EWCE 331
Water Supply Engineering

Lecture 1

Instructor

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Department of EWCE, MIST

Lecture outline

Surface Water Supply Scheme

Topics	References
• **Surface water collection units** • **Water treatment units**	**1. A Text Book of Water Supply Engineering** Authors: M. A. Aziz 1st ed., Hafiz Book Center **3. Water Supply and Sanitation** Authors: M. Feroz Ahmed, Md. Mujibur Rahman 1st ed., ITN-BUET **3. Water and Environmental Engineering** Authors: M. Habibur Rahman, Abdullah Al-Muyeed 1st ed., ITN-BUET

Public Water Supply



- Public water supply refers to water withdrawn by public and private water suppliers and delivered to users.
- Public water suppliers provide water to domestic, commercial and industrial users.
- Provides water to at least 25 people or has a minimum of 15 service connections.

Objectives of Public Water Supply

- To supply safe and wholesome water to consumers
- To supply water in adequate quantity
- To make water easily available to consumers so as to encourage personal and household cleanliness.



Elements of Public Water Supply

1. Source of supply
2. Collection system
3. Treatment or purification plant
4. Distribution system

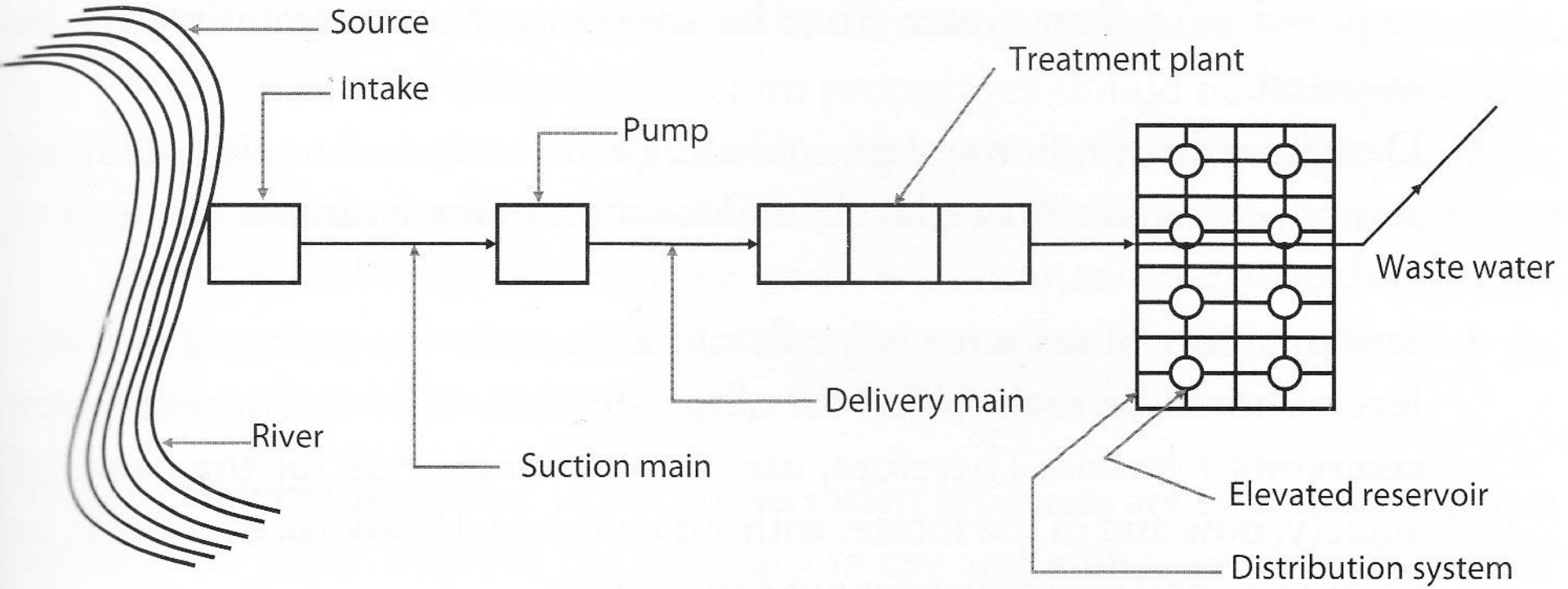
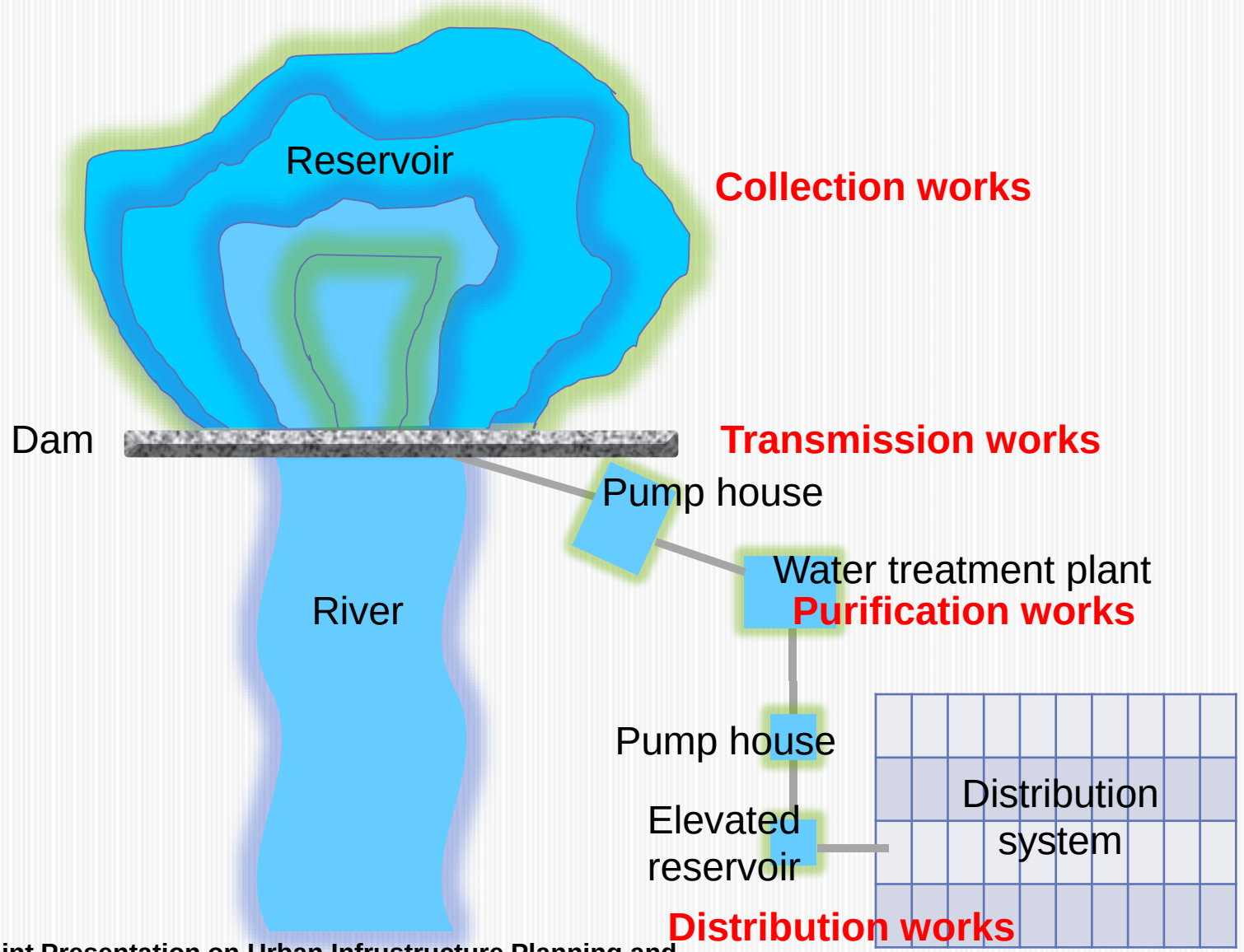


Figure 1.21: Essential Elements of Water supply System

Surface Water Supply Scheme



Source: Powerpoint Presentation on Urban Infrustructure Planning and Mgt, PG URBAN PLANNING, Civil Engineering Department, M.Tech. (Urban Planning), Sardar Vallabhbhai National Institute of Technology, Surat

Surface Water Collection System

- Collection system is a sort of engineering works designed to convey water from a source to a treatment plant.

- Essential units in a collection system are:
  (a) Intake
  (b) Intake main (conduit)
  (c) Aqueduct or transmission main
  (d) Pumping station

Surface Water Collection System Units

1. Intake

- An intake is a device or a structure placed in a surface water source to permit the withdrawal of water from the source and its discharge into an intake conduit or pipe (intake main).

- From the intake main the water will then flow into the water-works system.

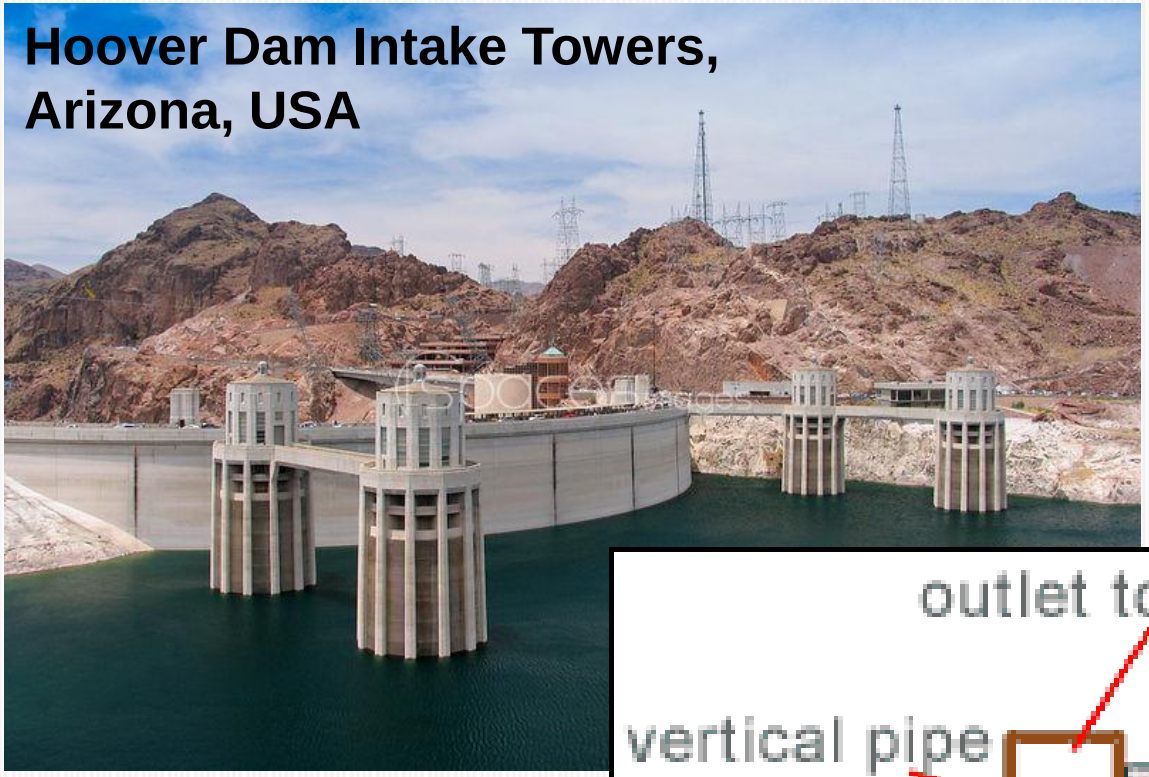
- Intakes are generally consist of opening protected by a strainer or grating through which the water enters the intake main.

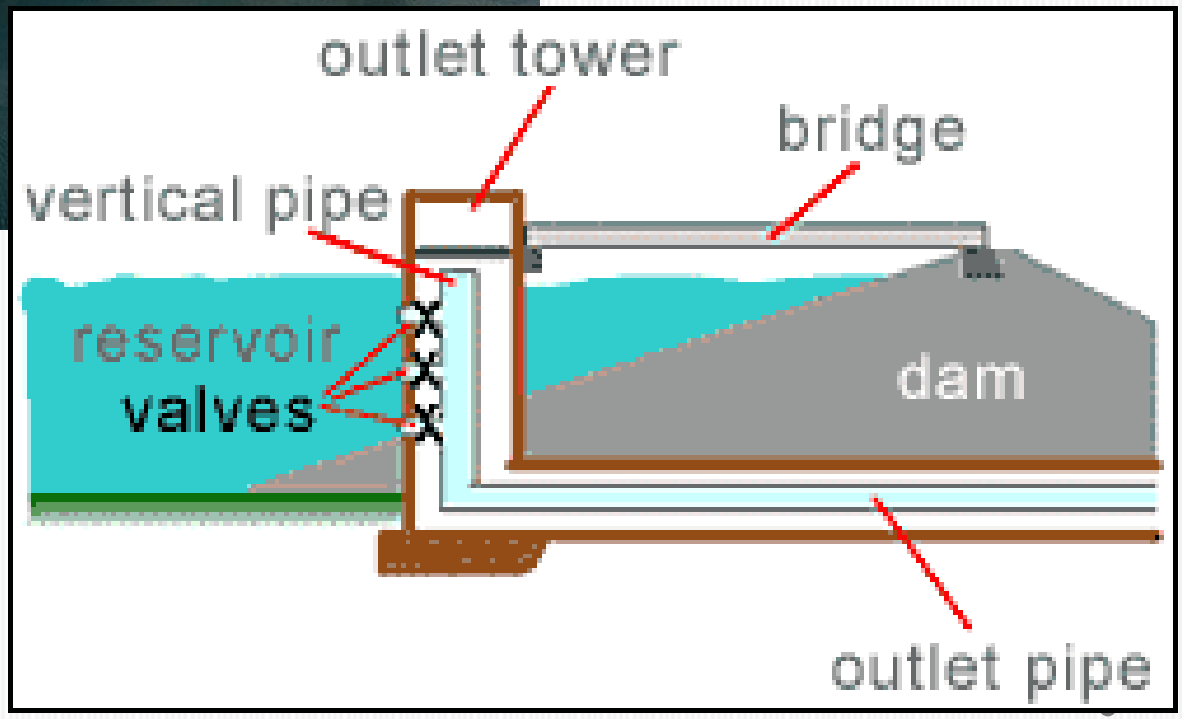
Surface Water Collection System Units

1. Intake

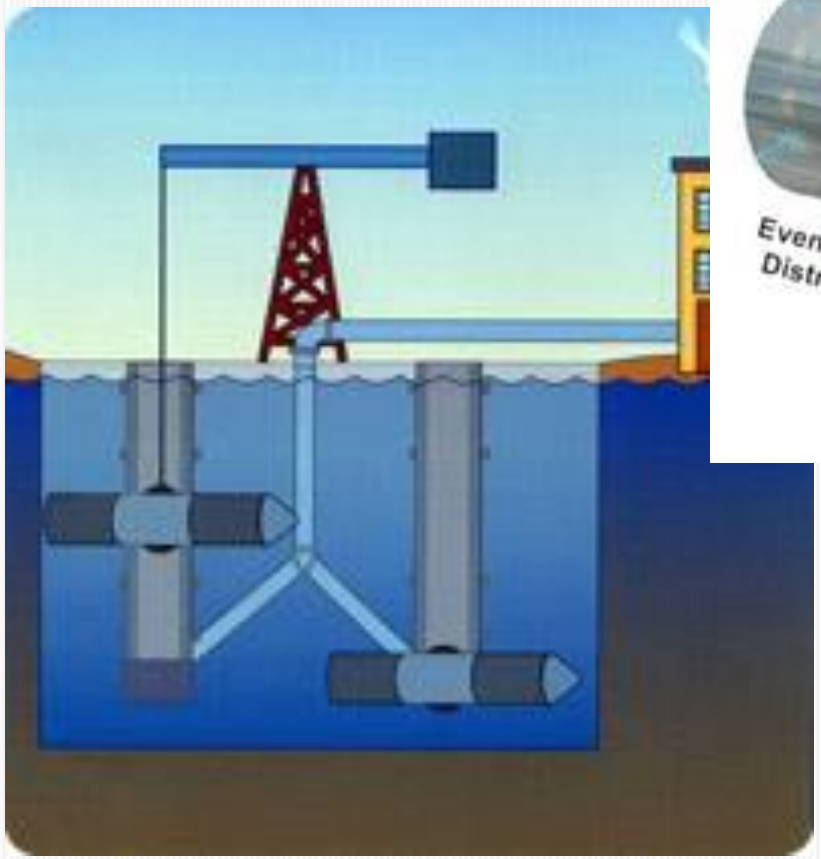
- Types of intake structures consist of –
  - ✓ Intake towers
  - ✓ Submerged intakes
  - ✓ Intake pipes or conduits
  - ✓ Movable intakes
  - ✓ Shore intakes

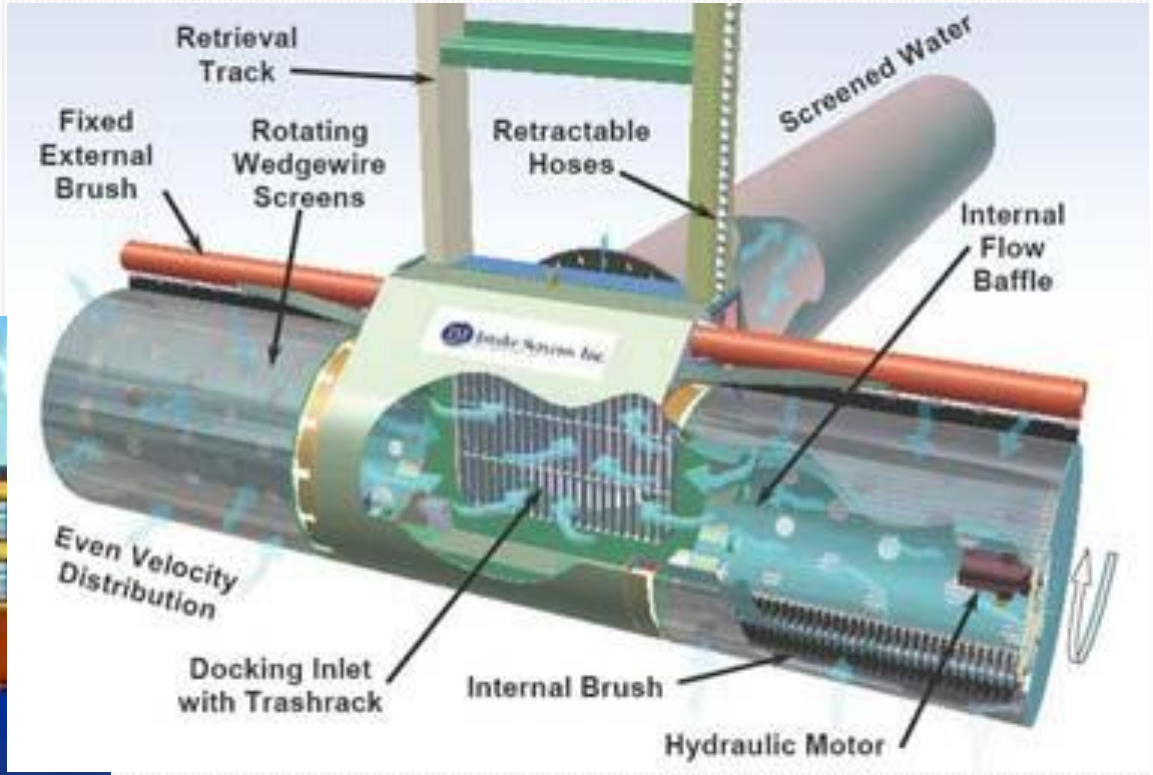
Surface Water Collection Units – **Intake Towers**





Surface Water Collection Units – **Submerged Intake**





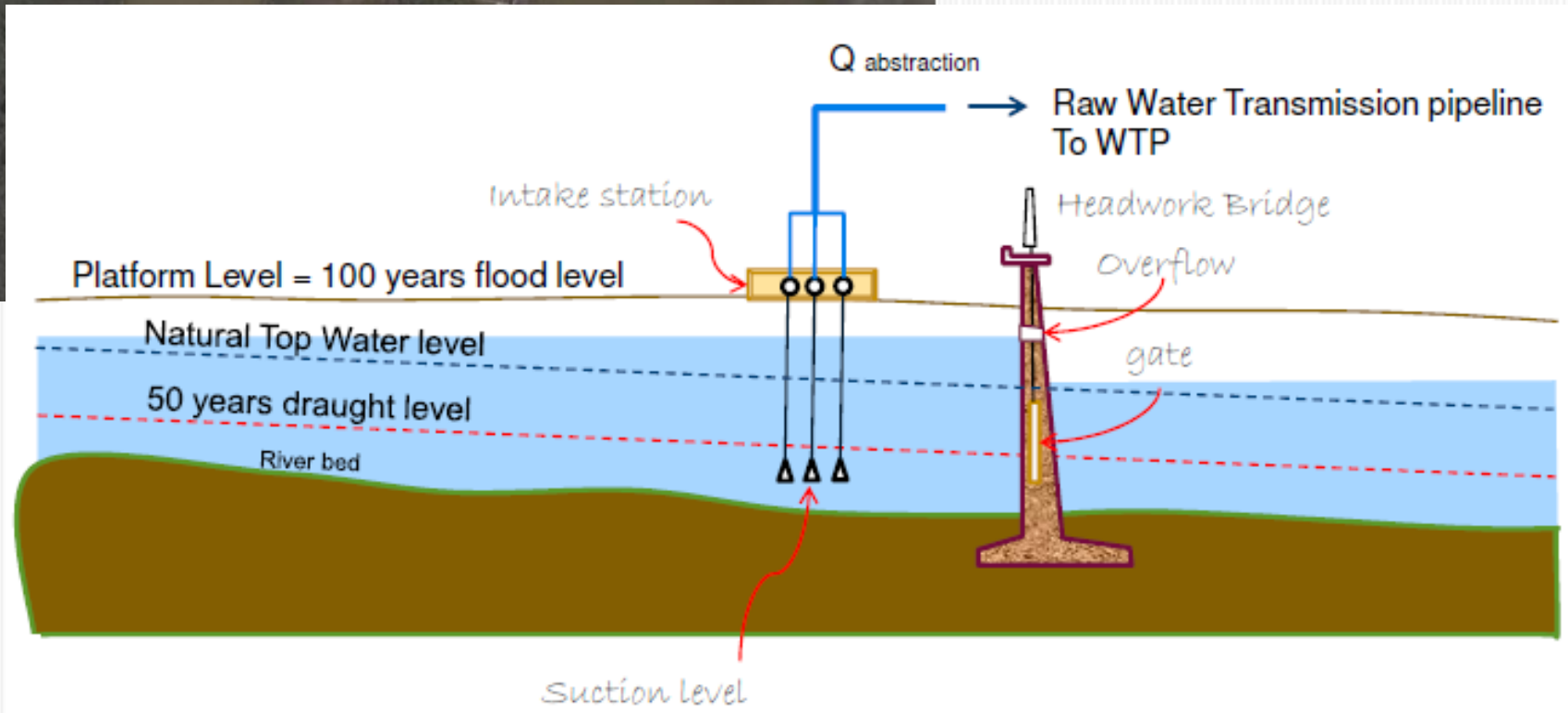
Surface Water Collection Units – **Movable Intake**



Movable weir with intake screen, Japan

Surface Water Collection Units – **Intake Structure**





Surface Water Collection System Units - **Intake**

Consideration for designing and locating the intake structures -

- The source of supply must be considered including the wide fluctuation in water level.
- Intake surroundings should be considered. For example depth of water around intake.
- Characteristics of bottom, navigation requirements, the effect of floods and storm to the structure and scouring in the bottom are also considered.

Surface Water Collection System Units - **Intake**

Consideration for designing and locating the intake structures -

- The location with respect to the sources of pollution is also considered.
- The frequency of floating materials such as ice, vegetation is considered.
- Intake capacity must be large enough to meet the requirement of design discharge.

Type of Intakes for Water Collection

According to type of source

- River Intake
- Canal Intake
- Reservoir Intake
- Lake Intake

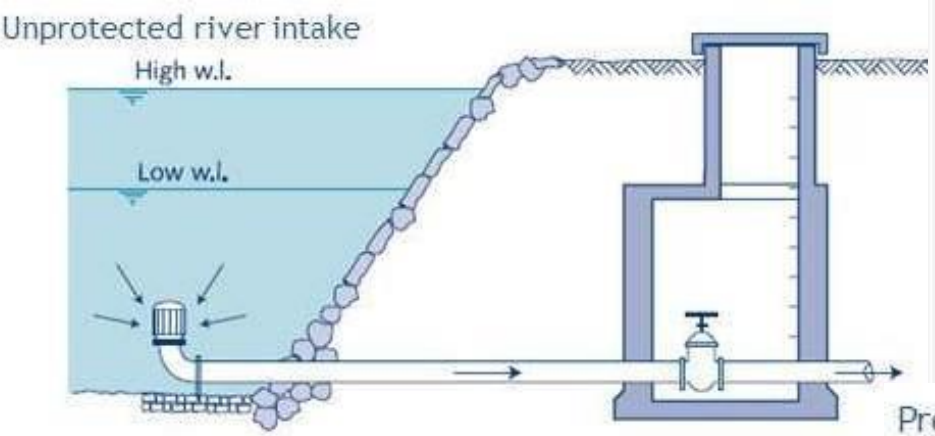
According to position of Intake

- Submerged Intake
- Exposed Intake

According to presence of water in the intake tower

- Wet Intake
- Dry Intake

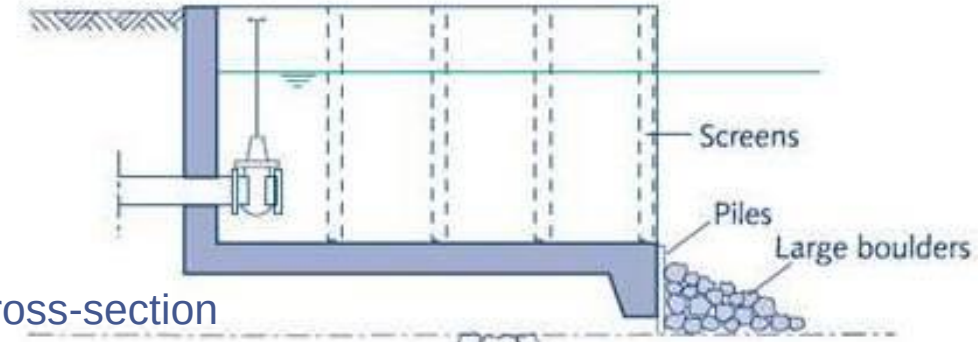
Intakes for Water Collection



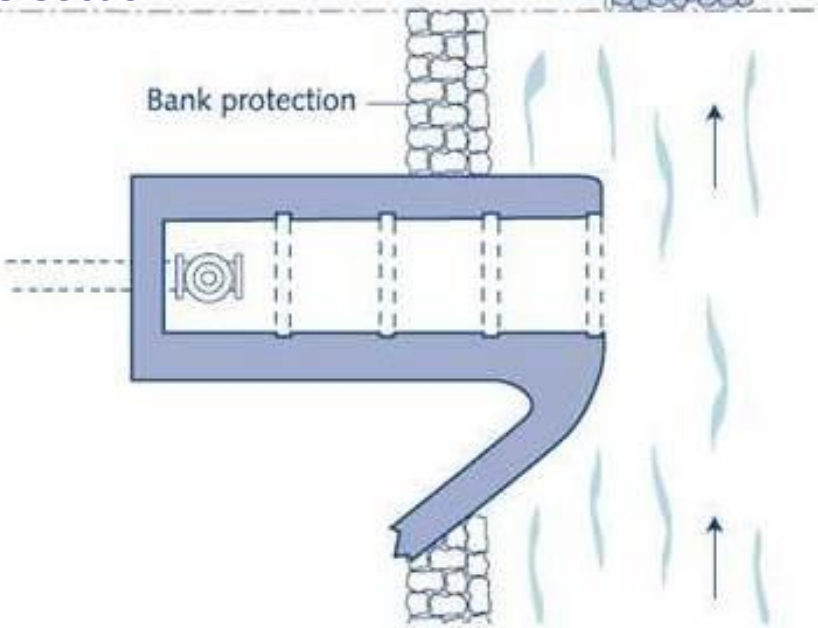
Protected river intake



Trash Rack/ Screen



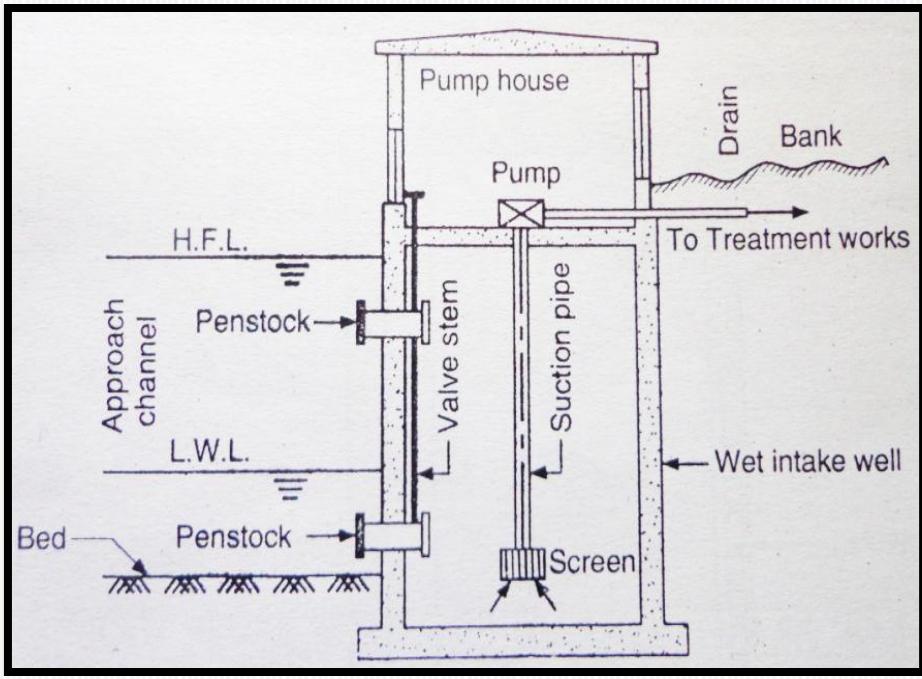
Cross-section



Plan

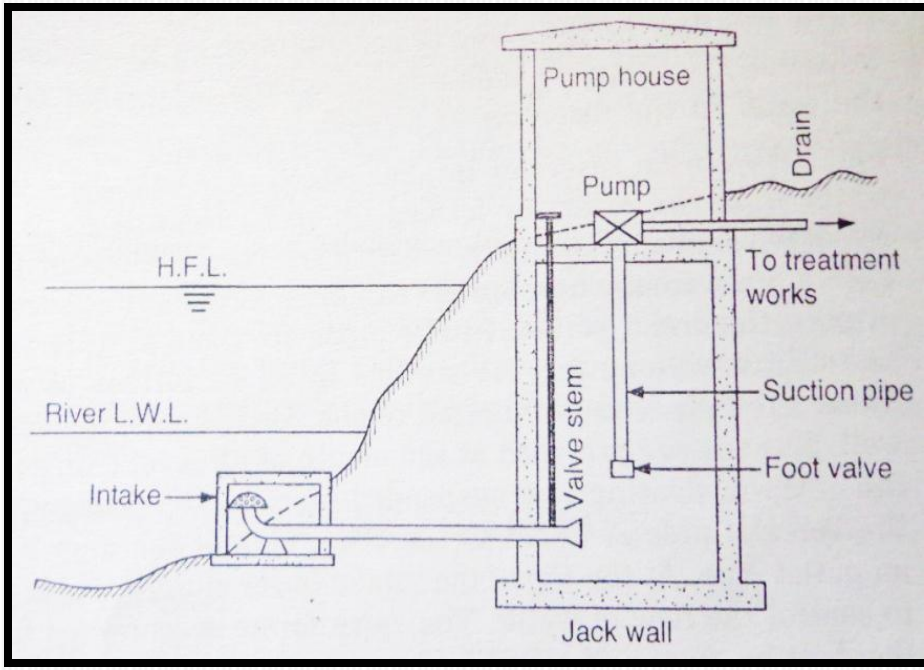
Intakes for Water Collection – River Intakes

- River Intakes are constructed well upstream from points of discharge of sewage and industrial wastes.
- They are located sufficiently inside the river so that necessary demand of water can be met in all the seasons of the year.
- Preferable locations will have deep water, stable river bottom and favorable water quality.
- Locations will have protection against floods, debris and river traffic.



Intakes for Water Collection – River Intakes

- For fluctuating river beds, intakes are mounted on carriages, that are able to move up and down on a free water surface.



- The intake tower permits the entry of water through several entry ports located at various levels to cope with fluctuations in the water levels during different seasons.

- This are also called as **penstocks.** The penstocks are covered with suitable design screens to prevent entry of floating impurities.

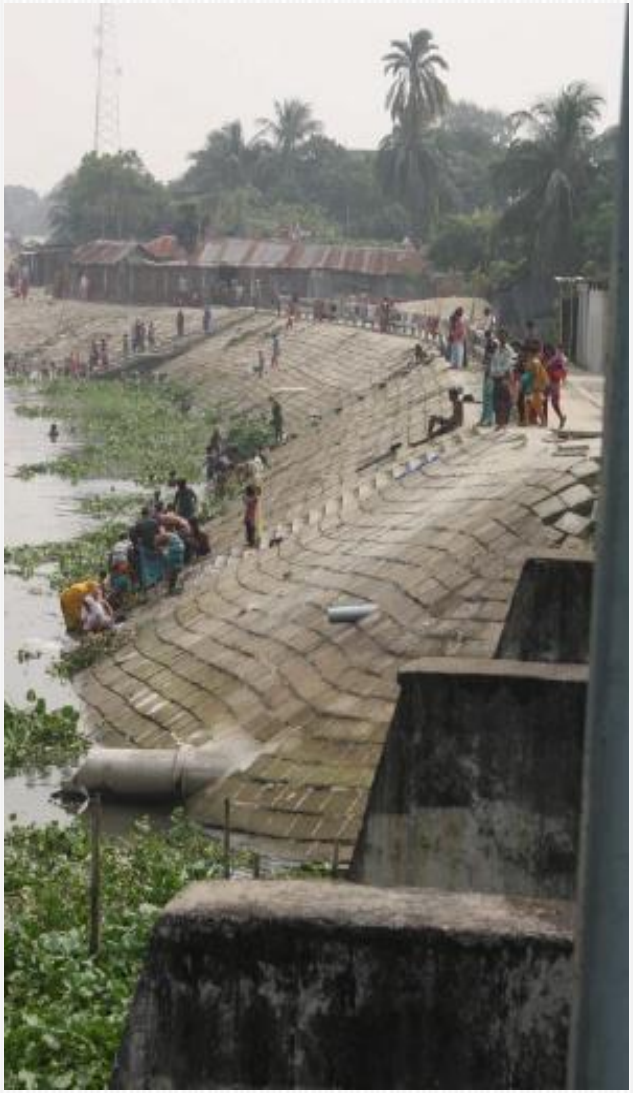
Sharulia Intake Station, SWTP, DWASA, Dhaka





Bar Screens on the outside

Sharulia Intake Station, SWTP, DWASA



River training works to protect the banks besides the intake



Additional screens before pumping

Sharulia Intake Station, SWTP, DWASA



Sluice gates to control the flow



Inside the pump station

Sharulia Intake Station, SWTP, DWASA



Water is pumped and discharged to WASA conveyance canal



WASA conveyance canal

Intakes for Water Collection – Reservoir Intake

- It is constructed when the flow in the river is not guaranteed throughout the year.
- A dam is constructed across the river to store the water in the reservoir so formed.
- Sited with due reference to sources of pollution, prevailing winds and surface currents.
- Reservoir intakes lie closer to bank in the deepest part of the reservoir.

Intakes for Water Collection – Reservoir Intake

- Reservoir Intakes essentially consist of an Intake tower constructed on the slope of Dam.
- The location of the intake tower should be such that the Intake can draw water in sufficient quantity even in the driest period.
- Intake pipes are fixed at different levels, so as to draw water near the surface in all variations of water levels.

Intakes for Water Collection – Reservoir Intake

- Intake towers are separately constructed in case of earthen dams.

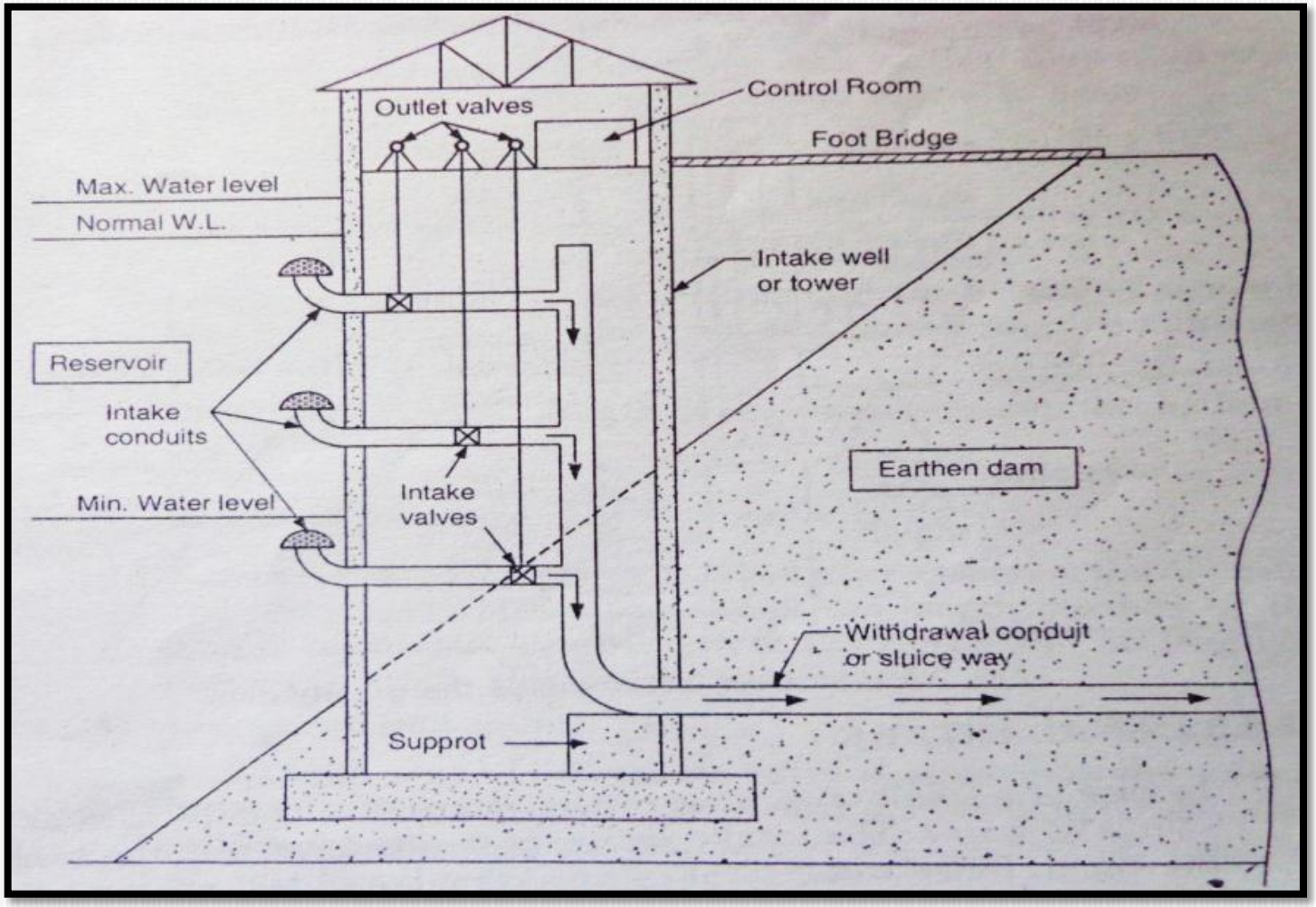


Fig: Valve tower situated at the upstream toe of an earthen dam

Intakes for Water Collection – Reservoir Intake

- In gravity dam, intake tower is constructed inside the dam itself.

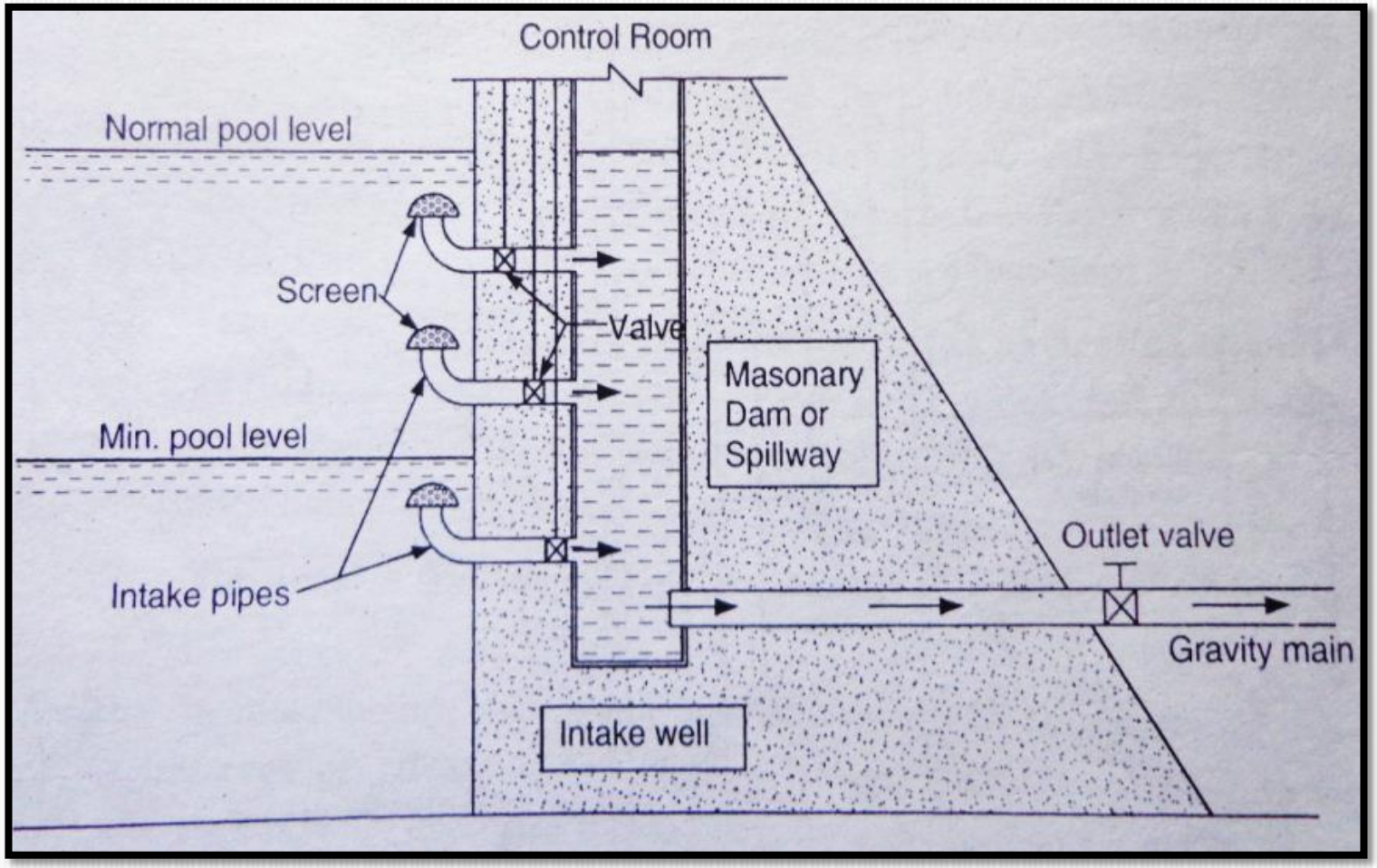
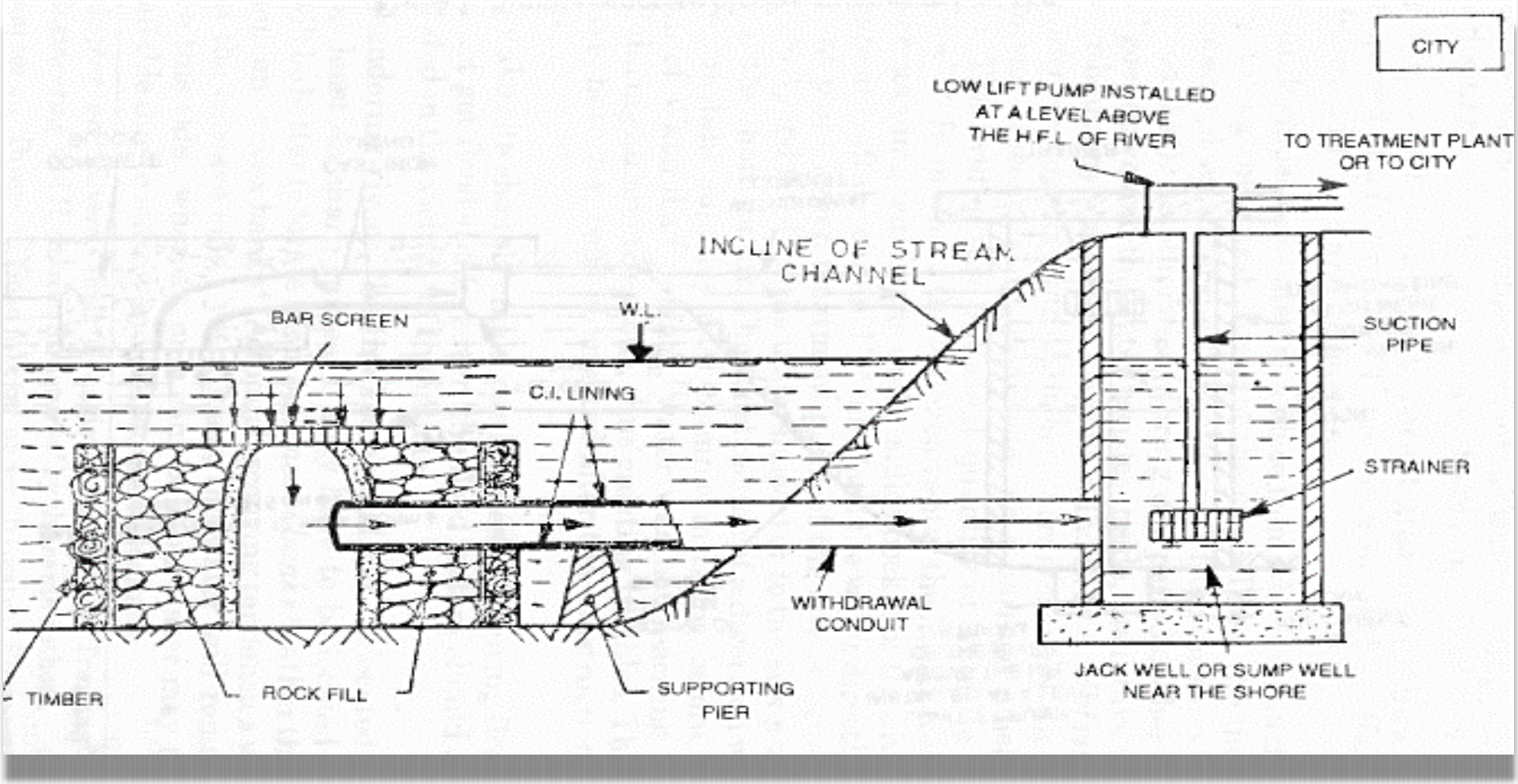


Fig: Intake well / Valve tower for concrete gravity or masonry dams

Intakes for Water Collection – Lake Intake

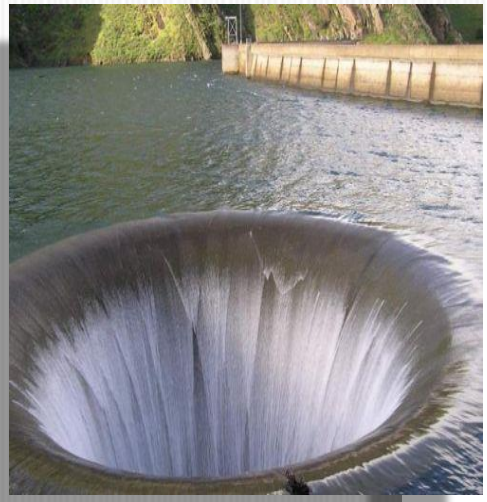
- Lake Intakes are mostly submerged intake.
- These Intakes are constructed in the bed of lake below the low water level so as to draw water even in dry season.
- It mainly consist of a pipe laid in the bed of the lake.
- One end of the pipe which is in middle of the lake is fitted with bell mouth opening covered with a mesh and protected timber or concrete crib.

Intakes for Water Collection – Lake Intake



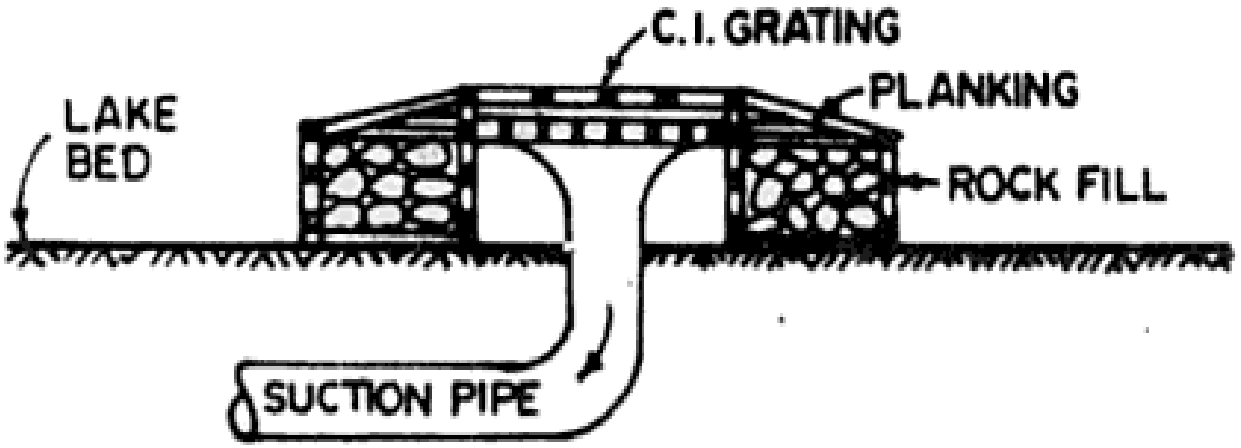
Intakes for Water Collection – Lake Intake

- The water enters in the pipe through the bell mouth opening and flows under gravity to the bank where it is collected in a sump well and then pumped to the treatment plant for necessary treatment.





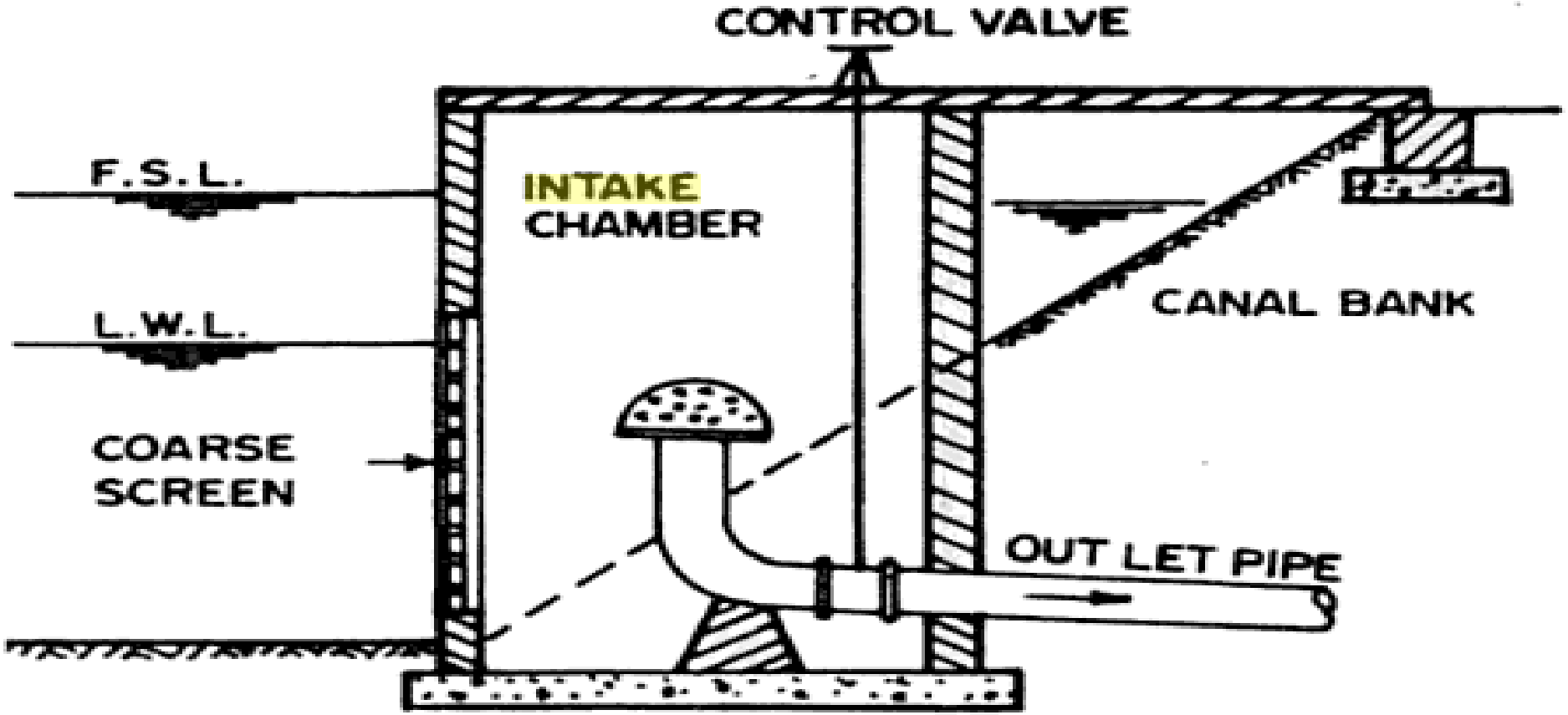
Bell Mouth Entrance



Intakes for Water Collection – Canal Intake

- For small town a nearby irrigation canal can be used as the source of water.
- The intake well is generally located in the bank of the canal.
- Canal should lie on upstream and downstream side of the intake to prevent erosion of sides and bed of canal.

Intakes for Water Collection – Canal Intake



Intake Design Consideration

Intake Velocity:

- velocity below 0.3 fps allows fish to escape, reduces ice problems and reduce entrainment of suspended matter

Intake Port Location:

- multiple intake ports at several elevations are preferable

- location of ports determined by testing water quality

- topmost port not less than 2m below water surface

- bottom port at least 1 m above bottom

Intake Design Consideration

Gates:

- Sluice gates typically used to control flow of water from source to the water conveyance system

Control of Ice: (for colder regions)

- keep intake ports sufficiently below water level

- steam piping, compressed air, space heaters

Intake Design Consideration - Screening

Coarse Screen:

- bar racks with 2- 3″ clear spacing
- should be installed in the outside
- provision for cleaning

Fine Screen:

- to remove smaller objects that might damage pumps
- heavy wire mesh having 0.25″ square openings
- design velocity 0.4 - 0.8 m/s
- requires frequent cleaning (travelling screens used often)

Intake Design Consideration - Screening

Microstrainer:

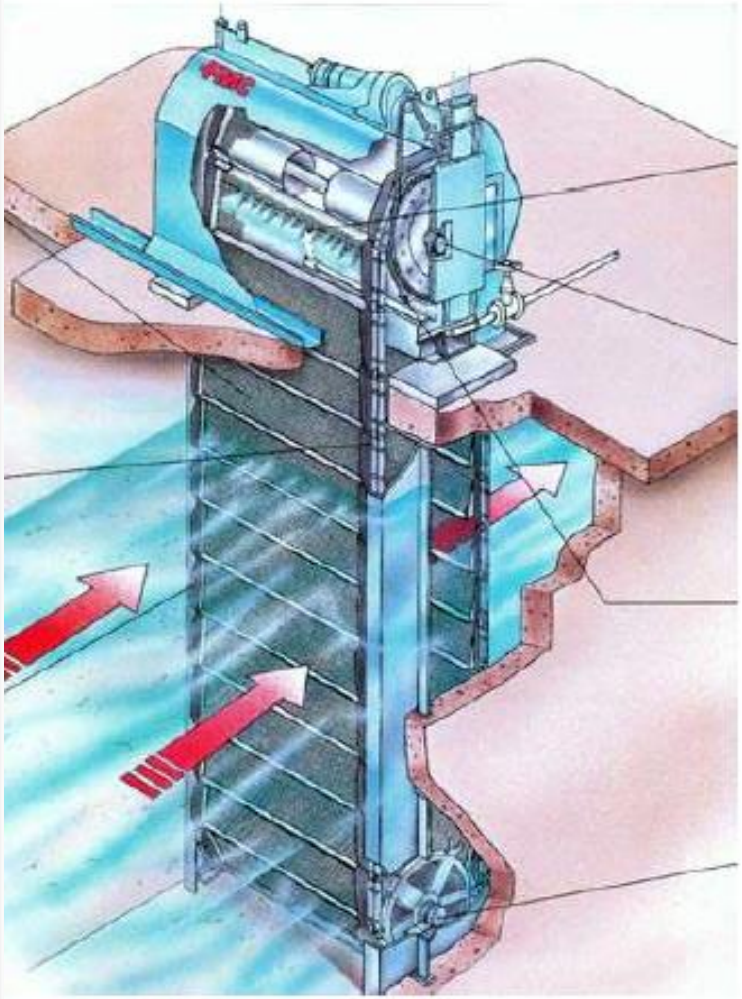
- to remove plankton and algae
(to improve sedimentation and chlorination performance)

- fine wire mesh

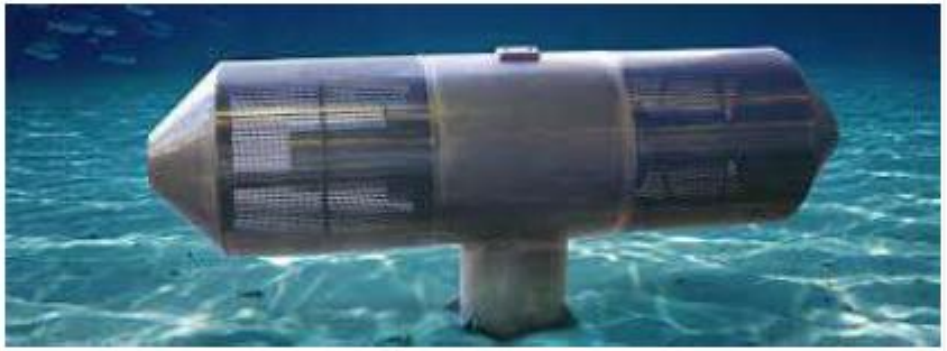
- slime build up

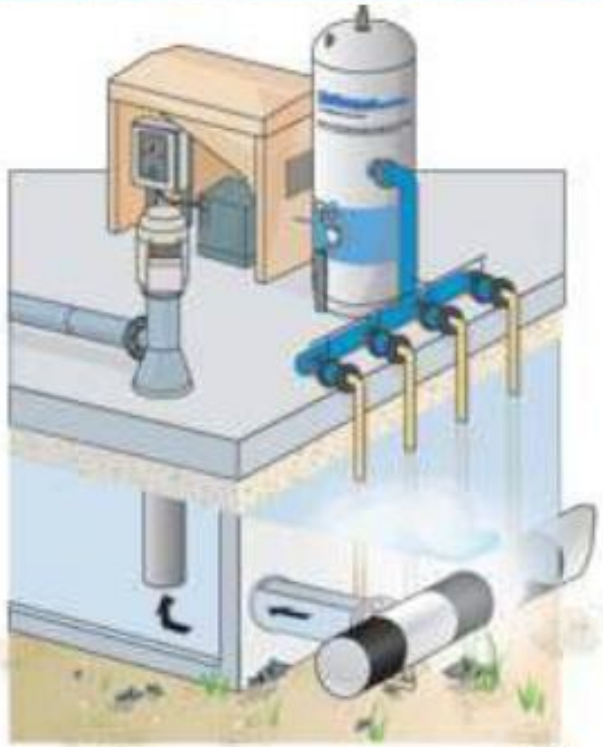
- will not handle sand, silt and abrasive material

Travelling and Passive Fine Screens



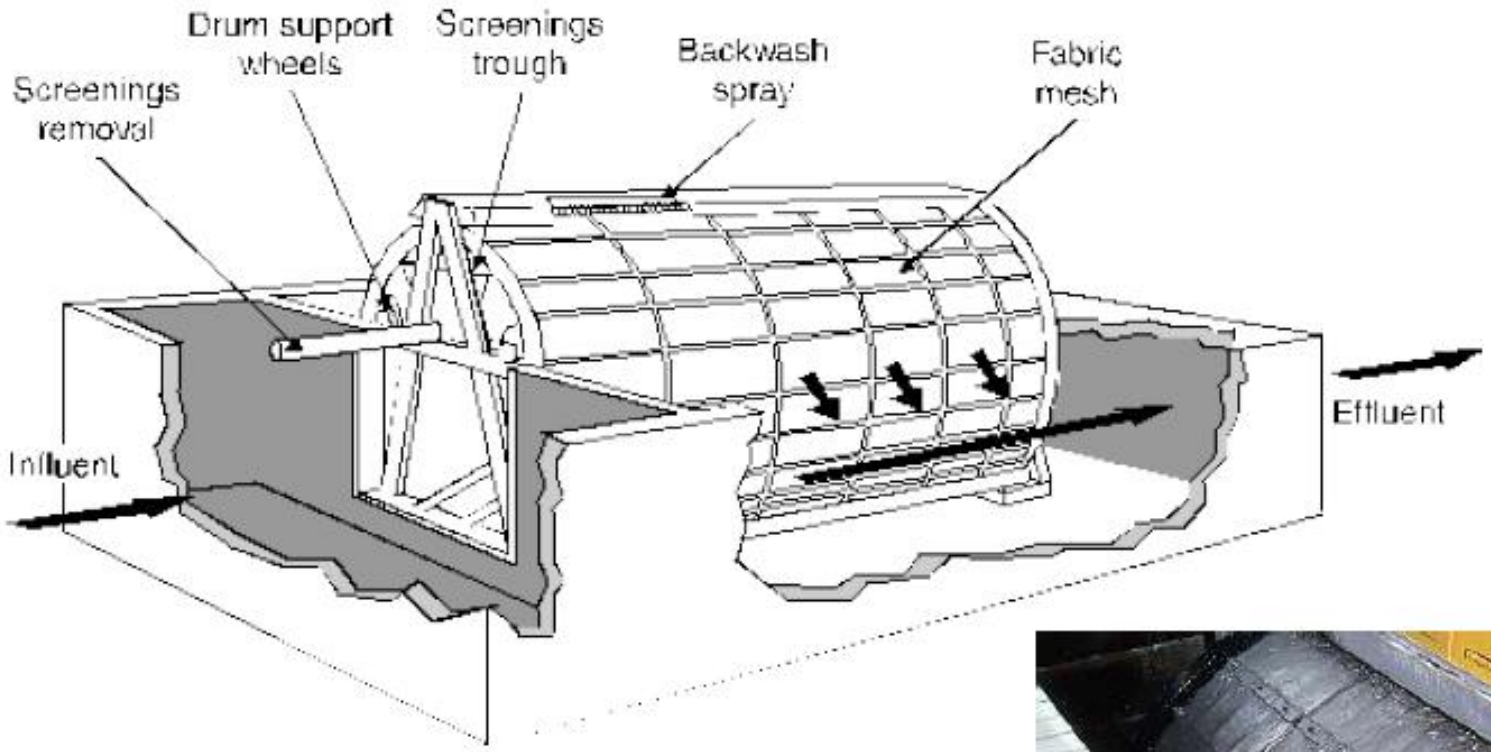
www.power-technology.com





www.johnsonscreens.com

Microstrainer

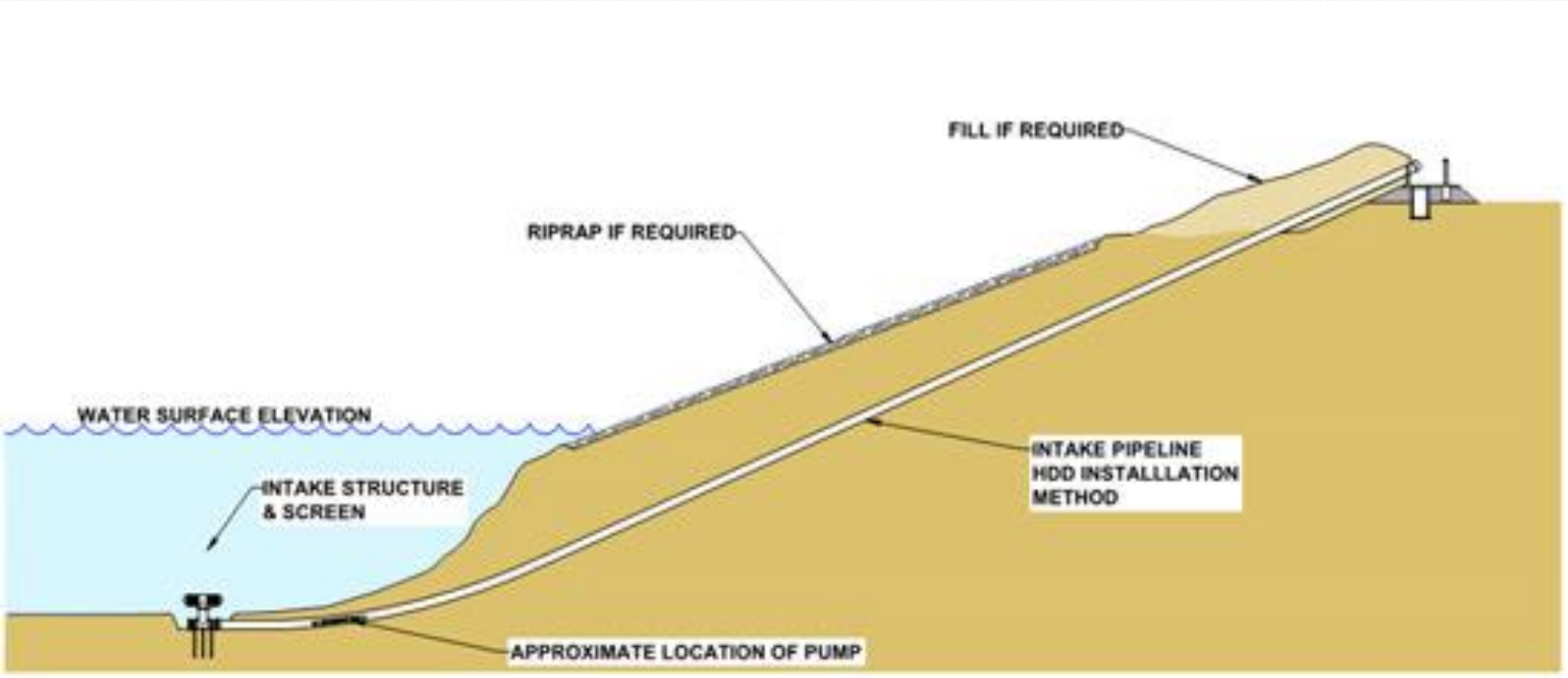


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Intake Main & Transmission Main

- A pipe line must be used to deliver water from the source to the treatment plant.
- Intakes located at long distances from the pumps usually deliver their water to the pump well at the shore end by gravity.



Intake Main & Transmission Main

- Conveyance of water from intake will require a large pipe or conduit so that the velocity would be low.

- But velocity should not be low enough to allow sedimentation.

- The conduit may be a submerged pipe or tunnel.

- A submerged pipe should be protected -

✓ By burying it in a trench

✓ By surrounding it with rock or holding it in place with piling

Intake Main & Transmission Main

- The kind of pipe to be used – cast iron, steel, concrete, asbestos cement or even wood, will depend to some extent on local conditions and local economy, determined on an engineering basis.

- The size of the pipe/ conduit is determined by the volume of water to be delivered and the pressure or head of water.

Surface Water Collection – **Pumping Station**

- A pumping station is essential for pumping water from the source through the intake to allow water to flow by gravity through the transmission main to the treatment plant.





[Source: ATC Williams Consultancy, Australia]

Surface Water Treatment – **Treatment Units**

- In case of **surface water**, the treatment procedure may involve the removal of –
  - ✓ turbidity
  - ✓ color
  - ✓ taste
  - ✓ odor
  - ✓ microorganisms (bacteria)

- **Ground water** from wells may be treated to reduce –
  - ✓ hardness
  - ✓ iron
  - ✓ corrosive qualities (alkalinity)

Surface Water Treatment – **Treatment Units**

- The type of treatment required depends on the physical, chemical and biological characteristics of water.

- The most common steps in water treatment are clarification and disinfection.

- Clarification involves –

  ✓ plain and chemical sedimentation to remove suspended and colloidal particles including color producing substances

  ✓ filtration to remove visible impurities and make the water acceptable to the consumers.

Surface Water Treatment – **Treatment Units**

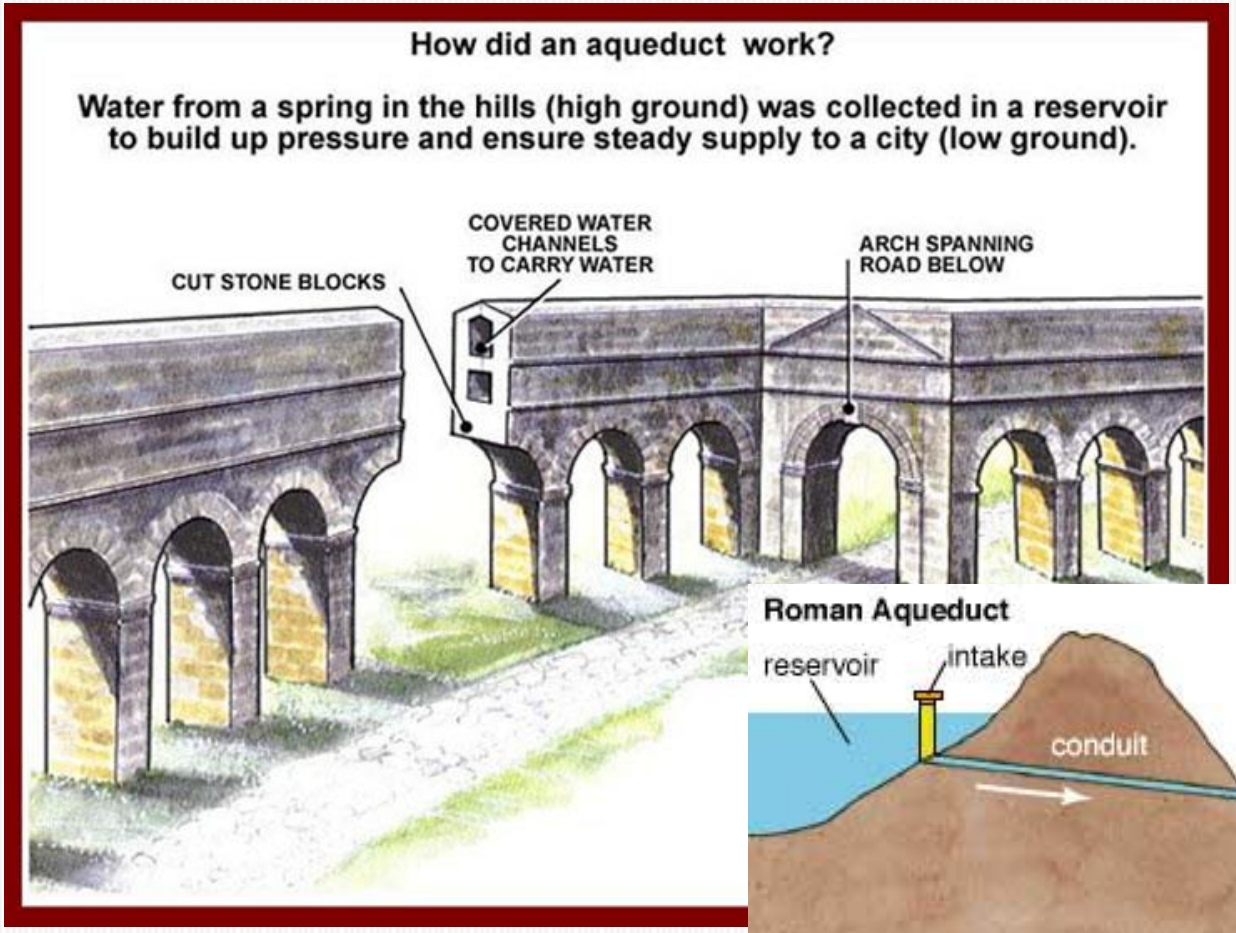
- Disinfection means destruction of pathogenic organisms to make the water safe.

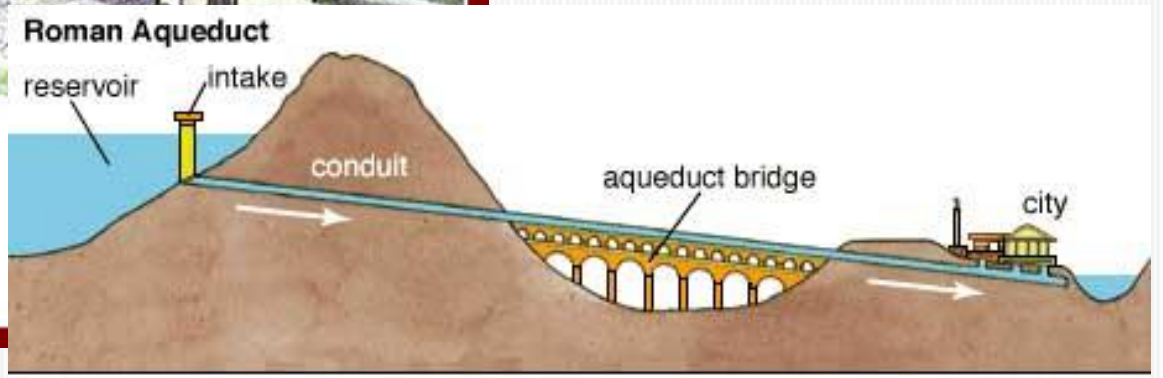
- Commonly used water treatment methods include –
  - ✓ screening
  - ✓ sedimentation
  - ✓ chemical treatment
  - ✓ sand filtration
  - ✓ disinfection

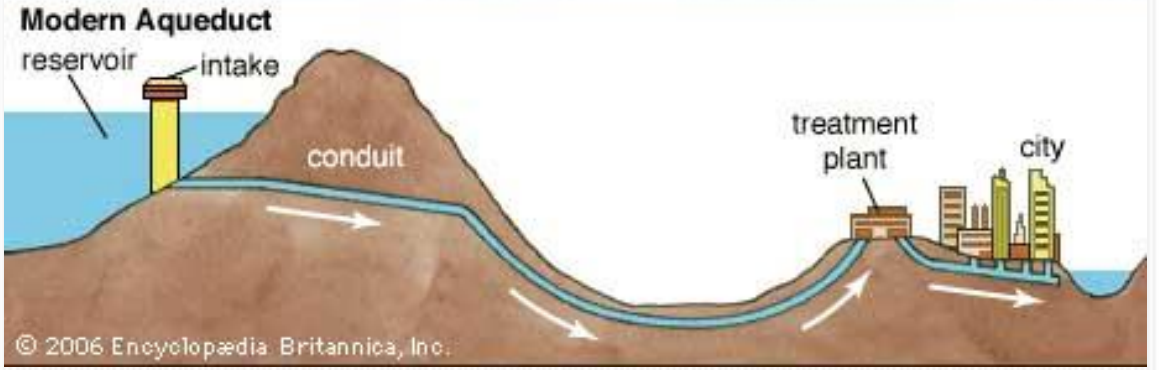
Surface Water Treatment – **Treatment Units**

- Some of the treatment processes/unit operations for removal of specific impurities are –
  - ✓ Aeration
  - ✓ Water softening
  - ✓ Arsenic removal
  - ✓ Iron removal
  - ✓ Activated carbon application
  - ✓ Fluoridation and de-fluoridation
  - ✓ Demineralization
  - ✓ Desalination

Appendix - Aqueduct







Appendix – Shore Intake

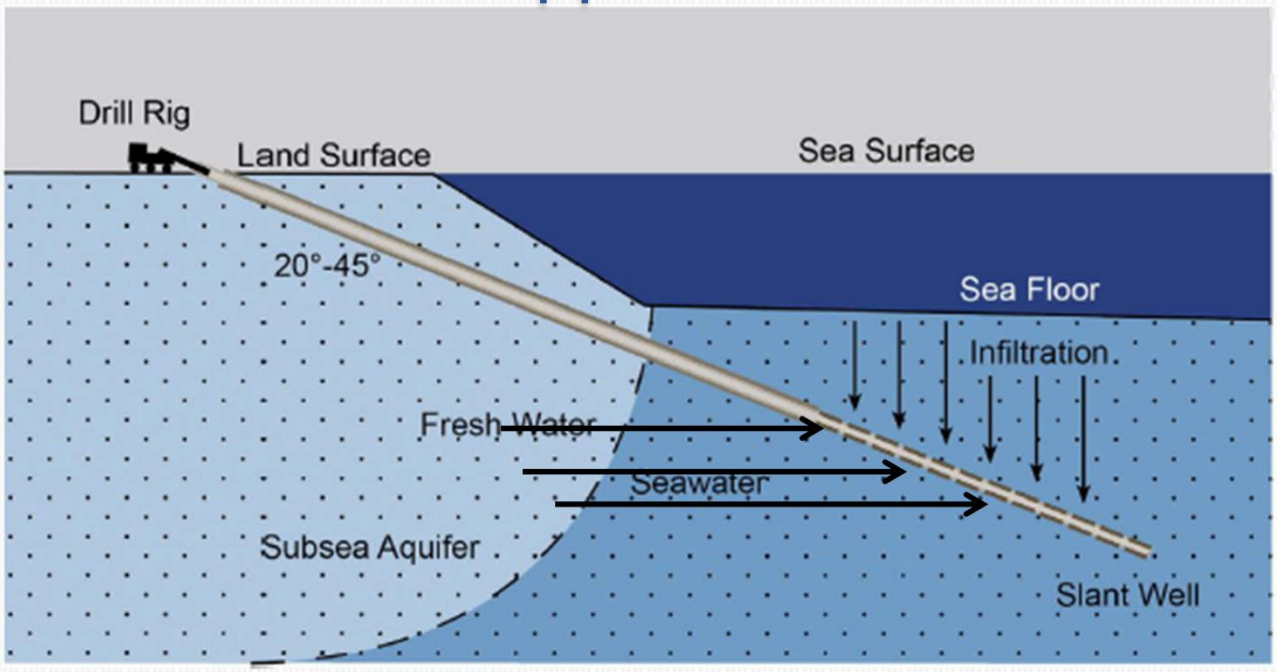


Figure 3.4. Conceptual diagram of the slant well (from Missimer et al., 2013).

