

WINDY CORNER ENVIRONMENTAL ASSESSMENT

APPENDIX B

2019 TRAFFIC NOISE ANALYSIS

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SEWARD HIGHWAY MP 105 – MP 107 WINDY CORNER

TRAFFIC NOISE ANALYSIS

State Project No.: Z566310000
Federal Aid Project No.: 0A3134

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LIST OF ACRONYMS

| | | |
|--------|-------|--|
| AADT | | annual average daily traffic |
| ANSI | | American National Standards Institute |
| ARRC | ..... | Alaska Railroad Corporation |
| CE | ..... | Categorical Exclusion |
| CFR | ..... | Code of Federal Regulations |
| dB | ..... | decibel |
| dB(A) | ..... | A-weighted decibel |
| DHV | ..... | Design Hourly Volume |
| DNL | ..... | day-night average sound level |
| DOT&PF | ..... | State of Alaska Department of Transportation and Public Facilities |
| DXF | ..... | Drawing eXchange Format |
| FHWA | ..... | Federal Highway Administration |
| FONSI | ..... | Finding of No Significant Impact |
| HOT | ..... | high occupancy toll |
| HOV | ..... | high occupancy vehicle |
| Ldn | ..... | Day-Night Average Sound Level |
| LOS | ..... | level of service |
| MP | ..... | Milepost |
| mph | ..... | miles per hour |
| NAC | ..... | Noise Abatement Criteria |
| NEPA | ..... | National Environmental Policy Act |
| ROD | ..... | Record of Decision |
| ROW | ..... | right-of-way |
| TNM | ..... | Traffic Noise Model |
| vpd | ..... | vehicles per day |

DEFINITIONS

Date of Public Knowledge. The date of approval of the Categorical Exclusion (CE), the Finding of No Significant Impact (FONSI), or the Record of Decision (ROD), as defined in the United States Code of Federal Regulations (CFR), 23 CFR 771, or, in the case of a state-funded project, approval of the State Environmental Checklist.

Day-Night Average Sound Level (DNL, denoted by the symbol L_{dn}). The average noise level over a 24-hour period.

Design Year. The future year used to estimate the probable traffic volume for which a highway is designed.

Existing Noise Levels. The worst noise hour resulting from the combination of natural and mechanical sources and human activity usually present in a particular area.

Federal-aid Project. Any project utilizing federal funds for one or more phases (i.e., Environmental, Design, Right-of-Way (ROW), or Construction) or that otherwise is subject to federal approval.

L10. The sound level that is exceeded 10 percent of the time (the 90th percentile) for the period under consideration, with L10(h) being the hourly value of L10.

Leq. The equivalent steady-state sound level, which in a stated period of time contains the same acoustic energy as the time-varying sound level during the same time period, with Leq(h) being the hourly value of Leq.

Receiver. Receivers are discrete points within a noise model that represent noise-sensitive land uses. An individual receiver may represent multiple receptors.

Receptor. A discrete or representative location of a noise-sensitive area(s) for any of the land uses listed in Table 1 of 23 CFR 772.

Statement of Likelihood. A statement provided in the environmental clearance document, based on the feasibility and reasonableness analysis completed at the time the environmental document is being approved.

Substantial noise increase. One of two types of highway traffic noise impacts. For a Type I project, DOT&PF considers an increase in noise levels of 15 dB(A) in the design year over the existing noise level to be a substantial noise increase.

Traffic Noise Impacts. Design-year build-condition noise levels that approach or exceed the noise-abatement criteria (NAC) listed in Table 1 in 23 CFR 772 for the future build condition; or design-year build-condition noise levels that create a substantial noise increase over existing noise levels. The DOT&PF defines “approach” as 1 dB(A) below the Federal Highway Administration (FHWA) NAC and a “substantial” noise increase as a 15-dB(A) increase over existing noise levels.

Type I Project.

1. The construction of a highway on a new location; or,
2. The physical alteration of an existing highway where there is either:
 - a. Substantial Horizontal Alteration. A project that halves the distance between the traffic noise source and the closest receptor between the existing condition to the future build condition; or,
 - b. Substantial Vertical Alteration. A project that removes shielding, therefore, exposing the line-of-sight between the receptor and the traffic noise source. This is done by either altering the vertical alignment of the highway or by altering the topography between the highway traffic noise source and the receptor; or,
3. The addition of a through-traffic lane(s). This includes the addition of a through-traffic lane that functions as a High-Occupancy Vehicle (HOV) lane, High-Occupancy Toll (HOT) lane, bus lane, or truck climbing lane; or,
4. The addition of an auxiliary lane, except for when the auxiliary lane is a turn lane; or,
5. The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange; or,
6. Restriping existing pavement for the purpose of adding a through-traffic lane or an auxiliary lane; or,
7. The addition of a new or substantial alteration of a weigh station, rest stop, ride-share lot or toll plaza.
8. If a project is determined to be a Type I project per Section (§) 772.5, then the entire project area as defined in the environmental document is a Type I project.

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EXECUTIVE SUMMARY

The State of Alaska Department of Transportation and Public Facilities, in cooperation with the Federal Highway Administration, is proposing to improve Seward Highway from Milepost 105 to Milepost 107 (Figure 1). The purpose of this study is to identify traffic noise impacts to adjacent noise-sensitive receptors and examine potential abatement measures in conformance with the State of Alaska Department of Transportation and Public Facilities Noise Policy and Federal Highway Administration’s Noise Regulation.

The project would widen and reconstruct the existing two-lane highway to a four-lane divided facility with two 12-foot-wide travel lanes, two 12-foot-wide auxiliary lanes, 4-foot-wide inside shoulders, 8-foot-wide outside shoulders, and a depressed 24-foot-wide median on an offset alignment to the west. The adjacent Alaska Railroad would be relocated to accommodate the highway widening/relocation. The existing scenic pullout/parking areas (rest stop) would be reconstructed and expanded within areas created by the new road and rail alignments. Because the project includes new travel lanes (auxiliary lanes) and the expansion/reconstruction of a rest stop, it meets the definition of a Type 1 project under 23 CFR 772 and the Alaska DOT&PF Noise Policy (November 2018), and a highway traffic noise analysis is required.

The Federal Highway Administration Traffic Noise Model, version 2.5 was used to predict existing and future highway traffic noise. Federal Highway Administration requires noise from all major noise sources be considered when designing noise abatement, so that the reasonableness of providing noise abatement for identified impacts includes consideration of the ability to abate the noise from all sources. Because the project includes a rail line, the manual procedure outlined in the Federal Highway Administration document entitled: “Advanced Prediction and Abatement of Highway Traffic Noise, June 1982”, was used to predict generalized background noise and noise from railroad line operations. The methodology provides day-night noise levels (average noise levels over a 24-hour period expressed as Ldn) for these noise sources, whereas the Traffic Noise Model predicts average noise levels over a one-hour period expressed as Leq(h). Highway traffic noise levels were converted to day-night noise levels and noise levels from all sources were combined. Impacts were identified using Federal Highway Administration’s two impact criteria, assuming Ldn = Leq(h) per the advanced prediction methodology.

The project will not result in highway traffic noise impacts. The predicted noise levels would not approach or exceed the Federal Highway Administration Noise Abatement Criteria or substantially exceed existing highway traffic noise levels. Consideration of noise abatement measures is not necessary.

Project construction would intermittently generate high noise levels on, and adjacent to, the site, but they would be minimized with the implementation of best management practices. The following measures will be incorporated into the project plans and specifications to minimize construction-related noise impacts:

- All construction equipment shall be properly maintained and have mufflers in acceptable working condition;
- Stationary construction equipment shall be located as far from nearby noise-sensitive receivers as possible;
- Excessive engine idling time on mobile or stationary equipment shall be avoided;
- Construction operations shall be scheduled to avoid periods of noise annoyance;
- Haul routes shall be designated to reduce truck traffic noise impacts to noise-sensitive areas;
- Detoured traffic shall be rerouted during construction to cause the least practicable noise impact on noise-sensitive areas; and
- The construction contractor shall comply with any and all local noise ordinances and acquire any necessary noise permits prior to construction.



Figure 1: Project Location/Vicinity Map

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1.0 INTRODUCTION

The National Environmental Policy Act (NEPA) of 1969 requires federal agencies to evaluate and consider the environmental effects of their actions, including highway traffic and construction noise. The Federal Highway Administration (FHWA) has developed and implemented a regulation for the analysis and mitigation of highway traffic noise impacts in Federal-aid highway projects. This regulation is the United States Code of Federal Regulations (CFR), Title 23, Part 772 (23 CFR 772), “Procedures for Abatement of Highway Traffic Noise and Construction Noise.”

This regulation (23 CFR 772) applies to this project since:

- 1) the proposed project is being developed, in part, with a FHWA funds, and
- 2) the project is a Type I project as defined in the regulations and restated in the definitions section of this document.

Because the project includes new travel lanes (auxiliary lanes) and the expansion/reconstruction of a rest stop, it meets the definition of a Type I project under the FHWA traffic noise regulation.

The regulation (23 CFR 772), when applicable, requires highway agencies to complete a highway traffic noise analysis in which the agency would: (1) identify highway traffic noise impacts; (2) examine potential abatement measures; (3) incorporate reasonable and feasible highway traffic noise abatement measures into the highway project; (4) coordinate with local officials to provide helpful information on compatible land-use planning and control; and (5) identify and incorporate necessary measures to abate construction noise.

The FHWA regulation (23 CFR 772) includes Noise Abatement Criteria (NAC) to identify noise impact thresholds for various land-use activities. These Federal NAC are followed to determine whether noise impacts exist and whether abatement is feasible and reasonable. For Federal-aid projects, if noise abatement is considered feasible and reasonable, DOT&PF would construct the abatement measures as part of the project.

All state highway agencies must adopt written highway traffic noise policies, approved by FHWA, to implement FHWA’s highway traffic noise regulation (23 CFR 772) for federal-aid projects. The State of Alaska Department of Transportation and Public Facilities (DOT&PF) Noise Policy

(November 2018) is located in Appendix A. This Traffic Noise Analysis was conducted in accordance with this state noise policy.

1.1 Project Background

Originally completed in 1951, the Seward Highway extends from Seward, Alaska north approximately 127 miles to Anchorage, Alaska. The full length of the Seward Highway is listed on the National Highway System (NHS). The Alaska Railroad extends from Seward, Alaska north approximately 470 miles to Fairbanks, Alaska and parallels the highway through the project area. The project highway segment is surrounded by Chugach State Park, with steep mountain slopes to the east and the Alaska Railroad and Turnagain Arm (Cook Inlet/Gulf of Alaska) to the west.

The existing roadway consists of two 12-foot-wide travel lanes and 8-foot-wide paved shoulders (Figure 2). The posted speed limit is 55 miles per hour (mph). The existing (2016) Annual Average Daily Traffic (AADT) is 9,659 vehicles per day (vpd), and the future (2037) AADT is 12,747 vpd. Traffic demands vary significantly depending on the season of the year, with daily traffic volumes exceeding 22,000 vehicles during peak summer weekends in July.

The project lies within a segment of roadway with an elevated rate of fatal and major injury crashes. The purpose of the project is to improve traffic operations and implement safety upgrades.

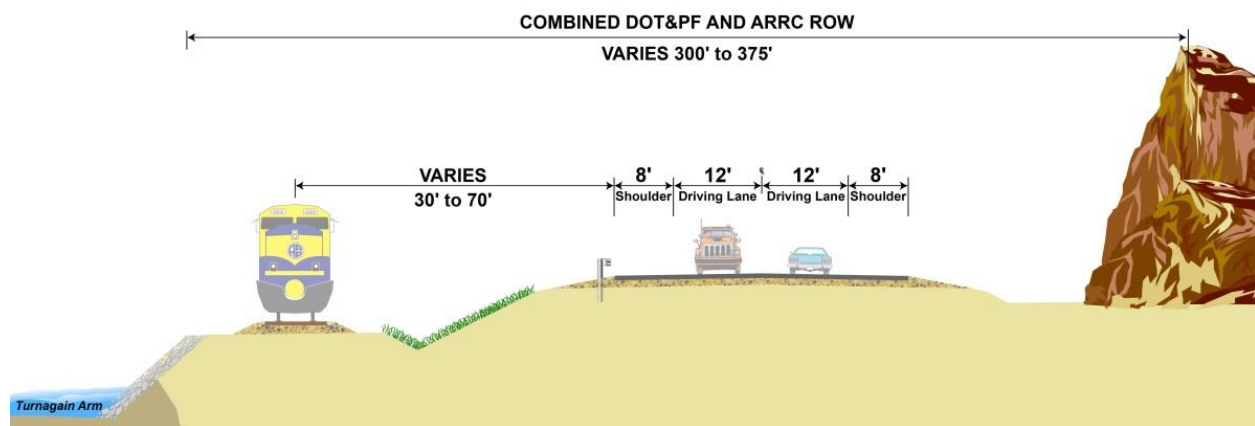


Figure 2: Existing Typical Section

1.1.1 Project Description

The project would widen and reconstruct a one and a half mile segment of the existing two-lane highway to a four-lane divided facility with two 12-foot-wide travel lanes, two 12-foot-wide

auxiliary lanes, 4-foot-wide inside shoulders, 8-foot-wide outside shoulders, and a depressed 24-foot-wide median on an offset alignment to the west (Figure 3). The adjacent Alaska Railroad would be relocated to accommodate the highway widening/relocation. The existing scenic pullout/parking areas (rest stop) would be reconstructed and expanded within areas created by the new road and rail alignments.

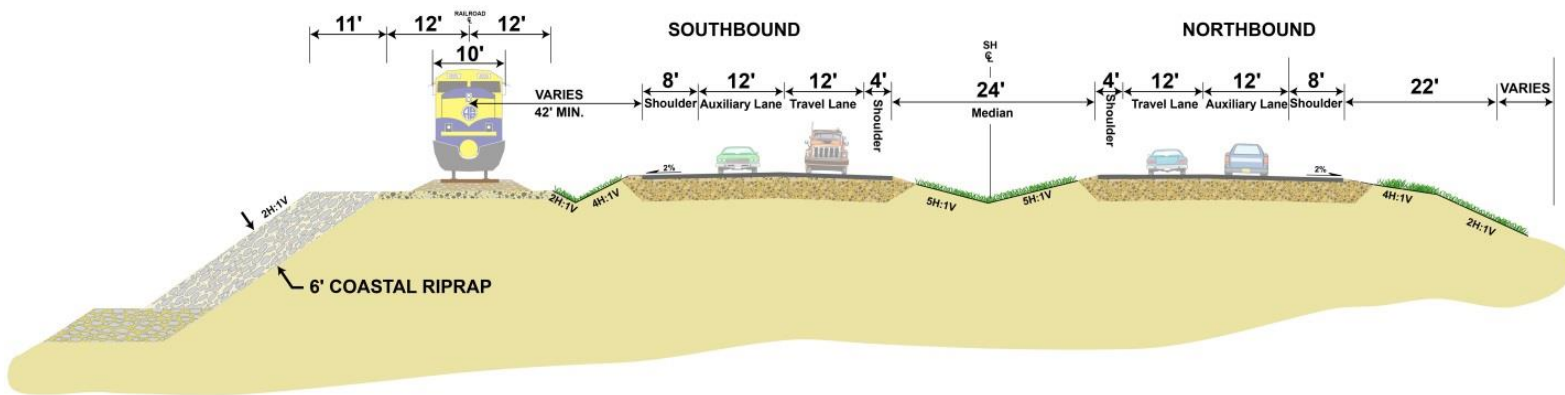


Figure 3: Proposed Typical Section

1.2 Purpose of Study

The purpose of this study is to identify traffic noise impacts to adjacent noise-sensitive receptors and examine potential abatement measures in conformance with the DOT&PF Noise Policy (November 2018) and FHWA’s Noise Regulation (23 CFR 772).

1.2.1 Study Area

The study area begins 1,000 feet south of the beginning of the project and extends north to 1,000 feet north of the end of the project, and 500 feet east and west of the proposed edge of pavement.

1.3 Terminology

1.3.1 Receiver

A noise modeling site that may represent one or more receptors.

1.3.2 Receptor

A discrete or representative location of a noise-sensitive area(s) for any of the land uses listed in Table 1 of 23 CFR 772.

2.0 NOISE-STUDY METHODOLOGY

This traffic noise study is performed in accordance with 23 CFR, Part 772, “Procedures for Abatement of Highway Traffic Noise and Construction Noise,” and the DOT&PF Noise Policy (November 2018).

2.1 Noise Metrics

The characteristics of sound include magnitude (loudness), frequency (pitch), and time (duration). Sound-pressure levels are used to measure the intensity (magnitude) of sound and are described in terms of decibels (dB). Sound is composed of various frequencies. Frequencies to which the human ear does not respond are filtered out when measuring highway traffic noise levels. Almost all environmental sound is measured in A-weighted decibels [dB(A) or dBA]. A-weighting is a summation of the sound levels across frequencies; this summation deemphasizes the levels at different frequencies and corresponds to the way people hear.

In addition to noise varying in frequency, noise intensity fluctuates with time. Total accumulation metrics are called equivalent levels and represent the sound levels for either a one-hour, symbolized as $Leq(h)$, or a 24-hour period, called the day-night average sound level (DNL). The hourly equivalent sound level, $Leq(h)$, is used as a descriptor of highway traffic noise.

Noise levels developed for this analysis are expressed in dB (decibels) using an “A”-scale weighting [dB(A)]. This scale most closely approximates the response characteristic of the human ear to typical traffic noise levels. All reported noise levels are hourly equivalent noise levels [$Leq(h)$]. The $Leq(h)$ is defined as the equivalent steady-state sound level that, in an hourly period, contains the same acoustic energy as the time-varying sound level for the same hourly period.

2.2 Criteria for Determining Noise Impacts

Highway traffic noise impacts occur when the predicted highway traffic noise levels approach or exceed the NAC, or when the predicted highway traffic noise levels substantially exceed the existing highway traffic noise levels, even though the predicted levels may not exceed the NAC. DOT&PF defines “approach” as 1 dB(A) below the FWHA NAC. As shown in Table 1, the NAC vary by Activity Category. DOT&PF defines a “substantial” increase as a 15 dB(A) increase over existing noise levels.

Table 1: Noise Abatement Criteria (NAC)

[Hourly A-Weighted Sound Level decibels (dB(A))¹]

| Activity Category | Activity Leq(h) | Criteria ² L10(h) | Evaluation Location | Activity Description |
|-------------------|-----------------|------------------------------|---------------------|---|
| A | 57 | 60 | Exterior | Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential, if the area is to continue to serve its intended purpose |
| B ³ | 67 | 70 | Exterior | Residential |
| C ³ | 67 | 70 | Exterior | Active sport areas, amphitheatres, auditoriums, campgrounds, cemeteries, daycare centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings |
| D | 52 | 55 | Interior | Auditoriums, daycare centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios |
| E ³ | 72 | 75 | Exterior | Hotels, motels, offices, restaurants/bars, and other developed lands, properties, or activities not included in A through D or F |
| F | - | - | - | Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing |
| G | - | - | - | Undeveloped lands that are not permitted |

¹Either Leq(h) or L10(h) (but not both) may be used on a project.

²The Leq(h) and L10(h) Activity Criteria values are for impact determination only and are not design standards for noise abatement measures.

³Includes undeveloped lands permitted for this activity category

Source: 23 CFR, Part 772, Procedures for Abatement of Highway Traffic Noise and Construction Noise, FHWA, 2010

2.3 Identification of Activity Categories and Applicable NAC of Adjacent Land Uses

All property adjacent to the proposed project consists of State of Alaska Chugach State Park land. The lands adjacent to the highway/rail corridor are designated as recreation development zones established to meet the more intensive recreational needs of the public by providing easy and well-defined access points into the park, and by developing appropriate facilities. The most intensive activities and developments are meant to occur in these zones, including developed parking facilities and trailheads, vehicle and tent camping, developed picnic and group areas, toilet facilities, visitor and interpretive centers, high-standard trails for all ages and abilities, and park management facilities.

Exterior areas of frequent human activity located within the study area consist of the Falls Creek Trail, the Turnagain Arm Trail Site #1 (Windy Corner Trailhead), a rock climbing area known as Goats Head Soup, and the Turnagain Arm Trail Site #2. The applicable NAC for these sites is Activity Category C. Locations within the study area with no exterior areas of frequent human activity fall under the Activity Category G classification. Information on noise compatible planning and the best estimation of future design year noise levels are provided in Section 6.0 for these lands.

2.4 Traffic Characteristics

The level of highway traffic noise is dependent on three factors: (1) the volume of traffic, (2) the speed of the traffic, and (3) the number of trucks in the flow of traffic. Generally, the levels of traffic noise are increased by heavier traffic volumes, higher speeds, and greater numbers of trucks. Noise level predictions are based on worst-case hour noise conditions. Generally, worst-case hour noise conditions occur when traffic volumes are at Level of Service (LOS) C or D, rather than heavier traffic volumes. In heavily congested urban areas, the peak traffic period (often LOS E or F) may not represent the worst-case noise conditions, as vehicle speeds are reduced. Seasonal traffic variations are also taken into consideration when determining the worst-case hour noise condition.

AADT volumes, design hourly volume (DHV), directional distribution and percent trucks were derived from the Seward Highway MP 105 to MP 107 (Windy Corner) design designations. The project corridor is subject to high seasonal variation in both traffic volumes and vehicle type. Therefore, an analysis was conducted to determine whether the DHV coincides with the worst-case noise hour (See Appendix B). The analysis revealed that the DHV does represent the worst-case noise hour for the project corridor. The volumes were then calculated to represent the worst-case traffic noise hour for the construction year 2016 (hereinafter referred to as the “existing year”) and the future 2037 (hereinafter referred to as the “design year”), for the purposes of this study.

Generally, for predicting noise levels, the future posted speed is used. The existing posted speed for this segment of Seward Highway is 55 mph and there are currently no plans to change the posted speed in the future. Therefore, the proposed future posted speed is 55 mph. FHWA’s *Highway Traffic Noise: Analysis and Abatement Guidance* (FHWA 2011) states that “Highway agencies should use the operating speed if it is determined to be consistently higher than the posted speed limit.” A speed study was conducted for the project corridor in the summer of 2016. The average operating speed was determined to be 59 mph. Therefore, existing and future noise levels have been predicted using the average operating speed of 59 mph. The speed study is provided in Appendix B.

Tables 2 and 3 provide the traffic data used to predict worst-case existing and future noise conditions for the build and no-build alternatives.

Table 2: Existing (2016) Worst-Case Traffic Data

| Street Name | Hourly Traffic Volume (DHV) (Two-Way Total) | Directional Split | Speed (mph) | Vehicle Type (Percentages) | | | |
|---------------------------------|---|-------------------|-------------|----------------------------|--------------|-------|-------------|
| | | | | Medium Trucks | Heavy Trucks | Buses | Motorcycles |
| Seward Highway MP 105 to MP 107 | 9,659* | 50/50 | 59 | 4.64% | 2.90% | 0.38% | 0.43% |

Table 3: Future (2037) Worst-Case Traffic Data

| Street Name | Hourly Traffic Volume (DHV) (Two-Way Total) | Directional Split | Speed (mph) | Vehicle Type (Percentages) | | | |
|---------------------------------|---|-------------------|-------------|----------------------------|--------------|-------|-------------|
| | | | | Medium Trucks | Heavy Trucks | Buses | Motorcycles |
| Seward Highway MP 105 to MP 107 | 12,747* | 50/50 | 59 | 4.64% | 2.90% | 0.38% | 0.43% |

* Note: While the existing and future years have been updated from 2016 and 2037 to 2020 and 2041 the DHV traffic volumes utilized in the analysis are still representative of existing and future conditions and do not change the results of this analysis. The DHVs for a 2020 existing year and 2041 future year would be 10,183 and 13,439 based on the projected annual traffic increase of 1.33%. This amounts to a 5.43% increase in DHV from 2016 and 2037. A doubling (or 100% increase) of traffic is needed to increase the traffic sound levels by 3 decibels. A 5.43% increase in traffic volume is considered negligible in terms of increasing the traffic noise prediction levels. This minute change in traffic volume would not be enough to change the predicted noise levels presented in this report by even one decibel.

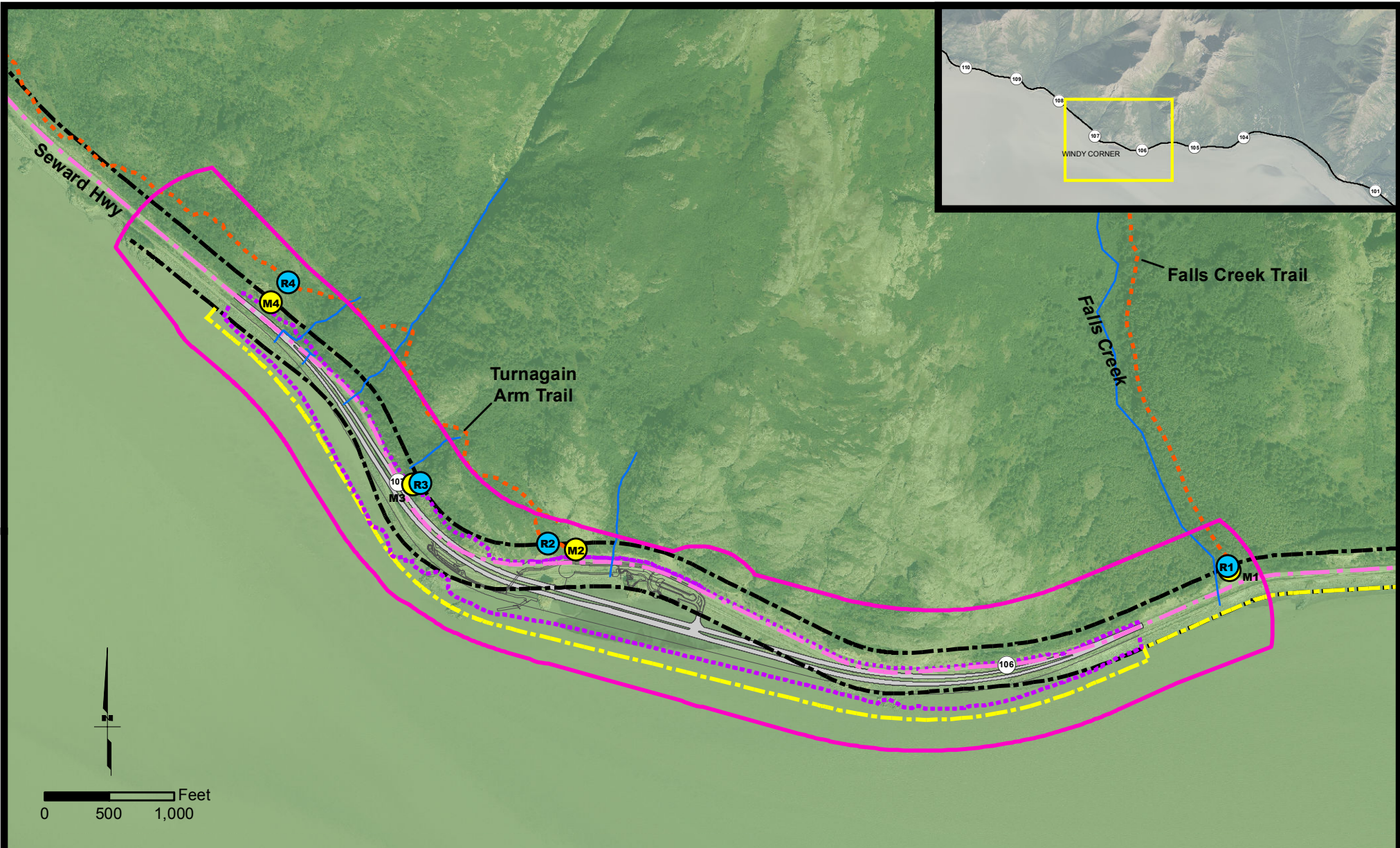
2.5 Traffic Noise Model

Predicted noise levels are produced using the FHWA Traffic Noise Model (TNM), version 2.5. The model computes a predicted noise level through a series of adjustments to a reference sound level. In the TNM, the reference level is the Vehicle Noise Emission Level, which refers to the maximum sound level emitted by a vehicle pass-by at a reference distance of 50 feet. Adjustments are made to the emission level to account for traffic flow, distance, and shielding.

2.5.1 Model Validation

23 CFR 772 requires validation of the noise model to verify the accuracy of noise model runs to predict existing noise levels for the project. The model is validated if existing highway traffic sound levels and predicted highway traffic sound levels for the existing condition are within plus or minus (+/-) 3 dB(A).

Validation of the model requires a series of noise measurements along a project, along with simultaneous traffic counts and vehicle speeds. Measurement sites were located at representative locations throughout the project corridor. Each measurement location is identified by the predecessor capital letter M. The measurement locations are shown on Figure 4.



- Proposed ROW
- Existing ROW
- Existing Centerline
- Proposed Roadway Improvements
- Waterways
- Trails
- Daylight Limits
- Measurement Location
- Receiver Location
- # Milepost
- Study Area
- Chugach State Park

**Seward Highway 105-107
Measurement/Modeling Locations**

S2-3 T10N R2W
Seward Meridian, Alaska



STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
AND PUBLIC FACILITIES

Project No. (State/Federal): Z566310000/OA3134
SEWARD HIGHWAY
MILEPOST 105-107

Anchorage, Alaska

| | |
|-------------------|----------|
| December 19, 2016 | FIGURE 4 |
|-------------------|----------|

All noise measurements were taken with an American National Standards Institute (ANSI) Type I integrating sound level meter and are A-weighted. Two 15-minute measurements were taken at each location. Any noise sources other than highway sources were noted, as well as any extenuating circumstances that may alter noise levels, e.g., construction. The location, date, time, weather, a description of groundcover, traffic conditions, and equipment used were recorded and are provided in the Noise Data Collection Worksheets in Appendix C. Measurements were performed in accordance with *Measurement of Highway-Related Noise*, FHWA-PD-96-046 (Lee & Fleming, 1996). Ambient noise levels in the project area range from 60.0 to 65.6 dB(A).

Roadways and terrain lines were imported into TNM using Drawing eXchange Format (DXF) files and appropriately assigned in the model for existing conditions. Traffic was modeled in the centerline of each one-directional roadway using the default pavement type. The pavement widths varied depending on the corridor sections of the modeled roadway including the presence of auxiliary lanes. The default ground type was set to loose soil. Additional ground types such as pavement, water, hard soil and field grass were used to define ground zones within the model.

The actual traffic counts, vehicle types, and speeds collected during the measurements were used as input to TNM and noise levels were predicted at each of the measurement locations. Table 4 provides a comparison of the measured and predicted results.

Table 4: Comparison of Measured and Predicted Traffic Noise Levels

| Measurement Location | Activity Category | Location Description | Measured Leq (dB(A)) ¹ | Predicted Leq (dB(A)) | Difference Leq (dB(A)) |
|----------------------|-------------------|---------------------------------|-----------------------------------|-----------------------|------------------------|
| M1 | C | Falls Creek Trail | 61.6 | 60.7 | -0.9 |
| M2 | C | Turnagain Arm Trail Site #1 | 65.6 | 63.0 | -2.6 |
| M3 | C | Rock Climbing – Goats Head Soup | 63.9 | 62.4 | -1.5 |
| M4 | C | Turnagain Arm Trail Site #2 | 60.0 | 60.4 | 0.4 |

¹Average of two measurements

Noise levels predicted by TNM were within three dB(A) of the measurements taken. Therefore, the noise model is considered valid and can be used to predict existing and future highway traffic noise levels. TNM outputs for the model validation are provided in Appendix C.

2.6 Non-Highway Noise Sources

Highway traffic noise analyses include noise from all sources. The reasonableness of providing highway traffic noise abatement for identified impacts includes consideration of the ability to abate the noise from all sources, not just highway traffic noise.

The proposed project includes a rail line belonging to the Alaska Railroad Corporation (ARRC). The *FHWA Highway Traffic Noise: Analysis and Abatement Guidance* (FHWA 2011) states that if a highway project includes a rail line, calculate the rail noise levels using the procedure

outlined in the FHWA document entitled: “*Advanced Prediction and Abatement of Highway Traffic Noise, June 1982*” (Appendix B).

The project also includes the reconstruction/expansion of existing scenic pullout/parking areas. The proposed pullout/parking improvements would not move traffic closer to sensitive receivers. The improvements would be constructed west of the centerline of the existing roadway, further from noise sensitive receivers and do not have the potential to cause impact given the likely dominance of noise from adjacent noise generators.

2.7 Prediction of Existing and Future Noise Levels

Existing and future noise levels were predicted using FHWA’s *Advanced Prediction and Abatement of Highway Traffic Noise, June 1982* manual calculations and the FHWA TNM. An excel spreadsheet was created to provide the calculations. The spreadsheets are provided in Appendix D.

FHWA guidance requires noise be predicted as day-night sound levels (DNL), reported as Ldn, which represents noise levels over a 24-hour period. Noise from traffic operations is predicted using the FHWA Traffic Noise Model, which results in noise levels averaged over one hour, reported as Leq. Noise from traffic operations is then converted to day-night sound levels per the FHWA policy and the rail noise and highway traffic noise are then added together for each receiver.

2.7.1 Community Noise Prediction (Background Noise Prediction)

The *Advanced Prediction and Abatement of Highway Traffic Noise, June 1982* assumes community noise is approximately proportional to 10 times the logarithm of the population density in an urbanized area, based on the population density of the census tract in people per square mile. The project is located in Anchorage Municipality Census Tract 29 containing 542 square miles (2010 US Census). The total population of Census Tract 29 in 2010 was 2,570. This results in a population density of five people per square mile. This figure was input into the spreadsheet and the day-night sound level for background noise was determined.

2.7.2 Rail Noise Prediction

Information regarding the number of diesel locomotives/rail cars, daytime and nighttime operations, and average vehicle speed, etc. was obtained from the Alaska Railroad (Appendix B). The data was analyzed and reasonable assumptions were made regarding the likelihood that a certain combination of events would take place in a given day (24-hour period). The following data was input into the spreadsheet and the day-night sound level for railroad operations was determined:

- Population density per square mile (Input Min. 1): 5;

- Type of track: Welded rails;
- No horn or whistle used;
- Two locomotives for freight trains and two locomotives for passenger trains;
- Seventy-five rail cars for freight trains and nine for passenger trains;
- Train speed: Average travel speed of 40 mph for ARRC trains;
- Average number of events per day: Three events per day for freight and seven events per day for passenger;
- Daytime and nighttime events: All passenger events will occur during the day and half of all freight events will occur at night; and
- Distance from source to receiver: value will be modified based on distance between receiver and railway centerline.

2.7.3 Traffic Noise Prediction

The FHWA TNM was used to predict existing and future build and no-build highway traffic noise levels. Roadways and terrain lines were imported into TNM using Drawing eXchange Format (DXF) files and appropriately assigned in the model for existing and future conditions. Traffic was modeled in the centerline of each one-directional roadway using the default pavement type. The pavement widths varied depending on the corridor sections of the modeled roadway including the presence of auxiliary lanes. The default ground type was set to loose soil. Additional ground types such as pavement, water, hard soil and field grass were used to define ground zones within the model.

Receiver points were placed at or near the right-of-way (ROW) line at exterior areas of frequent human activity. The receiver locations are represented by the predecessor capital letter R and are shown on Figure 4 at the end of this report. The hourly equivalent sound level, $Leq(h)$ was predicted at each receiver location and input into the spreadsheet. The TNM Outputs are provided in Appendix D.

2.7.4 Summation of Sources

In order to combine the day-night sound levels for generalized background noise and railroad line operations with the noise from highway operations, the day-night sound levels from highway operations were computed. The total day-night sound level from highway operations was combined with the day-night sound levels from generalized background noise and railroad line operations to determine noise exposure from all sources at each receiver location (Appendix D).

The predicted noise levels are provided in Table 5, along with a comparison of predicted noise levels for the no-build and build alternatives with the highway traffic noise abatement criteria and existing noise levels. This comparison identifies any highway traffic noise impacts associated with each alternative in terms of a substantial increase in noise levels or approach or exceeding of the NAC.

Table 5: Identification of Highway Traffic Noise Impacts

| Receiver ID | Location | Land Use | No. of Receptors | Activity Category | Modified NAC* (dB(A)) | Ldn Values | | | | | |
|-------------|-----------------------------|--------------------|------------------|-------------------|-----------------------|--|----------------------------------|-----------------------------|-------------------------------|-----------------------------|-----------------------------|
| | | | | | | Predicted Existing Noise Level (dB(A)) | Design Year No-Build Alternative | | Design Year Build Alternative | | |
| | | | | | | | Predicted Noise Level (dB(A)) | Incr. Over Existing (dB(A)) | Predicted Noise Level (dB(A)) | Incr. Over Existing (dB(A)) | Incr. Over No-Build (dB(A)) |
| R1 | Falls Creek Trail | Chugach State Park | 1 | C | 66 | 64 | 65 | 1 | 65 | 1 | 0 |
| R2 | Turnagain Arm Trail | Chugach State Park | 1 | C | 66 | 63 | 63 | 0 | 61 | -2 | -2 |
| R3 | MP 107 Rock Climbing Area | Chugach State Park | 1 | C | 66 | 65 | 66 | 1 | 65 | 0 | -1 |
| R4 | Turnagain Arm Trail Site #2 | Chugach State Park | 1 | C | 66 | 57 | 57 | 0 | 57 | 0 | 0 |

*Specific noise-abatement criteria for each activity category has been modified by the DOT&PF approach definition (i.e., For Activity Category C, the modified NAC would be 66 dB(A)).

2.8 Impact Determination

As noted previously, a location is impacted if: 1) the predicted worst-case hour noise level approaches or exceeds the NAC; or 2) there is a substantial increase in design year noise levels above existing noise levels. Per the FHWA manual methodology used for this project, $L_{dn} = L_{eq}$ for the purposes of determining noise impacts.

The predicted impacts at each modeled receiver are summarized in Table 5. No impacts would occur at any of the receiver locations.

2.9 Identification and Consideration of Highway Traffic Noise Abatement

The project will not result in highway traffic noise impacts. Consideration and evaluation of abatement measures is not necessary. Applicable sections of the feasibility and reasonableness worksheets were completed and are provided in Appendix E

FHWA and DOT&PF are not responsible for providing highway traffic noise abatement for new development that occurs adjacent to the proposed highway, after the “date of public knowledge” for a proposed highway project. The “date of public knowledge” is the date of approval of the CE, the Finding of No Significant Impact (FONSI), or the Record of Decision (ROD), as defined in 23 CFR 771, or, in the case of a state-funded project, approval of the State Environmental Checklist. However, in an effort to prevent future traffic noise impacts on currently undeveloped lands, DOT&PF will provide local officials with the best estimation of future noise levels for properties in the immediate vicinity of the project.

2.9.1 Statement of Likelihood

No feasibility and reasonableness analysis was conducted as a part of the environmental document for this project because the project will not result in noise impacts. No noise abatement is recommended for this project.

3.0 CONSTRUCTION NOISE

Noise impacts from construction activities are a function of the noise generated by individual construction equipment items, the location of the equipment, and the timing and duration of the noise-generating activities. The number, type, distribution and usage of construction equipment will differ depending on the activity being conducted. The equipment to be used is not generally operated continuously, nor is the equipment necessarily operated simultaneously. Therefore, noise levels from construction activities are difficult to predict.

FHWA recently conducted extensive measurements of equipment and operation noise levels taken in conjunction with larger projects in the lower 48. Actual measured equipment noise emissions from some typical construction equipment/activities are provided in Table 6.

Table 6: Construction Equipment Noise Emission Levels

| Equipment Description | Actual Measured Lmax @ 50 feet (dBA, slow) |
|-----------------------|--|
| Backhoe | 78 |
| Blasting* | 94 |
| Dozer | 82 |
| Dump Truck | 76 |
| Excavator | 81 |
| Impact Pile Driver* | 101 |
| Jackhammer | 89 |
| Rock Drill | 81 |
| Pneumatic Tools | 85 |

*Indicates equipment is an impact device generating noise of short duration, high intensity, abrupt onset and rapid decay.

Construction activities may also result in ground vibration. This is particularly true when blasting operations occur. There are no FHWA requirements directed specifically to traffic-induced or construction-related vibration.

The following measures shall be incorporated into the project plans and specifications to minimize construction-related noise impacts:

- All construction equipment shall be properly maintained and have mufflers in acceptable working condition;
- Stationary construction equipment shall be located as far from nearby noise-sensitive receivers as possible;
- Excessive engine idling time on mobile or stationary equipment shall be avoided;
- Construction operations shall be scheduled to avoid periods of noise annoyance;
- Haul routes shall be designated, to reduce truck traffic noise impacts to noise-sensitive areas;
- Detoured traffic shall be rerouted during construction so as to cause the least practicable noise impact on noise-sensitive areas; and
- The construction contractor shall comply with any and all local noise ordinances and acquire any necessary noise permits prior to construction.

4.0 CONCLUSION

The project will not result in highway traffic noise impacts. Predicted noise levels do not approach or exceed the FHWA NAC or substantially exceed existing highway traffic noise levels. Consideration of noise abatement measures is not necessary.

Project construction would intermittently generate high noise levels on, and adjacent to, the site, but they would be minimized with the implementation of best management practices.

5.0 INFORMATION FOR LOCAL OFFICIALS AND DATE OF PUBLIC KNOWLEDGE

Local governments are encouraged to practice noise-compatible land planning and control near highways. Highway agencies need to inform local officials as to what highway traffic noise levels to expect from a highway, to minimize future traffic noise impacts on currently undeveloped lands.

All land immediately adjacent to the proposed project is State of Alaska Chugach State Park land. In the case that Chugach State Park should develop these lands, design-year sound levels for areas along the proposed project corridor are provided in Table 7. Because of the uneven topography, sound levels were predicted every half mile at distances between 0 and 300 feet from the ROW. As indicated, sound levels near MP 105.5 to MP 106, within an approximate range of 50 feet to 100 feet from the ROW, and sound levels near MP 107 to MP 107.5, within an approximate range of 50 feet from the ROW, approach or exceed the NAC of 66 dB(A) for Category C land uses. Noise-sensitive land uses should generally not be constructed in these areas, unless noise mitigation measures are provided.

Table 7: Design Year 2037 Sound Level for Undeveloped Land

| Distance from ROW ⁽¹⁾ | Ldn(dB(A)) ⁽²⁾ | | | | |
|----------------------------------|---------------------------|--------|----------|--------|----------|
| | MP 105.5 | MP 106 | MP 106.5 | MP 107 | MP 107.5 |
| 0 feet | 67 | 64 | 60 | 63 | 65 |
| 50 feet | 65 | 63 | 59 | 62 | 63 |
| 100 feet | 61 | 62 | 59 | 61 | 61 |
| 150 feet | 58 | 61 | 59 | 61 | 59 |
| 200 feet | 56 | 58 | 61 | 62 | 61 |
| 250 feet | 55 | 54 | 58 | 59 | 59 |
| 300 feet | 55 | 53 | 57 | 58 | 58 |

⁽¹⁾ Perpendicular distance to the edge of ROW

⁽²⁾ Mile Post locations are approximate, sound levels predicted on mountain side of road only

The values in Table 7 do not represent the predicted sound levels at all additional locations adjacent to and particular with the proposed project corridor. Sound levels may vary with changes in terrain and will be affected by shielding of objects such as buildings. This information is being included to make local officials and planners aware of anticipated highway sound levels so that future development will be compatible with these levels.

APPENDIX A

DOT&PF Noise Policy (November 2018)

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THE STATE
of **ALASKA**
GOVERNOR BILL WALKER

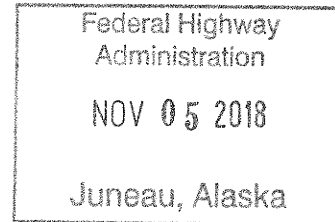
**Department of Transportation and
Public Facilities**

Statewide Design & Engineering Services
Environmental Section

3132 Channel Drive
Juneau, Alaska 99811-2500
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November 1, 2018

Sandra Garcia-Aline
P.O. Box 21648
Juneau, AK 99802-1648



Reference: DOT&PF Noise Policy

Dear Mrs. Garcia-Aline,

The Alaska Department of Transportation and Public Facilities (DOT&PF) hereby submits a copy of the DOT&PF Noise Policy dated October 2018 for review and approval by the Federal Highway Administration Alaska Division. We would like to thank your staff and Aileen Varela-Margolles of your Washington D.C. office for your review and comments on previous drafts. This policy is an update of DOT&PFs April 2011 policy and in response to changes in 23CFR 772. It is our intent that this Noise Policy will go into effect upon your approval.

Your approval of the attached noise policy is hereby requested. If you have any questions or wish to discuss further do not hesitate to contact Douglas Kolwaite of my office.

Approved: _____

Sandra Garcia-Aline
(Sandra Garcia-Aline, Division Administrator, FHWA Alaska Division)

Sincerely,

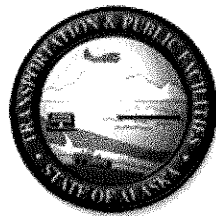
Kenneth J. Fisher
Kenneth J. Fisher, P.E.
Chief Engineer

Enclosure: DOT&PF Noise Policy (October 2018)

Alaska Department of Transportation & Public Facilities

Noise Policy

November 2018



ACRONYMS USED IN THIS DOCUMENT

ADT: Average Daily Traffic

ANSI: American National Standards Institute

BR: Benefitted Receptor

CE: Categorical Exclusion (as defined in 23 CFR Part 771)

CEI: Cost Effectiveness Index

CFR: Code of Federal Regulations

CPI: Consumer Price Index

dB: Decibel

dBA: Decibel when referring to an A-weighted sound level

DHV: Design Hourly Volume (for traffic)

DOT&PF: Alaska Department of Transportation and Public Facilities

EA: Environmental Assessment (as defined in 23 CFR 771)

EIS: Environmental Impact Statement (as defined in 23 CFR 771)

FHWA: Federal Highway Administration

FHWA TNM: Federal Highway Administration Traffic Noise Model

FONSI: Finding of No Significant Impact (as defined in 23 CFR 771)

LOS: Level of Service

L_{eq} : Equivalent sound level in dBA

$L_{eq}(h)$: One-hour equivalent sound level in dBA

NAC: Noise Abatement Criterion

NEPA: National Environmental Policy Act

NSA: Noise Study Areas

RCNM: Road Construction Noise Model

REM: Regional Environmental Manager

ROD: Record of Decision (as defined in 23 CFR 771)

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1.0 INTRODUCTION

This document contains the Alaska Department of Transportation and Public Facilities (DOT&PF) policy on highway traffic noise and construction noise as it affects the human environment. The policy describes DOT&PF's implementation of the requirements of the Federal Highway Administration (FHWA) Noise Standard at Title 23 Code of Federal Regulations (CFR) Part 772 (see Appendix A.) The policy also addresses how traffic noise is considered on state funded projects. DOT&PF developed this policy which was then, reviewed and approved by FHWA, and is considered effective as of the date on the title page. This policy replaces DOT&PF's Noise Policy dated April 2011.

During the rapid expansion of the Interstate Highway System and other roadways in the 20th century, communities began to recognize highway traffic noise and construction noise as important environmental impacts. In the 1972 Federal-aid Highway Act, Congress required FHWA to develop a noise standard for new Federal-aid highway projects. While providing national criteria and requirements for all highway agencies, the FHWA Noise Standard gives highway agencies flexibility that reflects state-specific attitudes and objectives in approaching the problem of highway traffic and construction noise. This document contains DOT&PF's policy on how highway traffic and construction noise impacts are defined, how noise abatement is evaluated, and how noise abatement decisions are made.

The FHWA Noise Standard requires noise abatement measures be considered when traffic noise impacts are identified for Type I federal projects, as defined in 23 CFR 772.5. Noise abatement measures found to be feasible and reasonable must be constructed for Type I federal projects. Feasible and reasonable noise abatement measures are eligible for federal-aid participation at the same ratio or percentage as other eligible project costs. As part of NEPA's requirement to consider the environmental effects of federally funded projects, the impact determinations and abatement considerations will be used to support development of the NEPA document.

2.0 PURPOSE

This policy outlines the DOT&PF program to implement the FHWA Noise Standards found in 23 CFR 772. These standards include traffic noise prediction requirements, noise analyses, noise abatement criteria, and requirements for informing local officials. Where FHWA has given DOT&PF flexibility in implementing the standard, this policy describes the DOT&PF approach to implementation. This policy also defines how the DOT&PF addresses traffic noise in State-funded projects.

The State of Alaska does not have any traffic noise regulations. It is the DOT&PF policy to follow the federal standards for traffic noise prediction requirements, and noise analyses. Federal noise abatement criteria are followed to determine whether noise

impacts exist and if abatement is feasible and reasonable, however, the decision to provide noise abatement on State-funded projects follows slightly different procedures (see Section 9.0 of this policy, *State-Funded Projects*.)

3.0 DEFINITIONS

A-Weighted Sound Level: The sound level in decibels measured with a frequency weighting network corresponding to the A-scale on a standard Type 1 or 2 sound level meter as specified by ANSI S1.4-1983 (R2006)/ANSI S1.4a-1985 (R2006,) American National Standard Specification for Sound Level meters (or latest version.) This is the most widely used weighting system for assessing transportation-related noise because it best approximates sound as heard by the normal human ear.

Acoustically Representative: A receptor location that represents the same land use category and magnitude of noise as another location. Proper acoustical representation includes nearly the same roadway geometry, topography, traffic flow, and distance from source to receptor.

Benefited Receptor: A receptor that receives at least a 5dBA noise reduction from an abatement measure.

Common Noise Environment: A group of receptors within the same Activity Category in 23 CFR 772, Table 1 that are exposed to similar noise sources and levels; traffic volumes, traffic mix, and speed; and topographic features. Generally, common noise environments occur between two secondary noise sources such as interchanges, intersections, and cross-roads.

Date of Development: The date at which land is permitted for development.

Date of Public Knowledge: The date of approval of the Categorical Exclusion (CE), the Finding of No Significant Impact (FONSI), the Record of Decision (ROD), or in the case of a state-funded project, approval of the State Environmental Checklist.

Decibel (dB): A unit of sound pressure level which denotes the ratio between two sound pressures; the number of decibels is 10 times the base 10 logarithm of this ratio.

Design Hourly Volume (DHV): The 30th highest hourly volume of the future year traffic assigned for the design, expressed in vehicles per hour.

Design Year: The future year used to estimate the probable traffic volume for which a highway is designed. This is determined by adding the project's design life to the anticipated date of construction completion.

Existing Noise Levels: The representative worst noise hour level resulting from the combination of natural and mechanical sources and human activity usually present in a particular area.

Feasibility: The combination of acoustical and engineering factors considered in the evaluation of a noise abatement measure.

Federal-aid Project: Any project utilizing federal funds for one or more phases (*i.e.*, Environmental, Design, Right of Way, or Construction) or that is otherwise subject to federal approval.

Field Measurement Point: Physical noise measurement site within the noise study boundary used to validate TNM and document existing noise levels. A field noise measurement point may also serve as a receiver in the TNM.

First Row Receptors: Closest residences or businesses impacted by noise from the highway facility.

Impacted Receptor: A noise-sensitive location for which a traffic noise impact has been calculated.

Leq: The equivalent steady-state sound level which in a stated period of time contains the same acoustic energy as the time-varying sound level during the same time period, with $L_{eq}(h)$ being the L_{eq} for one hour.

Multifamily Dwelling: A residential structure containing more than one residence. Each residence with a private exterior space in a multifamily dwelling shall be counted as one receptor when determining impacted receptors and benefited receptors and determining barrier reasonableness.

Noise Analysis Boundary: Limits of analysis for the proposed project(s). Boundaries typically extend 500 feet on either side of a proposed projects improvements; however, some geometric conditions and traffic volumes/mixes may cause noise impacts beyond 500 feet. The boundaries must encompass all potential noise impacts.

Noise Barrier: A physical obstruction constructed between the highway noise source and the noise sensitive receptor(s) that lowers the noise level by reducing the transmission of sound, including stand-alone noise walls, noise berms (earth or other material), and combination berm/wall systems.

Noise Contour: A line on a map representing points of equal sound level (similar to ground elevation contour lines on a topographic map.)

Noise Reduction Design Goal: The minimum desired sound level reduction, determined by calculating the difference between future build noise levels with and without abatement. The DOT&PF noise reduction design goal is 7 dBA.

Permitted: A definite commitment to develop land with an approved specific design of land use activities as evidenced by the issuance of a building permit.

Property Owner: An individual or group of individuals that holds a title, deed, or other legal documentation of ownership of a property or a residence.

Reasonableness: The combination of social, economic, and environmental factors considered in the evaluation of a noise abatement measure.

Receiver: A modeling point in the FHWA Traffic Noise Model (TNM) at which sound levels are predicted. An individual receiver may represent multiple receptors.

Receptor: A discrete or representative location (such as a residence or an activity area on a parcel of land) being studied for noise impacts.

Residence: A dwelling unit, such as a single family home or each dwelling unit in a multifamily dwelling.

Resident: Someone who resides at a dwelling unit. May not necessarily be the owner of the dwelling unit.

State-funded Project: A project that is solely funded by state monies appropriated by the Alaska State Legislature and requires no federal approvals for implementation.

Statement of Likelihood: A statement provided in the environmental clearance document based on the feasibility and reasonableness analysis completed at the time the environmental document is being approved.

Substantial Noise Increase: One of two types of highway traffic noise impacts. For a Type I project, DOT&PF defines it as an increase in design year noise levels of 15 or more dBA over the existing noise level.

Traffic Noise Impacts: Design year build condition noise levels that create a substantial noise increase (defined above) over existing noise levels or design year build condition noise levels that approach or exceed the Noise Abatement Criteria (NAC) listed in Table 1 in 23 CFR 772 for the future build condition. The DOT&PF defines “approach” as one dBA below the NAC.

Type I Project: As defined in 23 CFR 772:

- (1) The construction of a highway on new location; or,
- (2) The physical alteration of an existing highway where there is either:
 - (i) Substantial Horizontal Alteration. A project that halves the distance between the traffic noise source and the closest receptor between the existing condition to the future build condition; or,
 - (ii) Substantial Vertical Alteration. A project that removes shielding therefore exposing the line-of-sight between the receptor and the traffic noise source. This is done by either altering the vertical alignment of the highway or by altering the topography between the highway traffic noise source and the receptor; or,

- (3) The addition of a through-traffic lane(s). This includes the addition of a through-traffic lane that functions as a HOV lane, High-Occupancy Toll (HOT) lane, bus lane, or truck climbing lane; or,
- (4) The addition of an auxiliary lane, except when the auxiliary lane is a turn lane; or,
- (5) The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange; or,
- (6) Restriping existing pavement for the purpose of adding a through-traffic lane or an auxiliary lane; or,
- (7) The addition of a new or substantial alteration of a weigh station, rest stop, ride-share lot or toll plaza.
- (8) If a project is determined to be a Type I project under this definition, the entire project area as defined in the environmental document is a Type I project.

Type II Project: A Federal or Federal aid highway project for noise abatement on an existing highway. For a Type II project to be eligible for Federal-aid funding, the highway agency must develop and implement a Type II program in accordance with section 772.7(e). DOT&PF does not have a Type II program.

Type III Project: A Federal or Federal aid highway project that does not meet the classifications of a Type I or Type II project. Type III projects do not require a noise analysis.

Worst Noise Hour: A period of 60 minutes within a 24-hour day that reflects the noisiest hour resulting from the maximum amount of traffic traveling at the greatest speed. The worst noise hour may be when the vehicle mix is dominated by truck traffic rather than a high volume of automobile traffic.

4.0 APPLICABILITY

This Noise Policy applies to all Federal or Federal Aid Highway Projects authorized under Title 23, United States Code; therefore, this Noise Policy applies to any highway or multimodal project that:

1. Requires FHWA approval regardless of funding sources, or
2. Is funded with Federal Aid highway funds. This includes Federal or Federal-aid projects that are administered by Local Public Agencies as well as Alaska DOT&PF.

All projects without an approved noise report before the 2018 Noise Policy update adoption date shall use the 2018 Noise Policy update. Projects that have an approved noise report under the 2011 Noise Policy may continue to use the existing noise report or prepare a new noise report using the 2018 Noise Policy update. Projects that have an approved noise report under the 2011 Noise Policy have three years from the adoption date of the 2018 Noise Policy update to obtain an Authority to Proceed with Construction; otherwise, the noise report shall be updated to conform to the 2018 Noise Policy update.

4.1 Type I Projects

The requirements of this policy apply uniformly and consistently to all Type I federal projects, Type I State-funded projects (see Section 9.0 of this policy), and Type I Toll Authority projects within the State of Alaska. If a project is determined to be a Type I project under the definition outlined in 23 CFR 772.5, then the entire project area as defined in the environmental document is a Type I project.

4.2 Type II Projects

DOT&PF has elected not to participate in the voluntary Type II noise program; therefore, no noise analyses will be completed for Type II projects. Type II projects are not discussed further in this policy.

4.3 Type III Projects

Type III projects are those projects that neither meet the definition of a Type I or Type II project nor require a noise analysis or consideration of noise abatement. However, it may be necessary to consider conducting a construction noise analyses in certain circumstances (e.g., pile driving near residences.) Construction noise is discussed in Section 8.0 of this policy.

5.0 ANALYSIS OF TRAFFIC NOISE IMPACTS

It is important to determine early on in project scoping if a noise analysis is necessary, in order to accurately plan a project timeline.

5.1 Minimum Qualifications for Noise Analysts

DOT&PF highway traffic noise analyses must be performed by qualified personnel who have successfully completed training in the area of highway noise analysis and are proficient in the use of the latest version of the FHWA-approved traffic noise modeling software. These personnel must have experience conducting noise analysis studies for highway transportation projects and have a working knowledge of this policy and the regulations outlined in 23 CFR 772.

5.2 General Requirements for All Type I Projects

All Type I projects require a noise analysis; however, projects may not require the same level of analysis. This policy describes three levels of analyses:

- **Narrative Analysis** – a non-quantitative analysis of noise impacts where noise impacts are not anticipated.
- **Screening Analysis** – a streamlined quantitative analysis where noise impacts are unlikely or abatement actions are clearly not feasible and/or reasonable.

- Detailed Analysis – a comprehensive quantitative analysis where noise impacts are possible and noise abatement may be feasible and reasonable.

Coordination with the Statewide Environmental Office (SEO) is required before a narrative or screening analysis is conducted. Failure to coordinate with the SEO may result in a need to reanalyze the project using a detailed analysis. There are limitations to the narrative and screening procedures, and they are not applicable to all projects. The appropriate level of noise analysis will depend on the presence of noise sensitive land uses (existing or permitted), probable occurrence of highway traffic noise impacts, the potential for noise abatement measures, and/or noise-related public controversy. The levels of analysis are described in detail in Sections 5.4 through 5.6 of this policy.

For Type I projects, a traffic noise analysis is required for all build alternatives under detailed study in the NEPA process. All reasonable alternatives that have been carried forward for detailed analysis and were not rejected as unreasonable during the alternatives screening process will be analyzed for noise impacts. For Environmental Impact Statements or other studies that will examine broad corridors, the appropriate scope and methodology of the noise analysis should be discussed with participating agencies early in the project planning process.

A Type I traffic noise analysis generally consists of the following steps, which are described in more detail in subsequent sections of this policy:

1. Identify noise analysis boundaries and receptors by land use Activity Category (Section 5.3) and distance to the edge of the closest travel lane of the proposed project;
2. Determine existing noise levels at a representative subset of receptors;
3. Predict future “build” noise levels at a larger representative subset of receptors. Predict future “no-build” noise levels for the proposed project;
4. Determine traffic noise impacts;
5. Evaluate abatement feasibility and reasonableness if there are traffic noise impacts;
6. Address coordination with local officials;
7. Address construction noise; and
8. Prepare the noise analysis report (Section 6.7.)

Noise impact modeling and abatement evaluation/design for DOT&PF projects require use of the latest approved version of the FHWA Traffic Noise Model (FHWA TNM) or another model determined by FHWA to be consistent with the methodology of the FHWA TNM, pursuant to 23 CFR 772.9(a.)

If any segment or component of an alternative meets the definition of a Type I project, then the entire alternative is considered to be Type I and is subject to these noise analysis requirements. The noise analysis boundaries will be consistent with project limits, from the beginning of the project to the end of the project based on logical termini for that specific project (BOP to EOP).

5.3 Land Use Activity Categories

Federal land use activity categories are defined in 23 CFR 772. DOT&PF has accepted the FHWA definition of these activity categories (Appendix B, Table 1.) Noise analyses must address each activity category present within the noise analysis boundaries. If undeveloped land has been permitted for development (*i.e.*, a building permit has been issued on or before the date of public knowledge,) that land should be assigned to the appropriate activity category and analyzed in the same manner as developed lands in that category.

Activity Category A: Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.

Activity Category B: Residential (single-family and multi-family homes.) Noise receivers should be located in exterior areas that receive frequent human use (*i.e.*, patios, balconies, playgrounds, gardens, etc.) When an area of frequent use cannot be determined, an area mid-way between the residence and the right-of-way line should be chosen. For residences and structures that face the highway, choose an area of frequent use in the front, such as a front door landing. For apartment buildings, second-floor or higher balconies should be used in addition to ground floor units. For any shared-use exterior areas, the number of residential equivalents will be equal to the total number of dwelling units in multi-family building(s).

Activity Category C: Exterior areas of non-residential lands such as schools, parks, cemeteries, etc., as listed in Appendix B. Receivers should be located in areas that receive the most frequent human use and represent the typical use of the area. Since impact determinations are based on each area of frequent human use, the number of areas impacted should be calculated and an equivalent number of residential units should then be calculated to assess the feasibility and reasonableness of abatement measures. The equivalent number of residential units is calculated by determining the average residential lot size for the vicinity and dividing it into the non-residential area, for a total number of residential units. For example: if a park has an area of 87,120 square feet, and the average residential lot size is 60 feet by 200 feet, or 12,000 square feet, use 8 equivalent residential units to assess the feasibility and reasonableness of a proposed abatement measure. Receiver placement for non-residential use sites is similar to that of the residential analysis. Receivers should be placed at the closest location to the highway right of way (ROW) line where outdoor activity normally occurs to determine if the NAC is exceeded. In addition, receivers should be placed at locations away from the ROW line to determine the extent of impact and to consider sensitive receptors if the NAC are exceeded at the ROW line.

Activity Category D: Interiors of certain Category C facilities, such as those listed in Appendix B. Interior receptor locations should only be used if there are no reasonable

exterior (Category C) receptor options. Only consider the interior levels at these land uses after fully completing an analysis of any outdoor activity areas or determining that exterior abatement measures are not feasible or reasonable. The 52 dB(A) criteria for the category only apply to the interior areas of this category.

An interior analysis will only be performed after exhaustion all exterior options.

This will involve:

1.) identify the expected noise reduction due to the composition of the building envelope: Table 6.1 found in the FHWA publication HEP-18-065, Noise Measurement Handbook Final Report (2018)

www.fhwa.dot.gov/environment/noise/measurement/handbook.cfm#toc492990722

2.) Determine if interior noise levels should assume an open-window or closed window conditions; Open window should be assumed unless there is reliable information that the windows are in fact kept closed almost all of the time while the facility is in use.

3.) If the expected reductions cannot be determined as identified in #1 or #2, physical measurements of the amount of noise reduction provided by the building envelop will be conducted consistent with methodology found in the FHWA publication HEP-18-065, Noise Measurement Handbook Final Report (2018)

www.fhwa.dot.gov/environment/noise/measurement/handbook.cfm#toc492990722

Activity Category E: Exteriors of developed lands that are less sensitive to highway noise that are not included in Categories A-D of F. Noise measurements will be taken and predictions will be made at locations that receive the most frequent use. Category E are specifically excluded from Category D and no interior noise analysis is required. The FHWA research publication A Method to Determine Reasonableness and Feasibility of Noise Abatement at Special Use Locations shall be used to assess whether noise abatement is feasible and/or reasonable.

www.fhwa.dot.gov/environMent/noise/noise_barriers/abatement/reasonableness_2009/met02.cfm

Activity Category F: Land uses that are not sensitive to highway noise (examples listed in Appendix B.) No highway noise analysis is required under 23 CFR 772 for Activity Category F land uses. The noise analysis report should identify any Category F land uses by name, location, and type of land use.

Activity Category G: Undeveloped lands that are not permitted. Land permitted for development (*i.e.*, a building permit has been issued on or before the date of public knowledge) shall be analyzed under the Activity Category for that type of development. When possible, use the filed plat to choose receptor locations representing the exterior

areas of frequent human use. For residential plats, determine if each lot represents a single-family or multifamily dwelling. Choose representative receptor locations for second row residences as well (these receptors may be grouped two or three at a time.)

For lands not permitted for development by the date of public knowledge, DOT&PF shall determine future noise levels pursuant to 23 CFR 772.17(a). For detailed noise analyses, this analysis should report (at a minimum) the distances from the proposed edge of the near travel lane out to where worst hour $L_{eq}(h)$ levels of 60 and 64 dBA are modeled to occur. The results shall be documented in the project environmental documentation and in the noise analysis report, when applicable. Federal participation in noise abatement measures will not be considered for Category G lands unless another future Type I project is planned adjacent to such lands.

5.4 Narrative Analysis for Type I Projects

A narrative analysis is a qualitative analysis that may be completed for Type I projects where noise-related impacts are not anticipated. If there are no receptors that could potentially be exposed to traffic noise impacts, a narrative analysis is appropriate, and no further analysis is required. If there are receptors that could potentially be exposed to traffic noise impacts, and the project has the potential to adversely affect the acoustic environment based on an evaluation of the following factors, a quantitative analysis (i.e., screening or detailed analysis) is required and a narrative analysis is not applicable.

- The identification of any existing activities, developed lands, and undeveloped lands for which development is permitted which may be affected by noise from the proposed project;
- Change of traffic volume (greater than 10%);
- Change of traffic composition (increased truck volumes);
- Change of traffic speed (greater than 10 miles per hour);
- Change of geometric relationships (either horizontal or vertical) between the roadway facility and receptors;
- Projects on new location;
- Change in distribution of traffic patterns; and/or;
- Public controversy based on noise-related issues or perceptions.

It is impossible to identify and account for every special consideration that may arise on a specific highway project and address it in the corresponding noise analysis. Therefore, the list above is to be used as a guide and not considered inclusive.

A narrative analysis will consist of a discussion of the proposed project, its relationship to receptors (if present) and why further analysis is not required. If no receptors are present, a brief statement should be included that summarizes the fact that there are no noise-sensitive land uses within the noise analysis boundaries. Depending on the project circumstances, some analysis may be required to justify the results of the narrative analysis and to document the non-significance of the change in the acoustical

environment (e.g. noise measurements or using a simplified two-dimensional FHWA TNM run to assess the worst-case conditions.)

If local officials associated with undeveloped lands in the project area could benefit from information regarding future noise levels for planning purposes, then that information still needs to be provided even if a narrative analysis has been performed. This can be done using the simplified modeling procedure described in Section 5.5, below.

5.5 Screening Analysis for Type I Projects

For some Type I projects, a screening analysis may be appropriate. The screening analysis is a streamlined procedure in which simplified TNM modeling is used to predict traffic noise levels and make a conservative estimation of noise impacts. This procedure can be effective for reducing time and resources associated with a detailed analysis. If a project passes the screening analysis, additional noise analysis under 23 CFR 772 is normally not necessary. If a project is considered controversial, a detailed analysis (see “Detailed Analysis”) is warranted regardless of whether the screening procedure indicates otherwise.

A screening analysis is generally appropriate for projects where the following conditions occur:

- No noise impacts are anticipated;
- Noise impacts are anticipated but potential noise abatement actions will clearly not be feasible and reasonable.

Typically, these will be rural highway projects with uncontrolled access, few receptors, and large distances between receptors.

For example, acoustical feasibility (Section 6.4.1) requires that at least three receptors be protected by a continuous proposed noise barrier that guarantees at least a 5 dBA reduction in noise. If there are less than three receptors in the area where noise abatement is being considered, then no further analysis of noise abatement is required.

Unless or until there are other FHWA-approved screening methods available, TNM modeling must still be performed. However, the models may be simpler than for a detailed analysis. There are several simplifying measures that can be used in screening TNM template models, including using flat ground elevation data with straight-line roads. Receptors will be offset perpendicularly from the center of the model roads at distances that represent the distances from project roads to the nearest noise-sensitive receptors, and/or spaced at 50-foot intervals out to 500 feet to identify distances to NAC approach levels. The model roads will extend a minimum of 1,500 feet past the model receptors at each end of the study area.

The following items must be considered when using a screening analysis:

- Model validation is not required, but the need for onsite noise measurements will be determined on a case by case basis;
- Non-traffic noise sources important to the analysis area must be taken into account;
- Existing conditions for the analysis area must be modeled to determine if future noise levels may increase by 15 dBA or more;
- All of the future alternatives under consideration for the project must be modeled;
- Future noise levels must be evaluated for noise impacts according to the criteria in Section 3;
- If design year noise levels are 64 dBA or less or if noise levels are not predicted to increase more than 10 dBA over existing, then the screening analysis is sufficient;
- Traffic noise abatement actions will not be modeled;
- Noise measurements may be needed to justify results of a screening analysis that has identified impacts and feasible abatement appears unlikely.

This procedure can be used for Type I projects void of sensitive receptors in order to satisfy the requirement of analyzing noise impacts for undeveloped lands for use in local noise compatible planning (see Sections 5.4. and 5.6.4 of this policy.)

The decision to use a screening analysis in place of a detailed analysis should be made carefully. If the screening procedure is passed and no need for a detailed analysis is indicated, the results of the screening procedure are documented in a Noise Analysis report. If impacts are noted and abatement is clearly NOT feasible (*e.g.* driveway access), the screening procedure should suffice and a detailed analysis is not needed. However, impacts and the rationale for determining that noise abatement would not be feasible and reasonable must be clearly documented in a Noise Analysis report. If a project does not pass the screening procedure or if warranted by other conditions (*e.g.* public controversy), a detailed noise impact analysis must be performed.

5.6 Detailed Analysis for Type I Projects

A detailed noise analysis is the level of analysis performed for DOT&PF Type I projects when a narrative or screening analysis has been determined to not be appropriate. DOT&PF's processes for determining which projects qualify for a narrative or screening level analysis are described in Sections 5.4 and 5.5, respectively.

5.6.1 Identification of Analysis Boundaries, Noise Study Areas, and Receptors

Noise analysis boundaries must encompass all potential impacts. Potential benefits and impacts outside of the project limits may also need to be considered (*e.g.*, changes in traffic volumes on other facilities due to the proposed project.) All land uses within the noise analysis boundaries are identified and assigned to the appropriate Activity Categories.

It is usually beneficial on large projects to group land uses together into smaller noise study areas for the purposes of noise modeling and abatement evaluation. A noise

study area (NSA) is generally not longer than a mile. Decision factors for dividing a project into NSAs include the extents of individual neighborhoods or residential subdivisions, major terrain features, location of large tracts of undeveloped lands, and boundaries defining major changes in land use. Individual receptor locations within the land uses are also chosen, as outlined above in Section 5.3, Land Use Activity Categories.

5.6.2 Determination of Existing Noise Levels and Model Validation

For projects on new alignments, determine the worst hour existing noise levels (including non-highway traffic noise sources) for developed land uses and activities by field noise measurements. For projects on existing alignments, existing noise levels can be determined by modeling, although field measurements are recommended.

5.6.2.1 Ambient Noise Level Measurements

Field measurements are conducted in accordance with procedures outlined in FHWA's *Measurement of Highway-Related Noise* report (FHWA Report Number FHWA-PD-96-046, 1996) or the most recent available protocols. Field measurement points are generally a subset of all identified receptors, and should be chosen to be acoustically representative of a grouping of similarly located receptors.

Noise measurements typically consist of a series of 15-minute measurements (minimum of two at roughly the same time of day.) If these measurements differ by more than 3 dBA, a third measurement is needed, unless the variation can be explained by specific noise events that occurred during the measurement period.

On rural or smaller widening road projects, there may be a small number of receptors, such that determination of existing noise levels along the entire project may not be necessary. One approach to this situation is to make a longer term measurement (including peak traffic periods and daytime off-peak periods) at one measurement location close to the existing road. The results can then be used to determine the worst noise hour. Short term measurements taken at other locations during this longer term measurement can be adjusted later to represent the worst hour based on data from the longer term measurement location. While ambient noise level measurements should be made during the worst noise hour, it may not always be practical to do so in rural areas of Alaska.

5.6.2.2 Model Validation

Model validation is done by comparing measured noise levels with modeled noise levels using the same traffic volumes, mix, and speeds tallied during field noise measurements. Noise measurements for model validation do not have to be during the worst noise hour, but should not be made during periods of slow-moving traffic congestion.

Validation measurement locations should be representative of first-row receptor locations and should not be blocked by buildings or terrain features. Two or three measurements of at least 15 minutes in length are made at each location. Directional

traffic classification counts and average travel speeds of the five FHWA TNM vehicle types are made during each measurement. Pavement type must be noted and used in FHWA TNM.

For a FHWA TNM run of an NSA to be considered valid, two of the three modeled levels at each validation location must be within +/-3 dBA of the corresponding measured levels. When a discrepancy is over 3 dBA, the model input data should be examined for errors and refinements made. If a measured/modeled difference remains over 3 dBA after revision of the model, the discrepancy (and potential explanation) is noted in the noise analysis report.

5.6.3 Prediction of Future Noise Levels

Future condition noise predictions are made for each alternative under consideration, including the no-build alternative, using the latest version of the FHWA TNM program. Design year traffic conditions representing the worst noise hour (generally, Level of Service (LOS) C or D,) are used. Highway traffic noise analysis should consider absolute noise levels as well as substantial increases in noise levels for abatement evaluations.

Where appropriate, take into account any seasonal variations in traffic. Use the guidance in Sections 5.3 and 5.4.1 of this policy when choosing receptors for modeling as receivers in FHWA TNM. Loss of shielding of the roadway due to topography, buildings, or vegetation that may be eliminated when the roadway is built should be taken into account.

5.6.4 Determination of Future Noise Levels on Undeveloped Lands

Design year noise levels based on design hourly volumes need to be predicted for Category G lands. This can be done using the simplified modeling procedure described in Section 5.5 of this policy. At a minimum, this analysis should report the distances from the proposed edge of the near travel lane out to where worst hour $L_{eq}(h)$ levels of 60 and 64 dBA are modeled to occur. These results are then provided to local public agencies to assist them in planning.

Creation of noise contours for undeveloped lands will be considered on an individual project basis. Noise contours may only be used for project alternative screening or for land use planning purposes. They may not be used for determining highway traffic noise impacts.

5.6.5 Determination of Traffic Noise Impacts

For Type I projects, noise impacts must be determined for all Activity Category A-E land uses in the analysis area. Impacts occur when a proposed project results in a substantial noise increase or when the predicted design year noise levels approach, meet, or exceed the NAC. As defined in Section 3.0, a “substantial noise increase” occurs when a design year noise level ($L_{eq}(h)$) is predicted to increase 15 or more dBA above the existing level and “approach” means a design year noise level is predicted to be one decibel below the NAC for Activity Categories A-E (Appendix B, Table 1.) When

one or both impact type(s) occur, noise abatement measures must be evaluated for Type I projects.

6.0 ANALYSIS OF NOISE ABATEMENT MEASURES

Depending upon the date of public knowledge of the project and the Activity Category of the receptors, traffic noise abatement measures are to be considered when traffic noise impacts have been identified through the noise analysis process, with the exceptions noted in Sections 5.4 and 5.5.

6.1 Date of Public Knowledge

The date of public knowledge of a proposed transportation project is used to determine whether noise abatement should be considered as part of the project. This date (as defined in 23 CFR 772) is the date that a NEPA decision document was approved for the project. DOT&PF will only consider abatement measures if the impacted receptor was developed or permitted for development before the date of public knowledge.

6.2 Abatement Considerations

Noise abatement measures must be found to be both feasible and reasonable in order to be included in a proposed project. A Noise Abatement Recommendation Worksheet (located in Appendix C) should be completed to assist in the decision-making process. Feasibility and reasonableness are each described in detail later in this section.

For Type I projects that have had a Detailed Noise Analysis conducted, DOT&PF will evaluate noise abatement when traffic noise impacts are predicted for land use Activity Categories A-E, with some exceptions as noted in Section 5.3. When an impact is identified, noise abatement measures will be evaluated after first considering whether project design changes (*e.g.*, altering the horizontal and/or vertical alignment) may reduce or eliminate the impact.

6.3 Possible Noise Abatement Measures

Federal funds may be used for the following noise abatement measures when traffic noise impacts have been identified and abatement measures have been determined to be feasible and reasonable, pursuant to 23 CFR 772.13(d). The costs of such measures may be included in Federal-aid participation project costs with the Federal share being the same as that for the system on which the project is located.

The following noise abatement measures may be considered for incorporation into a Type I project to reduce traffic noise impacts.

- (1) Construction of noise barriers, including acquisition of property rights, either within or outside the highway right-of-way. Landscaping is not a viable noise abatement measure.

- (2) Traffic management measures including, but not limited to, traffic control devices and signing for prohibition of certain vehicle types, time-use restrictions for certain vehicle types, modified speed limits, and exclusive lane designations.
- (3) Alteration of horizontal and vertical alignments.
- (4) Acquisition of real property or interests therein (predominantly unimproved property) to serve as a buffer zone to preempt development which would be adversely impacted by traffic noise.
- (5) Noise insulation of Activity Category D land use facilities listed in Table 1. Post-installation maintenance and operational costs for noise insulation are not eligible for federal-aid funding.

Alternative (quieter) pavement is not a FHWA-approved noise abatement measure for Federal-aid projects and consequently cannot be used as noise abatement on Federal-aid projects. DOT&PF may consider using alternative pavements to reduce traffic noise on State-funded projects (see Section 9.0 of this policy.)

At this time, DOT&PF does not use absorptive treatments as a functional enhancement of noise barriers.

6.4 Feasibility

Determinations of noise abatement measure feasibility are made by considering whether a certain amount of noise reduction can be achieved by the measure and whether the measure is possible to design and construct.

6.4.1 Acoustical Feasibility

Acoustical feasibility refers to the minimum number of impacted receptors that must receive 5 dBA highway traffic noise reduction for a proposed abatement measure to be feasible. For DOT&PF projects, a 5 dBA or more reduction must be achieved for at least three impacted front row receptors in order for the abatement measure to be considered acoustically feasible.

If significant non-highway noise sources exist in the project area, such as rail lines or airports, noise barrier effectiveness may be compromised. These situations will be carefully evaluated to determine if a noise barrier for the highway noise sources is feasible.

6.4.2 Engineering Feasibility

Noise abatement measures are not feasible if they create a safety hazard to the driving public, protected receptors, or maintenance personnel. The project development team will consult with the appropriate DOT&PF functional groups when determining whether it is possible to design and construct a noise abatement measure. Noise abatement measures should be consistent with the following general design principles:

- Noise abatement measures should be located beyond the recovery zone of the traveled way; if a noise abatement measure must be located within the recovery zone, a traffic barrier may be warranted.

- Noise abatement measures may not block the recommended sight distance (Alaska Highway Preconstruction Manual, Chapter 11) between vehicles and intersecting roadways or on/off-ramps.
- Protrusions on noise abatement measures near a traffic lane should be avoided.
- Facings on noise abatement measures that can become dislodged, or barrier components that could shatter during an accident, or facings that create excessive glare should be avoided.
- Access should be provided to all sides of noise abatement measures to allow for maintenance activities to take place.

All noise abatement measures should consider the design principles outlined in the *"Guide on Evaluation and Abatement of Traffic Noise"*, AASHTO, 1993 and the *"FHWA Highway Noise Barrier Design Handbook"*, FHWA, 2000.

6.5 Reasonableness

The following three reasonableness factors must be evaluated in order for a noise abatement measure to be considered reasonable, pursuant to 23 CFR 772.13:

- 1) Viewpoints of the property owners and residents of the benefitted receptors.
- 2) Cost Effectiveness.
- 3) Noise Reduction Design Goal.

These three reasonableness factors must collectively be achieved in order for a noise abatement measure to be deemed reasonable. Refer to Section 9.0 for a list of additional optional reasonableness factors that may be used only on State-funded projects.

6.5.1 Viewpoints of the property owners and residents of the benefitted receptors

Public involvement for noise abatement is required for all categories of environmental document. To determine the views of benefitted households and property owners, DOT&PF will contact all benefitted households and property owners to determine the level of interest for a noise abatement measure. This contact can be in the form of a mail out questionnaire, phone call survey, or door to door interviews - whichever is most practical and cost effective for the size of the proposed project.

Noise abatement will be carried forward if there is a 60% majority of viewpoints received in support of the barrier. If a property has multiple dwelling units, the owner(s) of the multi-unit dwelling will provide input for the property as a whole, not for each individual dwelling unit. A second outreach attempt will be made if the response rate is less than 40% of all possible respondents.

6.5.2 Cost Effectiveness

The noise abatement measure cost is no more than \$38,000¹ per benefitted receptor, based upon the design engineer's estimate. This is determined by counting all receptors (including owner-occupied, rental units, mobile homes, and businesses) benefitted by the noise abatement measure in any subdivision and/or given development, and dividing that number into the total cost of the noise abatement measure. A benefitted receptor is defined as the recipient of an abatement measure that receives a noise reduction at or above the minimum threshold of 5 dBA. Each unit in a multi-family building will be counted as a separate receptor. Cost per benefitted receptor must be reanalyzed at a regular interval not to exceed 5 years.

When the design engineer determines abatement measure cost, the estimate will include all items necessary for the construction of the noise abatement measure. Examples of cost items that should be included are traffic control (related to the noise barrier), drainage modification, foundations, retaining walls and right-of-way. Include a cost item only if it is directly related to the construction of the noise abatement measure². If a necessary project feature such as a retaining wall is included, then that cost will not be added into the noise abatement construction cost estimate. If the project incorporates visual mitigation such as the use of a transparent barrier with surface texture, the additional cost will not be included in the abatement construction cost estimate for the purpose of determining reasonableness. Aesthetic treatments, such as artwork, re-vegetation, landscaping, and barrier treatments will not be included in the abatement measure cost estimate for the purpose of determining reasonableness.

6.5.3 Noise Reduction Design Goal

The DOT&PF noise reduction design goal is 7 dBA. At least 50 percent of the benefitted receptors in the first row of structures must achieve this design goal for the noise abatement to be considered reasonable. If this design goal is not attainable, then the noise abatement cannot be carried forward. Refer to Section 9.0 for a list of additional criteria that apply only to State-funded projects.

6.5.4 Noise Abatement Recommendation Worksheet

A noise abatement recommendation worksheet (Appendix C) will be filled out for each NSA in the noise analysis. The REM will approve and sign the worksheets. If an abatement measure is determined to not be feasible, then the reasonableness analysis section of the worksheet does not need to be completed. Likewise, if it is determined that the abatement measure is not reasonable, the feasibility portion of the worksheet does not have to be filled out.

¹ DOT&PFs April 2011 cost per benefitted receptor was adjusted for inflation (CPI September 2018) to \$38,000 cost per benefitted receptor.

² DOT&PF will need to provide proof to the FHWA Division Office that the cost of any of these are solely and directly related to the noise abatement measure

DOT&PF will only implement a noise abatement measure if it has been determined to be both feasible and reasonable. The REM will recommend or not recommend that a noise abatement measure be implemented. The recommendation worksheet will be submitted to the Project Manager (PM) who will sign the recommendation worksheet. If the PM does not approve the recommendation then the Preconstruction Engineer will resolve the dispute. The Preconstruction Engineer only needs to sign the noise abatement recommendation worksheet if alternative pavements are recommended as abatement on State-funded projects. The REM will ensure that the recommendation is included in the project's environmental document.

6.6 Third Party Funding

For Type I Federal-aid projects, third party funding cannot be used if the noise abatement would require the additional funding in order to be considered feasible and/or reasonable. Third party funding can be used to pay for additional features such as landscaping, aesthetic treatments, and functional enhancements for noise barriers that have already been determined to be feasible and reasonable.

6.7 Information Required for a NEPA Decision

It is important to maintain accurate and complete documentation of noise impact analyses and any decisions to provide noise abatement. The noise analysis reports for Type I projects are stand-alone documents. Information is taken from the noise analysis report to support the NEPA analysis and decision. The specific information required is outlined in 23 CFR 772.13.

Decisions to provide or not provide noise abatement must be well-explained and defensible. Prior to the NEPA decision, DOT&PF must identify and document:

- 1) Where noise impacts occur;
- 2) The prospective noise abatement measures that are feasible and reasonable, and are likely to be incorporated into the project; and
- 3) Noise impact locations for which no abatement appears to be feasible and reasonable.

For noise abatement measures that have been found to be feasible and reasonable, a statement of likelihood, similar to the following, should be included in the environmental document narrative in the interest of public disclosure:

“As a result of the feasibility and reasonableness analysis conducted as a part of the environmental document, the DOT&PF proposes to incorporate the following noise abatement measures (type, locations) into the proposed project. These noise abatement recommendations are preliminary and based upon the feasibility and reasonableness analysis completed at the time the environmental document. Final recommendations for noise abatement will be based upon the feasibility and reasonable analysis conducted during the detailed design of the project. Any changes in the final abatement

recommendations will result in the reevaluation of the approved NEPA document and the solicitation of additional public comment.”

The noise analysis report should include a description of each abatement measure considered, a discussion of the anticipated costs, problems, and disadvantages associated with that abatement measure, and a discussion of the anticipated benefits. The noise analysis must be appended to the environmental document, and should be in the following general format:

Cover Page
Table of Contents
Summary
Project Background
Purpose of Analysis
Methods
 Model
 Validation Process
Description of Land Use Categories along the Corridor
Results
Identification of Noise Impacts
Noise Abatement Analysis
Abatement Recommendations
Statement of Likelihood
Construction Noise
Conclusion
Appendices
 DOT&PF NOISE POLICY
 TNM Model inputs/outputs and supporting CAD/design files

During the detailed design of the proposed project, recommendations for noise abatement made in the environmental document will be reevaluated to determine if they are still valid. If it is determined that any noise abatement measure recommendation is no longer valid, then the affected public will be notified and the environmental document will be reevaluated or supplemented as appropriate.

6.8 Design-Build Projects

For design-build projects, as with any DOT&PF project, DOT&PF is ultimately responsible for the NEPA decisions and as such, noise abatement measures must be considered, developed, and constructed in accordance with the provisions of 23 CFR 772, 23 CFR 636.109, and this policy.

6.9 Inventory and Reporting of Abatement Measures

DOT&PF will maintain an inventory of all constructed noise abatement measures and will on a periodic basis provide the Alaska Division of FHWA the parameters outlined in

23 CFR 772.13(f). DOT&PF will enter the data into a spreadsheet as abatement measures are implemented.

7.0 INFORMATION FOR LOCAL OFFICIALS

In an effort to reduce future traffic noise impacts on currently undeveloped lands and to maintain compatibility between highways and future development, DOT&PF will provide the results of Type I highway traffic noise analyses to local government officials. With regard to undeveloped lands that have not been permitted for development, the results will include at a minimum the distances from the proposed edge of the traveled way to where the design year $L_{eq}(h)$ of 60 and 64 dBA are predicted to occur.

8.0 CONSTRUCTION NOISE

Construction of a highway project may cause localized, short-duration noise impacts. Construction noise can adversely affect people living in the area. Analysis and mitigation of construction noise impacts will be addressed when noise and vibration issues arise during project development or if complaints are received by the public.

For all Type I Federal and State Projects, it is DOT&PF policy to:

- (a) Identify land uses or activities that may be affected by noise from construction of the project. The identification is to be performed during the project development studies.
- (b) Determine the measures that are needed in the plans and specifications to minimize or eliminate adverse construction noise impacts to the community. This determination shall include a weighing of the benefits achieved and the overall adverse social, economic, and environmental effects and costs of the abatement measures.
- (c) Incorporate the needed abatement measures in the plans and specifications.

The REM, environmental analyst and design engineering manager will coordinate to incorporate appropriate mitigation measures for construction noise as determined appropriate by DOT&PF. These may be incorporated into the plans and specifications and include: requirements for staging areas, time periods where no noise generating activities can occur, and public outreach requirements.

In the event that construction noise complaints occur during the course of construction activities, measures will be taken by the Construction Project Engineer, in consultation with the REM, to resolve the problem to the extent practical. Measures might include locating stationary construction equipment as far from nearby noise sensitive receivers as possible, shutting off idling equipment, rescheduling construction operations to avoid periods of noise annoyance, notifying nearby residents whenever extremely noisy operations will be occurring, and installing permanent or portable acoustic abatement measures around stationary construction noise sources.

In some cases there are no alternatives to conducting construction activities during the night, on weekends, or on holidays. When deemed necessary, DOT&PF will make every effort to notify the public prior to conducting these activities. Public involvement in these cases should occur during design and throughout the construction duration. In some communities, local ordinances may restrict noise generating activities. DOT&PF and its contractor(s) will comply with local noise ordinances and acquire any necessary noise permits for construction activities prior to their initiation.

While construction noise modeling is not regularly done for Type I noise studies, the FHWA Roadway Construction Noise Model (RCNM) may be used to predict noise levels from various types of equipment and construction activities. In some cases (*e.g.*, pile driving near residences,) construction noise modeling may be warranted for Type III projects as well.

9.0 STATE-FUNDED PROJECTS

In general, the same methods are followed in the identification of noise impacts for Type I State-funded projects as for Type I Federal-aid projects. Results of noise analyses will be documented in the State Project Environmental Checklist. If noise abatement is determined to be feasible and reasonable, then the REM will make a recommendation to the Preconstruction Engineer. The Preconstruction Engineer will decide whether the recommended abatement measure will be constructed. Abatement will be provided only if it meets the feasibility and reasonableness criteria of this policy and the Preconstruction Engineer determines that the state funded appropriation can accommodate the expenditure.

In addition to the reasonableness factors outlined for Federal-aid projects in Section 6.5, above, the following optional reasonableness factors may be used to increase the cost allowed on State-funded projects:

- 1) Date of development.
- 2) Length of time receivers have been exposed to highway traffic noise impacts.
- 3) Exposure to higher absolute traffic noise levels.
- 4) Changes between existing and future build conditions.
- 5) Percentage of mixed zone development.
- 6) Use of noise compatible planning concepts by the local government.

No single optional reasonableness factor shall be used to determine that a noise abatement measure is unreasonable.

In addition to the criteria outlined for Federal-aid projects in Section 6.5.3, above, the following noise reduction design goal criteria apply only to State-funded projects:

- 1) Development vs. Highway Timing. At least 50 percent of impacted receptors in the development (subdivision, apartment complex, etc.) were built before initial construction of the highway. The date of development is an important part of the determination of reasonableness. More consideration is given to developments that were built before the highway was built.
- 2) Development Existence. At least 50 percent of impacted receptors in the development have existed for at least 10 years. More consideration is given to residents who have experienced traffic noise impacts for long periods of time.
- 3) Absolute Predicted Build Noise Level. The predicted future build noise levels are at least 66 dBA. More consideration should be given to areas with higher absolute traffic noise levels. Absolute noise levels typically found along highways, 60-75 dBA, are deemed undesirable and cause complaints from adjacent residents. In general, the higher the absolute noise, the more complaints.
- 4) Relative Predicted Build Noise Level. The predicted future build noise levels are at least 10 dBA greater than the existing noise levels. More consideration is given to areas with larger increases over existing noise levels. This gives greater consideration to projects for highways on new location and major reconstruction than it does to projects of smaller magnitude. For most people, a 3 dBA increase is barely perceptible, a 5 dBA increase is readily perceptible, and a 10 dBA increase doubles the perceived loudness of the noise.
- 5) Build vs. No-Build Noise Levels. The future build noise levels are at least 5 dBA greater than the future no-build noise levels. More consideration should be given to areas where larger changes in traffic noise levels are expected to occur if the project is constructed than if it is not.
- 6) Land use. Land use is not changing rapidly and there are local ordinances or zoning in place to control the new development of noise sensitive land uses adjacent to transportation corridors.

DOT&PF may consider using alternative pavements to reduce traffic noise on State-funded projects. However, the decision to provide such a measure will be made by the Preconstruction Engineer.

10.0 UPDATES TO POLICY

This policy is effective upon signature and replaces the Alaska DOT&PF April 2011 Noise Policy. Changes to the policy will be made as needed, or every 5 years, per FHWA recommendation.

REFERENCES

"Guide on Evaluation and Abatement of Traffic Noise" (AASHTO, 1993)

"FHWA Highway Noise Barrier Design Handbook" (FHWA, 2000)

"Measurement of Highway-Related Noise" report (FHWA Report Number FHWA-PD-96-046, 1996)

<http://www.fhwa.dot.gov/environment/noise/>

FHWA *Highway Traffic Noise: Analysis and Abatement Guidance* June 2010 is available at the following website

http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/analysis_and_abatement_guidance/guidancedoc.pdf

Noise Model Web site at the following URL <http://www.fhwa.dot.gov/environment/noise/index.htm>.

APPENDIX A - FHWA 23 CFR 772

Code of Federal Regulations

Current as of October 12, 2018

Title 23 → Chapter I → Subchapter H → Part 772

PART 772—PROCEDURES FOR ABATEMENT OF HIGHWAY TRAFFIC NOISE AND CONSTRUCTION NOISE

Contents

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Table 1 to Part 772—Noise Abatement Criteria

AUTHORITY: 23 U.S.C. 109(h) and (i); 42 U.S.C. 4331, 4332; sec. 339(b), Pub. L. 104-59, 109 Stat. 568, 605; 49 CFR 1.48(b).

SOURCE: 75 FR 39834, July 13, 2010, unless otherwise noted.

§772.1 Purpose.

To provide procedures for noise studies and noise abatement measures to help protect the public's health, welfare and livability, to supply noise abatement criteria, and to establish requirements for information to be given to local officials for use in the planning and design of highways approved pursuant to title 23 U.S.C.

§772.3 Noise standards.

The highway traffic noise prediction requirements, noise analyses, noise abatement criteria, and requirements for informing local officials in this regulation constitute the noise standards mandated by 23 U.S.C. 109(1). All highway projects which are developed in conformance with this regulation shall be deemed to be in accordance with the FHWA noise standards.

§772.5 Definitions.

Benefited receptor. The recipient of an abatement measure that receives a noise reduction at or above the minimum threshold of 5 dB(A), but not to exceed the highway agency's reasonableness design goal.

Common Noise Environment. A group of receptors within the same Activity Category in Table 1 that are exposed to similar noise sources and levels; traffic volumes, traffic mix, and speed; and topographic features. Generally, common noise environments occur between two secondary noise sources, such as interchanges, intersections, cross-roads.

Date of public knowledge. The date of approval of the Categorical Exclusion (CE), the Finding of No Significant Impact (FONSI), or the Record of Decision (ROD), as defined in 23 CFR part 771.

Design year. The future year used to estimate the probable traffic volume for which a highway is designed.

Existing noise levels. The worst noise hour resulting from the combination of natural and mechanical sources and human activity usually present in a particular area.

Feasibility. The combination of acoustical and engineering factors considered in the evaluation of a noise abatement measure.

Impacted Receptor. The recipient that has a traffic noise impact.

L10. The sound level that is exceeded 10 percent of the time (the 90th percentile) for the period under consideration, with L10(h) being the hourly value of L10.

Leq. The equivalent steady-state sound level which in a stated period of time contains the same acoustic energy as the time-varying sound level during the same time period, with Leq(h) being the hourly value of Leq.

Multifamily dwelling. A residential structure containing more than one residence. Each residence in a multifamily dwelling shall be counted as one receptor when determining impacted and benefited receptors.

Noise barrier. A physical obstruction that is constructed between the highway noise source and the noise sensitive receptor(s) that lowers the noise level, including stand alone noise walls, noise berms (earth or other material), and combination berm/wall systems.

Noise reduction design goal. The optimum desired dB(A) noise reduction determined from calculating the difference between future build noise levels with abatement, to future build noise levels without abatement. The noise reduction design goal shall be at least 7 dB(A), but not more than 10 dB(A).

Permitted. A definite commitment to develop land with an approved specific design of land use activities as evidenced by the issuance of a building permit.

Property owner. An individual or group of individuals that holds a title, deed, or other legal documentation of ownership of a property or a residence.

Reasonableness. The combination of social, economic, and environmental factors considered in the evaluation of a noise abatement measure.

Receptor. A discrete or representative location of a noise sensitive area(s), for any of the land uses listed in Table 1.

Residence. A dwelling unit. Either a single family residence or each dwelling unit in a multifamily dwelling.

Statement of likelihood. A statement provided in the environmental clearance document based on the feasibility and reasonableness analysis completed at the time the environmental document is being approved.

Substantial construction. The granting of a building permit, prior to right-of-way acquisition or construction approval for the highway.

Substantial noise increase. One of two types of highway traffic noise impacts. For a Type I project, an increase in noise levels of 5 to 15 dB(A) in the design year over the existing noise level.

Traffic noise impacts. Design year build condition noise levels that approach or exceed the NAC listed in Table 1 for the future build condition; or design year build condition noise levels that create a substantial noise increase over existing noise levels.

Type I project. (1) The construction of a highway on new location; or,

(2) The physical alteration of an existing highway where there is either:

(i) Substantial Horizontal Alteration. A project that halves the distance between the traffic noise source and the closest receptor between the existing condition to the future build condition; or,

(ii) Substantial Vertical Alteration. A project that removes shielding therefore exposing the line-of-sight between the receptor and the traffic noise source. This is done by either altering the vertical alignment of the highway or by altering the topography between the highway traffic noise source and the receptor; or,

(3) The addition of a through-traffic lane(s). This includes the addition of a through-traffic lane that functions as a HOV lane, High-Occupancy Toll (HOT) lane, bus lane, or truck climbing lane; or,

(4) The addition of an auxiliary lane, except for when the auxiliary lane is a turn lane; or,

(5) The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange; or,

(6) Restriping existing pavement for the purpose of adding a through-traffic lane or an auxiliary lane; or,

(7) The addition of a new or substantial alteration of a weigh station, rest stop, ride-share lot or toll plaza.

(8) If a project is determined to be a Type I project under this definition then the entire project area as defined in the environmental document is a Type I project.

Type II project. A Federal or Federal-aid highway project for noise abatement on an existing highway. For a Type II project to be eligible for Federal-aid funding, the highway agency must develop and implement a Type II program in accordance with section 772.7(e).

Type III project. A Federal or Federal-aid highway project that does not meet the classifications of a Type I or Type II project. Type III projects do not require a noise analysis.

§772.7 Applicability.

(a) This regulation applies to all Federal or Federal-aid Highway Projects authorized under title 23, United States Code. Therefore, this regulation applies to any highway project or multimodal project that:

(1) Requires FHWA approval regardless of funding sources, or

(2) Is funded with Federal-aid highway funds.

(b) In order to obtain FHWA approval, the highway agency shall develop noise policies in conformance with this regulation and shall apply these policies uniformly and consistently statewide.

(c) This regulation applies to all Type I projects unless the regulation specifically indicates that a section only applies to Type II or Type III projects.

(d) The development and implementation of Type II projects are not mandatory requirements of section 109(i) of title 23, United States Code.

(e) If a highway agency chooses to participate in a Type II program, the highway agency shall develop a priority system, based on a variety of factors, to rank the projects in the program. This priority system shall be submitted to and approved by FHWA before the highway agency is allowed to use Federal-aid funds for a project in the program. The highway agency shall re-analyze the priority system on a regular interval, not to exceed 5 years.

(f) For a Type III project, a highway agency is not required to complete a noise analysis or consider abatement measures.

§772.9 Traffic noise prediction.

(a) Any analysis required by this subpart must use the FHWA Traffic Noise Model (TNM), which is described in “FHWA Traffic Noise Model” Report No. FHWA-PD-96-010, including Revision No. 1, dated April 14, 2004, or any other model determined by the FHWA to be consistent with the methodology of the FHWA TNM. These publications are incorporated by reference in accordance with section 552(a) of title 5, U.S.C. and part 51 of title 1, CFR, and are on file at the National Archives and Record Administration (NARA). For information on the availability of this material at NARA, call (202) 741-6030 or go to http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html. These documents are available for copying and inspection at the Federal Highway Administration, 1200 New Jersey Avenue, SE., Washington, DC 20590, as provided in part 7 of title 49, CFR. These documents are also available on the FHWA's Traffic Noise Model Web site at the following URL: <http://www.fhwa.dot.gov/environment/noise/index.htm>.

(b) Average pavement type shall be used in the FHWA TNM for future noise level prediction unless a highway agency substantiates the use of a different pavement type for approval by the FHWA.

(c) Noise contour lines may be used for project alternative screening or for land use planning to comply with §772.17 of this part, but shall not be used for determining highway traffic noise impacts.

(d) In predicting noise levels and assessing noise impacts, traffic characteristics that would yield the worst traffic noise impact for the design year shall be used.

§772.11 Analysis of traffic noise impacts.

(a) The highway agency shall determine and analyze expected traffic noise impacts.

- (1) For projects on new alignments, determine traffic noise impacts by field measurements.
 - (2) For projects on existing alignments, predict existing and design year traffic noise impacts.
- (b) In determining traffic noise impacts, a highway agency shall give primary consideration to exterior areas where frequent human use occurs.
- (c) A traffic noise analysis shall be completed for:
- (1) Each alternative under detailed study;
 - (2) Each Activity Category of the NAC listed in Table 1 that is present in the study area;
- (i) *Activity Category A.* This activity category includes the exterior impact criteria for lands on which serenity and quiet are of extraordinary significance and serve an important public need, and where the preservation of those qualities is essential for the area to continue to serve its intended purpose. Highway agencies shall submit justifications to the FHWA on a case-by-case basis for approval of an Activity Category A designation.
- (ii) *Activity Category B.* This activity category includes the exterior impact criteria for single-family and multifamily residences.
- (iii) *Activity Category C.* This activity category includes the exterior impact criteria for a variety of land use facilities. Each highway agency shall adopt a standard practice for analyzing these land use facilities that is consistent and uniformly applied statewide.
- (iv) *Activity Category D.* This activity category includes the interior impact criteria for certain land use facilities listed in Activity Category C that may have interior uses. A highway agency shall conduct an indoor analysis after a determination is made that exterior abatement measures will not be feasible and reasonable. An indoor analysis shall only be done after exhausting all outdoor analysis options. In situations where no exterior activities are to be affected by the traffic noise, or where the exterior activities are far from or physically shielded from the roadway in a manner that prevents an impact on exterior activities, the highway agency shall use Activity Category D as the basis of determining noise impacts. Each highway agency shall adopt a standard practice for analyzing these land use facilities that is consistent and uniformly applied statewide.
- (v) *Activity Category E.* This activity category includes the exterior impact criteria for developed lands that are less sensitive to highway noise. Each highway agency shall adopt a standard practice for analyzing these land use facilities that is consistent and uniformly applied statewide.
- (vi) *Activity Category F.* This activity category includes developed lands that are not sensitive to highway traffic noise. There is no impact criteria for the land use facilities in this activity category and no analysis of noise impacts is required.

(vii) *Activity Category G*. This activity includes undeveloped lands.

(A) A highway agency shall determine if undeveloped land is permitted for development. The milestone and its associated date for acknowledging when undeveloped land is considered permitted shall be the date of issuance of a building permit by the local jurisdiction or by the appropriate governing entity.

(B) If undeveloped land is determined to be permitted, then the highway agency shall assign the land to the appropriate Activity Category and analyze it in the same manner as developed lands in that Activity Category.

(C) If undeveloped land is not permitted for development by the date of public knowledge, the highway agency shall determine noise levels in accordance with 772.17(a) and document the results in the project's environmental clearance documents and noise analysis documents. Federal participation in noise abatement measures will not be considered for lands that are not permitted by the date of public knowledge.

(d) The analysis of traffic noise impacts shall include:

(1) Identification of existing activities, developed lands, and undeveloped lands, which may be affected by noise from the highway;

(2) For projects on new or existing alignments, validate predicted noise level through comparison between measured and predicted levels;

(3) Measurement of noise levels. Use an ANSI Type I or Type II integrating sound level meter;

(4) Identification of project limits to determine all traffic noise impacts for the design year for the build alternative. For Type II projects, traffic noise impacts shall be determined from current year conditions;

(e) Highway agencies shall establish an approach level to be used when determining a traffic noise impact. The approach level shall be at least 1 dB(A) less than the Noise Abatement Criteria for Activity Categories A to E listed in Table 1 to part 772;

(f) Highway agencies shall define substantial noise increase between 5 dB(A) to 15 dB(A) over existing noise levels. The substantial noise increase criterion is independent of the absolute noise level.

(g) A highway agency proposing to use Federal-aid highway funds for a Type II project shall perform a noise analysis in accordance with §772.11 of this part in order to provide information needed to make the determination required by §772.13(a) of this part.

§772.13 Analysis of noise abatement.

(a) When traffic noise impacts are identified, noise abatement shall be considered and evaluated for feasibility and reasonableness. The highway agency shall determine and analyze alternative noise abatement measures to abate identified impacts by giving weight to the benefits and costs of abatement and the overall social, economic, and environmental effects by using feasible and reasonable noise abatement measures for decision-making.

(b) In abating traffic noise impacts, a highway agency shall give primary consideration to exterior areas where frequent human use occurs.

(c) If a noise impact is identified, a highway agency shall consider abatement measures. The abatement measures listed in §772.15(c) of this part are eligible for Federal funding.

(1) At a minimum, the highway agency shall consider noise abatement in the form of a noise barrier.

(2) If a highway agency chooses to use absorptive treatments as a functional enhancement, the highway agency shall adopt a standard practice for using absorptive treatment that is consistent and uniformly applied statewide.

(d) *Examination and evaluation of feasible and reasonable noise abatement measures for reducing the traffic noise impacts.* Each highway agency, with FHWA approval, shall develop feasibility and reasonableness factors.

(1) *Feasibility:* (i) Achievement of at least a 5 dB(A) highway traffic noise reduction at impacted receptors. The highway agency shall define, and receive FHWA approval for, the number of receptors that must achieve this reduction for the noise abatement measure to be acoustically feasible and explain the basis for this determination; and

(ii) Determination that it is possible to design and construct the noise abatement measure. Factors to consider are safety, barrier height, topography, drainage, utilities, and maintenance of the abatement measure, maintenance access to adjacent properties, and access to adjacent properties (*i.e.* arterial widening projects).

(2) *Reasonableness:*(i) *Consideration of the viewpoints of the property owners and residents of the benefited receptors.* The highway agency shall solicit the viewpoints of all of the benefited receptors and obtain enough responses to document a decision on either desiring or not desiring the noise abatement measure. The highway agency shall define, and receive FHWA approval for, the number of receptors that are needed to constitute a decision and explain the basis for this determination.

(ii) *Cost effectiveness of the highway traffic noise abatement measures.* Each highway agency shall determine, and receive FHWA approval for, the allowable cost of abatement by determining a baseline cost reasonableness value. This determination may include the actual construction cost of noise abatement, cost per square foot of abatement, the maximum square

footage of abatement/benefited receptor and either the cost/benefited receptor or cost/benefited receptor/dB(A) reduction. The highway agency shall re-analyze the allowable cost for abatement on a regular interval, not to exceed 5 years. A highway agency has the option of justifying, for FHWA approval, different cost allowances for a particular geographic area(s) within the State, however, the highway agency must use the same cost reasonableness/construction cost ratio statewide.

(iii) *Noise reduction design goals for highway traffic noise abatement measures.* When noise abatement measure(s) are being considered, a highway agency shall achieve a noise reduction design goal. The highway agency shall define, and receive FHWA approval for, the design goal of at least 7 dB(A) but not more than 10 dB(A), and shall define the number of benefited receptors that must achieve this design goal and explain the basis for this determination.

(iv) The reasonableness factors listed in §772.13(d)(5)(i), (ii) and (iii), must collectively be achieved in order for a noise abatement measure to be deemed reasonable. Failure to achieve §772.13(d)(5)(i), (ii) or (iii), will result in the noise abatement measure being deemed not reasonable.

(v) In addition to the required reasonableness factors listed in §772.13(d)(5)(i), (ii), and (iii), a highway agency has the option to also include the following reasonableness factors: Date of development, length of time receivers have been exposed to highway traffic noise impacts, exposure to higher absolute highway traffic noise levels, changes between existing and future build conditions, percentage of mixed zoning development, and use of noise compatible planning concepts by the local government. No single optional reasonableness factor can be used to determine reasonableness.

(e) *Assessment of Benefited Receptors.* Each highway agency shall define the threshold for the noise reduction which determines a benefited receptor as at or above the 5 dB(A), but not to exceed the highway agency's reasonableness design goal.

(f) *Abatement measure reporting:* Each highway agency shall maintain an inventory of all constructed noise abatement measures. The inventory shall include the following parameters: type of abatement; cost (overall cost, unit cost per/sq. ft.); average height; length; area; location (State, county, city, route); year of construction; average insertion loss/noise reduction as reported by the model in the noise analysis; NAC category(s) protected; material(s) used (precast concrete, berm, block, cast in place concrete, brick, metal, wood, fiberglass, combination, plastic (transparent, opaque, other); features (absorptive, reflective, surface texture); foundation (ground mounted, on structure); project type (Type I, Type II, and optional project types such as State funded, county funded, tollway/turnpike funded, other, unknown). The FHWA will collect this information, in accordance with OMB's Information Collection requirements.

(g) Before adoption of a CE, FONSI, or ROD, the highway agency shall identify:

(1) Noise abatement measures which are feasible and reasonable, and which are likely to be incorporated in the project; and

(2) Noise impacts for which no noise abatement measures are feasible and reasonable.

(3) *Documentation of highway traffic noise abatement:* The environmental document shall identify locations where noise impacts are predicted to occur, where noise abatement is feasible and reasonable, and locations with impacts that have no feasible or reasonable noise abatement alternative. For environmental clearance, this analysis shall be completed to the extent that design information on the alternative(s) under study in the environmental document is available at the time the environmental clearance document is completed. A statement of likelihood shall be included in the environmental document since feasibility and reasonableness determinations may change due to changes in project design after approval of the environmental document. The statement of likelihood shall include the preliminary location and physical description of noise abatement measures determined feasible and reasonable in the preliminary analysis. The statement of likelihood shall also indicate that final recommendations on the construction of an abatement measure(s) is determined during the completion of the project's final design and the public involvement processes.

(h) The FHWA will not approve project plans and specifications unless feasible and reasonable noise abatement measures are incorporated into the plans and specifications to reduce the noise impact on existing activities, developed lands, or undeveloped lands for which development is permitted.

(i) For design-build projects, the preliminary technical noise study shall document all considered and proposed noise abatement measures for inclusion in the NEPA document. Final design of design-build noise abatement measures shall be based on the preliminary noise abatement design developed in the technical noise analysis. Noise abatement measures shall be considered, developed, and constructed in accordance with this standard and in conformance with the provisions of 40 CFR 1506.5(c) and 23 CFR 636.109.

(j) Third party funding is not allowed on a Federal or Federal-aid Type I or Type II project if the noise abatement measure would require the additional funding from the third party to be considered feasible and/or reasonable. Third party funding is acceptable on a Federal or Federal-aid highway Type I or Type II project to make functional enhancements, such as absorptive treatment and access doors or aesthetic enhancements, to a noise abatement measure already determined feasible and reasonable.

(k) On a Type I or Type II projects, a highway agency has the option to cost average noise abatement among benefited receptors within common noise environments if no single common noise environment exceeds two times the highway agency's cost reasonableness criteria and collectively all common noise environments being averaged do not exceed the highway agency's cost reasonableness criteria.

§772.15 Federal participation.

(a) *Type I and Type II projects.* Federal funds may be used for noise abatement measures when:

(1) Traffic noise impacts have been identified; and

(2) Abatement measures have been determined to be feasible and reasonable pursuant to §772.13(d) of this chapter.

(b) *For Type II projects.* (1) No funds made available out of the Highway Trust Fund may be used to construct Type II noise barriers, as defined by this regulation, if such noise barriers were not part of a project approved by the FHWA before the November 28, 1995.

(2) Federal funds are available for Type II noise barriers along lands that were developed or were under substantial construction before approval of the acquisition of the rights-of-ways for, or construction of, the existing highway.

(3) FHWA will not approve noise abatement measures for locations where such measures were previously determined not to be feasible and reasonable for a Type I project.

(c) *Noise abatement measures.* The following noise abatement measures may be considered for incorporation into a Type I or Type II project to reduce traffic noise impacts. The costs of such measures may be included in Federal-aid participating project costs with the Federal share being the same as that for the system on which the project is located.

(1) Construction of noise barriers, including acquisition of property rights, either within or outside the highway right-of-way. Landscaping is not a viable noise abatement measure.

(2) Traffic management measures including, but not limited to, traffic control devices and signing for prohibition of certain vehicle types, time-use restrictions for certain vehicle types, modified speed limits, and exclusive lane designations.

(3) Alteration of horizontal and vertical alignments.

(4) Acquisition of real property or interests therein (predominantly unimproved property) to serve as a buffer zone to preempt development which would be adversely impacted by traffic noise. This measure may be included in Type I projects only.

(5) Noise insulation of Activity Category D land use facilities listed in Table 1. Post-installation maintenance and operational costs for noise insulation are not eligible for Federal-aid funding.

§772.17 Information for local officials.

(a) To minimize future traffic noise impacts on currently undeveloped lands of Type I projects, a highway agency shall inform local officials within whose jurisdiction the highway project is located of:

(1) Noise compatible planning concepts;

(2) The best estimation of the future design year noise levels at various distances from the edge of the nearest travel lane of the highway improvement where the future noise levels meet the highway agency's definition of "approach" for undeveloped lands or properties within the project limits. At a minimum, identify the distance to the exterior noise abatement criteria in Table 1;

(3) Non-eligibility for Federal-aid participation for a Type II project as described in §772.15(b).

(b) If a highway agency chooses to participate in a Type II noise program or to use the date of development as one of the factors in determining the reasonableness of a Type I noise abatement measure, the highway agency shall have a statewide outreach program to inform local officials and the public of the items in §772.17(a)(1) through (3).

§772.19 Construction noise.

For all Type I and II projects, a highway agency shall:

(a) Identify land uses or activities that may be affected by noise from construction of the project. The identification is to be performed during the project development studies.

(b) Determine the measures that are needed in the plans and specifications to minimize or eliminate adverse construction noise impacts to the community. This determination shall include a weighing of the benefits achieved and the overall adverse social, economic, and environmental effects and costs of the abatement measures.

(c) Incorporate the needed abatement measures in the plans and specifications.

Table 1 to Part 772—Noise Abatement Criteria

[Hourly A-Weighted Sound Level_{decibels (dB(A))}¹]

| Activity category | Activity Leq(h) | Criteria ² L10(h) | Evaluation location | Activity description |
|-------------------|-----------------|------------------------------|---------------------|---|
| A | 57 | 60 | Exterior | Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose. |
| B ³ | 67 | 70 | Exterior | Residential. |
| C ³ | 67 | 70 | Exterior | Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of |

| | | | | |
|----------------|----|----|----------|--|
| | | | | worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings. |
| D | 52 | 55 | Interior | Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios. |
| E ³ | 72 | 75 | Exterior | Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F. |
| F | | | | Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing. |
| G | | | | Undeveloped lands that are not permitted. |

¹Either Leq(h) or L10(h) (but not both) may be used on a project.

²The Leq(h) and L10(h) Activity Criteria values are for impact determination only, and are not design standards for noise abatement measures.

³Includes undeveloped lands permitted for this activity category.

APPENDIX B - Land Use Activity Categories and Noise Abatement Criteria

Table 1. Land Use Activity Categories and Noise Abatement Criteria

| <u>Activity Category</u> | <u>Activity Criteria¹</u> <u>L_{eq}(h), dBA</u> | <u>Evaluation Location</u> | <u>Activity Description</u> |
|--------------------------|---|----------------------------|---|
| A | 57 | Exterior | Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose. |
| B ² | 67 | Exterior | Residential. |
| C ² | 67 | Exterior | Active sport areas, amphitheatres, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings. |
| D | 52 | Interior | Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios. |
| E ² | 72 | Exterior | Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A–D or F. |
| F | --- | --- | Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing. |
| G | --- | --- | Undeveloped lands that are not permitted. |

¹Activity Criteria values are for impact determination only, and are not design standards for noise abatement measures.

²Includes undeveloped lands permitted for this activity category.

Is the proposed noise abatement measure engineering feasible

Yes No

Reasonableness

Is the proposed noise abatement measure considered reasonable?

Yes No

Federal Mandatory Factors

- 1 **Cost Effectiveness.** Is the abatement measure cost effective?
- 2 **Views of Benefited Residents and Property Owners.** Do at least 60 percent of the impacted residents and property owners' surveyed desire noise abatement?
- 3 **Noise reduction design goal?** Does the noise abatement measure provide 7 dBA reduction to 50 percent or more of the benefitted receptors in the first row of structures?

DOT&PF Mandatory Factors (State funded only)

- 4. **Development vs. Highway Timing.** Were at least 50 percent of benefitted receptors in the development built before highway construction?
- 5 **Development Existence.** Have at least 50 percent of benefitted receptors in the development existed for at least 10 years?
- 6 **Absolute Predicted Build Noise Level.** Are the predicted future build noise levels at least 66dBA?
- 7 **Relative Predicted Build Noise Level.** Are the predicted future build noise levels at least 10 dBA greater than the existing noise levels?
- 8 **Build vs. No-Build Noise Levels.** Are the future build noise levels at least 5 dBA greater than the future No-Build noise levels?
- 9. **Land Use.** Is the land use changing rapidly and are there local ordinances or zoning in place to control the new development of noise sensitive land uses adjacent to transportation corridors?

Is Noise Abatement recommended for this impacted receptor(s)?

What type of noise abatement is recommended? (Note – The use of quiet pavements is not an approved noise abatement measure on Federal- Aid Projects. Quiet pavements can be utilized as an abatement measure on State-funded projects with the approval of the Regional Preconstruction Engineer)

What is the basis for this recommendation?

Regional Environmental Manager

Date

DOT&PF Project Manager

Date

I have determined that the use of quiet pavement to mitigate noise impacts on a state-funded project is within the cost constraints of the legislative appropriation for the proposed project.

Preconstruction Engineer ³

Date

³ The Preconstruction Engineer's signature is only required if quiet pavements are recommended on State-funded projects. The Preconstruction Engineer must determine whether the incorporation of quiet pavements into the State-funded project is within the cost constraints of the legislative appropriation

APPENDIX B

Noise Study Methodology/Traffic Data

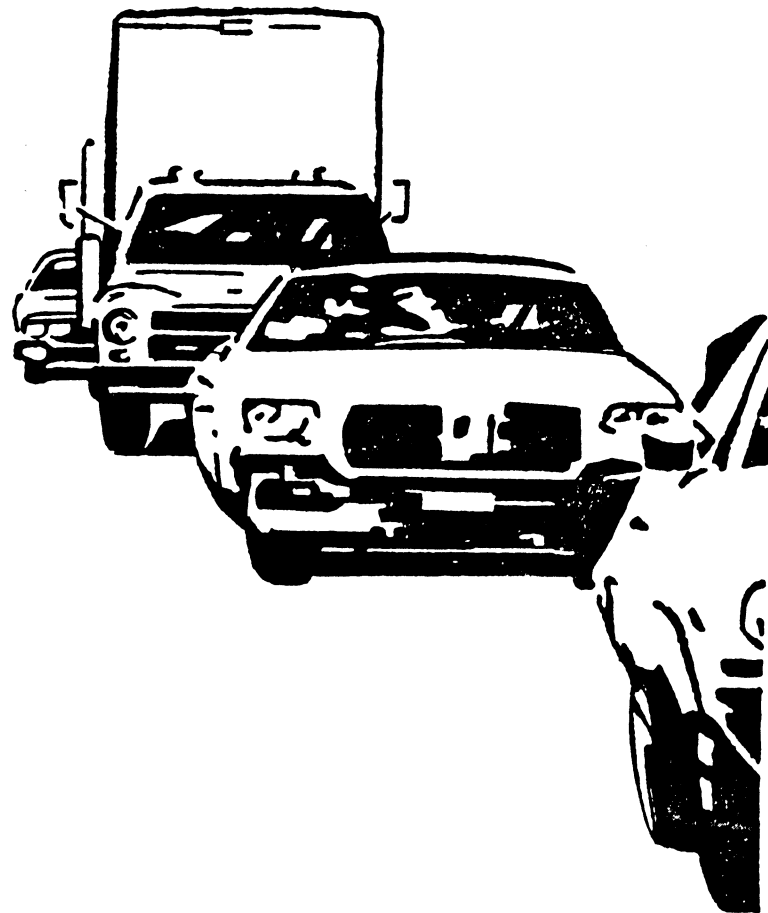
**Advanced Prediction and Abatement of Highway Traffic Noise
(FHWA Publication, June 1982)**

**September 22,2016
Noise Procedure and Input Memo**

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ADVANCED PREDICTION AND ABATEMENT
OF HIGHWAY TRAFFIC NOISE

Federal Highway Administration
Office of Environmental Policy
June 1982



NON-HIGHWAY NOISE SOURCES

INTRODUCTION

It is important to understand the contribution of noise sources other than the highway in order to determine the total noise exposure in an area, for both "existing" and "after" conditions. This understanding permits an estimate of the relative impact of highway noise, and also permits one to evaluate the benefits of highway noise control actions. For example, if aircraft noise exposure is equal to highway noise exposure, reducing highway noise by 15 dB through construction of a noise barrier reduces the total noise level by only 3 dB. Thus, constructing the barrier is not a very cost-effective action. On the other hand, if there is a railroad line adjacent to the highway, it may be possible to develop a noise barrier design which provides shielding to the community for both highway and railroad sources, thus providing a meaningful reduction in the total noise environment if the rail noise exposure is significant.

This section will cover predictions of noise exposure for several common sources at critical receiver locations. Why do we not just measure the noise levels from these sources? Unlike highways, many transportation systems exhibit considerable variability over a 24-hour period, making measurement of the noise exposure

for just a few key hours unrealistic. Further, for some sources there is considerable variability from day to day, making it difficult to select the proper day for making measurements. Finally, to evaluate "after" conditions, some sources may be expected to change with time, so predictions are necessary for future conditions.

In this section prediction procedures will be provided for general community noise, railroad line operations noise, and the noise of civil aircraft flight operations. Several sources that may occur in a community that will not be covered in this section include industrial noise, construction noise, the noise in the vicinity of railroad yards, and military and general aviation flight operations noise and all aircraft ground operations noise. Many of these sources are quite site specific, and not readily amenable to simplified prediction procedures. In some cases, as for certain industries, noise exposure does not change considerably and determination of levels can be obtained through measurements.

Before we get into the details concerning each prediction method, we must discuss the noise descriptors that will be utilized, so that the noise exposure from each noise source will be dealt with in a similar manner.

The average or equivalent sound level, over a time period T,

can be expressed as:

$$L_{eq}(T) = 10 \log \frac{1}{T} \int_T 10^{L(t)/10} dt$$

where L_{eq} is the equivalent sound level, in dB, $L(t)$ is the A-weighted instantaneous sound level as a function of time, in dB, and T is the calculation or measurement period. Since the L_{eq} represents the average A-weighted acoustic energy occurring over a time period T , the L_{eq} from several sources can be compared on a common basis, or combined together to provide a total L_{eq} for the noise environment. Many other common descriptors (such as L_{max} , L_{10} , L_{50}) cannot be combined together in this way. Also, such descriptors are not all meaningful for some sources (such as L_{50} for aircraft). As indicated by the above equation, the equivalent sound level is determined through knowledge of the A-weighted sound level at each moment of time. For many sources where the noise environment consists of a series of discrete single events, separated by periods of time when no noise occurs, a useful measure for calculation purposes is the sound exposure level, SEL. The sound exposure level is defined as follows:

$$SEL = 10 \log \int_{t_1}^{t_2} 10^{L(t)/10} dt$$

where SEL is the sound exposure level, in dB, and t_1 and t_2 are the times at the beginning and conclusion of the

noise event, defined as the times at which the noise level first rises within 10 decibels of the maximum level, and then falls below 10 decibels of the maximum level, respectively. As shown in Figure 4-1, the sound exposure level converts the A-weighted acoustic energy during the noise event into an average value, averaged over a reference duration of 1 second. Then, if there is one such event during time period T , the equivalent sound level during this period can be determined by:

$$L_{eq}(T) = SEL + 10 \log \frac{1}{T}$$

If there are N equal events during time period T , the equivalent level can be described as follows:

$$L_{eq}(T) = SEL + 10 \log \frac{1}{T} + 10 \log N$$

What time period T is most useful for community noise analysis? For $T=1$, $L_{eq}(1)$ is the hourly equivalent sound level, often used in highway noise analysis, where the hour chosen is the peak or design hour. For $T=24$, $L_{eq}(24)$ is the 24 hour equivalent sound level. Even more useful than the 24 hour L_{eq} is the day-night sound level, L_{dn} , in dB. The day-night sound level is the same as the 24 hour L_{eq} , except that noise levels occurring during nighttime hours (10 p.m. to 7 a.m.) are increased by 10 dB before averaging to account for people's greater sensitivity to noise

during these hours. If the hourly equivalent sound level is known for all 24 hours of the day, the L_{dn} is the energy average of all the 24 L_{eq} 's, with 10 dB added to the 9 L_{eq} 's corresponding to the night hours, before averaging:

$$L_{dn} = 10 \log \frac{1}{24} \sum_{i=1}^{24} 10^{[L_{eq}(1)_i + w_i]/10}$$

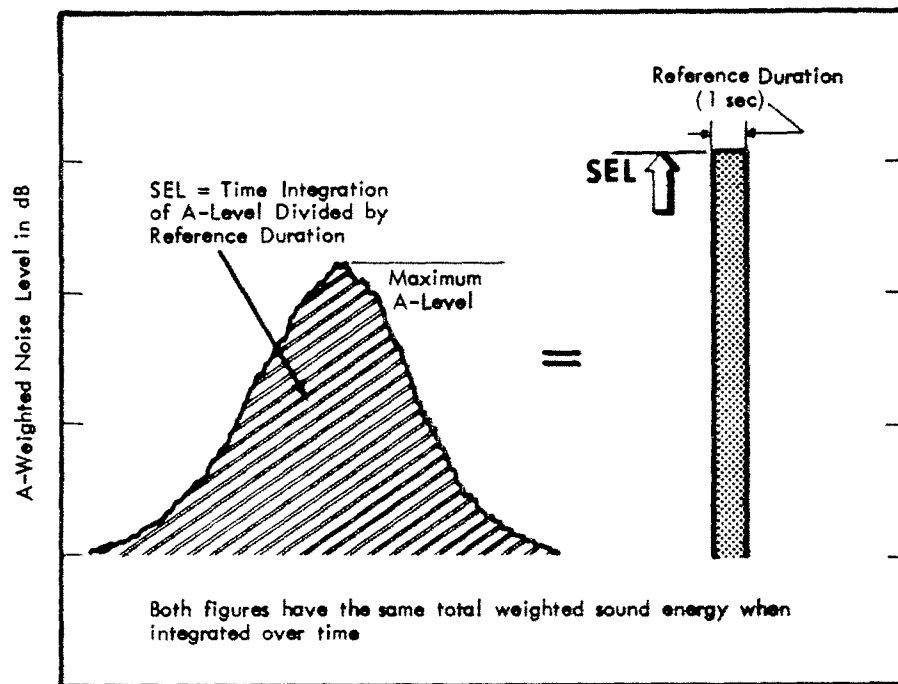
where $w_i = 0$ for $i = 1-7, 23, 24$

$w_i = 10$ for $i = 8-22$

Figure 4-2 shows the 24 hourly L_{eq} 's near a roadway plotted as a function of time, with the L_{dn} indicated on the figure.

The day-night sound level is now used for assessing community noise exposure and impact by HUD, in its "Noise Assessment Guidelines"; EPA, as the primary measure of community noise exposure; FAA, as the measure for aircraft noise assessment; the military, in its Tri-Services Noise Planning Manual; and NBS, in its Design Guide. Further, in a recent inter-agency agreement, EPA, DOT, HUD, DOD, and the Veteran's Administration recognize and recommend the use of the day-night level for defining land use compatibility guidelines.

Why has L_{dn} become so popular among these government agencies? There are many reasons. The day-night



TIME →

FIGURE 4-1

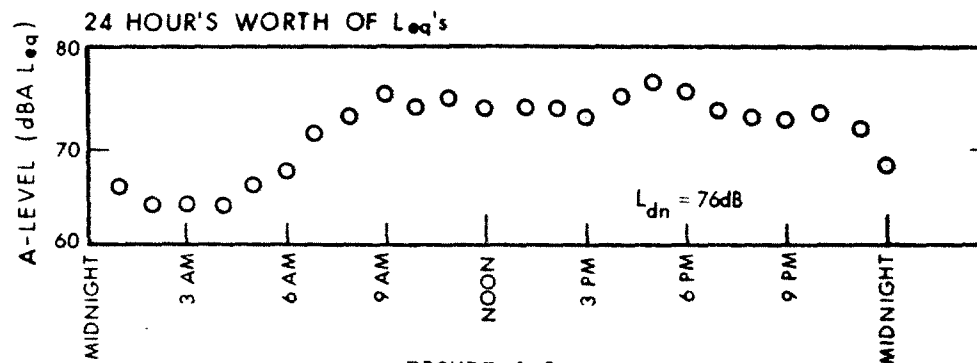


FIGURE 4-2

level correlates well with community response, and this correlation holds true for many different sources. See, for example, Figure 4-3, in which the day-night level is plotted as a function of the percentage of the community highly annoyed by different noise sources, for sources ranging from airports to roadways to railroad lines. Further, the L_{dn} is relatively easy to measure for many sources, with today's sophisticated measurement instrumentation. Finally, from many sources the L_{dn} is relatively easy to predict as will be seen in the following sections.

COMMUNITY NOISE

Model Development

It has been determined in a number of studies that surface transportation noise is the greatest contributor to environmental noise. Over a large range of population and population densities, several facts concerning transportation are relevant to the development of a noise prediction model. First, motor vehicles are the pre-dominant source of surface transportation noise. Also, the number of automobiles per person is relatively constant, as is the ratio of trucks to automobiles. Further, the usage of vehicles is directly proportional to the population density of an area. Finally, for non-freeway traffic in urban areas the average vehicle speed is generally constant. Since traffic noise is proportional to 10 times the logarithm of the number of vehicles

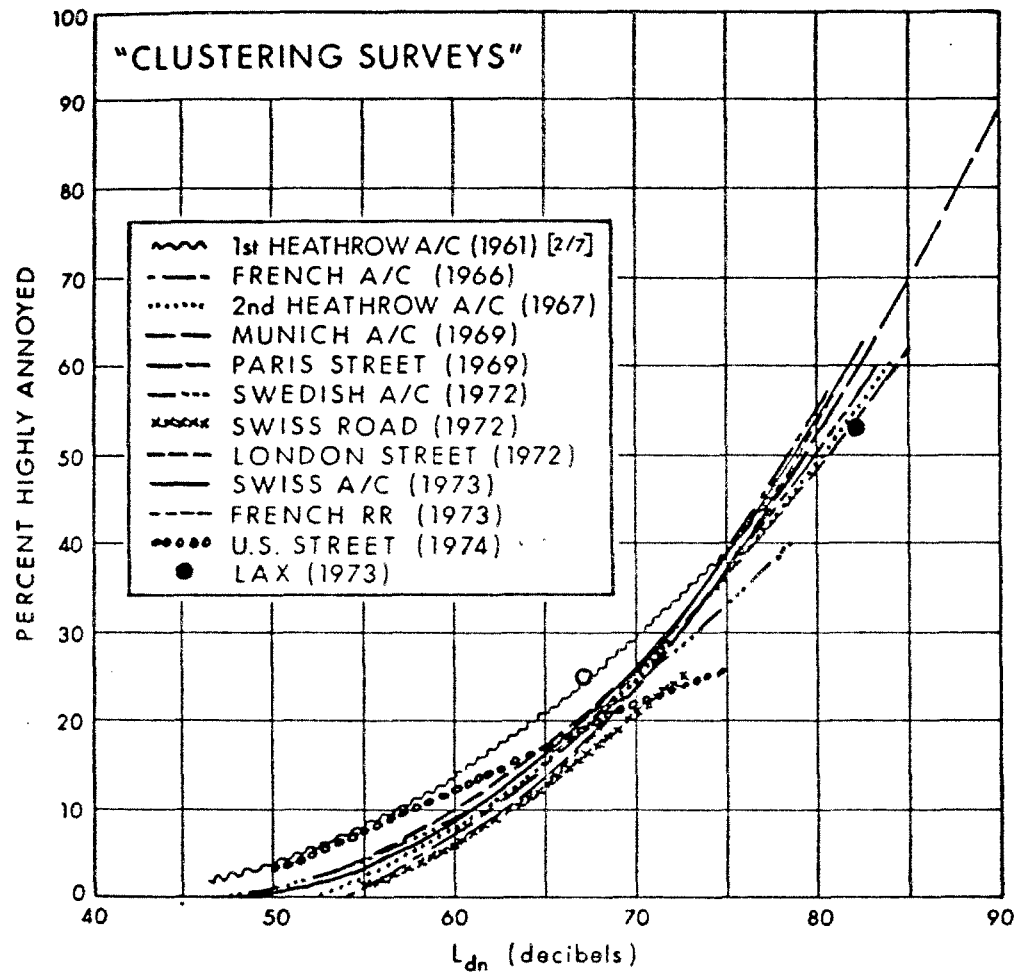


FIGURE 4-3

for a given speed, this leads to the conclusion that community noise is approximately proportional to 10 times the logarithm of the population density in an urbanized area.

Model Validation and Application

To test these hypotheses, day-night sound level measurements were obtained at over 100 locations spread across 14 urban areas of the United States (in the regions identified in Figure 4-4). A plot of the measured day-night sound level as a function of the population density of the area is shown in Figure 4-5. A line through these data points takes the form of:

$$\overline{L}_{dn} = 10 \log \rho + 22 \text{ dB}$$

where \overline{L}_{dn} is the average day-night sound level in the area, with a standard deviation of 4 dB, and ρ is the population density of the census tract in people per square mile which contains the measurement location. This equation, then, provides an estimate of the average day-night sound level in an area given knowledge of the area's population density. This day-night sound level is the background existing noise in the community, away from major highways, airports and other site-specific major noise sources. The average value can be assumed to be accurate to within a standard deviation of 4 dB.

RAILROAD LINE OPERATIONS

Comparison With Highway Operations

There are a number of striking similarities between rail operations on railroad lines and highway operations. In both cases, operations occur on fixed paths. Individual vehicles move past an observation point at a relatively constant speed. There are a limited number of vehicle types with relatively similar frequency spectra. Differences between rail and highway operations relate primarily to the noise emission levels of individual vehicles, and the time pattern of the operations. For rail operations, there are fewer vehicles in a given time period, with an irregular pattern throughout the day. (See Fig. 4-6.)

However, since the hourly equivalent level near a highway is determined by averaging the acoustic energy of individual vehicle passbys, and then summing over all vehicles, the hourly equivalent level for railroad operations can be determined in a similar manner. Thus, except for changes in vehicle categories and associated emission levels, we can use the FHWA manual method for rail line operations.

Noise Sources

Rail vehicles can be categorized into two major types: locomotives and rail cars. Diesel-electric locomotives haul over 99% of the trains in the United States. The diesel engine drives an alternator or generator, which powers an electric traction motor on the wheels. There are eight throt-

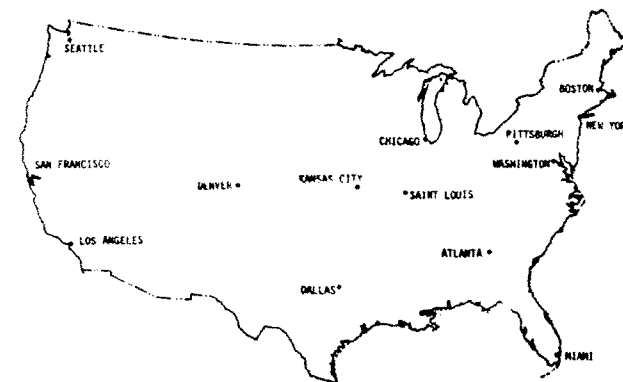


FIGURE 4-4

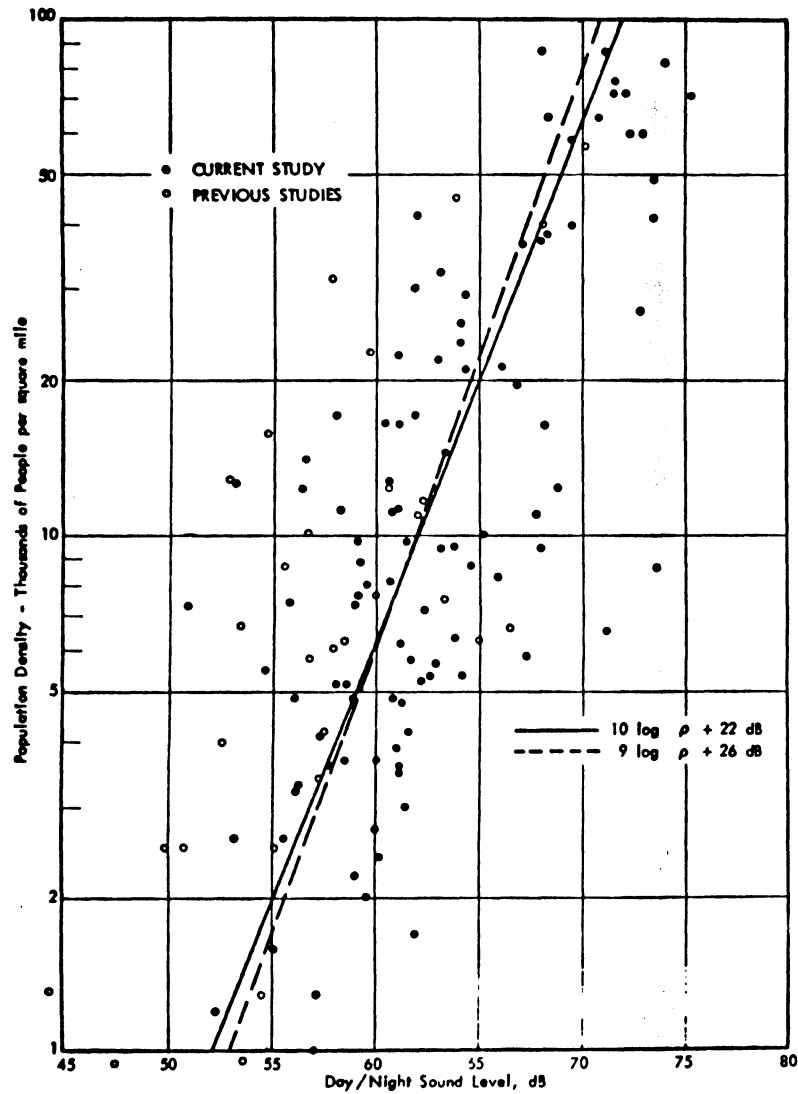


FIGURE 4-5

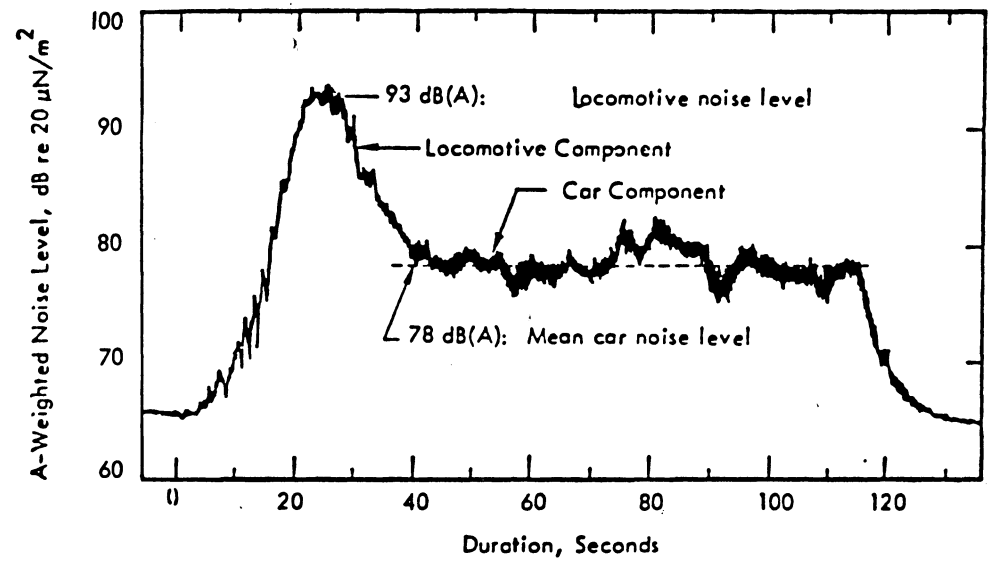


FIGURE 4-6

tle or power settings, in addition to idle. The noise level varies with throttle setting. The electrical system acts as an automatic transmission: for a given throttle setting, there is constant load for different speeds. Therefore the maximum level is speed-independent. Exhaust noise is the dominant sound.

For rail cars, the wheel/rail interaction is the major source. Resulting noises include the roar, or rolling noise, which increases as 30 log of the speed; impact, or the clickety-clack noise over joints and track irregularities, (jointed rail is 6 dB noisier than continuously welded rail); and squeal, which occurs over tight curves and is a high-pitched sound. Finally, at grade crossings and other selected locations, horn and whistle soundings can be an important source of noise for nearby community residents.

Rail Noise Prediction Method

The steps below permit prediction of rail noise day-night sound level using the FHWA traffic noise prediction model.

1. Categorize all rail vehicles on the track into two categories, diesel locomotives, and rail cars (including freight, passenger, and rapid transit cars).

2. For each of these categories, tabulate the number of such vehicles passing by the observer during daytime and nighttime periods, N_d and N_n . Remember that daytime is from 7 a.m. to 10 p.m., and nighttime is from 10 p.m. to 7 a.m.
3. For each category, tabulate the average vehicle speed (note that if there are major differences in speed for the same vehicle category, for example freight trains at 30 mph, passenger trains at 60 mph, both with locomotives and rail cars, divide the category into sub-categories by speed).
4. For each category or sub-category i , determine the effective number of operations, N_{eff} , by adding N_d to 10 times N_n .
5. Use the FHWA traffic noise prediction model, with the following modifications: (a) Use the reference energy mean emission levels for diesel locomotives and rail cars, shown in Figure 4-7. (b) Replace N_i with N_{effi} . (c) Replace $T=1$ hour with $T=24$ hours, or, equivalently, subtract 13.8 dB. Equation 1 of the FHWA model now becomes:

$$L_{dni} = (L_o)_{E_i} + 10 \log \left(\frac{N_{effi} D_o}{S_i} \right) + 10 \log \left(\frac{D_o}{D} \right)^{1+\alpha}$$

-25-13.8.

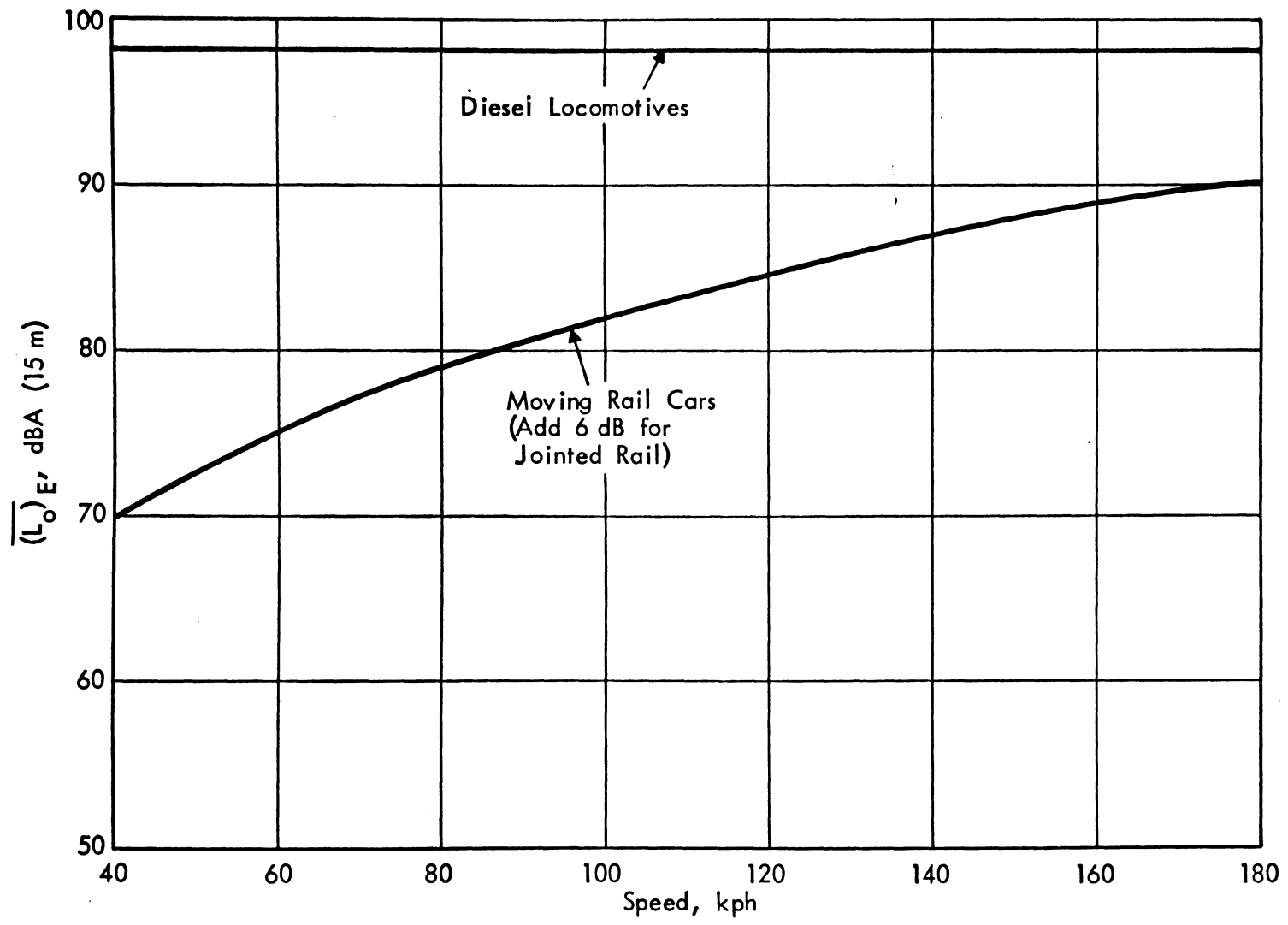


FIGURE 4-7

The model now predicts L_{dni} for category i of rail vehicles, instead of $L_{eq}(h)_i$ for category i of highway vehicles.

One additional factor must be considered in the estimation of rail line noise. If horns or whistles are sounded in the vicinity of the observer, the resulting noise exposure must be included in the summation of the L_{dni} 's for all categories and sub-categories of vehicles. Since the typical horn or whistle will produce a sound exposure level roughly 10 dB higher than the SEL of a diesel locomotive, the L_{dn} contribution for horns or whistles can be determined as follows:

$$L_{dnhw} = L_{dnd1} + 10 + 20 \log \frac{D}{D_{hw}}$$

where L_{dnhw} is the horn/whistle L_{dn} contribution, L_{dnd1} is the diesel locomotive L_{dn} contribution, and D_{hw} is the shortest distance from the observer to the location at which the horn or whistle is sounded. From this equation, if D_{hw} is more than 10 times D , the horn or whistle does not contribute to the total L_{dn} .

Except for the horn/whistle L_{dn} contribution, the procedures in the FHWA traffic noise prediction model can be used to estimate any barrier shielding effects, the influence of rows of houses, etc. If

the horn/whistle sounds are shielded, estimation of the L_{dn} contribution might best be determined through measurements.

EXAMPLE:

There are ten freight trains daily (including three at night) on a flat, straight track 60 m. from a location of interest. Each train consists of 3 locomotives and 60 rail cars, and travels at 64 kph. The terrain is "soft", and the track has continuously welded rail.

$$\begin{aligned} \text{For locomotives, } N_{eff} &= 3[7+10(3)] \\ &= 3(37) = 111 \end{aligned}$$

$$\begin{aligned} L_{dni} &= 98 + 10 \log \left(\frac{111 \times 15}{64} \right) + 10 \log \left(\frac{15}{60} \right)^{1.5} \\ &\quad - 25 - 13.8 = 64 \text{ dB} \end{aligned}$$

$$\begin{aligned} \text{For rail cars, } N_{eff} &= 60[7+10(3)] \\ &= 60(37) = 2220 \end{aligned}$$

$$\begin{aligned} L_{dni} &= 76 + 10 \log \left(\frac{2220 \times 15}{64} \right) + 10 \log \left(\frac{15}{60} \right)^{1.5} \\ &\quad - 25 - 13.8 = 55 \text{ dB} \end{aligned}$$

$$\text{Total } L_{dn} = 65 \text{ dB.}$$

AIRCRAFT FLIGHT OPERATIONS

Comparison With Highway Operations

There are major differences between aircraft and highway operations. ~~With aircraft operations~~

there are multiple, variable paths, as well as numerous types and categories of aircraft. In the vicinity of an airport, we are primarily interested in the noise during takeoff and landing (not the noise of cruising). See Figure 4-8 which depicts the kinds of activities occurring in the vicinity of an airport.

Since we will be concerned with aircraft in the air, noise levels at the observer locations will be based upon air-to-ground sound propagation, rather than ground-to-ground sound propagation, with no concern for the impact of shielding elements. Further, there are relatively few noise events, but those that do occur have very high noise levels. The pattern of operations is irregular throughout the day and may well vary from day-to-day or month-to-month.

The noise impact from aircraft operations extends perhaps many miles from the source. A final difference relates to the varied frequency spectra among aircraft types and between aircraft and highway vehicles.

Noise Sources

For jet aircraft, the two major sources are the jet exhaust noise and turbo machinery and fan noise (see Figure 4-9). Jet exhaust noise is a roar due to the

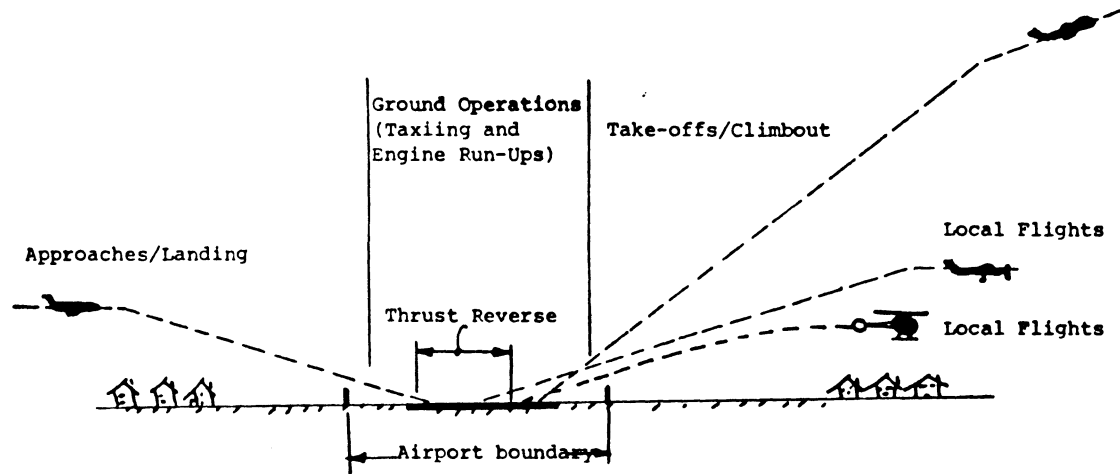


FIGURE 4-8

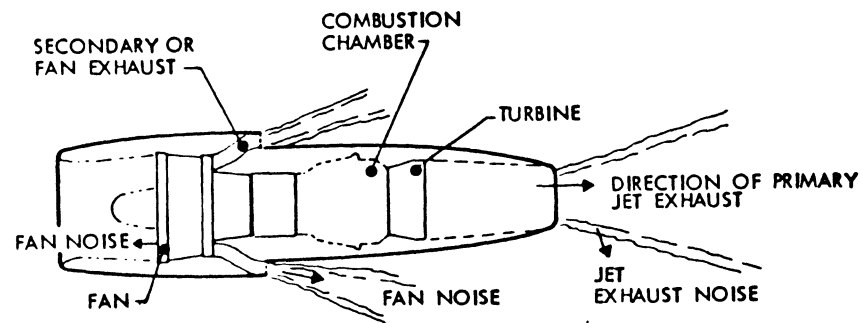


FIGURE 4-9

turbulent mixing of high velocity exhaust gases. It is broad-band in spectrum, with maximum radiation angle of approximately 45° (see Figure 4-10 for a directionality pattern). Because of these directionality characteristics, the maximum noise of a jet aircraft often occurs after the jet aircraft has passed. The noise level will vary with the 6th to 8th power of exhaust velocity. Turbo-machinery and fan noise is also broadband, with strong discrete frequency components, often called pure tones, associated with the blade passage frequency and its harmonics. The blade passage frequency is the number of blades in the compressor or fan multiplied by the rotational frequency.

There are a number of different kinds of jet aircraft engines. In the turbojet engine, the main source of noise is the jet exhaust, with turbo-machinery noise becoming important only when jet noise is greatly reduced such as under landing conditions. In the turbofan or bypass fan engine, some intake air bypasses the combustion chamber producing a lower effective exhaust velocity. This reduces the jet exhaust noise, but the intake fan (see Figure 4-9) generates pure tones in the 2000 to 4000 Hz frequency range. Finally, in the high bypass turbofan engine, there is an even higher ratio of intake air which bypasses the combustion chamber. In this engine the effective exhaust velocity is greatly reduced, as is the jet exhaust noise.

The inlet guide vanes, fan blades, and outlet vanes of the intake fan are designed to reduce the pure tone level, and shift the tones to less annoying frequencies so that the high bypass turbofan engine, as is found on the newer wide-bodied aircraft such as the B747, L-1011 and DC-10 aircraft, is, for its thrust, relatively quiet.

Propeller aircraft have two major sources of noise, vortex noise and rotational noise. Vortex noise is generated by the formation and shedding of vortices (whirlpools of air) in the flow past the propeller rotor or fan blades. It is broadband in frequency content. Rotational noise consists of pure tones occurring at harmonics of the blade passage frequency. It is generated by the oscillating pressure field on the air due to the passage of the blade. For helicopters, there is also a "blade slap". Fluctuating forces on the blades resulting from cutting one blade's tip vortices by another blade create high amplitude rotational noise plus highly modulated vortex noise. This blade slap has been observed to be quite annoying in the vicinity of helicopter operations.

Aircraft Noise Prediction

In this section we will refer to three techniques for estimating aircraft noise exposure levels. The first technique is to make use of existing noise exposure contours (see Figure

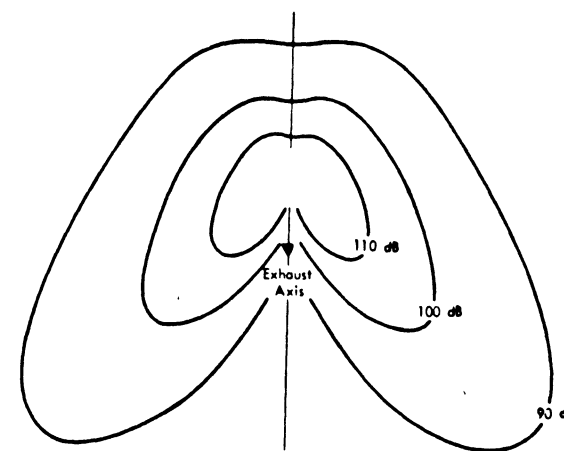


FIGURE 4-10

4-11, for example). For many civil, military, and general aviation airports, noise exposure contours are already available from local government and/or airport authorities. These are often generated as part of an airport master plan, airport expansion or environmental assessment study. If such contours are available, simply locate the site under study on the map and read the noise exposure levels from the contour map.

It is possible to develop approximate contours with a simple set of charts. Since this method is not extremely accurate, it is best used to screen the noise exposure to determine if aircraft impact is significant relative to highway impact. The procedure is as follows:

1. Determine the total number of daytime jet operations, N_d .
2. Determine the total number of nighttime jet operations, N_n .
3. Determine the effective number of operations, $N_{eff} = N_d + 10 N_n$.
4. Enter the charts in Figure 4-12 to determine distances A and B. These distances are used to draw a lozenge-shaped noise contour for different contour values of L_{dn} as illustrated in the top portion of the figure.
5. Draw the contours of appropriate dimensions around each airport

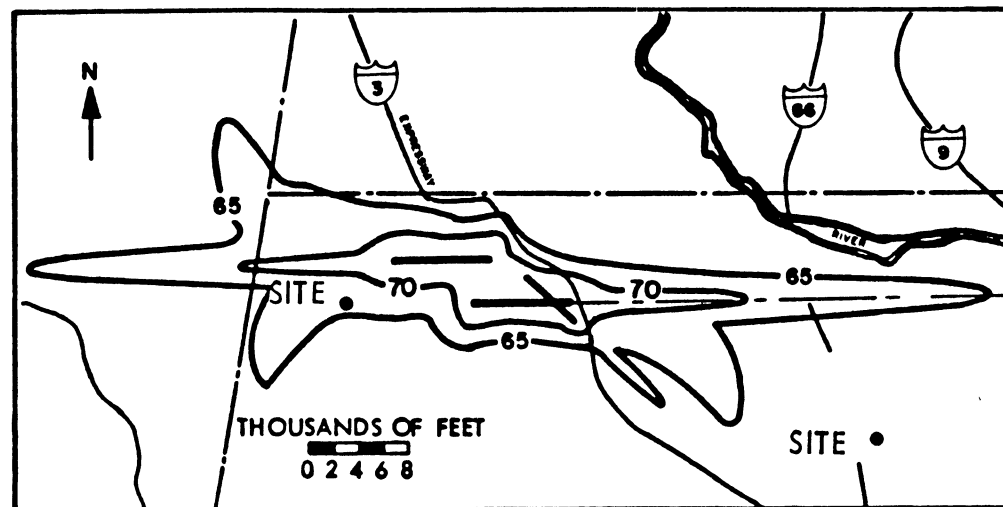


FIGURE 4-11

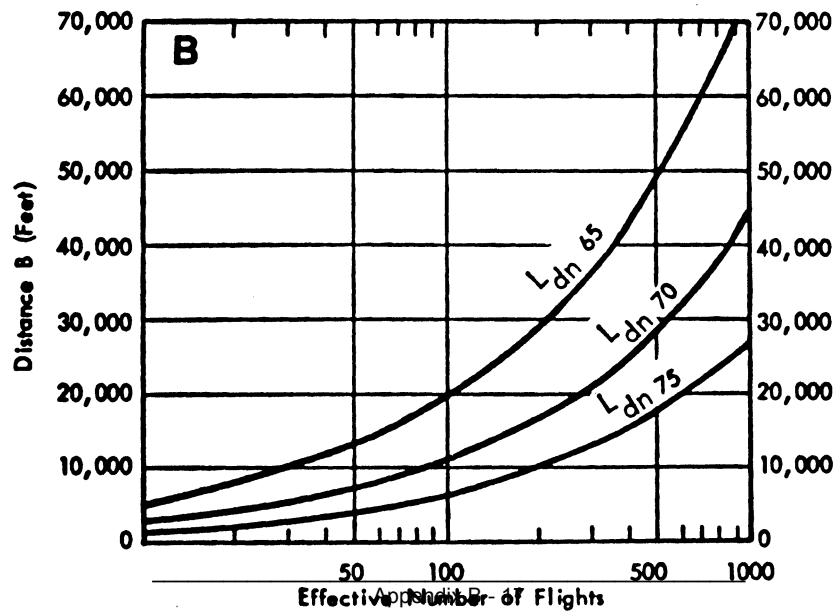
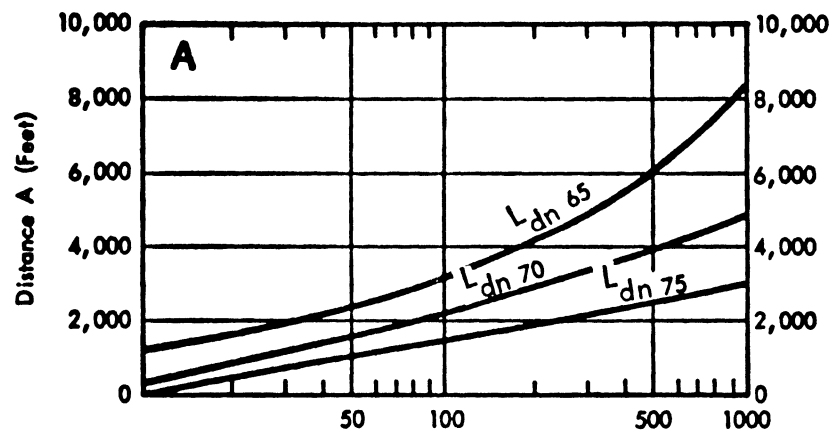
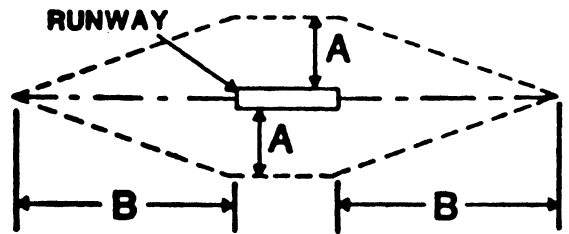


FIGURE 4-12

runway.

6. Locate the area of interest and determine the approximate aircraft L_{dn} value.
7. If aircraft L_{dn} is at least 10 dB below the highway L_{dn} , ignore the aircraft contribution. If the aircraft contribution is not to be ignored determine the aircraft L_{dn} more accurately, as outlined in the procedure to follow.

EXAMPLE:

A site is located near an airport with two runways. There are 125 daytime and 10 nighttime jet operations. Draw approximate contours and determine if the L_{dn} at the site is at or above 65 dB.

For these operations, $N_{eff} = 125 + 10(10) = 225$. From the charts $A = 2000$ and 4200 ft for the 65 and 75 dB contours, and $B = 11,000$ and $31,000$ ft for the same contours. The resulting contours are shown in Figure 4-13; the site L_{dn} is well below 65 dB.

The more accurate prediction of aircraft L_{dn} values is adopted from an EPA handbook "Calculation of Day-Night Levels (L_{dn}) Resulting from Civil Aircraft Operations" (EPA Report 550/9-77-450). The procedure outlined in this handbook permits the prediction of the day-night level at a single point, rather than the develop-

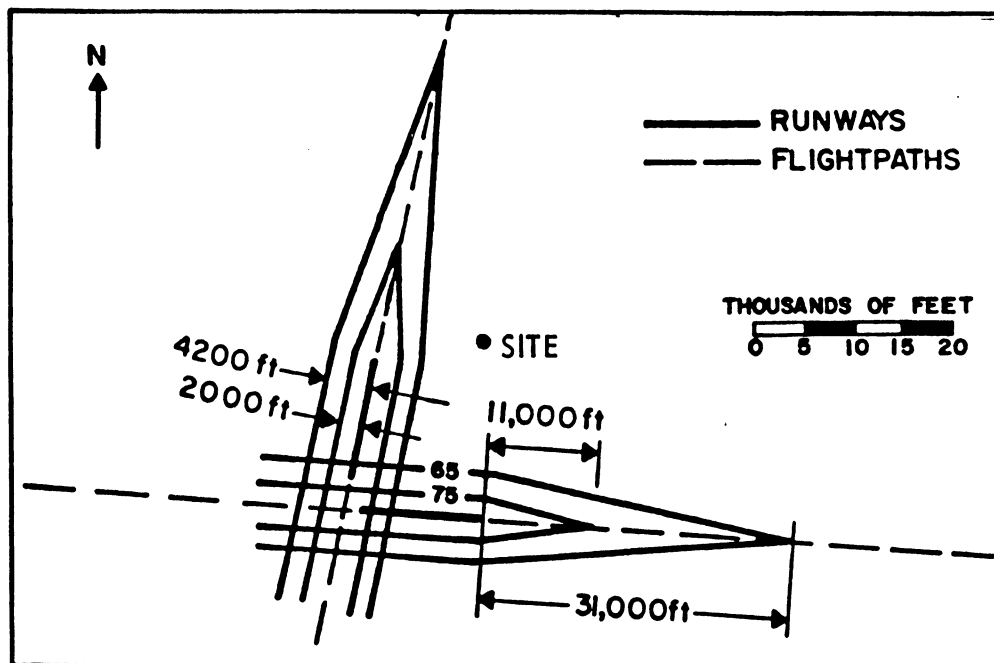


FIGURE 4-13

ment of actual noise contours. In this method, aircraft noise is categorized by type of aircraft and type of operation. The noise exposure contribution of each aircraft operation is described by its sound exposure level, SEL. For each type of aircraft operation, i , the L_{dni} is determined according to the equation:

$$L_{dni} = SEL_i + 10 \log(N_{di} + 10 N_{ni}) - 49.4$$

The total L_{dn} is then just the decibel sum of the L_{dni} 's of contributing aircraft types. Steps in the procedure are as follows:

1. Gather field information. Determine the physical layout and length of runways, and location of major flight tracks relative to the observer position. Figures 4-14 and 4-15 define two important parameters, D_1 and D_2 for both takeoff and approach operations. These distances will be used below in the determination of SEL values. Determine the various types of aircraft and their operational characteristics, and the number of daytime and nighttime operations for each aircraft type. Determine flight path utilizations and whether any special procedures exist.
2. Determine the SEL for each contributing aircraft event. The handbook contains a series of noise charts, such as the example shown in Figure 4-16. The charts are

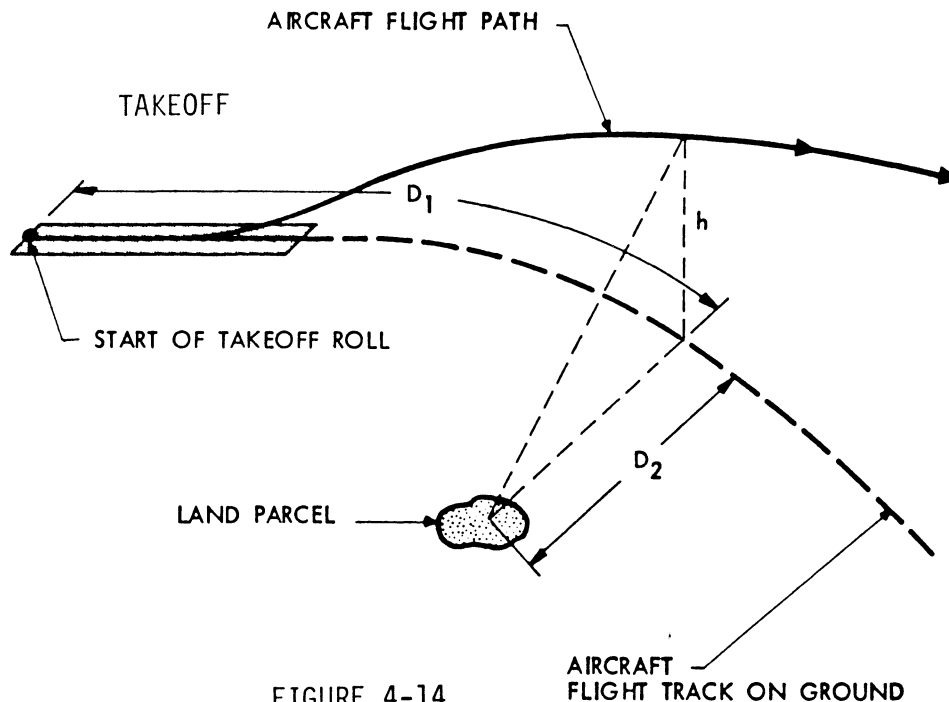


FIGURE 4-14

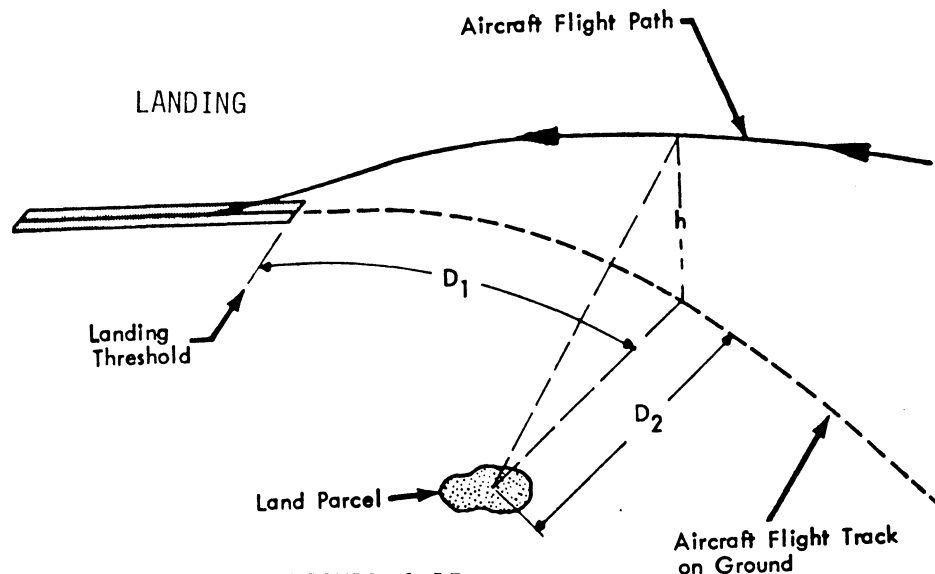


FIGURE 4-15

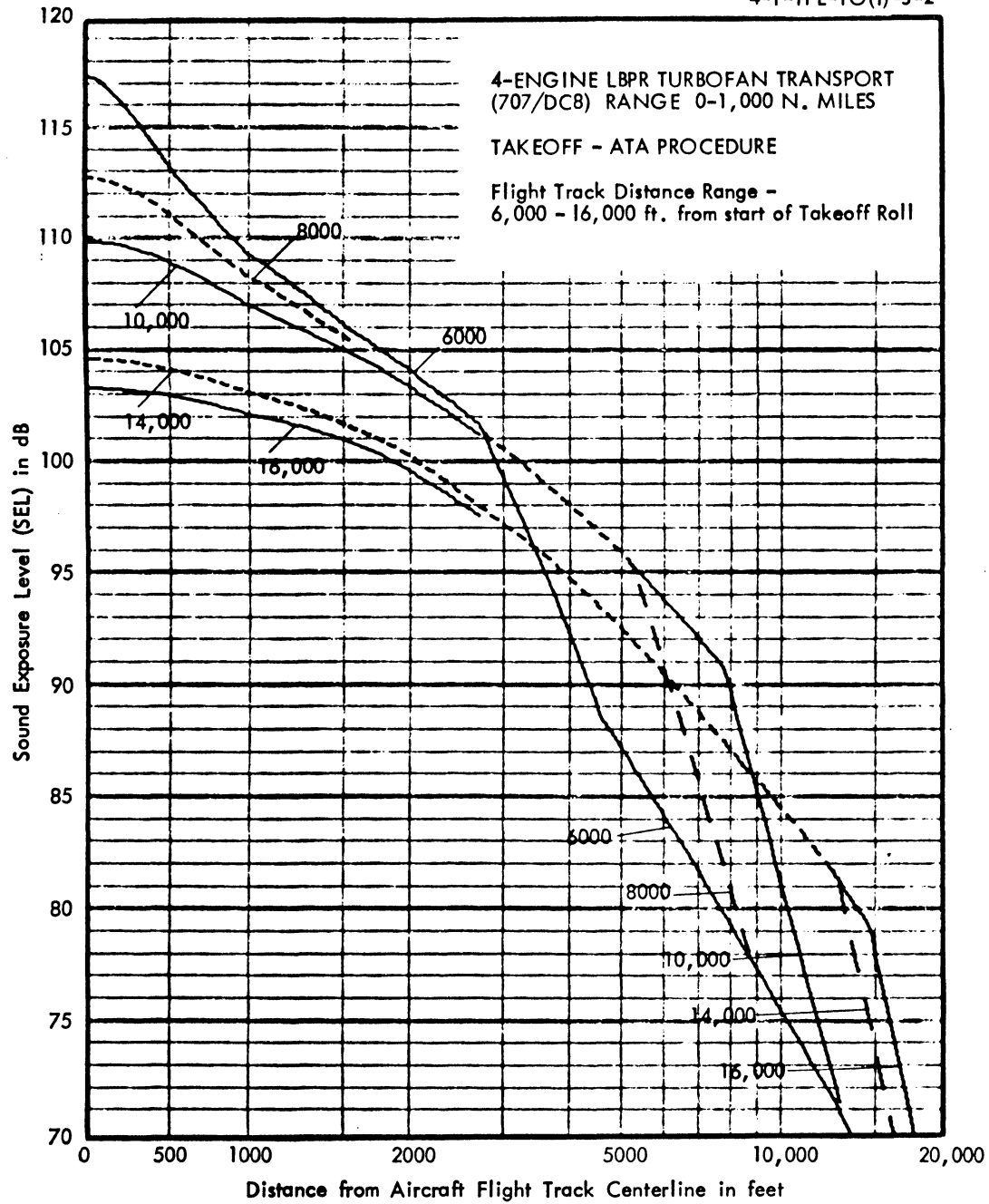


FIGURE 4-16

identified by a 6 component code, based on number of engines, type of aircraft, type of operation, and type of engines (see the handbook for more details). Select the noise chart corresponding to the aircraft event in the vicinity of the observer location. With the appropriate values of D_1 and D_2 , read the SEL from the chart.

3. Compute the partial day-night level. For each category of aircraft event, determine the value of K from the chart shown in Figure 4-17 using N_d and N_n . The chart depicts graphically the equation $K = 49.4 - 10 \log (N_d + 10 N_n)$. The partial L_{dn} is simply the sound exposure level value minus K for each category of aircraft.
4. Add the partial L_{dn} values together to obtain the total L_{dn} for all operations.

A worksheet, shown in Figure 4-18, is included in the handbook to facilitate the tabulation of operational information, noise data, and the final calculations. Also, Figure 4-19 lists noise levels by aircraft type at a single location, to give the reader a feeling for the relative noisiness of individual types of aircraft.

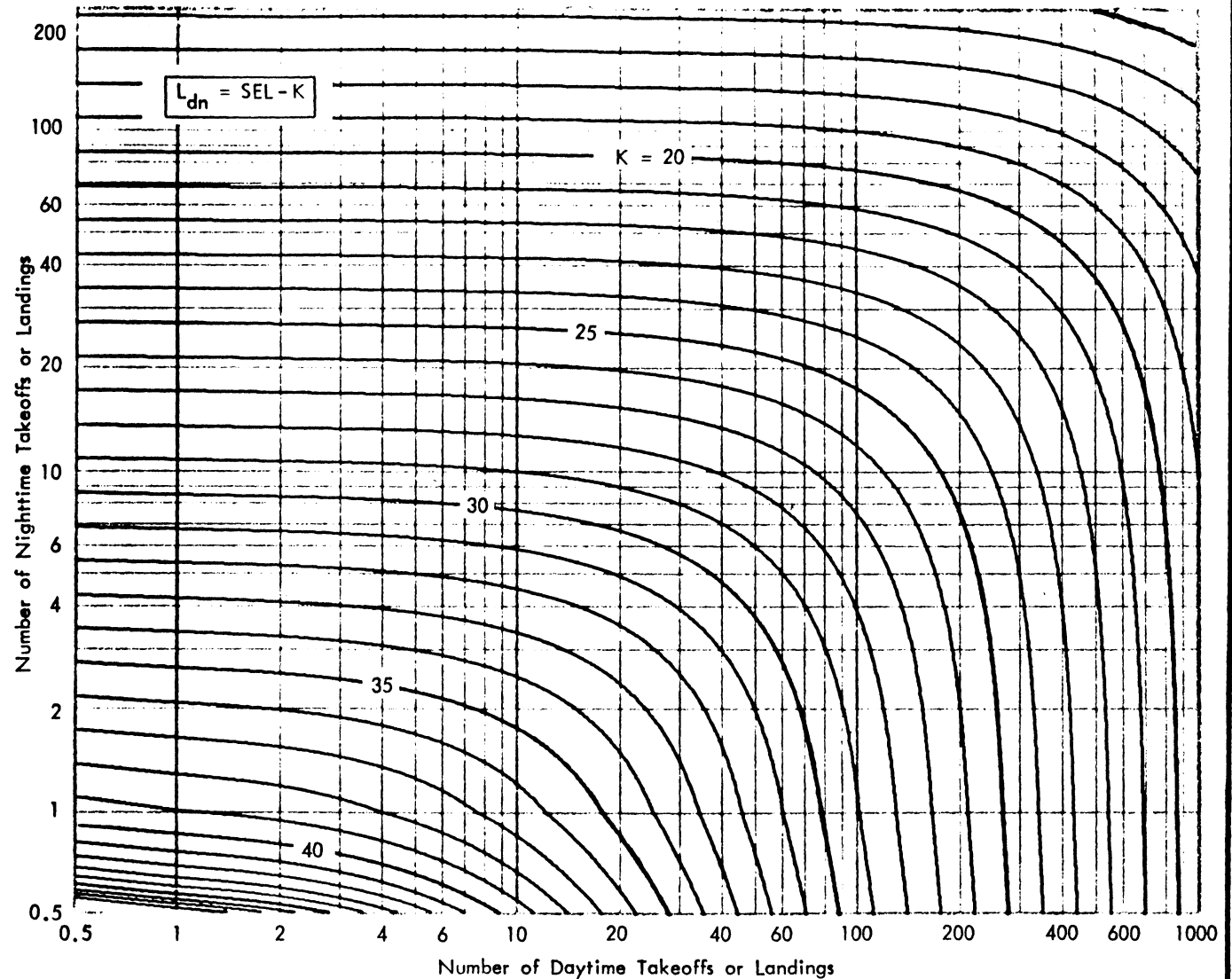


FIGURE 4-17

EXAMPLE:

A particular runway is used exclusively by 4-engine LBPR turbofan aircraft (eg. 707's). There are 30 daily takeoffs, including 3 at night. Estimate the L_{dn} at a location 800 feet to the side of the flight track, at a point 18,000 feet from start of takeoff roll.

At this location $D_1=18,000$ and $D_2=800$. From the chart, the SEL for these parameters is 103 dB. For 27 daytime takeoffs and 3 nighttime takeoffs $K=32$. Then $L_{dn}=103-32 = 71$ dB.

Other Aircraft Noise Descriptors

Although the day-night level is the noise descriptor utilized in this document, there are two other descriptors of which the reader should be aware.

The first of these is the Community Noise Equivalent Level, or CNEL. This measure is used exclusively in California. The CNEL is similar to the day-night level, except that an adjustment of 5 dB is utilized for evening hours (7 p.m. to 10 p.m.) in addition to the nighttime adjustment of 10 dB. Otherwise, the CNEL is identical to the day-night level, and for most situations, CNEL equals L_{dn} . The second measure to be aware of is the noise exposure forecast, or NEF. NEF values are based on summation of effective perceived noise level, or EPNL, values instead of SEL

AIRPORT _____ FLIGHT TRACK MAP OTHER

| | | | | | |
|------------------|--|--|--|--|--|
| TRACK | | | | | |
| AIRCRAFT | | | | | |
| OPERATION | | | | | |
| N_D | | | | | |
| N_N | | | | | |
| D_1 | | | | | |
| D_2 | | | | | |
| CHART | | | | | |
| SEL | | | | | |
| K | | | | | |
| PARTIAL L_{DN} | | | | | |

TOTAL L_{DN} _____

FIGURE 4-18

values. EPNL values differ from SEL values in that the perceived noise level weighting instead of the A-weighting is used in the measure (this weighting puts somewhat more emphasis on the low-frequency portion of the spectrum), and the EPNL incorporates a "pure tone" penalty in the measure. Also, the NEF incorporates a night-time weighting factor of 16.67 instead of 10. The noise exposure forecast was developed earlier than the day-night level, but is still used in some parts of the country and by some agencies, even though most agencies have shifted over to the day-night level descriptor. To a first approximation, L_{dn} equals NEF plus 35 dB.

SUMMATION OF SOURCES

Thus far, prediction procedures have been described to permit the estimation of the day-night level for generalized background noise, railroad line operations, and civil aircraft operations. In order to combine these with the noise of highway operations, the day-night level due to highway operations must be determined as well. If we assume that the peak hour equivalent sound level has already been determined at the point of interest for the highway, the steps to determine the day-night sound level are as follows:

1. Determine the peak hour percentage of the 24-hour volume.

NOISE CHART CODES ASSOCIATED WITH AIRCRAFT TYPES
RANKED BY APPROXIMATE NOISINESS

| <u>Aircraft Type</u> | <u>Aircraft Code</u> | <u>Typical Aircraft</u> | <u>Takeoff SEL at 15,000 ft. from Start of TO¹, dB</u> | <u>Landing SEL at 6,000 ft. from Threshold², dB</u> |
|---|----------------------|--|---|--|
| 4-Engine HBPR turbofan | 4-T-TFH | 747 | 111.5 | 108.3 |
| 4-Engine LBPR turbofan | 4-T-TFL | 707, DC-8 | 110.9 | 106.4 |
| 4-Engine LBPR turbofan (quiet nacelle) | 4-T-TFL(Q) | 707(QN) DC-8(QN) | 109.7 | 97.2 |
| 3-Engine LBPR turbofan | 3-T-TFL | 727 | 109.6 | 101.1 |
| 3-Engine LBPR turbofan (quiet nacelle) | 3-T-TFL(Q) | 727(QN) | 109.3 | 96.1 |
| 4-Engine HBPR turbofan (quiet nacelle) | 4-T-TFH(Q) | 747(QN) | 108.6 | 103.1 |
| 2-Engine Composite Business Jet (turbojet/turbofan) | 2-G-TJ | Jetstar I, Learjet 23-25, Learjet 35-36, Jetstar II | 104.9 | 101.3 |
| 2-Engine LBPR turbofan | 2-T-TFL | 737, DC-9 | 101.9 | 94.3 |
| 2-Engine LBPR turbofan | 2-T-TFL(Q) | 737(QN), DC-9(QN) | 101.9 | 93.1 |
| 3-Engine HBPR turbofan | 3-T-TFH | L-1011, DC-10 | 101.8 | 98.8 |
| 4-Engine propeller | 4-T-PP | DC-4, DC-6 | 98.8 | 90.3 |
| 4-Engine turboprop | 4-T-TP | Electra | 97.8 | 92.1 |
| 2-Engine G.A. ³ turboprop | 2-G-TP | Twin Otter, King Air, Turbo Commander | 93.5 | 92.4 |
| 2-Engine G.A. ³ propeller (large) | 2-G-LPP | DC-3 | 92.5 | 87.3 |
| 2-Engine G.A. ³ propeller (small) | 2-G-SPP | Cessna 310-401 | 83.2 | 80.5 |
| 2-Engine G.A. ³ turbofan (small) | 2-G-TFS | Cessna Citation | 81.4 | 80.3 |
| 1-Engine G.A. ³ propeller | 1-G-PP | Cessna 150-210, Piper Cher.140-235 | 81.8 | 72.9 |

¹ATA (Air Transport Association) takeoff procedure at max. weight category
²3° approach
³General aviation

FIGURE 4-19

2. Determine the daytime and nighttime percentages of the 24-hour volume.
3. Use the charts in Figure 4-20 to obtain adjustments Δ_1 and Δ_2 .
4. The day-night level is then the summation of the peak hour L_{eq} with Δ_1 and Δ_2 .

This approximation for the day-night level incorporates certain assumptions. It is assumed that the speed of highway vehicles remains relatively unchanged throughout most of the day. It also assumes that the volume percentages used in the charts in Figure 4-20 are appropriate to both automobiles and heavy trucks. It should be pointed out that the method is relatively insensitive to these assumptions, however, since it has been found for many roadways studied that the L_{dn} is equal to the peak hour L_{eq} +2 dB. This makes sense if one looks at the charts for typical traffic flows in which the peak hour percentage ranges from 8 to 12 percent and the nighttime percentage of the ADT ranges from 10 to 20 percent.

The total day-night level at each observer point is then the decibel sum of the contributing L_{dn} 's due to highway, rail, and aircraft sources, and the general background community noise.

EXAMPLE:

A site is exposed to L_{dn} values of 58 dB from aircraft overflights and 62 dB from a nearby railroad track. Also, the peak hour L_{eq} from a highway in the area is 65 dB. For this highway, the peak hour traffic is 8% of the ADT, and daytime traffic accounts for 80% of the ADT. Determine the total L_{dn} for the site, if it is located in an area with a population density of 5000 people per square mile.

$$\text{For } \rho = 5000, L_{dn} = 10 \log(5000) + 22 = 59 \text{ dB}$$

$$\text{For the highway, } \Delta_1 = -2.8; \\ \Delta_2 = 4.5.$$

$$L_{dn} = 65 - 2.8 + 4.5 = 67.$$

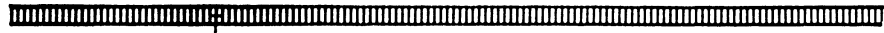
The total L_{dn} is the sum of 58 (aircraft), 62 (railroad), 67 (highway) and 59 (background), or 69 dB.

A complete example for the student to try is depicted on the next page. First, compute the L_{dn} due to the highway alone, due to all other sources, and due to all sources. Then examine the benefit of barriers which reduce highway noise only, by 5, 7, 10 and then 15 dB. How effective are these barriers? (SEL data for aircraft are attached.)

| Peak Hour % of ADT | Δ_1 , dB | |
|-----------------------|-----------------|--|
| 4 | 0.2 | |
| 5 | -0.8 | |
| 6 | -1.6 | |
| 7 | -2.3 | |
| 8 | -2.8 | |
| 9 | -3.3 | |
| 10 | -3.8 | |
| 11 | -4.2 | |
| 12 | -4.6 | |
| 13 | -4.9 | |
| 14 | -5.3 | |
| 15 | -5.6 | |
| 17 | -6.1 | |
| 20 | -6.8 | |

| Day % of ADT | Nite % of ADT | Δ_2 , dB |
|-----------------|------------------|-----------------|
| 100 | 0 | 0 |
| 95 | 5 | 1.6 |
| 90 | 10 | 2.8 |
| 85 | 15 | 3.7 |
| 80 | 20 | 4.5 |
| 75 | 25 | 5.1 |
| 70 | 30 | 5.7 |
| 65 | 35 | 6.2 |
| 60 | 40 | 6.6 |

FIGURE 4-20



RAILROAD OPS

14 Trains/Day
1 Train / Nite
4 Locos, 100 Cars/Train
100 kph Speed

150 m

"HARD" TERRAIN

50 m ● SITE (P = 8,000/sq mi)

HIGHWAY OPS

$L_{eq} = 73$ dB
ADT = 40,000 Veh.
Peak Hour = 4,000 Veh.
Nite Vol = 6,000 Veh.

1500 ft

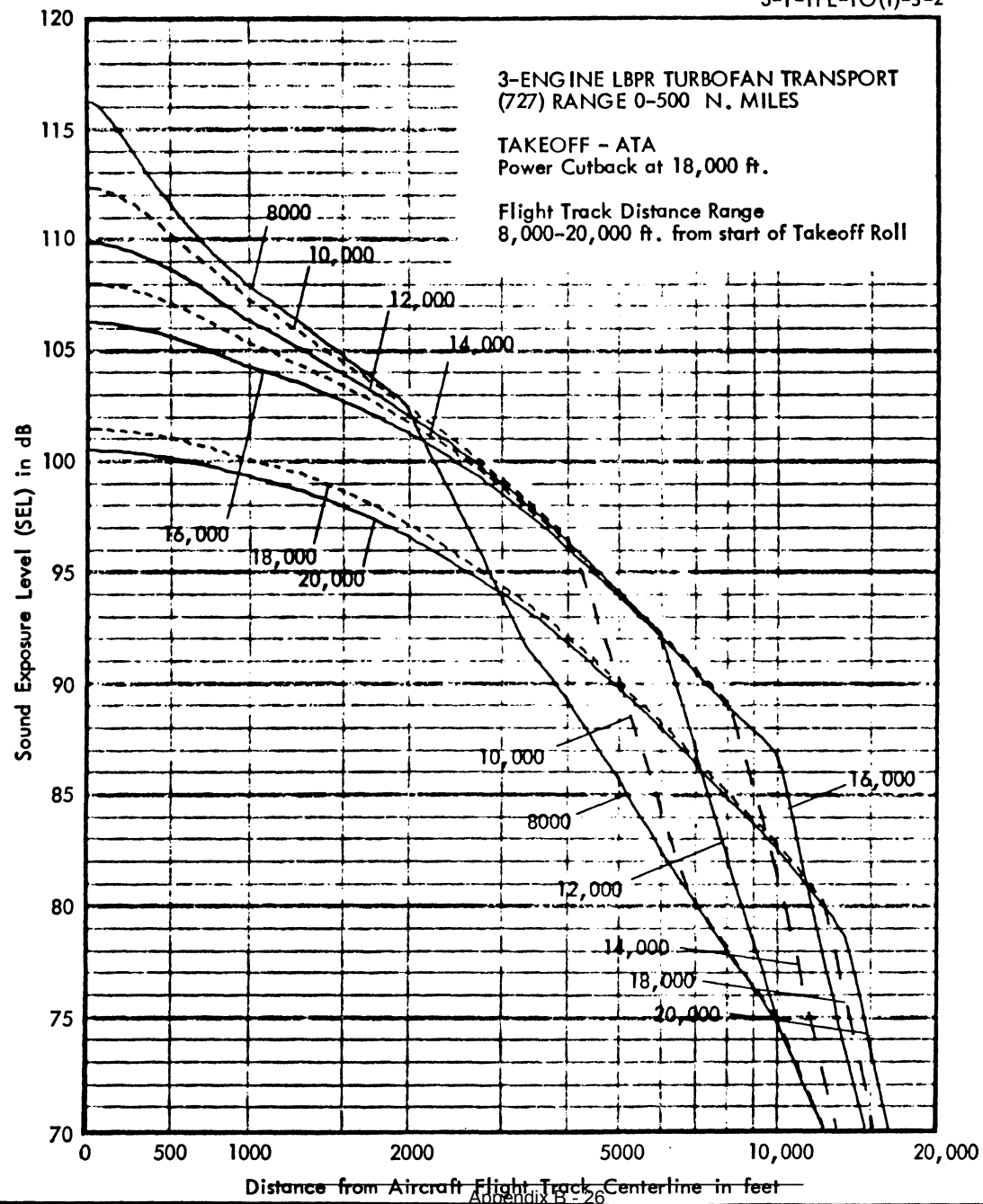
20,000 ft From Start of Takeoff

Takeoff Flight Track Centerline

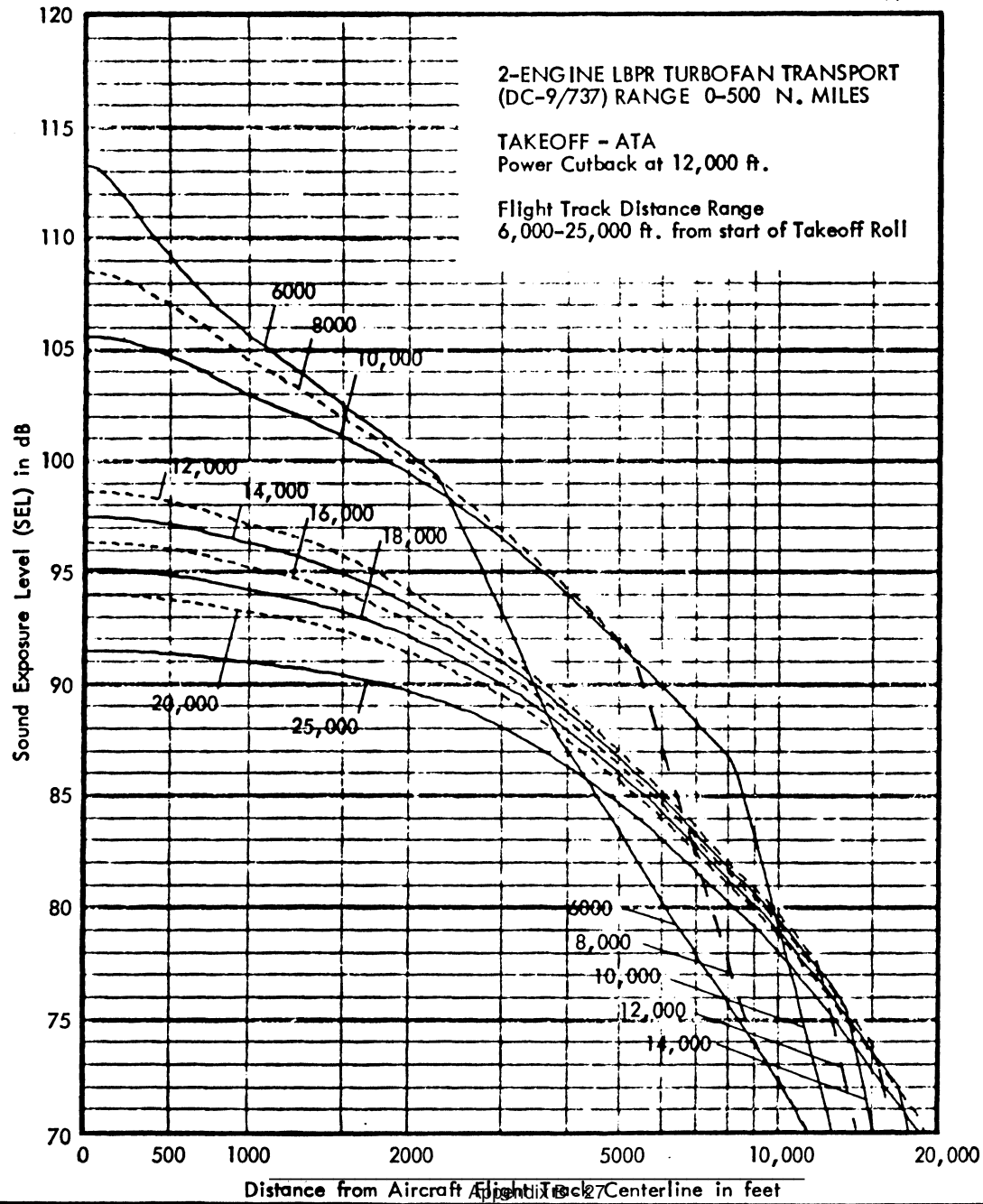
727 OPS
2/Day
2/Nite

737 OPS
35/Day
5/Nite

3-T-TFL-TO(I)-S-2



2-T-TFL-TO(I)-S-2



SOLUTION TO THE EXAMPLE

1. L_{dn} (Background) = $10 \log (8000) + 22 = 61$

2. L_{dn} (RR):

Locos: $L_{dn} = 98 + 10 \log \frac{24 \cdot 4 \cdot 15}{100} + 10 \log \frac{15}{150} - 25 - 13.8$

Rail Cars: $L_{dn} = 82 + 10 \log \frac{100 \cdot 24 \cdot 15}{100} + 10 \log \frac{15}{150} - 25 - 13.8$

$L_{dn} = 60.8 + 58.8 \approx 63 \text{ dB}$

3. L_{dn} (A/C):

727 : SEL = 98, K = 36, $L_{dn} = 62$

737 : SEL = 92, K = 30, $L_{dn} = 62$

Total A/C $L_{dn} = 62 + 62 = 65 \text{ dB}$

4. L_{dn} (H/W): $73 + (-3.8) + 3.7 \approx 73$

5. Effect of Noise Barrier:

| | No Barrier | Highway Barrier NR | | | |
|------------------|------------|--------------------|------|-------|-------|
| | | 5 dB | 7 dB | 10 dB | 15 dB |
| Highway L_{dn} | 73 | 68 | 66 | 63 | 58 |
| Other L_{dn} | 68 | 68 | 68 | 68 | 68 |
| Total L_{dn} | 74 | 71 | 70 | 69 | 68 |



MEMORANDUM

TO: Tom J. Schmid, P.E., Project Manager
State of Alaska Department of Transportation & Public Facilities

FROM: Steve K. Noble, P.E., PTOE, Project Manager *SKN*

DATE: September 22, 2016

SUBJECT: **Noise Consultation Document for Seward Highway:
MP 105 to MP 107 Windy Corner Project
Project No. 0A3134/Z566310000**

PROJECT SUMMARY:

DOWL is proposing to the State of Alaska Department of Transportation and Public Facilities (DOT&PF) to conduct noise monitoring activities at four (4) locations along the Seward Highway from Milepost (MP) 105 to MP 107 in support of the Seward Highway: MP 105 to MP 107 Windy Corner Project. Safety improvements identified in this project involve shifting the highway alignment to meet current design standards, dividing the highway, and constructing auxiliary lanes. This project is jointly funded through federal and State of Alaska sources. Due to the proposed addition of auxiliary lanes and alteration to the horizontal alignment and vertical profile, the Seward Highway MP 105 to MP 107 Project is defined as a Type I project under the 2011 Alaska DOT&PF Noise Policy.

NOISE MONITORING LOCATIONS:

The figure in Attachment A shows the proposed monitoring locations and the existing land-use designations within the study area. The proposed monitoring locations include representative noise sensitive areas along the project corridor as defined by Title 23 Code of Federal Regulations (CFR) Part 772. Per the DOT&PF Noise Policy, receptors were selected for monitoring within the noise study zone, which is defined as a 500-foot outline spanned from the edge of pavement along the study corridor, extending 1,000 feet beyond both project ends. A summary of the proposed monitoring locations can be found in Table 1.

Table 1: Summary of Proposed Noise Monitoring Locations

| Site No. | Noise Sensitive Area | NAC Activity Category | Exterior Area of Frequent Human Use | Description of Measurement Location |
|----------|----------------------|-----------------------|-------------------------------------|-------------------------------------|
| M-1 | Chugach State Park | C | Falls Creek Trailhead | Falls Creek Trailhead |
| M-2 | Chugach State Park | C | Turnagain Arm Trail Site #1 | Windy Corner Trailhead |
| M-3 | Chugach State Park | C | MP 107 Rock Climbing Area | Recreational Area |
| M-4 | Chugach State Park | C | Turnagain Arm Trail Site #2 | Turnagain Arm Trail Site #2 |

Only one noise-sensitive area was identified in the project noise study zone:

- Chugach State Park (CSP): Section 4(f) land encompasses the entire project extents. The approach Noise Abatement Criteria (NAC) level for this activity category is 66 A-weighted decibels (dBA).

The following Activity Categories were considered within the identified noise-sensitive areas for noise monitoring and modeling as a part of this project:

Activity Category A – Lands in which serenity is a significant factor and serve an important public need: Not present in the study area.

Activity Category B – Residential Sites: Not present in the study area.

Activity Category C – State Park: Four (4) monitoring sites are selected to represent areas of frequent human use within the CSP surrounding the Seward Highway belonging to Category C. CSP is a publicly-owned park/recreation area managed by the Alaska Department of Natural Resources (DNR) and qualifies for protection under Section 4(f). Note that sites located within project right-of-way (ROW) are exempt from Section 4(f); a summary of these sites can be seen in Table 2. Note that the Windy Corner Sheep Viewing Area near MP 106.5 was not included as a noise-sensitive site because it is part of a joint project between DOT&PF and DNR. These activities are exempt from consideration per the Section 4(f) Policy Paper (Attachment B), which provides additional details concerning the Federal Highway Administration (FHWA) guidelines for state parks.

Activity Category D – Interior Areas: Not present in the study area.

Activity Category E – Developed / Commercial Lands: Not present in the study area.

Activity Category F – Non-Sensitive Developed Areas: Not present in the study area.

Activity Category G – Undeveloped lands that are not permitted for future development: Not present in the study area.

Table 2: Summary of Exempt Noise Monitoring Locations

| Location | Exterior Area of Frequent Human Use | Exemption |
|--------------------------|--|---|
| MP 107 (Mountain Side) | Vehicle Pullout | Located within existing and proposed ROW |
| MP 106.6 (Ocean Side) | Sheep viewing area | Located within existing & proposed ROW |
| MP 106.5 (Mountain Side) | Sheep viewing area and Turnagain Arm Trail parking | Part of joint corridor development project with DNR |
| MP 105.5 (Mountain Side) | Falls Creek Trail parking | Located within existing & proposed ROW |

NOISE MEASUREMENT PROCEDURE:

Two continuous 15-minute intervals are proposed for each noise monitoring location with a five-minute gap between each 15-minute interval using a RION NL-52 Type I noise meter with a RION NC-74 calibrator. Using the equipment listed above, a noise analyst will be dispatched to collect noise data at each monitoring location within a day. Concurrent traffic conditions (number of vehicles, percentages of medium and heavy trucks including buses and motorcycles, and average travel speeds) will be collected simultaneously along the Seward Highway adjacent to each monitoring site using manual board counters and a radar-gun/piloted vehicle. Conditions such as temperature, sky cover, and wind speed at the time of traffic noise data collection will be recorded for each site including GPS coordinates. The collected noise-level and traffic data will be used to validate the noise model produced using the FHWA Traffic Noise Model (TNM) 2.5 software.

Based on the 2011-2013 DOT&PF Central Region Annual Traffic Report [station number: 11410031 9] included in Attachment C, the highest traffic hours along the highway occur in the evening. It is recommended that noise measurements take place between the hours of 2:00 p.m. and 6:00 p.m. on a Tuesday, Wednesday, or Thursday to ensure a constant stream of traffic along Seward Highway.

TRAFFIC NOISE MODEL DATA INPUT:

Existing and Future Analysis Years: The project Design Designations (see Attachment D) were provided by DOWL to DOT&PF in 2016 and are currently in review for approval. The Design Designations indicate that the existing and design years for the project are 2013 and 2037, respectively. For the noise study, the existing year was adjusted to 2016.

Vehicle Classification: A large component of roadway noise level is determined by vehicle classification. Different vehicles produce different noise levels; larger vehicles such as commercial trucks typically produce a louder noise at a lower pitch than the average passenger car. Average vehicle classifications for the year were obtained from the 2011-2013 DOT&PF Central Region Annual Traffic Report [station number: 11410031 9] (Attachment C). Table 3 summarizes the vehicle classification that will be utilized in the noise analysis.

Table 3: Summary of Vehicle Classification

| Vehicle Type | Vehicle Classification* |
|----------------------------|-------------------------|
| Medium Trucks | 4.64% |
| Heavy Trucks | 2.90% |
| Buses | 0.38% |
| Total Heavy Traffic | 7.92% |
| Motorcycles | 0.43% |

* Based on 2011-2013 DOT&PF Central Region Annual Traffic Report [Location #: 11410031 9]

Average Operating Speed versus Posted Speed: The existing highway has a posted speed of 55 miles-per-hour (mph). Although there are currently no plans to change the posted speed in the Windy Corner area, a 65-mph design speed is proposed. This is to improve safety and allow for some flexibility for future posted speed considerations.

For the purpose of the traffic noise analysis, the future posted speed is typically used to determine noise levels unless the existing average operating speed is found to be consistently higher, according to FHWA-HEP-10-025, page 22. A speed study was conducted to determine the existing average operating speed. The speed study (shown in Attachment E) was conducted on August 31, 2016 between the hours of 4:00 p.m. and 5:00 p.m. in correlation with the hour in which the Design Hourly Volume (DHV) occurs. The results are summarized in Table 4.

The existing average operating speed was found to be 59 mph, which is higher than the 55 mph posted speed. Therefore, it is recommended that existing and future noise levels be predicted using the existing average operating speed.

Table 4: Summary of Traffic Data

| Model Input | Project Approved Design Designations* | | Projected Design Designations for Noise Analysis | |
|--|---------------------------------------|-------------------|--|-------------------|
| | Existing Year, 2013 | Design Year, 2037 | Existing Year, 2016 | Design Year, 2037 |
| Annual Average Daily Traffic (AADT), vpd | 9,283 | 12,747 | 9,659 | 12,747 |
| Design Hourly Volume (DHV), % | 16.6 | 16.6 | 16.6 | 16.6 |
| Design Speed, mph | -- | 65 | -- | 65 |
| Existing Posted Speed, mph | 55 | -- | 55 | -- |
| Existing Average Operating Speed, mph | -- | -- | 59** | 59** |
| Future Posted Speed, mph | -- | 55 | -- | 55 |
| Truck, % | 7.92* | 7.92 | 7.92 | 7.92 |
| Growth Rate, % | 1.33 | 1.33 | 1.33 | 1.33 |
| Directional Split (D), % | 50/50 | 50/50 | 50/50 | 50/50 |

* Based on Design Designations. Refer to Table 3 for the vehicle mixes that will be used for predicting existing and future noise levels.

** Resulting average speed is rounded-up from raw value. Refer to Attachment F for Speed Study, conducted August 2016

Vehicle Volumes: The project corridor is subject to a high seasonal variation in both traffic volumes and vehicle types; this may result in the noisiest hour not coinciding with the DHV. Therefore, an analysis was conducted to determine when the DHV occurs. Monthly, daily, and hourly seasonal factors were obtained for the month of July from the 2011-2013 DOT&PF Central Region Annual Traffic Report [station number: 11410031 9] (Attachment C). The month of July was identified as the month with the highest monthly daily traffic (MDT) volumes for the project corridor. Hourly volumes were calculated for hours between 8:00 a.m. and 9:00 p.m. for each average day in July. The average travel speed (ATS) associated with each volume was then determined by inputting the hourly volumes into the Highway Capacity Software (HCS) 2010. Only hourly volumes larger than the DHV were considered for comparison. Hourly vehicle volumes and corresponding average speeds were then inputted into a generic TNM model to produce noise levels for each combination of vehicle volume and speed.

Noisiest Hour Results: TNM indicated that the noisiest hour in July occurs on Friday, Saturday, and Sunday between 4:00 p.m. and 6:00 p.m., with a calculated two-way hourly traffic volume ranging from 2,166 to 2,222 vehicles per hour (vph) and an ATS ranging from 47.8 mph to 48.2 mph, producing a noise level of 67.2 dBA. This was compared to the predicted noise level of

68.8 dBA resulting from a two-way DHV of 2,116 vph and existing average operating speed of 59 mph. The analysis revealed that the DHV coincides with the noisiest hour for the project corridor. Detailed calculations and results for the analysis can be found in Attachment F.

RAILWAY NOISE ASSESSMENT:

Due to the relocation of the Seward Highway as part of this project, the Alaska Railroad Corporation's (ARRC) railway must likewise be realigned. The railway generates noise that is considered part of the ambient noise level. Therefore, railway noise will need to be included in the existing and future noise level predictions. TNM is not capable of predicting noise levels from a railway source; therefore the following method is proposed to include railroad noise sources in TNM.

The Federal Transit Administration (FTA) provides a spreadsheet to predict noise levels for receivers located nearby railway. This FTA railway noise prediction will assume the following inputs:

- Source Type: "Fixed Guideway" to model railway.
- Specific Source: "Diesel Electric Locomotive" to describe locomotive on ARRC trains.
- Stationary Noise Source: None.
- Average Number of Locomotives/Train: three locomotives for freight, two for passengers.
- Train speed: average travel speed of 40 mph for ARRC trains.
- Average number of events/day: six events per day for freight and ten events per day for passengers.
- Distance from source to receiver (feet): value will be modified based on distance between receiver and railway centerline.

The above inputs are proposed values for modeling railway noise within Windy Corner. These values were obtained through correspondence with ARRC (see Attachment G for ARRC correspondence). The resulting values from these inputs will provide the Leq(day), Leq(night), and Ldn. Since the noisiest hour is expected to occur within the evening peak hour range, the Leq(day) result will be used to estimate railway noise within the noise study zone.

The equations used in the FTA spreadsheet do not account for topography within the study area, and therefore, cannot be used to directly estimate existing and future railway noise levels for each receiver location. Instead, TNM will be adjusted to predict railway noise. This process includes the following steps:

- Creation of a separate generic TNM model in which topography is not a factor. The model will consist of a generic narrow one-way road to represent the railway path with an initial arbitrary number of trucks assigned to it and known train speed provided by the ARRC.
- In the model, distance from source to receiver will be set equal to that for receivers 1 through 4 (see attachment A).
- The volume of heavy trucks along the railway path will then be modified through an iterative process to achieve railway noise levels similar to outputs from the FTA spreadsheet. Once the noise analyst finds a heavy truck volume that achieves noise levels that are ± 3 dBA within the outputs of the FTA spreadsheet for four (4) receiver offsets, then the process is complete.

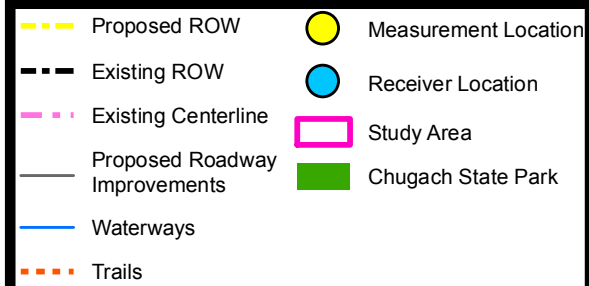
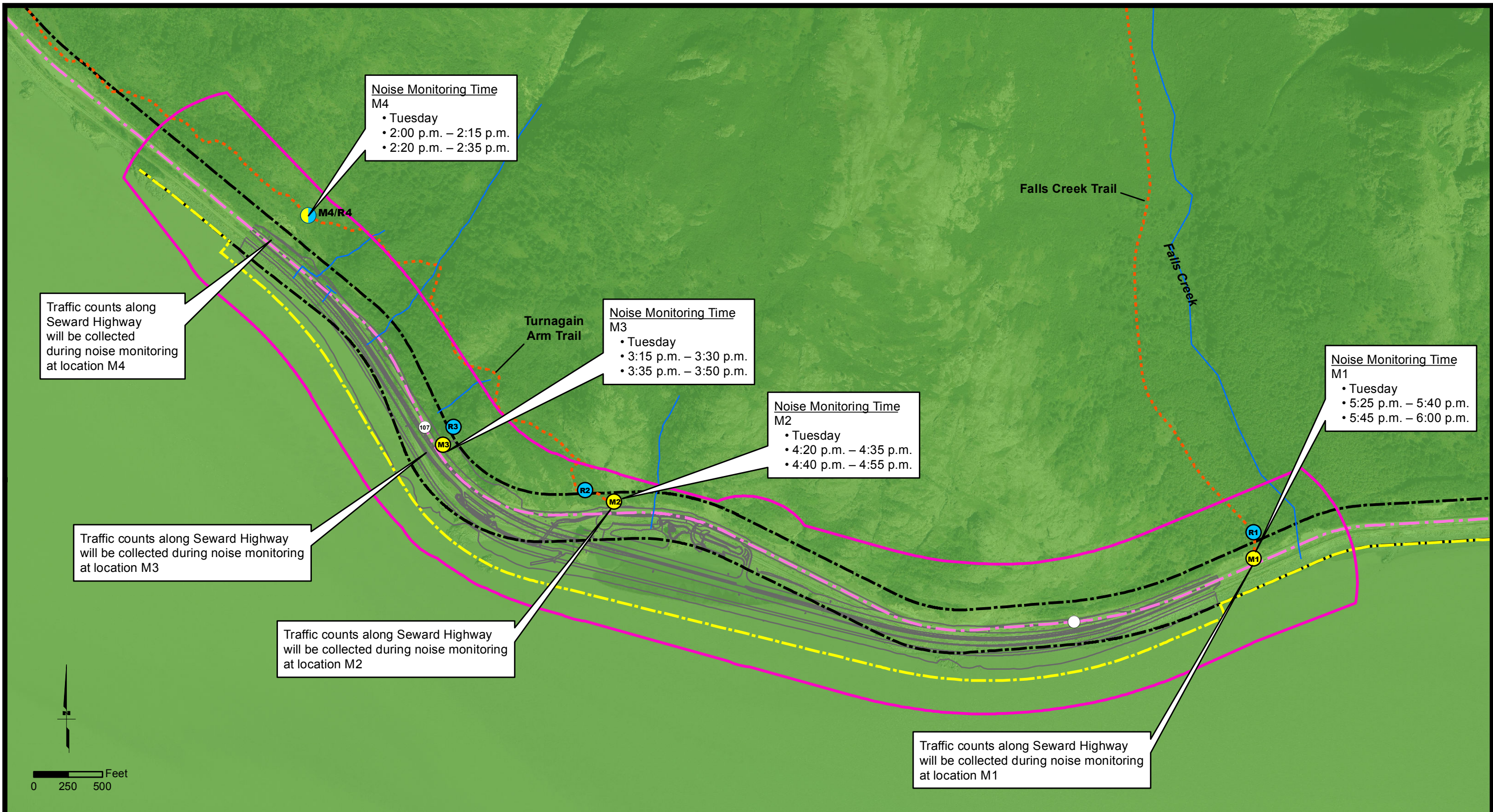
The resulting heavy truck volume/speed can then be used to predict railway noise in existing and future build/no-build TNM models. It will be assumed that the railroad schedule and average travel speed will not change between the existing and design years due to construction of the project.

Note that the TNM validation process for vehicle related noise will not include railway related noise. TNM cannot directly model railway noise; therefore, validation through railway field measurements is not possible. Train activity is not expected to be present during field measurements. Any instances of train activity during measurements will result in restarting the noise measurements in full after the train activity is clear of the project area.

LIST OF ATTACHMENTS

| | |
|---------------------|--|
| Attachment A: | Noise Study Zone and Land Use Map |
| Attachment B: | FHWA Section 4(f) Policy Paper, Part II |
| Attachment C: | Volume and Classification Data from 2013 DOT&PF Central Region ATR |
| Attachment D: | Design Designations |
| Attachment E: | Speed Study |
| Attachment F: | Analysis Calculations |
| Attachment G: | Correspondence with ARRC |

**Attachment A:
Noise Study Zone and Land Use Map**



Base Land Use Map

S32-33 T11N R2W
Seward Meridian, Alaska



STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
AND PUBLIC FACILITIES

DOT&PF Project No. 0A3-1(34)/56631
WINDY CORNER SEWARD HIGHWAY
MILEPOST 105-107

Anchorage, Alaska

September 16, 2016

FIGURE 1

**Attachment B:
FHWA Section 4(f) Policy Paper, Part II**

FHWA Section 4(f) Policy Paper

Part II – Questions and Answers Regarding Section 4(f) Applicability and Compliance

24. Joint Development (Park with Highway Corridor)

Question 24: *When a public park, recreation area, or wildlife and waterfowl refuge is established and an area within the Section 4(f) property is reserved for transportation use prior to or at the same time the Section 4(f) property was established, do the requirements of Section 4(f) apply?*

Answer: The FHWA must comply with 23 CFR 774.11(i) when determining if Section 4(f) applies to a property that was jointly planned for development with a future transportation corridor. Generally, the requirements of Section 4(f) do not apply to the subsequent use of the reserved area for its intended transportation purpose. This is because the land used for the transportation project was reserved from and, therefore, has never been part of the protected Section 4(f) property. Nor is a constructive use of the Section 4(f) property possible, since it was jointly planned with the transportation project. The specific governmental action that must be taken to reserve a transportation corridor with the Section 4(f) property is a question of State and local law, but may include ordinances, adopted land use plans, deed restrictions, or other actions. Evidence that the reservation was contemporaneous with or prior to the establishment of the Section 4(f) property should be documented in the project file. Subsequent statements of intent to construct a transportation project within the resource should not be considered sufficient documentation. All measures which have been taken to jointly develop the transportation corridor and the park should be completely documented in the project files. To provide flexibility for the future transportation project, State and local transportation agencies are advised to reserve wide corridors. Reserving a wide corridor will allow the future transportation project to be designed to minimize impacts on the environmental resources in the corridor. The FHWA encourages the joint planning for the transportation project and the Section 4(f) property to specify that any land not needed for the transportation project right-of-way be transferred to the adjacent Section 4(f) property once the transportation project is completed.

23 CFR 774.11(i) Section 4(f) Applicability

*(i) When a property is formally reserved for a future transportation facility before or at the same time a park, recreation area, or wildlife and waterfowl refuge is established and concurrent or joint planning or development of the transportation facility and the Section 4(f) resource occurs, then any resulting impacts of the transportation facility will not be considered a **use** as defined in § 774.17. Examples of such concurrent or joint planning or development include, but are not limited to:*

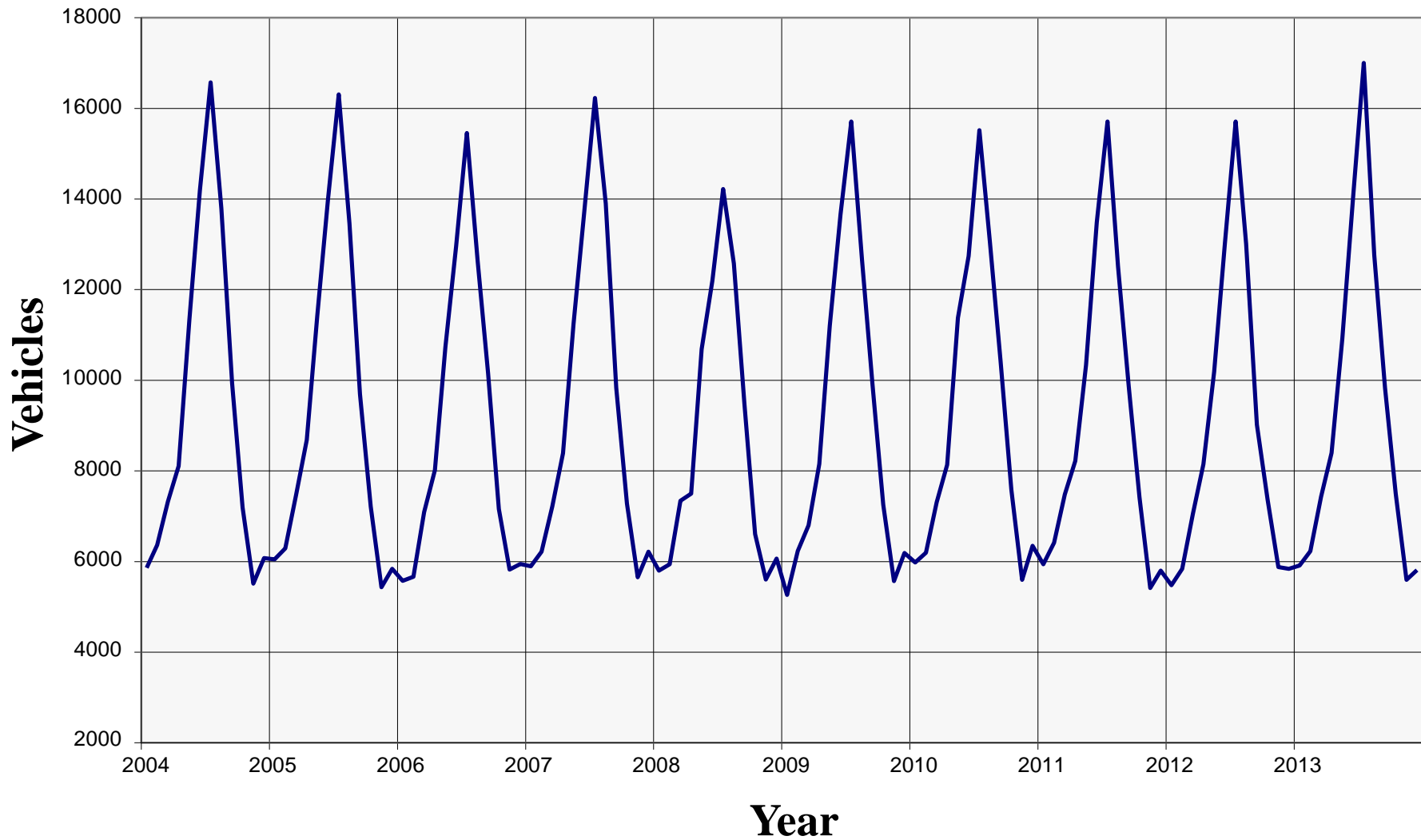
(1) Designation or donation of property for the specific purpose of such concurrent development by the entity with jurisdiction or ownership of the property for both the potential transportation facility and the Section 4(f) property; or

(2) Designation, donation, planning, or development of property by two or more governmental agencies with jurisdiction for the potential transportation facility and the Section 4(f) property, in consultation with each other.

**Attachment C:
Volume and Classification Data
from
2013 DOT&PF Central Region ATR**

Seward Highway at Potter Marsh

Monthly Average Daily Traffic



SEWARD HIGHWAY AT POTTER MARSH - TOTAL

ROUTE: 130000

MILEPOINT: 116.460

STATION NUMBER: 11410031 9

PERMANENT STN SUMMARY: 2013

| MNTH | MADT | % AADT | 6AM - 10PM | 10PM - 6AM | PERCENT OF AADT FOR DAY OF WEEK | | | | | | | | HISTORY | | PERCENT GROWTH |
|------|-------|--------|---------------|---------------|---------------------------------|------|-------|------|-------|-------|-------|-------|---------|------|-------------------|
| | | | | | MON | TUE | WED | THU | FRI | WKDY | SAT | SUN | YEAR | AADT | |
| JAN | 5912 | 63.7 | 93.5 | 6.5 | 93.6 | 86.1 | 89.3 | 92.5 | 117.5 | 95.8 | 119.1 | 101.8 | 2013 | 9283 | 4.5 |
| FEB | 6231 | 67.1 | 93.7 | 6.3 | 100.7 | 85.9 | 85.2 | 93.4 | 114.5 | 95.9 | 120.0 | 100.3 | 2012 | 8880 | -1.9 |
| MAR | 7432 | 80.1 | 93.8 | 6.2 | 87.3 | 93.3 | 91.4 | 90.7 | 108.6 | 94.3 | 118.5 | 110.0 | 2011 | 9050 | -1.5 |
| APR | 8394 | 90.4 | 93.6 | 6.4 | 81.9 | 77.3 | 78.8 | 89.8 | 117.5 | 89.1 | 133.1 | 121.6 | 2010 | 9187 | 1.5 |
| MAY | 10912 | 117.5 | 91.8 | 8.2 | 102.9 | 87.9 | 84.5 | 86.7 | 110.2 | 94.4 | 105.3 | 122.5 | 2009 | 9051 | 4.4 |
| JUN | 14021 | 151.0 | 89.5 | 10.5 | 89.8 | 86.0 | 88.1 | 91.6 | 111.9 | 93.5 | 115.8 | 116.9 | 2008 | 8670 | -6.9 |
| JUL | 17000 | 183.1 | 88.2 | 11.8 | 84.4 | 80.2 | 87.7 | 92.6 | 114.6 | 91.9 | 120.0 | 120.5 | 2007 | 9316 | 4.3 |
| AUG | 12756 | 137.4 | 91.5 | 8.5 | 91.3 | 86.6 | 82.3 | 91.6 | 112.8 | 92.9 | 117.6 | 117.7 | 2006 | 8936 | -4.1 |
| SEP | 9835 | 105.9 | 93.6 | 6.4 | 91.6 | 86.4 | 82.2 | 91.1 | 109.4 | 92.1 | 121.9 | 117.3 | 2005 | 9321 | -0.4 |
| OCT | 7492 | 80.7 | 93.7 | 6.3 | 87.7 | 89.3 | 90.7 | 89.7 | 121.5 | 95.8 | 123.4 | 97.6 | 2004 | 9356 | 1.4 |
| NOV | 5597 | 60.3 | 93.2 | 6.8 | 94.4 | 96.1 | 103.5 | 95.4 | 111.3 | 100.1 | 111.4 | 87.8 | 2003 | 9224 | -0.9 |
| DEC | 5810 | 62.6 | 93.1 | 6.9 | 103.6 | 96.7 | 86.2 | 90.2 | 111.1 | 97.6 | 110.7 | 101.4 | 2002 | 9311 | 9.4 |
| AADT | 9283 | | 92.4 | 7.6 | 92.4 | 87.7 | 87.5 | 91.3 | 113.4 | 94.5 | 118.1 | 109.6 | 2001 | 8514 | 2.5 |
| | | | | | | | | | | | | | 2000 | 8309 | 0.2 |
| | | | | | | | | | | | | | 1999 | 8294 | 0.0 |
| | | | | | | | | | | | | | 1998 | 8296 | 9.5 |
| | | | | | | | | | | | | | 1997 | 7574 | 1.5 |
| | | | | | | | | | | | | | 1996 | 7464 | -1.3 |
| | | | | | | | | | | | | | 1995 | 7565 | -0.1 |
| | | | | | | | | | | | | | 1994 | 7571 | 2.8 |
| | | | | | | | | | | | | | 1993 | 7366 | 6.3 |
| | | | | | | | | | | | | | 1992 | 6929 | 4.7 |
| | | | | | | | | | | | | | 1991 | 6621 | 69.3 |
| | | | | | | | | | | | | | 1990 | 3910 | |

| HIGH DAYS | 1ST | 2ND | 3RD | 4TH | 5TH | 6TH | 7TH | 8TH | 9TH | 10TH | AVG |
|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| VOLUME | 23411 | 22305 | 22092 | 20988 | 20209 | 19503 | 19270 | 19067 | 19031 | 18749 | 20463 |
| DAY | 07/21 | 07/19 | 07/20 | 07/06 | 07/28 | 07/13 | 07/07 | 07/14 | 07/27 | 07/26 | |
| % AADT | 252.2 | 240.3 | 238.0 | 226.1 | 217.7 | 210.1 | 207.6 | 205.4 | 205.0 | 202.0 | 220.4 |

| HIGH HOURS | 1ST | 2ND | 3RD | 4TH | 5TH | 6TH | 7TH | 8TH | 9TH | 10TH | 20TH | 30TH | 40TH | 50TH | AVG |
|------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| VOLUME | 1922 | 1920 | 1859 | 1826 | 1762 | 1758 | 1732 | 1703 | 1695 | 1694 | 1626 | 1539 | 1490 | 1462 | 1787 |
| HOUR | 6PM | 7PM | 4PM | 5PM | 5PM | 3PM | 3PM | 7PM | 4PM | 5PM | 2PM | 4PM | 6PM | 6PM | |
| DAY | 07/19 | 07/19 | 07/21 | 07/21 | 07/07 | 07/06 | 07/21 | 07/28 | 07/06 | 07/06 | 07/07 | 07/19 | 07/05 | 07/20 | |
| % AADT | 20.7 | 20.7 | 20.0 | 19.7 | 19.0 | 18.9 | 18.7 | 18.3 | 18.3 | 18.2 | 17.5 | 16.6 | 16.1 | 15.7 | 19.3 |

PERCENT OF AADT BY HOUR

| 1AM | 2AM | 3AM | 4AM | 5AM | 6AM | 7AM | 8AM | 9AM | 10AM | 11AM | 12PM | 1PM | 2PM | 3PM | 4PM | 5PM | 6PM | 7PM | 8PM | 9PM | 10PM | 11PM | 12AM |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| 1.1 | 0.7 | 0.5 | 0.4 | 0.5 | 0.9 | 1.9 | 3.3 | 4.1 | 5.0 | 5.5 | 6.0 | 6.7 | 6.9 | 7.3 | 7.7 | 8.1 | 7.9 | 7.2 | 5.8 | 4.6 | 3.6 | 2.5 | 1.6 |

Vehicle Classification Data

Part V contains a summary of vehicle classification data that has been automatically recorded by vehicle classification counters. Data collection locations are determined by either HPMS statistical sampling requirements or highway construction projects. Data is collected up to one week or longer in the summer if portable automatic vehicle classifiers (AVCs) are used, and throughout the year at some locations where permanent AVCs are installed.

The data is summarized to provide percentages of vehicles falling into categories determined by vehicle type and axle arrangement. The FHWA Vehicle Classification standard was used to categorize the vehicles into 13 classifications. The percentages of Class 1's, 2's and Class 3's may not be individually accurate due to limitations on the ability of AVC equipment to distinguish between all cars and pickup trucks based solely on axle spacing. The combined percentages of Class 1's, 2's and 3's do accurately represent the total of non-commercial vehicles. Classes 4 through 13 are considered commercial type vehicles. The volume of heavy commercial vehicles in the traffic stream is of major importance for road structural and geometric design.

In 2005 and 2009, some research and study of vehicle axle spacing, body type, vehicle class and physical characteristics was done in order to decrease the number of unclassified and improperly classified vehicles. The classification scheme was updated to reflect the findings.

FHWA 13 Classifications:

Single Unit

Class 1: Motorcycles

Class 2: Automobiles, Automobiles with Trailers

Class 3: Pickup Trucks, Pickup Trucks with Trailers

Class 4: Buses (2 or 3 axles)

Class 5: Delivery Trucks, Recreational Vehicles, Dump Trucks (2 axles, 6 tires)

Class 6: Dump Trucks, Recreational Vehicles (3 axles)

Class 7: Concrete Trucks, Fuel or Propane Delivery Trucks (4 or more axles)

Single Trailer

Class 8: Tractor/Truck with Trailer (3 or 4 axles)

Class 9: Tractor/Truck with Trailer (5 axles)

Class 10: Tractor/Truck with Trailer (6 or more axles)

Multi-Trailer

Class 11: Tractor/Truck with 2 Trailers (5 axles)

Class 12: Tractor/Truck with 2 or more Trailers (6 axles)

Class 13: Tractor/Truck with 2 or more Trailers (7 or more axles)

Traffic Direction Codes:

East bound = 3

North bound = 1

West bound = 7


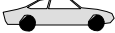



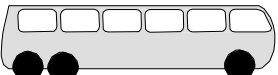

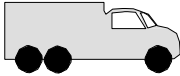
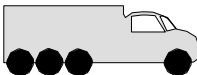








South bound = 5

FHWA VEHICLE CLASSIFICATION

CLASS GROUP

DESCRIPTION

NO. OF AXLES

| CLASS GROUP | DESCRIPTION | NO. OF AXLES |
|-------------|--|----------------------------------|
| 1 |  MOTORCYCLES | 2 |
| 2 |  ALL PASSENGER CARS | 2 |
| |  CARS W/ 1-AXLE TRAILER | 3 |
| |  CARS W/ 2-AXLE TRAILER | 4 |
| 3 |  PICK-UPS & VANS 1 & 2 AXLE TRAILERS | 2, 3, & 4 |
| 4 |  BUSES | 2 & 3 |
| 5 |  2-AXLE, SINGLE UNIT | 2 |
| 6 |  3-AXLE, SINGLE UNIT | 3 |
| 7 |  4-AXLE, SINGLE UNIT | 4 |
| 8 |  2-AXLE, TRACTOR, 1-AXLE TRAILER (2&1) | 3 |
| |  2-AXLE, TRACTOR, 2-AXLE TRAILER (2&2) | 4 |
| |  3-AXLE, TRACTOR, 1-AXLE TRAILER (3&1) | 4 |
| 9 |  3-AXLE, TRACTOR, 2-AXLE TRAILER (3&2) | 5 |
| |  3-AXLE, TRUCK W/ 2-AXLE TRAILER | 5 |
| 10 |  TRACTOR W/ SINGLE TRAILER | 6 & 7 |
| 11 |  5-AXLE MULTI-TRAILER | 5 |
| 12 |  6-AXLE MULTI-TRAILER | 6 |
| 13 | ANY 7 OR MORE AXLE | 7 or more |
| 14 | UNCLASSIFIED VEHICLES | DOES NOT MEET THE ABOVE CRITERIA |
| 15 | NOT USED | |

COMMERCIAL VEHICLES

Note: These are common vehicle classifications and do not represent all types of vehicles

| ROUTE | ROUTE NAME | MIPT | STATION | FC | DIR | YR | MTH | DAYS | TOTAL VHCLS | % Single Unit | | | | | | | % Single Trailer | | | % Multi Trailer | | | % Total Cmrc'l Vhcls | | |
|----------------------------|------------|---------|----------|----|-----|----|------|------|----------------|------------------|----------|----------|----------|----------|----------|----------|---------------------|----------|-----------|--------------------|-----------|-----------|-------------------------------|-------|-------|
| | | | | | | | | | | CLS 1 | CLS 2 | CLS 3 | CLS 4 | CLS 5 | CLS 6 | CLS 7 | CLS 8 | CLS 9 | CLS 10 | CLS 11 | CLS 12 | CLS 13 | | | |
| | | | | | | | 5 | 9 | 30 | 59610 | 0.47 | 53.50 | 32.31 | 0.66 | 7.27 | 0.64 | 0.01 | 0.99 | 1.88 | 1.05 | 0.00 | 0.00 | 1.22 | 13.71 | |
| | | | | | | | 1 | 10 | 30 | 40261 | 1.01 | 50.42 | 36.00 | 0.07 | 5.93 | 0.91 | 0.00 | 0.84 | 2.29 | 1.35 | 0.00 | 0.00 | 1.18 | 12.57 | |
| | | | | | | | 5 | 10 | 30 | 39206 | 0.29 | 56.48 | 31.26 | 0.26 | 5.25 | 0.59 | 0.01 | 0.80 | 2.42 | 1.06 | 0.00 | 0.00 | 1.58 | 11.97 | |
| | | | | | | | 1 | 11 | 29 | 27010 | 0.96 | 50.08 | 36.33 | 0.12 | 5.55 | 0.88 | 0.03 | 0.63 | 2.72 | 1.27 | 0.00 | 0.00 | 1.41 | 12.63 | |
| | | | | | | | 5 | 11 | 18 | 17227 | 0.15 | 52.81 | 33.26 | 0.37 | 6.37 | 0.56 | 0.02 | 0.64 | 2.71 | 1.10 | 0.00 | 0.01 | 2.01 | 13.79 | |
| | | | | | | | 1 | 12 | 30 | 26830 | 0.78 | 50.03 | 36.97 | 0.13 | 5.64 | 0.80 | 0.04 | 0.52 | 2.99 | 0.99 | 0.00 | 0.00 | 1.12 | 12.23 | |
| At Potter Marsh | | 116.46 | 11410031 | 11 | | 1 | 2013 | 1 | 31 | 91020 | 0.08 | 60.24 | 32.74 | 0.22 | 4.19 | 0.58 | 0.00 | 0.18 | 0.92 | 0.34 | 0.00 | 0.00 | 0.51 | 6.94 | |
| | | | | | | | | 5 | 1 | 31 | 90219 | 0.15 | 59.85 | 32.88 | 0.21 | 4.25 | 0.82 | 0.01 | 0.23 | 0.92 | 0.29 | 0.00 | 0.00 | 0.40 | 7.12 |
| | | | | | | | | 1 | 2 | 28 | 87011 | 0.08 | 61.35 | 31.99 | 0.21 | 3.93 | 0.55 | 0.01 | 0.17 | 0.91 | 0.29 | 0.00 | 0.00 | 0.52 | 6.58 |
| | | | | | | | | 5 | 2 | 28 | 87338 | 0.17 | 60.98 | 32.18 | 0.19 | 3.97 | 0.75 | 0.01 | 0.19 | 0.83 | 0.29 | 0.00 | 0.00 | 0.43 | 6.67 |
| | | | | | | | | 1 | 3 | 30 | 111786 | 0.08 | 62.56 | 31.31 | 0.17 | 3.56 | 0.52 | 0.00 | 0.17 | 0.82 | 0.31 | 0.00 | 0.00 | 0.49 | 6.06 |
| | | | | | | | | 5 | 3 | 30 | 113052 | 0.16 | 62.34 | 31.42 | 0.17 | 3.56 | 0.68 | 0.00 | 0.17 | 0.76 | 0.32 | 0.00 | 0.00 | 0.42 | 6.08 |
| | | | | | | | | 1 | 4 | 30 | 123493 | 0.30 | 62.54 | 29.94 | 0.31 | 4.58 | 0.51 | 0.00 | 0.19 | 0.88 | 0.28 | 0.00 | 0.00 | 0.46 | 7.22 |
| | | | | | | | | 5 | 4 | 30 | 124615 | 0.33 | 62.65 | 30.62 | 0.24 | 3.69 | 0.63 | 0.01 | 0.23 | 0.84 | 0.33 | 0.00 | 0.00 | 0.42 | 6.40 |
| | | | | | | | | 1 | 5 | 31 | 165317 | 0.84 | 61.84 | 29.74 | 0.52 | 4.59 | 0.56 | 0.00 | 0.39 | 0.83 | 0.27 | 0.00 | 0.00 | 0.42 | 7.58 |
| | | | | | | | | 5 | 5 | 31 | 170097 | 0.87 | 60.91 | 30.39 | 0.48 | 4.68 | 0.71 | 0.01 | 0.50 | 0.78 | 0.27 | 0.00 | 0.00 | 0.40 | 7.83 |
| | | | | | | | | 1 | 6 | 30 | 210750 | 0.96 | 60.68 | 29.83 | 0.69 | 4.82 | 0.76 | 0.01 | 0.53 | 0.88 | 0.44 | 0.00 | 0.00 | 0.38 | 8.52 |
| | | | | | | | | 5 | 6 | 30 | 213076 | 0.97 | 59.95 | 30.01 | 0.70 | 5.12 | 0.87 | 0.01 | 0.70 | 0.83 | 0.47 | 0.00 | 0.00 | 0.37 | 9.07 |
| | | | | | | | | 1 | 7 | 31 | 257877 | 0.76 | 58.79 | 31.16 | 0.61 | 5.45 | 0.70 | 0.00 | 0.76 | 0.96 | 0.45 | 0.00 | 0.00 | 0.35 | 9.29 |
| | | | | | | | | 5 | 7 | 31 | 258773 | 0.73 | 58.28 | 31.38 | 0.62 | 5.64 | 0.76 | 0.01 | 0.86 | 0.92 | 0.48 | 0.00 | 0.00 | 0.32 | 9.61 |
| | | | | | | | | 1 | 8 | 31 | 199788 | 0.62 | 60.13 | 29.80 | 0.80 | 5.29 | 0.81 | 0.00 | 0.67 | 0.92 | 0.47 | 0.00 | 0.00 | 0.48 | 9.44 |
| | | | | | | | | 5 | 8 | 31 | 197191 | 0.59 | 59.89 | 30.03 | 0.82 | 5.30 | 0.90 | 0.02 | 0.65 | 0.87 | 0.50 | 0.00 | 0.00 | 0.43 | 9.49 |
| | | | | | | | | 1 | 9 | 30 | 150168 | 0.67 | 59.97 | 29.73 | 0.57 | 5.07 | 1.19 | 0.00 | 0.55 | 1.09 | 0.66 | 0.00 | 0.00 | 0.48 | 9.62 |
| | | | | | | | | 5 | 9 | 30 | 144944 | 0.59 | 59.91 | 30.14 | 0.55 | 4.64 | 1.46 | 0.02 | 0.51 | 0.95 | 0.77 | 0.00 | 0.00 | 0.46 | 9.36 |
| | | | | | | | | 1 | 10 | 31 | 115024 | 0.33 | 59.55 | 30.87 | 0.23 | 5.78 | 0.83 | 0.01 | 0.35 | 1.04 | 0.43 | 0.00 | 0.00 | 0.57 | 9.25 |
| | | | | | | | | 5 | 10 | 31 | 114621 | 0.32 | 60.15 | 31.74 | 0.12 | 4.40 | 0.91 | 0.03 | 0.37 | 1.03 | 0.43 | 0.00 | 0.00 | 0.49 | 7.79 |
| | | | | | | | | 1 | 11 | 29 | 81553 | 0.16 | 58.57 | 31.99 | 0.26 | 6.13 | 0.62 | 0.01 | 0.26 | 1.05 | 0.36 | 0.00 | 0.00 | 0.59 | 9.28 |
| | | | | | | | | 5 | 11 | 29 | 82473 | 0.30 | 59.44 | 32.80 | 0.15 | 4.43 | 0.86 | 0.01 | 0.25 | 0.93 | 0.35 | 0.00 | 0.00 | 0.49 | 7.46 |
| | | | | | | | | 1 | 12 | 31 | 89561 | 0.12 | 60.89 | 32.30 | 0.11 | 4.11 | 0.55 | 0.01 | 0.19 | 1.01 | 0.28 | 0.00 | 0.00 | 0.42 | 6.68 |
| | | | | | | | | 5 | 12 | 31 | 90468 | 0.24 | 60.37 | 32.63 | 0.13 | 4.16 | 0.74 | 0.01 | 0.18 | 0.94 | 0.25 | 0.00 | 0.00 | 0.37 | 6.77 |
| South of 76th Avenue (WIM) | | 121.978 | 52321000 | 11 | | 1 | 2013 | 1 | 30 | 523273 | 0.00 | 67.24 | 25.28 | 0.13 | 6.45 | 0.35 | 0.00 | 0.05 | 0.31 | 0.08 | 0.00 | 0.00 | 0.11 | 7.48 | |
| | | | | | | | | 5 | 1 | 30 | 630158 | 0.00 | 70.71 | 24.38 | 0.26 | 4.13 | 0.33 | 0.00 | 0.03 | 0.09 | 0.03 | 0.00 | 0.00 | 0.04 | 4.91 |
| | | | | | | | | 1 | 2 | 27 | 494680 | 0.00 | 67.01 | 25.34 | 0.13 | 6.35 | 0.59 | 0.00 | 0.04 | 0.33 | 0.10 | 0.00 | 0.00 | 0.11 | 7.65 |
| | | | | | | | | 5 | 2 | 27 | 608299 | 0.00 | 70.54 | 24.13 | 0.24 | 4.24 | 0.63 | 0.00 | 0.03 | 0.11 | 0.05 | 0.00 | 0.00 | 0.04 | 5.33 |
| | | | | | | | | 1 | 3 | 14 | 280732 | 0.00 | 66.74 | 25.23 | 0.14 | 6.64 | 0.66 | 0.00 | 0.05 | 0.33 | 0.09 | 0.00 | 0.00 | 0.13 | 8.03 |
| | | | | | | | | 5 | 3 | 14 | 345697 | 0.00 | 70.35 | 24.09 | 0.28 | 4.37 | 0.70 | 0.00 | 0.03 | 0.09 | 0.04 | 0.00 | 0.00 | 0.04 | 5.56 |
| | | | | | | | | 1 | 4 | 12 | 234928 | 0.02 | 67.46 | 24.53 | 0.12 | 6.80 | 0.29 | 0.00 | 0.05 | 0.37 | 0.23 | 0.00 | 0.00 | 0.13 | 7.99 |
| | | | | | | | | 5 | 4 | 12 | 269543 | 0.00 | 71.20 | 23.68 | 0.24 | 4.45 | 0.27 | 0.00 | 0.03 | 0.06 | 0.03 | 0.00 | 0.00 | 0.03 | 5.12 |
| | | | | | | | | 1 | 5 | 18 | 360591 | 0.03 | 64.88 | 23.89 | 0.14 | 9.67 | 0.39 | 0.00 | 0.08 | 0.43 | 0.34 | 0.00 | 0.00 | 0.15 | 11.20 |
| | | | | | | | | 5 | 5 | 18 | 416861 | 0.01 | 70.06 | 23.95 | 0.25 | 5.04 | 0.38 | 0.00 | 0.05 | 0.16 | 0.07 | 0.00 | 0.00 | 0.05 | 5.99 |
| | | | | | | | | 5 | 6 | 17 | 378299 | 0.03 | 69.32 | 23.11 | 0.11 | 5.97 | 0.66 | 0.00 | 0.07 | 0.46 | 0.13 | 0.00 | 0.00 | 0.14 | 7.54 |
| | | | | | | | | 5 | 7 | 19 | 481285 | 0.02 | 68.22 | 23.51 | 0.11 | 6.42 | 0.74 | 0.00 | 0.07 | 0.54 | 0.20 | 0.00 | 0.00 | 0.16 | 8.24 |
| | | | | | | | | 5 | 8 | 24 | 580052 | 0.01 | 69.04 | 23.41 | 0.12 | 5.73 | 0.69 | 0.00 | 0.07 | 0.54 | 0.24 | 0.00 | 0.00 | 0.16 | 7.54 |

Seward Highway MP 105-107 Windy Corner

Potter Marsh Vehicle Classification Data
(2013 Annual Traffic Volume Report)

| Direction | Month | Days | Total Vehicles | % Single Unit | | | | | | | % Single Trailer | | | % Multi Trailer | | | % Total Commercial Vehicles |
|-----------|-------|------|----------------|---------------|-------|-------|-------|-------|-------|-------|------------------|-------|--------|-----------------|--------|--------|-----------------------------|
| | | | | CLS 1 | CLS 2 | CLS 3 | CLS 4 | CLS 5 | CLS 6 | CLS 7 | CLS 8 | CLS 9 | CLS 10 | CLS 11 | CLS 12 | CLS 13 | |
| 1 | 1 | 31 | 91020 | 0.08 | 60.24 | 32.74 | 0.22 | 4.19 | 0.58 | 0 | 0.18 | 0.92 | 0.34 | 0 | 0 | 0.51 | 6.94 |
| 5 | 1 | 31 | 90219 | 0.15 | 59.85 | 32.88 | 0.21 | 4.25 | 0.82 | 0.01 | 0.23 | 0.92 | 0.29 | 0 | 0 | 0.40 | 7.12 |
| 1 | 2 | 28 | 87011 | 0.08 | 61.35 | 31.99 | 0.21 | 3.93 | 0.55 | 0.01 | 0.17 | 0.91 | 0.29 | 0 | 0 | 0.52 | 6.58 |
| 5 | 2 | 28 | 87338 | 0.17 | 60.98 | 32.18 | 0.19 | 3.97 | 0.75 | 0.01 | 0.19 | 0.83 | 0.29 | 0 | 0 | 0.43 | 6.67 |
| 1 | 3 | 30 | 111786 | 0.08 | 62.56 | 31.31 | 0.17 | 3.56 | 0.52 | 0 | 0.17 | 0.82 | 0.31 | 0 | 0 | 0.49 | 6.06 |
| 5 | 3 | 30 | 113052 | 0.16 | 62.34 | 31.42 | 0.17 | 3.56 | 0.68 | 0 | 0.17 | 0.76 | 0.32 | 0 | 0 | 0.42 | 6.08 |
| 1 | 4 | 30 | 123493 | 0.30 | 62.54 | 29.94 | 0.31 | 4.58 | 0.51 | 0 | 0.19 | 0.88 | 0.28 | 0 | 0 | 0.46 | 7.22 |
| 5 | 4 | 30 | 124615 | 0.33 | 62.65 | 30.62 | 0.24 | 3.69 | 0.63 | 0.01 | 0.23 | 0.84 | 0.33 | 0 | 0 | 0.42 | 6.40 |
| 1 | 5 | 31 | 165317 | 0.84 | 61.84 | 29.74 | 0.52 | 4.59 | 0.56 | 0 | 0.39 | 0.83 | 0.27 | 0 | 0 | 0.42 | 7.58 |
| 5 | 5 | 31 | 170097 | 0.87 | 60.91 | 30.39 | 0.48 | 4.68 | 0.71 | 0.01 | 0.50 | 0.78 | 0.27 | 0 | 0 | 0.40 | 7.83 |
| 1 | 6 | 30 | 210750 | 0.96 | 60.68 | 29.83 | 0.69 | 4.82 | 0.76 | 0.01 | 0.53 | 0.88 | 0.44 | 0 | 0 | 0.38 | 8.52 |
| 5 | 6 | 30 | 213076 | 0.97 | 59.95 | 30.01 | 0.70 | 5.12 | 0.87 | 0.01 | 0.70 | 0.83 | 0.47 | 0 | 0 | 0.37 | 9.07 |
| 1 | 7 | 31 | 257877 | 0.76 | 58.79 | 31.16 | 0.61 | 5.45 | 0.70 | 0 | 0.76 | 0.96 | 0.45 | 0 | 0 | 0.35 | 9.29 |
| 5 | 7 | 31 | 258773 | 0.73 | 58.28 | 31.38 | 0.62 | 5.64 | 0.76 | 0.01 | 0.86 | 0.92 | 0.48 | 0 | 0 | 0.32 | 9.61 |
| 1 | 8 | 31 | 199788 | 0.62 | 60.13 | 29.80 | 0.80 | 5.29 | 0.81 | 0 | 0.67 | 0.92 | 0.47 | 0 | 0 | 0.48 | 9.44 |
| 5 | 8 | 31 | 197191 | 0.59 | 59.89 | 30.03 | 0.82 | 5.30 | 0.90 | 0.02 | 0.65 | 0.87 | 0.50 | 0 | 0 | 0.43 | 9.49 |
| 1 | 9 | 30 | 150168 | 0.67 | 59.97 | 29.73 | 0.57 | 5.07 | 1.19 | 0 | 0.55 | 1.09 | 0.66 | 0 | 0 | 0.48 | 9.62 |
| 5 | 9 | 30 | 144944 | 0.59 | 59.91 | 30.14 | 0.55 | 4.64 | 1.46 | 0.02 | 0.51 | 0.95 | 0.77 | 0 | 0 | 0.46 | 9.36 |
| 1 | 10 | 31 | 115024 | 0.33 | 59.55 | 30.87 | 0.23 | 5.78 | 0.83 | 0.01 | 0.35 | 1.04 | 0.43 | 0 | 0 | 0.57 | 9.25 |
| 5 | 10 | 31 | 114621 | 0.32 | 60.15 | 31.74 | 0.12 | 4.40 | 0.91 | 0.03 | 0.37 | 1.03 | 0.43 | 0 | 0 | 0.49 | 7.79 |
| 1 | 11 | 29 | 81553 | 0.16 | 58.57 | 31.99 | 0.26 | 6.13 | 0.62 | 0.01 | 0.26 | 1.05 | 0.36 | 0 | 0 | 0.59 | 9.28 |
| 5 | 11 | 29 | 82473 | 0.30 | 59.44 | 32.80 | 0.15 | 4.43 | 0.86 | 0.01 | 0.25 | 0.93 | 0.35 | 0 | 0 | 0.49 | 7.46 |
| 1 | 12 | 31 | 89561 | 0.12 | 60.89 | 32.30 | 0.11 | 4.11 | 0.55 | 0.01 | 0.19 | 1.01 | 0.28 | 0 | 0 | 0.42 | 6.68 |
| 5 | 12 | 31 | 90468 | 0.24 | 60.37 | 32.63 | 0.13 | 4.16 | 0.74 | 0.01 | 0.18 | 0.94 | 0.25 | 0 | 0 | 0.37 | 6.77 |
| AVG | | | | 0.43 | 60.49 | 31.15 | 0.38 | 4.64 | 0.76 | 0.01 | 0.39 | 0.91 | 0.39 | 0.00 | 0.00 | 0.44 | 7.92 |

| Axle Group | % AADT in Truck Category |
|-------------------------|--------------------------|
| 2-axle (CLS 4 and 5) | 5.02 |
| 3-axle (CLS 6 and 8) | 1.15 |
| 4-axle (CLS 7) | 0.01 |
| 5-axle (CLS 9 and 11) | 0.91 |
| 6-axle (CLS 10, 12, 13) | 0.83 |

| Direction | Total Vehicle | Directional % |
|-----------------|---------------|---------------|
| North Bound (1) | 1,683,348 | 50 |
| South Bound (5) | 1,686,867 | 50 |

**Attachment D:
Design Designations**

DESIGN DESIGNATION

State Route Number: 130000

Route Name: Seward Highway

Project Limits: MP 105 to MP 107 (Windy Corner)

State Project Number: 56631

Federal Aid Number: NH-0A3-1(34)

Project Description: The Seward Highway MP 105-107 Windy Corner project is located in the Municipality of Anchorage on the Seward Highway between Rainbow and Indian. The objective of the project is to continue Alaska Department of Transportation and Public Facilities (DOT&PF) efforts to address traffic safety concerns on the Seward Highway. This project will realign the highway and the railroad in the vicinity of Windy Corner. This road segment has a historically high crash severity rate. The segment is proposed to be designed as a two-lane divided highway with auxiliary lanes to meet current design standards. The new alignment may also create space for new or expanded roadside recreational facilities and wildlife viewing area (including parking and walkways).

Design Functional Classification: Urban Arterial Rural Arterial Major Collector Minor Collector Local

New Construction – Reconstruction: Rehabilitation (3R): Other_____

Project Design Life (years): 5 10 20 25 Other_____

| | Existing Year | Construction Year | Mid-Life Year | Future Year |
|--------------------------------------|--------------------------|------------------------------|--------------------------|------------------------|
| | 2013 | 2017 | 2027 | 2037 |
| AADT* | 9,283 | 9,787 | 11,169 | 12,747 |
| DHV | 16.6% | | | |
| Peak Hour Factor | 0.88 | | | |
| Directional Distribution | 50/50 | | | |
| Percent Recreational Vehicles | ** | | | |
| Percent Commercial Trucks | 7.92% | | | |
| Compound Growth Rate | 1.33% | | | |
| Pedestrians (Number/Day) | ** | | | |
| Bicyclists (Number/Day) | ** | | | |

* = Data from Potter PTR

** = Not presently available

Design Vehicles for Turning: WB-67

Design Vehicle Loading: HS15 HS20 HS25 Other_____

Equivalent Axle Loads: 2,752,585

APPROVED _____ DATE _____

**Attachment E:
Speed Study**

Windy Corner Speed Study

| | | |
|--|---------------------------|----------------------|
| Location | Seward Highway (MP 106.5) | Date: 8/31/2016 |
| Direction of Traffic: South | | Counted By: CAS/TW |
| Start Time: 4:20 PM | End Time: 4:50 PM | Weather: Sunny |
| Gun Position: ~_45_ feet from CL, vehicle _150_ feet away (~_17_ degree angle) | | Posted Speed: 55 mph |

| | | |
|----------------|---|-------------------------|
| Results | 85th Speed = 58.0 mph | Mean Speed = 55.8 mph |
| | * σ_e 85th (95% Confident) = 1.0 mph | Median Speed = 55.4 mph |
| | Standard Deviation, σ = 2.9 | Min Speed = 48.2 mph |
| | Sample Size, n_{total} = 50 | Max Speed = 62.7 mph |

| n | Speed | n | Speed | n | Speed | n | Speed | n | Speed |
|----|-------|----|-------|----|-------|-----|-------|-----|-------|
| 1 | 51.7 | 31 | 55.6 | 61 | | 91 | | 121 | |
| 2 | 57.7 | 32 | 57.8 | 62 | | 92 | | 122 | |
| 3 | 58.6 | 33 | 58.0 | 63 | | 93 | | 123 | |
| 4 | 62.1 | 34 | 58.1 | 64 | | 94 | | 124 | |
| 5 | 55.4 | 35 | 57.3 | 65 | | 95 | | 125 | |
| 6 | 54.4 | 36 | 55.3 | 66 | | 96 | | 126 | |
| 7 | 58.0 | 37 | 62.7 | 67 | | 97 | | 127 | |
| 8 | 55.0 | 38 | 53.4 | 68 | | 98 | | 128 | |
| 9 | 57.0 | 39 | 52.0 | 69 | | 99 | | 129 | |
| 10 | 54.3 | 40 | 53.9 | 70 | | 100 | | 130 | |
| 11 | 55.9 | 41 | 48.2 | 71 | | 101 | | 131 | |
| 12 | 55.6 | 42 | 56.5 | 72 | | 102 | | 132 | |
| 13 | 55.0 | 43 | 51.7 | 73 | | 103 | | 133 | |
| 14 | 55.2 | 44 | 57.6 | 74 | | 104 | | 134 | |
| 15 | 55.1 | 45 | 62.2 | 75 | | 105 | | 135 | |
| 16 | 57.0 | 46 | 54.1 | 76 | | 106 | | 136 | |
| 17 | 54.6 | 47 | 54.0 | 77 | | 107 | | 137 | |
| 18 | 57.3 | 48 | 52.8 | 78 | | 108 | | 138 | |
| 19 | 57.7 | 49 | 54.7 | 79 | | 109 | | 139 | |
| 20 | 57.1 | 50 | 59.7 | 80 | | 110 | | 140 | |
| 21 | 51.0 | 51 | | 81 | | 111 | | 141 | |
| 22 | 59.0 | 52 | | 82 | | 112 | | 142 | |
| 23 | 54.8 | 53 | | 83 | | 113 | | 143 | |
| 24 | 54.8 | 54 | | 84 | | 114 | | 144 | |
| 25 | 51.7 | 55 | | 85 | | 115 | | 145 | |
| 26 | 51.1 | 56 | | 86 | | 116 | | 146 | |
| 27 | 56.9 | 57 | | 87 | | 117 | | 147 | |
| 28 | 58.3 | 58 | | 88 | | 118 | | 148 | |
| 29 | 55.4 | 59 | | 89 | | 119 | | 149 | |
| 30 | 54.9 | 60 | | 90 | | 120 | | 150 | |

- Notes:
1. Only record vehicles that appear to be traveling at their desired speed and not decelerating, accelerating or significantly restricted.
 2. Sample size, n , shall be a minimum of 40 vehicles, preferred 100 vehicles. The corresponding Standard Error, σ_e 85th (95% Confident), is typically 2 mph and 1 mph, respectively.
 3. Equation used to calculate standard error (σ_e) was taken from *Manual of Transportation Engineering Studies*, pg 38, Eq. 3-2, using 95% confidence and the 85th percentile speed.

Windy Corner Speed Study

| | | |
|-----------------------|--|----------------------|
| Location: | Seward Highway (MP 106.5) | Date: 8/31/2016 |
| Direction of Traffic: | North | Counted By: CAS/TW |
| Start Time: | 4:00 PM | End Time: 4:20 PM |
| Gun Position: | ~30-feet from CL, vehicle 100-feet away (~17 degree angle) | Weather: Sunny |
| | | Posted Speed: 55 mph |

| | | |
|----------------|---|-------------------------|
| Results | 85th Speed = 59.1 mph | Mean Speed = 57.0 mph |
| | * σ_e 85th (95% Confident) = 0.9 mph | Median Speed = 56.8 mph |
| | Standard Deviation, σ = 2.5 | Min Speed = 51.0 mph |
| | Sample Size, n_{total} = 50 | Max Speed = 62.6 mph |

| n | Speed | n | Speed | n | Speed | n | Speed | n | Speed |
|----|-------|----|-------|----|-------|-----|-------|-----|-------|
| 1 | 58.2 | 31 | 54.3 | 61 | | 91 | | 121 | |
| 2 | 58.1 | 32 | 53.0 | 62 | | 92 | | 122 | |
| 3 | 53.5 | 33 | 55.5 | 63 | | 93 | | 123 | |
| 4 | 56.3 | 34 | 56.0 | 64 | | 94 | | 124 | |
| 5 | 53.8 | 35 | 56.8 | 65 | | 95 | | 125 | |
| 6 | 55.7 | 36 | 58.9 | 66 | | 96 | | 126 | |
| 7 | 56.9 | 37 | 51.0 | 67 | | 97 | | 127 | |
| 8 | 53.7 | 38 | 58.7 | 68 | | 98 | | 128 | |
| 9 | 56.1 | 39 | 58.5 | 69 | | 99 | | 129 | |
| 10 | 56.9 | 40 | 58.1 | 70 | | 100 | | 130 | |
| 11 | 59.0 | 41 | 56.7 | 71 | | 101 | | 131 | |
| 12 | 59.8 | 42 | 55.0 | 72 | | 102 | | 132 | |
| 13 | 55.1 | 43 | 59.1 | 73 | | 103 | | 133 | |
| 14 | 55.7 | 44 | 61.2 | 74 | | 104 | | 134 | |
| 15 | 56.1 | 45 | 57.8 | 75 | | 105 | | 135 | |
| 16 | 61.6 | 46 | 55.2 | 76 | | 106 | | 136 | |
| 17 | 62.6 | 47 | 58.6 | 77 | | 107 | | 137 | |
| 18 | 60.4 | 48 | 53.5 | 78 | | 108 | | 138 | |
| 19 | 58.7 | 49 | 58.8 | 79 | | 109 | | 139 | |
| 20 | 61.3 | 50 | 56.7 | 80 | | 110 | | 140 | |
| 21 | 52.8 | 51 | | 81 | | 111 | | 141 | |
| 22 | 57.1 | 52 | | 82 | | 112 | | 142 | |
| 23 | 59.7 | 53 | | 83 | | 113 | | 143 | |
| 24 | 56.8 | 54 | | 84 | | 114 | | 144 | |
| 25 | 61.1 | 55 | | 85 | | 115 | | 145 | |
| 26 | 57.0 | 56 | | 86 | | 116 | | 146 | |
| 27 | 53.8 | 57 | | 87 | | 117 | | 147 | |
| 28 | 57.0 | 58 | | 88 | | 118 | | 148 | |
| 29 | 55.6 | 59 | | 89 | | 119 | | 149 | |
| 30 | 56.4 | 60 | | 90 | | 120 | | 150 | |

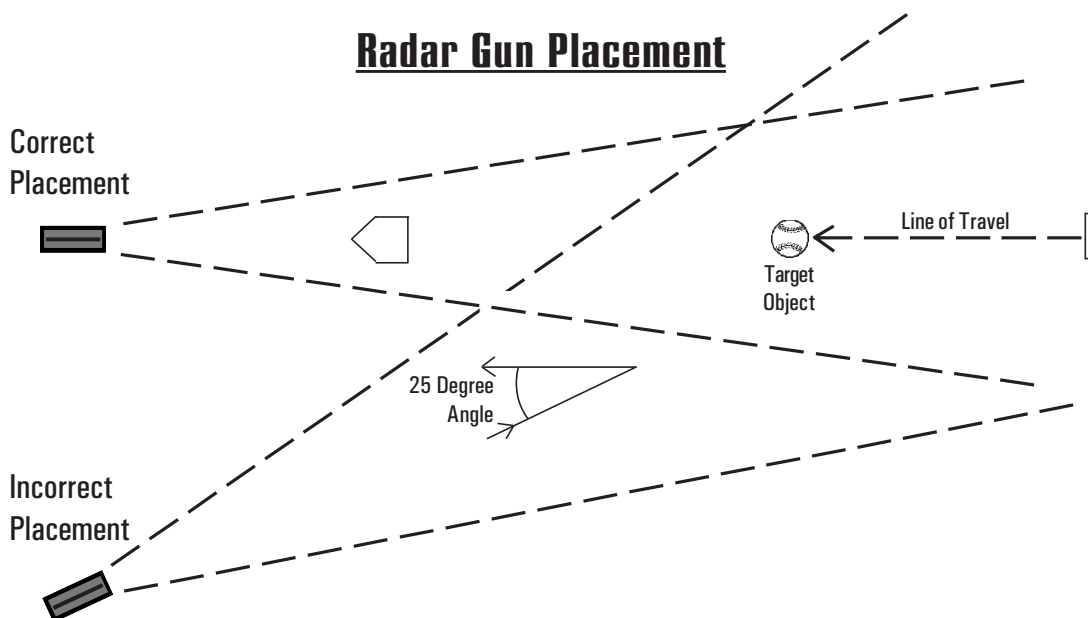
- Notes:
1. Only record vehicles that appear to be traveling at their desired speed and not decelerating, accelerating or significantly restricted.
 2. Sample size, n, shall be a minimum of 40 vehicles, preferred 100 vehicles. The corresponding Standard Error, σ_e 85th (95% Confident), is typically 2 mph and 1 mph, respectively.
 3. Equation used to calculate standard error (σ_e) was taken from *Manual of Transportation Engineering Studies*, pg 38, Eq. 3-2, using 95% confidence and the 85th percentile speed.

Angle Error

The most common mistake made with all radar guns is trying to clock targets at angles. All radar guns work on the Doppler principle and need to clock objects moving directly at or away from the gun. Clocking at an angle with a stationary radar will result in angle error, and the gun will display a speed that is LOWER than the actual speed.

Cosine Angle Error Chart

| | 0 Degrees | 5 Degrees | 10 Degrees | 15 Degrees | 30 Degrees | 45 Degrees | 90 Degrees |
|------------|-----------|-------------|-------------|-------------|--------------|--------------|-------------|
| True Speed | 0 % Error | 0.4 % Error | 1.5 % Error | 3.4 % Error | 13.4 % Error | 29.3 % Error | 100 % Error |
| 25.0 mph | 25.0 mph | 24.9 mph | 24.6 mph | 24.1 mph | 21.7 mph | 17.7 mph | 0 mph |
| 50.0 mph | 50.0 mph | 49.8 mph | 49.2 mph | 48.3 mph | 43.3 mph | 35.4 mph | 0 mph |
| 75.0 mph | 75.0 mph | 74.7 mph | 73.9 mph | 72.4 mph | 65.0 mph | 53.0 mph | 0 mph |
| 100.0 mph | 100.0 mph | 99.6 mph | 98.5 mph | 96.6 mph | 86.6 mph | 70.7 mph | 0 mph |
| 125.0 mph | 125.0 mph | 124.5 mph | 123.1 mph | 120.7 mph | 108.3 mph | 88.4 mph | 0 mph |
| 150.0 mph | 150.0 mph | 149.4 mph | 147.7 mph | 144.9 mph | 129.9 mph | 106.1 mph | 0 mph |
| 200.0 mph | 200.0 mph | 199.2 mph | 197.0 mph | 193.2 mph | 173.2 mph | 141.4 mph | 0 mph |
| 250.0 mph | 250.0 mph | 249.0 mph | 246.2 mph | 241.4 mph | 216.5 mph | 176.8 mph | 0 mph |



In order to get accurate readings, the radar gun must be placed in the line of travel of the target. At slight angles, the error will be very small, however at larger angles, the error will be substantial.

Calculating Angel Errors

If you know the angle that you are clocking at, you can calculate the actual speed by taking the radar reading and dividing by the cosine of the angle. For example: if you are clocking at 30 degrees, and the gun displays 129.9 mph. Take 129.9 and divide by the cosine of 30 degrees (0.866) to get a true speed of 150.0 mph.

Windy Corner Speed Study Angle Error Correction

| | | |
|--|---------------------------|----------------------|
| Location: | Seward Highway (MP 106.5) | Date: 8/31/2016 |
| Direction of Traffic: | South | Counted By: CAS/TW |
| Start Time: | 4:20 PM | End Time: 4:50 PM |
| | | Weather: Sunny |
| Gun Position: ~_45_ feet from CL, vehicle _150_ feet away (~_17_ degree angle) | | Posted Speed: 55 mph |

Mean Speed = 55.8 mph

True Mean Speed = $55.8 \times 1/\cos(17^\circ) = 58.3$ mph

| | | |
|--|---------------------------|----------------------|
| Location: | Seward Highway (MP 106.5) | Date: 8/31/2016 |
| Direction of Traffic: | North | Counted By: CAS/TW |
| Start Time: | 4:00 PM | End Time: 4:20 PM |
| | | Weather: Sunny |
| Gun Position: ~30-feet from CL, vehicle 100-feet away (~_17_ degree angle) | | Posted Speed: 55 mph |

Mean Speed = 57.0 mph

True Mean Speed = $57.0 \times 1/\cos(17^\circ) = 59.6$ mph

| |
|---|
| Average True Mean Speed = $\frac{58.3 + 59.6}{2} = 58.95$ mph |
|---|

**Attachment F:
Analysis Calculations**

| July Vehicle Mix Calculations | | | | | | | | | | | | | | | | | | | |
|-------------------------------|------|------------|------|--------|------|---------------|---------|-------------|------|------|------------------|------|------|-----------------|------|------|---------------|------|------|
| | | Motorcycle | | Car | | Bus | M.Truck | Heavy Truck | | | | | | | | | | | |
| FC DIR | YR | TOTAL | | CLS | CLS | % Single Unit | | | CLS | CLS | % Single Trailer | | | % Multi Trailer | | | % Total Cmrcl | | |
| | | MTH | DAYS | 1 | 2 | CLS | CLS | CLS | 6 | 7 | CLS | CLS | CLS | CLS | CLS | CLS | Vhcls | | |
| North | 2013 | 7 | 31 | 257877 | 0.76 | 58.79 | 31.16 | 0.61 | 5.45 | 0.70 | 0.00 | 0.76 | 0.96 | 0.45 | 0.00 | 0.00 | 0.35 | 9.28 | |
| South | 2013 | 7 | 31 | 258773 | 0.73 | 58.28 | 31.38 | 0.62 | 5.64 | 0.76 | 0.01 | 0.86 | 0.92 | 0.48 | 0.00 | 0.00 | 0.32 | 9.61 | |
| Average (%) | | | | | 0.74 | 89.80 | | 0.62 | 5.55 | 3.29 | | | | | | | | | 9.45 |

| Design Designation – Vehicle Mix Calculations | | | | | | | | | | | | | | | | |
|---|--|------------|-------|---------------|------|------|---------|-------------|------------------|------|------|-----------------|------|------|---------------|------|
| | | Motorcycle | | Car | | Bus | M.Truck | Heavy Truck | | | | | | | | |
| | | CLS | CLS | % Single Unit | | | CLS | CLS | % Single Trailer | | | % Multi Trailer | | | % Total Cmrcl | |
| | | 1 | 2 | CLS | CLS | CLS | 6 | 7 | CLS | CLS | CLS | CLS | CLS | CLS | Vhcls | |
| Yearly Vehicle % | | 0.43 | 60.49 | 0.38 | 0.38 | 4.64 | 0.76 | 0.01 | 0.39 | 0.91 | 0.39 | 0.00 | 0.00 | 0.44 | 7.92 | |
| Average (%) | | 0.43 | 91.64 | | 0.38 | 4.64 | 2.90 | | | | | | | | | 7.92 |

| | | Grown Future Year | | | | | | |
|--------------------|----------------|--|-------|-------|-------|--------|--------|--------|
| 2037 July : 23,339 | | Percent of AADT For Day of Week (July) | | | | | | |
| HOURL | % AADT By Hour | MON | TUES | WED | THURS | FRI | SAT | SUN |
| | | 84.4% | 80.2% | 87.7% | 92.6% | 114.6% | 120.0% | 120.5% |
| 8AM-9AM | 4.1% | 808 | 767 | 839 | 886 | 1097 | 1148 | 1153 |
| 9AM-10AM | 5.0% | 985 | 936 | 1023 | 1081 | 1337 | 1400 | 1406 |
| 10AM-11AM | 5.5% | 1083 | 1030 | 1126 | 1189 | 1471 | 1540 | 1547 |
| 11AM-12PM | 6.0% | 1182 | 1123 | 1228 | 1297 | 1605 | 1680 | 1687 |
| 12PM-1PM | 6.7% | 1320 | 1254 | 1371 | 1448 | 1792 | 1876 | 1884 |
| 1PM-2PM | 6.9% | 1359 | 1292 | 1412 | 1491 | 1846 | 1933 | 1941 |
| 2PM-3PM | 7.3% | 1438 | 1366 | 1494 | 1578 | 1953 | 2045 | 2053 |
| 3PM-4PM | 7.7% | 1517 | 1441 | 1576 | 1664 | 2060 | 2157 | 2166 |
| 4PM-5PM | 8.1% | 1596 | 1516 | 1658 | 1751 | 2167 | 2269 | 2278 |
| 5PM-6PM | 7.9% | 1556 | 1479 | 1617 | 1707 | 2113 | 2213 | 2222 |
| 6PM-7PM | 7.2% | 1418 | 1348 | 1474 | 1556 | 1926 | 2017 | 2025 |
| 7PM-8PM | 5.8% | 1143 | 1086 | 1187 | 1254 | 1551 | 1624 | 1631 |
| 8PM-9PM | 4.6% | 906 | 861 | 942 | 994 | 1230 | 1288 | 1294 |

| Volume by Vehicle Type | | | | | | | | | |
|------------------------|-----------------|------|------------------|--|----------|----------|-----|------------|------|
| Friday | | | | | | | | | |
| | Traffic (2-way) | ATS* | dBA [§] | Traffic by vehicle type (1-way) [#] | | | | | LOS* |
| | | | | Auto | M. Truck | H. Truck | Bus | Motorcycle | |
| All Day | 26751 | -- | -- | | | | | | -- |
| 4PM-5PM | 2167 | 48.2 | 67.2 | 973 | 60 | 36 | 7 | 8 | C |

* Derived using HCS 2010

§ Derived using generic TNM 2.5

50/50 directional split taken from design designation

| Saturday | | | | | | | | | |
|----------------|-----------------|------|------------------|--|----------|----------|-----|------------|------|
| | Traffic (2-way) | ATS* | dBA [§] | Traffic by vehicle type (1-way) [#] | | | | | LOS* |
| | | | | Auto | M. Truck | H. Truck | Bus | Motorcycle | |
| All Day | 28012 | -- | -- | | | | | | -- |
| 3PM-4PM | 2157 | 48.3 | 67.2 | 969 | 60 | 35 | 7 | 8 | C |
| 4PM-5PM | 2269 | 47.3 | 67.1 | 1019 | 63 | 37 | 7 | 8 | C |
| 5PM-6PM | 2213 | 47.8 | 67.1 | 994 | 61 | 36 | 7 | 8 | C |

* Derived using HCS 2010

§ Derived using generic TNM 2.5

50/50 directional split taken from design designation

| Sunday | | | | | | | | | |
|----------------|-----------------|------|------------------|--|----------|----------|-----|------------|------|
| | Traffic (2-way) | ATS* | dBA [§] | Traffic by vehicle type (1-way) [#] | | | | | LOS* |
| | | | | Auto | M. Truck | H. Truck | Bus | Motorcycle | |
| All Day | 28129 | -- | -- | | | | | | -- |
| 3PM-4PM | 2166 | 48.2 | 67.2 | 973 | 60 | 36 | 7 | 8 | C |
| 4PM-5PM | 2278 | 47.2 | 67.1 | 1023 | 63 | 37 | 7 | 8 | C |
| 5PM-6PM | 2222 | 47.7 | 67.2 | 998 | 62 | 37 | 7 | 8 | C |

* Derived using HCS 2010

§ Derived using generic TNM 2.5

50/50 directional split taken from design designation

| Design Hour Results with Average Operating Speed | |
|--|-------|
| Design Year 2037 | |
| DHV | 2,116 |
| Posted Speed (Mph) | 59 |
| dBA | 68.8 |
| Traffic by Vehicle Type (1-way) | |
| Auto | 970 |
| Medium Trucks | 49 |
| Heavy Trucks | 31 |
| Buses | 4 |
| Mortorcycles | 5 |

**Attachment F:
Analysis Calculations**

| July Vehicle Mix Calculations | | | | | | | | | | | | | | | | | | | |
|-------------------------------|------|------------|------|--------|------|---------------|---------|-------------|------|------|------------------|------|------|-----------------|------|------|---------------|------|------|
| | | Motorcycle | | Car | | Bus | M.Truck | Heavy Truck | | | | | | | | | | | |
| FC DIR | YR | TOTAL | | CLS | CLS | % Single Unit | | | CLS | CLS | % Single Trailer | | | % Multi Trailer | | | % Total Cmrcl | | |
| | | MTH | DAYS | 1 | 2 | CLS | CLS | CLS | 6 | 7 | CLS | CLS | CLS | CLS | CLS | CLS | Vhcls | | |
| North | 2013 | 7 | 31 | 257877 | 0.76 | 58.79 | 31.16 | 0.61 | 5.45 | 0.70 | 0.00 | 0.76 | 0.96 | 0.45 | 0.00 | 0.00 | 0.35 | 9.28 | |
| South | 2013 | 7 | 31 | 258773 | 0.73 | 58.28 | 31.38 | 0.62 | 5.64 | 0.76 | 0.01 | 0.86 | 0.92 | 0.48 | 0.00 | 0.00 | 0.32 | 9.61 | |
| Average (%) | | | | | 0.74 | 89.80 | | 0.62 | 5.55 | 3.29 | | | | | | | | | 9.45 |

| Design Designation – Vehicle Mix Calculations | | | | | | | | | | | | | | | | |
|---|--|------------|-------|---------------|------|------|---------|-------------|------------------|------|------|-----------------|------|------|---------------|------|
| | | Motorcycle | | Car | | Bus | M.Truck | Heavy Truck | | | | | | | | |
| | | CLS | CLS | % Single Unit | | | CLS | CLS | % Single Trailer | | | % Multi Trailer | | | % Total Cmrcl | |
| | | 1 | 2 | CLS | CLS | CLS | 6 | 7 | CLS | CLS | CLS | CLS | CLS | CLS | Vhcls | |
| Yearly Vehicle % | | 0.43 | 60.49 | 0.38 | 0.38 | 4.64 | 0.76 | 0.01 | 0.39 | 0.91 | 0.39 | 0.00 | 0.00 | 0.44 | 7.92 | |
| Average (%) | | 0.43 | 91.64 | | 0.38 | 4.64 | 2.90 | | | | | | | | | 7.92 |

| | | Grown Future Year | | | | | | |
|--------------------|----------------|--|-------|-------|-------|--------|--------|--------|
| 2037 July : 23,339 | | Percent of AADT For Day of Week (July) | | | | | | |
| HOURL | % AADT By Hour | MON | TUES | WED | THURS | FRI | SAT | SUN |
| | | 84.4% | 80.2% | 87.7% | 92.6% | 114.6% | 120.0% | 120.5% |
| 8AM-9AM | 4.1% | 808 | 767 | 839 | 886 | 1097 | 1148 | 1153 |
| 9AM-10AM | 5.0% | 985 | 936 | 1023 | 1081 | 1337 | 1400 | 1406 |
| 10AM-11AM | 5.5% | 1083 | 1030 | 1126 | 1189 | 1471 | 1540 | 1547 |
| 11AM-12PM | 6.0% | 1182 | 1123 | 1228 | 1297 | 1605 | 1680 | 1687 |
| 12PM-1PM | 6.7% | 1320 | 1254 | 1371 | 1448 | 1792 | 1876 | 1884 |
| 1PM-2PM | 6.9% | 1359 | 1292 | 1412 | 1491 | 1846 | 1933 | 1941 |
| 2PM-3PM | 7.3% | 1438 | 1366 | 1494 | 1578 | 1953 | 2045 | 2053 |
| 3PM-4PM | 7.7% | 1517 | 1441 | 1576 | 1664 | 2060 | 2157 | 2166 |
| 4PM-5PM | 8.1% | 1596 | 1516 | 1658 | 1751 | 2167 | 2269 | 2278 |
| 5PM-6PM | 7.9% | 1556 | 1479 | 1617 | 1707 | 2113 | 2213 | 2222 |
| 6PM-7PM | 7.2% | 1418 | 1348 | 1474 | 1556 | 1926 | 2017 | 2025 |
| 7PM-8PM | 5.8% | 1143 | 1086 | 1187 | 1254 | 1551 | 1624 | 1631 |
| 8PM-9PM | 4.6% | 906 | 861 | 942 | 994 | 1230 | 1288 | 1294 |

| Volume by Vehicle Type | | | | | | | | | |
|------------------------|-----------------|------|------------------|--|----------|----------|-----|------------|------|
| Friday | | | | | | | | | |
| | Traffic (2-way) | ATS* | dBA [§] | Traffic by vehicle type (1-way) [#] | | | | | LOS* |
| | | | | Auto | M. Truck | H. Truck | Bus | Motorcycle | |
| All Day | 26751 | -- | -- | | | | | | -- |
| 4PM-5PM | 2167 | 48.2 | 67.2 | 973 | 60 | 36 | 7 | 8 | C |

* Derived using HCS 2010

§ Derived using generic TNM 2.5

50/50 directional split taken from design designation

| Saturday | | | | | | | | | |
|----------------|-----------------|------|------------------|--|----------|----------|-----|------------|------|
| | Traffic (2-way) | ATS* | dBA [§] | Traffic by vehicle type (1-way) [#] | | | | | LOS* |
| | | | | Auto | M. Truck | H. Truck | Bus | Motorcycle | |
| All Day | 28012 | -- | -- | | | | | | -- |
| 3PM-4PM | 2157 | 48.3 | 67.2 | 969 | 60 | 35 | 7 | 8 | C |
| 4PM-5PM | 2269 | 47.3 | 67.1 | 1019 | 63 | 37 | 7 | 8 | C |
| 5PM-6PM | 2213 | 47.8 | 67.1 | 994 | 61 | 36 | 7 | 8 | C |

* Derived using HCS 2010

§ Derived using generic TNM 2.5

50/50 directional split taken from design designation

| Sunday | | | | | | | | | |
|----------------|-----------------|------|------------------|--|----------|----------|-----|------------|------|
| | Traffic (2-way) | ATS* | dBA [§] | Traffic by vehicle type (1-way) [#] | | | | | LOS* |
| | | | | Auto | M. Truck | H. Truck | Bus | Motorcycle | |
| All Day | 28129 | -- | -- | | | | | | -- |
| 3PM-4PM | 2166 | 48.2 | 67.2 | 973 | 60 | 36 | 7 | 8 | C |
| 4PM-5PM | 2278 | 47.2 | 67.1 | 1023 | 63 | 37 | 7 | 8 | C |
| 5PM-6PM | 2222 | 47.7 | 67.2 | 998 | 62 | 37 | 7 | 8 | C |

* Derived using HCS 2010

§ Derived using generic TNM 2.5

50/50 directional split taken from design designation

| Design Hour Results with Average Operating Speed | |
|--|-------|
| Design Year 2037 | |
| DHV | 2,116 |
| Posted Speed (Mph) | 59 |
| dBA | 68.8 |
| Traffic by Vehicle Type (1-way) | |
| Auto | 970 |
| Medium Trucks | 49 |
| Heavy Trucks | 31 |
| Buses | 4 |
| Mortorcycles | 5 |

**Attachment G:
Correspondence with ARRC**

Stepovich, Christopher

Subject: FW: Windy Corner - railroad noise analysis?

From: Brian Lindamood [<mailto:LindamoodB@akrr.com>]
Sent: Wednesday, September 14, 2016 12:07 PM
To: Whitesell, Patrick
Subject: RE: Windy Corner - railroad noise analysis?

No turnouts crossings, or crossovers. Train speed is 40 mph. I think most of the rail through there is welded as we have an active program to replace curved rail from jointed to CWR.

Passenger trains, May-September, 4-10 daily; October, 0-2. Length is 2-13 cars each (average around 8-9), 2 locomotives
Freight trains: 1-6 daily, Length 20-140 cars each (avg. about 75), 2-3 locomotives

From: Whitesell, Patrick [<mailto:pwhitesell@dowl.com>]
Sent: Wednesday, September 14, 2016 10:39 AM
To: Brian Lindamood
Subject: RE: Windy Corner - railroad noise analysis?

Specifically at Windy Corner.

From: Brian Lindamood [<mailto:LindamoodB@akrr.com>]
Sent: Wednesday, September 14, 2016 10:01 AM
To: Whitesell, Patrick
Subject: RE: Windy Corner - railroad noise analysis?

Is this specifically at Windy Corner, or elsewhere as well?

From: Whitesell, Patrick [<mailto:pwhitesell@dowl.com>]
Sent: Tuesday, September 13, 2016 3:46 PM
To: Brian Lindamood
Subject: RE: Windy Corner - railroad noise analysis?

Yes, please –

cars/train (I know this will vary, so perhaps a typical average or typical longest daily train' number), # trains / hour or per day, # locomotives per train, typical speed of trains, duration of trains for track crossovers.

Thanks,
Pat W

From: Brian Lindamood [<mailto:LindamoodB@akrr.com>]
Sent: Tuesday, September 13, 2016 2:54 PM
To: Whitesell, Patrick
Subject: RE: Windy Corner - railroad noise analysis?

FRA/FTA have standard noise calculations for noise from the sources listed below. Assuming you are doing the standard stuff, what you primarily need are the number of trains. I can get that info if that is what you need. I will have to dig for anything else.

From: Whitesell, Patrick [<mailto:pwhitesell@dowl.com>]
Sent: Tuesday, September 13, 2016 2:44 PM
To: Brian Lindamood
Subject: RE: Windy Corner - railroad noise analysis?

Good afternoon, Brian –

Have you had a chance to review the info request (below)? We'll be submitting the draft / proposed Noise Study Plan to DOT by the end of this week.

Cheers,
Pat Whitesell

From: Brian Lindamood [<mailto:LindamoodB@akrr.com>]
Sent: Thursday, September 01, 2016 11:29 AM
To: Whitesell, Patrick
Subject: RE: Windy Corner - railroad noise analysis?

I am out of state until next week, and will call when I return.

Sent from a fancy phone.

----- Original message -----

From: "Whitesell, Patrick" <pwhitesell@dowl.com>
Date: 9/1/16 15:24 (GMT-05:00)
To: Brian Lindamood <LindamoodB@akrr.com>
Subject: RE: Windy Corner - railroad noise analysis?

Hi Brian –

Have you had a chance to parse through the train info (below) for purposes of noise modeling?

Cheers,
Pat Whitesell

From: Whitesell, Patrick
Sent: Thursday, August 25, 2016 10:12 AM
To: 'Brian Lindamood'
Subject: RE: Windy Corner - railroad noise analysis?

Good morning, Brian –

I never got back to you last week.

Anyhow, below is what our junior noise modeler sent me as a list of 'need to verify / get' info regarding the train noise modeling. Can you help answer these, and moreover, do you see any items missing?

Model Input:

- Moving Noise Sources: Diesel commuter locomotives (I think this what AKRR uses)
- Stationary Noise Source (i.e. railroad yard, layover tracks.....etc.): n/a for Windy Corner
- Track Noise Sources: Jointed Track (I think this what AKRR uses?)
- Train Activity Data:
 - Number of trains per hour for:
 - Commuter, freight trains
 - Rail yards or shops and layover tracks (n/a for Windy Corner)
 - Track crossovers (n/a for Windy Corner)
 - Number of locomotives per train for:
 - Commuter trains
 - Freight trains
 - Number of cars per train for:
 - Commuter
 - Freight trains (length of cars)
 - Duration of trains for:
 - Track crossovers
 - Speed of vehicles for:
 - Trains
- Noise-Sensitive Receptor Data:
 - Land use type (FTA Category 1,3)
 - Distance to noise sources
 - Presence of noise barrier
 - Intervening building rows

Cheers,
Pat Whitesell

From: Brian Lindamood [<mailto:LindamoodB@akrr.com>]
Sent: Wednesday, August 17, 2016 12:54 PM
To: Whitesell, Patrick
Subject: RE: Windy Corner - railroad noise analysis?

I have some experience with them. We can talk after our 1:30 if you would like.

From: Whitesell, Patrick [<mailto:pwhitesell@dowl.com>]
Sent: Wednesday, August 17, 2016 11:55 AM
To: Brian Lindamood
Cc: Ashton, Nancy
Subject: Windy Corner - railroad noise analysis?

Hi Brian –

Can you tell me if you're familiar with railroad noise analyses?

I'd like to pick your brain, if you've got a moment or three. We're now moving ahead with a new environmental document (Categorical Exclusion, per FHWA), and must conduct a noise analysis. Since this is highway and railroad, it appears we must model noise for each.

Are you familiar with any such (road/rail noise) studies?

Thanks,
Pat W

Patrick A. Whitesell
Environmental Specialist



(907) 562-2000 ■ (800) 865-9847 (fax)
4041 B Street
Anchorage, Alaska 99503


Consider the **environment** before printing.


APPENDIX C


TNM Noise Model Validation Information

Noise Data Collection Worksheets/TNM Outputs

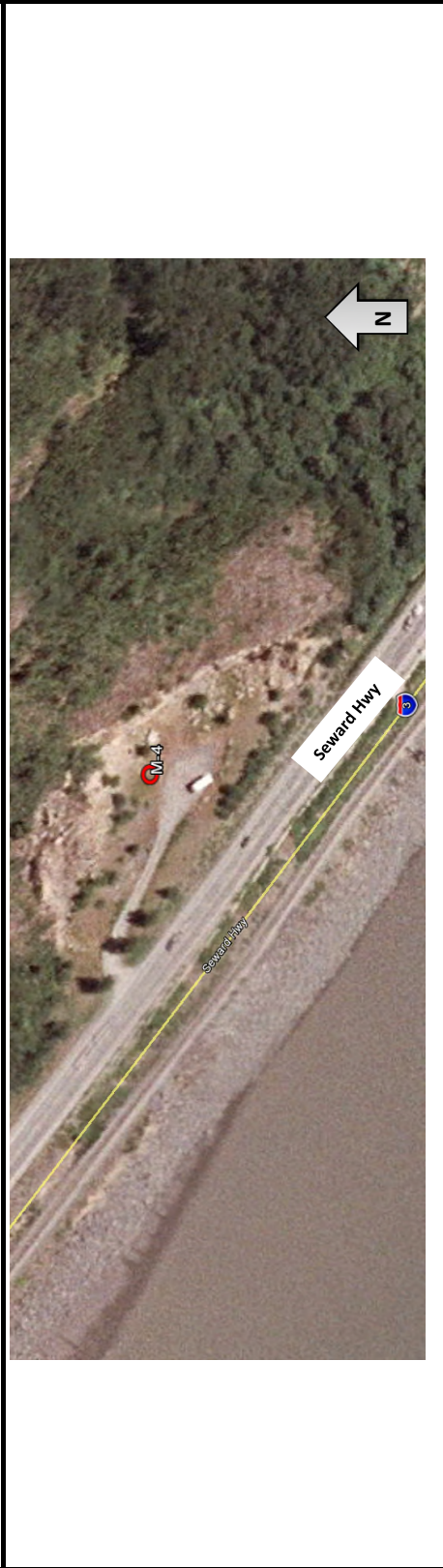
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| Noise Data Collection Worksheet | | | | | | |
|--|---|---------------|--------------|--|-------------|-------------|
| Date: 11/03/16 | Project: Seward Highway: MP 105-107 | | | | | |
| Monitoring Number: M-1 | Monitoring Location: Falls Creek Trailhead | | | | | |
| Sound Level Meter | Field Calibration | | | | | |
| Model #: RION NL-52 | Model #: RION NC-74 | | | | | |
| Serial #: 00642976 | Serial #: 34557120 | | | | | |
| Weighting: A | Calibration Level: 94.0 dB | | | | | |
| Terrain: Mountainous Roadside/Rolling roadway | GPS Coordinates | | | | | |
| | Lat, Long: 60° 59' 04.11" N, 149° 34' 33.48" W | | | | | |
| | Ground Cover: Right Side, Dirt/Grass / Left Side, Water | | | | | |
| | Activity Category: C | | | | | |
| | Weather Data | | | | | |
| | Weather: Sunny | | | | | |
| | Wind Speed: 6 mph, NW | | | | | |
| | Precipitation: No | | | | | |
| | Temperature: 38°F | | | | | |
| | Site Location Diagram | | | | | |
|  | | | | | | |
| Dominant Noise Sources: Traffic along Seward Highway | | | | | | |
| Traffic Data Collection | | | | | | |
| Seward Highway | Directional Hourly Traffic Volume (veh/hr) | | | | | |
| | Cars | Medium Trucks | Heavy Trucks | Buses | Motorcycles | Speed (mph) |
| Southbound | 230 | 0 | 4 | 0 | 0 | 110 |
| Northbound | 236 | 2 | 14 | 0 | 0 | |
| Noise Measurements | | | | | | |
| ID | Start Time | Stop Time | Leq (15 min) | Notes/Noise Contamination | | |
| M1 | 3:10 PM | 3:25 PM | 62.0 | | | |
| M1 | 3:30 PM | 3:45 PM | 61.1 | 3:39 PM - Door Slammed 3:40 PM - Door Slammed | | |
| Leq Noise Level (avg): 61.6 | | | | | | |

| Noise Data Collection Worksheet | | | | | | |
|--|--|---------------|--------------|--|-------------|-------------|
| Date: 11/03/16 | Project: Seward Highway: MP 105-107 | | | | | |
| Monitoring Number: M-2 | Monitoring Location: Turnagain Arm Trail 1 | | | | | |
| Sound Level Meter | Field Calibration | | | | | |
| Model #: RION NL-52 | Model #: RION NC-74 | | | | | |
| Serial #: 00642976 | Serial #: 34557120 | | | | | |
| Weighting: A | Calibration Level: 94.0 dB | | | | | |
| | GPS Coordinates | | | | | |
| Terrain: Mountainous Roadside/Rolling roadway | Lat, Long: 60° 59' 5.96" N, 149° 36' 16.10" W | | | | | |
| | Ground Cover: Right Side, Dirt/Grass (with some rock surfaces), Left Side, Water | | | | | |
| | Activity Category: C | | | | | |
| | Weather Data | | | | | |
| | Weather: Sunny | | | | | |
| | Wind Speed: 10 mph, SE | | | | | |
| | Precipitation: No | | | | | |
| | Temperature: 36°F | | | | | |
| | Site Location Diagram | | | | | |
|  | | | | | | |
| Dominant Noise Sources: Traffic along Seward Highway | | | | | | |
| Traffic Data Collection | | | | | | |
| Seward Highway | Directional Hourly Traffic Volume (veh/hr) | | | | | Speed (mph) |
| | Cars | Medium Trucks | Heavy Trucks | Buses | Motorcycles |  | Distance (ft) |
| Southbound | 230 | 0 | 0 | 0 | 0 | 90 |
| Northbound | 236 | 10 | 4 | 2 | 0 | |
| | | | | | | 57.2 |
| Noise Measurements | | | | | | |
| ID | Start Time | Stop Time | Leq (15 min) | Notes/Noise Contamination | | |
| M2 | 2:15 PM | 2:30 PM | 65.3 | 2:19 PM - Extraordinarily Loud Vehicle | | |
| M2 | 2:35 PM | 2:50 PM | 66.1 | 2:39 PM - Loud Muffler | | |
| | | | | 2:40 PM - Loud Muffler | | |
| | | | | 2:42 PM - Airplane | | |
| | | | | 2:44 PM - Extraordinarily Loud Vehicle | | |
| | | | | 2:45 PM - Airplane | | |
| | | | | 2:47 PM - Loud Muffler | | |
| | | | | 2:49 PM - Airplane | | |
| Leq Noise Level (avg): 65.6 | | | | | | |

| Noise Data Collection Worksheet | | | | | | |
|--|---|---------------|--------------|--|-------------|-------------|
| Date: 10/13/16 | Project: Seward Highway: MP 105-107 | | | | | |
| Monitoring Number: M-3 | Monitoring Location: Rock Climbing Area | | | | | |
| Sound Level Meter | Field Calibration | | | | | |
| Model #: RION NL-52 | Model #: RION NC-74 | | | | | |
| Serial #: 00642976 | Serial #: 34557120 | | | | | |
| Weighting: A | Calibration Level: 94.0 dB | | | | | |
| Terrain: Mountainous Roadside/Rolling roadway | GPS Coordinates | | | | | |
| | Lat, Long: 60° 59' 11.00" N, 149° 36' 41.63" W | | | | | |
| | Ground Cover: Right Side, Dirt/Grass (with some rock) | | | | | |
| Site Location Diagram | | | | | | |
|  | | | | | | |
| Dominant Noise Sources: Traffic along Seward Highway | | | | | | |
| Traffic Data Collection | | | | | | |
| Seward Highway | Directional Hourly Traffic Volume (veh/hr) | | | | | |
| | Cars | Medium Trucks | Heavy Trucks | Buses | Motorcycles | Speed (mph) |
| South Bound | 230 | 0 | 0 | 0 | 0 | 90 |
| Northbound | 236 | 8 | 4 | 2 | 2 | |
| Noise Measurements | | | | | | |
| ID | Start Time | Stop Time | Leq (15 min) | Notes/Noise Contamination | | |
| M3 | 3:15 PM | 3:30 PM | 64.1 | 5:20 PM - Loud Muffler | | |
| M3 | 3:35 PM | 3:50 PM | 63.7 | 3:37 PM - Car Screeching 3:49 PM - Airplane | | |
| Leq Noise Level (avg): 63.9 | | | | | | |

| Noise Data Collection Worksheet | |
|---|--|
| Date: 10/13/16 | Project: Seward Highway: MP 105-107 |
| Monitoring Number: M-4 | Monitoring Location: Trunagain Arm Trail 2 |
| Sound Level Meter | Field Calibration |
| Model #: RION NL-52 | Model #: RION NC-74 |
| Serial #: 00642976 | Serial #: 34557120 |
| Weighting: A | Calibration Level: 94.0 dB |
| | GPS Coordinates |
| Terrain: Mountainous Roadside/Rolling roadway | Lat, Long: 60° 59' 26.46" N, 149° 37' 1.02" W |
| | Activity Category: C |
| | Weather Data |
| | Weather: Sunny |
| | Wind Speed: 6 mph, NW |
| | Precipitation: No |
| | Temperature: 48°F |
| | Ground Cover: Right Side, Dirt/Grass (with some rock surfaces), Left Side, Water |



| Dominant Noise Sources: Traffic along Seward Highway | | | | | | |
|--|--|---------------|--------------|---|---------------|-------------|
| <u>Traffic Data Collection</u> | | | | | | |
| Seward Highway | Directional Hourly Traffic Volume (veh/hr) | | | | Distance (ft) | Speed (mph) |
| | Cars | Medium Trucks | Heavy Trucks | Buses |  |  | Motorcycles |
| South Bound | 230 | 0 | 4 | 4 | 130 | 56.8 |
| Northbound | 236 | 12 | 18 | 2 | | |
| <u>Noise Measurements</u> | | | | | | |
| ID | Start Time | Stop Time | Leq (15 min) | Notes/Noise Contamination | | |
| M4 | 2:00 PM | 2:15 PM | 59.9 | 2:05 PM - Squirrel 2:10 PM - Honking 2:12 PM - Airplane | | |
| M4 | 2:20 PM | 2:40 PM | 60.0 | 2:25 PM - Helicopter 2:29 PM - Unusual Car Noise | | |
| Leq Noise Level (avg): 60.0 | | | | | | |

RESULTS: SOUND LEVELS

Windy Corner, 11-03-16 Data

DOWL
CAS

1 December 2016
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS

PROJECT/CONTRACT: Windy Corner, 11-03-16 Data

RUN: Validation: M1

BARRIER DESIGN: INPUT HEIGHTS

ATMOSPHERICS: 68 deg F, 50% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

| Receiver | | | | | | | | | | | | | | |
|-----------------------|-----|-------|-----------------|-----|-----------------|-----|------------------------|--------|--------|-------------|------------|--------------|------------|--------------------------|
| Name | No. | #DUs | Existing | | No Barrier | | Increase over existing | | | Type Impact | | With Barrier | | Calculated minus Goal dB |
| | | | L Aeq1h | dBA | L Aeq1h | dBA | Calculated | Crit'n | Crit'n | Sub'l Inc | Calculated | Goal | Calculated |  | Goal |
| M1-2 | 1 | 1 | 61.6 | 66 | 60.7 | 66 | -0.9 | 10 | 10 | ---- | 60.7 | 8 | 8 | -8.0 |
| M2-2 | 1 | 1 | 0.0 | 66 | 0.0 | 66 | 0.0 | 10 | 10 | inactive | 0.0 | 8 | 8 | 0.0 |
| M4-2 | 1 | 1 | 0.0 | 66 | 0.0 | 66 | 0.0 | 10 | 10 | inactive | 0.0 | 8 | 8 | 0.0 |
| Dwelling Units | | | | | | | | | | | | | | |
| | | # DUs | Noise Reduction | | Noise Reduction | | | | | | | | | |
| | | | Min | Avg | Max | | | | | | | | | |
| | | | dB | dB | dB | | | | | | | | | |
| All Selected | | 3 | 0.0 | 0.0 | 0.0 | | | | | | | | | |
| All Impacted | | 0 | 0.0 | 0.0 | 0.0 | | | | | | | | | |
| All that meet NR Goal | | 0 | 0.0 | 0.0 | 0.0 | | | | | | | | | |

RESULTS: SOUND LEVELS

Windy Corner, 11-03-16 Data

DOWL
CAS

1 December 2016
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS

PROJECT/CONTRACT: Windy Corner, 11-03-16 Data

RUN: Validation: M2

BARRIER DESIGN: INPUT HEIGHTS

Average pavement type shall be used unless
a State highway agency substantiates the use
of a different type with approval of FHWA.

ATMOSPHERICS: 68 deg F, 50% RH

| Receiver Name | No. | #DUs | Existing | | No Barrier | | With Barrier | | Type Impact | Noise Reduction | | Calculated minus Goal dB | | | |
|-----------------------|-----|-------|-----------------|------|------------|--------|--------------|------------|-------------|-----------------|------------|--------------------------|------|--|--|
| | | | LAeq1h | dBA | LAeq1h | Crit'n | LAeq1h | Calculated | | Goal | Calculated | | Goal | | |
| M1-2 | 1 | 1 | 0.0 | 0.0 | 0.0 | 66 | 0.0 | 0.0 | 10 | inactive | 0.0 | 8 | 0.0 | | |
| M2-2 | 1 | 1 | 65.6 | 63.0 | 63.0 | 66 | -2.6 | 10 | ---- | | 63.0 | 8 | -8.0 | | |
| M4-2 | 1 | 1 | 0.0 | 0.0 | 0.0 | 66 | 0.0 | 10 | inactive | | 0.0 | 8 | 0.0 | | |
| Dwelling Units | | # DUs | Noise Reduction | | | | | | | | | | | | |
| | | | Min | Avg | Max | | | | | | | | | | |
| | | | dB | dB | dB | | | | | | | | | | |
| All Selected | | 3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | |
| All Impacted | | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | |
| All that meet NR Goal | | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | |

RESULTS: SOUND LEVELS

Windy Corner, 10-03-16 Data

DOWL
CAS

1 December 2016
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS

PROJECT/CONTRACT: Windy Corner, 10-03-16 Data

RUN: Validation: M3

BARRIER DESIGN: INPUT HEIGHTS

ATMOSPHERICS: 68 deg F, 50% RH

Average pavement type shall be used unless
a State highway agency substantiates the use
of a different type with approval of FHWA.

| Receiver Name | No. | #DUs | Existing | | No Barrier | | With Barrier | | Increase over existing | | Type Impact | Noise Reduction | | Calculated minus Goal dB |
|-----------------------|-----|-------|-----------------|------|------------|-----|--------------|-----|------------------------|------|-------------|-----------------|------|--------------------------|
| | | | LAeq1h | dBA | LAeq1h | dBA | LAeq1h | dBA | Calculated | Goal | | Calculated | Goal | |
| M2 | 1 | 1 | 0.0 | 0.0 | 66 | 66 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 8 | 0.0 |
| M3 | 1 | 1 | 63.9 | 62.4 | 66 | 66 | -1.5 | 10 | 62.4 | 0.0 | 8 | -8.0 | 8 | -8.0 |
| M1 | 1 | 1 | 0.0 | 0.0 | 66 | 66 | 0.0 | 10 | 0.0 | 0.0 | 0.0 | 0.0 | 8 | 0.0 |
| M4 | 1 | 1 | 0.0 | 0.0 | 66 | 66 | 0.0 | 10 | 0.0 | 0.0 | 0.0 | 0.0 | 8 | 0.0 |
| Dwelling Units | | # DUs | Noise Reduction | | | | | | | | | | | |
| | | | Min | Avg | Max | | | | | | | | | |
| | | | dB | dB | dB | | | | | | | | | |
| All Selected | | 4 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| All Impacted | | 0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| All that meet NR Goal | | 0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |

RESULTS: SOUND LEVELS

Windy Corner, 10-03-16 Data

DOWL
CAS

1 December 2016
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS

PROJECT/CONTRACT: Windy Corner, 10-03-16 Data

RUN: Validation: M4

BARRIER DESIGN: INPUT HEIGHTS

ATMOSPHERICS: 68 deg F, 50% RH

Average pavement type shall be used unless
a State highway agency substantiates the use
of a different type with approval of FHWA.

| Receiver Name | No. | #DUs | Existing | | No Barrier | | Increase over existing | | Type Impact | With Barrier | | Noise Reduction Calculated | Noise Reduction Goal | Calculated minus Goal |
|-----------------------|-----|------|----------|------|-----------------|------|------------------------|--------|-------------|--------------|--------|----------------------------|----------------------|-----------------------|
| | | | LAeq1h | dBA | LAeq1h | dBA | Calculated | Crit'n | | Calculated | Crit'n |  |  |  | LAeq1h | dBA |
| M2 | 1 | 1 | 0.0 | 0.0 | 0.0 | 0.0 | 66 | 0.0 | 10 | inactive | 0.0 | 0.0 | 8 | 0.0 |
| M3 | 1 | 1 | 0.0 | 0.0 | 0.0 | 0.0 | 66 | 0.0 | 10 | inactive | 0.0 | 0.0 | 8 | 0.0 |
| M1 | 1 | 1 | 0.0 | 0.0 | 0.0 | 0.0 | 66 | 0.0 | 10 | inactive | 0.0 | 0.0 | 8 | 0.0 |
| M4 | 1 | 1 | 60.0 | 60.4 | 60.4 | 60.4 | 66 | 0.4 | 10 | ---- | 60.4 | 0.0 | 8 | -8.0 |
| Dwelling Units | | | # DUs | | Noise Reduction | | | | | | | | | |
| | | | Min | Avg | Max | | | | | | | | | |
| | | | dB | dB | dB | | | | | | | | | |
| All Selected | | | 4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| All Impacted | | | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| All that meet NR Goal | | | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

APPENDIX D

Noise Level Predictions/TNM Outputs

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Advanced Prediction And Abatement of Highway Traffic Noise

| Analyst & Site Information | | |
|--|-------------------------|--|
| Analyst: | Chris S./Zaid H. (DOWL) | Major Facility : Seward Highway MP 105-107 |
| Analysis Date: | 12/20/2016 | Ground Type: Soft |
| Receiver #: | R1 | Day/Night Periods: [7:00 a.m.-10:00 p.m.]/[10:00 p.m.-7:00 a.m.] |
| Scenario: | Existing 2016 | Not Used Not Used |
| Step 1: Background Noise: | | |
| Population Density per Square Mile, P [Input Min. 1] | 1a | 5 |
| L_{dn} [Background] = [10 log P + 22 dB] | 1b | 29.0 |
| Step 2: Rail Noise: | | |
| Is Rail Track Jointed Rails? (Yes or No) | 2a | No |
| Is Horn or Whistle Used - Passenger Train? (Yes or No) | 2b | No |
| Distance Between Railroad and Site in Question (m), D | 2c | 65.5 |
| Shortest Distance From Site in Question to the Location at Which The Horn/Whistle is Sounded (m), D_{hw} | 2d | 0.0 |
| Is 2d 10 Times > 2c? (Yes or No) | 2e | No |
| L_{dnhw} [Horn/Whistle Contribution to Diesel Locomotives Passenger Rail] = [10 + 20 log 2c/2d] | 2f | 0.0 |
| Is Horn or Whistle Used - Freight Train? (Yes or No) | 2g | No |
| Distance Between Railroad and Site in Question (m), D | 2h | 65.5 |
| Shortest Distance From Site in Question to the Location at Which The Horn/Whistle is Sounded (m), D_{hw} | 2i | 0.0 |
| Is 2i 10 Times > 2h? (Yes or No) | 2j | No |
| L_{dnhw} [Horn/Whistle Contribution to Diesel Locomotives Freight Rail] = [10 + 20 log 2h/2i] | 2k | 0.0 |
| Daily Passenger Train # of Locomotives | 2l | 2.0 |
| Daily Passenger Train # of Rail Cars | 2m | 9.0 |
| Passenger Train Speed (kph/hr) | 2n | 64.4 |
| Daily Passenger Train Trips | 2o | 7.0 |
| Daily Passenger Train Trips During Day Time, N_d | 2p | 7.0 |
| Daily Passenger Train Trips During Night Time, N_n [2o-2p] | 2q | 0.0 |
| Effective # of Operations for Locomotives, N_{eff. Locomotives, Passenger} = [2l x (2p + 10 x 2q)] | 2r | 14.0 |
| Effective # of Operations for Rails, N_{eff. Rail, Passenger} = [2m x (2p + 10 x 2q)] | 2s | 63.0 |
| Daily Freight Train # of Locomotives: | 2t | 2.0 |
| Daily Freight Train # of Rail Cars: | 2u | 75.0 |
| Freight Train Speed (kph/hr): | 2v | 64.4 |
| Daily Freight Train Trips | 2w | 3.0 |
| Daily Freight Train Trips During Day Time | 2x | 2.0 |
| Daily Freight Train Trips During Night Time = [2w-2x] | 2y | 1.0 |
| Effective # of Operations for Locomotives, N_{eff. Locomotives, Freight} = [2t x (2x + 10 x 2y)] | 2z | 24.0 |
| Effective # of Operations for Rails, N_{eff. Rail, Freight} = [2u x (2x + 10 x 2y)] | 2aa | 900.0 |
| Reference Energy Mean Emission Levels for Locomotives (dBA), (L_o) _{E Locomotives-Passenger} [Figure 4-7] | 2ab | 98.0 |
| Reference Energy Mean Emission Levels for Rail Cars (dBA), (L_o) _{E Rail Cars-Passenger} [Figure 4-7] [If "2a = Yes", 6 dBA is Added to (L _o) _E] | 2ac | 76.0 |
| Reference Energy Mean Emission Levels for Locomotives (dBA), (L_o) _{E Locomotives-Freight} [Figure 4-7] | 2ad | 98.0 |
| Reference Energy Mean Emission Levels for Rail Cars (dBA), (L_o) _{E Rail Cars-Freight} [Figure 4-7] [If "2a = Yes", 6 dBA is Added to (L _o) _E] | 2ae | 76.0 |
| Ground Attenuation Factor, α [Soft Terrian = 0.5, Otherwise =0] | 2af | 0.5 |
| Noise Prediction for Locomotives (dBA), L_{dni Locomotives-Passenger} = [2ab + 10 log [(2r x 15)/2n] + 10 log [15/2c] ^{1+2aa} - 25 - 13.8] | 2ag | 54.7 |
| Noise Prediction for Rail Cars (dBA), L_{dni Rail Cars-Passenger} = [2ac + 10 log [(2s x 15)/2n] + 10 log [15/2c] ^{1+2aa} - 25 - 13.8] | 2ah | 39.3 |
| Sub-Total Passenger Rail Noise (dBA), L_{dn Rail Passenger} [10 Log (10 ^(2ag/10) + 10 ^(2ah/10))] | 2ad | 54.9 |
| Noise Prediction for Locomotives (dBA), L_{dni Locomotives-Freight} | 2ae | 57.1 |
| Noise Prediction for Rails Cars (dBA), L_{dni Rail Cars-Freight} | 2af | 50.8 |
| Sub-Total Passenger Rail Noise (dBA), L_{dn Rail Freight} [10 Log (10 ^(2ae/10) + 10 ^(2af/10))] | 2ag | 58.0 |
| Total Rail Noise (dBA), L_{dn} [10 Log (10 ^(2ad/10) + 10 ^(2ag/10))] | 2ah | 59.7 |
| Step 3: Highway Noise: | | |
| TNM 2.5 Predicted Peak Hour Noise Level (dBA), L_{eq} | 3a | 65.3 |
| Peak Hour Percent of 24-Hour (ADT) Volumes (%) | 3b | 16.6% |
| Day Time Traffic Volumes Percent of 24-hour (ADT) Volumes (%) | 3c | 92.2% |
| Night Time Traffic Volumes Percent of 24-hour (ADT) Volumes (%) | 3d | 7.8% |
| L_{eq} Noise Level Adjustment for Peak Hour % of ADT Volume (dBA), Δ₁ [Figure 4-20] | 3e | -6.0 |
| L_{eq} Noise Level Adjustment for Day Time % of ADT Volume (dBA), Δ₂ [Figure 4-20] | 3f | 2.3 |
| L_{eq} Noise Level Adjustment for Night Time % of ADT Volume (dBA), Δ₂ [Figure 4-20] | 3g | 2.3 |
| Highway Noise (dBA), L_{dn} = [3a + 3e + 3f (OR "3g")] | 3h | 61.6 |
| Step 4: Total Predicted Noise Level (Background+Highway+Rail), L_{dn} | | |
| Total (dBA), L_{dn} = [10 Log (10 ^(1b/10) + 10 ^(2ah/10) + 10 ^(3h/10))] | 4a | 64.0 |

References:

Advanced Prediction And Abatement of Highway Traffic Noise, FHWA Office of Environmental Policy (June 1982 "Recreated November 2016)

Advanced Prediction And Abatement of Highway Traffic Noise

| Analyst & Site Information | | |
|---|-------------------------|--|
| Analyst: | Chris S./Zaid H. (DOWL) | Major Facility : Seward Highway MP 105-107 |
| Analysis Date: | 12/20/2016 | Ground Type: Soft |
| Receiver #: | R2 | Day/Night Periods: [7:00 a.m.-10:00 p.m.]/[10:00 p.m.-7:00 a.m.] |
| Scenario: | Existing 2016 | Not Used Not Used |
| Step 1: Background Noise: | | |
| Population Density per Square Mile, P [Input Min. 1] | 1a | 5 |
| L_{dn} [Background] = [10 log P + 22 dB] | 1b | 29.0 |
| Step 2: Rail Noise: | | |
| Is Rail Track Jointed Rails? (Yes or No) | 2a | No |
| Is Horn or Whistle Used - Passenger Train? (Yes or No) | 2b | No |
| Distance Between Railroad and Site in Question (m), D | 2c | 72.9 |
| Shortest Distance From Site in Question to the Location at Which The Horn/Whistle is Sounded (m), D_{hw} | 2d | 0.0 |
| Is 2d 10 Times > 2c? (Yes or No) | 2e | No |
| L_{dnhw} [Horn/Whistle Contribution to Diesel Locomotives Passenger Rail] = [10 + 20 log 2c/2d] | 2f | 0.0 |
| Is Horn or Whistle Used - Freight Train? (Yes or No) | 2g | No |
| Distance Between Railroad and Site in Question (m), D | 2h | 72.9 |
| Shortest Distance From Site in Question to the Location at Which The Horn/Whistle is Sounded (m), D_{hw} | 2i | 0.0 |
| Is 2i 10 Times > 2h? (Yes or No) | 2j | No |
| L_{dnhw} [Horn/Whistle Contribution to Diesel Locomotives Freight Rail] = [10 + 20 log 2h/2i] | 2k | 0.0 |
| Daily Passenger Train # of Locomotives | 2l | 2.0 |
| Daily Passenger Train # of Rail Cars | 2m | 9.0 |
| Passenger Train Speed (kph/hr) | 2n | 64.4 |
| Daily Passenger Train Trips | 2o | 7.0 |
| Daily Passenger Train Trips During Day Time, N_d | 2p | 7.0 |
| Daily Passenger Train Trips During Night Time, N_n [2o-2p] | 2q | 0.0 |
| Effective # of Operations for Locomotives, N_{eff. Locomotives, Passenger} = [2l x (2p + 10 x 2q)] | 2r | 14.0 |
| Effective # of Operations for Rails, N_{eff. Rail, Passenger} = [2m x (2p + 10 x 2q)] | 2s | 63.0 |
| Daily Freight Train # of Locomotives: | 2t | 2.0 |
| Daily Freight Train # of Rail Cars: | 2u | 75.0 |
| Freight Train Speed (kph/hr): | 2v | 64.4 |
| Daily Freight Train Trips | 2w | 3.0 |
| Daily Freight Train Trips During Day Time | 2x | 2.0 |
| Daily Freight Train Trips During Night Time = [2w-2x] | 2y | 1.0 |
| Effective # of Operations for Locomotives, N_{eff. Locomotives, Freight} = [2t x (2x + 10 x 2y)] | 2z | 24.0 |
| Effective # of Operations for Rails, N_{eff. Rail, Freight} = [2u x (2x + 10 x 2y)] | 2aa | 900.0 |
| Reference Energy Mean Emission Levels for Locomotives (dBA), (L_o)_{E Locomotives-Passenger} [Figure 4-7] | 2ab | 98.0 |
| Reference Energy Mean Emission Levels for Rail Cars (dBA), (L_o)_{E Rail Cars-Passenger} [Figure 4-7] [If "2a = Yes", 6 dBA is Added to (L _o) _E] | 2ac | 76.0 |
| Reference Energy Mean Emission Levels for Locomotives (dBA), (L_o)_{E Locomotives-Freight} [Figure 4-7] | 2ad | 98.0 |
| Reference Energy Mean Emission Levels for Rail Cars (dBA), (L_o)_{E Rail Cars-Freight} [Figure 4-7] [If "2a = Yes", 6 dBA is Added to (L _o) _E] | 2ae | 76.0 |
| Ground Attenuation Factor, α [Soft Terrian = 0.5, Otherwise =0] | 2af | 0.5 |
| Noise Prediction for Locomotives (dBA), L_{dni Locomotives-Passenger} = [2ab + 10 log [(2r x 15)/2n] + 10 log [15/2c] ^{1+2aa} - 25 - 13.8] | 2ag | 54.0 |
| Noise Prediction for Rail Cars (dBA), L_{dni Rail Cars-Passenger} = [2ac + 10 log [(2s x 15)/2n] + 10 log [15/2c] ^{1+2aa} - 25 - 13.8] | 2ah | 38.6 |
| Sub-Total Passenger Rail Noise (dBA), L_{dn Rail Passenger} [10 Log (10 ^(2ag/10) + 10 ^(2ah/10))] | 2ad | 54.2 |
| Noise Prediction for Locomotives (dBA), L_{dni Locomotives-Freight} | 2ae | 56.4 |
| Noise Prediction for Rails Cars (dBA), L_{dni Rail Cars-Freight} | 2af | 50.1 |
| Sub-Total Passenger Rail Noise (dBA), L_{dn Rail Freight} [10 Log (10 ^(2ae/10) + 10 ^(2af/10))] | 2ag | 57.3 |
| Total Rail Noise (dBA), L_{dn} [10 Log (10 ^(2ad/10) + 10 ^(2ag/10))] | 2ah | 59.0 |
| Step 3: Highway Noise: | | |
| TNM 2.5 Predicted Peak Hour Noise Level (dBA), L_{eq} | 3a | 63.9 |
| Peak Hour Percent of 24-Hour (ADT) Volumes (%) | 3b | 16.6% |
| Day Time Traffic Volumes Percent of 24-hour (ADT) Volumes (%) | 3c | 92.2% |
| Night Time Traffic Volumes Percent of 24-hour (ADT) Volumes (%) | 3d | 7.8% |
| L_{eq} Noise Level Adjustment for Peak Hour % of ADT Volume (dBA), Δ₁ [Figure 4-20] | 3e | -6.0 |
| L_{eq} Noise Level Adjustment for Day Time % of ADT Volume (dBA), Δ₂ [Figure 4-20] | 3f | 2.3 |
| L_{eq} Noise Level Adjustment for Night Time % of ADT Volume (dBA), Δ₂ [Figure 4-20] | 3g | 2.3 |
| Highway Noise (dBA), L_{dn} = [3a + 3e + 3f (OR "3g")] | 3h | 60.2 |
| Step 4: Total Predicted Noise Level (Background+Highway+Rail), L_{dn} | | |
| Total (dBA), L_{dn} = [10 Log (10 ^(1b/10) + 10 ^(2ah/10) + 10 ^(3h/10))] | 4a | 63.0 |

References:

Advanced Prediction And Abatement of Highway Traffic Noise, FHWA Office of Environmental Policy (June 1982 "Recrated November 2016)

Advanced Prediction And Abatement of Highway Traffic Noise

| Analyst & Site Information | | |
|---|-------------------------|--|
| Analyst: | Chris S./Zaid H. (DOWL) | Major Facility : Seward Highway MP 105-107 |
| Analysis Date: | 12/20/2016 | Ground Type: Soft |
| Receiver #: | R3 | Day/Night Periods: [7:00 a.m.-10:00 p.m.]/[10:00 p.m.-7:00 a.m.] |
| Scenario: | Existing 2016 | Not Used Not Used |
| Step 1: Background Noise: | | |
| Population Density per Square Mile, P [Input Min. 1] | 1a | 5 |
| L_{dn} [Background] = [10 log P + 22 dB] | 1b | 29.0 |
| Step 2: Rail Noise: | | |
| Is Rail Track Jointed Rails? (Yes or No) | 2a | No |
| Is Horn or Whistle Used - Passenger Train? (Yes or No) | 2b | No |
| Distance Between Railroad and Site in Question (m), D | 2c | 76.8 |
| Shortest Distance From Site in Question to the Location at Which The Horn/Whistle is Sounded (m), D_{hw} | 2d | 0.0 |
| Is 2d 10 Times > 2c? (Yes or No) | 2e | No |
| L_{dnhw} [Horn/Whistle Contribution to Diesel Locomotives Passenger Rail] = [10 + 20 log 2c/2d] | 2f | 0.0 |
| Is Horn or Whistle Used - Freight Train? (Yes or No) | 2g | No |
| Distance Between Railroad and Site in Question (m), D | 2h | 76.8 |
| Shortest Distance From Site in Question to the Location at Which The Horn/Whistle is Sounded (m), D_{hw} | 2i | 0.0 |
| Is 2i 10 Times > 2h? (Yes or No) | 2j | No |
| L_{dnhw} [Horn/Whistle Contribution to Diesel Locomotives Freight Rail] = [10 + 20 log 2h/2i] | 2k | 0.0 |
| Daily Passenger Train # of Locomotives | 2l | 2.0 |
| Daily Passenger Train # of Rail Cars | 2m | 9.0 |
| Passenger Train Speed (kph/hr) | 2n | 64.4 |
| Daily Passenger Train Trips | 2o | 7.0 |
| Daily Passenger Train Trips During Day Time, N_d | 2p | 7.0 |
| Daily Passenger Train Trips During Night Time, N_n [2o-2p] | 2q | 0.0 |
| Effective # of Operations for Locomotives, N_{eff. Locomotives, Passenger} = [2l x (2p + 10 x 2q)] | 2r | 14.0 |
| Effective # of Operations for Rails, N_{eff. Rail, Passenger} = [2m x (2p + 10 x 2q)] | 2s | 63.0 |
| Daily Freight Train # of Locomotives: | 2t | 2.0 |
| Daily Freight Train # of Rail Cars: | 2u | 75.0 |
| Freight Train Speed (kph/hr): | 2v | 64.4 |
| Daily Freight Train Trips | 2w | 3.0 |
| Daily Freight Train Trips During Day Time | 2x | 2.0 |
| Daily Freight Train Trips During Night Time = [2w-2x] | 2y | 1.0 |
| Effective # of Operations for Locomotives, N_{eff. Locomotives, Freight} = [2t x (2x + 10 x 2y)] | 2z | 24.0 |
| Effective # of Operations for Rails, N_{eff. Rail, Freight} = [2u x (2x + 10 x 2y)] | 2aa | 900.0 |
| Reference Energy Mean Emission Levels for Locomotives (dBA), (L_o) _{E Locomotives-Passenger} [Figure 4-7] | 2ab | 98.0 |
| Reference Energy Mean Emission Levels for Rail Cars (dBA), (L_o) _{E Rail Cars-Passenger} [Figure 4-7] [If "2a = Yes", 6 dBA is Added to (L_o) _E] | 2ac | 76.0 |
| Reference Energy Mean Emission Levels for Locomotives (dBA), (L_o) _{E Locomotives-Freight} [Figure 4-7] | 2ad | 98.0 |
| Reference Energy Mean Emission Levels for Rail Cars (dBA), (L_o) _{E Rail Cars-Freight} [Figure 4-7] [If "2a = Yes", 6 dBA is Added to (L_o) _E] | 2ae | 76.0 |
| Ground Attenuation Factor, α [Soft Terrian = 0.5, Otherwise =0] | 2af | 0.5 |
| Noise Prediction for Locomotives (dBA), L_{dni Locomotives-Passenger} = [2ab + 10 log [(2r x 15)/2n] + 10 log [15/2c] ^{1+2aa} - 25 - 13.8] | 2ag | 53.7 |
| Noise Prediction for Rail Cars (dBA), L_{dni Rail Cars-Passenger} = [2ac + 10 log [(2s x 15)/2n] + 10 log [15/2c] ^{1+2aa} - 25 - 13.8] | 2ah | 38.2 |
| Sub-Total Passenger Rail Noise (dBA), L_{dn Rail Passenger} [10 Log (10 ^(2ag/10) + 10 ^(2ah/10))] | 2ad | 53.8 |
| Noise Prediction for Locomotives (dBA), L_{dni Locomotives-Freight} | 2ae | 56.0 |
| Noise Prediction for Rails Cars (dBA), L_{dni Rail Cars-Freight} | 2af | 49.8 |
| Sub-Total Passenger Rail Noise (dBA), L_{dn Rail Freight} [10 Log (10 ^(2ae/10) + 10 ^(2af/10))] | 2ag | 57.0 |
| Total Rail Noise (dBA), L_{dn} [10 Log (10 ^(2ad/10) + 10 ^(2ag/10))] | 2ah | 58.7 |
| Step 3: Highway Noise: | | |
| TNM 2.5 Predicted Peak Hour Noise Level (dBA), L_{eq} | 3a | 67.8 |
| Peak Hour Percent of 24-Hour (ADT) Volumes (%) | 3b | 16.6% |
| Day Time Traffic Volumes Percent of 24-hour (ADT) Volumes (%) | 3c | 92.2% |
| Night Time Traffic Volumes Percent of 24-hour (ADT) Volumes (%) | 3d | 7.8% |
| L_{eq} Noise Level Adjustment for Peak Hour % of ADT Volume (dBA), Δ₁ [Figure 4-20] | 3e | -6.0 |
| L_{eq} Noise Level Adjustment for Day Time % of ADT Volume (dBA), Δ₂ [Figure 4-20] | 3f | 2.3 |
| L_{eq} Noise Level Adjustment for Night Time % of ADT Volume (dBA), Δ₂ [Figure 4-20] | 3g | 2.3 |
| Highway Noise (dBA), L_{dn} = [3a + 3e + 3f (OR "3g")] | 3h | 64.1 |
| Step 4: Total Predicted Noise Level (Background+Highway+Rail), L_{dn} | | |
| Total (dBA), L_{dn} = [10 Log (10 ^(1b/10) + 10 ^(2ah/10) + 10 ^(3h/10))] | 4a | 65.0 |

References:

Advanced Prediction And Abatement of Highway Traffic Noise, FHWA Office of Environmental Policy (June 1982 "Recreated November 2016)

Advanced Prediction And Abatement of Highway Traffic Noise

| Analyst & Site Information | | |
|---|-------------------------|--|
| Analyst: | Chris S./Zaid H. (DOWL) | Major Facility : Seward Highway MP 105-107 |
| Analysis Date: | 12/20/2016 | Ground Type: Soft |
| Receiver #: | R4 | Day/Night Periods: [7:00 a.m.-10:00 p.m.]/[10:00 p.m.-7:00 a.m.] |
| Scenario: | Existing 2016 | Not Used Not Used |
| Step 1: Background Noise: | | |
| Population Density per Square Mile, P [Input Min. 1] | 1a | 5 |
| L_{dn} [Background] = [10 log P + 22 dB] | 1b | 29.0 |
| Step 2: Rail Noise: | | |
| Is Rail Track Jointed Rails? (Yes or No) | 2a | No |
| Is Horn or Whistle Used - Passenger Train? (Yes or No) | 2b | No |
| Distance Between Railroad and Site in Question (m), D | 2c | 123.8 |
| Shortest Distance From Site in Question to the Location at Which The Horn/Whistle is Sounded (m), D_{hw} | 2d | 0.0 |
| Is 2d 10 Times > 2c? (Yes or No) | 2e | No |
| L_{dnhw} [Horn/Whistle Contribution to Diesel Locomotives Passenger Rail] = [10 + 20 log 2c/2d] | 2f | 0.0 |
| Is Horn or Whistle Used - Freight Train? (Yes or No) | 2g | No |
| Distance Between Railroad and Site in Question (m), D | 2h | 123.8 |
| Shortest Distance From Site in Question to the Location at Which The Horn/Whistle is Sounded (m), D_{hw} | 2i | 0.0 |
| Is 2i 10 Times > 2h? (Yes or No) | 2j | No |
| L_{dnhw} [Horn/Whistle Contribution to Diesel Locomotives Freight Rail] = [10 + 20 log 2h/2i] | 2k | 0.0 |
| Daily Passenger Train # of Locomotives | 2l | 2.0 |
| Daily Passenger Train # of Rail Cars | 2m | 9.0 |
| Passenger Train Speed (kph/hr) | 2n | 64.4 |
| Daily Passenger Train Trips | 2o | 7.0 |
| Daily Passenger Train Trips During Day Time, N_d | 2p | 7.0 |
| Daily Passenger Train Trips During Night Time, N_n [2o-2p] | 2q | 0.0 |
| Effective # of Operations for Locomotives, N_{eff. Locomotives, Passenger} = [2l x (2p + 10 x 2q)] | 2r | 14.0 |
| Effective # of Operations for Rails, N_{eff. Rail, Passenger} = [2m x (2p + 10 x 2q)] | 2s | 63.0 |
| Daily Freight Train # of Locomotives: | 2t | 2.0 |
| Daily Freight Train # of Rail Cars: | 2u | 75.0 |
| Freight Train Speed (kph/hr): | 2v | 64.4 |
| Daily Freight Train Trips | 2w | 3.0 |
| Daily Freight Train Trips During Day Time | 2x | 2.0 |
| Daily Freight Train Trips During Night Time = [2w-2x] | 2y | 1.0 |
| Effective # of Operations for Locomotives, N_{eff. Locomotives, Freight} = [2t x (2x + 10 x 2y)] | 2z | 24.0 |
| Effective # of Operations for Rails, N_{eff. Rail, Freight} = [2u x (2x + 10 x 2y)] | 2aa | 900.0 |
| Reference Energy Mean Emission Levels for Locomotives (dBA), (L_o) _{E Locomotives-Passenger} [Figure 4-7] | 2ab | 98.0 |
| Reference Energy Mean Emission Levels for Rail Cars (dBA), (L_o) _{E Rail Cars-Passenger} [Figure 4-7] [If "2a = Yes", 6 dBA is Added to (L_o) _E] | 2ac | 76.0 |
| Reference Energy Mean Emission Levels for Locomotives (dBA), (L_o) _{E Locomotives-Freight} [Figure 4-7] | 2ad | 98.0 |
| Reference Energy Mean Emission Levels for Rail Cars (dBA), (L_o) _{E Rail Cars-Freight} [Figure 4-7] [If "2a = Yes", 6 dBA is Added to (L_o) _E] | 2ae | 76.0 |
| Ground Attenuation Factor, α [Soft Terrian = 0.5, Otherwise =0] | 2af | 0.5 |
| Noise Prediction for Locomotives (dBA), L_{dni Locomotives-Passenger} = [2ab + 10 log [(2r x 15)/2n] + 10 log [15/2c] ^{1+2aa} - 25 - 13.8] | 2ag | 50.6 |
| Noise Prediction for Rail Cars (dBA), L_{dni Rail Cars-Passenger} = [2ac + 10 log [(2s x 15)/2n] + 10 log [15/2c] ^{1+2aa} - 25 - 13.8] | 2ah | 35.1 |
| Sub-Total Passenger Rail Noise (dBA), L_{dn Rail Passenger} [10 Log (10 ^(2ag/10) + 10 ^(2ah/10))] | 2ad | 50.7 |
| Noise Prediction for Locomotives (dBA), L_{dni Locomotives-Freight} | 2ae | 52.9 |
| Noise Prediction for Rails Cars (dBA), L_{dni Rail Cars-Freight} | 2af | 46.7 |
| Sub-Total Passenger Rail Noise (dBA), L_{dn Rail Freight} [10 Log (10 ^(2ae/10) + 10 ^(2af/10))] | 2ag | 53.8 |
| Total Rail Noise (dBA), L_{dn} [10 Log (10 ^(2ad/10) + 10 ^(2ag/10))] | 2ah | 55.6 |
| Step 3: Highway Noise: | | |
| TNM 2.5 Predicted Peak Hour Noise Level (dBA), L_{eq} | 3a | 54.5 |
| Peak Hour Percent of 24-Hour (ADT) Volumes (%) | 3b | 16.6% |
| Day Time Traffic Volumes Percent of 24-hour (ADT) Volumes (%) | 3c | 92.2% |
| Night Time Traffic Volumes Percent of 24-hour (ADT) Volumes (%) | 3d | 7.8% |
| L_{eq} Noise Level Adjustment for Peak Hour % of ADT Volume (dBA), Δ₁ [Figure 4-20] | 3e | -6.0 |
| L_{eq} Noise Level Adjustment for Day Time % of ADT Volume (dBA), Δ₂ [Figure 4-20] | 3f | 2.3 |
| L_{eq} Noise Level Adjustment for Night Time % of ADT Volume (dBA), Δ₂ [Figure 4-20] | 3g | 2.3 |
| Highway Noise (dBA), L_{dn} = [3a + 3e + 3f (OR "3g")] | 3h | 50.8 |
| Step 4: Total Predicted Noise Level (Background+Highway+Rail), L_{dn} | | |
| Total (dBA), L_{dn} = [10 Log (10 ^(1b/10) + 10 ^(2ah/10) + 10 ^(3h/10))] | 4a | 57.0 |

References:

Advanced Prediction And Abatement of Highway Traffic Noise, FHWA Office of Environmental Policy (June 1982 "Recreated November 2016)

Advanced Prediction And Abatement of Highway Traffic Noise

| Analyst & Site Information | | |
|---|-------------------------|--|
| Analyst: | Chris S./Zaid H. (DOWL) | Major Facility : Seward Highway MP 105-107 |
| Analysis Date: | 12/20/2016 | Ground Type: Soft |
| Receiver #: | R1 | Day/Night Periods: [7:00 a.m.-10:00 p.m.]/[10:00 p.m.-7:00 a.m.] |
| Scenario: | No Build 2037 [Future] | Not Used Not Used |
| Step 1: Background Noise: | | |
| Population Density per Square Mile, P [Input Min. 1] | 1a | 5 |
| L_{dn} [Background] = [10 log P + 22 dB] | 1b | 29.0 |
| Step 2: Rail Noise: | | |
| Is Rail Track Jointed Rails? (Yes or No) | 2a | No |
| Is Horn or Whistle Used - Passenger Train? (Yes or No) | 2b | No |
| Distance Between Railroad and Site in Question (m), D | 2c | 65.5 |
| Shortest Distance From Site in Question to the Location at Which The Horn/Whistle is Sounded (m), D_{hw} | 2d | 0.0 |
| Is 2d 10 Times > 2c? (Yes or No) | 2e | No |
| L_{dnhw} [Horn/Whistle Contribution to Diesel Locomotives Passenger Rail] = [10 + 20 log 2c/2d] | 2f | 0.0 |
| Is Horn or Whistle Used - Freight Train? (Yes or No) | 2g | No |
| Distance Between Railroad and Site in Question (m), D | 2h | 65.5 |
| Shortest Distance From Site in Question to the Location at Which The Horn/Whistle is Sounded (m), D_{hw} | 2i | 0.0 |
| Is 2i 10 Times > 2h? (Yes or No) | 2j | No |
| L_{dnhw} [Horn/Whistle Contribution to Diesel Locomotives Freight Rail] = [10 + 20 log 2h/2i] | 2k | 0.0 |
| Daily Passenger Train # of Locomotives | 2l | 2.0 |
| Daily Passenger Train # of Rail Cars | 2m | 9.0 |
| Passenger Train Speed (kph/hr) | 2n | 64.4 |
| Daily Passenger Train Trips | 2o | 7.0 |
| Daily Passenger Train Trips During Day Time, N_d | 2p | 7.0 |
| Daily Passenger Train Trips During Night Time, N_n [2o-2p] | 2q | 0.0 |
| Effective # of Operations for Locomotives, N_{eff. Locomotives, Passenger} = [2l x (2p + 10 x 2q)] | 2r | 14.0 |
| Effective # of Operations for Rails, N_{eff. Rail, Passenger} = [2m x (2p + 10 x 2q)] | 2s | 63.0 |
| Daily Freight Train # of Locomotives: | 2t | 2.0 |
| Daily Freight Train # of Rail Cars: | 2u | 75.0 |
| Freight Train Speed (kph/hr): | 2v | 64.4 |
| Daily Freight Train Trips | 2w | 3.0 |
| Daily Freight Train Trips During Day Time | 2x | 2.0 |
| Daily Freight Train Trips During Night Time = [2w-2x] | 2y | 1.0 |
| Effective # of Operations for Locomotives, N_{eff. Locomotives, Freight} = [2t x (2x + 10 x 2y)] | 2z | 24.0 |
| Effective # of Operations for Rails, N_{eff. Rail, Freight} = [2u x (2x + 10 x 2y)] | 2aa | 900.0 |
| Reference Energy Mean Emission Levels for Locomotives (dBA), (L_o)_{E Locomotives-Passenger} [Figure 4-7] | 2ab | 98.0 |
| Reference Energy Mean Emission Levels for Rail Cars (dBA), (L_o)_{E Rail Cars-Passenger} [Figure 4-7] [If "2a = Yes", 6 dBA is Added to (L _o) _E] | 2ac | 76.0 |
| Reference Energy Mean Emission Levels for Locomotives (dBA), (L_o)_{E Locomotives-Freight} [Figure 4-7] | 2ad | 98.0 |
| Reference Energy Mean Emission Levels for Rail Cars (dBA), (L_o)_{E Rail Cars-Freight} [Figure 4-7] [If "2a = Yes", 6 dBA is Added to (L _o) _E] | 2ae | 76.0 |
| Ground Attenuation Factor, α [Soft Terrian = 0.5, Otherwise =0] | 2af | 0.5 |
| Noise Prediction for Locomotives (dBA), L_{dni Locomotives-Passenger} = [2ab + 10 log [(2r x 15)/2n] + 10 log [15/2c] ^{1+2aa} - 25 - 13.8] | 2ag | 54.7 |
| Noise Prediction for Rail Cars (dBA), L_{dni Rail Cars-Passenger} = [2ac + 10 log [(2s x 15)/2n] + 10 log [15/2c] ^{1+2aa} - 25 - 13.8] | 2ah | 39.3 |
| Sub-Total Passenger Rail Noise (dBA), L_{dn Rail Passenger} [10 Log (10 ^(2ag/10) + 10 ^(2ah/10))] | 2ad | 54.9 |
| Noise Prediction for Locomotives (dBA), L_{dni Locomotives-Freight} | 2ae | 57.1 |
| Noise Prediction for Rail Cars (dBA), L_{dni Rail Cars-Freight} | 2af | 50.8 |
| Sub-Total Passenger Rail Noise (dBA), L_{dn Rail Freight} [10 Log (10 ^(2ae/10) + 10 ^(2af/10))] | 2ag | 58.0 |
| Total Rail Noise (dBA), L_{dn} [10 Log (10 ^(2ad/10) + 10 ^(2ag/10))] | 2ah | 59.7 |
| Step 3: Highway Noise: | | |
| TNM 2.5 Predicted Peak Hour Noise Level (dBA), L_{eq} | 3a | 66.5 |
| Peak Hour Percent of 24-Hour (ADT) Volumes (%) | 3b | 16.6% |
| Day Time Traffic Volumes Percent of 24-hour (ADT) Volumes (%) | 3c | 92.2% |
| Night Time Traffic Volumes Percent of 24-hour (ADT) Volumes (%) | 3d | 7.8% |
| L_{eq} Noise Level Adjustment for Peak Hour % of ADT Volume (dBA), Δ₁ [Figure 4-20] | 3e | -6.0 |
| L_{eq} Noise Level Adjustment for Day Time % of ADT Volume (dBA), Δ₂ [Figure 4-20] | 3f | 2.3 |
| L_{eq} Noise Level Adjustment for Night Time % of ADT Volume (dBA), Δ₂ [Figure 4-20] | 3g | 2.3 |
| Highway Noise (dBA), L_{dn} = [3a + 3e + 3f (OR "3g")] | 3h | 62.8 |
| Step 4: Total Predicted Noise Level (Background+Highway+Rail), L_{dn} | | |
| Total (dBA), L_{dn} = [10 Log (10 ^(1b/10) + 10 ^(2ah/10) + 10 ^(3h/10))] | 4a | 65.0 |

References:

Advanced Prediction And Abatement of Highway Traffic Noise, FHWA Office of Environmental Policy (June 1982 "Recreated November 2016)

Advanced Prediction And Abatement of Highway Traffic Noise

| Analyst & Site Information | | |
|---|-------------------------|--|
| Analyst: | Chris S./Zaid H. (DOWL) | Major Facility : Seward Highway MP 105-107 |
| Analysis Date: | 12/20/2016 | Ground Type: Soft |
| Receiver #: | R2 | Day/Night Periods: [7:00 a.m.-10:00 p.m.]/[10:00 p.m.-7:00 a.m.] |
| Scenario: | No Build 2037 [Future] | Not Used Not Used |
| Step 1: Background Noise: | | |
| Population Density per Square Mile, P [Input Min. 1] | 1a | 5 |
| L_{dn} [Background] = [10 log P + 22 dB] | 1b | 29.0 |
| Step 2: Rail Noise: | | |
| Is Rail Track Jointed Rails? (Yes or No) | 2a | No |
| Is Horn or Whistle Used - Passenger Train? (Yes or No) | 2b | No |
| Distance Between Railroad and Site in Question (m), D | 2c | 72.9 |
| Shortest Distance From Site in Question to the Location at Which The Horn/Whistle is Sounded (m), D_{hw} | 2d | 0.0 |
| Is 2d 10 Times > 2c? (Yes or No) | 2e | No |
| L_{dnhw} [Horn/Whistle Contribution to Diesel Locomotives Passenger Rail] = [10 + 20 log 2c/2d] | 2f | 0.0 |
| Is Horn or Whistle Used - Freight Train? (Yes or No) | 2g | No |
| Distance Between Railroad and Site in Question (m), D | 2h | 72.9 |
| Shortest Distance From Site in Question to the Location at Which The Horn/Whistle is Sounded (m), D_{hw} | 2i | 0.0 |
| Is 2i 10 Times > 2h? (Yes or No) | 2j | No |
| L_{dnhw} [Horn/Whistle Contribution to Diesel Locomotives Freight Rail] = [10 + 20 log 2h/2i] | 2k | 0.0 |
| Daily Passenger Train # of Locomotives | 2l | 2.0 |
| Daily Passenger Train # of Rail Cars | 2m | 9.0 |
| Passenger Train Speed (kph/hr) | 2n | 64.4 |
| Daily Passenger Train Trips | 2o | 7.0 |
| Daily Passenger Train Trips During Day Time, N_d | 2p | 7.0 |
| Daily Passenger Train Trips During Night Time, N_n [2o-2p] | 2q | 0.0 |
| Effective # of Operations for Locomotives, N_{eff. Locomotives, Passenger} = [2l x (2p + 10 x 2q)] | 2r | 14.0 |
| Effective # of Operations for Rails, N_{eff. Rail, Passenger} = [2m x (2p + 10 x 2q)] | 2s | 63.0 |
| Daily Freight Train # of Locomotives: | 2t | 2.0 |
| Daily Freight Train # of Rail Cars: | 2u | 75.0 |
| Freight Train Speed (kph/hr): | 2v | 64.4 |
| Daily Freight Train Trips | 2w | 3.0 |
| Daily Freight Train Trips During Day Time | 2x | 2.0 |
| Daily Freight Train Trips During Night Time = [2w-2x] | 2y | 1.0 |
| Effective # of Operations for Locomotives, N_{eff. Locomotives, Freight} = [2t x (2x + 10 x 2y)] | 2z | 24.0 |
| Effective # of Operations for Rails, N_{eff. Rail, Freight} = [2u x (2x + 10 x 2y)] | 2aa | 900.0 |
| Reference Energy Mean Emission Levels for Locomotives (dBA), (L_o)_{E Locomotives-Passenger} [Figure 4-7] | 2ab | 98.0 |
| Reference Energy Mean Emission Levels for Rail Cars (dBA), (L_o)_{E Rail Cars-Passenger} [Figure 4-7] [If "2a = Yes", 6 dBA is Added to (L _o) _E] | 2ac | 76.0 |
| Reference Energy Mean Emission Levels for Locomotives (dBA), (L_o)_{E Locomotives-Freight} [Figure 4-7] | 2ad | 98.0 |
| Reference Energy Mean Emission Levels for Rail Cars (dBA), (L_o)_{E Rail Cars-Freight} [Figure 4-7] [If "2a = Yes", 6 dBA is Added to (L _o) _E] | 2ae | 76.0 |
| Ground Attenuation Factor, α [Soft Terrian = 0.5, Otherwise =0] | 2af | 0.5 |
| Noise Prediction for Locomotives (dBA), L_{dni Locomotives-Passenger} = [2ab + 10 log [(2r x 15)/2n] + 10 log [15/2c] ^{1+2aa} - 25 - 13.8] | 2ag | 54.0 |
| Noise Prediction for Rail Cars (dBA), L_{dni Rail Cars-Passenger} = [2ac + 10 log [(2s x 15)/2n] + 10 log [15/2c] ^{1+2aa} - 25 - 13.8] | 2ah | 38.6 |
| Sub-Total Passenger Rail Noise (dBA), L_{dn Rail Passenger} [10 Log (10 ^(2ag/10) + 10 ^(2ah/10))] | 2ad | 54.2 |
| Noise Prediction for Locomotives (dBA), L_{dni Locomotives-Freight} | 2ae | 56.4 |
| Noise Prediction for Rails Cars (dBA), L_{dni Rail Cars-Freight} | 2af | 50.1 |
| Sub-Total Passenger Rail Noise (dBA), L_{dn Rail Freight} [10 Log (10 ^(2ae/10) + 10 ^(2af/10))] | 2ag | 57.3 |
| Total Rail Noise (dBA), L_{dn} [10 Log (10 ^(2ad/10) + 10 ^(2ag/10))] | 2ah | 59.0 |
| Step 3: Highway Noise: | | |
| TNM 2.5 Predicted Peak Hour Noise Level (dBA), L_{eq} | 3a | 65.1 |
| Peak Hour Percent of 24-Hour (ADT) Volumes (%) | 3b | 16.6% |
| Day Time Traffic Volumes Percent of 24-hour (ADT) Volumes (%) | 3c | 92.2% |
| Night Time Traffic Volumes Percent of 24-hour (ADT) Volumes (%) | 3d | 7.8% |
| L_{eq} Noise Level Adjustment for Peak Hour % of ADT Volume (dBA), Δ₁ [Figure 4-20] | 3e | -6.0 |
| L_{eq} Noise Level Adjustment for Day Time % of ADT Volume (dBA), Δ₂ [Figure 4-20] | 3f | 2.3 |
| L_{eq} Noise Level Adjustment for Night Time % of ADT Volume (dBA), Δ₂ [Figure 4-20] | 3g | 2.3 |
| Highway Noise (dBA), L_{dn} = [3a + 3e + 3f (OR "3g")] | 3h | 61.4 |
| Step 4: Total Predicted Noise Level (Background+Highway+Rail), L _{dn} | | |
| Total (dBA), L_{dn} = [10 Log (10 ^(1b/10) + 10 ^(2ah/10) + 10 ^(3h/10))] | 4a | 63.0 |

References:

Advanced Prediction And Abatement of Highway Traffic Noise, FHWA Office of Environmental Policy (June 1982 "Recreated November 2016)

Advanced Prediction And Abatement of Highway Traffic Noise

| Analyst & Site Information | | |
|---|-------------------------|--|
| Analyst: | Chris S./Zaid H. (DOWL) | Major Facility : Seward Highway MP 105-107 |
| Analysis Date: | 12/20/2016 | Ground Type: Soft |
| Receiver #: | R3 | Day/Night Periods: [7:00 a.m.-10:00 p.m.]/[10:00 p.m.-7:00 a.m.] |
| Scenario: | No Build 2037 [Future] | Not Used Not Used |
| Step 1: Background Noise: | | |
| Population Density per Square Mile, P [Input Min. 1] | 1a | 5 |
| L_{dn} [Background] = [10 log P + 22 dB] | 1b | 29.0 |
| Step 2: Rail Noise: | | |
| Is Rail Track Jointed Rails? (Yes or No) | 2a | No |
| Is Horn or Whistle Used - Passenger Train? (Yes or No) | 2b | No |
| Distance Between Railroad and Site in Question (m), D | 2c | 76.8 |
| Shortest Distance From Site in Question to the Location at Which The Horn/Whistle is Sounded (m), D_{hw} | 2d | 0.0 |
| Is 2d 10 Times > 2c? (Yes or No) | 2e | No |
| L_{dnhw} [Horn/Whistle Contribution to Diesel Locomotives Passenger Rail] = [10 + 20 log 2c/2d] | 2f | 0.0 |
| Is Horn or Whistle Used - Freight Train? (Yes or No) | 2g | No |
| Distance Between Railroad and Site in Question (m), D | 2h | 76.8 |
| Shortest Distance From Site in Question to the Location at Which The Horn/Whistle is Sounded (m), D_{hw} | 2i | 0.0 |
| Is 2i 10 Times > 2h? (Yes or No) | 2j | No |
| L_{dnhw} [Horn/Whistle Contribution to Diesel Locomotives Freight Rail] = [10 + 20 log 2h/2i] | 2k | 0.0 |
| Daily Passenger Train # of Locomotives | 2l | 2.0 |
| Daily Passenger Train # of Rail Cars | 2m | 9.0 |
| Passenger Train Speed (kph/hr) | 2n | 64.4 |
| Daily Passenger Train Trips | 2o | 7.0 |
| Daily Passenger Train Trips During Day Time, N_d | 2p | 7.0 |
| Daily Passenger Train Trips During Night Time, N_n [2o-2p] | 2q | 0.0 |
| Effective # of Operations for Locomotives, N_{eff. Locomotives, Passenger} = [2l x (2p + 10 x 2q)] | 2r | 14.0 |
| Effective # of Operations for Rails, N_{eff. Rail, Passenger} = [2m x (2p + 10 x 2q)] | 2s | 63.0 |
| Daily Freight Train # of Locomotives: | 2t | 2.0 |
| Daily Freight Train # of Rail Cars: | 2u | 75.0 |
| Freight Train Speed (kph/hr): | 2v | 64.4 |
| Daily Freight Train Trips | 2w | 3.0 |
| Daily Freight Train Trips During Day Time | 2x | 2.0 |
| Daily Freight Train Trips During Night Time = [2w-2x] | 2y | 1.0 |
| Effective # of Operations for Locomotives, N_{eff. Locomotives, Freight} = [2t x (2x + 10 x 2y)] | 2z | 24.0 |
| Effective # of Operations for Rails, N_{eff. Rail, Freight} = [2u x (2x + 10 x 2y)] | 2aa | 900.0 |
| Reference Energy Mean Emission Levels for Locomotives (dBA), (L _o) _{E Locomotives-Passenger} [Figure 4-7] | 2ab | 98.0 |
| Reference Energy Mean Emission Levels for Rail Cars (dBA), (L _o) _{E Rail Cars-Passenger} [Figure 4-7] [If "2a = Yes", 6 dBA is Added to (L _o) _E] | 2ac | 76.0 |
| Reference Energy Mean Emission Levels for Locomotives (dBA), (L _o) _{E Locomotives-Freight} [Figure 4-7] | 2ad | 98.0 |
| Reference Energy Mean Emission Levels for Rail Cars (dBA), (L _o) _{E Rail Cars-Freight} [Figure 4-7] [If "2a = Yes", 6 dBA is Added to (L _o) _E] | 2ae | 76.0 |
| Ground Attenuation Factor, α [Soft Terrian = 0.5, Otherwise =0] | 2af | 0.5 |
| Noise Prediction for Locomotives (dBA), L_{dni Locomotives-Passenger} = [2ab + 10 log [(2r x 15)/2n] + 10 log [15/2c] ^{1+2aa} - 25 - 13.8] | 2ag | 53.7 |
| Noise Prediction for Rail Cars (dBA), L_{dni Rail Cars-Passenger} = [2ac + 10 log [(2s x 15)/2n] + 10 log [15/2c] ^{1+2aa} - 25 - 13.8] | 2ah | 38.2 |
| Sub-Total Passenger Rail Noise (dBA), L_{dn Rail Passenger} [10 Log (10 ^(2ag/10) + 10 ^(2ah/10))] | 2ad | 53.8 |
| Noise Prediction for Locomotives (dBA), L_{dni Locomotives-Freight} | 2ae | 56.0 |
| Noise Prediction for Rails Cars (dBA), L_{dni Rail Cars-Freight} | 2af | 49.8 |
| Sub-Total Passenger Rail Noise (dBA), L_{dn Rail Freight} [10 Log (10 ^(2ae/10) + 10 ^(2af/10))] | 2ag | 57.0 |
| Total Rail Noise (dBA), L_{dn} [10 Log (10 ^(2ad/10) + 10 ^(2ag/10))] | 2ah | 58.7 |
| Step 3: Highway Noise: | | |
| TNM 2.5 Predicted Peak Hour Noise Level (dBA), L_{eq} | 3a | 69.1 |
| Peak Hour Percent of 24-Hour (ADT) Volumes (%) | 3b | 16.6% |
| Day Time Traffic Volumes Percent of 24-hour (ADT) Volumes (%) | 3c | 92.2% |
| Night Time Traffic Volumes Percent of 24-hour (ADT) Volumes (%) | 3d | 7.8% |
| L_{eq} Noise Level Adjustment for Peak Hour % of ADT Volume (dBA), Δ₁ [Figure 4-20] | 3e | -6.0 |
| L_{eq} Noise Level Adjustment for Day Time % of ADT Volume (dBA), Δ₂ [Figure 4-20] | 3f | 2.3 |
| L_{eq} Noise Level Adjustment for Night Time % of ADT Volume (dBA), Δ₂ [Figure 4-20] | 3g | 2.3 |
| Highway Noise (dBA), L_{dn} = [3a + 3e + 3f (OR "3g")] | 3h | 65.4 |
| Step 4: Total Predicted Noise Level (Background+Highway+Rail), L_{dn} | | |
| Total (dBA), L_{dn} = [10 Log (10 ^(1b/10) + 10 ^(2ah/10) + 10 ^(3h/10))] | 4a | 66.0 |

References:

Advanced Prediction And Abatement of Highway Traffic Noise, FHWA Office of Environmental Policy (June 1982 "Recreated November 2016)

Advanced Prediction And Abatement of Highway Traffic Noise

| Analyst & Site Information | | |
|---|-------------------------|--|
| Analyst: | Chris S./Zaid H. (DOWL) | Major Facility : Seward Highway MP 105-107 |
| Analysis Date: | 12/20/2016 | Ground Type: Soft |
| Receiver #: | R4 | Day/Night Periods: [7:00 a.m.-10:00 p.m.]/[10:00 p.m.-7:00 a.m.] |
| Scenario: | No Build 2037 [Future] | Not Used Not Used |
| Step 1: Background Noise: | | |
| Population Density per Square Mile, P [Input Min. 1] | 1a | 5 |
| L_{dn} [Background] = [10 log P + 22 dB] | 1b | 29.0 |
| Step 2: Rail Noise: | | |
| Is Rail Track Jointed Rails? (Yes or No) | 2a | No |
| Is Horn or Whistle Used - Passenger Train? (Yes or No) | 2b | No |
| Distance Between Railroad and Site in Question (m), D | 2c | 123.8 |
| Shortest Distance From Site in Question to the Location at Which The Horn/Whistle is Sounded (m), D_{hw} | 2d | 0.0 |
| Is 2d 10 Times > 2c? (Yes or No) | 2e | No |
| L_{dnhw} [Horn/Whistle Contribution to Diesel Locomotives Passenger Rail] = [10 + 20 log 2c/2d] | 2f | 0.0 |
| Is Horn or Whistle Used - Freight Train? (Yes or No) | 2g | No |
| Distance Between Railroad and Site in Question (m), D | 2h | 123.8 |
| Shortest Distance From Site in Question to the Location at Which The Horn/Whistle is Sounded (m), D_{hw} | 2i | 0.0 |
| Is 2i 10 Times > 2h? (Yes or No) | 2j | No |
| L_{dnhw} [Horn/Whistle Contribution to Diesel Locomotives Freight Rail] = [10 + 20 log 2h/2i] | 2k | 0.0 |
| Daily Passenger Train # of Locomotives | 2l | 2.0 |
| Daily Passenger Train # of Rail Cars | 2m | 9.0 |
| Passenger Train Speed (kph/hr) | 2n | 64.4 |
| Daily Passenger Train Trips | 2o | 7.0 |
| Daily Passenger Train Trips During Day Time, N_d | 2p | 7.0 |
| Daily Passenger Train Trips During Night Time, N_n [2o-2p] | 2q | 0.0 |
| Effective # of Operations for Locomotives, N_{eff. Locomotives, Passenger} = [2l x (2p + 10 x 2q)] | 2r | 14.0 |
| Effective # of Operations for Rails, N_{eff. Rail, Passenger} = [2m x (2p + 10 x 2q)] | 2s | 63.0 |
| Daily Freight Train # of Locomotives: | 2t | 2.0 |
| Daily Freight Train # of Rail Cars: | 2u | 75.0 |
| Freight Train Speed (kph/hr): | 2v | 64.4 |
| Daily Freight Train Trips | 2w | 3.0 |
| Daily Freight Train Trips During Day Time | 2x | 2.0 |
| Daily Freight Train Trips During Night Time = [2w-2x] | 2y | 1.0 |
| Effective # of Operations for Locomotives, N_{eff. Locomotives, Freight} = [2t x (2x + 10 x 2y)] | 2z | 24.0 |
| Effective # of Operations for Rails, N_{eff. Rail, Freight} = [2u x (2x + 10 x 2y)] | 2aa | 900.0 |
| Reference Energy Mean Emission Levels for Locomotives (dBA), (L_o)_{E Locomotives-Passenger} [Figure 4-7] | 2ab | 98.0 |
| Reference Energy Mean Emission Levels for Rail Cars (dBA), (L_o)_{E Rail Cars-Passenger} [Figure 4-7] [If "2a = Yes", 6 dBA is Added to (L _o) _E] | 2ac | 76.0 |
| Reference Energy Mean Emission Levels for Locomotives (dBA), (L_o)_{E Locomotives-Freight} [Figure 4-7] | 2ad | 98.0 |
| Reference Energy Mean Emission Levels for Rail Cars (dBA), (L_o)_{E Rail Cars-Freight} [Figure 4-7] [If "2a = Yes", 6 dBA is Added to (L _o) _E] | 2ae | 76.0 |
| Ground Attenuation Factor, α [Soft Terrian = 0.5, Otherwise =0] | 2af | 0.5 |
| Noise Prediction for Locomotives (dBA), L_{dni Locomotives-Passenger} = [2ab + 10 log [(2r x 15)/2n] + 10 log [15/2c] ^{1+2aa} - 25 - 13.8] | 2ag | 50.6 |
| Noise Prediction for Rail Cars (dBA), L_{dni Rail Cars-Passenger} = [2ac + 10 log [(2s x 15)/2n] + 10 log [15/2c] ^{1+2aa} - 25 - 13.8] | 2ah | 35.1 |
| Sub-Total Passenger Rail Noise (dBA), L_{dn Rail Passenger} [10 Log (10 ^(2ag/10) + 10 ^(2ah/10))] | 2ad | 50.7 |
| Noise Prediction for Locomotives (dBA), L_{dni Locomotives-Freight} | 2ae | 52.9 |
| Noise Prediction for Rail Cars (dBA), L_{dni Rail Cars-Freight} | 2af | 46.7 |
| Sub-Total Passenger Rail Noise (dBA), L_{dn Rail Freight} [10 Log (10 ^(2ae/10) + 10 ^(2af/10))] | 2ag | 53.8 |
| Total Rail Noise (dBA), L_{dn} [10 Log (10 ^(2ad/10) + 10 ^(2ag/10))] | 2ah | 55.6 |
| Step 3: Highway Noise: | | |
| TNM 2.5 Predicted Peak Hour Noise Level (dBA), L_{eq} | 3a | 55.7 |
| Peak Hour Percent of 24-Hour (ADT) Volumes (%) | 3b | 16.6% |
| Day Time Traffic Volumes Percent of 24-hour (ADT) Volumes (%) | 3c | 92.2% |
| Night Time Traffic Volumes Percent of 24-hour (ADT) Volumes (%) | 3d | 7.8% |
| L_{eq} Noise Level Adjustment for Peak Hour % of ADT Volume (dBA), Δ₁ [Figure 4-20] | 3e | -6.0 |
| L_{eq} Noise Level Adjustment for Day Time % of ADT Volume (dBA), Δ₂ [Figure 4-20] | 3f | 2.3 |
| L_{eq} Noise Level Adjustment for Night Time % of ADT Volume (dBA), Δ₂ [Figure 4-20] | 3g | 2.3 |
| Highway Noise (dBA), L_{dn} = [3a + 3e + 3f (OR "3g")] | 3h | 52.0 |
| Step 4: Total Predicted Noise Level (Background+Highway+Rail), L_{dn} | | |
| Total (dBA), L_{dn} = [10 Log (10 ^(1b/10) + 10 ^(2ah/10) + 10 ^(3h/10))] | 4a | 57.0 |

References:

Advanced Prediction And Abatement of Highway Traffic Noise, FHWA Office of Environmental Policy (June 1982 "Recrated November 2016)

Advanced Prediction And Abatement of Highway Traffic Noise

| Analyst & Site Information | | |
|--|----------------------------|--|
| Analyst: | Chris S./Zaid H. (DOWL) | Major Facility : Seward Highway MP 105-107 |
| Analysis Date: | 12/20/2016 | Ground Type: Soft |
| Receiver #: | R1 | Day/Night Periods: [7:00 a.m.-10:00 p.m.]/[10:00 p.m.-7:00 a.m.] |
| Scenario: | Design Build 2037 [Future] | Not Used Not Used |
| Step 1: Background Noise: | | |
| Population Density per Square Mile, P [Input Min. 1] | 1a | 5 |
| L_{dn} [Background] = [10 log P + 22 dB] | 1b | 29.0 |
| Step 2: Rail Noise: | | |
| Is Rail Track Jointed Rails? (Yes or No) | 2a | No |
| Is Horn or Whistle Used - Passenger Train? (Yes or No) | 2b | No |
| Distance Between Railroad and Site in Question (m), D | 2c | 65.5 |
| Shortest Distance From Site in Question to the Location at Which The Horn/Whistle is Sounded (m), D_{hw} | 2d | 0.0 |
| Is 2d 10 Times > 2c? (Yes or No) | 2e | No |
| L_{dnhw} [Horn/Whistle Contribution to Diesel Locomotives Passenger Rail] = [10 + 20 log 2c/2d] | 2f | 0.0 |
| Is Horn or Whistle Used - Freight Train? (Yes or No) | 2g | No |
| Distance Between Railroad and Site in Question (m), D | 2h | 65.5 |
| Shortest Distance From Site in Question to the Location at Which The Horn/Whistle is Sounded (m), D_{hw} | 2i | 0.0 |
| Is 2i 10 Times > 2h? (Yes or No) | 2j | No |
| L_{dnhw} [Horn/Whistle Contribution to Diesel Locomotives Freight Rail] = [10 + 20 log 2h/2i] | 2k | 0.0 |
| Daily Passenger Train # of Locomotives | 2l | 2.0 |
| Daily Passenger Train # of Rail Cars | 2m | 9.0 |
| Passenger Train Speed (kph/hr) | 2n | 64.4 |
| Daily Passenger Train Trips | 2o | 7.0 |
| Daily Passenger Train Trips During Day Time, N_d | 2p | 7.0 |
| Daily Passenger Train Trips During Night Time, N_n [2o-2p] | 2q | 0.0 |
| Effective # of Operations for Locomotives, N_{eff. Locomotives, Passenger} = [2l x (2p + 10 x 2q)] | 2r | 14.0 |
| Effective # of Operations for Rails, N_{eff. Rail, Passenger} = [2m x (2p + 10 x 2q)] | 2s | 63.0 |
| Daily Freight Train # of Locomotives: | 2t | 2.0 |
| Daily Freight Train # of Rail Cars: | 2u | 75.0 |
| Freight Train Speed (kph/hr): | 2v | 64.4 |
| Daily Freight Train Trips | 2w | 3.0 |
| Daily Freight Train Trips During Day Time | 2x | 2.0 |
| Daily Freight Train Trips During Night Time = [2w-2x] | 2y | 1.0 |
| Effective # of Operations for Locomotives, N_{eff. Locomotives, Freight} = [2t x (2x + 10 x 2y)] | 2z | 24.0 |
| Effective # of Operations for Rails, N_{eff. Rail, Freight} = [2u x (2x + 10 x 2y)] | 2aa | 900.0 |
| Reference Energy Mean Emission Levels for Locomotives (dBA), (L_o) _{E Locomotives-Passenger} [Figure 4-7] | 2ab | 98.0 |
| Reference Energy Mean Emission Levels for Rail Cars (dBA), (L_o) _{E Rail Cars-Passenger} [Figure 4-7] [If "2a = Yes", 6 dBA is Added to (L _o) _E] | 2ac | 76.0 |
| Reference Energy Mean Emission Levels for Locomotives (dBA), (L_o) _{E Locomotives-Freight} [Figure 4-7] | 2ad | 98.0 |
| Reference Energy Mean Emission Levels for Rail Cars (dBA), (L_o) _{E Rail Cars-Freight} [Figure 4-7] [If "2a = Yes", 6 dBA is Added to (L _o) _E] | 2ae | 76.0 |
| Ground Attenuation Factor, α [Soft Terrian = 0.5, Otherwise =0] | 2af | 0.5 |
| Noise Prediction for Locomotives (dBA), L_{dni Locomotives-Passenger} = [2ab + 10 log [(2r x 15)/2n] + 10 log [15/2c] ^{1+2aa} - 25 - 13.8] | 2ag | 54.7 |
| Noise Prediction for Rail Cars (dBA), L_{dni Rail Cars-Passenger} = [2ac + 10 log [(2s x 15)/2n] + 10 log [15/2c] ^{1+2aa} - 25 - 13.8] | 2ah | 39.3 |
| Sub-Total Passenger Rail Noise (dBA), L_{dn Rail Passenger} [10 Log (10 ^(2ag/10) + 10 ^(2ah/10))] | 2ad | 54.9 |
| Noise Prediction for Locomotives (dBA), L_{dni Locomotives-Freight} | 2ae | 57.1 |
| Noise Prediction for Rail Cars (dBA), L_{dni Rail Cars-Freight} | 2af | 50.8 |
| Sub-Total Passenger Rail Noise (dBA), L_{dn Rail Freight} [10 Log (10 ^(2ae/10) + 10 ^(2af/10))] | 2ag | 58.0 |
| Total Rail Noise (dBA), L_{dn} [10 Log (10 ^(2ad/10) + 10 ^(2ag/10))] | 2ah | 59.7 |
| Step 3: Highway Noise: | | |
| TNM 2.5 Predicted Peak Hour Noise Level (dBA), L_{eq} | 3a | 66.5 |
| Peak Hour Percent of 24-Hour (ADT) Volumes (%) | 3b | 16.6% |
| Day Time Traffic Volumes Percent of 24-hour (ADT) Volumes (%) | 3c | 92.2% |
| Night Time Traffic Volumes Percent of 24-hour (ADT) Volumes (%) | 3d | 7.8% |
| L_{eq} Noise Level Adjustment for Peak Hour % of ADT Volume (dBA), Δ₁ [Figure 4-20] | 3e | -6.0 |
| L_{eq} Noise Level Adjustment for Day Time % of ADT Volume (dBA), Δ₂ [Figure 4-20] | 3f | 2.3 |
| L_{eq} Noise Level Adjustment for Night Time % of ADT Volume (dBA), Δ₂ [Figure 4-20] | 3g | 2.3 |
| Highway Noise (dBA), L_{dn} = [3a + 3e + 3f (OR "3g")] | 3h | 62.8 |
| Step 4: Total Predicted Noise Level (Background+Highway+Rail), L_{dn} | | |
| Total (dBA), L_{dn} = [10 Log (10 ^(1b/10) + 10 ^(2ah/10) + 10 ^(3h/10))] | 4a | 65.0 |

References:

Advanced Prediction And Abatement of Highway Traffic Noise, FHWA Office of Environmental Policy (June 1982 "Recrated November 2016)

Advanced Prediction And Abatement of Highway Traffic Noise

| Analyst & Site Information | | |
|---|----------------------------|--|
| Analyst: | Chris S./Zaid H. (DOWL) | Major Facility : Seward Highway MP 105-107 |
| Analysis Date: | 12/20/2016 | Ground Type: Soft |
| Receiver #: | R2 | Day/Night Periods: [7:00 a.m.-10:00 p.m.]/[10:00 p.m.-7:00 a.m.] |
| Scenario: | Design Build 2037 [Future] | Not Used Not Used |
| Step 1: Background Noise: | | |
| Population Density per Square Mile, P [Input Min. 1] | 1a | 5 |
| L_{dn} [Background] = [10 log P + 22 dB] | 1b | 29.0 |
| Step 2: Rail Noise: | | |
| Is Rail Track Jointed Rails? (Yes or No) | 2a | No |
| Is Horn or Whistle Used - Passenger Train? (Yes or No) | 2b | No |
| Distance Between Railroad and Site in Question (m), D | 2c | 154.6 |
| Shortest Distance From Site in Question to the Location at Which The Horn/Whistle is Sounded (m), D_{hw} | 2d | 0.0 |
| Is 2d 10 Times > 2c? (Yes or No) | 2e | No |
| L_{dnhw} [Horn/Whistle Contribution to Diesel Locomotives Passenger Rail] = [10 + 20 log 2c/2d] | 2f | 0.0 |
| Is Horn or Whistle Used - Freight Train? (Yes or No) | 2g | No |
| Distance Between Railroad and Site in Question (m), D | 2h | 154.6 |
| Shortest Distance From Site in Question to the Location at Which The Horn/Whistle is Sounded (m), D_{hw} | 2i | 0.0 |
| Is 2i 10 Times > 2h? (Yes or No) | 2j | No |
| L_{dnhw} [Horn/Whistle Contribution to Diesel Locomotives Freight Rail] = [10 + 20 log 2h/2i] | 2k | 0.0 |
| Daily Passenger Train # of Locomotives | 2l | 2.0 |
| Daily Passenger Train # of Rail Cars | 2m | 9.0 |
| Passenger Train Speed (kph/hr) | 2n | 64.4 |
| Daily Passenger Train Trips | 2o | 7.0 |
| Daily Passenger Train Trips During Day Time, N_d | 2p | 7.0 |
| Daily Passenger Train Trips During Night Time, N_n [2o-2p] | 2q | 0.0 |
| Effective # of Operations for Locomotives, N_{eff. Locomotives, Passenger} = [2l x (2p + 10 x 2q)] | 2r | 14.0 |
| Effective # of Operations for Rails, N_{eff. Rail, Passenger} = [2m x (2p + 10 x 2q)] | 2s | 63.0 |
| Daily Freight Train # of Locomotives: | 2t | 2.0 |
| Daily Freight Train # of Rail Cars: | 2u | 75.0 |
| Freight Train Speed (kph/hr): | 2v | 64.4 |
| Daily Freight Train Trips | 2w | 3.0 |
| Daily Freight Train Trips During Day Time | 2x | 2.0 |
| Daily Freight Train Trips During Night Time = [2w-2x] | 2y | 1.0 |
| Effective # of Operations for Locomotives, N_{eff. Locomotives, Freight} = [2t x (2x + 10 x 2y)] | 2z | 24.0 |
| Effective # of Operations for Rails, N_{eff. Rail, Freight} = [2u x (2x + 10 x 2y)] | 2aa | 900.0 |
| Reference Energy Mean Emission Levels for Locomotives (dBA), (L_o)_{E Locomotives-Passenger} [Figure 4-7] | 2ab | 98.0 |
| Reference Energy Mean Emission Levels for Rail Cars (dBA), (L_o)_{E Rail Cars-Passenger} [Figure 4-7] [If "2a = Yes", 6 dBA is Added to (L _o) _E] | 2ac | 76.0 |
| Reference Energy Mean Emission Levels for Locomotives (dBA), (L_o)_{E Locomotives-Freight} [Figure 4-7] | 2ad | 98.0 |
| Reference Energy Mean Emission Levels for Rail Cars (dBA), (L_o)_{E Rail Cars-Freight} [Figure 4-7] [If "2a = Yes", 6 dBA is Added to (L _o) _E] | 2ae | 76.0 |
| Ground Attenuation Factor, α [Soft Terrian = 0.5, Otherwise =0] | 2af | 0.5 |
| Noise Prediction for Locomotives (dBA), L_{dni Locomotives-Passenger} = [2ab + 10 log [(2r x 15)/2n] + 10 log [15/2c] ^{1+2aa} - 25 - 13.8] | 2ag | 49.1 |
| Noise Prediction for Rail Cars (dBA), L_{dni Rail Cars-Passenger} = [2ac + 10 log [(2s x 15)/2n] + 10 log [15/2c] ^{1+2aa} - 25 - 13.8] | 2ah | 33.7 |
| Sub-Total Passenger Rail Noise (dBA), L_{dn Rail Passenger} [10 Log (10 ^(2ag/10) + 10 ^(2ah/10))] | 2ad | 49.3 |
| Noise Prediction for Locomotives (dBA), L_{dni Locomotives-Freight} | 2ae | 51.5 |
| Noise Prediction for Rails Cars (dBA), L_{dni Rail Cars-Freight} | 2af | 45.2 |
| Sub-Total Passenger Rail Noise (dBA), L_{dn Rail Freight} [10 Log (10 ^(2ae/10) + 10 ^(2af/10))] | 2ag | 52.4 |
| Total Rail Noise (dBA), L_{dn} [10 Log (10 ^(2ad/10) + 10 ^(2ag/10))] | 2ah | 54.1 |
| Step 3: Highway Noise: | | |
| TNM 2.5 Predicted Peak Hour Noise Level (dBA), L_{eq} | 3a | 63.3 |
| Peak Hour Percent of 24-Hour (ADT) Volumes (%) | 3b | 16.6% |
| Day Time Traffic Volumes Percent of 24-hour (ADT) Volumes (%) | 3c | 92.2% |
| Night Time Traffic Volumes Percent of 24-hour (ADT) Volumes (%) | 3d | 7.8% |
| L_{eq} Noise Level Adjustment for Peak Hour % of ADT Volume (dBA), Δ₁ [Figure 4-20] | 3e | -6.0 |
| L_{eq} Noise Level Adjustment for Day Time % of ADT Volume (dBA), Δ₂ [Figure 4-20] | 3f | 2.3 |
| L_{eq} Noise Level Adjustment for Night Time % of ADT Volume (dBA), Δ₂ [Figure 4-20] | 3g | 2.3 |
| Highway Noise (dBA), L_{dn} = [3a + 3e + 3f (OR "3g")] | 3h | 59.6 |
| Step 4: Total Predicted Noise Level (Background+Highway+Rail), L _{dn} | | |
| Total (dBA), L_{dn} = [10 Log (10 ^(1b/10) + 10 ^(2ah/10) + 10 ^(3h/10))] | 4a | 61.0 |

References:

Advanced Prediction And Abatement of Highway Traffic Noise, FHWA Office of Environmental Policy (June 1982 "Recrated November 2016)

Advanced Prediction And Abatement of Highway Traffic Noise

| Analyst & Site Information | | |
|---|----------------------------|--|
| Analyst: | Chris S./Zaid H. (DOWL) | Major Facility : Seward Highway MP 105-107 |
| Analysis Date: | 12/20/2016 | Ground Type: Soft |
| Receiver #: | R3 | Day/Night Periods: [7:00 a.m.-10:00 p.m.]/[10:00 p.m.-7:00 a.m.] |
| Scenario: | Design Build 2037 [Future] | Not Used Not Used |
| Step 1: Background Noise: | | |
| Population Density per Square Mile, P [Input Min. 1] | 1a | 5 |
| L_{dn} [Background] = [10 log P + 22 dB] | 1b | 29.0 |
| Step 2: Rail Noise: | | |
| Is Rail Track Jointed Rails? (Yes or No) | 2a | No |
| Is Horn or Whistle Used - Passenger Train? (Yes or No) | 2b | No |
| Distance Between Railroad and Site in Question (m), D | 2c | 90.5 |
| Shortest Distance From Site in Question to the Location at Which The Horn/Whistle is Sounded (m), D_{hw} | 2d | 0.0 |
| Is 2d 10 Times > 2c? (Yes or No) | 2e | No |
| L_{dnhw} [Horn/Whistle Contribution to Diesel Locomotives Passenger Rail] = [10 + 20 log 2c/2d] | 2f | 0.0 |
| Is Horn or Whistle Used - Freight Train? (Yes or No) | 2g | No |
| Distance Between Railroad and Site in Question (m), D | 2h | 90.5 |
| Shortest Distance From Site in Question to the Location at Which The Horn/Whistle is Sounded (m), D_{hw} | 2i | 0.0 |
| Is 2i 10 Times > 2h? (Yes or No) | 2j | No |
| L_{dnhw} [Horn/Whistle Contribution to Diesel Locomotives Freight Rail] = [10 + 20 log 2h/2i] | 2k | 0.0 |
| Daily Passenger Train # of Locomotives | 2l | 2.0 |
| Daily Passenger Train # of Rail Cars | 2m | 9.0 |
| Passenger Train Speed (kph/hr) | 2n | 64.4 |
| Daily Passenger Train Trips | 2o | 7.0 |
| Daily Passenger Train Trips During Day Time, N_d | 2p | 7.0 |
| Daily Passenger Train Trips During Night Time, N_n [2o-2p] | 2q | 0.0 |
| Effective # of Operations for Locomotives, N_{eff. Locomotives, Passenger} = [2l x (2p + 10 x 2q)] | 2r | 14.0 |
| Effective # of Operations for Rails, N_{eff. Rail, Passenger} = [2m x (2p + 10 x 2q)] | 2s | 63.0 |
| Daily Freight Train # of Locomotives: | 2t | 2.0 |
| Daily Freight Train # of Rail Cars: | 2u | 75.0 |
| Freight Train Speed (kph/hr): | 2v | 64.4 |
| Daily Freight Train Trips | 2w | 3.0 |
| Daily Freight Train Trips During Day Time | 2x | 2.0 |
| Daily Freight Train Trips During Night Time = [2w-2x] | 2y | 1.0 |
| Effective # of Operations for Locomotives, N_{eff. Locomotives, Freight} = [2t x (2x + 10 x 2y)] | 2z | 24.0 |
| Effective # of Operations for Rails, N_{eff. Rail, Freight} = [2u x (2x + 10 x 2y)] | 2aa | 900.0 |
| Reference Energy Mean Emission Levels for Locomotives (dBA), (L _o) _{E Locomotives-Passenger} [Figure 4-7] | 2ab | 98.0 |
| Reference Energy Mean Emission Levels for Rail Cars (dBA), (L _o) _{E Rail Cars-Passenger} [Figure 4-7] [If "2a = Yes", 6 dBA is Added to (L _o) _E] | 2ac | 76.0 |
| Reference Energy Mean Emission Levels for Locomotives (dBA), (L _o) _{E Locomotives-Freight} [Figure 4-7] | 2ad | 98.0 |
| Reference Energy Mean Emission Levels for Rail Cars (dBA), (L _o) _{E Rail Cars-Freight} [Figure 4-7] [If "2a = Yes", 6 dBA is Added to (L _o) _E] | 2ae | 76.0 |
| Ground Attenuation Factor, α [Soft Terrian = 0.5, Otherwise =0] | 2af | 0.5 |
| Noise Prediction for Locomotives (dBA), L_{dni Locomotives-Passenger} = [2ab + 10 log [(2r x 15)/2n] + 10 log [15/2c] ^{1+2aa} - 25 - 13.8] | 2ag | 52.6 |
| Noise Prediction for Rail Cars (dBA), L_{dni Rail Cars-Passenger} = [2ac + 10 log [(2s x 15)/2n] + 10 log [15/2c] ^{1+2aa} - 25 - 13.8] | 2ah | 37.2 |
| Sub-Total Passenger Rail Noise (dBA), L_{dn Rail Passenger} [10 Log (10 ^(2ag/10) + 10 ^(2ah/10))] | 2ad | 52.7 |
| Noise Prediction for Locomotives (dBA), L_{dni Locomotives-Freight} | 2ae | 55.0 |
| Noise Prediction for Rails Cars (dBA), L_{dni Rail Cars-Freight} | 2af | 48.7 |
| Sub-Total Passenger Rail Noise (dBA), L_{dn Rail Freight} [10 Log (10 ^(2ae/10) + 10 ^(2af/10))] | 2ag | 55.9 |
| Total Rail Noise (dBA), L_{dn} [10 Log (10 ^(2ad/10) + 10 ^(2ag/10))] | 2ah | 57.6 |
| Step 3: Highway Noise: | | |
| TNM 2.5 Predicted Peak Hour Noise Level (dBA), L_{eq} | 3a | 68.3 |
| Peak Hour Percent of 24-Hour (ADT) Volumes (%) | 3b | 16.6% |
| Day Time Traffic Volumes Percent of 24-hour (ADT) Volumes (%) | 3c | 92.2% |
| Night Time Traffic Volumes Percent of 24-hour (ADT) Volumes (%) | 3d | 7.8% |
| L_{eq} Noise Level Adjustment for Peak Hour % of ADT Volume (dBA), Δ₁ [Figure 4-20] | 3e | -6.0 |
| L_{eq} Noise Level Adjustment for Day Time % of ADT Volume (dBA), Δ₂ [Figure 4-20] | 3f | 2.3 |
| L_{eq} Noise Level Adjustment for Night Time % of ADT Volume (dBA), Δ₂ [Figure 4-20] | 3g | 2.3 |
| Highway Noise (dBA), L_{dn} = [3a + 3e + 3f (OR "3g")] | 3h | 64.6 |
| Step 4: Total Predicted Noise Level (Background+Highway+Rail), L_{dn} | | |
| Total (dBA), L_{dn} = [10 Log (10 ^(1b/10) + 10 ^(2ah/10) + 10 ^(3h/10))] | 4a | 65.0 |

References:

Advanced Prediction And Abatement of Highway Traffic Noise, FHWA Office of Environmental Policy (June 1982 "Recreated November 2016)

Advanced Prediction And Abatement of Highway Traffic Noise

| Analyst & Site Information | | |
|---|----------------------------|--|
| Analyst: | Chris S./Zaid H. (DOWL) | Major Facility : Seward Highway MP 105-107 |
| Analysis Date: | 12/20/2016 | Ground Type: Soft |
| Receiver #: | R4 | Day/Night Periods: [7:00 a.m.-10:00 p.m.]/[10:00 p.m.-7:00 a.m.] |
| Scenario: | Design Build 2037 [Future] | Not Used Not Used |
| Step 1: Background Noise: | | |
| Population Density per Square Mile, P [Input Min. 1] | 1a | 5 |
| L_{dn} [Background] = [10 log P + 22 dB] | 1b | 29.0 |
| Step 2: Rail Noise: | | |
| Is Rail Track Jointed Rails? (Yes or No) | 2a | No |
| Is Horn or Whistle Used - Passenger Train? (Yes or No) | 2b | No |
| Distance Between Railroad and Site in Question (m), D | 2c | 125.0 |
| Shortest Distance From Site in Question to the Location at Which The Horn/Whistle is Sounded (m), D_{hw} | 2d | 0.0 |
| Is 2d 10 Times > 2c? (Yes or No) | 2e | No |
| L_{dnhw} [Horn/Whistle Contribution to Diesel Locomotives Passenger Rail] = [10 + 20 log 2c/2d] | 2f | 0.0 |
| Is Horn or Whistle Used - Freight Train? (Yes or No) | 2g | No |
| Distance Between Railroad and Site in Question (m), D | 2h | 125.0 |
| Shortest Distance From Site in Question to the Location at Which The Horn/Whistle is Sounded (m), D_{hw} | 2i | 0.0 |
| Is 2i 10 Times > 2h? (Yes or No) | 2j | No |
| L_{dnhw} [Horn/Whistle Contribution to Diesel Locomotives Freight Rail] = [10 + 20 log 2h/2i] | 2k | 0.0 |
| Daily Passenger Train # of Locomotives | 2l | 2.0 |
| Daily Passenger Train # of Rail Cars | 2m | 9.0 |
| Passenger Train Speed (kph/hr) | 2n | 64.4 |
| Daily Passenger Train Trips | 2o | 7.0 |
| Daily Passenger Train Trips During Day Time, N_d | 2p | 7.0 |
| Daily Passenger Train Trips During Night Time, N_n [2o-2p] | 2q | 0.0 |
| Effective # of Operations for Locomotives, N_{eff. Locomotives, Passenger} = [2l x (2p + 10 x 2q)] | 2r | 14.0 |
| Effective # of Operations for Rails, N_{eff. Rail, Passenger} = [2m x (2p + 10 x 2q)] | 2s | 63.0 |
| Daily Freight Train # of Locomotives: | 2t | 2.0 |
| Daily Freight Train # of Rail Cars: | 2u | 75.0 |
| Freight Train Speed (kph/hr): | 2v | 64.4 |
| Daily Freight Train Trips | 2w | 3.0 |
| Daily Freight Train Trips During Day Time | 2x | 2.0 |
| Daily Freight Train Trips During Night Time = [2w-2x] | 2y | 1.0 |
| Effective # of Operations for Locomotives, N_{eff. Locomotives, Freight} = [2t x (2x + 10 x 2y)] | 2z | 24.0 |
| Effective # of Operations for Rails, N_{eff. Rail, Freight} = [2u x (2x + 10 x 2y)] | 2aa | 900.0 |
| Reference Energy Mean Emission Levels for Locomotives (dBA), (L_o) _{E Locomotives-Passenger} [Figure 4-7] | 2ab | 98.0 |
| Reference Energy Mean Emission Levels for Rail Cars (dBA), (L_o) _{E Rail Cars-Passenger} [Figure 4-7] [If "2a = Yes", 6 dBA is Added to (L_o) _E] | 2ac | 76.0 |
| Reference Energy Mean Emission Levels for Locomotives (dBA), (L_o) _{E Locomotives-Freight} [Figure 4-7] | 2ad | 98.0 |
| Reference Energy Mean Emission Levels for Rail Cars (dBA), (L_o) _{E Rail Cars-Freight} [Figure 4-7] [If "2a = Yes", 6 dBA is Added to (L_o) _E] | 2ae | 76.0 |
| Ground Attenuation Factor, α [Soft Terrian = 0.5, Otherwise =0] | 2af | 0.5 |
| Noise Prediction for Locomotives (dBA), L_{dni Locomotives-Passenger} = [2ab + 10 log [(2r x 15)/2n] + 10 log [15/2c] ^{1+2aa} - 25 - 13.8] | 2ag | 50.5 |
| Noise Prediction for Rail Cars (dBA), L_{dni Rail Cars-Passenger} = [2ac + 10 log [(2s x 15)/2n] + 10 log [15/2c] ^{1+2aa} - 25 - 13.8] | 2ah | 35.1 |
| Sub-Total Passenger Rail Noise (dBA), L_{dn Rail Passenger} [10 Log (10 ^(2ag/10) + 10 ^(2ah/10))] | 2ad | 50.6 |
| Noise Prediction for Locomotives (dBA), L_{dni Locomotives-Freight} | 2ae | 52.9 |
| Noise Prediction for Rails Cars (dBA), L_{dni Rail Cars-Freight} | 2af | 46.6 |
| Sub-Total Passenger Rail Noise (dBA), L_{dn Rail Freight} [10 Log (10 ^(2ae/10) + 10 ^(2af/10))] | 2ag | 53.8 |
| Total Rail Noise (dBA), L_{dn} [10 Log (10 ^(2ad/10) + 10 ^(2ag/10))] | 2ah | 55.5 |
| Step 3: Highway Noise: | | |
| TNM 2.5 Predicted Peak Hour Noise Level (dBA), L_{eq} | 3a | 55.8 |
| Peak Hour Percent of 24-Hour (ADT) Volumes (%) | 3b | 16.6% |
| Day Time Traffic Volumes Percent of 24-hour (ADT) Volumes (%) | 3c | 92.2% |
| Night Time Traffic Volumes Percent of 24-hour (ADT) Volumes (%) | 3d | 7.8% |
| L_{eq} Noise Level Adjustment for Peak Hour % of ADT Volume (dBA), Δ₁ [Figure 4-20] | 3e | -6.0 |
| L_{eq} Noise Level Adjustment for Day Time % of ADT Volume (dBA), Δ₂ [Figure 4-20] | 3f | 2.3 |
| L_{eq} Noise Level Adjustment for Night Time % of ADT Volume (dBA), Δ₂ [Figure 4-20] | 3g | 2.3 |
| Highway Noise (dBA), L_{dn} = [3a + 3e + 3f (OR "3g")] | 3h | 52.1 |
| Step 4: Total Predicted Noise Level (Background+Highway+Rail), L_{dn} | | |
| Total (dBA), L_{dn} = [10 Log (10 ^(1b/10) + 10 ^(2ah/10) + 10 ^(3h/10))] | 4a | 57.0 |

References:

Advanced Prediction And Abatement of Highway Traffic Noise, FHWA Office of Environmental Policy (June 1982 "Recrated November 2016)

RESULTS: SOUND LEVELS

Windy Corner, Seward Hwy: MP 105-107

DOWL
CAS

13 December 2016
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS

PROJECT/CONTRACT: Windy Corner, Seward Hwy: MP 105-107

RUN: Existing, 2016

BARRIER DESIGN: INPUT HEIGHTS

Average pavement type shall be used unless
a State highway agency substantiates the use
of a different type with approval of FHWA.

ATMOSPHERICS: 68 deg F, 50% RH

| Receiver | | With Barrier | | | | | | | | | | No Barrier | | | Increase over existing | | | Type Impact | | Noise Reduction | | Calculated minus Goal | |
|-----------------------|-----|--------------|-----------------|------|-------------------|------|-----------------|--------|-----------------|--------|-----------------|------------|-----------------|------------|------------------------|------------|-----------------|-------------|-----------------|-----------------|-----------------|-----------------------|-----|
| Name | No. | #DUs | Existing LAeq1h | | No Barrier LAeq1h | | Calculated | | Crit'n | | dB | | dBA | | dB | | dB | | dB | | dB | | |
| | | | LAeq1h | dB | LAeq1h | dB | Calculated | Crit'n | Calculated | Crit'n | Sub'l Inc | Calculated | dB | Calculated | dB | Calculated | dB | Calculated | dB | Calculated | Goal | Calculated minus Goal | dB |
| R1 | 1 | 1 | 0.0 | 65.3 | 0.0 | 65.3 | 66 | 65.3 | 10 | 65.3 | 10 | 65.3 | 65.3 | 0.0 | 8 | 65.3 | 0.0 | 8 | 8 | 8 | -8.0 | | |
| R2 | 1 | 1 | 0.0 | 63.9 | 0.0 | 63.9 | 66 | 63.9 | 10 | 63.9 | 10 | 63.9 | 63.9 | 0.0 | 8 | 63.9 | 0.0 | 8 | 8 | 8 | -8.0 | | |
| R3 | 1 | 1 | 0.0 | 67.8 | 0.0 | 67.8 | 66 | 67.8 | 10 | 67.8 | 10 | 67.8 | 67.8 | 0.0 | 8 | 67.8 | 0.0 | 8 | 8 | 8 | -8.0 | | |
| R4 | 1 | 1 | 0.0 | 54.5 | 0.0 | 54.5 | 66 | 54.5 | 10 | 54.5 | 10 | 54.5 | 54.5 | 0.0 | 8 | 54.5 | 0.0 | 8 | 8 | 8 | -8.0 | | |
| Dwelling Units | | # DUs | Noise Reduction | | Noise Reduction | | Noise Reduction | | Noise Reduction | | Noise Reduction | | Noise Reduction | | Noise Reduction | | Noise Reduction | | Noise Reduction | | Noise Reduction | | |
| | | | Min | Avg | Max | Min | Avg | Max | Min | Avg | Max | Min | Avg | Max | Min | Avg | Max | Min | Avg | Max | Min | Avg | Max |
| | | | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB | dB |
| All Selected | | 4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| All Impacted | | 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| All that meet NR Goal | | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

RESULTS: SOUND LEVELS

Windy Corner, Seward Hwy: MP 105-107

13 December 2016
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS

PROJECT/CONTRACT: Windy Corner, Seward Hwy: MP 105-107
RUN: No Build, 2037

BARRIER DESIGN: INPUT HEIGHTS

ATMOSPHERICS: 68 deg F, 50% RH

Average pavement type shall be used unless
a State highway agency substantiates the use
of a different type with approval of FHWA.

| Receiver Name | No. | #DUs | Existing | | No Barrier | | Increase over existing | | Type Impact | | With Barrier | | Calculated minus Goal dB |
|-----------------------|-----|--------------|------------------------|------------|------------|-----|------------------------|--------|-------------|-----------|--------------|------|--------------------------|
| | | | LAeq1h | dBA | LAeq1h | dBA | Calculated | Crit'n | Calculated | Sub'l Inc | Calculated | Goal | |
| R1 | 1 | 1 | 65.3 | 66.5 | 66.5 | 66 | 1.3 | 10 | Snd Lvl | 66.5 | 0.0 | 8 | -8.0 |
| R2 | 1 | 1 | 63.9 | 65.1 | 66 | 66 | 1.2 | 10 | ----- | 65.1 | 0.0 | 8 | -8.0 |
| R3 | 1 | 1 | 67.8 | 69.1 | 66 | 66 | 1.3 | 10 | Snd Lvl | 69.1 | 0.0 | 8 | -8.0 |
| R4 | 1 | 1 | 54.5 | 55.7 | 66 | 66 | 1.2 | 10 | ----- | 55.7 | 0.0 | 8 | -8.0 |
| Dwelling Units | | # DUs | Noise Reduction | | | | | | | | | | |
| | | | Min | Avg | Max | | | | | | | | |
| | | | dB | dB | dB | | | | | | | | |
| All Selected | | 4 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | |
| All Impacted | | 2 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | |
| All that meet NR Goal | | 0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | |

RESULTS: SOUND LEVELS

Windy Corner, Seward Hwy: MP 105-107

13 December 2016
 TNM 2.5
 Calculated with TNM 2.5

RESULTS: SOUND LEVELS

PROJECT/CONTRACT: Windy Corner, Seward Hwy: MP 105-107
 Design Build, 2037
BARRIER DESIGN: INPUT HEIGHTS
ATMOSPHERICS: 68 deg F, 50% RH

Average pavement type shall be used unless
 a State highway agency substantiates the use
 of a different type with approval of FHWA.

| Receiver Name | No. | #DUs | Existing LAeq1h | No Barrier | | Increase over existing | | Type Impact | With Barrier | | Calculated minus Goal | |
|-----------------------|-----|--------------|------------------------|-------------------|------------|------------------------|------------------|-------------|-------------------|----------------------------|-----------------------|----------------------|
| | | | | LAeq1h Calculated | Crit'n dBA | Calculated | Crit'n Sub'l Inc | | LAeq1h Calculated | Noise Reduction Calculated | | Noise Reduction Goal |
| | | | dB | dB | dB | dB | dB | | dB | dB | dB | |
| R1 | 1 | 1 | 65.3 | 66.5 | 66 | 1.2 | 10 | Snd Lvl | 66.5 | 0.0 | 8 | -8.0 |
| R2 | 1 | 1 | 63.9 | 63.3 | 66 | -0.6 | 10 | ---- | 63.3 | 0.0 | 8 | -8.0 |
| R3 | 1 | 1 | 67.8 | 68.3 | 66 | 0.5 | 10 | Snd Lvl | 68.3 | 0.0 | 8 | -8.0 |
| R4 | 1 | 1 | 54.5 | 55.8 | 66 | 1.3 | 10 | ---- | 55.8 | 0.0 | 8 | -8.0 |
| Dwelling Units | | # DUs | Noise Reduction | | | | | | | | | |
| | | | Min | Avg | Max | | | | | | | |
| | | | dB | dB | dB | | | | | | | |
| All Selected | | 4 | 0.0 | 0.0 | 0.0 | | | | | | | |
| All Impacted | | 2 | 0.0 | 0.0 | 0.0 | | | | | | | |
| All that meet NR Goal | | 0 | 0.0 | 0.0 | 0.0 | | | | | | | |

APPENDIX E

Feasibility and Reasonableness Worksheet

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Feasibility and Reasonableness Worksheet Example

HIGHWAY TRAFFIC NOISE ABATEMENT FOR PROJECT:

Receiver ID No.(s): R1, R2, R3 & R4

Location/Description: Chugach State Park

Activity Category type: C

Noise Abatement Criteria for this Activity Category(Leq) (Table 1 DOT&PF Noise Policy): 66 dBA

Existing Noise Level (Leq): 57-65 dBA

Future Build Noise Level (Leq): 57-65 dBA

Future No-Build Noise Level: 57-66 dBA

Has a noise impact been identified (If yes continue filling out worksheet. If no, no noise abatement is required. Sign worksheet and recommend no noise abatement)?: Yes No

Highway Traffic Noise Abatement Feasibility and Reasonableness Analysis:

Feasibility

| | | |
|--|-----|----|
| Is the proposed noise abatement measure acoustically feasible? | Yes | No |
| Is the proposed noise abatement measure engineering feasible | Yes | No |

Reasonableness

| | | |
|--|-----|----|
| Is the proposed noise abatement measure considered reasonable? | Yes | No |
|--|-----|----|

Federal Mandatory Factors

- 1 **Cost Effectiveness.** Is the abatement measure cost effective?
 - 2 **Views of Benefited Residents and Property Owners.** Do at least 60 percent of the impacted residents and property owners surveyed desire noise abatement?
 - 3 **Noise reduction design goal?** Does the noise abatement measure provide 7 dBA reduction to 50 percent or more of the benefitted receptors in the first row of structures?
- DOT&PF Mandatory Factors (State funded only)**
4. **Development vs. Highway Timing.** Were at least 50 percent of benefited receptors in the development built before highway construction?
 - 5 **Development Existence.** Have at least 50 percent of benefited receptors in the development existed for at least 10 years?
 - 6 **Absolute Predicted Build Noise Level.** Are the predicted future build noise levels at least 66dBA?
 - 7 **Relative Predicted Build Noise Level.** Are the predicted future build noise levels at least 10 dBA greater than the existing noise levels?
 8. **Build vs. No-Build Noise Levels.** Are the future build noise levels at least 5 dBA greater than the future No Build noise levels?

9..**Land Use.** Is the-land use changing rapidly and are there local ordinances or zoning in place to control the new development of noise sensitive land uses adjacent to transportation corridors?

Is Noise Abatement recommended for this impacted receptor(s)? **No**

What type of noise abatement is recommended? (Note – The use of quiet pavements is not an approved noise abatement measure on Federal Aid Projects. Quiet pavements can be utilized as an abatement measure on State funded projects with the approval of the Regional Preconstruction Engineer)

What is the basis for this recommendation? No noise impact identified



Regional Environmental Manager



Date



DOT&PF Project Manager



Date

I have determined that the use of quiet pavement to mitigate noise impacts on a state-funded project is within the cost constraints of the legislative appropriation for the proposed project.

Preconstruction Engineer ³

Date

³ The Preconstruction Engineer's signature is only required if quiet pavements are recommended on State funded projects. The Preconstruction Engineer must determine whether the incorporation of quiet pavements into the State-funded project is within the cost constraints of the legislative appropriation