Appendix K
Environmental Noise Impact Assessment
(Hatch - May 2019)

Environmental Noise Impact Assessment

2019-05-17	0	For Use	D. Jiang D. Chamberlain	M. Choy	M. Armstrong	-
Date	**Rev.**	**Status**	**Prepared By**	**Checked By**	**Approved By**	**Approved By**
HATCH						**Client**

Project Report

City of Kingston

Third Crossing Bridge

Distribution

M. Armstrong
M. Choy
D. Franco
Z. McGee
S. Majstorovic
B. Rajlic
J. Scheer

Environmental Noise Impact Assessment

Table of Contents

List of Appendices

Appendix A

Zoning map

Appendix B

Sources: Road Information, Traffic Counts, Construction Equipment, Train Traffic

Appendix C

Receptor Result

Appendix D

Sound Level Contour Plots

Appendix E

Permanent and Temporary Barrier Locations

1. Introduction

The City of Kingston (The City) is planning to build the Third Crossing Bridge across the Cataraqui River in Kingston, Ontario (The Project). The Project connects the existing John Counter Boulevard to the west of the Cataraqui River with Gore Road to the east. Existing residential and potential residential developments surround the project. Several noise impact studies have been performed on for both the construction and the operation scenarios of The Project, namely by RWDI AIR Inc. in 2012 [1] and by Golder Associates in 2017 [10].

The objective of this study is to re-assess the community noise impact of operations and construction of the Third Crossing Bridge. The study area includes the regions immediately around each end of the bridge, and the bridge itself. Where applicable, permanent and temporary noise controls are proposed based on the latest traffic models, detailed design of the Third Crossing Bridge, surrounding road modifications (such as the Highway 15 widening), and anticipated construction zones. This noise impact study predicts and evaluates changes in the noise environment due to the Third Crossing Bridge at the year of construction completion (2022), its 12-year horizon (2034), and during the anticipated worse case construction phase.

2. Assessment Criteria

2.1 Operational Criteria

Relevant transportation noise criteria is listed below in Table 2-1

Table 2-1: List of Guidelines and Bylaws

Governing Body	Document	Time	Location of Assessment[1]	Criteria to Consider Mitigation[2]
Ontario Ministry of Transportation (MTO)	Environmental Guide for Noise (October 2006) [[1]]	Daytime	Outdoor Living Area (OLA) (1.2 m above grade)	≥ 65 dBA OR ≥ 5 dBA change
Ontario Ministry of the Environment, Conservation, and Parks (MOECP)	NPC-300: Environmental Noise Guideline -Stationary and Transportation Sources –	Daytime	Outdoor Living Area (OLA)	> 55 dBA
		Daytime	Indoor	> 45 dBA

Governing Body	Document	Time	Location of Assessment[1]	Criteria to Consider Mitigation[2]
	Approval and Planning (August 2013) [[3]]	Nighttime	Indoor	> 40 dBA
City of Kingston	By-Law Number 2004-52 [[4]]	N/A	Point of Reception	Time restrictions depending on the activity type and location

[1]Outdoor Living Area (OLA): 1.5 m above grade unless otherwise specified. Indoor: same height as Plane of Window (POW), 4.5 m above grade.

[2]Level based on 16 hr daytime Leq (07:00 – 23:00) or 8 hr nighttime Leq (23:00 – 07:00)

As The Project is not part of the provincial highway network, where Ministry of Transportation Ontario (MTO) guidelines apply, the Ministry of the Environment, Conservation, and Parks (MECP) NPC-300 would be a suitable basis. However, NPC-300 guidelines for addressing transportation noise sources mainly focuses on criteria applied by residential developers. As a result, several noise controls such as air conditioning, building window construction, and building wall construction remain unavailable as options for The Project.

Therefore a combined assessment criteria that considers the most suitable guidelines recommend by MTO and MECP for residential road development have been established and summarized in Table 2-2.

Table 2-2: Assessment Criteria

Change in Noise Level Above Ambient / Projected Noise Levels with Proposed Improvements		Mitigation Effort Required
OLA (daytime only)	≤ 55 dBA	None
	Between 55 and 65 dBA, ≤ 5 dB change	None
	Between 55 and 65 dBA, > 5 dB change	Investigate noise control measures on right-of-way
	> 65 dBA	Investigate noise control measures on right-of-way
	≤ 45 dBA	None

Change in Noise Level Above Ambient / Projected Noise Levels with Proposed Improvements		Mitigation Effort Required
Indoor (day)	> 45 dBA	Investigate noise control measures on right-of-way
Indoor (night)	≤ 40 dBA	None
	> 40 dBA	Investigate noise control measures on right-of-way

Where mitigation is required, the control should be technically, economically, and administratively feasible. Technically feasible would require a minimum 5 dB reduction at any one of the representative receptors in order to be considered. Economically feasible would consider the size of the barrier does not significantly outweigh the number of receptors it serves. Administratively feasible should allow that the control can be appropriately placed on an available right of way without significantly diminishing its effectiveness.

2.2 Construction Criteria

Due to the temporary nature of construction, municipal and provincial noise guidelines for construction noise are limited and are commonly based on industry best practices. In January 2017, Health Canada published a guideline for assessing the human health impacts from environmental noise [5]. The guideline recommends that construction activity lasting more than 1-year should apply controls when the change in the percentage of highly annoyed between the existing and worst case construction phase exceeds 6.5%.

The 6.5% Highly Annoyed threshold is relatively consistent with identifying areas where noise levels increase by 10 dB or more due to construction, which has been recommended as part of other construction noise guidelines such as in US FTA [6].

Where the 6.5% Highly Annoyed threshold is identified, temporary noise controls shall be recommended to reduce the percentage highly annoyed to 6.5% or below where reasonably practical.

3. Noise Source Summary

3.1 Operational Sources

The overall noise impact at a receptor is a combination of stationary sources, such as industrial facilities, and traffic sources, including road, rail, and air traffic. There are no large industrial facilities or airports within the close proximity of the Project, and most of the surrounding areas are residential and small businesses. The existing railway and road noise sources are considered in this assessment.

The study assesses the increase of road traffic noise from the year of construction completion (2022) to 12 years after the completion (2034) for both “Build” (with The Project) and “No Build” (without The Project) cases, four scenarios in total. Road improvements considered include widening of Gore Rd, as well as the construction of the Third Crossing Bridge over the Cataraqui River and the connection to John Counter Boulevard and Gore Rd.

Road traffic noise is based on vehicle size, speed, road width, and traffic counts. Road information was mainly obtained from Hatch Design Criteria – Civil [[6]] (bridge), Traffic Forecast and Truck Composition [[8]] (bridge), John Counter Boulevard / Montreal Street Access Alternatives by Dillon Consulting [[9]] (west shore), and Noise Impact Study by Golder Associates [[10]] (east shore).

AADT (Annual Average Daily Traffic) and peak hour traffic counts from the four sources mentioned above were adjusted to generate daytime and nighttime hourly traffic counts for each segment of road within the assessed area, for each scenario. This traffic information is presented in further detail in Appendix B.

The following assumptions were made when calculating the hourly traffic counts:

- A growth rate of 2% is applied for No Build cases.
- A growth rate calculated using information from Hatch Design Criteria – Civil is applied for Build cases.
- 90% of the AADT is assumed to be during daytime, 16 hours from 7 AM to 11 PM.

3.2 Construction Sources

Construction activity is anticipated to occur largely in 7 separate zones. These zones are identified in Figure 3-1: West and East Shore Construction Zones

below.

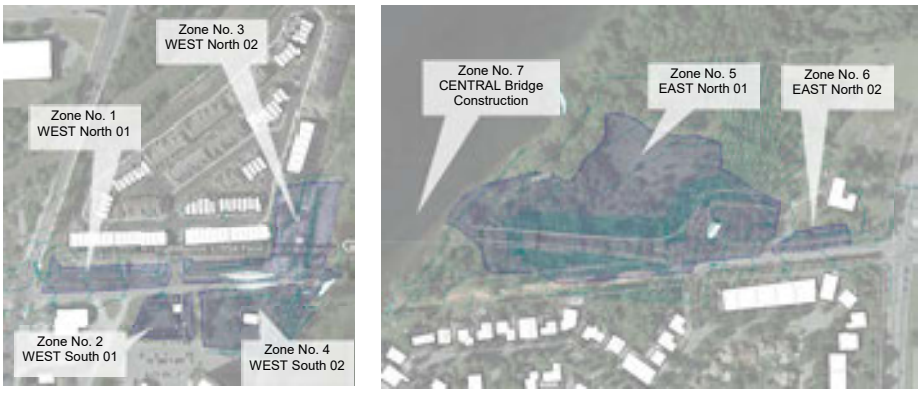


Figure 3-1: West and East Shore Construction Zones

Each construction zone is modeled as an area source at 1.5 m above grade. The sound power of each area source is composed of all the anticipated construction equipment that could be operating simultaneously during the expected worse case construction phase. All area sources are modeled to be simultaneously active. The modelling is therefore conservative in this aspect. The construction equipment and associated sound powers for each construction zone are listed in Appendix B.

Piling pier construction on water has also been included in the noise assessment model. The worst case scenario of piling was modelled at each end of the bridge at the closest pier locations to the shore. Piling is anticipated to occur at 1 pier location at a time. Once again, the construction equipment and associated sound powers for piling pier construction are listed in Appendix B.

4. Receptor Summary

Twenty-four (24) locations were chosen to represent dwellings or potential residential areas that would be most sensitive to changes in the noise environment resulting from the road improvements. These receptor locations are listed in Table 4-1 below.

Table 4-1: Representative Receptor Locations

ID	Land Use	Address	UTM Coordinates (Zone 18)	
			Easting	Northing
			(m)	(m)
NR1	Residential Home	132 Briceland St	381270	4901580
NR2	Community Center	730 John Counter Blvd	381392	4901462
NR3	Residential Home	901 Montreal St	381637	4901429
NR4	Residential Home	806 Newmarket Ln	381672	4901557
NR5	Residential Home	760 Newmarket Ln	381856	4901565
NR6	Apartment	67 Village Dr	381819	4901415
NR7	Residential Home	82 Kenwoods Cir	382976	4901608
NR8	Residential Home	64 Kenwoods Cir	382852	4901457
NR9	Residential Home	100 Kenwoods Cir	383123	4901607
NR10	Residential Home	83 Barker Dr	383254	4901643
R11	Library	80 Gore Rd	383356	4901725
NR12	Residential Home	71 Barker Dr	383368	4901634
NR13	Residential Home	708 MacLean Ct	383487	4901653

ID	Land Use	Address	UTM Coordinates (Zone 18)	
			Easting	Northing
			(m)	(m)
NR14	Residential Home	6 Dalgleish Ave	383481	4901747
NR15	Undeveloped Land - Potential Residential	-	383288	4901874
NR16	Residential Home	63 Barker Dr	383379	4901571
NR17	Residential Home	104 Point St Mark Dr	383215	4901628
NR18	Residential Home	73 Barker Dr	383361	4901665
NR19	Residential Home	88 Kenwoods Cir	383033	4901620
NR21	Residential Home	746 Newmarket Ln	381899	4901637
NR23	Residential Home	770 Newmarket Ln	381785	4901560
NR24	Residential Home	778 Newmarket Ln	381763	4901559

Following the NPC-300 guideline, all the receptors representing Outdoor Living Amenities (OLAs) are located 3 m from the back of the dwelling unit at a height of 1.5 m. Where applicable, OLAs represented by the prefix NR, have an associated Plane of Window (POW) assessment point at the dwelling on the same property positioned 4.5 m high. These POW receptors are identified with a prefix R.

5. Impact Assessment

5.1 Noise Modelling

The noise model used for the acoustic assessment was built using the acoustic modeling software CADNA-A employing the Federal Highway Administration (FHWA) Traffic Noise Model (TNM) algorithm for traffic and the ISO 9613 algorithm for stationary sources (construction zones). Since the waterbody occupies majority of the assessed area, a conservative approach of applying an overall absorption factor of 0.1 was used in the model. The maximum order of reflections was set to be 1. The configuration parameters of “No sub. Of neg. Ground Att” and “No neg. path difference” were activated to conservatively model excessive ground attenuation and barriers that do not break the line of sight with receptors. Ground elevation, road/bridge elevation and height of the dwellings were also considered in the noise model.

5.2 Predicted Noise Levels

5.2.1 Operational Noise Levels

The predicted daytime noise exposure levels at representative OLAs for two (2) barrier option layouts are listed in Table 5-1. Option 1 applies the noise barriers required to achieve compliance on shore. While Option 2 applies the required amount of barriers on the bridge.

Similarly, predicted indoor noise exposure levels at representative receptors for each option are listed in Table 5-2.

. Summarizing the criteria outlined in Table 2-2, non-compliance occurs when:

- OLA levels during the 'Build' case are between 55 and 65 dBA AND the difference between the 'No Build' and 'Build' is greater than 5 dB
- OLA during the 'Build' case is greater than 65 dBA
- Indoor 'Build' case day levels are greater than 45 dBA
- Indoor 'Build' case night levels are greater than 40 Dba

Therefore, if either the with barrier build case is 55 dBA or less or the change between the barrier build and the no build case is less than 5 dB, the location is in compliance. Achieving either of these conditions is highlighted in GREEN in Table 5-1.

5.2.2 Barrier Effectiveness

At two representative receptors (highlighted in ORANGE in Table 5-1), the compliance requirements as noted above in Section 2.1 are met. However, the proposed options 1 and 2 that achieve compliance for surrounding NSAs, do not provide a 5 dB reduction. The options are therefore not considered technically feasible.

For NR4, there is an existing barrier and the adjoining barrier NBRW01 provides effective noise shielding to adjacent dwellings to the east despite only providing a 4 dB reduction for NR4. NBRW01 should be retained in order maintain adequate noise reduction for adjacent receptors.

For NR7, the barrier that provides noise shielding is NBRE09-2. NBRE09-2, which is erected along the crash barrier on the bridge is capable of lowering noise levels at directly affected receptors to 55 dBA. However, the effectiveness of NBRE09-2 is limited to a maximum reduction of 3 dB based on practical constraints. The optional installation of NBRE09-2 should be considered given its effectiveness does not achieve the recommended minimum 5 dB reduction as per the Ministry of Transportation Ontario (MTO) guidelines.

Table 5-1 Daytime Sound Levels at OLA

ID	2022 No Build [dBA]	2022 Build (w/o barrier) [dBA]	Barrier Option 1: 2022 Build (w/ barrier) [dBA]	Barrier Option 1: Difference (Build w/ barrier minus No Build) [dB]	Barrier Option 2: 2022 Build (w/ barrier) [dBA]	Barrier Option 2: Difference (Build w/ barrier minus No Build) [dB]	2034 No Build [dBA]	2034 Build (w/o barrier) [dBA]	Barrier Option 1: 2034 Build (w/ barrier) [dBA]	Barrier Option 1: Difference (Build w/ barrier minus No Build) [dB]	Barrier Option 2: 2034 Build (w/ barrier) [dBA]	Barrier Option 2: Difference (Build w/ barrier minus No Build) [dB]	Compliance And Barrier Effectiveness	Feasibility[1]
NR1	59	61	61	2	61	2	61	62	62	1	62	1	Compliant	NA
NR2	52	56	56	4	56	4	53	57	57	4	57	4	Compliant	NA
NR3	61	63	63	2	63	2	62	65	65	3	65	3	Compliant	NA
NR4	57	63	59	2	59	2	59	64	60	1	60	1	Compliant Barr. -4 dB[2]	X
NR5	53	63	57	4	57	4	54	63	58	4	58	4	Compliant Barr. -5 dB	✓
NR6	38	51	51	13	51	13	39	51	51	12	51	12	Compliant	NA
NR7	42	58	55	13	55	13	43	58	55	12	55	12	Compliant Barr. -3 dB[2]	X
NR8	39	51	51	12	51	12	40	51	52	12	51	11	Compliant	NA
NR9	35	52	47	12	43	8	36	52	47	11	43	7	Compliant Barr. -5 dB	✓
NR10	51	64	57	6	56	5	52	64	57	5	56	4	Compliant Op.2 2034 Barr. -7 to -8 dB	✓
NR12	35	37	38	3	38	3	36	37	38	2	38	2	Compliant	✓
NR13	60	61	61	1	61	1	61	62	62	1	62	1	Compliant	NA
NR14	59	60	60	1	60	1	60	61	61	1	61	1	Compliant	NA

ID	2022 No Build [dBA]	2022 Build (w/o barrier) [dBA]	Barrier Option 1: 2022 Build (w/ barrier) [dBA]	Barrier Option 1: Difference (Build w/ barrier minus No Build) [dB]	Barrier Option 2: 2022 Build (w/ barrier) [dBA]	Barrier Option 2: Difference (Build w/ barrier minus No Build) [dB]	2034 No Build [dBA]	2034 Build (w/o barrier) [dBA]	Barrier Option 1: 2034 Build (w/ barrier) [dBA]	Barrier Option 1: Difference (Build w/ barrier minus No Build) [dB]	Barrier Option 2: 2034 Build (w/ barrier) [dBA]	Barrier Option 2: Difference (Build w/ barrier minus No Build) [dB]	Compliance And Barrier Effectiveness	Feasibility[1]
NR15	47	52	52	5	52	5	48	52	52	4	52	4	Compliant	NA
NR16	61	61	61	0	61	0	62	62	62	0	62	0	Compliant	NA
NR17	47	61	58	11	53	6	48	61	58	10	54	6	Compliant Barr. -3 to -8 dB	✔
NR18	57	67	60	3	60	3	58	68	61	3	61	3	Compliant Barr. -7 dB	✔
NR19	42	58	54	12	54	12	43	59	54	11	54	11	Compliant Barr. -4 to -5 dB	✔
NR21	46	55	55	9	55	9	47	55	55	8	55	8	Compliant	✔
NR23	56	63	57	1	57	1	57	64	57	0	57	0	Compliant Barr. -6 to -7 dB	✔
NR24	56	63	56	0	56	0	57	64	56	-1	56	-1	Compliant Barr. -7 to -8 dB	✔

[1] (N/A) indicates noise controls are not applied to achieve compliance, (✔) indicates proposed controls meet administrative, economic, and technical feasibility requirements, (**X**) indicates one or more of the feasibility requirements are not met
[2]The control used to achieve compliance does not result in a 5 dB or more reduction for all receptors in the Noise Sensitive Area that it is designed to mitigate. The control is therefore considered not technically feasible.

Table 5-2 Daytime and Nighttime Levels Indoors

ID	2022 Build				2034 Build				Compliance
	w/barrier Option 1		w/barrier Option 2		w/barrier Option 1		w/barrier Option 2		
	Day	Night	Day	Night	Day	Night	Day	Night	
R1	39	38	39	38	39	39	39	39	Compliant
R2[1]	36	N/A	36	N/A	37	N/A	37	N/A	Compliant
R3	37	31	37	31	38	32	38	32	Compliant
R4	39	33	39	33	39	33	39	33	Compliant
R5	38	32	38	32	39	32	39	32	Compliant
R6	25	19	24	19	25	20	25	20	Compliant
R7	31	25	30	25	31	26	30	25	Compliant
R8	26	22	26	22	27	23	26	23	Compliant
R9	25	20	22	18	25	21	22	19	Compliant
R10	38	31	37	31	38	31	37	31	Compliant
R11[1]	40	N/A	40	N/A	40	N/A	40	N/A	Compliant
R12	18	13	18	13	19	14	18	14	Compliant
R13	35	29	35	29	35	29	35	29	Compliant
R14	35	29	35	29	36	29	36	29	Compliant
R16	34	28	34	28	35	28	35	28	Compliant
R17	35	29	33	27	35	29	34	27	Compliant

ID	2022 Build				2034 Build				Compliance
	w/barrier Option 1		w/barrier Option 2		w/barrier Option 1		w/barrier Option 2		
	Day	Night	Day	Night	Day	Night	Day	Night	
R18	42	35	42	35	42	35	42	35	Compliant
R19	31	24	30	25	31	25	30	25	Compliant
R21	30	26	30	26	31	26	31	26	Compliant
R24[2]	38	32	38	32	39	32	39	32	Compliant
R25[2]	38	32	38	32	39	32	39	32	Compliant

[1]R2: community center and R11: library. Nighttime levels are not applicable for these locations.

[2]R24,R25: R24 is associated with the NR23 receptor and R25 is associated with the NR24 receptor.

The indoor sound level was determined by applying an assumed wall construction transmission loss to the outdoor level at the plane of window. The three types of dwellings, and resulting wall construction transmission loss were categorized as: Residential Home, Apartment, and Community Center/Library.

Residential Home and Apartment are assumed to have 20% window coverage while Community Center/Library has a window coverage of 50%. The wall construction transmission losses for each dwelling type were calculated as 42 dB, 42 dB, and 38 dB for Residential Homes, Apartments, and Community Center/Library respectively.

Detailed results at each receptor are presented in Appendix C.

Appendix D includes contour plots illustrating the spatial noise progression for the horizon years of 2022 and 2034, along with regions where the difference in noise levels between the build and no build case greater than 5 dB are illustrated in Figures D-1 and D-2. To illustrate the effectiveness of noise barriers, Figures D-3 and D-4 show the revised spatial noise progression for the horizon years of 2022 and 2034 respectively along with regions where the noise levels have decreased by more than 5 dB due to the barriers.

The contour plots were produced with 10m x 10m grids. Since a 10m x 10m grid resolution was applied to improve the processing time of the contours, slight discrepancies between the plots in Appendix D and the calculated values in Appendix C may be observed. These discrepancies have been verified and confirmed; that with a smaller scaled grid, the contour plots better match the calculated receptor levels. Therefore the plots should be only used to provide an overall image of the noise environment.

5.2.3 Construction Noise Levels

The predicted change in noise levels above the 2017 baseline traffic levels during the daytime from anticipated construction activities are listed in Table 5-3. Since construction is anticipated to only occur during daytime hours, only daytime levels at outdoor amenity areas are evaluated. Table 5-3 further includes the change in noise levels at representative noise receptors resulting from the building of permeant barriers with additional supplementary temporary construction hoarding. As there are two permanent barrier layout options, two construction options are presented.

Changes in levels that exceed 10 dB AND changes in the percentage of highly annoyed (Δ%HA) greater than 6.5% are highlighted in RED. Where the change remains above 10 dB and the Δ%HA remains above 6.5%, the following explanations are provided:

- NR04, NR05, NR 07, NR09, NR17, NR 19, NR21, NR 23, and NR 24 - will not see a less than 10 dB change from the existing background or a percentage highly annoyed of 6.5%

or less with a temporary barrier in place. However, the effectiveness of a temporary barrier for these receptors are 3-15 dB and Δ%HA between 9% and 40%, which is an appreciable impact. Further reductions are not be practically achievable.

- NR 11 – Not practical to mitigate outdoor amenity areas of high-rises
- NR 15 – Dog park that is not privately owned

Table 5-3: Change in Daytime Noise levels due to Construction and Change in Percentage Highly Annoyed (Δ %HA)

		No Barriers			Option 1			Option 2			
Location	[A] 2017 Baseline dBA	[B] Level dBA	[B-A] Diff. dB	Δ%HA %	[C] Level dBA	[C-A] Diff. dB	Δ%HA %	[D] Level dBA	[D-A] Diff. dB	Δ%HA %	Notes
NR01	59	54	-5	-5	54	-5	-5	54	-5	-5	
NR02	51	44	-7	-2	44	-7	-2	44	-7	-2	
NR03	61	62	1	10	62	1	11	62	1	11	
NR04	57	78	21	61	74	17	47	74	17	47	4 dB & 14% Δ%HA reduction from no barrier case
NR05	52	77	25	61	72	20	46	72	20	46	5 dB & 15% Δ%HA reduction from no barrier case
NR06	38	62	24	19	62	24	19	62	24	19	Not practical, NR6 is a high-rise
NR07	41	66	25	30	57	16	9	58	17	11	10 dB& 21% Δ%HA reduction from no barrier case
NR08	39	52	13	5	52	13	5	52	13	5	
NR09	35	60	25	15	52	17	6	55	20	9	8 dB& 9% Δ%HA reduction from no barrier case
NR10	50	67	17	31	58	8	10	58	8	11	
R11	54	79	25	65	79	25	65	79	25	65	Apartment without amenity area
NR12	34	51	17	6	50	16	5	50	16	5	Δ%HA below 6.5% due to low baseline
NR13	59	66	7	21	66	7	21	66	7	21	
NR14	59	66	7	22	66	7	23	66	7	23	
NR15	46	66	20	28	66	20	28	66	20	28	Dog Park
NR16	60	47	-13	-6	47	-13	-6	47	-13	-6	

Location	[A]	No Barriers			Option 1			Option 2			Notes
	2017 Baseline dBA	[B] Level dBA	[B-A] Diff. dB	Δ%HA %	[C] Level dBA	[C-A] Diff. dB	Δ%HA %	[D] Level dBA	[D-A] Diff. dB	Δ%HA %	
NR17	47	69	22	37	60	13	14	64	17	22	9 dB & 19% Δ%HA reduction from no barrier case
NR18	57	78	21	62	60	3	10	60	3	10	
NR19	41	68	27	35	57	16	11	60	19	14	9 dB & 24% Δ%HA reduction from no barrier case
NR21	45	73	28	51	58	13	11	58	13	11	15 dB & 40% Δ%HA reduction from no barrier case
NR23	55	78	22	61	70	15	38	70	15	38	7 dB & 23% Δ%HA reduction from no barrier case
NR24	56	78	22	63	56	0	0	56	0	0	44 dB & 63% Δ%HA reduction from no barrier case

Diff.	Highlighted where levels increase by 10 dB or more over the existing 2017 baseline
Δ%HA	Highlighted where the Change in Percentage Highly Annoyed exceeds 6.5%

6. Mitigation Measures

6.1 Permanent Noise Controls

In order to achieve compliance at all receptor locations for each of the two barrier layout options, the acoustic barriers as listed in Table 6-1 are to be installed. The layout of these barriers relative to the Project site are illustrated in Drawing SEG01-0002 for the west shore [11] and Drawing SEG03-0003 (Option 1) [12] and SEG03-0004 (Option 2) [13] for the east shore which are included in Appendix E.

Acoustic Barriers shall have a minimum surface density of 20 kg/m^2. Subject to technical justification, the surface density can be reduced to no lower than 10 kg/ m^2. Barriers should be structurally sound, appropriately designed to withstand wind and snow load, and constructed without cracks or surface gaps. Where gaps are required for drainage, they shall be kept to a minimum and localized where possible. The MECP recommends that acoustic barriers comply with CAN/CSA-Z107.9-00 (R2004). Minimum Noise Reduction Coefficients (NRC) for the barriers are listed in Table 6-1.

An interest has been expressed by the City and residential stakeholders to maintain the aesthetics of the landscape and achieve consistency with respect to wooden fencing in the area (see Figure 6-1). The use of similar existing engineered wooden fences as acoustic barriers can satisfy the MECP's 20 kg/m^2 minimum surface density recommendation. While wooden fences are acoustically effective, special consideration must be made with respect to the durability and longevity of the barriers. The wooden fence illustrated in Figure 6-2 is an example of an acceptable wooden noise barrier design. This wooden barrier satisfies the surface density requirements for permanent noise barriers and has no surface gaps between panels. This or a similar design is an acceptable alternative for onshore barriers.

Figure 6-1: Existing wooden barrier installed on the corner of Montreal Street and John Counter Blvd.

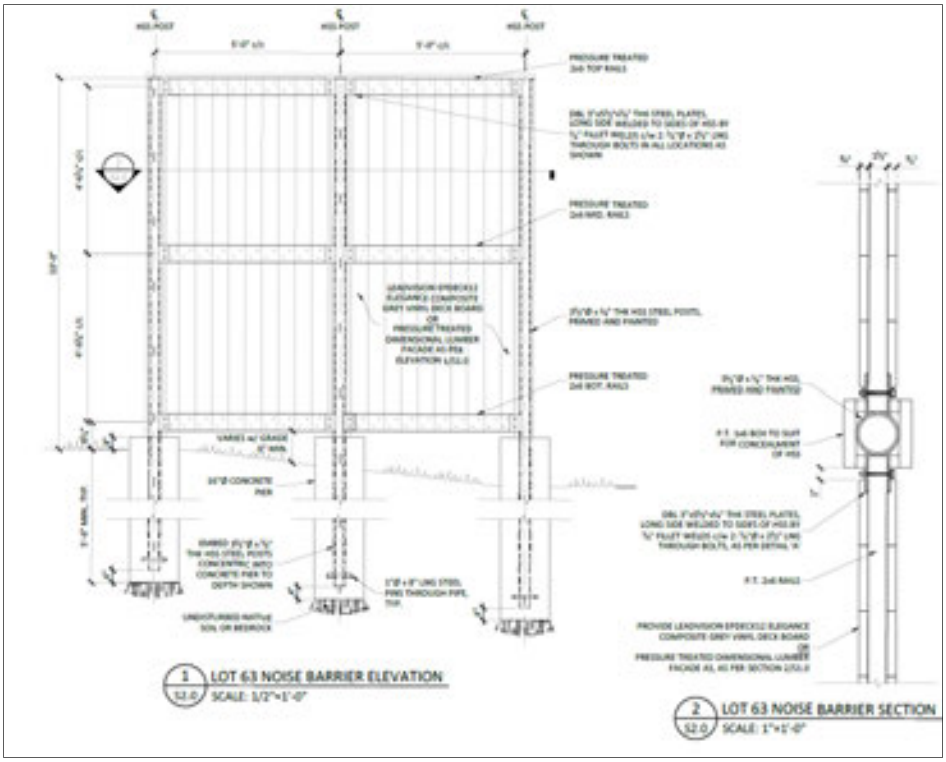


Figure 6-2: Wooden noise barrier design

Table 6-1: List of Permanent Barriers

Barrier ID	Option 1		Option 2		Min NRC	Material
	Approximate Height (m)	Approximate Length (m)	Approximate Height (m)	Approximate Length (m)		
NBRW01	2.3	128	2.3	113	0.3	Wood Optional
NBRW02	2.3	96	2.3	96	0.3	Wood Optional
NBRE01	5m WALL, 3m BERM	140m WALL, 150m BERM	N/A	N/A	0.3	Wood Optional
NBRE02	2.3	30	N/A	N/A	0.3	Wood Optional
NBRE03	2.3	178	2.3	178	0.3	Wood Optional
NBRE04	3.5-5	140	N/A	N/A	0.3	Wood Optional
NBRE07	N/A	N/A	2.3	31	0.3	Wood Optional
NBRE09-1	N/A	N/A	3	167	0.3	Wood Optional
NBRE09-2	N/A	N/A	1.5m NOISE BARRIER 1.5m CRASH BARRIER	117	0.0	Non-Wood

It should be noted that Permanent Barrier NBRE09-2 (applicable to Option 2) would be located on the bridge running adjacent to the EB traffic lane and installed on top of the crash barrier which separates the multi-use pathway from the roadway. The following Figure 6-3 illustrates an example of a permanent noise barrier installed on top of a pre-existing traffic crash barrier. The installation of NBRE09-2 would be similar to this. The acoustic model has been set to accommodate for the use of a noise barrier with a highly reflective surface along the crash barrier. This therefore allows for the use of transparent noise barriers at this location. NBRE09-1 which is located on the east shore would run adjacent to the southern parapet/retaining wall and would stop at the same point as the end of this wall without extending further onto the bridge. NBRE09-2 along with the crash barrier would then extend from this point further west onwards onto the bridge. There is no noise barrier overlap between NBRE09-1 and NBRE09-2 on this option.

Figure 6-3: Example of a permanent noise barrier installation on a pre-existing traffic crash barrier. NBRE09-2 would follow a similar set-up

6.2 Temporary Noise Controls

In order to streamline the construction process, where applicable, permanent noise barriers would be erected prior to construction in order to double as construction barriers. Additional solid temporary noise hoarding may be erected or attached to the permanent noise barriers as a supplement to accommodate the addition of construction noise. It should be noted that the proposed temporary construction barriers (hoarding) are being presented as an optional solution that may be applied on a case by case basis according to the community noise complaint protocol of the project. The permanent barriers shall be erected first prior to any additional temporary barriers.Table 6-2 lists the primary permanent noise barriers and supplemental temporary barriers (optional) to be installed for the construction phase of the project. The construction barrier arrangements relative to the Project site are illustrated in Drawing SEG01-0001 for the west shore [14] and Drawing SEG03-0001 (Option 1) [15] and SEG03-0002 (Option 2) for the east shore [16] which are included in Appendix E.

The pile jacking construction process for the piers supporting the bridge across the river is not a dominant noise contributor. However, to limit the noise impact of pile jacking, only 1 pile will be installed at a time over the span of the river. Pile jacking will be limited by the City of Kingston construction noise bylaw to occur only between the daytime hours of 07:00 to 19:00 on weekdays and Saturdays.

Table 6-2: Primary Permanent and Supplementary Temporary Barriers for Construction

Barrier ID	Option 1		Option 2		Min NRC	Material
	Approximate Height (m)	Approximate Length (m)	Approximate Height (m)	Approximate Length (m)		
NBRW01	2.3	128	2.3	113	0.3	Wood Optional Permeant Noise Barrier
NBRW02	2.3	96	2.3	96	0.3	Wood Optional Permeant Noise Barrier
TPBRW01	5.0	60	5.0	60	0.3	Hoarding
TPBRW02	5.0	40	5.0	40	0.3	Hoarding
NBRE01	5m WALL, 3m BERM	140m WALL, 150m BERM	N/A	N/A	0.3	Wood Optional Permeant Noise Barrier
TPBRE01	5	105	N/A	N/A	0.3	Hoarding
TPBRE01-2	N/A	N/A	5	258	0.3	Hoarding
NBRE02	2.3	30	N/A	N/A	0.3	Wood Optional Permeant Noise Barrier
NBRE03 TPBRE03	2.3m + 2.7m TEMP EXTENSION FASTENED TO TOP	178	2.3m + 2.7m TEMP EXTENSION FASTENED TO TOP	178	0.3	Wood Optional Permeant Noise Barrier + Hoarding Extension
NBRE07	N/A	N/A	2.3	31	0.3	Wood Optional Permeant Noise Barrier

7. Conclusions

Acoustic modelling of latest design of The Project area has been completed. Upon applying the proposed barrier layout and design listed in Table 6-1, The community noise impact of the Project has been shown to be in compliance with the assessment criteria.

For option 2, noise barrier NBRE09-2 has been shown to lower levels to achieve compliance for all designated receptors. However, NBRE09-2 provides a maximum noise reduction of 3 dB, 2 dB less than the 5 dB minimum to consider the barrier technically feasible. Provisions should therefore be made for the installation of noise barrier NBRE09-2; however the barrier need not be erected under .

Upon applying a combination of proposed permanent and supplementary temporary barriers during the construction phase as listed in Table 6-2, the change in noise environment during construction and likely percentage of highly annoyed will be minimized. Both options are viable and meet acoustic compliance.

8. References

[1] RWDI Air Inc – Environmental Noise Assessment, April 2012.

[2] Ontario Ministry of Transportation (MTO) - Environmental Guide for Noise, October 2006.

[3] Ontario Ministry of the Environment, Conservation, and Parks (MOECP) – NPC-300 - Environmental Noise Guideline -Stationary and Transportation Sources – Approval and Planning, August 2013.

[4] City of Kingston – By-Law Number 2004-52 (A By-Law To Regulate Noise), March 2004.

[5] Health Canada, Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise, January 2017.

[6] US Federal Transit Administration, Transit Noise and Vibration Impact Assessment, May 2006.

[7] Hatch Ltd. – Design Criteria – Civil, October 2018.

[8] Hatch Ltd. – Project Memo: Traffic Forecast and Truck Composition, November 2018.

[9] Dillon Consulting – John Counter Boulevard / Montreal Street Access Alternatives, May 2018.

[10] Golder Associates – Noise Impact Study, March 2017.

[11] Hatch Ltd. – Noise Barrier West Shore, Drawing No. SEG1-0002, Sheet No. 1.

[12] Hatch Ltd. – Noise Barrier East Shore Option 1, Drawing No. SEG3-0003, Sheet No. 2.

[13] Hatch Ltd. – Noise Barrier East Shore Option 2, Drawing No. SEG3-0004, Sheet No. 3.

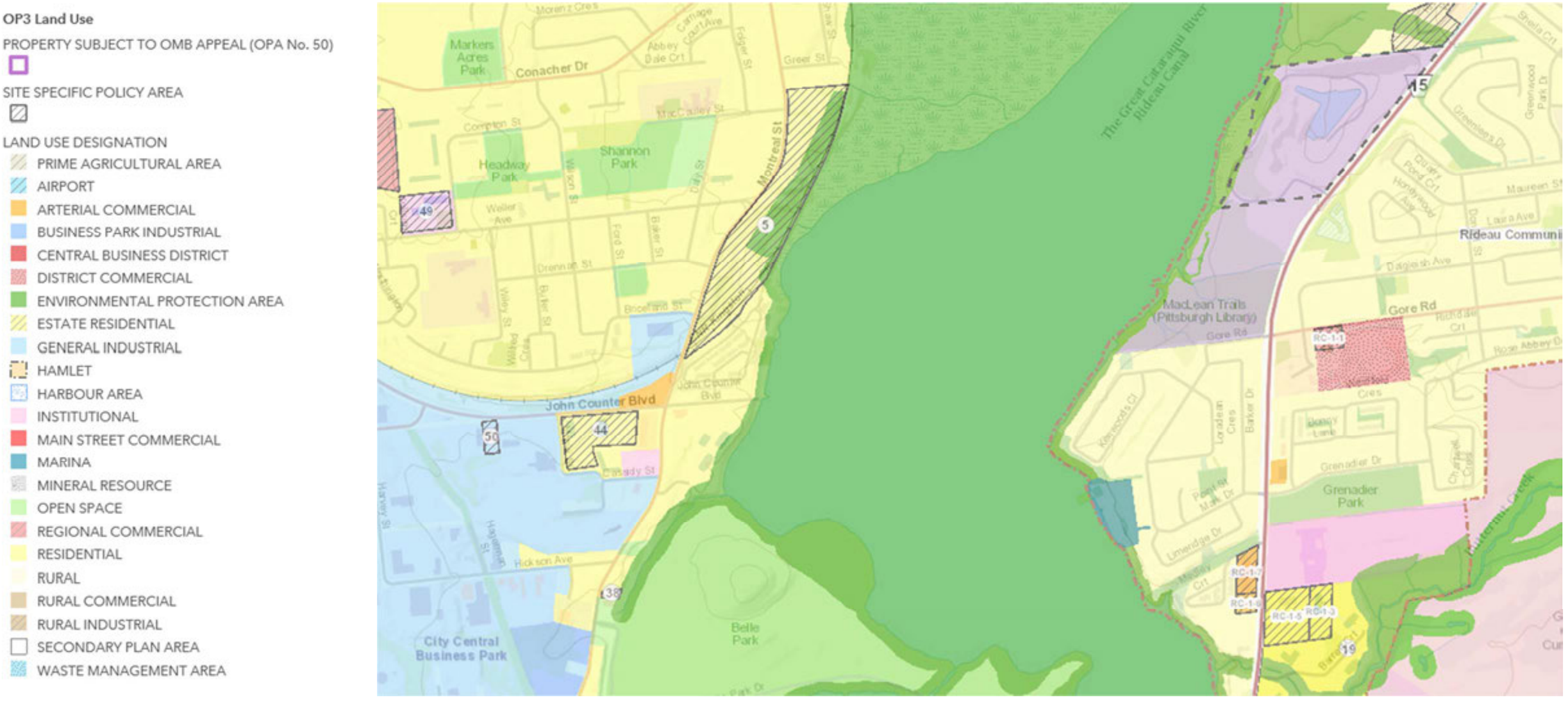
[14] Hatch Ltd. – Construction Noise Barrier West Shore, Drawing No. SEG1-0001, Sheet No. 1.

[15] Hatch Ltd. – Construction Noise Barrier East Shore Option 1, Drawing No. SEG3-0001, Sheet No. 2.

[16] Hatch Ltd. – Construction Noise Barrier East Shore Option 2, Drawing No. SEG3-0002, Sheet No. 3.

Appendix A

Zoning map



Excerpt from The City of Kingston Planning and Development Map

Appendix B

Sources: Road Information, Traffic Counts, Construction Equipment, Train Traffic

Street Name	Speed (km/h)		Width (m)		% Heavy Vehicle		Traffic Volume Daytime /hr				Traffic Volume Nighttime /hr			
	No-Build	Build	No-Build	Build	No-Build	Build	2022NB	2034NB	2022B	2034B	2022NB	2034NB	2022B	2034B
John Counter Blvd before Montreal St	50	60	7	7	3.125	5	452	574	1195	1262	101	127	265	280
John Counter Blvd before Ascot Lane	50	60	7	7	3.75	8	270	342	1256	1327	60	76	279	295
Montreal St N	50	60	7	7	8	8	804	1019	801	1007	179	227	178	224
Montreal St S	50	60	7	7	8	8	842	1067	861	1152	187	237	191	256
Ascot Lane	50	50	10	10	2	2	53	68	50	54	12	15	11	12
Apartment Access	50	50	7	7	2	2	26	33	25	27	6	7	5	6
Library Access	50	50	7	7	2	2	18	23	22	23	4	5	5	5
Point Saint Mark Dr	50	50	8.3	8.3	2	2	61	77	73	77	14	17	16	17
Gore Rd after Point St Mark Dr	40	60	7	10.5	2	8	61	77	896	946	14	17	199	210
Gore Rd after Highway 15	40	60	7	10.5	2	5	61	77	98	104	14	17	22	23
Highway 15 N	60	60	7	7	8	8	599	759	719	759	133	169	160	169
Highway 15 S	60	60	7	7	8	8	1262	1601	1516	1601	281	356	337	356
Third Crossing	N/A	60	N/A	7	N/A	8	N/A	N/A	1119	1182	N/A	N/A	249	263

WEST - North (01) - Rd. Const	Octave band sound power levels, Hz, (linear)								
Construction Equipment	**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Standard Dump Truck 1	114	114	107	107	107	107	112	97	88
Tracked Excavator 1	106	106	106	103	99	100	96	91	83
Grader	116	116	115	111	107	112	106	102	93
Total Sound Power (Lw)	**118**	**118**	**116**	**113**	**110**	**113**	**113**	**103**	**94**

WEST - South (01) - Rd Const	Octave band sound power levels, Hz, (linear)								
Construction Equipment	**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Standard Dump Truck	114	114	107	107	107	107	112	97	88
Tracked Excavator	106	106	106	103	99	100	96	91	83
Grader	116	116	115	111	107	112	106	102	93
Total Sound Power (Lw)	**118**	**118**	**116**	**113**	**110**	**113**	**113**	**103**	**94**

WEST - North (02) Laydown & Offices + Rd Const	Octave band sound power levels, Hz, (linear)								
Construction Equipment	**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Wheeled Loader 1	114	114	110	105	102	98	94	90	83
Standard Dump Truck	114	114	107	107	107	107	112	97	88
Tracked Excavator	106	106	106	103	99	100	96	91	83
Flat Bed 1	111	111	102	94	97	98	106	88	83
Generator 1	108	108	102	85	82	81	76	73	65
Hand-held circular saw (cutting paving slabs)	97	97	103	105	102	99	98	102	97
Crane	115	115	110	106	102	99	95	88	80
Water Pump (Diesel)	98	98	93	94	92	92	91	84	74
Compressor	112	112	101	92	87	85	83	86	75
Total Sound Power (Lw)	**121**	**121**	**115**	**113**	**111**	**110**	**113**	**104**	**98**

WEST - South (02) Laydown + Rd Const.	Octave band sound power levels, Hz, (linear)								
Construction Equipment	**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Wheeled Loader 1	114	114	110	105	102	98	94	90	83
Standard Dump Truck	114	114	107	107	107	107	112	97	88
Tracked Excavator	106	106	106	103	99	100	96	91	83
Flat Bed 1	111	111	102	94	97	98	106	88	83
Crane	115	115	110	106	102	99	95	88	80
Water Pump (Diesel)	98	98	93	94	92	92	91	84	74
Compressor	112	112	101	92	87	85	83	86	75
Total Sound Power (Lw)	**121**	**121**	**115**	**112**	**110**	**109**	**113**	**100**	**91**

EAST - North (01) Laydown & Offices	Octave band sound power levels, Hz, (linear)								
Construction Equipment	**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Wheeled Loader 1	114	114	110	105	102	98	94	90	83
Standard Dump Truck 1	114	114	107	107	107	107	112	97	88
Standard Dump Truck 2	114	114	107	107	107	107	112	97	88
Tracked Excavator 1	106	106	106	103	99	100	96	91	83
Flat Bed 1	111	111	102	94	97	98	106	88	83
Flat Bed 2	111	111	102	94	97	98	106	88	83
Generator 1	108	108	102	85	82	81	76	73	65
Grader	116	116	115	111	107	112	106	102	93
Hand-held circular saw (cutting paving slabs)	97	97	103	105	102	99	98	102	97
Crane	115	115	110	106	102	99	95	88	80
Water Pump (Diesel)	98	98	93	94	92	92	91	84	74
Compressor	112	112	101	92	87	85	83	86	75
Total Sound Power (Lw)	**123**	**123**	**119**	**116**	**113**	**115**	**117**	**107**	**100**

EAST - North (02) Rd Const	Octave band sound power levels, Hz, (linear)								
Construction Equipment	**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Standard Dump Truck	114	114	107	107	107	107	112	97	88
Tracked Excavator	106	106	106	103	99	100	96	91	83
Grader	116	116	115	111	107	112	106	102	93
Total Sound Power (Lw)	**118**	**118**	**116**	**113**	**110**	**113**	**113**	**103**	**94**

Equipment	Octave Band Sound Power Levels (dB)							
	63	125	250	500	1k	2k	4k	8k
Piling Activities								
Off-shore								
110 Ton Crawler Crane	101	99	96	98	94	91	82	77
Drill Rig Assembly	103	107	104	101	102	107	102	97
Tug Boat	111	106	99	96	87	83	77	72
Barge	118	113	106	103	94	90	84	79
Total Sound Power Barge 1	**119**	**115**	**109**	**106**	**103**	**107**	**102**	**97**
Mobile Mixer (50% Usage)	118	113	106	103	94	90	84	79
Total Sound Power	**122**	**117**	**111**	**108**	**104**	**107**	**102**	**97**

Day	0700-2300				
TYPE OF TRAIN	VOLUMES	MAX. CONSIST	MAX. SPEED (MILES PER HOUR)	MAX. SPEED (KM PER HOUR)	MAX. POWER
FREIGHT	11	140	55	89	4
WAY FREIGHT	0	25	55	89	4
PASSENGER	30	10	65	105	2

Night	2300-0700				
TYPE OF TRAIN	VOLUMES	MAX. CONSIST	MAX. SPEED (MILES PER HOUR)	MAX. SPEED (KM PER HOUR)	MAX. POWER
FREIGHT	7	140	55	89	4
WAY FREIGHT	0	25	55	89	4
PASSENGER	0	10	65	105	2

	0700-2300		2300-0700
YEAR	VOLUME FREIGHT	VOLUME PASSENGER	VOLUME FREIGHT
2019	11	30	7
2020	11	31	7
2021	12	32	7
2022	12	32	8
2023	12	33	8
2024	12	34	8
2025	13	35	8
2026	13	36	8
2027	13	37	9
2028	14	37	9
2029	14	38	9
2030	14	39	9
2031	15	40	9
2032	15	41	10
2033	16	42	10
2034	16	43	10

Appendix C

Receptor Result

Table C-1 Daytime OLA Receptor Levels – OPTION 1

ID	2022 No Build	2022 Build		2034 No Build	2034 Build	
	w/o barriers	w/o barrier	w/ barrier	w/o barriers	w/o barrier	w/ barrier
NR1	59	61	61	61	62	62
NR2	52	56	56	53	57	57
NR3	61	63	63	62	65	65
NR4	57	63	59	59	64	60
NR5	53	63	57	54	63	58
NR6	38	51	51	39	51	51
NR7	42	58	55	43	58	55
NR8	39	51	51	40	51	52
NR9	35	52	47	36	52	47
NR10	51	64	57	52	64	57
NR12	35	37	38	36	37	38
NR13	60	61	61	61	62	62
NR14	59	60	60	60	61	61
NR15	47	52	52	48	52	52
NR16	61	61	61	62	62	62
NR17	47	61	58	48	61	58
NR18	57	67	60	58	68	61
NR19	42	58	54	43	59	54
NR21	46	55	55	47	55	55
NR23	56	63	57	57	64	57
NR24	56	63	56	57	64	56

Table C-2 Daytime OLA Receptor Levels – OPTION 2

ID	2022 No Build	2022 Build		2034 No Build	2034 Build	
	w/o barriers	w/o barrier	w/ barrier	w/o barriers	w/o barrier	w/ barrier
NR1	59	61	61	61	62	62
NR2	52	56	56	53	57	57
NR3	61	63	63	62	65	65
NR4	57	63	59	59	64	60
NR5	53	63	57	54	63	58
NR6	38	51	51	39	51	51
NR7	42	58	55	43	58	55
NR8	39	51	51	40	51	51
NR9	35	52	43	36	52	43
NR10	51	64	56	52	64	56
NR12	35	37	38	36	37	38
NR13	60	61	61	61	62	62
NR14	59	60	60	60	61	61
NR15	47	52	52	48	52	52
NR16	61	61	61	62	62	62
NR17	47	61	53	48	61	54
NR18	57	67	60	58	68	61
NR19	42	58	54	43	59	54
NR21	46	55	55	47	55	55
NR23	56	63	57	57	64	57
NR24	56	63	56	57	64	56

Appendix D

Sound Level Contour Plots

LEGEND

- Project Footprint
- Receptor

Noise Impact (dBA)

<50 | 50-55 | 55-60 | 60-65 | >65 | Difference >5 dB

DATA SOURCES:

1. Spatial References: NAD 1983 UTM Zone 18N
2. Image Sources: Roads - Land Information Ontario
3. Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

0 75 150 300 450 Meters

1:6,000

HATCH SYSTRA Kiewit KINGSTON

Kingston Third Crossing
2022 Build Sound Level and Difference between Build and No Build Level

DWG BY:	CHK BY:	DWG NO.:	REV NO.:
K. MACAPILI	R. LIU	D-1	B
DATE: 2019/04/16	PAGE: 1 of 1		

LEGEND

- Project Footprint
- Receptor

Noise Impact (dBA)

<50 | 50-55 | 55-60 | 60-65 | >65 | Difference >5 dB

DATA SOURCES:

1. Spatial References: NAD 1983 UTM Zone 18N
2. Image Sources: Roads - Land Information Ontario
3. Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

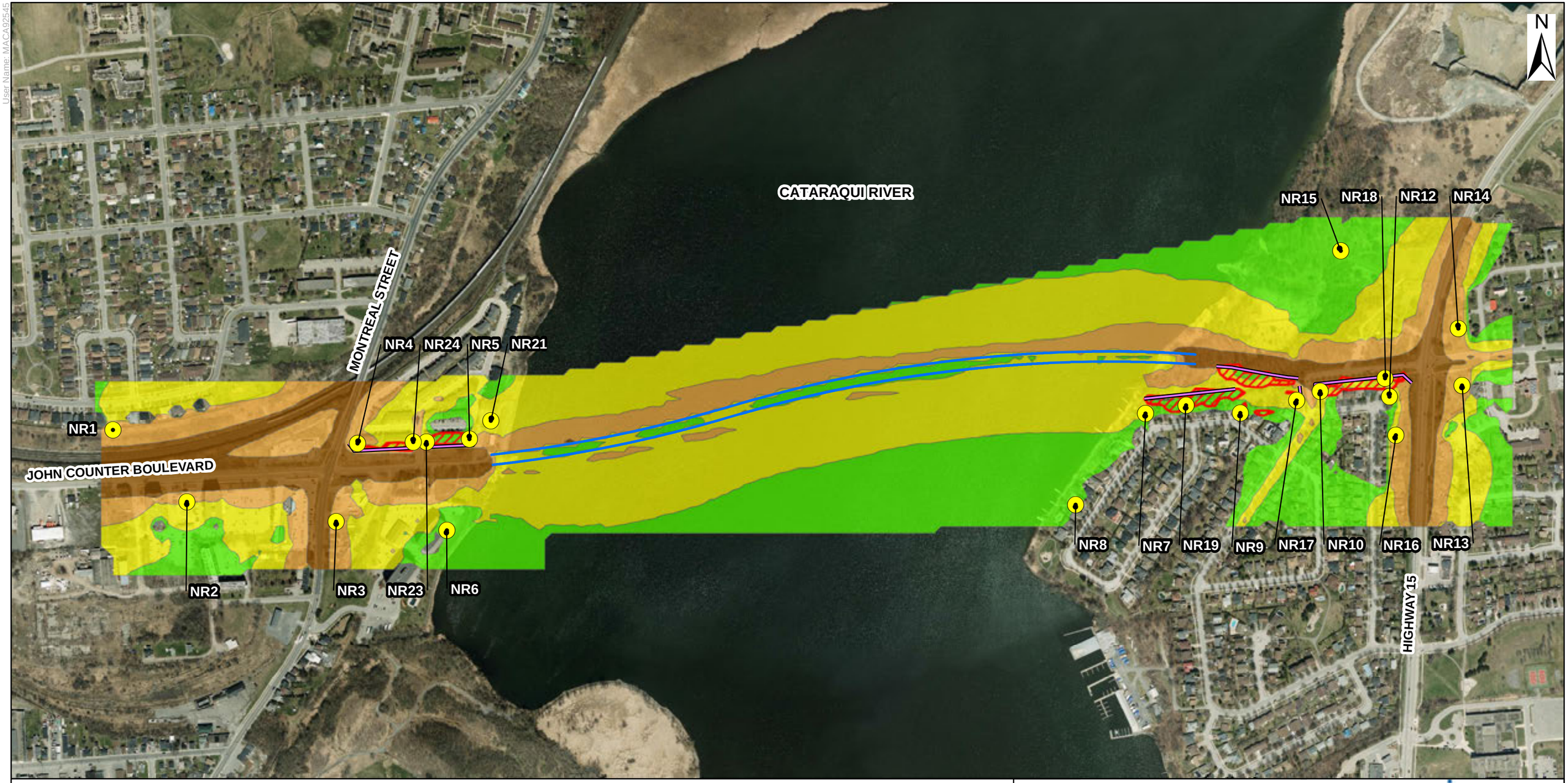
0 75 150 300 450 Meters

1:6,000

HATCH SYSTRA Kiewit KINGSTON

Kingston Third Crossing
2034 Build Sound Level and Difference between Build and No Build Level

DWG BY:	CHK BY:	DWG NO.:	REV NO.:
K. MACAPILI	R. LIU	D-2	B
DATE: 2019/04/16	PAGE: 1 of 1		



LEGEND

- Receptor
- Project Footprint
- Permanent Noise Barrier

Noise Impact (dBA)

<50 | 50-55 | 55-60 | 60-65 | >65 | Difference >5 dB

DATA SOURCES:

1. Spatial References: NAD 1983 UTM Zone 18N
2. Image Sources: Roads - Land Information Ontario
3. Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

0 75 150 300 450 Meters

1:6,000

HATCH SYSTRA Kiewit KINGSTON

Kingston Third Crossing
2022 Option 1 Permanent Barriers Mitigated Sound Level and Reduction

DWG BY:	CHK BY:	DWG NO.:	REV NO.:
K. MACAPILI	D. CHAMBERLAIN	D-3	B
DATE: 2019/04/16	PAGE: 1 of 1		

CATARAQUI RIVER

MONTREAL STREET

JOHN COUNTER BOULEVARD

HIGHWAY 15

NR1 NR2 NR3 NR4 NR5 NR6 NR7 NR8 NR9 NR10 NR12 NR13 NR14 NR15 NR16 NR17 NR18 NR19 NR21 NR23 NR24

N

LEGEND

- Receptor
- Project Footprint
- Permanent Noise Barrier

Noise Impact (dBA)

<50 | 50-55 | 55-60 | 60-65 | >65 | Difference >5 dB

DATA SOURCES:

1. Spatial References: NAD 1983 UTM Zone 18N
2. Image Sources: Roads - Land Information Ontario
3. Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

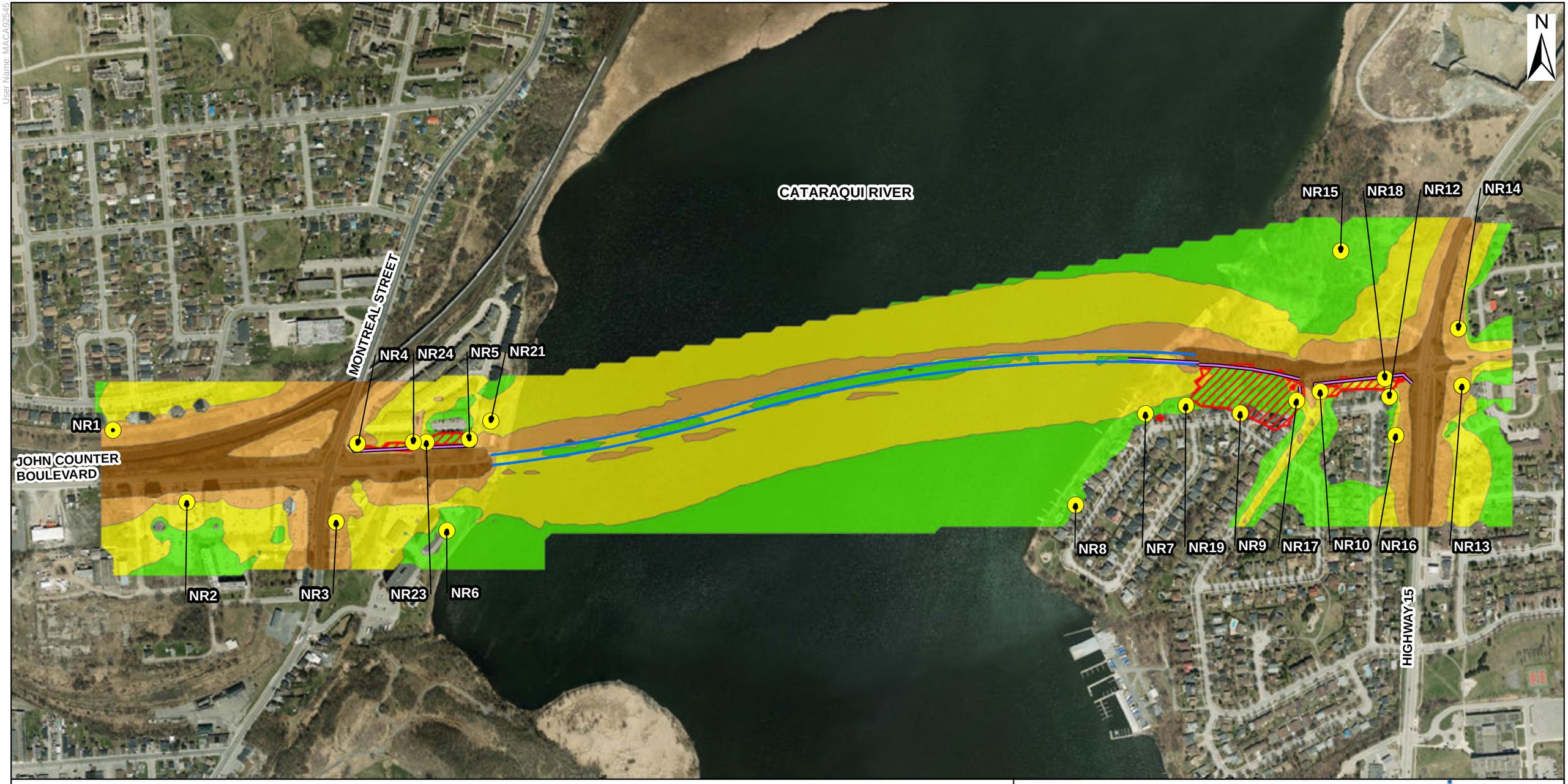
0 75 150 300 450 Meters

1:6,000

HATCH SYSTRA Kiewit KINGSTON

Kingston Third Crossing
2034 Option 1 Permanent Barriers Mitigated Sound Level and Reduction

DWG BY:	CHK BY:	DWG NO.:	REV NO.:
K. MACAPILI	D. CHAMBERLAIN	D-4	B
DATE: 2019/04/16	PAGE: 1 of 1		



LEGEND

- Receptor
- Project Footprint
- Permanent Noise Barrier

Noise Impact (dBA)

<50 | 50-55 | 55-60 | 60-65 | >65 | Difference >5 dB

DATA SOURCES:

1. Spatial References: NAD 1983 UTM Zone 18N
2. Image Sources: Roads - Land Information Ontario
3. Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

0 75 150 300 450 Meters

1:6,000

HATCH SYSTRA Kiewit KINGSTON

Kingston Third Crossing
2022 Option 2 Permanent Barriers Mitigated Sound Level and Reduction

DWG BY:	CHK BY:	DWG NO.:	REV NO.:
K. MACAPILI	D. CHAMBERLAIN	D-5	B
DATE: 2019/04/16	PAGE: 1 of 1		

LEGEND

- Receptor
- Project Footprint
- Permanent Noise Barrier

Noise Impact (dBA)

<50 | 50-55 | 55-60 | 60-65 | >65 | Difference >5 dB

DATA SOURCES:

1. Spatial References: NAD 1983 UTM Zone 18N
2. Image Sources: Roads - Land Information Ontario
3. Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

0 75 150 300 450 Meters

1:6,000

HATCH SYSTRA Kiewit KINGSTON

Kingston Third Crossing
2034 Option 2 Permanent Barriers Mitigated Sound Level and Reduction

DWG BY:	CHK BY:	DWG NO.:	REV NO.:
K. MACAPILI	D. CHAMBERLAIN	D-6	B
DATE: 2019/04/16	PAGE: 1 of 1		

LEGEND

- Receptor
- Pier Piling Construction Location
- Project Footprint
- Construction Zone
- Noise Impact (>10 dB)

Noise Barrier

- Permanent
- Temporary

DATA SOURCES:

1. Spatial References: NAD 1983 UTM Zone 18N
2. Image Sources: Roads - Land Information Ontario
3. Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

0 50 100 200 300 Meters

1:6,000

HATCH SYSTRA Kiewit KINGSTON

Kingston Third Crossing
Construction Option 1 Permanent and Temporary Barriers

DWG BY:	CHK BY:	DWG NO.:	REV NO.:
K. MACAPILI	D. CHAMBERLAIN	D-7	B
DATE: 2019/04/16	PAGE: 1 of 1		

LEGEND

- Receptor
- Pier Piling Construction Location
- Project Footprint
- Construction Zone
- Noise Impact (>10 dB)

Noise Barrier

- Permanent
- Temporary

DATA SOURCES:

1. Spatial References: NAD 1983 UTM Zone 18N
2. Image Sources: Roads - Land Information Ontario
3. Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

0 50 100 200 300 Meters

1:6,000

HATCH SYSTRA Kiewit KINGSTON

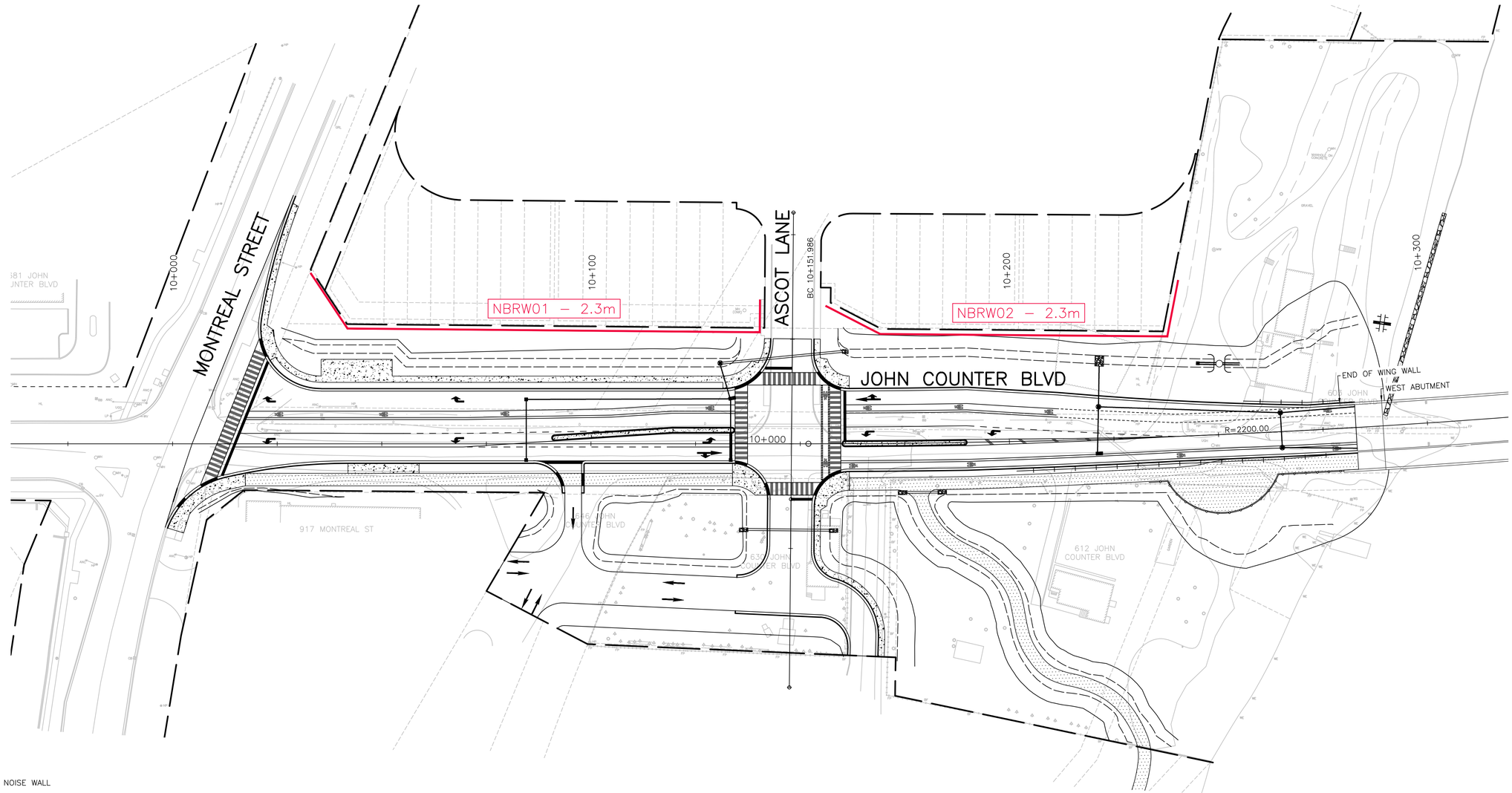
Kingston Third Crossing
Construction Option 2 Permanent and Temporary Barriers

DWG BY:	CHK BY:	DWG NO.:	REV NO.:
K. MACAPILI	D. CHAMBERLAIN	D-8	B
DATE: 2019/04/16	PAGE: 1 of 1		

Appendix E

Permanent and Temporary Barrier Locations

METRIC



LEGEND

NOISE WALL

INTEGRATED PROJECT DELIVERY TEAM:

HATCH · SYSTRA INTERNATIONAL BRIDGE TECHNOLOGIES · PKS · Kiewit · KINGSTON

No.	DATE	REVISIONS	BY	CHECKED
B	04–22–19	FOR PERMANENT CONDITIONS	DC	MC
A	02–22–19	FOR PERMANENT CONDITIONS	DC	MC

DESIGN COMPANY: HATCH

DESIGN: DC
DRAWN: LW
CHECKED: MC

KINGSTON THIRD CROSSING

NOISE BARRIER WEST SHORE

OPTION 1

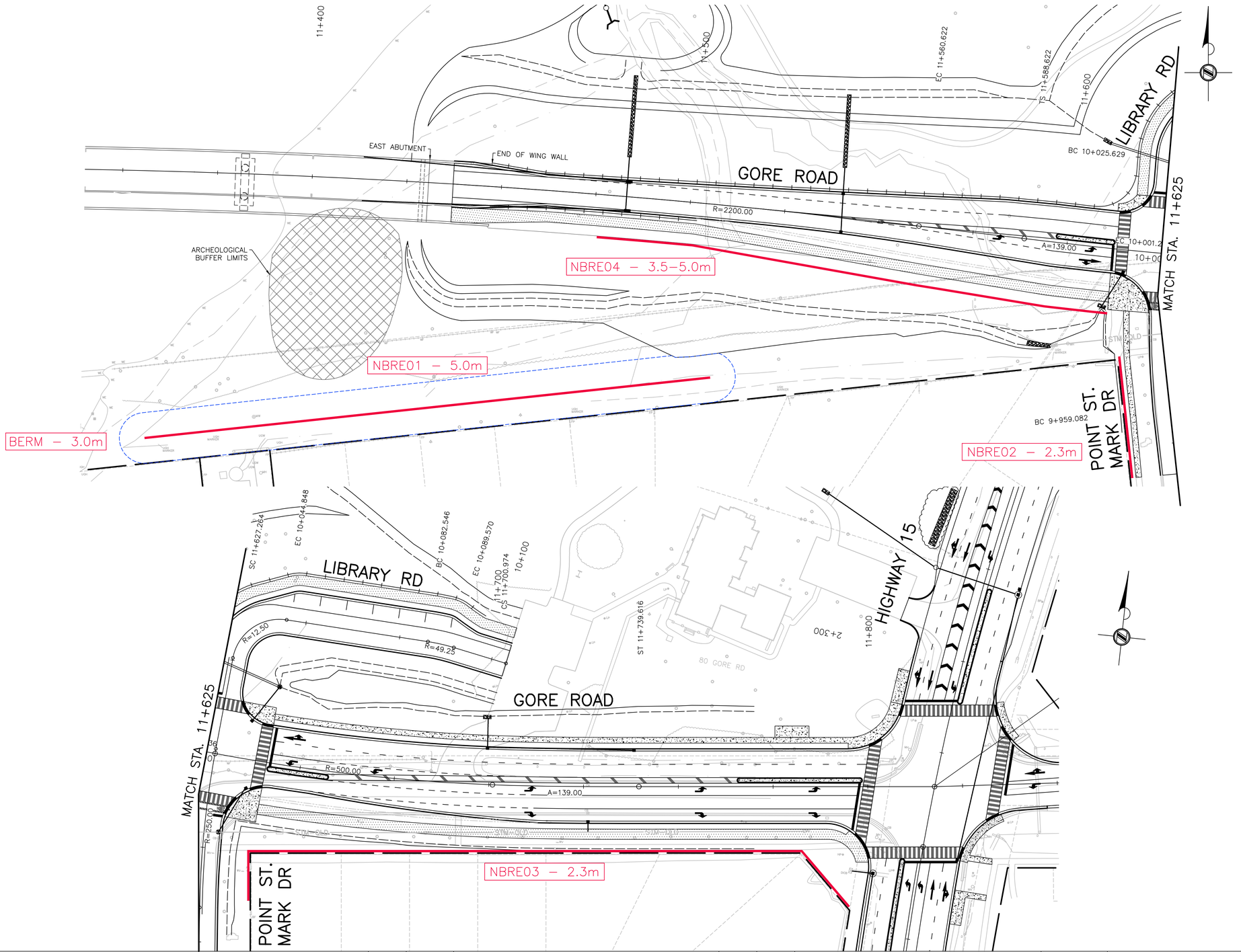
STA. 10+000 TO STA. 10+310

DATE: 04–22–19
SCALE: 1:500

DRAWING NO. SEG1–0002
SHEET NO. 1
REVISION B

DRAWING NAME: H357883–83–260–SEG0–0001.dwg
SAVED BY: WEST867507
SAVE DATE: 4/23/2019 1:27 PM
PLOT DATE: 4/23/2019 1:28 PM

METRIC



LEGEND

- NOISE WALL
- EDGE OF BERM

INTEGRATED PROJECT DELIVERY TEAM:

HATCH · SYSTRA INTERNATIONAL BRIDGE TECHNOLOGIES · Kiewit · KINGSTON

No.	DATE	REVISIONS	BY	CHECKED
B	04–22–19	FOR PERMANENT CONDITIONS	DC	MC
A	02–22–19	FOR PERMANENT CONDITIONS	DC	MC

DESIGN COMPANY: HATCH

DESIGN: DC	KINGSTON THIRD CROSSING
DRAWN: LW	NOISE BARRIER EAST SHORE
CHECKED: MC	OPTION 1
	STA. 11+340 TO STA. 11+850
DATE: 04–22–19	SCALE: 1:500
DRAWING NO.	SEG3–0003
SHEET NO.	2
REVISION	B

DRAWING NAME: H357883–83–260–SE00–0001.dwg SAVE DATE: 4/23/2019 1:27 PM PLOT DATE: 4/23/2019 1:29 PM
SAVED BY: WES7867507

METRIC

11+300
11+400
11+500
EC 11+560.622
11+588.622
11+600
LIBRARY RD
BC 10+025.629
EAST ABUTMENT
END OF WING WALL
GORE ROAD
R=2200.00
A=139.00
EC 10+001.2
10+00
MATCH STA. 11+625
NBRE09–2 – 3.0m
NBRE09–1 – 3.0m
ARCHEOLOGICAL BUFFER LIMITS
BC 9+959.082
POINT ST. MARK DR
NBRE07 – 2.3m
SC 11+627.264
EC 10+044.848
BC 10+082.546
EC 10+089.570
CS 11+700.974
11+700
10+100
LIBRARY RD
R=12.50
R=49.25
ST 11+739.616
2+300
11+800
HIGHWAY 15
80 GORE RD
GORE ROAD
MATCH STA. 11+625
R=500.00
A=139.00
R=250.00
NBRE03 – 2.3m
POINT ST. MARK DR

LEGEND

NOISE WALL

DRAWING NAME: H357883-83-260-SE00-0001.dwg
SAVED BY: WEST867507
SAVE DATE: 4/23/2019 1:27 PM
PLOT DATE: 4/23/2019 1:29 PM

INTEGRATED PROJECT DELIVERY TEAM:

HATCH | SYSTRA INTERNATIONAL BRIDGE TECHNOLOGIES | PKS Kiewit | KINGSTON

No.	DATE	REVISIONS	BY	CHECKED
B	04–22–19	FOR PERMANENT CONDITIONS	DC	MC
A	02–22–19	FOR PERMANENT CONDITIONS	DC	MC

DESIGN COMPANY: HATCH

DESIGN: DC
DRAWN: LW
CHECKED: MC

KINGSTON THIRD CROSSING

NOISE BARRIER EAST SHORE

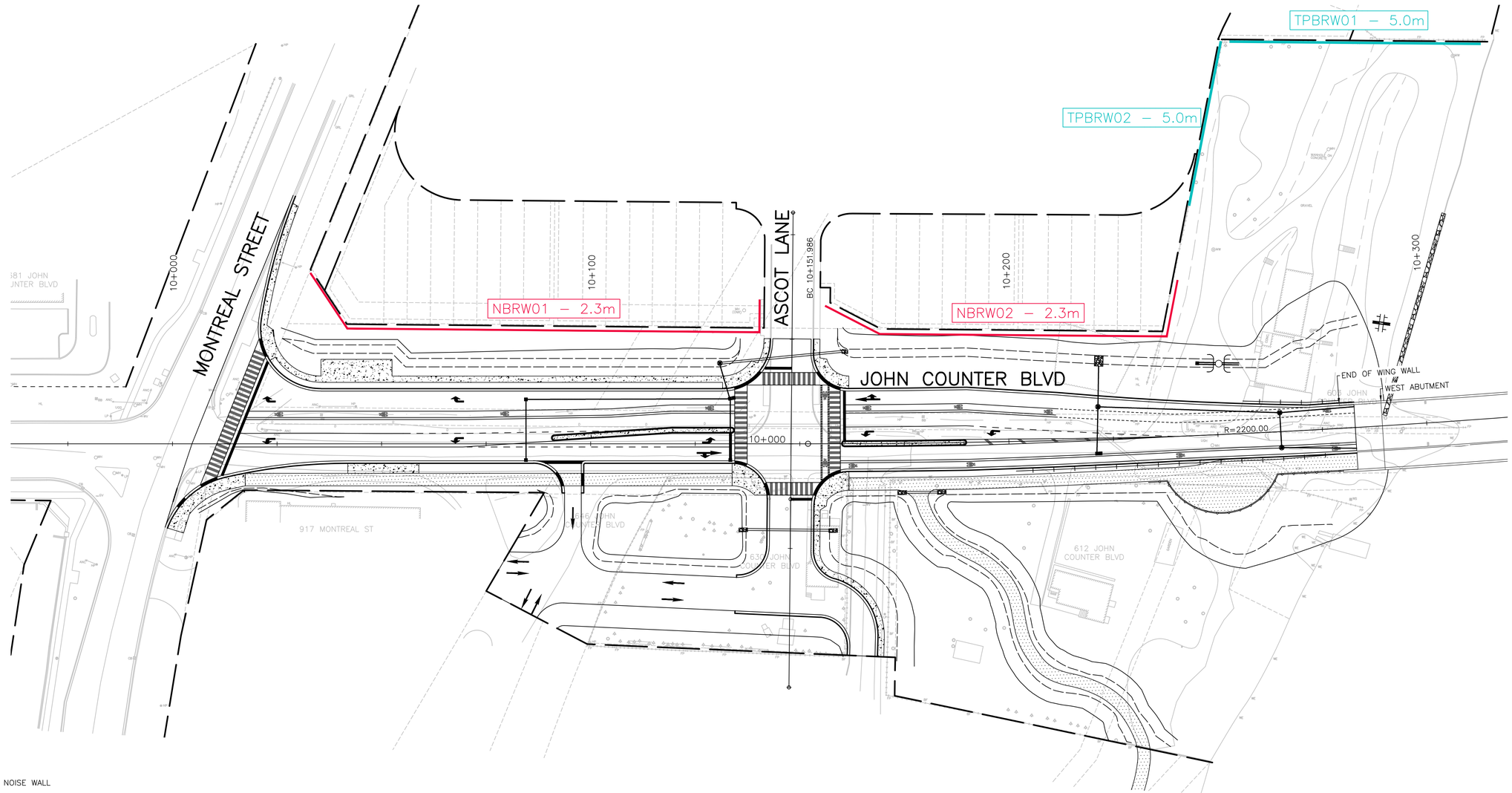
OPTION 2

STA. 11+225 TO STA. 11+850

DATE: 04–22–19
SCALE: 1:500

DRAWING NO. SEG3–0004
SHEET NO. 3
REVISION B

METRIC



LEGEND

NOISE WALL

TEMPORARY NOISE WALL

INTEGRATED PROJECT DELIVERY TEAM:

HATCH · SYSTRA INTERNATIONAL BRIDGE TECHNOLOGIES · PKS · Kiewit · KINGSTON

No.	DATE	REVISIONS	BY	CHECKED
B	04–22–19	FOR TEMPORARY CONDITIONS	DC	MC
A	02–22–19	FOR TEMPORARY CONDITIONS	DC	MC

DESIGN COMPANY: HATCH

DESIGN: DC

DRAWN: LW

CHECKED: MC

KINGSTON THIRD CROSSING

NOISE BARRIER
WEST SHORE
OPTION 1

STA. 10+000 TO STA. 10+310

DATE: 04–22–19

SCALE: 1:500

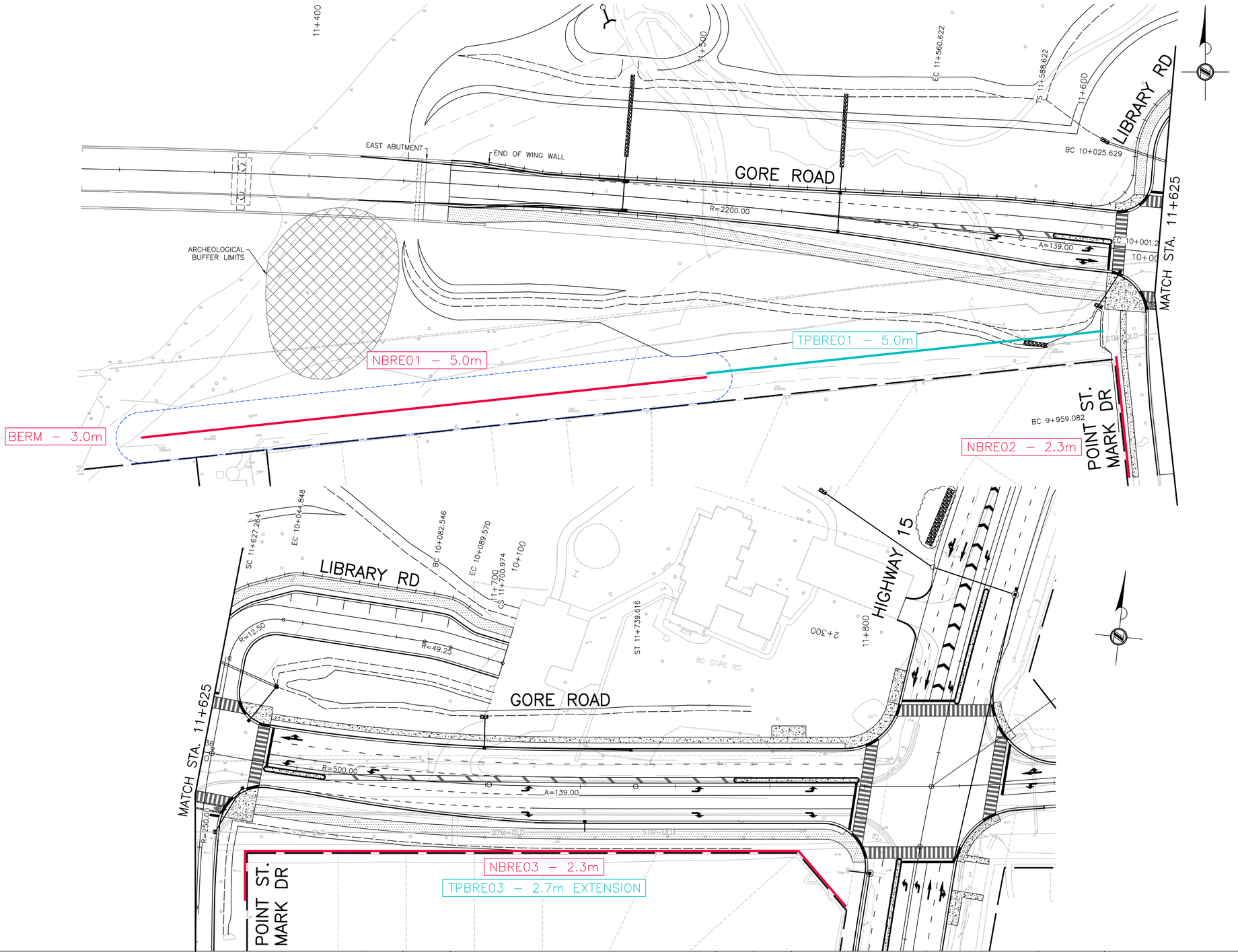
DRAWING NO. SEG1–0001

SHEET NO. 1

REVISION B

DRAWING NAME: H357883–83–260–SEG0–0001.dwg
SAVED BY: WEST867507
SAVE DATE: 4/23/2019 1:27 PM
PLOT DATE: 4/23/2019 1:27 PM

METRIC



LEGEND

- NOISE WALL
- TEMPORARY NOISE WALL
- EDGE OF BERM

INTEGRATED PROJECT DELIVERY TEAM:

HATCH · SYSTRA INTERNATIONAL BRIDGE TECHNOLOGIES · PKS Kiewit · KINGSTON

No.	DATE	REVISIONS	BY	CHECKED
B	04–22–19	FOR TEMPORARY CONDITIONS	DC	MC
A	02–22–19	FOR TEMPORARY CONDITIONS	DC	MC

DESIGN COMPANY: HATCH

DESIGN: DC
DRAWN: LW
CHECKED: MC

KINGSTON THIRD CROSSING

NOISE BARRIER EAST SHORE

OPTION 1

STA. 11+340 TO STA. 11+850

DATE: 04–22–19
SCALE: 1:500

DRAWING NO. SEG3–0001
SHEET NO. 2
REVISION B

DRAWING NAME: H357883–83–260–SE00–0001.dwg
SAVED BY: WEST867507
SAVE DATE: 4/23/2019 1:27 PM
PLOT DATE: 4/23/2019 1:28 PM

METRIC

11+300
11+400
11+500
EC 11+560.622
11+588.622
11+600
LIBRARY RD
BC 10+025.629
EAST ABUTMENT
END OF WING WALL
GORE ROAD
R=2200.00
A=139.00
EC 10+001.2
10+00
MATCH STA. 11+625
ARCHEOLOGICAL BUFFER LIMITS
TPBRE01-2 – 5.0m
BC 9+959.082
POINT ST. MARK DR
NBRE07 – 2.3m
SC 11+627.264
EC 10+044.848
BC 10+082.546
EC 10+089.570
CS 11+700.974
11+700
10+100
LIBRARY RD
R=12.50
R=49.25
ST 11+739.616
2+300
11+800
HIGHWAY 15
80 GORE RD
GORE ROAD
R=500.00
A=139.00
R=250.00
MATCH STA. 11+625
POINT ST. MARK DR
NBRE03 – 2.3m
TPBRE03 – 2.7m EXTENSION

LEGEND

NOISE WALL

TEMPORARY NOISE WALL

DRAWING NAME: H357883-83-260-SE00-0001.dwg
SAVED BY: WES7867507
SAVE DATE: 4/23/2019 1:27 PM
PLOT DATE: 4/23/2019 1:28 PM

INTEGRATED PROJECT DELIVERY TEAM:

HATCH | SYSTRA INTERNATIONAL BRIDGE TECHNOLOGIES | PKS Kiewit | KINGSTON

No.	DATE	REVISIONS	BY	CHECKED
B	04-22-19	FOR TEMPORARY CONDITIONS	DC	MC
A	02-22-19	FOR TEMPORARY CONDITIONS	DC	MC

DESIGN COMPANY: HATCH

DESIGN: DC
DRAWN: LW
CHECKED: MC

KINGSTON THIRD CROSSING

NOISE BARRIER EAST SHORE
OPTION 2

STA. 11+225 TO STA. 11+850

DATE: 04-22-19
SCALE: 1:500

DRAWING NO. SEG3-0002
SHEET NO. 3
REVISION B