ONE-PAGE PLACE ASSESSMENT: HARARE, ZIMBABWE

LOCATED IN THE ZAMBEZI RIVER WATERSHED

CLIMATE ⚐1

AVERAGE HIGH & LOW TEMPERATURES[1] *1897 – 1950*

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
°C HIGH	26.2	25.8	25.7	25.3	23.2	21.2	21.1	23.4	26.9	28.9	28.0	26.3	25.2
°C LOW	15.5	15.2	14.4	12.1	8.8	6.3	5.9	7.6	10.9	13.9	15.1	15.3	11.7
°F HIGH	79.2	78.4	78.3	77.5	73.8	70.2	70.0	74.1	80.4	84.0	82.4	79.3	77.4
°F LOW	59.9	59.4	57.9	53.8	47.8	43.3	42.6	45.7	51.6	57.0	59.2	59.5	53.1

RECORD HIGH[2] 35.0° C | 95.0° F | *November* — RECORD LOW[2] 0.0° C | 32.0° F | *August*

SUN ⚐2

LATITUDE -17.8°

ELEVATION 1,491 m / 4,890 FT

	MAR 21	JUN 21	SEP 21	DEC 21
DEGREES N or S of DUE EAST THE SUN RISES[3]	0°	24°N	0°	25°S
DEGREES N or S of DUE WEST THE SUN SETS[3]	0°	24°N	0°	25°S
SOLAR-NOON ALTITUDE ANGLE (ABOVE NORTHERN HORIZON)[a,3,4]	72°	49°	72°	96°

SOLAR-NOON WINTER-SOLSTICE SHADOW RATIO[b] 1 : 0.88 ...AND AZIMUTH[c] 0°

9AM & 3PM WINTER-SOLSTICE SHADOW RATIO[b,3] 1 : 1.75 ...AND AZIMUTH[c,3] 48°

WIND ⚐3

PREVAILING WIND DIRECTION[d] & AVERAGE SPEED[5] MAX SPEED m/s MPH

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
	ENE	ENE	E	ENE	ENE	E	E	ENE	ENE	ENE	ENE	ENE	ANNUAL
m/s	2.6	2.6	2.8	2.8	2.8	3.0	3.3	3.6	3.9	3.8	3.3	2.9	3.1
MPH	5.8	5.8	6.3	6.3	6.3	6.7	7.4	8.1	8.7	8.5	7.4	6.5	6.9

WATER ⚐4

AVERAGE PRECIPITATION (GAIN)[6] *1890 – 1989*

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
mm	190.4	176.7	106.8	32.5	10.1	2.8	1.2	2.3	6.6	31.8	93.1	173.1	827.4
INCHES	7.50	6.96	4.20	1.28	0.40	0.11	0.05	0.09	0.26	1.25	3.67	6.81	32.57

AVERAGE PAN EVAPORATION (POTENTIAL LOSS)[e,7]

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
mm	163.0	137.0	156.0	138.0	128.0	112.0	125.0	162.0	213.0	242.0	192.0	163.0	1,931.0
INCHES	6.40	5.40	6.10	5.40	5.00	4.40	4.90	6.40	8.40	9.50	7.60	6.40	75.90

WETTEST YEAR'S RAIN[8] — DRIEST YEAR'S RAIN[8]

LONGEST PERIOD WITH NO MEASURABLE PRECIPITATION[9]

RAINFALL INCOME[f] 941 lpcd / 249 GPCD

AREA[g,10] 872 km² / 336.8 SQ MILES

POPULATION[g,10] 2,100,000 *2012*

UTILITY-WATER USE[h,11] 125 lpcd / 33 GPCD

DEPTH TO GROUNDWATER[i]

CURRENT GROUNDWATER EXTRACTION — NATURAL GROUNDWATER RECHARGE[i]

WATERGY ⚐5

of AVG LOCAL HOMES THAT COULD BE POWERED W/ ENERGY USED TO MOVE & TREAT HARARE'S WATER

TOTEM SPECIES ⚐6

PLANT: FISH: MAMMAL:

AMPHIBIAN: BIRD: REPTILE:

Available online at HarvestingRainwater.com/one-page-place-assessments

FOR MORE INFORMATION & HOW TO APPLY IT

1. For more CLIMATE information, see the introduction and chapters 1, 2, & 4 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.

HARARE'S 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 June 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 north) 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 north at those times (±3 hours from solar noon) on June 21.

d. The direction of a prevailing wind is the direction *from* which the wind blows.

e. An evaporation pan holds water whose depth is measured daily as water evaporates from it. 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). Stated as a ratio of rainfall to pan evaporation, the cut-off for drylands is 1:1.5; when the number on the right is higher than 1.5, the environment is drylands. 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 data above yield a rainfall:pan-evaporation ratio of 1:2.28, suggesting per both definitions above a drylands environment.

f. Rainfall income calculated in situ w/ average rainfall, area, & population.

g. Greater Harare

h. Converted from 2002 national statistic of 589,000,000 cubic meters/year for domestic use. 589,000,000 cubic meters x 1,000 liters/cubic meter ÷ stated national population of 12,932,000 people ÷ 365 days/year = 125 liters/person/day.

i.

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

HARARE PLACE-ASSESSMENT REFERENCES

1. Salisbury (Harare) Weather Station, www.WorldClimate.com, accessed 1/12/2014

2. En.wikipedia.org/wiki/Harare, accessed 1/12/2014

3. Rainwater Harvesting for Drylands & Beyond, Vol 1, or esrl.noaa.gov/gmd/grad/solcalc, accessed when?

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

5. *Selected climatic data for a global set of standard stations for vegetation science,* M.J. Muller, Springer Science & Business Media, 2012. Data for Salibury Station (prior name of Harare), accessed 3/28/2016 via Google Books

6. Harare Belvedere Weather Station, worldclimate.com, accessed 1/11/2014

7. Kutsaga Tobacco Research Station data, as estimated from line graph (Fig. 9) in The Mupfure Catchment report accessed 1/14/2014 at www.geogr.uni-jena.de/fileadmin/Geoinformatik/projekte/iwrms/www/download/other-reports/mupfure_catchment_description.pdf

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10. Key Statistics, hararecity.co.zw, accessed 1/12/2014

11. Fao.org/nr/water/aquastat/countries_regions/zimbabwe/zimbabwe_cp.pdf, accessed 1/11/2014

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