Shaping State Regulations Based on Field Experimental and Demonstration Projects, Virginia Experiences

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

Presentation Outline

- Regulator's view on the regulatory concepts (Don Alexander)
- Virginia Regulatory Frame-Work in mid-1990s (Don Alexander)
- Experimental and Demonstration Projects in Virginia (Anish Jantrania)
- Impacts of the Projects on Regulatory Reform/Changes (Anish Jantrania)
- Q & A + Discussion

A Fundamental Concept

- If your only tool is a hammer, everything will look like a nail
- If your only tool is a septic tank-df system…
  - Not all sites are suitable for a wastewater system
  - There soils that “perc” and soils that “don’t perc”
- Most people think the problem is the unsuitable soil
- The real problem is a lack of tools.

Getting to the Fundamental Concept

- Seeing what doesn't exit is difficult
- In 1976 the septic system was the only tool in Virginia
- I was a new EHS in Virginia and the new guy never gets the glamorous jobs.
  - Assigned to the Complaint Program
  - It was here I learned about failing systems

The First Step Toward a Solution
Identify the Problem

- The status quo was to issue a repair permit
  - Find the best soils (typically poor soils for a SS)
  - Issue a permit and a NOV with a time to correct
  - Hope for the best
- There was no inquiry into the cause of failure
- There were no options to the septic system
- And the results were….less than stellar

A Serendipitous Partner

- Our county had a crackerjack soil ***scientist***
- We worked together for several years
- Our approach was always a scientific inquiry
  - We developed basic failure evaluation methods
  - We identified several common causes of failure
  - We also read the literature
  - Repair permitting began to change

A Few Common Failure Causes

- Mismatching the system to the site conditions
  - Previously ID'd as soils that don't perc
  - Now ID's as soils we don't know how to use
- Construction errors
  - Commonly poorly located and leaking pump chambers
  - Leaky septic tanks
  - Abused absorption areas
  - Water use in excess of design flow

Gaining Clarity

- Onsite systems needed to:
  - Treat WW to avoid groundwater contamination and
  - Disperse the WW back into the environment
  - Avoid public health risks and nuisances
- Repair permits shouldn’t repeat past errors

Treatment and Disposal as a Mantra

- Prior to leaving the county in 1986 to direct the Onsite Program, repair permitting was changing (in our county)
- Instead of simply issuing a new permit and a NOV
  - We evaluated WHY a system failed
  - We attempted to match the repair to the problem
  - It seems incredibly obvious today but is wasn't the practice then
- Low pressure systems were used where perc rates exceeded 60 mpi
- Treatment was used in high water table system
- It was a start, not a complete solution

The 1982 Regulations…

- A definite step forward
  - Recognized soils for WW treatment
  - Recognized Low Pressure systems for dispersal
  - Recognized Wisconsin Mounds
  - Allowed for Experimental Systems
- The problem was a lot of land still didn't "perc"
- In 1986 I became program manager and the #1 complaint was "My Land Doesn't Perc, what can I do?"

The Conundrum

- Public Health vs Science vs Engineering
  - The Scientist wants to understand and measure the system
  - The Engineer wants to design a solution
  - The Public Health Professional wants zero risk
- The ‘82 regs had a seriously flawed compromise
  - It allowed a few experimental systems
  - And it required an approved backup
- The result - no experimentation
  - Time and money
  - Permitting would take longer and the system cost more

Addressing the Conundrum

- Expanding the use of Experimental Systems by
  - Waiver granted to permit 100 systems
  - Waiver granted to backup system requirement
  - Performance Data required
- Identify conventional technology that can be used now
  - Spray irrigation (1995)
    - Minimal soil criteria
    - Large lot size
  - Discharging system (including dry ditch) (1995)
  - Peat filter (1996)

Addressing the Conundrum

- By 1995 I believed VDH had moved as far as we could with existing staff and knowledge
- Remember how I said it's difficult to imagine what doesn't exist?
- We needed someone who could imagine a future where wastewater treatment and dispersal were no longer limitations.

Addressing the Conundrum

- July 1996 I hired Anish Jantrania, PhD, PE, MBA
- I wanted a fresh and open minded approach
- One of the first assignments I gave him….and oddly (to me anyway) one of the last he accomplished was
  - Find a solution to wastewater dispersal in high shrink-swell soils
  - I assumed he'd work in Iredell soils but he instead chose a marine clay
  - As expected, he began by using soil data and used conservative assumption to design a system…
  - But he needs to tell you about solving the conundrum…

Experimental and Demonstration Projects in Virginia from 1997 to 2008

1. Weldon Dean (Rockingham County)
2. Hillis Bowen (Accomack County)
3. Shirley Webb (Wythe County)
4. Horne's Restaurant (Caroline County)
5. Masonic Lodge (Fauquier County)
6. Jefferson (Charles City County)
7. Dean Willis (Fredrick County)
8. Explore Park (Roanoke County)
9. Genito West (Powhatan County)
10. Dixon (Halifax County)
11. Leila Williams (Montgomery County)
12. Community Systems (Charles City County)
13. Imboden (Wise County)
14. Garner site (Westmoreland County)

Main reason for undertaking these projects was permit denial due to Soil and Site Issues

- Hydraulic conductivity/permeability,
- Shallow depth to limitations,
- Small area,
- All combinations of the three issues.

How can a system be engineered to offer the same degree of public health and environmental quality protection on sites that do not meet the VDH regulations?

Virginia Administrative Code
Title 12. Health
Agency 5. Department of Health
Chapter 610. Sewage Handling and Disposal Regulations

Table 4.3.
Summary of Separation Distances between Systems Using Naturally Occurring Undisturbed Soils and Limiting Site Factors.

Site Factor	In-Ground System[1]		Shallow-Placed System[1]	
	Septic Tank Effluent	Secondary Effluent	Septic Tank Effluent	Secondary Effluent
Bed Rock	18"	12"	n/a	18"
Restriction	18"	12"	n/a	18"
Shrink-Swell Soil	18"	12"	n/a	18"
Slope	50%	50%	n/a	50%
Perc Rate	5-120 mpi	5-120 mpi	n/a	5-45 mpi
Water Table	18"	12"	n/a	12"

[1]The separation distances for in-ground and shallow-placed systems are measured from the trench bottom or other infiltrative interface vertically down to listed site factor.

Virginia Administrative Code
Title 12. Health
Agency 5. Department of Health
Chapter 610. Sewage Handling and Disposal Regulations

Table 5.4.
Area Requirements for Absorption Trenches Receiving Septic Tank Effluent.

Percolation Rate (Minutes/Inch)	Area Required (Ft^2/100 Gals)			Area Required (Ft^2/Bedroom)		
	Gravity	Gravity Gravelless	Low Pressure Distribution	Gravity	Gravity Gravelless	Low Pressure Distribution
5	110	83	110	165	124	165
10	120	90	120	180	135	180
15	132	99	132	198	149	198
20	146	110	146	218	164	218
25	158	119	158	237	178	237
30	174	131	164	260	195	255
35	191	143	170	286	215	260
40	209	157	176	314	236	264
45	229	172	185	344	258	279
50	251	188	193	376	282	293
55	275	206	206	412	309	309
60	302	227	217	452	339	325
65	331	248	228	496	372	342
70	363	272	240	544	408	359
75	398	299	251	596	447	375
80	437	328	262	656	492	394
85	479	359	273	718	539	409
90	525	394	284	786	590	424
95	575	489	288	862	733	431
100	631	536	316	946	804	473
105	692	588	346	1038	882	519
110	759	645	379	1138	967	569
115	832	707	416	1248	1061	624
120	912	775	456	1368	1163	684

Projects versus Site Issues

Soil Permeability

Weldon Dean (Rockingham County)
Genito West (Powhatan County)
Masonic Lodge (Fauquier County)

Shallow Depth to Rock/Wetness Indicators

Weldon Dean (Rockingham County)
Hillis Bowen (Accomack County)
Jefferson (Charles City County)
Dixon (Halifax County)
Community Systems (Charles City County)
Garner (Westmoreland County)

Small Area

Horne's Restaurant (Caroline County)
Leila Williams (Montgomery County) Shirley Webb (Wythe County)

Environmental Quality

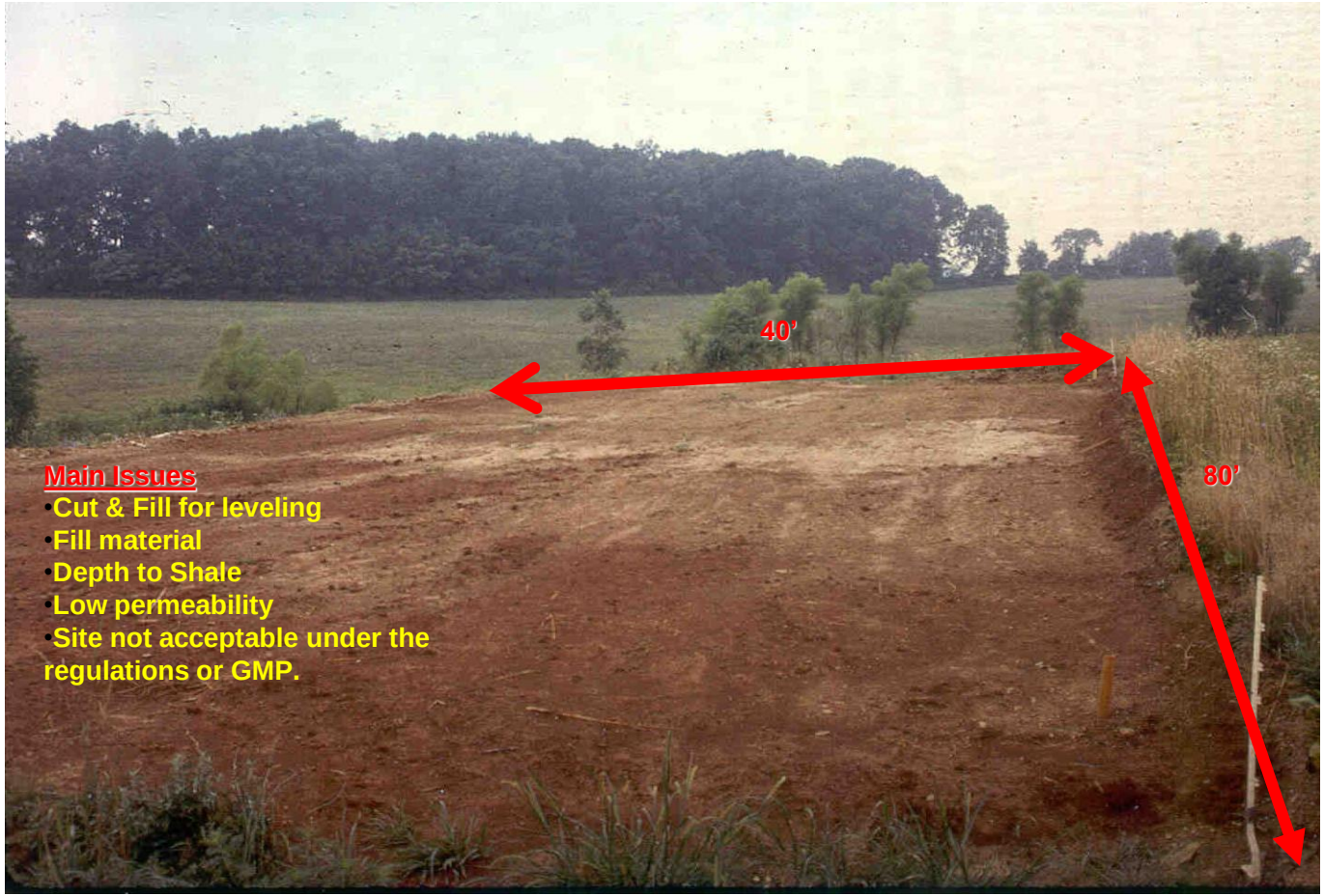
Weldon Dean (Rockingham County)
Hillis Bowen (Accomack County)
Jefferson (Charles City County)
Dixon (Halifax County)
Community Systems (Charles City County)
Garner (Westmoreland County)
Explore Park (Roanoke County)

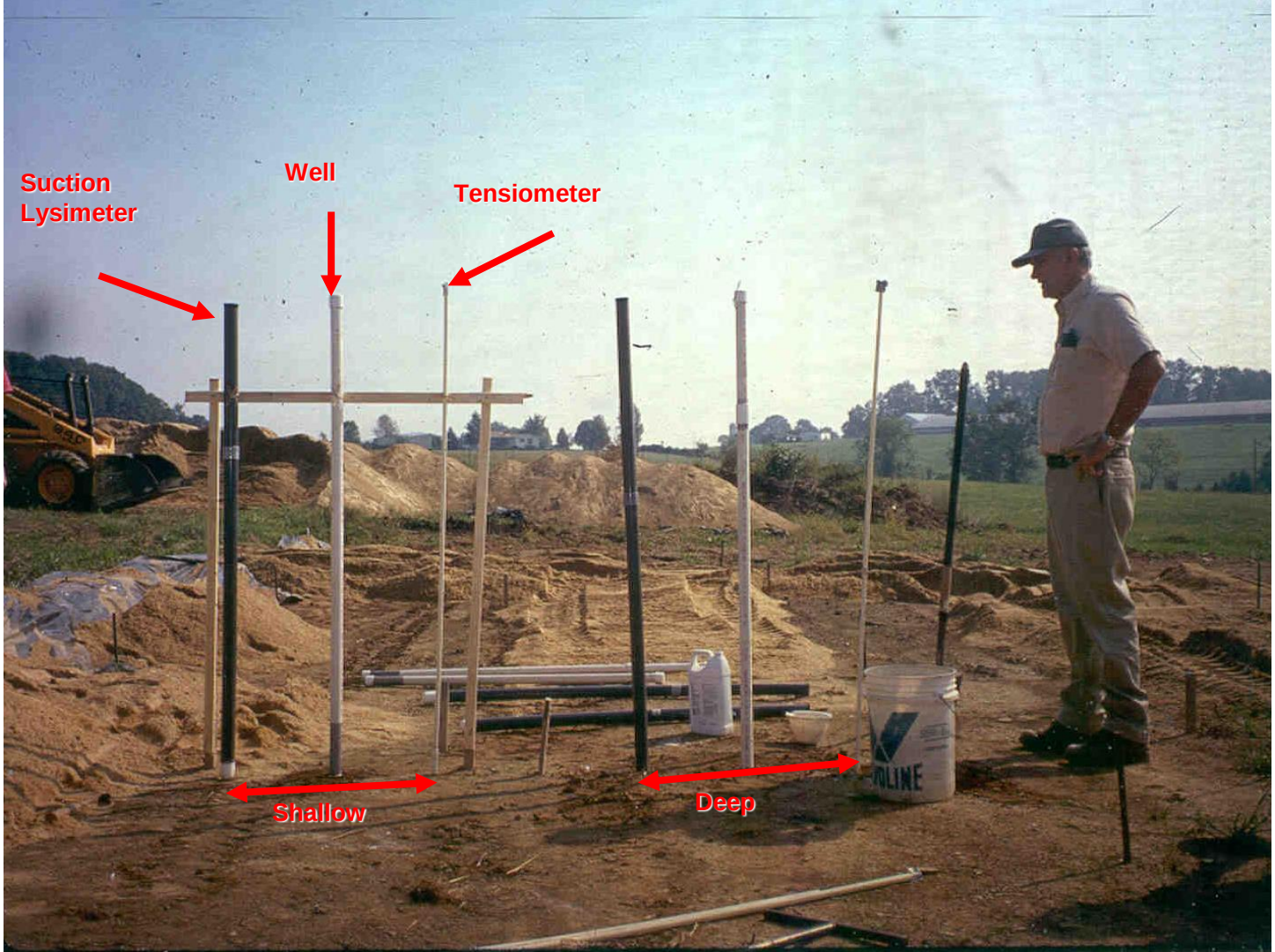
Let’s talk about 3 projects (first, last, and one in the middle)

Weldon Dean Project

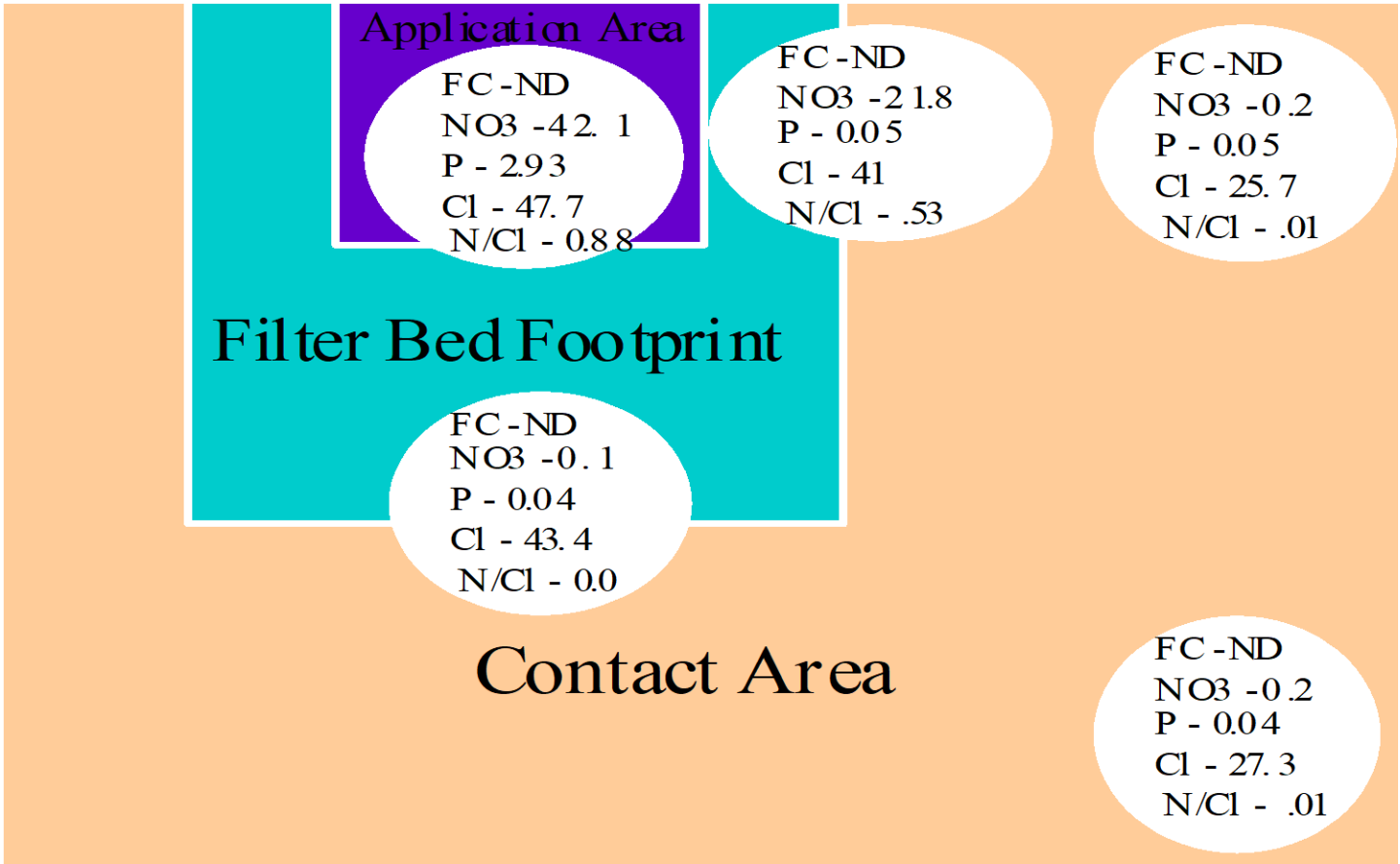
- Mr. Dean built a new 3-bedroom home with a permit for a spray system;
- Mr. Dean learned about "*Aquarobic Filterbed*" System and wanted to use that system;
- Site did not meet the GMP85 - shallow depth to rock and fill material in the bed area;
- Decided to go with an Experimental Permit in 1997;
- Case study presented at Spring 1999 VDH Manager's Meeting.

Rockingham County, VA – Year 1997


40'
80'
Main Issues
·Cut & Fill for leveling
·Fill material
·Depth to Shale
·Low permeability
·Site not acceptable under the regulations or GMP.


Suction
Lysimeter
Well
Tensiometer
Shallow
Deep

Constituent Levels



Mr. Dean Happy with the system performance ~ three years after installation, **Y2000**


Mr. and Mrs. Dean no longer with us, new homeowner getting used to the system… Site visited in **Y2021.**

Genito West Projects

- Four homes had sewage “problems”;
- Four types of media filter systems for wastewater treatment;
- New shallow drip system **&** time-dosing of treated effluent to existing deep drain field;
- Case study presented at the Fall 2001 Manager’s meeting;
- AOSE training seminar and site visits in May and July 2002.

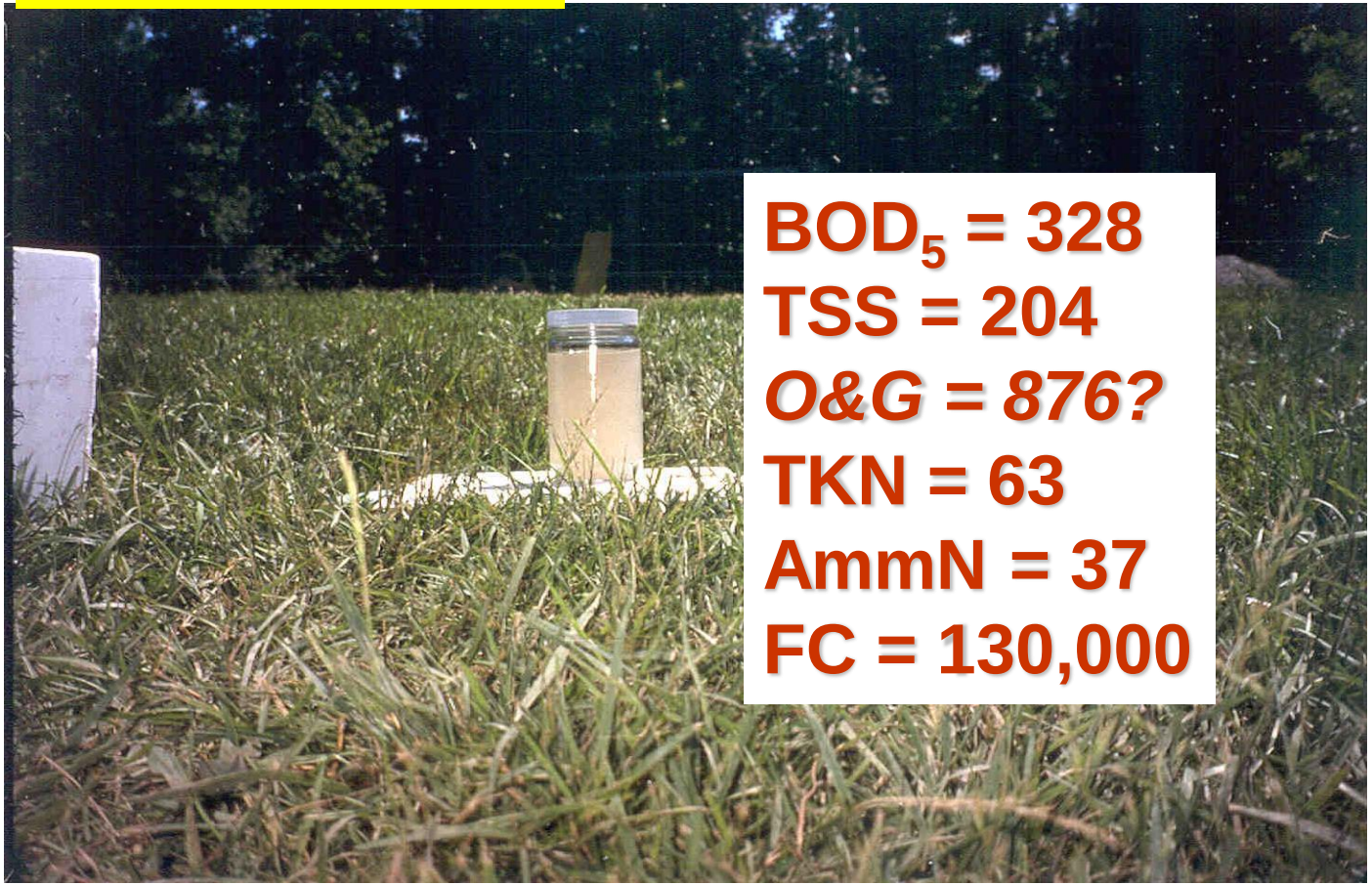
Homeowners reported "problems" with their septic systems.

Types of Problems:
> Sewage on ground
> Odor
> Back-up in house

Soil evaluation


5 24 '00

Wastewater evaluation



Media Filter Effluent Quality

	House-A	House-B	House-C	House-D
BOD_5	5	<3	2	<2
TSS	1	4	5	6
O&G	<5	<5	<5	<5
TKN	3.4	2.2	2.2	3.9
Ammn	1.1	<1	<1	1.1
Nitrate	7.6	3.8	5.9	12.9
Total-N	11	6	8.1	16.8
Fecal	1600	>1600	>1600	500

Before

After

Before

After

Before

After

Before

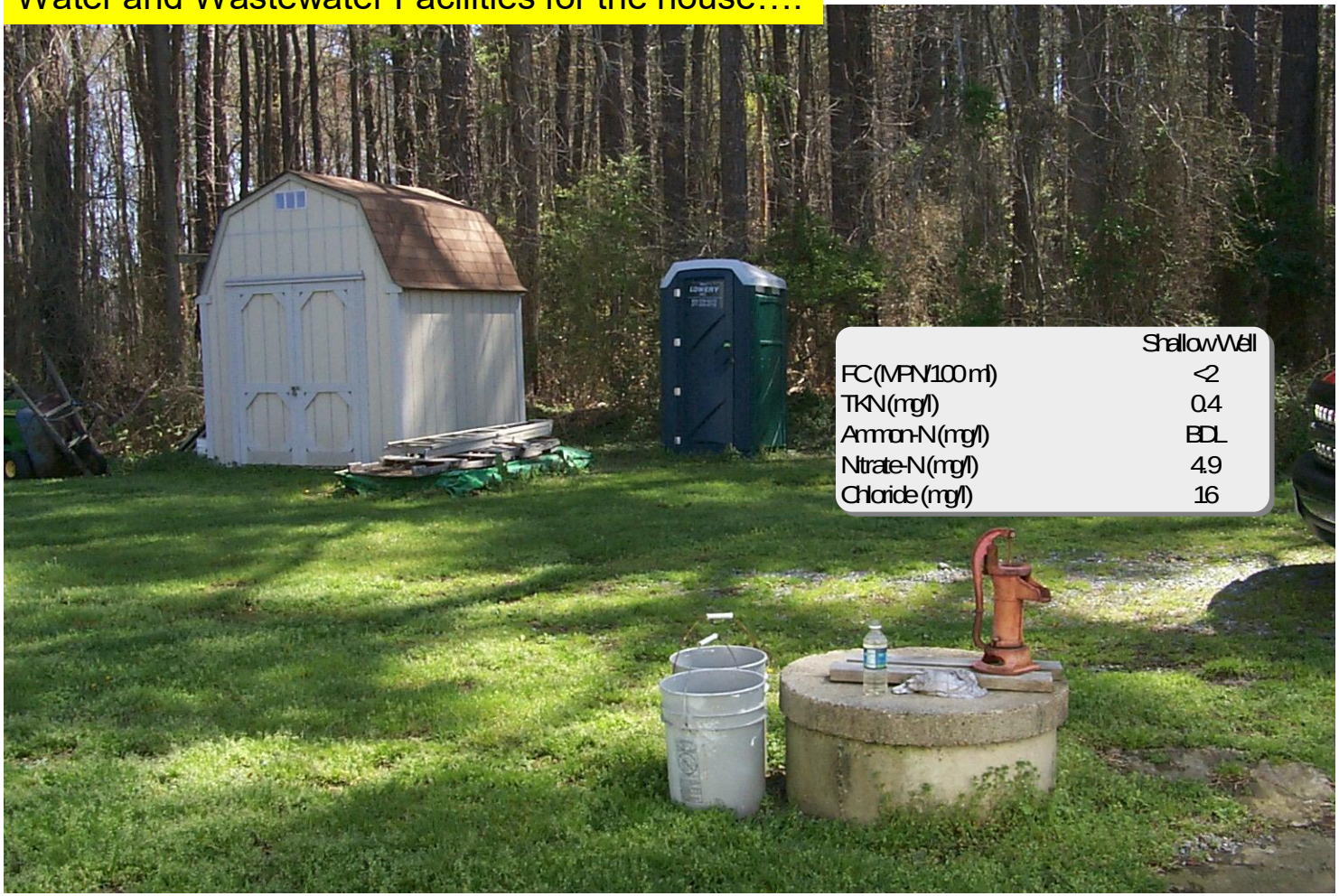
After

Westmoreland County Project

- This is it, the final challenge for me….
- Homeowner wants to improve his quality of life without moving out of his property…
- IPR project is ready to help the homeowner getting a new home with Indoor Plumbing IF the VDH would issue a permit….
- Small lot, wet soil, shrink-swell may be?
- Hydrus model indicated that a subsurface system would fail within a year
- Soil physics indicated that a deep system with high-pressure could work
- Performance-based permit to “test” the theory?
- Homeowner was ready to work with the VDH to conduct a field-test and pay for the engineered system!

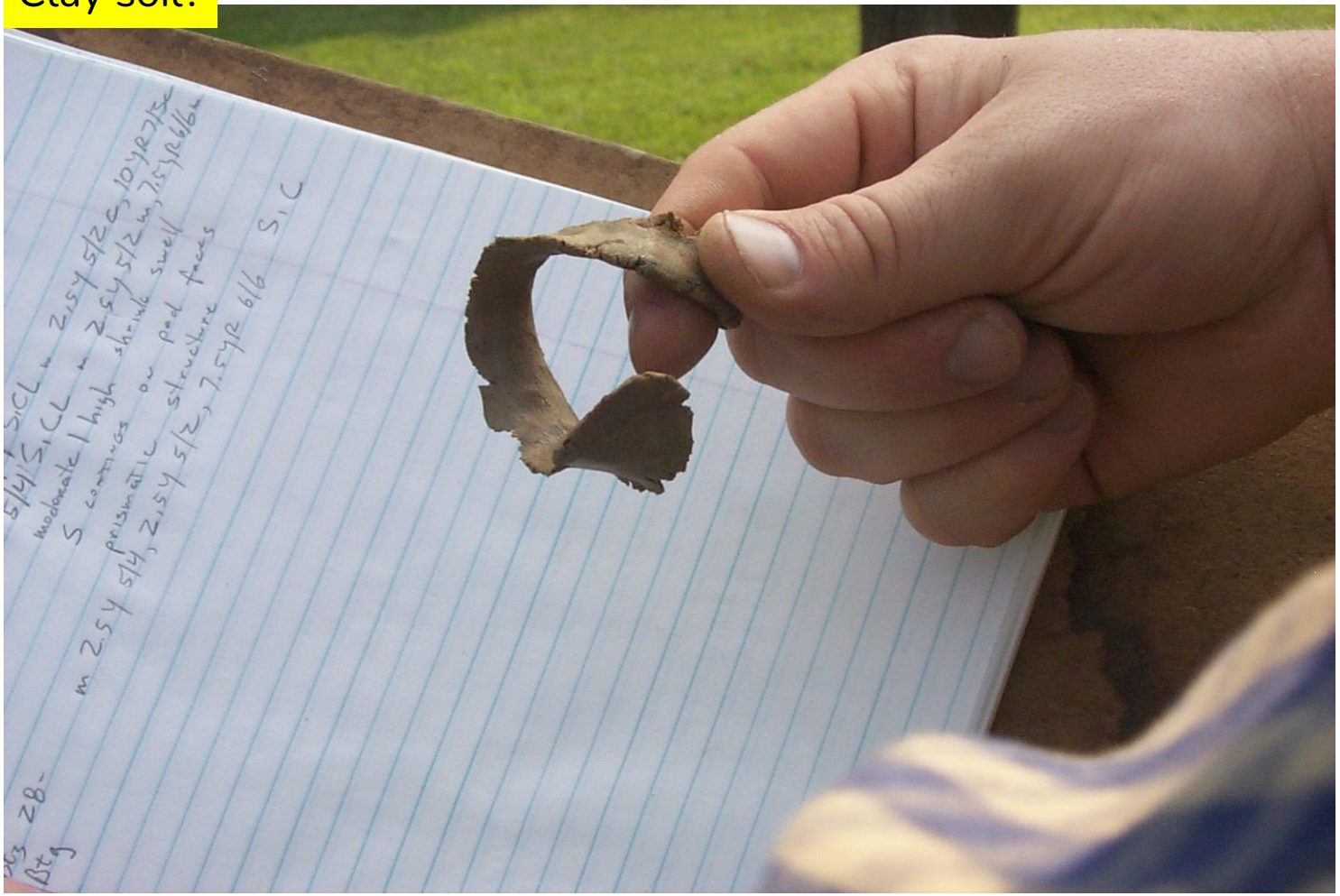
Westmoreland County, VA – Year 2003

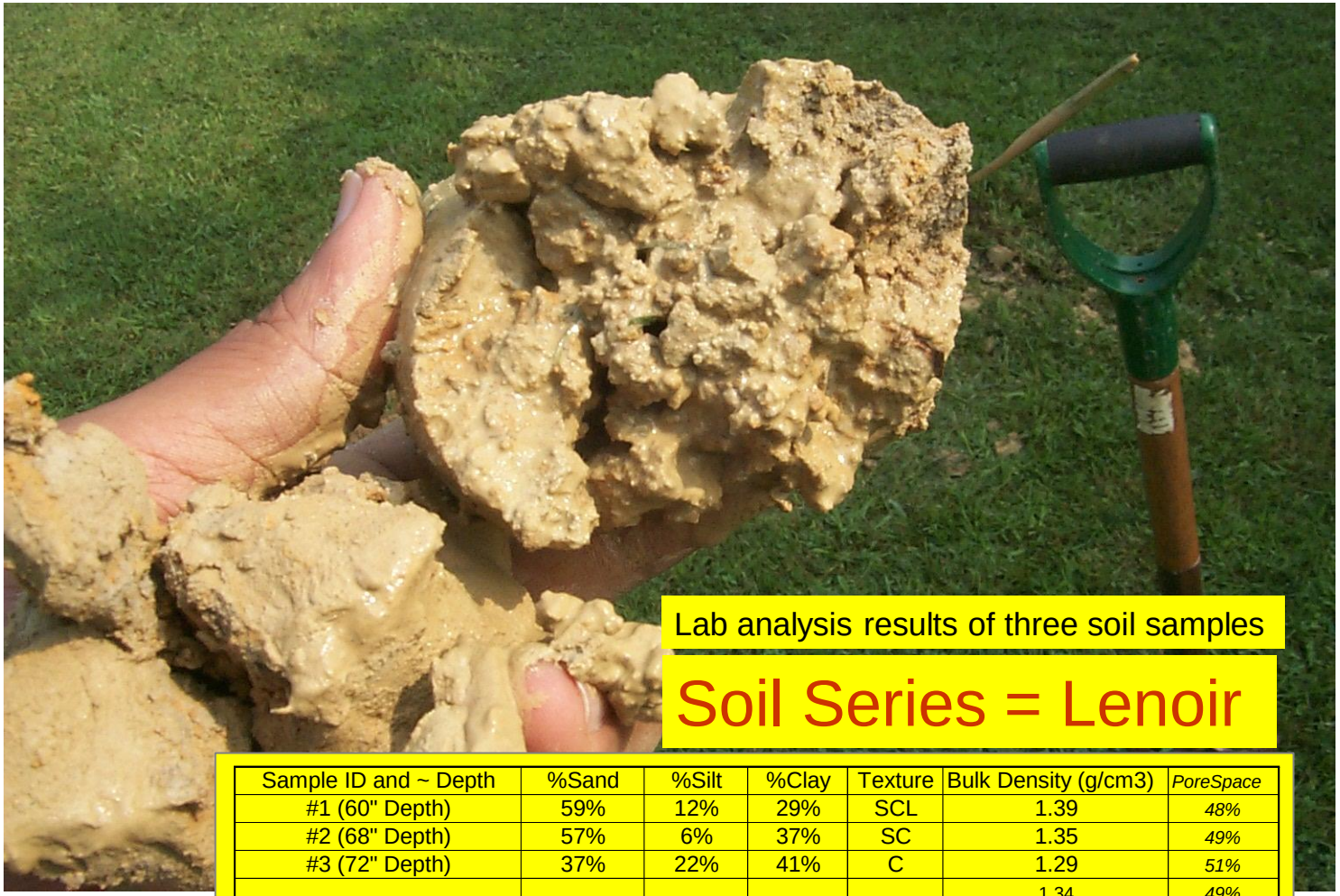
Water and Wastewater Facilities for the house….



	Shallow Well
FC (MPN/100 ml)	<2
TKN (mg/l)	0.4
Ammon-N (mg/l)	BDL
Nitrate-N (mg/l)	4.9
Chloride (mg/l)	16

Clay soil?





Lab analysis results of three soil samples

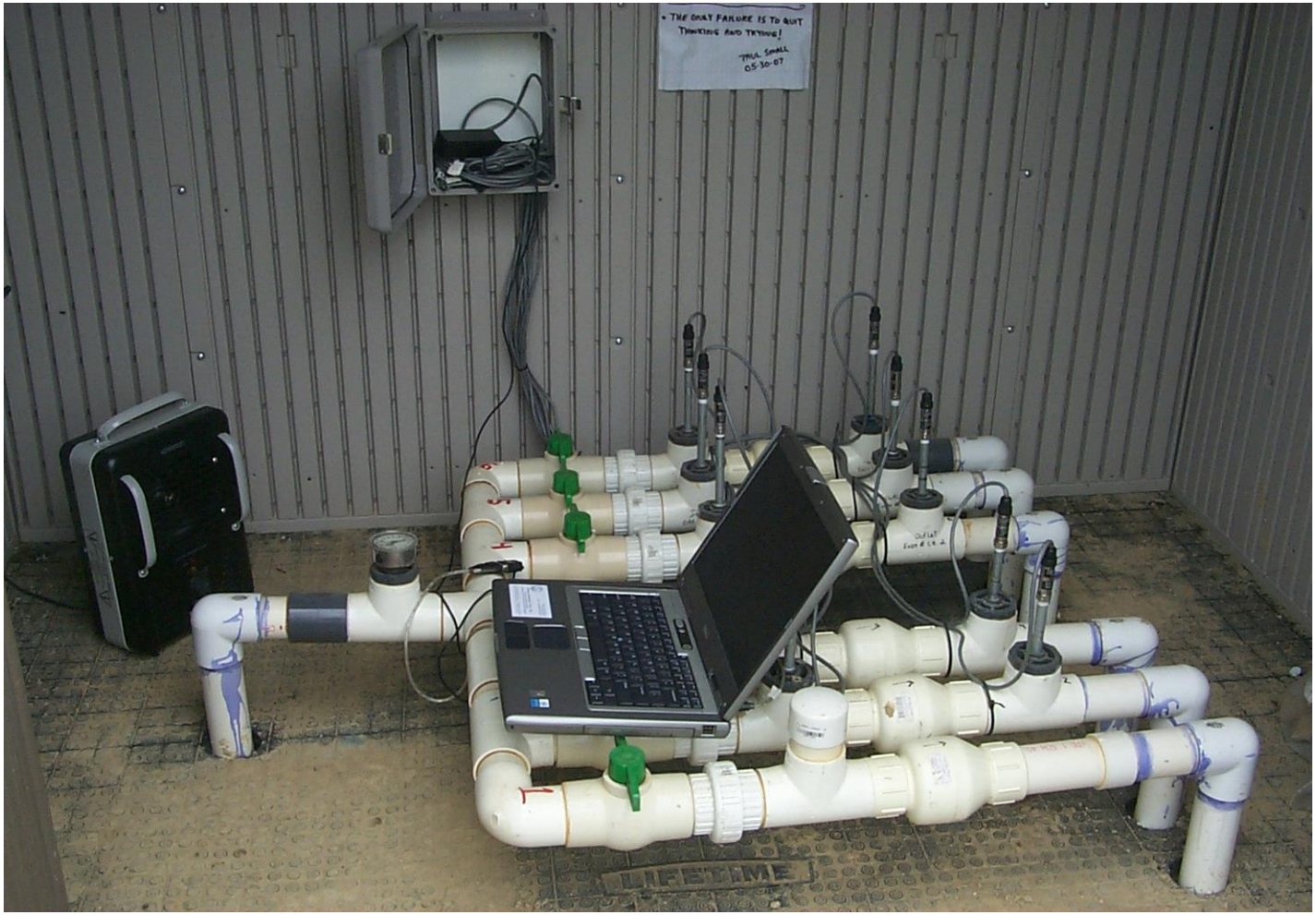
Soil Series = Lenoir

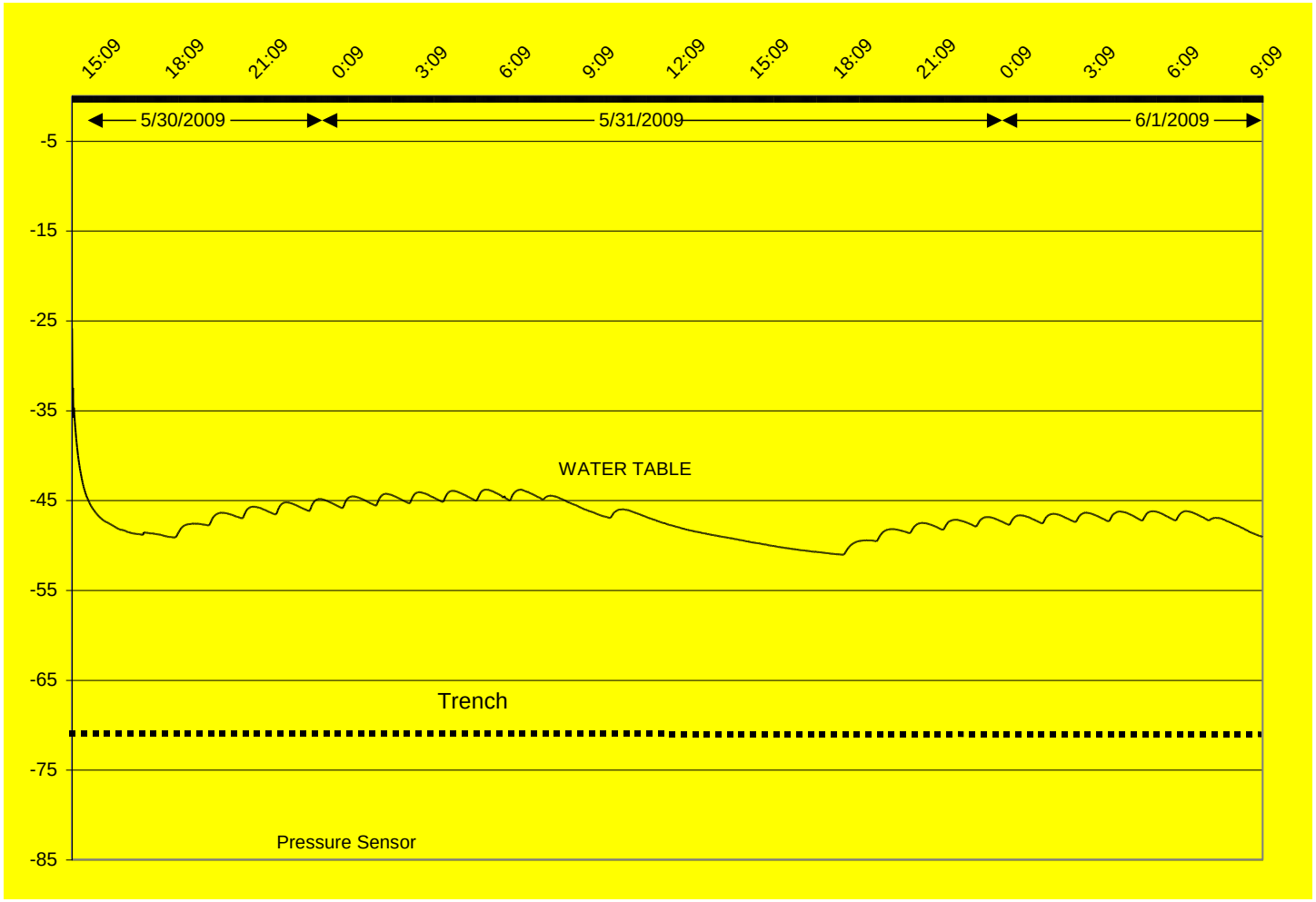
Sample ID and ~ Depth	%Sand	%Silt	%Clay	Texture	Bulk Density (g/cm3)	*PoreSpace*
#1 (60" Depth)	59%	12%	29%	SCL	1.39	*48%*
#2 (68" Depth)	57%	6%	37%	SC	1.35	*49%*
#3 (72" Depth)	37%	22%	41%	C	1.29	*51%*
					1.34	*49%*


Proposed
Trenches

Subsurface *"LBEDS"* working at the site:

Subsurface *"LBEDS"* installed at the site (2007)


• THE ONLY FAILURE IS TO QUIT
THINKING AND TRYING!
PAUL SMALL
05-30-07
LIFETIME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18:09
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5/30/2009
5/31/2009
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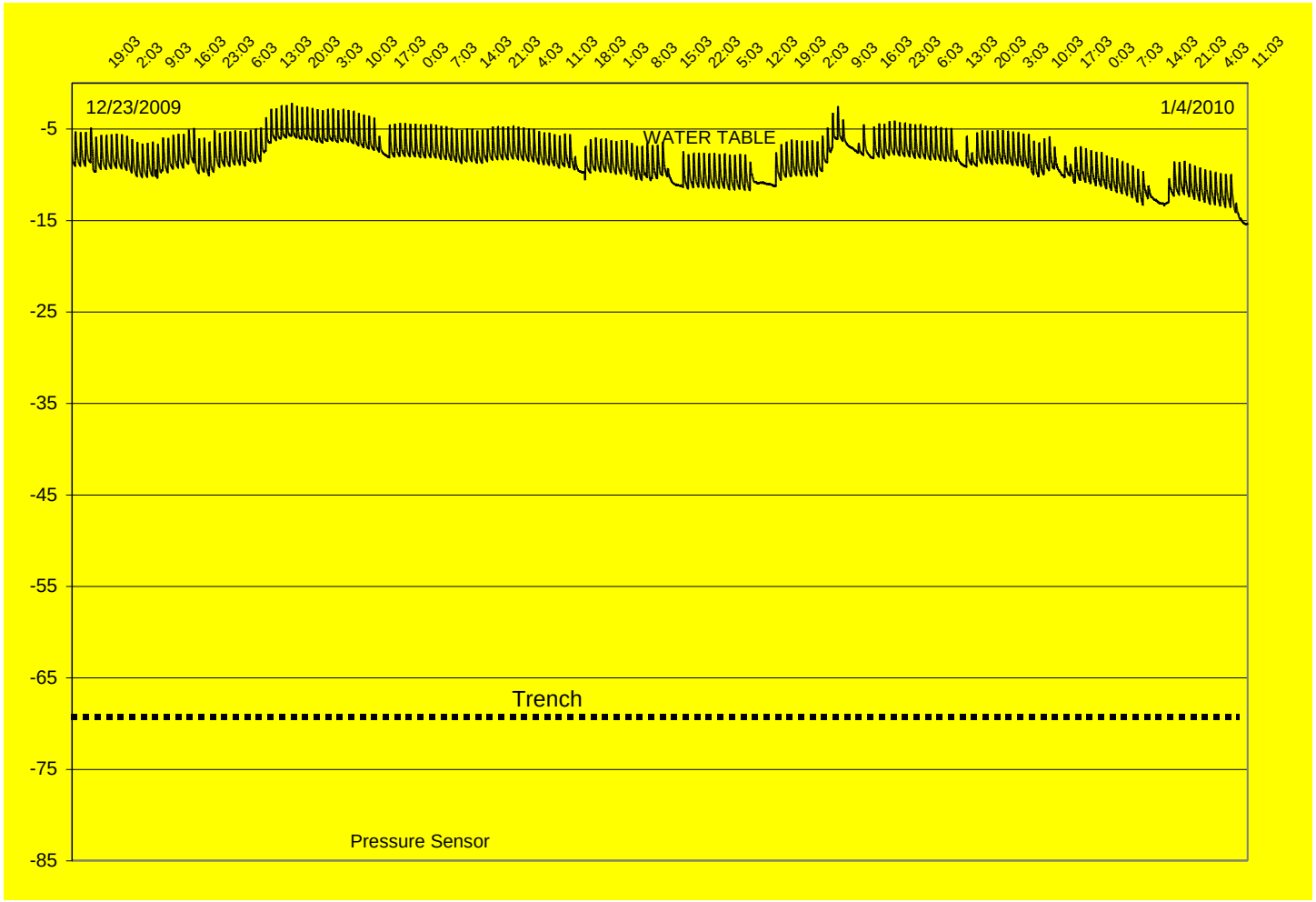
-5
-15
-25
-35
-45
-55
-65
-75
-85
WATER TABLE
Trench
Pressure Sensor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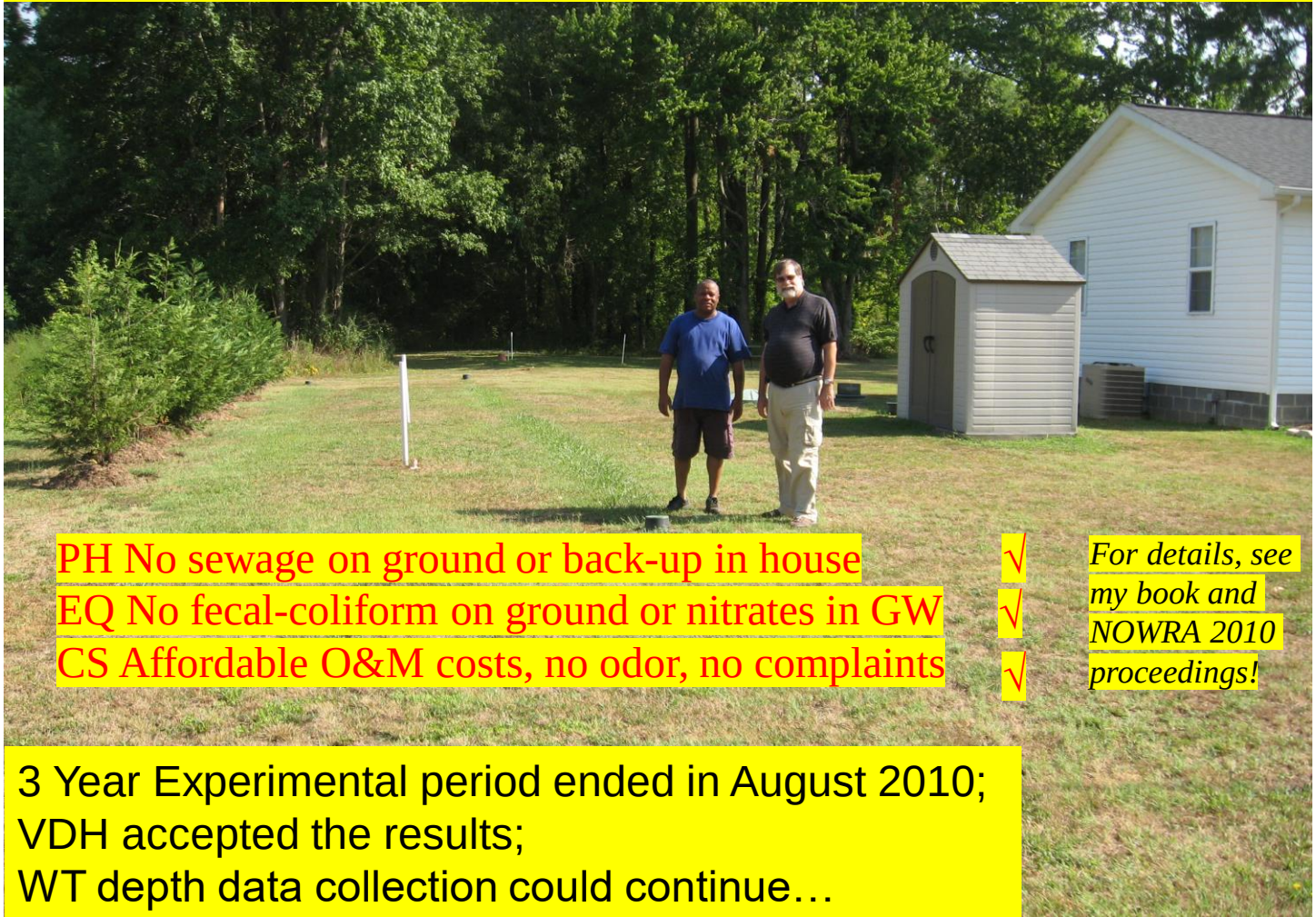
12/23/2009
1/4/2010
WATER TABLE
-5
-15
-25
-35
-45
-55
-65
-75
-85
Trench
Pressure Sensor

Happy homeowner and Chief Regulator… on the final inspection day..



PH No sewage on ground or back-up in house √

EQ No fecal-coliform on ground or nitrates in GW √

CS Affordable O&M costs, no odor, no complaints √

For details, see my book and NOWRA 2010 proceedings!

3 Year Experimental period ended in August 2010;
VDH accepted the results;
WT depth data collection could continue…


Site as of October 18, 2023 (>15 years in operation)

12VAC5-613-80. Performance requirements; general.

Table 1
Maximum Pressure-Dosed Trench Bottom Hydraulic Loading Rates

Percolation Rate (MPI)	Saturated hydraulic conductivity (cm/day)	TL-2 Effluent (gpd/sf)	TL-3 Effluent (gpd/sf)
≤15	> 17	1.8	3.0
15 to 25	15 to 17	1.4	2.0
>25 to 45	10 to < 15	1.2	1.5
>45 to 90	4 to < 10	0.8	1.0
>90	< 4	0.4	0.5

https://law.lis.virginia.gov/admincode/title12/agency5/chapter613/section80/

12VAC5-613-80. Performance requirements; general.

Table 2

Minimum Effluent Requirements for Vertical Separation to Limiting Features

Vertical Separation	Minimum Effluent Quality
≥18" (requires naturally occurring, undisturbed soils)	Septic
<18" to 12" (requires minimum 6" of naturally occurring, undisturbed soils)	TL-2
0" to <12"	TL-3 and standard disinfection*

*Note: Where direct dispersal of effluent to ground water occurs, effluent quality shall be governed by 12VAC5-613-90 C.

https://law.lis.virginia.gov/admincode/title12/agency5/chapter613/section90/

In Conclusion….

- Regulations for on-site systems are rapidly “evolving” in the 21st Century and catching-up with the technology and knowledge developed in the late 20th Century;
- Experimental and demonstration projects done in Virginia within the regulatory constraints set the stage up to support their current “Regulations for Alternative Onsite Sewage Systems”;
- Next step for the on-site industry professionals is to work on similar projects related to **On-Site Wastewater Reuse**;
- Wastewater reuse technologies are available, however more research is needed to evaluate their performance in real-world;
- Texas on-site industry has started that work!

Q & A + Discussion

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