Water Sources

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SSWM
sustainable sanitation and water management

Contents

Rainwater Harvesting

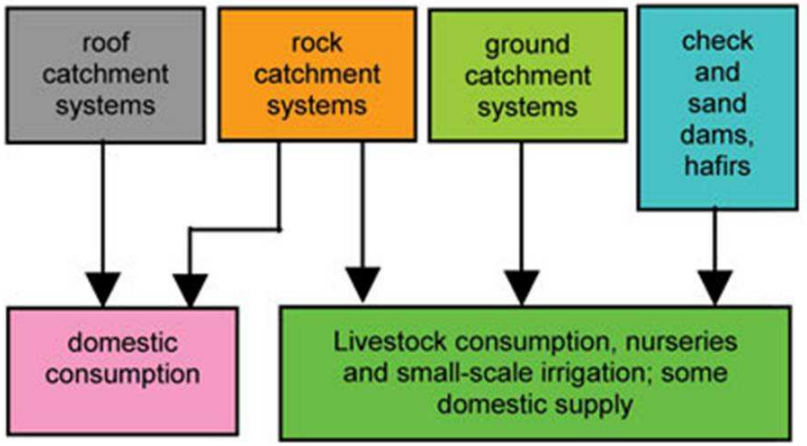
1. Rainwater harvesting

Concept

Rainwater harvesting means capturing the rain where it falls or capturing the runoff and taking measures to store that water and keep it clean.

Rainwater harvesting can be undertaken through a variety of ways:

- capturing run-off from roof tops
- capturing run-off from local catchments
- capturing seasonal floodwater from local streams
- conserving water through watershed management



Rainwater harvesting systems and uses
Source: unknown

1. Rainwater harvesting

Functions of rainwater harvesting

Harvesting rainwater has several functions:

- providing water to people and livestock
- providing water for food and cash crops
- increasing groundwater recharge
- reducing storm water discharges, urban floods and overloading of sewage treatment plants
- reducing seawater ingress in coastal areas

Source: unknown

1. Rainwater harvesting

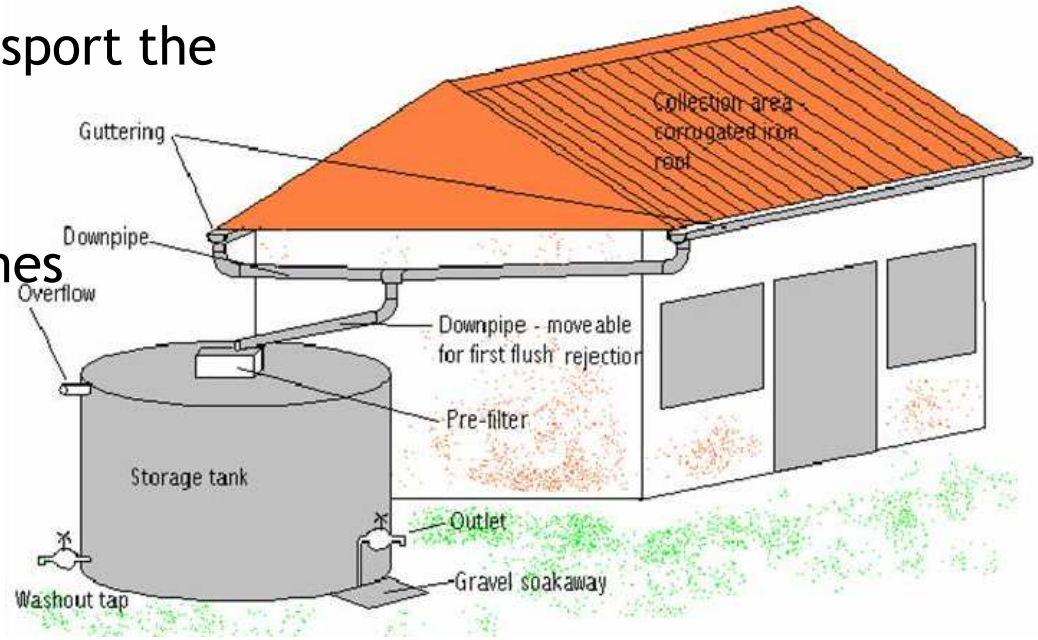
System components (adapted from MBUGUA unknown; http://www.irc.nl/redir/content/download/128508/350879/file/TP40_7%20Rain%20water%20harvesting.pdf [Accessed 1.6.2010]

Domestic rainwater harvesting system consist of:

- a collection surface,
- a storage tank, and
- guttering or channels to transport the water from one to the other.

Peripheral equipment sometimes incorporated:

- a first-flush system,
- a filtration equipment, and
- settling chambers



Conceptual sketch of rooftop rainwater harvesting system
Source: http://www.eng.warwick.ac.uk/DTU/rainwaterharvesting/index.html

1. Rainwater harvesting

Example

Rooftop rainwater harvesting at school in Misore, India

Source: M. Wafler

Spring Water Tapping

2. Spring water tapping

Concept (adapted from TAYONG 2002; http://www.irc.nl/redir/content/download/128509/350882/file/TP40_8%20Spring%20water%20tapping.pdf [Accessed 1.6.2010])

Spring water is usually fed from a sand or gravel water-bearing soil formation called an aquifer, or a water flow through fissured rock. Where solid or clay layers block the underground flow of water, it is forced upwards to the surface.

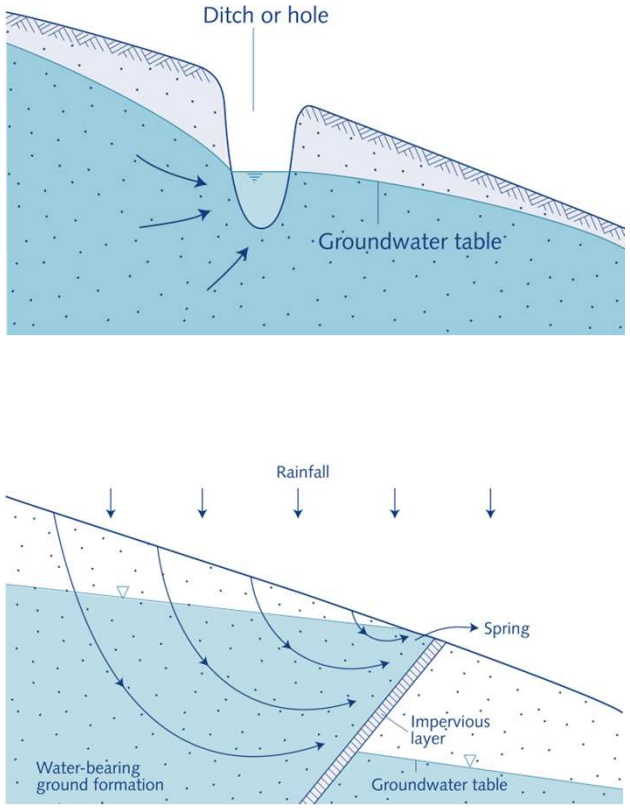
Distinct types of springs:

- gravity springs (water surfaces as a result of discontinuities in the strata that held the water underground),
- artesian springs (water surfaces under pressure)

2. Spring water tapping

Gravity springs (adapted from TAYONG 2002; http://www.irc.nl/redir/content/download/128509/350882/file/TP40_8%20Spring%20water%20tapping.pdf [Accessed 1.6.2010])

- occur in unconfined aquifers
- 2 main types:
  - *gravity depression springs*: ground surface dips below water table,
  - *gravity overflow springs*: outcrop of impervious soil, such as a solid or clay fault zone, forces water to surface



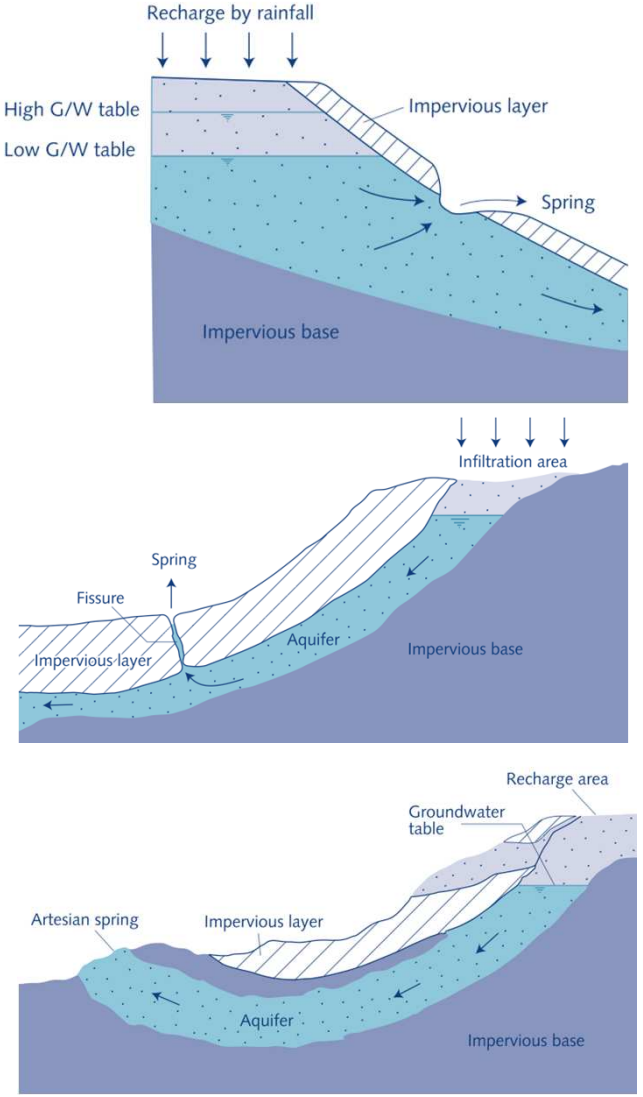
Schematic sketch of gravity depression (top) and overflow spring (bottom)

Source: TAYONG 2002; http://www.irc.nl/redir/content/download/128509/350882/file/TP40_8%20Spring%20water%20tapping.pdf [Accessed 1.6.2010]

2. Spring water tapping

Artesian springs (adapted from TAYONG 2002; http://www.irc.nl/redir/content/download/128509/350882/file/TP40_8%20Spring%20water%20tapping.pdf [Accessed 1.6.2010])

- water prevented from rising to its free water table level by presence of overlaying impervious layer
- 3 main types:
  - *artesian depression spring:* similar in appearance to gravity depression springs; higher discharge, less fluctuation (water is under pressure)
  - *artesian fissure spring:* water emerges under pressure through a fissure in impervious overburden
  - *artesian overflow spring:* often have large recharge area, sometimes great distance away



Schematic sketch of artesian depression (top), fissure (middle) and overflow spring (bottom)

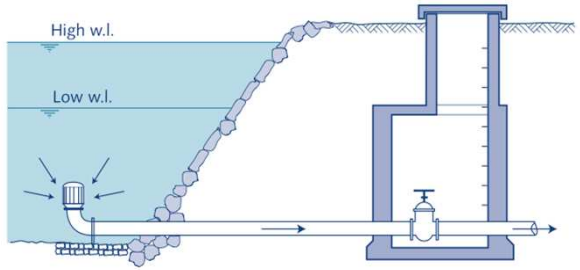
Source: TAYONG 2002; http://www.irc.nl/redir/content/download/128509/350882/file/TP40_8%20Spring%20water%20tapping.pdf [Accessed 1.6.2010]

Surface Water Intake

3. Surface water intake

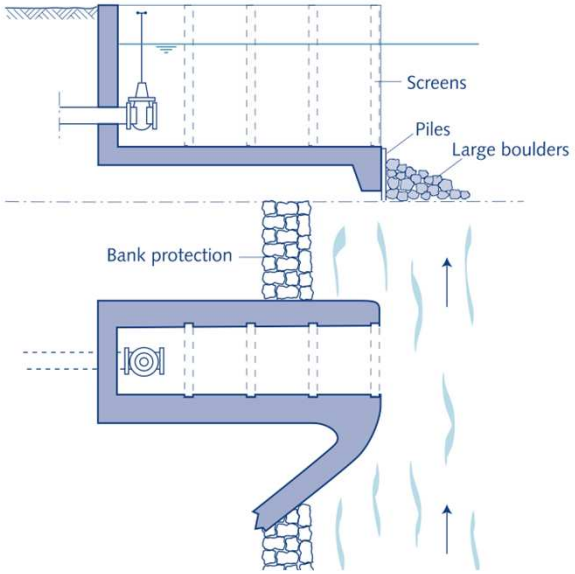
Concept (adapted from MASANGANISE 2002; http://www.irc.nl/redir/content/download/128533/350991/file/TP40_11%20Surface%20water.pdf [Accessed 1.6.2010])

natural streams, rivers or reservoirs close by are frequently most convenient source of water for small communities



River water intake (adapted from MASANGANISE 2002; http://www.irc.nl/redir/content/download/128533/350991/file/TP40_11%20Surface%20water.pdf [Accessed 1.6.2010])

- Main types:
  - o *unprotected river intake*: where river transports no boulders or rolling stones
  - o *protected river intake:* where protection of intake is necessary



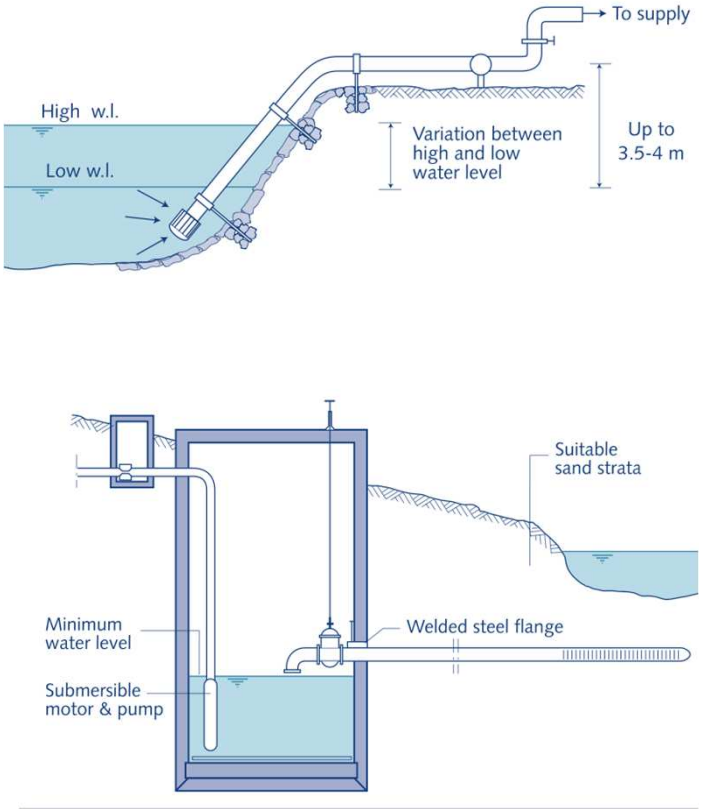
Schematic sketch of unprotected (top) and protected (bottom; section & top view) river intake

Source: MASANGANISE 2002; http://www.irc.nl/redir/content/download/128533/350991/file/TP40_11%20Surface%20water.pdf [Accessed 1.6.2010]

3. Surface water intake

River water intake (adapted from MASANGANISE 2002; http://www.irc.nl/redir/content/download/128533/350991/file/TP40_11%20Surface%20water.pdf [Accessed 1.6.2010])

- Main types (contd.):
  - o *pumped river (or lake) water intake:* if variation between high and low water level in river (or lake) is small suction pump can be placed on banks
  - o *bank river intake using infiltration drains:* water is collected with infiltration drains laid under riverbed and flows under gravity into sump

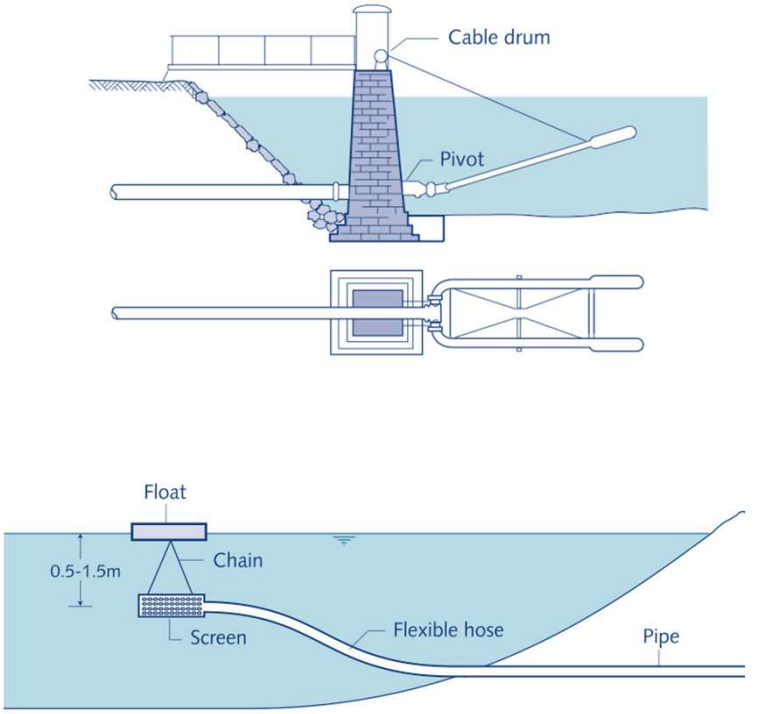


Schematic sketch of pumped (top) and bank river intake using infiltration drains (bottom)
Source: MASANGANISE 2002; http://www.irc.nl/redir/content/download/128533/350991/file/TP40_11%20Surface%20water.pdf [Accessed 1.6.2010]

3. Surface water intake

Lake water intake (adapted from MASANGANISE 2002; http://www.irc.nl/redir/content/download/128533/350991/file/TP40_11%20Surface%20water.pdf [Accessed 1.6.2010])

- for water supply purposes, water from deeper strata will have advantage of a practically constant temperature
- provision should be made to withdraw the water at some depth below the surface



Schematic sketch of variable depth lake water intake (top) and simple intake (bottom)

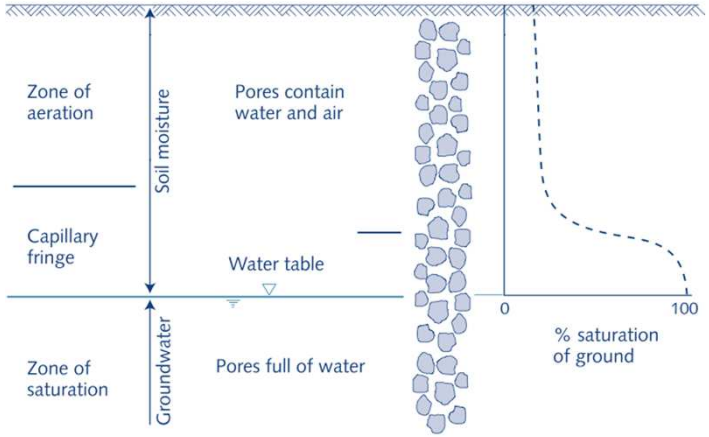
Source: MASANGANISE 2002; http://www.irc.nl/redir/content/download/128533/350991/file/TP40_11%20Surface%20water.pdf [Accessed 1.6.2010]

Ground Water Withdrawl

4. Ground water withdrawl

Concept (adapted from OKUNI 2002; http://www.irc.nl/redir/content/download/128511/350888/file/TP40_10%20Groundwater%20Withdrawal.pdf [Accessed 1.6.2010])

- groundwater occurs in pores, voids or fissures of ground formations
- almost always preferred source for community water supply systems
- withdrawal often be continued long after drought (less subject to seasonal fluctuation)
- Main types of wells:
  - *dug wells*
  - *driven wells*
  - *drilled wells*



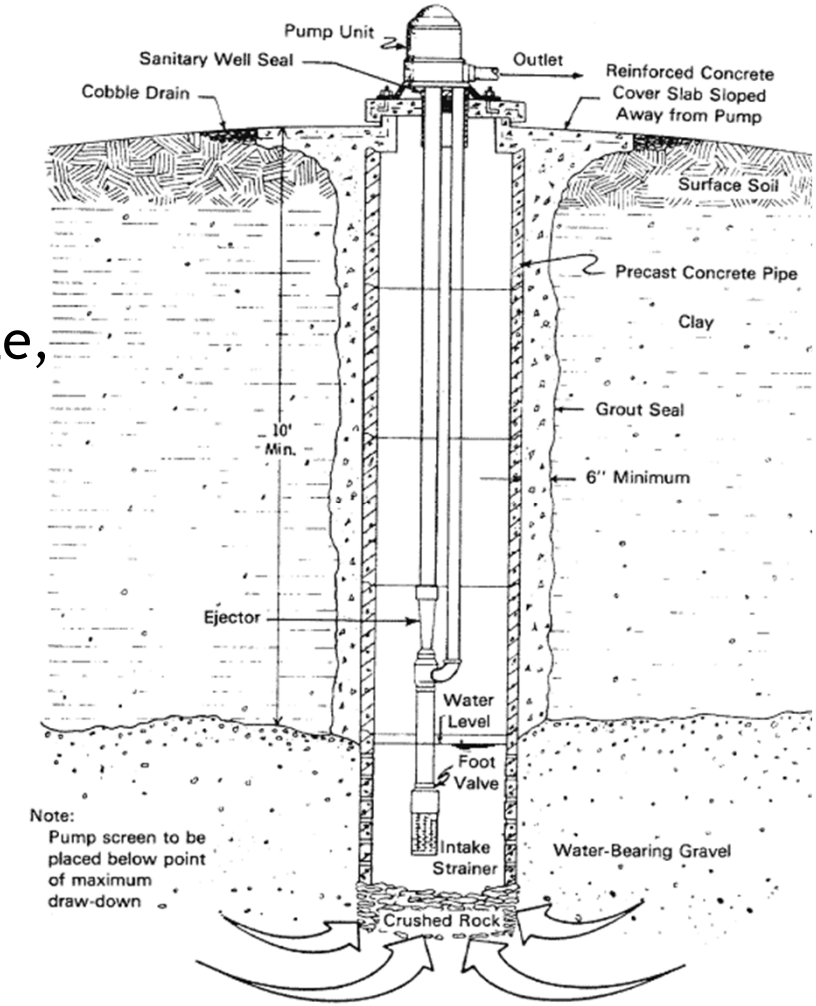
Water distribution above and in a porous unconfined aquifer

Source: OKUNI 2002; http://www.irc.nl/redir/content/download/128511/350888/file/TP40_10%20Groundwater%20Withdrawal.pdf [Accessed 1.6.2010]

4. Ground water withdrawl

Dug wells (adapted from EPA 2006; URL: http://epa.gov/OGWDW/privatewells/basic_dug.html [Accessed 1.6.2010])

- holes in the ground dug by shovel or backhoe
- then lined (cased) with stones, brick, tile, or other material to prevent collapse
- covered with a cap of wood, stone, or concrete
- not very deep (typically, 10 to 30 feet deep) since difficult to dig beneath ground water table
- highest risk of becoming contaminated



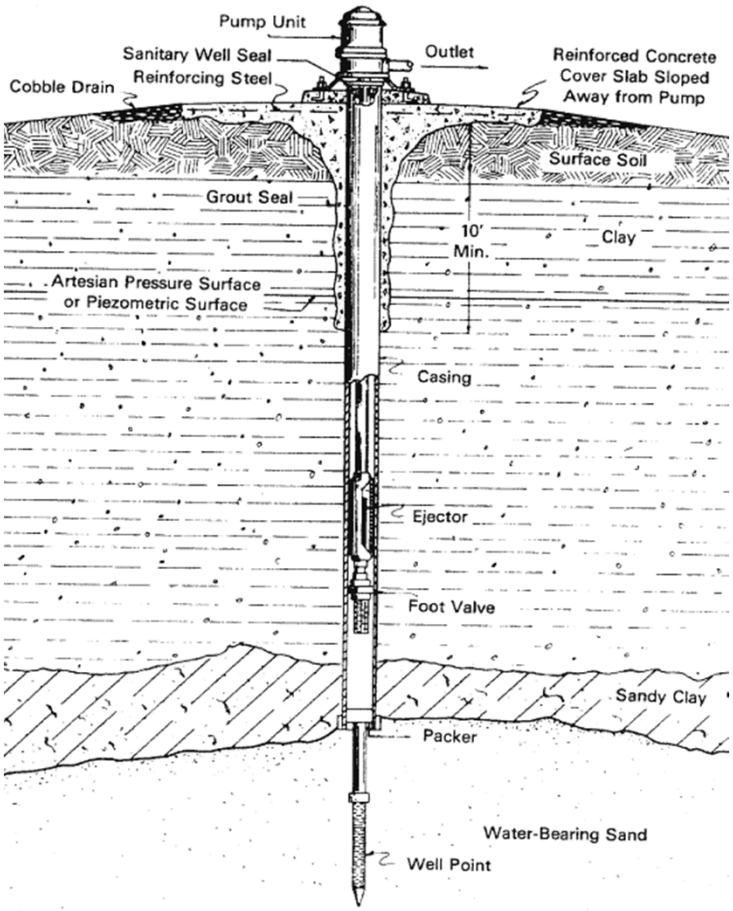
Schematic sketch of dug well

Source: http://www.fda.gov/ucm/groups/fdagov-public/documents/image/ucm151333.gif [Accessed 1.6.2010]

4. Ground water withdrawl

Driven wells (adapted from EPA 2006; URL: http://epa.gov/OGWDW/privatewells/basic_driven.html [Accessed 1.6.2010])

- pull water from the water-saturated zone above the bedrock (like dug wells)
- deeper than dug wells (typically 30 to 50 feet deep)
- usually located in areas with thick sand and gravel deposits where ground water table is within 15 feet of ground's surface
- In proper geologic setting, driven wells can be easy and relatively inexpensive to install
- moderate-to-high risk of contamination (as still relatively shallow)



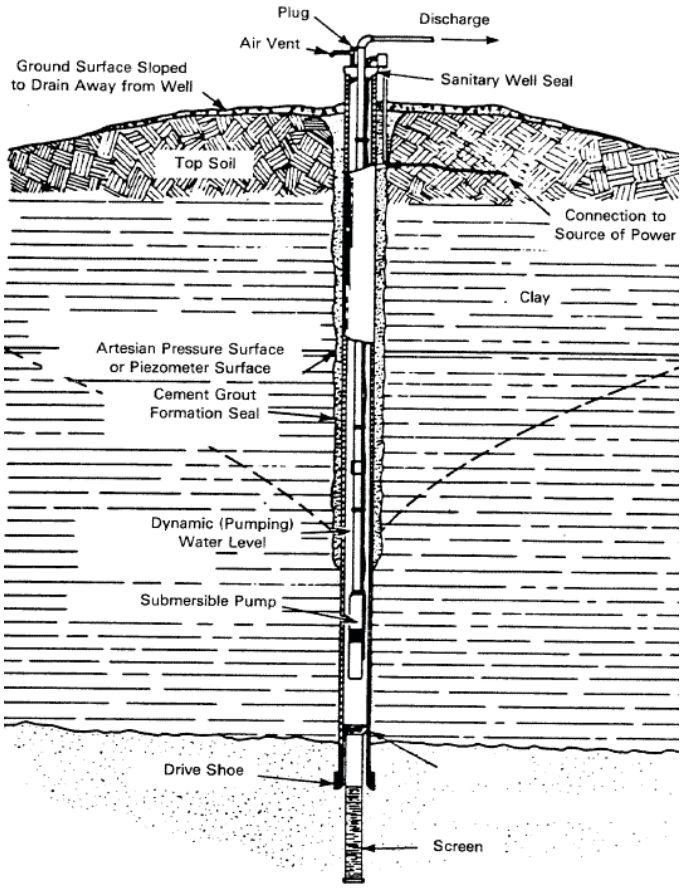
Schematic sketch of driven well

Source: http://www.fda.gov/ucm/groups/fdagov-public/documents/image/ucm151326.gif [Accessed 1.6.2010]

4. Ground water withdrawl

Drilled wells (adapted from EPA 2006; URL: http://epa.gov/OGWDW/privatewells/basic_drilled.html [Accessed 1.6.2010])

- penetrate about 100-400 feet into the bedrock
- must intersect bedrock fractures containing ground water



Schematic sketch of drilled well with submersible pump

Source: http://www.fda.gov/ucm/groups/fdagov-public/documents/image/ucm151329.gif [Accessed 1.6.2010]

5. Applicability

Rainwater harvesting

Means of providing water for domestic purposes. Especially where groundwater resources are unavailable or costly to develop.

Spring water tapping

Mainly in hilly or mountainous areas.

Surface water intake

Most convenient source of water if natural stream, river or reservoir with sufficiently good water is close by.

Groundwater withdrawl

Often the preferred source of water supply for domestic purposes

6. Advantages and disadvantages

Rainwater harvesting

Advantages:

- source of water where groundwater resources are unavailable or costly

Disadvantages:

- unreliable

Spring water tapping

Advantages:

- can easily be tapped
- water usually has a high natural quality
- intake arrangements are relatively straightforward

Disadvantages:

- in periods of drought springs may cease to flow completely

6. Advantages and disadvantages

Surface water intake

Advantages:

- convenient source of water for small communities

Disadvantages:

- seasonal fluctuation in flow (especially in tropical countries) may affect quality of water
- surface water almost always requires extensive treatment to render it fit for drinking and domestic purposes

Groundwater withdrawl

Advantages:

- in general, safe water source

Disadvantages:

- high costs for water production

7. References

MBUGUA, J. (2002): 7. Rain water harvesting. URL: http://www.irc.nl/redir/content/download/128508/350879/file/TP40_7%20Rain%20water%20harvesting.pdf. In: SMET, J., van WIJK, Ch. (2002): Small Community Water Supplies: Technology, people and partnership (=Technical Paper no 40). Available from: http://www.irc.nl/page/1917 [Accessed 1.6.2010]

TAYONG, A. (2002): 8. Spring water tapping. URL: http://www.irc.nl/redir/content/download/128509/350882/file/TP40_8%20Spring%20water%20tapping.pdf. In: SMET, J., van WIJK, Ch. (2002): Small Community Water Supplies: Technology, people and partnership (=Technical Paper no 40). Available from: http://www.irc.nl/page/1917 [Accessed 1.6.2010]

OKUNI, P., FARR, J. (2002): 10. Groundwater withdrawl. URL: http://www.irc.nl/redir/content/download/128511/350888/file/TP40_10%20Groundwater%20Withdrawal.pdf. In: SMET, J., van WIJK, Ch. (2002): Small Community Water Supplies: Technology, people and partnership (=Technical Paper no 40). Available from: http://www.irc.nl/page/1917 [Accessed 1.6.2010]

MASANGANISE, N. (2002): 11. Surface water intake and small dams. URL: http://www.irc.nl/redir/content/download/128533/350991/file/TP40_11%20Surface%20water.pdf. In: SMET, J., van WIJK, Ch. (2002): Small Community Water Supplies: Technology, people and partnership (=Technical Paper no 40). Available from: http://www.irc.nl/page/1917 [Accessed 1.6.2010]

EPA (2006): Dug Wells. URL: http://epa.gov/OGWDW/privatewells/basic_dug.html [Accessed 1.6.2010]

EPA (2006): Driven Wells. URL: http://epa.gov/OGWDW/privatewells/basic_driven.html [Accessed 1.6.2010]

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