ENVIRONMENTAL GUIDE FOR NOISE

2022

Ministry of Transportation

MINISTRY OF TRANSPORTATION

Environmental Guide for Noise

Part of the Environmental Standards and Practices

ISSUED BY:

ENVIRONMENTAL POLICY OFFICE

MINISTRY OF TRANSPORTATION

301 ST. PAUL STREET, 2nd FLOOR

ST. CATHARINES, ONTARIO, L2R 7R4

Ontario

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Acknowledgments

This document was updated in consultation with various groups within the Ministry of Transportation (MTO) as well as external stakeholders including the Ministry of Environment, Conservation and Parks (MECP) and Metrolinx.

This Guide is intended to be a living document that will be reviewed and revised every five years. It is applicable to projects undertaken by, or on behalf of, the Ontario Ministry of Transportation.

Comments and Suggestions

MTO 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.

Alternate Format

The Ontario Public Service strives to demonstrate leadership for accessibility in Ontario. Our goal is to ensure accessibility for our employees and the public we serve in our services, products and facilities. This document is available in an alternate format upon request.

VERSION HISTORY

VERSION #	DATE	DESCRIPTION OF MAJOR CHANGE
1.0	2006	Original publication.
1.1	Updated July 2008	Several formatting changes and Figure 7.1 was slightly revised to better reflect the text. Several typographical errors were also corrected.
2.0	Updated Feb 2022	Update MTO approved traffic models, consideration for pavement types in analysis, removal of 'most exposed side' from analysis, new definition of Noise Sensitive Area (NSA), various edits/ revisions for clarity.

Disclaimer

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1 INTRODUCTION

This document (referred to as the Noise Guide) updates, improves, and supersedes the *Ministry of Transportation Ontario (MTO) Environmental Guide for Noise (2006)*.

The Noise Guide was developed to provide guidance for MTO personnel and consultants in the analysis of highway/freeway noise, its effects, and mitigation options. Other transportation jurisdictions may use this Guide but may have to adapt it to comply with local requirements and/or regulations.

1.1 SCOPE

A full noise analysis will be required where there is new road infrastructure or significant improvements to existing road infrastructure that could affect noise levels and there are noise sensitive areas (NSAs) nearby. Site-specific factors should also be considered when assessing the need for a noise analysis. Typical instances in which a noise assessment is needed include:

- New highway or highway extension;
- Increased highway capacity through additional lanes (including new on/off ramps at interchanges);
- New, reconstructed, and/or extended MTO-related Bus Rapid Transit (BRT) lanes
- Horizontal realignment of at least 3 metres closer to receptor(s);
- Change greater than 1 m in the vertical alignment;
- Highway resurfacing in which the material will change from asphalt to concrete (see section 8.1);
- New truck inspection stations; or
- Increase in the posted speed limit which may require a noise assessment (consult the MTO Acoustical Specialist. See section 8.2).

The contents of the Noise Guide are to be applied only to projects after it has been published and will not be applied retroactively to previously completed noise assessments under previous versions of this guide. For projects that are in progress at the time of publication, noise assessments completed under the previous guide may continue to be used, subject to the discretion of MTO. All noise assessments undertaken one year from this publication must follow the requirements of this Guide.

1.2 GUIDE LAYOUT

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: Methodology,** 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 MTO.

- **Section 4: Qualifications** for Acoustic Specialists.

- **Section 5: Noise Prediction Methodologies**, provides an overview of the approved noise models.

- **Sections 6 to 10**: provide details for the consideration and analysis of noise effects for the following stages:
    - Transportation Planning (Section 6);
    - Highway Design – Preliminary Design (Section 7);
    - Highway Design – Detail Design (Section 8);
    - Construction (Section 9); and
    - Operations and Maintenance (Section 10).

- **Section 11: Computer Data Maintenance**, provides guidance on the management of computer data throughout and after the project.

- **Section 12: Reference Documents**, provides a list of publications referred to in this document.

1.3 TERMINOLOGY

Definitions and explanations in this Guide are provided in the MTO Environmental Glossary. Definitions and explanations of key terms specific to the Noise Guide are provided in Appendix A for convenience.

1.4 THE ROLE OF OTHER MTO DOCUMENTS

Numerous MTO environmental design and construction documents are related to or have a role in this Guide, as described below. The documents listed here are current at the time of publication but may be updated in the future. These documents are available on MTO's Technical Publications, Environmental Standards & Practices database.

1.4.1 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.

1.4.2 ENVIRONMENTAL ASSESSMENT ACT

The *Environmental Assessment Act* (EA Act) sets out a planning and decision-making process that a proponent must follow for projects that are subject to the Act (such as via Comprehensive Environmental Assessments and Streamlined Environmental Assessments), to ensure potential environmental impacts are considered before a project is completed.

1.4.3 ENVIRONMENTAL REFERENCE FOR HIGHWAY DESIGN

The Environmental Reference for Highway Design (ERD, 2013, or as amended/updated) addresses requirements for consultants undertaking MTO projects including scope of work, staff qualifications, scheduling, and documentation for each environmental specialty area. This Guide supports and explains the requirements outlined in the ERD.

1.4.4 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 expansion of existing provincial highways are outlined in this Guide. The process for noise analysis has been in place for over 35 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. 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. MECP Approvals, the federal *Impact Assessment Act* (IAA), and Municipal Noise Bylaws are also discussed in this section.

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 an NSA. To determine a noise impact, a comparison shall be made for predicted future sound levels with and without the undertaking for the Outdoor Living Area (OLA) of NSAs. See Appendix A for a list of definitions.

Where significant increases in noise levels are predicted or absolute noise levels are above a threshold, the mitigation efforts to be applied for the predicted change in future noise levels due to the undertaking are shown in Table 2-1.

Therefore, the predicted noise levels at relevant receptors will be considered and documented in the noise report under the following scenarios:

- **Future No-Build** – Future sound levels without the undertaking;
- **Future Build** – Future sound levels with the undertaking and no noise mitigation; and,
- **Future Build with Mitigation (if required)** – Future sound levels with the undertaking for each noise mitigation option identified (if noise mitigation consideration is required as determined in Table 2-1 below).

The objective for outdoor sound levels is to achieve the future sound levels that would have occurred without the undertaking (i.e., attempt to mitigate to Future No-Build noise levels).

Table 2-1: Mitigation Effort Required

Change in Noise Level due to Proposed Improvements / Projected Future Build Noise Levels	Mitigation Effort Required
< 5 dB change & < 65 dBA	• None
≥ 5 dB change OR ≥ 65 dBA	• Investigate noise control measures within MTO right-of-way. • Introduce noise control measures within right-of-way and mitigate to a Future No-Build noise levels if technically, economically, and administratively feasible. • Noise control measures, where introduced, should achieve a minimum of 5 dBA attenuation averaged over first row receptors (see Appendix A for definition of first row receptors)

*Values from the assessment shall be rounded to the nearest whole number before being compared to the above.

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 be technically, economically, and administratively feasible as described in Table 2-2, below.

Table 2-2: Noise Mitigation Feasibility Considerations

Technical Feasibility	Review the constructability of the noise mitigation (i.e., design of wall, roadside safety, shadow effect, topography, ability to provide a continuous barrier). The proposed mitigation option must achieve a minimum 5 dB sound-level reduction averaged over the first row of receptors to be considered technically feasible (See Appendix A for the definition of first-row receptors).[2]
Economic Feasibility	Carry out a cost-benefit assessment of the noise mitigation (i.e., determine cost per benefitted unit).[1,2]
Administrative Feasibility	Determine the ability to locate the noise mitigation on lands within public ownership (i.e., provincial or municipal right-of-way) and within project constraints.

Notes:
1. A benefitted receptor receives a minimum of 5 dB reduction in noise regardless of which row it is in or its absolute noise level. Refer to section 6.7 for determining economic feasibility.
2. Values shall be rounded to the nearest whole number before being compared to the above.

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. Blasting operations will be in accordance with OPSS 120 (General Specification for the Use of Explosives) and MECP Publication NPC-119 (“Blasting” of the Model Municipal Noise Control By-Law).

2.3 MINISTRY OF THE ENVIRONMENT, CONSERVATION AND PARKS REQUIREMENTS

The determination of potential noise impacts including the justification for whether noise mitigation is recommended must be documented in the Noise Report, which will be included in Environmental Assessment (EA) documentation (see Section 7.5).

2.4 NOISE BARRIER RETROFIT POLICY

In keeping with Government policy, MTO developed a Retrofit Noise Barrier List to alleviate noise impacts on existing noise sensitive areas built before 1977 and adjacent to existing freeways. New developments are not eligible for the Retrofit List. See Appendix B for details.

2.5 IMPACT ASSESSMENT ACT

This document does not contemplate environmental assessment processes and requirements set out under the federal *Impact Assessment Act* (IAA) or its successors as may be implemented from time to time. Federal legislation and regulatory requirements shall be referenced and adhered to as required.

2.6 MUNICIPAL NOISE CONTROL BYLAWS

MTO recognizes the impact noise can have on a community, and all reasonable attempts should be made to work within local noise bylaws. In certain situations, a contract may require work that does not align with municipal noise control bylaws (e.g., night construction) which normally requires a noise bylaw exemption issued by the municipality. Municipal noise bylaws do not apply to provincial transportation projects including MTO, its agencies or its agents (i.e. contractors) and as such, MTO is not required to obtain noise exemption by-law permits.

Although noise exemption permits are not required, MTO will continue to work with the local municipality to address local concerns on a project-by-project basis and apply best practices to reduce noise impacts to the community during construction. See section 7.4 for details.

3 METHODOLOGY

The process for noise analysis has been in place for over 35 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, including preliminary and detailed 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.

MTO's contract models, including P3, are continually evolving to meet ministry needs. The technical analysis is independent of the contract type. Contact MTO if additional details are required.

Figure 3-1 illustrates the noise assessment process through the planning, preliminary design, detail design, and construction stages.

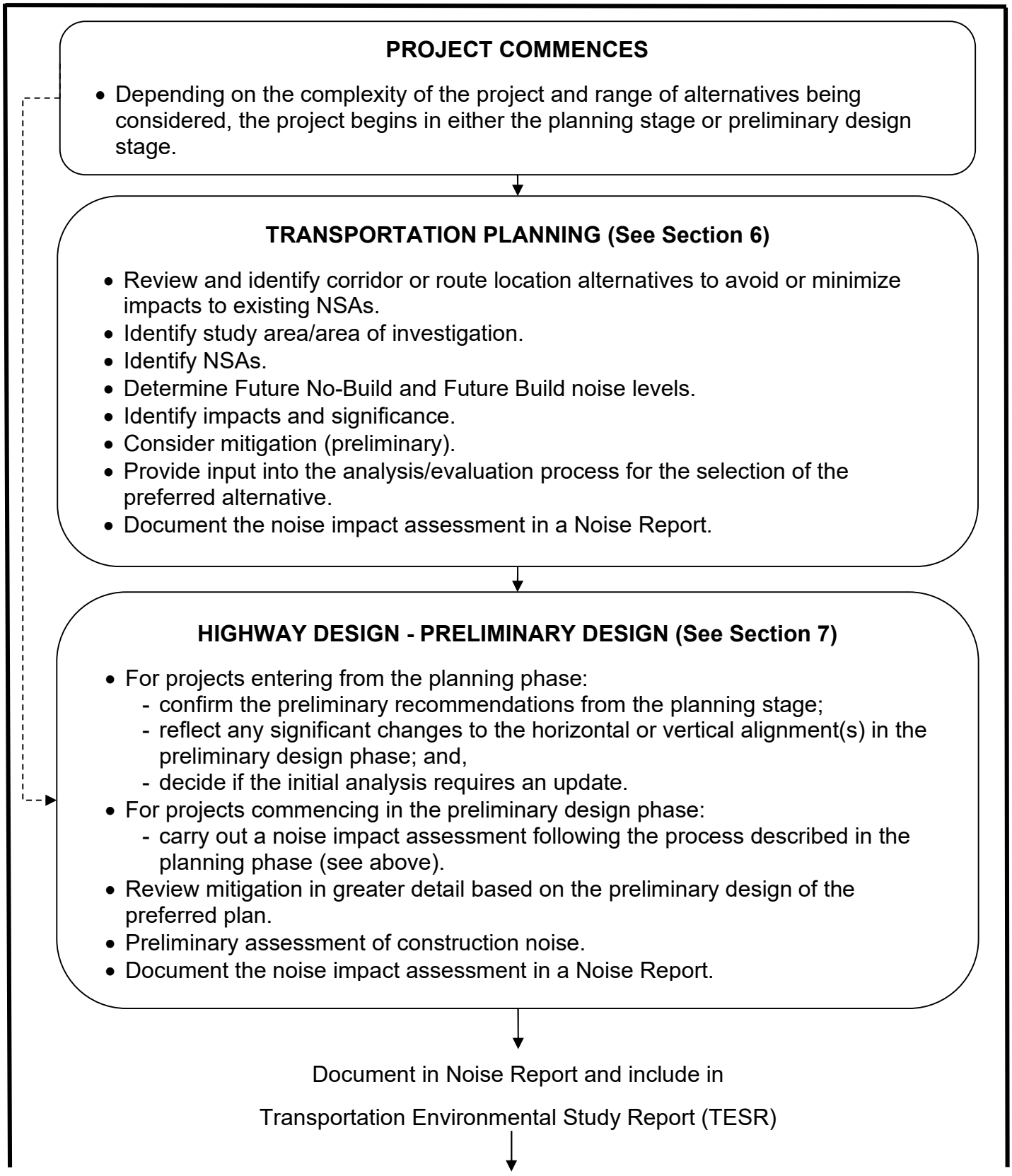
Auxiliary transportation facilities (i.e., truck inspection stations, maintenance yards, travel plazas) associated with a highway project are considered stationary sources and shall be assessed as described in Section 6.5.

Environmental Assessment Process Changes

- At the time of publication, MTO's approach to the Environmental Assessment process is being reviewed. For example, certain Group C projects such as new noise barriers may be exempt from the EA process under the new approach. As a result, processes, flow charts and guidance related to the Environmental Assessment process stated in this Guide may change once MTO has formally adopted the new approach to Environmental Assessments. At that time, the updated MTO Class EA will supersede any EA-related processes stated in this Guide.

- The most recent version of the MTO Class Environmental Assessment for Provincial Transportation Facilities should be reviewed in conjunction with this Guide.

Figure 3-1: Summary of Noise Analysis in MTO Planning and Design Process



TESR submitted, accepted and approved. Refer to the *Environmental Assessment Act* for updates.

HIGHWAY DESIGN - DETAIL DESIGN PROCEDURES FOR NOISE MITIGATION

(See Section 8)

- Confirm or undertake additional noise analysis of mitigation measures, if required.
- Address requirements of MECP Conditions of Approval if required.
- Acoustically design the barrier identifying optimal location for noise reduction, height, offset, aesthetics, and recommend special provisions, if applicable.
- Provide acoustical recommendations for mitigation and general construction measures for preparation of the contract package.

CONSTRUCTION

(See Section 9)

- Ensure all construction noise adheres to MECP Special Provisions pertaining to noise.
- Investigate any noise complaints and advise contractor of the appropriate action, if applicable.

4 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 experienced, professional judgement.

5 NOISE PREDICTION METHODOLOGIES

Road and traffic predictions have been widely used in Ontario as part of the land-use and transportation planning process for many years. Noise prediction calculations must only be undertaken using noise prediction methodologies approved by the MECP as set out in Publication *NPC-306, Methods to Determine Sound Levels Due to Road and Rail Traffic*.

As stated previously, the referenced publication may be replaced with updated or amended versions from time to time. Consult the MECP website for the latest versions of the reference document.

NPC-306 – Methods to Determine Sound Levels Due to Road and Rail Traffic

- At the time of this publication, MECP is in the process of updating their direction of determining sound levels for road and rail traffic. This is anticipated to include a two-year transition from the date of publication.
- Once NPC-306 is published, it must be followed for MTO traffic noise assessments (Check the MECP website for the latest reference document). The rest of this document is written as though NPC-306 has already been published.
- Until NPC-306 is published, the “Traffic Noise Model” (TNM) algorithm by the United States Federal Highway Administration (FHWA), together with the TNM software available must be used for MTO traffic noise assessments. Alternatively, TNM can be used together with any other software which is authorized by the FHWA or representative sample calculations can be provided to show similar results using the TNM software and the other software.

5.1 NPC-306 TRANSITION PERIODS

NPC-306 is expected to include a 2-year transition period whereby noise assessments reviewed by MECP two years after the date NPC-306 is published, must use the noise models specified in NPC-306. To avoid duplicating work, increasing project costs and delaying project timelines due to the NPC-306 transition period, MTO will take the approach outlined below.

If a noise analysis was completed using the models recommended in MTO's Environmental Guide for Noise (2006), and the EA is cleared two years after the date NPC-306 is published, or it is known the noise analysis will be reviewed by MECP two years after the date NPC-306 is published, the MTO project team will decide if the noise analysis should be updated with the model(s) recommended in NPC-306. If the MTO project team decides not to update the noise analysis, the rationale shall be documented. Some considerations for updating noise analyses are listed below:

- Number of years ago the initial analysis was completed;
- Substantial change(s) to adjacent NSAs, topography, alignment, traffic projections, etc.;
- Initial site-specific noise mitigation recommendations.

In the event that MECP reviews this noise analysis, MTO will work with MECP to consider the validity of the noise model and/or report on a case-by-case basis and determine if remodeling is required.

6 TRANSPORTATION PLANNING – CORRIDOR AND ROUTE LOCATION ALTERNATIVES

6.1 SUMMARY OF SECTION

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 NSAs or lands that are zoned as future NSAs.

From Figure 3-1, the steps for Transportation Planning are:

1. Identify study area/ area of investigation;
2. Identify NSAs;
3. Review and identify corridor or route location alternatives to avoid or minimize impacts to existing NSAs;
4. Determine Future Build and Future No-Build noise levels;
5. Identify impacts and significance;
6. Consider mitigation (preliminary);
7. Provide input into the analysis/evaluation process for the selection of the preferred alternative; and
8. Document the noise impact assessment in a Noise Report.

The purpose of the planning stage is to develop a transportation plan to address the transportation needs at the concept level of detail. The level of analysis and screening will depend on the complexity of the study and the range of alternatives being considered.

6.2 AREA OF INVESTIGATION

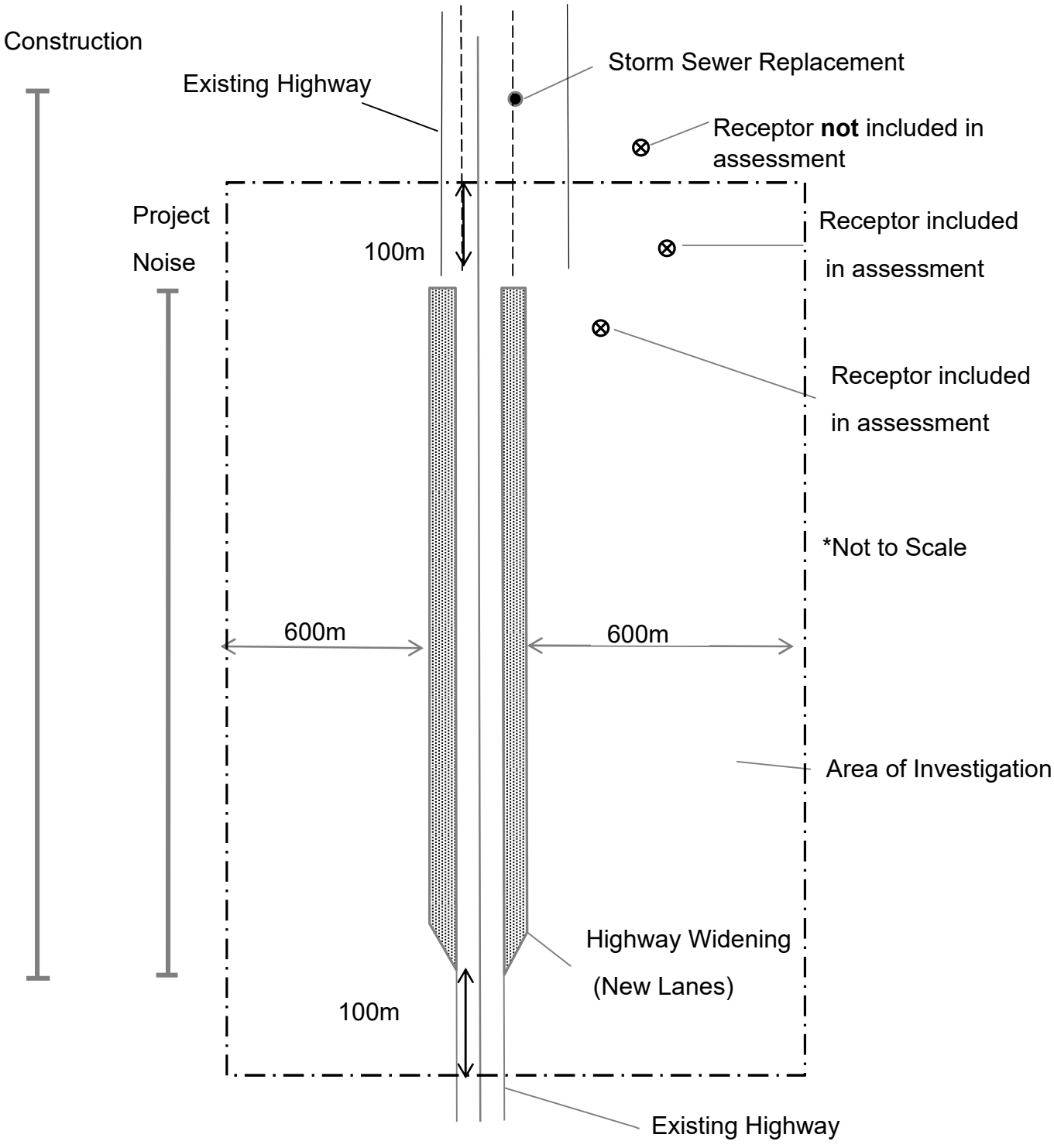
Where corridor or route location alternatives are located through or adjacent to existing NSAs, the area of investigation must be determined using one of the following methods:

- Using 5-decibel contour lines extending from the source to an NSA where there is no increase above the Future No-Build sound level; or
- An NSA where there is no increase above the Future No-Build sound level; or
- A perpendicular distance of 600 m from the closest edge of pavement and 100 m from the ends of the pavement.

The area of investigation must be determined where there are NSAs based on where the project could be reasonably expected to affect noise levels (Noise Project Limits rather than Construction Limits – See Appendix A). For example, if a project includes storm sewer replacements and a section of highway is being widened with additional lanes, NSAs within 600 metres perpendicular to the new lane(s) and 100 metres away from the ends of the new lane(s) should be used to determine the area of investigation (not the

location of storm sewer replacements since these are not expected to significantly affect noise levels). See Figure 6-1 below.

Figure 6-1: Area of Investigation



6.3 NOISE SENSITIVE AREAS (NSAs)

There is no minimum number of noise sensitive land uses that defines an NSA. Therefore, all noise sensitive land uses, regardless of size or location (urban or rural), must be considered for application of noise-control measures. NSAs must be identified using current air photo/mapping/zoning, documented on a plan, and confirmed through field review. See Appendix A for the definition of NSA.

This guide differentiates between Traditional NSAs (e.g. residences) and Special Land Use Area NSAs (e.g. educational facilities). Some special land use areas may only be considered for mitigation if they are part of a community (i.e. beside a Traditional NSA). See Appendix A for definitions.

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 MECP requirements under the *Planning Act* and submit them to the designated authority under the *Planning Act*. Based on current MECP requirements, the developer is responsible for ensuring that noise levels in the outdoor living area (OLA) 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) to mitigate these impacts. 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. Consult the MECP document NPC-300 for details.

Accordingly, where transportation 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:

- Noise calculations assumed that the proposed improvements to the provincial highway were in place;
- Traffic assumptions were consistent with the traffic assumptions for the proposed improvements to the provincial highway; and
- 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 transportation corridor or route location alternatives. This information must be documented in the Noise Report.

6.4 OUTDOOR LIVING AREA (OLA)

An OLA is an area at ground level, adjacent to an NSA, intended and designed for the enjoyment of the outdoor environment, and readily accessible from the building. This area is typically situated in the backyard of a dwelling but may be situated on any side of the NSA. The usual distance from the dwelling unit wall is 3 m. The vertical height is 1.5 m above the existing ground surface. Other examples include outdoor swimming pools/ tennis courts for hotels/ motels. See Appendix A for definitions.

Where the Acoustical Specialist has explored all options (e.g., site visit, satellite imagery) to identify the location of the OLA, but it is still unknown, the side closest to the highway should be assumed. Paved areas for multiple dwelling residential units are not be defined as an OLA.

Determining when mitigation is required is based on the analysis of the predicted noise level at the OLA, which is typically the rear yard, and can include shielding from the building, where applicable.

6.5 DETERMINATION OF FUTURE NO-BUILD NOISE LEVELS

An acoustical assessment must be conducted to determine the Future No-Build 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. Receptor locations must be determined for the NSAs at approximately 3 m away from dwelling unit wall at the outdoor living area:

    - 1.5 m above ground;
    - A minimum of one receptor per three units. Receptors in subsequent rows may be placed more broadly;
    - Where there are isolated NSAs, each will be considered individually; or
    - Where there is continuous development of NSAs of a similar nature (e.g. residential subdivision), the above three points apply.

3. Where an existing freeway/highway/roadway is the main noise source (i.e., noise level predictions can be done), a noise-prediction model approved in NPC-306 shall be used to predict the Future No-Build noise levels 10 years after the proposed construction year without noise contribution from the undertaking.

Predicted Future No-Build noise levels shall include all relevant noise mitigation features such as existing noise barriers/ berms (including those built by third parties such as residential developers) and planned noise barriers/ berms expected to be built (including those built by third parties such as residential developers) 10 years after the proposed construction.

It should be noted that the contribution from transient noise sources (e.g. rail, air, etc.) are typically excluded from the determination of the Future No-Build noise levels. 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 in consultation with both MTO and MECP (contact the MTO Acoustical Specialist for details first). Where included, a methodology as approved by the Ontario MECP/ MTO must be used for predicting train 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 Future No-Build sound levels will be assumed for the MECP Class 1-4 Areas as defined in Appendix A and MECP's NPC-300:

     - Class 1 Area (urban) - 50 dBA
     - Class 2 Area (suburban) - 45 dBA
     - Class 3 Area (rural) - 40 dBA
     - Class 4 Area – 55 dBA

     MTO and MECP must confirm the assumed Future No-Build sound level.

   - In special circumstances, where necessary, the assumed Future No-Build noise level must be supported with field measurements 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 sources 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 MECP Publications NPC-103 "Procedures" and NPC-233 "Information to be Submitted for Approval of Stationary Sources of Sound". Additional guidance is also available in MECP Publication NPC-300.

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).

6.6 DETERMINATION OF FUTURE BUILD NOISE LEVELS

To predict future noise levels after the undertaking is constructed, an acoustical assessment is to be undertaken using a noise-prediction model approved in NPC-306. The following are required for the assessments:

1. Predicted Future Build noise levels must be determined for 10 years after the undertaking is constructed at the OLA 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 future posted speed limits. Projects where the only change is an increase in posted speed limit may require a noise assessment. See Section 8.2 and consult the MTO Acoustical Specialist for guidance.

   - The higher of Annual Average Daily Traffic (AADT) or Summer Average Daily Traffic (SADT).

   - 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 are typically based on a 16-hour period.

- If pavement type (concrete or asphalt) has already been determined at this stage, the noise analysis will be modelled appropriately. Otherwise, the assessment shall have 2 scenarios modeled: a concrete scenario and an asphalt scenario. This is limited to asphalt and concrete pavement types and there is no need to distinguish between different types of asphalt or concrete. Subsequent mitigation analysis shall consider these scenarios separately.

- 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 Build and Future No-Build noise levels 10 years after construction must be compared to determine any noise level changes at modelled receptors. These predicted noise levels shall include all relevant noise mitigation features such as existing noise barriers/berms (including those built by third parties such as residential developers) and planned noise barriers/berms expected to be built (including those built by third parties such as residential developers) 10 years after the proposed construction.

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).

Inclusion and assessment of stationary sources associated with MTO's transportation facilities (i.e., truck inspection stations, maintenance yards, travel plazas) must be

discussed with MTO and MECP. The following should be applied when reviewing the impact of these types of facilities adjacent to an 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 No-Build noise level vs. Future Build noise level with the stationary source). In accordance with Publication NPC-300, the assessment of stationary sources (Part B) should be referred to.

- If the stationary source is constructed after the transportation undertaking, then the stationary source will be assessed with the undertaking (i.e., Future Build noise level vs. Future Build noise level with the stationary source). In accordance with Publication NPC-300, the assessment of stationary sources (Part B) should be referred to.

- 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.

Refer to NPC-300 for further information.

6.7 DETERMINATION OF POTENTIAL IMPACT

The following should be completed to determine the potential impact of noise:

1. The Future No-Build noise level must be compared to the Future Build noise level for the undertaking projected 10 years after construction at the OLA of the dwelling unit.

2. Where contours have been developed, the predicted Future Build noise level contours should be superimposed on the Future No-Build noise level contours. Where specific receptors are considered, the predicted Future Build noise level must be compared to the Future No-Build noise level.

3. The absolute noise levels and changes in noise levels must be documented in a summary table. Report tables shall follow the format found in Table 6-1 below.

Table 6-1: Sample Summary Table of Future Build vs Future No-Build Noise Levels

		Future Build Alternative "X"		Future Build Alternative "Y"	
Receptor Number	**Year 'Z' Future No-Build Leq (24 hr)**	**Year 'Z' Leq (24 hr)**	**Change due to undertaking**	**Year 'Z' Leq (24 hr)**	**Change due to undertaking**
1	50.1 dBA	61.4 dBA	+11.3 dB	63.5 dBA	+13.4 dB
2	55.3 dBA	61.1 dBA	+5.8 dB	66.6 dBA	+11.3 dB
3	49.5 dBA	53.8 dBA	+4.3 dB	51.6 dBA	+2.1 dB

Notes:
Year 'Z' – 10 years following projected opening of the highway

6.8 PRELIMINARY ASSESSMENT OF MITIGATION

Where predicted Future Build noise level increases are less than 5 dB above Future No-Build noise levels and the projected Future Build noise levels are less than 65 dBA, the consideration of the provision of mitigation is not required.

Where the predicted Future Build noise level at the OLA results in an increase of 5 dB or greater over the Future No-Build noise level; or the projected Future Build noise level is equal to or greater than 65 dBA, the significance of the noise impact should be summarized in a summary table. Report tables shall follow the format found in Table 6-2. Separate results/tables must be shown if multiple pavement scenarios are performed

Values shall be rounded to the nearest whole number before the assessment of consideration for noise mitigation is performed. Tables with rounded whole numbers should be available for communication purposes to the public upon MTO request.

Table 6-2: Sample Summary Table for Determining the Need for Mitigation Consideration

					Noise Mitigation Consideration Required? [2]	
Receptor Number	**Number of OLAs represented**	**Year 'Z' Future No-Build Leq (24 hr)[1]**	**Year 'Z' Future Build Leq (24 hr) [1]**	**Change due to Undertaking**	**≥ +5 dB**	**≥ 65 dBA**
1	1	47.1 dBA	58.9 dBA	+11.8 dB	✓	×
2	3	55.2 dBA	61.6 dBA	+6.4 dB	✓	×
3	1	49.6 dBA	53.2 dBA	+3.6 dB	×	×

Notes:
1. Year 'Z' - 10 years following projected opening of the highway
2. Values are rounded to the nearest whole number before the consideration of noise mitigation

Where the Future Build noise level in the OLA results in 5 dB or greater increase over the Future No-Build noise level; or the projected Future Build noise level is equal to or greater than 65 dBA, the following must occur:

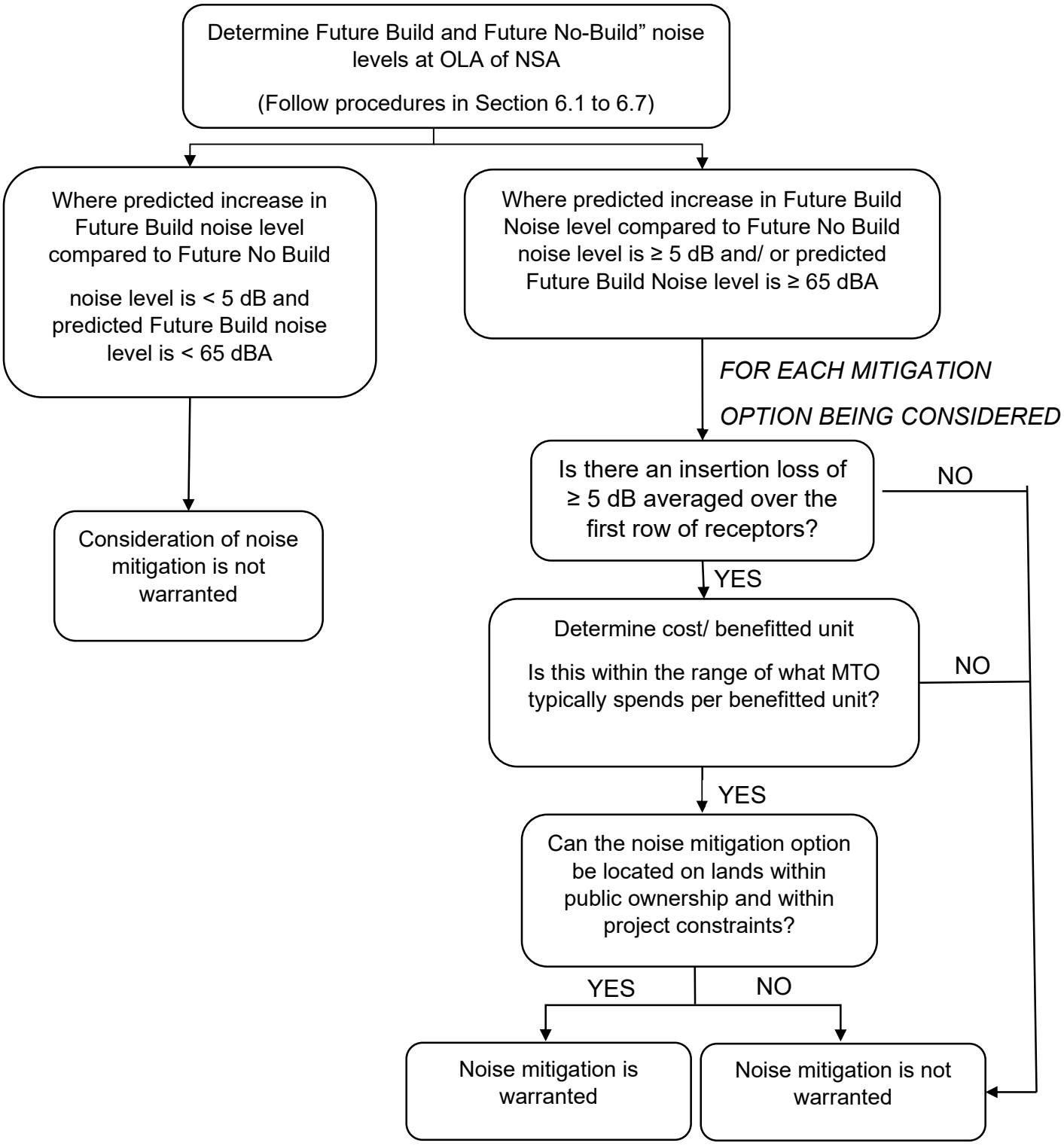
- Noise-control measures must be investigated within the right-of-way

- If the noise-control measures are considered technically, economically, and administratively feasible, the selected measures within the right-of-way are to be implemented.

- Some special land use areas that are part of a community (i.e. beside a Traditional NSA) may receive noise mitigation if the Traditional NSA has technically, economically, and administratively feasible noise mitigation as described above. See Appendix A for definitions. In this situation, MTO will consider the feasibility of extending that noise mitigation to also mitigate for the special land use area on a case-by-case basis. Contact the MTO Acoustical Specialist prior to completing the model for details on this approach.

Figure 6-2 summarizes the basic process for the assessment of noise mitigation based on the OLA in NSAs.

Figure 6-2: Preliminary Assessment of Mitigation



* This figure summarizes the basic process; however, the assessment of mitigation must be read in conjunction with sections 6.1 to 6.7 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.

The determination of whether mitigation is provided is based on the review of technical, economic and administrative feasibility while considering the projected Future Build and Future No-Build noise levels, the predicted noise level decreases and the number of benefitting receptors.

The review of technical, economic, and administrative feasibility of providing mitigation is described in sections 6.8.1 to 6.8.3.

6.8.1 TECHNICAL FEASIBILITY

Review the constructability of the noise mitigation (i.e., design of wall, roadside safety, shadow effect, topography, ability to provide a continuous barrier). The proposed mitigation option must achieve a minimum 5 dB sound-level reduction averaged over the first row of receptors to be considered technically feasible. See Appendix A for the definition of first-row receptors. Predicted average attenuation shall be rounded to the nearest whole number before being compared to this 5 dB value.

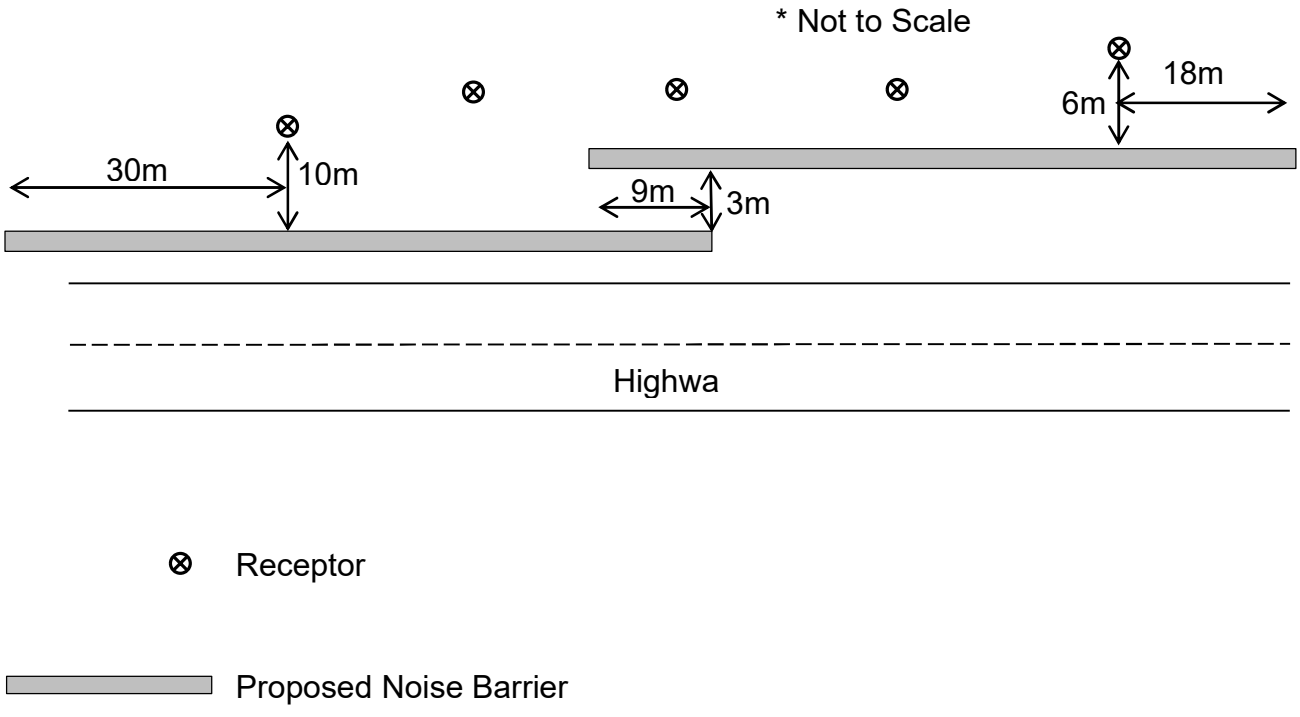
MTO noise barriers are to be considered/constructed to the highest height MTO allows, even if a lower noise barrier may achieve the minimum 5 dB reduction described above (this height may have structural or other limitations not related to noise that must be taken into consideration). Currently, MTO uses noise barriers up to a maximum height of 5 metres.

The length of noise walls is generally determined by applying a minimum 3:1 ratio to the distance between the noise wall and each end receptor location. For example, if the distance between a proposed noise barrier and an end receptor is 10 m, the noise barrier should extend 30 m past the end receptor. See Figure 6-3 below.

Similarly, if a noise barrier cannot be continuous due to other constraints, the disconnected noise barrier overlap is generally determined by applying a minimum 3:1 ratio to the distance between the disconnected noise barriers. For example, a distance between two disconnected noise barriers being 3 m generally requires a 9 m minimum noise barrier overlap. See Figure 6-3 below.

Technical feasibility for special land use areas are unique and are to be considered on a case-by-case basis. Contact the MTO Acoustical Specialist prior to completing the model for details on this approach.

Figure 6-3: Barrier Lengths Example



6.8.2 ECONOMIC FEASIBILITY

Carry out a cost-benefit assessment of the noise mitigation (i.e., determine cost per benefitted unit). Once a noise mitigation option is technically feasible (average of at least 5 dB reduction in the first row of receptors), all receptors regardless of which row they are located may be considered in the economic feasibility assessment. Any OLA predicted to receive at least a 5 dB noise reduction due to the proposed noise mitigation is considered to be a benefitted unit. Predicted noise attenuation due to noise mitigation shall be rounded to the nearest whole number before being compared to the 5 dB criteria. The estimated cost of the noise mitigation option is then divided by the number of benefitted units to calculate a cost-benefit ratio. If this ratio is within the range of what MTO typically spends per benefitted unit, the noise barrier is considered economically feasible. MTO should be contacted for the current cost-benefit ratio used for noise walls.

Economic feasibility for special land use areas are unique and are to be considered on a case-by-case basis. Contact the MTO Acoustical Specialist prior to completing the model for details on this approach.

Below is an example calculation that should be used in determining economic feasibility.

Example*:* A 5-metre-high barrier with a total length of 400 metres is proposed to protect a neighbourhood of 10 residences as illustrated in Figure 6-4. The values presented in this example are for illustrative purposes only.

- The first row of receptors is predicted to achieve the minimum average sound level reduction of 5 dB (i.e., the barrier is technically feasible).

- Of the 10 residences considered, 8 are predicted to benefit from the noise wall since they achieve the minimum sound level reduction of 5 dB regardless of which row they are in. Receptors should be placed beyond the 1st row until the noise barrier is predicted to attenuate less than 5 dB in order to identify all benefitted receptors. Predicted noise attenuation due to noise mitigation shall be rounded to the nearest whole number before being compared to the 5 dB criteria for a benefitted receptor.

- The total area of the proposed barrier is 400 m x 5 m = 2,000 m^2

- The cost of the barrier is estimated at $"X" per square metre for a total of

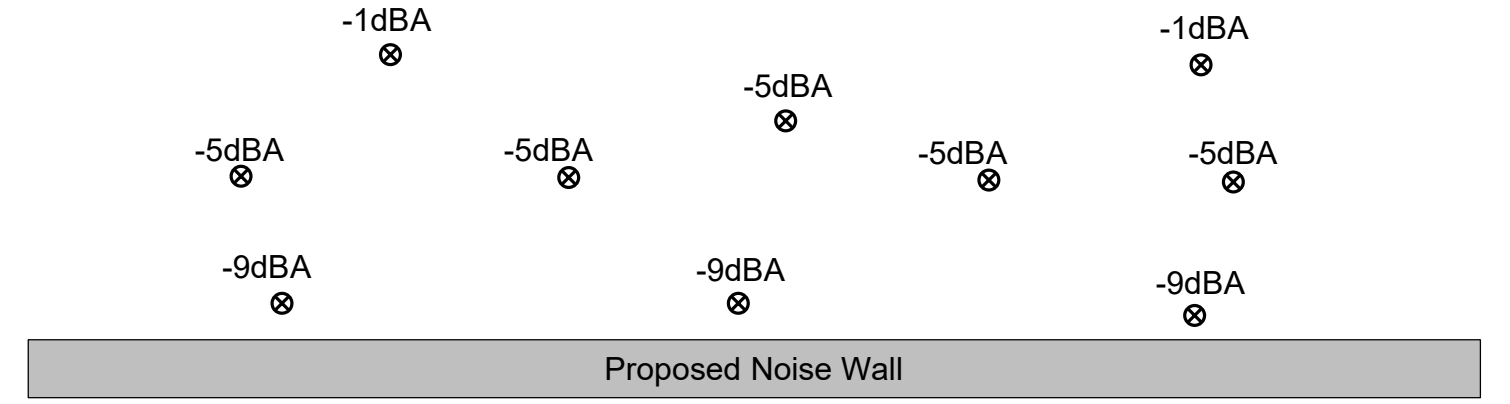
- 2,000 m^2 * $"X" / m^2 = $"Y". MTO should be contacted for current costing estimates prior to the economic analysis.

- The cost-effectiveness of this barrier is then determined to be

- $"Y" / Total Benefitted Receptors = $"Y" / 8 = $ "Z" / Benefitted Receptor.

- MTO should be contacted for the current cost-benefit ratio used for noise walls. Based on a comparison of these values, the noise wall may be determined to be economically feasible.

Figure 6-4: Economic Feasibility Example



Notes:

- Predicted change in noise due to proposed noise wall are listed next to each receptor

- Not to scale

⊗ Receptor

6.8.3 ADMINISTRATIVE FEASIBILITY

Determine the ability to locate the noise mitigation on lands within public ownership (i.e., provincial or municipal right-of-way) within project constraints. Some municipalities may have maximum noise barrier height limitations which must also be considered.

At this stage, all mitigation options available will be considered including:

- Alignment, including vertical and horizontal;
- Pavement types; and,
- Barriers, such as earth berms and 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 receptor per three units is the typical standard to determine the best noise barrier design. Each of the three units should have their OLAs appropriately represented by the one receptor (i.e. similar noise levels).

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). Results of the mitigation investigation should be presented in a summary table. Report tables shall follow the format found in Table 6-3 below.

Values shall be rounded to the nearest whole number before the feasibility assessments are performed. Tables with rounded whole numbers should be available for communication purposes to the public upon MTO request.

Table 6-3: Sample Summary Table for Consideration of Noise Wall Attenuation

Receptor Number	Number of Units Represented	Row #	Year 'Z' Future Build Leq (24-hr) (dBA) [1]	Year 'Z' Future Build Leq (24-hr) with 5m High Noise Wall (dBA) [1]	Predicted Attenuation (dB)	Predicted Average Attenuation in Row (dBA) [2]	Length of 5m High Noise Wall (m)	Number of Benefited Units [3]	Estimated Cost of Noise Wall [4]	Estimated Noise Wall Cost per Benefited Units
1	1	1	66.8	57.5	-9.3	-6.1	100	6	$"Y"	$"Z"
2	3		65.4	60.4	-5.0					
3	1	2	58.6	53.2	-5.4	N/A				
4	1		58.9	53.8	-5.1					
5	2	3	55.1	53.5	-1.6	N/A	-	-	-	-

Notes:

1. Year 'Z' – 10 years following projected opening of the highway
2. Since the average attenuation in the first row OLAs is at least 5 dB, this noise wall is technically feasible. The average attenuation is rounded to the nearest whole number before being compared for technical feasibility
3. Any unit which receives a minimum 5 dB noise reduction from the noise wall is a benefitted receptor in the economic assessment. The predicted attenuation at each receptor is rounded to the nearest whole number before being considered for a benefitted receptor
4. Estimated average cost of noise barriers to determine economic feasibility shall be predicted in consultation with the MTO representative.
5. All receptors in this table are in the OLA

6.9 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.

6.10 DOCUMENTATION

If there are no existing or planned 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.

For projects that require a noise analysis, the Noise Report is to include, as a minimum, the following:

- A detailed description of the overall project and, in a separate list, aspects of the project that are expected to affect noise levels at NSAs;
- A description of the NSAs (identifying discrete receptor locations);
- A map illustrating the location of the NSAs and receptor locations;
- A map indicating Noise Project Limits, Construction Limits and proposed improvements expected to affect noise levels at receptors (see Appendix A for definitions);
- The name of the noise prediction model used;
- A summary of key model inputs such as traffic volume and commercial vehicle percentage;
- Results of Future Build and Future No-Build noise level predictions at NSAs for each route alternative (if more than one);
- A table identifying project impacts (see Table 6-1 and 6-2);
- 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, construction timing and the proposed location of the mitigation option(s)

(e.g. a noise barrier is recommended on the fence line, shoulder or on top a berm). See Table 6-3;

- 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 6.7); and

- An analysis of construction noise impacts and project requirements including the following:

    - location and number of NSAs;
    - identification of municipal noise control bylaws;
    - identification of steps MTO may take if work is found not to align with municipal noise control bylaws. See section 7.4; and
    - the construction noise complaint process.

7 HIGHWAY DESIGN - PRELIMINARY DESIGN

7.1 SUMMARY OF SECTION

From Figure 3-1 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; and,
  - decide if the initial analysis requires an update;

- For projects commencing in the preliminary design stage:
  - carry out a noise impact assessment following the process described in the planning phase;

- Review mitigation in greater detail based on the preliminary design of the preferred plan;

- Preliminary assessment of construction noise; and,

- Document the noise impact assessment in a Noise Report.

7.2 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. The methodology will be the same as followed during the planning stage of the study (see Section 6).

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 the planning analysis will suffice and document the rationale.

If a project was put on hold and the noise analysis was completed more than 5 years ago, the MTO Acoustical Specialist must review the report, decide if the analysis must be updated (due to significantly more accurate traffic count availability/ projections, changes in topography/ NSAs, etc.) and if an update is not required, document the rationale.

Also see Section 5 for discussion on implementation of NPC-306 approved models.

7.3 PROJECTS WITH A COMBINED PLANNING AND PRELIMINARY DESIGN STAGE

For projects commencing in the preliminary design stage, there will likely be no previous noise analysis available and so the process for planning stage must be followed as described in Section 6. In summary, this must include:

- Identification of area of investigation. The area of investigation must be determined where there are NSAs based on where significant changes could be reasonably expected to affect noise levels. See Section 6.1;
- Identification of noise sensitive areas;
- Determination of Future No-Build noise levels;
- Determination of Future Build noise levels;
- Determination of potential impact; and
- Assessment of mitigation.

Also see Section 5 for discussion on implementation of NPC-306 approved models.

7.4 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 optimal location of noise barrier(s) for noise reduction;
- The feasibility of the use of earth berms and berm/walls as alternatives to barrier walls;
- The aesthetics of each alternative treatment (i.e., berm, berm/wall, wall) based on the overall visual environment of the area. For example, if space permits, a berm or combination berm/wall may be considered over just a noise wall;
- 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).

7.5 CONSTRUCTION NOISE

The following must be undertaken with regard to construction noise:

- NSAs must be identified during the project planning stage. For each NSA:
  - identify a single, worst-case dwelling,
  - state the approximate number of dwellings in each NSA, and
  - illustrate the location of each NSA and receptor location in a map.
- 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;
- 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;
- The technical and economic feasibility of various alternatives must be evaluated in order to select the appropriate construction noise control measures; and
- In certain situations, a contract may require work that does not align with municipal noise control bylaws. Municipal noise bylaws do not apply to provincial transportation projects including MTO, its agencies or its agents (i.e. contractors) and as such, MTO is not required to obtain noise exemption by-law permits. Although noise exemption

by-law permits are not required, MTO will ensure clear and frequent communication with the municipality, address local concerns on a project-by-project basis, strive to work within the spirit of the municipal noise bylaw, and apply best practices to reduce noise impacts to the community during construction.

In the event that MTO has work that does not align with municipal noise control bylaws that would normally require a noise bylaw exemption (e.g. project may create noise in the evening/night as defined in the local municipal noise bylaw), the following best practices shall be considered:

- Consider and implement, as appropriate, mitigation measures to reduce the impact of construction noise on the local community;

- Provide advertising/ notification of the project prior to commencement of any work advising local residents and businesses of the project timeframe and that the project may create noise in the evening and/or night. Timing should be consistent with the timelines the local municipality would normally require in a noise bylaw exemption for a project of this scope/magnitude (typically 2-4 weeks prior to work commencing and 2-4 weeks prior to work recommencing each spring);

- Provide notification to property owners adjacent to the worksite prior to work commencing advising of the project timeframe and that the project may create noise in the evening and/or night (e.g. door-to-door flyers). Timing should be consistent with the timelines the local municipality would normally require in a noise bylaw exemption for a project of this scope/magnitude (typically 2-4 weeks prior to work commencing and 2-4 weeks prior to work recommencing each spring); and

- Provide a contact number to the local municipality for residents to call if they have any concerns or questions (typically the Contract Administrator or Contract Services Administrator).

Special Provisions dealing with construction noise must be included in the contract package as applicable. See Section 9 for more details on construction noise.

7.6 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.

If a noise analysis was carried out, the work in Section 7 must be documented in a Noise Report that includes, as a minimum, the same documentation criteria as listed in Section 6.9.

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

7.7 CONDITIONS OF ENVIRONMENTAL ASSESSMENT APPROVAL PERTAINING TO NOISE

During the review and approval of an Individual (Comprehensive) Environmental Assessment, MECP may impose Condition(s) of Approval for noise which must be addressed.

8 HIGHWAY DESIGN - DETAIL DESIGN

8.1 SUMMARY OF SECTION

From Figure 3-1, the steps for Detail Design are:

- Confirm or undertake additional noise analysis of mitigation measures, if required;
- Address requirements of MECP Conditions of Approval if required;
- Acoustically confirm the design of the barrier, identifying optimal location for noise reduction (e.g. station numbers), 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 6.

If a project was put on hold and the previous noise analysis was completed 5 years ago or more, the MTO Acoustical Specialist must review the report, decide if the analysis must be updated (due to updated traffic count availability/ projections, changes in topography/ NSAs, etc.) and if an update is not required, document the rationale.

Also see Section 5 for discussion on implementation of NPC-306 approved models.

8.2 HIGHWAY SURFACE REPLACEMENT PROJECTS

Resurfacing projects would likely begin in the detail design stage but do not normally require a noise assessment. However, a continuous highway surface replacement project adjacent to NSAs where the existing asphalt pavement is being replaced by concrete pavement, requires consultation with the MTO Acoustical Specialist for advice on the need for this analysis (these types of projects typically apply to resurfacing projects greater than 5-lane kilometres).

This assessment would compare the Future Build concrete scenario and the Future Build asphalt scenario. This analysis does not distinguish between different types of asphalt or different types of concrete. The criteria for noise mitigation consideration for this type of assessment is limited to ≥ 5 dB increase in noise (does not use the ≥ 65 dBA future build noise level for noise mitigation consideration). If a ≥ 5 dB increase is predicted, subsequent noise mitigation analysis will then be considered.

This assessment is not required for pavement patching projects, crack sealing projects, any interim pavement states (such as temporary grooved pavement), or continuous highway surface replacement projects that uses the same pavement type as before (i.e. “like for like” resurfacing).

8.3 INCREASES IN POSTED SPEED LIMIT

If a project is seeking to increase the existing posted speed limit, the potential noise impacts to the community must be considered. The need for a noise assessment is dependent on several factors including proximity to NSAs, length of highway affected, magnitude of increase in posted speed limit, etc. The MTO Acoustical Specialist must be consulted before initiating any noise assessment related to an increase in posted speed limit.

The criteria for noise mitigation consideration for this type of assessment is limited to ≥ 5 dB increase in noise (does not use the ≥ 65 dBA future build noise level for noise mitigation consideration). If a ≥ 5 dB increase is predicted, subsequent noise mitigation analysis will then be considered.

8.4 MITIGATION

Where a noise analysis has been previously completed and noise mitigation is recommended, a noise analysis must be reviewed during the detail design stage to respond to any Environmental Assessment commitment and confirm the reasonableness of proposed mitigation measures.

Any Condition(s) of Approval required by MECP for noise must be addressed (see Section 7.6).

Construction noise is addressed in Section 9.

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

- Horizontal and vertical alignment;
- Pavement type; and
- Barriers/berms.

8.4.1 HORIZONTAL AND VERTICAL ALIGNMENT

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

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 receptor. 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; and
- Placement of highway service facilities (i.e. truck inspection stations, travel plazas, patrol yards) away from NSAs.

8.4.2 PAVEMENT TYPE

If concrete is to be used in final construction, research has shown that concrete with longitudinal grooves are quieter than transverse grooves and may be factored into the decision-making process.

8.4.3 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.

8.4.4 BARRIER RECOMMENDATIONS

Description of barrier identifying optimal location for noise reduction (e.g. station numbers), height, length and absorbency (absorptive vs. reflective) 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 assumptions and recommendations must be confirmed. 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.

8.4.4.1 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);
- 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. (this can only be determined once the contract has been awarded and the supplier is selected. This will be dependent on the supplier's available selection. Consult with the MTO environmental planner or Acoustical Specialist when determining this);
- Absorptive barrier vs. reflective barrier vs. barrier on structure (consultation with Acoustical Specialist and/or environmental planner required);
- 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.

8.4.4.2 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);

- 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.

8.4.4.3 BARRIERS WITH ADDITIONAL BENEFITS

- New noise barrier technologies such as the combination of mitigating noise impacts while simultaneously removing air pollutants are becoming available. If a noise assessment has found that noise mitigation is warranted, consideration may also be given to these new technologies if it is advantageous to simultaneously mitigate for noise and elevated concentrations of air pollutants.

- Novel technologies under consideration must still act as effective noise barriers and be listed under MTO's Designated Sources for Materials Manual list.

9 CONSTRUCTION

The requirements for consideration of construction noise during detail design will be the same as followed during the preliminary design stage of the study as described in section 7.4. However, during detail design (section 8), more project details are known, and specific recommendations should be provided.

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.

9.1 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. In this case, the Contract Services Administrator (CSA) must contact the MTO Acoustical Specialist. Noise complaints occur more often during nighttime construction. 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.

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*.

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

10 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.

11 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.

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

12 REFERENCE DOCUMENTS

All the referenced publications may be replaced with updated or amended versions from time to time. The latest versions of the reference documents and other applicable guidelines should be used:

1. NPC-102 – “Instrumentation” of the Model Municipal Noise Control By-Law, Final Report, Ontario Ministry of the Environment, Conservation and Parks, August 1978.

2. NPC-103 – “Procedures” of the Model Municipal Noise Control By-Law, Final Report, Ontario Ministry of the Environment, Conservation and Parks, August 1978.

3. NPC-104 – “Sound Level Adjustments” of the Model Municipal Noise Control By-Law, Final Report, Ontario Ministry of the Environment, Conservation and Parks, August 1978.

4. NPC-115 – “Construction Equipment” of the Model Municipal Noise Control By-Law, Final Report, Ontario Ministry of the Environment, Conservation and Parks, August 1978.

5. NPC-118 – “Motorized Conveyances” of the Model Municipal Noise Control By-Law, Final Report, Ontario Ministry of the Environment, Conservation and Parks, August 1978.

6. NPC-119 – “Blasting” of the Model Municipal Noise Control By-Law, Final Report, Ontario Ministry of the Environment, Conservation and Parks, August 1978.

7. NPC-233 – “Information to be Submitted for Approval of Stationary Sources of Sound", Ontario Ministry of the Environment, Conservation and Parks, October 1995.

8. NPC-300 – Environmental Noise Guideline Noise Assessment Criteria for Stationary Sources and for Land Use Planning, Ontario Ministry of the Environment, Conservation and Parks, August 2013.

APPENDIX A: DEFINITION OF KEY TERMS

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 receptor, 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 visual interaction between the highway and the surrounding landscape.

Benefitted Receptor: A modeled receptor predicted to experience a minimum 5 dB sound level reduction due to noise mitigation.

Class 1 Area: means an area with an acoustical environment typical of a major population centre, where the background sound level is dominated by the activities of people, usually road traffic, often referred to as "urban hum."

Class 2 Area: means an area with an acoustical environment that has qualities representative of both Class 1 and Class 3 areas:

- sound levels characteristic of Class 1 during daytime (07:00 to 19:00 or to 23:00 hours); and
- low evening and night background sound level defined by natural environment and infrequent human activity starting as early as 19:00 hours (19:00 or 23:00 to 07:00 hours).

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;
- an agricultural area;
- a rural recreational area such as a cottage or a resort area; or
- a wilderness area.

Class 4 Area: means an area or specific site that would otherwise be defined as Class 1 or 2 and which:

- is an area intended for development with new noise sensitive land use(s) that are not yet built;
- is in proximity to existing, lawfully established stationary source(s); and
- has formal confirmation from the land use planning authority with the Class 4 area classification which is determined during the land use planning process.

Additionally, areas with existing noise sensitive land use(s) cannot be classified as Class 4 areas.

Construction Limits: The geographical extent to which any MTO work is planned regardless of its potential noise impact on receptors (see "Project Noise Limits").

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 Receptors: means the line of adjacent receptors closest to the highway, usually running parallel to each other. In some cases where the first row receptors do not run parallel to highway (e.g. a N-S highway with a row of houses running SE-NW), first row receptors are interpreted to be adjacent receptors where noise level differences are imperceptible (within 3 dB) from the receptor 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 "No-Build" Noise Levels: the total noise level associated with and representative of a given environment and includes all natural and man-made sound from many sources (e.g. existing highways and roadways) both near and far projected 10 years after scheduled construction but without the proposed undertaking.

In areas with existing residential development, future "no-build" noise levels are 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 future "No-Build" noise levels may be assumed as discussed in Section 6.4 of this Guide. Where necessary, assumed future "No-Build" noise levels shall be supported with field measurements of existing noise levels. All measurements shall be

conducted in accordance with procedures outlined in Section 6 of this Guide and MECP's measurement guidelines.

The contribution from transient noise sources (e.g. rail, air) 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 MECP. Where included, a methodology as approved by MECP/MTO will be used for predicting train noise

Future "Build" Noise Levels: means those sound levels (L_{eq} (24 hr) based on traffic volumes for a time period 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.

Lane – Kilometre: Measurement of length of each lane, rather than the overall length of the roadway. For example, one km of a four-lane highway will be counted as four lane-km under the method.

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):

New NSA definitions described here are to be used at the time this Guide has been published and will not be applied retroactively to past projects that used the previous version of this guide.

Traditional NSAs

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.

Special Land Use NSAs

The sub-section introduces the concept "as part of a community" meaning the special land use is next to a Traditional NSA as defined above. Noise mitigation for special land use areas that are "part of a community" may receive noise mitigation only if the Traditional NSA beside the Special Land Use area already has a technically, economically and administratively feasible noise mitigation.

Where a freeway/ highway improvement or project is planned, the following special land use areas would qualify as NSAs **only as part of a community** in addition to the traditional NSAs 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 OLAs' (i.e. swimming pool area etc.) for visitors.
- Community centres with OLAs (e.g. outdoor basketball courts etc.).
- Municipal parks (excluding golf courses and trails).
- Places of worship with OLAs.

Where a new freeway/highway corridor or route is planned, the following special land use areas would qualify as NSAs in addition to the traditional NSAs 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.

- Community centres with OLAs (e.g. outdoor basketball courts etc.).
- Municipal parks only as part of a community (excluding golf courses and trails).
- Places of worship with OLAs only as part of a community.

NSA's must have an OLA

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

- Apartment balconies above ground floor
- Cemeteries
- All commercial
- All industrial

Outdoor Living Area (OLA): means an area at ground level, adjacent to an NSA, intended and designed for the enjoyment of the outdoor environment, and readily accessible from the building. This area is typically situated in the backyard for a dwelling unit but may be situated on any side of the NSA. The usual distance from the dwelling unit wall is 3 m. The vertical height is 1.5 m above the existing ground surface. Other examples include outdoor swimming pool/ tennis courts for hotels/ motels. Where the Acoustical Specialist has explored all options (e.g. site visit, satellite imagery etc.) to identify the location of the OLA but it is still unknown, the side closest to the highway should be assumed. Paved areas for multiple dwelling residential units are not to be defined as an OLA. See the definition for Noise Sensitive Areas.

Project Noise Limits: The geographical extent to which any MTO work is planned where the planned changes could be reasonably expected to increase noise levels at receptors (see "Construction Limits").

Receptor: means a point entered in the noise model used to represent OLA(s). One receptor may be used to represent a maximum of three reasonably acoustically similar OLAs. In the case where an OLA is shared by multiple residences (e.g. an OLA for an apartment building), the receptor may be assumed to represent 10% of the residences that could use the shared OLA (i.e. it is expected that a maximum of 10% of the building tenants would be using the shared OLA at any one time).

APPENDIX B: NOISE BARRIER RETROFIT POLICY

Noise Barrier Retrofit Policy

On February 8, 1977, the Ministers 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 List 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, Conservation and Parks and in consultation with the affected municipality.

It is not the intent of the retrofit list 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 are 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 and place of worship;
- Cemeteries;
- Parks and picnic areas that are not inherently part of a NSA;
- Day care centres;
- All commercial; and
- 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 List**

This includes barrier candidate sites that satisfy all warrants for construction and therefore qualify for construction 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 MTO does not rely on the use of noise measurements for the reasons set out in Section 6.4. The MTO accepts the following computerized models:

- STAMINA 2.0,
- The latest version of Traffic Noise Model (TNM©)
- 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. Receptors shall be located in the OLA.

5. **Selection of Candidate Sites**

a. The MTO 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. 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 Retrofit List 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. The objective noise level for rural areas will be considered on a case-by-case basis.

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

c. When designing noise control measures, input on aesthetic treatments should be sought from the Regional Environmental Sections/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. Transparent Noise Barriers

Fully or partially transparent noise barriers can be considered to:

- improve views from the highway;
- avoid reducing views from homes caused by the construction of an opaque noise barrier;
- reduce wall shadow in yards;
- reduce visual height of the barrier wall;
- maintain visibility to adjacent commercial businesses;
- reduce ‘closed in’ feeling for drivers; or
- reduce visual structure height for barriers on structure or elevated sections of highways.

Care must be taken to avoid detrimental noise reflections to the opposing side of the highway or in cases where there could be unwanted reflections from the window areas of the walls.

9. **Reconstruction/Maintenance of Barriers**

a. Previously constructed MTO 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 dB (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 MTO 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.

10. **Non-Barrier Noise Control Measures**

Each MTO region is encouraged to consider all forms of noise control measures within their right-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.

11. **Updating Noise Predictions**

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

12. **Updating Candidate Sites for Noise Barrier Retrofit List**

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