WATER RESOURCE AND ITS SUSTAINABLE DEVELOPMENT

By
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ALLAHABAD

“Mahatma's Vision”

26th July 1942

“The village will have its own waterworks, ensuring clean water supply. This can be done through controlled wells or tanks “

1ST APRIL 2009

MOVING TOWARDS

THIS

DIRECTION- VILLAGE SECURITY PLAN

Water Resources of India

Rainfall Distribution : Uneven.

varies from 150 mm in Jaisalmer, in the we
to 11,690 mm at Mousinram near Cherrapu

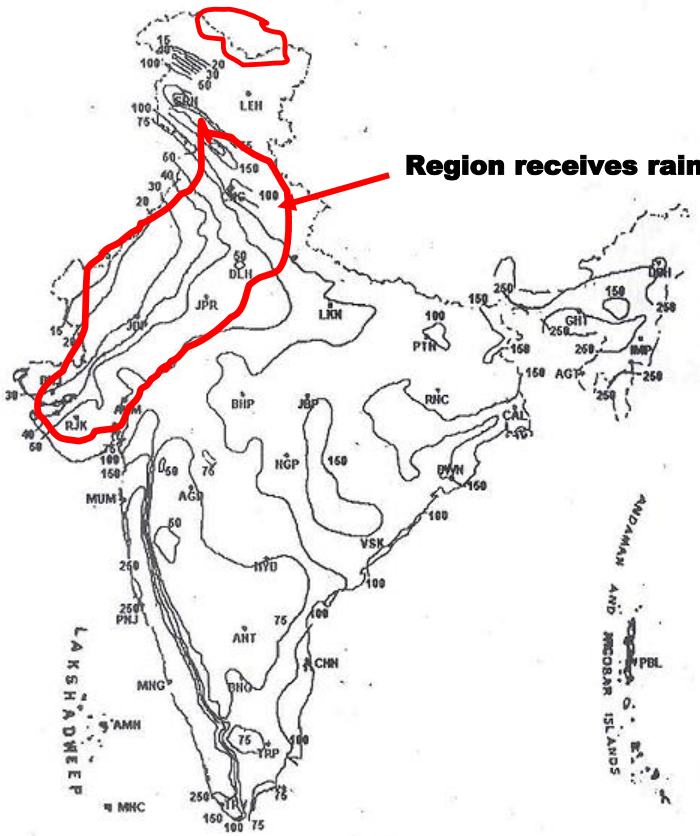
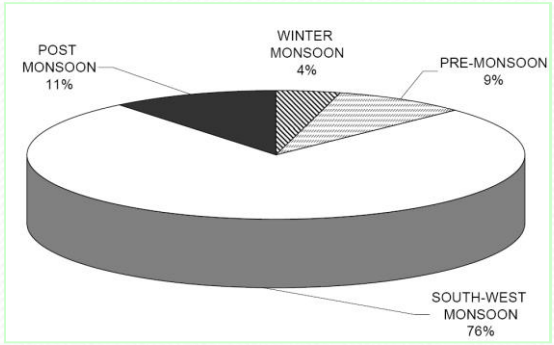


Figure Distribution of normal annual rainfall in India (IMD, 2004).



Average Annual Rainfall : 1160 mm
(76% receives in 120 days)

Nearly, 21 % area receives rainfall < 750 mm. 15% area receives rainfall ≈ 1500 mm.

INDIA TODAY

TYPE OF WATER POLLUTION

- **Geogenic**
  - When the pollution occurs in water due to leaching or weathering of soil/minerals and rocks.

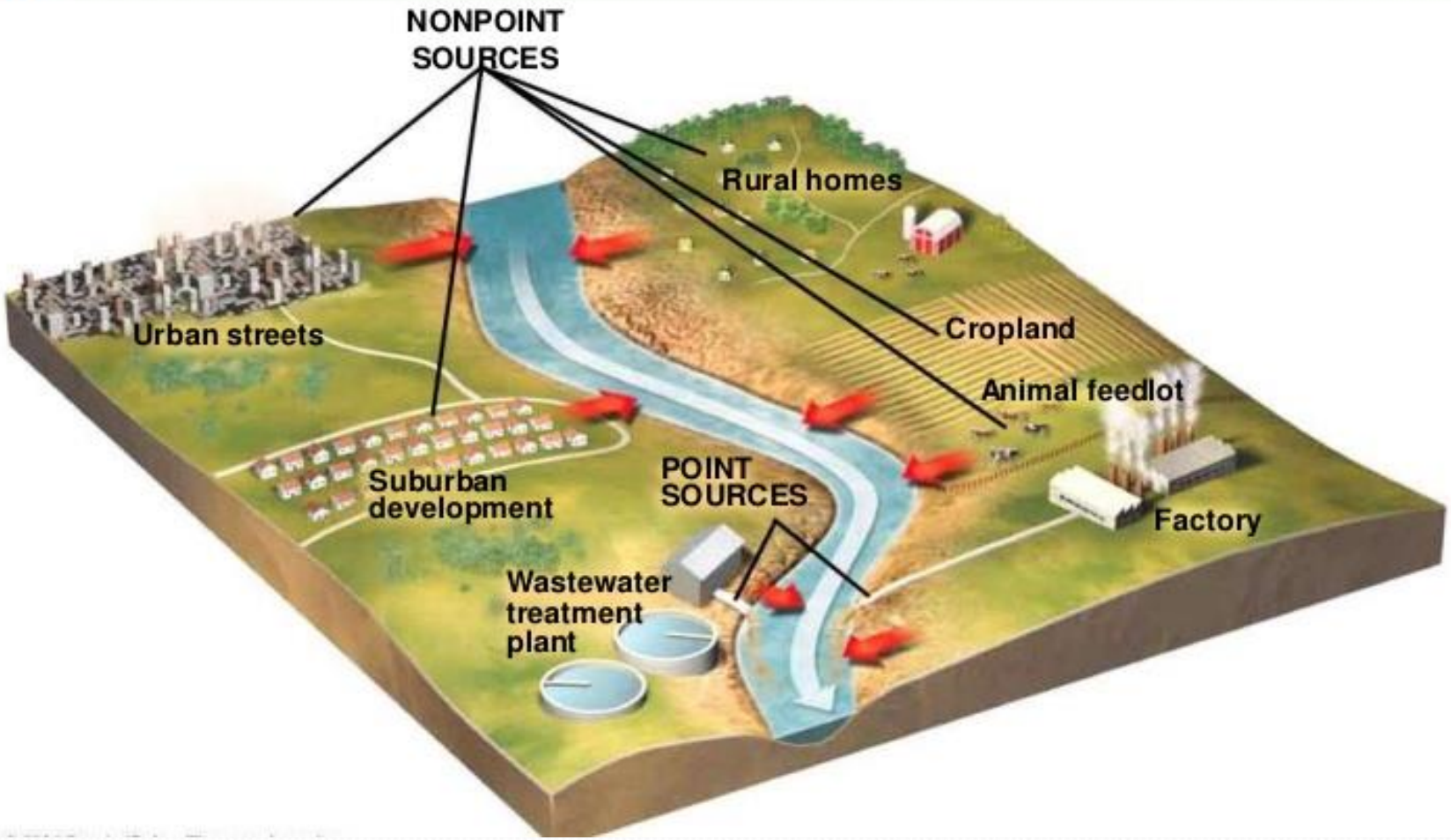
    Example: Fluoride, Arsenic and Iron

  Anthropogenic

  When the pollution occurs due to interventions of man made activities.

  Example: Chromium, Nickel, Cobalt, Phenol, Glycerine, Nitrate etc.

Sources of Water Pollution



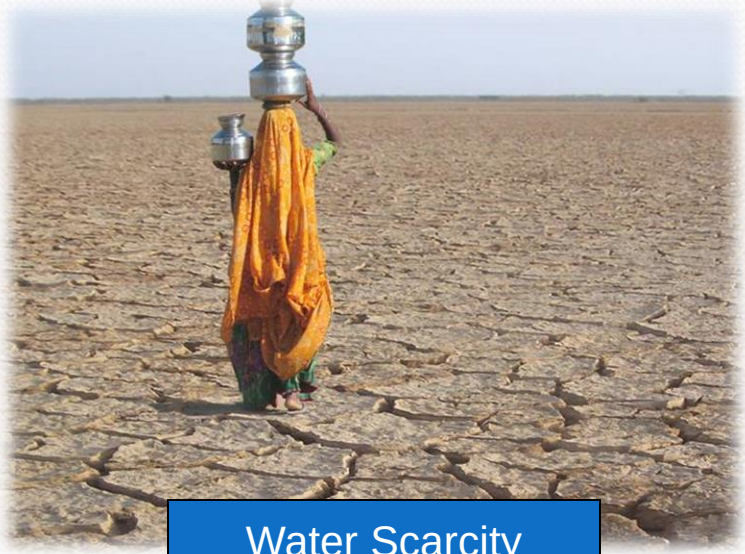
NON-POINT SOURCE

SOURCES FOR CONTAMINATION OF WATER, THEIR PERMISSIBLE LIMIT (BIS:10591,1991) AND HEALTH HAZARDS

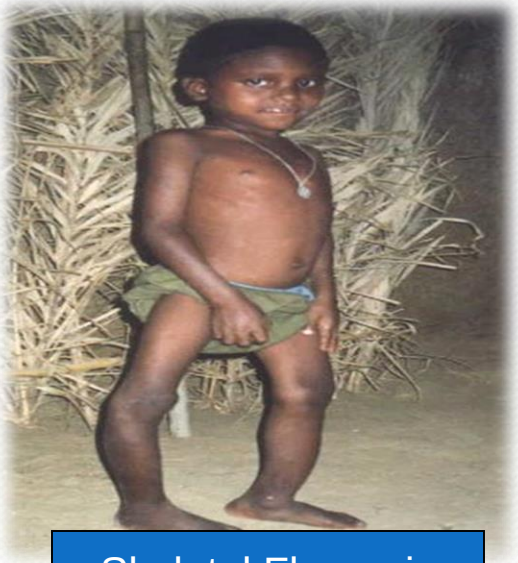
Chemical Constituents	Desirable limit	Permissible limit	Probable Source	Health Hazards
TDS	500	2000	Soil and rock interaction	Bad test, inflammation in intestine and dysentery
Chloride	250	1000	Natural rock like halite and industrial waste	Indigestion and harmful to patient of Heart
Hardness	300	600	Dolomite and Gypsum	Gall bladder stone and more consumption of soap
Magnesium	30	100	Magnesite and Dolomite	It activates enzymes and also causes dysentery
Calcium	75	200	Limestone, Gypsum	Weakness in bone and formation of gall bladder stone
Sulphate	200	400	Gypsum, detergents and Industrial waste	Inflammation in intestine and dysentery
Nitrate	45	100	Sewer and fertilizers	Gastrointestinal cancer and Blue baby syndrome
Fluoride	1.0	1.5	Fluorite, Mica and fertilizers	Moulting of teeth and skeletal fluorosis
Boron	1.0	5.0	Kyanite and Colominite Glass and Jewellery industry	Central Nervous system and vibrations in limbs
Iron	0.3	1.0	Haematite and Magnetite	Bitter taste and gastrointestinal problem
Copper	0.05	1.5	Cuprite, Malachite and industrial pollution	Necessary for children excess would affect Central Nervous system
Cadmium	0.01	No relaxation	Battery, ceramic, photography pesticides	Kidney, lungs Itai-Itai deasises

Lead	0.05	No relaxation	Galena, Battery, Dyes and printing press	Anaemia, Stomach pain and paralysis
Zinc	5.0	15	Mining of Zinc, Zincite and	Bad test but essential for metabolism
Chromium	0.05	No relaxation	Chromite, Steel, Ceramic and paper industry	Nodes in lungs and Ulcer, skin dieses
Arsenic	0.01	No relaxation	Arsenopyrite	Skin cancer and problem in blood circulation
Aluminium	0.03	0.2	Bauxite and aluminosilicate	Lymphatic disorder
Mercury	0.001	No relaxation	Cinnabar, Chemical, Electrical and medicinal industry	Kidney disorder
Manganese	0.1	0.3	Pyrolusite, Battery, Glass and ceramic industry	Affects regarding formation of Haemoglobin
Selenium	0.01	No relaxation	Ceramic, rubber, paint and rocks	Loss of sensation in fingers
Nickel	0.02	No relaxation	Battery, Glass and ceramic industry	DNA and Carcinogenic
Pesticides	0	0.005	Chemicals	Loss of Immunity and central Nervous system

Issues of Water Availability & quality



Water Scarcity



Skeletal Fluorosis

Due to arsenic - Arsenicosis

ARTIFICIAL RECHARGE

- The augmentation of ground water reservoir by modifying the natural movement of surface water utilizing suitable techniques

NEED

- Water level declining trend
- Pre-monsoon and Post-monsoon
- If it is >0.25m/year
- Drought Prone Area
- G.W. Quality Problem

WATER AVAILABILTY

- Source of Water

- Quality of water

  Before and after of schemes

QUANTIFICATION

- Catchments area
- Average Annual Rainfall
- Intensity of rainfall
- It's variation in space and time
- Number of rainy days
- Rainfall-runoff coefficient

SCOPE OF GROUND WATER RECHARGE

- Ground water level and it's flow
- Long term seasonal water level fluctuation
- Sub-surface litho logical behavior

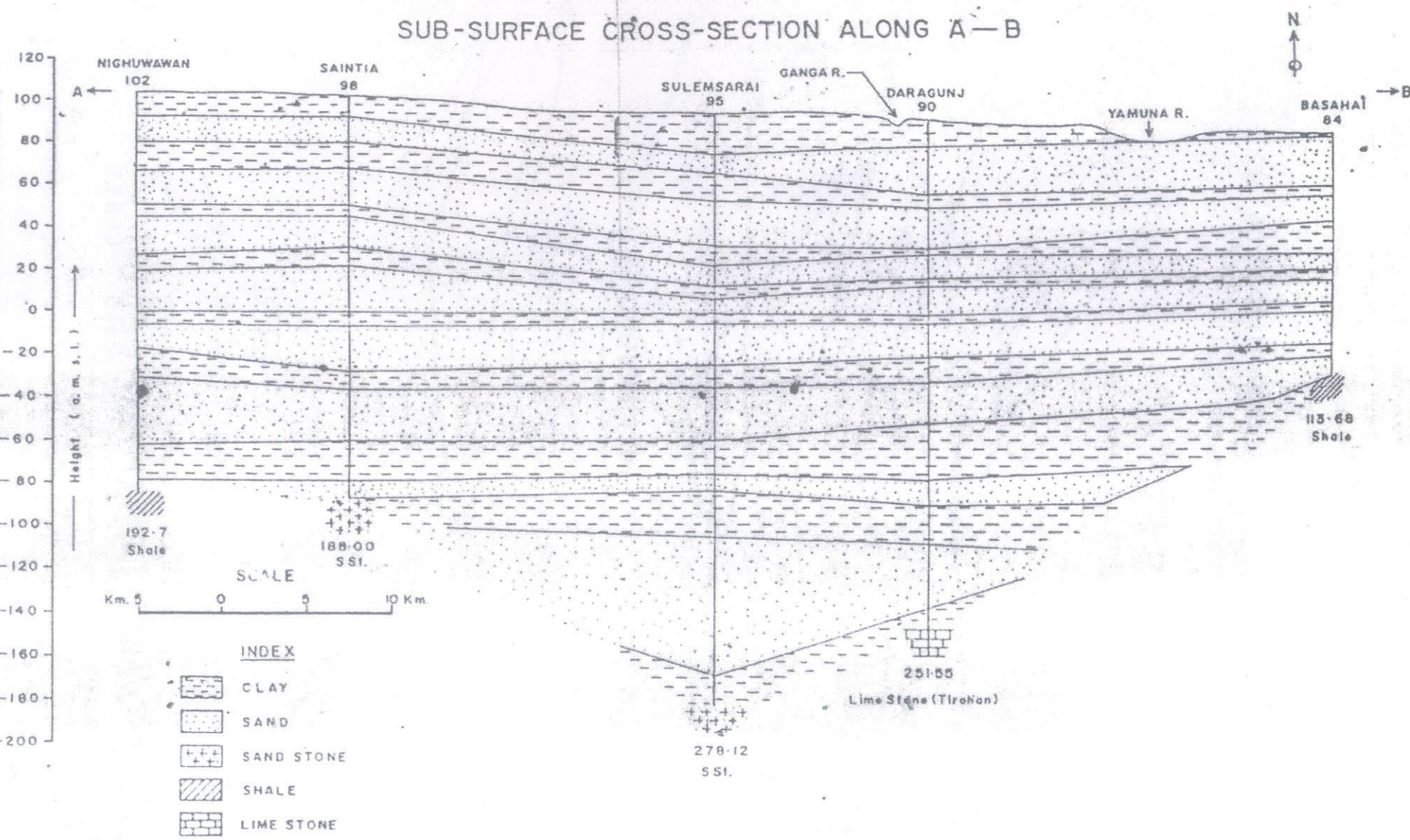
SUB-SURFACE LITHOLOGICAL BEHAVIOR

- Strata chart of Hand pump / tubewell
- Temporal relationship
- Intake value
- Gravel> Sand> fractured hard rock> Kankar> silt

Sub-surface lithology

Depth (mbgl)	Lithology
0-4	Grey colour clay
4-12	Kankar with fine sand
12-26	Fine grained sand
26-35	Medium grained sand
35-40	Clay
40-60	Coarse grained sand

SUB-SURFACE CROSS-SECTION ALONG A—B



C.G.W.B.,NR, Dr. No. 1677/04

Cost-Benefit Ratio

- Cost of Project
- Life of Project
- Quantity of recharged water

IMPACT ASSESSEMENT

- Quantitative
- Qualitative
- Total volume as intake
- Rise in water level
- Improvement in soil moisture and greenery

TECHNIQUE OF RAINWATER HARVESTING

- Rural area
- Urban area

PREREQUISTS

- Depth to water
- Water level fluctuation
- Sub-surface lithological behavior
- Rainfall pattern / Intensity

SURFACE TECHNIQUE

- FLOODING
- BASINS/PERCOLATION TANKS
- STREAM AUGMENTION
- DITCH AND FURROW SYSTEM
- OVER IRRIGATION

SUBSURFACE TECHNIQUE

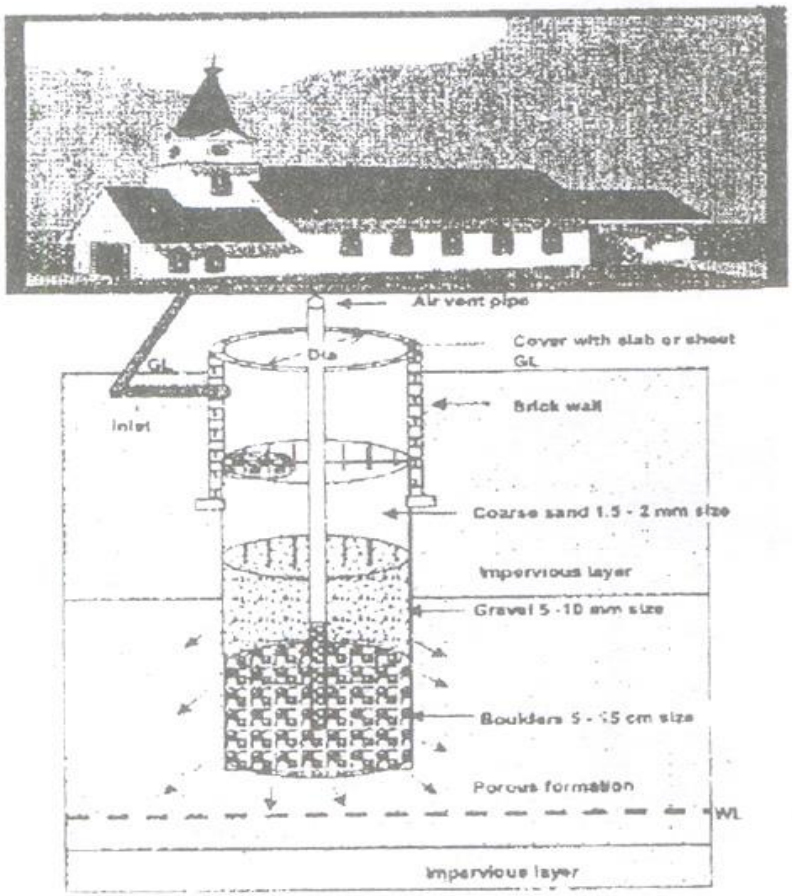
- INJECTION WELLS OR RECHARGE WELLS
- RECHARGE PITS AND SHAFTS
- DUGWELL RECHARGE
- RECHARGE THROUGH ABONDONED TUBEWELLS

RECHARGE SHAFT

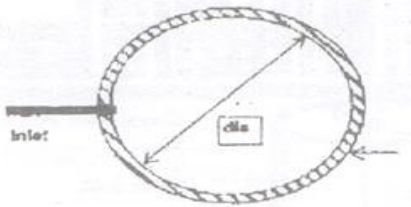
- STRATA SHOULD BE NON-CAVING
- DIAMETER: 2-2.5m
- DEPTH: 15-20m
- USEFUL FOR OPEN LAND AREA AND PARK, etc.

DESIGN OF RECHARGE SHAFT

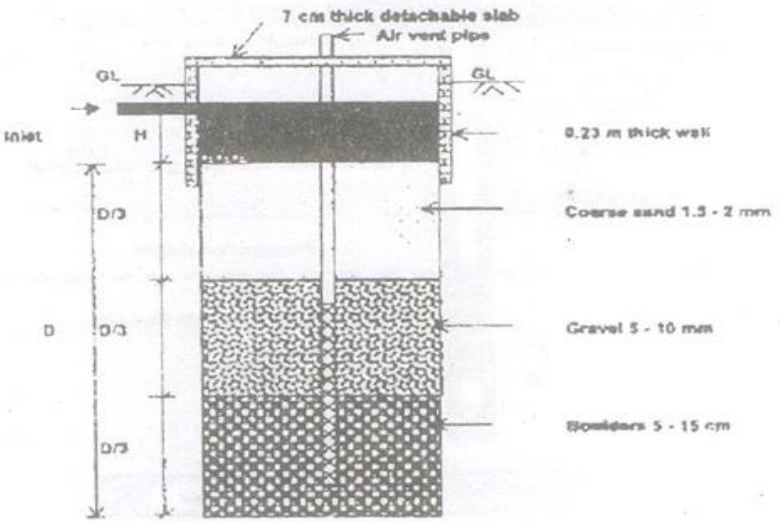
Recharge Shaft



ENGINEERING DESIGN OF RECHARGE SHAFT

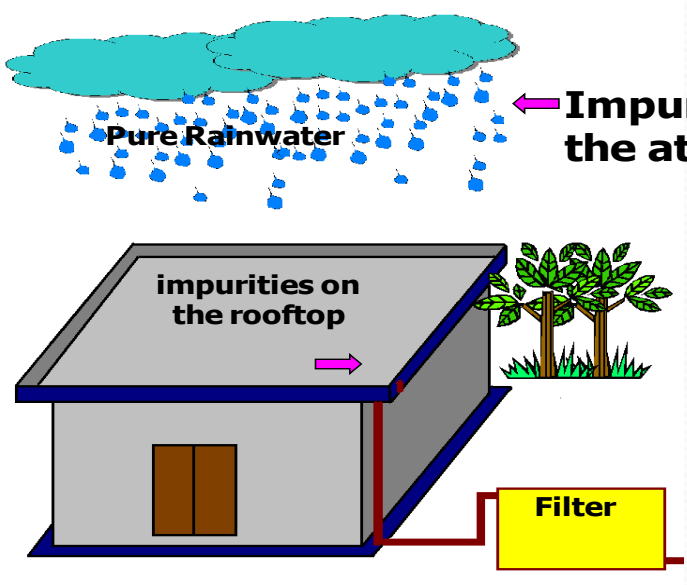


PLAN

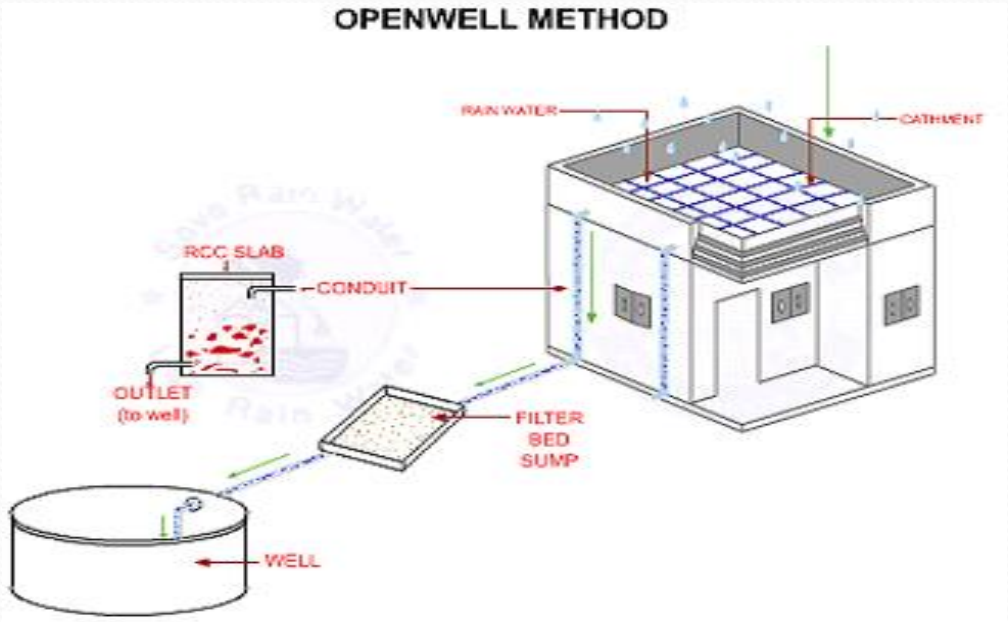


SECTION

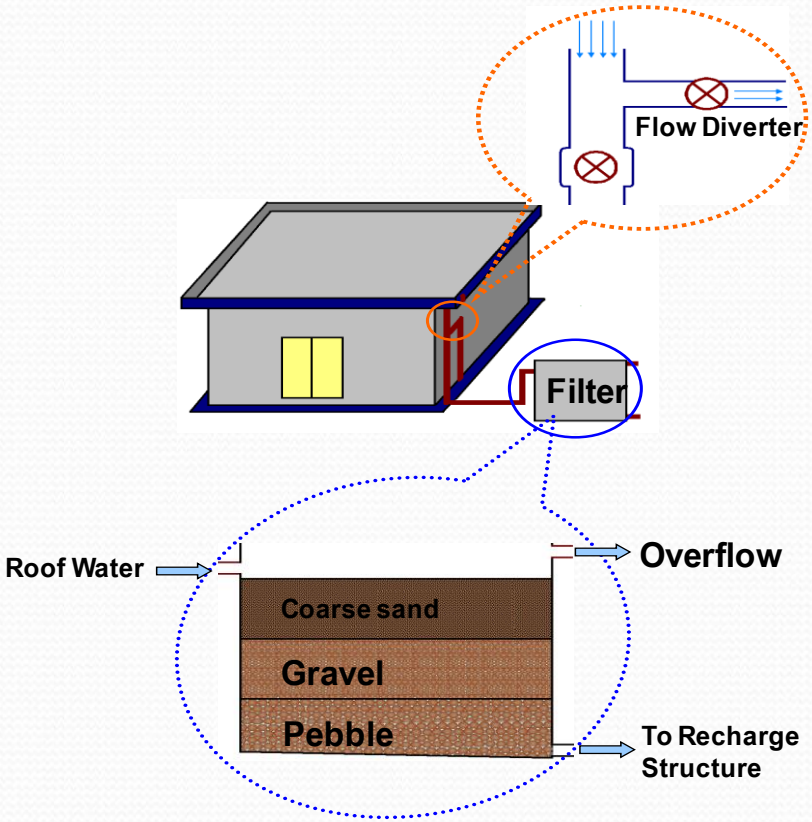
ROOF TOP RAIN WATER HARVESTING



ROOF TOP RAIN WATER HARVESTING



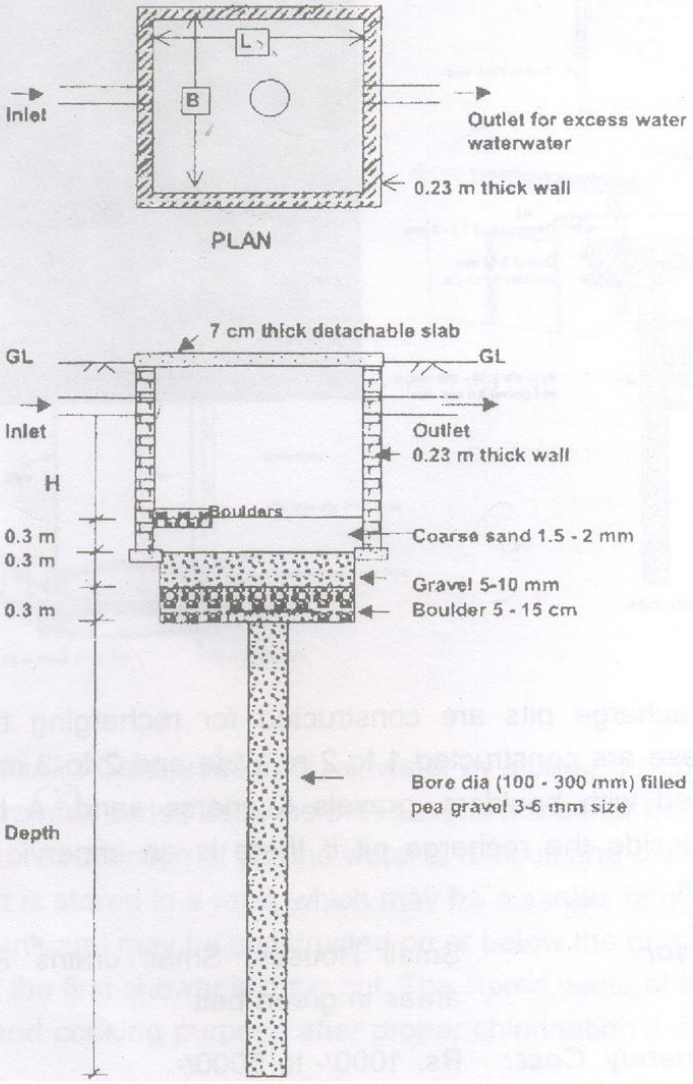
FILTER CHAMBER

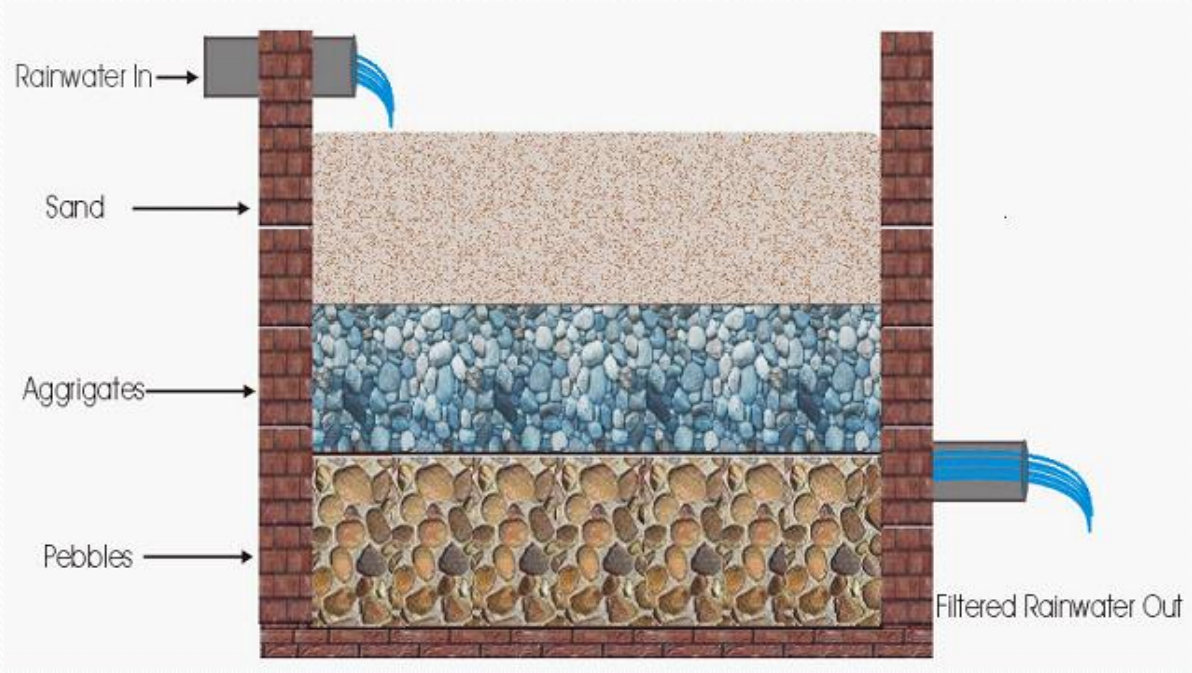


RECHARGE WELL

- Very useful for urban area due to paucity of land
- Runoff from Roof/ Paved area only
- Proper upkeep/ maintenance of structures

DESIGN OF RECHARGE PIT WITH BORE HOLE FOR RECHARGING RUNOFF SMALL HOUSES

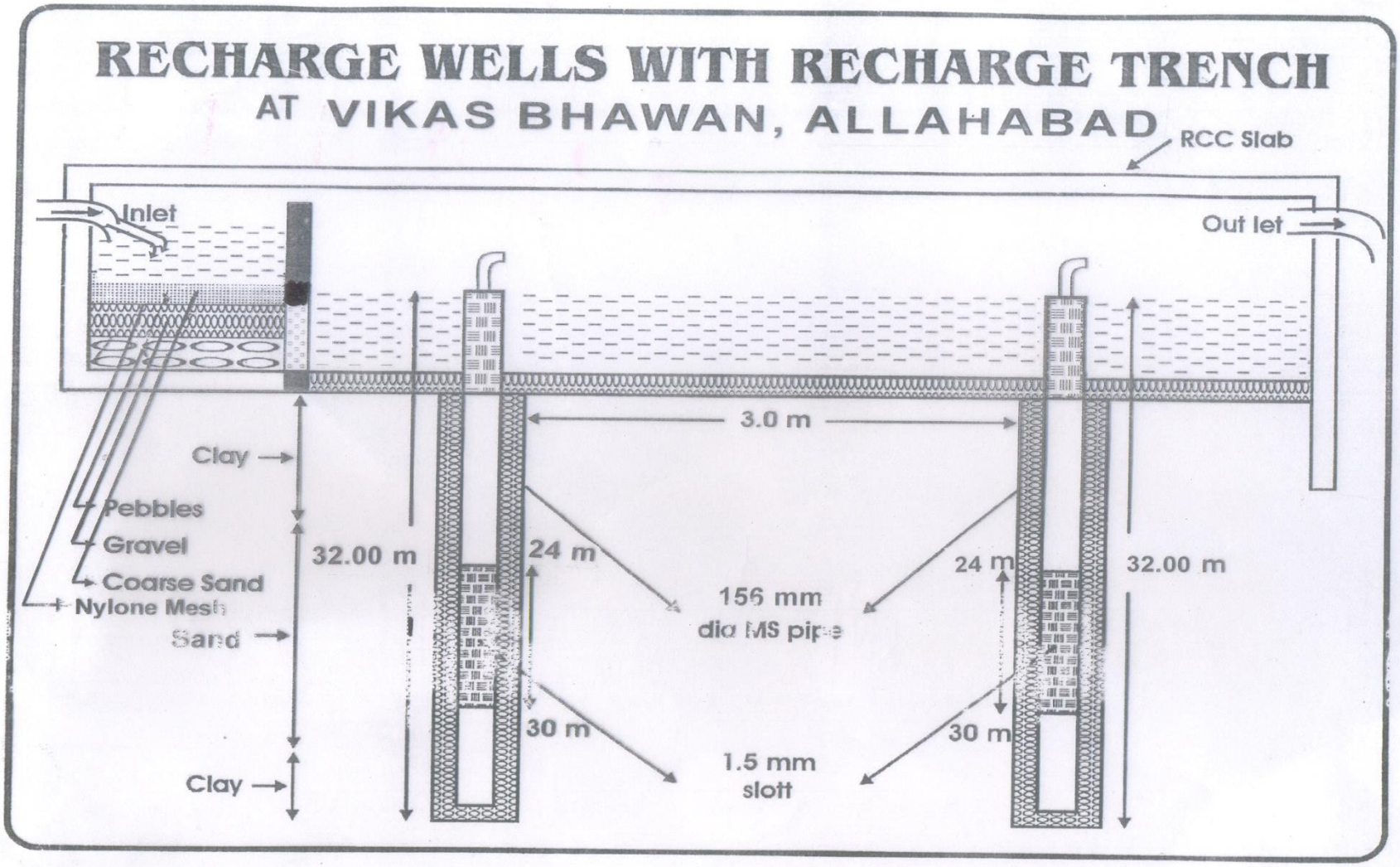



Rainwater In
Sand
Aggrigates
Pebbles
Filtered Rainwater Out

(3)

RECHARGE WELLS WITH RECHARGE TRENCH

AT VIKAS BHAWAN, ALLAHABAD



ENGINEERING DESIGN OF TRENCH WITH RECHARGE WELL

For recharging the shallow as deeper aquifers, lateral trench of 1.5 to 3 m wide & 10 to 30 m long depending upon availability of water with one or more bore wells drives in it may be constructed. The lateral trench is back filled with boulders, gravels & coarse sand.

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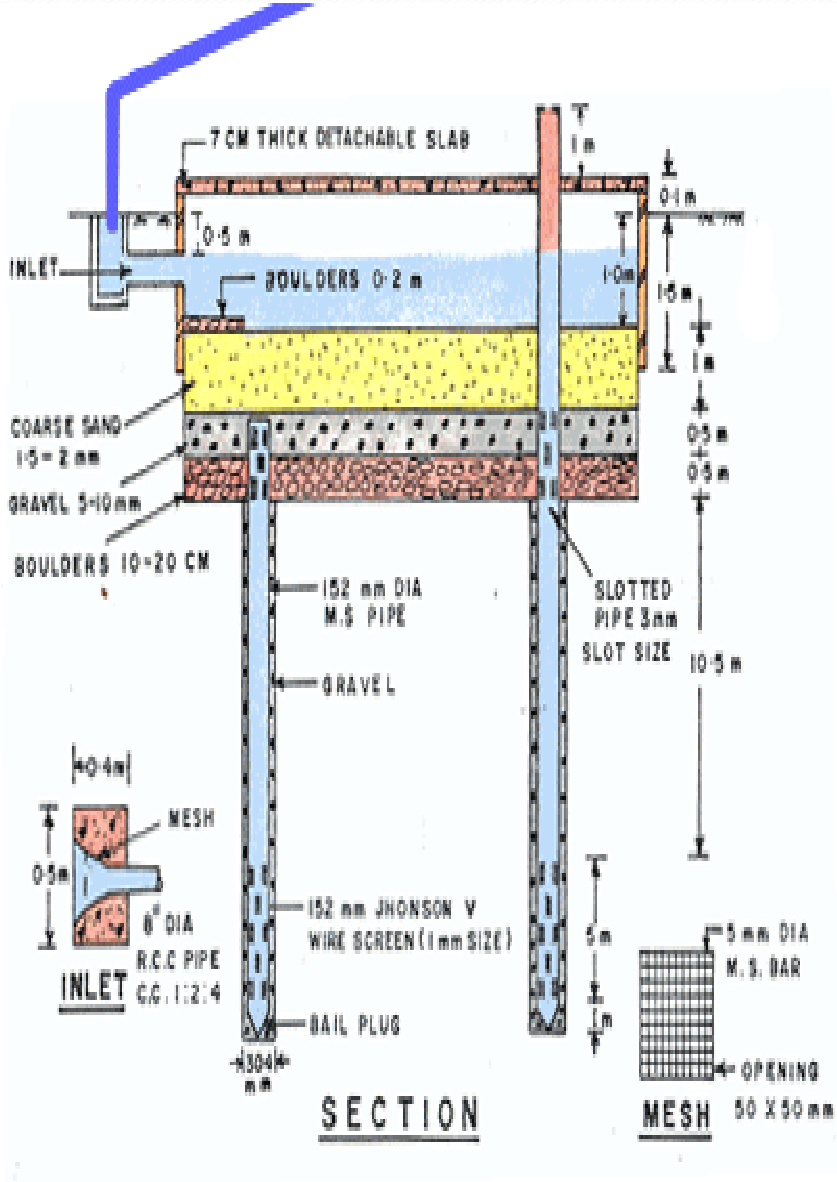


TECHNIQUES FOR RURAL AREA

- Dug Well Recharge
- Gabion Structure
- Form Pond & Recharge Well
- Check Dam
- Ditch & Furrow

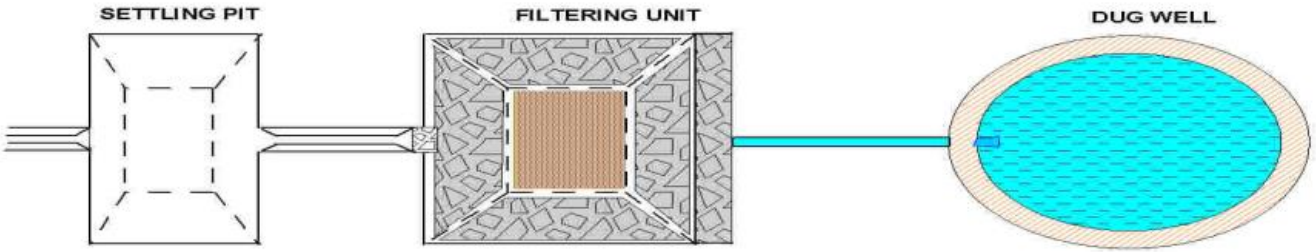
DUG WELL RECHARGE

- Exiting or abandoned dug wells in alluvial or hard rock area

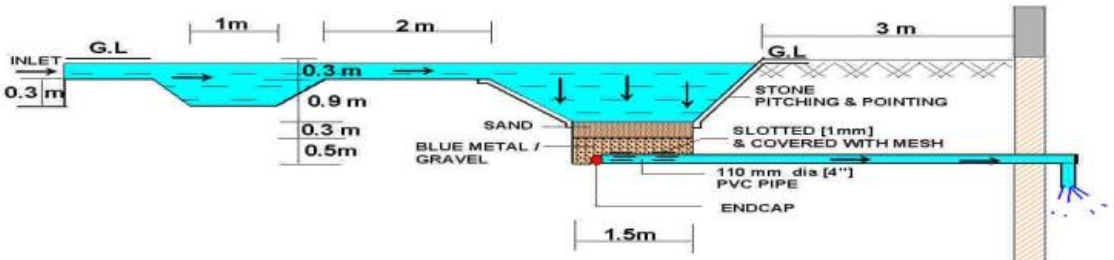
- Recharge water is guided through a pipe to the bottom of well below the water level to avoid scoring of bottom and entrapment of air bubbles in the aquifer.

DESIGN - II

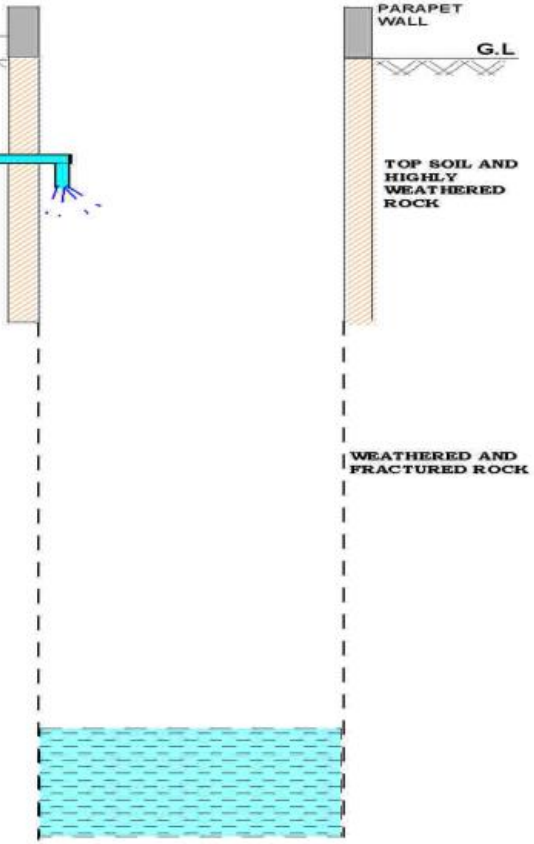
DUG WELL RECHARGE STRUCTURE



PLAN



SECTIONAL VIEW

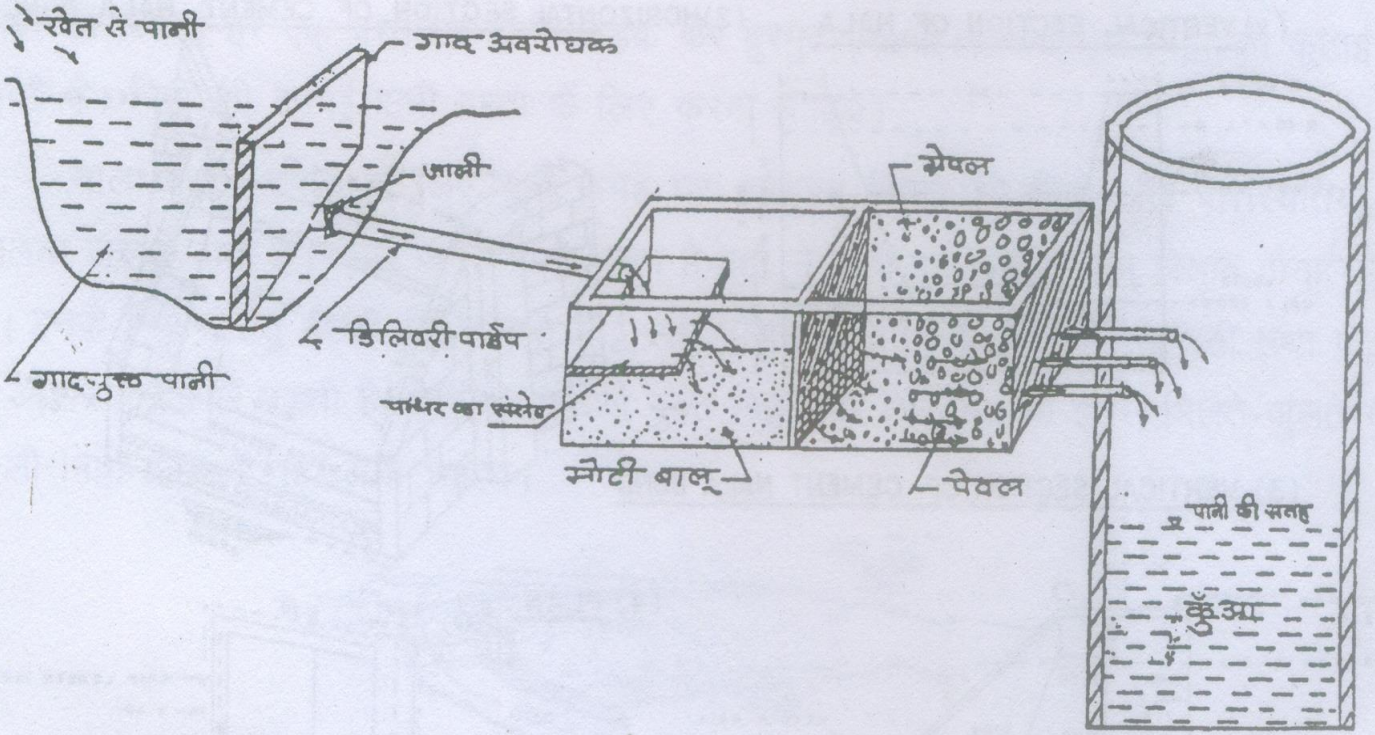


SCALE: 1cm =1 m

Design of Recharge Tank, Conveyance Pipe and Recharge Wells

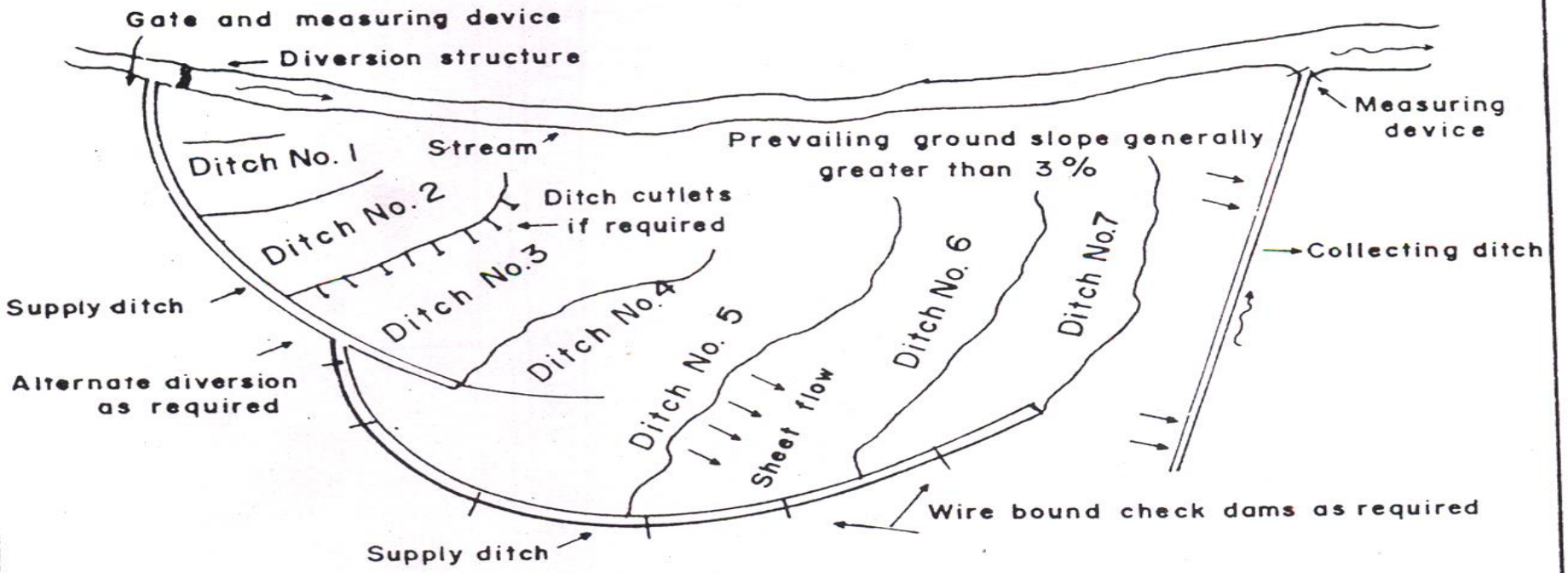
- Roof Area: 1200 Sq m
- Average Annual Rainfall: 950 mm
- Average per hour rainfall intensity: 60mm
- Static Water level : 14mbgl

RECHARGE WELL IN AGRICULTURE FIELD



DITCH& FURROW

- IRREGULAR TERRAIN
- MINIMUM DEPOSITION OF SEDIMENTS
- DITH SHOULD BE SHALLOW, FLAT BOTTOMED AND CLOSELY SPACED.

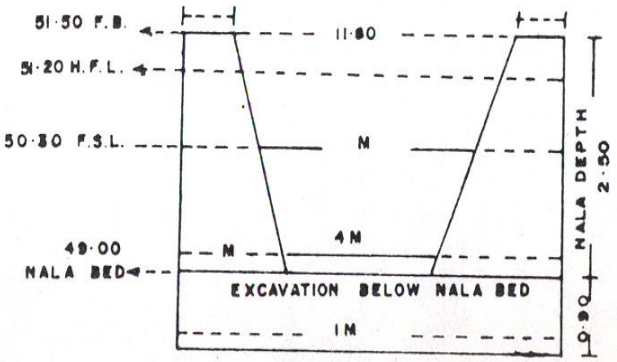


DITCH AND FURROW METHOD

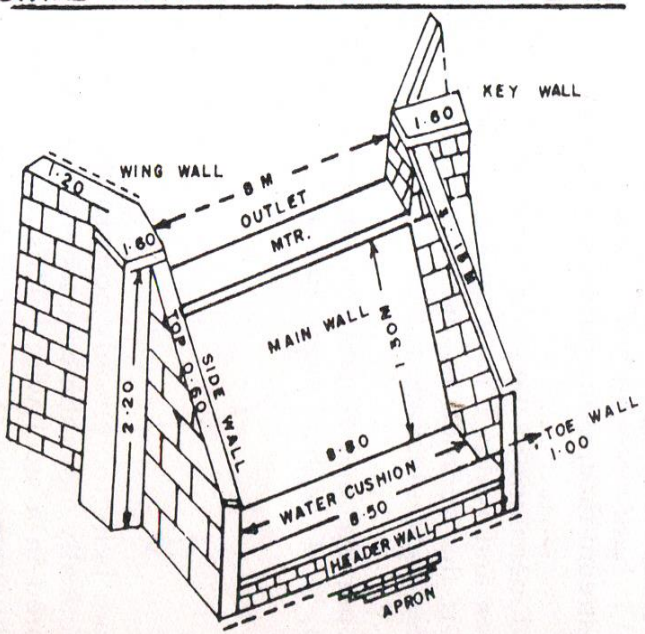
CHECK DAMS

- Width of nala bed should be 5-15m and depth of bed should not be < 1m.
- Gentle bed slope
- Catchment area should be between 40-100 Hectares land.
- Soil of downstream area should not be prone to waterlogging.

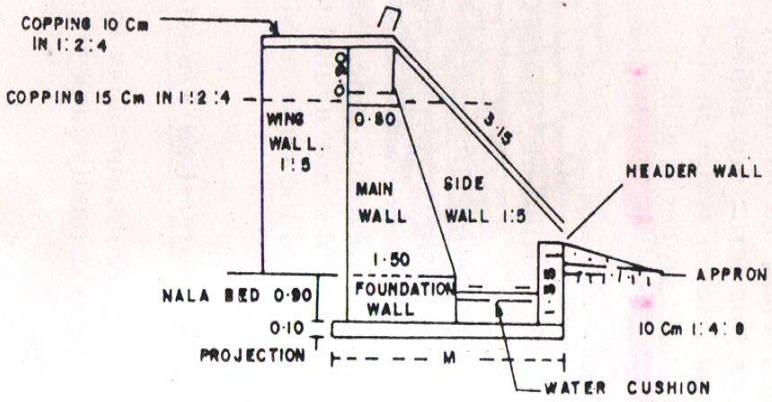
(1) VERTICAL SECTION OF NALA



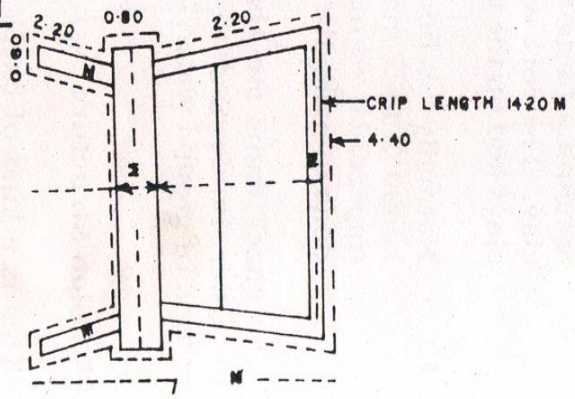
(2) HORIZONTAL SECTION OF CEMENT NALA BUND



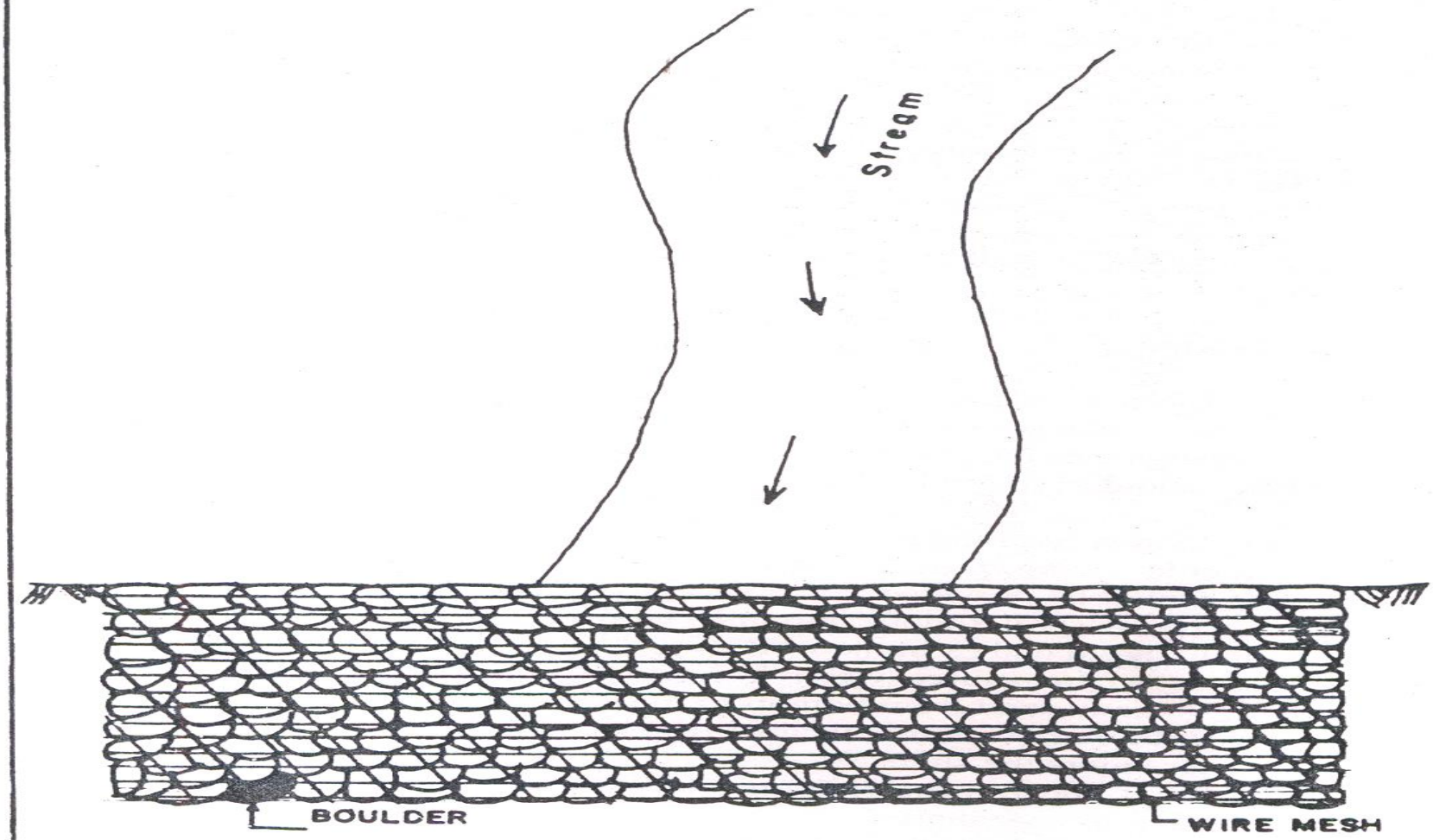
(3) VERTICAL SECTION OF CEMENT NALA BUND



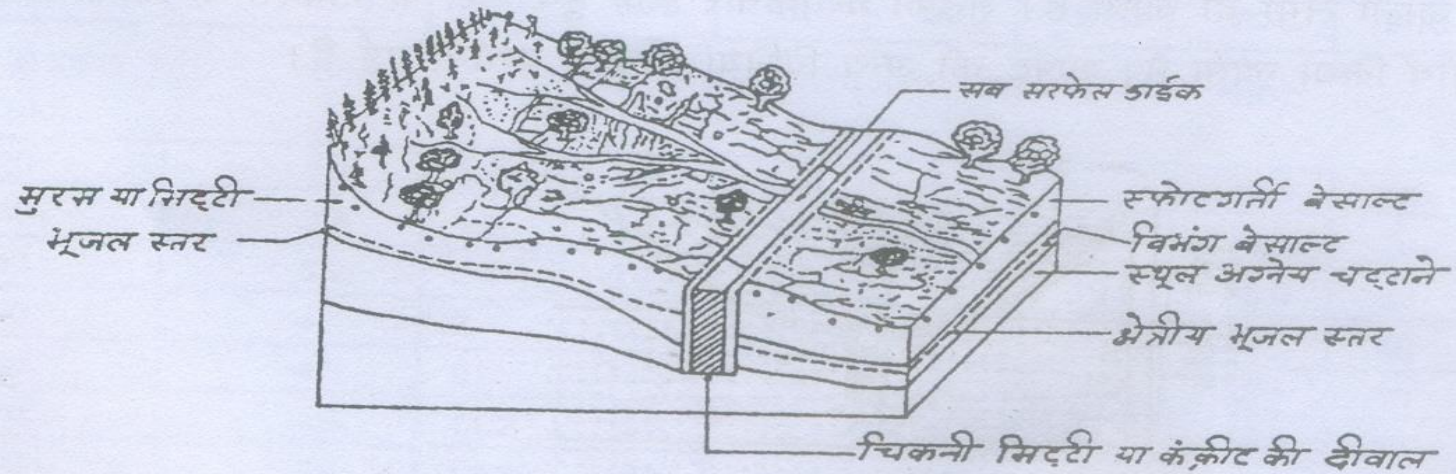
(4) PLAN

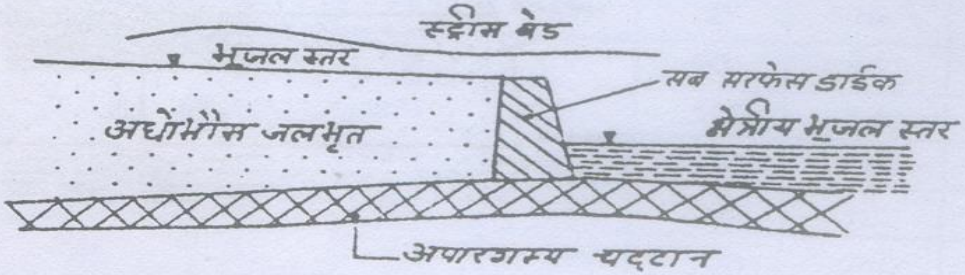


GABION STRUCTURE



SUB-SURFACE DYKE





पानी को प्रदूषण से बचाओं।

QUANTIFICATION

- Area x rainfall (hourly) x coefficient

  - 1200 x .06x .85

  = 61.2 m^3 / hour

INTAKE CPACITY OF RECHARGE WELL

- Either by slug test (Hard rock) or By water Tank Method
  - Steps:

    1. Pour fixed quantity of water and measures the drop in water level with time.

    2. Keeping the water level as SWL, time taken for the fixed quantity of water poured in well .

RECHARGE WELL

- Depth of Recharge well: 38m
- Diameter of Recharge Well: 151mm
- Intake capacity of one recharge well: 85lpm
- Intake capacity of one recharge well: 5.1 m^3/hour

DESIGN OF RECHARGE/ STORAGE TANK

- Total water available for recharge= 61.2 m^3 / hour
- Intake capacity of one recharge well: 5.1 m^3/hour
- Space required to accommodate the remaining water: 61.2 – 5.1 m^3/hour
- = 56.1 or 56 m^3/hour
- Two no of Recharge Well: 5.1 x2 = 10.2
  - 61.2-10.2= 51 m^3 / hour

DIAMETER OF RAINWATER PIPE

- Rainfall: 600mm/hr
- Roof area: 500m^2
- Volume: .6 x 500= 30m^3/hr
- 90% of It: 27m^3/hr

Contd.

- Q= AV
- A = area, V= entrance velocity of water(1m/sec) or 3600m/hr

  Q= Volume/ Discharge

  A=Q/V = 27/3600= 0.0075m^2

  0.0075m^2= “$\prod / R^2$

  R= $\sqrt{}$.0075/3.14= .045M

  D= 9cm or 3.6”


THANKS
Water is precious.
Save and conserve
it. Don't Pollute it.