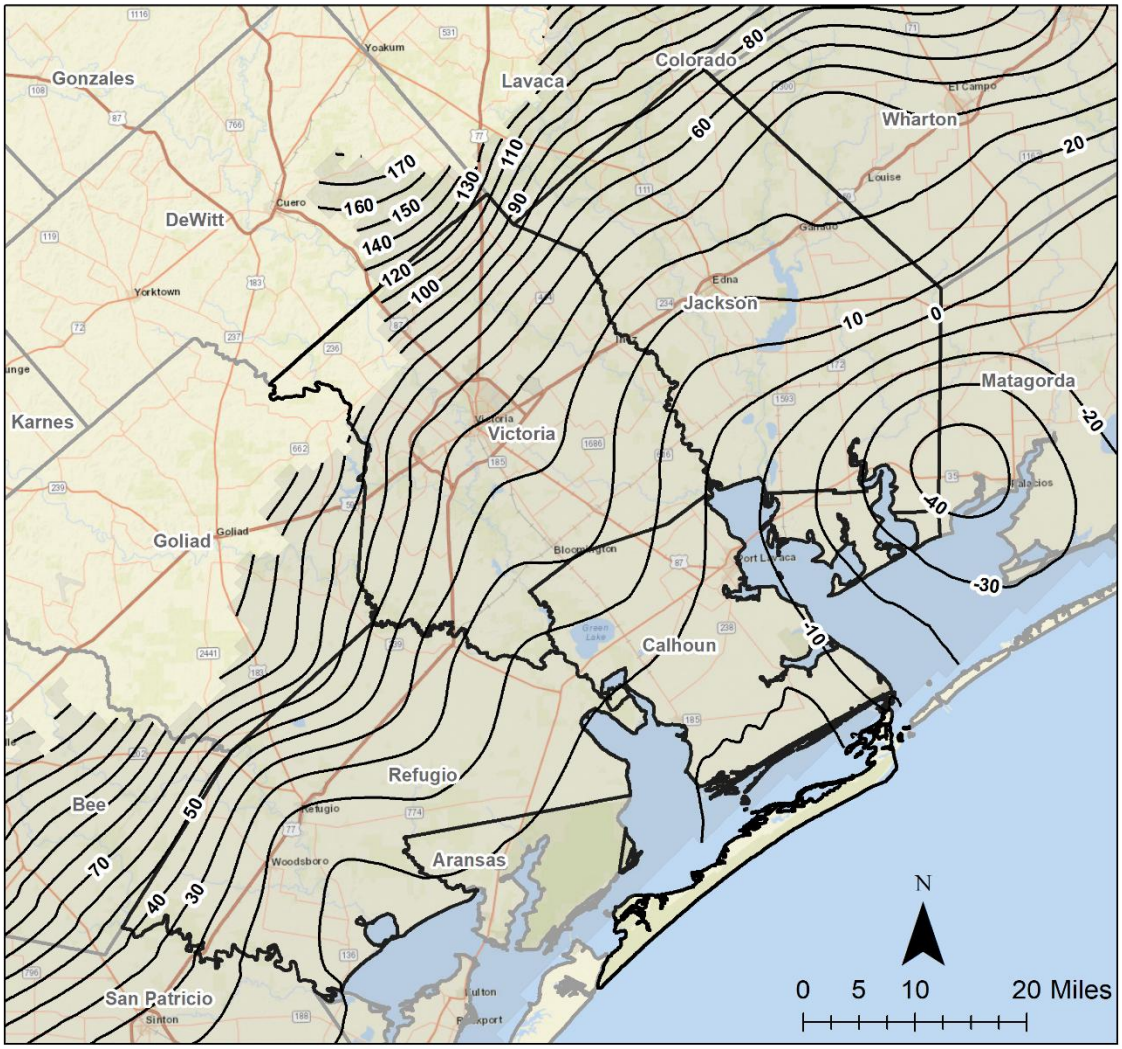
Water Level (ft):
Chicot, 2000 Analysis Year

Water Level (famsl)

Counties of Interest

Counties

Figure 3 Contours of the Water Levels Generated for the Chicot Aquifer for the 2000 Analysis Year



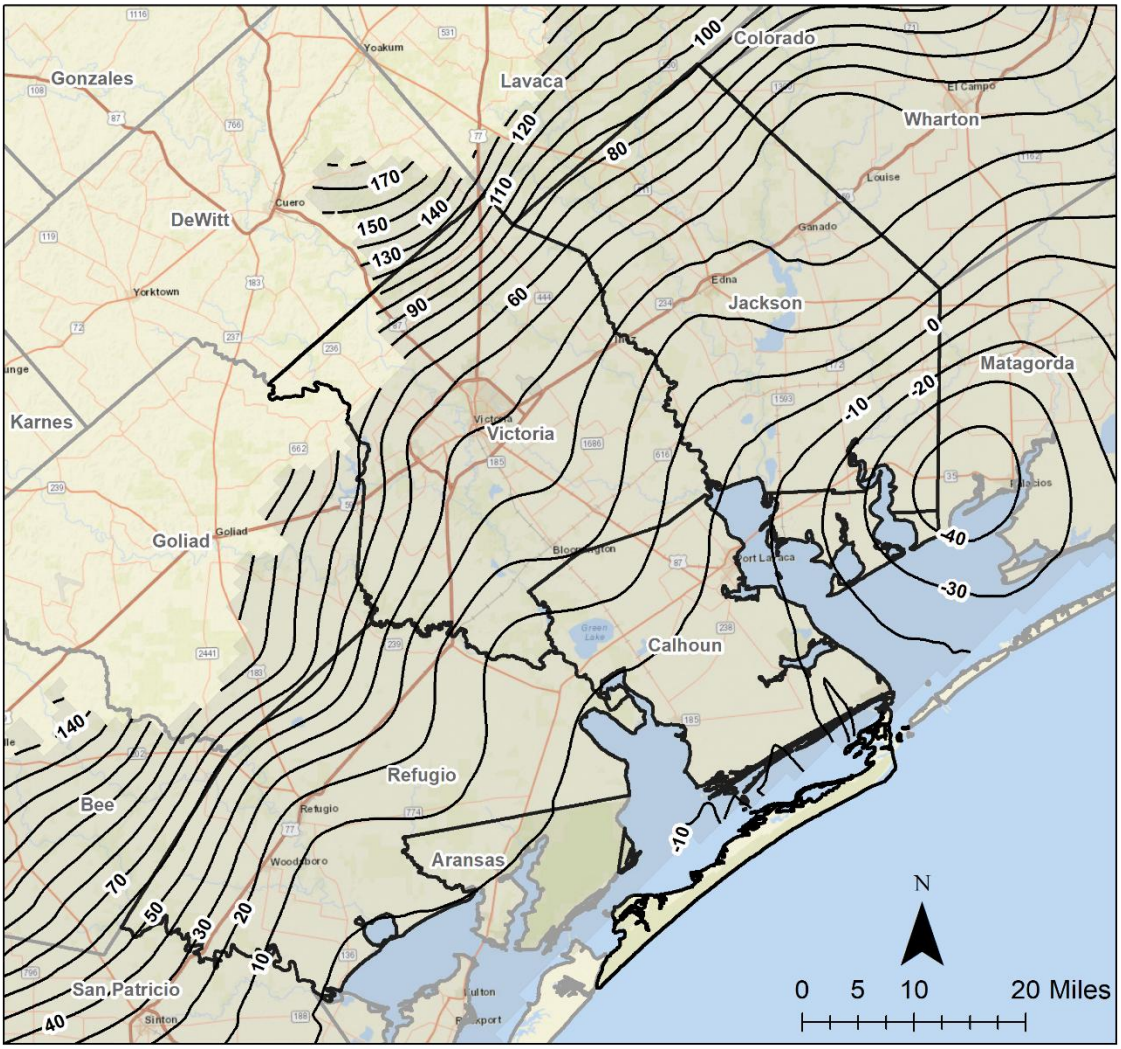
Water Level (ft):
Chicot, 2024 Analysis Year

Water Level (famsl)

Counties of Interest

Counties

Figure 4 Contours of the Water Levels Generated for the Chicot Aquifer for the 2024 Analysis Year



Water Level (ft):
Chicot, 2025 Analysis Year

Water Level (famsl)

Counties of Interest

Counties

Figure 5 Contours of the Water Levels Generated for the Chicot Aquifer for the 2025 Analysis Year

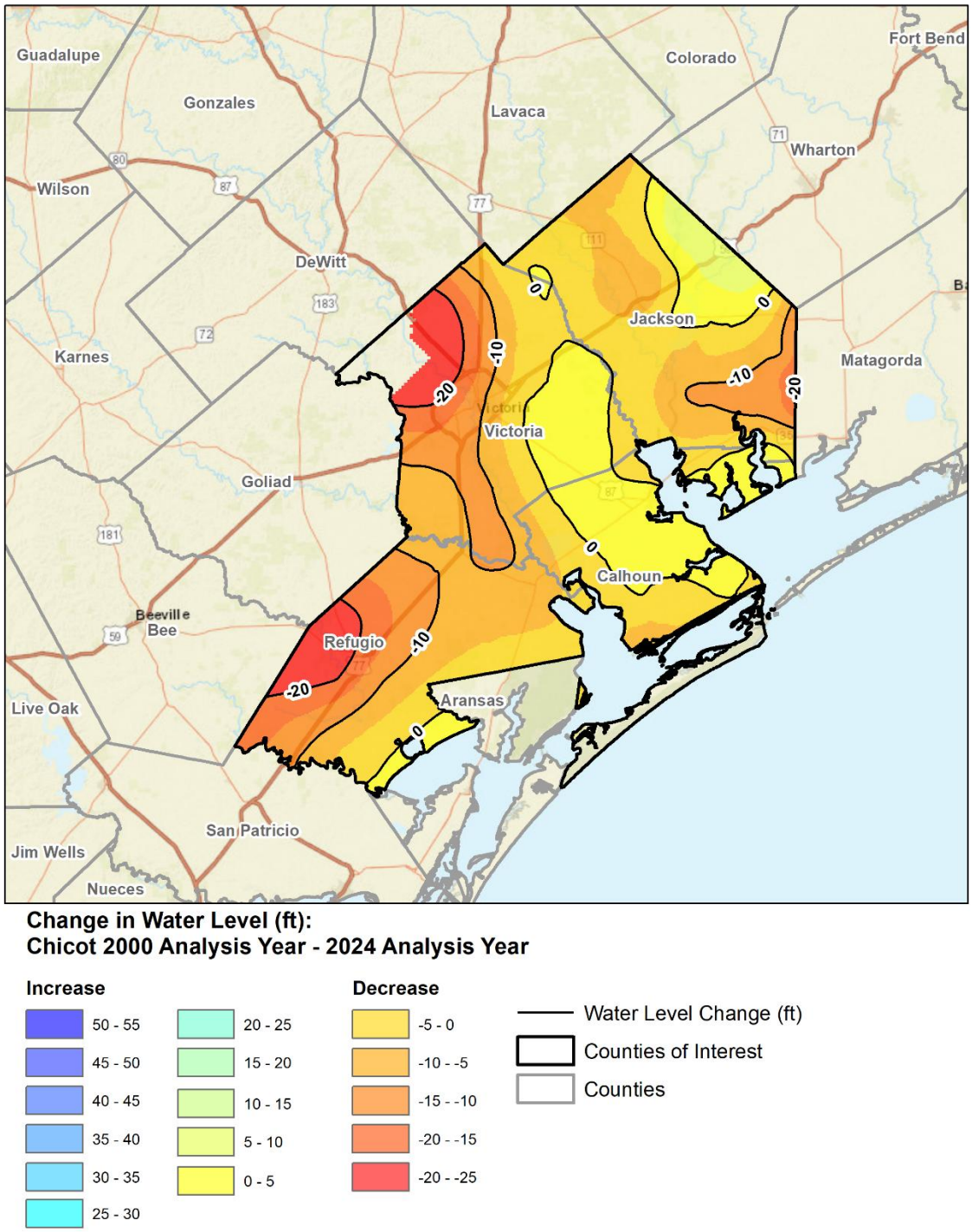


Figure 6 Contours of the change in water levels in the Chicot Aquifer from the 2000 Analysis Year to the 2024 Analysis Year

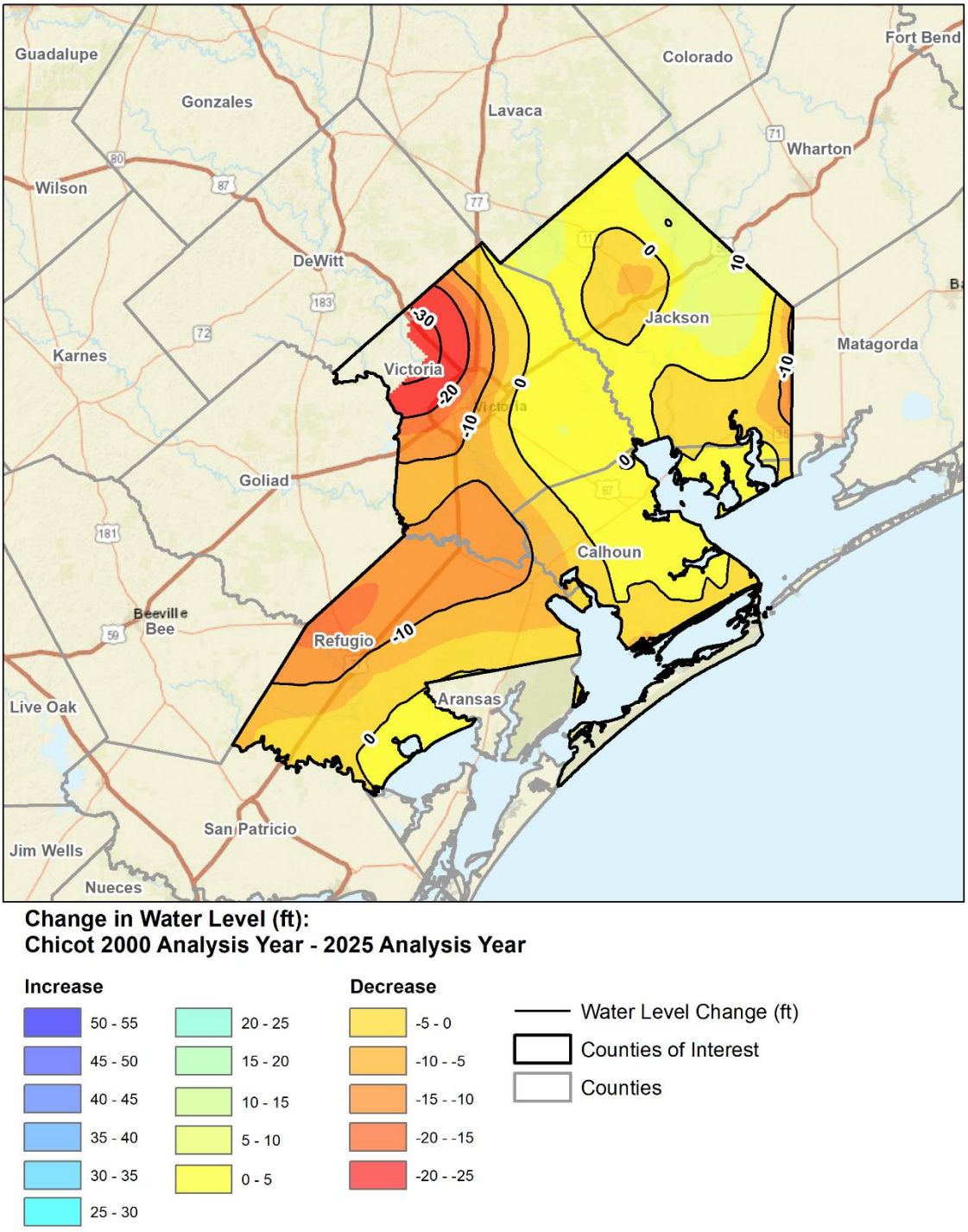


Figure 7 Contours of the change in water levels in the Chicot Aquifer from the 2000 Analysis Year to the 2025 Analysis Year

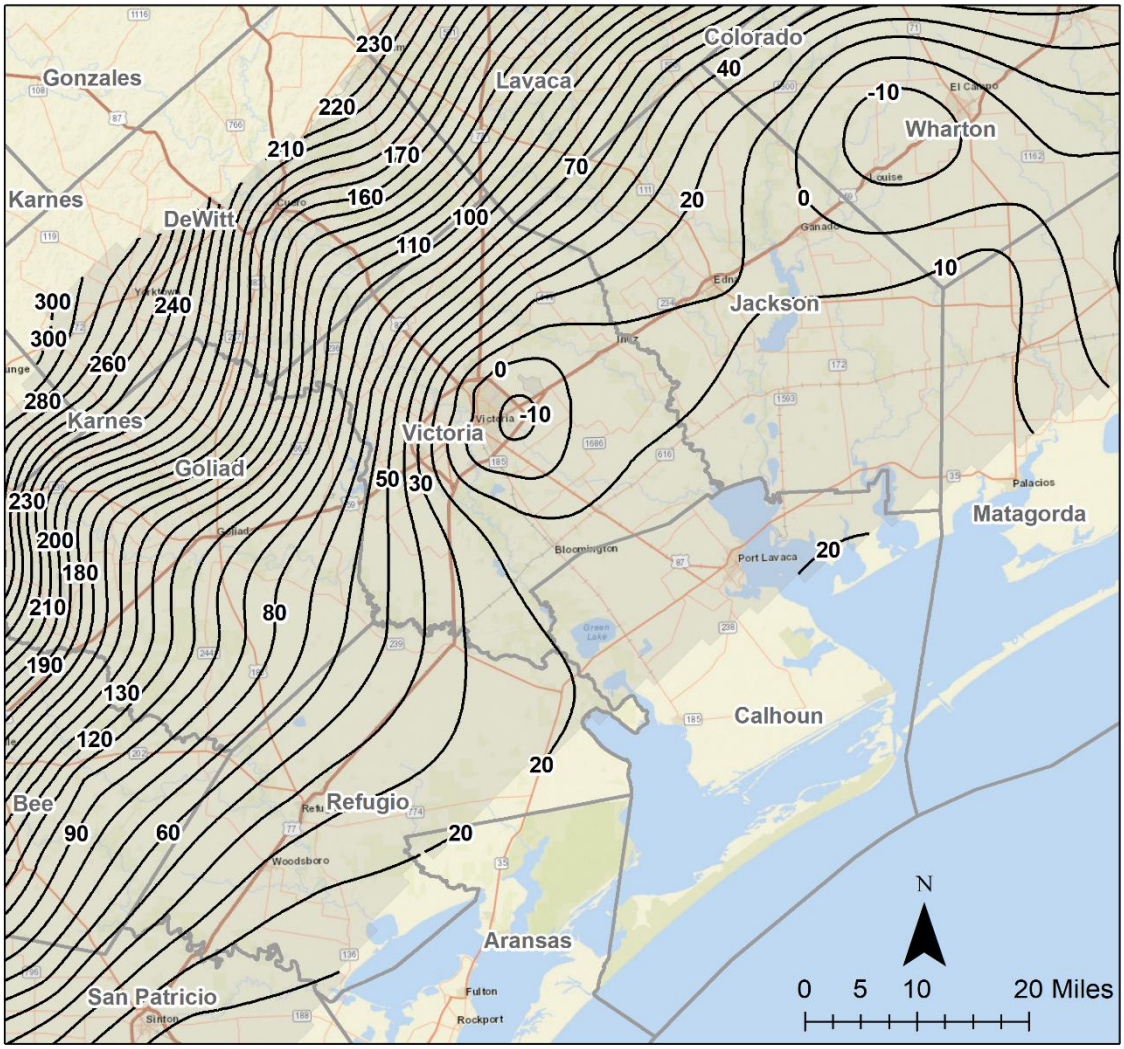


Figure 8 Contours of the Water Levels Generated for the Evangeline Aquifer for the 2000 Analysis Year

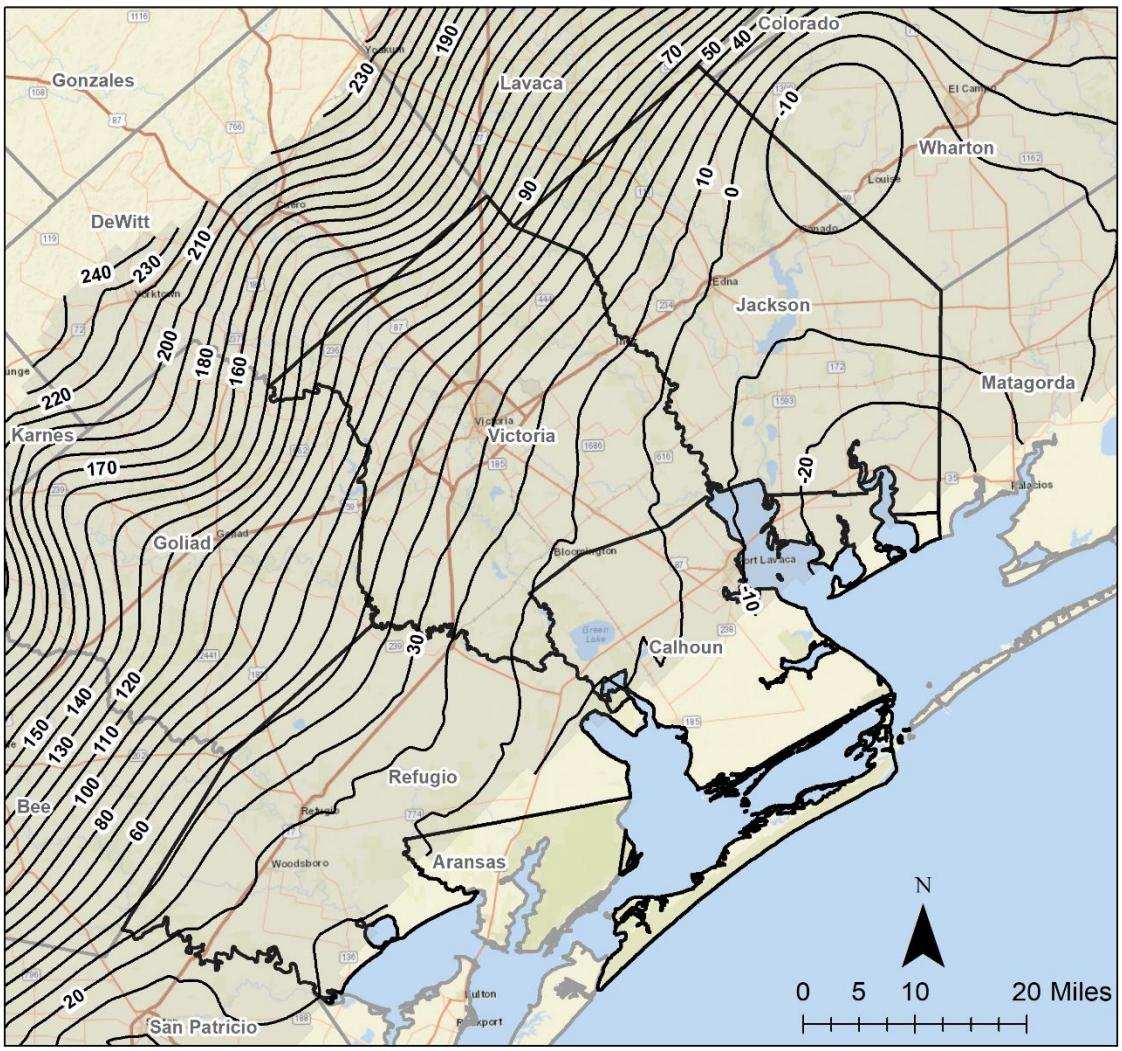


Figure 9 Contours of the Water Levels Generated for the Evangeline Aquifer for the 2024 Analysis Year

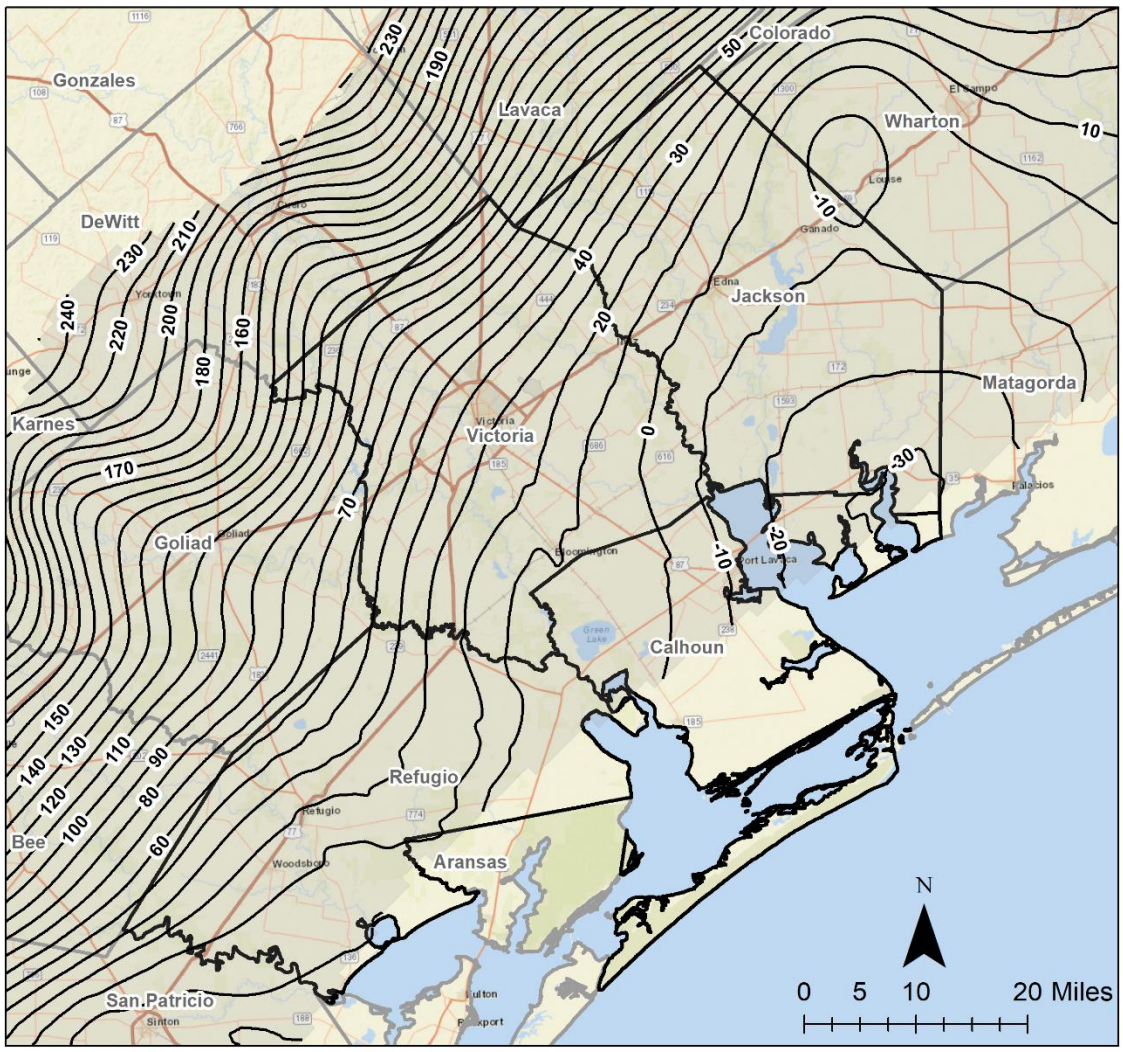


Figure 10 Contours of the Water Levels Generated for the Evangeline Aquifer for the 2025 Analysis Year

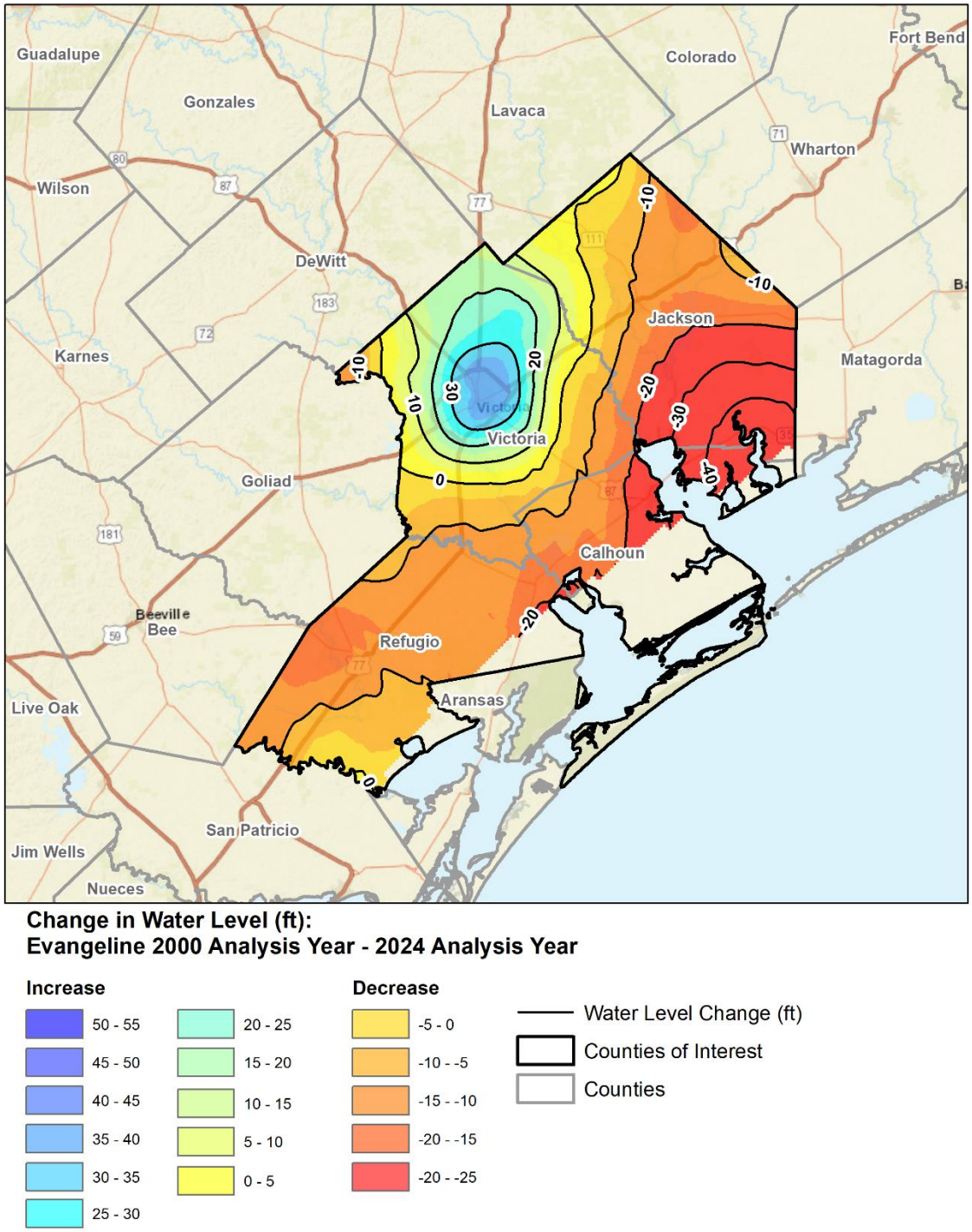


Figure 11 Contours of the change in water levels in the Evangeline Aquifer from the 2000 Analysis Year to the 2024 Analysis Year

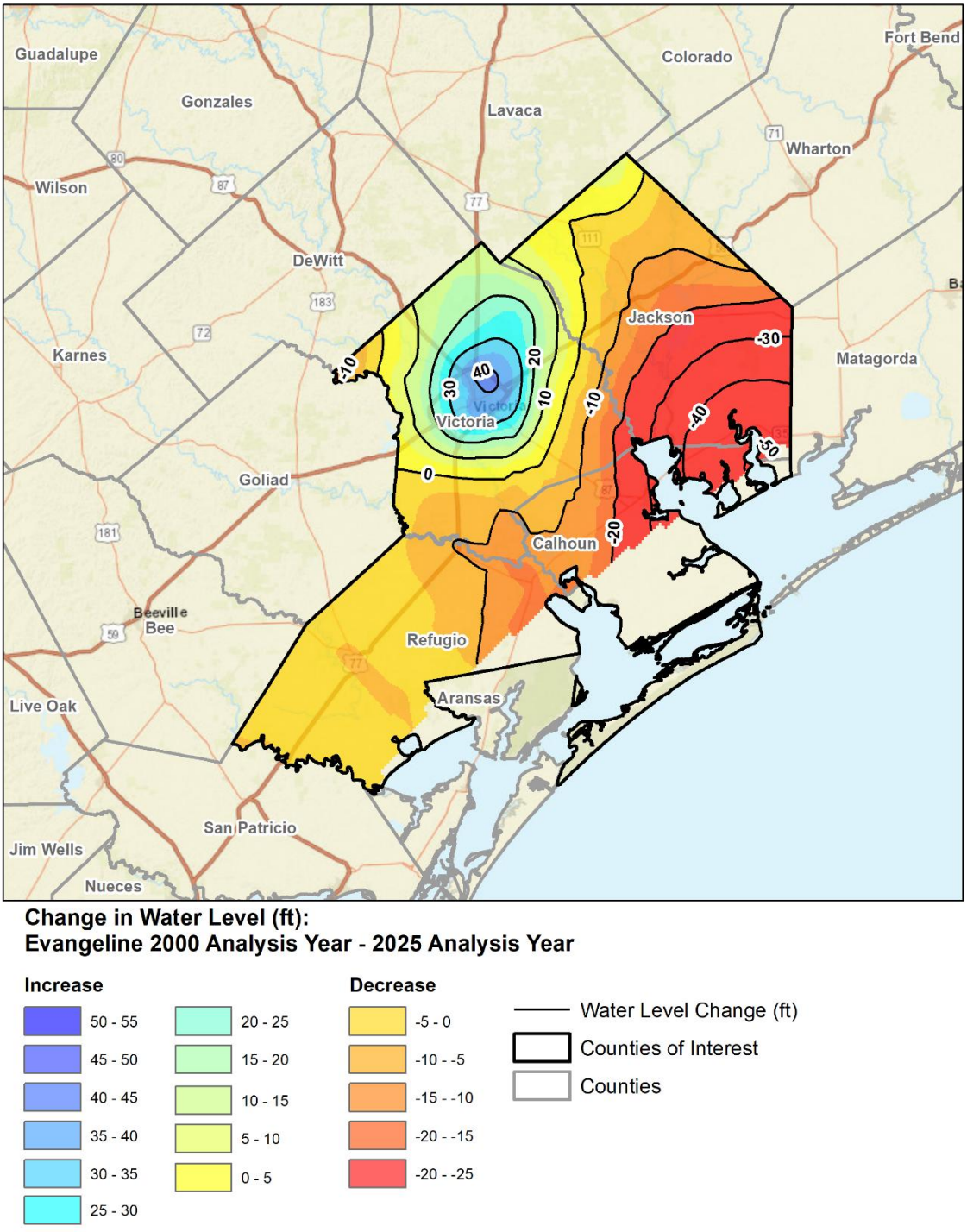


Figure 12 Contours of the change in water levels in the Evangeline Aquifer from the 2000 Analysis Year to the 2025 Analysis Year

Attachment B
Table of Water Levels Used in Analysis Years 2021 through 2025

Response to Questions of Concern

Table 1 was compiled and evaluated to investigate several questions regarding spatial patterns and magnitudes of water-level change observed in previous analyses. The review focused on measured data from Analysis Years 2021 through 2025 and assessed how monitoring density and model detrending may have influenced interpolated results.

Question 1

Why did the 2023 analysis show approximately 20 feet of decline in the Chicot Aquifer in Refugio County?

The mapped results for 2023 indicate an area of approximately 20 feet of decline in the Chicot Aquifer within Refugio County. Review of the measured water levels confirms that some wells in Refugio County exhibit a decreasing trend over recent years; however, the magnitude of measured decline does not fully support the extent of change shown on the interpolated surface.

This discrepancy is most likely attributable to the spatial and temporal distribution of pumping represented in the underlying GAM simulation used for detrending. Because the SSWL+KR method relies on residuals calculated relative to the smoothed simulated water-level surface, any misrepresentation of pumping patterns in the model can influence the magnitude and spatial expression of the kriged residuals. In areas with moderate monitoring density, localized residual patterns may amplify model-driven artifacts, resulting in contour magnitudes that exceed the observed well-level trends.

Question 2

Why are water-level declines observed in the Evangeline Aquifer near the intersection of Jackson and Calhoun Counties?

Evaluation of the compiled dataset indicates that no Evangeline water-level measurements were available in Calhoun County for any of the analysis years reviewed (2021–2025), and historical coverage in that aquifer has also been limited. Without direct monitoring control in Calhoun County, the SSWL+KR process cannot calculate local residuals to correct the regional trend represented by the smoothed GAM surface.

As a result, the interpolated water-level surface in this area is driven primarily by:

- The regional simulated trend from the GAM; and
- Residuals calculated from wells located in adjacent counties.

If pumping is inaccurately distributed within the model in this region, those errors are not effectively corrected in areas lacking monitoring wells. Consequently, the observed declines near the Jackson–Calhoun boundary likely reflect limitations in both monitoring density and pumping representation within the model rather than confirmed measured declines within Calhoun County itself.

Question 3

Why don’t the rasters cover the southern half of Calhoun County for the Evangeline Aquifer?

The model does not simulate Evangeline Aquifer there so there is no data to detrend in these parts. See the water level contour figures in the above analysis. In light gray is the extent of each aquifer in the GAM.

Questions 4

Why were relatively large Evangeline changes observed in Calhoun County and in Jackson County in 2018?

These questions are addressed by the same underlying data limitation identified in Question 2.

- **Calhoun County:** No Evangeline monitoring wells were available to constrain the interpolation.
- **Jackson County:** Monitoring density was limited (approximately four wells during 2021–2025), resulting in sparse spatial control.

Where monitoring density is low, detrending and kriging are less able to correct for potential inaccuracies in the regional simulated pumping distribution. In these areas, interpolation artifacts and model-driven residual patterns may become more pronounced, leading to mapped changes that exceed what can be directly confirmed from measured data.

Table 1 List of Wells and Water Levels Used to Generate the Water Levels Surfaces for the Chicot and the Evangeline aquifers for Analysis Years 2021 through 2025.

GCD Well ID	SWN	Land Surface Elevation (ft)	Number Observations	X Coordinate (EPSG: 10481)	Y Coordinate (EPSG: 10481)	County	Assigned Unit	2021 WL (famsl)	2022 WL (famsl)	2023 WL (famsl)	2024 WL (famsl)	2025 WL (famsl)
	7964701	3.3	1	5851373.017	18521824.54	Aransas	Chicot		7.1	1.1	2.3	-2.0
	8049702	6.6	1	5892009.945	18562939.8	Aransas	Chicot		3.7	2.0	1.7	1.0
Calhoun County GCD - GW-00001	8027302	16.4	1	5991911.186	18739720.36	Calhoun	Chicot				-6.1	-4.4
Calhoun County GCD - GW-00001		16.4	4	5991910.701	18739720.4	Calhoun	Chicot	-3.4	1.4	-5.3		
Calhoun County GCD - GW-00003		32.8	1	5962449.707	18724077.11	Calhoun	Chicot	16.3	21.5	17.9	17.5	16.3
Calhoun County GCD - GW-00005		16.4	1	6057654.554	18765891.28	Calhoun	Chicot	-11.7	-16.8	-17.1	-18.4	-19.4
Calhoun County GCD - GW-00009	8026501	36.1	4	5946727.647	18715821.74	Calhoun	Chicot	3.5	7.0	4.9		
Calhoun County GCD - GW-00009		36.1	1	5946667.866	18715854.35	Calhoun	Chicot				6.9	1.5
Calhoun County GCD - GW-00014	8019503	26.2	2	5978895.412	18761233.37	Calhoun	Chicot	8.4	10.0	5.7		
Calhoun County GCD - GW-00092		16.4	1	5980700.091	18703019.58	Calhoun	Chicot				-3.2	-3.2
Calhoun County GCD - NW-00024	8021512	16.4	1	6057948.556	18764966.73	Calhoun	Chicot				-19.8	-19.8
Calhoun County GCD - NW-00024		16.4	3	6057948.407	18764966.77	Calhoun	Chicot	-11.3	-17.4	-18.2		
Texana GCD - NW-00762		13.1	1	6066416.661	18767369.16	Calhoun	Chicot				-46.9	
	8019507	23.0	1	5980282.618	18763042.08	Calhoun	Chicot				3.4	
	8027302	16.4	6	5991911.186	18739720.36	Calhoun	Chicot	-3.4		-5.7		
	6614703	259.2	1	6072226.873	19170190.71	Colorado	Chicot	234.5	239.6	234.2	234.2	234.1
	6637607	160.8	1	6059602.652	19049939.81	Colorado	Chicot	123.4	121.8	122.7	122.7	122.4
	6637615	157.5	4	6061205.538	19042884.25	Colorado	Chicot	121.1	122.4	118.4		
	7931502	108.3	1	5817681.641	18716912.63	Goliad	Chicot	68.7	65.6	67.8	67.8	67.8
	7931702	98.4	1	5804062.066	18702007.88	Goliad	Chicot	75.1	75.5	74.7	74.7	73.9
	7937912	85.3	1	5759652.331	18657347.1	Goliad	Chicot	48.7	57.3	55.7	55.2	
	7937918	88.6	1	5762827.757	18658938.93	Goliad	Chicot	52.4	52.7	45.8	45.8	
	7938201	118.1	1	5781467.527	18692654.87	Goliad	Chicot	87.6	79.4	81.5	81.5	81.3
	7938202	101.7	1	5784027.609	18682705.42	Goliad	Chicot	71.2	69.2	71.7	71.7	70.2
	7938301	88.6	1	5796293.988	18684421.31	Goliad	Chicot	65.8	66.0	64.9	64.9	65.6
	7938303	101.7	179	5798699.968	18692195.75	Goliad	Chicot	76.3	76.3	75.3	75.1	75.0
	7938704	78.7	4	5766222.124	18658817.25	Goliad	Chicot	50.2	53.0	43.4		
	7939104	88.6	1	5805191.966	18692428.64	Goliad	Chicot	63.1	66.0	63.1	63.1	63.5
Texana GCD - GW-00090		9.8	1	6084103.509	18776239	Jackson	Chicot					-55.8
Texana GCD - GW-00091		9.8	1	6084719.212	18776461.57	Jackson	Chicot					-57.1
Texana GCD - GW-00119	8021214	23.0	1	6056887.325	18781847.63	Jackson	Chicot			-19.5		
Texana GCD - GW-00123	8021213	19.7	1	6058360.264	18783466.29	Jackson	Chicot			-24.6		

GCD Well ID	SWN	Land Surface Elevation (ft)	Number Observations	X Coordinate (EPSG: 10481)	Y Coordinate (EPSG: 10481)	County	Assigned Unit	2021 WL (famsl)	2022 WL (famsl)	2023 WL (famsl)	2024 WL (famsl)	2025 WL (famsl)
Texana GCD - GW-00244		59.1	1	6056319.623	18884717.68	Jackson	Chicot				42.9	34.4
Texana GCD - GW-00247		62.3	1	6053458.53	18888167.73	Jackson	Chicot				37.4	37.2
Texana GCD - GW-00251	6661809	62.3	2	6057434.527	18891432.4	Jackson	Chicot	33.2		34.2		
Texana GCD - GW-00251		62.3	1	6057434.394	18891432.56	Jackson	Chicot					33.3
Texana GCD - GW-00284	8011502	39.4	1	5981625.725	18819358.84	Jackson	Chicot					10.7
Texana GCD - GW-00284		39.4	1	5981885.275	18819449.22	Jackson	Chicot	11.4		11.4		
Texana GCD - GW-00285	8011201	49.2	2	5983004.154	18832654.55	Jackson	Chicot	14.2	17.4	16.2		
Texana GCD - GW-00291	8004504	49.2	1	6023006.661	18866156.51	Jackson	Chicot	11.0	14.8	23.2	20.5	21.1
Texana GCD - GW-00310		13.1	1	6060513.624	18783341.78	Jackson	Chicot			-29.0		
Texana GCD - GW-00311		13.1	1	6052577.917	18779638.67	Jackson	Chicot			-25.7		
Texana GCD - GW-00312		16.4	1	6054803.921	18782811.61	Jackson	Chicot			-21.8		
Texana GCD - GW-00320	8004101	65.6	2	6004036.506	18876903.41	Jackson	Chicot	40.4		36.7		
Texana GCD - GW-00410	802904	52.5	1	5952710.105	18847845.7	Jackson	Chicot	18.5		19.1		
Texana GCD - GW-00410		55.8	1	5952730.94	18847869.9	Jackson	Chicot				24.7	24.1
Texana GCD - GW-00411	8002608	59.1	4	5956995.414	18850095.31	Jackson	Chicot	25.1		25.3		
Texana GCD - GW-00411		59.1	1	5957013.705	18850090.8	Jackson	Chicot				24.2	26.3
Texana GCD - GW-00446		13.1	1	6088011.725	18774049.43	Jackson	Chicot		-34.0	-46.4	-49.4	
Texana GCD - GW-00566		45.9	1	6033295.104	18860439.37	Jackson	Chicot		34.7	31.3	33.3	30.0
Texana GCD - NW-00075	8022407	9.8	1	6086947.351	18776099.94	Jackson	Chicot					-55.6
Texana GCD - NW-00140		13.1	1	6087062.821	18775630.35	Jackson	Chicot					-52.6
Texana GCD - NW-00195		52.5	1	5963117.572	18850902.84	Jackson	Chicot	20.3	25.4	19.6		
Texana GCD - NW-00310		88.6	1	5955473.505	18902363.12	Jackson	Chicot	47.0	49.9	45.9	47.0	48.1
Texana GCD - NW-00451		13.1	1	6088067.115	18772901.36	Jackson	Chicot	-33.0	-32.3	-51.0	-51.0	
Texana GCD - NW-00487		9.8	6	6087813.442	18770099.55	Jackson	Chicot	-6.9		-9.0	-9.4	-7.4
Texana GCD - NW-00488		9.8	6	6087799.767	18770090.71	Jackson	Chicot				-60.3	-65.6
Texana GCD - NW-00489		6.6	6	6082613.047	18769810.71	Jackson	Chicot	-10.4		-12.7	-13.3	-10.7
Texana GCD - NW-00490		6.6	6	6082488.732	18769672.54	Jackson	Chicot	-39.7		-47.8	-59.5	-64.1
Texana GCD - NW-00491		9.8	6	6077158.575	18769296.97	Jackson	Chicot	-6.4		-8.6	-9.0	-8.2
Texana GCD - NW-00492		9.8	6	6077134.284	18769279.22	Jackson	Chicot	-34.0		-42.1	-52.6	-54.4
Texana GCD - NW-00750		29.5	1	6080324.928	18824730.22	Jackson	Chicot				-66.5	
Texana GCD - NW-00751		68.9	1	6062157.206	18895479.68	Jackson	Chicot				29.9	
Texana GCD - NW-00759		23.0	1	6095994.896	18810605.49	Jackson	Chicot				-47.0	
Texana GCD - NW-00760		16.4	1	6073447.701	18816567.06	Jackson	Chicot				-33.6	
Texana GCD - NW-00761		124.7	1	5962601.475	18949236.69	Jackson	Chicot				55.7	
Texana GCD - NW-00785		29.5	1	6056837.515	18788502.59	Jackson	Chicot				-12.5	
Texana GCD - NW-00786		59.1	1	5980828.882	18851941.48	Jackson	Chicot				-2.9	
	6658607	88.6	4	5955472.948	18902363.42	Jackson	Chicot	47.0		46.4		

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	8003405	52.5	2	5963117.343	18850902.72	Jackson	Chicot	20.3		19.6		
	8011502	39.4	2	5981625.725	18819358.84	Jackson	Chicot	11.4		11.4		
	8021616	9.8	2	6077160.066	18769298.17	Jackson	Chicot	-5.8		-7.3		
	8022410	9.8	2	6087810.707	18770096.46	Jackson	Chicot	-5.9		-9.5		
	8022412	6.6	2	6082612.561	18769810.37	Jackson	Chicot	-9.2		-10.6		
	6643704	137.8	1	5967240.228	18980535.75	Lavaca	Chicot	109.7	113.2	109.4	109.2	109.1
	6549901	55.8	6	6230061.499	18942351.78	Matagorda	Chicot		24.6	20.9	20.4	
	6557802	49.2	6	6219418.964	18899243.41	Matagorda	Chicot		-2.7	-15.4	-15.8	
	6664401	68.9	1	6160776.466	18906953.11	Matagorda	Chicot	-10.0	-13.1	-24.3	-24.3	
	8007203	52.5	183	6143994.133	18884507.04	Matagorda	Chicot	-17.2	-11.8	-41.7	-42.4	-33.8
	8007312	49.2	1	6152653.899	18877926	Matagorda	Chicot	-29.8	-22.2	-33.3		-36.2
	8008106	49.2	1	6159940.879	18877674.74	Matagorda	Chicot	34.2		34.2	34.9	33.6
	8008504	49.2	1	6176109.668	18872274.29	Matagorda	Chicot	0.0	-31.1	-44.2	-44.2	-43.4
	8008505	45.9	1	6172160.52	18871233.55	Matagorda	Chicot	42.2		40.5	42.4	39.8
	8014801	13.1	1	6102738.157	18800830.93	Matagorda	Chicot	-9.2	-3.6	-14.5	-17.6	-20.9
	8014903	9.8	4	6118841.322	18799150.3	Matagorda	Chicot		-31.6	-54.6	-63.4	
	8015301	26.2	6	6153771.251	18833134.28	Matagorda	Chicot		6.2	-1.5	-1.2	
	8015405	29.5	1	6130067.603	18816834.25	Matagorda	Chicot	-36.4		-38.2		-54.6
	8015502	19.7	6	6146809.079	18818624.39	Matagorda	Chicot	-38.1	-26.5	-36.1	-37.3	
	8024201	6.6	1	6180466.903	18784693.96	Matagorda	Chicot	-3.8	3.8	-4.4	-5.6	-3.5
	8024406	3.3	1	6167321.865	18771551.13	Matagorda	Chicot	-32.9	-28.4	-35.5	-37.5	-38.1
	8024601	3.3	1	6190489.65	18772919.87	Matagorda	Chicot					-8.8
	8024802	3.3	1	6180793.792	18765481.19	Matagorda	Chicot	-25.8	-26.6	-31.5	-34.2	-31.8
	8101102	49.2	1	6206145.409	18881248.16	Matagorda	Chicot				-46.0	
	8101205	32.8	6	6223727.844	18876224.6	Matagorda	Chicot		-24.0	-36.8	-37.6	
	8102404	29.5	1	6249975.431	18874671.68	Matagorda	Chicot	-19.6	-21.0	-26.9	-27.0	-27.3
	8102605	23.0	6	6276665.867	18870928.85	Matagorda	Chicot		-10.0	-14.5	-15.1	
	8102901	13.1	1	6267894.448	18847112.47	Matagorda	Chicot	-24.1	-23.2	-19.5	-18.7	-17.5
	8103406	26.2	1	6281487.122	18869263.76	Matagorda	Chicot	-13.8	-14.2	-14.0	-14.7	-13.8
	8111901	3.3	1	6318467.483	18810818.38	Matagorda	Chicot	-16.1	-16.5	-17.6	-17.9	-24.6
	8117405	3.3	1	6213794.743	18768895.57	Matagorda	Chicot	-20.6	-18.5	-22.5		-21.8
Refugio GCD - GW-00079	7954803	32.8	4	5788400.26	18565322.7	Refugio	Chicot			11.1		
Refugio GCD - GW-00079		32.8	1	5788400.544	18565322.23	Refugio	Chicot				12.4	9.9
Refugio GCD - GW-00152	7932803	75.5	2	5859118.467	18700082.36	Refugio	Chicot				42.6	
Refugio GCD - GW-00234	7932802	72.2	1	5869035.161	18706009.41	Refugio	Chicot	24.7	25.4	23.8	24.7	14.3
Refugio GCD - GW-00439	8033901	19.7	6	5915666.984	18651560.7	Refugio	Chicot	5.5		5.5		
Refugio GCD - GW-00439		19.7	1	5915671.437	18651595.75	Refugio	Chicot				6.0	5.2

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Refugio GCD - NW-00474		82.0	1	5816148.317	18685825.82	Refugio	Chicot					50.7
Refugio GCD - NW-00539		29.5	1	5924352.26	18668867.35	Refugio	Chicot	4.5	5.9	3.4	3.5	3.6
Refugio GCD - NW-00570	8034709	23.0	1	5928362.769	18656774.27	Refugio	Chicot				-0.1	-0.3
Refugio GCD - NW-00570		23.0	4	5928363.346	18656773.92	Refugio	Chicot	0.4	3.5	-1.9		
Refugio GCD - NW-00672		68.9	1	5787015.581	18636971.96	Refugio	Chicot				13.6	
Refugio GCD - NW-00686		88.6	1	5770068.193	18633299.7	Refugio	Chicot				37.6	
Refugio GCD - NW-00690		39.4	1	5788241.63	18615869.45	Refugio	Chicot				4.4	
Refugio GCD - NW-00695		65.6	1	5785817.305	18649589.89	Refugio	Chicot				32.6	
Refugio GCD - NW-00696		29.5	1	5842864.979	18607719.92	Refugio	Chicot				-0.5	
Refugio GCD - NW-00697		62.3	1	5872955.093	18691167.14	Refugio	Chicot				0.3	
	8033611	29.5	6	5924354.516	18668876.37	Refugio	Chicot	4.5		3.9		
	8034709	23.0	6	5928362.769	18656774.27	Refugio	Chicot	0.4		-2.1		
	7960104	88.6	134	5698116.234	18550806.75	San Patricio	Chicot					63.0
	8303506	91.9	1	5672900.246	18492149.5	San Patricio	Chicot				23.7	23.7
Victoria County GCD - GW-000001		88.6	1	5865111.826	18799324.8	Victoria	Chicot					50.8
Victoria County GCD - GW-000021	6657801	124.7	6	5904636.096	18893727.26	Victoria	Chicot		85.8	82.0		
Victoria County GCD - GW-000021		124.7	1	5904613.228	18893776.14	Victoria	Chicot				85.6	
Victoria County GCD - GW-000138		128.0	1	5878025.893	18842542.95	Victoria	Chicot				48.4	46.8
Victoria County GCD - GW-000150	8010502	55.8	4	5943861.16	18806815.19	Victoria	Chicot	29.4	33.0	26.6		
Victoria County GCD - GW-000150		55.8	1	5943903.2	18806836.81	Victoria	Chicot					28.4
Victoria County GCD - GW-000158		187.0	1	5813419.576	18847271.27	Victoria	Chicot				111.5	109.1
Victoria County GCD - GW-000159		173.9	1	5815326.612	18847326.94	Victoria	Chicot				94.3	92.7
Victoria County GCD - GW-000192	8018103	52.5	6	5934175.219	18775580.34	Victoria	Chicot	23.1		24.1		
Victoria County GCD - GW-000192		52.5	1	5933986.071	18775735.18	Victoria	Chicot				24.4	24.4
Victoria County GCD - GW-000227		52.5	1	5933035.071	18775137.97	Victoria	Chicot				22.5	27.2
Victoria County GCD - GW-000271		114.8	1	5854399.848	18821200.07	Victoria	Chicot				65.9	51.7
Victoria County GCD - GW-000377	8002804	62.3	1	5944472.34	18844064.74	Victoria	Chicot	39.9	33.8	31.8	31.9	24.3
Victoria County GCD - GW-000489	8018402	55.8	4	5932192.858	18760855.67	Victoria	Chicot	22.8	24.6	21.8		
Victoria County GCD - GW-000489		55.8	1	5932162.674	18760778.02	Victoria	Chicot				22.6	22.2
Victoria County GCD - GW-000492		52.5	1	5890901.822	18714776.65	Victoria	Chicot				9.7	8.3
Victoria County GCD - GW-000544		91.9	1	5836822.759	18838077.27	Victoria	Chicot					57.2
Victoria County GCD - GW-000562		82.0	1	5932542.662	18866159.64	Victoria	Chicot				39.7	38.7
Victoria County GCD - GW-000583		23.0	1	5883277.419	18703750.62	Victoria	Chicot				16.7	
Victoria County GCD - GW-000587		134.5	1	5849141.864	18849421.15	Victoria	Chicot				71.5	77.5
Victoria County GCD - GW-000588		200.1	1	5793673.118	18826566.57	Victoria	Chicot					105.2
Victoria County GCD - GW-000606		183.7	1	5856867.428	18865149.39	Victoria	Chicot				91.0	
Victoria County GCD - GW-000607		108.3	1	5864683.974	18832525.08	Victoria	Chicot				59.9	59.0

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Victoria County GCD - GW-000608	7915903	121.4	1	5834887.21	18789166.21	Victoria	Chicot	79.6	80.4	76.6	76.3	75.6
Victoria County GCD - GW-000609		98.4	1	5835360.258	18777848.87	Victoria	Chicot				63.0	59.3
Victoria County GCD - GW-000611	7924102	95.1	6	5853905.733	18772769.33	Victoria	Chicot		45.4	41.4		
Victoria County GCD - GW-000611		95.1	1	5853824.569	18772834.92	Victoria	Chicot				41.0	
Victoria County GCD - GW-000614		118.1	1	5908426.081	18875613.14	Victoria	Chicot					63.6
Victoria County GCD - GW-000735		118.1	1	5908451.641	18875581.07	Victoria	Chicot	56.4		48.6		73.7
Victoria County GCD - GW-000989		55.8	1	5922368.254	18777520.85	Victoria	Chicot				31.2	31.1
Victoria County GCD - NW-000779	8025402	62.3	1	5884446.006	18719892.1	Victoria	Chicot				16.6	16.1
Victoria County GCD - NW-000779		62.3	2	5884445.927	18719891.07	Victoria	Chicot	17.7		16.1		
Victoria County GCD - NW-001253		49.2	1	5932217.816	18774341	Victoria	Chicot				25.4	
	8025402	62.3	4	5884446.006	18719892.1	Victoria	Chicot	17.4		21.9		
	6541401	88.6	1	6198256.727	18995950.09	Wharton	Chicot	56.0	56.1	52.3	51.0	53.2
	6541402	82.0	1	6203539.476	18999077.92	Wharton	Chicot	33.9	34.2	30.9	29.8	31.6
	6541707	82.0	1	6205759.858	18989136.63	Wharton	Chicot	23.2	30.1	21.0		20.1
	6631107	154.2	182	6122179.874	19103703	Wharton	Chicot	114.6	120.1	99.5	102.1	104.3
	6631504	137.8	1	6132547.061	19085146.19	Wharton	Chicot	99.7	102.0	92.9	91.5	92.0
	6632809	118.1	1	6171485.592	19076993.61	Wharton	Chicot	72.3	72.9	69.9	68.9	69.9
	6638202	150.9	1	6093611.984	19053361.81	Wharton	Chicot	122.0	125.2	115.9	114.3	113.5
	6638304	150.9	1	6100084.854	19053365.73	Wharton	Chicot	110.9	112.5	109.0	108.1	106.3
	6638801	124.7	1	6097280.11	19031607.62	Wharton	Chicot	98.0	101.2	95.3	94.9	94.7
	6639106	144.4	38	6121378.25	19063400.46	Wharton	Chicot	91.5	94.0	82.7		
	6639801	111.5	1	6134553.263	19025937.14	Wharton	Chicot	72.0	79.9	67.4	67.4	67.1
	6640401	111.5	6	6155759.048	19049810.16	Wharton	Chicot	65.1	64.1	57.2	55.6	
	6640505	108.3	38	6168424.948	19053801.07	Wharton	Chicot	70.2	76.2	66.5		
	6645601	141.1	6	6065663.092	19003942.01	Wharton	Chicot	92.0	95.5	89.2	87.3	
	6645916	128.0	1	6070130.383	18986272.42	Wharton	Chicot	76.2	79.1	74.0	73.4	74.0
	6646201	141.1	1	6090538.293	19016977.77	Wharton	Chicot	92.2	97.1	91.3	91.3	91.3
	6646402	131.2	1	6083253.374	18996116.7	Wharton	Chicot	78.9	78.8	76.5	76.6	77.1
	6646601	128.0	1	6100968.889	19005917.5	Wharton	Chicot	81.0	85.6	79.3	79.1	79.4
	6647101	121.4	1	6121878.439	19007333.23	Wharton	Chicot	72.2	72.4	69.6	68.7	
	6647201	114.8	1	6131293.736	19013830.77	Wharton	Chicot	66.0	70.3	60.9	59.5	59.4
	6647703	108.3	1	6120387.622	18983595.31	Wharton	Chicot	74.6	77.9	73.7	74.4	
	6647904	95.1	1	6145183.102	18980517.7	Wharton	Chicot	36.5	43.1	31.1	31.1	
	6648502	91.9	6	6172114.129	19007159.5	Wharton	Chicot	74.3	77.3	72.0	71.5	
	6648701	95.1	6	6167462.346	18988671.46	Wharton	Chicot	61.7	64.6	60.9	60.8	
	6648802	91.9	1	6173494.703	18985747.34	Wharton	Chicot	53.0	54.7	51.0	50.8	51.2
	6648907	88.6	1	6193433.15	18980084.43	Wharton	Chicot	26.1	29.2	20.5	20.7	23.0

GCD Well ID	SWN	Land Surface Elevation (ft)	Number Observations	X Coordinate (EPSG: 10481)	Y Coordinate (EPSG: 10481)	County	Assigned Unit	2021 WL (famsl)	2022 WL (famsl)	2023 WL (famsl)	2024 WL (famsl)	2025 WL (famsl)
	6648908	88.6	1	6191979.556	18983575.02	Wharton	Chicot	61.9	63.9	61.3	61.3	61.3
	6648909	88.6	1	6191979.556	18983575.02	Wharton	Chicot				22.5	24.6
	6652603	105.0	1	6029944.114	18953203.32	Wharton	Chicot	39.2	40.0	38.2	38.2	
	6653406	98.4	79	6036420.73	18950512.02	Wharton	Chicot	36.0	48.4	33.9	31.5	
	6653503	91.9	2	6058869.823	18948659.59	Wharton	Chicot	43.3	46.1	42.8		
	6653804	85.3	1	6051880.184	18929103.87	Wharton	Chicot	37.7	41.8	42.6	41.9	42.9
	6654108	98.4	1	6088646.644	18961475.3	Wharton	Chicot	51.0	55.6	48.2	47.5	47.5
	6654906	88.6	1	6112212.761	18932202.79	Wharton	Chicot	18.4	20.2	12.4	14.9	11.7
	6655603	82.0	6	6149516.077	18960305.59	Wharton	Chicot	65.4	73.6	63.3	62.7	
	6656302	85.3	1	6191165.679	18964413.37	Wharton	Chicot	0.0	15.1	7.9	6.0	15.8
	6656304	88.6	6	6189340.54	18978215.94	Wharton	Chicot		38.3	28.3	26.6	
	6656403	78.7	6	6157041.492	18950243.82	Wharton	Chicot	29.3	33.2	21.6	16.1	
	6661302	82.0	159	6066066.68	18923387.85	Wharton	Chicot	28.6	33.1	24.4	26.0	27.1
	6661305	78.7	1	6066476.616	18921680.66	Wharton	Chicot	36.0	41.9	35.1	35.1	36.2
	6662104	85.3	1	6088853.659	18923122.59	Wharton	Chicot	33.3	39.3	33.3	32.6	32.8
	6662307	85.3	1	6114430.596	18921650.54	Wharton	Chicot	57.2	60.6	58.0	58.0	58.2
	6662309	82.0	6	6110449.803	18916152.05	Wharton	Chicot	47.1	50.1	46.2	45.2	
	6662313	82.0	1	6109788.591	18928406.53	Wharton	Chicot	3.7		0.3	-0.2	-1.4
	6663105	78.7	1	6126817.093	18919743.76	Wharton	Chicot	0.0		60.5		61.4
	6663507	68.9	1	6131081.958	18906530.07	Wharton	Chicot	60.0	59.6	58.8	60.1	58.4
	6663509	62.3	1	6143136.039	18903525.44	Wharton	Chicot	-18.5	-13.1	-26.5	-27.0	-28.9
	7917801	498.7	4	5588244.058	18749581.47	Bee	Evangeline	433.4		433.9		
	7925506	357.6	1	5588531.994	18705815.3	Bee	Evangeline				315.9	314.6
	7934202	367.5	1	5622966.876	18682494.9	Bee	Evangeline				227.3	
	7934409	337.9	165	5611873.1	18666690.77	Bee	Evangeline				202.7	202.2
	7935101	259.2	1	5653850.936	18675987.78	Bee	Evangeline					192.1
	7935305	223.1	1	5678784.836	18682716.41	Bee	Evangeline	163.5	167.6	165.0	164.5	162.9
	7942213	272.3	1	5626138.388	18643518.71	Bee	Evangeline				201.1	199.2
	7942703	242.8	1	5613291.981	18608678.97	Bee	Evangeline				176.9	176.2
	7943903	134.5	1	5675083.986	18603841.03	Bee	Evangeline				86.3	
	7944103	150.9	1	5694551.945	18639705.47	Bee	Evangeline	94.7	103.9	96.6		94.2
	6612204	315.0	1	6006651.686	19197891.07	Colorado	Evangeline				279.2	278.8
	6612603	292.0	1	6017965.978	19175508.14	Colorado	Evangeline	201.4	203.0	200.6	200.6	200.7
	6619804	347.8	1	5971828.084	19115859.93	Colorado	Evangeline	278.7	280.2	276.0	274.9	277.5
	6619904	331.4	182	5980068.273	19120713.03	Colorado	Evangeline				187.9	188.2
	6620602	200.1	1	6018373.354	19139235.28	Colorado	Evangeline	152.7		145.1		142.9
	6620901	242.8	1	6021363.335	19116718.14	Colorado	Evangeline					171.4

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	6621603	232.9	1	6063695.902	19127747.32	Colorado	Evangeline	167.4	173.0	162.7	161.2	
	6622201	223.1	1	6086651.313	19149302.71	Colorado	Evangeline	182.6	192.6	181.9		180.0
	6626202	252.6	1	5926215.532	19095570.03	Colorado	Evangeline	199.8	207.8	198.7	198.7	
	6628702	249.3	1	6005623.182	19069861.89	Colorado	Evangeline	171.0	177.4	167.4	167.4	169.6
	6644702	137.8	1	6004466.608	18984090.16	Colorado	Evangeline	42.2	56.8	36.5	31.6	42.1
Pecan Valley GCD - PV-04114		272.3	2	5823932.366	18947025.39	DeWitt	Evangeline		176.6	226.3		
	6755606	262.5	1	5825873.241	18949665.14	DeWitt	Evangeline				217.1	216.9
	6755803	219.8	1	5813221.433	18924993.51	DeWitt	Evangeline				206.9	205.1
	6760905	318.2	2	5707380.304	18880588.7	DeWitt	Evangeline	249.4	238.4	231.7		
	6762404	262.5	6	5763216.587	18900796.04	DeWitt	Evangeline		217.5	210.0		
	6763703	187.0	1	5807430.478	18886276.33	DeWitt	Evangeline				122.6	118.8
	7905507	232.9	1	5745464.836	18851246.81	DeWitt	Evangeline				210.6	206.4
	7906206	239.5	1	5775930.765	18862246.15	DeWitt	Evangeline				171.9	
	7906306	229.7	1	5795317.061	18875270.1	DeWitt	Evangeline	150.7	153.6	150.7	149.6	148.3
	7906707	200.1	1	5769491.407	18842468.74	DeWitt	Evangeline	150.7	154.2	150.7	151.8	148.7
	7906708	216.5	1	5770808.023	18843107.1	DeWitt	Evangeline	151.1	156.2	150.6	151.2	149.3
	7906714	200.1	1	5769969.115	18841063.85	DeWitt	Evangeline		152.8	152.6	153.2	
	7907402	226.4	1	5805258.779	18857306.29	DeWitt	Evangeline			118.9	119.0	
Refugio GCD - NW-00692		108.3	1	5778636.897	18681961.45	Goliad	Evangeline				76.3	
	7905606	200.1	1	5748885.986	18846532.42	Goliad	Evangeline	182.9	181.1	178.2	176.8	178.3
	7905903	216.5	1	5758981.754	18836350.31	Goliad	Evangeline		166.2	164.2	163.0	163.1
	7905904	196.9	1	5759231.133	18837064.56	Goliad	Evangeline	171.0	173.1	169.5	168.8	168.5
	7905905	216.5	1	5758086.957	18836632.85	Goliad	Evangeline	165.0	165.3	163.7	162.4	162.4
	7905907	232.9	1	5759363.093	18835246.6	Goliad	Evangeline	165.5	168.5	164.6	163.1	162.8
	7905908	269.0	1	5756474.593	18833458.72	Goliad	Evangeline	186.5	192.1	188.2	187.3	
	7905909	255.9	1	5757738.031	18834115.57	Goliad	Evangeline	183.8	185.7	182.8	182.8	182.3
	7906706	219.8	1	5764635.626	18833854.54	Goliad	Evangeline	162.7	165.6	164.0	165.7	159.9
	7906715	239.5	1	5767659.38	18829981.4	Goliad	Evangeline	182.4	180.1	176.2	175.5	
	7912305	301.8	1	5716644.99	18819591.94	Goliad	Evangeline	215.5		212.4	211.5	210.3
	7912602	285.4	4	5713614.173	18800203.44	Goliad	Evangeline	187.9	187.2	184.7		
	7912704	265.7	4	5685566.058	18791702.1	Goliad	Evangeline	204.7		202.8		
	7913223	236.2	1	5744686.193	18817198.96	Goliad	Evangeline	190.0	183.9	180.7	181.4	180.0
	7913224	232.9	1	5742449.535	18817854.92	Goliad	Evangeline	220.3		214.7	214.0	212.3
	7913225	229.7	1	5742447.187	18817956.11	Goliad	Evangeline		182.6	178.1	175.9	174.5
	7913229	229.7	1	5739395.352	18819301.51	Goliad	Evangeline	172.0	177.4	169.0	167.9	169.0
	7913230	249.3	1	5734969.879	18822436.47	Goliad	Evangeline		173.1	169.8	168.1	167.3
	7913231	232.9	1	5743786.346	18817683.86	Goliad	Evangeline			215.9	215.3	213.4

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	7913304	242.8	1	5745429.62	18827230.67	Goliad	Evangeline	170.6	173.3	167.9	166.2	165.9
	7913507	282.2	1	5739647.837	18812226.32	Goliad	Evangeline	169.4		168.9	167.9	167.6
	7913510	282.2	1	5747120.15	18800463.58	Goliad	Evangeline			154.6	154.6	
	7913512	269.0	1	5743029.818	18812001.24	Goliad	Evangeline	169.8	171.2	165.1	165.1	163.9
	7913513	292.0	1	5745568.95	18801150.67	Goliad	Evangeline	161.5		158.0	156.3	154.8
	7913515	295.3	1	5738914.509	18813119.77	Goliad	Evangeline				165.3	
	7913803	255.9	1	5740711.821	18789289.08	Goliad	Evangeline		186.3	186.9	186.2	185.9
	7913804	242.8	1	5741490.594	18790217.47	Goliad	Evangeline			144.5	142.7	143.2
	7913805	288.7	1	5747159.404	18791158.46	Goliad	Evangeline	195.5	191.0	193.5	194.2	191.7
	7913806	236.2	1	5742412.123	18788822.72	Goliad	Evangeline	152.9		149.0	147.9	148.0
	7913807	269.0	1	5743394.441	18788643.19	Goliad	Evangeline		183.1	188.5	188.6	186.9
	7913808	255.9	1	5743911.221	18789363.27	Goliad	Evangeline	152.5		149.0	147.8	147.4
	7913809	252.6	1	5742383.99	18790035.86	Goliad	Evangeline			151.8	150.0	149.9
	7913810	265.7	1	5742989.677	18790757.96	Goliad	Evangeline	189.9	183.3	189.3	189.7	187.6
	7913811	229.7	1	5740608.938	18789893.58	Goliad	Evangeline	184.9	180.3	183.5	183.0	182.2
	7913813	272.3	1	5745012.457	18791715.33	Goliad	Evangeline	190.6	189.6	189.5	189.6	188.0
	7914105	187.0	1	5771106.461	18823513.8	Goliad	Evangeline				147.1	
	7914203	170.6	1	5784394.855	18817538.36	Goliad	Evangeline	122.6	124.1	119.7	117.9	
	7914604	200.1	1	5795259.877	18805352.25	Goliad	Evangeline				108.3	
	7914903	200.1	1	5789282.857	18791118.18	Goliad	Evangeline				124.1	
	7915401	177.2	1	5806221.318	18808163.77	Goliad	Evangeline	99.0	91.9	98.8	98.1	
	7915402	187.0	1	5801194.044	18807886.66	Goliad	Evangeline				101.2	
	7915702	141.1	1	5812434.957	18794359.83	Goliad	Evangeline	89.4	88.8	87.3	86.4	
	7919511	239.5	1	5665504.156	18764155.13	Goliad	Evangeline				179.4	
	7920305	226.4	1	5712262.325	18773166.62	Goliad	Evangeline				150.6	
	7920704	229.7	4	5687643.797	18751734.84	Goliad	Evangeline		164.0	164.9		
	7920705	259.2	4	5683861.494	18747447.98	Goliad	Evangeline		171.2	170.3		
	7921307	206.7	1	5761017.143	18776716.42	Goliad	Evangeline	132.4	135.4	129.1	129.7	
	7921503	236.2	1	5740937.398	18762239.44	Goliad	Evangeline				121.6	
	7921607	190.3	1	5757904.887	18757829.63	Goliad	Evangeline				114.5	
	7921608	196.9	1	5757544.935	18758147.82	Goliad	Evangeline				139.2	
	7922508	154.2	1	5777868.449	18764071.85	Goliad	Evangeline	96.9	95.7	93.6	92.1	
	7922604	147.6	1	5797946.873	18760659.66	Goliad	Evangeline				78.6	82.8
	7923703	114.8	1	5810803.645	18745730.32	Goliad	Evangeline				73.8	73.8
	7927202	305.1	1	5666978.766	18733759.33	Goliad	Evangeline	213.1		212.9	213.2	211.8
	7928302	213.3	1	5722141.731	18726055.36	Goliad	Evangeline	132.6	136.0	132.3	131.9	131.8
	7928303	223.1	1	5719192.545	18726090	Goliad	Evangeline	133.5	126.5	132.3	131.9	

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	7928304	236.2	1	5719471.553	18728574.06	Goliad	Evangeline	127.4	126.6	125.7	124.9	124.9
	7929302	177.2	1	5751915.51	18724863.04	Goliad	Evangeline				88.9	93.2
	7930301	114.8	1	5802056.693	18732501.08	Goliad	Evangeline	73.2	69.8	70.4	69.7	70.6
	7937911	82.0	1	5758933.945	18657532.41	Goliad	Evangeline	45.4	51.9	45.4	44.9	
	7937919	85.3	1	5762208.125	18658722.04	Goliad	Evangeline	43.2	45.1	45.4	45.4	
	7938706	75.5	1	5765836.16	18656280.12	Goliad	Evangeline	50.9	48.8	47.4	47.4	
Texana GCD - GW-00278	6660613	62.3	2	6033810.071	18897966.46	Jackson	Evangeline	12.5		20.0		
Texana GCD - GW-00278		62.3	1	6033784.059	18897992.71	Jackson	Evangeline				-8.2	-5.5
Texana GCD - GW-00294	6651505	124.7	2	5977947.093	18956868.8	Jackson	Evangeline	45.3	55.4	44.2		
Texana GCD - GW-00444		13.1	1	6088356.45	18774052.25	Jackson	Evangeline		-33.4	-40.9	-48.5	-55.1
	6633905	210.0	1	5908114.458	19023554.2	Lavaca	Evangeline				169.0	168.5
	6634201	193.6	1	5933719.186	19049932.98	Lavaca	Evangeline	169.9	174.4	169.6	170.1	169.4
	6634202	206.7	1	5931836.103	19049189.45	Lavaca	Evangeline	172.6		171.5	171.4	171.0
	6634207	226.4	1	5939639.746	19054849.36	Lavaca	Evangeline	176.1	177.5	174.9	174.8	173.4
	6635901	210.0	1	5981361.693	19025695.66	Lavaca	Evangeline	142.8		141.1	140.4	141.8
	6641203	223.1	1	5890038.379	19014343.34	Lavaca	Evangeline	176.2	184.7	175.5	175.5	175.3
	6641703	219.8	1	5878642.034	18972449.62	Lavaca	Evangeline	152.7	154.8	151.6	151.2	151.4
	6641903	206.7	1	5909797.01	18973925.52	Lavaca	Evangeline	120.2	118.8	118.9	118.2	119.7
	6643801	150.9	1	5978943.028	18980688.91	Lavaca	Evangeline					64.2
	6643803	150.9	1	5978121.568	18980556.94	Lavaca	Evangeline	58.2	68.5	53.6	51.2	57.7
	6644402	160.8	1	5996118.753	18999623.99	Lavaca	Evangeline	71.8	88.5	59.2	59.2	
	6649701	170.6	1	5887970.644	18936520.58	Lavaca	Evangeline	117.1	118.2	117.3	117.6	117.6
	6649901	170.6	1	5905505.203	18939146.01	Lavaca	Evangeline	105.1	105.2	108.6	108.7	108.7
	6740301	278.9	1	5872546.276	19054023.88	Lavaca	Evangeline	264.4	272.1	265.3	265.3	264.4
	6740504	351.0	4	5857247.286	19040850.76	Lavaca	Evangeline	279.0	289.9	278.1		
	8007102	55.8	1	6121250.178	18880083.72	Matagorda	Evangeline	17.5	25.5	17.6	14.9	11.3
Refugio GCD - GW-00124	7931901	85.3	2	5840659.786	18703644.83	Refugio	Evangeline	46.6	54.5	43.6		
Refugio GCD - NW-00691		82.0	1	5778904.002	18663205.12	Refugio	Evangeline				49.0	
	7957608	131.2	1	5603508.017	18533335.32	San Patricio	Evangeline				82.6	78.2
	7958201	157.5	1	5622727.348	18545099.39	San Patricio	Evangeline				72.5	71.6
Victoria County GCD - GW-000047	7916102	124.7	2	5840900.711	18831506.51	Victoria	Evangeline	68.7	75.1	70.6		
Victoria County GCD - GW-000047		124.7	1	5840867.308	18831536.7	Victoria	Evangeline					68.1
Victoria County GCD - GW-000158	7907504	183.7	6	5813410.536	18847292.74	Victoria	Evangeline	113.5		107.0		
Victoria County GCD - GW-000321	8017502	65.6	183	5898363.869	18763672.73	Victoria	Evangeline	33.2		32.6	32.1	32.0
Victoria County GCD - GW-000339	6657406	180.4	2	5882490.042	18902628.4	Victoria	Evangeline	86.0	90.3	82.0		
Victoria County GCD - GW-000366	8002102	91.9	1	5925448.322	18869724.66	Victoria	Evangeline	35.4		35.5	37.4	36.1
Victoria County GCD - GW-000494	7915305	177.2	6	5833240.564	18825440.9	Victoria	Evangeline	71.9	85.3	83.5		

GCD Well ID	SWN	Land Surface Elevation (ft)	Number Observations	X Coordinate (EPSG: 10481)	Y Coordinate (EPSG: 10481)	County	Assigned Unit	2021 WL (famsl)	2022 WL (famsl)	2023 WL (famsl)	2024 WL (famsl)	2025 WL (famsl)
Victoria County GCD - GW-000494		173.9	1	5833206.571	18825404.96	Victoria	Evangeline				80.2	67.4
Victoria County GCD - GW-000552	7907505	157.5	4	5820506.333	18847573.79	Victoria	Evangeline	97.5	98.7	93.0		
Victoria County GCD - GW-000552		160.8	1	5820536.5	18847614.23	Victoria	Evangeline				95.4	95.1
Victoria County GCD - GW-000577	7908404	144.4	1	5848863.919	18849621.77	Victoria	Evangeline	87.4	95.3	91.9	88.9	87.8
Victoria County GCD - GW-000578	7908403	134.5	1	5848780.437	18849417.07	Victoria	Evangeline	88.0	94.0	87.1	87.1	85.1
Victoria County GCD - GW-000589	7908807	108.3	1	5856941.199	18836277.76	Victoria	Evangeline	62.4	79.0	62.5	59.9	
Victoria County GCD - GW-000601	7916702	101.7	2	5853390.534	18795717.78	Victoria	Evangeline	55.7	56.9	69.5		
Victoria County GCD - GW-000601		101.7	1	5853385.148	18795787.81	Victoria	Evangeline				69.5	
Victoria County GCD - GW-000602	7916701	101.7	1	5853411.826	18794909.15	Victoria	Evangeline	56.2	60.2	53.4	53.4	55.7
Victoria County GCD - GW-000603	7916703	105.0	1	5853471.277	18794009.97	Victoria	Evangeline	56.6		49.6		
Victoria County GCD - GW-000603		105.0	1	5853471.277	18794009.97	Victoria	Evangeline				49.6	56.3
Victoria County GCD - GW-000606	7908201	183.7	4	5856888.131	18865110.88	Victoria	Evangeline	92.2		90.9		
Victoria County GCD - GW-000607	7908805	108.3	6	5864678.96	18832537.48	Victoria	Evangeline	58.3	62.5	58.8		
Victoria County GCD - GW-000609	7923303	98.4	6	5835357.168	18777848.91	Victoria	Evangeline	63.7	62.6	61.5		
Victoria County GCD - GW-000614	8001301	118.1	2	5908423.048	18875619.63	Victoria	Evangeline	43.8		57.5		
Victoria County GCD - GW-000778		91.9	1	5924953.02	18871339.72	Victoria	Evangeline			37.9		
Victoria County GCD - NW-000016	7907503	170.6	4	5813866.971	18846798.37	Victoria	Evangeline	102.5		97.6		
Victoria County GCD - NW-000016		170.6	1	5813867.202	18846798.33	Victoria	Evangeline				92.8	102.7
Victoria County GCD - NW-000097	7907707	183.7	2	5804088.79	18840179.6	Victoria	Evangeline			102.2		
Victoria County GCD - NW-000426	7907404	229.7	1	5809823.691	18848720.06	Victoria	Evangeline	101.2		98.7	100.6	
	7916603	62.3	1	5875662.766	18807338.17	Victoria	Evangeline				6.9	13.6
	6654622	98.4	1	6108756.769	18955871.73	Wharton	Evangeline				20.5	22.8
	6663610	68.9	1	6154729.457	18909654.1	Wharton	Evangeline	-19.2		-22.4	-25.1	-30.4

Table 4 Average annual water level (ft, msl) and change in the average annual water level for Refugio County for the Chicot Aquifer, the Evangeline Aquifer and the Chicot & Evangeline aquifers

Aquifer	Water Level/ Change	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Chicot	avg. WL (ft)	24.8	23.6	28.3	27.2	24.5	28.3	24.6	27.4	29.0	24.3	22.7	23.5	23.0	19.4	4.5	14.5	19.6	19.2	19.0	20.0	18.4	14.9	19.6	17.3	15.5	18.5
	change (ft)*	0.0	-1.2	3.6	2.5	-0.2	3.5	-0.1	2.6	4.3	-0.5	-2.1	-1.2	-1.8	-5.4	-20.2	-10.3	-5.2	-5.6	-5.8	-4.8	-6.4	-9.9	-5.2	-7.5	-9.3	-6.3
Evangeline	avg. WL (ft)	32.5	31.7	34.2	39.8	37.9	40.7	38.3	35.4	31.2	31.7	21.7	31.6	33.1	27.0	23.9	22.3	24.6	30.4	20.5	28.2	30.9	24.6	28.3	24.1	21.1	27.7
	change (ft)*	0.0	-0.8	1.6	7.2	5.3	8.1	5.8	2.8	-1.3	-0.9	-10.8	-1.0	0.5	-5.5	-8.6	-10.3	-7.9	-2.2	-12.0	-4.3	-1.7	-7.9	-4.2	-8.4	-11.4	-4.8
Chicot & Evangeline	avg. WL (ft)	26.3	25.4	29.1	31.0	28.8	31.8	28.9	29.0	28.5	26.1	20.7	25.6	25.8	21.4	11.9	16.7	20.4	22.8	18.6	22.4	22.6	17.8	22.2	19.0	18.1	22.7
	change (ft)*	0.0	-0.9	2.8	4.7	2.5	5.6	2.6	2.7	2.2	-0.1	-5.5	-0.7	-0.5	-4.9	-14.4	-9.5	-5.8	-3.5	-7.7	-3.9	-3.7	-8.4	-4.1	-7.3	-8.2	-3.6

* change is measured relative to the year 2000; avg WL is measured relative to mean sea level

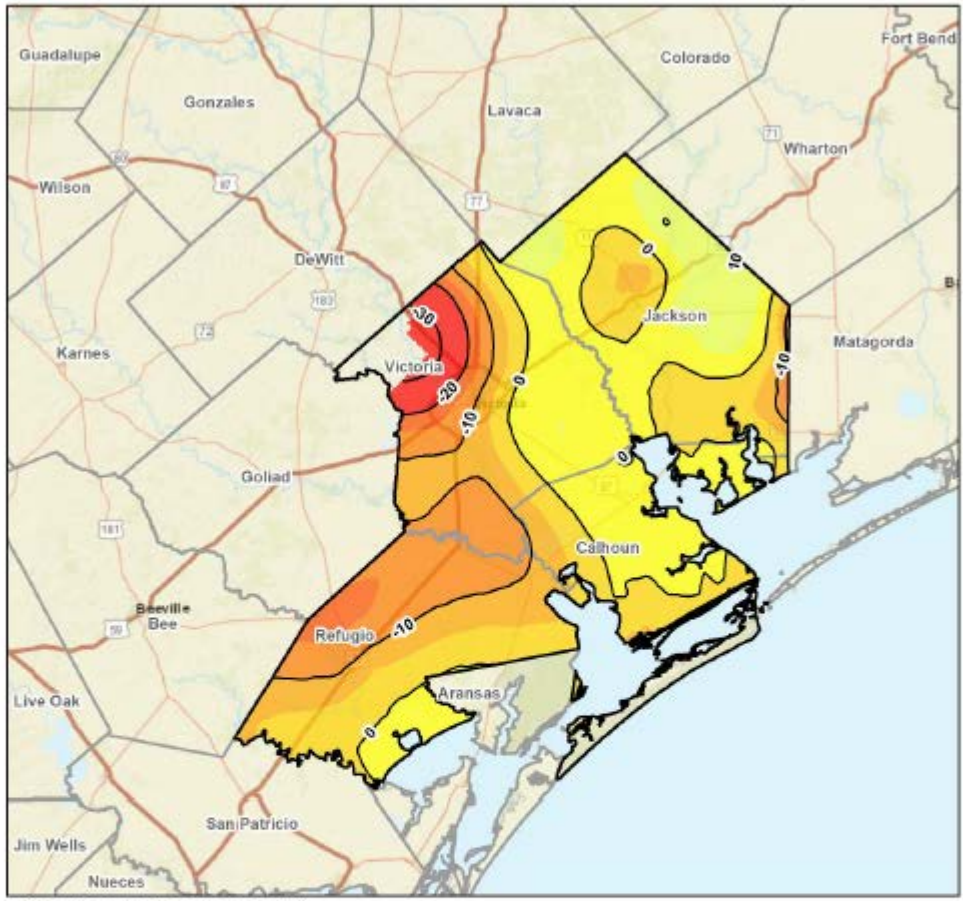


Figure 7 Contours of the change in water levels in the Chicot Aquifer from the 2000 Analysis Year to the 2025 Analysis Year

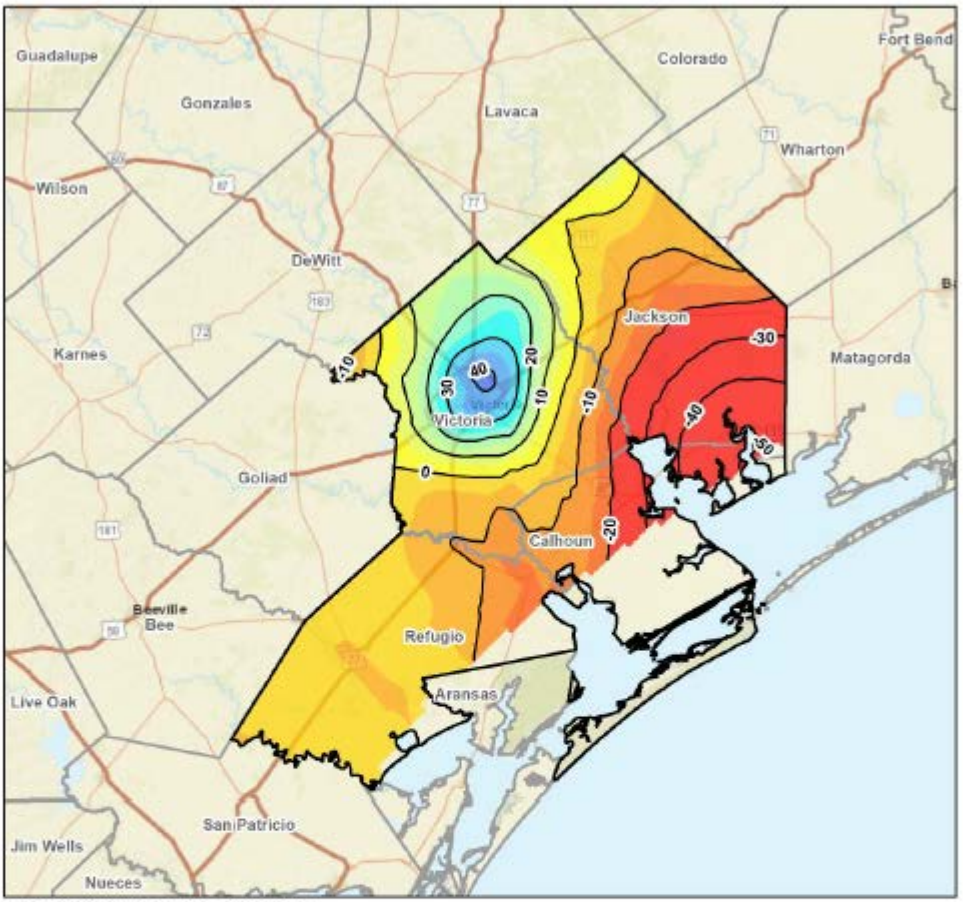


Figure 12 Contours of the change in water levels in the Evangeline Aquifer from the 2000 Analysis Year to the 2025 Analysis Year

OUTDOOR TIPS

Plant water-efficient, well-adapted, and/or native shrubs, trees, and grasses. Choose plants that are drought and heat tolerant and can survive the minimum winter temperatures in your area. In odd-shaped areas, use drought-tolerant groundcover instead of grass. Many cities provide lists of water-efficient plants.

Don't abuse the benefits of an automatic sprinkler system by over-watering. Set it to provide thorough but infrequent watering. Check sprinkler heads regularly to make sure they are working properly. Install rain shut-off devices and adjust sprinklers to eliminate coverage on pavement. For plants that need more water, use a hose or watering can to give them additional water.

Prevent evaporation of water. Water lawns early in the morning. Never water on windy days. Use drip irrigation systems for bedded plants, trees, or shrubs and use low-angle sprinklers for lawns. Cover pools and spas. This can save the equivalent of your pool volume each year!

Harvest the rain. Buy a rain barrel or a cistern and collect the water from your gutters to water your plants.

Use your water efficiently. Don't waste water by cleaning patios or sidewalks with it; use a broom.

Taller grass holds moisture better. Don't cut more than one-third of its length at one time. Don't scalp lawns when mowing during hot weather. Leave lawn clippings on the lawn instead of bagging.

Use lots of mulch around your shrubs and trees. It will retain moisture, reduce run-off, moderate soil temperatures, and help with weed control.

Don't over-fertilize! Get a soil kit to determine what nutrients your soil needs. If you apply fertilizer only in the spring and fall, your grass will be healthy, use less water, and require less mowing.

Use a car wash that recycles water. If you are washing your car at home, use a bucket of soapy water and a hose nozzle that shuts off the water while you scrub.

Did you know that as of September 1, 2013, all Texas homeowners can save water with drought-resistant landscaping? Some homeowner associations may require preliminary approval of any major changes to the landscape, but Senate Bill 198 (83rd Texas Legislature) prohibits an association from restricting a property owner's decision to make water-wise landscape choices.



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Texas Water Development Board
www.twdb.texas.gov

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www.epa.gov/watersense

rev. 05/14

WATER CONSERVING TIPS



USING WATER MORE EFFICIENTLY

will not only save money but, more importantly, will protect the quality of life of current and future Texans.

With the vastness of Texas, it's easy to forget two important facts about our state: we are subject to frequent droughts and our population is projected to nearly double in the next 50 years.

To ensure that we have enough water for current and future Texans, we need to reduce the amount of water we waste. A few small changes in your water use habits can make a huge difference in water savings.

POSSIBLE WATER SAVINGS

- High-efficiency toilets, water-efficient washing machines, rainwater harvesting systems, and water-efficient landscaping can all help reduce household water demands.
- Water-efficient showerheads and aerators for faucets can significantly reduce the amount of water you use. In fact, installing a water-efficient showerhead is one of the most effective water-saving steps you can take inside your house.
- Leaky faucets and toilets can waste thousands of gallons of water monthly, and they are inexpensive to fix.
- Outdoor water use can account for more than 30 percent of total home water use. With proper management, you can have a beautiful, healthy landscape and reduce your water use significantly. This can amount to hundreds of dollars in savings a year in water and wastewater costs.



INDOOR TIPS

Bathroom

- Replace your showerhead with a water-efficient model.
- Get in the shower as soon as the water becomes warm enough.
- Take short showers.
- Reduce the level of water used in a bathtub by half, or better yet, take a short shower.
- Turn off the water while you are shaving. Fill the sink with an inch of hot water instead of letting the water run continuously.
- Replace your old toilet with a high-efficiency toilet that uses 1.3 gallons per flush.
- Check toilets for leaks. Simply take the top off of your toilet tank and add a few drops of food coloring or a dye tablet to the water in the tank. Do not flush the toilet. If the coloring appears in the bowl within a few minutes, the toilet has a leak that most likely can be fixed by replacing the flapper or rubber washer. Cheap fix, huge savings!
- Never use the toilet to dispose of trash.
- Don't waste water when brushing your teeth or washing your hands. Shut off the water until it's time to rinse.
- Look for the WaterSense label when installing or replacing plumbing fixtures. They are tested and certified to perform as well or better than their less efficient counterparts and on average are 20 percent more water efficient.
- The next time you use one of these water-saving tips when you take a shower, wash your hands, brush your teeth, or flush the toilet, congratulate yourself for doing your part to help protect our precious water resources!

Kitchen

- Run the dishwasher only when full. This practice will save water, energy, detergent, and money. If your machine has a quick wash or light duty setting, use it!
- Install faucet aerators. You'll never notice the difference, and you'll cut your sink water consumption in half!
- Dry scrape dishes instead of rinsing. Your dishwasher will take care of the rest.
- Use garbage disposals sparingly. They can waste water unnecessarily.
- Soak pans rather than scrubbing them with the water running.
- Rinse your vegetables in a pan of cold water; it doesn't take gallons of water to get the dirt off.

Laundry room

- Wash only full loads.
- Use the lowest water level setting on the washing machine for light or partial loads whenever possible.
- Use cold water as often as possible to save energy and conserve hot water for uses that cold water cannot serve.
- Conventional washing machines can use up to twice as many gallons of water per load compared to high efficiency machines.

Additional tips

- Don't ignore leaky faucets; they are often easy and inexpensive to repair. Turn off the valve under the sink until you get around to repairing the leak. A slow drip can waste as much as 170 gallons of water each day and will add to your water bill.
- Know where your master water shut-off valve is in case a pipe bursts. Insulate hot water pipes. You won't waste water waiting for it to get hot, and you will save energy.
- Install water-softening systems only when necessary and, if you have one, save water and salt by running the minimum amount of regenerations necessary to maintain water softness.
- Replace water-to-air heat pumps and air conditioners with air-to-air if you are purchasing new units. They are just as efficient and do not waste water.
- Find other uses for water rather than letting it go down the drain. Use a bucket to capture water in the shower or sink while waiting for it to get hot, then use that water on your landscape.



Victoria County Groundwater Conservation District

P.O. Box 69, Victoria, Texas 77902
Phone: (361)579-6863 | Email: admin@vcgcd.org | Website: www.vcgcd.org

April 7, 2026

Victoria County Groundwater Conservation District
P.O. Box 69
Victoria, Texas 77902

RE: Proposed Amended Desired Future Conditions of Groundwater Management Area 15

Victoria County Groundwater Conservation District,

After completing all necessary public notice requirements and a quorum of representatives present, the representatives of Groundwater Management Area 15 (GMA 15) met at the Offices of the Victoria County Groundwater Conservation District on March 12, 2026, at 9:30 AM. During the meeting, the representatives of the member districts considered proposals to amend the Desired Future Conditions (DFC) of relevant aquifers within the management area.

The representatives of the member districts of GMA 15 approved a motion to amend DFC, establish interim DFC values, and approved the plain-language explanations for the proposed changes to the previously adopted DFCs for GMA 15 for distribution to the districts in the management area in accordance with 36.108(d-2) of the Texas Water Code, as follows:

	Identified Interim Values for the Proposed DFCs by Decade					***Proposed DFC*** [Note 1]
	2030	*2040*	*2050*	*2060*	*2070*	*2080*
Bee County	*7 feet of drawdown of the Gulf Coast Aquifer System*	*7 feet of drawdown of the Gulf Coast Aquifer System*	*7 feet of drawdown of the Gulf Coast Aquifer System*	*7 feet of drawdown of the Gulf Coast Aquifer System*	*7 feet of drawdown of the Gulf Coast Aquifer System*	*7 feet of drawdown of the Gulf Coast Aquifer System*
Calhoun County	*5 feet of drawdown of the Gulf Coast Aquifer System*	*5 feet of drawdown of the Gulf Coast Aquifer System*	*5 feet of drawdown of the Gulf Coast Aquifer System*	*5 feet of drawdown of the Gulf Coast Aquifer System*	*5 feet of drawdown of the Gulf Coast Aquifer System*	*5 feet of drawdown of the Gulf Coast Aquifer System*
Colorado County	*17 feet of drawdown of the*	*17 feet of drawdown of the*	*17 feet of drawdown of the*	*17 feet of drawdown of the*	*17 feet of drawdown of the*	*17 feet of drawdown of the*

	Identified Interim Values for the Proposed DFCs by Decade					***Proposed DFC*** [Note 1]
	2030	*2040*	*2050*	*2060*	*2070*	*2080*
	Chicot and Evangeline Aquifers	*Chicot and Evangeline Aquifers*	*Chicot and Evangeline Aquifers*	*Chicot and Evangeline Aquifers*	*Chicot and Evangeline Aquifers*	*Chicot and Evangeline Aquifers*
Colorado County	*25 feet of drawdown of the Jasper Aquifer*	*25 feet of drawdown of the Jasper Aquifer*	*25 feet of drawdown of the Jasper Aquifer*	*25 feet of drawdown of the Jasper Aquifer*	*25 feet of drawdown of the Jasper Aquifer*	*25 feet of drawdown of the Jasper Aquifer*
DeWitt County	*10 feet of drawdown of the Gulf Coast Aquifer System*	*10 feet of drawdown of the Gulf Coast Aquifer System*	*10 feet of drawdown of the Gulf Coast Aquifer System*	*15 feet of drawdown of the Gulf Coast Aquifer System*	*15 feet of drawdown of the Gulf Coast Aquifer System*	*17 feet of drawdown of the Gulf Coast Aquifer System*
Fayette County	*20 ft of drawdown of the Gulf Coast Aquifer System*	*20 ft of drawdown of the Gulf Coast Aquifer System*	*25 ft of drawdown of the Gulf Coast Aquifer System*	*35 ft of drawdown of the Gulf Coast Aquifer System*	*40 ft of drawdown of the Gulf Coast Aquifer System*	*44 feet of drawdown of the Gulf Coast Aquifer System*
Goliad County	*4.875 ft of drawdown of the Chicot Aquifer*	*6.5 ft of drawdown of the Chicot Aquifer*	*8.125 ft of drawdown of the Chicot Aquifer*	*9.75 ft of drawdown of the Chicot Aquifer*	*11.375 ft of drawdown of the Chicot Aquifer*	*13 feet of drawdown of the Chicot Aquifer* [Note 2]
Goliad County	*12.75 ft of drawdown of the*	*17 ft of drawdown of the*	*21.25 ft of drawdown of the*	*25.5 ft of drawdown of the*	*29.75 ft of drawdown of the*	*34 feet of drawdown of the*

	Identified Interim Values for the Proposed DFCs by Decade					***Proposed DFC*** [Note 1]
	2030	*2040*	*2050*	*2060*	*2070*	*2080*
	Evangeline Aquifer	*Evangeline Aquifer*	*Evangeline Aquifer*	*Evangeline Aquifer*	*Evangeline Aquifer*	*Evangeline Aquifer* [Note 2]
Goliad County	*7.875 ft of drawdown of the Burkeville Aquifer*	*10.5 ft of drawdown of the Burkeville Aquifer*	*13.125 ft of drawdown of the Burkeville Aquifer*	*15.75 ft of drawdown of the Burkeville Aquifer*	*18.375 ft of drawdown of the Burkeville Aquifer*	*21 feet of drawdown of the Burkeville Aquifer* [Note 2]
Goliad County	*7.875 ft of drawdown of the Jasper Aquifer*	*10.5 ft of drawdown of the Jasper Aquifer*	*13.125 ft of drawdown of the Jasper Aquifer*	*15.75 ft of drawdown of the Jasper Aquifer*	*18.375 ft of drawdown of the Jasper Aquifer*	*21 feet of drawdown of the Jasper Aquifer* [Note 2]
Goliad County	*10.5 feet of drawdown of the Gulf Coast Aquifer*	*14 feet of drawdown of the Gulf Coast Aquifer*	*17.5 feet of drawdown of the Gulf Coast Aquifer*	*21 feet of drawdown of the Gulf Coast Aquifer*	*24.5 feet of drawdown of the Gulf Coast Aquifer*	*28 feet of drawdown of the Gulf Coast Aquifer* [Note 2]
Jackson County	*15 ft of drawdown of the Gulf Coast Aquifer System*	*15 ft of drawdown of the Gulf Coast Aquifer System*	*15 ft of drawdown of the Gulf Coast Aquifer System*	*15 ft of drawdown of the Gulf Coast Aquifer System*	*15 ft of drawdown of the Gulf Coast Aquifer System*	*15 feet of drawdown of the Gulf Coast Aquifer System*
Karnes County	*22 feet of drawdown of the Gulf Coast*	*22 feet of drawdown of the Gulf Coast*	*22 feet of drawdown of the Gulf Coast*	*22 feet of drawdown of the Gulf Coast*	*22 feet of drawdown of the Gulf Coast*	*22 feet of drawdown of the Gulf Coast*

	Identified Interim Values for the Proposed DFCs by Decade					***Proposed DFC*** [Note 1]
	2030	*2040*	*2050*	*2060*	*2070*	*2080*
	Aquifer System	*Aquifer System*	*Aquifer System*	*Aquifer System*	*Aquifer System*	*Aquifer System*
Matagorda County	*15 feet of drawdown of the Chicot and Evangeline Aquifers*	*15 feet of drawdown of the Chicot and Evangeline Aquifers*	*15 feet of drawdown of the Chicot and Evangeline Aquifers*	*15 feet of drawdown of the Chicot and Evangeline Aquifers*	*15 feet of drawdown of the Chicot and Evangeline Aquifers*	*15 feet of drawdown of the Chicot and Evangeline Aquifers* [Note 3]
Refugio County	*5 ft of drawdown of the Gulf Coast Aquifer System*	*5 ft of drawdown of the Gulf Coast Aquifer System*	*5 ft of drawdown of the Gulf Coast Aquifer System*	*5 ft of drawdown of the Gulf Coast Aquifer System*	*5 ft of drawdown of the Gulf Coast Aquifer System*	*5 feet of drawdown of the Gulf Coast Aquifer System*
Victoria County	*5 ft of drawdown of the Gulf Coast Aquifer System*	*5 ft of drawdown of the Gulf Coast Aquifer System*	*5 ft of drawdown of the Gulf Coast Aquifer System*	*5 ft of drawdown of the Gulf Coast Aquifer System*	*5 ft of drawdown of the Gulf Coast Aquifer System*	*5 feet of drawdown of the Gulf Coast Aquifer System*
Wharton County	*15 feet of drawdown of the Chicot and Evangeline Aquifers*	*15 feet of drawdown of the Chicot and Evangeline Aquifers*	*15 feet of drawdown of the Chicot and Evangeline Aquifers*	*15 feet of drawdown of the Chicot and Evangeline Aquifers*	*15 feet of drawdown of the Chicot and Evangeline Aquifers*	*15 feet of drawdown of the Chicot and Evangeline Aquifers*

Note 1: The basis and explanation for proposing the amended desired future conditions is portions of Groundwater Management Area 15 are not located within a district boundary charged with the

responsibility to regulate groundwater resources. The lack of regulatory authority regarding the spacing of wells and production of groundwater resources in these areas results in the complete inability by a member district of Groundwater Management Area 15 to, individually or collectively, actively manage groundwater resources to achieve any desired future condition encompassing those unregulated areas. Therefore, this proposal for an amended desired future condition eliminates the County-Specific DFCs" for those unregulated areas, Aransas County and Lavaca County, and eliminates the "GMA-Wide DFC Statement" which applies to those unregulated areas.

Note 2: The basis and explanation for proposing the amended desired future conditions is restatement of the conditions for the Chicot, Evangeline, Burkeville, and Jasper Aquifers as future drawdowns of 13, 34, 21, 21 feet, and 28 feet of drawdown collectively in the Gulf Coast Aquifer System, respectively, represents a realistic and achievable management goal that more closely aligns with the goals established through GMA 15 for adjacent districts.

Note 3: The basis and explanation for proposing the amended desired future conditions is increasing the acceptable of groundwater drawdown of the Chicot and Evangeline Aquifers across Matagorda County from 11 feet of drawdown to 15 feet of drawdown may increase the amount of groundwater that could be produced in Matagorda County to meet future water needs while adequately conserving groundwater resources within Matagorda County and Groundwater Management Area 15.

The motion was approved unanimously by the following record vote:

- Lonnie Stewart, Bee Groundwater Conservation District - Aye
- Tim Andruss, Calhoun County Groundwater Conservation District - Aye
- Neil Hudgins, Coastal Bend Groundwater Conservation District - Aye
- Neil Hudgins - Coastal Plains Groundwater Conservation District - Aye
- Ed Griffin, Evergreen Underground Water Conservation District - Aye
- David Van Dresar, Fayette County Groundwater Conservation District - Aye
- Terrell Graham, Goliad County Groundwater Conservation District - Aye
- Cindy Parma, Pecan Valley Groundwater Conservation District - Aye
- Tim Andruss, Refugio Groundwater Conservation District - Aye
- Tim Andruss, Texana Groundwater Conservation District - Aye
- Tim Andruss, Victoria County Groundwater Conservation District - Aye

Representatives of Colorado County Groundwater Conservation District and Corpus Christi Aquifer Storage and Recovery Conservation District were not present.

A copy of the draft explanatory report can be accessed at https://www.vcgcd.org/gma-15-desired-future-conditions-4th-cycle.

If you have any questions regarding this matter, please contact me at your earliest convenience.

Regards,

Tim Andruss
Chair of Groundwater Management Area 15

Refugio Groundwater Conservation District
Meeting Minutes for February 17, 2026

THE STATE OF TEXAS REFUGIO COUNTY

The Board of Directors of the Refugio Groundwater Conservation District convened a meeting at First Baptist Church of Woodsboro Fellowship Hall, 309 Johnson Street, Woodsboro, Texas 78393 at 6:00 PM.

Item 1 - Call the meeting to order and welcome guests.

Staff completed the necessary public notification requirements for the meeting.

Mr. Borden called the meeting to order at 6:01 p.m. and called the roll of representatives:

Precinct 1: Mr. John Snyder, Vice President: Present.
Precinct 2: Mr. Carroll Borden, President: Present.
Precinct 3: Ms. Cynthia Rose, Treasurer: Present.
Precinct 4: Mr. Fredric Biery, Secretary: Present.
At Large: Vacant: .
General Manager: Mr. Tim Andruss: Present.
General Counsel: Mr. James Allison: Absent.

Item 2 - Receive Public Comment

No public comments were offered at the meeting.

Item 3 - Consideration of and possible action on matters related to groundwater management including the efforts and activities of the District regarding permitting, complaints, investigations, violations, and enforcement cases associated with permitting.

Mr. Andruss provided a summary of the rules and regulations for groundwater production permitting, including details regarding high-capacity on-historic use permitting and deep-saline, non-historic-use permitting.

Item 4 - Consideration of and possible action on matters related to groundwater protection including complaints, investigations, violations, and enforcement cases related to groundwater contamination and waste.

Item 5 - Consideration of and possible action on matters related to groundwater monitoring.
Item 6 - Consideration of and possible action on matters related to groundwater conservation.
Item 7 - Consideration of and possible action on matters related to groundwater resource planning including Groundwater Management Area 15 Joint Planning and regional water planning.
Item 8 - Consideration of and possible action on matters related to groundwater policy including the Management Plan of the District and the Rules of the District.
Item 9 - Consideration of and possible action on matters related to administration and management including the minutes of previous meetings, amendments to the annual budget of the district, bank accounts, investments, financial reports of the district, bills and invoices of the district, management goals and objectives of the district, administrative policies, staffing, consultant agreements, interlocal cooperation agreements, and support services provided to and from other groundwater conservation
districts.
Topic 9.1 - Report

Mr. Anduss provided the following information:

Regarding Director Compensation Processing

As of February 13, 2026, staff have processed 21 fees of office payments during FY2026:

1. ACCTP-20251009-01 - $250.00 - Carrol Borden
2. ACCTP 20251009 02 $250.00 John Snyder
3. ACCTP 20251009 03 $250.00 Fredric Biery
4. ACCTP-20251028-01 - $250.00 - Carroll Borden
5. ACCTP-20251028-04 - $250.00 - John Snyder
6. ACCTP 20251117 01 $250.00 Carroll Borden
7. ACCTP 20251117 02 $250.00 John Snyder
8. ACCTP-20251117-03 - $250.00 - Fredric Biery
9. ACCTP-20251117-04 - $250.00 - Cynthia Rose
10. ACCTP 20251216 01 $250.00 C. Borden
11. ACCTP 20251216 02 $250.00 C. Rose
12. ACCTP-20251216-03 - $250.00 - F. Biery
13. ACCTP-20251216-04 - $250.00 - J. Snyder
14. ACCTP 20251216 05 $250.00 C. Borden
15. ACCTP 20260120 01 $250.00 C. Borden
16. ACCTP-20260120-02 - $250.00 - John Snyder

17. ACCTP 20260120 03 $250.00 Fredric Biery
18. ACCTP-20260217-04 - $250.00 - C. Rose
19. ACCTP-20260217-03 - $250.00 - F. Biery
20. ACCTP 20260217 02 $250.00 J. Snyder
21. ACCTP 20260217 01 $250.00 C. Borden

Regarding Public Notice and Meeting Coordination

The next meetings of the Board is scheduled for April 20, 2026, with each meeting to convene at 6:00 PM. Regular meetings will be rescheduled as necessary and special meeting may be scheduled to address unforeseen issues.

Topic 9.2 - Minutes of Previous Meeting

Mr. Andruss provided the following:

The minutes for January 20, 2026, were drafted by the Administrative Coordinator, reviewed by the alternate Administrative Coordinator, and made available to the directors for review prior to the meeting. The minutes appear to accurately reflect the actions taken by the board and the context which those actions were taken. The minutes for the previous meeting were sent to the board members prior to the meeting.

Board Action: Mr. Borden moved to accept and approve the meeting minutes for January 20, 2026, as drafted. Mr. Biery seconded the motion. The motion passed unanimously.

Topic 9.3 - Financial Transaction Report

Mr. Andruss explained that as of February 17, 2026, and since January 1, 2026, there have been 11 accounts payable transactions and 7 accounts receivable transactions recorded.

Topic 9.6 - Unpaid Invoices and Bills

Mr. Andruss provided the following:

The District has outstanding accounts payable invoices that are NOT considered regular and routine for which the District has received the goods and services billed for under the invoices.

Board Action: Ms. Rose moved to authorize the general manager to pay the following items:

1. ACCTP-20260217-01 - $250.00 - C. Borden - February Board Meeting
2. ACCTP 20260217 02 $250.00 J. Snyder February Board Meeting
3. ACCTP 20260217 03 $250.00 F. Biery February Board Meeting
4. ACCTP-20260217-04 - $250.00 - C. Rose - February Board Meeting

Mr. Borden seconded the motion. The motion passed unanimously.

Topic 9.7 - Review of Administrative Policies

Mr. Andruss provided the following items:

In order to ensure that the bylaws of the District conform with relevant statutes and present practices of the District, management has drafted certain revisions to the previously adopted bylaws of the District in consultation with legal counsel of the District. The revisions (1) remove superfluous or repetitive material or (2) revise the provisions of the Bylaws to conform to Chapter 36, Water Code, or current district policies.

Board Action: Mr. Borden moved to adopt the following policies as the administrative policies of the District, as presented: By Laws. Mr. Snyder seconded the motion. The motion passed unanimously.

Item 10.0 - Consideration of and possible action on matters related to legal counsel report.

This item was not discussed or acted upon during the meeting.

Item 11.0 - Adjourn

Board Action: Mr. Borden moved to adjourn the meeting at approximately 7:13 p.m. after concluding all business of the District. Mr. Biery seconded the motion. The motion passed unanimously.

THE ABOVE AND FOREGOING MINUTES WERE READ AND APPROVED ON THIS THE _____ DAY OF A.D. .

_____ Director of the Refugio Groundwater Conservation District

ATTEST:

_____ Director of the Refugio Groundwater Conservation District

Refugio Groundwater Conservation District

INVESTMENT REPORT

Reporting Period: January 2026

This report has been prepared by the investment officer of the district in accordance with the Public Funds Investment Act (PFIA), Texas Government Code, Section 2256.023 and the investment policy of the district.

Detailed Description of Investment Position - PFIA 2256.023(b)(1)

The investment position of the District during the reporting period was limited to:

1) cash deposited into a demand deposit account for the purpose of holding monies of the Operating Fund and Reserve Fund,
2) cash deposited into time deposits (certificates of deposit) for the purpose of holding monies of the Reserve Fund, and
3) cash deposited into a pooled group fund (Texas Local Government Investment Pool) for the purpose of holding monies of the Reserve Fund.

During the reporting period, the District deposited cash in an interest-bearing, demand deposit account at Vantage Bank Texas (Account Number**: DDA-1658**) for the purpose of holding monies of the Operating Fund and Reserve Fund, receiving tax deposits from the tax assessor-collector, receiving interest deposits of the account, receiving deposits of district fees, and paying bills and invoices of the District.

During the reporting period, the District deposited cash in an interest-bearing, pooled fund account at the Texas Local Government Investment Pool (Account Number**: PGFA-9982**) for the purpose of holding monies of the Operating Fund and Reserve Fund and receiving interest deposits of the account.

Refugio Groundwater Conservation District

INVESTMENT REPORT

Reporting Period: January 2026

Summary of Pooled Fund Groups – PFIA 2256.023(b)(4)

Beginning Market Value of Investments in Pooled Fund Groups:	$1,390,438.06
Total Deposits in Pooled Fund Groups:	$100,000.00
Total Withdrawals in Pooled Fund Groups:	$0.00
Fully Accrued Interest of Investments in Pooled Fund Groups:	$4,583.35
Ending Market Value of Investments in Pooled Fund Groups:	**$1,495,021.41**

Book and Market Values by Asset Type and Fund Type Statement – PFIA 2256.023(b)(5-7)

Asset Type	Asset	Fund Types	Yield / Rate	Maturity Date	Book Value	Market Value
Demand Deposit Account	Vantage Bank Texas – DDA-1658	Operating and Reserve	0.1000%	N/A	$43,710.06	$43,710.06
Time Deposit Account			0.0		0.0	0.0
Pooled Group Fund	TexPool – PGFA-9982	Reserve	3.72%	1/31/2026	1,495,021.41	1,495,021.41
				Totals:	**$1,538,731.47**	**$1,538,731.47**

Refugio Groundwater Conservation District

INVESTMENT REPORT

Reporting Period: January 2026

Summary of Insurance and Collateral by Institution

Depository Institution: **Vantage Bank**

Type of Coverage	Investment Type	Coverage Amount	Total Deposits	Uninsured Deposits
FDIC Deposit Insurance	Demand Deposit Accounts	$250,000.00	$43,710.06	0.0
FDIC Deposit Insurance	Time Deposit Accounts	0.00	0.00	0.0
		Totals:	**$43,710.06**	**0.0**

Type of Coverage	Investment Type	Coverage Amount	Total Uninsured Deposits	Uncollateralized Deposits
Pledged Collateral	Deposit Accounts	$1,500,000.000	$0.00	**$0.00**

Depository Institution: **TexPool**

Type of Coverage	Investment Type	Coverage Amount	Total Deposits	Uninsured Deposits
FDIC Deposit Insurance	Pooled Group Fund	N/A	$1,495,021.41	$1,495,021.41

Type of Coverage	Investment Type	Coverage Amount	Total Uninsured Deposits	Uncollateralized Deposits
Pledged Collateral	Deposit Accounts	$0.00	$1,495,021.41	$1,495,021.41

Refugio Groundwater Conservation District

INVESTMENT REPORT

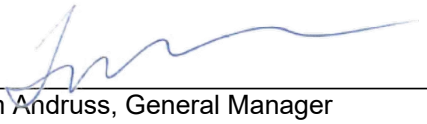
Reporting Period: January 2026

Statement of Compliance – PFIA 2256.0023(b)(8)

The investment portfolio of the district complies with the investment strategy of the district as expressed in the investment policy of the district. The investment portfolio of the district complies with the Public Funds Investment Act.

Statement regarding Report Preparation – PFIA 2256.0023(b)(2-3)

By my signature, I represent that 1) this report was written under my direct supervision; 2) I have thoroughly reviewed all the information contained within and used to develop this report; and 3) I believe this report to be true and correct to the best of my knowledge.



Tim Andruss, General Manager

3/3/2026

Date

Refugio Groundwater Conservation District

INVESTMENT REPORT

Reporting Period: February 2026

This report has been prepared by the investment officer of the district in accordance with the Public Funds Investment Act (PFIA), Texas Government Code, Section 2256.023 and the investment policy of the district.

Detailed Description of Investment Position - PFIA 2256.023(b)(1)

The investment position of the District during the reporting period was limited to:

1) cash deposited into a demand deposit account for the purpose of holding monies of the Operating Fund and Reserve Fund,
2) cash deposited into time deposits (certificates of deposit) for the purpose of holding monies of the Reserve Fund, and
3) cash deposited into a pooled group fund (Texas Local Government Investment Pool) for the purpose of holding monies of the Reserve Fund.

During the reporting period, the District deposited cash in an interest-bearing, demand deposit account at Vantage Bank Texas (Account Number: **DDA-11658**) for the purpose of holding monies of the Operating Fund and Reserve Fund, receiving tax deposits from the tax assessor-collector, receiving interest deposits of the account, receiving deposits of district fees, and paying bills and invoices of the District.

During the reporting period, the District deposited cash in an interest-bearing, pooled fund account at the Texas Local Government Investment Pool (Account Number: **PGFA-79982**) for the purpose of holding monies of the Operating Fund and Reserve Fund and receiving interest deposits of the account.

Refugio Groundwater Conservation District

INVESTMENT REPORT

Reporting Period: February 2026

Summary of Pooled Fund Groups – PFIA 2256.023(b)(4)

Beginning Market Value of Investments in Pooled Fund Groups:	$1,495,021.41
Total Deposits in Pooled Fund Groups:	$0.00
Total Withdrawals in Pooled Fund Groups:	$0.00
Fully Accrued Interest of Investments in Pooled Fund Groups:	$4,221.12
Ending Market Value of Investments in Pooled Fund Groups:	**$1,499,242.53**

Book and Market Values by Asset Type and Fund Type Statement – PFIA 2256.023(b)(5-7)

Asset Type	Asset	Fund Types	Yield / Rate	Maturity Date	Book Value	Market Value
Demand Deposit Account	Vantage Bank Texas 11658	Operating and Reserve	0.1000%	N/A	$80,479.75	$80,479.75
Pooled Group Fund	TexPool – 79982	Operating and Reserve	3.68%	N/A	$1,499,242.53	$1,499,242.53
				Totals:	**$1,579,722.28**	**$1,579,722.28**

Refugio Groundwater Conservation District

INVESTMENT REPORT

Reporting Period: February 2026

Summary of Insurance and Collateral by Institution

Depository Institution: **Prosperity Bank**

Type of Coverage	Investment Type	Coverage Amount	Total Deposits	Uninsured Deposits
FDIC Deposit Insurance	Demand Deposit Accounts	$250,000.00	$80,479.75	$0.00
		Totals:	**$80,479.75**	**$0.00**

Type of Coverage	Investment Type	Coverage Amount	Total Uninsured Deposits	Uncollateralized Deposits
Pledged Collateral	Deposit Accounts	$1,500,000.000	$0.00	**$0.00**

Depository Institution: **TexPool**

Type of Coverage	Investment Type	Coverage Amount	Total Deposits	Uninsured Deposits
FDIC Deposit Insurance	Pooled Group Fund	N/A	$1,499,242.53	$1,499,242.53

Type of Coverage	Investment Type	Coverage Amount	Total Uninsured Deposits	Uncollateralized Deposits
Pledged Collateral	Deposit Accounts	$0.00	$1,499,242.53	$1,499,242.53

Refugio Groundwater Conservation District

INVESTMENT REPORT

Reporting Period: February 2026

Statement of Compliance – PFIA 2256.0023(b)(8)

The investment portfolio of the district complies with the investment strategy of the district as expressed in the investment policy of the district. The investment portfolio of the district complies with the Public Funds Investment Act.

Statement regarding Report Preparation – PFIA 2256.0023(b)(2-3)

By my signature, I represent that 1) this report was written under my direct supervision; 2) I have thoroughly reviewed all the information contained within and used to develop this report; and 3) I believe this report to be true and correct to the best of my knowledge.

Tim Andruss, General Manager

4/8/2024
Date

Refugio Groundwater Conservation District

Internal Financial Report

Reporting Period: January 2026

Note: reports developed using cash-basis accounting.
Tab: Report Cover

Sheet Index

Account	Institution	Fund	Account Type	Statement Reconciliation ID	Reported Ending Balance	Reported Yield / Rate
11658	Vantage Bank	Operating	Demand Deposit Account	11658 : AS-20260130-01: DATE: 01/30/2026	$ 43,710.06	0.1000%
79982	TexPool	Reserve	Pooled Group Fund	79982 : AS-20260131-01: DATE: 01/31/2026	$ 1,495,021.41	3.7200%
Total					**$ 1,538,731.47**	

Note: reports developed using cash-basis accounting.
Tab: Latest Account Balances

Sheet Index

Institution	Type	CUSIP	Description	Safekeeping Location	Safekeeping Receipt	Credit Rating	Market Value
Vantage Bank	FDIC Insurance - Demand De	N/A	N/A	N/A		N/A	$ 250,000.00
Vantage Bank	Letter of Credit		LOC 2901001698	FHLB-Dallas		N/A	$ 1,500,000.00
Total							**$ 1,750,000.00**

Note: reports developed using cash-basis accounting.
Tab: FDIC and Collateral

Sheet Index

	Sum of Budget Amount
Budget Adoption	**$ (956,100.00)**
Reserve	$ (713,700.00)
Operating	$ (242,400.00)
Grand Total	**$ (956,100.00)**

Note: reports developed using cash-basis accounting.
Tab: Budget Summary - Fund

Sheet Index

		Sum of Budget Amount
Budget Adoption	**$**	**(956,100.00)**
Reserve	**$**	**(713,700.00)**
1000 - Administration	$	242,800.00
3000 - Groundwater Management	$	(111,500.00)
4000 - Groundwater Monitoring	$	(645,000.00)
8000 - Groundwater Resource Planning	$	(200,000.00)
Operating	**$**	**(242,400.00)**
1000 - Administration	$	(74,800.00)
2000 - Groundwater Conservation	$	(16,300.00)
3000 - Groundwater Management	$	(21,300.00)
4000 - Groundwater Monitoring	$	(53,800.00)
5000 - Groundwater Policy	$	(21,800.00)
6000 - Groundwater Protection	$	(21,800.00)
7000 - Groundwater Research	$	(15,800.00)
8000 - Groundwater Resource Planning	$	(16,800.00)
Grand Total	**$**	**(956,100.00)**

Note: reports developed using cash-basis accounting.
Tab: Budget Summary - Program

Sheet Index

	Sum of Budget Amount
Budget Adoption	**$ (956,100.00)**
Reserve	**$ (713,700.00)**
PRJ-20261300.03 - Tax Revenue Collection	$ 204,200.00
PRJ-20261300.04 - Interest Revenue Collection	$ 38,600.00
PRJ-20261300.10 - Financial Account Management	$ -
PRJ-20263000.01 - General Groundwater Permitting	$ (111,500.00)
PRJ-20264000.01 - General Groundwater Monitoring	$ (645,000.00)
PRJ-20268000.01 - General Groundwater Resource Planning	$ (200,000.00)
Operating	**$ (242,400.00)**
PRJ-20261000.01 - General Administration	$ -
PRJ-20261001.01 - GCD Support - 1000 Adm	$ (15,800.00)
PRJ-20261001.02 - Director Compensation Processing	$ (15,000.00)
PRJ-20261200.01 - Election Coordination	$ -
PRJ-20261300.01 - Financial Audit	$ (10,000.00)
PRJ-20261300.02 - Budget Development	$ -
PRJ-20261300.03 - Tax Revenue Collection	$ (8,500.00)
PRJ-20261300.04 - Interest Revenue Collection	$ 1,600.00
PRJ-20261300.05 - Fee Revenue Collection	$ -
PRJ-20261300.06 - Financial Account Coordination	$ -
PRJ-20261300.10 - Financial Account Management	$ -
PRJ-20261400.01 - Technology	$ (7,700.00)
PRJ-20261500.01 - Public Notice Coordination	$ (800.00)
PRJ-20261500.02 - District Meeting Coordination	$ -
PRJ-20261700.01 - Office Administration	$ (8,600.00)
PRJ-20261700.02 - General Legal Counsel Representation	$ (10,000.00)
PRJ-20261700.03 - GCD Support	$ -
PRJ-20261900.01 - Digital Record Archiving	$ -
PRJ-20261900.02 - Physical Record Archiving	$ -
PRJ-20262000.01 - General Groundwater Conservation	$ (500.00)
PRJ-20262001.01 - GCD Support - 2000 GC	$ (15,800.00)
PRJ-20262100.01 - Promote Conservation	$ -
PRJ-20263001.01 - GCD Support - 3000 GMa	$ (15,800.00)
PRJ-20263100.01 - Well Registration Processing	$ -
PRJ-20263100.02 - Production Permit Renewal Processing	$ (1,000.00)
PRJ-20263100.03 - Permit Processing	$ (2,500.00)
PRJ-20263100.04 - Groundwater Production Report Processing	$ (1,000.00)
PRJ-20263100.05 - Manage Investigations related to Permitting Violations	$ (500.00)

Note: reports developed using cash-basis accounting.
Tab: Budget Summary - Project

Sheet Index

	Sum of Budget Amount
PRJ-20263100.06 - Manage Enforcement Cases related to Permitting Violations	$ (500.00)
PRJ-20263100.07 - Permit Report Processing	$ -
PRJ-20264001.01 - GCD Support - 4000 GMo	$ (15,800.00)
PRJ-20264100.01 - Drought Condition Monitoring	$ -
PRJ-20264100.02 - Water Level Monitoring	$ (3,000.00)
PRJ-20264100.03 - Water Quality Aquifer Monitoring	$ (5,000.00)
PRJ-20264100.04 - Advanced Aquifer Monitoring	$ (5,000.00)
PRJ-20264100.05 - Water Level Assessment	$ (5,000.00)
PRJ-20264100.06 - Water Quality Assessment	$ -
PRJ-20264100.07 - Subsidence Assessment	$ (10,000.00)
PRJ-20264100.08 - Monitoring Effort Assessment and Improvement	$ (10,000.00)
PRJ-20265000.01 - General Groundwater Policy	$ -
PRJ-20265001.01 - GCD Support - 5000 GPo	$ (15,800.00)
PRJ-20265100.01 - Management Plan Revisions	$ (500.00)
PRJ-20265100.02 - Rule Amendments	$ (500.00)
PRJ-20265100.03 - Legislative Support and Lobbying	$ (5,000.00)
PRJ-20266000.01 - General Groundwater Protection	$ -
PRJ-20266001.01 - GCD Support - 6000 GP	$ (15,800.00)
PRJ-20266100.01 - Well Inspections	$ -
PRJ-20266100.02 - Manage Investigations related to Groundwater Protection	$ (500.00)
PRJ-20266100.03 - Manage Enforcement Cases related to Groundwater Protection	$ (500.00)
PRJ-20266100.04 - Well Plugging Sponsorship	$ (5,000.00)
PRJ-20267000.01 - General Groundwater Research	$ -
PRJ-20267001.01 - GCD Support - 7000 GR	$ (15,800.00)
PRJ-20268001.01 - GCD Support - 8000 GRP	$ (15,800.00)
PRJ-20268100.01 - Regional Water Planning Participation	$ (500.00)
PRJ-20268100.02 - GMA 15 Joint Planning for 4th Planning Cycle	$ (500.00)
Grand Total	**$ (956,100.00)**

Note: reports developed using cash-basis accounting.
Tab: Budget Summary - Project

Sheet Index

Row Labels	Sum of Actual Credit Amount	Sum of Actual Debit Amount
Operating		
PRJ-20261000.01 - General Administration	$ -	$ -
PRJ-20261001.01 - GCD Support - 1000 Adm	$ -	$ (7,588.38)
PRJ-20261001.02 - Director Compensation Processing	$ -	$ (4,500.00)
PRJ-20261200.01 - Election Coordination	$ -	$ -
PRJ-20261300.01 - Financial Audit	$ -	$ -
PRJ-20261300.02 - Budget Development	$ -	$ -
PRJ-20261300.03 - Tax Revenue Collection	$ -	$ (6,271.17)
PRJ-20261300.04 - Interest Revenue Collection	$ 9,155.40	$ -
PRJ-20261300.05 - Fee Revenue Collection	$ -	$ -
PRJ-20261300.06 - Financial Account Coordination	$ -	$ (66.13)
PRJ-20261300.10 - Financial Account Management	$ -	$ (190,000.00)
PRJ-20261400.01 - Technology	$ -	$ -
PRJ-20261500.01 - Public Notice Coordination	$ -	$ -
PRJ-20261500.02 - District Meeting Coordination	$ -	$ -
PRJ-20261700.01 - Office Administration	$ 271.20	$ (1,539.23)
PRJ-20261700.02 - General Legal Counsel Representation	$ -	$ (1,460.00)
PRJ-20261700.03 - GCD Support	$ -	$ -
PRJ-20261900.01 - Digital Record Archiving	$ -	$ -
PRJ-20261900.02 - Physical Record Archiving	$ -	$ -
PRJ-20262000.01 - General Groundwater Conservation	$ -	$ -
PRJ-20262001.01 - GCD Support - 2000 GC	$ -	$ (3,937.50)
PRJ-20262100.01 - Promote Conservation	$ -	$ -
PRJ-20263001.01 - GCD Support - 3000 GMa	$ -	$ (3,937.50)
PRJ-20263100.01 - Well Registration Processing	$ -	$ -
PRJ-20263100.02 - Production Permit Renewal Processing	$ -	$ -
PRJ-20263100.03 - Permit Processing	$ -	$ -
PRJ-20263100.04 - Groundwater Production Report Processing	$ -	$ -
PRJ-20263100.05 - Manage Investigations related to Permitting Violations	$ -	$ -
PRJ-20263100.06 - Manage Enforcement Cases related to Permitting Violations	$ -	$ -
PRJ-20263100.07 - Permit Report Processing	$ -	$ -
PRJ-20264001.01 - GCD Support - 4000 GMo	$ -	$ (3,937.50)
PRJ-20264100.01 - Drought Condition Monitoring	$ -	$ -

Note: reports developed using cash-basis accounting.
Tab: Budget Performance by Project

Sheet Index

Row Labels	Sum of Actual Credit Amount	Sum of Actual Debit Amount
PRJ-20264100.02 - Water Level Monitoring	$ -	$ -
PRJ-20264100.03 - Water Quality Aquifer Monitoring	$ -	$ (420.00)
PRJ-20264100.04 - Advanced Aquifer Monitoring	$ -	$ -
PRJ-20264100.05 - Water Level Assessment	$ -	$ -
PRJ-20264100.06 - Water Quality Assessment	$ -	$ -
PRJ-20264100.07 - Subsidence Assessment	$ -	$ -
PRJ-20264100.08 - Monitoring Effort Assessment and Improvement	$ -	$ -
PRJ-20265000.01 - General Groundwater Policy	$ -	$ -
PRJ-20265001.01 - GCD Support - 5000 GPo	$ -	$ (3,937.50)
PRJ-20265100.01 - Management Plan Revisions	$ -	$ -
PRJ-20265100.02 - Rule Amendments	$ -	$ -
PRJ-20265100.03 - Legislative Support and Lobbying	$ -	$ -
PRJ-20266000.01 - General Groundwater Protection	$ -	$ -
PRJ-20266001.01 - GCD Support - 6000 GP	$ -	$ (3,937.50)
PRJ-20266100.01 - Well Inspections	$ -	$ -
PRJ-20266100.02 - Manage Investigations related to Groundwater Protection	$ -	$ -
PRJ-20266100.03 - Manage Enforcement Cases related to Groundwater Protection	$ -	$ -
PRJ-20266100.04 - Well Plugging Sponsorship	$ -	$ -
PRJ-20267000.01 - General Groundwater Research	$ -	$ -
PRJ-20267001.01 - GCD Support - 7000 GR	$ -	$ (3,937.50)
PRJ-20268001.01 - GCD Support - 8000 GRP	$ -	$ (3,937.50)
PRJ-20268100.01 - Regional Water Planning Participation	$ -	$ -
PRJ-20268100.02 - GMA 15 Joint Planning for 4th Planning Cycle	$ -	$ -
Reserve		
PRJ-20261300.03 - Tax Revenue Collection	$ 152,112.10	$ -
PRJ-20261300.04 - Interest Revenue Collection	$ 8,847.15	$ -
PRJ-20261300.10 - Financial Account Management	$ 190,000.00	$ -
PRJ-20263000.01 - General Groundwater Permitting	$ -	$ -
PRJ-20264000.01 - General Groundwater Monitoring	$ -	$ -
PRJ-20268000.01 - General Groundwater Resource Planning	$ -	$ -
Grand Total	**$ 360,385.85**	**$ (239,407.41)**

Note: reports developed using cash-basis accounting.
Tab: Budget Performance by Project

Sheet Index

	Sum of Budget Item Amount	Sum of Net Approved Encumbrance Amount	Credits - Actual	Debits - Actual	Encumbrance - Outstanding
Reserve					
PRJ-20261300.03 - Tax Revenue Collection | Revenue | Reserve | Budget Adoption | 20250829 | Budget Adoption	$ 204,200.00	$ 1,600.00	$ 152,112.10	$ -	$ (150,512.10)
PRJ-20261300.04 - Interest Revenue Collection | Revenue | Reserve | Budget Adoption | 20250829 | Budget Adoption	$ 38,600.00	$ -	$ 8,847.15	$ -	$ (8,847.15)
PRJ-20261300.10 - Financial Account Management | Fund Transfer | Reserve | Budget Adoption | 20250829 | Budget Adoption	$ -	$ -	$ 190,000.00	$ -	$ (190,000.00)
PRJ-20263000.01 - General Groundwater Permitting | Expense | Reserve | Budget Adoption | 20250829 | Budget Adoption	$(111,500.00)	$ (15,750.00)	$ -	$ -	$ (15,750.00)
PRJ-20264000.01 - General Groundwater Monitoring | Expense | Reserve | Budget Adoption | 20250829 | Budget Adoption	$(645,000.00)	$ (15,750.00)	$ -	$ -	$ (15,750.00)
PRJ-20268000.01 - General Groundwater Resource Planning | Expense | Reserve | Budget Adoption | 20250829 | Budget Adoption	$(200,000.00)	$ (15,750.00)	$ -	$ -	$ (15,750.00)
Operating					
PRJ-20261000.01 - General Administration | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ (15,750.00)	$ -	$ -	$ (15,750.00)
PRJ-20261001.01 - GCD Support - 1000 Adm | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (15,800.00)	$ (15,000.00)	$ -	$ (7,588.38)	$ (7,411.62)
PRJ-20261001.02 - Director Compensation Processing | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (15,000.00)	$ -	$ -	$ (4,500.00)	$ 4,500.00
PRJ-20261200.01 - Election Coordination | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ (10,000.00)	$ -	$ -	$ (10,000.00)
PRJ-20261300.01 - Financial Audit | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (10,000.00)	$ -	$ -	$ -	$ -
PRJ-20261300.02 - Budget Development | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ (8,500.00)	$ -	$ -	$ (8,500.00)
PRJ-20261300.03 - Tax Revenue Collection | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (8,500.00)	$ 204,200.00	$ -	$ (6,271.17)	$ 210,471.17

Note: reports developed using cash-basis accounting.
Tab: Encumbrance Summary

Sheet Index

	Sum of Budget Item Amount	Sum of Net Approved Encumbrance Amount	Credits - Actual	Debits - Actual	Encumbrance - Outstanding
PRJ-20261300.04 - Interest Revenue Collection | Revenue | Operating | Budget Adoption | 20250829 | Budget Adoption	$ 1,600.00	$ 38,600.00	$ 9,155.40	$ -	$ 29,444.60
PRJ-20261300.05 - Fee Revenue Collection | Revenue | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ -	$ -	$ -	$ -
PRJ-20261300.06 - Financial Account Coordination | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ (7,700.00)	$ -	$ (66.13)	$ (7,633.87)
PRJ-20261300.10 - Financial Account Management | Fund Transfer | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ -	$ -	$ (190,000.00)	$ 190,000.00
PRJ-20261400.01 - Technology | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (7,700.00)	$ (800.00)	$ -	$ -	$ (800.00)
PRJ-20261500.01 - Public Notice Coordination | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (800.00)	$ -	$ -	$ -	$ -
PRJ-20261500.02 - District Meeting Coordination | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ (8,600.00)	$ -	$ -	$ (8,600.00)
PRJ-20261700.01 - Office Administration | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (8,600.00)	$ (10,000.00)	$ 271.20	$ (1,539.23)	$ (8,731.97)
PRJ-20261700.02 - General Legal Counsel Representation | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (10,000.00)	$ -	$ -	$ (1,460.00)	$ 1,460.00
PRJ-20261700.03 - GCD Support | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ -	$ -	$ -	$ -
PRJ-20261900.01 - Digital Record Archiving | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ -	$ -	$ -	$ -
PRJ-20261900.02 - Physical Record Archiving | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ (500.00)	$ -	$ -	$ (500.00)
PRJ-20262000.01 - General Groundwater Conservation | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (500.00)	$ (15,750.00)	$ -	$ -	$ (15,750.00)
PRJ-20262001.01 - GCD Support - 2000 GC | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (15,800.00)	$ -	$ -	$ (3,937.50)	$ 3,937.50

Note: reports developed using cash-basis accounting.
Tab: Encumbrance Summary

Sheet Index

	Sum of Budget Item Amount	Sum of Net Approved Encumbrance Amount	Credits - Actual	Debits - Actual	Encumbrance - Outstanding
PRJ-20262100.01 - Promote Conservation | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$(111,500.00)	$ -	$ -	$ (111,500.00)
PRJ-20263001.01 - GCD Support - 3000 GMa | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (15,800.00)	$ -	$ -	$ (3,937.50)	$ 3,937.50
PRJ-20263100.01 - Well Registration Processing | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ (1,000.00)	$ -	$ -	$ (1,000.00)
PRJ-20263100.02 - Production Permit Renewal Processing | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (1,000.00)	$ (2,500.00)	$ -	$ -	$ (2,500.00)
PRJ-20263100.03 - Permit Processing | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (2,500.00)	$ (1,000.00)	$ -	$ -	$ (1,000.00)
PRJ-20263100.04 - Groundwater Production Report Processing | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (1,000.00)	$ (500.00)	$ -	$ -	$ (500.00)
PRJ-20263100.05 - Manage Investigations related to Permitting Violations | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (500.00)	$ (500.00)	$ -	$ -	$ (500.00)
PRJ-20263100.06 - Manage Enforcement Cases related to Permitting Violations | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (500.00)	$ -	$ -	$ -	$ -
PRJ-20263100.07 - Permit Report Processing | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$(645,000.00)	$ -	$ -	$ (645,000.00)
PRJ-20264001.01 - GCD Support - 4000 GMo | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (15,800.00)	$ -	$ -	$ (3,937.50)	$ 3,937.50
PRJ-20264100.01 - Drought Condition Monitoring | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ (3,000.00)	$ -	$ -	$ (3,000.00)
PRJ-20264100.02 - Water Level Monitoring | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (3,000.00)	$ (5,000.00)	$ -	$ -	$ (5,000.00)
PRJ-20264100.03 - Water Quality Aquifer Monitoring | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (5,000.00)	$ (5,000.00)	$ -	$ (420.00)	$ (4,580.00)

Note: reports developed using cash-basis accounting.
Tab: Encumbrance Summary

Sheet Index

	Sum of Budget Item Amount	Sum of Net Approved Encumbrance Amount	Credits - Actual	Debits - Actual	Encumbrance - Outstanding
PRJ-20264100.04 - Advanced Aquifer Monitoring | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (5,000.00)	$ (5,000.00)	$ -	$ -	$ (5,000.00)
PRJ-20264100.05 - Water Level Assessment | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (5,000.00)	$ -	$ -	$ -	$ -
PRJ-20264100.06 - Water Quality Assessment | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ (10,000.00)	$ -	$ -	$ (10,000.00)
PRJ-20264100.07 - Subsidence Assessment | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (10,000.00)	$ (10,000.00)	$ -	$ -	$ (10,000.00)
PRJ-20264100.08 - Monitoring Effort Assessment and Improvement | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (10,000.00)	$ -	$ -	$ -	$ -
PRJ-20265000.01 - General Groundwater Policy | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ (15,750.00)	$ -	$ -	$ (15,750.00)
PRJ-20265001.01 - GCD Support - 5000 GPo | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (15,800.00)	$ (500.00)	$ -	$ (3,937.50)	$ 3,437.50
PRJ-20265100.01 - Management Plan Revisions | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (500.00)	$ (500.00)	$ -	$ -	$ (500.00)
PRJ-20265100.02 - Rule Amendments | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (500.00)	$ (5,000.00)	$ -	$ -	$ (5,000.00)
PRJ-20265100.03 - Legislative Support and Lobbying | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (5,000.00)	$ -	$ -	$ -	$ -
PRJ-20266000.01 - General Groundwater Protection | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ (15,750.00)	$ -	$ -	$ (15,750.00)
PRJ-20266001.01 - GCD Support - 6000 GP | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (15,800.00)	$ -	$ -	$ (3,937.50)	$ 3,937.50
PRJ-20266100.01 - Well Inspections | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ (500.00)	$ -	$ -	$ (500.00)

Note: reports developed using cash-basis accounting.
Tab: Encumbrance Summary

Sheet Index

	Sum of Budget Item Amount	Sum of Net Approved Encumbrance Amount	Credits - Actual	Debits - Actual	Encumbrance - Outstanding
PRJ-20266100.02 - Manage Investigations related to Groundwater Protection | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (500.00)	$ (500.00)	$ -	$ -	$ (500.00)
PRJ-20266100.03 - Manage Enforcement Cases related to Groundwater Protection | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (500.00)	$ (5,000.00)	$ -	$ -	$ (5,000.00)
PRJ-20266100.04 - Well Plugging Sponsorship | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (5,000.00)	$ -	$ -	$ -	$ -
PRJ-20267000.01 - General Groundwater Research | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ (15,750.00)	$ -	$ -	$ (15,750.00)
PRJ-20267001.01 - GCD Support - 7000 GR | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (15,800.00)	$(200,000.00)	$ -	$ (3,937.50)	$ (196,062.50)
PRJ-20268001.01 - GCD Support - 8000 GRP | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (15,800.00)	$ (500.00)	$ -	$ (3,937.50)	$ 3,437.50
PRJ-20268100.01 - Regional Water Planning Participation | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (500.00)	$ (500.00)	$ -	$ -	$ (500.00)
PRJ-20268100.02 - GMA 15 Joint Planning for 4th Planning Cycle | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (500.00)	$ -	$ -	$ -	$ -
Grand Total	**$(956,100.00)**	**$(955,700.00)**	**$ 360,385.85**	**$ (239,407.41)**	**$ (1,076,678.44)**

Note: reports developed using cash-basis accounting.
Tab: Encumbrance Summary

Refugio Groundwater Conservation District

Internal Financial Report

Reporting Period: February 2026

Note: reports developed using cash-basis accounting.
Tab: Report Cover

Sheet Index

Account	Institution	Fund	Account Type	Statement Reconciliation ID	Reported Ending Balance	Reported Yield / Rate
11658	Vantage Bank	Operating	Demand Deposit Account	11658 : AS-20260227-01: DATE: 02/27/2026	$ 80,479.75	0.1000%
79982	TexPool	Reserve	Pooled Group Fund	79982 : AS-20260228-02: DATE: 02/28/2026	$ 1,499,242.53	3.6900%
Total					**$ 1,579,722.28**	

Note: reports developed using cash-basis accounting.
Tab: Latest Account Balances

Sheet Index

Institution	Type	CUSIP	Description	Safekeeping Location	Safekeeping Receipt	Credit Rating	Market Value
Vantage Bank	FDIC Insurance - Demand De	N/A	N/A	N/A		N/A	$ 250,000.00
Vantage Bank	Letter of Credit		LOC 2901001698	FHLB-Dallas		N/A	$ 1,500,000.00
Total							**$ 1,750,000.00**

Note: reports developed using cash-basis accounting.
Tab: FDIC and Collateral

Sheet Index

		Sum of Budget Amount
Budget Adoption	**$**	**(956,100.00)**
Reserve	$	(713,700.00)
Operating	$	(242,400.00)
Budget Amendment	**$**	**(6,000.00)**
Operating	$	(6,000.00)
Grand Total	**$**	**(962,100.00)**

Note: reports developed using cash-basis accounting.
Tab: Budget Summary - Fund

Sheet Index

		Sum of Budget Amount
Budget Adoption	**$**	**(956,100.00)**
Reserve	**$**	**(713,700.00)**
1000 - Administration	$	242,800.00
3000 - Groundwater Management	$	(111,500.00)
4000 - Groundwater Monitoring	$	(645,000.00)
8000 - Groundwater Resource Planning	$	(200,000.00)
Operating	**$**	**(242,400.00)**
1000 - Administration	$	(74,800.00)
2000 - Groundwater Conservation	$	(16,300.00)
3000 - Groundwater Management	$	(21,300.00)
4000 - Groundwater Monitoring	$	(53,800.00)
5000 - Groundwater Policy	$	(21,800.00)
6000 - Groundwater Protection	$	(21,800.00)
7000 - Groundwater Research	$	(15,800.00)
8000 - Groundwater Resource Planning	$	(16,800.00)
Budget Amendment	**$**	**(6,000.00)**
Operating	**$**	**(6,000.00)**
4000 - Groundwater Monitoring	$	(6,000.00)
Grand Total	**$**	**(962,100.00)**

Note: reports developed using cash-basis accounting.
Tab: Budget Summary - Program

Sheet Index

	Sum of Budget Amount
Budget Adoption	**$ (956,100.00)**
Reserve	**$ (713,700.00)**
PRJ-20261300.03 - Tax Revenue Collection	$ 204,200.00
PRJ-20261300.04 - Interest Revenue Collection	$ 38,600.00
PRJ-20261300.10 - Financial Account Management	$ -
PRJ-20263000.01 - General Groundwater Permitting	$ (111,500.00)
PRJ-20264000.01 - General Groundwater Monitoring	$ (645,000.00)
PRJ-20268000.01 - General Groundwater Resource Planning	$ (200,000.00)
Operating	**$ (242,400.00)**
PRJ-20261000.01 - General Administration	$ -
PRJ-20261001.01 - GCD Support - 1000 Adm	$ (15,800.00)
PRJ-20261001.02 - Director Compensation Processing	$ (15,000.00)
PRJ-20261200.01 - Election Coordination	$ -
PRJ-20261300.01 - Financial Audit	$ (10,000.00)
PRJ-20261300.02 - Budget Development	$ -
PRJ-20261300.03 - Tax Revenue Collection	$ (8,500.00)
PRJ-20261300.04 - Interest Revenue Collection	$ 1,600.00
PRJ-20261300.05 - Fee Revenue Collection	$ -
PRJ-20261300.06 - Financial Account Coordination	$ -
PRJ-20261300.10 - Financial Account Management	$ -
PRJ-20261400.01 - Technology	$ (7,700.00)
PRJ-20261500.01 - Public Notice Coordination	$ (800.00)
PRJ-20261500.02 - District Meeting Coordination	$ -
PRJ-20261700.01 - Office Administration	$ (8,600.00)
PRJ-20261700.02 - General Legal Counsel Representation	$ (10,000.00)
PRJ-20261700.03 - GCD Support	$ -
PRJ-20261900.01 - Digital Record Archiving	$ -
PRJ-20261900.02 - Physical Record Archiving	$ -
PRJ-20262000.01 - General Groundwater Conservation	$ (500.00)
PRJ-20262001.01 - GCD Support - 2000 GC	$ (15,800.00)
PRJ-20262100.01 - Promote Conservation	$ -
PRJ-20263001.01 - GCD Support - 3000 GMa	$ (15,800.00)
PRJ-20263100.01 - Well Registration Processing	$ -
PRJ-20263100.02 - Production Permit Renewal Processing	$ (1,000.00)
PRJ-20263100.03 - Permit Processing	$ (2,500.00)
PRJ-20263100.04 - Groundwater Production Report Processing	$ (1,000.00)
PRJ-20263100.05 - Manage Investigations related to Permitting Violations	$ (500.00)

Note: reports developed using cash-basis accounting.
Tab: Budget Summary - Project

Sheet Index

		Sum of Budget Amount
PRJ-20263100.06 - Manage Enforcement Cases related to Permitting Violations	$	(500.00)
PRJ-20263100.07 - Permit Report Processing	$	-
PRJ-20264001.01 - GCD Support - 4000 GMo	$	(15,800.00)
PRJ-20264100.01 - Drought Condition Monitoring	$	-
PRJ-20264100.02 - Water Level Monitoring	$	(3,000.00)
PRJ-20264100.03 - Water Quality Aquifer Monitoring	$	(5,000.00)
PRJ-20264100.04 - Advanced Aquifer Monitoring	$	(5,000.00)
PRJ-20264100.05 - Water Level Assessment	$	(5,000.00)
PRJ-20264100.06 - Water Quality Assessment	$	-
PRJ-20264100.07 - Subsidence Assessment	$	(10,000.00)
PRJ-20264100.08 - Monitoring Effort Assessment and Improvement	$	(10,000.00)
PRJ-20265000.01 - General Groundwater Policy	$	-
PRJ-20265001.01 - GCD Support - 5000 GPo	$	(15,800.00)
PRJ-20265100.01 - Management Plan Revisions	$	(500.00)
PRJ-20265100.02 - Rule Amendments	$	(500.00)
PRJ-20265100.03 - Legislative Support and Lobbying	$	(5,000.00)
PRJ-20266000.01 - General Groundwater Protection	$	-
PRJ-20266001.01 - GCD Support - 6000 GP	$	(15,800.00)
PRJ-20266100.01 - Well Inspections	$	-
PRJ-20266100.02 - Manage Investigations related to Groundwater Protection	$	(500.00)
PRJ-20266100.03 - Manage Enforcement Cases related to Groundwater Protection	$	(500.00)
PRJ-20266100.04 - Well Plugging Sponsorship	$	(5,000.00)
PRJ-20267000.01 - General Groundwater Research	$	-
PRJ-20267001.01 - GCD Support - 7000 GR	$	(15,800.00)
PRJ-20268001.01 - GCD Support - 8000 GRP	$	(15,800.00)
PRJ-20268100.01 - Regional Water Planning Participation	$	(500.00)
PRJ-20268100.02 - GMA 15 Joint Planning for 4th Planning Cycle	$	(500.00)
Budget Amendment	**$**	**(6,000.00)**
Operating	**$**	**(6,000.00)**
PRJ-20264100.05 - Water Level Assessment	$	(6,000.00)
Grand Total	**$**	**(962,100.00)**

Note: reports developed using cash-basis accounting.
Tab: Budget Summary - Project

Sheet Index

Row Labels	Sum of Actual Credit Amount	Sum of Actual Debit Amount
Operating		
PRJ-20261000.01 - General Administration	$ 6.00	$ -
PRJ-20261001.01 - GCD Support - 1000 Adm	$ -	$ (7,588.38)
PRJ-20261001.02 - Director Compensation Processing	$ -	$ (5,500.00)
PRJ-20261200.01 - Election Coordination	$ -	$ -
PRJ-20261300.01 - Financial Audit	$ -	$ -
PRJ-20261300.02 - Budget Development	$ -	$ -
PRJ-20261300.03 - Tax Revenue Collection	$ -	$ (6,271.17)
PRJ-20261300.04 - Interest Revenue Collection	$ 13,381.76	$ -
PRJ-20261300.05 - Fee Revenue Collection	$ -	$ -
PRJ-20261300.06 - Financial Account Coordination	$ -	$ (83.12)
PRJ-20261300.10 - Financial Account Management	$ -	$ (190,000.00)
PRJ-20261400.01 - Technology	$ -	$ -
PRJ-20261500.01 - Public Notice Coordination	$ -	$ -
PRJ-20261500.02 - District Meeting Coordination	$ -	$ -
PRJ-20261700.01 - Office Administration	$ 271.20	$ (1,539.23)
PRJ-20261700.02 - General Legal Counsel Representation	$ -	$ (2,020.00)
PRJ-20261700.03 - GCD Support	$ -	$ -
PRJ-20261900.01 - Digital Record Archiving	$ -	$ -
PRJ-20261900.02 - Physical Record Archiving	$ -	$ -
PRJ-20262000.01 - General Groundwater Conservation	$ -	$ -
PRJ-20262001.01 - GCD Support - 2000 GC	$ -	$ (3,937.50)
PRJ-20262100.01 - Promote Conservation	$ -	$ -
PRJ-20263001.01 - GCD Support - 3000 GMa	$ -	$ (3,937.50)
PRJ-20263100.01 - Well Registration Processing	$ -	$ -
PRJ-20263100.02 - Production Permit Renewal Processing	$ -	$ -
PRJ-20263100.03 - Permit Processing	$ -	$ -
PRJ-20263100.04 - Groundwater Production Report Processing	$ -	$ -
PRJ-20263100.05 - Manage Investigations related to Permitting Violations	$ -	$ -
PRJ-20263100.06 - Manage Enforcement Cases related to Permitting Violations	$ -	$ -
PRJ-20263100.07 - Permit Report Processing	$ -	$ -
PRJ-20264001.01 - GCD Support - 4000 GMo	$ -	$ (3,937.50)
PRJ-20264100.01 - Drought Condition Monitoring	$ -	$ -

Note: reports developed using cash-basis accounting.
Tab: Budget Performance by Project

Sheet Index

Row Labels	Sum of Actual Credit Amount	Sum of Actual Debit Amount
PRJ-20264100.02 - Water Level Monitoring	$ -	$ -
PRJ-20264100.03 - Water Quality Aquifer Monitoring	$ -	$ (420.00)
PRJ-20264100.04 - Advanced Aquifer Monitoring	$ -	$ -
PRJ-20264100.05 - Water Level Assessment	$ -	$ -
PRJ-20264100.06 - Water Quality Assessment	$ -	$ -
PRJ-20264100.07 - Subsidence Assessment	$ -	$ -
PRJ-20264100.08 - Monitoring Effort Assessment and Improvement	$ -	$ -
PRJ-20265000.01 - General Groundwater Policy	$ -	$ -
PRJ-20265001.01 - GCD Support - 5000 GPo	$ -	$ (3,937.50)
PRJ-20265100.01 - Management Plan Revisions	$ -	$ -
PRJ-20265100.02 - Rule Amendments	$ -	$ -
PRJ-20265100.03 - Legislative Support and Lobbying	$ -	$ -
PRJ-20266000.01 - General Groundwater Protection	$ -	$ -
PRJ-20266001.01 - GCD Support - 6000 GP	$ -	$ (3,937.50)
PRJ-20266100.01 - Well Inspections	$ -	$ -
PRJ-20266100.02 - Manage Investigations related to Groundwater Protection	$ -	$ -
PRJ-20266100.03 - Manage Enforcement Cases related to Groundwater Protection	$ -	$ -
PRJ-20266100.04 - Well Plugging Sponsorship	$ -	$ -
PRJ-20267000.01 - General Groundwater Research	$ -	$ -
PRJ-20267001.01 - GCD Support - 7000 GR	$ -	$ (3,937.50)
PRJ-20268001.01 - GCD Support - 8000 GRP	$ -	$ (3,937.50)
PRJ-20268100.01 - Regional Water Planning Participation	$ -	$ -
PRJ-20268100.02 - GMA 15 Joint Planning for 4th Planning Cycle	$ -	$ -
Reserve		
PRJ-20261300.03 - Tax Revenue Collection	$ 190,447.54	$ -
PRJ-20261300.04 - Interest Revenue Collection	$ 8,847.15	$ -
PRJ-20261300.10 - Financial Account Management	$ 190,000.00	$ -
PRJ-20263000.01 - General Groundwater Permitting	$ -	$ -
PRJ-20264000.01 - General Groundwater Monitoring	$ -	$ -
PRJ-20268000.01 - General Groundwater Resource Planning	$ -	$ -
Grand Total	**$ 402,953.65**	**$ (240,984.40)**

Note: reports developed using cash-basis accounting.
Tab: Budget Performance by Project

Sheet Index

	Sum of Budget Item Amount	Sum of Net Approved Encumbrance Amount	Credits - Actual	Debits - Actual	Encumbrance - Outstanding
Reserve					
PRJ-20261300.03 - Tax Revenue Collection | Revenue | Reserve | Budget Adoption | 20250829 | Budget Adoption	$ 204,200.00	$ 1,600.00	$ 190,447.54	$ -	$ (188,847.54)
PRJ-20261300.04 - Interest Revenue Collection | Revenue | Reserve | Budget Adoption | 20250829 | Budget Adoption	$ 38,600.00	$ -	$ 8,847.15	$ -	$ (8,847.15)
PRJ-20261300.10 - Financial Account Management | Fund Transfer | Reserve | Budget Adoption | 20250829 | Budget Adoption	$ -	$ -	$ 190,000.00	$ -	$ (190,000.00)
PRJ-20263000.01 - General Groundwater Permitting | Expense | Reserve | Budget Adoption | 20250829 | Budget Adoption	$(111,500.00)	$ (15,750.00)	$ -	$ -	$ (15,750.00)
PRJ-20264000.01 - General Groundwater Monitoring | Expense | Reserve | Budget Adoption | 20250829 | Budget Adoption	$(645,000.00)	$ (15,750.00)	$ -	$ -	$ (15,750.00)
PRJ-20268000.01 - General Groundwater Resource Planning | Expense | Reserve | Budget Adoption | 20250829 | Budget Adoption	$(200,000.00)	$ (15,750.00)	$ -	$ -	$ (15,750.00)
Operating					
PRJ-20261000.01 - General Administration | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ (15,750.00)	$ 6.00	$ -	$ (15,756.00)
PRJ-20261001.01 - GCD Support - 1000 Adm | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (15,800.00)	$ (15,000.00)	$ -	$ (7,588.38)	$ (7,411.62)
PRJ-20261001.02 - Director Compensation Processing | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (15,000.00)	$ -	$ -	$ (5,500.00)	$ 5,500.00
PRJ-20261200.01 - Election Coordination | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ (10,000.00)	$ -	$ -	$ (10,000.00)
PRJ-20261300.01 - Financial Audit | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (10,000.00)	$ -	$ -	$ -	$ -
PRJ-20261300.02 - Budget Development | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ (8,500.00)	$ -	$ -	$ (8,500.00)
PRJ-20261300.03 - Tax Revenue Collection | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (8,500.00)	$ 204,200.00	$ -	$ (6,271.17)	$ 210,471.17

Note: reports developed using cash-basis accounting.
Tab: Encumbrance Summary

Sheet Index

	Sum of Budget Item Amount	Sum of Net Approved Encumbrance Amount	Credits - Actual	Debits - Actual	Encumbrance - Outstanding
PRJ-20261300.04 - Interest Revenue Collection | Revenue | Operating | Budget Adoption | 20250829 | Budget Adoption	$ 1,600.00	$ 38,600.00	$ 13,381.76	$ -	$ 25,218.24
PRJ-20261300.05 - Fee Revenue Collection | Revenue | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ -	$ -	$ -	$ -
PRJ-20261300.06 - Financial Account Coordination | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ (7,700.00)	$ -	$ (83.12)	$ (7,616.88)
PRJ-20261300.10 - Financial Account Management | Fund Transfer | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ -	$ -	$ (190,000.00)	$ 190,000.00
PRJ-20261400.01 - Technology | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (7,700.00)	$ (800.00)	$ -	$ -	$ (800.00)
PRJ-20261500.01 - Public Notice Coordination | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (800.00)	$ -	$ -	$ -	$ -
PRJ-20261500.02 - District Meeting Coordination | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ (8,600.00)	$ -	$ -	$ (8,600.00)
PRJ-20261700.01 - Office Administration | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (8,600.00)	$ (10,000.00)	$ 271.20	$ (1,539.23)	$ (8,731.97)
PRJ-20261700.02 - General Legal Counsel Representation | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (10,000.00)	$ -	$ -	$ (2,020.00)	$ 2,020.00
PRJ-20261700.03 - GCD Support | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ -	$ -	$ -	$ -
PRJ-20261900.01 - Digital Record Archiving | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ -	$ -	$ -	$ -
PRJ-20261900.02 - Physical Record Archiving | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ (500.00)	$ -	$ -	$ (500.00)
PRJ-20262000.01 - General Groundwater Conservation | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (500.00)	$ (15,750.00)	$ -	$ -	$ (15,750.00)
PRJ-20262001.01 - GCD Support - 2000 GC | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (15,800.00)	$ -	$ -	$ (3,937.50)	$ 3,937.50

Note: reports developed using cash-basis accounting.
Tab: Encumbrance Summary

Sheet Index

	Sum of Budget Item Amount	Sum of Net Approved Encumbrance Amount	Credits - Actual	Debits - Actual	Encumbrance - Outstanding
PRJ-20262100.01 - Promote Conservation | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$(111,500.00)	$ -	$ -	$ (111,500.00)
PRJ-20263001.01 - GCD Support - 3000 GMa | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (15,800.00)	$ -	$ -	$ (3,937.50)	$ 3,937.50
PRJ-20263100.01 - Well Registration Processing | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ (1,000.00)	$ -	$ -	$ (1,000.00)
PRJ-20263100.02 - Production Permit Renewal Processing | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (1,000.00)	$ (2,500.00)	$ -	$ -	$ (2,500.00)
PRJ-20263100.03 - Permit Processing | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (2,500.00)	$ (1,000.00)	$ -	$ -	$ (1,000.00)
PRJ-20263100.04 - Groundwater Production Report Processing | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (1,000.00)	$ (500.00)	$ -	$ -	$ (500.00)
PRJ-20263100.05 - Manage Investigations related to Permitting Violations | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (500.00)	$ (500.00)	$ -	$ -	$ (500.00)
PRJ-20263100.06 - Manage Enforcement Cases related to Permitting Violations | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (500.00)	$ -	$ -	$ -	$ -
PRJ-20263100.07 - Permit Report Processing | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$(645,000.00)	$ -	$ -	$ (645,000.00)
PRJ-20264001.01 - GCD Support - 4000 GMo | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (15,800.00)	$ -	$ -	$ (3,937.50)	$ 3,937.50
PRJ-20264100.01 - Drought Condition Monitoring | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ (3,000.00)	$ -	$ -	$ (3,000.00)
PRJ-20264100.02 - Water Level Monitoring | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (3,000.00)	$ (5,000.00)	$ -	$ -	$ (5,000.00)
PRJ-20264100.03 - Water Quality Aquifer Monitoring | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (5,000.00)	$ (5,000.00)	$ -	$ (420.00)	$ (4,580.00)

Note: reports developed using cash-basis accounting.
Tab: Encumbrance Summary

Sheet Index

	Sum of Budget Item Amount	Sum of Net Approved Encumbrance Amount	Credits - Actual	Debits - Actual	Encumbrance - Outstanding
PRJ-20264100.04 - Advanced Aquifer Monitoring | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (5,000.00)	$ (5,000.00)	$ -	$ -	$ (5,000.00)
PRJ-20264100.05 - Water Level Assessment | Expense | Intera Cost Share | Operating | Budget Amendment | 20260120 | Budget Amendment	$ (6,000.00)	$ (6,000.00)	$ -	$ -	$ (6,000.00)
PRJ-20264100.05 - Water Level Assessment | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (5,000.00)	$ -	$ -	$ -	$ -
PRJ-20264100.06 - Water Quality Assessment | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ (10,000.00)	$ -	$ -	$ (10,000.00)
PRJ-20264100.07 - Subsidence Assessment | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (10,000.00)	$ (10,000.00)	$ -	$ -	$ (10,000.00)
PRJ-20264100.08 - Monitoring Effort Assessment and Improvement | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (10,000.00)	$ -	$ -	$ -	$ -
PRJ-20265000.01 - General Groundwater Policy | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ (15,750.00)	$ -	$ -	$ (15,750.00)
PRJ-20265001.01 - GCD Support - 5000 GPo | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (15,800.00)	$ (500.00)	$ -	$ (3,937.50)	$ 3,437.50
PRJ-20265100.01 - Management Plan Revisions | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (500.00)	$ (500.00)	$ -	$ -	$ (500.00)
PRJ-20265100.02 - Rule Amendments | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (500.00)	$ (5,000.00)	$ -	$ -	$ (5,000.00)
PRJ-20265100.03 - Legislative Support and Lobbying | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (5,000.00)	$ -	$ -	$ -	$ -
PRJ-20266000.01 - General Groundwater Protection | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ (15,750.00)	$ -	$ -	$ (15,750.00)
PRJ-20266001.01 - GCD Support - 6000 GP | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (15,800.00)	$ -	$ -	$ (3,937.50)	$ 3,937.50

Note: reports developed using cash-basis accounting.
Tab: Encumbrance Summary

Sheet Index

	Sum of Budget Item Amount	Sum of Net Approved Encumbrance Amount	Credits - Actual	Debits - Actual	Encumbrance - Outstanding
PRJ-20266100.01 - Well Inspections | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ (500.00)	$ -	$ -	$ (500.00)
PRJ-20266100.02 - Manage Investigations related to Groundwater Protection | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (500.00)	$ (500.00)	$ -	$ -	$ (500.00)
PRJ-20266100.03 - Manage Enforcement Cases related to Groundwater Protection | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (500.00)	$ (5,000.00)	$ -	$ -	$ (5,000.00)
PRJ-20266100.04 - Well Plugging Sponsorship | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (5,000.00)	$ -	$ -	$ -	$ -
PRJ-20267000.01 - General Groundwater Research | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ -	$ (15,750.00)	$ -	$ -	$ (15,750.00)
PRJ-20267001.01 - GCD Support - 7000 GR | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (15,800.00)	$(200,000.00)	$ -	$ (3,937.50)	$ (196,062.50)
PRJ-20268001.01 - GCD Support - 8000 GRP | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (15,800.00)	$ (500.00)	$ -	$ (3,937.50)	$ 3,437.50
PRJ-20268100.01 - Regional Water Planning Participation | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (500.00)	$ (500.00)	$ -	$ -	$ (500.00)
PRJ-20268100.02 - GMA 15 Joint Planning for 4th Planning Cycle | Expense | Operating | Budget Adoption | 20250829 | Budget Adoption	$ (500.00)	$ -	$ -	$ -	$ -
Grand Total	**$(962,100.00)**	**$(961,700.00)**	**$ 402,953.65**	**$ (240,984.40)**	**$ (1,123,669.25)**

Note: reports developed using cash-basis accounting.
Tab: Encumbrance Summary

RGCD - Adm - FM - Internal Control Review Report - ICRR-20260131-01 - January 31, 2026

Accounts and Statements (Registry of Financial Accounts: RGCD - Registry of Financial Accounts)

1. Account ID: Operating 11658: AS-20260131-01 - Vantage Bank-11658
2. Account ID: TexPool 79982: AS-20260131-02 - TexPool-449-7998200001
3. Account ID: CD 1118: NONE
4. Account ID: CD 65382: NONE

Associated Collateral Record Notes:

1. CR-20260131-01 - FHL BANK - January 2026

List of VOIDED Check Notes:

1. RGCD - Adm - FM - Voided Check - Vantage Bank-11658 - 4345 - 20260120
2. RGCD - Voided Check No. 4345

List of CANCELLED Transaction Notes: NONE

List of DISPUTED and UNPAID Accounts Payable (ACCTPs)Notes: NONE

List of DISPUTED and UNPAID Accounts Receivable (ACCTRs)Notes: NONE

Internal Control Review

Question #1: Do all account statements reconcile with the associated Internal Financial Report? Yes No

Associated Internal Financial Report: IFR_20260131_01__FY2026_03__January 2026

Comments: NONE

Question#2: Are dual signatures present on all checks? Yes

Comments: NONE

Question#3: Are all expenditures associated with employees, including credit card expenditures, or contractors appropriate and properly authorized? Yes
Comments: NONE

Question#4: Are all electronic transactions (drafts and transfers) appropriate and properly documented? Yes
Comments: NONE

Question#5: Are all voided checks properly marked and recorded? Yes
Comments: RGCD - Voided Check No. 4345 - C. Rose

Question#6: Does the market valueof the pledged collateral and FDIC insurance exceed the total of investments per banking institution? Yes
Comments: NONE

Question#7: Do the external financial recordscomport with internal financial records of the District? Yes
Comments: NONE

Question#8: Do all directors checks have dual signatures and a signed Verified Statement of Service? Yes

Certification:

I certify that I have reviewed the documentation referenced above and the answers provided to the questions are true and accurate.

Lisa A. Ramirez _____ 02/18/2026

Signature of District Official Date

_____

Name of District Official

RGCD - Adm - FM - Internal Control Review Report - ICRR-20260228-01 - February 28, 2026

Accounts and Statements (Registry of Financial Accounts: RGCD - Registry of Financial Accounts)

1. Account ID: Operating 11658: AS-20260228-01 - Vantage Bank-11658
2. Account ID: TexPool 79982: AS-20260228-02 - TexPool-449-7998200001

Associated Collateral Record Notes:

1. CR-20260228-01 - FHL Bank - February 2026

List of VOIDED Check Notes: None

List of CANCELLED Transaction Notes: None

List of DISPUTED and UNPAID Accounts Payable (ACCTPs)Notes: None

List of DISPUTED and UNPAID Accounts Receivable (ACCTRs)Notes: None

Internal Control Review

Question #1: Do all account statements reconcile with the associated Internal Financial Report? Yes No

Associated Internal Financial Report: IFR-20260228-01 - FY2026-M05 - February 2026

Comments: NONE

Question#2: Are dual signatures present on all checks? Yes

Comments: NONE

Question#3: Are all expenditures associated with employees, including credit card expenditures, or contractors appropriate and properly authorized? Yes
Comments: NONE

Question#4: Are all electronic transactions (drafts and transfers) appropriate and properly documented? Yes
Comments: NONE

Question#5: Are all voided checks properly marked and recorded? NONE
Comments: NONE

Question#6: Does the market valueof the pledged collateral and FDIC insurance exceed the total of investments per banking institution? No
Comments: All uncollateralized funds of the district are invested in TexPool per the board of directors of operation.

Question#7: Do the external financial records comport with internal financial records of the District? Yes
Comments: NONE

Question#8: Do all directors checks have dual signatures and a signed Verified Statement of Service? Yes

Certification:

I certify that I have reviewed the documentation referenced above and the answers provided to the questions are true and accurate.

Lisa A. Ramirez
_____ 3/19/2026
Signature of District Official Date

_____
Name of District Official