

**An Interim Report of an Air Quality Assessment of Fort Cherry:
Air measurements during Pre-Drilling and Drilling Activity**



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To the Fort Cherry School Board,

Thank you for using the Speck Air Quality Monitors provided to you by SWPA Environmental Health Project (EHP). We are providing you with an analysis of the data collected by the Speck monitors. With information on the particles in your air, we can determine whether there are patterns of exposures and whether high levels could be produced by indoor activity or if it is more likely generated from outside, possibly from shale gas related activity.

What's in this Report? This report provides a summary of results from your air monitoring. With the development of a third natural gas well pad, Yonkers, located within a mile of Fort Cherry School, concerns about air quality and potential health effects of students were raised by several parents of Fort Cherry students.

In response to those concerns, Fort Cherry and EHP are conducting an air quality assessment at the school regarding particulate matter (PM_{2.5}) and volatile organic compounds (VOCs) levels found in the air.

Air monitoring at Fort Cherry began in August 2016, and will continue until activity at the Yonkers well pad concludes. As of May 2017, the well pad is in the drilling phase, which will be followed by fracking then finishing processes. **This report includes air quality measurements taken during a baseline period, a pre-drilling phase, and lastly during the drilling phase.** Current air quality measurements recorded at the school indicate that the indoor monitors captured lower levels of PM_{2.5} exposures, compared to the outdoor monitors. The outdoor PM_{2.5} exposures may have many causes, although it was assumed that the monitor with highest concentration values would come from the school bus loading zone due to bus emission, however, the site closest to the Yonkers well pad reported the highest values. These results are further explained on pages 5 and 6.

At Fort Cherry, there are four monitoring locations. Two are indoors and two are outdoors. The locations include the High School's administrative office, the High School's auditorium, the school bus loading zone of the Middle School, and lastly outside on the southeast wall of the Middle School, located closest to the developing Yonkers Natural Gas Well Pad.

If you have any questions, please do not hesitate to contact me at: rgrode@environmentalhealthproject.org or 724-260-5504.

Monitoring Activity at Fort Cherry:

Equipment used in the collection of air quality measurements included, Speck air quality monitors for PM_{2.5} and summa canisters for volatile organic compounds (VOCs) measurements. Speck monitors collect real-time data and were placed at the four monitoring sites on August 19th 2016. Speck monitors will continue to collect data until the Yonkers Well Pad is capped and producing natural gas.

An air quality baseline measurement collected prior to any well pad or school activity provides EHP with an understanding of what concentration of PM_{2.5} and VOCs are naturally found in the air. Due to the timing of this project, a baseline greater than several weeks was unable to be captured. EHP was able to gather several weeks of calm activity prior to the school year, although, this calm period included 'new 7th grade orientation', 'new high school student orientation' and 'teacher in-service days' as well as routine maintenance and cleaning activity. While the outdoor measurements remained undisturbed, the indoor readings included air quality disturbance of students, teachers and maintenance.

On August 25th 2016, EHP measured for VOCs using two, 6-liter summa canisters. Each canister was equipped with a 24-hour flow regulator and followed the Environmental Protection Agency's (EPA) TO-15 method for analysis. One summa canister was placed outdoors behind the middle school near the playground and detected the presence of 3 VOCs. The other canister was placed indoors, at the high school, in the administrative office and detected the presence of 17 VOCs. These results may have been expected as indoor activity was much greater than outdoor, and included exposure to maintenance and cleaning materials. Refer to table 1.0 for a summary of the VOC results on page 4.

The Pennsylvania Department of Environmental Protection (PA DEP) reported the Yonkers natural gas well pad, located South-Southeast of Fort Cherry was spudded on December 30th 2016. The spud date refers to the date that natural gas drilling activity begins. As of May 1st 2017, the well pad is still in the drilling stage. Air monitoring using Specks and summa canisters will continue throughout the drilling, fracking and finishing processes of the Yonkers well pad and will be reported in a subsequent report.

Table 1.0 - Summary of Indoor and Outdoor Volatile Organic Compounds (VOCs) Detected using 24-Hour Summa Canisters. Measurements are reported in ug/m (concentration) and ppbV (mass).

| Location | Compound | Result (ug/m) | MRL (ug/m)* | Result (ppbV) | MRL (ppbV)* |
|-------------------------------|----------------------------------|---------------|-------------|---------------|-------------|
| Indoor: Admin. office | Propene | 2.4 | 0.85 | 1.4 | 0.49 |
| | Dichlorodifluoromethane (CFC 12) | 1.8 | 0.85 | 0.37 | 0.17 |
| | Ethanol | 190 | 8.5 | 100 | 4.5 |
| | Acetone | 56 | 8.5 | 24 | 3.6 |
| | Trichlorofluoromethane | 1.0 | 0.85 | 0.18 | 0.15 |
| | 2-Propanol (Isopropyl Alcohol) | 19 | 8.5 | 7.8 | 3.4 |
| | Ethyl Acetate | 3.9 | 1.7 | 1.1 | 0.47 |
| | n-Hexane | 1.6 | 0.85 | 0.44 | 0.24 |
| | Cyclohexane | 4.1 | 1.7 | 1.2 | 0.49 |
| | n-Heptane | 1.3 | 0.85 | 0.31 | 0.21 |
| | Toluene | 2.5 | 0.85 | 0.66 | 0.22 |
| | Ethylbenzene | 0.98 | 0.85 | 0.22 | 0.19 |
| | m,p-Xylenes | 1.8 | 1.7 | 0.42 | 0.39 |
| | n-Nonane | 1.7 | 0.85 | 0.33 | 0.16 |
| | alpha-Pinene | 0.91 | 0.85 | 0.16 | 0.15 |
| | 1,2,4-Trimethylbenzene | 1.4 | 0.85 | 0.16 | 0.15 |
| | d-Limonene | 3.5 | 0.85 | 0.63 | 0.15 |
| | | | | | |
| Outdoor: Behind school | Dichlorodifluoromethane (CFC 12) | 1.8 | 0.82 | 0.37 | 0.17 |
| | Trichlorofluoromethane | 0.96 | 0.82 | 0.17 | 0.15 |
| | Ethyl Acetate | 2.4 | 1.6 | 0.65 | 0.46 |

*An MRL is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse noncancerous health effects over a specified duration of exposure

Speck Air Quality Monitor Data Analysis:

The Environmental Health Project has designed an environmental exposure analysis of data collected by Speck monitors. This analysis examines the 'peaks' within a 32-day monitoring period. The data analysis focuses on 5 exposure components: 1) frequency of peaks, 2) duration of peaks, 3) amount of time between peaks, 4) the baseline value, and 5) the total sum of particles measured over time.

Each of these 5 exposure parameters are given a weighted score ranging from 0-10. Higher scores, closer to 10, represent greater exposures and lower scores represent minor exposures. Only a score of zero would indicate the absence of an exposure. Table 2.0 depicts the results of the PM_{2.5} analysis. The **Index Value** is the overall weighted score for a particular data set.

Table 2.0 - Speck Data Analysis

| Monitoring Period | Monitor Location | Dates Monitored | Index Value | Peak* Frequency | Peak* Duration | Time between Peaks* | Baseline Value | Sum of Particles |
|--------------------------|---|-------------------|-------------|-----------------|----------------|---------------------|----------------|------------------|
| Pre-Drilling Activity | High school, Admin office | 9-1-16 – 10-2-16 | 3.96 | 0.78 | 8.44 | 0.72 | 5.33 | 2.28 |
| During Drilling Activity | High school, Admin office | 2-1-17 – 3-4-17 | 3.08 | 1.02 | 8.14 | 1.14 | 1.92 | 5.12 |
| Pre-Drilling Activity | High school, Auditorium | 9-1-16 – 10-2-16 | 3.04 | 0.12 | 0.06 | 9.92 | 0.36 | 9.16 |
| During Drilling Activity | High school, Auditorium | 2-1-17 – 3-4-17 | N/A | N/A | N/A | N/A | N/A | N/A |
| Pre-Drilling Activity | Middle school, outside the southeast wall of school | 9-1-16 – 10-2-16 | N/A | N/A | N/A | N/A | N/A | N/A |
| During Drilling Activity | Middle school, outside the southeast wall of school | 2-1-17 – 3-4-17 | 6.02 | 3.88 | 9.01 | 3.68 | 7.89 | 2.5 |
| Pre-Drilling Activity | Middle school, bus loading zone | 9-1-16 – 10-2-16 | 4.24 | 8.22 | 2.3 | 8.68 | 2.76 | 1.68 |
| During Drilling Activity | Middle school, bus loading zone | 2-22-17 – 3-10-17 | 4.60 | 4.93 | 0.33 | 4.67 | 4.41 | 8.95 |

*EHP defines a peak as any 15-minute interval where air quality measurements are greater than 2 standard deviations from the mean. Meaning, peaks occur in the 95th percentile or greater.

Discussion of Air Quality Findings:

Indoor Results

Among all indoor and outdoor monitoring locations, the indoor monitors had the lowest index scores, (i.e lowest exposure levels), with the auditorium having the lowest value of 3.04. This result was expected as EHP was told that the auditorium would have little to no school activity during the monitoring period. The index values among the indoor monitors ranged between 3.04 – 3.96, meaning each monitor recorded PM_{2.5} exposures well below the average of what EHP typically analyzes. The indoor monitors recorded an average of 0.64 peaks per day (min=0.12 max=1.02) lasting an average of 5.54 minutes (min=0.06 max=8.44) with the average time between peak exposures lasting 3.93 hours (min=0.72 max=9.94).

Outdoor Results and Meteorology

Previous studies regarding air quality and source emissions conducted by EHP express the importance of meteorology in outdoor air quality measurements. Therefore, hourly wind direction and wind speed recorded at the Pittsburgh International Airport between September 1st 2016 – April 30th 2017 was analyzed and included in EHP's conclusions. Using this NOAA recorded weather data, EHP found the most frequent wind speeds ranged between 5-9 mph. According to the Beaufort Scale for wind speed, calm to light wind breezes range between 0-12mph, and moderate to strong wind speeds range between 12-25mph. A strong wind speed (categorized by greater than 12mph) could likely carry air pollutants further away from a source, or potentially, depending on the plume and topography, disperse the pollutants. However, a low or non-existent wind speed is not likely to disperse the pollutants to any great distance, meaning they may remain nearby the source.

The highest index values, among all indoor and outdoor monitors, came from the outdoor monitors with the site closest to the Yonkers well pad holding the highest value, 6.02. This could be explained by the low wind speed recorded during the drilling activity. EHP typically sees higher peaks of PM under these conditions. Air quality measurements will be recorded throughout the drilling phase and paired with recorded meteorological data to show how the wind speed and direction can affect the emissions potentially reaching Fort Cherry School.

The index values among all outdoor monitors ranged between 4.24 – 6.02, meaning the monitors recorded PM_{2.5} exposures near the average of what EHP typically analyzes, with one monitor (located closest to the Yonkers well pad) recording slightly higher than the normal measurements. There was an average of 5.67 peaks per day (min=3.88 max=8.22) lasting an average of 3.88 minutes each (min=0.33 max=9.01) with an average time between peaks lasting 5.70 hours (min=3.68 max=8.68). Again, further measurements will be recorded throughout drilling, fracking and completing the well pad to determine whether or not the monitor closest to the well pad measures the highest concentration of PM_{2.5}.

Project Limitations

An ongoing limitation in this project is the collection of PM_{2.5} data by the Speck air monitors. Unfortunately, due to an electrical outlet issue, EHP was unable to retrieve air quality measurements from one of the outdoor monitors during the pre-drilling phase. The outlet did not supply a steady flow of power to the monitor, rendering the data set unusable. In addition to the outdoor monitor unsuccessfully collecting data, a Speck monitor placed in the high school auditorium was unplugged by an unknown party during drilling activity. Fort Cherry High School's performing arts program was in the midst of preparing for school play, and the Speck monitor located in the auditorium was unplugged and placed on a shelf. However, following QA/QC techniques, EHP placed more than one monitors indoors and outdoors which allowed for the collection of properly measured data used in the analysis.

A final limitation was the absence of a true baseline air quality measurement. Ideally, a measurement of air quality prior to any school or natural gas activity would have been advantageous to this project. Due to the time constraints between the planning of this project and the placement of monitors onsite, EHP was unable to collect a proper baseline.

Further information about your Speck results

Much of our concern about the risks associated with air contaminants produced by the natural gas industry is focused on occasional high levels of exposure. Not every peak of PM_{2.5} puts you at serious risk, but it's good to be a critical reader when faced with comments about air quality near shale gas activity. Please refer to the appendix following this report for an in depth explanation of the peak events captured by the speck monitors.

If you have any questions, ***please do not hesitate to contact me at: rgrode@environmentalhealthproject.org or 724-260-5504.***

Thank you again for working with EHP
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Appendix I: A summary of Speck Data Analysis

YOUR INDOOR PM_{2.5} RESULTS: High School Administrative Office

Monitoring Dates: 9/1/16 – 10/2/16

Your score on a scale of 0 to 10: **3.96**

This score means that relative to all the Speck data we have reviewed so far at EHP
The level of this indoor air PM_{2.5} values during the monitoring period were **3.96** out of 10,
Slightly lower than most sites we've monitored.

Your score is a composite value based on the following components:

| Score component (0-10) | Definition |
|--|---|
| 0.78 for the frequency of peaks | The number of large scale changes ("peaks") in air quality over the course of a 32-day measuring period: 1.8 |
| 8.44 for the duration of peaks | The average length of time the peaks lasted was 36.9 minutes |
| 0.72 for the time between peaks | The average length of time between peaks was 13.0 hours |
| 2.28 for baseline air quality | The level of particles generally found at your home when peaks are not occurring: 4.1 ug/m³ |

YOUR INDOOR PM_{2.5} RESULTS: High School Administrative Office

Monitoring Dates: 2/1/17 – 3/4/17

Your score on a scale of 0 to 10: **3.08**

This score means that relative to all the Speck data we have reviewed so far at EHP
The level of this indoor air PM_{2.5} values during the monitoring period were **3.08** out of 10,
Slightly lower than most sites we've monitored.

Your score is a composite value based on the following components:

| Score component (0-10) | Definition |
|--|---|
| 1.02 for the frequency of peaks | The number of large scale changes ("peaks") in air quality over the course of a 32-day measuring period: 2.1 |
| 8.14 for the duration of peaks | The average length of time the peaks lasted was 36.2 minutes |
| 1.14 for the time between peaks | The average length of time between peaks was 10.7 hours |
| 5.12 for baseline air quality | The level of particles generally found at your home when peaks are not occurring: 6.7 ug/m3 |
| 1.92 for the total sum of particle counts | The amount of particulate matter accumulated over a given time period: 2698 ug/m3/day |

YOUR INDOOR PM_{2.5} RESULTS: High School Auditorium

Monitoring Dates: 9/1/16 – 10/2/16

Your score on a scale of 0 to 10: **3.04**

This score means that relative to all the Speck data we have reviewed so far at EHP
The level of this indoor air PM_{2.5} values during the monitoring period were **3.04** out of 10,
Slightly lower than most sites we've monitored.

Your score is a composite value based on the following components:

| Score component (0-10) | Definition |
|--|---|
| 0.12 for the frequency of peaks | The number of large scale changes ("peaks") in air quality over the course of a 32-day measuring period: 0.7 |
| 0.06 for the duration of peaks | The average length of time the peaks lasted was 0.1 minutes |
| 9.94 for the time between peaks | The average length of time between peaks was 0.2 hours |
| 9.16 for baseline air quality | The level of particles generally found at your home when peaks are not occurring: 15.1 ug/m3 |
| 0.36 for the total sum of particle counts | The amount of particulate matter accumulated over a given time period: 1197 ug/m3/day |

YOUR OUTDOOR PM_{2.5} RESULTS: Southeast Side of Middle School

Monitoring Dates: 2-1-17 – 3-4-17

Your score on a scale of 0 to 10: **6.02**

This score means that relative to all the Speck data we have reviewed so far at EHP
The level of your indoor air PM_{2.5} values during the monitoring period were **6.02** out of 10,
Slightly higher than most homes we've monitored.

Your score is a composite value based on the following components:

| Score component (0-10) | Definition |
|--|---|
| 3.88 for the frequency of peaks | the number of large scale changes ("peaks") in air quality over the course of a 32-day measuring period: 2.6 |
| 9.01 for the duration of peaks | the average length of time the peaks lasted was 30.7 minutes |
| 3.68 for the time between peaks | the average length of time between peaks was 9.1 hours |
| 2.5 for baseline air quality | The level of particles generally found at your home when peaks are not occurring: 5.8 ug/m³ |
| 7.89 for the total sum of particle counts | The amount of particulate matter accumulated over a given time period: 8196 ug/m³/day |

YOUR OUTDOOR PM_{2.5} RESULTS: Middle School Front Door (Bus Drop-Off Area)

Monitoring Dates: 2-22-17 – 3-10-17

Your score on a scale of 0 to 10: **4.60**

This score means that relative to all the Speck data we have reviewed so far at EHP
The level of your indoor air PM_{2.5} values during the monitoring period were **4.60** out of 10,
Slightly lower than most homes we've monitored.

Your score is a composite value based on the following components:

| Score component (0-10) | Definition |
|--|---|
| 4.93 for the frequency of peaks | the number of large scale changes ("peaks") in air quality over the course of a 32-day measuring period: 2.8 |
| 0.33 for the duration of peaks | the average length of time the peaks lasted was 19.2 minutes |
| 4.67 for the time between peaks | the average length of time between peaks was 8.5 hours |
| 8.95 for baseline air quality | The level of particles generally found at your home when peaks are not occurring: 17.5 ug/m3 |
| 4.41 for the total sum of particle counts | The amount of particulate matter accumulated over a given time period: 4304 ug/m3/day |

YOUR OUTDOOR PM_{2.5} RESULTS: Middle School Front Door (Bus Drop-Off Area)

Monitoring Dates: 2-22-17 – 3-10-17

Your score on a scale of 0 to 10: **4.24**

This score means that relative to all the Speck data we have reviewed so far at EHP
The level of your indoor air PM_{2.5} values during the monitoring period were **4.24** out of 10,
Slightly lower than most homes we've monitored.

Your score is a composite value based on the following components:

| Score component (0-10) | Definition |
|--|---|
| 8.22 for the frequency of peaks | the number of large scale changes ("peaks") in air quality over the course of a 32-day measuring period: 3.5 |
| 2.3 for the duration of peaks | the average length of time the peaks lasted was 21.7 minutes |
| 8.68 for the time between peaks | the average length of time between peaks was 6.6 hours |
| 1.68 for baseline air quality | The level of particles generally found at your home when peaks are not occurring: 4.7 ug/m³ |
| 2.76 for the total sum of particle counts | The amount of particulate matter accumulated over a given time period: 3512 ug/m³/day |

