INTERA Incorporated
1812 Centre Creek Drive, Suite 300
Austin, Texas, USA 78754
512.425.2000

DRAFT TECHNICAL MEMORANDUM

To: Steve Walthour, General Manager, North Plains Groundwater Conservation District

From: Neil Deeds, INTERA

Date: April 6, 2016

RE: DRAFT GMA-1 Predictive Runs

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1 INTRODUCTION

Four predictive runs were completed for GMA-1 with the TWDB High Plains Aquifer System GAM. These runs represent variations of the run described in the memo submitted to TWDB August 31st, 2015, titled "DRAFT GMA-1 Predictive Runs Performed Under TWDB Contract for Development of the High Plains Aquifer System Groundwater Availability Model."

Two new runs were completed. The guidelines for these runs are provided by GMA-1 representatives. Run numbering starts at #5, to discriminate between these new runs and the four runs described in a previous memo of March 16. Variations in the scenarios are described below.

Run 2016.5: Initial pumping rates in the Ogallala Aquifer were set for all counties in North Plains GCD (NPGCD), along with target rates for year 2020 for four of the counties in NPGCD as follows (acre-feet per year):

County	2012	2013	2014	2015	2016	2020
Dallam	371,965	399,272	393,624	314,899	400,000	390,000
Hansford	218,793	201,914	211,634	169,307	277,961	
Hartley	458,696	458,998	442,058	353,646	450,000	400,000
Hutchinson	72,230	69,716	73,992	59,194	74,000	
Lipscomb	55,572	42,519	48,791	39,033	55,000	
Moore	234,688	228,297	209,907	167,926	235,000	215,000
Ochiltree	109,213	98,280	106,278	85,022	115,000	
Sherman	348,012	346,685	361,336	289,069	365,000	400,000

Ogallala Aquifer. With the exception of High Plains Water District (HPWD), targets were based on fraction remaining after 50 years (in 2062), specifically NPGCD-west (0.40), NPGCD-east (0.50), Panhandle GCD (PGCD) (0.50), and Hemphill County Underground Water Conservation District (HCUWCD) (0.80). In HPWD, targets were based on average drawdown, corresponding to pumping rates set at 150% of 2012 pumping rates. The resulting drawdowns are provided in tables following this section.

Dockum Aquifer. As with the August 31st, 2015 run, the Dockum targets were set as a fraction of available drawdown in NPGCD-west (0.40). In the other districts, Dockum targets were based on average drawdown after 50 years (in 2062). Specifically, Panhandle GCD (30'), HPWD (40'), Oldham County-No GCD (30'), Randall County – No GCD (40').

In Run 2016.1, the saturated thickness where pumping was curtailed was set to 30 feet.

Run 2016.6: Same as 2016.5, except saturated thickness where pumping was curtailed was set to 10 feet.

For both of these runs, pumping in GMA-2 was set to the 2012 estimated rate, multiplied by a factor of 1.5. Limited sensitivity analyses indicated that GMA-1 results were not very sensitive to GMA-2 pumping rates.

2 RESULTS

The results are provided in the form of tables for each of the runs. Tables 1 – 6 for each run are identical in format and content to Tables 1 – 6 provided in the August 31, 2015 memo, with the exception that 2070 results are added to all tables. Note that tables are prefixed with the run number, e.g. Table 6, Run 5 is titled 2016.5.6. The run results are presented sequentially.

In all cases, District targets were met within 0.005 for fraction remaining, and 0.5 ft for drawdown.

The effect of decreasing the saturated thickness at which pumping was curtailed was to increase availability slightly in some counties. For example, in Dallam County in 2016 the target pumping was 400,000 acre-feet/year. When the minimum was 30', only 395,000 acre-feet/year was achieved (Table 2015.5.4), while a 10' minimum allowed the full 400,000 acre-feet/year to be achieved (Table 2016.6.4).

Table 2016.5.1: Groundwater in storage and fraction remaining by zone for the Ogallala Aquifer in GMA-1.

Ogallala	Groundwater In Storage (af)							Fraction Remaining from 2012					
Zone	2012	2020	2030	2040	2050	2062	2070	'20	'30	'40	'50	'62	'70
North Plains GCD - West	58,258,886	48,599,829	39,195,551	32,014,723	26,925,644	23,344,959	22,225,821	0.84	0.67	0.55	0.46	0.40	0.38
North Plains GCD - East	68,850,807	64,397,228	57,006,628	49,791,550	42,758,214	34,550,322	29,206,785	0.94	0.83	0.72	0.62	0.50	0.42
Hemphill County UWCD	15,434,318	15,056,398	14,369,077	13,686,823	13,032,615	12,289,613	11,821,746	0.98	0.93	0.89	0.84	0.80	0.77
Panhandle GCD	76,865,219	71,216,151	62,071,200	53,719,244	46,241,251	38,427,583	33,892,620	0.93	0.81	0.70	0.60	0.50	0.44
High Plains UWCD No. 1	3,073,984	2,860,686	2,542,905	2,254,864	2,017,547	1,785,576	1,657,118	0.93	0.83	0.73	0.66	0.58	0.54
No GCD	9,635,730	8,836,429	7,645,995	6,625,769	5,787,730	5,007,151	4,598,369	0.92	0.79	0.69	0.60	0.52	0.48

Table 2016.5.2: Fraction remaining by zone for the Dockum Aquifer in GMA-1.

	Fraction Remaining from 2012					
Zone	2020	2030	2040	2050	2062	2070
North Plains GCD - West	0.89	0.75	0.62	0.51	0.40	0.33
Panhandle GCD	0.93	0.82	0.72	0.65	0.57	0.53
High Plains UWCD No. 1	0.86	0.72	0.60	0.51	0.41	0.36
No GCD	0.94	0.86	0.79	0.73	0.68	0.65

Table 2016.5.3: Available groundwater and average drawdown in the Rita Blanca Aquifer for the Dallam County in GMA-1.

Rita Blanca	Available Groundwater (afy)							Average Drawdown (ft)					
County	2015[1]	2020	2030	2040	2050	2062	2070	2020	2030	2040	2050	2062	2070
Dallam	6,197	6,207	6,197	6,177	6,145	6,151	5,914	13	27	39	47	53	57

[1]2015 rates are identical to the last year of the calibrated model (2012) except in NPGCD where other rates were provided by NPGCD staff.

Table 2016.5.4: Available groundwater and average drawdown in the Ogallala Aquifer for the counties comprising GMA-1.

Ogallala	Available Groundwater (afy)								Average Drawdown (ft)					
County	**2015**	**2016**	**2020**	**2030**	**2040**	**2050**	**2062**	**2070**	**2020**	**2030**	**2040**	**2050**	**2062**	**2070**
North Plains GCD														
Dallam	305,394	395,833	382,325	281,007	220,013	160,745	97,105	65,036	15	29	40	47	52	54
Hansford	169,191	276,822	275,769	272,655	271,968	270,280	269,478	269,128	17	41	66	89	116	134
Hartley	353,307	450,493	398,674	271,523	212,902	154,432	90,842	58,539	20	37	49	58	64	65
Hutchinson	59,153	74,151	62,975	64,522	65,831	66,075	65,956	64,791	13	33	53	73	95	110
Lipscomb	39,006	55,112	267,540	266,710	267,370	266,591	266,556	266,546	12	34	55	75	99	115
Moore	167,811	235,480	215,441	172,620	139,703	105,016	67,650	47,446	20	41	57	69	77	80
Ochiltree	84,963	115,225	244,446	243,931	244,670	244,050	244,085	244,094	13	37	61	84	112	130
Sherman	288,843	364,947	399,146	348,894	282,462	212,744	136,775	93,843	24	53	75	91	104	108
District Total	1,467,668	1,968,063	2,246,316	1,921,862	1,704,919	1,479,933	1,238,447	1,109,423						
Hemphill County UWCD														
Hemphill	21,935	55,176	52,338	52,217	52,409	52,305	52,340	52,358	4	11	18	25	32	37
Panhandle GCD														
Armstrong	7,495	57,669	58,142	53,413	48,302	43,461	38,080	34,782	6	16	25	34	42	47
Carson	129,714	181,368	192,661	184,263	170,395	153,767	134,054	121,448	12	29	44	57	71	79
Donley	39,476	69,404	75,012	76,288	73,162	67,872	60,901	56,275	5	13	21	27	33	37
Gray	41,540	171,475	181,601	175,267	163,099	148,713	131,744	121,136	9	25	40	53	66	74
Hutchinson	74	10,106	15,777	16,740	15,197	13,324	11,454	10,171	14	41	67	91	115	129
Potter	7,349	15,775	17,015	15,820	14,480	13,162	11,609	10,644	3	7	11	14	17	19
Roberts	79,284	359,716	431,798	455,129	428,388	390,246	342,747	311,054	20	55	87	117	148	166
Wheeler	13,534	114,844	130,782	138,810	137,761	132,311	123,308	116,837	8	23	35	47	59	66
District Total	318,466	980,357	1,102,788	1,115,730	1,050,784	962,856	853,897	782,347						

[1]2015 rates are identical to the last year of the calibrated model (2012) except in NPGCD where other rates were provided by NPGCD staff.

Table 2016.5.4 continued: Available groundwater and average drawdown in the Ogallala Aquifer for the counties comprising GMA-1.

Ogallala	Available Groundwater (afy)								Average Drawdown (ft)					
County	**2015**	**2016**	**2020**	**2030**	**2040**	**2050**	**2062**	**2070**	**2020**	**2030**	**2040**	**2050**	**2062**	**2070**
High Plains Water District														
Armstrong	1,073	1,484	1,289	1,048	868	722	591	521	2	5	8	10	12	13
Potter	149	225	225	224	225	223	220	218	2	4	7	9	12	14
Randall	26,175	39,322	39,190	37,987	32,566	28,333	24,458	22,482	4	9	14	18	22	24
District Total	27,397	41,031	40,704	39,259	33,659	29,278	25,269	23,221						
No GCD														
Hartley	240	18,432	19,581	17,638	14,566	11,147	7,457	5,246	5	12	18	22	24	24
Hutchinson	5,643	18,853	16,492	14,432	13,390	12,973	13,170	14,395	6	16	25	34	44	51
Moore	2,237	8,167	8,956	8,597	7,612	6,186	4,532	3,585	5	11	15	18	20	21
Oldham	13,775	40,879	44,721	40,203	33,513	26,206	18,617	16,165	3	7	10	12	13	14
Randall	18,039	23,890	24,894	23,944	21,923	19,471	16,541	14,684	3	8	12	16	20	22
Total	39,934	110,221	114,644	104,814	91,004	75,983	60,317	54,075						
GMA-1 Total	1,875,400	3,154,848	3,556,790	3,233,882	2,932,775	2,600,355	2,230,270	2,021,424						

[1]2015 rates are identical to the last year of the calibrated model (2012) except in NPGCD where other rates were provided by NPGCD staff.

Table 2016.5.5: Available groundwater and average drawdown in the Dockum Aquifer for the counties comprising GMA-1.

Dockum	Available Groundwater (afy)								Average Drawdown (ft)					
County	**2015**	**2016**	**2020**	**2030**	**2040**	**2050**	**2062**	**2070**	**2020**	**2030**	**2040**	**2050**	**2062**	**2070**
North Plains GCD														
Dallam	2,755	14,234	14,231	14,188	14,224	14,184	14,183	14,183	30	78	119	156	194	217
Hartley	1,793	13,063	11,633	10,766	10,552	10,559	10,895	11,326	21	51	77	101	127	144
Moore	1,604	5,072	4,814	4,531	4,505	4,416	4,261	4,158	9	21	31	39	48	52
Sherman	484	127	127	127	127	127	92	87	16	36	51	62	70	73
District Total	6,636	32,496	30,805	29,612	29,408	29,286	29,431	29,754	24	60	92	120	150	168
Panhandle GCD														
Armstrong	138	5,658	7,150	9,023	9,614	9,704	9,493	9,270	5	13	20	27	34	38
Carson	29	53	68	108	140	169	203	225	6	15	23	30	37	42
Potter	914	32,021	38,909	39,112	37,037	34,504	31,557	29,665	4	10	16	21	26	29
District Total	1,081	37,732	46,127	48,243	46,791	44,377	41,253	39,160	4	11	18	24	30	34
High Plains Water District														
Armstrong	33	166	96	0	0	0	0	0	1	3	7	10	15	18
Potter	434	29	21	0	0	0	0	0	3	9	16	24	32	37
Randall	1,597	1,575	2,195	2,714	2,961	3,111	3,228	3,289	9	19	28	36	45	50
District Total	2,064	1,770	2,312	2,714	2,961	3,111	3,228	3,289	8	16	25	32	40	45
No GCD														
Hartley	226	42,620	43,766	44,269	44,525	44,303	43,941	43,521	9	27	44	59	78	89
Moore	0	230	419	575	528	509	497	481	5	13	19	25	30	33
Oldham	1,128	111,290	129,354	128,828	120,848	111,196	99,735	92,701	4	11	18	24	30	34
Randall	1,006	6,320	9,007	11,302	11,941	12,002	11,806	11,555	7	16	24	32	40	45
Total	2,360	160,460	182,546	184,974	177,842	168,010	155,979	148,258	5	14	22	30	38	42
GMA-1 Total	12,141	232,458	261,790	265,543	257,002	244,784	229,891	220,461						

Table 2016.5.6: Groundwater in storage and fraction remaining from 2012 in the Ogallala Aquifer for counties comprising GMA-1.

Ogallala	Groundwater In Storage (af)								Fraction Remaining from 2012					
County	2012	2015	2020	2030	2040	2050	2062	2070	'20	'30	'40	'50	'62	'70
North Plains GCD														
Dallam	14,671,925	13,780,883	12,194,020	9,809,884	8,032,927	6,809,253	6,002,926	5,786,218	0.83	0.67	0.55	0.46	0.41	0.39
Hansford	23,999,740	23,499,747	22,254,715	19,723,282	17,226,621	14,796,746	11,980,003	10,161,126	0.93	0.82	0.72	0.62	0.50	0.42
Hartley	16,109,356	14,899,515	12,934,097	10,350,950	8,422,325	7,085,680	6,205,561	5,984,848	0.80	0.64	0.52	0.44	0.39	0.37
Hutchinson	6,283,204	6,138,287	5,856,123	5,224,580	4,564,721	3,918,708	3,183,164	2,722,310	0.93	0.83	0.73	0.62	0.51	0.43
Lipscomb	17,979,150	17,880,482	16,931,575	14,901,570	13,007,153	11,180,008	9,041,619	7,637,255	0.94	0.83	0.72	0.62	0.50	0.42
Moore	9,531,217	9,010,018	8,062,267	6,603,420	5,452,356	4,616,877	3,997,676	3,781,750	0.85	0.69	0.57	0.48	0.42	0.40
Ochiltree	20,588,713	20,348,826	19,354,815	17,157,196	14,993,055	12,862,752	10,345,536	8,686,094	0.94	0.83	0.73	0.62	0.50	0.42
Sherman	17,946,388	17,048,100	15,409,445	12,431,297	10,107,115	8,413,834	7,138,796	6,673,005	0.86	0.69	0.56	0.47	0.40	0.37
Dist. Total	127,109,693	122,605,858	112,997,057	96,202,179	81,806,273	69,683,858	57,895,281	51,432,606	0.89	0.76	0.64	0.55	0.46	0.40
Hemphill County UWCD														
Hemphill	15,434,318	15,372,022	15,056,398	14,369,077	13,686,823	13,032,615	12,289,613	11,821,746	0.98	0.93	0.89	0.84	0.80	0.77
Panhandle GCD														
Armstrong	4,418,838	4,390,635	4,103,026	3,568,023	3,089,254	2,665,255	2,226,578	1,974,621	0.93	0.81	0.70	0.60	0.50	0.45
Carson	14,900,617	14,533,317	13,644,675	11,911,925	10,332,170	8,928,035	7,476,078	6,642,625	0.92	0.80	0.69	0.60	0.50	0.45
Donley	4,372,716	4,295,059	4,022,028	3,503,564	3,038,977	2,634,834	2,226,949	1,998,735	0.92	0.80	0.69	0.60	0.51	0.46
Gray	13,723,357	13,607,295	12,765,180	11,144,776	9,666,585	8,347,418	6,971,180	6,173,121	0.93	0.81	0.70	0.61	0.51	0.45
Hutchinson	877,413	870,844	820,953	715,416	614,210	521,737	426,395	372,014	0.94	0.82	0.70	0.59	0.49	0.42
Potter	1,610,450	1,579,081	1,482,291	1,299,978	1,141,001	1,005,837	870,404	794,515	0.92	0.81	0.71	0.62	0.54	0.49
Roberts	29,922,260	29,671,432	27,858,805	24,289,080	20,980,905	17,982,690	14,810,631	12,948,403	0.93	0.81	0.70	0.60	0.49	0.43
Wheeler	7,039,568	7,014,771	6,519,193	5,638,438	4,856,142	4,155,445	3,419,368	2,988,586	0.93	0.80	0.69	0.59	0.49	0.42
Dist. Total	76,865,219	75,962,434	71,216,151	62,071,200	53,719,244	46,241,251	38,427,583	33,892,620	0.93	0.81	0.70	0.60	0.50	0.44

Table 2016.5.6 continued: Groundwater in storage and fraction remaining from 2012 in the Ogallala Aquifer for counties comprising GMA-1.

Ogallala	Groundwater In Storage (af)								Fraction Remaining from 2012					
County	2012	2015	2020	2030	2040	2050	2062	2070	'20	'30	'40	'50	'62	'70
High Plains Water District														
Armstrong	169,520	164,755	154,467	135,707	119,559	106,032	92,818	85,496	0.91	0.80	0.71	0.63	0.55	0.50
Potter	334,379	331,599	325,365	310,868	295,212	279,313	260,975	249,542	0.97	0.93	0.88	0.84	0.78	0.75
Randall	2,570,085	2,523,203	2,380,854	2,096,330	1,840,093	1,632,202	1,431,783	1,322,080	0.93	0.82	0.72	0.64	0.56	0.51
Dist. Total	3,073,984	3,019,557	2,860,686	2,542,905	2,254,864	2,017,547	1,785,576	1,657,118	0.93	0.83	0.73	0.66	0.58	0.54
No GCD														
Hartley	908,097	899,854	801,455	638,348	518,298	438,390	388,804	378,468	0.88	0.70	0.57	0.48	0.43	0.42
Hutchinson	3,937,385	3,879,960	3,676,579	3,241,343	2,810,387	2,400,962	1,946,585	1,669,519	0.93	0.82	0.71	0.61	0.49	0.42
Moore	492,564	478,653	428,082	344,643	285,201	244,850	217,139	208,926	0.87	0.70	0.58	0.50	0.44	0.42
Oldham	2,031,746	1,998,077	1,813,872	1,510,905	1,287,630	1,141,056	1,054,733	1,031,801	0.89	0.74	0.63	0.56	0.52	0.51
Randall	2,265,938	2,221,861	2,116,441	1,910,756	1,724,253	1,562,472	1,399,890	1,309,655	0.93	0.84	0.76	0.69	0.62	0.58
Total	9,635,730	9,478,405	8,836,429	7,645,995	6,625,769	5,787,730	5,007,151	4,598,369	0.92	0.79	0.69	0.60	0.52	0.48
GMA-1 Tot.	232,118,944	226,438,276	210,966,721	182,831,356	158,092,973	136,763,001	115,405,204	103,402,459	0.91	0.79	0.68	0.59	0.50	0.45

Table 2016.6.1: Groundwater in storage and fraction remaining by zone for the Ogallala Aquifer in GMA-1.

Ogallala	Groundwater In Storage (af)							Fraction Remaining from 2012					
Zone	2012	2020	2030	2040	2050	2062	2070	'20	'30	'40	'50	'62	'70
North Plains GCD - West	58,258,886	48,547,509	39,237,159	32,082,294	26,966,459	23,318,033	22,149,904	0.83	0.68	0.55	0.46	0.40	0.38
North Plains GCD - East	68,850,807	64,397,228	57,006,623	49,791,522	42,758,130	34,550,162	29,206,570	0.94	0.83	0.72	0.62	0.50	0.42
Hemphill County UWCD	15,434,318	15,055,885	14,367,965	13,685,507	13,031,217	12,288,167	11,820,281	0.98	0.93	0.89	0.84	0.80	0.77
Panhandle GCD	76,865,219	71,198,396	62,035,499	53,673,892	46,189,911	38,370,446	33,831,038	0.93	0.81	0.70	0.60	0.50	0.44
High Plains UWCD No. 1	3,073,984	2,855,265	2,527,302	2,217,579	1,961,756	1,705,250	1,562,905	0.93	0.82	0.72	0.64	0.55	0.51
No GCD	9,635,730	8,818,135	7,607,435	6,566,130	5,705,232	4,894,588	4,471,862	0.92	0.79	0.68	0.59	0.51	0.47

Table 2016.6.2: Fraction remaining by zone for the Dockum Aquifer in GMA-1.

	Fraction Remaining from 2012					
Zone	2020	2030	2040	2050	2062	2070
North Plains GCD - West	0.89	0.75	0.62	0.51	0.40	0.33
Panhandle GCD	0.93	0.82	0.72	0.65	0.57	0.53
High Plains UWCD No. 1	0.86	0.72	0.60	0.51	0.41	0.36
No GCD	0.94	0.86	0.79	0.73	0.68	0.65

Table 2016.6.3: Available groundwater and average drawdown in the Rita Blanca Aquifer for the Dallam County in GMA-1.

Rita Blanca	Available Groundwater (afy)								Average Drawdown (ft)					
County	2015	2016	2020	2030	2040	2050	2062	2070	2020	2030	2040	2050	2062	2070
Dallam	6,197	6,191	6,207	6,197	6,214	6,159	6,168	5,916	14	28	39	47	53	58

[1]2015 rates are identical to the last year of the calibrated model (2012) except in NPGCD where other rates were provided by NPGCD staff.

Table 2016.6.4: Available groundwater and average drawdown in the Ogallala Aquifer for the counties comprising GMA-1.

Ogallala	Available Groundwater (afy)								Average Drawdown (ft)					
County	**2015**	**2016**	**2020**	**2030**	**2040**	**2050**	**2062**	**2070**	**2020**	**2030**	**2040**	**2050**	**2062**	**2070**
North Plains GCD														
Dallam	312,426	400,754	390,609	280,186	222,651	165,147	101,646	68,996	15	29	40	48	53	55
Hansford	169,191	276,822	275,769	272,655	271,968	270,280	269,478	269,128	17	41	66	89	116	134
Hartley	353,403	450,899	400,792	265,158	209,317	153,198	91,355	59,454	20	37	49	57	63	65
Hutchinson	59,153	74,151	62,975	64,522	65,831	66,075	65,956	64,791	13	33	53	73	95	110
Lipscomb	39,006	55,112	267,540	266,710	267,370	266,591	266,556	266,547	12	34	55	75	99	115
Moore	167,811	235,482	215,441	172,621	139,709	105,042	67,695	47,491	20	41	57	69	77	80
Ochiltree	84,963	115,225	244,446	243,931	244,670	244,050	244,085	244,094	13	37	61	84	112	130
Sherman	288,843	364,947	399,146	348,920	282,538	212,885	136,920	93,946	24	53	75	91	104	108
District Total	1,474,796	1,973,392	2,256,718	1,914,703	1,704,054	1,483,268	1,243,691	1,114,447						
Hemphill County UWCD														
Hemphill	21,935	55,302	52,549	52,432	52,600	52,474	52,490	52,498	4	11	18	25	32	37
Panhandle GCD														
Armstrong	7,495	57,976	58,602	53,821	48,653	43,765	38,353	35,069	6	16	26	34	42	47
Carson	129,825	181,423	192,719	184,317	170,443	153,808	134,089	121,481	12	29	44	57	71	79
Donley	39,491	70,819	76,925	78,237	74,944	69,493	62,383	57,704	5	14	21	27	33	37
Gray	41,540	171,664	182,087	175,968	163,729	149,267	132,280	121,649	9	25	40	53	66	74
Hutchinson	74	10,106	15,777	16,740	15,197	13,324	11,454	10,171	14	41	67	91	115	129
Potter	7,789	16,399	17,742	16,538	15,142	13,794	12,209	11,220	3	7	11	14	17	19
Roberts	79,284	359,716	431,798	455,129	428,388	390,246	342,747	311,054	20	55	87	117	148	166
Wheeler	13,711	116,334	133,554	141,727	140,359	134,609	125,426	119,017	9	23	36	47	59	66
District Total	319,209	984,437	1,109,204	1,122,477	1,056,855	968,306	858,941	787,365						

[1]2015 rates are identical to the last year of the calibrated model (2012) except in NPGCD where other rates were provided by NPGCD staff.

Table 2016.6.4 continued: Available groundwater and average drawdown in the Ogallala Aquifer for the counties comprising GMA-1.

Ogallala	Available Groundwater (afy)								Average Drawdown (ft)					
County	**2015**	**2016**	**2020**	**2030**	**2040**	**2050**	**2062**	**2070**	**2020**	**2030**	**2040**	**2050**	**2062**	**2070**
High Plains Water District														
Armstrong	1,202	1,808	1,679	1,387	1,113	827	601	493	3	6	9	12	14	15
Potter	149	225	225	224	225	224	224	224	2	4	7	9	12	14
Randall	26,384	39,617	39,534	39,227	34,400	30,138	26,580	24,404	4	9	15	19	23	26
District Total	27,735	41,650	41,438	40,838	35,738	31,189	27,405	25,121						
No GCD														
Hartley	240	19,027	20,442	18,744	15,877	12,554	8,686	6,192	5	13	19	23	25	26
Hutchinson	5,643	19,203	17,190	15,352	14,243	13,792	13,909	15,059	6	16	25	35	45	51
Moore	2,287	8,733	9,577	9,185	8,126	6,638	4,908	3,903	5	11	16	19	21	22
Oldham	15,466	42,643	47,439	43,228	36,677	29,681	22,426	19,470	3	7	11	13	14	15
Randall	18,143	23,890	24,894	23,950	21,969	19,529	16,578	14,711	3	8	12	16	20	22
Total	41,779	113,496	119,542	110,459	96,892	82,194	66,507	59,335						
GMA-1 Total	1,885,454	3,168,277	3,579,451	3,240,909	2,946,139	2,617,431	2,249,034	2,038,766						

[1]2015 rates are identical to the last year of the calibrated model (2012) except in NPGCD where other rates were provided by NPGCD staff.

Table 2016.6.5: Available groundwater and average drawdown in the Dockum Aquifer for the counties comprising GMA-1.

Dockum	Available Groundwater (afy)								Average Drawdown (ft)					
County	**2015**	**2016**	**2020**	**2030**	**2040**	**2050**	**2062**	**2070**	**2020**	**2030**	**2040**	**2050**	**2062**	**2070**
North Plains GCD														
Dallam	2,755	14,234	14,231	14,188	14,224	14,184	14,183	14,183	30	78	119	156	195	217
Hartley	1,793	13,063	11,633	10,766	10,552	10,559	10,895	11,326	21	51	77	101	127	144
Moore	1,604	5,072	4,814	4,531	4,505	4,416	4,261	4,158	9	21	31	39	48	52
Sherman	484	127	127	127	127	127	92	87	16	36	51	62	70	73
District Total	6,636	32,496	30,805	29,612	29,408	29,286	29,431	29,754	24	60	92	120	150	168
Panhandle GCD														
Armstrong	138	5,658	7,150	9,032	9,628	9,718	9,507	9,283	5	13	20	27	34	38
Carson	29	53	68	108	140	169	203	225	6	15	23	30	38	42
Potter	914	32,028	38,915	39,118	37,041	34,507	31,560	29,667	4	10	16	21	26	29
District Total	1,081	37,739	46,133	48,258	46,809	44,394	41,270	39,175	4	11	18	24	30	34
High Plains Water District														
Armstrong	33	166	96	0	0	0	0	0	1	3	7	11	15	18
Potter	434	29	21	0	0	0	0	0	3	9	16	24	32	37
Randall	1,597	1,575	2,195	2,714	2,961	3,111	3,228	3,289	9	19	28	37	45	50
District Total	2,064	1,770	2,312	2,714	2,961	3,111	3,228	3,289	8	17	25	32	40	45
No GCD														
Hartley	226	42,620	43,766	44,269	44,525	44,303	43,941	43,521	9	27	44	59	78	89
Moore	0	230	419	575	533	509	497	481	5	13	19	25	30	33
Oldham	1,128	111,301	129,364	128,837	120,854	111,201	99,739	92,704	4	11	18	24	30	34
Randall	1,006	6,320	9,007	11,302	11,941	12,002	11,806	11,555	7	16	24	32	40	45
Total	2,360	160,471	182,556	184,983	177,853	168,015	155,983	148,261	5	14	22	30	38	42
GMA-1 Total	12,141	232,476	261,806	265,567	257,031	244,806	229,912	220,479						

Table 2016.6.6: Groundwater in storage and fraction remaining from 2012 in the Ogallala Aquifer for counties comprising GMA-1.

Ogallala	Groundwater In Storage (af)								Fraction Remaining from 2012					
County	2012	2015	2020	2030	2040	2050	2062	2070	'20	'30	'40	'50	'62	'70
North Plains GCD														
Dallam	14,671,925	13,764,050	12,148,376	9,785,245	7,990,600	6,725,500	5,862,949	5,613,373	0.83	0.67	0.54	0.46	0.40	0.38
Hansford	23,999,740	23,499,747	22,254,715	19,723,282	17,226,621	14,796,740	11,980,000	10,161,111	0.93	0.82	0.72	0.62	0.50	0.42
Hartley	16,109,356	14,899,163	12,928,113	10,417,096	8,531,215	7,211,298	6,326,636	6,095,378	0.80	0.65	0.53	0.45	0.39	0.38
Hutchinson	6,283,204	6,138,287	5,856,123	5,224,575	4,564,693	3,918,630	3,183,018	2,722,128	0.93	0.83	0.73	0.62	0.51	0.43
Lipscomb	17,979,150	17,880,482	16,931,575	14,901,570	13,007,153	11,180,008	9,041,608	7,637,238	0.94	0.83	0.72	0.62	0.50	0.42
Moore	9,531,217	9,010,017	8,062,143	6,603,965	5,454,025	4,619,384	4,000,310	3,783,925	0.85	0.69	0.57	0.48	0.42	0.40
Ochiltree	20,588,713	20,348,826	19,354,815	17,157,196	14,993,055	12,862,752	10,345,536	8,686,093	0.94	0.83	0.73	0.62	0.50	0.42
Sherman	17,946,388	17,048,016	15,408,877	12,430,853	10,106,454	8,410,277	7,128,138	6,657,228	0.86	0.69	0.56	0.47	0.40	0.37
Dist. Total	127,109,693	122,588,588	112,944,737	96,243,782	81,873,816	69,724,589	57,868,195	51,356,474	0.89	0.76	0.64	0.55	0.46	0.40
Hemphill County UWCD														
Hemphill	15,434,318	15,372,022	15,055,885	14,367,965	13,685,507	13,031,217	12,288,167	11,820,281	0.98	0.93	0.89	0.84	0.80	0.77
Panhandle GCD														
Armstrong	4,418,838	4,390,635	4,102,197	3,566,408	3,087,197	2,662,895	2,223,786	1,971,374	0.93	0.81	0.70	0.60	0.50	0.45
Carson	14,900,617	14,533,005	13,644,285	11,911,477	10,331,684	8,927,497	7,475,483	6,641,990	0.92	0.80	0.69	0.60	0.50	0.45
Donley	4,372,716	4,295,022	4,017,354	3,494,304	3,027,511	2,622,148	2,213,257	1,984,546	0.92	0.80	0.69	0.60	0.51	0.45
Gray	13,723,357	13,607,295	12,764,118	11,141,346	9,661,878	8,342,006	6,965,408	6,167,144	0.93	0.81	0.70	0.61	0.51	0.45
Hutchinson	877,413	870,844	820,948	715,369	614,095	521,569	426,200	371,818	0.94	0.82	0.70	0.59	0.49	0.42
Potter	1,610,450	1,576,900	1,478,246	1,294,423	1,134,241	998,567	862,864	786,960	0.92	0.80	0.70	0.62	0.54	0.49
Roberts	29,922,260	29,671,432	27,858,805	24,289,067	20,980,860	17,982,558	14,810,391	12,948,052	0.93	0.81	0.70	0.60	0.49	0.43
Wheeler	7,039,568	7,014,285	6,512,443	5,623,105	4,836,426	4,132,671	3,393,057	2,959,154	0.93	0.80	0.69	0.59	0.48	0.42
Dist. Total	76,865,219	75,959,418	71,198,396	62,035,499	53,673,892	46,189,911	38,370,446	33,831,038	0.93	0.81	0.70	0.60	0.50	0.44

Table 2016.6.6 continued: Groundwater in storage and fraction remaining from 2012 in the Ogallala Aquifer for counties comprising GMA-1.

Ogallala	Groundwater In Storage (af)								Fraction Remaining from 2012					
County	2012	2015	2020	2030	2040	2050	2062	2070	'20	'30	'40	'50	'62	'70
High Plains Water District														
Armstrong	169,520	164,173	151,345	128,316	108,347	92,553	77,853	70,229	0.89	0.76	0.64	0.55	0.46	0.41
Potter	334,379	331,599	325,357	310,824	295,109	279,105	260,463	248,790	0.97	0.93	0.88	0.83	0.78	0.74
Randall	2,570,085	2,522,531	2,378,563	2,088,162	1,814,123	1,590,098	1,366,934	1,243,886	0.93	0.81	0.71	0.62	0.53	0.48
Dist. Total	3,073,984	3,018,303	2,855,265	2,527,302	2,217,579	1,961,756	1,705,250	1,562,905	0.93	0.82	0.72	0.64	0.55	0.51
No GCD														
Hartley	908,097	899,854	799,203	631,878	506,733	420,801	365,091	353,079	0.88	0.70	0.56	0.46	0.40	0.39
Hutchinson	3,937,385	3,879,951	3,675,073	3,237,360	2,805,526	2,395,676	1,941,072	1,664,052	0.93	0.82	0.71	0.61	0.49	0.42
Moore	492,564	478,587	425,912	339,662	278,442	236,870	208,436	200,204	0.86	0.69	0.57	0.48	0.42	0.41
Oldham	2,031,746	1,992,342	1,801,834	1,488,514	1,253,284	1,092,885	985,032	950,699	0.89	0.73	0.62	0.54	0.48	0.47
Randall	2,265,938	2,221,549	2,116,113	1,910,021	1,722,145	1,559,000	1,394,957	1,303,828	0.93	0.84	0.76	0.69	0.62	0.58
Total	9,635,730	9,472,283	8,818,135	7,607,435	6,566,130	5,705,232	4,894,588	4,471,862	0.92	0.79	0.68	0.59	0.51	0.46
GMA-1 Tot.	232,118,944	226,410,614	210,872,418	182,781,983	158,016,924	136,612,705	115,126,646	103,042,560	0.91	0.79	0.68	0.59	0.50	0.44