SEWAGE DISPOSAL
AND
TREATMENT
HENG 3141
DEPARTMENT OF COTM

2020

Chapter 1

Introduction to wastewater

1.1 General

Definition of Wastewater

- Wastewater is water that has come into contact with any of a variety of contaminants and is not fit for human consumption.

- From the stand point of sources of generation , wastewater may be defined as a combination of the liquid or water carried wastes removed from residences , institutions , and commercial establishments together with such groundwater, surface water , and storm water as may be present (Metcalf and Eddy, 2007).

Objectives of Wastewater Treatment

- is to mitigate against the ill effects of wastewater constituents through the application of basic principles of science and engineering in a manner proportional with environmental, economical , social and political concerns.

✓ Ensure good water quality in natural environment

✓ Remove pollutants most efficiently and economically

- ✓ Avoid or minimize other environmental impacts like:
  - solid disposal
  - gas emission
  - Odour creation
  - noise generation

- ❖ Another important aim is to recover energy, nutrients, water and other valuable resources from waste water

Important Terminologies

1. Refuse:-

It is a rejected or worthless wastes. It may be in liquid, semi liquid or solid form. It is divided into 6 categories.

i. Garbage
ii. Rubbish
iii. Sullage
iv. Sewage
v. Subsoil water
vi. Storm water

i. Garbage:

It indicates dry refuse. It includes waste paper, decayed fruits, vegetables, grass and leaves……

ii. Rubbish :

It indicates solid waste from office, residence and other buildings.

iii. Sullage :

It indicates wastewater from bath rooms, kitchens, washing places and wash basins etc…

iv. Sewage:

is defined as the liquid portion of waste produced in residences, commercial establishments, and institutions; discharged from industries, it may or may not be mixed with any surface, subsurface or storm water.

v. Sub soil water:

It is the ground water that finds it entry into sewers through leaks.

vi. Storm water:

The surface runoff derived during and immediately after a storm rainfall event and joins the sewers or drains through inlets.

2.Sewer:- refers to a conduit or channel intended to convey sewage.

3.Contaminant:- any constituent in the water deleterious to a particular end use regardless of its origin and whether it occurs in the watershed, source or in a water supply system

4.Pollutant: - any constituent in the water source deleterious to a particular end use that is of anthropogenic origin

Pollutant = subset of contaminant

5.Drain:- refers to a line of pipes including all fittings and equipment's such as man-holes, gullies and floor traps, used for the drainage of buildings or a number of buildings or yard including open channels used for conveying surface water.

6. Sewerage system:- is the system installed for the collection, treatment and disposal of liquid wastes. Sewerage works or sewage works include all the physical infrastructures required for the collection, treatment and disposal.

Where does the wastewater come from?

2 main categories:

1. Sanitary Wastewater: Wastewater from residential, commercial, institutional and industrial sources.
2. Storm water Runoff: roofs, and other impervious surfaces.

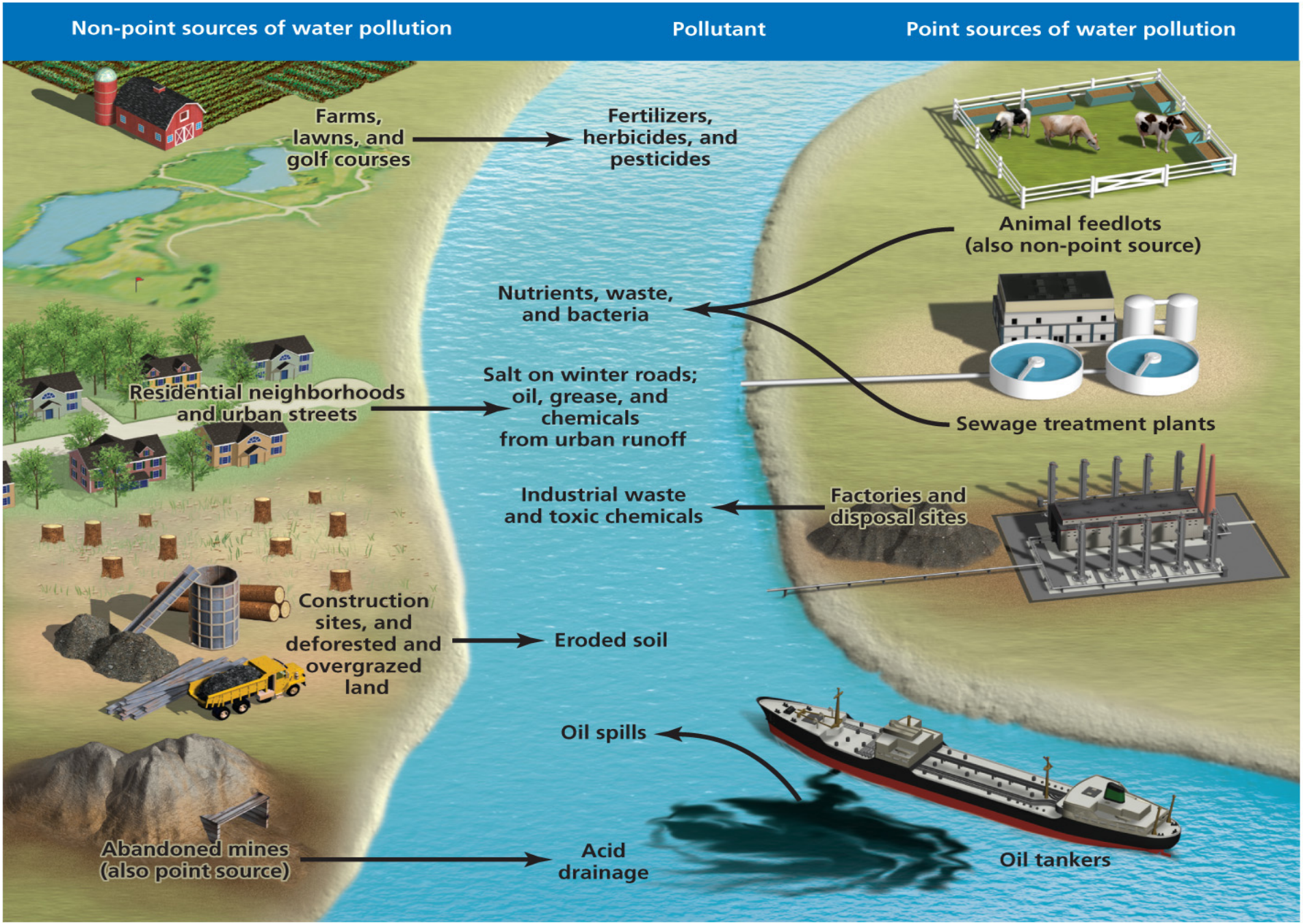
✓ Domestic Wastewater: from Residences, Institutions: hospitals, school, commercial establishments

✓ Industrial WW: Industrial waste Predominate

✓ Infiltration/Inflow:

- *Infiltration:* extraneous water entering wastewater system through cracks, joints…breaks
- *Inflow:* storm water that enters sewer from storm drain connections…

✓ Storm Water: Runoff from rainfall…..snow melt



❖Infiltration to Sanitary Sewer Systems

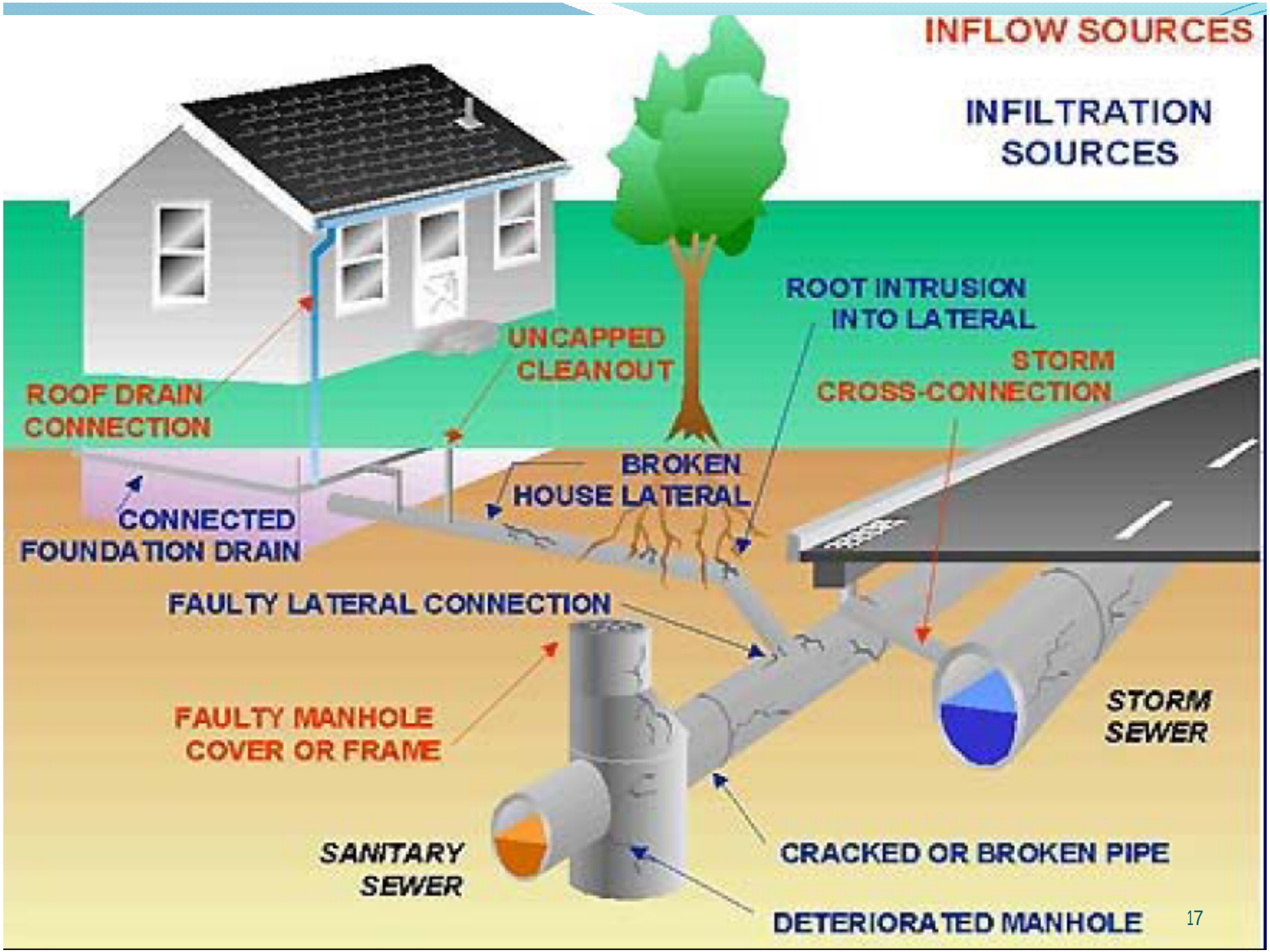
Groundwater/percolating water in the subsurface entering a sewer system through:

- Defective pipes
- Leaking pipe joints
- Poor connections
- Cracked manhole walls – etc.

❖ Inflow to Sanitary Sewer Systems

Water entering a sewer system from surface sources such as:

- Leaking manhole covers
- Directly connected roof gutters
- Cellar or foundation drains
- Cross connections from storm drains and combined sewers
- Yard and area drains
- Cooling-water discharges
- Drains from springs and swampy areas
- Street wash water, Etc.


INFLOW SOURCES
INFILTRATION SOURCES
ROOT INTRUSION INTO LATERAL
UNCAPPED CLEANOUT
STORM CROSS-CONNECTION
ROOF DRAIN CONNECTION
BROKEN HOUSE LATERAL
CONNECTED FOUNDATION DRAIN
FAULTY LATERAL CONNECTION
FAULTY MANHOLE COVER OR FRAME
STORM SEWER
SANITARY SEWER
CRACKED OR BROKEN PIPE
DETERIORATED MANHOLE

What will happen if untreated wastewater is allowed to accumulate?

1. *The decomposition of the Organic materials it contains can lead to the production of large quantities of malodorous gases.*
2. *Untreated wastewater usually contains numerous pathogenic or disease causing microorganisms that dwell in the human intestinal tract or that may be present in certain industrial waters.*
3. *It also contains 'nutrients' NO3 and NO2, which can stimulate the growth of aquatic plants, and may contain toxic compounds, e.g., Eutrophication of lakes.*

- *Therefore, the immediate and nuisance free removal of wastewater from its source of generation, followed by treatment and disposal, is not only desirable but also necessary.*

Some Facts of Global sanitation

- 2.6 – 3 billion peoples live without proper sanitation
- Over 2 million people die annually only to diarrhea
- Every day 6000 children die to diarrhea related diseases
- WHO and UNICEF , access to clean water and sanitation cost approximately 9 billion USD annually (2005 - 2015)
- cost of global armament (weapon) (780 billion USD annually),
- cost of alcohol and cigarette consumption in Europe 155 billion USD annually
- cost of ice-cream consumption in Europe (11 billion USD)

Sustainable wastewater management requires knowledge of

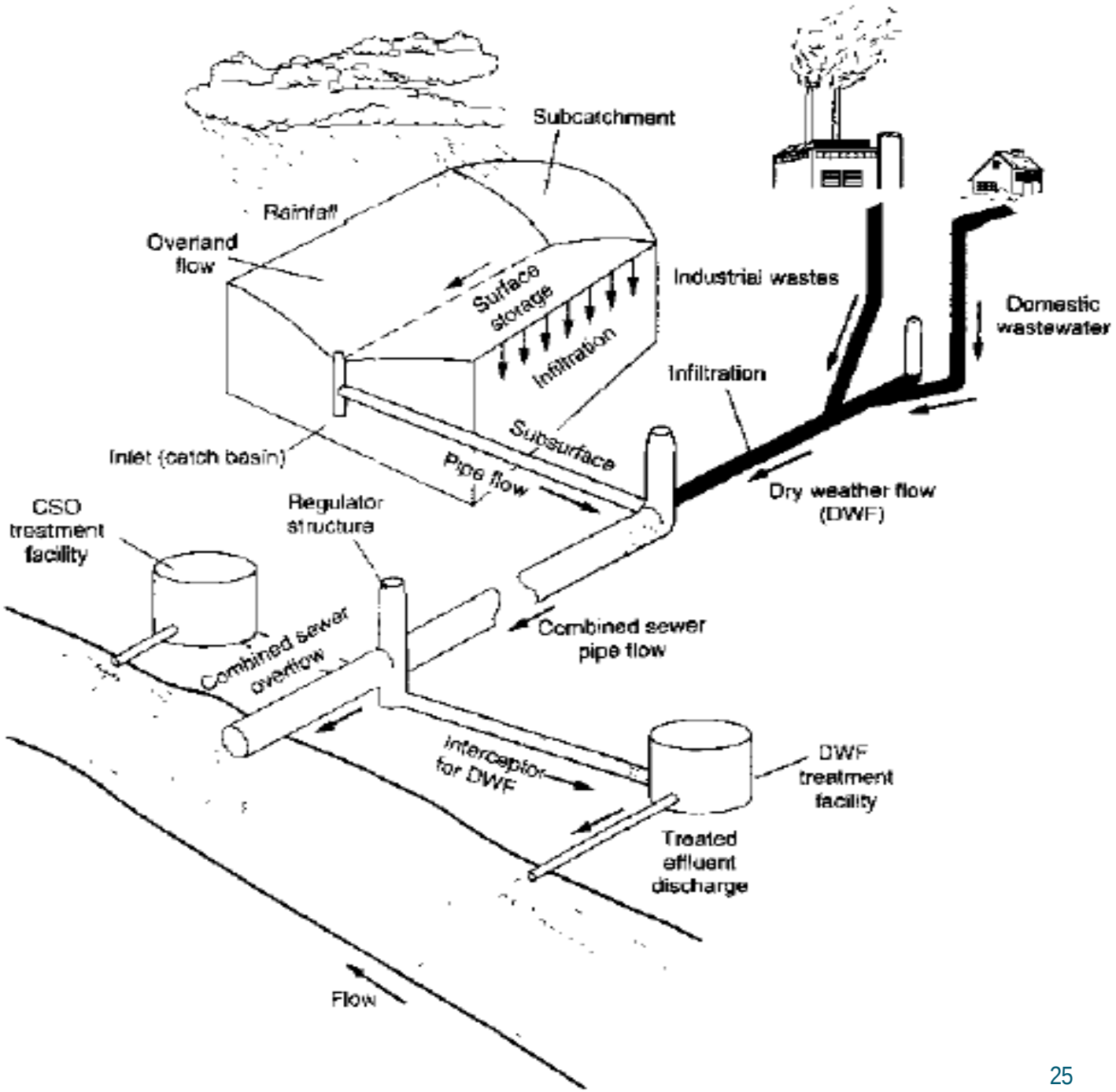
- Constituent's of concern in wastewater
- Impacts of these constituents when wastewater is disposed in to the environment.
- The transformation and long-term fate/consequence of these constituent's in treatment processes
- Treatment methods that can be used to remove or modify the constituent found in wastewater, and
- Methods for beneficial use or disposal of solids generated by the treatment systems

Sewage Project

- After the installation of water supply scheme, the sanitary project is installed.
- The purpose of sanitary project is to drain stale water.
- Sanitary projects are very costly and it is usually challenging to install them at once; hence, they are normally executed in a stage by stage basis. i.e. only a volume work that can be completed by the available fund should be installed at a time
- 1850s:-Engineer Chesborough designed the first comprehensive sewage system in Chicago.

Figure 1–1

Schematic diagram of a wastewater management infrastructure.



Sewage Project cont'd…

The following are some points to be considered in any public sewage project:

- Population of the city to be served,
- Available funds for the project,
- Quality of sewage to be handled,
- Rainfall in the locality,
- Rate of sewage expected to be available,
- Source of Sewage,
- Existing arrangement of disposal,
- Topographic features of the area,
- Treatment methods, and
- Future development trend of the city.

1.2 Waste Water Collection Methods

- The collection and conveyance of Waste water from where it is generated is the first step in effective management of community waste water
- **Type of Waste Water Collection System**

1. **Sanitary(Separate) Wastewater**: Wastewater from residential, commercial, institutional and industrial sources.
2. **Storm water Runoff :** Wastewater resulting from rainfall running off streets, roofs, and other impervious surfaces.
3. **Combined WWCS:** Sanitary + Runoff

Types of Sewer Pipes in a Typical Separate Sanitary Collection System

- Sanitary sewers must be laid near all occupied buildings in order to collect wastewater.
- Based on the function of sewers the principal type of sewers found in most of the collection system are:

❑**Building Sewer**: Connects the building plumbing to the public sanitary wastewater collection system.

- ❖Convey wastewater from the buildings to lateral or branch sewer, or any other sewer except another building sewer.
- ❖Normally begins outside the building foundation

Lateral or Branch Sewer:

- Forms the first element of a wastewater collection system.
- Usually in streets or special utility basements.
- Used to collect wastewater from one or more building sewers and convey it to a main sewer.

Main Sewers:

- Main sewers are used to convey wastewater from one or more lateral sewers to trunk sewers or to intercepting sewers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- **Trunk Sewers:** Trunk sewers are large sewers that are used to convey wastewater from main sewers to treatment or other disposal facilities, or to large intercepting sewers.

- **Intercepting Sewer:** Intercepting sewers are large sewers that are used to intercept a number of main or trunk sewers and convey the wastewater to treatment or other disposal facilities

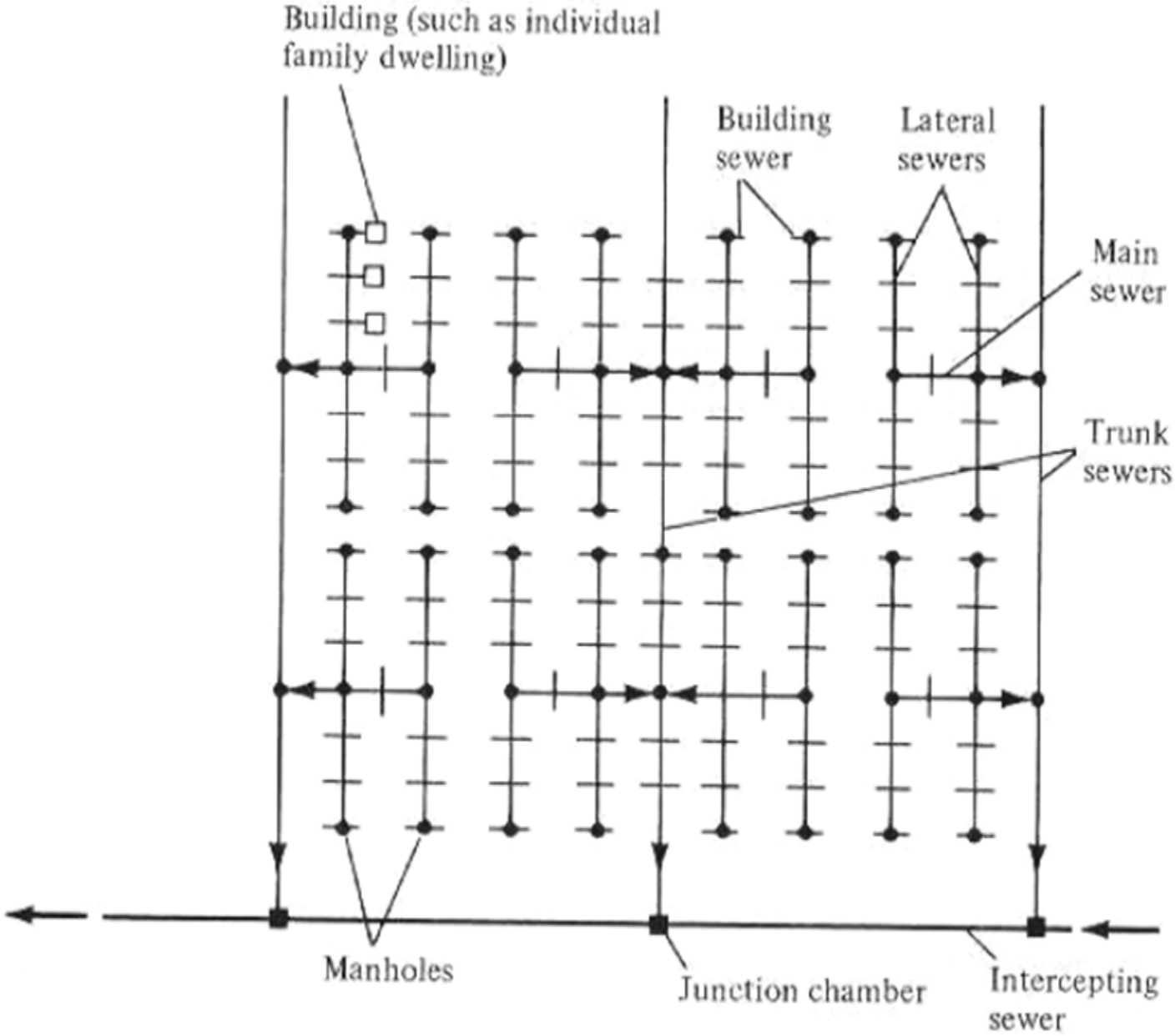

Figure 4-1 Definition sketch for various types of sewers in a typical collection system