ASSESSMENT OF ROOFTOP RAINWATER HARVESTING POTENTIAL FOR SELECTED BUILDINGS IN SOLAPUR

(SOLAPUR, MAHARASHTRA)

PREPARED FOR

ICLEI
NEW DELHI

PREPARED BY

ENVIRAJ CONSULTING PVT. LTD.
F-29 BHAGAT SINGH NAGAR
GWALIOR, M.P-474005

DECEMBER, 2019
EXECUTIVE SUMMARY

Rainwater harvesting refers to an ancient practice of collecting rainwater from the roofs or other impermeable surfaces for future use in satisfying daily water needs or recharge to the ground to improve groundwater storage. The practice helps to conserve water, reduce runoff, reduce municipal energy costs for pumping water and delay costly expenditures on new water treatment plants or existing plant expansion.

In this assessment, a total of 27 public buildings in Solapur district including 11 schools, 8 hospitals and 8 shopping complexes were selected to evaluate the potential of each building towards harvesting of the rainwater from the rooftop. A field survey is carried out to collect the relevant data on the annual water demand of the selected buildings, physical measurement of rooftop area and review of existing RWH structure (if any).

KEY FINDINGS

Rainwater Harvesting Potential

There is a significant untapped rainwater harvesting potential at most of the public buildings, particularly at shopping complexes.

Rainwater harvesting potential is the total amount of water that can be effectively harvested from a building rooftop. Theoretically, it is calculated by multiplying the average rainfall, roof area and runoff coefficient.

The survey data indicates shopping complexes have the great RWH potential and Khumbhar Ves shopping centre is found to have the highest among all the surveyed buildings. Schools and hospitals also have good RWH potential. Manpa Mule No 29 and Ramwadi hospital leads the way in school and hospital category.

Water Demand

Hospitals have more annual water demand when compared to schools and shopping complexes.

The schools, hospitals and shopping complexes have very different water usage pattern. Hospitals are found to have the highest annual water demand. Most of the hospitals withdraw freshwater from the borewell. This water is used for various purposes like laundry, drinking and sanitation. High water demand makes hospitals an important site for implementing rainwater harvesting. Bhavnarishi, Chakote and Ahillyadevi Hospital are found to have the highest annual water demand.

Schools and complexes have moderate water demand. In schools and complexes fresh water is mostly used for sanitation and drinking purposes.
Rooftop Rainwater Harvesting Assessment

Risk of Contamination

Risk of contamination: An important parameter to consider while designing the rainwater harvesting system

Harvesting rainwater is good but only when the collected water is protected from the contamination. Schools with large campus area are found to have a lower risk of contamination whereas hospitals are at moderate risk and shopping complexes are at higher risk of contamination due to congested built-up area, unclean roofs and proximity to the sewage network.

Conclusion

Solely looking on RWH potential there is no doubt shopping complexes have the highest RWH potential among all the public buildings but they also have a high risk of contamination which makes them least attractive for harvesting rain.

On the other hand, high water demand makes hospitals an important site for rainwater harvesting but comparatively hospitals have less RWH potential and also have a moderate risk of contamination. Therefore, schools are the most preferred sites for harvesting rainwater as they have good RWH potential, large campus area and lower risk of contamination.

Recommendations

A) Schools are the most preferred for rainwater harvesting among all the public buildings.

B) Groundwater recharge through the injection well is recommended.

C) Some sites are found to have dry borewell which can be easily converted into an injection well for groundwater recharge.

D) Installation of injection well must be done at least 10 meters away from the sewage network to avoid contamination during the rain event.

E) Periodic maintenance of the RWH system is mandatory to ensure its functionality resulting in the availability of collected rainwater both in terms of quality and quantity.

F) The development of reliable pre- operational, operational and post operational water quality monitoring is an important part for a successful ground water recharge scheme.
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Rooftop Rainwater Harvesting Assessment

Site Name: Manpa Mule Camp  
Address: Lashkar, Camp Imarat Solapur

Summary
The rooftop rainwater harvesting potential for this site is 2,75,132 liters (275 m³). Installation of the RWH system in the building shall fulfil 50% of annual water demand.

Location
- Location: Solapur
- Latitude: 17.65374
- Longitude: 75.90767
- Effective Roof Area (m²): 750
- Roof Type: Flat
- Runoff Coefficient: 0.7
- Average Annual Rainfall: 524.06
- Daily Water Demand (L): 1500

Rainfall
The last five year average rainfall at this location varies between 0 mm in the driest month (January) and 120.14 mm in the wettest month (June). The total annual rainfall in an average year is 524.06 mm.

Water Available for Reuse/Recharge
The total yearly amount of water that can be collected from the roof in an average year.

<table>
<thead>
<tr>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,75,132</td>
<td>275</td>
</tr>
</tbody>
</table>

Annual Water Demand
The annual water demand of the building

<table>
<thead>
<tr>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>5,47,500</td>
<td>547</td>
</tr>
</tbody>
</table>

Demand to Supply Ratio
1.98

Potential to Fulfill Annual Water Demand (%)
50

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Summary
The rooftop rainwater harvesting potential for this site is 1,15,188 liters (115 m³). Installation of the RWH system in the building shall fulfil 31% of annual water demand.

Location
Location: Solapur
Latitude: 17.657002
Longitude: 75.910467
Effective Roof Area (m²): 314
Roof Type: Flat
Runoff Coefficient: 0.7
Average Annual Rainfall: 524.06
Daily Water Demand (L): 1000

Rainfall
The last five year average rainfall at this location varies between 0 mm in the driest month (January) and 120.14 mm in the wettest month (June). The total annual rainfall in an average year is 524.06 mm.

Water Available for Reuse/Recharge
The total yearly amount of water that can be collected from the roof in an average year.

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<tr>
<th>Liters</th>
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<tr>
<td>1,15,188</td>
<td>115</td>
</tr>
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</table>

Annual Water Demand
The annual water demand of the building

<table>
<thead>
<tr>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,65,000</td>
<td>365</td>
</tr>
</tbody>
</table>

Demand to Supply Ratio

| 3.16 |

Potential to Fulfill Annual Water Demand (%)

| 31 |
Rooftop Rainwater Harvesting Assessment

Site Name: Manpa Urdu Muli Camp

Address: Lashkar, Camp Imarat Solapur

Summary
The rooftop rainwater harvesting potential for this site is 1,94,426 liters (194 m³). Installation of the RWH system in the building shall fulfil 176% of annual water demand.

Location
Location: Solapur
Latitude: 17.657191
Longitude: 75.910595
Effective Roof Area (m²): 530
Roof Type: Flat
Runoff Coefficient: 0.7
Average Annual Rainfall: 524.06
Daily Water Demand (L): 300

Rainfall
The last five year average rainfall at this location varies between 0 mm in the driest month (January) and 120.14 mm in the wettest month (June). The total annual rainfall in an average year is 524.06 mm.

Water Available for Reuse/Recharge
The total yearly amount of water that can be collected from the roof in an average year.

<table>
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<tr>
<th></th>
<th>Liters</th>
<th>m³</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>1,94,426</td>
<td>194</td>
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</tbody>
</table>

Annual Water Demand
The annual water demand of the building

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<tr>
<th></th>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1,09,500</td>
<td>109</td>
</tr>
</tbody>
</table>

Demand to Supply Ratio
0.56

Potential to Fulfill Annual Water Demand (%)
177
Rooftop Rainwater Harvesting Assessment

Site Name: Manpa Mule No 26
Address: Lashkar, Camp Imarat Solapur

Summary
The rooftop rainwater harvesting potential for this site is 82,539 liters (82 m³). Installation of the RWH system in the building shall fulfil 45% of annual water demand.

Location
- Location: Solapur
- Latitude: 17.656823
- Longitude: 75.910427
- Effective Roof Area (m²): 175
- Roof Type: Iron
- Runoff Coefficient: 0.9
- Average Annual Rainfall: 524.06
- Daily Water Demand (L): 500

Rainfall
The last five year average rainfall at this location varies between 0 mm in the driest month (January) and 120.14 mm in the wettest month (June). The total annual rainfall in an average year is 524.06 mm.

Water Available for Reuse/Recharge
The total yearly amount of water that can be collected from the roof in an average year.

<table>
<thead>
<tr>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>82,539</td>
<td>82</td>
</tr>
</tbody>
</table>

Annual Water Demand
The annual water demand of the building

<table>
<thead>
<tr>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,82,500</td>
<td>182</td>
</tr>
</tbody>
</table>

Demand to Supply Ratio
Potential to Fulfill Annual Water Demand (%)

| 2.21 | 45 |

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Rooftop Rainwater Harvesting Assessment

Site Name: Savitri Bai Phule (EM)  
Address: Lashkar, Camp Imarat Solapur

Summary
The rooftop rainwater harvesting potential for this site is 3,30,158 liters (330 m³). Installation of the RWH system in the building shall fulfil 60% of annual water demand.

Location
Location: Solapur  
Latitude: 17.656099  
Longitude: 75.910548  
Effective Roof Area (m²): 900  
Roof Type: Flat  
Runoff Coefficient: 0.7  
Average Annual Rainfall: 524.06  
Daily Water Demand (L): 1500

Rainfall
The last five year average rainfall at this location varies between 0 mm in the driest month (January) and 120.14 mm in the wettest month (June). The total annual rainfall in an average year is 524.06 mm.

Water Available for Reuse/Recharge
The total yearly amount of water that can be collected from the roof in an average year.

<table>
<thead>
<tr>
<th>Month</th>
<th>Liters</th>
<th>m³</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>3,30,158</td>
<td>330</td>
</tr>
</tbody>
</table>

Annual Water Demand
The annual water demand of the building

<table>
<thead>
<tr>
<th></th>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5,47,500</td>
<td>547</td>
</tr>
</tbody>
</table>

Demand to Supply Ratio
Potential to Fulfill Annual Water Demand (%)

|        | 1.65 | 60 |

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Rooftop Rainwater Harvesting Assessment

Site Name: Manpa Urdu Mule Camp
Address: Lashkar, Camp Imarat Solapur

Summary
The rooftop rainwater harvesting potential for this site is 2,23,774 liters (223 m³). Installation of the RWH system in the building shall fulfil 102% of annual water demand.

Location
Location: Solapur
Latitude: 17.657202
Longitude: 75.911066
Effective Roof Area (m²): 610
Roof Type: Flat
Runoff Coefficient: 0.7
Average Annual Rainfall: 524.06
Daily Water Demand (L): 600

Rainfall
The last five year average rainfall at this location varies between 0 mm in the driest month (January) and 120.14 mm in the wettest month (June). The total annual rainfall in an average year is 524.06 mm.

Water Available for Reuse/Recharge
The total yearly amount of water that can be collected from the roof in an average year:

<table>
<thead>
<tr>
<th>Month</th>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
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<td>Jan</td>
<td></td>
<td></td>
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<tr>
<td>Feb</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mar</td>
<td>12.1</td>
<td>0.0121</td>
</tr>
<tr>
<td>Apr</td>
<td>10.34</td>
<td>0.01034</td>
</tr>
<tr>
<td>May</td>
<td>20.18</td>
<td>0.02018</td>
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<tr>
<td>Jun</td>
<td>120.14</td>
<td>0.12014</td>
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<tr>
<td>Jul</td>
<td>61.9</td>
<td>0.0619</td>
</tr>
<tr>
<td>Aug</td>
<td>95.42</td>
<td>0.09542</td>
</tr>
<tr>
<td>Sep</td>
<td>118.28</td>
<td>0.11828</td>
</tr>
<tr>
<td>Oct</td>
<td>68.32</td>
<td>0.06832</td>
</tr>
<tr>
<td>Nov</td>
<td>12.8</td>
<td>0.0128</td>
</tr>
<tr>
<td>Dec</td>
<td>2.38</td>
<td>0.00238</td>
</tr>
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</table>

Annual Water Demand
The annual water demand of the building:

<table>
<thead>
<tr>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,19,000</td>
<td>219</td>
</tr>
</tbody>
</table>

Demand to Supply Ratio
0.97

Potential to Fulfill Annual Water Demand (%)
102

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Rooftop Rainwater Harvesting Assessment

Site Name: Manpa Mule No 11
Address: Tehti Naka, Solapur

Summary
The rooftop rainwater harvesting potential for this site is 33,016 liters (33 m³). Installation of the RWH system in the building shall fulfil 90% of annual water demand.

Location
Location Solapur
Latitude 17.681053
Longitude 75.900275
Effective Roof Area (m²) 90
Roof Type Flat
Runoff Coefficient 0.7
Average Annual Rainfall 524.06
Daily Water Demand (L) 100

Rainfall
The last five year average rainfall at this location varies between 0 mm in the driest month (January) and 120.14 mm in the wettest month (June). The total annual rainfall in an average year is 524.06 mm.

Water Available for Reuse/Recharge
The total yearly amount of water that can be collected from the roof in an average year.

<table>
<thead>
<tr>
<th></th>
<th>Liters</th>
<th>m³</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>33,016</td>
<td>33</td>
</tr>
</tbody>
</table>

Annual Water Demand
The annual water demand of the building

<table>
<thead>
<tr>
<th></th>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>36,500</td>
<td>36</td>
</tr>
</tbody>
</table>

Demand to Supply Ratio
Potential to Fulfill Annual Water Demand (%)

<table>
<thead>
<tr>
<th></th>
<th>1.1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>90</td>
</tr>
</tbody>
</table>
Rooftop Rainwater Harvesting Assessment

Site Name: Manpa Mule No 27
Address: Avanti Nagar, S.T Stand, Solapur

Summary
The rooftop rainwater harvesting potential for this site is 1,46,737 liters (146 m³). Installation of the RWH system in the building shall fulfil 80% of annual water demand.

Location
Location: Solapur
Latitude: 17.681823
Longitude: 75.895362
Effective Roof Area (m²): 400
Roof Type: Flat
Runoff Coefficient: 0.7
Average Annual Rainfall: 524.06
Daily Water Demand (L): 500

Rainfall
The last five year average rainfall at this location varies between 0 mm in the driest month (January) and 120.14 mm in the wettest month (June). The total annual rainfall in an average year is 524.06 mm.

Water Available for Reuse/Recharge
The total yearly amount of water that can be collected from the roof in an average year.

<table>
<thead>
<tr>
<th>Months</th>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>1,46,737</td>
<td>146</td>
</tr>
</tbody>
</table>

Annual Water Demand
The annual water demand of the building

<table>
<thead>
<tr>
<th>Months</th>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>1,82,500</td>
<td>182</td>
</tr>
</tbody>
</table>

Demand to Supply Ratio
1.24

Potential to Fulfill Annual Water Demand (%)
80
Rooftop Rainwater Harvesting Assessment

Site Name: Manpa Mule No 21 & Muli No 16

Address: Kasturba Market, Solapur

Summary
The rooftop rainwater harvesting potential for this site is 2,71,463 liters (271 m³). Installation of the RWH system in the building shall fulfil 148% of annual water demand.

Location
Location: Solapur
Latitude: 17.684453
Longitude: 75.904645
Effective Roof Area (m²): 740
Roof Type: Flat
Runoff Coefficient: 0.7
Average Annual Rainfall: 524.06
Daily Water Demand (L): 500

Rainfall
The last five year average rainfall at this location varies between 0 mm in the driest month (January) and 120.14 mm in the wettest month (June). The total annual rainfall in an average year is 524.06 mm.

Water Available for Reuse/Recharge
The total yearly amount of water that can be collected from the roof in an average year.

<table>
<thead>
<tr>
<th>Months</th>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan - Dec</td>
<td>2,71,463</td>
<td>271</td>
</tr>
</tbody>
</table>

Annual Water Demand
The annual water demand of the building

<table>
<thead>
<tr>
<th>Months</th>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan - Dec</td>
<td>1,82,500</td>
<td>182</td>
</tr>
</tbody>
</table>

Demand to Supply Ratio
0.67

Potential to Fulfill Annual Water Demand (%)
148
Rooftop Rainwater Harvesting Assessment

Site Name: Manpa Mule No 2
Address: Tuljapur Base, Solapur

Summary
The rooftop rainwater harvesting potential for this site is 1,65,079 liters (165 m³). Installation of the RWH system in the building shall fulfil 90% of annual water demand.

Location
Location: Solapur
Latitude: 17.684494
Longitude: 75.909886
Effective Roof Area (m²): 450
Roof Type: Flat
Runoff Coefficient: 0.7
Average Annual Rainfall: 524.06
Daily Water Demand (L): 500

Rainfall
The last five year average rainfall at this location varies between 0 mm in the driest month (January) and 120.14 mm in the wettest month (June). The total annual rainfall in an average year is 524.06 mm.

Water Available for Reuse/Recharge
The total yearly amount of water that can be collected from the roof in an average year.

<table>
<thead>
<tr>
<th>Water Available for Reuse/Recharge</th>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1,65,079</td>
<td>165</td>
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Annual Water Demand
The annual water demand of the building

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<thead>
<tr>
<th>Annual Water Demand</th>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1,82,500</td>
<td>182</td>
</tr>
</tbody>
</table>

Demand to Supply Ratio
1.1

Potential to Fulfill Annual Water Demand (%)
90
Rooftop Rainwater Harvesting Assessment

Site Name: Manpa Mule No 29

Address: Kumbhar Ves, Solapur

Summary
The rooftop rainwater harvesting potential for this site is 5,20,916 liters (520 m³). Installation of the RWH system in the building shall fulfil 142% of annual water demand.

Location
Location: Solapur
Latitude: 17.683207
Longitude: 75.913339
Effective Roof Area (m²): 1420
Roof Type: Flat
Runoff Coefficient: 0.7
Average Annual Rainfall: 524.06
Daily Water Demand (L): 1000

Rainfall
The last five year average rainfall at this location varies between 0 mm in the driest month (January) and 120.14 mm in the wettest month (June). The total annual rainfall in an average year is 524.06 mm.

Water Available for Reuse/Recharge
The total yearly amount of water that can be collected from the roof in an average year.

<table>
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<tr>
<th>Liters</th>
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<tr>
<td>5,20,916</td>
<td>520</td>
</tr>
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</table>

Annual Water Demand
The annual water demand of the building

<table>
<thead>
<tr>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,65,000</td>
<td>365</td>
</tr>
</tbody>
</table>

Demand to Supply Ratio
0.7

Potential to Fulfill Annual Water Demand (%)
142
Rooftop Rainwater Harvesting Assessment

Site Name: Chakote Hospital
Address: Jodbhavi Pedh, Gol Chavdi Dawakhana, Solapur

Summary
The rooftop rainwater harvesting potential for this site is 1,43,068 liters (143 m³). Installation of the RWH system in the building shall fulfill 11% of annual water demand.

Location
- Location: Solapur
- Latitude: 17.65374
- Longitude: 75.90767
- Effective Roof Area (m²): 390
- Roof Type: Flat
- Runoff Coefficient: 0.7
- Average Annual Rainfall: 524.06
- Daily Water Demand (L): 3500

Rainfall
The last five year average rainfall at this location varies between 0 mm in the driest month (January) and 120.14 mm in the wettest month (June). The total annual rainfall in an average year is 524.06 mm.

Water Available for Reuse/Recharge
The total yearly amount of water that can be collected from the roof in an average year.

<table>
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<tr>
<th>Month</th>
<th>Liters</th>
<th>m³</th>
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<td>143</td>
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Annual Water Demand
The annual water demand of the building

<table>
<thead>
<tr>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>12,77,500</td>
<td>1277</td>
</tr>
</tbody>
</table>

Demand to Supply Ratio

| 8.92 | |

Potential to Fulfill Annual Water Demand (%)
11

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Rooftop Rainwater Harvesting Assessment

Site Name: Hinglajmata Hospital
Address: Kanna Chowk, Solapur

Summary
The rooftop rainwater harvesting potential for this site is 1,65,079 liters (165 m³). Installation of the RWH system in the building shall fulfil 30% of annual water demand.

Location
Location: Solapur
Latitude: 17.677083
Longitude: 75.915536
Effective Roof Area (m²): 450
Roof Type: Flat
Runoff Coefficient: 0.7
Average Annual Rainfall: 524.06 cm
Daily Water Demand (L): 1500

Rainfall
The last five year average rainfall at this location varies between 0 mm in the driest month (January) and 120.14 mm in the wettest month (June). The total annual rainfall in an average year is 524.06 mm.

Water Available for Reuse/Recharge
The total yearly amount of water that can be collected from the roof in an average year.

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<td></td>
<td></td>
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<tr>
<td>Mar</td>
<td>12.1</td>
<td></td>
</tr>
<tr>
<td>Apr</td>
<td>10.34</td>
<td></td>
</tr>
<tr>
<td>May</td>
<td>20.18</td>
<td></td>
</tr>
<tr>
<td>Jun</td>
<td>120.14</td>
<td>165</td>
</tr>
<tr>
<td>Jul</td>
<td>61.9</td>
<td></td>
</tr>
<tr>
<td>Aug</td>
<td>95.42</td>
<td></td>
</tr>
<tr>
<td>Sep</td>
<td>118.28</td>
<td></td>
</tr>
<tr>
<td>Oct</td>
<td>68.32</td>
<td></td>
</tr>
<tr>
<td>Nov</td>
<td>12.8</td>
<td></td>
</tr>
<tr>
<td>Dec</td>
<td>2.38</td>
<td></td>
</tr>
</tbody>
</table>

Annual Water Demand
The annual water demand of the building

<table>
<thead>
<tr>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>5,47,500</td>
<td>547</td>
</tr>
</tbody>
</table>

Demand to Supply Ratio
3.31

Potential to Fulfill Annual Water Demand (%)
30
Rooftop Rainwater Harvesting Assessment

Site Name: I.D Hospital
Address: Civil Hospital, Samor

Summary
The rooftop rainwater harvesting potential for this site is 88,042 liters (88 m³). Installation of the RWH system in the building shall fulfil 48% of annual water demand.

Location
Location: Solapur
Latitude: 17.666407
Longitude: 75.911933
Effective Roof Area (m²): 240
Roof Type: Flat
Runoff Coefficient: 0.7
Average Annual Rainfall: 524.06
Daily Water Demand (L): 500

Rainfall
The last five year average rainfall at this location varies between 0 mm in the driest month (January) and 120.14 mm in the wettest month (June). The total annual rainfall in an average year is 524.06 mm.

Water Available for Reuse/Recharge
The total yearly amount of water that can be collected from the roof in an average year.
88,042 m³

Annual Water Demand
The annual water demand of the building
1,82,500 m³

Demand to Supply Ratio
2.07

Potential to Fulfill Annual Water Demand (%)
48

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Rooftop Rainwater Harvesting Assessment

Site Name: Bhavnarishi Hospital
Address: Ashok Chowk

Summary
The rooftop rainwater harvesting potential for this site is 84,374 liters (84 m³). Installation of the RWH system in the building shall fulfil 5% of annual water demand.

Location
Location: Solapur
Location: Solapur
Latitude: 17.664344
Longitude: 75.922586
Effective Roof Area (m²): 230
Roof Type: Flat
Runoff Coefficient: 0.7
Average Annual Rainfall: 524.06
Daily Water Demand (L): 4000

Rainfall
The last five year average rainfall at this location varies between 0 mm in the driest month (January) and 120.14 mm in the wettest month (June). The total annual rainfall in an average year is 524.06 mm.

Water Available for Reuse/Recharge
The total yearly amount of water that can be collected from the roof in an average year.

<table>
<thead>
<tr>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>84,374</td>
<td>84</td>
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</tbody>
</table>

Annual Water Demand
The annual water demand of the building

<table>
<thead>
<tr>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>14,60,000</td>
<td>1460</td>
</tr>
</tbody>
</table>

Demand to Supply Ratio
Potential to Fulfill Annual Water Demand (%)

17.3
5
Rooftop Rainwater Harvesting Assessment

Site Name: Darasha Hospital  
Address: Gandhi Nagar, Solapur

Summary
The rooftop rainwater harvesting potential for this site is 1,28,395 liters (128 m³). Installation of the RWH system in the building shall fulfil 11% of annual water demand.

Location
Location: Solapur  
Latitude: 17.656499  
Longitude: 75.910131  
Effective Roof Area (m²): 350  
Roof Type: Flat  
Runoff Coefficient: 0.7  
Average Annual Rainfall: 524.06  
Daily Water Demand (L): 3000

Rainfall
The last five year average rainfall at this location varies between 0 mm in the driest month (January) and 120.14 mm in the wettest month (June). The total annual rainfall in an average year is 524.06 mm.

Water Available for Reuse/Recharge
The total yearly amount of water that can be collected from the roof in an average year.

<table>
<thead>
<tr>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,28,395</td>
<td>128</td>
</tr>
</tbody>
</table>

Annual Water Demand
The annual water demand of the building

<table>
<thead>
<tr>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>10,95,000</td>
<td>1095</td>
</tr>
</tbody>
</table>

Demand to Supply Ratio
8.52

Potential to Fulfill Annual Water Demand (%)
11
Rooftop Rainwater Harvesting Assessment

Site Name: Ramwadi Hospital
Address: Ramwadi

Summary
The rooftop rainwater harvesting potential for this site is 2,16,437 liters (216 m³). Installation of the RWH system in the building shall fulfil 39% of annual water demand.

Location
Location: Solapur
Latitude: 17.658396
Longitude: 75.894166
Effective Roof Area (m²): 590
Roof Type: Flat
Runoff Coefficient: 0.7
Average Annual Rainfall: 524.06
Daily Water Demand (L): 1500

Rainfall
The last five year average rainfall at this location varies between 0 mm in the driest month (January) and 120.14 mm in the wettest month (June). The total annual rainfall in an average year is 524.06 mm.

Water Available for Reuse/Recharge
The total yearly amount of water that can be collected from the roof in an average year.

Annual Water Demand
The annual water demand of the building

Demand to Supply Ratio
Potential to Fulfill Annual Water Demand (%)

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Rooftop Rainwater Harvesting Assessment

Site Name: Ahillyadevi Holkar Hospital

Address: Dufreen Chowk, Solapur

Summary
The rooftop rainwater harvesting potential for this site is 2,12,768 liters (212 m³). Installation of the RWH system in the building shall fulfil 19% of annual water demand.

Location
Location: Solapur
Latitude: 17.667518
Longitude: 75.902568
Effective Roof Area (m²): 580
Roof Type: Flat
Runoff Coefficient: 0.7
Average Annual Rainfall: 524.06
Daily Water Demand (L): 3000

Rainfall
The last five year average rainfall at this location varies between 0 mm in the driest month (January) and 120.14 mm in the wettest month (June). The total annual rainfall in an average year is 524.06 mm.

Water Available for Reuse/Recharge
The total yearly amount of water that can be collected from the roof in an average year.

<table>
<thead>
<tr>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,12,768</td>
<td>212</td>
</tr>
</tbody>
</table>

Annual Water Demand
The annual water demand of the building

<table>
<thead>
<tr>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>10,95,000</td>
<td>1095</td>
</tr>
</tbody>
</table>

Demand to Supply Ratio

| 5.14 |

Potential to Fulfill Annual Water Demand (%)

| 19 |
Rooftop Rainwater Harvesting Assessment

Site Name: Jijamata Hospital
Address: Jail Road, Police Station Jawal, Solapur

Summary
The rooftop rainwater harvesting potential for this site is 1,70,582 liters (170 m³). Installation of the RWH system in the building shall fulfil 31% of annual water demand.

Location
Location: Solapur
Latitude: 17.673047
Longitude: 75.913426
Effective Roof Area (m²): 465
Roof Type: Flat
Runoff Coefficient: 0.7
Average Annual Rainfall: 524.06
Daily Water Demand (L): 1500

Rainfall
The last five year average rainfall at this location varies between 0 mm in the driest month (January) and 120.14 mm in the wettest month (June). The total annual rainfall in an average year is 524.06 mm.

Water Available for Reuse/Recharge

<table>
<thead>
<tr>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,70,582</td>
<td>170</td>
</tr>
</tbody>
</table>

Annual Water Demand

<table>
<thead>
<tr>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>5,47,500</td>
<td>547</td>
</tr>
</tbody>
</table>

Demand to Supply Ratio

3.2

Potential to Fulfill Annual Water Demand (%)

31
Rooftop Rainwater Harvesting Assessment

Site Name: Kumbhar Ves Shopping Center
Address: Shivganga Mandhir Road

Summary
The rooftop rainwater harvesting potential for this site is 5,86,947 liters (586 m³). Installation of the RWH system in the building shall fulfil 80% of annual water demand.

Location
Location: Solapur
Latitude: 17.681393
Longitude: 75.911914
Effective Roof Area (m²): 1600
Roof Type: Flat
Runoff Coefficient: 0.7
Average Annual Rainfall: 524.06
Daily Water Demand (L): 2000

Rainfall
The last five year average rainfall at this location varies between 0 mm in the driest month (January) and 120.14 mm in the wettest month (June). The total annual rainfall in an average year is 524.06 mm.

Water Available for Reuse/Recharge
The total yearly amount of water that can be collected from the roof in an average year.

<table>
<thead>
<tr>
<th>Month</th>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>2.2</td>
<td>0.0022</td>
</tr>
<tr>
<td>Feb</td>
<td>12.1</td>
<td>0.0121</td>
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<tr>
<td>Mar</td>
<td>10.34</td>
<td>0.0103</td>
</tr>
<tr>
<td>Apr</td>
<td>20.18</td>
<td>0.0202</td>
</tr>
<tr>
<td>May</td>
<td>120.14</td>
<td>1.2014</td>
</tr>
<tr>
<td>Jun</td>
<td>61.9</td>
<td>0.0619</td>
</tr>
<tr>
<td>Jul</td>
<td>95.42</td>
<td>0.0954</td>
</tr>
<tr>
<td>Aug</td>
<td>118.28</td>
<td>1.1828</td>
</tr>
<tr>
<td>Sep</td>
<td>68.32</td>
<td>0.6832</td>
</tr>
<tr>
<td>Oct</td>
<td>12.8</td>
<td>0.0128</td>
</tr>
<tr>
<td>Nov</td>
<td>2.38</td>
<td>0.0024</td>
</tr>
</tbody>
</table>

Annual Water Demand
The annual water demand of the building

<table>
<thead>
<tr>
<th></th>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>73000</td>
<td>7.3000</td>
</tr>
</tbody>
</table>

Demand to Supply Ratio
1.24

Potential to Fulfill Annual Water Demand (%)
80
Rooftop Rainwater Harvesting Assessment

Site Name: Bhulabai Shopping Center
Address: Rajendra Chowk, Bus Depot Jawal

Summary
The rooftop rainwater harvesting potential for this site is 4,40,210 liters (440 m³). Installation of the RWH system in the building shall fulfil 120% of annual water demand.

Location
Location: Solapur
Latitude: 17.678583
Longitude: 75.918073
Effective Roof Area (m²): 1200
Roof Type: Flat
Runoff Coefficient: 0.7
Average Annual Rainfall: 524.06
Daily Water Demand (L): 1000

Rainfall
The last five year average rainfall at this location varies between 0 mm in the driest month (January) and 120.14 mm in the wettest month (June). The total annual rainfall in an average year is 524.06 mm.

Water Available for Reuse/Recharge
The total yearly amount of water that can be collected from the roof in an average year.

<table>
<thead>
<tr>
<th></th>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4,40,210</td>
<td>440</td>
</tr>
</tbody>
</table>

Annual Water Demand
The annual water demand of the building

<table>
<thead>
<tr>
<th></th>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3,65,000</td>
<td>365</td>
</tr>
</tbody>
</table>

Demand to Supply Ratio

<table>
<thead>
<tr>
<th></th>
<th>Potential to Fulfill Annual Water Demand (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.82</td>
<td>120</td>
</tr>
</tbody>
</table>

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Rooftop Rainwater Harvesting Assessment

Site Name: Shakhar Peth Bihir Shopping Center
Address: Shakhar Peth, Solapur

Summary
The rooftop rainwater harvesting potential for this site is 69,700 liters (69 m³). Installation of the RWH system in the building shall fulfil 38% of annual water demand.

Location
Location: Solapur
Latitude: 17.675751
Longitude: 75.913891
Effective Roof Area (m²): 190
Roof Type: Flat
Runoff Coefficient: 0.7
Average Annual Rainfall: 524.06
Daily Water Demand (L): 500

Rainfall
The last five year average rainfall at this location varies between 0 mm in the driest month (January) and 120.14 mm in the wettest month (June). The total annual rainfall in an average year is 524.06 mm.

Water Available for Reuse/Recharge
The total yearly amount of water that can be collected from the roof in an average year.

<table>
<thead>
<tr>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>69,700</td>
<td>69</td>
</tr>
</tbody>
</table>

Annual Water Demand
The annual water demand of the building

<table>
<thead>
<tr>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,82,500</td>
<td>182</td>
</tr>
</tbody>
</table>

Demand to Supply Ratio
Potential to Fulfill Annual Water Demand (%)

| 2.61 | 38 |
Rooftop Rainwater Harvesting Assessment

Site Name: Veer Rani Kitur Shopping Center
Address: Kanna Chowk, Solapur

Summary
The rooftop rainwater harvesting potential for this site is 77,037 liters (77 m³). Installation of the RWH system in the building shall fulfil 42% of annual water demand.

Location
Location: Solapur
Latitude: 17.678248
Longitude: 75.913844
Effective Roof Area (m²): 210
Roof Type: Flat
Runoff Coefficient: 0.7
Average Annual Rainfall: 524.06
Daily Water Demand (L): 500

Rainfall
The last five year average rainfall at this location varies between 0 mm in the driest month (January) and 120.14 mm in the wettest month (June). The total annual rainfall in an average year is 524.06 mm.

Water Available for Reuse/Recharge
The total yearly amount of water that can be collected from the roof in an average year.

<table>
<thead>
<tr>
<th>Month</th>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>77,037</td>
<td>77</td>
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</tbody>
</table>

Annual Water Demand
The annual water demand of the building

<table>
<thead>
<tr>
<th></th>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1,82,500</td>
<td>182</td>
</tr>
</tbody>
</table>

Demand to Supply Ratio
Potential to Fulfill Annual Water Demand (%)
2.36
42
Rooftop Rainwater Harvesting Assessment

Site Name: Hutatma Shopping Center
Address: Park Chowk, Solapur

Summary
The rooftop rainwater harvesting potential for this site is 5,68,605 liters (568 m³). Installation of the RWH system in the building shall fulfil 77% of annual water demand.

Location
Location: Solapur
Latitude: 17.670123
Longitude: 75.900367
Effective Roof Area (m²): 1550
Roof Type: Flat
Runoff Coefficient: 0.7
Average Annual Rainfall: 524.06
Daily Water Demand (L): 2000

Rainfall
The last five year average rainfall at this location varies between 0 mm in the driest month (January) and 120.14 mm in the wettest month (June). The total annual rainfall in an average year is 524.06 mm.

Water Available for Reuse/Recharge
The total yearly amount of water that can be collected from the roof in an average year.

<table>
<thead>
<tr>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>5,68,605</td>
<td>568</td>
</tr>
</tbody>
</table>

Annual Water Demand
The annual water demand of the building

<table>
<thead>
<tr>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>7,30,000</td>
<td>730</td>
</tr>
</tbody>
</table>

Demand to Supply Ratio
1.28

Potential to Fulfill Annual Water Demand (%)
77
Rooftop Rainwater Harvesting Assessment

Site Name: Janta Shopping Center
Address: Navi Peth, Solapur

Summary
The rooftop rainwater harvesting potential for this site is 4,40,210 liters (440 m³). Installation of the RWH system in the building shall fulfil 40% of annual water demand.

Location
Location: Solapur
Latitude: 17.676421
Longitude: 75.900101
Effective Roof Area (m²): 1200
Roof Type: Flat
Runoff Coefficient: 0.7
Average Annual Rainfall: 524.06
Daily Water Demand (L): 3000

Rainfall
The last five year average rainfall at this location varies between 0 mm in the driest month (January) and 120.14 mm in the wettest month (June). The total annual rainfall in an average year is 524.06 mm.

Water Available for Reuse/Recharge
The total yearly amount of water that can be collected from the roof in an average year.

<table>
<thead>
<tr>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>4,40,210</td>
<td>440</td>
</tr>
</tbody>
</table>

Annual Water Demand
The annual water demand of the building

<table>
<thead>
<tr>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>10,95,000</td>
<td>1095</td>
</tr>
</tbody>
</table>

Demand to Supply Ratio
Potential to Fulfill Annual Water Demand (%)

2.48
40
Rooftop Rainwater Harvesting Assessment

Site Name: Lalbahadur Shastri Shopping Center

Address: Navi Peth, Solapur

Summary
The rooftop rainwater harvesting potential for this site is 4,95,237 liters (495 m³). Installation of the RWH system in the building shall fulfil 67% of annual water demand.

Location

- Location: Solapur
- Latitude: 17.676421
- Longitude: 75.900492
- Effective Roof Area (m²): 1350
- Roof Type: Flat
- Runoff Coefficient: 0.7
- Average Annual Rainfall: 524.06
- Daily Water Demand (L): 2000

Rainfall
The last five year average rainfall at this location varies between 0 mm in the driest month (January) and 120.14 mm in the wettest month (June). The total annual rainfall in an average year is 524.06 mm.

Water Available for Reuse/Recharge
The total yearly amount of water that can be collected from the roof in an average year.

<table>
<thead>
<tr>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>4,95,237</td>
<td>495</td>
</tr>
</tbody>
</table>

Annual Water Demand
The annual water demand of the building

<table>
<thead>
<tr>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>7,30,000</td>
<td>730</td>
</tr>
</tbody>
</table>

Demand to Supply Ratio

| 1.47 |

Potential to Fulfill Annual Water Demand (%)

| 67 |
Rooftop Rainwater Harvesting Assessment

Site Name: Dr. Antolikar Shopping Center
Address: Dutta Chowk, Solapur

Summary
The rooftop rainwater harvesting potential for this site is 4,03,526 liters (403 m³). Installation of the RWH system in the building shall fulfil 73% of annual water demand.

Location
Location: Solapur
Latitude: 17.676644
Longitude: 75.904443
Effective Roof Area (m²): 1100
Roof Type: Flat
Runoff Coefficient: 0.7
Average Annual Rainfall: 524.06
Daily Water Demand (L): 1500

Rainfall
The last five year average rainfall at this location varies between 0 mm in the driest month (January) and 120.14 mm in the wettest month (June). The total annual rainfall in an average year is 524.06 mm.

Water Available for Reuse/Recharge
The total yearly amount of water that can be collected from the roof in an average year.

<table>
<thead>
<tr>
<th></th>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available for Reuse/Recharge</td>
<td>4,03,526</td>
<td>403</td>
</tr>
</tbody>
</table>

Annual Water Demand
The annual water demand of the building

<table>
<thead>
<tr>
<th></th>
<th>Liters</th>
<th>m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Water Demand</td>
<td>5,47,500</td>
<td>547</td>
</tr>
</tbody>
</table>

Demand to Supply Ratio
Potential to Fulfill Annual Water Demand (%)

<table>
<thead>
<tr>
<th></th>
<th>1.35</th>
<th>73</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand to Supply Ratio</td>
<td>Potential to Fulfill Annual Water Demand (%)</td>
<td></td>
</tr>
</tbody>
</table>
# Rooftop Rainwater Harvesting Assessment

## Summary Sheet

### Rooftop Rainwater Harvesting Potential for all the selected buildings

<table>
<thead>
<tr>
<th>S.N</th>
<th>Site Name</th>
<th>RWH Potential (Cum)</th>
<th>S.N</th>
<th>Site Name</th>
<th>RWH Potential (Cum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kumbhar Ves</td>
<td>586</td>
<td>16</td>
<td>Manpa Mule No 2</td>
<td>165</td>
</tr>
<tr>
<td>2</td>
<td>Hutatma</td>
<td>568</td>
<td>17</td>
<td>Hinglajmata Hospital</td>
<td>165</td>
</tr>
<tr>
<td>3</td>
<td>Manpa Mule No 29</td>
<td>520</td>
<td>18</td>
<td>Manpa Mule No 27</td>
<td>146</td>
</tr>
<tr>
<td>4</td>
<td>Lalbahadur Shastri</td>
<td>495</td>
<td>19</td>
<td>Chakote Hospital</td>
<td>143</td>
</tr>
<tr>
<td>5</td>
<td>Bhulabai</td>
<td>440</td>
<td>20</td>
<td>Darasha Hospital</td>
<td>128</td>
</tr>
<tr>
<td>6</td>
<td>Janta</td>
<td>440</td>
<td>21</td>
<td>Manpa Muli Camp</td>
<td>115</td>
</tr>
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**Figure 1:** Annual Rooftop Rainwater harvesting potential and water demand at selected Schools in Solapur District

Enviraj Consulting Pvt. Ltd.
F-29 Bhagat Singh Nagar, Bhind Road Gwalior-474005 | P: 7987416137 | E: info@enviraj.com | W: www.enviraj.com
Rooftop Rainwater Harvesting Assessment

Figure 2 - Annual Rooftop Rainwater harvesting potential and water demand at selected Hospitals in Solapur District

Figure 3 - Annual Rooftop Rainwater harvesting potential and water demand at selected Shopping Complexes in Solapur District
**APPENDIX I**

## Customized Rainfall Information System (CRIS)

Hydromet Division
India Meteorological Department
Ministry of Earth Sciences
New Delhi-110 003

Choose the State/UT : MAHARASHTRA | Select District : SHOLAPUR | GO

### District: SHOLAPUR

- **Note:**
  1. The District Rainfall in millimeters (R/F) shown below are the arithmetic averages of Rainfall of Stations under the District.
  2. % Dep. are the Departures of rainfall from the long period averages of rainfall for the District.
  3. Blank spaces show non-availability of data.

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**Last Five Years Rainfall Data**
### Estimation of Daily Water Demand

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Note: The estimated daily water demand is based on data collected during the site visit and interview done with the building manager.