

Drinking Water 1



Room 2.99

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Introduction

Types of treatment schemes for:

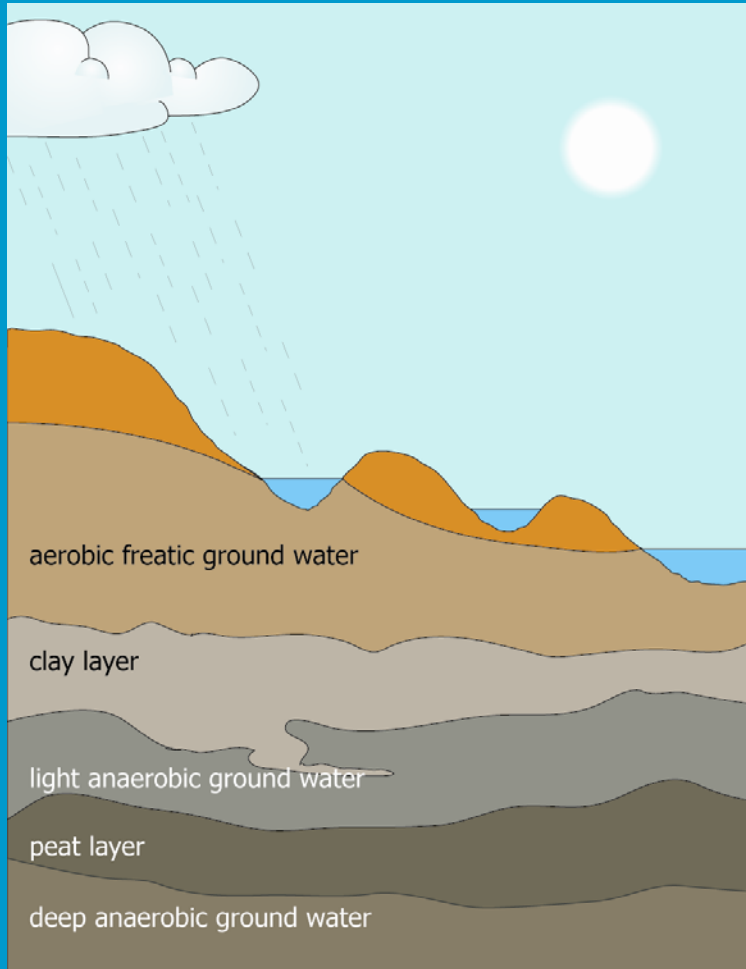
3 types of ground water:

- aerobic unconfined ground water
- anaerobic ground water
- deep anaerobic ground water

3 types of surface water:

- direct treatment
- infiltration water
- bank filtration

Ground water treatment



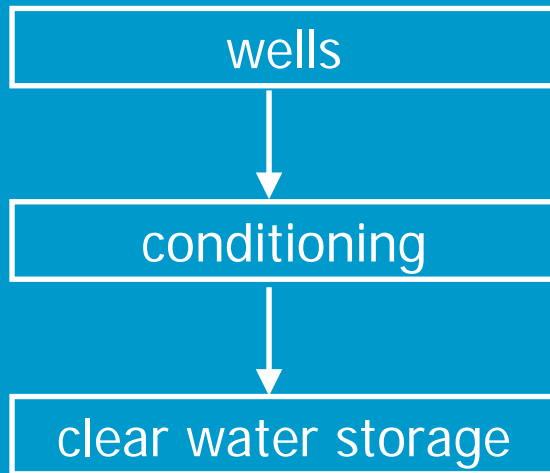
Ground water treatment

Aerobic ground water (unconfined)



Ground water treatment

Aerobic ground water (unconfined)



characteristics:
limited to no treatment

with soil of sand:
aggressive, low pH → marble filtration
 $\text{CaCO}_3 + \text{CO}_2 + \text{H}_2\text{O} \rightarrow 2 \cdot \text{HCO}_3^- + \text{Ca}^{2+}$

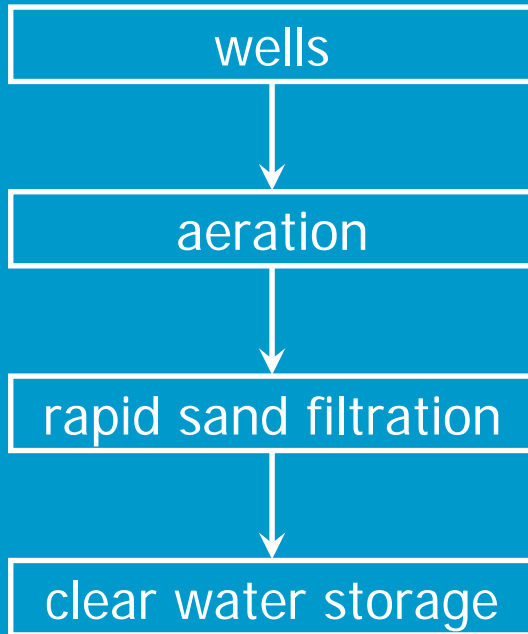
with calcareous soil (Z-Limburg):
high hardness → softening
 $\text{NaOH} + \text{Ca}^{2+} + \text{HCO}_3^- \rightarrow \text{CaCO}_3 + \text{Na}^+ + \text{H}_2\text{O}$
 $\text{Ca}(\text{OH})_2 + \text{Ca}^{2+} + 2 \cdot \text{HCO}_3^- \rightarrow 2 \cdot \text{CaCO}_3 + 2 \cdot \text{H}_2\text{O}$

Ground water treatment



Ground water treatment

Anaerobic ground water (confined)



characteristics:

ammonium, iron and manganese

aeration:

removal of CO_2 ; increase of O_2



filtration:



1 mg iron uses: 0.14 mg O_2

1 mg manganese uses: 0.29 mg O_2

1 mg ammonium uses: 3.55 mg O_2

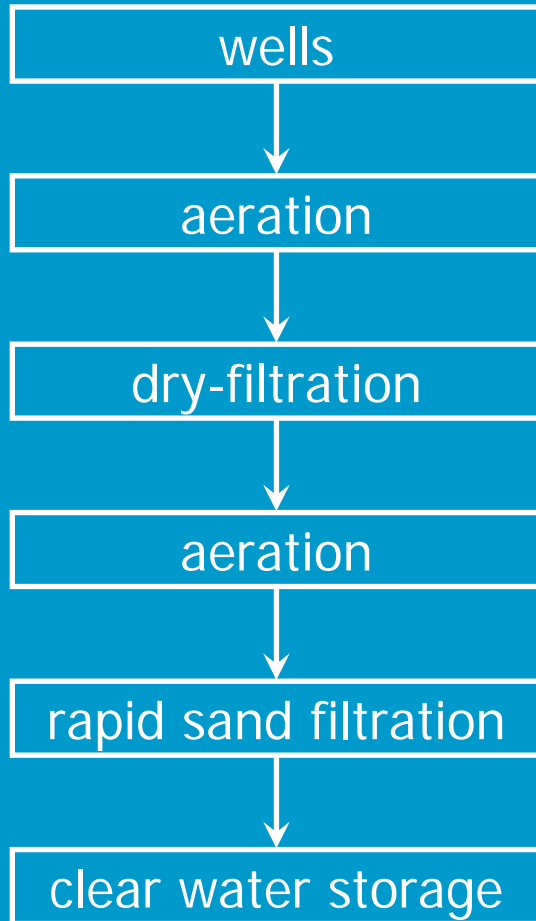
Ground water treatment

Deep anaerobic ground water (confined)



Ground water treatment

Deep anaerobic ground water (confined)



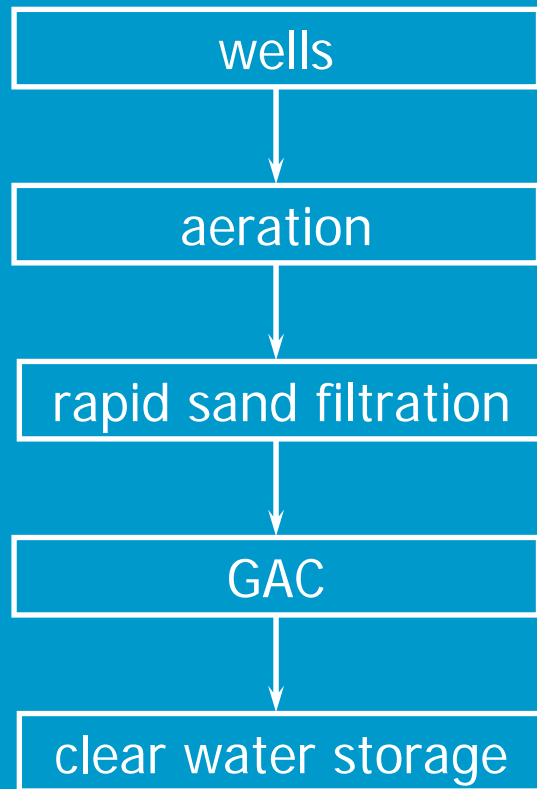
characteristics:

high concentration ammonium,
methane, hydrogen sulfide

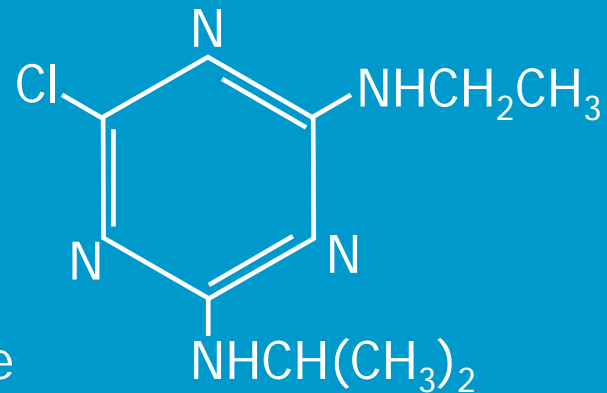
1 mg ammonium uses 3.55 mg O₂,
therefore dry-filtration !!

Ground water treatment

Activated carbon filtration



characteristics:
pesticides
odor, taste



atrazine

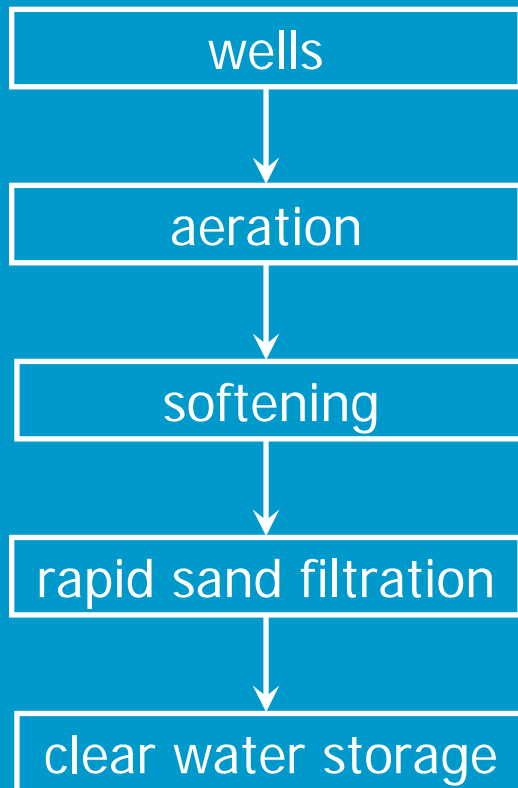
Ground water treatment

Activated carbon filtration

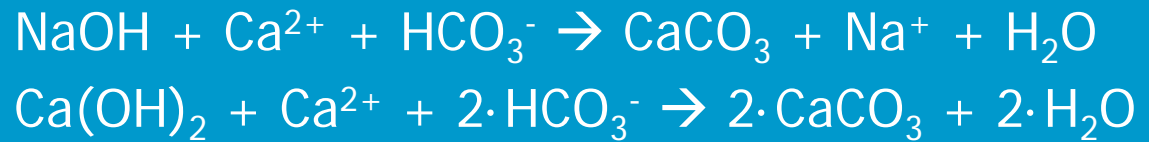


Ground water treatment

Softening

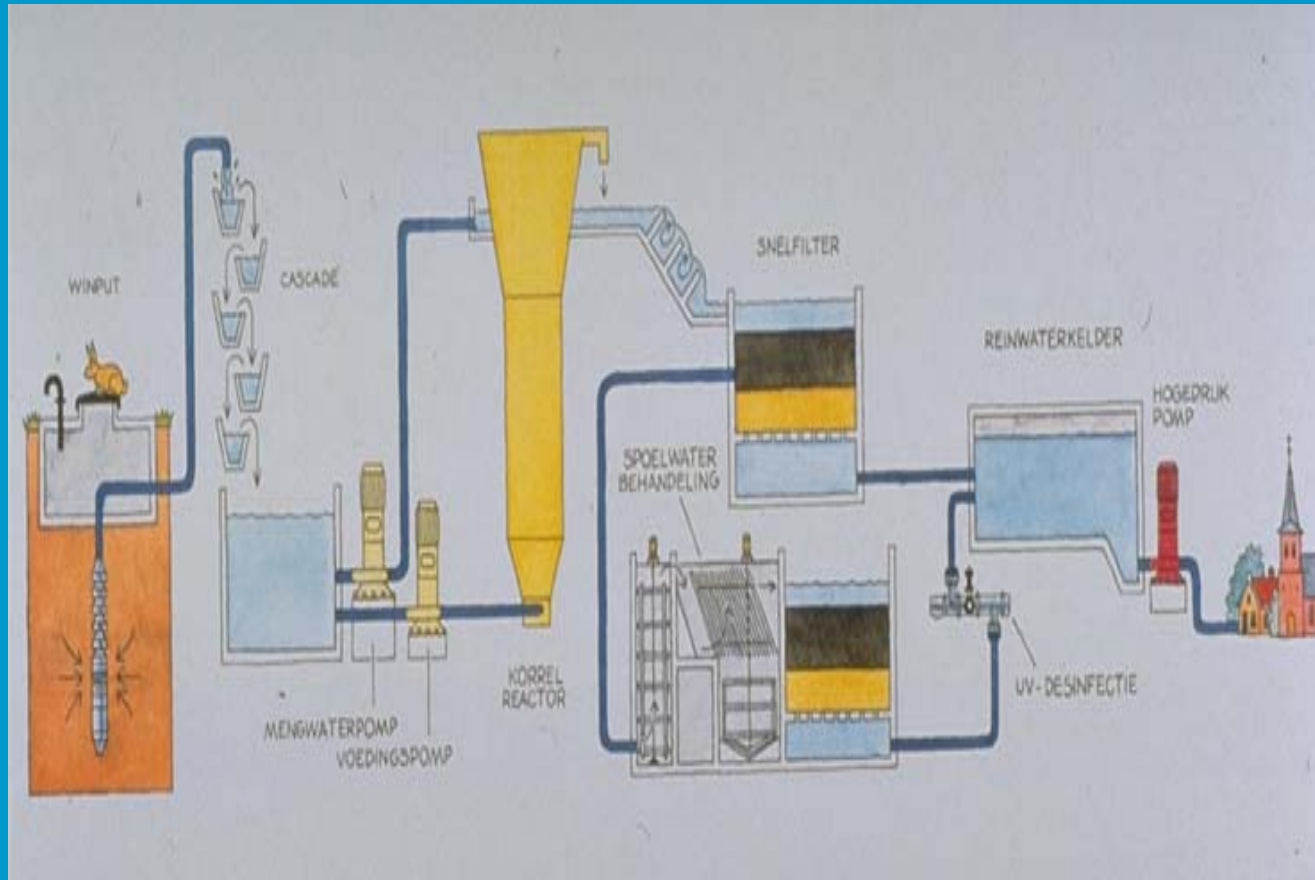


characteristics:
high hardness



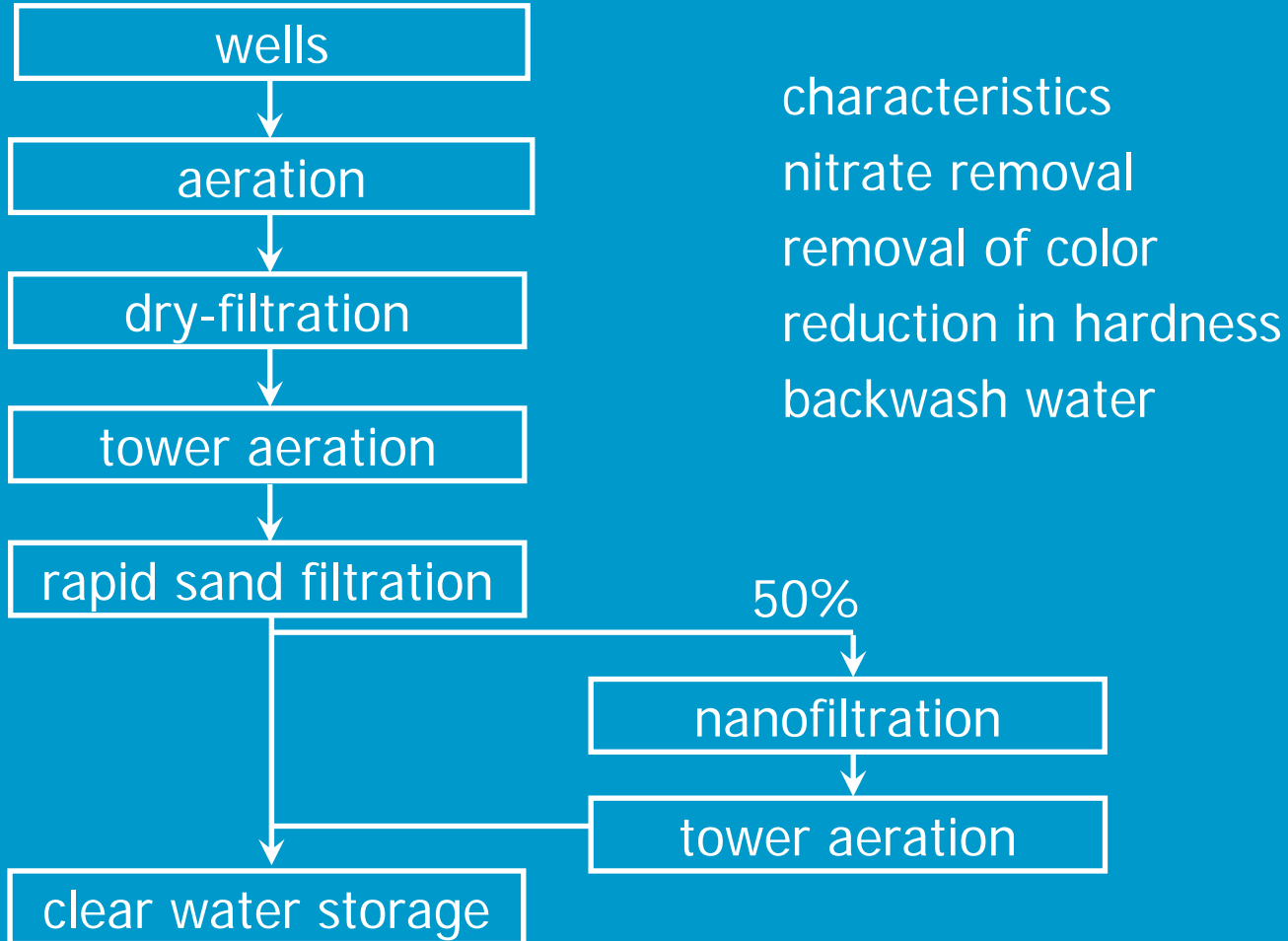
Ground water treatment

Softening



Ground water treatment

Membrane filtration



Ground water treatment

Membrane filtration

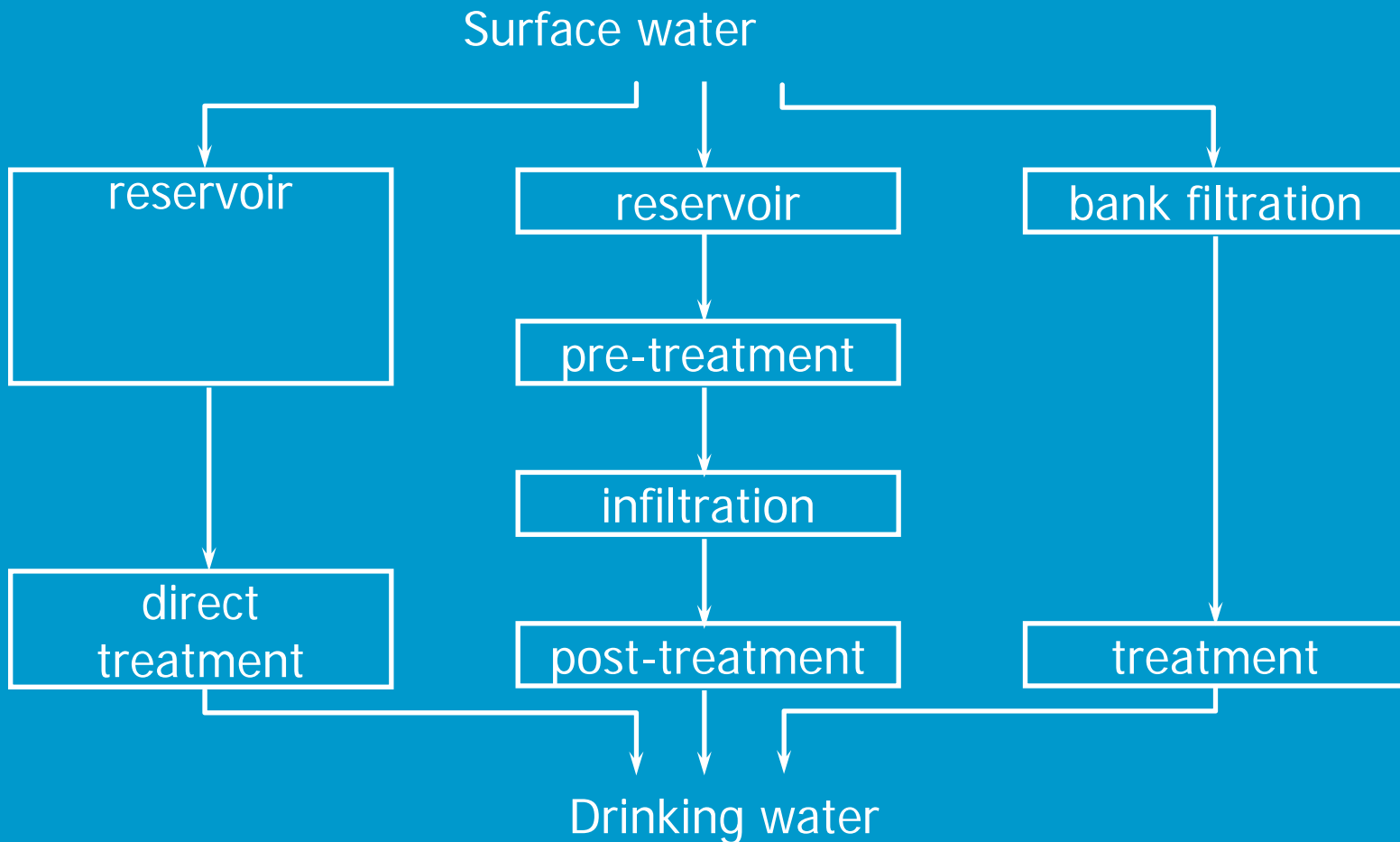


Surface water treatment



Surface water treatment

Types of surface water



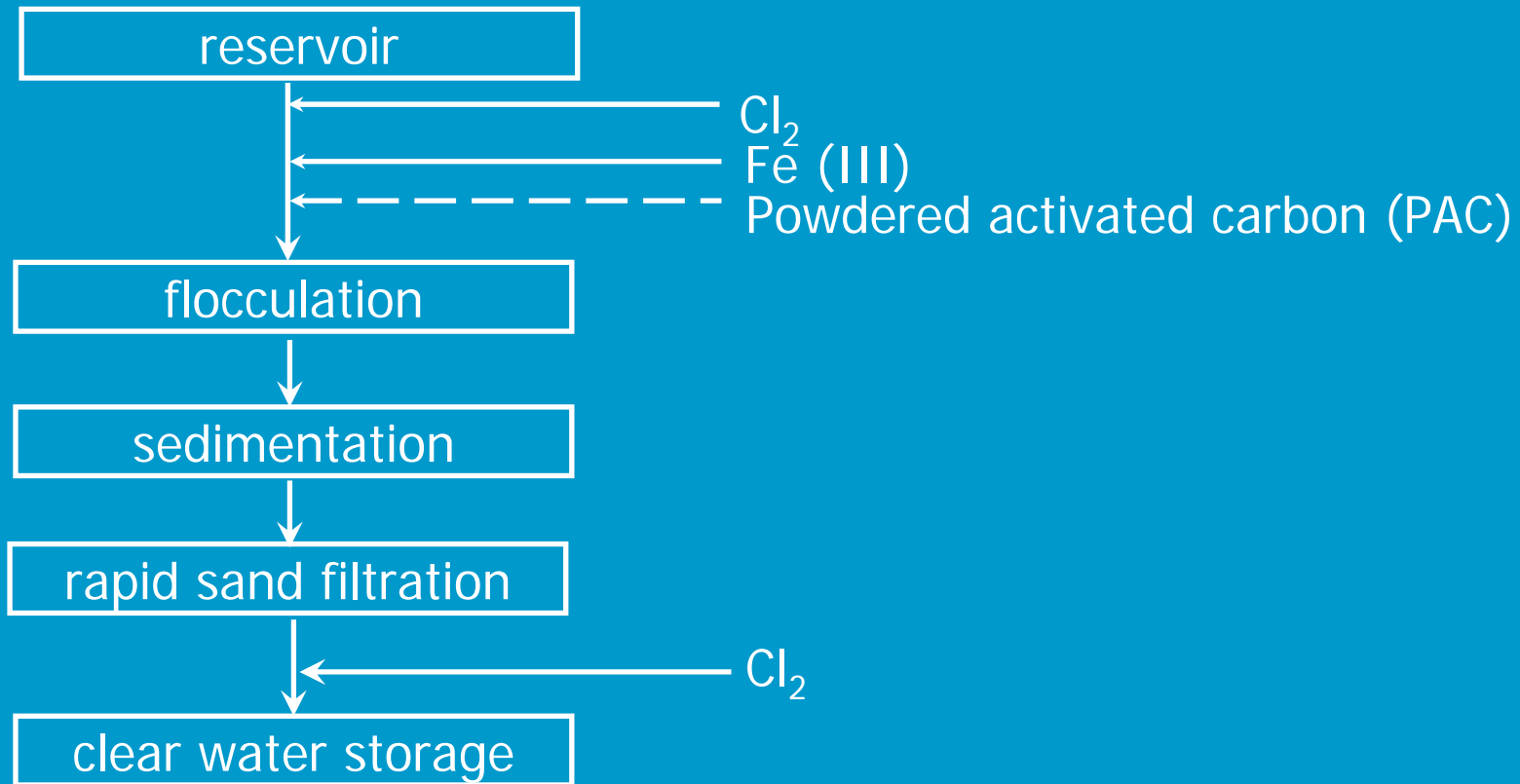
Surface water treatment

Direct treatment of surface water (traditional)



Surface water treatment

Direct treatment of surface water (traditional)



Surface water treatment

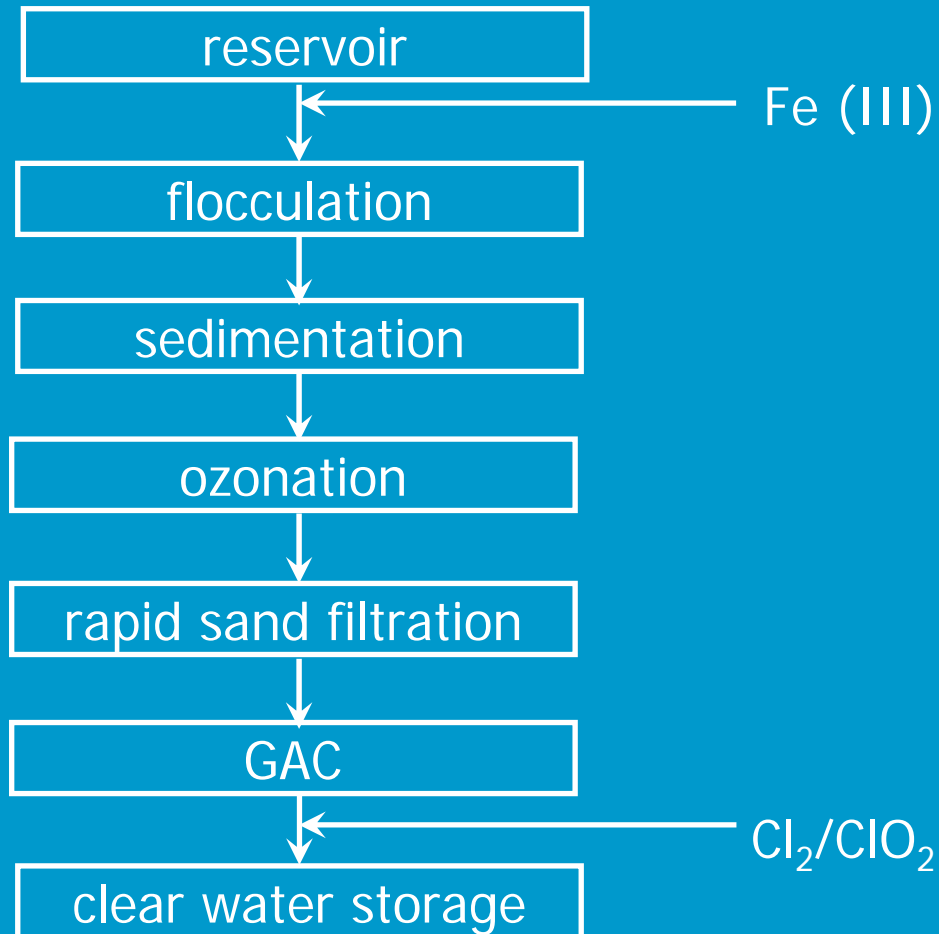
Requirements for treatment of surface water

- no turbidity
- no taste and odour
- no bacteria
- selective intake

- disinfection byproducts (1973 trihalomethanes)
- pesticides (1987 bentazon)
- disinfection byproducts (1995 bromate)

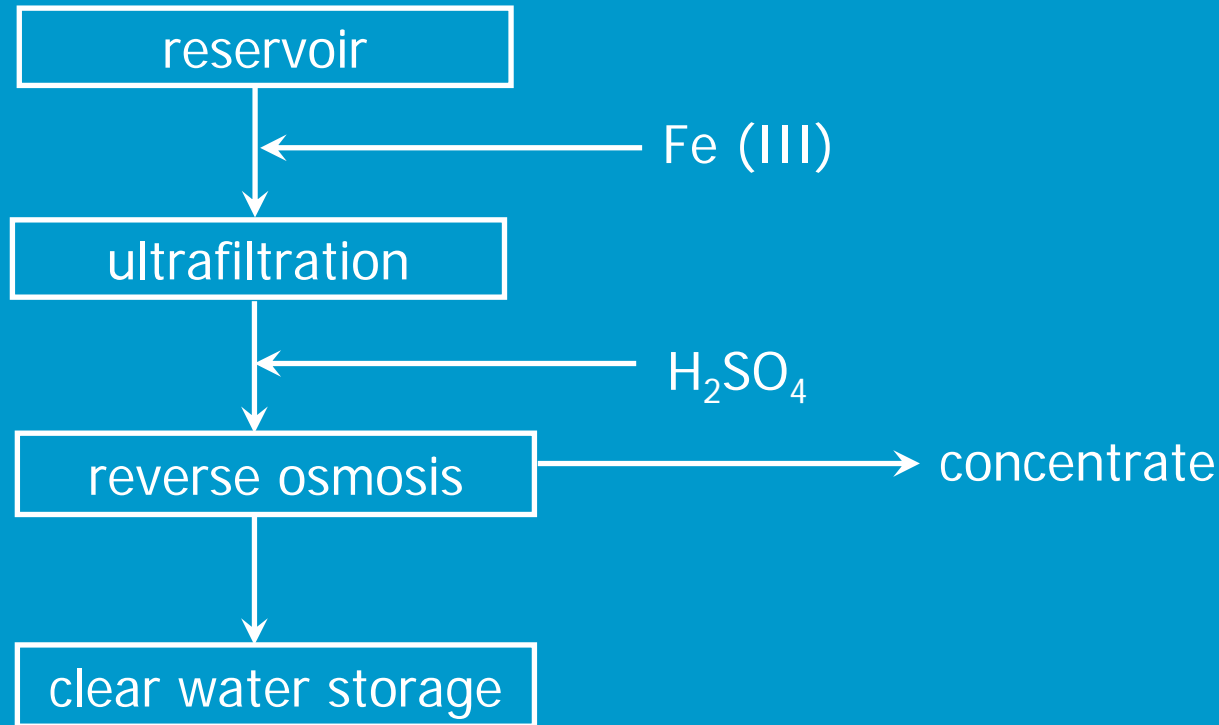
Surface water treatment

Direct treatment of surface water (modern)



Surface water treatment

Direct treatment of surface water (future)



Surface water treatment

Direct treatment of surface water(future)



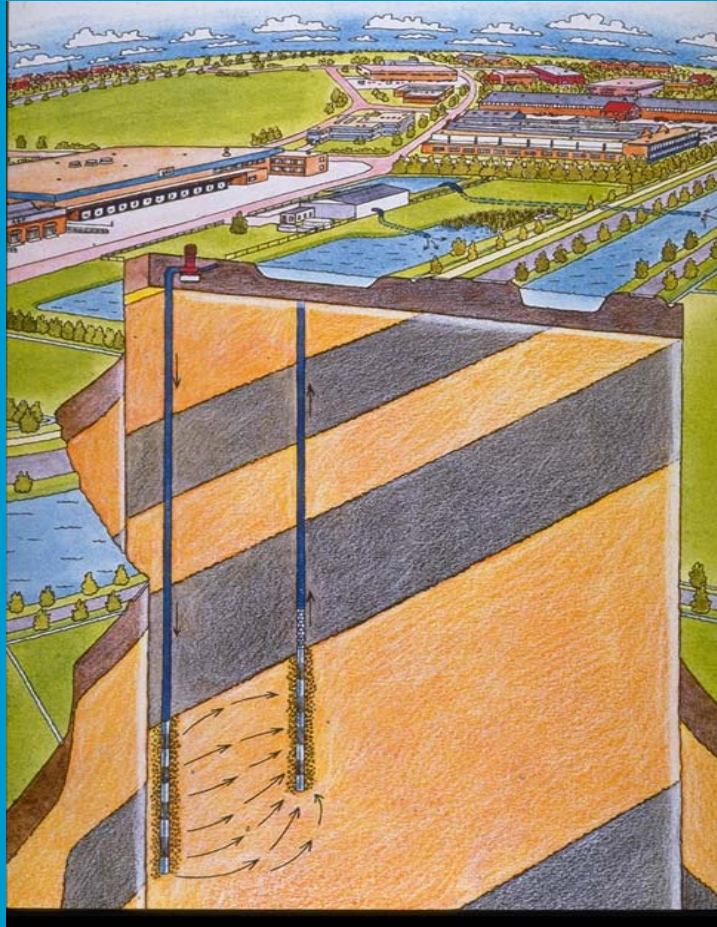
Surface water treatment

Treatment with artificial recharge (open infiltration)



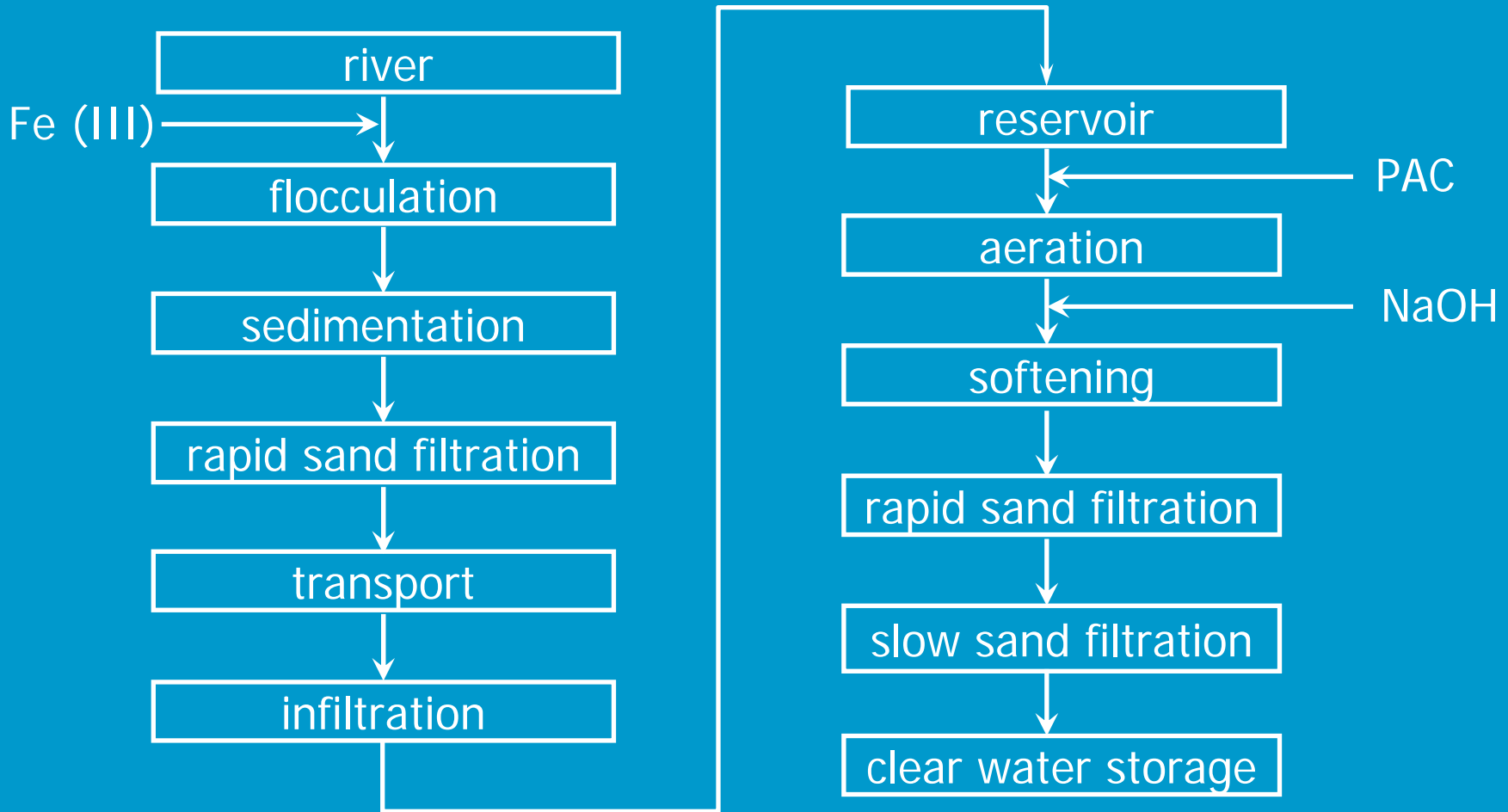
Surface water treatment

Treatment with artificial recharge (deep infiltration)



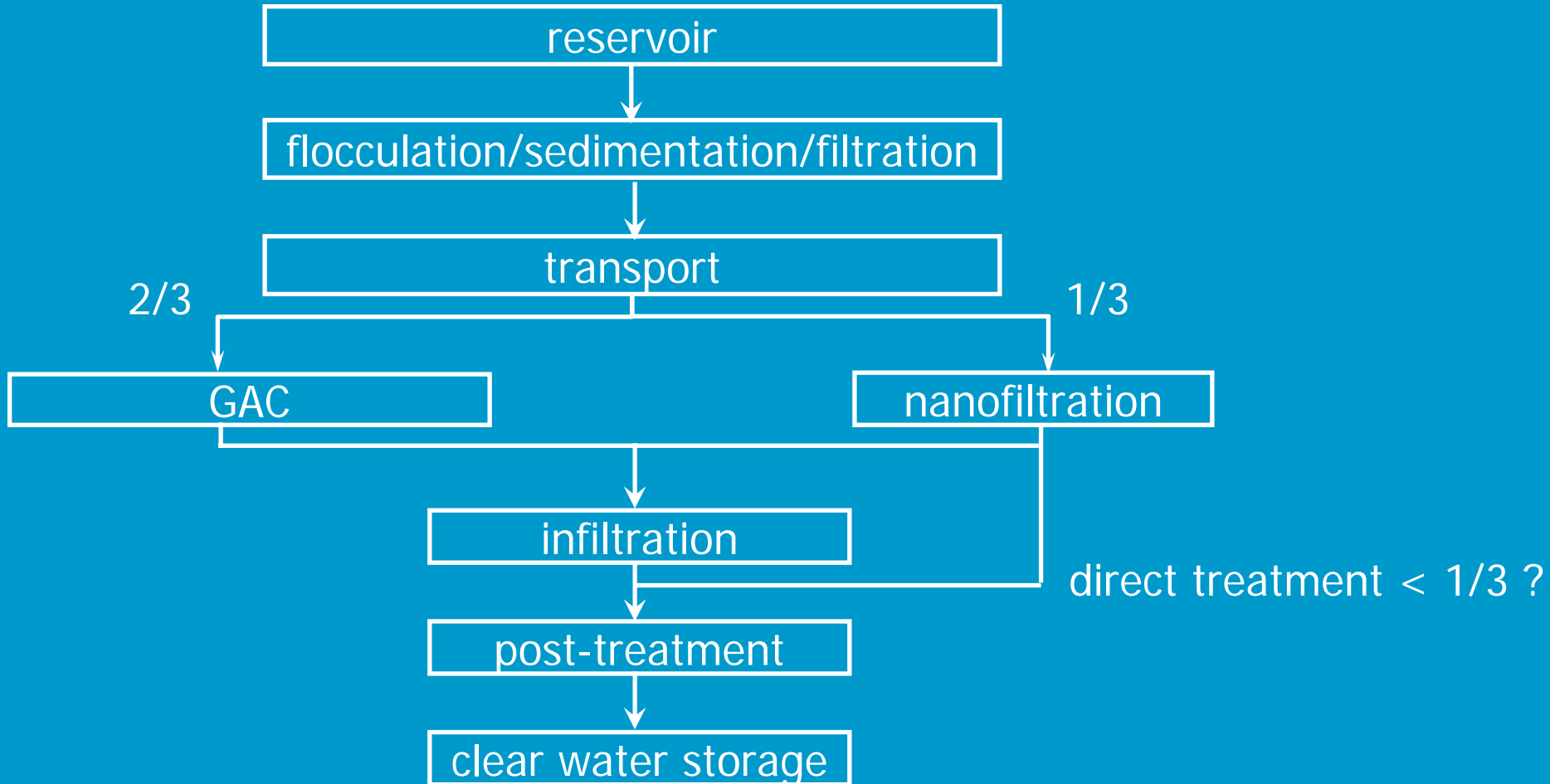
Surface water treatment

Treatment with artificial recharge (traditional)



Surface water treatment

Treatment with artificial recharge (future)



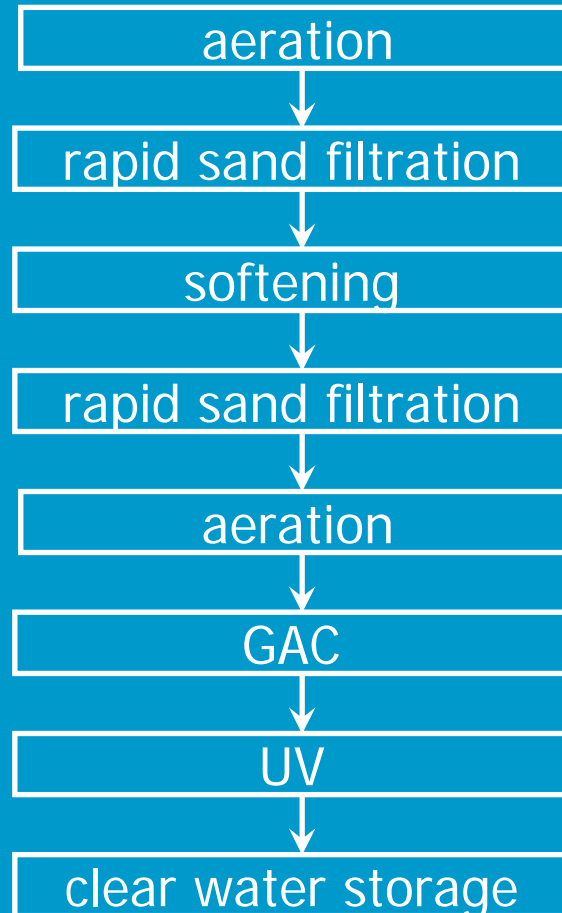
Surface water treatment

Treatment with bankfiltration



Surface water treatment

Treatment with bankfiltration



Treatment processes

Which treatment process and its purpose?

aeration/degasification	→	CH_4 , O_2 , CO_2 , H_2S , dissolved compounds, Fe^{2+} , Mn^{2+} , NH_4^+ ,
rapid sand filtration	→	suspended solids (flocs < $1\mu\text{m}$)
slow sand filtration	→	suspended solids, colloids, org. and anorg. degradable compounds
activ. carbon filtration	→	dissolved organic compounds
softening	→	Ca^{2+} , HCO_3^-
membrane filtration	→	dissolved anorg. and org. compounds
coagulation/flocculation	→	colloids, suspended solids
sedimentation/flotation	→	suspended solids (flocs > $1\mu\text{m}$)
oxydation/disinfection	→	organic compounds, micro-organisms