RAINWATER HARVESTING

An Overview of Rainharvesting Systems

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Content

- Rainwater as a resource
- Rainwater use around Domestic and Commercial Buildings
- Components used for Rainwater Harvesting Systems
- Community Benefits
RAINWATER AS A RESOURCE
RAINWATER AS A RESOURCE

• RAINWATER: Water collected from roof runoffs or other structures after a rain event.
• GREYWATER: Water that has been used for showering, laundry and faucet uses. Kitchen sink and toilet water is excluded.
• STORM WATER: Any rainwater that touches the ground and flows across the surface of the ground (roadways, parking surfaces, gullies, creeks, streams, etc.).
HOW MUCH WATER CAN YOU CAPTURE?

- Roof area ($m^2$) x rainfall(mm) = volume that can be captured
- Thus $200m^2 \times 15mm = 3000L$
- A more accurate equation would be as follows:
- Roof area ($m^2$) x rainfall (mm) x roof material coefficient = volume that can be captured
- Thus $200m^2 \times 15mm \times 0.90 = 2700L$
Certain roof types are more efficient at capturing water with metal sheeting being the most efficient (around 95%) and greens roofs being less efficient (30 - 50%).

It is important to take the efficiency of the rainwater filtering system into account:

Roof area (m²) x rainfall (mm) x roof material coefficient x filter efficiency = volume that can be captured

Thus 200m² x 15mm x 0.90 x 0.95 = 2565L
Water Regulations

- There are currently no national regulations that explicitly deal with rainwater harvesting.
- Many municipalities and the Dept of Water Affairs promote it.
- Explicitly mentioned in the National Water Resource Strategy 2013
- SANS 10400 XB will deal with this in some way
- SANS 10252 – Plumbing regulations may also change
Johannesburg’s annual rainfall is between 650 and 750mm of rain per year thus:

- $200m^2 \times 750mm \times 0.90 \times 0.95 = 128 000L$

- $100L - 200L/\text{person} \times 4 \text{ people} = 400L - 800L \text{ per day in house use} = 146 000L - 290 000L \text{ per year or } 146\text{KL} – 290\text{KL}$
RAINWATER USE AROUND DOMESTIC AND COMMERCIAL BUILDINGS
REDUCE, RE-USE, RECYCLE

- Check for a water leak or dripping taps
- Install a leak detection device
- Replace the 25L/min shower head with one that uses less than 10L/min
- Install a double flush mechanism in the toilet
- Replace exotic lawn with permeable paving or water-wise alternatives
- Readjust the controller for the irrigation system and install a rain sensor
- Reduce garden watering times during winter
- Replace plants in the garden with water-wise indigenous varieties
- Cover the swimming pool to reduce evaporation
- Install water efficient taps or tap aerators
- Water before 9am and after 5pm
RAINWATER SYSTEMS VS RAINWATER TANKS

• More than just a tank!
• The better designed a system, the better the efficiency of how it works.
• The better the pre-filtration the better the longevity of a system and the better the maintenance intervals.
Dry System

- Rainwater is directly led into top of tank.
Wet System

- Rainwater is piped underground to the tank.
Wet System
RAINWATER IS USED FOR

- Garden irrigation
- Car washing
- Swimming pool and pond top up
- Paving spray down (do you really need to do that)!
- Toilet flushing
- Washing machine use
- Dishwasher use
- Showering and bathing
- Drinking water – subject to specialist design
RAINWATER USE: PASSIVE DESIGNS

Passive design concentrates on using rainwater in the garden from roofs or downspouts.

- Berms and swales
- Rain gardens
- Stormwater attenuation
- Roof gardens
RAINWATER USE: ACTIVE DESIGNS

• Active design using pressurised vs gravity systems.
• Pressurised systems use pressure pumps to deliver water - Energy usage from 100W upwards to 1100W
• Gravity feed systems - Farm tanks on stands
• 1m of head height = 0.1 Bar thus 20m = 2 Bar pressure
# Water Use in South African Households

<table>
<thead>
<tr>
<th></th>
<th>Low Income Households</th>
<th>Mid to High Income Households</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toilets</td>
<td>73%</td>
<td>37%</td>
</tr>
<tr>
<td>Baths and Showers</td>
<td>19%</td>
<td>32%</td>
</tr>
<tr>
<td>Washing Machines</td>
<td>N/A</td>
<td>17%</td>
</tr>
<tr>
<td>Other e.g. Cooking, washing dishes, drinking</td>
<td>8%</td>
<td>14%</td>
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</tbody>
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WATER USE IN SA HOUSEHOLDS

<table>
<thead>
<tr>
<th>Households with Gardens</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gardening</td>
<td>46%</td>
</tr>
<tr>
<td>Other</td>
<td>54%</td>
</tr>
</tbody>
</table>
IRRIGATION USE

- 200m² x 750mm x 0.90 x 0.95 = 128 000L

- 100L - 200L/ person x 4 people = 400L - 800L per day in house use = 146 000L - 290 000L per year

- 290 000 @ 46% = 133 000L for garden use so can theoretically not be reliant on municipality

- Consider greywater use for this

  50L x 4 = 200L per day = 73 000L = 50% garden supplementation
NON-POTABLE USES

• \[200 \text{m}^2 \times 750 \text{mm} \times 0.90 \times 0.95 = 128\,000\text{L}\]

• \[100\text{L} - 200\text{L/ person} \times 4\text{ people} = 400\text{L} - 800\text{L per day in house use} = 146\,000\text{L} - 290\,000\text{L per year}\]

• \[146\,000\text{L} @ 54\% = 78\,000\text{L so can be covered}\]

• \[128\,000 - 78\,000 = 50\,000\text{L spare for garden use}\]
POTABLE USE

- Consider when municipal water supply is inaccessible
- 146 000L family use per year so can get close - 85% to being self reliant if tank storage space is available.
- By using water saving devices can get close to being 100% self reliant.
- Purification costs increase the costs of the system.
COMPONENTS USED FOR RAINWATER HARVESTING SYSTEMS
COMPONENTS

• Collection or Catchment Surface
• Gutters and Downpipes
• Pre-filtration
• Rainwater Storage
• Pumps and Controls
• Treatment and Purification
GOOD SURFACES

- Metal sheeting
- Clay tiles
- Concrete/ Cement Tiles
- Shingles (Wooden)
- Glazed Tiles
BAD SURFACES

- roofs where lead is used
- roofs that have been painted with paints that contain unsafe ingredients (lead, chromate, fungicides or other toxins)
- roofs where bitumen (tar) has been used
- roofing materials that contain asbestos
GUTTERS ETC

• Cast iron
• Zinc
• Copper, lead
• Aluminium
• PVC
• Steel
DOWNPIPES

• Gutters need 0.5% - 2% slope.
• Downpipe positions:
  – Always try place downpipes as close to the storage vessel as possible, or vessel to downpipe.
  – A gutter downpipe should serve 10m - 15m of gutter length maximum
  – 110m2 of roof area served by a single downpipe
  – The larger the roof area; the larger the diameter of the downpipe
PREFILTRATION

• Basket Filters
PREFILTRATION

• Leaf screens/ Leaf Heads/ Rain Heads
• One per downpipe
PREFILTRATION

- Leaf screens/ Leaf Heads/ Rain Heads
- One per downpipe
PREFILTRATION
FIRST FLUSH DIVERTERS

• Improve water quality
• Not always necessary for irrigation but highly recommended for in house use.
• 0.5 - 2mm of rain can be diverted.
• Minimum of 20L / 100M2 of roof area
WATER STORAGE

- Different types of tank storage materials:
  - Plastic
  - Metal
  - Concrete
  - Fibreglass
  - Bladders
SIZING OF STORAGE

- Biggest size that budget and space allows.
- Yield/ Consumption/ Water Quality /Storage Size
- This gives you Minimum Size requirements
- $128,000L \times 0.049 = 6,200L$
- $146,000L \times 0.049 = 7,100L$
- More complicated software programs are available.
PUMPS

• Rainwater can flow from a tank using gravity but will trickle. Best suited for watering can use, bucket use or allow a hose to slow trickle onto areas downhill.

• Systems otherwise will require pressure pumps. These can be externally mounted or submersible pumps inside the tanks.

• Can pump water from ground level tanks to a tank on a stand to generate header pressure.

  1m = 0,1 Bar

• Energy usage of pumps can be from 100W upwards.
TREATMENT

• Rainwater used in the garden needs no further filtration, as long as rainwater is filtered before it enters the tank.
• Filtration prevents tanks from clogging, reduces pump blockage and reduces smell of water.
• First flush diverters do improve quality of water and should be considered for rainwater stored for irrigation use.
TREATMENT CONTINUED

• Rainwater systems used for internal non-potable use should have pre-filters, FFD’s and perhaps a post pump carbon filter.
• Rainwater can be used for potable uses and would need filtration such as sediment filters, carbon filters, UV light sterilisation or ozonation (depending on legislation).
• Can use Reverse Osmosis but remember that Reverse Osmosis produces waste water. This should be directed into the garden or to your greywater system for further use.
COMMUNITY BENEFITS OF RAINWATER HARVESTING
COMMUNITY BENEFITS

- Right thing to do
- Reduces reliance on municipal water
- Helps during drought conditions
- Helps with storm water mitigation and flooding
- Saves electricity
THANK YOU