Small Lot on the Lake? How Do I Fit It In

Achieving Balance Nature's Way

Achieving Bioreactor Balance


Water→Volume


Water→Volume

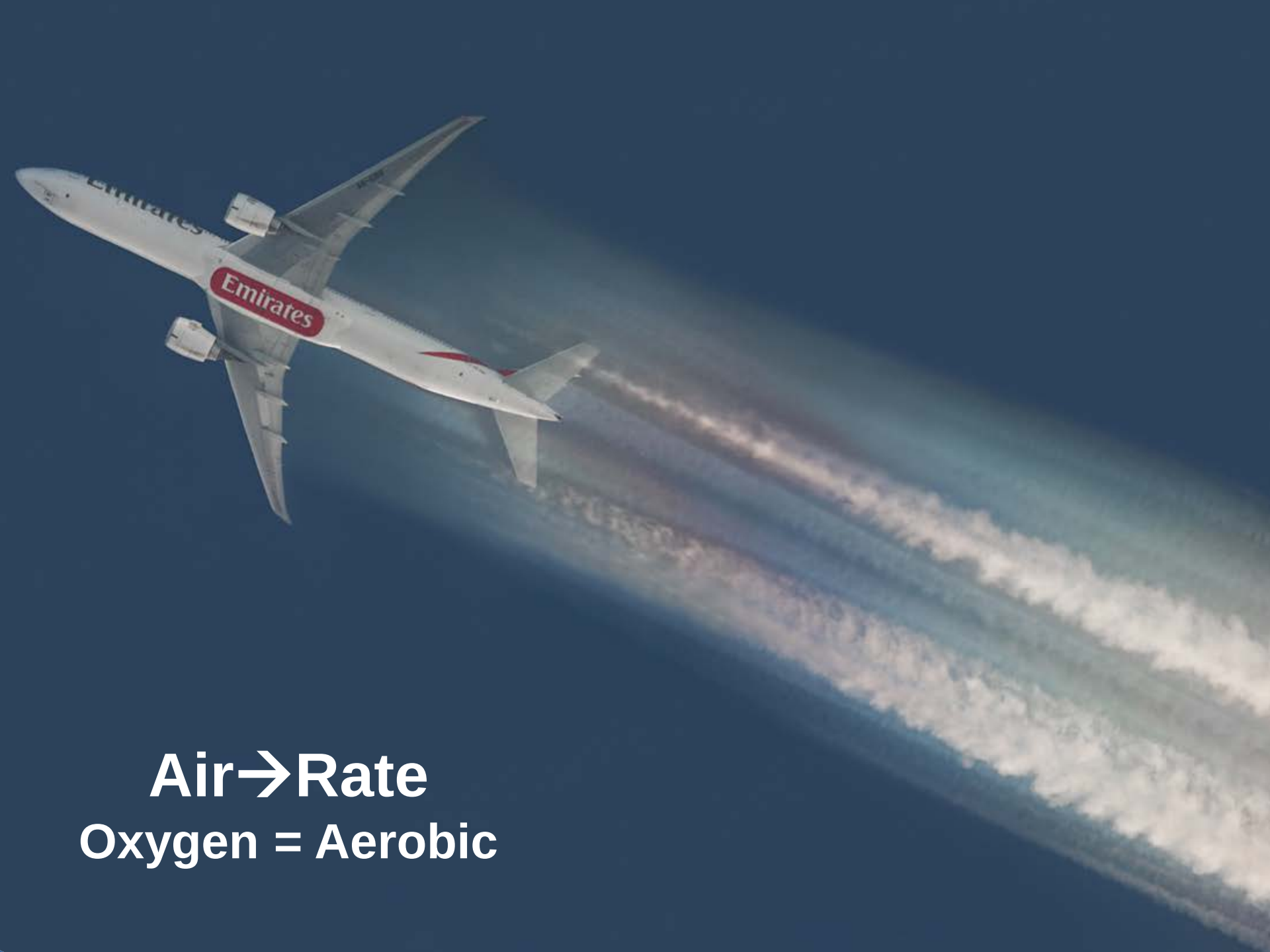

Water→Volume


Water→Rate

Water→Rate

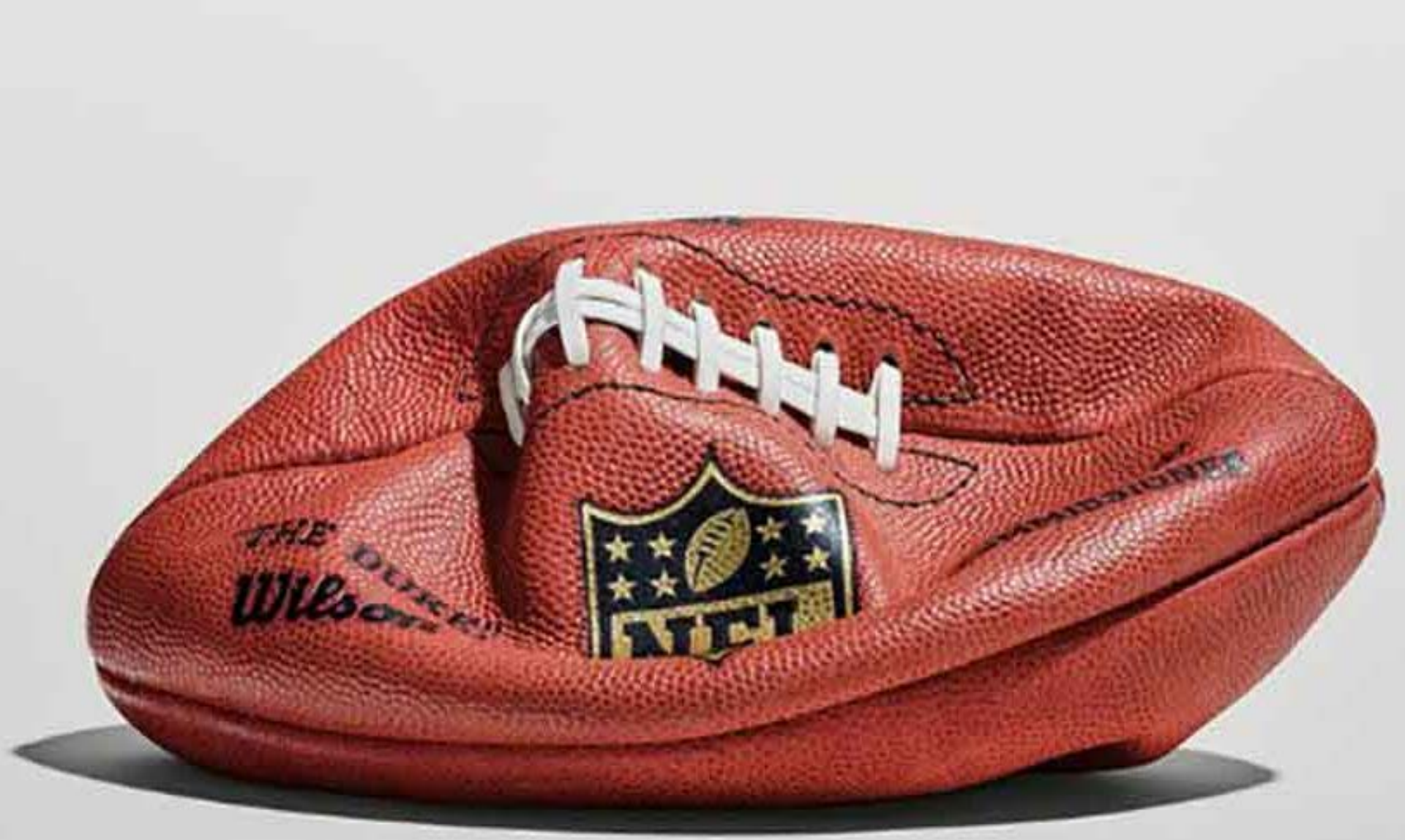

Water→Rate


Air→Volume
Oxygen = Aerobic



Air→Rate

Oxygen = Aerobic



No Air

Anoxic or Anaerobic

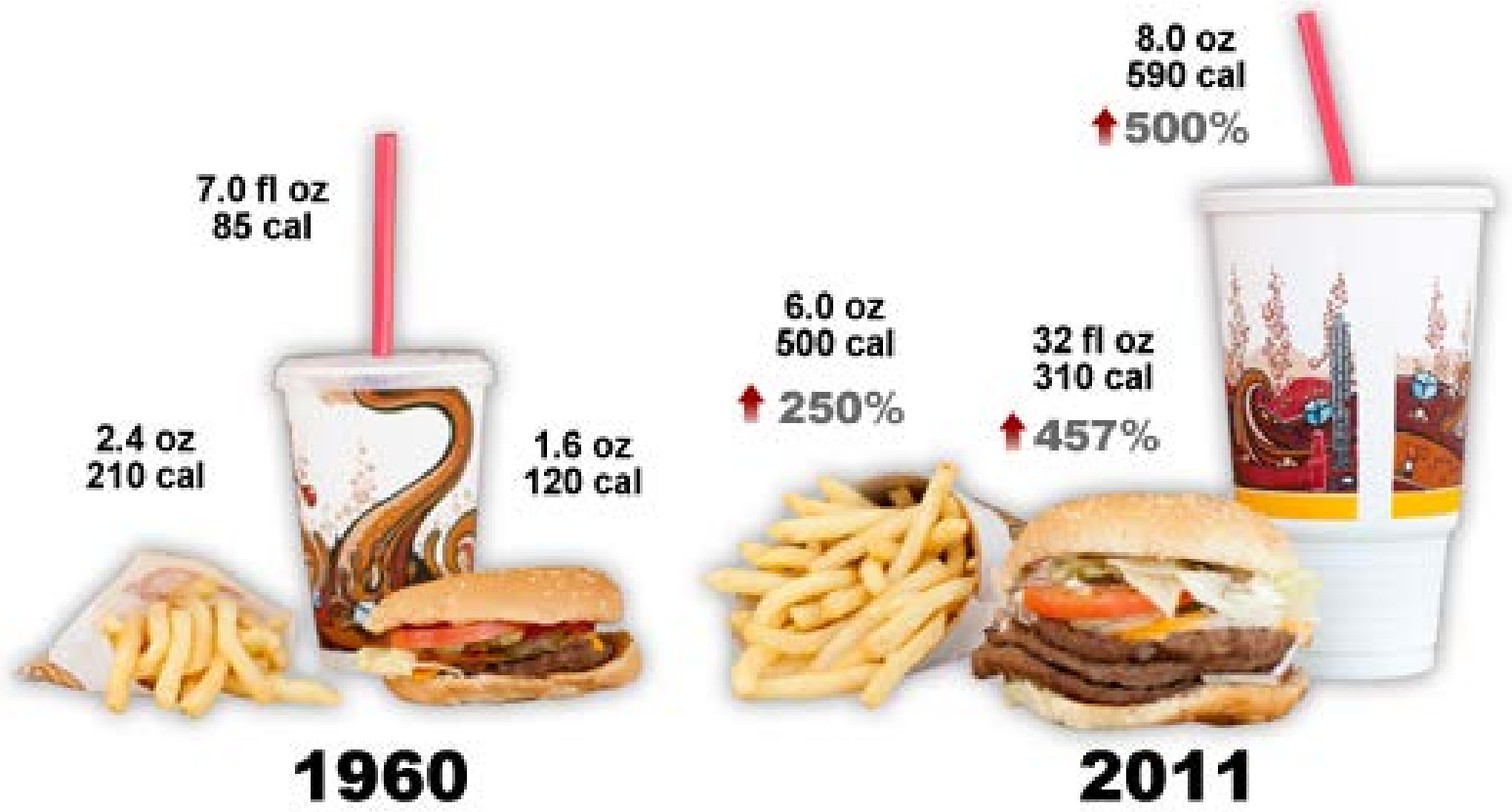
Time


MODE
SPLIT/RESET
SELECT
START/STOP
SET
FASTIME
S M T W T F S
1:51'63
MIN SEC.C 1/100
FASTIME ZERO 1
1/100SEC.


January
1


12
1
2
3
4
5
6
7
8
9
10
11

Food


7.0 fl oz
85 cal
2.4 oz
210 cal
1.6 oz
120 cal
1960
6.0 oz
500 cal
250%
32 fl oz
310 cal
457%
8.0 oz
590 cal
500%
2011

Achieving Bioreactor Balance

Example Methods for Achieving Balance

- Primary treatment
  - Recognized performance for decades
  - Flattens hydraulic & organic load peaks (buffering)

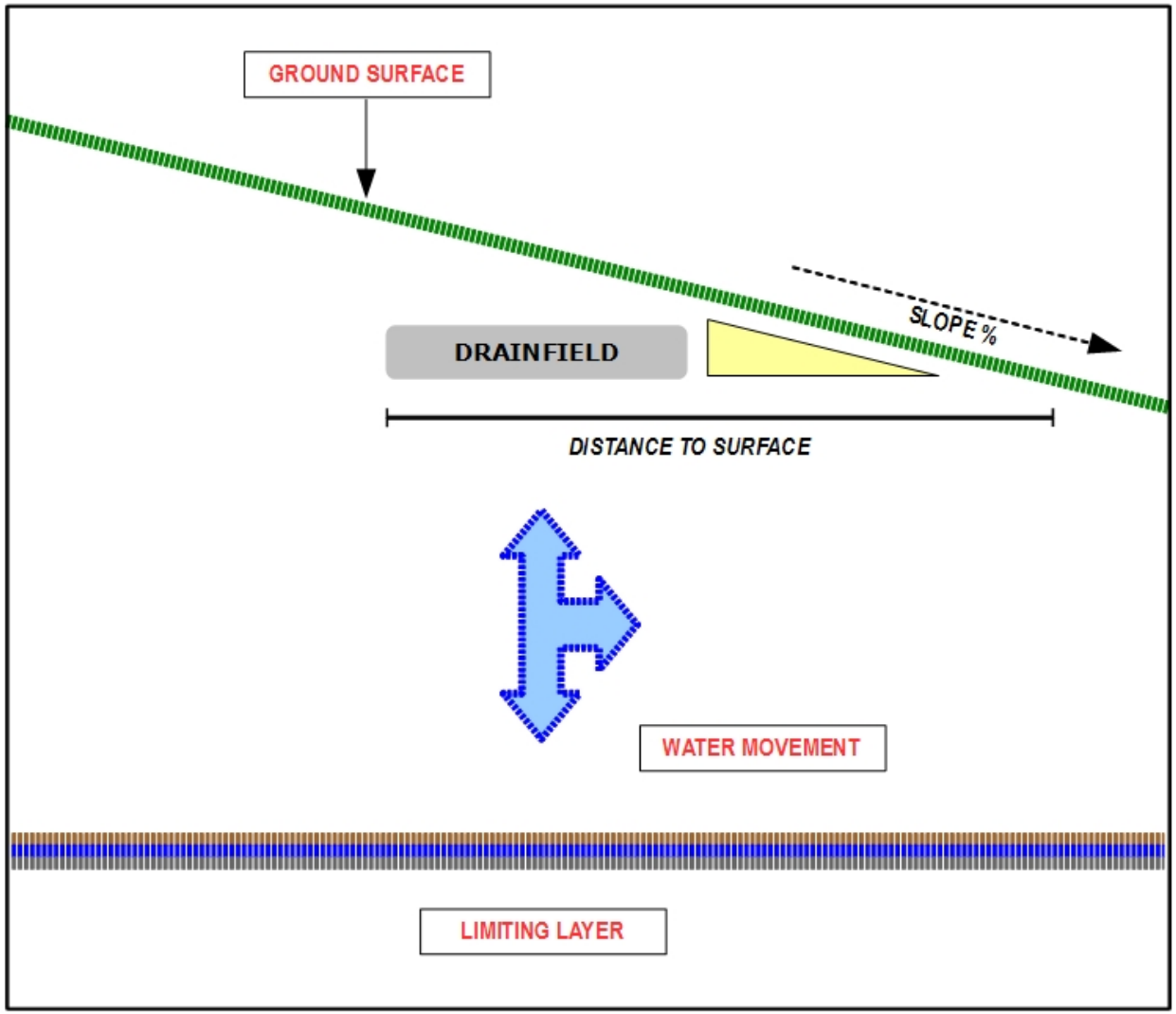
Example Methods for Achieving Balance

- Timed dose pumping
  - Process control
  - Allows for correct balance of…
    - Water
    - Air
    - Time
    - Food

Health and Environmental Goals for Treated Effluent

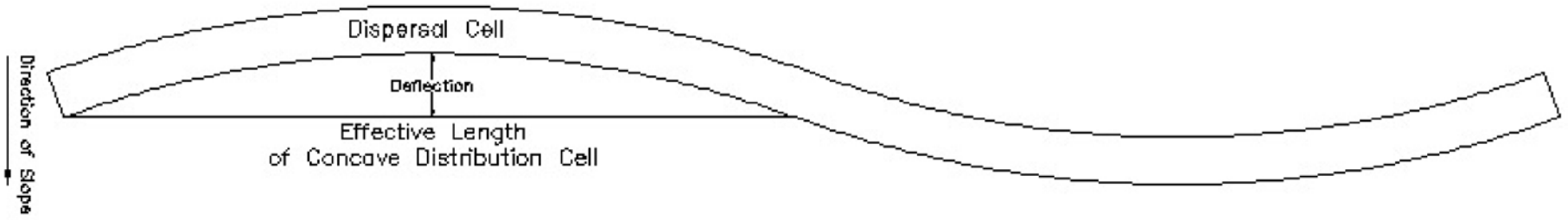
- Disperse or reuse water
- It can’t surface
- It can’t pollute other water or the environment

Water Can Move In All Directions!



Effluent Dispersal

- Infiltration loading rates
  - GPD in 1 ft^2
- Hydraulic linear loading
  - GPD per 1 ft
  - Horizontal flow capacity
    - Impacted by limiting layers

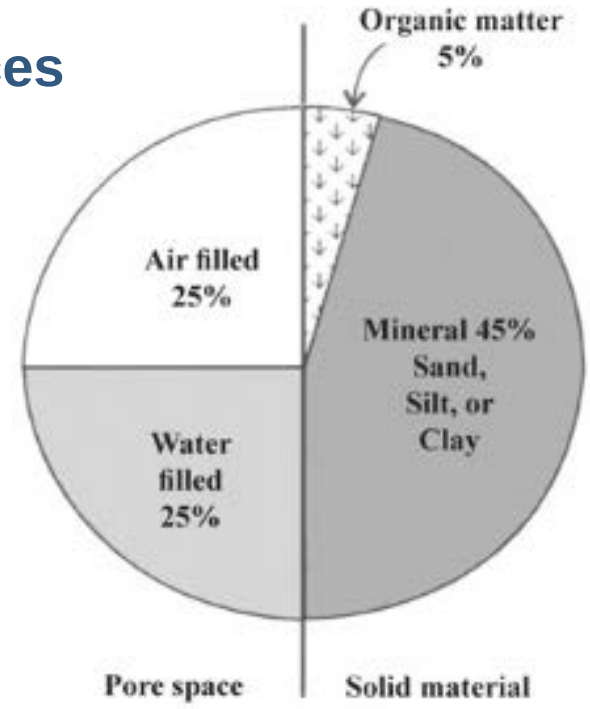


Effluent Dispersal

- **Limiting layers**

Effluent Dispersal

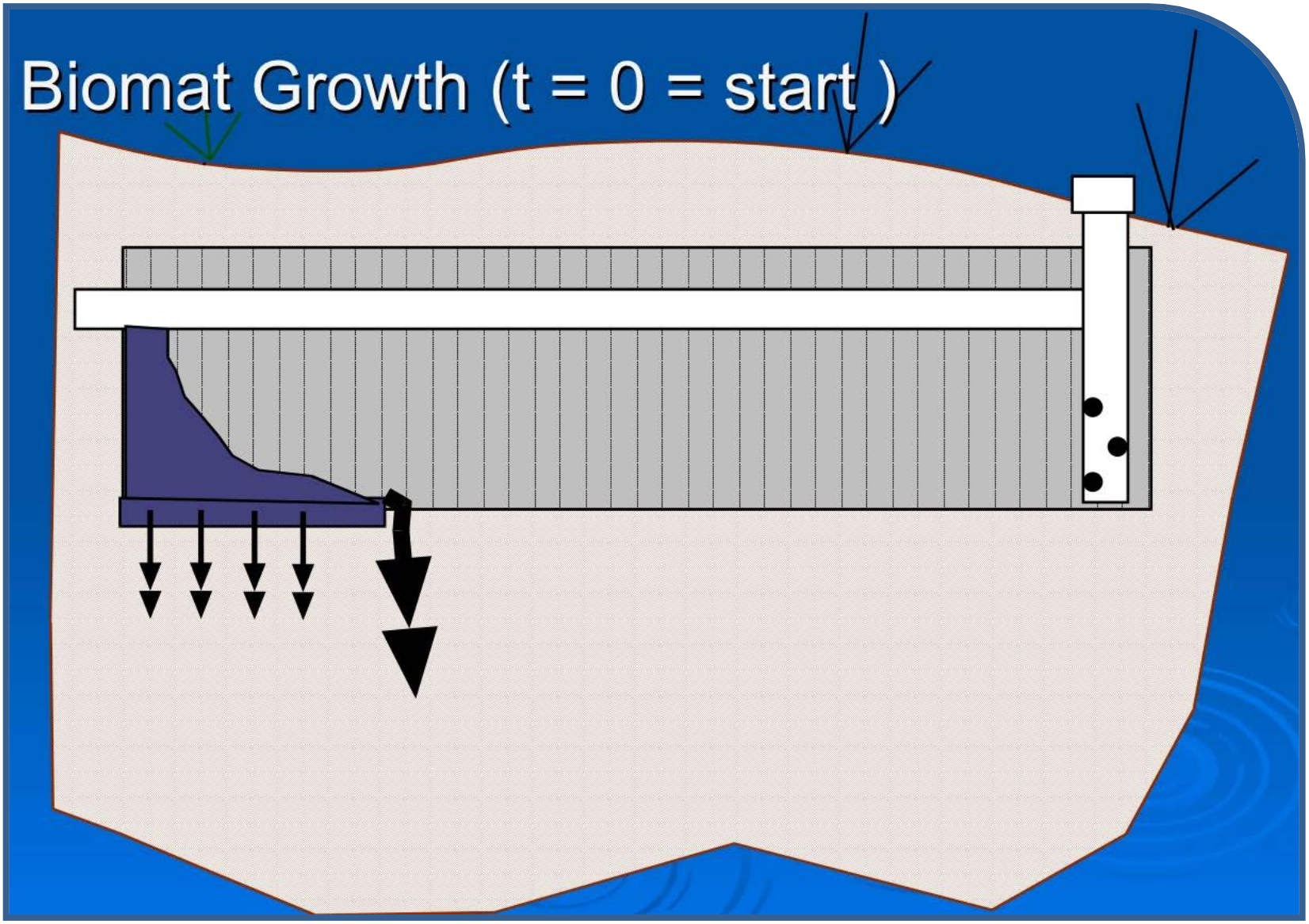
- Infiltration & linear loading rates
  - Soil characteristics
  - Presence/absence of biomat layer
  - Saturated or unsaturated flow
    - Capillary vs. gravitational forces



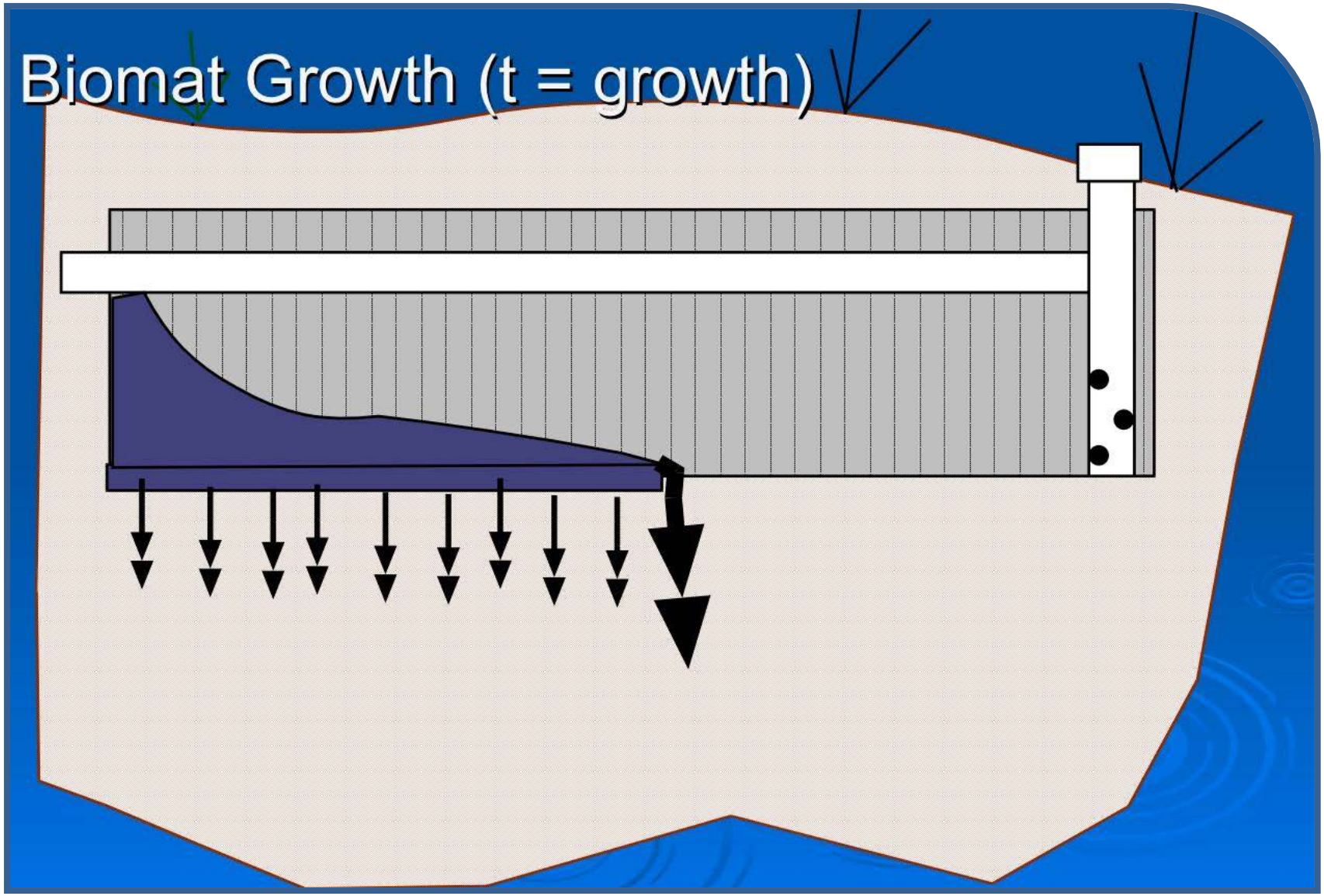
Effluent Dispersal

- Gravity drainfields progressively clog
- Anaerobic biomat
  - Sticky
  - Gooey
  - Thick

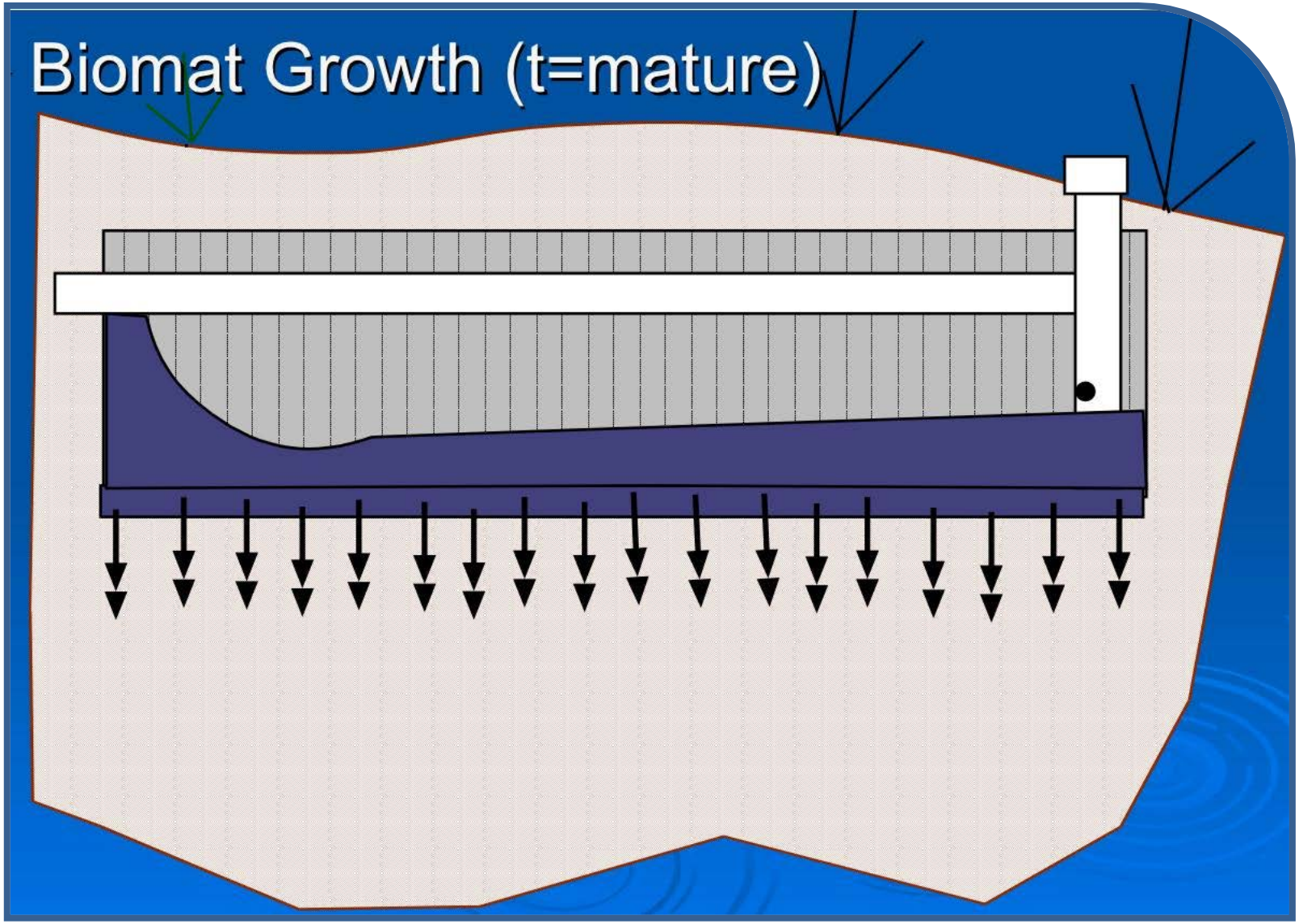
Effluent Dispersal



Effluent Dispersal



Effluent Dispersal

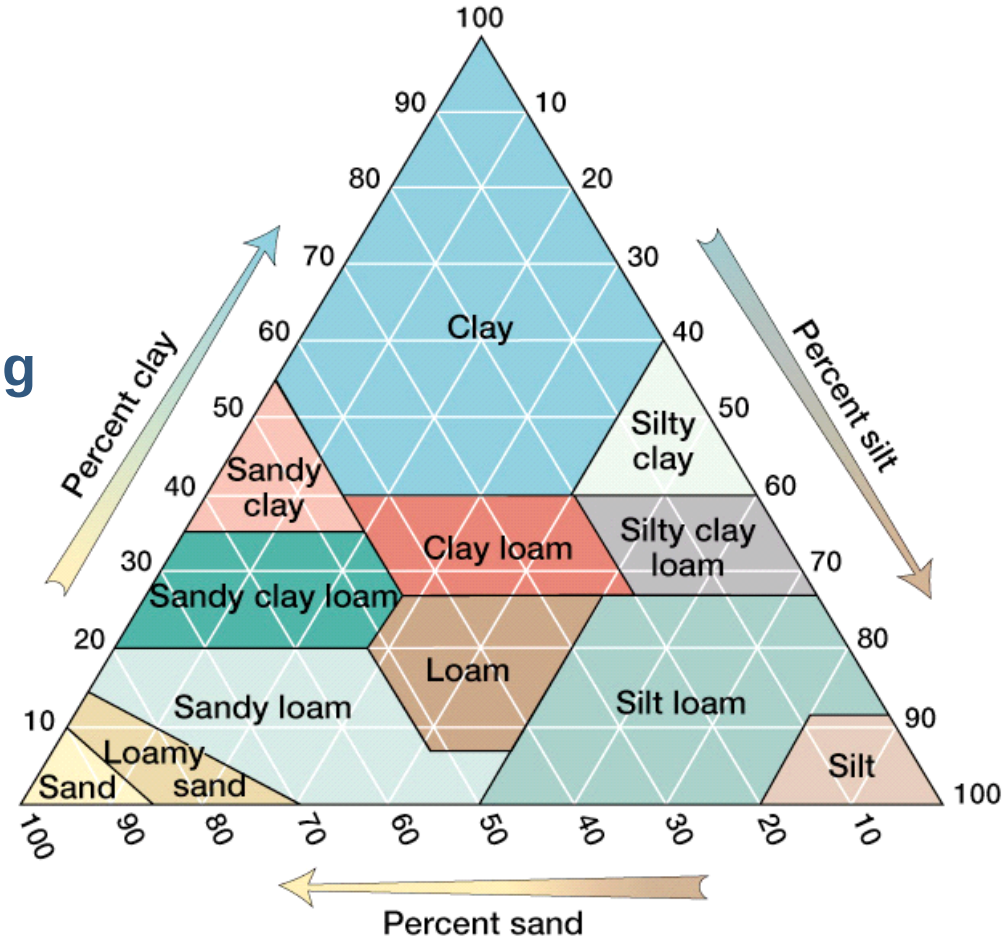


Water Mounding Models

- Step 1 → Identify soil textures
- Step 2 → Estimate Ksat
- Step 3 → Use soil & site characteristics to select model
  - Identify limiting layers → impede water movement
  - Identify slope for horizontal water movement
- Step 4 → Know available length & area for drainfield
- Step 5 → Know effluent volume (gpd) & dosing pattern
- Step 6 → Know effluent quality (BOD, TSS, etc)

Identify Ksat

- **Soil texture used to estimate saturated hydraulic conductivity (K_{sat}) in water mounding models**



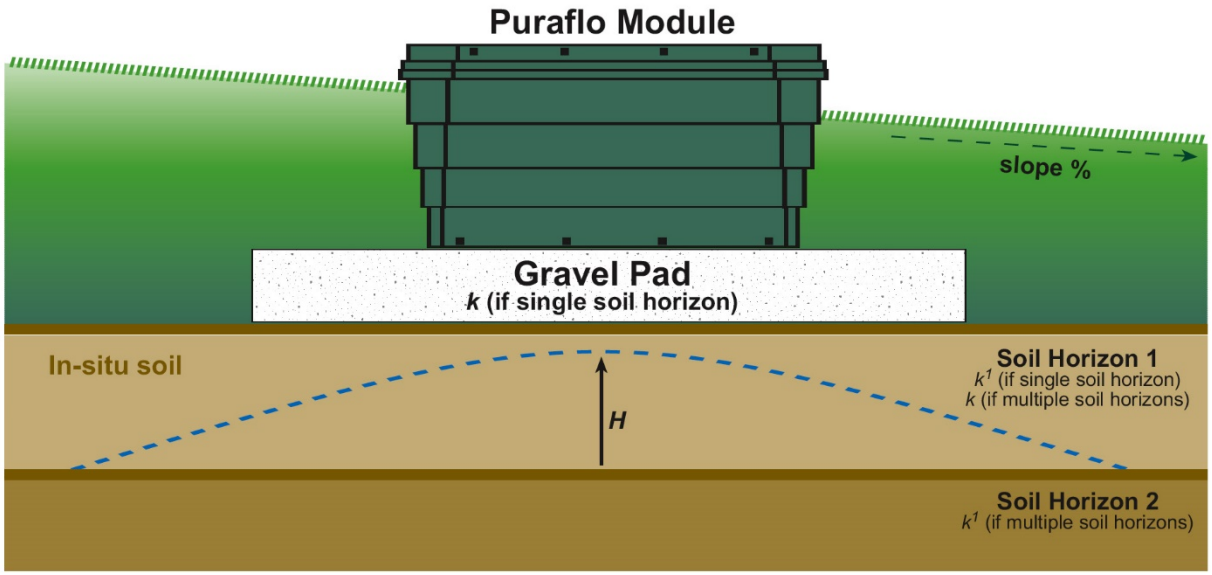
Estimating Ksat

- Table is ballpark estimate
- Field test very helpful for tough sites

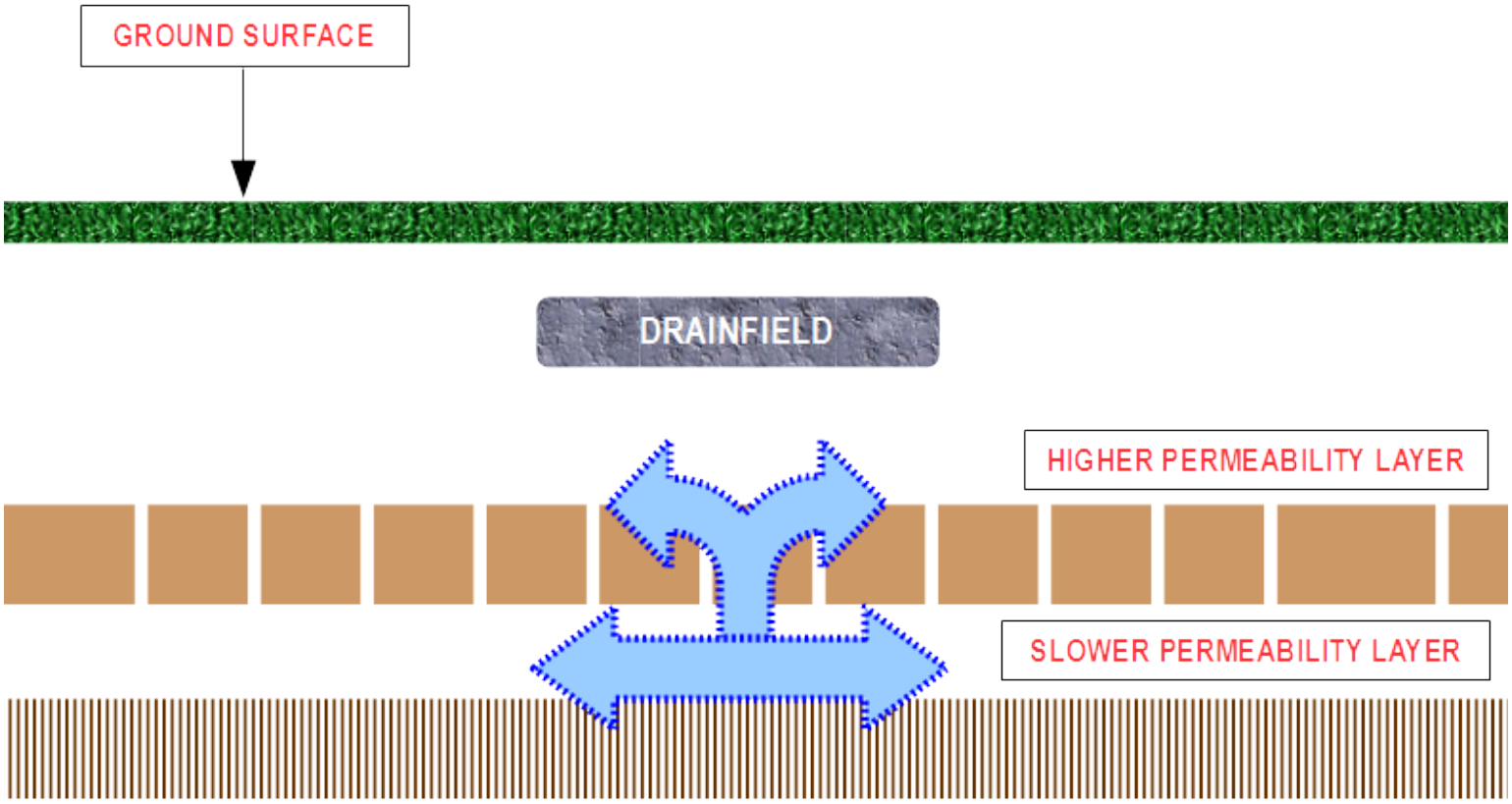
Ksat Values	Rawls et al, 1998		VA AOSS Regulations, 2011	
	mm/h	gpd/ft^2	cm/d	gpd/ft^2
Sand	181.90	107.11	>17	>4.17
Fine Sand	141.30	83.20		
Loamy Sand	123.00	72.43		
Sandy Loam	55.80	32.86	10 to 17	2.45 to 4.17
Loam	6.20	3.65		
Silt Loam	14.40	8.48		
Sandy Clay Loam	7.70	4.53	4 to <10	0.98 to <2.45
Clay Loam	4.20	2.47		
Silty Clay Loam	4.90	2.89		
Sandy Clay	0.90	0.53	<4	<0.98
Silty Clay	1.80	1.06		
Clay	2.00	1.18		

Water Mounding Models

- Incorporate Darcy's Law into equations
- Height of water mounding is calculated

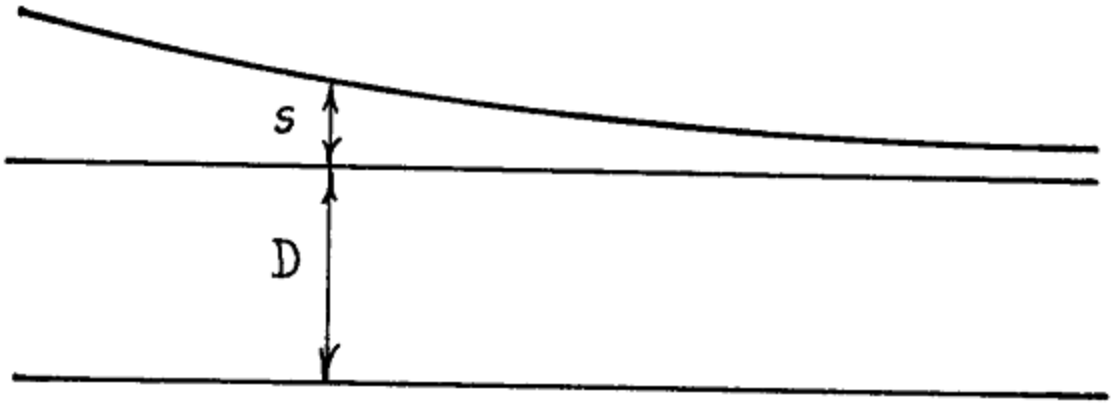


Kaplan Model

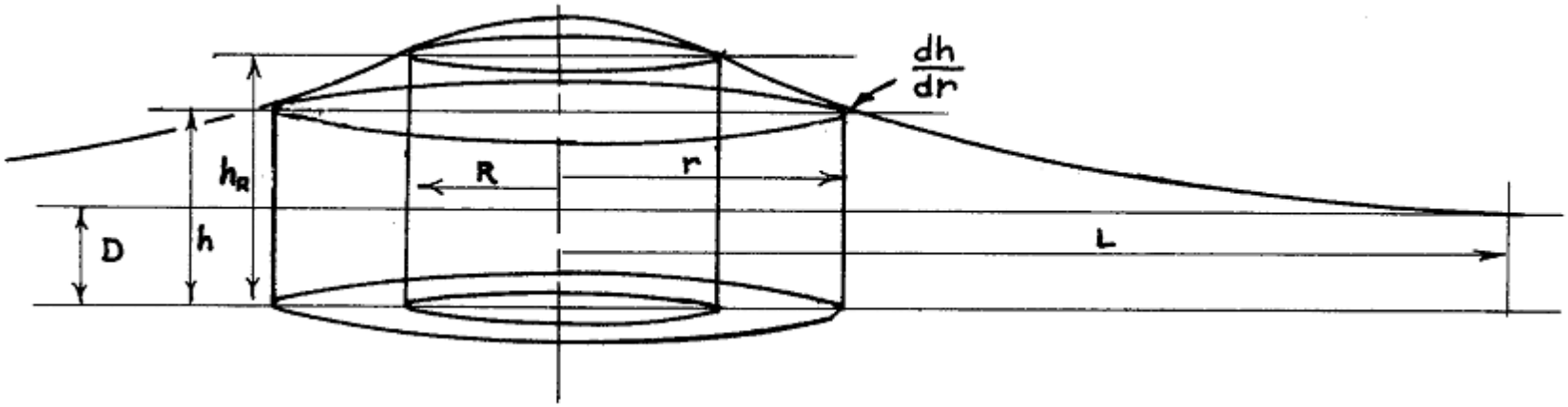


Allen Model

- Water mounding height above saturated layer
  - Seasonal or permanent water table

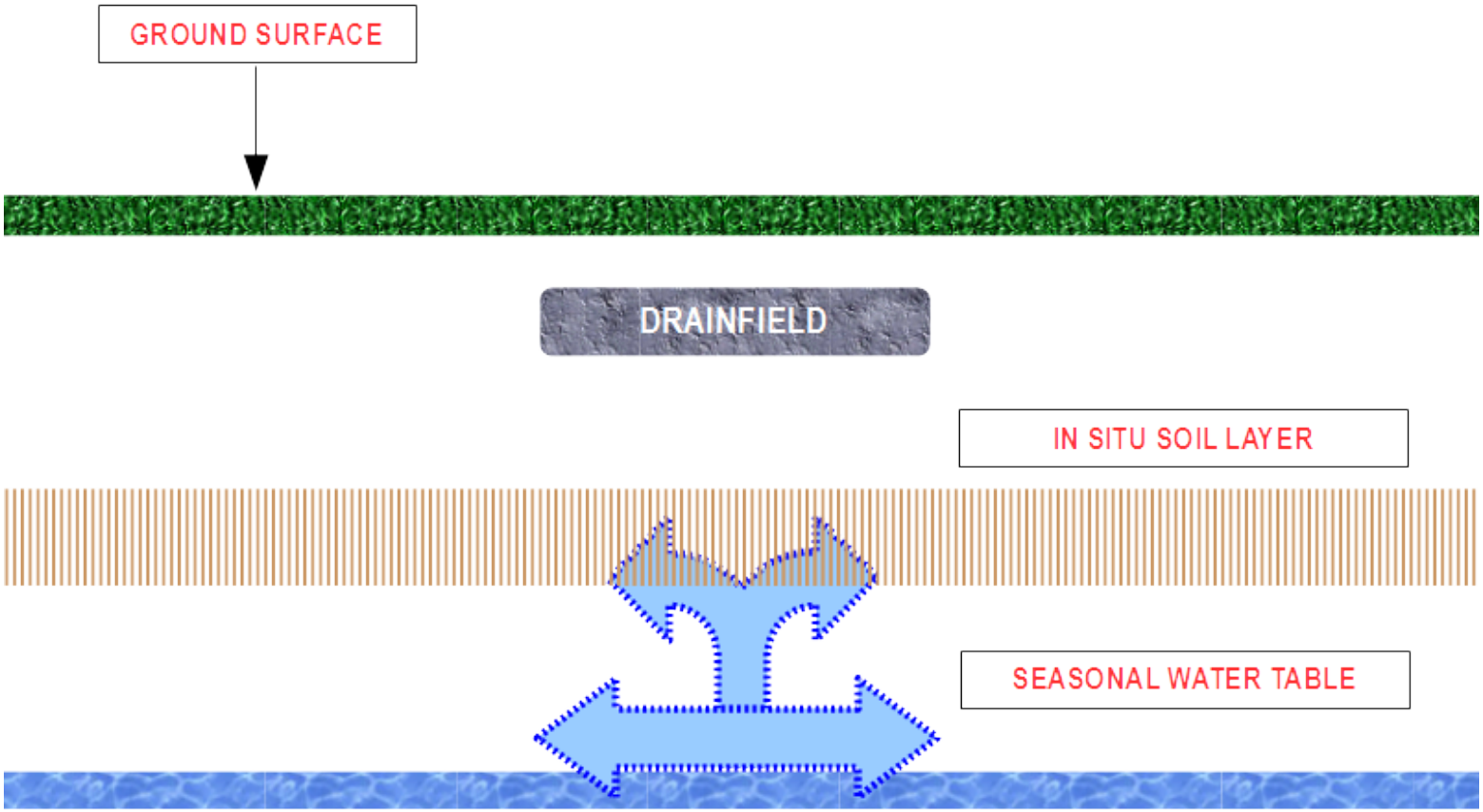


Allen Model



$$H^2 = D^2 + \frac{Q}{\pi K}\left(\ln \frac{L}{R} + 1/2\right)$$

Allen Model


GROUND SURFACE
DRAINFIELD
IN SITU SOIL LAYER
SEASONAL WATER TABLE

Poeter Model

- **Height of water mound = H_{max}**

(Equation 2)

$$H_{\max} = w\left[\frac{q'}{K_1}\left(\frac{q'}{K_2} - 1\right)\right]^{1/2}$$

(Equation 3)

$$L = w\frac{q'}{K_2}.$$

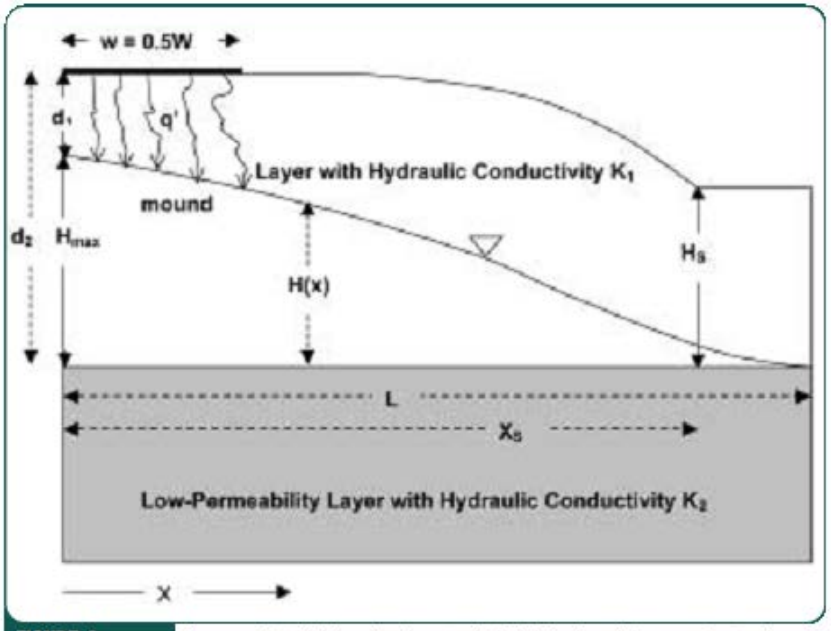
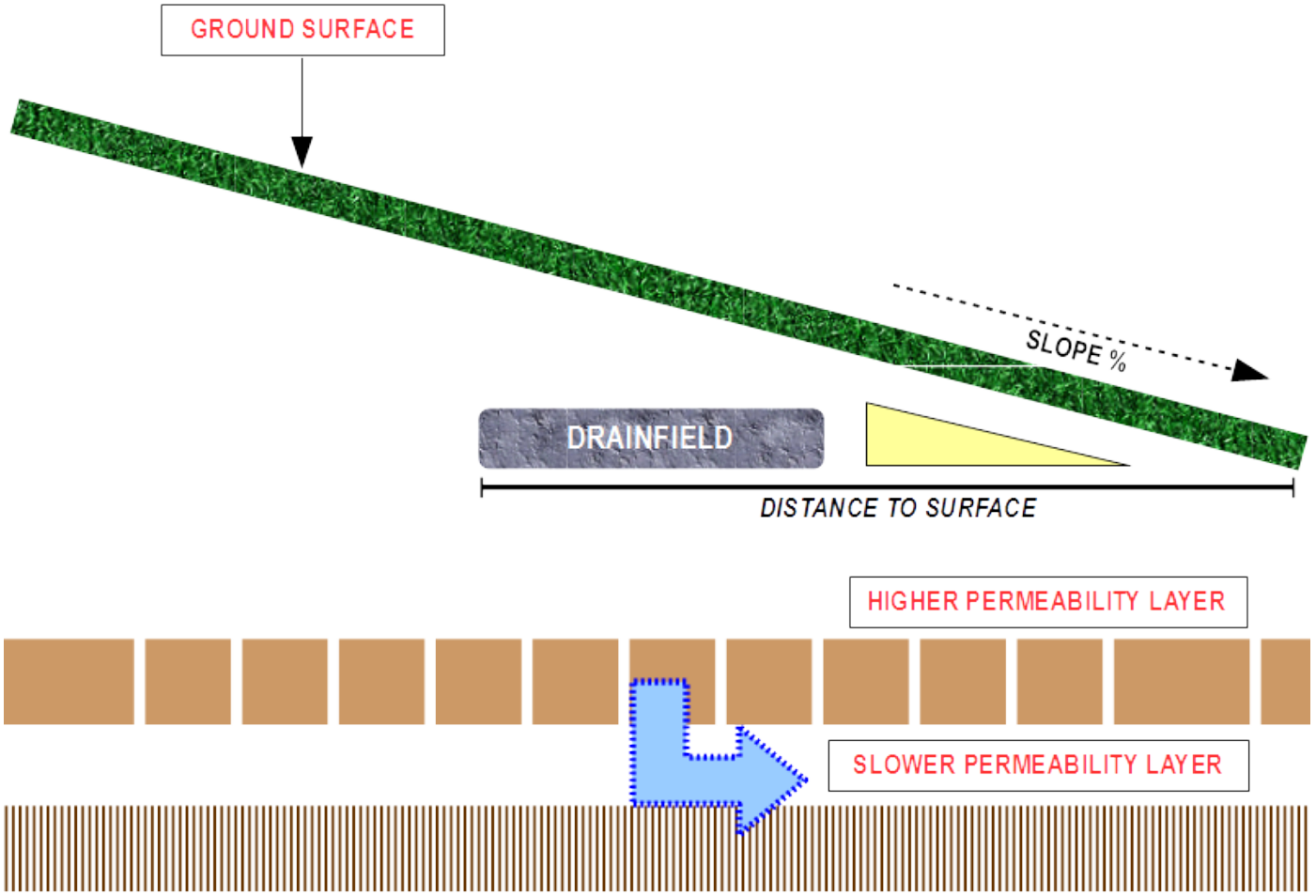


FIGURE 4 Conceptual Model for the Khan Analytical Solution. (Khan et al., 1976)

Note: Remember to keep units the same.

Poeter Model



Thoughts and Suggestions

- K_{sat} tables are guides
  - Field measurements can be performed
- Models are GUIDES
- Always use professional judgment
- No substitution for walking sites
- Dosing regime & effluent quality play important roles
- Other models are available
  - University of Minnesota
  - Others

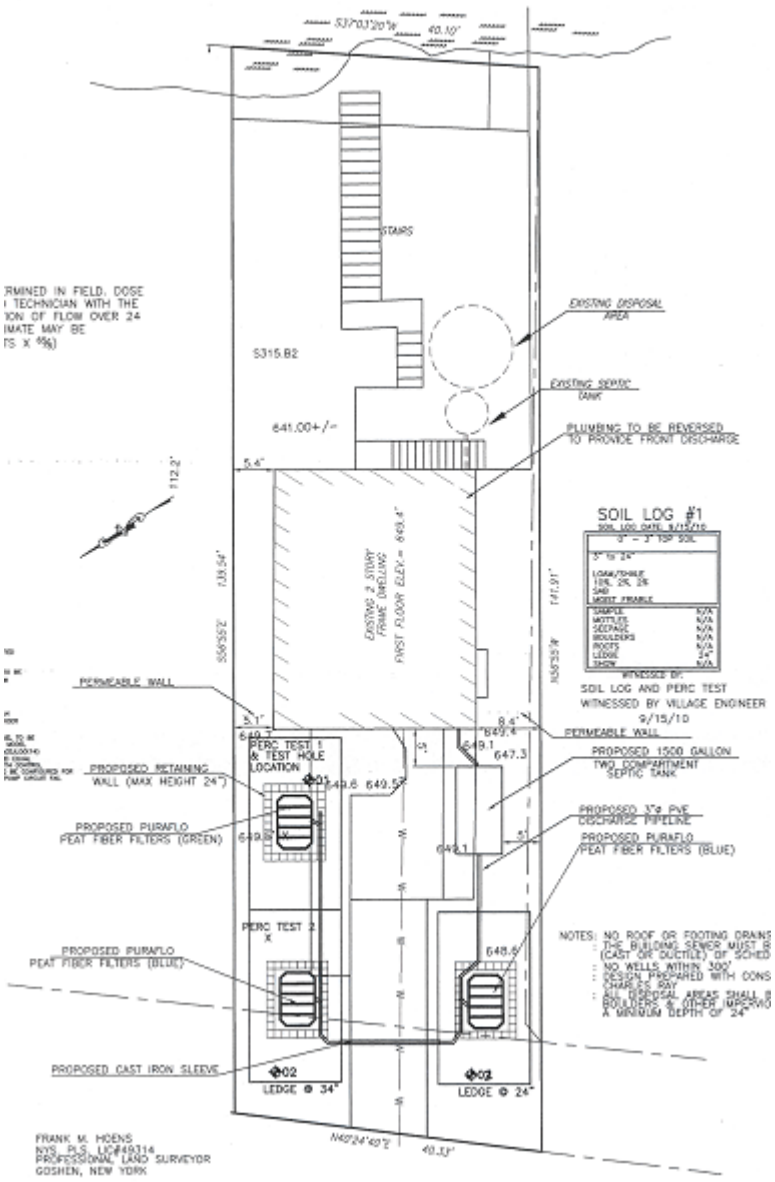
Greenwood Lake, New York

Greenwood Lake, New York

- Replacement system
- Sandy loam soil
- 24 inches deep over bedrock
- Site slope ~13%
- Front lot width = 40.33 feet


572 Jersey Ave, Greenwood Lake, NY 10925
© 2012 Google
Google
Date: 6/17/2010
1994
41°12'47.58" N 74°18'24.87" W elev 644 ft
Eye alt

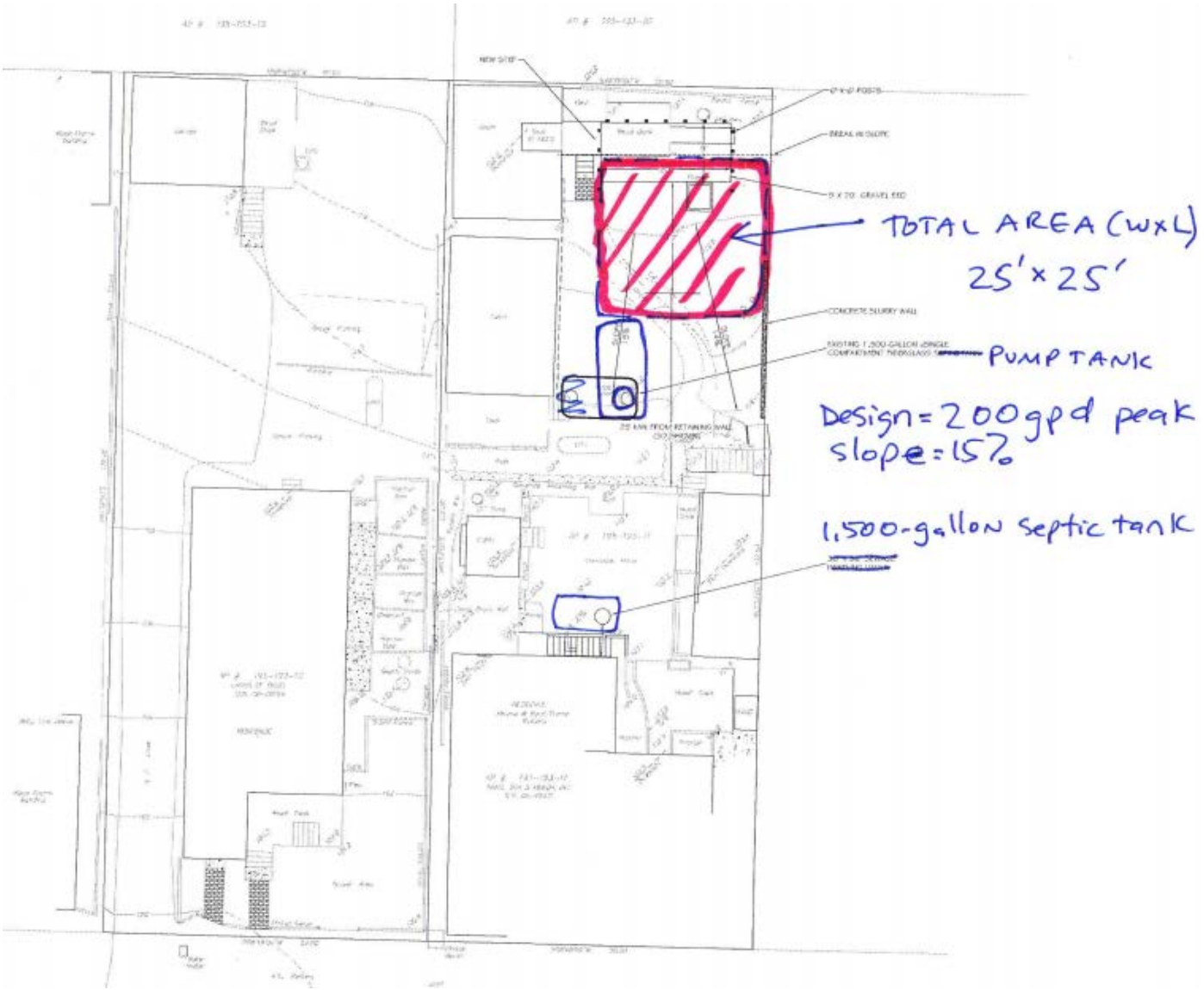
Greenwood Lake, New York



Stinson Beach, California

- Depth to limiting layer = 30 inches
- Very limited space 25’ x 25’
- Sandy clay loam over sandy clay
- Soil application rate = 0.5 gpd/ft^2
- 200 gpd peak & 150 gpd avg design flow
- Linear loading rate of 10.6 gpd/ft due to space

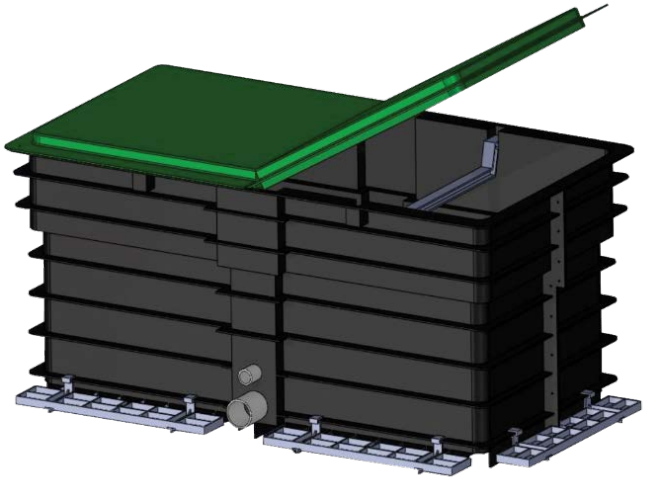
Stinson Beach, California

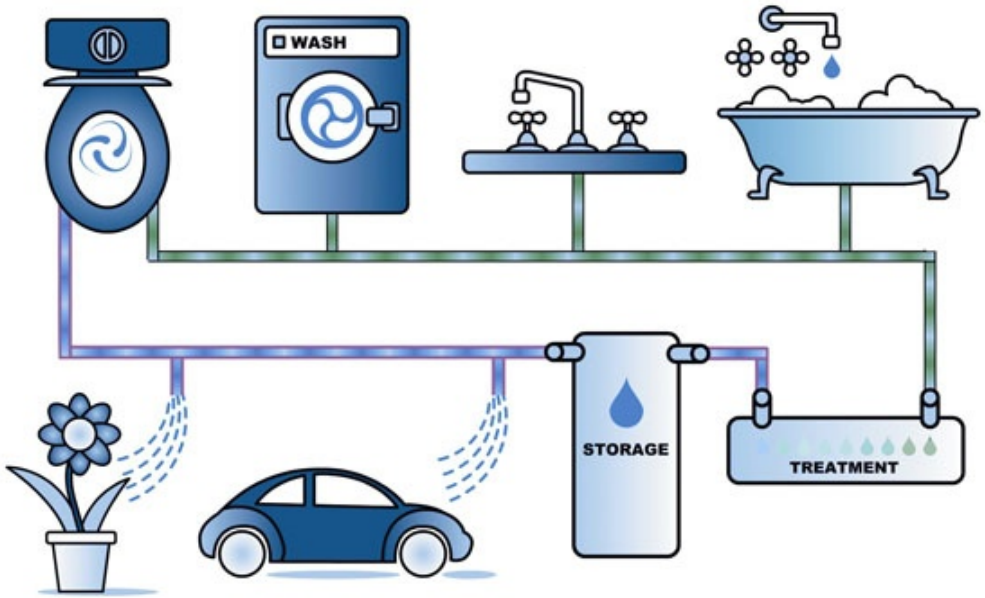



Peat Fiber Biofilter
Fill Pad

Total Water Reuse Opportunity

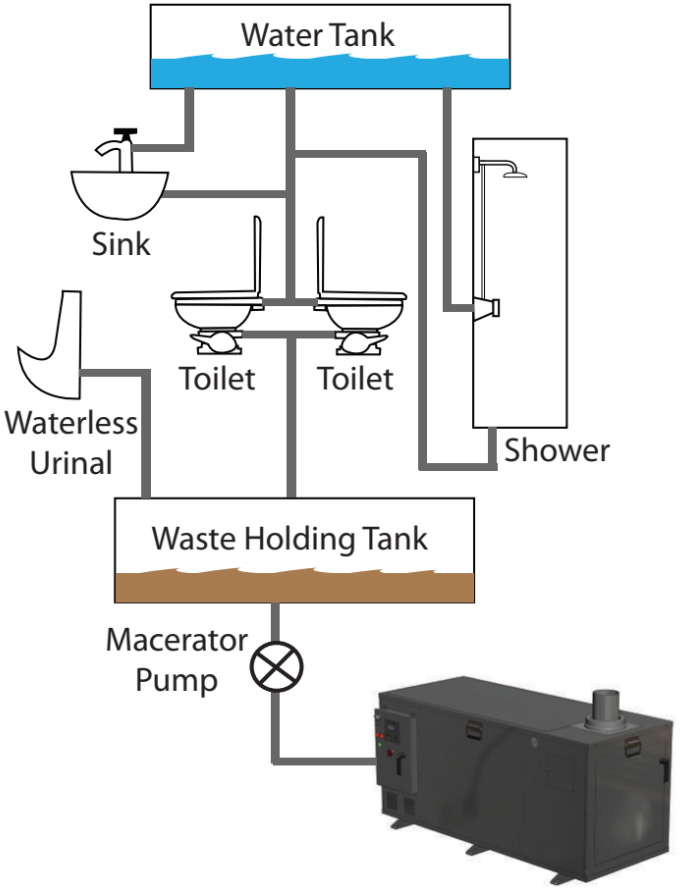
- NSF 350 in UPC
- E-Z Treat → NSF 350
- Save water
- Further drainfield sizing reduction

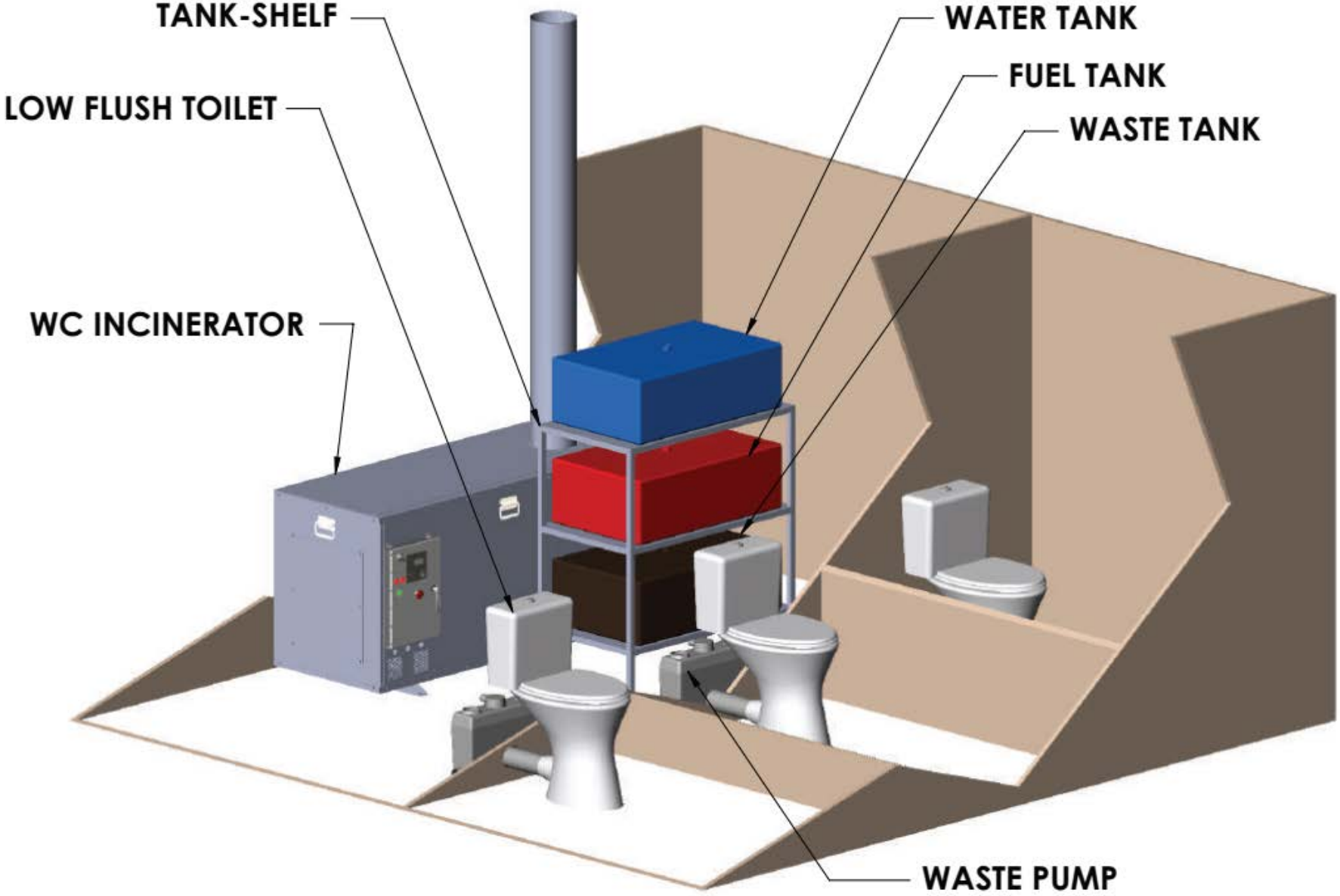




Site Water Reduction

- **Ecojohn → Incineration System**




TANK-SHELF
LOW FLUSH TOILET
WC INCINERATOR
WATER TANK
FUEL TANK
WASTE TANK
WASTE PUMP

Contact

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