Air, Noise, and Light Monitoring Results For Horizontal Gas Well Drilling Operations

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Questions to be Addressed

Are well location restrictions regarding occupied dwelling structures inadequate or otherwise require alteration?

Are further regulations necessary for air pollution occurring from well sites, to address the possible health impacts, the need for air quality inspections during drilling, the need for inspections of compressors, pits and impoundments, and any other potential air quality impacts that could be generated from this type of drilling activity that could harm human health or the environment?

Setback

- From well pad center/not from roads
- Terrain Issues
- Meteorological Issues
- Toxicological Issues

Well Pad Center

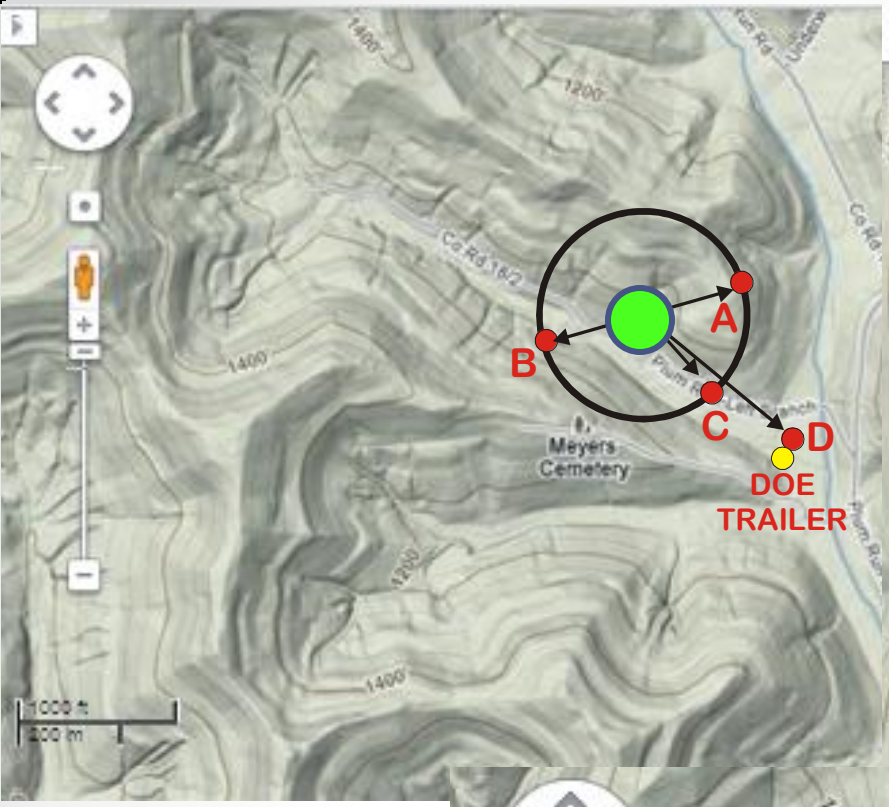
Maximum Noise Emission Levels as Required by EPA for In-Use Medium and Heavy Trucks with GVWR Over 4,525 Kilograms Engaged in Interstate Commerce(40CFR202)

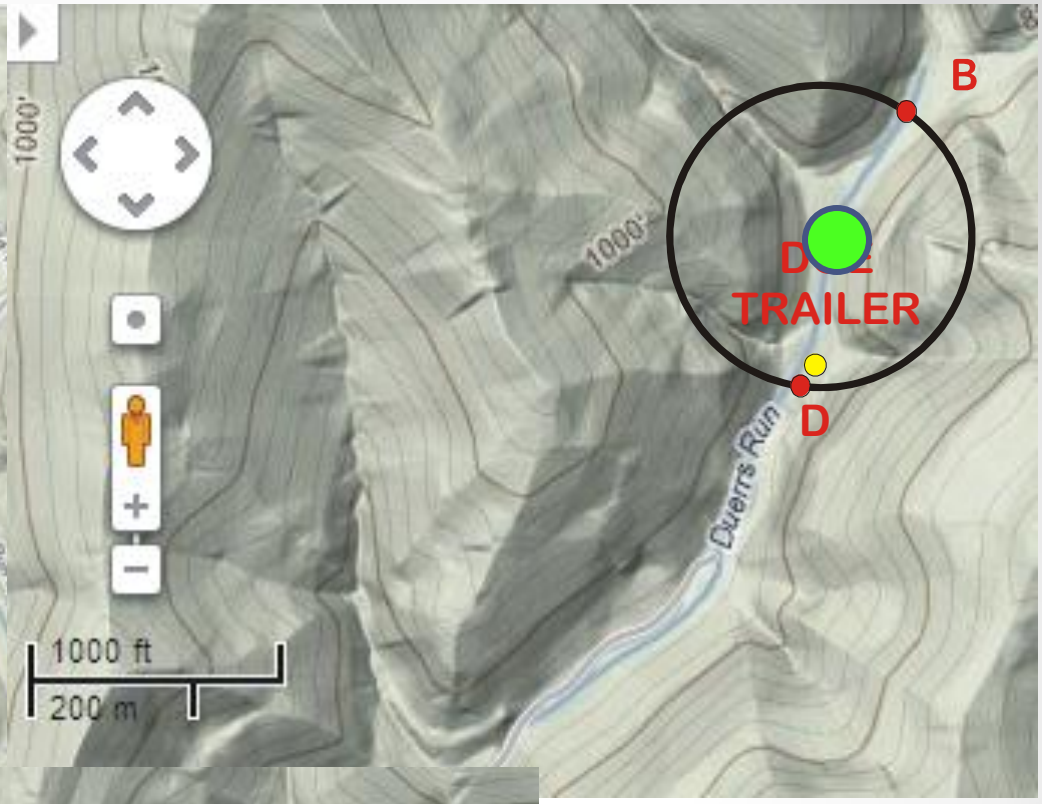
Speed	Maximum Noise Level 15 Meters from Centerline of Travel
< 56 kph	83 dBA
> 56 kph	87 dBA
Stationary	85 dBA

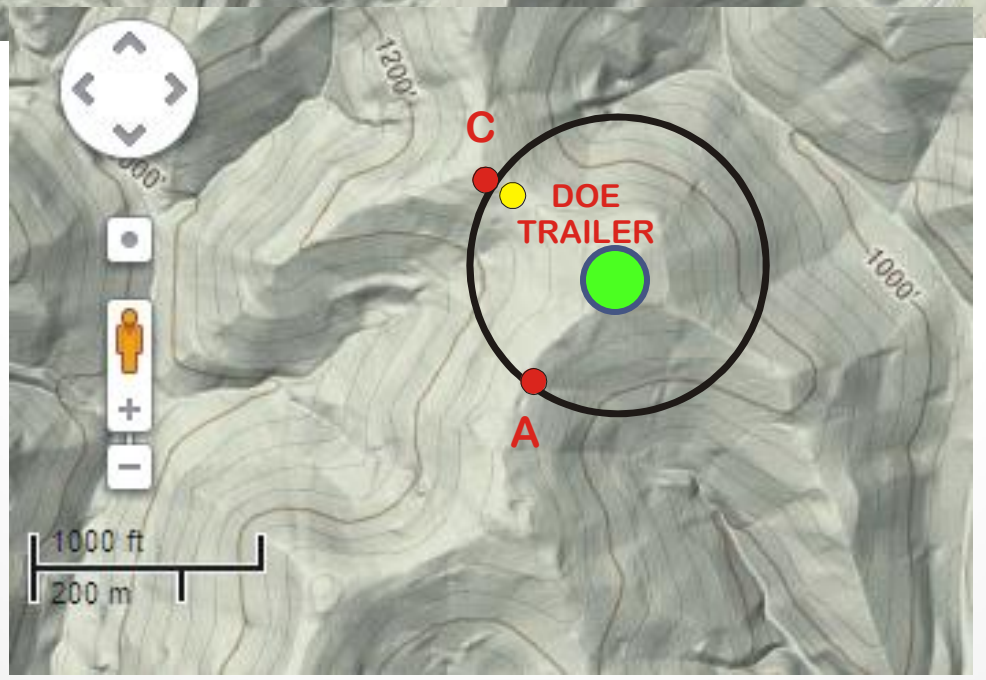
ACTIVITY AT 625 FEET FROM WELL CENTER


BOSTITCH
WAYNE W. SELL CORP
SARVER PA
TO-Can

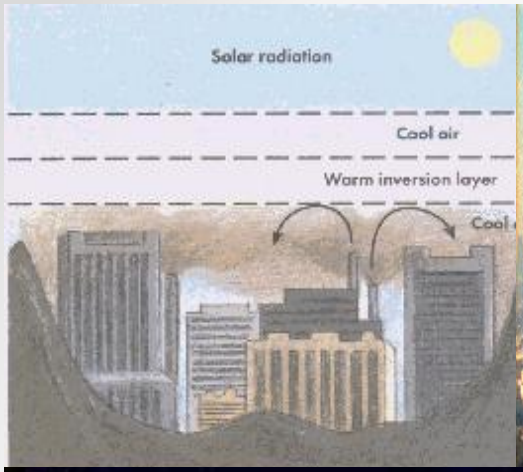
Terrain

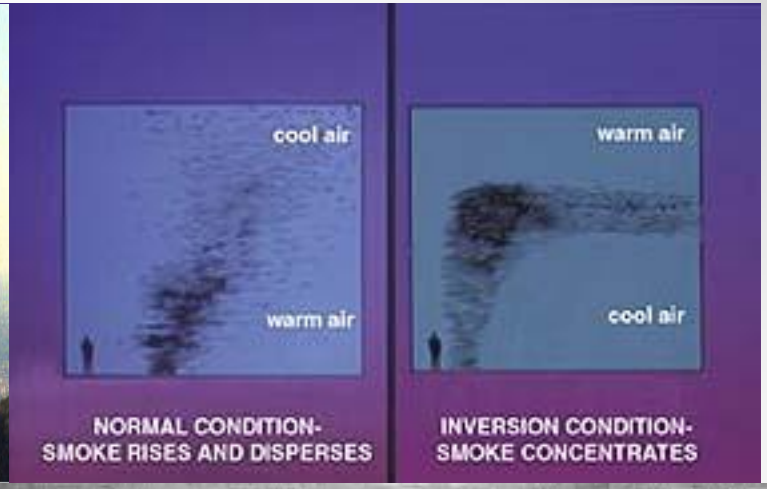

A
B
C
D
DOE
TRAILER
Meyers
Cemetery
1000 ft
200 m

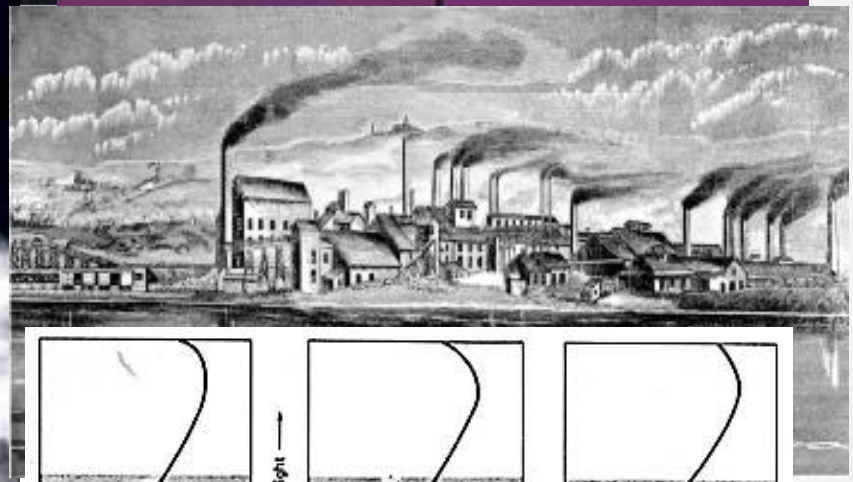

B
TRAILER
D
Queens Run
1000 ft
200 m

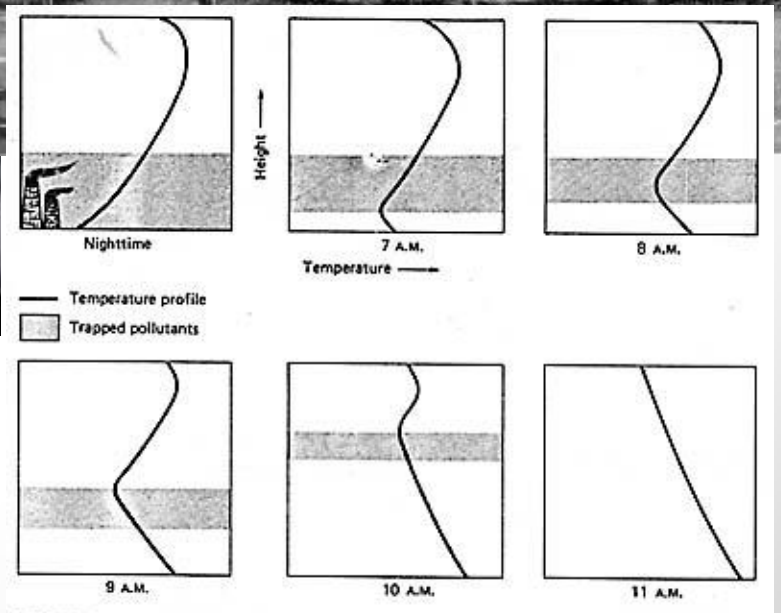

C
DOE
TRAILER
A
1000 ft
200 m

Meteorology


Solar radiation
Cool air
Warm inversion layer


cool air
warm air
warm air
cool air
NORMAL CONDITION-
SMOKE RISES AND DISPERSES
INVERSION CONDITION-
SMOKE CONCENTRATES




Nighttime
Height
7 A.M.
8 A.M.
Temperature
Temperature profile
Trapped pollutants
9 A.M.
10 A.M.
11 A.M.

Inversions

Toxicology

NAAQS

USEPA National Ambient Air Quality Standards

Pollutant		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide		primary	8-hour 1-hour	9 ppm 35 ppm	Not to be exceeded more than once per year
Lead		primary and secondary	Rolling 3 month average	0.15 μg/m^3	Not to be exceeded
Nitrogen Dioxide		primary	1-hour	100 ppb	98th percentile, **averaged over 3 years**
		primary and secondary	Annual	53 ppb	Annual Mean
Ozone		primary and secondary	8-hour	0.075 ppm	Annual fourth-highest daily maximum 8-hr concentration, **averaged over 3 years**
Particle Pollution	$PM_{2.5}$	primary	Annual	12 μg/m^3	annual mean, **averaged over 3 years**
		secondary	Annual	15 μg/m^3	annual mean, **averaged over 3 years**
		primary and secondary	24-hour	35 μg/m^3	98th percentile, **averaged over 3 years**
	PM_{10}	primary and secondary	24-hour	150 μg/m^3	Not to be exceeded more than once per year on average **over 3 years**
Sulfur Dioxide		primary	1-hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, **averaged over 3 years**
		secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

Minimal Risk Levels (MRLs) Used for HCs

- Developed by Agency for Toxic Substances and Disease Registry (ATSDR)
- Similar in value and use to RfCs
- Used as screening values to identify chemicals of potential health concern at hazardous waste sites
- Not intended as precise values above which adverse health effects will occur
- Indicates that further evaluation of the exposure scenario and potentially exposed population may be warranted
- The more often the MRL is exceeded and the greater the magnitude of the value by which the MRL is exceeded, the greater the likelihood that an adverse health outcome will occur
- Three distinct exposure scenarios: acute (14 days or less), intermediate (15-364 days), and chronic (365 days or more)
- Development process entails internal peer review, external peer review, and an opportunity for public comment

HAZARD QUOTIENT = EXPOSURE/MRL

Monitoring

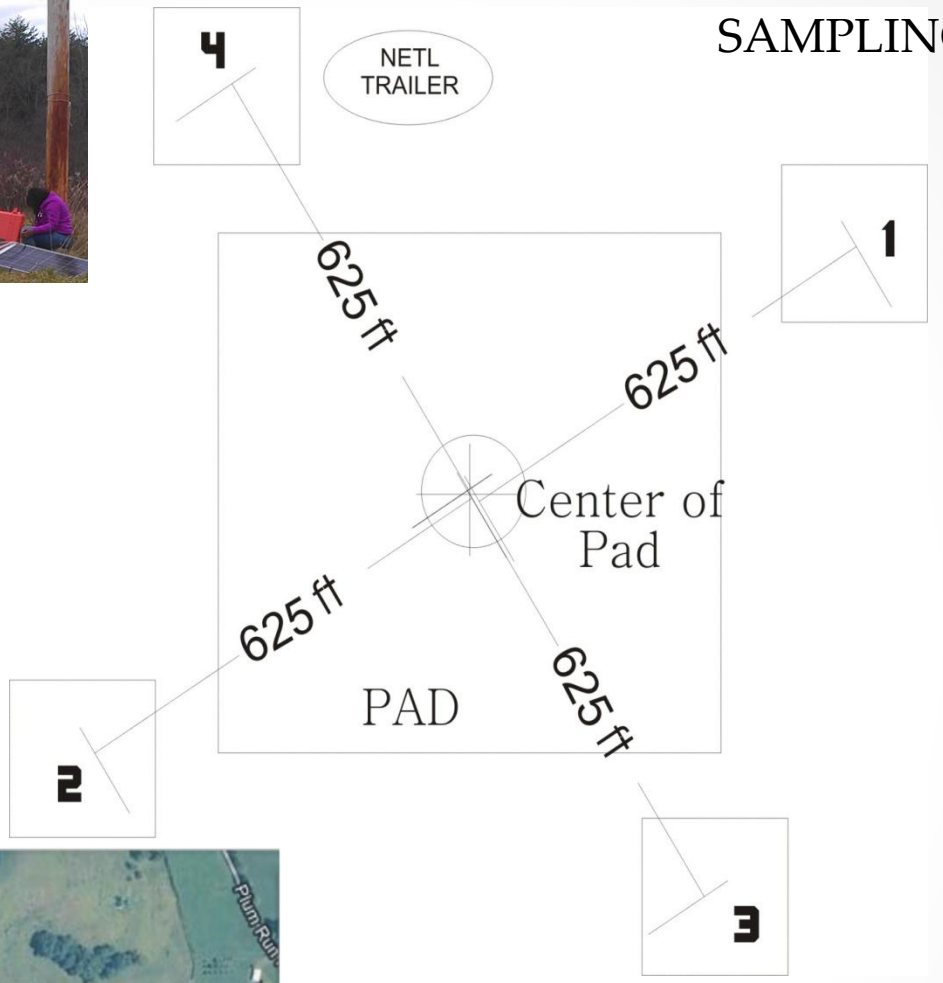
- **WVU**

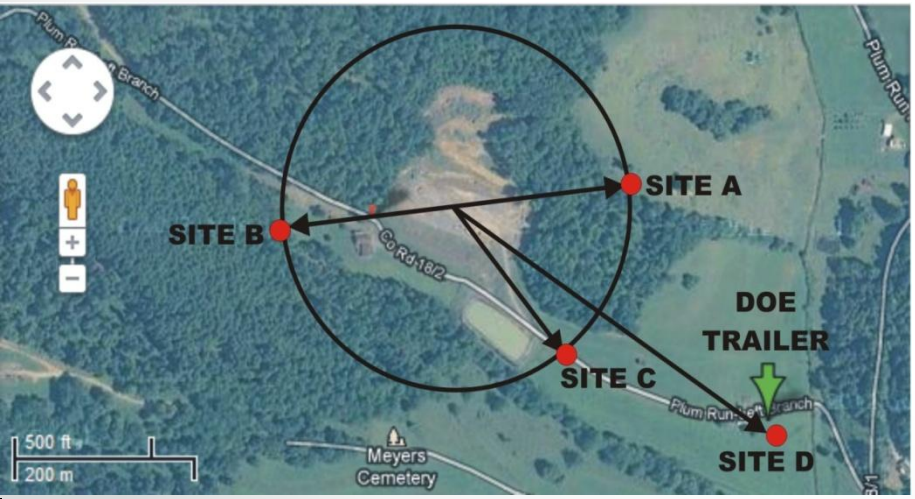
PM2.5 (Dust), HCs, Light, Ionizing Radiation and Noise at multiple locations at each site

- **DOE**

PM10, PM2.5, HCs, Light, O3, SO2, NOx, OC/EC, NH3, CO2(and isotopes), CH4(and isotopes) at a single location at each site

ARRANGEMENT OF SAMPLING STATIONS



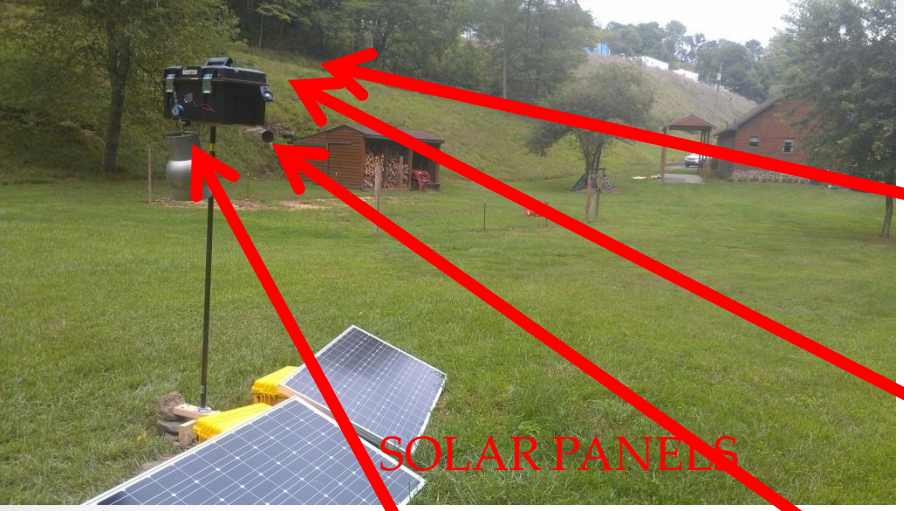


24 Hour Averages Measured by TEOM

	PM10 (µg/m3)	PM2.5 (µg/m3)
NAAQS 24 Hour Standard	**150**	**35**
Donna Pad	12-29	6-15
Weekley Pad	9-32	5-20
Mills-Wetzel Pad 2	9-54	6-17
Maury Pad	9-90	5-24
Lemons Pad	5-24	3-13
WVDNR Pad	2-50	1-13

Gases

	Donna WVDNR	Weekley	Mills	Wetzel2	Maury	Lemons
O3(8 hr avg)	9-56 ppb ppb	4-78 ppb	20-67 ppb	2-69 ppb	11-61 ppb	14-56
NOx(1 hr avg)	1.3-30 ppb	3.4-12ppb	7.8-38 ppb	23-138 ppb	9-151 ppb	-
CH4(6 day avg)	2.1ppm ppm	2.0 ppm	2.0 ppm	2.0 ppm	2.1 ppm	1.9
SO2(3 hr avg)	1.9-10.4ppb ppb	1.1-12.4ppb	1.6-8.4 ppb	1.1-9.6 ppb	1.7-3.7 ppb	2.1-5.3

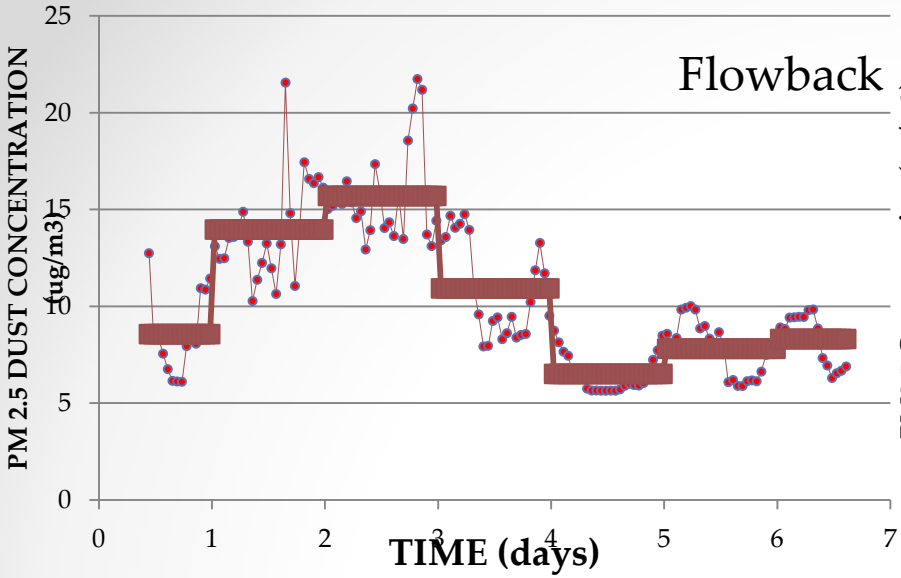


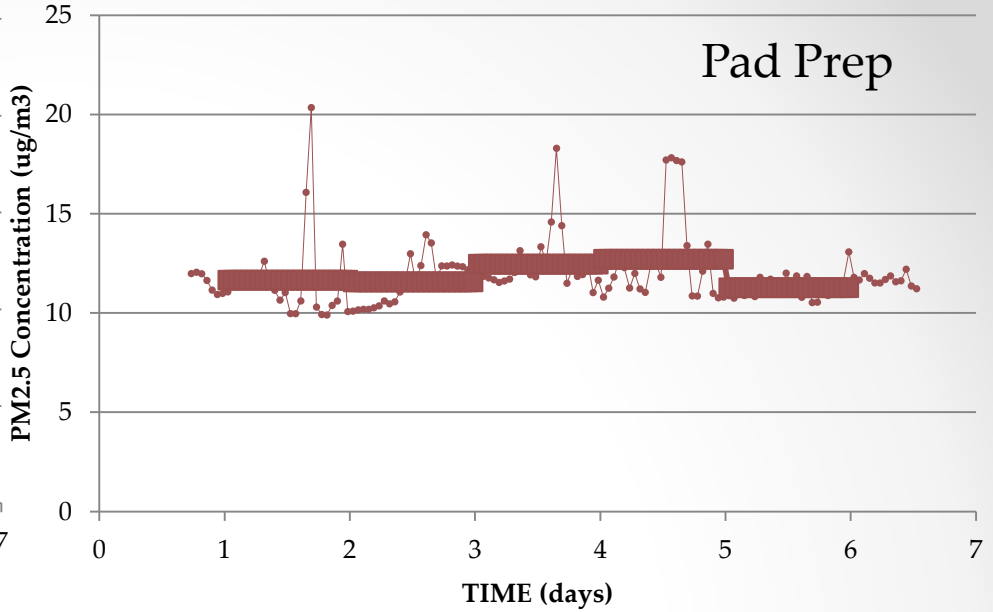
LIGHT

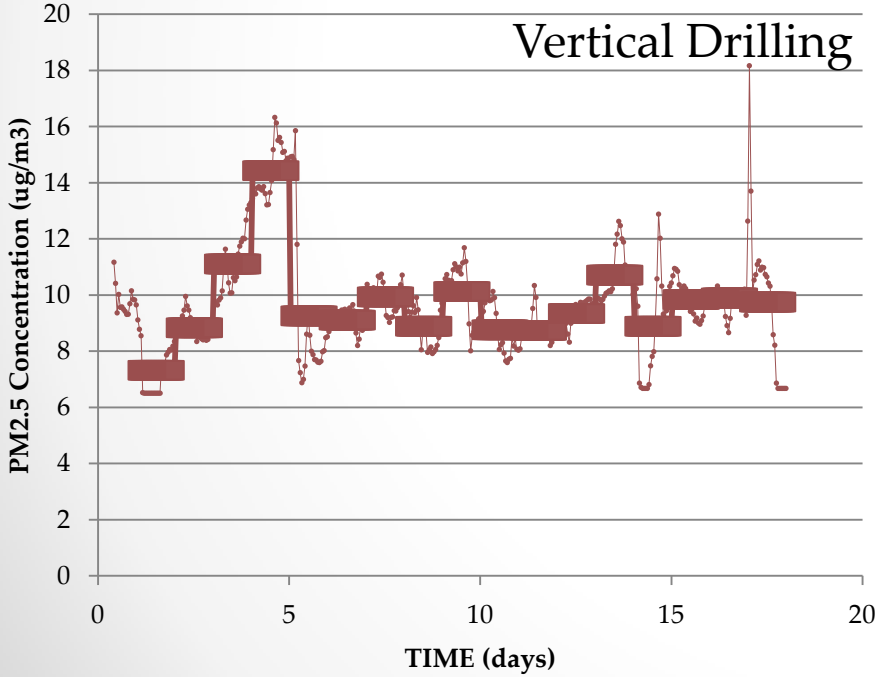
DUST

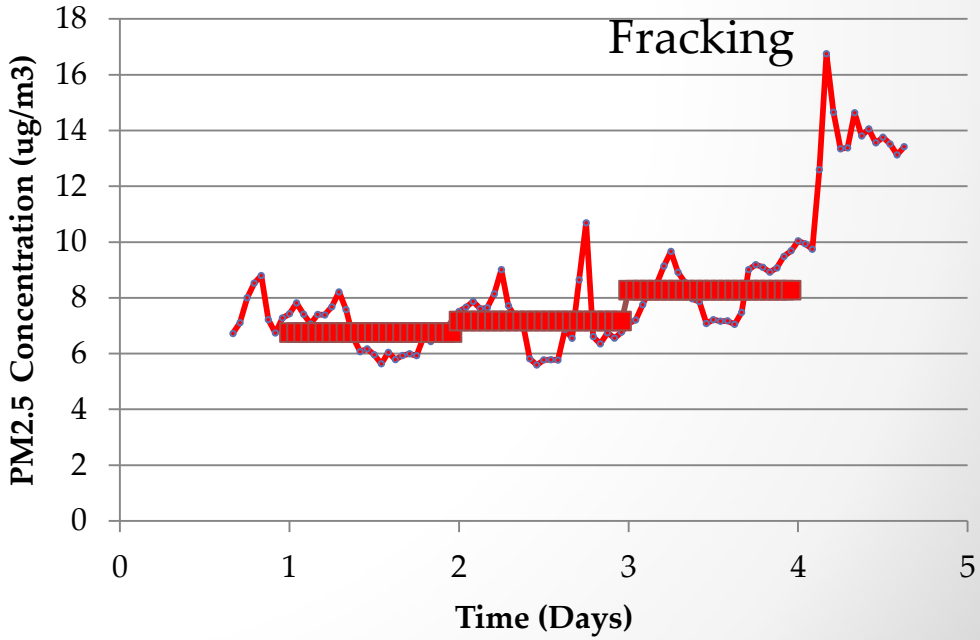
HYDROCARBONS

NOISE


Flowback
PM 2.5 DUST CONCENTRATION (ug/m3)
TIME (days)
0
5
10
15
20
25
0
1
2
3
4
5
6
7

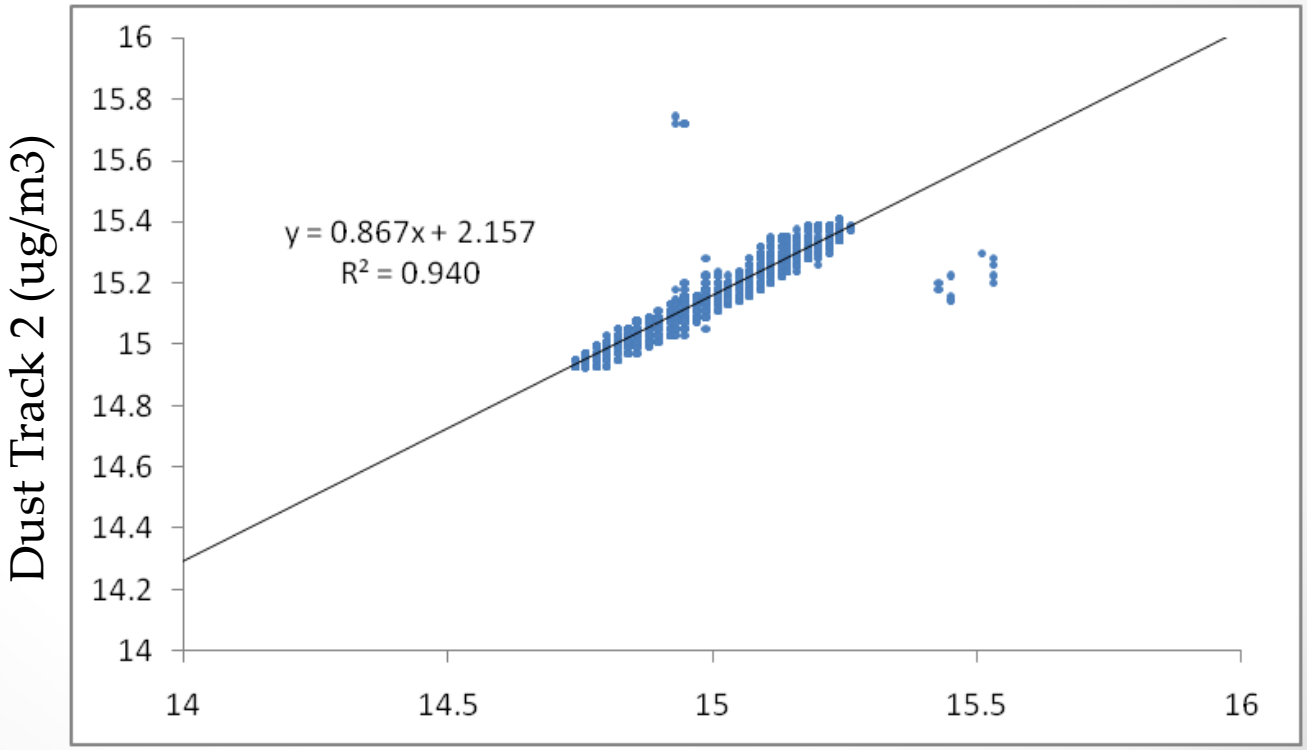

Pad Prep
PM2.5 Concentration (ug/m3)
TIME (days)
0
5
10
15
20
25
0
1
2
3
4
5
6
7

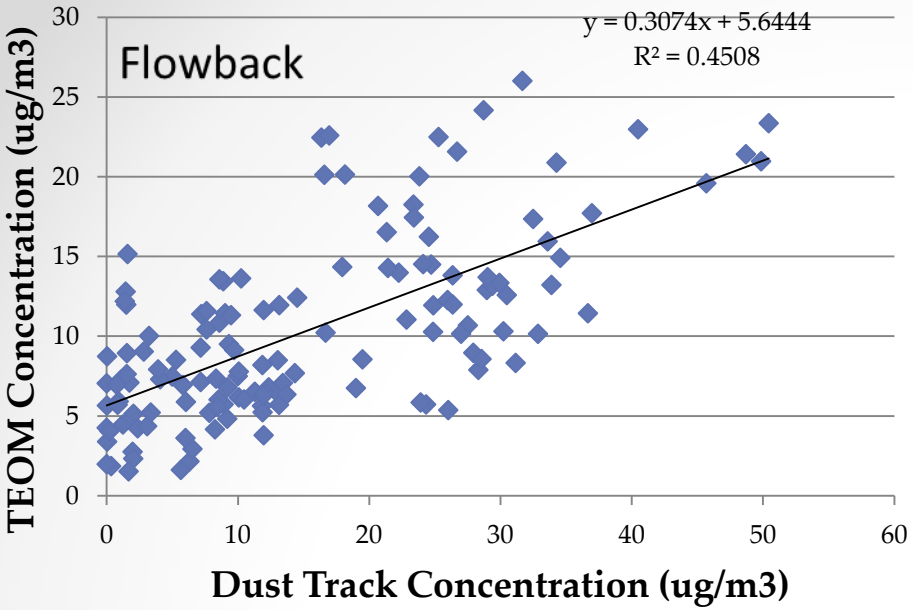

Vertical Drilling
PM2.5 Concentration (ug/m3)
TIME (days)
0
2
4
6
8
10
12
14
16
18
20
0
5
10
15
20

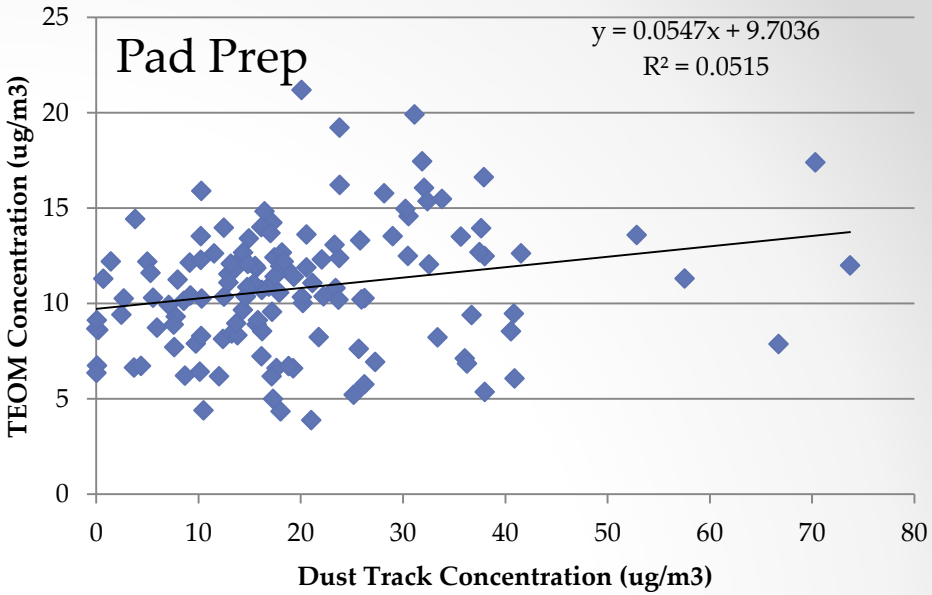

Fracking
PM2.5 Concentration (ug/m3)
Time (Days)
0
2
4
6
8
10
12
14
16
18
0
1
2
3
4
5

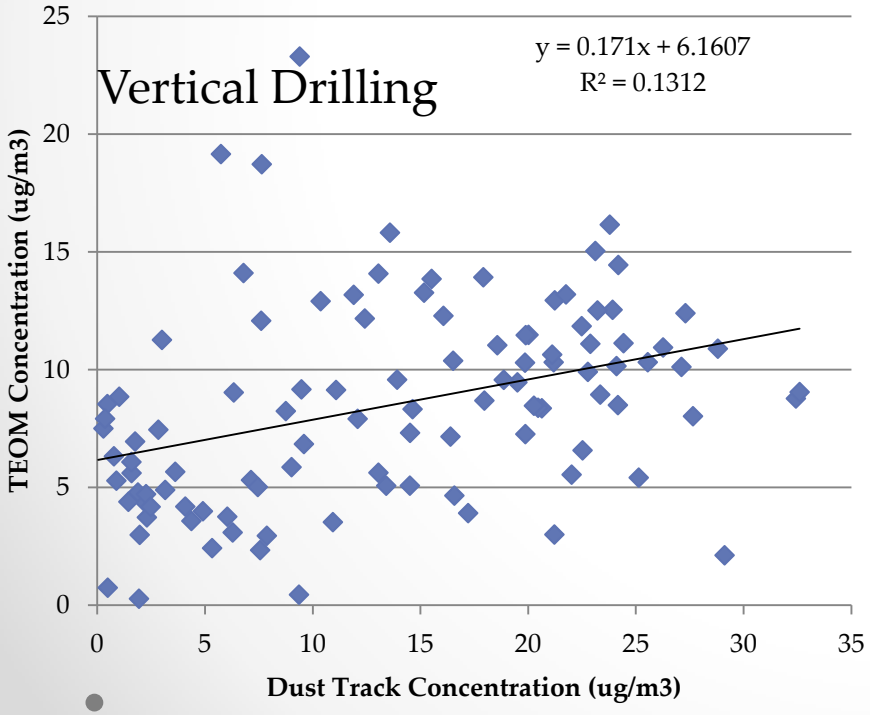
PM 2.5

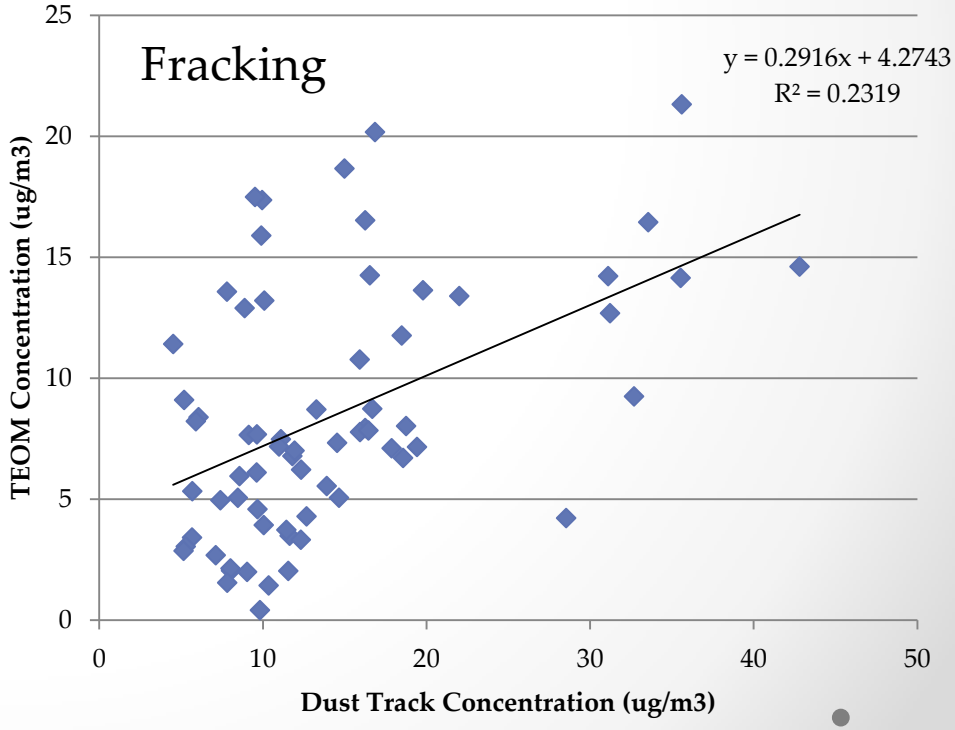
Comparison of Particle Monitors after 1 year in field

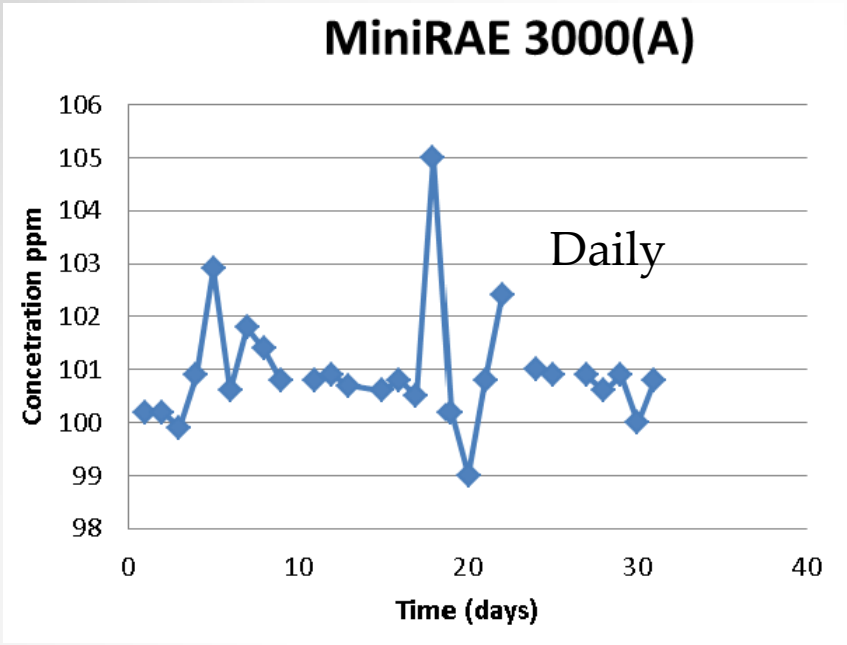


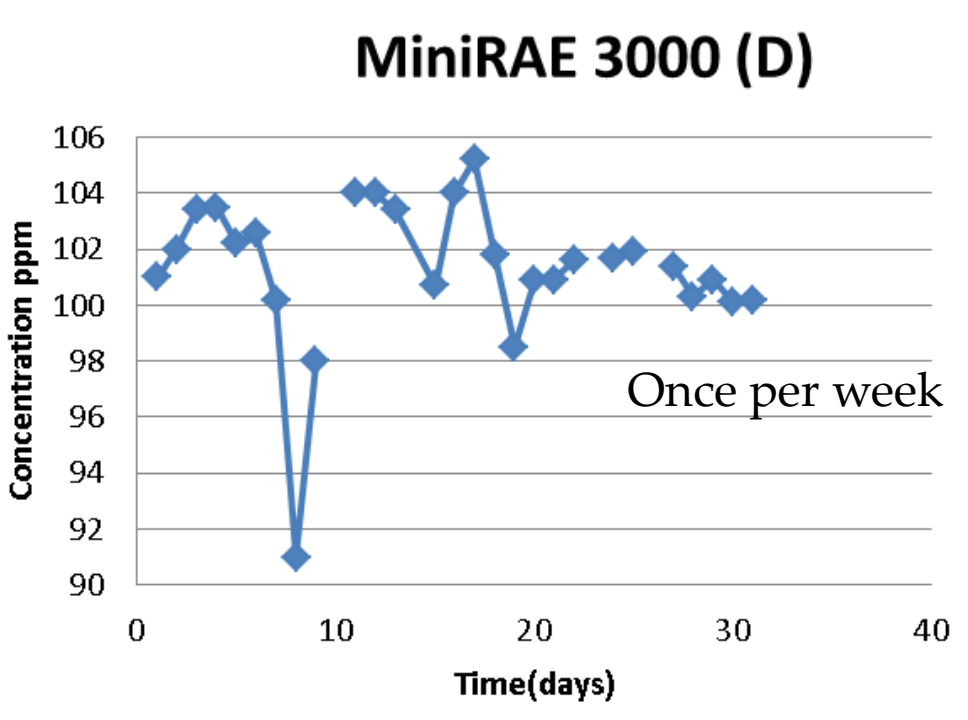

Flowback
y = 0.3074x + 5.6444
R² = 0.4508
TEOM Concentration (ug/m3)
Dust Track Concentration (ug/m3)
0
5
10
15
20
25
30
0
10
20
30
40
50
60

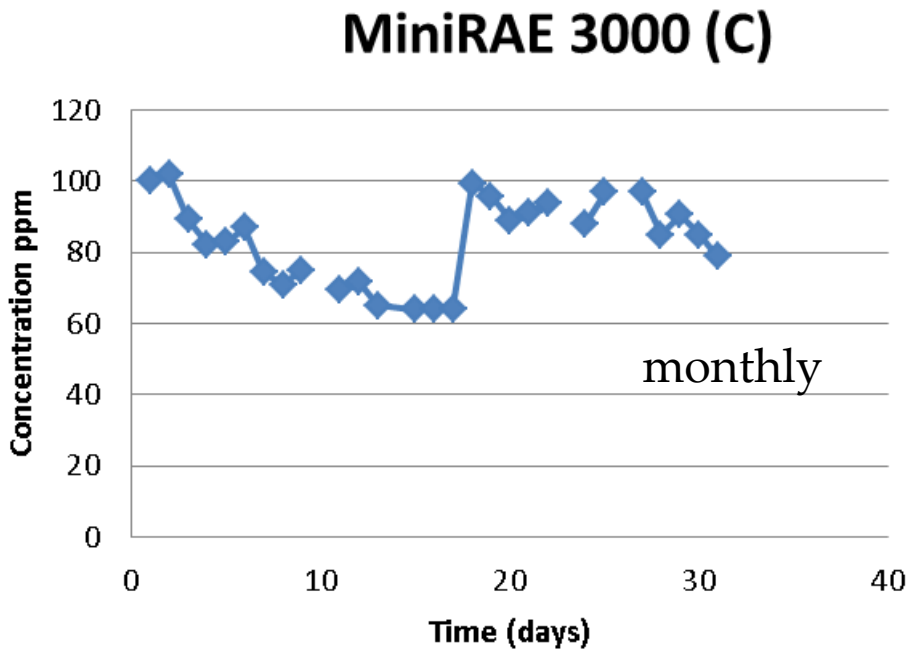

Pad Prep
y = 0.0547x + 9.7036
R² = 0.0515
TEOM Concentration (ug/m3)
Dust Track Concentration (ug/m3)
0
5
10
15
20
25
0
10
20
30
40
50
60
70
80


Vertical Drilling
y = 0.171x + 6.1607
R² = 0.1312
TEOM Concentration (ug/m3)
Dust Track Concentration (ug/m3)
0
5
10
15
20
25
0
5
10
15
20
25
30
35


Fracking
y = 0.2916x + 4.2743
R² = 0.2319
TEOM Concentration (ug/m3)
Dust Track Concentration (ug/m3)
0
5
10
15
20
25
0
10
20
30
40
50


MiniRAE 3000(A)
Concetration ppm
106
105
104
103
102
101
100
99
98
0
10
20
30
40
Time (days)
Daily


MiniRAE 3000 (D)
Concentration ppm
106
104
102
100
98
96
94
92
90
0
10
20
30
40
Time(days)
Once per week


MiniRAE 3000 (C)
Concentration ppm
120
100
80
60
40
20
0
0
10
20
30
40
Time (days)
monthly

Summa Canister – 3 day average by EPA Method TO 15 (Rpt. limit 0.5ppb Benzene)

CHRONIC MRL HAZARD QUOTIENTS

Pad	site	RESULTS ppb(v)	RESULTS (ug/m3)	Hazard Quotient	COMPOUND NAME
Lewis Wetzel Three	4	1.1	3.6	0.4	Benzene
Lewis Wetzel Three	4	1.0	3.3	0.3	Benzene
Lewis Wetzel Three	4	0.78	2.5	0.3	Benzene
Lewis Wetzel Two	3	3.0	9.7	**1.0**	Benzene
Lewis Wetzel Two	3	2.4	7.8	0.8	Benzene
Lewis Wetzel Two	3	2.4	7.7	0.8	Benzene
Lewis Wetzel Two	3	2.1	6.7	0.7	Benzene
MAURY (Fracking)	5	85	270	**28.3**	Benzene
MAURY (Fracking)	5	49	160	**16.3**	Benzene
MAURY (Fracking)	5	12	39	**4.0**	Benzene
WEEKLEY (Fracking)	2	8.2	26	**2.7**	Benzene
WEEKLEY	2	4.5	14	**1.5**	Benzene
WEEKLEY	2	4.2	13	**1.4**	Benzene
WEEKLEY	2	3.9	12	**1.3**	Benzene
WEEKLEY	2	2.9	9.2	**1.0**	Benzene
WVDNR (Horizontal Drill)	7	13	41	**4.3**	Benzene
WVDNR	7	3.0	9.5	**1.0**	Benzene
DONNA	1	2.2	7.0	0.7	Benzene
DONNA	1	2.1	6.8	0.7	Benzene
DONNA	1	1.7	5.3	0.6	Benzene
LEMON (Vertical Drill)	6	15	48	**5.0**	Benzene

CHRONIC MRL = 3ppb; INTERMEDIATE = 6 ppb; ACUTE = 9 ppb

365 days + 14-364 days 1-14 days

NOISE

- EPA has identified a 24-hour exposure level of 70 decibels as the level of environmental noise which will prevent any measurable hearing loss over a lifetime

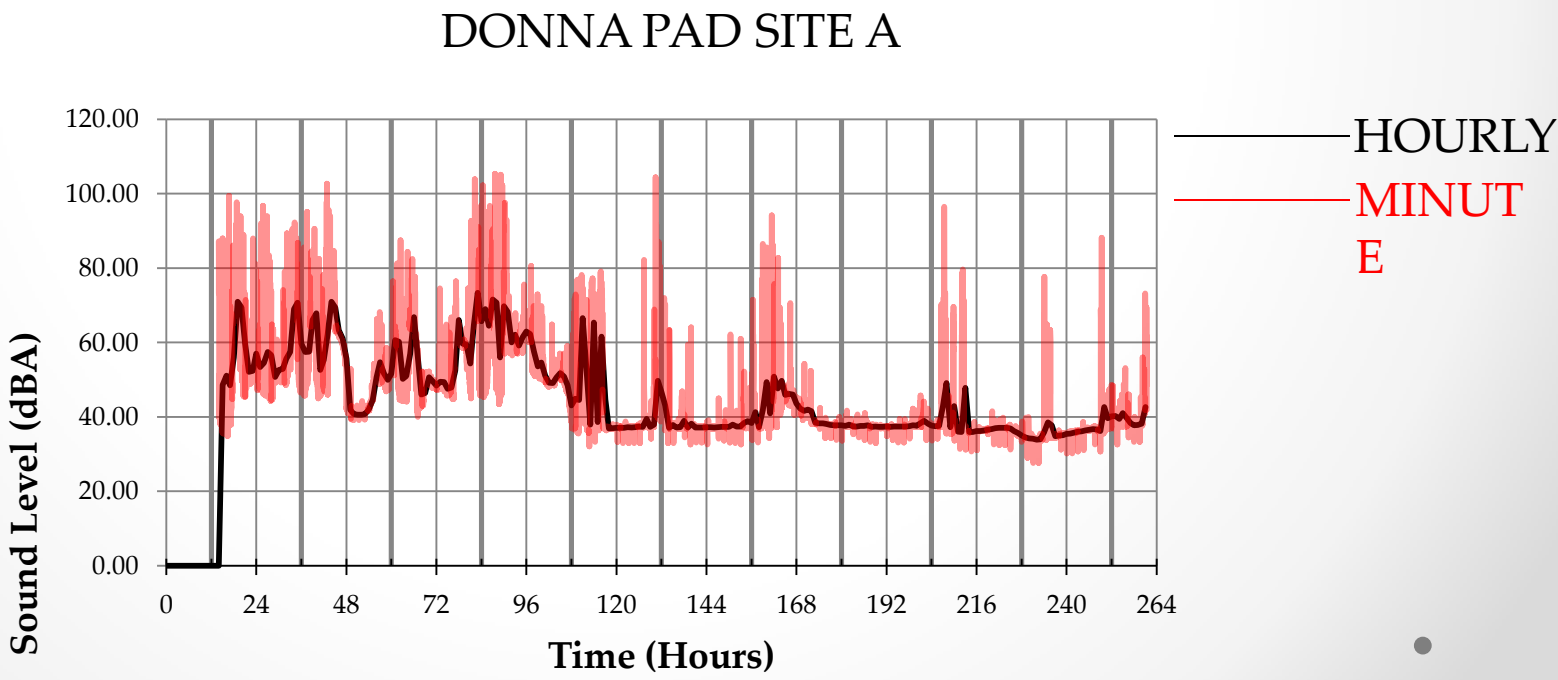
	dBA		dBA		dBA
Quiet Room	28-33	Printer	58-65	Garbage Disposal	76-83
Whisper, Quiet Library at 6'	30	Normal conversation at 3'	60-65	Air Popcorn Popper	78-85
Computer	37-45	Window Fan on High	60-66	City Traffic (inside car)	85
Refrigerator	40-43	Alarm Clock	60-80	Jackhammer at 50'	95
Typical Living Room	40	Dishwasher	63-66	Snowmobile, Motorcycle	100
Forced Hot Air Heating System	42-52	Clothes Washer	65-70	12 Gauge Shotgun Blast	165
Clothes Dryer	56-58	Phone	66-75		
		Push Reel Mower	68-72		
		Inside Car, Windows Closed, 30 MPH	68-73		
		Handheld Electronic Games	68-76		
		Kitchen Exhaust Fan, High	69-71		
		Inside Car, Windows Open, 30 MPH	72-76		

Increased risk of cardiovascular disease – 66-70dBA
Increased risk of hypertension - 66-70dBA

NOISE

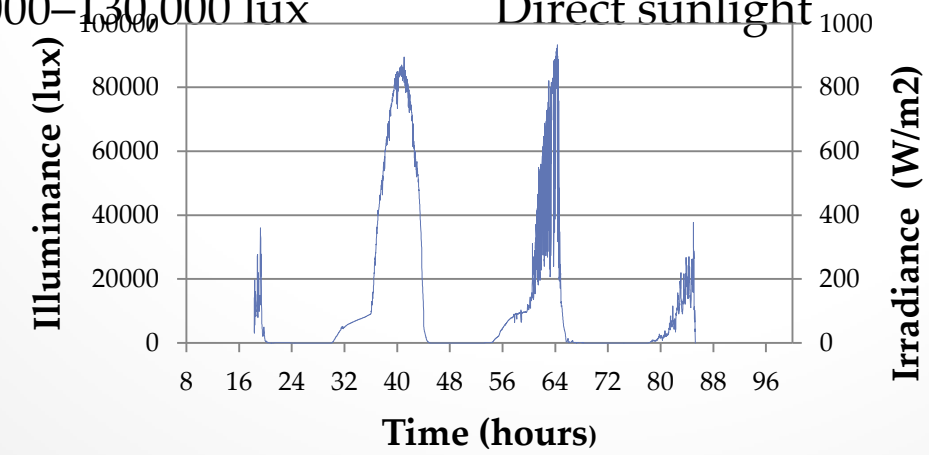
AVERAGE FOR ENTIRE SAMPLING PERIOD

	Donna	Mills Wetzel 2	Mills Wetzel 3	Maury	Lemon
Mean (dBA)	52	65	64	58	54
Standard Deviation	10	10	8	6	4



LIGHT

Illuminance	**Surfaces illuminated by:**
0.002 lux	Moonless clear night sky
0.27–1.0 lux	Full moon on a clear night
3.4 lux	Dark limit of civil twilight under a clear sky
50 lux	Family living room
80 lux	Office building hallway
100 lux (1 W/m2)	Very dark overcast day
320–500 lux	Office lighting
400 lux	Sunrise or sunset on a clear day.
1,000 lux	Overcast day
10,000–25,000 lux	Full daylight (not direct sun)
32,000–130,000 lux	Direct sunlight



RADIATION

pCi/L	Risk of cancer equal to:
0.4	Outdoor background exposure risk
1.3	Indoor background exposure risk
4	Risk of dying in a car crash

NON-DETECTABLE AT ALL PADS

RECOMMENDATIONS

- A definitive sampling and health effects study needs to be done to address the issues of potential exposures from gas drilling and setback limits.
- Air Quality Standards appropriate for assessment of air contaminants from drilling operations need to be developed.
- Currently available IH real-time and/or portable monitors, at "SENSITIVE" sites, could be used by industry for control or feedback and by government for regulation of drilling operations.

RECOMMENDATIONS

- A more definitive sampling and health effects study needs to be done to address the issues of potential exposures from gas drilling.
- Better use of roadway wetting agents would reduce many of the peak dust exposures seen from roadside samples that were taken over the course of the survey.
- Greater spacing of diesel container-trucks while waiting on line for fracking could reduce the local concentration of diesel exhaust and may reduce noise as well.
- Noise reduction, particularly from traffic may be abated by several well-established methods used with highway construction.
- Feedback from real-time and/or portable monitors could be used by industry for control, especially of noise, and by government for regulation.

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Questions?

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