HOW TO ENHANCE UNIFORM DISTRIBUTION WITHIN A PERFORATED PIPE - A MATTER OF SWEET BALANCE

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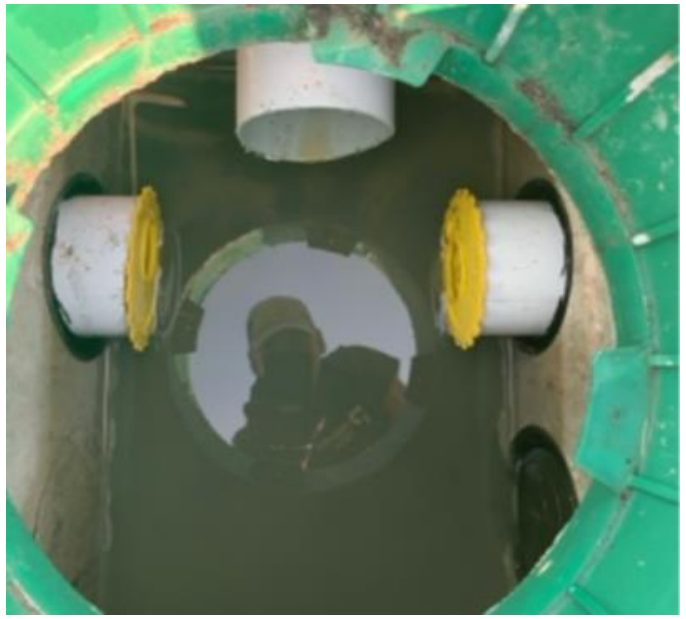
Context

Quality of wastewater treatment highly depends on water distribution method efficiency

Compact biofilter technology

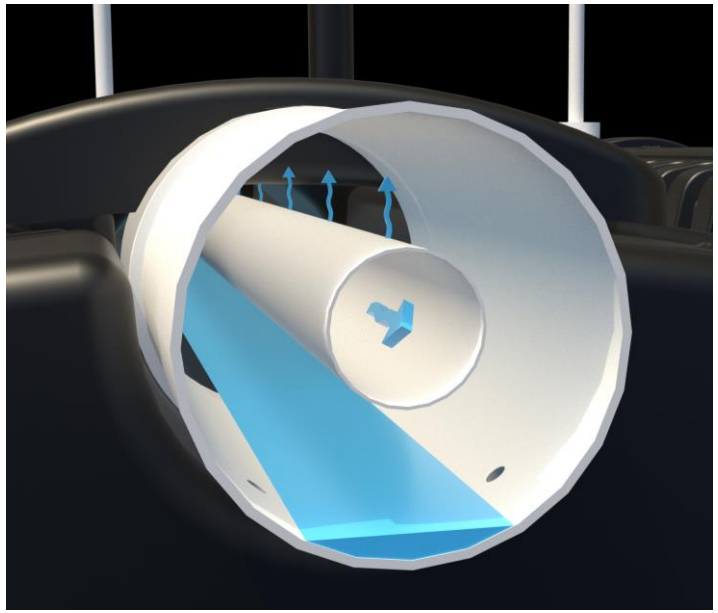
Conventional system

Dosing methods



Gravity

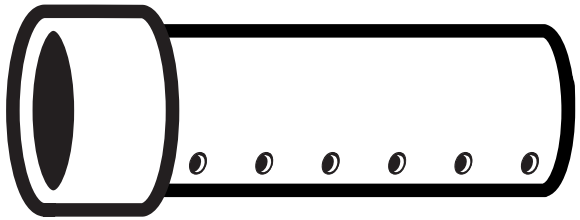
Dosing



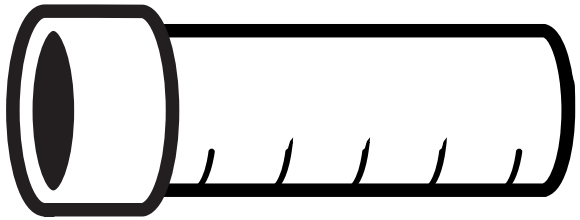
Low pressure

Increased distribution quality

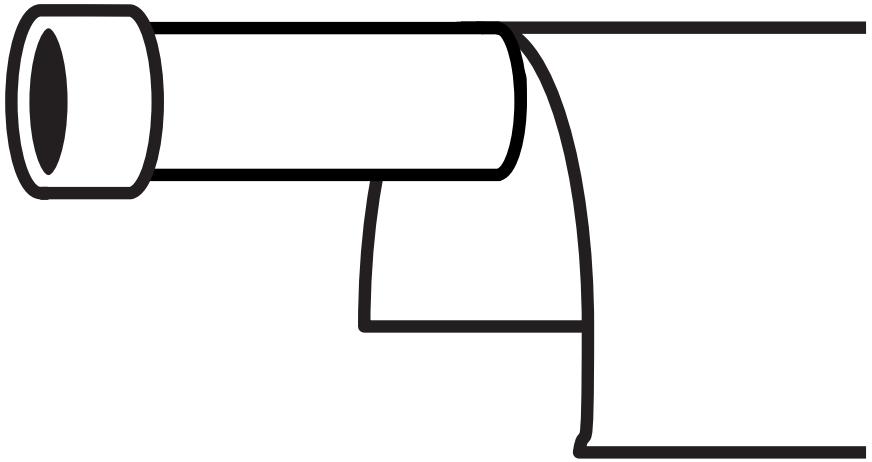
Distribution methods



Perforated pipes

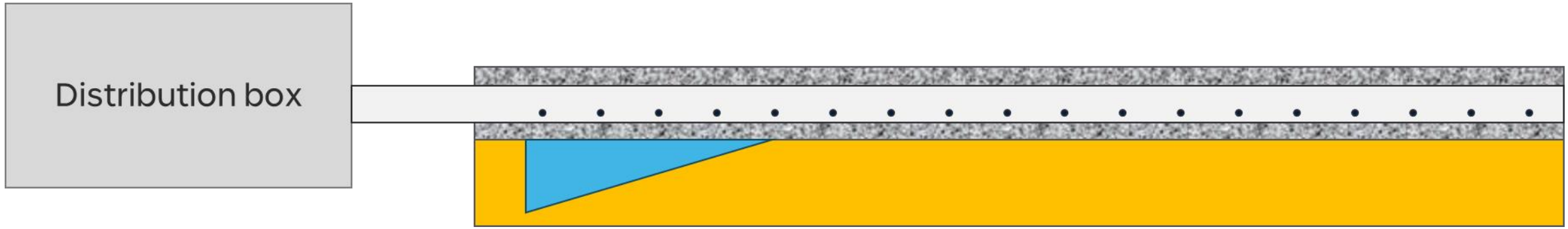


Slotted pipes



Gravel-less and alternate system

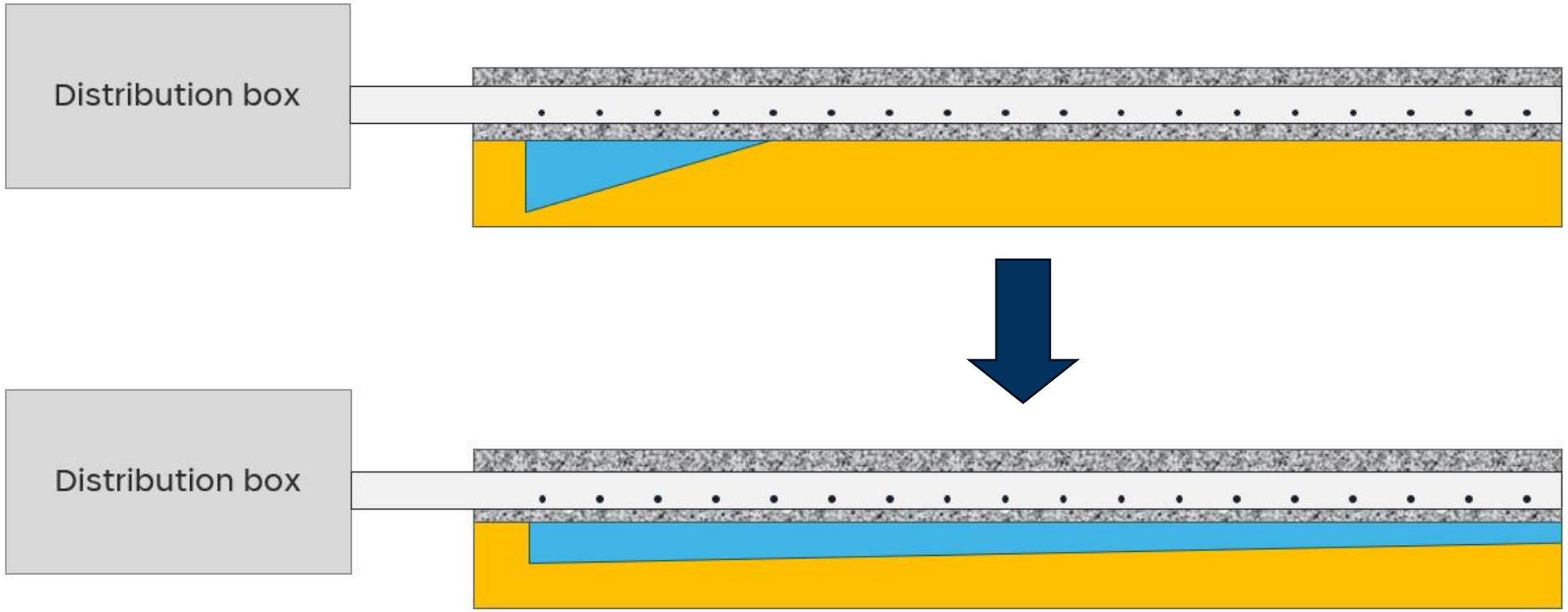
Field observation



- Highly dependent on installation quality
- Uneven distribution between lines
- Point loading at the beginning of line

Objective

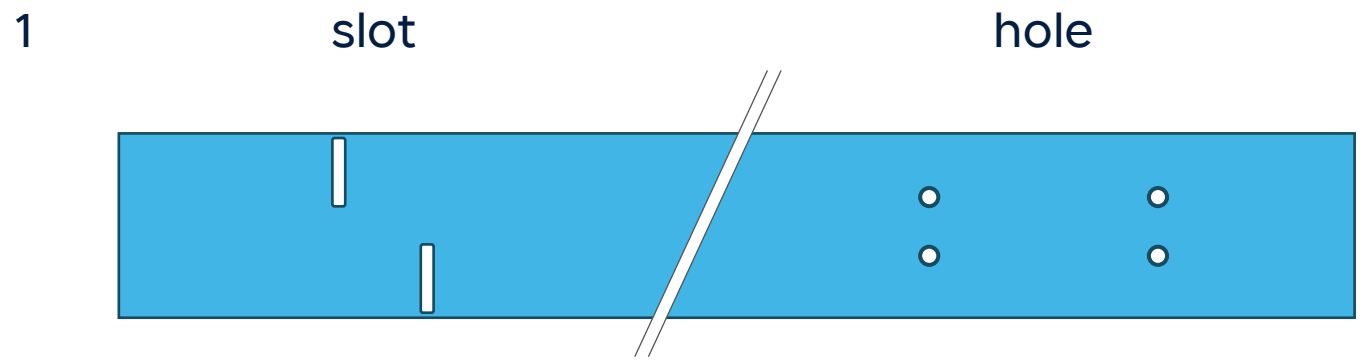
Improve water distribution along a system run



Design

Variables

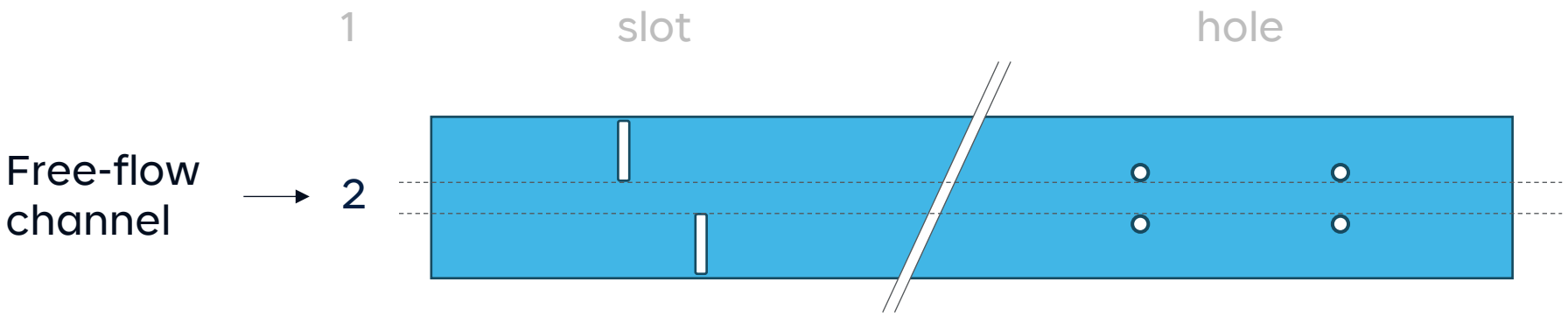
	Variable	Description
1.	Perforation geometry	Hole vs. slot



Design

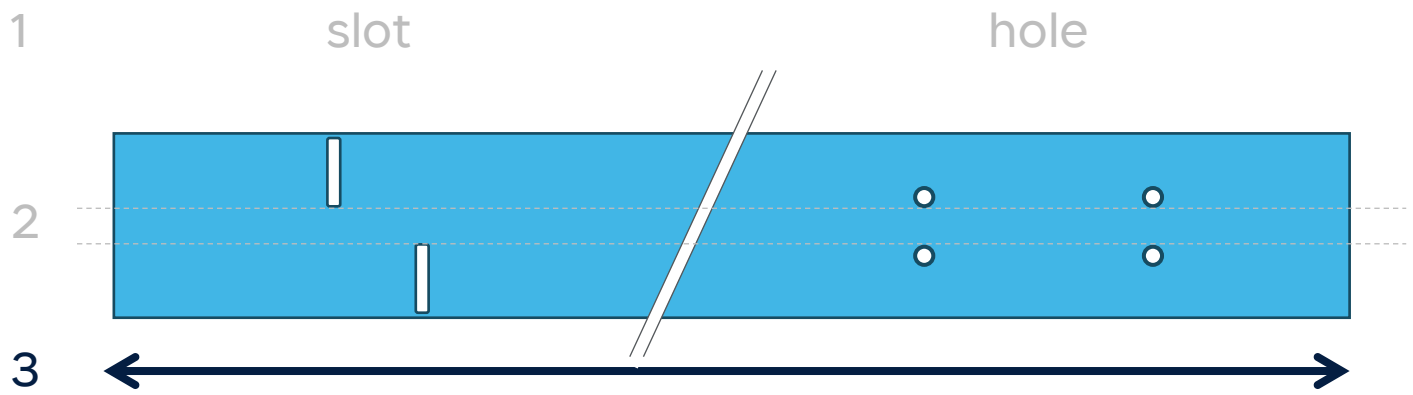
Variables

	Variable	Description
1.	Perforation geometry	Hole vs slot
2.	Free-flow channel width	Space at the bottom of the distribution channel without perforation allowing water to freely flow further



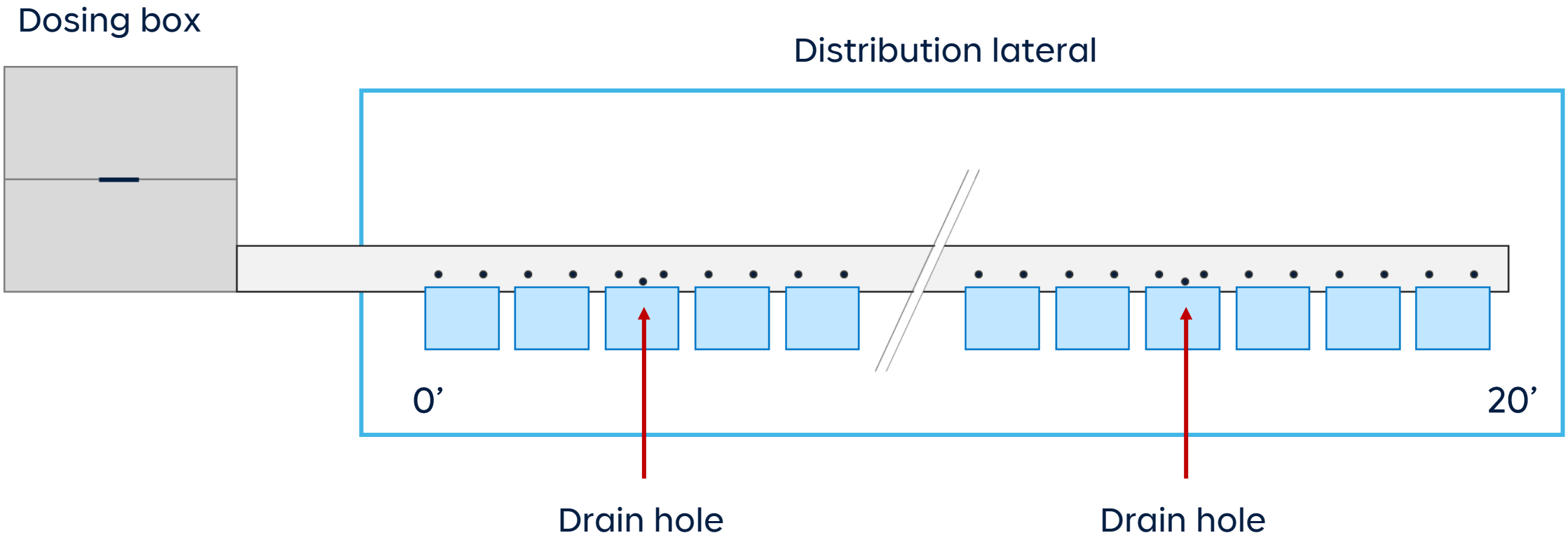
Design
Variables

	Variable	Description
1.	Perforation geometry	Hole vs slot
2.	Free-flow channel width	Space at the bottom of the distribution channel without perforation allowing water to freely flow further
3.	Perforation density	Number of perforations per feet of distribution channel



Design

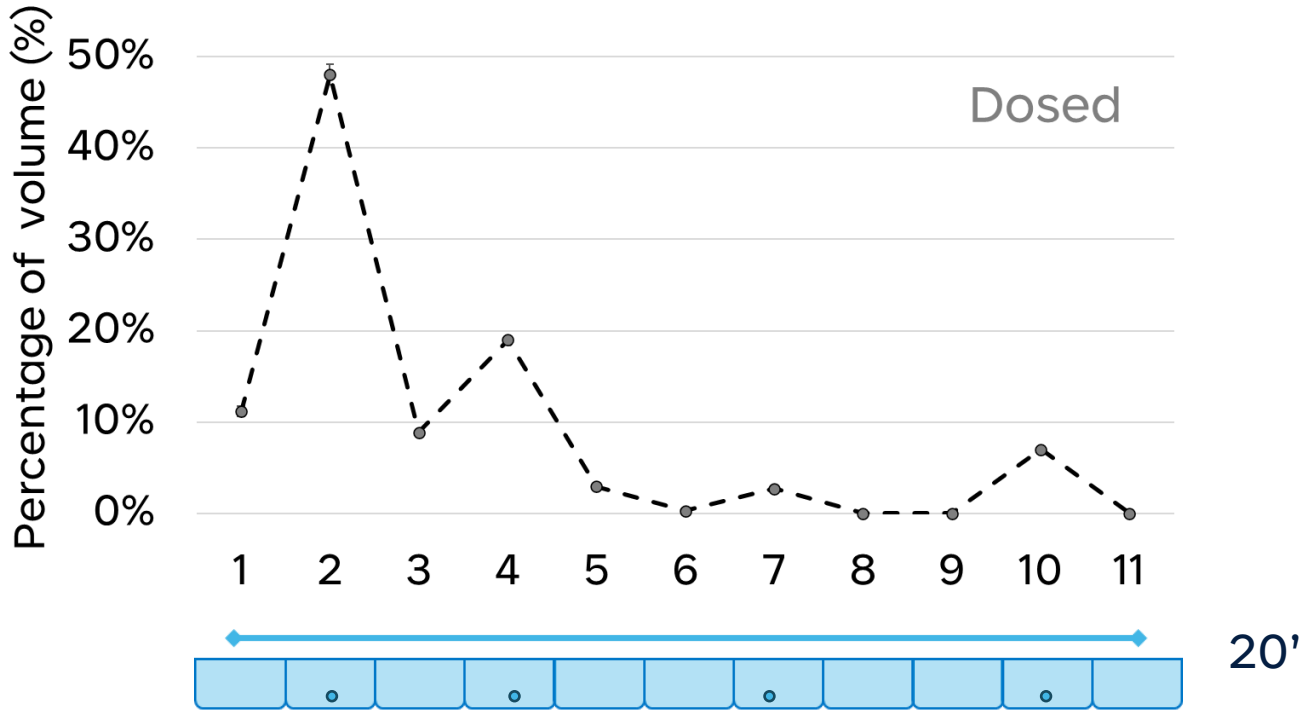
Experimental setup



Design

Results

	Perforation geometry			Free-Flow	Variance
– –	Holes	½'' ø	2 pairs/ft	4''	157 %

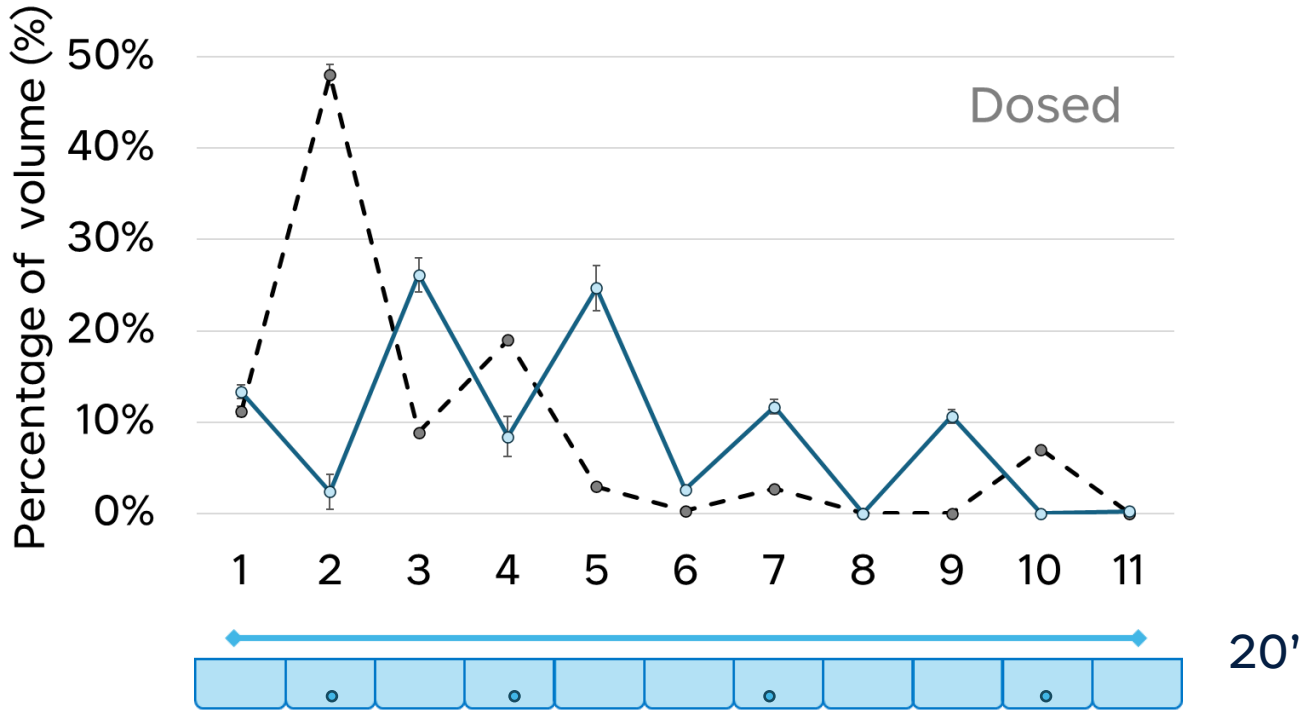


Design

Results

	Perforation geometry			Free-Flow	Variance
– –	Holes	½'' ø	2 pairs/ft	4''	157 %
———	Holes	½'' ø	2 pairs/ft	4''	104 %

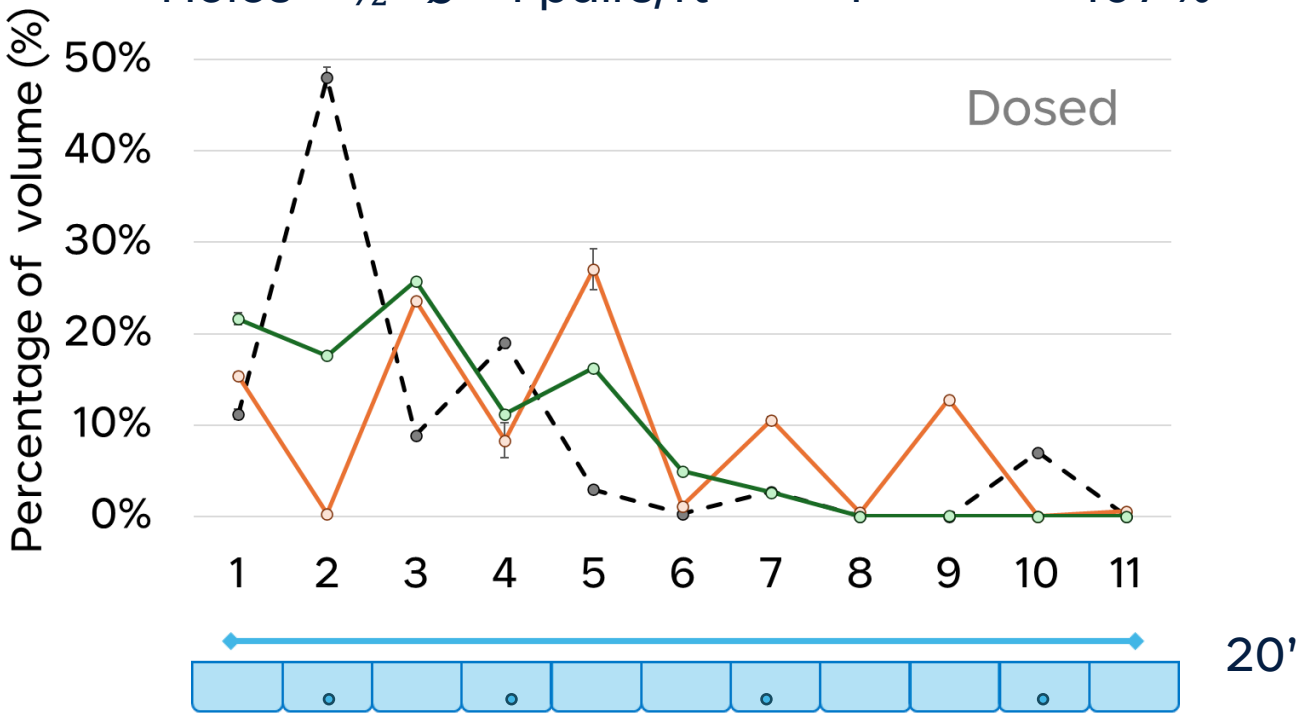
1. Absence of drain hole have a positive effect on the quality of distribution



Design

Results

Perforation geometry			Free-Flow	Variance
Holes	½'' ø	2 pairs/ft	4''	157 %
Holes	½'' ø	1 pairs/ft	4''	108 %
Holes	½'' ø	1 pairs/ft	1''	107 %

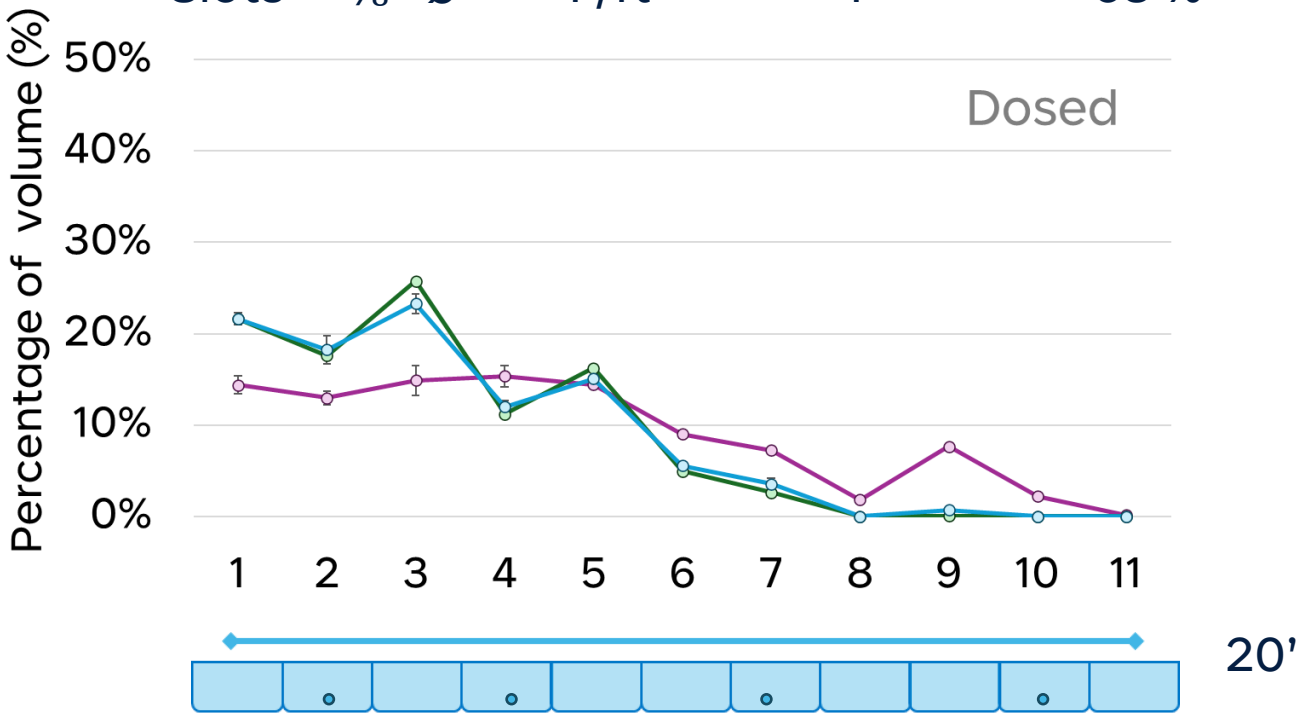


1. Absence of drain hole have a positive effect on the quality of distribution
2. Reduction of perforation density and free-flow channel width has a positive impact on distribution quality

Design

Results

Perforation geometry			Free-Flow	Variance
Holes	½'' ø	1 pairs/ft	1''	107 %
Holes	⅜'' ø	1 pairs/ft	1''	101 %
Slots	⅛'' ø	1 /ft	1''	63 %



1. Absence of drain hole have a positive effect on the quality of distribution
2. Reduction of perforation density and free-flow channel width has a positive impact on distribution quality
3. Reduction of perforation width has a positive impact on distribution quality

Design

Proposed pattern

Perforated pipe

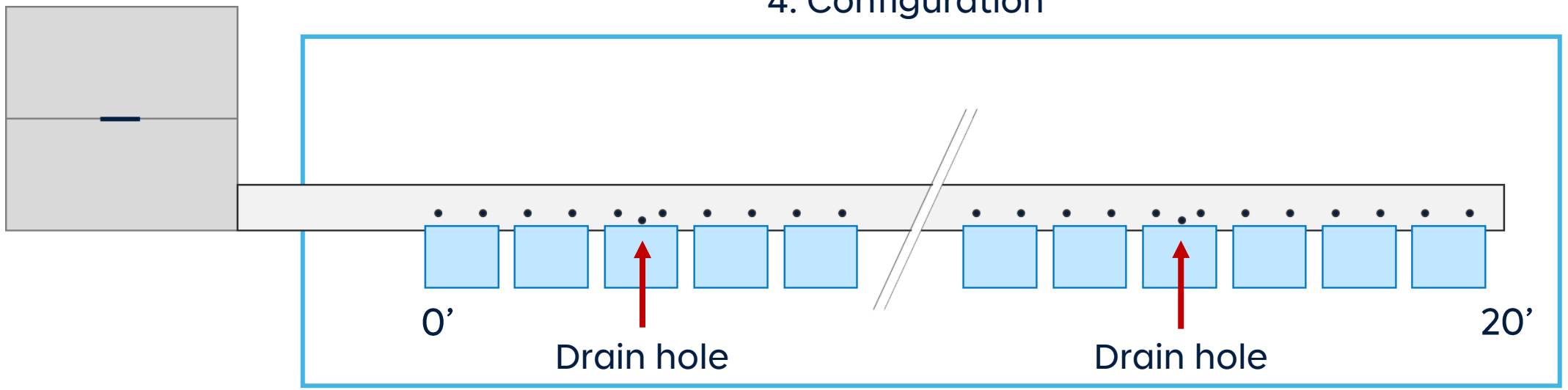
Proposed Pattern

Benchmark

Variables

	Variable	Description
4.	Configuration	Perforated 3'' piping (holes at 2 pairs/ft) New pattern (slots 1/ft or 2/ft) New pattern (slot 1/ft with drain)

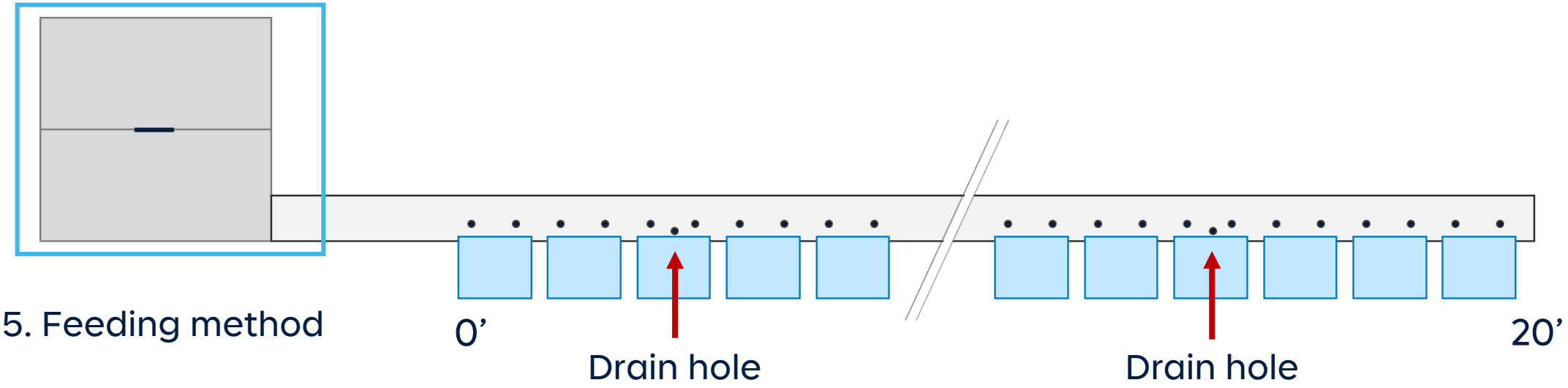
4. Configuration



Benchmark

Variables

	Variable	Description
4.	Configuration	Perforated 3'' piping (holes at 2 pairs/ft) New pattern (slots 1/ft or 2/ft) New pattern (slot 1/ft with drain)
5.	Feeding method	Gravity (0.13 to 2.6 gal/min) Dosed



5. Feeding method

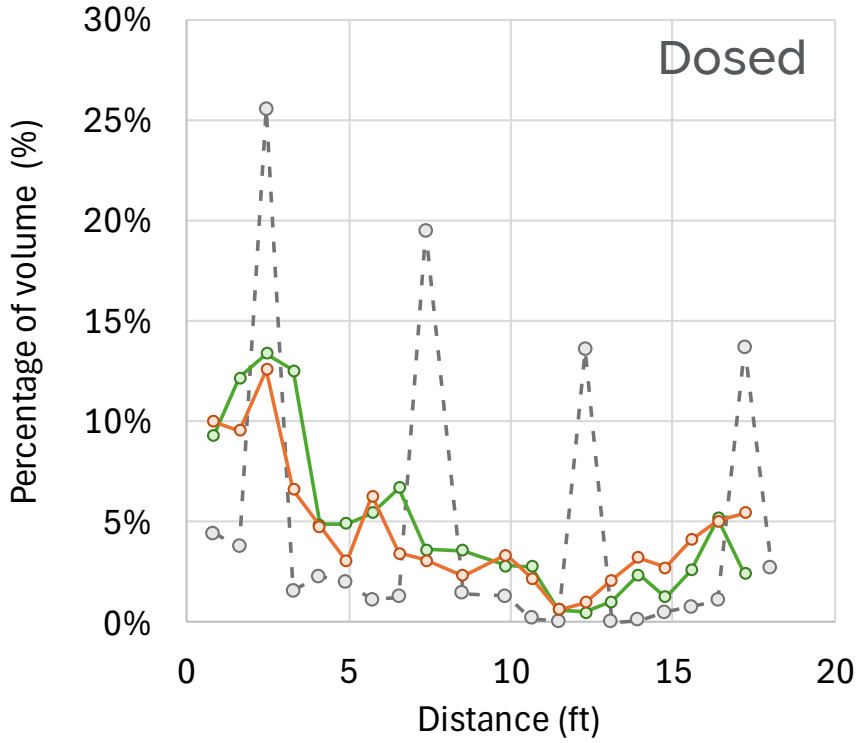
Benchmark

Experimental setup

Benchmark

Results

New distribution patterns (slots, no drain) greatly improved distribution along the entire length of the run, with a reduction of up to 81% in the variance measured

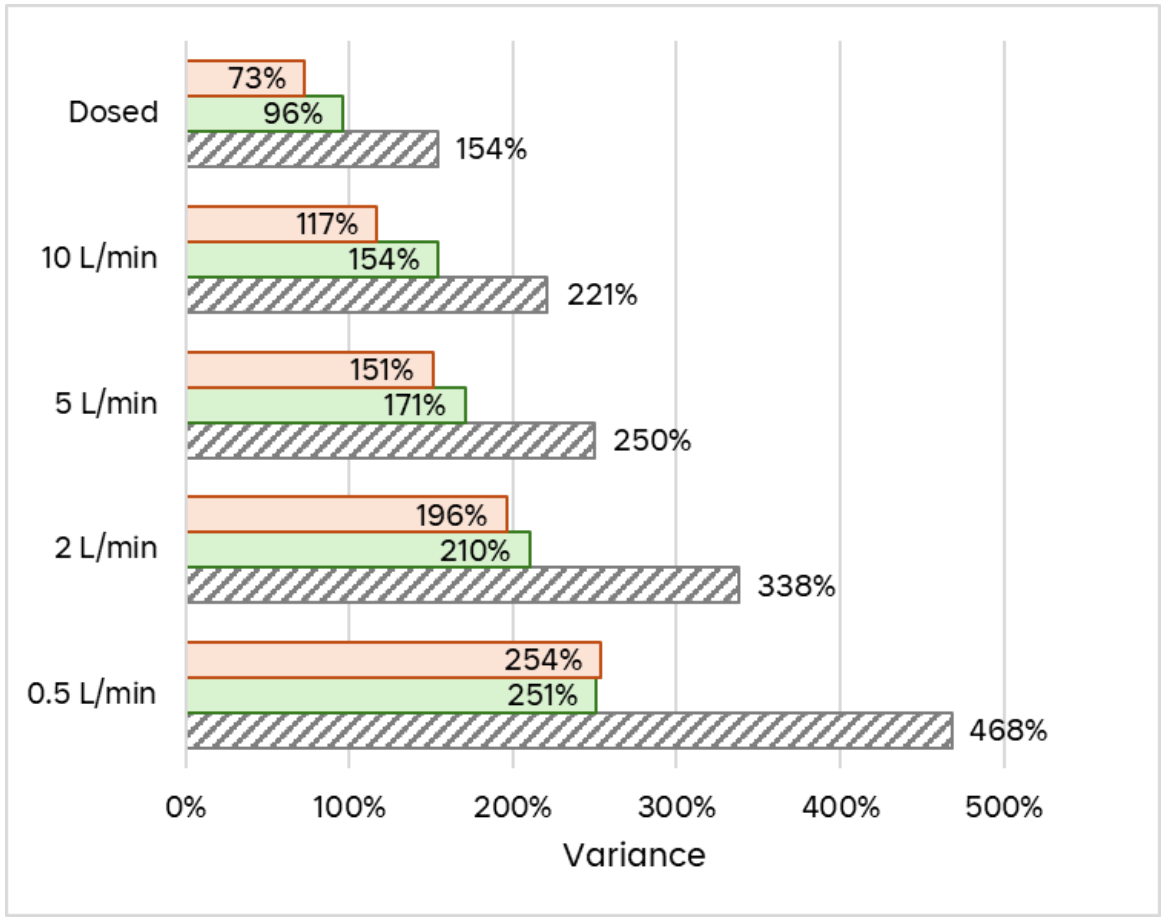


	Perforation geometry			Free-Flow	Variance
———	Slots	3/16" ø	2 /ft	1"	96 %
———	Slots	3/16" ø	1 /ft	1"	73 %
- - -	Holes	½" ø	2 pairs /ft	1"	154 %

Benchmark

Results

Perforation geometry			Free-Flow	Variance
Slots	3/16'' ø	2 /ft	1''	96 %
Slots	3/16'' ø	1 /ft	1''	73 %
Holes	½'' ø	2 pairs /ft	1''	154 %



Volume of the dose applied:

- Improves the quality of distribution
- Has significantly less impact in the absence of a drain hole
- Is of lesser impact on distribution quality when comparing perforation density

Tolerance to installation flaws

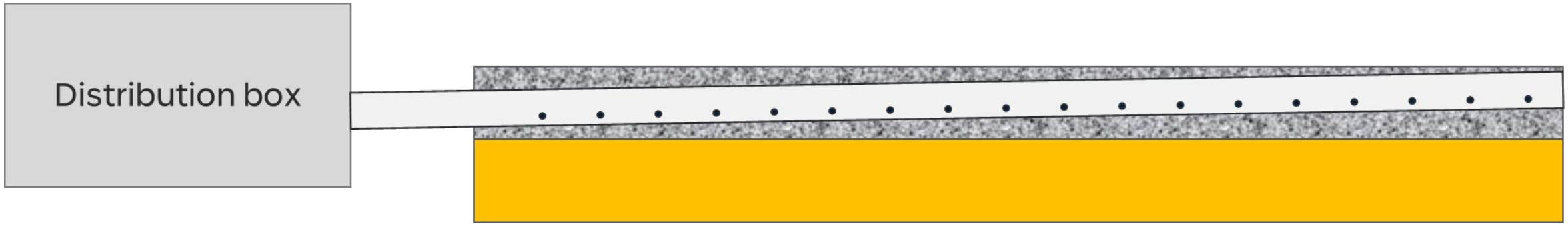
Trial to compare the new system's robustness to field reality:

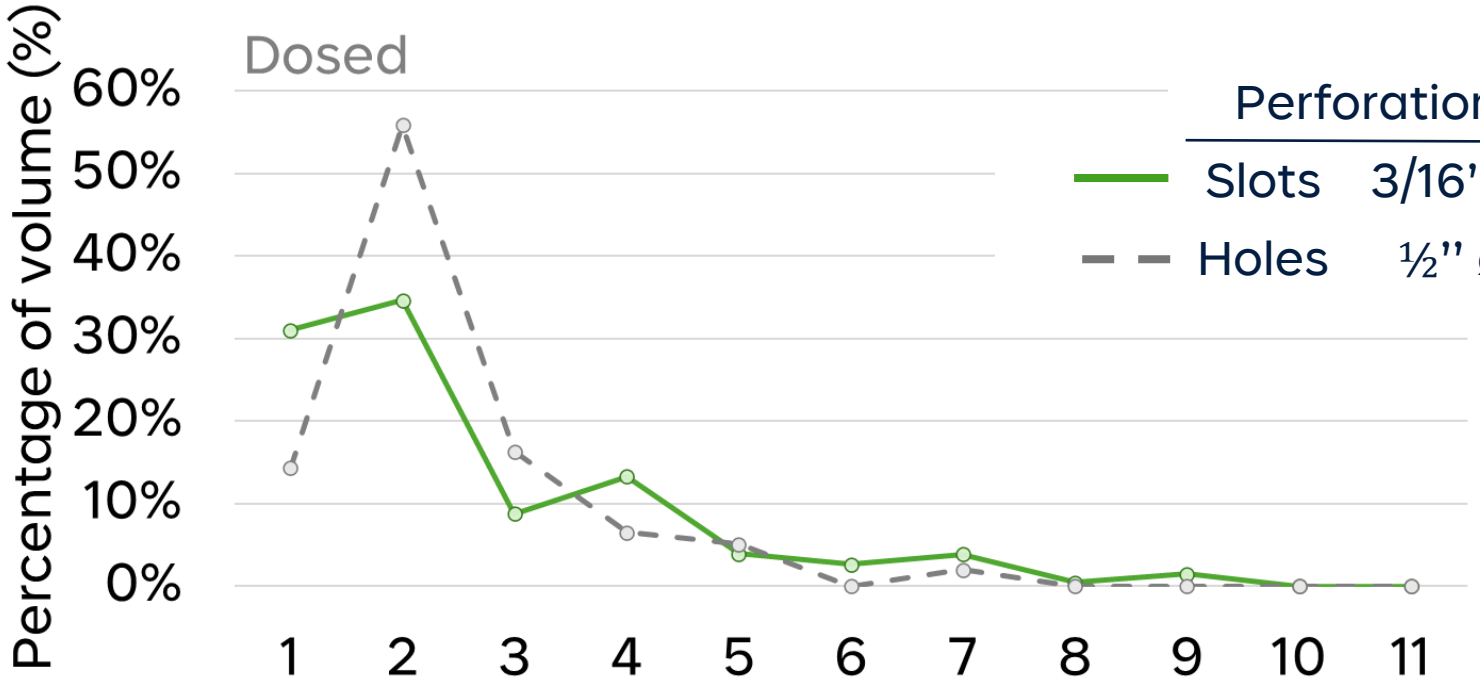
- Movement due to thaw/frost cycle
- Natural settlement of the ground

Scenario #1	Countersloped (-0.5%)
Scenario #2	Sloped (+0.5%)
Scenario #3	Uneven installation along the run (+ 0.5% and - 0.5%)
Scenario #4	Unaligned distribution holes / distribution channel torsion

Scenario #1

Counterslope -0.5%

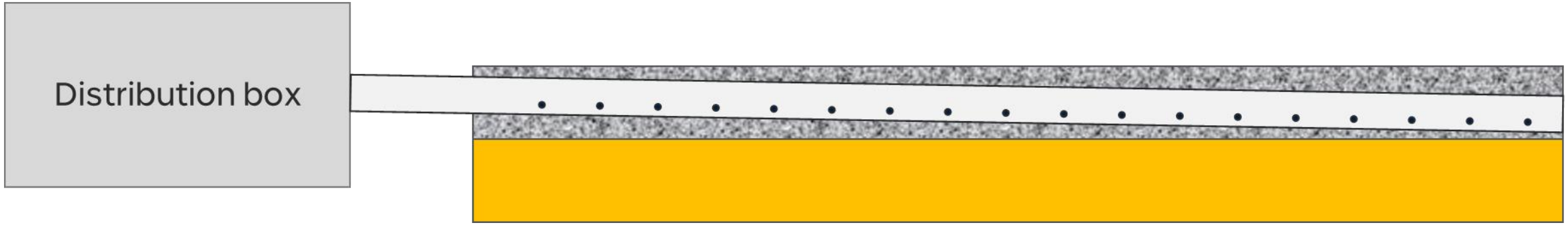


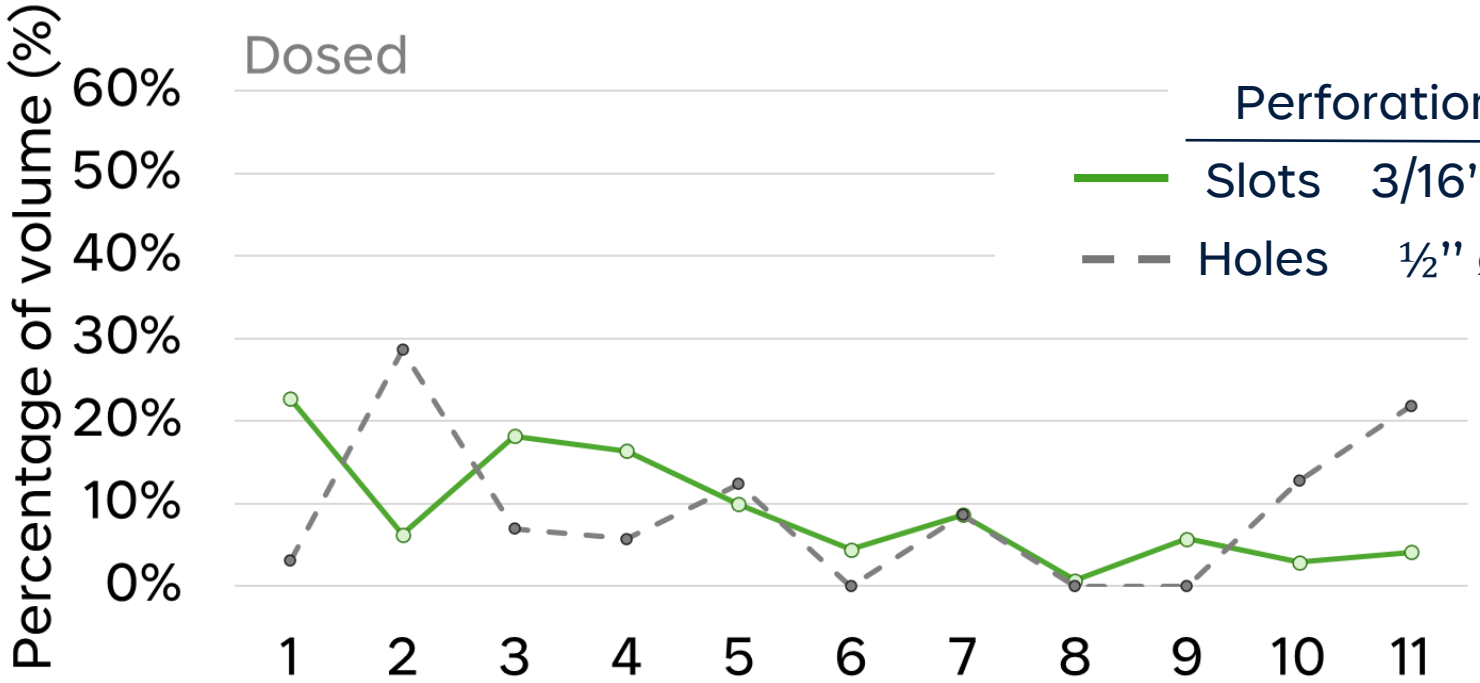


Perforation geometry			Free-Flow	Variance
Slots	3/16'' ø	1 /ft	2''	137 %
Holes	½'' ø	2 pairs /ft	3''	182 %

Scenario #2

Sloped +0.5%

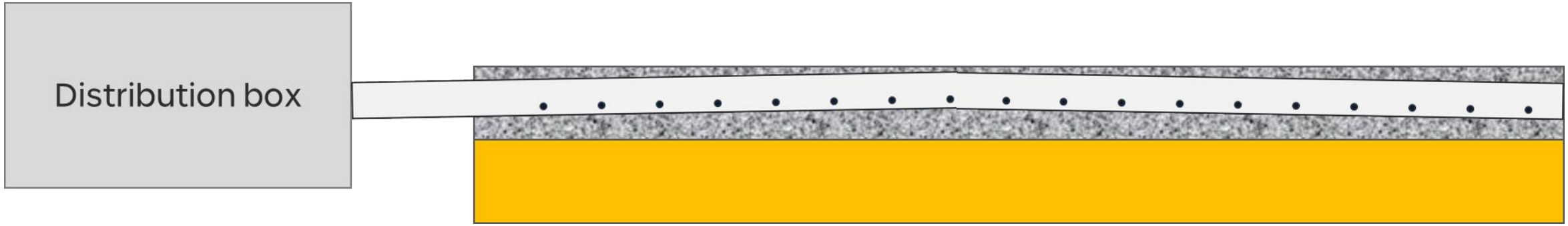


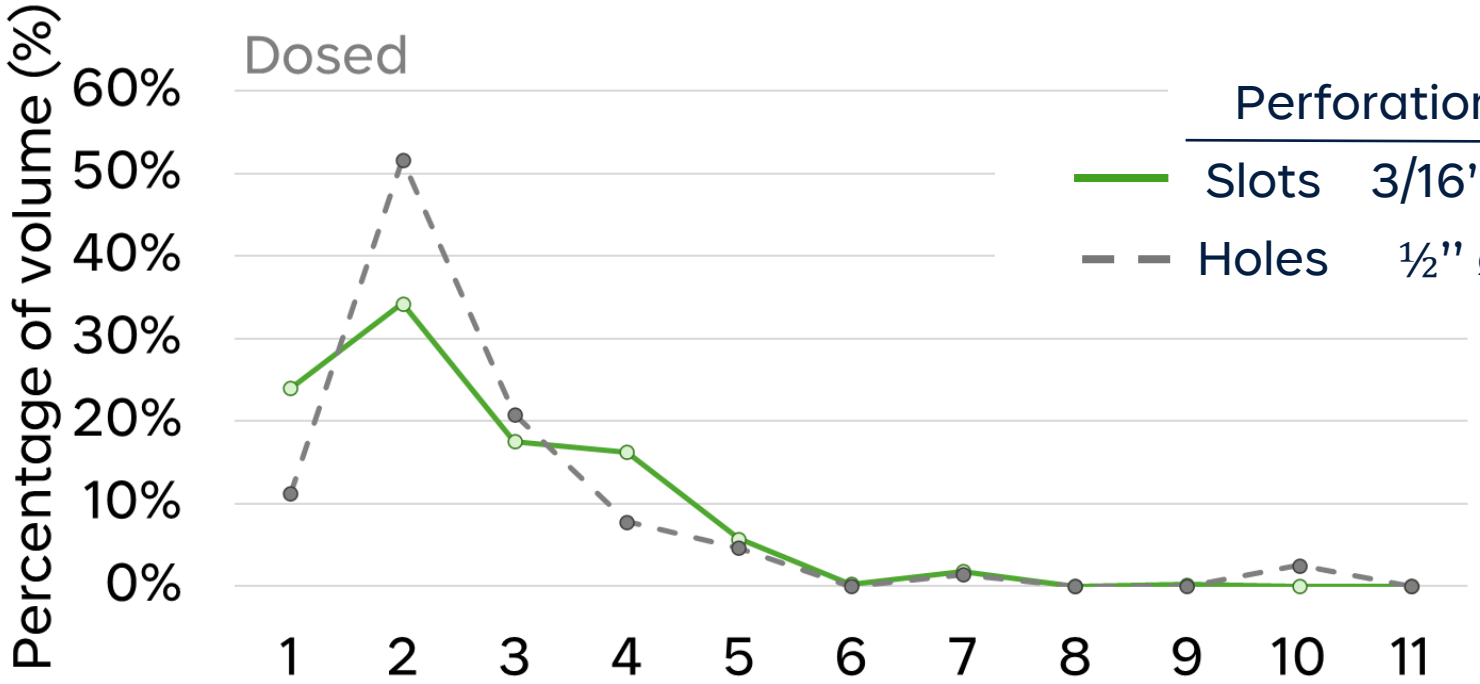


	Perforation geometry		Free-Flow	Variance
Slots	3/16'' ø	1 /ft	2''	77 %
Holes	½'' ø	2 pairs /ft	3''	103 %

Scenario #3

Uneven installation along the run +/- 0.5%

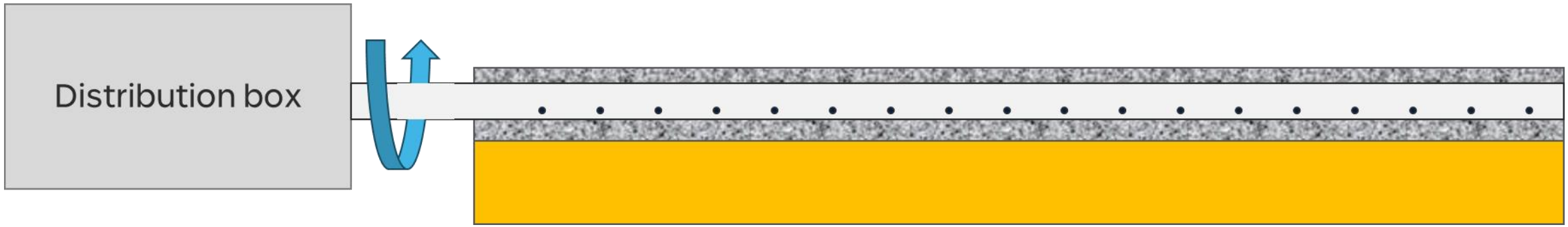


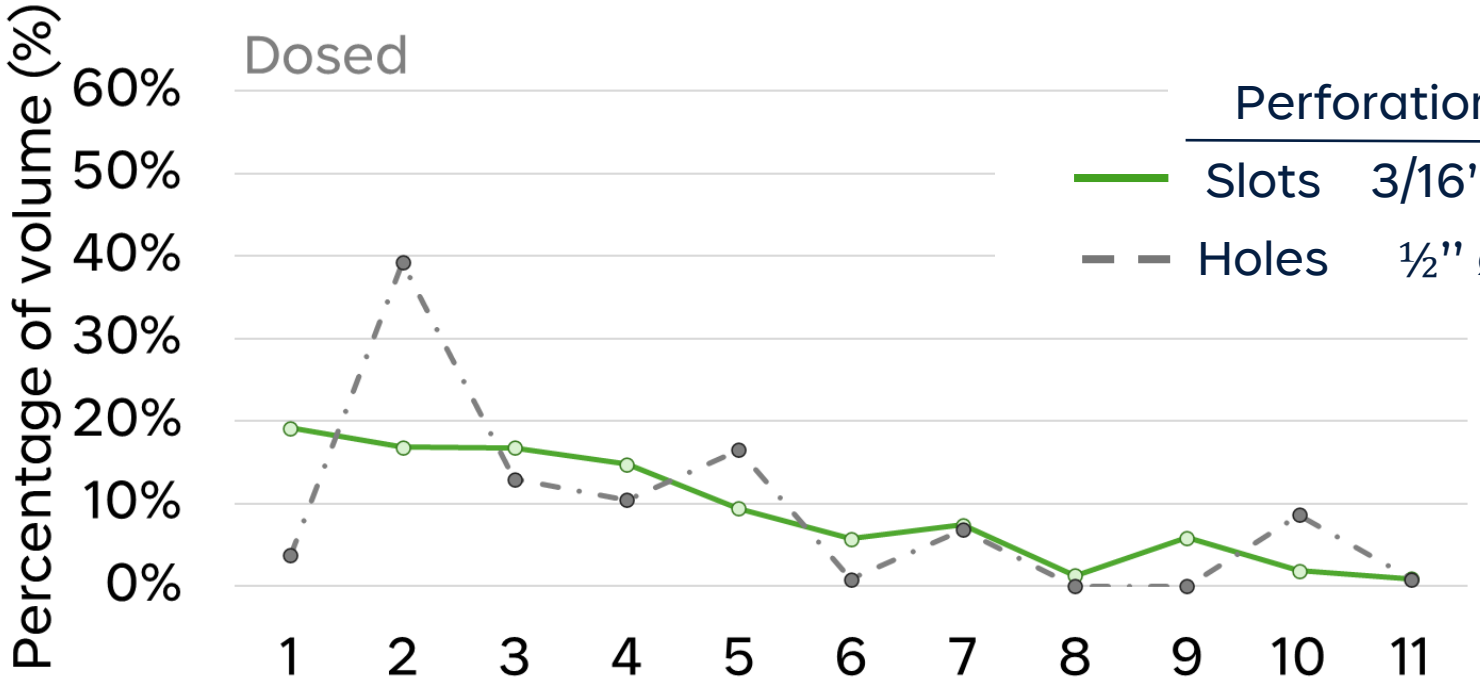


Perforation geometry			Free-Flow	Variance
Slots	3/16'' ø	1 /ft	2''	132 %
Holes	½'' ø	2 pairs /ft	3''	171 %

Scenario #4

Unaligned distribution holes – Torsion





Perforation geometry			Free-Flow	Variance
Slots	3/16'' ø	1 /ft	2''	74 %
Holes	½'' ø	2 pairs /ft	3''	126 %

Integrated perforated distribution channel

No pipes required

Thank you
Any questions?