Environmental Engineering -I

Lecture 9 – Components of Water Supply Scheme

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Technical Overview

- Water supply systems get water from a variety of locations, including **groundwater (aquifers), surface water (lakes and rivers)**
- In most cases **treated and purified**
- Then either flows by gravity or is pumped to reservoirs, which can be elevated such as water towers or on the ground.
- Once water is used, wastewater is typically discharged in a sewer system and treated in a wastewater treatment plant before being discharged.

Technical Overview

The water supply system is organized into following sections:

- **Planning**
- **Designing**
- **Calculations**

Planning a Water Supply System

The following points are kept in mind before selection of any system of water supply and those are:

- **Selection per capita water consumption**
- **Future population forecast**
- **Design period**
- **Length of life structure**
- **Ease of extension**

In technical terms we call ***"Design Criteria"***

Components of Water Supply Systems

- When planning a scheme , mark the boundaries and perform the survey of an area i.e. check existing roads, rivers and all important features

- For a housing schemes we marking of roads , commercial area etc. 30-35% of roads and 60% consists of lawns, houses

Components of Water Supply Scheme

- Collection Works

(Dams ,Reservoir, Intake, Pumping station, Tube wells)

- Calculate the requirement of water
- Development of source to meet the requirement
- Consider future requirement rather then present requirement

- Purification Works

(Sedimentation, Coagulation, Filtration, Disinfection, Storage.)

- Check the quality of water if quality meets the standards then there will be no treatment done. Otherwise application of treatment options mentioned above is required.
- Surface water has more suspended impurities where as ground water has more dissolve ones

For selection of treatment there are two basic things

1- Characteristics of raw water

2- Intended use after treatment

*Consideration of 'Health' aspects is important

*Check Industrial requirement in terms of water quality i.e. hardness

Components of Water Supply Scheme

- Transmission Works

(Conduits, Valves, Pumping Station, Gravity flow.)

- When available source is at some recognizable distance than we have to transport water into a community, hence there transmission works are required.

- Distribution Works

(Pumping Station, Overhead reservoir, Feeders, Mains, Pipes, Valves, Fire Hydrants.)

- Supply water to consumers in desired quantity and adequate pressure

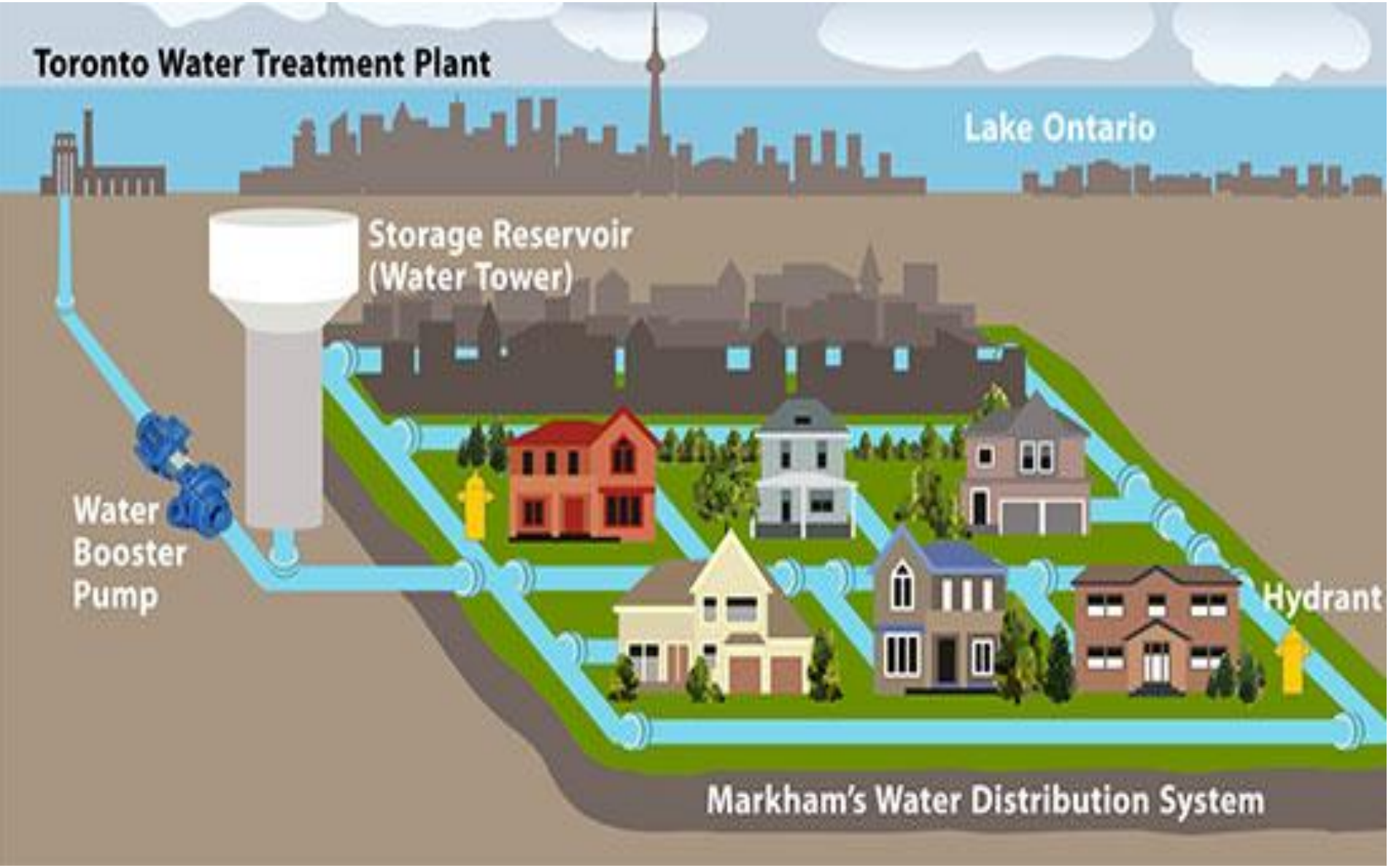
1) Required quantity should be supplied

2) Required residual pressure should be there

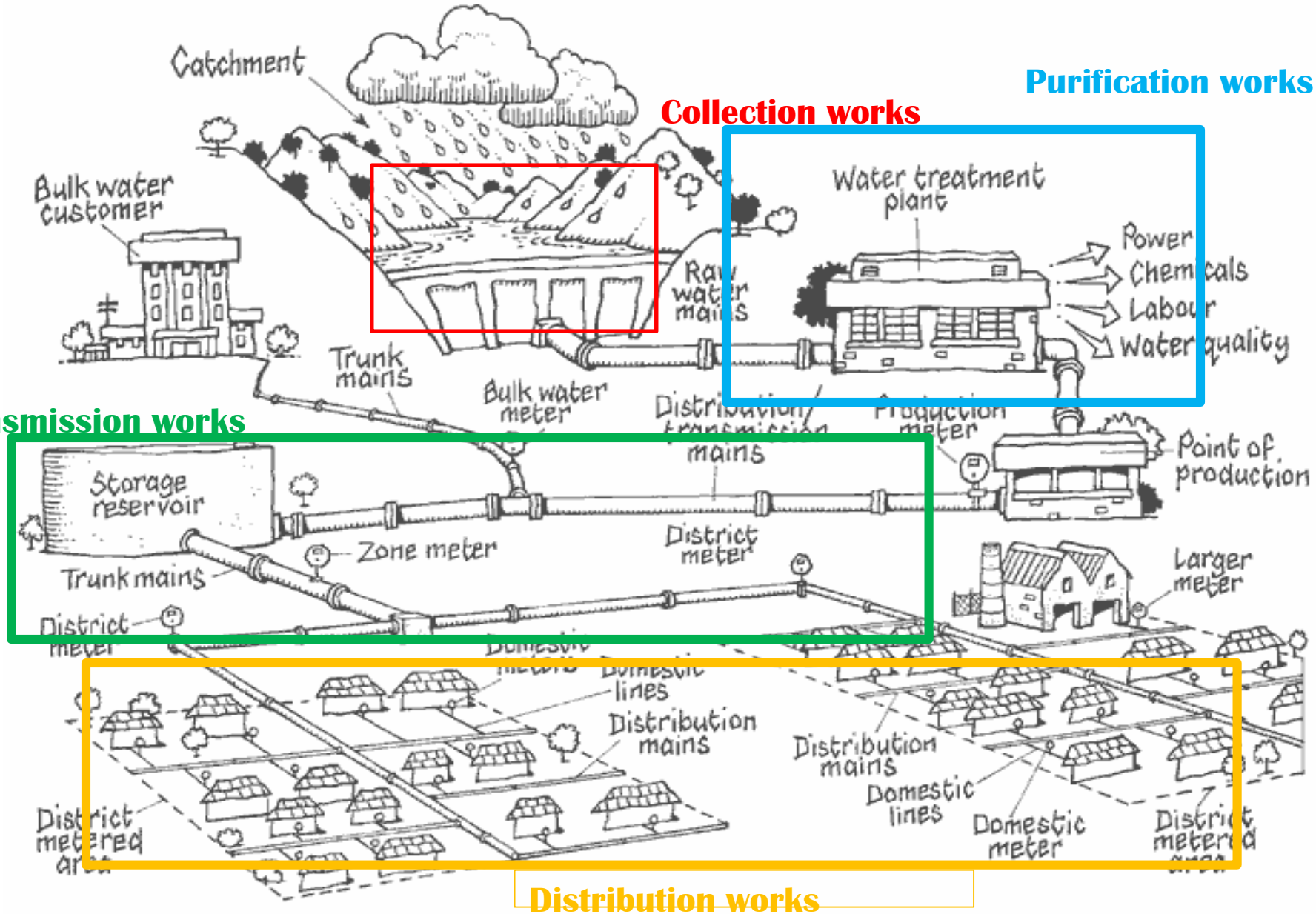
Pressure depends upon the area and height of building.

- In Lahore height of a house should not be > 38feet.
- Minimum residual pressure in Lahore is = 20Psi

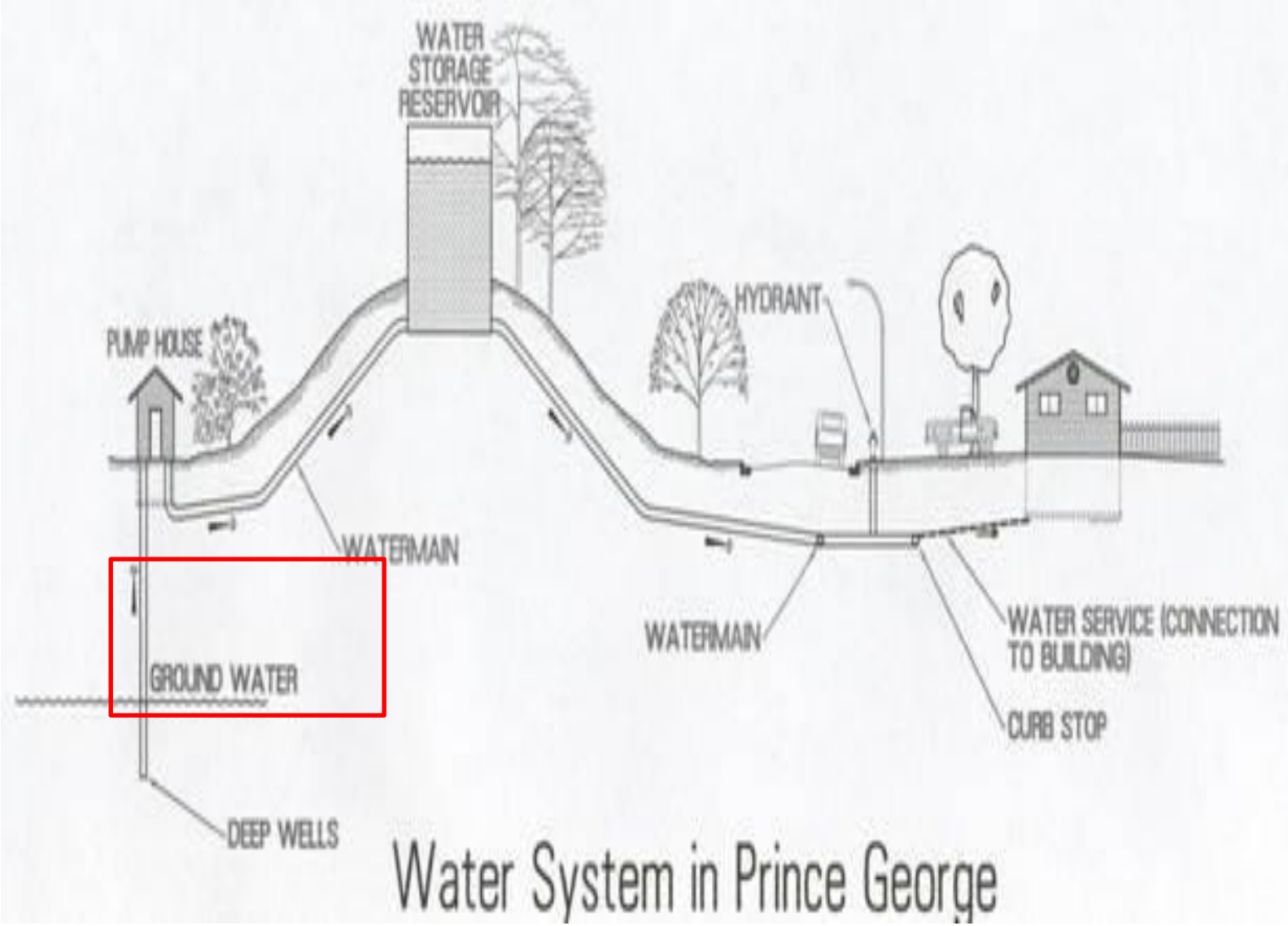
Water Supply & Distribution System



Components of Water Supply Scheme



Components of Water Supply Scheme



Future Water Requirement

- Selection of per capita water consumption(WC)
- Future population forecast
- **Design period**

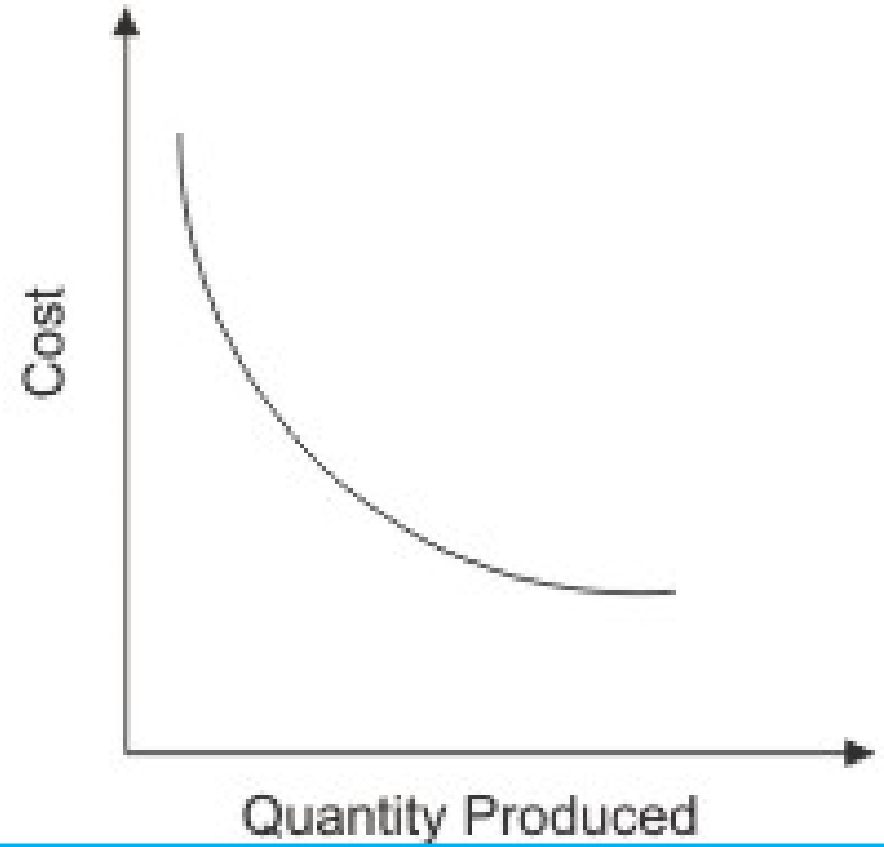
- **Economical Period of Design**

"Number of years in future for which proposed facility would meet the demand of the community "

- Length /Life of structure ↑ - Design Period ↑
- Ease of extension ↑ - Design period ↓
- First cost ↑ -Design period ↑
- Rate of interest ↑ -Design period ↓
- Economy of scale ↑ -Design Period ↑
- Lead time ↑ - Design period ↑

Economy of scale

Figure 1: Typical Average Cost Curve



200 mm diameter water supply pipe 1km long serves 3000 persons;
Cost =Rs 300000 ;Cost/head=Rs100
400 mm diameter water supply pipe 1km long serves 12000 persons;
Cost =Rs 4800000 ;Cost/head=Rs 40

Design Periods & Design flows for various Water Supply Facility

Facilities	Design Period	Design Flow
Large dams, Impounding reservoirs, Transmission main (conduit)	**25-50 years**	Design flow of Impounding Reservoir **Maximum daily demand** Conduits are designed on **Maximum daily consumption**
Tube wells	**5 years**	Peak hourly demand(without storage) Maximum daily demand (with storage)
Water treatment plant	**10-15 years**	Maximum daily demand
Pumping station	**10 years**	**(1)** Peak flow **(2)**Maximum flow+ fire flow, **(3)** Average flow & minimum flow
Distribution system	**25 years**	(1) Maximum daily flow + fire demand (2) Peak hourly demand+ fire demand

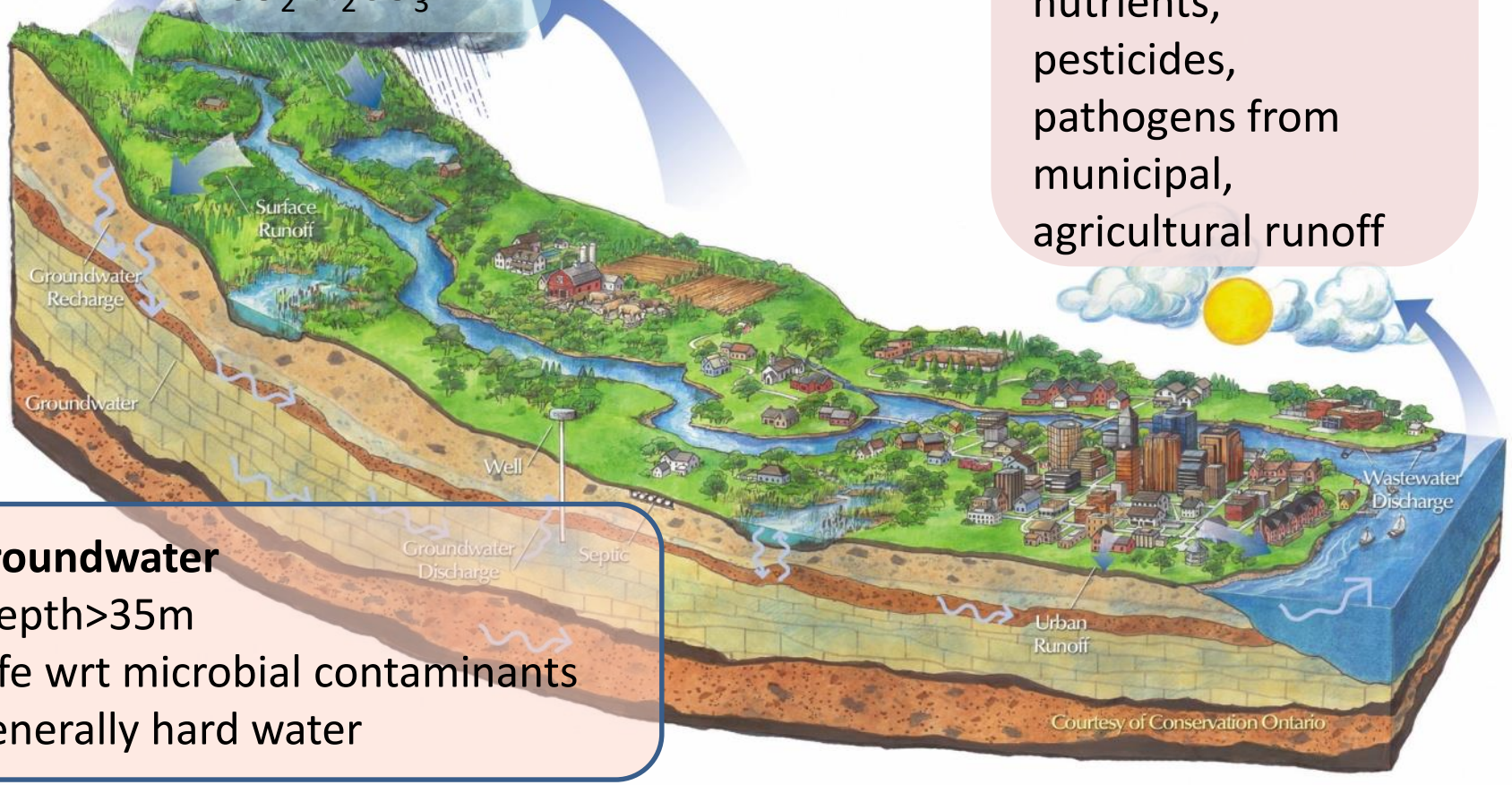
Problem-Design period

- Problem 1 : A small community had a population of 65000 and 85000 in the year of 1995 and 2005 respectively. Assuming a geometric growth rate and an average WC of 300lit/cap/day. Calculate the design flow for the treatment plant and the transmission main from current year. **Select an appropriate value for design period**.
- Problem 2: The present population of a community is 160000 increasing at a geometric growth rate of 0.043 per yr. The present water requirement of the community are fully met by a number of tube wells installed in the city. The average WC is 350l/c/d using a design period of 15 yrs. Calculate the number of additional tube-wells of 3.4m3/min capacity to meet the demand of design period.

Sources of Water

Rainwater
dissolution of CO_2-H_2CO_3

Surface water
suspended solids(silt clay) inorganic salts, oils, organics, nutrients, pesticides, pathogens from municipal, agricultural runoff



Groundwater
Depth>35m
safe wrt microbial contaminants
Generally hard water

Sources of Water

Rain water

- Generally satisfactory
- Dissolution of carbon dioxide(H2CO3)
- Affected by collection system and storage conditions.

Surface water

- Include rivers, streams, lakes
- Generally soft water but may contains;
  - Significant load of suspended solids(SS) from land erosion.
  - Color , odour(decaying vegetation)
  - Heavy metals, inorganic salts, oils, organic compounds, nutrients, pesticides, pathogens from municipal, industrial and agricultural runoffs.
  - Lead, acid deposition from atmosphere.
- Surface waters require elaborate treatment for use as drinking water supplies.

Sources of Water

Groundwater

- Ground water are generally safe with respect to microbial concentration.
- Rich in total dissolved solids
- May contains naturally occurring subsoil heavy metals such as As, F, Fe, Mn.
- Ground water may be polluted due to:
  - Seepage of agricultural chemicals(NO_3, Pesticides, Insecticides)
  - Sanitary landfill leachates
  - Microbial pollution introduced by soakage pit
  - Industrial waste impounds may increase heavy metals, salt and organic matter concentrations
- Ground water generally considered as hard water.
- Ground waters mostly require minimal treatment (disinfection only) for use as drinking water.

Collection of Surface Water

Intake

- Device or structure placed in a surface water source to permit the withdrawal of water from that source

Parts of intake: consists of three parts

1. An opening or strainer or grating through which the water enters
2. A conduit , to convey water to sump
3. A sump or well from where water is pumped to treatment plant.

Types of Intake

1. Single port:

To draw water from a constant /fixed depth

2. Multi port:

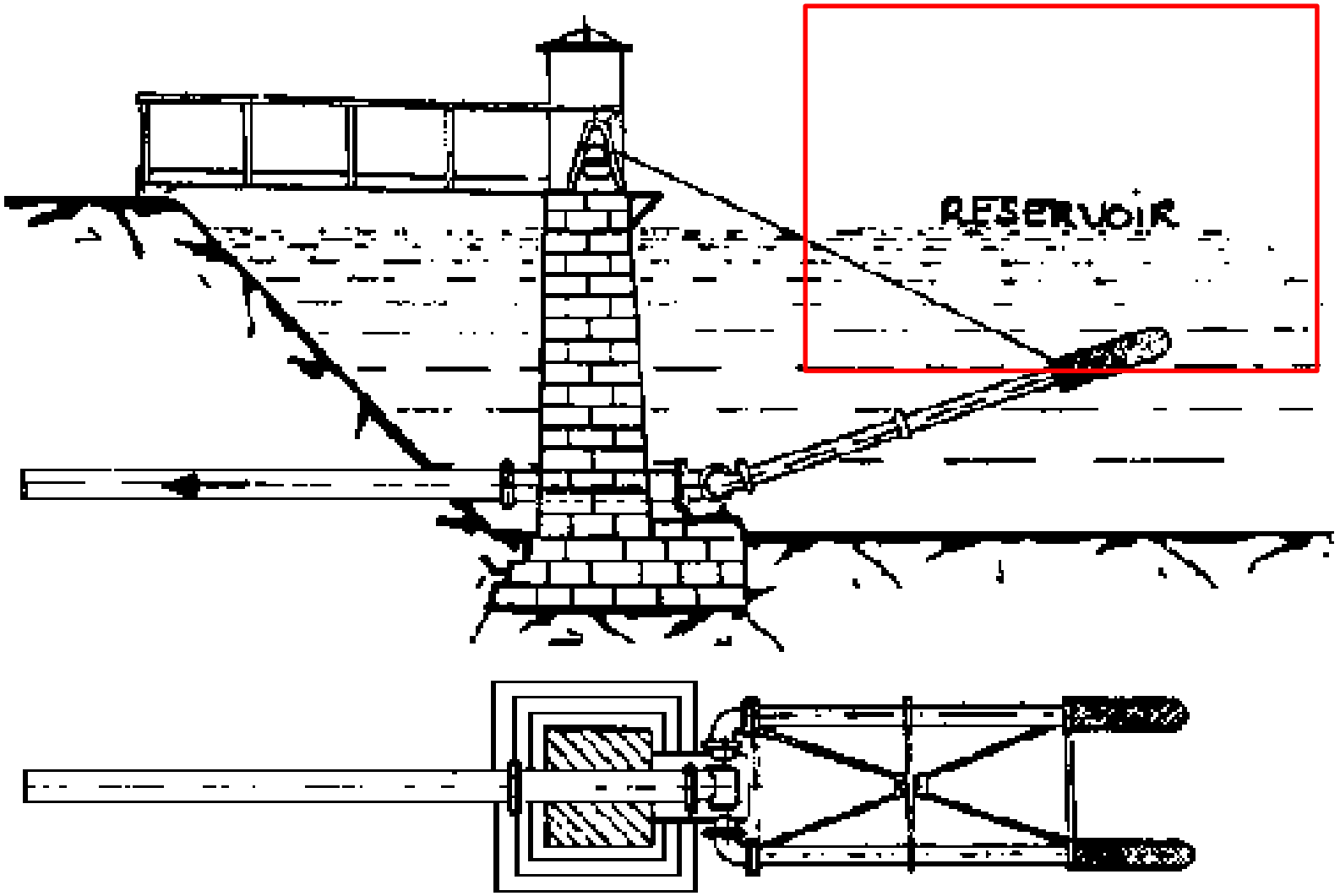
For selective draft for various depths

Factors Affecting Intake Type

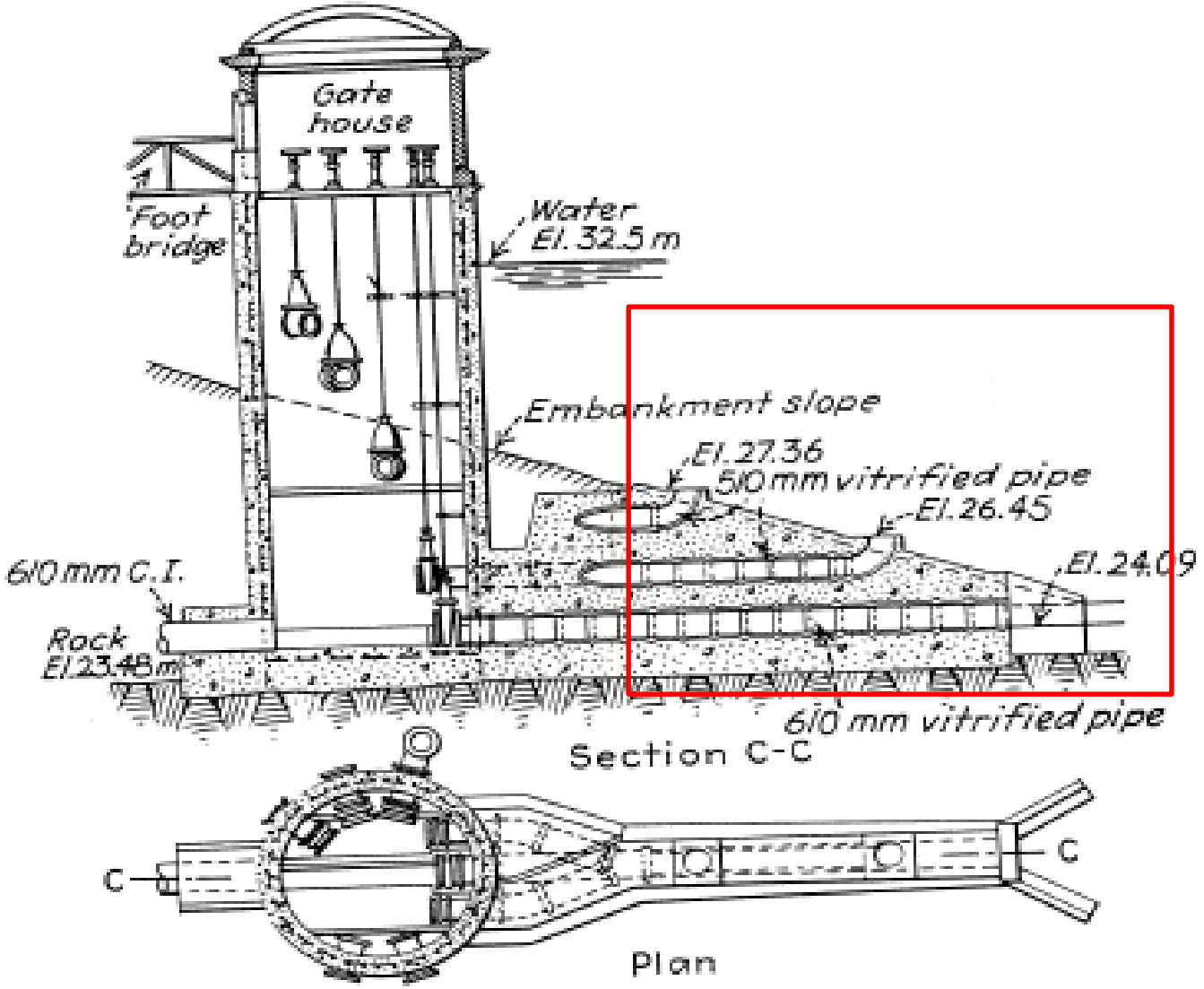
Source of supply:

1. River , lake — Single port
2. Reservoir — Multi port

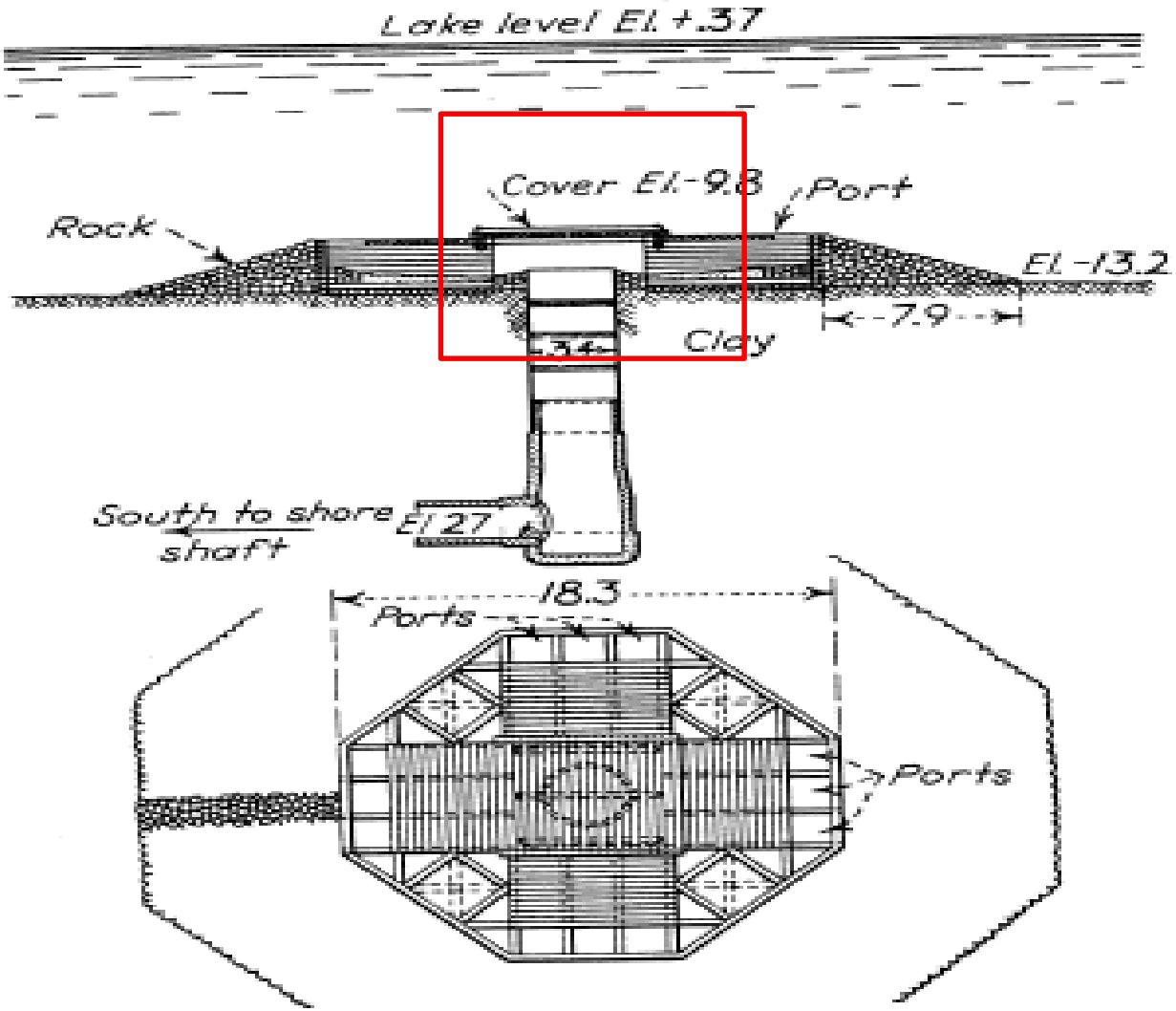
Reservoir Intake (Single port)



Reservoir Intake(Multiple Port)



Lake intake(single port)



River intake (single port)

Figure 6-4 Screened pipe intake. *(Courtesy The Ranney Company.)*

Collection of Ground Water