COGCC Form 2A and WOGLA 1041
Noise Mitigation Plan

Windom 5N67W24 1-46 Pad
Weld County, Colorado

Prepared for:

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1. EXECUTIVE SUMMARY

Urban Solution Group, LLC (Urban) was commissioned to prepare a Noise Mitigation Plan (NMP) for the proposed Windom 5N67W24 1-46 Pad (Windom Pad) to be operated by PDC Energy (PDC). PDC is proposing to develop oil and natural gas wells at the Windom Pad in Weld County, Colorado. The purpose of this plan is to assess predicted environmental noise impacts from the proposed operations on the surrounding area as compared to the maximum permissible noise level (MPNL) limits described in both the Colorado Oil and Gas Conservation Commission (COGCC) Rule 423, and the Weld County Oil and Gas Location Assessment (WOGLA) Section 21-5-435, noise regulations.

To facilitate this work, the following analyses were completed:

- Pre-operational ambient sound level survey for surrounding area
- Completion of a full site-specific Noise Impact Assessment (NIA) with individual models for;
    - Drilling operations with the Ensign 142 Drilling Rig on grid/line power (no gensets)
    - Completions operations with a Liberty Oilfield Services Quiet Fleet
    - Production operations with equipment and layout proposed by PDC (electric VRUs)
- Specification of Best Management Practices (BMPs) that will be implemented at the proposed Windom location such that all operations comply with both noise regulations and minimize environmental noise impact on the surrounding area.

The results of the analyses with full implementation of the BMPs for the Windom location are summarized as follows;

Analysis Type	Result
Noise points of compliance	• One A-weighted and one C-weighted compliance point for drilling and completions operations as outlined in Figure 2. • Two WOGLA and one COGCC A-scale compliance points, as well as one combined C-scale compliance point for production operations as shown in Figure 3.
Pre-Operational Ambient Sound Level Survey	• Ambient sound levels were measured at one location near the pad. • Ambient sound levels are below MPNLs, no adjustments apply.
Drilling Operations NIA	• Compliant without mitigation. However, PDC will implement same partial perimeter sound wall used for completions to reduce noise impact on the surrounding area.
Completions Operations NIA	• Compliant with mitigation. Partial perimeter sound wall consisting of 640 linear feet of 32-foot tall, STC32, and 176 linear feet of 24-foot tall, STC43.
Flowback Operations	• Utilizes a fraction of similar, but smaller equipment compared to the three other operations studied. Leave perimeter sound walls in place until flows are initiated.
Production Operations NIA	• Compliant without mitigation. Mitigation not required at this time. PDC agrees to take responsible action in the event of a complaint generated east of the location and will consider the potential for implementation of appropriate noise mitigation strategies at that time.

2. REGULATIONS AND NOISE STANDARDS SUMMARY

Noise for energy related facilities located in Weld County, Colorado, is regulated through two separate agencies. The first, at the state level is through the Colorado Oil and Gas Conservation Commission (COGCC) 423 series noise regulation. The second is through Weld County's Oil and Gas Location Assessment (WOGLA) Section 21-5-435, noise regulation. These regulations set the MPNLs, which limit noise emitted from energy facilities within the study area over a specified period, as measured at noise points of compliance. These allowable limits are dependent on the land use zoning within the study area. An overview of the COGCC regulation is presented first, followed by the Weld County WOGLA noise regulation. The most constraining components of each are the summarized at the end of this section to clarify compliance requirements.

COGCC Rule 423 Noise Regulation – Brief Overview

Section 423.b (1) of COGCC Rule 423 (the Regulation) states that all Oil and Gas Operations will comply with the MPNLs in Table 1 below unless otherwise required by Rule 423.

Table 1: *Maximum Permissible Noise Levels (COGCC Table 423-1)*

Zone	Daytime (7:00 a.m. – 7:00 p.m.)	Nighttime (7:00 p.m. – 7:00 a.m.)
Residential/Rural/State Parks & Wildlife Areas	55 dB(A)	50 dB(A)
Commercial/Agricultural	60 dB(A)	55 dB(A)
Light industrial	70 dB(A)	65 dB(A)
Industrial	80 dB(A)	75 dB(A)
All Zones	60 dB(C)	60 dB(C)

Exceptions to these MPNLs for Drilling, Completions and Flowback Operations are outlined in section 423.b (2) as follows;

> A. In Residential/Rural or Commercial/Agricultural, MPNLs will be 60 dBA in the hours between 7:00 p.m. to 7:00 a.m. and 65 dBA in the hours between 7:00 a.m. to 7:00 p.m.; and
>
> B. In all zones MPNLs will be 65 dBC in the hours between 7:00 p.m. to 7:00 a.m. and 65 dBC in the hours between 7:00 a.m. to 7:00 p.m.

These maximum allowable noise levels are applied at "noise points of compliance". These points are chosen as outlined in section 423.a (5) of the Regulation;

> (5) For proposed Oil and Gas Locations with a Working Pad Surface within 2,000 feet of one or more Residential Building Units (RBUs), at least one, and no more than six noise points of compliance where monitors will be located. Operators will identify noise points of compliance using the following criteria:

A. Provide one noise point of compliance in each direction in which an RBU is located within 2,000 feet of the proposed Working Pad Surface.

B. Noise points of compliance will be located at least 350 feet from the Working Pad Surface, and no less than 25 feet from the exterior wall of the RBU that is closest to the Working Pad Surface. If a Surface Owner or tenant refuses to provide the Operator with access to install a noise monitor, then the noise point of compliance will be located at either the next-closest RBU or an alternative location approximately the same distance and direction from the Working Pad Surface.

Demonstration of compliance with noise level limits during operation is outlined in section 423.c (2) as follows;

A. In response to a complaint or at the Director's request, Operators will measure sound levels at 25 feet from the complainant's occupied structure towards the noise source for low frequency (dBC) indicated issues. For high frequency (dBA) measurement will be at the nearest point of compliance. For equipment installed at Oil and Gas Locations subject to a Form 2A approved prior to January 15, 2021, after the Commencement of Production Operations, no single piece of equipment will exceed the MPNLs listed in Table 423-1 as measured at a point 350 feet from the equipment generating the noise in the direction from which the complaint was received.

Finally, adjustments to the MPNLs based on the measured pre-existing ambient noise levels is allowed. However, the new maximum allowable noise levels for permanent facilities such as Production Operations are capped and based on cumulative noise levels. Ambient adjustments and cumulative noise levels are outlined in section 423.d of the Regulation as follows;

d. Cumulative Noise. All noise measurements will be cumulative.

(1) Noise measurements taken at noise points of compliance designated pursuant to Rule 423.a.(5) will take into account ambient noise, rather than solely the incremental increase of noise from the facility targeted for measurement.

(2) At new or substantially modified Oil and Gas Locations where ambient noise levels at noise points of compliance designated pursuant to Rule 423.a.(5) already exceed the noise thresholds identified in Table 423-1, then Operators will be considered in compliance with Rule 423, unless at any time their individual noise contribution, measured pursuant to Rule 423.c, increases noise above ambient levels by greater than 5 dBC and 5 dBA between 7:00 p.m. and 7:00 a.m. or 7 dBC and 7 dBA between 7:00 a.m. and 7:00 p.m. This Rule 423.d.(2) does not allow Operators to increase noise above the maximum cumulative noise thresholds specified in Table 423-2 after the Commencement of Production Operations.

(3) After the Commencement of Production Operations, if ambient noise levels already exceed the maximum permissible noise thresholds identified in Table 423-1, under no circumstances will new Oil and Gas Operations or a significant modification to an existing Oil and Gas Operations raise cumulative ambient noise above the following:

Table 2: *Maximum Cumulative Noise Levels (COGCC Table 423-2)*

Zone	Daytime (7:00 a.m. – 7:00 p.m.)	Nighttime (7:00 p.m. – 7:00 a.m.)
Residential/Rural/State Parks & Wildlife Areas	65 dB(A)	60 dB(A)
Commercial/Agricultural	70 dB(A)	65 dB(A)
Light Industrial	80 dB(A)	75 dB(A)
Industrial	90 dB(A)	85 dB(A)
All Zones	75 dB(C)	70 dB(C)

WOGLA Noise Regulations and Standards – Section 21-5-435

Section 21-5-435 of the WOGLA regulations require operators to describe plans for noise mitigation that demonstrate their capability to meet the MPNLs outlined in Table 435 A.1, which are reproduced in Table 3 below.

Table 3. *WOGLA Table 435 A.1 Maximum Permissible Noise Levels*

Noise Levels	Daytime (7:00 a.m. – 7:00 p.m.)	Nighttime (7:00 p.m. – 7:00 a.m.)
A-scale		
NL-1	55 dB(A)	50 dB(A)
NL-2	60 dB(A)	55 dB(A)
NL-3	65 dB(A)	60 dB(A)
NL-4	70 dB(A)	65 dB(A)
C-scale		
All Zones	65 dB(C)	65 dB(C)

Section 21-5-435 also states:

1. During the Construction Phase or during operations involving Pipeline or Gas Facility installation or maintenance, use of a Workover rig, or stimulation, operators must comply with the following noise levels:

    a. For Oil and Gas Locations within the Ag-Rural Planning Area, as depicted on the map in Appendix 21-B, Operators shall comply with the MPNL for the NL-4 standard.

    b. For Oil and Gas Locations within the Near-Urban Planning Area, as depicted on the map in Appendix 21-B, Operators shall comply with the MPNL for the NL-3 standard.

c. The OGED Director may require Operators to comply with a lower MPNL in consultation with the Colorado Department of Public Health and Environment, or Colorado Parks and Wildlife.

To demonstrate compliance with the standards set forth in Section 21-5-435.A, sound levels shall be measured according to the following standards:

1. Pursuant to an A-scale complaint:

    a. Sound levels shall be measured at a distance of three hundred fifty (350) feet from the Oil and Gas Location, in the direction of the complainant.

    b. At the request of the complainant or OGED Director, sound levels may be measured at a point beyond three hundred fifty (350) feet that the complainant or OGED Director believes is more representative of the noise impact.

    c. If an Oil and Gas Location is located closer than three hundred fifty (350) feet from an existing occupied structure, sound levels shall be measured at a point twenty-five (25) feet from the structure towards the Oil and Gas Location.

    d. On property owned by the Operator, noise levels shall be measured at three hundred fifty (350) feet from the Oil and Gas Location, or at the property line, whichever is greater.

    e. In situations where measurement of noise levels at three hundred fifty (350) feet is unrepresentative or non-attainable due to topography, measurements may be taken at a more attainable/accessible distance and be extrapolated to a three hundred fifty (350) foot equivalent using the following formula:

        Unknown db(A) = Known db(A) - (20 × log10(d2/d1))

        This same formula should also be used when calculating db(C).

        (d2 = standard distance 350 ft. & d1 = measured distance)

    f. If a baseline noise survey has been conducted, the overall Leq within the closest direction of the complainant will be utilized to determine compliance.

2. Pursuant to a C-scale complaint:

    a. In situations where the complaint or on-site inspection indicates that low frequency noise is a component of the problem, sound level measurements shall be taken twenty-five (25) feet from the exterior wall of the complainant's residence or occupied structure in the direction of the Oil and Gas Location, using a noise meter calibrated to the db(C) scale.

    b. If the noise source is on the same property as the complainant, db(C) readings will be taken twenty-five (25) feet from the exterior wall of the residence.

c. If the sound levels exceed the MPNLs as defined in Table 435 A.1, the OGED Director shall require the Operator to obtain a low frequency noise impact analysis by a qualified sound expert, including identification of any reasonable control measures available to mitigate such low frequency noise impact. Such study shall be provided to the OGED Director for review and possible action.

d. If a baseline noise survey has been conducted, the overall Leq within the closest direction of the complainant will be utilized to determine compliance.

Compliance Summary

Given that all of the components from both noise regulations must be met simultaneously, compliance requirements are simply the combination of the most stringent parts of each. Therefore, the A-weighted compliance locations are chosen at points 350 feet from the proposed Windom location in the direction of residences located within 2,000 feet of the proposed location. The C-weighted compliance points are chosen as the residences located within 2,000 feet of the proposed Windom location (25 feet away from the residence in the direction of the proposed location).

Note that for production, the A-weighted complaince point is moved a small distance further away from the proposed facility pad due to topographical considerations as outlined in detail in Section 5.

The location is zoned with an Agricultural land use designation, and is situated in the Near-Urban planning area based on information from the Weld County Zoning Department. The applicable MPNLs as applied at the noise compliance points are summarized in the table below.

Table 4: *Compliance Summary Maximum Permissible Noise Levels*

Zone	Operation	Daytime (7:00 a.m. – 7:00 p.m.)	Nighttime (7:00 p.m. – 7:00 a.m.)
Commercial/Agricultural	Drilling, Completions & Flow Back	65 dB(A)	60 dB(A)
		65 dB(C)	65 dB(C)
	Production	55 dB(A)	50 dB(A)
		60 dB(C)	60 dB(C)

Maximum Permissible Noise Levels (Adjusted) - Summary

The results of the ambient sound level survey for the Windom Pad are presented in Section 7 of this document.

Section 423.d(2) of the COGCC Regulation and Section 21-5-435.C of the WOGLA regulation allow for adjustments to the MPNLs if the measured ambient sound levels exceed the MPNLs. COGCC code allows for an adjustment of 7dBA/dBC during daytime, and 5dBA/5dBC during nighttime for all operations (though production operations are also constrained by the cumulative maximums in Table 423-2 of COGCC Rule 423). Whereas the WOGLA regulation Section 21-5-435.C allows for an adjustment of 5dBA/dBC for both daytime and nighttime periods during drilling, completions, and flowback operations; and production operations are not allowed to exceed the measured ambient noise level.

For drilling, completions, flowback, and production operations, the ambient noise levels are all below the listed MPNLs, and no adjustments apply.

3. SUMMARY OF BMPS AND MITIGATION TO BE IMPLEMENTED

Best Management Practices (BMPs) are practices that are designed to prevent or reduce impacts caused by oil and gas operations on the environment and wildlife, and to minimize adverse impacts to public health, safety, and welfare.

The BMP's that PDC plans to implement for the proposed Windom site are as follows;

- PDC has conducted a Noise Impact Assessment for each phase of operations (drilling, completions, and production) to assess operational noise levels against the maximum permissible dBA and dBC noise levels stated in both the COGCC Rule 423 and the WOGLA Section 21-5-435 noise regulations. Each phase of operation will comply with the MPNLs of both codes as summarized in Table 4 in Section 2 of this document (with production operations dBA compliance considered at receptor C due to topographical factors as outlined in Section 5).
- Prior to commencement of drilling and completion activities, a partial perimeter, engineered sound wall consisting of approximately 640 linear feet 32-foot tall, STC 32 wall, will be installed along the east side of the pad; and 176 linear feet, 24-foot tall wall, rated at STC 43 will be installed along the north side of the pad to reduce noise levels at the critical receptor points.
- The drilling rig will utilize electric power supplied by the local utility company. Thus, the three gensets that normally operate during all drilling operations will be completely shut down and only used for emergency backup in the case that the electric grid is temporarily unavailable.
- PDC will utilize a low noise completions fleet for all completions operations.
- Flowback operations and equipment were reviewed as part of this noise mitigation plan (NMP). Flowback utilizes a fraction of similar, but smaller equipment compared to the three other operations studied. Leaving perimeter sound walls in place until flows are initiated will appropriately manage noise levels for this operation.
- A pre-production ambient sound level survey was conducted at the location outlined in Figure 4 to quantify pre-existing A and C-weighted sound levels.
- Throughout the duration of preproduction operations and any construction lasting longer than 24-hours, PDC will conduct continuous noise monitoring at the A-weighted noise point of compliance outlined in Figure 2 of Section 5.
- If the drilling rig or completions fleet is changed prior to commencement of operations, the mitigation measures employed will be equally or more protective. A sundry form will be submitted to outline any changes per both codes as required.
- PDC will post contact information to receive and address noise complaints arising from pre-production operations around the clock, 24-hours, 7 days per week. Upon receipt of a complaint, either directly to PDC, from the COGCC, or from Weld County, a PDC representative will contact the associated stakeholder within 48-hours of receipt.

4. SITE INFORMATION

The proposed Windom Pad will be located west of County Road 25 and north of County Road 54 near Greeley, CO. The location is zoned with an Agricultural land use designation, and is situated in the Near-Urban planning area based on information from the Weld County online zoning portal.

The Windom location is slated for drilling, completions and production operations. Drilling is planned with Ensign 142 Drilling Rig running on grid power (no gensets), and completions will be carried out with a Quiet Fleet from Liberty Oilfield Services. Planned production equipment is provided in Figure 19 of Appendix 1, with significant noise sources limited to five electric drive LP separator VRUs, four electric drive tank/surge VRUs, forty-six HLP separators, six instrument air compressors, three water LACTS, six oil LACTS, and fifteen ECDs (Enclosed Combustion Devices).

Detailed location information is presented below, and an aerial view of the proposed location is shown in Figure 1.

Location:	NW 1/4 SE 1/4 SEC. 24, T5N, R67W, 6TH P.M.
Drilling Rig:	Ensign 142 Drilling Rig on grid/line power (no gensets)
Completions Rig:	Liberty Oilfield Services Quiet Fleet
Production Equipment:	Details provided in Figure 19 of Appendix 1
Pad Location Coordinates:	40°23'0.09"N, 104°50'25.00"W
Regulation Noise Target:	COGCC Rule 423 and WOGLA Section 21-5-435

Figure 1: *Aerial View of the Proposed Windom Pad*

5. COMPLIANCE POINTS

The MPNLs for all operations are applied at noise points of compliance. These points are chosen as outlined in both the COGCC Rule 423, and the Weld County WOGLA Section 21-5-435, noise regulations. Two separate sets of compliance points are chosen due to the distance between the well pad and facility pad with respect to the only RBU within 2,000 feet of the proposed location, as shown in Figure 2 and Figure 3.

For drilling and completions operations, the A-weighted compliance location is chosen at a point 350 feet from the proposed Windom location between the well pad and RBU to the east. The C-weighted compliance point is chosen as the RBU to the east (25 feet away from the residence in the direction of the proposed Windom location).

For production operations, three A-weighted receptor locations are presented. The first is chosen at a point 350 feet from the proposed Windom location between the facility pad and RBU to the east as outlined by WOGLA Section 21-5-435. Due to a large hill between the Windom location and residence that crests at 550 feet from the Windom location towards the residence, the second A-weighted receptor location (Receptor C) is chosen as the compliance point (770 feet from the proposed Windom location between the facility pad and RBU to the east) as it is more representative of the noise impact at the residence. A full discussion on how the large hill impacts noise levels beyond the crest of the hill is presented in the production noise model results of Section 8. The third A-weighted compliance location is chosen at the residence (25 feet away from the residence in the direction of the proposed Windom location) as outlined by COGCC Rule 423. The C-weighted compliance point for both COGCC and WOGLA regulations is located at the residence (25 feet away from the residence in the direction of the proposed Windom location).

Figure 2 below shows an aerial view of the Windom location as well as the noise compliance points for drilling and completions operations. One A-weighted compliance point is indicated in blue and one C-weighted compliance point located at the residence is indicated in red.

Figure 3 below shows an aerial view of the Windom location as well as the noise compliance points for production operations. Three A-weighted compliance points are indicated in blue and one C-weighted compliance point located at the residence is indicated in red.

Figure 2: *Drilling and Completions Operations Compliance Points*

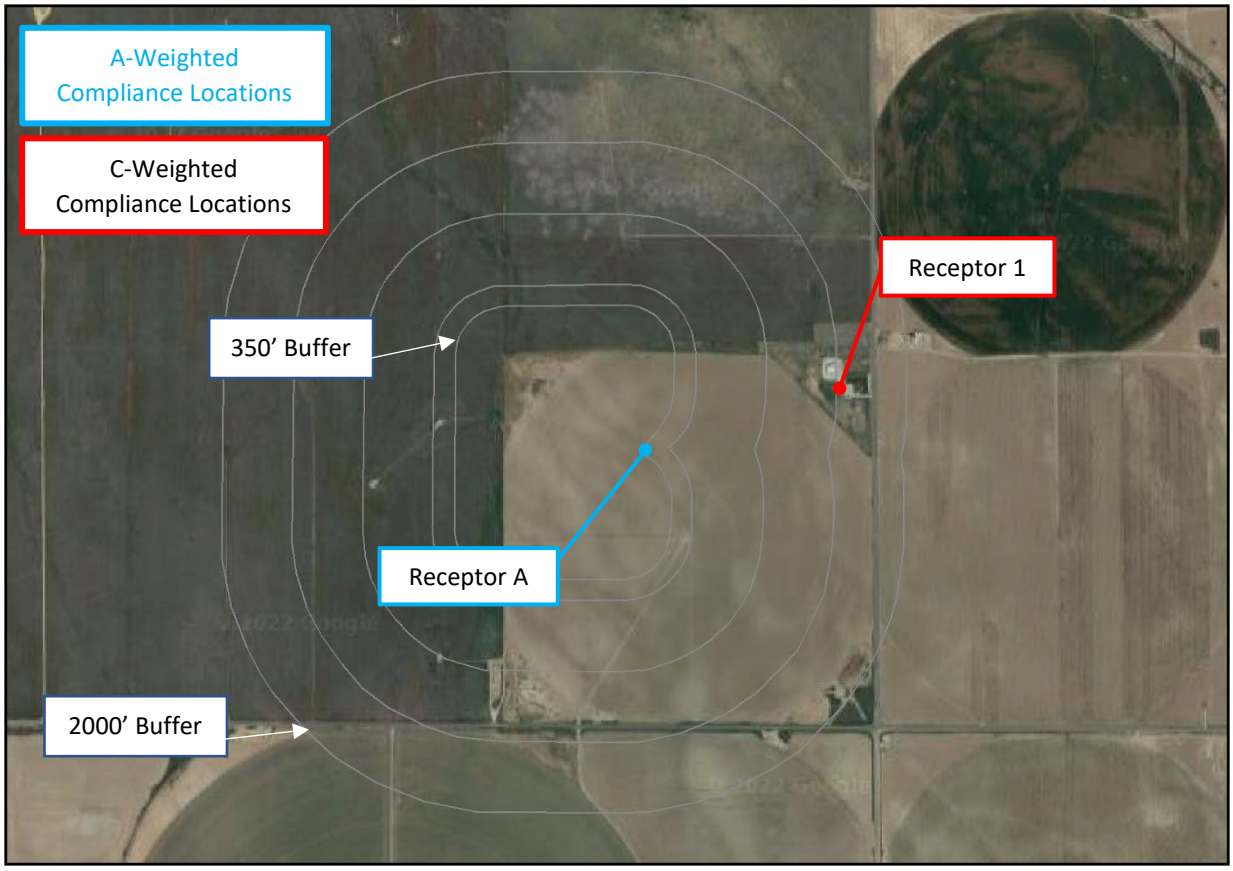
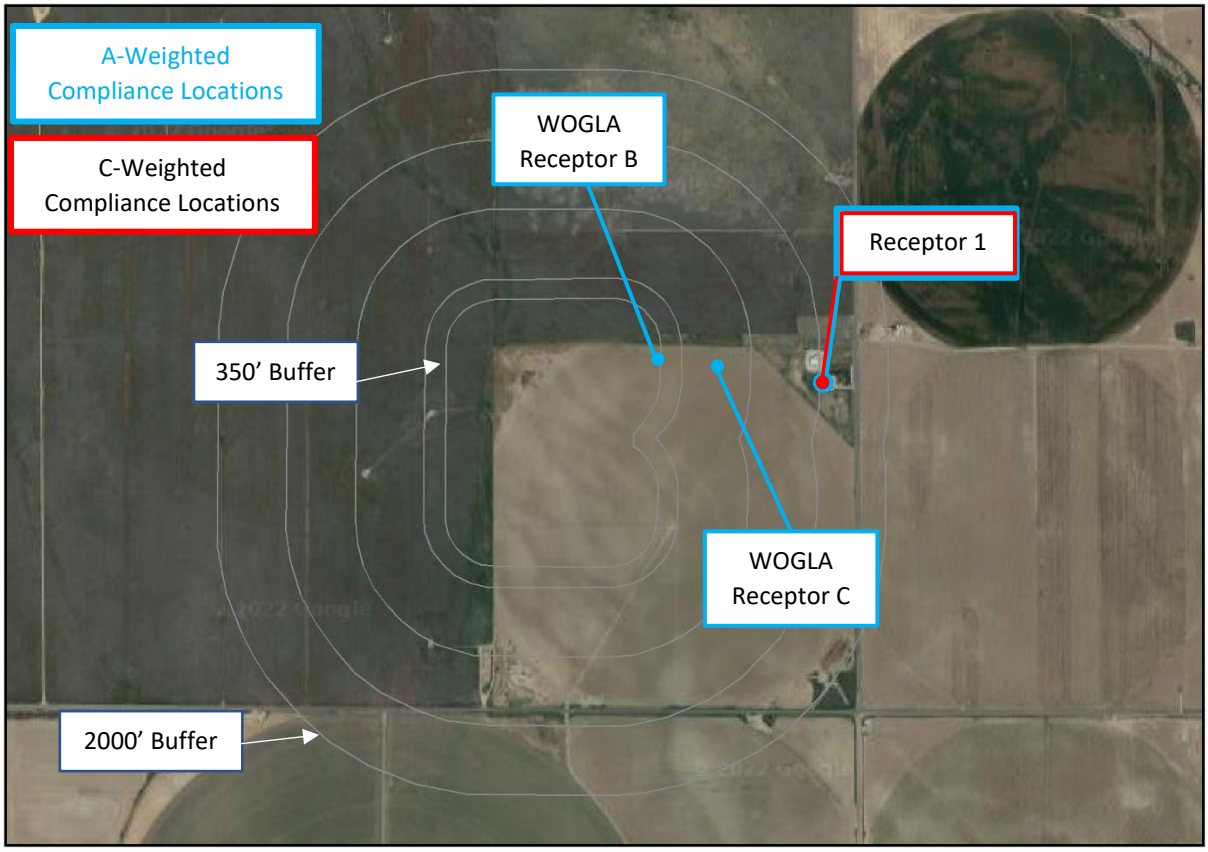


Figure 3: *Production Operations Compliance Points*



6. ESTIMATED OPERATIONS & DURATION SCHEDULE

The following table reflects PDC's planned construction and operations schedule for the Windom Pad at the time of this Noise Mitigation Plan. The schedule in Table 5 below includes an estimated duration of each stage of operation, including construction, drilling, completion, flowback, and production.

Table 5: *PDC's Planned Operations Schedule*

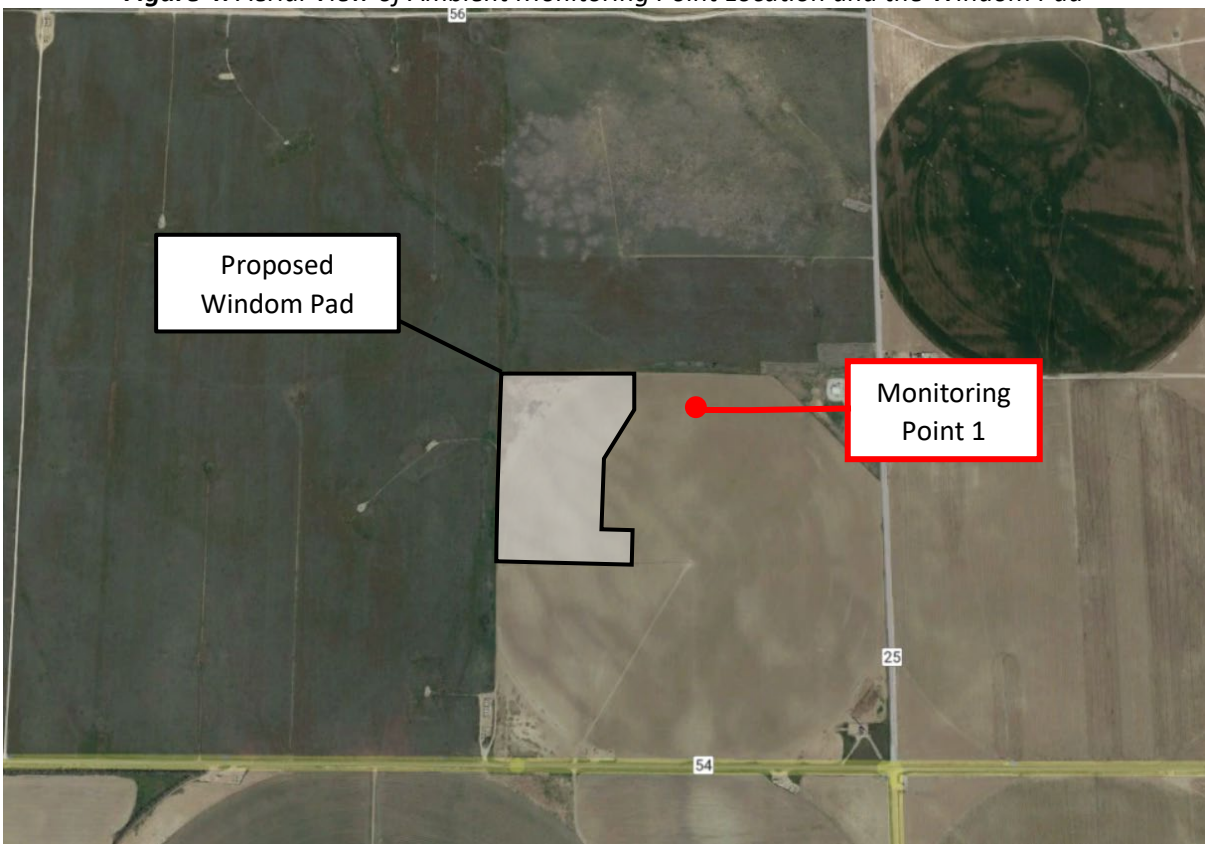
PHASE	DURATION (DAYS)	ESTIMATED START DATE
Construction	60	Q2 2024
Drilling	204	Q4 2024
Completion	112	Q3 2025
Flowback	77	Q3 2025
Production	10,585 (29 years)	Q3 2025

7. AMBIENT SOUND LEVEL SURVEY

Section 423.b of the COGCC regulation requires that the Operator conduct a background ambient noise survey to establish baseline conditions for both A-scale and C-scale noise levels near the site. Urban conducted a 72-hour ambient sound monitoring study to monitor and document pre-operational ambient sound levels using a Type 1 noise monitoring station. The sound level meters collect measurements of both A and C-weighted decibel levels at the monitoring location and are calibrated before and after the measurement period. The Leq average values are calculated by averaging 1-minute Leq noise levels when the wind speed is below 5 miles per hour, per Weld County and COGCC guidelines.

The ambient monitoring location in relation to the Windom Pad is shown in Figure 4 below. A-weighted and C-weighted sound levels were collected at the location from Saturday December 10, 2022, at 12:00 a.m., to Tuesday December 13, 2022, at 12:00 a.m., inclusive.

Figure 4: *Aerial View of Ambient Monitoring Point Location and the Windom Pad*



In addition to the ambient noise levels acquired, the sound level meter (SLM) was set to record audio files when the levels exceed 55 dBA in the daytime (7:00 a.m. – 7:00 p.m.) and 50 dBA in the nighttime (7:00 p.m. – 7:00 a.m.). Based on the recordings, the most common sounds for the monitoring location includes vehicle traffic and airplane noise.

Table 6 below shows the overall A and C-weighted averages (Leq) for the 72-hour monitoring period for the SLM. Averages shown represent the overall sound levels when wind was below five (5) miles per hour. Data was filtered to remove values with wind speeds exceed five (5) miles per hour, per COGCC and Weld County guidelines.

Table 6. *Overall Leq Background Ambient Noise Levels (Filtered for Wind Speed)*

Location	Daytime Averages (Leq)		Nighttime Averages (Leq)		Overall Averages (Leq)	
	dBA	dBC	dBA	dBC	dBA	dBC
Monitoring Point 1	41.1	58.1	36.9	55.6	**39.5**	**57.0**

Figure 20 in Appendix 2 contains a chart with the unfiltered hourly averages and wind speeds for the monitoring point.

8. NOISE IMPACT ASSESSMENT

A Noise Impact Assessment (NIA) was conducted for the proposed Windom Pad using a three-dimensional computer noise modeling software. This is a predictive model to aid in ascertaining the environmental impact of the proposed facility during all planned operations on the surrounding environment. The results of this assessment will compare the predicted levels of the Windom Pad operations to the permissible noise level limits described in both the COGCC Rule 423, and WOGLA Section 21-5-435 noise regulations.

A brief explanation of the methodology is presented first, followed by noise model results for drilling, completions, and production.

Methodology

All computer models and predicted noise levels generated for the assessment are developed with the commercial noise modeling software SoundPLAN 8.2. The ISO 9613-1 and 2 international standards are utilized in this software as they are widely accepted both internationally as well as in North America. The algorithms used in the commercial software package are based on methods and theory accepted in the environmental acoustics community. Both detailed equipment technical information and location specific topography, are used to generate comprehensive noise predictions that take into account environmental conditions, buildings, ground cover and barriers (natural, topographical, and otherwise). Note that actual field measurements may differ from modeled noise levels on any given day due to ever changing environmental factors and other noise sources in the study area not explicitly in the computer model. Table 7 below lists the conditions used in the model.

Table 7. *Conditions Used in SoundPLAN 8.2 Software*

Parameter	Modeled Input and Description
Temperature	55°F – Represents typical summer nighttime temperature
Topography	Modeled as is, with proposed location modified per grading plan
Wind Velocity	2.2 - 11.2 mph – ISO 9613 uses a slight downwind condition from each noise source to each receiver.
Wind Direction	From the noise source to the receptor points
Relative Humidity	40% - Typical summer nighttime relative humidity
Ground Absorption	Ranges from 0.0 for water bodies & major roadways up to 1.0 for thick grasslands

It is assumed that facility operating conditions do not change significantly between the daytime and nighttime periods. The resulting predicted noise levels are compared to the MPNLs outlined in both regulations to determine if the subject facility is compliant.

The noise levels generated in this predictive model are strictly from oil and gas operations at the proposed facility. Pre-existing sound sources such as those from animals, weather, road traffic, and all other ambient sounds are not included in the noise models.

Receptor points in this assessment are shown in Figure 2 and Figure 3 of Section 5. A and C-weighted receptor points were modeled at the locations identified in Section 5. The closest residential structure, Receptor 1, is located approximately 1,600 feet east of the Windom Location.

Equipment Information and Site Layouts

Drilling Operations at the Windom Pad are carried out using the Ensign 142 Drilling Rig on grid electrical power (without gensets). The sound power levels used in this NIA are taken from the E21054 Ensign 142 Drilling Rig Sound Signature Report prepared by Urban in September 2021. The drilling equipment layout for the Windom Pad is shown in Figure 17 of Appendix 1.

Completions Operations at the Windom Pad are carried out using the Liberty Oilfield Services (LOS) Quiet Fleet. The sound power levels used for the LOS Quiet Fleet in this NIA are taken from the E21055 LOS Quiet Fleet Sound Signature Report prepared by Urban in September 2021.The completions equipment layout for the Windom Pad is shown in Figure 18 of Appendix 1.

Production Operations at the Windom Pad are implemented per the equipment layout supplied by PDC. The sound power levels used for the production equipment used in this NIA are taken from the E21079 Production Equipment Sound Signature Report prepared by Urban in September 2021. The production equipment layout for the Windom site is shown in Figure 19 of Appendix 1.

Drilling Noise Model Results

Results for both unmitigated and mitigated Drilling Operations are presented in Table 8 below. The receptor locations in the table correspond to the locations identified in Figure 2 of Section 5.

Although drilling results are below the MPNLs per COGCC Rule 423 and WOGLA Section 21-5-435, PDC plans to implement the same partial perimeter sound wall for drilling that is needed for completions operational compliance to reduce the noise impact on the surrounding area. The partial perimeter wall consists of 640 linear feet of 32 foot tall, engineered sound wall, rated at STC-32 and 176 linear feet of 24-foot tall, engineered sound wall, rated at STC-43. This sound wall layout is shown in Figure 5 on the next page.

Table 8. *Drilling Operations Noise Model Results*

Receptor	Distance & Direction from the Working Pad Surface (feet)	Max Permissible Noise Level		Drilling Unmitigated		Drilling Mitigated	
		dBA	dBC	dBA	dBC	dBA	dBC
Receptor A	350 E	60.0	--	53.1	--	48.2	--
Receptor 1	1,600 E	--	65.0	--	61.0	--	60.7

The predicted levels only include sound levels from drilling operations and do not include ambient noise or noise contributions from other sources outside of the planned operations.

Noise contour maps are provided for the area surrounding the Windom Pad. The contours are provided in 5 dB increments with the color scale indicating the sound level of each contour. Unmitigated drilling operations noise contour maps are presented in Figure 6 and Figure 7, whereas mitigated contours are shown in Figure 8 and Figure 9.

Figure 5. *Drilling and Completions Operations Sound Wall Layout*

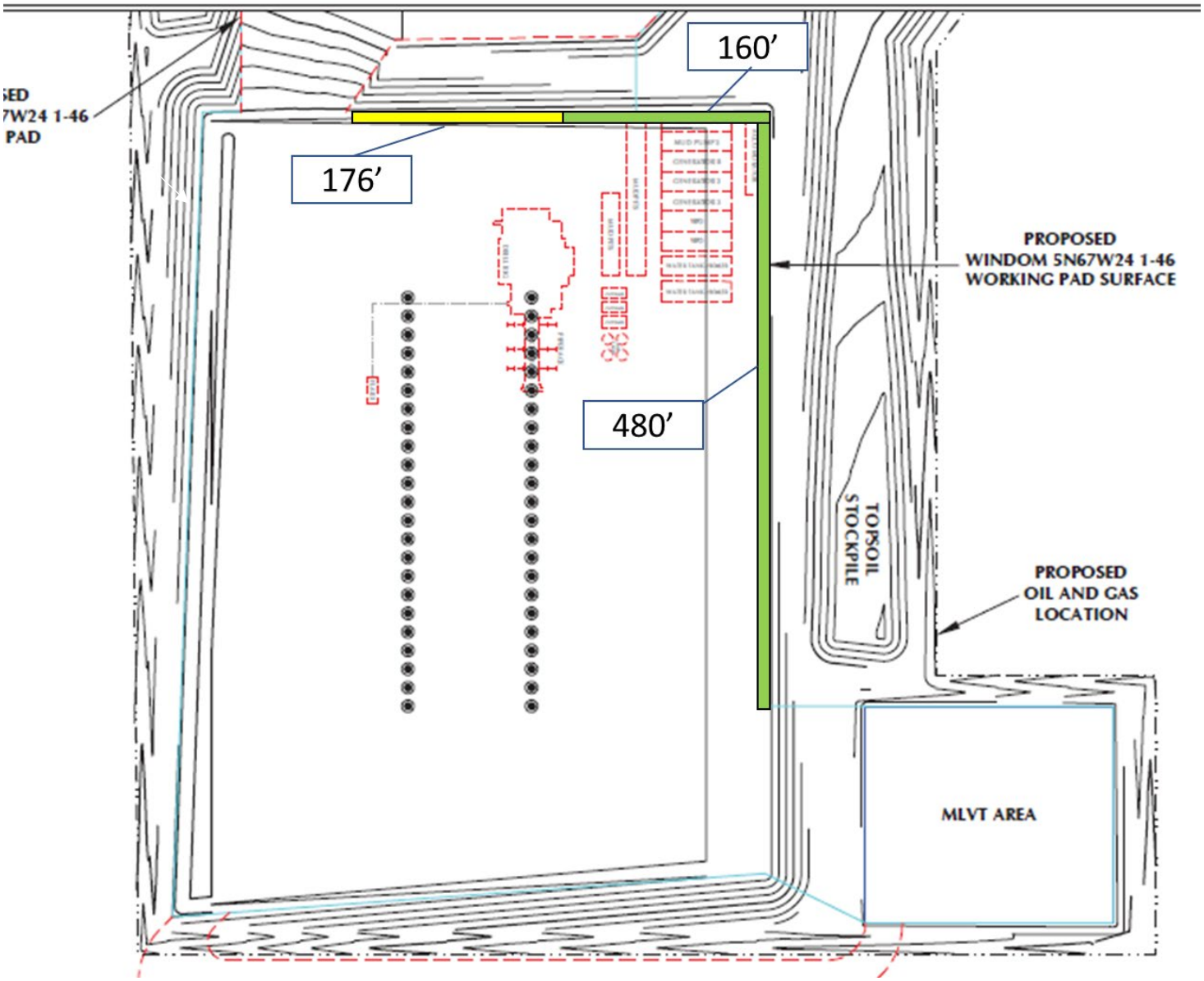


Figure 6. *Unmitigated Drilling Noise Contour Map (dBA)*

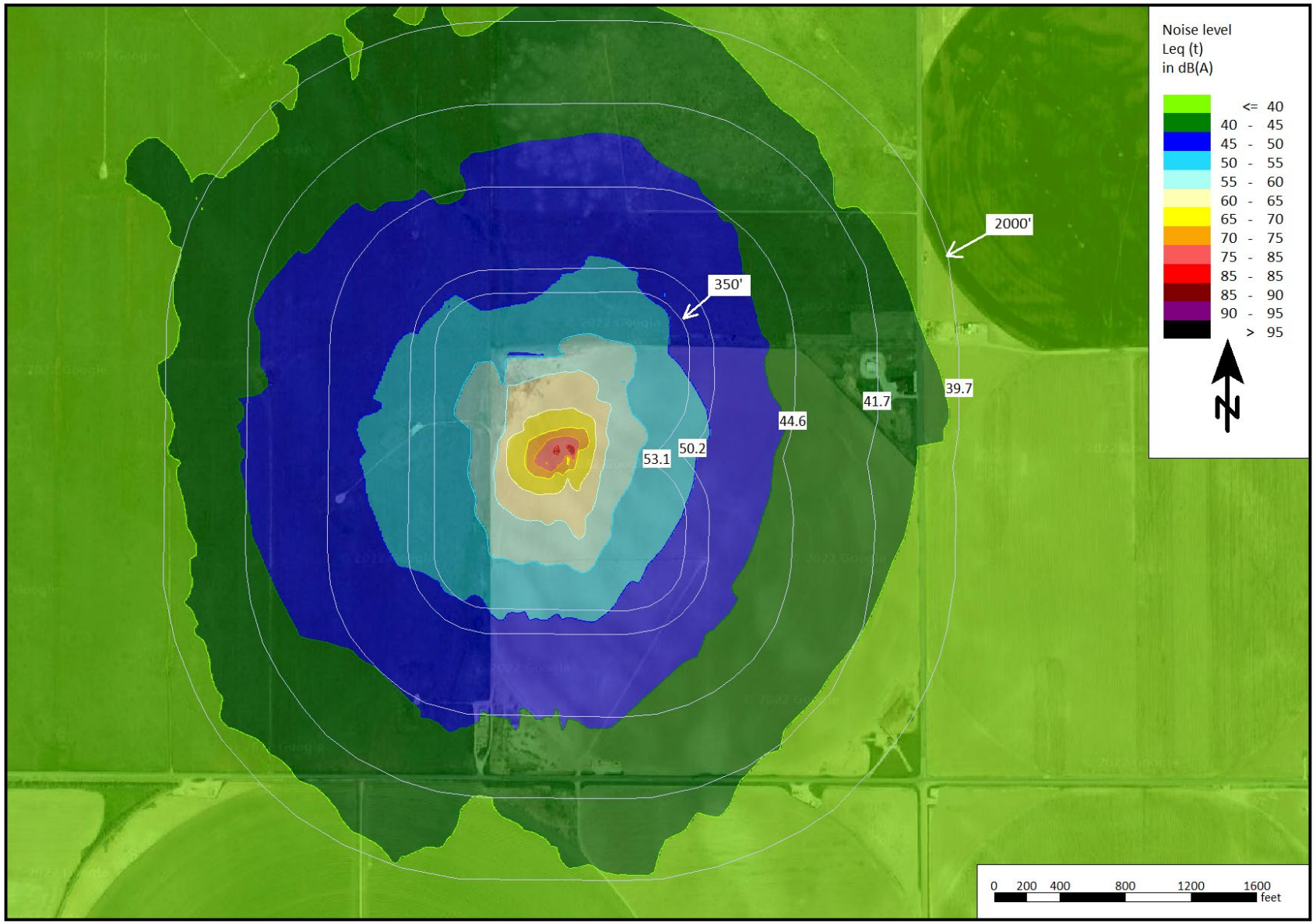


Figure 7. *Unmitigated Drilling Noise Contour Map (dBC)*

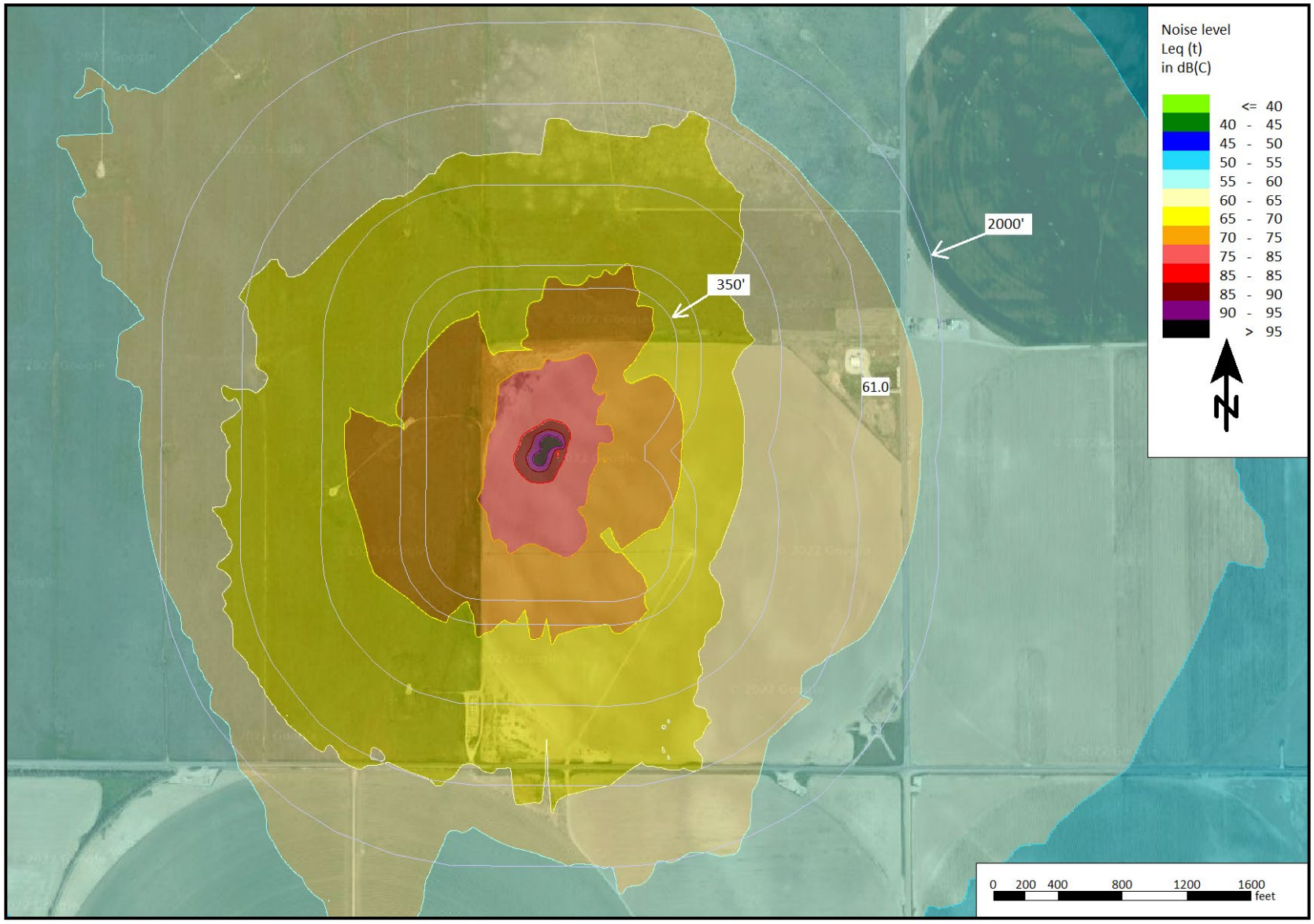


Figure 8. *Mitigated Drilling Noise Contour Map (dBA)*

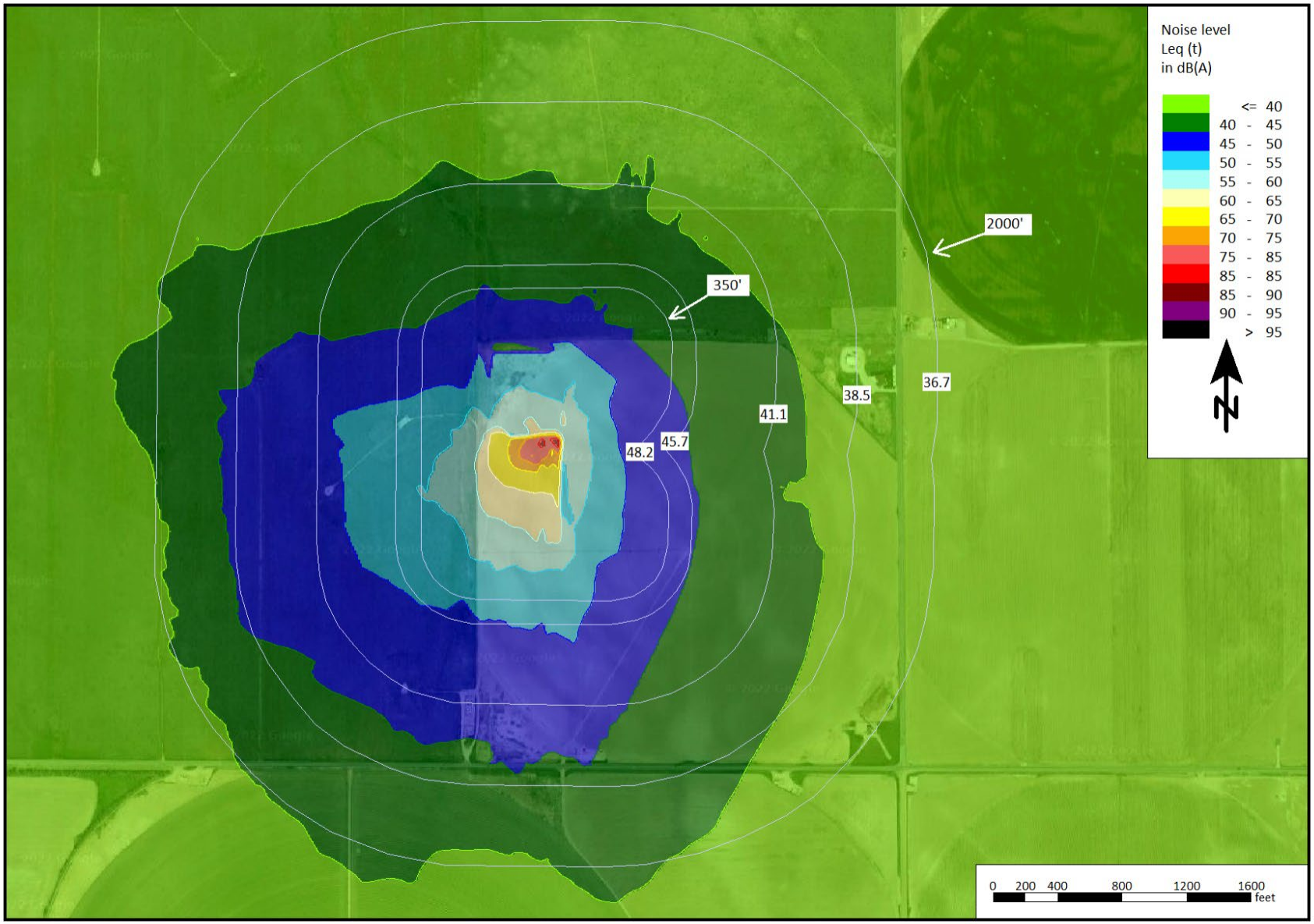
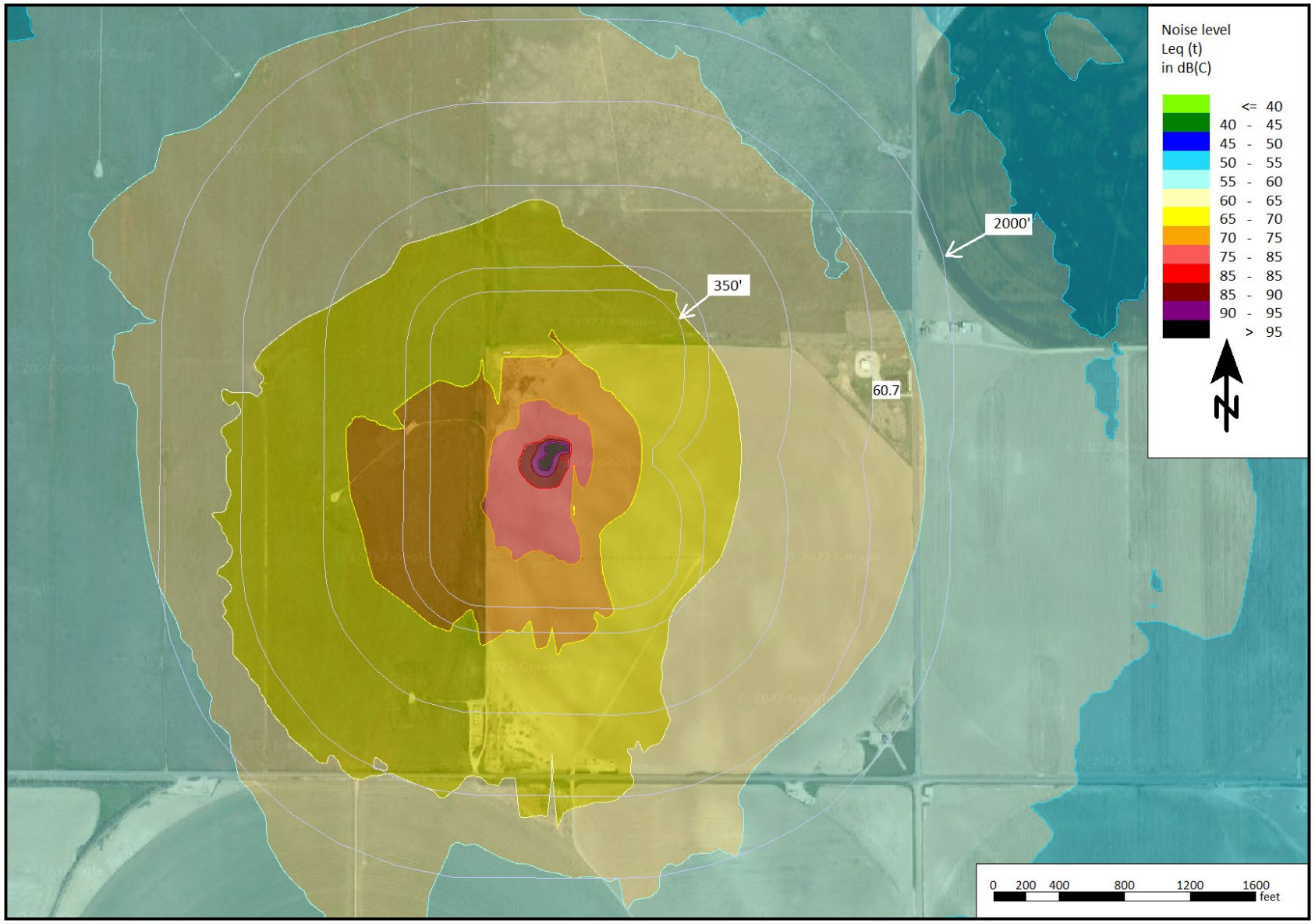


Figure 9. *Mitigated Drilling Noise Contour Map (dBC)*



Completions Noise Model Results

Results for both unmitigated and mitigated completions operations are presented in Table 9 below. The receptor locations in the table correspond to the locations identified in Figure 2 of Section 5.

Unmitigated completions operational noise levels exceed A-weighted MPNLs of 60dBA at Receptor A. Mitigation is therefore required to bring the operation into compliance. The mitigation consists of a partial perimeter wall consisting of 640 linear feet of 32 foot tall, engineered sound wall, rated at STC-32 as well as 176 linear feet of 24-foot tall, engineered sound wall, rated at STC-43. The same mitigation layout will be used for both drilling and completions operations. The sound wall layout is shown in Figure 5 above.

Table 9. *Completions Operations Noise Model Results*

Receptor	Distance & Direction from the Working Pad Surface (feet)	Max Permissible Noise Level		Completions Unmitigated		Completions Mitigated	
		dBA	dBC	dBA	dBC	dBA	dBC
Receptor A	350 E	60.0	--	62.1	--	57.3	--
Receptor 1	1,600 E	--	65.0	--	65.0	--	64.3

The predicted levels only include sound levels from completions operations and do not include ambient noise or noise contribution from other sources outside of the planned operations.

Noise contour maps are provided for the area surrounding the Windom Pad. The contours are provided in 5 dB increments with the color scale indicating the sound level of each contour. Unmitigated Completions Operations noise contour maps are presented in Figure 10 and Figure 11, whereas mitigated contours are shown in Figure 12 and Figure 13.

Figure 10. *Unmitigated Completions Noise Contour Map (dBA)*

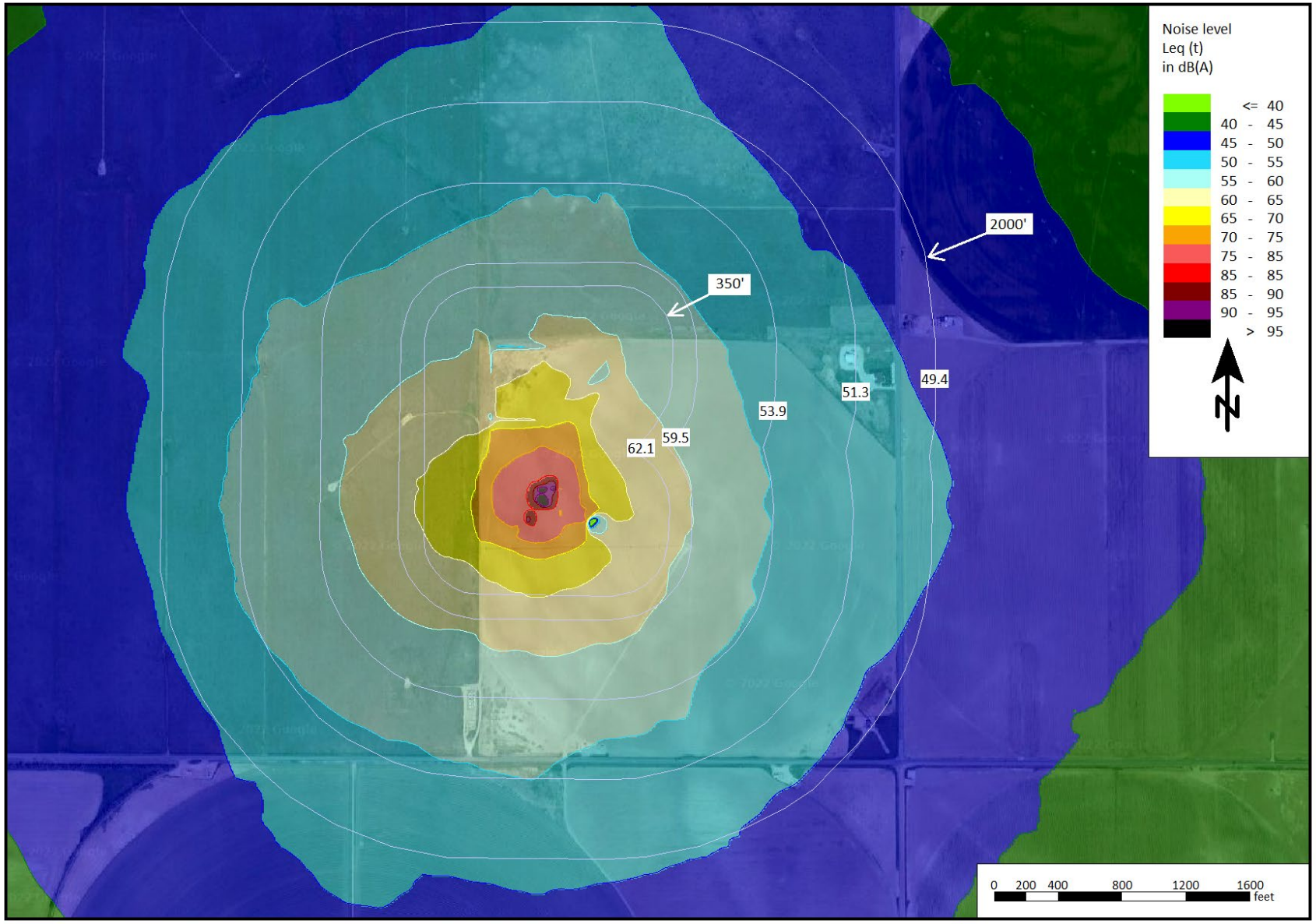


Figure 11. *Unmitigated Completions Noise Contour Map (dBC)*

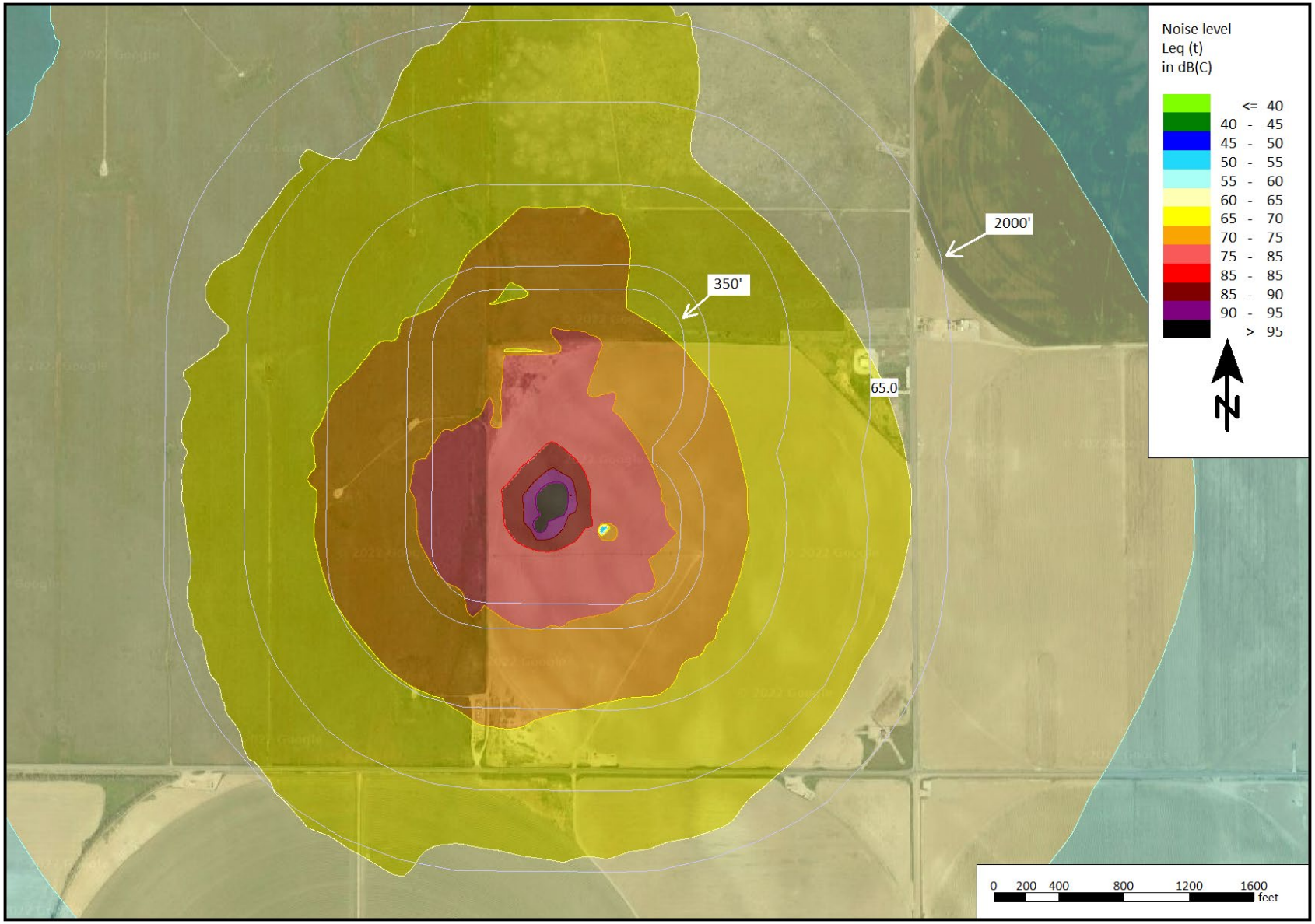


Figure 12. *Mitigated Completions Noise Contour Map (dBA)*

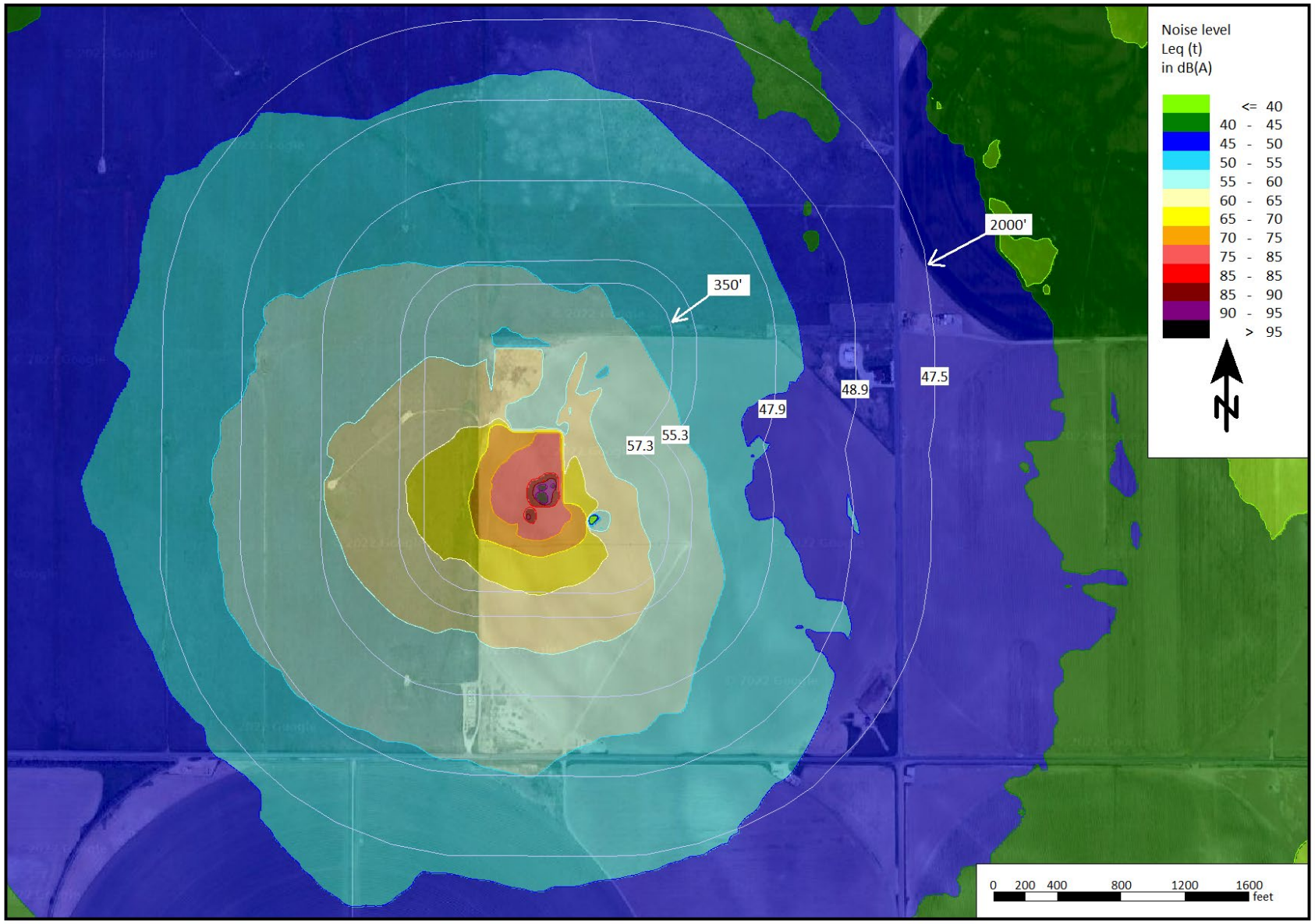
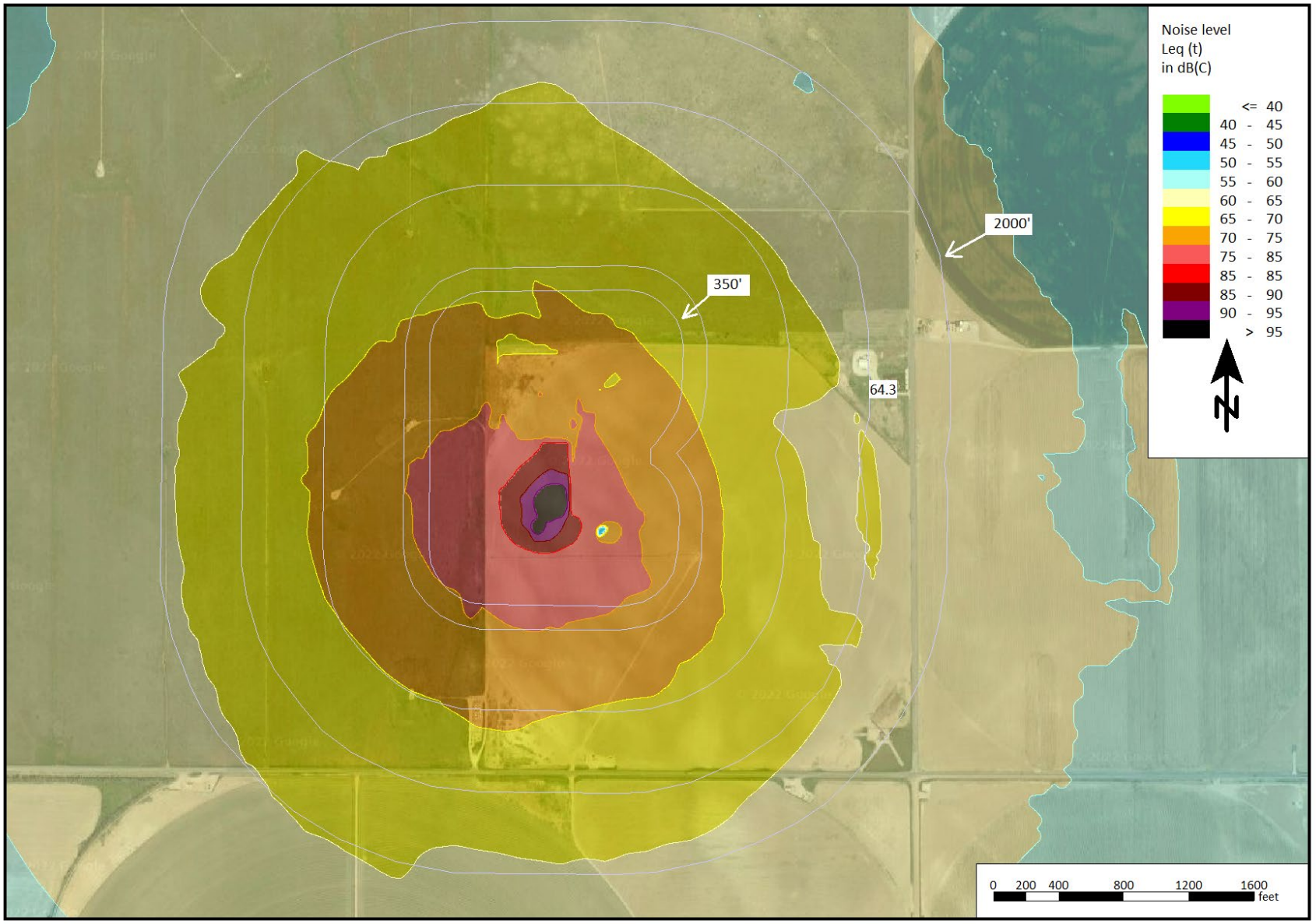


Figure 13. *Mitigated Completions Noise Contour Map (dBC)*



Production Noise Model Results

Model results for unmitigated production operations are presented in Table 10 below. The receptor locations in the table correspond to the locations identified in Figure 3 of Section 5. The predicted levels only include sound levels from production operations and do not include ambient noise or noise contribution from other sources outside of the planned operations.

Table 10. *Production Operations Noise Model Results*

Receptor	Distance & Direction from the Working Pad Surface (feet)	Max Permissible Noise Level		Production Unmitigated	
		dBA	dBC	dBA	dBC
WOGLA Receptor B	350 E	50.0	--	55.5	--
WOGLA Receptor C	770 E	50.0	--	47.8	--
Receptor 1	1,600 E	55.0	60.0	43.3	53.5

Unmitigated production operational noise levels are below the C-weighted MPNL at Receptor 1, but exceed the A-weighted MPNL of 50dBA at WOGLA Receptor C. However, an investigation of the local topography indicates a large hill between the proposed facility and the RBU at Receptor 1. As can be seen in Figure 14 on the next page, the 350 foot dBA receptor location required for Weld County compliance is on the facility side of the hill, and thus does not represent the noise reduction provided by this natural topographical barrier at the RBU. Thus, two other A-weighted receptor locations (WOGLA Receptor C and Receptor 1) were provided to quantify dBA noise levels on the RBU side of the hill and at the RBU itself to gain insight into the issue. It can be seen that the noise level on the RBU side of the hill (WOGLA Receptor C) experiences noise levels 5.5dBA to 6.0dBA lower than that due to divergence alone, at this location. Since this would make the 350 foot receptor location compliant (i.e.: if the 350ft receptor were in a position to benefit from the natural barrier/hill), it is more reasonable that compliance should be based on the WOGLA Receptor C location. Thus, based on this topographical consideration and the discussion above, the production facility is complaint on a dBA and dBC basis and no further noise mitigation is recommended at this time.

Figure 14. *Topography Between the Windom Location and Receptor 1*

PDC understands that based on the analysis and topographical considerations, production operations will not require mitigation at this time as there is a very low probability of complaint generation east of the proposed location. However, PDC agrees to take responsible action in the event of a complaint generated from the eastern direction and consider the potential for implementation of noise mitigation strategies at that time.

Noise contour maps are provided for the area surrounding the Windom Pad. The contours are provided in 5 dB increments with the color scale indicating the sound level of each contour. Unmitigated Production Operations noise contour maps are presented in Figure 15 and Figure 16.

Figure 15. *Unmitigated Production Noise Contour Map (dBA)*

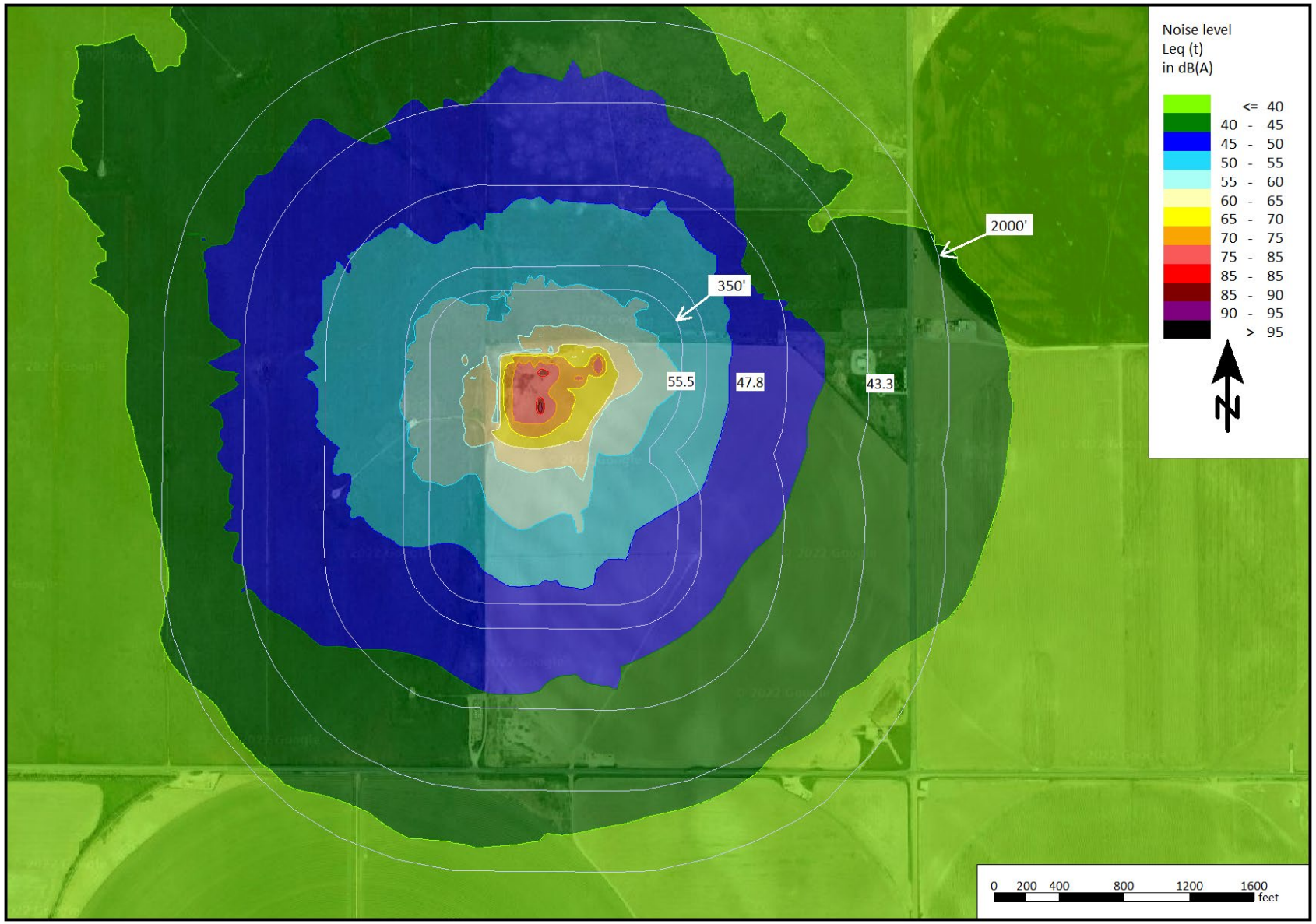
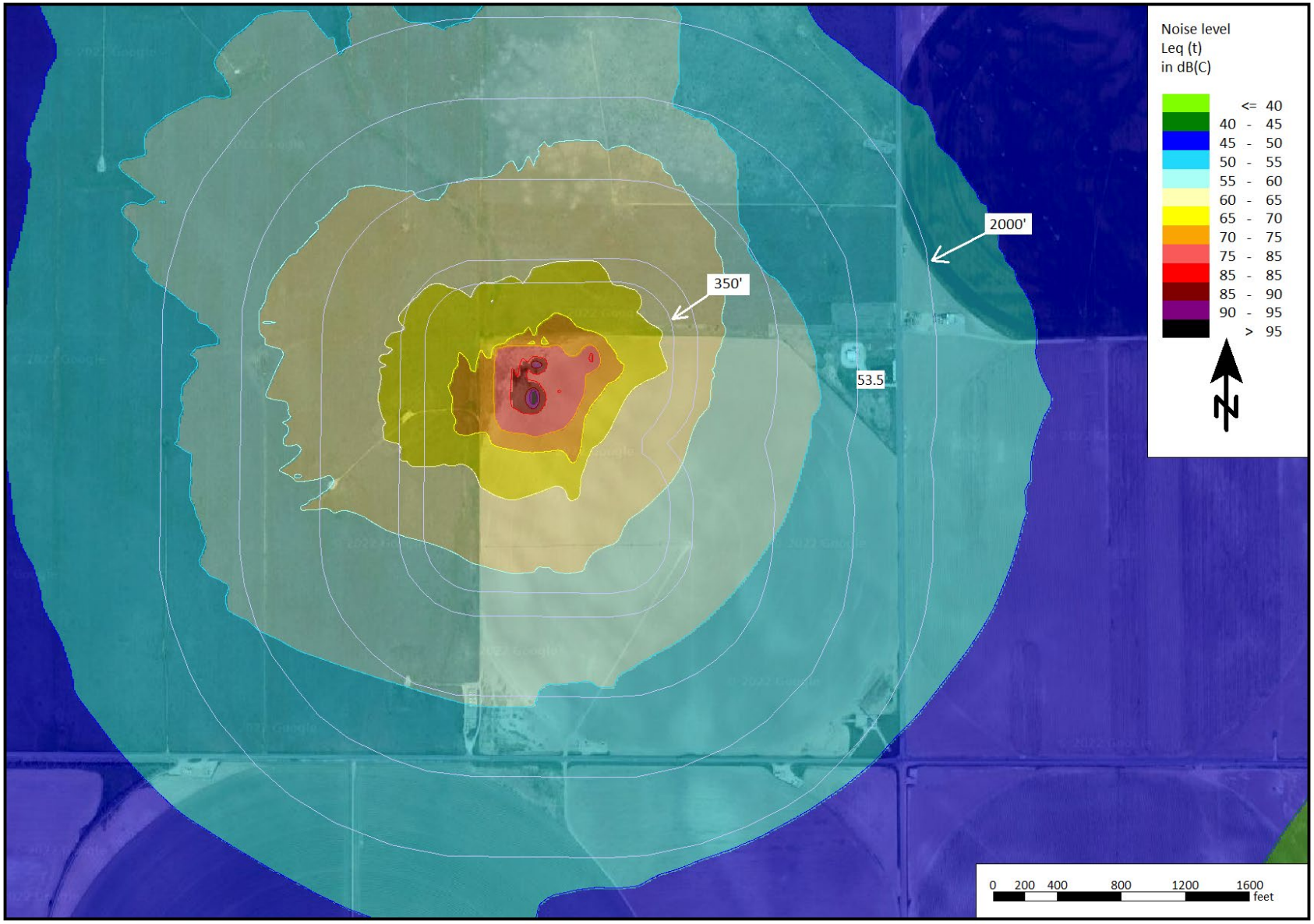


Figure 16. *Unmitigated Production Noise Contour Map (dBC)*



Flowback Operations Review

A review of flowback operations was carried out by Urban based on information supplied by PDC. It was determined that flowback can be reduced to two simple, successive, operations from a noise perspective; these are “drill out” and “surface flow”. Both flowback operational components were assessed, and it was found that neither warrant noise modeling as outlined below.

The drill out operation utilizes equipment similar to a large production drilling rig, but much smaller in size, with reduced equipment quantities and produce much lower noise signatures as compared to the large production rig. This results in a noise signature of the drill out portion of flowback operation having much lower noise levels than either the production drilling rig or completions operations (on both a dBA and dBC basis).

The second part of the flowback operation is conducted once the drill out operation is complete, when well flows are initiated and directed to a series of temporary valves, screens, sand traps, separators, and mobile tanks instead of the production facility equipment. The temporary flowback equipment is similar to the production equipment already studied for production operations but utilizes smaller units with reduced quantities of individual equipment pieces, again with lower noise levels. This results in noise levels lower than the production operation studied in this assessment (on both a dBA and dBC basis). Since flowback operations are held to the higher MPNLs of preproduction operations instead of the lower MPNLs associated with production operations, there is very low risk from a nuisance environmental noise perspective for the surface flow portion of flowback operations.

Given the characteristics of the two components of the flowback operation outlined above and the fact that both the drill out and surface flow portions have noise levels significantly lower than other phases of operations assessed in this study, there is no need for special consideration (noise modeling, etc.) of the flowback operation as long as any perimeter sound walls needed for drilling/completions compliance are left in place until surface flows are initiated.

9. CONTINUOUS MONITORING / COMPLAINT RESOLUTION

Throughout the duration of preproduction operations, PDC will conduct Continuous Noise Monitoring at the A-weighted noise point of compliance outlined in Figure 2 of Section 5.

Continuous monitoring services are deployed to provide continuous noise level documentation and compliance verification throughout preproduction operations. If a noise complaint is made to either PDC directly (or to the COGCC, or to Weld County), or the Local Government Designee, and the Operator is notified of the complaint, PDC is able to reference continuous monitoring data and identify the source of any sound level 'spike(s)' throughout the monitoring period.

The sound level meters collect measurements of A and C-weighted decibel (dB) levels by continuously sampling sound levels, logging the specified data every minute. The meters are calibrated before and after the measurement period to ensure accuracy. They also have an internal system check function that runs daily and will issue an alert if necessary, so that any issues detected can be attended to promptly. The hourly Leq values shown in Continuous Noise Monitoring reporting are calculated by averaging 1-minute Leq noise levels when the wind is below 5 miles per hour, per COGCC Rule 423 and WOGLA Section 21-5-435, noise regulations.

PDC will post contact information to receive and address noise complaints arising from pre-production operations around the clock, 24-hours, 7 days per week. Upon receipt of a complaint, either directly to PDC or from the COGCC, or Weld County, PDC will contact the associated stakeholder within 48 hours of receipt.

10. CONCLUSION

The results of the proactive planning, noise modeling, and implementation of Best Management Practices as discussed in this NMP indicate that noise levels generated by PDC's proposed oil and gas operations at the Windom Pad are expected to comply with permissible noise levels required by both the COGCC Rule 423 and WOGLA Section 21-5-435, noise regulations for all operations proposed (drilling, completions, flowback, and production).

11. NOTATIONS

The services provided for this project were performed in accordance with generally accepted professional consulting services. No warranty, expressed or implied, is made or intended by rendition of these consulting services or by furnishing oral or written reports of the findings made. Urban Solution Group generated this report for the exclusive use of PDC.

Appendix 1 – Equipment Layout

Figure 17. *Drilling Equipment Layout for the Ensign 142 Drilling Rig*

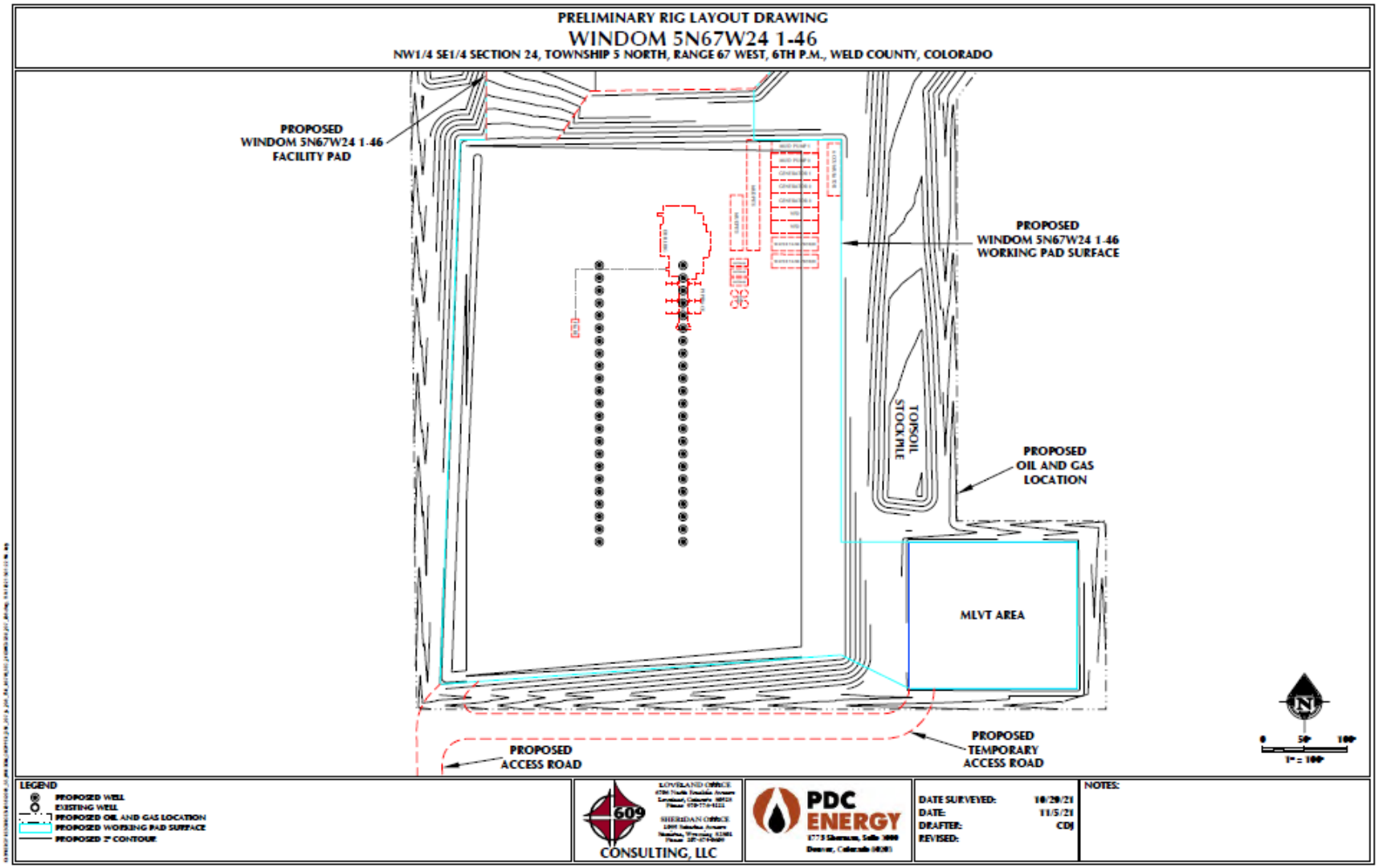


Figure 18. *Completions Equipment Layout for the Liberty Oilfield Services Quiet Fleet*

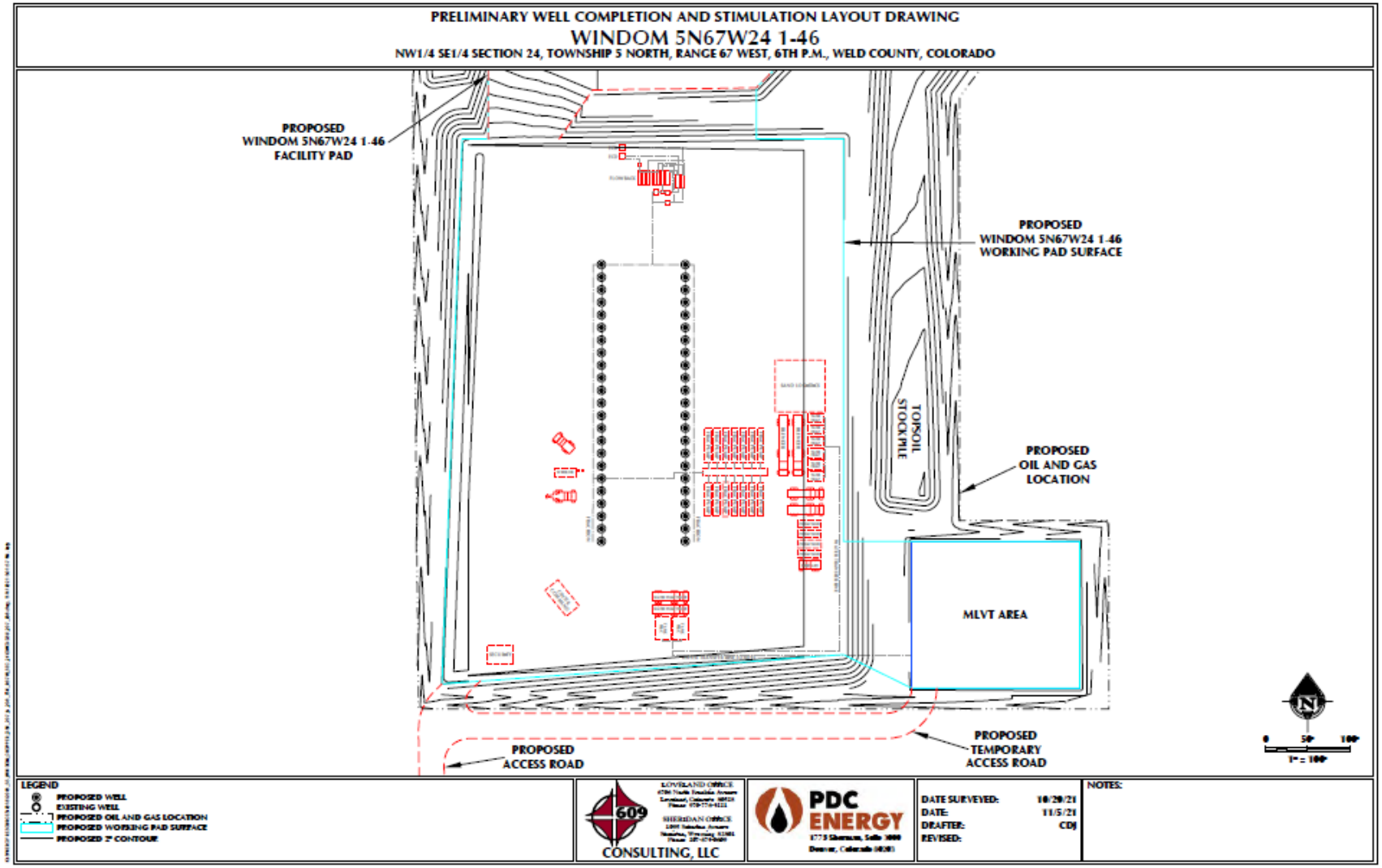
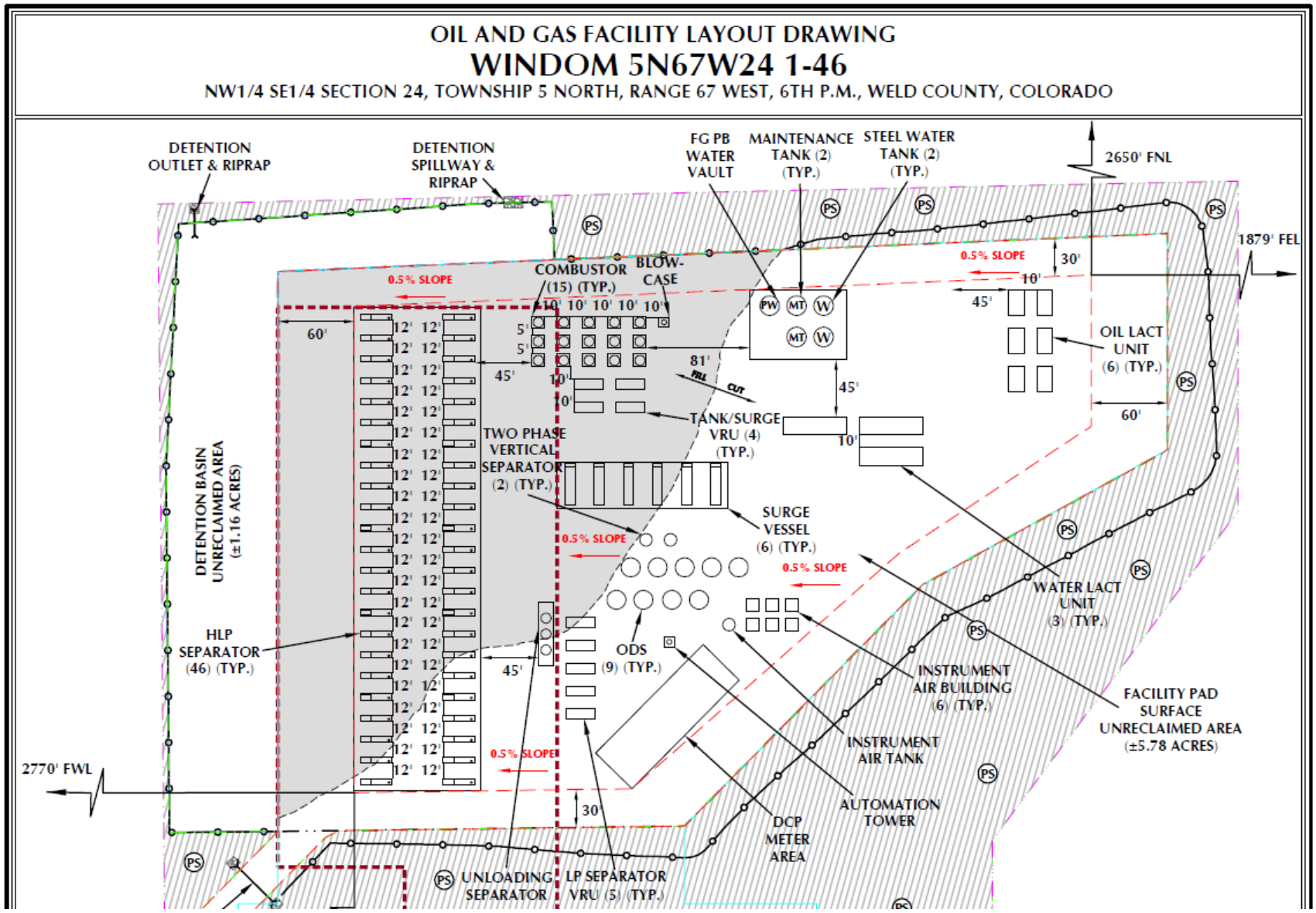
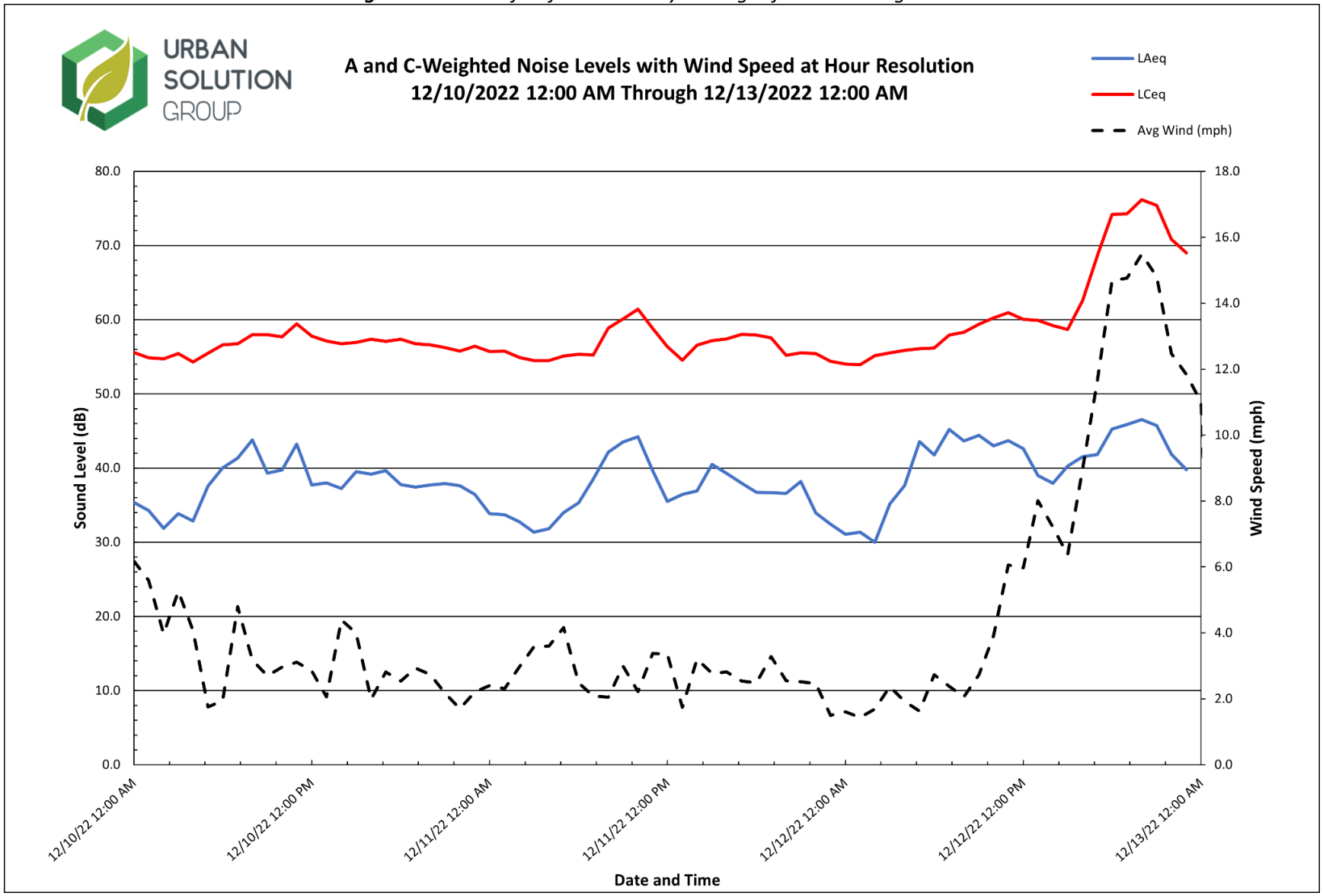


Figure 19. *Production Equipment and Layout*



Appendix 2 – Ambient Data and Charts

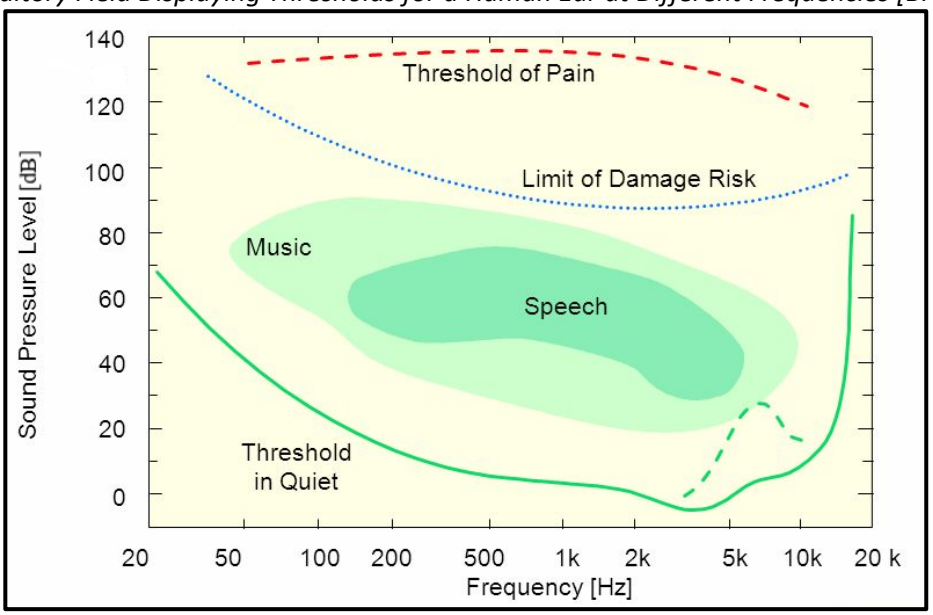
Figure 20. *Chart of Unfiltered Hourly Averages for Monitoring Point 1*



Appendix 3 – Sound Fundamentals

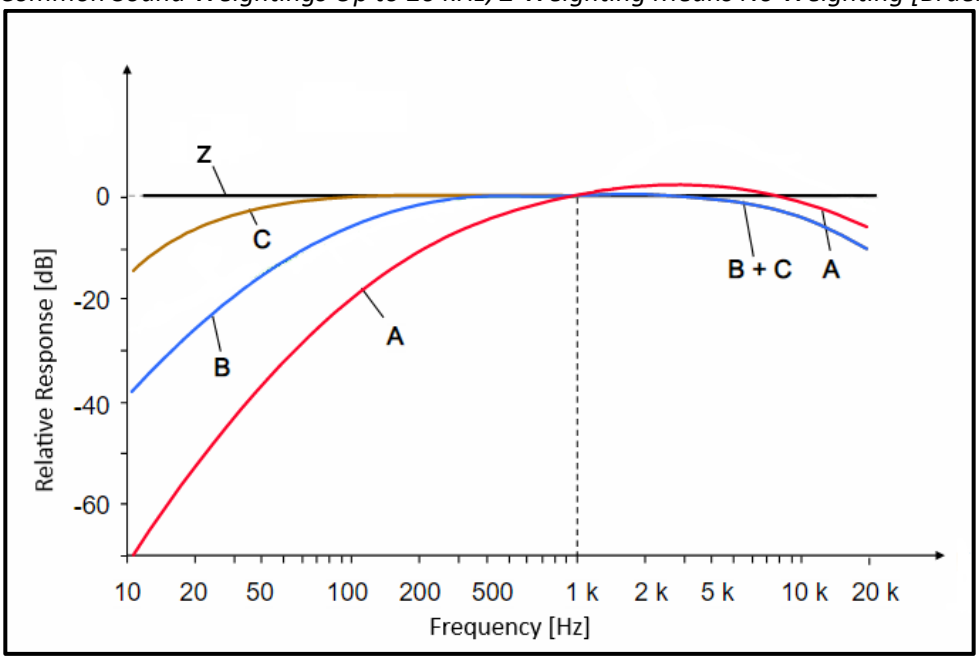
Sound is a series of vibrations transmitted through the air, or other medium, and can be heard when they are processed by the human ear. There are two important properties that describe sound; frequency and amplitude. Frequency is determined by the rate of movement and is measured in cycles per second, which is known as Hertz (Hz). A healthy human ear can hear 20 Hz – 20,000 Hz (Figure A). The sensation associated with frequency is commonly referred to as the pitch of a sound. High frequencies produce a higher pitch and vice versa. The amplitude of a sound is determined by the maximum displacement of air molecules produced by the vibrations. These displacements lead to pressure fluctuations in air, which are expressed in decibels (dB). Decibels are a logarithmic ratio of sound pressure over the standard threshold of hearing. The more energy a sound has, the larger the pressure fluctuations, resulting in a louder sound.

Figure A: *Auditory Field Displaying Thresholds for a Human Ear at Different Frequencies [Bruel and Kjaer]*



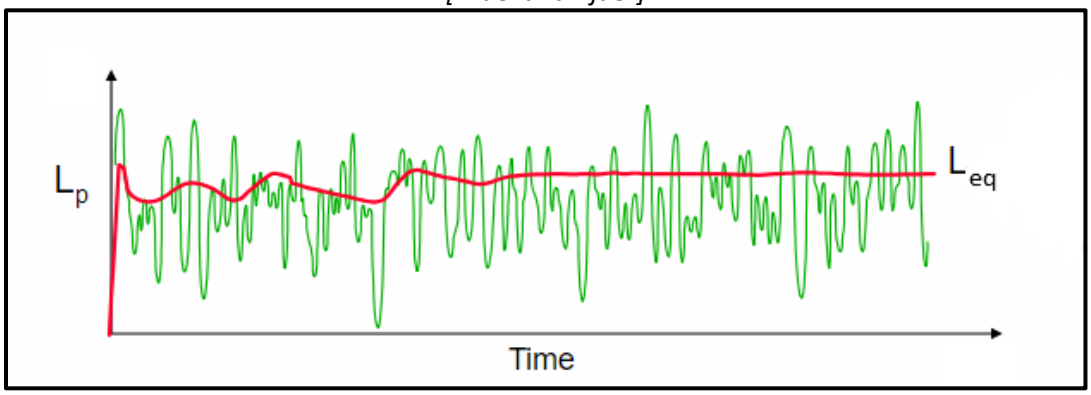
Frequency weightings are applied to measurements to provide a better match between measured results and human perception. Each weighting, in relation to their frequency components, allows for a consistent measurement of the different type of noise sources. A-weighted decibel sound pressure levels (dBA) are measurements recorded from a sound level meter measuring sounds similar to the response of the ear (Figure B). While C-weighted (dBC) measurements are for low-frequency components.

Figure B: *Common Sound Weightings Up to 20 kHz, Z-Weighting Means No Weighting [Bruel and Kjaer]*



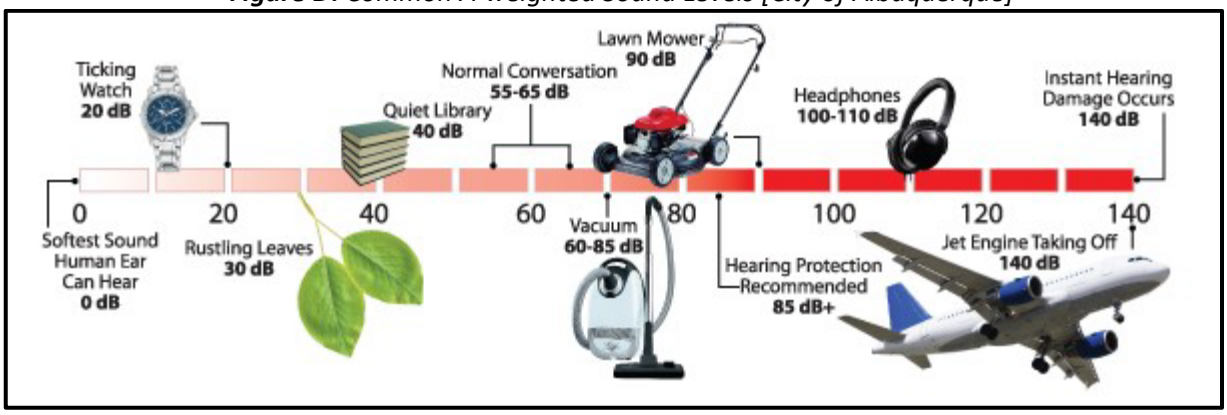
Each measurement has an exponential time factor. Slow time weighting is the most common for environmental noise measurements and will be used for these measurements. For recording over long periods of time, the sound level meter records each weighted decibel reading with an equivalent, or average, continuous sound level reading (Leq). Leq represents the same energy as the actual time varying sound signal (Figure C). LAeq refers to the equivalent continuous sound level for an A-weighted measurement.

Figure C: *Sound Level Recording Displaying Leq, a Steady-State Sound Level, Over a Noise Measurement [Bruel and Kjaer]*



Environmental noise is a combination of various noise sources. These sources may include; vehicle traffic, aircraft flyovers, wind, weather disturbances, commercial or industrial activities, and other short-term events. These sources create “background noise”. Background noise varies throughout the day, generally following the cycle of human activity. Figure D below presents typical A-weighted (dBA) sound levels for common sources of sound.

Figure D: *Common A-weighted Sound Levels [City of Albuquerque]*



Appendix 4 – Glossary

Average Sound Level
See Energy Equivalent Sound Level.

A-weighted sound level
The sound level as measured on a sound level meter using a setting that emphasizes the middle frequency components similar to the frequency response of the human ear.

Calibration
A procedure used for the adjustment of a sound level meter using a reference source of a known sound pressure level and frequency. Calibration must take place before and after the sound level measurements.

C-weighted Sound Level
The C-weighting approximates the sensitivity of human hearing at the industrial noise levels (above 85 dBA). The C-weighted sound level is more sensitive to the sounds used to assess the low- frequencies than the A-weighted sound level. It is sometimes used to assess the low-frequency content of complex sound environments.

Day Night Sound Level (Ldn)
Is the average noise level over a 24-hour period. The noise between the hours of 22:00 and 07:00 is artificially increased by 10 dB. The nighttime noise is weighted to consider the decrease in community background noise.

Daytime Average Sound Level
The time-averaged A-weighted sound level measured between the daytime hours, which are usually 7:00 am to 7:00 pm (7:00 am to 9:00 pm for COUNTY Code).

Decibel (dB)
A unit of measure of sound pressure that compresses a large range of numbers into a more meaningful scale. The basic unit of measurement for sound levels.

dBA
The decibel (dB) sound pressure level filtered through the A filtering network to approximate human hearing response. See dB and A-weighted Sound Level.

dBC
The decibel (dB) sound pressure level filtered through the C filtering network. See dB and C-weighted Sound Level.

Energy Equivalent Sound Level (Leq)
The Leq is a single-number average, sound level that represents cumulative acoustical energy as measured over a specified time interval.

Facility
Any operation used in exploration, processing, development and transportation of energy resources.

Frequency
The number of oscillations per second for a sound wave.

Impulse Noise
Unwanted, instantaneous sharp sounds that create sudden impulses of pressure similar to gunfire and explosions.

Noise Reduction
The difference in sound pressure level between two points

Ldn
See Day night sound level.

Leq
See Energy Equivalent Sound Level.

Noise
Generally understood as unwanted sound.

Noise Mitigation Plan (NMP)
Identifies the expected sound level emanating from operations and receptor points are placed in locations related to compliance. It also identifies what the permissible sound level is and how it was calculated.

Noise Reduction Coefficient (NRC)
A single number rating of the sound absorption properties for a material. An NRC value of zero indicates the material is purely reflective. An NRC value of one indicates perfect absorption.

Octave
A series of electronic filters separate sound into discrete frequency bands, making it possible to know how sound energy is distributed as a function of frequency. The octave band has a center frequency that is double the center frequency of the octave band preceding it.

Point Source
A source that radiates sound from a single point. Generally used to model equipment when looking at the sound impact over a large area.

Receiver
A person or piece of equipment that is affected by noise.

Sound
A series of vibrations transmitted through the air, or other medium, and can be heard when they are processed by the human ear.

Sound Level Meter (SLM)
An instrument that contains a microphone and filter used to measure sound levels, using standard frequency-weightings and exponentially weighted time averaging.

Sound Power Level
A physical measurement of the amount of power a sound source radiates into the surrounding air. It is the rate at which sound energy is emitted, or received, per unit time.

Sound Transmission Class (STC)
An integer rating that measures how well a barrier or building partition attenuates sound. Indicates how well a barrier is at stopping sound from transmitting through it.

1/3 Octave
The 1/3 octave band analysis provides a finer breakdown of sound distribution as a function of frequency.