RF Impact Study

For Construction Near an AM Transmission site

Oakville, ON

Prepared for

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Introduction

Yves R. Hamel et Associés Inc. was retained by Delmanor West Oak Inc. to evaluate the possible radiofrequency impact related to a planned seniors' housing project development at the intersection of Dundas St W and Fourth Line in the Town of Oakville ON, just east of the St. Volodymyr's Cultural Centre. Such evaluation was requested by the Town of Oakville given the close proximity of the project with the transmission site of two commercial AM broadcast stations.

The first objective of this study is to validate that the location is safe for both the future residents and the workers during the construction. For such analysis, we will verify that the radiofrequency (RF) levels are within the prescribed limits of the Safety Code 6[1], a guideline produced by Health Canada that specifies the maximum levels of human exposure to RF energy at frequencies between 3 kHz and 300 GHz.

The second objective is to verify the possible impact that the proposed buildings could have on the operation of both commercial AM broadcast stations. While the goal is not to evaluate with precision such impact, we will discuss the basic concepts of re-radiation and the possible distortion to the stations' operation and coverage, as well as the potential solutions if such distortion would be outside the licensed values.

Finally, this study reviews the technical literature to identify nuisance factors that might arise for residents of the retirement community, considering their proximity with the transmission site. This section will pay special attention to electric and electronic equipment typically found in seniors' residences, as well as potential mitigation measures.

Project Description

The proposed development is located just east of the St. Volodymyr's Cultural Centre located at 1280 Dundas St. W, Oakville, ON and across the street from the AM transmitter site. The development portrayed below and shown on figure 2 and 3 relative to the antenna arrays, will consist of a senior's retirement community including an 8 storey building (30.5 m in height) and 27 independent living units (1.5 storey/ 6 m high).

Figure 1 - Proposed development overview

Broadcast Station Description

A review of the ISED (Innovation Science and Economic Development Canada) broadcast database, indicates that 2 AM (Amplitude Modulation) stations, CJYE-AM and CJMR-AM, are operating from the coordinates 43˚27'29" N - 79˚45'16" W. The reference coordinates of these stations are less than 200 m from the proposed construction project, just across Dundas Street.

CJYE-AM

CJYE-AM is a Canadian Class B AM station operating on 1250 kHz with a power of 10,000 Watts for both Day and Night operation. The antenna system consists of 4 towers, 60 m high, producing a directional pattern, identical for both Day and Night operation, with its major lobe in an azimuth of 24.3°.

Tower No.	Field Ratio	Phase (deg)	Spacing (deg)	Orientation (deg)	Electrical Height (deg)
1	**1.000**	**0.00**	**0.00**	**0.00**	**90.00**
2	0.703	-61.90	144.00	319.99	90.00
3	0.594	33.30	169.81	288.00	90.00
4	1.052	109.40	90.00	230.00	90.00

Table 1 - CJYE-AM Operating parameters

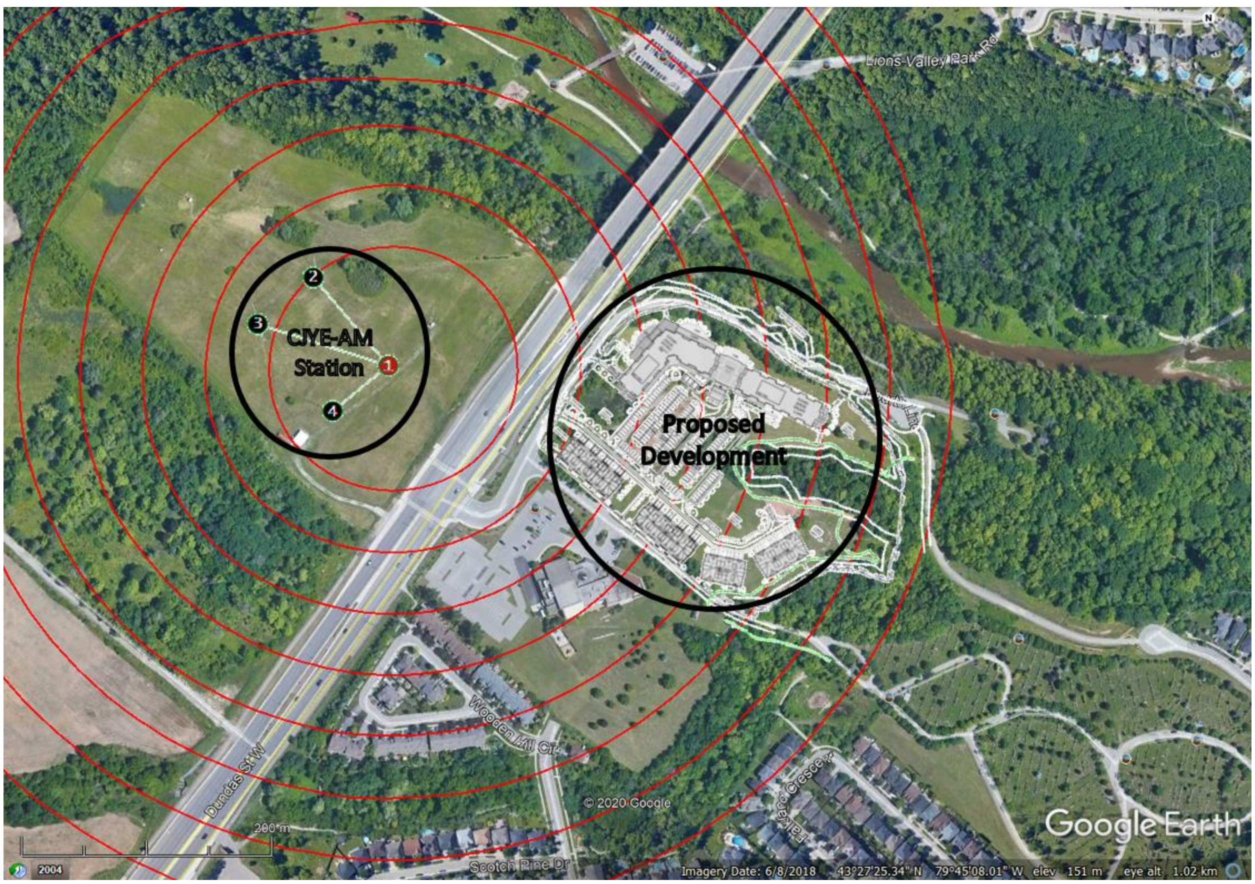


Figure 2 - CJYE-AM position

Using the above information, we can determine that the new development is located at a distance of approximately 150 m to 375 m from the reference tower number 1 in an azimuth between 80° and 130°.

Using the standard non-attenuated field at 1 km of 770 mV/m at 80° and 522 mV/m at 130° along with a ground conductivity of 5 mS/m for this region, we evaluate the RF signal at the project main building will be in the range of 2 V/m to 4 V/m. It should be noted that our evaluation is based on the far field calculation and because the site uses a multiple-tower array, at least parts of the development will be situated in the transition zone between the near-field and the far-field of the array, making it challenging to accurately predict field intensities using the stations' radiation pattern.

CJMR-AM

CJMR-AM is a Canadian Class B AM station operating on 1320 kHz with a power of 10,000 Watts for both Day and Night operation. The antenna system consists of 6 towers, 60 m high, producing a directional pattern, identical for both Day and Night operation, with its major lobe in an azimuth of 26.1°.

Tower No.	Field Ratio	Phase (deg)	Spacing (deg)	Orientation (deg)	Electrical Height (deg)
1	0.270	-76.40	74.62	41.08	95.00
2	**1.000**	**0.00**	**0.00**	**0.00**	**95.00**
3	1.040	-81.00	152.06	319.99	95.00
4	1.100	24.30	176.32	287.99	95.00
5	0.230	-57.10	338.90	308.92	95.00
6	0.800	91.04	95.04	230.00	95.00

Table 2 - CJMR-AM Operating parameters

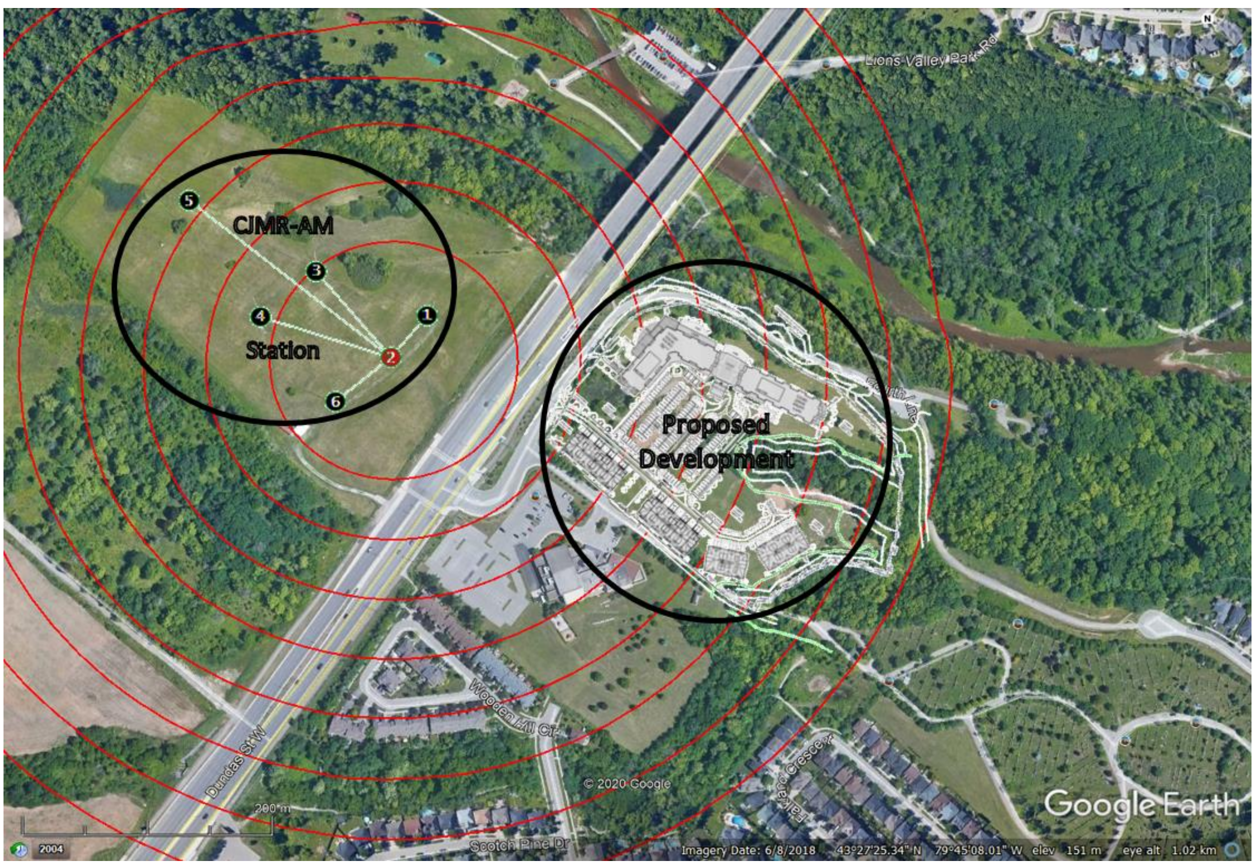


Figure 3 - CJMR-AM Position

Using the above information, we can determine that the new development is located at a distance of approximately 150 m to 375 m from the reference tower number 2 in an azimuth between 80° and 130°. Using the standard non-attenuated field at 1 km of 533 mV/m at 80° and 269 mV/m at 130° along with a ground conductivity of 5 mS/m for this region, we evaluate the RF signal at the project main building will be in the range of 1 V/m to 3 V/m. It should be noted that our evaluation is based on the far field calculation and because the site uses a multiple-tower array, at least parts of the development will be situated in the transition zone between the near-field and the far-field of the array, making it challenging to accurately predict field intensities using the stations' radiation pattern.

Additional Information

Multiple-tower AM station antenna arrays are used to produce directional radiation patterns, providing a good coverage in the target market area, as well as protecting other stations, most often located in the USA, using the same frequencies or adjacent frequencies. The shape of the directional radiation pattern for each station can be found in Appendix 1.

Safety Code 6

Health Canada publishes a document called "Safety Code 6" where the limits of human exposure to RF energy are detailed, for frequencies between 3 kHz and 300 GHz. The exposure limits specified in Safety Code 6 have been established based on a thorough evaluation of scientific literature related to thermal and non-thermal effects of RF fields, using a weight-of-evidence approach. The limits in Safety Code 6 are based on the lowest exposure levels at which any scientifically established adverse health effect occur. Furthermore, safety margins are incorporated into these exposure limits to ensure that even the worst-case exposure remains far below the established thresholds. Finally, the scientific approach used to establish the exposure limits in Safety Code 6 is comparable to that employed by other science-based international bodies such as the World Health Organisation (WHO) and the International Commission for Non Ionizing Radiation Protection (ICNIRP).

Safety Code 6 limits are set for two types of environments: Controlled Environments and Uncontrolled Environments. These two types of environments are defined as follows:

> **Controlled Environment**: An area where the RF field intensities have been adequately characterized by means of measurements or calculations and exposure is incurred by persons who are: aware of the potential for RF field exposure, cognizant of the intensity of the RF fields in their environment, aware of the potential health risks associated with RF field exposure and able to control their risk using mitigation strategies.
>
> **Uncontrolled Environment**: An area where any of the criteria defining the controlled environment are not met.

For this analysis we will use the Uncontrolled Environment standard for all normally accessible areas such as ground or buildings around the site.

The standard used in this report is based on the most recent Safety Code 6 2015 recommendations.

Frequency (MHz)	Reference Level Basis	Reference Level (E_{RL}), (V/m, RMS)		Reference Period
		Uncontrolled Environment	Controlled Environment	
0.003–10	NS	83	170	Instantaneous*
1.0–10	SAR	$87 / f^{0.5}$	$193 / f^{0.5}$	6 minutes**

Frequency, f, is in MHz. The precise frequencies at which SAR-based electric field strength reference levels for Uncontrolled and Controlled Environments begin are 1.10 MHz and 1.29 MHz, respectively.

Frequency (MHz)	Reference Level Basis	Reference Level (H_{RL}), (A/m, RMS)		Reference Period
		Uncontrolled Environment	Controlled Environment	
0.003–10	NS	90	180	Instantaneous*
0.1–10	SAR	$0.73 / f$	$1.6 / f$	6 minutes**

Frequency, f, is in MHz.

Figure 4 – Safety Code 6 electric and magnetic field limits for the frequencies in use

General Public Safety

Two collocated AM stations are operating in the vicinity of the proposed development. These stations operate using an array of 4 and 6 towers. The table below summarizes key characteristics of these two stations.

Station	Frequency	Wavelength	Power	Number of towers	Electrical height
CJYE-AM	1250 kHz	239.8 m	10 000 W	4	90°
CJMR-AM	1320 kHz	227.1 m	10 000 W	6	95°

Table 3 - Main characteristics of the AM stations used in Safety Code 6 analysis

The frequencies of operation fall under the purview of Safety Code 6 in two different ways: in the first place, Safety Code 6 sets limits on the intensity of electromagnetic fields in areas accessible to the general public (Uncontrolled Environment). Field intensity is measured in V/m for the electric field and A/m for the magnetic field. However, since the operating frequencies are situated below 10 MHz, Safety Code 6 limits are designed to limit two different effects: dielectric heating as well as nerve stimulation. The field limits for these two effects are specified using different basic restrictions and result in different limit values. Since both effects need to be controlled, the stricter of the two restrictions should apply.

Second, Safety Code 6 sets limits on induced and contact currents that may be generated by these frequencies. Induced currents are a measure of electrical current that may be induced in the body of a person simply by being in the vicinity of such an installation. Contact currents are currents that will be induced in other objects, such as fences, vehicles and other conductive objects like ducts and conduits, and then travel through the body of a person when they come in contact with that object. The limits on currents through the body, both induced and contact, are specified in terms of mA.

The Safety Code 6 limits for the operating frequencies are:

Electric Field	83 V/m (heating) 75.7 V/m (nerve stimulation)
Magnetic Field	90 A/m (heating) 0.584 A/m (nerve stimulation)
Induced Currents	40 mA
Contact Currents	20 mA

Table 4 - Safety Code 6 limit values for the frequencies of the AM stations Evaluation of Field Intensity

It is possible to predict the intensity of the electric and the magnetic field in the near-field of a tower array using existing reference plots (FCC OET bulletin 65.a)[2]. These curves are based on a single tower 1 kW transmit power and exist for various electric tower heights. They can be adapted for other transmit powers. For multiple-tower arrays, a worst-case estimate has been adopted by assuming that the total power is present in each tower. In our case this could be achieved by evaluating the distance to the limit values for 20 kW (compounding the effect of both stations) and comparing that to the distance between the proposed development and the nearest tower of the array.

The figure below can be used to estimate the distance to electric and magnetic field intensity limit values.

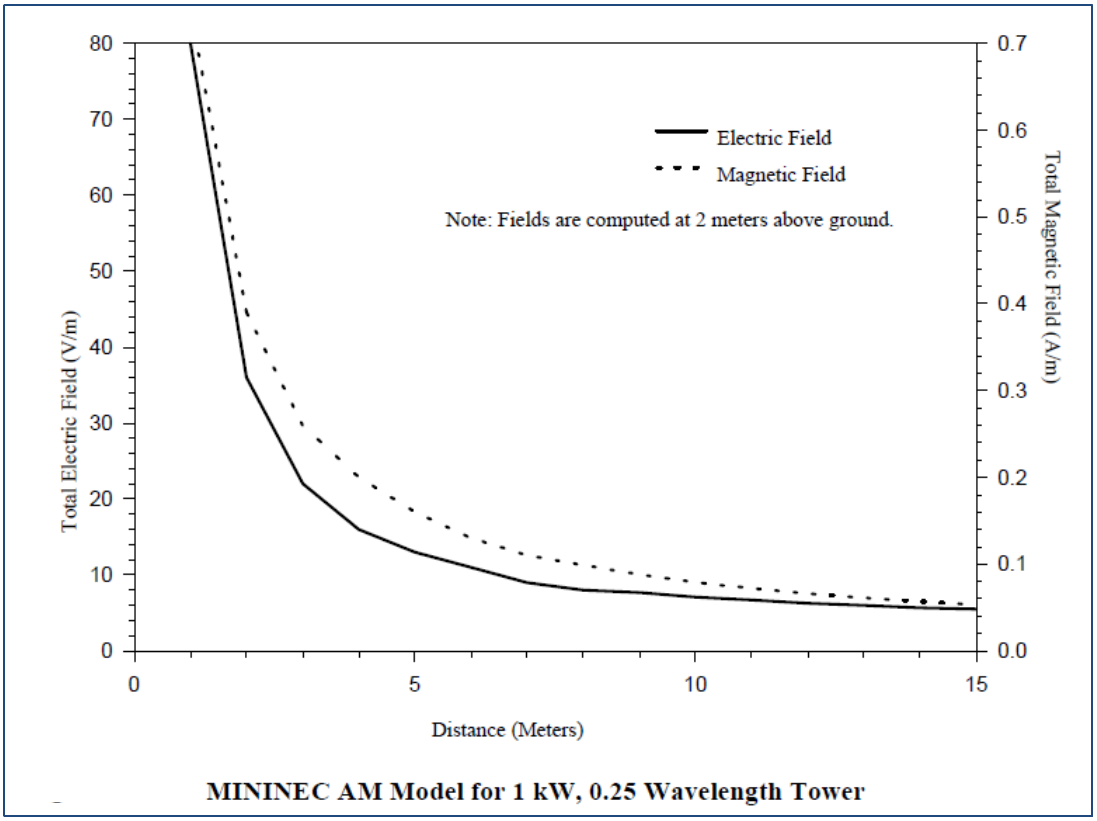


Figure 5 - Curves for evaluating field intensities near AM towers (from FCC OET 95.a)

It is important to bear in mind that these curves are valid for a 1 kW transmitter power, and we have adjusted these to account for 20 kW (worst case estimate). We used these graphs to estimate worst case distances to levels corresponding to 100%, 50% and 25% of the limit specified by Safety Code 6. The following table shows the corrected safety distances for all three of those limits, for both electric and magnetic fields.

	Limit Value based on SC6	Distance to limit @ 1 kW	Distance to limit @ 20 kW	Distance to 50% of limit @ 20 kW	Distance to 25% of limit @ 20 kW
Electric Field	75.7 V/m	1.2 m	**5.3 m**	**8.9 m**	**15.6 m**
Magnetic Field	0.584 A/m	1.5 m	**6.7 m**	**9.8 m**	**24.2 m**

Table 5 - Worst case distances from a tower to Safety Code 6 limit values

According to this worst-case estimate, the safety distance around any of the towers will not exceed 10 m, which is approximately one order of magnitude lower than the distance to the closest point of the proposed development.

Considering that this is an absolute worst-case estimate, supposing all power radiated from the nearest tower, we can be confident in stating that the terrain of the proposed development will comply with Safety Code 6 limits for electric and magnetic field intensities, at ground level.

We should note that these graphs do not allow for computing at heights other than up to 2 m above ground. However, based on the available safety margin, it is unlikely the levels will reach or exceed the Safety Code 6 limits at greater heights above ground.

Evaluation of Contact and Induced Currents

Induced and contact currents cannot be precisely predicted as their levels depend on many variables. However, it is known that induced current levels exceeding Safety Code 6 limits may exist in situations where field intensities are as low as 25% of the limit. Based on the results obtained in the previous section, it is unlikely that induced currents exceeding the Safety Code 6 limits will exist at the site of the proposed development.

As a general statement, contact currents are typically not an issue when considering relatively small conductive objects such as cars or fences. In the case of a large multi-storey building, it is possible that there will be conductive elements of a greater length, such as ventilation, plumbing or electrical conduits. When these elements have lengths approaching a significant fraction of the wavelength (15 to 20 m in this case), the effects of induced charges may become more pronounced, however, the appearance of these effects cannot be predicted with precision, although, as noted above, they are of low likelihood of occurrence.

Worker Safety During Construction

The main concern for worker safety is in the electromagnetic interference caused by currents induced in cranes, ladders, boom trucks, hoists and other conductive equipment with considerable vertical dimension. However, cranes are usually the main source of concern, simply due to their size.

There have been some reported cases where interference results in injuries to workers and damage to equipment. The induced currents can result in intense electrical shock that can either injure workers directly or result in mishandling of equipment, resulting in injury.

Damage to equipment can be caused by arcing resulting in fires as well as interference with crane controllers, rendering them inoperable or inducing erratic behaviors, causing damages to equipment or injuries to workers or both.

The extent and intensity of these effects cannot be predicted with precision, as they have been shown to depend on multiple variables, including atmospheric conditions, the size of equipment relative to the operating wavelengths, position and orientation of the equipment in the electromagnetic field and so on.

Worker protection can be achieved, at the minimum, by implementing the use of appropriate safety gear, such as insulated gloves and boots [3]. The use of non-conductive nylon or Kevlar slings and cables when possible and the use of insulated links to prevent the crane cable and structure forming a loop antenna is suggested, as well as the use of non-conductive or insulated tag lines. The use of short grounding cables to connect a conductive material lifted load to the grounded conductive structure before handling it with bare hands can be used on large metallic components and structure.

Attention must also be paid to the crane operation. The crane structure should be well grounded using cables and grounding electrodes shunting the crane foundation.

In conclusion, worker safety for most workers involved with crane related work, will require the use of personal protective equipment to lessen the currents due to charges induced in the body. Overall, worker safety can generally be addressed through the measures discussed above.

Nuisance Factors

As indicated earlier, the senior's housing development is planned in close proximity to the co-located AM stations and although the RF impacts are estimated to be well below the Safety Code 6 dictated limits, the proposed development will be in an environment experiencing a fairly high degree of electromagnetic field exposure, especially when considering the combined fields of both stations, and accordingly, a degree of caution should be exercised under these circumstances.

Substantial research has been conducted in the last few decades, with the deployment of a multitude of new wireless technologies and networks, to determine if the increased RF electromagnetic fields in the environment could have any impact on the general public health. Recent research has focused on studying the impact of mobile wireless technologies, as well as the impact of 50 or 60 Hz fields and some other low frequency technologies used in metal detectors or RFID systems. Some studies indicate that due to their long wavelength, the lower frequencies used in AM stations would have a reduced risk of impact on body-worn or implanted medical devices compared to some higher mobile wireless systems frequencies.

The cellular phones and LMR (Land Mobile Radio) portable or mobile units can be operated at very short distances (less than 1 m) from body-worn medical devices and especially for LMR, due to their higher transmitter power and operating frequencies, can represent a higher risk of interference. This explains partly why many incidents potentially involving portable radio and cellphones are reported and why multiple research related to these Ultra High Frequency (UHF) bands are still ongoing. However, the possibility that the Medium Frequencies (MF) used by the AM stations would interact with body worn medical devices is remote.

The general scientific consensus is that there is no evidence that these non-ionizing radiations have any impact on the public health, other than the thermal effect on the human body when placed, for a sufficient period of time, under an excessive electromagnetic field. In Canada, Safety Code 6 is covering this aspect and defines some electric and magnetic field limits ensuring the protection of the public and the workers who work in these RF environments.

However, the significant electric fields which are present within proximity of the high-power AM stations, even if not impacting public health, can cause some adverse effects on electrical and electronic equipment, at much lower intensity than what would impact human beings. As the proposed development will likely be experiencing electric fields of the same magnitude as the BPR-2[4] and EMCAB-2[5] specified thresholds of 1.83 V/m and 3.16 V/m, some building systems controls might be impacted as well as the electronic equipment used by the occupant. However, manufacturers of modern electronic equipment and appliances are typically designing their devices to have better electromagnetic compatibility than the minimum recommended in the manufacturing guidelines, which minimize the risk of occurrence.

In the case of the building systems which could be affected, one of the most common issue reported is related to public address and audio distribution systems, which may not be applicable to this project, as well as radio and television receivers. Under some circumstances, often related to long connecting wires or AC supply circuits, a sufficient RF current is induced in these conductors acting as an antenna and the AM station RF signal is demodulated by the connected device, as TV set, audio amplifier or others, which result in hearing the AM station transmitted audio through that device. It is typically possible to filter out the induction in the broadcast receivers and audio systems using ferrite cores or other filtering methodology customized to a specific case.

Similar phenomenon has been reported from loose or oxidized electrical connections. The larger and taller buildings have a higher risk of such behavior, since these buildings have longer metallic structural components for ventilation, electricity distribution and cabling, which represents a larger fraction of the AM station signal wavelength.

In the process of licensing a new AM station, the applicable Broadcasting Procedures and Rules (BPR-2) identifies some limitations on the number of people living within some defined high field contours when the station is deployed. However, there is no guideline about the limitations of the number of homes or buildings being added later within these high field contours. For instance, there have been new developments north of Dundas Street, within proximity of these AM stations over the last 10 years, following the construction of the Sixteen Mile Sport Complex.

Impact on the Operation of CJYE-AM and CJMR-AM

The proximity of any conducting structure near an AM radio station antenna array could cause a distortion of the AM station's authorized radiation pattern, a phenomenon often referred to as "secondary radiation from a nearby conducting structure". This phenomenon is relatively well known for isolated and simple shape structures such as telecommunication towers, but it is more complex for large buildings.

Secondary radiation caused by a conducting structure located near an AM station is fairly complex, but in a simplified way, it could be described as a re-radiation in all directions of the signal received from the transmitting AM station. The electric field near a high-power AM station is very important, reaching values in excess of 5 V/m at distances up to 1 km (in the range of 4 V/m in the case of this development at, around 200 m distance). Such electric field intensities can induce a significant electric current in any metallic or other conducting material through which the radio frequency current passes, especially when the dimension of the metallic object represents a significant fraction of the wavelength inducing the current flow.

The induced current flowing in the conductive object generates a new electric field around the object, with a phase and amplitude that will vary depending on the distance separating the object from the AM station and the physical characteristics of the object. This induced current flowing in the structure will radiate exactly as if the structure was driven directly by the same transmitter as the AM directional antenna array, however, the radiated or re-radiated field from this object is governed by properties not under the direct control of the station licensee but rather by the physical properties of the structure itself. Any new electric field is added to the one radiated directly from the AM transmitting station in some azimuths and subtracted in others, depending on the phase relationship between these two signals. The resulting radiation will therefore be an augmentation or a reduction of the original electric field level, as the case may be.

Most AM stations must use a directional pattern in order to adequately serve their target market and protect neighboring stations using the same frequency or an adjacent channel. According to an International Agreement between the US and Canada[6], operating stations and recognized allocations using co-channel and 1st, 2nd and 3rd adjacent frequencies must be protected to pre-established interference limits. These directional antenna systems are usually relatively complex. The careful selection of the relative position of each element and the signal power and phasing supplied to each element produces the required radiation pattern adapted to the situation. Design constraints are further complicated by consideration of the propagation conditions that are very different between the daytime and night-time. The majority of AM stations are indeed subject to certain pattern radiation constraints for emissions between sunrise and sunset and other constraints, often more restrictive for emissions between sunset and sunrise. By day, the propagation of these medium wavelength frequency waves is based on ground wave propagation, while during the night, the phenomenon of the reflected waves (sky-wave propagation) is added for distances larger than approximately 400 km, due to reflections on ionosphere. In general, while AM stations have to adapt their radiation pattern to protect nearby stations within a radius of 500 km or more during the day, this protection distance can and does reach several thousand kilometers during the night.

The integrity of these radiation patterns must be preserved to maintain adequate protection for other stations operating on the same channel or adjacent channels, hence the importance of verifying the potential of secondary radiation from conducting structures built near AM stations.

As described in the previous section, both CJYE-AM and CJMR-AM stations are using directional patterns with their maximum oriented towards approximately 25° and both have deep nulls compared to their maximum values as presented in the following table.

Station	Azimuth (deg)	Standard non attenuated field @ 1 km	
		Emin (mV/m)	Emax (mV/m)
CJYE-AM	24.3		2024.7
	100.7	384.6	
	181.8	108.3	
	262.1	38.1	
CJMR-AM	26.1		2324.8
	98.6	94.2	
	162.5	52.1	
	236.4	159.4	
	276.9	82.4	

Table 6 - Station pattern maximums and nulls

A potential re-radiating structure positioned in the direction of a null of an AM radiation pattern will have a very low or possibly no influence in terms of pattern deformation. On the other hand, if the structure positioning is in the main lobe of an AM radiation pattern, it could have a significant impact on the resulting pattern, which may cause the radiation to exceed the maximum allowed by the so-called standard pattern. Since the energy re-emitted by this structure will have an omnidirectional pattern characteristic, exceeding the maximum allowable values occur initially in the null azimuths of the AM station pattern, whose objective is to protect neighboring co-channel and adjacent channels stations against excessive interference. As a result of this increased interference, there could be an adverse effect to listeners of that neighboring station located at the limits of the service area of the affected station. Re-radiation problems in these cases can lead to compliance issues with respect to the station's licence requirements.

In case of excessive pattern deformation, it is occasionally possible to slightly modify the station’s operating parameters to restore the proper protection to a neighboring station, however, this approach is not always possible, especially when protection needs to be restored to multiple stations. In some cases, it may be possible to file for augmented parameters to address the issue, provided no interference is caused to another station.

Proposed Buildings

Since the seniors independent living units are only 6 m high (1.5 storey), they do not represent a threat to either station, their height being very small compared to the operating wavelength of both CJYE-AM (1250 kHz: wavelength of 240 m) and CJMR-AM (1320 kHz: wavelength of 227 m). The proposed 8 storey seniors building would be 30.5 m high which would be close to 1/8 of the wavelength of the AM stations and potentially introduces a risk of impact on the stations’ radiation patterns.

As shown on the following figure 6, it is important to stress the fact that tall buildings in the range of 15 to 20 storeys, have been erected within one kilometer of an AM station in the suburb of Toronto. The CFRB-AM station is transmitting with a power of 50 kW from their transmitter site located at 2226 Royal

Windsor Drive, in the Clarkson neighborhood in Mississauga. Our evaluation indicates that the electric field values at these building locations in Toronto would be approximately of the same or greater magnitude than the electric field values for this present project.

Figure 6 – North view from the CFRB-AM reference tower

There has been significant urban development in close proximity to the CFRB-AM station since it began operation at that location in 1948. The construction of these larger buildings may have had a slight impact on the station radiation pattern, but not to an extent that could not be addressed, as the station has maintained its transmitter operating parameters. We have no indication that any significant issue was reported in these buildings located near the CFRB-AM station, either with the building's control systems or the tenant's electronic devices. We have no reason to believe that it would be much different for the Delmanor West Oak development and the CJYE-AM and CJMR-AM stations.

Summary

Even if the buildings in the proposed development are subjected to significant electromagnetic fields, there is no indication that it would get close to the limits imposed by the Health Canada Safety Code 6 standard applicable to human exposure. Although unlikely, it is possible that the actual field intensities in different parts of the building may cause issues with some electronic devices or audio systems. In such cases, certain measures can be taken to mitigate the impact of such interference (e.g., shielding electrical cables).

Worker safety during construction will need to be addressed at the level of personal protective gear for workers to protect them from induced body currents as well as at the level of equipment, especially cranes and boom trucks, to protect the equipment and the workers nearby from electric discharges. Every worker on site should be briefed on the RF field present in the project environment, and they should be informed of the applicable safety procedures, especially when involved in load lifting and crane operation.

From the perspective of the AM stations operation, the construction of the 8 storey main building of the seniors housing project may possibly have an impact on the radiation pattern of each station. Given the complexity of the structural and all conducting elements of this type of building, it is impossible to predict in advance with precision the level of changes to the patterns that the building may introduce and if the modified pattern would cause excessive interference to the neighboring stations it needs to protect.

In case of impact on the radiation patterns, certain mitigation techniques can be adopted to resolve the issue and some preventive measures can be used to minimize the risk. For instance, the structure of the building will be reinforced concrete, which reduces the level of induced current in the reinforcing steel compared to a steel beam structure, since it is encased in concrete.

References

1- Health Canada. Limits of Human Exposure to Radiofrequency Electromagnetic Energy in the Frequency Range from 3 kHz to 300 GHz. Safety Code 6, 2015

2- Federal Communications Commission, Office of Engineering & Technology, Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields – Additional Information for Radio and Television Broadcast Stations, OET Bulletin 65 Supplement A (edition 97-01)

3- Faith Üstüner, National Research Institute of Electronics and Cryptology, Interaction of an AM Broadcast Transmitter with a Large Crane Posing Health Hazards; A Real World Event Analysis, 2012 IEEE Electromagnetic Compatibility Magazine – Volume 1 – Quarter 2

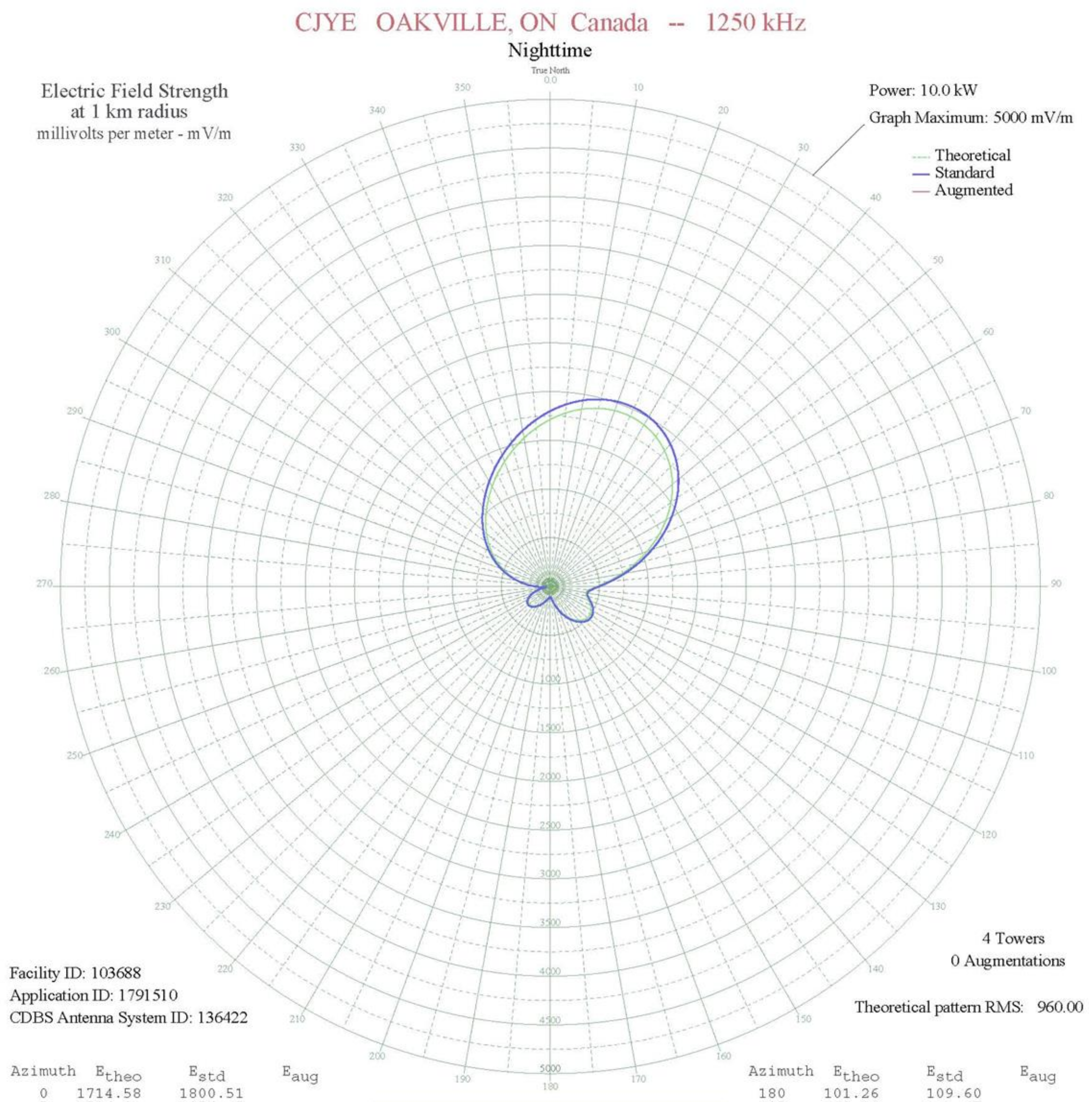
4- Innovation Science and Economic Development Canada (ISED), Broadcasting Procedures and Rules Part 2: Application Procedures and Rules for AM Broadcasting Undertakings (BPR-2), Issue 3, February 2016.

5- Industry Canada (IC), Electromagnetic Compatibility Advisory Bulletin (EMCAB-2), Issue 1, June 1994.

6- Agreement between the Government of the United States of America and the Government of Canada relating to the AM broadcasting service in the Medium Frequency band, Ottawa, 1984

Appendix 1 – Station information

CJYE-AM Horizontal non attenuated pattern at 1km



Azimuth	E_{theo}	E_{std}	E_{aug}
0	1714.58	1800.51	
5	1786.91	1876.45	
10	1847.32	1939.87	
15	1892.75	1987.56	
20	1920.38	2016.58	
25	1927.85	2024.42	
30	1913.36	2009.20	
35	1875.82	1969.80	
40	1814.95	1905.88	
45	1731.27	1818.03	
50	1626.21	1707.73	
55	1502.04	1577.37	
60	1361.87	1430.22	
65	1209.65	1270.42	
70	1050.14	1102.97	
75	889.01	933.84	
80	733.07	770.18	
85	590.89	621.00	
90	473.71	498.11	
95	395.36	415.98	
100	365.76	384.96	
105	378.48	398.29	
110	413.10	434.57	
115	450.76	474.04	
120	480.22	504.93	
125	496.11	521.59	
130	496.52	522.02	
135	481.61	506.39	
140	452.84	476.22	
145	412.55	433.99	
150	363.66	382.77	
155	309.50	326.07	
160	253.69	267.69	
165	200.10	211.78	
170	153.15	162.99	
175	118.26	126.99	

The theoretical pattern is used to create the standard pattern. Augmentations (if any) expand the standard pattern in specified directions. See Sections 73.150 and 73.152 of the FCC's Rules.

AM coverage may not mirror the pattern shown here. Additional factors such as ground conductivity or skywave propagation affect how far the AM signal will travel.

Patterns for stations outside the USA are based on notified parameters.

AM directional patterns created before 1982 used units of 1 mV/m at 1 mile, not one kilometer. The pattern values on such plots at 1 mile will be 0.62137 of the values listed here. Measured pattern values may vary from values shown here.

Plot is best printed on 11" by 17" or larger paper.

27 Aug 2020

Prepared by Audio Division, Media Bureau
Federal Communications Commission

Azimuth	E_{theo}	E_{std}	E_{aug}
180	101.26	109.60	
185	103.29	111.67	
190	117.95	126.67	
195	138.53	147.87	
200	161.98	172.15	
205	187.16	198.31	
210	213.02	225.25	
215	237.79	251.09	
220	258.96	273.20	
225	273.62	288.52	
230	278.91	294.06	
235	272.41	287.26	
240	252.43	266.38	
245	218.21	230.66	
250	170.00	180.47	
255	109.30	117.80	
260	41.96	51.47	
265	55.80	64.34	
270	140.52	149.92	
275	232.10	245.15	
280	325.65	342.97	
285	418.88	440.62	
290	510.30	536.47	
295	599.14	629.66	
300	685.28	720.04	
305	769.14	808.03	
310	851.53	894.50	
315	933.49	980.52	
320	1016.09	1067.22	
325	1100.23	1155.55	
330	1186.50	1246.11	
335	1275.01	1339.03	
340	1365.32	1433.83	
345	1456.36	1529.41	
350	1546.48	1624.02	
355	1633.44	1715.32	

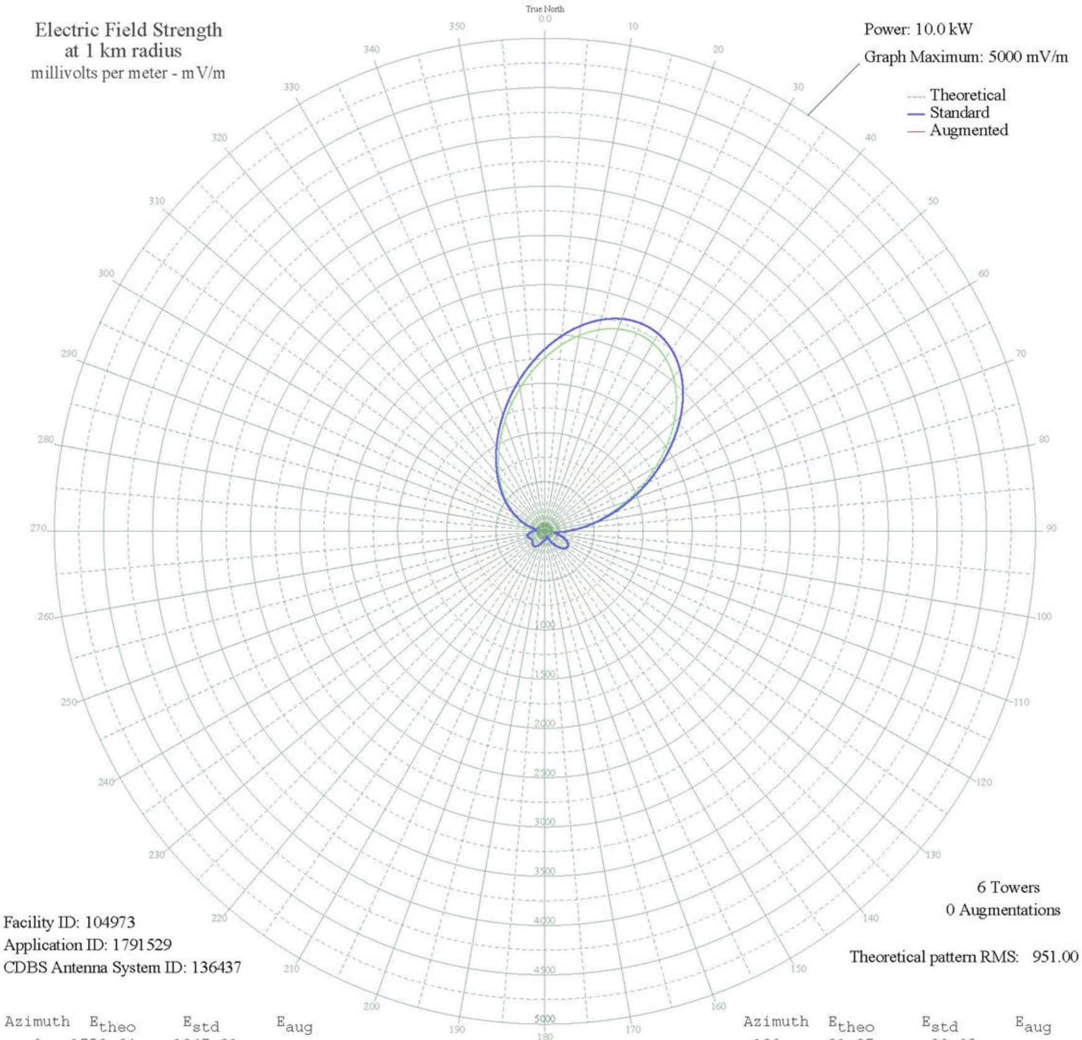
CJMR-AM Horizontal non attenuated pattern at 1km

CJMR OAKVILLE, ON Canada -- 1320 kHz

Nighttime

Electric Field Strength
at 1 km radius
millivolts per meter - mV/m

Power: 10.0 kW
Graph Maximum: 5000 mV/m



6 Towers
0 Augmentations

Facility ID: 104973
Application ID: 1791529
CDBS Antenna System ID: 136437

Theoretical pattern RMS: 951.00

Azimuth	E_{theo}	E_{std}	E_{aug}
0	1759.64	1847.81	
5	1895.15	1990.09	
10	2016.05	2117.02	
15	2114.50	2220.39	
20	2182.53	2291.81	
25	2212.92	2323.72	
30	2200.30	2310.47	
35	2142.04	2249.30	
40	2038.93	2141.04	
45	1895.25	1990.19	
50	1718.45	1804.58	
55	1518.20	1594.34	
60	1305.17	1370.69	
65	1089.72	1144.52	
70	880.78	925.20	
75	685.10	719.85	
80	507.15	533.18	
85	349.68	368.14	
90	215.52	227.88	
95	114.56	123.23	
100	90.11	98.33	
105	140.04	149.46	
110	194.70	206.18	
115	235.55	248.78	
120	259.24	273.51	
125	265.59	280.15	
130	255.85	269.98	
135	232.34	245.42	
140	198.17	209.80	
145	157.17	167.18	
150	113.77	122.42	
155	73.58	81.76	
160	46.35	55.54	
165	45.66	54.91	
170	60.41	68.84	
175	73.67	81.85	

The theoretical pattern is used to create the standard pattern. Augmentations (if any) expand the standard pattern in specified directions. See Sections 73.150 and 73.152 of the FCC's Rules.

AM coverage may not mirror the pattern shown here. Additional factors such as ground conductivity or skywave propagation affect how far the AM signal will travel.

Patterns for stations outside the USA are based on notified parameters.

AM directional patterns created before 1982 used units of 1 mV/m at 1 mile, not one kilometer. The pattern values on such plots at 1 mile will be 0.62137 of the values listed here. Measured pattern values may vary from values shown here.

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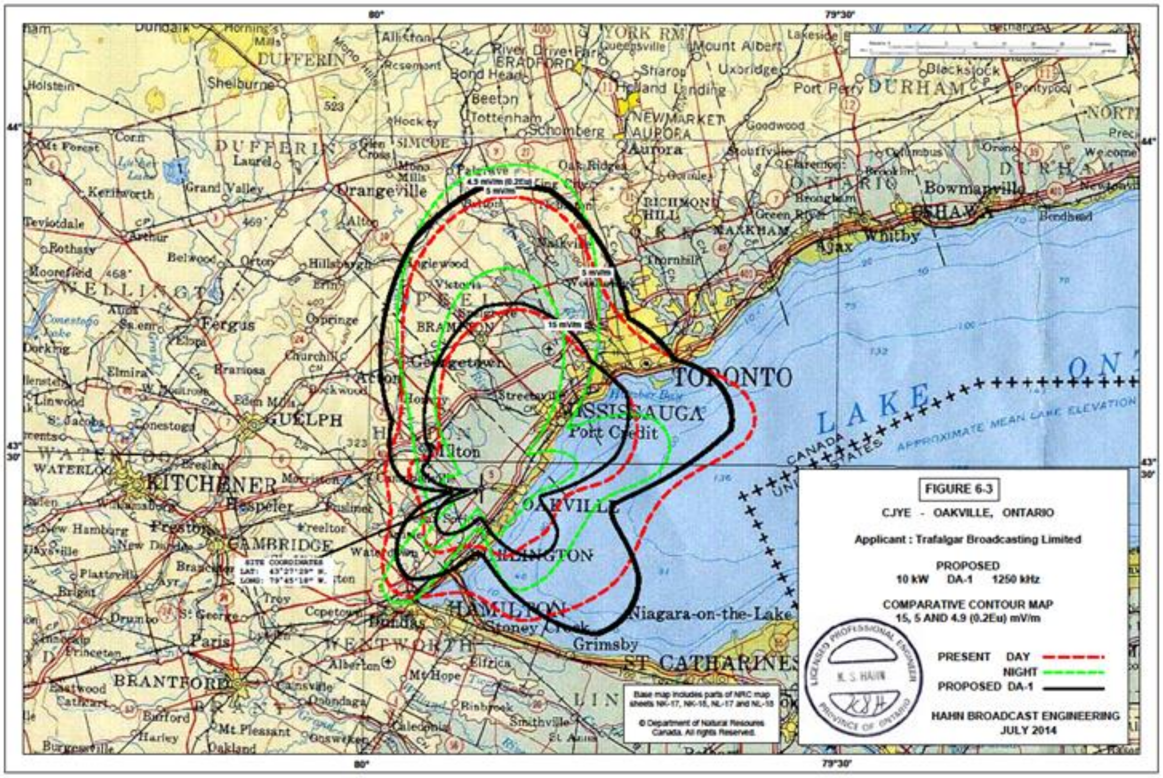
27 Aug 2020

Prepared by Audio Division, Media Bureau
Federal Communications Commission

Azimuth	E_{theo}	E_{std}	E_{aug}
180	81.87	90.03	
185	87.49	95.69	
190	95.60	103.88	
195	110.01	118.57	
200	130.00	139.09	
205	151.13	160.92	
210	168.25	178.67	
215	177.44	188.22	
220	177.11	187.88	
225	168.77	179.22	
230	157.35	167.37	
235	150.09	159.85	
240	152.21	162.04	
245	161.91	172.10	
250	171.79	182.35	
255	174.29	184.95	
260	164.65	174.94	
265	141.64	151.11	
270	108.40	116.93	
275	78.01	86.17	
280	84.91	93.08	
285	136.13	145.42	
290	205.64	217.57	
295	282.37	297.69	
300	362.90	381.99	
305	446.43	469.51	
310	533.39	560.69	
315	624.89	656.68	
320	722.32	758.90	
325	826.96	868.72	
330	939.80	987.15	
335	1061.29	1114.67	
340	1191.20	1251.04	
345	1328.52	1395.20	
350	1471.29	1545.09	
355	1616.45	1697.48	

CJYE-AM Contour map (extract from CRTC file 2014-0932-6)



CJMR-AM Contour map (extract from CRTC file 2014-0934-2)