

Behrens and Associates, Inc.

Environmental Noise Control



February 3, 2015

Bayswater Exploration
730 17th Street, Suite #610
Denver, Colorado 80202

Attention: Dan Brugeman

Subject: Arellano Noise Modeling Report

Dear Mr. Brugeman:

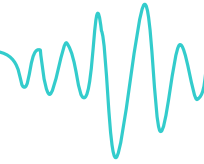
The following report provides an analysis of noise levels produced by the Bayswater drilling operations at the Arellano site located approximately 1,000 feet south of East 16th Street and 650 feet west of Fern Avenue near Garden City, Colorado. The noise modeling includes both unmitigated and mitigated scenarios for the rig oriented with the V-door facing southeast and northwest. There are existing occupied structures in the vicinity of the drilling site located to the north, south, east and west of the drilling rig. This report includes the Colorado Oil and Gas Conservation Commission (COGCC) noise standards, the results of our noise modeling and our assessment relative to the standards. See Attachment 1 for the Arellano site location.

Colorado Oil and Gas Conservation Commission Noise Standards

The analysis was developed to evaluate measured 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 1.

Table 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



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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:

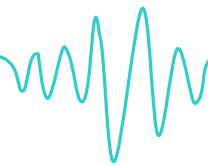
In situations where the complainant or Commission onsite inspection indicates that low frequency noise is a component of the problem, the Commission shall obtain a sound level measurement twenty-five (25) feet from the exterior wall of residence or occupied structure to the noise source, using a noise 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.

Colorado Oil and Gas Conservation Commission Setback Rules

Section 604.c.(2)

A. Noise.

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.



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The site was modeled with fourteen receivers (Receivers #1 to #14), placed to predict noise levels at the Arellano site. Receiver #1 was placed 350 ft from the nearest drilling equipment on the Arellano site in the direction of the nearest occupied structure to the northwest. Receiver #2 was placed 350 ft from the nearest drilling equipment in the direction of the nearest occupied structure to the west. Receiver #3 was placed 350 ft from the nearest drilling equipment in the direction of the nearest occupied structure to the southwest. Receiver #4 was placed 350 ft from the nearest drilling equipment in the direction of the nearest occupied structure to the south. Receiver #5 was placed 350 ft from the nearest drilling equipment in the direction of the nearest occupied structure to the southeast. Receiver #6 was placed 350 ft from the nearest drilling equipment in the direction of the nearest occupied structure to the east. Receiver #7 was placed 350 ft from the nearest drilling equipment in the direction of the nearest occupied structure to the north. A-weighted (dBA) noise levels were assessed at Receivers #1 to #7.

The remaining receivers (Receivers #8 to #14) have been placed 25 ft from the nearest occupied structures towards the pad in the north, east, south and west directions respectively to assess the C-weighted (dBC) noise levels. The placement of the receivers are in compliance with COGCC Noise Standards Section 802C.(1) and Section 802(d).

See Attachment 1 for all receiver locations.

Sound Modeling Methodology

Sound level measurements for the Frontier Rig #8 drilling equipment were obtained on Thursday, May 22, 2014. Measurements were taken adjacent to and at increasing distances from noise emitting equipment while the rig was operational at another site. Measurements of this equipment were conducted with a Brüel & Kjær Type 1 Model 2250 Sound Level Meter.

The noise model was created using SoundPlan 7.3 software which calculates noise levels in accordance with ISO 9613-2:1996 standards. This noise model predicts noise levels 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.

Upon completion of the unmitigated noise models, acoustical barriers and generator silencer upgrades were added to the model to evaluate the noise mitigation system. The following table summarizes the modeled drilling scenarios.

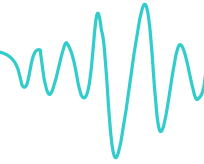


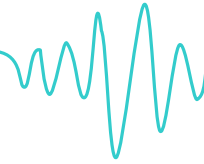
Table 2. Modeled Drilling Scenarios

Modeled Scenario	Description
Unmitigated- Southeast Orientation	No noise mitigation
Unmitigated- Northwest Orientation	No noise mitigation
Mitigated- Southeast Orientation	<ul style="list-style-type: none">• 16- ft high, 80 ft long Acoustical Barrier around generators• 32-ft high, 1,520 ft long Acoustical Barrier around drilling equipment• 40-ft high, 400 ft long Acoustical Barrier around drilling equipment• Generator exhaust silencer upgraded to achieve an additional minimum 15 dB reduction (see Attachment 4)
Mitigated- Northwest Orientation	<ul style="list-style-type: none">• 12- ft high, 40 ft long Acoustical Barrier around generators• 32-ft high, 1,560 ft long Acoustical Barrier around drilling equipment• 40-ft high, 360 ft long Acoustical Barrier around drilling equipment• Generator exhaust silencer upgraded to achieve an additional minimum 15 dB reduction<ul style="list-style-type: none">• (see Attachment 10)

Noise Modeling Results

The noise levels in this section represent the contribution of the drilling operations to the overall sound levels at the specified receiver points. Actual field sound level measurements may vary from the projected noise levels due to existing non-drilling related noise sources such as traffic, other human activity, or environmental factors.

Tables 3 and 4 show the predicted noise levels of the drilling operations at the receivers as identified in Attachment 1 for the southeast rig orientation. Tables 5 and 6 show the predicted noise levels of the drilling operations at the receivers as identified in Attachment 7 for the northwest rig orientation. The results are reported utilizing the A-weighted and C-weighted decibel scale.

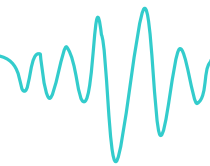


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A-weighted sound levels represent the response to sound of human hearing and emphasize the mid to high frequencies. C-weighted sound levels emphasize the low frequency spectrum. Noise level reports typically only show the A-weighted results. The C-weighted results are displayed in this report to assess the level of low frequency noise at the receivers per the COGCC noise standards.

Table 3. Predicted Noise Levels in dBA For Drilling Operations with Southeast Orientation

Location	Location Description	Unmitigated Drilling Operations (dBA)	Mitigated Drilling Operations (dBA)
Receiver #1	350 ft from the noise source towards a residence located to the northwest	67.6	55.6
Receiver #2	350 ft from the noise source towards a residence located to the west	66.9	55.8
Receiver #3	350 ft from the noise source towards a residence located to the southwest	69.6	56.1
Receiver #4	350 ft from the noise source towards a residence located to the south	69.5	53.5
Receiver #5	350 ft from the noise source towards a residence located to the southeast	73.8	53.9
Receiver #6	350 ft from the noise source towards a residence located to the east	71.9	54.2
Receiver #7	350 ft from the noise source towards a residence located to the north	64.3	54.1
Allowable noise level	350 ft from the noise source towards an existing, occupied structure or at the property line, whichever is greater	70.0 Day / 65.0 Night	



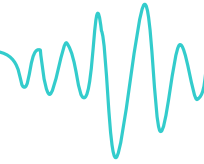
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Table 4. Predicted Noise Levels in dBC For Drilling Operations with Southeast Orientation

Location	Location Description	Unmitigated Drilling Operations (dBC)	Mitigated Drilling Operations (dBC)
Receiver #8	25 ft from the exterior wall of a residence located to the northwest of the site	70.2	64.4
Receiver #9	25 ft from an exterior wall of a residence located to the west of the site	70.6	63.6
Receiver #10	25 ft from an exterior wall of a residence located to the southwest of the site	70.2	64.6
Receiver #11	25 ft from an exterior wall of a residence located to the south of the site	75.7	64.3
Receiver #12	25 ft from an exterior wall of a residence located to the southeast of the site	78.4	63.6
Receiver #13	25 ft from an exterior wall of a residence located to the east of the site	77.2	64.8
Receiver #14	25 ft from an exterior wall of a residence located to the north of the site	65.5	64.4
Allowable noise level	25 ft from the exterior wall of a residence or occupied structure towards the noise source	65.0	



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Table 5. Predicted Noise Levels in dBA For Drilling Operations with Northwest Orientation

Location	Location Description	Unmitigated Drilling Operations (dBA)	Mitigated Drilling Operations (dBA)
Receiver #1	350 ft from the noise source towards a residence located to the northwest	72.7	56.9
Receiver #2	350 ft from the noise source towards a residence located to the west	71.8	57.1
Receiver #3	350 ft from the noise source towards a residence located to the southwest	70.2	56.5
Receiver #4	350 ft from the noise source towards a residence located to the south	69.3	53.5
Receiver #5	350 ft from the noise source towards a residence located to the southeast	69.1	53.9
Receiver #6	350 ft from the noise source towards a residence located to the east	68.1	54.3
Receiver #7	350 ft from the noise source towards a residence located to the north	74.6	57.8
Allowable noise level	350 ft from the noise source towards an existing, occupied structure or at the property line, whichever is greater	70.0 Day / 65.0 Night	

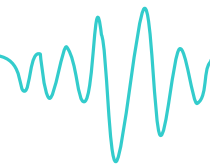
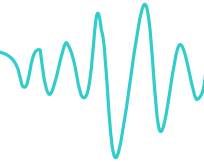


Table 6. Predicted Noise Levels in dBC For Drilling Operations with Northwest Orientation

Location	Location Description	Unmitigated Drilling Operations (dBC)	Mitigated Drilling Operations (dBC)
Receiver #8	25 ft from the exterior wall of a residence located to the northwest of the site	75.0	64.4
Receiver #9	25 ft from an exterior wall of a residence located to the west of the site	73.7	63.6
Receiver #10	25 ft from an exterior wall of a residence located to the southwest of the site	71.9	63.8
Receiver #11	25 ft from an exterior wall of a residence located to the south of the site	73.5	64.3
Receiver #12	25 ft from an exterior wall of a residence located to the southeast of the site	74.4	63.8
Receiver #13	25 ft from an exterior wall of a residence located to the east of the site	73.7	64.9
Receiver #14	25 ft from an exterior wall of a residence located to the north of the site	72.8	63.4
Allowable noise level	25 ft from the exterior wall of a residence or occupied structure towards the noise source	65.0	

The results of the noise modeling are displayed as noise contour maps and are included as attachments to this report. Maps showing the noise contour lines of the drilling operations are provided in dBA and dBC for the unmitigated and mitigated scenarios. The noise contours are provided in 5 dB increments with the color scale on the right of the maps indicating the sound level of each contour. Attachments 2 and 3 show the unmitigated drilling operation noise contour maps for the southeast orientation in dBA and dBC respectively. Attachment 4 shows the mitigated scenario wall configuration for the southeast rig orientation. Attachments 5 and 6 show the mitigated drilling operation noise contour maps for the southeast rig orientation in dBA and dBC respectively. Attachments 8 and 9 show the unmitigated drilling operation noise contour maps for the northwest orientation in dBA and dBC respectively. Attachment 10 shows the mitigated scenario wall configuration for the northwest rig orientation. Attachments 11 and 12 show the mitigated drilling operation noise contour maps for the northwest rig orientation in dBA and dBC respectively.



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Assessment of Impact

The results of the noise monitoring predict operational noise levels up to 73.8 dBA and 78.4 dBC at the Receivers for the southeast rig orientation. The calculated noise levels exceed the COGCC allowable noise limits of 70/65 dBA during the day and night for A-weighted compliance points and 65 dBC at the C-weighted compliance points therefore noise mitigation is required.

With the inclusion of the noise mitigation outlined in Table 2, the predicted noise levels will comply with the COGCC allowable noise limits for the southeast rig orientation at all receiver points.

The results of the noise monitoring predict operational noise levels up to 74.6 dBA and 75.0 dBC at the Receivers for the northwest rig orientation. The calculated noise levels exceed the COGCC allowable noise limits of 70/65 dBA during the day and night for A-weighted compliance points and 65 dBC at the C-weighted compliance points therefore noise mitigation is required.

With the inclusion of the noise mitigation outlined in Table 2, the predicted noise levels will comply with the COGCC allowable noise limits for the northwest rig orientation at all receiver points.

To achieve compliance, the overall mitigation requirements for the southeast rig orientation are greater in terms of noise wall height and extent. Therefore it is recommended that the rig is oriented with the V-door to the northwest to minimize the required mitigation.

Conclusions

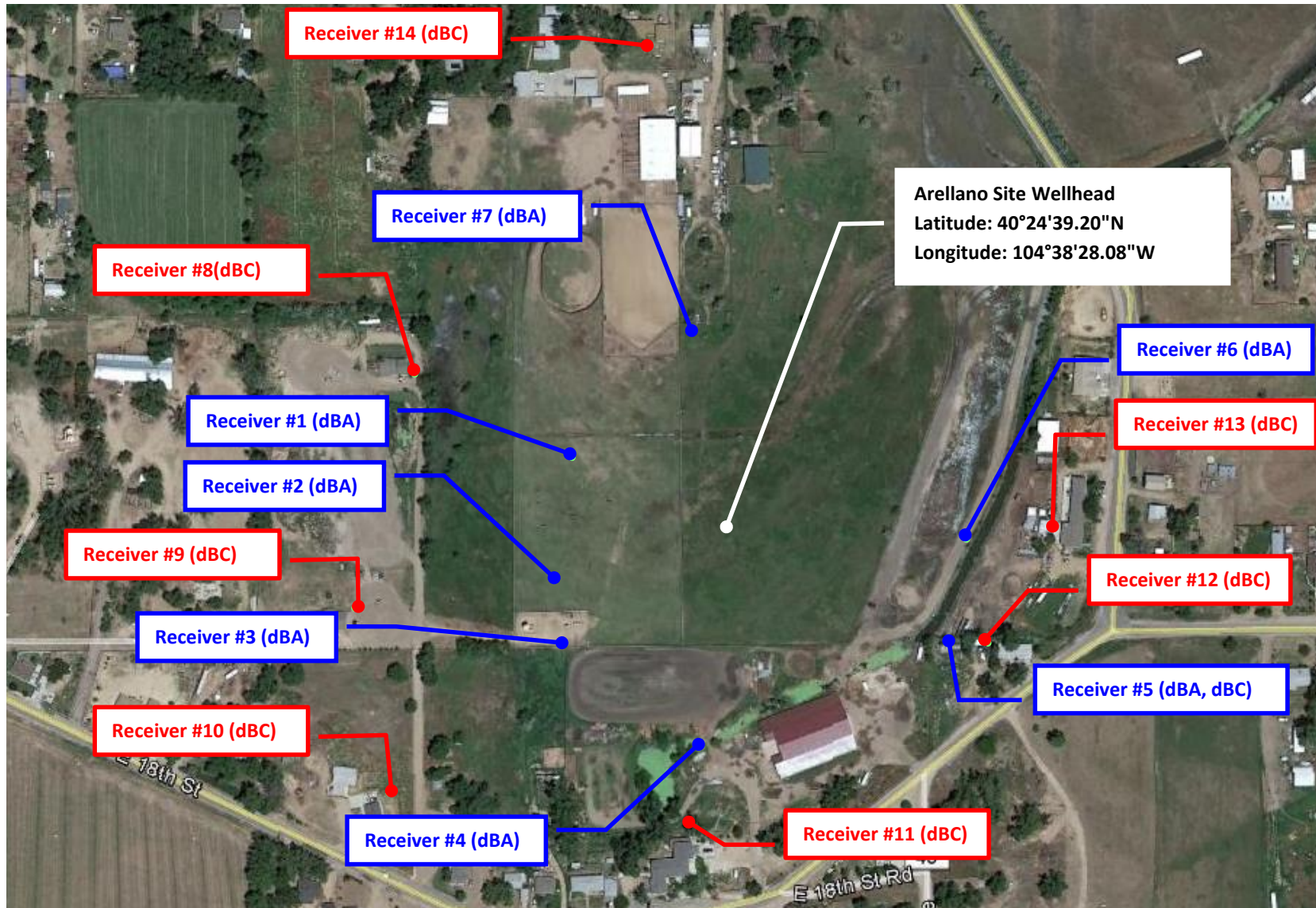
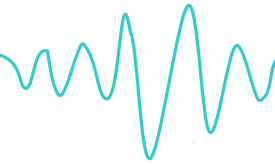
The Arellano drilling site noise levels will exceed the COGCC allowable noise limits for the southeast and northwest rig orientations, requiring noise mitigation. With the inclusion of the noise walls and upgraded generator exhaust silencers outlined in Table 2, the predicted noise levels will comply with the COGCC allowable noise limits at all receiver points for both rig orientations. It is recommended that the rig is oriented with the V-door to the northwest to minimize the required mitigation.

Feel free to contact me with any questions or comments.

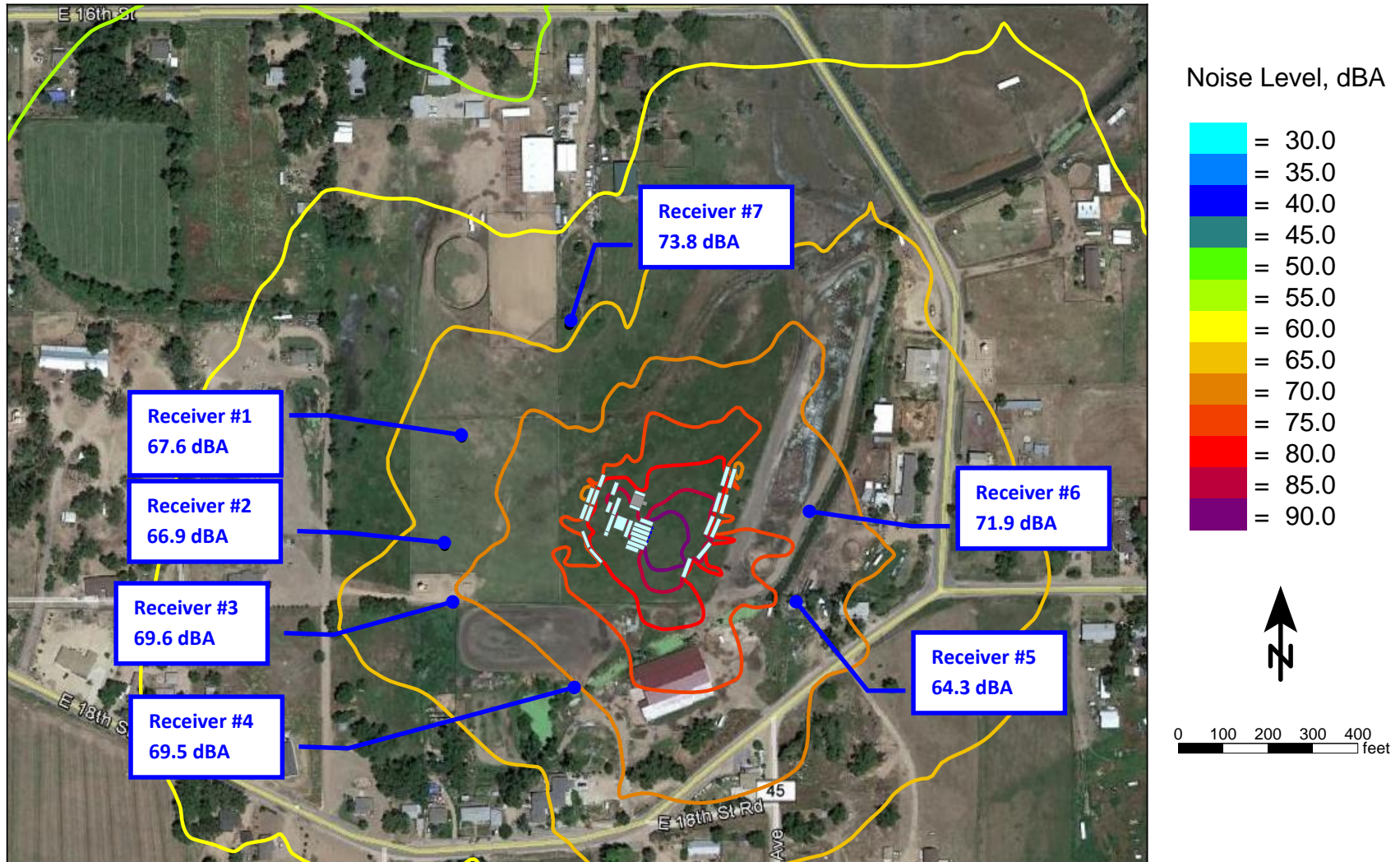
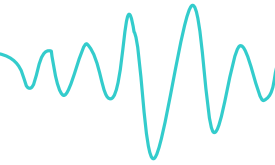
Regards,

Justin Puggioni
Acoustical Consultant

Attachments

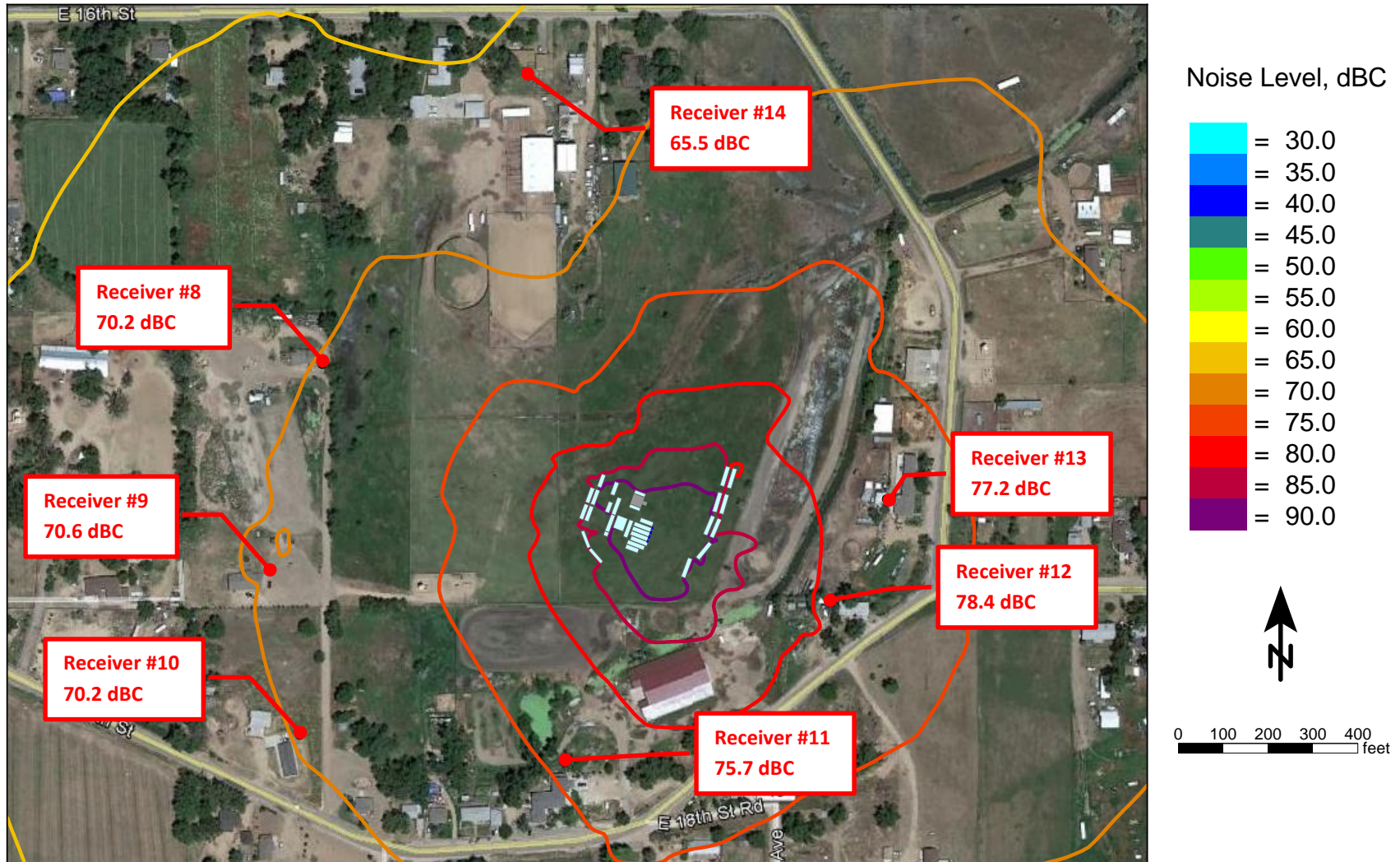
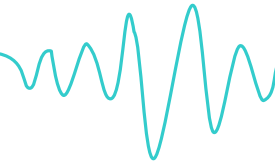


Attachment 1
Arellano Wellhead Location and Receivers Map- Southeast Orientation



Attachment 2

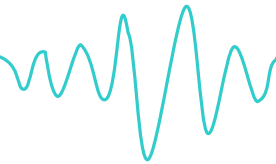
Unmitigated Bayswater Arellano Drilling Noise Contour Map- Southeast Orientation (dBA)






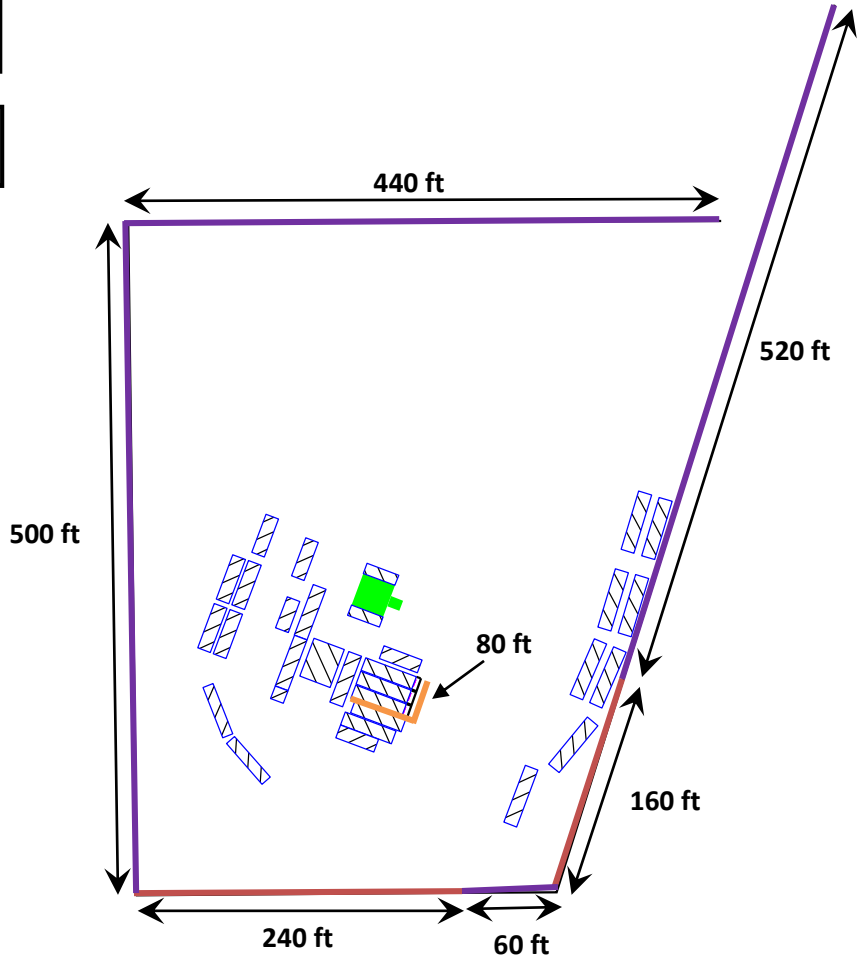
Attachment 3
Unmitigated Bayswater Arellano Drilling Noise Contour Map (dBC)

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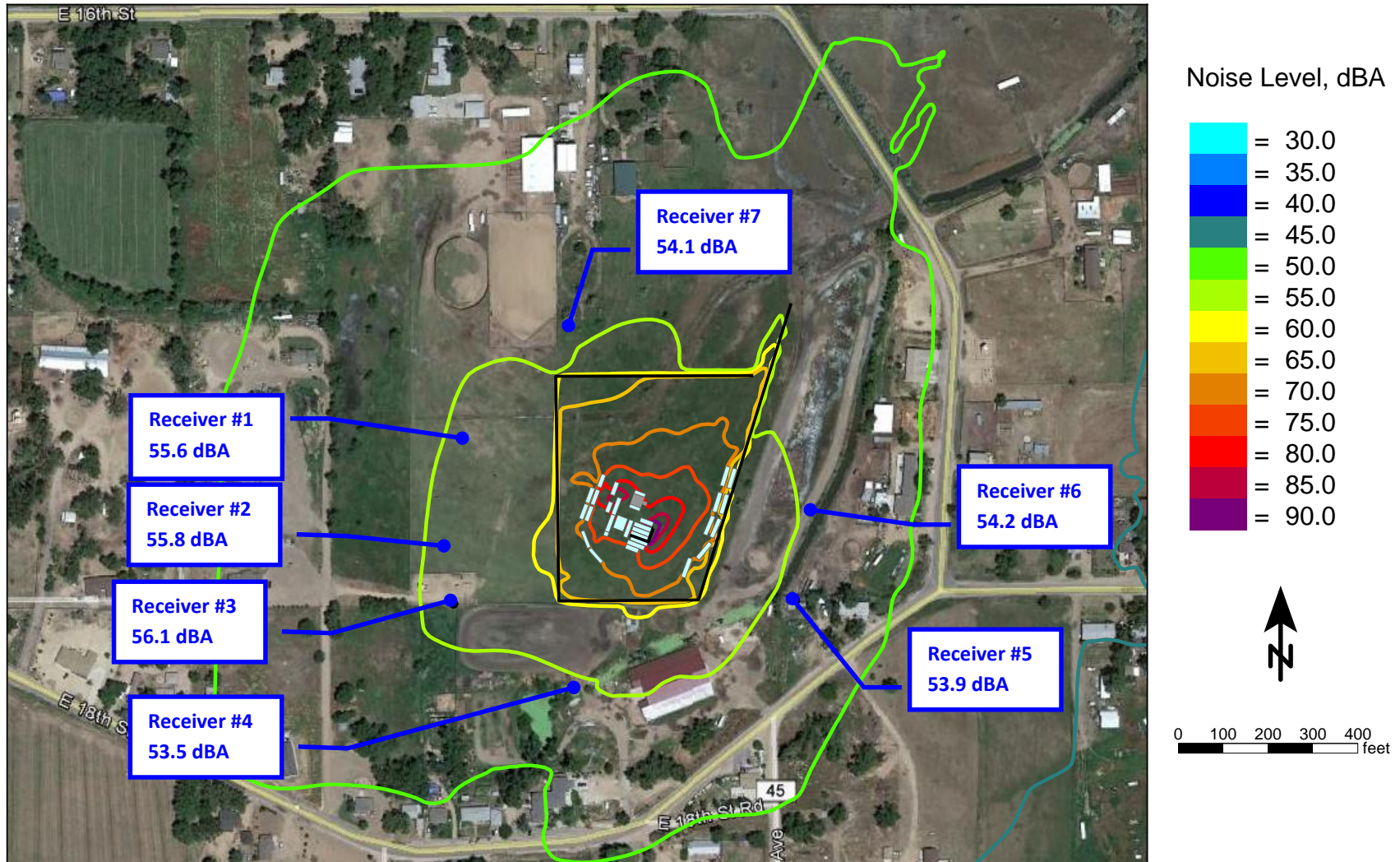
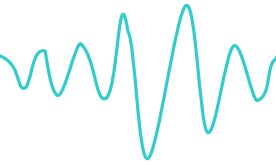
Environmental Noise Control



-  Total 16 ft high x 80 ft long Acoustical Barrier
-  Total 32 ft high x 1,520 ft long Acoustical Barrier
-  Total 40 ft high x 400 ft long Acoustical Barrier

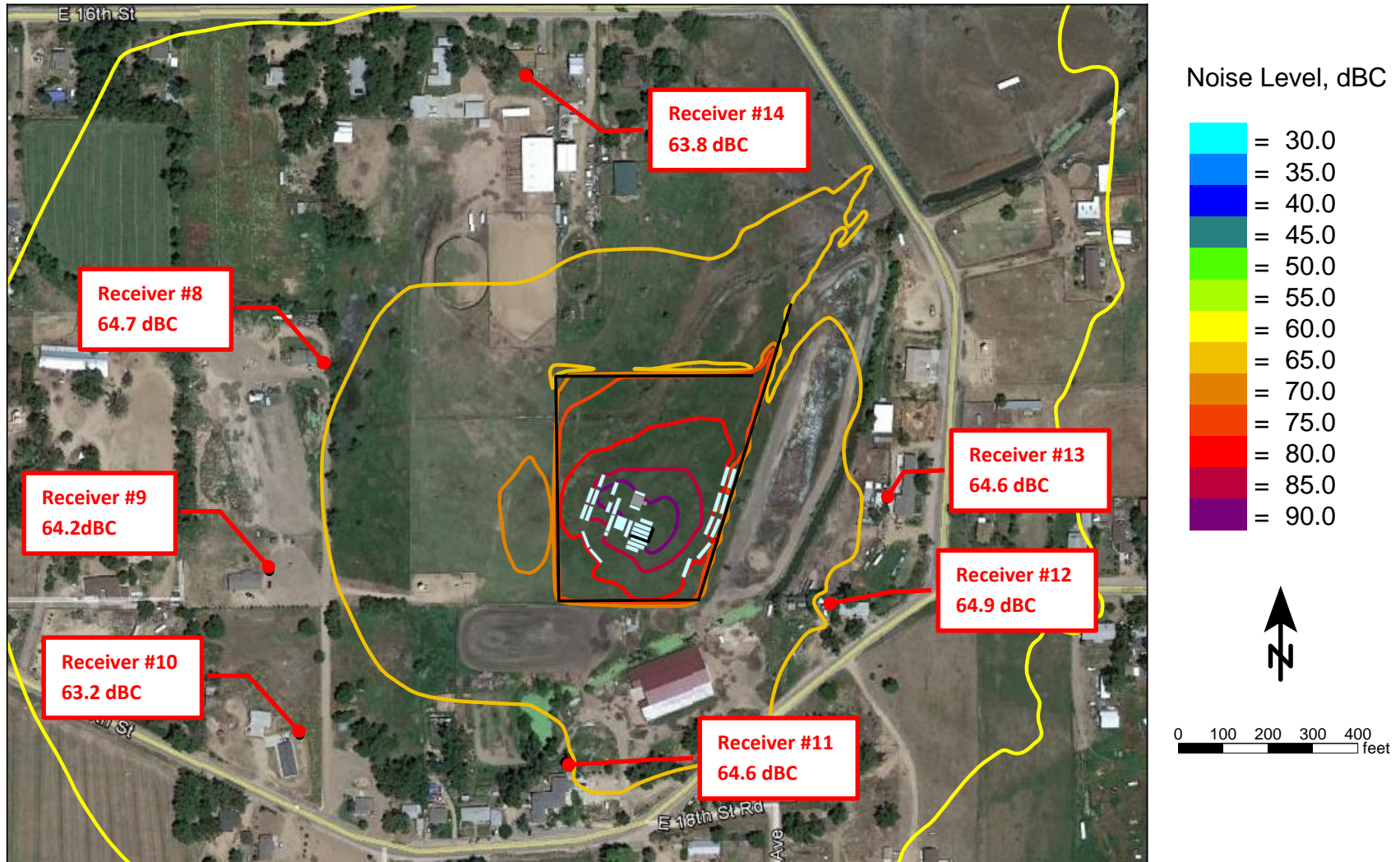
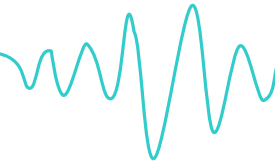


Attachment 4
Arellano Site Acoustical Panels and Dimensions- Southeast Orientation

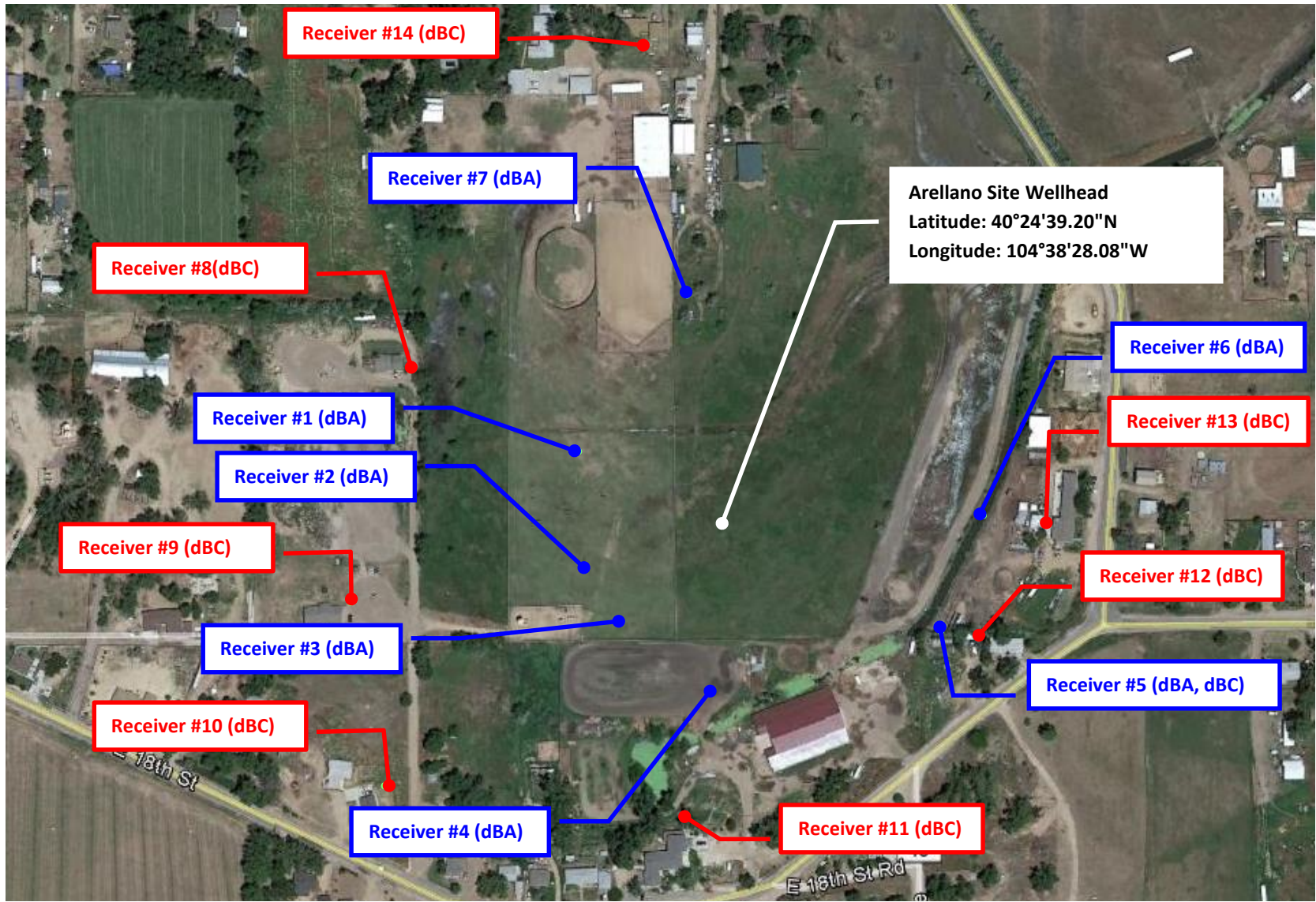
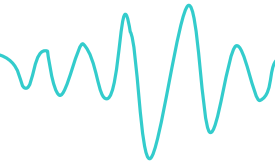


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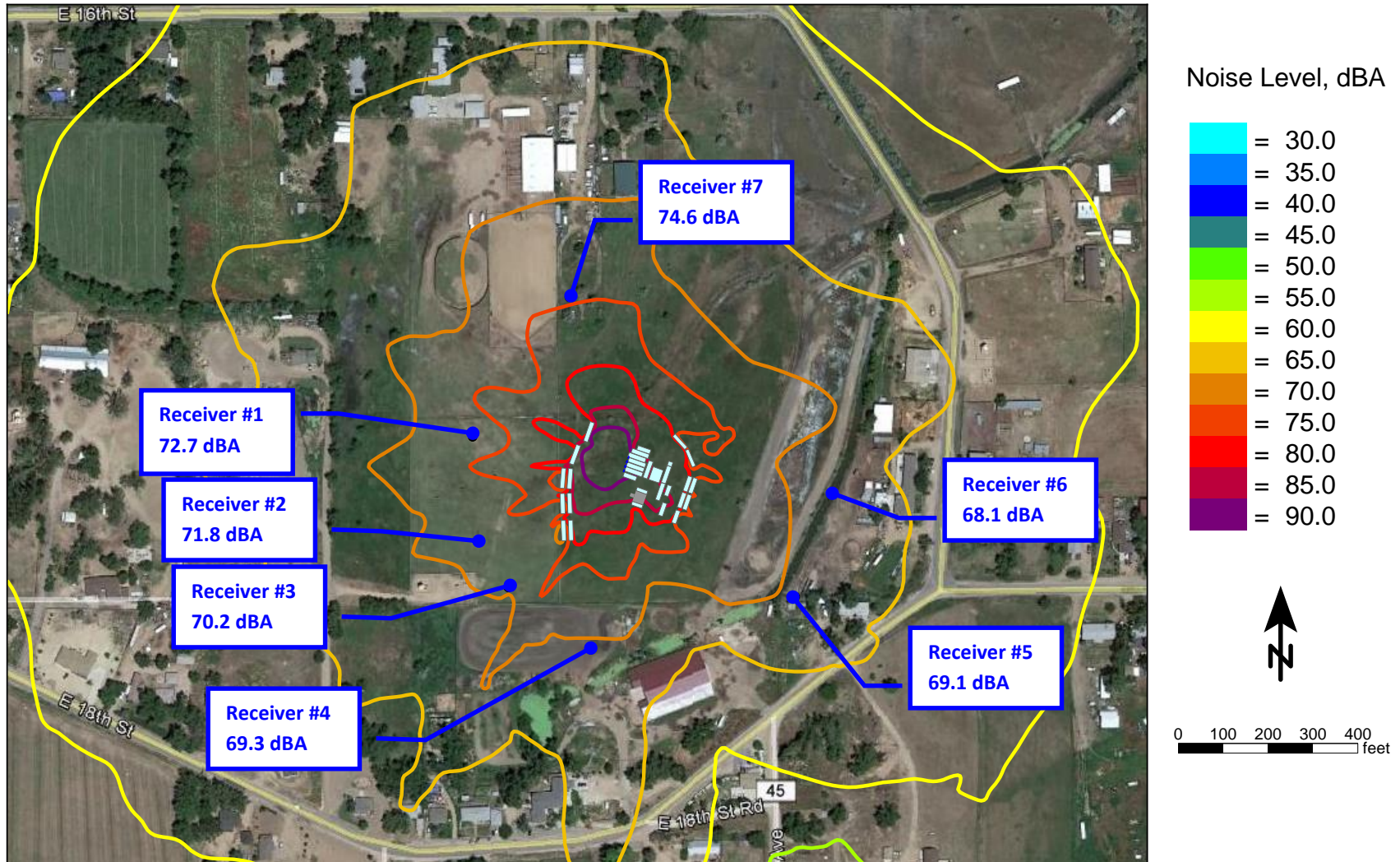
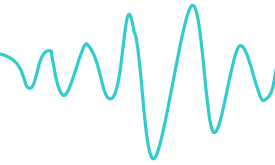
Mitigated Bayswater Arellano Drilling Noise Contour Map- Southeast Orientation (dBA)



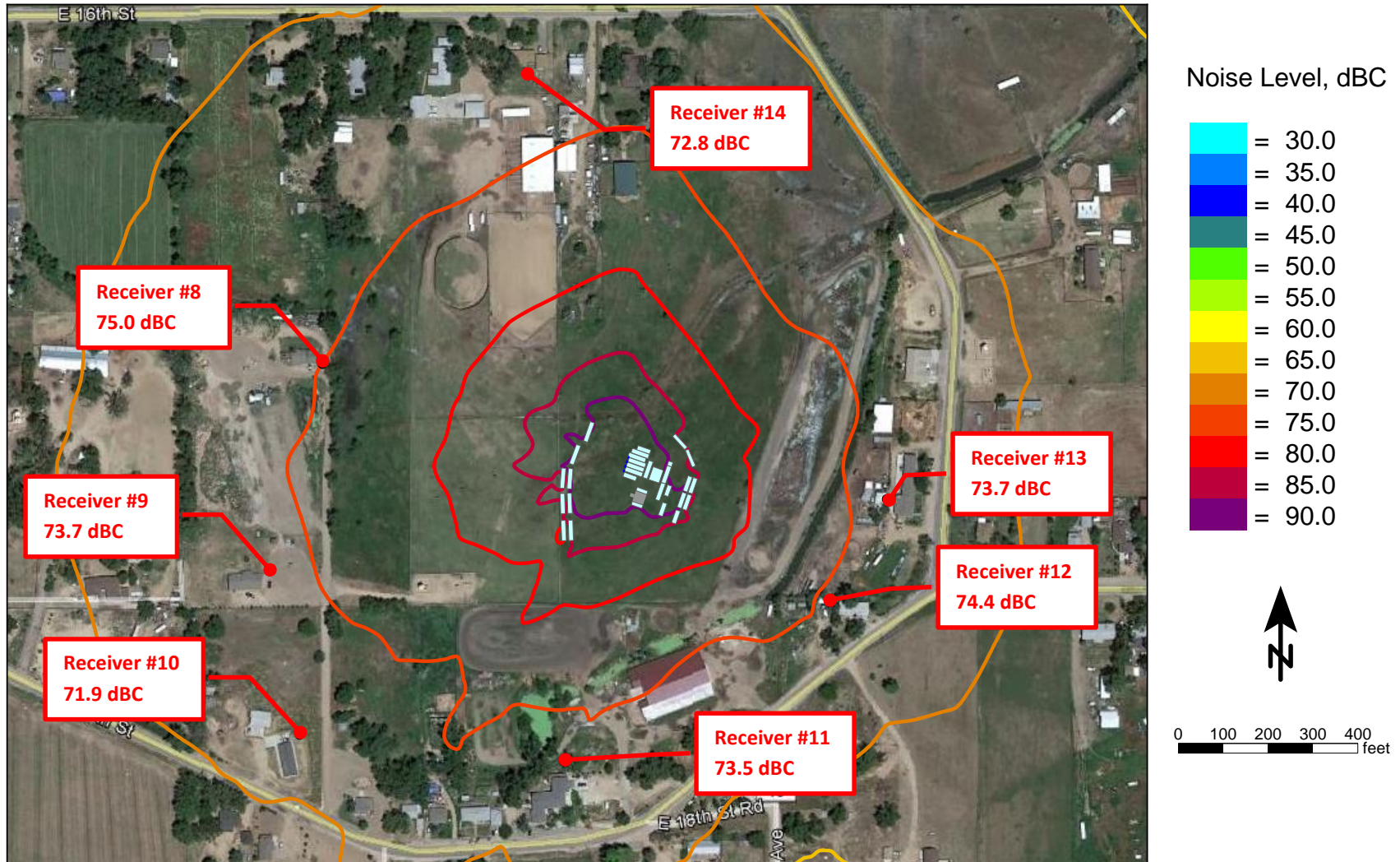
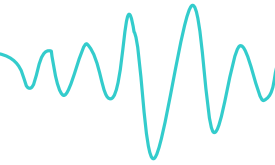
Attachment 6
Mitigated Bayswater Arellano Drilling Noise Contour Map- Southeast Orientation (dBC)



Attachment 7
Arellano Wellhead Location and Receivers Map- Northwest Orientation



Attachment 8
Unmitigated Bayswater Arellano Drilling Noise Contour Map- Northwest Orientation (dBA)

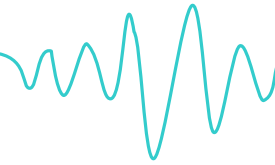





Attachment 9

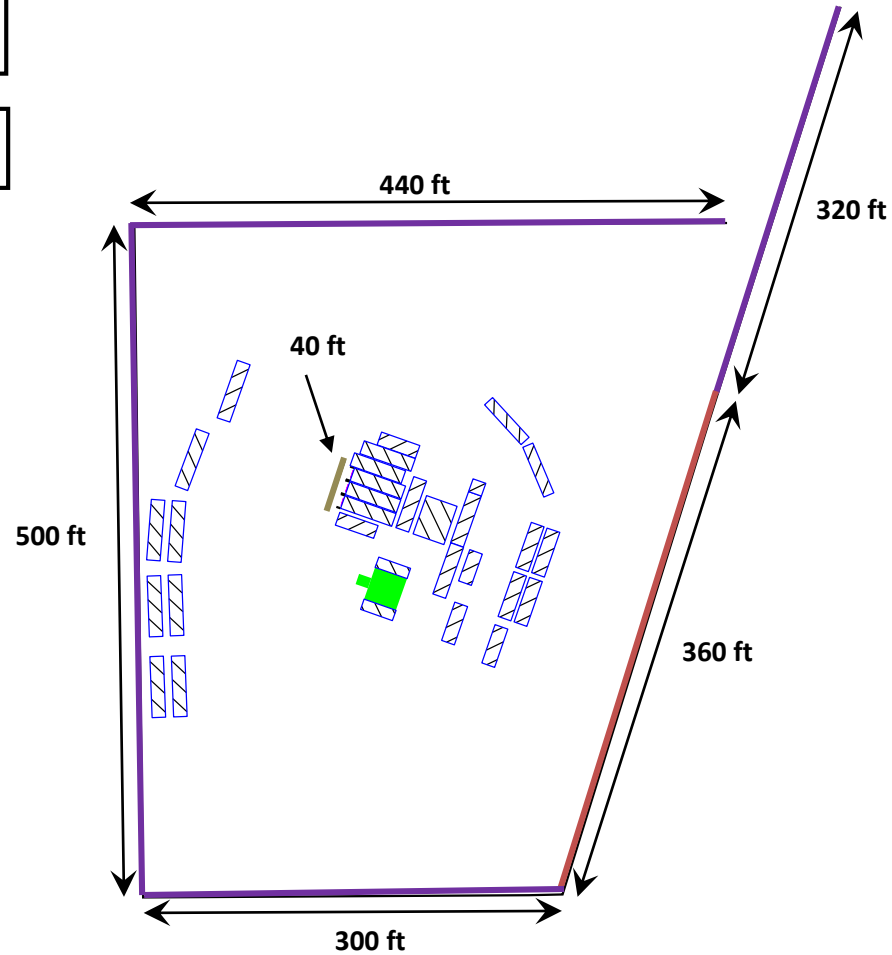
Unmitigated Bayswater Arellano Drilling Noise Contour Map- Northwest Orientation (dBC)

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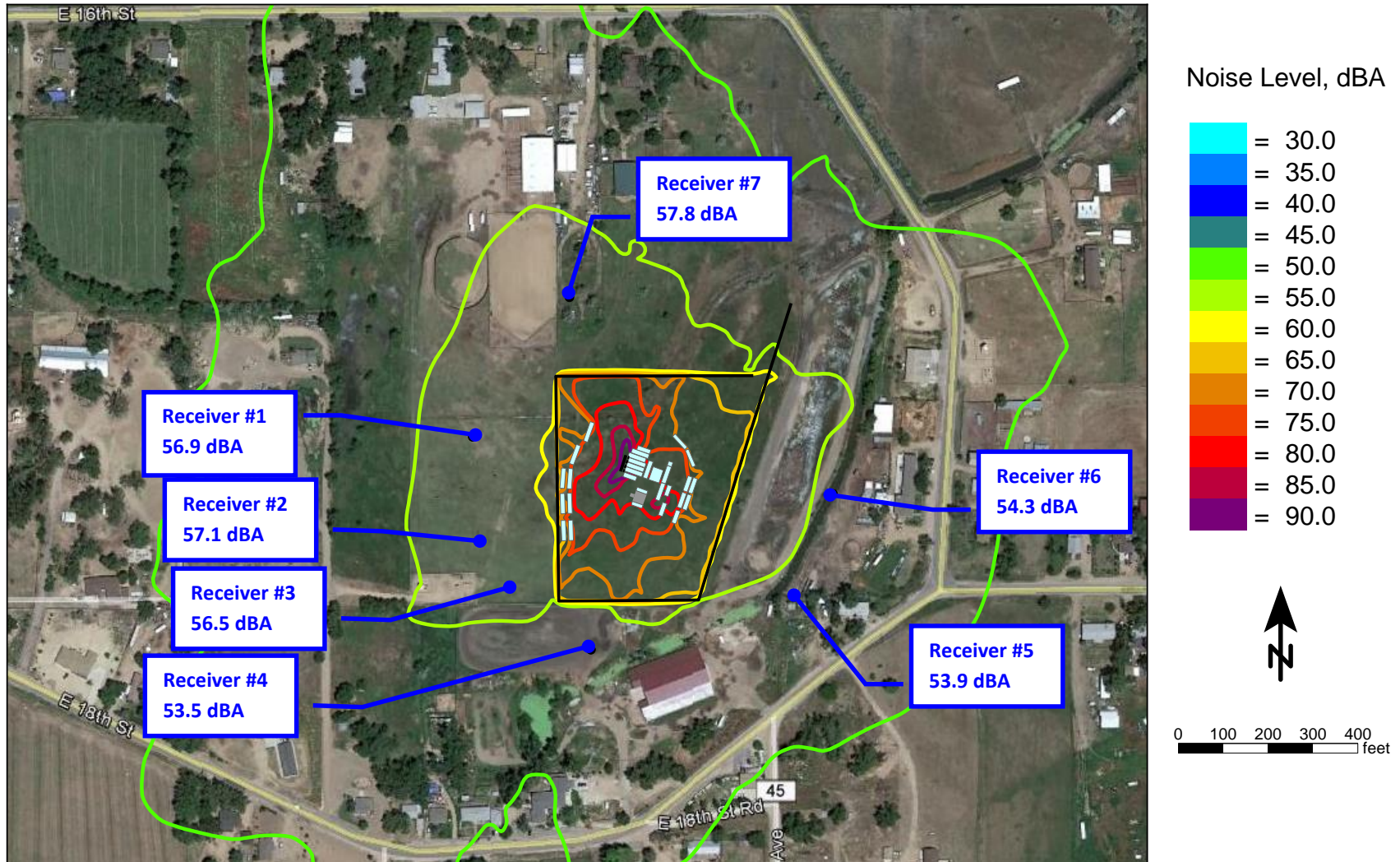
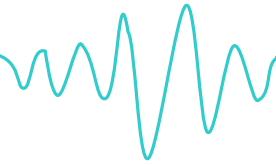
Environmental Noise Control



-  Total 12 ft high x 40 ft long Acoustical Barrier
-  Total 32 ft high x 1,560 ft long Acoustical Barrier
-  Total 40 ft high x 360 ft long Acoustical Barrier

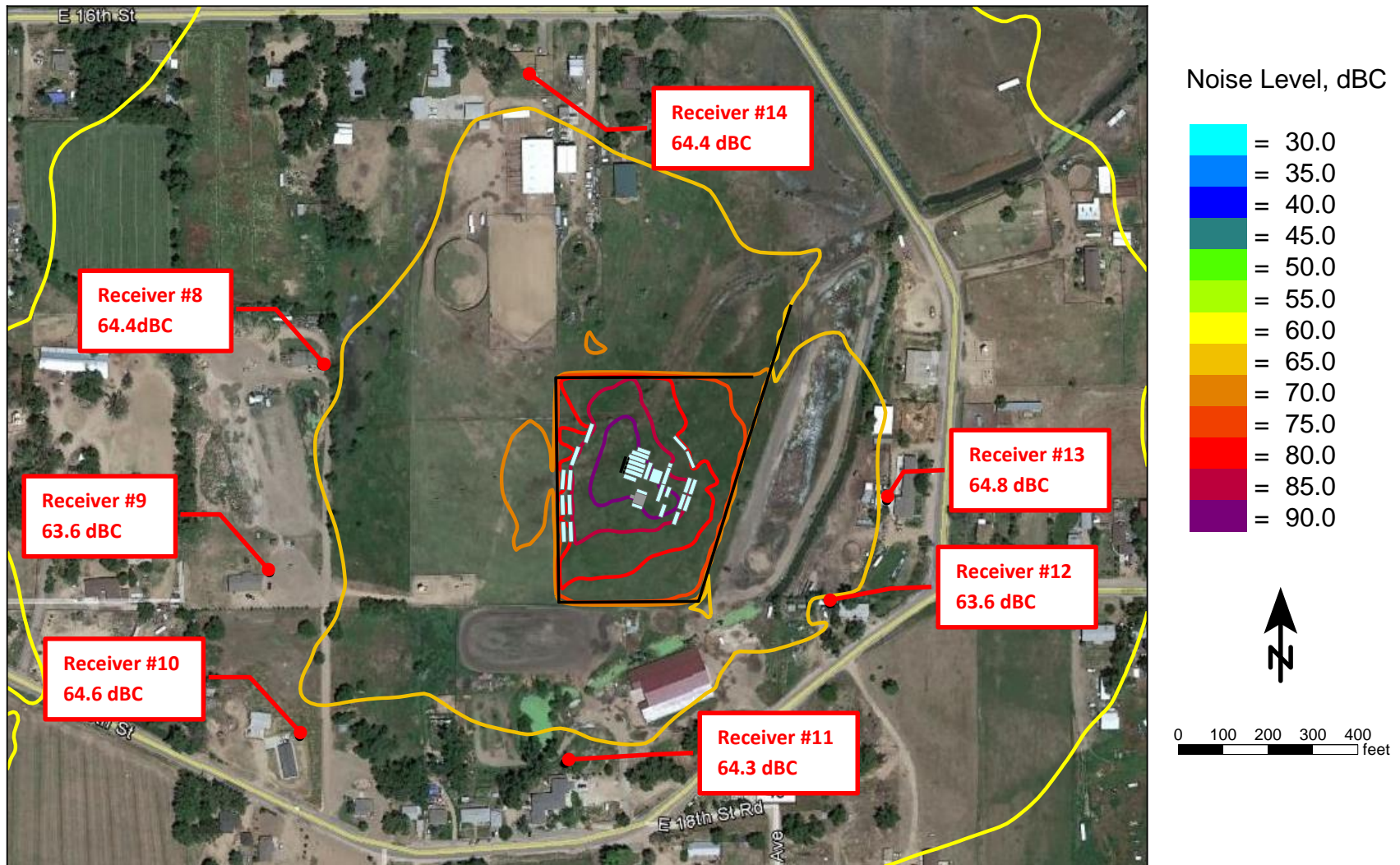
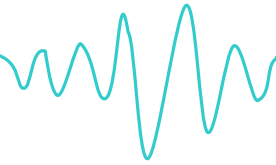


Attachment 10
Arellano Site Acoustical Panels and Dimensions- Northwest Orientation



Attachment 11

Mitigated Bayswater Arellano Drilling Noise Contour Map- Northwest Orientation (dBA)



Attachment 12
Mitigated Bayswater Arellano Drilling Noise Contour Map- Northwest Orientation (dBC)