Experimental Testing of Gravity Distribution Methods for Onsite Wastewater Treatment Systems

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The materials being presented represent my own opinion, and do NOT reflect the opinions of NOWRA.

Acknowledgments

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Background & Purpose

- Many onsite wastewater treatment systems (OWTS) rely on gravity-fed parallel distribution
- Such systems are often designed on the assumption of even distribution across the soil treatment area
- Distribution devices may favor some outlets due to off-level installation, settling, and freeze/thaw cycles
- Experiment sought to test evenness of distribution in both level and off-level configurations

The goal of distribution

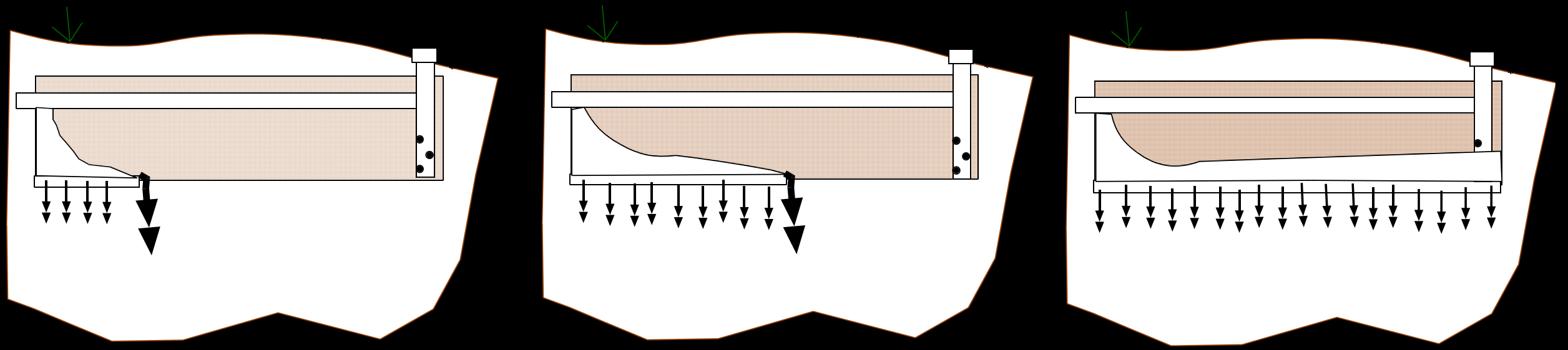
Uniform distribution of effluent to maximize treatment capability
Spread it out over <u>space and time</u>

Provide time for treatment to occur

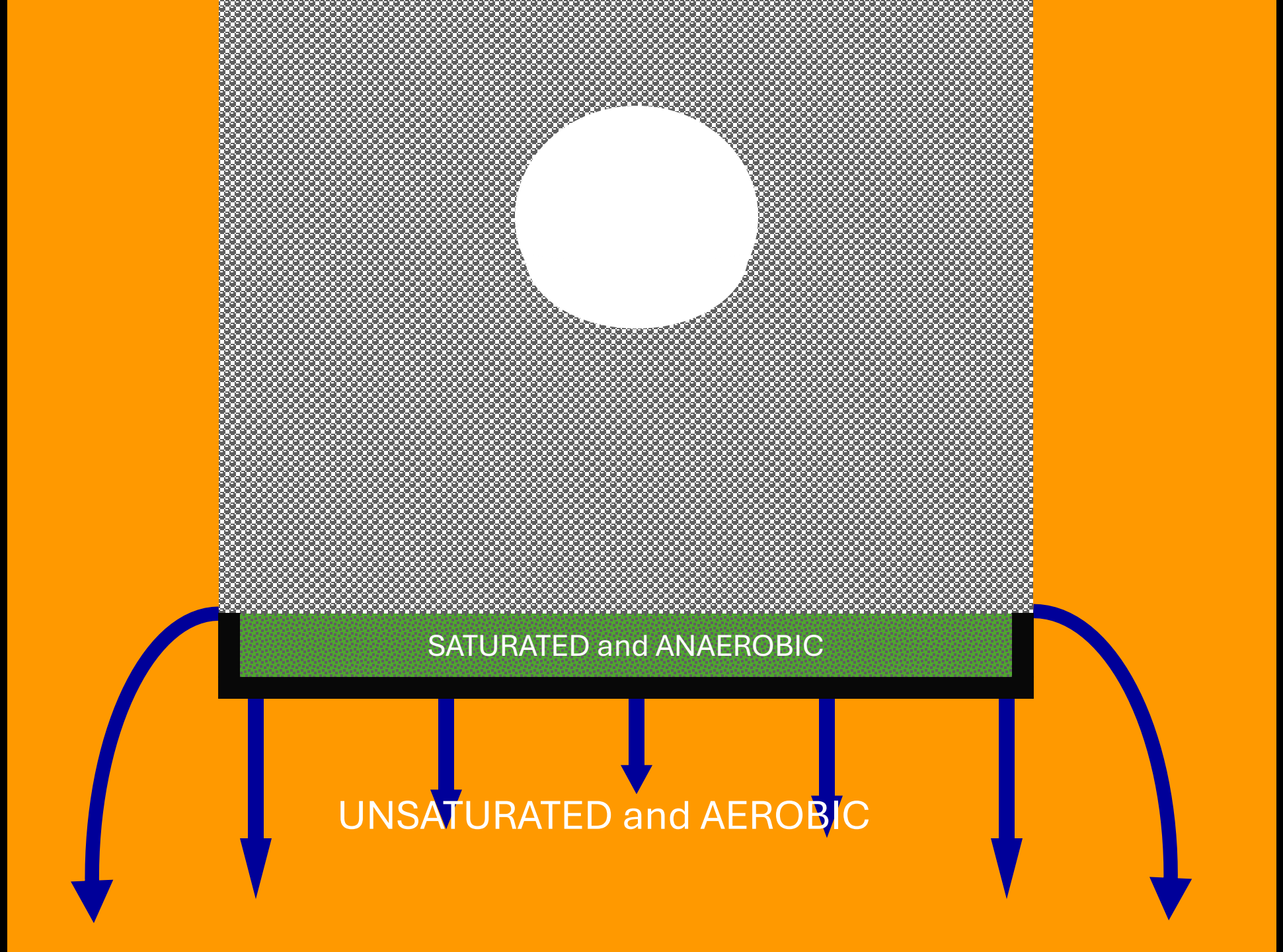
Promote unsaturated flow to: Allow for treatment of contaminants

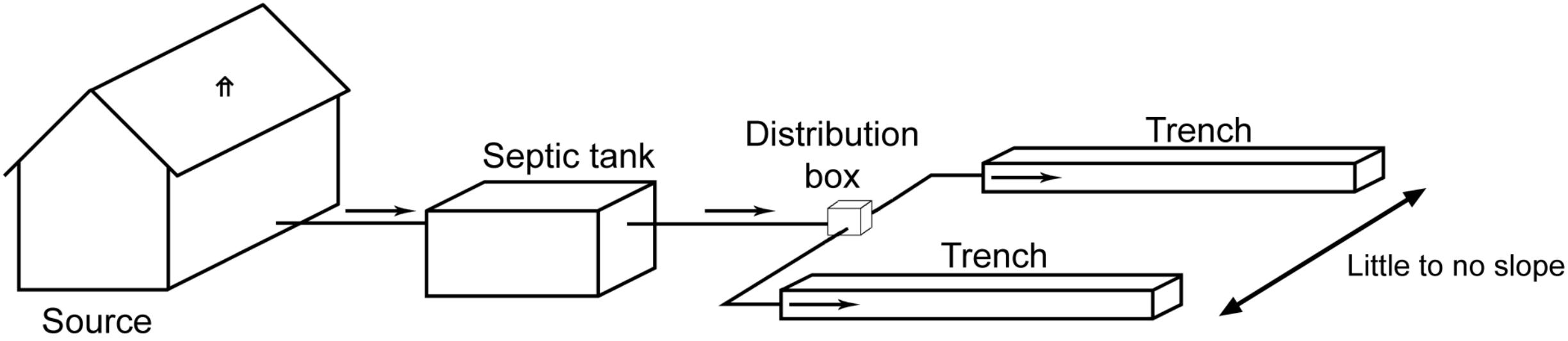
Disperse the liquid

Flow pattern in a gravity trench - Biomat growth over time



Time 0 → *Mature*


SATURATED and ANAEROBIC
UNSATURATED and AEROBIC



Parallel gravity distribution

- Ideally used on fairly level sites
- *Assumes* effluent splits equally
- Trenches - equal length, even elevation

Parallel distribution

- Should be accessible from the surface for O&M
- Each lateral should be parallel to slope contour
- Bottom of each lateral should be flat
- Even if there are equal flows to each lateral, flows will not be uniform down length of laterals

Parallel distribution

Flow equalizers – speed levelers

Experimental Scope: Devices

Header pipes

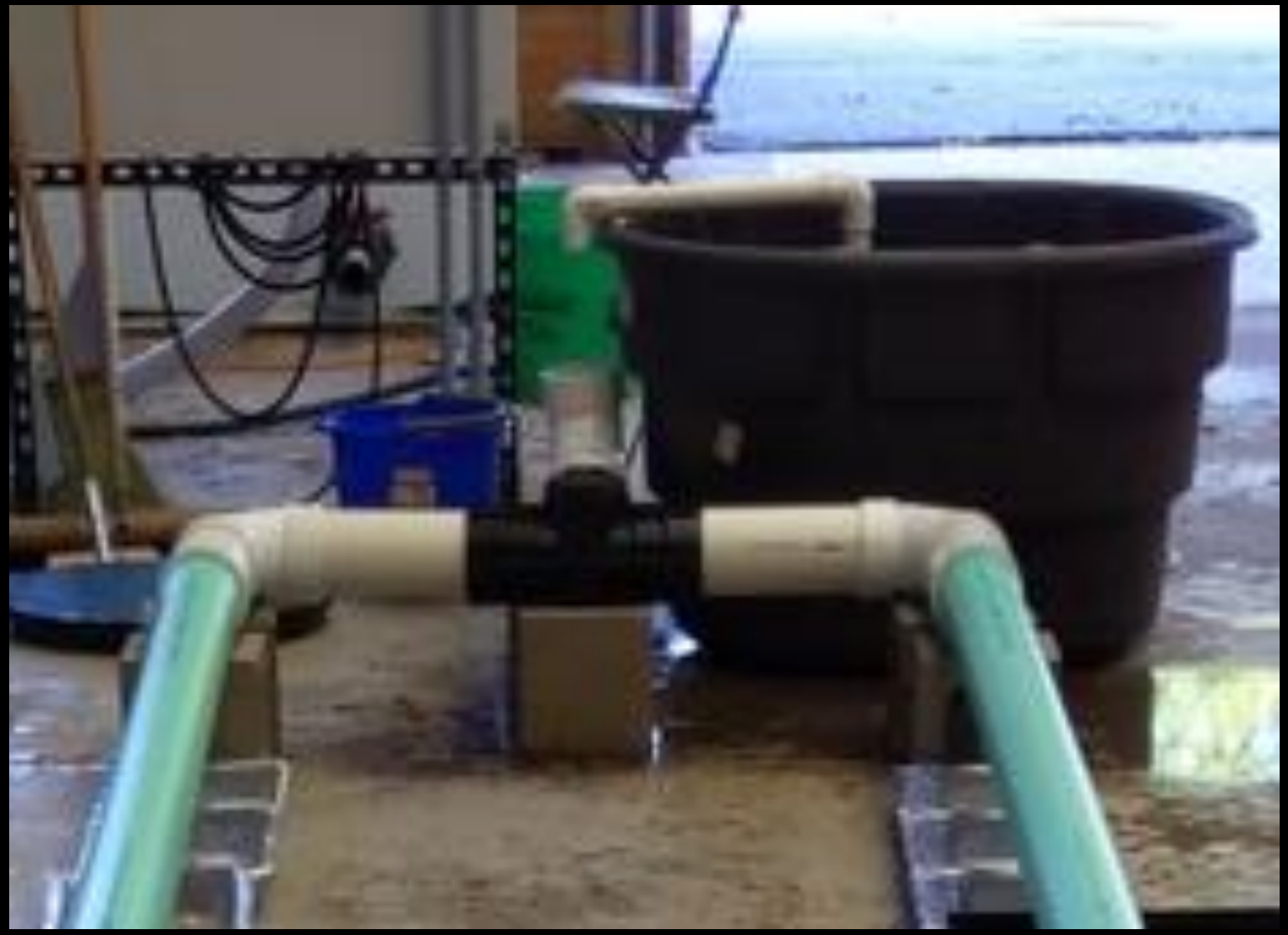
Splitter tee

Distribution box

- No insert
- SeptiSurge dosing manifold
- Unadjusted speed levelers
- Adjusted speed levelers

Header Pipes

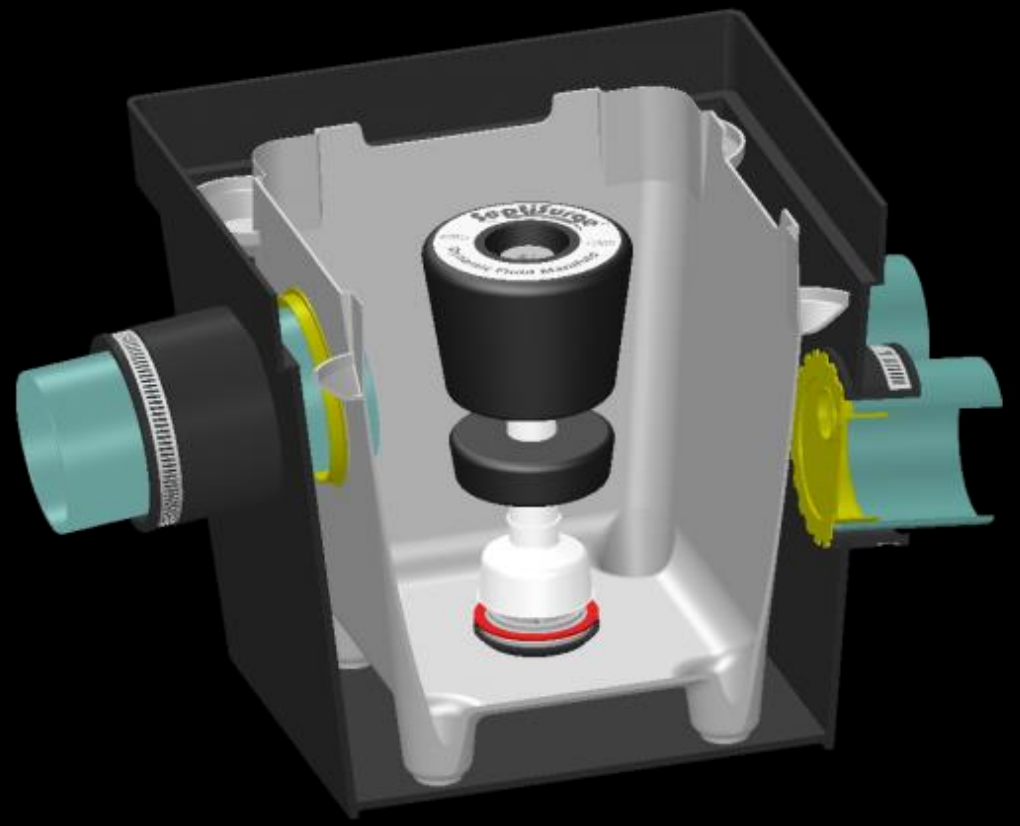
Splitter Tee



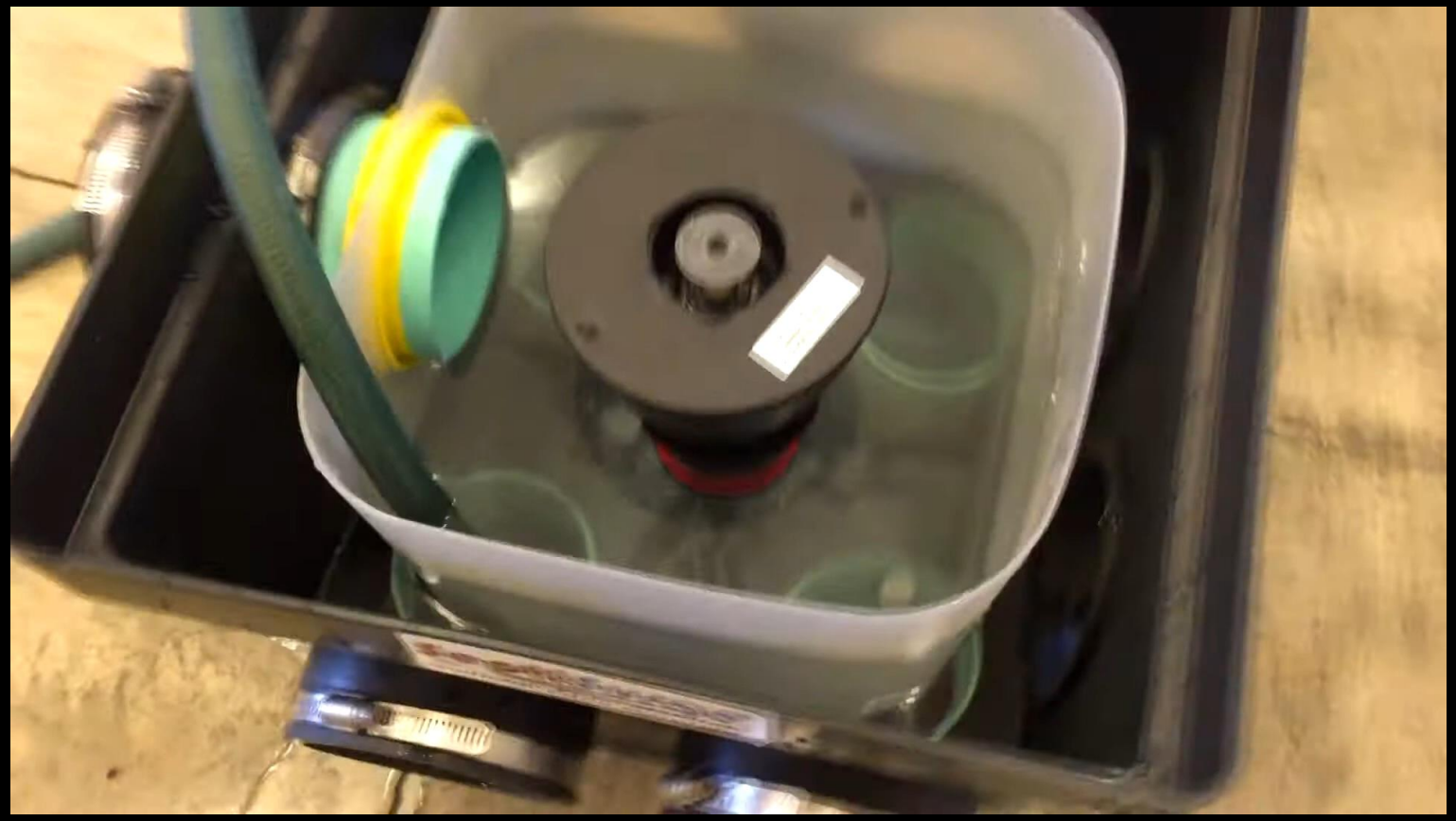
Shown here with SpetiSurge dosing manifold insert

Distribution Box

SeptiSurge Dosing Manifold



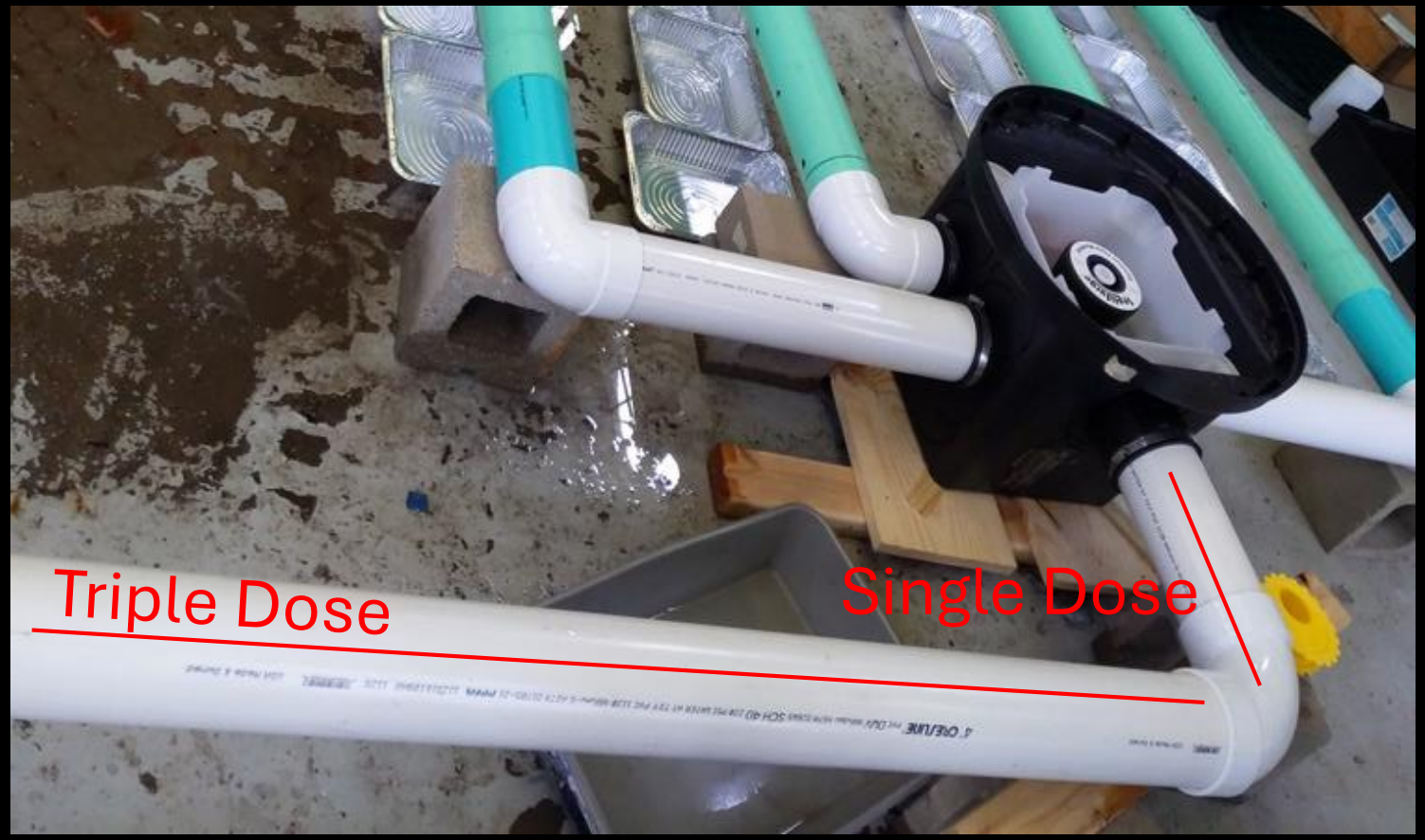
SeptiSurge Dosing Manifold



SeptiSurge Dosing Manifold

Single dose
≈ 10 L

Triple dose
≈ 30 L
Extra length of pipe added (pictured)



Experimental Scope: Flow Rates

Intended to simulate outflow from septic tank in various systems

2 GPM (smaller system)

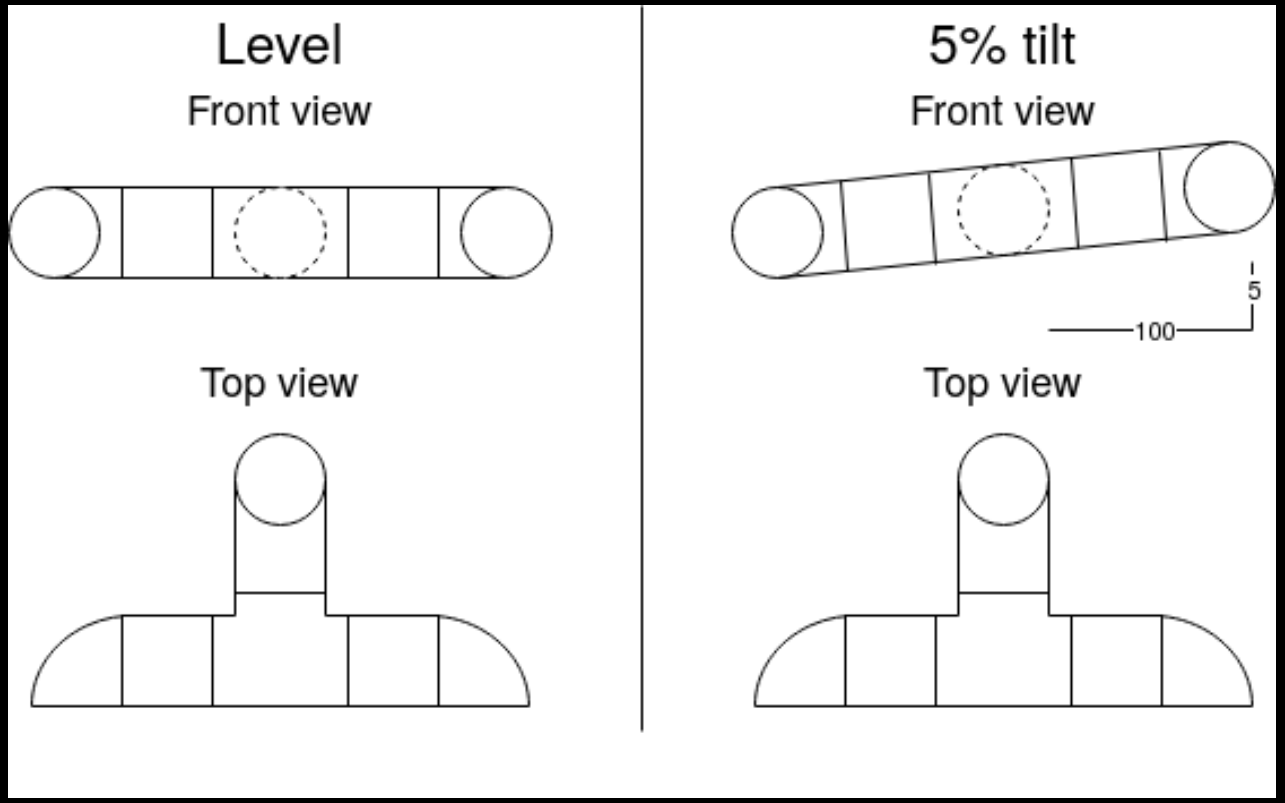
5 GPM (larger system)

25 GPM (pump to gravity)

Pump to Gravity Configuration

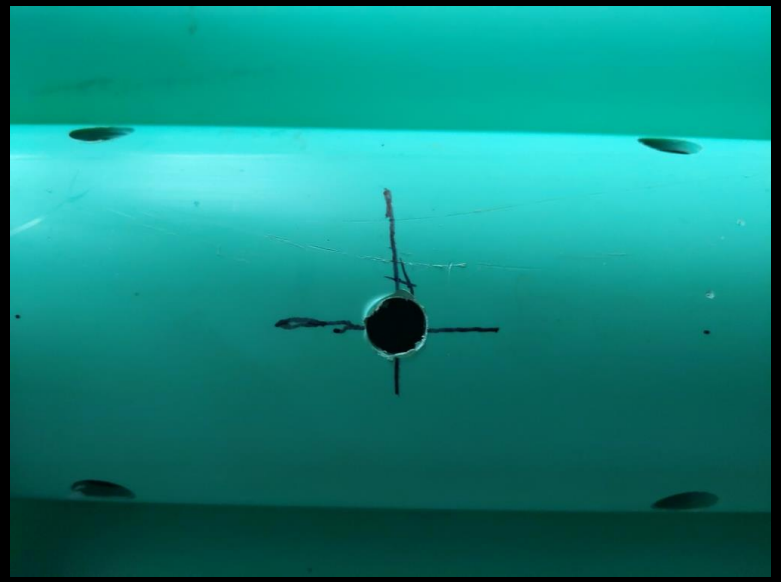
Experimental Scope: Device Tilt

- Level
- 2% tilt
- 5% tilt

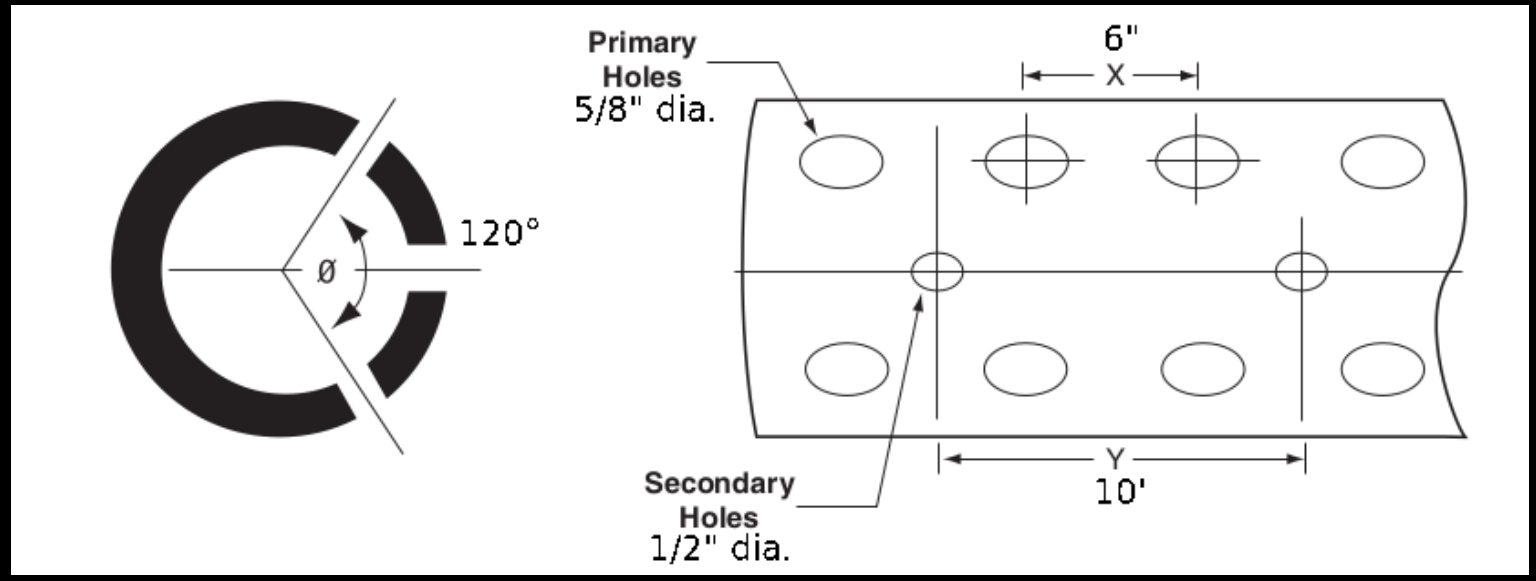


Experimental Scope: Outlets and Drainpipes

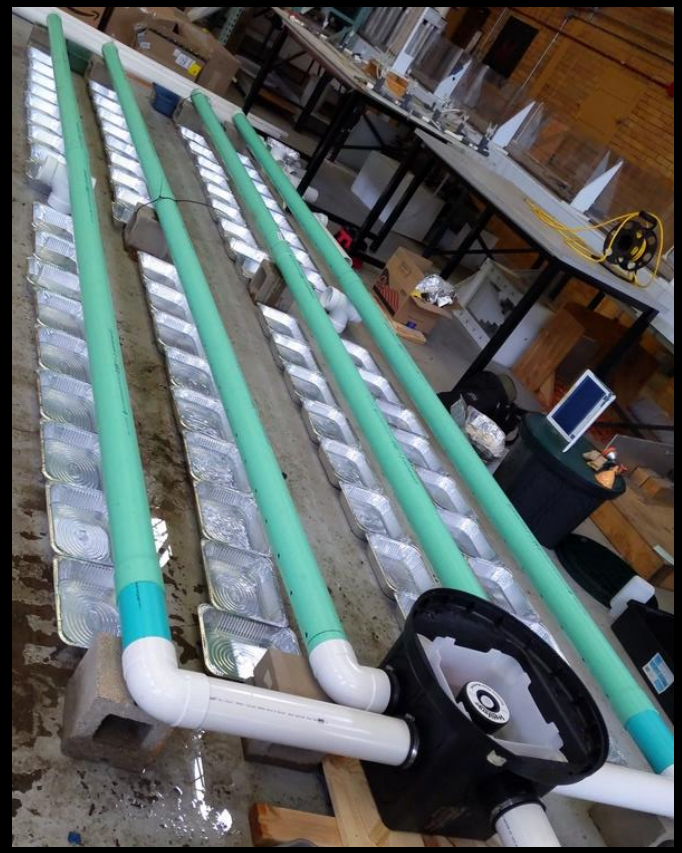
- Outlets: 2 or 4
- Distribution pipes with 4 and 8 o’clock holes only
- Distribution pipes with additional 6 o’clock drain holes (pictured)



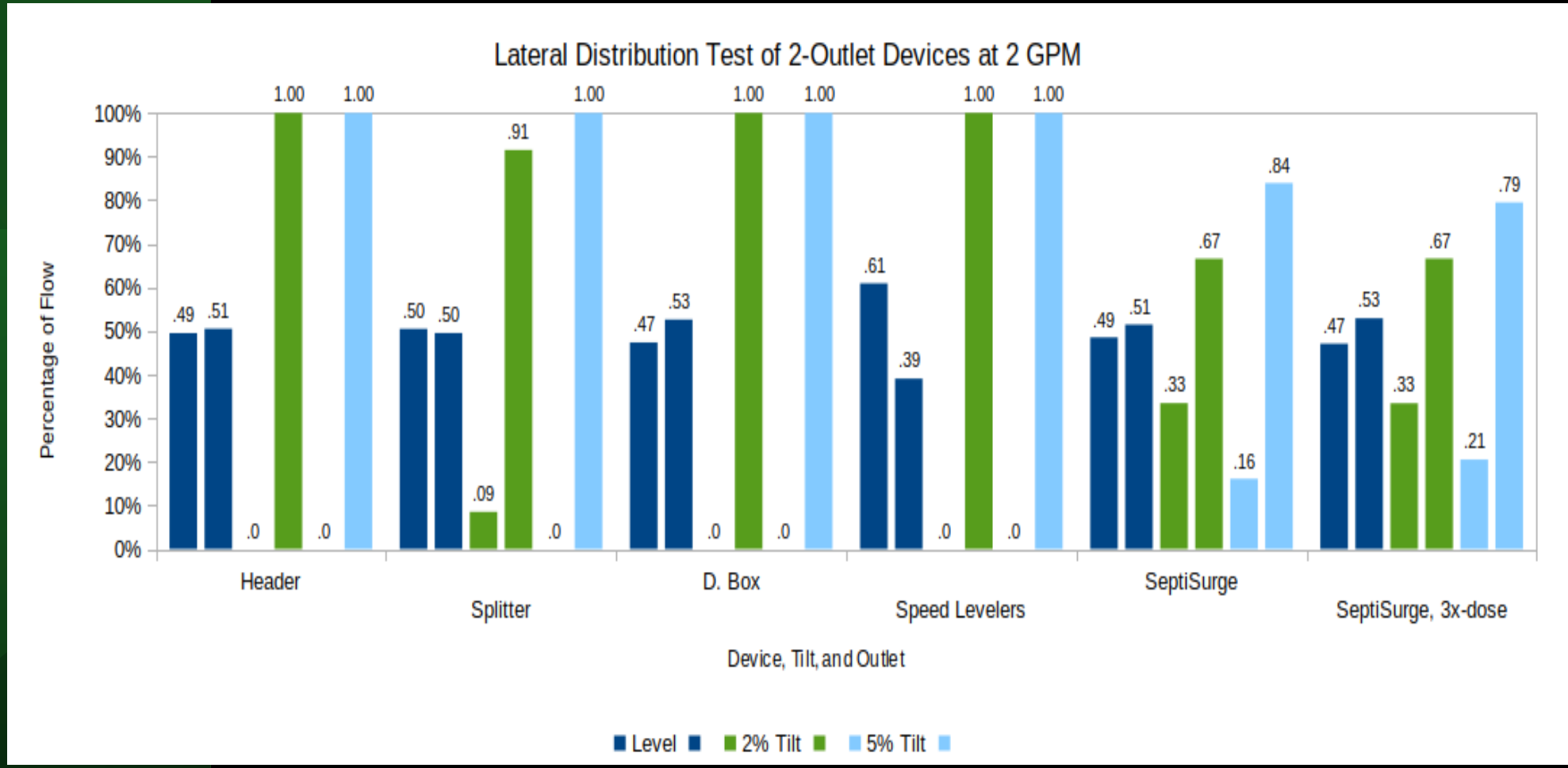
Drain Hole Dimensions



Setup: Drainpipes

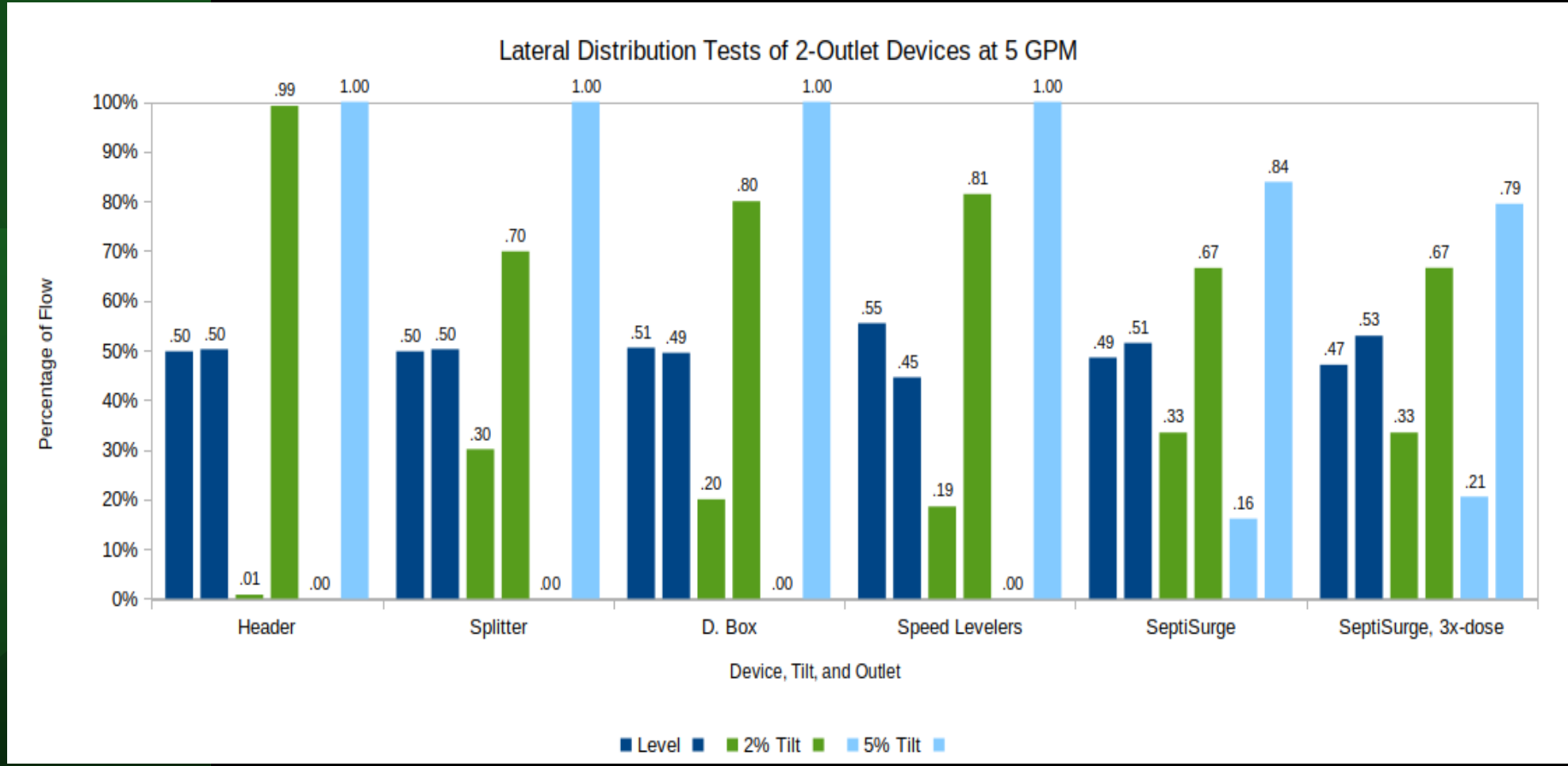


Results: 2 Outlets 2 GPM Lateral



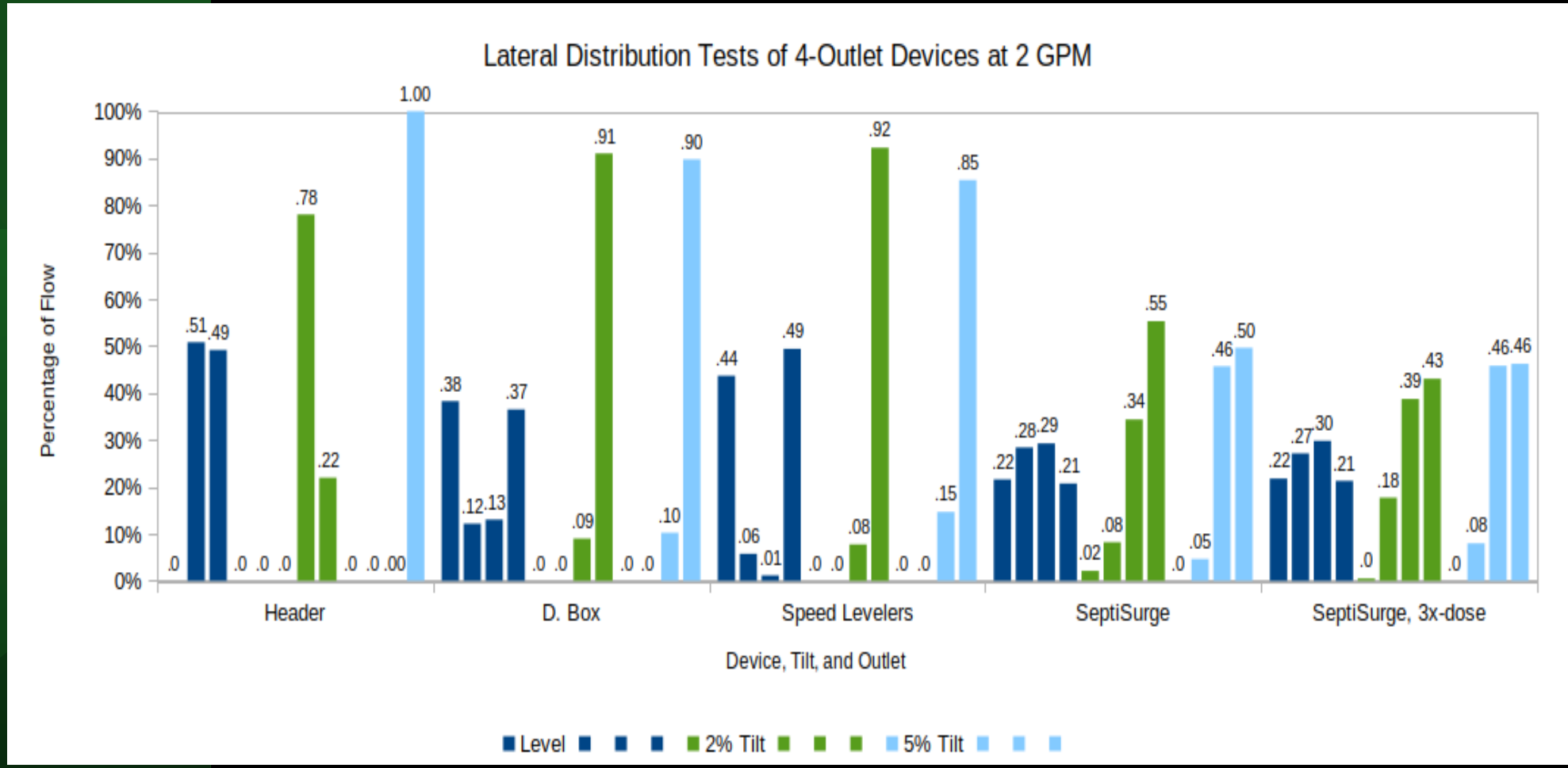
Traditional distribution devices routed < 9% of flow to higher outlet when tilted

Results: 2 Outlets 5 GPM Lateral



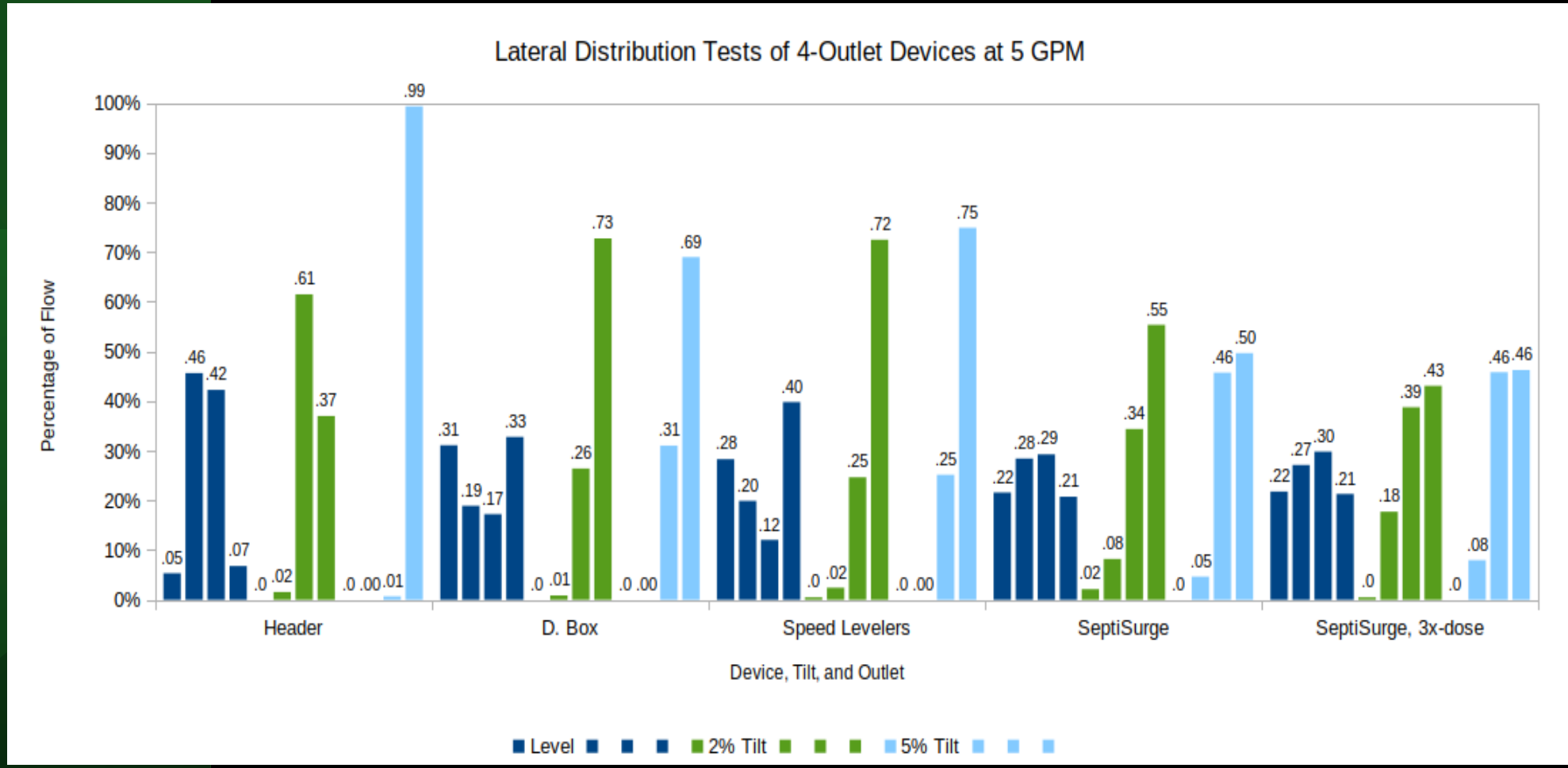
Traditional distribution devices routed < 30% of flow to higher outlet at 2% tilt, and no flow at 5% tilt

Results: 4 Outlets 2 GPM Lateral



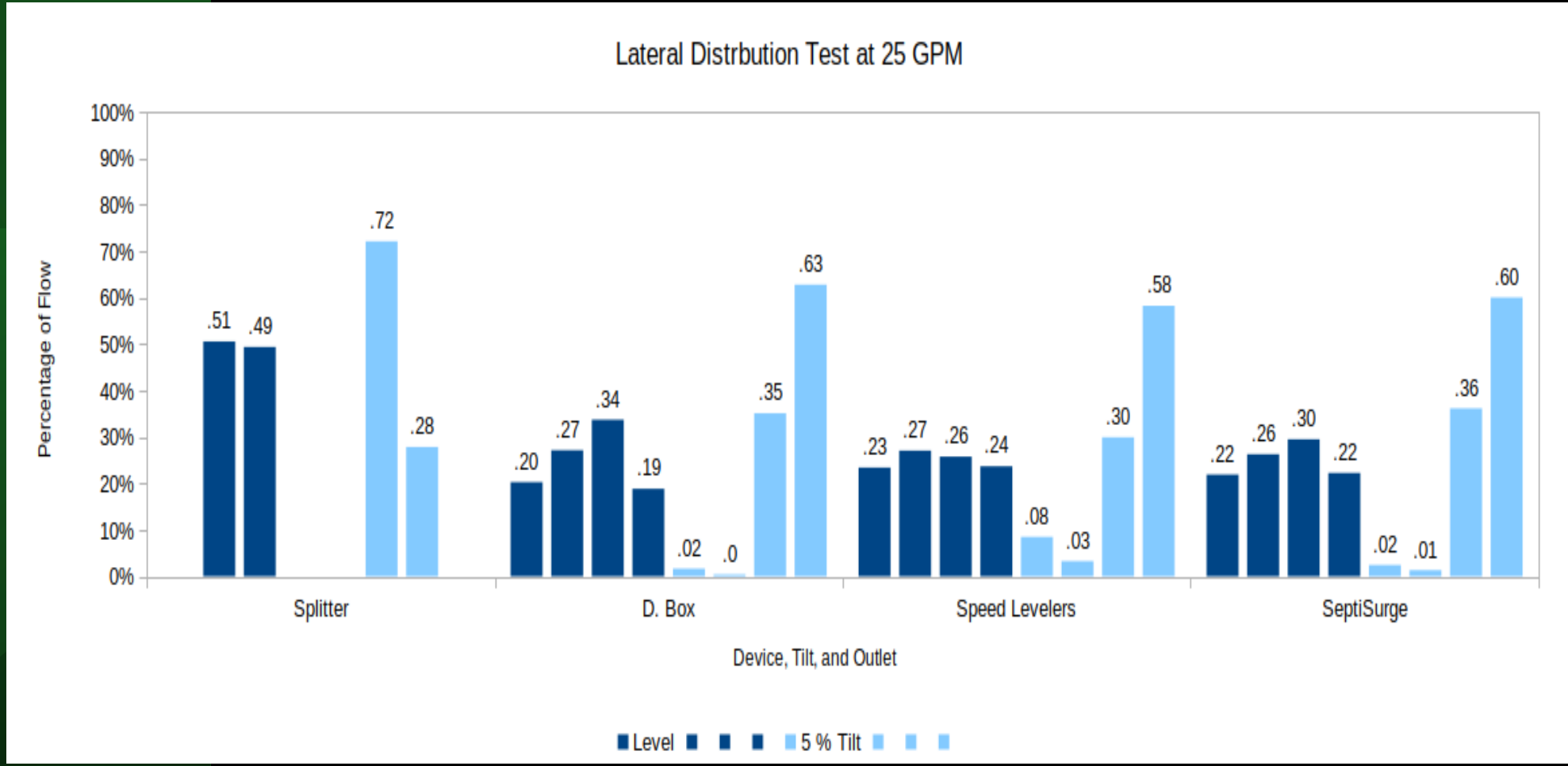
Traditional distribution devices routed no flow to higher two outlets when tilted

Results: 4 Outlets 5 GPM Lateral



Traditional distribution devices routed < 2% of flow to higher two outlets when tilted

Results: 25 GPM Lateral



All devices provided at least some flow to higher outlets when tilted
Lower outlets still heavily favored

Results: Lateral Distribution

Header pipes and distribution box favor specific outlets even when level

Header pipes and distribution box provide no flow to higher outlets when tilted

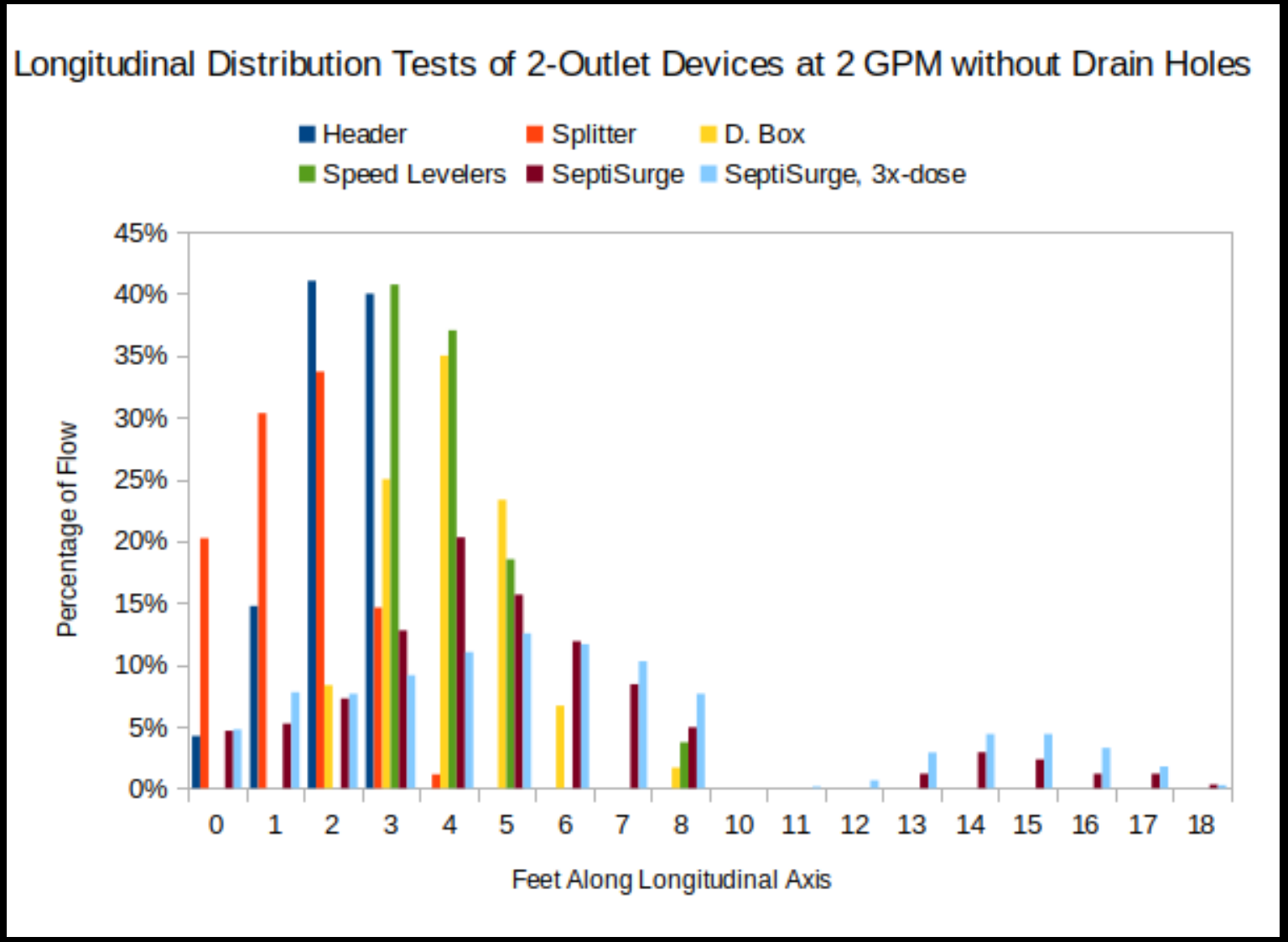
Only SeptiSurge provides even distribution in all 2-outlet configurations

SeptiSurge also most even in tilted configurations

Adjusted speed levelers recover even distribution

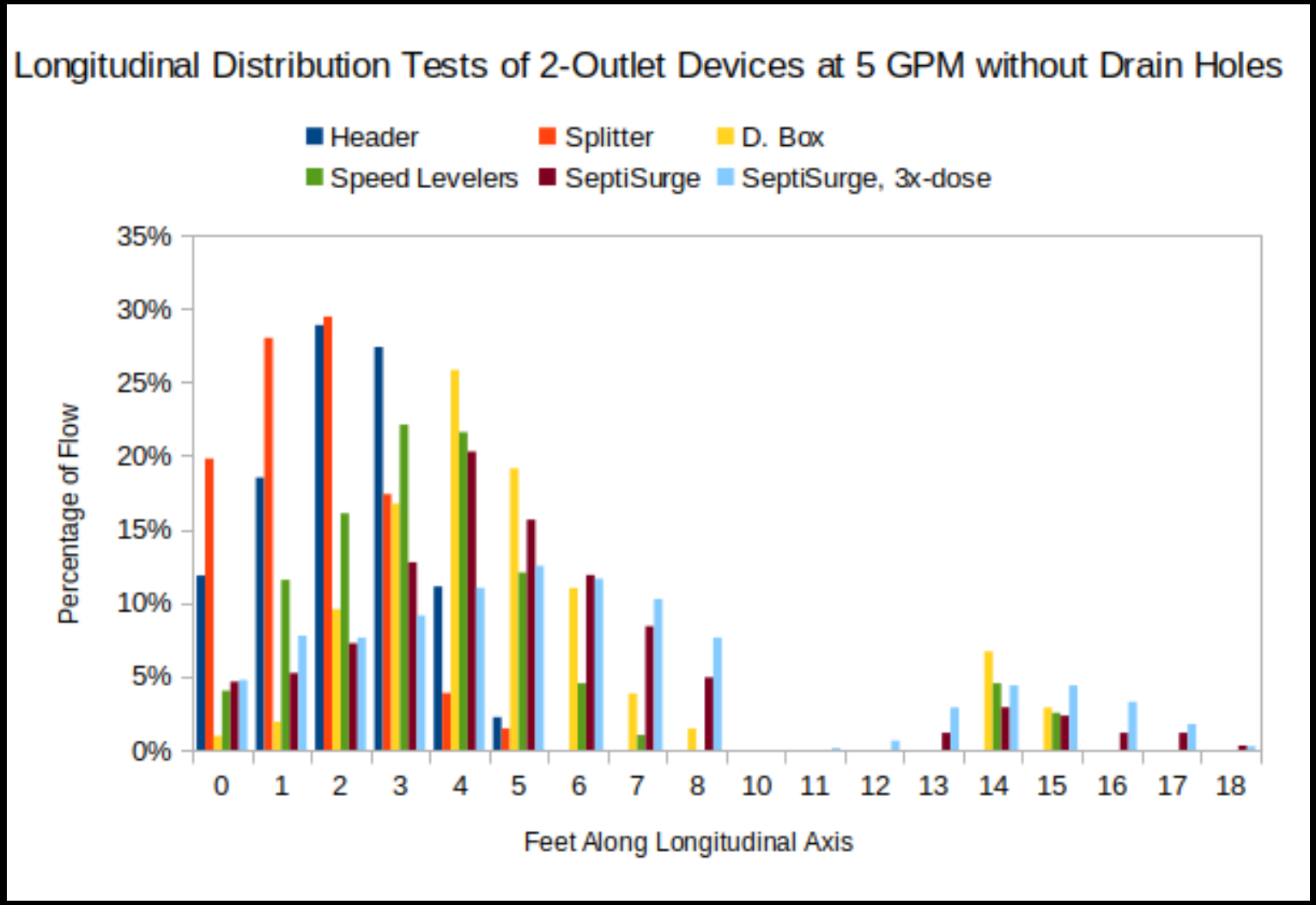
Pump to gravity improved distribution of all devices

Results:
2 Outlets
2 GPM
Longitudinal



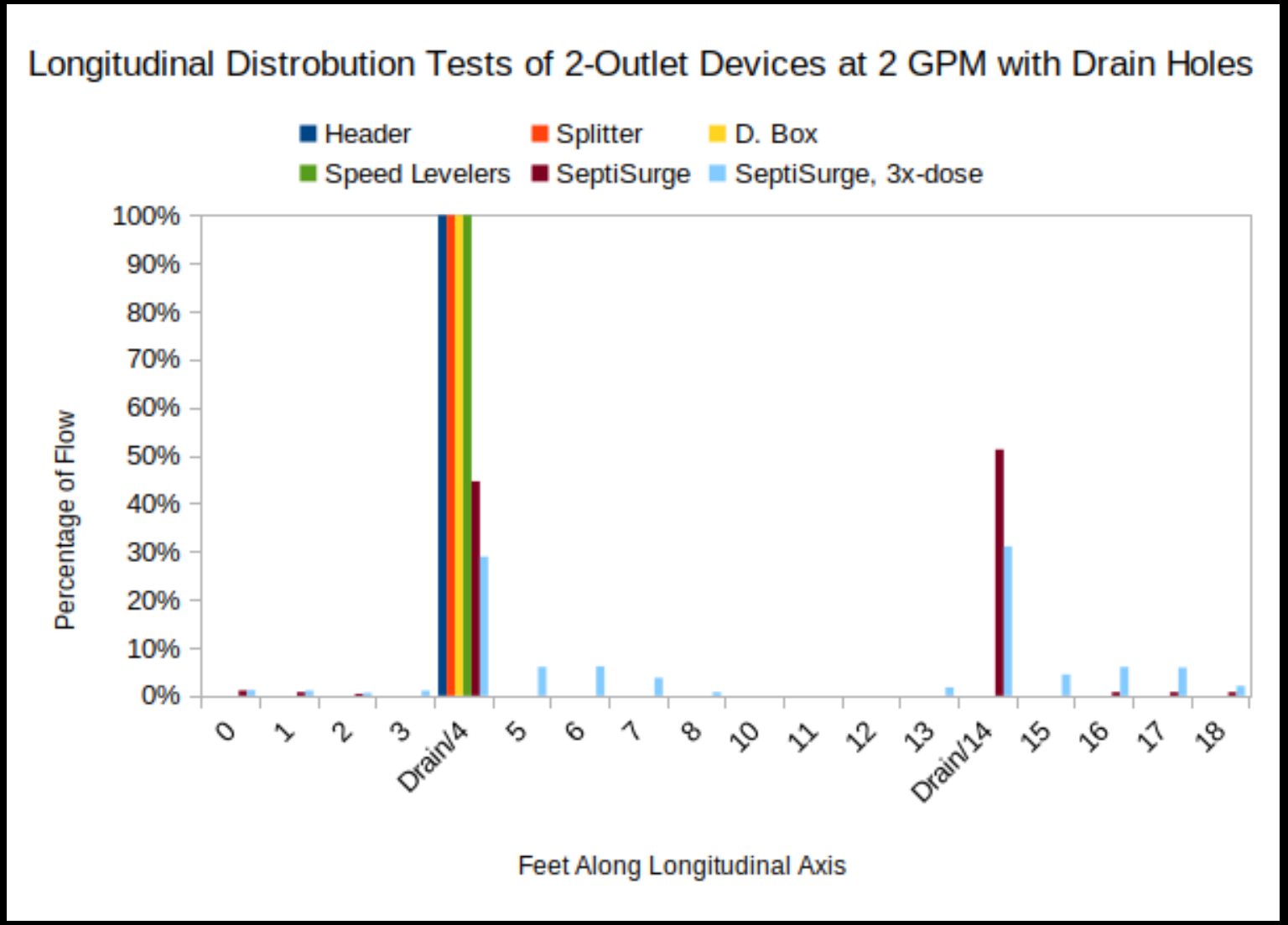
Only SeptiSurge provided flow to farther half of pipe

Results:
2 Outlets
5 GPM
Longitudinal



SeptiSurge, speed levelers, and unmodified distribution box all provided flow to farther half

Results:
2 Outlets
2 GPM
Longitudinal + Drain Holes



Traditional devices use only first 6 o’clock drain hole

Results: Longitudinal Distribution

SeptiSurge consistently provides most even distribution

Triple-dose SeptiSurge provides better distribution than single

At 2 GPM and 5 GPM most outflow used 6 o’clock drain holes when present, and only SeptiSurge provided flow to other holes

Pump to gravity improved distribution of all devices; 4 and 8 o’clock holes were used, but 6 o’clock drain holes still preferred

Conclusions

- Traditional distribution devices performed poorly when tilted
- SeptiSurge provided even lateral distribution except in the most extreme tilt cases
- SeptiSurge also provided more even longitudinal distribution than traditional devices
- When 6 o’clock drain holes were present, they were heavily favored by all devices
- Triple-dose SeptiSurge performed better than single dose
- Pump to gravity improved distribution, but was still uneven when tilted and with 6 o’clock drain holes

Study Limitations

- No biofilm or solids deposition
- No biomat
- No distribution media

Questions & more information

Paper written for the conference!

Got an idea for an article send and email me to sfheger@gmail.com