

2022

GROUNDWATER DISCHARGE AND USAGE



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AUTHORITY

2022 GROUNDWATER DISCHARGE AND USAGE

Groundwater discharges from the Edwards Aquifer either as springflow or as pumping from wells. Comal and San Marcos springs, the largest and second-largest springs in Texas, respectively, are fed by the Edwards Aquifer. This springflow greatly benefits the recreational economies in New Braunfels and San Marcos, and both springs provide habitat for threatened and endangered species. Figure 1 shows locations of the major springs in the Edwards Aquifer region. Wells drilled into the Edwards Aquifer throughout the region provide water for many diverse uses, including irrigation, municipal water supplies, industrial applications, and domestic/livestock consumption.

Estimates of total annual groundwater discharge from combined springflow and pumping for the Edwards Aquifer are provided in Table 1 for the period of record (1934–2022). Annual total groundwater discharge estimates range from a low of 388,800 acre-feet in 1955 to a high of 1,130,000 acre-feet in 1992. In 2022, the total groundwater discharged from the Edwards Aquifer from both wells and springs is estimated at 607,200 acre-feet: 219,900 acre-feet as springflow and 387,200 acre-feet as pumping from wells.

The portion of discharge as springflow is estimated by measuring streamflow downstream of the springs and converting the streamflow measurements to spring discharge by subtracting any estimated contributions from surface runoff. Total annual spring discharge has varied from a low of 69,800 acre-feet in 1956 to a high of 802,800 acre-feet in 1992. Monthly springflow estimates for 2022 at each of

the six major Edwards Aquifer springs are provided in Table 2.

In Figures 2 and 3, flows at Comal and San Marcos springs are shown as mean annual flows compared with the long-term historical mean annual flow rate for the available period of record. The 2022 mean annual flow rate was less than the historical mean discharge at both Comal Springs and San Marcos Springs.

Discharge as well pumping can be classified as either reported or unreported discharge. Reported discharge refers to water pumped from the aquifer by a person or entity holding a groundwater withdrawal permit. These users, who are typically larger quantity users, meter their withdrawals and report the totals to the EAA. Unreported discharge refers to use that does not require a groundwater withdrawal permit from the EAA, such as domestic, livestock, or federal facility use. Unreported discharge is estimated based on numbers of wells and statistical estimates of per-well usage. In 2022, unreported discharge for domestic and livestock wells was estimated at 14,866 acre-feet, and non-reporting federal facility discharge was estimated at 5,482 acre-feet, for a total of 20,348 acre-feet of unreported discharge. Reported discharge totaled 366,873 acre-feet. The total of all reported and unreported pumping discharge is 387,221 acre-feet.

Table 3 provides a summary of well and spring discharge for 2022 based on type of use and county. The distribution of discharge from springflows and the different types of pumping for 2022 is shown graphically in Figure 4. Total annual discharge from pumping and springflow

are compared in Figure 5 for the period of record from 1934–2022. The years when springflow exceeds pumping tend to be wet years when pumping demand is lowered by more frequent rainfall and higher aquifer levels produce increased springflows. Conversely, during dry years pumping tends to exceed springflow due to increased municipal and agricultural

demand and lower aquifer levels. Since 1997, however, the increase in pumping demand during dry years has been limited by the withdrawal permit system and critical period pumping reductions implemented under the Edwards Aquifer Authority Act. Table 4 provides a historical list of total annual discharge by type of use for the period 1955–2022.

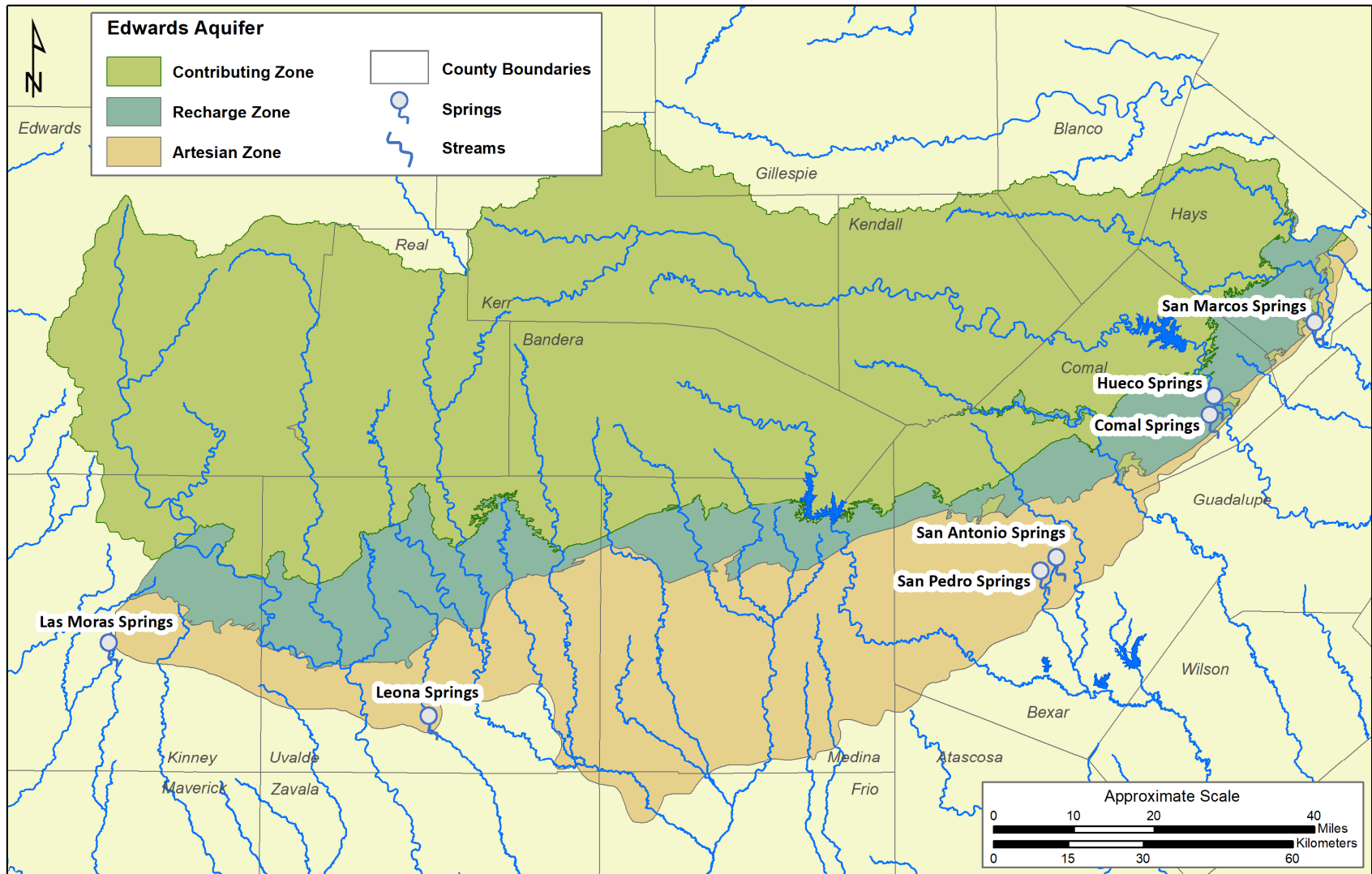


Figure 1. Locations of major Springs in the San Antonio segment of the Edwards (Balcones Fault Zone) Aquifer.

Table 1. Annual Estimated Groundwater Discharge Data by County for the Edwards Aquifer 1934–2022 (measured in thousands of acre-feet)

Year	Uvalde ^a	Medina	Bexar ^b	Comal ^c	Hays	Total	Total Wells	Total Springs
1934	12.6	1.3	109.3	229.1	85.6	437.9	101.9	336.0
1935	12.2	1.5	171.8	237.2	96.9	519.6	103.7	415.9
1936	26.6	1.5	215.2	261.7	93.2	598.2	112.7	485.5
1937	28.3	1.5	201.8	252.5	87.1	571.2	120.2	451.0
1938	25.2	1.6	187.6	250.0	93.4	557.8	120.1	437.7
1939	18.2	1.6	122.5	219.4	71.1	432.8	118.9	313.9
1940	16.1	1.6	116.7	203.8	78.4	416.6	120.1	296.5
1941	17.9	1.6	197.4	250.0	134.3	601.2	136.8	464.4
1942	22.5	1.7	203.2	255.1	112.2	594.7	144.6	450.1
1943	19.2	1.7	172.0	249.2	97.2	539.3	149.1	390.2
1944	11.6	1.7	166.3	252.5	135.3	567.4	147.3	420.1
1945	12.4	1.7	199.8	263.1	137.8	614.8	153.3	461.5
1946	6.2	1.7	180.1	261.9	134.0	583.9	155.0	428.9
1947	13.8	2.0	193.3	256.8	127.6	593.5	167.0	426.5
1948	9.2	1.9	159.2	203.0	77.3	450.6	168.7	281.9
1949	13.2	2.0	165.3	209.5	89.8	479.8	179.4	300.4
1950	17.8	2.2	177.3	191.1	78.3	466.7	193.8	272.9
1951	16.9	2.2	186.9	150.5	69.1	425.6	209.7	215.9
1952	22.7	3.1	187.1	133.2	78.8	424.9	215.4	209.5
1953	27.5	4.0	193.7	141.7	101.4	468.3	229.8	238.5
1954	26.6	6.3	208.9	101.0	81.5	424.3	246.2	178.1
1955	28.3	11.1	215.2	70.1	64.1	388.8	261.0	127.8
1956	59.6	17.7	229.6	33.6	50.4	390.9	321.1	69.8
1957	29.0	11.9	189.4	113.2	113.0	456.5	237.3	219.2
1958	23.7	6.6	199.5	231.8	155.9	617.5	219.3	398.2
1959	43.0	8.3	217.5	231.7	118.5	619.0	234.5	384.5
1960	53.7	7.6	215.4	235.2	143.5	655.4	227.1	428.3
1961	56.5	6.4	230.3	249.5	140.8	683.5	228.2	455.3
1962	64.6	8.1	220.0	197.5	98.8	589.0	267.9	321.1
1963	51.4	9.7	217.3	155.7	81.9	516.0	276.4	239.6
1964	49.3	8.6	201.0	141.8	73.3	474.0	260.2	213.8
1965	46.8	10.0	201.1	194.7	126.3	578.9	256.1	322.8
1966	48.5	10.4	198.0	198.9	115.4	571.2	255.9	315.3
1967	81.1	15.2	239.7	139.1	82.3	557.4	341.3	216.1
1968	58.0	9.9	207.1	238.2	146.8	660.0	251.7	408.3
1969	88.5	13.6	216.3	218.2	122.1	658.7	307.5	351.2
1970	100.9	16.5	230.6	229.2	149.9	727.1	329.4	397.7
1971	117.0	32.4	262.8	168.2	99.1	679.5	406.8	272.7
1972	112.6	28.8	247.7	234.3	123.7	747.1	371.3	375.8
1973	96.5	14.9	273.0	289.3	164.3	838.0	310.4	527.6
1974	133.3	28.6	272.1	286.1	141.1	861.2	377.4	483.8
1975	112.0	22.6	259.0	296.0	178.6	868.2	327.8	540.4
1976	136.4	19.4	253.2	279.7	164.7	853.4	349.5	503.9
1977	156.5	19.9	317.5	295.0	172.0	960.9	380.6	580.3
1978	154.3	38.7	269.5	245.7	99.1	807.3	431.8	375.5
1979	130.1	32.9	294.5	300.0	157.0	914.5	391.5	523.0
1980	151.0	39.9	300.3	220.3	107.9	819.4	491.1	328.3

Table 1. (Continued)

Year	Uvalde ^a	Medina	Bexar ^b	Comal ^c	Hays	Total	Total Wells	Total Springs
1981	104.2	26.1	280.7	241.8	141.6	794.4	387.1	407.3
1982	129.2	33.4	305.1	213.2	105.5	786.4	453.1	333.3
1983	107.7	29.7	277.6	186.6	118.5	720.1	418.5	301.6
1984	156.9	46.9	309.7	108.9	85.7	708.1	529.8	178.3
1985	156.9	59.2	295.5	200.0	144.9	856.5	522.5	334.0
1986	91.7	41.9	294.0	229.3	160.4	817.3	429.3	388.0
1987	94.9	15.9	326.6	286.2	198.4	922.0	364.1	557.9
1988	156.7	82.2	317.4	236.5	116.9	909.7	540.0	369.7
1989	156.9	70.5	305.6	147.9	85.6	766.5	542.4	224.1
1990	118.1	69.7	276.8	171.3	94.1	730.0	489.4	240.6
1991	76.6	25.6	315.5	221.9	151.0	790.6	436.0	354.6
1992	76.5	9.3	370.5	412.4	261.3	1,130.0	327.2	802.8
1993	107.5	17.8	371.0	349.5	151.0	996.7	407.3	589.4
1994	95.5	41.1	297.7	269.8	110.6	814.8	424.6	390.2
1995	90.8	35.2	272.1	235.0	127.8	761.0	399.6	361.3
1996	117.6	66.3	286.8	150.2	84.7	705.6	493.6	212.0
1997	77.0	31.4	260.2	243.3	149.2	761.1	377.1	383.9
1998	113.1	51.3	312.4	271.8	168.8	917.6	453.5	464.1
1999	104.0	49.2	307.1	295.5	143.0	898.8	442.7	456.1
2000	89.1	45.1	283.6	226.1	108.4	752.3	414.8	337.5
2001	68.6	33.9	291.6	327.7	175.4	890.0	367.7	529.6
2002	76.2	40.6	311.9	350.4	202.1	981.2	371.3	609.9
2003	89.4	34.8	331.7	344.7	176.3	976.9	362.1	621.5
2004	91.3	22.5	331.9	341.4	153.1	940.3	317.4	622.9
2005	107.4	37.3	366.1	349.3	175.6	1,035.7	388.5	647.1
2006	107.5	64.9	289.5	216.7	87.9	766.5	454.5	312.0
2007	64.6	18.4	330.2	331.7	196.0	940.9	319.9	621.0
2008	102.0	48.8	320.4	266.6	108.0	845.7	428.6	417.1
2009	76.9	47.3	265.2	206.6	87.8	683.7	395.7	287.9
2010	53.1	36.4	298.5	312.1	162.5	862.6	372.6	490.0
2011	79.6	57.4	277.2	187.7	91.0	692.9	427.7	265.2
2012	57.6	44.3	267.5	193.4	124.2	687.0	384.7	302.3
2013	43.6	42.8	251.0	154.9	96.0	588.6	355.8	232.8
2014	41.5	43.1	230.5	114.5	97.9	527.5	332.2	195.4
2015	27.1	27.6	256.3	239.8	178.8	729.7	325.2	404.5
2016	46.9	31.9	262.6	320.7	208.3	870.3	325.3	545.0
2017	63.0	43.6	305.3	294.0	166.8	872.2	379.2	493.0
2018	69.9	42.0	277.1	244.0	130.4	763.6	370.6	393.0
2019	76.8	40.9	290.7	306.1	225.0	884.6	358.6	526.0
2020	79.1	50.5	236.6	235.2	114.7	716.2	362.4	353.7
2021	56.1	39.8	222.3	235.2	113.7	667.1	326.6	340.5
2022	70.7	56.4	241.7	143.1	92.9	607.2	387.2	219.9
For period of record (1955--2022):								
Median	69.9	22.5	256.3	235.2	118.5	705.6	332.2	383.9
Mean	71.1	25.2	249.6	230.1	125.0	700.4	318.8	381.7
For last ten years (2012--2022):								
Median	57.6	42.8	256.3	235.2	124.2	716.2	358.6	353.7
Mean	57.5	42.1	258.3	225.5	140.8	719.5	355.3	364.2

Data source: USGS Letter Report to Edwards Aquifer Authority files, dated April 3, 2023.

a = As of 2008, no longer includes Kinney County discharge; prior years include 1,900 acre-feet of discharge for Kinney County.

b = Includes reports of Edwards Aquifer irrigators in Atascosa County.

c = Includes reports of Edwards Aquifer industrial and municipal users in Guadalupe County.

Differences in totals may occur due to rounding.

Table 2. Estimated Spring Discharge from the Edwards Aquifer in 2022 (in acre-ft)

Month	Leona Springs and Leona River	San Pedro Springs	San Antonio Springs	Comal Springs	Hueco Springs	San Marcos Springs	Total
Jan	542	158	0	16,800	1,210	9,820	28,500
Feb	521	180	0	15,800	1,850	9,400	27,700
Mar	462	86	0	16,400	1,030	10,400	28,400
Apr	392	2	0	13,200	583	8,730	22,900
May	360	0	0	11,700	309	7,900	20,300
Jun	274	0	0	8,460	124	6,430	15,300
Jul	133	0	0	7,080	7	6,160	13,400
Aug	27	0	0	6,400	2	5,580	12,000
Sep	96	0	0	6,880	446	5,220	12,700
Oct	130	0	0	5,930	195	5,200	11,500
Nov	173	0	0	7,130	511	5,220	13,000
Dec	222	0	0	7,760	515	5,360	13,900
Total	3,330	426	0	124,000	6,790	85,400	220,000

Data source: USGS letter report dated April 3, 2023.

Totals may not equal sum of discharge values due to rounding.

Table 3. Discharge Summary for Calendar Year 2022 (in acre-feet)

County	<i>Wells – measured</i>			<i>Wells – not measured</i>		Total Well Discharge	Total Spring Discharge	Total Well and Spring Discharge
	Irrigation	Municipal	Industrial	Domestic, Livestock, Limited Pumping†	Federal Facilities†			
Atascosa	1,869	0	7	0	0	1,876	0	1,876
Bexar	5,491	203,940	17,395	9,392	5,100	241,317	426	241,743
Comal	87	7,496	4,038	700	0	12,322	130,790	143,112
Guadalupe	0	100	229	30	0	359	0	359
Hays	142	5,009	1,073	923	382	7,528	85,400	92,928
Medina	42,044	8,361	4,871	1,168	0	56,444	0	56,444
Uvalde	61,392	3,216	114	2,653	0	67,375	3,330	70,705
Total	111,024	228,122	27,727	14,866	5,482	387,221	219,946	607,167

†Federal facilities, and domestic and livestock wells are not required to report annual use; these quantities are estimated.

Totals may not equal sum of discharge values due to rounding.

San Marcos Springs annual mean flow compared to historical mean flow for period of record 1933-2022

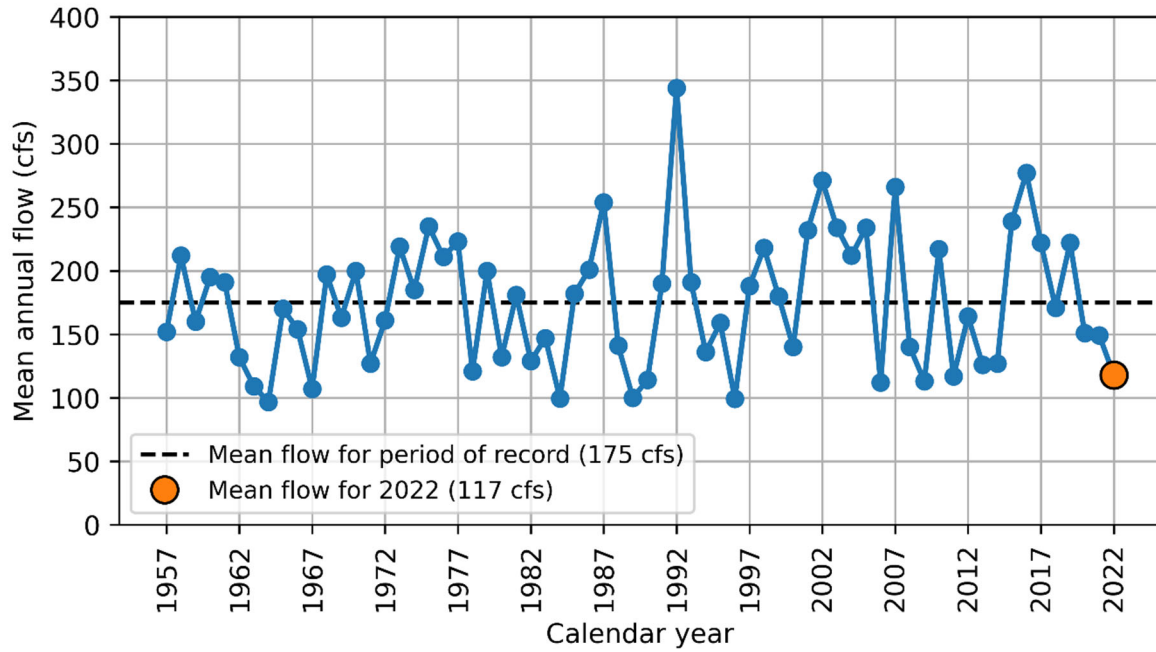


Figure 2. Historical time series of mean annual flow at San Marcos Springs.

Comal Springs annual mean flow compared to historical mean flow for period of record 1933-2022

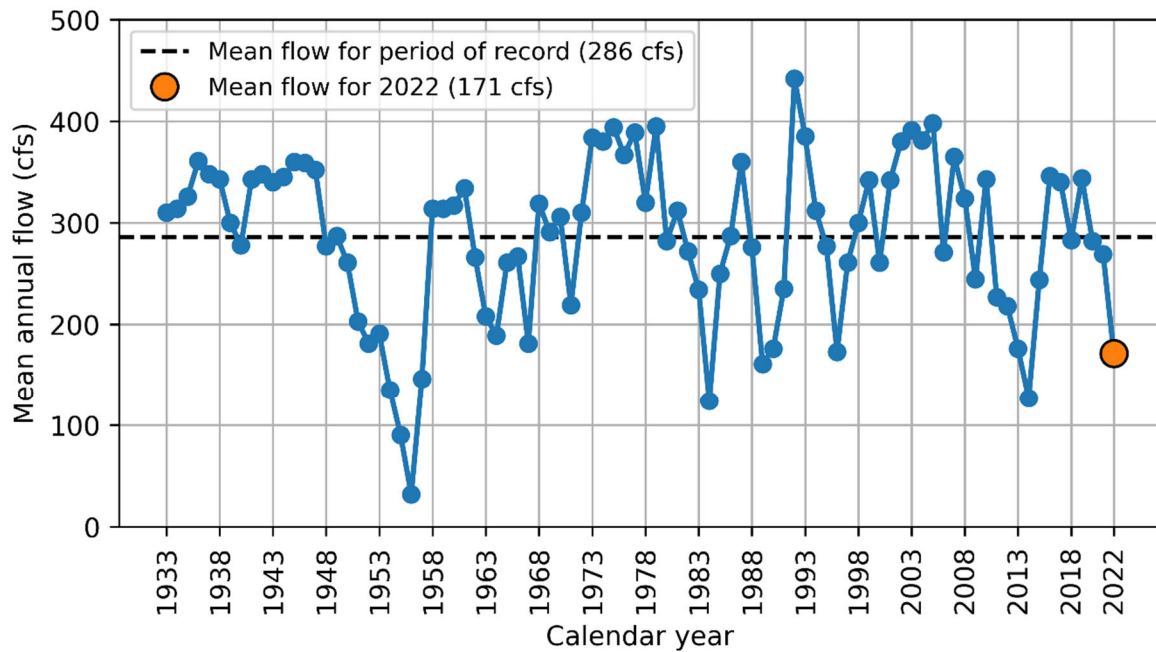
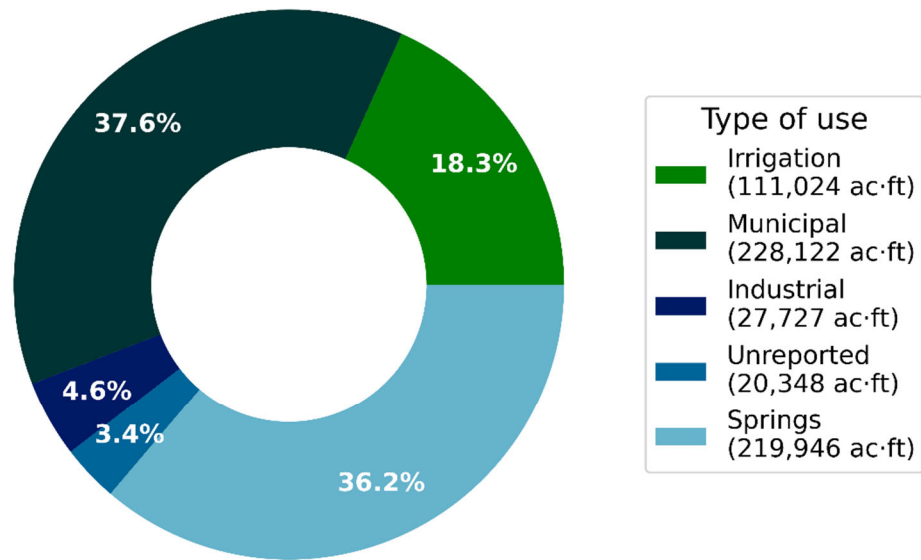


Figure 3. Historical time series of mean annual flow at Comal Springs.

2022 discharge from the Edwards Aquifer by type of use



Total well and spring discharge = 607,167 ac·ft

Figure 4. Discharge from the Edwards Aquifer by type of use.

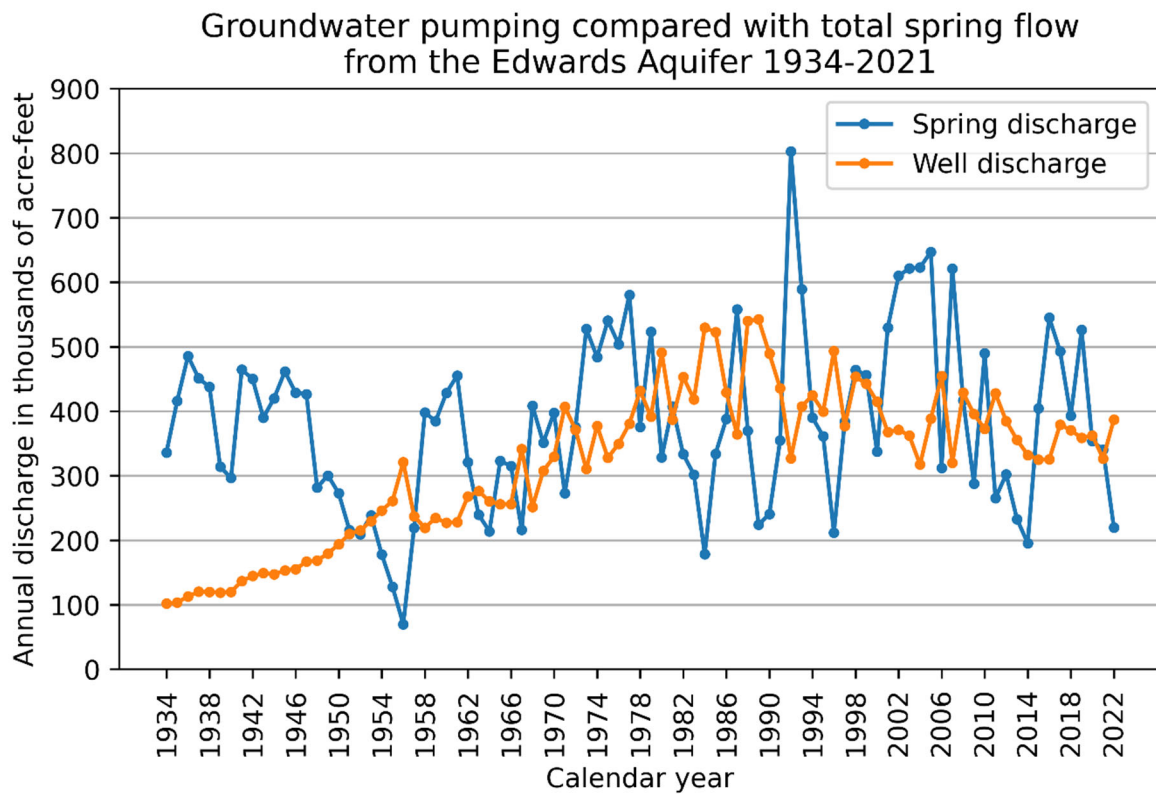


Figure 5. Historical time series of Edwards Aquifer spring discharge compared with groundwater pumping.

Table 4. Annual Estimated Edwards Aquifer Groundwater Discharge by Use, 1955–2021 (in thousands of acre-feet)

Year	Irrigation	Municipal	Domestic/ Stock	Industrial/ Commercial	Springs
1955	85.2	120.5	30.1	25.1	127.8
1956	127.2	138.3	28.9	22.4	69.8
1957	68.8	116.1	29.8	22.6	219.2
1958	47.2	113.7	33.4	25.1	398.2
1959	60.0	118.9	31.5	24.2	384.5
1960	54.9	121.1	31.5	23.3	428.3
1961	52.1	124.5	29.6	22.2	455.3
1962	72.7	143.7	28.8	22.8	321.1
1963	75.4	151.8	27.8	21.8	239.6
1964	72.6	140.2	26.3	21.7	213.8
1965	68.0	138.8	27.0	22.3	322.8
1966	68.2	141.8	23.3	22.6	315.3
1967	119.4	171.0	25.1	25.8	216.1
1968	59.3	146.9	25.5	20.0	408.3
1969	95.2	162.0	29.2	21.1	351.2
1970	110.1	167.5	29.3	22.5	397.7
1971	159.4	196.2	28.6	22.6	272.7
1972	128.8	190.5	30.8	21.1	375.8
1973	82.2	177.1	32.3	18.8	527.6
1974	140.4	174.6	33.5	15.1	483.3
1975	96.4	182.5	33.6	15.3	540.4
1976	118.2	182.1	34.6	14.7	503.9
1977	124.2	205.3	38.1	13.0	580.3
1978	165.8	214.2	40.3	11.5	375.5
1979	126.8	208.9	40.7	15.2	523.0
1980	177.9	256.2	43.3	13.7	328.3
1981	101.8	231.8	40.9	12.6	407.3
1982	130.0	268.6	39.5	15.0	333.3
1983	115.9	249.2	38.8	14.7	301.5
1984	191.2	287.2	36.2	15.2	178.3
1985	203.1	263.7	39.2	16.5	334.0
1986	104.2	266.3	42.0	16.8	388.0
1987	40.9	260.9	43.5	18.7	557.9
1988	193.1	286.2	41.9	18.8	369.7
1989	196.2	285.2	38.2	22.9	224.1
1990	172.9	254.9	37.9	23.7	240.6
1991	88.5	240.5	39.5	67.5	354.6
1992	27.1	236.5	34.8	29.0	802.8
1993	69.3	252.0	49.9	36.1	589.4
1994	104.5	247.0	33.9	39.3	390.2
1995	95.6	255.0	11.6	37.3	361.3
1996	181.3	261.3	12.3	38.8	212.0

Table 4. (Continued)

Year	Irrigation	Municipal	Domestic/ Stock	Industrial/ Commercial	Springs
1997	77.4	253	12.3	34.4	383.9
1998	131.9	266.5	13.4	41.7	464.1
1999	113.6	273.3	13.4	42.4	456.1
2000	106.3	261.3	13.4	33.8	337.5
2001	79	245.9	13.4	29.4	529.4
2002	97.1	228.4	13.6	32.3	609.9
2003	79.6	237.2	13.7	31.7	621.5
2004	55.4	220.3	13.8	28.1	622.9
2005	85.3	255.1	13.8	34.3	647.1
2006	149.1	259.1	13.8	34.5	312
2007	42.5	236	13.8	27.6	620.6
2008	112.7	273.6	13.5	28.8	417.1
2009	108.9	247.5	13.6	25.7	288
2010	72.7	259.9	13.6	26.4	490
2011	124.9	265.5	13.6	23.6	265.2
2012	90.6	257.9	13.7	22.6	302.3
2013	76.3	239.5	13.7	26.3	232.8
2014	75.3	220.1	13.9	22.8	195.4
2015	42.2	247.2	13.9	21.9	404.5
2016	54.7	232.6	14	24	545
2017	74.1	268.3	14	22.8	493
2018	84	250.5	14.1	22.1	393
2019	73.7	241.5	14.1	23.8	526
2020	97.7	223.4	14.6	26.8	353.7
2021	74.3	212	14.5	25.7	340.5
2022	111.0	228.1	14.9	27.7	220.0
For period of record (1955--2022):					
Median	95.4	236.3	28.2	22.9	379.9
Mean	100.9	217.0	25.8	24.9	389.7
For last ten years (2012--2022):					
Median	75.3	239.5	14.0	23.8	353.7
Mean	77.6	238.3	14.1	24.2	364.2