

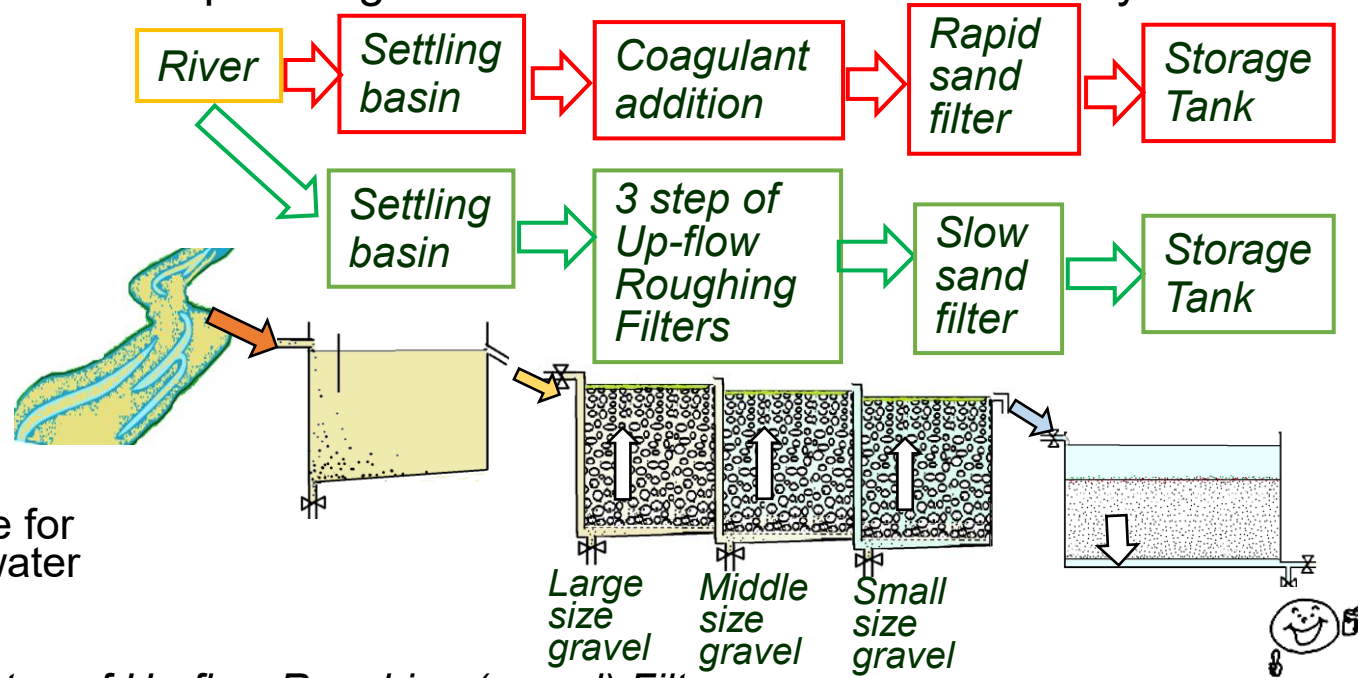
⑩ Sri Lanka, Pakistan



I advised a renewal WTP of National Hospital in Sri Lank in 2000.

Mr. Okada, Japanese consultant visited to the Ratnapura Hospital site. Existing old Rapid Sand Filter plant did not work well. Original plan was a renewal of RSF. He asked me that a suitable treatment system for turbid water in tropical region. I advised to use of new URF system for turbid water.

⑩8 slides



Two set of settling basins, URFs and sand filters were constructed for easy maintenance.

These open system was covered with metal mesh screen to protect fallen leaves and plastic bags.



Intake for raw water

Settling basin



Sank heavy particles

3 step of Up-flow Roughing (gravel) Filters



A fairly large size of 3 steps of URF

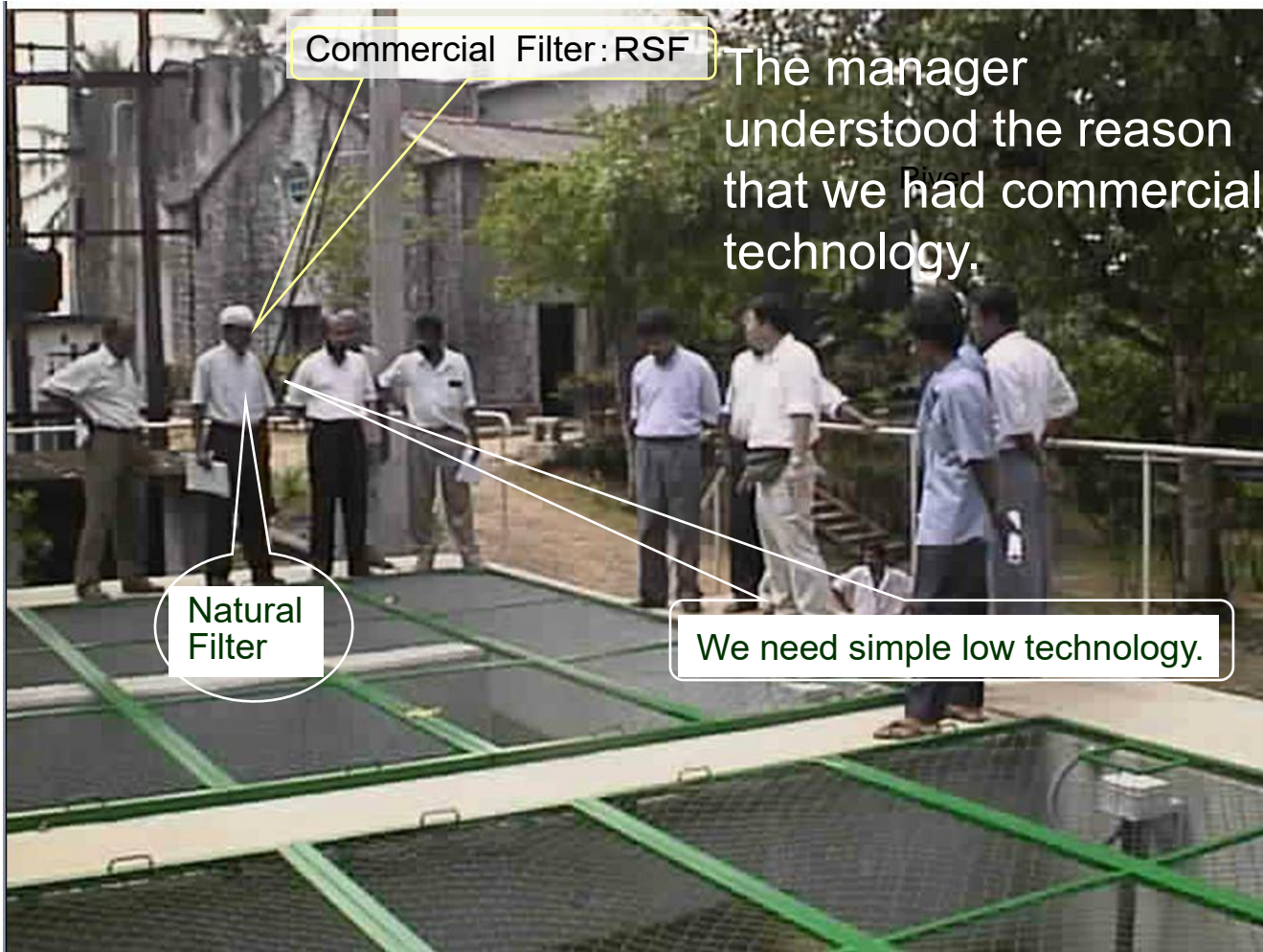
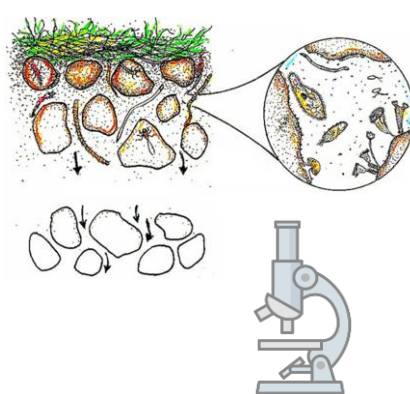


Slow Sand Filter

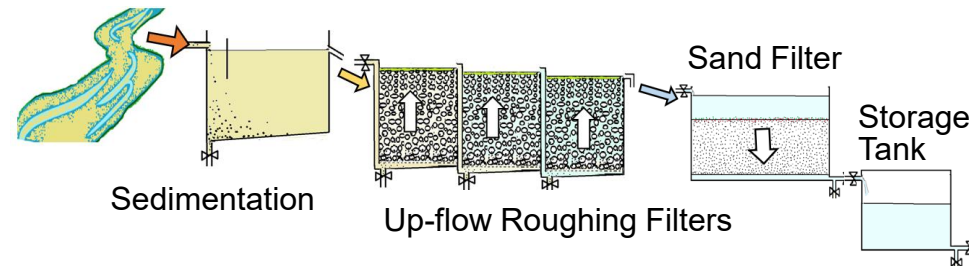


Storage tank





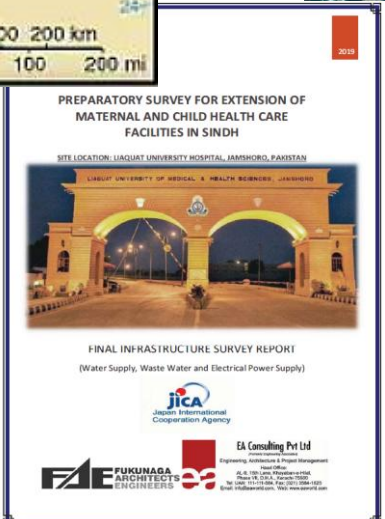
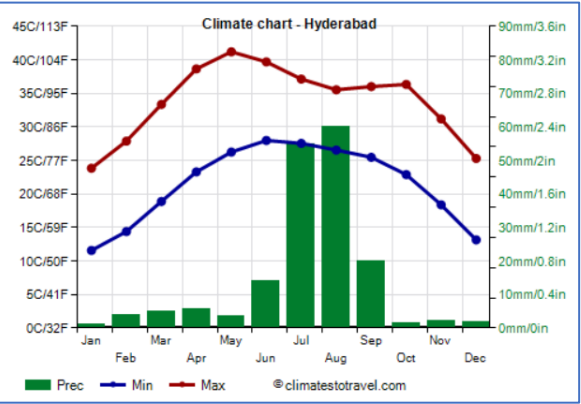
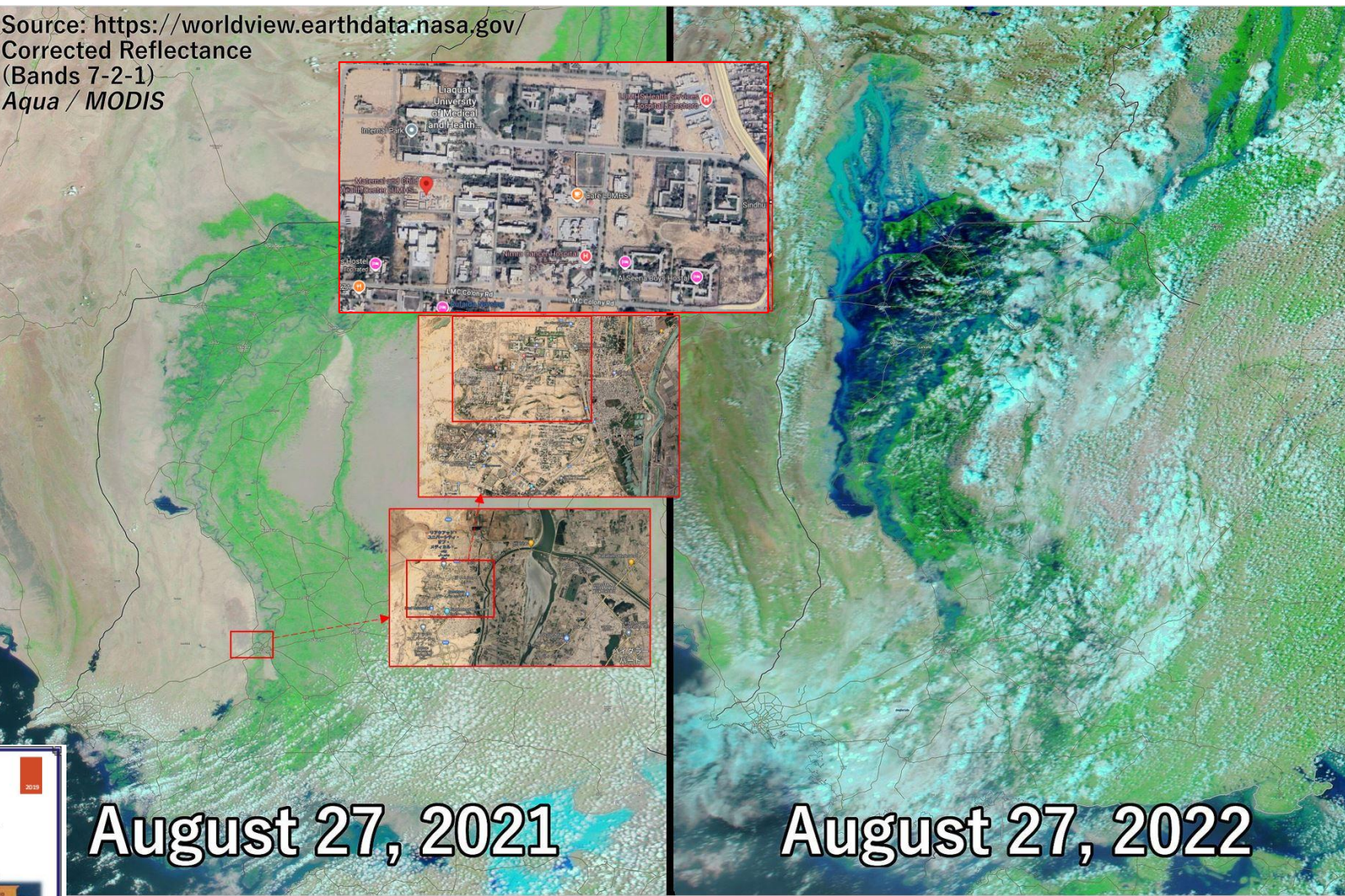
I explained the chemical free mechanism of EPS, the maintenance and management of EPS at the site to the engineers. This was wise use of natural system.



I visited again this site after construction in 10 years later. The hospital director said there was no problem.

EPS plant for a big national hospital
in Jamshoro, Hyderabad, in Pakistan.

Source: <https://worldview.earthdata.nasa.gov/>
Corrected Reflectance
(Bands 7-2-1)
Aqua / MODIS



August 27, 2021

August 27, 2022

There is heavy rain from July to September, Indian monsoon period. In this period, there is often a big flood of Indus River. However, there is severe dry period.

I advised to construction of a new water purification plant for safe water to a big national hospital (Maternal and Child Health Center LUMHS Jamshoro) in Jamshoro, Hyderabad, in Pakistan from 2019.

We proposed URF and SSF.

Two lines of 2 steps of URF and SSF were completed in 2025

50m3/day



Turbid water from Indus canal in Jamshoro, Hyderabad.

Settling pond

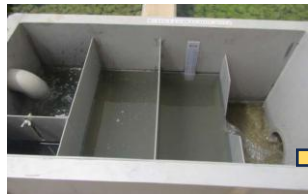
Coagulant + Rapid Sand Filter

Incomplete performance

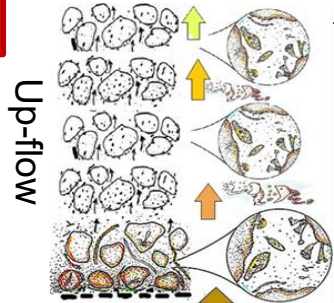


Turbid water

Flow rate measure unit

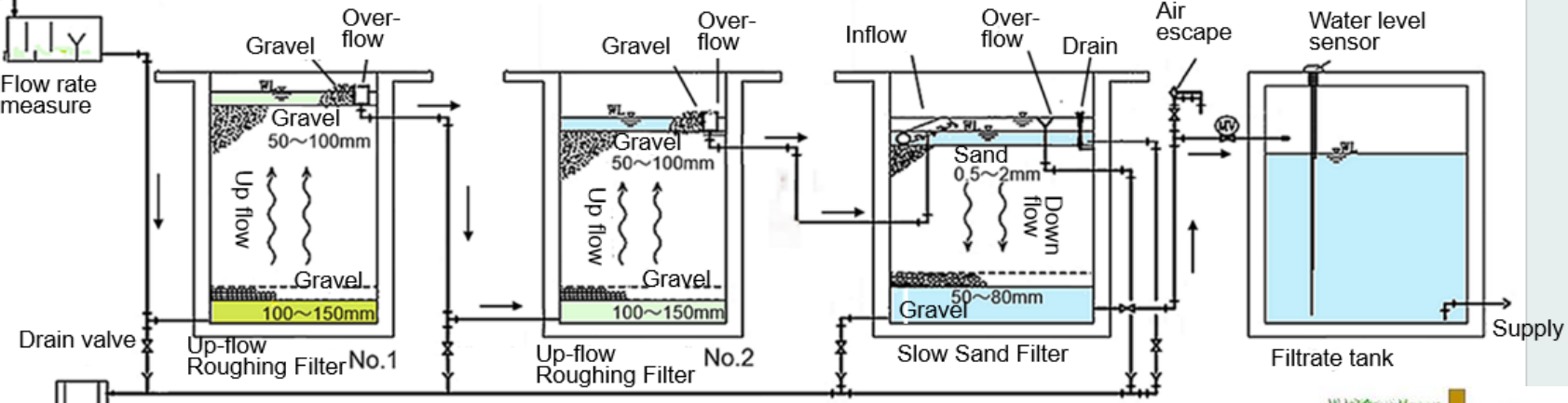


The biological community (mud) within the URF captures and decomposes the turbidity. Only a small amount of turbidity adheres to the surface of the gravel. Only a small amount of turbidity adheres to the surface of the gravel.

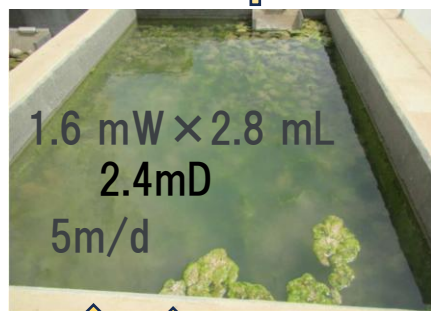


Test run

Sometimes, sludge drain. DO is always supplied.



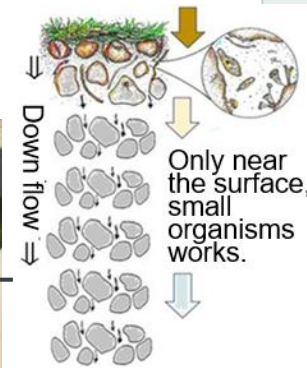
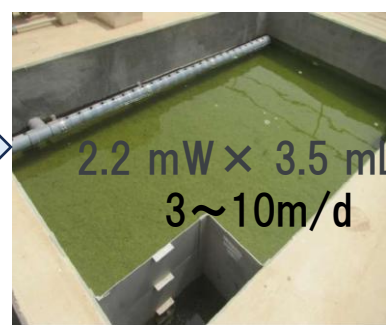
No. 1 URF



No. 2 URF



Slow Sand Filter



URF does not become clogged with large pebbles. Dissolved oxygen is constantly supplied from below, allowing biological communities to thrive in a safe environment.

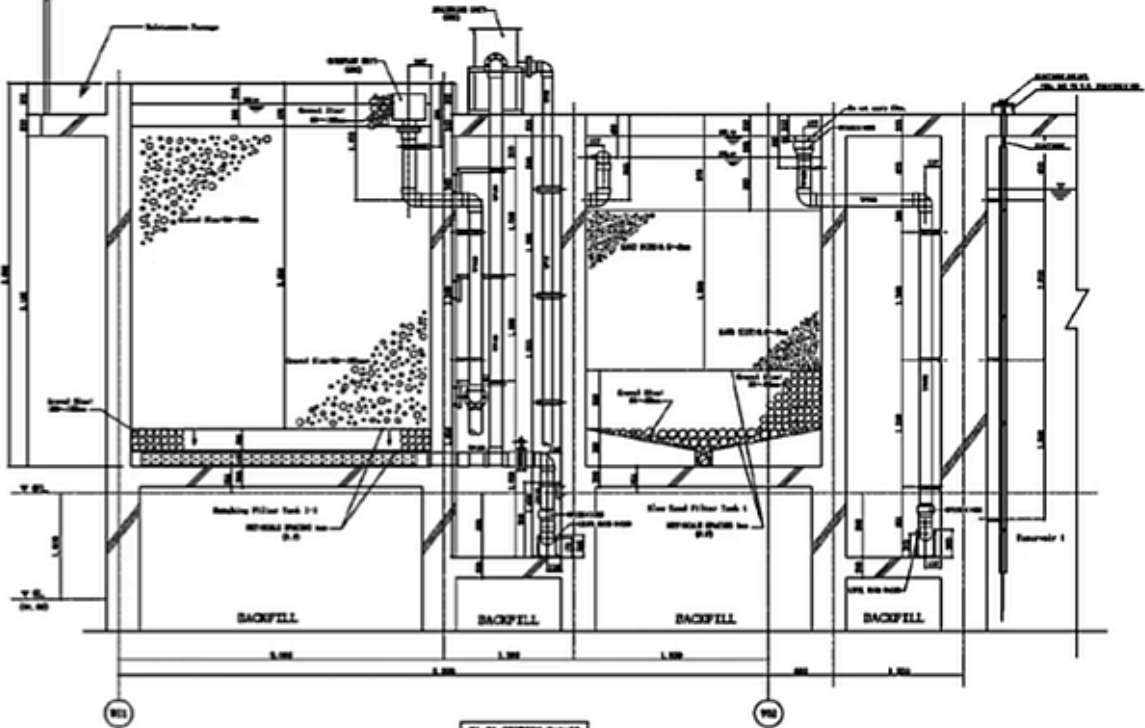
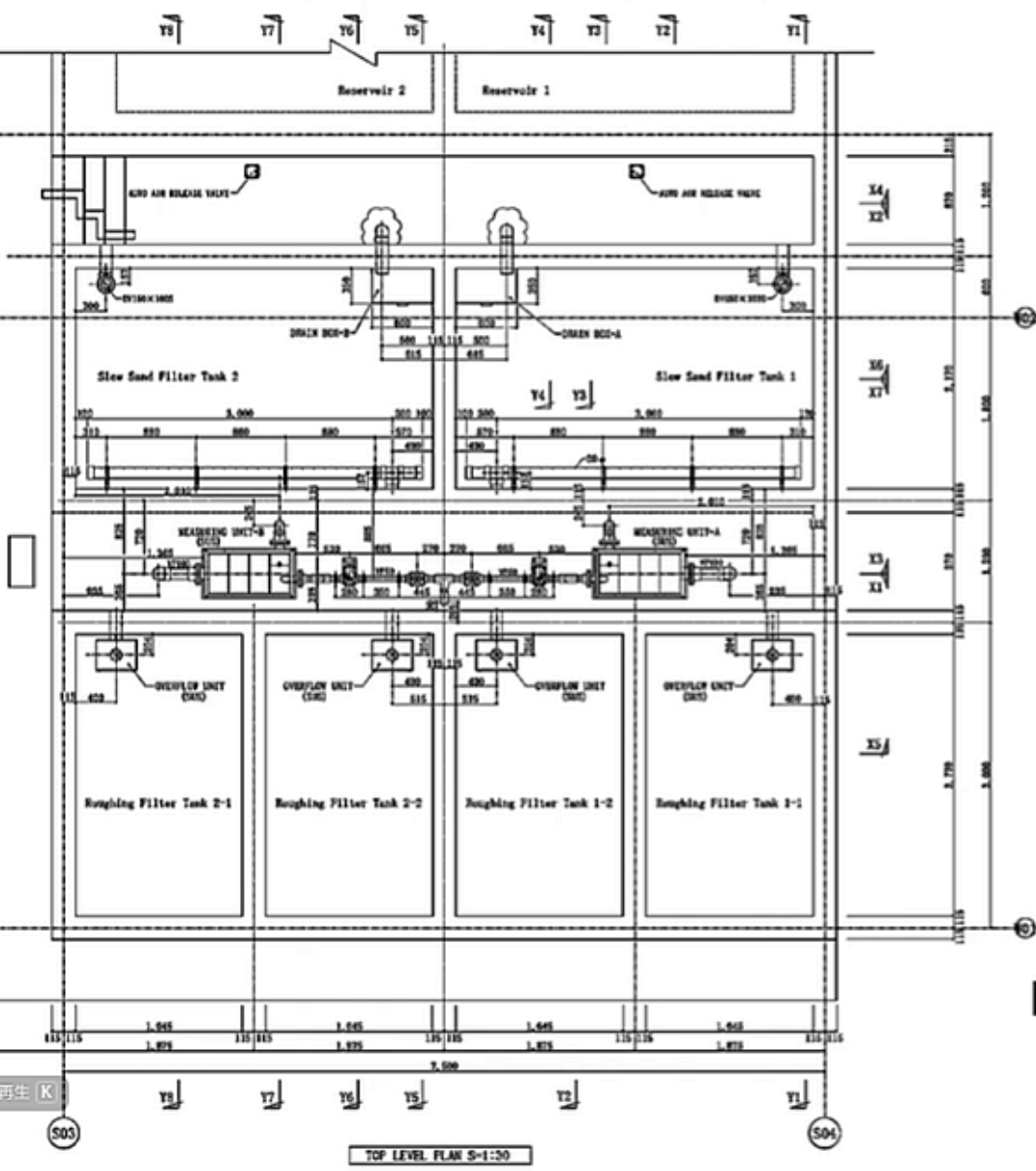
Sludge drain is occasionally; a small amount is sufficient. Do not remove it all.

If the water depth of the SSF is shallow, there will be no oxygen shortage at night. And a faster flow rate prevents oxygen depletion.

Living organisms capture and break down dissolved substances and turbidity that react with them.

When biological communities are active, clogging does not occur.

Two set of filtration system for maintenance



Each URF:
 1.645 m width
 x 2.77 m length
 x 3.6 m depth

Upper layer: 2.85 m
 Small gravel: 50-100 mm

Lower layer: 0.2 m
 Large gravel: 100-150 mm

Flow rate: 5.4 m/day

SSF
 2.17 m width
 x 3.52 m length
 x 3.3 m depth

Upper layer: 1.2 m
 Small sand: 0.5-2 mm
Net (to separate) 1 mm

Support: 0.55+0.35 m
 small gravel: 50-80 mm

Flow rate: 3.2 m/day

This flow rate (3.2 m/day) is too slow in comparison with English standard rate. We can apply more higher rate in tropical region. Present Thames Water company says that the rate is 12 m/day.

There are dry and re-wetting phenomena.

Biological community develops at the boundary where is almost constant flow.

When dry and re-wetting condition or a sudden change of water quality attack to this site, biological organisms escape to deep layer.

Escaped organisms become a resting form.

Living organisms has an ability to escape from risks. Snail survives during dry period. When rain comes, snail move around quickly.

Dry, rewetting and resting forms



Anhydrobiosis and Cryptobiosis, Drying-Rewetting

Become bad condition: less water, no water

Turn to resting form (cyst or egg) for dry condition. They tolerate during bad condition.

They escape to better site and survive from bad condition and period.

Water comes back again.

Organisms reactivate again when water comes.

Organisms come back to fresh water site where is food for them.

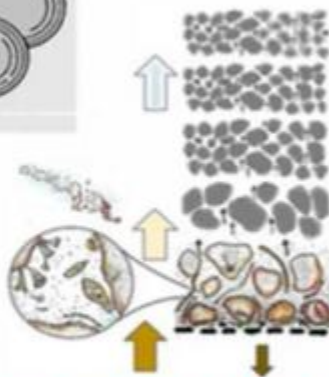
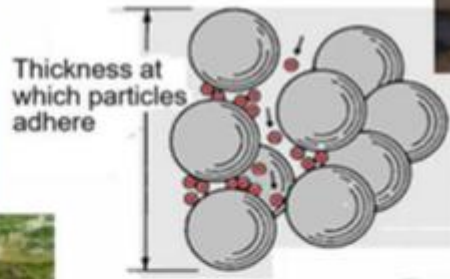
Anhydrobiosis and cryptobiosis phenomena are common in nature. Organisms, especially aquatic small organisms have a strong ability to tolerate and escape the severe period. The life span of micro-organisms is short. Their adaptability is high. They can tolerate severe period.

In case of this plant, the raw water comes only 4 hours every day. This condition may not be severe condition.

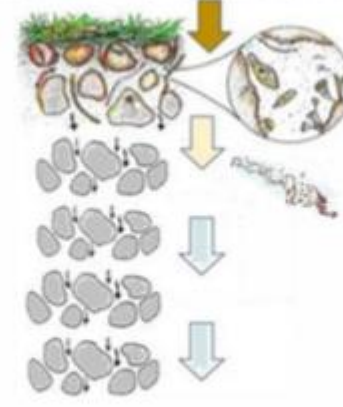
Dry and Rewetting

If some unexpected sudden change of water quality or interruption of inflow water, grazing animals escape to deep layer from the surface where is more gentle and safe condition to survive. Some turbid matter passes the surface to deep layer. And this passed matter adheres to the surface of sand.

This phenomenon occurs in soil. Rain fall is not constant. Penetrated rain drops flow slowly into deep place.



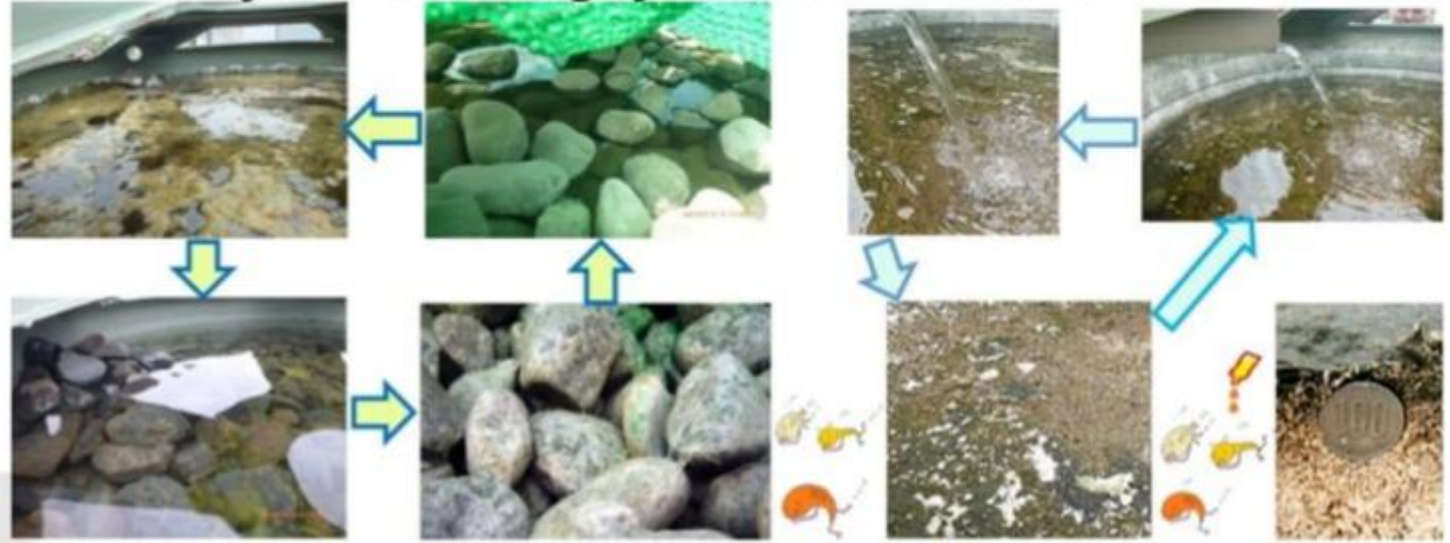
Small organisms escape from the top into gravel layer in case of trouble happened. Some particles are not trapped by small organisms.



In case of sand filter, small organisms escape from the top into deep sand layer.

In case of EPS, interruption of water flow happened then the surface nearly dried up. After dry condition, it takes time re-start and re-develop an active healthy ecosystem. Before re-start the ecosystem, some impurities may leak through the system.

Dry and re-wetting cycle of URF and sand filter.



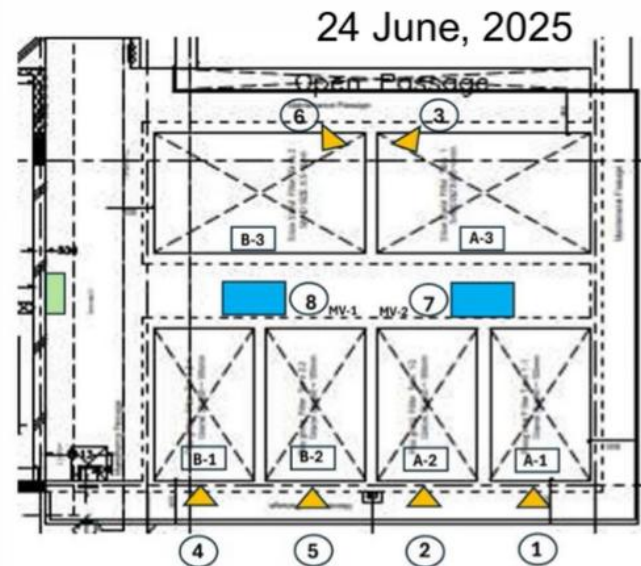
In case of this plant, the raw water comes only 4 hours every day. There are enough depth of adhere gravel layer and sand layer. This condition may not be severe condition.



<https://youtu.be/cWxaIGnK4R4>
10 min 12 sec.



Please watch this YouTube.



⑧ Measuring Unit B

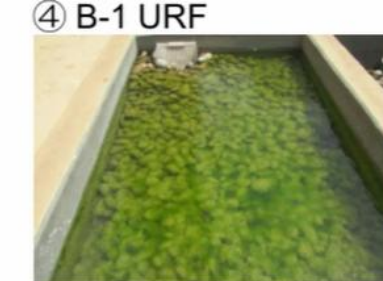


Flow rate ca 2m³/h

⑦ Measuring Unit A



Flow rate ca 2m³/h



⑤ B-2 URF



⑥ B-3 SSF



② A-2 URF



③ A-3 SSF



Dry and re-wetting cycle of URF and sand filter.



Dry and re-wetting phenomena.