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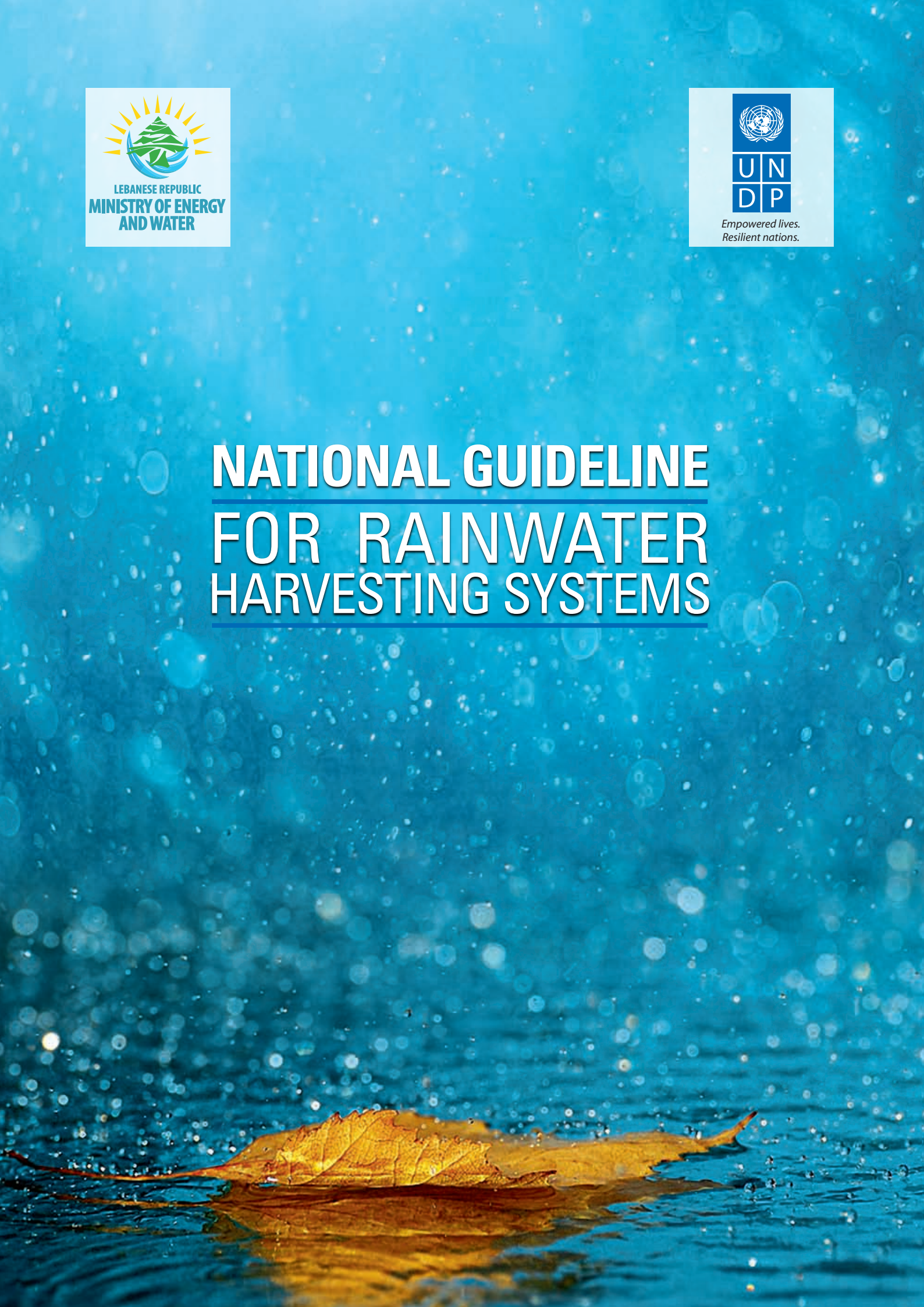
NATIONAL GUIDELINE FOR RAINWATER HARVESTING SYSTEMS



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NATIONAL GUIDELINE FOR RAINWATER HARVESTING SYSTEMS

2016

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INTRODUCTION

Fresh water is a very precious and rare resource. Water covers 75% of the surface of our planet but only some 2.5% is fresh water and less than 1% is readily accessible for human use, the rest being locked as ice, in biomass or practically out of reach (ref:1).

Currently it is estimated that the available renewable freshwater resources in Lebanon for an average rainy year amount to 4,100 MCM (fig.1) or practically 1000 m³/capita/year based on a population of 4.3 million inhabitants not including non-Lebanese residents. This value for water availability is practically equal to the 1,000 m³/capita/year water scarcity threshold recognized by UNEP (ref:2).

In other words and contrary to popular belief, Lebanon is approaching the red zone as far as fresh water resources are concerned. The mismanagement of the water sector exacerbates this dire situation which may get worse due to two main factors namely climate change and population increase. The first one may lead to a potential 10-15% decrease in precipitations and an increase of 4-20% in evapotranspiration across Lebanon by 2040 (ref:3), while population is estimated to increase by 30% over the same period (ref:4), ((not taking into consideration non Lebanese residents)). Studies have shown that Lebanon has already experienced an 8% drop in precipitations in Beirut and Tripoli areas (where rainfall records are available) during the last 30 years when compared with earlier periods of the previous century (ref:5).

Because of the relatively low availability and bad governance of its water resources, Lebanon is experiencing extreme water shortages in many regions and is dangerously depleting its underground water reservoirs up to a point of no return. Consequently, water levels of underground reservoirs are dropping at continuous and alarming rates in many regions of Lebanon and sea water intrusion is observed in most of the coastal aquifers.

This situation does not bode well and is not conducive to a sustainable development of the country.

The *National Guideline for Rainwater Harvesting Systems in Lebanon* is part of a national strategy, outlined in a document that was published in 2010 entitled the "National Water Sector Strategy", aiming to improve water governance in Lebanon with the ultimate goal of preserving our national water resources and using them in a way that is conducive to sustainable economic growth, to healthy social development and flourishing biodiversity.

LEBANON CANNOT PROSPER WITHOUT A STEADY, SECURE AND SAFE SUPPLY OF FRESH WATER

RAINWATER HARVESTING DOES NOT ONLY PROVIDE A SOURCE OF WATER THAT INCREASES WATER SUPPLY BUT ALSO IT CAN INVOLVE THE PUBLIC IN WATER MANAGEMENT, MAKING WATER MANAGEMENT EVERYBODY'S BUSINESS.

IT GIVES CONSUMERS A SENSE OF PRIDE AND RESPONSIBILITY

The present document offers detailed guidelines, technical and commercial information on how to size and implement rainwater harvesting systems in rural and urban settings mainly for domestic applications and external uses as applied to residential units, schools, hospitals and any other facility where domestic uses of water are found.

Rainwater Harvesting 'RWH' consists of collecting precipitations falling on roofs, terraces or any adequate surface that can catch water with a view of storing it for later use as prescribed in this document. It has many social, economic and environmental advantages;

- Rainwater being soft water, pipes scaling and corrosion will be drastically reduced, the same could be said for heating equipment like boilers, hot water tanks and solar water heaters.

- Much less quantities of soap and detergents are needed with soft water for washing hands and cleaning cloth thus making economies and reducing the chemical loading of waste water being rejected to nature. Liquid detergent softeners are not required.

- Blending treated rainwater with municipality water will reduce the hardness of the water without necessitating the use of softeners thus sparing the cost of the softener and its operation.

- Users that heavily rely on water trucks will find RWH a blessing, it may simply eliminate the truckloads. Also in the eventual occurrence of water metering in Lebanon at the consumer premises, thus introducing the "pay as you consume principle", rainwater harvesting will definitely reduce the water bill. Rainwater harvesting may easily cut by half the municipality water requirements of a household.

- Rainfall being captured at the source instead of flowing, storm water abatement reduces the possibility of soil erosion and flood risks. This is of particular importance in built up areas

where soil permeability has been practically reduced to nil thus increasing storm water surface flows. Collecting the rainwater will reduce the stress on the municipality storm water network.

- Reduce the load on the water supply network during summer time when water use is at its peak and rainfall is practically nil. This is especially important knowing that Lebanon is increasingly reliant on ground water pumping which gravely impacts water tables levels.

This guideline is intended to be used by all categories of people including those with no technical background. The information is presented in an easily accessible and straightforward way where hopefully the reader will enjoy a stimulating experience to devise and build a rainwater harvesting system that will provide some water supply independence.

The contents are divided into three sections with supporting annexes;

Section 1 is a birds-eye view of the country with a focus on characteristics that relate to its hydrology as well as other water issues.

Section 2 introduces the art and science of rainwater harvesting starting with a description of the different components of the system as well as an overall view about the different options and scenarios possible for rainwater use.

Section 3 offers detailed guidelines how to plan, size, price, implement and maintain a rainwater harvesting system together with tips how to save water. The annexes contain useful information as well as necessary data to perform some of the calculations presented in this section.

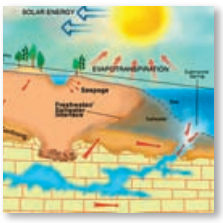
RWH IS AN ACT OF RESPONSIBLE CITIZENSHIP

Rainwater harvesting has been practiced in this region for thousands of years; as the archeological finds in Jbeil and Jericho have shown. Nearer to us in space and time is of course the vernacular architecture of the mountain, as well as that of the urban environment where rainwater harvesting was one of its main features.

Evapotranspiration
4,500 MCM

Average Total Rainfall
(Including Snowfalls)
On Lebanese Territory
8,600 MCM

Gross Renewable Water
Resources on National Territory
4,100 MCM



Unexploitable
Groundwater
To sea springs
400 MCM

Average available Renewable Water
Resources on National Territory as
Groundwater 500 MCM and
Surface Streams 2,200 MCM

Unavoidable Surface and
Groundwater Flows to
Neighboring
Countries 1000 MCM

Fig.1 Water Budget of Lebanon in a Glimpse (ref:6)

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Typical cube configuration (House 1)

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LIST OF ABBREVIATIONS

AGT	Above Ground Tank
cfu/100ml	Colony Forming Units per 100 ml liter
CP	Chlorination Pump
ESMLR	Eastern slopes of Mount Lebanon Range
GWB	Grey Water Blending
HCT	Hypochlorite Chlorination Tank
l/m²/d	Liter per square meter per day
LMTA	Lebanon Mountain Trail Association
l/p/d	Liter per person per day
l/shr/d	Liter per shrub per day
MCM	Million cubic meters
m³/capita/year	Cubic meters per capita per year
m³/d	Cubic meters per day
mg/l	Milligram per liter
MWA	Municipal Water Availability
MWB	Municipal Water Blending
PE	Polyethylene
p/km²	Persons per square kilometer
PVC	Poly-Vinyl Chloride
RWH	Rainwater Harvesting
RWHCAT	Rainwater Harvesting Categories
RWHS	Rainwater Harvesting System
RWT	Rainwater Treatment
S	Scheme
TDH	Total Discharge Head
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
UGT	Under Ground Tank
UNDP	United Nation Development Program
UNEP	United Nation Environment Program
USAID	United States Agency for International Development
USECAT	Use categorization
WMM	Western Mid-Mountain
WSMLR	Western Slopes of Mount Lebanon Range
WTCAT	Water Treatment Categorization

I

LEBANON, A BRIEF OVERVIEW

The main purpose of this section is to give a brief summary of the characteristics of the country directly related to Rainwater Harvesting and water availability thus giving the reader some background on and an appreciation of the subject being dealt with.

1 LAND TOPOGRAPHY

Lebanon is located on the Eastern shores of the Mediterranean Sea, it has a nominal area of 10,452 km². The country stretches 225 km lengthwise along a N-NE / S-SW axis with a width tapering from 88 km in the North to 35 km in the South. Its latitudinal span is 33.2 – 34.7 ºN while its longitudinal one is 35.2 – 36.6 ºE.

Its topography is made up West to East of a coastal plain and two parallel mountain ranges that taper off at both ends, respectively the Lebanon and the Anti-Lebanon separated by an inland plateau, the Bekaa.

The narrow very fertile coastal plain squeezed between the Mediterranean Sea and the Western foothills of the Lebanon Range has a maximum width not exceeding 6.5 km in the North interrupted in few places by the advances of promontories plunging abruptly into the sea as at *"Nahr el Kalb"*.

The Lebanon Range with its highest peak towering above 3000 m in the North has a very abrupt and rugged topography characterized by valleys and deep clefts running East-West perpendicular to its dorsal therefore dividing the range into steep sloped natural bastions that form drainage basins for waterways and springs. The snow- capped ranges of Mount Lebanon at altitudes above 1800 m constitute the open air water reservoirs of the country that feed waterways and underground aquifers long after the rain has stopped. However till the present time, the exact contribution of the snow cover to the water supply of the country has not been well studied and investigated.

The Bekaa Plain, lying at the East of the Lebanon Range is a very fertile High Land about 16 km wide and 129 km long gently sloping from an altitude of 1100 to 900 m from North to South. It is crossed lengthwise along its lower stretch by the Litani river, the most important waterway in Lebanon. The Hermel is the northern stretch of the Bekaa plain, it is itself crossed lengthwise by the Orontes river, one of two rivers shared with bordering countries, the other being the Hasbani.

THE SNOW- CAPPED RANGES OF MOUNT LEBANON AT ALTITUDES ABOVE 1800 M CONSTITUTE THE OPEN AIR WATER RESERVOIRS OF THE COUNTRY THAT FEED WATERWAYS AND UNDERGROUND AQUIFERS LONG AFTER THE RAIN HAS STOPPED.

East of the Bekaa stands the Anti-Lebanon Range which separates between Lebanon and the Syrian inland, its highest peak located southward, Mount Hermon, rises to 2860 m. Unlike the Lebanon Range, the Anti-Lebanon is rather thinly populated and vegetated. The Hasbani, a tributary of the Jordan river, is the only perennial waterway in Lebanon having its sources from the Anti-Lebanon.

2 CLIMATE AND PRECIPITATION

Lebanon exhibits diverse micro climates with varying amounts of precipitations. It has a rather long dry season extending from April to October and a shorter wet season from November to March characterized by relatively short, interspersed but heavy downpours. Overall, on an average rainy year, Lebanon receives some 800 mm of rainfall.

Rainfall monthly percentage distribution is practically the same all over Lebanon (Table 1) despite variations in quantities depending on regions (Table 2).

Table 1. Average Percentage Distribution Of Rainfall On A Monthly Basis For Lebanon – (Ref:22)

SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
0.7%	6.8%	11.8%	19.9%	22.4%	17.1%	12.9%	6.4%	1.6%	0.3%	0.1%	0.1%

Source: Meteorological data of Lebanon

Practically speaking, around 85% of the precipitations in Lebanon are concentrated over 5 month from November to March. This has profound implications on RWHS and especially in what relates to storage.

The littoral and the Western Slopes of Mount Lebanon Range (WSMLR) have predominantly a Mediterranean climate where up to 500 m altitude, average yearly precipitations vary between 800 and 1000mm while at higher altitudes up to 1800 m average yearly rainfall may reach 1400 mm (Dahr el-Baidar, Qartaba). Generally, rainfall increases on the WSMLR at the rate of 25mm for each 100m elevation.

There are no precise precipitations data at altitudes higher than 1800 m because the available measuring equipment is not adapted to snowy and cold weather according to the meteorological service at Beirut airport. However this is of no serious consequence for the purpose of this document because there is hardly any permanent human settlement in Lebanon above 1900 m altitude. Actually the highest village in Lebanon, Bkaa Kafra in the North, lies between 1600 - 1800 m altitudes.

On average, the littoral and the WSMLR, experience between 60 and 80 rainy days a year and at altitudes above 1200 m, around half that amount of snowy days.

The Eastern slopes of Mount Lebanon Range, the Bekaa plain and the Anti-Lebanon Range have more of a continental climate being less exposed to the dampening effect of the Mediterranean. The average yearly rainfall in the Bekaa plain varies in increasing intensity from North to South. It ranges from 450 mm (Haouch Snaid) to 1000 mm (Khorbet Kanafar) while the Hermel area which lies at the northern extremities of the Bekaa plain experiences a rather arid climate with average yearly rainfalls not exceeding 250 mm. Baalbeck itself which is the southern gateway to the Hermel receives an average of 450 mm.
There are no readings for the Anti-Lebanon which receives together with the Hermel area the least amount of rain, however some areas in the Wadi el Taym corridor which lies at the foothills of

the Anti-Lebanon at the level of the southern Bekaa plain still receive some 1000 mm of rainfall (Hasbaya, Kfair ez-zayt).

Table 2. Average Rainfalls For Selected Regions Of Lebanon – (Ref:22)

Region	Rainfall (mm/year)
Beirut	710
Littoral North up to 500 m altitude	745
Littoral Center up to 500 m altitude	850
Littoral South up to 500 m altitude	655
WSMLR 500 – 1200 m	1200
WSMLR 1200 – 1800 m	1100
Bekaa North	450
Bekaa Center	690
Bekaa South	870
Litani basin	718
Orontes basin	450
Yammouneh	1000
Hermel	250
Wadi el Taym	917

Source: Meteorological data of Lebanon

Predominant winds in Lebanon blow in a West/South-West direction for most of the year, Easterlies and Northern winds are of lesser occurrence but of significant effect especially Easterlies that bring sandstorms from the Syrian inland and Arabian peninsula during spring and less frequently in summer and autumn.

The winds do have an impact on RWHS as far as rainfall water quality is concerned as shown further below.

Precipitations in Lebanon could have drastic annual variability; in some regions inter-annual variability may exceed 500% between exceptionally rainy and dry years. The year 2014 is a good example of a dry year where average precipitations on the national soil were nearly half the annual average knowing that this year is not the worst that Lebanon has experienced or will probably experience in the future.

On average, rainfall events in Lebanon rarely exceed 10 days, the weighted average being around 1.5 days. Moreover rainfall event exceeding 4 days rarely occur more than once a year. Basically, heavy rainfall events in Lebanon are characterized by their brevity and intensity which is typical of a Mediterranean climate. It is not uncommon for daily rainfalls to reach 200 mm at mid altitudes or 100 mm at the littoral.

On average, one rainy day out of 10 receives more than 30 mm of rainfall in the coastal region and 45 mm at mid altitudes, while around half of the rainy days on the national territory yield less than 5 mm. Overall heavy rainy days that yield rainfalls in excess of 40 mm do not exceed 20% of rainy days over any one year.

Rainfall recording started in Lebanon some 137 years ago at the meteorological observatory of the American University of Beirut. Since then many stations were added over the years to cover most areas of Lebanon and some even in Syria. By 1975 some 146 stations were more or less operational but this number quickly diminished at the onset of instability during that year. Practically only three stations kept operating namely Beirut airport, Ksara in the Bekaa and Tripoli. Thus only these stations have complete recording series that extend over relatively long periods of time.

Starting in the 1990s, some more existing stations were recording again and new stations were put into service, currently 39 stations are operational with more being planned. The stations listing are as shown in Annex B.

3 POPULATION

With a current population of some 4,200,000 inhabitants yielding an occupancy density of around 400p/km², Lebanon is one of the ten most populated countries in the world if small entities like the Vatican state and Honk Kong are not taken into consideration. If non-national residents are taken into account, it is one of the five most populated countries in the world.

Table 3. Mohafazat Population Growth Over Year 2030 Horizon (Ref:4)

MOHAFAZAT	2000	2030	% Growth
Beirut & Mount Lebanon	1,910,896	2,310,000	21.22
North Lebanon & Akkar	807,204	1,140,000	41.18
South Lebanon & Nabatyeh	747,477	1,040,000	37.93
Bekaa & Baalbeck-Hermel	539,448	740,000	38.90
TOTAL	4,005,025	5,230,000	30.79

Source: NPMPLT, 2005, chapter 2, Table 4

However, the age pyramid of Lebanon is starting to thin out at the bottom a clear indication of demographic maturity and lower future population growth rates (ref:7).

Residents in Lebanon are expected to top 5 million by 2030 (Table 3) with an expected average yearly growth rate of 1 % (ref:4). The most economically developed areas of Lebanon namely Beirut and Mount Lebanon are heavily urbanized while the periphery which is sill to a certain extent rural is less so (Table 4).

Table 4. Population Distribution Over The Land Horizon 2030 (Ref:4)

MOHAFAZAT	YEAR 2000			YEAR 2030		
	TOTAL POPULATION	POPULATION IN URBAN CENTERS		TOTAL POPULATION	POPULATION IN URBAN CENTERS	
Beirut & Mount Lebanon	1,910,896	1,651,000	86%	2,310,000	1,990,000	86%
North Lebanon & Akkar	807,204	385,000	48%	1,140,000	620,000	54%
South Lebanon & Nabatyeh	747,477	327,000	44%	1,040,000	490,000	48%
Bekaa & Baalbeck-Hermel	539,448	181,000	34%	740,000	300,000	40%
TOTAL	4,005,025	2,544,000	64%	5,230,000	3,400,000	65%

Source: NPMPLT, 2005, chapter 2, Table 6

80% of the residents live on the coastal zone (0-400 m) making out of it one of the most densely populated areas in the world (1310 p/km²) as shown in (Table 5).

Table 5. Lebanon Population Density As Function Of Altitude (Ref:4)

ALTITUDE RANGE (m)	POPULATION DENSITY (P/Km²)	CLIMATE ZONE
0 – 400	1,310	Coastal (Zone 1)
400 – 800	278	Coastal (Zone 1)
800 – 1200	257	WMM (Zone 2) & In-land Plateau (Zone 3)
1200 – 1600	91	WMM (Zone 2) up to 1400 m
1600 – 2000	15	High Mountain (Zone 4)
> 2000	1	High Mountain (Zone 4)

Source: NPMPLT, 2005, (column 3 added), WMM: Western Mid-Mountain

However with the huge influx of people to Lebanon fleeing conflict areas in neighboring Syria most demographic statistics of Lebanon are currently outdated thus requiring major revisions.

It is estimated that the current resident population in Lebanon is around 5.5 million and while this number may increase in the near future depending on the situation in the area, it might not drop down any time soon thus putting increased pressure on water demand.

The effect on water demand caused by the alarming increase in population is even further magnified by the higher living standards sought out by the population as a direct outcome of economic growth and social awareness.

Currently, the average household size in Lebanon is estimated at 4.3 persons, living in around 1 million dwelling units.

CURRENTLY, THE AVERAGE HOUSEHOLD SIZE IN LEBANON IS ESTIMATED AT 4.3 PERSONS, LIVING IN AROUND 1 MILLION DWELLING UNITS.

4 ADMINISTRATION

Lebanon is divided into 6 governorates (Mohafazat) namely, North Lebanon, Bekaa, Mount Lebanon, Beirut, Nabatyeh and South Lebanon, divided into a total of 25 districts (caza) themselves composed of municipalities. Beirut has no districts but has a municipality.

With the exception of Beirut, the Mohafazats and their caza extend over several climatic zones thus experiencing different rainfall regimes. Hence, with the exception of Beirut, any one Mohafazat or even caza cannot be characterized by one average rainfall number for the purposes of this guidebook if a minimum of accuracy in the calculations is to be ensured. Consequently rainfall data will be presented at the town and village level.

This is possible because all the meteorological stations in Lebanon are located in or nearby towns and villages, as for agglomerations that are far away, geographical characteristics similar to areas where the meteorological stations are located will be used as proxy. Basically the two parameters that govern such similarity are altitude and topographical locations. Thus for example two villages relatively far apart but having nearly similar altitudes and topographical locations (located on the western side of mount Lebanon range) will experience roughly the same amount of rain fall.

Fig.2 The Administrative Organization of Lebanon

5 WATER DEMAND IN LEBANON

Agriculture is the largest water consumer; it absorbs some 55% of the water supply. This share is expected to rise to 60% by 2030 (ref:14). The domestic water supply was estimated at 505 MCM for 2010, it is roughly distributed as follows over the different Mohafazat;

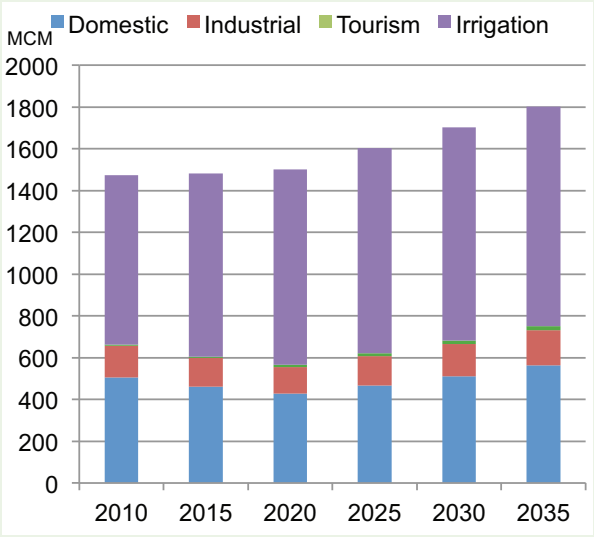


Fig.3 Water Demand (ref:14)

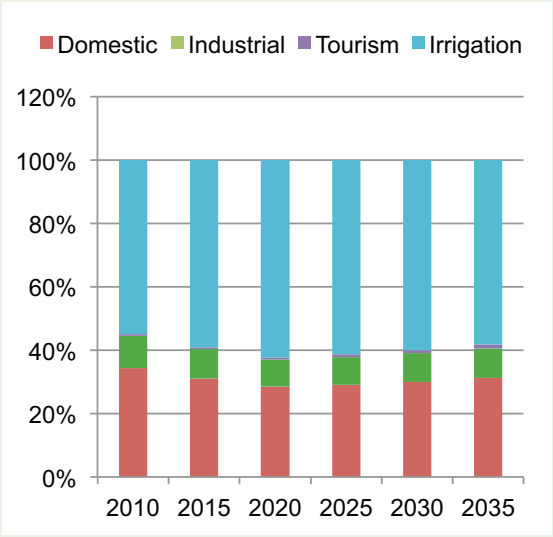


Fig.4 Water Demand as a percentage (ref:14)

It is worthwhile noting that population density and a weak regulatory environment is resulting in serious pollution to water resources which could be considered a form of hidden demand. Actually water supplies that have been polluted could be considered as used water even though they were never physically touched or used by consumers. This is the basic assumption of the water footprint concept.

WATER DEMAND IN LEBANON IS EXPECTED TO INCREASE BY 250 MCM OVER THE NEXT 20 YEARS WITH IRRIGATION ABSORBING MOST OF THIS INCREASE

6 WATER REGULATIONS AND WATER QUALITY

The regulatory framework regarding water is quite weak in Lebanon. Decree 1039 of 2/8/1999 (ref:18) sets quality requirements regarding the physical, chemical and bacteriological properties for tap water (potable/drinking water not bottled water). These requirements are shown in Annex C of this guideline. (Decree 1039 needs updating…).

There are no standards or regulations in Lebanon concerning rainwater harvesting and the use of rainwater. Consequently, the present guideline document has the objective to set clear requirements regarding the collection, storage, treatment and use of harvested rainwater.

Most of Lebanon's waterways are polluted because of uncontrolled sewage, industrial waste dumping and irrigation water leaching. The most flagrant example is probably the Litani River and Qaraoun Lake which exhibit alarming levels of all sorts of pollution. Tables 6 & 7 give an idea of the extent of pollution in some of the waterways (ref:14).

Table 6. Quality Parameters For Selected Rivers In The Dry Season (Ref:14)

River	BOD_5 (mg/L)	NO_3 (mg/L)	TDS (mg/L)	SO_3 (mg/L)	Total Coliform (c/100mL)	E. Coli (c/100mL)
Kabir	14.4	3	270	20	900	20
Bared	28.2	2.8	225	28	610	17
Abou Ali	39.3	3.4	280	22	26,500	3,000
Ibrahim	62.8	1	150	8	3,500	200
Antelias	53.2	3	300	30	28,000	6,000
Damour	21.3	3	200	38	490	15
Awali	33.4	7	210	22	710	1
Qasmieh	22.5	5.5	250	21	80	0
Limit Value	**Nil**	**50**	**600**	**250**	**500**	**100**

Source: STLE, 2010, Table 3.11

Table 7. Litani River Basin Water Quality (Ref:14)

Indicator	BAMAS 2005 (Summer)			LRBMS 2010 (summer)			Drinking Water Standard	
	Min	Mean	Max	Min	Mean	Max	Libnor	EPA
Surface Waters								
TDS (mg/l)	88	290.96	706	187	502	1979	<500	<500
pH (pH units)	6.57	7.09	7.68	7.27	7.93	8.66	6.5-8.5	6.5-8.5
BOD (mg/l)	2	48.46	624	2.50	547	1530	NA	NA
Nitrates (mg/l as N)	3	13.46	62	0.10	1.23	4.90	45	<10
Phosphates (mg/l)	0	11.75	197	0	8.58	72	NA	NA
Fecal Coliform (CFU/100ml)	0	223,487	1,500,00	1	71.61	400	0	0
Cadmium (mg/l)	NA	NA	NA	0.005	0.01	0.079		<0.005
Lake Water								
TDS (mg/l)	120	160	196	221	235	256	<500	<500
pH (pH units)	6.5	7	7.5	8.2	8.27	8.32	6.5-8.5	6.5-8.5
BOD (mg/l)	<2	2.57	4	2.0	2.65	3.30	NA	NA
Nitrates (mg/l as N)	16	21	62	0.8	0.93	1.2	45	<10
Phosphates (mg/l)	0.01	0.13	0.35	0	0.09	0.24	NA	NA
Fecal Coliform (CFU/100ml)	0	17	450	0	160	400	0	0
Cadmium (mg/l)	NA	NA	NA	0.0007	0.01	0.021		<0.005

Source: STLE, 2010, Table 3.14

Under a USAID-funded water awareness program, the Lebanon Mountain Trail Association (LMTA) in 2013 analyzed 53 springs located on the LMT, out of 72 springs on the trail. The samples were tested at the North Lebanon WWE lab in Tripoli and the Industrial Research Institute in Hadath. The results showed that 38% of the springs have no bacteriologically contamination, 30% have low to moderate contamination, 15% have moderate to high contamination, and 17% are highly contaminated. Some of the highly contaminated springs are located at higher elevations (e.g., Ain Bahr in Qehmez, Mount Lebanon, 1604m), an indication that the pollution is also occurring at higher elevations most probably due to septic tanks and discharge into open wells.

Furthermore, over pumping ground wells in coastal areas has dangerously increased their salinity level.

II

RAINWATER HARVESTING AS A VIABLE ALTERNATIVE OPTION FOR WATER SUPPLY

Rainwater harvesting as scoped in this document is the capture and storage of rainwater for different purposes including domestic use for drinking, bathing, cloth washing, toilet flushing, housekeeping as well as external uses like landscaping irrigation, surface cleaning, hosing and car washing. This guideline is concerned with applications mainly focused on residential units, schools, hospitals, hotels and other facilities where the above mentioned purposes are practiced. It is not meant to deal with large scale irrigation schemes or industrial processes.

This guide book is addressed to all people interested in implementing a RWH system for the targeted applications described above. Consequently, the information is presented in a simple straightforward way that is easy to grasp and implement. The guidebook could be used for implementing rainwater harvesting systems for new projects or as retro-fits for existing projects.

The present section deals in some details with the concepts behind RWH as proposed in this guideline while the next one offers methodologies how to size, price, implement, operate and maintain a RHW system.

1 HOW BEST TO USE RAINWATER IN THE LEBANESE CONTEXT

Harvesting rainwater for use during the rainy season is not very advantageous for users connected to the municipality water supply. Usually in winter, municipality water is in abundant supply, it is in summer that water is scarce and has the most economic value. Therefore it is normal to store the rainwater for the lean days. However for users not connected to the municipality network, rainwater supply could be used also during the rainy season which could reduce the storage tank size but this option reduces the strategic water storage during the dry period.

Consequently, this guideline not only recommends the use of relatively large rainwater storage tanks to cater for the dry season water requirements but also the use of separate municipality water storage tanks but of lesser storage capacity as will be shown in the section that follows.

Municipality water should not normally feed the rainwater storage tank, the two systems should be kept separate. It is very important to follow these guidelines to make sure rainwater does not back feed into the municipality water network. This situation may represent a health hazard to all the community connected to the municipality network.

FOR OPTIMUM WATER RESOURCES USE AS WELL AS FOR SAFETY REASONS, IT IS IMPORTANT TO PROVIDE A MUNICIPALITY WATER STORAGE TANK. THIS TANK WILL ACT AS A PHYSICAL SEPARATION BETWEEN THE MUNICIPALITY WATER FEED NETWORK AND THE RAINWATER SYSTEM.

2 RAINWATER HARVESTING, SYSTEM DESCRIPTION

Understanding how the fundamental components of a rainwater system work is crucial when contemplating designing or installing a RWH system.

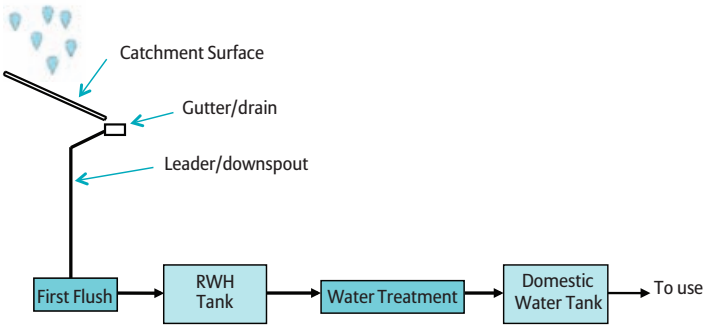


Fig.5 General Configuration of a RWH System

Rainwater harvesting systems comprise three basic components namely:

- Catchment Surface: It is the collection surface from which rainfall runs off, it could be the roof of a building, a terrace, a parking pergola roof, a driveway or any area suitable for rainwater collection. The location, construction and exposure of the catchment surface to polluting vectors have a decisive influence on the quality of the rainwater being collected. Hence the less exposed a catchment surface is to atmospheric pollution, human access and use, the lower is the probability of serious pollution being entrained by the rainwater run-off. Thus a roof in a rural area that is not normally accessed will most probably have fewer pollutants than a terrace near an industrial zone or one that is continuously used.
- Drain system: Run off water collectors (Drains / gutters) and conveying conduits from catchment area to the storage tank. They could be made of metal or plastic as will be explained in the next section.
- Storage Tank: Also called cistern where collected rainwater is stored for future usage. The tank could be located above ground or underground. The tank could be of concrete, plastic or fiberglass. If rainwater quality is an issue for the intended purpose, additional components could be introduced, namely:
- First Flush tank: The purpose of this tank is to get rid of the first rainwater for each rain fall event to avoid channeling debris, mud, contaminated particles and other pollution to the rainwater storage tank. As the name implies, the purpose of this tank is to flush the catchment surface before collecting water for storage. Its main advantage apart from improving rainwater quality is to avoid the hassle of manually diverting the collected rainwater to the drain at least at the beginning of the rainy season. However because Lebanon climate is characterized by rain events that are separated by a relatively long stretch of non-rainy days during which the collection surfaces may be subjected to pollution vectors, flushing the first rainwater at each rain fall event is a necessity for higher quality rainwater.
- Water Treatment: Its purpose is to improve the quality of the rainwater to expand the range of its use namely for domestic purposes. Water treatment usually includes media and micro-filters, carbon filters, sterilization and domestic water storage tanks. The extent of the water treatment depends upon the end use of the collected rainwater as shown further below.

3 RAINWATER HARVESTING CATEGORIZATION

Rainwater harvesting categorization helps expand as much as possible the safe use of rainwater in the Lebanese context. This is so for three main reasons;

1. There are no existing regulations in Lebanon regarding the safe collection and use of rainwater.
2. The consumer has largely no control over rain fall quality.
3. The intent of this document is to maximize the collection and use of rainwater in a safe and rational way, thus to offer the most options and scenarios for rainwater harvesting and the subsequent use of the collected water.

Furthermore the categorization helps consumer acquire a heightened awareness and a more informed approach concerning the safe collection and use of rainwater.

For the purpose of this guideline, four Rainwater Harvesting CATegories (RWHCAT) are defined ranging from highest quality RWHCAT1 to lowest quality RWHCAT4;

1- RWHCAT1 complies with the following minimum requirements:
- Facility is above 500 m altitude if located in Mount Lebanon Mohafaza.
- Facility is at least 3 km away from any industrial plant that has smokestacks and 1,500 m away from a hospital that incinerates its medical waste.
- Facility is located in a village or an area that is sparsely populated.
- Lowest point of collection surface is at least 3 m above ground level.
- Collection area is not accessible for continuous human circulation, occupancy or use for solar water heating, photovoltaic, ventilation fans, AC condensing units or any sort of equipment and planters.
- Collection area has no exhaust outlets like kitchen exhaust, chimney outlet, boiler outlet, etc. that are at less than 2 m height from collection surface.
- There are no overhanging trees above Collection surface.
- Trees having a crown above the collection surface should be at least 3 meters away.
- Collection surface and drainage equipment are not made of asbestos, copper, lead or zinc.
- Collection surface is not used for plantations of any kind and has no soil layer.
- Rainwater storage tank should have food grade interior finish. For plastic or fiberglass tanks, food grade labeling should be specified by the tank manufacturer, for built on site concrete tanks, food grade is determined by the type of surface coating which should be specified food grade by the coating manufacturer.
- Rainwater harvesting system has a first flush tank in good working order.

2- RWHCAT2 complies with the following minimum requirements:
- Collection area is not accessible for continuous human circulation, occupancy or use however equipment that is not filled with liquids (i.e: fans and photovoltaics) or filled only with water without additives (i.e: vacuum tubes solar collectors without anti-freeze) are tolerated.
- Collection surfaces and drainage equipment are not made of asbestos.

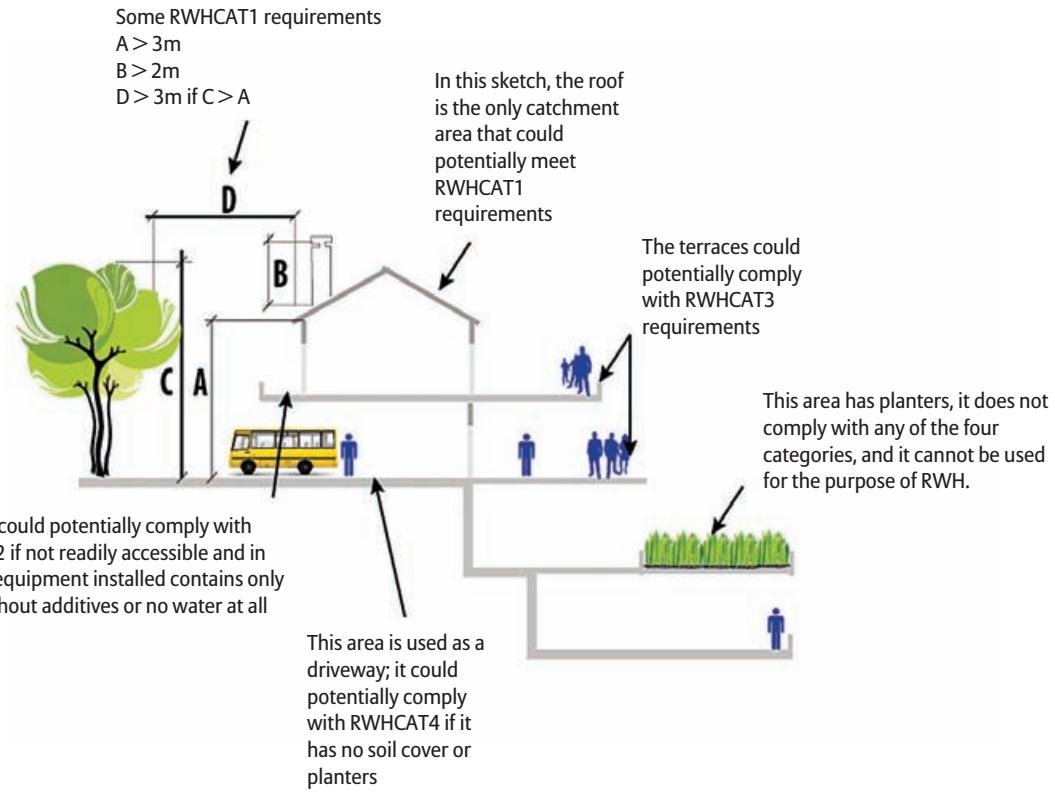


Fig.6 Raw Water Harvesting Categorization

- Collection surface is not used for plantations of any kind and has no soil layer.
- Rainwater harvesting system has a first flush tank in good working order.

3- RWHCAT3 complies with the following minimum requirements:

- Collection surface is not used as a driveway.
- Collection surface is not used for plantations of any kind and has no soil layer.
- Rainwater harvesting system has a first flush tank in good working order.

4- RWHCAT4 complies with the following minimum requirements:

- Collection surface is not used for plantations of any kind and has no soil layer.

RAINWATER HARVESTING CATEGORIZATION HELPS EXPAND AS MUCH AS POSSIBLE THE SAFE USE OF RAINWATER IN THE LEBANESE CONTEXT.

IMPORTANT

In this guideline rainwater that drains from planted areas cannot be used in rainwater harvesting applications.

4 RAINWATER USE CATEGORIZATION

Rainwater use categorization is a function of rainwater quality and treatment process, there are four USE CATegories (USECAT) defining the scope of rainwater usage on the consumer premises; They range from the highest USECAT1 to the lowest USECAT4. Of course the higher usage category could be used for the lower application, but obviously this implies a misallocation of resources.

Table 8. Water Use Categorization

USE CATEGORY	RECOMMENDED RAINWATER USE
USECAT1	Drinking, cooking (see note below)
USECAT2	Suitable for human contact except drinking and cooking (i.e: bathing, hand wash, housekeeping, laundry, sprinkler irrigation, car wash, hosing, surface cleaning)
USECAT3	Preferably no human contact, (i.e: Toilet flushing, laundry, drip irrigation)
USECAT4	Not suitable for human contact (i.e: Toilet flushing, sub-surface irrigation)

IMPORTANT NOTE

USECAT1 is not applicable to hospitals, schools, hotels and other large facilities because RWHCAT1 which is a pre-requisite to USECAT1 is practically impossible for hospitals, hotels and most other public or office buildings while for schools and other large facilities, it may not be guaranteed that water quality is being constantly monitored as per USECAT1 requirements.
Therefore USECAT1 is limited to residential applications.

DECIDING ON THE USE OF THE COLLECTED RAINWATER IS THE MOST IMPORTANT FACTOR IN PLANNING A RAINWATER HARVESTING SYSTEM

ALL OTHER CONSIDERATIONS INCLUDING RWH SYSTEM CONFIGURATION DEPEND ON IT

5 RAINWATER TREATMENT CATEGORIZATION

The categorization of the rainwater treatment is a function of RWHCAT and USECAT as explained in the next section.

Two Water Treatment CATegories (WTCAT) are proposed in this guideline, namely WTCAT1 and WTCAT2.

WTCAT1 as (fig.7) below shows consists of a pre-treatment, a first stage treatment followed by a second stage treatment.

The pre-treatment stage consists of straining in the First flush tank then settling in the storage tank. The first stage treatment consists of Chlorination, media filtration then micro-filtration, the carbon filter may follow the first treatment stage but is not part of this stage. The product water is stored in a domestic water tank. The second stage consists of micro filtration, followed by a carbon filter if it was not installed downstream of the first stage then UV sterilization. The product water is stored in a potable water stainless steel storage tank. **This water treatment category implies also the monthly testing of the potable water at the potable water tap for bacteriological contamination.**

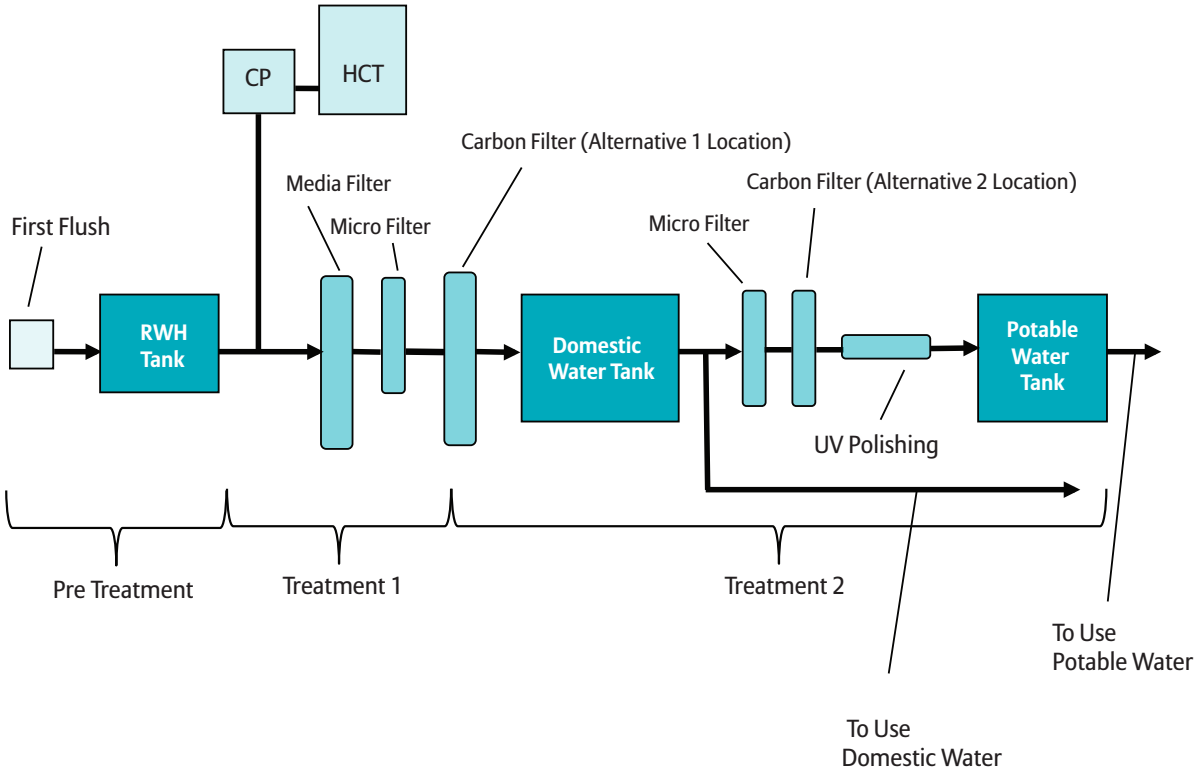


Fig.7 Water Treatment Category 1 Process Diagram - WTCAT1

WTCAT2 as (fig.8) below, consists of a pre-treatment and a first stage treatment. The pre-treatment stage consists of straining in the First flush tank then settling in the storage tank. The first stage treatment consists of Chlorination, media filtration then micro-filtration. The product water is stored in a domestic water tank. This guideline does not recommend a carbon filter for this application because for non-potable domestic water use, residual chlorine does no harm in the event some is still present in the water at the tap.

Kindly refer to Annex H to find out more about rainwater quality.

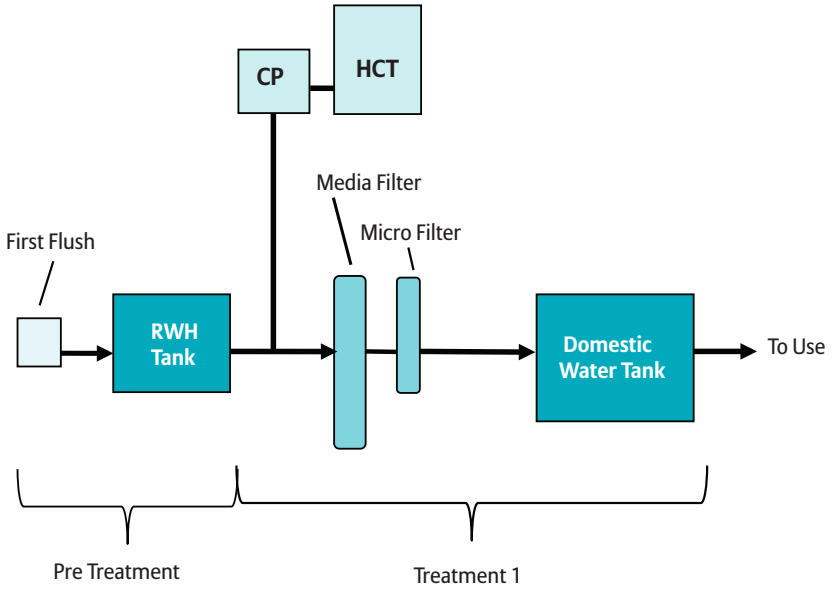


Fig.8 Water Treatment Category 2 Process Diagram - WTCAT2

WITHIN THE SCOPE OF THIS GUIDELINE, WATER TREATMENT IS NOT A LUXURY NOR IS IT AN OPTIONAL ITEM THAT COULD BE OVERLOOKED, IT IS A NECESSITY FOR THE SAFE USE OF RAINWATER

6 DIFFERENT OPTIONS FOR RAINWATER USE

The schematic below shows seven different schemes S1 to S7 that offer preferred combinations between RWH and RWT methods in view of a contemplated water use. The schemes represent minimum acceptable constructions to achieve water quality for a given use; it is always advisable to devise rainwater schemes that are more stringent than what is proposed below.

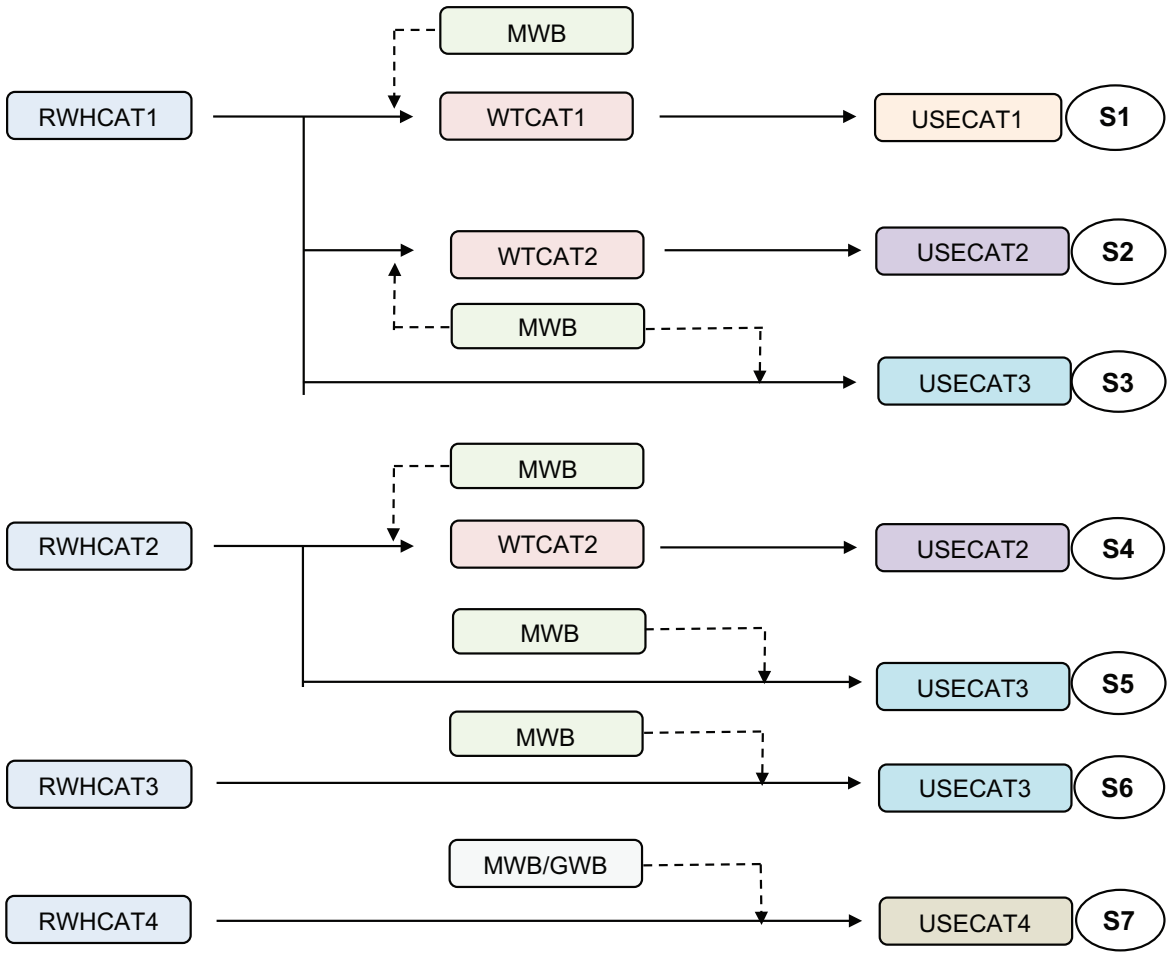


Fig.9 Recommended Rainwater Use Decision Tree

Even though not shown in the figure above, USECAT4 is applicable to RWHCAT1, 2 and 3 without any treatment, but it is not a recommended application from a resources allocation view point.

The reader will note that strategies S1 to S6 propose the optional use of Municipal Water Blending (MWB) while S7 shows the option of using Municipal water or Grey Water Blending (GWB), all with the aim of optimizing water resources use.

In S1, S2, S4 and S5 blending is done in a blending tank upstream of the treatment 1 stage while in S3 and S6 blending is done in a blending tank before water use. Dotted arrows in above combinations represent optional additions in the process that are not necessary to reach the sought after water quality using the proposed combination of RWH and RWT in a given scenario (See Chapter 3 for more details).

Blending has major advantages as follows:

1. It requires the storage of municipal water during the rainy season, (See next section)
2. It extends as much as possible the use of the rainwater stock
3. It is a natural and economic way to soften municipal or well water which is relatively hard in Lebanon. The TDS of municipal water is above 650 ppm in most regions of Lebanon and actually could be sensibly higher. Blending 50% rainwater 50% municipal water will cut the TDS practically by two and thus drastically decrease the hardness of the water without using a softener.

Actually in WTCAT1 and 2 softening is out of the question because rainwater even in the storage tank is still a relatively distilled water.

Detailed explanations on water treatment will be provided in section 3 below where system design will be tackled.

THE READER WILL NOTE THAT STRATEGIES S1 TO S6 PROPOSE THE OPTIONAL USE OF MUNICIPAL WATER BLENDING (MWB) WHILE S7 SHOWS THE OPTION OF USING MUNICIPAL WATER OR GREY WATER BLENDING (GWB), ALL WITH THE AIM OF OPTIMIZING WATER RESOURCES USE.

7 THE MUNICIPALITY WATER STORAGE TANK

Large storage tanks for municipality water are a common occurrence for all types of buildings in Lebanon. One of the main reasons for such practice is the fact that utility water is not in continuous supply, actually in some regions of the country it is not uncommon for the municipality water to be cut off for several days in a row or even for weeks during the dry season especially in low rain years.

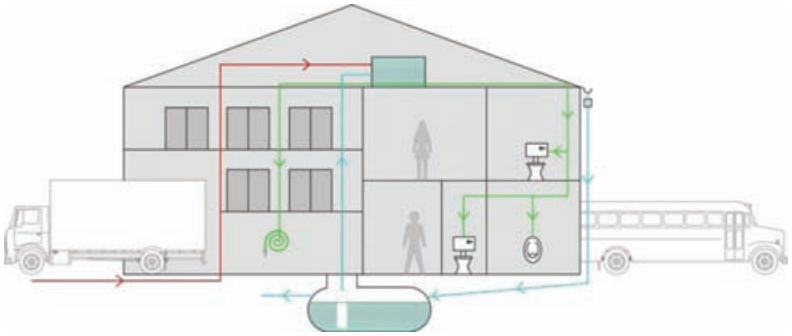
If blending is contemplated then municipality water storage tanks are a necessity. Because of water scarcity in Lebanon, such a tank has a similar function to the rainwater storage tank, but it harvests municipality water instead of rainwater. The idea is that from December to June municipality water is in good supply in most regions of the country, therefore the storage tank could be filled over few weeks while at the same time catering for the facility day to day use thus storing water for the dry season.

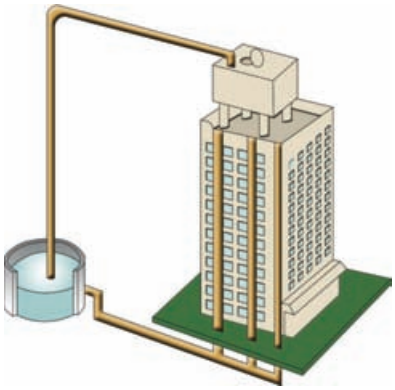
During the dry season, blending water could be drawn from the municipality water tank on a daily basis in conjunction with the rainwater use. As a rule of thumb, the municipality tank volume should be between 30 – 50% of the rainwater storage tank volume depending on the severity of municipal water cuts during the dry season and the coverage period provided by the rainwater storage capacity. More on this will be covered in Chapter 3. Municipality water tanks offer strategic water storage especially during the period from August to October when municipality water or even truck water supply is at its lowest.

IMPORTANT

One major advantage of blending equally rainwater with municipality water is the possibility to enjoy a supply of soft domestic water for an extended period without the use of softeners thus improving quality of life in the facility at minimum cost in case rainwater is in limited quantities but anyway is being contemplated as a source of water supply for the building.

Another strong point is that blending saves on the water storage volume in case of equal quantities blending because the municipality water tank is usually replenished with water though at a slow rate during the dry season.
The approach of this guideline is to completely disconnect between the municipality water supply and the rainwater system upstream of the blending tank. Thus it is not recommended to provide the rainwater storage tank with a municipality water supply line.





8 GREY WATER SYSTEM

Grey water is the effluent from lavatories, showers and bathtubs **only**. WC, Laundry machines, Dish washers, kitchen sink and other plumbing fixtures must not be part of the grey water network.

In a grey water system, these three types of fixtures are connected to a separate grey water drainage network that feeds into a grey water treatment scheme made up mainly of a settling/skimming tank, an aeration tank with chlorination, a 200 – 300 micron pressure filter and an effluent grey water tank which acts also as a blending tank.

In this guideline, Grey water systems are allowed only for blending with rainwater in USECAT4 applications. In this case rainwater from the RWH storage tank (RWHT) is conveyed to the effluent grey water tank (GWT) which acts also as a blending tank. The effluent grey water tank should be located in the grey water treatment plant. In no case it is allowed to pump the effluent grey water to a blending tank in the mechanical room where water treatment or water storage equipment is located. System should be designed to prevent backflow of GWT into RWHT.

Effluent grey water blending is done in order to improve the quality of the grey water as far as hardness and alkalinity are concerned. This will greatly help to prevent clogging of the grey water supply pipes, valves and irrigation devices orifices.

IMPORTANT

Treated Grey water should not be conveyed to any part of the facility other than the point of use. In the case of blending, rainwater from the RWH tank should be conveyed to the effluent grey water tank. It is not recommended to have a grey water blending tank in the mechanical room where water treatment equipment is located.

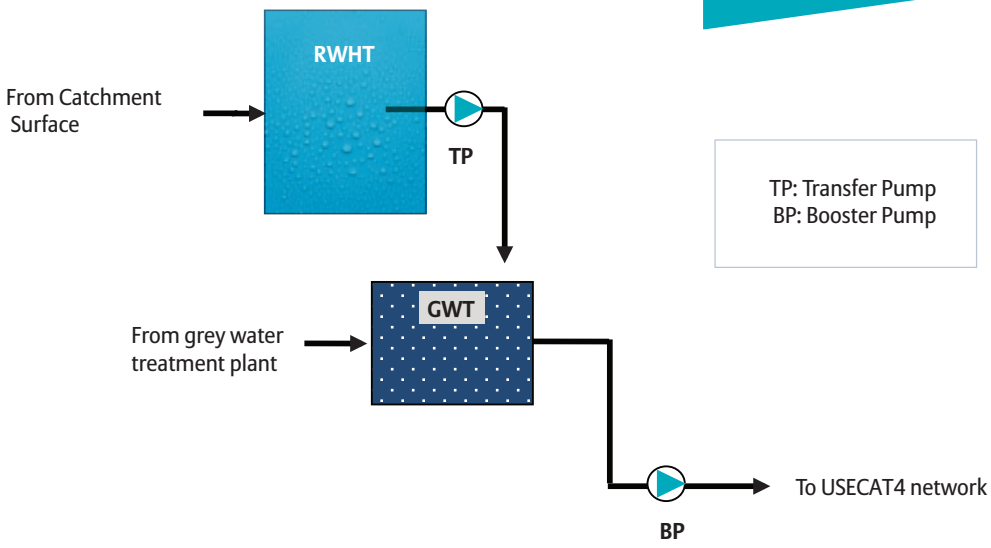


Fig.10 Grey water blending schematic

9 STORAGE TANKS HYGIENE

Rainwater or municipality water can be stored for several months without degradation in quality provided the storage tank does not allow sun light and the water is aerated. The issue of sun light is relatively simple to address, a concrete tank or plastic tank of opaque surfaces will do the job. Aeration is another issue, it is most recommended to equip tanks higher than 50 m² capacity or tanks where water will be stored for more than 2 month, with a recirculation line. This system uses the storage tank pump which operates for a limited time daily to pump water and spray it back in the tank. Of course the tank should be vented with an outlet protected by an insect screen.

10 THE CASE OF TWO OR MORE CATCHMENT AREAS

If the facility has two or more potential catchment areas of different RWHCAT, it is preferable to have a storage tank for each area in order to avoid mixing higher quality rainwater with lower quality one. Indeed, if rainwater from a RWHCAT1 catchment surface is mixed with rainwater from a RWHCAT3 catchment surface the mix will be considered a RWHCAT3, thus losing the advantages of the higher quality water.

However by judicious combinations, the two tanks could be used for common applications, for example a RWHCAT1 tank could feed in common with a RWHCAT2 tank the domestic plumbing system.

11 PLUMBING CIRCUIT CONFIGURATION

Normally, all plumbing fixtures are fed from one common circuit; however this does not need to be so if flexibility is required in order to optimize the use of water resources. Normally, all water that is used for domestic applications should be of potable quality because such water comes in contact with our skin and we may even ingest some un-voluntarily when under a shower for example.

Studies in several countries have shown that water used in WC and laundry machines do not need to be of potable quality with no effect on human health. This is so because to a certain extent, water used in laundry machines do not come in contact with our skin and this is more so with water for WC flushing.

Consequently, using separate plumbing circuits allows feeding laundry machines and WC or at least WC with lower quality water, (Table 9).

Four plumbing configurations are proposed, these offer the maximum flexibility in rainwater use depending on user requirements, site conditions, plumbing design and other related factors.

DEDICATED PLUMBING NETWORKS FOR WC AND LAUNDRY ALLOW BETTER OPTIMIZATION IN THE USE OF WATER RESOURCES FROM A RAINWATER HARVESTING PERSPECTIVE

PLUMBING

PLUMBING1: facility has one plumbing circuit that feeds all plumbing fixtures (Lavatories, bidet, shower, WC, laundry machine, kitchen sink, dishwasher, housekeeping hose bibs)

PLUMBING2CL: facility has two plumbing circuits; one feeds lavatories, bidet, shower, kitchen sink, dishwasher, housekeeping hose bibs and the other feeds the WC and laundry machine.

PLUMBING2C: facility has two plumbing circuits one feeds lavatories, bidet, shower, laundry machine, kitchen sink, dishwasher, housekeeping hose bibs and the other feeds the WC.

PLUMBING2L: facility has two plumbing circuits one feeds lavatories, bidet, shower, WC, kitchen sink, dishwasher, housekeeping hose bibs and the other feeds the laundry machine.

NOTES

- USECAT1 is not considered because it applies only to potable water for cooking and drinking thus it has a separate plumbing network in all cases.
- PLUMBING 2C could be adopted also in case grey water is to be used for domestic purposes.
- The differentiation between PLUMBING 2C1 and 2C2 is necessary to indicate whether WC are fed with USECAT3 or USECAT4 water.

IMPORTANT

- USECAT4 must be entered if irrigation network is underground; in this case the RWHCAT is irrelevant.

Table 9. Plumbing Network Configurations With Respect To USECAT Options

USECAT option	PLUMBING option	Remarks
USECAT2	PLUMBING1	All fixtures are fed from the same plumbing network, it does not make sense to have two plumbing circuits if one type of water quality is used for all fixtures.
USECAT3	PLUMBING2CL *(best)*	*PLUMBING2CL* is the preferred option, it allows the supply of WC and laundry with lower grade but most suitable water. It allows maximum use of rainwater for lower quality water. *PLUMBING 2C1* is the second best choice, it allows lesser flexibility in water use management but still allows considerable savings in water. *PLUMBING 2L* is the least recommended because only limited quantities of lower quality rainwater could be used, but still it is a viable alternative.
	PLUMBING2C1 *(good)*	
	PLUMBING2L *(acceptable)*	
USECAT4	PLUMBING2C2	PLUMBING 2C2 is compulsory if USECAT4 water is to be used for domestic purposes.

III

RAINWATER HARVESTING DESIGN GUIDE

1 INTRODUCTION

This design guide deals only with rainwater harvesting systems applicable to domestic use, external housekeeping and landscaping requirements whether for residences, schools, hospitals, governmental institutions or any other facility where such uses are found.

Furthermore, the guide is intended for a large spectrum of people, from those technically minded who need additional information on the subject to those lay people that require a document that presents a step by step procedure how to devise, size, price and implement a rainwater harvesting system.

This section gives detailed procedures and calculations methods for the different steps towards implementing a RWHS while supporting data is found in the annexes.

It is worthwhile noting here that rainwater harvesting systems are available in many configurations therefore it is not practical for this guideline to cover all of these if the document is to be kept at a manageable size. Many factors influence component selection when designing or selecting the right rainwater system for a specific end use application. Available catchment areas, water conveyance, building architectural and structural features, aesthetics, buried utilities, soil types, slopes, site drainage, existing plumbing, electricity, routing of overflows, local regulations and neighbors are some of the many items that deserve attention when considering the implementation of RWH systems.

This guideline will give the necessary information to tackle effectively any configuration that is contemplated for a specific project.

THIS SECTION GIVES DETAILED PROCEDURES AND CALCULATIONS METHODS FOR THE DIFFERENT STEPS TOWARDS IMPLEMENTING A RWHS WHILE SUPPORTING DATA IS FOUND IN THE ANNEXES.

2 APPLICABLE CODES, STANDARDS AND GUIDELINES

Local regulations related to rainwater harvesting systems are very sparse and deal with generalities, the only text relevant to consult is the potable water standard found in Annex C.

- Building law 646 dated 11/12/2004 (ref:15)
- Building law implementation decree 15873 (ref:16)
- Environment protection law 444 dated 29/7/2002 (ref:17)
- Potable water standard, decree 1039 dated 2/8/1999 (ref:18), (Annex C)

The following international codes and standards are of relevance for those who may be interested to consult them;

- International plumbing code 2006 (ref:8)
- NSF Protocol P151, Health Effects from Rainwater Catchment Systems Components (ref:23)

3 ADDITIONAL CONSIDERATIONS

These guidelines apply to buildings at the concept stage as well as for existing buildings. However the latter category may narrow the options offered in this document because the building structure already exists as well as the plumbing works. However, if the building is to be refurbished, then the guidelines could be used to maximum advantage.

Practically, this document contains all the information required to size a rainwater system without the need to have recourse to any other source or document unless the user embarks in very complex systems or wishes to consult other publications on this subject with the aim to expand their knowledge in this field.

4 DESIGN AND INSTALLATION GUIDELINES

This section addresses the sizing of the different components of the rainwater system, the selection of materials as well as installation tips. Reference will be made to annexes that contain the necessary data and information to properly perform the calculations for system sizing.

As previously indicated, a rainwater harvesting system consists of the following basic building blocks; a catchment surface, a conveying network and a storage component. These will be discussed first before tackling the two components that relate to improving the quality of the harvested rainwater namely the first flush tank and water treatment.

4.1 Catchment Surface

A main component of rainwater harvesting is the collection of rainwater from a catchment surface. The catchment surface could be a building roof, balconies, terraces, a fully closed top parking lot pergola or even a driveway. Water quality from different roof catchment surfaces is a function of the type of catchment surface, roof material, climatic conditions, and the surrounding environment. These factors will be tackled as we proceed below, however first let us find out how to compute the catchment area.

4.1.a Catchment surface area

The example of an individual building will be considered, however the methodology explained could be used for any type of building or catchment surface.

The house in (fig.11) is a typical construction with a gabled roof (sloped roof) with :
length A = 18.5 m and width B = 23 m which represent the building footprint on the ground.

When dealing with sloped roofs, one should assume that the gables do not exist thus the building footprint dimensions are what matters.

Hence for this particular construction the effective catchment area;

Area (m^2) = Length (m) X Width (m) = 23 x 18.5 = 425 m^2

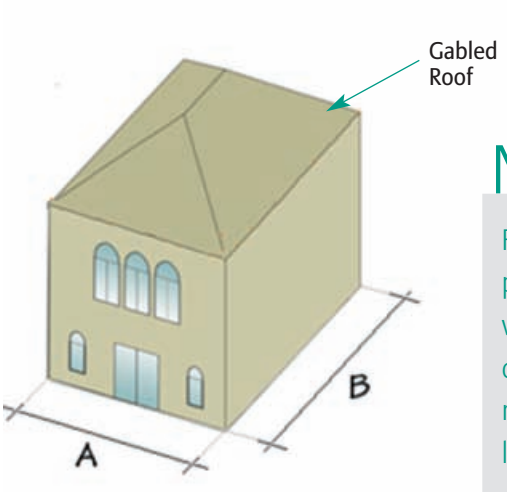


Fig. 11 *Typical cube configuration (House 1)*

NOTE

For all practical purposes do not worry about decimals, always round to the lower number.

Let us consider a slightly more elaborate example, an L shaped half gabled roof building as shown in (fig.12). Again even with a flat topped gable the golden rule still applies

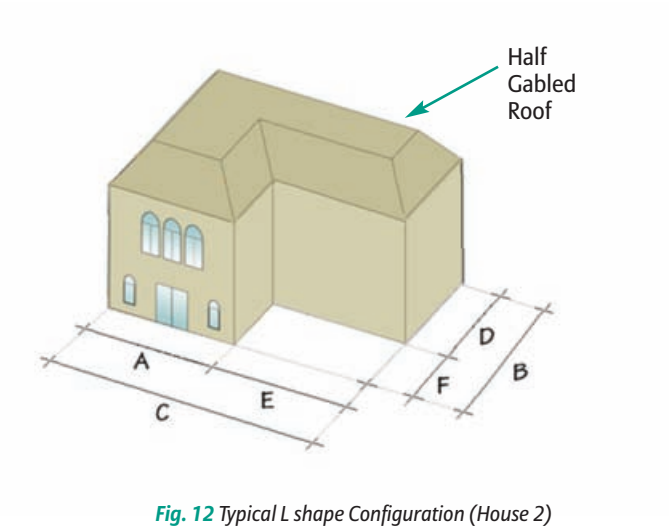


Fig. 12 Typical L shape Configuration (House 2)

Based on the above the footprint of the building in (fig.12) is;

Building Footprint Area = Effective Catchment Area =
A x F + D x C = A x B + D x E

This formula was arrived at by dividing the L shaped building into two parts, the long and short branches of the L shape. This could be computed in two different ways depending on our choice of the long and short-branches.

Assuming A = 20 m, B= 26 m, C = 40 m, D = 16 m, E = 20 m, F = 10 m

Catchment area = 20*10 + 16*40 = 20*26 + 16*20 = 840 m²

GOLDEN RULE

Regardless of the pitch, the shape, or the complexity of any roof surface, it is the overall footprint of the building that determines the effective catchment area.

Now that the catchment areas are known for both buildings, it will be simple to compute the potential rainwater that could be harvested over one rainy season. Remember from Chapter 1 that rainfall was expressed in mm height. Thus for example in Bhamdoun the average yearly rainfall is around 1300 mm or 1.3 meters (See annex A for precipitations corresponding to your location, if your exact location is not shown look for the nearest location available and use its precipitation data).

Imagine now that we remove the gables of houses 1 and 2 and put instead an open air reservoir, the water collected from the rain will reach a level of 1.3 meters for one average rainy season (assuming of course no evaporation). What is then the volume of water that could be collected?

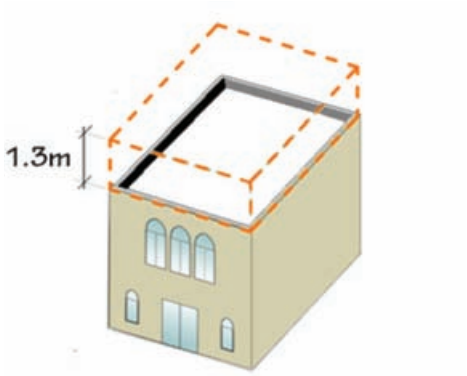


Fig. 13 Typical House 1 Virtual RWH Roof Reservoir

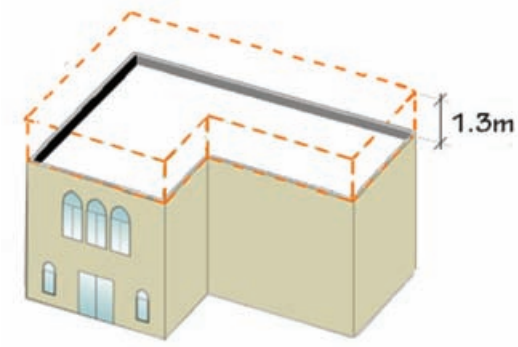


Fig. 14 Typical House 2 Virtual RWH Roof Reservoir

THEORETICALLY, FOR EVERY SQUARE METER OF ROOF CATCHMENT AREA, 1 LITER OF RAINFALL CAN BE CAPTURED PER MILLIMETER OF RAINFALL.

Volume (m^3) = Area (m^2) x Height (m)

Based on the above formula the potential water that could be collected is:

For house 1 volume of harvested (collected)
rainwater = 425 x 1.3 = 552 m^3
For house 2 volume of harvested (collected)
rainwater = 840 x 1.3 = 1092 m^3

However in practice and as seen in the previous section, the water is not collected directly by roof reservoirs, the run-off flows on the catchment area, it is then collected by the gutters or drains then routed to storage reservoirs at lower level. This process implies water losses due to the following;

- Nearly 50% of rainwater events in Lebanon yield less than 5 mm of water, in such cases, not much water reaches the storage reservoir because of evaporation on the roof, absorption by the roof material, leakage losses or loss in the first flush tank.
- In case of heavy rainfall, rain drops will cause splashing thus unavoidable losses.
- Also wind gusts may result in water carry over thus increasing the losses.
- Gutters, drain pipes and water storage reservoirs may be leaky.
- Clogged drainage pipes, drains, gutters and downspouts may cause overflows, thus loss of collectable water.

Based on the above, it is recommended to apply the de-rating factors as shown in Table 10.

Table 10. De-Rating Factor For RWH Catchment Surfaces

Type of roof	De-rating factor
Gabled catchment surfaces with concrete finish, terra cotta or glazed tiles.	0.75
Flat catchment areas with concrete finish, corrugated plastic sheet, tiled finish or water proofing membrane finish.	0.75
Flat roof with gravel layer finish	0.7

Source: Author estimates *

Estimates * : Based on several efficiency factors.
- DIN 1989-1: 2001-10.Rainwater Harvesting systems-Part 1 :Planning, Installation, Operation and maintenance. 2002 "Fachvereinigung Betriebs-und Regenwassermutzung e.v.fbr.Darmstadt"
- Watershed Management Group, 2006, Calculating Runoff for Water Harvesting.

HINTS TO CONSIDER

- Roof materials should be preferably of smooth finish to facilitate surface flow and avoid microbial nesting.
- Pitched catchment surfaces are preferred to flat surfaces for RWH because of higher run off velocity thus providing better surface wash.
- Provide a slope of 1% for flat catchment surfaces towards drains to ensure good run off and avoid water settling, which is a source of pollution.
- Roofs with lead components (for example, flashing or solder), copper, zinc or asbestos should not be used in any application with a potential for human ingestion (i.e. drinking water, pool filling, vegetable gardens).
- Green roofs are not suitable for rainwater harvesting.
- Do not mix whenever possible rainwater of different qualities in a common storage tank.

Thus the **effective rainwater harvested** for both examples are respectively:

Volume of effective harvested rainwater for House 1 = 425 x 1.3 x 0.75 = 414 m³
Volume of effective harvested rainwater for House 2 = 840 x 1.3 x 0.75 = 819 m³

A de-rating factor of 0.75 was used because both houses have gabled roofs with terra-cota tile finish.

4.1.b Catchment Surface Materials

The designer of a RWHS has no control over the rainwater quality falling from the sky but he/she can influence the amount of contaminants transferred from the roofing materials to the flowing water once it runs off the catchment surface. The selection of roofing material is a design choice and can have a significant effect on the quality of harvested rainwater especially in what relates to toxicity. Chemical reactions on catchment surfaces are often rapid because of the acidity of rainfall and sometimes because of the relatively high temperatures on many rooftops especially when it rains after a sunny interlude. These reactions make the choice of roofing material an important consideration in designing a rainwater harvesting system, particularly for potable uses.

There are four types of materials that should not be used for catchment surfaces used to convey rainwater destined for potable use namely; asbestos, copper, lead and zinc. For other applications, these restrictions could be relaxed except for asbestos, thus only asbestos is not recommended in all cases.

4.2 Drains, Gutters, Leaders and Downspouts

Drains and Gutters collect the flow of rainwater from catchment surfaces to be routed by Leaders and Downspouts to the storage reservoir. It is now high time to clarify what the four terms (Drains, Gutters, Leaders and Downspouts) are about.

Drains collect run off water, they are used mainly for flat surfaces like a flat roof, a terrace or a driveway. Drains could have flat strainers (fig.15), domed strainers (fig.16) or tower strainers (fig.17).

A strainer is the slotted surface where water enters the drain, it is slotted to prevent relatively big objects to enter the drain and clog it. Flat strainer drains are used for locations where there is little possibility to have debris of relatively large size that could block the drain strainer.

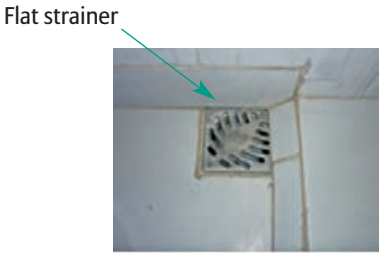


Fig. 15 Floor Drain

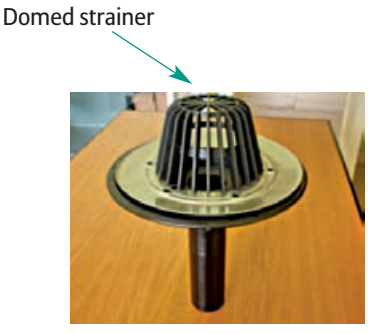


Fig. 16 Dome Type Roof Drain

Thus flat drains are used usually indoors and also on balconies and terraces which sometimes may be the source of great annoyance due to flooding if the strainer is clogged by leaves.
Domed strainers are used on roofs and other surfaces where there is high probability of encountering leaves, papers and other large objects that may obstruct the drain inlet. Tower drains are used mainly for tiled roofs where water could be drained from the surface as well as below the tiles.

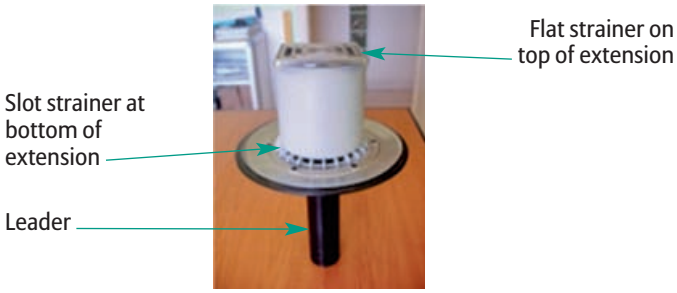


Fig. 17 Tower Type Roof Drain

Drains are connected to leaders or pipes that convey the water to the storage tank. Thus to the term **Drain**, we associate the term **Leader** to mean the drainage pipe.

Gutters are more commonly associated with gabled roofs, they are more adapted than Drains to carry out this function. While Drains are point collection devices Gutters are linear, they run along the perimeter of the surface to be drained at its lowest level (fig.18).
Gutters usually have half circular, square or trapezoidal shapes. Downspouts are connected to gutters to conduct the water to the storage tank (fig.18).
Gutters do not usually have strainers; they are open channels that could collect all sorts of debris that may clog the entrance to the Downspout.

Fig. 18 Typical Gutter & Downspout Configuration for a Gabled Roof

4.2.a Sizing Drains, Gutters, Leaders and Downspouts

Sizing of Drains, Gutters, Leaders and Downspouts is fairly easy but should be properly done to maximize the quantity of harvested rainwater and avoid spill overs, overflows and other malfunctioning. Let us consider the two houses of the previous section. Suppose the houses have flat roofs, therefore making drains a more suitable proposition.

Drains are specified by their connection size, hence a 4 inch (110 mm) drain connects to a 4 inch pipe or Leader. As a rule of thumb, every 200 m² of projected roof area requires a 110 mm drain. Actually the present guidelines do not recommend roof drains of smaller size even for roof areas less than 200 m². Thus if a roof has a projected area of 300 m² then allocate one 110 mm drain for each 150 m². The roof slopes should be worked out accordingly.

Thus for house 1 based on an area of 425 m², 2x110 mm drains will be most appropriate.
House 2 has a catchment area of 819 m², thus 4x110 mm drains should be provided.

We have now the size of the drains and vertical leaders. What about if the Leaders should run horizontally to reach the rainwater harvesting storage tank?

(Table 11) returns the size of horizontal leaders for a given slope and catchment area based on a maximum rainfall rate of 50 mm/hour. The slope is the amount of inclination of a horizontally running pipe expressed as vertical drop per meter of horizontal run, thus 1% slope is a drop of 1 cm per 100 cm of pipe run.

In the case of house 1, if the 110 mm vertical leader is to be routed horizontally, it is necessary to have a slope of 2% if it has to serve the area of 425 m². In (Table 11) the maximum catchment surface area served by a 110 mm horizontal leader with 2% slope is 492 m². If it is impossible to run a 2% slope because of obstructions and only a 1% slope is possible then the leader size should be increased to 125 mm.

Table 11. Sizing Of Horizontal Leaders - (Ref:8)

DIAMETER OF HORIZONTAL PIPING (inches)/mm	HORIZONTALLY PROJECTED ROOF AREA (m²) FOR A RAINFALL RATE OF 50 mm/hour			
	1 % SLOPE	2 % SLOPE	3 % SLOPE	4 % SLOPE
(4)/110	349	492	595	699
(5)/125	621	877	1,059	1,241
(6)/150	994	1,403	1,695	1,988
(8)/200	2,137	3,028	3,651	4,273

Source: IPC 2006

Sizing Gutters follows the same methodology but involves additional considerations. (Table 12) is used to size semi- circular gutters but any gutter shape could be accommodated by using the equivalent circular size which is the circle that could fit inside the contemplated shape.

Thus if a rectangular gutter can accommodate a 110 mm circle, then it has a 110 mm equivalent circular size. In other words it is equivalent to a 110 mm semi-circular gutter.

Gutters are sized by sections because each section serves one gable. **It is not recommended to have flow direction change in a gutter.** Thus if Gutters drain the gabled roof of house 1, one straight run will drain each side of the gable, however the downspouts at the extremities of two adjacent gutters could be joined into one downspout (fig.20).

Table 12. Sizing Of Gutters - (Ref:8)

DIAMETER OF GUTTERS (inches)/mm	HORIZONTALLY PROJECTED ROOF AREA (m^2) FOR A RAINFALL RATE OF 50 mm/hour				
	0.50% SLOPE	1% SLOPE	2% SLOPE	3% SLOPE	4% SLOPE
(3)/90	32	45	63	76	89
(4)/110	67	95	134	162	190
(5)/125	116	163	232	281	329
(6)/150	178	253	357	436	515
(7)/180	256	362	513	619	725
(8)/200	370	520	739	890	1040
(10)/250	669	948	1338	1598	1858

Source: IPC 2006

Moreover even though there may be four gables, but in no case should the allocated catchment area for any one section of gutter serving one gable be less than half the projected area of the roof.

As a practical example, consider again house 1, each gable face will be drained by one gutter, the two adjacent gutters of faces 1 and 2 will be sloped towards each other and their downspouts will be connected. The same happens for faces 3 and 4.

IMPORTANT TO REMEMBER

The de-rating factor used to compute the potential rainwater quantity that could be harvested does not apply when sizing drains, leaders, gutters and downspouts for rainwater harvesting.

HINTS TO CONSIDER

- Straight sections of gutters served by two downspouts should have opposite slopes starting at their middle.
- The outside face of the gutter should be lower than the inside face to encourage water flow away from the building wall.
- Half-round or trapezoidal gutters are preferred for rainwater harvesting because of more efficient drainage. Square or rectangular sections should be avoided; they are more difficult to clean.
- It is preferable to increase the slope of the gutter by 0.5% on the last 1/3 length of the gutter before the downspout.
- Downspouts shall serve no more than 20 m of gutter length.

Any gutter of house 1 will be sized to drain a catchment area 425/2 m² or 212 m². Assuming a 1% slope is selected, (Table 12) gives a diameter of 150 mm.

Downspouts sizing is rather straightforward, these should have the same circular size as the gutters they drain. It is important to note that downspouts may have rectangular shapes (Fig.19). In such cases the rectangular downspout will be considered equivalent to a circular pipe having a diameter equal to the smallest side of the rectangular downspout. For the rectangular downspout shown in the below photo it is 110 mm, thus the downspout was considered equivalent to a 4 inch pipe.

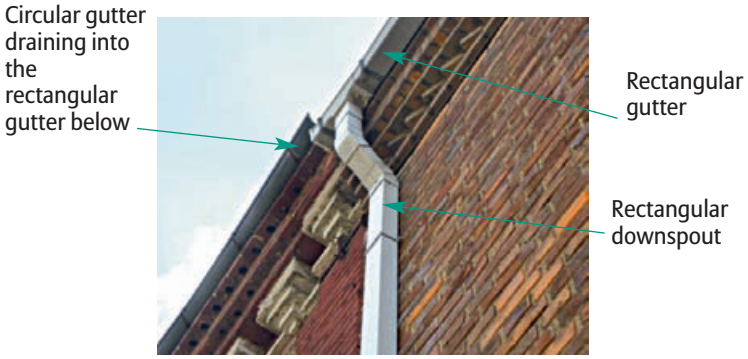


Fig. 19 *View of a Rectangular Downspout*

It is important to note that downspouts cannot serve more than 20 meters of gutters length, this is so because of flow conditions and the probability of clogging a downspout because of debris.

Going back to the example of house 1, one side of the building has a length higher than 20 meters, thus it is important to have two downspouts per section of gutter serving that side.

Each downspout is sized based on the area served by the gutter, thus for the first section serving an area of 215 m², it will have two downspouts of 110 mm each. If a rectangular downspout is to be used, then its smaller side should be no less than 110 mm.

Moreover, It is possible to join two stretches of gutters into a single downspout as long as the gutters have their individual downspouts outlets (Fig.20) and the downspout is sized accordingly taking into consideration the total area of gables being drained.

Gutter and downspout made of PVC, this type of material is not recommended for locations with high solar exposure

Fig. 20 *Detail of a common Downspout*

4.2.b Drains, Gutters, Leaders and Downspouts materials

Drains for external surfaces come mostly in three constructions for the body and the strainer, namely PVC, PE or cast Iron. It is recommended to use cast iron drains with cast iron strainers for exposed surfaces to the sun.

Gutters, Leaders and downspouts could be PVC, galvanized sheet metal, epoxy coated sheet metal, anodized sheet metal, copper, seamless aluminum or even stainless steel. It is recommended not to use PVC for exposed components as it structurally weakens if continuously exposed to the sun's rays. Copper may oxidize thus it should be ruled out if the intent is to use rainwater for domestic purposes. The choice in order of decreasing preference is stainless steel, aluminum, epoxy coated sheet metal and last galvanized sheet.

Gutters with built in wire mesh as cover is an excellent idea as it will greatly reduce the probability of leaves and other solid objects entering the waterways thus clogging the gutter.

Regardless of material, other necessary components in addition to the horizontal gutters are the drop outlet, which routes water from the gutters downward through the downspout pipe. Additional components include support brackets and straps which could be of similar material as for gutters and downspouts. Use fasteners that do not rust to avoid rust smearing on the fascia and walls.

HINTS TO CONSIDER

- For domestic rainwater use including potable water applications (USECAT1 & 2), lead cannot be used as gutter solder. Rainwater acidity could dissolve lead and thus induce lead contamination. Certified solder material should be selected.
- Where possible, locate the Leader or downspout near the location of the rainwater storage tank.

4.3 First Flush Tank

This device shown in figures 22-23 below serves to divert to waste the first rains of each rainfall event which are usually laden with contaminants carried over from the catchment area like dropping, dust, leaves, blooms, twigs, insect bodies, pesticides and other airborne residues.

The tank is sized to flush the equivalent of around 1.5 mm height of rainfall. It will then automatically rout the relatively clean rainwater to the storage tank. This device has two main advantages;

- It saves the trouble of having to divert the first rains manually, a practice that wastes rainwater. This is especially so because rainfall events in Lebanon are sometimes separated by a relatively lengthy dry period that may extend for weeks, the catchment surface flushing needs to be performed at the onset of nearly each important rainfall event.
- It improves rainwater quality that enters the storage tank, thus enabling a greater flexibility in its use while saving on water treatment.

The method of operation of the first flush tank is extremely simple and practically trouble free if the tank is cleaned at the end of the rainy season. The inlet water is intercepted by a strainer that retains all objects bigger than 2 mm. The water then runs off the sloped plate below the strainer and into the waste chamber through the 90 mm center hole.

The water exits the bottom of the tank at a very low flow rate (thru the Ø32 mm drain pipe or by percolation) thus resulting in an increase in water level which raises the 100 mm plastic ball till it closes completely the center hole thus diverting the water to the tank outlet and into the storage tank (fig.21).

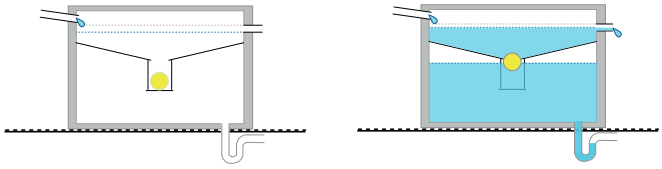


Fig. 21 Detail of First Flush Tank Operation

The first flush tank could be installed below ground or above ground depending on the system configuration. (fig.22A/22B)

For optimum water use, the waste water from the first flush tank could be stored in a separate tank that could be used for irrigation purposes. This tank needs to be cleaned yearly of deposits.

For Construction details see Annex F.

4.3.a First flush tank sizing

The sizing is fairly straight-forward, the only dimension required is X which is for one side because the tank has a square configuration. X is given as a function of catchment area as follows;

X = 0.005*S where S is the projected surface of the catchment area.
Thus for a 200 m² catchment area, (S=200), X = 0.005*200 = 1 m

FOR OPTIMUM WATER USE, THE WASTE WATER FROM THE FIRST FLUSH TANK COULD BE STORED IN A SEPARATE TANK THAT COULD BE USED FOR IRRIGATION PURPOSES.

It is recommended not to exceed a catchment area of 200 m² per tank. Thus for a catchment area of 350 m² of same RHWCAT, it is recommended to have two tanks operating in parallel. each sized for half the projected area.

4.3.b First flush tank material

For underground installations, a masonry or reinforced concrete body is recommended while the trim (Tank cover, strainer, run off plate, ball holding plate, threaded rods) should be preferably galvanized steel or epoxy coated steel. The ball should be of good quality plastic or alternatively brass.

For aboveground installations the body may also be made of galvanized steel especially if the first flush tank is installed near ceiling level in mechanical room.

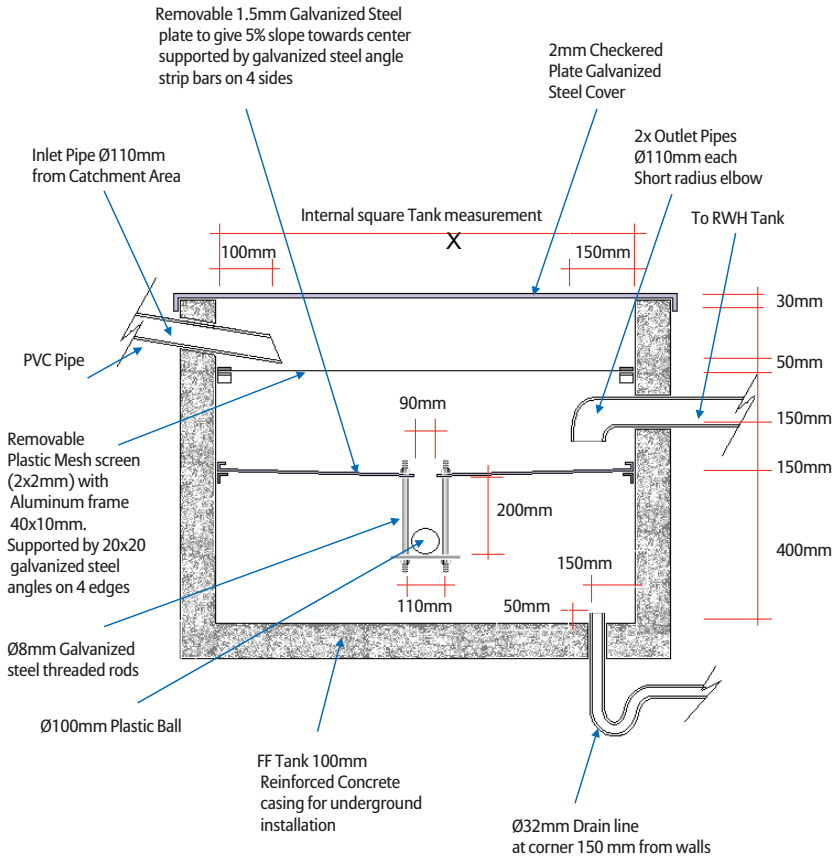


Fig. 22 A Detail of Underground First Flush Tank

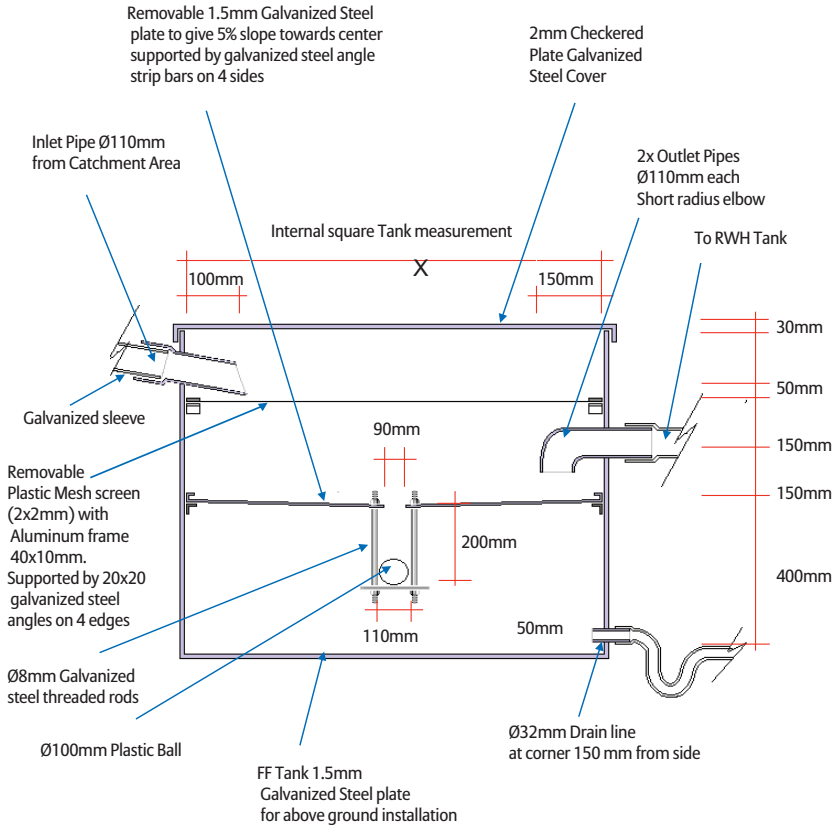


Fig. 22B Detail of Above Ground First Flush Tank

4.4 Storage Tanks

The storage tank or cistern generally is the most critical design component of a rainwater harvesting system. In most cases it is permanent and its placement should be carefully thought out.

Tanks can be placed either above or below ground. For both options, water should be able to gravity feed to the tank. Locating the tank near the building and the water use reduces the amount of pipe and site work necessary as well as pumping demands. Though no hard and fast rules govern the decision of aboveground or belowground tanks, in general, once the storage volume exceeds 10 m³ belowground storage is often the most viable option. Beyond this, tank location is dependent on aesthetics, climate and soil conditions. However, placing tanks underground ads to the installation costs and may be limited in areas where soil is especially rocky or areas with a high water table. When tanks are installed below ground, water is maintained at a cool temperature and light is blocked, which reduces the chances of bacterial growth.

Existing structures should be considered when installing a RWH system. Water is normally conveyed from the catchment area to storage tanks by gravity. Think carefully about the location of drains, gutters and downspouts to maximize the use of existing installations and to collect water from a roof area that will support water demand. For above ground installations, the tank foundation must be flat, and capable of supporting the weight of maximum storage. Locate tanks in areas that are not subject to erosion, flooding or other factors that might undermine the integrity of the foundation. Consider how electricity can be delivered to the pump of the RWH system, and how rainwater supply lines can be safely added to existing plumbing.

More than one storage tank may be considered if catchment areas and site conditions dictate that decision or if segregation of collected rainwater by quality is planned. It is a waste to mix a RWHCAT1 source with a RWHCAT3. For example the tank could have different compartments to accommodate each rainwater category.

4.4.a Sizing storage tanks

While rainwater harvesting has a number of environmental benefits, it must also be economically viable to enter the mainstream of building practices. Because the tank is often the most expensive component of a rainwater harvesting system, decision-making on tank size can have a strong impact on the economic feasibility of rainwater harvesting.

The size of storage tanks is dictated by several variables including:

- Rainfall in the area considered
- Projected daily water demand
- Length of dry season
- Catchment surface area
- Aesthetics, personal preference
- Budget.

No doubt the Length of the dry period is one of the most important governing factors in the design of a RWHS in Lebanon which experiences a dry season that extends over some 7 – 8 month. This is not the case for countries further west like Europe where rain hardly stops around the year. Consequently, rainwater harvesting tanks in Lebanon should be of relatively large size if one plans to use rainwater as a source of water supply.

The sizing process starts by determining what use will be made of the rainwater and the quantity required. This guideline proposes four use categories defined in Chapter 2. The decision on the use category should be made based on the availability of corresponding catchment areas. For example it does not make

economic sense to decide on a USECAT1 or even USECATE2 if only a RWHCAT3 or RWHCAT4 area is available.

Once this decision is made, the required quantity of water could be determined using the demand table in Annex D and the time coverage. The table gives water demand data based on demand type detailed down to the type of fixture used, use category, use type (Domestic, irrigation, car wash), types of plants for irrigation, irigation type (sprinkler, drip, hose, underground), use mode (water saving or normal) and application (residential, school, hospital, etc.), based on these choices one can read the required water demand. Column 8 (plumbing) is not required for determining water demand but rather it shows the type of plumbing installation necessary for certain applications.

Fig. 23 ***S****torage Tanks*

As an example, consider that house 1 is occupied by a family of 6 persons and has a garden having 25 m² of green lawn (gazon) as well as 250 m² planted with 60 shrubbery and Trees. The owner decides to have USECAT1 and USECAT2 for domestic purposes (including car wash, external surface cleaning) and for the lawn (sprinklers) and USECAT3 for trees and shrubbery (drip). The rainwater supply should be enough to cover 5 month of consumption (Tc = 5 month) which is the period when municipal water supply is somewhat reduced and owners do not want to take the risk of relying on private tankers. The owners did not install a swimming pool, not because they lack the means but because they believe it is a luxury the water supply condition of the country cannot afford. The owner is very conscious about water saving, therefore all plumbing fixtures are water saving type as well as the dishwasher and laundry machine.

RWHCAT1 catchment surface will be used to supply USECAT1, USECAT2 and USECAT3 because the roof of the house complies with all requirements for RWHCAT1. No other surface is available for harvesting other than the driveway and owner does not wish to use it as catchment area.

RWHCAT1 supply is calculated as per Tables 13/14/15 below using data from Annex D.

Table 13. House 1 Domestic Water Consumption

RWHCAT1 supply	Demand (l/p/d)	Persons	Period (days)	Total m³
USECAT1 (Drinking, Cooking)	3	6	150	2.7
USECAT2 (Domestic saving mode)	85	6	150	76

Table 14. House 1 Irrigation Water Consumption Sprinklers

RWHCAT1 supply	Demand (l/m²/d)	Area m²	Period (days)	Total m³
USECAT2 (Sprinkler for green lawn)	7	25	150	26

Table 15. House 1 Irrigation Water Consumption Shrubberies/Trees

RWHCAT1 supply	Demand (l/shr/d)	Shrubs pcs	Period (days)	Total m³
USECAT3 (Shrubbery and trees)	1.5	60	150	13.5

The total water demand of the house is 116 m³ which is the rainwater storage quantity required assuming municipality water is not used during the coverage period. The rainwater quantity required is well within the potential 414 m³ that could be collected on an average rainy year. Actually rainwater could cover house 1 needs even in the dry years when rainfall could reach 40% of the yearly average.

It is worthwhile noting that the 25 m² of green lawn consume twice as much as the 250 m² of shrubbery and 1/3 of the overall domestic consumption. Green lawns could be a nice thing but they are practically an environmental disaster from a water consumption viewpoint in the Lebanese context.

Thus for house 1 a 150 m³ nominal volume underground RWH storage tank is required, nominal volume being the physical volume of the tank and not the effective water holding capacity. As a rule of thumb physical volume should be 20% larger than effective holding capacity, mainly to allow for the sedimentation zone at the bottom (approximately 10% of tank volume) and the overflow clearance at the top section of the tank.

Because the roof catchment capacity is larger than reservoir capacity, the reservoir will overflow once filled up and the surplus water will be directed to the storm drainage network. Or alternatively, the owner could decide to extend the period of use to seven month and build a 200 m³ storage tank.

In all cases, the tank should overflow at least once a year so that floating debris are drained away from the water surface.

There is a point of diminishing returns beyond which increasing the tank size provides only a marginal benefit, in the case of House 1, the optimum size is actually 200 m³.

Use of blending with municipality water

If blending is contemplated thus extending the period of use of soft water in case rainwater is in limited supply or the RWH tank needs to be downsized, municipality water is equally blended with rainwater thus cutting by half the RWH tank capacity. Sizing of the municipality water storage tank will be done as follows.

Check the Municipality Water Availability (MWA) in your area according to the classification shown in Table 16 below;

Table 16. Classification Of Municipality Water Availability

MWA	DESCRIPTION
HIGH	Municipality water is available: • All year round at least once every two days for at least 5 hours
MEDIUM	Municipality water is available: • November – May: at least once every three days for at least 5 hours • June – October: at least once every four days for at least 5 hours
LOW	Municipality water is available: • November – May: at least once every three days for at least 5 hours • June – August: at least once every four days for at least 5 hours • September – October: once every week for at least 5 hours
VERY LOW	Municipality water is available: • November – May: at least once every three days for at least 5 hours • June – August: at least once every four days for at least 5 hours • September – October: Municipality water is Ooccasional or completely cut off
NONE	Facility is not connected to the municipality network or municipality water is occasional

Based on the MWA classification obtained from Table 16 above, on the overall daily water demand of the facility (Dw) and on the coverage period required (Tc), the municipality water storage tank effective volume (Vm) could be computed according to below;

1. Case 1: If MWA = High,

Vm = 20 m^3 if the facility water demand for 20 days is less than 20 m^3,
Otherwise,
Vm = 20*Dw

2. Case 2: If MWA = Medium

Vm = 30*Dw if Tc > 4 month,
Otherwise,
Vm = 20*Dw

3. Case 3: If MWA = Low

Vm = 50*Dw if Tc > 6 month,
Otherwise,
Vm = 30*Dw

4. Case 4: If MWA = Very Low

Vm = 70*Dw if Tc > 6 month,
Otherwise,
Vm = 50*Dw

The volume of the tank is obtained by multiplying the effective volume computed above by 1.2

Going back to house 1, suppose the occupants are interested in blending for cost reduction considerations given that municipality water is fairly available. The occupants consider that the MWA could be rated as low however to be on the safe side they opt for a very low MWA.

Based on a Tc = 5 month, Dw = 116/(5*30) = 0.77 m³/day
This is case 4 with Tc < 6 month, accordingly Vm = 50*0.77 ~ 40 m³ for rounding purposes.
Thus the savings in storage volume is = 1.2*(116/2 - 40) = 22 m³

Note: the factor 1.2 is used to compute actual tank volume given the effective water volume to be used.

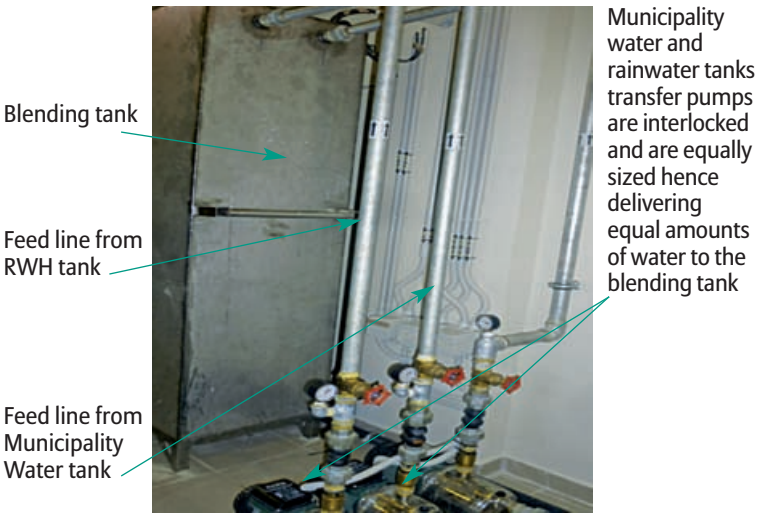


Fig. 24 Typical blending tank configuration

Use of grey water

Suppose the occupants of a facility wish to use grey water blending in a USECAT4 application, the purpose being to enhance the quality of the effluent grey water from the grey water treatment plant. The first step should be the evaluation of USECAT4 demand which could consist only of irrigation water or water for WCs or alternatively a combination of irrigation water and water for WCs.

The Table in Annex D can be used to determine USECAT4 demand of the facility based on the choices made by the occupants.

The Effluent grey water and rainwater quantity required for blending should be computed based on an equal percentage blending.

Back to house 1, suppose the occupants would like to use the grey water for irrigation and WC. Typically, grey water from lavatories and showers amount between 35% to 40% of domestic water consumption, while WC consumption is equivalent to some 30% of domestic water consumption. From Tables 13, 14 and 15 above, irrigation amounts to 52% or domestic water consumption, consequently grey water even if blended cannot meet the irrigation and WC consumption requirements.

Consequently, blending should be done with a higher rainwater contribution. The reduction in rainwater requirements is around 76*0.35 = 27 m³. (See table 12 above)

GWT size should not be higher than the daily USECAT4 consumption, in our case it should be sized as (26 + 13.5 + 76*0.4)/150 ~ 0.5 m³ (as nominal volume). Whatever inflow exceeds the holding capacity of the GWT will overflow to the sewer system of the facility.

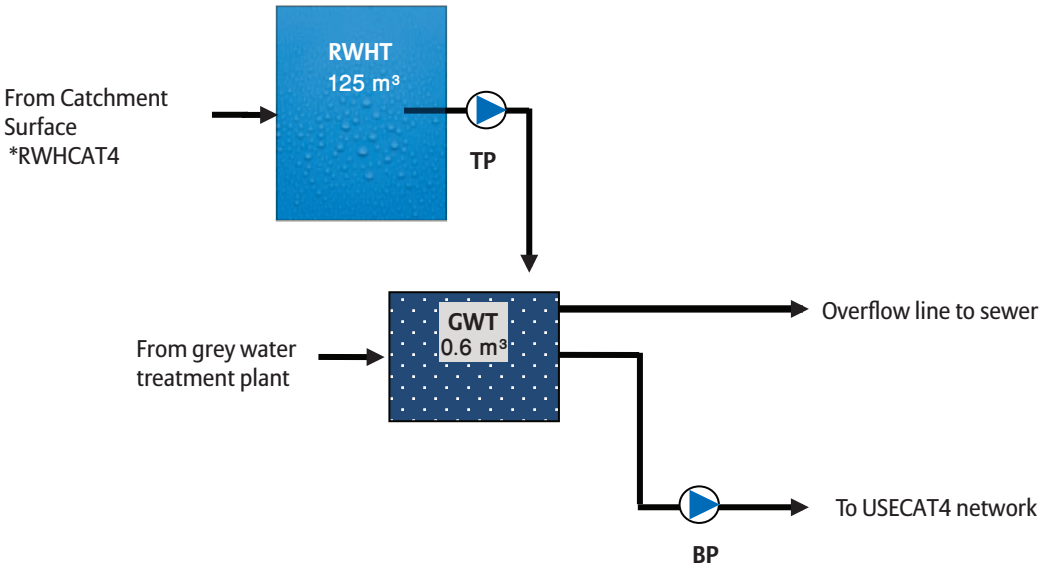


Fig.25 Grey water blending schematic example

The transfer pump TP should be timed to deliver 15% of GWT capacity every hour between 8 am and 10 pm, hence in our case if the pump flow is rated 1.5 m³/hr, then pump should operate for 0.15*0.5/1.5 = 0.05 hour or 3 minutes/hour. However timing could be modulated according to the facility schedule and occupancy the objective being to approach as much as possible the targeted blending ratio between the rainwater and grey water. Of course the GWT should be equipped with a low level pump actuation in order to operate TP if tank is empty.

Level control in storage tanks

Storage tanks should be equipped with high/low level alarm float switches for pump protection and provide warning of malfunctions. For monitoring purposes tanks should be equipped with level indication systems consisting of a level sensor located in the tank and a level display device located in an easily accessible location. The display device could have lead lights that indicate tank level status.

HINTS TO CONSIDER

- Aboveground tanks should be opaque to prevent algae growth, UV resistant to prevent tank failure, and piping should be protected against freezing.
- Belowground tanks must be appropriately load-rated for the site (i.e. under a pedestrian area or a parking lot).
- Tanks should be installed according to manufacturers' instructions.
- Only watertight tanks designed for storage should be used
- Tank should not have been used to store any other material.
- Tank should be sized according to the planned RWHCAT and the demand for corresponding USECAT.
- Tank should have an access opening minimum 450mm to facilitate installation, inspection and maintenance of components within the tank.
- For cases where venting by means of conveyance drainage piping and overflow drainage piping is considered insufficient, a vent shall be installed, with a min height of 150mm above grade and no less than 75mm in size equipped with a gooseneck bend and insect screen.

RAINWATER STORAGE TANK SIZING PROCEDURE

CASE 1: Rainwater is used only during the dry season (from May onward)

- If facility water demand for the planned period during the dry season is higher than the possible RWH volume, then tank effective volume should not exceed the corresponding effective surface catchment capacity for an average year.
- If facility water demand for the planned period during the dry season is lower than the possible RWH volume, then tank effective volume should be equal to the facility water demand for the planned period.
- The storage tank nominal volume should be 20% larger than the effective rainwater volume required. Tank physical dimensions are based on the nominal volume.
- If blending with municipality water is contemplated, then RWH tank volume could be cut by half compared to the case of no blending but on the other side a municipality water storage tank needs to be provided and sized according to the procedure shown above.
- If grey water is to be used, then the RWH tank volume could be reduced by the volume of grey water used for irrigation and/or WC flushing.

CASE 2: Rainwater is used during the rainy as well as dry season (From December onward)

- If facility water demand for the planned period during the wet and dry season is higher than the possible RWH volume, then tank effective volume should not exceed 60% of the corresponding effective surface catchment capacity for an average year.
- If facility water demand for the planned period during the wet and dry season is lower than the possible RWH volume, then tank effective volume should be equal to the facility water demand for the planned period.
- The storage tank nominal volume should be 20% larger than the effective rainwater volume required. Tank physical dimensions are based on the nominal volume.
- If blending with municipality water is contemplated, then RWH tank volume could be cut by half compared to the case of no blending but on the other side a municipality water storage tank needs to be provided and sized according to the procedure shown above.
- If grey water is to be used, then the RWH tank volume could be reduced by the volume of grey water used for irrigation and/or WC flushing

HINTS TO CONSIDER

- Tank should be provided with a calming inlet located at the bottom, it is used to direct the entering water upwards to prevent disturbing the fine particulate matter on the bottom of the tank. Calming inlets also introduces oxygen into the bottom of the tank.
- Underground tanks should have a sump for drainage
- Tanks should have an overflow of at least the same diameter as the inlet pipe. Overflow should be routed to the storm network and not the sewer network. Overflow should be trapped if tank is for USECAT1 or USECAT2 applications.

4.4.b Storage Tank Material

Rainwater storage tanks construction could be of different material, such as concrete, masonry, epoxy coated steel, stainless steel, galvanized sheet metal, Polyethylene or fiberglass. The characteristics of the installation such as above or underground configuration, indoors or outdoors, size as well as end use of the stored rainwater do influence the choice of material and type of construction.

Concrete tanks are sturdy, provide extreme flexibility in shape, size, configuration and internal design. They could be either cast in situ or prefabricated for above or underground installation. Cast-in-place tanks can be integrated into new construction under a patio or a basement, they will thus form an integral part of the building structure. For existing buildings, adding a concrete tank requires the expertise of a structural engineer to determine the size and spacing of reinforcing steel to match the structural loads. Concrete tanks may be prone to cracking and leaking, especially if built on weak foundations like clay soils. One other advantage of concrete tanks is that they also neutralize the acidity of harvested rainwater and by doing so impart a desirable taste to the water thanks to the dissolved carbonated compounds. For USECAT1 systems, it is essential that the interior of the tank be finished with food grade plaster and paint.

Polyethylene: A wide range of selection is available with multiple sizes. They can be used above and below ground

RAINWATER STORAGE TANKS CONSTRUCTION COULD BE OF DIFFERENT MATERIAL

according to specifications. They exist in single, double and triple layers, with vertical and horizontal models. Fittings on tanks are easily installed. Some models are food grade approved, good for potable water storage.

Underground PE tank

Triple Layer PE Tank

Underground Modular PE tank

Fig. 26 Polyethylene Tanks

Stainless Steel type 316 is an excellent choice for USECAT1 applications but pricey, good for above ground applications especially if indoors, however sizes above 8 m³ may be problematic as far as construction is concerned. The grade of the stainless steel should be carefully selected, many tank manufacturers in Lebanon make claims they do not meet as far as stainless steel tanks are concerned. A bad selection of stainless steel grade or bad workmanship will result in the unpleasant surprise of a corroded tank 6 month after installation.

(Fig.27 shows 3x4 m³ 316 stainless steel tanks as well as 1x500 liter potable water tank (lower rightmost)
The overflow (top most pipes) and drainage (lower most pipes with valves) connections are clearly seen. The pipes above the drain lines are the pump feed lines.

Fig. 27 Stainless Steel Tank

Galvanized Steel is cheaper but suffers the same limitations as stainless steel as far as sizes limitations are concerned, moreover if not properly constructed it will suffer severe corrosion at the seams.

Table 17. Tank Materials Evaluation

	Tank Material	Advantages	Disadvantages
Concrete	Poured in place Prefabricated	Durable Lasts very long Suitable for Above or Belowground installations Neutralizes acidic rainwater Imparts desirable water taste	Potential to crack or leak Immovable
Plastic	Polyethylene	Commercially available Affordable Available in variety of sizes Easy to install Above or Belowground Little maintenance Triple layer, Insulated, UV resistant & food grade, no coloring inside, maintains pureness of water inside. Underground modules/ unlimited capacity. Alterable & movable	UV degradable Must be painted or tinted
Metal	Stainless Steel 316	Commercially available Little maintenance Alterable & movable	Expensive Size limitations
	Galvanized Steel	Commercially available Alterable & movable	Possible corrosion and rust, that can lead to leaching of metal

Tank should be provided with a calming inlet (fig.28) routed to the tank bottom, it is used to direct the entering water upwards to prevent disturbing the fine particulate matter settled at the bottom of the tank. Calming inlets also introduces oxygen into the bottom layers of the tank.

All tanks should be provided with overflows (fig.29) connected to facility drainage network through a water trap or a positive air break to avoid contamination.

It is preferable that drain inlets be funneled to ease the water flow. Funnel diameter to be three times the overflow pipe diameter.

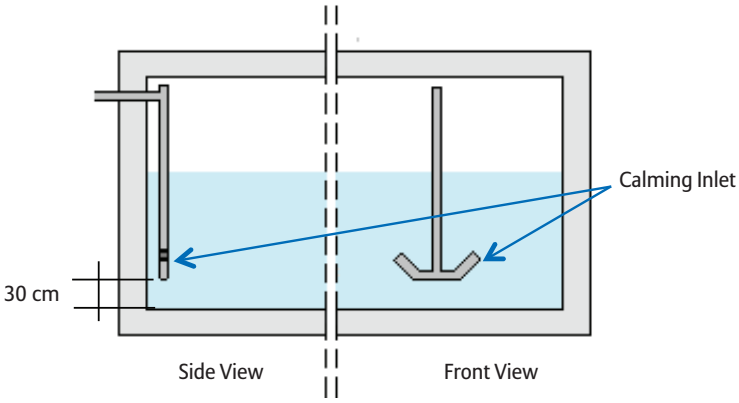


Fig. 28 Calming Inlet

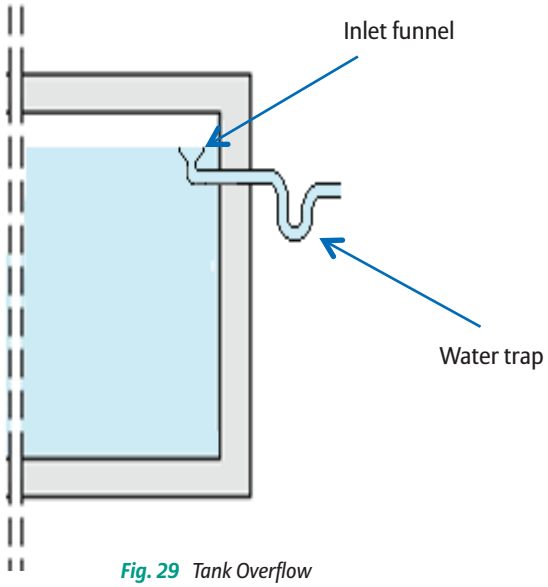


Fig. 29 Tank Overflow

4.5 Water Treatment

The general public is often leery about consuming and utilizing rainwater for potable and/or non-potable use, but proper system design with strict implementation and monitoring makes harvested rainwater a safe water source. Crossing the psychological barrier is a real challenge.

The environment, the catchment surface, the conveying network and the storage tanks can affect the quality of harvested rainwater. Unnecessary degradation of collected rainwater can be minimized through good housekeeping but this is not enough if rainwater is to be used for domestic purposes (USECAT1/USECAT2) even if RWHCAT1 catchment surfaces are used.

Water treatment is a complex discipline, however for the purposes of this guideline and the applications involved we can narrow water treatment to few basic components namely straining, sedimentation, filtration, chlorine sterilization, carbon adsorption and UV polishing. These will be discussed here below.

Straining and sedimentation effectively belong to pre-treatment stages. Straining occurs at the first flush tank where relatively large size objects and bulk pollution is removed before reaching the storage tank.

Sedimentation occurs in the storage tank where particles settle to the bottom due to gravity, For sedimentation to be effective, the water body should not be agitated, this is the reason why inlet calmers are devised to minimize water agitation when fresh rainwater enters the tank. Several days are

required for suspended particles to settle down to the tank bottom. Sedimentation can remove up to 80% of the particles entering the tank.

Consequently the storage tank should be cleaned at least once every three years if a first flush tank is used and once every year if a flush tank is not used.

Pressure filters

The first water treatment stage is filtration; filters could be of different types, for our purpose, only media type pressure filters are used followed by micro filters. Media filters are filled with sand or any other small grain media that retains suspended particles in the water that did not settle in the storage tank like pollen, coarse dust particles, human hair, etc. Media filters remove particles 5 micron and larger, this is practically 95% by weight of all suspended particles and by doing so these filters remove a lot of biological pollutants because these usually adhere to solid particles.

Media Pressure filters could be elongated cylinders or spherical in shape (fig.30).

Micro Filters

Micro filters or cartridge filters are installed downstream of media filters, their task is to remove the fine particles down to 0.5 micron size range that media filters cannot remove. They are made of tightly interwoven natural or synthetic threads that stop very fine dust and other pollutants particles like insecticide dust. For the sake of comparison, the thickness of a human hair is around 100 microns.

THE STORAGE TANK SHOULD BE CLEANED AT LEAST ONCE EVERY THREE YEARS

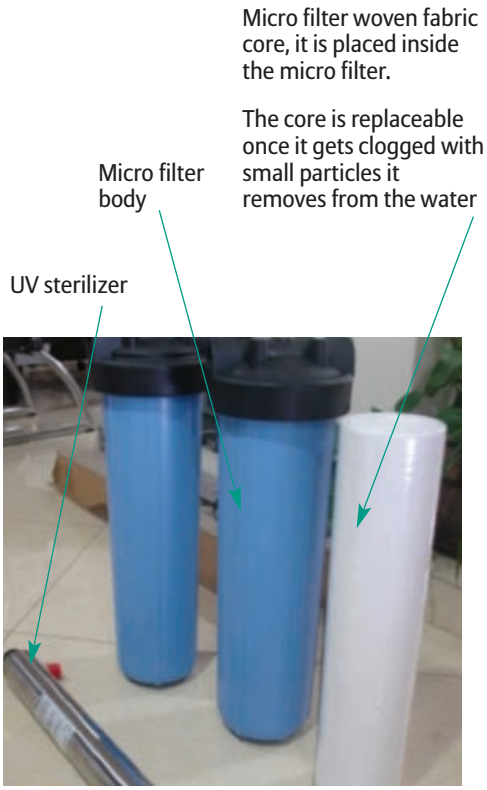


Fig. 30 *Pressure Filters*

Fig. 31 *Micro Filters*

Chlorine Sterilization

Filters remove solid particles and in the process they remove some bacteriological pollution adhering to these particles, but filters are not designed to remove effectively bacteriological pollution like viruses. This is the job of chlorine sterilization. Usually a solution of sodium hypochlorite is injected in the pipe work upstream of the media filter. For that purpose, a hypochlorite tank (Fig.32, right picture) and a dosing pump (Fig.32, left picture) are used.

The injection pump draws the solution from the tank and injects it in the pipework upstream of the blending tank if one is installed. The injected chlorine will sterilize the media filter as well as the micron filter. **Chlorine should never be added in the RWH storage tank. Keeping a 0.1 mg/l concentration of chlorine in the system is recommended at this stage as the water may spend few days in the treated tank or even in the rooftop reservoir if there is one.**

The dosing pump should be interlocked with the RWH storage tank transfer pump as well as with the municipality tank transfer pump if blending is carried out.

At this stage the treated water is fit for domestic use but not for cooking or drinking. The treatment above is satisfactory for USECAT2 if RWHCAT1 or RWHCAT2 is available. The treated water could be stored in a treated water tank preferably made of stainless steel or PE. The treatment discussed above is called first stage treatment in this guideline.

Fig. 32 *Chlorination dosing pump & Hypochlorite Tank*

Carbon filters

As a polishing stage, carbon filters are installed to remove any traces of hydrocarbon pollution like pesticides, sub- micron level particles as well as the remaining chlorine in the water. Carbon filters look exactly like media filters. They may or may not be installed downstream of the first stage treatment.

If some of the product water is to be used for cooking or drinking then a second stage treatment is required. Some of the water is pumped from the treated water tank into another micro filter (on the left of the picture (Fig.34) then passed through an Ultra Violet sterilizer (center of picture with bypass for maintenance purposes) then the water is stored in a potable water tank (The top of the stainless steel potable water tank could be seen at the bottom of the picture) The product water is fit for drinking or cooking purposes. It is now USECAT1. The carbon filter if not installed directly after the first stage treatment could be installed downstream of the micro filter in the second stage. The second option may allow a smaller size carbon filter.

Fig.33 below shows a general view of a first stage treatment with a downstream carbon filter for a RWHCAT2 catchment area destined for a USECAT2.
Raw water from the blending tank enters the first stage water treatment from the right of the picture.

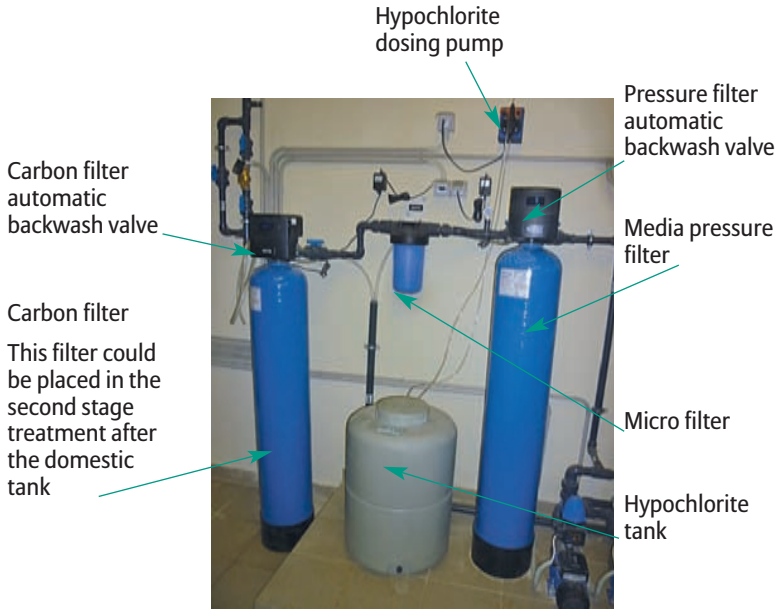


Fig. 33 *1st Stage Water Treatment Configuration with Down Stream Carbon Filter*

Rightmost is the media filter followed by the smaller size micro filter then the carbon filter on the left of the picture. The hypochlorite tank is seen below the micro filter while the hypochlorite dosing pump is fixed to the wall above the media filter. The plastic tubing connecting the hypochlorite dosing pump to the hypochlorite tank is the suction line, while the injection line could be partly seen at the top right of the picture. It injects chlorine upstream of the media filter in the blending tank (not appearing in the picture).

The product water is routed to the domestic water 316 stainless steel tank.

Fig.34 shows a second stage treatment but without carbon polishing which was inserted in the first stage. Water from the domestic tank at the left of the picture enters the micro filter then the UV sterilizer before entering the potable water tank which top is seen in the picture.

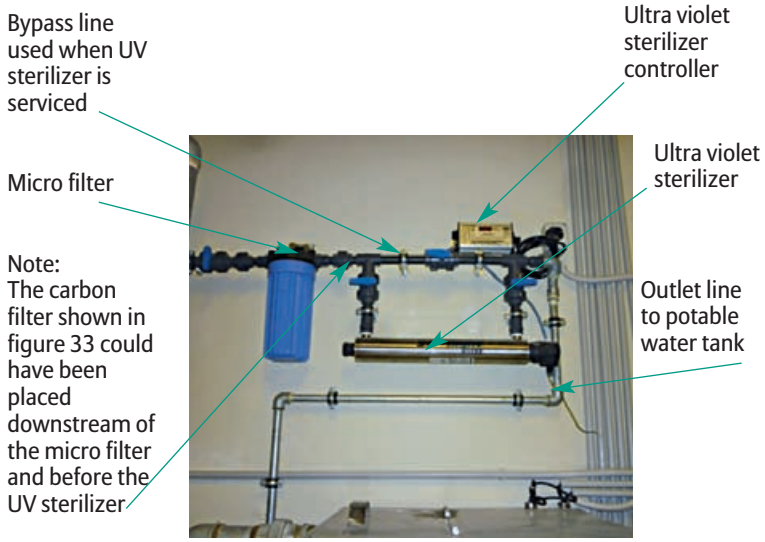


Fig. 34 *2nd Stage Water Treatment Configuration without Carbon Filter*

IMPORTANT

USECAT1 does not involve only a RWHCAT1 coupled to a WTCAT1 but also a monthly bacteriological testing of a water sample taken from the potable water tap.

- The first and second stages of water treatment described above form WTCAT1.
- WTCAT2 is equivalent to a first stage treatment.
- Carbon filters may be installed after the first stage treatment or they may form part of the second stage treatment depending on preferences. Carbon filters are recommended only if USECAT1 is contemplated.
- WTCAT3 consists basically of the first flush tank and the settling in the storage tank. Consequently WTCAT3 is effectively a pretreatment without filtration or sterilization.

HINTS TO CONSIDER

Filtration will assist in the prevention of discoloration of plumbing fixtures and is a safeguard against small debris or sediment entering the toilet valves, thus maintaining proper function.

Filtration removes turbidity (cloudiness) which interferes with disinfection.

4.5.a Water treatment equipment sizing

In order to size a water treatment installation for RWH, the major parameter to consider is water flow. For optimum efficiency, it is advised not to oversize equipment, this will not improve water quality but may rather give negative results.

Filters selection and sizing

Filters are sized based on water flow, as an example let us consider House 1 again. The first task consists of sizing the filters of the primary treatment. We have already seen that USECAT1 & USECAT2 for domestic use as well as USECAT2 for irrigation amount to 105 m³ for 5 month equivalent to 150 days. Consequently the average daily consumption is 0.7 m³/day. For all purposes a media filter of 1 m³/day will be selected or the nearest available size. The same applies to the cartridge micron filter.

It is recommended to order the media filter with automatic backwash for self-cleaning. Indeed, media filters need to get rid of all the pollutants that accumulate inside the media, this is done by reversing the flow through the media thus the term backwash. The automatic backwash mechanism avoids the hassle of manual backwash every other day. The backwash line should be routed to the drain.

Micron filters are not backwashed, the fabric cartridge inside the filter is simply replaced every six month or depending on clogging. It is therefore recommended to have pressure gages across filters to monitor their state of clogging.

Dosing pumps and chlorination tanks

The hypochlorite tank is filled with water then liquid sodium hypochlorite solution (15% by weight) is added to reach a concentration of no more than 3% chlorine (by weight) in the hypochlorite tank. In order to reach that concentration, fill a 100 liter hypochlorite tank with 80 liters of water and 20 liters of sodium hypochlorite solution. Hypochlorite tank size should be such that one fill should not last for more than 15 days because chlorine gas goes out of solution. Always use soft water from the RWH tank to fill the hypochlorite tank.

As a rule of thumb, every 1 m³ of treated domestic water requires 1 liter of hypochlorite solution at a concentration of 3% which is the concentration in the hypochlorite tank. Thus if a house consumes 30 m³ of treated domestic water per month, a 50 liter solution tank is ideal.

Dosing pumps are also selected based on water flow as shown above, these devices come in standard sizes, one size fits a wide range of water flows. Basically dosing pump flow is 1 liter/day for every 1 m³/day of treated water always based on a 3% solution tank concentration.

UV sterilizers

These also are sized based on flow, UV-C radiation dose should be no less than 40 mj/cm^2 according to class A requirements of the ANSI/NSF standard 55 (ref:23).

4.5.b Water treatment equipment materials

Always use first quality equipment from renowned manufacturers in what relates to water treatment. In order to assure that filters do not leach undesirable contaminants into the water, use filtration systems that have been certified to meet ANSI/NSF Standard 61 requirements (ref:23).

Use sodium hypochlorite compounds that are certified in accordance with ANSI/NSF Standard 60 requirements (ref:23). Avoid products that contain fragrances and UV stabilizers. Most specifically do not use chlorine compounds designed for use in swimming pools as these products often contain cyanide based UV stabilizers. This guideline does not recommend the use of calcium hypochlorite compounds because it is less stable and may result in maintenance and storage problems.

Table 18. Treatment Techniques

	Method	Location	Result
WATER TREATMENT	SCREENING Leaf screens and strainers	Drains, gutters and downspouts	Prevent leaves and other debris from entering tank
	SETTLING Sedimentation	Within Tank	Settles out particulate matter
	FILTERING First Flush diverters Sand filter Carbon Filter/Activated charcoal	Before tank After pump After chlorination	Reduces suspended material Sieves sediment Removes chlorine, odors, hydrocarbons, improves taste
	DISINFECTING Chemical treatment/ Chlorine	Within Tank or at pump (liquid or granule), before activated charcoal filter	Kills microorganisms
	Ultraviolet light	After activated charcoal and carbon filters, before storage/tap	Kills microorganisms

4.6 Pumps

Pumps are used to move fluids and impart to them the necessary pressure required in any given process. They are of different types and models, In RWHS pumps are vital, therefore a good understanding of the different kinds involved, their functioning and how to select them is very important. Basically a pump for the purpose of this guideline is made of two parts, the pump itself that imparts movement to the fluid and the electric motor that drives the pump.

A pump is characterized by two major operating parameters namely the **flow** and the **head**. The flow as the name implies is the quantity of water handled by the pump per unit time, it is expressed usually as liters/sec or m³/hr. The head represents the pressure that could be developed by the pump, it is expressed as Bars or height in meters of water. 1 bar is equivalent to the pressure at the bottom of a column of water 10 meters high. Therefore 1 bar is equivalent to 10 meters head.

Submersible pumps

As the name implies, these pumps are immersed in the water usually when the storage tank is underground making it difficult to have a side intake. Two kinds of submersible pumps are encountered, the submersible well pump and the submersible pit pump.

Below, is a picture of a submersible well pump showing its main components. As the name implies this type of pump is usually installed in wells which are of small diameter therefore the water passes along the motor and cools it before entering the pump intake. In case a well pump is to be used in a RWH storage reservoir, then it has to be installed horizontally at the bottom of the tank otherwise much of the storage reservoir volume cannot be pumped and second it needs to have a sleeve around the motor, open only on the motor end to force the water to enter the sleeve and cool the motor. Actually the sleeve replaces the well. It is preferable to connect the open end of the sleeve to a floating suction intake to prevent the suction of dirt from the tank bottom.

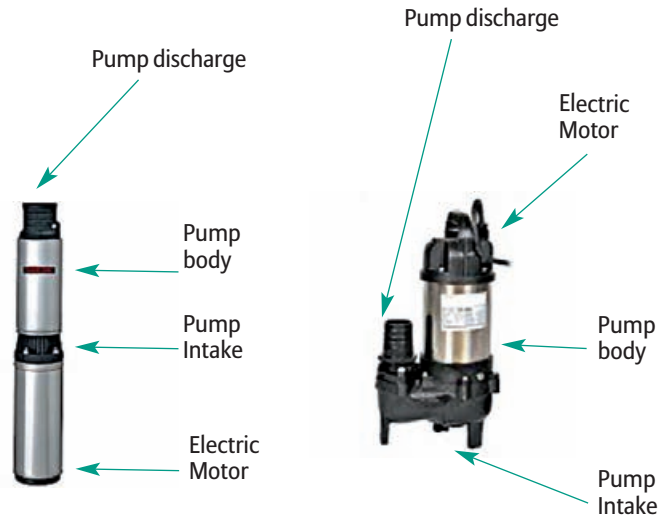


Fig. 35 Submersible Pumps

The other type of submersible pump is the submersible pit pump, as the name implies it is installed in a pit. It does not need a sleeve as it is designed to operate in a tank however its only drawback is that it can generate much less pressure than a submersible well pump and the suction could draw dirt from the tank bottom as it is practically impossible to fit the pump with a floating suction intake. However this issue may be overcome if the pump is installed on a slightly elevated pad.

Both configurations need careful design and to devise practical ways to pull them out of the tank in case repair or maintenance is required while the tank may be full. A definite advantage of submersibles is that they are noiseless.

Fig. 36 *Duplex Submersible Pit Pumps*

Booster Pumps

These are installed external to the tank usually in a mechanical room or an enclosure pit to protect them from the weather and dampen the noise. As fig 36 below shows, booster pumps consist of an electric motor and a pump body. These pumps are also called end suction pumps because they draw water from one end of the pump.

Booster pumps have a wide range of operating characteristics as far as flow and pressure, they are simple to install and service but the drawback is the possible noisy operation if installed nearby living quarters.

Booster set:

It is an assembly made of one (simplex), two (duplex) or three (triplex) booster pumps equipped with a pressure tank and pressure switch to actuate the pumps upon of fall in pressure in the pipework. Booster sets usually supply water to end users so that supply pressure remains fairly constant. This may avoid the unpleasant experience of reduced flow under a shower if other toilets are being used when the network has un-sufficient pressure.

(Fig.38) shows a duplex booster set complete with a skid rail (below the pumps), the pumps, the stainless steel suction manifold that feed the pumps with water, the pressure actuated variable speed drivers (black boxes above the pumps) and the discharge manifold to which the pressure switch (grey) and pressure tank (red) are connected.

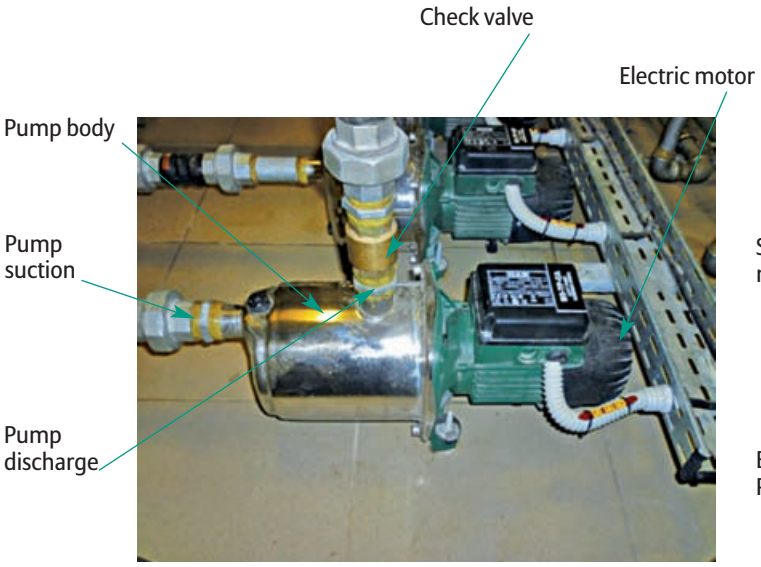


Fig. 37 *Horizontal Booster Pump*

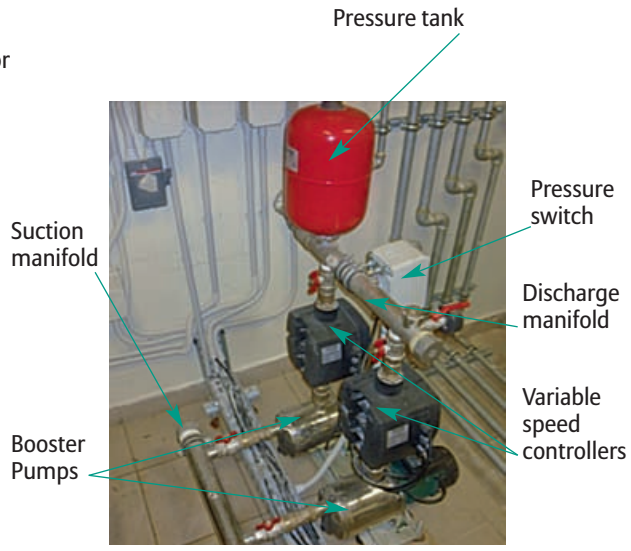


Fig. 38 *Duplex Booster set*

Pressure tanks and switches

Pressure switches activate the controls that activate the pump to meet the demand. The size of the pressure tank determines whether your system operates efficiently and effectively. The rule of thumb for sizing a pressure tank is three times the liters/minute of the pump equals the liter size of the pressure tank. Thus if a pump delivers 60 liters/minute the pressure tank size will be 180 liters.

PUMPS ARE USED TO MOVE FLUIDS AND IMPART TO THEM THE NECESSARY PRESSURE REQUIRED IN ANY GIVEN PROCESS

Pump protection

Should your rainwater cistern become low on water, it will be essential that the pump is protected from running while there is not sufficient water for the pump to function. If the pump continues to run without sufficient water, the pump will be damaged. A simple float switch in the rainwater cistern will protect the pump from running when the water level declines. A float switch automatically resets when the tank refills.

A check valve should be installed at the pump discharge to avoid water backflow which may also damage the pump and empty the discharge line.

In order to protect the pump from erosion and possible jams resulting from fairly big solid particles entrained in the water like rust flakes, small wood pieces, plastics, small pieces of cloth, etc. a strainer should be installed at the pump suction intake.

Flexible connectors should be installed at suction and discharge connections of pump to minimize vibration and noise transmission through piping especially if it is steel.

Floating suction intake strainer

To aspirate the water from the tank, a floating intake strainer is located at the end of the pump's suction hose. Sediment, bacteria and other pollutants generally settle to the bottom of the tank, with concentrations of pollutants higher at the bottom than at the surface of the water. Studies have also shown that bacteria levels can be higher at the surface of the cistern water than elsewhere in the tank (ref:23). To avoid these two areas of concern, the floating filter takes water from the tank a few centimeters below the water surface. Floating suction intake strainers seldom clog, they should be made of high-quality stainless steel.

Fig. 39 *Booster pump connection details*

4.6.a Pump sizing

Pumps are sized using two main parameters, flow and Head. Flow depends on water demand while Head depends on the characteristics of the project like building elevation, distance between storage tank and point of use, type of water treatment equipment, etc.

A rainwater harvesting system network may involve more than one type of pump, therefore each pumping function will be discussed here below.

Starting with the most basic function, namely pumping water from the underground storage tank to a roof tank. Taking House1 as example, we have seen previously that the daily water demand is around 0.75 m³/day. Thus the pump needs to raise daily that amount to the roof. But in practice the roof tank may be around 2 m³ to allow spare reserve for two days in case of a malfunction. If we assume that the pump needs to fill the roof tank in one hour time then the flow will be Q = 2 m³/hr, which is a fairly small pump. Having determined the flow, it is now time to compute the head.

(Fig. 40) Below gives a good representation of a widely used installation for lifting water to a higher level from an underground reservoir. The pump is located above the tank and is equipped with a suction line terminated with a foot valve. That valve could be of the floating type.

The head of the pump is the summation of several factors:

- The vertical distance between the pump centerline and the underground tank water surface, the pump needs to "lift" the water over that distance. Usually it is assumed the pump operates in worst case conditions (i.e: an empty tank) thus it is practically distance A expressed in meters.

- The vertical distance the pump needs to push the water, which in worst case conditions is height E between the pump centerline and the pipework discharge into the elevated tank expressed in meters.

- The friction between the water in the pipe and the pipe walls which the pump needs to overcome. This friction resistance is also expressed in meters and can be computed once the pipe size, pipe length, pipe type and flow are given. It is expressed as Hf.

- The head required to operate any end of line device like an automatic valve, a ball valve, etc. in our case we have none. It is expressed as Ha.

PUMPS ARE SIZED USING TWO MAIN PARAMETERS, FLOW AND HEAD.

FLOW DEPENDS ON WATER DEMAND WHILE HEAD DEPENDS ON THE CHARACTERISTICS OF THE PROJECT

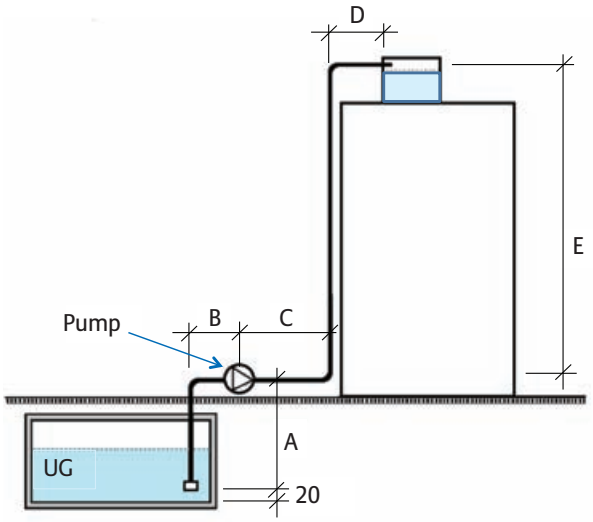


Fig. 40 Underground Reservoir pipework to roof tank in suction lift configuration

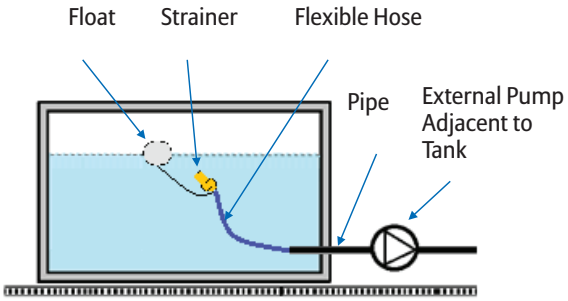


Fig. 40A Reservoir with float strainer in submerged suction configuration

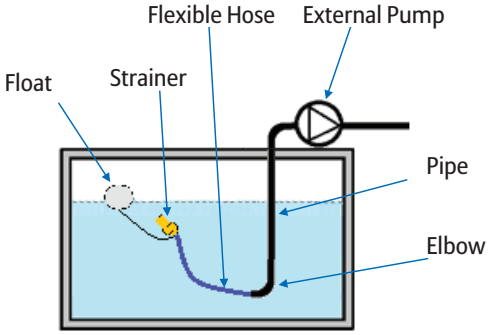


Fig. 40B Reservoir with float strainer in suction lift configuration

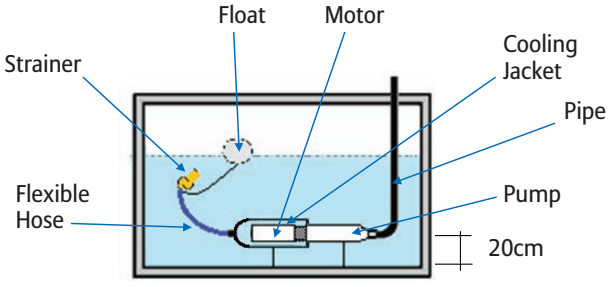


Fig. 40C Reservoir with float strainer in submersible well pump configuration

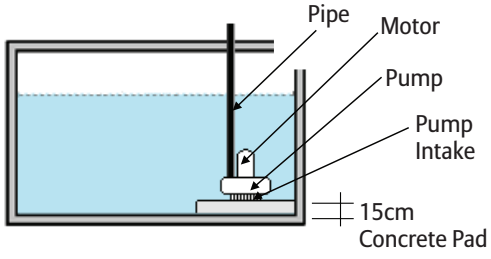


Fig. 40D Reservoir with float strainer in submersible pit pump configuration

The Total Discharge Head (TDH) of the pump his expressed as:

T.D.H = A + E + Hf + Ha.

A and E are fairly easy to determine, they can be measured from drawings or site. It is important to note that A could be positive or negative depending on the type of configuration. In configurations 40A, 40C and 40D A is negative while in configurations 40 and 40B A is positive. Note that in configurations 40 and 40B, A should never exceed 3 meters as the pump may lose its prime and get damaged.

Hf is the product of the pipe friction factor hf determined from Annex E and the overall pipe length. In our case the overall pipe length L = A + B + C + E + D.

Thus Hf = hf*L

Ha in our case = 0

Assume A = 2.5 meters, B = 2 meters, C = 4 meters, E = 18 meters, D = 3.5 meters.

Then, L = 30 meters.

To find hf follow the steps below

- If pipe is exposed or buried, opt for a galvanized steel type. If pipe is protected in a shaft then PPR or PEX is acceptable. Suppose in our case pipe is exposed thus requiring the selection of a Galvanized Steel Pipe (GSP).

- Using the Table in Annex E select pipe size using the hourly flow determined above (Q = 2 m³/hr and type of pipe determined in the previous step (GSP). The friction factor hf can also be determined. In our case pipe diameter is ½ inch and hf = 0.038871

we specify the pipe as GSP, sched 40, Ø = 3/4 inch

Q = 2 m³/hr

hf is found to be = 0.1913 then Hf = 30*0.1913 = 5.7 meters.

Note that hf takes into consideration fittings losses

Therefore TDH = 2.5 + 18 + 5.7 = 26.2 m to be rounded to 27 m

Our pump can now be specified as a booster pump having a flow Q = 2 m³/hr at a TDH = 27 m.

Exactly the same calculations would apply for all pumps configurations except that one needs to pay attention to the sign of "A"

Suppose now that the circuit above goes through a filtration unit consisting of a media filter and a micro filter. The pressure drop through the media filter is 0.5 bars when clogged and that of the micro filter is 0.6 bars. Both of them will have an Ha = 11 meters. The pipework length increases from 30 to 45 m because it has to be routed to the mechanical room.

Therefore

Hf = 45*0.1913 = 8.6 m

T.D.H = 2.5 + 18 + 8.6 + 11 = 40.1 m to be rounded to 41 m

Our pump can now be specified as a booster pump having a flow Q = 2 m³/hr at a TDH = 41 m.

Another application to consider is when a booster set feeds water to the building as shown in (fig.41) below. The pump feeds the domestic water network however the Jacuzzi which is two floors below requires 2 bar (the equivalent of 20 m water column) for its operation.

In this case the pump is not lifting water but rather delivering water to lower floors. In this case the TDH could be written as

TDH = -8 + Hf + Ha

Where Ha = 2 bars or 20 m head. (-8 is the negative head between the pump and the fixture for which the pressure calculations are required). Whenever the load is below the pump, the lift is negative.

The pump flow requirement is 0.7 m³/day or 0.2 m³/hr. To convert from average daily flow to hourly peak flow divide daily flow by 4 in order for the pump to meet peak demand.

Pipe length L = 8 m, considering PPR pipe Ø 20 mm, hf = 0.04 for Q = 0.2 m³/hr as per Annex E.

Consequently
TDH = -8 + 8*0.04 + 20 ~ 12 m

Therefore a duplex booster set with pump characteristics Q = 0.2 m³/hr and TDH = 12 m is to be ordered. The booster set should have an expansion tank of 12 liters.

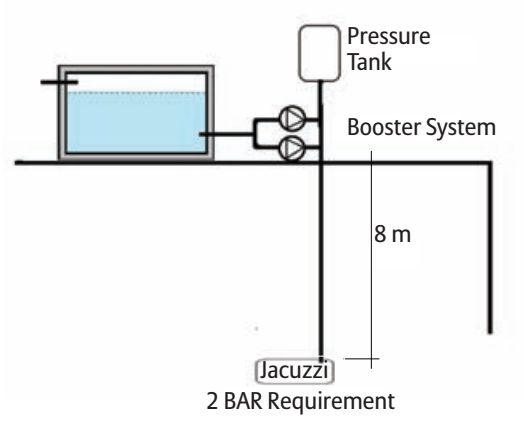


Fig. 41 Booster Set feeding the building network

HINTS TO CONSIDER

- Pump systems should be designed to meet the expected peak demand
- Pumps drawing water from the underwater storage tank should have their intake just below the water surface using a floating intake strainer
- Pumps should not have a suction lift exceeding 3 meters
- Pumps should always have low level cut off to protect them from dry running
- Never oversize pumps, pumps should always operate at their best duty pump
- Always choose pumps from well-known manufacturers
- Pumps should be preferably all stainless steel 316 construction

4.6.b Pump Material

Apart from the electric motor, pumps consist mainly of two components, the pump casing and the impeller. The material of construction of the casing and impeller greatly affect the durability and proper operation of the pump. Pump casings could be made of cast iron or 316 stainless steel sheets stampings while the impeller could be bronze, stainless steel stampings or Noryl.

For submersible and booster pumps, it is recommended to choose an all 316 stainless steel construction for all pumps applications related to rainwater. Whenever possible chose a low speed pump 1500 rpm instead of a high speed 3000 rpm, however the pump flow and head may dictate a 3000 rpm pump. Always purchase pumps from well-known manufacturers.

Pumps should always be protected against dry running with low level cut off float switches.

5 MAINTENANCE

Careful preventive maintenance by the owner or operator is the best way to assure long trouble free life for the equipment and the highest level of water quality. Common sense and sound installation practices should prevail.

The following maintenance practices are recommended;

- Every 3 years or less

  - Clean all tanks, disinfect and flush.
  - Check inner surfaces plaster lining of concrete tanks. If necessary repair lining if cracked or peeling and paint again using appropriate paint.
  - Check submersible pumps in tanks for apparent damage, rust, inlet cogging or damaged electrical cable.
  - Change water treatment filter media if recommended by supplier.
  - Change UV lamp as per manufacturer recommendation.

CAREFUL PREVENTIVE MAINTENANC IS THE BEST WAY TO ASSURE LONG TROUBLE FREE LIFE FOR THE EQUIPMENT

- Every year before rainy season check the following

  - Gutters and drains are not obstructed.
  - No polluting objects on catchment surfaces (dead birds or rodents, organic waste, etc.).
  - First flush tank is clear of debris and cleaned.
  - Strainer of first flush tank is not damaged, if torn or cracked replace.
  - Tree branches and any vegetation that interferes with the gutters or overhangs RWHCAT1 roofs should be pruned.

- After first rain event that lasts more than 30 minutes

  - Clean strainer of first flush tank.
  - Clean sump of first flush tank, make sure drain pipe is not clogged.

- After each torrential rain event

  - Clean strainer of first flush tank.
  - Clean sump of first flush tank, make sure drain pipe is not clogged.

- On a 6 month basis

  - Check cartridge filter of micro filter and replace if clogged.
  - Clean inner part of micro filter housing.
  - Check UV lamp operation as per manufacturer instructions, replace if necessary.
  - Check high/low level alarm float switches operation by operating manually.
  - Check validity of hypochlorite chemicals that are in stock. Hypochlorite chemicals should not be kept in store for more than one year.
  - Check validity of fire extinguishers.

• On a regular basis check the following

- Pumps for abnormal noises or vibrations.
- Any leakage from pipes or above ground tanks.
- Control panels for burned out lamps.
- Liquid level in hypochlorite tanks.
- Clogging of filters.
- Pressure tank gas charge.
- Booster system operation, if booster system is hunting this may mean that pressure tank diaphragm is damaged or pressure tank lost its gas charge.
- Water quality. USECAT1 water should be tested at the tap on a fortnight basis or at most monthly basis.
- Hypochlorite chemicals are not exposed to the sun.
- Technical rooms are clean and well lighted.
- Replace burned light bulbs.
- Quickly wash with abundant water any spill of hypochlorite on your skin.
- Exit lights are properly functioning.
- As a general rule, the cleaner the water going into the cistern, the higher the water quality and the better the system's overall performance will be.
- Maintenance of the UV light involves cleaning of the quartz sleeve and the bulb itself. Some UV lights are designed with an integral wiper unit. Again, follow the manufacturer's instructions and recommendations.

Efficient water use practices

- Close water taps when not used
- Dripping taps should be repaired
- Use water efficient faucets, plumbing fixtures and washing machines
- Use plants and shrubberies adapted to the local weather, it is strongly advised not to plant gazon
- It is strongly advised not to have a swimming pool or a water pond in single family residences
- Do not rinse floors with water, use mops
- Adopt dual plumbing circuits for grey water use

Safety and Health

- Always wear goggles, gloves and dust masks when filling hypochlorite tanks
- Wash with abundant water any part of the body that came in contact with hypochlorite
- Always shut off power on equipment being serviced
- Keep an operating fire extinguisher in the technical room
- Keep a first aid kit in a prominent location in or nearby the technical room
- Post in a prominent place the contact numbers of the neatest medical care center, the red- cross and civil defense
- Make sure technical room floors are always dry and not slippery and objects are not lying on the floor
- Make sure technical rooms are well lighted
- Always use the proper tools for the job
- Use gloves, goggles and ear plugs when using grinder

GLOSSARY

CALMING INLET	A device located at the bottom of a storage tank that permits water to enter a storage tank with minimal disturbance to particles that may have settled to the bottom of the tank.
CATCHMENT SURFACE AREA	Area from which rainwater is collected to be used in a rainwater harvesting system (e.g. roof area).
CODE	Refers to the International Plumbing Code.
DEBRIS EXCLUDER	A screen or other device installed to prevent the accumulation of leaves, needles, or other debris in the system.
DISINFECTION (STERELIZATION)	Reduction of viable microorganisms to a level that is deemed suitable for the intended applications. Typical units of measure are Colony Forming Units per 100ml liter (cfu/100ml).
DOMESTIC WATER	Water for household and commercial areas of use that does not have to have the quality of drinking water.
DRAIN	Collect run off water, they are used mainly for flat surfaces like a flat roof, a terrace or driveway.
DRY RUNNING PROTECTION	System for protecting the water pump against running when no water is present.
FILTRATION	Physical removal of liquid-born contaminants by means of separation from the output flow. Particulate filtration removes suspended particles, measured in units of total suspended solids (TSS), while other forms of filtration, such as carbon/absorption filtration, removes dissolved compounds measured in units of total dissolved solids (TDS).
FIRST FLUSH TANK	A device or method for removal of debris from collection surface by diverting initial rainfall from entry into the cistern / tank.
FLAT	Having a slope no greater than 1 in 50.
FRESH WATER	Naturally occurring water on the Earth's surface; in ice sheets, ice caps, glaciers, icebergs, bogs, ponds, lakes, rivers and streams, and underground as groundwater in aquifers and underground streams. Fresh water is generally characterized by having low concentrations of dissolved salts and other total dissolved solids. Water that infiltrates into the ground and no longer flows across the surface.

GREY WATER	The effluent from lavatories, showers and bathtubs only. WC, washing machines, dish washers, kitchen sink and other plumbing fixtures must not be part of the grey water network.
GROUND WATER	Water that infiltrates into the ground and no longer flows across the surface.
GUTTER	A channel at the eaves or a collector on the sloped roof of a building, for carrying off rainwater.
HARVESTED WATER	Rainwater that is collected in the cistern / tank.
INFILTRATION FIELD	Element in the ground that is filled with gravel, ballast or special non-permeable plastic elements and that stores rainwater that is fed into it on an intermediate basis before the water evaporates into the atmosphere or seeps into the surrounding soil.
LEADER / DOWNSPOUT	Drains are connected to leaders or pipes that convey the water to the storage tank.
MINIMUM WATER VOLUME	Residual water volume that is constrained by the process in which neither sediment nor scum can be sucked in for the protection of the pump.
OVERFLOW LEVEL	The highest level that water in a cistern can rise before flowing out of the tank.
OVERFLOW LINE	Line for leading excess rainwater away when the cistern is full.
PIPING SYSTEM	Pipes that convey the harvested rainwater and distribute it to various fixtures.
PRECIPITATION CHARACTERISTICS	Characteristics of a precipitation event (e.g. intensity, duration).
RAINWATER	Water collected from runoff of roofs or other structures after a rain event.
RAINWATER HARVESTING SYSTEM	Water system for utilizing rainwater, consisting of a cistern/tank, pipe, fittings, pumps and/or other plumbing appurtenances, required for and/or used to harvest and distribute rainwater.
RAINWATER YIELD	Useful water volume (water inflow) determined over a certain period of time.
RETURN ELBOW	A section of pipe with a 180-degree bend.

ROOF DRAINAGE SYSTEM	A system, comprised of roof drains, overflow drains, scuppers, gutters and down spouts, used to convey the rainwater from the roof surface to the tank/cistern.
SCREEN	A filtration device, constructed of corrosion resistant wire or other mesh, having openings in determined areas.
SEDIMENTATION	Separation of solids from the water via gravity.
STRAINER	It is the slotted surface where water enters the drain.
SYSTEM PRESSURE	Pressure needed to deliver water to the designated fixtures.
SLOPED / GABLED ROOF	Having a slope greater than 1 in 50.
SUB-SURFACE IRRIGATION	A method of providing water to plants by raising the water table to the root zone of the crop or by carrying moisture to the root zone by perforated underground pipe. Also known as subirrigation.
SURFACE IRRIGATION	Application of water to the soil by means of pipes or furrows along the surface.
SURFACE WATER	Any rainwater that touches the ground and flows across the surface of the ground (roadway, parking surface, gully, creeks, streams, etc.).
SYSTEM PRESSURE	Pressure needed to deliver water to the designated fixtures.
TANK / CISTERN	The central water storage component of the rainwater harvesting system. Protection and maintenance of the tank is essential for the health of the system.
TRANSPIRATION FIELD	Element in the ground that is filled with gravel, ballast or special permeable plastic elements and that stores rainwater that is fed into it on an intermediate basis before the water seeps into the surrounding soil.
QUANTITY OF PRECIPITATION	Amount of rain, expressed as the water height in millimeters over a horizontal area for a span of time under consideration.
USEFUL VOLUME	Volume that can be completely used during operation (typically 80 – 90% of storage volume).

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ANNEXES

ANNEXE A

ANNEXE B

ANNEXE C

ANNEXE D

ANNEXE E

ANNEXE F

ANNEXE G

ANNEXE H

ANNEX A RAINFALL DATA FOR LEBANESE LOCALITIES

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Beirut	BEIRUT	Beirut	بيروت	710
Bekaa	BAALBEK	Aabla	عبلا	450
Bekaa	BAALBEK	Aaqidiyeh	العقيدية	450
Bekaa	BAALBEK	Aarsal	عرسال	550
Bekaa	BAALBEK	Aayoun Orghoche	عيون أرغش	700
Bekaa	BAALBEK	Abrouk	أبروك	450
Bekaa	BAALBEK	Ain Ahla	عين أهلا	450
Bekaa	BAALBEK	Ain bourday	عين بورضاي	450
Bekaa	BAALBEK	Ain El Jaouze	عين الجوزة	700
Bekaa	BAALBEK	Ain El Bnaiye	عين البنية	700
Bekaa	BAALBEK	Ain El Delbeh	عين الدلبة	700
Bekaa	BAALBEK	Ain El Qabou	عين القبو	450
Bekaa	BAALBEK	Ain El Saaa	عين الساعة	700
Bekaa	BAALBEK	Ainata	عيناتا	1000
Bekaa	BAALBEK	Baal	البعل	450
Bekaa	BAALBEK	Baalbek	بعلبك	410
Bekaa	BAALBEK	Barqa	برقا	550
Bekaa	BAALBEK	Bechouat	بشوات	450
Bekaa	BAALBEK	Bednayel	بتدايل	450
Bekaa	BAALBEK	Beit Bou Slaibi	بيت بو صليبي	550
Bekaa	BAALBEK	Beit Chama	بيت شاما	410
Bekaa	BAALBEK	Beit Habchi	بيت حبشي	550
Bekaa	BAALBEK	Beit Matar	بيت مطر	550
Bekaa	BAALBEK	Beit Mchaik	بيت مشيك	550
Bekaa	BAALBEK	Beit Medlej	بيت مدلج	450
Bekaa	BAALBEK	Bejjaje	بجاجة	450
Bekaa	BAALBEK	Betdaai	بتداعي	450
Bekaa	BAALBEK	Bir Aarram	بير عرام	450
Bekaa	BAALBEK	Bissaileh	بصيلة	450
Bekaa	BAALBEK	Blaiqa	بليقة	550
Bekaa	BAALBEK	Boudai	بوداي	450
Bekaa	BAALBEK	Britel	بريتال	450
Bekaa	BAALBEK	Chaaibe	الشعيبة	700
Bekaa	BAALBEK	Chaat	شعث	450
Bekaa	BAALBEK	Chamhariyeh	الشمهرية	450
Bekaa	BAALBEK	Chlifa	شليفا	405
Bekaa	BAALBEK	Chmistar	شمسطار	450
Bekaa	BAALBEK	Dar el Ouassaa	دار الواسعة	1000
Bekaa	BAALBEK	Dawret EL Namel	دورة النمل	700
Bekaa	BAALBEK	Deir El Ahmar	دير الأحمر	510
Bekaa	BAALBEK	Douris	دورس	350
Bekaa	BAALBEK	El Ain	العين	450
Bekaa	BAALBEK	Fakehe	الفاكهة	350
Bekaa	BAALBEK	Flaoui	فلاوي	450
Bekaa	BAALBEK	Hadet	الحدث	450
Bekaa	BAALBEK	Halbata	حلبتا	450
Bekaa	BAALBEK	Ham	حام	700
Bekaa	BAALBEK	Haouch Ed Dahab	حوش الذهب	450
Bekaa	BAALBEK	Haouch En Nabi	حوش النبي	450
Bekaa	BAALBEK	Haouch Snaid	حوش سنيد	450
Bekaa	BAALBEK	Haouch Tall Safiye	حوش تل صفية	450
Bekaa	BAALBEK	Haour Taala	حور تعلا	450
Bekaa	BAALBEK	Harata	حرتا	450
Bekaa	BAALBEK	Hafayer	الحفاير	450
Bekaa	BAALBEK	Hay El Mathaneh	حي المطحنة	450
Bekaa	BAALBEK	Hizzine	حزين	450

Bekaa	BAALBEK	Houch Barada	حوش بردى	450
Bekaa	BAALBEK	Houch El Nahleh	حوش النحلة	450
Bekaa	BAALBEK	Houch Er Rafqa	حوش الرافقة	450
Bekaa	BAALBEK	Iaat	ايعات	450
Bekaa	BAALBEK	Jabboule	جبولة	450
Bekaa	BAALBEK	Jdaide	الجديدة	450
Bekaa	BAALBEK	Jibaa	جبعا	450
Bekaa	BAALBEK	Jinta	جنتا	450
Bekaa	BAALBEK	Joubaniyeh	جوبانية	550
Bekaa	BAALBEK	Kfar Dabach	كفر دبش	450
Bekaa	BAALBEK	Kfar Dane	كفر دان	450
Bekaa	BAALBEK	Kherbet El Raayan	خربة الرعيان	700
Bekaa	BAALBEK	Kherbet Rafeq	خربة رافق	450
Bekaa	BAALBEK	Khodor	الخضر	450
Bekaa	BAALBEK	Khormata	خرمتا	450
Bekaa	BAALBEK	Khraibe	الخربية	550
Bekaa	BAALBEK	Knaisse	الكنيسة	450
Bekaa	BAALBEK	Laboue	اللبوة	450
Bekaa	BAALBEK	Maallaqa	المعلقة	450
Bekaa	BAALBEK	Maarboun	معربون	550
Bekaa	BAALBEK	Majdaloun	مجدلون	450
Bekaa	BAALBEK	Maqne	مقنة	450
Bekaa	BAALBEK	Maqr	المقر	450
Bekaa	BAALBEK	Maqsous	مقصوص	550
Bekaa	BAALBEK	Mar Charbel	مار شربل	700
Bekaa	BAALBEK	Masnaa Bidnael	مصنع بدنايل	450
Bekaa	BAALBEK	Masnaa El Zahrah	مصنع الزهرة	700
Bekaa	BAALBEK	Mazraat Ali Miflih	مزرعة علي مفلح	700
Bekaa	BAALBEK	Mazraat Beit El Ghousain	مزرعة بيت الغصين	450
Bekaa	BAALBEK	Mazraat Beit Taqch	مزرعة بيت طقش	450
Bekaa	BAALBEK	Mazraat Bou Slaibi	مزرعة بو صليبي	450
Bekaa	BAALBEK	Mazraat El Dahr	مزرعة الضهر	450
Bekaa	BAALBEK	Mazraat Ed Dallil	مزرعة الضليل	450
Bekaa	BAALBEK	Mazraat El Saiyed	مزرعة السيد	450
Bekaa	BAALBEK	Mchairfeh	المشيرفة	450
Bekaa	BAALBEK	Mchaitiye	مشيتية	1000
Bekaa	BAALBEK	Mhajrine	المهاجرين	450
Bekaa	BAALBEK	Mhatet Ras Baalbek	محطة راس بعلبك	450
Bekaa	BAALBEK	Mirmagha	المرماغة	550
Bekaa	BAALBEK	Moqraq	مقراق	450
Bekaa	BAALBEK	Mrah Abou Ibrahim	مزاح أبو ابراهيم	550
Bekaa	BAALBEK	Mrah Abou Raji	مزاح أبو راجي	450
Bekaa	BAALBEK	Mrah Beit El Qazah	مزاح بيت القزح	450
Bekaa	BAALBEK	Mrah El Aassi	مزاح العاصي	700
Bekaa	BAALBEK	Mrah El Aawj	مزاح العوج	550
Bekaa	BAALBEK	Mrah El Aawjah	مزاح العوجه	550
Bekaa	BAALBEK	Mrah El Ahmar	مزاح الأحمر	550
Bekaa	BAALBEK	Mrah El Blata	مزاح البلاطة	450
Bekaa	BAALBEK	Mrah El Chire	مزاح الشير	450
Bekaa	BAALBEK	Mrah El Harfouch	مزاح الحرفوش	450
Bekaa	BAALBEK	Mrah Najib	مزاح نجيب	550
Bekaa	BAALBEK	Mrah El Qloud	مزاح القلود	550
Bekaa	BAALBEK	Mrah Silm	مزاح سلم	450
Bekaa	BAALBEK	Mrah Simaan	مزاح سمعان	550
Bekaa	BAALBEK	Mrah Soukar	مزاح سكر	550
Bekaa	BAALBEK	Mrah Wadi El Zrayeb	مزاح وادي الزرايب	450
Bekaa	BAALBEK	Mrah Zouaiter	مزاح زعيتر	550

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Bekaa	BAALBEK	Nabaa El Litani	نبع الليطاني	450
Bekaa	BAALBEK	Nabha	نبحا	450
Bekaa	BAALBEK	Nabha El Qeddam	نبحا القدام	450
Bekaa	BAALBEK	Nabi Batha	النبي بطحا	450
Bekaa	BAALBEK	Nabi Chit	النبي شيت	450
Bekaa	BAALBEK	Nabi Ismail	النبي اسماعيل	700
Bekaa	BAALBEK	Nabi Osmane	النبي عثمان	450
Bekaa	BAALBEK	Nabi Rachade	النبي رشاده	450
Bekaa	BAALBEK	Nabi Saleh	النبي صالح	550
Bekaa	BAALBEK	Nabi Sbat	النبي شباط	700
Bekaa	BAALBEK	Nabi Sraij	النبي سرايج	700
Bekaa	BAALBEK	Nahle	نحلة	450
Bekaa	BAALBEK	Naqra	النقرا	550
Bekaa	BAALBEK	Qaa	القاع	450
Bekaa	BAALBEK	Qarha	قرحا	450
Bekaa	BAALBEK	Qasr El Banat	قصر البنات	450
Bekaa	BAALBEK	Qasr El Lajouj	قصر اللجوج	550
Bekaa	BAALBEK	Qasr El Namroud	قصر النمرود	700
Bekaa	BAALBEK	Qiddam (el)	قدام	450
Bekaa	BAALBEK	Qild El Sabea	قلد السبع	700
Bekaa	BAALBEK	Qlaileh	قليلة	550
Bekaa	BAALBEK	Qouttara	القطارة	550
Bekaa	BAALBEK	Qsamaba	قصمبا	450
Bekaa	BAALBEK	Ram	رام	450
Bekaa	BAALBEK	Ras Baalbek	راس بعلبك	450
Bekaa	BAALBEK	Ras El Aassi	راس العاصي	450
Bekaa	BAALBEK	Ras El Ain	راس العين	450
Bekaa	BAALBEK	Rasm El Hadet	رسم الحدث	450
Bekaa	BAALBEK	Riha	ريحا	450
Bekaa	BAALBEK	Saaide	السعيدة	450
Bekaa	BAALBEK	Safra	صفرا	450
Bekaa	BAALBEK	Saidet EL Najat	سيدة النجاة	700
Bekaa	BAALBEK	Saraain el Faouqa	سرعين الفوقا	520
Bekaa	BAALBEK	Saraain et Tahta	سرعين التحتا	450
Bekaa	BAALBEK	Sbouba	صبوبا	450
Bekaa	BAALBEK	Sifri	سفري	450
Bekaa	BAALBEK	Siret Hana	سيرة هنا	550
Bekaa	BAALBEK	Souwaniyeh	السوانية	450
Bekaa	BAALBEK	Tahoun El Motran	طاحون المطران	450
Bekaa	BAALBEK	Taibe	الطيبة	450
Bekaa	BAALBEK	Tal El Aalaiq	تل العلق	450
Bekaa	BAALBEK	Tal El Masoudiyeh	تل المسعودية	450
Bekaa	BAALBEK	Tal Sougha	تل صوغا	450
Bekaa	BAALBEK	Talet El Dair	تلة الدير	450
Bekaa	BAALBEK	Talia	طليا	450
Bekaa	BAALBEK	Tammine et Tahta	تمنين التحتا	450
Bekaa	BAALBEK	Tamnine El Faouqa	تمنين الفوقا	450
Bekaa	BAALBEK	Taraiya	طاريا	450
Bekaa	BAALBEK	Tfail	الطفيل	700
Bekaa	BAALBEK	Tibchar	تبشار	450
Bekaa	BAALBEK	Tlaileh	التليلة	450
Bekaa	BAALBEK	Toufiqiye	توفيقية	450
Bekaa	BAALBEK	Wadi El hjara	وادي الحجارة	450
Bekaa	BAALBEK	Yahfoufa	يحفوفا	450
Bekaa	BAALBEK	Yammoune	اليمونة	1010
Bekaa	BAALBEK	Yanabiaa El Yamouneh	ينابيع اليمونة	1010
Bekaa	BAALBEK	Younine	يونين	450
Bekaa	BAALBEK	Zabboud	زبود	450
Bekaa	BAALBEK	Zarayeb	الزرايب	1000
Bekaa	BAALBEK	Ziri	الزيري	450
Bekaa	BAALBEK	Zrazir	الزرازير	450
Bekaa	HERMEL	Ain El Tifeha	عين التفاحة	250
Bekaa	HERMEL	Barghach	برغش	250
Bekaa	HERMEL	Baoul	البعول	250
Bekaa	HERMEL	Bdita	بديتا	250
Bekaa	HERMEL	Beit Aallam	بيت علام	250
Bekaa	HERMEL	Beit Aallouh	بيت علوه	250
Bekaa	HERMEL	Beit Hira	بيت حيرا	250
Bekaa	HERMEL	Beit El Sammaqa	بيت السماقة	250
Bekaa	HERMEL	Bouaida	بويضة	250
Bekaa	HERMEL	Boustane	البستان	250
Bekaa	HERMEL	Braij	البرج	250
Bekaa	HERMEL	Brisa	بريصا	250
Bekaa	HERMEL	Byout El Ain	بيوت العين	250
Bekaa	HERMEL	Chammis El Tourkmane	شميس التركمان	250
Bekaa	HERMEL	Charbine	الشربين	250
Bekaa	HERMEL	Charbine El Fawqa	شربين الفوقا	250
Bekaa	HERMEL	Chilmane	الشلمان	250
Bekaa	HERMEL	Chouaghir	الشواغر	250
Bekaa	HERMEL	Chouaghir El Tahta	الشواغر التحتا	250
Bekaa	HERMEL	Dair Mar Maroun	دير مار مارون	250
Bekaa	HERMEL	Dawra	الدورة	250
Bekaa	HERMEL	Faarah	فعره	250
Bekaa	HERMEL	Fissane	فيسان	250
Bekaa	HERMEL	Haouch Es Saiyad Aali	حوش السيد علي	250
Bekaa	HERMEL	Harit El Maasir	حارة المعاصير	250
Bekaa	HERMEL	Hariqa	الحريقة	250
Bekaa	HERMEL	Hawch Beit Ismail	حوش بيت اسماعيل	250
Bekaa	HERMEL	Hawchariyeh	حوشرية	250
Bekaa	HERMEL	Hermel	الهرمل	250
Bekaa	HERMEL	Hmaire	الحميرة	250
Bekaa	HERMEL	Jawz	الجوز	250
Bekaa	HERMEL	Jbab El Homor	جباب الحمر	250
Bekaa	HERMEL	Jiser El Assi	جسر العاصي	250
Bekaa	HERMEL	Jouar El Hachich	جوار الحشيش	250
Bekaa	HERMEL	Kharayeb	الخرايب	250
Bekaa	HERMEL	Kouakh	الكواخ	250
Bekaa	HERMEL	Maaisr	معيصرة	250
Bekaa	HERMEL	Maallaqit Jbab	معلقة جباب	250
Bekaa	HERMEL	Mahlisa	مخليصا	250
Bekaa	HERMEL	Marjhine	مرجحين	250
Bekaa	HERMEL	Mazraat Ain El Zarqa	مزرعة عين الزرقا	250
Bekaa	HERMEL	Mazraat Beit El Tochm	مزرعة بيت الطشم	250
Bekaa	HERMEL	Mazraat El Taleh	مزرعة التلة	250
Bekaa	HERMEL	Mazraat Sojod	مزرعة سجد	250
Bekaa	HERMEL	Mdawich	مداوش	250
Bekaa	HERMEL	Mnaira	المنيرة	250
Bekaa	HERMEL	Mrah Abbas	مزاح عباس	250
Bekaa	HERMEL	Mrah Beit Aalawh	مزاح بيت علوه	250
Bekaa	HERMEL	Mrah Beit Ouwad	مزاح بيت عواد	250
Bekaa	HERMEL	Mrah Bikdach	مزاح بكداش	250
Bekaa	HERMEL	Mrah Bou Handal	مزاح بو حندل	250
Bekaa	HERMEL	Mrah Bou Kamar El Din	مزاح بو قمر الدين	250

RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Bekaa	HERMEL	Mrah Daher El Chir	مزاح ضهر الشير	250
Bekaa	HERMEL	Mrah El Aaqbeh	مزاح العقبة	250
Bekaa	HERMEL	Mrah El Aataibeh	مزاح العتيبة	250
Bekaa	HERMEL	Mrah El Abd	مزاح العبد	250
Bekaa	HERMEL	Mrah El Ain	مزاح العين	250
Bekaa	HERMEL	Mrah El Arab	مزاح العرب	250
Bekaa	HERMEL	Mrah El Chaeb	مزاح الشعب	250
Bekaa	HERMEL	Mrah El Chammis	مزاح الشميس	250
Bekaa	HERMEL	Mrah El Dallil	مزاح الدليل	250
Bekaa	HERMEL	Mrah El Mahlisa	مزاح المخليصة	250
Bekaa	HERMEL	Mrah El Mechrif	مزاح المشرف	250
Bekaa	HERMEL	Mrah El Moughr	مزاح المغر	250
Bekaa	HERMEL	Mrah El Naher	مزاح النهر	250
Bekaa	HERMEL	Mrah El Nawas	مزاح النواس	250
Bekaa	HERMEL	Mrah El Qorraiteh	مزاح القريطة	250
Bekaa	HERMEL	Mrah El Siyed	مزاح السيّاد	250
Bekaa	HERMEL	Mrah El Wadi	مزاح الوادي	250
Bekaa	HERMEL	Mrah El Zaarour	مزاح الزعرور	250
Bekaa	HERMEL	Mrah El Zikbeh	مزاح الزكبة	250
Bekaa	HERMEL	Mrah El Zwarib	مزاح الزواريب	250
Bekaa	HERMEL	Mrah Elias	مزاح الياس	250
Bekaa	HERMEL	Mrah Houssain Taan	مزاح حسين طعّان	250
Bekaa	HERMEL	Mrah Sejoud	مزاح سجد	250
Bekaa	HERMEL	Mrah Yassine	مزاح ياسين	250
Bekaa	HERMEL	Nasriye	ناصرية	250
Bekaa	HERMEL	Ouadi el Oss	وادي العص	250
Bekaa	HERMEL	Ouadi El Ratle	وادي الرطل	250
Bekaa	HERMEL	Ouadi et Tourkmane	وادي التركمان	250
Bekaa	HERMEL	Qanafez	قنافد	250
Bekaa	HERMEL	Qasr	القصر	250
Bekaa	HERMEL	Qild El Diab	قلد الذياب	250
Bekaa	HERMEL	Qorneh	قرنة	250
Bekaa	HERMEL	Qornit Bassil	قرنة باسيل	250
Bekaa	HERMEL	Quadi Brit	وادي بريت	250
Bekaa	HERMEL	Quadi Faara	وادي فعره	250
Bekaa	HERMEL	Sahlat El Ma	سهلات الماء	250
Bekaa	HERMEL	Souaisse	السويسة	250
Bekaa	HERMEL	Swaidia	السويدية	250
Bekaa	HERMEL	Tal El Far	تل الفار	250
Bekaa	HERMEL	Wadi El Karm	وادي الكرم	250
Bekaa	HERMEL	Zighrine	الزغرين	250
Bekaa	HERMEL	Zighrine El Tahta	زغرين التحتا	250
Bekaa	HERMEL	Zwaitineh	الزويتينة	250
Bekaa	RACHAIYA	Aaiha	عيحا	917
Bekaa	RACHAIYA	Aaqbe	العقبة	917
Bekaa	RACHAIYA	Ain Aarab	عين عرب	917
Bekaa	RACHAIYA	Ain Aata	عين عطا	917
Bekaa	RACHAIYA	Ain El Aalaq	عين العلق	917
Bekaa	RACHAIYA	Ain Hircha	عين حرشا	917
Bekaa	RACHAIYA	Aita el Foukhar	عيتا الفخار	917
Bekaa	RACHAIYA	Bakka	بكا	917
Bekaa	RACHAIYA	Bakkifa	بكيفا	917
Bekaa	RACHAIYA	Beit Lahia	بيت لهيا	917
Bekaa	RACHAIYA	Bire	البيره	917
Bekaa	RACHAIYA	Chammis El Hami	شميس الهامي	917
Bekaa	RACHAIYA	Dahr el Ahmar	ضهر الأحمر	917
Bekaa	RACHAIYA	Deir el Aachayer	دير العشاير	917
Bekaa	RACHAIYA	El Aaqabeh	العقبة	917
Bekaa	RACHAIYA	El Faqaa	الفاقعة	917
Bekaa	RACHAIYA	El Mradeh	المرذة	917
Bekaa	RACHAIYA	El Mrouj	المروج	917
Bekaa	RACHAIYA	El Nabaat	النبعات	917
Bekaa	RACHAIYA	Haloua	حلوة	917
Bekaa	RACHAIYA	Haouch	الحوش	917
Bekaa	RACHAIYA	Hawch Hafouna	حوش حافونا	917
Bekaa	RACHAIYA	Jabal El Cheikh	جبل الشيخ	917
Bekaa	RACHAIYA	Job Farah	جب فرح	917
Bekaa	RACHAIYA	Kaoukaba	كوكبا	917
Bekaa	RACHAIYA	Kfar Danis	كفر دنيس	917
Bekaa	RACHAIYA	Kfar Mechki	كفر مشكي	917
Bekaa	RACHAIYA	Kfar Qouq	كفر قوق	845
Bekaa	RACHAIYA	Khirbet Rouha	خربة روحا	917
Bekaa	RACHAIYA	Majdal Balhis	مجدل بلهيص	917
Bekaa	RACHAIYA	Marj El Samah	مرج السماح	917
Bekaa	RACHAIYA	Mazraat Aazeh	مزرعة عزة	917
Bekaa	RACHAIYA	Mazraat El Chammiseh	مزرعة الشميسة	917
Bekaa	RACHAIYA	Mazraat El Yabissiyeh	مزرعة اليابسية	917
Bekaa	RACHAIYA	Mazraat Jaafar	مزرعة جعفر	917
Bekaa	RACHAIYA	Mazraat Silsata	مزرعة سلسانا	917
Bekaa	RACHAIYA	Mdoukha	مدوخا	917
Bekaa	RACHAIYA	Mhaidse	المهيدسة	917
Bekaa	RACHAIYA	Mrah El Qadi	مزاح القاضي	917
Bekaa	RACHAIYA	Mraimis	مريميس	917
Bekaa	RACHAIYA	Nabi Safa	النبي صفا	917
Bekaa	RACHAIYA	Qaraoun	القرعون	732
Bekaa	RACHAIYA	Qanaabeh	قنعبة	730
Bekaa	RACHAIYA	Rachaiya	راشيا	860
Bekaa	RACHAIYA	Rafid	الرفيد	917
Bekaa	RACHAIYA	Tal Bijeh	تل بيجة	917
Bekaa	RACHAIYA	Tannoura	تنورة	917
Bekaa	RACHAIYA	Toultata	طولتا	917
Bekaa	RACHAIYA	Wadi Ghar El Jamous	وادي غار الجاموس	917
Bekaa	RACHAIYA	Yanta	يانطا	917
Bekaa	WEST BEKAA	Aamiq	عميق	870
Bekaa	WEST BEKAA	Aana	عانا	870
Bekaa	WEST BEKAA	Ain El Falouj	عين الفلوج	870
Bekaa	WEST BEKAA	Ain El Tineh	عين التينة	870
Bekaa	WEST BEKAA	Ain el Tineh	عين التينة	870
Bekaa	WEST BEKAA	Ain Zebde	عين زبدة	870
Bekaa	WEST BEKAA	Aitanit	عيتنيت	870
Bekaa	WEST BEKAA	Baaloul	بعلول	1,050
Bekaa	WEST BEKAA	Bab Maraa	باب مارع	870
Bekaa	WEST BEKAA	Beit El Badawiyeh	بيت البدوية	870
Bekaa	WEST BEKAA	Beit Fares	بيت فارس	870
Bekaa	WEST BEKAA	Bouhairit El Qaraoun	بحيرة القرعون	870
Bekaa	WEST BEKAA	Chebreqiye	الشبرقية	870
Bekaa	WEST BEKAA	Dakoue	الدكوة	870
Bekaa	WEST BEKAA	Deir Ain ej Jaouze	دير عين الجوزة	870
Bekaa	WEST BEKAA	Deir Tahnich	دير طحنيش	870
Bekaa	WEST BEKAA	Dillafi	دلافي	870
Bekaa	WEST BEKAA	El Chaara	الشعارة	870
Bekaa	WEST BEKAA	El Chammis	الشميس	870
Bekaa	WEST BEKAA	El Cheikh Hassan El Marj	الشيخ حسن المرج	870

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Bekaa	WEST BEKAA	El Jazira	الجزيرة	870
Bekaa	WEST BEKAA	El Kharaib	الخرايب	870
Bekaa	WEST BEKAA	El Marj	المرج	870
Bekaa	WEST BEKAA	El Nassar	النصار	870
Bekaa	WEST BEKAA	El Rawda	الروضة	870
Bekaa	WEST BEKAA	Fadar el Faouqa	فدار الفوقا	1,050
Bekaa	WEST BEKAA	Fadar el Tahta	فدار التحتا	870
Bekaa	WEST BEKAA	Ghazze	غزة	870
Bekaa	WEST BEKAA	Hammara	حمارة	870
Bekaa	WEST BEKAA	Hawch Aamiq	حوش عميق	870
Bekaa	WEST BEKAA	Hawch El Saalouk	حوش الصعلوك	870
Bekaa	WEST BEKAA	Houch el Harime	حوش الحريمة	870
Bekaa	WEST BEKAA	Jabal Bir El Daher	جبل بير الضهر	1,050
Bekaa	WEST BEKAA	Joub Jannine	جب جنين	715
Bekaa	WEST BEKAA	Jwar Qourqoumaz	جوار قرقمز	870
Bekaa	WEST BEKAA	Kafraiya	كفريا	870
Bekaa	WEST BEKAA	Kamed el Laouz	كامد اللوز	870
Bekaa	WEST BEKAA	Khiara	الخيارة	870
Bekaa	WEST BEKAA	Khirbet Qanafar	خربة قنافار	870
Bekaa	WEST BEKAA	Lala	لالا	1,050
Bekaa	WEST BEKAA	Libbaya	لبايا	1,050
Bekaa	WEST BEKAA	Loussia	لسيا	870
Bekaa	WEST BEKAA	Machgara	مشغرة	1,440
Bekaa	WEST BEKAA	Manara	المنارة	1,050
Bekaa	WEST BEKAA	Mansoura	المنصورة	620
Bekaa	WEST BEKAA	Meidoun	ميدون	870
Bekaa	WEST BEKAA	Mrah El Bacha	مراح الباشا	1,050
Bekaa	WEST BEKAA	Nabea El kHraizat	نبع الخريزات	870
Bekaa	WEST BEKAA	Nabi Noun	النبي نون	870
Bekaa	WEST BEKAA	Nabi Zraiq	النبي زريق	1,050
Bekaa	WEST BEKAA	Qaraoun	القرعون	560
Bekaa	WEST BEKAA	Qilya	قليا	870
Bekaa	WEST BEKAA	Sahrij	صهريج	870
Bekaa	WEST BEKAA	Saghbine	صغبين	1,050
Bekaa	WEST BEKAA	Sohmor	سحمر	870
Bekaa	WEST BEKAA	Souairi	الصويري	870
Bekaa	WEST BEKAA	Soultane Yaaqoub el Faouqa	السلطان يعقوب الفوقا	870
Bekaa	WEST BEKAA	Tall El Zaazaa	تل الزعزع	1,050
Bekaa	WEST BEKAA	Tall Znoub	تل ذنوب	870
Bekaa	WEST BEKAA	Tall Znoub El Jdideh	تل ذنوب الجديدة	870
Bekaa	WEST BEKAA	Yohmor el Bekaa	يحمر	870
Bekaa	WEST BEKAA	Zellaya	زلايا	870
Bekaa	ZAHLE	Aali en Nahri	علي النهري	690
Bekaa	ZAHLE	Anjar	عنجر	690
Bekaa	ZAHLE	Ablah	ابلح	690
Bekaa	ZAHLE	Ain El Aasal	عين العسل	1,000
Bekaa	ZAHLE	Ain Kfar Zabad	عين كفرزبد	690
Bekaa	ZAHLE	Ain Jabbour	عين جبور	690
Bekaa	ZAHLE	Ain Jahhaf	عين جحاف	690
Bekaa	ZAHLE	Bar Elias	بر الياس	690
Bekaa	ZAHLE	Beit Mbarak	بيت مبارك	690
Bekaa	ZAHLE	Bhana	بحنا	1,000
Bekaa	ZAHLE	Bouarej	بوارج	1,000
Bekaa	ZAHLE	Chtaura	شتوره	840
Bekaa	ZAHLE	Dahr Blit	ضهر بليط	690
Bekaa	ZAHLE	Dahr el Baydar	ضهر البيدر	1,000

Bekaa	ZAHLE	Dalhamiye	دلهمية	690
Bekaa	ZAHLE	Dandin	دندين	690
Bekaa	ZAHLE	Deir el Ghazal	دير الغزال	690
Bekaa	ZAHLE	Deir Zinoun	دير زنون	690
Bekaa	ZAHLE	El Aawayni	العويني	690
Bekaa	ZAHLE	El Borj	البرج	1,000
Bekaa	ZAHLE	El Forzol	الفرزل	690
Bekaa	ZAHLE	El Karmeh	الكرمة	690
Bekaa	ZAHLE	El Maalaqa	المعلقة	690
Bekaa	ZAHLE	El Masnaa	المصنع	690
Bekaa	ZAHLE	El Mazraa	المزرعة	1,000
Bekaa	ZAHLE	El Wakef	الوقف	690
Bekaa	ZAHLE	Hai el Fikani	حي الفيكاني	690
Bekaa	ZAHLE	Haouch Moussa	حوش موسى	690
Bekaa	ZAHLE	Harf Bou Ne'meh	حرف بو نعمه	1,000
Bekaa	ZAHLE	Harit El Fikani	حارة الفيكاني	690
Bekaa	ZAHLE	Hazerta	حزرتا	1,000
Bekaa	ZAHLE	Hawch El Mandara	حوش المنذرة	690
Bekaa	ZAHLE	Hawch El Omara	حوش الأمراء	690
Bekaa	ZAHLE	Hawch El Sayadine	حوش الصيادين	690
Bekaa	ZAHLE	Hawch Al Zraana	حوش الزراعة	690
Bekaa	ZAHLE	Hmoul	حمول	690
Bekaa	ZAHLE	Hochmoch	حشمش	690
Bekaa	ZAHLE	Houch El-Ghanam	حوش الغنم	606
Bekaa	ZAHLE	Houch Hala	حوش حالا	690
Bekaa	ZAHLE	Jdita	جديتا	690
Bekaa	ZAHLE	Jenta	جنتا	690
Bekaa	ZAHLE	Jlala	جلالا	690
Bekaa	ZAHLE	Kaisar	كيسر	690
Bekaa	ZAHLE	Karak Nouh	كرك نوح	690
Bekaa	ZAHLE	Kfar Zabad	كفرزبد	690
Bekaa	ZAHLE	Kherbet Wadi Salem	خربة وادي سالم	690
Bekaa	ZAHLE	Ksara	الكسارة	690
Bekaa	ZAHLE	Majdel Anjar	مجدل عنجر	535
Bekaa	ZAHLE	Marj Ali	مرج علي	690
Bekaa	ZAHLE	Massa	ماسا	690
Bekaa	ZAHLE	Meksi	مكسه	690
Bekaa	ZAHLE	Moghr El Habis	مغر الحبيس	690
Bekaa	ZAHLE	Mreijat	مريجات	690
Bekaa	ZAHLE	Nabaa Chamsin	نبع شمسين	690
Bekaa	ZAHLE	Nabaa El Berdawni	نبع البردوني	690
Bekaa	ZAHLE	Nabaa El Faour	نبع الفاعور	690
Bekaa	ZAHLE	Nabi Aazair	نبي عزير	690
Bekaa	ZAHLE	Nabi Aila	نبي ايلا	690
Bekaa	ZAHLE	Nasriye	الناصرية	690
Bekaa	ZAHLE	Niha	نيحا	690
Bekaa	ZAHLE	Qarqoud	قرقود	690
Bekaa	ZAHLE	Qousaya	قوسايا	690
Bekaa	ZAHLE	Ouadi ed Deloum	وادي الدلم	690
Bekaa	ZAHLE	Ouadi el Aarayech	وادي العرايش	690
Bekaa	ZAHLE	Qaa er Rim	قاع الريم	1,225
Bekaa	ZAHLE	Qabb Elias	قب الياس	690
Bekaa	ZAHLE	Qommal	قمال	690
Bekaa	ZAHLE	Raite	رعيت	690
Bekaa	ZAHLE	Ramtaniyeh	رمتانية	1,000
Bekaa	ZAHLE	Ras El Ain	راس العين	690
Bekaa	ZAHLE	Rayak	رياق	690

RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Bekaa	ZAHLE	Saadnayel	سعدنايل	690
Bekaa	ZAHLE	Sahem El Tawbeh	سهم التوبة	690
Bekaa	ZAHLE	Siret El Khnezir	سيرة الخنازير	690
Bekaa	ZAHLE	Taallabaya	تعلّبايا	690
Bekaa	ZAHLE	Taanayel	تعنايل	690
Bekaa	ZAHLE	Tall Al Aamara	تلّ العمارة	690
Bekaa	ZAHLE	Tall el Akhdar	تلّ الأخضر	690
Bekaa	ZAHLE	Tall El Hjara	تلّ الحجارة	690
Bekaa	ZAHLE	Tall El Sarhoum	تلّ السرحُون	690
Bekaa	ZAHLE	Tallet Ayoub	تلة أيوب	690
Bekaa	ZAHLE	Terbol	تربّل	690
Bekaa	ZAHLE	Touaite	تُويته	690
Bekaa	ZAHLE	Zahle	زحلة	690
Bekaa	ZAHLE	Zebdol	زبدل	690
Mount Lebanon	ALEY	Aabey	عَبيه	960
Mount Lebanon	ALEY	Aamrousiyeh	عمّروسية	850
Mount Lebanon	ALEY	Aaramoun	عرمون	850
Mount Lebanon	ALEY	Aazzouniye	عزّونية	1185
Mount Lebanon	ALEY	Ain Anoub	عين عنّوب	850
Mount Lebanon	ALEY	Ain Dara	عين دارة	1100
Mount Lebanon	ALEY	Ain Drafil	عين ذرافيل	850
Mount Lebanon	ALEY	Ain El Biyada	عين البيّاضة	1100
Mount Lebanon	ALEY	Ain El Jawzeh	عين الجوزة	945
Mount Lebanon	ALEY	Ain El Jdide	عين الجديدة	1065
Mount Lebanon	ALEY	Ain el Fraidis	عين الفريديس	1100
Mount Lebanon	ALEY	Ain el Halzoun	عين الحلزون	1000
Mount Lebanon	ALEY	Ain El Hawl	عين الحوْر	1015
Mount Lebanon	ALEY	Ain El Lawzeh	عين اللوزة	1100
Mount Lebanon	ALEY	Ain El Marj	عين المرج	1100
Mount Lebanon	ALEY	Ain El Remmane	عين الرمّانة	1065
Mount Lebanon	ALEY	Ain El Saydeh	عين السيدة	1000
Mount Lebanon	ALEY	Ain Hammana	عين حمّانة	1010
Mount Lebanon	ALEY	Ain Hjay	عين حجاي	870
Mount Lebanon	ALEY	Ain Jouaiq	عين جويّق	922
Mount Lebanon	ALEY	Ain Ksour	عين قُسُور	955
Mount Lebanon	ALEY	Ain Mirei	عين مرعي	900
Mount Lebanon	ALEY	Ain Trez	عين ترز	925
Mount Lebanon	ALEY	Ainab	عينَاب	965
Mount Lebanon	ALEY	Aitat	عيتات	915
Mount Lebanon	ALEY	Aley	عاليه	1050
Mount Lebanon	ALEY	Baaouerta	بعورته	870
Mount Lebanon	ALEY	Baissour	بيصور	975
Mount Lebanon	ALEY	Bchamoun	بشامون	850
Mount Lebanon	ALEY	Bdedoun	بدادون	850
Mount Lebanon	ALEY	Bedghane	بدغان	1100
Mount Lebanon	ALEY	Bhamdoun	بحمدون الضيعة	1170
Mount Lebanon	ALEY	Bhamdoun El Dayaa	بحمدون الضيعة	1175
Mount Lebanon	ALEY	Bhouara	بحوارة	935
Mount Lebanon	ALEY	Bihat	بيحات	850
Mount Lebanon	ALEY	Bkhechtay	بخشتاي	1050
Mount Lebanon	ALEY	Blaibel	بليبل	850
Mount Lebanon	ALEY	Bmahray	بمهراي	1100
Mount Lebanon	ALEY	Bmekkine	بمكين	950
Mount Lebanon	ALEY	Bnaiye	البنيه	985
Mount Lebanon	ALEY	Bou Zraide	بوزريده	850
Mount Lebanon	ALEY	Boudin	بودين	850

Mount Lebanon	ALEY	Bserrine	بسرّين	1025
Mount Lebanon	ALEY	Bsounnay	بصنايه	1175
Mount Lebanon	ALEY	Bsous	بسوس	850
Mount Lebanon	ALEY	Btalloun	بطلّون	1165
Mount Lebanon	ALEY	Btater	بتاتر	1125
Mount Lebanon	ALEY	Bwar El Din	بوار الدين	850
Mount Lebanon	ALEY	Chammis	شميس	900
Mount Lebanon	ALEY	Chanay	شانيه	1150
Mount Lebanon	ALEY	Charoun	شارُون	1140
Mount Lebanon	ALEY	Chartoun	شرتُون	850
Mount Lebanon	ALEY	Chatra	شطرة	975
Mount Lebanon	ALEY	Chawyet Ain El Krayem	شاوية عين الكريم	1050
Mount Lebanon	ALEY	Chemlane	شملان	900
Mount Lebanon	ALEY	Chouifete	شويفات	850
Mount Lebanon	ALEY	Daher Ain El Hajal	ضهر عين الحجل	1100
Mount Lebanon	ALEY	Daher El Wahch	ضهر الوحش	850
Mount Lebanon	ALEY	Daqqoun	دقُون	862
Mount Lebanon	ALEY	Dawhet Aaramoun	دوحة عرمون	850
Mount Lebanon	ALEY	Deir Mar Youhanna (Rechmaya)	دير مار يُوحنّا	925
Mount Lebanon	ALEY	Deir Saydet El Maouna (Aaibay)	دير سيدة المعونات(عيبه)	975
Mount Lebanon	ALEY	Deir Saydet El Maounat (Chimlan)	دير سيدة المعونات	900
Mount Lebanon	ALEY	Deir Sir (Deir Mar Antonios)	دير سير (دير مار انطونيوس)	1057
Mount Lebanon	ALEY	Deir Qoubil	دير قوبل	850
Mount Lebanon	ALEY	Dfoun	دفُون	940
Mount Lebanon	ALEY	Dhour El Aabediye	ضهور العابدية	1120
Mount Lebanon	ALEY	Doueir er Remmane	دُوير الرمّان	925
Mount Lebanon	ALEY	El Aadaiseh	العديسة	1100
Mount Lebanon	ALEY	El Blata	البلاطة	850
Mount Lebanon	ALEY	El Bsatine	البساتين	900
Mount Lebanon	ALEY	El Bwait	البويت	850
Mount Lebanon	ALEY	El Dqarine	الدكارين	975
Mount Lebanon	ALEY	El Kharaib	الخرايب	1050
Mount Lebanon	ALEY	El Khraibi	الخريبة	900
Mount Lebanon	ALEY	El Maaysir	المعيصر	1175
Mount Lebanon	ALEY	El Machrah	المشرح	1050
Mount Lebanon	ALEY	El Mansoura	المنصورة	892
Mount Lebanon	ALEY	El Marj	المرج	935
Mount Lebanon	ALEY	El Nasraniye	النصرانية	850
Mount Lebanon	ALEY	El Rwaisat	الرويسات	862
Mount Lebanon	ALEY	El Qalaa	القلعة	850
Mount Lebanon	ALEY	El Wata	الوطى	1085
Mount Lebanon	ALEY	Flajjine	فلّجين	1000
Mount Lebanon	ALEY	Fsaqine	فساقين	890
Mount Lebanon	ALEY	Ghaboun	غابون	950
Mount Lebanon	ALEY	Habramoun	حبرامون	900
Mount Lebanon	ALEY	Hanan	حنان	1090
Mount Lebanon	ALEY	Haret el Mir	حارة المير	925
Mount Lebanon	ALEY	Haret Salem	حارة سالم	850
Mount Lebanon	ALEY	Harit Hamzeh	حارة حمزة	875
Mount Lebanon	ALEY	Homset Hama	حمصة حما	920
Mount Lebanon	ALEY	Houmal	حومال	850
Mount Lebanon	ALEY	Ighmid	إغميد	1160
Mount Lebanon	ALEY	Jal El Baher	جل البحر	850
Mount Lebanon	ALEY	Jisr el Qadi	جسر القاضي	850
Mount Lebanon	ALEY	Jourit El Ballout	جورة البلّوط	850
Mount Lebanon	ALEY	Kahale	الكحاله	875
Mount Lebanon	ALEY	Kaifoun	كيفُون	1000

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Mount Lebanon	ALEY	Khaldeh	خلده	850
Mount Lebanon	ALEY	Khalwat Rwaisi	خلوات الرويسة	850
Mount Lebanon	ALEY	Khalwet Aainab	خلوة عينات	1025
Mount Lebanon	ALEY	Khalwet El Mouwnseh	خلوة المونسة	905
Mount Lebanon	ALEY	Kfar Aamaiy	كفر عميه	1050
Mount Lebanon	ALEY	Kfar Matta	كفرمتى	1045
Mount Lebanon	ALEY	Klailiye	خليليه	850
Mount Lebanon	ALEY	Maaisanoun	معيسنون	950
Mount Lebanon	ALEY	Maasraiti	معصريتي	850
Mount Lebanon	ALEY	Machqiti	مشقيتي	1100
Mount Lebanon	ALEY	Majdalaya	مجدلايا	850
Mount Lebanon	ALEY	Majdel Baana	مجدل بعنا	1125
Mount Lebanon	ALEY	Mansouriye	منصورية	1145
Mount Lebanon	ALEY	Mar Elias	مار الياس	850
Mount Lebanon	ALEY	Matar	مطار	850
Mount Lebanon	ALEY	Mazraat en Nahr	مزرعة النهر	865
Mount Lebanon	ALEY	Mdairej	المدارج	1100
Mount Lebanon	ALEY	Mechrefe	المشرفة	1085
Mount Lebanon	ALEY	Mejdel Baana	مجدلبعنا	1130
Mount Lebanon	ALEY	Mhattet Bhamdoun	محدون المحطه	1125
Mount Lebanon	ALEY	Midan El Zir	ميدان الزير	850
Mount Lebanon	ALEY	Mighwaya	مغوايا	975
Mount Lebanon	ALEY	Mreijat	مزيجات	1110
Mount Lebanon	ALEY	Nabaa es Safa	نبع الصفا	850
Mount Lebanon	ALEY	Nabaa Majed	نبع ماجد	1100
Mount Lebanon	ALEY	Qabr Chamoun	قبر شمون	975
Mount Lebanon	ALEY	Qmatiye	قماطية	900
Mount Lebanon	ALEY	Qoubrous	قبرص	850
Mount Lebanon	ALEY	Ramliye	رملية	875
Mount Lebanon	ALEY	Ramtoun	رمطون	1025
Mount Lebanon	ALEY	Ras Aarram	راس عرام	1050
Mount Lebanon	ALEY	Ras El Aaqabeh	راس العقبة	850
Mount Lebanon	ALEY	Ras Mana	راس مانا	850
Mount Lebanon	ALEY	Rechmaiya	رشميا	915
Mount Lebanon	ALEY	Rejme	الرجمة	1000
Mount Lebanon	ALEY	Remhala	رمحالا	850
Mount Lebanon	ALEY	Rjoum	رجوم	865
Mount Lebanon	ALEY	Rmaile	الرميلة	920
Mount Lebanon	ALEY	Rouissat Sofar	رويسات صوفر	1195
Mount Lebanon	ALEY	Rouisset en Naamane	رويسة النعمان	1119
Mount Lebanon	ALEY	Rwaisat Abd El Malek	رويسات عبد الملك	850
Mount Lebanon	ALEY	Sarahmoul	سرحمول	850
Mount Lebanon	ALEY	Sibaal	سبعل	1110
Mount Lebanon	ALEY	Silfaya	سلفايا	850
Mount Lebanon	ALEY	Sofar	صوفر	1100
Mount Lebanon	ALEY	Souq el Gharb	سوق الغرب	980
Mount Lebanon	ALEY	Taazniye	تعزانية	1050
Mount Lebanon	ALEY	Tardala	طردلا	925
Mount Lebanon	ALEY	Twaiteh	تويتيه	1100
Mount Lebanon	ALEY	Wadi Bidghan	وادي بدغان	1050
Mount Lebanon	ALEY	Wata Charone	وطى شارون	1075
Mount Lebanon	BAABDA	Aabadiye	العبادية	990
Mount Lebanon	BAABDA	Aarbaniye	العربانية	920
Mount Lebanon	BAABDA	Aasfouriye	العصفورية	850
Mount Lebanon	BAABDA	Ain Abou Qatmeh	عين ابو قطمة	1105
Mount Lebanon	BAABDA	Ain Blit	عين بليط	1100
Mount Lebanon	BAABDA	Ain El Delbeh	عين الدلبة	860
Mount Lebanon	BAABDA	Ain El Sohah	عين الصحة	1100
Mount Lebanon	BAABDA	Ain er Roummane	عين الرمانة	850
Mount Lebanon	BAABDA	Ain Hamadeh	عين حماده	930
Mount Lebanon	BAABDA	Ain Mouaffaq	عين موفق	965
Mount Lebanon	BAABDA	Arayia	عاريا	860
Mount Lebanon	BAABDA	Arsoun	أرصون	990
Mount Lebanon	BAABDA	Baabda	بعبدا	850
Mount Lebanon	BAABDA	Baalchmay	بعلشميه	1125
Mount Lebanon	BAABDA	Bhala	بحالا	1175
Mount Lebanon	BAABDA	Bir Hassan	بير حسن	850
Mount Lebanon	BAABDA	Bmariam	بمريم	1015
Mount Lebanon	BAABDA	Bogle	بقلة	912
Mount Lebanon	BAABDA	Borj el Brajne	برج البراجنة	850
Mount Lebanon	BAABDA	Boutchai	بطشاي(سابقاً مراح توما)	850
Mount Lebanon	BAABDA	Bsalba	بسابا	850
Mount Lebanon	BAABDA	Btaaline	بتعلين	1050
Mount Lebanon	BAABDA	Btebyat	بتبيات	980
Mount Lebanon	BAABDA	Btekhnay	بتخنيه	1100
Mount Lebanon	BAABDA	Bzebdine	بزبدين	1060
Mount Lebanon	BAABDA	Chamiseh	الشميسة	875
Mount Lebanon	BAABDA	Chbaniye	الشبانية	1030
Mount Lebanon	BAABDA	Chiayah	الشياح	850
Mount Lebanon	BAABDA	Chouit	شويت	925
Mount Lebanon	BAABDA	Dar Sayya	دار صيا	895
Mount Lebanon	BAABDA	Dahr el Baydar	ضهر البيدر	1100
Mount Lebanon	BAABDA	Daichouniye	ديشونية	850
Mount Lebanon	BAABDA	Deir el Harf	دير الحرف	1120
Mount Lebanon	BAABDA	Deir El Qarqafeh	دير القرقفة	850
Mount Lebanon	BAABDA	Deir Khouna	دير خونا	875
Mount Lebanon	BAABDA	Deir Mar Afram El Raghm	دير مار افرام الزعم	987
Mount Lebanon	BAABDA	Deir Mar Elias - El Kahlouniye	دير مار الياس(الكحلونية)	1005
Mount Lebanon	BAABDA	Deir Mar Youhanna-Qobbai	دير مار يوحنا(القبي)	900
Mount Lebanon	BAABDA	Dlaibe	الدلبة	900
Mount Lebanon	BAABDA	Faiyadiye	الفياضية	850
Mount Lebanon	BAABDA	Falougha	فالوغا	1100
Mount Lebanon	BAABDA	Forn El Chebak	فرن الشباك	850
Mount Lebanon	BAABDA	Ghabet El Chbaniyeh	غابة الشبانية	1125
Mount Lebanon	BAABDA	Ghbaire	الغبيري	850
Mount Lebanon	BAABDA	Haqel Hassan	حقل حسن	900
Mount Lebanon	BAABDA	Haqel Safi	حقل صافي	1100
Mount Lebanon	BAABDA	Hadet	الحدث	850
Mount Lebanon	BAABDA	Hammana	حمانا	1150
Mount Lebanon	BAABDA	Haret el Botom	حارة البطم	850
Mount Lebanon	BAABDA	Haret El Tahta	حارة التحتا	1100
Mount Lebanon	BAABDA	Haret es Saft	حارة الست	850
Mount Lebanon	BAABDA	Haret Hamze	حارة حمزة	920
Mount Lebanon	BAABDA	Haret Hraik	حارة حريك	850
Mount Lebanon	BAABDA	Hasbaiya el Metn	حاصبيا المتن	975
Mount Lebanon	BAABDA	Hay El Byader	حي البيادر	1100
Mount Lebanon	BAABDA	Hazmiye	الحازمية	850
Mount Lebanon	BAABDA	Hlaliye	الهلالية	875
Mount Lebanon	BAABDA	Jabal El Knayseh	جبل الكنيسة	1100
Mount Lebanon	BAABDA	Jamhour	الجمهور	850
Mount Lebanon	BAABDA	Jouar el Haouz	جوار الحوز	1100
Mount Lebanon	BAABDA	Jouret Arsoun	جورة أرصون	1065
Mount Lebanon	BAABDA	Jouret El Darb	جورة الدرب	1100

RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Mount Lebanon	BAABDA	Kahlouniye	الكحلونية	1005
Mount Lebanon	BAABDA	Kfar Selouane	كفر سلوان	1100
Mount Lebanon	BAABDA	Kfarchima	كفر شيما	850
Mount Lebanon	BAABDA	Khallouiye	خلوية	1020
Mount Lebanon	BAABDA	Khalwat	الخلوات	925
Mount Lebanon	BAABDA	Khalwat Falougha	خلوات فالوغا	1150
Mount Lebanon	BAABDA	Khraibe	الخريبة	1055
Mount Lebanon	BAABDA	Knisse	الكنيسة	925
Mount Lebanon	BAABDA	Lailake	الليلكة	850
Mount Lebanon	BAABDA	Louaize	اللويزة	1025
Mount Lebanon	BAABDA	Maadan	معدن	950
Mount Lebanon	BAABDA	Maaden	معادن	1025
Mount Lebanon	BAABDA	Mar Taqla	مار تقلا	850
Mount Lebanon	BAABDA	Mazraat Ayoub	مزرعة أيوب	850
Mount Lebanon	BAABDA	Mazraat El Maaysrah	مزرعة المعيصرة	935
Mount Lebanon	BAABDA	Merdache	المرداشة	850
Mount Lebanon	BAABDA	Mghaitheh	مغيثة	1100
Mount Lebanon	BAABDA	Mhata	المحطة	850
Mount Lebanon	BAABDA	Mouwasi	مواسي	950
Mount Lebanon	BAABDA	Mraije	المزيجة	850
Mount Lebanon	BAABDA	Nabea El Chaghour	نبع الشاغور	1100
Mount Lebanon	BAABDA	Ouadi Chahrour	وادي شحرور	850
Mount Lebanon	BAABDA	Ouadi Dlab	وادي الدلاب	850
Mount Lebanon	BAABDA	Ouzai	الأوزاعي	850
Mount Lebanon	BAABDA	Qalaa	القلعة	1125
Mount Lebanon	BAABDA	Qanater Zbaydeh	قناطر زبيدة	850
Mount Lebanon	BAABDA	Qirtada	قرطاضة	900
Mount Lebanon	BAABDA	Qornayel	قرنايل	1180
Mount Lebanon	BAABDA	Qoubbeiaa	قبيع	1090
Mount Lebanon	BAABDA	Qraiye	القرية	1100
Mount Lebanon	BAABDA	Qsaibe	القصيبة	890
Mount Lebanon	BAABDA	Qtale	قطالة	895
Mount Lebanon	BAABDA	Ras el Harf	راس الحرف	1000
Mount Lebanon	BAABDA	Ras el Metn	راس المتن	1070
Mount Lebanon	BAABDA	Rouisset el Ballout	رويسة البلوط	935
Mount Lebanon	BAABDA	Rwaysat El Marj	رويسات المرج	1035
Mount Lebanon	BAABDA	Rwaysat Qobbai	رويسات قبيع	1100
Mount Lebanon	BAABDA	Rwaysat Salima	رويسات سليما	1017
Mount Lebanon	BAABDA	Salima	سليما	1025
Mount Lebanon	BAABDA	Sibnay	سبنيه	850
Mount Lebanon	BAABDA	Tahouitet el Ghadir	تحوطة الغدير	850
Mount Lebanon	BAABDA	TAhouitet en Naher	تحوطة النهر	850
Mount Lebanon	BAABDA	Taltita	تل تيته	900
Mount Lebanon	BAABDA	Tarchich	ترشيش	1100
Mount Lebanon	BAABDA	Tayouneh	الطيونة	850
Mount Lebanon	BAABDA	Yarzeh	اليرزة	850
Mount Lebanon	BAABDA	Zandouqa	زندوقة	875
Mount Lebanon	BAABDA	Zhaimeh	الزهيمة	850
Mount Lebanon	BAABDA	Zire	الزيرة	850
Mount Lebanon	CHOUF	Aammatour	عماطور	1110
Mount Lebanon	CHOUF	Aammiq	عمّيق	865
Mount Lebanon	CHOUF	Aanout	عانوت	970
Mount Lebanon	CHOUF	Aaqlayn	عاقلين	850
Mount Lebanon	CHOUF	Aatrine	عترين	990
Mount Lebanon	CHOUF	Ain Bal	عين بال	1030
Mount Lebanon	CHOUF	Ain Bou Khattar	عين بو خطّار	900
Mount Lebanon	CHOUF	Ain El Assad	عين الأسد	850
Mount Lebanon	CHOUF	Ain el Haaour	عين الحور	915
Mount Lebanon	CHOUF	Ain El Saadeh	عين السعادة	850
Mount Lebanon	CHOUF	Ain Ghazi	عين غازي	900
Mount Lebanon	CHOUF	Ain Qeni	عين قني	1015
Mount Lebanon	CHOUF	Ain Wouzain	عين وزين	1100
Mount Lebanon	CHOUF	Ain Zhalta	عين زحلتا	1145
Mount Lebanon	CHOUF	Arez Ain Zhalta	أرز عين زحلتا	1100
Mount Lebanon	CHOUF	Arez El Barouq	أرز البارووك	1100
Mount Lebanon	CHOUF	Arez Maaser El Chouf	أرز معاصر الشوف	1100
Mount Lebanon	CHOUF	Almane ed Daiaa	عَلمان	850
Mount Lebanon	CHOUF	Baadarane	بعذران	1125
Mount Lebanon	CHOUF	Baal en Naame	بعل الناعمة	850
Mount Lebanon	CHOUF	Baaqline	بعقلين	1030
Mount Lebanon	CHOUF	Baasir	بعاصير	850
Mount Lebanon	CHOUF	Baidar El Mir	بيدر المير	850
Mount Lebanon	CHOUF	Baidar El Ramel	بيدر الرمل	850
Mount Lebanon	CHOUF	Baiqoun	بيقون	1030
Mount Lebanon	CHOUF	Baqaoun et Bakhaoun	بقعون	850
Mount Lebanon	CHOUF	Barja	برجا	850
Mount Lebanon	CHOUF	Barouk	البارّوك	1155
Mount Lebanon	CHOUF	Bater	باتر	1010
Mount Lebanon	CHOUF	Batloun	بتلون	1140
Mount Lebanon	CHOUF	Battal	بتال	850
Mount Lebanon	CHOUF	Bchatfine	بشتفين	850
Mount Lebanon	CHOUF	Beit ed Dine	بيت الدين	1030
Mount Lebanon	CHOUF	Benoeti	بنويتي	850
Mount Lebanon	CHOUF	Bire	البيره	1060
Mount Lebanon	CHOUF	Biqaata	بقعاتا	1025
Mount Lebanon	CHOUF	Bkechtine	بكشتين	915
Mount Lebanon	CHOUF	Bkifa	بكيفا	880
Mount Lebanon	CHOUF	Bkirzay	بكرزيه	900
Mount Lebanon	CHOUF	Bnemre	بنمره	850
Mount Lebanon	CHOUF	boqseh	بقسه	850
Mount Lebanon	CHOUF	Borjein	البرجين	850
Mount Lebanon	CHOUF	Boutme	بطمة	1060
Mount Lebanon	CHOUF	Brih	بريح	1000
Mount Lebanon	CHOUF	Bsaba	بسابا	1025
Mount Lebanon	CHOUF	Bsonay	بصنايه	1000
Mount Lebanon	CHOUF	Cheikh Mohammad Al Dimas	الشيخ محمد الديماس	850
Mount Lebanon	CHOUF	Chhime	شحيم	880
Mount Lebanon	CHOUF	Chmaarine	شمعرين	850
Mount Lebanon	CHOUF	Chmis	الشميس	850
Mount Lebanon	CHOUF	Chouit	شويت	850
Mount Lebanon	CHOUF	Chourit	شوريت	915
Mount Lebanon	CHOUF	Dabheh	دبشة	975
Mount Lebanon	CHOUF	Daher Aaqlayn	ضهر عاقلين	850
Mount Lebanon	CHOUF	Daher El Jabal	ضهر الجبل	850
Mount Lebanon	CHOUF	Dahr el Mghara	ضهر المغارة	850
Mount Lebanon	CHOUF	Dalhamiye	دلهمية	850
Mount Lebanon	CHOUF	Dalhoun	دلهون	850
Mount Lebanon	CHOUF	Damour	الدامور	850
Mount Lebanon	CHOUF	Daraiya	دارتيا	850
Mount Lebanon	CHOUF	Daraiya	دارتيا	970
Mount Lebanon	CHOUF	Deir Baba	دير بابا	850
Mount Lebanon	CHOUF	Deir Dourite	دير دوريت	900
Mount Lebanon	CHOUF	Deir El Mkhales	دير المخلص	850

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Mount Lebanon	CHOUF	Deir el Qamar	دير القمر	995
Mount Lebanon	CHOUF	Deir El Rahbat	دير الراهبات	850
Mount Lebanon	CHOUF	Deir El Saydeh	دير السيدة	850
Mount Lebanon	CHOUF	Deir Koucheh	دير كوشه	850
Mount Lebanon	CHOUF	Deir Mar Aabda (Deir El Qamar)	دير مار عبدا (دير القمر)	1099
Mount Lebanon	CHOUF	Deir Mar Jerjes (EL Ne'meh)	دير مار جرجس (الناعمة)	850
Mount Lebanon	CHOUF	Deir Mar Maroun (Ber Snain)	دير مار مارون (بر سنين)	945
Mount Lebanon	CHOUF	Dibbiye	الديبية	850
Mount Lebanon	CHOUF	Dmit	دميت	850
Mount Lebanon	CHOUF	El Aatiqa	العتيقة	850
Mount Lebanon	CHOUF	El Bachqiyeh	الباشقية	850
Mount Lebanon	CHOUF	El Battal	البطال	850
Mount Lebanon	CHOUF	El Bissayl	البصايل	1025
Mount Lebanon	CHOUF	El Biyadeh	البياضة	1050
Mount Lebanon	CHOUF	El Bqayaa	البقيعة	850
Mount Lebanon	CHOUF	El Charbine	الشربين	940
Mount Lebanon	CHOUF	El Chwaliq	الشوالق	865
Mount Lebanon	CHOUF	El Daher	الضهر	935
Mount Lebanon	CHOUF	El Dweir	الدوير	850
Mount Lebanon	CHOUF	El Fathat	الفاتحات	850
Mount Lebanon	CHOUF	El Fatha	الفاتحة	850
Mount Lebanon	CHOUF	El Fawara	الفوارة	935
Mount Lebanon	CHOUF	El Fistqaniyeh	الفستقانية	850
Mount Lebanon	CHOUF	El Fkhayteh	الفخيتة	850
Mount Lebanon	CHOUF	El Foukhara	الفخارة	975
Mount Lebanon	CHOUF	El Hara	الحارة	850
Mount Lebanon	CHOUF	El Hardouch	الحرذوش	850
Mount Lebanon	CHOUF	El Hiara	الخيارة	975
Mount Lebanon	CHOUF	El Hirkan	الحركان	850
Mount Lebanon	CHOUF	El Hjajiyeh	الحجاجية	880
Mount Lebanon	CHOUF	El Jaayil	الجعايل	1130
Mount Lebanon	CHOUF	E Jrid	الجريد	1000
Mount Lebanon	CHOUF	El Khandaq	الخندق	850
Mount Lebanon	CHOUF	El Marj	المرج	850
Mount Lebanon	CHOUF	El Meghraiqa	المغريقة	850
Mount Lebanon	CHOUF	El Mermata	المرماطة	850
Mount Lebanon	CHOUF	El Mghayreh	المغيرة	850
Mount Lebanon	CHOUF	El Mourraneh	المرانة	850
Mount Lebanon	CHOUF	El Mtayriyat	المطيريات	850
Mount Lebanon	CHOUF	El Mtolleh	المطلة	1000
Mount Lebanon	CHOUF	El Nabi Ayoub	النبي أيوب	985
Mount Lebanon	CHOUF	El Nabi Youniss	النبي يونس	850
Mount Lebanon	CHOUF	El Qachya	القاشيا	1050
Mount Lebanon	CHOUF	El Qate'	القاطع	850
Mount Lebanon	CHOUF	El Qate'	القاطع	850
Mount Lebanon	CHOUF	El Qrayaa	القريعة	875
Mount Lebanon	CHOUF	El Qrayeh	القريعة	1025
Mount Lebanon	CHOUF	El Rimmaneh	الرمانة	850
Mount Lebanon	CHOUF	E Rizzeniyeh	الرزانية	850
Mount Lebanon	CHOUF	El khyam	الخيام	850
Mount Lebanon	CHOUF	El Sarouniye	السرغونية	850
Mount Lebanon	CHOUF	El Siyyar	السيار	850
Mount Lebanon	CHOUF	El Zaarour	الزعرور	850
Mount Lebanon	CHOUF	El Zaitouniyeh	الزيتونية	912
Mount Lebanon	CHOUF	Fraidiss	الفريديس	1150
Mount Lebanon	CHOUF	Ghabit Jaafar	غابة جعفر	915
Mount Lebanon	CHOUF	Gharife	غريفة	940
Mount Lebanon	CHOUF	Hbaichiyeh	حبيشية	850
Mount Lebanon	CHOUF	Halyouneh	هليونة	850
Mount Lebanon	CHOUF	Haret Baasir	حارة بعاصير	850
Mount Lebanon	CHOUF	Haret El Aaqabe	حارة العقبة	850
Mount Lebanon	CHOUF	Haret EL Naame	حارة الناعمة	850
Mount Lebanon	CHOUF	Haret Jandal	حارة جندل	1000
Mount Lebanon	CHOUF	Hasrout	حصروت	980
Mount Lebanon	CHOUF	Iskandarouna	اسكندرونة	850
Mount Lebanon	CHOUF	Jabal El Barouq	جبل البارُوك	1100
Mount Lebanon	CHOUF	Jadra	جدرا	850
Mount Lebanon	CHOUF	Jahliye	الجاهلية	850
Mount Lebanon	CHOUF	Jamailiye	الجميلية	850
Mount Lebanon	CHOUF	Jbaa	جباع	1165
Mount Lebanon	CHOUF	Jdaide	الجديدة	1000
Mount Lebanon	CHOUF	Jiblay	جبليه	1050
Mount Lebanon	CHOUF	Jiye	الجية	850
Mount Lebanon	CHOUF	Jlailiye	الجليلية	935
Mount Lebanon	CHOUF	Job Ghebra	جب عبرة	850
Mount Lebanon	CHOUF	Joun	جون	850
Mount Lebanon	CHOUF	Kahlouniye	الكحلونية	1020
Mount Lebanon	CHOUF	Ketermaya	كترمايا	850
Mount Lebanon	CHOUF	Kfar Faqoud	كفرفاقود	855
Mount Lebanon	CHOUF	Kfar Hamal	كفر حمل	975
Mount Lebanon	CHOUF	Kfar Hay	كفر حي	855
Mount Lebanon	CHOUF	Kfar Him	كفر حيم	900
Mount Lebanon	CHOUF	Kfar Nabrakh	كفر نبرخ	1105
Mount Lebanon	CHOUF	Kfar Niss	كفر نيس	1065
Mount Lebanon	CHOUF	Kfar Qatra	كفر قطره	980
Mount Lebanon	CHOUF	Khalwat Bou Ezz El Din	خلوات بو عز الدين	950
Mount Lebanon	CHOUF	Khalwat Jimaya	خلوات جرنايا	975
Mount Lebanon	CHOUF	Khalwet el Kataleb	خلوة القطايب	1035
Mount Lebanon	CHOUF	Khirbit Bisri	خربة بسري	850
Mount Lebanon	CHOUF	Khraibe	الخربية	1120
Mount Lebanon	CHOUF	Klayli	كليلي	850
Mount Lebanon	CHOUF	Knisse	الكنيسة	860
Mount Lebanon	CHOUF	Lahbiye	الاهبية	850
Mount Lebanon	CHOUF	Maaniye	المعنية	850
Mount Lebanon	CHOUF	Maaser Beit ed Dine	معاصر بيت الدين	1030
Mount Lebanon	CHOUF	Maasser ech Chouf	معاصر الشوف	1175
Mount Lebanon	CHOUF	Majdalouna	مجدلونا	850
Mount Lebanon	CHOUF	Majdel el Meouch	مجدل المعوش	1010
Mount Lebanon	CHOUF	Maqsabe	المقصبة	850
Mount Lebanon	CHOUF	Mar Mkhayel Bnabil	مار مخايل	850
Mount Lebanon	CHOUF	Marjiiat	المرجيات	850
Mount Lebanon	CHOUF	Mazboud	مزبود	850
Mount Lebanon	CHOUF	Mazmoura	مزمورة	895
Mount Lebanon	CHOUF	Mazraat El Barghoutiyeh	مزرعة البرغوتية	850
Mount Lebanon	CHOUF	Mazraat El Chouf	مزرعة الشوف	1070
Mount Lebanon	CHOUF	Mazraat El Dahr	مزرعة الضهر	925
Mount Lebanon	CHOUF	Mazraat El Dwair	مزرعة الدوير	875
Mount Lebanon	CHOUF	Mazraat El Naher	مزرعة النهر	850
Mount Lebanon	CHOUF	Mechref	المشرف	850
Mount Lebanon	CHOUF	Mghairiye	المغيرية	850
Mount Lebanon	CHOUF	Mouhtoqra	مختقرة	850
Mount Lebanon	CHOUF	Moukhtara	المختارة	1025
Mount Lebanon	CHOUF	Mqifti	مقفتي	900

RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Mount Lebanon	CHOUF	Mtailleh	مطيلة	975
Mount Lebanon	CHOUF	Mristi	مرستي	1100
Mount Lebanon	CHOUF	Naame	الناعمة	850
Mount Lebanon	CHOUF	Nabaa El Barouq	نبع البارُوك	1150
Mount Lebanon	CHOUF	Nabaa El Kharroubeh	نبع الخرّوبة	850
Mount Lebanon	CHOUF	Nabaa El Safa	نبع الصفا	1125
Mount Lebanon	CHOUF	Niha	نيحا	1110
Mount Lebanon	CHOUF	Ouadi Bnahle	وادي بْنحلّيه	850
Mount Lebanon	CHOUF	Ouadi ed Deir	وادي الدير	850
Mount Lebanon	CHOUF	Ouadi es Sitt	وادي الست	900
Mount Lebanon	CHOUF	Ouarhaniye	الورهانية	1130
Mount Lebanon	CHOUF	Qassoube	قصُوبة	850
Mount Lebanon	CHOUF	Qatlit Issa	قتلة عيسى	850
Mount Lebanon	CHOUF	Quardaniye	الوردانية	850
Mount Lebanon	CHOUF	Raiboun	ريبون	965
Mount Lebanon	CHOUF	Ras El Nabi Youniss	راس النبي يُونس	850
Mount Lebanon	CHOUF	Rmaile (er)	الرميلة	850
Mount Lebanon	CHOUF	Saadiyat	السعديات	850
Mount Lebanon	CHOUF	Sabouniyeh	صابُونية	850
Mount Lebanon	CHOUF	Safa	صفا	1062
Mount Lebanon	CHOUF	Samqaniye	السمقانية	1060
Mount Lebanon	CHOUF	Sibline	سبلين	850
Mount Lebanon	CHOUF	Sirjbal	سرجبال	850
Mount Lebanon	CHOUF	Souwaneh	صوّانة	850
Mount Lebanon	CHOUF	Wadi Abou Youssef	وادي أبو يُوسف	850
Mount Lebanon	CHOUF	Wadi Deir Dourit	وادي دير دُوريت	850
Mount Lebanon	CHOUF	Wadi El Zaineh	وادي الزينة	850
Mount Lebanon	CHOUF	Yarouteh	يارُوته	850
Mount Lebanon	CHOUF	Zaarouriye	الزعرُورية	935
Mount Lebanon	EL METN	Aairoun	عيرون	1070
Mount Lebanon	EL METN	Aamaret Chalhoub	عمارة شلهوب	850
Mount Lebanon	EL METN	Aatchane	العطشانة	950
Mount Lebanon	EL METN	Aawkar	عوكر	850
Mount Lebanon	EL METN	Abou Mizane	أبو ميزان	960
Mount Lebanon	EL METN	Ailout	عيلوت	850
Mount Lebanon	EL METN	Ain Aalaq	عين علّق	965
Mount Lebanon	EL METN	Ain Aar	عين عار	905
Mount Lebanon	EL METN	Ain El Hage Elias	عين الحاج الياس	1165
Mount Lebanon	EL METN	Ain El Kharroube	عين الخرّوبة	965
Mount Lebanon	EL METN	Ain El Lkch	عين اللقش	1065
Mount Lebanon	EL METN	Ain El Qabou	عين القبو	1165
Mount Lebanon	EL METN	Ain El Safsaf	عين الصفصاف	1125
Mount Lebanon	EL METN	Ain El Sindiane	عين السنديانة	1125
Mount Lebanon	EL METN	Ain El Toufaha	عين التفاحة	1165
Mount Lebanon	EL METN	Ain El Zaitouneh	عين الزيتونة	1175
Mount Lebanon	EL METN	Ain Najm	عين نجم	867
Mount Lebanon	EL METN	Ain Saade	عين السعادة	905
Mount Lebanon	EL METN	Aintoura	عينطوره	1100
Mount Lebanon	EL METN	Aiyoun	العيون	940
Mount Lebanon	EL METN	Baabdat	بعبدات	1025
Mount Lebanon	EL METN	Baaqrif	بعقريف	930
Mount Lebanon	EL METN	Balouaa	بالوع	1170
Mount Lebanon	EL METN	Baouchriye	البوشرية	850
Mount Lebanon	EL METN	Beqaateh El Naher	بقعاتة النهر	1175
Mount Lebanon	EL METN	Baskinta	بسكنتا	1100
Mount Lebanon	EL METN	Beit Aayal	بيت عيال	1090
Mount Lebanon	EL METN	Beit Chebab	بيت شباب	915
Mount Lebanon	EL METN	Beit Ech Chaar	بيت الشعار	850
Mount Lebanon	EL METN	Beit El Koukko	بيت الكوكو	895
Mount Lebanon	EL METN	Beit Meri	بيت مري	970
Mount Lebanon	EL METN	Belvo	بلفو	850
Mount Lebanon	EL METN	Bhanis	بحنس	1135
Mount Lebanon	EL METN	Bharsaf	بحرصاف	1080
Mount Lebanon	EL METN	Bherdoq	بحرذق	850
Mount Lebanon	EL METN	Biaqout	بياقوت	850
Mount Lebanon	EL METN	Bikfayia	بكفيا	1055
Mount Lebanon	EL METN	Bnabil	بنابيل	850
Mount Lebanon	EL METN	Bolonia	بولونيا	1100
Mount Lebanon	EL METN	Borj Hammoud	برج حمود	850
Mount Lebanon	EL METN	Bqallayaa	بقليع	1100
Mount Lebanon	EL METN	Bqennaya	بقنايا	850
Mount Lebanon	EL METN	Broumana	برمانا	990
Mount Lebanon	EL METN	Bsalim	بصاليم	850
Mount Lebanon	EL METN	Bsifrin	بسفرين	922
Mount Lebanon	EL METN	Bteghrine	بتغرين	1075
Mount Lebanon	EL METN	Chaouiye	شاوية	865
Mount Lebanon	EL METN	Chirchar	شرشار	1087
Mount Lebanon	EL METN	Chouaiya	شويا	1110
Mount Lebanon	EL METN	Choueir	الشوير	1100
Mount Lebanon	EL METN	Chrain	شرين	1065
Mount Lebanon	EL METN	Daher El Bacheq	ضهر الباشق	850
Mount Lebanon	EL METN	Daher El Housain	ضهر الحصين	850
Mount Lebanon	EL METN	Dahr El Souane	ضهر الصوّان	1060
Mount Lebanon	EL METN	Dbaiye	ضبية	850
Mount Lebanon	EL METN	Deir Chamra	دير شمرا	905
Mount Lebanon	EL METN	Deir El Qalaa	دير القلعة	965
Mount Lebanon	EL METN	Deir El Salib	دير الصليب	850
Mount Lebanon	EL METN	Deir Mar Aabda (EL Mchamar)	دير مار عبدا (المشمر)	850
Mount Lebanon	EL METN	Deir Mar Botros (Kraim El Tin)	دير مار بطرس (كريم التين)	965
Mount Lebanon	EL METN	Deir Mar Doumed	دير مار مضوسط	865
Mount Lebanon	EL METN	Deir Mar Elias (Chwaya)	دير مار الياس (شويا)	1125
Mount Lebanon	EL METN	Deir Mar Jerjes (Aawkar)	دير مار جرجس (عوكر)	850
Mount Lebanon	EL METN	Deir Mar Mansour	دير مار منصور	1115
Mount Lebanon	EL METN	Deir Mar Maroun (El Qnaitra)	دير مار مارون (القنيطرة)	925
Mount Lebanon	EL METN	Deir Mar Mikhail	دير مار ميخائيل (بحر صاف)	1030
Mount Lebanon	EL METN	Deir Mar Mkhayel (Bnabil)	دير مار مخايل (بنابيل)	1150
Mount Lebanon	EL METN	Deir Mar Roukos	دير مار روكز	850
Mount Lebanon	EL METN	Deir Mar Sasine (Baskenta)	دير مار ساسين(بسكنتا)	1100
Mount Lebanon	EL METN	Deir Mar Simaane	دير مار سمعان	1165
Mount Lebanon	EL METN	Deir Mar Simaane (Wadi El Karm)	دير مار سمعان (وادي الكرم)	1160
Mount Lebanon	EL METN	Deir Mar Youhanna (El Sabegh)	دير مار يحنا (الصابغ)	1065
Mount Lebanon	EL METN	Deir Mar Youssof (El Borj)	دير مار يوسف (البرج)	850
Mount Lebanon	EL METN	Deir Tamich	دير تميدة طاميش	850
Mount Lebanon	EL METN	Dekouane	دكوانة	850
Mount Lebanon	EL METN	Dhour Ech Choueir	ضهور الشوير	1100
Mount Lebanon	EL METN	Dik El Mehdi	ديك المحدي	850
Mount Lebanon	EL METN	Douar	الدوار	1175
Mount Lebanon	EL METN	El Aaraar	العرعار	1075
Mount Lebanon	EL METN	El Aammariya	العمارية	850
Mount Lebanon	EL METN	El Aaqabeh	العقبة	850
Mount Lebanon	EL METN	El Aayoun	العيون	945
Mount Lebanon	EL METN	El Borj	البرج	850
Mount Lebanon	EL METN	El Chakhroub	الشخروب	1100

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Mount Lebanon	EL METN	El Chammis	الشميس	850
Mount Lebanon	EL METN	El Chwair	الشوير	1137
Mount Lebanon	EL METN	El Chwyieh	الشاوية	860
Mount Lebanon	EL METN	El Dawra	الدورة	850
Mount Lebanon	EL METN	El Daychouniyeh	الديشونية	850
Mount Lebanon	EL METN	El Faida	الفيضة	1100
Mount Lebanon	EL METN	El Fardaws	الفردوس	850
Mount Lebanon	EL METN	El Ghawbat	الغوبات	850
Mount Lebanon	EL METN	El Ghazeleh	الغزالة	850
Mount Lebanon	EL METN	El Hadira	الحضيرة	850
Mount Lebanon	EL METN	El Jouweniyeh	الجوانية	850
Mount Lebanon	EL METN	El Khaleh	الخلة	1115
Mount Lebanon	EL METN	El Kheljan	الخلجان	850
Mount Lebanon	EL METN	El Manqaleh	المنقلة	850
Mount Lebanon	EL METN	El Moukhada	المخاضة	850
Mount Lebanon	EL METN	El Mountazah	المنتزه	850
Mount Lebanon	EL METN	El Mourrach	المرّاش	850
Mount Lebanon	EL METN	El Moukhada	المخاضة	850
Mount Lebanon	EL METN	El Mzakeh	المزكة	1000
Mount Lebanon	EL METN	El Naa's	النعص	1100
Mount Lebanon	EL METN	El Qalaa	القلعة	850
Mount Lebanon	EL METN	El Qalaa	القلعة	1125
Mount Lebanon	EL METN	El Qnaitra	القنيطرة	925
Mount Lebanon	EL METN	El Rabwa	الربوة	850
Mount Lebanon	EL METN	El Rabyieh	الرابية	850
Mount Lebanon	EL METN	El Raqayeq	الرقايق	1100
Mount Lebanon	EL METN	El Rfailiyeh	الرفيلية	855
Mount Lebanon	EL METN	El Rwaiseh	الرويسة	850
Mount Lebanon	EL METN	El Sabtiyeh	السبتية	850
Mount Lebanon	EL METN	El Tabche	الطبشة	1090
Mount Lebanon	EL METN	El Wata	الوطى	1025
Mount Lebanon	EL METN	El Zaaitriyeh	الزعيترية	850
Mount Lebanon	EL METN	El Zaarour	الزعرور	1100
Mount Lebanon	EL METN	Fanar	الفنار	850
Mount Lebanon	EL METN	Fawar Antillias	فوار انطلياس	850
Mount Lebanon	EL METN	Fraike	الفريكة	850
Mount Lebanon	EL METN	Ghabe	الغابة	1100
Mount Lebanon	EL METN	Hamlaya	حملايا	1000
Mount Lebanon	EL METN	Haret Chalhoub	حارة شلهوب	850
Mount Lebanon	EL METN	Haret el Bellane	حارة البلان	850
Mount Lebanon	EL METN	Haret El Cheikh	حارة الشيخ	850
Mount Lebanon	EL METN	Haret El Ghwarneh	حارة الغوارنة	850
Mount Lebanon	EL METN	Haret Wazen	حارة وازن	850
Mount Lebanon	EL METN	Hbous	الحبوس	850
Mount Lebanon	EL METN	Intilias	أنطلياس	850
Mount Lebanon	EL METN	Jabal Sannin	جبل صنين	1100
Mount Lebanon	EL METN	Jall Ed Dib	جلّ الذيب	850
Mount Lebanon	EL METN	Jall Hsain	جلّ حسين	850
Mount Lebanon	EL METN	Jdaide	الجديدة	850
Mount Lebanon	EL METN	Jisr El Bacha	جسر الباشا	850
Mount Lebanon	EL METN	Jouar	الجوار	1065
Mount Lebanon	EL METN	Jouret El Ballout	جورة البلوط	915
Mount Lebanon	EL METN	Kafra	كفرا	930
Mount Lebanon	EL METN	Kfar Aaqab	كفر عقاب	1160
Mount Lebanon	EL METN	Kfartay	كفرتاي	1135
Mount Lebanon	EL METN	Khenchara	خنشارة	1135

Mount Lebanon	EL METN	Kherbet El Aadas	خربة العدس	850
Mount Lebanon	EL METN	Machraa	المشرع	1100
Mount Lebanon	EL METN	Majdel Tarchich	مجدل ترشيش	1100
Mount Lebanon	EL METN	Majdoub	مجدوب	850
Mount Lebanon	EL METN	Mansouriye	منصورية	850
Mount Lebanon	EL METN	Mar Boutrous Karm Et Tine	مار بطرس كرم التين	965
Mount Lebanon	EL METN	Mar Chaaya	مار شعيا	1030
Mount Lebanon	EL METN	Mar Challita	مار شليطا	1100
Mount Lebanon	EL METN	Mar Mkhayel Bnabil	مار مخايل	1150
Mount Lebanon	EL METN	Mar Mousa Ed Daouar	مار موسى(الدوار)	1080
Mount Lebanon	EL METN	Mar Nohra	مار نهرا	850
Mount Lebanon	EL METN	Mar Youhana (Zikrit)	مار يوحنا (زكريت)	850
Mount Lebanon	EL METN	Marj Baskenta	مرج بسكنتا	1100
Mount Lebanon	EL METN	Marjaba	مرجا	1170
Mount Lebanon	EL METN	Masqa	المسقى	915
Mount Lebanon	EL METN	Mayasse	مياسة	930
Mount Lebanon	EL METN	Mazraat Bnabil	مزرعة بنابيل	1125
Mount Lebanon	EL METN	Mazraat Deir Aaoukar	مزرعة دير عوكر	850
Mount Lebanon	EL METN	Mazraat El Nakhle	مزرعة النخلة	1100
Mount Lebanon	EL METN	Mazraat Yachoua	مزرعة يشوع	910
Mount Lebanon	EL METN	Mcheikha	مشيخا	1050
Mount Lebanon	EL METN	Mhaydse	محيدثة	1075
Mount Lebanon	EL METN	Mizhir	مزهر	850
Mount Lebanon	EL METN	Mkalless	مكلس	850
Mount Lebanon	EL METN	Monteferdi	مونتفردي	850
Mount Lebanon	EL METN	Mrah Ghanem	مراح غانم	950
Mount Lebanon	EL METN	Mrouj	المرّوج	1100
Mount Lebanon	EL METN	Mtaileb	مطيلب	850
Mount Lebanon	EL METN	Mtein	المتين	1140
Mount Lebanon	EL METN	Nabaa El Jwaizat	نبع الجويزات	1100
Mount Lebanon	EL METN	Nabaa El Manboukh	نبع المنبوخ	1100
Mount Lebanon	EL METN	Nabaa Sanin	نبع صنين	1100
Mount Lebanon	EL METN	Nabay	نابيه	850
Mount Lebanon	EL METN	Naqqach	نقاش	850
Mount Lebanon	EL METN	Qsaibe	قصيبه	950
Mount Lebanon	EL METN	Ouadi Chahine	وادي شاهين	920
Mount Lebanon	EL METN	Ouadi El karm	وادي الكرم	1180
Mount Lebanon	EL METN	Ouata El Mrouj	وطى المرّوج	1100
Mount Lebanon	EL METN	Qaaqour	القعقور	1065
Mount Lebanon	EL METN	Qanabet Salima	قنابة سليما	930
Mount Lebanon	EL METN	Qanat Bakich	قناة باكيش	1100
Mount Lebanon	EL METN	Qennabet Broummana	قنابة برمانا	880
Mount Lebanon	EL METN	Qornet Chahouane	قرنة شهوان	920
Mount Lebanon	EL METN	Qornet El Hamra	قرنة الحمرا	850
Mount Lebanon	EL METN	Ramyieh	رامية	850
Mount Lebanon	EL METN	Roumie	رومية	930
Mount Lebanon	EL METN	Sad el Baouchriye	سدّ البوشريّة	850
Mount Lebanon	EL METN	Sannine	صنين	1100
Mount Lebanon	EL METN	Saqeit El Misk	ساقية المسك	1050
Mount Lebanon	EL METN	Sin El Fil	سن الفيل	850
Mount Lebanon	EL METN	Sfaile	سفيلة	940
Mount Lebanon	EL METN	Tall ez Zaatar	تلّ الزعتر	850
Mount Lebanon	EL METN	Tallit Aaranta	تلة عرنتا	1035
Mount Lebanon	EL METN	Wadi El Dilb	وادي الدلب	1100
Mount Lebanon	EL METN	Wadi El Jamajem	وادي الجماجم	900
Mount Lebanon	EL METN	Zabbougha	زبوغا	1100
Mount Lebanon	EL METN	Zaghrine	زغرين	1115

RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Mount Lebanon	EL METN	Zahriye	الزاهرية	910
Mount Lebanon	EL METN	Zalqa	الزلقا	850
Mount Lebanon	EL METN	Zaraaoun	زرعون	1115
Mount Lebanon	EL METN	Zikrit	زكريت	850
Mount Lebanon	EL METN	Ziraaya	زرعايا	1125
Mount Lebanon	EL METN	Zouk el Kharab	زوق الخراب	850
Mount Lebanon	JUBAIL	Aabeidat	عبيدات	925
Mount Lebanon	JUBAIL	Aaboud	عبود	1170
Mount Lebanon	JUBAIL	Aayoun El Aalaq	عيون العلق	1100
Mount Lebanon	JUBAIL	Aaidamoun	عيدمون	850
Mount Lebanon	JUBAIL	Ain El Batraq	عين البطرك	1100
Mount Lebanon	JUBAIL	Ain El Chalal	عين الشلال	1100
Mount Lebanon	JUBAIL	Ain El Deir	عين الدير	1137
Mount Lebanon	JUBAIL	Ain Qara	عين قارة	1100
Mount Lebanon	JUBAIL	Ain Qouna	عين قونا	1100
Mount Lebanon	JUBAIL	Ain El Souwaneh	عين السوانة	1112
Mount Lebanon	JUBAIL	Aainat	عينات	850
Mount Lebanon	JUBAIL	Aalita	عاليتا	925
Mount Lebanon	JUBAIL	Aamchit	عمشيت	850
Mount Lebanon	JUBAIL	Aannaya	عنايا	1195
Mount Lebanon	JUBAIL	Aaqoura	العقورة	1100
Mount Lebanon	JUBAIL	Aarab El Laqlouq	عرب اللقلوق	1100
Mount Lebanon	JUBAIL	Aarab el Lhib	عرب الهيب	1100
Mount Lebanon	JUBAIL	Aarasta	عرسنا	1135
Mount Lebanon	JUBAIL	Aarkaba	عركبة	850
Mount Lebanon	JUBAIL	Adonis	أدونيس	860
Mount Lebanon	JUBAIL	Afqa	افقا	1100
Mount Lebanon	JUBAIL	Ain Ed Delbe	عين الدلبة	1110
Mount Lebanon	JUBAIL	Ain El Ghouaibe	عين الغويبة	1125
Mount Lebanon	JUBAIL	Ain Jrain	عين جرين	1085
Mount Lebanon	JUBAIL	Ain Kfaa	عين كفاع	850
Mount Lebanon	JUBAIL	Almat ech Chemaliye	علمات الشمالية	1055
Mount Lebanon	JUBAIL	Almat Ej Jnoubiye	علمات الجنوبية	1055
Mount Lebanon	JUBAIL	Arez Jaj	أرز جاج	1100
Mount Lebanon	JUBAIL	Arnia	ارنيا	885
Mount Lebanon	JUBAIL	Baachta	بعشتا	850
Mount Lebanon	JUBAIL	Baatara	بعتارة	1100
Mount Lebanon	JUBAIL	Bahra	البحرة	1100
Mount Lebanon	JUBAIL	Balhoss	بلحص	1165
Mount Lebanon	JUBAIL	Barbara	البربارة	850
Mount Lebanon	JUBAIL	Bchelli	بشلي	875
Mount Lebanon	JUBAIL	Bechtelida	بشتليدا	1060
Mount Lebanon	JUBAIL	Behdaidat	بحديدات	850
Mount Lebanon	JUBAIL	Beit El Boume	بيت البومة	850
Mount Lebanon	JUBAIL	Beit Hbaq	بيت حباق	875
Mount Lebanon	JUBAIL	Bejje	بجة	850
Mount Lebanon	JUBAIL	Bekhaaz	بخعاز	850
Mount Lebanon	JUBAIL	Bentaael	بنتاعل	860
Mount Lebanon	JUBAIL	Berkit Hjoula	بركة خجولا	940
Mount Lebanon	JUBAIL	Beziyoun	بزيون	990
Mount Lebanon	JUBAIL	Bikwen	بكوان	850
Mount Lebanon	JUBAIL	Bir El Hait	بير الهيت	985
Mount Lebanon	JUBAIL	Bkerta	بكرتا	1100
Mount Lebanon	JUBAIL	Blat	بلاط	850
Mount Lebanon	JUBAIL	Bmehrain	بمهرين	850
Mount Lebanon	JUBAIL	Bqechqich	بقشقش	1100
Mount Lebanon	JUBAIL	Braij	برّيج	850
Mount Lebanon	JUBAIL	Chaabiet El Fawqa	شعابية الفوقا	850
Mount Lebanon	JUBAIL	Chamat	شامات	850
Mount Lebanon	JUBAIL	Chammis El Kazah	شمّيس القزح	1100
Mount Lebanon	JUBAIL	Charbine	الشربينة	1100
Mount Lebanon	JUBAIL	Chakhnia	شخنيا	1095
Mount Lebanon	JUBAIL	Chikhane	شيخان	850
Mount Lebanon	JUBAIL	Chlomas	شلومص	990
Mount Lebanon	JUBAIL	Chmout	شموت	850
Mount Lebanon	JUBAIL	Chqif	شقيف	850
Mount Lebanon	JUBAIL	Chwata	شوتا	1100
Mount Lebanon	JUBAIL	Daher Saria	ضهر صريا	900
Mount Lebanon	JUBAIL	Deir El Arbaain Shahid	دير الأربعين شهيد	850
Mount Lebanon	JUBAIL	Deir Mar Aabda (Maad)	دير مار عبدا(معاد)	862
Mount Lebanon	JUBAIL	Deir Mar Challita (El Qoutara)	دير مار شليطا (القطارة)	1140
Mount Lebanon	JUBAIL	Deir Mar Ghaleb	دير مار غالب	850
Mount Lebanon	JUBAIL	Deir Mar Mama	دير مار ماما	887
Mount Lebanon	JUBAIL	Deir Mar Maroun (Aanaya)	دير مار مارون(عنايا)	1175
Mount Lebanon	JUBAIL	Deir Mar Sarkis w Bakhos (qortouba)	دير مار سركيس وباخوس (قرطبا)	1157
Mount Lebanon	JUBAIL	Deir Mar Sofita	دير مار صوفيتا	850
Mount Lebanon	JUBAIL	Deir el Qattara	دير القطارة	1140
Mount Lebanon	JUBAIL	Deir Sayedet El Maounat (Deir El Banat)	دير سيدة المعونات (دير البنات)	850
Mount Lebanon	JUBAIL	Dmalsa	دملسا	850
Mount Lebanon	JUBAIL	Douwar Bou Chahine	دوّار بو شاهين	1100
Mount Lebanon	JUBAIL	Edde	إده	850
Mount Lebanon	JUBAIL	Ehmej	إهمج	1170
Mount Lebanon	JUBAIL	El Aafes	العفص	850
Mount Lebanon	JUBAIL	El Aarich	العريش	1100
Mount Lebanon	JUBAIL	El Aawaini	العوينى	1100
Mount Lebanon	JUBAIL	El Biad	البياض	850
Mount Lebanon	JUBAIL	El Bouqaa	البقعة	850
Mount Lebanon	JUBAIL	El Braij	البرّيج	950
Mount Lebanon	JUBAIL	El Borj	البرج	850
Mount Lebanon	JUBAIL	El Chawi	الشاوي	1100
Mount Lebanon	JUBAIL	El Daouq	الداعوق	1100
Mount Lebanon	JUBAIL	El Dawra	الدورة	850
Mount Lebanon	JUBAIL	El Dwair	الدوير	850
Mount Lebanon	JUBAIL	El Halzoun	الحلزون	1075
Mount Lebanon	JUBAIL	El Housainat	الحسينات	1100
Mount Lebanon	JUBAIL	El Houssoun	الحصّون	975
Mount Lebanon	JUBAIL	El Hraiqat	الحريقات	1120
Mount Lebanon	JUBAIL	El Hrazmil	الحرازمل	1195
Mount Lebanon	JUBAIL	El Hrouf	الحروف	855
Mount Lebanon	JUBAIL	El Kafr	الكفر	850
Mount Lebanon	JUBAIL	El Ksar	الكسار	1150
Mount Lebanon	JUBAIL	El Maloukh	المسلوخ	850
Mount Lebanon	JUBAIL	El Mnaitra	المنيطرة	1100
Mount Lebanon	JUBAIL	El Mazraa	المزرعة	850
Mount Lebanon	JUBAIL	El Maaden	المعادن	1180
Mount Lebanon	JUBAIL	El Mazarib	المزاريب	1125
Mount Lebanon	JUBAIL	El Moukhada	المخاضة	1100
Mount Lebanon	JUBAIL	El Naqour	النقور	850
Mount Lebanon	JUBAIL	El Qamouaa	القاموعة	1100
Mount Lebanon	JUBAIL	El Qarqouf	القرقوف	1185
Mount Lebanon	JUBAIL	El Qate'	القاطع	850
Mount Lebanon	JUBAIL	El Qhaf	القحاف	1100
Mount Lebanon	JUBAIL	El Qmaira	القميرة	850

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Mount Lebanon	JUBAIL	El Qottara	القطّارة	1125
Mount Lebanon	JUBAIL	El Qottine	القطّين	905
Mount Lebanon	JUBAIL	El Rmaileh	الرميلة	1100
Mount Lebanon	JUBAIL	El Rwais	الرويس	1100
Mount Lebanon	JUBAIL	El Saqi	الساقي	970
Mount Lebanon	JUBAIL	El Wata	الوطى	850
Mount Lebanon	JUBAIL	El Wata	الوطى	1100
Mount Lebanon	JUBAIL	Fare	فاره	850
Mount Lebanon	JUBAIL	Fatre	فاتري	850
Mount Lebanon	JUBAIL	Fdar El ahta	فدار التحتا	850
Mount Lebanon	JUBAIL	Fdar El Fawqa	فدار الفوقا	875
Mount Lebanon	JUBAIL	Ferhet	فرحت	990
Mount Lebanon	JUBAIL	Fghal	فغال	850
Mount Lebanon	JUBAIL	Fidar	فدار	850
Mount Lebanon	JUBAIL	Frat	فراط	1000
Mount Lebanon	JUBAIL	Ghabat	الغابات	1115
Mount Lebanon	JUBAIL	Ghalboun	غلبون	850
Mount Lebanon	JUBAIL	Gharfine	غرفين	850
Mount Lebanon	JUBAIL	Gharzouz	غرزوز	850
Mount Lebanon	JUBAIL	Ghbaline	غبالين	850
Mount Lebanon	JUBAIL	Habboub	حبوب	850
Mount Lebanon	JUBAIL	Habil	هابيل	975
Mount Lebanon	JUBAIL	Halat	حالات	850
Mount Lebanon	JUBAIL	Haqel	حاقل	935
Mount Lebanon	JUBAIL	Haqlit El Tine	حقلة التينة	875
Mount Lebanon	JUBAIL	Hballin	حبالين	850
Mount Lebanon	JUBAIL	Hdaline	هدلينة	1120
Mount Lebanon	JUBAIL	Heloue	الحلوة	850
Mount Lebanon	JUBAIL	Hjoula	حجولا	1060
Mount Lebanon	JUBAIL	Horcha	حرشا	910
Mount Lebanon	JUBAIL	Hosn Aar	حصن عار	1025
Mount Lebanon	JUBAIL	Hosna	حصنا	1055
Mount Lebanon	JUBAIL	Housrayel	حصرايل	850
Mount Lebanon	JUBAIL	Hsarat	حصارات	850
Mount Lebanon	JUBAIL	Ilij	إليج	1100
Mount Lebanon	JUBAIL	Jabal El Mnaitra	جبل المنيطرة	1100
Mount Lebanon	JUBAIL	Jaj	جاج	1100
Mount Lebanon	JUBAIL	Janne	جنة	950
Mount Lebanon	JUBAIL	Jbail	جبيل	850
Mount Lebanon	JUBAIL	Jdayel	جدايل	850
Mount Lebanon	JUBAIL	Jeser El Djej	جسر الدجاج	850
Mount Lebanon	JUBAIL	Jillab	جلاب	860
Mount Lebanon	JUBAIL	Jinjel	جنجل	850
Mount Lebanon	JUBAIL	Jlaisse	الجليسة	890
Mount Lebanon	JUBAIL	Jouret El Qattine	جورة القطين	905
Mount Lebanon	JUBAIL	Jouret El Moutran	جورة المطران	1100
Mount Lebanon	JUBAIL	Jrabta	جربتا	925
Mount Lebanon	JUBAIL	Kafe	كافه	850
Mount Lebanon	JUBAIL	Kalach	كلش	1100
Mount Lebanon	JUBAIL	Kfar Baal	كفر بعال	1060
Mount Lebanon	JUBAIL	Kfar Chilli	كفر شيلي	1125
Mount Lebanon	JUBAIL	Kfar Chkhai	كفر شخي	850
Mount Lebanon	JUBAIL	Kfar Hatta	كفر حتا	850
Mount Lebanon	JUBAIL	Kfar Hbal	كفر حبال	1075
Mount Lebanon	JUBAIL	Kfar Kekhle	كفر كخلة	850
Mount Lebanon	JUBAIL	Kfar Killas	كفر كلاس	850
Mount Lebanon	JUBAIL	Kfar Kidda	كفر كده	850
Mount Lebanon	JUBAIL	Kfar Mashoun	كفر مشحون	850
Mount Lebanon	JUBAIL	Kfar Mili	كفر ميلي	1125
Mount Lebanon	JUBAIL	Kfar Qaouass	كفر قواص	910
Mount Lebanon	JUBAIL	Kfar Sali	كفر سالي	850
Mount Lebanon	JUBAIL	Kfar Saiada	كفر صيادا	850
Mount Lebanon	JUBAIL	Kfar Zbouna	كفر زبونا	850
Mount Lebanon	JUBAIL	Kfoun	كفون	850
Mount Lebanon	JUBAIL	Khaabia	خعبيا	1180
Mount Lebanon	JUBAIL	Kharbe	الخاربة	955
Mount Lebanon	JUBAIL	Kirkoz	كركز	990
Mount Lebanon	JUBAIL	Koukadan	كوكدان	1117
Mount Lebanon	JUBAIL	Kour El Hooua	كور الهوا	850
Mount Lebanon	JUBAIL	Laqlouq	اللقلوق	1100
Mount Lebanon	JUBAIL	Lassa	لاسا	1165
Mount Lebanon	JUBAIL	Lehfed	لحفد	1085
Mount Lebanon	JUBAIL	Maad	معاد	855
Mount Lebanon	JUBAIL	Maaitiq	معيتيق	850
Mount Lebanon	JUBAIL	Machhilan	مشحلان	850
Mount Lebanon	JUBAIL	Machnaqa	المشنقة	1125
Mount Lebanon	JUBAIL	Maifouq	ميفوق	1030
Mount Lebanon	JUBAIL	Majdel	المجدل	1100
Mount Lebanon	JUBAIL	Mar Edna	مار إدنا	1100
Mount Lebanon	JUBAIL	Mar Iliachaa	مار إليشع	1162
Mount Lebanon	JUBAIL	Mar Youhana	مار يوحنا	850
Mount Lebanon	JUBAIL	Mazraat El Ain	مزرعة العين	1000
Mount Lebanon	JUBAIL	Mazraat El Haj Khalil	مزرعة الحاج خليل	872
Mount Lebanon	JUBAIL	Mazraat El Jmail	مزرعة الجميل	850
Mount Lebanon	JUBAIL	Mazraat El Siyad	مزرعة السياد	1170
Mount Lebanon	JUBAIL	Mdamit	مداميت	865
Mount Lebanon	JUBAIL	Mechane	مشان	850
Mount Lebanon	JUBAIL	MechMech	مشمش	1100
Mount Lebanon	JUBAIL	Mestita	مستيتا	850
Mount Lebanon	JUBAIL	Mghaira	المغيري	1180
Mount Lebanon	JUBAIL	Mhamaret Bejjeh	محمرة بجة	960
Mount Lebanon	JUBAIL	Moftah El Salameh	مفتاح السلامة	850
Mount Lebanon	JUBAIL	Monsef	المنصف	850
Mount Lebanon	JUBAIL	Mrah Sghir	مراح صغير	1000
Mount Lebanon	JUBAIL	Nabaa Afqa	نبع افقا	1182
Mount Lebanon	JUBAIL	Nabaa El Rweis	نبع الرويس	1100
Mount Lebanon	JUBAIL	Nahrh Ibrahim	نهر ابراهيم	850
Mount Lebanon	JUBAIL	Nawfal	نوفل	1100
Mount Lebanon	JUBAIL	Qarqafe	القرقفة	1185
Mount Lebanon	JUBAIL	Qartaba	قرطبا	1185
Mount Lebanon	JUBAIL	Qartaboun	قرطبون	850
Mount Lebanon	JUBAIL	Qas	قص	970
Mount Lebanon	JUBAIL	Qehmez	قهمز	1100
Mount Lebanon	JUBAIL	Qeriaqous	قرياقوس	1160
Mount Lebanon	JUBAIL	Qernaya	قرنايا	885
Mount Lebanon	JUBAIL	Qerqraiya	قرقرايا	975
Mount Lebanon	JUBAIL	Ramout	الرامط	860
Mount Lebanon	JUBAIL	Ras Osta	راس أسطا	1050
Mount Lebanon	JUBAIL	Rihani	الريحانة	850
Mount Lebanon	JUBAIL	Richkol	رشكل	1100
Mount Lebanon	JUBAIL	Roumieh	رومية	850
Mount Lebanon	JUBAIL	Saidet El Qaren	سيدة القرن	1100
Mount Lebanon	JUBAIL	Salib Ghalboun	صليب غلبون	850

RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Mount Lebanon	JUBAIL	Saqi Rechmaiya	ساقي رشميا	1165
Mount Lebanon	JUBAIL	Saqiet el Khait	ساقية الخيط	940
Mount Lebanon	JUBAIL	Sariita	سرّعيتا	1125
Mount Lebanon	JUBAIL	Sbail	سبيل	960
Mount Lebanon	JUBAIL	Sibrine	سبرين	1000
Mount Lebanon	JUBAIL	Sinnawr	سنّور	850
Mount Lebanon	JUBAIL	Souane	صوّانه	1115
Mount Lebanon	JUBAIL	Souq El Ferreh	سوق الفرّي	935
Mount Lebanon	JUBAIL	Sourat	سورات	850
Mount Lebanon	JUBAIL	Siran	سيران	850
Mount Lebanon	JUBAIL	Tartij	ترتج	1150
Mount Lebanon	JUBAIL	Tarwel	ترول	850
Mount Lebanon	JUBAIL	Toudmor	تدمر	1100
Mount Lebanon	JUBAIL	Tourzaiya	طورزيا	1075
Mount Lebanon	JUBAIL	Wata El Ban	وطى البان	850
Mount Lebanon	JUBAIL	Wata El Kalb	وطى الكلب	1095
Mount Lebanon	JUBAIL	Wata Youssef	وطى يوسف	850
Mount Lebanon	JUBAIL	Yanouh	يانوح	1160
Mount Lebanon	JUBAIL	Zardah	زردا	1000
Mount Lebanon	JUBAIL	Zebdine	زبدين	885
Mount Lebanon	JUBAIL	Zilehmaya	زلحميا	850
Mount Lebanon	JUBAIL	Zoummar	زمار	850
Mount Lebanon	JUBAIL	Zoummar	زمار	1050
Mount Lebanon	KASROUANE	Aabra	العبرة	1025
Mount Lebanon	KASROUANE	Aachqout	عشقوت	1100
Mount Lebanon	KASROUANE	Aajaltoun	عجلتون	1100
Mount Lebanon	KASROUANE	Aaqeibe	العقيبة	850
Mount Lebanon	KASROUANE	Aaramoun	عرمون	965
Mount Lebanon	KASROUANE	Adma	ادما	850
Mount Lebanon	KASROUANE	Adonis	أدونيس	877
Mount Lebanon	KASROUANE	Ain Ebaail	عين ابعل	1100
Mount Lebanon	KASROUANE	Ain El Delbe	عين الدلبة	1100
Mount Lebanon	KASROUANE	Ain El Henblas	عين الحنبلاس	1000
Mount Lebanon	KASROUANE	Ain El Jorn	عين الجرن	1100
Mount Lebanon	KASROUANE	Ain El Rihane	عين الريحانة	850
Mount Lebanon	KASROUANE	Ain Jwaia	عين جويا	1100
Mount Lebanon	KASROUANE	Ain Warqa	عين ورقة	934
Mount Lebanon	KASROUANE	Aintoura	عينطوره	850
Mount Lebanon	KASROUANE	Aiyoun El Simane	عيون السيمان	1100
Mount Lebanon	KASROUANE	Bain El Nhour	بين النهور	1100
Mount Lebanon	KASROUANE	Balloune	بلونة	925
Mount Lebanon	KASROUANE	Batha	بطحا	890
Mount Lebanon	KASROUANE	Beit Eid	بيت عيد	1115
Mount Lebanon	KASROUANE	Beit El Kreidi	بيت الكريدي	850
Mount Lebanon	KASROUANE	Beit El Mehdi	بيت المهدي	1100
Mount Lebanon	KASROUANE	Beit Khachbaw	بيت خشبو	850
Mount Lebanon	KASROUANE	Beqaatet Aachqout	بقعاتة عشقوت	1100
Mount Lebanon	KASROUANE	Biout El Kraim	بيوت الكريم	1100
Mount Lebanon	KASROUANE	Biqaatet Kannane	بقعاتة كنعان	1150
Mount Lebanon	KASROUANE	Bizhel	بزحل	850
Mount Lebanon	KASROUANE	Bkirke	بكركي	850
Mount Lebanon	KASROUANE	Bouar	البوار	850
Mount Lebanon	KASROUANE	Bqaatouta	بقعتوتة	1100
Mount Lebanon	KASROUANE	Bqaq El Din	بقاق الدين	850
Mount Lebanon	KASROUANE	Bzoummar	بزمار	1060
Mount Lebanon	KASROUANE	Chabrouh	شبروح	1100
Mount Lebanon	KASROUANE	Chahtoul	شحتول	1065
Mount Lebanon	KASROUANE	Chnanaair	شنعير	850
Mount Lebanon	KASROUANE	Chouene	شوان	850
Mount Lebanon	KASROUANE	Chwaia	شويا	950
Mount Lebanon	KASROUANE	Dafne	الدفنة	850
Mount Lebanon	KASROUANE	Daraaoun	درعون	875
Mount Lebanon	KASROUANE	Darayia	داريا	945
Mount Lebanon	KASROUANE	Deir Baqlouch	دير بقلوش	850
Mount Lebanon	KASROUANE	Deir Bzommar	دير بزمار	1065
Mount Lebanon	KASROUANE	Deir El Hriq	دير الحريق	1150
Mount Lebanon	KASROUANE	Deir El Kraim	دير الكريم	900
Mount Lebanon	KASROUANE	Deir Mar Aabda	دير مار عبدا	937
Mount Lebanon	KASROUANE	Deir Mar Challita Mouqbes	دير مار شليطا مقبس	1000
Mount Lebanon	KASROUANE	Deir Mar Doumed (El Bwar)	دير مار ضومط (البوار)	850
Mount Lebanon	KASROUANE	Deir Mar Doumed (Faitaroun)	دير مار ضومط (فيطرون)	1100
Mount Lebanon	KASROUANE	Deir Mar Elias	دير مار الياس	850
Mount Lebanon	KASROUANE	Deir Mar Nohra	دير مار نهرا	900
Mount Lebanon	KASROUANE	Deir Mar Nqoula	دير مار نقولا	975
Mount Lebanon	KASROUANE	Deir Mar Rouhana	دير مار روحانا	975
Mount Lebanon	KASROUANE	Deir Mar Roukoz	دير مار روكز	1010
Mount Lebanon	KASROUANE	Deir El Mkhales	دير المخلص	850
Mount Lebanon	KASROUANE	Deir El Qiameh	دير القيامة	1100
Mount Lebanon	KASROUANE	Deir El Raifoun	دير زيفون	1125
Mount Lebanon	KASROUANE	Deir El Roumieh	دير الرومية	1090
Mount Lebanon	KASROUANE	Deir Nisbai	دير نسبيه	1000
Mount Lebanon	KASROUANE	Deir Sayedet El Bzaz	دير سيدة البزاز	850
Mount Lebanon	KASROUANE	Deir Sayedet El Haqleh	دير سيدة الحقلة	1037
Mount Lebanon	KASROUANE	Deir Sayedet El Hosn	دير سيدة الحصن	1100
Mount Lebanon	KASROUANE	Deir Sayedet El Lwaizeh	دير سيدة اللويزة	850
Mount Lebanon	KASROUANE	Deir Sayedet El Najat	دير سيدة النجاة	975
Mount Lebanon	KASROUANE	Deir Sayedet El Niah	دير سيدة النياح	1100
Mount Lebanon	KASROUANE	Deir Hrach	دير خراش	850
Mount Lebanon	KASROUANE	Deir Khashbaw	دير خشبو	850
Mount Lebanon	KASROUANE	Deir Om Allah	دير أم الله	1000
Mount Lebanon	KASROUANE	Delbta	دلبتا	935
Mount Lebanon	KASROUANE	Dirali	درعلي	1100
Mount Lebanon	KASROUANE	Dqarine	دقارين	850
Mount Lebanon	KASROUANE	El Aafs	العفص	925
Mount Lebanon	KASROUANE	El Aazr	العزر	990
Mount Lebanon	KASROUANE	El Aazra	العزره	1010
Mount Lebanon	KASROUANE	El Aazra et el Aazr	العزره والعزر	975
Mount Lebanon	KASROUANE	El Bhairi	البحيري	850
Mount Lebanon	KASROUANE	El Chaab	الشعب	850
Mount Lebanon	KASROUANE	El Charfeh	الشرفة	975
Mount Lebanon	KASROUANE	El Chawieh	الشاوية	1100
Mount Lebanon	KASROUANE	El Harif	الحريف	850
Mount Lebanon	KASROUANE	El Maaden	المعادن	987
Mount Lebanon	KASROUANE	El Masiaf	المصيف	970
Mount Lebanon	KASROUANE	El Mchati	المشاتي	1119
Mount Lebanon	KASROUANE	El Mdar	المدار	940
Mount Lebanon	KASROUANE	E Qacha	القاشا	1100
Mount Lebanon	KASROUANE	El Qalaa	القلعة	1100
Mount Lebanon	KASROUANE	El Qanater	القناطر	1100
Mount Lebanon	KASROUANE	El Qatine	القطين	990
Mount Lebanon	KASROUANE	El Qmairzeh	القميرزة	850
Mount Lebanon	KASROUANE	El Rihaneh	الريحانة	850
Mount Lebanon	KASROUANE	El Salhieh	الصالحية	850

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Mount Lebanon	KASROUANE	El Slayekh	السلايخ	1100
Mount Lebanon	KASROUANE	El Souwaneh	الصوّانة	1190
Mount Lebanon	KASROUANE	El Talleh	التلّة	1100
Mount Lebanon	KASROUANE	El Wata	الوطى	850
Mount Lebanon	KASROUANE	El Tarouaa	التّارّوع	950
Mount Lebanon	KASROUANE	El Zaaitarieh	الزّعيتّرية	850
Mount Lebanon	KASROUANE	Faitroun	فيطرّون	1070
Mount Lebanon	KASROUANE	Faqra	فقرا	1100
Mount Lebanon	KASROUANE	Faraiya	فارايا	1100
Mount Lebanon	KASROUANE	Fatqa	فتقا	860
Mount Lebanon	KASROUANE	Fnaiwan	فنيون	850
Mount Lebanon	KASROUANE	Ghadir	غادير	850
Mount Lebanon	KASROUANE	Ghadras	غدراس	925
Mount Lebanon	KASROUANE	Ghawabi	غوابي	1100
Mount Lebanon	KASROUANE	Ghazir	غزير	850
Mount Lebanon	KASROUANE	Ghbalé	غبالة	1045
Mount Lebanon	KASROUANE	Ghine	الغينة	1075
Mount Lebanon	KASROUANE	Ghouchraya	غوشرايا	850
Mount Lebanon	KASROUANE	Ghosta	غوسطا	925
Mount Lebanon	KASROUANE	Hadchet	حدشيت	975
Mount Lebanon	KASROUANE	Haqel El Rayes	حقل الرّيس	1100
Mount Lebanon	KASROUANE	Haret el Mir	حارة المير	850
Mount Lebanon	KASROUANE	Haret Sakher	حارة صخر	850
Mount Lebanon	KASROUANE	Harhraiya	هرهرايا	1035
Mount Lebanon	KASROUANE	Harissa	حريصا	910
Mount Lebanon	KASROUANE	Hay El Manzoul	حي المنزول	850
Mount Lebanon	KASROUANE	Hayata	حياطة	1030
Mount Lebanon	KASROUANE	Haylan	حيلان	900
Mount Lebanon	KASROUANE	Hossain	الحصين	975
Mount Lebanon	KASROUANE	Hrajel	حراجل	1100
Mount Lebanon	KASROUANE	Ighbeh El Tahta	إغبة التحتا	1125
Mount Lebanon	KASROUANE	Ighbeh El Fawqa	إغبة الفوقا	1100
Mount Lebanon	KASROUANE	Jabal Moussa	جبل موسى	1100
Mount Lebanon	KASROUANE	Jazaier	جزاير	850
Mount Lebanon	KASROUANE	Jdaidet Ghazir	جديدة غزير	870
Mount Lebanon	KASROUANE	Jitta	جعيتا	850
Mount Lebanon	KASROUANE	Jounie	جونيه	850
Mount Lebanon	KASROUANE	Jouret Bedrane	جورة بدران	1030
Mount Lebanon	KASROUANE	Jouret Et Tormoss	جورة الترمس	1105
Mount Lebanon	KASROUANE	Jouret Mghad	جورة مغاد	1170
Mount Lebanon	KASROUANE	Jwar El Bwacheq	جوار البواشق	1165
Mount Lebanon	KASROUANE	Jwar El Hachich	جوار الحشيش	1185
Mount Lebanon	KASROUANE	Kaslik	كسليك	850
Mount Lebanon	KASROUANE	Kfar Aaos	كفر عاص	950
Mount Lebanon	KASROUANE	Kfar Chham	كفر شحام	850
Mount Lebanon	KASROUANE	Kfar Debian	كفر دبيان	1100
Mount Lebanon	KASROUANE	Kfar Hbab	كفر حباب	850
Mount Lebanon	KASROUANE	Kfar Jrif	كفر جريف	850
Mount Lebanon	KASROUANE	Kfartai	كفرتيه	1100
Mount Lebanon	KASROUANE	Kfaryassine	كفرياسين	850
Mount Lebanon	KASROUANE	Kfour	الكفور	1015
Mount Lebanon	KASROUANE	Khrayeb Nahr Ibrahim	خراب نهر ابراهيم	850
Mount Lebanon	KASROUANE	Maamelteine	المعاملتين	850
Mount Lebanon	KASROUANE	Maarab	معراب	981
Mount Lebanon	KASROUANE	Mairouba	ميروبا	1100
Mount Lebanon	KASROUANE	Maissra	المعيصرة	925
Mount Lebanon	KASROUANE	Mar Edna	مار إدنا	850
Mount Lebanon	KASROUANE	Mar Youhana	مار يوحنا	850
Mount Lebanon	KASROUANE	Mazraat Kfardibiane	مزرعة كفرذبيان	1100
Mount Lebanon	KASROUANE	Mazraat El Boustan	مزرعة البستان	925
Mount Lebanon	KASROUANE	Mazraat El kherbeh	مزرعة الخربة	850
Mount Lebanon	KASROUANE	Mazraat El Mraijeh	مزرعة المرجة	1100
Mount Lebanon	KASROUANE	Mazraat El Ras	مزرعة الراس	850
Mount Lebanon	KASROUANE	Mazraat Sabrine	مزرعة صبرين	1190
Mount Lebanon	KASROUANE	Mehqan El Mazloum	محقان المظلوم	1100
Mount Lebanon	KASROUANE	Mghayer	المغاير	1100
Mount Lebanon	KASROUANE	Mhaibet	مهيبت	850
Mount Lebanon	KASROUANE	Mradiye	المرادية	990
Mount Lebanon	KASROUANE	Mrah El Mir	مراح المير	1045
Mount Lebanon	KASROUANE	Nabaa El Aasal	نبع العسل	1100
Mount Lebanon	KASROUANE	Nabaa El Hadid	نبع الحديد	1100
Mount Lebanon	KASROUANE	Nabaa El Khdaira	نبع الخضيرة	850
Mount Lebanon	KASROUANE	Nabaa El Laban	نبع اللبن	1100
Mount Lebanon	KASROUANE	Nabaa El Mghara	نبع المغارة	1100
Mount Lebanon	KASROUANE	Nabaa Jaaita	نبع جعيتا	850
Mount Lebanon	KASROUANE	Nahr El Dahab	نهر الذهب	1040
Mount Lebanon	KASROUANE	Naher El Kaleb	نهر الكلب	850
Mount Lebanon	KASROUANE	Nmoura	النمورة	1005
Mount Lebanon	KASROUANE	Ouata Ej Jaouz	وطى الجوز	1100
Mount Lebanon	KASROUANE	Ouata Slam	وطى سلام	850
Mount Lebanon	KASROUANE	Qarsa	قرصا	925
Mount Lebanon	KASROUANE	Qlaiaat	قليعات	1125
Mount Lebanon	KASROUANE	Qouwaleh	قوالة	850
Mount Lebanon	KASROUANE	Rachiine	رشعين	1100
Mount Lebanon	KASROUANE	Ram Bou Daqen	رام بو دقن	930
Mount Lebanon	KASROUANE	Rayfoun	ريفون	1125
Mount Lebanon	KASROUANE	Safra	الصفرا	850
Mount Lebanon	KASROUANE	Sahel Aalma	ساحل علما	850
Mount Lebanon	KASROUANE	Sarba	صربا	850
Mount Lebanon	KASROUANE	Saidet El Nchif	سيدة النشيف	975
Mount Lebanon	KASROUANE	Saidet El Qalaa	سيدة القلعة	1188
Mount Lebanon	KASROUANE	Sinawr	سنور	1100
Mount Lebanon	KASROUANE	Shail	شهيلة	885
Mount Lebanon	KASROUANE	Snawbar	صنوبر	970
Mount Lebanon	KASROUANE	Tabarja	طبرجا	850
Mount Lebanon	KASROUANE	Tabrieh	طبرية	1100
Mount Lebanon	KASROUANE	Wadi Tali	وادي تالي	850
Mount Lebanon	KASROUANE	Yahchouch	يحشوش	935
Mount Lebanon	KASROUANE	Zaaitra	زعيترة	975
Mount Lebanon	KASROUANE	Zeitoun	زيتون	890
Mount Lebanon	KASROUANE	Zouk Mosbeh	زوق مصبح	890
Mount Lebanon	KASROUANE	Zouq Mkayel	زوق مكايل	850
Nabatieh	BENT JUBAIL	Aainata	عينتا	775
Nabatieh	BENT JUBAIL	Aaita ez Zott	عيتا الزوط	745
Nabatieh	BENT JUBAIL	Aaitaroun	عيترون	730
Nabatieh	BENT JUBAIL	Ain Ebel	عين إبل	655
Nabatieh	BENT JUBAIL	Aita Ech Chaab	عيتا الشعب	730
Nabatieh	BENT JUBAIL	Aita El Jabal	عيتا الجبل	745
Nabatieh	BENT JUBAIL	Beit Lif	بيت ليف	670
Nabatieh	BENT JUBAIL	Beit Yahnoun	بيت ياحون	805
Nabatieh	BENT JUBAIL	Bent Jbail	بنت جبيل	790
Nabatieh	BENT JUBAIL	Bir El Sanasel	بير السناسل	725
Nabatieh	BENT JUBAIL	Borj Qalaouiye	برج قلاويه	655

RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Nabatieh	BENT JUBAIL	Braachit	برعشيت	755
Nabatieh	BENT JUBAIL	Chaqra	شقرا	715
Nabatieh	BENT JUBAIL	Debel	دبل	695
Nabatieh	BENT JUBAIL	Deir Ntar	دير النطار	680
Nabatieh	BENT JUBAIL	El Habis	الحبيس	780
Nabatieh	BENT JUBAIL	El Qalaa	القلعة	740
Nabatieh	BENT JUBAIL	El Soultanieh	السلطانية	705
Nabatieh	BENT JUBAIL	Ghandouriye	غندورية	655
Nabatieh	BENT JUBAIL	Haddata	حداثا	785
Nabatieh	BENT JUBAIL	Hanine	حانين	740
Nabatieh	BENT JUBAIL	Haris	حاريص	765
Nabatieh	BENT JUBAIL	Jabal Aamel	جبل عامل	786
Nabatieh	BENT JUBAIL	Jbab el Arab	جباب العرب	715
Nabatieh	BENT JUBAIL	Jmaijime	جميجمة	750
Nabatieh	BENT JUBAIL	Kafra	كفرا	775
Nabatieh	BENT JUBAIL	Kfar Dounine	كفر دونين	695
Nabatieh	BENT JUBAIL	Khirbit Immiyeh	خربة إمية	722
Nabatieh	BENT JUBAIL	Khirbit Silim	خربة سلم	720
Nabatieh	BENT JUBAIL	Kouniine	كونين	760
Nabatieh	BENT JUBAIL	Maroun er Ras	مارون الراس	865
Nabatieh	BENT JUBAIL	Mazraat Froun	مزرعة فرون	765
Nabatieh	BENT JUBAIL	Qalaouiye	قلويه	655
Nabatieh	BENT JUBAIL	Qatmoun	القطمون	685
Nabatieh	BENT JUBAIL	Qouzah	القوزح	770
Nabatieh	BENT JUBAIL	Rachaf	رشاف	735
Nabatieh	BENT JUBAIL	Ramiye	رامية	695
Nabatieh	BENT JUBAIL	Rmaich	رميش	690
Nabatieh	BENT JUBAIL	Safad el Battikh	صفد البطيخ	745
Nabatieh	BENT JUBAIL	Salhani	صلحاني	720
Nabatieh	BENT JUBAIL	Sammoukha	سموخة	740
Nabatieh	BENT JUBAIL	Sribbine	صربين	700
Nabatieh	BENT JUBAIL	Taire	الطيري	780
Nabatieh	BENT JUBAIL	Tebnine	تبنين	740
Nabatieh	BENT JUBAIL	Yaroun	يارون	780
Nabatieh	BENT JUBAIL	Yater	ياطر	760
Nabatieh	HASBAYA	Abou Qamha	ابو قمحة	685
Nabatieh	HASBAYA	Ain El Mantaneh	عين المنطنة	755
Nabatieh	HASBAYA	Ain Fjour	عين فجور	835
Nabatieh	HASBAYA	Ain Jerfa	عين جرفا	780
Nabatieh	HASBAYA	Ain Qenya	عين قنيا	885
Nabatieh	HASBAYA	Ain Tinta	عين تنتا	850
Nabatieh	HASBAYA	Beit Isber	بيت إسبر	805
Nabatieh	HASBAYA	Beit Nawfal	بيت نوفل	830
Nabatieh	HASBAYA	Beit Sanieh	بيت سنيه	772
Nabatieh	HASBAYA	Berghoz	برغز	660
Nabatieh	HASBAYA	Chebaa	شبعا	1100
Nabatieh	HASBAYA	Chouaia	شويا	940
Nabatieh	HASBAYA	Dnaibe	دنيبة	815
Nabatieh	HASBAYA	El Aabasieh	العباسية	655
Nabatieh	HASBAYA	El Dhairjat	الدهيرجات	655
Nabatieh	HASBAYA	El Ghajar	الغجر	655
Nabatieh	HASBAYA	El Khalwat	الخلوات	880
Nabatieh	HASBAYA	Fachkoul	فشكول	705
Nabatieh	HASBAYA	Fardis	الفرديس	690
Nabatieh	HASBAYA	Halta	حلتا	755
Nabatieh	HASBAYA	Hasbaiya	حاصبيا	780

Nabatieh	HASBAYA	Hebbariye	الهبارية	780
Nabatieh	HASBAYA	Isamiyeh	إسلامية	655
Nabatieh	HASBAYA	Jisr El Hasbani	جسر الحاصباني	680
Nabatieh	HASBAYA	Kaoukaba	كوكبا	735
Nabatieh	HASBAYA	Kfair	الكفير	855
Nabatieh	HASBAYA	Kfar Chouba	كفر شوبا	1100
Nabatieh	HASBAYA	Kfar Hamam	كفر حمام	805
Nabatieh	HASBAYA	Khallit El Ghazala	خلة الغزالة	705
Nabatieh	HASBAYA	khalwat EL Biyada	خلوات البياضة	860
Nabatieh	HASBAYA	Khalwit Jibli	خلوة جبلي	805
Nabatieh	HASBAYA	Khirbit El Dweir	خربة الدوير	655
Nabatieh	HASBAYA	Khirbit EL Hadat	خربة الحدث	755
Nabatieh	HASBAYA	Khraibe	الخريبة	685
Nabatieh	HASBAYA	Majidiye	المجيدية	655
Nabatieh	HASBAYA	Mari	الماري	665
Nabatieh	HASBAYA	Marj ez Zouhour (Istabl)	مرج الزهور	820
Nabatieh	HASBAYA	Mazraat Brakhta	مزرعة برخطا	1100
Nabatieh	HASBAYA	Mazraat Qafwa	مزرعة قفوا	805
Nabatieh	HASBAYA	Mimes	ميمس	805
Nabatieh	HASBAYA	Moghr Chebaa	مغر شبعا	655
Nabatieh	HASBAYA	Mrah EL Bireh	مراح البيره	1100
Nabatieh	HASBAYA	Mrah Sabya	مراح صبيا	980
Nabatieh	HASBAYA	Nabaa EL Jawz	نبع الجوز	1100
Nabatieh	HASBAYA	Nabaa El Mghara	نبع المغارة	955
Nabatieh	HASBAYA	Nkhaile	النخيلة	655
Nabatieh	HASBAYA	Nkhaile	نخيلة	655
Nabatieh	HASBAYA	Rachaiya el Foukhar	راشيا الفخار	780
Nabatieh	HASBAYA	Ramta	رمتا	1100
Nabatieh	HASBAYA	Ras Baidar	راس بيدر	685
Nabatieh	HASBAYA	Sfineh	سفينة	805
Nabatieh	HASBAYA	Slayib	صليب	655
Nabatieh	HASBAYA	Souq El Khan	سوق الخان	705
Nabatieh	HASBAYA	Zighleh	زغلة	780
Nabatieh	MARJAYOUN	Aadaisse	عديسة	755
Nabatieh	MARJAYOUN	Aadchit el Qsair	عدشيت القصير	655
Nabatieh	MARJAYOUN	Aalmane	علمان	655
Nabatieh	MARJAYOUN	Aarab El Louaizeh	عرب الويزة	655
Nabatieh	MARJAYOUN	Aarma	عرما	655
Nabatieh	MARJAYOUN	Ain Aarab	عين عرب	655
Nabatieh	MARJAYOUN	Baiyouda	البويضة	680
Nabatieh	MARJAYOUN	Bani Aawaida	بني عويضة	835
Nabatieh	MARJAYOUN	Bani Haiyane	بني حيان	657
Nabatieh	MARJAYOUN	Blat	بلاط	745
Nabatieh	MARJAYOUN	Blida	بليدا	720
Nabatieh	MARJAYOUN	Borj El Moulouk	برج الملوك	717
Nabatieh	MARJAYOUN	Deir Mimas	دير ميماس	695
Nabatieh	MARJAYOUN	Deir Seriane	دير سريان	667
Nabatieh	MARJAYOUN	Dibbine	دبين	730
Nabatieh	MARJAYOUN	Doubieh	دوبيه	655
Nabatieh	MARJAYOUN	El Deir	الدير	717
Nabatieh	MARJAYOUN	El Wazani	الوزاني	655
Nabatieh	MARJAYOUN	Houla	حولا	785
Nabatieh	MARJAYOUN	Houra	هورا	655
Nabatieh	MARJAYOUN	Ibl es Saqi	إبل السقي	785
Nabatieh	MARJAYOUN	Jdaidir Marjaayoun	جديدة مرجعيون	805
Nabatieh	MARJAYOUN	Jiser El Khardale	جسر الخردلة	655
Nabatieh	MARJAYOUN	Jlali El Ghezlan	جلالي الغزلان	680

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
Nabatieh	MARJAYOUN	Kfar Kila	كفركلا	655
Nabatieh	MARJAYOUN	Khiam	الخيام	752
Nabatieh	MARJAYOUN	Khirbe	خربه	717
Nabatieh	MARJAYOUN	Maisat	ميسات	655
Nabatieh	MARJAYOUN	Majdel Silim	مجدل سلم	685
Nabatieh	MARJAYOUN	Marjayoun	مرجعيون	770
Nabatieh	MARJAYOUN	Markaba	مركبا	755
Nabatieh	MARJAYOUN	Mazraat El Joulenieh	مزرعة الجولانية	730
Nabatieh	MARJAYOUN	Mazraat El Jrain	مزرعة الجرين	717
Nabatieh	MARJAYOUN	Mazaat EL Sahsahiyeh	مزرعة الصحصحية	725
Nabatieh	MARJAYOUN	Meiss ej Jabal	ميس الجبل	720
Nabatieh	MARJAYOUN	Mhaibib	محيبيب	740
Nabatieh	MARJAYOUN	Nabaa El Dardara	نبع الدردارة	667
Nabatieh	MARJAYOUN	Nabaa El Houjair	نبع الحجير	655
Nabatieh	MARJAYOUN	Nabi Youchaa	نبي يوشع	705
Nabatieh	MARJAYOUN	Qabrikha	قبريخا	655
Nabatieh	MARJAYOUN	Qalaa Doubieh	قلعة دوبيه	745
Nabatieh	MARJAYOUN	Qalaa Salloum	قلعة سلوم	755
Nabatieh	MARJAYOUN	Qantara	قنطرة	655
Nabatieh	MARJAYOUN	Qlaiaa	قليعة	735
Nabatieh	MARJAYOUN	Qsair	القصير	655
Nabatieh	MARJAYOUN	Rabb et Talatine	رب الثلاثين	715
Nabatieh	MARJAYOUN	Sarda	سردة	655
Nabatieh	MARJAYOUN	Souane	صوانة	675
Nabatieh	MARJAYOUN	Taibe	الطيبة	735
Nabatieh	MARJAYOUN	Tallouse	طلوسة	665
Nabatieh	MARJAYOUN	Tamrieh	طمرية	677
Nabatieh	MARJAYOUN	Touline	تولين	655
Nabatieh	MARJAYOUN	Wadi El Slouki	وادي السلوقي	655
Nabatieh	MARJAYOUN	Ziqieh	زقية	655
Nabatieh	NABATIEH	Aabba	عبا	655
Nabatieh	NABATIEH	Aadchit ech Chqif	عدشيت الشقيف	655
Nabatieh	NABATIEH	Aarnoun	أرنون	700
Nabatieh	NABATIEH	Aazze	عزة	655
Nabatieh	NABATIEH	Ain Bou Souar	عين بوسوار	880
Nabatieh	NABATIEH	Ain Qana	عين قانا	745
Nabatieh	NABATIEH	Arab Salim	عرب صاليم	685
Nabatieh	NABATIEH	Bfaroua	بفرّوه	655
Nabatieh	NABATIEH	Braiqaa	برقيع	655
Nabatieh	NABATIEH	Charqiye	الشرقية	655
Nabatieh	NABATIEH	Choukine	شوكين	675
Nabatieh	NABATIEH	Deir ez Zahrani	دير الزهراني	655
Nabatieh	NABATIEH	Deir Mar Antonios	دير مار أنطونيوس	655
Nabatieh	NABATIEH	Doueir	الدوير	655
Nabatieh	NABATIEH	El Jawharieh	الجوهرية	655
Nabatieh	NABATIEH	El Manzaleh	المنزلة	655
Nabatieh	NABATIEH	Fadoulieh	فضولية	655
Nabatieh	NABATIEH	Ghbartine	غبرتين	655
Nabatieh	NABATIEH	Habbouch	حبوش	655
Nabatieh	NABATIEH	Hamra	الحمرا	655
Nabatieh	NABATIEH	Harouf	حاروف	655
Nabatieh	NABATIEH	Hima Aarnoun	حمى أرنون	670
Nabatieh	NABATIEH	Hmailleh	الحميلة	655
Nabatieh	NABATIEH	Houmine el Faouqa	حومين الفوقا	680
Nabatieh	NABATIEH	Houmine et Tahta	حومين التحتا	655
Nabatieh	NABATIEH	Insar	انصار	655
Nabatieh	NABATIEH	Jarjouaa	جرجوع	825
Nabatieh	NABATIEH	Jbaa	جباع الحلاوي	790
Nabatieh	NABATIEH	Jibchit	جبشيت	655
Nabatieh	NABATIEH	Kafra	كفرا	730
Nabatieh	NABATIEH	Kfar Dajjal	كفردجال	655
Nabatieh	NABATIEH	Kfar Fila	كفرفيلا	660
Nabatieh	NABATIEH	Kfar Roummane	كفررمان	655
Nabatieh	NABATIEH	Kfar Sir	كفر صير	655
Nabatieh	NABATIEH	Kfar Tebnit	كفر تبنيت	655
Nabatieh	NABATIEH	Kfour	الكفور	655
Nabatieh	NABATIEH	Ksar Zaatar	كسار زعتر	655
Nabatieh	NABATIEH	Maifadoun	ميفدون	655
Nabatieh	NABATIEH	Maqsam Ali El Taher	مقسم علي الطاهر	690
Nabatieh	NABATIEH	Mazraat Bsafour	مزرعة بصفور	655
Nabatieh	NABATIEH	Mazraat Chelbael	مزرعة شلبعل	655
Nabatieh	NABATIEH	Mazraat Dmoul	مزرعة دمول	655
Nabatieh	NABATIEH	Mazraat el Bayada	مزرعة البياض	655
Nabatieh	NABATIEH	Mazraat El Khraibeh	مزرعة الخربة	655
Nabatieh	NABATIEH	Mazraat Kfar ej Jouz	مزرعة كفرجوز	655
Nabatieh	NABATIEH	Mazraat Maiiaseh	مزرعة مياسة	805
Nabatieh	NABATIEH	Mgharet Chqif	مغارة الشقيف	655
Nabatieh	NABATIEH	Mrah El Qabou	مراح القبو	655
Nabatieh	NABATIEH	Nabatiye	النبطية	655
Nabatieh	NABATIEH	Nabatiye el Faouqa	نبطية الفوقا	655
Nabatieh	NABATIEH	Nabatiye el Tahta	نبطية التحتا	655
Nabatieh	NABATIEH	Nmairiye	النميرية	655
Nabatieh	NABATIEH	Qaaqaait ej Jisr	قعقعية الجسر	655
Nabatieh	NABATIEH	Qalaat El Chqif	قلعة الشقيف	762
Nabatieh	NABATIEH	Qsaibe	القصيبة	655
Nabatieh	NABATIEH	Roumine	رومين	655
Nabatieh	NABATIEH	Rwais El Kharoub	رؤوس الخروب	655
Nabatieh	NABATIEH	Sarba	صربا	690
Nabatieh	NABATIEH	Selouane Sir	سلوان سير	655
Nabatieh	NABATIEH	Sini	سني	655
Nabatieh	NABATIEH	Sir el Gharbiye	صير الغربية	655
Nabatieh	NABATIEH	Tal El Zaatar	تل الزعتر	655
Nabatieh	NABATIEH	Toul	تول	655
Nabatieh	NABATIEH	Yohmor	يحمر	670
Nabatieh	NABATIEH	Zaouta ech Charqiye	زوطر الشرقية	655
Nabatieh	NABATIEH	Zaoutar el Gharbiye	زوطر الغربية	655
Nabatieh	NABATIEH	Zebdine	زبدين	655
Nabatieh	NABATIEH	Zefta	زفتا	655
North	AKKAR	Aabboudiye	العبودية	745
North	AKKAR	Aadbel	عدبل	745
North	AKKAR	Aaidmoun	عيدمون	867
North	AKKAR	Aaiyat	عيات	835
North	AKKAR	Aaklar El Attiqa	عكار العتيقة	905
North	AKKAR	Aamaret el Bikat	عمار البيكات	745
North	AKKAR	Aamriye	العامرية	745
North	AKKAR	Aandqet	عندقت	805
North	AKKAR	Aaouinat	عوينات	745
North	AKKAR	Aarab Jourmnaya	عرب جرمنايا	783
North	AKKAR	Aradi El Soud	أراضي السود	745
North	AKKAR	Aarme	العرمة	745
North	AKKAR	Aarida	عريضة	745
North	AKKAR	Aarqa	عرقا	745
North	AKKAR	Aayoun	العيون	780

RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
North	AKKAR	Aayoun El Ghezlaane	عيون الغزلان	745
North	AKKAR	Ain Aarous	عين عروس	775
North	AKKAR	Ain Achma	عين أشما	745
North	AKKAR	Ain El Hamam	عين الحمام	745
North	AKKAR	Ain El Qabou	عين القبو	845
North	AKKAR	Ain El Rsas	عين الرصاص	745
North	AKKAR	Ain El Wardeh	عين الوردة	1100
North	AKKAR	Ain El Zait	عين الزيتونة	745
North	AKKAR	Ain Tanta	عين تنتا	745
North	AKKAR	Ain Yaaqoub	عين يعقوب	840
North	AKKAR	Akroum	أكروم	935
North	AKKAR	Badouaa	بدوع	745
North	AKKAR	Baghdadi	بغدادي	745
North	AKKAR	Bajaa	بجعا	745
North	AKKAR	Balde	بلدة	745
North	AKKAR	Barcha	برشا	745
North	AKKAR	Barde	البارده	745
North	AKKAR	Bebnine	ببنين	745
North	AKKAR	Beino	بينو	755
North	AKKAR	Beit Ayoub	بيت أيوب	1020
North	AKKAR	Beit Daoud	بيت داود	790
North	AKKAR	Beit El Gharib	بيت الغريب	870
North	AKKAR	Beit el Ghattas	بيت غطاس	745
North	AKKAR	Beit el Haj	بيت الحاج	745
North	AKKAR	Beit El khalil	بيت الخليل	895
North	AKKAR	Beit El Zahleh	بيت الزحلة	785
North	AKKAR	Beit Haouch	بيت الحوش	745
North	AKKAR	Beit Jaalouk	بيت جعلوك	745
North	AKKAR	Beit Mellat	بيت ملات	765
North	AKKAR	Beit Quehbe	بيت وهبه	745
North	AKKAR	Beit Younes	بيت يونس	970
North	AKKAR	Berbara	بربارة	745
North	AKKAR	Berqayel	برقايل	745
North	AKKAR	Bezbina	ببنينا	825
North	AKKAR	Bire	البيره	760
North	AKKAR	Borj	البرج	790
North	AKKAR	Borj El Aarab	برج العرب	745
North	AKKAR	Bqerzala	بقرزلا	745
North	AKKAR	Braghit	براغيت	745
North	AKKAR	Bzaita	بزبينا	745
North	AKKAR	Bzal	بزال	745
North	AKKAR	Chaab Wabel	شعب وابل	975
North	AKKAR	Chadra	شدرا	745
North	AKKAR	Chambouq	شمبوق	1090
North	AKKAR	Chane	شان	810
North	AKKAR	Chaqdouf	الشقدوف	805
North	AKKAR	Chaqdouf Aakkar	شقدوف عكار	970
North	AKKAR	Charbila	شربيلا	745
North	AKKAR	Charifeh	شريفة	795
North	AKKAR	Cheikh Mohammad	الشيخ محمد	745
North	AKKAR	Cheikh Aayach	الشيخ عياش	745
North	AKKAR	Cheikh Hmairine	شيخ حميرين	745
North	AKKAR	Cheikh Ismail	الشيخ اسماعيل	810
North	AKKAR	Cheikh Maarouf	الشيخ معروف	745
North	AKKAR	Cheikh Mhandeh	الشيخ مهنده	745
North	AKKAR	Cheikh Taba	الشيخ طابا	745
North	AKKAR	Cheikh Zennad	الشيخ زناد	745
North	AKKAR	Cheikhlar	شيخلار	745
North	AKKAR	Chittaha	الشطاحة	755
North	AKKAR	Dabadeb	دبابب	745
North	AKKAR	Dabbabiye el Cahrqiyeh	دبابية الشرقية	745
North	AKKAR	Dabbabiye el Gharbie	دبابية الغربية	745
North	AKKAR	Daghle	الدغلي	745
North	AKKAR	Dahr Aaiyas	ضهر عياص	745
North	AKKAR	Daher Billa	ضهر بلا	745
North	AKKAR	Daher El Bellan	ضهر البلان	845
North	AKKAR	Daher El Housain	ضهر الحسين	745
North	AKKAR	Daher El Kniseh	ضهر الكنيسة	745
North	AKKAR	Daher El Qambar	ضهر القنبر	745
North	AKKAR	Daher Laisineh	ضهر ليسينة	745
North	AKKAR	Dahra	الضهرة	745
North	AKKAR	Danbo	دنبو	810
North	AKKAR	Danke	دنكه	745
North	AKKAR	Daoura	دورة	785
North	AKKAR	Daousse et Baghdadi	دوسه	745
North	AKKAR	Dar Ain El Aawra	دار عين العورا	745
North	AKKAR	Dar Chwita	دار شويتا	795
North	AKKAR	Darine	دارين	745
North	AKKAR	Deir Dalloum	دير دلوم	745
North	AKKAR	Deir Jannin	دير جنين	745
North	AKKAR	Deir Mar Elias	دير مار الياس	745
North	AKKAR	Deir Mar Jerjos	دير مار جرجوس	745
North	AKKAR	Deir Mart moura	دير مارت مورا	745
North	AKKAR	Deir Saidet El Qalaa	دير سيدة القلعة	745
North	AKKAR	Dibebiet El Charqieh	دبابية الشرقية	745
North	AKKAR	Ditir	دير طير	765
North	AKKAR	Doueir Aadouiye	دوير عدوية	745
North	AKKAR	El Aabde	العبدة	745
North	AKKAR	El Aawadeh	العوادة	745
North	AKKAR	El Aawaichat	العويشات	745
North	AKKAR	El Aawaineh	العوينة	995
North	AKKAR	El Aakr	العكر	745
North	AKKAR	El Aalaiqa	العليقة	970
North	AKKAR	El Aamara	العمارة	745
North	AKKAR	El Aamayer	العماير	745
North	AKKAR	El Aarida	العريضة	745
North	AKKAR	El Bqaiaa	البقيعة	745
North	AKKAR	El Hicheh	الهيشة	745
North	AKKAR	El Hamra	الحمرا	745
North	AKKAR	El Hawch	الحوش	745
North	AKKAR	El Hekr	الحكر	745
North	AKKAR	El Hmaira	الحميرة	1045
North	AKKAR	El Hmaira	الحميرة	745
North	AKKAR	El Housainia	الحسينية	745
North	AKKAR	El Khalsa	الخالصة	745
North	AKKAR	El Khan	الخان	745
North	AKKAR	El Khirbeh	الخربة	745
North	AKKAR	El Kharnoubeh	الخرنوبة	745
North	AKKAR	El Khodr	الخضر	770
North	AKKAR	El Krahneh	الكراخنة	745
North	AKKAR	El Kroum	الكروم	745
North	AKKAR	El Mahmoudia	المحمودية	745
North	AKKAR	El Mahmra	المحمرة	745

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
North	AKKAR	El Majdel	المجدل	745
North	AKKAR	El Masla	المصلا	745
North	AKKAR	El Mbarkieh	المباركية	745
North	AKKAR	El Mchaielha	المشيلحة	745
North	AKKAR	El Meghraq	المغراق	745
North	AKKAR	El Mouwachi	المواشي	745
North	AKKAR	El Mouwachi	المواشي	870
North	AKKAR	El Mouwenseh	المولسة	770
North	AKKAR	El Mzaiehmeh	المزيحمة	745
North	AKKAR	El Nabi Osman	النبي عثمان	795
North	AKKAR	El Nsour	النسور	745
North	AKKAR	El Qlaiaat	القليعات	745
North	AKKAR	El Rameh	الرامة	745
North	AKKAR	El Ransia	الرنسية	745
North	AKKAR	El Rwaimeh	الرويمة	1100
North	AKKAR	El Rwais	الرويس	770
North	AKKAR	El Said	السيد	745
North	AKKAR	El Samounieh	السمونية	745
North	AKKAR	El Sawalha	الصوالحة	745
North	AKKAR	El Tlaill	التليل	745
North	AKKAR	El Zireh	الزيرة	745
North	AKKAR	El Zouq	الزوق	745
North	AKKAR	El Zwaitini	الزويتيني	745
North	AKKAR	Fnaidek	فنيدق	1070
North	AKKAR	Fraidis	فريديس	745
North	AKKAR	Fsiqine et Ain Echma	فسيقين	745
North	AKKAR	Ghwaia	غوايا	800
North	AKKAR	Ghzaileh	غزيلة	745
North	AKKAR	Habchit	حبشيت	785
North	AKKAR	Haitla	هيتلا	745
North	AKKAR	Haizouq	حيزوق	745
North	AKKAR	Hakour	الحكور	745
North	AKKAR	Halba	حلبا	745
North	AKKAR	Haouchah	حوشب	745
North	AKKAR	Haret El Jdaideh	حارة الجديدة	745
North	AKKAR	Harf Bteaana	حرف بتعنا	805
North	AKKAR	Harf El Sim	حرف السيم	745
North	AKKAR	Hawchab	حوشب	745
North	AKKAR	Hedd	الهد	745
North	AKKAR	Hekr El Cheikh Taba	حكر الشيخ طابا	745
North	AKKAR	Hekr El Dahri	حكر الضاهري	745
North	AKKAR	Hekr El Koussa	حكر الكوسا	745
North	AKKAR	Hekr Janine	حكر جانين	745
North	AKKAR	Hissa	الحيصا	745
North	AKKAR	Hmais	حميص	745
North	AKKAR	Hnaider	حنيدر	765
North	AKKAR	Houaich	حويش	745
North	AKKAR	Hrar	حرار	935
North	AKKAR	Ilat	إيلات	745
North	AKKAR	Jabal Akroum	جبل أكروم	1038
North	AKKAR	Janin	جانين	745
North	AKKAR	Jdaide	الجديدة	745
North	AKKAR	Jdaidet El Joumeh	جديدة الجومة	745
North	AKKAR	Jdaidet El Qaiteaa	جديدة القيطع	745
North	AKKAR	Jebrayel	جبرايل	745
North	AKKAR	Jwar El Aarab	جوار العرب	745

North	AKKAR	Karm Aafour	كرم عصفور	745
North	AKKAR	Karm Zebdin	كرم زبدين	780
North	AKKAR	Kfar El Ftouh	كفر الفتوح	765
North	AKKAR	Kfar Harra	كفرحرة	745
North	AKKAR	Kfar Melki	كفر ملكه	745
North	AKKAR	Kfar Noun	كفرنون	745
North	AKKAR	Kfar Toun	كفرتون	940
North	AKKAR	Khain	خان	745
North	AKKAR	Khirbit Ain Tibo	خربة عين طيبو	825
North	AKKAR	Khirbet Char	خربة شار	745
North	AKKAR	Khirbet Daoud	خربة داود	765
North	AKKAR	Khirbit El Jord	خربة الجرد	900
North	AKKAR	Khirbit El Rimman	خربة الرمان	745
North	AKKAR	Khoja Boustan	خوجا بستان	745
North	AKKAR	Khoucha	خوشا	745
North	AKKAR	Khraibet ej Joundi	خربية الجندي	745
North	AKKAR	Knaiseh	كنيسة	765
North	AKKAR	Knaisse	الكنيسة	745
North	AKKAR	Kouachra	الكواشرة	745
North	AKKAR	Koucha	كوشا	745
North	AKKAR	Kouwaikhat	كويخات	745
North	AKKAR	Kroum el Arab	كروم عرب	745
North	AKKAR	Machha	مشحا	745
North	AKKAR	Machta Hammoud	مشتى حمود	745
North	AKKAR	Machta Hassan	مشتى حسن	745
North	AKKAR	Mahmoudiet El Hiker	محمودية الحكر	745
North	AKKAR	Majdel	مجدل	795
North	AKKAR	Majdla	مجدلا	745
North	AKKAR	Malkiye	ملكية	745
North	AKKAR	Mar Challita	مار شليطا	845
North	AKKAR	Mar Edna	مار إدنا	745
North	AKKAR	Mar Elias	مار الياس	845
North	AKKAR	Mar Sarkis	مار سركيس	770
North	AKKAR	Mar Touma	مار توما	745
North	AKKAR	Marlayeh	مارلايه	995
North	AKKAR	Marayet Haddara	مارلايه حدارة	745
North	AKKAR	Maretmoura	مرتمورة	795
North	AKKAR	Masla	المصلا	745
North	AKKAR	Massaaoudiye	المسعودية	745
North	AKKAR	Mazraat Baldeh	مزرعة بلدة	745
North	AKKAR	Mazraat El Nahriye	مزرعة النهرية	745
North	AKKAR	Mechmech	مشمش	1025
North	AKKAR	Meghraqa	مغراقة	745
North	AKKAR	Menjez	منجز	745
North	AKKAR	Midane	ميدان	795
North	AKKAR	Mimneaa	ممنع	970
North	AKKAR	Minyara	منيارة	745
North	AKKAR	Mouqam El Cheikh Zinnad	مقام الشيخ زناد	745
North	AKKAR	Mqaible	مقيبلة	745
North	AKKAR	Mqaitaa	المقيطع	885
North	AKKAR	Mrah El Aalnouneh	مراح العلونة	745
North	AKKAR	Mrah El Aaliq	مراح العليق	920
North	AKKAR	Mrah El Amir	مراح الأمير	745
North	AKKAR	Mrah El Khaoukh	مراح الخوخ	865
North	AKKAR	Mrahat Aakar	مراحات عكار	785
North	AKKAR	Nabaa El Ghzaileh	نبع الغزيلة	745
North	AKKAR	Nabaa El Safa	نبع الصفا	745

RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
North	AKKAR	Nabi Ayoub	نبي أيوب	1100
North	AKKAR	Nabi Barri	نبي برّي	745
North	AKKAR	Nabi Khaled	نبي خالد	1100
North	AKKAR	Nabi Youniss	نبي يونس	970
North	AKKAR	Nahriye	نهرية	745
North	AKKAR	Nasrieh	ناصرية	745
North	AKKAR	Nemneaa	نمنيعا	975
North	AKKAR	Nfaisse	النفيسة	745
North	AKKAR	Noura el Faouqa	نورا الفوقا	745
North	AKKAR	Noura el Tahta	نورا التحتا	745
North	AKKAR	Oboula	قبولا	760
North	AKKAR	Omar El Din	عمر الدين	745
North	AKKAR	Ouadi Ej jamous	وادي الجاموس	745
North	AKKAR	Ouadi Khaled	وادي خالد	745
North	AKKAR	Ourtousa	أرطوسا	995
North	AKKAR	Qaabrine	قعبرين	745
North	AKKAR	Qabaait	قبعيت	790
North	AKKAR	Qaber El Badawi	قبر البدوي	895
North	AKKAR	Qaber El Tourkman	قبر التركمان	920
North	AKKAR	Qalaaet El Borj	قلعة البرج	755
North	AKKAR	Qamouaa	قموعة	1100
North	AKKAR	Qantara	القنطرة	745
North	AKKAR	Qaraha	قرحيا	752
North	AKKAR	Qarqaf	القرقف	745
North	AKKAR	Qatlabeh	قطلبة	945
North	AKKAR	Qatteh	قتة	745
North	AKKAR	Qbour El Bid	قبور البيض	745
North	AKKAR	Qjnieh	قجنية	831
North	AKKAR	Qlaiaat	قليعات	745
North	AKKAR	Qloud El Baqriye	قلود البقرية	745
North	AKKAR	Qobet Chamra	قبة شمرا	745
North	AKKAR	Qochloq	قشلق	745
North	AKKAR	Qorne	القرنة	1100
North	AKKAR	Qoubaiyat El Fawqa	قبيات الفوقا	820
North	AKKAR	Qoubaiyat el Gharbiye	قبيات الغربية	790
North	AKKAR	Qoubaiyat ez Zouq	قبيات الزوق	765
North	AKKAR	Qraiyat	قريات	970
North	AKKAR	Qsair	القصير	745
North	AKKAR	Quadi el Hour	وادي الحور	745
North	AKKAR	Rababiye	ربابية	745
North	AKKAR	Rahbeh	رحبه	795
North	AKKAR	Rihaniye	الريحانية	745
North	AKKAR	Rijem Beit Hsain	رجم بيت حسين	745
North	AKKAR	Rmah en Nahriye	رماح	745
North	AKKAR	Rmoul	الرمول	745
North	AKKAR	Saadine	سعدين	745
North	AKKAR	Sabagha	صباغة	745
North	AKKAR	Sadaqa	صدقة	770
North	AKKAR	Safinet ed Draib	سفينة الدريب	745
North	AKKAR	Safinet El Qaiteaa	سفينة القيطع	850
North	AKKAR	Sahle	السهلة	845
North	AKKAR	Saida	صنيدا	745
North	AKKAR	Saidet Kmaa	سيدة كماع	945
North	AKKAR	Saidnaya	صيدنايا	745
North	AKKAR	Saissouq	سيسوق	745
North	AKKAR	Semmaqiye	السماقية	745

North	AKKAR	Sindianet El kawachra	سنديانة الكواشرة	745
North	AKKAR	Sindianet Zaidan	سنديانة زيدان	765
North	AKKAR	Souaisse	السويسة	745
North	AKKAR	Soultan Ibrahim	سلطان ابراهيم	745
North	AKKAR	Srar	سرار	745
North	AKKAR	Tacheaa	تاشيع	1060
North	AKKAR	Tahoun El Aaboudeh	طاحون العبودة	745
North	AKKAR	Takrit	تكريت	765
North	AKKAR	Tall Aabbas el Gharbi	تل عباس الغربي	745
North	AKKAR	Tall Abbas ech Charqi	تل عباس الشرقي	745
North	AKKAR	Tall Bibi	تل بيبي	745
North	AKKAR	Tall Bire	تل بيره	745
North	AKKAR	Tall El Hayet	تل الحيات	745
North	AKKAR	Tall El Zafir	تلة الزفير	745
North	AKKAR	Tall Hmaire	تل حميرة	745
North	AKKAR	Tall Kiri	تل كيري	745
North	AKKAR	Tall Lajini	تل لاجيني	745
North	AKKAR	Tall Meaalan	تل معلان	745
North	AKKAR	Tall Sibaael	تل سبعل	745
North	AKKAR	Tall Zaka	تل زكا	745
North	AKKAR	Talle		745
North	AKKAR	Tallet El Mjabar	تلة المجبر	745
North	AKKAR	Tallet El Zraaa	تلة الزراعة	745
North	AKKAR	Tallet Tlais	تلة الطليس	820
North	AKKAR	Tallet W Shattaha	تلة وشطاحة	770
North	AKKAR	Tlailleh	تليلة	767
North	AKKAR	Wadi El Hawr	وادي الحور	745
North	AKKAR	Wata	وطى	745
North	AKKAR	Zaboud	زبود	975
North	AKKAR	ZakZouk	زكزك	745
North	AKKAR	Zouarib	الزواريب	745
North	AKKAR	Zouq El Bacha	زوق الباشا	745
North	AKKAR	Zouq el Habalsa	زوق الحبالصة	745
North	AKKAR	Zouq El Hassine	زوق الحصنية	745
North	AKKAR	Zouq El Mqachrine	زوق المقشرين	745
North	AKKAR	Zouq Hadara	زوق حضارة	745
North	BATROUN	Aabdelle	عبدلي	815
North	BATROUN	Aabrine	عبرين	745
North	BATROUN	Aafs	العفص	745
North	BATROUN	Aalali	العلالي	920
North	BATROUN	Aaoura	عوره	850
North	BATROUN	Aaqabeh	العقبة	870
North	BATROUN	Aartez	عرطز	745
North	BATROUN	Aazaqa	العزاقة	745
North	BATROUN	Ain Billawze	عين بلوز	1100
North	BATROUN	Ain El Batyeh	عين الباطية	1100
North	BATROUN	Ain El Blat	عين البلاط	1100
North	BATROUN	Ain Chmouna	عين شمونا	745
North	BATROUN	Ain El Raha	عين الراحة	1020
North	BATROUN	Arez Niha	أرز نيحا	1100
North	BATROUN	Arez Tanourin	أرز تنورين	1100
North	BATROUN	Assia	اسيا	895
North	BATROUN	Balaa	بلعه	1100
North	BATROUN	Basbina	بسبينا	745
North	BATROUN	Batha	بطحا	1050
North	BATROUN	Batroun	البترون	745
North	BATROUN	Bcheale	بشعلي	845

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
North	BATROUN	Bchealli	بْشَعْلة	1100
North	BATROUN	Bechtoudar	بشْتودار	955
North	BATROUN	Beit Chlala	بيت شْلالا	805
North	BATROUN	Beit Kassab	بيت كساب	995
North	BATROUN	Bijdarfel	بجدرفل	745
North	BATROUN	Biyad	البَيّاض	745
North	BATROUN	Birzqain	برزقين	745
North	BATROUN	Blat	البَلاط	1020
North	BATROUN	Boroj	البَرج	745
North	BATROUN	Boustane El Aassi	بستان العصي	785
North	BATROUN	Btibyat	بْتيبيات	1070
North	BATROUN	Bqaiaa	البَقيعة	785
North	BATROUN	Bqosmaiya	بَقسْمايا	745
North	BATROUN	Chaabiyeh	شَعْبيّة	1100
North	BATROUN	Chabtine	شبطين	745
North	BATROUN	Chatine	شاتين	1100
North	BATROUN	Chekka	شْكّا	745
North	BATROUN	Chekka El Aatiqa	شْكا العَتيقة	745
North	BATROUN	Daael	داعل	820
North	BATROUN	Dahr Abi Yaghi	ضهر أبي ياغي	770
North	BATROUN	Dahr El Qatlab	ضهر القَطْلب	770
North	BATROUN	Dawra	الدَّوْرة	745
North	BATROUN	Deir Bassa	دير بصه	982
North	BATROUN	Deir Billa	دير بلّا	860
North	BATROUN	Deir Chouwah	دير شْوَاح	745
North	BATROUN	Deir Kfifane	دير كْفيفان	745
North	BATROUN	Deir Houb	دير حُوبْ	1100
North	BATROUN	Deir Mar Doumet	دير مار ضُومط	1100
North	BATROUN	Deir Mar Richa	دير مار ريشا	745
North	BATROUN	Deir Mar Youhana Maroun	دير مار يُوحنّا مارُون	745
North	BATROUN	Deir Mar Youssof	دير مار يُوسُف(جَرْبتا)	745
North	BATROUN	Deir Mar Youssof	دير مار يُوسُف (عَرْبين)	745
North	BATROUN	Deir Nouriyeh	دير النّورية	745
North	BATROUN	Derya	دريا	752
North	BATROUN	Diria	ديريا	750
North	BATROUN	Douma	دوما	1025
North	BATROUN	Douq	دُوق	900
North	BATROUN	Dwair	الدّوير	1100
North	BATROUN	Edde	إدّه	745
North	BATROUN	El - Heri	الهري	745
North	BATROUN	Fadaaous	فْدَاعوس	745
North	BATROUN	Fahta	فحْتا	1100
North	BATROUN	Fawar	الفوّار	1100
North	BATROUN	Fayadiyeh	فيّاضية	1100
North	BATROUN	Fitra	فترا	920
North	BATROUN	Ftaihat	فتّاحات	770
North	BATROUN	Ghouma	غوما	745
North	BATROUN	Hadtoun	حدْتون	1010
North	BATROUN	Halta	حلْتا	810
North	BATROUN	Hamat	حامات	745
North	BATROUN	Hannouch	حنّوش	745
North	BATROUN	Harbouna	هربونا	745
North	BATROUN	Hardine	حَرْدين	1015
North	BATROUN	Harisa	حريصا	1100
North	BATROUN	Hourata	حُوراتا	1100
North	BATROUN	Ijdabra	إجْدبرا	745
North	BATROUN	Jabla	جبْلا	745
North	BATROUN	Jindi	الجَنْدي	915
North	BATROUN	Jrane	جْران	745
North	BATROUN	Jrebta	جْربتا	755
North	BATROUN	Kfar Aabeida	كْفر عبيدا	745
North	BATROUN	Kfar Chlaimane	كْفر شْليمان	845
North	BATROUN	Kfar Hatna	كْفر حتنا	745
North	BATROUN	Kfar Hay	كْفر حيّ	745
North	BATROUN	Kfar Helda	كْفر حلْدا	815
North	BATROUN	Kfar Khoullos	كْفر خُلّص	745
North	BATROUN	Kfifane	كْفيفان	745
North	BATROUN	Kfour El Aarbi	كْفور العَرْبي	1030
North	BATROUN	Khirhil	خرحل	1100
North	BATROUN	Khormalaya	خرملايا	1100
North	BATROUN	Khraibeh	الخَرَيبة	770
North	BATROUN	Kibraya	كبرايا	1100
North	BATROUN	Koubba	كبّا	745
North	BATROUN	Kour	كُورْ	745
North	BATROUN	Ksara	الكْسارة	1100
North	BATROUN	Madfoun	المَدْفون	745
North	BATROUN	Mahlisa	مَحْليصا	1045
North	BATROUN	Mar Abdallah	مار عبد الله	765
North	BATROUN	Mar Chira	مار شيرا	995
North	BATROUN	Mar Elias	مار الياس	745
North	BATROUN	Mar Hanna	مار حنّا	1007
North	BATROUN	Mar Jerjes	مار جرجس	995
North	BATROUN	Mar Mama	مار ماما	940
North	BATROUN	Mar Mikhael	مار مخايل	1100
North	BATROUN	Mar Saba	مار سابا	880
North	BATROUN	Mar Sarkis	مار سركيس	1100
North	BATROUN	Mar Simaan	مار سمعان	745
North	BATROUN	Mar Touma	مار تُوما	915
North	BATROUN	Mar Yaaqoub	مار يعْقوب	1020
North	BATROUN	Markaz	المركز	1100
North	BATROUN	Masrah	مسْرح	850
North	BATROUN	Mihmarche	مَحْمَرْش	955
North	BATROUN	Mrah Chdid	مْراح بو شْديد	745
North	BATROUN	Mrah El Haj	مْراح الحاج	870
North	BATROUN	Mrah Ez Zaiat	مْراح الزّيّات	745
North	BATROUN	Mrouj	المْرُوج	1100
North	BATROUN	Nahle	نحْلة	905
North	BATROUN	Nahriyeh	النهرية	745
North	BATROUN	Naqraya	نقريا	745
North	BATROUN	Niha	نيحا	1100
North	BATROUN	Niha	نيحا	920
North	BATROUN	Ouata Haub	وطى حُوب	1100
North	BATROUN	Qalaa	القلعة	745
North	BATROUN	Qalaat El Hosn	قلعة الحصن	1100
North	BATROUN	Qalaat EL Msailha	قلعة المسيلحة	745
North	BATROUN	Qandoula	قنْدولا	920
North	BATROUN	Qarnaoun	قرْنعون	745
North	BATROUN	Qornit El Mrah	قُرنة المْراح	920
North	BATROUN	Quajh El - Hajar	وجه الحجر	745
North	BATROUN	Racha	راشا	955
North	BATROUN	Rachana	راشانا	745
North	BATROUN	Rachkaidah	راشكيدة	745
North	BATROUN	Rachkiddeh	راشكده	765

RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
North	BATROUN	Ram	رام	1085
North	BATROUN	Ramat	رامات	745
North	BATROUN	Ras Chaqaa	راس الشقعة	745
North	BATROUN	Ras Nhache	راس نحاش	745
North	BATROUN	Rweis	الرويس	945
North	BATROUN	Salaa	صلّعة	745
North	BATROUN	Salaata	سلّعاتا	745
North	BATROUN	Sghar	صغار	745
North	BATROUN	Smar Jbail	سمار جبيل	745
North	BATROUN	Sourat	صورات	745
North	BATROUN	Tannourine el Faouqa	تنّورين الفوقا	1100
North	BATROUN	Tanourine Et Tahta	تنّورين التحتا	955
North	BATROUN	Tel Ras Nhash	تل راس نحاش	745
North	BATROUN	Thoum	ثوم	745
North	BATROUN	Toula	تولا	820
North	BATROUN	Wata Sfarta	وطى صفرتا	745
North	BATROUN	Yarita	يا ريتا	820
North	BATROUN	Zane	زان	782
North	BATROUN	Ziri	الزيري	785
North	BCHARRE	Aabdine	عبدين	975
North	BCHARRE	Aaichana	عيشانة	1100
North	BCHARRE	Ain Baqrah	عين بقرة	1100
North	BCHARRE	Aatryata	عترياتا	1100
North	BCHARRE	Al Arz	الأرز	1100
North	BCHARRE	Bane	بان	1100
North	BCHARRE	Bain El Nahrain	بين النهرين	845
North	BCHARRE	Barhalioun	برحليون	1000
North	BCHARRE	Bazaoun	بزعون	1100
North	BCHARRE	Bcharre	بشري	1100
North	BCHARRE	Beit El Chaar	بيت الشعار	845
North	BCHARRE	Beit Menzer	بيت منذر	1070
North	BCHARRE	Beit Raad	بيت رعد	1100
North	BCHARRE	Billa	بلا	1090
North	BCHARRE	Blaouza	بلوزا	1100
North	BCHARRE	Bnahleh	بنحلة	1100
North	BCHARRE	Bqaa Kafra	بقاع كفرا	1100
North	BCHARRE	Bqerqacha	بقرقاشا	1100
North	BCHARRE	Braissat	بريسات	1100
North	BCHARRE	Chana	شانا	1100
North	BCHARRE	Dahr El Qadib	ضهر القضيب	1100
North	BCHARRE	Deir Qozhaia	دير قزحيا(دير مار انطونيوس)	1045
North	BCHARRE	Deir Mar Lichaa	دير مار ليشع	1100
North	BCHARRE	Deir Mar Simaane	دير مار سمعان	1100
North	BCHARRE	Dimane	الديمان	1100
North	BCHARRE	El Ouadi	القاضي	950
North	BCHARRE	Fam El Mizab	فم الميزاب	1100
North	BCHARRE	Hadchit	حدشيت(عن طريق بشري)	1100
North	BCHARRE	Hadet Ej jebbe	حدث الجبة	1100
North	BCHARRE	Haret Chaaya	حارة شعيا	1100
North	BCHARRE	Hasroun	حصرون	1100
North	BCHARRE	Hqallet Marouna	حقلة مارونا	1100
North	BCHARRE	Kfar Saroun	كفر صارون	1100
North	BCHARRE	Kizbar	كزبر	1100
North	BCHARRE	Mar Sarkis	مار سركيس	1100
North	BCHARRE	Mazraat Assaf	مزرعة عساف	975
North	BCHARRE	Mazraat Beni Saalt	مزرعة بني صعب	1000
North	BCHARRE	Metrit	مترىت	875
North	BCHARRE	Mgharet Qadicha	مغارة قاديشا	1100
North	BCHARRE	Moghr El Ahwal	مغر الأحول	825
North	BCHARRE	Qassouba	قصوبا	1100
North	BCHARRE	Qatea Bou Mrad	قاطع بو مراد	1100
North	BCHARRE	Qnaiouer	قنيور	1100
North	BCHARRE	Qnat	قنات	1070
North	BCHARRE	Tourza	طورزا	835
North	BCHARRE	Wadi Qanoubine	وادي قنوبين	950
North	BCHARRE	Yamleh	يملة	1100
North	DINNIYE-MINYE	Aaimar	عيمار	1040
North	DINNIYE-MINYE	Ain El Sofsafe	عين الصفصافة	1100
North	DINNIYE-MINYE	Ain El Tineh	عين التينة	930
North	DINNIYE-MINYE	Aaraman	عرمان	745
North	DINNIYE-MINYE	Aasaimout	عصيمات	830
North	DINNIYE-MINYE	Aasoun	عاصون	957
North	DINNIYE-MINYE	Aayoun El Samak	عيون السمك	745
North	DINNIYE-MINYE	Aazqi	عزقي	745
North	DINNIYE-MINYE	Afqa	افقا	1045
North	DINNIYE-MINYE	Baazqoun	بعزقون	770
North	DINNIYE-MINYE	Bahwita	بحويتا	1070
North	DINNIYE-MINYE	Bakhaaoun	بخعون	820
North	DINNIYE-MINYE	Beit Bakour	بيت بكور	815
North	DINNIYE-MINYE	Beit Dawoud	بيت داود	875
North	DINNIYE-MINYE	Beit El Aarab	بيت العرب	745
North	DINNIYE-MINYE	Beit El Chami	بيت الشامي	745
North	DINNIYE-MINYE	Beit El Faqes	بيت الفقس	995
North	DINNIYE-MINYE	Beit Hasna	بيت حسنا	870
North	DINNIYE-MINYE	Beit Hawik	بيت حاويك	920
North	DINNIYE-MINYE	Beit Hotman	بيت حتمان	820
North	DINNIYE-MINYE	Beit Jida	بيت جيدا	920
North	DINNIYE-MINYE	Beit Moumneh	بيت مومنه	1055
North	DINNIYE-MINYE	Beir Radwan	بير رضوان	895
North	DINNIYE-MINYE	Beit Zoud	بيت زود	830
North	DINNIYE-MINYE	Berkit El Hamra	بركة الحمرا	745
North	DINNIYE-MINYE	Bchenata	بشناتا	1100
North	DINNIYE-MINYE	Bchetaya	بشتايا	820
North	DINNIYE-MINYE	Bhanin	بحنين	745
North	DINNIYE-MINYE	Bqaa Safrin	بقاع صفرين	1045
North	DINNIYE-MINYE	Bqarsouna	بقرصونا	1020
North	DINNIYE-MINYE	Btermaz	بطرماز	820
North	DINNIYE-MINYE	Borj El Yahoudiye	برج اليهودية	745
North	DINNIYE-MINYE	Btehlin	بتخلين	865
North	DINNIYE-MINYE	Btelai	بطلّيه	1100
North	DINNIYE-MINYE	Chalout	شالوط	1070
North	DINNIYE-MINYE	Daraya	دارايا	1070
North	DINNIYE-MINYE	Debaal	دبعل	795
North	DINNIYE-MINYE	Deir Aamar	دير عمار	745
North	DINNIYE-MINYE	Deir Nbouh	دير نبوح	745
North	DINNIYE-MINYE	El Aayoun	العيون	840
North	DINNIYE-MINYE	El Arbaain	الاربعين	1100
North	DINNIYE-MINYE	El Bidawi	البداوي	745
North	DINNIYE-MINYE	El Borji	البرجي	845
North	DINNIYE-MINYE	El Chammis	الشميس	895
North	DINNIYE-MINYE	El Daidaba	الديدبة	745
North	DINNIYE-MINYE	El Dhebieh	الذهبية	745
North	DINNIYE-MINYE	El Hazmieh	الحازمية	875

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
North	DINNIYE-MINYE	El Hekr	الحكر	745
North	DINNIYE-MINYE	El Malha	المالحة	855
North	DINNIYE-MINYE	El Manchara	المنشرة	995
North	DINNIYE-MINYE	El Maqtouaa	المقطوعة	1070
North	DINNIYE-MINYE	El Menieh	المنية	745
North	DINNIYE-MINYE	El Nabi Kzaiber	النبي كزبير	745
North	DINNIYE-MINYE	El Nabi Nsar	النبي نصار	1070
North	DINNIYE-MINYE	El Nabi Yaaqoub	النبي يعقوب	995
North	DINNIYE-MINYE	El Nabi Youchaa	النبي يوشع	745
North	DINNIYE-MINYE	El Qaren	القرن	970
North	DINNIYE-MINYE	El Qattin	القطين	870
North	DINNIYE-MINYE	El Rawda	الروضة	745
North	DINNIYE-MINYE	El Rihanieh	الريحانية	745
North	DINNIYE-MINYE	El Sfira	السفيرة	1005
North	DINNIYE-MINYE	El Snawbar	السنوبر	1045
North	DINNIYE-MINYE	El Swaqi	السواقي	1100
North	DINNIYE-MINYE	El Watieh	الواطية	745
North	DINNIYE-MINYE	Faqous	فاقوس	875
North	DINNIYE-MINYE	Ferjeh	فرجة	962
North	DINNIYE-MINYE	Harf El Siad	حرف السياد	820
North	DINNIYE-MINYE	Hawara	حوارة	985
North	DINNIYE-MINYE	Hay El Aatiqa	حي العتيقة	745
North	DINNIYE-MINYE	Hay El Blat	حي البلاط	745
North	DINNIYE-MINYE	Heqel El Aazimeh	حقل العزيمة	895
North	DINNIYE-MINYE	Hraiqes	حريقص	745
North	DINNIYE-MINYE	Izal	إيزال	970
North	DINNIYE-MINYE	Jabal El Makmal	جبل المكمل	1100
North	DINNIYE-MINYE	Jabal Tirbol	جبل تربل	797
North	DINNIYE-MINYE	Jairoun	جيرون	1020
North	DINNIYE-MINYE	Jiha	جحا	820
North	DINNIYE-MINYE	Jourit El Khouri	جورة الخوري	922
North	DINNIYE-MINYE	Kahef El Malloul	كهف الملول	965
North	DINNIYE-MINYE	Karm El Akhras	كرم الأخرس	745
North	DINNIYE-MINYE	Karm El Mohr	كرم المهر	1020
North	DINNIYE-MINYE	Kfar Bebnine	كفر ببنين	1065
North	DINNIYE-MINYE	Kfar Chillan	كفر شلان	745
North	DINNIYE-MINYE	Kfar Habou	كفر حبو	745
North	DINNIYE-MINYE	Kharnoub	خرنوب	820
North	DINNIYE-MINYE	Markibta	مار كبتا	745
North	DINNIYE-MINYE	Marmar	مرمر	805
North	DINNIYE-MINYE	Mazraat Ketran	مزرعة كترات	745
North	DINNIYE-MINYE	Mgharet El Cheikh	مغارة الشيخ	1055
North	DINNIYE-MINYE	Moulid	مولد	840
North	DINNIYE-MINYE	Mrah El Sfireh	مراح السفيرة	945
North	DINNIYE-MINYE	Mrah El Sraij	مراح السريج	755
North	DINNIYE-MINYE	Mrebin	مربين	1100
North	DINNIYE-MINYE	Nabaa El Sokar	نبع السكر	1100
North	DINNIYE-MINYE	Nemrine	نمرين	970
North	DINNIYE-MINYE	Qarhaia	قرحيا	745
North	DINNIYE-MINYE	Qarsita	قرصيتا	1070
North	DINNIYE-MINYE	Qimmamin	قمامين	895
North	DINNIYE-MINYE	Qornet El Sawda	قرنة السودا	1100
North	DINNIYE-MINYE	Qraiin	قرين	845
North	DINNIYE-MINYE	Ramlet El Hamra	رملة الحمرا	1090
North	DINNIYE-MINYE	Sartouka	سرتوكه	895
North	DINNIYE-MINYE	Sir el Dinniye	سير	952

North	DINNIYE-MINYE	Taran	طاران	825
North	DINNIYE-MINYE	Tirbol	تربل	795
North	DINNIYE-MINYE	Tirmalik	طرمالك	815
North	DINNIYE-MINYE	Wadi El Nahle	وادي النحلة	745
North	DINNIYE-MINYE	Wadi El Njas	وادي النجاص	1100
North	DINNIYE-MINYE	Wadi Jhanam	وادي جهنم	1100
North	DINNIYE-MINYE	Wadi Serri	وادي سري	895
North	DINNIYE-MINYE	Zghirtighrin	زغرتغرين	895
North	KOURA	Aaba	عابا	745
North	KOURA	Aafsdiq	عفصديق	745
North	KOURA	Ain Aakrine	عين عكرين	815
North	KOURA	Ain Frachlo	عين فرشلو	745
North	KOURA	Ain Iqach	عين ايقاف	745
North	KOURA	Amioun	اميون	745
North	KOURA	Bahbouch	بحبوش	745
North	KOURA	Balamend	بلمند	745
North	KOURA	Barghoun	برغون	745
North	KOURA	Barsa	برسا	745
North	KOURA	Batroumine	بترومين	745
North	KOURA	Bdeihoun	بديهون	745
North	KOURA	Bdibba	بديا	745
North	KOURA	Bechmizzine	بشمزين	745
North	KOURA	Bednayel	بدنايل	745
North	KOURA	Bkeftine	بكفتين	745
North	KOURA	Bkomra	بكمرا	745
North	KOURA	Bnehrane	بنهران	780
North	KOURA	Bsarma	بصرما	745
North	KOURA	Btaaboura	بتعبورة	745
North	KOURA	Btouratij	بتورات ايج	745
North	KOURA	Btourram	بطرام	745
North	KOURA	Bziza	بزيزا	745
North	KOURA	Charlita	شرليطا	745
North	KOURA	Chira	شيرا	852
North	KOURA	Chnata	شناطا	775
North	KOURA	Dahr El Ain	ضهر العين	745
North	KOURA	Dar Baachtar	دار بعشتار	745
North	KOURA	Dar chmizzine	دار شمزين	745
North	KOURA	Dedde	ددّه	745
North	KOURA	Deir El Balamand	دير البلمند	745
North	KOURA	Deir Saidet El Bariyeh	دير سيدة البرية	745
North	KOURA	Deir Saidet EL Najat (Bsarma)	دير سيدة النجاة (بصرما)	745
North	KOURA	Deir Saidet El Natour	دير سيدة الناطور	745
North	KOURA	Dhou El Hawa	ضهور الهوا	745
North	KOURA	El Aaqabeh	العقبة	745
North	KOURA	El Bahsas	البحصاص	745
North	KOURA	El Hariq	الحريق	745
North	KOURA	El Nakhle	النخلة	745
North	KOURA	El Rwais	الرويس	745
North	KOURA	Enfe	انفه	745
North	KOURA	Fiaa	فيع	745
North	KOURA	Haql Zwain	حقل زوين	745
North	KOURA	Haret El Ain	حارة العين	745
North	KOURA	Haret El Khalsa	حارة الخلصة	745
North	KOURA	Ijdabrine	اجدعرين	745
North	KOURA	Jdaidet Barqacha	جديدة برقاشا	745
North	KOURA	Kaftoun	كفتون	745
North	KOURA	Kelbata	كلبتا	745

RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
North	KOURA	Kfar Aaqqa	كفر عقا	745
North	KOURA	Kfar Hata	كفر حاتا	745
North	KOURA	Kfar Hazir	كفر حزير	745
North	KOURA	Kfar Qahel	كفر قاهل	745
North	KOURA	Kfar Saroun	كفر صارون	745
North	KOURA	Kifraiya	كفريا	745
North	KOURA	Kousba	كوسبا	745
North	KOURA	Majdel	مجدل	745
North	KOURA	Mjaidel	مجيدل	745
North	KOURA	Mar Fawqa	مار فوقا	745
North	KOURA	Mar Semaan	مار سمعان	745
North	KOURA	Mar Yaaqoub	مار يعقوب	745
North	KOURA	Mar Youhanna	مار يوحنا	745
North	KOURA	Mrah El Habcheh	مراح الحبشي	745
North	KOURA	Qalhat	القلحات	745
North	KOURA	Ras Masqa El Chmaliye	راس مسقا الشمالية	745
North	KOURA	Ras Masqa El Janoubieh	راس مسقا الجنوبية	745
North	KOURA	Rechdibin	رشديين	832
North	KOURA	Waata Fares	وطى فارس	745
North	KOURA	Zakroun	زكرون	745
North	KOURA	Zakzouk	زكزوك	745
North	KOURA	Zgarta El Mtoule	زغرتا المتولة	860
North	TRIPOLI	Aamar	عمار	1020
North	TRIPOLI	Aassaimout	عصيمات	830
North	TRIPOLI	Aassoun	عصون	967
North	TRIPOLI	Abou Halqa	ابو حلقة	745
North	TRIPOLI	Ain Et Tine	عين التين	1090
North	TRIPOLI	Azqey	ازكي	745
North	TRIPOLI	Bakhaoun	بخعون	810
North	TRIPOLI	Beit El Arabe	بيت العرب	920
North	TRIPOLI	Beit El Faqs	بيت القس	975
North	TRIPOLI	Beit Haouik	بيت حاويك	915
North	TRIPOLI	Beit Hatmane	بيت حتمانه	820
North	TRIPOLI	Borj El Yahoudiye	برج اليهودية	745
North	TRIPOLI	Bqaa Safrin	بقاع صفرين	995
North	TRIPOLI	Bqarsouna	بقرصونا	1010
North	TRIPOLI	Btahline	بتحلين	865
North	TRIPOLI	Btoumaz	بطماز	818
North	TRIPOLI	Chalout	شالوت	1100
North	TRIPOLI	Deir Amar	دير عمار	745
North	TRIPOLI	Deir Nbouh	دير نبوح	745
North	TRIPOLI	El Beddaoui	البداوي	745
North	TRIPOLI	El Mina	الميناء	745
North	TRIPOLI	El Minie	المنية	745
North	TRIPOLI	El Qalamoun	القلمون	745
North	TRIPOLI	En Nabi Youchaa	النبي يوشع	745
North	TRIPOLI	Haoura	حورا	985
North	TRIPOLI	Haql El Aazime	حقل العزيمه	875
North	TRIPOLI	Haret E Charfeh	حارة الشرفة	745
North	TRIPOLI	Haret El Fouar	حارة الفوار	745
North	TRIPOLI	Hart Es saiyad	حارة الصياد	830
North	TRIPOLI	Hazmiye	حازميه	875
North	TRIPOLI	Izal	ازال	975
North	TRIPOLI	Jairoun	جيرون	1020
North	TRIPOLI	Kahf El - Mallouf	كهف الملوف	965
North	TRIPOLI	Karm El - Mohr	كرم المهر	1020
North	TRIPOLI	Kfar Bebnine	كفر بينين	1065
North	TRIPOLI	Kfar Chillane	كفر شيلان	745
North	TRIPOLI	Kfar Habou	كفر حبو	745
North	TRIPOLI	Kharnoub	خرنوب	825
North	TRIPOLI	Markabta	مركبتا	745
North	TRIPOLI	Mrah Es Sreiij	مراح السريج	755
North	TRIPOLI	Nemrine Et Bkoura	نمرين وبكورا	970
North	TRIPOLI	Qarsita	قرصيتا	1050
North	TRIPOLI	Qattine	قطينه	870
North	TRIPOLI	Qemmamine	قمامين	895
North	TRIPOLI	Qraiin	قرين	845
North	TRIPOLI	Sfire	سفيره	1005
North	TRIPOLI	Sir Ed Donie	سير الضنية	945
North	TRIPOLI	Terbol	تربل	795
North	TRIPOLI	Trablous	طرابلس	745
North	TRIPOLI	Zghartighrine	زغرتغرين	890
North	ZGHARTA	Aachach	عشاش	745
North	ZGHARTA	Aadwi	عدوي	745
North	ZGHARTA	Aalma	علما	745
North	ZGHARTA	Aarbet Qozhaiya	عربة قزحيا	990
North	ZGHARTA	Aardat	عردات	745
North	ZGHARTA	Aarjess	عرجس	745
North	ZGHARTA	Aaqbeh	عقبة	875
North	ZGHARTA	Ain Tourine	عيطورين	1100
North	ZGHARTA	Aitou	ايطو	970
North	ZGHARTA	Arde	ارده	745
North	ZGHARTA	Aslout	اسلوت	970
North	ZGHARTA	Asnoun	اسنون	745
North	ZGHARTA	Bafhoum	بفحوم	805
North	ZGHARTA	Baiader Rachaain	بيادر رشعين	745
North	ZGHARTA	Baslouqit	بسلوقيت	1100
North	ZGHARTA	Beit Qnati	بيت قناتي	745
North	ZGHARTA	Bchihara	بشحار	815
North	ZGHARTA	Bchama	بشاما	745
North	ZGHARTA	Bchannine	بشنين	745
North	ZGHARTA	Beit Aabeid	بيت عبيد	745
North	ZGHARTA	Beit Aaoukar	بيت عوكر	745
North	ZGHARTA	Beit Barakat	بيت بركات	745
North	ZGHARTA	Beit Daoud	بيت داوود	875
North	ZGHARTA	Bhaira (el)	البحيرة	1070
North	ZGHARTA	Bnichaai	بنشعي	745
North	ZGHARTA	Bouhairet Toula	بحيرة طولا	1070
North	ZGHARTA	Bousit	بوسيط	790
North	ZGHARTA	Bqoufa	بقوفا	1100
North	ZGHARTA	Bsilbaal	بسلعل	745
North	ZGHARTA	Darayia	دارتا	745
North	ZGHARTA	Deir Hamatoura	دير حماطورا	745
North	ZGHARTA	Deir Mar Jerjes (Aachach)	دير مار جرجس	745
North	ZGHARTA	Deir Mar Jerjes (Ijbaa)	دير مار جرجس	1070
North	ZGHARTA	Deir Mar Jerjes (Hammatoura)	دير مار جرجس	847
North	ZGHARTA	Deir Mar Sarkis	دير مار سركيس	1100
North	ZGHARTA	Deir Mar Simaan	دير مار سمعان	1060
North	ZGHARTA	Deir Mar Yaaqoub	دير مار يعقوب	870
North	ZGHARTA	Deir Mart Moura	دير مارت مورا	745
North	ZGHARTA	Ehden	اهدن	1100
North	ZGHARTA	El Aaqbeh	العقبة	745
North	ZGHARTA	El Hara El Jadida	الحارة الجديدة	745

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
North	ZGHARTA	El Jbabieh	الجبابية	745
North	ZGHARTA	El Khaldieh	الخالدية	745
North	ZGHARTA	El Talleh	التلة	745
North	ZGHARTA	El Qadriye	القادرية	745
North	ZGHARTA	Fradis	الفرديس	850
North	ZGHARTA	Hairouna	حيرونا	875
North	ZGHARTA	Haouqa El Naher	حوق النهر	755
North	ZGHARTA	Harf Hazir	حرف حزير	840
North	ZGHARTA	Haret El Fawar	حارة الفوار	745
North	ZGHARTA	Harf Mizaira	حرف مزيارة	965
North	ZGHARTA	Harf Arde	حرف ارده	745
North	ZGHARTA	Hawqa	حوقا	1100
North	ZGHARTA	Hilane	حيلان	745
North	ZGHARTA	Hmaiis	حميص	870
North	ZGHARTA	Iaal	إيعال	745
North	ZGHARTA	Ijbaa	إجبع	1070
North	ZGHARTA	Jdaideh	جديدة	745
North	ZGHARTA	Kaabouch	كعبوش	745
North	ZGHARTA	Kafar Zeina	كفرزينا	745
North	ZGHARTA	Kafraiya	كفريا	755
North	ZGHARTA	Karabach	قره باش	745
North	ZGHARTA	Karbaraiba	كربريبه	745
North	ZGHARTA	Karm Sadde	كرمسده	795
North	ZGHARTA	Kfar Chakhna	كفرشخنا	745
North	ZGHARTA	Kfar dlaqous	كفردلقوس	745
North	ZGHARTA	Kfar Fou	كفرفو	745
North	ZGHARTA	Kfar Hada	كفرحادا	745
North	ZGHARTA	Kfar Haoura	كفرحورا	745
North	ZGHARTA	Kfar Sghab	كفر صغاب	1100
North	ZGHARTA	Kfar Yachit	كفريائيت	745
North	ZGHARTA	Laal	لال	745
North	ZGHARTA	Majdalaya	مجدليا	745
North	ZGHARTA	Mar Aabda	مار عبدا	1100
North	ZGHARTA	Mar Jerjes	مار جرجس	1007
North	ZGHARTA	Mazraat Balhiss	مزرعة بالحيص	1100
North	ZGHARTA	Mazraat El Naher	مزرعة النهر	780
North	ZGHARTA	Mazraat El Toufah	مزرعة التفاح	935
North	ZGHARTA	Mazraat Hraiqis	مزرعة خريقص	745
North	ZGHARTA	Miryata	مزياطة	745
North	ZGHARTA	Miziara	مزيارة	890
North	ZGHARTA	Morh Kfar Sghab	مرح كفر صغاب	745
North	ZGHARTA	Nabaa fraijeh	نبع فريجة	855
North	ZGHARTA	Nabaa Jouaait	نبع جوعيت	1100
North	ZGHARTA	Nabaa Mar Sarkis	نهر مار سركيس	1100
North	ZGHARTA	Rachaain	رشعين	745
North	ZGHARTA	Raskifa	راسكيفا	745
North	ZGHARTA	Richtaamout	رشتعموت	845
North	ZGHARTA	Rmaileh	رميلة	745
North	ZGHARTA	Saidet El Hoson	سيدة الحصن	1100
North	ZGHARTA	Sakhra	صخرة	745
North	ZGHARTA	Sebaal	سبعل	805
North	ZGHARTA	Selouane Sghab	سلوان سغاب	1100
North	ZGHARTA	Seraal	سرعل	850
North	ZGHARTA	Toula	تولا	1055
North	ZGHARTA	Zgharta	زغرتا	745
South	JAZZINE	Aadour	عاضور	885
South	JAZZINE	Aaichiye	العيشية	735
South	JAZZINE	Aain El Tafra	عين الطفرة	960
South	JAZZINE	Aaramta	عرمتى	920
South	JAZZINE	Aariye	عارية	730
South	JAZZINE	Aarqoub	عرقوب	700
South	JAZZINE	Aazibeh	عزيبة	980
South	JAZZINE	Aazour	عازور	820
South	JAZZINE	Ain el Mir	عين المير	655
South	JAZZINE	Ain Majdalain	عين مجدلين	1100
South	JAZZINE	Anane	آنان	715
South	JAZZINE	Baanoub	بعانوب	655
South	JAZZINE	Baba	البابا	750
South	JAZZINE	Baissour	بيصور	655
South	JAZZINE	Bhannine	بحنين	715
South	JAZZINE	Binwati	بنواتي	785
South	JAZZINE	Bisri	بسري	655
South	JAZZINE	Bkassine	بكاسن	810
South	JAZZINE	Bouslaya	بصليا	755
South	JAZZINE	Bteddine el Loqch	بتدين اللقش	815
South	JAZZINE	Chbail	شبيل	815
South	JAZZINE	Chamkha	شامخة	850
South	JAZZINE	Chamkha	شامخة	655
South	JAZZINE	Choualiq	شوالق	655
South	JAZZINE	Chqadif	شقاديف	705
South	JAZZINE	Dahr El Deir	ضهر الدير	655
South	JAZZINE	Dahr El Ramleh	ضهر الرملة	905
South	JAZZINE	Darayia	دارايا	655
South	JAZZINE	Deir El Mkhales	دير المخلص	855
South	JAZZINE	Deir El Saydeh	دير السيدة	830
South	JAZZINE	Deir Mar Jerjes	دير مار جرجس	980
South	JAZZINE	Deir Qatin	دير قطين	835
South	JAZZINE	Dilghani	دلغاني	800
South	JAZZINE	Dillacha	دلاشا	755
South	JAZZINE	Dimechqiye	الدمشقية	655
South	JAZZINE	El Aaraimeh	العرينمة	905
South	JAZZINE	El Biada	البياضة	955
South	JAZZINE	El Houranieh	الحورانية	730
South	JAZZINE	El Marj	المرج	805
South	JAZZINE	El Massous	المصوص	695
South	JAZZINE	El Mghaibeh	المغيبة	695
South	JAZZINE	El Mzairaa	المزيرعة	1007
South	JAZZINE	El Nabaa	النبعة	730
South	JAZZINE	El Qate'	القاطع	725
South	JAZZINE	El Rimmaneh	الرمانة	1100
South	JAZZINE	El Wardieh	الوردية	695
South	JAZZINE	Rmaich	رميش	962
South	JAZZINE	Rous El Franj	رؤوس الفرنج	655
South	JAZZINE	Ghbatiye	الغباطية	740
South	JAZZINE	Haidab	حيداب	655
South	JAZZINE	Haitoule	حيتوله	655
South	JAZZINE	Haitoura	حيطوره	935
South	JAZZINE	Harf	الحرف	805
South	JAZZINE	Harf El Dqiq	حرف الدقيق	705
South	JAZZINE	Hassaniye	الحسانية	655
South	JAZZINE	Homsiye	الحمصية	885
South	JAZZINE	Houtai	هوتيه	810
South	JAZZINE	Jabal Niha	جبل نيحا	1100

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
South	JAZZINE	Jabal Toura	جبل طورة	1100
South	JAZZINE	Jal Nachi	جل ناشي	805
South	JAZZINE	Jarmaq	الجرمق	655
South	JAZZINE	Jdidet Bkasin	جديدة بكاسين	755
South	JAZZINE	Jdaidet el Ouadi	جديدة الوادي	755
South	JAZZINE	Jensnaya	جنسنايا	655
South	JAZZINE	Jernaya	جرنايا	655
South	JAZZINE	Jezzine	جزين	880
South	JAZZINE	Jwar Bakich	جوار باكيش	995
South	JAZZINE	Jwar El Sous	جوار السوس	785
South	JAZZINE	Karkha	كرخا	655
South	JAZZINE	Kfar Falous	كفرفالوس	655
South	JAZZINE	Kfar Houne	كفرحونة	930
South	JAZZINE	Kfar Jarra	كفرجرة	655
South	JAZZINE	Kfar Taala	كفر تعلا	655
South	JAZZINE	Khallet Khazen	خلة خازن	790
South	JAZZINE	Khirkhaila	خرخيا	890
South	JAZZINE	Kroum El Jabal	كروم الجبل	980
South	JAZZINE	Lebaa	لبعا	655
South	JAZZINE	Louazie	اللوزية	835
South	JAZZINE	Lwaiziyeh	لويزية	700
South	JAZZINE	Machmouche	مشموشة	850
South	JAZZINE	Mahmoudiye	المحمودية	695
South	JAZZINE	Maknouniye	المكنونية	850
South	JAZZINE	Manqle	المنقلة	655
South	JAZZINE	Mar Hanna	مار حنا	655
South	JAZZINE	Marous El Fawqa	مارّوس الفوقا	655
South	JAZZINE	Marous El Tahta	مارّوس التحتا	655
South	JAZZINE	Mazraat Aaraiji	مزرعة عراجي	947
South	JAZZINE	Mazraat El Khawkh	مزرعة الخوخ	1100
South	JAZZINE	Mazraat el mathane	مزرعة المطحنة	655
South	JAZZINE	Mazraat El Rohban	مزرعة الرهبان	1100
South	JAZZINE	Mazraat El Swairi	مزرعة الصويري	735
South	JAZZINE	Mharbiye	المحاربية	655
South	JAZZINE	Midane	الميدان	790
South	JAZZINE	Mjaidel	مجيدل	655
South	JAZZINE	Mlikh	ملّيح	870
South	JAZZINE	Mrah Bou Shdid	مراح بو شديد	795
South	JAZZINE	Mrah El Hbas	مراح الحباس	655
South	JAZZINE	Nabaa El Taseh	نبع الطاسة	745
South	JAZZINE	Nabi Sojod	نبي سجد	967
South	JAZZINE	Ouadi Jezzine	وادي جزين	810
South	JAZZINE	Ouqmana	عقمانا	867
South	JAZZINE	Qaitoule	قيتولي	850
South	JAZZINE	Qalaat Abi El Hesen	قلعة أبي الحسن	655
South	JAZZINE	Qatrani	قطراني	905
South	JAZZINE	Qattine	قطين	825
South	JAZZINE	Qoubeaa	القبع	865
South	JAZZINE	Qrouh	قروح	770
South	JAZZINE	Qtaile	قطالة	655
South	JAZZINE	Quadi Baanqoundine	وادي بعقوندين	655
South	JAZZINE	Raimat	ريمات	750
South	JAZZINE	Ransiyeh	رانسية	655
South	JAZZINE	Rihane	الريحان	905
South	JAZZINE	Roukhsa	رخصة	695
South	JAZZINE	Roum	روم	850

South	JAZZINE	Sabah	صبّاح	940
South	JAZZINE	Salima	سليما	655
South	JAZZINE	Salloum	سلّوم	655
South	JAZZINE	Sejoud	سجد	920
South	JAZZINE	Sfarai	صفارية	665
South	JAZZINE	Sidoun	صيدون	765
South	JAZZINE	Sniye	سنية	765
South	JAZZINE	Sriri	السريرة	860
South	JAZZINE	Taaid	تعيد	705
South	JAZZINE	Tamra	طمرة	655
South	JAZZINE	Tayouneh	طيونة	855
South	JAZZINE	Toumat Niha	تومات نيحا	1100
South	JAZZINE	Wadi El Laimoun	وادي الليمون	655
South	JAZZINE	Wazaaieh	وازعية	705
South	JAZZINE	Zaitoun	زيتون	755
South	JAZZINE	Zighrin	زغرين	830
South	JAZZINE	Zhalta	زحلتا	950
South	SAIDA	Aabra	عبرا	655
South	SAIDA	Aaddoussiye	العدوسية	655
South	SAIDA	Aaitanieh	عيتانية	655
South	SAIDA	Abou El Aswad	أبو الأسود	655
South	SAIDA	Abou Zaid	أبو زيد	655
South	SAIDA	Aadloun	عدلون	655
South	SAIDA	Aanqoum	عنقون	655
South	SAIDA	Aaqtanit	عقتنيت	655
South	SAIDA	Aarab Tabaia	عرب طبايا	655
South	SAIDA	Aarab El Jal	عرب الجل	655
South	SAIDA	Aarab Sokar	عرب سكر	655
South	SAIDA	Aarnaba	عرنابا	655
South	SAIDA	Ain El Delb	عين الدلب	655
South	SAIDA	Ain El Helweh	عين الحلوة	655
South	SAIDA	Babliye	البابلية	765
South	SAIDA	Baissariye	البيسارية	655
South	SAIDA	Barti	برتي	655
South	SAIDA	Boustan Ain El Qantara	بستان عين القنطرة	655
South	SAIDA	Bnaafoul	بنعفول	655
South	SAIDA	Bqosta	بقسطا	655
South	SAIDA	Brak El Tall	براك التل	655
South	SAIDA	Bramiye	البرامية	655
South	SAIDA	Daher Tarraf	ضهر طراف	655
South	SAIDA	Daoudiye	الداودية	655
South	SAIDA	Darb es Silm	درب السيم	655
South	SAIDA	Deir Taqla	دير تقلا	655
South	SAIDA	El Aaqbieh	العقبية	655
South	SAIDA	El Blata	البلاطة	655
South	SAIDA	El khodr	الخضر	655
South	SAIDA	El Mahmoudia	المحمودية	655
South	SAIDA	El Mghairieh	المغيرية	655
South	SAIDA	El Qanaia	القناية	655
South	SAIDA	El QerQachieh	القرقاشية	655
South	SAIDA	El Qnaitra	القنيطرة	655
South	SAIDA	El Qraieh	القرية	655
South	SAIDA	El Qraieh	القرية	655
South	SAIDA	Ghassaniye	غسانية	655
South	SAIDA	Ghaziye	الغازية	655
South	SAIDA	Hajjie	الحجة	655
South	SAIDA	Harit Saida	حارة صيدا	655

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
South	SAIDA	Hartaii	الحارتاويه	655
South	SAIDA	Hlalliye	الهلالية	655
South	SAIDA	Insariye	الصارية	655
South	SAIDA	Irkay	إركي	655
South	SAIDA	Irzai	إرزي	655
South	SAIDA	Izfirta	إزفرتا	655
South	SAIDA	Jal Aajram	جل عجرم	655
South	SAIDA	Jazire	الجزيرة	655
South	SAIDA	Jdaideh	جديدة	655
South	SAIDA	Jinjlaya	جنجلايا	655
South	SAIDA	Kafraiya	كفرايا	655
South	SAIDA	Kaoutariyet es Siyad	كوثرية السياد	655
South	SAIDA	Karm El Hanach	كرم الحنش	655
South	SAIDA	Khaizaran	خيزران	655
South	SAIDA	Khanousieh	خنوسية	655
South	SAIDA	Kherbet El Basal	خربة البصل	655
South	SAIDA	Kherbet Dwair	خربة الدوير	655
South	SAIDA	Khoutaryet er Rezz	كوثرية الرز	655
South	SAIDA	Kfar Badde	كفربدّه	655
South	SAIDA	Kfar Beit	كفربيت	655
South	SAIDA	Kfar Chellal	كفرشلال	655
South	SAIDA	Kfar Hatta	كفرحتّى	655
South	SAIDA	Kfar Melki	كفرملكي	655
South	SAIDA	Kharayeb	الخرايب	655
South	SAIDA	Khartoum	خرطوم	655
South	SAIDA	Khaziz	خزيز	655
South	SAIDA	Loubiye	اللوبية	655
South	SAIDA	Maamriye	معمرية	655
South	SAIDA	Maamriyet el Kharab	معمرية الخراب	655
South	SAIDA	Maghdouche	مغدوشة	655
South	SAIDA	Majdelyoun	مجدليون	655
South	SAIDA	Maknounieh	مكنونية	655
South	SAIDA	Manhaleh	منحلة	655
South	SAIDA	Maqsam Ej Jaouhari	مقسم الجوهري	655
South	SAIDA	Maqsam El Bizri	مقسم البزري	655
South	SAIDA	Mar Elias	مار الياس	655
South	SAIDA	Mar Youssof	مار يوسف	655
South	SAIDA	Matariyet ech Choumar	مطيرية الشومر	655
South	SAIDA	Mazraat Dawdieh	مزرعة داودية	655
South	SAIDA	Mazaat El Houssainia	مزرعة الحسينية	655
South	SAIDA	Mazraat El Wasta	مزرعة الوسطة	655
South	SAIDA	Mazraat Iskandarouna	مزرعة اسكندرونة	655
South	SAIDA	Mazraat Jamjim	مزرعة جمجيم	655
South	SAIDA	Mazraat Matariyet Jbaa	مزرعة مطيرية جباع	655
South	SAIDA	Mazraat Tobbaya	مزرعة طوبيا	655
South	SAIDA	Meghraqa	مغراقة	655
South	SAIDA	Merhaqa	مرحاقا	655
South	SAIDA	Merouaniye	المروانية	655
South	SAIDA	Mgharet El Bzaz	مغارة البزاز	655
South	SAIDA	Mhaidle	مخيلة	655
South	SAIDA	Mheidil	محيديل	655
South	SAIDA	Miye Ou Miye	ميه وميه	655
South	SAIDA	Mosfat El Zahraneh	مزرعة الزهراني	655
South	SAIDA	Mqasam ez Zein	مقسم الزين	655
South	SAIDA	Mrah El Jabal	مزاح الجبل	655
South	SAIDA	Mrah Mahdoum	مزاح مهدوم	655
South	SAIDA	Mrah Qiwan	مزاح كيوان	655
South	SAIDA	Msaileh	مصيلح	655
South	SAIDA	Nabi Nasser	نبي ناصر	655
South	SAIDA	Najjaryie	النجارية	655
South	SAIDA	Nhawleh	نحولة	655
South	SAIDA	Qaaqaali es Snoubar	قعقعية الصنوبر	655
South	SAIDA	Qinnarit	قنارية	655
South	SAIDA	Qnaitra	القنيطرة	655
South	SAIDA	Saida	صيدا	655
South	SAIDA	Saidet El Mantra	سيدة المنطرة	655
South	SAIDA	Saksakiye	السكسكية	655
South	SAIDA	Salhiye	الصالحية	655
South	SAIDA	Sarafand	الصرفند	655
South	SAIDA	Sari	ساري	655
South	SAIDA	Sfenti	سفنتي	655
South	SAIDA	Snaiber	سنيبر	655
South	SAIDA	Tanbourit	طنبوريت	655
South	SAIDA	Tibna	تبنا	655
South	SAIDA	Tifahta	تفاحتا	655
South	SAIDA	Toufahta	تفاحتا	655
South	SAIDA	Wousamiat	وسامية	655
South	SAIDA	Zaghdraiya	زغدرايا	655
South	SAIDA	Zaiita	زيتا	655
South	SAIDA	Zaitouna	زيتونة	655
South	SAIDA	Zrariye	الزرارية	655
South	SOUR	Aabbassiye	عباسية	655
South	SOUR	Aain El Zarqa	عين الزرقا	655
South	SOUR	Aaitit	عيتيت	655
South	SOUR	Aaiya	عيّا	655
South	SOUR	Aalma ech Chaab	علما الشعب	655
South	SOUR	Aamrane	عمران	655
South	SOUR	Aazziye	العزية	655
South	SOUR	Aazziyet Maarakeh	عزية معركة	655
South	SOUR	Abou Chahch	أبو شاش	655
South	SOUR	Ain Abu Aabdalla	عين أبو عبد الله	655
South	SOUR	Ain Baal	عين بعال	655
South	SOUR	Arzoun	أرزون	730
South	SOUR	Bafliye	بافليه	655
South	SOUR	Barich	باريش	655
South	SOUR	Batouliye	باتوليه	655
South	SOUR	Bazouriye	البازورية	655
South	SOUR	Bedias	بدياس	655
South	SOUR	Bistyat	بستيات	655
South	SOUR	Biyad	البياض	655
South	SOUR	Borj ech Chmali	برج الشمالي	655
South	SOUR	Borj el Haoua	برج الهوا	655
South	SOUR	Borj el Qibli	برج القبلي	655
South	SOUR	Borj Rahhal	برج رحال	655
South	SOUR	Bourghliye	البرغلية	655
South	SOUR	Boustane	البستان	655
South	SOUR	Boustane Jwar El Tanour	بستان جوار التنور	655
South	SOUR	Chaaitiye	الشعيتية	655
South	SOUR	Chabriha	شبريحا	655
South	SOUR	Chadrjit	شدرجيت	655
South	SOUR	Chahour	شحور	655
South	SOUR	Chamaa	شمع	655
South	SOUR	Charnaiye	شارنيه	655

RAINFALL DATA FOR LEBANESE LOCALITIES CONT'D

Mouhafaza	Caza	LOCATIONS	المواقع	Rainfall
South	SOUR	Chehabiye	الشهابية	655
South	SOUR	Chihine	شيحين	655
South	SOUR	Chouran	شوران	655
South	SOUR	Dbach	دباش	655
South	SOUR	Debaal	دبعال	655
South	SOUR	Deir Aamess	دير عامص	655
South	SOUR	Deir en Naher	دير النهر	655
South	SOUR	Deir Kifa	دير كيفا	655
South	SOUR	Deir Qanoun	دير قانون	655
South	SOUR	Deir Qanoun en Nahr	دير قانون النهر	655
South	SOUR	Dirdghaya	دردغيا	655
South	SOUR	El Bass	البص	655
South	SOUR	El Boustane	البستان	655
South	SOUR	El Btaichiyeh	البطيشية	655
South	SOUR	El Khraibeh	الخريبة	655
South	SOUR	El Rachidiyeh	الرشيدية	655
South	SOUR	El Rafid	الرفيد	655
South	SOUR	El Taibeh	الطيبة	655
South	SOUR	El Zhaira	الظهيرة	655
South	SOUR	El Zahriyeh	الزاهرية	655
South	SOUR	Hallousiyet el Faouqa	الحلوسية الفوقا	655
South	SOUR	Halloussiye	الحلوسية	655
South	SOUR	Hammadiye	حمادية	655
South	SOUR	Hamoul	حمول	655
South	SOUR	Hannaouiye	حناوية	655
South	SOUR	Hanniye	الحنية	655
South	SOUR	Haumeiri	الحميرة	655
South	SOUR	Iskandarouna	إسكندرونة	655
South	SOUR	Jannata	جناتا	655
South	SOUR	Jbal el Botm	جبال البطم	655
South	SOUR	Jebbain	الجبين	655
South	SOUR	Jijjim	ججيم	655
South	SOUR	Jouaiya	جويا	655
South	SOUR	Jour en Nakhl	جوار النخل	655
South	SOUR	Hamoul	حامول	655
South	SOUR	Kfar Nai	كفرناي	655
South	SOUR	Knisse	الكنيسة	655
South	SOUR	Labboune	لبونة	655
South	SOUR	Maachouq	معشوق	655
South	SOUR	Maaliye	معلية	655
South	SOUR	Maarake	معركة	655
South	SOUR	Maaroub	معروب	655
South	SOUR	Mahroouna	مخرونة	655
South	SOUR	Majdel Zoun	مجدل زون	655
South	SOUR	Malkiyet es Sahel	مالكية الساحل	655
South	SOUR	Mansouri	المنصوري	655
South	SOUR	Marnaba	مزنبا	655
South	SOUR	Marouahine	مروحين	655
South	SOUR	Matmoura	مطمورة	655
South	SOUR	Mazraat Boustane EL Aain	مزرعة بستان العين	655
South	SOUR	Mazraat Byout El Siyad	مزرعة بيوت السياد	655
South	SOUR	Mazraat Bsaileh	مزرع بصيلة	655
South	SOUR	Mazraat Deir Hanna	مزرعة دير حنا	655
South	SOUR	Mazraat el Biyada	مزرعة البياضة	655
South	SOUR	Mazraat EL Khraibeh	مزرعة الخريبة	655
South	SOUR	Mazraat Jal EL Bahr	مزرعة جل البحر	655
South	SOUR	Mazraat Ksar El Ramel	مزرعة كسار الرمل	655
South	SOUR	Mazraat Mechref	مزرعة المشرف	655
South	SOUR	Mazraat Om Aafiyeh	مزرعة أم عفية	655
South	SOUR	Mjadel	مجادل	655
South	SOUR	Mrah EL Aaqbeh	مراح العقبة	655
South	SOUR	Mrah El Aaziyeh El Fawqa	مراح العزية الفوقا	655
South	SOUR	Mrah El Byar	مراح البيار	655
South	SOUR	Nabaa Ras EL Aain	نبع راس العين	655
South	SOUR	Nabi Qassem	نبي قاسم	655
South	SOUR	Naffakhiye	نفاخية	655
South	SOUR	Naqoura	الناقورة	655
South	SOUR	Niha	نيحا	655
South	SOUR	Om EL Rab	أم الرب	655
South	SOUR	Om Touteh	أم توته	655
South	SOUR	Ouadi Jilou	وادي جيلو	655
South	SOUR	Ouardaniye	الوردانية	655
South	SOUR	Qabr El Haj Moussa	قبر الحج موسى	655
South	SOUR	Qasmiye	القاسمية	655
South	SOUR	Qana	قانا	655
South	SOUR	Qlaileh	قليلة	655
South	SOUR	Raqliye	رقلية	655
South	SOUR	Ras el Ain	راس العين	655
South	SOUR	Ras El Mayaseh	راس المياسة	655
South	SOUR	Ras El Naqoura	راس الناقورة	655
South	SOUR	Rechkananey	رشكنانيه	655
South	SOUR	Rmadiye	رمادية	655
South	SOUR	Salaa	سلعا	655
South	SOUR	Sammaaiye	السماعية	655
South	SOUR	Siddiqine	صديقين	655
South	SOUR	Sikket Basma	سكة بسما	655
South	SOUR	Sour	صور	655
South	SOUR	Soukara	سكرة	655
South	SOUR	Srifa	صريفا	655
South	SOUR	Tair Debba	طير دبة	655
South	SOUR	Tair Filsay	طير فلسيه	655
South	SOUR	Tair Harfa	طير حرفا	655
South	SOUR	Tair Samhat	طير سمحات	655
South	SOUR	Tal Mrah El Qasr	تل مراح القصر	655
South	SOUR	Touairi	طويري	655
South	SOUR	Toura	طورا	655
South	SOUR	Yarine	يارين	655
South	SOUR	Ynouh	ينوح	655
South	SOUR	Zabqine	زبقين	655
South	SOUR	Zalloutiye	زلوطية	655

ANNEX B
LIST OF METEOROLOGICAL STATIONS

Station Name	Altitude	Mouhafaza	Caza
BEYROUTH-GOLF	14	Beirut	Beirut
HOUCH-El-OUMARA_ZAHLE	926	Bekaa	Zahle
DAHR EL BAIDAR	1516	Bekaa	Zahle
AL ARZ-LES CEDRES	1891	North	Bcharre
RAYAK- AMARA	852	Bekaa	Zahle
EL ABDE	37	North	Akkar
SOUR	4	South	Sour
ZAHRANI	10	South	Saida
EL QLAIAAT-AKKAR	5	North	Akkar
EL QOUBAYAT	497	North	Akkar
QARTABA	1222	Mount Lebanon	Jbeil
EL QOUSSAIBAH-Ksaibe	584	Mount Lebanon	Baabda
BAYSSOUR	940	Mount Lebanon	Aley
JEZZIN	1070	South	Jezzine
FAQRA	1655	Mount Lebanon	Kesrouan
EL HERMEL	605	Bekaa	Hermel
DEIR-EL-AHMAR	943	Bekaa	Baalbek
EL QARAOUN-BARRAGE	843	Bekaa	West Bekaa
MARJAYOUN	827	Nabatiye	Marjayoun
TRIPOLI- BOUEE	0	North	Tripoli
ZAHRANI- BOUEE	0	South	Saida
BEYROUTH- BOUEE	0	Beirut	Beirut
BALAMAND	359	North	Koura
SYR-ED-DENNIYE	926	North	Minieh-Dinnieh
KAFAR CHAKHNA	260	North	Zgharta
KASLIK JOUNIEH	41	Mount Lebanon	Kesrouan
DEIR-EL-KAMAR	794	Mount Lebanon	Chouf
BAROUK FRAIDIS	1114	Mount Lebanon	Chouf
SAIDA	14	South	Saida
LEBAA	331	South	Jezzine
EL QUASMIYE	9	South	Sour
EL_QAA	513	Bekaa	Hermel
KAFAR QOUQ / RACHAYA	1205	Bekaa	Rachaya
TANNOURINE	1838	North	Batroun
KAFAR DOUNINE	560	Nabatiye	Bent Jbeil
EL MESHREF	395	Mount Lebanon	Chouf
Beirut International Airport	12.3	Mount Lebanon	Baabda
TRIPOLI_IPC	5	North	Tripoli
HEMLAYA	805	Mount Lebanon	Metn
DOURIS	1009	Bekaa	Baalbek

ANNEX C
POTABLE WATER STANDARDS DECREE 1039/1999:161

1. Chemical & Physical properties for Potable (drinking water) - Max concentration

Chemical name - Chemical symbol	Max allowed concentration (mg/L)
Chlorine (CL_2)	0.3
pH value	5.6 – 5.8
Total dissolved solids (TDS)	500
Copper - cu	1
Iron - Fe	0.3
Magnesium - Mg	50
Manganese - Mn	0.05
Sulfates - SO4	250
Zinc - Zn	5
Calcium as CaCO3	200
Chlorides - CL	200
Total Hardness as CaCO3	250
Phenolic compounds as Phenol except natural Phenols that do not react with Chlore	0.001
Mineral oils	None
Chloroform extract on coal (carbon)	5.0
Effective surface factors (Kipritonat Alkyl-Benzene)	none
Ammonia	none
Phosphate - P2O5	1
Organic material	5.0
Nitrite - NO2	0.05
Hydrogen Sulfide H2S	0.05
Nitrate - NO3	5
Sodium - Na	150
Potassium - K	12
Aluminum - Al	0.2
Arsenic - As	0.05
Cadmium - Cd	0.005
Cyanide - Cn	0.05
Mercury - Hg	0.001
Selenium - Se	0.01
Lead - Pb	0.01
Hexavalent chromium - Cr	0.05
Barium - Ba	0.5
Silver - Ag	0.01
Nickel - Ni	0.02

Aromatic Hydrocarbons:	
Fluoranthene	0.0002
3.4 Benzflorantin	0.0002 & 0.0002
11.12 Benzflorantin	0.0001 combined
3.4 Benzopyrene	0.0001
1.12 Benzipirilin	0.0002
Alandino (1, 2.3, c, d) pyrene	0.0002
Fluoride between 8 & 12 deg C	1.5
25 & 30 deg C	0.7
Halogenated organic compounds	0.06
Chloroform	0.1
Dieldrin	0.00002
Lindane	0.0002
Methoxy Chlor	0.02
Toxaphene	0.003
2.4 binary acid summarize Klorvinnox	0.03
2 (2, 4.5) tri Klorvinnox	0.009

2. Microbial properties in drinking water

Characteristics	Max allowed
Total Coliforms	0 in 100 mm
Streptococcus faecalis	0 in 250 mm
Anaerobies sporules – Sporulaed sulphite / reducing anaerobes	0 in 50 mm
Feacal colifrm	0 in 250 mm
Esherichia coli	0 in 250 mm
Pseudomonas aeruginosa	0 in 250 mm
The total number of microorganisms at temperatures 22 degree for 72 hours	100 in 1mm
37 degree for 24 hours	20 in 1 mm

ANNEX D
WATER DEMAND CATEGORIZATION

DEMAND TYPE	CATEGORY	USE TYPE	PLANTS	IRRIG. TYPE	USE MODE	APPLICATION	PLUMBING	CONSUMPTION	UNITS
Drinking, Cooking Residential	USECAT1	NA	NA	NA	NA	NA	NA	3	l/p/d
Domestic Normal Residential	USECAT2	DOMESTIC	NA	NA	NORMAL	RESIDENTIAL	NA	140	l/p/d
Domestic Saving Residential	USECAT2	DOMESTIC	NA	NA	SAVING	RESIDENTIAL	NA	85	l/p/d
Domestic Normal Hospital	USECAT2	DOMESTIC	NA	NA	NORMAL	HOSPITAL	NA	70	l/p/d
Domestic Saving Hospital	USECAT2	DOMESTIC	NA	NA	SAVING	HOSPITAL	NA	45	l/p/d
Domestic Normal Hotel	USECAT2	DOMESTIC	NA	NA	NORMAL	HOTEL	NA	100	l/p/d
Domestic Saving Hotel	USECAT2	DOMESTIC	NA	NA	SAVING	HOTEL	NA	70	l/p/d
Domestic Normal School	USECAT2	DOMESTIC	NA	NA	NORMAL	SCHOOL	NA	20	l/p/d
Domestic Saving School	USECAT2	DOMESTIC	NA	NA	SAVING	SCHOOL	NA	15	l/p/d
Domestic Normal Jail	USECAT2	DOMESTIC	NA	NA	NORMAL	JAIL	NA	50	l/p/d
Domestic Saving Jail	USECAT2	DOMESTIC	NA	NA	SAVING	JAIL	NA	35	l/p/d
Domestic Normal Office Building	USECAT2	DOMESTIC	NA	NA	NORMAL	OFFICE BLDG	NA	15	l/p/d
Domestic Saving Office Building	USECAT2	DOMESTIC	NA	NA	SAVING	OFFICE BLDG	NA	10	l/p/d
Domestic Normal Public Building	USECAT2	DOMESTIC	NA	NA	NORMAL	PUBLIC BLDG	NA	3	l/p/d
Domestic Saving Public Building	USECAT2	DOMESTIC	NA	NA	SAVING	PUBLIC BLDG	NA	2	l/p/d
Domestic Car Wash	USECAT2	CAR WASH	NA	NA	NA	NA	NA	30	l/cw/m
Irrigation Hose Green Lawn	USECAT2	IRRIGATION	GREEN LAWN	HOSE	NA	NA	NA	9	l/m²/d
Irrigation Sprinkler Green Lawn	USECAT2	IRRIGATION	GREEN LAWN	SPRINKLER	NA	NA	NA	7	l/m²/d
Irrigation Sprinkler Green Lawn	USECAT2	IRRIGATION	GREEN LAWN	SUB-SURFACE	NA	NA	NA	5	l/m²/d
Irrigation Hose Shrubbery & Trees	USECAT2	IRRIGATION	SHRUBBERY	HOSE	NA	NA	NA	3	l/s/d
Irrigation Hose Shrubbery & Trees	USECAT2	IRRIGATION	SHRUBBERY	DRIP	NA	NA	NA	1.5	l/s/d
Irrigation Hose Shrubbery & Trees	USECAT2	IRRIGATION	SHRUBBERY	SUB-SURFACE	NA	NA	NA	1	l/s/d
Laundry, WC Normal, Residential	USECAT3	DOMESTIC	NA	NA	NORMAL	RESIDENTIAL	PLUMBING 2CL	40	l/p/d
Laundry, WC Saving Residential	USECAT3	DOMESTIC	NA	NA	SAVING	RESIDENTIAL	PLUMBING 2CL	26	l/p/d
Laundry, WC Normal, Hospital	USECAT3	DOMESTIC	NA	NA	NORMAL	HOSPITAL	PLUMBING 2CL	50	l/p/d
Laundry, WC Saving Hospital	USECAT3	DOMESTIC	NA	NA	SAVING	HOSPITAL	PLUMBING 2CL	35	l/p/d
Laundry, WC Normal, Hotel	USECAT3	DOMESTIC	NA	NA	NORMAL	HOTEL	PLUMBING 2CL	50	l/p/d
Laundry, WC Saving Hotel	USECAT3	DOMESTIC	NA	NA	SAVING	HOTEL	PLUMBING 2CL	35	l/p/d
WC Normal, School	USECAT3	DOMESTIC	NA	NA	NORMAL	SCHOOL	PLUMBING 2CL	5	l/p/d
WC Saving School	USECAT3	DOMESTIC	NA	NA	SAVING	SCHOOL	PLUMBING 2CL	3	l/p/d
Laundry, WC Normal, Jail	USECAT3	DOMESTIC	NA	NA	NORMAL	JAIL	PLUMBING 2CL	30	l/p/d
Laundry, WC Saving Jail	USECAT3	DOMESTIC	NA	NA	SAVING	JAIL	PLUMBING 2CL	20	l/p/d
WC Normal, Office Building	USECAT3	DOMESTIC	NA	NA	NORMAL	OFFICE BLDG	PLUMBING 2CL	10	l/p/d
WC Saving Office Building	USECAT3	DOMESTIC	NA	NA	SAVING	OFFICE BLDG	PLUMBING 2CL	7	l/p/d
WC Normal, Public Building	USECAT3	DOMESTIC	NA	NA	NORMAL	PUBLIC BLDG	PLUMBING 2CL	3	l/p/d
WC Saving Public Building	USECAT3	DOMESTIC	NA	NA	SAVING	PUBLIC BLDG	PLUMBING 2CL	2	l/p/d
Irrigation Sprinkler Green Lawn	USECAT3	IRRIGATION	GREEN LAWN	SUB-SURFACE	NA	NA	NA	5	l/m²/d
Irrigation Drip Shrubbery and Trees	USECAT3	IRRIGATION	SHRUBBERY	DRIP	NA	NA	NA	1.5	l/s/d

DEMAND TYPE	CATEGORY	USE TYPE	PLANTS	IRRIG. TYPE	USE MODE	APPLICATION	PLUMBING	CONSUMPTION	UNITS
Irrigation Drip Shrubbery and Trees	USECAT3	IRRIGATION	SHRUBBERY	SUB-SURFACE	NA	NA	NA		
WC Normal, Residential	USECAT3	DOMESTIC	NA	NA	NORMAL	RESIDENTIAL	PLUMBING 2C1	20	l/p/d
WC Saving Residential	USECAT3	DOMESTIC	NA	NA	SAVING	RESIDENTIAL	PLUMBING 2C1	15	l/p/d
WC Normal, Hospital	USECAT3	DOMESTIC	NA	NA	NORMAL	HOSPITAL	PLUMBING 2C1	20	l/p/d
WC Saving Hospital	USECAT3	DOMESTIC	NA	NA	SAVING	HOSPITAL	PLUMBING 2C1	15	l/p/d
WC Normal, Hotel	USECAT3	DOMESTIC	NA	NA	NORMAL	HOTEL	PLUMBING 2C1	20	l/p/d
WC Saving Hotel	USECAT3	DOMESTIC	NA	NA	SAVING	HOTEL	PLUMBING 2C1	15	l/p/d
WC Normal, School	USECAT3	DOMESTIC	NA	NA	NORMAL	SCHOOL	PLUMBING 2C1	85	l/p/d
WC Saving School	USECAT3	DOMESTIC	NA	NA	SAVING	SCHOOL	PLUMBING 2C1	70	l/p/d
WC Normal, Jail	USECAT3	DOMESTIC	NA	NA	NORMAL	JAIL	PLUMBING 2C1	15	l/p/d
WC Saving Jail	USECAT3	DOMESTIC	NA	NA	SAVING	JAIL	PLUMBING 2C1	8	l/p/d
WC Normal, Office Building	USECAT3	DOMESTIC	NA	NA	NORMAL	OFFICE BLDG	PLUMBING 2C1	70	l/p/d
WC Saving Office Building	USECAT3	DOMESTIC	NA	NA	SAVING	OFFICE BLDG	PLUMBING 2C1	20	l/p/d
WC Normal, Public Building	USECAT3	DOMESTIC	NA	NA	NORMAL	PUBLIC BLDG	PLUMBING 2C1	15	l/p/d
WC Saving Public Building	USECAT3	DOMESTIC	NA	NA	SAVING	PUBLIC BLDG	PLUMBING 2C1	50	l/p/d
Laundry, Normal, Residential	USECAT3	DOMESTIC	NA	NA	NORMAL	RESIDENTIAL	PLUMBING 2L	20	l/p/d
Laundry, Saving Residential	USECAT3	DOMESTIC	NA	NA	SAVING	RESIDENTIAL	PLUMBING 2L	11	l/p/d
Laundry, Normal, Hospital	USECAT3	DOMESTIC	NA	NA	NORMAL	HOSPITAL	PLUMBING 2L	30	l/p/d
Laundry, Saving Hospital	USECAT3	DOMESTIC	NA	NA	SAVING	HOSPITAL	PLUMBING 2L	20	l/p/d
Laundry, Normal, Hotel	USECAT3	DOMESTIC	NA	NA	NORMAL	HOTEL	PLUMBING 2L	30	l/p/d
Laundry, Saving Hotel	USECAT3	DOMESTIC	NA	NA	SAVING	HOTEL	PLUMBING 2L	20	l/p/d
Laundry, Normal, Jail	USECAT3	DOMESTIC	NA	NA	NORMAL	JAIL	PLUMBING 2L	15	l/p/d
Laundry,Saving Jail	USECAT3	DOMESTIC	NA	NA	SAVING	JAIL	PLUMBING 2L	12	l/p/d
WC Normal, Residential	USECAT4	DOMESTIC	NA	NA	NORMAL	RESIDENTIAL	PLUMBING 2C2	20	l/p/d
WC Saving Residential	USECAT4	DOMESTIC	NA	NA	SAVING	RESIDENTIAL	PLUMBING 2C2	15	l/p/d
WC Normal, Hospital	USECAT4	DOMESTIC	NA	NA	NORMAL	HOSPITAL	PLUMBING 2C2	20	l/p/d
WC Saving Hospital	USECAT4	DOMESTIC	NA	NA	SAVING	HOSPITAL	PLUMBING 2C2	15	l/p/d
WC Normal, Hotel	USECAT4	DOMESTIC	NA	NA	NORMAL	HOTEL	PLUMBING 2C2	20	l/p/d
WC Saving Hotel	USECAT4	DOMESTIC	NA	NA	SAVING	HOTEL	PLUMBING 2C2	15	l/p/d
WC Normal, School	USECAT4	DOMESTIC	NA	NA	NORMAL	SCHOOL	PLUMBING 2C2	5	l/p/d
WC Saving School	USECAT4	DOMESTIC	NA	NA	SAVING	SCHOOL	PLUMBING 2C2	3	l/p/d
WC Normal, Jail	USECAT4	DOMESTIC	NA	NA	NORMAL	JAIL	PLUMBING 2C2	15	l/p/d
WC Saving Jail	USECAT4	DOMESTIC	NA	NA	SAVING	JAIL	PLUMBING 2C2	8	l/p/d
WC Normal, Office Building	USECAT4	DOMESTIC	NA	NA	NORMAL	OFFICE BLDG	PLUMBING 2C2	10	l/p/d
WC Saving Office Building	USECAT4	DOMESTIC	NA	NA	SAVING	OFFICE BLDG	PLUMBING 2C2	7	l/p/d
WC Normal, Public Building	USECAT4	DOMESTIC	NA	NA	NORMAL	PUBLIC BLDG	PLUMBING 2C2	3	l/p/d
WC Saving Public Building	USECAT4	DOMESTIC	NA	NA	SAVING	PUBLIC BLDG	PLUMBING 2C2	2	l/p/d
Irrig. BG Green Lawn	USECAT4	IRRIGATION	GREEN LAWN	SUB SURFACE	NA	NA	NA	5	l/m²/d
Irrig. BG Shrubbery and Trees	USECAT4	IRRIGATION	SHRUBBERY	SUB SURFACE	NA	NA	NA	1	l/s/d

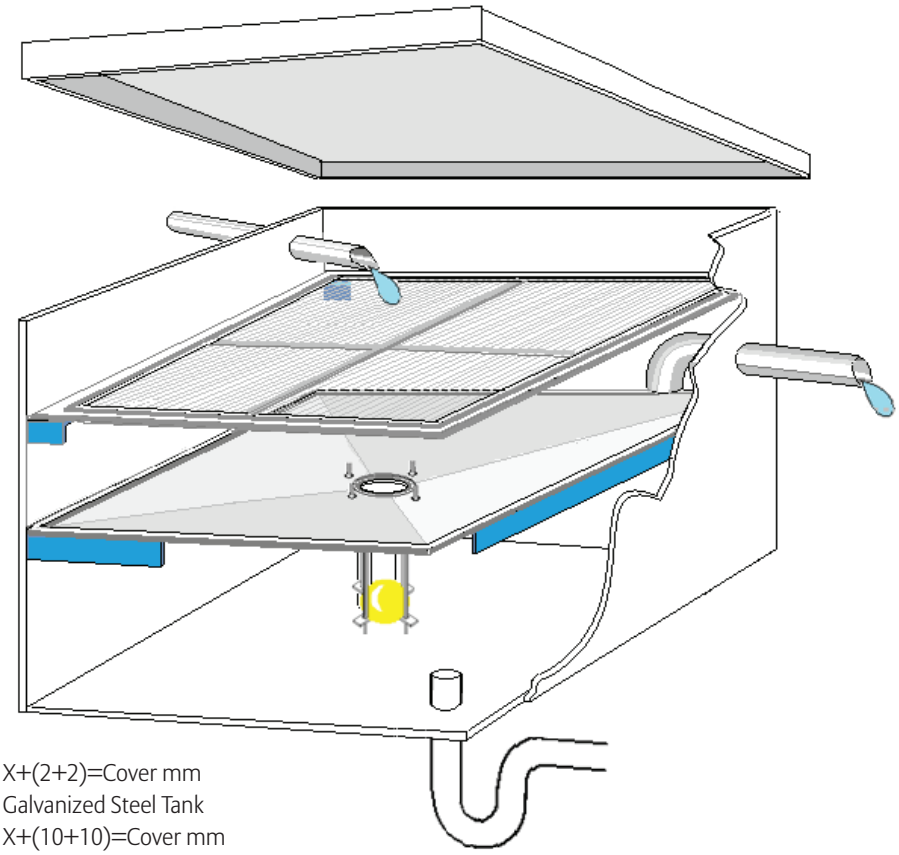
ANNEX E
PIPE SIZES AND FRICTION FACTORS

	PPR SCHED 20		PEX SCHED 20		GSP SCHED 40	
Q (m³/hr)	DN (mm)	hf	DN (mm)	hf	DN (inch)	hf
0.1	20	0.0075	20	0.0042	1/2	0.0022
0.2	20	0.0306	20	0.0201	1/2	0.0129
0.3	20	0.0625	20	0.0409	1/2	0.0266
0.4	20	0.1045	20	0.0683	1/2	0.0448
0.5	20	0.1565	20	0.1020	1/2	0.0675
0.6	20	0.2183	20	0.1420	1/2	0.0945
0.7	20	0.2897	20	0.1882	1/2	0.1259
0.8	20	0.3708	20	0.2404	1/2	0.1617
0.9	20	0.4614	20	0.2988	1/2	0.2018
1	20	0.5615	20	0.3632	1/2	0.2462
1.1	20	0.6711	20	0.4337	1/2	0.2949
1.2	20	0.7902	25	0.1676	1/2	0.3480
1.3	25	0.2907	25	0.1942	1/2	0.4054
1.4	25	0.3337	25	0.2228	1/2	0.4670
1.5	25	0.3795	25	0.2532	3/4	0.1331
1.6	25	0.4281	25	0.2854	3/4	0.1503
1.7	25	0.4796	25	0.3196	3/4	0.1686
1.8	32	0.1572	25	0.3556	3/4	0.1879
1.9	32	0.1737	25	0.3934	3/4	0.2082
2	32	0.1911	25	0.4331	3/4	0.1913
2.1	32	0.2092	25	0.4747	3/4	0.2519
2.2	32	0.2281	32	0.1456	3/4	0.2753
2.3	32	0.2478	32	0.1581	3/4	0.2997
2.4	32	0.2683	32	0.1711	3/4	0.3251
2.5	32	0.2896	32	0.1846	3/4	0.3515
2.6	32	0.3117	32	0.1986	3/4	0.3790
2.7	32	0.3345	32	0.2130	3/4	0.4075
2.8	32	0.3582	32	0.2280	3/4	0.4370
2.9	32	0.3826	32	0.2435	3/4	0.4675
3	32	0.4078	32	0.2594	3/4	0.4991
3.1	32	0.4338	32	0.2758	1	0.1469
3.2	32	0.4605	32	0.2928	1	0.1561
3.3	32	0.4881	32	0.3102	1	0.1655
3.4	40	0.1655	32	0.3281	1	0.1752
3.5	40	0.1747	32	0.3465	1	0.1851

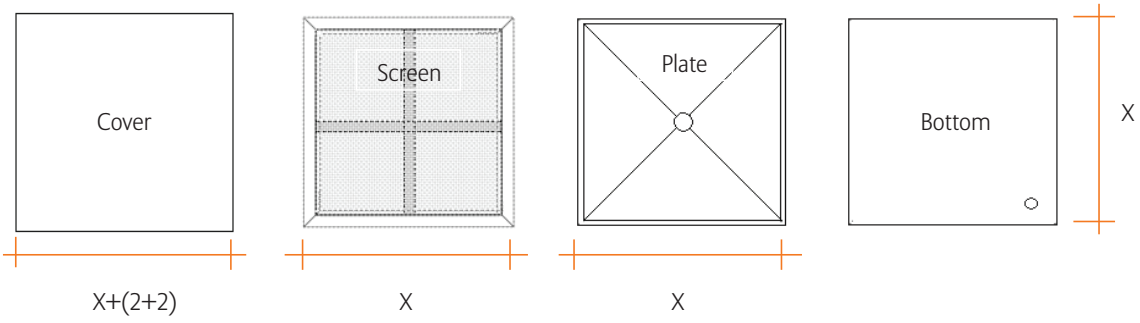
PIPE SIZES AND FRICTION FACTORS (CONT'D)

	PPR SCHED 20		PEX SCHED 20		GSP SCHED 40	
Q (m³/hr)	DN (mm)	hf	DN (mm)	hf	DN (inch)	hf
3.6	40	0.1841	32	0.3653	1	0.1954
3.7	40	0.1938	32	0.3847	1	0.2059
3.8	40	0.2037	32	0.4045	1	0.2166
3.9	40	0.2138	32	0.4249	1	0.2277
4	40	0.2242	32	0.4457	1	0.2390
4.1	40	0.2349	32	0.4670	1	0.2506
4.2	40	0.2457	32	0.4888	1	0.2624
4.3	40	0.2568	40	0.1667	1	0.2746
4.4	40	0.2682	40	0.1740	1	0.2870
4.5	40	0.2797	40	0.1815	1	0.2996
4.6	40	0.2916	40	0.1891	1	0.3126
4.7	40	0.3036	40	0.1969	1	0.3258
4.8	40	0.3159	40	0.2048	1	0.3393
4.9	40	0.3284	40	0.2129	1	0.3530
5	40	0.3412	40	0.2211	1	0.3670
5.1	40	0.3542	40	0.2295	1	0.3813
5.2	40	0.3674	40	0.2380	1	0.3959
5.3	40	0.3809	40	0.2467	1	0.4107
5.4	40	0.3946	40	0.2556	1 1/4	0.1129
5.5	40	0.4086	40	0.2646	1 1/4	0.1169
5.6	40	0.4228	40	0.2737	1 1/4	0.1210
5.7	40	0.4372	40	0.2830	1 1/4	0.1252
5.8	40	0.4519	40	0.2924	1 1/4	0.1294
5.9	40	0.4668	40	0.3020	1 1/4	0.1337
6	40	0.4819	40	0.3118	1 1/4	0.1381
6.1	40	0.4973	40	0.3216	1 1/4	0.1425
6.2	50	0.1633	40	0.3317	1 1/4	0.1470
6.3	50	0.1682	40	0.3419	1 1/4	0.1516
6.4	50	0.1733	40	0.3522	1 1/4	0.1562
6.5	50	0.1784	40	0.3627	1 1/4	0.1609
6.6	50	0.1836	40	0.3734	1 1/4	0.1657
6.7	50	0.1889	40	0.3842	1 1/4	0.1706
6.8	50	0.1942	40	0.3951	1 1/4	0.1755
6.9	50	0.1996	40	0.4062	1 1/4	0.1805
7	50	0.2051	40	0.4174	1 1/4	0.1855

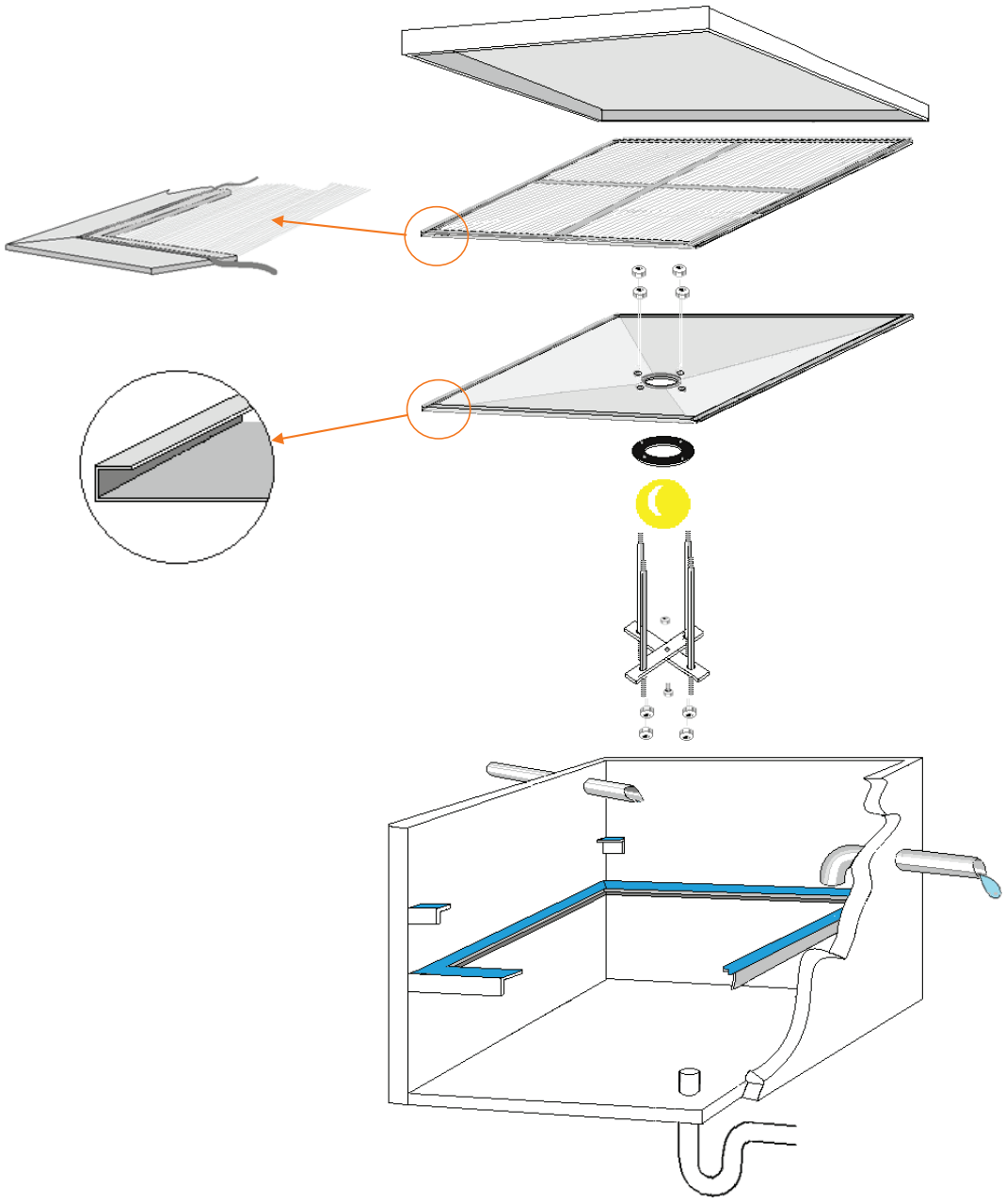
ANNEX F
FIRST FLUSH TANK DETAILS



X+(2+2)=Cover mm
Galvanized Steel Tank
X+(10+10)=Cover mm
Concrete Tank



FIRST FLUSH TANK DETAIL (CONT'D)



ANNEX G
PRICING ESTIMATES OF SYSTEM COMPONENTS
AS PER DATE; July 2014

Table 1. Storage Tank Material Pricing (July 2014)

Material	Size / Liters	Price $
Concrete	18000	4000
	40000	6500
PE Above Ground		
Single layer Tanks	300	66
	2000	209
Large Capacity Tanks	22000	2750
Triple Layer Tanks	80	52
	500	117
	2000	347
PE Under Ground		
Tanks	6000	1296
	10000	2145
Modular	19000	6600
*PE with RWH System**	*4500*	*3100*
Stainless Steel	200	750

Assumptions; Consumption: $2m^2/p/d$
Concrete price: $1m^3$=250$

RWH System: PE Tank with several chambers within, to include water treatment, of a certain size. (NOT INCLUDED WITHIN THIS STUDY)

Table 2. Drains Pricing (July 2014)

Roof Drains	Specifications	Price $
Roof drain (Dome Type)	- PP - Outlet types: side/bottom - Dome cover – prevent large debris - Linked to normal piping	70
Roof Double drain (Tower Type)	- PP - outlet types: side/bottom - Double drainage - Gravel guard - Linked to normal piping	90

PRICING ESTIMATES OF SYSTEM COMPONENTS (CONT'D)

Table 3. Gutters/Downspouts Pricing (July 2014)

Piping	Material	Price $/m
Gutters	PVC rain gutters – 174mm diam.	8.5
	Additional Components	8.5
Down Risers	PVC – 4" pipe with 4.3mm thickness	6

Table 4. Piping Pricing (July 2014)

Piping	Source	Price $/4 or $/6m					
PPR		20mm	25mm	32mm	40mm	50mm	
4m long pipe	Turkish	3.3	4.3	8.0	12.0	18.0	
4m long pipe	German	6.5	10.0	16.0	26.0	40.0	
Galvanized Steel		1/2in	3/4in	1in	1 1/4in	1 1/2in	2in
6m long pipe	Turkish	14.0	19.0	30.0	37.0	44.0	60.0

Table 5. Pumps Pricing (July 2014)

Pumps	Type	Price $	Picture
Horizontal			
multistage pump	0.5 m^3/h @ ~30m W.G	370	
lift pump or booster pump	1 m^3/h @ ~30 m W.G	370	
	2 m^3/h @ ~30 m W.G	400	
	3 m^3/h @ ~30 m W.G	400	
	5 m^3/h @ ~30 m W.G	680	
Vertical			
multistage pump	2 m^3/h @ ~45 m W.G	1107	
lift pump or booster pump	3 m^3/h @ ~45 m W.G	1290	
Used when a high pressure is required	5 m^3/h @ ~45 m W.G	1290	
Submersible			
lifting pump to be installed inside tank (horizontal setup)	1 m^3/h @ ~30 m W.G	1537	
	2 m^3/h @ ~30 m W.G	1600	
	3 m^3/h @ ~30 m W.G	1600	
	5 m^3/h @ ~30 m W.G	1720	

PRICING ESTIMATES OF SYSTEM COMPONENTS (CONT'D)

Table 6. Carbon & Sedimentation Cartridge Pricing (July 2014)

Size	Carbon Cartridge			Sedimentation Cartridge			Body
	5 micron		0.5 micron	5 micron		0.5 micron	
	Source						
	US / EUR	Chinese	US / EUR	US / EUR	Chinese	US / EUR	
	Price $						
10 in	44	17	70	26	13	30	66
20 in	74	35	135	40	20	37	108

Table 7. Ultraviolet Light Pricing (July 2014)

Flow Rate	19 L/min (5gpm)	30 L/min (8gpm)	45 L/min (12gpm) - High flow
	Price $		
Device	600	750	950
Light Lamp	100	130	160

Table 8. Chlorination Dosing System Pricing (July 2014)

Size	Source	Price $
2-40 m3 / day	Spanish 300	US 500

Table 9. Sand / Carbon Filter Pricing (July 2014)

Sizing according to flow rate	Sand Filter	Carbon Filter
	Price $	
10 gpm / sq ft	1100	1250

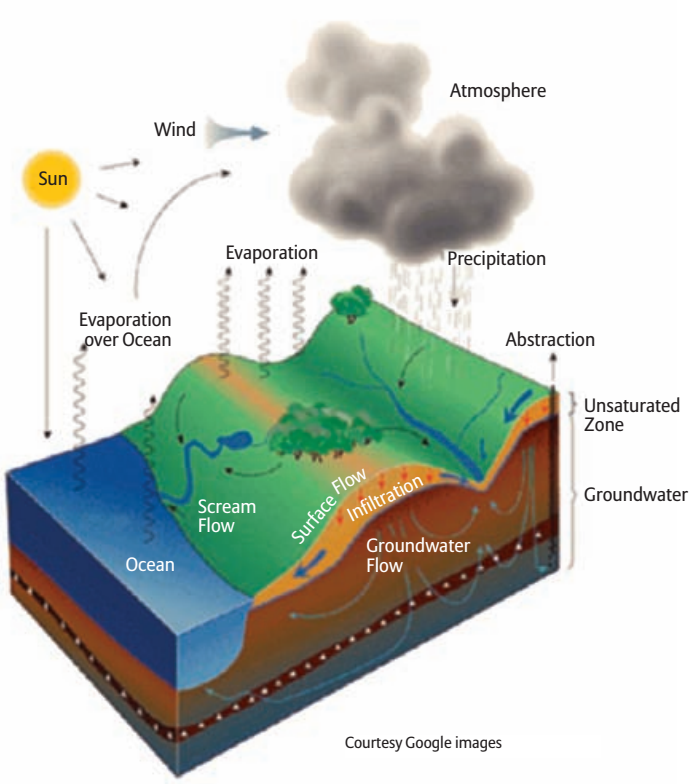
ANNEX H

THE CHEMICAL AND BACTERIOLOGICAL CHARACTERISTICS OF RAINWATER

Rainwater is the product of a distillation process which is inherent to the natural cycle of the water. Water evaporates from the ground, from water bodies, from plants, etc. and rises in the atmosphere as water vapor to form clouds which are the source of precipitations as rainfall and snow.

In theory rain should be pure water devoid of any chemicals or pollution before reaching the ground, but in practice this is not the case because rainwater collects on its way to the ground all kinds of chemicals and particles like dust, pollen, soot etc. present in the atmosphere.

Two major offending gases present in the atmosphere as a result of human and natural activities are the oxides of Nitrogen and Sulfur (respectively NOx and SOx). Of course there are many others but these two gases greatly influence the acidity of the rainwater, a major chemical property that det water quality. Upon their dissolution in rainwater, nitrogen oxides gases form nitric acid and sulfur oxides gases form sulfuric acid. These are the culprits behind acid rains that wreck-havoc with forests around the world.



The Water Cycle

In Lebanon Sulfur dioxides result mainly from burning diesel and heavy fuel in industry, electricity power plants, transportation and the construction sector. Oxides of Nitrogen result mainly from the transport sector and to a lesser extent from the electricity production sector.

Dust, soot and other particles generated by human activities like industry, construction, traffic, etc. are also found in relatively high concentration in the atmosphere above urban and industrial centers. However a dusty atmosphere can result also from the easterly winds blowing from the Arabian Peninsula and across the Syrian inland. Many of us experienced the unpleasant sight of a recently washed car that was all muddied by first rains that carried the dust from the atmosphere and deposited it on our cars. Another major factor is the influence of the maritime environment; studies have shown that rain fall along coastal regions of the Mediterranean show a marked increase in chlorides, potassium, calcium, magnesium and Sodium.

Therefore we can safely say that there is a direct relation between air quality and rainwater quality. Consequently rainwater that falls over Beirut or the coastal region where the bulk of the economic activity is concentrated is surely of lesser quality than rainwater that falls at 800 meters altitude. This said, predominant winds could carry pollution far away, thus the low and mid altitudes of the western side of mount Lebanon range could suffer from pollutants generated on the coast and entrained by the dominant winds that blow West-South West.

However it is important to put things into perspective, rainwater that has not touched the ground even in Beirut has still way less chemicals than the purest spring water in Lebanon. Moreover, one study carried between October 2005 and April 2006 over 28 sites covering the Lebanese territory showed that the rainwater acidity varied between 6.6 and 7.7 which is an indication that acid rain is not an issue for Lebanon at least during the sampling period.

However once rainwater touches collection surfaces, then it is entirely a different ball game. Probabilities of bacteriological contamination are very high due to the presence of droppings, insects, rodents, etc. moreover chemical pollution may take a more serious turn if traces of heavy metals deposits are present on collection surfaces in industrial or heavily congested urban areas.

Therefore location specific collected rainwater quality is more related to collection surfaces which are to a far extent directly dependent on air quality and the exposure of such surfaces to biological pollution. Thus to give an example, areas of Beirut were pigeon communities are flourishing will invariantly have rainwater collection surfaces with high biological contamination, indeed probably much higher than any area in the mountain were wild life is more flourishing. This will be also be aggravated by probable deposits of traces of heavy metals due to combustion exhaust, aerosols, tires erosion, etc. The same could be said of all areas near heavily polluting industries (cement, carton, chemicals, etc.).

Further contamination and chemical loading may occur during the storage phase depending on the type of storage reservoirs and their cleanliness.

RAINWATER QUALITY IS LARGELY DEPENDENT ON AMBIENT AIR QUALITY AND GEOGRAPHICAL LOCATION.

CASE STUDIES

Though rainwater harvesting existed historically, it is not a commonly used system in Lebanon nowadays. Some individuals and institutions within the country have adopted rainwater harvesting practices for a variety of reasons, mainly due to weather changes, lack of rain and water scarcity. The following will cover examples of actual rainwater harvesting systems located in Lebanon, including why rainwater harvesting was chosen, design challenges and the benefits of utilizing rainwater harvesting on the site.

These cases do not reflect the best practices for RWH, treatment and use, but surely show the possible positive impact that rainwater collection would have on water supply & demand, water quality and the environment.

CASE STUDY # 1
A PUBLIC SCHOOL

CASE STUDY # 2
A MULTI-DISCIPLINARY CENTER

CASE STUDY # 3
A PRIVATE SCHOOL

CASE STUDY # 4
RESIDENTIAL BUILDING

CASE STUDY # 5
SOS VILLAGE

CASE STUDY # 1
A PUBLIC SCHOOL

PROJECT:	**ISKANDAR RIZK PUBLIC SCHOOL**
LOCATION:	ACHKOUT – KASERWAN (CAZA) – MOUNT LEBANON (MOUHAFAZA)
ALTITUDE:	1000 m
APPLICATION:	STUDENTS TOILETS FLUSHING, TEACHERS TOILETS FAUCETS AND FLUSHING, CLEANING
SYSTEM:	2 ABOVEGROUND PE TANKS 22,000 X 2 = 44,000L TO CONTAIN THE RAINWATER, TREATMENT PLANT FOR DOMESTIC USE, 1 PE TANK = 22,000L TO CONTAIN THE TREATED WATER
CATCHMENT AREA:	EXTERNAL PLAYGROUND RARELY USED BY CHILDREN, CONCRETE FLOOR AREA OF 690 m^2
COST:	15,000$ (Tanks /Piping/ Pumps/ Treatment, civil work not included) *Note: Cost was affected in a positive way due to the system's being part of the whole project.*
DATE:	NOV. 2013 – MARCH 2014

Sponsor:
HSBC (MENA competition for 4 public schools as part of an awareness campaign.)

Client:
arcenciel

Designer:
Sustainable Environmental Solutions - SES

The system was part of a complete water conservation and management plan for the school that serves 410 students with 40 teachers and staff members. The project includes waste water treatment plant and rainwater harvesting system. Water saving and rainwater use are the two main goals of the school to cover for the shortage in municipal water supply. The school, on the average, was always short of 50% of its need from municipal water. The rainwater harvesting covers the shortage and replaces the need to buy 3,000-4,000 liters / Week. 2 polyethylene tanks 22,000 liter each, were placed to store 44,000 liters of collected rainwater (22,000 x 2) that will be treated after collection to become good for domestic use and will be stored in a 22,000 liter PE tank. The collected water is used for toilet flushing, teachers' toilet wash basins and for cleaning the school.

On site, there was no problem in placing the RWH tanks. It had the perfect location area as to the whole project, for the waste treatment plant and for the rainwater harvesting system that was a dead unused space. This made the cost related to placement and connection as minimal. A reinforced concrete platform was constructed to insure well placement of tanks after excavations and leveling. Overflows of rainwater tanks were directed towards the forest nearby.

The system showed its success due to the amount of rainwater that was collected and used. The tanks are still full in the summer season, so the school will have no water shortage when school year starts in September especially that municipal water supply was cut in mid-summer season.

CASE STUDY # 2
A MULTI-DISCIPLINARY CENTER

PROJECT:	**ARCENCIEL TAANAYEL CENTER - Nursery / Workshop / Restaurant**
LOCATION:	TAANAYEL – ZAHLE (CAZA) – BEKAA (MOUHAFAZA)
ALTITUDE:	830 m
APPLICATION:	TOILETS FLUSHING, FAUCETS AND CLEANING
SYSTEM:	2 ABOVEGROUND PE TANKS 22,000 X 2 = 44,000 L TO CONTAIN THE RAINWATER, TREATMENT PLANT FOR DOMESTIC USE, PUSH BUTTON FAUCETS IN TOILETS
CATCHMENT AREA:	CONCRETE ROOF, AREA OF 300 m^2
COST:	25,000 $ (Tanks/Piping/Pumps/Treatment/included civil work of roof) *Note: Cost was affected negatively due to being one of the first projects implemented by the company, thus it was time consuming and had higher engineering cost.*
DATE:	2013

In response to the drought and as part of an ongoing effort towards a more sustainable location, the center built a rainwater collection system for domestic use and toilet flushing. With the growing shortage in municipal water supply and the continuous need to pump from the center's water well, the rainwater system was a need to the center that serves 300 persons. 2 polyethylene tanks 22,000 liter each, were placed to store 44,000 liters of collected rainwater (22,000 x 2), that would be treated after collection to become good for domestic use, after which water will be mixed with municipal water in the center's already existing tanks.

In winter, the rainy season, water well pumps and treatment plant would be turned off so to retain water volume in the well and help replenishing the water table to its normal natural levels. In summer season, when no more municipal water supply and water well level is low or no good (smelly), then, water treatment plant would be turned on. Nevertheless, the RWH system will be fully operational in the winter season to cover the shortage from the municipal water. This will result in lengthening the lifespan of the underground water, instead of using the underwater during the whole year they will use it only during summer season, thus resulting in better water quality with lower pollution concentration.

The system showed its success due to the amount of rainwater that was collected and used. The tanks are still half full in the summer season, end August.

Sponsor:
Coca Cola Fund / UNDP

Client:
arcenciel

Designer:
Sustainable Environmental Solutions – SES

CASE STUDY # 3
A PRIVATE SCHOOL

PROJECT:	**AVE MARIA SCHOOL**
LOCATION:	ASIA – BATROUN (CAZA) - NORTH LEBANON (MOUHAFAZA)
ALTITUDE:	800 m
APPLICATION:	TOILETS FLUSHING AND CLEANING
SYSTEM:	3 ABOVEGROUND PE TANKS 10,000 X 3 = 30,000 L TO CONTAIN THE RAINWATER
CATCHMENT AREA:	TILED ROOF, AREA OF 400 m^2
COST:	10,000 $ (Tanks/Piping/Pumps) *Note: Cost was affected negatively due to being the first project to be Implemented.*
DATE:	NOV 2013 – MARCH 2014

Encouraged to take some action as a response to draught, the school wanted supplemental water to use for toilet flushing and cleaning. The school that serves 200 students with 30 teachers and staff members, already had an underground existing concrete tank of 70,000 liter supplied with municipal water. The 30,000 liters of harvested rainwater will only be screened from debris and leaves before being collected and mixed with municipal water. At the end of the project implementation, the school had a total volume of water storage equal to 100,000 liters.

Water is currently flowing over, so no water problem.

Sponsor:
Coca Cola Fund / UNDP

Client:
arcenciel

Designer:
Sustainable Environmental Solutions – SES

CASE STUDY # 4
RESIDENTIAL BUILDING

PROJECT:	SARKIS BUILDING
LOCATION:	KENNABET BROUMANA – METN (CAZA) – MOUNT LEBANON (MUHAFAZA)
ALTITUDE:	450 m
APPLICATION:	ALL DOMESTIC USE AND IRRIGATION
SYSTEM:	REINFORCED CONCRETE TANK 40 m^3
CATCHMENT AREA:	BRICK TILED SLOPED ROOF, 2 SURFACES 100 m^2 x 2 = 200 m^2
COST:	MINIMAL - None
DATE:	1994

The building's design was a reflection of the owners' belief and awareness of environmental issues, water in particular. The rainwater harvesting system was part of the design of the building from its early stages. The building was not linked to municipal water due to multiple reasons one of which was the condition of municipal conveyance system. A 40 m^3 concrete tank was built on the basement level to store rainwater collected from 2 brick tiled sloped roofs as catchment surfaces of 200 m^2 area. This collected water is used by 4 families of around 20 people for all their domestic daily use and irrigation. No extra charge was needed due to the fact that it was the same charge accounted for the water conveyance system to be used. No special water treatment was implemented; only the addition of chlorine on regular basis is done, as disinfection.

Up until this year, water crisis year, the collected rainwater was being used from September till June of every year without any problem; about 9 to 10 months. Owners have future vision of exploiting an unused area of 140 m^2 flat roof with water treatment to be accounted for as well. They also have a belief in the importance of legislation and incentives in relation to the system's public spreading.

Sponsor:
Private

Client:
Sarkis Family

Designer:
R.Sarkis Consultant

CASE STUDY # 5
SOS VILLAGE

PROJECT:	KFARHAY SOS VILLAGE
LOCATION:	KFARHAY – BATROUN (CAZA) - NORTH LEBANON (MOUHAFAZA)
ALTITUDE:	400 m
APPLICATION:	IRRIGATION, TOILETS FLUSHING AND CLEANING
SYSTEM:	REHABILITATION (PIPING, PUMPS, SHOWER HEADS AND FAUCETS)
CATCHMENT AREA:	- - - - -
COST:	3,500 $ (Piping/Pumps)
DATE:	2014

The village design that was done by a German architect in mid-90's, which already incorporates rainwater harvesting tanks under all 10 houses from their roofs as catchment areas. Pumps pull water from house tanks to the main concrete tower which in itself is divided into 4 compartments for different water usage.

To keep the system working efficiently, rehabilitation was done to conveyance system and all leaking pipes and pumps were changed. This was part of a bigger project including a waste treatment plant and drop irrigation system. The collected rainwater will be added to the treated waste water and used for irrigation, toilet flushing and cleaning.

All shower heads, toilet faucets and kitchen faucets were changed as part of a complete water conservation and management plan.

Sponsor:
HSBC

Client:
SOS Villages

Designer:
Sustainable Environmental Solutions - SES

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