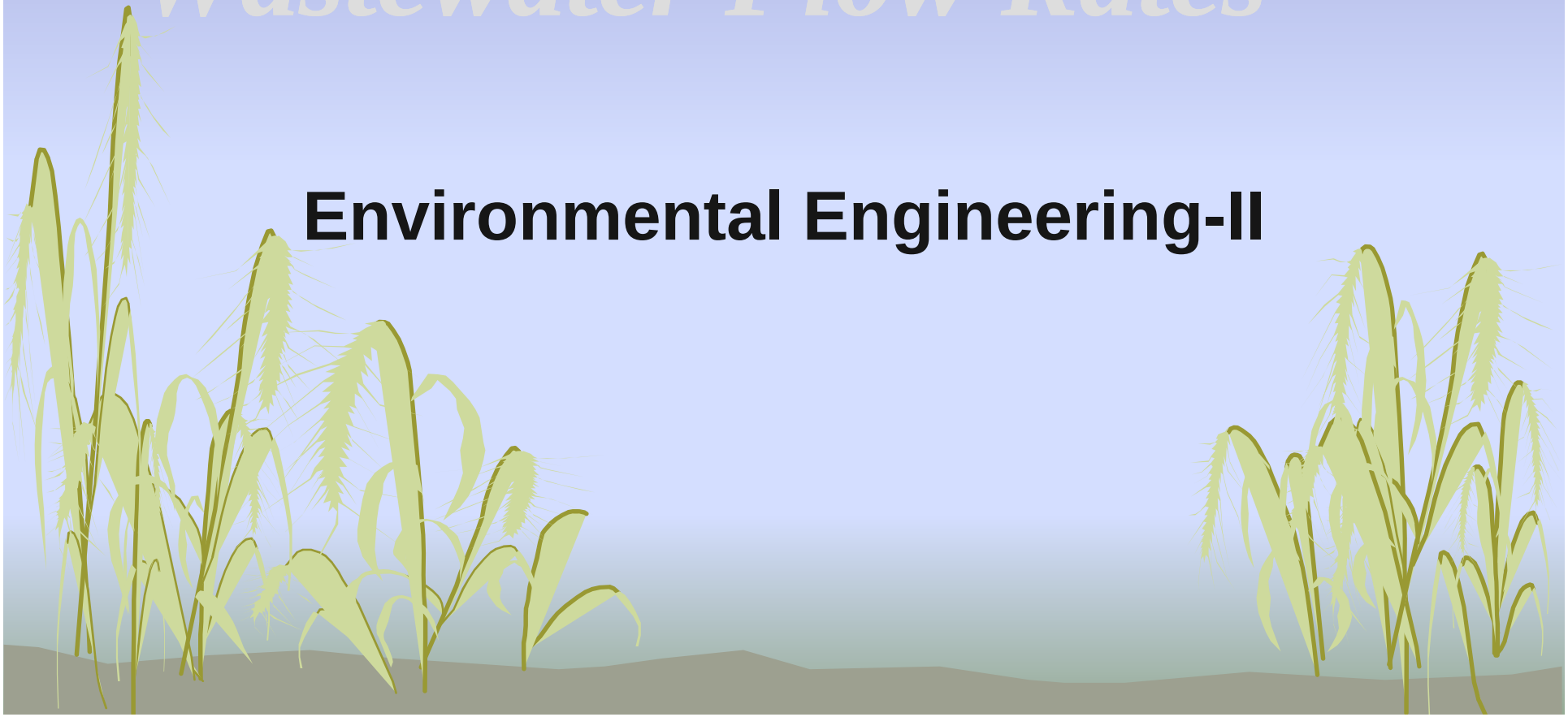
L-4

Wastewater Flow Rates



Environmental Engineering-II

Introduction

- In order to determine the section of the sewer, it is essential to know the total quantity of wastewater or sewage that would flow through the sewer.
- The total wastewater flow can be divided two components :

(a) **Dry weather flow (D.W.F.) and**

(b) **Storm water flow**

The dry weather flow (DWF)

- The *dry weather flow* is the flow through the sewers that would normally be available during **non-rainfall periods**.

It consists mainly of

(i) Domestic sewage and

(ii) Industrial wastewater

DRY WEATHER FLOW

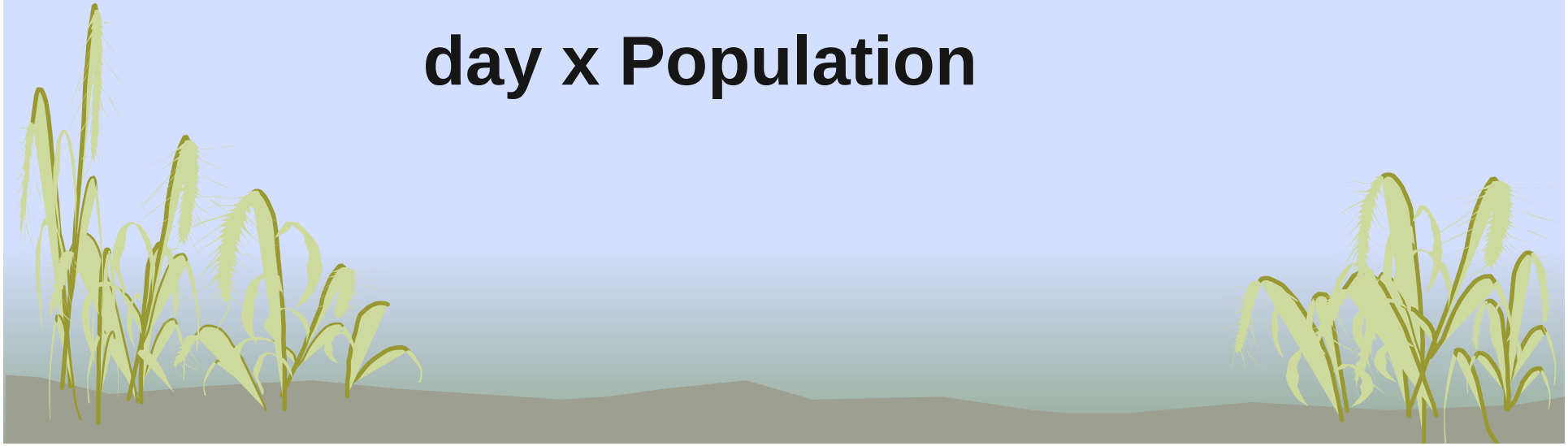
- It is that quantity of wastewater that flows through a sewer in dry weather when no storm water is in the sewer.
- The dry weather flow is also sometimes called as 'sanitary sewage', and is obtained from the following sources :

1. Domestic wastewater from houses- WCs, Baths, urinals, wash basins etc
2. Industrial waste water from industries
3. Wastewater from public facilities
4. Ground water infiltration

Wastewater Quantity Estimation

- The flow of sanitary sewage alone in the absence of storms in dry season is known as dry weather flow (DWF).

- **Quantity= Per capita sewage contributed per day x Population**



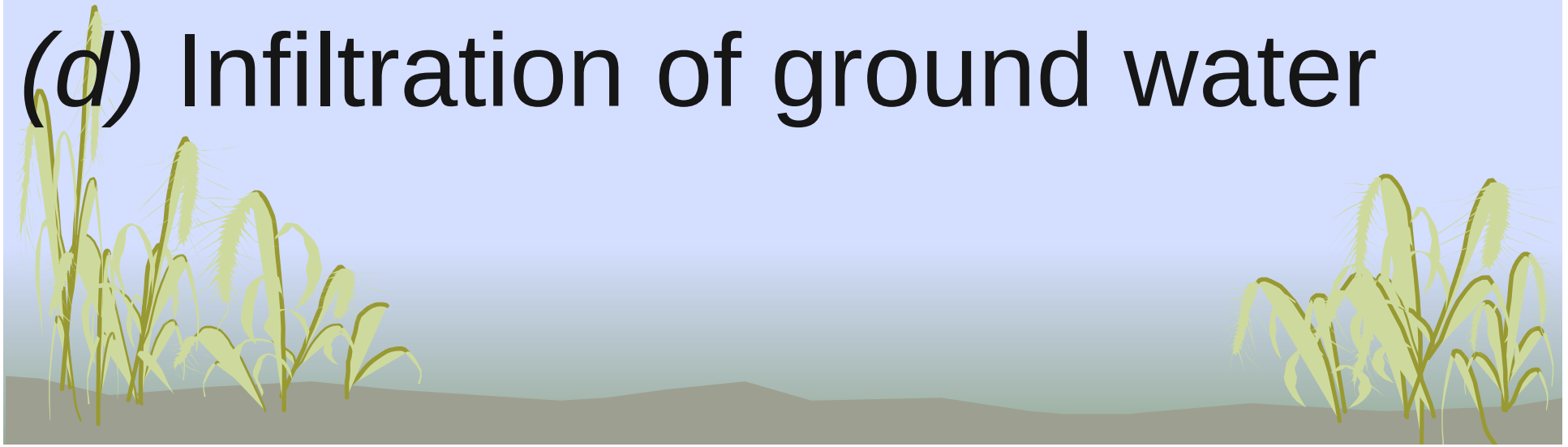
FACTORS AFFECTING DRY WEATHER FLOW

(a) Rate of water supply.

(b) Population growth.

(c) Type of area served

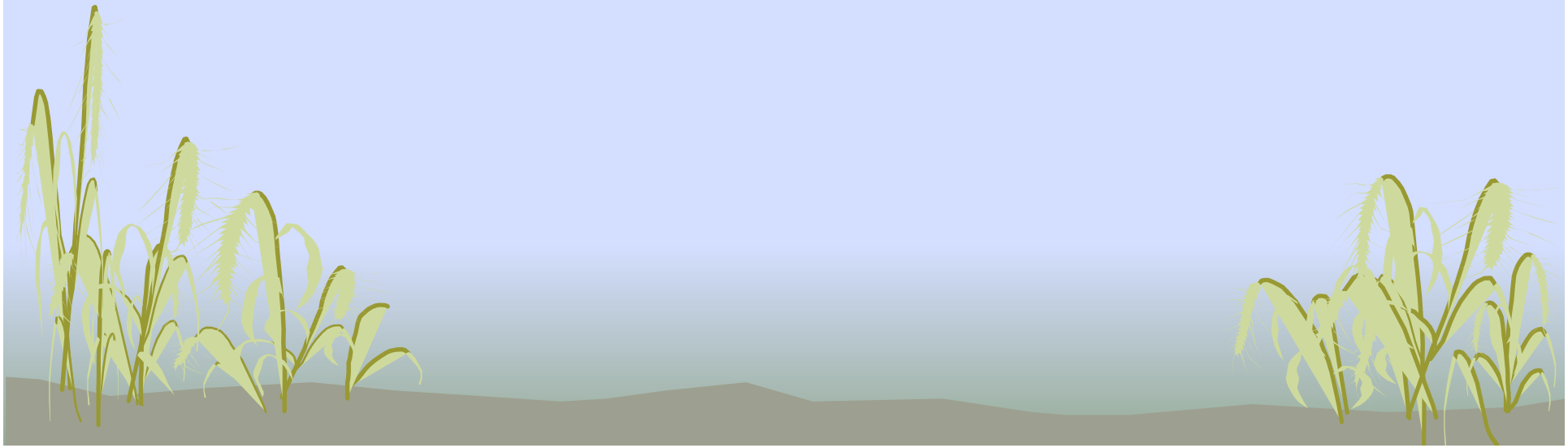
(d) Infiltration of ground water



a. Rate of water supply

- The quantity of wastewater produced from a community would naturally depend upon the rate of water supply per capita' per day. The quantity of wastewater entering the sewers would be less than the total quantity of water supplied.
- This is because of the fact that water is lost in domestic consumption *(i.e.* cooking etc.), evaporation, lawn sprinkling, fire fighting, industrial consumption etc.

- In general it is assumed that waste generation quantity is 80% of rate of water supply



b. Population Growth

- The various methods adopted for estimating future populations are given below. The particular method to be adopted for a particular case or for a particular city depends largely on the factors discussed in the methods, and the selection is left to the the designer.

- *Arithmetic Increase Method*
- *Geometric Increase Method*
- *Incremental Increase Method*
- *Decreasing Rate of Growth Method*
- *Simple Graphical Method*
- *Comparative Graphical Method*
- *Ratio Method*
- *Logistic Curve Method*

- In case the desired information on population is not available in the Master Plan of the town, the densities given in following Table may be adopted as suggested by the Manual on Sewage and Sewage Treatment prepared by the Public Health and Environmental Engineering Organisation

Sizeo/Town (Population)	*Density / population per hectare*
l. Upto 5000	75 -150
2. 5000 - 20,000	150-250
3. 20,000 - 50,000	250-300
4. 50,000 to 100,000	300-350
5. Above 100,000	350-1000

Effect of growth of population

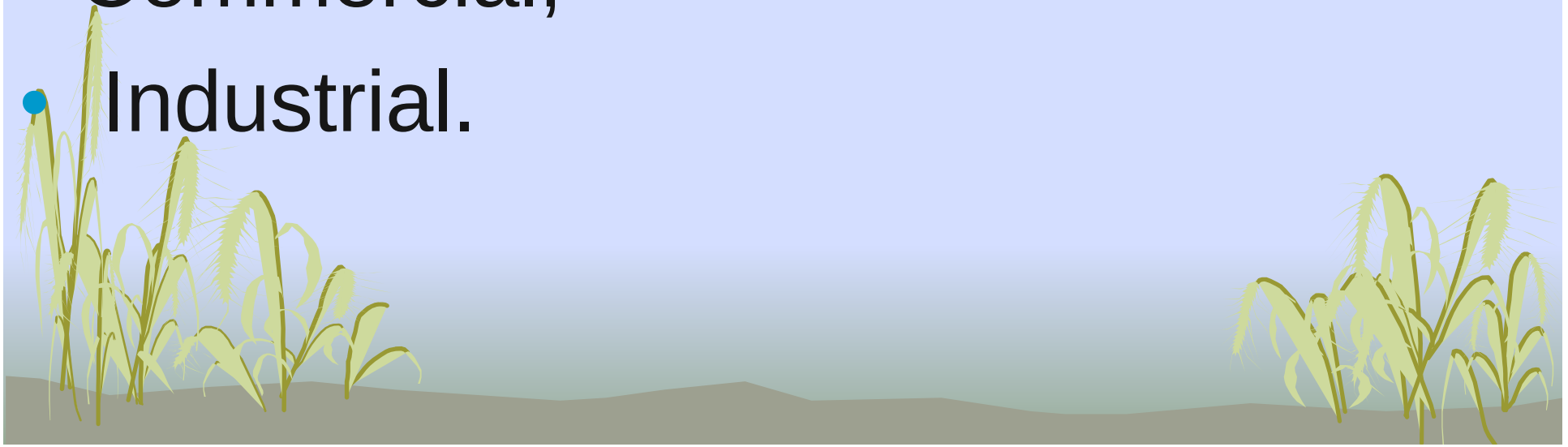
Population	***Rate of water supply lit./capita/day***	***Sewage production lit/capita/day***
Below 2 lacs	**130-160**	**110-120**
2 to 5 lacs	**160-180**	**130-140**
5 to 10 lacs	**180-200**	**150-170**
More than 10 lacs	**200-250**	**I80-200**

Design period as per CPHEEO manual

1. Branches of sewer – 30 years
2. Pumping stations – 30 years
3. The treatment plant - 30 year
4. Pumping machinery – 15 years
5. Effluent disposal and utilisation – 30 years

c. Type of area served.

- The quantity of wastewater produced depends upon whether the area to be served is
- Residential,
- Commercial,
- Industrial.



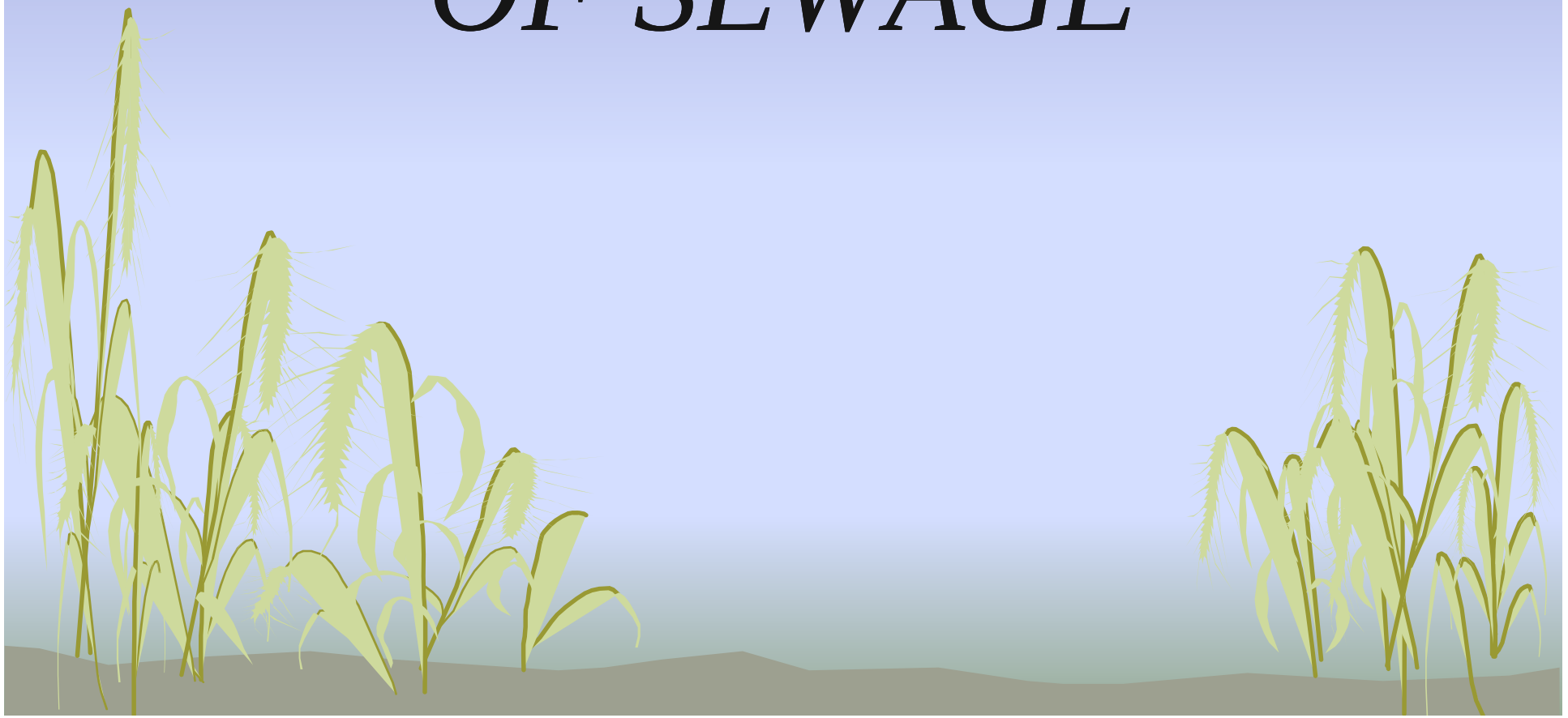
- The wastewater from the residential area directly depends upon the rate of water supply. If there is no infiltration of water in the sewers, and if there are no private sources of supply.
- The wastewater produced from the residential area may be assumed to be equal to 70 to 80% of the water supplied through the public supply system

- The amount of waste water produced from the industrial locality depends upon the types of industries and their corresponding industrial processes.
- The same is the case with the commercial un-dertakings. The sewage flow rates can be determined after careful study of the various process involved.

d. Infiltration of sub-soil water

- Ground water or subsoil water may infiltrate into the sewers through the leaky joints. *Exfiltration* is the reverse process which indicates the flow of wastewater from the sewer into the ground.
- While due to the infiltration the quantity of flow through sewer increases, exfiltration results in decrease in the flow and consequent increase in the pollution of ground water. Both infiltration as well as exfiltration are undesirable and take place due to imperfect joints.

VARIATIONS IN RATE OF SEWAGE



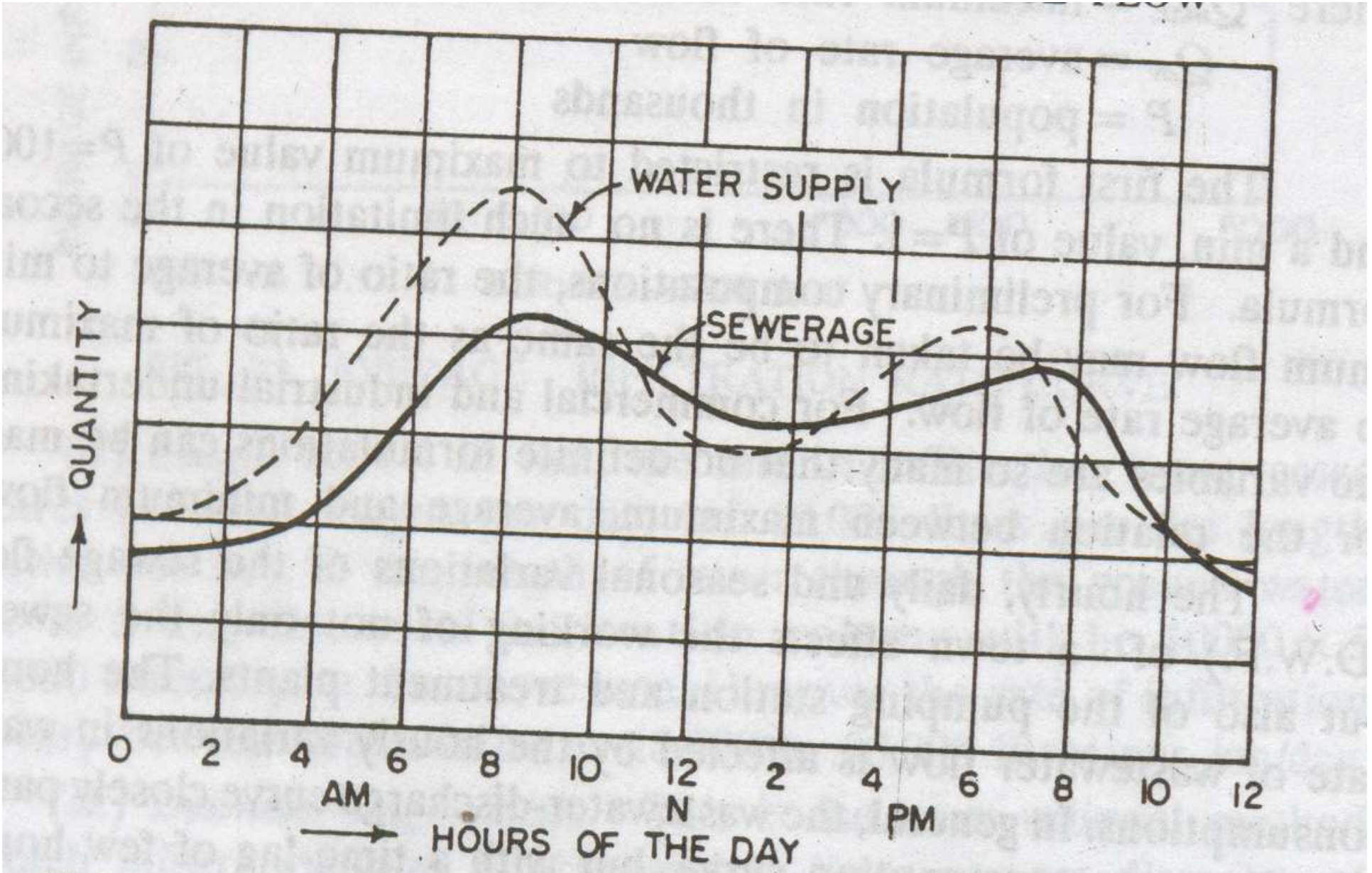


FIG. 3.3. SEWAGE FLOW VARIATIONS WITH RESPECT TO WATER SUPPLY

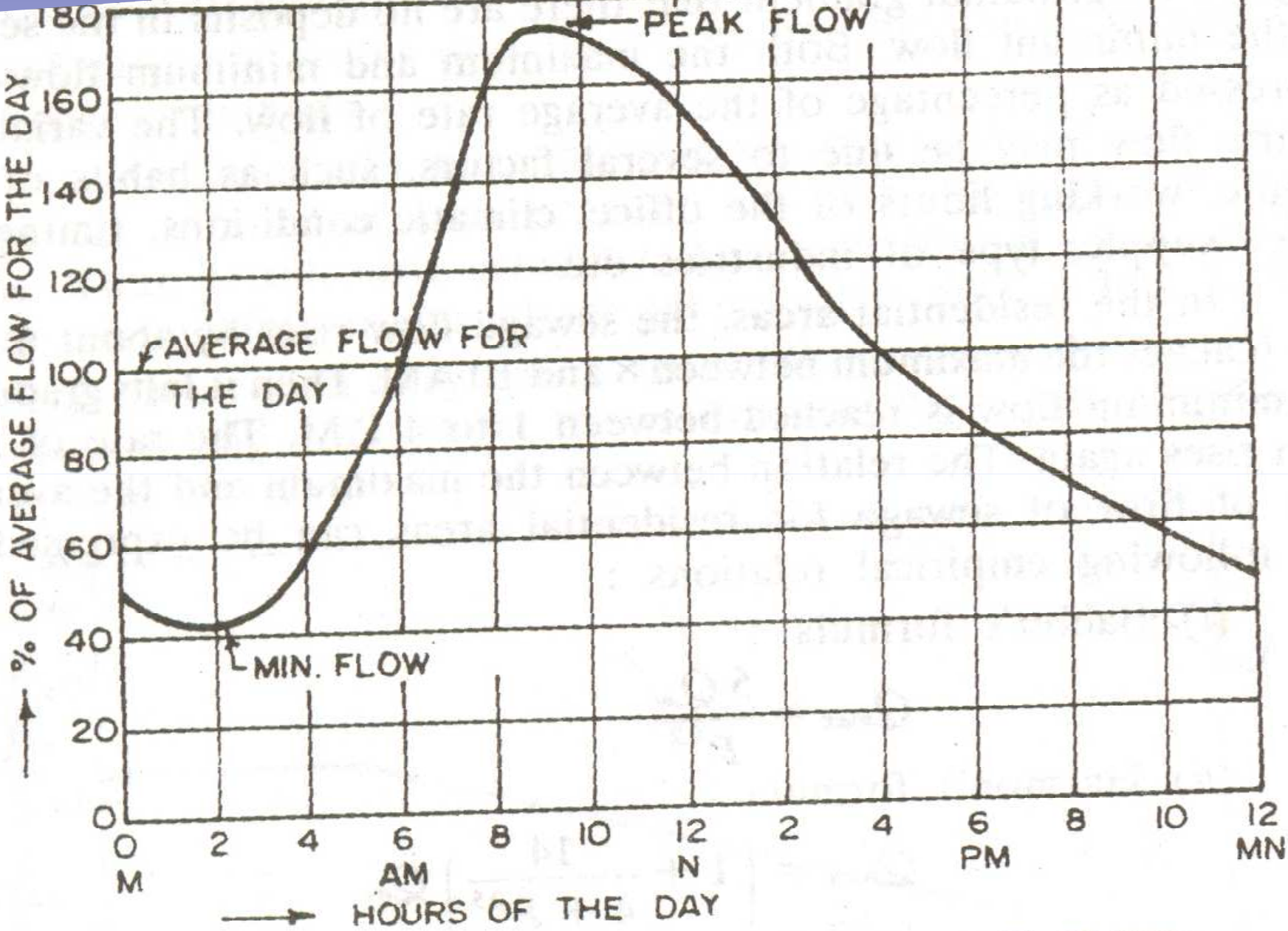
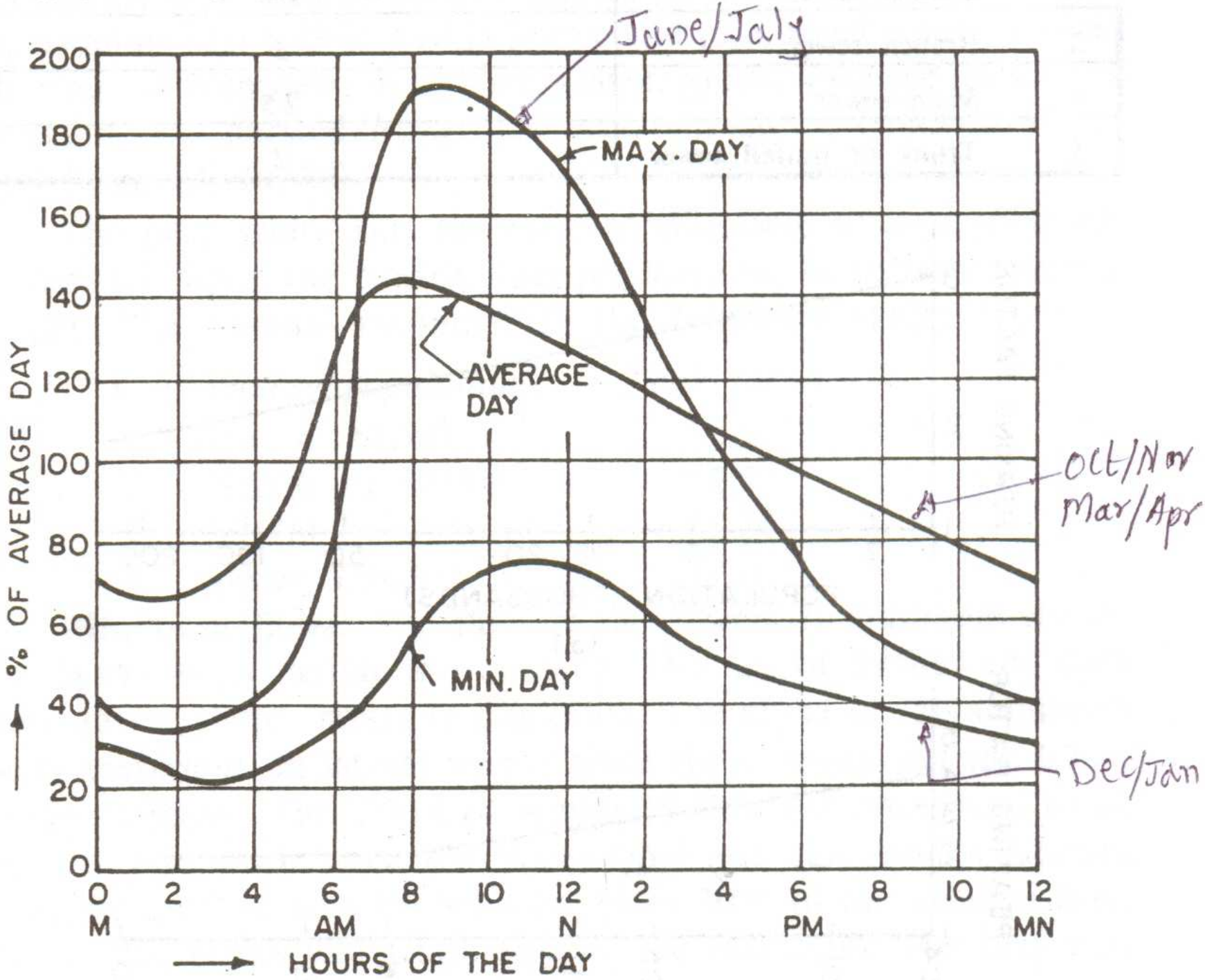


FIG. 3.2. HOURLY VARIATIONS OF SEWAGE FLOW


June/July
MAX. DAY
AVERAGE DAY
MIN. DAY
Oct/Nov
Mar/Apr
Dec/Jan
% OF AVERAGE DAY
200
180
160
140
120
100
80
60
40
20
0
0 2 4 6 8 10 12 2 4 6 8 10 12
M AM N PM MN
HOURS OF THE DAY

Peaking factors

Contributory population	***Peak factor***
Up to 20,000	**3.0**
20,000 to 50,000	**2.5**
50,000 to 750,000	**2.25**
above 750,000	**2.0**

TABLE 3.3. PEAKING FACTORS OF SEWER DESIGN

Sewer	Factor to multiply average rate of annular flow
1. Domestic sewer	6
2. Lateral sewer	4–6
3. Branch sewer	3
4. Main sewer	2.5
5. Trunk or outfall sewer	2

Objective Questions

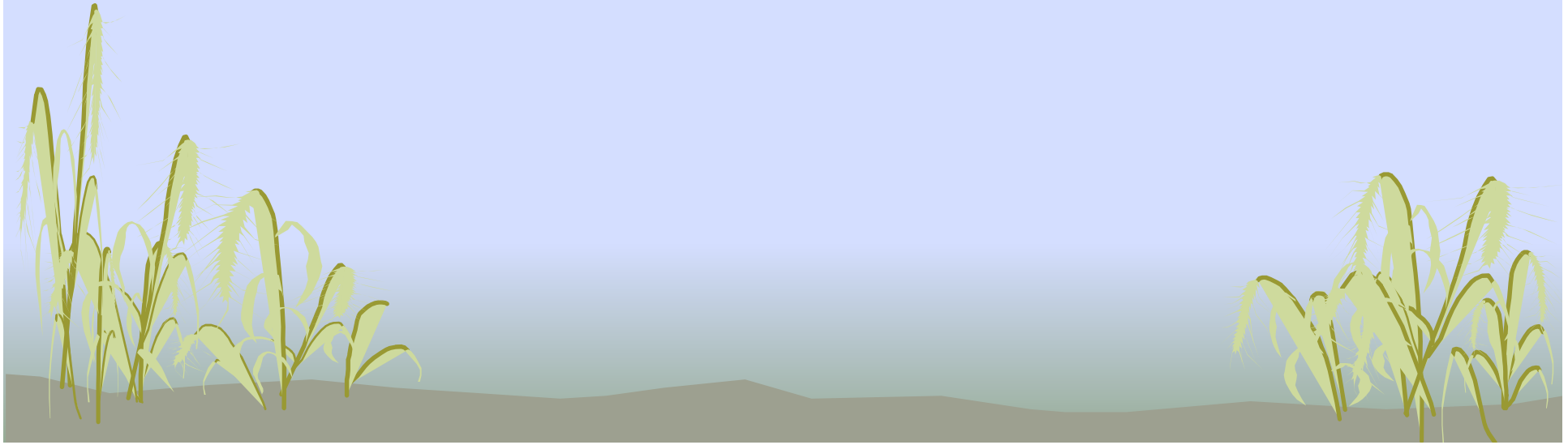
1. DWF is the flow in sewers available in _____ periods. (rainy/non rainfall/both a and b/none of these).
2. Pumping machinery is designed for period ____ years (10/15/20/30). (**)
3. For a town having population 1,00,000 the density of population considered is _____ people/hectare (50-100/100-150/150-200/200-250).
4. For population of 5 to 10 lacs the sewage production is _____ lpcd (110-120/130-140/150-170/180-200)

5. The design period of branch sewer is _____ years. (15/30/20/25). (**)
6. For town having population 50,000 to 100000 the density of population per hectare is _____.(50-100/75-100/110-120/120-150).
7. For design of sewers the peak factor for population above750000 is considered as ___.(2/2.25/2.5/3.5)
8. For town having population 5000 the density of population per hectare is _____.(50-75/75-150/100-200/200/300)

9.For population of below 2 lac rate of water supply is _____lpcd. (100-130/150-170/130-160/180-200)

10 For population of 2 to 5 lacs the sewage production is _____ lpcd (110-120/130-140/150-170/180-200)

11. For population of upto 20000 the peak factor is ____. (2.5/3.0/3.5/4.0)



Theory Questions

Q1. Explain any two factors affecting DWF. *(Nov 2010, 5 marks)*

Q2. What is DWF? Explain any four factors affecting DWF. *(Nov 2010 old, 8 marks)*