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August 15, 2017

Noise Monitoring Adjacent to Pratt Well Site July 18, 2017, to July 31, 2017

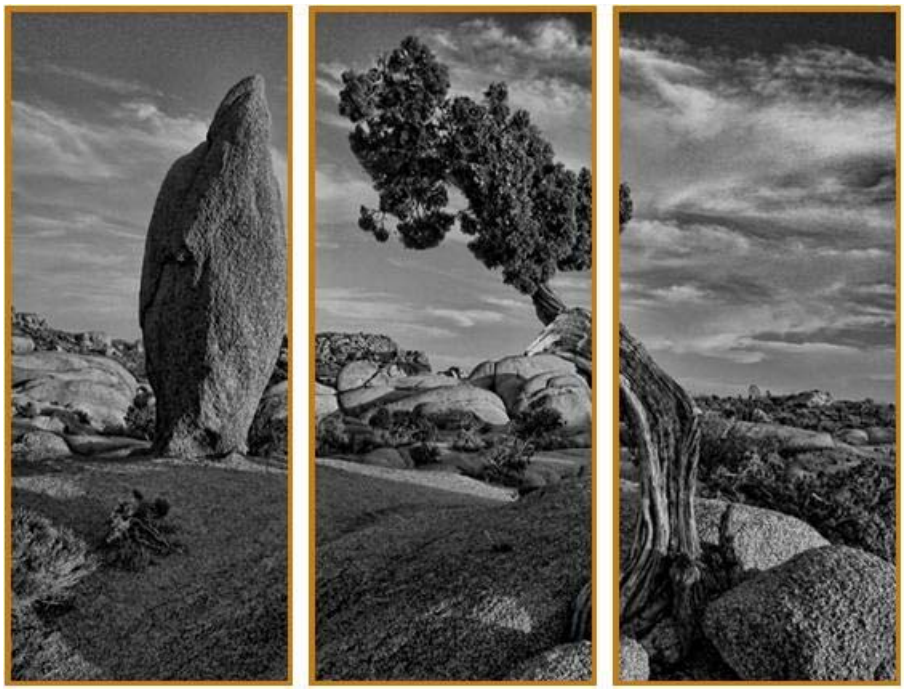
Noise Monitoring of Crestone Peak Resources Operations Erie, Colorado

Prepared For:

Town of Erie
645 Holbrook Street
Erie, CO 80516

Pinyon Project No.:

1/17-695-02.1300



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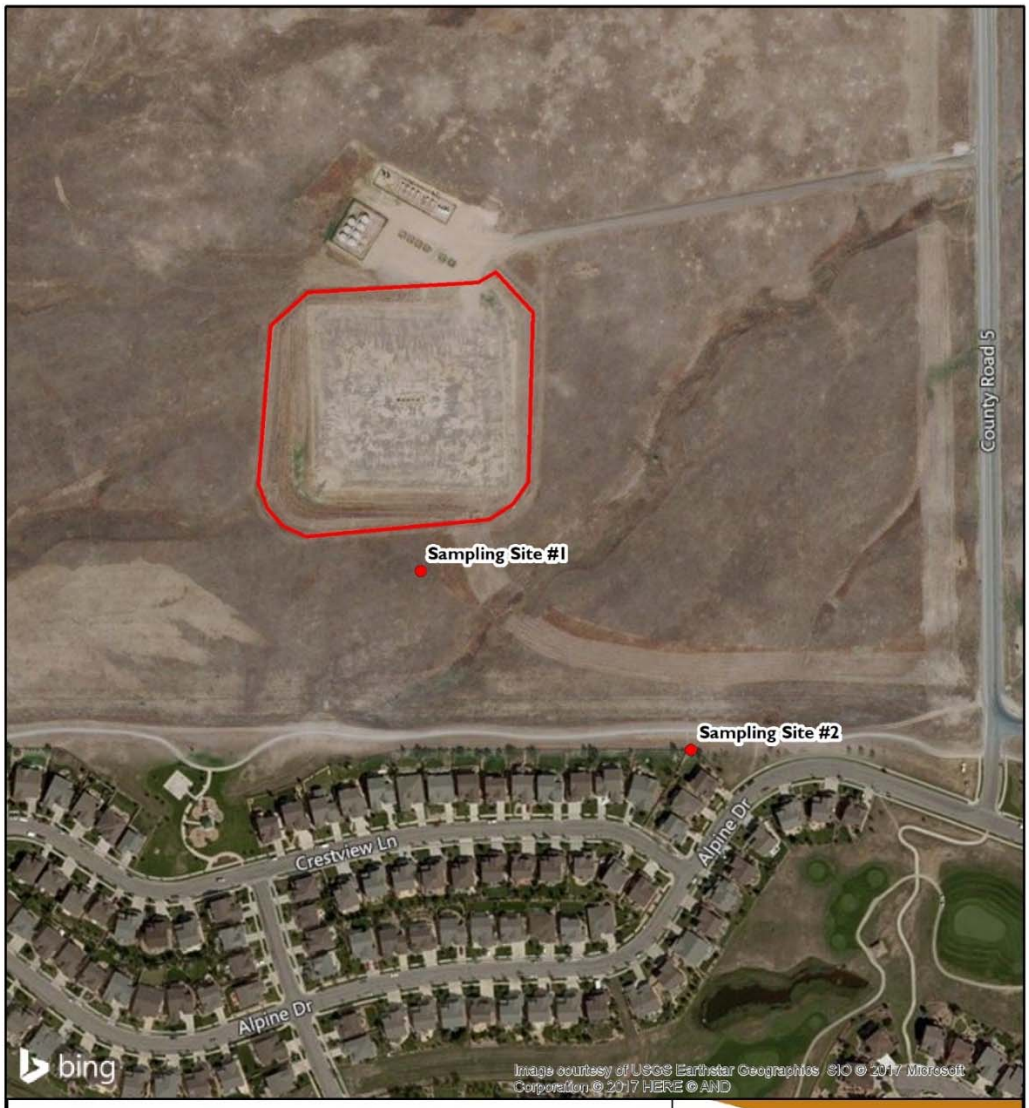
1. Introduction

The Town of Erie (Town) has contracted with Pinyon Environmental, Inc. (Pinyon), to perform noise monitoring near the Crestone Peak Resources (Crestone) Pratt well site. Pinyon collected continuous noise measurements at two locations adjacent to the well site (Figure 1). Sampling Site 1 is located approximately 350 feet to the south of the well site and was used to collect A-weighted noise measurements. Sampling Site 2 is located near a residential neighborhood approximately 830 feet to the southeast of the well site. Both A-weighted and C-weighted noise measurements were collected at Sampling Site 2. C-weighted noise was collected at Sampling Site 2 only, as Sampling Site 1 is not located near any occupied structures. Crestone began drilling operations at the Pratt well site on July 21, 2017, and continued activities at this location throughout the reporting period. Prior to the start of drilling, Pinyon also collected baseline noise data from July 18, 2017, to July 21, 2017, that is used to assess how ambient noise levels may change during Crestone's activities during this reporting period. This report details noise measurements collected during drilling activities, from July 21, 2017, at 7:00 AM through July 31, 2017, at 7:00 PM, and compares these levels to the baseline data. The noise monitoring data was analyzed to evaluate noise levels at the two locations during Crestone's drilling activities.

Figure 1-1 Noise Monitoring Locations



2. Methodology

2.1 Noise Monitoring Approach

In accordance with Colorado Oil and Gas Conservation Committee (COGCC) Rule 802, well production facilities may not exceed the maximum permissible noise levels established in accordance to Section 802.b of the rule (Table 2-1). In addition to the maximum permissible A-weighted noise levels, expressed in A-weighted decibels (dBA) (Table 2-1), COGCC Rule 802 specifies that operators may not exceed 65 C-weighted decibels (dBC) measured from the exterior wall of the residence or occupied structure nearest to the noise source, at a distance of 25 feet from the structure.

Table 2-1 COGCC Maximum Permissible Noise Levels

Zone	Maximum Permissible Noise Level	
	7:00am to 7:00pm	7:00pm to 7:00am
Residential/Agricultural/Rural	55 dBA	50 dBA
Commercial	60 dBA	55 dBA
Light Industrial	70 dBA	65 dBA
Industrial	80 dBA	75 dBA

dBA A-weighted decibel

Pinyon mobilized to sampling Site 1 and sampling Site 2 and monitored for noise at these locations using 3M Quest SoundPro DL Type 1 datalogging sound level meters. The sound level meters collected continuous measurements of both A-weighted and C-weighted decibels, as applicable to the location. At Sampling Site 1, the sound level meter monitored continuously for A-weighted noise. At sampling Site 2, continuous A-weighted and C-weighted noise measurements were collected. The monitoring period for this report lasted from July 18, 2017, at 1:00 PM through July 31, 2017, at 7:00 PM. Crestone began drilling operations at the well site at on July 21, 2017 and has continued well drilling activities throughout this reporting period.

The sound level meters are configured with a data logging system that uploads one minute time resolved measurements to a secure online database at 10-minute intervals. The sound level meters are configured with an alert system that will send a message to Pinyon's noise specialist as soon as the data is uploaded, whenever established noise criteria levels have been exceeded, based on the monitored equivalent continuous noise level (Leq). Leq is the preferred method to describe noise levels that vary over time, resulting in a single decibel value that takes into account the total sound energy over the period of time of interest. The Town and Pinyon agreed to set the alert system at 75 Leq dBA for A-weighted noise at Sampling Site 1, 60 Leq dBA for A-weighted noise at Sampling Site 2 and 70 Leq dBC for C-weighted noise at Sampling Site 2. These noise criteria levels were established based on the COGCC's maximum permissible noise levels, as well as baseline noise monitoring data collected prior to Crestone mobilizing to the well site. The C-weighted noise alert criteria level at Sampling Site 2 is set higher than the COGCC's maximum permissible noise level because baseline noise measurements collected prior to Crestone beginning operations at the well site exceeded this level.

2.2 Noise Monitoring Data Analysis

Pinyon's noise specialist downloaded the noise monitoring data from the online database for this collection period. The data was then formatted into spreadsheets that allowed for analysis of the noise monitoring data. Pinyon utilized statistical methods, as well as graphical representations of the data, to determine baseline noise levels at the two sampling locations during the monitoring period. COGCC's Rule 802 specifies different

maximum permissible noise levels based on time of day (Table 2-1). Therefore, for the statistical analysis of the noise measurements, the monitor data was split into two discrete analytical groups based on time of day:

- Daytime: 7:00 AM—6:59 PM
- Nighttime: 7:00 PM—6:59 AM

The daytime and nighttime analytical groups ended at 6:59 PM and 6:59 AM, respectively, in order to not complete a duplicate analysis of the 7:00 AM and 7:00 PM noise measurements.

To evaluate how noise levels may change over time during Crestone's operations at the well site, the monitoring data was separated into the following discrete analysis periods with each monitoring period then subdivided by time of day:

- July 18, 2017, at 1:00 PM to July 21, 2017, at 6:59 AM (Baseline Monitoring Period)
- July 21, 2017, at 7:00 AM to July 31, 2017, at 6:59 PM

Section 3-2 describes how differences in the statistical mean between these monitoring periods were analyzed to confirm the existence of statistically significant increases in average observed noise levels as compared to the baseline monitoring period. To determine the distribution of the noise monitoring data, the statistical mean, median and mode were calculated. The statistical mean, median and mode are used to evaluate the statistical distribution of the noise monitoring data. Large data sets, such as several days of continuous noise monitoring data, tend to follow the normal distribution, which is referred to as the central limit theorem (Shao, 2004). Determining the distribution of the noise monitoring data is important because this distribution is used to determine the appropriate statistical methods for further analysis. The observed relationship between the statistical mean, median and mode for the monitored datasets was determined to follow the normal distribution. The standard deviation for each monitoring periods was also calculated to evaluate the amount of variation in the baseline noise monitoring data and allow for a test of significance in differences between mean noise levels as compared to the baseline monitoring period.

3. Data Analysis Results

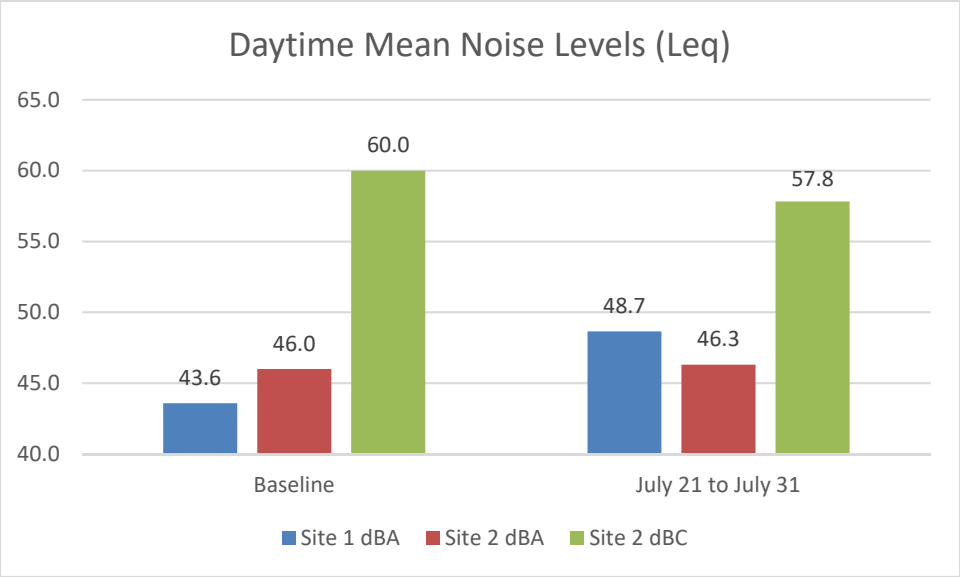
3.1 Graphical Representations of Data

Pinyon evaluated the noise monitoring data and generated several graphs that represented average and maximum noise level conditions during the monitoring periods.

3.1.1 Average Daytime Conditions

The statistical mean for each noise monitoring period was calculated for the daytime hours (7:00 AM to 6:59 PM) (Figure 3-1). Noise levels were variable between the monitoring periods, with the largest increases relative to the baseline observed in A-weighted noise at Sampling Site 1. At Sampling Site 2, there was a decrease in C-weighted noise between monitoring periods. Although Crestone had not begun drilling at the Pratt well site during the baseline monitoring period, Pinyon staff did observe staging activities occurring during this time. It is possible that the noise associated with these activities resulted in measured C-weighted noise being higher during the baseline than during the subsequent drilling activities.

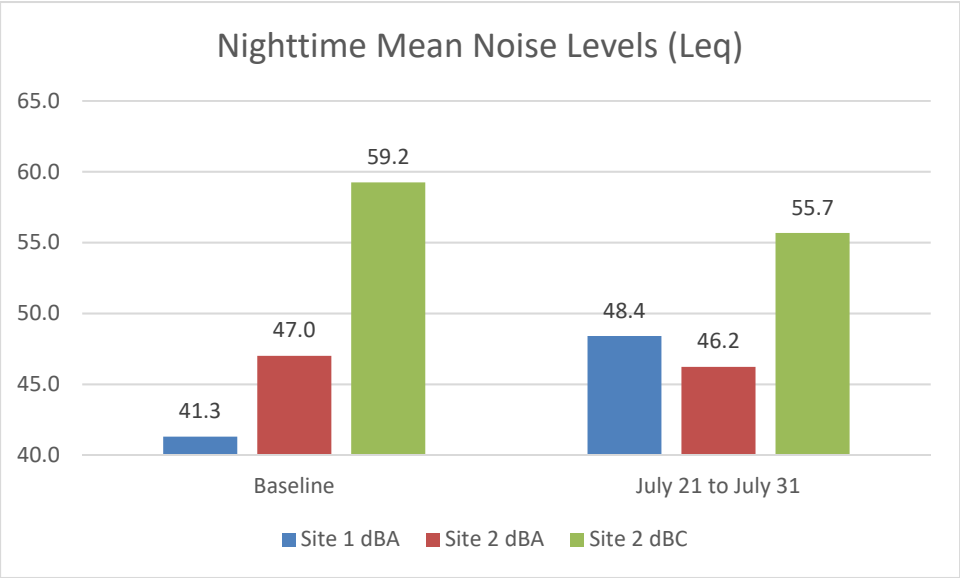
Figure 3-1 Daytime Mean Noise Levels



3.1.2 Average Nighttime Conditions

Figure 3-2 shows the statistical mean of noise monitoring data collected during the nighttime period (7:00 PM to 6:59 AM). Large increases in average A-weighted noise levels were observed at Sampling Site 1, which is located closer to the well site than Sampling Site 2. At Sampling Site 2 a decrease in C-weighted noise was observed, as well as a slight decrease in A-weighted noise.

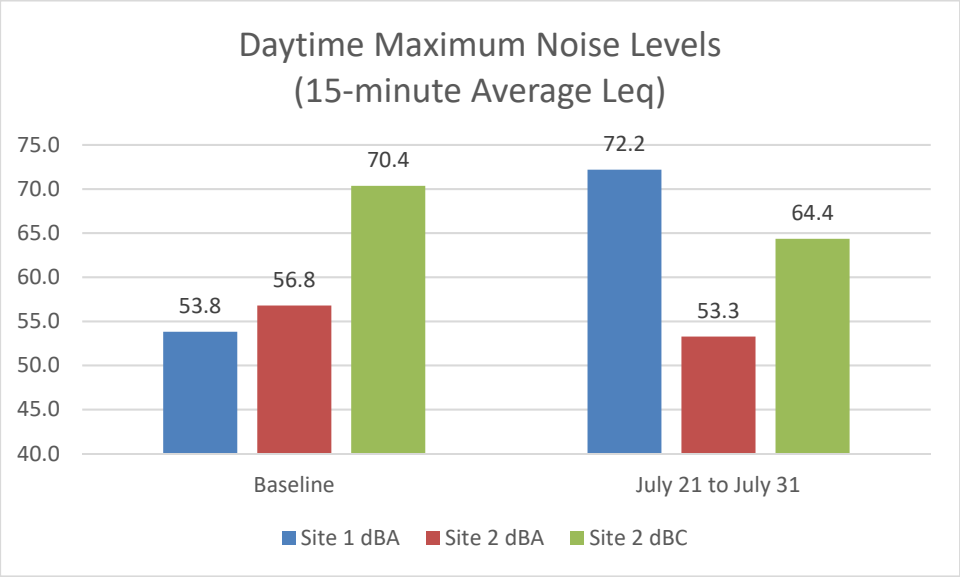
Figure 3-2 Nighttime Mean Noise Levels



3.1.3 Maximum Observed Daytime Noise Levels

Figure 3-3 shows the maximum 15-minute average noise measurements collected during the daytime condition for the monitoring periods. At Sampling Site 1 there was a significant increase in 15-minute average maximum A-weighted noise levels; however, no exceedances of the COGCC's maximum permissible noise criteria were observed. No exceedances of A-weighted or C-weighted noise at Sampling Site 2 were observed during the drilling phase of this reporting period.

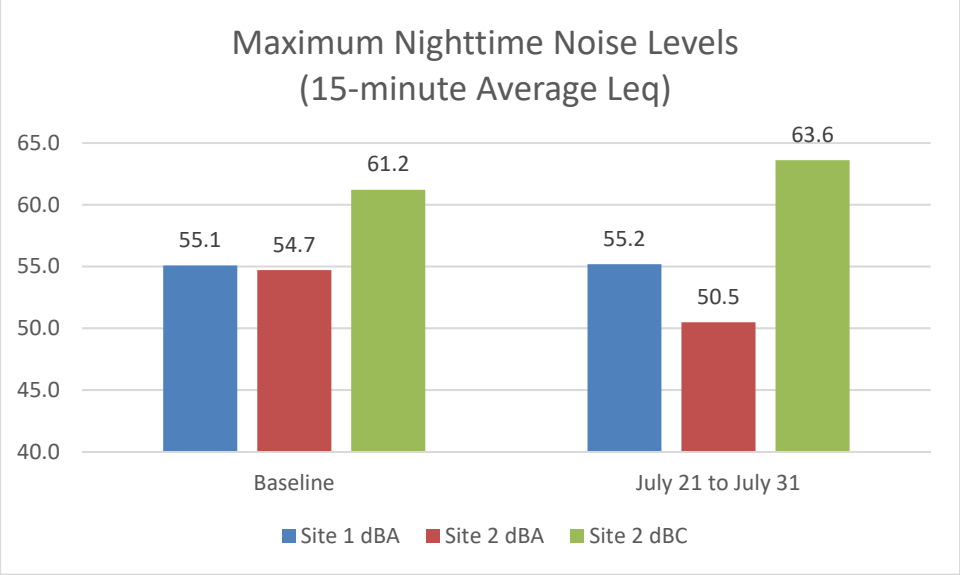
Figure 3-3 Daytime Maximum Noise Levels



3.1.4 Maximum Observed Nighttime Noise Levels

Figure 3-4 shows the maximum 15-minute average noise measurements collected during the nighttime monitoring periods. No exceedances of the COGCC's maximum permissible noise criteria were observed at Sampling Site 1 or Sampling Site 2 for A-weighted or C-weighted noise.

Figure 3-4 Maximum Nighttime Noise Levels



3.2 Statistical Analysis of Noise Monitor Data

3.2.1 Increase in Mean Noise Levels as Compared to the Baseline Monitoring Period

Pinyon observed a statistically significant change in in the mean measured noise values from the baseline monitoring period while analyzing the monitoring data. Furthermore, this difference was also observed when generating graphical representations of the measured noise values at the three noise monitors for this reporting period, which was separated into six analysis periods for each monitor. A t-test was performed to determine whether the difference in calculated mean values were statistically significant. A t-test is a statistical method for evaluating the difference in means between two sample groups (Davis, 2003). The higher the t-value the greater the difference between the two means. To assess the level of confidence in the calculated t-value, a p-value is calculated. The p-value is based on the magnitude of the t-value and the total number of samples collected between the two monitoring periods. A p-value of less than or equal to 0.001 means that there is a 99.9% confidence level that the difference between means is statistically significant. The variation in statistical mean, the t-value and the p-value was calculated for the three noise monitors for each analysis period. The calculated p-values were less than 0.001 for all comparisons meaning that the means are statistically significantly different at the 99.9% confidence interval. A 99.9% confidence interval indicates that there is less than a 0.01% likelihood that the calculated differences in statistical means are insignificant.

At Sampling Site 1 there was a statistically significant increase in A-weighted noise relative to the baseline noise measurements for both the daytime and nighttime monitoring periods (Table 3-1, Table 3-2). This increase is expected at Sampling Site 1, as it is located in close proximity to Crestone's activities, and prior to the start of Crestone's operations there were few other noise sources (e.g., roadways) located within a short distance of the monitor.

Table 3-1 Variation in Daytime Statistical Mean for A-weighted Noise at Site 1 Leq

Period	Mean (dBA)	Change (dBA)	t-value	p-value
Baseline	43.6	NA	NA	NA
July 21 to July 31	48.7	5.1	43.7	<0.0001

dBA A-weighted decibels

Table 3-2 Variation in Nighttime Statistical Mean for A-weighted Noise at Site 1 Leq

Period	Mean (dBA)	Change (dBA)	t-value	p-value
Baseline	41.3	NA	NA	NA
July 21 to July 31	48.4	7.1	66.4	<0.0001

dBA A-weighted decibels

At Sampling Site 2, there was a small, but still statistically significant increase in mean A-weighted noise levels during the daytime monitoring period (Table 3-3). The increase in mean measured noise levels was 0.3 dBA during the daytime period. This increase is less than 3 dBA and would not be considered perceptible to the human ear. A slight decrease in mean noise levels relative to the baseline monitoring period was observed during the nighttime monitoring period (Table 3-4). The decrease in A-weighted noise levels during this analysis period indicates that prolonged instances of elevated nighttime noise attributable to drilling activities at the well site were not occurring at Sampling Site 2.

Table 3-3 Variation in Daytime Statistical Mean for A-weighted Noise at Site 2 Leq

Period	Mean (dBA)	Change (dBA)	t-value	p-value
Baseline	46.0	NA	NA	NA
July 21 to July 31	46.3	0.3	4.2	<0.0001

dBA A-weighted decibels

Table 3-4 Variation in Nighttime Statistical Mean for A-weighted Noise at Site 2 Leq

Period	Mean (dBA)	Change (dBA)	t-value	p-value
Baseline	47.0	NA	NA	NA
July 21 to July 31	46.2	-0.8	-10.4	<0.0001

dBA A-weighted decibels

At Sampling Site 2 there was a decrease in C-weighted noise relative to the baseline noise measurements for all of the monitoring periods (Table 3-5, Table 3-6). Although Crestone had not begun drilling at the Pratt well site during the baseline monitoring period, Pinyon staff did observe staging activities occurring during this time. It is possible that the noise associated with these activities resulted in measured C-weighted noise being higher during the baseline than the drilling activities monitored during this reporting period.

Table 3-5 Variation in Daytime Statistical Mean for C-weighted Noise at Site 2 Leq

Period	Mean (dBC)	Change (dBC)	t-value	p-value
Baseline	60.0	NA	NA	NA
July 21 to July 31	57.8	-2.2	-35.5	<0.001

dBC C-weighted decibels

Table 3-6 Variation in Nighttime Statistical Mean for C-weighted Noise at Site 2 Leq

Period	Mean (dBC)	Change (dBC)	t-value	p-value
Baseline	59.2	NA	NA	NA
July 21 to July 31	55.7	-3.5	-91.1	<0.001

dBC C-weighted decibels

4. Conclusions

Pinyon collected continuous noise measurements at two monitoring locations adjacent to Crestone's Pratt well site from July 21, 2017, at 7:00 AM to July 31, 2017, at 7:00 PM. On July 21, 2017 Crestone commenced drilling operations at the well site and has continued activities throughout this reporting period. Prior to the start of Crestone's operations, Pinyon collected baseline data at both locations from July 18, 2017, at 1:00 PM to July 21, 2017, at 7:00 AM.

An evaluation of the noise measurements collected showed an increase in ambient noise levels that are likely attributable to Crestone's activities during this reporting period at Sampling Site 1. At Sampling Site 2 a small, but still statistically significant increase in A-weighted noise was observed during the daytime monitoring period. Analysis of the noise measurements indicated statistically significant differences between observed mean values between the baseline monitoring period and the monitoring period that captured Crestone's drilling activities, which were broken down between daytime and nighttime hours.

During this reporting period, no exceedances of the COGCC's maximum permissible A-weighted noise level were observed at Sampling Site 1 or Sampling Site 2. The COGCC's maximum permissible C-weighted noise levels were exceeded at Sampling Site 2 during the baseline monitoring period. Although Crestone had not commenced drilling during the baseline monitoring period, staging activities were occurring at the well site. A definitive assumption cannot be made as to whether elevated C-weighted noise at Sampling Site 2 during the baseline monitoring period was directly attributable to Crestone's activities at the well site. It is possible that some degree of the increase in C-weighted noise is attributable to activity in the neighborhood adjacent to Site 2.

Pinyon will continue to monitor continuously for noise at Site 1 and Site 2 throughout Crestone's operations at the well site and will compare measured levels of A-weighted and C-weighted noise to baseline levels, in order to assess potential changes in ambient noise levels during various phases of activity and evaluate whether potential exceedances of the COGCC's maximum permissible noise levels are observed.

5. References

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Shao, J. 2004. "Mathematical Statistics." Second Edition. Springer Texts in Statistics. ISBN-13: 978-0387953823