# Shadow Mountain Bike Park Sensory Impact Assessment - Noise

Final Report

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# Abbreviations

| | |
|---|---|
| dB | Decibel |
| dBA | Decibel (A-weighted) |
| GA | Ground absorption |
| Hz | Hertz |
| ISO | International Standards Organization |
| $L_{eq}$ | Equivalent continuous sound level |
| $L_{0}$ | Sound level exceeded for 0% of the time |
| $L_{10}$ | Sound level exceeded for 10% of the time |
| $L_{25}$ | Sound level exceeded for 25% of the time |
| $L_{50}$ | Sound level exceeded for 50% of the time |
| $L_{90}$ | Sound level exceeded for 90% of the time |
| $L_{max}$ | Maximum sound level |
| $L_{min}$ | Minimum sound level |
| LDR | Land Development Regulations |
| SIA | Sensory Impact Assessment |
| SLM | Sound level meter |
| SMBP | Shadow Mountain Bike Park |

# Executive Summary

The SE Group has retained Stantec Consulting Services Inc. (Stantec) to complete a Sensory Impact Assessment (SIA) to evaluate noise impacts generated by the proposed Shadow Mountain Bike Park (SMBP). The proposed location of the SMBP is along Shadow Mountain Drive in Conifer, Jefferson County, Colorado (the Site). The proposed SMBP will consist of a downhill mountain bike park with lift services, 320 parking spaces, a day lodge building, and a maintenance building.

This SIA was completed in accordance with the requirements of the Jefferson County Colorado Land Development Regulation (LDR), amended December 6, 2022, which requires that proposed Developments not create sensory impacts including noise, odor, and visual impacts at nearby sensitive receptors such as parks, schools, or residentials buildings. The scope of this SIA is limited to the evaluation of the impacts of noise resulting from the operation of the proposed SMBP only.

Operational noise from the SMBP was modelled using CADNA/A acoustic modelling software (version 2021 MR2) published by Datakustik GmBH, configured to implement ISO-9613-2 environmental noise propagation algorithms. Operational noise sources from Stantec's database were used for this assessment as final equipment selections and final design of the SMBP have yet to be completed at the time of writing of this report.

Stantec recommends that this study be updated when final design of the SMBP is complete to validate the assumptions of this SIA.

Predicted sound levels indicate that the noise generated by the proposed SMBP at nearby noise sensitive areas and highest impacted/worst case property line locations is below the applicable daytime and nighttime noise limits for nearby residential receptors. The results of this SIA demonstrate that the SMBP is expected to comply with the Jefferson County LDR noise limits.

# 1 Introduction

The SE Group has retained Stantec Consulting Services Inc. (Stantec) to complete a Sensory Impact Assessment (SIA) to evaluate noise impacts generated by the Shadow Mountain Bike Park (SMBP). The proposed location of the SMBP is along Shadow Mountain Drive in Conifer, Jefferson County, Colorado (The Site). The proposed SMBP will consist of a downhill mountain bike park with lift services, 320 parking spaces, a day lodge building, and a maintenance building.

This SIA was prepared in accordance with Section 26 of the Jefferson County Land Development Regulations (LDR) amended December 6, 2022.

**Figure A.1** included in **Appendix A** shows the location of the Site.

# 2 Noise Terminology

Sound is caused by vibrations that generate waves of minute pressure fluctuations in the surrounding air. Sound levels are measured using a logarithmic decibel (dB) scale. Human hearing varies in sensitivity for different sound frequencies, and the frequency sensitivity changes based on the overall sound level. The ear is most sensitive to sound at frequencies between 800 and 8,000 hertz (Hz) and is least sensitive to sound at frequencies below 400 Hz or above 12,500 Hz. Consequently, several different frequency weighting schemes have been used to approximate the way the human ear responds to various frequencies at different sound levels. The A-weighted decibel, or dBA, scale is the most widely used for regulatory requirements, as it discriminates against low frequency noise similar to the response of the human ear at the low to moderate sound levels typical of environmental sources. Sound levels without a frequency weighting applied, referred to as unweighted or linear, are generally reported as dB or dBZ.

The sound power level (PWL or $L_w$) of a noise source is the strength or intensity of noise that the source emits regardless of the environment in which it is placed. Sound power is a property of the source, and therefore is independent of distance. The radiating sound power then produces a sound pressure level (SPL or $L_p$) at a point of which human beings can perceive as audible sound. The sound pressure level is dependent on the acoustical environment (e.g., indoor, outdoor, absorption, reflections) and the distance from the noise source. Unless otherwise stated, sound levels in this report are sound pressure levels.

Numerous metrics and indices have been developed to quantify the temporal characteristics (changes over time) of community noise. The equivalent continuous sound level, $L_{eq}$, metric is the level of a hypothetical steady sound that would have the same energy as the fluctuating sound level over a defined period of time. The $L_{eq}$ represents the time average of the fluctuating sound pressure level. The maximum and minimum sound levels, or $L_{max}$ and $L_{min}$, are the loudest and quietest instantaneous sound levels occurring during a period of time. The $L_{max}$ is particularly useful for evaluating loud, impulsive noise events.

Other statistical metrics useful to understanding environmental sound levels include the n-percent exceedance sound percentile levels, or $L_n$. This report includes the $L_{25}$ metric, or the noise level that is exceeded 25% of the time and the $L_0$ which is the sound level exceeded 0% of the time. The $L_0$ can be considered equivalent to the $L_{max}$ or maximum sound level. The $L_{10}$ can be approximated as the sound level between $L_{max}$ and $L_{25}$.

A change in sound levels of 3 decibels is generally considered to be the threshold of perception, whereas a change of 5 decibels is clearly perceptible, and a change of 10 decibels is perceived as a doubling or halving of loudness.

# 3 Facility Description

The proposed SMBP will consist of a four-passenger chairlift to transport guests and bikes to the top terminal area for gravity flow and downhill trails. The SMBP will operate during daytime hours, as defined by Section 26 of the Jefferson County LDR, between 7 a.m. to 7 p.m. The chairlift will require one terminal in the base area and the terminal area at the top of Shadow Mountain. Chairlift construction will require a 40-foot-wide corridor to accommodate the associated infrastructure. The corridor will be cleared during the construction phase of the project. The chairlift will require power at the bottom and top terminal areas as well as communication lines along the lift infrastructure.

The SMBP will provide approximately 16 miles of trails with varying levels of difficulty. Trails will be constructed of earth, wood, steel, and other materials. All trails will be setback a minimum of 50 feet from property lines.

Parking for approximately 300 guest vehicles will be provided near the base area using the access road along Shadow Mountain Drive. A day lodge will be constructed in the base area of the SMBP to provide guest services including indoor seating, ticketing, restrooms, changing rooms, bike and equipment rentals, and outdoor guest space and seating. Water will be supplied by a commercial water well and sewage will be handled by an onsite wastewater system.

There will be no permanent kitchen space in the day lodge. To address the food and beverage needs of guests, food truck vendors will be brought on site during operational hours.

A maintenance building will be constructed along the maintenance access road for facility operations. Parking for approximately 20 employees will be provided adjacent to the maintenance building.

# 4 Noise Sources

Based on the facility description, the primary sources of noise from the SMBP are assumed to be the following:

- Chairlift terminals at the base area and top of Shadow Mountain.
- HVAC equipment at the day lodge, maintenance building, and chairlift buildings.
- Vehicle noise from movements in the parking lot.
- Vehicle noise along the maintenance road from the maintenance shop to the mountain top.
- Speakers near the day lodge outside dining area.
- A food truck idling adjacent to the day lodge.

The primary noise sources expected to operate at the proposed SMBP are consistent with the definition of steady state or quasi steady state impulsive sound. Steady state or quasi steady state impulsive sound can generally be defined as a sequence of impulsive sound emitted from the same source having a time interval of less than 0.5 seconds between successive impulsive sounds. Impulsive sound can be generally defined as a single pressure pulse or a single burst of pressure pulses with a time interval of equal or greater than 0.5 seconds. Examples of impulsive sound can include dump truck gate banging or impact pile driver operation.

Other potential sources of noise on site such as human or electric powered mountain bikes travelling along the proposed SMBP trails or noise along the chairlift line are assumed to have an insignificant impact to nearby sensitive noise receptors.

# 5 Noise Sensitive Areas

Noise sensitive areas (NSAs) were identified around the SMBP based on a review of satellite imagery and zoning. Thirteen NSA locations were selected to evaluate the noise impact from steady state noise SMBP sources at residences. Five (5) additional locations were selected near the property lines of the Site as representative worst-case locations. Property line locations were assessed 25 feet from the property limits of the proposed SMBP consistent with the evaluation requirements of the Jefferson County LDR. A summary of NSAs is provided in **Table 5.1**. A location map of NSAs is included as **Figure A.2** in **Appendix A**. A zoning map for the area surrounding the site is included as **Figure A.3** in **Appendix A.**

**Table 5.1: Noise Sensitive Location Summary**

| Noise Sensitive Area ID | Description and Approximate Street Address[1] | UTM NAD 83 Coordinates | | |
|---|---|---|---|---|
| | | Zone | Easting | Northing |
| NSA01 | Residence at 30812 Shadow Mountain Drive | 13S | 469462 | 4376303 |
| NSA02 | Residence at 10188 Christopher Drive | 13S | 469795 | 4375463 |
| NSA03 | Residence at 10178 Christopher Drive | 13S | 469781 | 4375299 |
| NSA04 | Residence at 10218 Christopher Drive | 13S | 469621 | 4375781 |
| NSA05 | Residence at 29795 Kennedy Gulch Road | 13S | 470473 | 4374826 |
| NSA06 | Residence at 30241 Shadow Mountain Drive | 13S | 470491 | 4376172 |
| NSA07 | Residence at 29611 Shadow Mountain Drive | 13S | 470742 | 4375981 |
| NSA08 | Residence at 29365 Kennedy Gulch Road | 13S | 471070 | 4375165 |
| NSA09 | Residence at 30772 Shadow Mountain Drive | 13S | 469711 | 4376453 |
| NSA10 | Residence at 30192 Shadow Mountain Drive | 13S | 470205 | 4376076 |
| NSA11 | Residence at 29455 Kennedy Gulch Road | 13S | 470684 | 4374893 |
| NSA12 | Residence at 29405 Kennedy Gulch Road | 13S | 470988 | 4374980 |
| NSA13 | Residence at 29152 Shadow Mountain Drive | 13S | 471269 | 4375568 |
| NSA14 | 25 ft. from West Property Line | 13S | 469810 | 4375391 |
| NSA15 | 25 ft. from North Property Line | 13S | 470170 | 4376056 |
| NSA16[2] | 50 ft. from Northeast Property Line | 13S | 470456 | 4376057 |
| NSA17 | 25 ft. from East Property Line | 13S | 470525 | 4375820 |
| NSA18 | 25 ft. from East Property Line | 13S | 470523 | 4375937 |

[1] All residences conservatively assumed to be two-story residences. Property line assessment height assumed to be one story.

[2] NSA16 has been assessed at approximately 50 ft. from the northeast property line as 25 ft. from the northeast property line is in the center of Shadow Mountain Drive within the public right-of-way. The assessment point at 50 ft. from the northeast property line is located along a pathway which is more representative of a noise sensitive assessment location.

# 6 Assessment Criteria

The December 6, 2022, revision of the Jefferson County, Colorado LDR regulates the development of lands in the County with consideration given to protecting land, environment, and natural resources. Section 26 of the LDR regulates sensory impacts from a Development which can include noise, odor, and visual impacts. This assessment is limited to assessing the noise impact of the proposed SMBP.

The applicable criteria for the project under Section 4, Subsection A is:

> *"Noise generated from the proposed development shall not exceed the dBA levels set forth in Section 25-12-103, C.R.S. or as may be amended from time to time. The dBA levels are depicted in the dBA Table: (reloc. 7-12-05; am. 4-4-06)"*

The table referenced in the LDR is provided as **Table 6.1**.

**Table 6.1: Jefferson County LDR Noise Criteria[1]**

| dBA Table | | | | | |
|---|---|---|---|---|---|
| **Time** | **7 a.m. to 7 p.m.** | **7 a.m. to 7 p.m.** | **7 a.m. to 7 p.m.** | **7 p.m. to 7 a.m.** | **7 p.m. to 7 a.m.** |
| **Frequency** | **$L_{25}$** | **$L_0$** | **Periodic/Impulsive** | **$L_0$** | **Periodic/Impulsive** |
| Park/School, Residential | 55 | 65 | 50 | 50 | 45 |
| Commercial | 60 | 70 | 55 | 55 | 50 |
| Light Industrial | 70 | 80 | 65 | 65 | 60 |
| Industrial | 80 | 90 | 75 | 75 | 70 |

[1] Source Jefferson County Colorado Land Development Regulation December 2022

The area surrounding the proposed SMBP is zoned primarily residential or agricultural with existing residences. Stantec has adopted the steady state (i.e., non-periodic/impulsive) noise limits for residential areas and property line evaluation locations for this assessment. The applicable limits for residential areas are $L_{25}$ of 55 dBA or $L_0$ of 65 dBA during daytime hours and $L_0$ of 50 dBA during nighttime hours for steady state noise sources measured 25 ft. from the property limits of the SMBP.

The SMBP is not expected to have any significant sources of periodic or impulsive noise and operations will be limited to daytime hours only, with the exception of HVAC units. The $L_{10}$ noise level of a noise source can typically be estimated by adding 3 dBA to the $LA_{eq}$ noise level[1] and, by definition, the $L_{25}$ noise level for a piece of equipment will be lower than the $L_{10}$ noise level. For this study, the $L_{25}$ noise level was conservatively estimated by adding a 3 dBA correction factor to modelled $LA_{eq}$ noise levels. The $L_0$ noise level, which is higher than both the $L_{10}$ and $L_{25}$, was conservatively estimated by adding a 6 dBA correction factor to modelled $LA_{eq}$ noise levels.

[1] Federal Highway Administration Roadway Construction Noise Model (RCNM) User's Guide. January 2006.

# 7 Methodology

## 7.1 Operational Noise Analysis

The proposed SMBP will include several sources of steady state noise as described in **Section 4**. As final equipment selections have not been completed at the time of writing of this report, Stantec has selected representative sound power levels to model the predicted impact of the SMBP.

The representative equipment sound power levels used in the analysis are summarized in **Table 7.1.**

**Table 7.1: Equipment Sound Power Levels**

| Equipment Type | Type | Octave Band Sound Power Level (dB) | | | | | | | | | Total Sound Power Level (dBA) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 31.5 Hz | 63 Hz | 125 Hz | 250 Hz | 500 Hz | 1,000 Hz | 2,000 Hz | 4,000 Hz | 8,000 Hz | |
| Chair Lift Terminal | Leq | 73 | 78 | 93 | 90 | 93 | 88 | 96 | 83 | 78 | 98 |
| Vehicle Passby | Lmax | 64 | 59 | 65 | 58 | 55 | 54 | 50 | 45 | 40 | 90 |
| HVAC Unit | Leq | 85 | 86 | 82 | 78 | 76 | 73 | 69 | 64 | 56 | 78 |
| Truck Idle | Leq | 30 | 94 | 96 | 94 | 88 | 85 | 81 | 78 | 74 | 91 |
| Speaker | Leq | 86 | 93 | 91 | 86 | 90 | 95 | 91 | 87 | 81 | 98 |

**Table 7.2** summarizes the modelling assumptions used for equipment quantities, operating parameters including speed and operating time, and other modelling parameters.

**Table 7.2: Modelling Assumption Summary**

| Equipment Type | Quantity | Operation Time | Operational Notes |
|---|---|---|---|
| Chair Lift Terminal | 2 | 7 a.m. to 7 p.m. | Operations at the top terminal area and at the base terminal area. Operating continuously during daytime hours only. Top terminal area to be located 150 ft. from west property line. |
| Transport Truck | 1 | 7 a.m. to 7 p.m. | One truck per hour along the maintenance road connecting the top terminal to the maintenance building. Speed assumed to be 10 mph and operating during daytime hours only. |
| HVAC Unit | 6 | 24-hour operation | One HVAC unit at the top terminal chairlift, one at the bottom terminal chairlift, two at the day lodge building, and two at the maintenance building. All operating continuously over a 24-hour period |
| Truck Idle | 1 | 7 a.m. to 7 p.m. | One food truck idling along the southwest side of the lodge building operating continuously during daytime hours only. |
| Speaker | 1 | 7 a.m. to 7 p.m. | One speaker adjacent to the outdoor seating area at the southwest side of the lodge building operating continuously during daytime hours only |
| Vehicle Parking Noise | 241 | 7 a.m. to 7 p.m. | A worst case 241 vehicles per hour entering and exiting the site in the parking lot area has been assumed. |

Noise modeling was completed using the Datakustik CadnaA environmental noise modeling software. The operational noise modeling followed typical modeling standards, input parameters, and assumptions, namely:

- The ISO 9613-2 standard[2] algorithm for outdoor sound propagation was used.
- Ground absorption factor of G=0.8 was used.
- Ground elevations were included in the model using equal height contour lines.
- Meteorology parameters were set to 10 degrees Celsius and 70 percent relative humidity.
- Receptor height of 4.5 m (15 ft.) to be representative of a two-storey residence.
- No sound attenuation from vegetation (foliage) to simulate a worst-case condition when leaves have fallen off trees.
- Meteorological conditions are conducive to sound propagation with all receptors located downwind of all noise sources.

[2] ISO 9613-2: 1996. Acoustics – Attenuation of sound during propagation outdoors. Part 2: General method of calculation.

## 7.2 Construction Noise Assessment

Construction activities related to the Development of the proposed SMBP will occur in phases and generally consist of site preparation including tree clearing and road construction, installation of the chair lift, construction of the lodge, and installation of utilities. Construction activities will typically be limited to daytime only.

In accordance with the Jefferson County Regulatory Policy – Noise Abatement adopted April 24, 2007 (“*Policy No. Part 3, Regulations, Chapter 1, Noise, Section 1”)* construction activities are subject to the noise limits summarized in **Table 7.3**.

**Table 7.3: Construction Noise Limits**

| Time Period | Limits[1] |
|---|---|
| 7 a.m. to 7 p.m. | 80 dB(A) |
| 7 p.m. to 7 a.m. | 75 dB(A) |

[1] Noise limits are applicable 25 ft. from the property line of the Development.

At this stage of the proposed SMBP development, detailed construction phasing including equipment selections and timelines have not been finalized. In general, noise impacts from construction equipment will vary by type, age of equipment, overall condition, and operators. During construction of the proposed SMBP, noise from construction activities may be audible at nearby sensitive receptors; however, not all construction equipment required for the construction of the SMBP will be operating at the same time. Additionally, activities will be spread across the Project area and be temporary in duration which will reduce the overall noise impact of construction activities.

The minimum setback distance of noise sensitive areas identified in **Section 5** is approximately 200 feet from major project components such as the chairlift, parking lot, and day lodge. A summary of representative noise levels for anticipated construction equipment is provided in Table 7.4 at 50 ft. Maximum sound levels from equipment is expected to below the applicable construction noise limits identified in **Table 7.3**; however, Stantec recommends that the construction equipment list and setback distances be reviewed and confirmed prior to construction.

**Table 7.4: Construction Equipment Noise Levels[1]**

| Equipment | Noise Level at 50 feet from Source (dBA $L_{max}$) | Noise Level at 200 feet from Source (dBA $L_{max}$) |
|---|---|---|
| Bulldozer | 85 | 73 |
| Crane | 85 | 73 |
| Chainsaw | 85 | 73 |
| Excavator | 81 | 69 |
| Front end loader | 79 | 67 |
| Concrete batch plant | 83 | 71 |
| Drill Rig Truck | 79 | 67 |

| Equipment | Noise Level at 50 feet from Source (dBA $L_{max}$) | Noise Level at 200 feet from Source (dBA $L_{max}$) |
|---|---|---|
| Grader | 85 | 73 |
| Haul/Dump Truck | 84 | 72 |
| Flat Bed Truck | 74 | 62 |
| Pneumatic Tools | 85 | 73 |
| Backhoe | 80 | 68 |

[1] Source: Federal Highway Administration Roadway Construction Noise Model (RCNM) User's Guide. January 2006.

### 7.2.1 Construction Noise Mitigation

Construction noise is typically mitigated by implementing best practices such as ensuring construction equipment and associated mufflers are in good working order, limiting the loudest construction activities to daytime hours, using alternative quieter construction methods and/or scheduling work to minimize concurrent use of the loudest equipment, and establishing a noise complaint resolution process. Placement of noise barriers around work sites can be considered for activities in the near vicinity of noise-sensitive land uses.

# 8 Operational Noise Assessment

Operational noise modelling was completed for the proposed SMBP with the modelling assumptions and methodology outlined in **Section 7.1**. With the exception of HVAC equipment, on-site noise sources will operate during daytime hours only. Due to the varying nature of vehicle passbys as they travel along a modelled path, Stantec has conservatively evaluated vehicle passbys using the $LA_0$ noise metric. As all other sources of noise are stationary, they have been evaluated using the $LA_{25}$ noise metric.

Predicted project-generated noise levels at the noise sensitive areas and property lines are summarized in **Table 8.1** and **Table 8.2** for stationary noise sources. Predicted project-generated noise levels at the noise sensitive areas and representative property line locations are summarized in **Table 8.3** for mobile noise sources. Mobile noise source impacts were evaluated as a result of vehicle passbys along the maintenance road and parking lot. The $LA_{25}$ is the noise level exceeded 25 percent of the time and the $LA_0$ is the maximum noise level.

**Table 8.1: Noise Impact Summary Table – $LA_{25}$ Stationary Noise Sources**

| Noise Sensitive Area ID | Description | Daytime Project Noise Level ($LA_{25}$ dBA)[1] | Nighttime Project Noise Level ($LA_{25}$ dBA)[1] | Day Limit ($LA_{25}$ dBA)[1] | Night Limit ($LA_{25}$ dBA)[1] | Complies with Limits? |
|---|---|---|---|---|---|---|
| NSA01 | Residence at 30812 Shadow Mountain Drive | 25 | 13 | 55 | - | Yes |
| NSA02 | Residence at 10188 Christopher Drive | 50 | 31 | 55 | - | Yes |
| NSA03 | Residence at 10178 Christopher Drive | 41 | 24 | 55 | - | Yes |
| NSA04 | Residence at 10218 Christopher Drive | 32 | 20 | 55 | - | Yes |
| NSA05 | Residence at 29795 Kennedy Gulch Road | 22 | 10 | 55 | - | Yes |
| NSA06 | Residence at 30241 Shadow Mountain Drive | 45 | 27 | 55 | - | Yes |
| NSA07 | Residence at 29611 Shadow Mountain Drive | 40 | 23 | 55 | - | Yes |
| NSA08 | Residence at 29365 Kennedy Gulch Road | 27 | 13 | 55 | - | Yes |
| NSA09 | Residence at 30772 Shadow Mountain Drive | 31 | 20 | 55 | - | Yes |
| NSA10 | Residence at 30192 Shadow Mountain Drive | 45 | 33 | 55 | - | Yes |
| NSA11 | Residence at 29455 Kennedy Gulch Road | 27 | 14 | 55 | - | Yes |
| NSA12 | Residence at 29405 Kennedy Gulch Road | 26 | 12 | 55 | - | Yes |
| NSA13 | Residence at 29152 Shadow Mountain Drive | 31 | 16 | 55 | - | Yes |
| NSA14 | 25 ft. from West Property Line | 55 | 36 | 55 | - | Yes |
| NSA15 | 25 ft. from North Property Line | 44 | 34 | 55 | - | Yes |
| NSA16 | 50 ft. from Northeast Property Line | 53 | 32 | 55 | - | Yes |
| NSA17 | 25 ft. from East Property Line | 50 | 31 | 55 | - | Yes |
| NSA18 | 25 ft. from East Property Line | 53 | 31 | 55 | - | Yes |

[1] $LA_{25}$ estimated based on $LA_{eq}$ sound level with +3 dBA correction factor.

**Table 8.2: Noise Impact Summary Table – $LA_0$ Stationary Noise Sources**

| Noise Sensitive Area ID | Description | Daytime Project Noise Level ($LA_0$ dBA)[1] | Nighttime Project Noise Level ($LA_0$ dBA)[1] | Day Limit ($LA_0$ dBA)[1] | Night Limit ($LA_0$ dBA)[1] | Complies with Limits? |
|---|---|---|---|---|---|---|
| NSA01 | Residence at 30812 Shadow Mountain Drive | 27 | 16 | 65 | 50 | Yes |
| NSA02 | Residence at 10188 Christopher Drive | 53 | 34 | 65 | 50 | Yes |
| NSA03 | Residence at 10178 Christopher Drive | 44 | 27 | 65 | 50 | Yes |
| NSA04 | Residence at 10218 Christopher Drive | 34 | 23 | 65 | 50 | Yes |
| NSA05 | Residence at 29795 Kennedy Gulch Road | 24 | 12 | 65 | 50 | Yes |
| NSA06 | Residence at 30241 Shadow Mountain Drive | 48 | 30 | 65 | 50 | Yes |
| NSA07 | Residence at 29611 Shadow Mountain Drive | 43 | 26 | 65 | 50 | Yes |
| NSA08 | Residence at 29365 Kennedy Gulch Road | 30 | 15 | 65 | 50 | Yes |
| NSA09 | Residence at 30772 Shadow Mountain Drive | 34 | 23 | 65 | 50 | Yes |
| NSA10 | Residence at 30192 Shadow Mountain Drive | 48 | 36 | 65 | 50 | Yes |
| NSA11 | Residence at 29455 Kennedy Gulch Road | 29 | 15 | 65 | 50 | Yes |
| NSA12 | Residence at 29405 Kennedy Gulch Road | 29 | 14 | 65 | 50 | Yes |
| NSA13 | Residence at 29152 Shadow Mountain Drive | 33 | 18 | 65 | 50 | Yes |
| NSA14 | 25 ft. from West Property Line | 58 | 38 | 65 | 50 | Yes |
| NSA15 | 25 ft. from North Property Line | 46 | 36 | 65 | 50 | Yes |
| NSA16 | 50 ft. from Northeast Property Line | 54 | 35 | 65 | 50 | Yes |
| NSA17 | 25 ft. from East Property Line | 53 | 34 | 65 | 50 | Yes |
| NSA18 | 25 ft. from East Property Line | 54 | 34 | 65 | 50 | Yes |

[1] $LA_0$ estimated based on $LA_{eq}$ sound level with +6 dBA correction factor.

**Table 8.3: Noise Impact Summary Table – $LA_0$ Mobile Noise Sources**

| Noise Sensitive Area ID | Description | Daytime Project Noise Level ($LA_0$ dBA)[1] | Nighttime Project Noise Level ($LA_0$ dBA)[1] | Day Limit ($LA_0$ dBA)[1] | Night Limit ($LA_0$ dBA)[1] | Complies with Limits? |
|---|---|---|---|---|---|---|
| NSA01 | Residence at 30812 Shadow Mountain Drive | 20 | - | 65 | 50 | Yes |
| NSA02 | Residence at 10188 Christopher Drive | 49 | - | 65 | 50 | Yes |
| NSA03 | Residence at 10178 Christopher Drive | 39 | - | 65 | 50 | Yes |
| NSA04 | Residence at 10218 Christopher Drive | 28 | - | 65 | 50 | Yes |
| NSA05 | Residence at 29795 Kennedy Gulch Road | 27 | - | 65 | 50 | Yes |
| NSA06 | Residence at 30241 Shadow Mountain Drive | 35 | - | 65 | 50 | Yes |
| NSA07 | Residence at 29611 Shadow Mountain Drive | 31 | - | 65 | 50 | Yes |
| NSA08 | Residence at 29365 Kennedy Gulch Road | 19 | - | 65 | 50 | Yes |
| NSA09 | Residence at 30772 Shadow Mountain Drive | 27 | - | 65 | 50 | Yes |
| NSA10 | Residence at 30192 Shadow Mountain Drive | 46 | - | 65 | 50 | Yes |
| NSA11 | Residence at 29455 Kennedy Gulch Road | 26 | - | 65 | 50 | Yes |
| NSA12 | Residence at 29405 Kennedy Gulch Road | 20 | - | 65 | 50 | Yes |
| NSA13 | Residence at 29152 Shadow Mountain Drive | 20 | - | 65 | 50 | Yes |
| NSA14 | 25 ft. from West Property Line | 52 | - | 65 | 50 | Yes |
| NSA15 | 25 ft. from North Property Line | 56 | - | 65 | 50 | Yes |
| NSA16 | 50 ft. from Northeast Property Line | 56 | - | 65 | 50 | Yes |
| NSA17 | 25 ft. from East Property Line | 38 | - | 65 | 50 | Yes |
| NSA18 | 25 ft. from East Property Line | 54 | - | 65 | 50 | Yes |

[1] $LA_0$ estimated based on $LA_{eq}$ sound level with +6 dBA correction factor.

The above tables demonstrate that Project sound levels are predicted to be below the applicable daytime and nighttime noise criteria at all nearby existing sensitive receptors and 25 feet from the property line of the SMBP for NSA14, NSA15, NSA17, and NSA18.

The noise level at NSA16, representing the northeast property line, was assessed using a setback distance of 50 ft. rather than 25 ft. The location that is 25 ft. from the property line is situated at the center of Shadow Mountain Drive, which is not a noise sensitive location. The 50 ft. setback distance situates NSA16 along the pathway on the north side of Shadow Mountain drive which is a more representative noise sensitive location.

Stationary sound level contours at 15 feet above ground are presented in **Figure A.4** and **Figure A.5** for $LA_{25}$ noise levels and **Figure A.6** and **Figure A.7** for $L_0$ noise levels in **Appendix A**. Mobile sound level contours at 15 ft above ground from vehicle passbys are presented as **Figure A.8** in **Appendix A**. The sound level contours illustrate how sound is expected to propagate in the area surrounding the Project and account for the effects of local site topography. The sound level contours further show that Project noise levels are below the applicable limits at nearby receptors and at locations 25 feet from the property line of the proposed SMBP.

# 9 Conclusion

This sensory impact assessment was completed to evaluate the noise impact of the proposed Shadow Mountain Bike Park the Jefferson County Land Development Regulations. An operational noise model was developed and used to predict the noise impacts of proposed equipment on the Site.

The results of the noise modelling for operational noise predict that noise levels at the nearby sensitive noise receivers will comply with the Jefferson County requirements.

Additionally, construction noise impacts from equipment predicted to be required for the construction of the Shadow Mountain Bike Park are expected to be below the applicable construction noise limits.

This assessment was completed using the preliminary site layout and equipment locations provided by the SE group. Locations of equipment and equipment selection may change and additional construction equipment, not considered in this assessment, such as impact pile drivers may be required during construction. Stantec recommends that this study be updated when final design is completed to evaluate compliance with applicable noise criteria and validate the assumptions made for this assessment.

# Appendices

# Appendix A Figures


Stantec

Legend

- Site Limits
- Site Limits (2km buffer)

0 0.5 1 km

1:25,000 (At original document size of 11x17)

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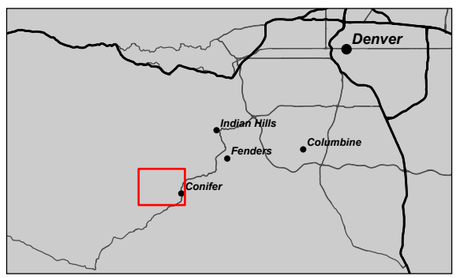


Project Location
Jefferson County, CO

181711248 REVA
Prepared by MDA on 2024-03-20
Technical Review by BCC on 2023-11-30

Client/Project
SE Group
Shadow Mountain Sensory Impact Study - Noise

Figure No.
**A.1**

Title
**Site Plan**



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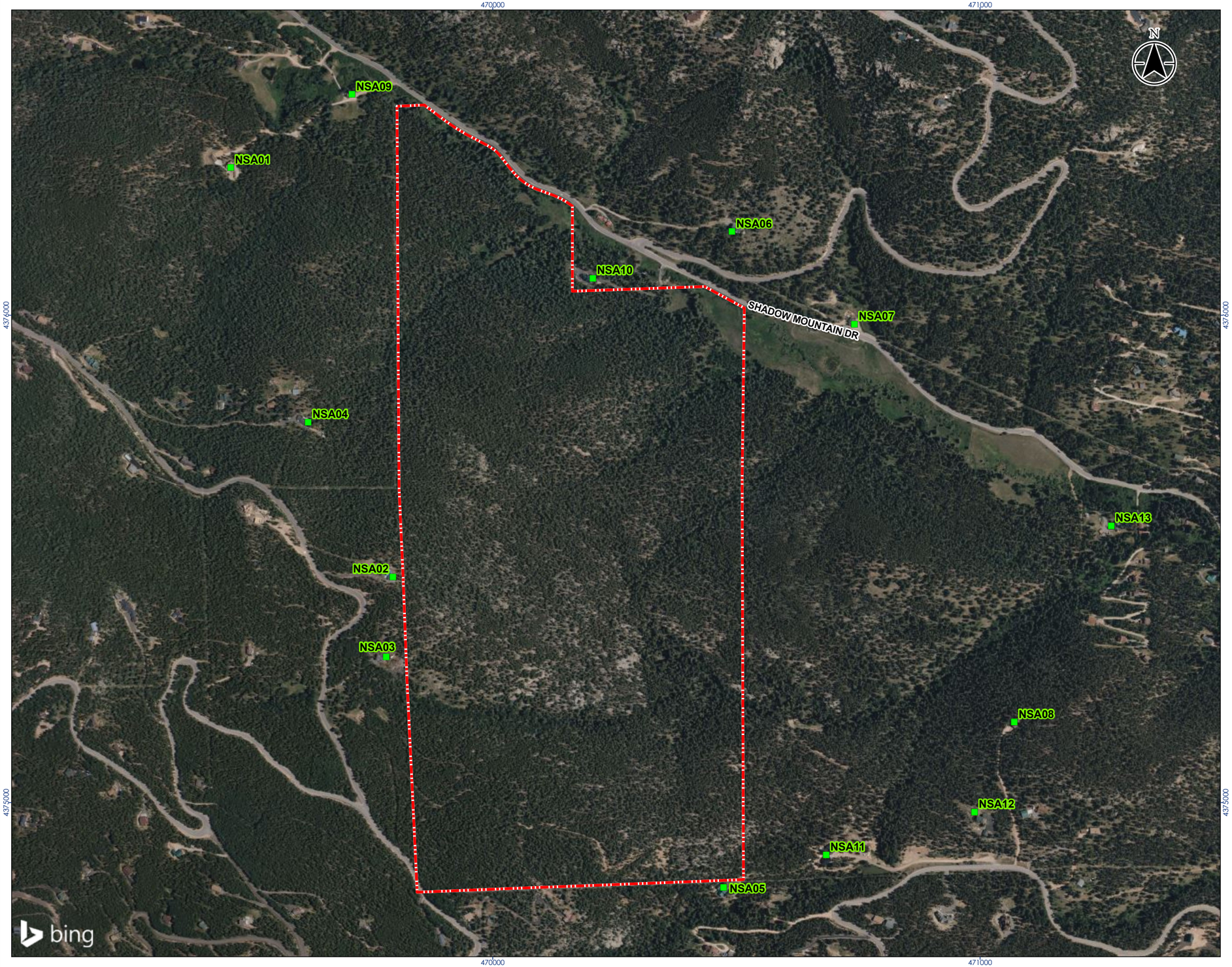


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**Legend**

- Site Limits
- Noise Receptor

0 250 500 m

1:8,000 (At original document size of 11x17)

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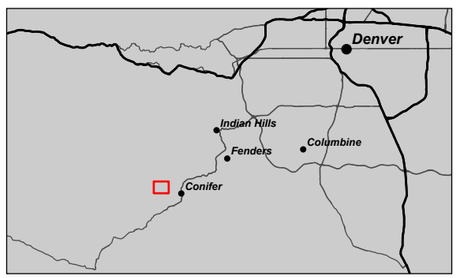


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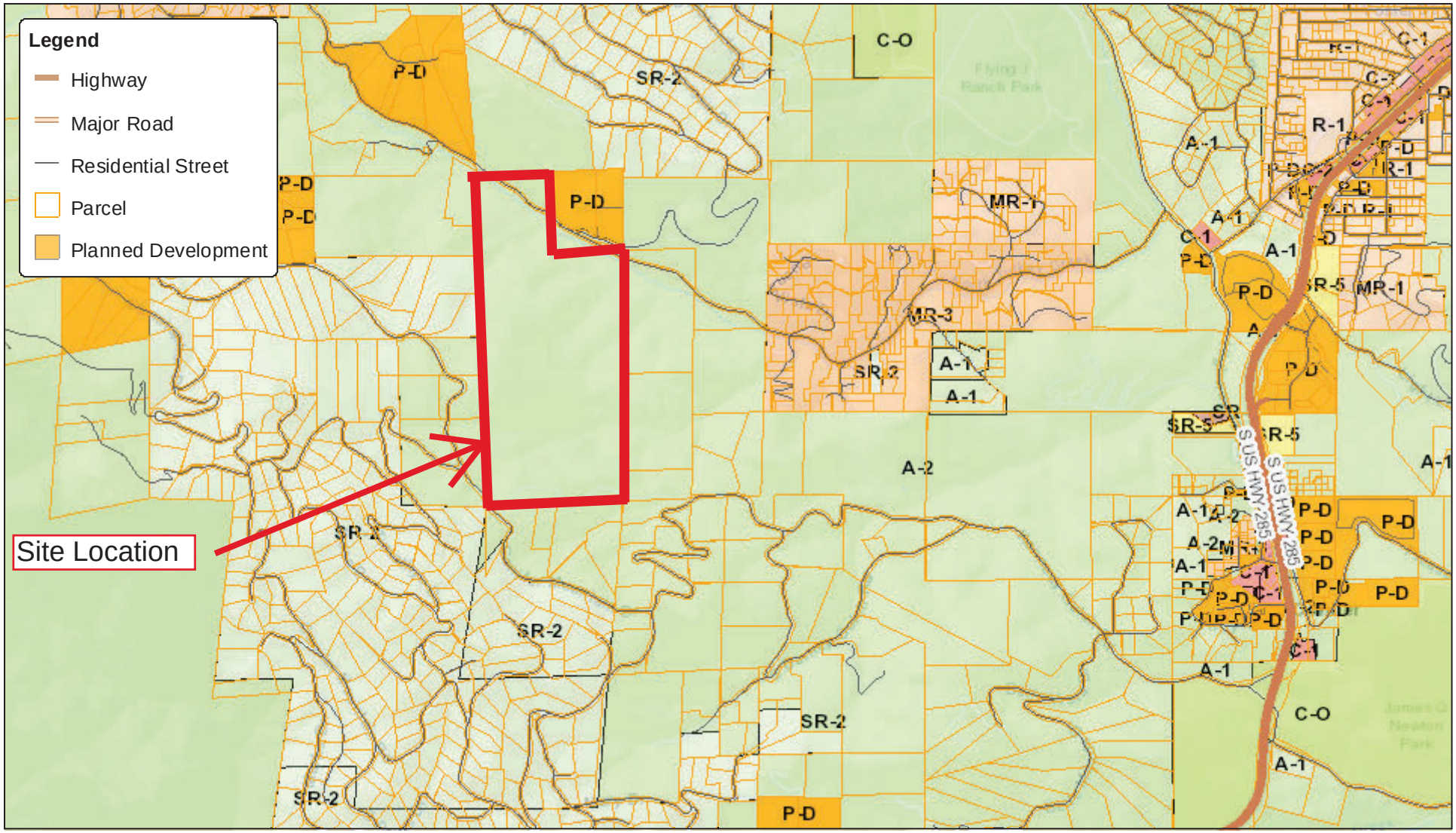
Figure No.
**A.2**

Title
**Noise Source Plan**



\\cab004-fpfs\04\work_group\01669\active_Other_PCs_Active_669_GIS\181711248\03_data\gis_cad\gis\mxds\noise\report_figures\noise_a\181711248_noise_a.aprx\181711248_Fig02_NSPlan Revised: 2024-03-20 By: matcazaren

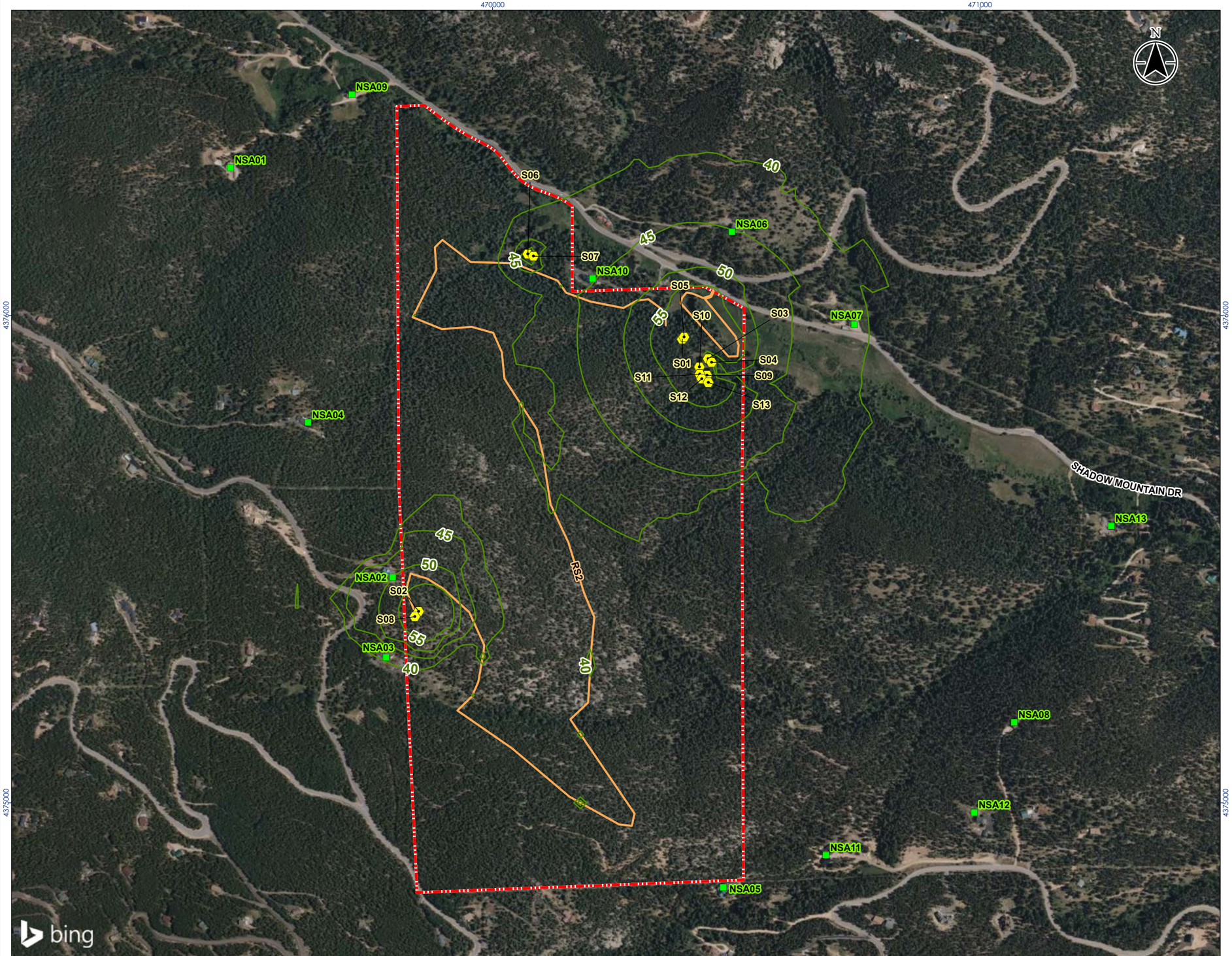
# Jefferson County, Colorado






Author: ArcGIS Web AppBuilder
Date: 11/27/2023

**Figure A.3 Zoning Map**

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**Legend**

- Site Limit
- Noise Receptor
- Point Source
- Line Source
- Daytime Noise Contour 4.5m (15ft.) AG

0 250 500 m

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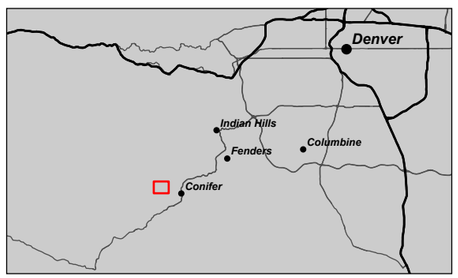


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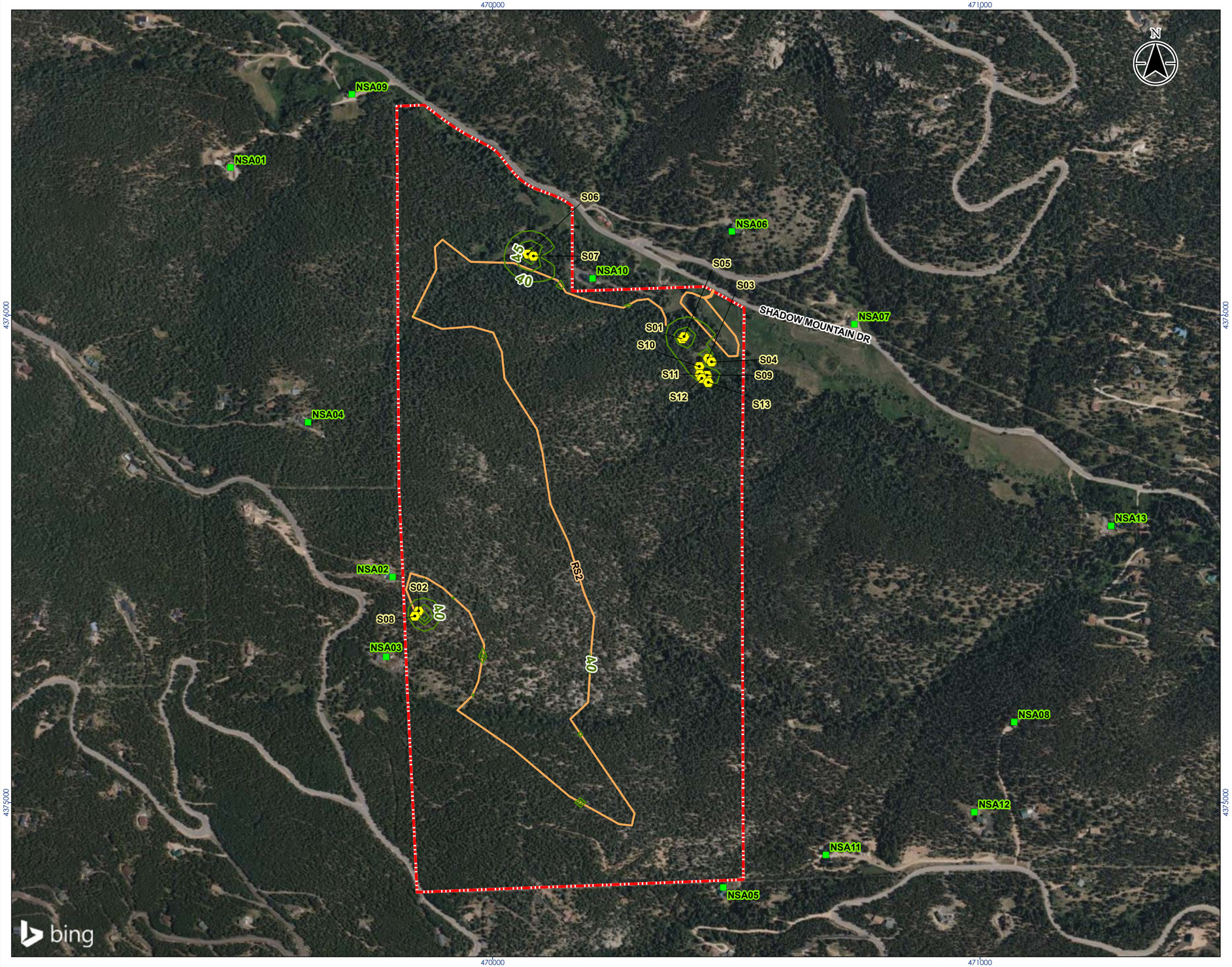
Shadow Mountain Sensory Impact Study - Noise

Figure No.
**A.4**

Title
**Daytime Stationary Noise Contour $LA_{25}$ 4.5m (15 ft. AG)**

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**Legend**

- Site Limit
- Noise Receptor
- Point Source
- Line Source
- Nighttime Noise Contour 4.5m (15 ft.) AG

0 250 500 m

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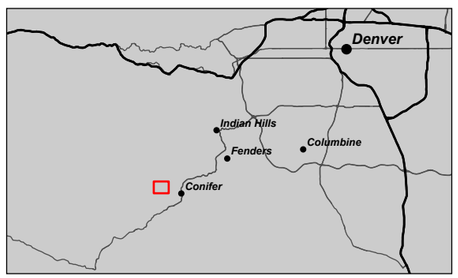


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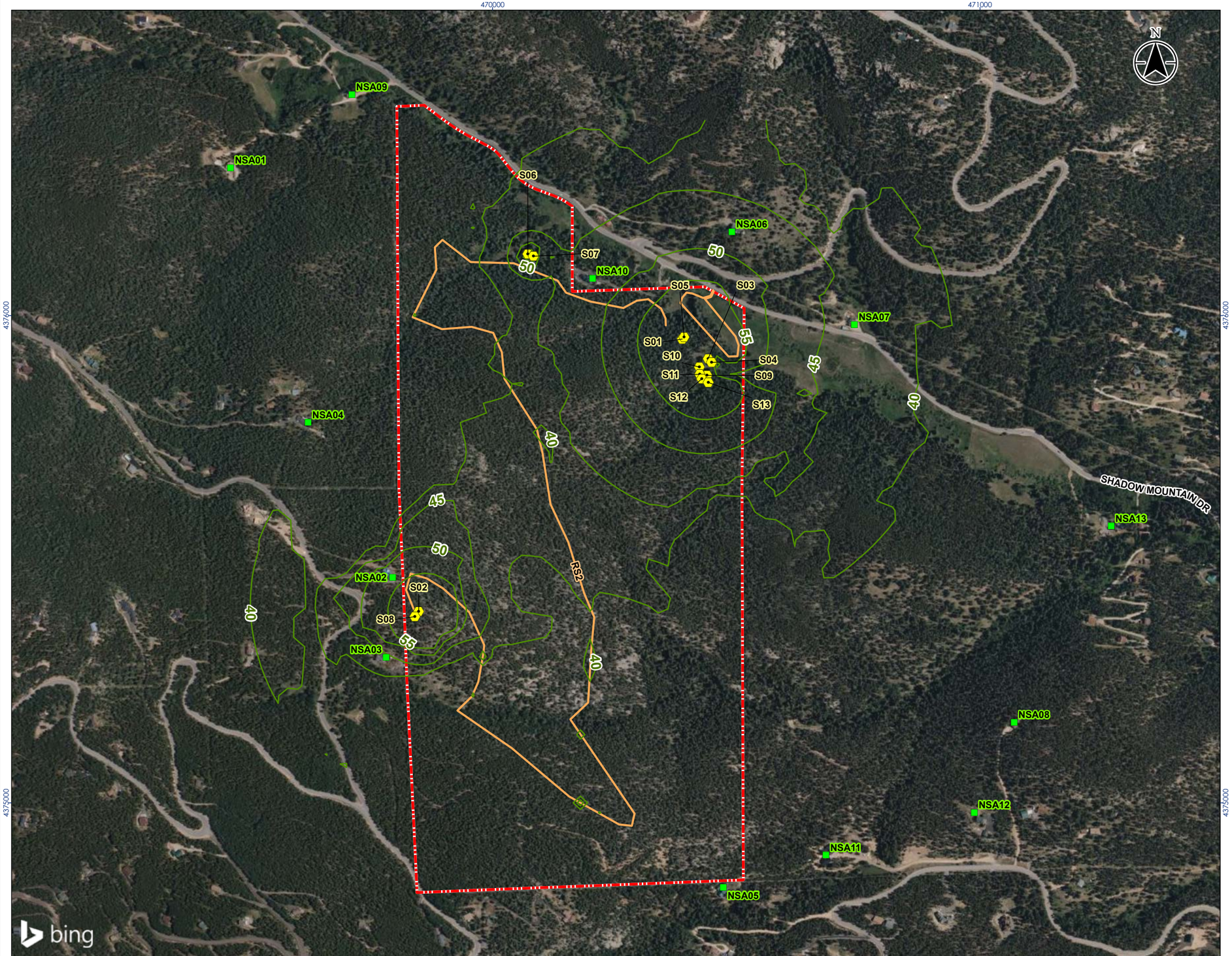
Figure No.
**A.5**

Title
**Nighttime Stationary Noise Contour $LA_{25}$ 4.5m (15 ft. AG)**




Stantec

**Legend**

- Site Limit
- Noise Receptor
- Point Source
- Line Source
- Daytime Noise Contour 4.5m (15ft.) AG

0 250 500 m

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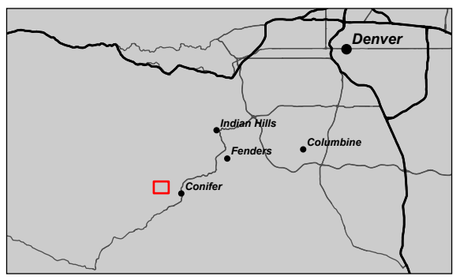


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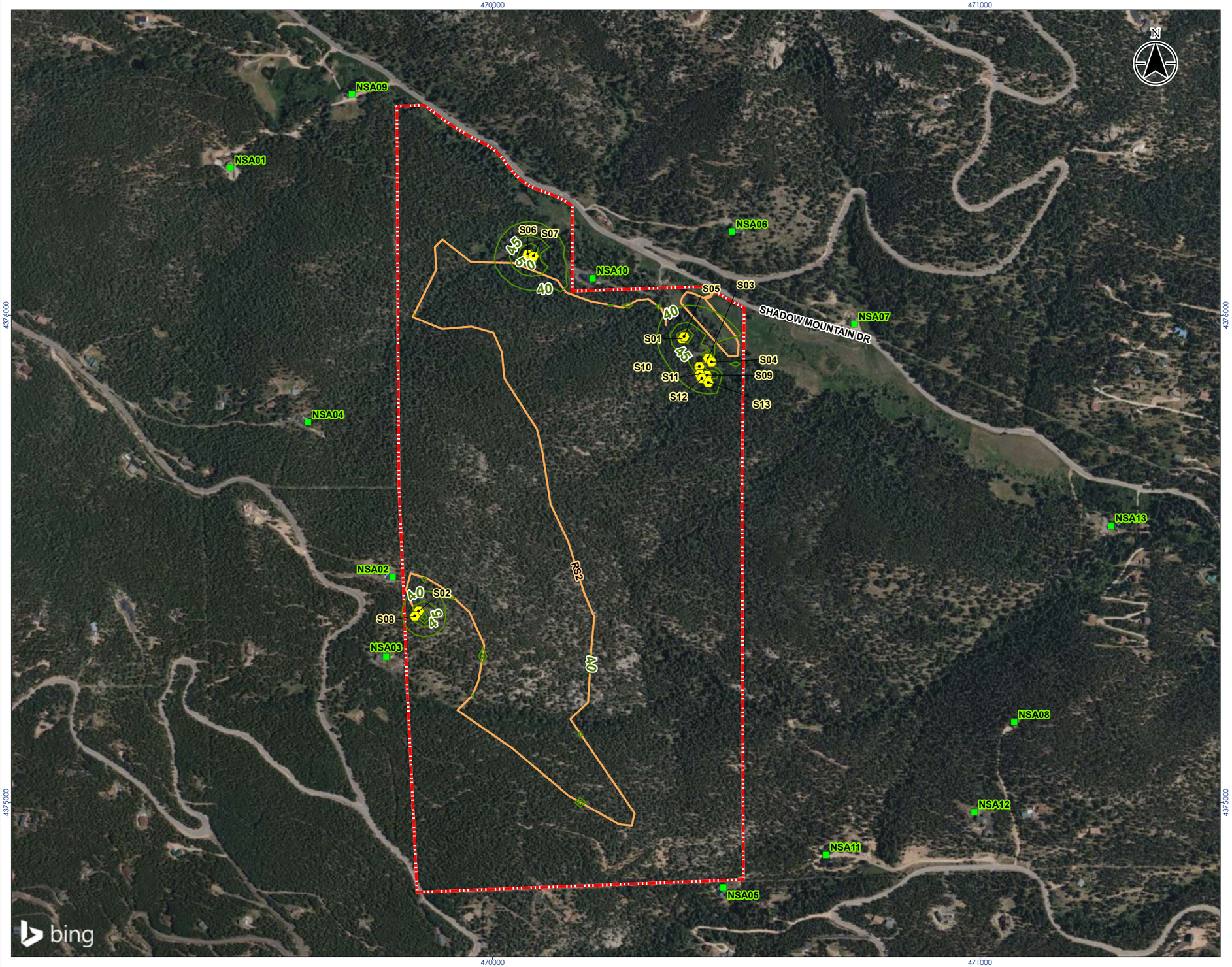
Shadow Mountain Sensory Impact Study - Noise

Figure No.
**A.6**

Title
**Daytime Stationary Noise Contour $LA_0$ 4.5m (15 ft. AG)**

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**Legend**

- Site Limit
- Noise Receptor
- Point Source
- Nighttime Noise Contour 4.5m (15 ft.) AG
- Line Source

0 250 500 m

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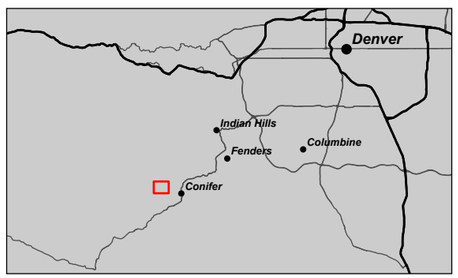


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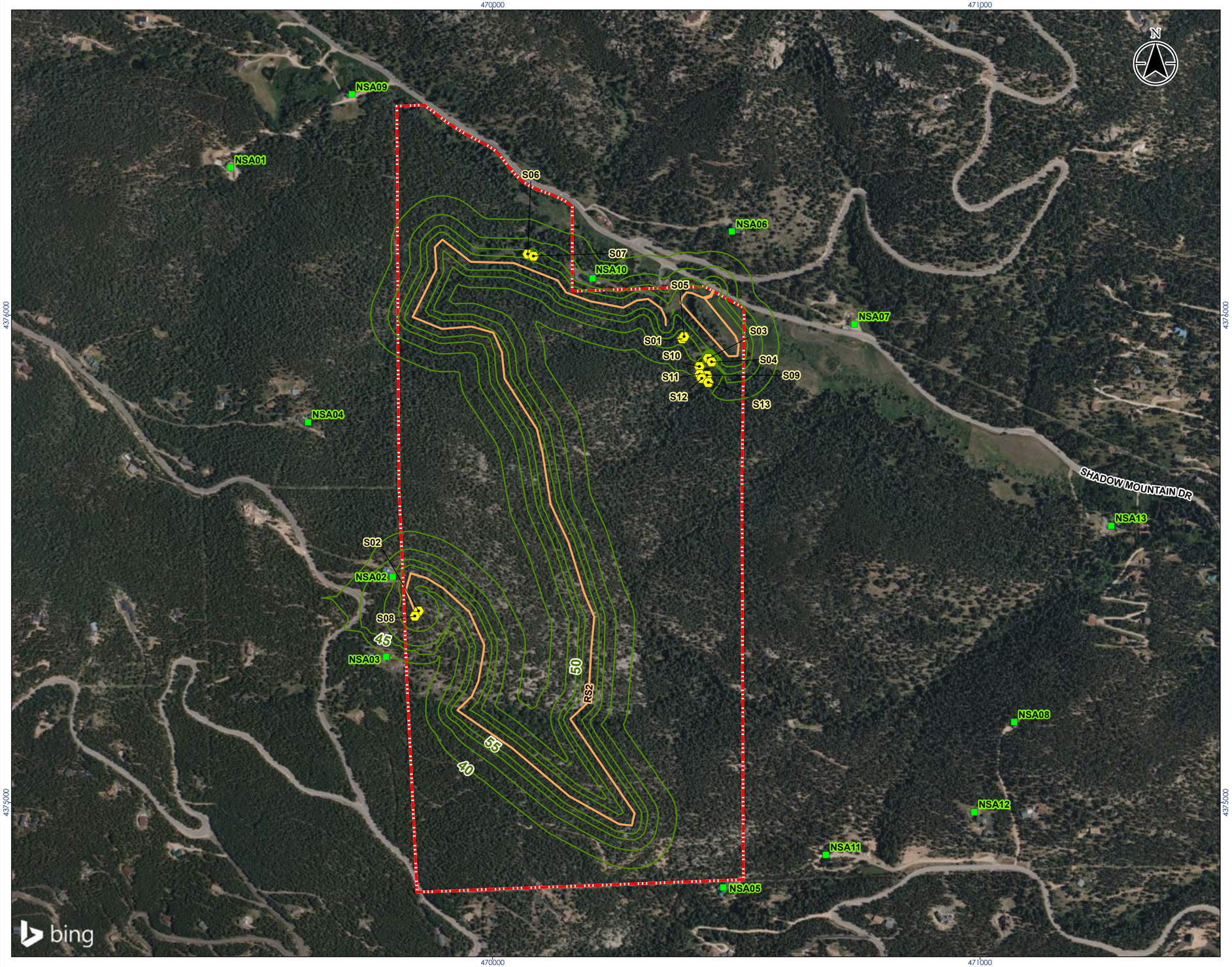
Shadow Mountain Sensory Impact Study - Noise

Figure No.
**A.7**

Title
**Nighttime Stationary Noise Contour $LA_0$ 4.5m (15 ft. AG)**

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**Legend**

- Site Limit
- Noise Receptor
- Point Source
- Line Source
- Daytime Noise Contour Lmax (dBA)

0 250 500 m

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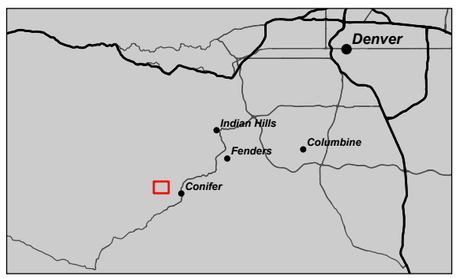


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Figure No.
**A.8**

Title
**Daytime Mobile Noise Contour $LA_0$ 4.5 AG (15 ft. AG)**