MINISTRY OF TRANSPORTATION

Environmental Guide for Noise

Version: October 2006

MINISTRY OF TRANSPORTATION

Environmental Guide for Noise

Part of the Environmental Standards and Practices

ISSUED BY:

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This document was developed under the direction of the Environmental Standards Project (ESP) Team comprised of MTO staff in the Provincial and Environmental Planning Office (Jamie Dougall – Project Director and Brenda Carruthers – Project Manager) and the lead consultant firm of Ecoplans Limited (Bob Hodgins - Project Director and Clark Gunter – Project Manager).

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Comments and Suggestions

The Ministry of Transportation welcomes comments and suggestions on ways to improve the document with the objective of providing a practical and pragmatic approach to environmental management in the Province of Ontario. MTO anticipates that changes will be warranted to clarify, improve and incorporate new information.

The format of the document is designed to accommodate such changes. Such revisions and amendments will be incorporated in later editions of this document. MTO will not formally respond to unsolicited comments submitted in response to the document.

Ce document hautement spécialisé n'est disponsible qu'en anglais en vertue du règlement 411/97, qui en exempte l'application de la Loi sur les services en français. Pour obtenir de l'aide en français, veuillez communiquer avec le ministère des Transports, Bureau des services en français au: 905-704-2045 ou 905-704-2046.

VERSION HISTORY

VERSION #	DATE	DESCRIPTION OF MAJOR CHANGE
1.1	Updated July 2008	Several formatting changes were made and Figure 7.1 was slightly revised to better reflect the text. Several typographical errors were also corrected.

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APPENDICES

1 INTRODUCTION

The Ontario Ministry of Transportation (MTO) Environmental Guide for Noise (referred to as the Noise Guide) was developed to provide guidance for MTO personnel and consultants in the analysis of highway noise and its effects. It replaces the Environmental Office Manual – Technical Areas – Noise, EO-V-1000-00 (May 1992).

The Noise Guide has been organized as follows:

- ***Section 2: Policy Framework***, provides a summary of requirements and procedures for noise as outlined in this Guide.
- ***Section 3: Reference Documents,*** provides a list of Ontario Ministry of Environment (MOE) publications related to noise.
- ***Section 4: Approach,*** provides an overview of the step-by-step process for the consideration and analysis of noise effects throughout all stages of the studies/projects carried out for the Ministry of Transportation.
- ***Section 5: Qualifications*** for Acoustic Specialists.
- ***Section 6: Noise Prediction Methodologies,*** provides an overview of the approved noise models.
- ***Sections 7 to 11:*** provide details for the consideration and analysis of noise effects for the following stages:
  - Transportation Planning (Section 7);
  - Highway Design - Preliminary Design (Section 8);
  - Highway Design - Detail Design (Section 9);
  - Construction (Section 10); and
  - Operations and Maintenance (Section 11).
- ***Section* 12: *Computer Data Maintenance,*** management of computer data throughout and after the project.

1.1 Terminology for this Guide

Definitions and explanations in this guide are provided in the MTO Environmental Glossary. Definitions and explanations of key terms are provided in Appendix A for convenience.

1.2 The Role of Other MTO Documents in this Guide

Numerous MTO environmental design and construction documents are related to or have a role in this Guide, as described below:

Environmental Protection Requirements for Transportation Planning and Highway Design, Construction, Operations and Maintenance

Environmental Protection Requirements (EPRs) are a list of statements, organized by environmental factors. The EPRs are a synthesis and interpretation of the over sixty statutes and their supporting regulations and formal government policies applicable to environmental aspects of transportation planning, and highway design, construction, operation and maintenance activities.

Class Environmental Assessment for Provincial Transportation Facilities, 2000

The Environmental Assessment Act (EA Act) provides for the preparation of Class Environmental Assessments (Class EA). MTO's Class EA is an approved planning document that defines groups of projects and activities and the environmental assessment (EA) processes, which MTO commits to following for each of these undertakings.

Environmental Reference for Highway Design

The Environmental Reference for Highway Design (ERD) addresses requirements for consultants undertaking MTO projects including scope of work, staff qualifications, scheduling and documentation for each environmental specialty area. (Section 3.4 outlines the technical, documentation and qualification requirements for noise). This Guide supports and explains these requirements.

Environmental Standards and Practices User Guide

The Environmental Standards and Practices User Guide (User Guide) contains a brief overview of typical potential environmental impacts associated with highway projects for each environmental factor assessed by MTO, provides design considerations in managing those impacts and lists applicable technical documents (like this Guide). As such, the User Guide is a roadmap to relevant standards and guides.

Environmental Reference for Contract Preparation

The Environmental Reference for Contract Preparation (ERCP) contains a brief overview of potential environmental impacts associated with highway construction and all relevant Ontario Provincial Standard Specifications (OPSS) and MTO Standard Special Provisions (SSP) that may be used as part of a construction contract to mitigate those impacts.

2 POLICY FRAMEWORK

Requirements for noise assessment and mitigation relating to the construction of new or the expansion of existing Provincial Highways are outlined in this Guide, which updates, improves, and supersedes the MTO/MOE (Ministry of the Environment) *Noise Protocol* and the MTO *Quality and Standards Directive A-1* - Noise Policy and Acoustical Standards for Provincial Highways. These requirements have been summarized into two (2) Environmental Protection Requirements (EPRs): Noise-1 (Planning & Design) and Noise-2 (Construction), and are discussed in the following sub-sections. In addition, MOE Approvals, Canadian Environmental Assessment Act (CEAA), and Municipal Noise Bylaws are discussed in this section.

Other references that may provide guidance include:

- MOE NPC-205, NPC-203 and NPC-233; and
- "National Guidelines of Environmental Noise Control – Procedures and Concepts for the Drafting of Environmental Noise Regulations/By-laws in Canada", Environmental Health Directorate, Health Protection Branch, Health Canada (March 1989, as applicable).

2.1 Environmental Protection Requirement (EPR) Noise-1 – Planning & Design

Environmental Protection Requirement (EPR) Noise-1 requires that potential noise impacts be investigated where a highway construction project is proposed through or adjacent to a Noise Sensitive Area (NSA). In order to determine a noise impact, a comparison shall be made for future sound levels with and without the proposed improvements for the Outdoor Living Area (OLA) of NSAs. The objective for outdoor sound levels is to achieve the future ambient that would occur without the proposed improvements. The significance of a noise impact is quantified by using this objective in addition to the change in sound level above the future ambient (i.e. the future sound level without the proposed improvements is compared to the future sound level with the proposed improvements).

Where increases in noise levels are predicted, the mitigation efforts to be applied for the predicted change in noise level above the ambient and the projected noise level with the proposed improvements are shown in Table 2.1.

Table 2.1 Mitigation Effort Required for the Projected Noise Level with the Proposed Improvements above the Ambient

Change in Noise Level Above Ambient / Projected Noise Levels with Proposed Improvements	Mitigation Effort Required
< 5 dBA change & < 65 dBA	- None
≥ 5 dBA change OR ≥ 65 dBA	- Investigate noise control measures on right-of-way. - Introduce noise control measures within right-of-way and mitigate to ambient if technically, economically and administratively feasible. - Noise control measures, where introduced, should achieve a minimum of 5 dBA attenuation, over first row receivers.

On right-of-way mitigation measures must be identified, considered and implemented where warranted. Mitigation measures within the right-of-way include:

- acoustical barriers;
- berms;
- vertical and horizontal alignments; and
- pavement surfaces.

Mitigation must attempt to achieve levels as close to, or lower than, the objective level (i.e., future predicted ambient without the proposed improvements) as is technically, economically, and administratively feasible.

The technical, economic, and administrative feasibility of providing mitigation is required to be reviewed as follows:

Technical Feasibility	Review the constructability of the noise mitigation (i.e. design of wall, roadside safety, shadow effect, topography, achieve a 5 dBA reduction, ability to provide a continuous barrier, etc.).
Economic Feasibility	Carry out a cost/benefit assessment of the noise mitigation (i.e., determine cost per benefited receiver).
Administrative Feasibility	Determine the ability to locate the noise mitigation on lands within public ownership (i.e., provincial or municipal right-of-way).

The determination of whether or not mitigation is provided must be based on the review of technical, economical and administrative feasibility while considering the existing and projected noise levels, the predicted noise level decreases and the number of benefiting receivers. The findings of this review must be documented in the Noise Report.

2.2 Environmental Protection Requirement (EPR) Noise-2 - Construction

Highway construction projects must be undertaken in accordance with the requirements and procedures outlined in this Guide, which indicates that construction activities will be undertaken in a manner to minimize noise levels and identify a process for dealing with public complaints during construction. Pile driving and blasting operations will be in accordance with OPSS 120 and MOE Publication NPC-119.

2.3 Ministry of the Environment Requirements

The determination of potential noise impacts including the justification for whether or not providing noise mitigation must be documented in the Noise Report, which will be included in Environmental Assessment (EA) documentation (see Section 8.5).

2.4 Noise Barrier Retrofit Policy

In keeping with Government policy, MTO developed a Retrofit Noise Barrier Program to alleviate noise impacts on existing noise sensitive areas adjacent to existing freeways. See Appendix B for details.

2.5 Canadian Environmental Assessment Act (CEAA)

If the Canadian Environmental Assessment Act (CEAA) is triggered, then the noise impact assessment must satisfy the requirements of the CEAA review process.

If CEAA is triggered, the proponent should contact the CEA Agency and Responsible Authority, who will provide specific guidance on CEAA noise requirements in consultation with other federal agencies including Health Canada, Environmental Health Services.

2.6 Municipal Noise Control Bylaws

Construction operations must abide by municipal noise control bylaws. Therefore, municipal bylaws must be reviewed for construction requirements prior to the commencement of construction activities. In certain situations, a contract may require work (e.g., night construction) that is in contravention of a municipal noise control bylaw. In these cases, an exemption must be obtained from the municipality prior to construction. If the exemption is not obtained, the construction project may not go on in a manner that is in contravention of the bylaw.

3 REFERENCE DOCUMENTS

For noise assessment requirements, references are made to the following Ontario Ministry of Environment (MOE) publications, or any amendment thereof:

1) NPC-101 - Technical Definitions
2) NPC-102 – Instrumentation
3) NPC-103 – Procedures
4) NPC-205 - Sound Level Limits for Stationary Sources in Class 1 & 2 Areas (Urban)
5) NPC-232 - Sound Level Limits for Stationary Sources In Class 3 Areas (Rural)
6) LU-131 – Noise Assessment Criteria in Land Use Planning
7) ORNAMENT, Ontario Road Noise Analysis Method for Environment and Transportation, Technical Document, Ontario Ministry of the Environment, ISBN 0-7729-6376,1989

References 1 to 6 can be found on the MOE website (www.ene.gov.on.ca).

4 APPROACH

The process for noise analysis has been in place for over 25 years and is based on the overall approach developed by MTO for complying with the requirements of the Ontario Environmental Assessment Act and those policies which relate directly to noise.

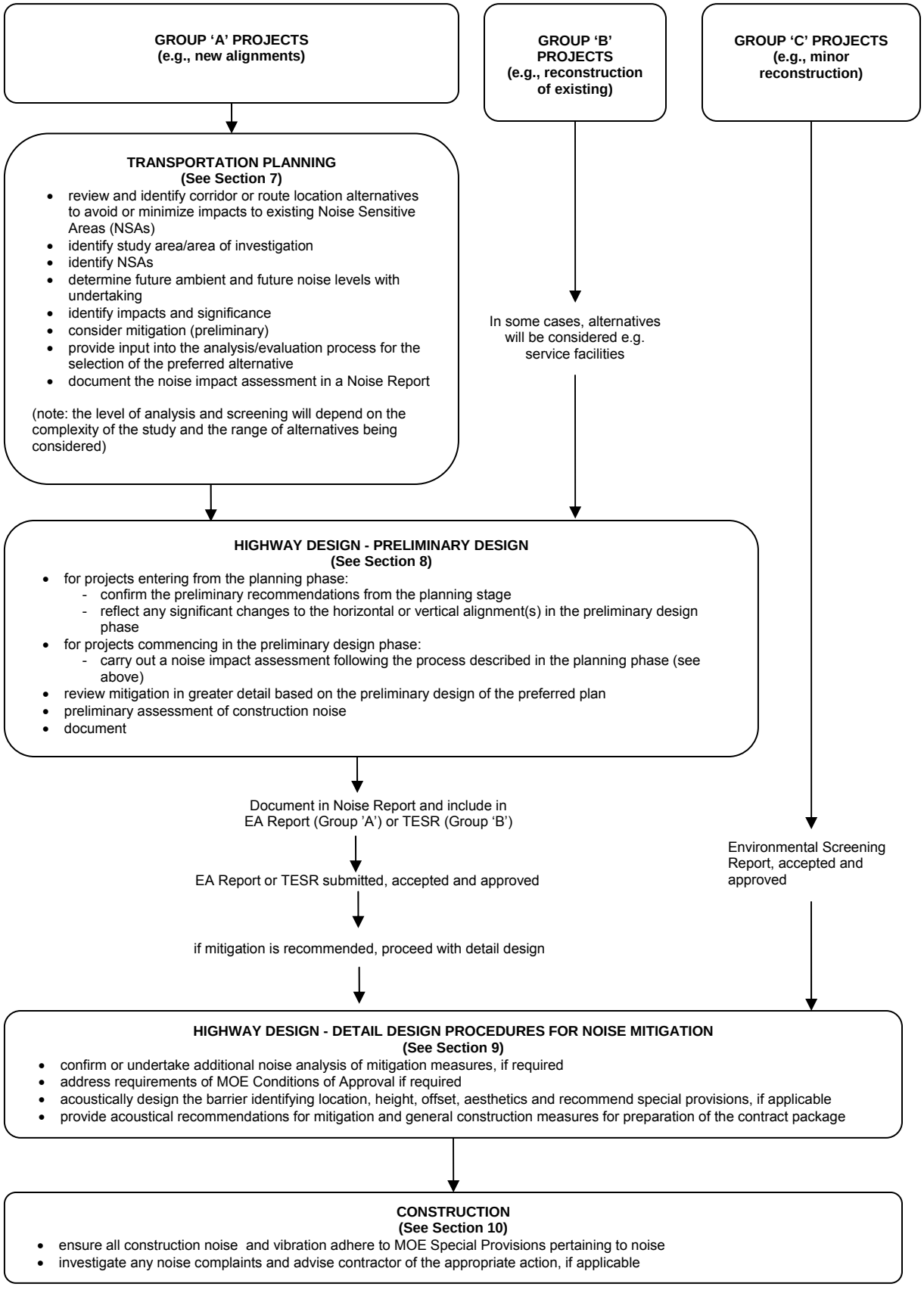
This Guide follows this well established process, and provides 'step-by-step' guidance for the consideration and analysis of noise effects throughout all project stages including:

- Transportation Planning;
- Highway Design;
  - Preliminary Design,
  - Detail Design;
- Construction; and
- Operations and Maintenance.

The results of the assessment of noise may affect the decisions that are made in each of the stages of MTO's planning and design process. Furthermore, the analysis of noise may be an iterative process where the results of one stage may necessitate review of the findings from a previous stage. Therefore, this guide has been prepared in a manner that integrates both the process and the technical analysis requirements.

Figure 4.1 illustrates the noise assessment process through the planning, preliminary design, detail design and construction stages.

Figure 4.1 Summary of Noise Analysis in MTO Planning and Design Process



5 QUALIFICATIONS

Noise analyses must be undertaken by a recognized Acoustical Specialist. An Acoustical Specialist must have demonstrated knowledge of pertinent Ontario noise policies and procedures as well as demonstrated expertise / experience in highway noise analysis and mitigation, and construction noise, from having completed at least three projects of similar scale and complexity for the Ontario Ministry of Transportation.

Furthermore, the application of these guidelines requires sound, experienced, professional judgement.

6 NOISE PREDICTION METHODOLOGIES

Noise prediction calculations must only be undertaken using noise prediction methodologies approved by the Ontario Ministry of the Environment (MOE) and MTO. As of 2006, there are two noise prediction methodologies approved by the MOE and MTO. These are described in Table 6.1. The Acoustical Specialist must document the rationale for the noise prediction methodology used.

Table 6.1 Description of Approved Noise Prediction Methodologies

Name	Description	Considerations for Appropriate Use
ORNAMENT	ORNAMENT (Ontario Road Noise Analysis Method) is a methodology that uses input that is general in nature and simple calculations. It has been modified for use on a personal computer using the STAMSON computer program. See Ontario Road Noise Analysis Method for Environment and Transportation, Technical Document, Ontario Ministry of the Environment, ISBN 0-7729-6376 (1989) for details.	o topography is not complex o noise level increases are expected to be less than 5 dBA o informal verification of the output from STAMINA 2.0.
STAMINA 2.0	STAMINA 2.0 is a computer program based on the United States Federal Highway Administration (FHWA) Highway Noise Prediction Model. It uses more complex calculations and requires more detailed input data.	o noise level increases greater than 5 dBA and mitigation is probable o detailed evaluation of various factors such as, topography, cuts and fills, alignment, grade is needed o Environmental Assessment bump-up requests are anticipated; and o ORNAMENT results indicate increases approaching or greater than 5 dBA.

7 TRANSPORTATION PLANNING – CORRIDOR AND ROUTE LOCATION ALTERNATIVES

During the selection of corridor or route location alternatives, efforts are to be made to locate corridors or route location alternatives that avoid or minimize impacts to existing Noise Sensitive Areas (NSAs) or lands that are zoned as future NSAs.

From Figure 4.1, the steps for Transportation Planning are:

- review and identify corridor or route location alternatives to avoid or minimize impacts to existing Noise Sensitive Areas (NSAs);
- identify study area/area of investigation;
- identify NSAs;
- determine future ambient and future noise levels with undertaking;
- identify impacts and significance;
- consider mitigation (preliminary);
- provide input into the analysis/evaluation process for the selection of the preferred alternative; and
- document the noise impact assessment in a Noise Report.

Note: the level of analysis and screening will depend on the complexity of the study and the range of alternatives being considered.

7.1 Area of Investigation

Where corridor or route location alternatives are located through or adjacent to existing NSAs, the area of investigation must be determined using one of the following methods:

- using 5 decibel contour lines extending from the source to a NSA where there is no increase above the future ambient sound level, or;
- a NSA where there is no increase above the future ambient sound level, or;
- a perpendicular distance of 600 m from the closest edge of pavement.

The rationale for determining the area of investigation must be documented in the Noise Report.

7.2 Noise Sensitive Areas (NSAs)

There is no minimum number of noise sensitive land uses that defines a Noise Sensitive Area (NSA). Therefore, all noise sensitive land uses, regardless of size or location (urban or rural), must be assessed for application of noise control measures. NSAs must be identified using current air photo/mapping, documented on a plan and confirmed through field review.

Where land has been developed for residential uses adjacent to an existing or planned Provincial Highway after February 8, 1977, the developer would have been required to prepare noise study reports as per the MOE requirements under the Planning Act and submit them to MOE or the designated authority under the Planning Act. Based on MOE requirements, the developer is responsible for ensuring that noise levels in the outdoor living area are consistent with the provincial objective of 55 dBA ten years after construction. In such cases, it is the responsibility of the developer to identify and implement indoor and outdoor noise attenuation (i.e. noise walls, air conditioning, forced ventilation, etc.). Even with noise attenuation measures, if the provincial objective of 55 dBA cannot be achieved ten years after construction, noise warning clauses are required on title of those properties affected. Accordingly, where corridor or route location alternatives are located through or adjacent to existing residential areas constructed after 1977, the Acoustical Specialist must determine if a noise study report was completed as part of the subdivision agreement. If so, the Acoustical Specialist must review the report to determine:

- if the noise calculations assumed that the proposed improvements to the Provincial Highway were in place;
- if their traffic assumptions were consistent with the traffic assumptions for the proposed improvements to the Provincial Highway; and
- if there are noise warning clauses on title at the adjacent residential houses.

Based on this review, the Acoustical Specialist must determine how the residential subdivision should be included in the acoustical assessment of the corridor or route location alternatives. The foregoing must be documented in the Noise Report.

7.3 Outdoor Living Area (OLA) vs. Most Exposed Side

In the past, noise levels for highways and freeways were calculated for the OLA (see Appendix A for definitions), where the receiver location is defined as 3 m from the back of the dwelling unit.

This guide introduces an additional requirement whereby the “most exposed side” of the dwelling unit of the NSA is to be assessed as part of an initial screening. This is

discussed in Section 7.7. The most exposed side refers to the closest side of the dwelling unit or NSA, even if there is no OLA associated with the most exposed side. Accordingly, the most exposed side includes all sides of the dwelling unit, not just the back of the building, whether or not there is an OLA. This rationale is to determine the noise level at the side of the dwelling unit most exposed to the highway or freeway without the benefit of shielding from the dwelling unit. The determination of the provision of mitigation, however, is based on the analysis of the predicted noise level at the OLA, which is typically the rear yard, and may include shielding from the building, where applicable.

7.4 Determination of Future Ambient

An acoustical assessment must be conducted to determine the future ambient noise levels. This assessment will involve the following:

1) A general review of the study area must be undertaken in terms of topography and land use. Any field services necessary must be conducted to produce the topographic contours necessary to operate noise prediction models.

2) Receiver locations must be determined for the NSAs at approximately 3 m away from dwelling unit wall at the most exposed side:
   - 1.2 m above ground;
   - where there is a continuous development of NSAs of a similar nature (e.g. residential subdivision), representative locations will be identified; and
   - where there are isolated NSAs, each will be considered individually.

3) Where an existing highway/roadway is the main noise source (i.e. noise level predictions can be done), a prediction methodology as approved by the Ontario MOE/MTO must be used to predict the future ambient, i.e. 10 years after the construction of the undertaking.

   It should be noted that the contribution from transient noise sources (e.g. rail, air, etc.) are typically excluded from the determination of the ambient. In special circumstances, should these sources be the dominant in duration as well as sound level, they should be considered on a project-by-project basis with confirmation with MTO and MOE. Where included, a methodology as approved by the Ontario MOE/MTO must be used for predicting train or air noise.

4) Where no dominant noise source currently exists or is projected to exist in the future (i.e. noise level predictions cannot be done):

- As a guideline, the following ambient sound levels will be assumed for the MOE Class 1-3 Areas as defined in Appendix A and MOE's *NPC-205* and *NPC-233*:
  - Class 1 Area (urban) - 55 dBA
  - Class 2 Area (suburban) - 50 dBA
  - Class 3 Area (rural) - 45 dBA

  MTO and MOE must confirm the assumed ambient sound level.

- Where necessary, the assumed ambient must be supported with noise levels measured in the field as a means to justify the levels selected. Nonetheless, it should be noted that field measurements can be inconsistent, unreliable and only represent a 'snapshot' with respect to a Leq(24hr) situation. Given this, MTO does not typically rely on field measurements. If noise measurements are undertaken, the following procedures must be adhered to:

  i. Identify study objectives followed by a site visit.

  ii. Study maps and other documentation and predict the existing and future sound levels to identify the area where the noise measurements should be taken.

  iii. Select measurement sites according to location category.

  iv. Select measurement times to include both peak and off-peak periods.

  v. Specify duration of measurements. The minimum duration of measurements required must be in accordance with MOE Publications NPC-103 & NPC-233.

  vi. Document the following:

  * name of Acoustical Specialist performing the measurements;
  * type of sound level instrumentation used;
  * date of calibration;
  * site of measurements;
  * date and time of day;
  * weather conditions (temperature, wind speed, wind direction, humidity, etc.);
  * traffic counts;
  * sound levels;
  * duration of measurements; and
  * any additional comments about the nature of audible sounds.

vii. Evaluate and check study findings by comparing measured and predicted results, if applicable.

viii. Request additional sound level measurements, if required.

5) Where there is continuous development of NSAs of a similar nature (e.g. residential subdivision), noise contours must be plotted in increments of 5 dBA, e.g., 45 dBA, 50 dBA, 55 dBA, 60 dBA, etc.

7.5 Determination of Future Noise Levels with the Undertaking

An acoustical assessment is to be undertaken; using a prediction methodology as approved by MOE/MTO, to predict future noise levels after the undertaking is constructed. The following are required for the assessments:

1) Predicted future noise levels must be determined for 10 years after the undertaking is constructed at the most exposed side of the dwelling unit using the following data (where data is not available, use the best available data):
   - Vehicle speeds used in the evaluation of impacts shall be the posted speed limits.
   - The higher of Annual Average Daily Traffic (AADT) or Summer Average Daily Traffic (SADT) as determined by a recognized traffic analyst must be used.
   - The forecasting of future traffic volumes for freeways and highways within a high-density urban area (e.g. City of Toronto) should be based on the ultimate capacity of the roadway, as new or expanded freeways and highways within a high-density urban area typically operate at or near capacity once construction is completed. The forecasting of future traffic volumes for freeways and highways outside of a high-density urban area (e.g. rural environment) must be determined for 10 years after the construction of the undertaking. The forecasting of future traffic volumes must be confirmed by a recognized traffic analyst.
   - Traffic volumes for freeways must be based on a 24-hour period. Traffic volumes for all other classes of highways and arterial roads must be based on a 16-hour period.
   - Commercial vehicle percentages should be based on traffic data provided by a recognized traffic analyst. Where data is not available, the following will be assumed:
     - commercial vehicle percentage for freeways should be assumed to be 20% (15% heavy trucks and 5% medium trucks);
     - for all other classes of highways, the percentage is 13% (8% heavy trucks and 5% medium trucks); and

- for arterial roads, truck percentages should be obtained from the local road authority.

2) Predicted future noise levels must be compared with the undertaking 10 years after construction to the future ambient to determine if there are any noise level changes and, if so, what they are.

3) Where there is continuous development of NSAs of a similar nature (e.g., residential subdivision), noise contours must be plotted in increments of 5 dBA, e.g., 45 dBA, 50 dBA, 55 dBA, 60 dBA, etc.

Inclusion and assessment of stationary sources associated with MTO's transportation facilities (i.e., truck inspection stations, maintenance yards, travel plazas, etc.) must be discussed with MTO and MOE. The following should be applied when reviewing the impact of these types of facilities adjacent to a NSA:

- If the stationary source is part of the transportation construction project, then the sum of the stationary source and the undertaking will be assessed (i.e. future ambient noise level without the undertaking vs. future noise level with the undertaking and stationary source).
- If the stationary source is constructed after the transportation undertaking, then the stationary source will be assessed with the undertaking (i.e. future noise level with the undertaking vs. future noise level with undertaking and the stationary source).
- If a maintenance yard, etc., is constructed away from the undertaking (i.e., on an arterial road with access to the highway), then the stationary source will be assessed independently.

The assessment of stationary sources must follow *MOE's NPC-205* and *NPC-232*.

7.6 Determination of Potential Impact

1) The future ambient must be compared to the noise level for the undertaking projected 10 years after construction at the most exposed side of the dwelling unit. Where roadways that affect the future ambient are present, the impact must be determined by comparing the noise levels for the undertaking projected 10 years after construction, with the future ambient levels also projected to that date.

2) Where contours have been developed, the predicted future noise level contours should be superimposed on the future ambient level contours. Where specific receivers are considered, the predicted future noise level with the undertaking must be compared to the future ambient noise level.

3) The absolute levels and noise level increases must be documented in a summary table. Table 7.1 is an example.

Table 7.1 Sample Summary Table of Future Noise Levels with and without Proposed Undertaking

			Alternative 'X'		Alternative 'Y'	
Receiver Location	**No. of Noise Sensitive Land Uses**	**Year 'Z' Ambient**	**Year 'Z' L_{eq} (24 hr)**	**Change due to undertaking**	**Year 'Z' L_{eq} (24 hr)**	**Change due to undertaking**
1	20	50.2 dBA	60.8 dBA	+10.6 dBA	63.3 dBA	+13.1 dBA
2	1	55.4 dBA	60.5 dBA	+5.1 dBA	65.8 dBA	+10.4 dBA

Year 'Z' - 10 years following projected opening of the highway

7.7 Determination of Significance

The term significance is meant to be the level at which MTO begins determining whether or not the provision of noise mitigation requires investigation. The significance of highway noise must be decided for each NSA that is expected to experience increases in the absolute noise level over 45 dBA ten (10) years after construction. They must be grouped as follows:

- 45.0 to 49.9 dBA,
- 50.0 to 54.9 dBA,
- 55.0 to 59.9 dBA,
- 60 to 64.9 dBA,
- etc.

The study must include a comparison of the alternatives and an assessment of impacts. As such, the NSA's are to be grouped by predicted noise level increases into the following:

- 0 to 5.0 dBA
- 5.1 to 10.0 dBA
- 10.1 to 15.0 dBA, and
- > 15.1 dBA.

Similar groupings documenting sound level reductions must also be identified (i.e., –5.0 to –0.1 dBA). This assessment is the basis for the determination of impact significance. Mitigation efforts to be applied for various noise level increases are outlined in Section 2.1.

7.8 Preliminary Assessment of Mitigation

Figure 7.1 summarizes the basic process for the assessment of noise mitigation based on the most exposed side vs. OLA for NSAs.

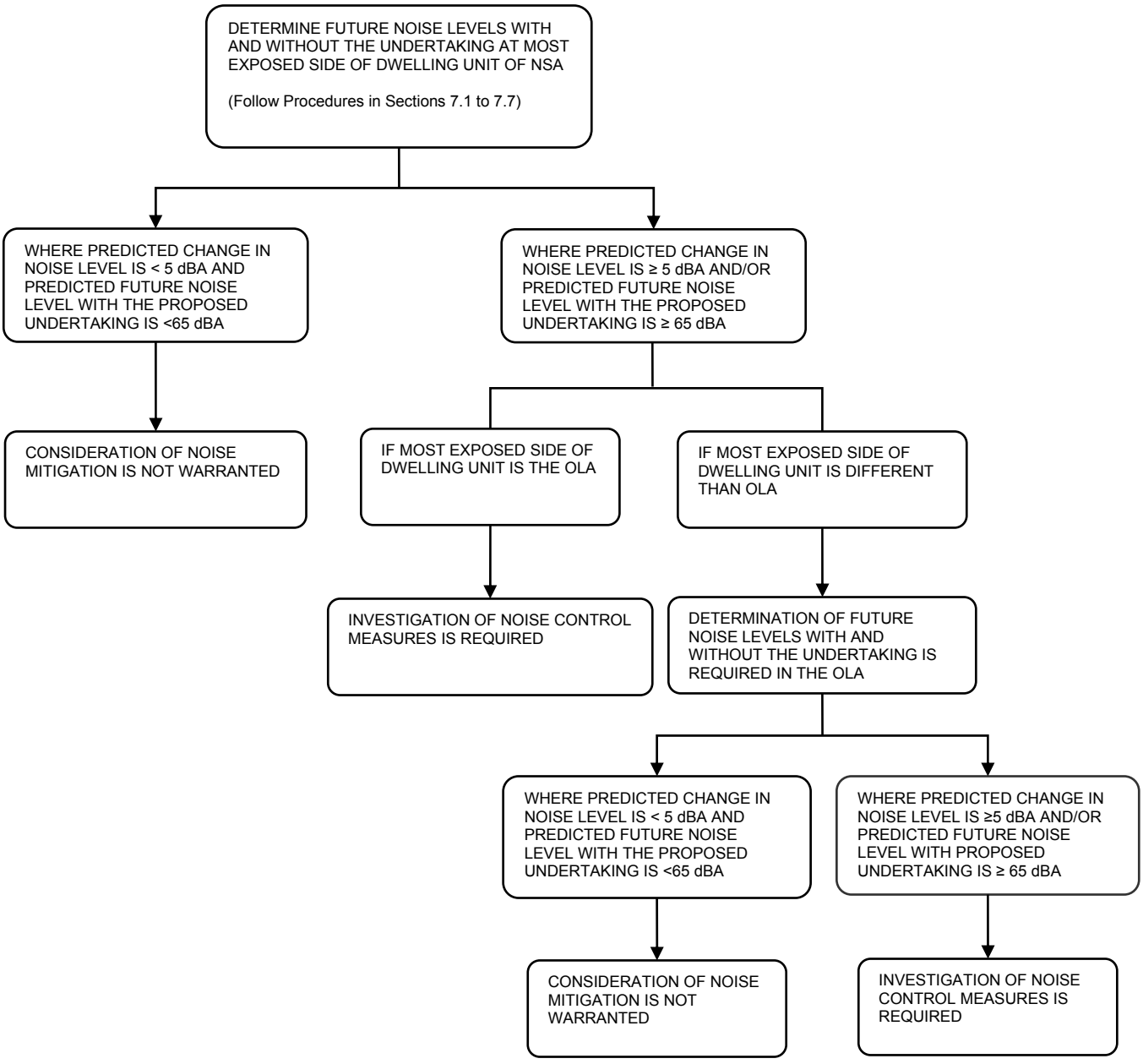
Where predicted noise increases above the ambient are less than 5 dBA and projected noise levels are less than 65 dBA, the consideration of the provision of mitigation is not required.

Where the future noise level with the proposed improvements at the most exposed side result in a greater than 5 dBA increase over the future noise level without the proposed improvements; or the projected noise level is equal to or is greater than 65 dBA, the future noise level must be predicted in the OLA to determine the significance of the noise impact.

Where the future noise level with the proposed improvements in the OLA result in a greater than 5 dBA increase over the future noise level without the proposed improvements; or the projected noise level is equal to or is greater than 65 dBA, the following must occur:

- noise control measures must be investigated within the right-of-way;
- if a minimum attenuation of 5 dBA can be achieved in the OLA averaged over first row receivers, the selected measures within the right-of-way are to be implemented.

Figure 7.1 Preliminary Assessment of Mitigation



* This figure summarizes the basic process, however, the assessment of mitigation has to be read in conjunction with sections 7.1 to 7.7 in the Noise Guide, which includes the detailed requirements

On right-of-way mitigation measures are to be identified, considered and implemented where warranted. Mitigation measures within the right-of-way include: acoustical barriers, berms, vertical and horizontal alignments, pavement surfaces, etc.

Mitigation must attempt to achieve levels as close to, or lower than, the objective level (i.e., future predicted ambient without the proposed improvements) as is technically, economically, and administratively feasible.

The determination of whether or not mitigation is provided is based on the review of technical, economical and administrative feasibility while considering the existing and projected noise levels, the predicted noise level decreases and the number of benefiting receivers.

The review of technical, economic, and administrative feasibility of providing mitigation is based on the following:

- **Technical Feasibility:** Review the constructability of the noise mitigation (i.e., design of wall, roadside safety, shadow effect, topography, achieve a 5 dBA reduction, ability to provide a continuous barrier, etc.).
- **Economic Feasibility:** Carry out a cost/benefit assessment of the noise mitigation (i.e., determine cost per benefited unit).
- **Administrative Feasibility:** Determine the ability to locate the noise mitigation on lands within public ownership (i.e., provincial or municipal right-of-way).

At this stage, mitigation is considered in the broadest sense, i.e.:

- alignment;
  - vertical
  - horizontal
- pavement types
- barriers
  - earth berms
  - walls

If new noise barriers need to be designed, acoustical recommendations for noise barrier design alternatives must be provided including recommendations for noise barrier heights and lengths. A minimum of one receiver per three homes is the typical standard to determine the best noise barrier design.

The acoustical recommendations must also include a cost analysis of the noise mitigation alternatives (i.e., providing noise barriers vs. changes in grade and/or alignment).

7.9 Aesthetic Considerations

Potential visual impacts associated with noise control measures should be reviewed. The feasibility of non-structural mitigation planning alternatives (e.g., lowering the grade or alignment shifts away from the sensitive land uses) should also be examined to mitigate noise/visual impacts. If these planning alternatives are feasible, there is significant aesthetic benefit in the elimination of the need for structural noise control and the associated need for visual impact mitigation.

7.10 Documentation

The Noise Report is to include, as a minimum, the following:

- a description of the NSAs (usually identifying discrete receiver locations);
- a map illustrating the location of the NSAs and receiver locations;
- the name of the noise prediction model used;
- results of existing ambient and future noise level predictions at NSAs for each route alternative (if more than one);
- a table identifying project impacts;
- where the consideration of mitigation is required, the Noise Report must include a discussion of mitigation measures including needs, cost/effectiveness, applicability to the project, and construction timing. The practicability of each measure must be evaluated by such factors as the effectiveness of the mitigation (i.e., predicted noise level decrease), and technical, economic and administrative feasibility (see Sub-section 7.2); and
- an analysis of construction noise impacts and project requirements including the following:
    - location and number of NSAs;
    - identification of municipal noise control bylaws;
    - need to obtain noise bylaw exemptions as required by MTO;
    - an explanation of any hardships to the project caused by municipal noise control bylaws; and
    - the construction noise complaint process.

8 HIGHWAY DESIGN - PRELIMINARY DESIGN

From Figure 4.1 the steps for Preliminary Design are:

- for projects entering from the planning stage:
  - confirm the preliminary recommendations from the planning stage;
  - reflect any significant changes to the horizontal or vertical alignment(s) in the preliminary design stage;
- for projects commencing in the preliminary design stage, carry out a noise impact assessment following the process described in the planning stage;
- review mitigation in greater detail based on the preliminary design of the preferred plan;
- address construction noise; and
- document.

8.1 Projects Entering from Planning Stage

Following the selection of a preferred alternative in the planning stage, the preliminary design stage will include assessing:

i) the route alignment alternatives; and

ii) the preferred alignment in more detail.

For projects entering the preliminary design stage from the planning stage, varying levels of noise analysis will already exist. If a noise analysis has been completed and mitigation has been recommended, then, during the preliminary design stage, the objective will be to undertake the analysis in more detail in order to:

- confirm the preliminary recommendations from the planning stage;
- reflect any horizontal or vertical alignment adjustments that may occur during the preliminary design stage; and
- detail the effects and mitigation requirements, if any.

The degree of accuracy required for predicting future levels at this stage is greater than that for the planning stage. Typically, STAMINA 2.0 is used for the detailed evaluation of various factors such as complex topography, cuts and fills, alignment, grade and mitigation. The methodology will be the same as followed during the planning stage of the study (see Section 7).

In those cases where the topography is simple, the changes in sound level are below the range of impact and there are no significant engineering changes, then the Acoustical Specialist must determine whether or not the planning analysis will suffice and document the rationale.

8.2 Projects Commencing in Preliminary Design Stage

For projects commencing in the preliminary design stage (i.e., reconstruction / widening of existing facilities), there will likely be no previous noise analysis available and so the process for planning stage must be followed as described in Section 7. In summary, this must include:

- identification of area of investigation;
- identification of noise sensitive areas;
- determination of future ambient;
- determination of future noise levels with the undertaking;
- determination of potential impact;
- determination of significance; and
- assessment of mitigation.

In those cases where topography is less complex and it is apparent that the levels are below the range of impact, ORNAMENT should be sufficient. Where a detailed evaluation of various factors such as topography, cuts and fills, alignment, grade, and where noise level increases greater than 5 dBA are expected, STAMINA 2.0 should be used. The Acoustical Specialist must document the rationale for the noise prediction methodology used.

8.3 Mitigation Considerations

If acoustical barriers are required, the potential negative visual impact should be reviewed by the specification of appropriate barrier types, and the proper control of their configuration. The Acoustical Specialist must evaluate and document the following:

- the feasibility of the use of earth berms and berm/walls as alternatives to barrier walls;
- the aesthetic merits of each alternative treatment (i.e., berm, berm/wall, wall) based on the overall visual environment of the area;
- the potential impact of each alternative treatment on the existing vegetation and other landscape features; and
- the feasibility of mitigation measures pertaining to each alternative treatment (i.e., in the case of wall treatment, the suitability of colour, texture, pattern control).

8.4 Construction Noise

During the Environmental Assessment process, the following must be undertaken with regard to construction noise:

1) NSAs must be identified during the project planning stage;

2) Potential noise impacts of construction equipment on NSAs must be identified. These might include impacts resulting from hours or type of operation or proximity of equipment;

3) Potential mitigation of noise impacts from construction equipment must be identified. These might include measures such as timing constraints, setbacks of certain operations from NSAs, or quieter equipment;

4) The technical and economic feasibility of various alternatives must be evaluated in order to select the appropriate construction noise control measures;

5) Municipal noise control bylaws must be reviewed for requirements that may cause hardship to the project. This can be a particular problem when the need for night construction work is identified; and

6) In certain situations, a contract may require work that is in contravention of a municipal noise control bylaw. In these cases, an exemption must be obtained from the municipality before construction. If the exemption is not obtained, the construction project may not proceed in a manner that is in contravention of the bylaw.

8.5 Documentation

If there are no NSAs located within the area of investigation and no noise analysis was carried out, then the rationale for not undertaking noise analysis must be documented in the Environmental Assessment documentation (i.e., Transportation Environmental Study Report, Design and Construction Report, etc.).

If noise analysis was carried out, the work in Section 8 must be documented in a Noise Report that includes, as a minimum, the following:

- a description of the NSAs (usually identifying discrete receiver locations) including maps as appropriate;
- the name of the noise prediction model used;
- results of existing ambient and future noise level predictions at NSAs for each route alternative (if more than one);
- a table identifying project impacts;

- where the consideration of mitigation is necessary, the report must include a discussion of mitigation measures including needs, cost/effectiveness, and applicability to the project and construction timing;
- the practicability of each measure evaluated by such factors as the effectiveness of the mitigation (i.e. predicted noise level decrease), and technical, economic and administrative feasibility; and
- an analysis of construction noise impacts and project requirements including the following:
    - location and number of NSAs;
    - identification of municipal noise control by-laws;
    - the need to obtain noise bylaw exemptions;
    - an explanation of any hardships to the project caused by municipal noise control bylaws; and
    - the construction noise complaint process.

Environmental Assessment documentation must state that, where work is done by contract, enforcement of noise control bylaws is the responsibility of the municipality.

Special Provisions dealing with construction noise and vibration must be included in the contract package as applicable.

8.6 Conditions of EA Approval Pertaining to Noise

During the review and approval of and Individual Environmental Assessment, MOE may impose Condition(s) of Approval for noise. If this occurs, the following are required:

1. the requirements of the Condition of Approval must be addressed;
2. methodology and results must be documented in an Acoustical Report explaining how the Condition of Approval has been addressed; and
3. the Noise Report must be submitted to MOE for review and comment.

Upon review and approval, a formal letter from MOE confirming that the conditions have been met is required before proceeding with project implementation.

9 HIGHWAY DESIGN - DETAIL DESIGN

From Figure 4.1, the steps for Detail Design are:

- confirm or undertake additional noise analysis of mitigation measures, if required;
- address requirements of MOE Conditions of Approval if required;
- acoustically design the barrier, identifying location, height, offset, aesthetics and recommended special provisions, if applicable; and
- provide acoustical recommendations for mitigation and general construction measures for preparation of the contract package;

Where an acoustical analysis has not been carried out in the previous stages, the process for the planning stage must be followed as described in Section 7.

9.1 Mitigation

Where a noise analysis has been previously done and noise mitigation is recommended, a noise analysis must be done during the detail design stage to:

- determine the most cost-effective manner in which the noise mitigation can be achieved; and
- respond to any Environmental Assessment commitment.

Any Condition(s) of Approval required by MOE for noise must be addressed (see Section 8.6).

Where mitigation is required, the following must be reviewed, where applicable:

- horizontal and vertical alignment;
- pavement type; and
- barriers.

9.1.1 Horizontal and Vertical Alignment

The horizontal alignment is reviewed to determine the feasibility and cost-effectiveness to locate the proposed facility to avoid NSAs or increase the distance between source and receiver.

The vertical alignment is reviewed to determine the feasibility and cost-effectiveness to shift the vertical profile to reduce noise levels by affecting the line of sight between the source and the receiver. For example, depressing the highway can provide excess material for construction of berms and/or a buffering effect from the natural ground line. The feasibility of shallow cuts to provide berming material should be reviewed.

The geometric design of the highway often affects the operation of vehicles travelling it. In areas of dense residential land use, design elements, including but not limited to the following, are to be reviewed:

- maximization of radii for curves of ramps, lengths of acceleration and deceleration lanes, and length of weave sections;
- minimization of steep upgrades on interchange ramps and long grades;
- location of “on-ramps” on downgrades and “off ramps” on upgrades to improve acceleration and deceleration characteristics;
- selection of appropriate pavement type (see Sub-section 9.1.2 for discussion); and
- placement of highway service facilities (i.e. truck inspection stations, service centres, patrol yards, etc.) away from NSAs.

9.1.2 Pavement Type

Pavement mix designs (i.e. open graded friction course or OFC) that reduce noise levels produced by the interaction of the tires with the pavement surface are to be reviewed to determine their cost-effectiveness.

9.1.3 Rumble Strips

Noise created by longitudinal rumble strips occurs infrequently since the rumble strips alert drivers when they leave the travel lane. Noise created by transverse rumble strips occurs more frequently since these strips are located on the travel lane. The use of longitudinal or transverse rumble strips is to be reviewed to determine their safety benefit and noise impact at adjacent noise sensitive areas. The justification for either installing or eliminating rumble strips or eliminating them along roadway sections immediately adjacent to NSAs must be documented in the Noise Report.

9.1.4 Barrier Recommendations

The required location, height, length, absorbency and aesthetics of the noise barrier must be recommended. A number of noise barrier options may be identified. Once the noise barrier design options are identified on the site plan, noise analysis must be undertaken using prediction methodology approved by the MOE/MTO. Upon determining a recommendation, the barrier location and height, colour, barrier absorbency and any specialized barrier treatments or specifications must be identified and documented.

Recommended noise barrier designs (i.e. type of noise wall) must be included on the list in MTO's Designated Sources for Materials Manual.

9.1.4.1 Barrier Aesthetics

If earth berms or berm/wall combinations are proposed, recommendations must include but are not limited to:

- aesthetically sensitive grading design of the berms (e.g. variable side slopes, meandering alignment, contoured grading, etc.);
- landscaped planting of trees and shrubs and special ground cover vegetation for the berms suitable for the site conditions such as type of fill, prevailing winds, existing visual and natural environment, compliance with roadside safety etc; and
- transitional treatment to visually blend in the berm and wall combinations and end treatments.

If walls are the selected acoustical treatment, recommendations must include:

- general controls on material, colour, texture, patterns, etc;
- retention of existing vegetation adjacent to the barrier alignment;
- post construction landscape development where feasible to complement, soften or screen the walls; and
- special graphic design to provide visual relief of negative, monotonous effects and/or eliminate potential claustrophobic effects of barriers.

9.1.4.2 Maintenance Considerations

Maintenance issues that are to be taken into consideration in the design of the barrier include:

- maintaining accessibility for maintenance activities (i.e. noise wall repair, landscaping, etc.);
- locating barrier to avoid shading of roadway and shoulder for winter maintenance ice control;
- avoiding barrier gaps which might create snow drift problems;
- locating the barrier as far from the shoulder as possible to provide optimum space for snow storage and to eliminate the need for hand removal of winter sand along the guide rail; and
- if berms are built, providing desirable slopes of 3:1 or flatter for right-of-way maintenance.

9.2 Construction – Contract Preparation

General construction measures, setbacks from NSAs, timing constraints, or specific scheduling of construction activities including preconstruction of noise barriers, where required and where practical, must be included in the contract documents. The NSAs must be identified in the contract package using SP 199F33. See MTO's *Environmental Reference for Contract Preparation*.

When known before contract preparation, the details of any exemption from any municipal noise control bylaw must be outlined in the contract documents using SP 199F31.

Special Provisions 199F31 and 199F33, which are to be placed in contract documents, must be taken from the Contract Preparation System (CPS).

10 CONSTRUCTION

The noise mitigation measures for construction activities are specified in design and included in the contract documents (see Sub-section 9.2). During construction, these measures and a process to manage noise complaints are implemented and enforced.

10.1 Construction Noise Complaint Process

Despite compliance with any noise control measures identified in the contract documents, a persistent complaint must require a field investigation to determine noise level emissions. If noise level emissions for the construction equipment in use exceed the sound level criteria for construction equipment contained in the MOE Model Municipal Noise Control Bylaw, MTO requires the contractor to comply with the sound level criteria where quieter alternative equipment is reasonably available.

11 OPERATIONS AND MAINTENANCE NOISE

The main noise issues/concerns relating to highway operations are addressed during the planning and design stages so that potential impacts are identified and addressed as required prior to actual operation. Major repairs are usually addressed as part of a construction project. Therefore, the relevant construction provisions would apply.

MTO's policy regarding the retrofitting of existing freeways and highways is documented in Appendix B.

12 COMPUTER DATA MAINTENANCE

Ongoing computer data maintenance is required during the course of, and, following the completion of the study in order to:

- permit ease of information retrieval;
- provide required background support data to calculations included in the Noise Report; and
- allow for the retention of data which may be required many years following the completion of the study, for example, for an Environmental Assessment Board hearing.

At the completion of the study, all computer files must be provided to MTO.

APPENDIX A: Definition of Key Terms

See Separate File

APPENDIX B: Noise Barrier Retrofit Policy

See Separate File

MINISTRY OF TRANSPORTATION

APPENDIX A: Definition of Key Terms

Environmental Guide for Noise

Version: October 2006

VERSION HISTORY

VERSION #	DATE	DESCRIPTION OF MAJOR CHANGE

Acoustical Barriers: means walls, berms and combinations of the two, which are effective in reducing sound levels.

Acoustical Specialist: means one who has demonstrated knowledge of pertinent Ontario noise policies and procedures as well as demonstrated expertise / experience in highway noise analysis and mitigation, and construction noise, from having completed at least three projects of similar scale and complexity for the Ontario Ministry of Transportation.

Adjacent: means those Noise Sensitive Areas (NSAs) lying near highway rights-of-way, although not necessarily contiguous to them. An intervening land use may be located between the source and receiver, if that land use is such that its zoning or official plan designation is anticipated to prevent a change in the future to a use which, in itself, will be a barrier to noise.

Aesthetics: means recognition of the sensitivity of the interaction between the highway and the surrounding landscape.

Ambient Noise Level: means the total sound which is associated with and representative of a given environment and includes all natural and man-made sound from many sources (i.e., existing highways and roadways, industries, etc.) both near and far. It is the noise level prior to construction of an undertaking.

In areas with existing residential development, ambient noise level is the predicted level due to existing highways and major roadways using an approved noise prediction model.

For rural areas, where there is no dominant noise source (i.e. where predictions cannot be done), the ambient or background sound level may be assumed to be 45 dBA (Leq 24 hr). Where necessary, assumed ambient sound levels, shall be supported with field measurements of existing ambient sound levels. All measurements must be conducted in accordance with procedures outlined in the MTO Noise Guide and MOE NPC-103/NPC-233 measurement guidelines.

The contribution from transient noise sources (e.g. rail, air, etc.) are typically excluded from the determination of the ambient. In special circumstances, should these sources be the dominant noise source in duration as well as sound level, they should be considered on a project-by-project basis with confirmation with MTO and MOE. Where included, a methodology as approved by the Ontario MOE/MTO will be used for predicting train or air noise.

Class 1 Area: means an area with an acoustical environment typical of a major population centre, where the background noise is dominated by the urban hum.

Class 2 Area: means an area with an acoustical environment that has qualities representative of both Class 1 and Class 3 Areas, and in which a low ambient sound level, normally occurring only between 23:00 and 07:00 hours in Class 1 Areas, will typically be realized as early as 19:00 hours.

Other characteristics which may indicate the presence of a Class 2 Area include:

- absence of urban hum between 19:00 and 23:00 hours;
- evening background sound level defined by natural environment and infrequent human activity; and
- no clearly audible sound from stationary sources other than from those under impact assessment.

Class 3 Area: means a rural area with an acoustical environment that is dominated by natural sounds having little or no road traffic, such as the following:

- a small community with less than 1000 population;
- an agricultural area;
- a rural recreational area such as a cottage or a resort area; or
- a wilderness area.

Decibel Scale: means a linear numbering scale used to define a logarithmic amplitude scale, thereby compressing a wide range of amplitude values to a small set of numbers. This system is used to compress sound pressure levels. The scale is often weighted using the "A" weighting frequency adjustments because it most closely approximates the frequency response of the average human ear.

dBA: means 'A-weighting' or 'dBA-scale', which is considered to be an accurate approximation of noise perceived by the average human ear.

First Row Receivers: means those adjacent receivers where noise level differences are imperceptible (within 3 dBA) from the receiver experiencing the highest noise levels.

Freeway: means controlled access median divided highway facility with grade separated crossings and interchanges (i.e. QEW and 400 series highways).

Future Ambient: means the ambient noise level projected 10 years after construction without the proposed undertaking.

For rural areas, where there is no dominant noise source (i.e. where predictions cannot be done), the ambient sound levels may be assumed as discussed in Section 7.5 of this Guide. Where necessary, assumed ambient sound levels shall be supported with field measurements of existing ambient sound levels. All measurements shall be conducted in accordance with procedures outlined in the Section 7 of this Guide and MOE's *NPC-103* and *NPC-233* measurement guidelines.

Future Noise Levels: means those sound levels (L_{eq} (24 hr) that are based on traffic volumes for a time period at least 10 years after the completed construction of the undertaking. The higher of the Annual Average Daily Traffic (AADT) or Summer Average Daily Traffic (SADT) is used.

Highway: means roadway under the jurisdiction of MTO including King's highways, secondary highways and tertiary roads. This includes all components within the associated right-of-way, e.g. structures, drainage works, traffic and safety devices.

Highway Undertaking: means the planning, design and construction of a new highway or highway improvement which can include widenings, realignments, etc.

Mitigation Measures: means measures that are designed to result in reduced noise levels in Noise Sensitive Areas (NSAs). These measures include walls, berms, adjustment to horizontal and vertical alignments and pavement types, which are designed to result in reduced noise levels in NSA's.

Noise Level (Leq 24 hour): means the 24 hour equivalent sound level (L_{eq} 24 hr) expressed on the A-weighted decibel scale (dBA). L_{eq}(24 hr) is used because it is a widely accepted descriptor of community noise for freeways and since traffic volumes are usually available for that period of time.

Noise Level (Leq 16 hour): means the 16 hour equivalent sound level (Leq 16 hr) for the time period 7:00 a.m. to 11:00 p.m. expressed on the A-weighted decibel scale (dBA). Leq (16 hr) is used for other classes of highways than freeways and for arterial roadways because these roadway classes typically have a distinct difference in traffic volumes between the daytime (7:00 a.m. to 11:00 p.m.) and night-time (11:00 p.m. to 7:00 a.m.)

Noise Sensitive Areas (NSAs): means the following land uses, with an Outdoor Living Area (OLA) associated with them:

- Private homes such as single family residences (owned or rental)
- Townhouses (owned or rental)
- Multiple unit buildings, such as apartments with OLA's for use by all occupants
- Hospitals, nursing homes for the aged, where there are OLA's for the patients

There is no minimum number of land uses that defines a NSA. Therefore, all noise sensitive land uses, regardless of size or location (urban or rural), will be assessed for application of noise control measures.

Where a new freeway/highway corridor or route is planned, the following land uses would qualify as NSAs in addition to the land uses noted above:

- Educational facilities and day care centres, where there are OLA's for students
- Campgrounds that provide overnight accommodation

- Hotels / motels where there are OLA's (i.e. swimming pool area, etc.) for visitors

NSA's must have an OLA.

Land uses listed below, by themselves do not qualify as NSA's:

- Apartment balconies above ground floor
- Churches
- Cemeteries
- Parks and picnic areas which are not inherently part of a NSA
- All commercial
- All industrial

Outdoor Living Area (OLA): means an area at ground level, adjacent to a NSA and accommodating outdoor living activities. This area may be situated on any side of the NSA. The usual distance from the dwelling unit wall is 3 m. The vertical height is 1.2 m above the existing ground surface. Where unknown, the side closest to the highway should be assumed. Paved areas for multiple dwelling residential units may not be defined as an OLA.

Significant Noise Impact: means the basis established in the Ontario MTO/MOE Noise Protocol for determining whether or not the provision of noise mitigation requires investigation. This term 'significance' does not have the same meaning as the term 'significant adverse environmental effect' as defined by the Canadian Environmental Assessment Act.

MINISTRY OF TRANSPORTATION

APPENDIX B:

NOISE BARRIER RETROFIT POLICY

Environmental Guide for Noise

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VERSION HISTORY

VERSION #	DATE	DESCRIPTION OF MAJOR CHANGE

Policy

On February 8, 1977, the Ministries of Housing (now Ministry of Municipal Affairs and Housing) and Transportation and Communications (now Ministry of Transportation (MTO)) jointly released a policy statement regarding noise associated with major freeways. On May 29, 1979, the Ministry of Housing released a supplementary guideline for noise on behalf of the Government.

In keeping with Government policy, MTO developed a Retrofit Noise Barrier Program to alleviate noise impacts on existing noise sensitive areas adjacent to existing freeways. This policy is based on the principle that existing Noise Sensitive Areas (NSAs) exposed to high noise levels due to their proximity to a freeway should receive some consideration. Similarly, to avoid future noise problems, developers must design new residential areas in an acoustically sensitive manner in accordance with the guidelines issued by the Ministries of Municipal Affairs and Housing and Environment and in consultation with the affected municipality.

It is not the intent of the retrofit program to provide noise barriers at all sites on the Candidate Sites for Noise Barrier Retrofit List. Some sites may not be constructed for a number of reasons such as the inability to achieve perceptible attenuation, excessive costs to provide mitigation for a few homes, or physical limitations. Full implementation of this policy is dependent upon budget allocations and subject to prioritization of candidate sites.

1. NSAs for Retrofit

   a) NSAs shall be interpreted to mean areas that are either:

   - Adjacent to existing freeways and are existing residential areas where approvals were received under the *Planning Act* prior to February 8, 1977. Except as noted below, residential developments approved after the announcement in 1977 of the policy for noise and new residential developments adjacent to freeways do not qualify;

   - Adjacent to new freeways and are existing residential developments where approvals were received under the *Planning Act* prior to the designation of the proposed freeway route under the *Public Transportation and Highway Improvement Act*; or

   - Adjacent to expanding freeways and are existing residential developments where approvals were received under the *Planning Act* prior to the implementation of the highway expansions and where noise control measures were not required at the time of highway construction.

b) The majority of the residences in the area must be zoned as residential and taxed as principal residences to ensure that funds are directed to areas of greatest need (i.e. principal residences).

c) There is no minimum number of residences that define a NSA. Therefore, all noise sensitive land uses, regardless of size or location (urban or rural), should be assessed for application of noise control measures.

d) Discretion should be exercised for situations where there is a potential for the zoning to be changed from a noise sensitive land use to a non-sensitive land use.

e) NSAs must have an Outdoor Living Area (OLA) associated with the residential unit (see Appendix A).

f) The following land uses, with OLAs associated with them would qualify as NSAs under the above criteria:

- Private homes such as single-family residences;
- Townhouses;
- Multiple unit buildings, such as apartments with OLAs for use by all occupants; and
- Hospitals, nursing homes for the aged, where there are OLAs for the patients.

g) Land uses listed below, by themselves do not qualify as NSAs:
- Apartment balconies above ground floor;
- Educational facilities (except dormitories with common OLAs);
- Churches;
- Cemeteries;
- Parks and picnic areas that are not inherently part of a NSA;
- Day care centres;
- All commercial;
- All industrial.

2. Candidate Site

This includes NSAs, which meet the criteria for inclusion on the Candidate Sites for Noise Barrier Retrofit List. This does not necessarily mean that the site will satisfy all warrants for noise barrier construction.

3. Retrofit Barrier Site

This includes barrier candidate sites that satisfy all warrants for construction and therefore qualify for inclusion on the capital construction program when priorities dictate and funds become available.

4. Noise Level

a) Noise levels are the 24-hour equivalent sound level ($L_{Aeq\ 24\ hr}$) expressed on the A-weighted decibel scale (dBA).

b) Noise predictions will be calculated using the United States Federal Highway Administration (FHWA) Noise Prediction Model. The Ministry does not rely on the use of noise measurements for the reasons set out in Section 4.3.1.3. The Ministry accepts the following computerized models:

- STAMINA 2.0,
- Traffic Noise Model (TNM©), Version 2.5
- Stamson©, Version 5.0, or
- other versions or programs subsequently approved for use by the Ministry.

c) When setting retrofit barrier priorities and undertaking noise barrier design the traffic volume shall be the higher of the Average Annual Daily Traffic (AADT) or Summer Average Daily Traffic (SADT) volume.

d) Vehicle speeds used in the evaluation of impacts shall be the posted speed limits.

e) Commercial vehicle percentage shall be those available from Regional Traffic Sections/Offices. Where unknown, the percentage can be assumed to be 20% (15% heavy trucks and 5% medium trucks).

f) Receivers shall be located in the OLA.

5. Selection of Candidate Sites

a) The Ministry shall consider retrofit noise control measures for existing freeways where NSAs receive noise levels in excess of 60 dBA $L_{Aeq24\ hr}$, if such measures can reduce the noise levels by at least 5 dBA averaged in the first row.

b) A benefit/cost analysis will be carried out for all candidate sites and will be used to establish a priority listing. The analysis will account for the absolute sound level, noise barrier insertion loss, number of NSAs and the barrier cost.

c) Sites will be selected for inclusion on the multi-year capital construction program primarily on a priority basis.

d) Retrofit barriers should be scheduled as part of another capital construction project only where there is a significant cost savings or where a serious construction problem is avoided. Only sites, which are already on the multi-year capital construction program, should be considered for possible inclusion with another project.

6. Mitigation Standards

a) The objective is to reduce noise levels as much as is technically and economically practicable towards the provincial noise level objective of 55 dBA.

b) Noise barriers must achieve a minimum barrier insertion loss of 5 dBA averaged in the first row NSAs.

c) Noise barrier retrofit sites approaching or exceeding 70 dBA, should be designed to provide additional attenuation, where technically feasible, and not economically prohibitive.

d) When designing noise control measures, input on aesthetic treatments should be sought from the Regional Environmental Units/Offices. Consideration should be given to aesthetic impacts when considering increases in barrier height.

7. Parallel Barriers

When it can be shown that a barrier will cause detrimental noise reflections to the opposing side of the highway, then the parallel sites should be constructed at the same time. Otherwise, barriers should be built in priority sequence. To reduce reflections, consideration should be given to specifying the use of absorptive noise barrier materials.

8. Reconstruction/Maintenance of Barriers

a) Previously constructed Ministry noise walls and additional walls on existing berms, will be reprioritized when the following criteria are met:
   i) an existing barrier did not achieve a 5 dBA attenuation averaged over first row NSAs;
   ii) there is a serious existing problem;
   iii) there is ongoing public concern;
   iv) a new barrier could reduce noise levels by an additional 3 dBA (over existing conditions) averaged over first row NSAs; and
   v) all other warrants can be met.

b) When a barrier is to be completely rebuilt it shall be designed and constructed to current Ministry standards for noise barriers. Prior to reconstruction, an acoustical analysis must be conducted to determine the most effective location and height of the new barrier.

c) Where visually justified, and funds are available, consideration should be given to improving aesthetically undesirable features in existing barriers. These improvements could include, but are not limited to screening by vegetation, painting and texturing of barrier panels.

9. Non-Barrier Noise Control Measures

Each MTO region is encouraged to consider all forms of noise control measures within their Rights-of-Way when assessing a problem and is allowed the flexibility to make recommendations concerning this type of measure based on the specific circumstances associated with the project.

10. Updating Noise Predictions

All acoustical reports are valid until site conditions change significantly. For example, if project construction is delayed, the noise barrier design recommendations should be re-examined; including using updated road traffic volume information.

11. Updating Candidate Sites For Noise Barrier Retrofit List

The Ministry maintains a Candidate Sites for Noise Barrier Retrofit List. The list is updated on an annual basis to remove constructed sites, add new sites and to reprioritize sites based on new road traffic volumes and site conditions.