Big Sky Acoustics, LLC

P.O. Box 27 • Helena, Montana 59624
Tel: (406) 457-0407 • Fax: (406) 442-1296
www.bigskyacoustics.com

November 7, 2016

Mr. Brian Wells
Team Development, LLC
PO Box 1642
Brush Prairie, WA 98606

Re: Southside Estates Subdivision
Kalispell Bypass Traffic Noise Contour Analysis
BSA Project #16143

Dear Brian:

Big Sky Acoustics, LLC (BSA) has completed the Traffic Noise Contour Analysis for the proposed Southside Estates Subdivision along the Kalispell Bypass. The enclosed report summarizes the analysis, and provides recommendations to meet the City 60 dBA requirement.

Thank you for the opportunity to assist you. If you have any questions or comments regarding the information presented in the report, please do not hesitate to call me at (406) 457-0407 or email me at sean@bigskyacoustics.com.

Sincerely,

Sean Connolly

Sean Connolly
BIG SKY ACOUSTICS, LLC

Attachment

cc: Rory Young / Jackola

Big Sky Acoustics, LLC
P.O. Box 27 • Helena, Montana 59624
Tel: (406) 457-0407 • Fax: (406) 442-1296
www.bigskyacoustics.com

SOUTHSIDE ESTATES SUBDIVISION
KALISPELL BYPASS TRAFFIC NOISE CONTOUR ANALYSIS

1.0 INTRODUCTION

Big Sky Acoustics (BSA) completed a Traffic Noise Contour Analysis for the proposed Southside Estates Subdivision along the Kalispell Bypass. The City of Kalispell requires that noise from major arterial roads not exceed 60 dBA at a subdivision lot line, and that subdivisions incorporate noise mitigation to reduce traffic noise impacts (City of Kalispell 2011). The planned Subdivision includes 37 lots with one story, single family homes and three common areas (Jackola 2016b).

The proposed Southside Estates Subdivision is located approximately 0.5 mile southeast of Foys Lake Road and along the eastern edge of the Kalispell Bypass. This section of the Bypass consists of two 12-foot travel lanes and 8-foot shoulders, with a current speed limit of 55 miles per hour (mph). The Bypass right-of-way (ROW) fence forms the western Subdivision property boundary, paralleled by the bike path and the Montana Department of Transportation (MDT) concrete traffic noise barrier wall. The existing barrier wall is adjacent to the northern half of the subdivision, blocking the line of sight to the roadway, and tapers down to its terminus exposing the southern portion, as shown in the following picture, and **Figure 1** (attached).

Photo 1: Looking south from measurement Location 1 at the western Subdivision property boundary, MDT ROW fence, bike path, existing concrete barrier wall and the Kalispell Bypass.

This report summarizes the Traffic Noise Contour Analysis for the Southside Estates Subdivision, including the calculated location of the 60 dBA traffic noise contour. The analysis was based on the following sources:

- The proposed Subdivision grading plan and lot/road layout (Jackola 2016a, 2016b)
- Existing ground surface elevations of the Subdivision (Jackola 2016c)
- Kalispell Bypass as-built plans and sections (Stelling Engineers 2012)
- Updated traffic data and projections for the Kalispell Bypass (MDT 2016).

If the Bypass traffic data or speed limit, the Southside Estates Subdivision grading elevations, lot layout or building height, etc. change, then the noise analysis will need to be updated.

2.0 NOISE TERMINOLOGY

Noise levels are quantified using units of decibels (dB). Noise levels can also be expressed as A-weighted decibels (dBA). Humans typically have reduced hearing sensitivity at low frequencies compared with their response at high frequencies, and the A-weighting of noise levels closely correlates to the frequency response of normal human hearing. By utilizing A-weighted noise levels in a study, a person's response to noise can be assessed. Decibels are logarithmic values, and cannot be combined using normal algebraic addition. For example, the combined noise level of two 50-dBA noise sources would be 53 dBA, not 100 dBA.

Noise can be quantified using many different metrics and time periods. For environmental noise studies, ambient noise levels and noise impact criteria are based on A-weighted equivalent noise levels, L_{eq}, during a certain time period. The equivalent noise level during a one-hour period is represented as $L_{eq}(h)$ and is the metric used by the Federal Highway Administration (FHWA) and MDT for traffic noise studies. The equivalent noise level is defined as the steady state noise level that has the same acoustical energy as the actual, time-varying noise signal during the same time period. The $L_{eq}(h)$ metric is useful for traffic noise studies because it uses a single number to describe the constantly fluctuating ambient noise levels at a receptor location during one hour of time. All noise levels used in this report refer to the $L_{eq}(h)$ metric unless noted otherwise.

3.0 NOISE ANALYSIS

3.1 Ambient Noise Level Measurements

BSA completed two simultaneous noise level measurements on October 19, 2016 to determine the existing ambient noise levels on the northern and southern sections of the Southside Estates Subdivision. The measurements were 1-hour in duration. The measurement locations are depicted on **Figure 1** and **Table 3-1** summarizes the measured ambient $L_{eq}(h)$ noise levels.

BSA conducted the ambient noise level measurements using a Larson Davis Model 831 Type I Sound Level Meters with preamplifiers and 0.5-inch diameter microphones. The meters were calibrated using a Larson Davis Model CAL200 Acoustical Calibrator prior to and checked after

the measurements. The sound level meters were set to "slow" response per FHWA requirements. The meters were mounted on tripods such that the microphones were approximately 5 feet above the ground surface, and windscreens were used over the microphone. Atmospheric conditions were measured using a Kestrel 3000 meter, with a field temperature of 54°F, relative humidity of 51%, and calm conditions with occasional gusts to 8mph.

Table 3-1: Outdoor Ambient Noise Level Measurements

Meas. Location	Date and Time (hours)	Description (Figure 1)	Approx. Distance and Direction from Existing Centerline	Field Measured $L_{eq}(h)$ (dBA)	Dominant Noise Source during Measurements
1	10/19/16 1415 to 1515	Northern section of Southside Estates Subdivision, approximately 28 feet east of ROW fence. Line of sight to Kalispell Bypass blocked by MDT concrete barrier wall.	135 feet east	55.4	Kalispell Bypass traffic
2	10/19/16 1415 to 1515	Southern section of Southside Estates Subdivision, approximately 28 feet east of ROW fence. Clear line of sight to Kalispell Bypass with both traffic lanes visible.	135 feet east	61.1	Kalispell Bypass traffic

3.2 Creating and Verifying the Traffic Noise Model

BSA predicted traffic noise levels at the proposed Southside Estates Subdivision using the FHWA-approved Traffic Noise Model (TNM), Version 2.5 software program, which predicts the noise due to moving vehicles. The ambient noise level measurements taken by BSA (**Table 3-1**) were used to verify that the TNM model was reasonably accurate.

TNM 2.5 uses a three-dimensional coordinate system (x, y, and z) to define the location of the roadway, receptor locations and terrain elevations. The number and type of vehicles traveling on the roadway that were tallied during the measurements, the approximate speed of the traffic, the location of the centerlines of the driving lanes, the approximate ground elevations between the measurement locations and the roadway, and the measurement locations were entered into the model. BSA used the existing and proposed grading topographic elevations of the Subdivision (Jackola 2016a, 2016b and 2016c) and the as-built plan and section data (Stelling Engineers 2012) in the model.

Table 3-2 lists the traffic data BSA counted during the field measurements and used to compare the field-measured noise levels to the traffic noise levels predicted by the TNM model at the measurement locations. The difference between each field-measured $L_{eq}(h)$ level and the level predicted by the TNM model for the traffic conditions during each measurement period was <0.3 dBA. A difference of +/- 3 dBA between measured and predicted traffic noise levels indicates that a TNM model is reasonably accurate (MDT 2011).

Table 3-2: Measured Ambient vs. Predicted Noise Levels

Meas. Location	Date and Time (hours)	Distance and Direction from Centerline	Northbound Traffic Tallied During Measurement[1]	Southbound Traffic Tallied During Measurement	Field Measured $L_{eq}(h)$	Predicted $L_{eq}(h)$ by TNM Model
1	10/19/16 1415 to 1515	135 feet west	Autos: 190 MT: 12 HT: 10	Autos: 242 MT: 18 HT: 12	55.4 dBA	55.1 dBA
2	10/19/16 1415 to 1515	135 feet west			61.1 dBA	60.9 dBA

Autos Automobiles – 2-axle, 4-wheel vehicles including pickup trucks (FHWA Vehicle Classes 1 – 3)
MT Medium trucks – 2-axle, 6-wheel vehicles, plus automobiles pulling trailers (FHWA Vehicle Classes 4 – 5)
HT Heavy trucks – 3 or more axles (FHWA Vehicle Classes 6 – 16)

3.3 Traffic Data Used for the Traffic Noise Predictions

BSA calculated the traffic noise levels for the future Kalispell Bypass conditions. The traffic volumes provided by MDT were the Design Year (2035) average annual daily traffic (AADT) data (MDT 2016). For the noise analysis, the Design Hourly Volume (DHV) data was used in the TNM model, and estimated to be approximately 10% of the AADT (MDT 2016). BSA assumed that the traffic would be evenly divided between the travel lanes in each direction. **Table 3-3** shows the traffic data that BSA used for the noise level predictions.

Table 3-3: Traffic Data Used for Noise Level Predictions

Roadway	Design Condition	Year	AADT	DHV	Autos	MT	HT
Kalispell Bypass	Build Alternative	2035	12,373	1,237	96.7%	1.4%	1.9%

AADT Average Annual Daily Traffic
DHV Design Hourly Volume
Autos Automobiles – 2-axle, 4-wheel vehicles including pickup trucks (FHWA Vehicle Classes 1 – 3)
MT Medium trucks – 2-axle, 6-wheel vehicles, plus automobiles pulling trailers (FHWA Vehicle Classes 4 – 5)
HT Heavy trucks – 3 or more axles (FHWA Vehicle Classes 6 – 16)

3.4 Results

The traffic noise contours in this report are based on a receptor height of 6 feet above the ground level to evaluate ground-level areas of exterior human use (MDT 2011). The predicted traffic noise contours without any noise mitigation for the Subdivision are shown on **Figure 2** (attached). As shown, the existing MDT barrier wall is shielding the northern half of the Southside Estates Subdivision, but without an additional noise barrier, the noise levels are predicted to exceed 60 dBA in the southern half. Therefore, BSA completed a barrier analysis to meet the City's requirement (City of Kalispell 2011).

4.0 RECOMMENDATIONS

4.1 Additional Subdivision ROW Barrier

To meet the City's requirement to reduce traffic noise to 60 dBA at the Subdivision lot lines, BSA evaluated the use of an additional traffic noise barrier wall on the Bypass ROW in the southern portion of the Subdivision. The City of Kalispell restricts the height of a barrier wall to 6.5 feet above grade (City of Kalispell 2011), but the barrier wall can be located on a short berm to increase the overall height of the barrier.

To mitigate the traffic noise, BSA recommends an 8-foot high barrier to meet the City's 60 dBA requirement for the subdivision. The traffic noise contours associated with the recommended 8-foot ROW barrier are shown on **Figure 3** (attached). To achieve the 8-foot total height, a 6-foot barrier can be located on a 2-foot earthen berm, or a 6.5-foot barrier on a 1.5-foot berm. The elevations for the ground surface at the base of the berm and at the top of the ROW barrier are shown on **Figure 3**. To maintain continuous shielding from north to south, the recommended barrier wall for the Southside Estates Subdivision should overlap the existing MDT barrier by a minimum of 75 feet.

As shown on **Figure 3**, the 8-foot ROW barrier will reduce traffic noise levels across the Subdivision. However, even with the barrier, the 60 dBA noise contour does project onto the Subdivision through the proposed opening for the bike path. As shown on **Figure 4** (attached), this can be mitigated if the bike path opening is moved to the north end of BSA's proposed ROW barrier, adjacent to the central common area in the Subdivision, or at the west end of the north cul-de-sac.

4.2 Barrier Design and Materials

Barriers are used for noise control by shielding a receptor location from a noise source, such as a roadway. A barrier is most effective when it is continuous and solid, and blocks the direct line-of-sight between the entire roadway and a receptor. Barriers can be constructed using built up dirt to create a berm, using concrete, concrete block, other similar masonry materials, metal panels, or thick wood to create a wall, or a combination of a berm with a wall on top.

As a rule of thumb, barriers need to be approximately 4 pounds per square foot (psf) to be effective for noise control. Other concerns such as structural integrity, wind loading, durability, etc., can increase the weight of the materials used to construct a barrier. The Subdivision ROW barrier, berm and footings should be designed by a licensed structural engineer.

Although it may be used for visual screening, vegetation, such as trees and shrubs, are not considered effective barrier material since sound passes readily through vegetation. An earthen berm typically has a large base for support and may also require additional land to accommodate construction. To be effective, the barrier wall must be continuous and solid with no gaps, holes or openings in it, including between the bottom edge of the barrier wall and the ground surface.

Barrier design guidelines are available in the *FHWA Highway Noise Barrier Design Handbook, February 2000*. The Handbook includes information concerning various types of barriers and materials, aesthetics, and structural, drainage and safety considerations.

Examples of barrier wall materials include the following, among others:

Post-and-Panel Systems

- Noishield Sound Barrier manufactured by Industrial Acoustics Company (www.industrialacoustics.com)
- Noiseblock Barrier Wall System manufactured by Kinetics Noise Control (www.kineticsnoise.com)
- Acoustax Noise Barriers manufactured by Acoustax (www.acoustax.com)
- LSE Noise Barrier Wall System manufactured by Sound Fighter Systems (www.soundfighter.com)
- UltraScreen Sight & Sound Barriers manufactured by AFM Corporation (www.sightandsoundbarrier.com)

Concrete

- Glacier Precast Concrete in Kalispell, Montana (www.glacierprecast.com)
- StoneTree Concrete Fence Wall manufactured by StoneTree Concrete Fence Systems. (www.stonetreefence.com)
- SoundSorb manufactured by Concrete Solutions, Inc. (www.soundsorb.com)
- Whisper Wall manufactured by Concrete Systems Northwest, LLC (www.concsys.com)

Concrete block

- Soundblox manufactured by The Proudfoot Company (www.soundblox.com)

Wood

- Plywall manufactured by Hoover Treated Wood Products, Inc. (www.plywall.com)

Polyethylene

- Ecostone Plus by SimTek (www.simtekfence.com)

5.0 REFERENCES

City of Kalispell. 2011. Title 28, Subdivision Regulations. 28.3.09 Highway Sound Mitigation.

Jackola, P.C. 2016a. Southside Estates Subdivision proposed grading plan. Transmitted by Rory Young, P.E. by email on October 19, 2016. *ACAD-Pintail_Design Surface.dxf*

Jackola, P.C. 2016b. Southside Estates Subdivision Lot Layout with roads. Transmitted by Rory Young, P.E. by email on October 27, 2016. *ACAD-Pintail_Sitekey.dxf*

Jackola, P.C. 2016c. Southside Estates Subdivision survey data of existing ground surface elevations. Transmitted by Rory Young, P.E. on November 1, 2016. *ACAD-Pintail_TOPO.dxf*

Montana Department of Transportation (MDT). 2016. Kalispell Bypass traffic data and projections. Transmitted by Marie Stump on October 26, 2016.

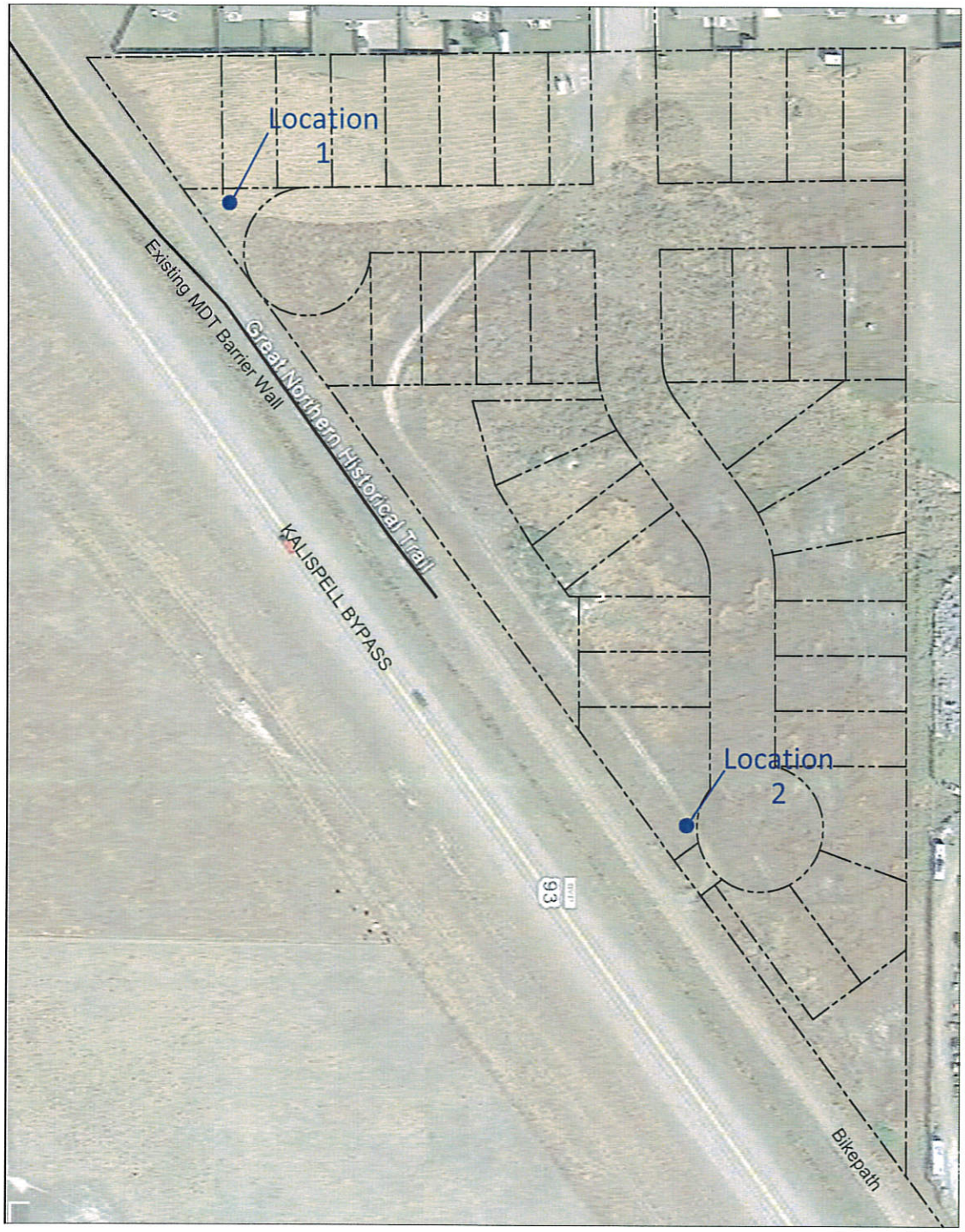
Montana Department of Transportation (MDT). 2011. Traffic Nosie Analysis and Abatement Policy.

Stelling Engineers, Inc. 2012. MDT As-built plans and sections for KBP – Airport Rd to Foys Lake Rd.

6.0 STANDARD OF CARE

To complete this report, BSA has endeavored to perform its services consistent with the professional skill and care ordinarily provided by acoustical consultants practicing in similar markets and under similar project conditions. BSA is fully experienced and properly qualified to perform acoustical consulting services. However, acoustical consulting services as offered and engaged in by BSA does not include "engineering" or "practice of engineering" or the "practice or offer to practice engineering" as these phrases are defined under Montana law.

BSA makes no warranty, either expressed or implied, as to the professional services it has rendered to complete this report. For the completion of this report, BSA has used data provided by Jackola, MDT, and Stelling Engineers in performing its services and is entitled to rely upon the accuracy and completeness thereof. Therefore, if the information and assumptions used to create this report change, then the noise analysis and the recommended noise control measures may need to be reevaluated.

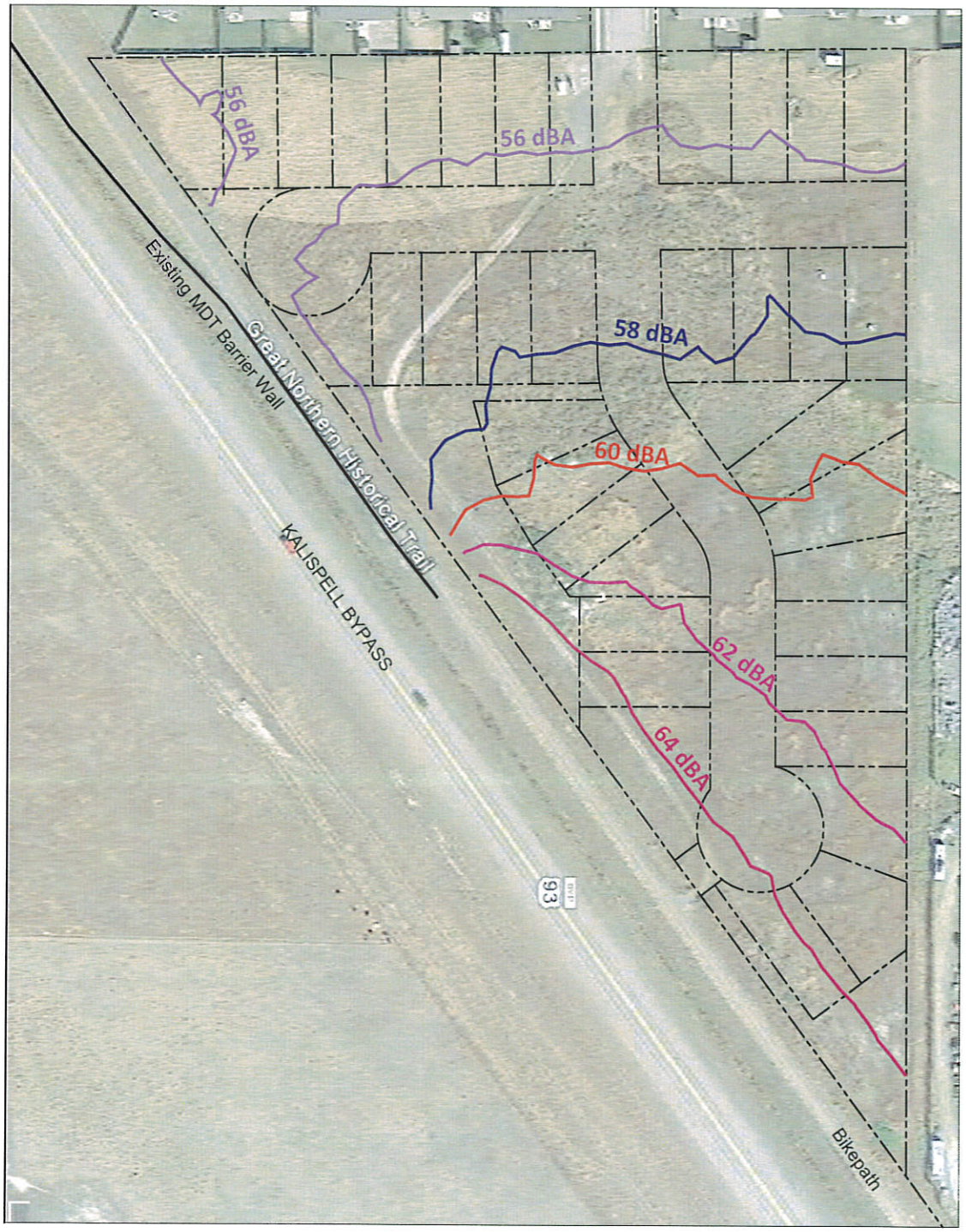


NORTH

Big Sky Acoustics, LLC

FIGURE 1

Subdivision Layout & Noise Measurement Locations
Southside Estates Subdivision
Scale: 1" = 150 ft. (8.5"x11")

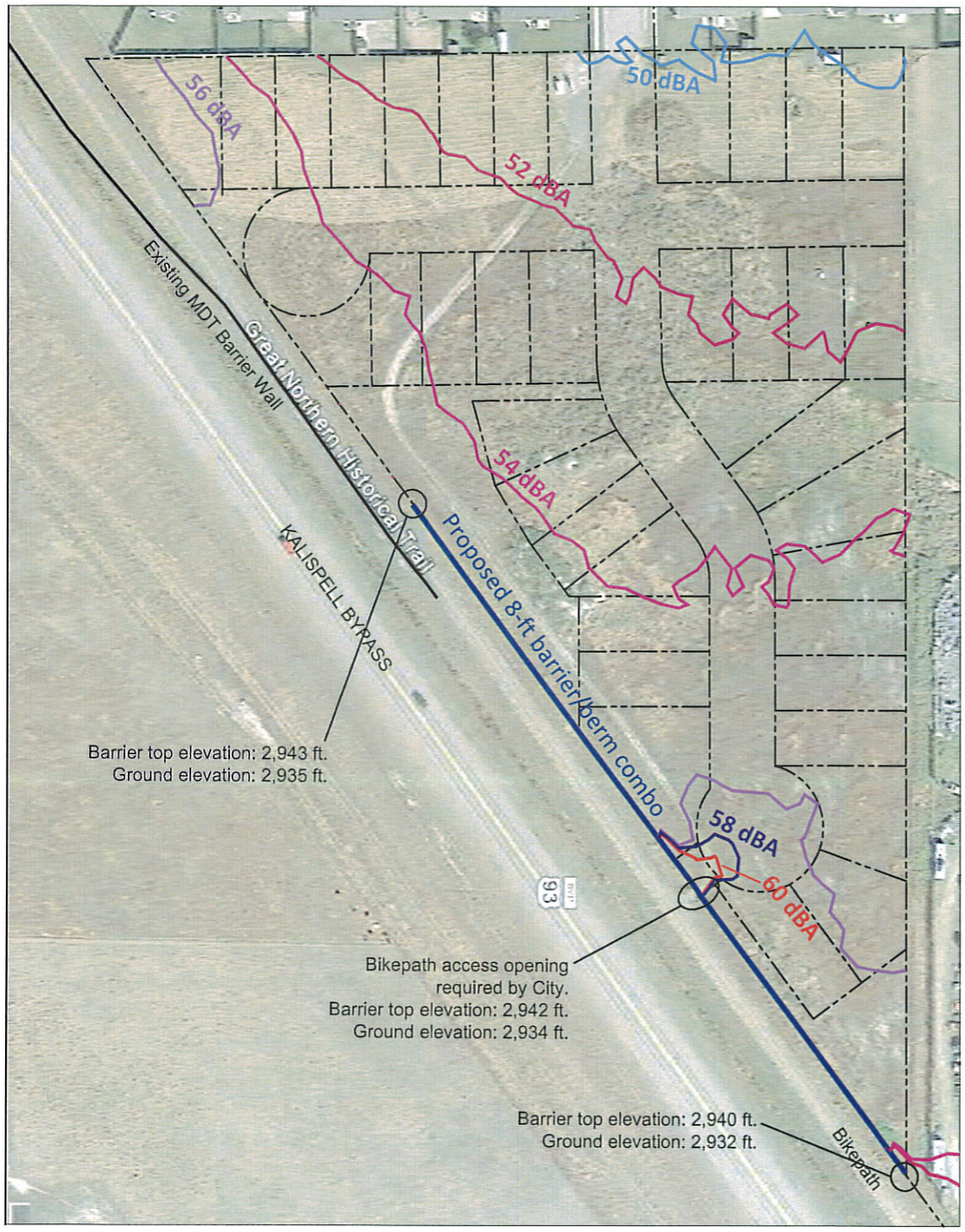


NORTH

Big Sky Acoustics, LLC

FIGURE 2

Traffic Noise Contours, Year 2035: No Barrier
Southside Estates Subdivision
Scale: 1" = 150 ft. (8.5"x11")

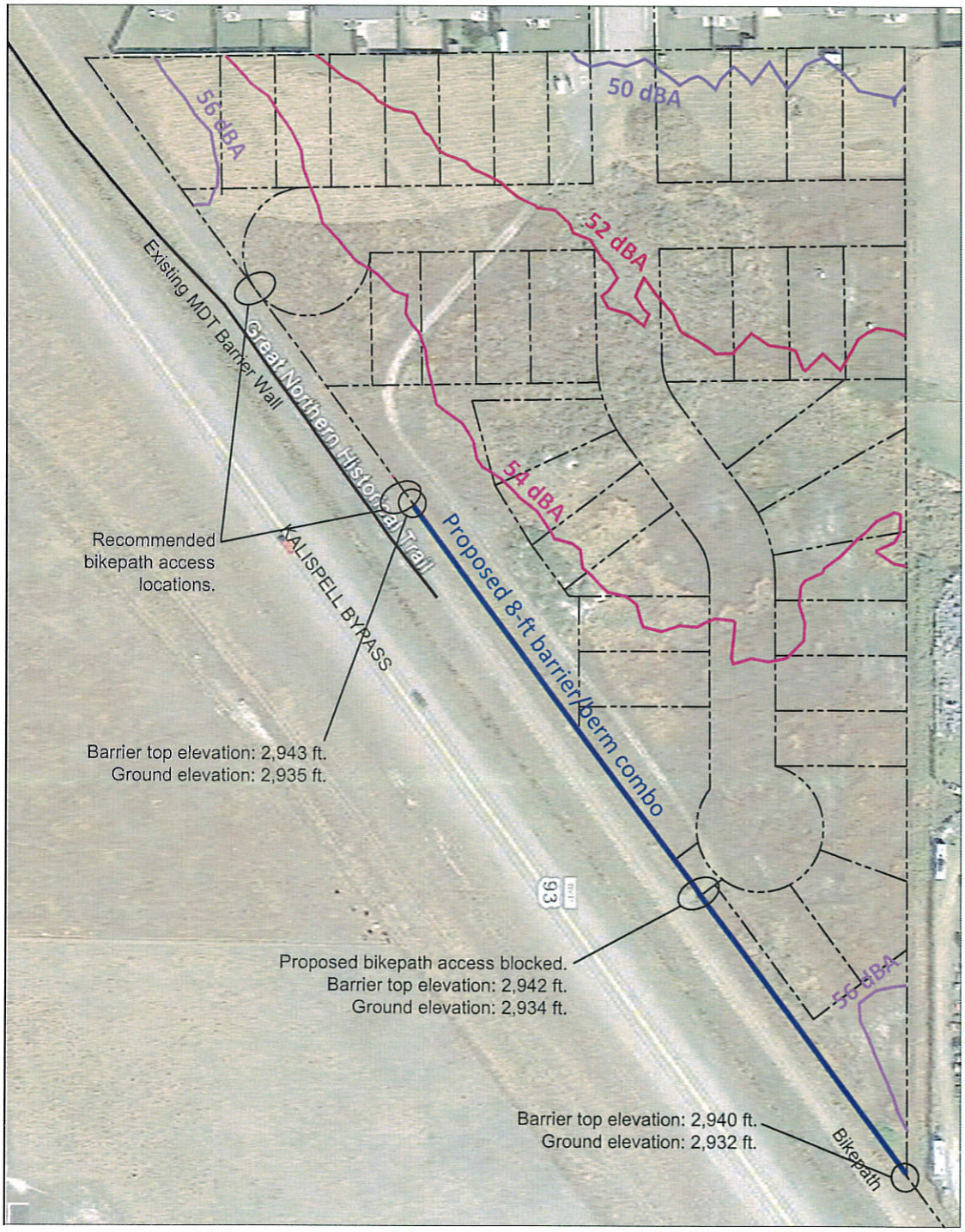


NORTH

Big Sky Acoustics, LLC

FIGURE 3

Traffic Noise Contours, Year 2035: With 8-ft Barrier on ROW Line and Proposed Bikepath Access
Southside Estates Subdivision
Scale: 1" = 150 ft. (8.5"x11")



NORTH

Big Sky Acoustics, LLC

FIGURE 4

Traffic Noise Contours, Year 2035: With Continuous 8-ft Barrier on ROW Line
Southside Estates Subdivision
Scale: 1" = 150 ft. (8.5"x11")