

1.1.1. Sanitary Engineering. *The branch of engineering which deals with the removal and disposal of the sewage (liquid waste) without causing any nuisance to the community is called Sanitary Engineering.*

1.1.2. Importance of sanitary engineering. Sanitary Engineering deals with the removal and disposal of waste of the entire city. Its importance is because it helps

in:

- (i) General developments of the city.
- (ii) Protecting water supplies from pollution.
- (iii) Collecting and disposing off the waste of the city.
- (iv) Removing rain water from a town.
- (v) Maintaining good environments for public.
- (vi) Preventing the pollution of natural streams etc.
- (vii) Preventing the occurrence of disease e.g. malaria, typhoid etc.

Sewers carries \rightarrow

- ① Domestic sewage.
- ② Industrial sewage.
- ③ Storm water

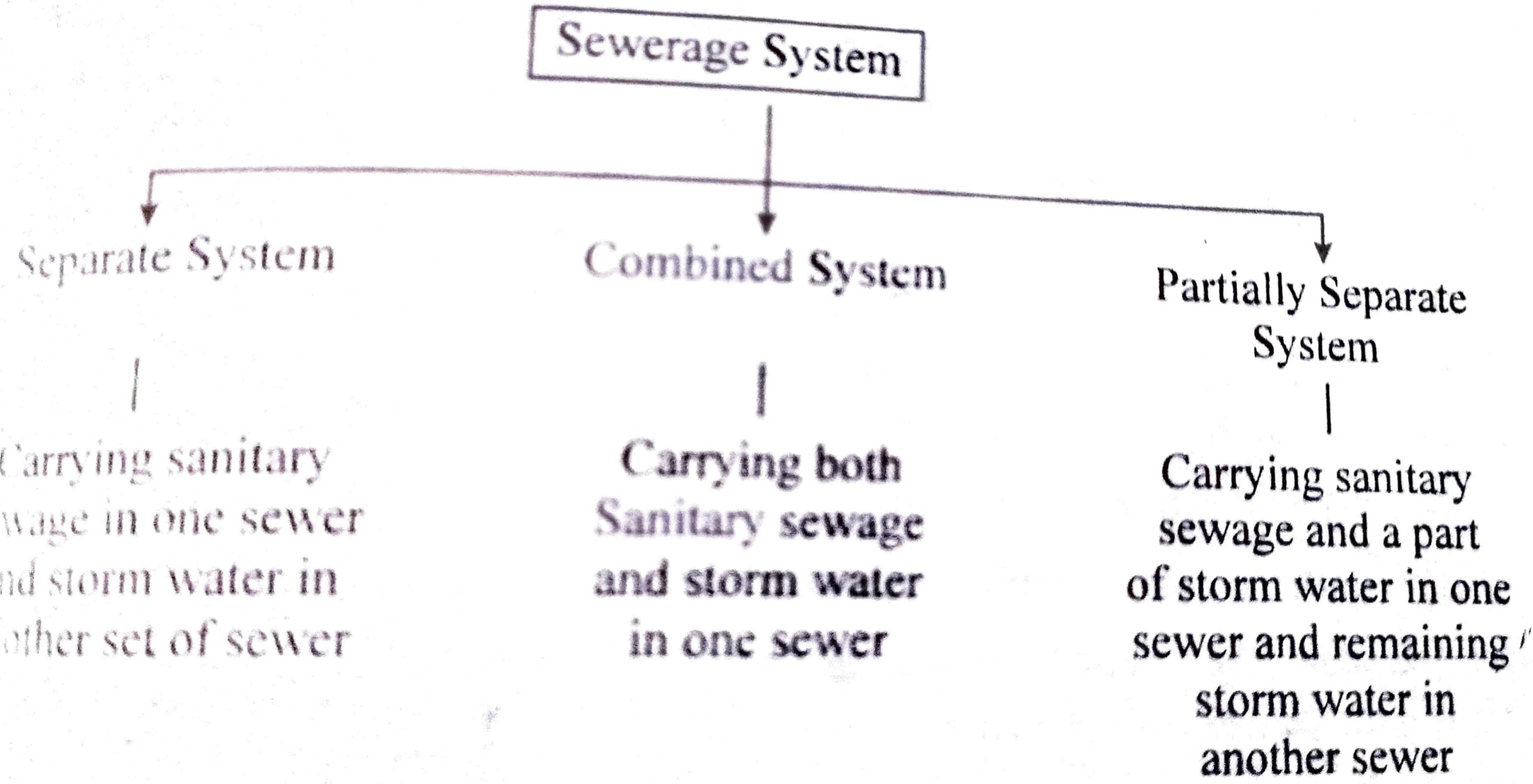
Concentration of impurities \downarrow
Storm \angle Domestic sewage \angle Industrial sewage

Degree of treatment \downarrow Storm \angle D.S \angle I.S

Discharge \downarrow Storm $>$ D.S + I.S

Sewerage systems are of three types

1. Separate system
2. Combined system
3. Partially separate system

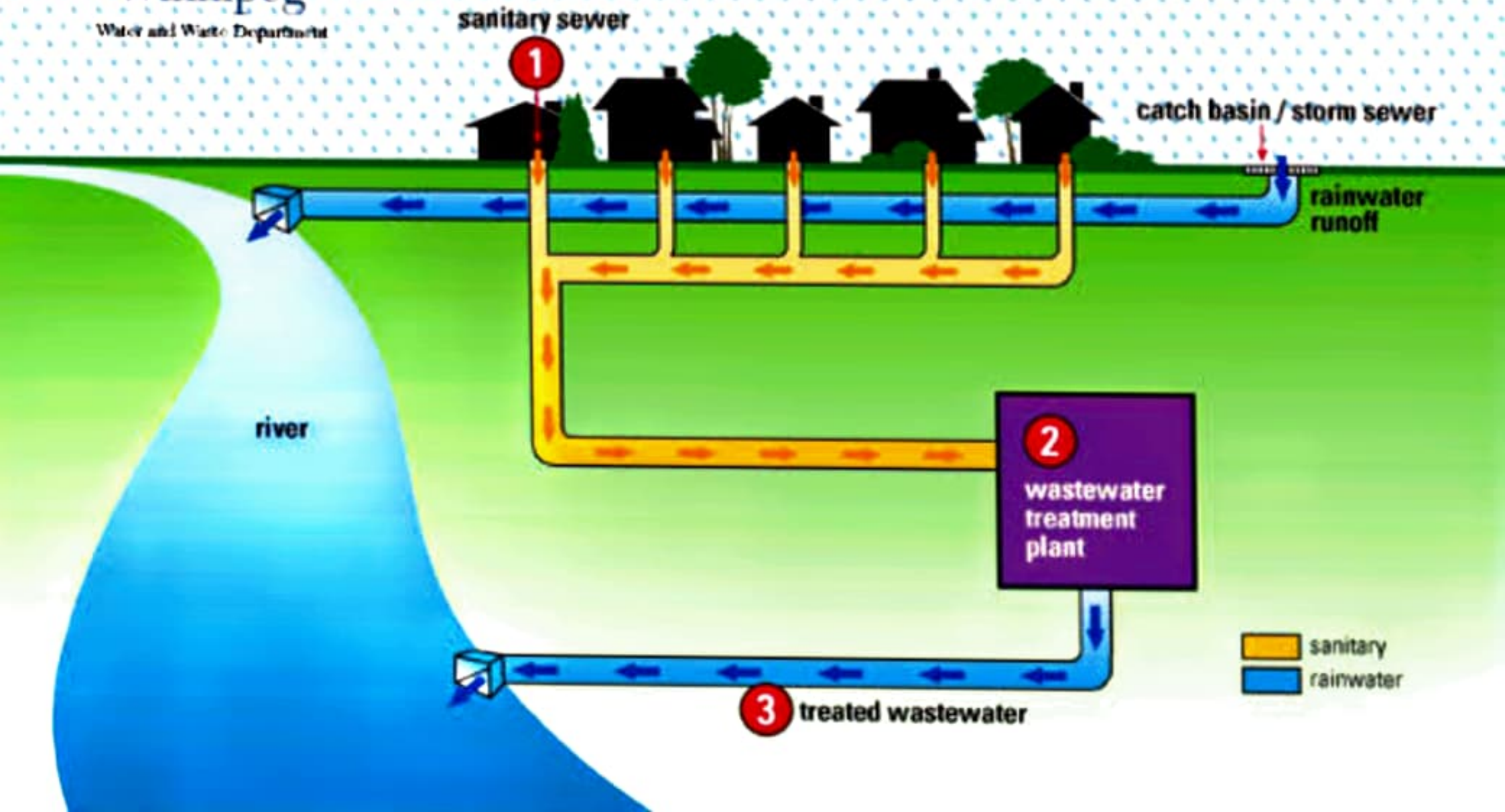


3.2.1. Separate System. In this system two separate sets of sewers are installed, one for carrying sanitary sewage and other for storm water. This system is suitable for use under the following conditions :


- (a) When the topography of the area is flat and deep excavation is necessary for combined sewers.
- (b) Where rainfall is uneven.
- (c) When only sanitary sewage is to be treated and storm water is not treated.
- (d) When sewers are to be constructed in rocky strata and cost of cutting is more for large combined sewer.



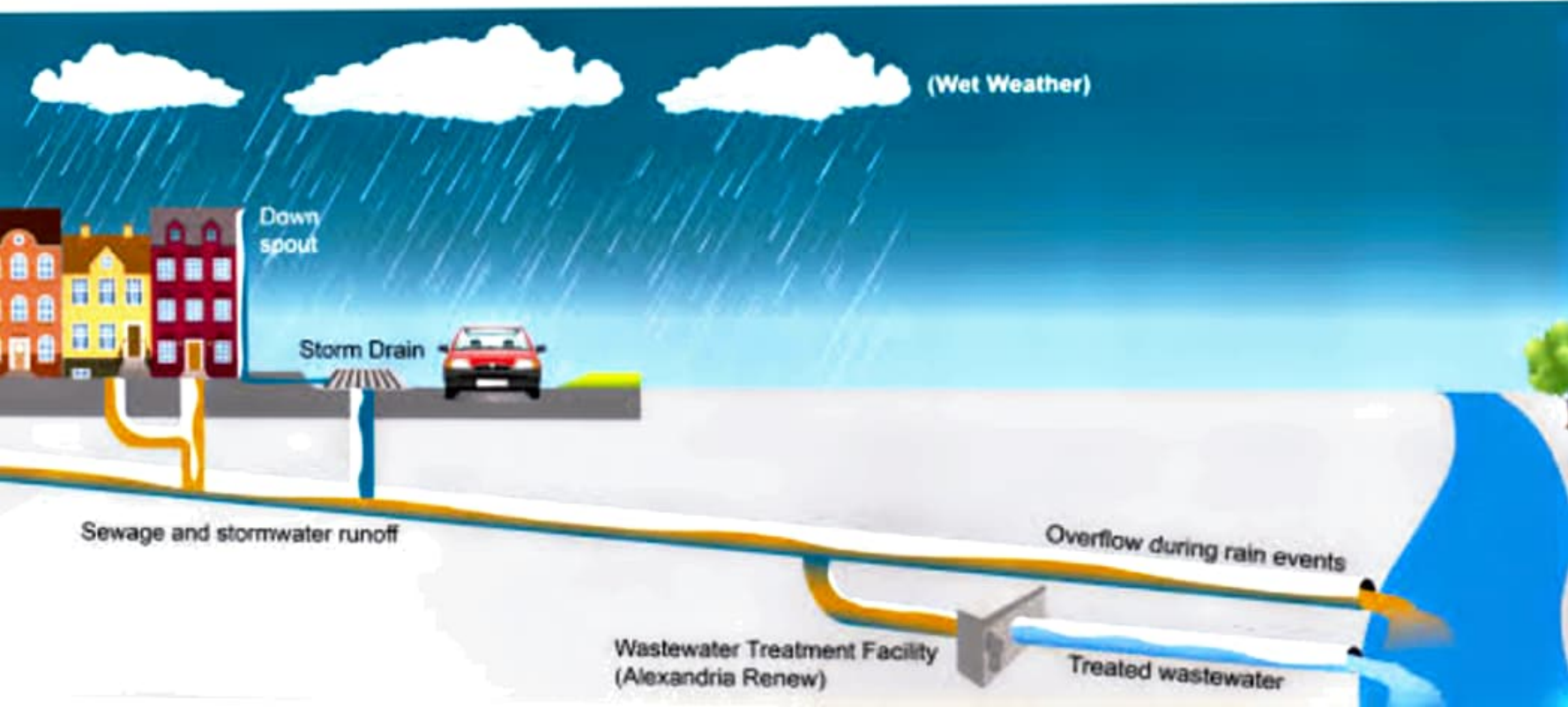
Separate Sewer System



3.2.2. Combined System. In this system both sanitary sewage and storm water are carried in single sewer. Combined system is used under following circumstances

- (a) When rainfall is even throughout the year.
 - (b) Both sanitary sewage and storm water require pumping.
 - (c) When the quantity of sanitary sewage is small and can be admitted to already existing storm water sewer.
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Combined Sewer Systems



3.2.3. Partially Separate System. In partially separate system, in addition to sanitary sewage, a portion of storm water is allowed to enter in the sewers carrying sanitary sewage. The remaining portion of storm water is diverted into a separate set of sewers.

* Difference b/w Combined and separate system :-

(i) Discharge, $Q_{\text{Combined}} > Q_{\text{separate}}$

(ii) dia, $d_{\text{Combined}} > d_{\text{Sep.}}$

(iii) Cost of installation, $C_{\text{Comb}} < C_{\text{Sep.}}$

(iv) Initial Cost Combined $>$ Separate

(v) Degree of treatment, Sep $>$ Comb.

A House Sewer. It is a pipe conveying sewage from the plumbing system of a single building to a common sewer or a point of immediate disposal.

Lateral Sewer. It gets discharge directly from building through house drain. It has no other common sewer discharging into it.

Sub-main Sewer or Branch Sewer. It is one that receives the discharge of a number of lateral sewers.

A Main Sewer. A main sewer also known as a trunk sewer, receives the discharge of one or more submain sewers.

A Sewer Outfall. A sewer outfall receives the discharge from the collecting system and conducts it to a treatment plant or point of final disposal.

Components of sewerage system

Components of sewerage system are :

a) Drain b) Manhole c) Pumping station d) Sewer

Drain: Is a plumbing fixture that provides an exit-point for waste water or water

Manhole: The opening or hole through which a man can enter the sewer line or other closed structure for inspection and cleaning

Components of sewerage system

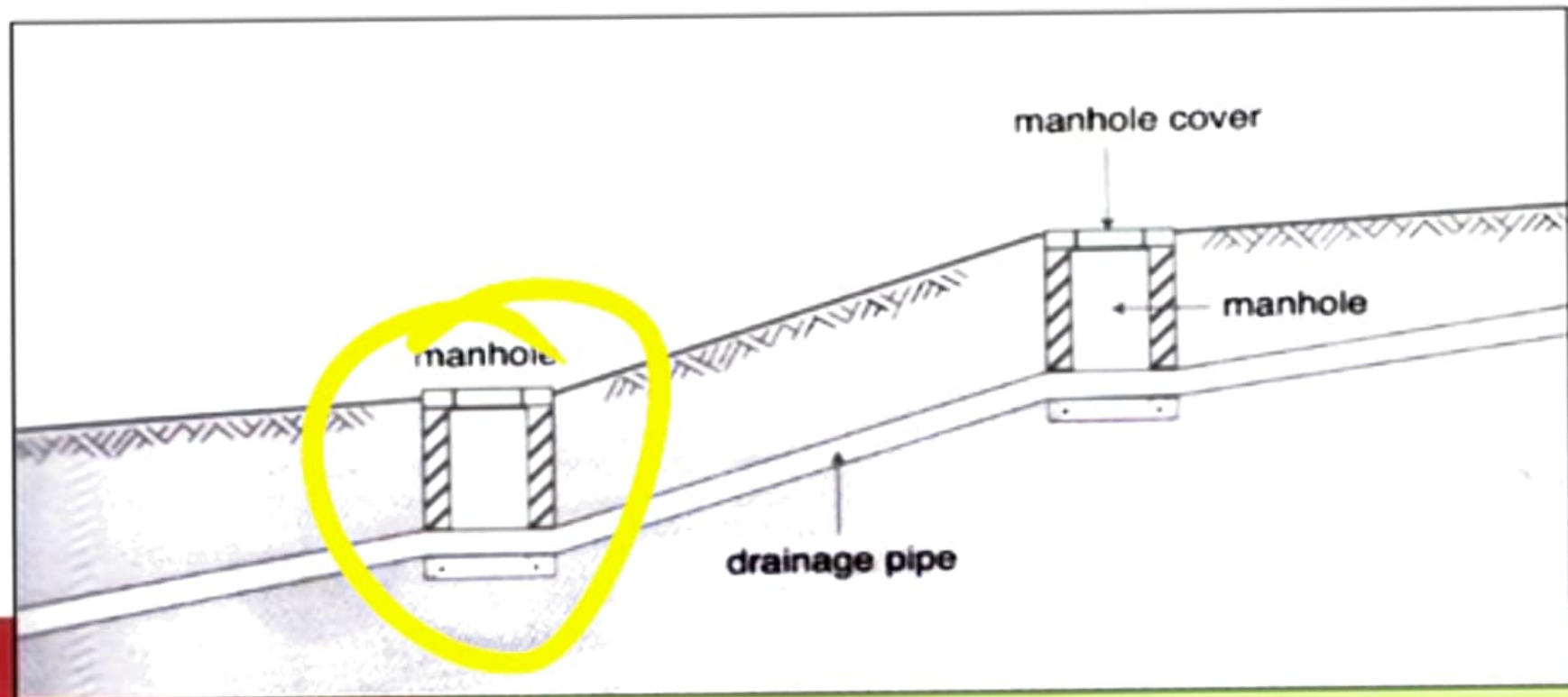
Pumping Station: Includes pumps & equipment's for pumping fluids.

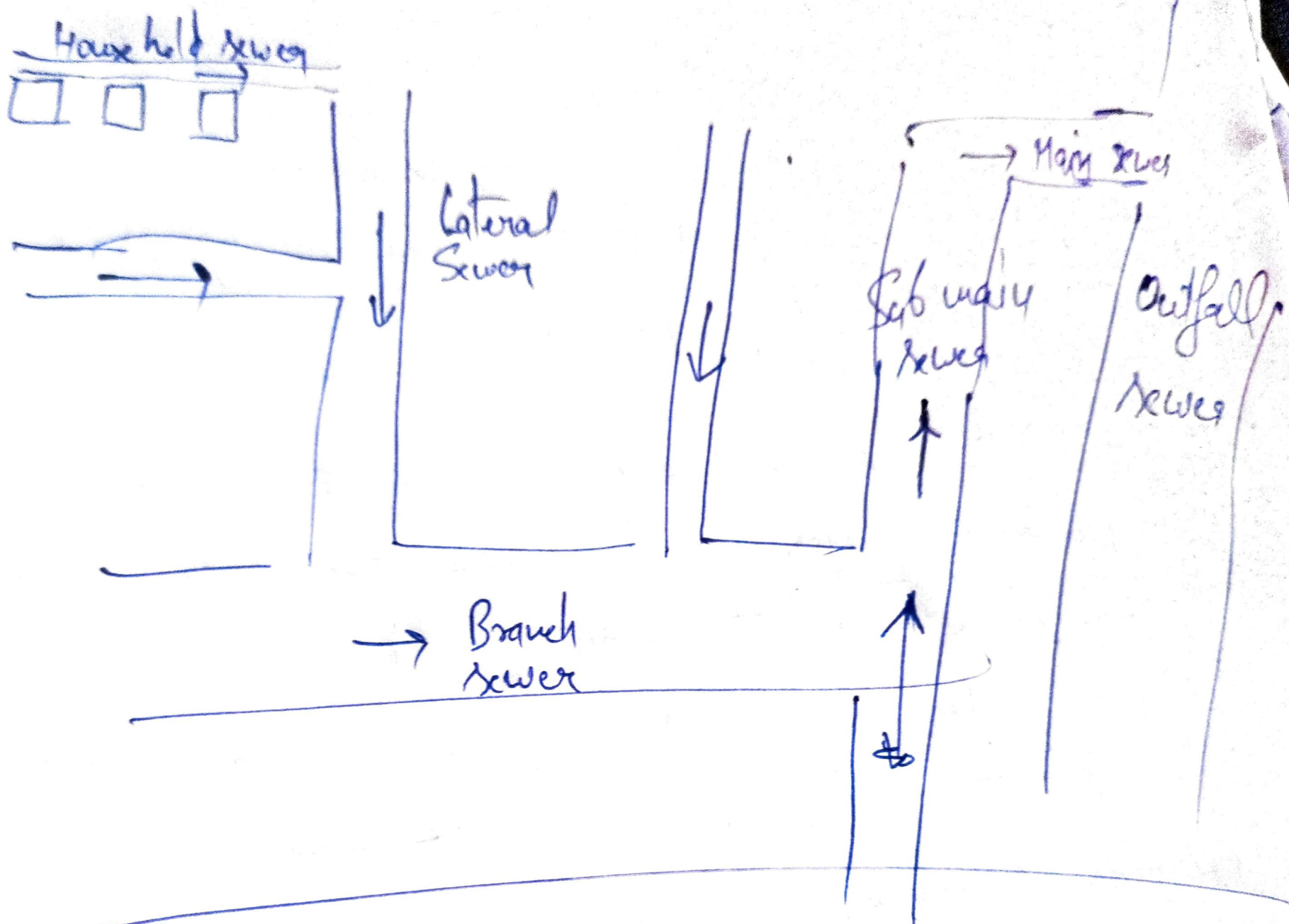
- Supplies water to remove sewage from processing site

Sewers : Conduit carrying the sewage mostly by gravity



Manholes





$$D_{H.S} < D_{L.S} < D_{B.S} < D_{S.M.S} < D_{M.S} < D_{outfall}$$

2.4. DRY-WEATHER FLOW (D.W.F.)

It is the flow of only sanitary sewage in the absence of storms in dry season generally expressed in litres per capita per day.

$$\text{DWF} = \text{Population} \times \text{per capita rate of sewage contributed per day}$$

or,

$$\text{DWF} = (\text{Density of population} \times \text{Area served by sewer}) \times \text{per capita rate of flow}$$

26. VARIATION IN DRY WEATHER FLOW

Dry weather flow depends on the quantity of water used and as the rate of water consumption is not constant in practice, there will be variation in dry weather flow also. The variation may be seasonal or monthly, daily and hourly.

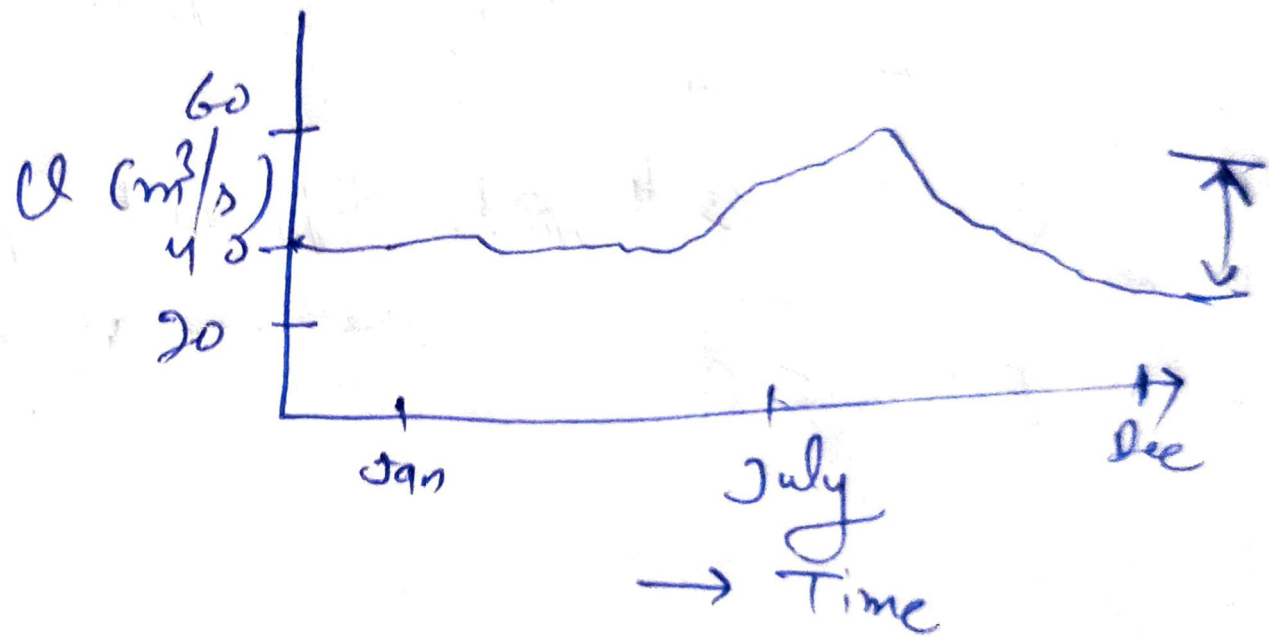
The *seasonal* variations are due to climatic effect. The consumption of water is more in summer than in winter and this change in consumption of water directly affects the quantity of sewage.

The *daily* variations are due to the local conditions, involving habits and customs of people. In India, the consumption of water is more in Sundays or other holidays as compared to working days due to cloth washing, house cleaning etc.

Variation of discharge :-

H.S > L.S > B.S > SMS > MS > Outfall

Seasonal Variation :-



* Sewers are designed for Max. hourly flow.

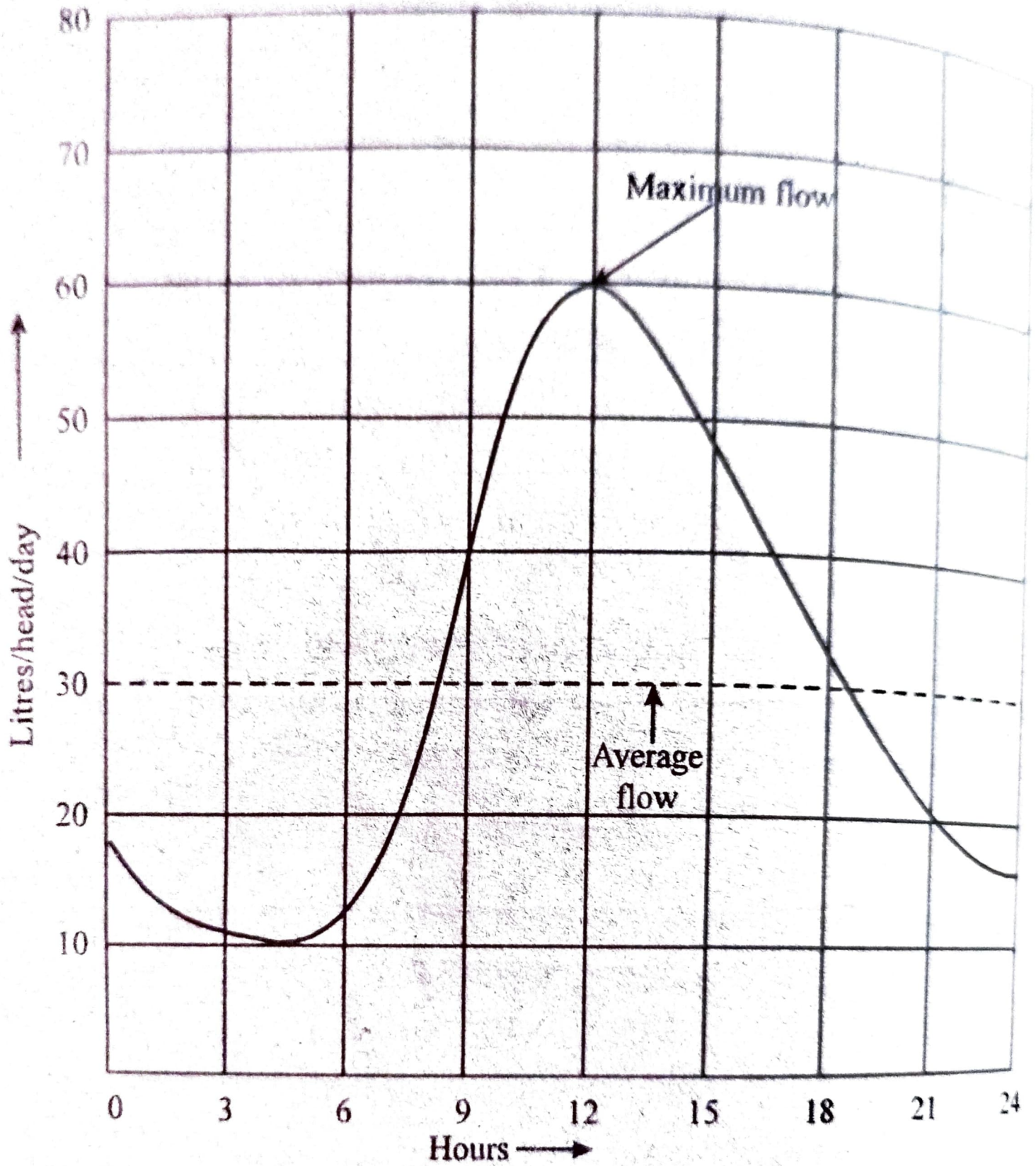


Fig. 2.1. Hourly variation in sewage flow.