Eastern Hills 4-65 17-18 1AH-2CH
Noise Modeling Report

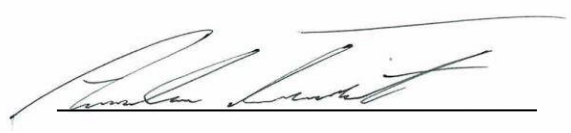
November 21, 2019

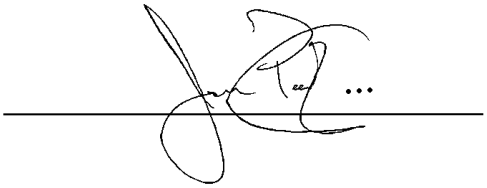
Prepared for:

ConocoPhillips
34501 East Quincy Avenue
Watkins, CO 80137

Prepared by:

Behrens and Associates, Inc.
13806 Inglewood Avenue
Hawthorne California 90250





Andrew Truitt
Senior Engineer

Jason Peetz
Engineering Manager

1. Introduction

The purpose of this study is to assess the noise impact of the drilling and fracing operations at the Eastern Hills 4-65 17-18 1AH-2CH (North) pad located approximately 0.35 miles south of the E Alameda Avenue and S Powhaton Road intersection in Arapahoe County, Colorado as shown in Figure 1-1. The drilling and fracing noise levels have been assessed in terms of the Colorado Oil and Gas Conservation Commission (COGCC) Noise Standards as well as the Oil and Gas Operator Agreement (OA) between ConocoPhillips Company and Burlington Resources Oil & Gas Company LP and the City of Aurora, Colorado dated June 5, 2019. To assess the noise impact, a noise model representing the drilling and fracing operations was constructed and compared to the allowable noise levels.

The following is provided in this report:

- A review of the ambient sound level study performed at the site.
- A review of the COGCC and OA noise standards.
- The results of the noise modeling representing the drilling and fracing operations at the site.
- Recommendations for noise mitigation measures to decrease noise emissions of the drilling and fracing operations.



Figure 1-1 Pad Location

2. Noise Fundamentals

Sound is most commonly experienced by people as pressure waves passing through air. These rapid fluctuations in air pressure are processed by the human auditory system to produce the sensation of sound. The rate at which sound pressure changes occur is called the frequency. Frequency is usually measured as the number of oscillations per second or Hertz (Hz). Frequencies that can be heard by a healthy human ear range from approximately 20 Hz to 20,000 Hz. Toward the lower end of this range are low-pitched sounds, including those that might be described as a "rumble" or "boom". At the higher end of the range are high-pitched sounds that might be described as a "screech" or "hiss".

Environmental noise generally derives, in part, from a combination of distant noise sources. Such sources may include common experiences such as distant traffic, wind in trees, and distant industrial or farming activities. These distant sources create a low-level "background noise" in which no particular individual source is identifiable. Background noise is often relatively constant from moment to moment but varies slowly from hour to hour as natural forces change or as human activity follows its daily cycle.

Superimposed on this low-level, slowly varying background noise is a succession of identifiable noisy events of relatively brief duration. These events may include the passing of single-vehicles, aircraft flyovers, screeching of brakes, and other short-term events. The presence of these short-term events causes the noise level to fluctuate. Detailed acoustical definitions are provided in Appendix A.

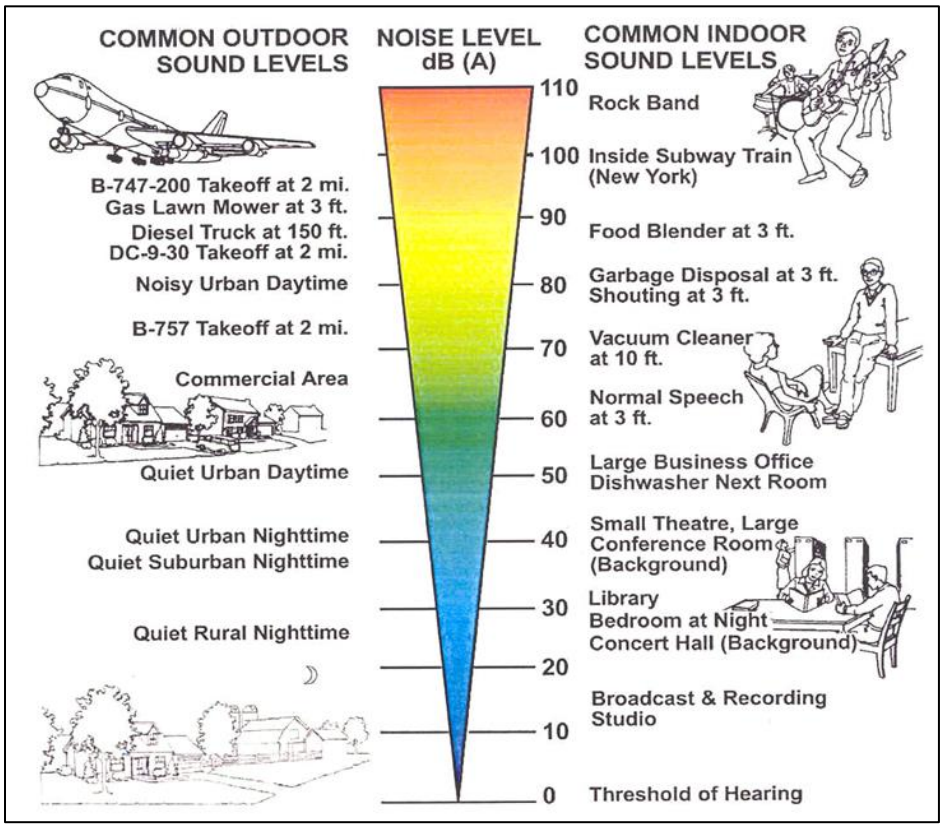


Figure 2-1 Typical Indoor and Outdoor Sound Levels

3. Ambient Sound Level Survey

An ambient sound level survey was performed adjacent to the proposed Eastern Hills North well pad near Aurora, CO from Thursday, July 18th to Monday, July 22nd, 2019 to measure and document the ambient sound levels on and near the property prior to pad construction or operational startup of proposed drilling and completions activities.

The instrumentation used for each monitoring location was a Svantek Model 971, Type 1, integrating and logging sound level meter with a windscreen. The Svantek sound level meters were calibrated with a Quest QC-10 calibrator prior to deployment. The metering systems were deployed in accordance with the Colorado Oil and Gas Conservation Commission (COGCC) standards. A Davis Vantage Vue weather station was deployed to measure wind speeds on site. The ambient survey included the measurement of A-weighted (dBA) and C-weighted (dBC) sound pressure levels documented as hourly and 15-minute equivalent sound levels (Leq). No oil and gas operations or pad construction activities were taking place throughout the duration of the survey. Per the COGCC code, measurements should not be conducted when the wind velocity exceeds five (5) miles per hour. As a result, the weather data recorded during the survey has been used to excluded sound level readings captured when wind speeds exceeded five (5) miles per hour from the reported results.

The measured ambient noise levels were used to calculate typical daytime (7am to 7pm) and nighttime (7pm to 7am) equivalent (Leq) values at the three monitoring locations shown in Figure 3-1. The calculated ambient daytime and nighttime noise levels are summarized in Table 3-1. The measured 1-hour and 15-minute Leq values are show graphically and in tables in Appendix B. Pictures of each deployment location are also shown in Appendix B.

Table 3-1 presents the overall dBA and dBC daytime and nighttime equivalent (Leq) ambient sound level per day for the entire deployment period with sound level data during high winds (> 5mph) omitted per COGCC. The measured sound levels vary between the daytime and nighttime periods and also vary per monitoring location. Noise level variations throughout the day are typically caused by daily cycles in traffic levels and other surrounding industrial, commercial, and residential activities. Monitoring Locations 1 and 3 registered higher daytime and nighttime dBA and dBC levels than Monitoring Location 2 due to their closer proximity to the neighborhood developments to the north and southwest.

Table 3-1 Average Ambient Sound Level Measurements

Day	Monitoring Location 1				Monitoring Location 2				Monitoring Location 3			
	Daytime Leq Ambient Noise Levels		Nighttime Leq Ambient Noise Levels		Daytime Leq Ambient Noise Levels		Nighttime Leq Ambient Noise Levels		Daytime Leq Ambient Noise Levels		Nighttime Leq Ambient Noise Levels	
	dBA	dBC	dBA	dBC	dBA	dBC	dBA	dBC	dBA	dBC	dBA	dBC
1	49.3	68.3	46.3	61.0	52.0	75.1	49.2	68.0	54.8	69.6	49.8	61.0
2	48.6	69.2	43.8	57.7	51.7	74.4	46.2	64.2	56.9	69.0	46.9	59.6
3	48.8	62.1	46.3	60.7	54.0	77.4	49.6	69.0	51.9	71.7	48.9	60.9
4	50.7	72.9	41.1	60.4	55.2	81.7	42.7	65.3	53.6	70.8	45.7	63.9
5	53.0	71.5			52.9	72.2			58.7	71.2		
Overall Leq	50.4	70.0	44.9	60.1	53.4	77.5	47.7	67.1	55.8	70.6	48.1	61.6

Notes: Day 1 Daytime is an Leq (logarithmic average) from 2pm until 7pm and Day 5 Daytime is an Leq (logarithmic average) from 7am until 2pm. These days were partial due to deployment and decommission time of the meters.

The overall daytime and nighttime average sound levels from Monitoring Location 3 were used to establish representative ambient sound levels for the site. Monitoring Location 3 represents the closest monitoring location to the proposed Eastern Hills North pad as well as the closest proximity to the nearest Residential Building Units (RBU's). The representative ambient sound levels for the site that were used to establish allowable noise level limits are shown in Table 3-2.

Table 3-2 Eastern Hills Pad Representative Ambient Sound Levels

Daytime - Overall Leq		**Nighttime - Overall Leq**	
dBA	**dBC**	**dBA**	**dBC**
55.8	70.6	48.1	61.6



Figure 3-1 Ambient Monitoring Locations

4. Noise Standards

4.1 Colorado Oil and Gas Conservation Commission (COGCC)

The analysis was developed to evaluate drilling and fracing noise levels at adjacent occupied structures and verify compliance of drilling operations with the Colorado Oil and Gas Conservation Commission (COGCC) Section 802 "Noise Abatement" requirements. The COGCC Code lists exterior noise limits for stationary noise sources. The noise limits are provided in Table 4-1.

Table 4-1 COGCC Sec. 802(b) Noise Abatement Requirements "Exterior Noise Level Limits"

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

Section 802.b of the standard states:

> The type of land use of the surrounding area shall be determined by the Director in consultation with the Local Government Designee taking into consideration any applicable zoning or other local land use designation. In the hours between 7:00 a.m. and the next 7:00 p.m. the noise levels permitted above may be increased ten (10) dB(A) for a period not to exceed fifteen (15) minutes in any one (1) hour period. The allowable noise level for periodic, impulsive or shrill noises is reduced by five (5) dB (A) from the levels shown.
>
> (1) Except as required pursuant to Rule 604.c.(2)A., operations involving pipeline or gas facility installation or maintenance, the use of a drilling rig, completion rig, workover rig, or stimulation is subject to the maximum permissible noise levels for industrial zones.

Section 802C.(1) of the standard states:

> Sound levels shall be measured at a distance of three hundred and fifty (350) feet from noise source. At the request of the complainant, the sound level shall also be measured at a point beyond three hundred fifty (350) feet that the complainant believes is more representative of the noise impact. If an oil and gas well site, production facility, or gas facility is installed closer than three hundred and fifty (350) feet from an existing occupied structure, sound levels shall be measured at a point twenty-five feet from the structure toward the noise source. Noise levels from oil and gas facilities located on surface property owned, leased, or otherwise controlled by the operator shall be measured at the three hundred and fifty (350) feet or at the property line, whichever is greater.

Section 802(d) of the standard states:

> In situations where the complainant or Commission onsite inspection indicates that low frequency noise is a component of the problem, the Commission shall obtain a sound level measurement twenty-five (25) feet from the exterior wall of residence or occupied structure to the noise source, using a noise meter calibrated to the dB(C). If this reading exceeds 65 dB(C), the Commission shall require the operator to obtain a low frequency noise impact analysis by qualified sound expert, including identification of any reasonable control measures available to mitigate such low frequency noise impact.

Section 604.c.(2) A. Noise of the standard states:

> Operations involving pipeline or gas facility installation or maintenance, or the use of a drilling rig, are subject to the maximum permissible noise levels for Light Industrial Zones, as measured at the nearest Building Unit. Short-term increases shall be allowable as described in 802.c. Stimulation or re-stimulation operations and Production Facilities are governed by Rule 802.

4.2 The Oil and Gas Operator Agreement (OA) Between ConocoPhillips Company and Burlington Resources Oil & Gas Company LP and The City of Aurora, Colorado Dated June 5, 2019.

Exhibit C. 2. Noise Mitigation:

2.1 COGCC 800 Series Regulations

> Operator shall comply with the sound limitation regulations set forth in the COGCC 800 Series Aesthetic and Noise Control Regulations.

2.2 Noise Baseline Study

> Operator shall perform a baseline noise study if a New Well is planned within 2,640 feet of an area with five Residential Building Units or one High Occupancy Building. If the noise study indicates the need for sound mitigation, Operator shall utilize appropriate measures to meet acceptable OSHA and COGCC requirements for A and C scale sound unless Operator obtains waivers from all affected property owners within that distance. Operator shall provide a copy of the noise study to the City.

2.3 Noise Mitigation

> During Drilling Phase and Completion Phase, Operator shall use noise mitigation for any New Well located (1) in the Northeast Plains Medium Density Residential Subarea (or equivalent zoning per adoption of the unified development code) and west of the longitudinal line that is parallel with Hudson Road, as shown on Exhibit A-2, or (2) within 1,320 feet of a Residential Building Unit or within 1,500 feet of one High Occupancy Building unless Operator obtains waivers from all affected property owners within that distance.

2.4 Additional Noise Measures

For New Wells within 1,320 feet of Residential Building Unit, Operator may be required to provide for additional noise mitigation based on the following site-specific characteristics: 2.4.1. Nature and proximity of adjacent development (design, location, use); 2.4.2. Prevailing weather patterns, including wind directions;
2.4.3. Type and intensity of the noise emitted; and 2.4.4. Vegetative cover on or adjacent to the site or topography. Based on the foregoing, for New Wells within 1,320 feet of a Residential Building Unit, the City may request additional noise abatement measures or BMPs depending on the site including a noise management plan specifying: the hours of maximum noise and the type, frequency and level of noise emitted, the mitigation methods to be employed to control both A and C scale noise, and restriction on unloading pipe from delivery trucks between 8:00 pm and 7:00 am.

2.5 COGCC Rule 802

The Operator shall comply with all provisions of COGCC Rule 802 on Noise Abatement with respect to the Well Sites; provided, however, that other than during Construction, Drilling, and Completions Phases, the maximum permissible noise levels to be applied under Rule 802 will be the greater of: the levels set forth for the land use type of "Residential/Agricultural/Rural" under Rule 802 if measurements are taken at 1,320 feet from the sound walls at the Well Site; or four dB(A) higher than baseline ambient sound measure at 1,320 feet from the sound walls at the Well Site. All measurements considered for compliance with this section will be taken by a third-party contractor using industry standard equipment and practices.

2.6 C Scale Noise

The Operator shall address C scale noise/vibration through berming, capable sound walls, and other associated BMPs. During the Drilling and Completion Phases of New Wells within 1,320 feet of a Residential Building Unit or 1,500 feet of a High Occupancy Building, the Operator shall construct a sound mitigating wall or comparable measures to mitigate noise as appropriate on a case-by-case or modeled basis. Additional mitigations must be taken by the Operator if C-scale noise levels are increased the larger of either 5db over ambient or above 65db at 25' from the nearest Residential Building Unit.

2.7 COGCC Measurement Rules

All sound measurements must be taken in accordance with the COGCC Rules and additional considerations including: Wind speed; Proper documenting; Average measurement periods; and Measurements 4 feet off the ground or as close as possible.

2.8 Financial Obligations

All noise mitigation measures shall be paid for by the Operator.

4.3 Site-Specific Noise Requirements

Per Section 2.1 of the OA with The City of Aurora, the Applicant (ConocoPhillips) will comply with the sound limitation regulations set forth in the COGCC 800 Series Aesthetic and Noise Control regulations.

Per Section 2.2 of the OA, the Applicant is required to conduct a baseline noise study if a New Well is planned within 2,640'of 5 Residential Building Units (RBU) or 1 High Occupancy Building (HOBU). There are greater than (5) RBU's within 2,640' of the Eastern Hills North Well Site, but there are no HOBU's within 2,640' of the Eastern Hills North Well Site, so a baseline noise study is required. The Applicant had Behrens and Associates Environmental Noise Control (BAENC), a third-party engineering firm, perform an environmental noise impact assessment and will follow its mitigation recommendations to stay in compliance with the COGCC 800 series requirements. The Applicant will provide Behrens' Noise Modeling Report to the City.

Per Section 2.3 of the OA, Applicant is required to use noise mitigation if a New Well is within the area identified on Exhibit A-2 to the OA or if the New Well is within 1,320' of a RBU or 1,500' of a HOBU. There are no (0) RBU's within 1,320' of the Eastern Hills North Well Site, and there are no (0) HOBU's within 1,500' of the Eastern Hills North Well Site. However, the Eastern Hills North Well Site is located within the area identified on Exhibit A-2 to the OA, so Applicant will use noise mitigation during the Drilling and Completion Phases for the Eastern Hills North Well Site. Applicant will use berming, bales, or sound walls to mitigate noise emissions during these phases.

Per Section 2.4 of the OA, Applicant may be required to conduct additional noise mitigation for New Wells within 1,320' of a RBU. As stated above, there are no RBU's within 1,320' of the Eastern Hills North Well Site.

Per Section 2.5 of the OA, the Applicant shall comply with all provision of COGCC Rule 802. Based on the COGCC Rule 802 noise regulations, the operational drilling noise levels at the site will be limited to the light industrial limit of 65.0 dBA at 350 feet from the noise sources or the property line of the site (whichever is farther). The operational fracing noise levels at the site will be limited to the industrial limit of 75.0 dBA at 350 feet from the noise sources or the property line of the site (whichever is farther). The ambient sound level data collected and presented in Section 3 of this report was not high enough to alter the COGCC Rule 802 dBA limits for drilling or fracing.

Per Section 2.6 of the OA, Applicant is required to address C scale noise/vibration if a New Well is within 1,320' of a RBU or 1,500' of a HOBU. As stated above, there are no (0) RBU's within 1,320' of the Eastern Hills North Well Site, and there are no (0) HOBU's within 1,500' of the Eastern Hills North Well Site. However, Applicant will already be using noise mitigation during the Drilling and Completion Phases for the Eastern Hills North Well Site pursuant to Section 2.3 of the OA.

Section 2.6 also states "Additional mitigations must be taken by the Operator if C-scale noise levels are increased the larger of either 5db over ambient or above 65db." An ambient sound level study was performed by Behrens and Associates from July 18th to July 22nd, 2019 and is summarized in Section 3 of this report. Based on the representative ambient sound levels presented in Table 3-2 and the allowances offered by Section 2.6 of the OA, an adjustment to the allowable daytime and nighttime dBC limits is permissible.

The measured daytime ambient noise level of 70.6 dBC with an increase of 5 dB (75.6 dBC) is greater than the stated limit of 65 dBC. Additionally, the measured nighttime ambient noise level of 61.6 dBC with an increase of 5 dB (66.6 dBC) is greater than the stated 65 dBC limit. The measured ambient dBC levels as well as the permissible adjusted code limits are presented in Table 4-2. Since the proposed drilling and fracing operations could operate 24 hrs/day,

the more conservative nighttime allowable dBC limit of 66.6 will be used as the acoustical design target for the unmitigated and mitigated modeling scenarios analyzed in Section 5 of this report. It is noted that the measured ambient daytime dBC levels were significantly higher than the 66.6 dBC nighttime target and therefore field measurements conducted during daytime hours will be likely be greater than 66.6 dBC and should be compared to the daytime limit of 75.6 dBC.

Table 4-2 Measured and Adjusted dBC Code Limits Based

Daytime Allowable Ambient Level (dBC)		**Nighttime Allowable Ambient Level (dBC)**	
Measured Ambient Level	**Adjusted Level (Measured Ambient + 5 dBC)**	**Measured Ambient Level**	**Adjusted Level (Measured Ambient + 5 dBC)**
70.6	75.6	61.6	66.6

Per Section 2.7 of the OA, all sound measurements will be taken in accordance with the COGCC Rules.

Per Section 2.8 of the OA, the Applicant had Behrens and Associates Environmental Noise Control (BAENC) perform an environmental noise impact assessment.

5. Eastern Hills 4-65 17-18 1AH-2CH Pad Noise Modeling

The noise impact analysis was conducted with the application of three-dimensional computer noise modeling software. All models in this report are developed with SoundPLAN 8.0 software using the ISO 9613-2 standard. Noise levels are predicted based on the locations, noise levels and frequency spectra of the noise sources, and the geometry and reflective properties of the local terrain, buildings and barriers.

Sound level data utilized in the drilling model was based on file data of the Nabors B-16 rig. Rig placement and orientation was coordinated with ConocoPhillips and oriented to minimize noise impact when possible. The rig was modeled with the V-door facing east and the backyard equipment positioned on the south side of the pad. The predicted modeling results are dependent on equipment and mitigation orientation as indicated.

Sound level data utilized in the fracing model was based on file data of the Halliburton Q10 Fleet. Fleet placement and orientation was coordinated with ConocoPhillips and oriented to minimize noise impact when possible. Eleven hydraulic fracturing pump trucks operating simultaneously have been included in the model and were positioned west of the well heads. The predicted modeling results are dependent on equipment and mitigation orientation as indicated.

The noise sensitive receptor locations have been chosen to be consistent with the requirements of the COGCC and OA noise standards. The requirements state that dBA noise levels shall comply with the applicable noise limits as measured at 350 feet from the nearest noise source or at the property line, whichever is greater. The requirements state that dBC noise levels shall comply with the applicable noise limits as measured at 25 feet from the exterior wall of nearby residences or occupied structures. Figure 5-1 shows the dBA and dBC noise sensitive receptor locations.
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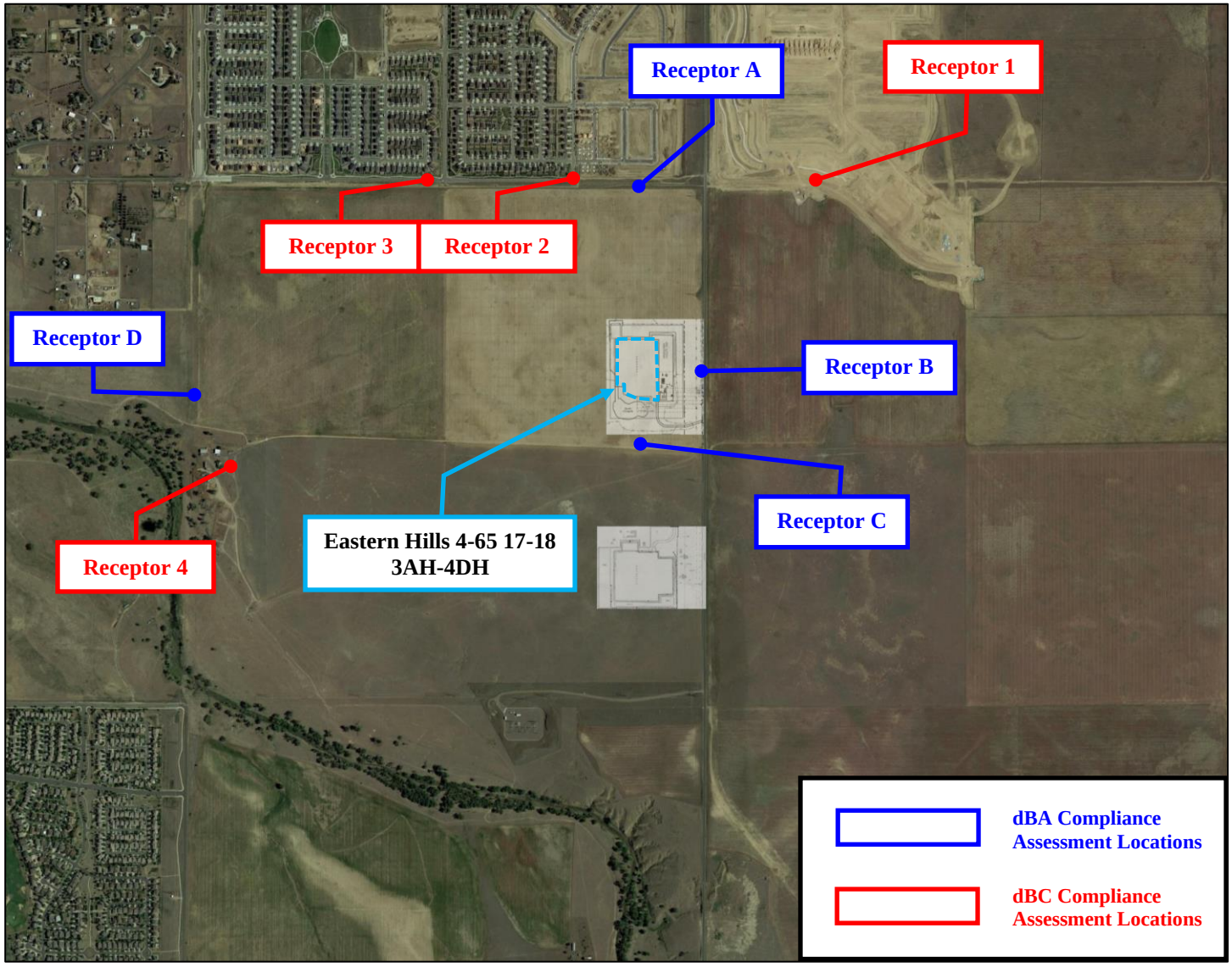


Figure 5-1 Receiver Locations

5.1 Unmitigated Noise Modeling Results

The results of the unmitigated drilling and fracing noise modeling are presented in Table 5-1 and Table 5-2. The locations in the tables correspond to the locations identified in Figure 5-1. The results of the noise modeling are also shown as noise contour maps. Figure 5-2 shows the unmitigated drilling noise contour map in the A-weighted scale and Figure 5-3 shows the unmitigated drilling noise contour map in the C-weighted scale. Figure 5-4 shows the unmitigated fracing noise contour map in the A-weighted scale and Figure 5-5 shows the unmitigated fracing noise contour map in the C-weighted scale. The noise contours are provided in 5 dB increments with the color scale indicating the sound level of each contour.

The predicted noise levels represent only the contribution of the project operations and do not include ambient noise or noise from other facilities. Ambient data is not included in the modeling results due to the fact that the ambient data varies by monitoring location and day to day, as indicated in Table 3-1, and therefore will have varying levels of contribution to the overall measured field sound levels depending on the time of day and location. Actual field sound level measurements may vary from the modeled noise levels due to other noise sources such as traffic, other facilities, other human activity, or environmental factors.

The results of the unmitigated noise modeling indicate that all modeled receivers are predicted to comply with the A-weighted COGCC noise limits for both drilling and fracing operations. Additionally, all modeled receivers are predicted to comply with the C-weighted COGCC noise limit during drilling operations, however, multiple modeled receiver locations are predicted to exceed the C-weighted COGCC nighttime noise limit during fracing operations by as much as 4.3 dBC.

Table 5-1 A-Weighted Unmitigated Noise Modeling Results

Receiver	Drilling	Fracing
A	43.7	59.2
B	57.2	68.8
C	52.7	67.9
D	33.0	45.1
COGCC Noise Limit	**70.0 Day / 65.0 Night**	**80.0 Day / 75.0 Night**

Table 5-2 C-Weighted Unmitigated Noise Modeling Results

Receiver	Drilling	Fracing
1	57.7	67.1
2	58.3	70.9
3	55.1	67.3
4	51.5	61.5
Adjusted COGCC Noise Limit	**75.6 Day / 66.6 Night**	

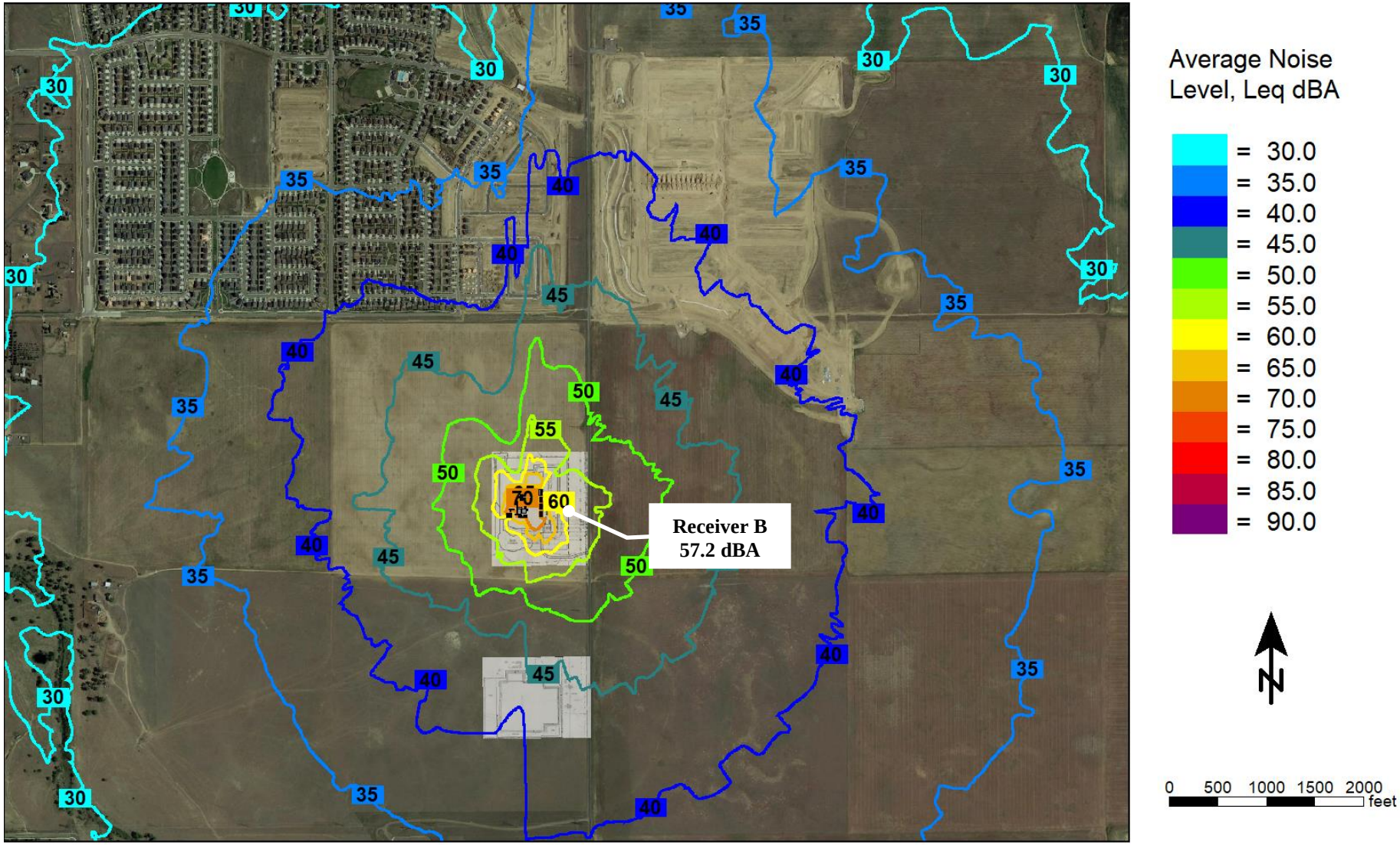


Figure 5-2 Unmitigated Drilling Noise Contour Map (dBA)

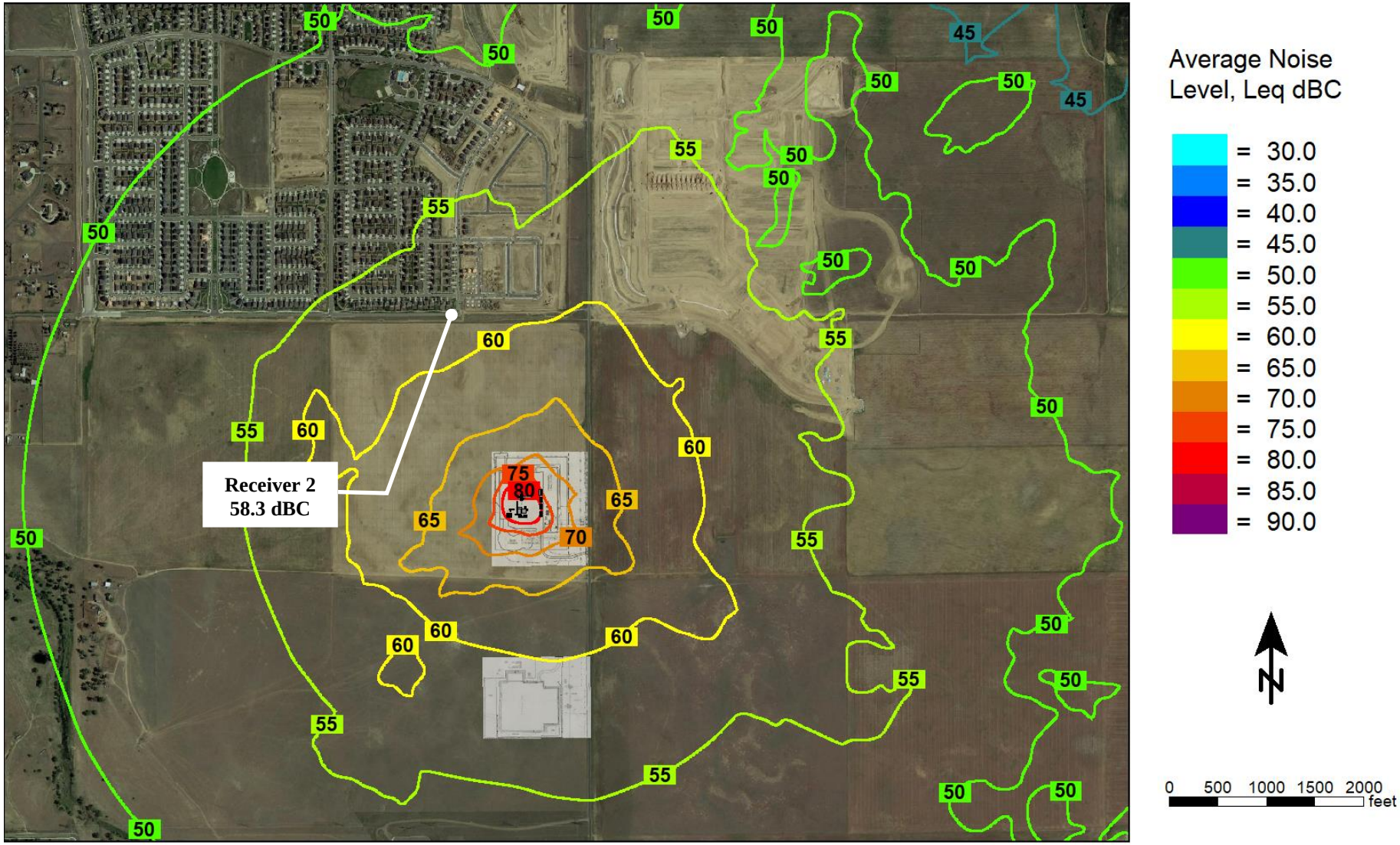


Figure 5-3 Unmitigated Drilling Noise Contour Map (dBC)

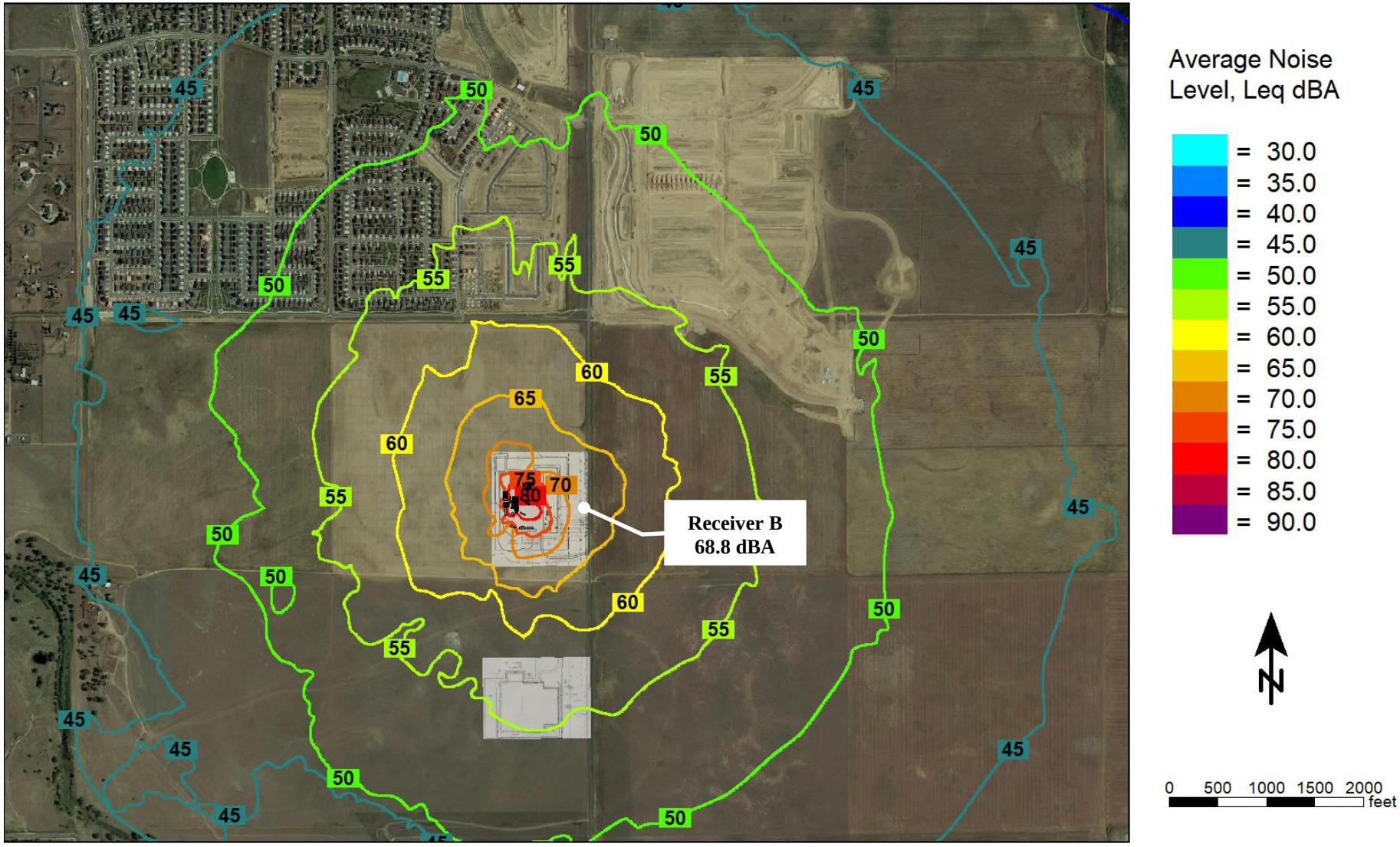


Figure 5-4 Unmitigated Fracing Noise Contour Map (dBA)

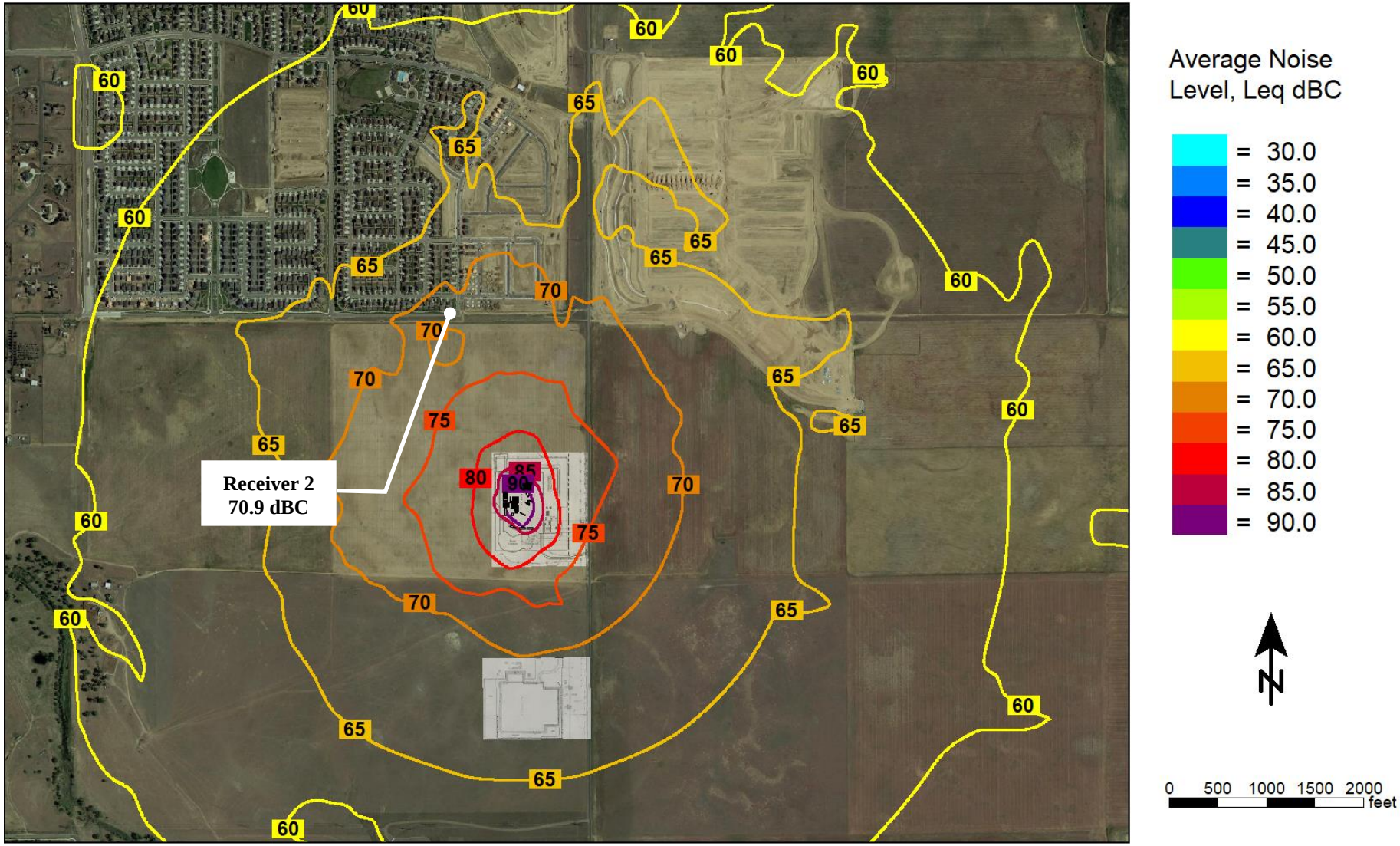


Figure 5-5 Unmitigated Fracing Noise Contour Map (dBC)

5.2 Mitigated Noise Modeling Scenarios

Noise mitigation was added to reduce noise levels at the residences in close proximity to the site. The noise mitigation included in the modeling is presented in Table 5-3. The modeled mitigated fracing layout is shown in Figure 5-6.

Table 5-3 Modeled Mitigation Scenarios

Modeled Scenario	Description
Fracing	• Approximately 440 linear feet of 40-foot-high, Sound Transmission Class (STC) 32 acoustical wall installed along the northern perimeter of the site. • Approximately 740 total linear feet of 32-foot-high, STC-32 acoustical wall installed along the western and eastern perimeter of the site. • Approximately 104 linear feet of 24-foot-high, STC-43 portable acoustical panels installed north of the fracing trucks. • The fracing pump trucks are positioned west of the well heads

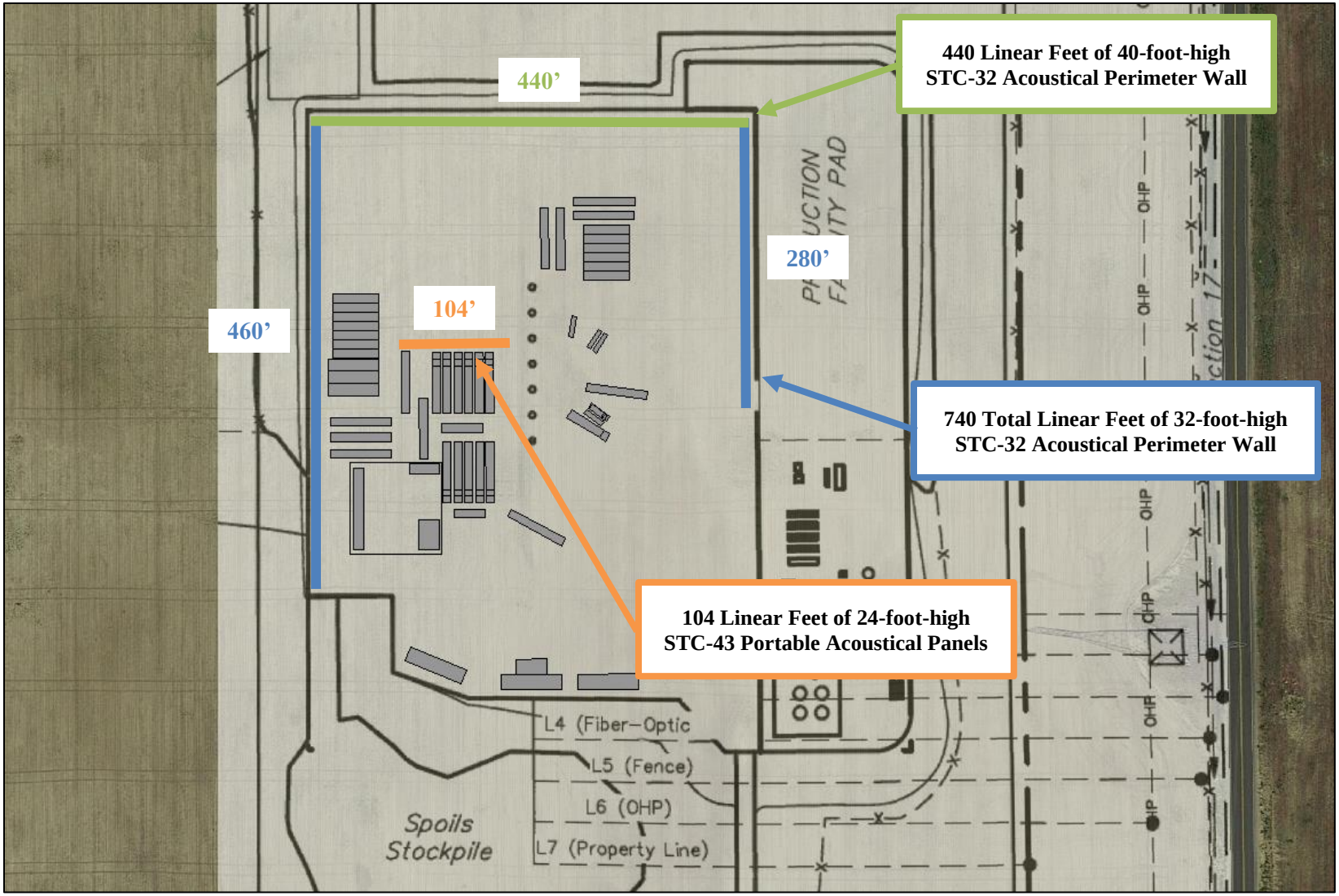


Figure 5-6 Fracing Mitigation Layout

5.3 Mitigated Noise Modeling Results

The results of the mitigated drilling and fracing noise modeling are presented in Table 5-4 and Table 5-5. The locations in the tables correspond to the locations identified in Figure 5-1. The results of the noise modeling are also shown as noise contour maps. Figure 5-7 shows the mitigated fracing noise contour map in the A-weighted scale and Figure 5-8 shows the mitigated fracing noise contour map in the C-weighted scale. The noise contours are provided in 5 dB increments with the color scale indicating the sound level of each contour.

The predicted noise levels represent only the contribution of the project operations and do not include ambient noise or noise from other facilities. Ambient data is not included in the modeling results due to the fact that the ambient data varies by monitoring location and day to day, as indicated in Table 3-1, and therefore will have varying levels of contribution to the overall measured field sound levels depending on the time of day and location. Actual field sound level measurements may vary from the modeled noise levels due to other noise sources such as traffic, other facilities, other human activity, or environmental factors.

The results of the mitigated noise modeling indicate that with implementation of the recommended mitigation measures, all modeled receivers are predicted to comply with the C-weighted COGCC noise limit during the fracing operations.

Table 5-4 A-Weighted Fracing Noise Modeling Results

Receiver	Unmitigated	Mitigated
A	59.2	48.4
B	68.8	66.8
C	67.9	67.9
D	45.1	44.7
COGCC Noise Limit	**80.0 Day / 75.0 Night**	

Table 5-5 C-Weighted Fracing Noise Modeling Results

Receiver	Unmitigated	Mitigated
1	67.1	64.9
2	70.9	64.9
3	67.3	63.6
4	61.5	61.2
Adjusted COGCC Noise Limit	**75.6 Day / 66.6 Night**	

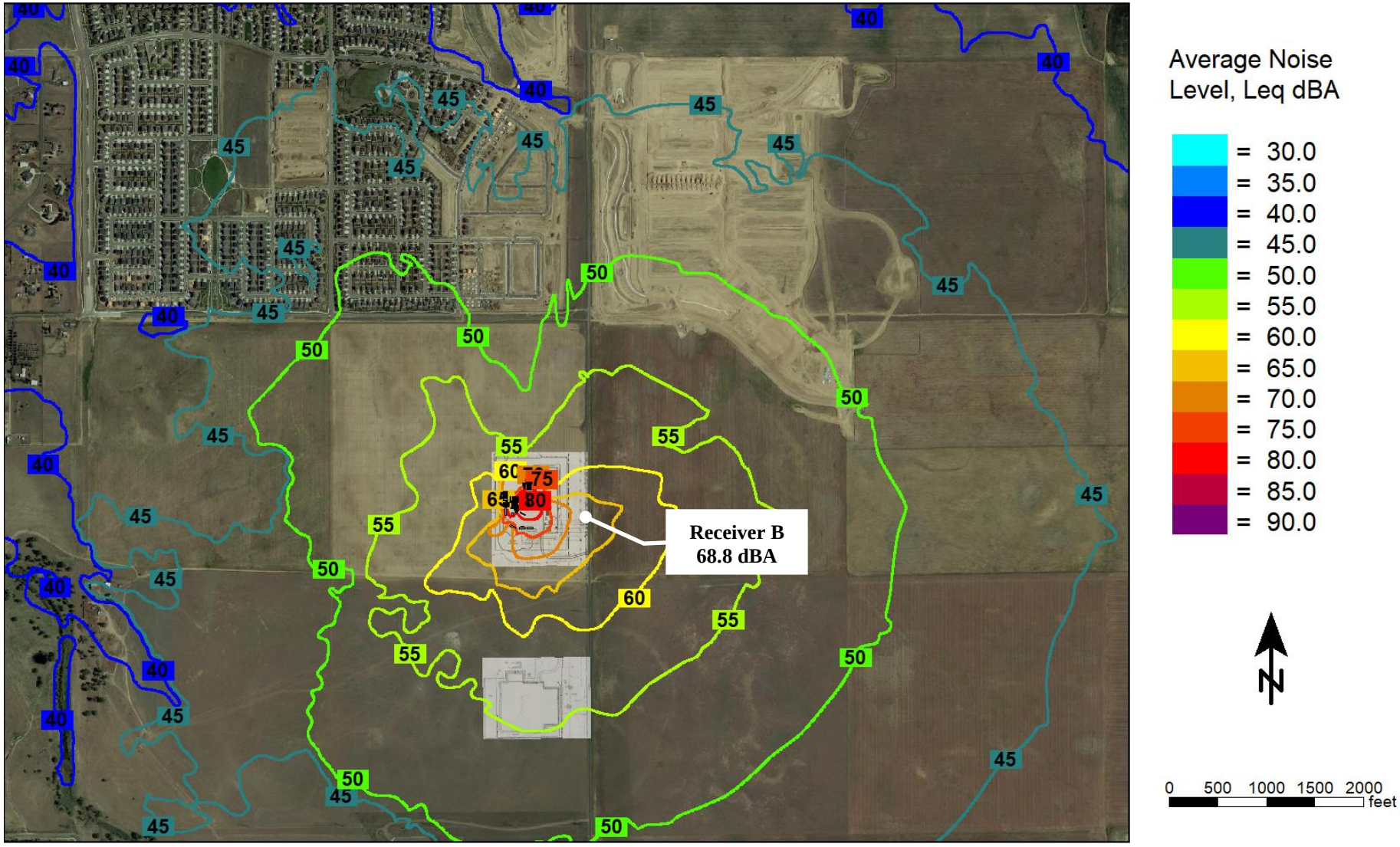


Figure 5-7 Mitigated Fracing Noise Contour Map (dBA)

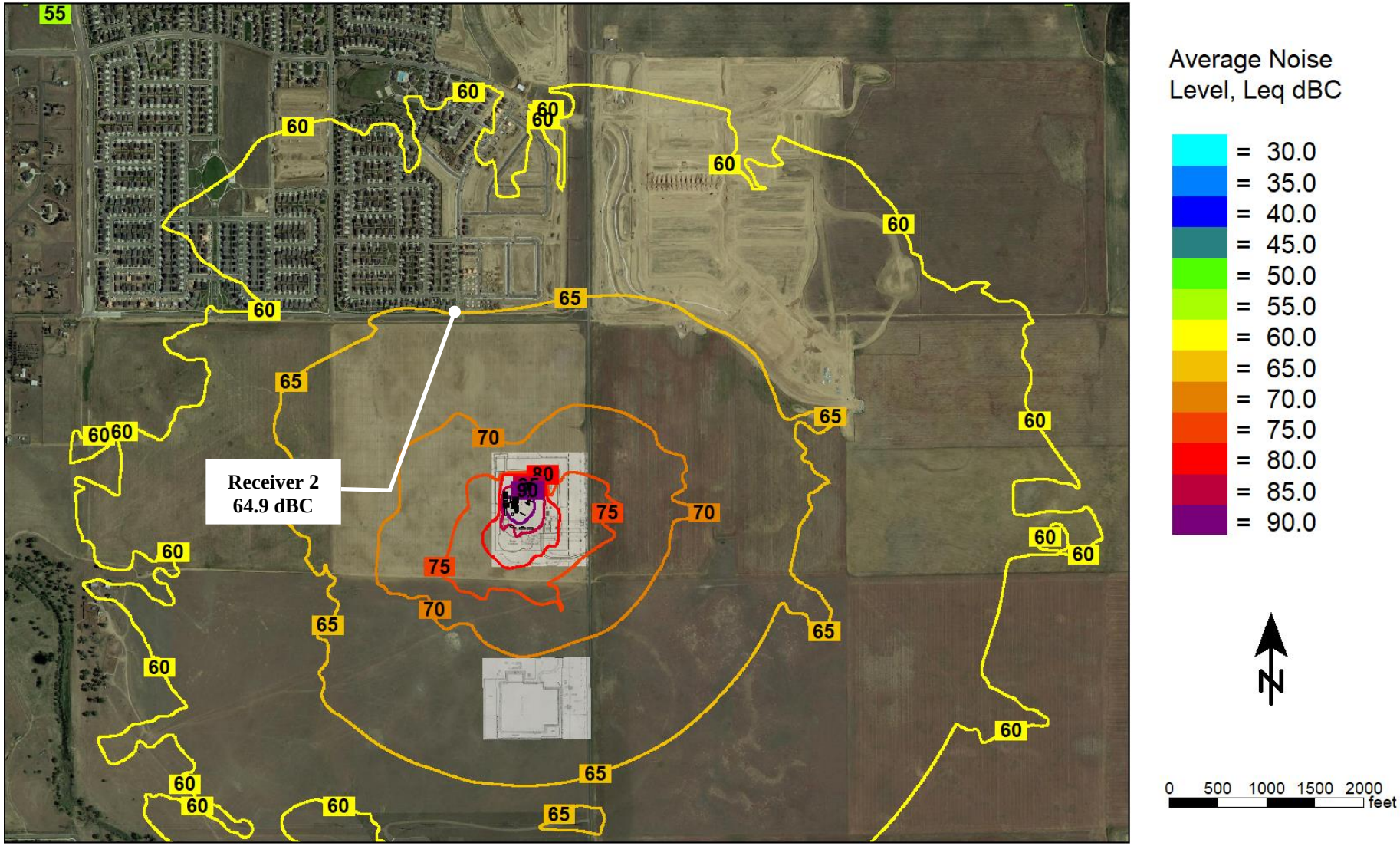


Figure 5-8 Mitigated Fracing Noise Contour Map (dBC)

6. Conclusion

Noise models of the proposed drilling and fracing operations were constructed for the Eastern Hills 4-65 17-18 1AH-2CH pad in Arapahoe County, Colorado. The unmitigated noise models indicate that the fracing operations will exceed the C-weighted COGCC and OA noise limit at multiple modeled receiver locations.

Mitigation was added to the unmitigated fracing noise model to reduce the noise levels at the residences in close proximity to the pad. With implementation of the recommended mitigation measures, the fracing operations are predicted to comply with the A-weighted and C-weighted COGCC and OA noise limit at all modeled receiver locations.

Appendix A Glossary of Acoustical Terms

Ambient Noise
The all-encompassing noise associated with a given environment at a specified time, usually a composite of sound from many sources both near and far.

Average Sound Level
See Equivalent-Continuous Sound Level

A-Weighted Sound Level, dB(A)
The sound level obtained by use of A-weighting. Weighting systems were developed to measure sound ina way that more closely mimics the ear's natural sensitivity relative to frequency so that the instrument is less sensitive to noise at frequencies where the human ear is less sensitive and more sensitive at frequencies where the human ear is more sensitive.

C-Weighted Sound Level, dBC
The sound level obtained by use of C-weighting. Follows the frequency sensitivity of the human ear at very high noise levels. The C-weighting scale is quite flat and therefore includes much more of the low-frequency range of sounds than the A and B scales. In some jurisdictions, C-weighted sound limits are used to limit the low-frequency content of noise sources.

Community Noise Equivalent Level (CNEL)
A 24-hour A-weighted average sound level which takes into account the fact that a given level of noise may be more or less tolerable depending on when it occurs. The CNEL measure of noise exposure weights average hourly noise levels by 5 dB for the evening hours (between 7:00 pm and 10:00 pm), and 10 dB between 10:00 pm and 7:00 am, then combines the results with the daytime levels to produce the final CNEL value. It is measured in decibels, dB.

Day-Night Average Sound Level (Ldn)
A measure of noise exposure level that is similar to CNEL except that there is no weighting applied to the evening hours of 7:00 pm to 10:00 pm. It is measured in decibels, dB.

Daytime Average Sound Level
The time-averaged A-weighted sound level measured between the hours of 7:00 am to 7:00 pm. It is measured in decibels, dB.

Decibel (dB)
The basic unit of measurement for sound level.

Direct Sound
Sound that reaches a given location in a direct line from the source without any reflections.

Divergence
The spreading of sound waves from a source in a free field, resulting in a reduction in sound pressure level with increasing distance from the source.

Energy Basis
This refers to the procedure of summing or averaging sound pressure levels on the basis of their squared pressures. This method involves the conversion of decibels to pressures, then performing the necessary arithmetic calculations, and finally changing the pressure back to decibels.

Equivalent-Continuous Sound Level (Leq)
The average sound level measured over a specified time period. It is a single-number measure of time-varying noise over a specified time period. It is the level of a steady sound that, in a stated time period and at a stated location, has the same A-Weighted sound energy as the time-varying sound. For example, a person who experiences an Leq of 60 dB(A) for a period of 10 minutes standing next to a busy street is exposed to the same amount of sound energy as if he had experienced a constant noise level of 60 dB(A) for 10 minutes rather than the time-varying traffic noise level.

Fast Response
A setting on the sound level meter that determines how sound levels are averaged over time. A fast sound level is always more strongly influenced by recent sounds, and less influenced by sounds occurring in the distant past, than the corresponding slow sound level. For the same non-steady sound, the maximum fast sound level is generally greater than the corresponding maximum slow sound level. Fast response is typically used to measure impact sound levels.

Field Impact Insulation Class (FIIC)
A single number rating similar to the impact insulation class except that the impact sound pressure levels are measured in the field.

Field Sound Transmission Class (FSTC)
A single number rating similar to sound transmission class except that the transmission loss values used to derive this class are measured in the field.

Flanking Sound Transmission
The transmission of sound from a room in which a source is located to an adjacent receiving room by paths other than through the common partition. Also, the diffraction of noise around the ends of a barrier.

Frequency
The number of oscillations per second of a sound wave

Hourly Average Sound Level (HNL)
The equivalent-continuous sound level, Leq, over a 1-hour time period.

Impact Insulation Class (IIC)
A single number rating used to compare the effectiveness of floor/ceiling assemblies in providing reduction of impact-generated sound such as the sound of a person's walking across the upstairs floor.

Impact Noise
The noise that results when two objects collide.

Impulse Noise
Noise of a transient nature due to the sudden impulse of pressure like that created by a gunshot or balloon bursting.

Insertion Loss
The decrease in sound power level measured at the location of the receiver when an element (e.g., a noise barrier) is inserted in the transmission path between the sound source and the receiver.

Inverse Square Law
A rule by which the sound intensity varies inversely with the square of the distance from the source. This results in a 6dB decrease in sound pressure level for each doubling of distance from the source.

L_n Sound Level
Time-varying noise environments may be expressed in terms of the noise level that is exceeded for a certain percentage of the total measurement time. These statistical noise levels are denoted L_n, where n is the percent of time. For example, the L_{50} is the noise level exceeded for 50% of the time. For a 1-hour measurement period, the L_{50} would be the noise level exceeded for a cumulative period of 30 minutes in that hour.

Masking
The process by which the threshold of hearing for one sound is raised by the presence of another sound.

Maximum Sound Level (Lmax)
The greatest sound level measured on a sound level meter during a designated time interval or event.

NC Curves (Noise Criterion Curves)
A system for rating the noisiness of an occupied indoor space. An actual octave-band spectrum is compared with a set of standard NC curves to determine the NC level of the space.

Noise Reduction
The difference in sound pressure level between any two points.

Noise Reduction Coefficient (NRC)
A single number rating of the sound absorption properties of a material. It is the average of the sound absorption coefficients at 250, 500, 1000, and 2000 Hz, rounded to the nearest multiple of 0.05.

Octave
The frequency interval between two sounds whose frequency ratio is 2. For example, the frequency interval between 500 Hz and 1,000 Hz is one octave.

Octave-Band Sound Level
For an octave frequency band, the sound pressure level of the sound contained within that band.

One-Third Octave
The frequency interval between two sounds whose frequency ratio is 2^(1/3). For example, the frequency interval between 200 Hz and 250 Hz is one-third octave.

One-Third-Octave-Band Sound Level
For a one-third-octave frequency band, the sound pressure level of the sound contained within that band.

Outdoor-Indoor Transmission Class (OITC)
A single number rating used to compare the sound insulation properties of building façade elements. This rating is designed to correlate with subjective impressions of the ability of façade elements to reduce the overall loudness of ground and air transportation noise.

Peak Sound Level (Lpk)
The maximum instantaneous sound level during a stated time period or event.

Pink Noise
Noise that has approximately equal intensities at each octave or one-third-octave band.

Point Source
A source that radiates sound as if from a single point.

RC Curves (Room Criterion Curves)
A system for rating the noisiness of an occupied indoor space. An actual octave-band spectrum is compared with a set of standard RC curves to determine the RC level of the space.

Real-Time Analyzer (RTA)
An instrument for the determination of a sound spectrum.

Receiver
A person (or persons) or equipment which is affected by noise.

Reflected Sound
Sound that persists in an enclosed space as a result of repeated reflections or scattering. It does not include sound that travels directly from the source without reflections.

Reverberation
The persistence of a sound in an enclosed or partially enclosed space after the source of the sound has stopped, due to the repeated reflection of the sound waves.

Room Absorption
The total absorption within a room due to all objects, surfaces and air absorption within the room. It is measured in Sabins or metric Sabins.

Slow Response
A setting on the sound level meter that determines how measured sound levels are averaged over time. A slow sound level is more influenced by sounds occurring in the distant past that the corresponding fast sound level.

Sound
A physical disturbance in a medium (e.g., air) that is capable of being detected by the human ear.

Sound Absorption Coefficient
A measure of the sound-absorptive property of a material.

Sound Insulation
The capacity of a structure or element to prevent sound from reaching a receiver room either by absorption or reflection.

Sound Level Meter (SLM)
An instrument used for the measurement of sound level, with a standard frequency-weighting and standard exponentially weighted time averaging.

Sound Power Level
A physical measure of the amount of power a sound source radiates into the surrounding air. It is measured in decibels.

Sound Pressure Level
A physical measure of the magnitude of a sound. It is related to the sound's energy. The terms sound pressure level and sound level are often used interchangeably.

Sound Transmission Class (STC)
A single number rating used to compare the sound insulation properties of walls, floors, ceilings, windows, or doors. This rating is designed to correlate with subjective impressions of the ability of building elements to reduce the overall loudness of speech, radio, television, and similar noise sources in offices and buildings.

Source Room
A room that contains a noise source or sources

Spectrum
The spectrum of a sound wave is a description of its resolution into components, each of different frequency and usually different amplitude.

Tapping Machine
A device used in rating different floor constructions against impacts. It produces a series of impacts on the floor under test, 10 times per second.

Tone
A sound with a distinct pitch

Transmission Loss (TL)
A property of a material or structure describing its ability to reduce the transmission of sound at a particular frequency from one space to another. The higher the TL value the more effective the material or structure is in reducing sound between two spaces. It is measured in decibels.

White Noise
Noise that has approximately equal intensities at all frequencies.

Windscreen
A porous covering for a microphone, designed to reduce the noise generated by the passage of wind over the microphone.

Appendix B Ambient Sound Level Survey Data



Figure B-1 Ambient Monitoring Location #1



Figure B-2 Ambient Monitoring Location #2



Figure B-3 Ambient Monitoring Location #3

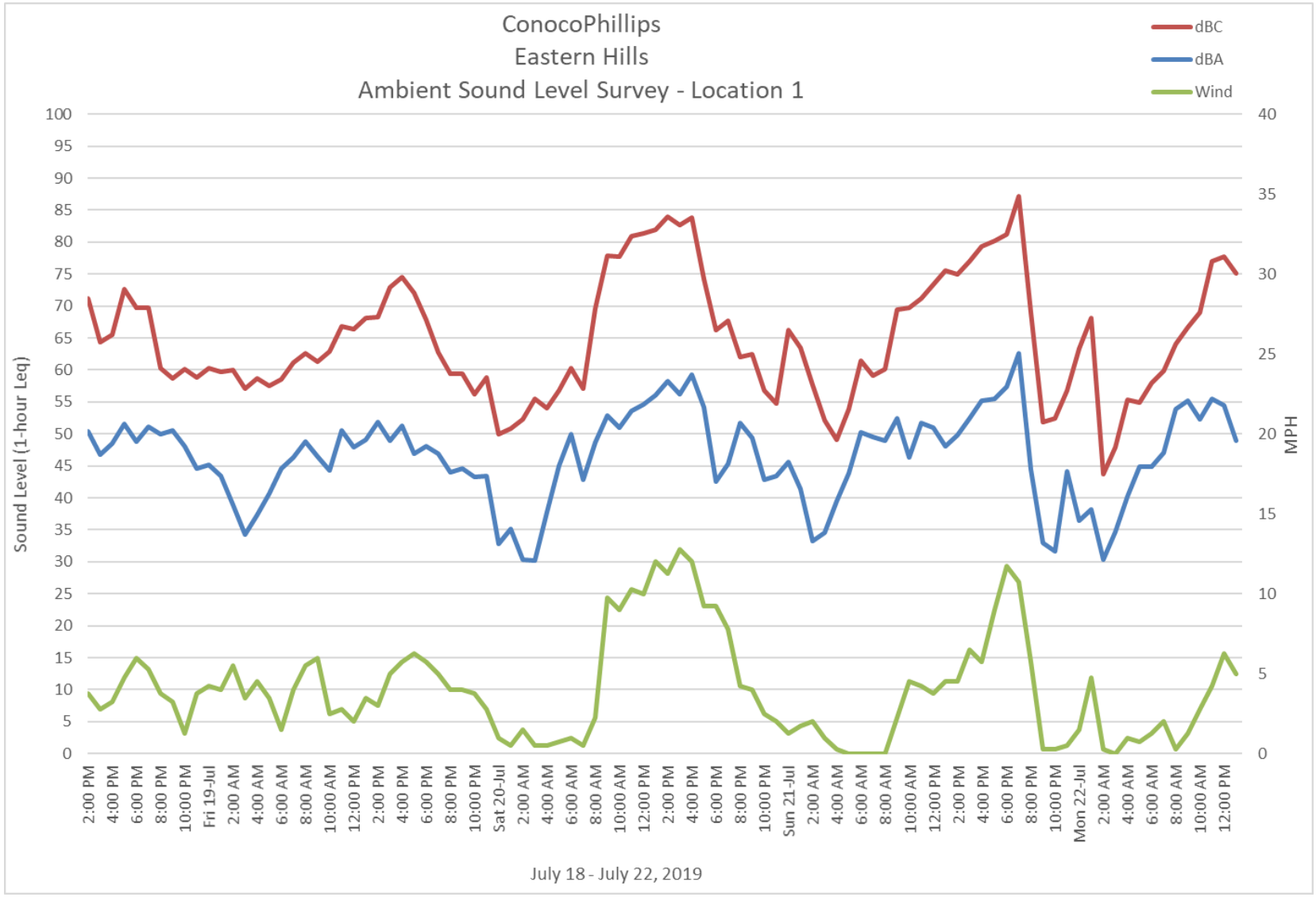


Figure B-4 Ambient Monitoring Location #1 – 1 Hr Leq Data

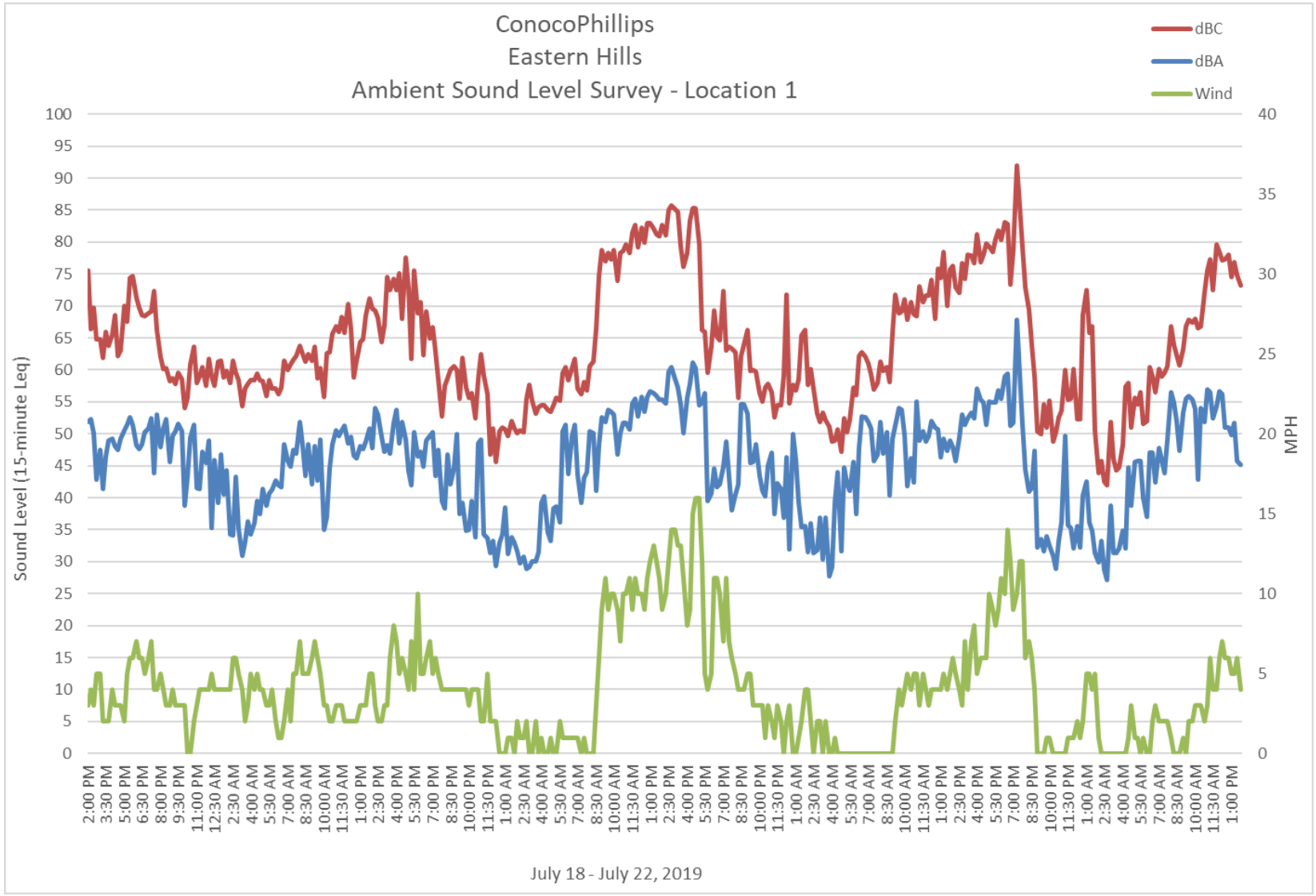


Figure B-5 Ambient Monitoring Location #1 – 15 Min Leq Data

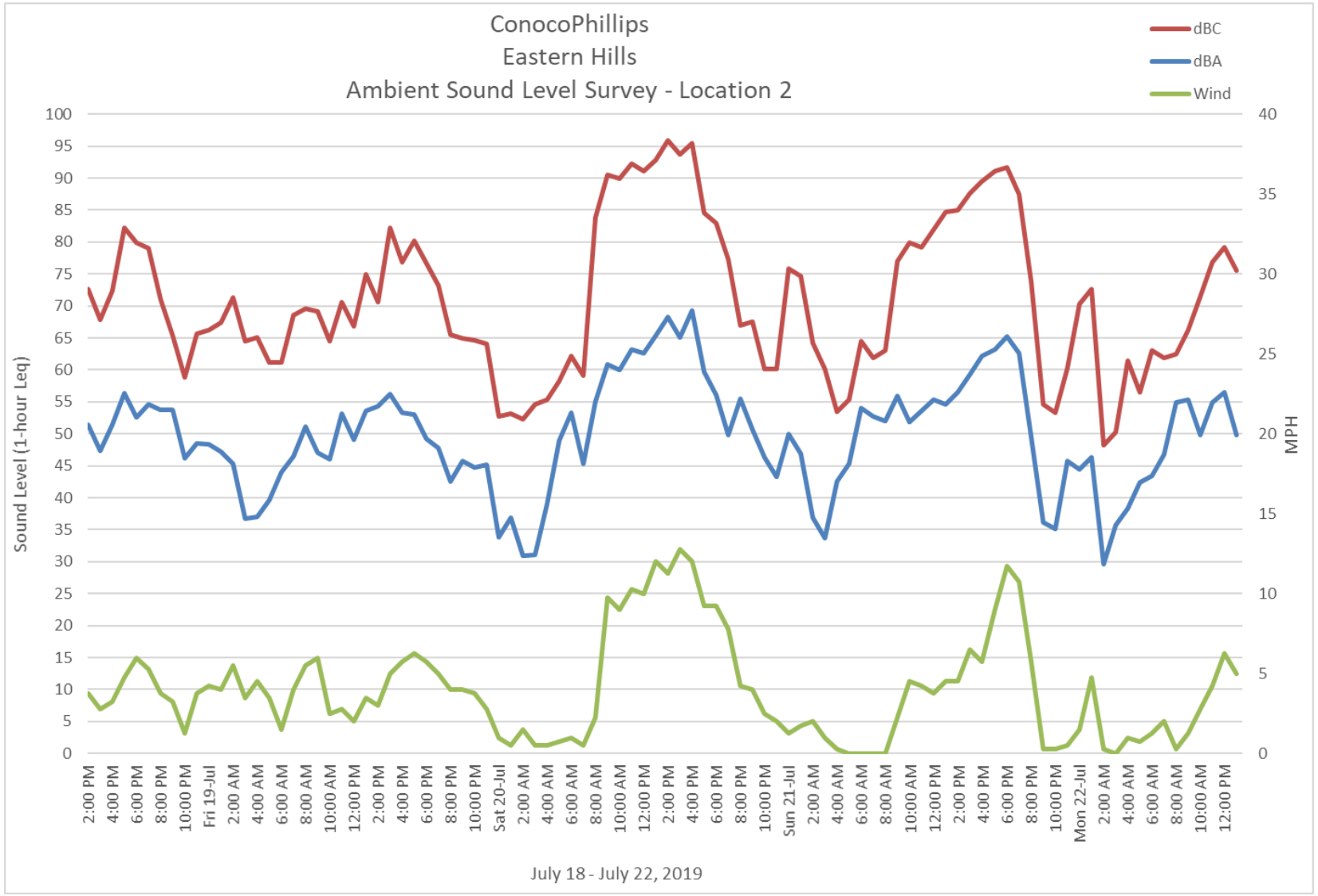


Figure B-6 Ambient Monitoring Location #2 – 1 Hr Leq Data

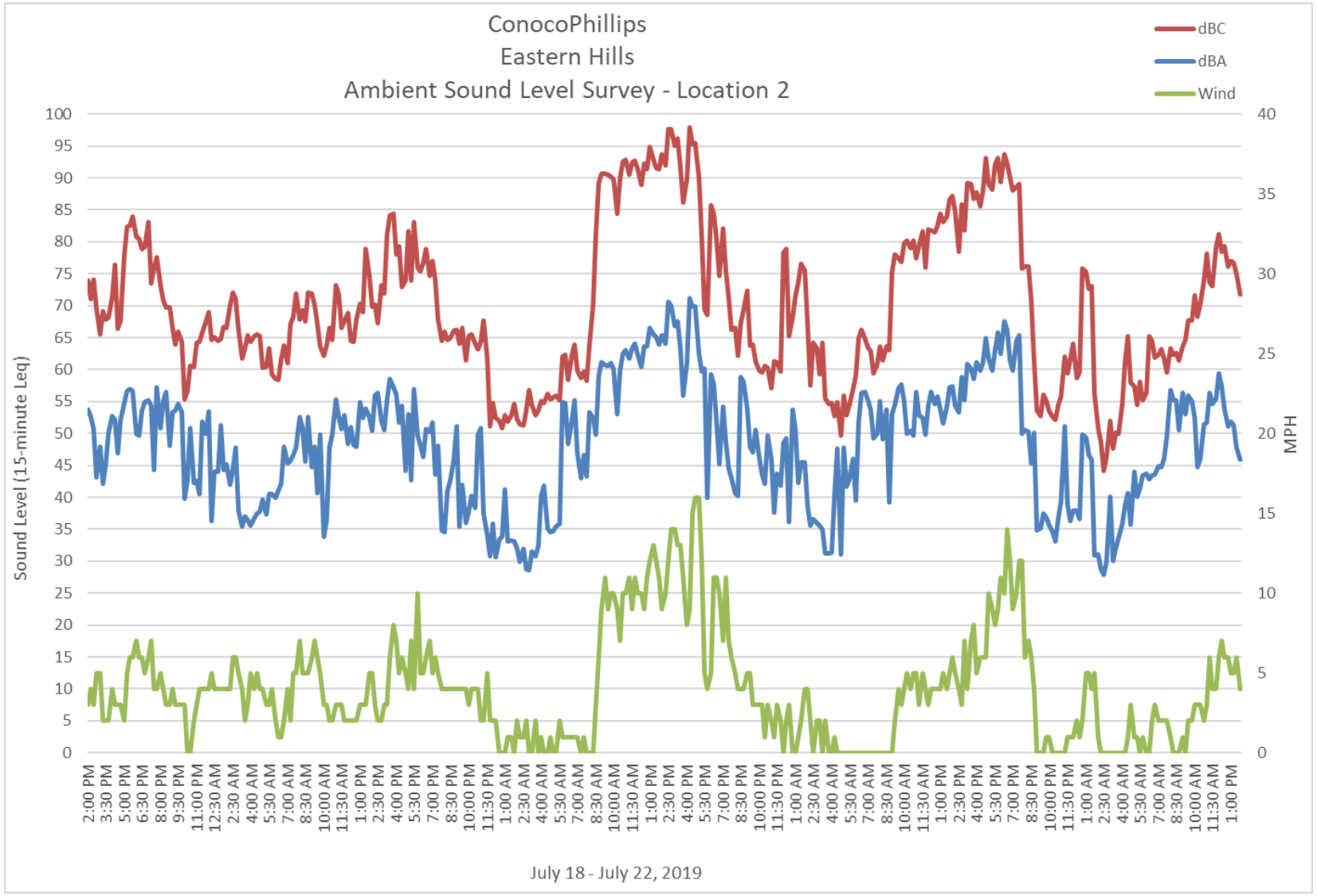


Figure B-7 Ambient Monitoring Location #2 – 15 Min Leq Data

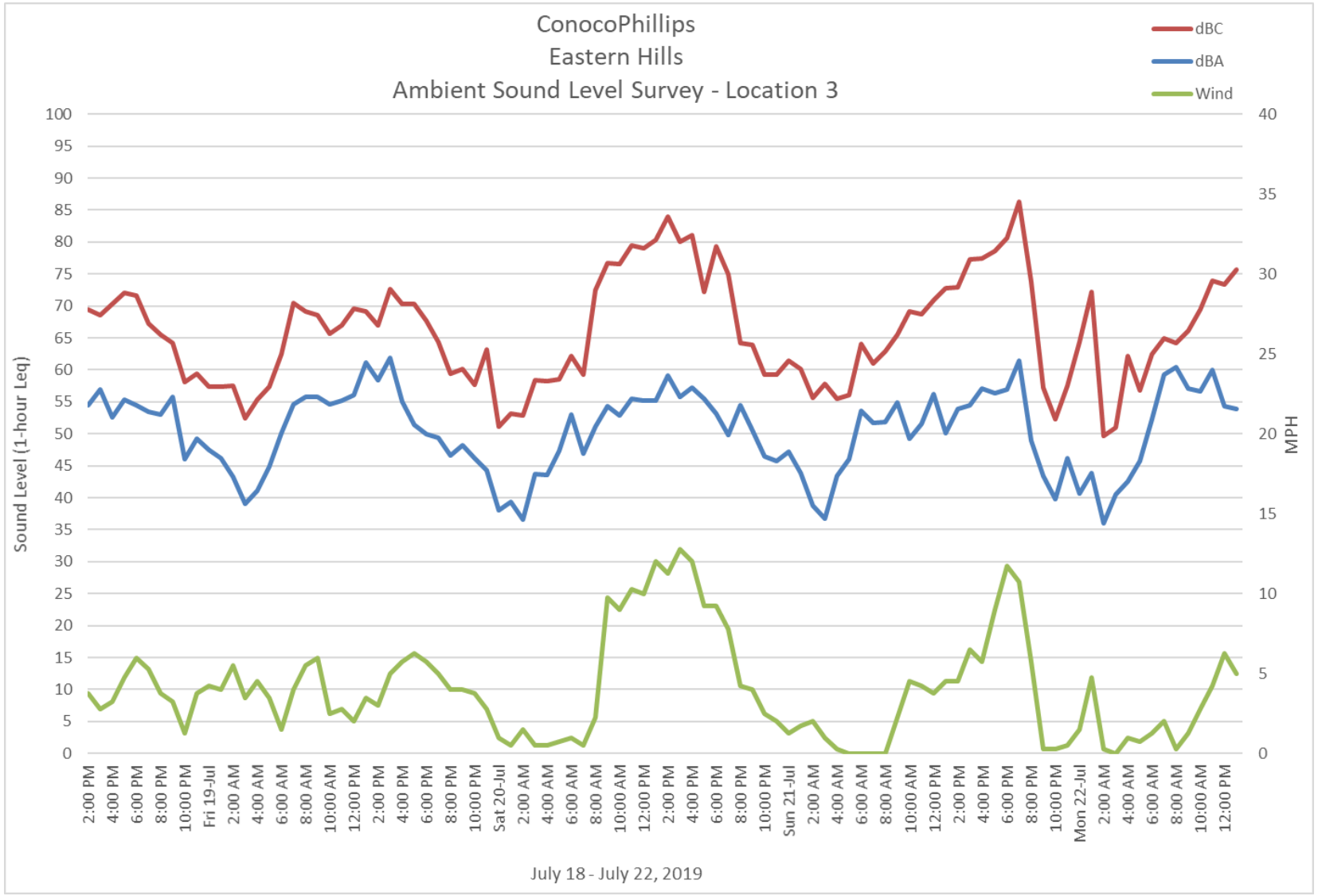


Figure B-8 Ambient Monitoring Location #3 – 1 Hr Leq Data

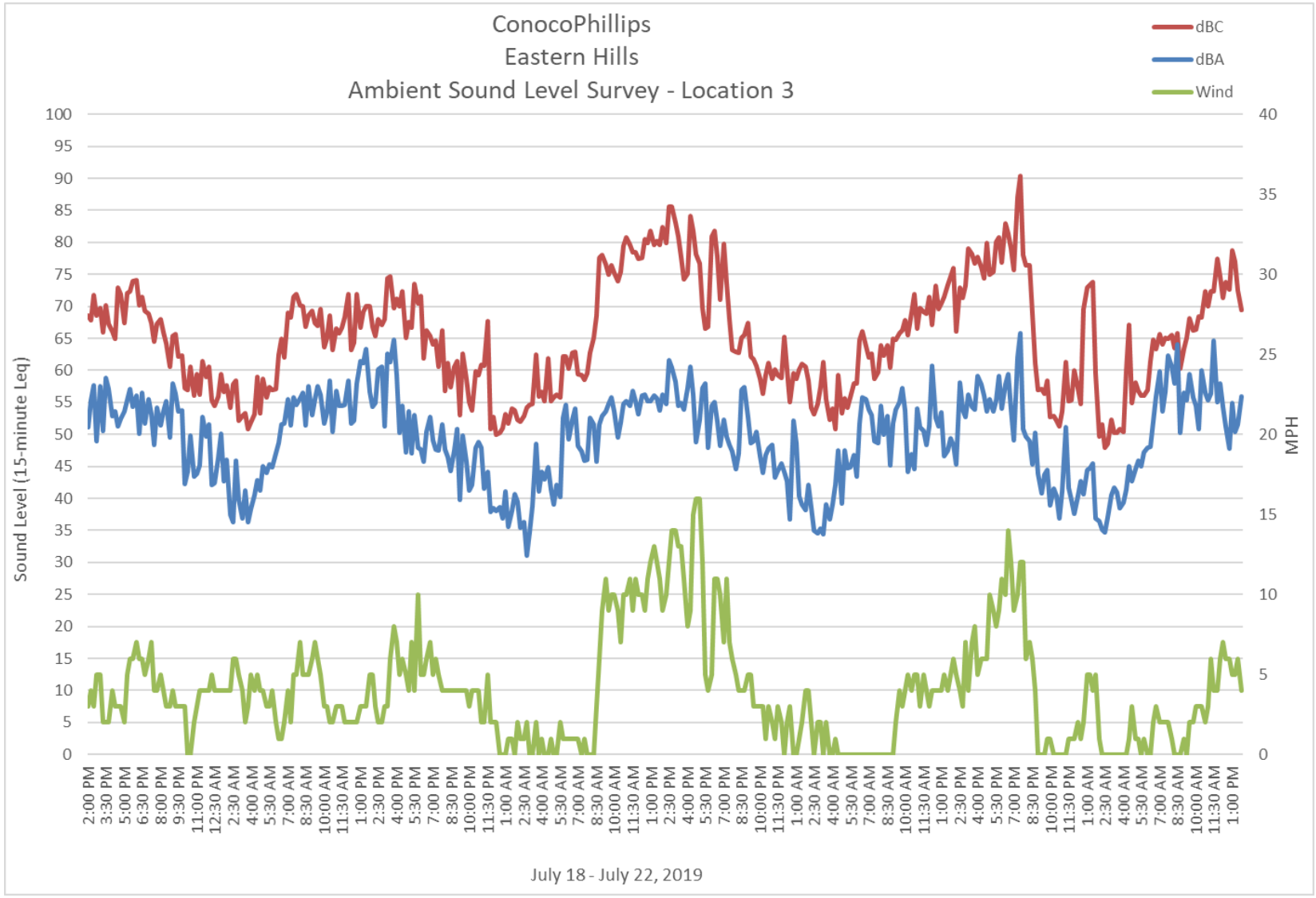


Figure B-9 Ambient Monitoring Location #3 – 15 Min Leq Data

ConocoPhillips - Eastern Hills					
Location 1 - Hourly Leq					
Time	dBA	dBC	Time	dBA	dBC
2:00 PM	50.4	71.2	2:00 PM	58.3	84.0
3:00 PM	46.8	64.4	3:00 PM	56.2	82.7
4:00 PM	48.6	65.6	4:00 PM	59.2	83.9
5:00 PM	51.5	72.6	5:00 PM	54.2	74.2
6:00 PM	48.8	69.7	6:00 PM	42.5	66.3
7:00 PM	51.2	69.7	7:00 PM	45.3	67.8
8:00 PM	49.9	60.4	8:00 PM	51.8	62.0
9:00 PM	50.6	58.7	9:00 PM	49.4	62.5
10:00 PM	48.0	60.2	10:00 PM	42.9	56.8
11:00 PM	44.6	58.9	11:00 PM	43.4	54.8
Fri 19-Jul	45.1	60.3	Sun 21-Jul	45.7	66.2
1:00 AM	43.5	59.7	1:00 AM	41.4	63.5
2:00 AM	39.0	60.0	2:00 AM	33.2	57.7
3:00 AM	34.3	57.1	3:00 AM	34.6	52.2
4:00 AM	37.3	58.7	4:00 AM	39.6	49.1
5:00 AM	40.6	57.6	5:00 AM	43.8	53.8
6:00 AM	44.7	58.6	6:00 AM	50.3	61.4
7:00 AM	46.4	61.2	7:00 AM	49.5	59.1
8:00 AM	48.9	62.6	8:00 AM	49.0	60.1
9:00 AM	46.5	61.4	9:00 AM	52.5	69.4
10:00 AM	44.2	62.9	10:00 AM	46.3	69.8
11:00 AM	50.5	66.9	11:00 AM	51.7	71.2
12:00 PM	47.9	66.3	12:00 PM	50.9	73.3
1:00 PM	49.0	68.1	1:00 PM	48.1	75.6
2:00 PM	51.8	68.3	2:00 PM	49.9	74.9
3:00 PM	49.0	72.9	3:00 PM	52.4	77.0
4:00 PM	51.3	74.5	4:00 PM	55.2	79.3
5:00 PM	46.9	72.0	5:00 PM	55.5	80.2
6:00 PM	48.0	67.9	6:00 PM	57.3	81.2
7:00 PM	46.9	62.7	7:00 PM	62.6	87.2
8:00 PM	44.0	59.4	8:00 PM	44.4	69.0
9:00 PM	44.6	59.4	9:00 PM	33.0	51.9
10:00 PM	43.3	56.3	10:00 PM	31.7	52.4
11:00 PM	43.5	58.8	11:00 PM	44.1	56.8
Sat 20-Jul	32.8	49.9	Mon 22-Jul	36.5	63.3
1:00 AM	35.1	50.9	1:00 AM	38.3	68.2
2:00 AM	30.4	52.3	2:00 AM	30.4	43.8
3:00 AM	30.3	55.4	3:00 AM	34.8	47.9
4:00 AM	37.7	54.1	4:00 AM	40.2	55.3
5:00 AM	45.0	56.8	5:00 AM	44.9	55.0
6:00 AM	49.9	60.4	6:00 AM	44.9	58.0
7:00 AM	42.8	57.1	7:00 AM	47.1	59.8
8:00 AM	48.6	69.6	8:00 AM	53.9	64.1
9:00 AM	52.9	77.9	9:00 AM	55.1	66.7
10:00 AM	51.0	77.8	10:00 AM	52.3	69.0
11:00 AM	53.6	80.9	11:00 AM	55.4	77.0
12:00 PM	54.7	81.4	12:00 PM	54.5	77.8
1:00 PM	56.1	81.9	1:00 PM	49.0	75.1

ConocoPhillips - Eastern Hills					
Location 2 - Hourly Leq					
Time	**dBA**	**dBC**	**Time**	**dBA**	**dBC**
2:00 PM	51.4	72.6	2:00 PM	68.3	95.9
3:00 PM	47.3	67.9	3:00 PM	65.1	93.7
4:00 PM	51.5	72.3	4:00 PM	69.3	95.5
5:00 PM	56.4	82.2	5:00 PM	59.7	84.6
6:00 PM	52.6	79.9	6:00 PM	56.0	83.0
7:00 PM	54.6	79.1	7:00 PM	49.8	77.3
8:00 PM	53.8	71.1	8:00 PM	55.6	67.0
9:00 PM	53.8	65.3	9:00 PM	50.8	67.6
10:00 PM	46.2	58.8	10:00 PM	46.3	60.1
11:00 PM	48.5	65.7	11:00 PM	43.3	60.1
Fri 19-Jul	48.4	66.2	Sun 21-Jul	50.0	75.9
1:00 AM	47.2	67.5	1:00 AM	46.9	74.7
2:00 AM	45.3	71.3	2:00 AM	36.8	64.2
3:00 AM	36.8	64.5	3:00 AM	33.7	60.1
4:00 AM	37.0	65.1	4:00 AM	42.5	53.5
5:00 AM	39.7	61.1	5:00 AM	45.3	55.3
6:00 AM	44.1	61.1	6:00 AM	54.1	64.5
7:00 AM	46.5	68.6	7:00 AM	52.8	61.9
8:00 AM	51.2	69.6	8:00 AM	52.1	63.1
9:00 AM	47.0	69.2	9:00 AM	56.0	77.0
10:00 AM	46.1	64.6	10:00 AM	51.9	79.9
11:00 AM	53.2	70.7	11:00 AM	53.6	79.1
12:00 PM	49.1	66.9	12:00 PM	55.4	82.0
1:00 PM	53.6	74.9	1:00 PM	54.7	84.7
2:00 PM	54.4	70.7	2:00 PM	56.5	85.0
3:00 PM	56.3	82.3	3:00 PM	59.2	87.6
4:00 PM	53.3	76.8	4:00 PM	62.2	89.6
5:00 PM	53.1	80.1	5:00 PM	63.2	91.1
6:00 PM	49.2	76.8	6:00 PM	65.2	91.7
7:00 PM	47.8	73.2	7:00 PM	62.6	87.5
8:00 PM	42.6	65.5	8:00 PM	49.5	73.8
9:00 PM	45.8	65.0	9:00 PM	36.2	54.6
10:00 PM	44.8	64.6	10:00 PM	35.2	53.3
11:00 PM	45.2	64.1	11:00 PM	45.7	60.3
Sat 20-Jul	33.8	52.8	Mon 22-Jul	44.5	70.3
1:00 AM	36.8	53.2	1:00 AM	46.3	72.6
2:00 AM	30.9	52.3	2:00 AM	29.6	48.2
3:00 AM	31.0	54.7	3:00 AM	35.8	50.2
4:00 AM	39.0	55.4	4:00 AM	38.3	61.5
5:00 AM	49.0	58.3	5:00 AM	42.5	56.5
6:00 AM	53.3	62.2	6:00 AM	43.4	63.0
7:00 AM	45.4	59.2	7:00 AM	46.8	61.9
8:00 AM	55.1	83.9	8:00 AM	55.0	62.5
9:00 AM	60.9	90.5	9:00 AM	55.3	66.3
10:00 AM	60.0	90.0	10:00 AM	49.8	71.5
11:00 AM	63.1	92.2	11:00 AM	54.9	76.8
12:00 PM	62.7	91.1	12:00 PM	56.5	79.1
1:00 PM	65.4	92.9	1:00 PM	49.9	75.6

ConocoPhillips - Eastern Hills					
Location 3 - Hourly Leq					
Time	**dBA**	**dBC**	**Time**	**dBA**	**dBC**
2:00 PM	54.5	69.5	2:00 PM	59.1	84.0
3:00 PM	56.9	68.6	3:00 PM	55.8	80.1
4:00 PM	52.6	70.3	4:00 PM	57.3	81.1
5:00 PM	55.3	72.0	5:00 PM	55.4	72.2
6:00 PM	54.5	71.7	6:00 PM	53.2	79.4
7:00 PM	53.4	67.3	7:00 PM	49.8	75.0
8:00 PM	53.0	65.5	8:00 PM	54.5	64.3
9:00 PM	55.8	64.2	9:00 PM	50.5	63.9
10:00 PM	46.0	58.1	10:00 PM	46.5	59.2
11:00 PM	49.3	59.4	11:00 PM	45.8	59.3
Fri 19-Jul	47.5	57.3	Sun 21-Jul	47.2	61.5
1:00 AM	46.2	57.4	1:00 AM	43.9	60.2
2:00 AM	43.3	57.5	2:00 AM	38.7	55.6
3:00 AM	39.0	52.4	3:00 AM	36.8	57.9
4:00 AM	41.1	55.3	4:00 AM	43.5	55.6
5:00 AM	44.8	57.3	5:00 AM	46.1	56.1
6:00 AM	50.1	62.5	6:00 AM	53.6	64.0
7:00 AM	54.6	70.5	7:00 AM	51.8	61.1
8:00 AM	55.8	69.1	8:00 AM	51.9	62.9
9:00 AM	55.9	68.5	9:00 AM	55.0	65.5
10:00 AM	54.6	65.7	10:00 AM	49.3	69.2
11:00 AM	55.2	66.9	11:00 AM	51.5	68.7
12:00 PM	56.1	69.5	12:00 PM	56.2	70.9
1:00 PM	61.2	69.1	1:00 PM	50.1	72.8
2:00 PM	58.4	66.9	2:00 PM	53.9	72.9
3:00 PM	62.0	72.6	3:00 PM	54.5	77.3
4:00 PM	55.1	70.4	4:00 PM	57.1	77.5
5:00 PM	51.4	70.4	5:00 PM	56.4	78.6
6:00 PM	49.9	67.7	6:00 PM	57.0	80.7
7:00 PM	49.3	64.3	7:00 PM	61.5	86.2
8:00 PM	46.6	59.4	8:00 PM	48.9	73.9
9:00 PM	48.2	60.2	9:00 PM	43.4	57.2
10:00 PM	46.2	57.7	10:00 PM	39.8	52.3
11:00 PM	44.4	63.2	11:00 PM	46.2	57.5
Sat 20-Jul	38.1	51.2	Mon 22-Jul	40.7	64.3
1:00 AM	39.4	53.2	1:00 AM	43.9	72.2
2:00 AM	36.6	52.9	2:00 AM	36.0	49.7
3:00 AM	43.7	58.3	3:00 AM	40.6	51.0
4:00 AM	43.6	58.2	4:00 AM	42.6	62.2
5:00 AM	47.3	58.5	5:00 AM	45.8	56.8
6:00 AM	53.0	62.2	6:00 AM	52.3	62.5
7:00 AM	47.0	59.3	7:00 AM	59.3	65.0
8:00 AM	51.1	72.5	8:00 AM	60.5	64.3
9:00 AM	54.4	76.7	9:00 AM	57.1	66.1
10:00 AM	52.9	76.6	10:00 AM	56.6	69.5
11:00 AM	55.6	79.5	11:00 AM	60.0	73.9
12:00 PM	55.3	79.1	12:00 PM	54.3	73.3
1:00 PM	55.3	80.4	1:00 PM	53.8	75.8