ONE-PAGE PLACE ASSESSMENT: MARFA, TEXAS

LOCATED IN THE ALAMITO SUBWATERSHED WITHIN THE RIO GRANDE-AMISTAD WATERSHED

CLIMATE ⚐1

AVERAGE HIGH & LOW TEMPERATURES[1] — 1958 – 2009

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
°F HIGH	60.2	63.9	71.2	78.8	85.8	91.2	89.6	87.5	83.6	77.3	67.6	60.8	76.5
°F LOW	25.7	28.1	33.5	41.4	50.1	57.6	60.2	59.1	54.0	44.1	33.4	26.6	42.8
°C HIGH	15.7	17.7	21.8	26.0	29.9	32.9	32.0	30.8	28.7	25.2	19.8	16.0	24.7
°C LOW	-3.5	-2.2	0.8	5.2	10.1	14.2	15.7	15.1	12.2	6.7	0.8	-3.0	6.0

RECORD HIGH[1]: 106° F | 41.1° C | *June 15, 1980*

RECORD LOW[1]: -2° F | -18.9° C | *January 5, 1972*

SUN ⚐2

LATITUDE: 30.3°

ELEVATION: 4,690 FT / 1,430 m

	MAR 21	JUN 21	SEP 21	DEC 21
DEGREES N or S of DUE EAST THE SUN RISES[2]	0°	28°N	0°	27°S
DEGREES N or S of DUE WEST THE SUN SETS[2]	0°	28°N	0°	27°S
SOLAR-NOON ALTITUDE ANGLE (ABOVE HORIZON)[a,2,3]	60°	83°	60°	36°

SOLAR-NOON WINTER-SOLSTICE SHADOW RATIO[b]: 1 : 1.36 ...AND AZIMUTH[c]: 0°

9AM & 3PM WINTER-SOLSTICE SHADOW RATIO[b,2]: 1 : 2.59 ...AND AZIMUTH[c,2]: 44°

WIND ⚐3

MAX SPEED[e,5]: 46 MPH | 74 km/h

PREVAILING WIND DIRECTION (FROM WHERE) & AVERAGE SPEED[d,4]

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
	W & N	W	W	W	W & N	S	E	N	N	N	N	N	
MPH	8.4	9.8	9.9	10.5	9.6	8.3	7.4	7.0	7.3	7.8	7.9	8.3	8.5
km/h	14	16	16	17	15	13	12	11	12	13	13	13	14

WATER ⚐4

AVERAGE RAINFALL (GAIN)[1] — 1958 – 2009

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
INCHES	0.42	0.47	0.31	0.59	1.17	1.78	2.73	2.89	2.57	1.39	0.58	0.50	15.40
mm	10.7	11.9	7.9	15.0	29.7	45.2	69.3	73.4	65.3	35.3	14.7	12.7	391.2

AVERAGE PAN EVAPORATION (POTENTIAL LOSS)[f,6] — 1940 – 1955

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
INCHES	2.86	3.81	6.55	8.26	9.04	10.16	9.77	9.03	6.93	5.23	3.73	2.87	78.24
mm	72.6	96.8	166.4	209.8	229.6	258.1	248.2	229.4	176.0	132.8	94.7	72.9	1,987.3

WETTEST YEAR'S RAIN[1]: 27.47 INCHES | 698 mm | *1990*

DRIEST YEAR'S RAIN[1]: 8.38 INCHES | 213 mm | *1964*

LONGEST PERIOD WITH NO MEASURABLE PRECIPITATION[7]: 227 DAYS: *October 19, 1970 – June 3, 1971*

RAINFALL INCOME[g]: 592 GPCD / 2,242 lpcd

AREA[h,8]: 1.6 SQ MILES / 4.1 km²

POPULATION[h,8]: 1,981 *2010*

UTILITY-WATER USE[i,9]: 146 GPCD / 553 lpcd

HISTORICAL: 170 FT | 51.8 m | *1948*

DEPTH TO GROUNDWATER[j,10]: 181 FT | 55.2 m | *2014* CURRENT

CURRENT GROUNDWATER EXTRACTION

NATURAL GROUNDWATER RECHARGE[k,11]

WATERGY ⚐5

% OF MARFA'S MUNICIPAL ENERGY CONSUMPTION USED TO MOVE & TREAT WATER[12]

TOTEM SPECIES ⚐6

FISH: Chihuahua shiner *(Notropis chihuahua)* MAMMAL: Mexican long-nosed bat *(Leptonycteris nivalis)*

BIRD: Common black hawk *(Buteogallus anthracinus)* REPTILE: Chihuahuan mud turtle *(Trimorphodon vilkinsonii)*

MOLLUSK: Texas hornshell *(Popenaias popeii)* PLANT: Hinckley's oak *(Quercus hinckleyi)* MEGAFAUNA: Gray wolf *(Canis lupus)*

[13]

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.

MARFA PLACE-ASSESSMENT NOTES

a. The solar-noon altitude angle (a.k.a., solar-noon elevation angle) refers to the number of degrees the sun is located above the equator-facing horizon at solar noon on the given date. In the northern hemisphere, the equator-facing horizon is to the south. In the southern hemisphere, the equator-facing horizon is to the north.

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 ÷ tangent (90 - (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. Marfa's prevailing wind direction is highly variable. For example, in May, the wind comes equally frequently from the west and north, followed closely in frequency by winds from the south, northeast, and north-northeast (ref. 4).

e. Given is maximum sustained wind speed (February 24, 2007, at 17:15, from 270° (W)). Highest recorded gust was 66 mph (January 22, 2012, at 18:55, from 260° (W)). Period of record: 1/2004–9/2014 (ref. 5).

f. 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. According to one definition, if pan-evaporation rates exceed rainfall rates, you are in a dryland environment. Another definition states that drylands are "land areas where the mean annual precipitation is less than two thirds of potential evapotranspiration (potential evaporation from soil plus transpiration by plants), excluding polar regions and some high mountain areas which meet this criterion but have completely different ecological characteristics" (Greenfacts.org). The higher the ratio of potential evaporation to rainfall, the more important evaporation-reducing strategies such as mulch, windbreaks, shading, and covered water storage become. The given pan-evaporation data are from Balmorhea, the most comparable station with such data available. Balmorhea Station is about 50 miles north of Marfa at an elevation of 3,220', about 1,470' lower than Marfa, with average annual high temperatures 3.5°F higher. Per E.L. Peck's report (ref. 8), "Pan evaporation for ... open locations on top of major ridges and along their southern slopes and on sites subject to strong night time drainage winds were found to have no discernable variation with elevation. For protected sites and those on northern slopes, pan evaporation showed a small decrease with increasing elevation. The effect of elevation (atmosphere pressure) independently on evaporation rates was investigated through the use of data from stations where the other meteorological factors involved, other than pressure, were the same. The study indicated that pan evaporation increases with increase in pressure, all other factors considered being the same." Marfa's rainfall:evaporation ratio is about 1:5.

g. Calculated in situ w/ average rainfall, area, & population

h. City proper

i. "Old deteriorated and leaky pipes and illegal/un-metered connections may also contribute to [a] loss of water. Calculating a per capita use without the inclusion of the unaccounted for water yields a per capita demand of 146 gpcd without the commercial/industrial demand and a composite rate of 218 gpcd including commercial/industrial demand (ref. 9).

j. City of Marfa's Well #3 (State ID #5148603) located at 30°18'52", -104°01'17", selected for its longest-available period of record. Well level in 1948 was taken on July 19, well level in 2014 was taken on March 8 (ref. 10).

k.

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

MARFA PLACE-ASSESSMENT REFERENCES

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2. Rainwater Harvesting for Drylands & Beyond, Vol 1, or esrl.noaa.gov/gmd/grad/solcalc, accessed 9/17/2014

3. RWHDB Vol 1, or Mar 21 = 90–latitude, Jun 21 = 90–(latitude–23.44), Sep 21 = 90–latitude, Dec 21 = 90–(latitude+23.44)

4. Custom Wind Rose Plots, mesonet.agron.iastate.edu/sites/dyn_windrose.phtml?station=MRF&network=TX_ASOS, accessed 9/17/2014

5. Kyle Brehe, User Services Climatologist, Southern Regional Climate Center, via email 9/17/2014

6. NOAA Technical Report NWS 34: Mean Monthly, Seasonal, and Annual Pan Evaporation for the United States, www.nws.noaa.gov/oh/hdsc/PMP_related_studies/TR34.pdf, accessed 9/16/2014

7. Michelle Breckner, Service Climatologist, WRCC, via phone 9/15/2014
8. Marfa, Texas, en.wikipedia.org/wiki/Marfa,_Texas, accessed 9/17/2014
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10. Texas Water Development Board's Groundwater Database, wiid.twdb.texas.gov/ims/wwm_drl/viewer.htm, accessed 9/17/2014
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13. Rare, Threatened, and Endangered Species of Texas, www.tpwd.state.tx.us/gis/ris/es/, accessed 9/19/2014