WATER MOVEMENT IN THE CAPILLARY FRINGE UNDER SIMULATED SEPTIC SYSTEM DRAINFIELDS

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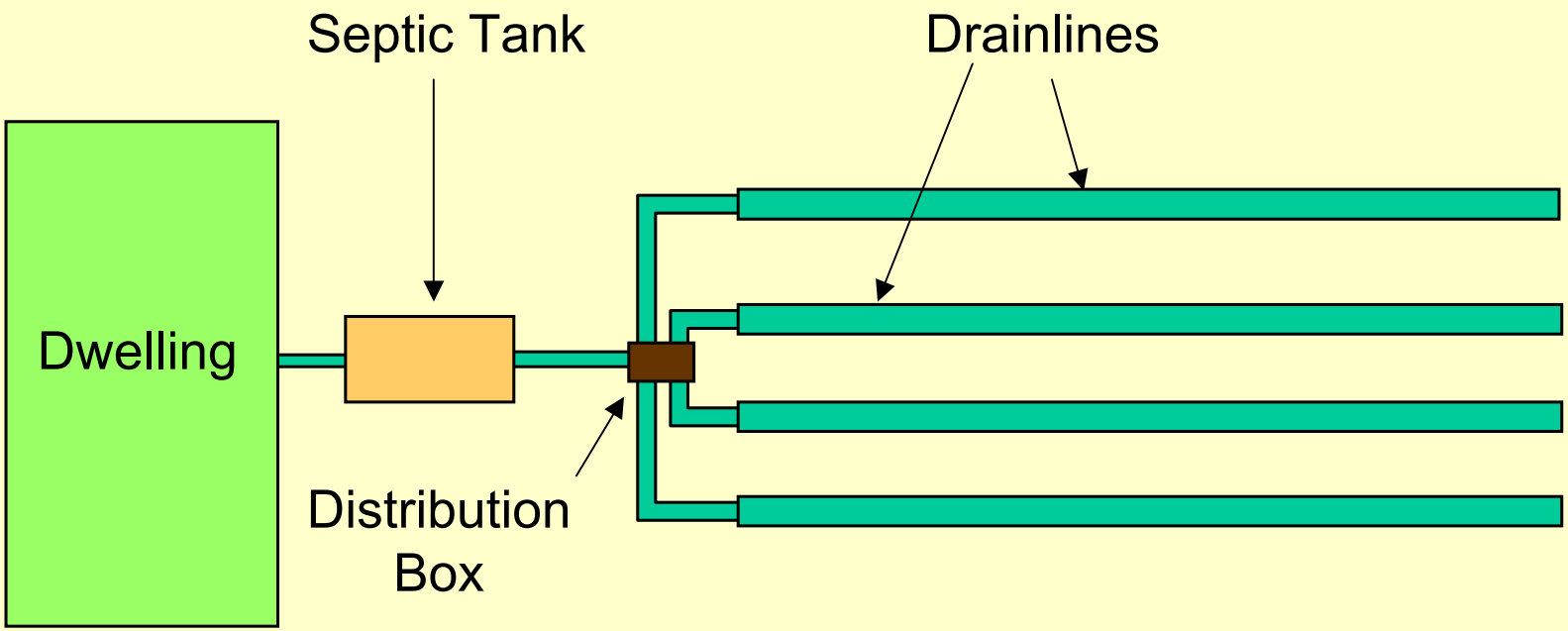
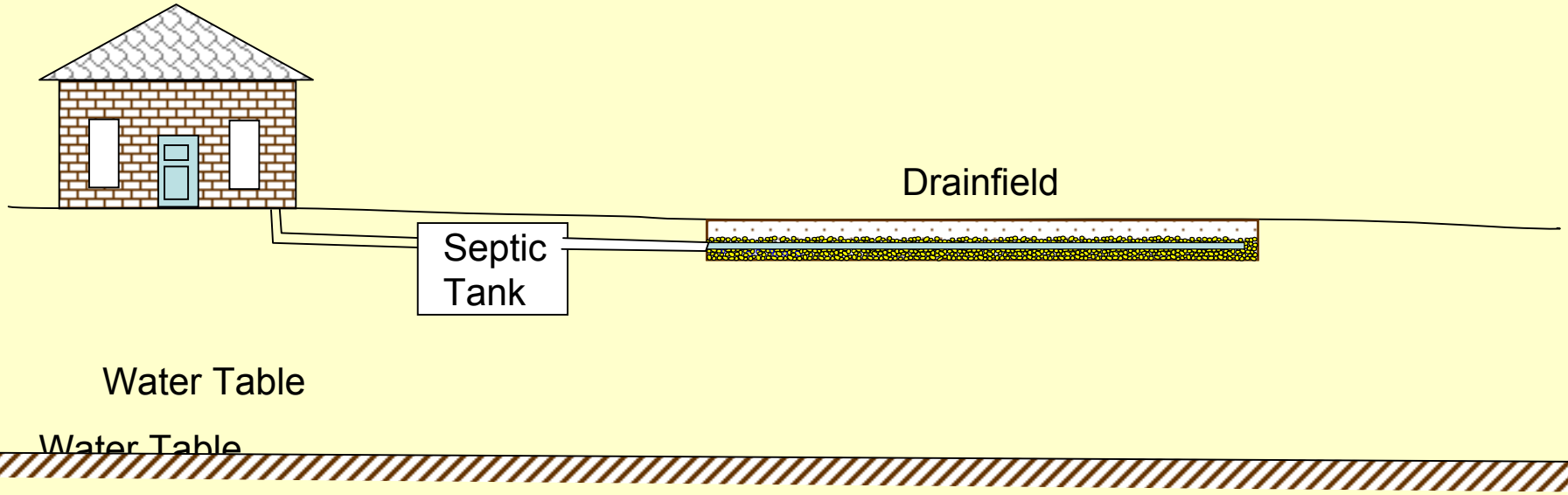
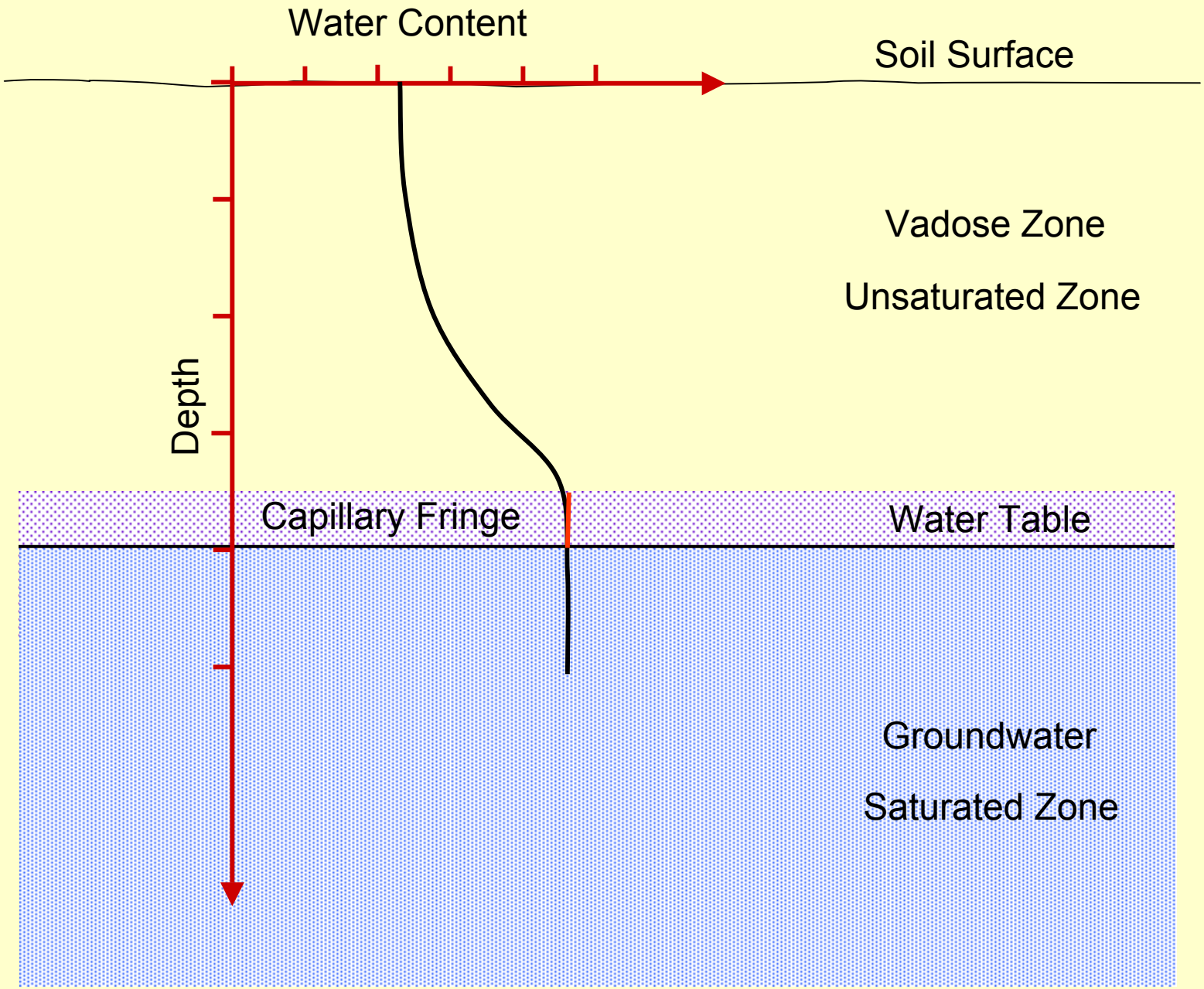
Components of Septic Systems



What does happen if water does not move away from the drainfield?




Water Content
Soil Surface
Vadose Zone
Unsaturated Zone
Depth
Capillary Fringe
Water Table
Groundwater
Saturated Zone

Capillary Fringe

The tension saturated zone immediately above the water table

The soil in the capillary fringe is almost saturated, but the pressure head is negative

Monitoring Transport of Pollutants

In the unsaturated zone, pollutants generally move in vertical direction.

In the saturated zone, pollutants generally move in horizontal direction toward a drainage outlet or well.

Monitoring transport of pollutants from a waste disposal site (e.g., a septic system) is generally performed by collecting ground water samples from the saturated zone (i.e., below the water table) using a well.

Ground Water Monitoring

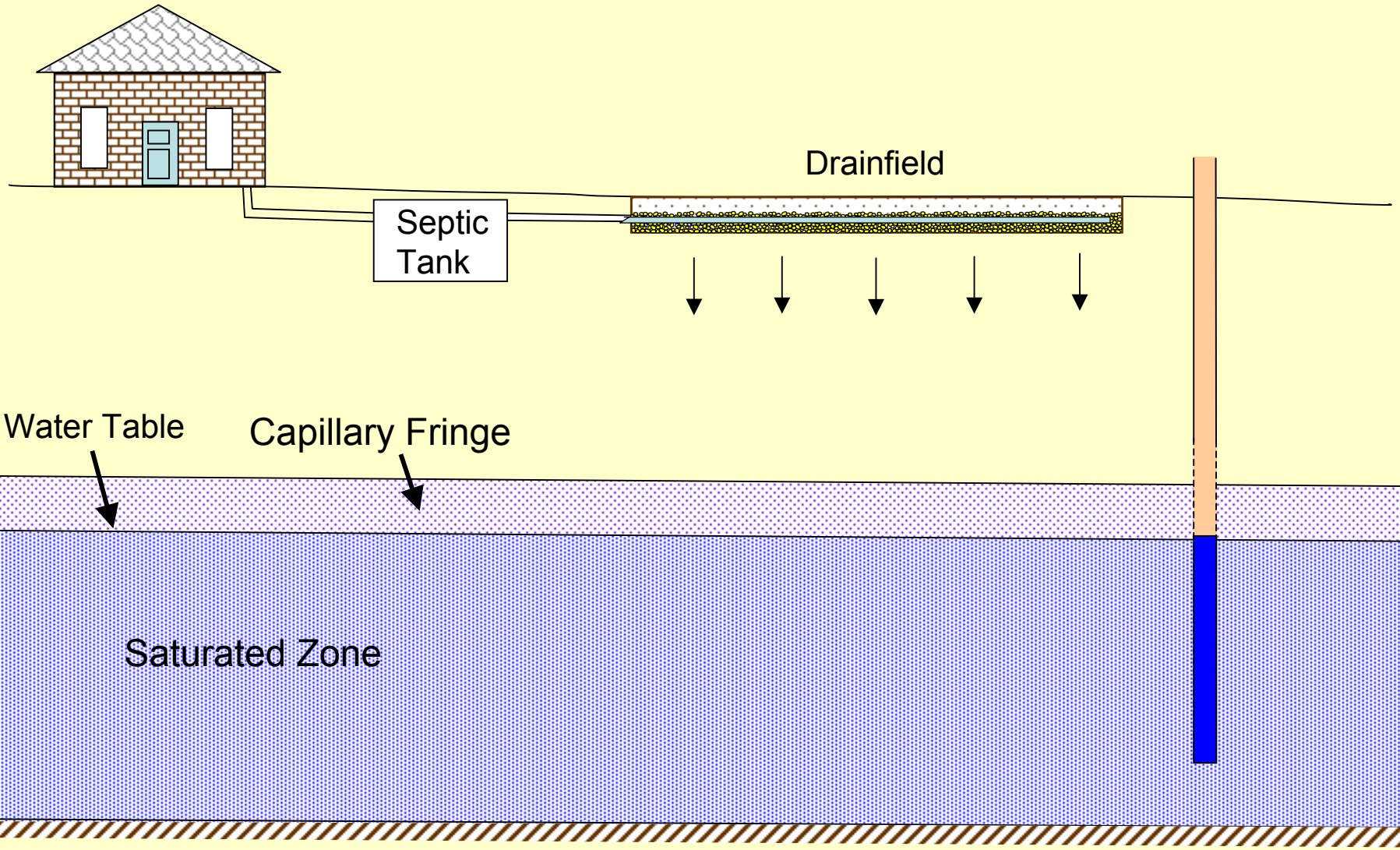
Fetter: "Methods of installing monitoring wells and collection of ground-water samples have been developed **with the specific intention of obtaining a representative sample of water from an aquifer**."

Two of the purposes of monitoring wells listed by Fetter:

Measuring the elevation of water table

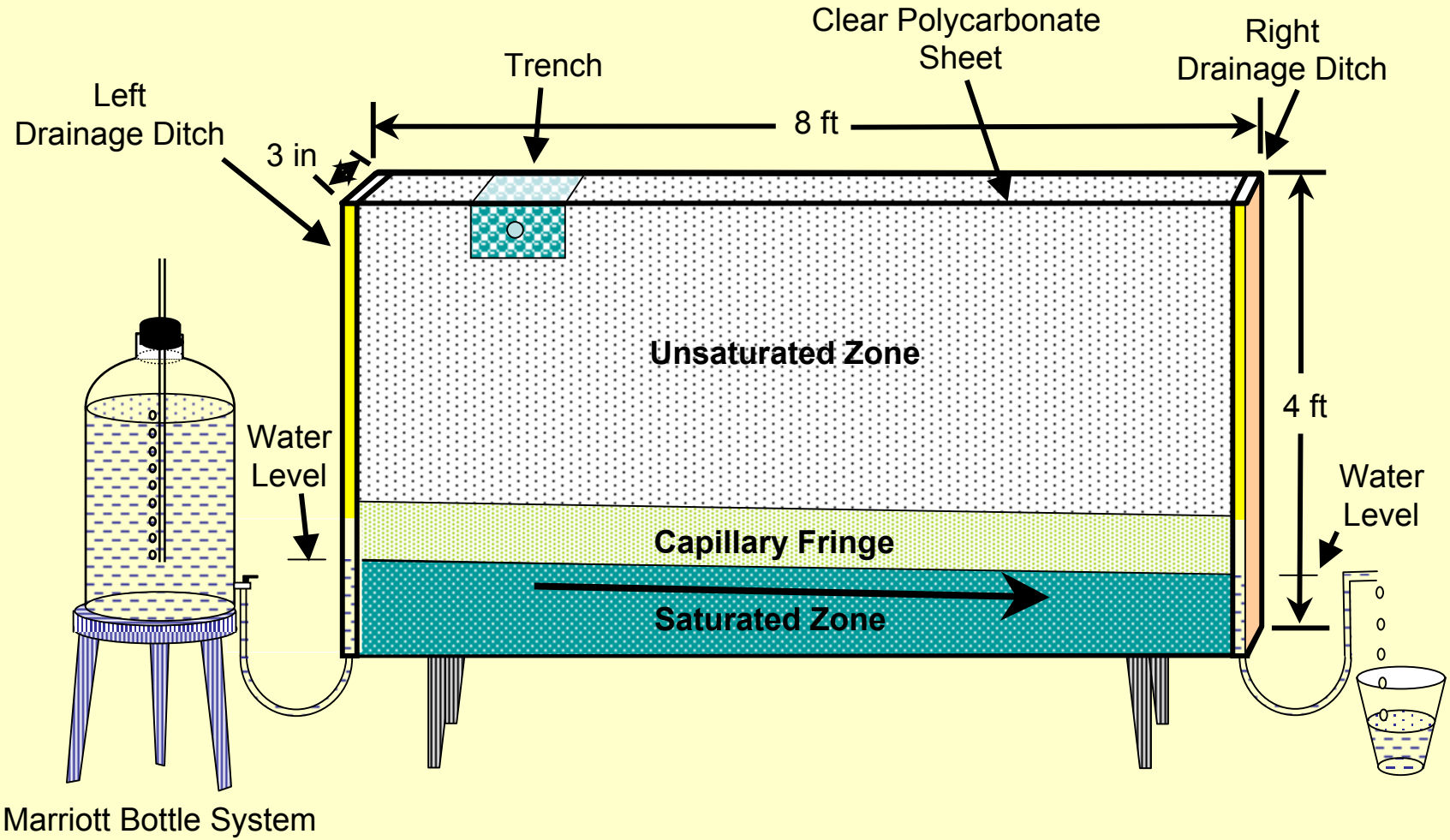
Collecting a water sample for chemical analysis

What would happen if pollutants move laterally above the water table?

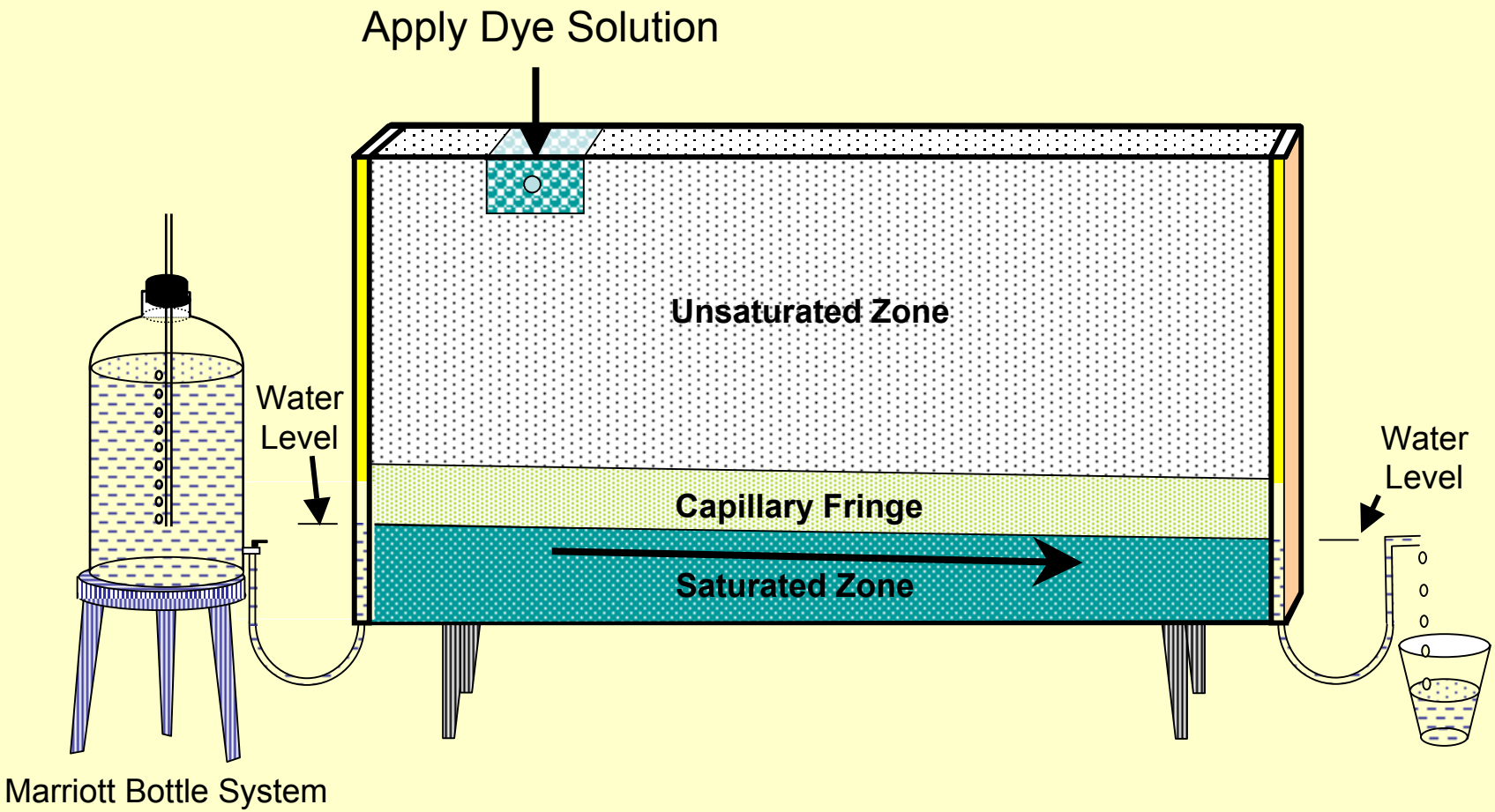


OBJECTIVE

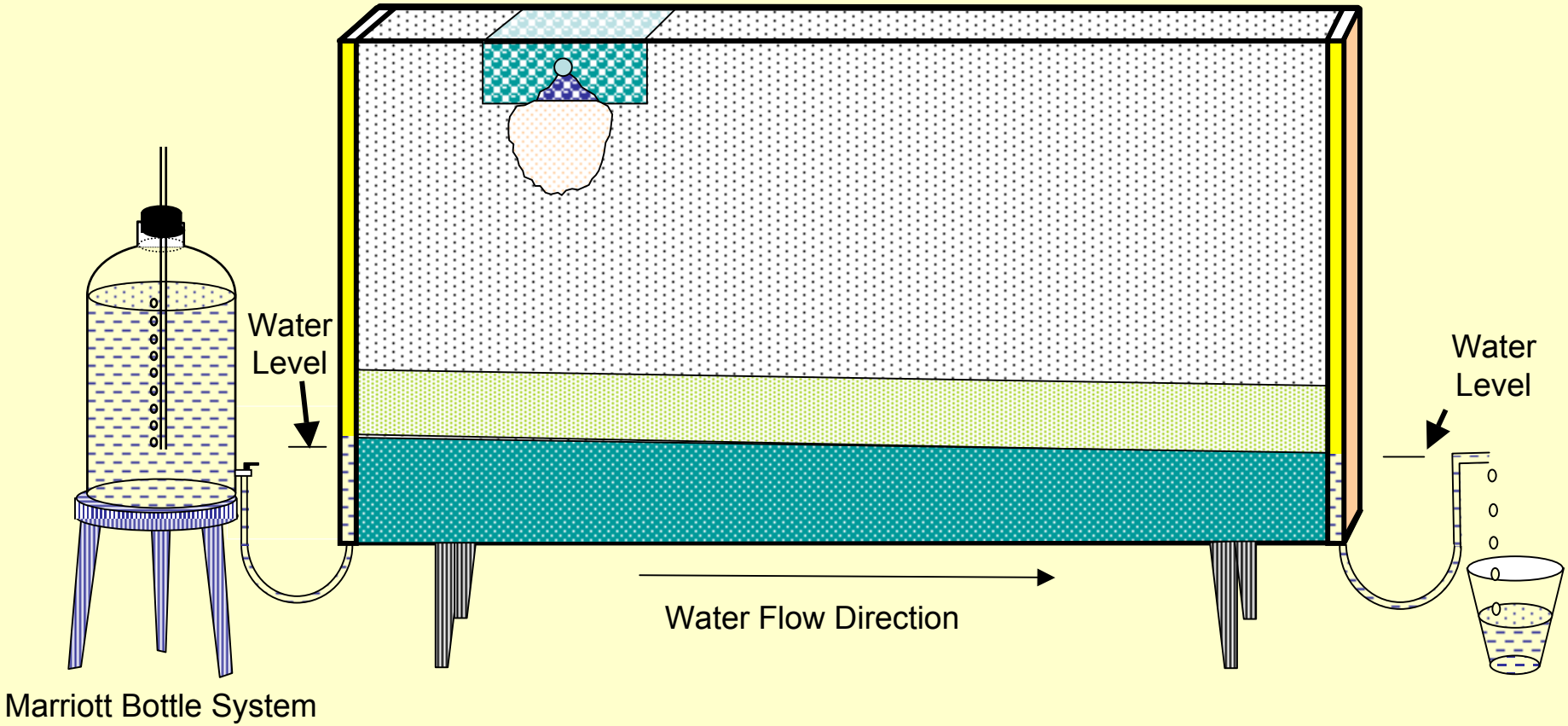
To evaluate water movement from simulated septic system trenches through the unsaturated and saturated zones in a homogeneous soil with a shallow water table.

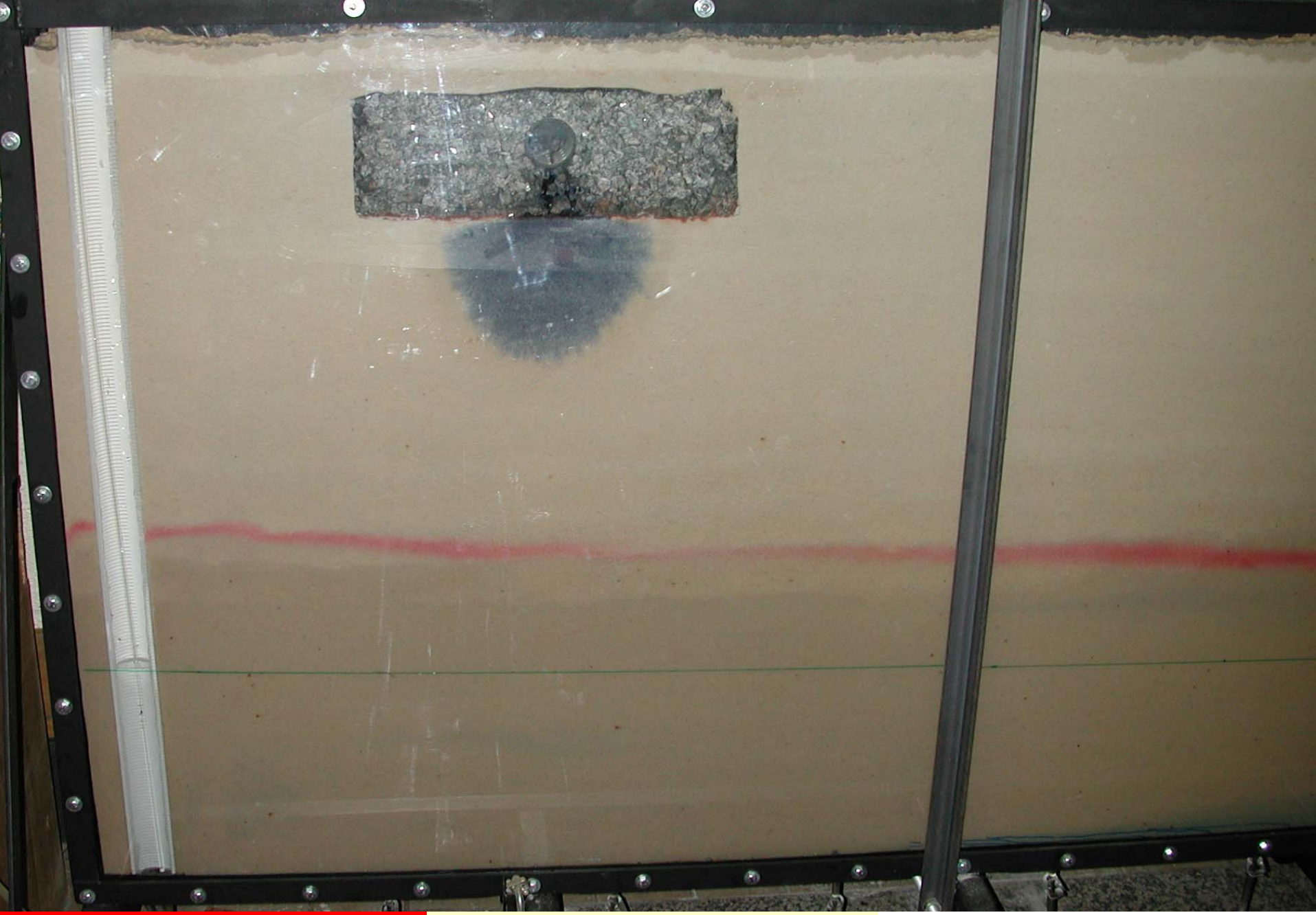

Clear Polycarbonate Sheet
Right Drainage Ditch
Trench
Left Drainage Ditch
8 ft
3 in
Unsaturated Zone
4 ft
Water Level
Water Level
Capillary Fringe
Saturated Zone
Marriott Bottle System

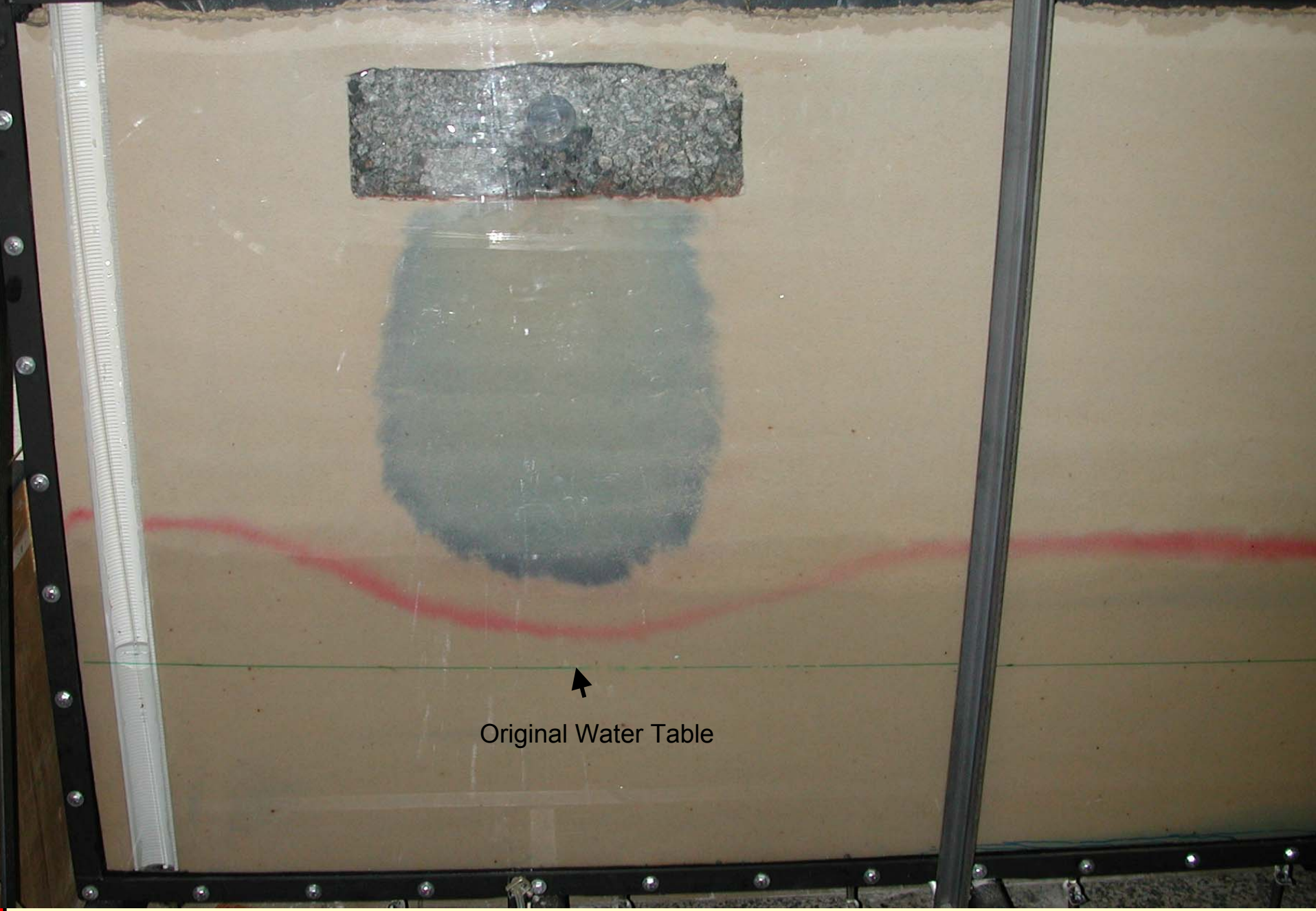

8 ft
3 inches (thickness)
4 ft
Capillary Fringe
Direction of movement of
simulated ground water

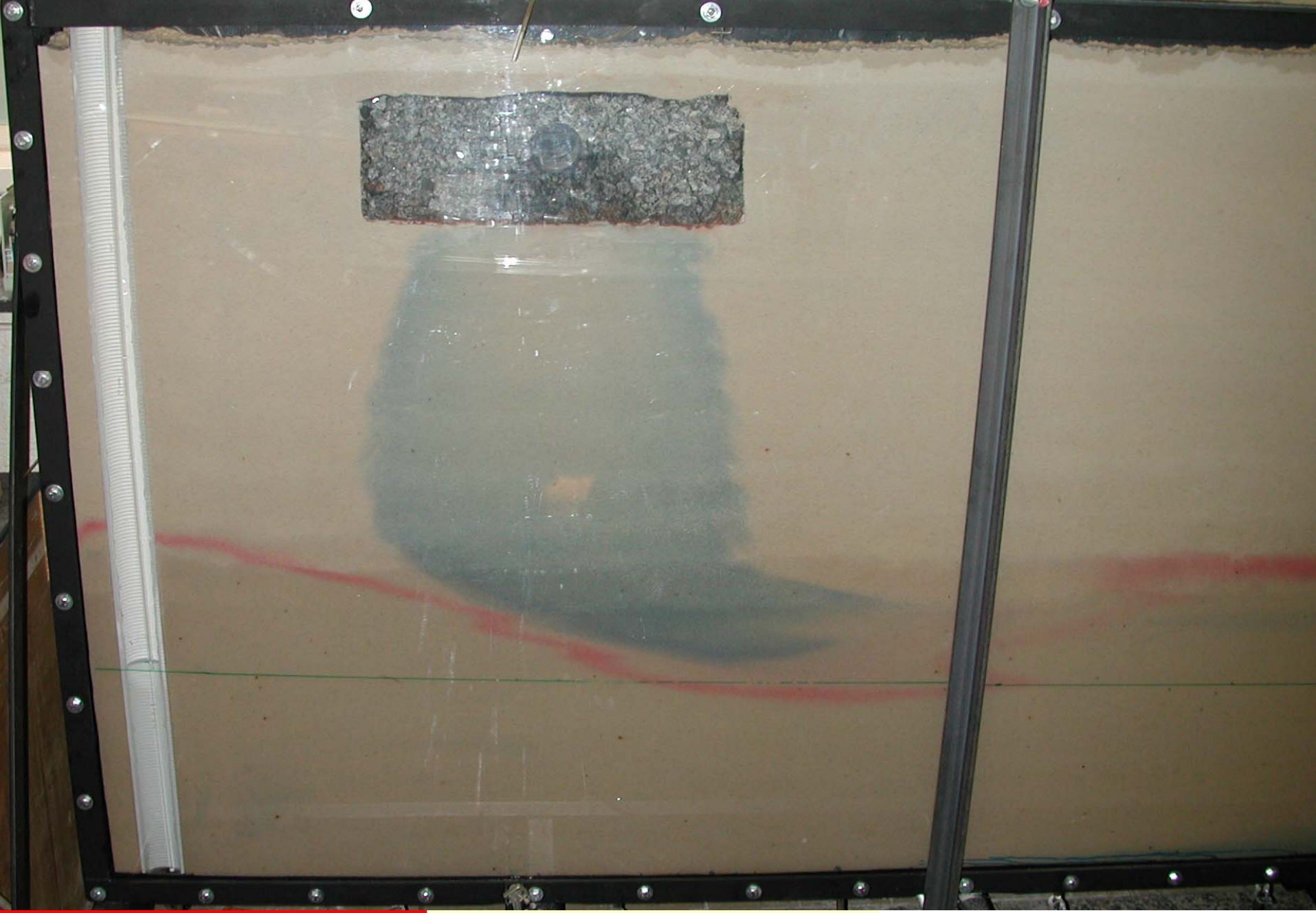

Apply Dye Solution
Unsaturated Zone
Water Level
Capillary Fringe
Saturated Zone
Water Level
Marriott Bottle System

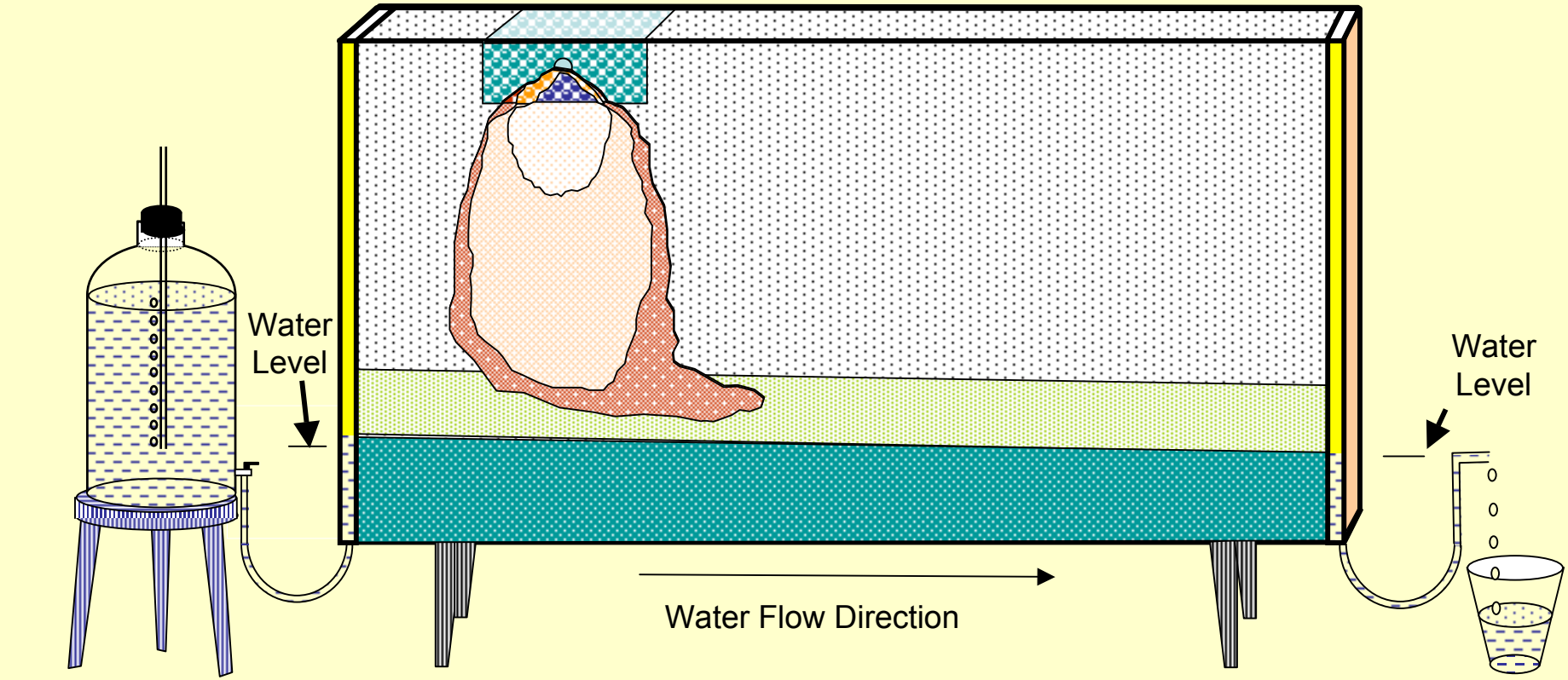
EXPERIMENT 1: Simulating Wastewater Application in Doses (e.g., an LPP system)





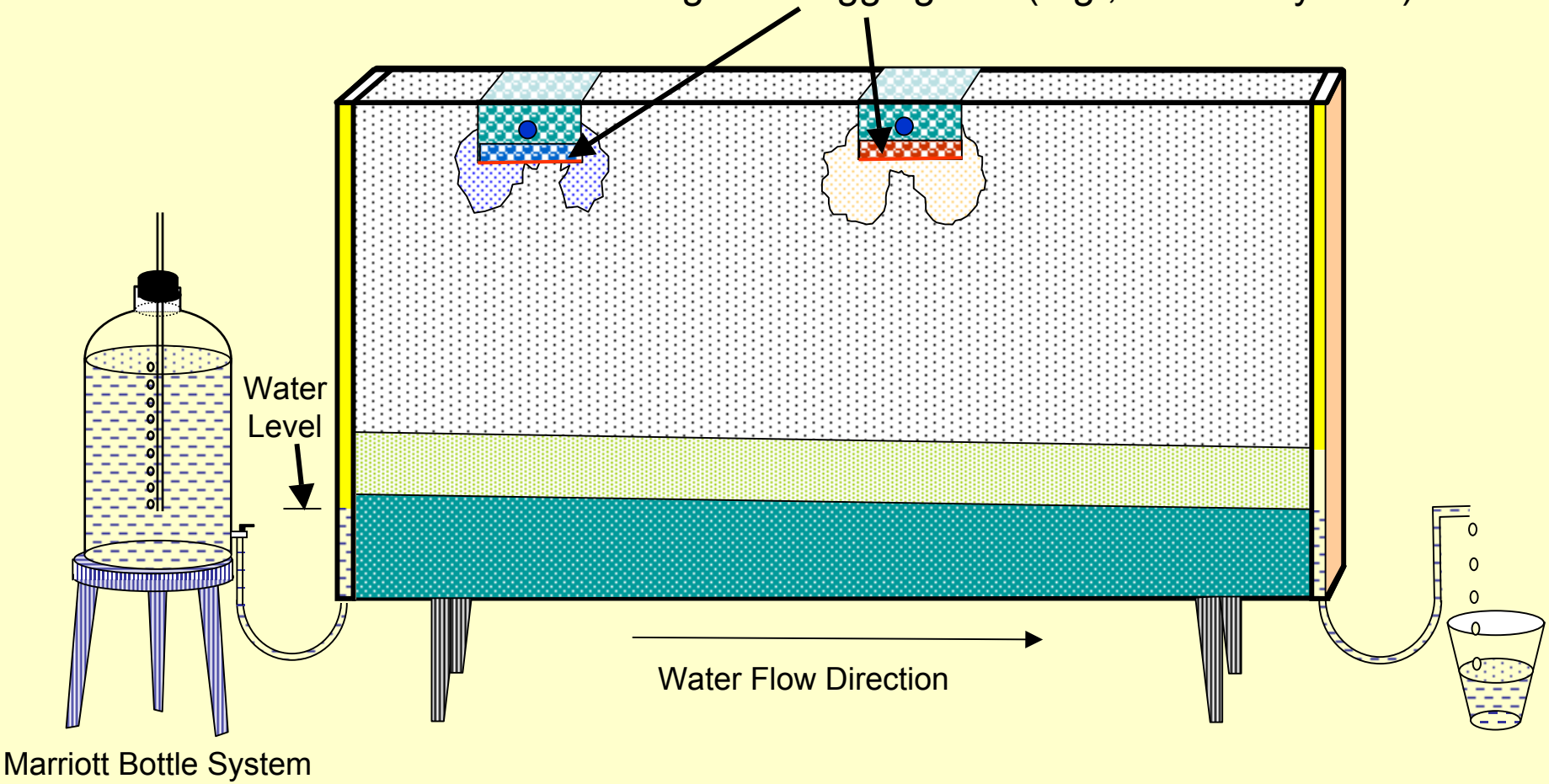

Original Water Table

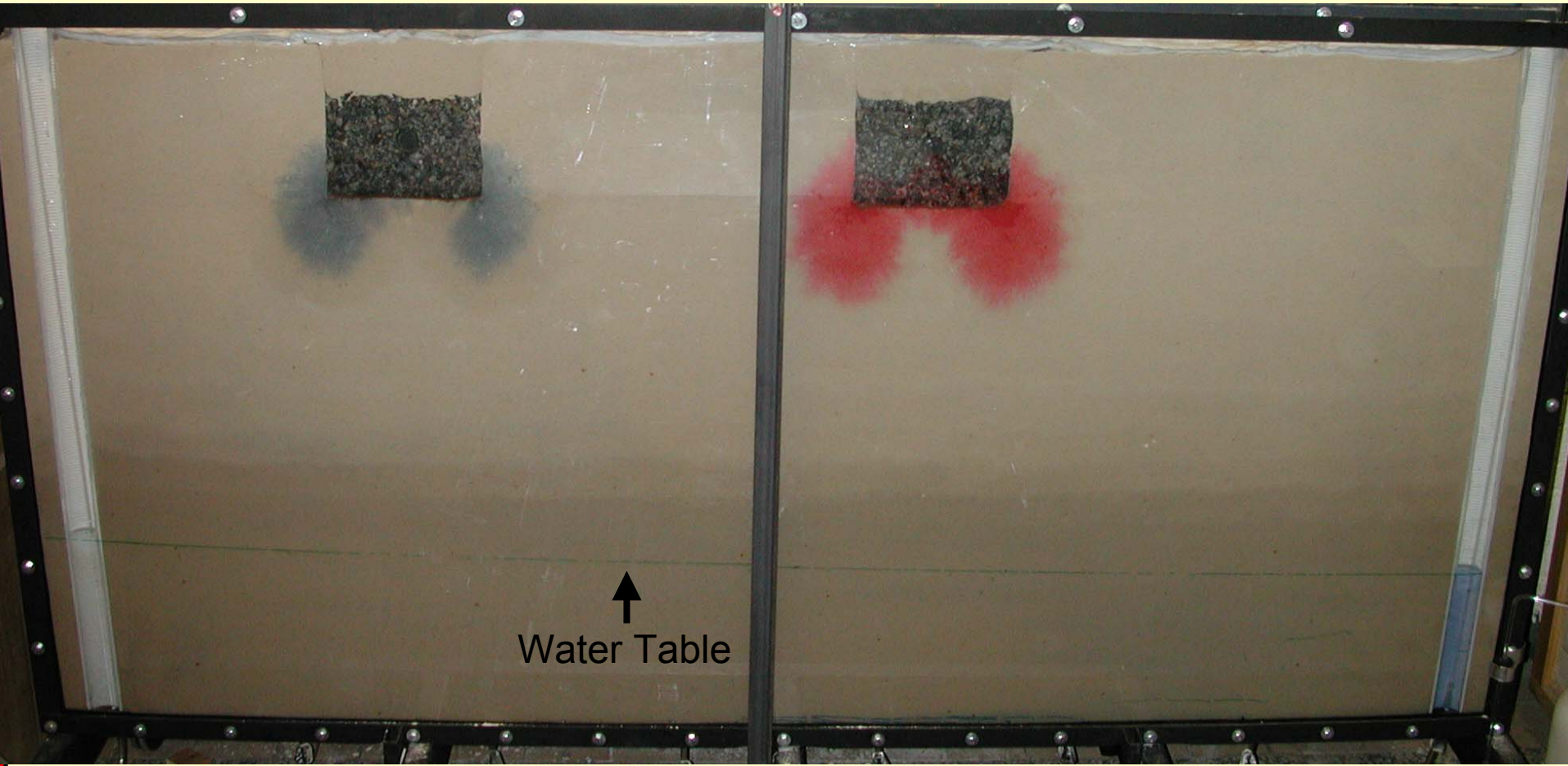


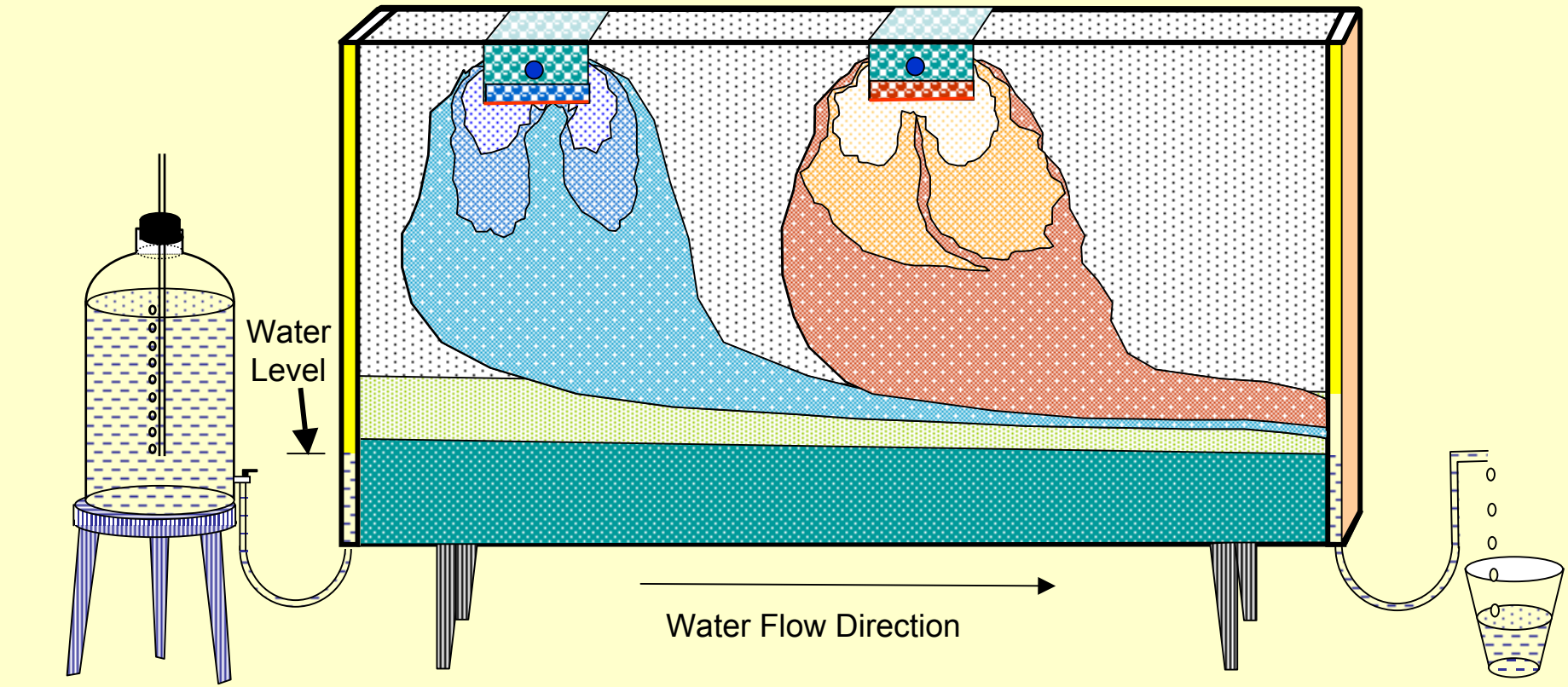


Marriott Bottle System

EXPERIMENT 2: Simulating Wastewater Application in Doses with a Simulated Biological Clogging Mat (e.g., an LPP system)

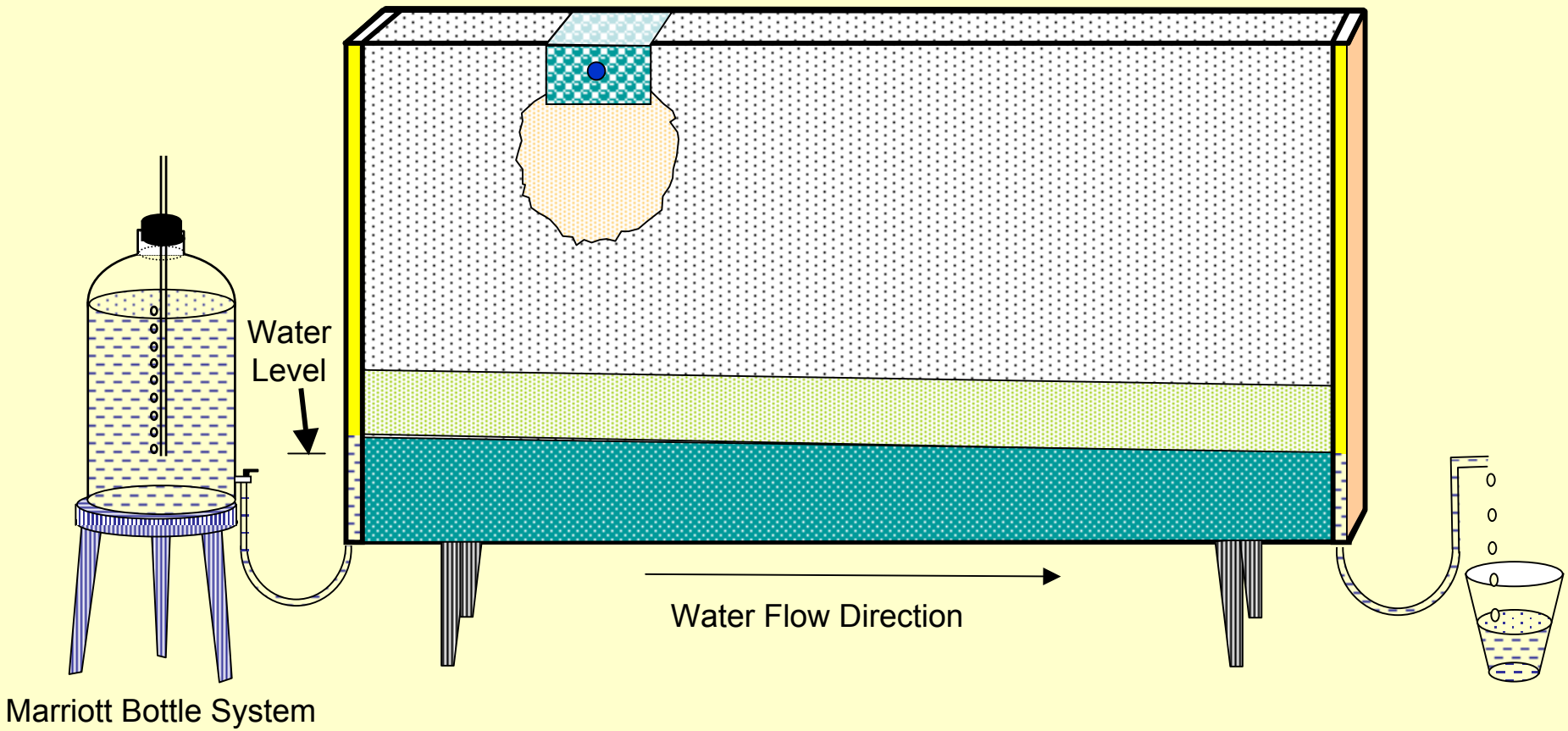


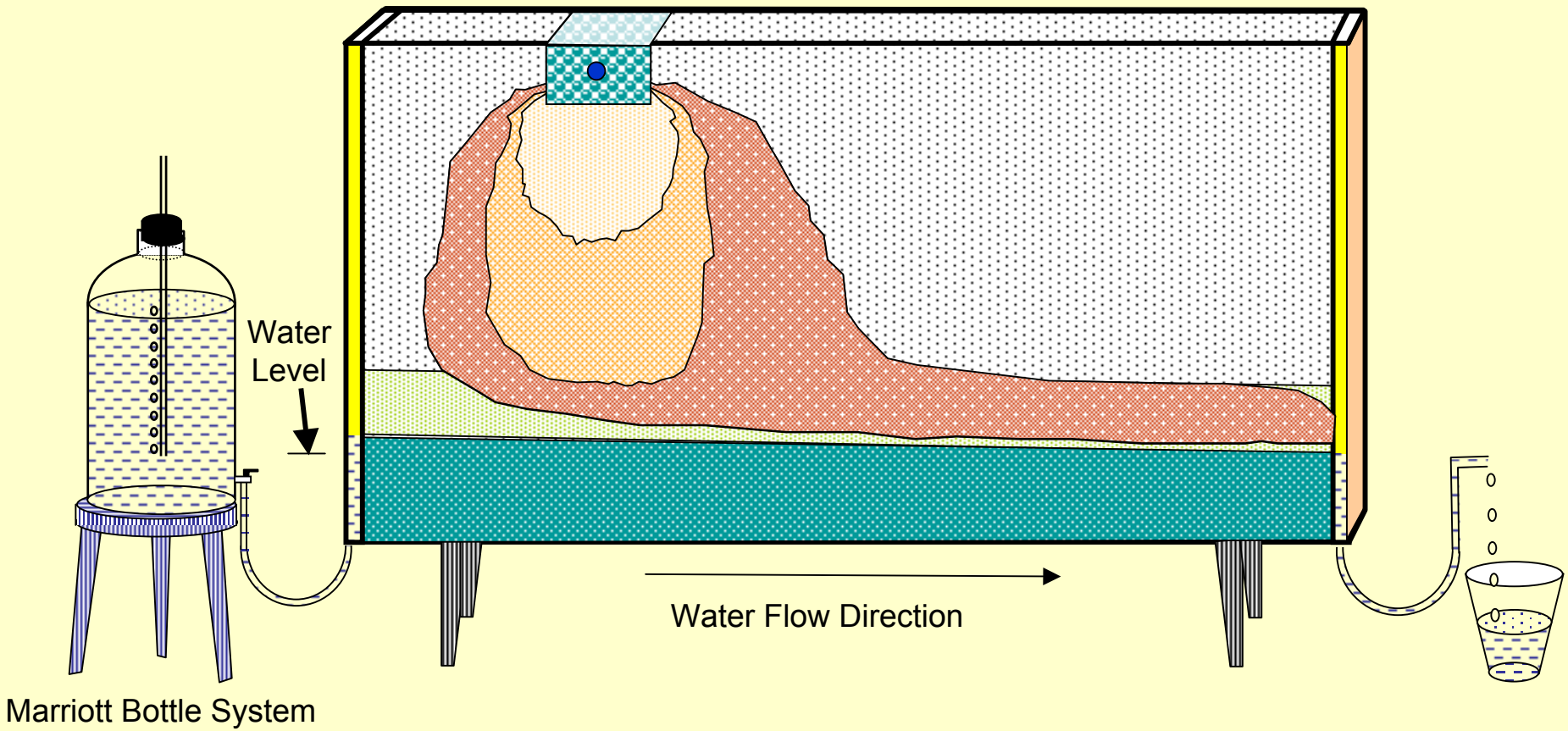

Water Table

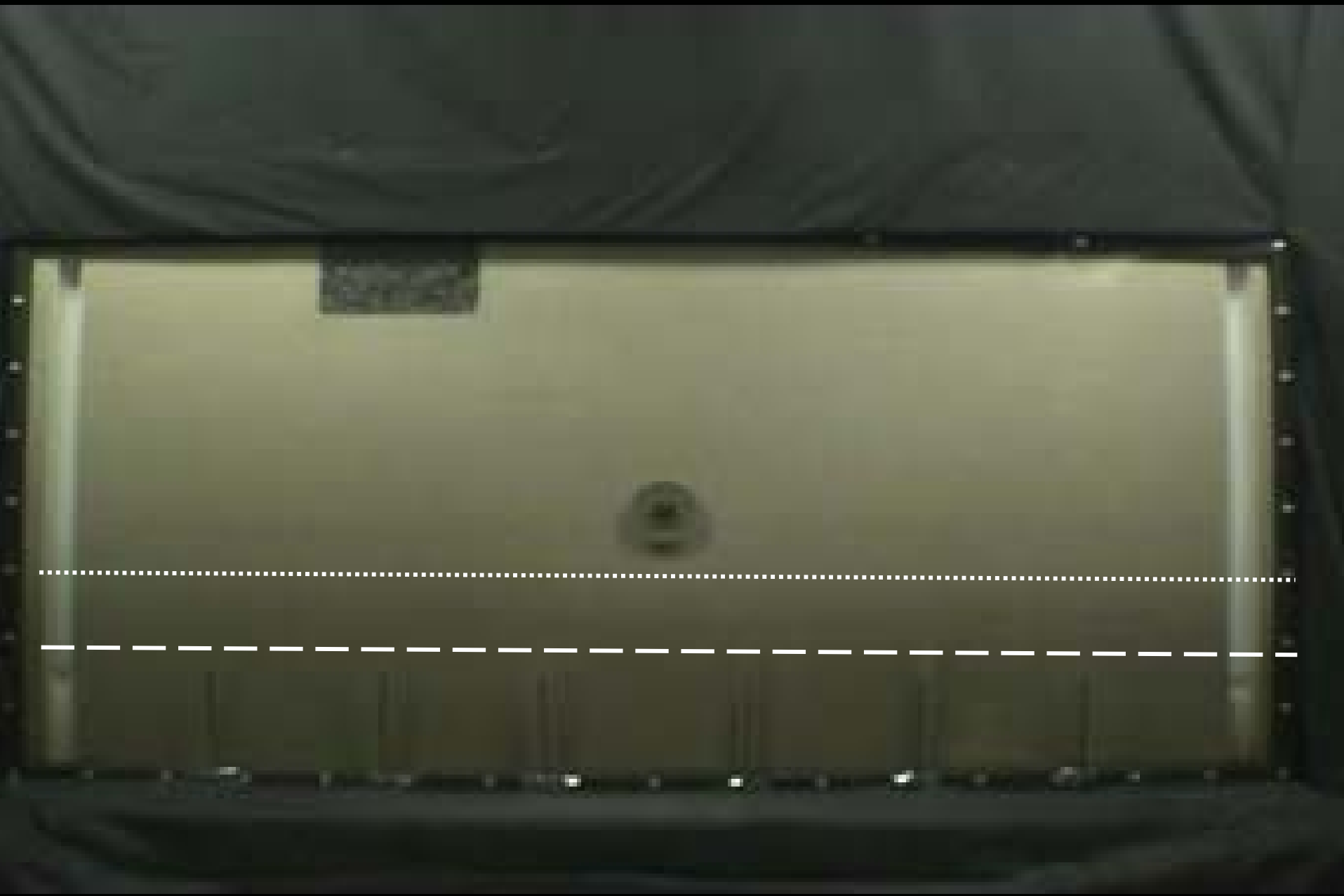


Marriott Bottle System

EXPERIMENT 3: Simulating Wastewater Application to Trenches Under Ponded Condition (e.g., a gravity fed system)




Water
Level
Water Flow Direction
Marriott Bottle System



Reasons for Retention of Solutes in Capillary Fringe

Capillary fringe is almost saturated

Unless there is a vertical gradient below the water table, vertical gradient in the capillary fringe is near zero

Horizontal gradient in capillary fringe follows the same pattern as the ground water gradient

Water table fluctuation is often due to vertical percolation from the vadose zone above the capillary fringe instead of upward movement of ground water

CONCLUSIONS

In uniform and homogeneous soils wastewater applied to the septic system trenches moves vertically down.

In the capillary fringe water and pollutants move horizontally until pushed down into the water table by downward percolating water.

Capillary fringe may remain aerobic, so little to no denitrification may occur in it.

CONCLUSIONS CONTINUED

If the results hold true under field conditions, ground water sampling from under the drainfield may not be adequate for monitoring septic systems.