Direct Soil Depressurization Mitigation

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- Slides are available WPB-Radon website

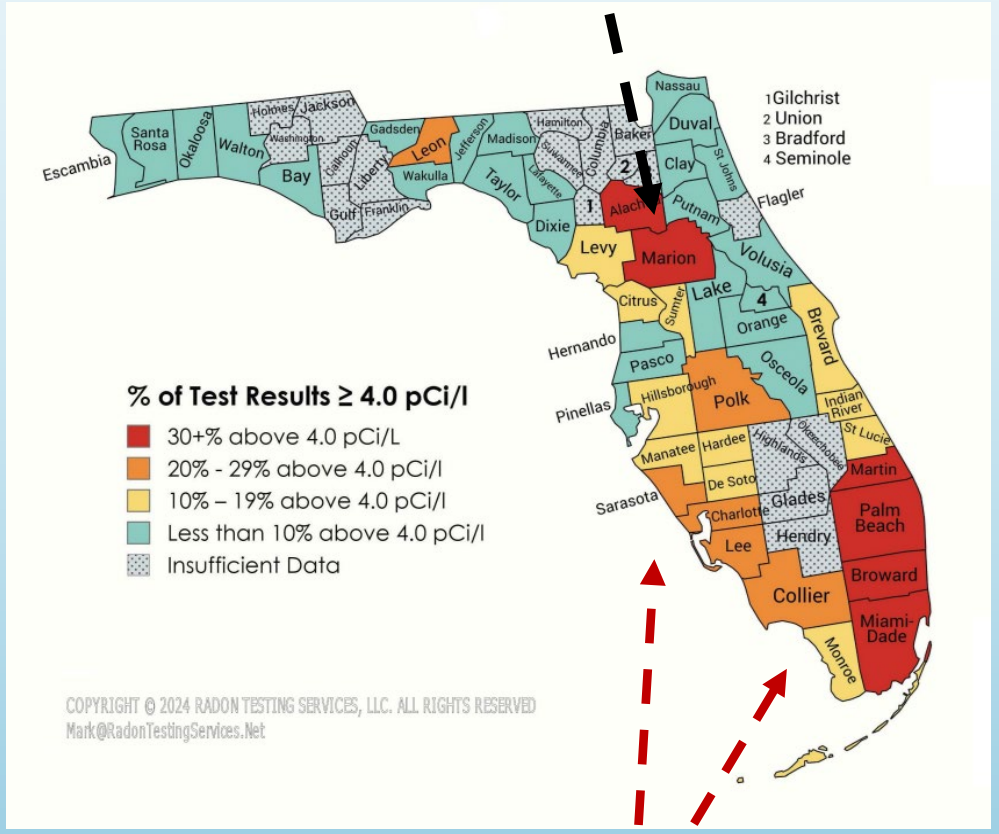


Project was a
Double-Wide Mobile Home
with a vented Crawl Space



Crawl Space Vents all around the home

Home is located in Marion County, below Ocala, Florida



30% of homes above 4.0 in red zones

Pre-Mitigation
Radon Test Results
December 2025

Vented Crawl Space average = 21.8 pCi/L

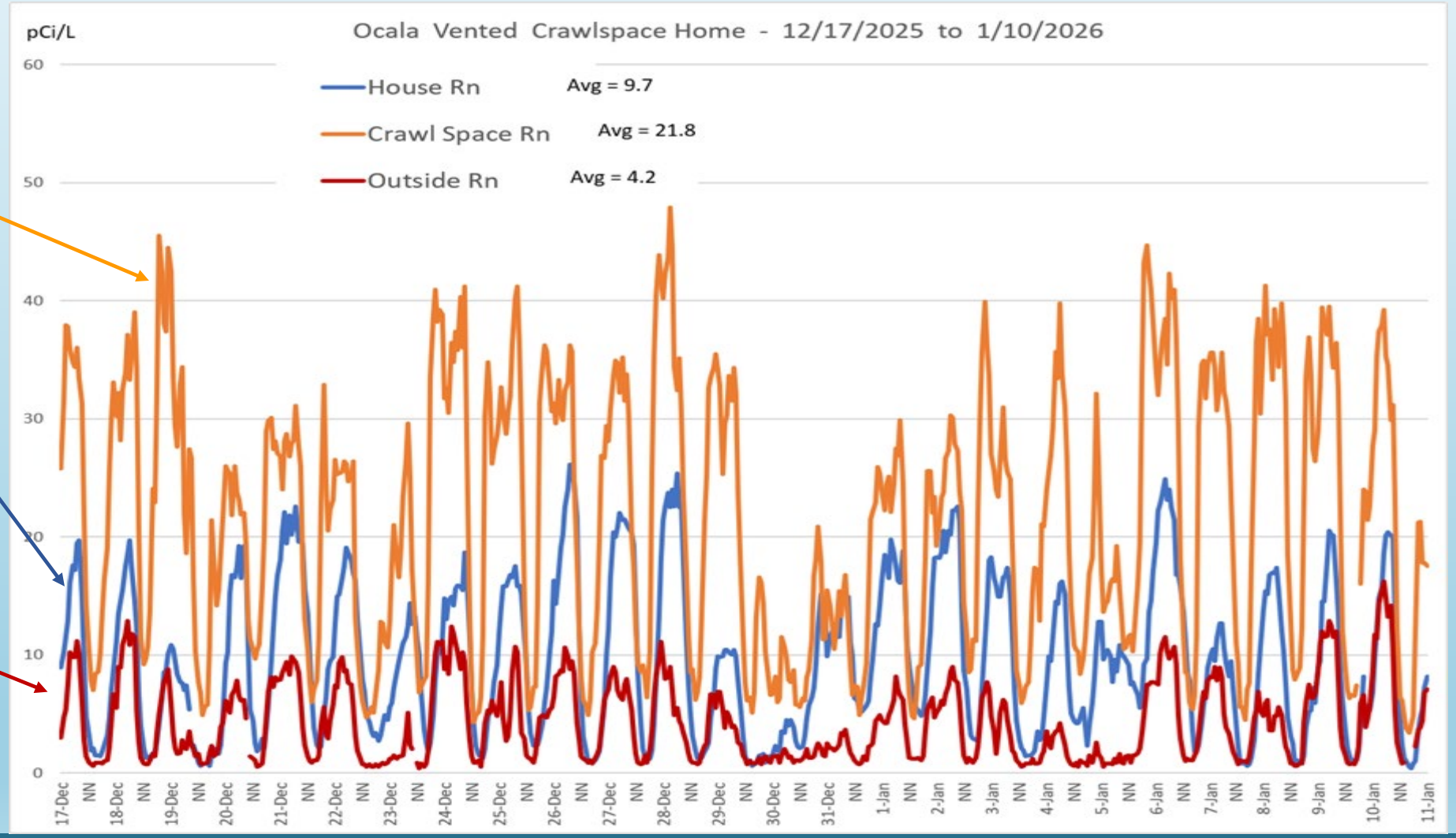
House inside average = 9.7 pCi/L

Outside average = 4.2 pCi/L

Vented Crawl Space Peaks at 40 pCi/L

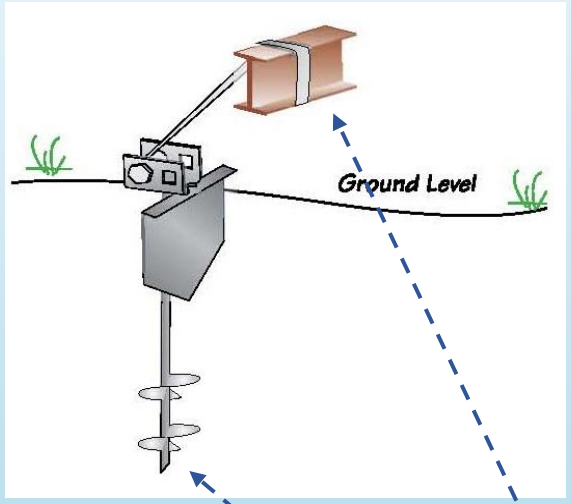
House radon one-half of crawl space radon

Outdoor radon peaks at 10 pCi/L



Any wind drives radon levels lower

Manufactured Homes in Florida are resting on multiple piers

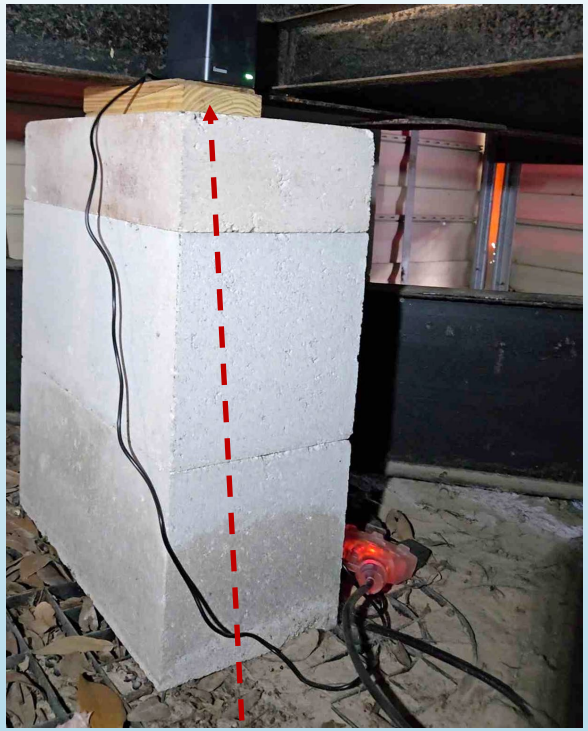


Threaded rods are drilled into the sand

Rods are attached to steel beams on the ground and routed to house steel joists



Concrete blocks are dry stacked on plastic grids laid on the sand.



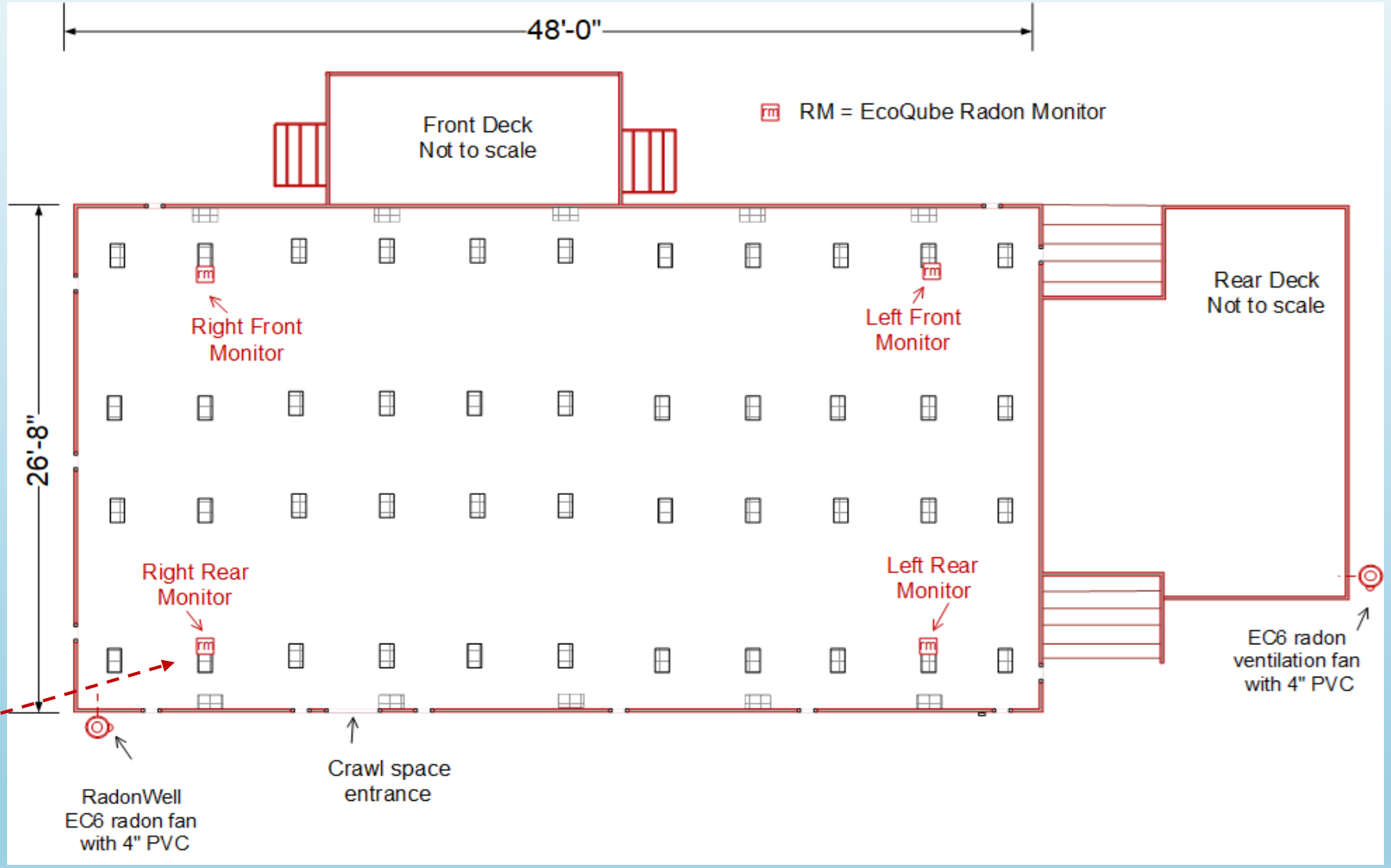
Wood plates and house steel joists rest on concrete piers

House dimensions were 48’0” by 26’8”

There are over 50 concrete piers in this crawl space!

Each corner had a hurricane metal anchoring system

Continuous radon monitor in each corner of the crawl space



Typical Crawl Space Membrane Depressurization was not practical

Steel beams on the sand and metal bracing on each corner

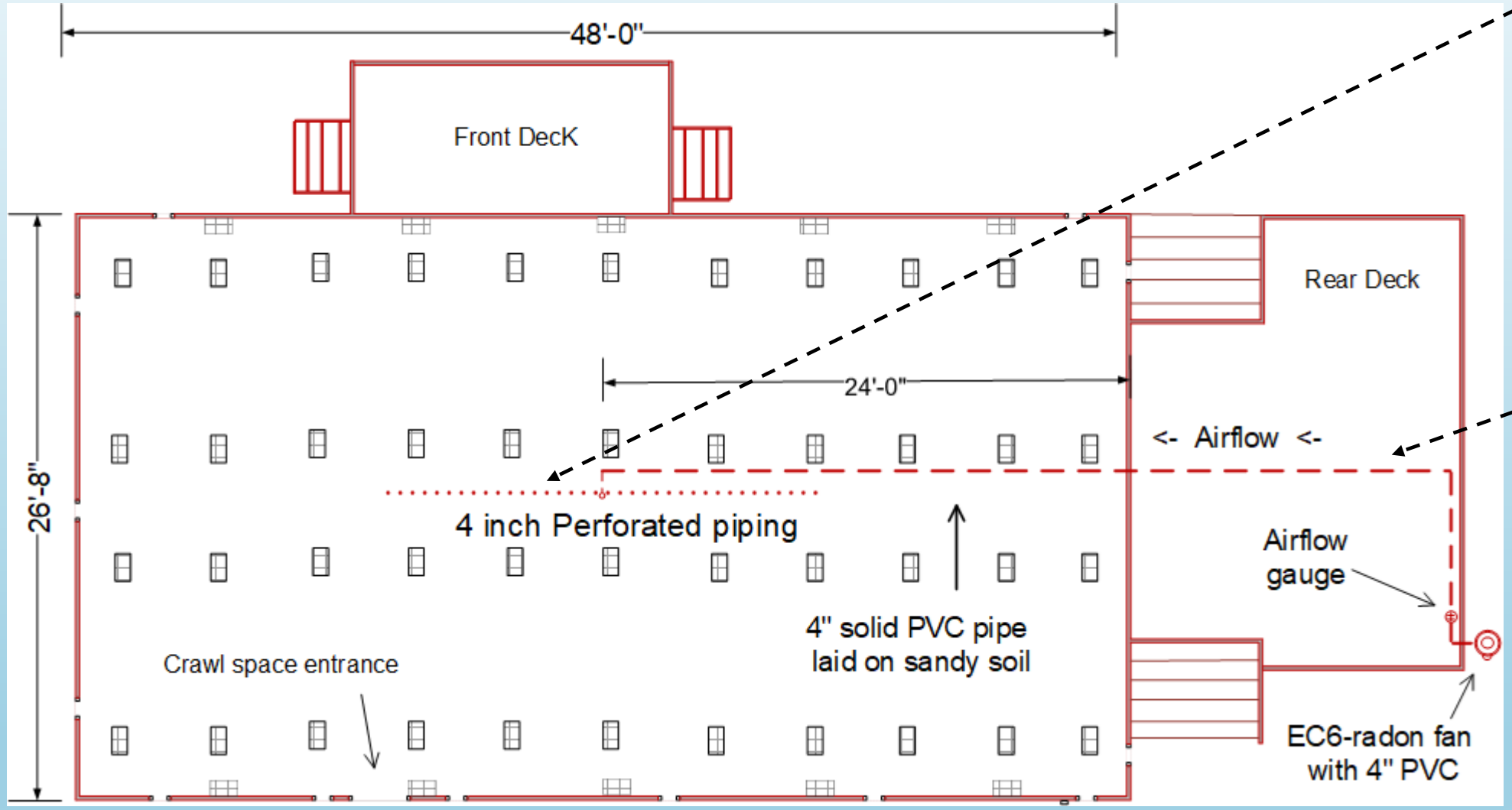


Over fifty concrete piers



First mitigation method - Positive Ventilation

Positive Ventilation was supplied to center of Crawl Space



Perforated PVC pipes distributed air in center of crawl space

Solid PVC pipes routed to center of crawl space

Adjustable EC6 fan was blowing air into the crawl space

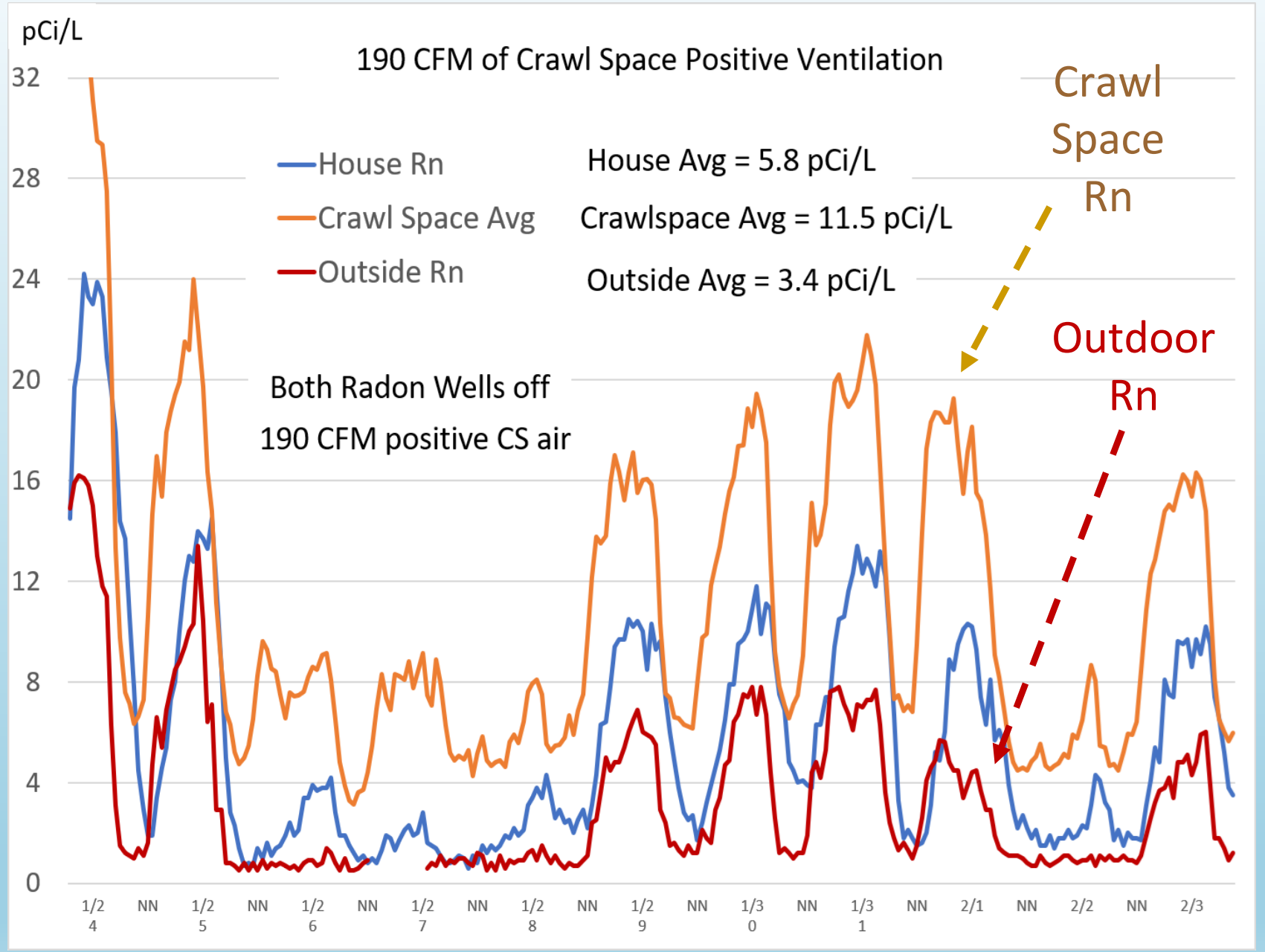
Ventilation Test Results

EC6 fan provided
190 CFM
at maximum speed

Note:
Positive CS Ventilation is only practical in very southern states

Crawl space radon
(11.5 pCi/L)
was reduced by half.

50% lower radon
was not acceptable



It was not practical to install a traditional Sub-Membrane Depressurization system



RadonWell® (RW) Direct Soil Depressurization was the practical choice.

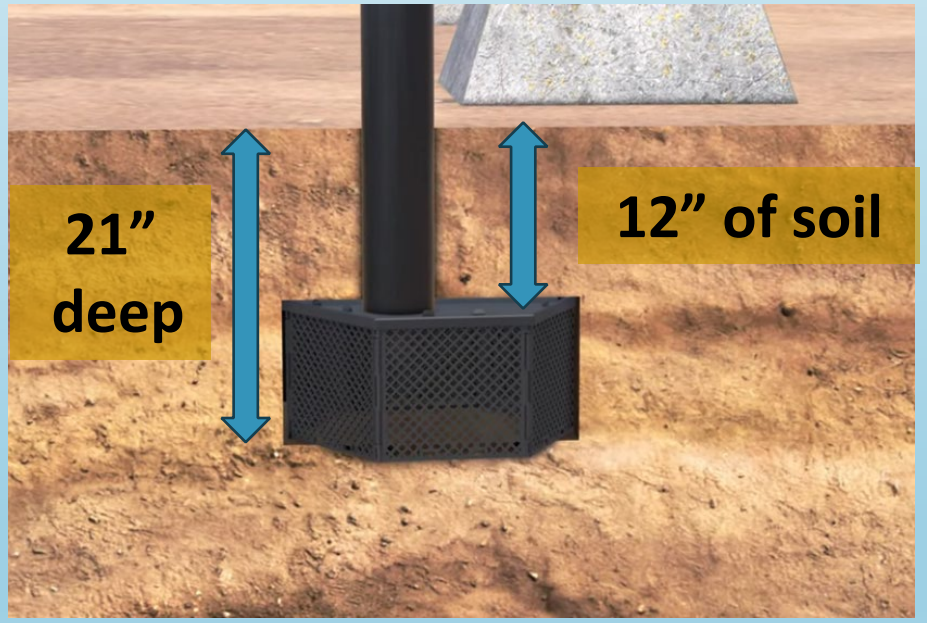
Two separate RadonWell pits were installed



1st Pit
Single-height RW
21 inches deep

2nd Pit
Double-height (stacked) RW
30 inches deep

Each had 12” of soil on top with a surface concrete cap



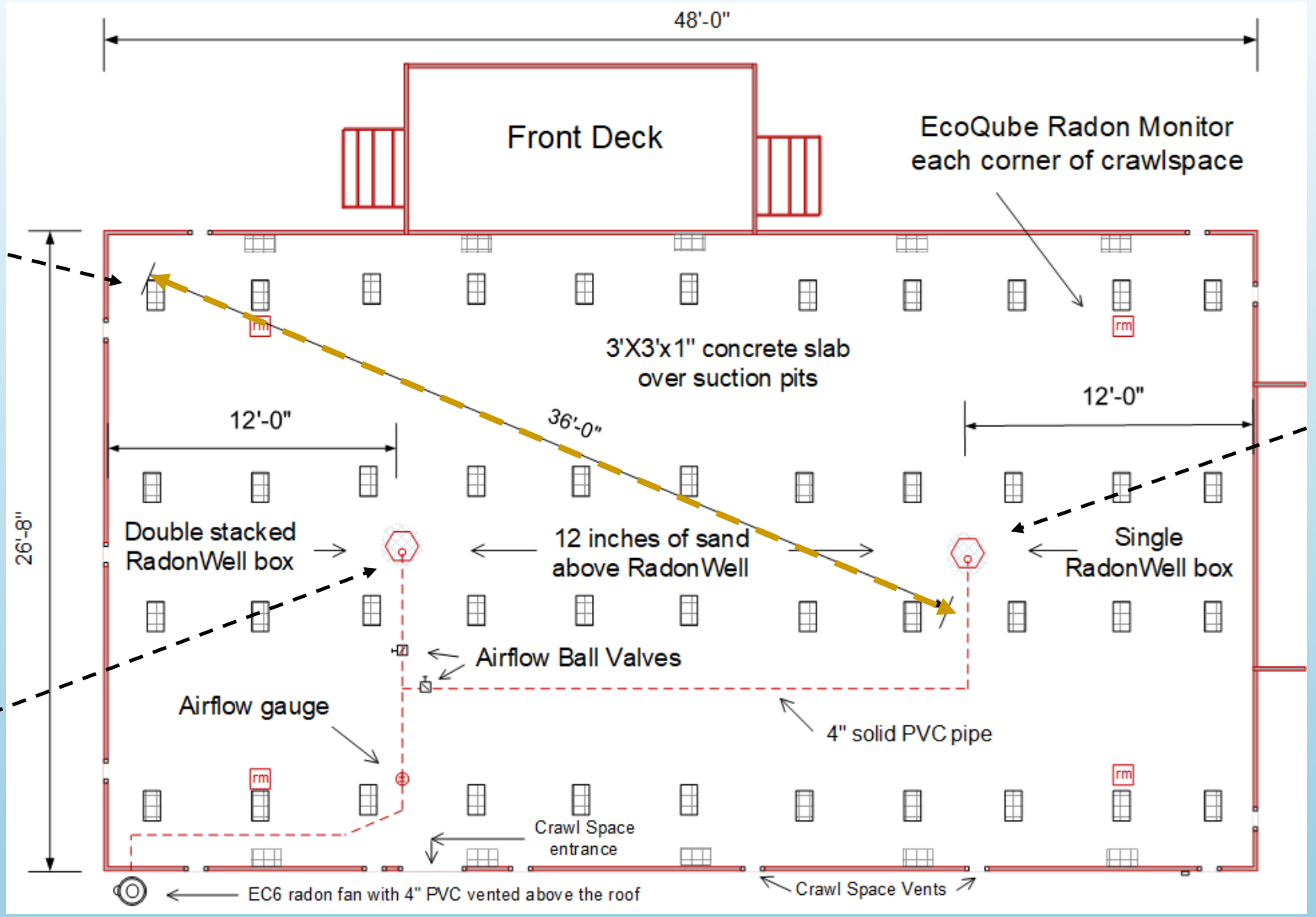
Orientation is from the front of the home

Right Front

Left Front

Maximum PFE to each far corner was about 36 feet

A double or stacked RadonWell® installed on Right side



Single RadonWell® Installed on Left side

12 inches of sand & concrete cap above each RadonWell

Right Rear

Left Rear

RadonWell Installation Video

Outer temporary 8-sided basket used to hold dug sand back

6-sided RadonWell® wrapped in geotextile fabric and backfilled with gravel

3 or 4 inch PVC pipe routed into the RW

12 inches of sand compacted on top of RW and then capped with a 1” concrete slab

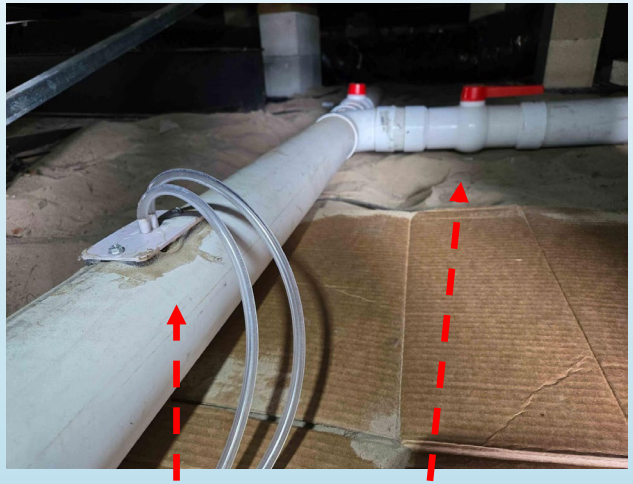


Next, a one minute video of the RadonWell® single basket.

RADON SYSTEM COMPONENTS

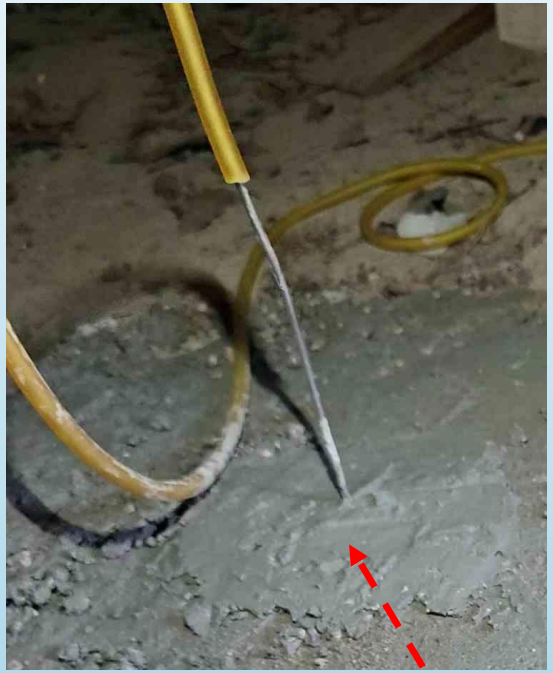


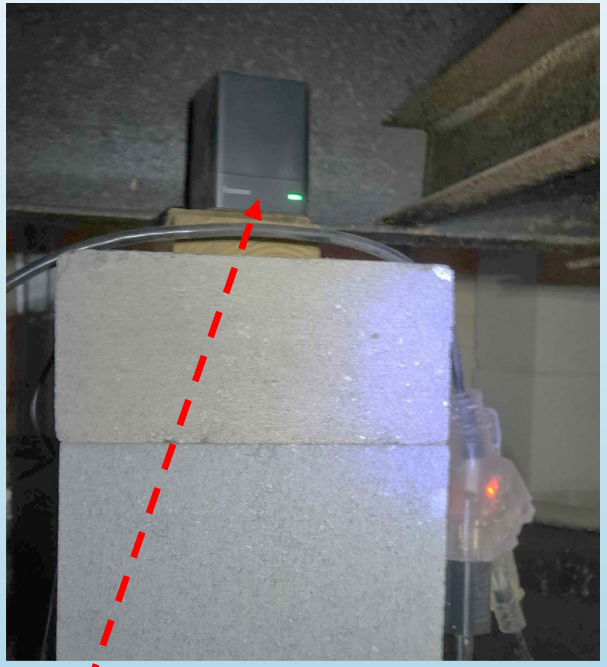
Adjustable EC6
Radon Fan &
Pressure gauge



Airflow gauge

Two ball valves
control airflow
to single & stacked
RadonWell®





All four corners of the crawlspace
had a soil pressure probe
and a radon monitor

Wind affect

Any Wind reduces radon in three locations

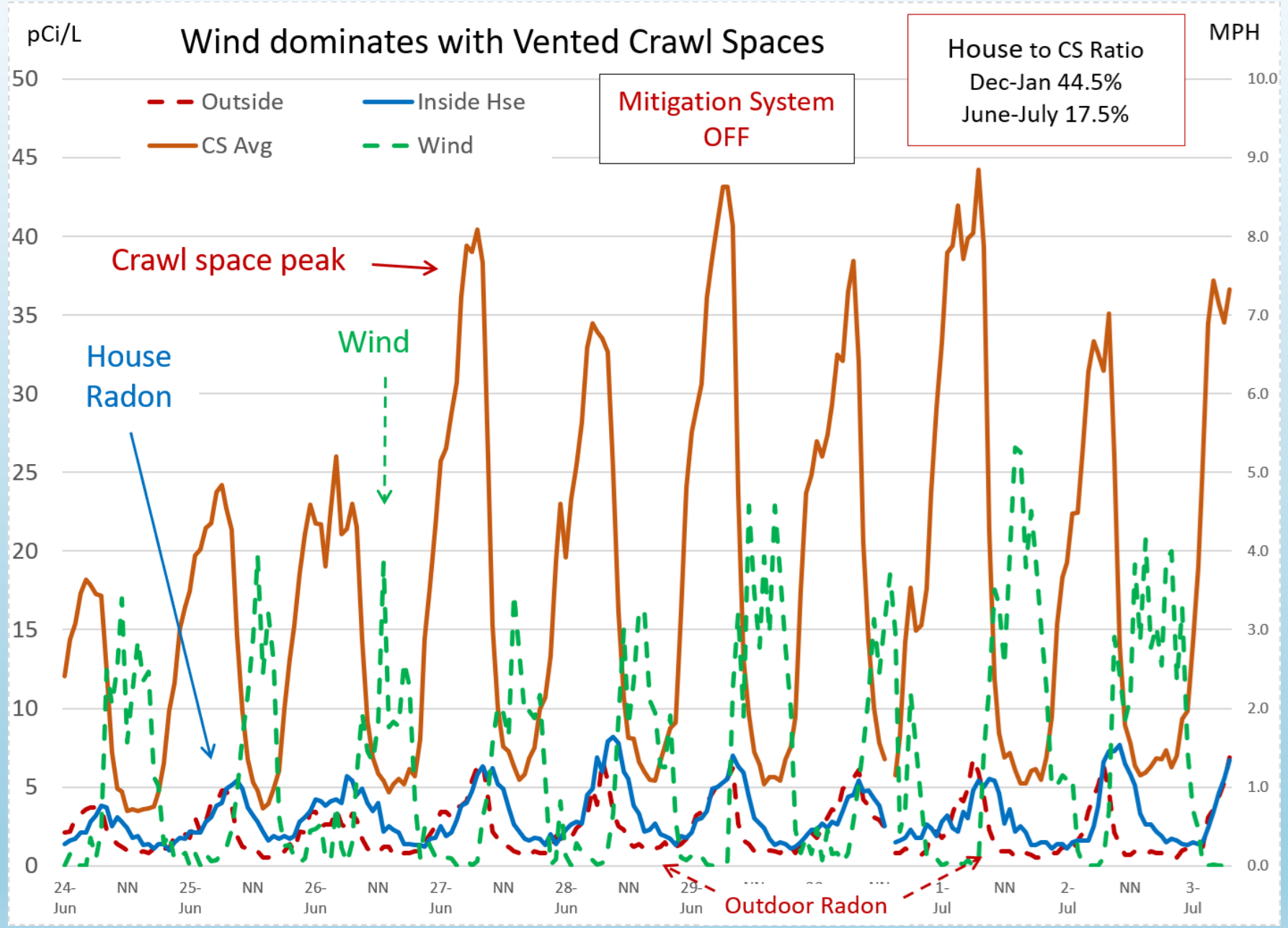
Outside

Crawl space

Inside home

Crawl space radon not house radon was used to evaluate RW

Outdoor radon was subtracted from crawl-space radon to determine RW performance

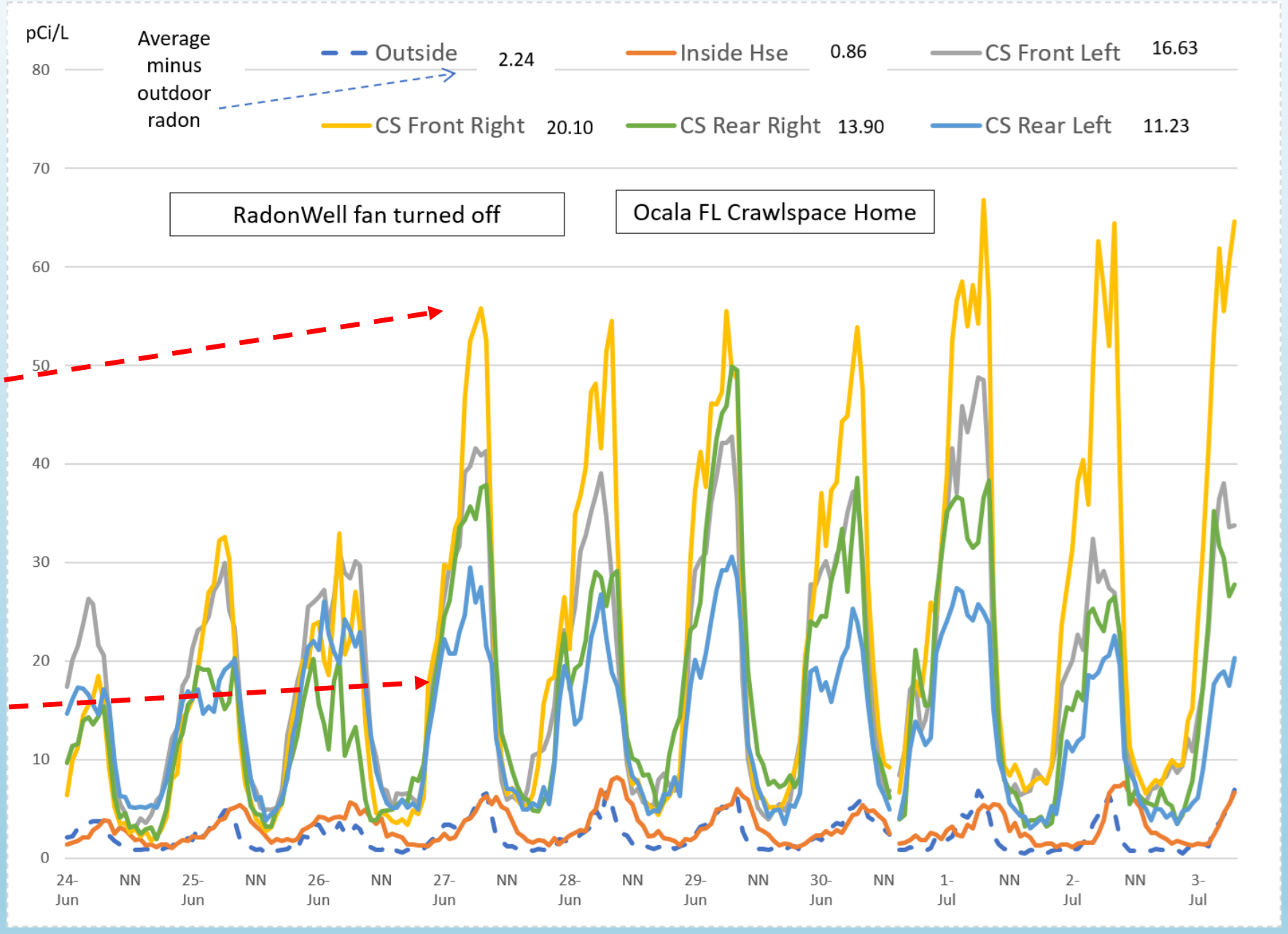


Radon variation at crawl space corners

RW system is off

Front corner near stacked Radonwell® had highest radon average 20.1 pCi/L

Rear corner near single RadonWell® had lowest radon average 11.2 pCi/L

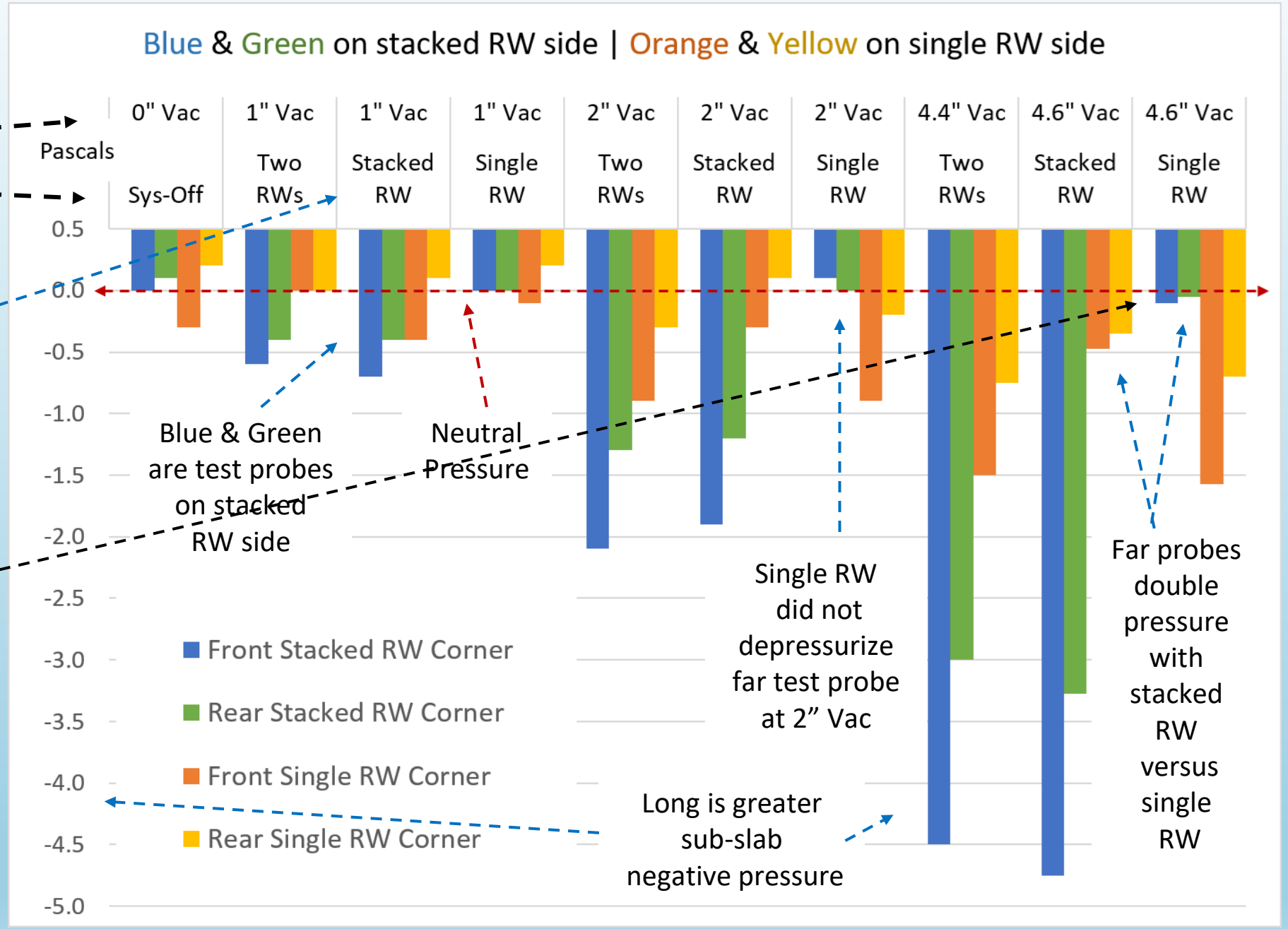


Sub-slab pressures at each corner as vacuum & valves adjusted

Stacked RadonWell® had double sub-slab negative pressure of single RadonWell

Single RadonWell® only depressurized far test holes (36 ft away) at maximum 4.6” fan vacuum

Airflow ranged from 3 CFM to 24 CFM



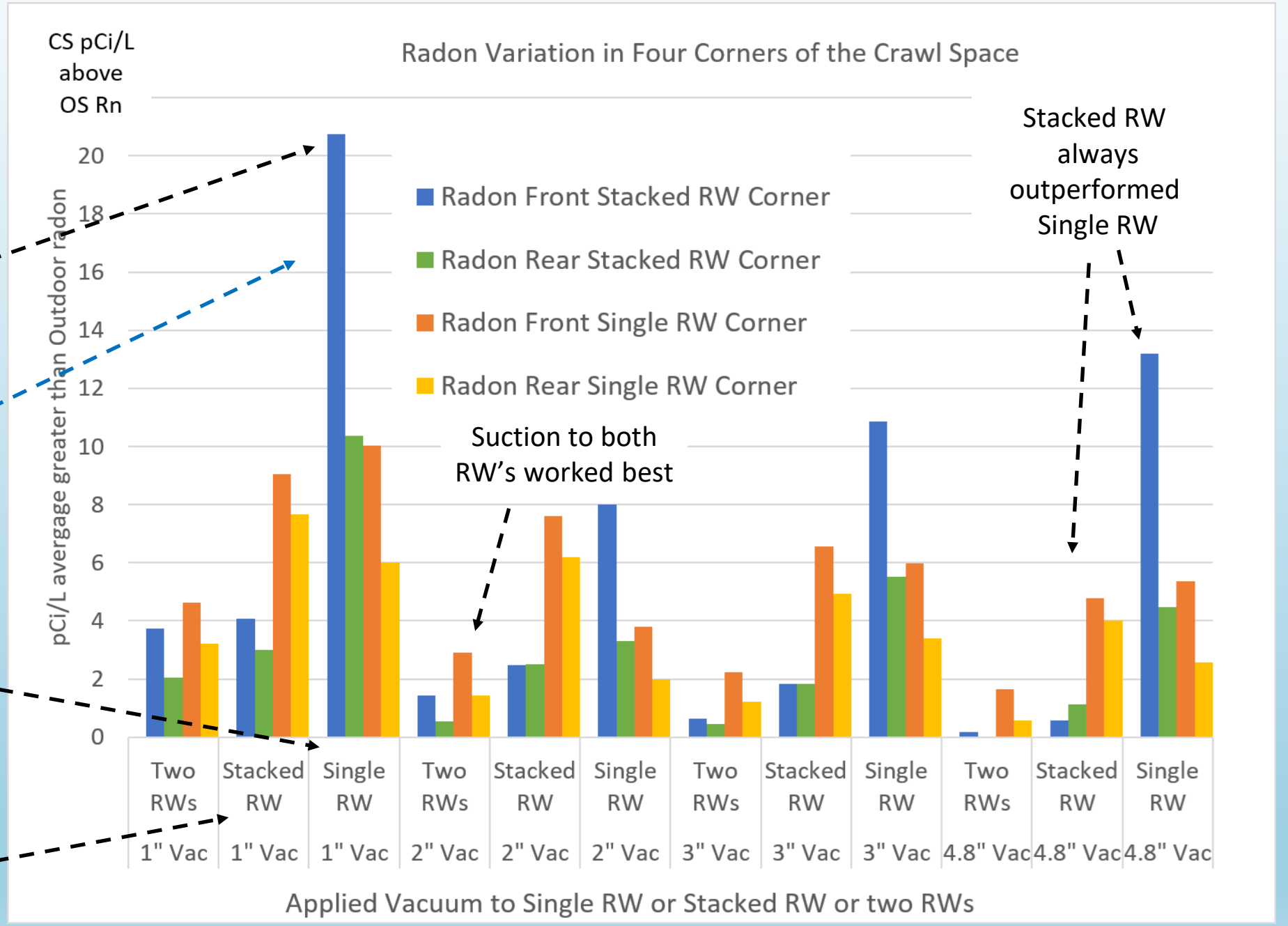
Week-long average radon levels greater than outdoor radon with increasing Sys Vac

Higher bar equals worse performance

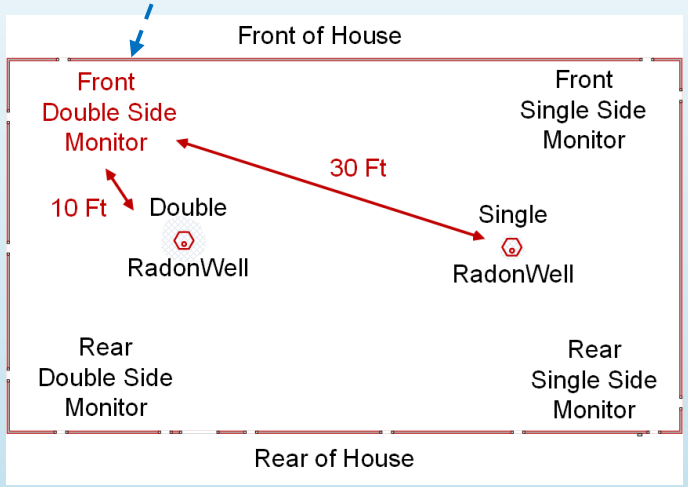
Front corner (Blue) near stacked RW always had highest Radon

Single RW – CS avg
11.8 pCi/L at 1” vac
6.4 pCi/L at 3” vac

Stacked RW – CS avg
6.0 pCi/L at 1” vac
3.8 pCi/L at 3” vac

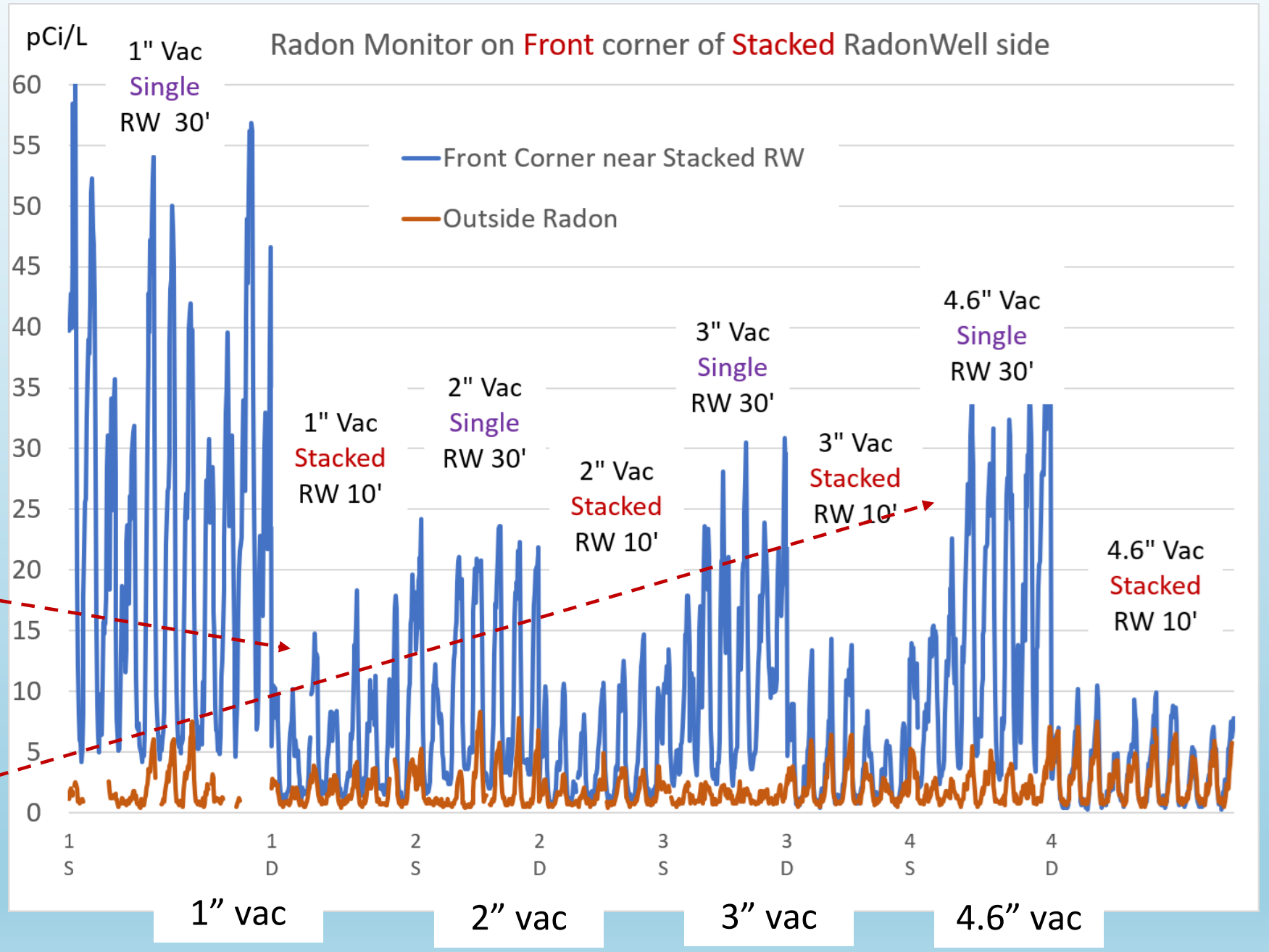


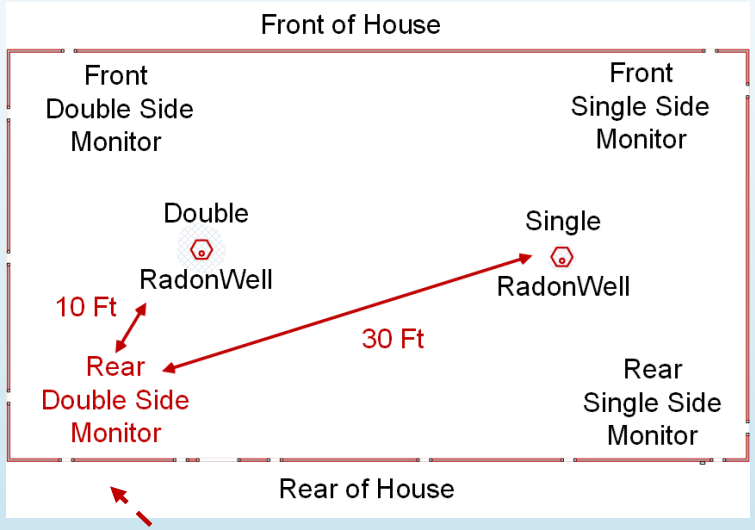
Front corner radon always highest radon



1” vacuum applied to Stack RW - 10 feet away reduced radon

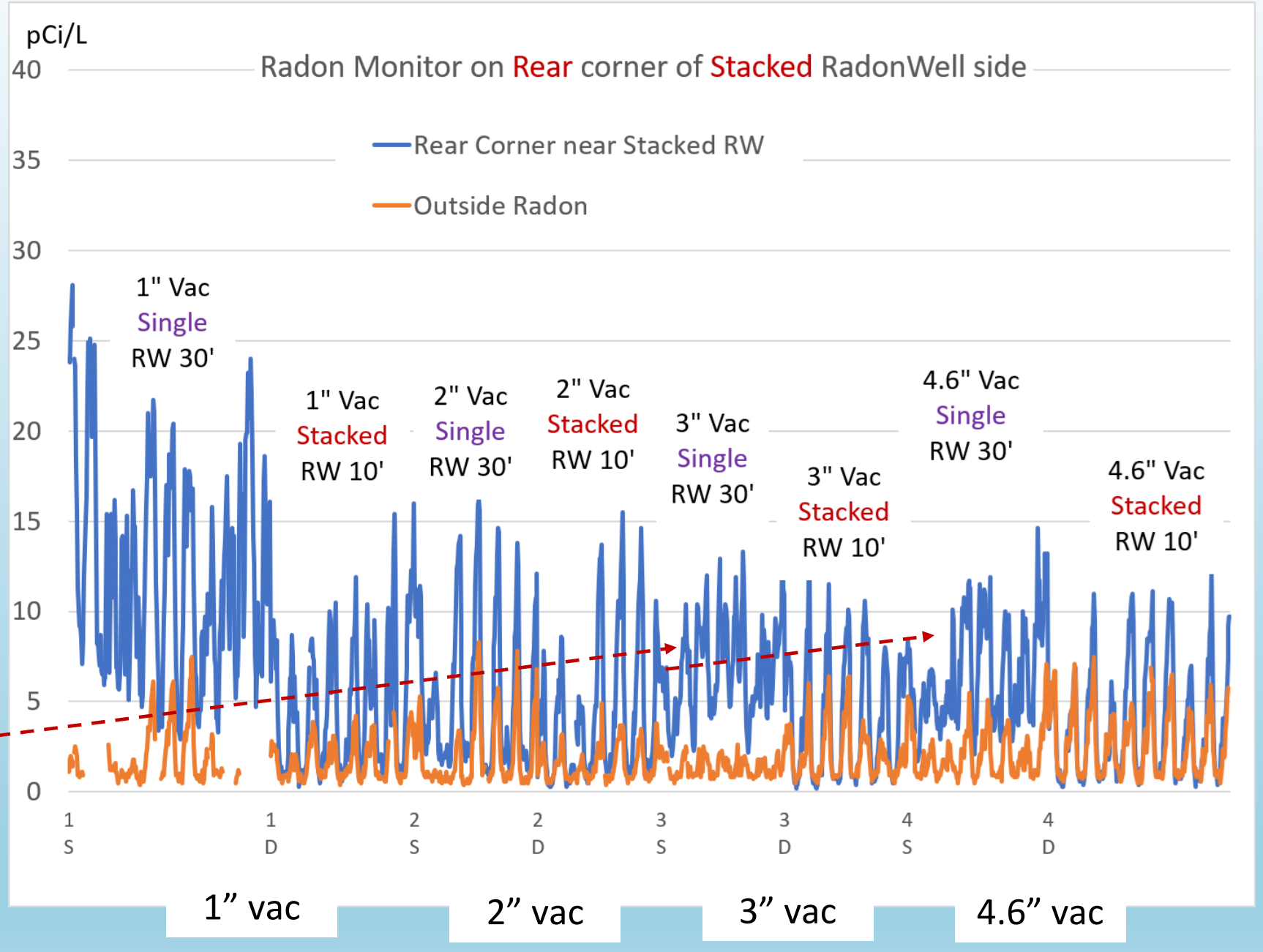
4.6” vacuum applied to Single RW - Cut radon levels in half 30 feet away



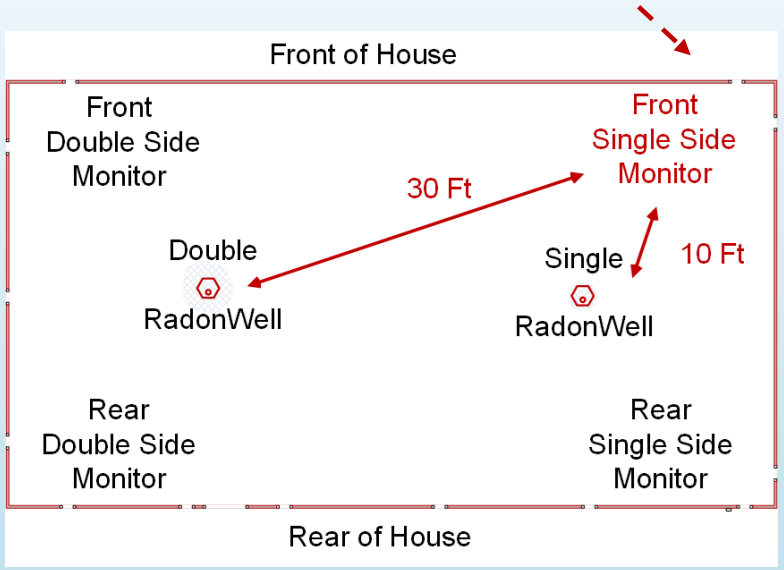


Rear corner radon levels

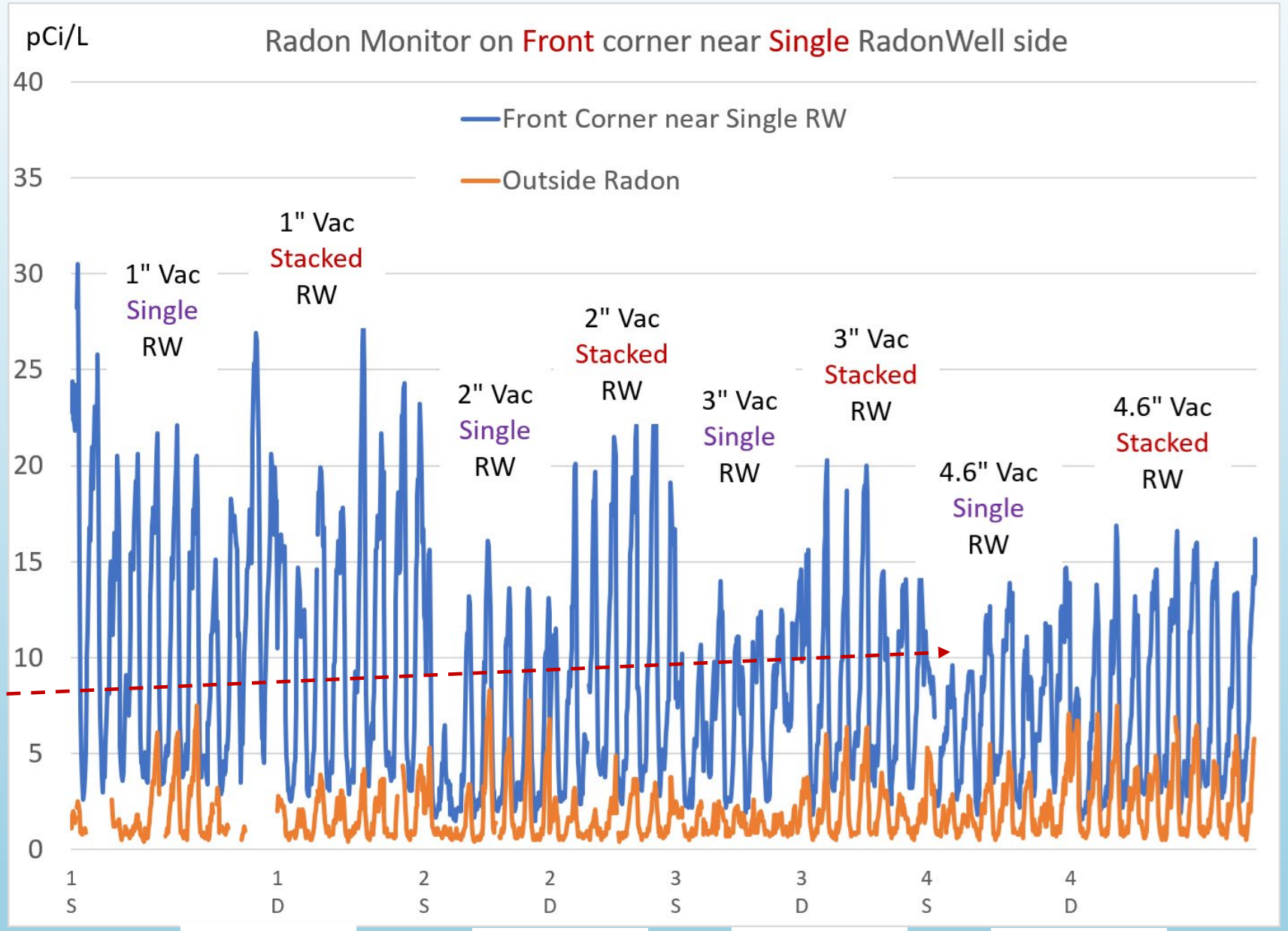
Single RW
30 feet away
with 3” to 4.6” of vacuum
Reduced radon by about 75%



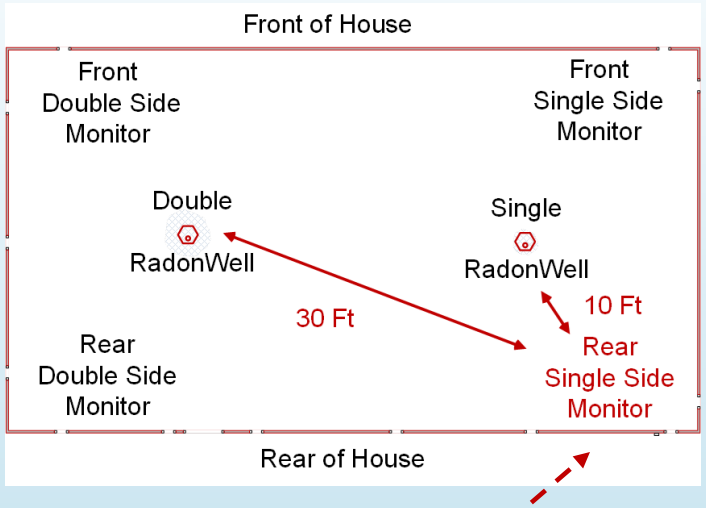
Front corner radon levels



Vacuum from
stacked RW - 30 ft away
performed almost as well
as single RW
only 10 feet away



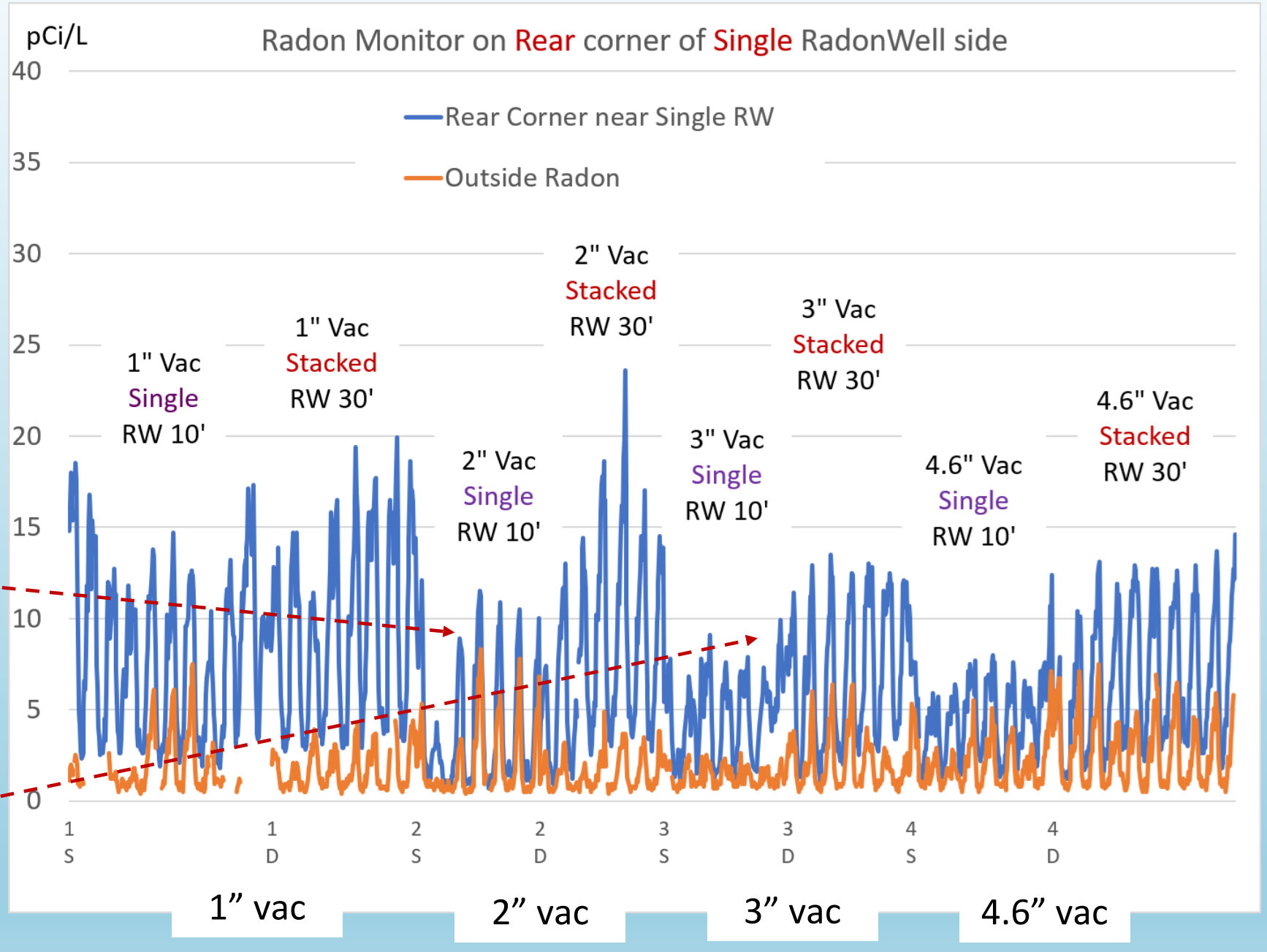
1” vac | 2” vac | 3” vac | 4.6” vac



Rear corner radon levels

Only 2” vac needed from single RW 10 ft away for good performance.

3” vacuum needed from stacked RW 30 ft away for best performance.



Caution: Results of RadonWell® performance are for Sandy Soil

This is CC1000 classification of soil Permeability

Comparisons for Hydraulic Conductivity of Natural Soils and Aggregates

Note—Grey background indicate materials not considered gas permeable

Range of Hydraulic Conductivity of Natural Soils			
USCS class	Soil Type	Hydraulic Conductivity Range gallons per day/ft²	Permeability description
GP	Uniform gravel	4,000 to 20,000	High
GW	Well-graded gravel	1,000 to 6,000	Moderate to high
SP	Uniform sand	100 to 4,000	Moderate to high
SW	Well-graded sand	20 to 2,000	Low to moderate
SM	Silty sand	20 to 100	Low
SC	Clayey sand	20 to 20	Low to very low
ML	Silt	1 to 2	Very low
CL	Clay	0.02 to 0.2	Very low to impermeable

Soil at Test House is listed as Arredondo Sand

Arredondo Hydraulic conductivity ranges from 900 to 3000 gallons/day/ft2

Conclusions from Direct Soil Depressurization (DSD) Study

- Florida homes built over a vented crawl space can still have elevated radon
- 190 CFM of crawlspace ventilation reduced CS radon levels by about half
- Direct Soil Ventilation is a viable choice for crawl space homes in Florida
- Deeper Suction Pit with stacked RadonWell® made a significant improvement
- Distance from the suction pit to the corners of the crawl space need to be minimized
- Stronger Vacuum Fans or multiple suction pits improve performance
- Airflow was less than 25 CFM even with two pits at 4.8 inch vacuum.
- These study results are based on permeable sandy soil.

Slides or other papers are available at WPB-Radon.com website

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