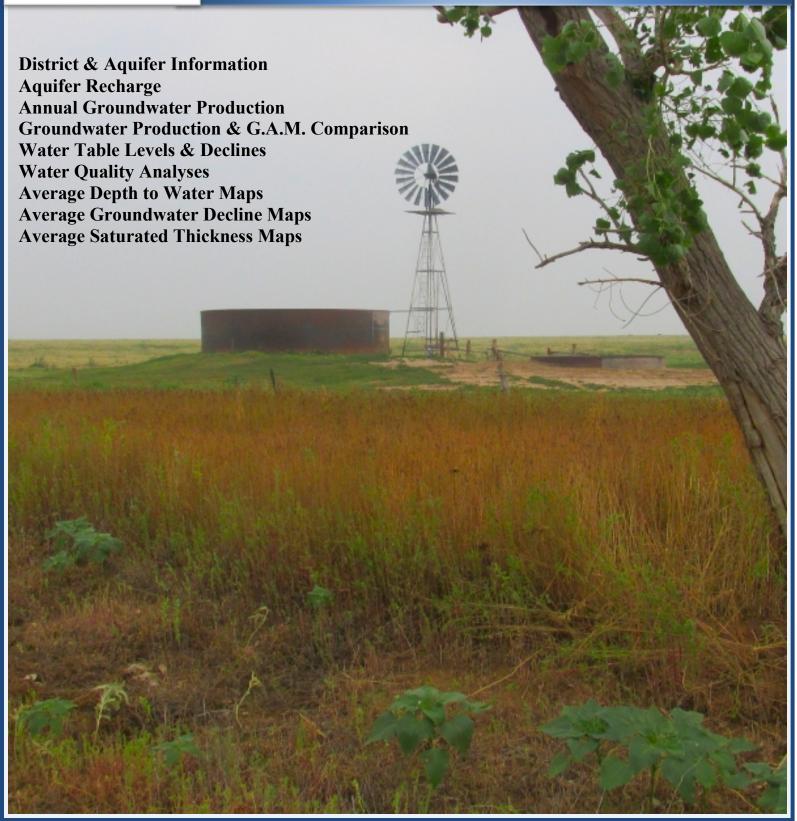


Hydrology & Groundwater Resources 2020-2021

Fourteenth Edition



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Disclaimer: This document is a general information report about the regional hydrology and groundwater resources within the North Plains Groundwater Conservation District. The groundwater resources or hydrological properties of any property can and do vary significantly from those indicated by, or what might be inferred from this document. This document and the information contained within is provided on an "as is" basis. Neither the District Board of Directors nor District Staff make any claims or warranties as to this document's suitability for any use public or private.

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I. Introduction

The North Plains Groundwater Conservation District (NPGCD or District) manages groundwater resources in all or part of eight counties in the Northern Texas Panhandle and is governed by an elected seven-member Board of Directors. The Board established the District's mission, "maintaining our way of life through conservation, protection, and preservation of our groundwater resources" and achieves this mission through the development of long-range management plans, creating and enforcing rules, being actively involved in regional and state water planning, undertaking conservation demonstrations projects, and providing public outreach and education programs.

To further advance its management strategies the District promotes new conservation management methods and technologies, cooperates with private, corporate and government entities to promote the conservation, protection, and preservation of the area's critically important groundwater resources. The District manages and operates information collection programs, undertakes scientific investigations, and offers well GPM testing and water quality analysis services as part of its on-going efforts to monitor aquifer conditions.

Information collected by the District and other agencies is broadly summarized in this "Hydrology and Groundwater Resources" report. District's staff prepared maps for this report showing the District boundaries, estimated depth to water, estimated average annual water level declines, estimated aquifer saturated thickness and maps showing District monitor well locations. This report summarizes the number of active and inactive wells, the number of new wells drilled, measured annual groundwater production, and provides a broad overview of general water quality.

II. Definitions

Cretaceous- A geological period corresponding to 65-144 million years ago.

DFC- (Desired Future Condition) a goal set by the District Board of Directors specifying the condition that an Aquifer will be in at a specified time in the future.

GAM- (Groundwater Availability Model) a predictive numerical computer model of Aquifers that the Texas Water Development Board maintains and operates.

Heterogeneous- Consisting of dissimilar elements or parts; not homogeneous.

Jurassic- A geological period corresponding to 144-208 million years ago.

Inter-formational Flow- A flow of water from one formation into another formation.

Intra-formational Flow- A flow of water from one part of a formation into another part of the same formation.

MAG- (Managed Available Groundwater) a groundwater volume results of a GAM based on specified DFC's.

Permian- A geological period corresponding to 245-286 million years ago.

Pliocene- A geological period corresponding to 2.5 to 5.3 million years before the present.

Recharge- The process whereby water is added to an aquifer either through natural or artificial means. Recharge normally refers to rainfall infiltrating an aquifer through a recharge zone.

Red-Bed- a geological strata consisting primarily of red to orange clays and silts in place below the base of the Ogallala Aquifer.

Saturated Thickness - The distance from the top of an aquifer to the base of the aquifer where the pore spaces are filled with water.

Triassic- A geological period corresponding to 208-245 million years ago.

Unconformably (Unconformity) - the surface between successive strata representing a missing interval in the geologic time record.

III. District Boundaries

The North Plains Groundwater Conservation District is in the Texas Panhandle, north of the city of Amarillo and North of the Canadian River. The District consists of approximately 7,390 square miles which includes all of Dallam, Hansford, Lipscomb, Ochiltree and Sherman counties, as well as part of Hartley, Hutchinson and Moore counties.

The original (1954/1955) area of the District included part of Hartley, Moore and Hutchinson counties and all of Sherman, Hansford and Ochiltree counties. Other areas have annexed into the District over time.

Map 1: District boundaries including areas that annexed into the District over time.

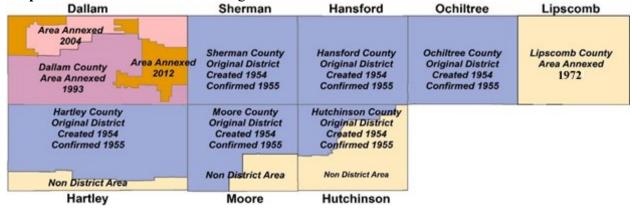


Table 1: County area and percent of each county within the NPGCD.

County	County Area (Sq. Mi.)	Estimated Area in District (Sq. Mi.)	Approximate Number of Acres	Percent of County in the District
Dallam	1505	1505	963,200	100 %
Hansford	907	907	580,480	100 %
Hartley	1463	1244	796,160	83.56 %
Hutchinson	894	278	177,920	30.55 %
Lipscomb	934	934	597,760	100 %
Moore	914	699	447,360	76.51 %
Ochiltree	907	907	580,480	100 %
Sherman	916	916	586,240	100 %
Totals	8440 Sq. Mi.	7390 Sq. Mi.	4,729,600 Acres	

IV. General Geology and Hydrology

Ogallala Aquifer

The Ogallala Aquifer extends from the northern United States into the Texas Panhandle and West Texas and is the primary source of water within the District. The aquifer consists of sands, gravel, silts, and clay sediments that were deposited as part of ancient river systems from about three million to about six million years ago during the Neogene geologic period. An ancient land surface separates the Ogallala from much older strata below of the Permian, Triassic, Jurassic, and Cretaceous geologic periods which range in age from 65 million years to 286 million years. This ancient land surface is called an unconformity and represents between six million years and 65 million years of missing geologic strata in the area.

South of the District, the Canadian River has totally or partially eroded through the Ogallala along much of its length and separates the North Plains from the South Plains. Water-bearing units of Cretaceous and Jurassic ages combine to form the Rita Blanca (a minor aquifer) in the western part of Dallam and Hartley counties. Underlying these aquifers and much of the Ogallala are Triassic age (Dockum Aquifer) sediments and Red Bed strata. The Dockum is a minor, confined to semi-confined aquifer located under Dallam, Hartley and far western Sherman and Moore counties. The water bearing strata is generally locally referred to as the Santa Rosa. For this document, the Ogallala Aquifer is considered to consist of the Ogallala formation and any underlying, potable water-bearing geologic units hydraulically connected with it.

Red Bed (Base of the Aquifer)

Throughout much of the District, the Ogallala aquifer is underlain by "Red Bed". The geology consists of mixed deposits of reddish to orange clay, sands and gravel. The reddish color is caused by staining from the oxides of iron containing minerals. In some areas, the red bed may be absent and in other areas may be several hundred feet thick.

V. Aquifer Thickness or Saturated Material

Saturated thickness maps depict the vertical distance from the water level to the bottom of the aquifer. The saturated thickness of the Ogallala Aquifer ranges from less than 10 feet to over 300 feet and has an estimated average thickness (Table 2) of 148 feet. Saturated thicknesses are calculated every other year and use data from District monitor wells. Other calculation methods will give differing results.

Table 2: 2020-2021 Estimated average aquifer thickness by county (District Area only).

Dallam	Hartley	Sherman	Moore	Hansford	Hutchinson	Ochiltree	Lipscomb
164 ft.	132 ft.	140 ft.	118 ft.	163 ft.	128 ft.	137 ft.	218 ft.

Next scheduled update: Summer of 2023.

VI. Aquifer Recharge, Inflows and Outflows

Surface water and precipitation provide minimal annual recharge to the Ogallala aquifer especially when compared to aquifer withdrawals. District-wide average recharge estimates vary slightly but tend to be below one third of an inch per year. Other inflows and outflows, from and to streams and lateral inflows and outflows tend to be somewhat equal. Some areas of the District however may experience significant local recharge.

The recharge information below (Tables 3,4 and 5) are from the Texas Water Development Board's (TWDB) Groundwater Availability Model Run 17-008. The GAM run was requested by the District for use in the 2018 District Management Plan.

Table 3: Summarized recharge, inflows and out flows to the Ogallala Aquifer. All values are in acre-feet per year rounded to the nearest acre-foot.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from	Ogallala Aquifer	137,029
precipitation to the district		
Estimated annual volume of water that		
discharges from the aquifer to springs and	Ogallala Aquifer	26,368
any surface-water body including lakes,	Oganaia Aquilei	20,308
streams, and rivers		
Estimated annual volume of flow into the	Ogallala Aquifer	50,186
district within each aquifer in the district		
Estimated annual volume of flow out of the	Ogallala Aquifer	94,559
district within each aquifer in the district		
Estimated net annual volume of flow	From Ogallala Aquifer to	
between each aquifer in the district	Rita Blanca and Dockum	3,807
_	Aquifers	

TABLE 4: Summarized inflows and outflows to the Dockum Aquifer. All values are in acre-feet per year rounded to the nearest acre-foot.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from	Dockum Aquifer	49
precipitation to the district		
Estimated annual volume of water that		
discharges from the aquifer to springs and	Do alman A maife	0
any surface-water body including lakes,	Dockum Aquifer	0
streams, and rivers		
Estimated annual volume of flow into the	Dockum Aquifer	4,097
district within each aquifer in the district		
Estimated annual volume of flow out of the	Dockum Aquifer	2,293
district within each aquifer in the district		
Estimated net annual volume of flow	From Dockum Aquifer to	
between each aquifer in the district1	Ogallala and Rita Blanca	1,997
	Aquifers	

TABLE 5: Summarized inflows and outflows to the Rita Blanca Aquifer. All values are in acrefeet per year rounded to the nearest acre-foot.

Management Plan requirement	Aquifer or confining unit	Results		
Estimated annual amount of recharge from	Rita Blanca Aquifer	0		
precipitation to the district				
Estimated annual volume of water that				
discharges from the aquifer to springs and	Dita Dlamas Aguifan	0		
any surface-water body including lakes,	Rita Blanca Aquifer	0		
streams, and rivers				
Estimated annual volume of flow into the	Rita Blanca Aquifer	902		
district within each aquifer in the district				
Estimated annual volume of flow out of the	Rita Blanca Aquifer	229		
district within each aquifer in the district	_			
_	From Ogallala Aquifer to	2 000		
Estimated net annual volume of flow	Rita Blanca Aquifer	2,909		
between each aquifer in the district	ach aquifer in the district From Dockum Aquifer to			
-	Rita Blanca Aquifer	555		

VII. Annual Groundwater Production and Modeled Available Groundwater

Municipal, Industrial, and Agriculture water user groups reported 1,707,029.93 acre-feet groundwater production in the North Plains Groundwater Conservation District in 2020. Production by District County in acre-feet as summarized in Table 6.

Table 6. Groundwater Production (acre-feet) in the District for 2020

County	2020
Dallam	342,745.65
Hartley	402,242.14
Moore	199,359.43
Sherman	328,409.54
Hansford	195,120.62
Hutchinson	79,388.98
Lipscomb	54,522.30
Ochiltree	105,241.27
West	1,272,756.76
East	434,273.17
Total	1,707,029.93

District groundwater production exceeded the 5-year historical production average by approximately 138,830 acre-feet. 2020 production was 15,230 acre-feet higher than 2018 but ranged 38,381 to 341,381 acre-feet less than the Districts annual production from 2011 to 2014. Table 7 below represents annual groundwater production in acre-feet from 2016 to 2020 collectively from all aquifers in the district.

Table 7. Annual groundwater production in acre-feet from 2016 to 2020

County	2016	2017	2018	2019	2020	Average
Dallam	339,200	312,300	349,900	303,200	342,745.65	329,500
Hartley	391,600	376,000	422,600	349,200	402,242.14	388,300
Moore	185,700	173,100	200,600	157,700	199,359.43	183,300
Sherman	285,300	265,100	312,000	255,400	328,409.54	289,200
Hansford	170,400	146,700	190,800	162,300	195,120.62	173,100
Hutchinson	67,700	63,600	75,500	68,400	79,388.98	70,900
Lipscomb	42,300	44,200	44,200	43,400	54,522.30	45,700
Ochiltree	81,400	77,300	95,500	81,800	105,241.27	88,200
West	1,201,800	1,126,500	1,285,100	1,065,500	1,272,756.76	1,190,300
East	361,800	331,800	406,000	355,900	434,273.17	377,900
Totals	1,563,600	1,458,300	1,691,100	1,421,400	1,707,029.93	1,568,200

The District annually reviews groundwater production from the previous year and determines if there are conditions that may trigger District Rule 8.4 and District Rule 8.5 evaluation to reduce Allowable Annual Production. The determination in part is based on the Modeled Available Groundwater (MAG) measured in acre-feet to achieve the desired future conditions (DFCs) in the District. Texas Water Development Board GR16-029 MAG Report provides the model data for the assessment. The table below is a compilation of MAG for Dockum aquifer, Ogallala aquifer and Rita Blanca aquifer DFCs.

Table 8. Compilation of MAG for Dockum aquifer, Ogallala aquifer and Rita Blanca aquifer DFCs.

Modeled Available Groundwater (Acre-Feet)							
County	Aquifer	2020	2030	2040	2050	2060	2062
Dallam	Ogallala/Rita Blanca	387,471	287,205	225,573	166,890	112,864	103,258
Hansford	Ogallala	275,016	272,656	271,226	270,281	269,589	269,479
Hartley	Ogallala	397,585	271,523	212,321	154,433	100,407	90,842
Hutchinson	Ogallala	62,803	64,522	65,652	66,075	66,027	65,956
Lipscomb	Ogallala	266,809	266,710	266,640	266,591	266,559	266,557
Moore	Ogallala	214,853	172,621	139,322	105,016	73,384	67,650
Ochiltree	Ogallala	243,778	243,932	244,002	244,051	244,082	244,085
Sherman	Ogallala	398,056	348,895	281,690	212,744	148,552	136,776
Total	Ogallala	2,246,371	1,928,064	1,706,426	1,486,081	1,281,464	1,244,603
_							T
Dallam	Dockum	14,192	14,188	14,186	14,184	14,184	14,184
Moore	Dockum	4,801	4,532	4,493	4,417	4,289	4,261
Hartley	Dockum	11,602	10,766	10,524	10,560	10,815	10,895
Sherman	Dockum	127	127	127	127	95	93
Total	Dockum	30,722	29,613	29,330	29,288	29,383	29,433
East Zone M	IAG	848,406	847,820	847,520	846,998	846,257	846,077
West Zone N	MAG	1,428,687	1,109,857	888,236	668,371	464,590	427,959
Total Distric	et MAG	2,277,093	1,957,677	1,735,756	1,515,369	1,310,847	1,274,036

Groundwater production within the district for 2020 is below 2020 MAG. Hutchinson County exceeds the 2020 MAG; however, the total groundwater production in East and West Groundwater Management Zones are below the district's target 2020 MAG and 2030 MAG. The table shows the 2020 MAG compared to 2020 Production in acre-feet by county and by management zone.

2020 Annual Production does not exceed the 2020 MAG. Therefore, there are no conditions that trigger District Rule 8.4 and District Rule 8.5 evaluation to reduce Allowable Annual Reduction.

Table 9. Comparison of 2020 annual production to the District's 2020 MAG.

County	2020 MAG	2020 Production	2020 Percent Difference between MAG and Production	Average Production 2016-2020	Average Percent Difference between MAG and Production 2016-2020
Dallam	401,663	342,746	-14.67%	329,500	-17.97%
Hartley	409,187	402,242	-1.70%	388,300	-5.10%
Moore	219,654	199,359	-9.24%	183,300	-16.55%
Sherman	398,183	328,410	-17.52%	289,200	-27.37%
Hansford	275,016	195,121	-29.05%	173,100	-37.06%
Hutchinson	62,803	79,389	26.41%	70,900	12.89%
Lipscomb	266,809	54,522	-79.57%	45,700	-82.87%
Ochiltree	243,778	105,241	-56.83%	88,200	-63.82%
West	1,428,687	1,272,757	-10.91%	1,190,300	-16.69%
East	848,406	434,273	-48.81%	377,900	-55.46%
Total	2,277,093	1,707,030	-25.03%	1,568,200	-31.13%

VIII. Depth to Water, Average Declines Based on Groundwater Production and Declines Observed in District Monitor Wells

Changes in the water table, calculated from monitor well measurements vary from rises in the water level to declines that may locally exceed 8-12 feet per year. Each county in the District has areas experiencing little or no decline as well as areas of much greater decline. Declines are caused predominately by agricultural pumping and are influenced primarily by surface recharge of the aquifer and lateral flows into and out of the aquifer.

Recharge is affected by rainfall, surface runoff, evaporation and plant uptake, depth to water, soil porosity and the geologic substrata present. An aquifer characteristic that affects the speed an aquifer refills and consequently how much water a well can produce is intra-formational flow. Intra-formational flow is the flow of water from one part of an aquifer into another part of the same aquifer.

Table 10: Average yearly county declines in water levels calculated from groundwater production reports.

County	Average Annual Feet of Decline
Dallam	1.98
Hansford	1.87
Hartley	2.81
Hutchinson	2.48
Lipscomb	0.51
Moore	2.48
Ochiltree	1.01
Sherman	3.11

Average declines in water level are calculated values (Table 10) created using reported annual groundwater production and an estimated aquifer specific yield of 18 percent.

Average county declines and average declines observed in monitor wells differ because District monitor wells are predominately located near areas of high pumping. This bias in monitor well location tends to cause an over estimation of declines when used to calculate county averages.

*Table 11: 2020-2021, Average depth to water and comparisons of average declines in <u>select</u> District water level monitor wells.

County	Avg. Depth to Water (Feet)	2020 Avg. Well Decline (Feet)	2019 Avg. Well Decline (Feet)	Current 5-Year Avg. Well Decline (Feet)	Previous 5-Year Avg. Well Decline (Feet)	Current 10-Year Avg. Well Decline (Feet)	Previous 10-Year Avg. Well Decline (Feet)
Dallam	290	2.96	2.58	2.98	3.08	3.05	2.96
Hansford	303	1.67	1.71	1.66	1.63	1.65	1.62
Hartley	365	3.18	3.05	3.14	3.11	3.12	3.43
Hutchinson	350	1.52	1.47	1.51	1.49	1.50	1.59
Lipscomb	164	0.64	0.49	0.63	0.63	.64	0.58
Moore	358	2.12	2.34	2.17	2.26	2.21	1.95
Ochiltree	341	1.68	1.18	1.59	1.40	1.46	1.43
Sherman	321	2.64	2.48	2.61	2.54	2.55	2.48
District-wide	312	2.05	1.91	2.04	2.02	2.02	2.01

^{*}The information in Table 11 is derived from statistical analyses of monitor well hydrographs created from current and historical information. The statistical analyses (indicating both rises and declines) may indicate the quality of information collected from some wells is less than optimal. Such data may be included in the calculations of declines and depth to water as it represents the best or in some cases the only information available.

IX Active Production Wells within the District

District records indicate that there are over 16,000 well permits that have been issued since the District was created in 1955. Currently there are 10,526 large active wells which include wells varying in production between 18 GPM to over 1,000 GPM. During 2021, the District issued 222 permits of all types from January through May 25.

Table 12: Summary of wells in the District and recent new well permits.

County	Active Production Wells	Capped Wells	Small Registered Wells	2020 Permits Issued	2021 Permits Issued Through May 2021
Dallam	2537	267	750	90	64
Hansford	900	434	288	11	10
Hartley	2600	153	416	199	64
Hutchinson	393	146	125	7	8
Lipscomb	286	71	248	7	1
Moore	1310	349	523	27	38
Ochiltree	547	249	289	12	3
Sherman	1953	324	301	32	34
Total	10526	1993	2740	385	222

^{*}Well count totals may vary over time due to differing database query techniques and as any errors are corrected.

X. District Monitor Wells



Typical District Monitor Well

The District monitors declines in groundwater levels by maintaining a network of water-level monitoring wells. Currently the District measures 432 wells (Table 13). Monitor wells are measured annually beginning in January and measurements are complete March or by mid-March at the latest. The information collected is analyzed, used to create maps and plays a vital role in making reasonable long-term management decisions based on the best available data.

As part of its water level monitoring program, the District may drill or install water level monitoring equipment in wells (up to ten wells) annually. The drilled wells are non-production wells dedicated solely to data collection which provide information of more accuracy, reliability, and consistency than other types of wells the District monitors. They are also readily available, if needed, for conducting aquifer tests that cannot be easily conducted using other well types.

Table 13: 2021 water level monitor wells by county.

County	Number of Monitor Wells
Dallam	68
Hartley	67
Sherman	60
Moore	52
Hansford	67
Hutchinson	25
Ochiltree	48
Lipscomb	45
Total	432

District monitor well under construction

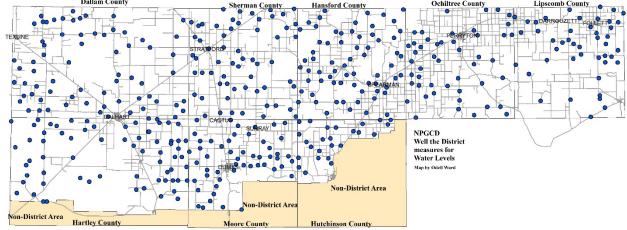


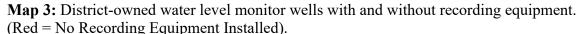
XI. District Monitor Well Locations and On-line Interactive Maps

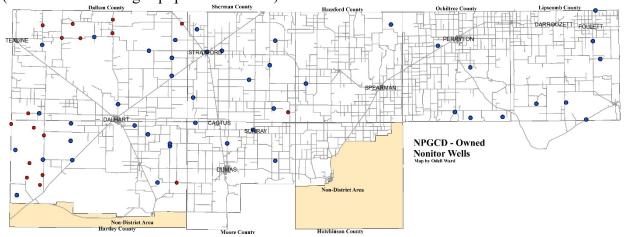
The District maintains a website where data from wells, monitor wells and recording equipment may be viewed. The map is always a work in progress and all data may not yet be available. More data and other map layers may become available as work on the on-line map progresses.

http://map.northplainsgcd.org/

Map 2: Map of private well locations from which the District annually measures water levels.







XII. Water Quality

The District's goals for groundwater is that future water supplies are of sufficient quantity and also of excellent quality. The District monitors groundwater chemistry by analyzing samples from select wells within the District and performing water quality analyses upon request from area residents.

District Natural Resource Specialist performing a water quality analysis.



The District may analyze water samples for the following parameters as necessary:

Total Hardness,

Chloride,

Conductivity,

Fluoride,

Iron,

Nitrate,

pH,

Sodium,

Sulfate,

Total Dissolved Solids.

The Presence or Absence of Coliform Bacteria.

Groundwater within the District is considered excellent although it is "hard" water and contains considerable calcium and some magnesium carbonate (hardness) (Table 14). The District also performs analyses to indicate the presence or absence of coliform bacteria. In the rare instance an analysis indicates the presence of coliform bacteria, the contamination source is often located within a few yards of the sampled well. Normally a well that tests positive for coliform bacteria can be decontaminated by eliminating the contaminate source, chlorinating the well, pipes and water storage equipment and then purging the well, pipes and water storage equipment.

Table 14: Typical mineral analyses from wells within the District.

Parameter	Units	2018 Number of Analyses	2018 Average Analysis Result	2019 Number of Analyses	2019 Average Analysis Result	2020 Number of Analyses	2020 Average Analysis Result
Sulfate	mg/l	32	50.8	29	44.68	USGS Samples	Due 2021
Nitrate	mg/l	22	11.14	29	1.653	USGS Samples	Due 2021
Total Iron	mg/l	22	0.234	29	.0433	USGS Samples	Due 2021
Chlorides	mg/l	22	60.77	29	30.57	USGS Samples	Due 2021
Fluoride	mg/l	22	.0466	29	.661	USGS Samples	Due 2021
Total Hardness	mg/l	22	217	29	208	USGS Samples	Due 2021

^{*}Due to the 2019-2020 Corvid19 pandemic, routine scheduled sampling and analyses were not undertaken. However, 16 samples were taken in cooperation between United States Geological Survey and the District. Results due to be published in late 2021.

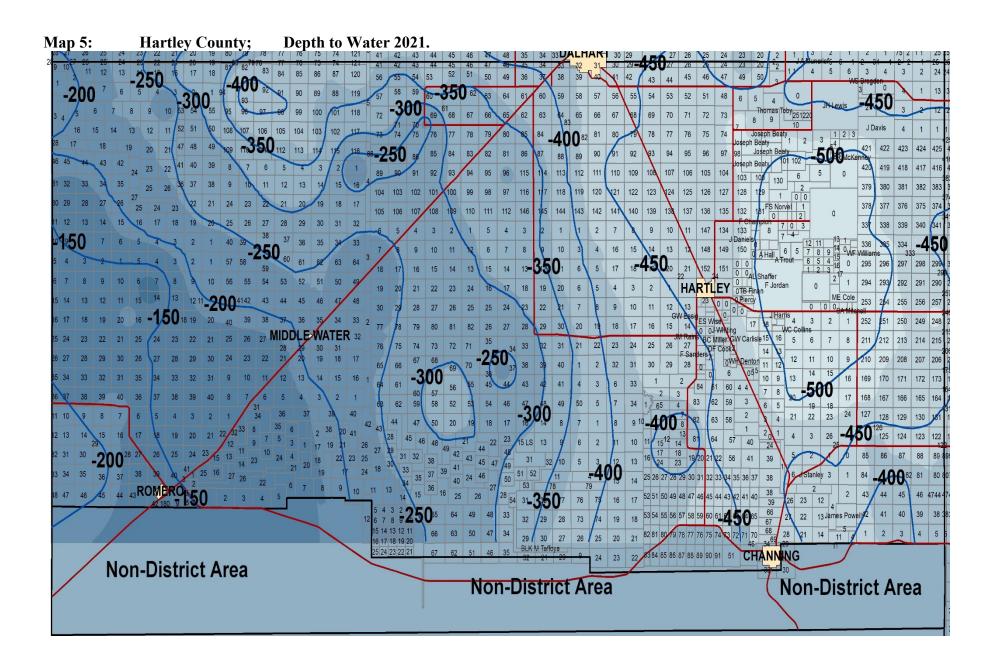
Table 14 shows the average mineral compositions indicated from analyses of well water from within the District. The District samples random wells at the owner's request as well as annually analyzing a subset of wells from the District's monitoring well program. No meaningful conclusions may be drawn from the above table about potential changes in water quality over time as the values are not all from the same set of wells. District residents may request a groundwater analysis by contacting the District. In most instances the analyses are free to District residents.

XIII. 2021 Depth to Water from Land Surface

Maps depicting depth to water below land surface are created from statistical analyses of current and historical water level measurements. The most recent water level measurements were measured in January and February of 2021. Those water level measurements represent the depth to water at the end of the 2020 agricultural pumping season and prior to the beginning of the 2020 pumping season. It would be valid to title the maps either 2020 or 2021 Depth to Water.

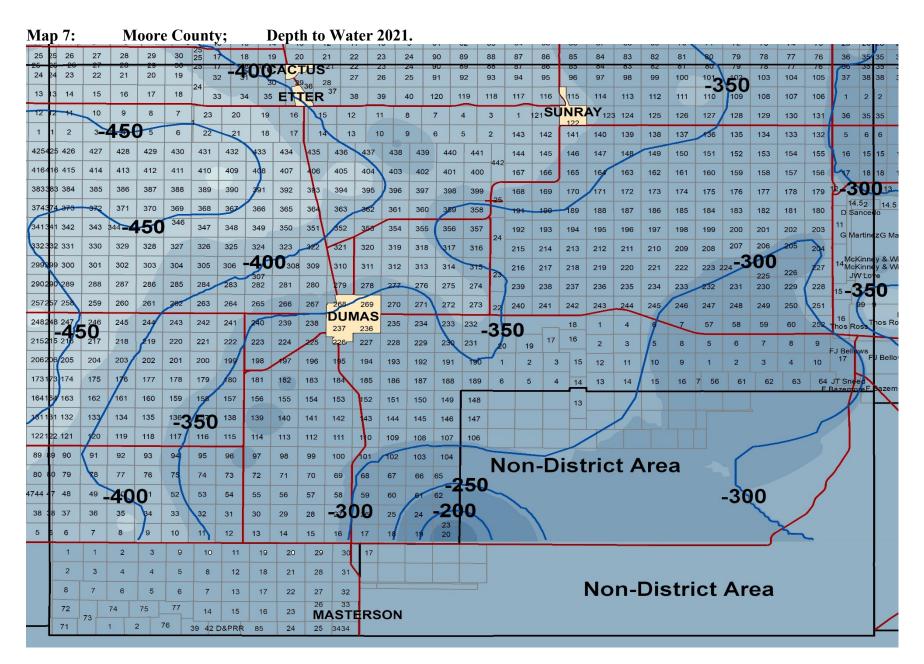
Accuracy: The accuracy of the depth to water is estimated to be equal to the contour interval, +/-50 feet.

Map 4: Dallam County; Depth to Water 2021.

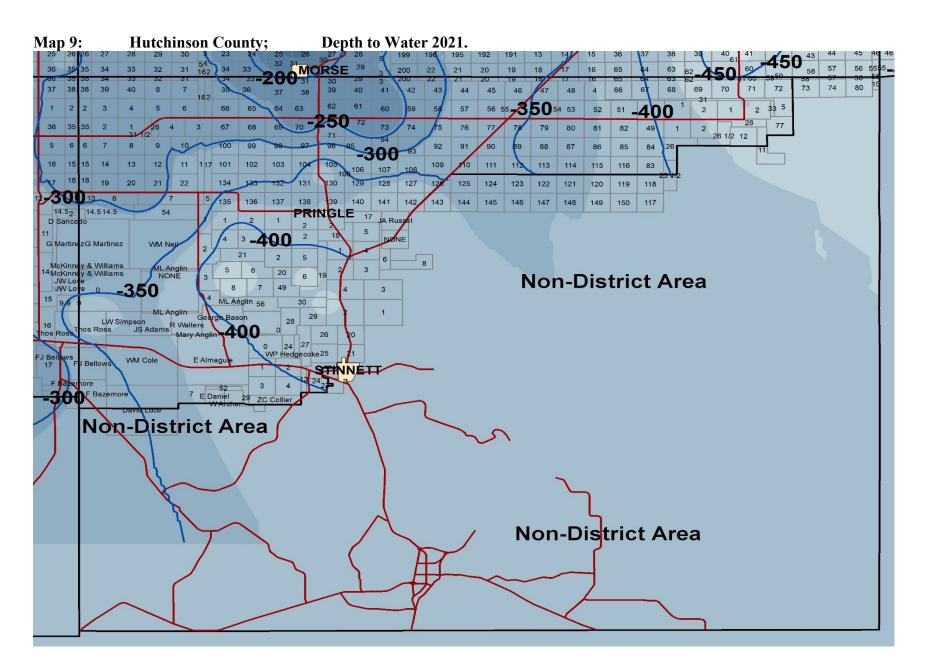


Map 6: Sherman County; Depth to Water 2021.

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14	14	13	12	11	10	9	8	7	6	5	4	3	2	1	196	195	166	165	136	135	106	105	76	75	46	45	_	15		30 0	8 4
23	23	24	25	26	27	28	29	30	31	32	33	800	35	224	197	194	167	164	137		107	104	77	74	47	3∯C	17	14	2	47 4	7 5
48	48	47	46	45	44	43	42	41	40	39	38	37	36	228	198	193	250	163	30	Т	108	103	78	73	48	43	18	13	3	46 4	6 5
57	57	58	59	60	61	62	63	64	65	66	67	68	69	222	199	192	168 169	162	138	133	109	102	79	72	49	42	19	12	4	45 4	5 5:
82	82	81	80	79	78	77	76	75	74	73	72	71	70	221	200	191	170	161	140	131	110	101	80	71	50	41	20	11	5	44 4	4 5
91	91	92	93	94	95	96	97	98	99	100	101	102	103	220	201	190	171	160	141	130	111	100	81	70	51	40	21	10	6	43	3 5
116	116	115	114	113	112	111	110	109	108	107	106	105	104	219	202	189	172	159	142	129	112	99	82	69	52	39	22	9	7	42 4	2 5
125	125	126	127	128	129	130	131	132	133	134	135	136	137	218	203	188	173	158	143	128	113	98	83	68	53	38	23	8	8	41 4	1 50
150	150	149	148	147	146	145	144	143	142	141	140	139	138	217	204	187	174	157	-36	0 127	114	97	84	67	54	37	24	7	9	40 4	0 5
159	159	160	161	162	163	164	165	166	167	168	169	170	171	216	205	186	175	156	145	126	115	96	85	66	55	36	25	6	10	39 3	9 58
184		183	182		STR	ATF	٧/	177	176	175	174	173	172	215	206	185	176	155	146	125	116	95	86	65	56	35	26	5	11	38	59
193	193	194	195	196	180	170 198	178 199	200	201	202	203	204	205	214	207	184	177	154	147	124	117	94	87	64	57	34	27	4	12	37 3	8— 7 60
218	218	217	216	215	214	213	212	211	210	209	208	207	206	213	208	183	178	153	148	123	118	93	88	63	58	33	28	3	13	36	6 6
227	227	228	229	230	231	232	238	234	235	236	237	238	239	212	209	182	179	152	149	122	119	92	89	62	59	32	29	2	14	35 3	5 62
252	252	251	250	249	248	247	246	245	244	243	242	241	240	211	210	181	180	151	150	121	120	91	90	61	60	31	30	1	15	34 3	4 63
261	261	262	263	264	265	266	267	268	269	270	271	272	273	55	54	37	36	19	18	1	72	55	54	37	36	19	18	1	16	33 3	3 64
286	286	285	284	283	282	281	280	279	278	277	276	275	274	56	53	38	35	20	17	2	71	56	53	38	35	20	17	2	17	32	2 65
295	295	296	297	298	299	300	301	302	303	304	305	306	307	57	52	39	34	300) ₁₆	3	70	57	52	39	34	21	16	3	18	31 6	5 6 66
320	320	319	318	317	316	315	314	313	312	311	310	309	308	58	51	40	33	22	15	4	69	58	51	40	33	22	15	-30		30 6	7 67
329	329	330	331	332	333	334	335	336	337	338	339	340	341	59	50	41	32	23	14	5	68	59	50	41	32	23	14	5	19	29 6	368
354	354	53	352	351	350	349	348	347	346	345	344	343	342	60	49	42	31	24	13	6	67	60	49	42	31	24	13	6	21	28 6	969
363	363	35	U 365	366	367	368	369	370	371	372	373	374	375	61	48	43	30	25	12	7	66	61	48	43	30	25	12	7	22	27 7	D 70
388	388	387	386	385	384	383	382	381	380	379	378	377	376	62	47	44	29	26	11	8	65	62	47	44	29	26	11	8	23	26 7	1 /
397	397	398	399	400	401	402	403	404	405	406	407	408	409	410	46	45	28	27	10	9	64	63	46	45	28	27	10	9	24	25 7	2 72
424	424	423	422	421	420	419	418	417	416	415	414	413	412	411	1	2	3	4	-5	6	7	8	9	10	11 1	2 1	3 1	4	15	1 /2	2
433	_2	100	435	436	437	438	439	440	21	50 44	12 443	444	445	446	30	29	28	27	26	25	24	23	22	21	20 1	9 1	8 1	7	16 1	12 11	11
433	460	459	458	457	456	455	454	453	452	451	450	449	448	447	31	32	33	34	35	36	37	38	³⁹ –3	50	41 4	2 4	3 4	14	45 1	13 14	14
	T.	1	2	3	4	5	1	2	3	4	5	6	7	8	60	59	58	57	56	55	54	53	52			9 4	8 4	17	46	24 23	23
77		10	9	8	7	-	16	15	14	13	12	11	10	9	61	62	63	64	65	66	67	68	69	70	71 7	2 7	3 7	4	75 2	25 26	28
25	25	26	27	28	29	30 25	17	18	19	20	21	22	23	24	90	89	88	87	86	85	84	83	82	81	80 7	9 7	8 7	7		36 35	35
24	24 :	23	22	21	20	19 24	32	31	30CA	CIL	JS ²¹	27	23 26	24 25	90	92	93	94	95	96	97	98	99 1	100 1	101 10	02 10	3 1	04 1	105	36 35 37 38	38



Map 8: Hansford County; Depth to Water 2021. HITCHLAND 145 192 193 240 146 191 195 238 15023 22 29 30 31 24 23 153 184 -200 -300 134 155 -3**50** 10 133 156 111 - 3300₅₉ 101 45 GRUVER 40 127 162 125 124 211 222 259 141 140 -250 SPEARMAN 117 124 149 150 310 158 DC Jones 159 160 102 103 103 152 151 113 11 177 178 153 154 183/ -300 -200 -350 23 22 32MORSE



Map 10: Ochiltree County; Depth to Water 2021.

∩ 22 22 7 / 4 − 8 9 10	14 5	000	21 29	13	12	11	19	1		2		3	4 4	22	1	22	5 4 6
150		121 100 9		56 55 34	1	- K	44 43	42	41 40	39	38	7 36	35	34 33	32		0 30 29 2
9 10 NOI	NE TEdwards	120 101 9	8 79 76	57 54 35	32 13	10	0 046	47	48 49	50 - 9	50	52 53	54	55 56	57	58 59	59 60 6
150 - 200 / N		119 102 9	7 80 75	58 53 36	31 14		7				400 4	25 404	123	100 10	120	1181	18
12 11 11 -250	T Tomlinson GF Sage JNO Hickm	20		59 52 37		0	132 131	130	129 128	127	126 1	25 124	123	122 12	120-1	BOO	KER117
19 20 20 HC Day TJ Sparks WJ Mito	hell JJ Ware	117 104 9 116 105 9		60 51 38 61 50 39			133 134	135	136 137	138	139 1	40 141	142	143 14	145	146 1471	47 148 1
22 21 2 3 4	5 6 7	20 115 106 9	_	62 49 40	_	1	188 1187	1186	1185 1184	1183	1182 1	181 118	0 1179	1178 11	77 1176	250	174 1173 1
-150 21 2 3 4 14 13 12 11	10 9 8	114 107 9	2 85 70	63 48 41	26 19	4 1	101 1102	1103	1104 110	5 1106	1107 1	108 110	9 1110	1111 11	12 1113		115 1116 1
-200 ₁₅ ₁₆ ₁₇ ₁₈	19 20 21	113 108 9	1 86 69	64 4746 42	243 25 20	21 2 1	1099	1098	1097 109	6 1095	1094 1	093 10	2 1091	1090 10	89 1088	1087 1	086 1085 1
31 31		27 12 109 9		300	9 24 PE		TON									1086	
2 1 1 28 - 300 26 25 2	50 ²³ ²²	28 111 110 8		45 44	23 22		013 1014		1016 101			020 102			24 1025	1027	027 1028 1
3 4 4 29 30 31 32	33 34 35	0 8 7	6 5	3	2	1	012 1011	1010	1009 100	B 1007	1006 1	005 10	4 1003	1002 10	01 1000	999 9988	998 997 !
6 5 5 42 41 40 39	38 37 36	9 10	11 12	13 14	15	16	925 926	927	928 929	930	931	932 93	934	935 9	937	938 9399	939 940 !
7 8 8 43 44 45 46	47 48 49	24 23	22 21	20 19	18	17 9	924 923	922	921 920	919	918	917 91	915	914 9	13 912	911 9109	909
10 9 9 56 55 54 53	52 51 50 FARNSWOR	8 7 TH	6 5	4 3	2	1 8	837 838	839	840 841	842	843	344 84	5 846	847 8	849	850 85 18	851 852
12 11 11 57 58 59 60	s 2 1	9 10	11 12	13 14	15	16 8	836 835	834	833 832	831	830	829 82	827	826 8	25 824	823 8228	
21 22 19 RM Thompson 22 22	4 5 -3	50 24 23	22 21	20 19	18	17	749 750	751	752 753	754	755	756 75	7 758	759 7	50 761	762	763
24 23 23 18 WAKA 16 15	9 8 7	25 26	27 28	29 30	31	32	748 747	746	-300	743	742	741 74	739	738 7	736	735 734	734 733
9 10 10 11 12 13 14	0 10 11 12	40 39	38 37	36 35	34	33 (661 662	663	664 665	000	667	668 66	9 670	200	2 673	674 67 56	676 6
28 27 27 26 25 24 23	13 31 2	41 42	43 44	45 46	3 47	48	660 659	658	657 656	655	654 653	250	652 651	650 6	19 648	647 6466	646 645 6
42 43 43 44 45 46 47	14 3	56 55	54 53	52 51	50	49	573 574	575	676 577	578		580 58	1 582	583 5	34 585	586 587	587 588
53 52 52 51 -450 48	15 16 17	₅₇ -400	59 60	61 62	63	64	572 571	570	569 568	567	566	565 56	563	- 50 5	560	559 558	558 557
72 73 73 74 75 76 77	20 19 18	72 71	70 69	68 67	66	65	485 486	487	488 489	490	491	192 49	3 494	495 4	6 497	498 4994	199 500 :
83 82 82 81 80 79 78	21 22 23	73 74	75 76	77 78	79	80 4	484 488	482	48 480	479	478	177 47	3 475	474	0047	2 471 4704	170 469
	3 26 25 24	88 87	86 85	84 83	82	81 3	397 396	396	400 401	402	403 4	04 40	406	407 4	¹⁸ -1 ⁴ 5	410 4 14	411 412
113 112 111 110 109 108	25 26 27	89 90	91 92	93 94	95	96 3	396 395	394	393 392	391	390 :	389 38	387	386 38		383 3823	382 381 :
132 133	24 6 3	104 103	102 101	100 96	98	97	309 310	311	312 313	314	315	316 31	7 318	319 3	321	322 3233	323 324
400	7 4 1	105 106	107 108	109 110	0 111	112 3	308 307	-35	3 04	303	302	301 30	299	298 29	7 -2(294 293 2
143 142 141 140 139 138 8 1 1 4 15 18 19	28	120 119	118 117	116 11	5 114	113 2	221 222		224 225	226	227 2	228 229	230	231 23	2 233	234 2352	235 236 2
7 222 3 14 16 17 20	28 22 0	121 122	123 124	125 120	6 127		221 40 220 219	218	217 216	226 -3 215	214	213 21:	2 211	210 20	208	207 2062	
13	21 Ja Ballentir		134 133	132 13			133 134		136 137		1	-		143	4 145		47 148
	20	137 138	139 140	141 14:	-/-		132 131		129 128			⁴⁰ 25	<u> </u>	122 12	300	119 118	250
45 46 46 47 48 49 18 56 55 55 54 53 50 1717	30 Anton		150 149	148 14			45 46	47	48 49	50		52 53		55 5			59 60
50 56	15 14	102 101	149	140 14	140	143	40	4	49	30	31	52 53	54	55 5	5/	58 51	39 60
80 [15]																	

Lipscomb County; Depth to Water 2021. Map 11: BOOKER117 1156 1158 1154 1153 1152 102 951 952 LIPSCOMB -200 160 161

XIV. Declines (from 2020 Pumping) in Monitor Wells by County

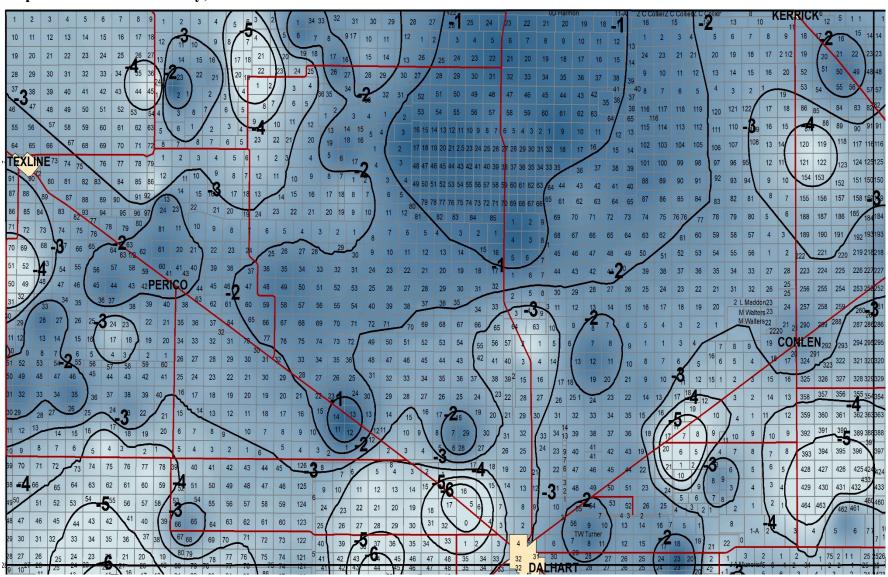
These maps do not include well measurements that indicate rises in water level. Rises may be valid for some specific areas but generally the statistical analyses do not indicate a high level of confidence in that data, therefore it is not used.

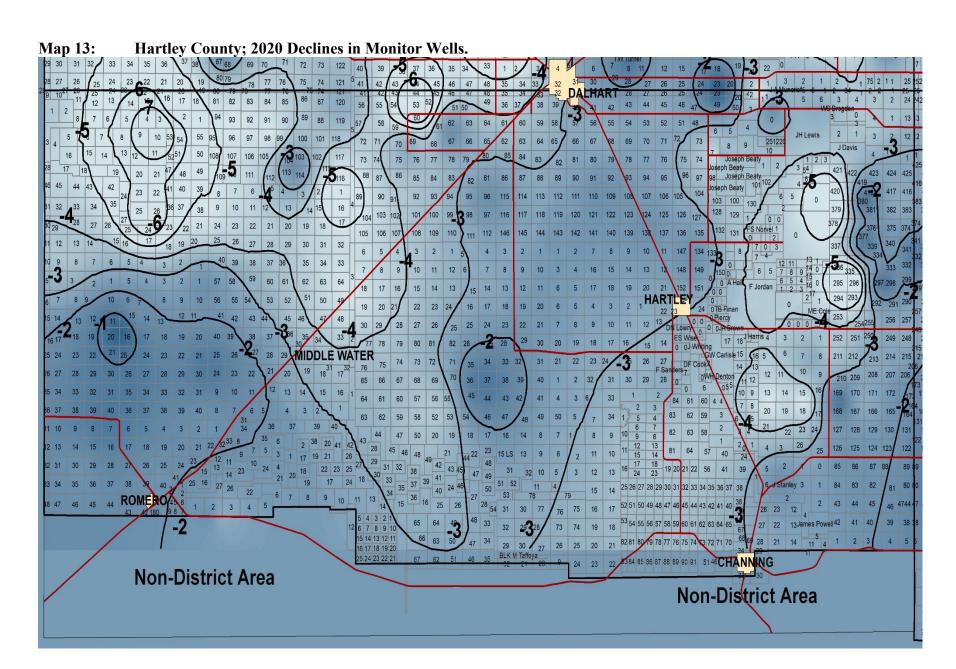
Maps depicting declines in monitor wells are created from a statistical analysis of current and historical water level measurements. The most recent water level measurements were taken in January and February of 2021. The declines represent declines resulting predominantly from the 2020 agricultural pumping season.

Declines are calculated using water level measurements taken from District monitor wells which are located primarily in high pumping areas. Consequently, these wells tend to show higher declines than what a true county-average-decline would show.

Accuracy: The accuracy of the decline maps is estimated to be +/- 2 feet.

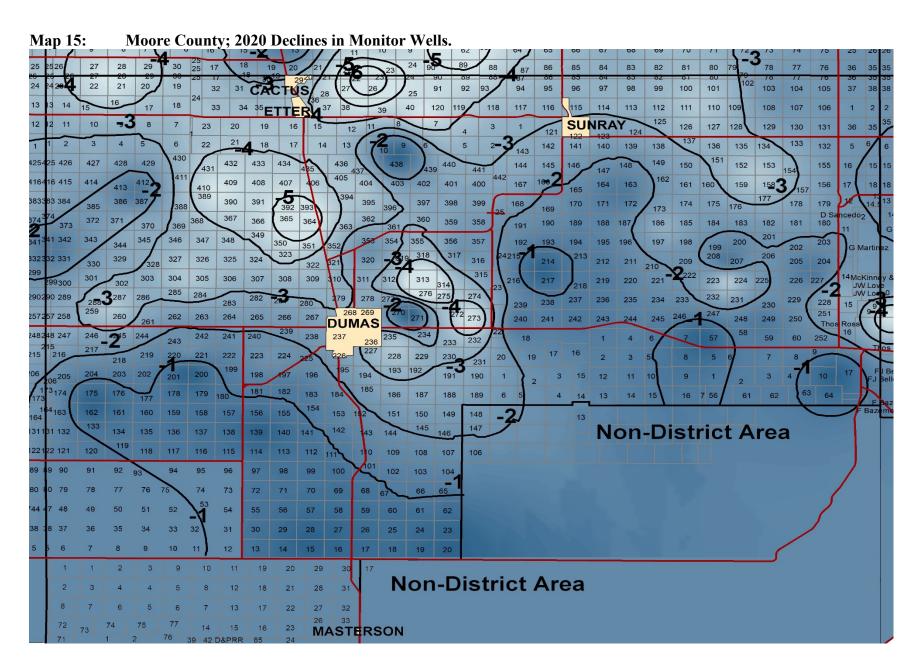
Map 12: Dallam County; 2020 Declines in Monitor Wells.



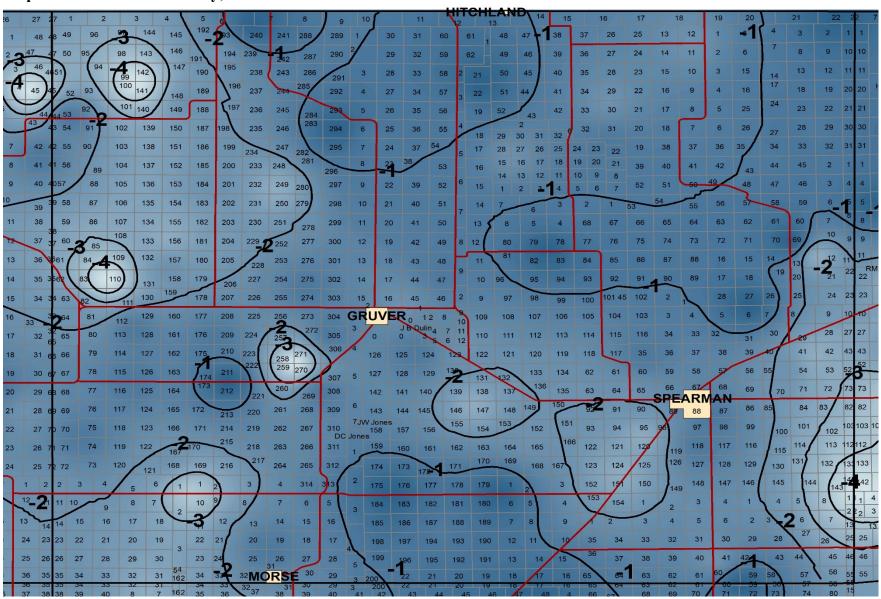


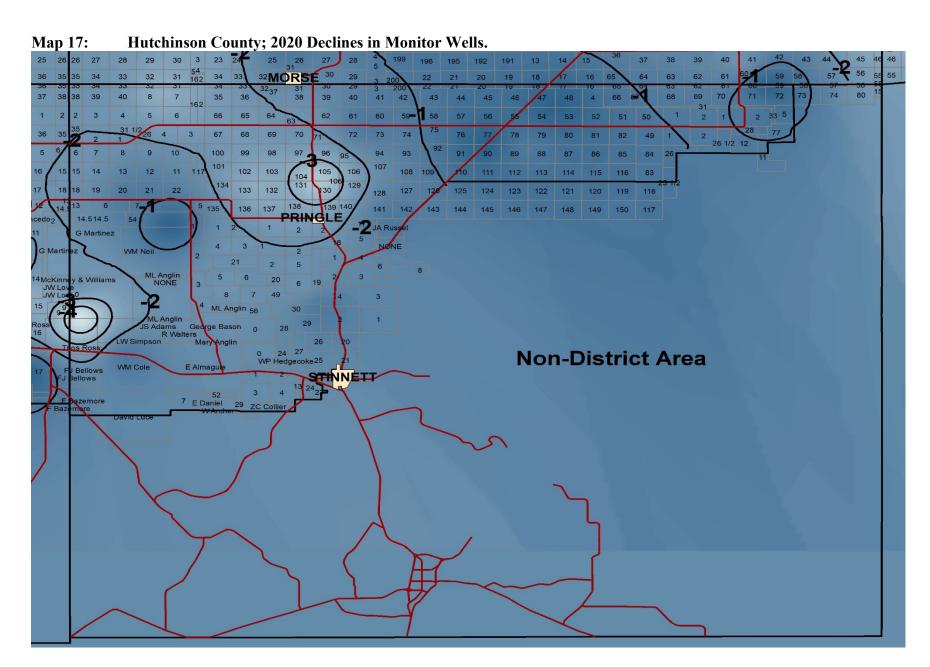
Map 14: Sherman County; 2020 Declines in Monitor Wells.

Map 14:	Snerm	an C	oun	ιy; 2	2020	Dec	iine	S III .	MOU	nor	w e	us.						TEY	HON	ЛΔ						
1 2	3 4	5 6	6	7	8	9	10	11	12	13	14	15	1	6	17 18		19 20	3	21	22	23	24_	2 :	25	26	27 27
14 14 13 12	11 10	9	8	7	6	5	4	3	2	1	196	195	166	165	136	135	106	105	2 76	75	46	45	16	15	1	48 48
23 23 24 325	26 27	28	29	30	31	32	33	34	35	224	197	194	167	164	137	3 ₁₃₄	107	104	77	74	47	44	17	14	2,3	47 47
48 48 47 46	45 3	43	⁴² -3	41	40	39	38	37	36	223	198	193	168	-2	138	133	108	103	78	73	48	43	18	13	(3)	46 4651
57 57 58	60 61	62	63	64	65	66	67_4	68	69	222	199	192	169	162	139	132	109	102	79	72	49	42	19	12	1_(4	45 45
82 82 81 80	79 78	77	76	75	74	73	72	19	70))	221	200	191	170	161	140	131	110	101	80	71	50	41	20	11	5	44/14
91 91 92 93	94 95	96	97	98	99	100	101	02	93	220	201	190	171	160	141	130	111	100	81	70	51	40	21	10	6	43/43
116 116 115 114	113 112	111	110	109	108	107	106	105	104	219	202	189	172	159	142	129	112	99	82	69	52	39	22	9	7	42 42
125 125 126 127	128 129	130	131	132	(133	134	135	136	137	218	203	188	173	158	143	128	113	98	83	68	53	38	23	8	8	41 41
150 150 149 148	14% 146	145	144	143	142	141	140	139	138	217	204	187	174	157	144	127	114	97	84	67	54	37	24	7	9	40 405
159 159 160 161	162 163	164	165	166	167	168	169	170	171	216	205	186	175	156	145	126	115	96	85	66	55	36	25	6	10	39 39
184 184 183	181 3 1	ATFO	178	177	176	175	174	173	172	215	206	185	176	155	146	125	116	95	86	65	56	35	26	5	11	38
193 193 194 19 5	3 196 197	198	199	200	201	202	203	204	205	214	207	184	177	154	147	124	117	94	87	64	57	34	27	4	12	37 37
218 218 217 216	215) 214_	3 :13	212	211	210	209	208	207	206	213	208	183	178	153	148	123	118	93	88	63	58	33	28	3	13	36 866
227 227 228 229	230 231		238	234	235	236	237	230	239	212	209	182	179	152	149	122	119	92	89	62	59	32	29	2	14	35 356
252252 251 250		247	246	245	244	243	242	241	240	211	210	181	180	151	150	121	120	91	90	61	60	31	30	1	15	34 34
261261 262 263	264 265	200	267	268	269	270	271	272	273	55	54	37	36	19	10	1	72	55	54	37	36	19	18	1	16	33 - 2
286 286 285 284	283 282 298 200	10/	280	279	278	277	276	275	274	56	53	38	35	20	17	2-	71	56	53	38	35	20	17	2	17	32 65
295 295 296 297	299	300	301	302	303	304	305	306	307	57	52	39	34	1	16	3	70	57	52	39	34	21	16	3	18	31 66
320 320 319 318	317 316	315 334	314	313	312	311	310	309	308	58	51	40	33	22	15	4	69	58	51	40	33	22	15	4	19	30 67
329 329 330 331			335	336	337	338	339	340	341	59	49	41	32	1	14	5	68	59	50	41	32	23	14	5	20	29 68
354 354 353 352		349	348	341	346	345	344	343	342	60	1.	43	31	24	13	6	67	60	49	42	31	24	13	6	21	28 69
363 363 364 365 386		368	369	370	371	372	-	374	375	61	48	1	30	7 L	12	7) "	61	48	43	30	25	12	7	22	27 70
388388 387	385 384	383	382	381	380	379	378	1	376	62	47	144	29	20-2	10	L.	65	62	47	44	29	26	11	8	23	26 71
397 398 399	421 421	402	1	404	405	406	407		409	410	46	45	28	27	-	_ 9	64	63	46	45	28	27 1	10	9	24	25 72
424 423 422	420		418	417	416	415	414	413	412	411	1	29	28	4	5		7	8		21			13 14		15	1 2 2
433 434 435	437	438	439		441	442 451	443	444	445	446 447 -	30	4		27	26	25		23	22	20	1			17 16		12 11 11
460 460 459 458	456		454	453	12	1	450	449	448		³¹	32	33		35		-		39	40 4		49			45 13	14 14
7 7 10 2	3 4	5		2	3	4	12	6	7	8	60	59	58	57	56	55		53	52		50	4				24 23 23
7 10 9 25 2526 27	8 7	6 30 25	16	15 18	10	13	//	11	5°	9 24	000	62 89	88	64	65 86	66 85		83		_	71 80 79					25 26 26 36 35 35
25 25 26 27 25 25 20 27 24 24 23 22	20 29	90 25	17	18	30 19	2970	1/21	225	23	74	90	89	88	87 87	86	85	84	83	62	81 0	50	70 7	0	77	76 3	35 35
13 3	21 20	19 24	32	³¹ C	AC	FUS	28	27	26	25	91	92	93	94	95	96	97	98	99 1	100 1	01	10	03 1	04 1	05 3	38 38



Map 16: Hansford County; 2020 Declines in Monitor Wells.





Map 18: Ochiltree County; 2020 Declines in Monitor Wells.

22 20 7 8 9 10 14	5			10 1	2 2	1 1 22 1 1 1 64 8 8
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	5 6	21 29 13 99 78 77 56 55	12 11 5 34 33 12 11	44 43 42 41	40 39 38 37	36 35 34 22 10 2 10 30 30 30 30 30 30 30 30 30 30 30 30 30
10 10 WM NONE	T Edwards 120 101	98 79 76 57 54	35 32 13 10	45 46 47 48	49 50 51 52	53 54 55 56 57 1 58 59 59
10 10	119 102		3 36 31 14 9	132 131 130 129	128 127 126 125	124 123 122 121 120 BOOK
GF Sage	T Tomlinson 118 103 JNO Hickman JJ Ware15 117 104		37 30 13 8	100	120	119 118 118
20 20 HC Day WJ Mitchell TJ Sparks GC W	oods 116 105		39 28 17 6	135	1182	47
21 21 1 2 3 4 5 6	⁷ ₂₆ 115 106		40 27 16 5	188 1187 1186 1185	1400	
30 30 14 13 12 11 10 9	8 114 107	92 85 70 63 48 91 86 69 64 47	7 42 25 20 2	101 1102 1103 1104	1105 1106 1107 1108	1 86
31 31 15 16 17	20 21 112 109	\ \ \cspF	RRYTON 2 2 1	100 1099 1098 1097	1096	1092 1091 1090 1089 1088 1087 1086
1 1 28 27 26 25 24 2	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	89 88 67 66 45	44 23 22 1	1015 1016	1017 1018 1019 1020	1021 1022 1023 1024 1025 1026 1027
33	34 35 87	6 5 4		012 1011 1010 1009	1007 1006 1005	1004 1003 1002 1001 1000 999 99 8998
5 5 42 41 / ₄₀ /-O ₃₉ 38	36 9 10	11 12 13	14 15 16 9	925 926 927 928	929 930 931 932	933 934 935 963 937 938 93939
	48 49 23 ²⁴ 25 51 50 8 7	22 21 20	19 18 17 9	924 923 922 921	920 919 918 917	916 915 914 913 912 9119 0910
9 9 56 55 54 53 52 5 FARN	SWORTH 50 8 7	6 5 4	3 2 1 8	837 838 839 840	841 842 843 844	845 846 847 848 ⁸⁴⁹ 850 85 1851
2 11 11 57 58 59 60	2 1 9 10	0 11 12 13	14 15 16 83	835 834 833	832 831 830 829	828 827 826 825 824 823 82 2822
22 RM Thompson 1 22 19 20 21 22 4	5 6 24 23	3 22 21 20	19 18 1	749 750 751 752	753 754 755 756	757 758 769 761 762 76 3763
4 23 23 18 WAKA 15 9	8 7 25 26	5 27 28 29	30 31 32 7	748 747 746 745	744 743 742 741	740 739 738 736 735 73 4734
10 10 11 12 13 14 40 10	11 12 40 39	9 38 37 36	35 34 33 6	661 662 663 664	665 666 667 668	669 670 671 672 673 674675675
27 27 26 25 24 23 13 3	1 2 41 42	2 43 44 45	46 47 48 6	660 659 658 657	656 655 654 653	652 651 650 649 648 64764 6646
43 43 44 45 46 47 14	3 56 5	2 / ₅₄ 53 52	51 50 49 5	573 574 575 576	577 578 579 580	TO CONTRACT OF THE PARTY OF THE
52 52 51 50 49 48 15 16	17 57 58	59 60 61	62 63 64 5	572 571 570 569	568 567 566 565	564 563 562 561 560 559 55 8558
73 73 74 75 76 32 20	19 18 72 7	70 69 68	67 66 65 48	486 487 488	489 490 491 492	493 494 495 496 497 498 48 94 99
82 82 81 78 21	22 23 73 74	4 75 76 77	78 79 80 4	484 483 482 481	480 479 478 477	476 475 474 473 472 471 470470
	25 24 88 87	7 86 85 84	83 82 81 3	396 396 400	401 402 403 404	405 406 407 408 409 410 411411
3 112112 110 109 108 25	27 89 90	91 92 93	94 95 96 3	396 395 394 393	392 391 390 389	388 387 386 385 384 383 382 382
111 7	3 104 10	3 102 101 100	99 98 97 3	394 310 311 312	313 314 315	6 317 318 319 ³²⁰ 321 322 323323
137	105 10	6 107 108 109	110 111 112 3	310	304 303 302 301	300 299 298 297 296 295 294 294
143	28	19 118 117 116	115 114 113 2	221 222 223 224	225 226 227 228	230 231 232 233 234 235 235
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13 13	JJ Ballentine	125	75	1	137 138 139 140	141 142 143 144 145
25 25 24 23 22 21 29	20 137 13		142 143 144 13		128 127 126 125	124 123 122 121 120 119 118118
5 48 46 47 48 49 18 30	19 Anton 157 15		147 146 145 45	2 47 48	49 50 51 52	-1
6 55 55 54 53 50 1717 16 1	5 14 132 13	1 130 149 146	17/ 140 145 45	47 48	49 50 51 52	53 54 55 56 57 58 59
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Map 19: Lipscomb County; 2020 Declines in Monitor Wells.

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30 30	29	28	27	2 6	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3-	2	1 127
59 59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	⁸⁸ 126
300K	ER44	116	115	114	113	112	111	110	109	108	107	106 DA	105 RRO	104 UZF	103	102	101	100	99	98	97	96	95	94	93	92	91	90	89 125
147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168 E	169)LLF	170	171	172	173	174	175	176 128
75 1174	1173	1172	1171	1170	1169	1168	1167	1166	1165	1164	1163)		1160	1159	1158	1157	1156	1155	1154		1152	1151	1150	1149	1148	1147	1146	1145 121
1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	1144
87 1086	1085	1084	1083	1082	1081	1080	1079	1078	1077	1076	1075	1074	1073	1072			1069	1068	1067	1066	1065	1064	1063	1062	1061	1060	1059	10 <u>5</u> 8	1057
26 1027 1027	1028	1029	1030	1031	1032	103	³ 1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056 119
99 99 8 998	997	996	995	994	993	992	991	990	989	988	987	986	985	984	983	982	981	980	979	978	977	976	975	974	973	972	971	970	969 115
919939	940	941	942	943	944	945	946	947/	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968 113
11 910910	909	908	907	906	905	904	903	902	901	900	899	898	897	896	895	894	893	892	891	890	889	888	887	886	885	884	883	882	881
50 85 1851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880 111
23 82 2822	821	820	819	818	817	816	815	814	813	812	811	810	809	808	807	806	805	804	803	802	801	800	799	798	797	796	795	794	793 110
62763763	764	765	766	767	768	769	6 %	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792
35 73 4734	733	732	731	730	729	728	727	726	725	724	723	722	721	720	719	718	717	716	715	714_	713	712	711	710	709	708	707	706	705 NON 108
74675675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704
47646646	645	644	643	642	641	640	639	638	637	636	635	634	633	632	631	630	629		627	626	625	624	623	622	621	620	619	618	617
86 58 7 587	588	589	590	591	592	593	594	595	596	597	598	599	600		sco		604	605	606 539	607	608	609	610	611	612	613	614	615	616 106
59 55 8558	557	556	555	554	553	552	551	550	549	548	547	546	545	544	543	542	541	540	0	538	537	536	535	534	533	532	531	530	529 105
98 49 9499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	451	519	520	521	522	523	1	525	526	527	528 103
71 47 0470	469	468	467	466	465	464	463	462	461	460	459	458	457	456	455	454	453	452		450	449	448	447	446	445	444	443	442	441 102
10 41 1411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432 361	433	434	435	436	437	438 355 _	439	440 97
33 382382	381	380	379	378	377	376	375	374	373	372	371	370	369	368	367	366	365	364	363	362	24	360	359	358	357	356	1	351	353
22 32 3323 95 294294	293	325	326 291	327	328	329	330	331 286	332 285	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349		1	352
34 23 5 2 3 5	293	292	238	290	240	288	287	243	285	284	283	282	281	280	279	278	277	276 253	275	274	273	272	271	270	269	268	267 262	266	265
07 206206	205	204	203	202	201	200	199	198	197	196	195	194	193	192	191	190	189	188	187	255 186	256 185	257 184	258 183	259 182	260	180	HIGO	65 178	177
46	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	181		179	175	176 82
118118	117	116	115	114	113	112	111	110	109	108	107	106	105	104	103	102	101	100	99	98	97	96	170	94	93	173 92	-	90	170
59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	91	81	82	83	84	92	91	90	09 04
0 09	60	01	62	63	64	05	-00	67	00	69	70	71	12	73	74	75	76		78	79	80	81	82	83	84	85	86	87	88

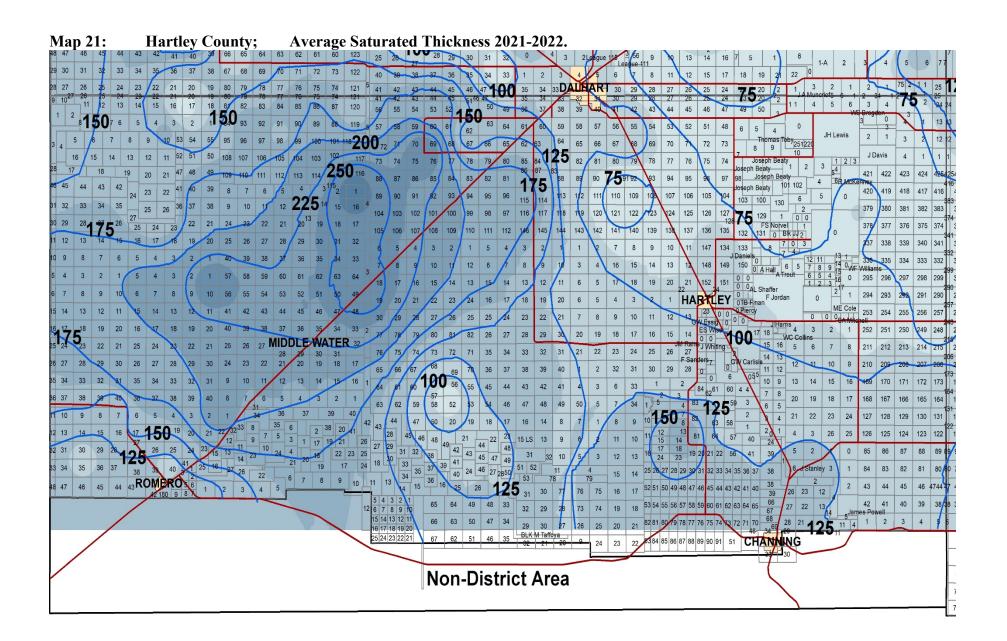
XV. 2021-2022 Estimated (Average) Saturated Thickness of the Ogallala Aquifer by County

Maps depicting estimated aquifer saturated thickness are created using geographical information mapping software and may be created by various methodologies. The most recent water measurements used in creating saturated thickness maps were taken in January, and February of 2021. The water level elevations calculated represent the water level elevations at the end of the 2020 pumping season and the beginning of the 2021 pumping season. The Saturated Thickness maps represent the saturated thickness at the beginning of 2021 and is considered reasonably accurate for at least a three-year period.

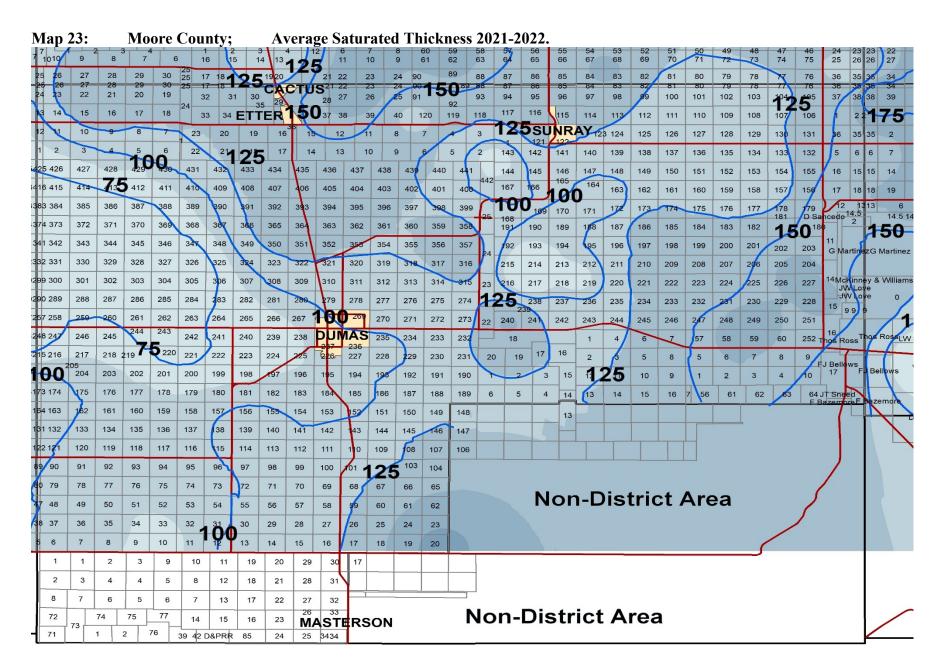
Estimated Saturated Thickness Maps are created every other year. The next set of estimated aquifer thickness maps are scheduled to be created by mid-Summer of 2023.

Accuracy: Map accuracy is estimated to be equal to +/- 50 feet. In some areas data may have been included from the Rita Blanca or the Dockum Aquifers due to the uncertainty in delineating those boundaries. Inclusion of such data may increase the value of the saturated thickness of the Ogallala above what may be encountered in the field.

Map 20: **Dallam County**; Average Saturated Thickness 2021-2022. CONLENS

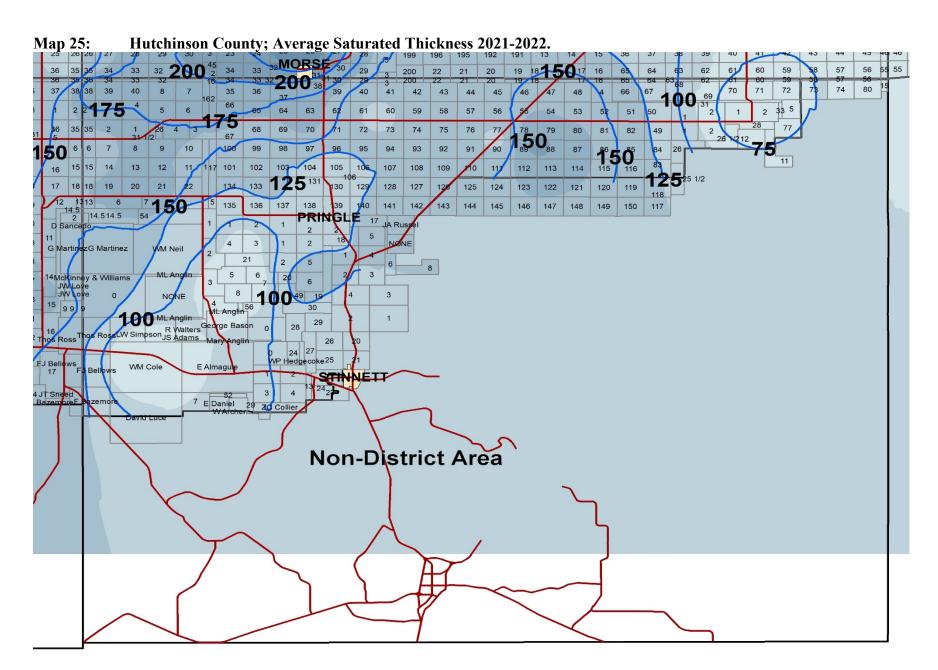


Map 22: **Sherman County**; Average Saturated Thickness 2021-2022. TEXHOMA 21 14 14 13 48 4 23 23 1/25 48 48 47 175₇₂ 169 215 57 57 45 52 4 53 43 43 54 17 116 116 24 125 125 126 132 133 51 150 150 149 58 159 15**9 50** 182 181 STRATEORD 85 184 184 183 92 193 193 194 218 218 217 216 36 61 34 34 63 53 252 252 251 249 248 60 26561 262 283 282 286286 285 94 295 295 296 31 66 320320 319 313 312 317 316 30 67 67 50 41 100 32 28 329329 330 332 333 29 68 68 55 354354 353 28 69 69 125₃₆₃ 371 372 27 70 70 39 388 388 387 386 1 7 5 384 383 380 379 26 71 71 25 72 72 421 420 419 413 412 436 437 438 150 440 444 445 150²⁸ 11 11 454 453 **125** 452 451 61 460 460 459 13 14 14 23 23 26 26 25 35 35 CACTUS



Map 24: Hansford County; Average Saturated Thickness 2021-2022.

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2	47	7 50	95	98	143	146	191	194	239	00	287	290	2	29	32	59	62	49	46	39	4	27	24	14	11	3/	6	7	8		10 10
3	142	5 51	94	99	142	147	190	195	238	243	286	291	3	28	33	58	2 21	50	45	40	35	28	23	15 2	50	3	15	14 1	13	12 1	11 11
4	45	45 52	93	100	141	7.	189	196	237	244	285	75°	92 4	27	34	57	3 22	51	44	41	34	29	22	16	25	4	16	17 1	18	19 2	20 20
5	44	4 53	92	101	140	149	188	197	236	245	284	293	5	26	35	56	19	52	43	42	33	30	21	17	23	5	25	24	23	22 2	21 21
6	43	43 54	91	102	139	150	187	198	235	246	283	294	6	25	36	55	4 18		2	1	32	31	20	18	7	6	26	27	28	29 3	30 30
7	42	42 55	90	103	138	151	186	199	234	10	282	295	7	24	37	54	_ 17	29	30 31 27 2 6		24 23		19	38	37	36	35	34	33	32 3	31 31
8	41	41 56	89	104	137	152	185	200	233	247 248	281	296	8	23	38	53	16	15	16 17	18	19 20		39	40	41	42	43	44	45	2	1 1
a		40 57	88	105	136	153	184	201	232	249	280		7 9	22	39	52	6	14	13 12		10 9	8	52	51	50	10	48		46	3	4 4
10	5 0		87								12	25 ²⁹					15	1	2 3		5 6				55	50	200	47	59	6	5 8
10				106	135	154	183	202	231	250	279	298	10	21	40	51	7 14	7	6	3	2 68	5 0	53	54	55	56	57	58		7	8 8
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12	37	37 60	85	108	133	156	181	204	229	252	277	300	12	19	42	49	8 12	80	79	78	77	76	75	74	73	72	71	17	#/		9 9
13	36	6 61	84	109	132	157	180	205	228 227	253	276	301	13	18	43	48	11	81	82	83	-84	85	86	87	88	16	15	14	13	12 1	11 11
14	35	35 62	83	110	131	158	179	206	17	(5 ²⁵²	275	302	14	17	44	47	10	96	95	94	93	92	91	50	89	17	18	19	20	21 2	22 22
15	34	34 63	82	-111	130	159	178	207	226	25525	274	303	15	16	45	46	2 9	97	98	99	100	101 45	102	2	1	28	27	26	25	24	23 23
16	20	3 64	81	112	129	160	177	208	225	00	273	304	GRU	AF	२ 0 1	2 8	10 10	10	8 107	106	105	104	103	3	4	5	6	7	8	9 1	10 10
17	32	32 65	80	113	128	161	176	209	224	257	272	305	3	B	Dalin)	4 7	11 11	11	1 112	113	114	115	116	34	33	32	31	30	29	28 2	27 27
18	31	66 66	79	114	127	162	175	210	22	5258	271	306	12	26 12	25 71	2012	12:	2 12	1 120	119	118	117	35	36	37	38	39	40	41	42 4	43 43
19	7	5 , 67	78	115	126	163	174	211	222	259	270	307	5 12	27 12	28 12	29 / 13	0 13	13	2 133	134	62	61	60	59	58	57	56	55	54	53 5	52 52
20		68 68	T	116	125	164	173	212	25	0 260	269	308	1		41 1	40 /13		8 13	7 136	135	63	64	65	66	67	68	69	70	71	72 7	73 73
21		69 69	76	117	124	165	172	213	220	261	268	309	6 1	7	17	5/ 14		-		-	_	91	90 S	PEA	RM	AN	86	85	84	83 8	82 82
			75	118	123	166	171	214	219	262	267	310	7JW	lones	- 1	5 0		4-			93	94	95	88	88 97	87 98	99	100	101	102 10	03103
22		70 70					170	214				DC	Jønes 1		4								/	110	118	117		115	114	113 1	12 112
23		71 71	74	119	122	167	170	215	218	263	266	311				128	16	-		_	+	121	120			25	120	130	131		33 133
24	25	72 72	73	120	121	168	169	216	217	264	2 65	312	1	74 1	73 1	72 17						124	125		127	128	129				10110
L	1 2	2 2	3	4	5 6	1	1	2	3	4	314	B13	1	75 1	76 1	77 17	78 17	9	1 2	3	152	15/1	150	149	148	147	146	145	144	143 14	11112
	50	11 11	10	9	8 7	2	10	9	8	7	6	5	3 1	84 1	83 1	82 18	31 18	0 6	5 5	4	153	154	1	2	3	10	0	4	5	8	222
	13	14 14	15	6	17 1	8	11	12	13	14	5	16	1	85 1	86 1	87 18	88 18	9	7 8	9	/	2	3	4	5	6	2	3	6	7	13 1
;	24 2	3 23	22 2	1 2	20 1!	9	22	21	20	19	18	17	4 1	98 1	97 1	94 1	93 19	0 1	2 11	10	35	34	33	32	31	30	29	28	27	26	25 25
	25 2	6 26):	27 2	8 2	29 3	0	23	24	25	26	27	28	₅ 1	199 1	96 1	95 1	92 19	91 1	3 14	15	36	37	38	39	40	41	5 42	43	44	45	46 46
District Co.	36 3	5 35	34 3	3 3	32 3	54 1 162	34	33	³² MC	RSI	30	29	3 2	200	22	21 2	20 1	9 18	150	17 16	65	64	63	62	61	60	59	58	57	56	55 55
5	36 3 37 3	8 38	34 3 39 4	0	52 3 8 7	162	34 35	33 36	32	38 ³¹	39	40	341	42	43	44	45	9 18 46	47 .	17 18 18 4	65 66	64	68	69	70	71	72	78	74	80	15



Map 26: Ochiltree County; Average Saturated Thickness 2021-2022.

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1 1					1	T		121	100 9			56 55	34		2 11	44 6	25	42	41	40	39	38	37	39	E:A	34	33	32	31 3	10 30
	١.	VVM		NØ	NE	TEd	ward	25	101 9	8 79	76	57 54	35	32 1	3 10	45	46	47	48	49	50	51	52		50	55	56	67	58 5	59
10 10	1	VVIVI	/	7		_			102 9	7 80	75	58 53	36	31 1	4 9			47						<i>J S S S S S S S S S S</i>	A		36	31	11	8118
11 11	1	_/	1	5 0	GE S	T Tor	nlinson	118	103 9	6 81	74	59 52	37	30 1	5 8	132	131	130	129	128	127	126	125	124	123	122	121	120 1	BO	OKE
20225	HC	DayTJ	Sparks	WJ Mite	chell	ago JINC	Hickm J Ware	15 117	104 9		_	60 51		29 1		133	134	135	136	137	138	139	140	141	142	143	144	145	146 14	7147 1
21 21		2	3	4	5	Woods 6	7	116	105 9	_		61 50 62 49	39	28 1	_	1188	1187	1186	1185	1184	1183	1182	1181	1180	1179	75 .	1177	1176	1175	1174
			13	/			2	115 114	106 9 107 9	3 84	71	101	40		8 5 9 4	1101	1402	1103	1104	1105	1106	1107	1108	1100	1110	4444				1115
30 30 2		J	12	(1	10	9	8	113			00	64 47	41	\rightarrow	0 3		102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114 111	5 1115
31 31	15 ¹⁴	16	_リ/	18	19	20	21	27 112	1	25 86 87		65 46			RR	1100 Y 10	1099	1098	1097	1096	1095	1094	1093	1092	1091	1090	1089	1088	1087	1086
111	28	17	26	25	24	23	22 ,	28 111	110 8	90 88	67	66 45		23 22		1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023	1024	1025	1026	1027
	29 /	27 30	31	32	100		35	8	7	6	5		3	2	1	1012	1011	1010	1009	1008	1007	1006	1005	1004	1003	1002	1001	1000	102 99999	il .
4 4		30	31		33	34		9	10	11	12	13	14	15	16	005	006	007	000	000	000	201		000	004					9939
5 8	42	41	40	39	38	37	36					-				925	926	927	928	929	930	931	932	933	934	935	963	2 0	938	
8 8 9	5 _	44	45	46	47	48	49 2	24	23	22	21	20	19	18	17	924	923	922	921	920	919	918	917	916	915	914	913	912	9119	0910
9 9	56	55	54	53	52	51	50	8	7	6	5	4	3	2	1	837	838	839	840	841	842	843	844	845	150		75	849	8508	1851
11 11	57	58	59	60	FAR		VOR	9	10	11	12	1,3	14	15	16	836	835	834	833	832	831	830	25		827	826	825	824	82382	2822
		RM Th	mpsor		4	5	6	24	23	22 2	112	5 20	19	18	17/	749	750	751	752	753	754	755	829	828	700	750	760	701	76076	2762
22 22	19	20	21	22		+ -	-								\mathbf{H}	143	730	731	732	755	754	755	756	757	758	759	760	761	16216	3763
23 23	18	WAT	(A	15	9	8	7	25	26	27	28	29	30	31	32	748	747	746	745	744	743	742	741	740	789	738	737	736	73573	4734
10 10	11	12	13	14	10	11	12	40	39	38	37	36	35	34	33	661	662	663	664	665	666	667	668	669	670	671	672	673	67467	5675
27 27	26	25	24	23	13		1 2	41	42	43	44	45	46	47	48	660	659	658	657	656	655	654	653	652	651	650	649	648	64764	6646
	20				14	31	3	- 56	55	54	53	52	51	50	49	573	574	575	576	577	578	579	580	581	582	583	584	585	E06 F	7587
43 43	44	45	46	100	<u> </u>		32												-		-	_	-	301					58658	
52 52	51	50	49	48	15	16	17	57	58	59	60	61	62	63	64	572	571	570	569	568	567	566	565	564	563	562	561	560	5595	8558
73 73	74	75	76	77	32 20	19	18	72	71	70	69	68	67	66	65	485	486	487	488	489	490	491	492	493	494	495	496	497	49849	9499
	81	80	79	78	21	22	23	73	74	75	76	77	15	A 79	80	484	483	482	481	480	479	478	477	476	475	474	473	472	47147	0470
				-	33 26	25	24	88	87	86	85	84	83	82	81	397	396	396	400	401	402	403	404	1 ₀₅	5 ₆	407	408	409	4104	1.411
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133133	134	135	136	137	24	6	3	104	103	102	101	100	99	98	97	309	310	311	312	313	314	315	316	317	318	319	320	321	32232	3323
142 142	141	140	139	138	7	5	2	105	106	107	108	109	110	111	112	308	307	306	305	304	303	302	301	300	299	298	297	296	29529	4294
	141				-	2	8	120	119	118	117	116	115	114	113		222	223	224	225	226	227	228	229	230	231	232	233	234 23	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	14	15	18	19	27	22	0									221			217		1				>	22	25			
13 13		16	17	20	28			121	122	123	124	1252	5 26	127	128	220	219	218	12	5 ²¹⁶	215	214	213	212	211	210	209	208	20720	6206
25 25	24	23	22	21	29	21JJ E	Ballentin	e 136	135	134	133	132	131	130	129	133	134	135	136	137	138	139	140	141	142	143	144	145	14614	7147
46 46	47	48	49	18	30	20	QΩ	137	138	139	140	141	142	143	144	12	131	130	129	128	127	126	125	124	123	122	121	120	119 1	8118
		-			-	19		152	151	150	149	148	147	146	145	45	46	47	48	49	50	51	52	53	54	55	56			
55 55	54 	53	50	1/1	7 16	15	<u> </u>	132	131	130	149		17'	140	145		40	47	40	49	30	31		33	34	755	30	57	58 5	59
h A																														

Map 27: Lipscomb County; Average Saturated Thickness 2021-2022.

10		6 9	7	8	98	10		7	, 11		12	6	14 151	6 17	18 ₅	19	20	4 2	1	22	23 24	25	26	27 28	2 29	30	31	1	53 34
30	29	²⁸ 25	27 25	26	25	24 65	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	72	00	5	4	3	2	1
59 8 118	60	61	25 62	63	64	75	66	67	68	69 2 C	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88
OK	ER₁₁	7 116	115	114	113	112	111	110	109	2 .0		106	105	104	103	102	101	20	O ⁹	98	97	96	95	94	93	92	91	90	89
7147	148	149	150	151	152	153	154	155	156	157 D	ARR 158	9 52	160	161	162	163	164	165	166	167	168 E 6	169	170	171	172	173	22	5 ¹⁷⁵	176
1174	1173	1172	1171	1170	1169	1168	1167	1166	1165	1164		1162	1161	1160	1159	1158	1157	1156	1155	1154	1153	1152	1151	1150	1149	1148	¹¹⁴⁷ 2	50	114
1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128 11		25	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	114
1086	1085	1084	1083	1082	1081	1080	1079	1078	1077	1076	1075	1074	1073	1072	1071	1070	1069	1068	1067	1066	1065	1064	1063	1062	1061	1060	1059	1058	105
1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	250	1043	1044	1045	1046	1047	1048	17	5 105	0 1051	1052	1053	1054	1055	105
8998	997	996	995	994	993	992	991	990	989	988	987	986	985	984	983	982	981	980	979	978	977	976	975	974	973	972	971	970	969
9939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968
0910	909	O°Ô	907	906	905	904	903	902	901	900	899	898	897	896	895	894	893	892	891	890	889	888	887	886	885	₆₈ 2	QO	882	88
1851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880
2822	821	820	819	818	817	816	815	814	813	812	811	810	809	808	807	806	805	804	803	802	801	800	799	798	150	796	795	794	79:
3763	764	765	766	767	768	769	770	771	772	773	774	775/	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	79
4734	733	732	731	730	729	728	727	726	725	724	723	722	721	720	719	718	717	716	715	714	713	712	711	710	709	708	707/	706	70
5675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	17.	25	703	70
6646	645	644	643	642	641/	640	639	638	637	636	635	634	633	632	631	630	629	628	627	626	625	624	623	622	621	620	225	618	61
7587	588	589	590	591	592	593	594	595	596	597	598	599	600	601 LIP	602 CO	603 MB	604	605	606	607	608	609	610	611	612	613	614	615	616
8558	557	556	555	554	553	552	551	550	549	548	547	546	545	544	543	542	541	540	539	538	537	536	535	534	533	532	531	530	529
9499	500	501	502	20	0 504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	0526	527	528
0470	469	468	467	466	465	464	463	462	461	460	459	458	457	456	455	454	453	452	451	450	449	448	447	446	445	444	443	442	44
1411	112	413	414	415	416	417	418	419	420	421	422	423	424	425	426	25	5Q.	429	430	431	432	25 (434	435	436	4:2	25	439	440
2382	381	380	379	378	377	376	375	374	373	372	371	370	369	368	367	366	365	364	363	362 36	27	5360		358	357	356	355	354	35
3323	324	325	326	327	328	329	330	331	332	333	つき	O ³³⁵	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	35
4294	293	292	291	290	289	288	287	286	285	284	283	282	281	280	279	278	277	276	275	274	273	272	271	270	269	268	267	266	26
5235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262 H	IGG	M.
6206	205	204	203	202	201	200	25	198	197	196	195	194	193	192	191	190	189	188	187	186	185	184		182	181	180	179	178	17
7147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	00	172	173	174	175	17
8118	117	116	115	114	113	112	111	110	109	108	107	106	105	104	103	102	101	100	99	98	97	96	95	94	93	92	91	90	89
9 59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88

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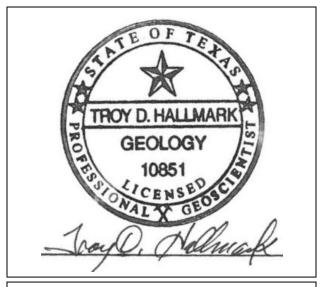
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