The materials being presented represent the speaker's own opinions and ***do NOT reflect the opinions of NOWRA.***

Onsite wastewater research program at the Texas A&M University: Low Pressure Dosing research

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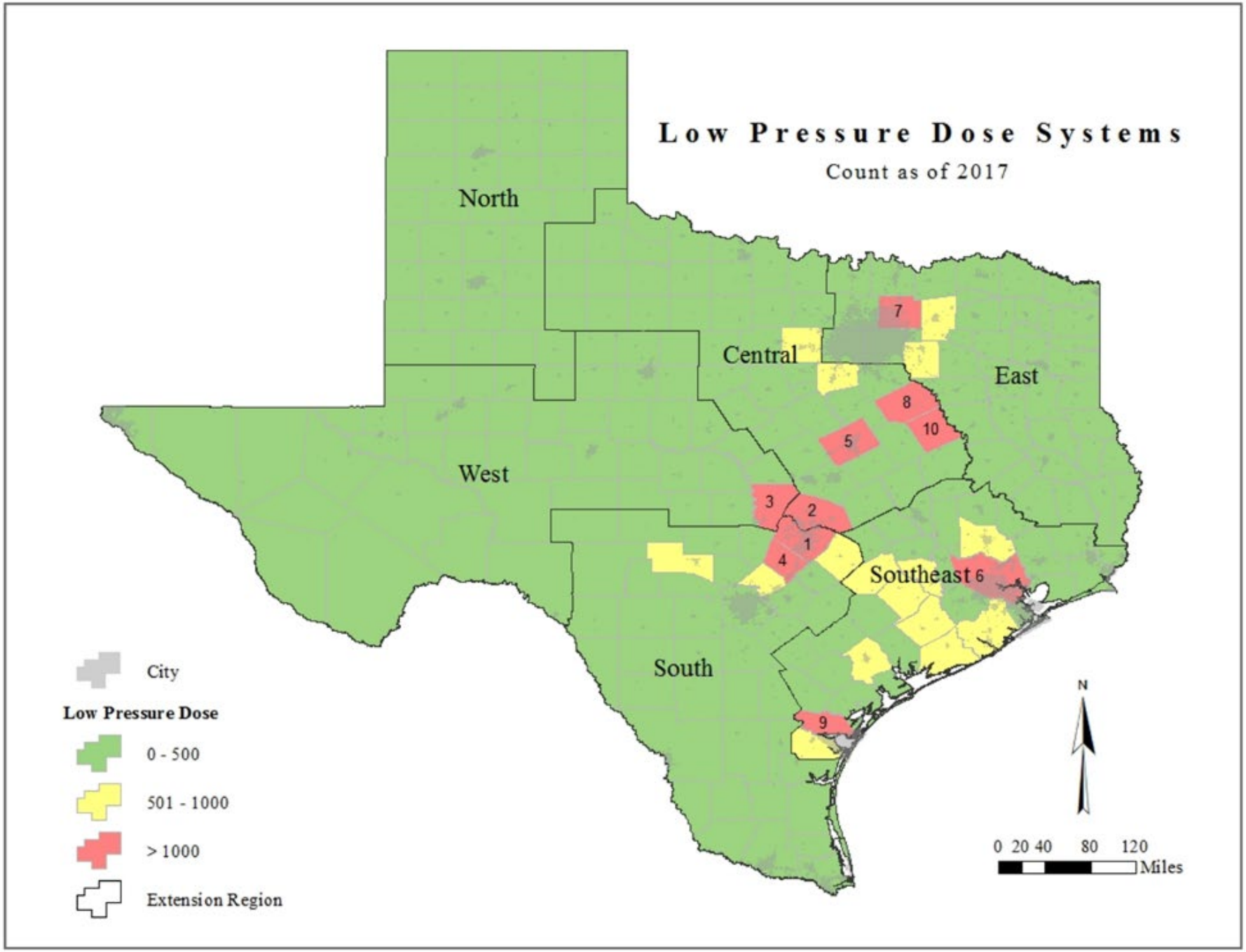
Outline

- Introduction and background
- Project questions
- Experiment methods, issues, and preliminary results
  - Survey
  - LPD Plumbing Configuration and experiment design
  - Construction
  - Wastewater distribution and monitoring
- Conclusions

Introduction and background

- In Texas, it is estimated that about 20% of the dwellings use On-Site Sewage Facilities (OSSF)
- State's environmental regulatory agency awarded competitive grants supporting applied research and demonstration projects 90s-2013
- 2017 85th Texas Legislative Session House Bill 2771
- 2019 OSSF Grant Program (TOGP):
  1) Black water non-potable reuse,
  2) Low pressure dose systems with various configurations,
  3) Dosing verses non-dosing in aerobic treatment units (ATU),
  4) Adequacy of ATUs designs with higher strength wastewater

- LPD advantages:
  - Uniform distribution of effluent,
  - Dosing and resting of soil treatment area,
  - Shallow placement of trenches to enhance aeration
- LPD in Texas: 43,000 LPD permits since 1992 (about 5% of the total; up to 49% in Navarro county)


Low Pressure Dose Systems
Count as of 2017
North
Central
East
West
South
Southeast
1
2
3
4
5
6
7
8
9
10
City
Low Pressure Dose
0 - 500
501 - 1000
> 1000
Extension Region
N
0 20 40 80 120
Miles

- Texas Commission on Environmental Quality (TCEQ) Solicitation suggests:
  - "*research is needed into whether the design can be improved*" (effluent distribution, maintenance)
  - Recommend revision of Texas rules (now mostly based on North Carolina State Sea Grant College Publication UNC-SG-82-03)
  - Compare specific alternative configurations

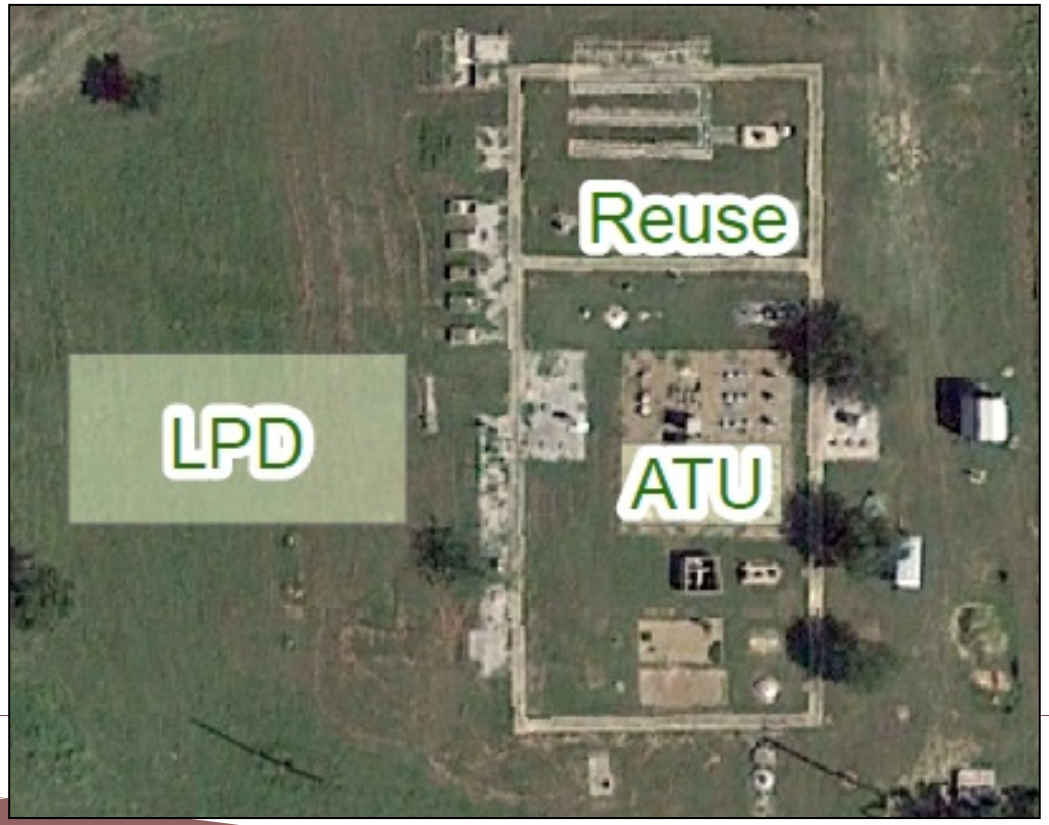
Project questions

- What are the operational problems faced by the users and operators with the current LPD design in Texas?
- Can the current design with holes facing down be improved with holes facing up, to achieve better distribution of effluent and to allow for better maintenance of LPD systems?
- Are changes required in the current design specifications of an LPD system in 30 TAC Chapter 285, and if so, what changes are to be recommended?

Experiment methods, issues, and preliminary results

- Presentations and survey (in person, email, online): Type and magnitude of problems faced in Texas
- Field experiment at AgriLife Waste Water Research Facility Center, at Texas A&M RELLIS Campus, Bryan Texas: Uniformity of effluent and water quality

- AgriLife OSSF Research Center – Bryan, TX



Objectives

1) Conduct interviews and surveys with regulators, owners, and license holders
2) Identify alternative LPD system designs and maintenance schemes
3) Design the experiment
4) Construct and run the experiment and monitor distribution uniformity and maintenance requirements
5) Analyze the data to compare performances
6) Submit final report and suggested changes to Texas regulations

- Texas OSSF Grant Program (TOGP) Committee Meetings to receive initial and final input
- TCEQ Quality Assurance Project Plan (QAPP)
- Corona-19 virus outbreak → ~~one year~~ to six months
- No-cost extension

Survey

TEXAS A&M AGRILIFE EXTENSION

Survey to get your feedback for improving low-pressure dosing (LPD) design in terms of effluent distribution uniformity, and ability to maintain the system

Please complete the following questions to the best of your ability.

About you

Indicate if you are a:

☐ Owner ☐ Designer ☐ Installer ☐ Maintenance Provider ☐ Regulator

Estimate number of LPD systems designed/installed/maintained/inspected: _____

Observed problems

- ☐ No problems
- ☐ Orifice plugging
- ☐ Not uniform distribution
- ☐ Maintenance
- ☐ Other _____

Please describe the type and frequency of problem/s: _____

Suggestions

Indicate your suggestions for improving LPD design:

Additional comments

FAQs

How will this information be used? Texas A&M AgriLife Extension is a public entity, therefore data collected is classified as public information. Data collected from surveys may be published in a report intended for research and educational purposes.

Why should I answer these questions? TCEQ have provided Texas A&M AgriLife Extension grant money[1] to conduct research to investigate whether the design of LPD systems can be improved in terms of effluent distribution over time, and ability to maintain the distribution system[2].

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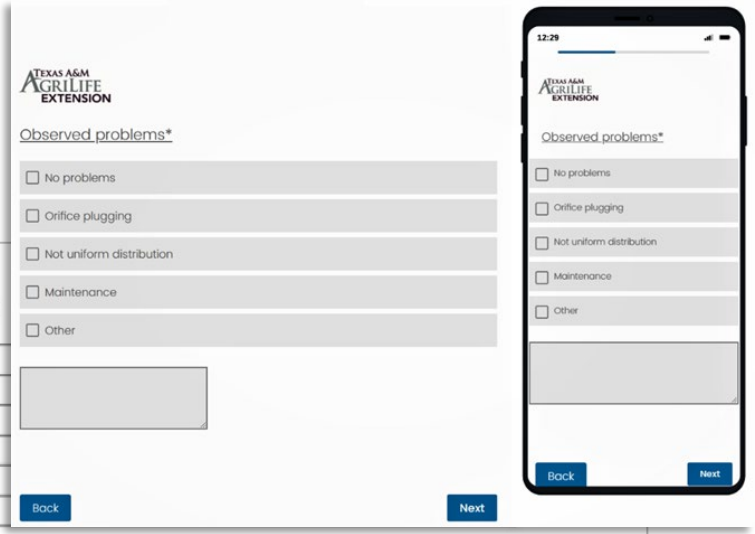
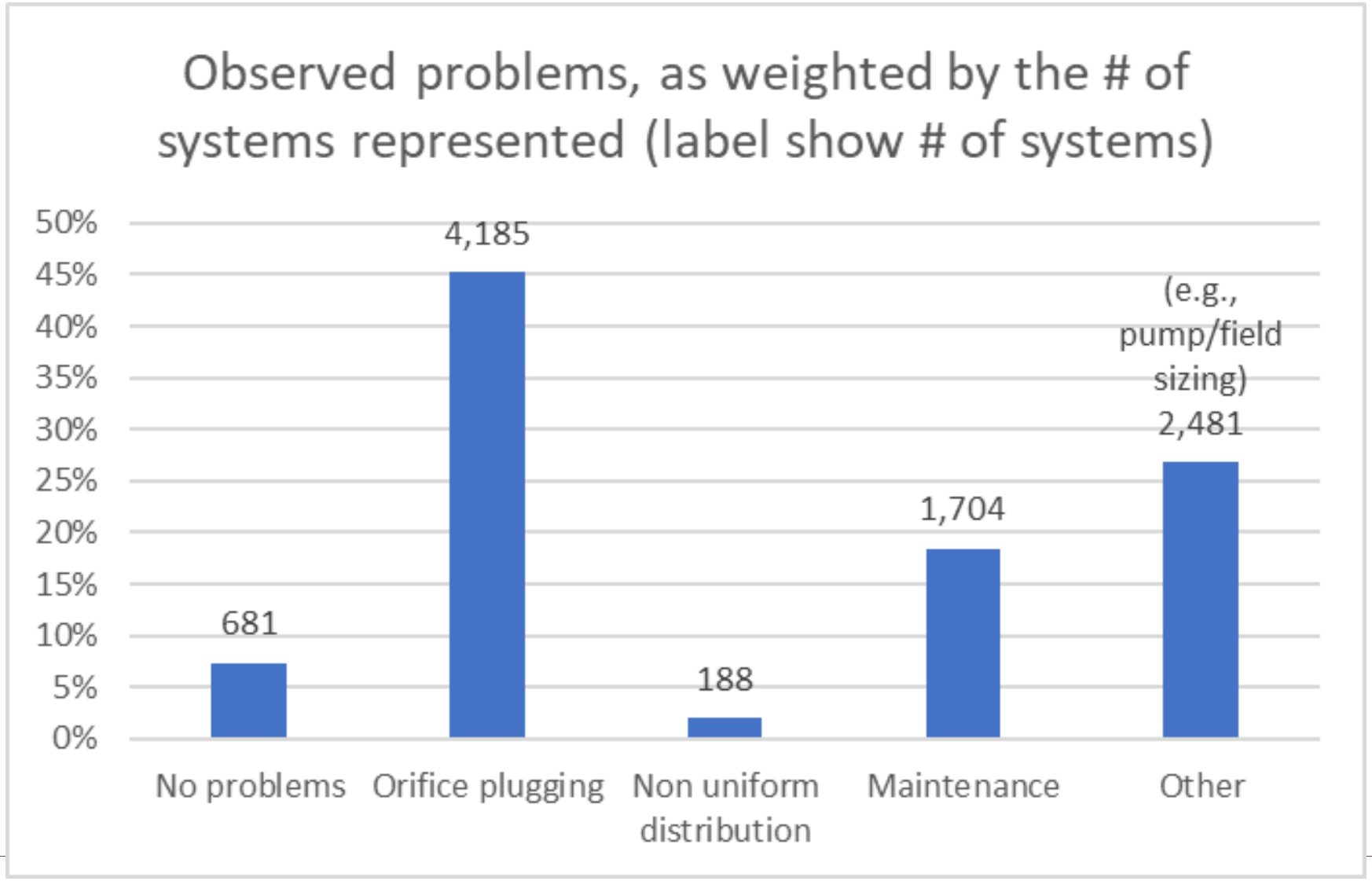
[1] TCEQ Solicitation 582-19-9377, RT-2.3.3
[2] North Carolina State Sea Grant College Publication UNC-S82-03 is currently used to aid in low-pressure dosing field design

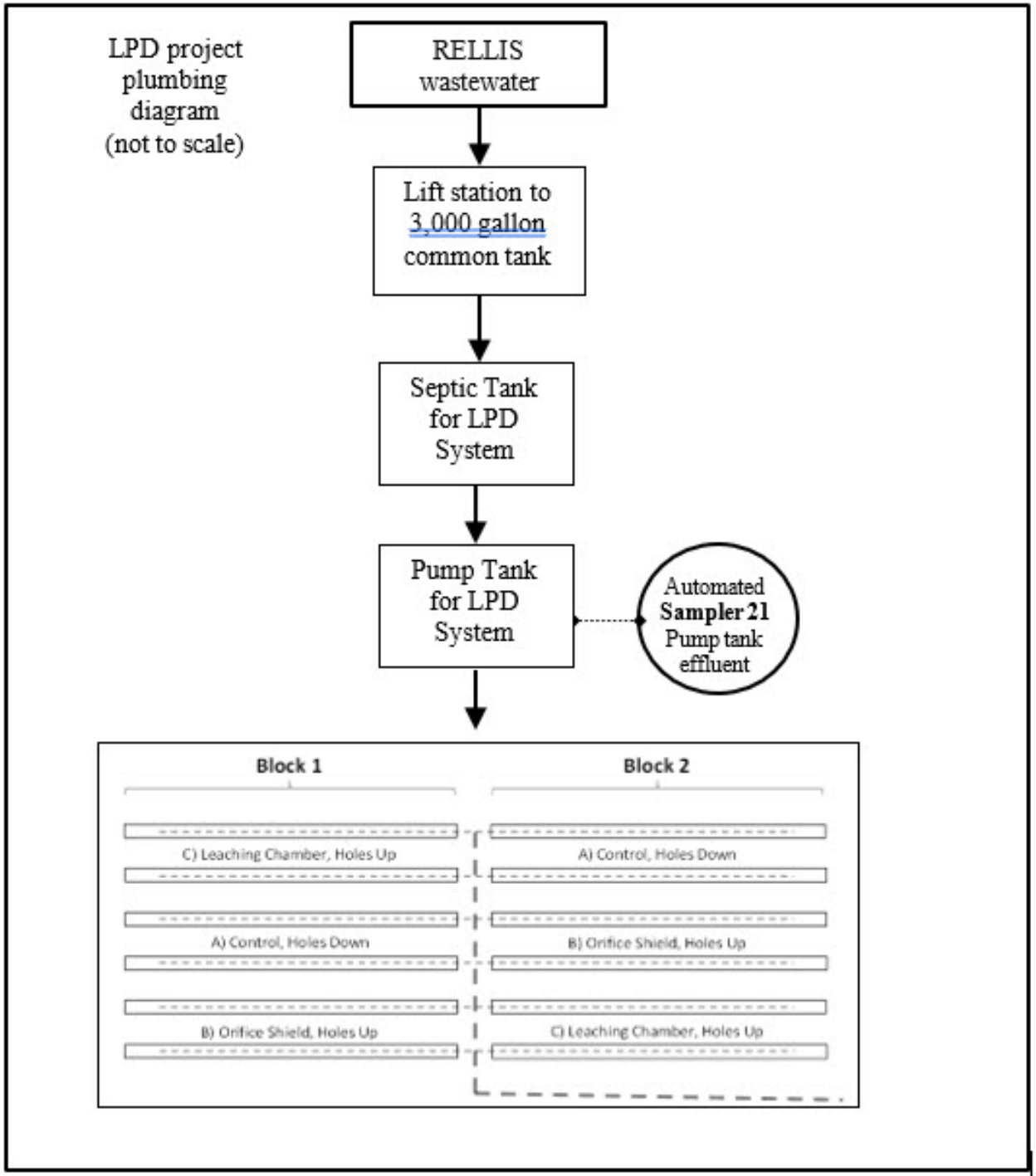


- TCEQ approval
- Texas Onsite Wastewater Association annual meeting
- Email for online survey to all Texas Authorized Agents (AA); Qualtrics software
- 6,248 systems represented (system is counted for each problem indicated)
  - Total: 45 surveys (in person + online)
  - Online: 11% feedback, 22% not delivered, 30% contact info
- Results focus on orifice clogging and maintenance

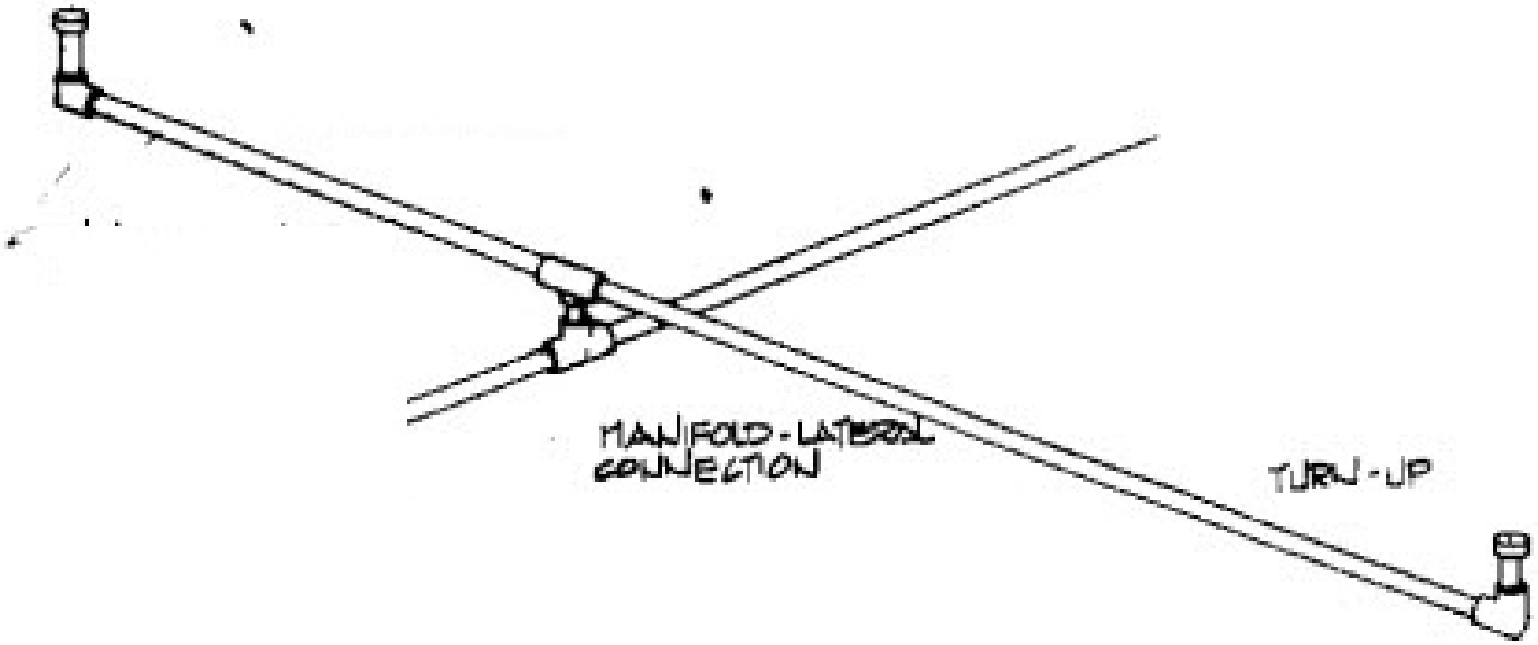

Observed problems, as weighted by the # of systems represented (label show # of systems)
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
681
4,185
188
1,704
(e.g., pump/field sizing)
2,481
No problems
Orifice plugging
Non uniform distribution
Maintenance
Other

LPD Plumbing Configuration and experiment design

- Continuous wastewater flow from RELLIS Campus sewer
- Existing 3,000-gallon common tank (feed tank)
- Dedicated pump in the feed tank to the Septic Tank, connected to a Pump Tank by gravity
- Both feed tank and septic tank have overflow pipe to drain back with highwater conditions
- Automatic sampler installed (Sampler #21) in pump tank


LPD project plumbing diagram (not to scale)
RELLIS wastewater
Lift station to 3,000 gallon common tank
Septic Tank for LPD System
Pump Tank for LPD System
Automated Sampler 21 Pump tank effluent
Block 1
Block 2
C) Leaching Chamber, Holes Up
A) Control, Holes Down
A) Control, Holes Down
B) Orifice Shield, Holes Up
B) Orifice Shield, Holes Up
C) Leaching Chamber, Holes Up

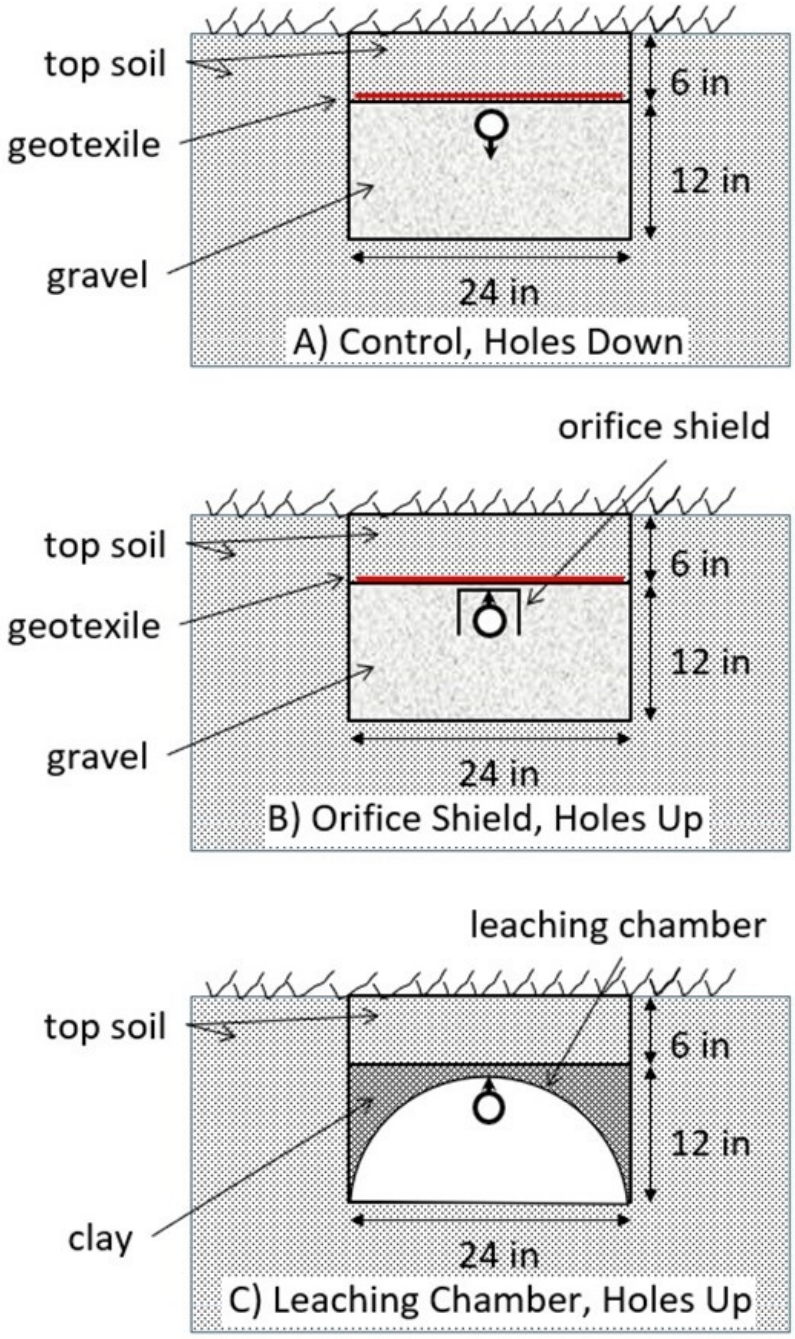
- Pump to time-dose the LPD field
- 2-inches supply and manifold pipes, below laterals level, check valve, pressure valve
- 1 ¼ inches diversion to laterals with ball valve


MANIFOLD - LATERAL
CONNECTION
TURN - UP


B: Cleanout
C: Feed Tank
E: ATU 1
G: LPD Septic Tank
H: LPD Drainfield (H1-4 = Design Replicates)
J: MBR
J
I
29
154
H1
H2
H
H3
H4
185
E
D
38
25
28
F
C
102
61
G
B
420

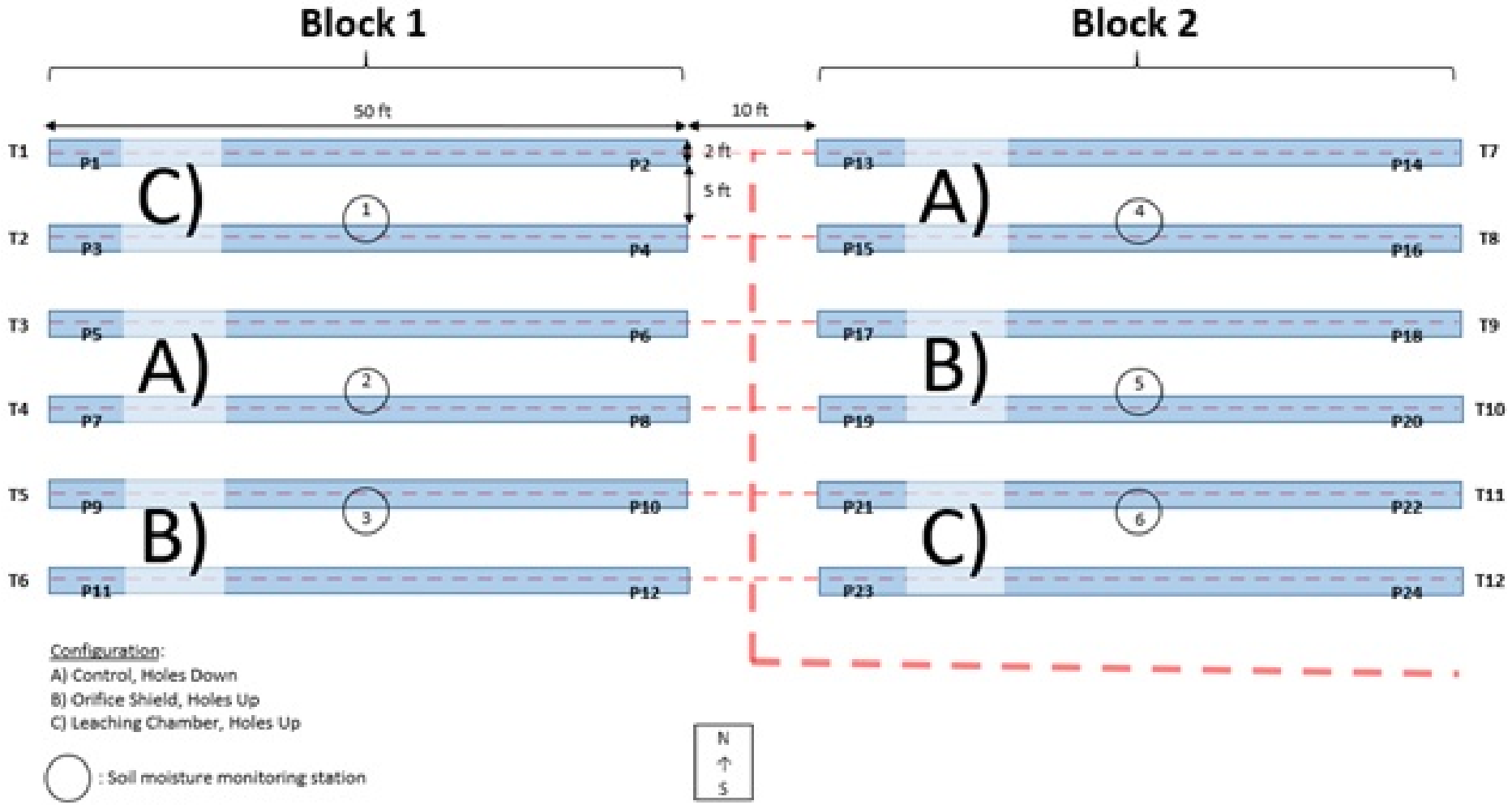
- In each trench:
  - Sizing (30 TAC Chapter 285 and UNC-S82-03 30) in parallel to natural surface contours (50 feet long, 18 inches deep, 24 inches wide, and 5 feet apart, about 10 inches drop NE→SW)
  - Laterals 1 inch in diameter, on top of 12 inches of washed 1/8-3/8 in-pea gravel (or hanging on top of a 2-feet large leaching chamber), 5/32-inch holes, spaced 5 feet
  - Two inspection ports (PVC SCH40 pipes 4 inches in diameter, protected by a metal screen), laterals with turn-up and ball valve

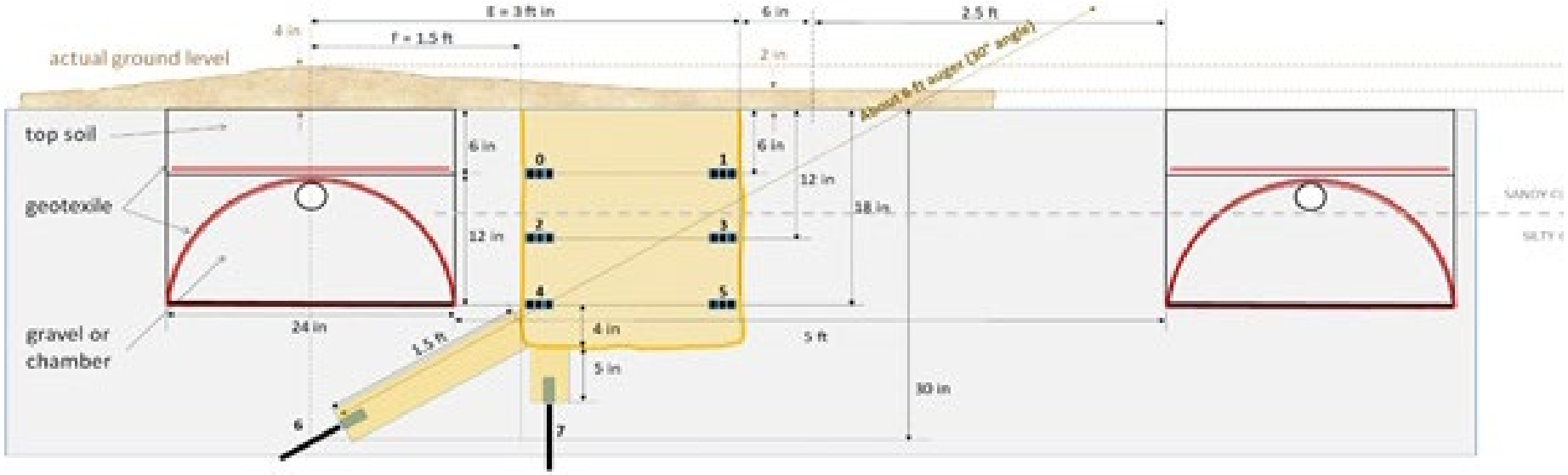
- Three configurations with four replicates (trenches):
  - Holes facing down (control);
  - Holes facing up protected by orifice shields; and
  - Holes facing up protected by leaching chambers


top soil
geotexile
gravel
6 in
12 in
24 in
A) Control, Holes Down
orifice shield
top soil
geotexile
gravel
6 in
12 in
24 in
B) Orifice Shield, Holes Up
leaching chamber
top soil
clay
6 in
12 in
24 in
C) Leaching Chamber, Holes Up

Monitoring:

- Effluent depth through the inspection ports once a week (additional measures after rainfall events);
- Laterals pressure each quarter, as column height in transparent PVC SCH40 pipes;
- Soil moisture along the soil profile adjacent to the trench, with TDR (Time Domain Reflectometer) sensors measured continuously;
- Septic tank effluent samples, once a week, analyzed for Total Suspended Solids (TSS) and 5-day Biochemical Oxygen Demand (BOD5)


Block 1
Block 2
50 ft
10 ft
2 ft
5 ft
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
P1
P2
P3
P4
P5
P6
P7
P8
P9
P10
P11
P12
P13
P14
P15
P16
P17
P18
P19
P20
P21
P22
P23
P24
C)
A)
B)
A)
B)
C)
1
2
3
4
5
6
Configuration:
A) Control, Holes Down
B) Orifice Shield, Holes Up
C) Leaching Chamber, Holes Up
: Soil moisture monitoring station
P#: Inspection port
T#: Trench
N
S



: Lateral

: TDR sensor, side view (electrodes lenght is 6 inches, head size is about 3x3 inches)

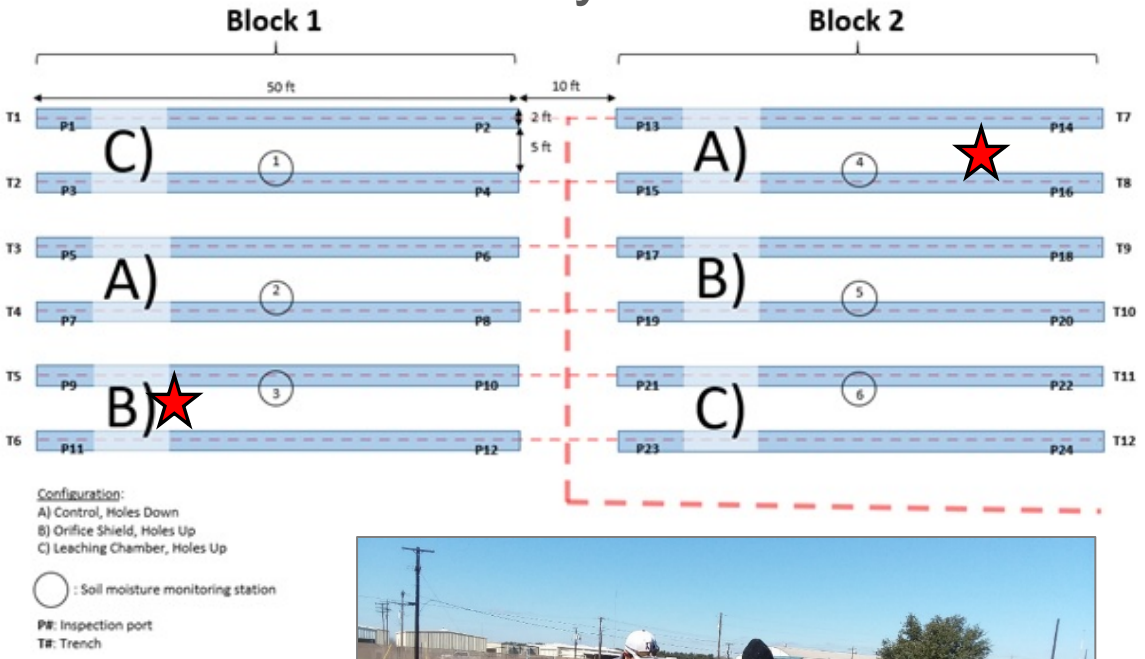
: TDR sensor, front view

: auger hole

: trench pit

Construction

- Permit to construct from Brazos County Health District
  - Soil evaluation
  - Drawings
  - Specifications
    - Home
    - Treatment tank



OSSF Soil & Site Evaluation

Date Performed: 2/14/2020

Site Location: Onsite Wastewater Training Center – RELLIS Campus
Proposed Excavation Depth: 18"

Soil Boring # 1				
Depth (inches)	**Soil Class**	**Soil Texture**	**Groundwater/ Water Table**	**Topography**
0 – 10"	**III**	Sandy Clay Loam	No	Flat
10 – 48"	**IV**	Silty Clay	No	Flat

Soil Boring # 2				
Depth (inches)	**Soil Class**	**Soil Texture**	**Groundwater/ Water Table**	**Topography**
0 – 12"	**III**	Sandy Clay Loam	No	Flat
12 – 48"	**IV**	Silty Clay	No	Flat

FEATURES OF SITE AREA

Presence of 100 Year Flood Zone	☐ Yes ☑No
Presence of Seasonal High Water Table	☐ Yes ☑No
Presence of Adjacent Ponds, Streams, Water Impoundments	☐ Yes ☑No
Existing or Proposed Water Well in Nearby Area (within 150 feet)	☐ Yes ☑ No
Restrictive rock horizon	☐ Yes ☑ No

Ground Slope 0.8 %

I certify that the findings of this report are based on my field observations and are accurate to the best of my ability.

Ryan Gerlich
(Signature of person performing evaluation)

2/21/2020
(Date)

OS0031317
Registration Number and Type

- Home Specifications
  - Not a home
  - Continuous flow of 240 gpd; the one reported for a single-family dwelling (three bedrooms), less than 2,500 square feet, with Water Saving Devices

- Treatment tank Specifications
  - tank size and type calculation:

Parameter	Unit	Value
Effluent Loading Rate (Ra)	gal/sf/d	0.1
Wastewater Usage Rate (V)	gpd	240
Absorptive Area (A) = V/Ra	sqft	2400

  - 750-gallon concrete tank serving as septic tank
  - 750-gallon concrete tank serving as a 500-gallon septic tank and 250-gallon pump tank

- Construction planned for the spring 2020 postponed
- November 3rd - December 12, 2020 (field distribution, plumbing, pump installation)
- December 17th head pressure tested and set to 5 feet pressure


CLEAR
TAMU
POTABLE
WATER
979-845-4311















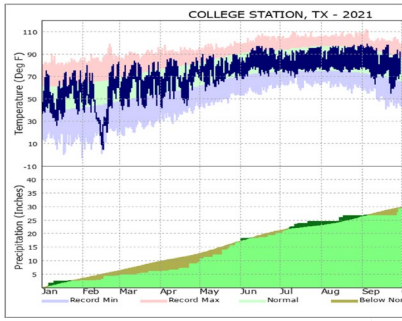

TEEX

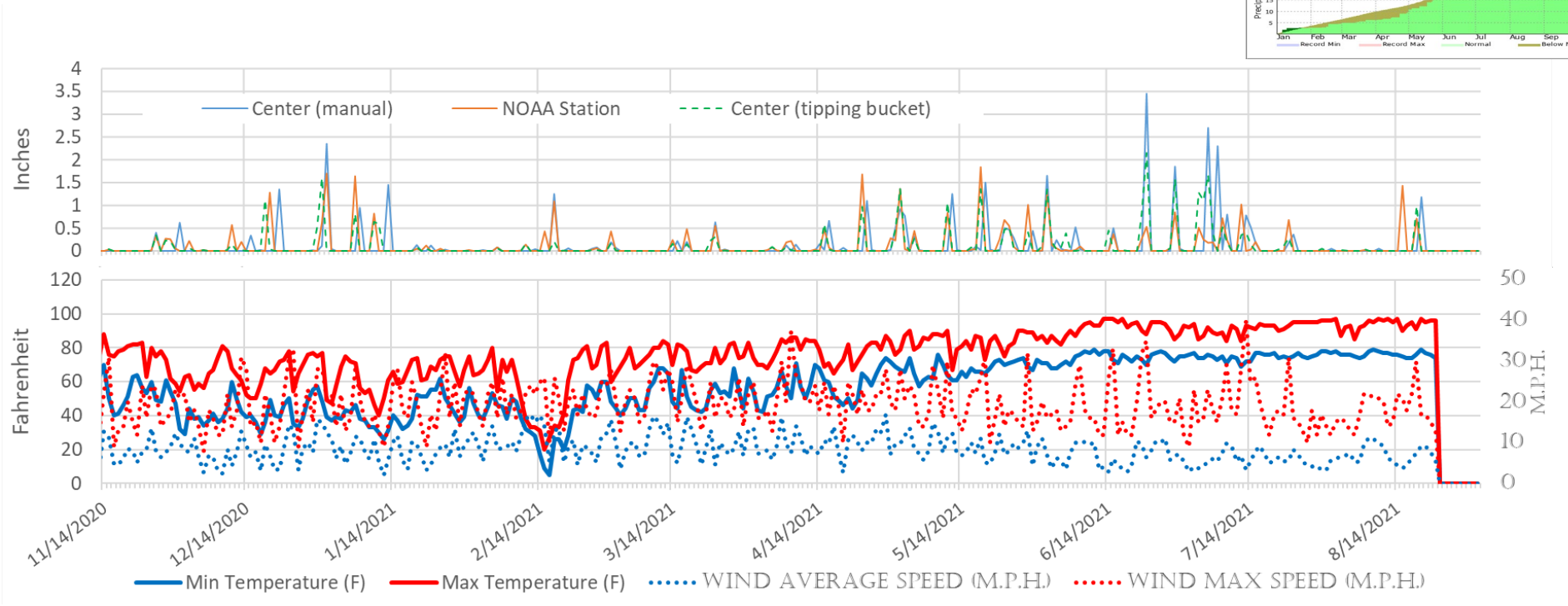
Wastewater distribution and monitoring

- Initial monitoring of ports with only rainfall water
- February 24, 2021, LPD pump distributing wastewater
- Run 1 minute/hour from feed tank (~8.5 gall/run = 204 gal/d)
- LPD pump tank on a demand basis (~3 runs/day)
- Calibration failure → 600 gal/d for four (4) consecutive days
- New calibration (~9.2 gal/run = 221 gal/d = 92% design load)
- One-time temporary reduction before heavy rain forecast (~109 gal/d, May 20, 2021).

Weather data:

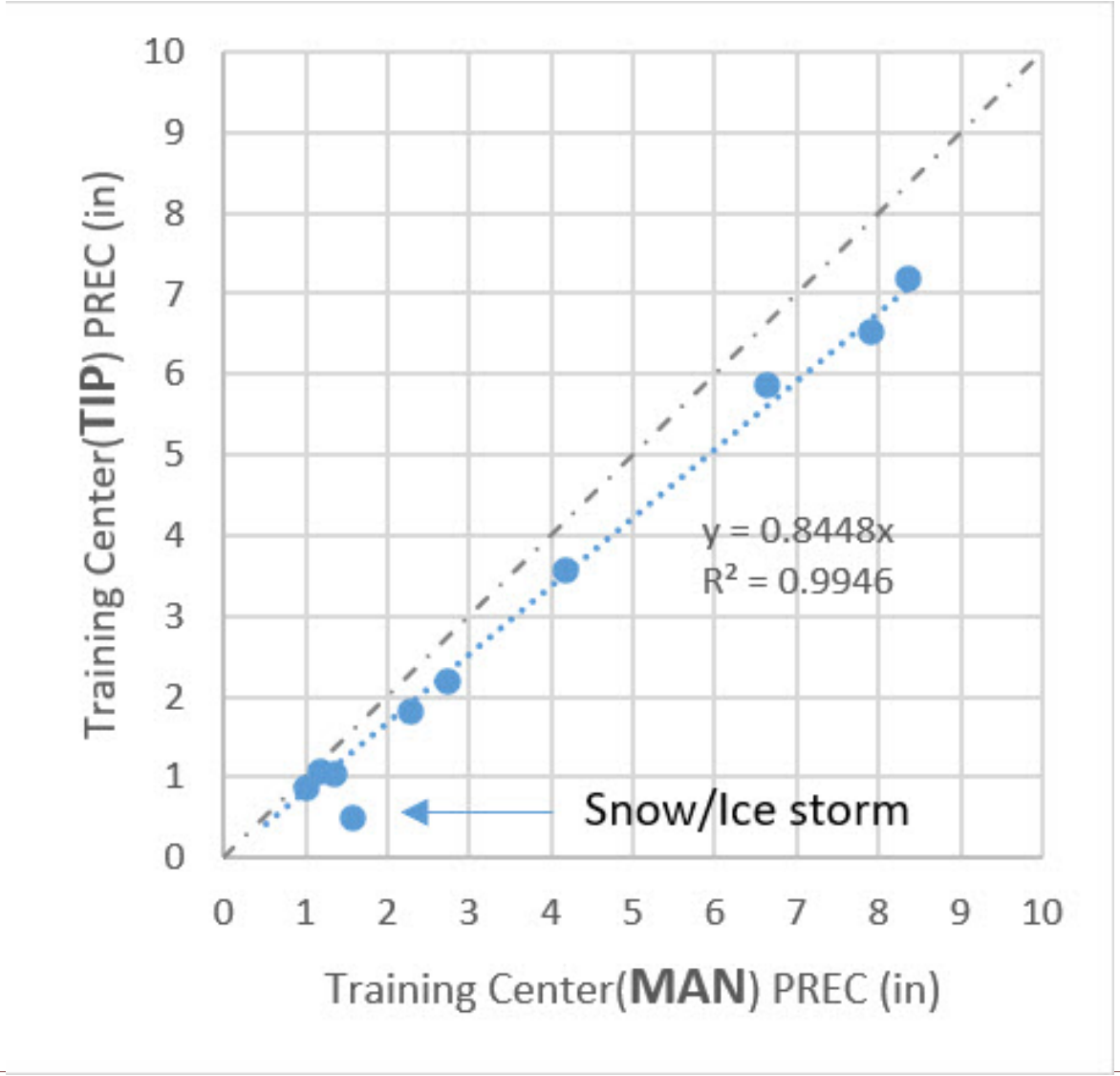
- Tipping bucket rain gauge, about 100 feet from the drain field (started November 15, 2020); 0.01-inches resolution, 5-minutes interval
- Manually from existing gauge (in some cases cumulated)
- College Station airport weather station: precipitation, air minimum and maximum temperature, wind average and maximum speed



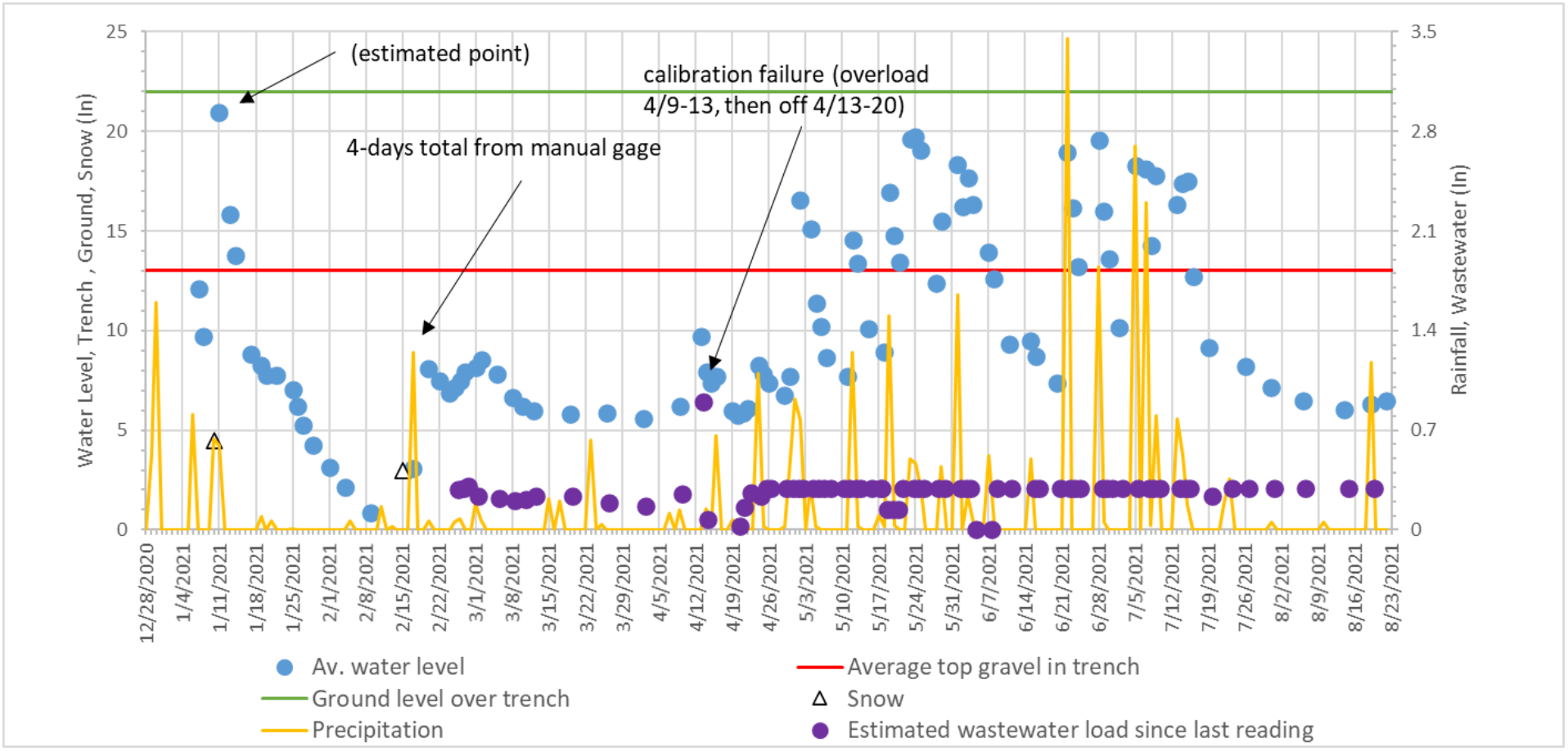


Top image: precipitation from manual gauge, NOAA Station (KCLL), tipping bucket
Bottom image: min and max temperature and average and max wind (KCLL)

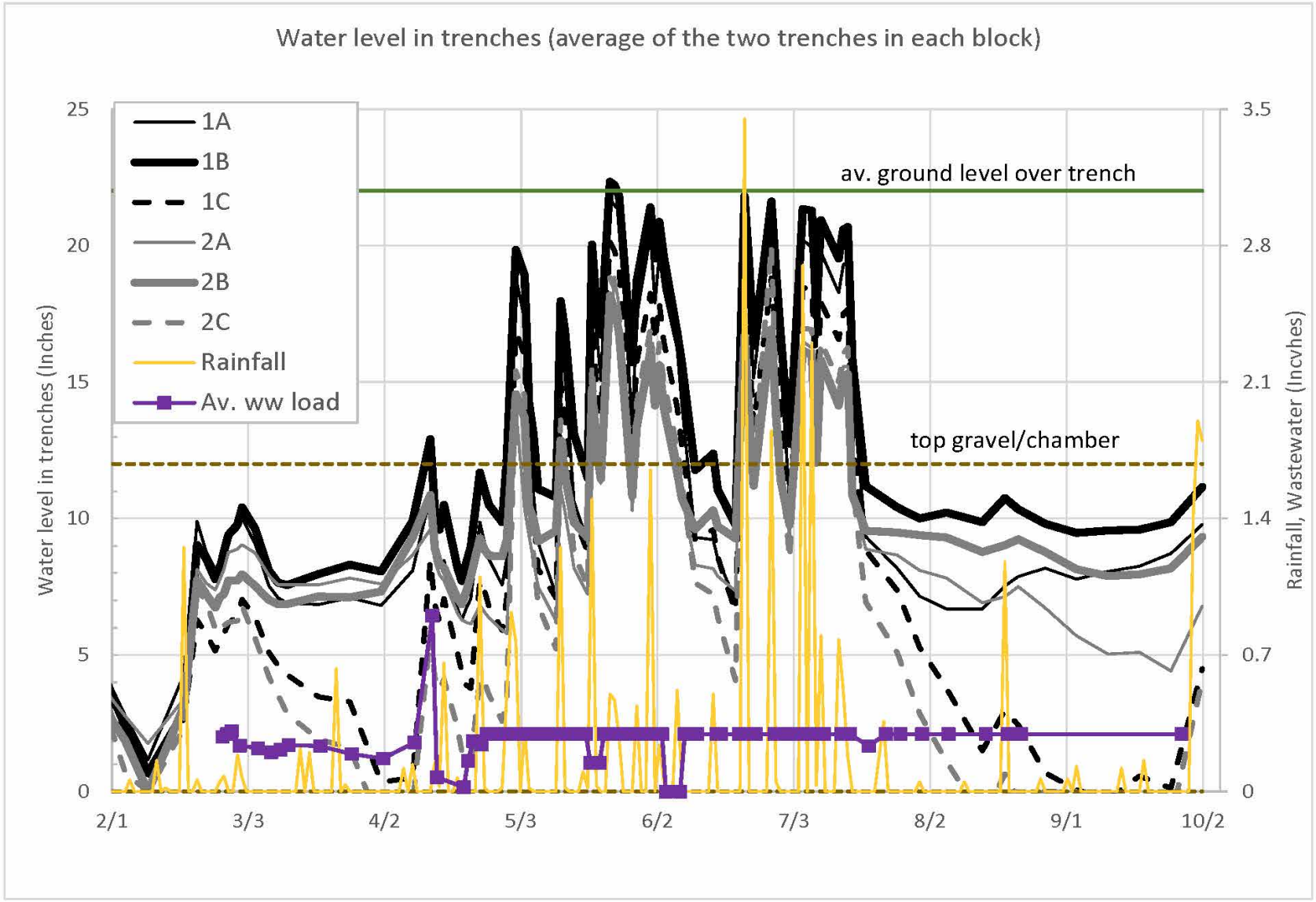
Precipitation from manual gauge and tipping bucket



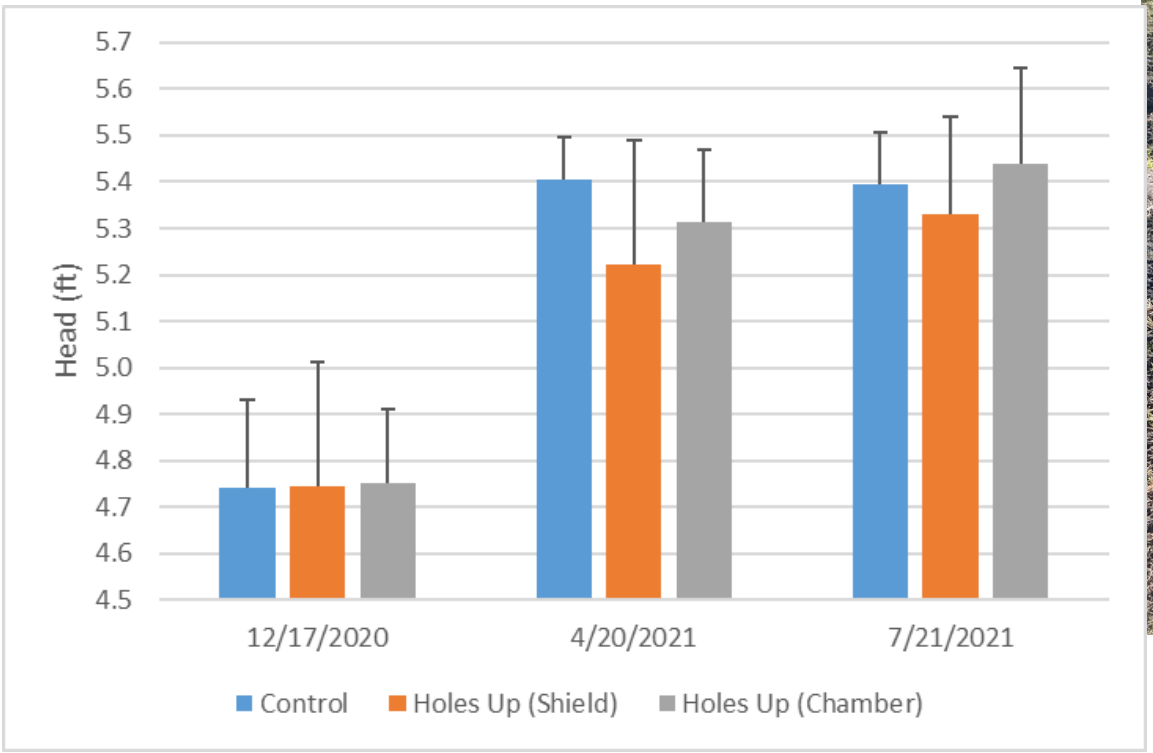
- Water level:
  - Started January 7, 2021
  - Initially every 1-2 days, then weekly (daily after rainfall events)
- Water pressure:
  - Started December 17, 2020
  - Quarterly and quite uniform among laterals
  - Slightly higher 2nd and 3rd measurement, and with sediment
- Water quality:
  - Grab samples started March 18, 2021
  - Weekly basis, BOD5 and TSS
  - BOD5 = 20-260 mg/L, TSS = 9-26 mg/L; likely, effect of filters



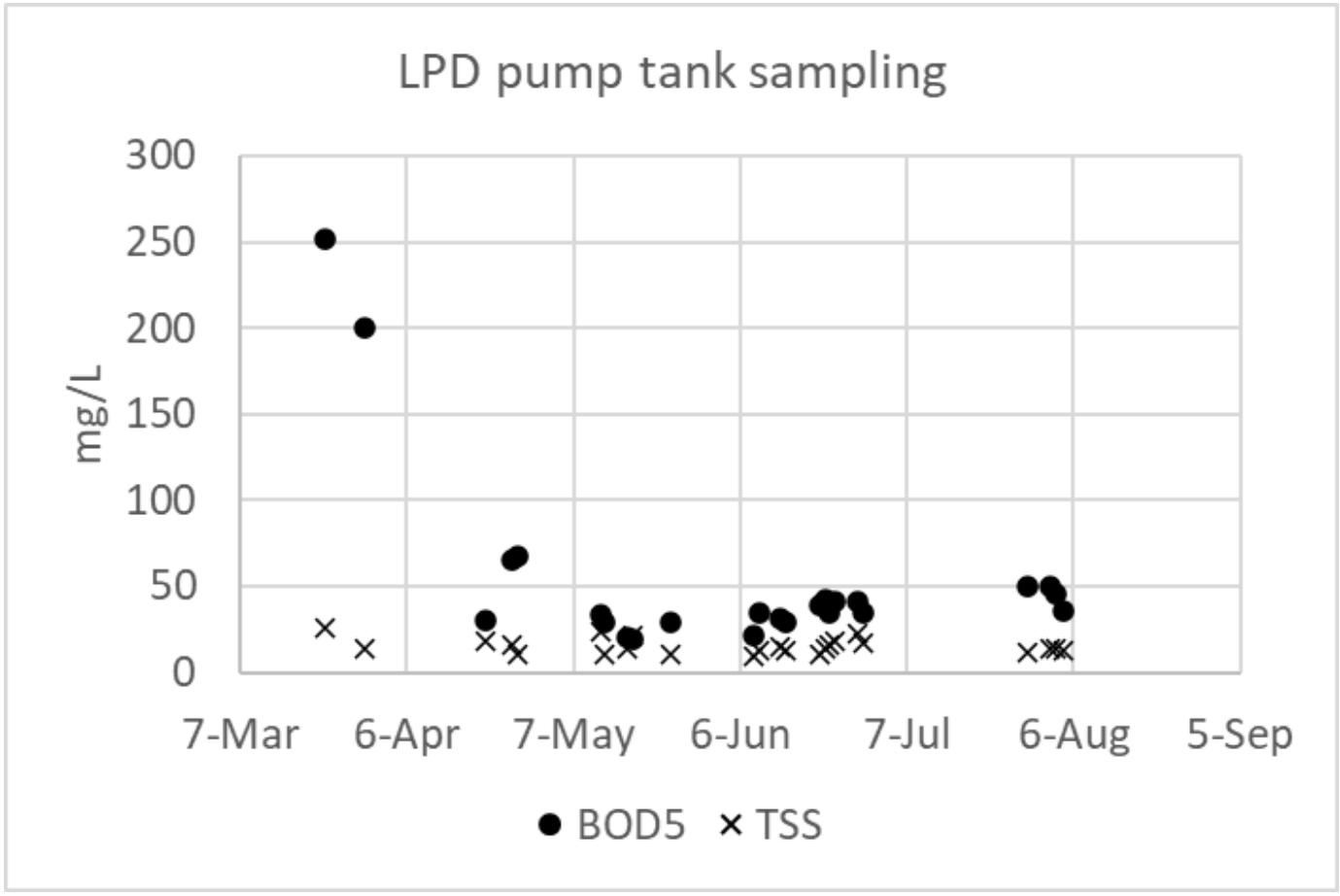
Average water level, rainfall, wastewater daily load, bottom and top levels for the average trench (top indicating either gravel or chamber), average ground level



Individual configurations



Pressure on laterals during the experiment months
(average value for each configuration and standard deviation)



Wastewater quality during the experiment months
(grab samples from LPD pump tank)

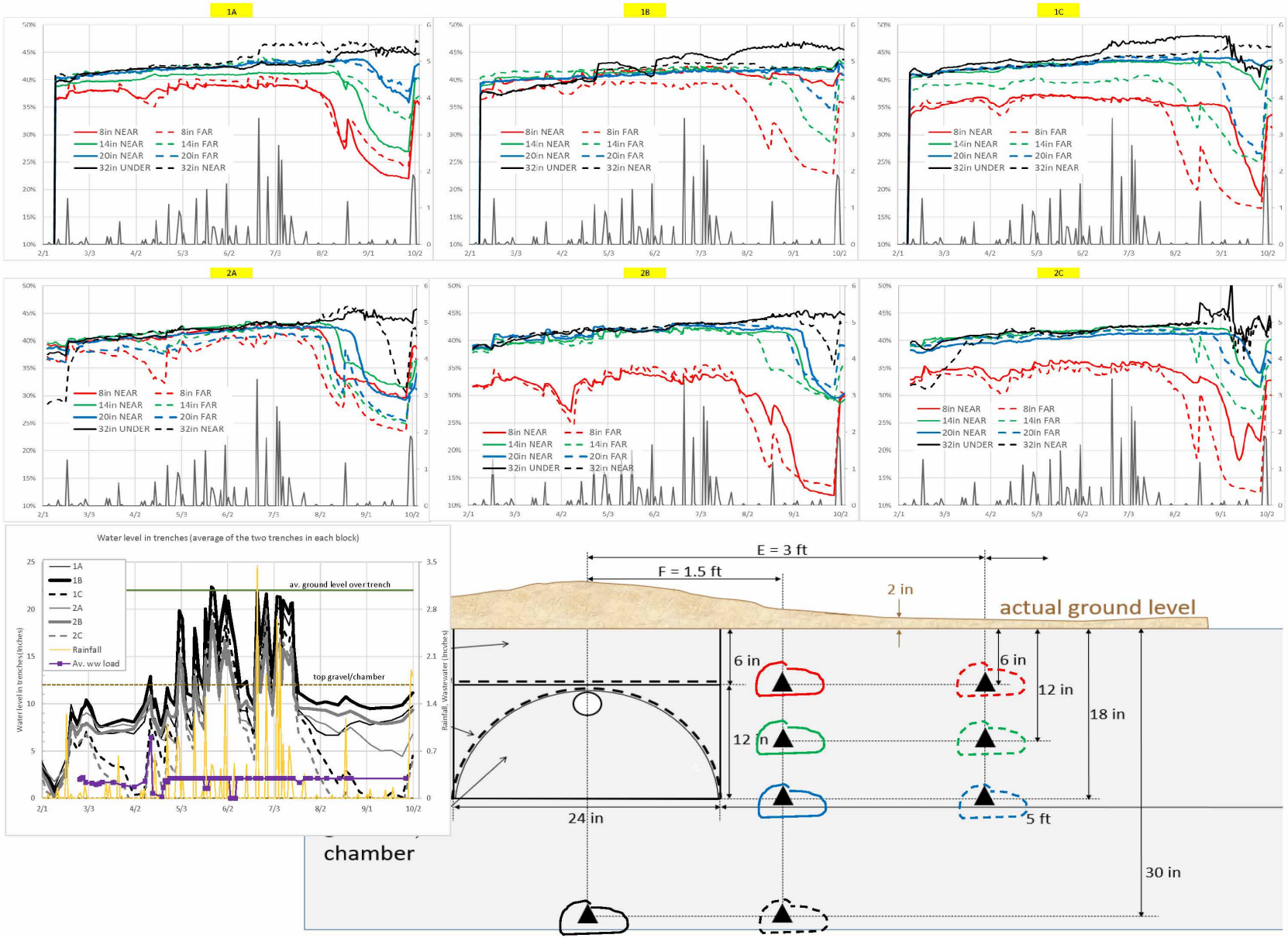
Soil monitoring:

- Soil moisture, preliminary before construction:
  - November 24, 2020 from 12 locations at four depths (3-9, 9-15, 15-21, 27-33 inches);
  - Gravimetric method
  - At 1/3 and 2/3 of the trench length, at approximate depth and location where TDR sensors were going to be located
  - West portion of the field (Block 1) more wet (16.6% on dry weight) with respect to the East portion (14.3%); no differences among configurations

- Soil moisture, continuous:
  - TDR315L sensor by Acclima, Inc. (three 15cm-long rods), connected to an ACC-AGR-NODE-II-915 Acclima sensor node, which communicates wireless to a ACC-AGR-GTWY-II-915 Acclima SDI-12 sensor data gateway;
  - The gateway communicates wireless with the Hologram website;
  - 60 minutes measurement interval, 4 hours upload interval
  - Installation and setup February 3-9, 2021
  - One sensor malfunctioning replaced; one node malfunctioning and likely damaged by weather replaced; some short interruptions (weather instability, not proper connections)

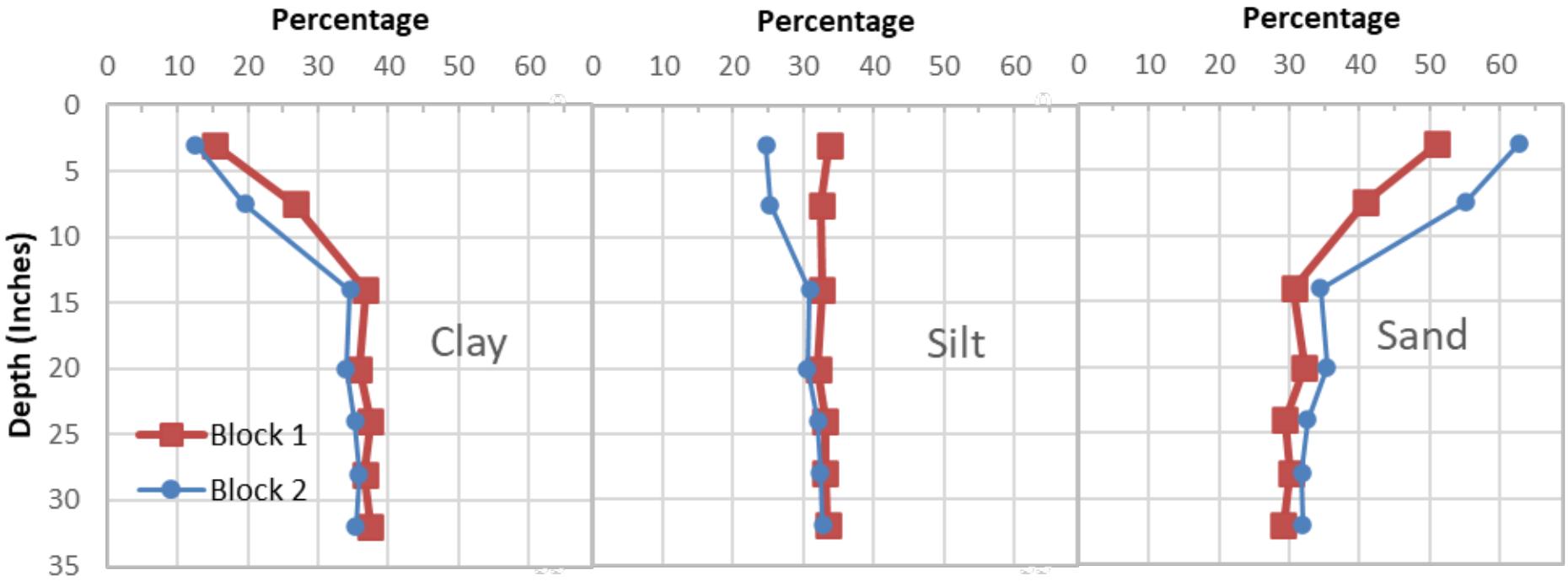

1
2
3
4
5
6
7
8
9


1
2
3
4
5
6
7
8
9



TDR preliminary data

- Soil physical and chemical monitoring:
  - March 5, 2020, two locations, 7 depths (0-6, 6-9, 12-16, 18-22, 22-26, 26-30, and 30-34 inches)
  - Texture and chemical characteristics (PSD basic, water-solution Cations/EC from saturated paste, Cation Exchange Capacity (CEC)), and clay detailed analysis (X-ray diffraction and Fourier transform infrared). No significant differences between the two locations
  - August 11 and 20, 2021, undisturbed samples, at each TDR station and each TDR depth (24 samples).
  - Moisture, bulk density, field capacity determined with Tempe cell, and wilting point determined with Pressure plate



Soil texture observed at the South-West side (Block 1) and the North-East side (Block 2) of the LPD drain field, near the corresponding TDR sensors

Conclusions

- Carefully planned but shorter experiment period – Focus on key work
- Blocks to reduce hydraulic interference and soil variability
- Existing features but slow set up (site, experiment, safety) and wastewater loading calibration
- Responses to inclement weather (multiple rain gauges, additional grading around drain field)

Conclusions

- Analysis of results not finalized
- Pressure uniform and not significantly different among configurations
- Slight differences in soil texture (effective grouping in blocks), and in water levels among configurations
- Effective effluent filters to reduce BOD5 and TSS
- Soil moisture and hydraulic properties to be analyzed

Questions?

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