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February 16, 2009
File: 1036538

Ms. Elizabeth Pugh, P.Eng.
Nova Scotia Department of
Transportation and Infrastructure Renewal
Johnson Building, 3rd Floor
1672 Granville Street
PO Box 186
Halifax, NS B3J 2N2

Attention: **Ms. Elizabeth Pugh**

Dear: Ms. Pugh

Reference: **Revised Results – Noise Modelling Exercise for Trunk 7 and Kell Road Highway 104 Antigonish – Phase 1**

Introduction

A noise modelling exercise was conducted to provide input into the design phase for potential mitigation at Trunk 7 and Kell Road along Phase 1 of the Highway 104 at Antigonish Project. The noise modelling exercise involved predicting the noise associated with six different scenarios. The scenarios modelled included the following:

- Scenario 1 – Proposed Highway 104 passing under Trunk 7.
- Scenario 2 – Proposed Highway 104 passing over Trunk 7, without mitigation.
- Scenario 3 – Proposed Highway 104 passing over Trunk 7, with mitigation (Jersey Barriers).
- Scenario 4 – Proposed Highway 104 passing over Kell Road, without mitigation.
- Scenario 5 – Proposed Highway 104 passing over Kell Road, with mitigation (Jersey Barriers).
- Scenario 6 – Proposed Highway 104 passing over Trunk 7 and Kell Road, with Porous Asphalt.

Methodology and Model Used

The noise modelling was conducted using CadnaA (Computer Aided Noise Abatement) version 3.7.124, a computer program capable of predicting noise levels at specified receiver positions originating from a variety of noise sources. The CadnaA noise modelling software has been used extensively for community noise prediction and assessment and has been accepted by many regulatory agencies in Canada. It has the capacity to handle industrial facilities, roads, railways, airports, stationary sources and heating, air conditioning and ventilation equipment, and has been accepted in most provinces in Canada, and at the federal level. Applicable national or international standards and protocols can also be included in its analysis,

such as those prescribed by ISO 9613. For this work, the ISO 9613 methodology was selected. CadnaA can also account for such factors as:

- Distance attenuation (i.e., geometrical dispersion of sound with distance);
- Atmospheric attenuation (i.e., the rate of sound absorption by atmospheric gases in the air between sound sources and receptors);
- Ground attenuation (i.e., effect of sound absorption by the ground as sound passes over various terrain and vegetation types between source and receptor);
- Screening effects of surrounding terrain; and
- Meteorological conditions and effects.

ISO9613-1 prescribes the methods for calculation of the attenuation of sound in air. ISO9613-2 prescribes algorithms for geometrical spreading and barrier effects.

Model Inputs

The CadnaA model incorporates the methodology of ISO 9613-2 when dealing with the influence of vegetation and meteorology on the prediction of noise levels. The model assumes that wind travels at moderate speed from the noise source to the receiver. This is conservative but does not necessarily represent the worst-case scenario. Extreme weather events could result in elevated noise levels.

Existing terrain data for the Study Area and the proposed Highway 104 design surface files were obtained from Nova Scotia Transportation and Infrastructure Renewal and compiled by Jacques Whitford drafting personnel. The associated ramps and round about structures were taken into account during the noise modelling in terms of their height as it acts as a shield to the Highway traffic noise.

The proposed Highway was incorporated into the model as a road noise source, with smooth mixed asphalt, and the expected traffic volumes per hour were calculated based on the average annual daily traffic (AADT) data presented in the Environmental Assessment Report Highway 104 at Antigonish (Jacques Whitford, 2005). The traffic volumes incorporated into each modelling scenario are presented in Table 1.

Table 1 Traffic Volume - Proposed Highway 104 at Antigonish (2002 data)

Proposed Highway Segment	AADT[1]	Vehicle Count/Hour		% Trucks[2]	
		Day	Night	Day	Night
Addington Forks Rd. to Trunk 7	6400	320	160	13	13
Trunk 7 to Beech Hill Rd.	8700	435	218	13	13

[1] Annual Average Daily Traffic
[2] % Trucks = 9 % Heavy Trucks plus 4 % Medium Trucks. The remaining 4% medium trucks are assumed to be passenger vehicles.

The following assumptions were made regarding the proposed Highway 104 traffic volume, and are the same as those used in the Environmental Assessment Report Highway 104 at Antigonish:

- Traffic distribution over a 24-hour period is 80 % during the day (7:00 to 23:00) and 20 % during the night (23:00 to 7:00);

- Highway vehicle mixes for the area is 13 % trucks and 87 % passenger cars; and
- Highway vehicle speeds are 110 km/hr.

Two discrete receptors, representing the same locations as noise monitoring stations 4 and 5 from the Environmental Assessment Report Highway 104 at Antigonish, were incorporated into each model run. A receptor grid, spaced 10 m by 10 m was also incorporated into each model run, in order to produce the sound contour maps. The receptors were given a height of 4 metres, to represent the height of a typical bedroom window.

For modelling scenarios three and five, noise mitigation in the form of 1 m, 3 m, and, 5 m Jersey barriers was employed. For modelling scenario six, noise mitigation in the form of porous asphalt was employed.

Results

The predicted noise levels, baseline noise levels, and the total predicted noise levels (predicted + baseline) for scenario 1 modelling, during the day and night, are presented in Table 2.

Table 2 Noise Modelling Results Scenario 1 - Proposed Highway 104 Passing Under Trunk 7 - Without Mitigation

Noise Monitoring Station	Baseline Noise Levels (dBA)	Predicted Noise Levels (dBA)	Total Predicted Noise Levels (dBA)
Daytime			
Station 4	54.0	54.8	57.4
Nighttime			
Station 4	48.6	51.8	53.5

The noise contours resulting from the receptor grid calculation are presented in Figures1 and 2 attached to this letter.

The predicted noise levels, baseline noise levels, and the total predicted noise levels (predicted + baseline) for scenario 2 modelling, during the day and night, are presented in Table 3.

Table 3 Noise Modelling Results Scenario 2 - Proposed Highway 104 Passing Over Trunk 7 - Without Mitigation

Noise Monitoring Station	Baseline Noise Levels (dBA)	Predicted Noise Levels (dBA)	Total Predicted Noise Levels (dBA)
Daytime			
Station 4	54.0	55.3	57.7
Nighttime			
Station 4	48.6	52.3	53.8

Reference: Revised Results – Noise Modelling Exercise for Trunk 7 and Kell Road Highway 104 Antigonish – Phase 1

The noise contours resulting from the receptor grid calculation are presented in Figures 3 and 4 attached to this letter.

The predicted noise levels, baseline noise levels, and the total predicted noise levels (predicted + baseline) for scenario 3 modelling at noise monitoring station 4, during the day and night, are presented in Table 4.

Table 4 Noise Modelling Results Scenario 3- Proposed Highway 104 Passing Over Trunk 7- with and without Mitigation (Station 4)

Noise Barrier Height (m)	Baseline Noise Levels (dBA)	Predicted Noise Levels (dBA)	Total Predicted Noise Levels (dBA)
Daytime			
No Barrier	54.0	55.3	57.7
1	54.0	53.2	56.6
3	54.0	49.2	55.2
5	54.0	47.0	54.8
Nighttime			
No Barrier	48.6	52.3	53.8
1	48.6	50.1	52.4
3	48.6	46.2	50.6
5	48.6	44.0	49.9

The noise contours resulting from the receptor grid calculation, based on a Jersey barrier at 1 m in height, are presented in Figures 5 and 6 attached to this letter.

The predicted noise levels, baseline noise levels, and the total predicted noise levels (predicted + baseline) for scenario 4 and 5 modelling at noise monitoring station 5, during the day and night, are presented in Table 5.

Table 5 Noise Modelling Results Scenario 4 & 5 - Proposed Highway 104 Passing Over Kell Road - with and without Mitigation (Station 5)

Noise Barrier Height (m)	Baseline Noise Levels (dBA)	Predicted Noise Levels (dBA)	Total Predicted Noise Levels (dBA)
Daytime			
No Barrier	53.4	56.9	58.5
1	53.4	55.5	57.6
3	53.4	53.4	56.4
5	53.4	52.3	55.9
Nighttime			
No Barrier	37.6	53.9	54.0
1	37.6	52.5	52.6
3	37.6	50.3	50.5
5	37.6	49.3	49.6

Reference: Revised Results – Noise Modelling Exercise for Trunk 7 and Kell Road Highway 104 Antigonish – Phase 1

The noise contours resulting from the receptor grid calculation, based on a Jersey barrier at 1 m in height, are presented in Figures 7 and 8 attached to this letter.

The predicted noise levels, baseline noise levels, and the total predicted noise levels (predicted + baseline) for scenario 6 modelling at noise monitoring stations 4 and 5, during the day and night, are presented in Table 6.

Table 6 Noise Modelling Results Scenario 6- Proposed Highway 104 Passing Over Trunk 7 and Kell Road - with Porous Asphalt

Noise Monitoring Station	Baseline Noise Levels (dBA)	Predicted Noise Levels (dBA)	Total Predicted Noise Levels (dBA)
Day			
Station 4	54.0	51.3	55.9
Station 5	53.4	52.9	56.2
Night			
Station 4	48.6	48.3	51.5
Station 5	37.6	49.9	50.1

The noise contours resulting from the receptor grid calculation, based on the use of porous asphalt instead of smooth asphalt, are presented in Figures 9 and 10 attached to this letter

A comparison between the noise levels predicted using smooth asphalt verus porous asphalt for the proposed Highway 104 passing over Trunk 7 and Kell Road is presented in Table 7.

Table 7 Noise Modelling Results Comparison - Smooth Vs. Porous Asphalt

Noise Monitoring Station	Predicted Noise Levels (dBA) - Smooth Asphalt	Predicted Noise Levels (dBA) - Porous Asphalt
Day		
Station 4	57.7	55.9
Station 5	58.5	56.2
Night		
Station 4	53.8	51.5
Station 5	54.0	50.1

Reference: Revised Results – Noise Modelling Exercise for Trunk 7 and Kell Road Highway 104 Antigonish – Phase 1

Closure

This report has been prepared for the sole use of Nova Scotia Transportation and Infrastructure Renewal. The report may not be used by any other person or entity without the express written consent of Jacques Whitford Limited Stantec Limited and Nova Scotia Transportation and Infrastructure Renewal.

Any uses that a third party makes of this report, or any reliance on decisions made based on it, are the responsibility of such third parties. Jacques Whitford Limited accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made, or actions taken, based on this report.

The information and conclusions contained in this report are based upon work undertaken by trained professional and technical staff in accordance with generally accepted engineering and scientific practices current at the time the work was performed. Conclusions and recommendations presented in this report should not be construed as legal advice.

If any conditions become apparent that differ significantly from our understanding of conditions as presented in this report, we request that we be notified immediately to reassess the conclusions provided herein.

We trust this work will meet your present requirements. Please do not hesitate to contact the undersigned directly at (902) 468-7777 if you should have any questions or concerns.

Sincerely,

JACQUES WHITFORD STANTEC LIMITED

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Attachments

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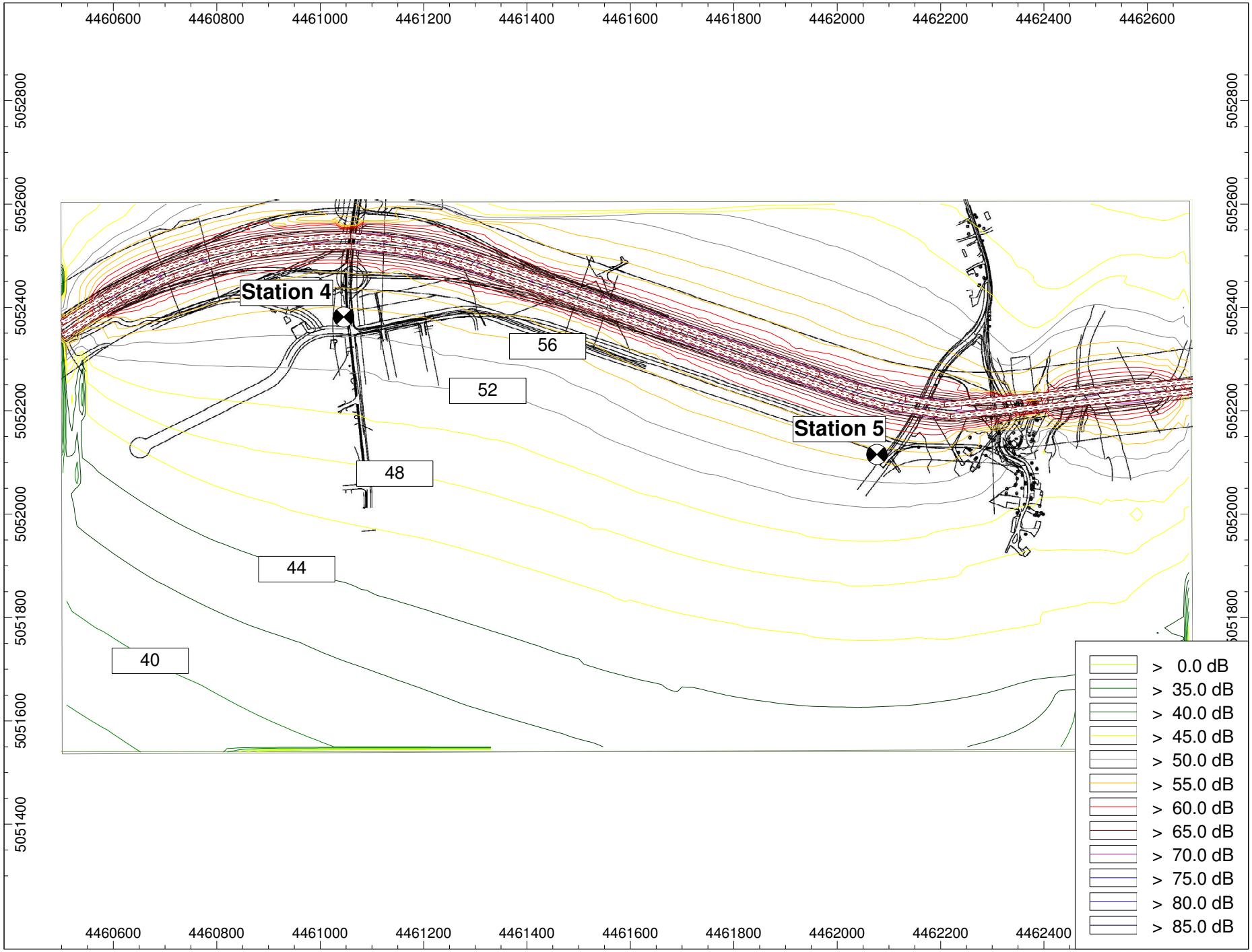

FIGURE 1 Predicted Daytime Noise Levels - Proposed Highway 104 Passing Over Trunk 7

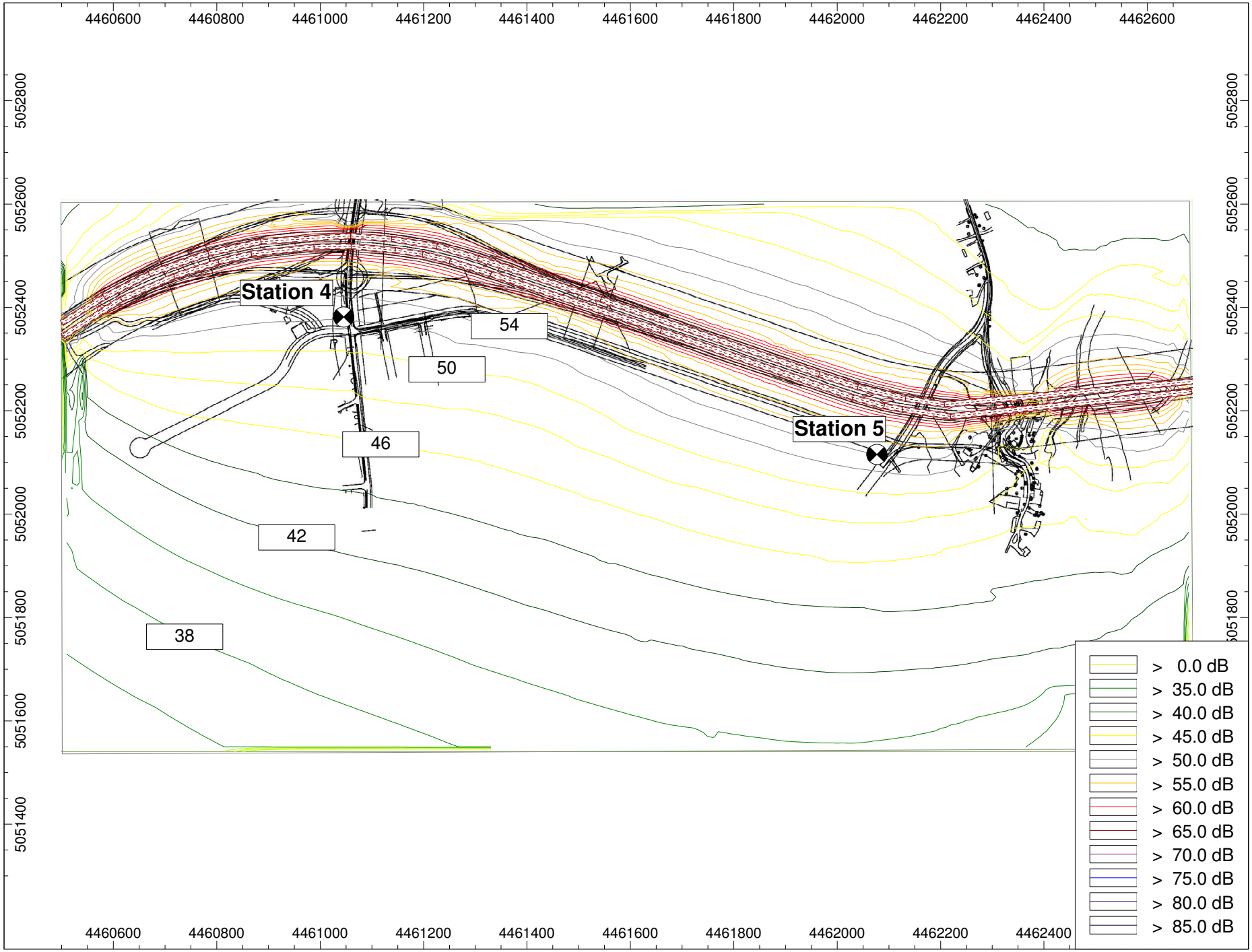

FIGURE 2 Predicted Nighttime Noise Levels - Proposed Highway 104 Passing Over Trunk 7

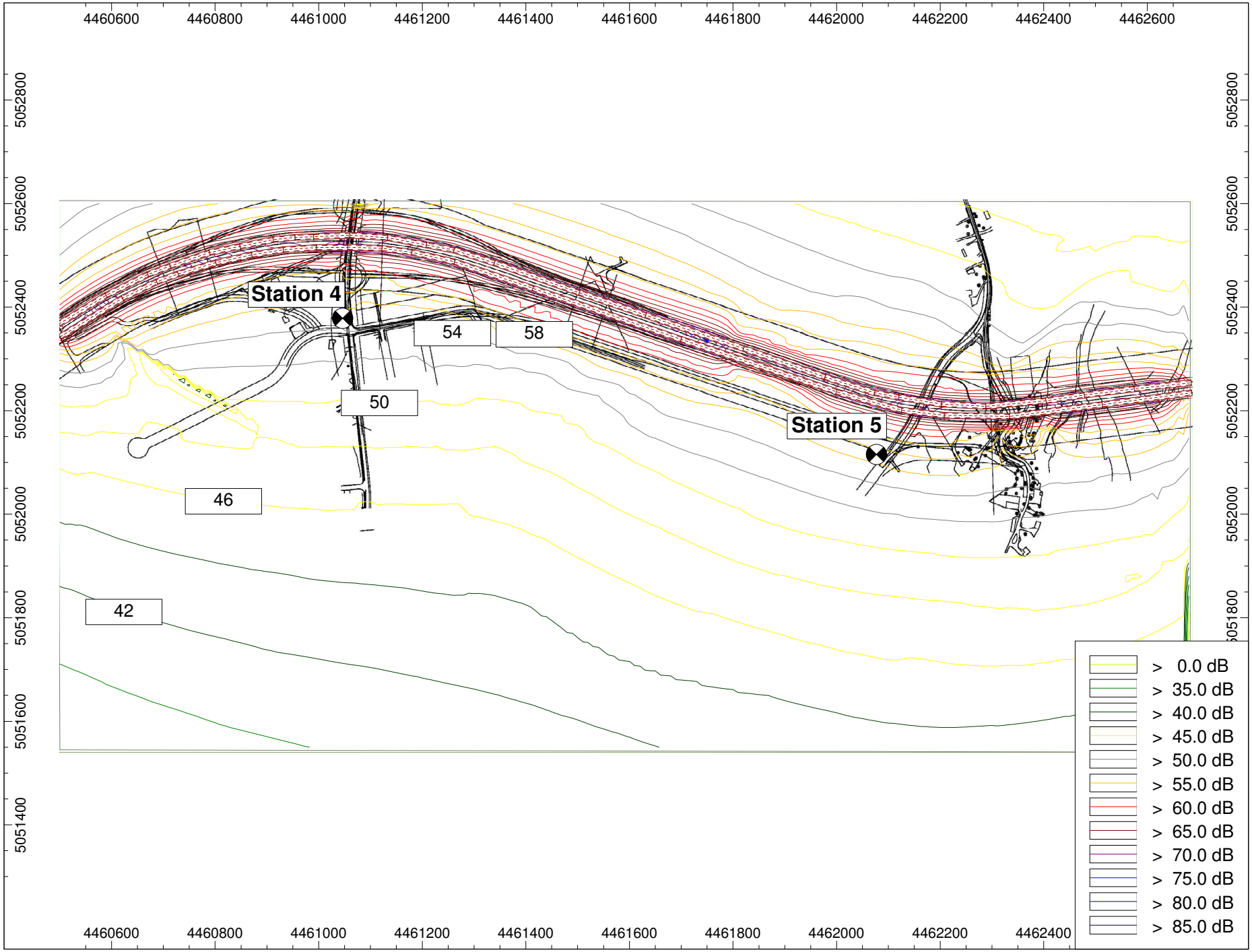

FIGURE 3 Predicted Daytime Noise Levels - Proposed Highway 104 Passing Under Trunk 7

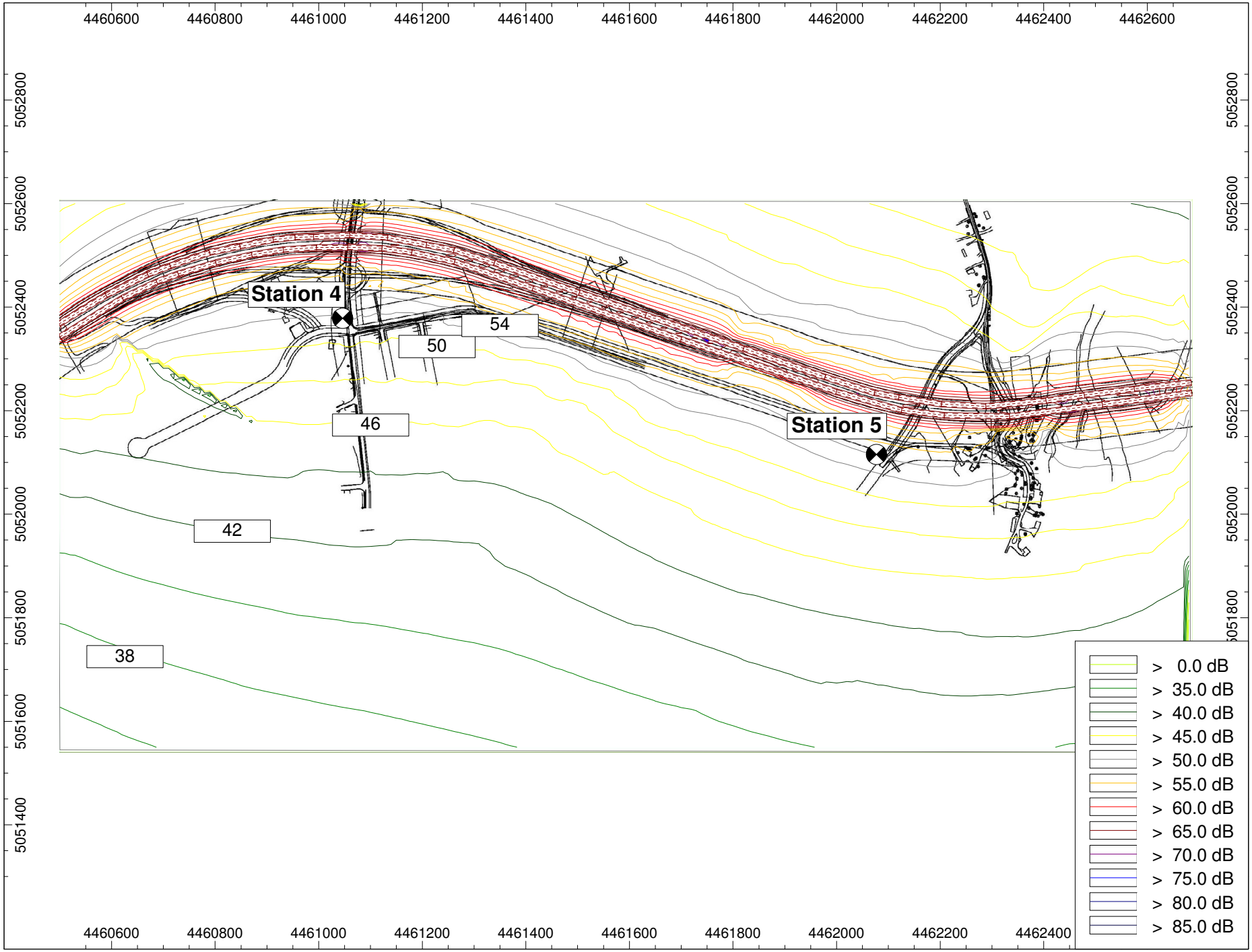

FIGURE 4 Predicted Nighttime Noise Levels - Proposed Highway 104 Passing Under Trunk 7

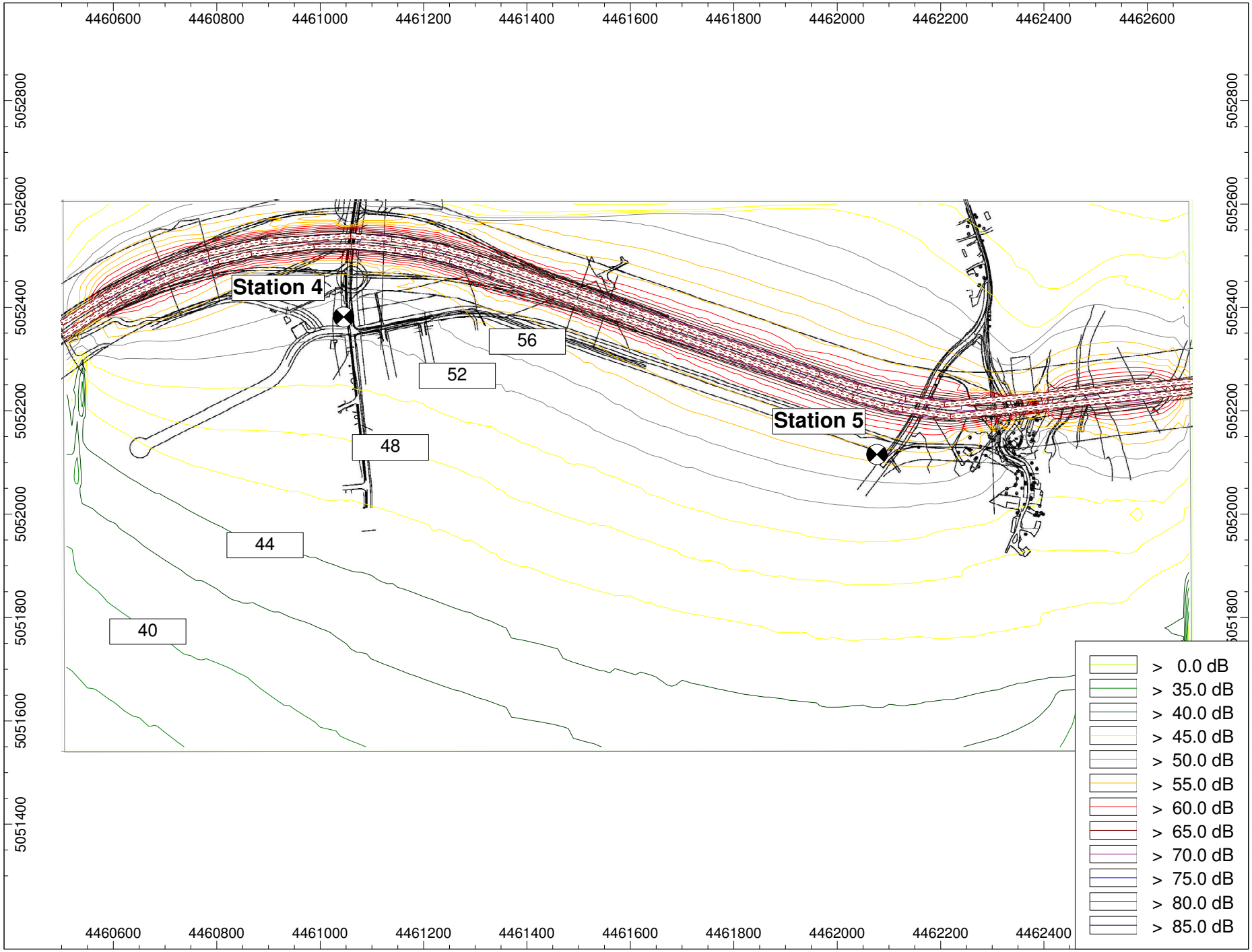

FIGURE 5 Predicted Daytime Noise Levels - Proposed Highway 104 Passing Over Trunk 7 With Mitigation

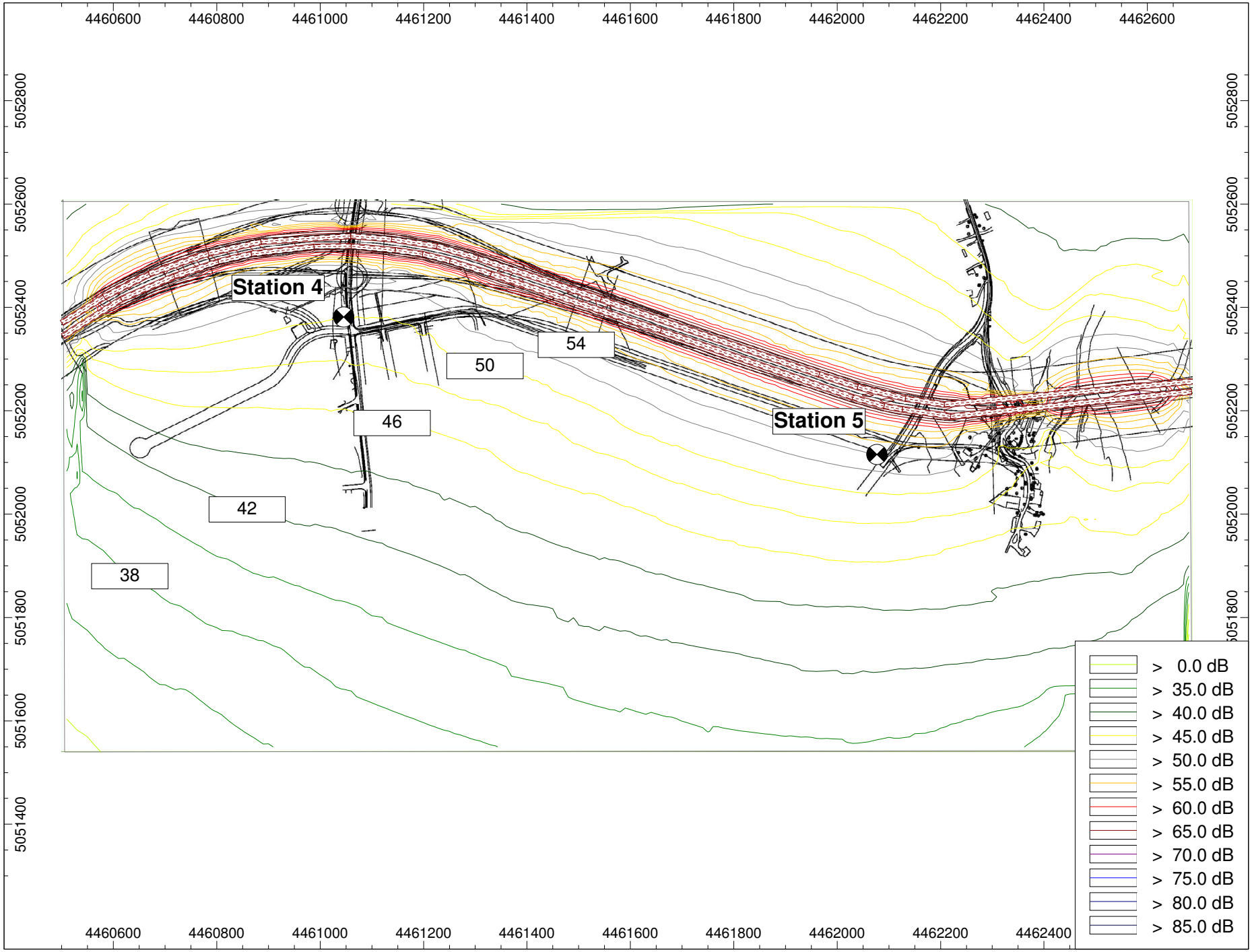

FIGURE 6 Predicted Nighttime Noise Levels - Proposed Highway 104 Passing Over Trunk 7 with Mitigation

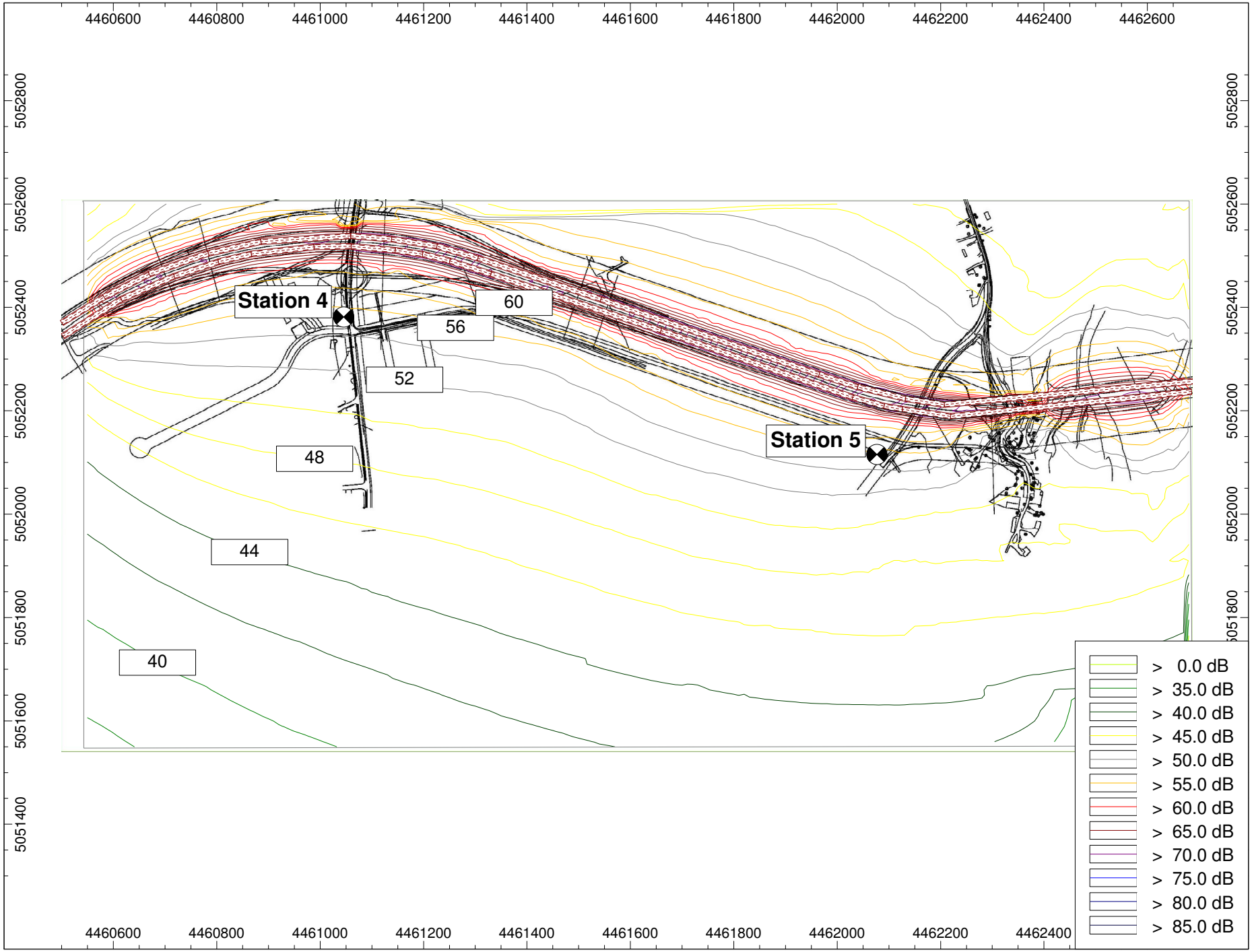

FIGURE 7 Predicted Daytime Noise Levels - Proposed Highway 104 Passing Over Kell Road with Mitigation

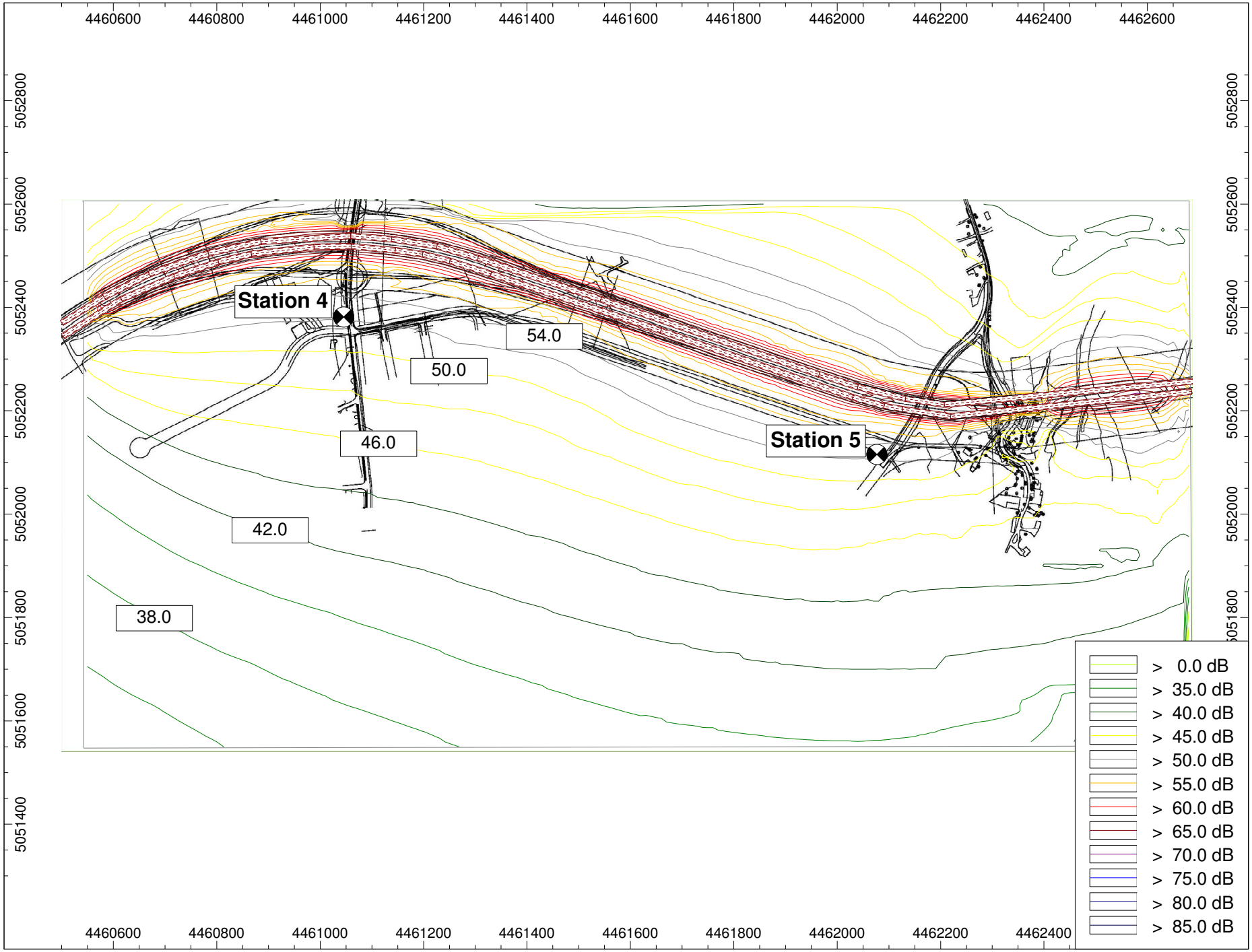

FIGURE 8 Predicted Nighttime Noise Levels - Proposed Highway 104 Passing Over Kell Road with Mitigation

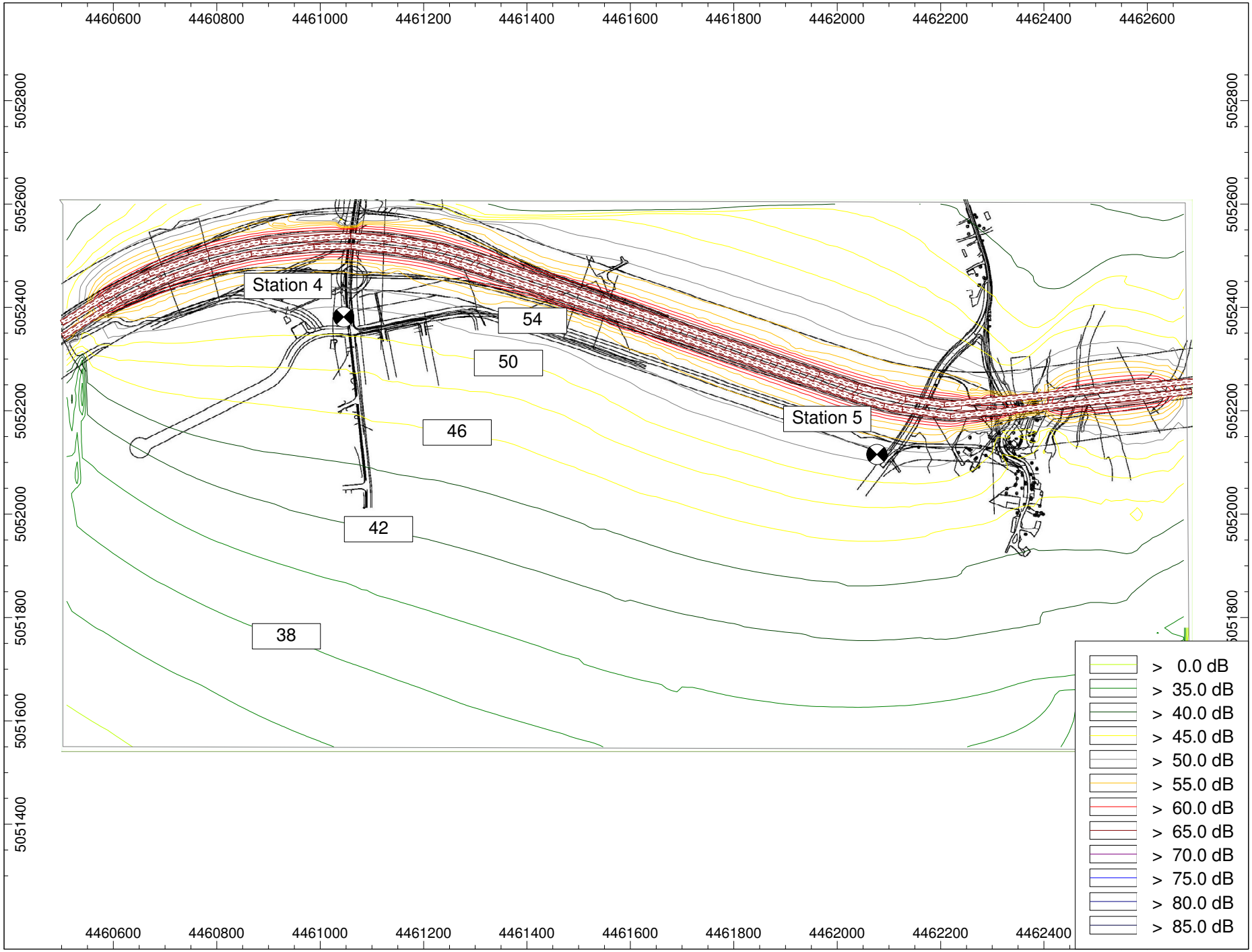

FIGURE 9 Predicted Daytime Noise Levels - Proposed Highway 104 Passing over Trunk 7 and Kill Road with Porous Asphalt.

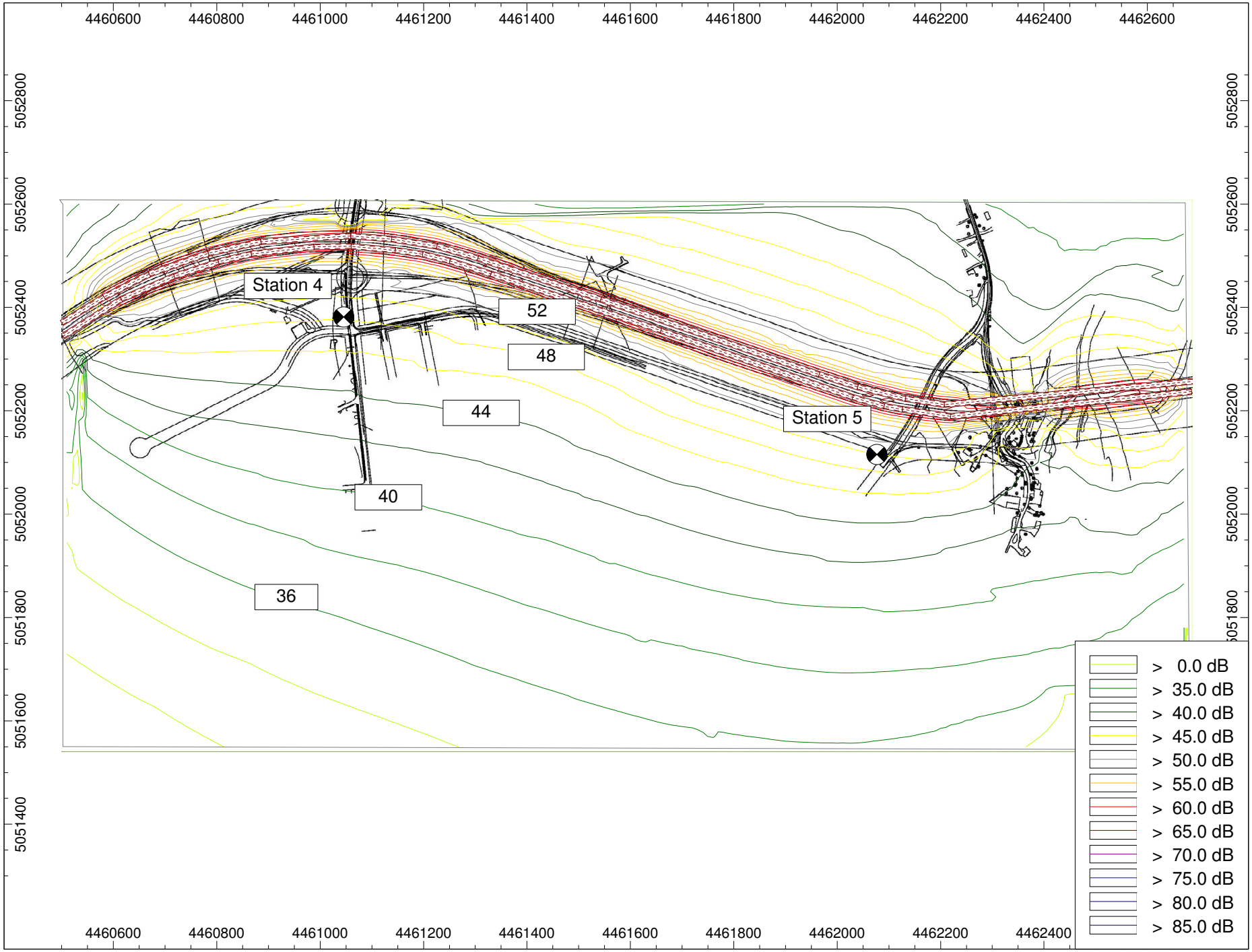

FIGURE 10 Predicted Nighttime Noise Levels - Proposed Highway 104 Passing Over Trunk 7 and Kill Road with Porous Asphalt.