

ONE-PAGE PLACE ASSESSMENT: SANTA FE, NEW MEXICO

LOCATED IN THE RIO GRANDE-SANTA FE SUBWATERSHED WITHIN THE RIO GRANDE WATERSHED

CLIMATE		AVERAGE HIGH & LOW TEMPERATURES ^{1,2}											1867 – 2013
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
° F HIGH	40.9	45.2	52.6	61.4	70.4	80.5	83.1	81.0	74.9	64.3	51.3	42.0	62.4
° F LOW	18.6	22.3	27.3	34.1	42.6	51.6	56.5	55.1	48.6	38.0	27.0	19.8	36.9
° C HIGH	4.9	7.3	11.4	16.3	21.3	26.9	28.4	27.2	23.8	17.9	10.7	5.6	16.9
° C LOW	-7.4	-5.4	-2.6	1.2	5.9	10.9	13.6	12.8	9.2	3.3	-2.8	-6.8	2.7
RECORD HIGH ²	99° F		37.2° C		June 26, 1994			RECORD LOW ²	-24° F		-31.1° C		February 3, 2011

SUN		MAR 21 JUN 21 SEP 21 DEC 21					
LATITUDE	35.7°	DEGREES N or S of DUE EAST THE SUN RISES ³		0°	30°N	0°	29°S
		DEGREES N or S of DUE WEST THE SUN SETS ³		0°	30°N	0°	29°S
ELEVATION	7,003 FT 2,135 m	SOLAR-NOON ALTITUDE ANGLE (ABOVE HORIZON) ^{a,3,4}		54°	78°	54°	31°
		SOLAR-NOON WINTER-SOLSTICE SHADOW RATIO ^b		1 : 1.67	...AND AZIMUTH ^c		0°
		9AM & 3PM WINTER-SOLSTICE SHADOW RATIO ^{b,3}		1 : 3.23	...AND AZIMUTH ^{c,3}		43°

WIND		PREVAILING WIND DIRECTION (FROM WHERE) ⁵ & AVERAGE SPEED ⁶											MAX SPEED ⁷		
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL	MPH	km/h
	N	N	N	N	WSW	N	N	N	N	N	N	N		77	124
MPH	8.9	9.5	9.9	11.2	10.6	10.5	9.2	8.8	8.8	9.1	8.7	8.5	9.5		
km/h	14.3	15.3	15.9	18.0	17.1	16.9	14.8	14.2	14.2	14.6	14.0	13.7	15.3		

WATER		AVERAGE RAINFALL (GAIN) ^{1,2}											1867 – 2013		
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL		
INCHES	0.63	0.65	0.80	0.85	1.17	1.06	2.35	2.20	1.50	1.13	0.73	0.72	13.79		
mm	16.0	16.5	20.3	21.6	29.7	26.9	59.7	55.9	38.1	28.7	18.5	18.3	350.3		
		AVERAGE PAN EVAPORATION (POTENTIAL LOSS) ^{d,8}											1867 – 2005		
INCHES	0.00	0.00	2.27	7.24	8.98	11.02	10.05	8.49	7.21	5.10	1.89	0.00	62.25		
mm	0.0	0.0	57.7	183.9	228.1	279.9	255.3	215.6	183.1	129.5	48.0	0.0	1,581.2		
WETTEST YEAR'S RAIN ¹	21.75 INCHES		552 mm		1881			DRIEST YEAR'S RAIN ¹	5.03 INCHES		128 mm		1917		
LONGEST PERIOD WITH NO MEASURABLE PRECIPITATION ⁹	90 DAYS: October 3, 1950 – January 1, 1951											RAINFALL INCOME ^e	436 GPCD		
													1,651 lpcd		
AREA ^{f,10}	45.98 SQ MILES		POPULATION ^{f,10}		69,204			UTILITY-WATER USE ¹¹	106 GPCD						
	119.0 km ²				2012 est.				401 lpcd						
HISTORICAL	102.33 FT	31.20 m	1951	DEPTH TO GROUNDWATER ^{g,12}	227.42 FT		69.34 m	2013	CURRENT						
CURRENT GROUNDWATER EXTRACTION													<	NATURAL GROUNDWATER RECHARGE ^{h,13}	

WATERGY	5	% of CITY OF SANTA FE'S ELECTRICITY CONSUMPTION USED TO PUMP WATER ^{i,14}	37%
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TOTEM SPECIES	6	PLANT: Silver Buffaloberry (<i>Shepherdia argentea</i>)	REPTILE: Texas Horned Lizard (<i>Phrynosoma cornutum</i>)
MEGAFAUNA:		Puma (<i>Puma concolor</i>)	BIRD: Southwestern Willow Flycatcher (<i>Empidonax traillii extimus</i>)
		MAMMAL: River Otter (<i>Lontra canadensis</i>)	
INSECT:		Orchard Mason Bee (<i>Osmia lignaria</i>)	FISH: Rio Grande Cutthroat Trout (<i>Oncorhynchus clarki virginalis</i>) ¹⁵

FOR MORE INFORMATION & HOW TO APPLY IT

1. For more CLIMATE information, see the introduction, chapters 1, 2, & 4, and appendix 5 of *Rainwater Harvesting for Drylands and Beyond (RWHDB)*, Volume 1, 2nd Edition
2. For more SUN information, see chapters 2 & 4 and appendices 5 & 7
3. For more WIND information, see chapters 2 & 4 and appendices 5 & 9
4. For more WATER information, see the introduction, chapters 1–4, and appendices 1–5
5. For more WATERGY information, see chapters 2 & 4 and appendix 9
6. For more TOTEM SPECIES information: the ethics, principles, and strategies throughout *RWHDB* help us shift from a negative to a positive impact on these species and their habitats and ecosystems, on which our quality of life also depends.

SANTA FE PLACE-ASSESSMENT NOTES

- a. Altitude angle (a.k.a., elevation angle) refers to the number of degrees the sun is located above the horizon at a given time and date.
- b. The solar-noon winter-solstice shadow ratio is the object's height : length of object's shadow cast on December 21 at noon (the longest noontime shadow of the year). The ratio is $1 : x$, where $x = 1 \div \tan(90 - (\text{latitude} + 23.44))$.
- c. Azimuth is the angle formed between a reference direction (here, due south) to the point on the horizon directly below a given object. Solar noon is the time on any day when the sun's azimuth is 0° . The 9 am & 3 pm winter-solstice azimuth indicates the sun's deviation, in degrees, east/west of due south at those times ($-/+$ 3 hours from solar noon) on December 21.
- d. An evaporation pan holds water whose depth is measured daily as water evaporates. These data allow us to determine evaporation rates at a given location. Compare average rainfall (water gain) to potential water loss via evaporation by looking up pan-evaporation rates for your area. If pan-evaporation rates exceed rainfall rates, you are in a dryland environment, where evaporation-reducing strategies such as mulch, windbreaks, shading, and covered water storage are very important.
- e. Calculated in situ w/ average rainfall, area, & population
- f. City proper
- g. This well is located on the property of the Santa Fe Indian School. The well number is USGS 354013105580601 17N.09E.27.441, located at latitude $35^\circ 40' 12.8''$, longitude $-105^\circ 58' 04.5''$. Land-surface elevation 6,845 feet above NGVD29. The depth of the well is 989 feet below land surface. Depth to groundwater varies greatly; this well was chosen due to its having the longest available period of record among area wells listed by this USGS resource. The 1951 reading was taken on December 27, and the 2013 reading was taken on February 7.
- h. Santa Fe's extracted groundwater comes from 2 well fields: the City field and the Buckman field west of town. Current extraction from the City field is $\sim 3,500$ acre-feet per year (roughly equal to natural recharge). Through 2010, extraction from Buckman (max. 6,000 a.f./year) exceeded natural recharge; however, as of January 1, 2011, Santa Fe Water Division reduced Buckman-extraction to 1,000–2,000 a.f./year (substantially less than natural recharge), sourcing the balance of Santa Fe's water from a project, Buckman Direct Diversion, which diverts surface water from the Rio Grande (see reference 13).
- i. This data is for 2012, and represents 12,127,000 kWh of energy.

CREDITS: Brad Lancaster, Resource concept | Megan Hartman, Resource creation, research

SANTA FE PLACE-ASSESSMENT REFERENCES

1. Santa Fe station (#298072), 1867–1972, wrcc.dri.edu, accessed 8/17/2013. Weighted monthly averages from this station & Santa Fe 2 station (see reference 2).
2. Santa Fe 2 station (#298085), 1972–2013, wrcc.dri.edu, accessed 8/17/2013. Weighted monthly averages from this station & Santa Fe station (see reference 1).
3. Rainwater Harvesting for Drylands & Beyond, Vol 1, or esrl.noaa.gov/gmd/grad/solcalc, accessed 8/18/2013
4. RWHDB Vol 1, or Mar 21 = $90 - \text{latitude}$, Jun 21 = $90 - (\text{latitude} - 23.44)$, Sep 21 = $90 - \text{latitude}$, Dec 21 = $90 - (\text{latitude} + 23.44)$
5. Santa Fe Airport station, www.wrcc.dri.edu/htmlfiles/westwinddir.html#NEW%20MEXICO, accessed 8/18/2013
6. Santa Fe Airport station, www.wrcc.dri.edu/climatedata/climtables/westwind/#NEW%20MEXICO, accessed 8/18/2013
7. Maximum wind speed occurred in March, www.myforecast.com/bin/climate.m?city=23762, accessed 8/18/2013
8. Weighted monthly averages from Santa Fe (1867–1972) & Santa Fe 2 (1972–2005) stations, www.wrcc.dri.edu/htmlfiles/westevap.final.html#NEW%20MEXICO, accessed 8/18/2013
9. At Santa Fe station (#298072), Michelle Breckner, Service Climatologist, WRCC, via phone 8/14/2013
10. Census.gov, accessed 8/18/2013
11. 2012 Annual Water Report, City of Santa Fe, April 2013. Downloaded at www.santafenm.gov/DocumentCenter/View/40782, accessed 8/19/2013.
12. Groundwater levels for New Mexico (Santa Fe County), USGS National Water Information System, nwis.waterdata.usgs.gov/nwis/gwlevels, accessed 8/19/2013
13. Rick Carpenter, Water Resources & Conservation Manager, Sangre de Cristo Water Division, Santa Fe, via phone 8/19/2013
14. Nicholas Schiavo, Director, City of Santa Fe Water Division, via telephone 8/23/2013
15. Joel Glanzberg, Regenesys Group, via email 8/21/2013