

Appendix J – Noise Report

*Kennedy Road Environmental Assessment between
Steeles Avenue and Major Mackenzie Drive*





REPORT

NOISE IMPACT STUDY

*Municipal Class Environmental Assessment for Kennedy Road
from Steeles Avenue to Major Mackenzie Drive*

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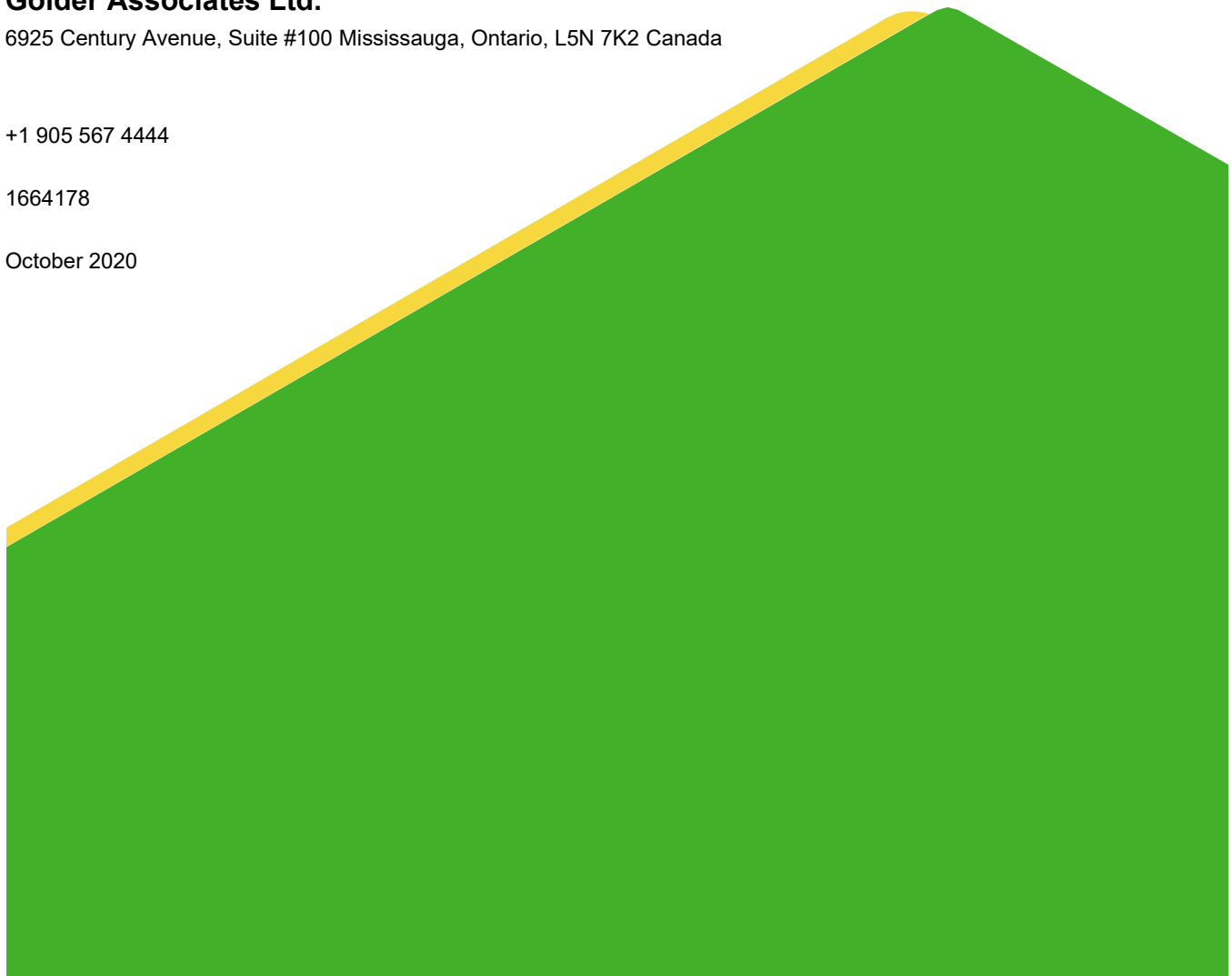
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1.0 INTRODUCTION

The Regional Municipality of York (the Region) retained HDR Inc. (HDR) as the Project Manager Consultant to complete the Municipal Class Environmental Assessment (EA) for proposed improvements to Kennedy Road in the City of Markham (the City), Ontario (the Project). The proposed improvements include widening Kennedy Road from four to six lanes to provide one Transit/High Occupancy Vehicle (HOV) lane in each direction, in addition to modifications to streetscaping and continuous active transportation facilities. HDR retained Golder Associates Ltd. (Golder) to assess the potential noise impact of the Project on identified neighbouring sensitive receptors and prepare this Noise Impact Study (NIS).

The purpose of this NIS is to complete an assessment along Kennedy Road from Steeles Avenue to Major Mackenzie Drive (Project Site). The assessed Kennedy Road Right-of-Way (ROW) (i.e., future with the Project) within the Project Site is shown on Figure 1.

The Region's *Traffic Noise Mitigation Policy for Regional Roads* – March 2006 (Traffic Noise Mitigation Policy) and the Region's *Transportation Services, Capital Delivery – Roads Standard Operating Procedures for Traffic Noise Mitigation on Regional Roads* – July 2010 (Noise Mitigation SOP) formed the basis of the assessment criteria and methodology for the NIS.

2.0 PROJECT DESCRIPTION

According to the Region's 2016 Transportation Master Plan, the need for improvements along Kennedy Road was identified. The objective of the improvements is to increase north-south capacity within the Region's arterial network, accommodate growth and improve overall network connectivity. The proposed improvements include widening Kennedy Road to six lanes to provide one Transit/HOV lane in each direction and modifying streetscaping and continuous active transportation facilities.

Within the Project Site, Kennedy Road crosses rail lines, environmentally sensitive areas, water crossings, Highway 407 and other major roadways.

2.1 Existing Conditions

Currently, Kennedy Road between Steeles Avenue and Major Mackenzie Drive is a four lane, north-south road located in the City of Markham in the Regional Municipality of York. The existing surrounding land uses are primarily residential and commercial. Figure 2 (i.e. Figure 2A through 2H) provides the zoning information surrounding the Project Site. The posted speed limit is 60 km/hr and the existing (2015) Annual Average Daily Traffic (AADT) count for Kennedy Road ranges from 25,096 to 43,971 within the Project Site. A number of intersecting roadways along Kennedy Road have been considered and are further discussed in Section 5.0.

2.1.1 Existing Noise Barriers Investigation

Existing noise barriers were considered in the assessment of noise levels due to the Project. The Region's Noise Mitigation SOP states the following as it relates to existing noise barriers on capital projects;

On capital projects where privately owned noise barriers already exist along reverse frontage properties new noise mitigation will not be provided. At the time when those developments were approved it was identified that noise levels warranted noise mitigation due to traffic on the Regional road. Purchasers of these homes knowingly assumed the responsibility of maintaining the noise barriers provided by the developer as part of their home purchase. In addition to development approval records, as part of the noise policy update study a complete inventory of the types and condition of privately owned noise barriers along Regional roads was completed. Attempts by private owners to remove existing noise fences in order to qualify for new noise barriers as part of a York Region capital project will be denied and these owners will be required to reinstate the noise barrier through enforcement of municipal property standards by-laws.

A preliminary assessment to determine the approximate location of existing physical structures that appeared to be noise barriers or privacy fencing (i.e., non-acoustic barriers such as security fencing or visual screening fencing) was carried out with the use of publicly readily-available information. The Region's Noise Mitigation SOP includes guidance on the design requirements of a noise barrier, but it is Golder's understanding that existing noise barriers may have been designed and constructed before July 2010 when the Region's Noise Mitigation SOP came into effect. Therefore, existing physical structures that are potential noise barriers were determined based on a visual inspection of the overall construction and design, and whether it was similar to other noise barriers typically constructed today (i.e., use of concrete or wood, continuous with no gaps).

Following the preliminary assessment, Golder carried out a Field Program to identify the location and approximate dimensions of existing physical structures that appeared to be effective noise barriers. Again, the determination of whether a barrier was a noise barrier was based on a visual inspection of the overall construction and design, and whether it was similar to other typical noise barriers constructed today (i.e. use of concrete or wood, continuous with no gaps). The identification of whether existing physical structures were noise barriers did not include detailed verifications (i.e. noise measurements, destructive testing, material certifications, material component dimensions, fastening methods, site grading, etc.). The information collected on the noise barriers and privacy fencing was based on observations made from the side along the public property that was readily accessible. The Field Program was carried out on July 19th, 2017 and consisted of the following stages; 1) Documented the Project Site through a drive-by investigation 2) Catalogued each existing physical structure that appeared to be a noise barrier, as described above, within the Project Site; information gathered included identifying its approximate location and providing an estimate of its overall height and length 3) Catalogued each existing non-acoustic barrier (i.e., privacy fence), identifying only its approximate location.

The heights of the existing noise barriers ranged from approximately 1.6 m to 2.6 m and their existing state (i.e., good condition or maintenance required) was also noted during the Field Program.

Intermittent noise-like barriers were identified during the Field Program along rows of homes that largely had privacy fencing. A review of subdivision agreements and/or drawings, where available, indicated that these noise-like barriers were not required as part of the development approval process for these homes. In cases where subdivision agreements were not available, historical publicly available imagery was reviewed to confirm that these noise-like barriers had replaced previously constructed privacy fences. In addition, these noise-like barriers were not identified in an existing noise barrier study (Giffels 2004). Therefore, it was considered that these homes are eligible for a new noise barrier. The acoustical performance of the intermittent noise-like barriers was conservatively not included as they were not considered to be effective and therefore not carried forward in the noise prediction modelling.

In one case, the majority of homes within a subdivision were identified as having noise barriers, while one or more homes within the subdivision were identified as having privacy fencing. A subdivision agreement was not available at this location, however through a review of available information, including the Field Program, historical publicly available imagery, and an existing noise barrier study (Giffels 2004), it was determined that these noise barriers were considered to be provided at this location as part of the development approval process and that the noise barriers were the responsibility of the homeowners. Therefore, as per the Region's Noise Mitigation SOP, these homes are not eligible for a new noise barrier as part of the Project.

Figure 3 summarizes the location of each existing noise barrier that was considered in the assessment.

2.1.2 Existing Terrain Elevations

The Region's Noise Mitigation SOP indicates reliable grade elevations at the receptors, barrier base elevations and road elevations shall be established. Therefore, Golder considered survey data provided by HDR within the Kennedy Road ROW and survey data collected in August 2017 in the backyards of the majority of selected representative receptors. These were supplemented with the Region's *1 m Elevation Contour Lines* dated 2016, readily available through the Region's open data portal.

The survey data indicates the existing terrain elevation ranges from 167 to 208 meters above sea level (masl). The survey data was compared to the Region's dataset and considered to be similar. Based on this review of the existing terrain elevations, it is Golder's opinion the combination of the survey data and the Region's *1 m Elevation Contour Lines* dated 2016 was appropriate for the purposes of the NIS.

2.2 Proposed Future Conditions

For the purposes of the NIS, it is understood the future proposed condition is for the year 2041 (i.e., the mature state of development year) when all construction will be completed and includes the Kennedy Road improvements discussed in Section 2.0. The construction of the Project will consist of at least two phases; per the Region's 2020 10-Year Roads and Transit Capital Construction Program, the segment from 14th Avenue to Highway 7 is anticipated to start construction in 2023 and the remaining segments (i.e., from Steeles Avenue to 14th Avenue and from Highway 7 to Major Mackenzie Drive) are anticipated to start construction sometime beyond 2030 (those segments are not included in the 2020 10-year plan, so it is assumed that construction will start in 2030 at the earliest).

The Kennedy Road ROW (i.e., future with the Project) does not encroach on any of the existing noise barriers identified in Section 2.1.1 and therefore it is expected that all identified existing noise barriers will remain in place.

The posted speed limit on Kennedy Road will remain at 60 km/hr and the 2041 AADT for Kennedy Road will range from 51,933 to 80,145 within the Project Site. The intersecting roadways along Kennedy Road that were considered are further discussed in Section 5.0.

The road profile for Kennedy Road and the intersecting roadways included in the NIS will generally remain as is, except for a proposed underpass beneath the rail line north of Clayton Drive. The future road elevation in this area was provided by HDR. The terrain elevations at the barrier base elevations are not expected to change substantially from the existing conditions assessment as a result of the Project. It was assumed that the existing terrain at the receptors will remain unchanged.

The NIS evaluated existing noise sensitive land uses in the vicinity of the Project Site as well as planned future developments through a review of noise studies provided by HDR, the Region, and individual municipalities. Noise studies were provided for four future developments, which are described as follows:

- 9721 Kennedy Road
 - Golder received an Environmental Noise Feasibility Study dated 20 January 2018 (9721 Kennedy Road Study). This proposed residential development is located on the east side of Kennedy Road, north of Bur Oak Avenue, and will be comprised of two rows of townhomes side facing Kennedy Road. The 9721 Kennedy Road Study identified that noise barriers 1.8 m to 2.2 m in height will be required for the back yards of the end units side-facing Kennedy Road. These will be the responsibility of the developer to provide and of the residents to maintain.

■ York Downs East

- Golder received a Preliminary Environmental Noise Report dated 4 October 2016 (York Downs East Report). This proposed residential development is located on the west side of Kennedy Road, north of 16th Avenue, on the existing York Downs Golf and Country Club property. It will be comprised of standalone homes and stacked townhouses. The York Downs East Report identified that noise barriers 2.2 m to 3.5 m in height will be required for the backyards of the end units directly abutting and side-facing Kennedy Road. These will be the responsibility of the developer to provide and of the residents to maintain.
- The York Downs East Report identifies an area that will contain stacked townhouses to be assessed in a separate environmental noise report which Golder did not receive. It is expected that the developer will develop the property to meet the Region's requirements.

■ Kylemore Yorkton Phase 2

- Golder received a Detailed Environmental Noise Report dated 8 March 2016 (Kylemore Yorkton Report). This proposed residential development is located on the west side of Kennedy Road, north of 16th Avenue, on the properties of 9350 to 9392 Kennedy Road, and will be comprised of townhouse blocks. The Kylemore Yorkton Report indicates that for all units immediately adjacent to Kennedy Road, any outdoor terraces will be less than 4 m in depth and therefore will not meet the Region's definition of an Outdoor Living Area (OLA, described in Section 5.2). Therefore, no noise barriers were identified for this development.
- Note there is a heritage home located on this property at 9392 Kennedy Road that is shown in the Kylemore Yorkton Report to remain after the development is completed. This home has been carried forward in this NIS.

■ 9332, 9336 and 9346 Kennedy Road

- Golder received an Environmental Noise Feasibility Study – Addendum #1 dated 24 May 2019 (Study Addendum) for a mixed-use building that will contain condo units, for which the OLA designs were not finalized prior to the completion of the Study Addendum. The Study Addendum identifies that noise barriers would be required for some of the private terraces with a depth of 4 m or greater, or alternatively the balconies/private terraces could be designed to be less than 4 m in depth and therefore not be considered as OLAs and not require noise barriers. It is expected that the final design will be consistent with this approach and that noise barriers will be provided by the developer for any OLAs meeting the Region's definition where noise levels indicate a noise barrier is required.

It is expected all other future applications to the applicable municipality for development projects that include noise sensitive land uses will be supported with appropriate noise assessments, which would consider future conditions, including this Project.

3.0 DESCRIPTION OF TECHNICAL TERMS

Acoustic values can be described in terms of noise or sound. While noise is defined as unwanted sound, the terms noise and sound are often used interchangeably. An introduction to key concepts used in the assessment of outdoor acoustics is provided below:

- “**Noise**” or “**noise levels**” refers to the levels that can be heard or quantified at a point of reception.
- A noise “**Point of Reception**” or “**Receptor**” is a location where predictions of noise levels are carried out.
- The “**level**” of a noise is expressed on a logarithmic scale, in units called decibels (dB). Since the scale is logarithmic, a noise source that emits twice the noise energy as another will only be three decibels (3 dB) higher.
- Noise emissions and noise levels have an associated frequency content. The human ear does not respond to all frequencies in the same way. Mid-range frequencies are most readily detected by the human ear, while low and high frequencies are harder to hear. Environmental noise levels used in this report are presented as “**A-weighted decibels**” (or dBA), which incorporates the frequency response of the human ear.
- Outdoor noise is usually expressed as an “**equivalent continuous noise level**” ($L_{eq,T}$), which is a logarithmic average (i.e., energy average) of the fluctuating noise levels over a given period of time (T).
- The “**daytime**” noise levels occur for the period from 7:00 to 23:00. The period of time (T) is therefore 16 hours. An equivalent noise level over the daytime period is referred to as $L_{eq,16hr}$.

4.0 RELEVANT GUIDELINES AND POLICIES

The following guidance documents and policies were used to establish the criteria for the assessment of noise from road traffic for this Project. These documents and their relevance to the NIS are summarized in Table 1 below.

Table 1: Applicable Noise Criteria

Governing Body	Guidance Document	Intended Use	Location of Assessment	Criterion to consider for noise mitigation
York Region	York Region Traffic Noise Mitigation Policy for Regional Roads (March 2006)	Regional Roads	<u><i>For Capital Projects:</i></u> Outdoor Living Area (OLA)	Daytime traffic only (i.e., 7:00 to 23:00, 16 hrs) ¹ <u><i>Capital Road Projects</i></u> No mitigation is required if Project start of construction and mature state of development noise levels are ≤60 dBA; Mitigation required when: <ul style="list-style-type: none"> ■ Project start of construction noise levels are >55 dBA and the increase in noise due to the Project is >5 dB. ■ Project start of construction or mature state of development noise levels are >60 dBA. A minimum attenuation of 6 dB must be achieved to warrant a barrier. Mitigation may be deferred until noise levels exceed 60 dBA.
York Region	Transportation Services, Capital Delivery – Roads Standard Operating Procedures for Traffic Noise Mitigation on Regional Roads (July 2010)	Regional Roads	<u><i>For Capital Projects:</i></u> Outdoor Living Area (OLA)	Applies the criterion defined in the <i>York Region Traffic Noise Mitigation Policy for Regional Roads (March 2006)</i>

Notes:

¹ Values represent average noise levels established over the given period.

The Region's Traffic Noise Mitigation Policy and Noise Mitigation SOP provide requirements for noise assessments and mitigation relating to the construction of new or the expansion of existing Regional roads. They identify the requirements regarding noise control measures for various scenarios, including Capital Program Projects. Mitigation is required when future (i.e. mature state of development) noise levels ($L_{eq,16hr}$, from 07:00 to 23:00) at an OLA are expected to increase by more than 5 dB and start of construction levels are expected to exceed 55 dBA, or when the start of construction or mature state of development noise levels are expected to exceed 60 dBA. If a noise barrier is deemed necessary, it must provide a minimum attenuation of 6 dB. Noise mitigation may be deferred until future noise levels exceed 60 dBA.

5.0 METHODOLOGY

According to the Region's policies, the assessment of road traffic noise impact is evaluated by prediction using road traffic information and the Ministry of Environment, Conservation and Parks (MECP) method entitled Ontario Road Noise Analysis Method for Environment and Transportation (ORNAMENT). The Region's Noise Mitigation SOP identifies the noise level descriptor assessed as the 16-hour daytime (i.e., 07:00 to 23:00) sound level, $L_{eq,16hr}$. In order to comply with the Region's Traffic Noise Mitigation Policy, the predicted sound level is assessed at an OLA. Where the noise impact exceeds the applicable criteria, noise barriers should be investigated.

To be inline with the Region's policies, the following methodology was developed to assess the potential noise impacts due to the proposed Project;

- identification of the Area of Investigation;
- identification of Noise Sensitive Areas (NSAs);
- identification of representative OLAs;
- determination of start of construction noise levels without the Project;
- determination of future mature state of development noise levels with the Project;
- determination of potential impact;
- determination of significance; and
- assessment of mitigation.

5.1 Area of Investigation

The Area of Investigation defines an area surrounding the proposed Project where potential noise levels due to road traffic are assessed at sensitive receptor locations. For the NIS, sensitive receptors up to 500 m from the edge of the Project Site were identified. Figure 1 illustrates the Area of Investigation.

5.2 Noise Sensitive Areas

In assessing the noise environment along the Project corridor, receptor locations where noise sensitive land uses exist were identified to satisfy the Region's policies. The Noise Sensitive Areas (NSAs) and respective OLAs were identified within the Area of Investigation and in accordance with the Region's Noise Mitigation SOP as further described below.

The Region's Noise Mitigation SOP defines an NSA as follows:

Noise Sensitive Areas/Land Use. *These are any OLA's associated with noise-sensitive buildings. The following land uses, with OLA's associated with them would qualify as NSA's: private homes such as single and semi-detached family residences; townhouses; multiple unit buildings such as apartments with OLA's for use by all occupants; hospitals or nursing homes where there are OLA's for the patients and day care facilities.*

Examples of noise sensitive land uses provided in the Region's Noise Mitigation SOP include:

- Residential developments.
- Seasonal residential developments.
- Hospitals, nursing/retirement homes, schools, day-care centres.

- Other land uses that may contain indoor and/or outdoor areas/spaces where an intruding noise may create an adverse effect.
- In general, a noise-sensitive land use could be any type of land use where environmental noise is likely to cause an adverse effect or material discomfort whether inside or outside of a building.

According to the Region's Noise Mitigation SOP, OLAs and Points of Reception (PORs) are defined as follows:

Outdoor Living Areas. *The part of an outdoor amenity area provided for the quiet enjoyment of the outdoor environment. The OLA is typically an area at ground level accommodating outdoor living activities. For sound level calculation purposes, the usual distance from the dwelling unit wall up to 4m. The vertical height is 1.5 meters above the ground level. Where unknown, the side closest to the source of noise should be assumed. Paved areas for multiple dwelling residential units may not be defined as OLA. The OLA may include private areas used by individual dwelling occupants or "common" areas used by multi-tenant dwelling occupants. OLA is also the part of an outdoor area easily accessible from the building and designed for the quiet enjoyment of the outdoor environment. Outdoor Living Areas include, but are not limited to, the following:*

- Backyards, front yards, gardens, terraces or patios.
- Balconies, provided they are the only Outdoor Living Areas for the occupant and meet the following conditions; minimum depth of 4 m, outside the exterior building facade, unenclosed.
- Common Outdoor Living Areas associated with multi-storey apartment buildings or condominiums.
- Passive recreational areas such as parks if identified by the City for such use.

Points of Reception. *PORs are defined as residential noise sensitive areas along a Regional surface transportation corridor where it may receive "unacceptable" sound level. The following land uses, with OLA's associated with them would qualify as points of reception under the above criteria:*

- Private homes such as single family residences.
- Townhouses and Multiple unit buildings, such as apartments with OLA's for use by all occupants.

Land uses listed below, by themselves do not qualify; except as previously defined in the "Noise Sensitive Land Use" as points of reception:

- Apartment or house balconies above ground floor;
- Educational facilities (except dormitories with OLA's);
- Places of Worship;
- Cemeteries or funeral homes;
- Public/Private Parks and picnic areas;
- All commercial and industrial areas.

Note: it is understood the Region is developing a new Noise Mitigation SOP which will update an OLA's distance from a dwelling unit wall to 3 m, which will be consistent with the Region's Traffic Noise Mitigation Policy. The Region's Noise Mitigation SOP is applicable to capital projects as well as other types of projects such as development applications and therefore the entire definition above is not strictly applicable to the Project. Only the OLA is considered for capital projects (i.e. indoor levels are not assessed) and PORs are selected from the identified NSAs if they have an OLA that meets the definition.

5.2.1 Noise Sensitive Areas Identification

NSAs and OLAs were identified and selected such that they were representative of the potential impact due to the Project on the acoustic environment within the Area of Investigation. The following methodology was applied to identify NSAs and OLAs along the Project Site;

- NSAs were initially identified along the entire Project Site within the Area of Investigation. Various types of NSAs were noted, due to orientation and location relative to the Project (i.e., front, side or rear facing; directly abutting the Kennedy Road ROW or on a window street).
- NSAs were grouped by area.
- Representative OLA locations (i.e., PORs) were then selected from the NSAs initially identified, at residences that were adjacent to the Kennedy Road ROW. The OLA assessment locations were defined at approximately every fifth home, at a height of 1.5 m above the terrain and 3 m from the centre of the rear façade, in general accordance with the Region's Traffic Noise Mitigation Policy.

A total of 104 representative OLAs were selected. Figure 3 (i.e., 3-A through 3-F) presents the location of the identified groups of NSAs and all representative OLAs. Table 2 below summarizes the representative OLAs and their respective dwelling orientation, proximity to the Kennedy Road ROW and whether they have existing noise barriers. Note, if any part of an NSA directly abuts the Kennedy Road ROW, it has been indicated as such in Table 2, even if the area near the OLA does not; these locations have been identified as such in Table 2.

There are no representative OLAs identified for certain NSAs (i.e., on the east side of Kennedy Road, south of Beckett Avenue and north of 16th Avenue, and on Woltner Way). These properties do not have OLAs that meet the definition of an OLA in accordance with the Region's Noise Mitigation SOP.

Table 2: Representative OLA Locations

ID	Dwelling Orientation	Directly Abut Kennedy Road ROW?	Noise Barrier Exists?
OLA001	Side Facing	No	Yes
OLA002	Front Facing	No	Yes
OLA003	Side Facing	Yes	Yes
OLA004	Front Facing	No	No
OLA005	Side Facing	No	Yes
OLA006	Side Facing	Yes	Yes
OLA007	Side Facing	Yes	Yes

ID	Dwelling Orientation	Directly Abut Kennedy Road ROW?	Noise Barrier Exists?
OLA008	Side Facing	Yes	Yes
OLA009	Side Facing	Yes	Yes
OLA010	Side Facing	No	Yes
OLA011	Front Facing	No	No
OLA012	Side Facing	No	Yes
OLA013	Front Facing	No	No
OLA014	Side Facing	Yes	Yes
OLA015	Side Facing	Yes	Yes
OLA016	Rear Facing	No	No
OLA017	Side Facing	Yes	Yes
OLA018	Side Facing	No	Yes
OLA019	Front Facing	No	No
OLA020	Side Facing	No	Yes
OLA021	Front Facing	No	No
OLA022	Front Facing	Yes ¹	No
OLA023	Front Facing	Yes ¹	No
OLA024	Front Facing	Yes ¹	No
OLA025	Side Facing	Yes	Yes
OLA026	Side Facing	Yes	No ²
OLA027	Rear Facing	Yes	No ²
OLA028	Rear Facing	Yes	No ²
OLA029	Rear Facing	Yes	Yes
OLA030	Front Facing	Yes ¹	No
OLA031	Rear Facing	Yes	No ²
OLA032	Rear Facing	No	No
OLA033	Rear Facing	Yes	No
OLA034	Side Facing	Yes	No

ID	Dwelling Orientation	Directly Abut Kennedy Road ROW?	Noise Barrier Exists?
OLA035	Side Facing	Yes	No ²
OLA036	Rear Facing	Yes	No ²
OLA037	Rear Facing	Yes	No
OLA038	Rear Facing	Yes	No ²
OLA039	Rear Facing	Yes	No
OLA040	Rear Facing	Yes	No
OLA041	Rear Facing	Yes	No
OLA042	Side Facing	Yes	No
OLA043	Rear Facing	Yes	No
OLA044	Rear Facing	Yes	No
OLA045	Rear Facing	Yes	No ²
OLA046	Side Facing	No ³	No
OLA047	Rear Facing	No	No
OLA048	Side Facing	No	No
OLA049	Rear Facing	Yes	Yes
OLA050	Rear Facing	Yes	No ²
OLA051	Rear Facing	Yes	Yes
OLA052	Rear Facing	Yes	No
OLA053	Rear Facing	Yes	Yes
OLA054	Rear Facing	Yes	Yes
OLA055	Rear Facing	Yes	No
OLA056	Rear Facing	Yes	Yes
OLA057	Rear Facing	Yes	No ²
OLA058	Rear Facing	Yes	Yes
OLA059	Rear Facing	Yes	No ²
OLA060	Rear Facing	Yes	Yes
OLA061	Rear Facing	Yes	No

ID	Dwelling Orientation	Directly Abut Kennedy Road ROW?	Noise Barrier Exists?
OLA062	Rear Facing	Yes	Yes
OLA063	Rear Facing	Yes	No
OLA064	Rear Facing	Yes	Yes
OLA065	Rear Facing	Yes	No ²
OLA066	Side Facing	Yes	No ²
OLA067	Rear Facing	No	Yes
OLA068	Side Facing	Yes	No ²
OLA069	Rear Facing	Yes	Yes
OLA070	Rear Facing	Yes	Yes
OLA071	Rear Facing	Yes	No ²
OLA072	Rear Facing	Yes	No ²
OLA073	Rear Facing	No	Yes
OLA074	Rear Facing	Yes	No ²
OLA075	Rear Facing	Yes	No
OLA076	Rear Facing	Yes	No
OLA077	Side Facing	Yes	No
OLA078	Side Facing	No	No
OLA079	Side Facing	Yes	No
OLA080	Rear Facing	Yes	No
OLA081	Rear Facing	No	No
OLA082	Rear Facing	Yes	Yes ⁴
OLA083	Rear Facing	Yes	Yes
OLA084	Side Facing	Yes	Yes
OLA085	Side Facing	Yes	Yes
OLA086	Side Facing	Yes	No
OLA087	Rear Facing	Yes	No
OLA088	Rear Facing	Yes	No

ID	Dwelling Orientation	Directly Abut Kennedy Road ROW?	Noise Barrier Exists?
OLA089	Front Facing	Yes ¹	No
OLA090	Rear Facing	No	No
OLA091	Front Facing	Yes ¹	No
OLA092	Side Facing	Yes	No
OLA093	Side Facing	Yes	Yes
OLA094	Rear Facing	Yes	Yes
OLA095	Front Facing	Yes ¹	No
OLA096	Rear Facing	No	No
OLA097	Rear Facing	Yes	Yes
OLA098	Rear Facing	No	Yes
OLA099	Condo Outdoor Amenity Area	Yes	No
OLA100	Rear Facing	Yes	Yes
OLA101	Rear Facing	Yes	Yes
OLA102	Side Facing	No	No
OLA103	Side Facing	No	No
OLA104	Side Facing	No	No

Notes:

- 1 While the property abuts the Kennedy Road ROW, the area containing the OLA does not. As discussed in Section 5.4, this property will not be carried forward to the additional noise barrier investigation.
- 2 This OLA represents one or more OLAs that have intermittent noise-like barriers, which were not considered in the NIS; refer to Section 2.1.1.
- 3 While this property does not directly abut the Kennedy Road ROW, there is only a small buffer (~1.5 m wide) between the Kennedy Road ROW and the property line. Therefore, this OLA was carried forward to the additional barrier investigation, where an additional noise barrier was considered on the Kennedy Road ROW.
- 4 One or more of the properties represented by this OLA have privacy fencing instead of a noise barrier. Based on available information, a noise barrier was required for all properties represented by this OLA through the development process and therefore is not the responsibility of the Region, as per the Region's Noise Mitigation SOP; refer to Section 2.1.1.

5.3 Traffic Volumes

The existing and future noise levels were predicted at the representative OLAs. Due to the proximity to other major roads with relatively similar or higher AADT volumes to that of Kennedy Road, the NIS included these additional roadways. Table 3 and Table 4 provide the summary of traffic volumes for the roadways considered.

Total and directional traffic volumes along Kennedy Road and for other major roadways within the Project Site were provided by HDR as AADT values for the years 2023, 2030 and 2041. The percentage breakdown of heavy and medium trucks, the 85th percentile speed data, and the daytime and nighttime period percentages for Kennedy Road and other roadways were provided by HDR. Although the posted speed limit along Kennedy Road is expected to remain at 60 km/hr, the existing 85th percentile operating speed data were used to represent the mature state of development 85th percentile vehicle speeds. The minimum 85th percentile vehicle speed at the mature state of development was conservatively considered to be 70 km/hr. In sections where the existing Kennedy Road 85th percentile speed is greater than 70 km/hr, it was conservatively assumed that the 85th percentile speed will be maintained. The traffic data used is summarized in Appendix A.

Table 3: Summary of Vehicle Class and Day/Night Breakdown

Roadway	% Commercial	Truck % (Medium/ Heavy)	Time of Day % (Daytime/ Nighttime) ¹	Posted Speed Limit (km/hr)	Start of Construction 85 th Percentile Speed (km/hr) Northbound	Start of Construction 85 th Percentile Speed (km/hr) Southbound	Mature State of Development 85 th Percentile Speed (km/hr) Northbound	Mature State of Development 85 th Percentile Speed (km/hr) Southbound
Kennedy Road – Major Mackenzie Drive to 16 th Avenue	4	2 / 2	93 / 7	60	75	68	75	70
Kennedy Road – 16 th Avenue to Highway 7	6	3 / 3	94 / 6	60	67	64	70	70
Kennedy Road – Highway 7 to Highway 407	7	3 / 4	93 / 7	60	54	66	70	70
Kennedy Road – Highway 407 to 14 th Avenue	7	4 / 3	93 / 7	60	54	66	70	70
Kennedy Road – 14 th Avenue to Denison Street	7	4 / 3	93 / 7	60	56	67	70	70
Kennedy Road – Denison Street to Steeles Avenue	2	2 / 0	94 / 6	60	56	67	70	70
Major Mackenzie Drive	4	2 / 2	93 / 7	70	81	81	81	81
16 th Avenue	4	2 / 2	94 / 6	60	66	70	66	70
Highway 7	8	4 / 4	93 / 7	70	59	57	59	57

Roadway	% Commercial	Truck % (Medium/ Heavy)	Time of Day % (Daytime/ Nighttime) ¹	Posted Speed Limit (km/hr)	Start of Construction 85 th Percentile Speed (km/hr) Northbound	Start of Construction 85 th Percentile Speed (km/hr) Southbound	Mature State of Development 85 th Percentile Speed (km/hr) Northbound	Mature State of Development 85 th Percentile Speed (km/hr) Southbound
Highway 407	16	9 / 7	93 / 7	100	-	-	-	-
14 th Avenue	6	3 / 3	93 / 7	60	67	69	67	69
Denison St	1	1 / 0	93 / 7	50	69	63	69	63
Steeles Avenue	0	0 / 0	94 / 6	50	-	-	-	-

Note:

1 Daytime (16 Hours) – 7:00 to 23:00. Nighttime (8 Hours) – 23:00 to 7:00.

Table 4: Traffic Data Summary

Roadway	AADT (2023 Start of Construction 14 th Ave to Highway 7)	AADT (2030 Start of Construction Steeles Ave to 14 th Ave and Highway 7 to Major Mackenzie Drive)	Directional Traffic Split % (Northbound / Southbound) Start of Construction	AADT (2041 Mature State of Development)	Directional Traffic Split % (Northbound / Southbound) Mature State of Development
Kennedy Road – Major Mackenzie Drive to 16 th Avenue	33,354	40,579	56 / 44	51,933	58 / 42
Kennedy Road – 16 th Avenue to Highway 7	41,135	48,746	48 / 52	60,705	48 / 52
Kennedy Road – Highway 7 to Highway 407	55,101	64,841	49 / 51	80,145	49 / 51
Kennedy Road – Highway 407 to 14 th Avenue	49,612	55,447	47 / 53	64,616	48 / 52

Roadway	AADT (2023 Start of Construction 14 th Ave to Highway 7)	AADT (2030 Start of Construction Steeles Ave to 14 th Ave and Highway 7 to Major Mackenzie Drive)	Directional Traffic Split % (Northbound / Southbound) Start of Construction	AADT (2041 Mature State of Development)	Directional Traffic Split % (Northbound / Southbound) Mature State of Development
Kennedy Road – 14 th Avenue to Denison Street	50,134	55,577	43 / 57	64,131	43 / 57
Kennedy Road – Denison Street to Steeles Avenue	45,986	51,969	48 / 52	61,371	48 / 52
Major Mackenzie Drive	12,954	13,803	-	15,137	-
16 th Avenue	27,608	30,164	-	34,179	-
Highway 7	36,800	39,766	-	44,428	-
Highway 407	10,323	12,723	-	16,495	-
14 th Avenue	29,904	30,880	-	32,414	-
Denison St	6,790	7,047	-	7,451	-
Steeles Avenue	38,896	41,671	-	46,030	-

Note:

Bolded text represents values used for the start of construction for each segment of roadway

The start of construction year of 2023 from 14th Avenue to Highway 7 is based on the Region's 2020 10-Year Roads and Transit Capital Construction Program which outlines construction planned to start within the next ten years. According to the Region, timing of improvements is subject to the annual review of the Region's 10-Year Roads and Transit Capital Construction Program. Construction from Steeles Avenue to 14th Avenue and from Highway 7 to Major Mackenzie Drive is not included in the 2020 10-Year Roads and Transit Capital Construction Program, and therefore the start of construction year is assumed to be 2030.

5.4 Noise Prediction Modelling

As required by the Region's Noise Mitigation SOP, Golder used the approved ORNAMENT prediction methodology to predict the start of construction and mature state of development conditions at the representative OLAs.

All predictions were carried out for the daytime period (i.e., 7:00 to 23:00), which represents a 16-hour equivalent sound level and is consistent with the Region's Traffic Noise Mitigation Policy. If the start of construction or mature state of development noise levels greater than 60 dBA were predicted at the representative OLA, or if start of construction noise levels were greater than 55 dBA and the change in noise levels due to the Project was greater than 5 dB, investigation of additional noise mitigation was carried out. The additional noise mitigation investigation was only carried out at representative OLAs without existing noise barriers and with backyards, or the amenity area in the case of the condo building, that directly abut the Kennedy Road ROW (i.e., OLAs indicated in Table 2 as side or rear facing and directly abutting the Kennedy Road ROW).

In addition, to including traffic volumes and respective traffic breakdowns for the relevant roadways, the following additional inputs were considered for the ORNAMENT prediction modelling:

- perpendicular distance between the roadway and the representative OLA;
- terrain elevations;
- pavement type of typical asphalt considered for the roadway;
- acoustical hardness of the surface (i.e., hard versus soft ground) between roadway and the representative OLA, based on site conditions;
- road grades, if greater than 2% and a change in elevation greater than 6 m, in accordance with ORNAMENT;
- current and future vehicle speeds, taken as the higher of the posted speed limit and the 85th percentile of the operating speed (note, the posted speed limit along Kennedy Road is expected to remain at 60 km/hr for mature state of development, however the existing 85th percentile operating speed data were used to represent the mature state of development 85th percentile vehicle speeds. The minimum 85th percentile vehicle speed at mature state of development is considered to be 70 km/hr. Where the Kennedy Road existing 85th percentile speed is greater than 70 km/hr it was assumed that the 85th percentile speed will be maintained);
- current and proposed widths of the roadway; and
- noise source exposure geometry at the receiver.

Following a conservative approach, the prediction modelling did not consider potential attenuation from existing privacy fencing (i.e., non-acoustic) between the Project Site and a given representative OLA, but existing noise barriers were included. If intermittent noise-like barriers exist along a row of homes that are otherwise largely unprotected, the performance of the intermittent noise-like barriers was conservatively not considered. Existing noise barriers on adjacent or nearby properties that were not directly along the property of a representative OLA were still considered in the noise prediction modelling in areas where they were expected to materially impact predicted noise levels.

Curved sections of Kennedy Road were split into multiple segments for the purposes of prediction modelling, consistent with the Region's Noise Mitigation SOP. Efforts were concentrated on the segments that were expected to dominate predicted noise levels at a given OLA.

Furthermore, the NIS considers traffic to be free-flowing along Kennedy Road (i.e., accelerating and decelerating not included).

As discussed in Section 2.1.1, a review of available information indicated that one subdivision (containing OLA082 through OLA084) with non-continuous noise barriers (i.e. included sections of privacy fencing) had requirements for a noise barrier as part of their development approval process and therefore is not eligible for a new noise barrier as part of the Project. Therefore, the noise modelling for the NIS considered the noise barrier along this subdivision as continuous (i.e., sections of privacy fencing were modelled as noise barriers).

Consideration was given to the potential for noise levels to increase due to reflections associated with the proposed underpass beneath the rail line north of Clayton Drive. As ORNAMENT is not capable of incorporating reflections from vertical surfaces, a correction factor was determined using the available underpass design and the CadnaA noise modelling software. Assuming that the sides of the underpass will be acoustically reflective, a correction factor of up to 1 dB was added to the noise levels predicted by ORNAMENT at OLAs located near the underpass (i.e., OLA100 and OLA101).

The investigation into additional Regional noise mitigation was carried out as follows:

- Any recommended additional Regional noise barriers will only be constructed at the edge of the Kennedy Road ROW, including corner daylight triangles (i.e., sight triangle), generally in line with existing or future property lines.
- Existing pedestrian walkways/access paths will be maintained (i.e. an opening in any additional Regional noise barrier was considered in the modelling, if applicable).
- Additional Regional noise barriers will not be constructed at land uses not considered to be noise sensitive (i.e. commercial plaza, gas station, etc.). If there is City-owned open space located between an NSA and the Kennedy Road ROW, an additional Regional noise barrier would not be constructed as it would block off the open space.
- Additional Regional noise barriers will be designed and installed in accordance with the Region's Traffic Noise Mitigation SOP; specifically, the panel material will meet a minimum surface density of 20 kg/m² and be continuous without any gaps.

6.0 RESULTS

Following the methodology described in Section 5.0, noise prediction modelling was completed using the ORNAMENT prediction model. The sections below summarize the potential noise impacts associated with the Project and provide an assessment of whether additional noise barriers would be potentially required along the Project Site.

6.1 Determination of Potential Noise Impacts

Results of the noise prediction modelling for all representative OLAs are presented in Table 5. The input data for the ORNAMENT prediction model has been summarized in Appendix B. A sample calculation using STAMSON is provided in Appendix C.

Table 5: Representative OLA Noise Prediction Modelling Results

OLA ID	Dwelling Orientation	Directly Abut Kennedy Road ROW?	Existing Noise Barrier Modelled?	Start of Construction Year	Leq,16hr Start of Construction (dBA)	Leq,16hr Mature State of Development (dBA)	Change in Leq,16hr (dB) ¹	Investigate Additional Noise Barrier?
OLA001	Side Facing	No	Yes	2030	52	53	1	No
OLA002	Front Facing	No	Yes	2030	56	57	1	No
OLA003	Side Facing	Yes	Yes	2030	60	61	1	No
OLA004	Front Facing	No	No	2030	55	56	1	No
OLA005	Side Facing	No	Yes	2030	63	64	1	No
OLA006	Side Facing	Yes	Yes	2030	61	62	1	No
OLA007	Side Facing	Yes	Yes	2030	61	62	1	No
OLA008	Side Facing	Yes	Yes	2030	61	62	1	No
OLA009	Side Facing	Yes	Yes	2030	64	65	1	No
OLA010	Side Facing	No	Yes	2030	59	61	2	No
OLA011	Front Facing	No	No	2030	60	61	1	No
OLA012	Side Facing	No	Yes	2030	58	60	2	No
OLA013	Front Facing	No	No	2030	52	54	2	No
OLA014	Side Facing	Yes	Yes	2030	64	65	1	No
OLA015	Side Facing	Yes	Yes	2030	63	64	1	No
OLA016	Rear Facing	No	No	2030	61	62	1	No
OLA017	Side Facing	Yes	Yes	2030	62	63	1	No
OLA018	Side Facing	No	Yes	2030	60	61	1	No
OLA019	Front Facing	No	No	2030	56	57	1	No
OLA020	Side Facing	No	Yes	2030	59	60	1	No

OLA ID	Dwelling Orientation	Directly Abut Kennedy Road ROW?	Existing Noise Barrier Modelled?	Start of Construction Year	Leq,16hr Start of Construction (dBA)	Leq,16hr Mature State of Development (dBA)	Change in Leq,16hr (dB) ¹	Investigate Additional Noise Barrier?
OLA021	Front Facing	No	No	2030	55	56	1	No
OLA022	Front Facing	Yes ²	No	2030	60	61	1	No
OLA023	Front Facing	Yes ²	No	2030	55	56	1	No
OLA024	Front Facing	Yes ²	No	2030	61	63	2	No
OLA025	Side Facing	Yes	Yes	2030	60	61	1	No
OLA026	Side Facing	Yes	No	2030	66	67	1	Yes
OLA027	Rear Facing	Yes	No	2030	64	65	1	Yes
OLA028	Rear Facing	Yes	No	2030	66	68	2	Yes
OLA029	Rear Facing	Yes	Yes	2030	60	61	1	No
OLA030	Front Facing	Yes ²	No	2030	59	61	2	No
OLA031	Rear Facing	Yes	No	2030	63	65	2	Yes
OLA032	Rear Facing	No	No	2030	61	63	2	No
OLA033	Rear Facing	Yes	No	2030	69	71	2	Yes
OLA034	Side Facing	Yes	No	2030	64	66	2	Yes
OLA035	Side Facing	Yes	No	2030	63	65	2	Yes
OLA036	Rear Facing	Yes	No	2030	69	71	2	Yes
OLA037	Rear Facing	Yes	No	2030	66	69	3	Yes
OLA038	Rear Facing	Yes	No	2030	69	71	2	Yes
OLA039	Rear Facing	Yes	No	2030	66	68	2	Yes
OLA040	Rear Facing	Yes	No	2030	69	71	2	Yes
OLA041	Rear Facing	Yes	No	2030	65	68	3	Yes
OLA042	Side Facing	Yes	No	2030	65	67	2	Yes
OLA043	Rear Facing	Yes	No	2030	68	70	2	Yes
OLA044	Rear Facing	Yes	No	2030	67	69	2	Yes
OLA045	Rear Facing	Yes	No	2030	66	68	2	Yes
OLA046	Side Facing	No ³	No	2030	66	68	2	Yes
OLA047	Rear Facing	No	No	2030	64	66	2	No
OLA048	Side Facing	No	No	2030	64	66	2	No
OLA049	Rear Facing	Yes	Yes	2030	57	59	2	No

OLA ID	Dwelling Orientation	Directly Abut Kennedy Road ROW?	Existing Noise Barrier Modelled?	Start of Construction Year	Leq,16hr Start of Construction (dBA)	Leq,16hr Mature State of Development (dBA)	Change in Leq,16hr (dB) ¹	Investigate Additional Noise Barrier?
OLA050	Rear Facing	Yes	No	2030	69	71	2	Yes
OLA051	Rear Facing	Yes	Yes	2030	59	61	2	No
OLA052	Rear Facing	Yes	No	2030	66	68	2	Yes
OLA053	Rear Facing	Yes	Yes	2030	57	59	2	No
OLA054	Rear Facing	Yes	Yes	2030	59	61	2	No
OLA055	Rear Facing	Yes	No	2030	65	67	2	Yes
OLA056	Rear Facing	Yes	Yes	2030	60	62	2	No
OLA057	Rear Facing	Yes	No	2030	65	67	2	Yes
OLA058	Rear Facing	Yes	Yes	2030	63	65	2	No
OLA059	Rear Facing	Yes	No	2030	66	68	2	Yes
OLA060	Rear Facing	Yes	Yes	2030	62	64	2	No
OLA061	Rear Facing	Yes	No	2030	66	67	1	Yes
OLA062	Rear Facing	Yes	Yes	2030	68	70	2	No
OLA063	Rear Facing	Yes	No	2030	72	73	1	Yes
OLA064	Rear Facing	Yes	Yes	2030	64	66	2	No
OLA065	Rear Facing	Yes	No	2030	70	72	2	Yes
OLA066	Side Facing	Yes	No	2030	64	66	2	Yes
OLA067	Rear Facing	No	Yes	2030	58	60	2	No
OLA068	Side Facing	Yes	No	2030	68	69	1	Yes
OLA069	Rear Facing	Yes	Yes	2030	58	60	2	No
OLA070	Rear Facing	Yes	Yes	2030	60	62	2	No
OLA071	Rear Facing	Yes	No	2030	69	70	1	Yes
OLA072	Rear Facing	Yes	No	2030	66	68	2	Yes
OLA073	Rear Facing	No	Yes	2030	61	63	2	No
OLA074	Rear Facing	Yes	No	2030	64	66	2	Yes
OLA075	Rear Facing	Yes	No	2030	62	64	2	Yes
OLA076	Rear Facing	Yes	No	2030	61	63	2	Yes
OLA077	Side Facing	Yes	No	2030	68	70	2	Yes
OLA078	Side Facing	No	No	2030	56	57	1	No

OLA ID	Dwelling Orientation	Directly Abut Kennedy Road ROW?	Existing Noise Barrier Modelled?	Start of Construction Year	Leq,16hr Start of Construction (dBA)	Leq,16hr Mature State of Development (dBA)	Change in Leq,16hr (dB) ¹	Investigate Additional Noise Barrier?
OLA079	Side Facing	Yes	No	2030	65	66	1	Yes
OLA080	Rear Facing	Yes	No	2030	70	72	2	Yes
OLA081	Rear Facing	No	No	2030	65	67	2	No
OLA082	Rear Facing	Yes	Yes	2023	64	66	2	No
OLA083	Rear Facing	Yes	Yes	2023	64	66	2	No
OLA084	Side Facing	Yes	Yes	2023	63	65	2	No
OLA085	Side Facing	Yes	Yes	2023	63	65	2	No
OLA086	Side Facing	Yes	No	2023	60	62	2	Yes
OLA087	Rear Facing	Yes	No	2023	63	65	2	Yes
OLA088	Rear Facing	Yes	No	2023	61	63	2	Yes
OLA089	Front Facing	Yes ²	No	2023	64	66	2	No
OLA090	Rear Facing	No	No	2023	68	69	1	No
OLA091	Front Facing	Yes ²	No	2030	61	63	2	No
OLA092	Side Facing	Yes	No	2030	66	67	1	Yes
OLA093	Side Facing	Yes	Yes	2030	67	68	1	No
OLA094	Rear Facing	Yes	Yes	2030	61	62	1	No
OLA095	Front Facing	Yes ²	No	2030	58	59	1	No
OLA096	Rear Facing	No	No	2030	60	61	1	No
OLA097	Rear Facing	Yes	Yes	2030	70	72	2	No
OLA098	Rear Facing	No	Yes	2030	63	64	1	No
OLA099	Condo Outdoor Amenity Area	Yes	No	2030	64	66	2	Yes
OLA100	Rear Facing	Yes	Yes	2030	57	56 ⁴	-1	No
OLA101	Rear Facing	Yes	Yes	2030	59	61 ⁴	2	No
OLA102	Side Facing	No	No	2030	57	59	2	No
OLA103	Side Facing	No	No	2030	58	60	2	No
OLA104	Side Facing	No	No	2030	56	57	1	No

Notes:

¹ 0 dB indicates where a small increase due to the Project was predicted but rounds to 0.² While the property abuts the Kennedy Road ROW, the area containing the OLA does not. As discussed in Section 5.4, this property was not carried forward to the additional barrier investigation.

- 3 While this property does not directly abut the Kennedy Road ROW, there is only a small buffer (~1.5 m wide) between the Kennedy Road ROW and the property line. Therefore, this OLA was still carried forward to the additional barrier investigation, where an additional noise barrier was considered on the Kennedy Road ROW.
- 4 Noise levels predicted at OLAs located adjacent to the proposed underpass under the rail line included a correction due to reflections from the sides of the underpass.

Based on the results presented in Table 5, the change due to the Project from the start of construction to mature state of development is less than 5 dB at all representative OLAs. However, the predicted noise levels at many representative OLAs exceed 60 dBA at mature state of development and therefore the Region's Traffic Noise Mitigation Policy indicates mitigation should be investigated at these representative OLAs. Therefore, the effectiveness of additional noise barriers was further investigated at the OLAs where 60 dBA was exceeded, where noise barriers do not already exist and where the OLAs are in areas that directly abut the Kennedy Road ROW.

6.2 Determination of Additional Noise Barriers and Review of Alternative Barrier Heights

Additional Regional noise barriers were further investigated at the representative OLAs that have predicted mature state of development noise levels greater than 60 dBA, where existing noise barriers were not identified and where OLAs were in areas that directly abut the Kennedy Road ROW. As discussed in Section 2.2, it is expected that all identified existing noise barriers will remain in place. It was assumed that proposed additional noise barriers will abut existing adjacent noise barriers or gateway features, where applicable, such that no gaps will exist. The reduction in noise level is based on a comparison of noise levels due to road traffic in the year 2041, with and without the noise barrier. The following were considered, as per the Region's Traffic Noise Mitigation Policy and Noise Mitigation SOP, when further investigating additional noise barriers:

- 1) A noise barrier is considered feasible when it can provide a reduction of 6 dB or greater.
- 2) The minimum and maximum permissible heights of noise barriers are 2.2 m and 3.0 m, respectively and the Commissioner of Transportation Services must approve noise barriers over 2.7 m, where deemed appropriate.
- 3) The noise barrier panel material will meet a minimum surface density of 20 kg/m² and be continuous without any gaps across the adjacent residential properties.
- 4) The noise barriers will only be permitted along the property line at the extreme outer edge of the Kennedy Road ROW.

Table 6 presents the predicted noise levels and summarizes the performance of alternative barrier heights for each of the investigated representative OLAs. The location of the representative OLAs and the investigated additional noise barriers are shown in Figure 4 (Figures 4-A through 4-F).

The results indicate there is an improvement in reducing the overall noise levels as the barrier height increases. Nine of the 16 noise barriers investigated provided the required 6 dB reduction for most of the respective representative OLAs. In these cases, although some of the representative OLAs modelled did not achieve the 6 dB reduction due to the proximity to the end of the noise barrier, a noise barrier was still recommended. The minimum recommended barrier height was based on satisfying the minimum 6 dB reduction at as many of the OLAs behind the barrier as possible. For NewBarrier01 located directly south of 16th Avenue, it is understood that as part of the EA of the road improvements to 16th Avenue, an additional noise barrier along 16th Avenue just west of Kennedy Road is recommended. Any interactions between the recommended 16th Avenue and Kennedy Road noise barriers will be dealt with during detailed design of both projects.

The required 6 dB reduction was not achieved by the remaining seven noise barriers due to the restriction of constructing noise barriers along the Kennedy Road ROW. Therefore, in these cases the additional noise barriers could not be extended far enough to achieve the required 6 dB reduction and would not be considered effective as a result.

During detailed design, the Project team will need to assess the non-acoustic technical (i.e. geotechnical, etc.), economic and administrative feasibility of constructing these identified additional noise barriers. The Region will hold a Public Meeting during the detailed design phase which will provide information to residents on who will receive additional noise barriers.

Table 6: Summary of Investigation of Additional Noise Barriers and Review of Alternative Barrier Heights

Representative OLA ID	Unmitigated 2041 $L_{eq,16hr}$ (dBA)	Additional Barrier		2.2 m High Barrier		2.7 m High Barrier		3.0 m High Barrier ¹		Barrier potentially satisfies the Region's Traffic Noise Mitigation Policy and Noise Mitigation SOP ²	Minimum Recommended Barrier Height (m) ³
		Barrier ID	Estimated Length (m)	2041 $L_{eq,16hr}$ (dBA)	Reduction in $L_{eq,16hr}$ (dB)	2041 $L_{eq,16hr}$ (dBA)	Reduction in $L_{eq,16hr}$ (dB)	2041 $L_{eq,16hr}$ (dBA)	Reduction in $L_{eq,16hr}$ (dB)		
OLA026	67	NewBarrier01	205	58	9	57	10	57	10	Yes	2.2
OLA028	68			60	8	59	9	59	9		
OLA031 ⁴	65			62	3	62	3	62	3		
OLA027	65	NewBarrier02	20	64	1	63	2	63	2	No	-
OLA033	71	NewBarrier03	330	65	6	64	7	64	7	Yes	2.2
OLA036	71			65	6	64	7	63	8		
OLA038	71			65	6	64	7	63	8		
OLA040	71			65	6	64	7	63	8		
OLA043	70			67	3	67	3	66	4		
OLA034	66	NewBarrier04	40	64	2	63	3	63	3	No	-
OLA035	65	NewBarrier05	255	60	5	59	6	58	7	Yes	2.7
OLA037	69			62	7	60	9	59	10		
OLA039	68			60	8	59	9	58	10		
OLA041	68			60	8	59	9	59	9		
OLA042	67			62	5	61	6	60	7		
OLA044	69	NewBarrier06	115	66	3	65	4	65	4	Yes	2.2

Representative OLA ID	Unmitigated 2041 L _{eq,16hr} (dBA)	Additional Barrier		2.2 m High Barrier		2.7 m High Barrier		3.0 m High Barrier ¹		Barrier potentially satisfies the Region's Traffic Noise Mitigation Policy and Noise Mitigation SOP ²	Minimum Recommended Barrier Height (m) ³
		Barrier ID	Estimated Length (m)	2041 L _{eq,16hr} (dBA)	Reduction in L _{eq,16hr} (dB)	2041 L _{eq,16hr} (dBA)	Reduction in L _{eq,16hr} (dB)	2041 L _{eq,16hr} (dBA)	Reduction in L _{eq,16hr} (dB)		
OLA045	68			62	6	61	7	60	8		
OLA046	68	NewBarrier07	35	64	4	64	4	64	4	No	-
OLA050	71	NewBarrier08 ⁵	545	66	5	65	6	64	7	Yes	2.7
OLA052	68			62	6	61	7	60	8		
OLA055	67			61	6	59	8	59	8		
OLA057	67			60	7	59	8	59	8		
OLA059	68			62	6	61	7	60	8		
OLA061	67			60	7	59	8	59	8		
OLA063	73			65	8	63	10	62	11		
OLA065	72			65	7	64	8	63	9		
OLA066	66			58	8	57	9	57	9		
OLA068	69	NewBarrier09	270	61	8	60	9	59	10	Yes	2.2
OLA071	70			63	7	62	8	61	9		
OLA072	68			62	6	60	8	60	8		
OLA074	66			63	3	63	3	62	4		
OLA075	64	NewBarrier10	110	59	5	57	7	56	8	Yes	2.7

Representative OLA ID	Unmitigated 2041 L _{eq,16hr} (dBA)	Additional Barrier		2.2 m High Barrier		2.7 m High Barrier		3.0 m High Barrier ¹		Barrier potentially satisfies the Region's Traffic Noise Mitigation Policy and Noise Mitigation SOP ²	Minimum Recommended Barrier Height (m) ³
		Barrier ID	Estimated Length (m)	2041 L _{eq,16hr} (dBA)	Reduction in L _{eq,16hr} (dB)	2041 L _{eq,16hr} (dBA)	Reduction in L _{eq,16hr} (dB)	2041 L _{eq,16hr} (dBA)	Reduction in L _{eq,16hr} (dB)		
OLA076	63			60	3	60	3	60	3		
OLA077	70	NewBarrier11	60 ⁶	66	4	64	6	64	6	Yes	2.7
OLA079	66	NewBarrier12	65	63	3	62	4	62	4	No	-
OLA080	72	NewBarrier13	60	68	4	67	5	66	6	Yes	3.0
OLA086	62	NewBarrier14 ⁵	85	60	2	59	3	59	3	No	-
OLA087	65			62	3	61	4	61	4		
OLA088	63			61	2	60	3	60	3		
OLA092	67	NewBarrier15	50	66	1	66	1	66	1	No	-
OLA099	66	NewBarrier16 ⁵	55	61	5	61	5	61	5	No	-

Notes:

- ¹ The Region's Commissioner of Transportation Services must approve noise barriers over 2.7 m where deemed appropriate.
- ² Following the Region's Traffic Noise Mitigation Policy and Noise Mitigation SOP, a barrier is generally only deemed feasible when it can provide a reduction of 6 dB or greater.
- ³ The minimum recommended barrier height is that which provides a reduction of at least 6 dB at the most representative OLAs.
- ⁴ Due to the diverging of the property line associated with this OLA and the Kennedy Road ROW, the additional noise barrier extends only part way across this property.
- ⁵ Walkways to provide access from Kennedy Road to other adjacent side streets or the condo building at 7363 Kennedy Road, result in openings in NewBarrier08, NewBarrier14, and NewBarrier16. The predicted noise levels consider the opening in the noise barriers, and the total lengths presented here do not include the distance across the opening.
- ⁶ The estimated northern extent and corresponding length of NewBarrier11 was determined based on the minimum length required for a 3.0 m high barrier to achieve a 6 dB reduction in noise level, while maintaining public walkways and considering the terrain (i.e., the slope down to the Rouge River) north of OLA077.

7.0 CONCLUSIONS

Based on the Noise Impact Study carried out by Golder Associates Ltd. for HDR Inc., the following conclusions were determined:

- The existing Kennedy Road right-of-way consists of adjacent properties with and without property line fences. For the properties with fences, both noise barriers and non-acoustic barriers (i.e., privacy fencing) exist.
- Outdoor Living Areas of homes with existing noise barriers were not considered for additional noise mitigation as the Region's policy for Capital Projects is that the Region will not implement new noise mitigation where noise barriers already exist.
- The change in sound levels due to the Project from start of construction to the mature state of development is less than 5 dB at all representative Outdoor Living Areas, which alone does not warrant consideration for mitigation.
- The Region's Policy has an additional sound level criterion for considering noise barrier mitigation (i.e., $L_{eq,16hrs} > 60$ dBA) which is exceeded at nearly all identified representative Outdoor Living Areas that are generally side or rear facing and do not already have a noise barrier.
- Sixteen groups of Noise Sensitive Areas with unmitigated Outdoor Living Areas along Kennedy Road were identified and examined for additional mitigation opportunities.
- Potential additional noise barriers along the Kennedy Road right-of-way were identified in the study and further investigated to determine whether they meet the Region Policy requirements. Nine noise barriers were able to meet the Region's policy requirements at their respective Outdoor Living Areas and were therefore considered to be effective in mitigating excess traffic noise levels.
- The Project team will need to assess the technical, economic and administrative feasibility of constructing the identified additional barriers during detailed design.

8.0 REFERENCES

Giffels Associates Limited. 2004. *York Region Ownership and Maintenance Options for Existing Noise Barriers Along Regional Roads*.

York Region – City Council. (March 23, 2006). *York Region Traffic Noise Mitigation Policy for Regional Roads*.

York Region – Transportation Services. (July 2010). *Standard Operating Procedure for Traffic Noise Mitigation on Regional Roads*.

Signature Page

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Golder Associates Ltd.

Original signed by

Shira Daltrop, M.A.Sc.
Noise Specialist

SD/JT/ng

Original signed by

Joe Tomaselli, P.Eng
Associate/Acoustics, Noise and Vibration Engineer

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FIGURES

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LEGEND

ASSESSED FUTURE RIGHT-OF-WAY

AREA OF INVESTIGATION

KEY MAP

1:60,000

0 250 500
METRES

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – ONTARIO. <https://www.ontario.ca/government/open-government-licence-ontario>

2. 2018 IMAGERY - SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AERGRID, IGN, AND THE GIS USER COMMUNITY

SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

PROJECTION: TRANSVERSE MERCATOR

DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

HDR CORPORATION

PROJECT

MUNICIPAL CLASS EA KENNEDY ROAD NOISE IMPACT STUDY

TITLE

SITE LOCATION

CONSULTANT	YYYY-MM-DD	2020-02-13
	DESIGNED	SO
	PREPARED	RRD
	REVIEWED	SD
	APPROVED	SC

PROJECT NO.	CONTROL	REV.	FIGURE
1664178	0001	A	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 28mm



LEGEND

ASSESSSED FUTURE RIGHT-OF-WAY

AREA OF INVESTIGATION

LANDUSE

AGRICULTURAL

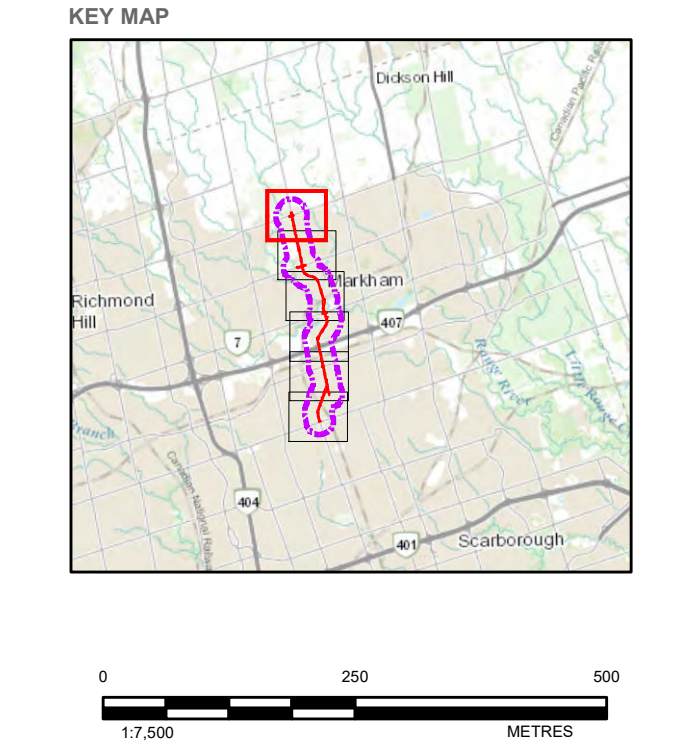
COMMERCIAL

OPEN SPACE/PARK

RESIDENTIAL

ENVIRONMENTAL PROTECTION

HAZARD



REFERENCE(S)

1. 2018 IMAGERY - SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AERGRID, IGN, AND THE GIS USER COMMUNITY SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

2. CITY OF MARKHAM LAND USE DATA PROVIDED BY CLIENT HDR.

PROJECTION: TRANSVERSE MERCATOR

DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT

HDR CORPORATION

PROJECT

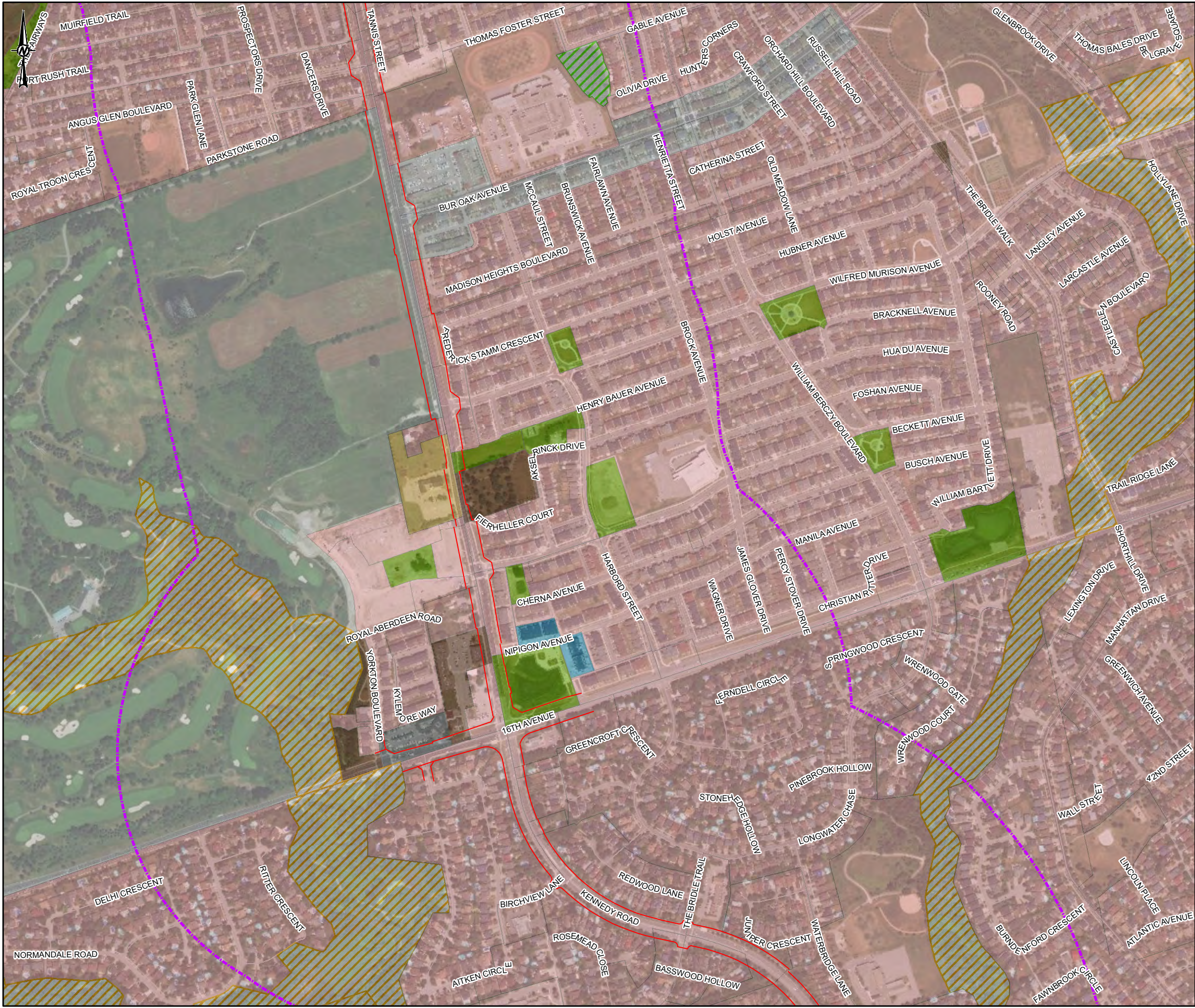
MUNICIPAL CLASS EA KENNEDY ROAD NOISE IMPACT STUDY

TITLE

ZONING

CONSULTANT	YYYY-MM-DD	2020-02-13
DESIGNED	SO	
PREPARED	CGE	
REVIEWED	SD	
APPROVED	SC	



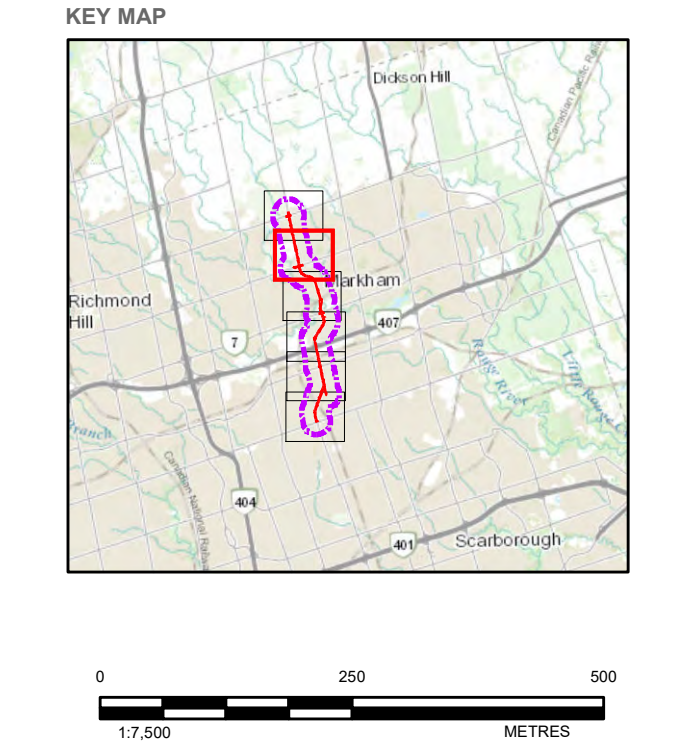


LEGEND

ASSESSED FUTURE RIGHT-OF-
 AREA OF INVESTIGATION

LANDUSE

- AGRICULTURAL
- COMMERCIAL
- NEIGHBOURHOOD
- COMMUNITY
- INSTITUTIONAL
- OPEN SPACE/PARK
- RESIDENTIAL
- ENVIRONMENTAL PROTECTION
- HAZARD



REFERENCE(S)

1. 2018 IMAGERY - SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AERGRID, IGN, AND THE GIS USER COMMUNITY
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PROJECTION: TRANSVERSE MERCATOR
DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
HDR CORPORATION

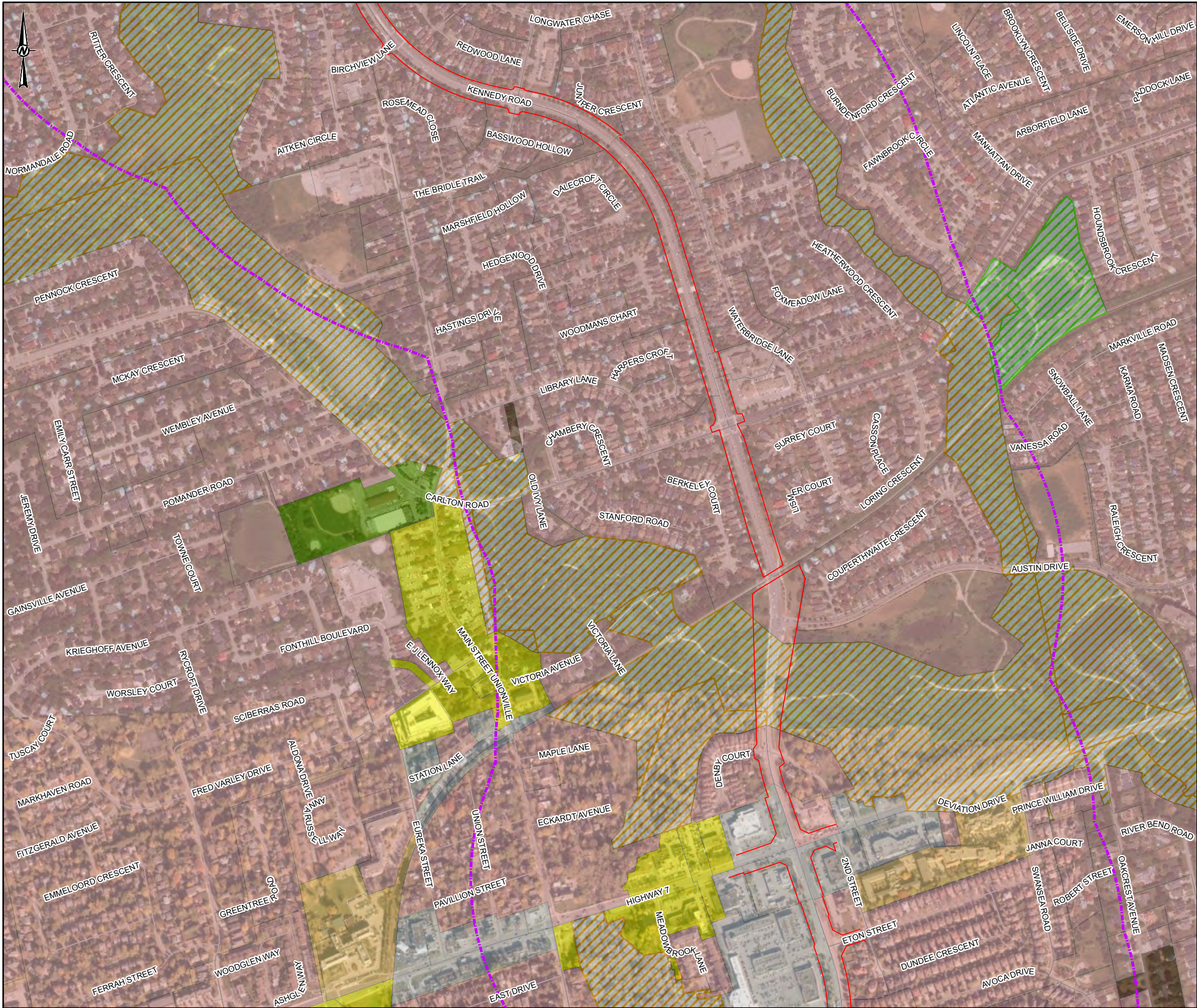
PROJECT
MUNICIPAL CLASS EA KENNEDY ROAD NOISE IMPACT STUDY

TITLE
ZONING

CONSULTANT	YYYY-MM-DD	2020-02-13
	DESIGNED	SO
	PREPARED	CGE
	REVIEWED	SD
	APPROVED	SC

GOLDER

PROJECT NO. 1664178	CONTROL 0001	REV. A	FIGURE 2-B
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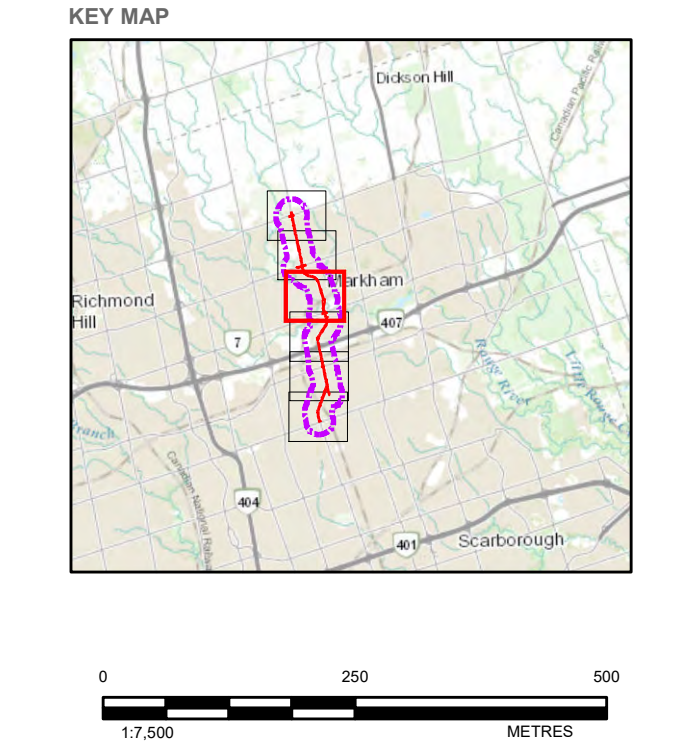
LEGEND

ASSESSSED FUTURE RIGHT-OF-WAY

AREA OF INVESTIGATION

LANDUSE

- AGRICULTURAL
- COMMERCIAL
- INSTITUTIONAL
- OPEN SPACE/PARK
- RESIDENTIAL
- SPECIAL POLICY
- ENVIRONMENTAL PROTECTION
- HAZARD



REFERENCE(S)

1. 2018 IMAGERY - SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRIID, IGN, AND THE GIS USER COMMUNITY
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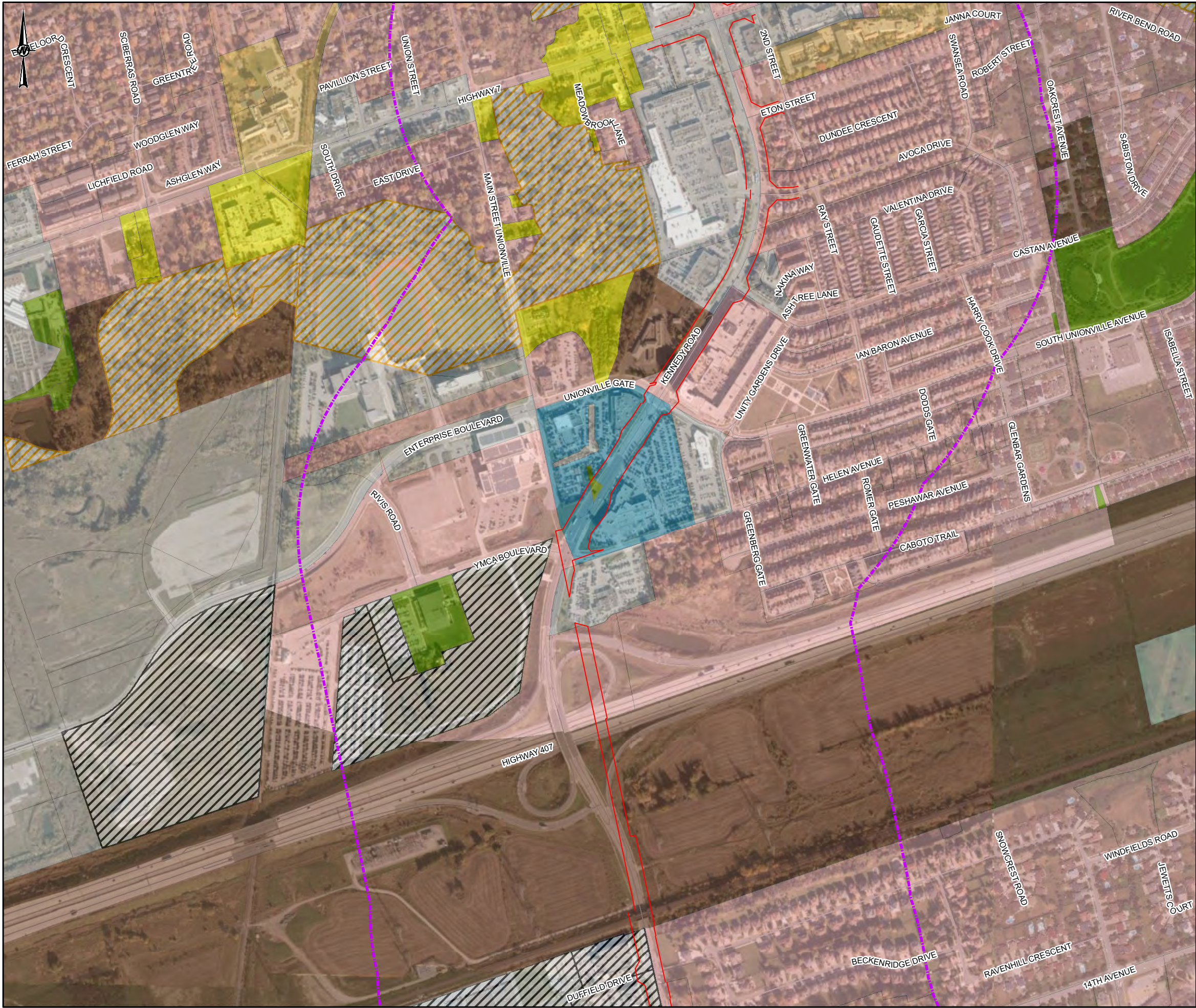
CLIENT
HDR CORPORATION

PROJECT
MUNICIPAL CLASS EA KENNEDY ROAD NOISE IMPACT STUDY

TITLE
ZONING

CONSULTANT	YYYY-MM-DD	2020-02-13
DESIGNED	SO	
PREPARED	CGE	
REVIEWED	SD	
APPROVED	SC	

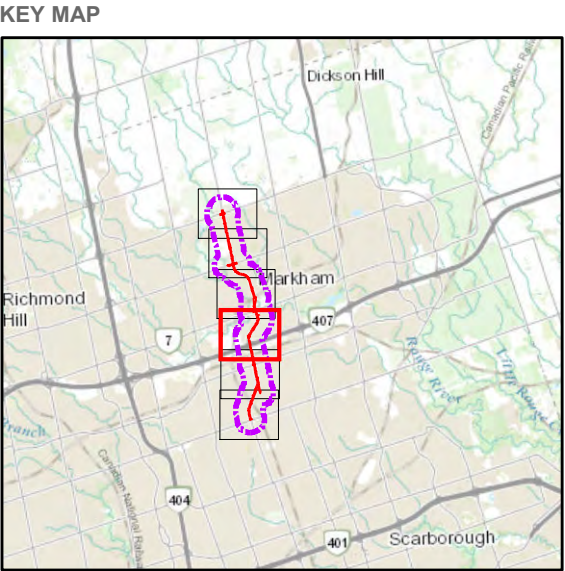




LEGEND

ASSESSED FUTURE RIGHT-OF-
 AREA OF
LANDUSE

- AGRICULTURAL
- COMMERCIAL
- COMMUNITY
- INDUSTRIAL
- INSTITUTIONAL
- OPEN SPACE/PARK
- RESIDENTIAL
- SPECIAL POLICY
- HAZARD



REFERENCE(S)

1. 2018 IMAGERY - SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRI, IGN, AND THE GIS USER COMMUNITY
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PROJECTION: TRANSVERSE MERCATOR
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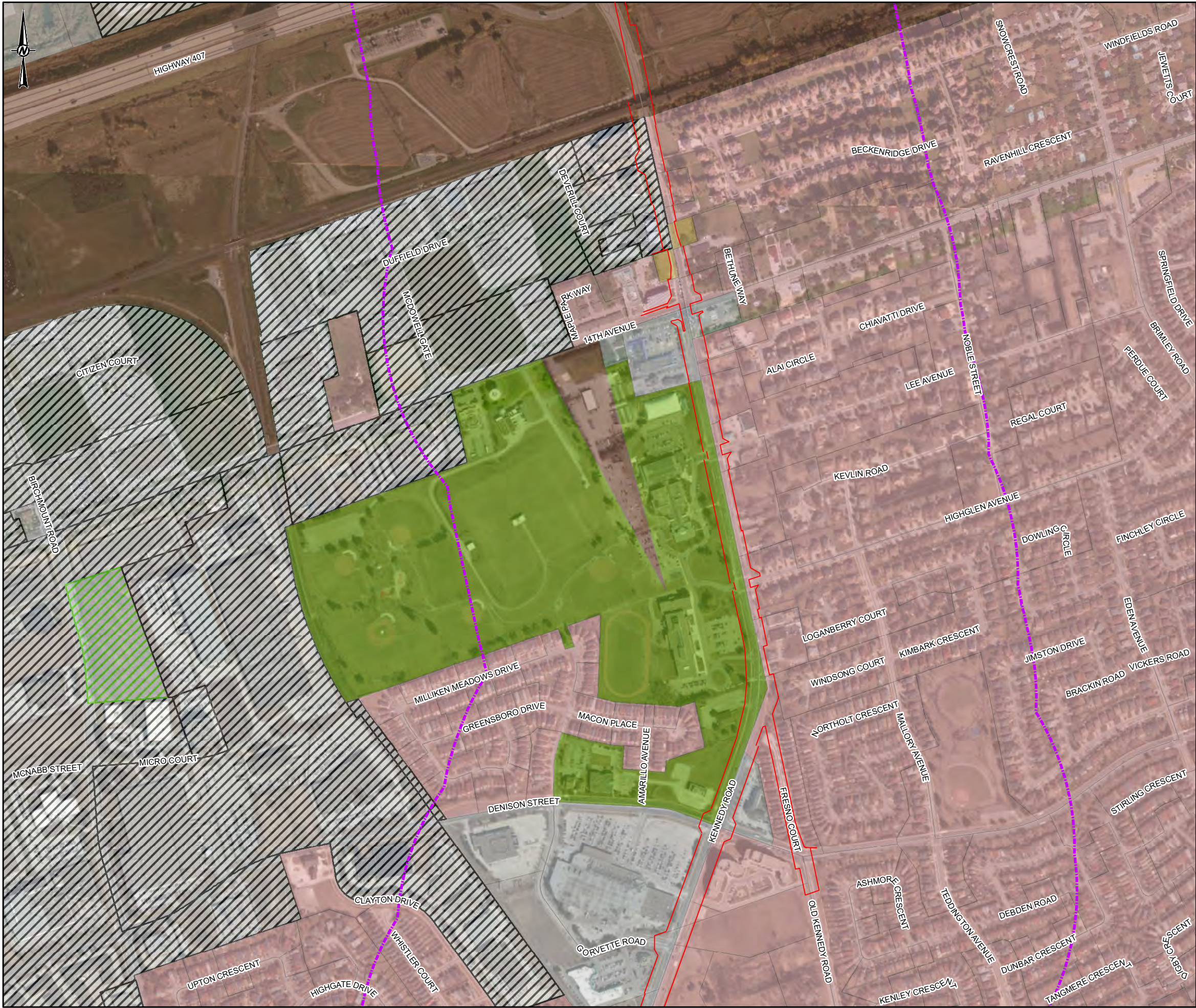
CLIENT
HDR CORPORATION

PROJECT
MUNICIPAL CLASS EA KENNEDY ROAD NOISE IMPACT STUDY

TITLE ZONING		
CONSULTANT	YYYY-MM-DD	2020-02-13
DESIGNED	SO	
PREPARED	CGE	
REVIEWED	SD	
APPROVED	SC	



PROJECT NO. 1664178	CONTROL 0001	REV. A	FIGURE 2-D
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LEGEND

ASSESSED FUTURE RIGHT-OF-WAY

AREA OF INVESTIGATION

LANDUSE

AGRICULTURAL

COMMERCIAL

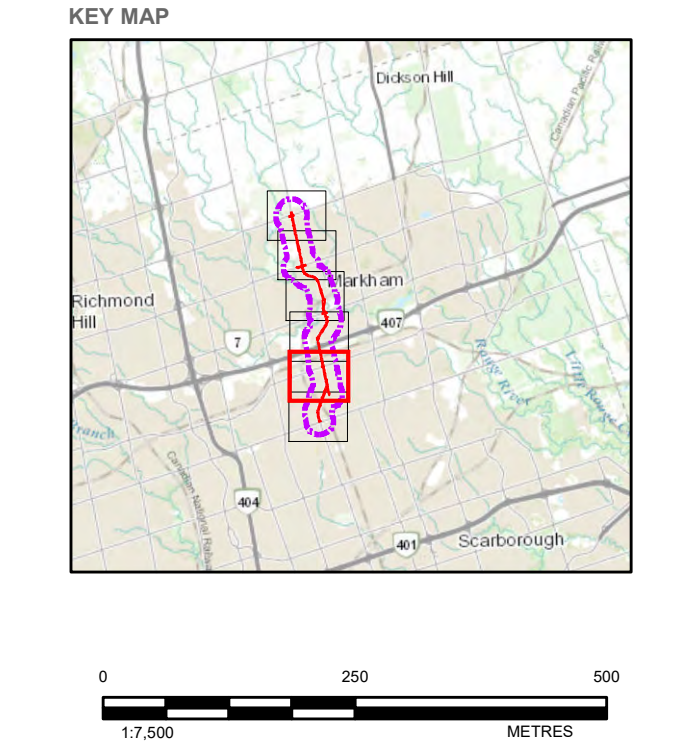
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INSTITUTIONAL

OPEN SPACE/PARK

RESIDENTIAL

ENVIRONMENTAL PROTECTION AREA;



REFERENCE(S)

1. 2018 IMAGERY - SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRI, IGN, AND THE GIS USER COMMUNITY
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PROJECTION: TRANSVERSE MERCATOR
DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT			
HDR CORPORATION			
PROJECT			
MUNICIPAL CLASS EA KENNEDY ROAD NOISE IMPACT STUDY			
TITLE			
ZONING			
CONSULTANT		YYYY-MM-DD	2020-02-13
		DESIGNED	SO
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		REVIEWED	SD
		APPROVED	SC
PROJECT NO.	CONTROL	REV.	FIGURE
1664178	0001	A	2-E