SEWAGE TREATMENT AND DISPOSAL

QUANTITY OF SANITARY SEWAGE AND STORM WATER

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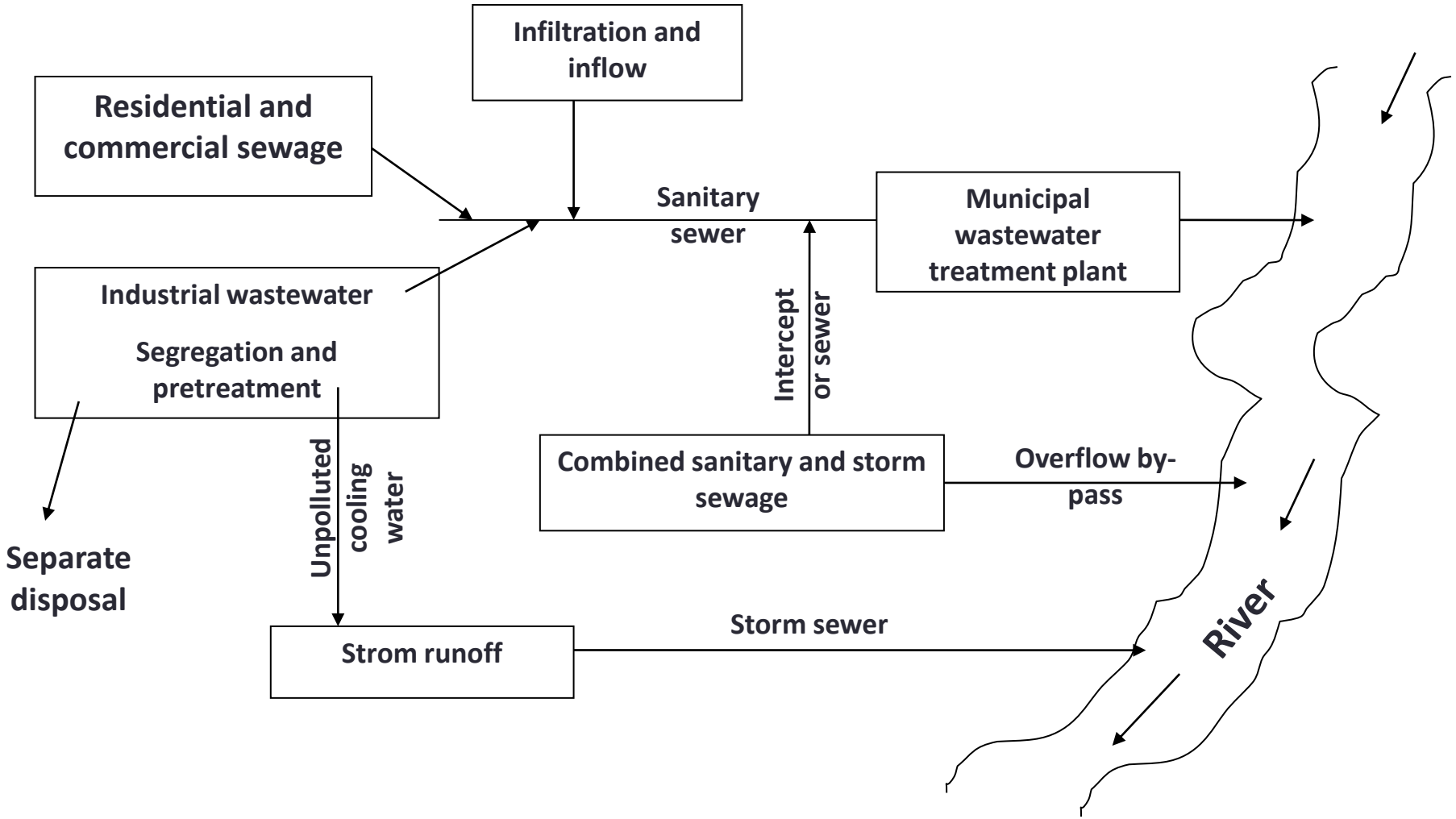
Sources of Sewage



Sources and quantities of sewage

- ***Domestic sewage***
  - From residential and commercial districts
  - Other sources include institutional and recreational facilities.
  - **The net quantity** = accounted water supplied + unaccounted private water supplies + infiltration – (water losses + water not entering the sewerage)
  - 70 to 130 percent of accounted water supplied

Sources and quantities of sewage

- ***Industrial waste water***
  - without internal reuse: 85-95% of the water used will probably become wastewater.
  - with internal water reuse → separate estimates must be made.
  - Average wastewater may vary from 30 - 95 l/capita/d.

Infiltration and Infow

- ***Infiltration:*** *groundwater entering sewers through defective joints, and broken or cracked or broken pipes and manholes.*
  - High during wet period, especially sewers constructed in or close to streambeds
- ***Inflow.*** *The water discharged into a sewer system, including service connections from such sources as roof downspouts; basement, yard, and area drains; manhole covers; surface runoff; street wash water; etc.*
  - Units: L/ha/day, L/km length, or L/cm diameter
  - Quantity may vary from 35 to 115 m^3/km.

Factors affecting Infiltration

- Depth of sewer invert below GWT
- Sewer size
- Material of the sewers
- Sewer length under GWT
- Nature and type of soil
- Type of joints
- workmanship

Factor affecting sanitary sewage

- Infiltration and ex-filtration
- Rate of water supply
- Population
- Type of area served i.e. residential, industrial or commercial
- Effect of growth of population on per capita production of sewage

Fluctuations in sewage flow

- The magnitude of the peak flow relative to the mean flow depends on the size of the contributing population;
- The larger the population, the lower the peaking factor since flow fluctuations are smoothed out during the time of travel in the sewer.
- The overall variation in the sewage is maximum in the smaller size sewers than large sizes.

Fluctuations in sewage flow

Types of Sewer	Ratio of Max/Avg flow
Small size sewers including laterals	4
Sewers up to 25 cm in diameter	4
Branch sewers up to 50 cm in diameter	3
Main sewers up to 100 cm in diameter	2
Trunk sewers up to 125 cm in diameter	1.5

Storm Sewage

- During rainfall, a part of rainfall water percolates into the ground and a part is evaporated in the atmosphere.
- The remaining part flows over the ground surface and is termed as surface run off, flood water, or storm water or storm sewage.
- Quantity of storm water depends on the following factors
  - Intensity and duration of rainfall
  - Nature of the surface over which rainfall takes place or nature of the catchment

Quantity Storm Sewage

- **Peak discharge:** sometimes called peak flow, is the maximum rate of flow of water passing a given point during or after a rainfall event.
- Hydrological analysis: Rational method, the SCS technique, hydrograph technique and computer simulation techniques
- Peak flow is calculated for an acceptable return period based on risk and economy

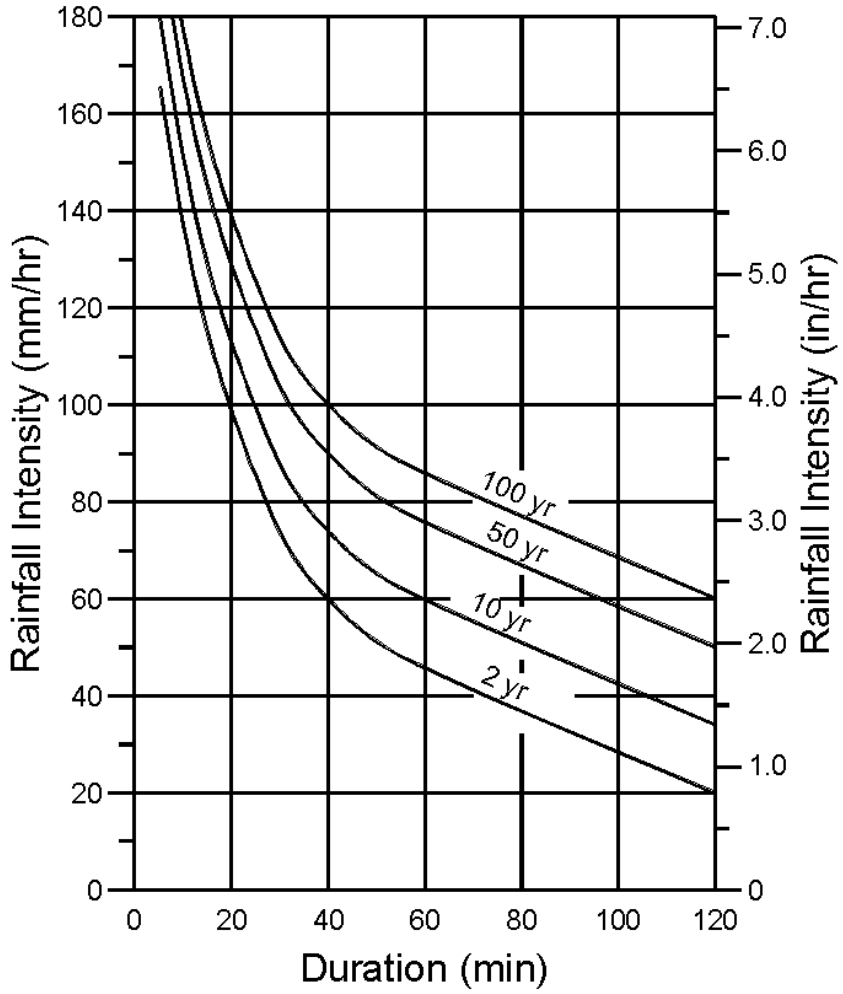
Frequency and risk

- The frequency with which a given flood can be expected to occur is the reciprocal of the probability or chance that the flood will be equaled or exceeded in a given year.
- The probability of occurrence of an event (say a flood of magnitude equal to or greater than *X*1) is expressed as:

$$P\{X1\} = N1/N$$

- The return period is then the reciprocal: $Tr = 1/P\{X1\}$

Constant Rainfall Intensity



IDF Curve

Example 1

- Calculate the estimated sanitary sewage for the following data
- Population to be served: 25,000
- Per capita sewage generation: 100 L/day
- Sewer length: 5.6 km
- Infiltration rate: 75 m^3/km
- **Solution**
- Average daily flow (Q) = 25,000 x 100 = 2500000 L/day = 2500 m3/day
- Assume peak flow (Q_p) = 3Q = 3 x 2500 = 7500 m^3/day
- Infiltration = 5.6 x 75 = 420 m^3/day
- Design Flow = 7500 + 420 = 7920 m^3/day

Examples 2: Design flow for sewer

A 40 hec drainage basin containing 24 hec net residential area with average 5 dwelling units per hec with 4 residents, and 16 hec zoned commercial area. Determine the design flow for a sewer servicing this area.

Take wastewater generation for

Residential = 300 l/capita/day

Commercial = 1800 l/hec/day

Peak I & I allowance = 9000 l/hec/day

Example 1 solution

- ADF for residential area

  (24 hec x 5 DU/hec x 4 Res./DU x 300 l/Res) = 144m^3/day

- ADF for commercial area

  (16 hec x 1800 l/Hec) = 288 m^3/day

- ADF from Res. And Comm. area

  = 144 m^3/day + 288 m^3/day = 432 m^3/day

- Calculate peaking factor

  PF= 15.05 $Q^{-0.167}$ =15.05x $(432)^{-0.167}$ = 5.45

- Calculate PDF

PDF = 5.45 x 432 + I & I = 2354.4 + 9 x40=2714.4 m^3/day

= 0.0314m^3/sec = 1.885 m^3/min

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