Roma, 31 gennaio 2018

WATER SERVICES MANAGEMENT

TECHNICAL MANAGEMENT

- WATER TREATMENT PLANT AND NETWORKS -

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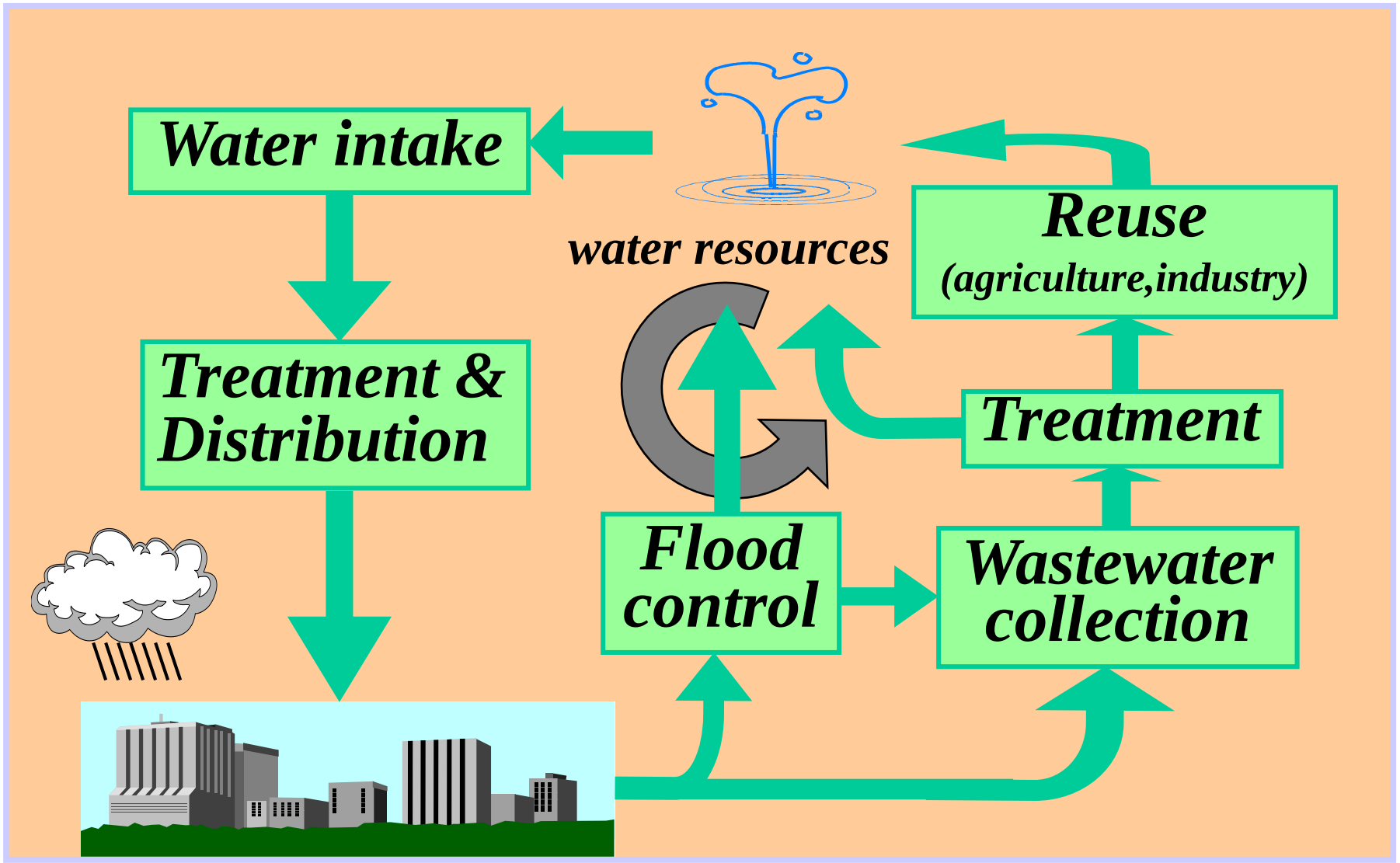
UTILITALIA

Water cycle management



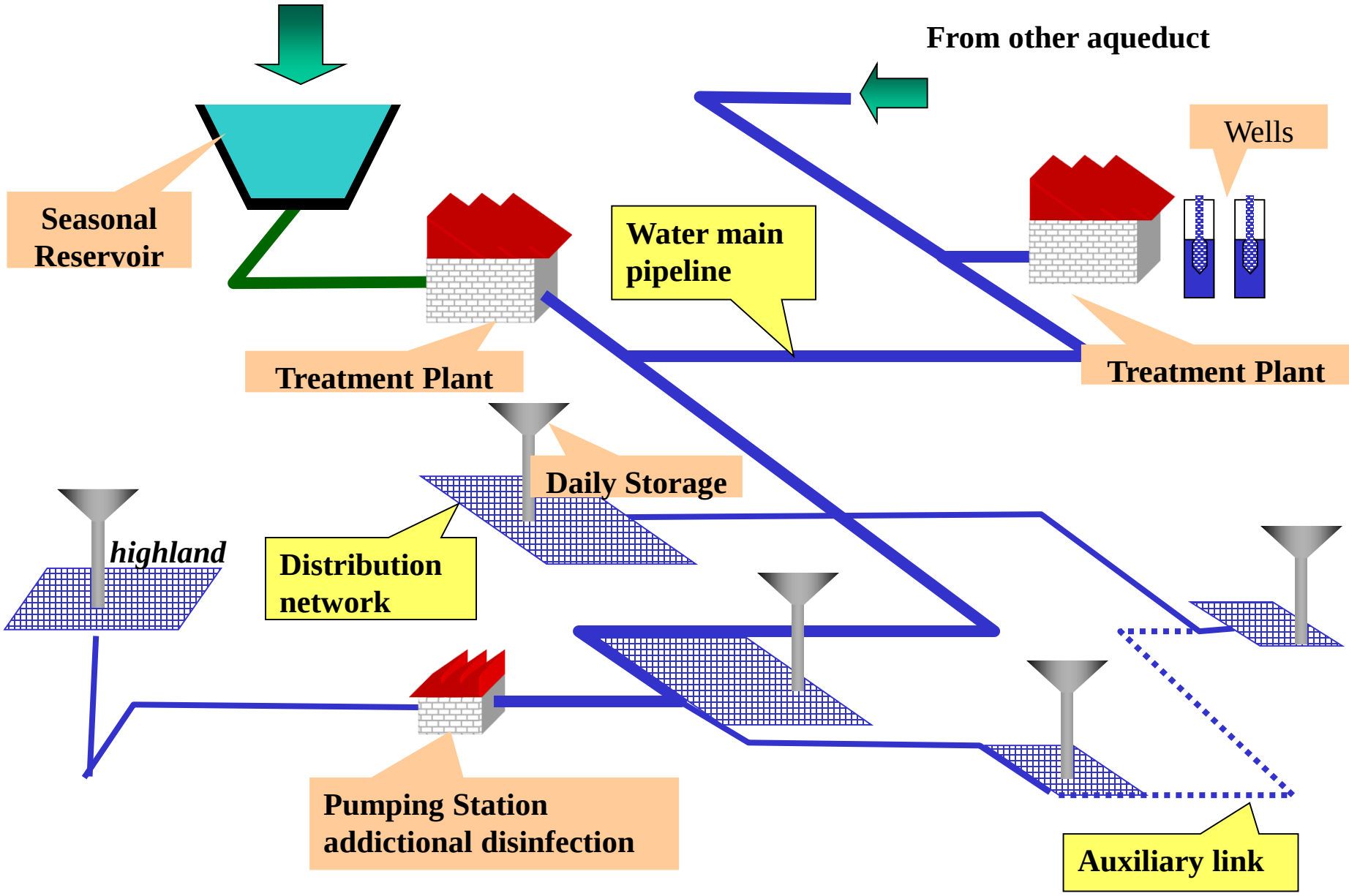
General layout of a drink water system

The general layout of the aqueduct depend by:
- nature and location of the water resources like groundwater, spring, rivers, lakes, seas,…
- geography and orography,
- customer served (quantity and quality requirement).

Normally the aqueduct network are operating at pressure > atmospheric pressure so the section of the pipe it's completely wet

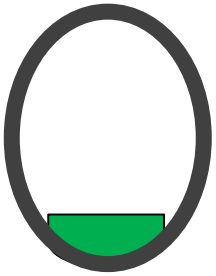
Now we examine the scheme and the component of drink water system in urban area.

General layout of a drink water system



General layout of a wastewater system

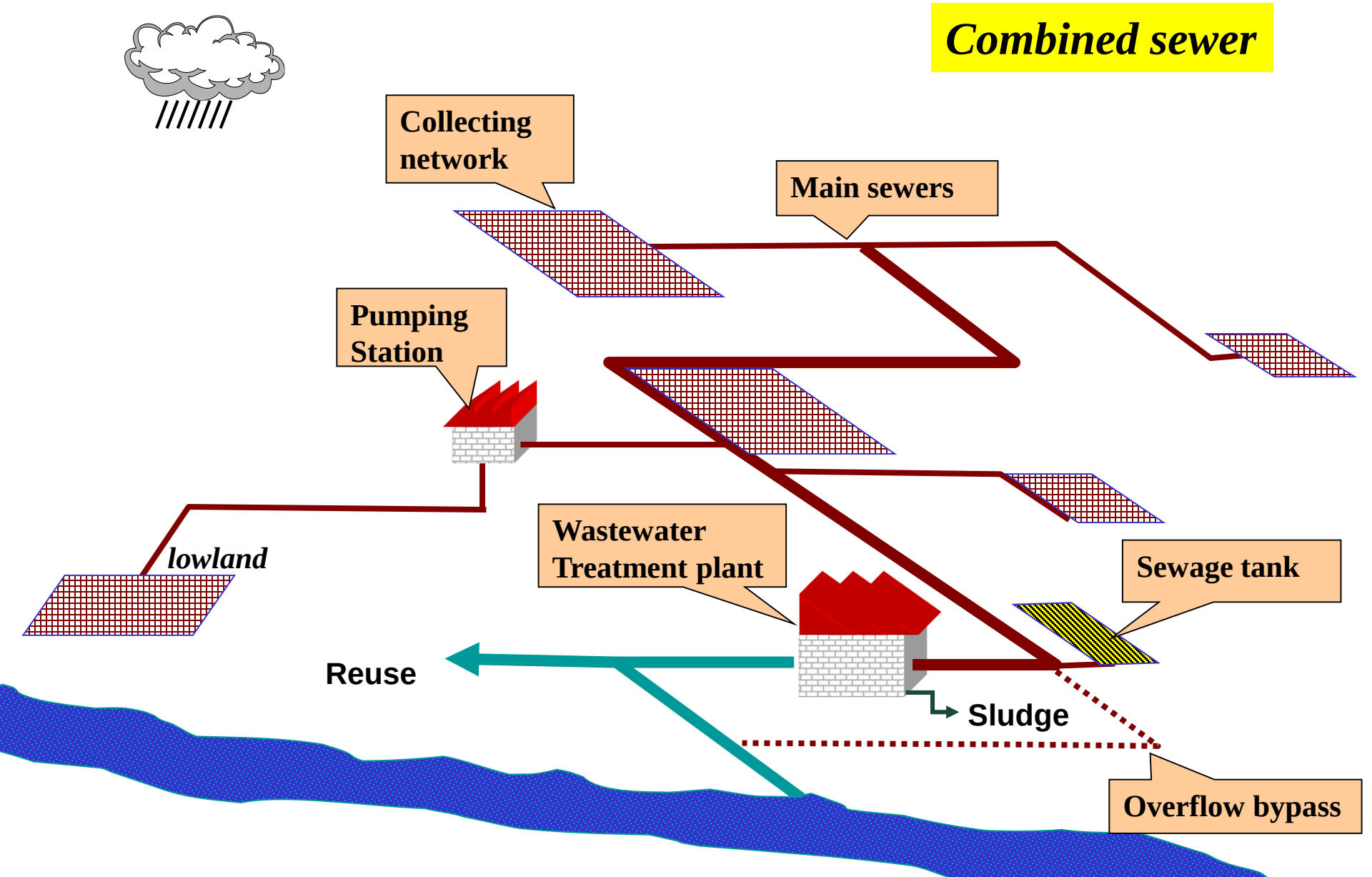
Normally the wastewater are carried by gravity flow.
Final destination is wastewater treatment plant.



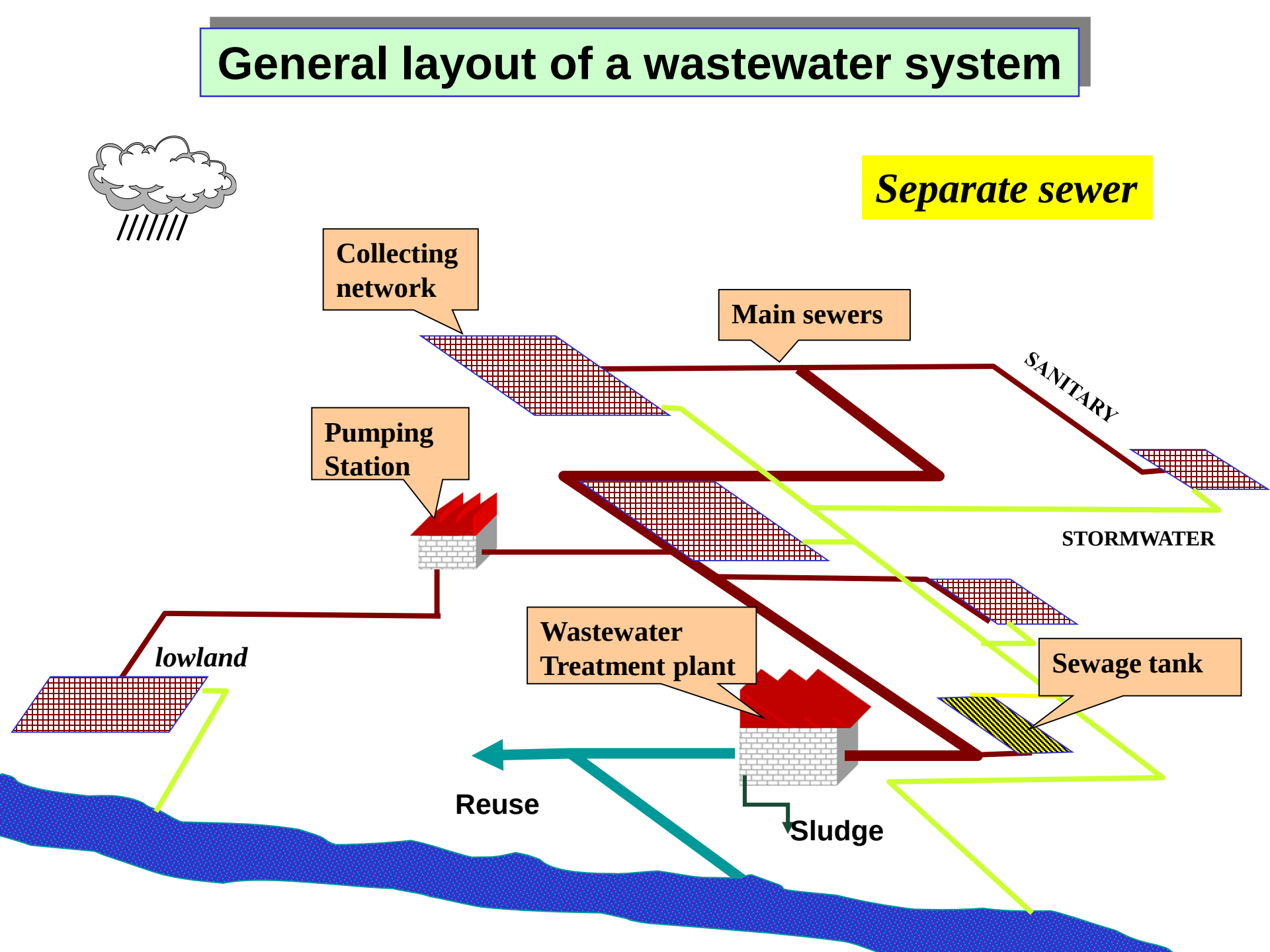
Normally the sewer network are operating at atmospheric pressure, so the section of the pipe it's not completely wet

Now we examine the scheme and the component of wastewater system in urban area.

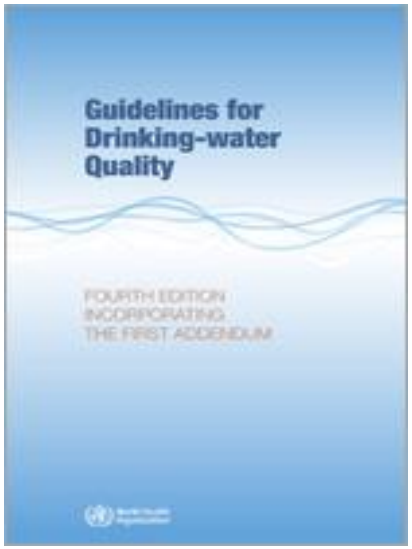
General layout of a wastewater system

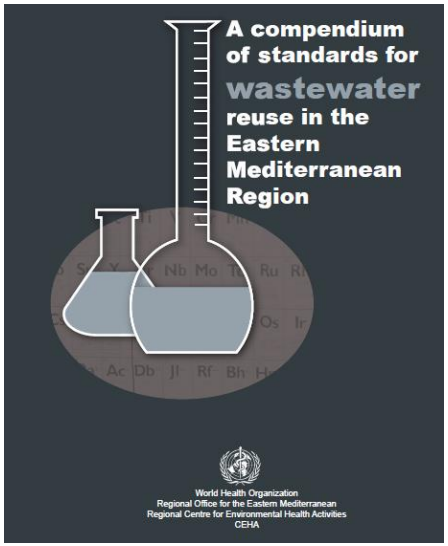


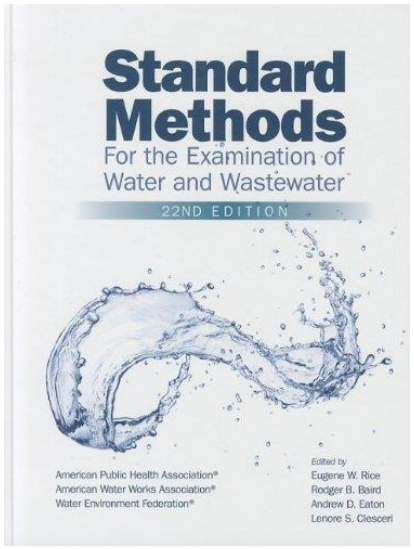
General layout of a wastewater system

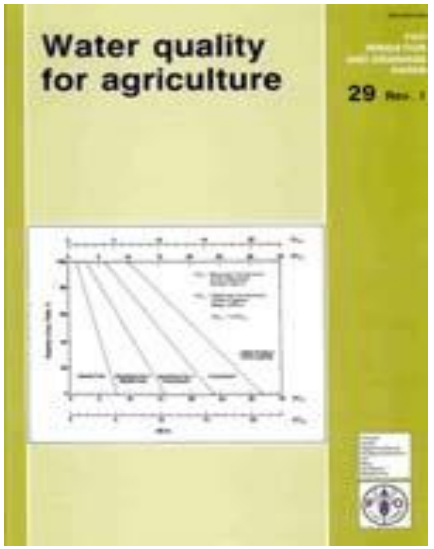


Quality Standard in Water and Wastewater









WHO ***AWWA*** ***FAO***

Directives adopted in European Union

91/271/cee wastewater

91/83/ce drink water

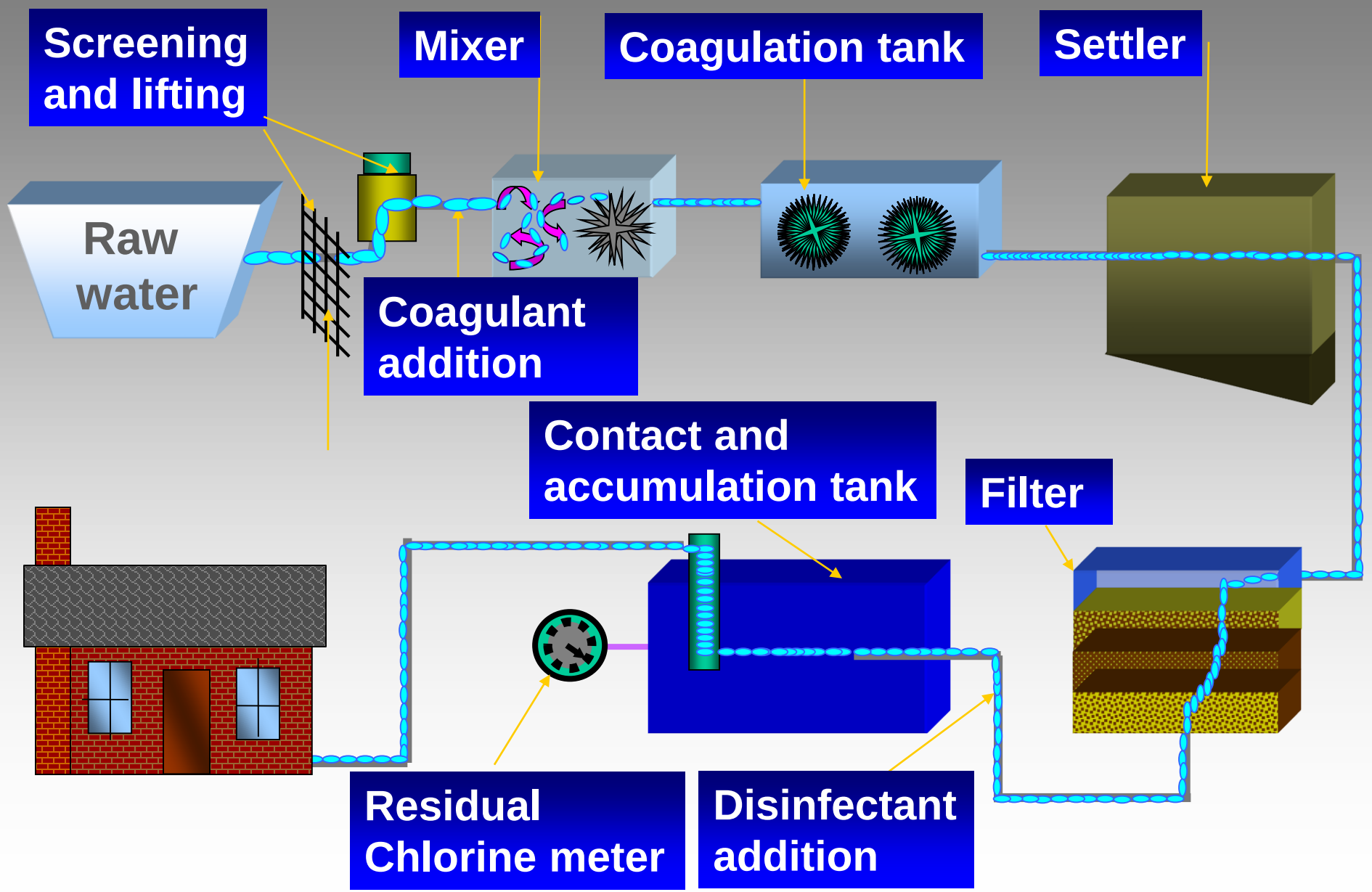
DRINK WATER TREATMENT PLANT

Surface Water Plant

Raw water intake

Drinking water outlet

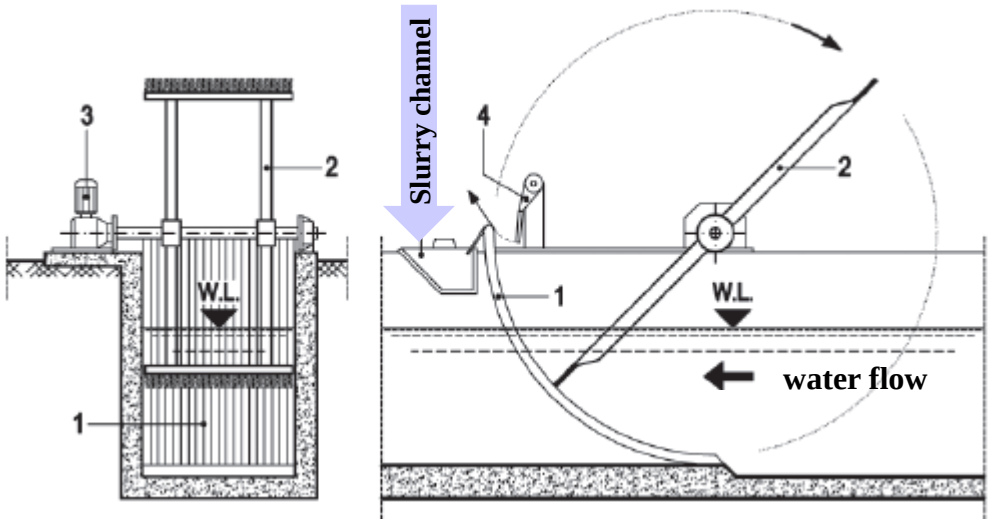
Typical treatment plant (surface water)



Initial screening

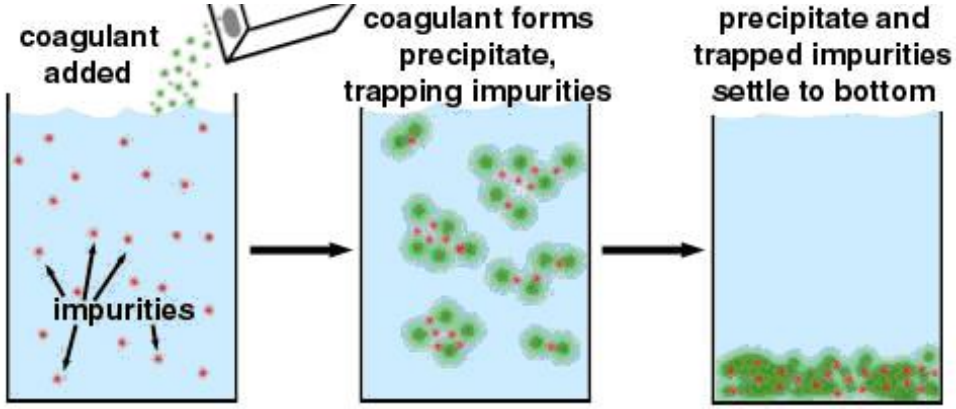
Initial screen capture and remove plastics and other solids from any water flow channels. The main reasons of this initial treatment is to protect mechanical parts of the following sections of the treatment plant.
The are different models: Linear, Drum and Arc Screen.

Arc Screen technology

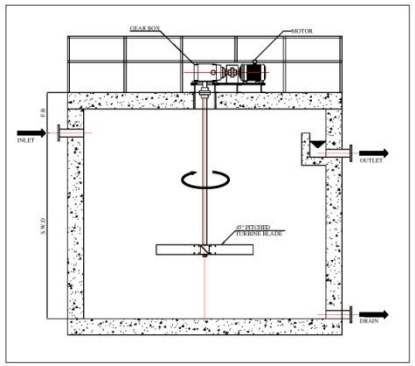


Coagulant (flocculant) agents

Flocculants agents are chemicals that promote flocculation in order to aggregate colloids and other suspended particles in liquids to forme a floc.

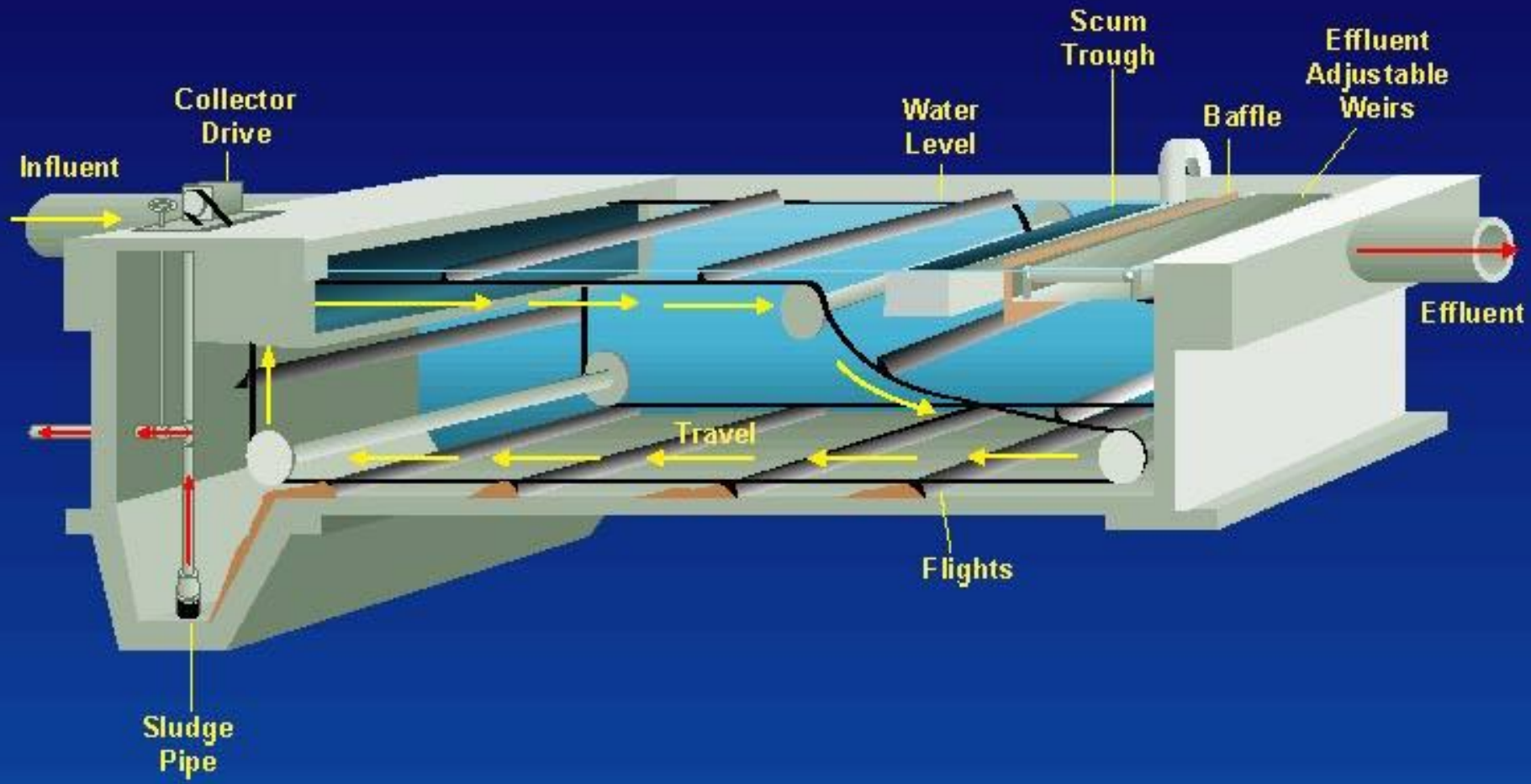


aluminium chlorohydrate
aluminium sulphate
calcium oxide
calcium hydroxide
iron(II) sulphate (ferrous sulphate)
iron(III) chloride (ferric chloride)
Polyacrylamide
sodium aluminate
sodium silicate

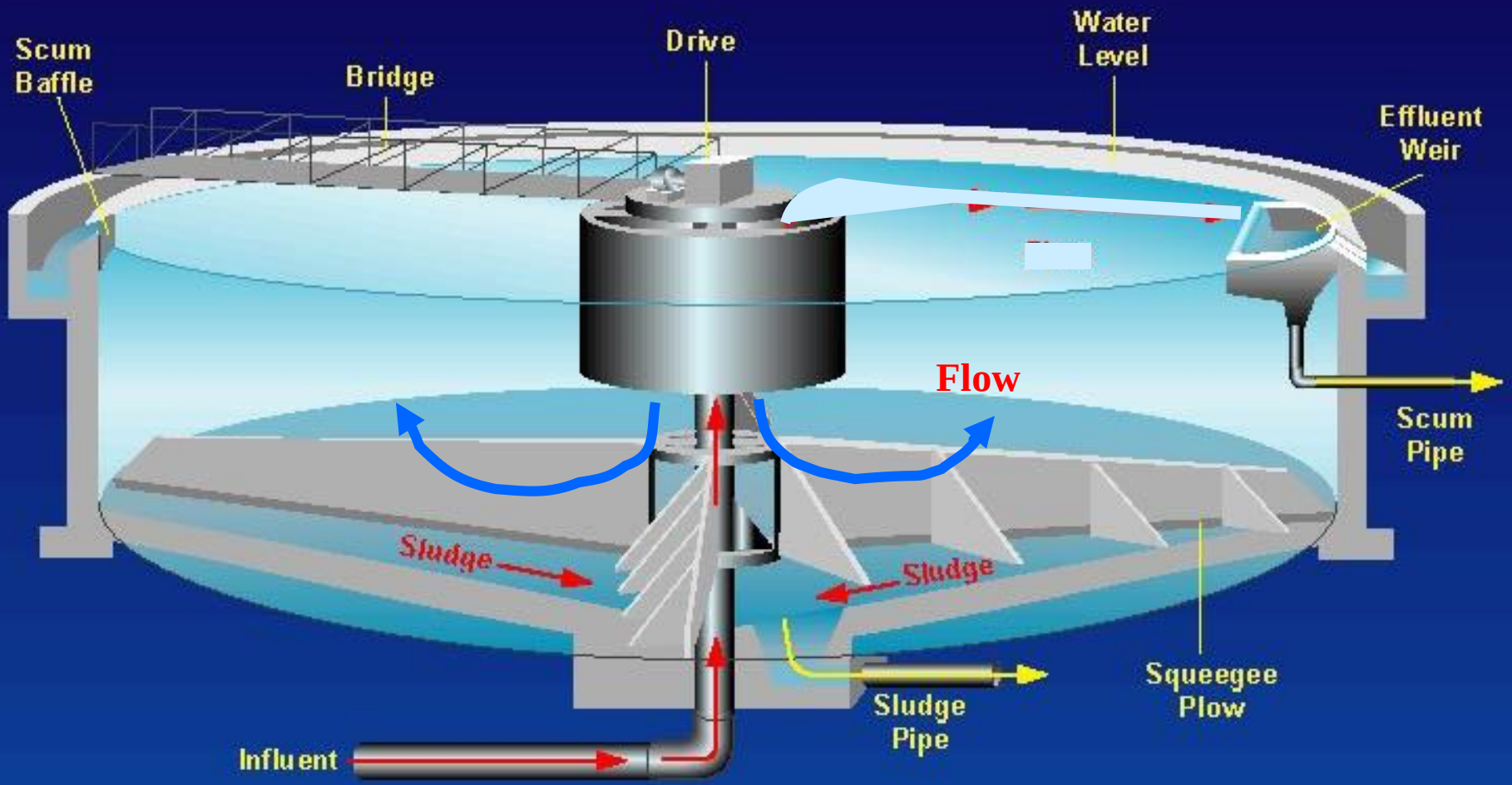


Thickener with rectangular section

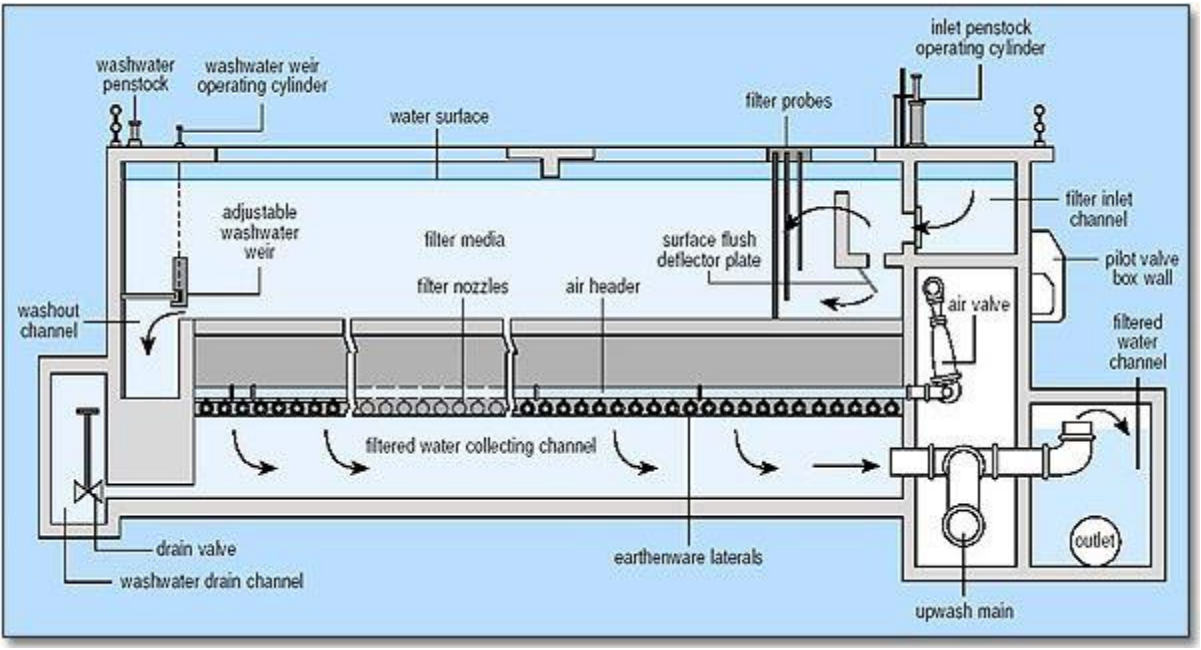
With continuous chain collector sludge removal system



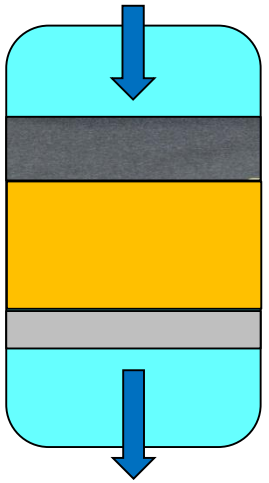
Thickener with circular section



Sand Filter



Pressure Sand Filter



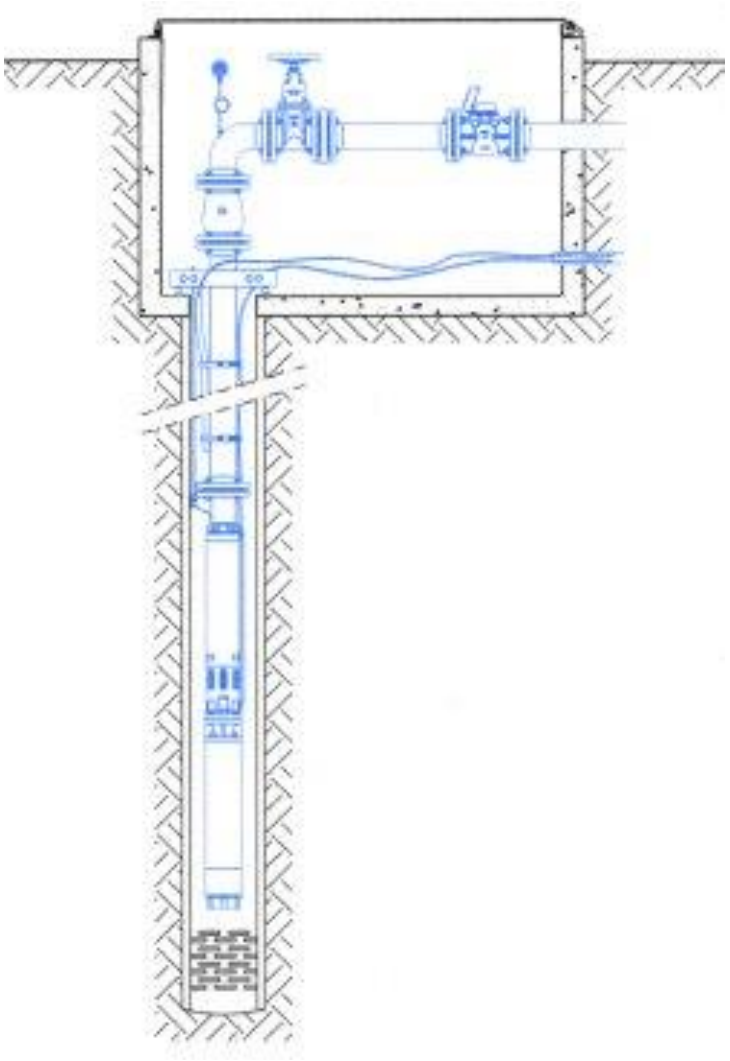
Anthracite

Sand

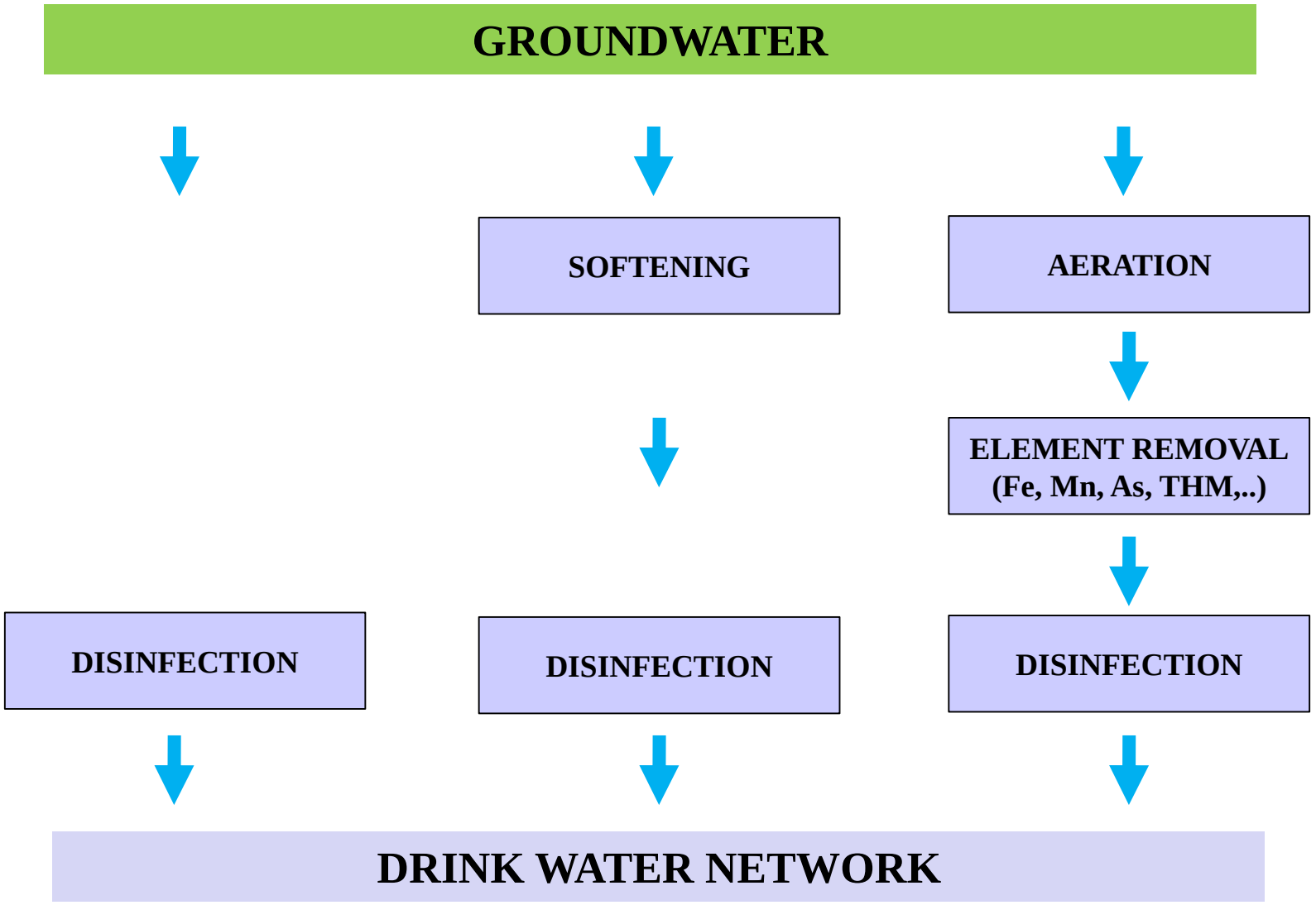
Gravel

Multilayer

Ground Water System

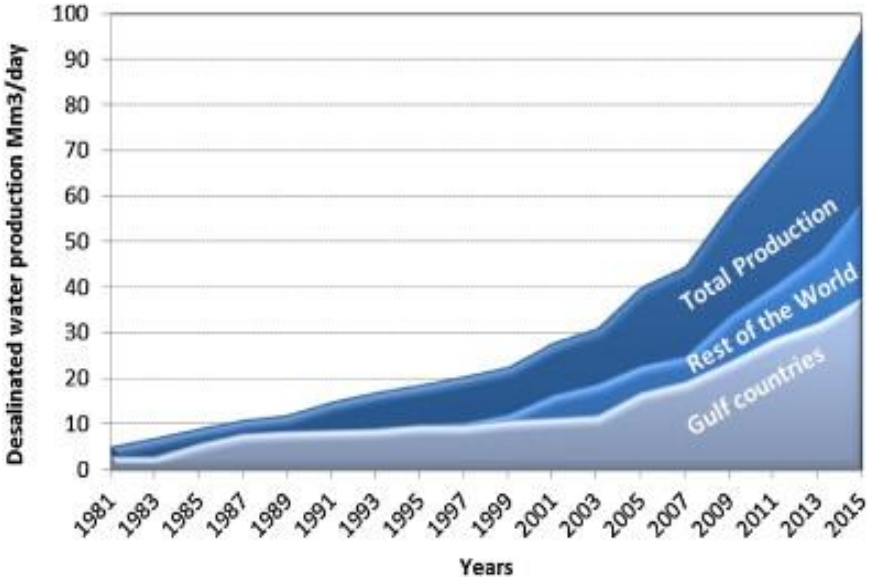


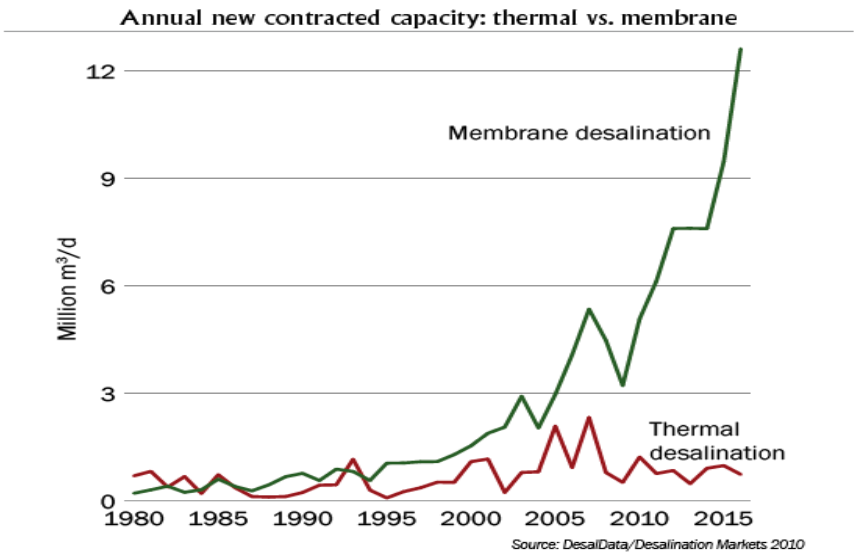
Typical Ground Water Treatment



Typical Ground Water Treatment

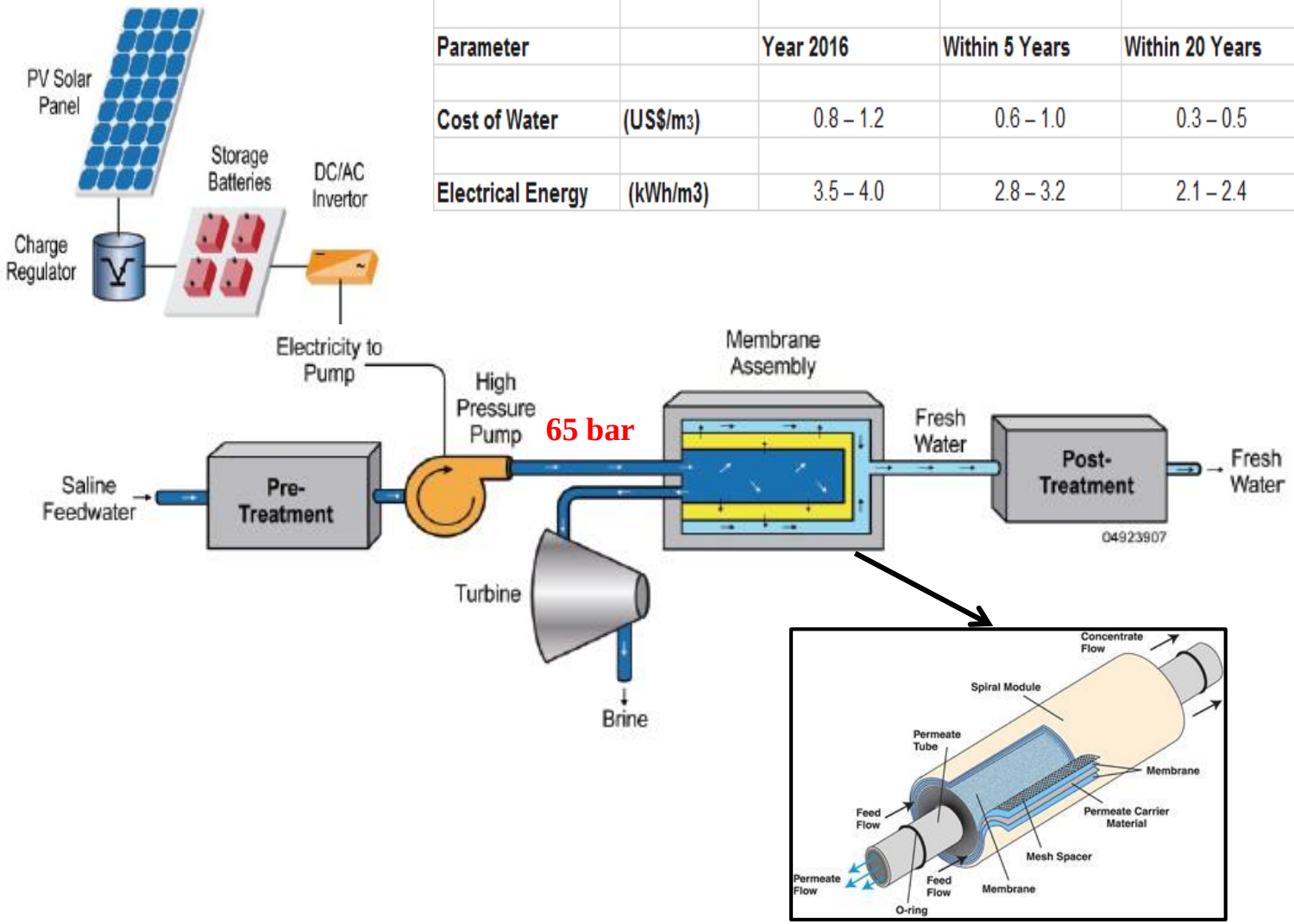
Desalination





Desalination: costs and technology

Parameter		Year 2016	Within 5 Years	Within 20 Years
Cost of Water	(US$/m3)	0.8 – 1.2	0.6 – 1.0	0.3 – 0.5
Electrical Energy	(kWh/m3)	3.5 – 4.0	2.8 – 3.2	2.1 – 2.4



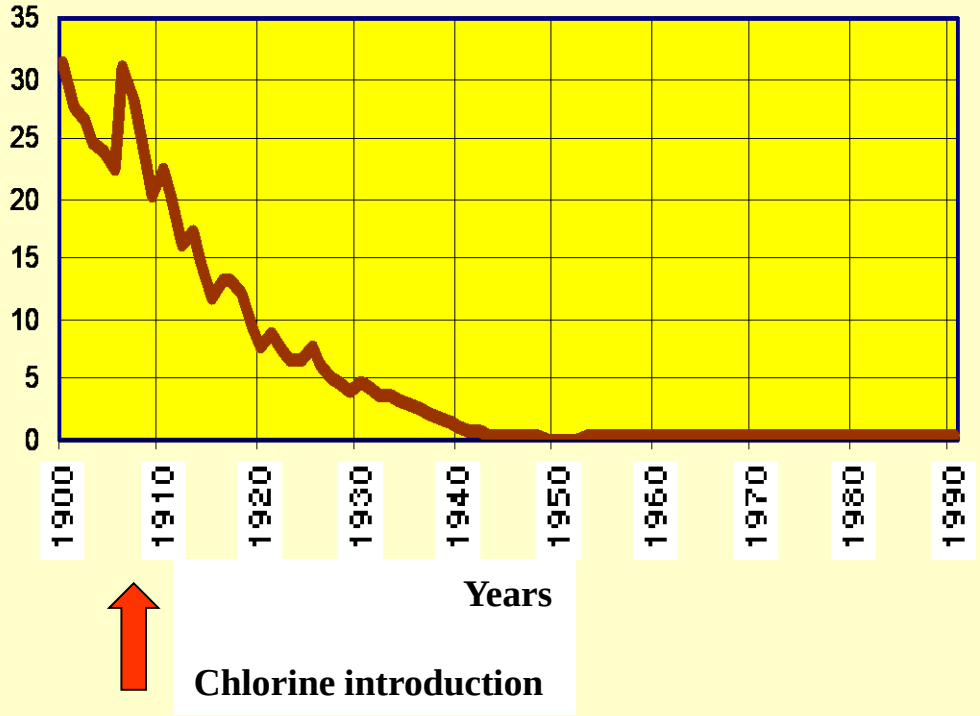
DISINFECTION

Importance of disinfection

The studies conducted between 1860 and 1880 by Louis Pasteur and Robert Koch allow to develop the theory of microorganisms as agents of disease and cause of epidemics (typhus, cholera, ..).

The aqueducts have started to introduce disinfectants against pathogenic microorganisms only since the beginning of the 20th century

Number of deaths from typhus per 100,000 inhabitants in USA



Disinfectants used in water treatment

	Danger in use	Effect after treatment	By-product	Cost	Drink Wat.	Wastewat.
Cl gas	XXX	XX	XXX	X	X	X
NaClO	XX	XX	XXX	XX	X	X
ClO_2	X	XXX	XX	XX	X	
Ozone	X	X	X	XXX	X	
UV	X	X		XXX	X	
Peracetic Acid	XX	XX	XX	XXX		X

By-product of disinfection

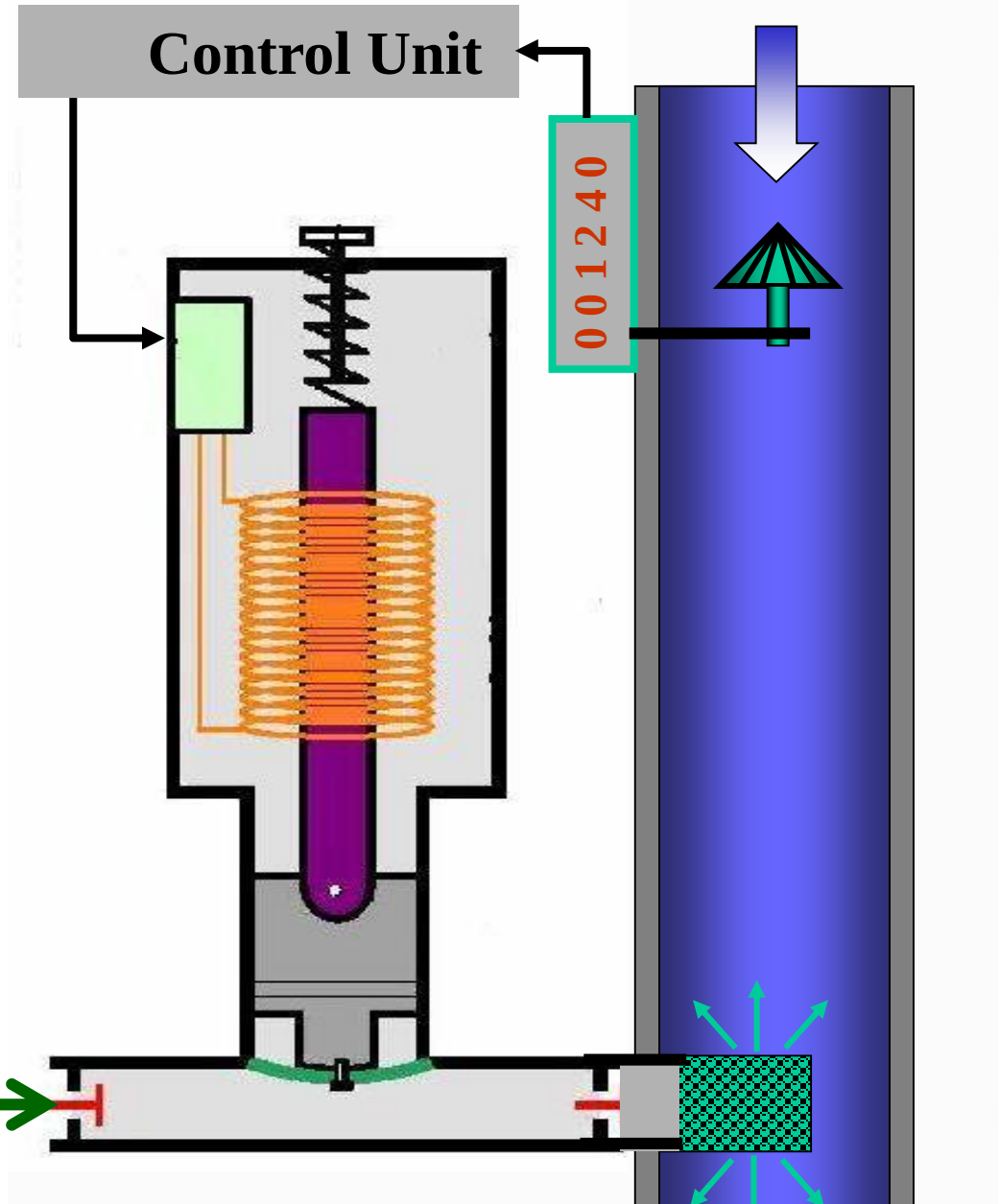
Disinfection agents such as chlorine are strong oxidizing agents able to destroy pathogenic microbes.

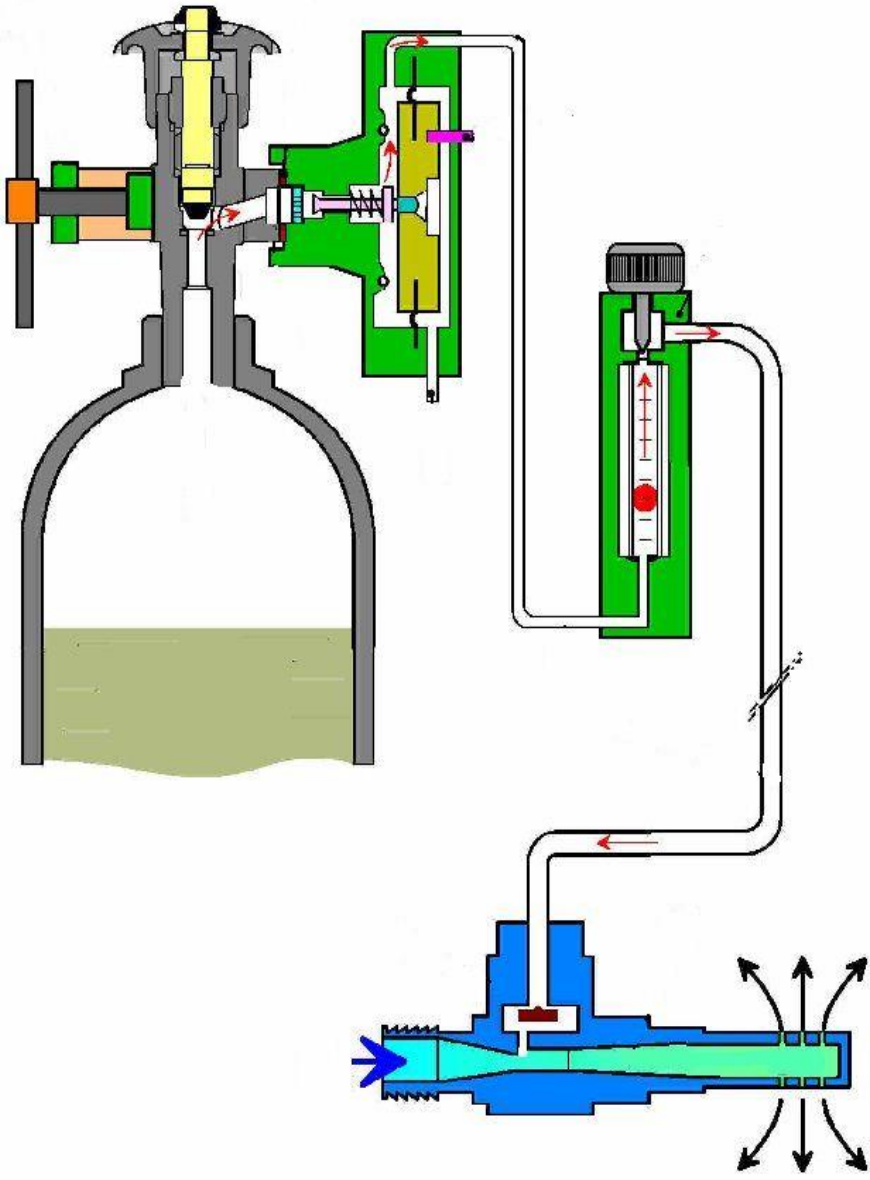
These disinfectants may also react with organic compound naturally present in the water and can produce a range by-product like trihalomethan, bromate, and other . This by-products may have an cancerogenic effect in high dose and for a long exposure period.

To reduce this risk it's necessary disinfect water with less content of organic compounds and avoid overdosing of disinfectant .

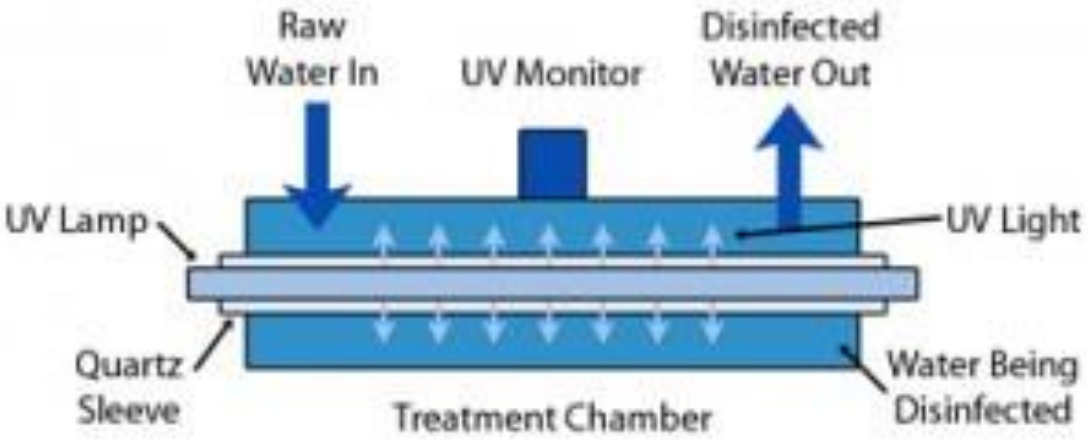
To minimize the presence of by-products and guarantee a disinfectant effect in the network, several potabilization plants use a mix of disinfectant (e.g. Ozone followed by Chlorine Dioxide).

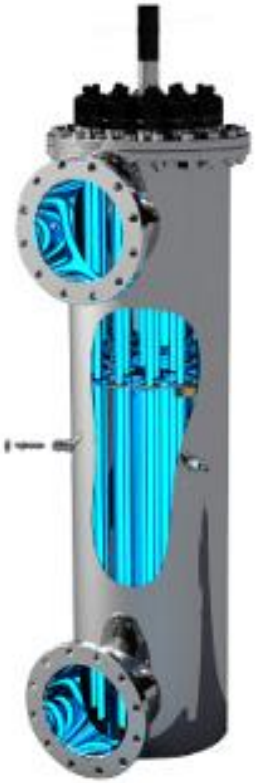
Disinfectant dosing ($NaClO$ and Cl_2)





U.V. Disinfection





With U.V. disinfection:

- there are no by-products
- there is no disinfectant effect in the network

U.V. disinfection requires water very transparent

WASTEWATER TREATMENT PLANT (WWTP)

Wastewater treatment is a process used to convert wastewater into an effluent that can be returned to the water cycle with minimal impact on the environment or directly reused (industry, agriculture,…).

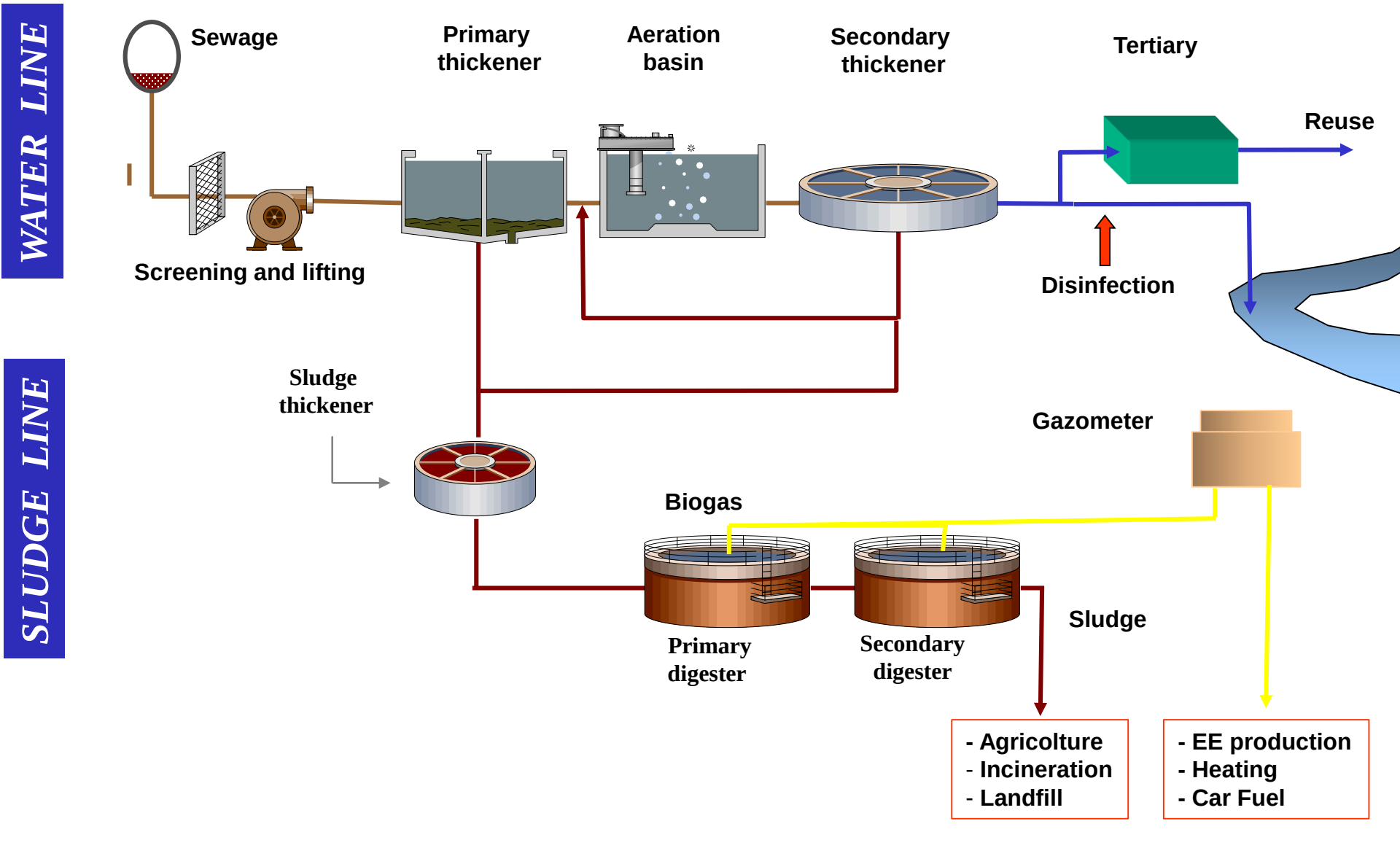
	INPUT			*OUTPUT*		
Susp. Solid Total	SST	180	mg/l	SST	8	mg/l
Chem. Ox. Dem.	COD	416	mg/l	COD	50	mg/l
Biol. Ox. Dem.	BOD_5	195	mg/l	BOD_5	10	mg/l
N- Ammonium	NH_{4+}	38	mg/l	NH_4	3	mg/l
Phosphorus	Ptot	6	mg/l	Ptot	2	mg/l

Large Wastewater Treatment Plant

Sewage intake

Treated water outlet

Large Wastewater Treatment Plant



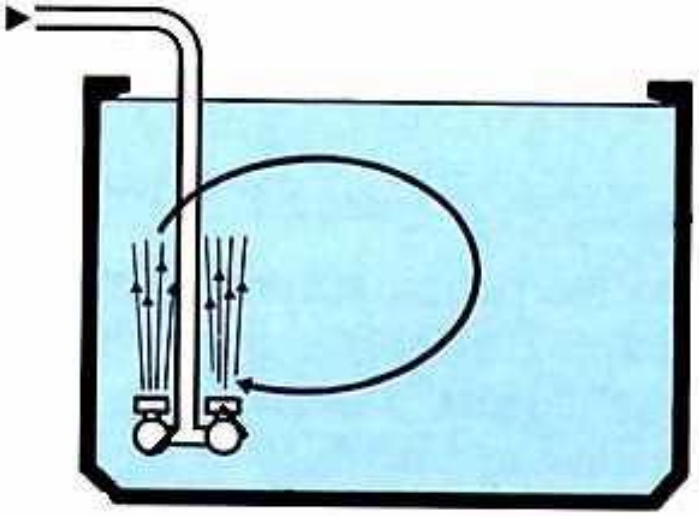
Large Wastewater Treatment Plant

Evolution in the aeration systems

SUBMERSED AERATION

Compressed air

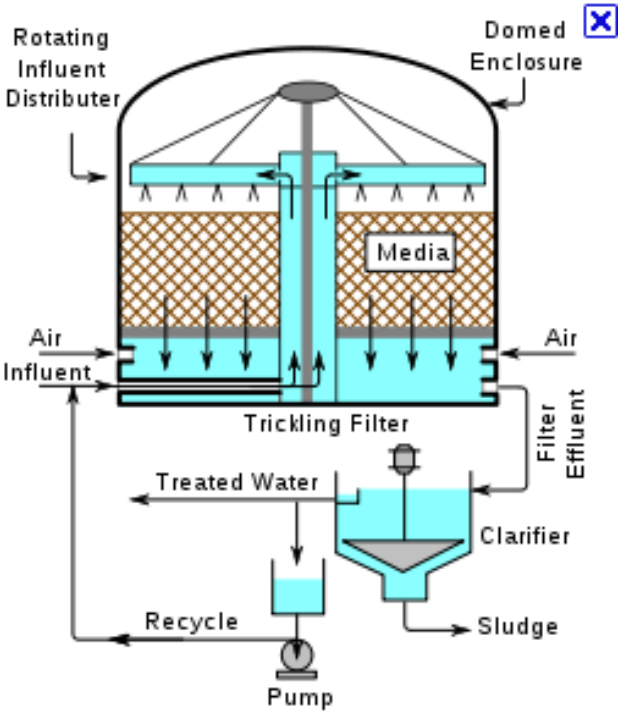
Pure oxygen



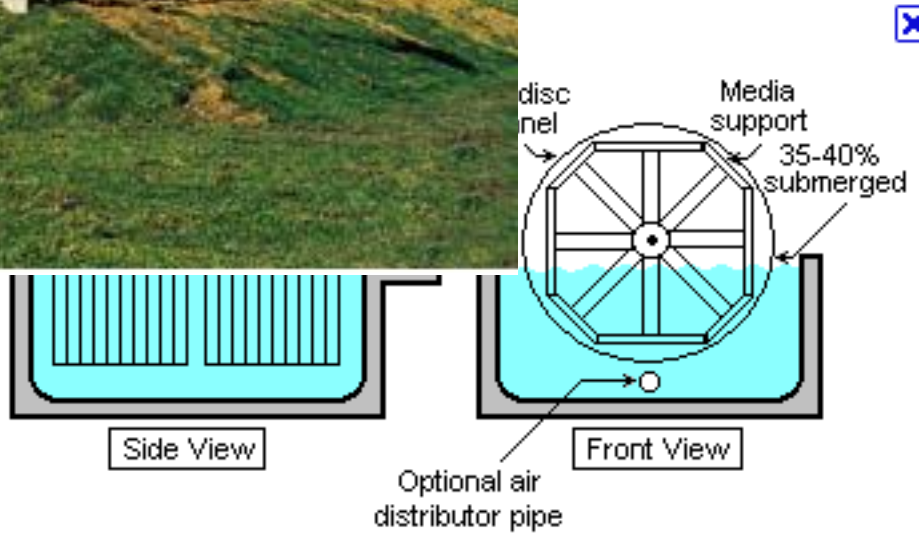
MECHANICAL AERATION

Aeration it’s a phase with the most energetic impact in a WWTP

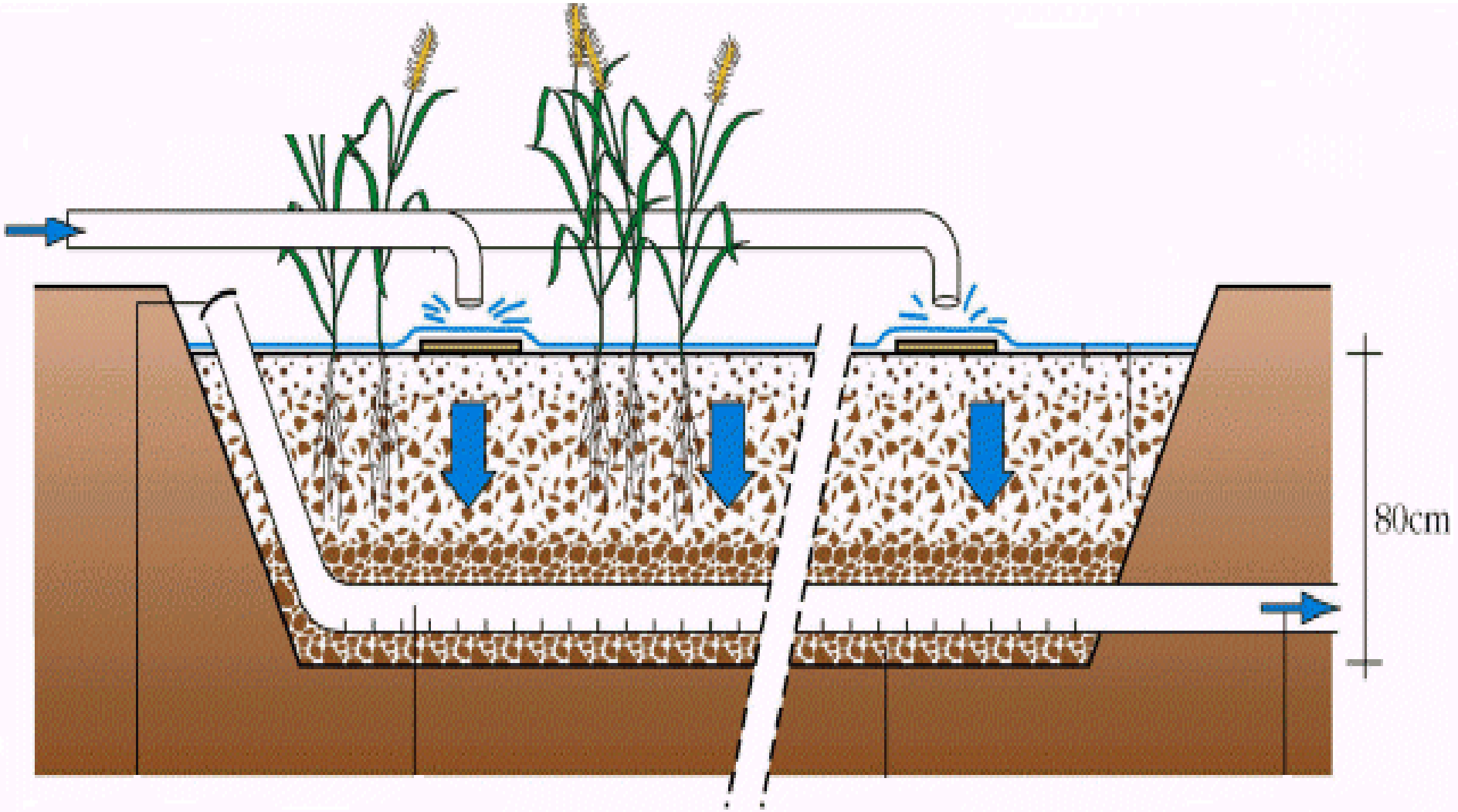
Biofilter Technology: trickling filter



Biofilter Technology: Rotating biological contactor



Phytodepuration system



Phytodepuration system: some examples

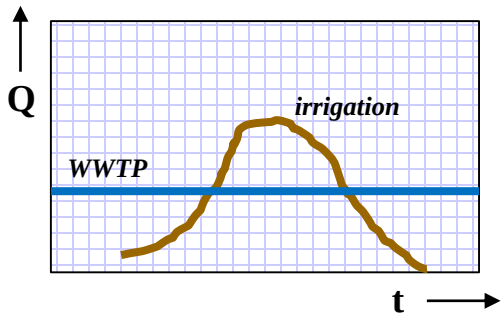
Reuse of treated wastewater

Agriculture sector (irrigation)

Industry sector

Civil sector (garden, ornamental fountains, street washing,..)

Reuse: different kinds of Tertiary plant



TERTIARY

COAGULATION

FILTRATION

DISINFECTION

RESERVOIR

SEWAGE

CONVENTIONAL WWTP PLANT

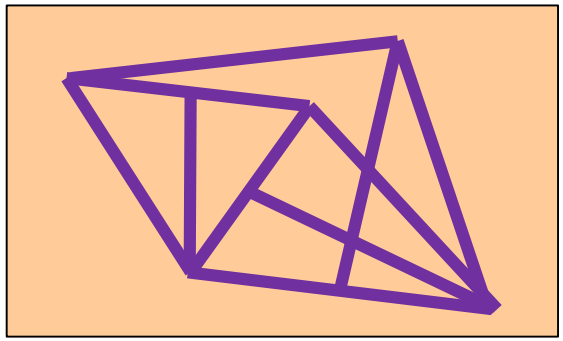
PHYTODEPURATION

CONVENTIONAL WWTP PLANT

INNOVATIVE PLANT USING MEMBRANES (MBR)

IRRIGATION NETWORK

WATER NETWORK AND PIPES



The distribution network is often the most expensive part of a water system. For this reason it must be calculated to meet multiple targets.

Ensure the necessary flow rates also in perspective (population increase)

Ensure easy network maintenance

Avoid excessive times of water permanence

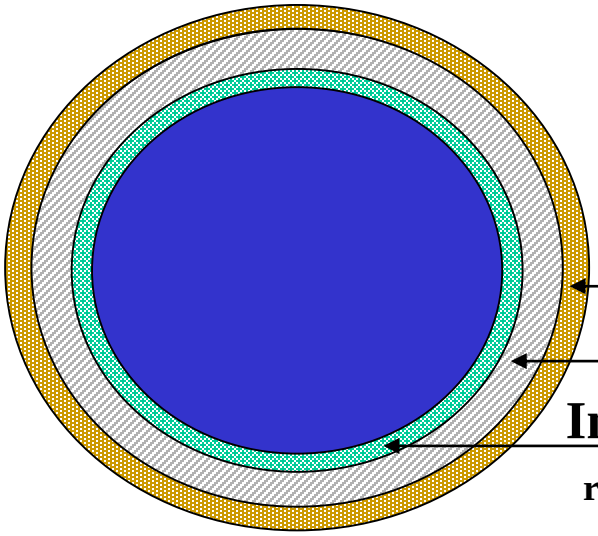
Avoid corrosion or tube fatigue

Limit water leakeges

Contain construction costs

Contain the lifting power costs

Pipe: the most important infrastructure



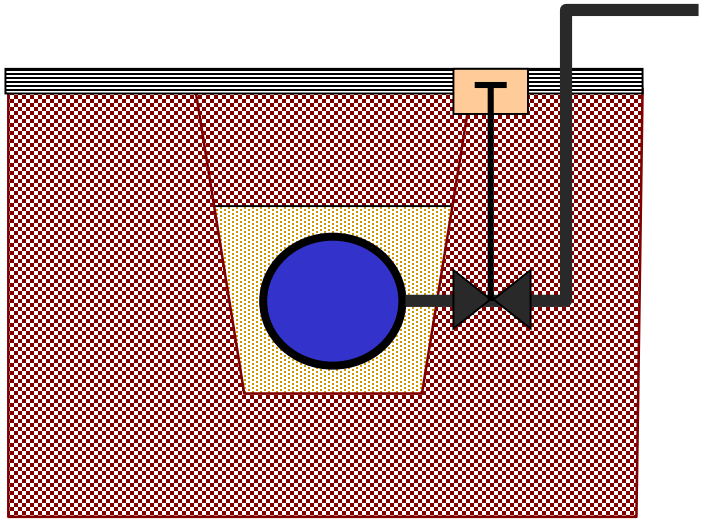
protection from the ground

External coating

Pipe

Internal coating

reduce friction



USED MATERIALS

METALLIC

- Steel
- Cast Iron
- Ductil Iron
- Cpper
- Lead

PLASTIC

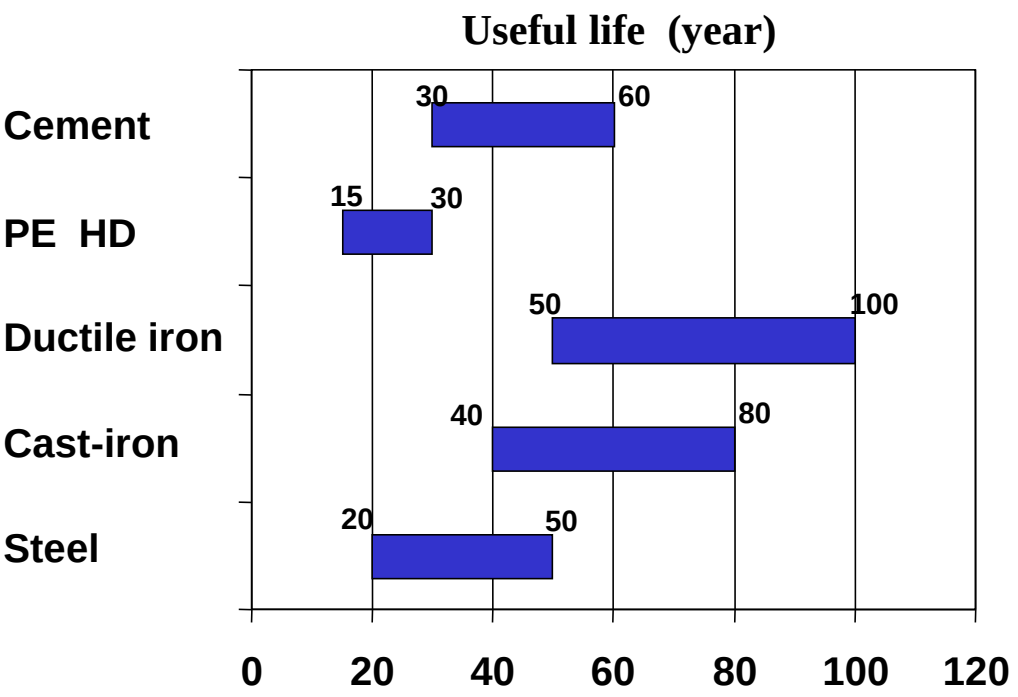
- PE h.d.
- PE l.d.
- PVC
- PP
- Fiberglass

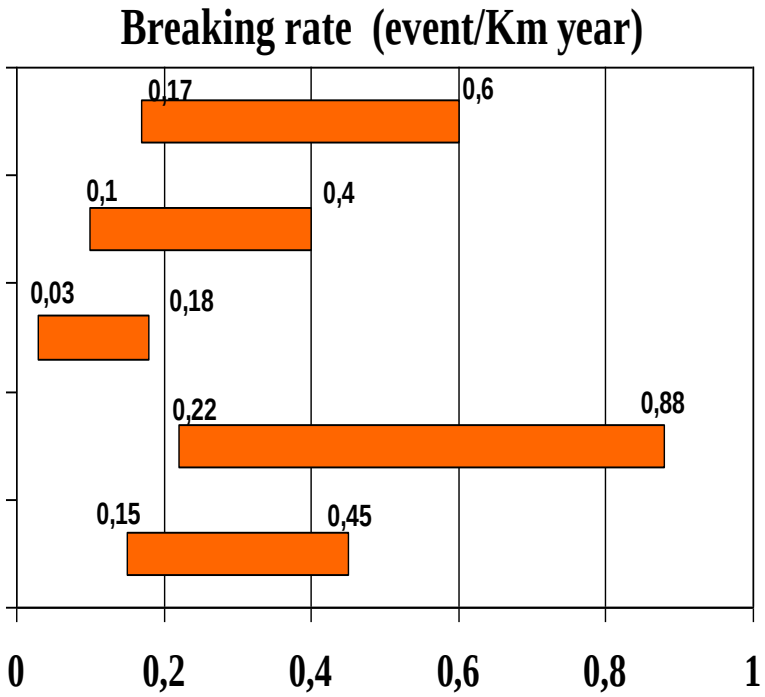
CEMENT/CERAMIC

- Cement
- Cement-asbestus
- Fiber cement
- Gres

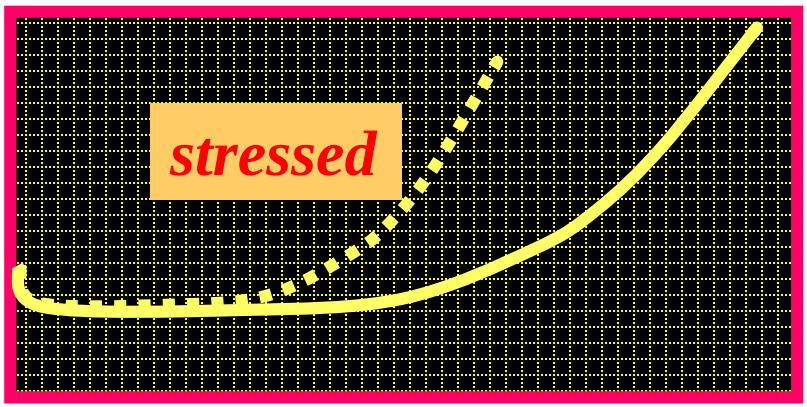
Aqueduct *Sewer pipe* *Obsolete*

Pipe's life

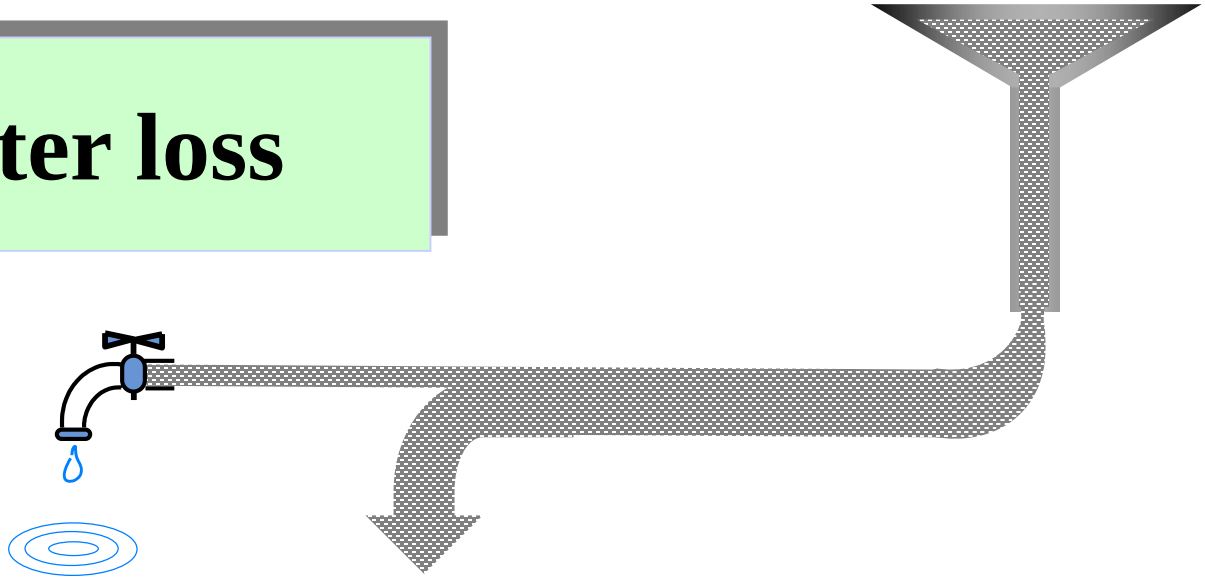


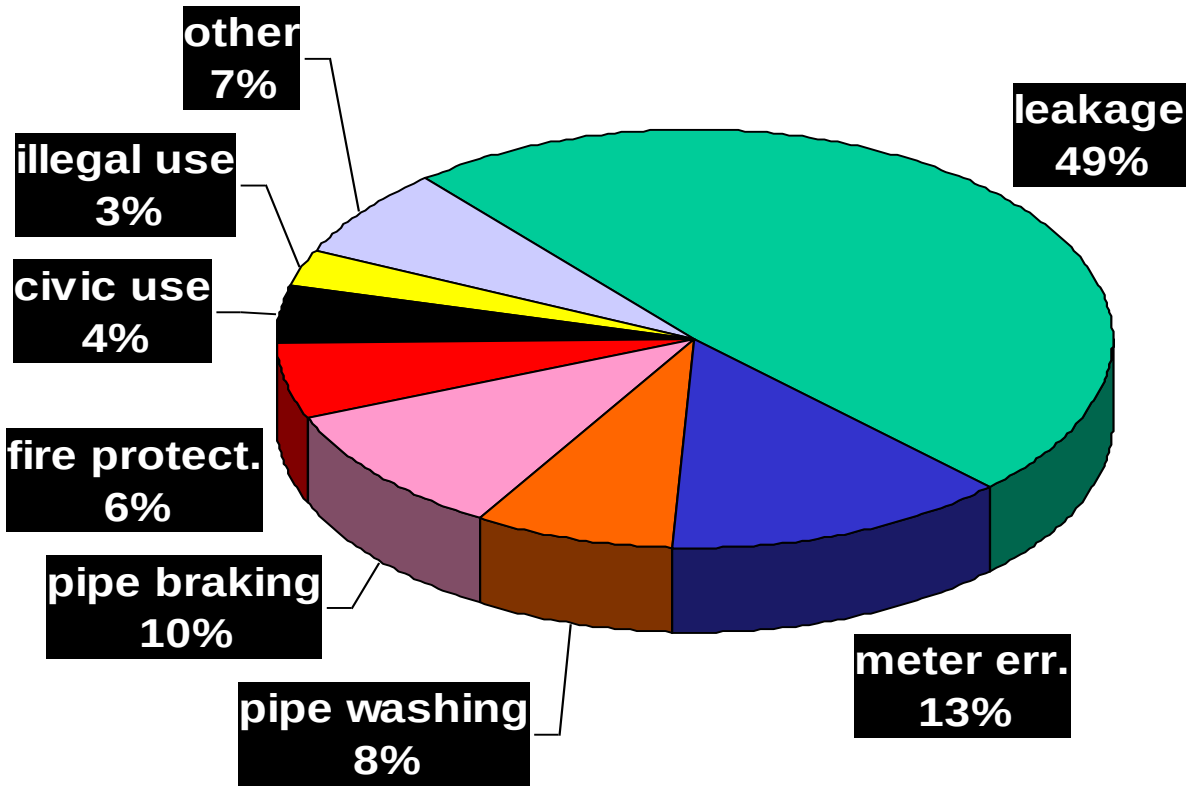


BREAKING RATE



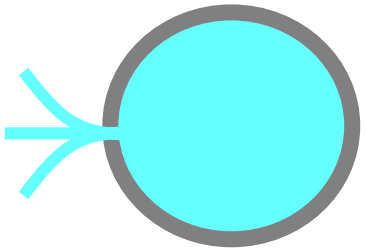
Water loss

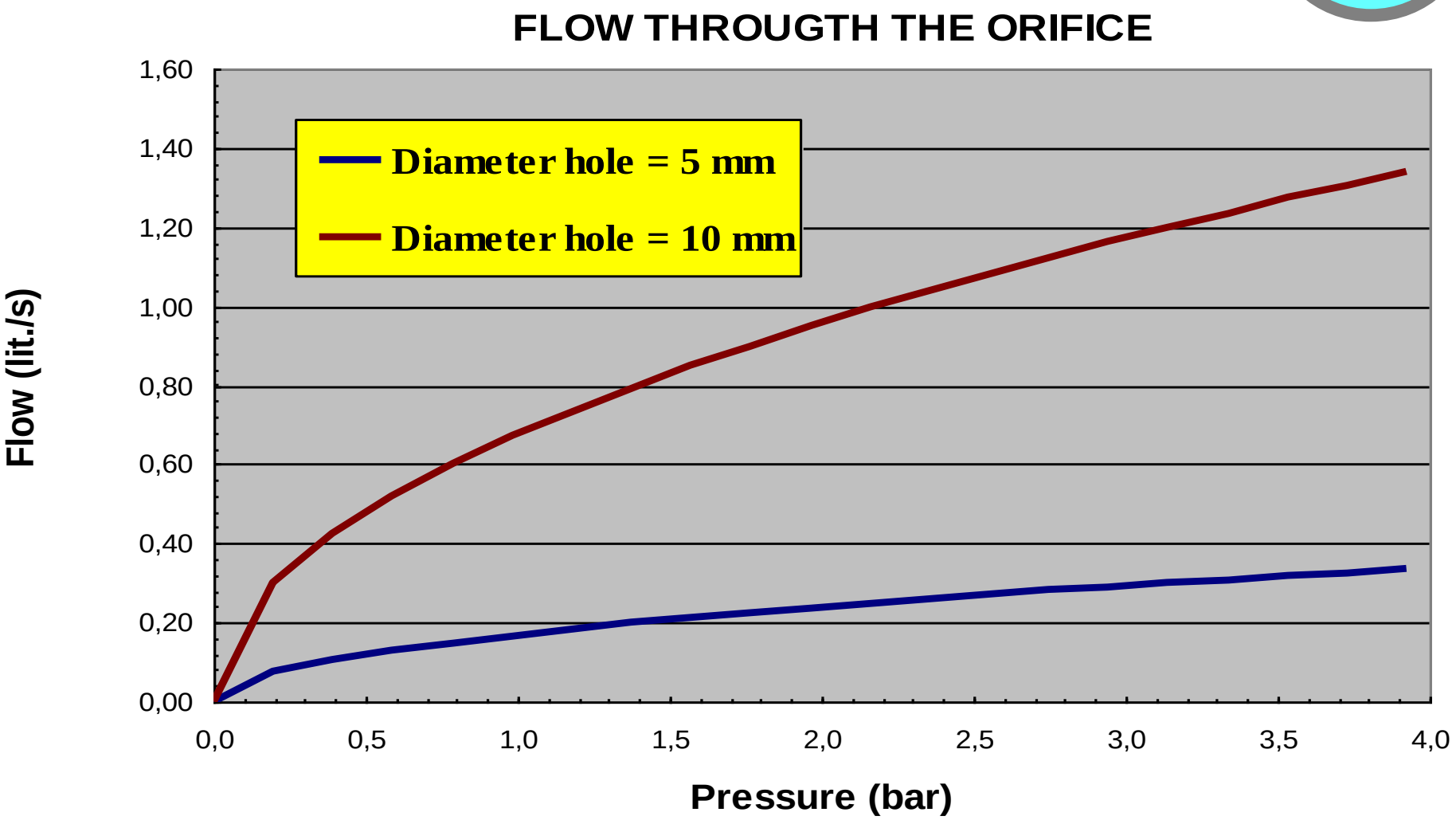



other
7%
leakage
49%
illegal use
3%
civic use
4%
fire protect.
6%
pipe braking
10%
meter err.
13%
pipe washing
8%

PRESSURE MANAGEMENT POLICY

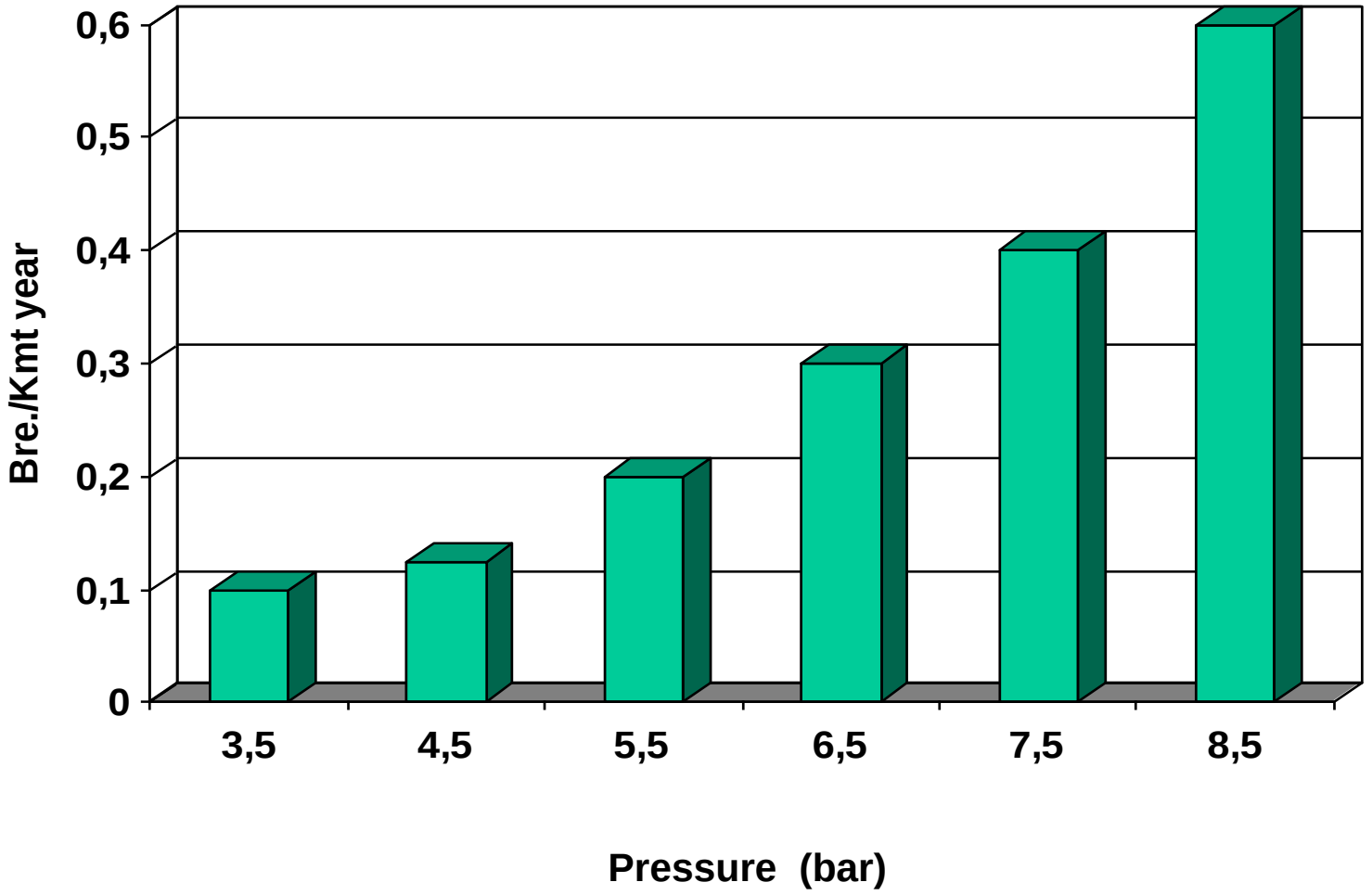
Leakage flow depend by pressure



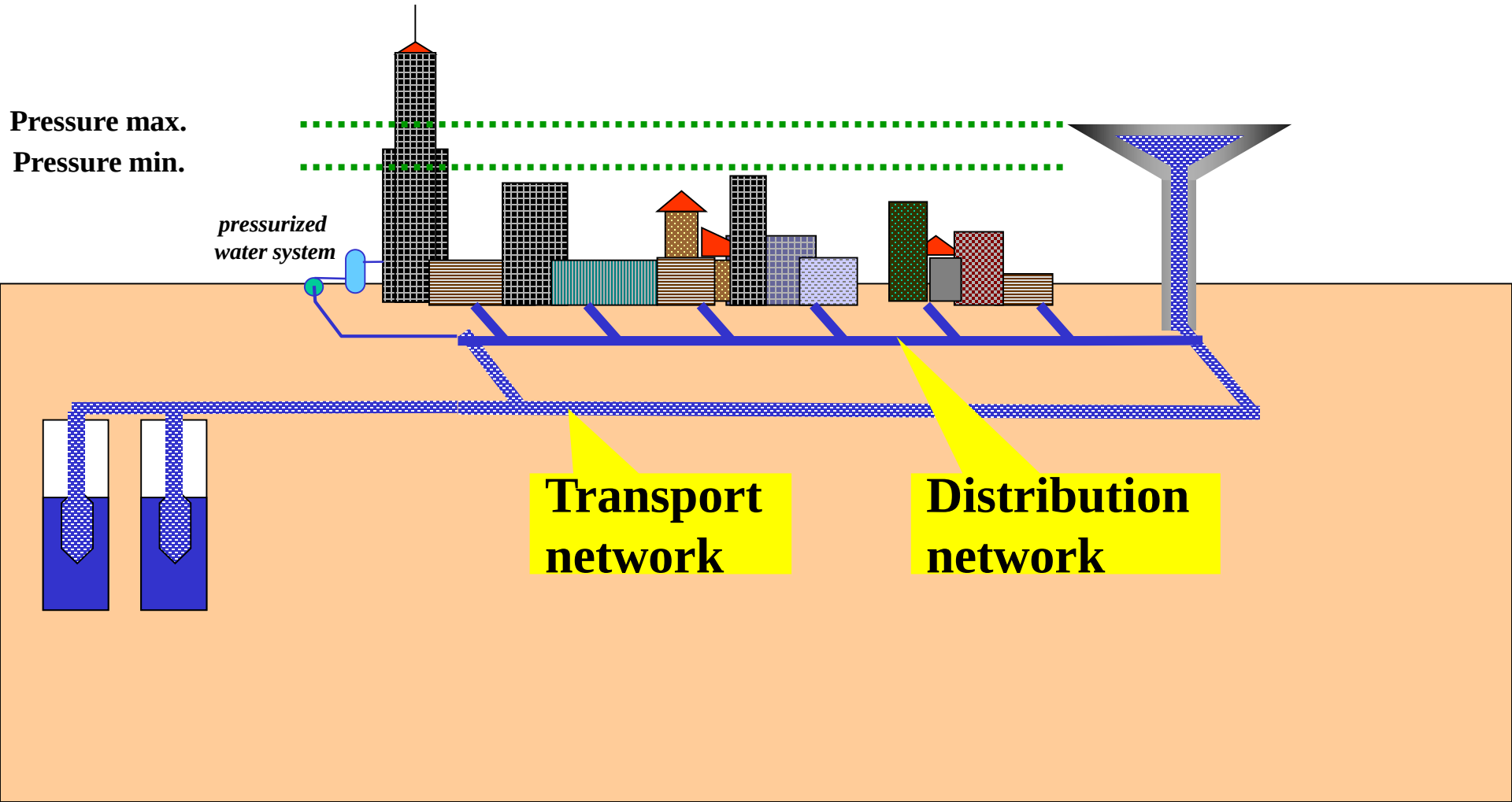


PRESSURE MANAGEMENT POLICY

Break rate of pipe depend by pressure

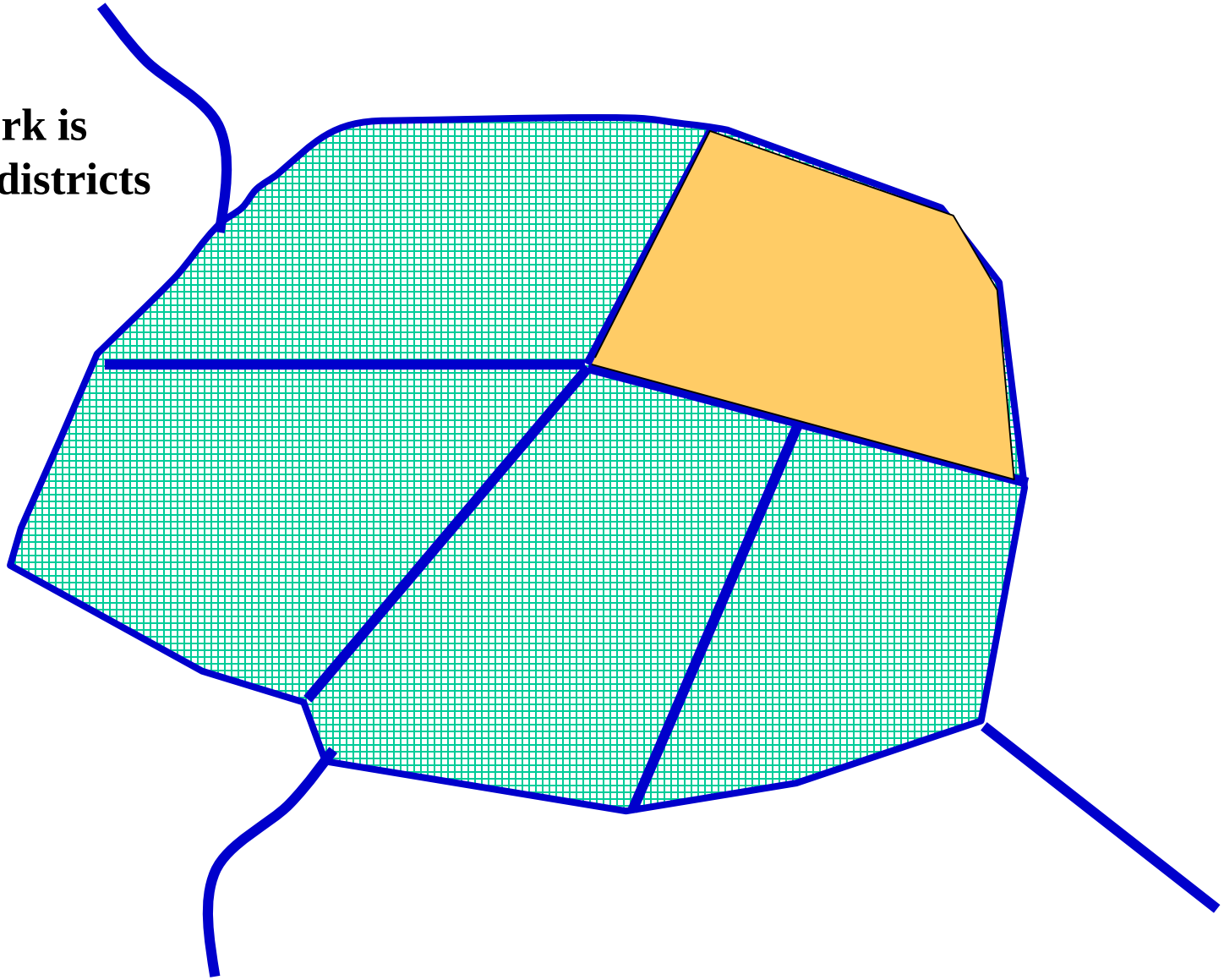


Role of the water pressure in a typical water service

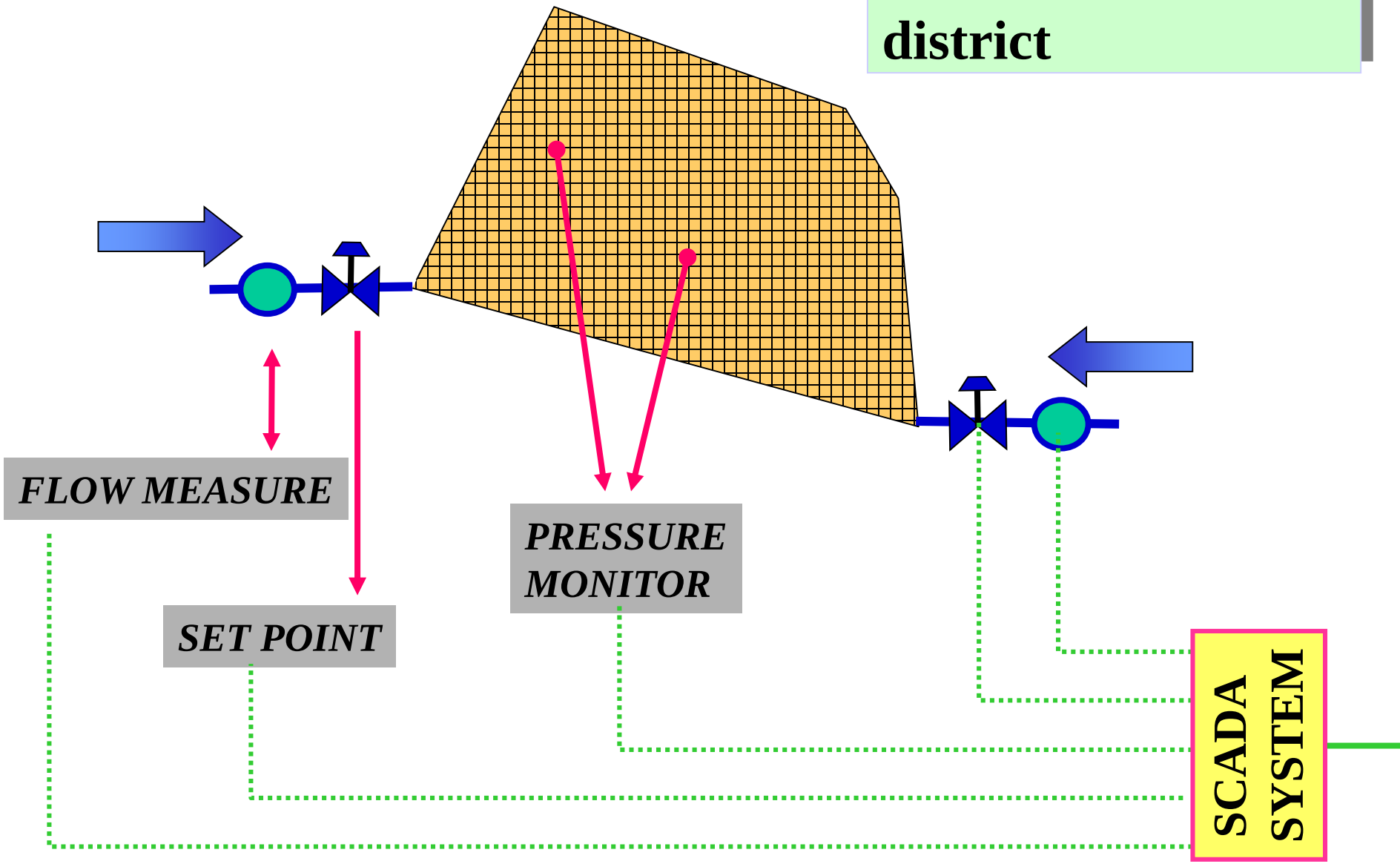


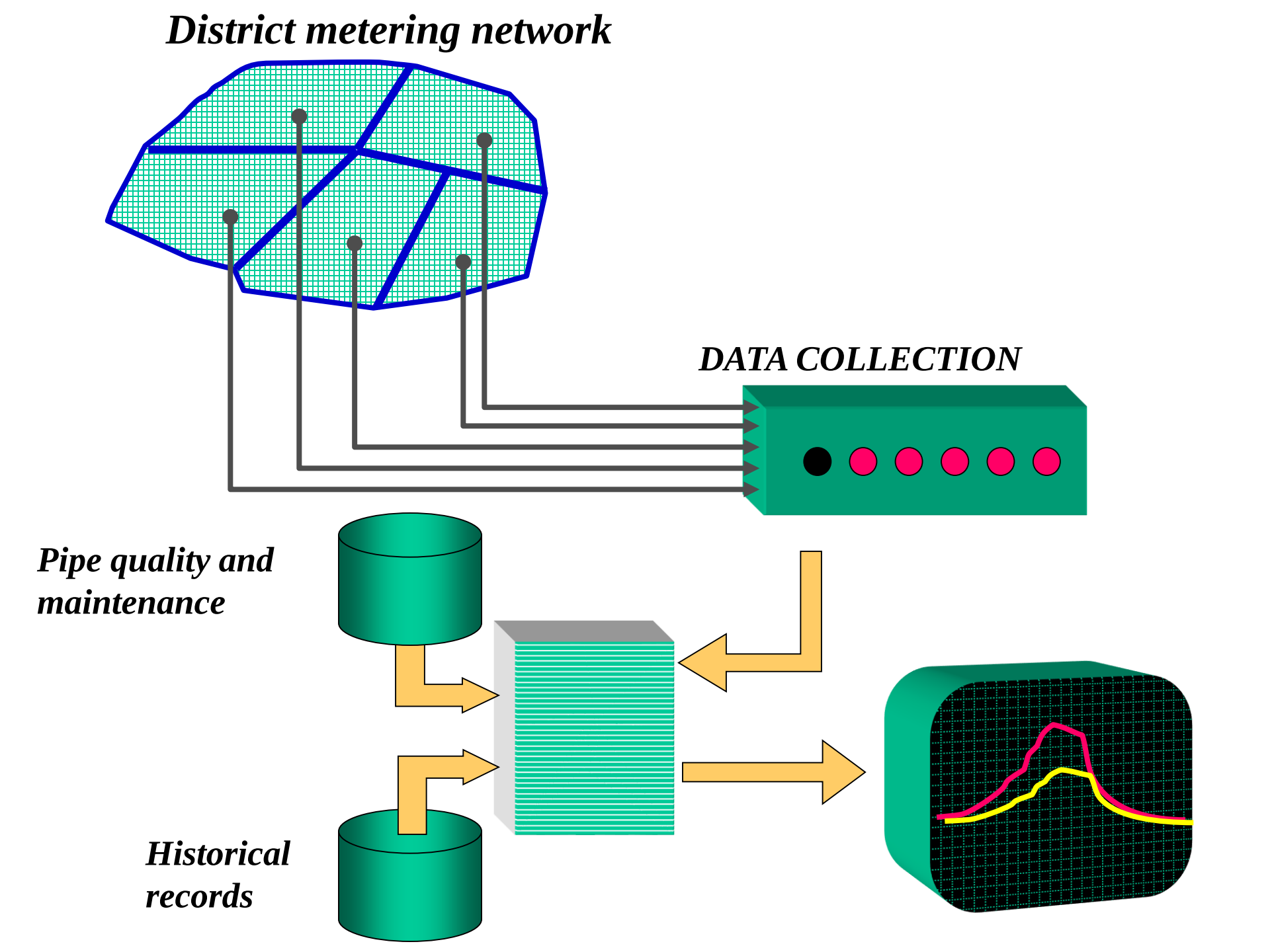
District metering

Water network is divided into districts



Measures for each district

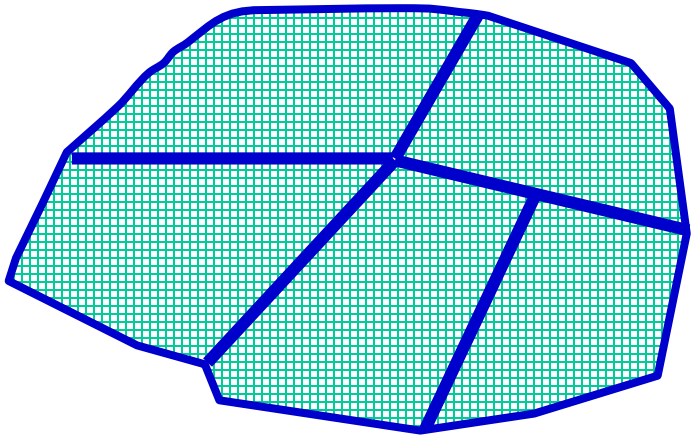



District metering network
DATA COLLECTION
Pipe quality and maintenance
Historical records

Comparison with previous days' supply curves makes it possible to identify (night time hours) anomalies in consumption and to consequently take targeted action to seek leakage in this particular district.

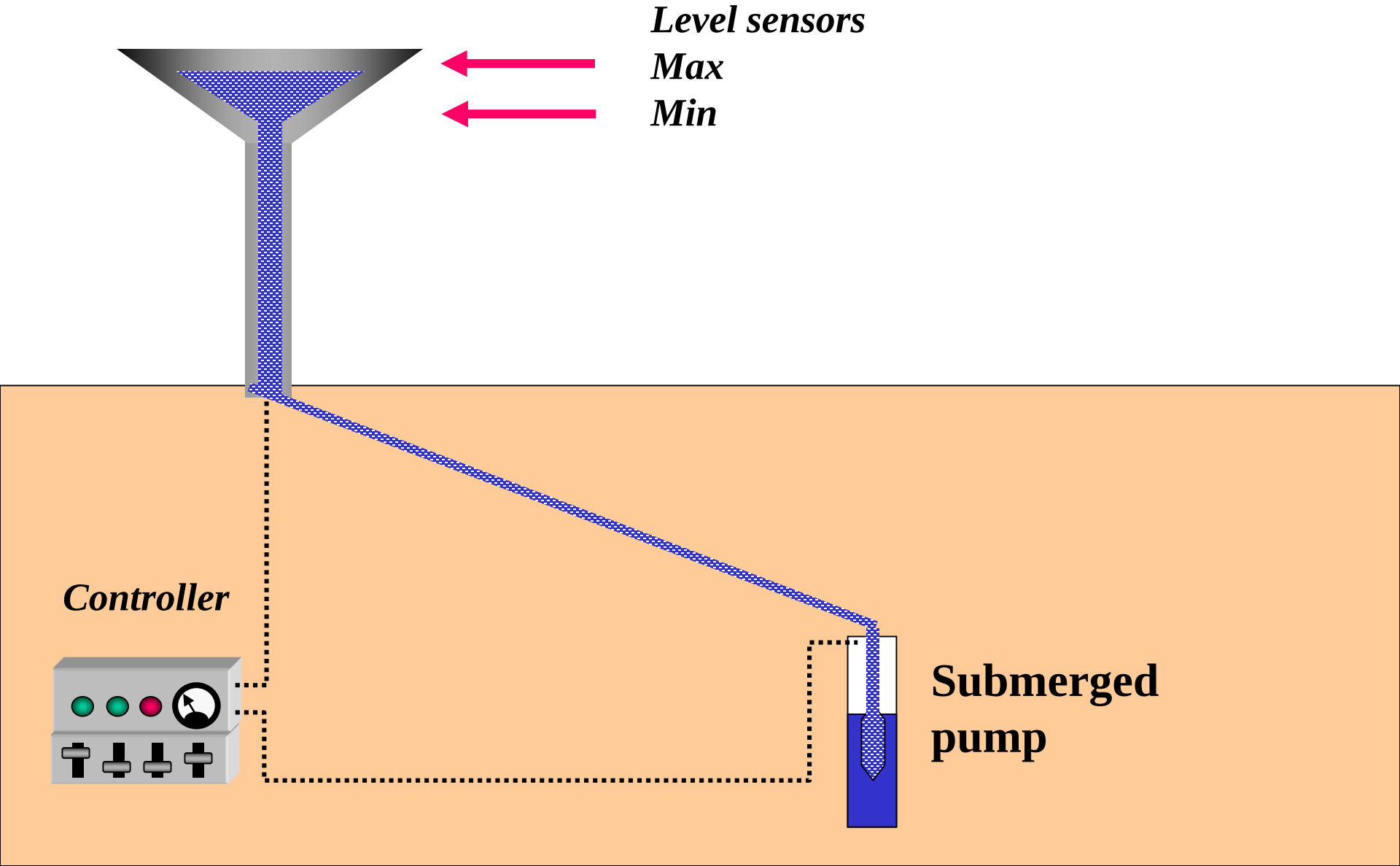
In the same time we can regulate in optimal way the pressure of each district .

District-based network



AUTOMATION
IN WATER MANAGEMENT

Automation and far-control: the first systems



Today a wide selection of sensors is possible

Physical parameters

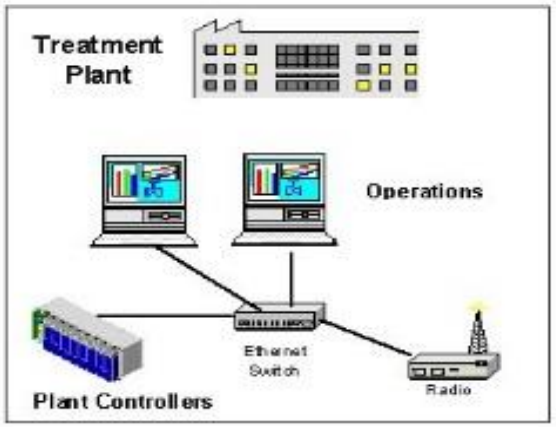
Flow rate, water level, temperature, switch, meteo status,……

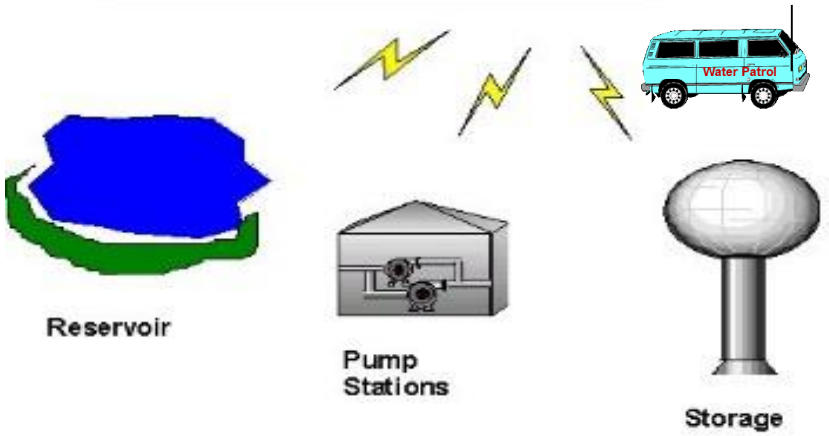
Chemical parameters

Dissolved oxygen, residual chlorine, PH, COD, ……

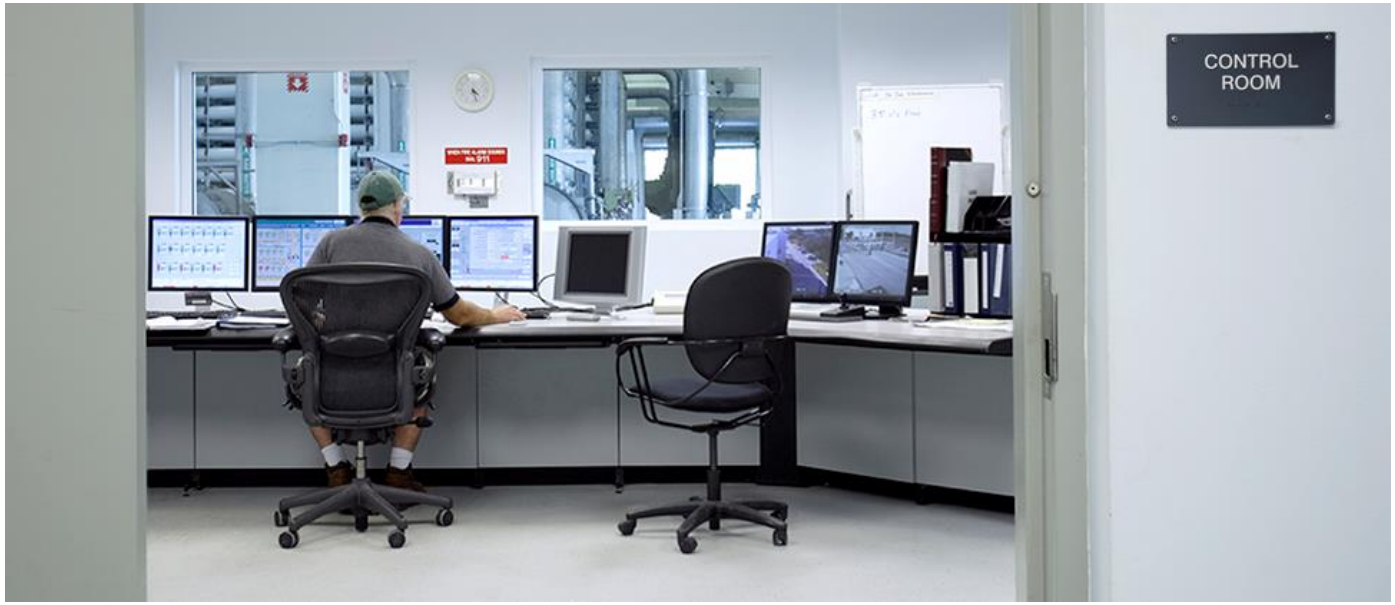
In general, the sensors require an electrical supply and a link with central control. If it is not available, you can use long-life batteries (or solar energy) and a Radio link.

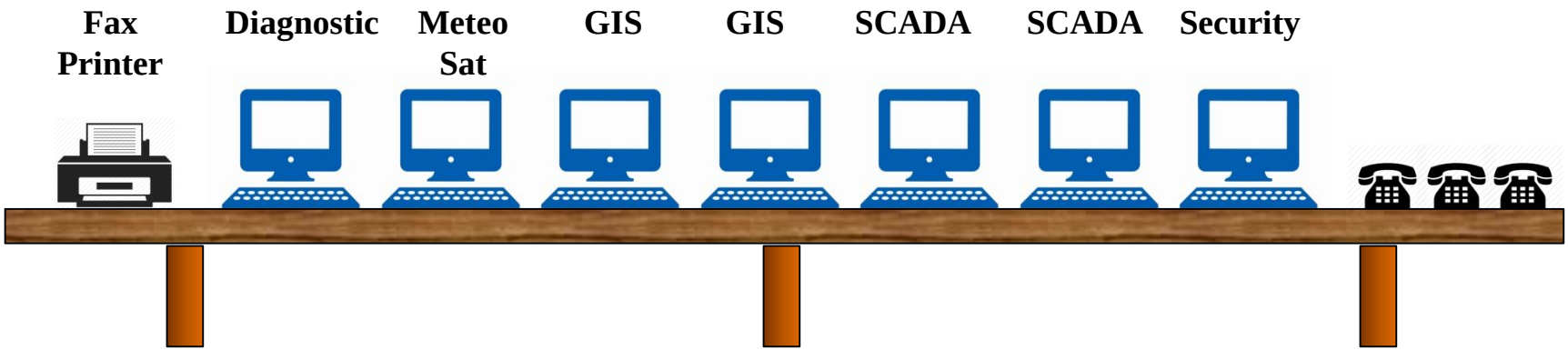
SCADA SYSTEMS
(Supervisory Control And Data Acquisition)





IDEAL DESK OF A SCADA SYSTEM





Roma, 31 gennaio 2018

WATER SERVICES MANAGEMENT

TECHNICAL MANAGEMENT

- WATER TREATMENT PLANT AND NETWORKS -

Renato
Drusiani

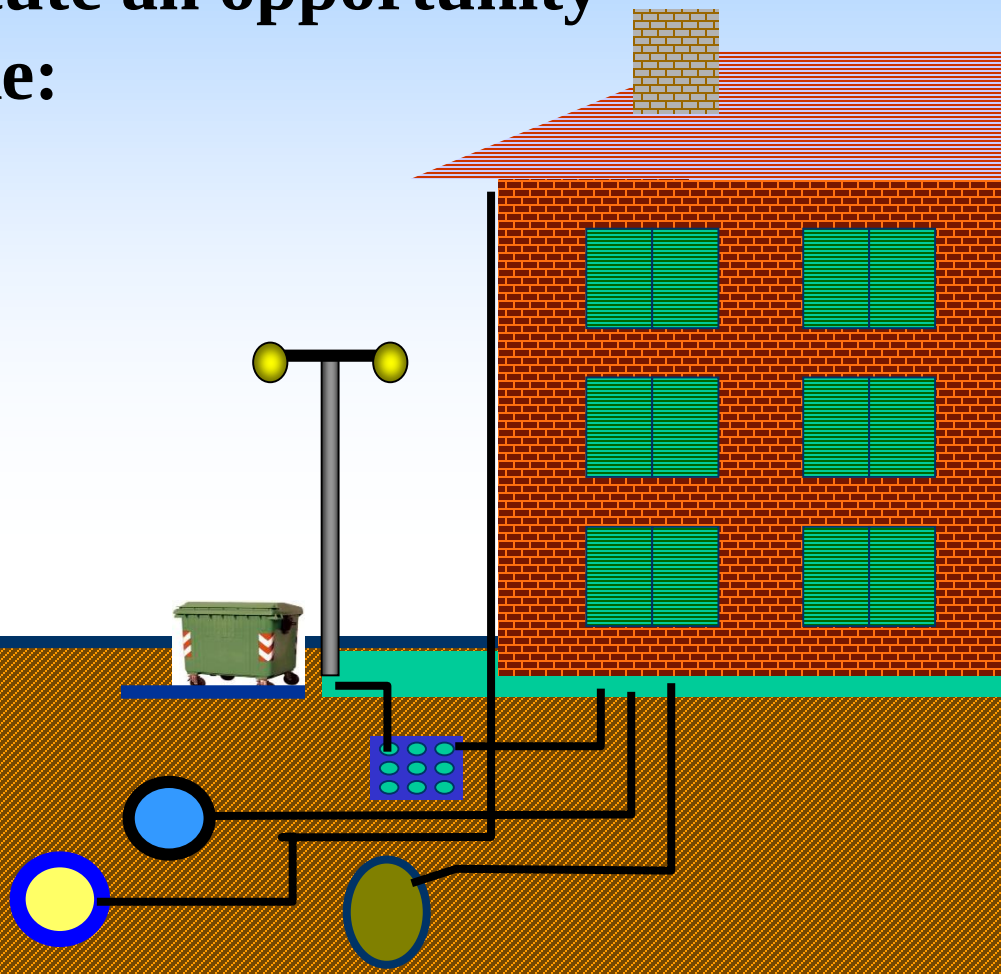
UTILITALIA

WATER SERVICES AND OTHER PUBLIC UTILITIES

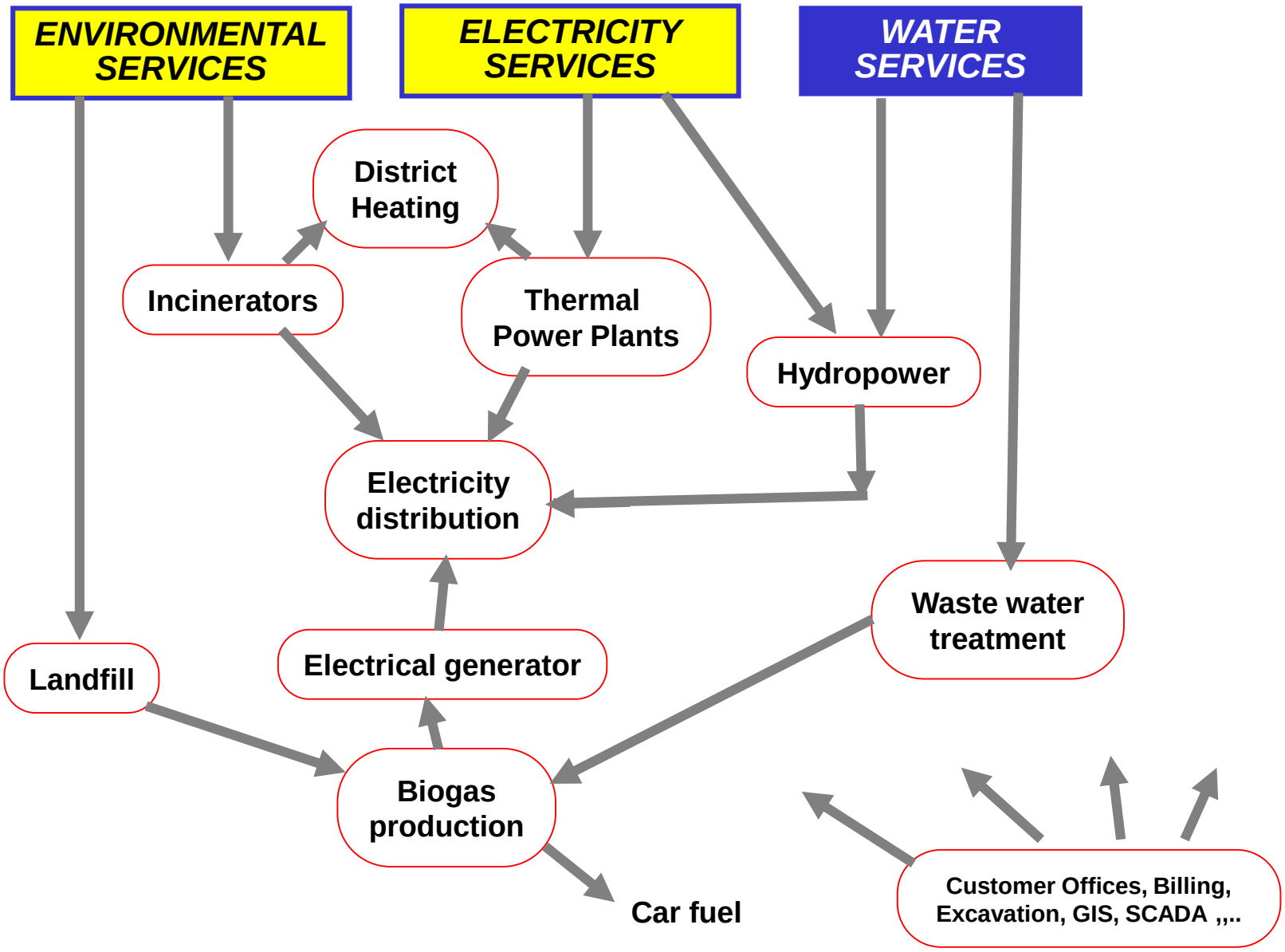
Public Utilities: a coordinated approach

The presence of different public utility services in an urban area can constitute an opportunity for operational synergies like:

Excavation
Cartography (GIS)
Billing services
Emergency patrols
……



Sinergies in managing public services



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