



UNITED STATES DEPARTMENT OF THE INTERIOR  
U.S. GEOLOGICAL SURVEY  
WATER RESOURCES DIVISION  
5563 De Zavala Rd., Suite 290  
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MEMORANDUM

March 31<sup>st</sup>, 2017

To: Jim Winterle, Director Data Management and Modeling, Edwards Aquifer Authority

From: Richard Slattery, Hydrologic Technician, USGS, San Antonio, TX

Thru: J. Ryan Banta, South Tx Program Office Studies Chief, USGS, San Antonio, TX

Subject: Estimated annual recharge to, and spring discharge from, the Edwards aquifer, 2016

Attached are two tables. The first table contains the estimated annual total recharge in thousands of acre-feet by river basin to the Edwards aquifer in the San Antonio area for the period 1934 through 2016. The second table contains the monthly total spring discharge discharging from the Edwards aquifer in acre-feet per month by spring for 2016.

Total recharge in 2016 was estimated to be approximately 1.2 million acre-feet; well above the annual average of 700 thousand acre-feet (table 1).

The accounted for total spring discharge from the Edwards aquifer in 2016 was estimated to be approximately 545 thousand acre-feet (table 2).

If you have questions regarding this information, please feel free to call me at (210) 691-9224 or email me at [rnslatte@usgs.gov](mailto:rnslatte@usgs.gov).

**Table 1.** Estimated annual recharge to the Edwards aquifer in the San Antonio area, by stream basin or ungauged area, 1934–2016. [thousands of acre-feet]

Calendar Year	Nueces-West Nueces River Basin	Frio-Dry Frio River Basin <sup>1</sup>	Sabinal River Basin <sup>1</sup>	Area Between Sabinal River and Medina River Basin <sup>1</sup>	Medina River Basin <sup>2</sup>	Area between Medina River Basin and Cibolo-Dry Comal Creek Basins <sup>1</sup>	Cibolo Creek and Dry Comal Creek Basin	Blanco River Basin <sup>1</sup>	Total <sup>3</sup>
1934	8.6	27.9	7.5	19.9	46.5	21	28.4	19.8	179.6
1935	411.3	192.3	56.6	166.2	71.1	138.2	182.7	39.8	1258.2
1936	176.5	157.4	43.5	142.9	91.6	108.9	146.1	42.7	909.6
1937	28.8	75.7	21.5	61.3	80.5	47.8	63.9	21.2	400.7
1938	63.5	69.3	20.9	54.1	65.5	46.2	76.8	36.4	432.7
1939	227	49.5	17	33.1	42.4	9.3	9.6	11.1	399
1940	50.4	60.3	23.8	56.6	38.8	29.3	30.8	18.8	308.8
1941	89.9	151.8	50.6	139	54.1	116.3	191.2	57.8	850.7
1942	103.5	95.1	34	84.4	51.7	66.9	93.6	28.6	557.8
1943	36.5	42.3	11.1	33.8	41.5	29.5	58.3	20.1	273.1
1944	64.1	76	24.8	74.3	50.5	72.5	152.5	46.2	560.9
1945	47.3	71.1	30.8	78.6	54.8	79.6	129.9	35.7	527.8
1946	80.9	54.2	16.5	52	51.4	105.1	155.3	40.7	556.1
1947	72.4	77.7	16.7	45.2	44	55.5	79.5	31.6	422.6
1948	41.1	25.6	26	20.2	14.8	17.5	19.9	13.2	178.3
1949	166	86.1	31.5	70.3	33	41.8	55.9	23.5	508.1
1950	41.5	35.5	13.3	27	23.6	17.3	24.6	17.4	200.2
1951	18.3	28.4	7.3	26.4	21.1	15.3	12.5	10.6	139.9
1952	27.9	15.7	3.2	30.2	25.4	50.1	102.3	20.7	275.5
1953	21.4	15.1	3.2	4.4	36.2	20.1	42.3	24.9	167.6
1954	61.3	31.6	7.1	11.9	25.3	4.2	10	10.7	162.1
1955	128	22.1	0.6	7.7	16.5	4.3	3.3	9.5	192
1956	15.6	4.2	1.6	3.6	6.3	2	2.2	8.2	43.7
1957	108.6	133.6	65.4	129.5	55.6	175.6	397.9	76.4	1142.6
1958	266.7	300	223.8	294.9	95.5	190.9	268.7	70.7	1711.2
1959	109.6	158.9	61.6	96.7	94.7	57.4	77.9	33.6	690.4
1960	88.7	128.1	64.9	127	104	89.7	160	62.4	824.8
1961	85.2	151.3	57.4	105.4	88.3	69.3	110.8	49.4	717.1
1962	47.4	46.6	4.3	23.5	57.3	16.7	24.7	18.9	239.4
1963	39.7	27	5	10.3	41.9	9.3	21.3	16.2	170.7
1964	126.1	57.1	16.3	61.3	43.3	35.8	51.1	22.2	413.2
1965	97.9	83	23.2	104	54.6	78.8	115.3	66.7	623.5
1966	169.2	134	37.7	78.2	50.5	44.5	66.5	34.6	615.2
1967	82.2	137.9	30.4	64.8	44.7	30.2	57.3	19	466.5
1968	130.8	176	66.4	198.7	59.9	83.1	120.5	49.3	884.7
1969	119.7	113.8	30.7	84.2	55.4	60.2	99.9	46.6	610.5
1970	112.6	141.9	35.4	81.6	68	68.8	113.8	39.5	661.6
1971	263.4	212.4	39.2	155.6	68.7	81.4	82.4	22.2	925.3
1972	108.4	144.6	49	154.6	87.9	74.3	104.2	33.4	756.4
1973	190.6	256.9	123.9	286.4	97.6	237.2	211.7	82.2	1486.5
1974	91.1	135.7	36.1	115.3	96.2	68.1	76.9	39.1	658.5
1975	71.8	143.6	47.9	195.9	93.4	138.8	195.7	85.9	973
1976	150.7	238.6	68.2	182	94.5	47.9	54.3	57.9	894.1
1977	102.9	193	62.7	159.5	77.7	97.9	191.6	66.7	952
1978	69.8	73.1	30.9	103.7	76.7	49.6	72.4	26.3	502.5
1979	128.4	201.4	68.6	203.1	89.4	85.4	266.3	75.2	1117.8
1980	58.6	85.6	42.6	25.3	88.3	18.8	55.4	31.8	406.4
1981	205	365.2	105.6	252.1	91.3	165	196.8	67.3	1448.4
1982	19.4	123.4	21	90.9	76.8	22.6	44.8	23.5	422.4
1983	79.2	85.9	20.1	42.9	74.4	31.9	62.5	23.2	420.1
1984	32.4	40.4	8.8	18.1	43.9	11.3	16.9	25.9	197.9

## ATTACHMENT 5

Calendar Year	Nueces-West Nueces River Basin	Frio-Dry Frio River Basin <sup>1</sup>	Sabinal River Basin <sup>1</sup>	Area Between Sabinal River and Medina River Basin <sup>1</sup>	Medina River Basin <sup>2</sup>	Area between Medina River Basin and Cibolo-Dry Comal Creek Basins <sup>1</sup>	Cibolo Creek and Dry Comal Creek Basin	Blanco River Basin <sup>1</sup>	Total <sup>3</sup>
1985	105.9	186.9	50.7	148.5	64.7	136.7	259.2	50.7	1003.3
1986	188.4	192.8	42.2	173.6	74.7	170.2	267.4	44.5	1153.7
1987	308.5	473.3	110.7	405.5	90.4	229.3	270.9	114.9	2003.6
1988	59.2	117.9	17	24.9	69.9	12.6	28.5	25.5	355.5
1989	52.6	52.6	8.4	13.5	46.9	4.6	12.3	23.6	214.4
1990	479.3	255	54.6	131.2	54	35.9	71.8	41.3	1123.2
1991	325.2	421	103.1	315.2	52.8	84.5	109.7	96.9	1508.4
1992	234.1	586.9	201.1	566.1	91.4	290.6	286.6	228.9	2485.7
1993	32.6	78.5	29.6	60.8	78.5	38.9	90.9	37.8	447.6
1994	124.6	151.5	29.5	45.1	61.1	34.1	55.6	36.6	538.1
1995	107.1	147.6	34.7	62.4	61.7	36.2	51.1	30.6	531.3
1996	130	92	11.4	9.4	42.3	10.6	14.7	13.9	324.3
1997	176.9	209.1	57	208.4	63.3	193.4	144.2	82.3	1134.6
1998	141.5	214.8	72.5	201.4	80.3	86.2	240.9	104.7	1142.3
1999	101.4	136.8	30.8	57.2	77.1	21.2	27.9	21	473.5
2000	238.4	123	33.1	55.2	53.4	28.6	48.6	34.1	614.5
2001	297.5	126.7	66.2	124.1	90	101.5	173.7	89.7	1069.4
2002	83.6	207.3	70.6	345.2	93.7	175.5	447.8	150	1573.7
2003	149.8	112.2	31.7	67.4	86.8	56.2	105.0	59.9	669.0
2004	481.9	424.5	116.0	343.9	95.5	213.4	315.0	185.8	2,176.1
2005	105.5	147.2	50.1	79.1	82.8	84.8	140.4	74.1	764.0
2006	45.5	60.2	9.0	5.0	47.7	5.1	11.2	17.9	201.6
2007	471.8	474.4	104.0	406.4	75.2	227.6	306.1	96.9	2,162.3
2008	48.2	44.5	5.9	9.8	53.6	9.6	22.8	18.5	212.9
2009	58.5	30.3	1.8	13.5	45.6	7.3	26.4	27.5	211.0
2010	135.4	104.9	31.5	186.3	68.2	81.4	148.2	57.5	813.5
2011	15.3	13.7	1.0	2.0	43.3	3.0	15.3	18.3	112.0
2012	78.3	82.6	8.9	14.4	41.6	3.9	32.2	51.6	313.5
2013	67.7	26.7	.5	2.8	10.8	3.3	28.7	42.1	182.7
2014	19.8	32.8	4.9	14.4	8.9	4	9.5	16.5	107.2
2015	343.8	281.9	42.2	218.4	54.6	131.6	177.3	108.3	1,358.1
<b>2016</b>	<b>275.7</b>	<b>247.8</b>	<b>52.4</b>	<b>184.1</b>	<b>77.5</b>	<b>110.9</b>	<b>186.4</b>	<b>86.3</b>	<b>1,221.1</b>
<b>Average</b>	<b>128.0</b>	<b>137.5</b>	<b>41.0</b>	<b>110.6</b>	<b>61.4</b>	<b>70.7</b>	<b>109.8</b>	<b>47.5</b>	<b>707.6</b>

<sup>1</sup> Includes recharge from unged areas

<sup>2</sup> Recharge to Edwards aquifer from Medina River Basin consists entirely of losses from Medina Lake (Puente, 1978, p. 23).

<sup>3</sup> Totals might not equal sum of basin values due to rounding.

**Table 2.** Summary of spring discharge in acre-feet per month, January–December 2016.

	Leona Springs and Underflow nr Uvalde, Tx (08204000)	San Pedro Springs at San Antonio, Tx (08178090)	San Antonio Springs at San Antonio, Tx (08177818)	Comal Springs at New Braunfels, Tx (08168710)	Hueco Springs nr New Braunfels Tx (08168000)	San Marcos Springs at San Marcos, Tx (08170000)	Total Discharge <sup>1</sup>
Jan	523	238	.02	19,810	4,740	17,880	43,190
Feb	514	165	0	16,810	3,840	14,550	35,880
Mar	503	202	0	18,250	4,100	14,790	37,840
Apr	494	203	33	18,040	5,030	15,320	39,120
May	509	442	1,220	20,550	6,520	19,170	48,410
Jun	599	708	3,880	22,790	6,350	20,380	54,710
Jul	545	260	226	21,110	4,320	19,390	45,850
Aug	747	297	440	21,980	4,720	17,520	45,700
Sep	1,340	483	1,400	22,330	3,410	15,650	46,610
Oct	1,860	495	1,810	22,670	4,970	16,580	48,380
Nov	2,210	620	2,740	22,100	4,750	14,660	47,080
Dec	2,450	843	5,590	24,230	6,270	14,820	54,200
<b>Total Annual Discharge in acre-feet per year<sup>1</sup>:</b>	12,300	4,960	17,360	250,700	59,020	200,700	544,990

<sup>1</sup> Totals might not equal sum of discharge values due to rounding.