NATURE OF COMPLAINT

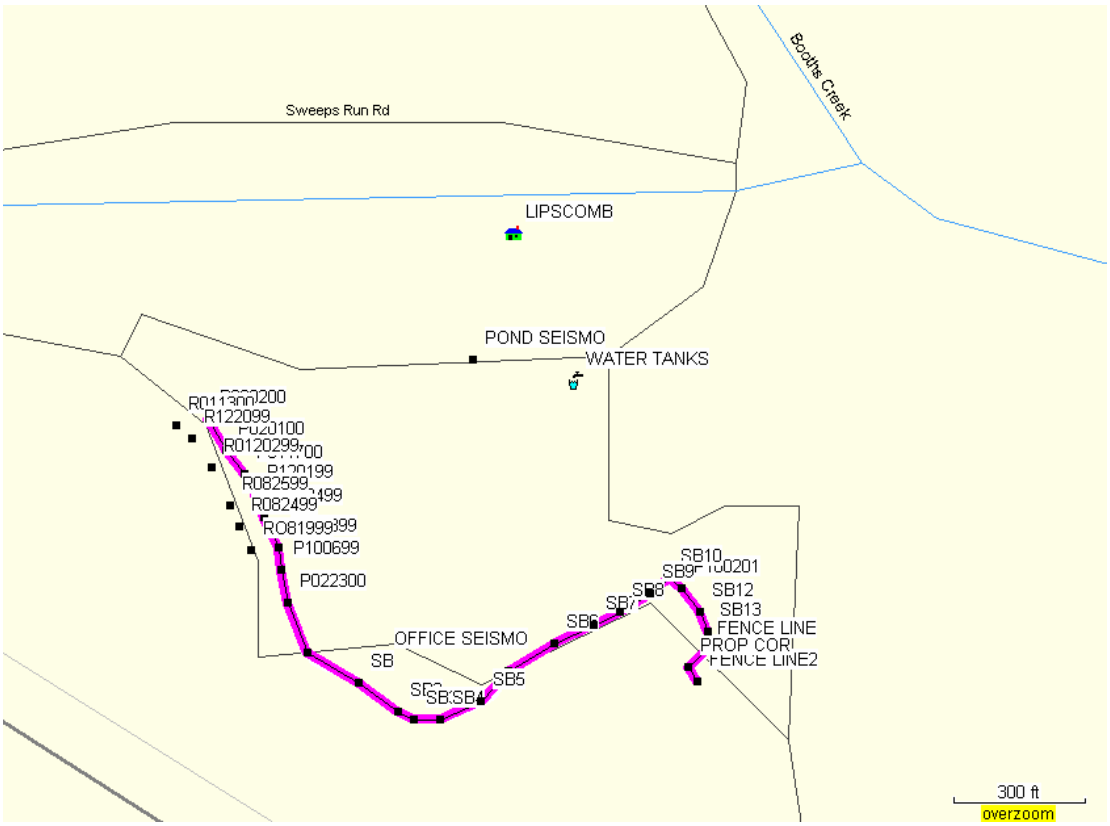
In a letter dated July 31, 2000, Mr. O. L. Lipscomb attributes numerous cracks in various masonry walls of his residence and malfunctioning of an entrance door to heavy blasting that occurred during the latter part of 1999. Furthermore, in a letter dated September 5, 2000, Mr. Lipscomb said flyrock landed within 75 feet of his residence in the latter part of 1999.

Sturm Environmental Services (Sturm) preformed a preblast survey on April 27, 1999 before blasting began on August 19, 1999.

The Lipscomb residence is shown in relation to the blasting activity at the Grace Enterprises, Inc. (Grace), Sweeps Number 2 mine on Figure 1. The heavier line approximates the closest perimeter of all blasts to the Lipscomb residence as documented on our site visit of October 4, 2001. The residence is topographically below the mine and the outcrop of the Pittsburgh coal being mined. .

SWEEPS RUN NO.2 MINE

The Sweeps Run No.2 mine began operation in April 1999 in the western part of the permit. Coal from both the Redstone (R prefix) and Pittsburgh (P prefix) coal beds were mined. Each blast through February 2000 is shown on below. The first blast was on August 19, 1999 and is shown as R081999 (R081999 is a blast above the Redstone coal bed on August 19, 1999).



After initially mining the Redstone and Pittsburgh coal beds towards the west, in February 2000 the direction of mining was to the east and included only the Pittsburgh coal bed. A single cut was taken to each coal bed along the previously mined bench. The markers shown as SB refer to the approximate blast boundaries based on field evidence and discussions with the mine foreman, Mike Southern. All blasts after this time through PI00201 were to the Pittsburgh coal bed. The western area will be the focus of this review since it corresponds to the damage claim period.

Based on the permit geologic cross sections the rock above the Redstone coal bed is the Sewickley limestone and the rock between the Redstone and Pittsburgh coal beds is the Redstone limestone and the Pittsburgh sandstone.

BLAST RECORD REVIEW

Each coal mine is required to keep records of how they blast and how they control the amount of ground vibrations and airblast that reach nearby homes. The three most important components of the log are the location of the blast, the distance to the nearest house and the amount of explosive detonated per delay.

The location of the blast determines the distance to the nearest protected structure. Accurate distances are vital in determining the allowable charge weight for blast design purposes.

To control vibrations, blasts are designed to detonate a series of charges or separate holes sequentially. If an adequate amount of time passes between the detonations of separate charges, they result in lower vibrations (both ground and air) than would result from the detonation of all the explosives at once. The minimum commonly accepted delay interval between charges is 8 milliseconds (8/1000 second). This constitutes the amount of explosives per delay.

Ground vibration is measured as peak particle velocity (PPV), and the unit of measure is inches per second. Air blast is measured in decibels (dB).

Flyrock is controlled by properly confining the explosives. If a charge is buried deep in the ground, no flyrock would be anticipated. However, the closer the charge is to the surface and the weaker the rock, the more likely the occurrence of flyrock. This is gauged by the powder factor which is a measure of pounds of explosive used per cubic yard of rock. Flyrock can also be caused by inadequate stemming (the amount of backfill on top of the explosive charge in the hole).

We reviewed the 33 blast logs between August 19, 1999 and May 5, 2001. The blasts were located within the permit boundary from the southwest to the southeast of the Lipscomb residence. The method of showing compliance with the vibration standards at this permit is scaled distance or maximum peak particle velocity for ground vibrations and periodic monitoring for airblast. Flyrock is not allowed to leave the permit area.

The blast logs were checked using the Blast Log Evaluation Program (BLEP). BLEP cross tabulates the blast log data and graphically plots the results. The graphs show how well the data

cross tabulates with the reported values, helps identify blasts with flyrock potential and gauges compliance with ground vibration and airblast limits. If data points fall within expected ranges, the blast logs reviewed can be deemed accurate with a high level of confidence. Where data points fall outside expected ranges the individual blast records need to be more closely checked by a blasting specialist to assess the discrepancy or possible violation of the rules. All but two of the data fields are taken from the blast log of each blast. The reviewer must determine the adequacy of how the blast location is documented to check the reported distances and look at the timing of the separate charges for overlaps.

At the Grace mine, the location of each blast within the permit was inadequate. Location refers to where blasting occurred within the permit area. The location given on the log was often given as Fairmont, WV or Bristol, WV up to February 2000. This was initially corrected on January 20, 2000 when the mine inspector required a grid map for blast locations. The grid map provided was on 500-foot squares. For a residence that is within 1000 feet of blasting, this does not provide the need level of accuracy to control vibrations. Fortunately for the mine operator, the mine is small and took only a single cut on both the Pittsburgh and Redstone coal bed so that the blast locations could be reestablished in the field by the foreman. This was done on October 4, 2001 and documented with a Global Positioning System (GPS), see Figure 1. With known blast locations we established the spatial relationship of the mine pit with the Lipscomb residence and entered the corrected distance as Distance Measured in BLEP. Later we will use the known locations to estimate vibration levels at the house for the damage claim period.

The blast data of 33 records were analyzed with the BLEP and the following observations were made from the graphs:

(1) Burden/Spacing, burden is sometimes greater than the spacing. This is poor recordkeeping or indicates that the blasts were detonated in the wrong sequence.

(2) Stemming Adequacy, the material used to confine the explosive charge to the bore hole, was minimal for some of the 1999 blasts and is further evidence by elevated airblast levels. Later blasts used gravel stemming to hold the top of the holes as reported on the records.

(3) Charge Weight per Hole, the charge weight per hole measurements were found to be accurate for the 1999 blasts and less accurate for the later blasts. Two separate groups of data exist, the upper group or "1999 blasts" and the lower or "post 1999 blasts".

(4) Charge Weight per Delay, this strongly effects vibrations. The charge weight per delay measurements were found to be accurate for the 1999 blasts and less accurate for the later blasts.

(5) Distance Comparison, the distances to the Lipscomb residence reported on the blast logs 1999 were equal to or less than the actual distances. The method of locating the blasts remains inadequate because of the 500-foot grid.

(6) Powder Factor by Materials, two blasts in1999 had powder factors of 1.661bs/ys3in soapstone or shale, these blasts had a high probability of causing flyrock. Many of the other powder factors are not appropriate for the type of material blasted.

(7) Compliance with Scaled Distance, eight blasts were reported to violate the scaled distance limitations, all in 1999. When the true distances were determined, none of the blasts were below the allowable scaled distance.

(8) Compliance with Peak Particle Velocity, 7 of 8 blasts that were reported to be less than the allowable scaled distance were monitored with a blasting seismograph at the Lipscomb residence and were in compliance with the limits. A violation was written for the missed blast. The highest recorded vibration was 0.28 in/s. These measurements correspond with the damage claim period. Many other blasts were monitored at the pond embankment below the mine and office trailer. The monitoring locations are shown on Figure 1.

(9) Scaled Distance vs Particle Velocity, all the reported values at the Lipscomb residence fall below the National Mean Reference Line. However, when the distances are modified to reflect the actual distances as verified in the field, the vibrations at the Lipscomb residence are slightly higher than expected for typical coal mine blasting.

(10) Compliance with the Blasting Level Chart, the ground vibrations at the Lipscomb residence generally have frequencies over 12 Hz.

(11) Airblast Analysis, The airblast levels recorded for all the blasts were under the regulatory limit of 133 decibels. However 6 of 8 blasts generated higher airblast than expected for typical coal mine blasts.

In summary, the blasting in the fall of 1999 caused slightly higher ground vibrations and airblast than expected for typical coal mine blasts. This was not obvious until the true distances were determined in the field. Based on the powder factors, the blasts were probably stronger than needed for the rock type above the coal seams being mined.

VIBRATION LEVELS AT THE LIPSCOMB RESIDENCE

Ground vibration can be predicted due to the relationship of charge weight per delay and the distance to a given point. The distance is scaled to the charge weight. This is referred to as square root scaled distance.

The highest ground vibration level recorded at the Lipscomb residence was 0.28 inls on October 6, 1999. At times when no monitoring occurred, the lowest reported scaled distance was 50 on November 24, 1999 (a violation was written on this event for placing the seismograph at the wrong place). The national mean reference line from the BLEP can be used to estimate the vibration levels for the blast on November 24, 1999. The equation is:

$$PPV = 119(SD>-1.52$$

This prediction formula was developed by the U.S. Bureau of Mines; where PPV is the Peak Particle Velocity and SD is the Scaled Distance. Ground vibrations at the Lipscomb residence would have been about 0.31 in/s on November 24, 1999 using a SD of 50.

Based on measurements at the Lipscomb residence, the ground vibration frequencies, were between 8 to 26 Hertz. Most of the frequencies were over 12 Hertz. Thus the site does not exhibit low frequency characteristics that enhance the damage potential to structures.

Airblast can also be predicted due to the relationship of charge weight per delay and the distance to a given point. Again, the distance is scaled to the charge weight. For airblast this is referred to as cube root scaled distance. However airblast is strongly affected by weather conditions.

At this mine, airblast was monitored for most of the blasts at either the Lipscomb residence or at the Pond above the residence. The highest airblast was from the first blast at the mine on August 19, 1999 at 132 decibels. The likely cause of the elevated level was the lack of stemming and possibly an elevated powder factor. Due to later modifications to the blast design, by using gravel for stemming, no reason exists for the levels to be any higher.

ALLEGED DAMAGES

The Lipscomb residence is a cinder block structure built into a hillside (Figure 2). The house front has two floors above ground level with a cantilevered front porch. Footings are reported to be below the frost line. Below grade the walls are 12-inch cinder block and 8-inch cinder block above grade to the roof line. The basement floor is a concrete slab. Second story floor joists (2" by 10") rest on the vertical cinder block wall without a sill plate to distribute the load. The front porch is cantilevered beyond the front wall, above the garage door without any vertical support which adds to the stress in this area.