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March 14, 2019

DELIVERED VIA EMAIL AND HAND DELIVERY

Town Clerk
Clerk's Department
Town of Oakville

Ms. Melissa Dalrymple, Planner
Town of Oakville

1225 Trafalgar Road
Oakville, Ontario
L6H 0H3

Dear Madams/Sirs:

Re: 393 Dundas LP (Distrikt Developments) – 393 Dundas Street West
Part of Lot 19, Concession 1, North of Dundas Street
Development Applications: Z.1319.07 and OPA 1319.07

We act for Whiteoaks Communications Group Limited ("Whiteoaks") with respect to the proposed development of 393 Dundas Street West by 393 Dundas LP (Distrikt Developments) (the "Proposed Development"). Whiteoaks owns and operates two AM radio stations from its property at 1303 Dundas Street West, which is approximately 1.5 kilometers away from the Proposed Development.

Our client is writing to provide comments regarding the land use compatibility issues that have the potential to cause significant adverse two-way impacts for Whiteoaks and the Proposed Development, along with supporting expert reports and studies. We have retained Lawrence Behr Associates Inc. ("LBA") to assess the potential impacts caused by a number of proposed development projects in proximity to Whiteoaks' lands, including the Proposed Development.

Based on the LBA Letter of Opinion and other relevant studies, the potential adverse impacts created by the Proposed Development are:

1. potential for electric shock and burn hazards to construction workers, including a risk of fire or explosion;

2. potential disruption and distortion of the radio signals of Whiteoaks' AM stations, causing them to operate outside of its federally licensed parameters and potentially

causing interference and loss of coverage for other AM stations; and

3. potential malfunction or damage of electronic equipment, including cranes.

As noted in the LBA Letter of Opinion, LBA expects the adverse impacts for the Proposed Development to be similar to those indicated in the LBA Graydon-Banning/Martillac Report, but potentially to a lesser degree. The Graydon-Banning/Martillac developments are adjacent to the site of the Proposed Development. The adverse impacts identified in the LBA Graydon-Banning/Martillac Report were:

1. disrupt and distort the radio signal of both stations, causing them to be outside of federally regulated and licensed parameters and potentially interfere with other radio stations signals;

2. pose a serious threat to the safety of construction workers and post-construction residents, including contact burns, shocks, and increased risk of catastrophic accidents leading to serous physical injuries and damage to property; and

3. interfere with construction equipment and consumer electronics, leading them to malfunction or fail, including catastrophic failures.

We understand the Town is also greatly concerned about the potential for land use incompatibility resulting from locating sensitive land uses and radio communications facilities in close proximity, which is the reason for its adoption of an Interim Radio communications Facilities Protocol, as amended.

However despite this concern, there has been no assessment by the developer of land use compatibility issues arising from locating new sensitive land uses near to an existing major radiocommunication facility. This is contrary to the applicable planning policies and guidance including the Provincial Policy Statement (PPS), the Region of Halton Official Plan, the 2006 Town Official Plan, the North Oakville East Secondary Plan and the Region's Land Use Compatibility Guidelines and the Ministry of the Environment, Conservation and Parks D-Series Land Use Compatibility Guidelines which all require that land use compatibility issues be assessed and addressed prior to development. As such the Proposed Development has not demonstrated consistency with the PPS or conformity with the Region and Town Official Plans.

Our client believes that this development application is premature. It is in the best interests of the Town, the developer and Whiteoaks to ensure that prior to any approval of the Proposed Development, all necessary studies are conducted and all necessary mitigation measures are adopted to ensure that no adverse effects or impacts will result to Whiteoaks operations, residents and construction workers from the construction of the Proposed Development. Not doing so is likely to result in a situation where all stakeholders lose and suffer significant negative consequences.

What follows is a summary of Whiteoaks' concerns, findings and recommendations to date, together with the following documents:

Appendix "A": "Letter of Opinion" by Lawrence Behr Associates Inc. regarding the 393 Dundas Street West development by 393 Dundas LP (Distrikt Developments) ("LBA Letter of Opinion")

Appendix "B": historical correspondence

Appendix "C": "Impacts of the Draft West Oak Trails Secondary Plan on the Operational Capacity of CHWO and CJMR Radio Planning Report" by Lehman & Associates and M.A. Tilston Engineering, dated February 1993 (the "Lehman-Tilston Report")

Appendix "D": CJMR-CJYE Graydon-Banning/Martillac Developments AM Modeling Report by Lawrence Behr Associates Inc. (the "LBA Graydon-Banning/Martillac Report")

Appendix "E": "North Dundas Encroachment and Development Report" by Firmin and Associates, a Division of Sound Reinforcement Limited, dated November 28, 2018 (the "Firmin and Associates Report")

Appendix "F": Excerpts from the Provincial Policy Statement (PPS), the Region of Halton Official Plan, the 2006 Town Official Plan and the North Oakville Secondary Plans.

BACKGROUND

Whiteoaks' radio stations have been a fixture of the Town of Oakville since 1956, broadcasting to the Halton and Peel regional markets for over 60 years. Whiteoaks owns and operates two AM radio stations: CJYE 1250 kHz & CJMR 1320 kHz & from its lands at 1303 Dundas Street West, where it has been broadcasting since 1979 (the "Transmission Site"). The stations moved to the Transmission Site after relocating from a prior site, in what is now Glen Abbey Estates, due to encroaching development.

Each station transmits 10,000 watts, 24 hours a day, seven days a week and can reach over six million people within the authorized pattern from the Town of Oakville. The Whiteoaks site is unique due to the co-location of two AM Transmitters that share the same set of six (formerly seven) 186-foot-tall radio telecommunication towers, but emit two separate DA-1 radiation patterns – one for each of CJYE and CJMR. The site was one of the first AM colocation sites in Canada, and remains rare to this day. The colocation of two AM stations using the same tower complex makes the site very complex form a radio telecommunication engineering standpoint.

Recently the two stations upgraded the site's operations with new transmission tuning & phasing apparatus (2016) and provided Innovation, Science and Economic Development Canada (ISED) with the required Proof of Performance for each station which included Safety Code 6 documentation verifying compliance.

AM Radio transmission sites can be adversely impacted by nearby development, compromising their long-term viability and can in turn have adverse effects upon sensitive land uses. For this reason, since 1979, Whiteoaks has expended considerable resources and effort to educate land use authorities, including the Town of Oakville and Halton Region, as well as developers on how to appropriately design and locate new development to prevent or mitigate adverse effects. Key points in this history include:

- 1978: Whiteoaks provided evidence at the OMB hearing of the 1978 Town Official Plan of the impacts of development

- 1986-1988: Michael Caine spearheaded a task force involving the federal Department of Communications, the CRTC, Industry Canada, the Ontario Ministry of Transportation and Communications, the Ontario Ministry of Municipal Affairs and the broadcasting industry to produce a computer program that identified the location of every broadcast transmitter in Ontario, which was then provided to over 800 municipal planning directors in Ontario

- 1993: Whiteoaks provided comments and expert planning and engineering reports (the Lehman-Tilston Report) for the planning process that led to the West Oak Trails Secondary Plan
- 1999, forward: Whiteoaks participated in and provided comments with respect to the planning process for development of Town lands north of Dundas (OPA #198)
- 2000: Whiteoaks provided comments on a proposed 20,000 seat soccer stadium in close proximity to the Whiteoaks site, as part of the Toronto 2008 Winter Olympics bid
- 2009: Whiteoaks provided comments on the North Oakville draft Zoning By-law
- 2010: Whiteoaks provided comments and advice and attended meetings with Halton Healthcare Services and the Region of Halton regarding the construction of the new Oakville Trafalgar Memorial Hospital
- 2010-2014: Whiteoaks provided comments and advice and attended meetings with respect to the construction of the 16 Mile Creek Dundas Bridge
- 2017-2018: Whiteoaks provided comments and advice with respect to the planning of the proposed new over 16 Mile Creek for the William Halton Parkway
- 2018-2019: Whiteoaks is a party to the LPAT appeal of the proposed Graydon-Banning/Martillac development adjacent to the Transmission Site due to concerns regarding adverse impacts
- 2019: Whiteoaks provided comments to the Town of Oakville regarding the nearby proposed development of the Health Science and Technology District by Oakville Green Development Inc.

KEY CONCERNS REGARDING THE DEVELOPMENT APPLICATION

As noted, the Proposed Development is located approximately 1.5 kilometers from the Transmission Site. The development application and supporting materials submitted by 393 Dundas LP (Distrikt Developments) indicates that the Proposed Development is for stacked townhomes and an apartment building which is 10 storeys in height.

As stated in the LBA Letter of Opinion, they expect the adverse impacts for the Proposed Development to be similar to those indicated in the LBA Graydon-Banning/Martillac Report, but potentially to a lesser degree. The Graydon-Banning/Martillac developments identified the following adverse impacts:

1. **Interference with the CJYE and CJMR signals:** construction of tall buildings in close proximity to AM transmission facilities adversely impact the radio signal in two main ways:

    (a) blocking or weakening the signal thereby reducing the number of households it reaches; and

(b) altering the broadcast pattern of the signal resulting in the stations' signals distorting the authorized transmission patterns, and as result, potentially causing interference to co and adjacent frequencies. Each station must protect 20khz either side of their assigned frequency. For instance, 1250 kHz must protect 1230, 1240, 1250, 1260,1270 kHz. While 1320 must protect 1300, 1310, 1320, 1330, 1340 kHz. Each radio station has its own broadcast authorized pattern that is protected by international treaty and domestic legislation.

The LBA Graydon-Banning/Martillac Report found, based on modelling, that "the AM stations' federally regulated patterns will be seriously affected during the construction activities and the presence of the buildings afterwards, causing both stations to be out of compliance with their strict, federally regulated and licensed parameters and potentially interfering with the signals of other AM radio stations." These adverse impacts are principally caused by:

- During construction: metal equipment, especially cranes, cables and construction elevators and components re-radiating the signal. The metal components are co-opted by the electromagnetic signal into becoming part of the antenna array, altering the broadcast pattern through re-radiation.

- Post-construction: the physical bulk of the buildings blocking the signal and the various metallic components within them (metal framing, wiring, re-bar etc.) re-radiating the signal.

2. **Public Health and Safety:** the LBA Graydon-Banning/Martillac Report found that the radiofrequency (RF) intensities at the site will cause safety hazards both during and after construction, unless properly mitigated as follows:

   Construction Phase Hazards:

   - contact current burns and shocks as well as arcing (sparks flying). These discharges can cause severe burns and other damage to the human body depending on the entry and exit points

   - accidents resulting from shocks to construction workers while handling equipment, carrying heavy objects or operating at elevations above ground level

   - electric sparks causing materials to combust

   - physical injury to persons and property as a result of malfunctioning equipment

   - arcing caused by the currents induced on metal structures and cables. The danger of sparks near combustible material is obvious. Static discharges can startle a person and cause the loss of grip on a handrail or an object with the risk of losing balance

   Post-Construction Hazards:

   - exterior metal railings and other long metal elements (such as aluminum window frames) can result in contact burns and shocks

   - compromised integrity of elevator cables

- malfunctioning garage door equipment

3. **Radio interference with construction equipment and consumer electronics**: the high levels of RF from the Transmission Site can interfere with nearby electronic devices. The interference can result in devices not functioning as predicted, total malfunction or premature failure. Special filters, shielding and excessive grounding will be required but may not eliminate all the effects to a desirable level. The LBA Graydon-Banning/Martillac Report identified the following impacts:

    - RF interference with construction equipment, especially cranes, causing equipment to be difficult to operate, inoperable or to malfunction potentially resulting in catastrophic failure and damage to property and bodily injury

    - arcing can damage cranes and elevator hoisting cables, rendering them useless

    - household devices like entertainment systems and the like, alarms, monitoring systems, intercoms, and garage doors will be subject of malfunction or interference, especially the ones connected to cables or cable networks that are long enough to act as antennas at the frequencies involved

    The recent experience during the construction of a bridge adjacent to the broadcast transmission site of CJMR/CJYE along Dundas Street is illustrative. High RF levels caused contact burns, while the PLC controlled crane lost several expensive electronic control boards and as a result the project was halted by health and safety personnel. A manual lift crane had to be brought in to complete the project (see Firmin & Associates Report).

    In Industry Canada's Spectrum Management CPC-2-0-03 (June 26, 2014) 7.2 it states that land use authorities (LUA):

    > *... have a responsibility to ensure that those moving into these areas, whether prospective residents or industry, are aware of the potential for their electronic equipment to malfunction when located in proximity to an existing broadcasting installation. For example, the LUA could ensure that clear notification be provided to future prospective purchasers.*

NEXT STEPS AND RECOMMENDATIONS

The forgoing land-use compatibility issues require a multi-stage impact assessment and mitigation process in order to achieve consistency with the PPS and conformity with the Region and Town Official plans. It is the responsibility of the developer and the Town to ensure the proposed new land uses are compatible with existing land uses. As such, detailed modeling and mitigation is ultimately the responsibility of the developer. Detailed modeling can only be conducted once detailed design has been completed. Based on the LBA Graydon-Banning/Martillac Report, the following steps will need to be undertaken:

1. modeling of both construction phase impacts and impacts post-construction, based on detail design and construction workplans

2. develop a detailed mitigation planning and design, containing the following components:

    a. initial mitigation design based on modeling of the detailed design of the development, based on an iterative modeling and design process

b. an RF engineer available on-site during the construction phase to adapt mitigation

c. on-going monitoring of both the construction site and the AM radiation pattern during construction to assess mitigation effectiveness

d. an emergency response plan for the construction phase to address any issues before they result in serious negative impacts to either the construction workers or the AM radiation pattern

e. post-construction availability of an RF engineer to address issues on a case-by-case basis

f. periodic monitoring of the AM radiation pattern and adaptive mitigation as required

3. warning clauses to warn purchasers of the potential risks involved

Our client is willing to cooperate with the Town and developer and provide the necessary technical information on its operations to achieve these goals. However, our client wishes to be clear that it has provided the Town and the developer full and detailed warning of its existing operation and any resulting worker injury, resident injury, damage to property or economic loss is solely the responsibility of the developer.

We respectfully request confirmation from the Town that it will be requiring the detailed modeling and mitigation plan, before approving of the Proposed Development, together with appropriate condition of draft approval that will ensure the mitigation plan is carried out and appropriate warning clauses in agreements of purchase and sale.

We are prepared to meet with the Town and the developer to discuss how to best move through this process in a manner that protects the interests of all involved, and to discuss appropriate conditions of approval to address the issues raised in this letter and the Lawrence Behr Associates study.

Yours truly,

O'CONNOR MACLEOD HANNA LLP

Konstantine J. Stavrakos
Encl.

Tab A

Lawrence Behr Associates INC
www.lbagroup.com

Letter of Opinion

CJMR-CJYE/393 Dundas Street West

RE: Two-way impacts relative to a proposed urban development located at 393 Dundas Street W in Oakville, Ontario, Canada, on the radiation patterns of CJMR and CJYE and potential hazards during construction and its use once built

LOCATION:

Oakville, Ontario, Canada

Requested by:

Whiteoaks Communications Group Limited

DATE:

March 12, 2019

3400 Tupper Drive | Greenville, NC 27834
252-317-2123 | 800-522-4464 | lbagrp@lbagroup.com

NOTICE

This work is based upon our best interpretation of available information. However, these data and their interpretation are constantly changing. Therefore, we do not warrant that any undertaking based on this report will be successful, or that others will not require further research or actions in support of this proposal or future undertaking. In the event of errors, our liability is strictly limited to replacement of this document with a corrected one. Liability for consequential damages is specifically disclaimed. Any use of this document constitutes an agreement to hold Lawrence Behr Associates, Inc. and its employees harmless and indemnify it for any and all liability, claims, demands, litigation expenses and attorney's fees arising out of such use.

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Lawrence Behr Associates INC

www.lbagroup.com | 3400 Tupper Dr. | Greenville, NC 27834
252 317 2123 | 800 522 4464 | lbagrp@lbagroup.com

Background

Whiteoaks Communications Group Limited owns and operates an AM radio transmission facility in Oakville, Ontario on Dundas Street West near Sixteen Mile Creek in the regional municipality of Halton. Licensed and operating diplexed at this site are CJYE 1250 kHz, DA-1 (Directional Antenna - 1 pattern for day and night times) at 10 kW and CJMR 1320 kHz, DA-1 at 10 kW. The site coordinates are 43° 27' 29" North latitude, 79° 45' 17" West longitude.

Whiteoaks Communications has requested Lawrence Behr Associates, Inc. (LBA) provide an initial opinion regarding the potential for two-way impacts of the proposed 393 Dundas Street West development on the CJYE-CJMR radiation patterns and potential hazards from the two AM signals during the development construction of a ten-story building and its use once built. Recommended next steps are provided in this letter. 393 Dundas Street West is to the Northeast of CJYE-CJMR at a distance of 1,610 m.

Statements provided are based on LBA's over 55 years of providing AM professional technical services and compliance services to the broadcast and wireless communication industries. This expertise has been applied to a review of the subject development plan information available to date and the government licensed parameters of CJYE-CJMR.

LBA has also performed in-depth theoretical modeling on the two-way impacts of the proposed urban developments of Martillac and Graydon-Banning on the CJYE and CJMR radiation patterns and potential hazards from the two AM signals during the development construction and its use once built. A report on the evaluation performed by the RF engineering team at LBA was delivered to Whiteoaks Communications. In this report, based on the results of the modeling, LBA found that the building activity involving the construction machinery and the permanence of the buildings after its construction is completed will affect the radiation patterns of CJMR and CJYE beyond the federally licensed limits. Also, the radiofrequency (RF) electric fields intensity will cause equipment malfunction, arcing between equipment members (sparks) and risk of shock and burn hazards.

Statements

Based on LBA experience and a review of the proposed 393 Dundas Street West development, the following can be stated relative to CJMR-CJYE and Dundas St. W 393:

1- The development's location is on a 40 degree azimuth bearing from the AM transmitting antennas. The center line of the main lobe of both AM signal radiation patterns is located on a 25 degree azimuth, just 15 degrees away from the center line on which the antennas transmit the maximum power. There is practically no difference of field strength intensity between the two azimuths. The projected building height is 10-stories.

2- The field strength intensity at proposed 393 Dundas Street West has been estimated to be around 1.2 V/m. In the locations where the phasing between the two signals is optimal, the field intensity of both AM stations could potentially add up to 2 V/m.

3- These field strength levels will create effects probably not as strong as the levels found in the case of the in-depth analysis of the Graydon-Banning and Martillac developments but said effects will happen. Shock and burn hazard and radiation patterns distortion during the construction of the projected building and during its permanence after built. Arcing (spark) can and has been verified in environments with a field intensity well below 1 V/m.

4- More in-depth analysis is recommended to determine the degree of potential hazards.

5- Potential radiation pattern distortion by the proposed 10 story building may change the federally licensed parameters of the radio stations resulting in loss of coverage and interference to other AM stations. To determine to what extent the pattern distortions will occur, an analysis using the Method of Moments (MOM) modeling is recommended.

6- The guidelines generally accepted in the industry prescribe that a MOM modeling analysis should be performed when structures are within a radius of 3 km of a DA-1 station to check if there is the need of detuning to mitigate radiation pattern distortion.

Summary

The radiation patterns of CJMR and CJYE will potentially be distorted during the construction phase of the building as it grows by the varying height of the structure and also by the dynamic geometry of the cranes on site during normal operation which at different positions and overall lengths of its structures will act as antennas at the frequencies involved.

The hazards that may be caused by the induction of RF energy onto the metal structures at the construction site are; high voltage which can cause electric shock and startle to personnel and create risk of loss of balance and dropped objects. Any spark generated can be a fire or explosion hazard in the presence of combustible materials. Electronic equipment malfunction of crane control circuits are possible and other machinery control devices may work erratically, not work at all or be damaged.

Potential mitigation solutions for any radiation patterns distortion and the potential hazards are complex when structures with varying geometries are involved. A satisfactory performance of any mitigation can't be guaranteed and may require constant monitoring by an RF Engineer with expertise in these specific cases.

To more specifically quantify the extent of the potential effects of the phenomenon mentioned above, an analysis using the Method of Moment modeling is required. For the modeling, more information on the building's dimensions, materials used and its evolving geometry would be needed. Information on the cranes involved, their heights and general geometries would be necessary as well.

NORTH CAROLINA
PROFESSIONAL
C.K.H.
SEAL
024506
3-12-19
ENGINEER
CHRISTOPHER K. HORNE

Christopher K. Horne

Christopher K. Horne, PhD, P.E.

Tab B

CHWO 1250

The Broadcast Centre
284 Church Street, Oakville
Ontario L6J 7N2

June 15, 2000.

Ms. Lynne Gough, MCIP, RPP,
Manager, Long Range Planning Section,
Planning Services Department,
Town of Oakville,
P.O. Box 310, 1225 Trafalgar Road,
Oakville, Ontario.
L6J 5A6

Dear Ms. Gough,

I thought I should formally follow up our telephone conversation of last week with a letter outlining the major concerns of CHWO 1250 Radio and CJMR 1320 Radio with the proposed building of a soccer stadium immediately east of the radio stations' transmitter site in Oakville.

For almost twenty-five years CHWO and CJMR have been advocating to the Town of Oakville the importance of early consultation between the radio stations and planners, developers and Town officials in order to attempt to avoid large and expensive problems that can potentially arise when development encroaches upon our (or any) broadcast transmitter site. For example:

- At the now famous Ontario Municipal Board Hearing of 1978 that dealt with Oakville's Official Plan, CHWO and CJMR presented evidence detailing the negative effects that urban development and radio transmission towers have on each other. The submission by CHWO Radio Limited and CJMR 1320 Radio Limited noted that if the Town and other interested parties had consulted with the radio stations at a much earlier stage, a lot of time and money would have been saved by all concerned since, in all likelihood, potential problems could have been avoided and resolved prior to the hearing. Of course, all of the documentation used by the stations in the presentation of their case and cause before the OMB was supplied to the Town.

.../2.

- From 1986 to 1988, I spearheaded a Task Force consisting of senior officials from the federal Department of Communications, the Ontario Ministry of Transportation and Communications, the Ontario Ministry of Municipal Affairs and the broadcasting industry. The raison d'etre of this formidable group was to co-operate with each other and jointly produce a computer program that would identify the exact location of every broadcast transmitter site in the province and provide the necessary technical and administrative information needed to initiate early consultation in the planning process between broadcasters and planners. When it was finished in 1988, it was made available at no charge to the over 800 municipal planning directors in Ontario at the time and hailed as a major success for planners, governments and broadcasters. However, despite my personally informing the Town's Planning Director that this valuable tool and resource was available, to the best of my knowledge, I don't believe the Town of Oakville has ever taken advantage of it in its planning process.
- In 1993, CHWO and CJMR submitted to the Town of Oakville and the Region of Halton a study entitled IMPACTS OF THE DRAFT WEST OAK TRAILS SECONDARY PLAN ON THE OPERATIONAL CAPACITY OF CHWO AND CJMR RADIO. This planning and technical report, prepared by Lehman & Associates, (a leading planning firm in Canada), and M.A. Tilston Engineering, (one of the foremost broadcast engineering firms in the country), was and still is one of the most comprehensive and enlightening research documents available anywhere in the world that examines the nature of AM radio signals in relation to encroaching urban development and land use. We have provided the "Lehman-Tilston Report" to fellow broadcasters across Canada to aid in their dealings with their local planning departments. Of particular note in this area, the CBC used the document as a focal point in its submission to the Town of Milton regarding proposed development near its transmitter site at Hornby.
- Since last year, representatives of CHWO and CJMR have been attending the information sessions sponsored by the Town of Oakville regarding future urban development on lands located north of Dundas Street. At every opportunity, we have been reminding Town officials and consultants of the ramifications of urban development near broadcast transmitter sites and asking them to please refer to the Lehman-Tilston Report and make it part of their planning process. I hope this is being done.

The story carried last week by our radio stations and other media about the building of a 20,000 seat soccer stadium in Oakville should the 2008 Olympic Games be awarded to Toronto is exciting news. However, it is the radio stations' position that the excitement generated by the announcement and any planning for the construction of the soccer facility must be put aside until it is determined whether or not the proposed

.../3.

stadium, which will be located less than a kilometer from the CHWO/CJMR transmitter site, will have an adverse affect on the ability of the stations to broadcast and fulfill their mandates as required under licence by the federal government. It is unfortunate that the Town of Oakville has chosen, once again, to ignore the past requests and submissions of CHWO Radio Limited and CJMR 1320 Radio Limited to inform, consult and involve the stations at an early stage so that possible problems and conflicts might be avoided and eliminated before plans are publicly announced, thus saving all concerned time, money and potential embarrassment.

You had indicated to me on the telephone that you would make available to the Parks and Recreation Department the Planning Department's copy of the of the Lehman-Tilston Report. I hope that that means I can expect a call in the near future from someone at the Town to arrange a meeting to discuss this matter further.

Thank you for your co-operation.

Yours truly,
CHWO RADIO LIMITED
CJMR 1320 RADIO LIMITED

Michael H. Caine
President

cc: Mayor and Members of Council
Blair Taylor

CHWO 1250

The Broadcast Centre
284 Church Street, Oakville
Ontario L6J 7N2

June 15th, 2000.

Mayor Mulvale and Councilors,
Town of Oakville,
1225 Trafalgar Road,
Oakville, Ontario.
L6J 5A6

Your Worship and Members of Council,

I am pleased to provide you with a copy of a letter I have sent today to Ms. Lynn Gough of the Town's Planning Department.

The purpose of sending you a copy of this letter is to keep you informed and provide you with some background of an issue of concern to CHWO Radio Limited and CJMR 1320 Radio Limited regarding the recent announcement that a 20,000 seat, ten million dollar soccer stadium may be built in close proximity to the radio stations' transmitter site on Dundas Street in Oakville.

Of course, anything you can do to encourage and facilitate early consultation between the radio stations and Town officials would be greatly appreciated.

Yours truly,
CHWO RADIO LIMITED
CJMR 1320 RADIO LIMITED

Michael H. Caine
President

O'CONNOR
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C. Douglas MacLeod, Q.C.
(1942-1982)

September 11, 2001

Hand Delivered

Mayor Ann Mulvale and Members of Council
The Corporation of the Town of Oakville
1225 Trafalgar Road
P.O. Box 310
OAKVILLE, Ontario
L6J 5A6

Dear Mayor Mulvale and Members of Council:

Re: CHWO Radio – Lands North of Highway #5
Official Plan Amendment No. 198
Our File No. 67,141

Please be advised that we act on behalf of CHWO Radio and CJMR Radio.

CHWO is 1250 Oakville and CJMR is 1320 serving the City of Mississauga.

CHWO and CJMR use the same transmitter site located on the north side of #5 Highway adjacent to the Fourth Line and the Sixteen Mile Creek.

The CHWO/CJMR transmitter site has been located at this location since 1979/1980.

West Oak Trails Secondary Plan

As part of my client's contribution to the public process processing of the West Oak Trails Secondary Plan a Planning Report was prepared by Bob Lehman of Lehman & Associates and Mark Tilston of M.A. Tilston Engineering dated February 1993.

This Report prepared to assist the Town of Oakville and developers in attempting to achieve land use compatibility between urban development and radio transmitter sites. We believe that this Report was the first of its kind.

The Report was submitted to the Town and considered during the preparation of the West Oak Trails Secondary Plan. We are pleased to report that obviously with a significant build out of the West

Oak Trails community there have been no complaints with regard to incompatibility between development and the radio station.

Official Plan Amendment No. 198

As the Town of Oakville considers development north of Highway #5 we thought it appropriate to resubmit this 1993 Study to remind Council and Staff of the considerations that were taken into account in the West Oak Trails Secondary Plan process.

We recognize that Council, at this stage, is dealing with macro issues and we would ask Council to recognize the existence of this site since 1980, and the contribution that community radio makes to both the Oakville and Mississauga communities.

It is my client's hope and expectation that the same sort of consideration that went into the West Oak Trails Secondary Plan designations will result in a similar positive outcome as it relates to land use compatibility between my client and the adjacent lands north of Highway #5.

All of which is respectfully submitted.

Yours faithfully,

O'CONNOR MACLEOD HANNA LLP

Blair S. Taylor

BST:gw

Enclosure

cc: Michael H. Caine (Fax 905-842-1250)

chwo.1993report

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Marian G. Gage
Chantel Goldsmith
Counsel: Paul D. Stunt

* Certified Specialist (Corporate and Commercial Law)
** Certified Specialist (Municipal Law: Local Government and Land Use Planning and Development)

October 9, 2009

Email danderson@oakville.ca and Regular Mail

Ms. Dana Anderson
Director of Planning Services
Town of Oakville
1225 Trafalgar Road
OAKVILLE, Ontario
L6J 5A6

Dear Ms. Anderson:

**Re: Whiteoaks Communications Group Limited
and Proposed North Oakville Draft Zoning By-law
Fourth Line and Dundas Street
Our File No. 79129**

We represent Whiteoaks Communications Group Limited whose radio towers are located at Fourth Line and Dundas Street, Oakville.

We have reviewed the Draft Zoning By-law and have a concern regarding the removal of the current site specific provision for these lands and the proposal for a generic ED zone category for this property.

Of general note, radio communication is a federally regulated activity over which municipalities have no jurisdiction. Radio communication is subject to strict licensing provisions that control the strength and location of their radio signals. My client is subject to both national and international regulations.

Zoning regulations are not applicable to these lands due to this fact.

However, it is also our view that it is important, as part of the education process of the community, that any land use document of the Town acknowledge this existing land use and include within the Draft Zoning By-law for these lands standards that reflect the activities occurring on this site.

For example, the current zoning of the lands is O2 – Special Provision 265. This provision recognizes the use of the site for radio and transmission towers and contains a specific regulation regarding building height. This current provision does not purport to "regulate" the height of the radio towers.

In contrast, the new proposed Zoning By-law contains a new definition for height as the vertical distance between the established grade and the highest point of a structure. A list of exclusions to the definition of height is provided within the Draft By-law but radio towers are not identified on that list. The new height provision would seek to apply to radio towers, and "make" the existing radio towers "non-conforming" in height. (Of course our position is that such a by-law is ultra vires).

But it is also our opinion that this change is not desirable.

We would like to meet with you and your staff and discuss this matter.

Our initial suggestion is that the Draft Zoning By-law be revised to include either the previous site specific provision or a new site specific provision to address this concern. We look forward to working with Town staff to resolve this issue.

Should you have any questions, please do not hesitate to contact me directly.

O'CONNOR MACLEOD HANNA LLP

Blair S. Taylor
BST:gw

cc: Clerk, Town of Oakville (Email)
Whiteoaks Communications Group Limited (Email)

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September 14, 2010

Mr. John Oliver
President
Halton Healthcare Services
327 Reynolds Street
OAKVILLE, Ontario L6J 3L7

Mr. Ron Glenn
Director of Planning Services and
Chief Planning Official
Planning Services
Legislative and Planning Services
Region of Halton
1151 Bronte Road
OAKVILLE, Ontario L6M 3L1

Dear Messrs. Oliver and Glenn:

Re: CJYE and CJMR AM Radio – Towers Site - Our File No. 79129

Further to our meeting on September 20, 2010, please find enclosed herewith, a disc of the 1993 Planning Report by Lehman & Associates.

Yours faithfully,

O'CONNOR MACLEOD HANNA LLP

Blair S. Taylor
BST:gw

Enclosure

cc: Michael Caine (with disc)

700 Kerr Street, Oakville, Ontario, Canada L6K 3W5 T: 905-842-8030 F: 905-842-2460

www.omh.ca

G Winslow

From: Morettin, Diego [diego.morettin@stantec.com]
Sent: Friday, January 28, 2011 10:58 AM
To: Michael Caine; Blair S.Taylor
Cc: 'BILL BAILEY'; Gina Winslow
Subject: RE: Whiteoaks Communications Group Limited - Radio Tower Report

Michael,

Thank you very much for you support and cooperation on this matter is greatly appreciated.

Regards,

Diego Morettin, OAA
Principal
Stantec
100 - 401 Wellington Street West
Toronto ON M5V 1E7
Ph: (416) 598-6677
Fx: (416) 598-6677
diego.morettin@stantec.com
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From: Michael Caine [mailto:mcaine@whiteoaksgroup.ca]
Sent: Friday, January 28, 2011 10:56 AM
To: Morettin, Diego; taylor@omh.ca
Cc: 'BILL BAILEY'; winslow@omh.ca
Subject: RE: Whiteoaks Communications Group Limited - Radio Tower Report

Diego:

I apologize for not confirming in writing earlier this week, as I said I would do, that Whiteoaks Communications Group Limited has no objection to you distributing the Lehman Report to bidders in relation to the building of the new Oakville hospital.

The Annual General Meeting of my company is this afternoon and I have been pre-occupied this week in preparing for it. Again, I apologize and I hope this short note will serve to give you the written authorization to distribute this document, as you requested.

Regards...

Michael Caine
President & CEO
Whiteoaks Communcations Group Limited

From: Morettin, Diego [mailto:diego.morettin@stantec.com]
Sent: January 28, 2011 10:29 AM

T[illegible]ylor@omh.ca
Cc: [illegible]ichael Caine; BILL BAILEY; winslow@omh.ca.
Subject: Whiteoaks Communications Group Limited - Radio Tower Report

Mr. Blair Taylor,

I am forwarding you this email on the request of my client William E. Bailey, Vice President, Redevelopment at Halton Healthcare, in part because the report in question was forwarded from your office on behalf of Whiteoaks Communications Group LTD. The matter is in regards to the current RFP project for the New Oakville Hospital, and authorization to provide the Draft1993 Planning Report by Lehman & Associates to the bidders as information. I have had conversations with Mr. Michael Caine, President & CEO Whiteoaks Communications Group Limited, who was very supportive of making the report available to the bidders, and have requested written confirmation prior to release.

We are in the final stages of the RFP process and the last date available for us to issue information is today. The timing is important because if we do not make the report available we will need to revise other documentation that is being issued today.

As timing is critical we will assume that based on the conversations I have had with Mr. Michael Caine, that Whiteoaks Communications Group Limited has no objections to providing the report to the bidders as additional information.

Regards,

Diego Morettin, OAA
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Tab C

IMPACTS OF THE DRAFT WEST OAK TRAILS SECONDARY PLAN ON THE OPERATIONAL CAPACITY OF CHWO AND CJMR RADIO

PLANNING REPORT

Prepared by:

Lehman & Associates
M.A. Tilston Engineering

February 1993

TABLE OF CONTENTS

1.0 Introduction 1

1.1 Purpose 1
1.2 Basis 1
1.3 Regulatory Context 1

2.0 Nature of AM Radio Signals 2

2.1 Integrity of the Signal 2
2.2 Health Hazards 4

3.0 Background 6

3.1 Golden Horseshoe Radio Network 6
3.2 Existing Broadcast Pattern 6
3.3 Transmitter Site Location 7
3.4 Existing Land Use 7
3.5 Adjacent Land Use 7
3.6 Draft West Oak Trails Secondary Plan 8
3.7 The Nepean Experience 9

4.0 Land Use Controls 9

4.1 Establishment of Minimum Separation Distances 9
4.2 Additional Controls 10

5.0 Summary and Conclusions 11

6.0 Recommendations 13

Maps

Map 1: Broadcast Allocation - 1250 kHz
Map 2: Broadcast Allocation - 1320 kHz
Map 3: Transmitter Site and Secondary Plan Area Location
Map 4: Transmitter Site Plan
Map 5: Adjacent Land Use
Map 6: Maximum Building Heights - West Oak Trails Secondary Plan
Map 7: Land Use Control Contours
Map 8: Primary Interference Contour

Appendicies

Appendix 1: Susceptible Equipment
Appendix 2: Radio Interference Survey and Task Force Report
Appendix 3: Technical Work by Dr. M. Tilston - General
Appendix 4: Technical Work by Dr. M. Tilston - CHWO & CJMR Specific

1.0 INTRODUCTION

1.1 Purpose

This Planning Report was prepared in response to a request to review the impact of a land use proposal on the operation of two existing AM radio stations. As the potential impact is serious, the report provides a technical and descriptive basis which justifies the need for additional planning controls to mitigate the impacts. It is a conclusion of this report that planning policies should be developed for inclusion within the Secondary Plans. Zoning standards should also be developed to recognize the impacts of development on transmission facilities and provide the required level protection for the continuing operation of the radio stations.

1.2 Basis

The Broadcasting Act identifies the importance of radio signals and the broadcasting system in providing a public service essential to the citizens of Canada. Section 3(1)(b) of the Act states that:

> *'the Canadian broadcasting system, operating primarily in English and French languages and comprising public, private and community elements, makes use of radio frequencies that are public property and provides, through its programming, a public service essential to the maintenance and enhancement of national identity and cultural sovereignty.'*

Local radio stations provide an essential service to the majority of Canadian communities by providing broadcasting that is entertaining and, in some cases, critical to life. This ranges from playing music, to providing daily news reports to the broadcast of bulletins which advise of life-threatening circumstances.

Radio signals and radio facilities are a valuable public resource, serving the public interest under license from the Federal Government. This resource should be preserved and considered when making land use planning decisions that may impact negatively upon the ability of the station to function. The impacts of development on transmission facilities can affect the immediate and adjacent community, as well as being far-reaching, affecting the national and international community.

1.3 Regulatory Context

The radio frequency spectrum is divided into bands for specific uses. Due to their nature, the high and low bands of the spectrum are reserved for very specialized uses. The bands in between are used for a variety of purposes, including AM/FM and shortwave radio, television, mobile telephone, microwave and satellite communications. The radio frequencies available for public and private broadcasting are carefully regulated in North America and are allocated on a geographic basis. This, when combined with variables of a technical, social and political nature, results in complex systems of communication functioning in concert with each other, although in a very delicate balance. The upset of this balance can cause significant domestic and/or international problems.

Private commercial use of a small part of the radio frequency spectrum is only available in a few countries around the world. The airwaves are a public entity and anyone wishing to operate a broadcasting station must obtain a license to 'lease' a frequency from their respective government. The Department of Communications (DOC) is the federal body responsible for the allocation and allotment of frequencies within Canada and for the enforcement of national and international regulations which govern the technical aspects of broadcasting.

The Canadian Radio-Television and Telecommunications Commission (CRTC) is an independent government body that controls access to the system and which concerns itself with programming, in the interests of the public. In addition, the federal government's legal authority over management of the frequency spectrum is based on Canada's constitutional laws, superseding any other piece of legislation enacted by, or power granted to, provincial or municipal jurisdiction.

2.0 NATURE OF AM RADIO SIGNALS

2.1 Integrity of the Signal

The integrity of AM signals may be compromised by any form of development involving a structure that occurs in proximity to its transmitter site. These sites and the signals which they broadcast have the potential to be impacted by development in the vicinity through one or both of the following ways:

1. *Blocking or Absorption of the Signal*

Large or high-rise structures located in the vicinity of the transmitter site have the potential to absorb or block a signal, essentially cutting off its path and not allowing it to reach its intended destination. In effect, this prevents a station from reaching all or a portion of its licensed coverage area. In turn, this may result in loss of a public service, a decline in listenership and advertising revenues and in the worst case, a forced closure of the station. It may be possible for an individual building to have this effect, but it is more likely that a grouping of buildings, such as a cluster of apartment buildings or a concentration of office development, would impact upon the signal in this manner.

2. *Re-Radiation of the Signal*

A radio station antennae radiates electromagnetic waves. As these waves travel outward from the antennae, they usually meet various man-made structures containing metal. The waves induce electrical currents to flow in the metal. These induced currents radiate their own electromagnetic waves at the same frequency as the radio station. The waves produced by the induced current are called reradiation.

Thus, the electromagnetic waves received by a listener of a radio station comprise radiation from the station's antenna and reradiation from other structures such as towers, power lines and buildings. Because of the nature of waves, the reradiation can combine with the direct radiation to either increase or decrease the strength of the signal. A decrease in signal strength is detrimental to the radio station's ability to broadcast to its whole market and an increase in signal strength is detrimental to the radio station's ability to restrict its signal in certain areas to avoid interfering with other radio stations.

By careful choice of tower heights and locations, adjustment of networks, and choice of transmitter power, the antenna will radiate its signal strongly in desired directions, and weakly in undesired directions. If the antenna consists of only one tower, the pattern is circular, but antennas with more towers can have complicated patterns. Regardless of the pattern type, the radio station must have its official pattern accepted by the Department of Communications (DOC), and must periodically prove to the Department, through measurements, that its actual pattern agrees with the official pattern, within a small tolerance level. This helps to ensure that the radio station properly serves its listeners, and properly suppresses interference with other radio stations.

Structures such as towers, power lines and buildings near an AM broadcasting site will reradiate and combine with the antenna radiation in forming the total radiation pattern. Steel and steel-reinforced buildings are the most likely types of structures to have an impact, although other steel structures, such as barns or bridges can be as equally troublesome. Due to these reradiation contributions from other structures, the total pattern may be modified out of tolerance, requiring antenna readjustment or more serious measures such as modifying or removing the structures, or moving the antenna. The cost to relocate an antenna can be in the millions of dollars.

2.2 Health Hazards

Regard should also be given to the potential impacts that AM radio signals may have on the health of the inhabitants of a future community in close proximity to a transmitter facility. In considering approval for a Draft Plan of Subdivision, Section 51(4) of the Planning Act, states that:

> *'.....regard shall be had, among other matters, to the health, safety, convenience and welfare of the present and future inhabitants of the local municipality and to the following.....'*

Planning controls may be a necessary measure to mitigate the impacts of these existing hazards on future residents in close proximity to transmitter sites. Future residents have the potential to be impacted by living in the vicinity of a transmitter facility in one or more of the following ways:

1. *Exposure*

Limits of Exposure to Radio Frequency Fields at Frequencies from 10 kHz - 300 GHz is one in a series of safety codes which have been prepared by the Bureau of Radiation and Medical Devices of Health and Welfare Canada. This document is commonly referred to as Safety Code 6. Safety Code 6 indicates that long-term exposure to excessive levels of radiofrequency (RF) energy over prolonged periods of time can cause adverse health effects. The type and extent of the hazard depends on factors such as the strength of the field, exposure duration, frequency of exposure, type of modulations, polarization and distance from the source. One of the purposes of Safety Code 6 is to specify maximum levels and duration of exposure to RF fields of frequencies between 10 kHz and 300 GHz.

2. *Contact Current*

Safety Code 6 sets out the following:

> *'An RF field induces electric charge on ungrounded or poorly grounded conducting (metallic) objects such as cars, trucks, buses, cranes and fences. When a person touches such objects, RF current flows from the person to ground. The amount of current depends on the object (its size, shape), the field frequency and strength and the person's impedance. The impedance in turn depends on the person's height, weight, and body composition (ratio of lean to fat body mass), type of contact (surface area of contact, ie. finger or grasp), and the type of footwear. The impedance also varies with the frequency of the RF field.*

Contact current flowing through the person is perceived at a certain level, at a higher level it becomes painful and at a still higher level may cause an injury (ie. local burn, respiratory tetanus, heart effects). Below a frequency of about 100 kHz the perception is of a tingling, prickling feeling in the finger or hand touching the object. At higher frequencies, heat is perceived.'

According to Safety Code 6, for finger contact, RF current perception occurs above 15 mA of current, and RF burning occurs above 40 mA. The perception limit applies to non-RF workers (general population). It is a problem because although it will not cause tissue damage, it may have a startling effect, thereby causing a person to fall from a ladder or scaffold, or to drop something on someone below.

Some specific situations in which someone may experience RF current perception include a construction worker touching the hook of a metal hoisting cable during the construction or maintenance of a building; a home owner grasping a cable hanging from a TV Tower; or, a painter grasping bare metal at the top of a building.

3. *Injuries Related to Malfunction of Equipment Susceptible to Electromagnetic Fields*

The exposure of electronic equipment to strong electromagnetic fields may cause failure of the equipment. The point of failure depends upon the radio frequency and the type of equipment, but significant failure of consumer electronic devices has been experienced at electric field strengths as little as 1 V/m. Consequences of such failures may range from mere inconveniences to the possibility of personal injury.

The following are some examples of the types of potential consumer problems that may be encountered:

- The open and closure of electric garage door openers by themselves;
- The disruption of conversations on telephone lines with the interference of local radio stations; and,
- The potential for injury sustained with the malfunction or failure of heart pacemakers or medical testing equipment.

A list has been attached as Appendix 1 which is representative of the types of equipment subject to malfunction due to susceptibility to electromagnetic fields.

3.0 BACKGROUND

3.1 Golden Horseshoe Radio Network

The Golden Horseshoe Radio Network is comprised of CHWO 1250 Radio Limited and CJMR 1320 Radio Limited. Both stations are licensed by the CRTC. CHWO was established in 1956 and its primary market is identified as the Region of Halton. CJMR, which began broadcasting in 1974, serves the City of Mississauga and the Region of Peel. Both stations, however, have a full coverage area which can reach approximately 6 million people in a 150 mile radius from Oakville.

CHWO and CJMR utilize the same transmitter site, sharing the antennae towers, ground system and other technical equipment. CHWO developed the first technology in the world that would allow the co-siting of transmitters for two, patterned, AM signals. Because of this technology, CJMR was able to go on the air in 1974 without having to use a separate tract of valuable, developable land.

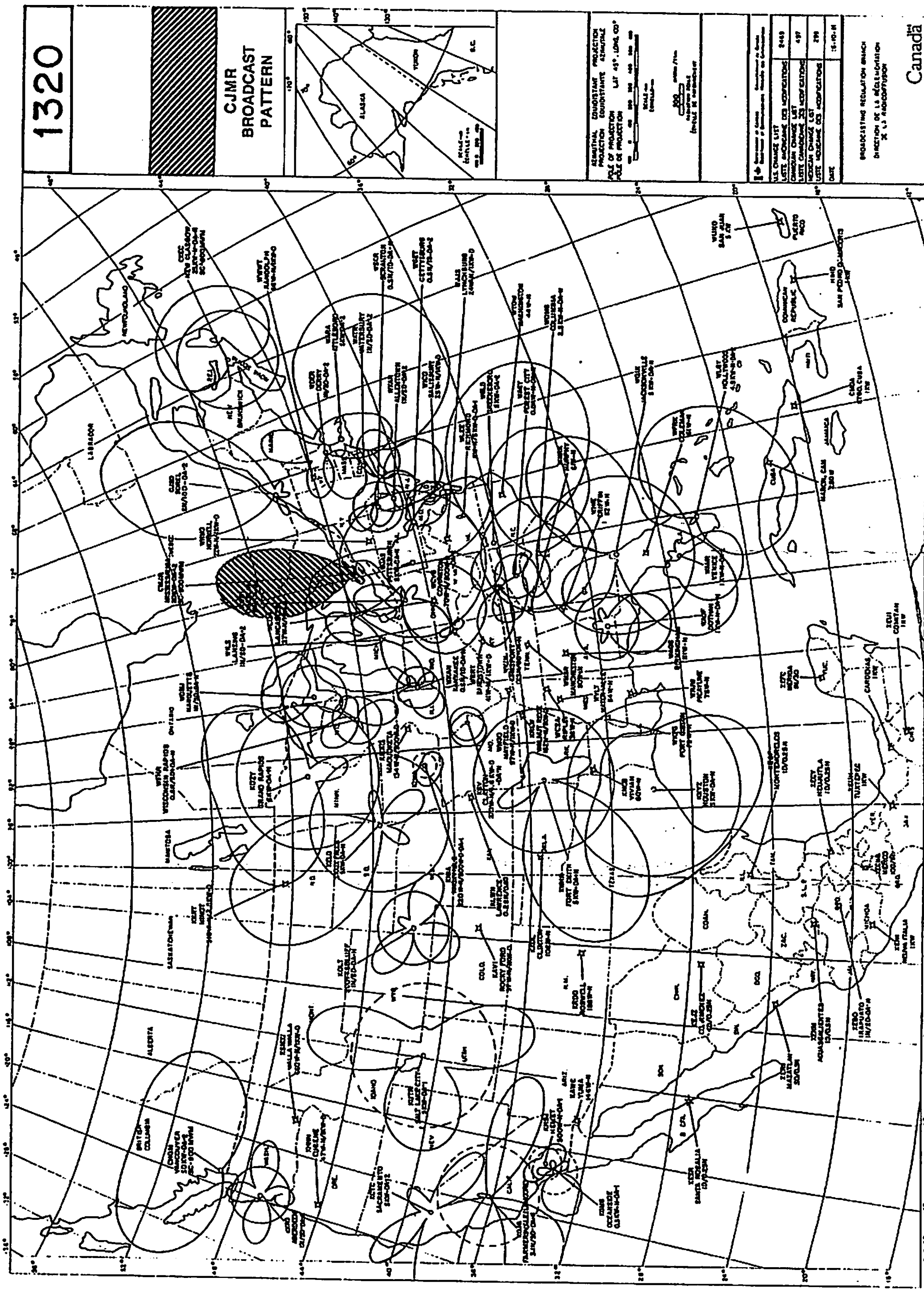
The original transmitter site was located in the middle of what is now the Glen Abbey Community. Following the station's participation in the 1978 Ontario Municipal Board Hearing into Oakville's Official Plan and after negotiations with Genstar Corporation, the major developer of Glen Abbey, the CHWO/CJMR transmitter site was moved to its present location during 1979/1980. Recognition of the needs of the station was given through a site specific zoning to allow the relocation of the transmission facility to its present site.

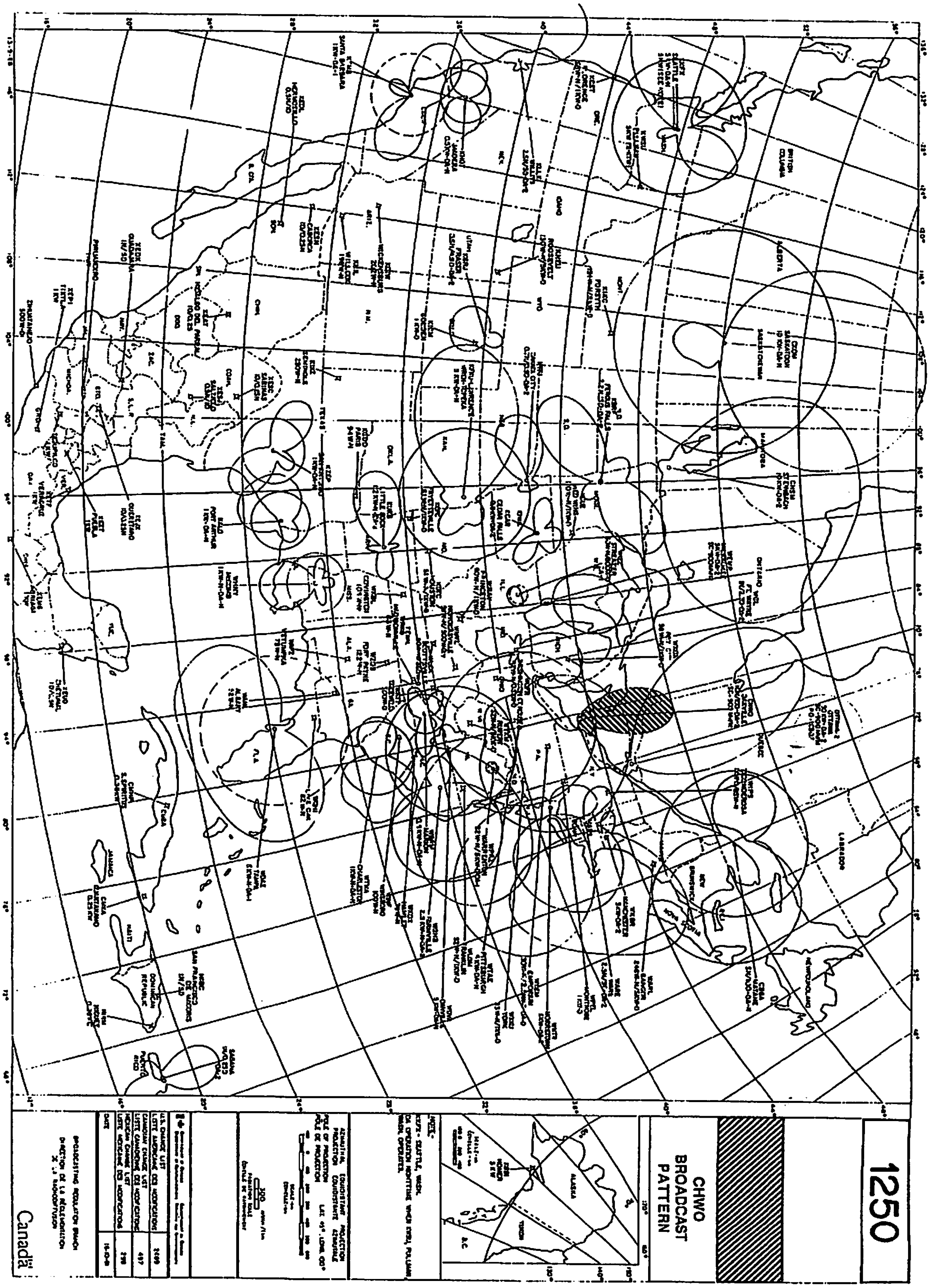
3.2 Existing Broadcast Pattern

CHWO and CJMR are just two of the many dozens of stations operating within southwestern Ontario and the thousands in operation within North America, all of which must fit together into a congested and complicated patchwork of broadcast patterns. Map 1: Broadcast Allocation - 1250 kHz highlights the broadcast pattern of CHWO and shows all of the other stations in North America on the same frequency and their respective broadcast patterns. Similarly, Map 2: Broadcast Allocation - 1320 kHz highlights the broadcast pattern of CJMR.

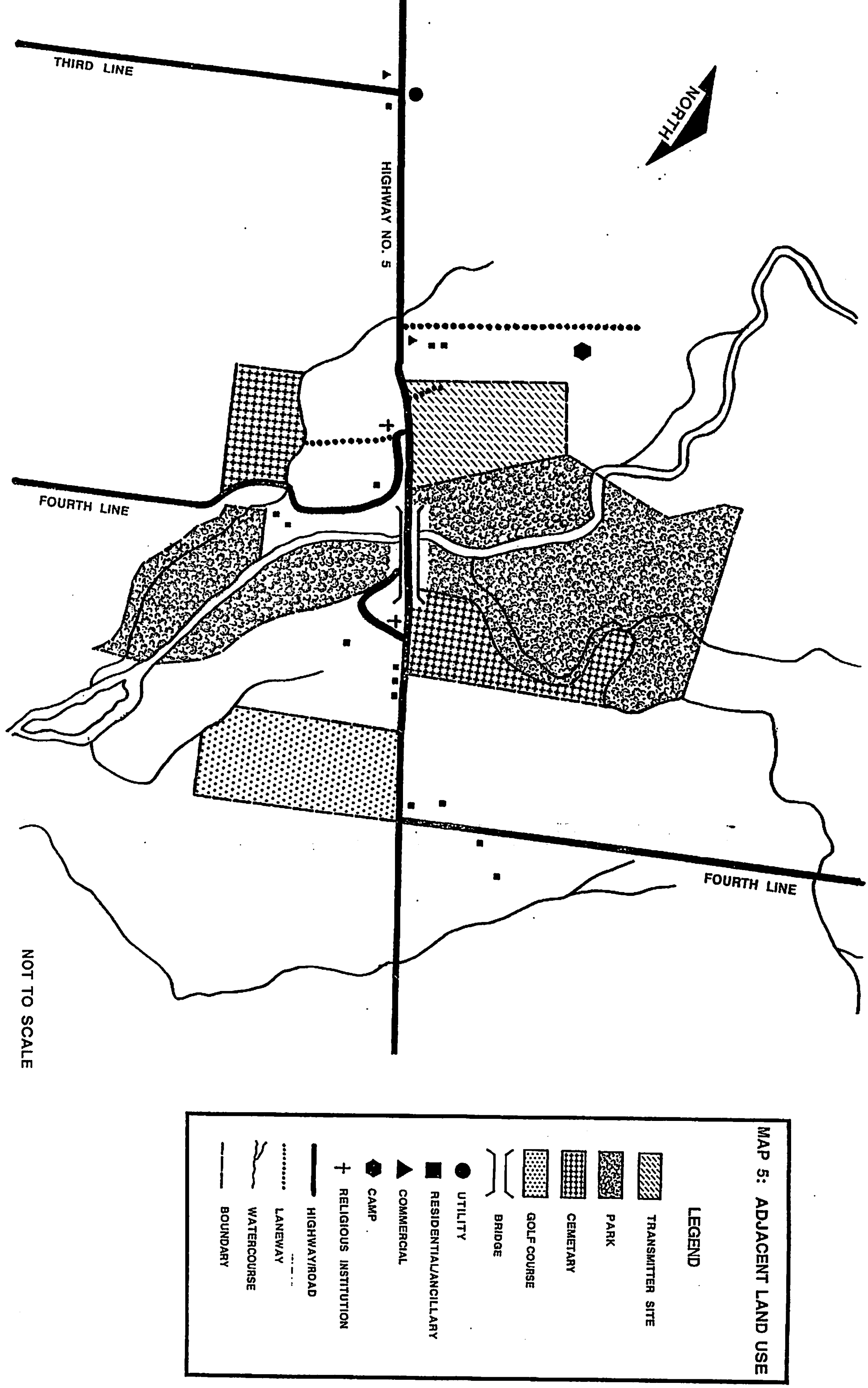
These maps indicate that the broadcast patterns of both stations have been technically manipulated so as to not interfere with a number of stations in both the United States and Canada. In total, the stations are required to protect, through their own actions, the broadcast pattern of 7 other stations during the day and 9 stations at night. If circumstances arose where either CHWO or CJMR were not able to control reradiation problems resulting in interference to these other stations, they would eventually be forced to reduce their power and correspondingly, would lose market share. In the worst case, they would be forced to shut down completely.

MAP 2: BROADCAST ALLOCATION - 1320 kHz





MAP 1: BROADCAST ALLOCATION - 1250 kHz


MAP 5: ADJACENT LAND USE
LEGEND
TRANSMITTER SITE
PARK
CEMETARY
GOLF COURSE
BRIDGE
UTILITY
RESIDENTIAL/ANCILLARY
COMMERCIAL
CAMP
RELIGIOUS INSTITUTION
HIGHWAY/ROAD
LANEWAY
WATERCOURSE
BOUNDARY
THIRD LINE
HIGHWAY NO. 5
FOURTH LINE
FOURTH LINE
NORTH
NOT TO SCALE

In 1986, Michael Caine of CHWO/CJMR was elected President of the Central Canada Broadcasters' Association (CBBA). This organization represents the majority of privately-owned, non-French AM, FM and TV stations and networks in Ontario and Quebec. During his term of office, Mr. Caine established the first-ever Broadcaster/Planner Task Force, a joint venture of CBBA, the Ministry of Municipal Affairs, the Ministry of Culture and Communications and the Department of Communications. One of the most successful initiatives implemented by the Task Force was the development of a user-friendly computer program that identifies every broadcast transmitter site located in the Province of Ontario. This program was written for municipal planners and for use in the planning and development of their communities.

3.3 Transmitter Site Location

The site is located in Lot 23, Concession 1N, Town of Oakville, on the north side of Highway 5 (Dundas Street) just west of Sixteen Mile Creek. Third Line South is less than a kilometre to the west, Fourth Line 4 South is approximately 200 metres to the west and Third Line North is less than 1.5 kilometres to the east. The site is shown on Map 3: Transmitter Site & Secondary Plan Area Location.

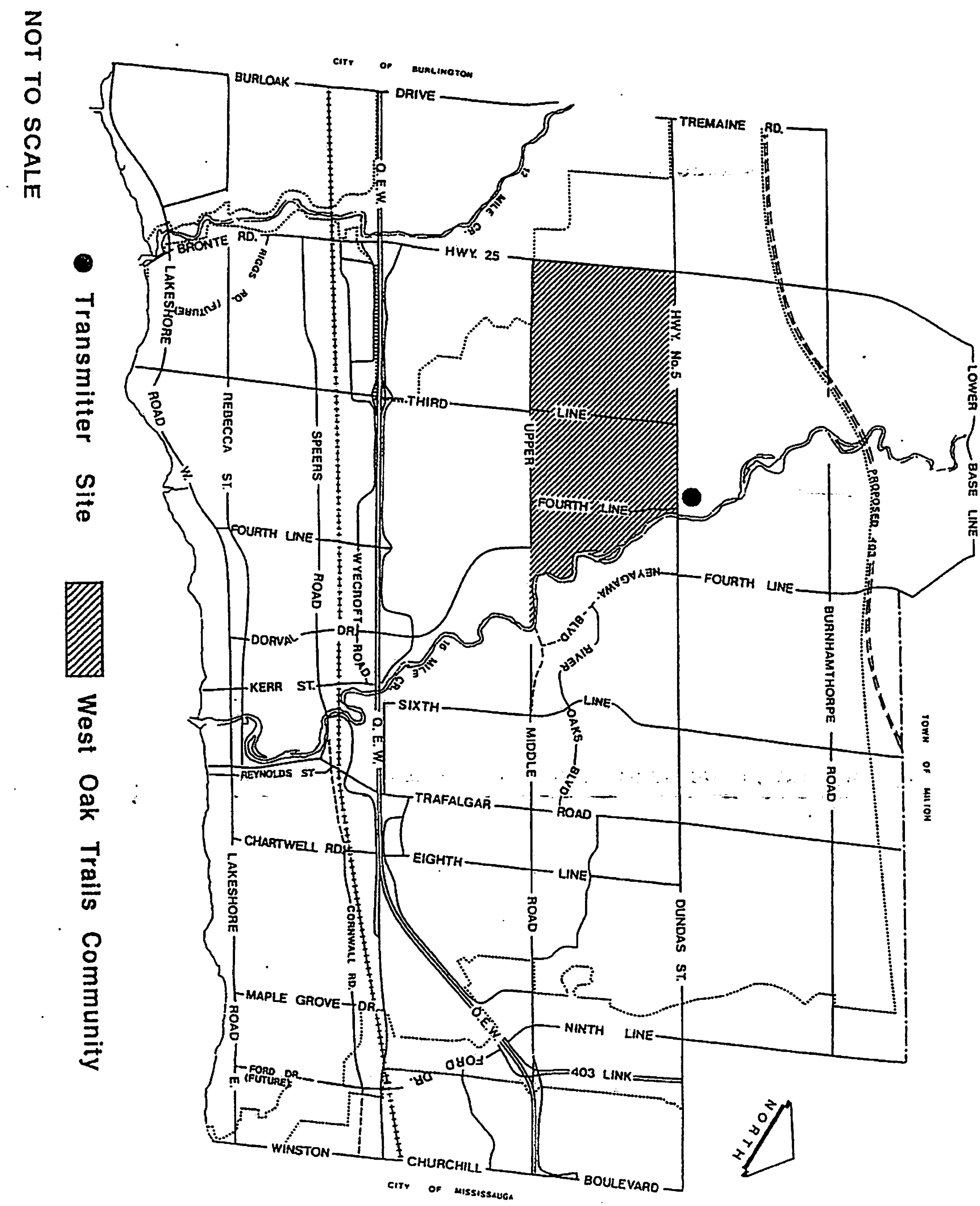
3.4 Existing Land Use

The site is currently used to house the CHWO's and CJMR's transmitter building and 7 transmitter towers. Access to the site is gained by way of an unpaved road off of Highway 5 with a gate. The transmitter building is located approximately 100 metres back from Highway 5 and the towers are located in a loose cluster, laying from 50 to 300 metres from the highway. Map 4: Transmitter Site Plan shows the existing land use on the site.

3.5 Adjacent Land Use

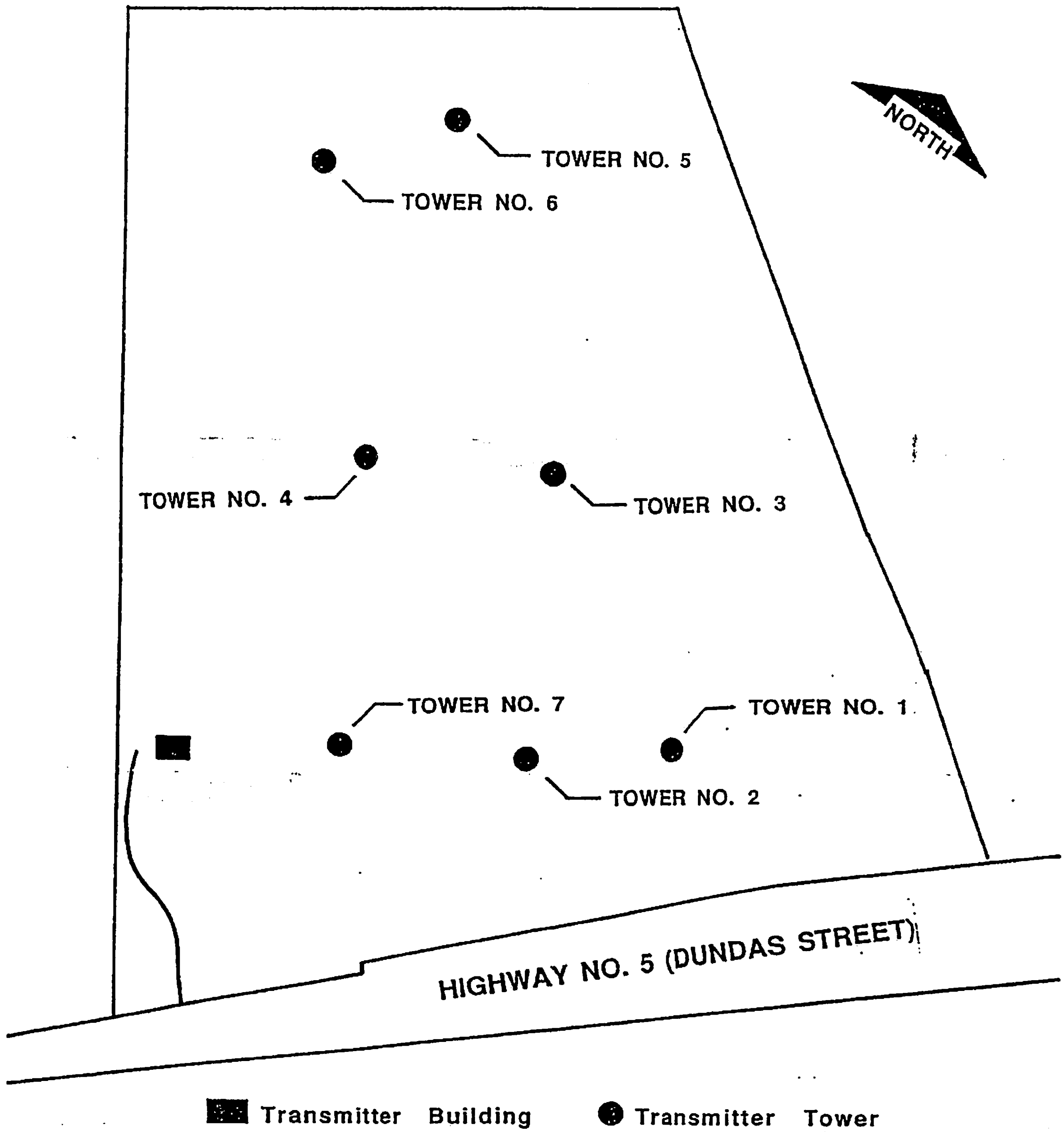
Generally, land uses along Highway 5 east and west of the site constitute a sparse mixture of commercial, residential and institutional uses. Map 5: Adjacent Land Use shows the existing land uses which surround the site.

Directly to the west of the site is a gas station, the Taras H. Sherchenko Museum and Memorial Park and the A.U.U.C. Ukrainian Children's Camp. The museum/memorial park and the children's camp appear to be a combined facility comprised of several dozen buildings on a small road network, two sewage lagoons and open space/playing fields. The property is quite large and stretches back several hundred metres to Sixteen Mile Creek. Further west, near the intersection of Highway 5 and Line 4, there exists a Union Gas Compressor Station, a kennel, a residence and a number of other buildings.



MAP 3: TRANSMITTER SITE & SECONDARY PLAN AREA LOCATION

MAP 4: TRANSMITTER SITE PLAN



NOT TO SCALE

To the south of the site, Line 4 intersects with Highway 5. Located on Line 4 in close proximity to the site are the St. Volodymyr Centre and Cemetery, a large barn and a residence. Southeast of the site, Highway 5 intersects with Lions Valley Road, on which is located the Knox Presbyterian Church, a residence with a workshop and the entrance to the Lions Valley Park.

To the east of the site, on the north side of Highway 5, is the Trafalgar Lawn Cemetery. Further east, a number of residences exist on the north and south side of Highway 5 and on the east and west side of Line 3. To the north of the site are agricultural lands and Sixteen Mile Creek, which also passes to the east of the site.

3.6 Draft West Oak Trails Secondary Plan

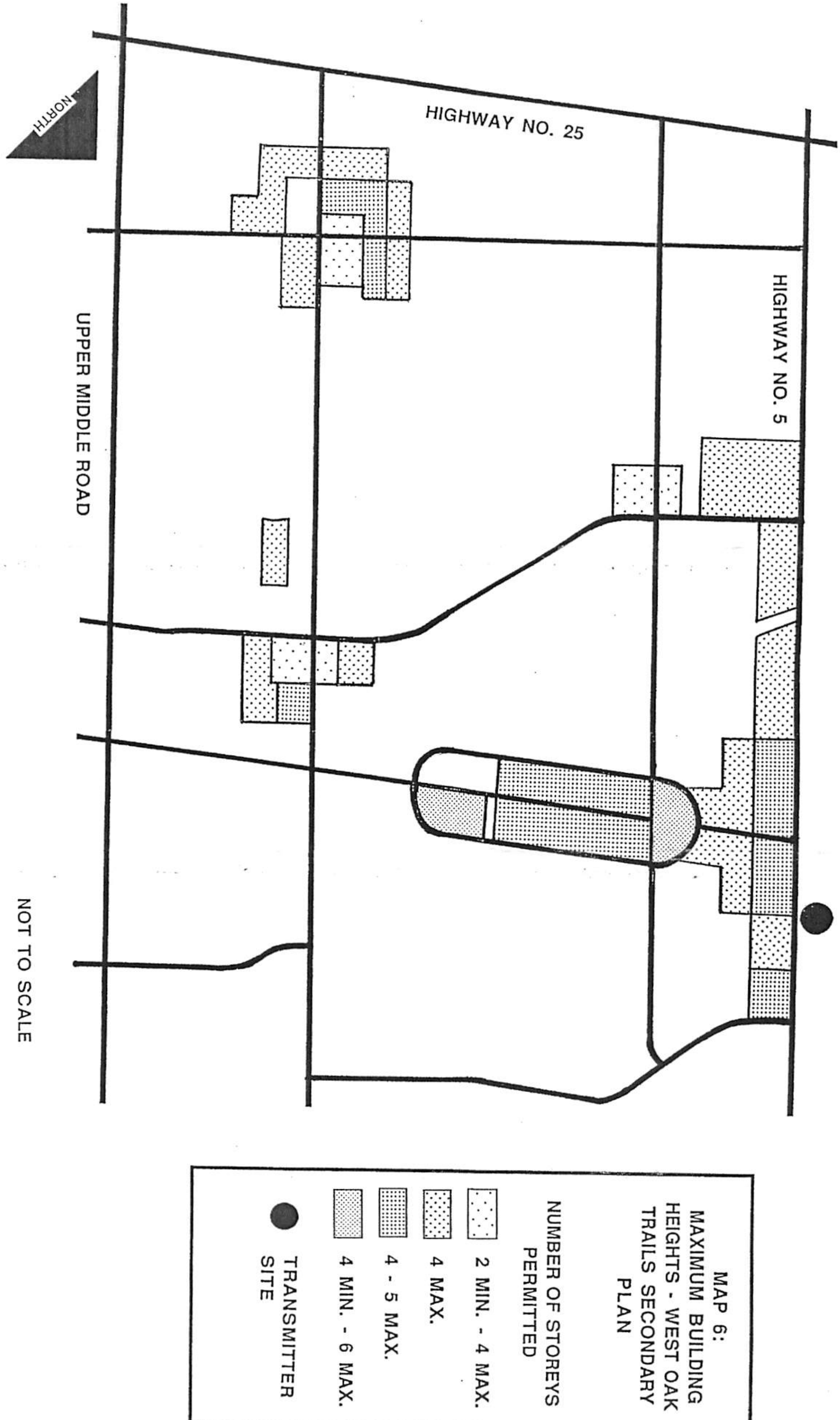
The Draft West Oak Trails Secondary Plan was completed by staff in November 1992. A public information meeting to discuss the draft plan is scheduled for February 17, 1993.

The boundaries of the planning area are Highway No. 5 to the north, Upper Middle Road to the south, Highway No. 25 to the west and Sixteen Mile Creek to the east (see Map 3: Transmitter Site and Secondary Plan Location). Lands along Highway No. 5 south of the transmitter site are proposed to be designated *Residential Medium Density and Residential High Density*. Maximum heights of buildings within this area will be between 4 and 5 stories. A designation of lands south along Third Line as Community Shopping Area will result in a large commercial node containing buildings with minimum heights of 4 stories and maximum heights of 6 stories. Map 6: Maximum Building Heights - West Oak Trails Secondary Plan illustrates these limits.

Final approval of the West Oak Trails Secondary Plan is the responsibility of the Minister of Municipal Affairs. Section 17(9) of the Planning Act indicates that in approving, refusing or modifying a plan, the Minister:

> *'......may confer with municipal, provincial or federal officials, with officials of commissions, authorities or corporations and with such other bodies or persons as the Minister considers may have an interest in the approval of the Plan......'*

In this instance, changes to the Official Plan have the potential to impact upon the short and long-term operational capacity of the two local radio stations. The regulation of radio signals is a federal jurisdiction and as such, is appropriately a matter to be dealt with through the planning process.



NORTH
HIGHWAY NO. 25
HIGHWAY NO. 5
UPPER MIDDLE ROAD
NOT TO SCALE
MAP 6:
MAXIMUM BUILDING HEIGHTS - WEST OAK TRAILS SECONDARY PLAN
NUMBER OF STOREYS PERMITTED
2 MIN. - 4 MAX.
4 MAX.
4 - 5 MAX.
4 MIN. - 6 MAX.
TRANSMITTER SITE

3.7 The Nepean Experience

A community in Nepean has experienced interference to home electronics and appliances due to proximity to an AM radio station's transmission facilities. This experience is directly relevant to this situation.

The transmission facilities of the radio station, Energy 1200 are located near the community of Barrhaven. Beginning in 1986, after the stations broadcast frequency was changed from 1440 KHz to 1200 KHz, the residents began to experience interference with a number of home electronics and appliances. A radio interference survey was undertaken by the Task Force on Radio Interference, which was established by the Barrhaven Community Association. In their report, the Task Force indicated that of the 290 responses to their questionnaire, 160 households experienced interference problems from Energy 1200. Other households also reported interference from other or 'unknown' sources. Only 15 households reported no interference problem. The most common problems were related to interference with video equipment and telephones.

The Task Force recognized that 'the growth of any community close to powerful radio transmitters is asking for interference to happen.'. At that time, plans were being established to expand Barrhaven in such a way as to surround the Energy 1200 transmission site, as well as other transmission sites, with residential development. It was recommended by the Task Force that 'the City of Nepean play a role in preventing this problem by restricting development in proximity to the transmitters.' The survey and report have been attached as Appendix 2.

4.0 LAND USE CONTROLS

Precedents exist for the establishment of land use controls that reflect and preserve the functional requirements for a variety of land uses. Examples of these types of controls include height limits for buildings or structures surrounding airports, minimum separation distances of non-agricultural uses from agricultural uses, berm and noise barrier requirements for development adjacent to waste disposal sites or highways and required setbacks of uses from obnoxious sources.

4.1 Establishment of Minimum Separation Distances

In order to implement land use controls that limit the impacts of development on the existing AM radio transmission facilities it is necessary to determine the geographic limits of the area that may be impacted. This area has been defined by the technical work carried out by Dr. Mark Tilston, an expert in this field. Dr. Tilston's calculations are based upon the maximum allowable levels of exposure to RF fields for the general population and contact currents for conducting objects in RF fields specified in Safety Code 6, as previously described. In addition, Dr.

Tilston's calculations have determined the maximum level of reradiation which is permissible within a defined area, based upon the requirements of the DOC and the need of the stations to continue to serve their respective markets. A detailed description of Dr. Tilston's technical work has been attached as Appendix 3 and Appendix 4. The following is generalized summary of the work which has been completed.

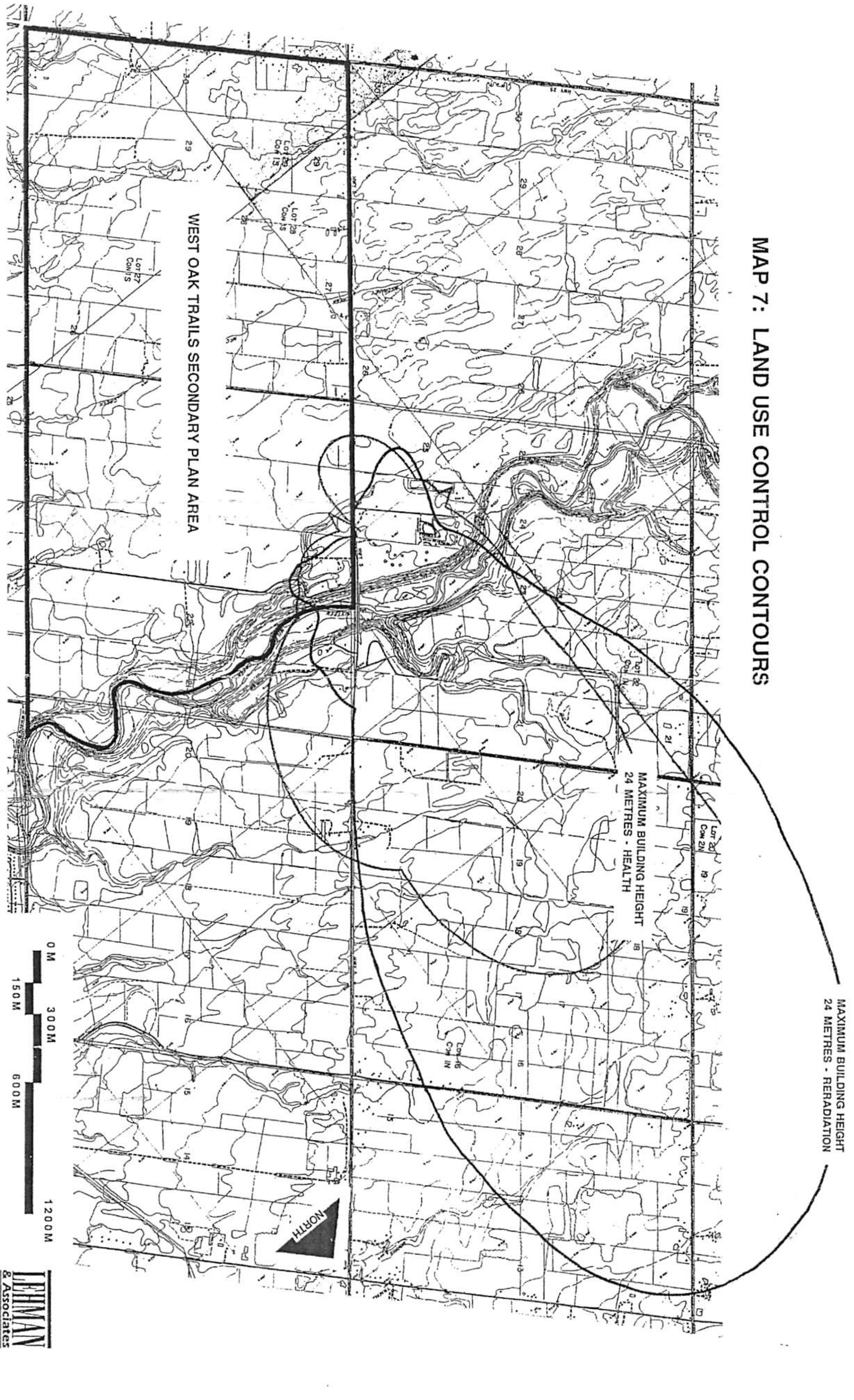
Given the irregular nature of AM radio signals, it was not possible to relate the area which would be impacted to any existing physical or administrative boundaries or to define the area in terms of a regular shape, such as a circle. As such, contours, which connect geographic points that have the same quantitative characteristics, were used to define the area. Two sets of contours were established: one that deals with the impacts upon health; and another that deals with the impacts of reradiation. Each set combines a number of variables, including the different frequencies of the two stations, as well as variations in power required to broadcast during different times of the day. Map 7: Land Use Control Contours shows these two sets of contours.

The calculations completed by Dr. Tilston consider factors of mass and height. Each contour describes the geographic area within which buildings should be limited to a given height to afford the highest level of safety and the lowest level of reradiation. Under the Draft West Oak Trails Secondary Plan, the maximum building height permitted is 24 metres. Calculations were completed to determine the impact of buildings ranging in height from 6 to 24 metres at intervals of 6 metres. The maximum mass of such a building was estimated according to the requirements of the Ontario Building Code. These calculations were used to establish a series of corresponding contours with gradations of maximum heights of buildings permitted in each contour.

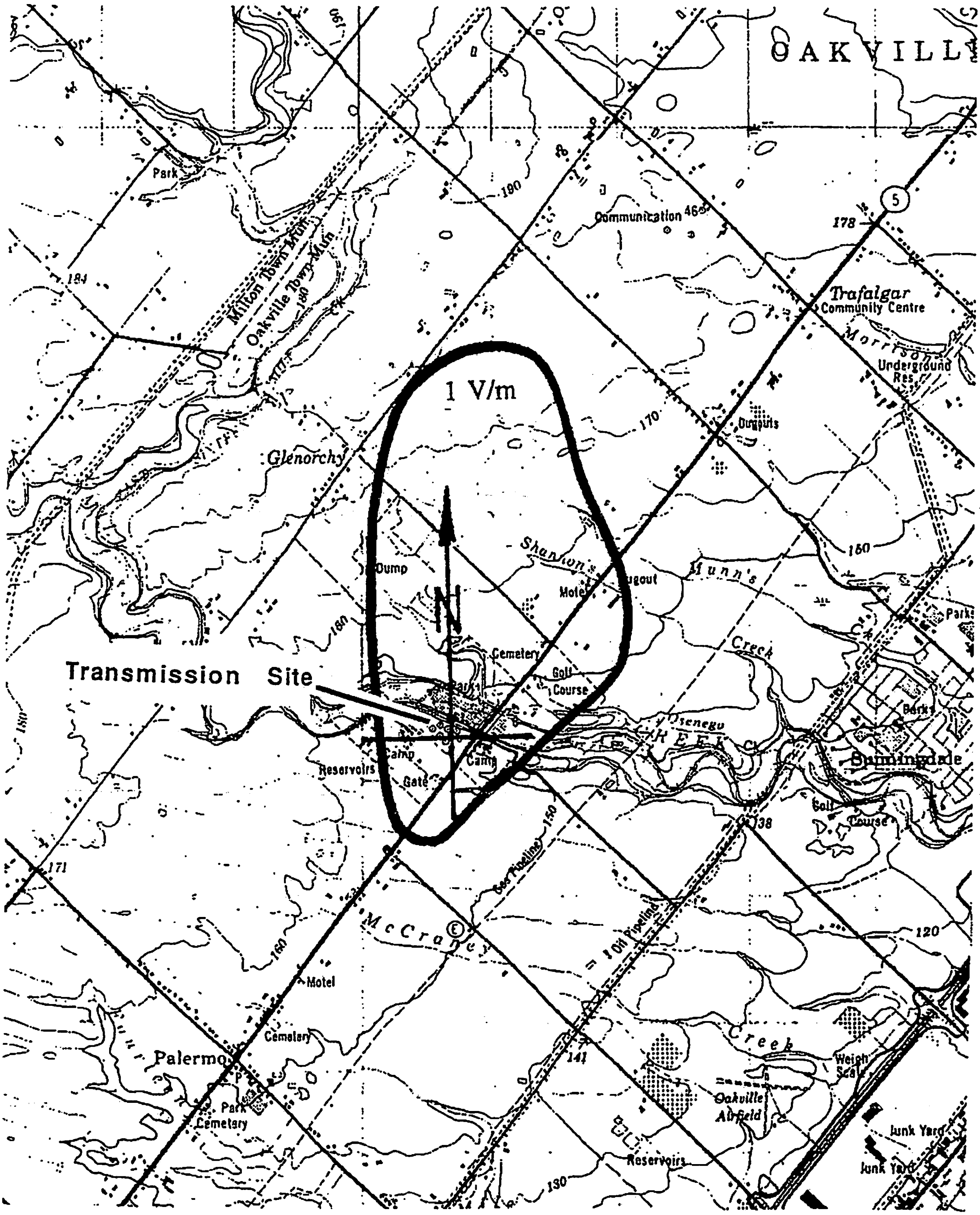
In addition, a contour delineating the area where CHWO and CJMR are likely to interfere with electronic equipment has been established and is illustrated on Map 8: Primary Interference Contour. Interference to RF devices and radio-sensitive equipment is explained in more detail within Dr. Tilston's report found in Appendix 4.

4.2 Additional Controls

An area intended for future urban development, the West Oak Trails Secondary Plan area is located immediately south of the transmitter site (see Map 3: Transmitter Site and Secondary Plan Location). Although most of the concern is regarding the impacts of development within this area, concerns do exist with development in other adjacent areas. In the past, problems have been experienced with structures such as steel barns and bridges. Fortunately, these problems have been resolved through mitigation techniques, allowing the stations to continue to operate. However, these solutions have only been arrived at with tremendous costs to the stations.


MAP 7: LAND USE CONTROL CONTOURS
WEST OAK TRAILS SECONDARY PLAN AREA
MAXIMUM BUILDING HEIGHT
24 METRES - HEALTH
MAXIMUM BUILDING HEIGHT
24 METRES - RERADIATION
0 M
150M
300M
600M
1200M
NORTH
LEHMAN
& Associates

MAP 8: PRIMARY INTERFERENCE CONTOUR



Through prior notification and consultation, these problems may have been resolved or avoided in a more cost-effective manner. It would be helpful if all proposed changes in land use within the surrounding non-urban areas requiring amendments to the Official Plan or Zoning By-law, a consent to sever or issuance of a building permit were to be reviewed by municipal officials for potential impacts upon the operation of the radio station and the health of existing and future residents of the area.

5.0 SUMMARY AND CONCLUSIONS

1. The Broadcasting Act provides legislation which recognizes the importance of radio signals and the broadcasting system in providing a service that can be seen as essential to the public. Access to the broadcasting system and programming is controlled by The Canadian Radio-Television and Telecommunications Commission, an independent government body. The objectives of the above-noted legislation and the mandate and authority of the corresponding agencies should be respected when decisions regarding land use are made.

2. There are a multitude of communication systems which utilize the radio frequency spectrum, operating in concert with each other. There are a number of AM radio stations which exist on any given frequency of the AM band. This factor, combined with a low tolerance for operation outside of strict technical parameters, results in a tenuous balance which, if upset, can cause significant national and international problems.

3. The integrity of AM radio signals can be compromised by the development of certain types and sizes of structures in proximity to its transmitter site. Large structures, specifically those of steel construction, have the ability to block or absorb a signal, thus preventing it from reaching its intended destination or audience. Such structures also have the ability to cause reradiation, which either increases or decreases the signal strength. A decrease in signal strength restricts the station's ability to reach its whole market. An increase in signal strength can cause interference with other stations and may ultimately result in a forced shutdown of the station by the authorities. Planning controls placed on development in communities adjacent to transmission facilities are necessary to mitigate these potential impacts.

4. Potential health hazards exist for residents located in close proximity to AM radio transmission facilities. Exposure to excessive levels of radiofrequency energy over prolonged periods of time may have an adverse effect on health. Injuries may also be caused by accidents which result either from the startling effect of

contact with radio generated current or the malfunction of equipment susceptible to electromagnetic fields.

5. CHWO and CJMR have been in operation and providing a public service in the communities of Oakville and Mississauga since 1956 and 1974, respectively. As the result of a 1978 OMB Hearing, the stations undertook a costly relocation to their present site. Once again, there is a potential threat to the operating capacity of the stations as a result of changes in land use which are proposed for the adjacent lands to the south under the West Oak Trails Secondary Plan. Relocation is not an alternative that can be considered due to the level of urban development within the remainder the market area resulting in an absence of suitable transmission sites. In addition, a change in frequency is not a solution due to the unavailability of other AM or FM frequencies from which to broadcast. As a result, the placement of planning controls on adjacent development is seen as the only means to allow the stations to continue to operate and to preserve a valuable public resource.

6. The use of the site, by way of a site specific rezoning, is a legitimate and accepted land use which has been in existence for over 13 years. In examining the existing adjacent land uses, it appears that most are compatible with the transmission facilities. Any technical conflicts which have arisen in the past were mitigated to the satisfaction of all landowners. However, it is the scale of the land uses proposed in the West Oak Trails Secondary Plan that have potential to conflict with the existing operation of the transmission facilities. If further control is not placed on the West Oak Trails Secondary Plan area, a portion of the proposed uses may jeopardize the operational capacity of long-standing land use and community service.

7. Contours produced on the basis of the Dr. Tilston's calculations are proposed to serve as the technical basis to limit the heights of buildings. These limits would ensure the safety of the general population and maintain the integrity of the signal for both radio stations. A contour has also been established outlining the area where it is likely that interference to RF devices and radio-sensitive equipment will occur. Objectives and polices are needed within the Secondary Plan to implement these types of quantitative controls. Controls need to be integrated into the Zoning By-law and also administered at various other stages of development control, for example, at the plan of subdivision or site plan stage.

8. In addition to height controls within the West Oak Trails Secondary Plan area, some form of control is needed to address changes in land use which occur in the rural areas to the north, east and west of the transmission facility site. Controls should be investigated

dealing with the granting of consents and the issuance of building permits. As with the policies for the West Oak Trails Secondary Plan area, the intent would be threefold; to preclude construction of buildings that would affect the signal, to warn individuals of prospective health risks, and to attempt to eliminate or minimalize the nuisance of interference to electronic equipment.

6.0 RECOMMENDATIONS

1. It is recommended that land use controls be implemented to:

   - Mitigate the impact of development on the transmission facilities of CHWO and CJMR radio; and,

   - Decrease the health risks to the population.

2. These controls should be implemented by inclusion of policies, regulations and approval conditions in the following land use documents and procedures:

   - West Oak Trails Secondary Plan;

   - Town of Oakville Zoning By-law;

   - Subdivision or Development Agreement;

   - Site Plan Control; and,

   - Consent to Sever.

APPENDICES

APPENDIX 1

SUSCEPTIBLE EQUIPMENT

The electronic equipment which may susceptible to radio frequency energy is not limited to communications receivers or equipment. The following list, by no means exhaustive, is representative of the types of equipment subject to malfunction due to susceptibility to electromagnetic fields.

Broadcast receivers (AM, FM, TV)

Digital Timers

Audio Systems (home & commercial)

Computers

Video games

Electro-explosive devices

Closed circuit video systems

Radio controlled models

Telephone switching equipment

Measuring equipment

Electronic calculators

Process control devices
- vehicle ignition
- vehicle brakes
- photographic
- manufacturing
- elevators
- power distribution

Heart pacemakers

Medical monitoring equipment

Medical test equipment

Metal detectors

Domestic Appliances

Prosthetic Devices

Computer terminal equipment

CATV systems

Electronic sensors

Cameras

Telephone distribution systems

VCR's

APPENDIX 2

BARRHAVEN COMMUNITY ASSOCIATION

97 Pheasant Run
Nepean, Ontario
K2J 2R8

28 September 1988

Mr. D.E. Armstrong
Vice President, Development
RAWICO Communications Ltd.
2773 - 37th Avenue North East
Box 660, Stn. M
Calgary, Alta. T2P 3Z2

Dear Mr. Armstrong:

Re: Interference Survey

Please find herewith a copy of the survey results which indicates the number of complaints attributed to your radio station. Copies have been sent to the Department of Communications for their information.

The Barrhaven Community Association (B_{CA}) would greatly appreciate your assistance in the suppression of the appliances in the households listed on the accompanying page(s). The types of appliances concerned are indicated on the list. A key to the letter codes is attached.

In order to keep the Community informed as to the progress of any suppression work you may perform, could you please ensure that the B_{CA} is kept informed of all the completed jobs. May I suggest that, for convenience, a list of all jobs completed in each week of suppression activities be forwarded, at the end of that week, to the undersigned.

I would appreciate an indication of the action you will be taking and the time frame involved as soon as possible.

If you have any queries regarding this issue, please do not hesitate to contact me at your convenience.

Yours sincerely,

Derek Uttley
Chairman
Task Force on Radio Interference

BARRHAVEN COMMUNITY ASSOCIATION
RADIO INTERFERENCE STUDY

KEY TO APPLIANCES AFFECTED

A - ALARM SYSTEM	B - STEREO RECEIVER
C - HIFI COMPONENT	D - MUSICAL INSTRUMENT
E - TELEVISION	F - VIDEO CASSETTE RCDR
G - BABY MONITOR	H - INTERCOM
I - ELECT. CONTROL	J - OTHER

Page No. 1
09/22/88

BARRHAVEN COMMUNITY ASSOCIATION : RADIO INTERFERENCE REPORT
INTERFERENCE FROM ENERGY 1200

REF NUM	LAST NAME	FIRST NAME	HOUS NMBR	STREET	PHONE #	APPLIANCES AFFECTED
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Page No. 2
09/22/88

BARRHAVEN COMMUNITY ASSOCIATION : RADIO INTERFERENCE REPORT
INTERFERENCE FROM ENERGY 1200

REF NUM	LAST NAME	FIRST NAME	HOUS NMBR	STREET	PHONE #	APPLIANCES AFFECTED
[redacted]						

Page No. 3
09/22/88

BARRHAVEN COMMUNITY ASSOCIATION : RADIO INTERFERENCE REPORT
INTERFERENCE FROM ENERGY 1200

REF NUM	LAST NAME	FIRST NAME	HOUS NMBR	STREET	PHONE #	APPLIANCES
[redacted]						

139

$1

BARRHAVEN COMMUNITY ASSOCIATION

REPORT OF THE TASK FORCE ON RADIO INTERFERENCE

The results of the Radio Interference Survey are as follows:

Out of 5000 questionnaires delivered to the Community 290 responses were received:

258 reported interference to one or more telephones;
100 reported interference from station CHU;
160 reported interference from Energy 1200;
58 reported interference from station W1310;
163 reported interference from an unknown source;
15 reported no interference problem.

Many responses indicated interference from several sources. This posed a problem when deciding on what radio station to send such complaints to. The Task Force on Radio Interference made the decision that, in such cases, the station perceived to have the greater impact on the complainant was to receive the complaint. This was decided with the knowledge that any suppression installed in an appliance would have a suppressive effect for all the problem signals.

Many reports of interference from an unknown source were received. These were usually related to video equipment where the interference manifested itself in a visual manner only, not giving an audible clue as to station identity. However, the majority of such reports also indicated interference with other appliances which was audibly identifiable. Where no identity could be attributed to interference in a household the complaints have been forwarded to the Department of Communications for their action.

All responses which indicated interference to telephones have been directed to Bell Canada for their attention. It is hoped that suppressing telephone lines at house entry and at each outlet jack will clean up the interference from the lines and allow the use of the majority of telephone sets, including non Bell types. However, suppression of telephone sets themselves may also be required in some instances.

The following lists the number of complaints sent to each interference source or related agency:

Energy 1200	139
CHU Time Signal	17
W1310	15
Department of Communications	64
Bell Canada	258

Each station has been requested to provide a free-of-charge suppression service to each complainant. If and when the station completes this work they have been requested to contact the Task Force in order that the relative success of the work can be assessed. Whereas the radio stations involved in the radio interference problem in Barrhaven are not legally obliged to provide any suppression to appliances, or other means of solving the problem, it is in the best interest to the radio stations to do so in order to maintain good relations with the Community.

The word *interference* has been used in this report in a colloquial form relating to an unwanted phenomenon. In essence the problem Barrhaven has is not strictly *interference*. Radio frequency interference (rfi) is true interference when an illegally operating transmitter, or device, generates signals which disrupt communication reception to a community. All the transmitters affecting Barrhaven are operating within the legal mandate given them by the Department of Communications. The principle problem Barrhaven faces is related to the inability of appliances to reject radio signals. Under conditions of lower field strength, than that experienced in Barrhaven, the majority of appliances will show no sign of malfunction. The growth of any community close to powerful radio transmitters is asking for *interference* to happen. Energy 1200, the station having the greater impact on Barrhaven, moved antenna towers closer to the Community some years ago, which resulted in a higher incidence of problems. The City of Nepean effectively assisted this antenna move by arranging a land swap with the station owners at that time. Plans are also established to expand Barrhaven in such a way as to surround the Energy 1200 transmission site with more housing. Housing developments are also creeping closer to the W1310 transmitter. The City of Nepean can play a role in preventing this problem by restricting development in proximity to the transmitters.

The Federal Government recently introduced a bill into Parliament which updates existing legislation regarding the powers available to the Department of Communications. Of importance to the Barrhaven issue is the fact that the bill will enable standards to be applied to appliances regarding susceptibility to radio frequency radiation. Currently there are no such standards in Canada. Also, when granting radio transmitter licenses, not only technical but also environmental issues can be taken into consideration, e.g., impact on community. Even if this bill manages to be passed into law, it will have no immediate impact on Barrhaven.

The problem of radio *interference* in Barrhaven will be with us for as long as there are radio transmitters close to residences. The cooperation of the radio stations is a necessity if the current hostile feelings of the Community are to be subdued. The City of Nepean must also play a role in preventing an escalation of the problem in the future, by planning appropriately.

Respectfully submitted.

Derek A. Uttley
Chairman
Task Force on Radio Interference
Barrhaven Community Association

APPENDIX 3

A GENERAL PROCEDURE TO COMPUTE CONTOUR MAPS NEAR AM BROADCAST STATIONS FOR (1) SAFE BUILDING HEIGHTS TO AVOID EXCESSIVE AM BROADCAST RERADIATION AND HUMAN HEALTH HAZARD, AND (2) ZONES OF INTERFERENCE TO RADIO-SENSITIVE EQUIPMENT

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February 22, 1993

TABLE OF CONTENTS

1.	INTRODUCTION		1
2.	AM BROADCAST TRANSMISSION AND ANTENNA		2
	2.1.	BACKGROUND	2
3.	RERADIATION		4
	3.1	BACKGROUND	4
	3.2.	ANALYSIS	6
	3.3.	CONCLUSIONS	7
4.	HEALTH HAZARD		8
	4.1.	BACKGROUND	8
	4.2.	ANALYSIS OF EXPOSURE TO RF RADIATION	9
	4.3.	ANALYSIS OF RF CONTACT CURRENT	10
	4.4.	CONCLUSIONS	13
5.	RF DEVICES AND RADIO SENSITIVE EQUIPMENT		14
	5.1.	BACKGROUND	14
	5.2.	CONCLUSIONS	15
6.	SUMMARY		16
7.	ENGINEER'S STAMP AND SIGNATURE		16
REFERENCES			17
FIGURES 1-4			
GLOSSARY			
APPENDIX A			
AUTHOR'S CURRICULUM VITAE			

1. INTRODUCTION

This report has been prepared for Golden Horseshoe Radio Network. It contains a general procedure to compute contour maps of maximum safe building heights in order to avoid excessive AM broadcast reradiation and to avoid exceeding the maximum limits recommended by Health and Welfare Canada, Safety Code 6, on AM broadcast electromagnetic exposure and contact current. It also defines contours within which there may be interference to radio-frequency (RF) receivers and radio-sensitive equipment. The introduction, background and conclusions are aimed at both the layman and the expert. However, the analysis sections are written more for the expert.

An AM broadcast station radiates electromagnetic energy in the form of radio waves. When a wave strikes a building which contains wires, metal pipes and possibly steel beams and cables, part of the wave scatters in all directions. This scatter is called *reradiation.* The reradiation can be a problem if it is strong enough and it travels toward another AM station on or near the same frequency, causing interference to listeners of that station. If the problem cannot be remedied, the Department of Communications might require the offending station to reduce power or even to shut down, resulting in a great financial loss to the station, and the loss of a valuable service to the community. The problem can be avoided by placing restrictions on building heights near broadcast antennas.

Human *health and safety* are also issues near AM broadcast stations. Exposure to radio waves at AM broadcast frequencies is not a danger under normal circumstances described later. However, when touching dangling hoisting cables, for example, there can be a risk of excessive contact current, which may be described as a tingling sensation or low-level shock. Its danger is in the startle effect, which could trigger an accident. This problem too can be avoided by placing restrictions on building heights near AM broadcast antennas.

Interference to RF receivers (RF devices) and other electronic equipment (radio-sensitive equipment) can occur near AM broadcast stations. This is because strong radio waves induce unexpected currents in electronic circuits, e.g. computer memory chips, which can cause them to perform erratically. Critical electronic circuits involving safety are made to withstand strong radio signals, however many poor quality consumer products are not. This problem is not related to building height, but merely to proximity of any building (or electronic device) to an AM broadcast station. If a problem arises, it can often be remedied by modifying the electronic device, or by replacing it with one having better RF immunity.

2. AM BROADCAST TRANSMISSION AND ANTENNA

2.1. BACKGROUND

The transmitting antenna of an AM broadcast station radiates electric and magnetic fields that vary with time in a cycle[1]. The number of cycles per second is the frequency in hertz (Hz). The AM broadcast band in North America has channels whose carrier frequencies are spaced every 10 kHz from 530 kHz to 1700 kHz (1 kHz = 1000 Hz). However, because of various limitations, 530 kHz and 1610-1700 kHz are almost vacant.

An AM broadcast transmitting antenna is very different from an FM or TV antenna, and cannot be placed on a tower. The following description of an AM broadcast antenna is taken primarily from Tilston [1]. The antenna is designed to radiate electromagnetic waves in the AM broadcast band. It consists of one or more steel towers typically 75 m high, fed by networks and

[1]This discussion considers only the carrier signal. When the carrier signal is amplitude modulated, e.g. by a voice or music signal, the RMS field strength and current increase by typically 22% (for 100% modulation), and the frequency spectrum of the resultant signal includes the carrier frequency plus sidebands generally within ±10 kHz of the carrier frequency.

transmission lines connected to the broadcast transmitter. Radio frequency (RF) current travels up and down the entire length of the antenna towers with a different time delay (phase) and magnitude for each tower. These currents radiate electric and magnetic fields which decrease in strength as the distance from the antenna increases. At a far enough distance, in the far field region, the fields form electromagnetic waves. The symbol for wavelength is λ. The wavelength λ in m depends on the frequency f in kHz and the speed of light in air c=299,800 km/s, according to the equation $\lambda=c/f$. For example, at a frequency of 1000 kHz, λ=299,800/1000 ≈300 m. Because a wavelength represents a cycle, it can be expressed as 360°. An efficient tower height in an AM broadcast array is .25λ or 90°, which at 1000 kHz is 75 m.

By careful choice of tower heights and locations, adjustment of networks, and choice of transmitter power, the antenna will radiate strongly in some directions and weakly in others (to avoid causing interference to other stations). The magnitude of the radiation on the ground at a given distance (usually 1 km) from the antenna for all bearings from the antenna can be plotted on polar graph paper, with the radial coordinate proportional to the radiation magnitude, and the polar angle equal to the bearing. This plot is called the radiation pattern. If the antenna consists of only one tower, the pattern is circular, but antennas with more towers can have complicated patterns, often with most of the radiation confined to one sector called the major lobe, and other sectors with minor lobes separated by minima or nulls. Regardless of the pattern type, the radio station must have its proposed pattern accepted and notified internationally by the Department of Communications, and must periodically prove to the Department, through measurements, that its actual pattern agrees with the notified one to within a small tolerance. This helps to insure that the radio station properly suppresses interference to other stations, while properly serving its listeners.

3. RERADIATION

3.1. BACKGROUND

The term reradiation can be defined as follows: When a metallic object is placed in an incident electric field, currents are induced in the metal at the same frequency as the incident electric field. These induced currents radiate their own electric field, termed reradiation in order to distinguish it from radiation coming directly from the transmitting antenna.

Buildings contain metal wires, pipes, and sometimes structural steel which may well grounded. These are sources of reradiation. As the building height decreases below 0.25λ, the amount of reradiation decreases. Similarly, as the incident field strength decreases, the reradiation decreases proportionately.

A receiver will receive the total field, which is the sum of the direct and reradiated fields. The magnitude of the total field may be larger or smaller than the magnitude of the direct field, depending on whether the direct and reradiated fields are in-phase or out-of-phase at the particular observation point.

The problem with reradiation is that it can add to the transmitting antenna pattern so as to (a) fill in the nulls, which are needed to avoid producing interference to other stations on or near the same frequency, or (b) notch out the main lobe of the pattern, which is needed to serve its listeners adequately. In effect, this reduces the coverage area.

Building height restrictions must be considered in order to avoid excessive null fill and main lobe notching due to reradiation. This subject is summarized in the Final Report of the Working Group on Reradiation Problems in AM Broadcasting [1].

An *ideal prediction* of the permissible height of a proposed building in order to avoid excessive reradiation of an AM broadcast signal would include predicting or measuring the combined effects of all reradiators (e.g. other buildings, steel-tower power lines and transmission towers) no matter how tall or distant. Such a prediction would be very difficult. If the AM station is already operating, rather than proposed, measurements could be done. However, it would always be necessary to rely on interpolation between the measurements points. This is not straightforward in the near-field region. Note that the standard AM broadcast field strength meters measure the magnetic field strength using an internal directional loop antenna, multiply the value by the intrinsic impedance of air, 377 Ω, and display the result in units of electric field strength, V/m. This procedure is not an accurate way to measure electric field strength in the near-field region. Furthermore, whether computations or measurements are utilized, they would need to be redone every time a significant reradiator was added near the AM array.

In order to overcome the difficulties mentioned above in computing or measuring and interpolating the total field including all reradiators, it has been common practice to consider one reradiator at a time in the presence of the AM array, ignoring other reradiators. This permits a simple computation of the field of an AM array at any location. In this computation, the measured ground conductivity should be used where available.

The field strength at points near an AM array must be predicted using a near-field computation. In this region the far-field approximation is too inaccurate to be relied upon. There is no all-inclusive definition of the boundary between the near-field and far-field regions, although there are several rules of thumb for different types of antennas (e.g. 10 times the maximum distance between any two towers in an AM array). When in doubt, it is best to use a near-field computation. The "modified" or "expanded" radiation patterns probably cannot be adapted to near-field computations because they are based upon empirical formulas for the far-field region, and they are primarily to account for the effects of reradiators, which it was mentioned above that were to be ignored for the present purpose.

3.2. ANALYSIS

Buildings generally contain various metal conductors in or on the exterior walls, such as electrical power, telephone and cable TV wires, metal plumbing, lightning ground wires, reinforced concrete, and sometimes steel frames. This highly variable and complicated network of conductors can be accurately modelled on the computer by a regular rectangular grid of sparser but thicker conductors. This type of modelling was found to agree well with measurements by Kavanagh and Balmain [2] on a 13 storey building of reinforced concrete at York University in Ontario.

Graphs of computed scattering cross-section in wavelengths squared σ/λ^2 versus building height in wavelengths, for various building widths and depths in wavelengths, are given in a report by Royer [3] part of which is contained here in Appendix A. The computations were done using a wire-grid building model and the NEC moment method computer program [4].

We can relate the scattering cross-section σ/λ^2 to the electric strength field incident on the building E_i and the reradiated inverse-distance electric field E_r versus the distance r from the building by expressing the reradiated power density p_r as follows:

$$p_r = \frac{E_r^2}{\eta} = \sigma\frac{E_i^2}{\eta}\frac{1}{4\pi r^2} \qquad (1)$$

where η is the intrinsic impedance of air (377 Ω). So at a distance $r=1\lambda$ from the building,

$$\frac{E_r}{E_i} = \left[\frac{\sigma/\lambda^2}{4\pi}\right]^{1/2} \qquad (2)$$

In general, as the building width and depth become larger, so does its reradiation.

The reradiated inverse-distance electric field at 1λ divided by the electric field incident on the building E_r/E_i for square buildings of three different widths obtained from Royer's graphs are plotted in Figure 1. The three widths are .032λ, .1λ and .2λ, which equal 10 m, 30 m and 60 m at 1000 kHz (λ=300 m). According to Figure 1, the building width of .2λ produces somewhat more reradiation than the other two widths. Furthermore, it is a reasonable choice for an upper limit on building width to consider. Taking the worst-case building width of .2λ for a square building, the corresponding reradiation versus building height is plotted in Figure 2 over building heights ranging from .01λ to .5λ, part of which is duplicated in Figure 1. A spot check on the computations was made using Royer's wire grid model but a different moment-method computer program (MBC wire program, Tilston [5]) for a height of .3λ. The computed reradiated electric field agreed with Royer's value to within 3%.

3.3. CONCLUSIONS

In order to avoid excessive AM broadcast reradiation due to buildings for a particular AM broadcast station, the following procedure is recommended:

(1) Determine the maximum permissible reradiation that can be tolerated while still meeting interference and coverage constraints.

(2) Assume that the reradiation comes from a single building, and has an approximately circular pattern. Given the maximum permissible reradiation, the incident electric field E_i versus building height can be obtained from Figure 2 for various building heights. Field strength contours of these E_i values should be plotted on maps suitable for use by municipal planners, and each contour labelled as to the corresponding building height.

(3) If a proposed building within a contour exceeds the height labelled on the contour, it should be assumed that there is a good chance that it will cause a reradiation problem.

(4) Note that, as stated in the Working Group on Reradiation report [1], treatment of a building to reduce reradiation has not been very successful.

4. HEALTH HAZARD

4.1. BACKGROUND

Recent recommendations for health standards in Canada are given in Safety Code 6 by Health and Welfare Canada [6], and are summarized here. The code differentiates between RF workers and general population when specifying limits to RF exposure and contact current. In the AM broadcast band for f in MHz (1 MHz = 1000 kHz), the following limits are given:

Class of Population	Electric Field Strength Exposure (V/m)		Magnetic Field Strength Exposure (A/m)		Contact Current (mA)
	f≤1	f>1	f≤1	f>1	all f
RF Workers	600	600/f	4.9	4.9/f	40
General Population	280	280/f	2.19	2.19/f	15

The exposure limits are averaged over a period of 0.1 hours. They are more restrictive for the general population than for RF workers because: some of the general population is more susceptible, for example, the aged, infants or chronically ill; the exposure time is generally greater for the general population; and workers are supposed to be informed of potential hazards, and can make a personal decision about whether to be exposed [7].

The contact current limits are based upon the possibility of pain or an RF contact burn in the case of RF worker limits, and RF contact current perception in the case of the general population, when a person touches a metallic object with a finger tip (grasping is less hazardous).

The hazard with RF perception (a warming, rather than a burn), is that it may have a startling effect, possibly causing a person to fall or drop something on another person.

When considering a building development near an AM broadcast station, the limits for general population are the applicable ones.

An *ideal prediction* of the permissible height of a proposed building in order to avoid excessive RF exposure or contact current would include predicting the combined effects of all radio signals, no matter how strong or weak (e.g. transmissions from all measurable AM, FM, TV and radio amateur stations). The method for prediction of these signals and their effects is impracticable. However, in the vast majority of cases where there is a strong field at some location from one AM station, there are no other strong radio transmissions of any type, except possibly for one other AM station. This is mainly because it is common practice to avoid locating AM broadcast stations near any other transmission towers, in order to avoid intermodulation interference and reradiation problems. In some cases, special precautions are taken (filters at tower bases) that allow two AM stations to be cosited, i.e. to share the same site.

If the AM station under consideration falls into the above category (the only significant fields are from one or two AM stations), then the analyses below can be applied.

4.2. EXPOSURE TO RF RADIATION

If a person is subjected to strong enough RF radiation, some portions of the body will heat beyond a normal range, possibly causing health problems[7]. The maximum permissible electric and magnetic fields for the general population recommended in Safety Code 6 and duplicated above range from 160-280 V/m and 1.29-2.19 A/m depending on the frequency.

In Canada, the federal Department of Communications limits the power of an AM broadcast transmitter to a maximum of 50 kW. A high gain broadcast antenna array at 50 kW will produce a maximum electric field of approximately 6 V/m at 1 km from the array centre. The centre of the array is generally at least .5λ from the site boundary, which equals a minimum of 94 m (corresponding to 1600 kHz). Therefore, a worst-case electric field at the boundary of an AM broadcast transmitter site is 6×1000/94=64 V/m using an inverse-distance relationship (which is safe because it tends to overestimate the field near the array in the pattern's main-lobe direction). The corresponding magnetic field strength is 64/377Ω=0.17 A/m.

These worst-case field strength values of 64 V/m and 0.17 A/m at the transmitter site boundaries are much less than the maximum permissible limits recommended by Health and Welfare Canada in Safety Code 6, and therefore this form of health hazard is unlikely to affect any development around the site.

If two AM stations are nearby or cosited, their combined effect must not exceed the Safety Code 6 recommendations. In this case, the combined RMS field E_0 is related to the two component RMS fields E_1 and E_2 according to the following formula:

$$E_0 = \left[E_1^2+E_2^2\right]^{1/2} \tag{3}$$

According to this formula, the maximum amount that E_0 can exceed the stronger of the two components is 41%. This still produces worst-case field strength values that are well within the Safety Code 6 recommendations.

4.3. RF CONTACT CURRENT

In Safety Code 6, Appendix IV, Figure IV-2, an equivalent circuit for the human body impedance is given. This impedance represents the impedance of an average male for finger contact with a plate electrode of area 144 mm^2, and a barefoot contact with a ground plane, as described by Chatterjee [8], and referred to by Stuchly [7] in her paper on which Safety Code

6 is based. Average females and children present higher impedances, and therefore will conduct less current.

This body impedance is plotted over the AM broadcast band in Figure 3. It is almost constant and almost entirely resistive. A safe value to use for all frequencies in the AM broadcast band is a pure resistance of 950Ω.

The limit on RF contact current in Safety Code 6 is based on finger contact because it was found to be the most susceptible type of contact to the perception of RF current. While grasping contact has a larger contact area, and therefore less impedance and more current, the current density (A/m^2) is less, and that is the determining quantity in the perception of RF current.

Three cases which could yield significant contact current were analyzed with the MBC moment method program: (1) a .2λx.2λ cross-section building having a drop wire (e.g. hoisting cable) that is shorted to the building structural steel, lightning ground system, or electrical ground system, possibly through hoisting machinery with an electrical motor having a ground, and is touched at the bottom by a person; (2) a situation similar to (1) except that the drop wire is insulated at the top; and (3) a pole that is insulated from the ground (e.g. a flagpole or lamp pole, especially during installation), and whose base is touched by a person. The computer model of the buildings was identical to Royer's model, shown in Appendix A, or contains more detail in order to provide a connection point for the drop wire. The drop wire diameter was .000032λ (.96 cm at 1000 kHz). The pole was a uniform diameter of .0005λ (15 cm at 1000 kHz).

The results are plotted in Figure 4, along with a proposed overall limit for the maximum permissible incident field versus building height in order to avoid excessive contact current. Although a purely empirical limit could have been used, the limit for building heights up to .25λ is based upon a simplified analysis of the current induced in a base loaded monopode receiving antenna, assuming that the current has a sinusoidal distribution and the load (human body impedance) is large enough that the antenna impedance can be ignored. This analysis yields the following incident electric field strength E required to produce a given base current I_b as follows:

$$\lambda E = Z_b I_b \frac{2\pi \sin(2\pi h/\lambda)}{1 - \cos(2\pi h/\lambda)} \tag{4}$$

where in our case, Z_b=950 Ω and I_b=15 mA. This appears to fit the lower limit of moment method values on Figure 4 well, with a small margin for safety. For building heights above .25λ, this analysis was found to be inaccurate, as expected because the current distribution is no longer well represented by a sinusoid. In this region a constant limit was used based upon moment method results. This means that increasing a building height above .25λ does not increase the health hazard of RF contact current.

It should be noted that while the author expects the few cases that were analyzed to include the worst-case situations, it may be possible to find worse situations. That is why there is some margin between the limit chosen in Figure 4 and the lowest moment method values shown.

As an example of the limit on building height for a specific frequency, consider a frequency of 1000 kHz (λ=300 m), and a building of height .05λ or 15 m. The incident electric field strength from Figure 4 must be limited according to λE=565 V, or E=1900 mV/m. Therefore, such a building must not be located within the station's 1900 mV/m contour.

If two AM stations are nearby or cosited, their combined effect must not exceed the Safety Code 6 recommendations. In this case, the combined RMS current I_0 is related to the two component RMS currents I_1 and I_2 according to the following formula:

$$I_0 = \left[I_1^2 + I_2^2\right]^{1/2} \tag{5}$$

According to this formula, the maximum amount that I_0 can exceed the stronger of the two components is 41%. This margin is built into the maximum limit set in Figure 4. Therefore, if Figure 4 is met by each station on an individual basis, the Safety Code 6 recommendations will be met on a combined basis.

4.4. CONCLUSIONS.

In order to meet the Safety Code 6 recommendations on RF exposure and contact current near an AM broadcast antenna site, the following procedure is recommended::

(1) In the vast majority of cases where there is a strong field at some location from one AM station, there are no other strong RF transmissions of any type, except possibly for one other AM station. In these cases, assuming that the AM stations are constructed and operating according to DOC rules, it is very unlikely that the Safety Code 6 recommendations on RF exposure limits can be exceeded outside the transmitter site, and they can reasonably be assumed to be safe.

(2) While there appear to be cases of existing stations and developments where the Safety Code 6 recommendations on RF contact current are exceeded without any reported problems, this could well be because those affected did not know the cause. In order to meet Safety Code 6, several building heights of interest should be selected. Divide the heights by the wavelength of the AM broadcast station to obtain h/λ, and read from

Figure 4 the corresponding value of wavelength times electric field λE. Divide these values of λE by λ, to obtain the electric field strength E in V/m for each building height. Plot contours of these field strengths on a map suitable for use by municipal planners, and label each contour as to the corresponding building height.

(3) If a proposed building within a contour exceeds the height labelled on the contour, it should be assumed that the limit on maximum RF contact current in Safety Code 6 could be exceeded.

(4) Note that while it possible to take precautions to avoid the perception of RF contact current, such as rubber soled (electrically insulated) shoes, rubber gloves, and insulating the hook from a hoisting cable, these measures could be impractical.

5. RF DEVICES AND RADIO-SENSITIVE EQUIPMENT

5.1. BACKGROUND

In this context, an RF device is any device intended to receive radio waves, e.g. AM, FM, TV receivers. Radio-sensitive equipment is any electronic equipment that may be unintentionally affected by radio waves, e.g. computers, microprocessors, calculators, audio or video tape recorders, record or disk players, electronic organs, telephones, hi-fi amplifiers, and garage door openers.

The DOC Broadcast Procedures and Rules [9], parts C-10.4 and C-10.5, state that the performance of some RF devices and radio-sensitive equipment may be degraded by high signal strengths from the station because of design limitations such as inadequate or improper shielding of the devices. The broadcaster is responsible for remedying valid complaints of such interference to RF devices within the station's 250 mV/m contour if those devices were introduced before the implementation of the station's current pattern. RF devices introduced after the station's implementation, as well as all radio-sensitive equipment, are not the responsibility of the broadcaster. Current DOC regulations require a broadcaster, when applying for a new station or pattern change, to provide the municipality with the above information and a map of the 250 mV/m contour.

This is not to say that there are expected to be widespread problems throughout the 250 mV/m contour. The DOC, through cooperation with the Canadian Standards Association (CSA) and participation in the International Special Committee for Radio Interference (CISPR), is working on the development of voluntary standards of RF immunity for RF devices and radio-sensitive equipment [10]. Based upon previous work by the above organizations and others (EIA and MIL standards), it appears that most equipment will withstand an electric field strength of up to 1 or 2 V/m (1.8 V/m is under consideration as a standard). Unfortunately, there does not seem to be sufficient statistical data on the RF immunity of various categories of electronic equipment to determine what are the chances that a particular type of equipment will be affected within a given field strength contour.

5.2. CONCLUSIONS

In order to show areas of expected interference to RF devices and radio-sensitive equipment, the following procedure is recommended:

(1) In view of the above mentioned known performance of electronic equipment, coupled with the fact that AM stations must file a map of their 1 V/m and 250 mV/m contours with the DOC, it is suggested that until the DOC comes out with their recommendations, the 1 V/m and 250 mV/m contours represent reasonable estimates of primary and secondary areas of potential RF interference to RF devices and radio sensitive equipment. These can be used by municipal planners to determine appropriate land-use controls. For

broadcasters applying for a new station or change of pattern, it is already a DOC requirement that the 250 mV/m contour be supplied.

6. SUMMARY

Based on detailed analyses, simplified procedures have been developed to produce contours of maximum permissible building heights around an AM broadcast station in order to avoid excessive reradiation that might jeopardize the continued operation of the radio station, and to avoid exceeding the recommended maximum limits on RF contact current contained in Health and Welfare Canada's Safety Code 6. It was shown that under normal circumstances described herein, it can be assumed that the limits on exposure to electric and magnetic fields will not be exceeded outside the boundaries of an AM broadcast transmitter site, .

It was also shown that the 1 V/m and 250 mV/m contours can be used to represent the contours of primary and secondary interference to RF devices and radio-sensitive equipment.

7. ENGINEER'S STAMP AND SIGNATURE

The undersigned is responsible for the contents of this report.

Mark A Tilston

Feb. 22/93

Mark A. Tilston, Ph.D., P.Eng.

member, Canadian Association of Broadcast Consultants

REFERENCES

[1] M.A. Tilston, "Final report of the working group on reradiation problems in AM broadcasting", vol. 1, Report for the Department of Communications, Ottawa, Ontario, DSS no. 36100-4-4195, July 12, 1985.

[2] S.J. Kavanagh and K.G. Balmain, "Highrise building reradiation and detuning at MF", IEEE Trans. Broadcasting, vol. BC-30, no. 1, pp. 8-16, 1984.

[3] G.M. Royer, "The distortion of AM broadcast antenna patterns as caused by nearby towers and highrise buildings", Department of Communications, Ottawa, Canada, CRC Report no. 1379, March 1985.

[4] G.J. Burke and A.J. Poggio, "Numerical electromagnetics code (NEC) - method of moments", Nat. Tech. Inform. Service, Springfield, VA 22151, NOSC TD 116, vol. 1 and 2, July 1977.

[5] M.A. Tilston and K.G. Balmain, "A multiradius reciprocal implementation of the thin-wire moment method", IEEE Trans. Antennas Propagat., vol. 38, no. 10, pp. 1636-1644, 1990.

[6] "Limits of exposure to radiofrequency fields at frequencies from 10 kHz to 300 GHz", Health and Welfare Canada, Safety Code 6, 1991.

[7] M.A. Stuchly, "Proposed revision of the Canadian recommendations on radiofrequency-exposure protection", Health Physics, vol. 53, no. 6 (December), pp. 649-665, 1987.

[8] I. Chatterjee, D. Wu and O.P Gandhi, "Human body impedance and threshold currents for perception and pain for contact hazard analysis in the VLF-MF band", IEEE Trans. Biomed. Eng., pp. 486-494, May 1986.

[9] "Broadcast procedures and rules, part II: application procedures and rules for AM broadcasting", Communications Canada, December 1990.

[10] "Spectrum management radio communication information circular: electromagnetic immunity (radio sensitive equipment)", Communications Canada, RIC-17, Issue 1, January 1, 1991.

GLOSSARY OF TERMS
(Simplified)

λ or lambda. The symbol for *wavelength.*

Ω or ohms. A unit of impedance.

A/m or amperes per metre. A unit of *magnetic field* strength.

array, AM broadcast. A group of towers comprising an AM broadcast antenna.

contact current, RF. Electric current that passes through the skin when a metallic object is touched in the presence of an electromagnetic field at radio frequencies.

electric field. A field whose force upon a charged particle (e.g. electron) is independent of the particle velocity. The field is emitted by any electric current. The strength of the field is called electric field strength.

electromagnetic wave. A wave whose peaks and valleys correspond to positive and negative values of *electric* and *magnetic field* strength. Any alternating electric current produces outward travelling electromagnetic waves.

electromagnetic field. The combination of *electric* and *magnetic fields* that are emitted by any electric current.

exposure, RF. Exposure of the human body to an *electromagnetic field* at *radio frequencies.* Some of the field is absorbed by the body, thereby producing heat.

far field region. The region far enough away from an electric current that its *electromagnetic field* is primarily wave-like (see *electromagnetic wave*).

general population. Anyone other than an *RF worker.*

GHz or gigahertz. 1,000,000,000 (10^9) *Hz.*

ground conductivity. A measure of how conductive the ground is to electric current, measured in millisiemens per metre (mS/m).

human body impedance. The amount by which a human body resists the flow of electric current, measured in ohms (Ω).

Hz or hertz. A unit of frequency meaning cycles per second.

kHz or kilohertz. 1,000 *Hz.*

magnetic field. A field whose force upon a charged particle (e.g. electron) is proportional to the particle velocity. The field is emitted by any electric current. The strength of the field is called magnetic field strength.

MBC. A *moment method program* by Tilston and Balmain.

MHz or megahertz. 1,000,000 *Hz*.

moment method program. A computer program used to compute electric currents in objects and their resultant *electromagnetic fields*.

near field region. The region near an electric current in which its *electromagnetic field* is only partially wave-like.

NEC. A *moment method program* by Burke and Poggio.

radio wave. An *electromagnetic wave* at *radio frequencies*.

radio-sensitive equipment. Electronic equipment that unintentionally reacts to strong electric currents or *electromagnetic fields* at *radio frequencies* (e.g. a VCR).

reradiation. The part of a wave that is scattered in all directions when an *electromagnetic wave* strikes an object containing metal.

RF device. A device that is intended to manipulate electric currents or *electromagnetic fields* at *radio frequencies* (e.g. a radio receiver).

RF or radio frequency. Any frequency that is useful for communication through *electromagnetic waves* and antennas, presently 10 kHz to 300 GHz.

RF worker. A worker who is aware of the possible dangers of RF *exposure and contact current* within his particular job situation.

V/m or volts per metre. A unit of *electric field* strength.

wavelength. The distance between two adjacent peaks of an *electromagnetic wave*. In air, it can be computed in metres by dividing 299,800 by the frequency in *kHz*.

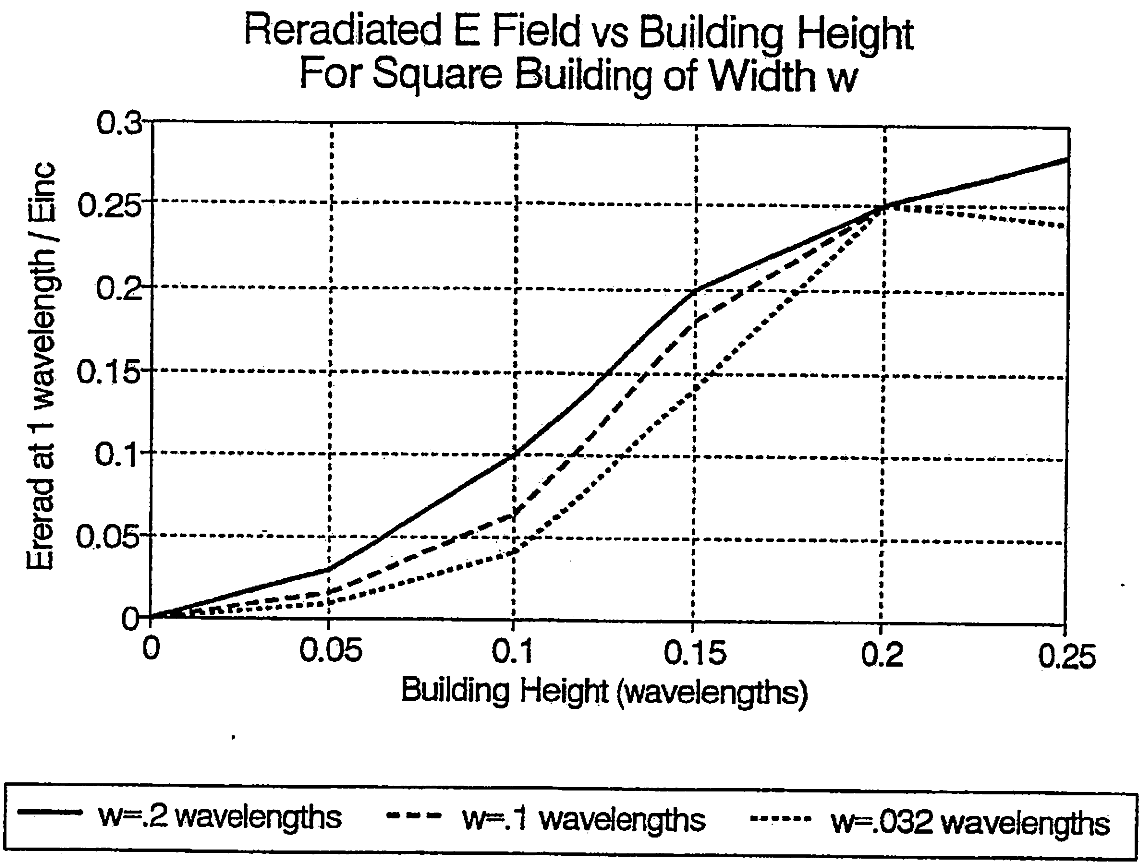

Fig. 1 Reradiated electric field from a building at a distance of 1λ, divided by incident electric field, versus building height in wavelengths obtained from Royer's graphs contained herein as Appendix A. Building cross-section is a square of width *w*.

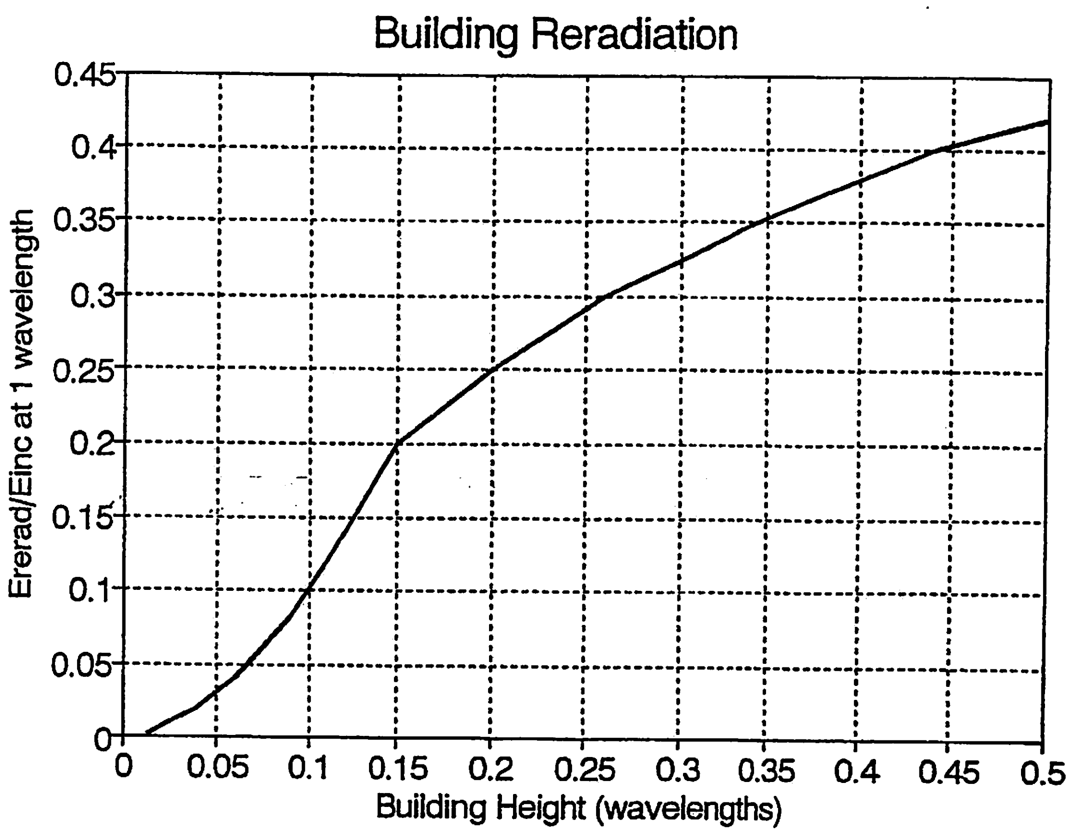

Fig. 2 Reradiated electric field from a building at a distance of 1λ, divided by incident electric field, versus building height in wavelengths obtained from Royer's graphs contained herein as Appendix A. Building cross-section is a square of width $w=.2\lambda$

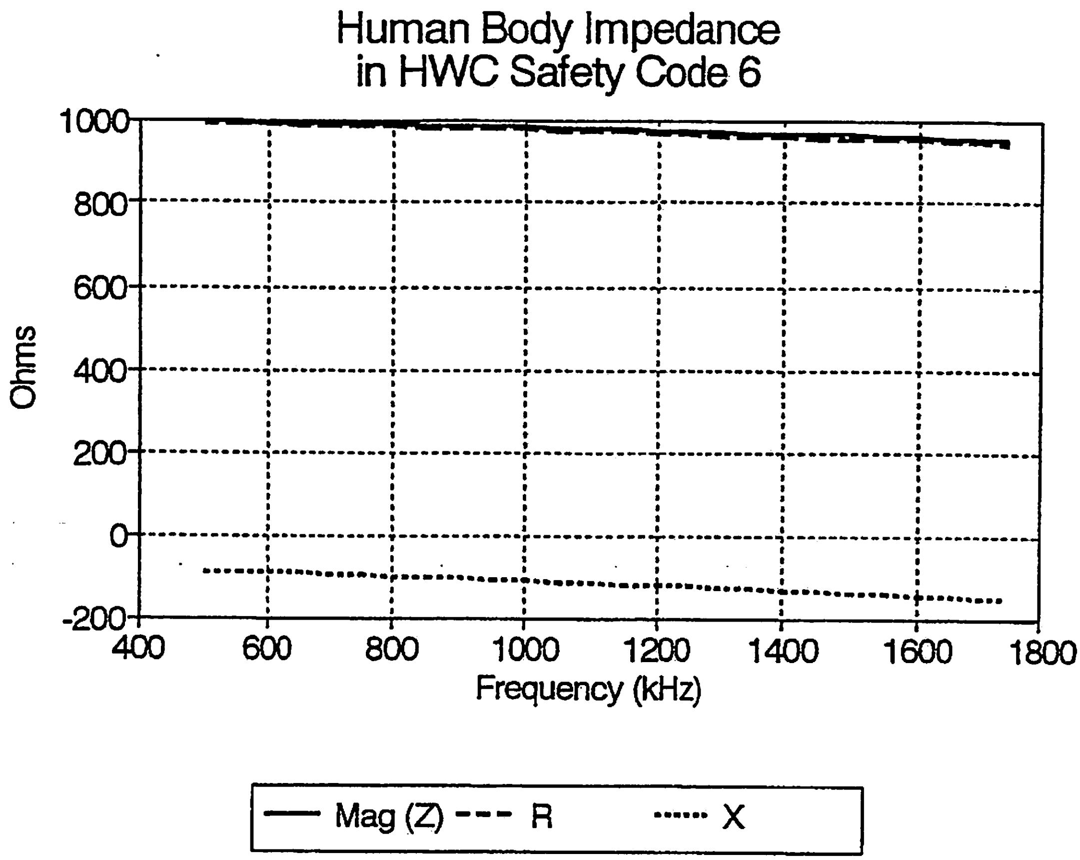

Fig. 3 Human body impedance computed from equivalent circuit given in Fig. IV-2, Appendix IV, Safety Code 6.

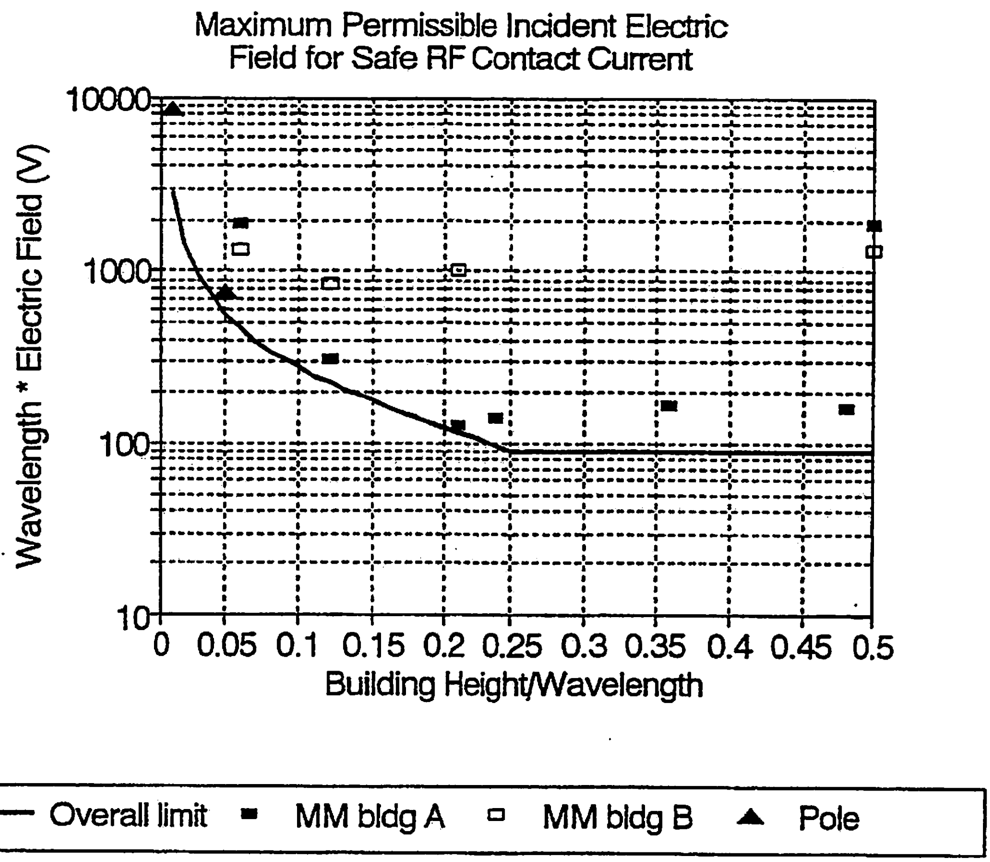

Fig. 4 Maximum permissible incident electric field strength times wavelength for safe RF contact current according to Safety Code 6, versus building height divided by one wavelength. Symbols are moment-method computations. Solid line is overall safe limit.

APPENDIX A

COMMUNICATIONS RESEARCH CENTRE

DEPARTMENT OF COMMUNICATIONS
CANADA

THE DISTORTION OF AM BROADCAST ANTENNA PATTERNS AS CAUSED BY NEARBY TOWERS AND HIGHRISE BUILDINGS

by

G.M. Royer

(Radar and Communications Technology Branch)

EXCERPT

CRC REPORT NO. 1379

March 1985
OTTAWA

A1

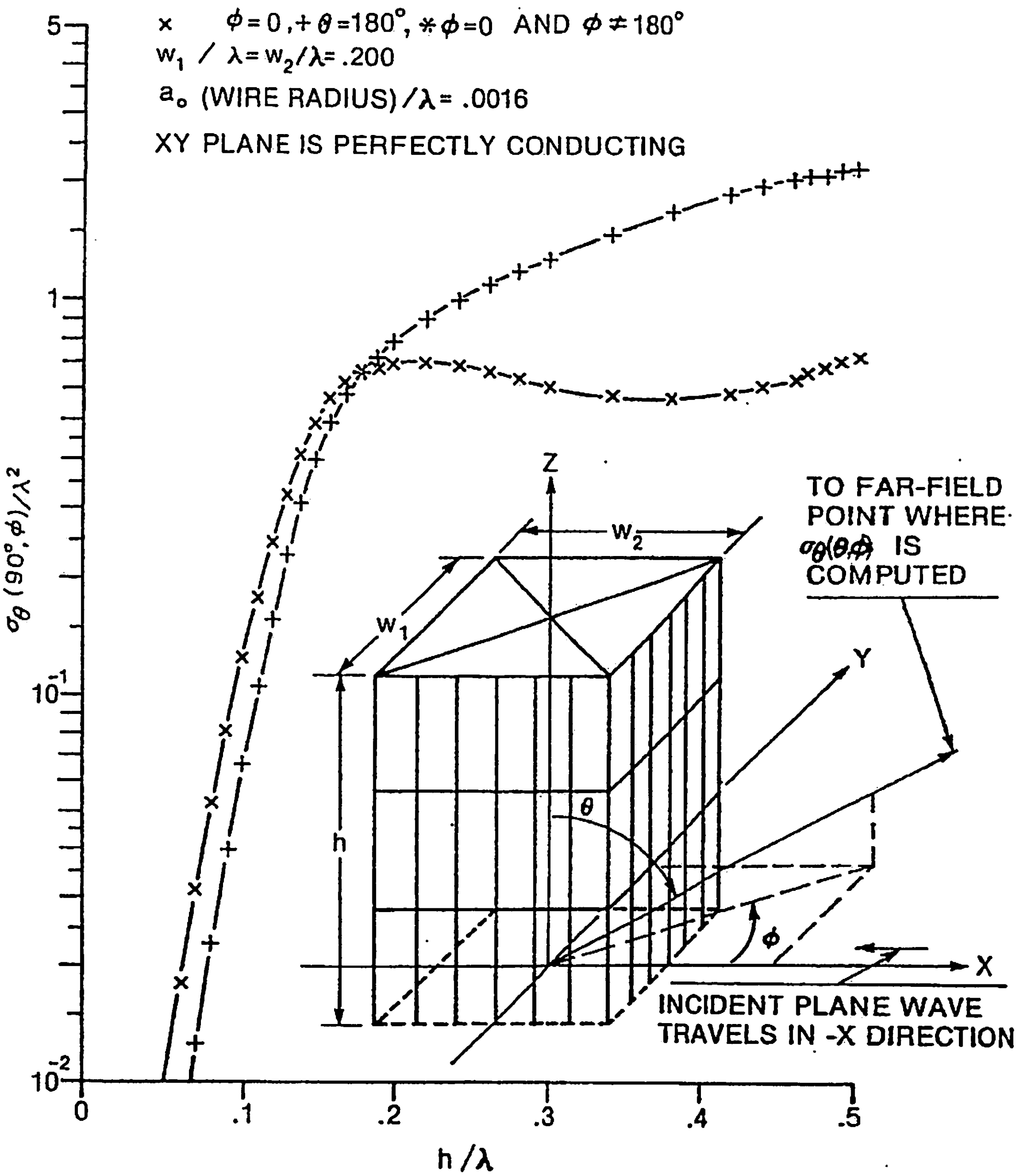

Fig. 19, $\sigma_\theta(90°,\phi)/\lambda^2$ as a function of h/λ for the wire-grid building shown. Note, although not indicated, the wire grids for the x/λ=-.1 and y/λ=.1 sides are the same as shown for the x/λ=.1 and y/λ=-.1 sides.

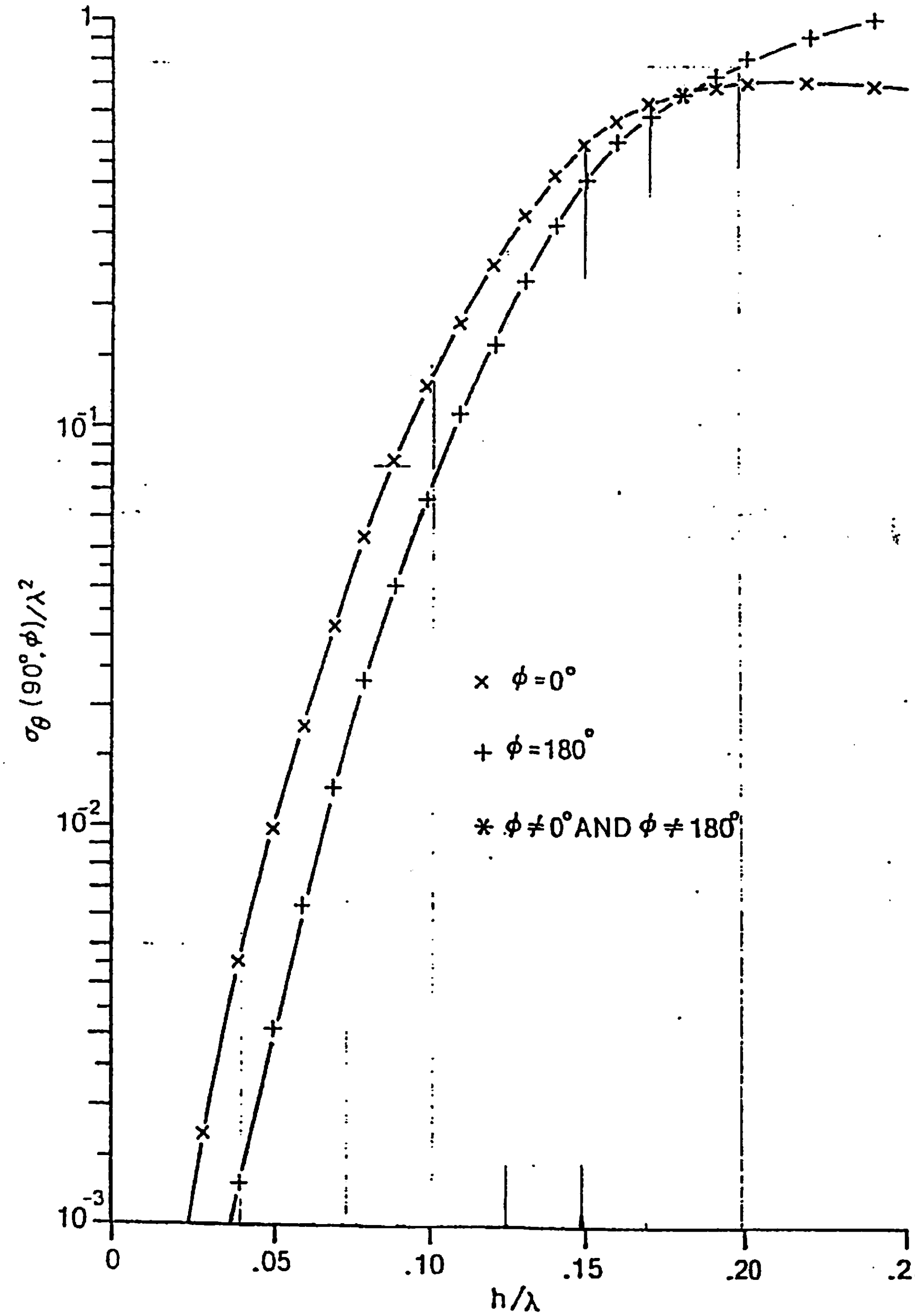

Fig. 20, $\sigma_\theta(90°,\phi)/\lambda^2$ as a function of h/λ, in the region $0 \leqq h/\lambda \leqq .25$, for the wire-grid building shown in Fig. 19.

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CURRICULUM VITAE

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(February 1993)

EDUCATION:

Ph.D. University of Toronto, Department of Electrical Engineering, 1989, thesis title "Thin-Wire Reciprocal Multiradius Implementation of the Electromagnetic Moment Method".

M.Eng. University of Toronto, Department of Electrical Engineering, 1983, thesis title "AM Broadcast Reradiation from Steel Tower Power Lines".

B.A.Sc. University of Toronto, Department of Electrical Engineering, 1974, thesis title "UHF TV Receiving Antennas - Swept Frequency Testing".

The theses included antenna measurements, physical scale modelling of scattering structures, moment-method analysis of antennas and scattering structures, and fundamental improvements to moment-method formulation and implementation.

PROFESSIONAL QUALIFICATIONS: professional engineer since 1976 (APEO), currently designated consulting engineer (APEO).

EMPLOYMENT HISTORY:

1982- M.A. Tilston Engineering (formerly M.A. Tilston, P.Eng.) - Consultant: AM, FM and TV broadcast antenna consulting involving interference and compatibility, biological hazards, system design, coverage, frequency allocation, and DOC applications.

1982- University of Toronto - Research Assistant to Prof. K.G. Balmain: Electromagnetic analysis of radiating structures and their environment, with an emphasis on use of, and improvements to, the moment method for EMC problems of antennas, power lines, and circuit boards.

1974-1981 Elder Engineering Inc. - Broadcast Consultant: Broadcast frequency allocation studies, related DOC briefs, AM broadcast phased array design, tune-up and pattern adjustment.

PAST RESEARCH PROJECTS: thesis work described above; microwave heating of food in microwave ovens (Alcan International Limited); circuit board radiation (University of Toronto and Bell Canada); lens antennas (University of Toronto); AM broadcast reradiation from buildings, towers and power lines (Ontario Hydro Corporation, Bell Cellular, DOC, CHUM Toronto); phased array antenna design (AM broadcast stations); cavity filter analysis (Til-Tek).

PAST PROFESSIONAL ENGINEERING PROJECTS: frequency allocation studies and engineering submissions to the DOC for AM, FM, and TV broadcast stations (CHUM and CHUM-FM Toronto, CFRA Ottawa); design of AM broadcast antenna tuning and phasing systems (CKEY Toronto, CFRA Ottawa); airborne measurements of FM broadcast antenna patterns (CHAY-FM Barrie); design of point-to-point radio links (CHYM Kitchener); assessment of radiation hazards to human health from transmitting antennas (City of Nepean); assessment of obstruction to transmitting antennas by nearby buildings and structures (City of Nepean).

EXAMPLES OF AM BROADCAST WORK AND REFERENCES:

- References at DOC, Ottawa: Mr. Doug Forde, Head, Spectrum Engineering; Mr. Jean-Marie Boilard, Head, AM Broadcast Engineering

- author of the Final Report of the Working Group on Reradiation Problems in AM Broadcasting (see partial list of reports)

- antenna adjustment and "Final Proof of Performance" submission to the DOC in 1979 for CFGM - Richmond Hill, Ontario (50 kW DA-2 1320 kHz); contact Mr. Bruce Carnegie, Chief Engineer, CHUM, (416) 926-4070 (formerly chief engineer for CFGM)

- antenna design in 1981 for CKEY - Toronto, Ontario (50 kW DA-1 590 kHz); contact Mr. Bill Onn, President, BES Electronics, (416) 624-5624 (formerly chief engineer for CKEY)

- antenna phasing system (feed system) design in 1984 for CKEY - Toronto, Ontario (50 kW DA-1 590 kHz); contact Mr. Bill Onn, President, BES Electronics, (416) 624-5624 (formerly chief engineer for CKEY)

- antenna adjustment and "Supplementary Proof of Performance" submission to the DOC in 1989 for CHUM - Toronto, Ontario (50 kW DA-2 1050 kHz); contact Mr. Bruce Carnegie, Chief Engineer, CHUM, (416) 926-4070 (formerly chief engineer for CFGM)

- "Engineering Brief for Change of Facilities" submission to the DOC in 1990 for CFRA - Ottawa, Ontario (50D/10N kW DA-2 580 kHz); contact Mr. George Roach, Director of Engineering, CFRA, (613) 738-2372

- phasing system design and specifications in 1990 for CFRA - Ottawa, Ontario (50D/10N kW DA-2 580 kHz); contact Mr. George Roach, Director of Engineering, CFRA, (613) 738-2372

PUBLICATIONS AND REPORTS CONTRIBUTED TO
(partial listing)

PUBLICATIONS:

[1] M.A. Tilston and K.G. Balmain, "A multiradius, reciprocal implementation of the thin-wire moment method", IEEE Trans. Antennas Propagat., vol. AP-38, no. 10 pp. 1636-1644, Oct. 1990.

[2] M.A. Tilston and K.G. Balmain, "On the suppression of asymmetric artifacts arising in an implementation of the thin-wire method of moments", IEEE Trans. Antennas Propagat., vol. AP-38, no. 2, pp. 281-285, Feb. 1990.

[3] M. Hilbert, M.A. Tilston and K.G. Balmain, "Resonance phenomena of logperiodic antennas: characteristic-mode analysis", IEEE Trans. Antennas Propagat., vol. AP-37, no. 10, pp. 1224-1234, Oct. 1989.

[4] M.A. Tilston and K.G. Balmain, "A microcomputer program for predicting AM broadcast reradiation from steel tower power lines", IEEE Trans. Broadcasting, vol. BC-30, no. 2, pp. 50-56, June 1984.

[5] M.A. Tilston and K.G. Balmain, "Medium frequency reradiation from a steel tower power line with and without a detuner", IEEE Trans. Broadcasting, vol. BC-30, no. 1, pp. 17-26, March 1984.

[6] M.A. Tilston and K.G. Balmain, "Medium frequency reradiation from an unstrung steel power line tower", IEEE Trans. Broadcasting, vol. BC-29, no. 3, pp. 93-100, September 1983.

[7] M.A. Tilston, S.E. Tilston and W.V. Tilston, "The coupling and decoupling of closely spaced antennas", Conference Record of the 33rd IEEE Vehicular Technology Conference, Toronto, Ontario, Canada, pp. 219-222, May 25-27, 1983.

REPORTS:

[1] M.A. Tilston, "Modification of a moment method electromagnetic analysis program to allow efficient use with an optimizer", Prepared for the Department of National Defence, Defence Research Establishment Ottawa, Shirley Bay, Ontario, under DSS contract no. W7714-8-5853/01-ST, March 30, 1990.

[2] M.A. Tilston, "Final report of the Working Group on Reradiation Problems in AM broadcasting", Prepared for the Department of Communications, Ottawa, Ontario, under DSS contract no. 36100-4-4195, July 12, 1985.

APPENDIX 4

ANALYSIS AND CONTOUR MAPS
NEAR AM BROADCAST STATIONS CHWO AND CJMR
AND THE NEARBY WEST OAK TRAILS DEVELOPMENT FOR
(1) SAFE BUILDING HEIGHTS
TO AVOID EXCESSIVE AM BROADCAST RERADIATION
AND HUMAN HEALTH HAZARD, AND
(2) ZONES OF INTERFERENCE TO RADIO-SENSITIVE EQUIPMENT

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February 22, 1993

TABLE OF CONTENTS

1. INTRODUCTION 1

2. CHWO AND CJMR BROADCAST ANTENNAS AND FIELDS 2

3. AM BROADCAST RERADIATION 4

4. SAFETY 5

5. INTERFERENCE TO RF DEVICES AND RADIO-SENSITIVE EQUIPMENT 5

6. SUMMARY 6

7. ENGINEER'S STAMP AND SIGNATURE 7

8. REFERENCES 7

TABLES 1 TO 4

FIGURES 1 TO 5

GLOSSARY

APPENDICES A TO B

AUTHOR'S CURRICULUM VITAE

1. INTRODUCTION

This report has been prepared for Golden Horseshoe Radio Network regarding their AM broadcast stations CHWO and CJMR, and the draft West Oak Trails Secondary Plan. It contains analyses and contour maps of maximum safe building heights in order to avoid excessive AM broadcast reradiation and to avoid exceeding the maximum limits recommended by Health and Welfare Canada, Safety Code 6, on AM broadcast electromagnetic exposure and contact current. It also defines contours within which there may be interference to radio-frequency (RF) receivers and radio-sensitive equipment. The general background and conclusions are given in a companion report [1]. That report introduces the following terminology.

An AM broadcast station radiates electromagnetic energy in the form of radio waves. When a wave strikes a building which contains wires, metal pipes and possibly steel beams and cables, part of the wave scatters in all directions. This scatter is called *reradiation*. The reradiation can be a problem if it is strong enough and it travels toward another AM station on or near the same frequency, causing interference to listeners of that station. If the problem cannot be remedied, the Department of Communications might require the offending station to reduce power or even to shut down, resulting in a great financial loss to the station, and the loss of a valuable service to the community. The problem can be avoided by placing restrictions on building heights near broadcast antennas.

Human *health and safety* are also issues near AM broadcast stations. Exposure to radio waves at AM broadcast frequencies is not a danger under normal circumstances described later. However, when touching dangling hoisting cables, for example, there can be a risk of excessive contact current, which may be described as a tingling sensation or low-level shock. Its danger is in the startle effect, which could trigger an accident. This problem too can be avoided by placing restrictions on building heights near AM broadcast antennas.

Interference to RF receivers (RF devices) and other electronic equipment (radio-sensitive equipment) can occur near AM broadcast stations. This is because strong radio waves induce unexpected currents in electronic circuits, e.g. computer memory chips, which can cause them to perform erratically. Critical electronic circuits involving safety are made to withstand strong radio signals, however many poor quality consumer products are not. This problem is not related to building height, but merely to proximity of any building (or electronic device) to an AM broadcast station. If a problem arises, it can often be remedied by modifying the electronic device, or by replacing it with one having better RF immunity. However, it is a problem that municipal planners should be aware of.

2. CHWO AND CJMR BROADCAST ANTENNAS AND FIELDS

Antenna descriptions, radiation patterns and field strength contour maps for CHWO and CJMR have been filed with the federal Department of Communications (DOC) by Elder Engineering Inc., excerpts of which are contained herein as Appendix A. Below is a summary of that data, along with an explanation of the field strength computations used herein.

CHWO operates on a frequency of 1250 kHz (wavelength of 239.8 m) with daytime and night-time 10 kW directional antenna patterns. CJMR operates on 1320 kHz (wavelength of 227.1 m) with daytime and night-time 20 kW directional antenna patterns. The antennas (arrays of towers) share the same towers and are located on the north side of Highway 5, just west of 16 Mile Creek, in the municipality of the Town of Oakville. This site will be referred to as the transmitter site.

The antenna radiation patterns mentioned above are plots of the field strength of the radio waves versus bearing from the antenna at distance of 1 km from the antenna. The patterns are plotted on polar graph paper with the radial coordinate representing field strength at 1 km from the array, and the azimuthal coordinate representing true bearing. In the standard radiation patterns, the far-field and perfect-ground-plane approximations are used, which result in the property that the field strength varies inversely with the distance from the antenna. Near the antenna, these approximations break down, and a more accurate "near field" analysis is required.

The field strength computations in this report use a near-field analysis along with a ground conductivity of 8 mS/m. This gives generally good agreement with available measured values. Some significant differences do occur near existing reradiators such as the two steel-tower power line corridors near the site, and near very rugged terrain such as the Sixteen Mile Creek ravine. In these latter cases, the effect is highly variable with location, and measurements are unreliable. It was explained in report [1] that these localized anomalies were impracticable to include in this analysis.

From predictions or measurements, contours of constant field strength, e.g. 1000 mV/m or 250 mV/m, can be plotted on a map. These are commonly referred to as field strength contour maps or service contour maps. Distances and bearings to contours tabulated herein are relative to a point midway between towers 3 and 4, although any other origin could have been used without changing the contour locations when plotted on a map.

Because of severe constraints on the siting of AM broadcast stations (coverage, interference, safety, and land availability), there are very limited opportunities for CHWO and CJMR to relocate.

3. AM BROADCAST RERADIATION

The following is based on the conclusions given in Section 3 of report [1].

Elder Engineering Inc. is the consulting firm responsible for designing and adjusting the CHWO and CJMR antenna patterns, and doing the "Proof of Performance" measurements required by the DOC. They were asked to determine what was the maximum amount of reradiation that could be tolerated from a building without causing interference to other radio stations, and without violating the DOC tolerances on radiation pattern. Those values are included as Appendix B, and are summarized below.

Pattern	Maximum Permissible Reradiation mV/m at 1 km from the Reradiator
CHWO Day	32
CHWO Night	20
CJMR Day	50
CJMR Night	12

The term *incident field* below means the field strength of the radio wave just before it strikes a building. Using these values and the graph of reradiation divided by incident field versus building height, given in Figure 2 of report [1], the maximum permissible incident field versus building height was computed for each of the four patterns above, and is graphed herein as Figures 1-1 and 1-2, and is tabulated in Table 1.

For any building height between 3 m and 24 m, and on any one of the four patterns given above, Table 1 was used to determine the maximum permissible incident electric field strength. The computed distance-to-contour values are given in Table 2. Only the worst case (largest distance) of the four patterns is shown at any particular bearing.

The resultant contours of maximum permissible building height in order to avoid excessive reradiation are plotted on a map in Figure 2. Ideally, linear interpolation would be used between the contours, but a simpler method may be necessary in practice, e.g. squared-off areas of constant building height restrictions.

4. SAFETY

Report [1] shows that the recommendations in Health and Welfare Canada's Safety Code 6 for RF exposure can be assumed to be met by the combined CHWO/CJMR field outside the transmitter site boundary. However, excessive RF contact current can arise, especially in the case where a metal hoisting cable is lowered from the top of a building to a person on the ground during construction or maintenance. Figure 4 of report [1] was used to determine the maximum permissible incident field of each station on buildings of various heights in order to avoid excessive combined RF contact current (specified in Safety Code 6 as 15 mA for other than RF workers). The results are plotted in Figure 3 and tabulated in Table 1.

The same procedure used in the previous section for reradiation was repeated here for safety values using the "health" columns in Table 1 for each of the four patterns in order to arrive at contours of maximum building height that would avoid excessive combined RF contact current. The results of the worst-case (maximum distance) values are tabulated in Table 3, and are plotted on a map in Figure 4.

5. INTERFERENCE TO RF DEVICES AND RADIO-SENSITIVE EQUIPMENT

The following is taken from Section 5 of report [1]. Critical equipment involving safety is unlikely to be adversely affected outside the transmitter site. The DOC is developing voluntary standards of RF immunity for non-critical electronic equipment that manufacturers should meet. One level that has been considered is 1.8 V/m. Unfortunately, there is insufficient statistical data on existing equipment, regarding the probability that a particular type of equipment will be adversely affected by a given field strength, to permit a quantitative assessment of the effects of CHWO and CJMR on electronic equipment.

However, based upon the available data, we can consider 1 V/m to be the primary interference contour in which almost all of the adverse effects will occur. The small remainder of the adverse effects would fall within the 250 mV/m contour, and would occur only on very poor quality equipment. The primary interference contour was computed for each of the four patterns. On any particular bearing and contour value, the worst-case (maximum distance) of the four patterns was taken, as tabulated in Table 4, and plotted on a map in Figure 5.

6. SUMMARY

Contour maps of maximum building height in order to avoid excessive reradiation and Safety Code 6 RF contact current have been computed and plotted (Figures 2 and 4 respectively). The primary and interference contour for RF devices and radio-sensitive equipment, regardless of building height, has been computed and plotted on a map (Figure 5). Either these maps or the corresponding numerical data (Tables 2, 3 and 4) should provide a basis for a planning expert to develop maps and procedures for use by municipal planners.

7. ENGINEER'S STAMP AND SIGNATURE

The undersigned is responsible for the contents of this report.

Mark A Tilston

REGISTERED PROFESSIONAL ENGINEER
M. A. TILSTON
PROVINCE OF ONTARIO

Feb 22/93

Mark A. Tilston, Ph.D., P.Eng.

member of the Canadian Association of Broadcast Consultants

8. REFERENCES

[1] M.A. Tilston Engineering, "A general procedure to compute contour maps of safe building heights in order to avoid excessive reradiation and human health hazard of AM broadcast stations", report for Golden Horseshoe Radio Network, February 22, 1993.

TABLE I

MAXIMUM PERMISSIBLE INCIDENT FIELD AT BUILDINGS NEAR CHWO AND CJMR

Building Height (m)	Maximum Permissible Incident Field (mV/m) In Order To Avoid Excessive Reradiation and RF Contact Current							
	CHWO Day		CHWO Night		CJMR Day		CJMR Night	
	Rerad	Health	Rerad	Health	Rerad	Health	Rerad	Health
3	45,000	10,000	27,000	10,000	70,000	9700	18,000	9700
6	15,000	5000	8300	5000	21,000	4800	5000	4800
9	7500	3100	4800	3100	11,000	3000	2800	3000
12	4700	2400	3000	2400	7000	2400	1700	2400
15	3200	1900	2000	1900	4900	1900	1200	1900
18	2400	1600	1600	1600	3600	1600	850	1600
21	1800	1300	1100	1300	2700	1300	650	1300
24	1600	1100	900	1100	2300	1100	550	1100

1993-01-06

TABLE 2-1

Building Height Restrictions Based Upon
CHWO and CJMR Day and Night Patterns Combined
Considering Reradiation

Distance to Contour:

Bearing	h=3m	h=6m	h=9m	h=12m	h=15m	h=18m	h=21m	h=24m
.000	.191	.670	1.150	1.805	2.447	3.273	4.073	4.648
5.000	.193	.705	1.210	1.896	2.566	3.425	4.255	4.851
10.000	.188	.716	1.230	1.926	2.605	3.475	4.314	4.917
15.000	.177	.701	1.205	1.889	2.557	3.413	4.240	4.834
20.000	.160	.658	1.135	1.784	2.419	3.236	4.028	4.597
25.000	.142	.591	1.024	1.614	2.196	2.949	3.681	4.209
30.000	.128	.505	.877	1.389	1.898	2.563	3.212	3.686
35.000	.121	.410	.707	1.124	1.544	2.098	2.646	3.047
40.000	.117	.325	.534	.841	1.158	1.585	2.013	2.330
45.000	.116	.269	.396	.580	.780	1.061	1.354	1.575
50.000	.115	.240	.323	.421	.513	.648	.848	.946
55.000	.115	.226	.293	.364	.478	.624	.813	.906
60.000	.114	.218	.282	.351	.458	.595	.772	.859
65.000	.113	.211	.276	.352	.436	.562	.726	.807
70.000	.111	.203	.268	.349	.432	.548	.678	.777
75.000	.110	.195	.256	.335	.419	.539	.671	.776
80.000	.110	.190	.244	.315	.389	.494	.609	.699
85.000	.120	.191	.240	.301	.363	.447	.536	.605
90.000	.136	.196	.242	.300	.355	.426	.497	.551
95.000	.144	.201	.248	.307	.362	.432	.500	.551
100.000	.080	.204	.254	.316	.375	.451	.526	.581
105.000	.070	.204	.255	.322	.386	.470	.554	.617
110.000	.064	.198	.251	.320	.387	.477	.569	.638
115.000	.060	.186	.238	.307	.375	.466	.559	.630
120.000	.056	.143	.218	.283	.347	.433	.521	.588
125.000	.053	.144	.194	.249	.305	.380	.457	.515
130.000	.051	.142	.184	.226	.273	.319	.376	.421
135.000	.050	.138	.178	.218	.263	.306	.359	.385
140.000	.050	.129	.169	.207	.249	.289	.338	.362
145.000	.050	.121	.157	.191	.230	.267	.313	.334
150.000	.050	.122	.145	.173	.207	.240	.283	.303
155.000	.050	.125	.140	.157	.181	.209	.248	.267
160.000	.050	.124	.137	.150	.164	.180	.208	.225
165.000	.050	.119	.133	.149	.172	.199	.224	.272
170.000	.050	.096	.130	.166	.197	.234	.270	.296
175.000	.050	.099	.139	.183	.220	.266	.309	.348
180.000	.050	.100	.145	.194	.237	.289	.339	.374
185.000	.050	.100	.148	.201	.247	.304	.358	.397
190.000	.050	.098	.146	.201	.251	.311	.369	.411
195.000	.050	.096	.141	.197	.249	.314	.378	.426
200.000	.050	.094	.134	.189	.244	.319	.395	.453
205.000	.051	.092	.127	.180	.241	.332	.429	.504
210.000	.054	.090	.120	.171	.245	.360	.481	.572
215.000	.055	.089	.120	.165	.259	.396	.532	.633
220.000	.056	.087	.118	.166	.280	.422	.563	.668
225.000	.057	.086	.115	.181	.295	.431	.567	.669
230.000	.057	.084	.111	.203	.300	.423	.547	.641
235.000	.056	.082	.110	.217	.299	.404	.512	.594
240.000	.054	.080	.138	.225	.294	.383	.474	.543
245.000	.052	.077	.160	.229	.288	.363	.439	.496

TABLE 2-2

250.000	.050	.075	.172	.231	.282	.346	.410	.458
255.000	.050	.072	.179	.230	.275	.331	.386	.427
260.000	.050	.137	.182	.228	.268	.317	.366	.402
265.000	.050	.059	.184	.224	.260	.305	.349	.383
270.000	.050	.050	.185	.220	.253	.296	.340	.373
275.000	.050	.050	.184	.218	.250	.296	.343	.378
280.000	.050	.159	.184	.219	.257	.309	.361	.400
285.000	.050	.160	.187	.231	.276	.333	.388	.437
290.000	.050	.163	.200	.253	.300	.358	.427	.491
295.000	.050	.173	.220	.274	.321	.377	.470	.540
300.000	.050	.191	.238	.291	.348	.400	.511	.586
305.000	.139	.204	.252	.306	.375	.431	.553	.636
310.000	.148	.214	.265	.324	.403	.466	.602	.696
315.000	.151	.224	.282	.355	.436	.518	.666	.776
320.000	.151	.237	.311	.414	.524	.683	.857	.993
325.000	.151	.258	.363	.521	.696	.945	1.207	1.406
330.000	.151	.293	.443	.676	.925	1.269	1.619	1.882
335.000	.154	.343	.552	.864	1.190	1.628	2.068	2.394
340.000	.160	.406	.677	1.071	1.472	2.004	2.533	2.920
345.000	.168	.477	.811	1.283	1.757	2.379	2.991	3.436
350.000	.177	.549	.941	1.485	2.026	2.730	3.417	3.916
355.000	.185	.616	1.057	1.664	2.262	3.035	3.786	4.328

TABLE 3-1

Building Height Restrictions Based Upon
CHWO and CJMR Day and Night Patterns Combined
Considering Health Hazard

Distance to Contour:

Bearing	h=3m	h=6m	h=9m	h=12m	h=15m	h=18m	h=21m	h=24m
.000	.356	.696	1.079	1.324	1.634	1.904	2.284	2.636
5.000	.372	.733	1.135	1.392	1.718	1.999	2.395	2.763
10.000	.375	.744	1.154	1.415	1.745	2.031	2.432	2.804
15.000	.365	.729	1.131	1.387	1.712	1.993	2.387	2.753
20.000	.340	.685	1.065	1.308	1.615	1.882	2.258	2.606
25.000	.303	.615	.960	1.180	1.460	1.704	2.048	2.368
30.000	.260	.525	.822	1.012	1.255	1.468	1.768	2.050
35.000	.231	.481	.760	.939	1.168	1.369	1.652	1.918
40.000	.238	.482	.756	.931	1.156	1.353	1.631	1.893
45.000	.241	.478	.743	.913	1.131	1.322	1.593	1.847
50.000	.242	.469	.722	.886	1.094	1.277	1.537	1.781
55.000	.240	.455	.694	.848	1.046	1.219	1.466	1.698
60.000	.236	.436	.659	.803	.988	1.150	1.380	1.597
65.000	.230	.413	.619	.751	.920	1.070	1.282	1.483
70.000	.221	.388	.573	.693	.846	.981	1.174	1.356
75.000	.211	.359	.524	.630	.767	.887	1.058	1.221
80.000	.200	.330	.473	.565	.684	.788	.938	1.080
85.000	.188	.300	.422	.500	.601	.689	.816	.937
90.000	.177	.271	.372	.437	.520	.592	.697	.796
95.000	.167	.246	.328	.379	.445	.504	.590	.671
100.000	.168	.225	.303	.359	.421	.476	.553	.627
105.000	.166	.223	.296	.348	.406	.456	.528	.595
110.000	.159	.224	.293	.342	.396	.443	.510	.573
115.000	.163	.225	.291	.338	.390	.435	.498	.558
120.000	.166	.225	.289	.334	.384	.427	.487	.544
125.000	.166	.224	.285	.328	.375	.417	.475	.529
130.000	.164	.220	.278	.319	.364	.403	.458	.510
135.000	.159	.212	.267	.306	.348	.385	.437	.485
140.000	.151	.201	.253	.289	.328	.362	.410	.455
145.000	.140	.186	.234	.267	.303	.334	.379	.420
150.000	.134	.168	.210	.240	.274	.303	.344	.382
155.000	.133	.154	.184	.209	.240	.267	.306	.343
160.000	.131	.148	.165	.180	.264	.301	.352	.401
165.000	.127	.142	.155	.263	.317	.364	.429	.491
170.000	.118	.135	.148	.156	.164	.171	.190	.234
175.000	.099	.127	.278	.336	.409	.472	.562	.648
180.000	.092	.184	.296	.361	.442	.512	.613	.708
185.000	.092	.187	.307	.377	.464	.541	.650	.753
190.000	.095	.184	.310	.383	.476	.557	.672	.782
195.000	.096	.176	.304	.380	.477	.560	.680	.793
200.000	.098	.166	.291	.369	.466	.552	.673	.788
205.000	.098	.158	.271	.349	.446	.532	.653	.767
210.000	.098	.155	.249	.323	.419	.502	.622	.735
215.000	.097	.158	.227	.295	.386	.467	.583	.692
220.000	.094	.159	.223	.268	.352	.428	.539	.644
225.000	.091	.158	.226	.273	.326	.392	.495	.595
230.000	.087	.156	.226	.276	.331	.379	.456	.550
235.000	.082	.151	.224	.275	.332	.381	.452	.519
240.000	.078	.145	.219	.271	.329	.380	.452	.520
245.000	.074	.137	.212	.265	.324	.375	.448	.517

TABLE 3-2

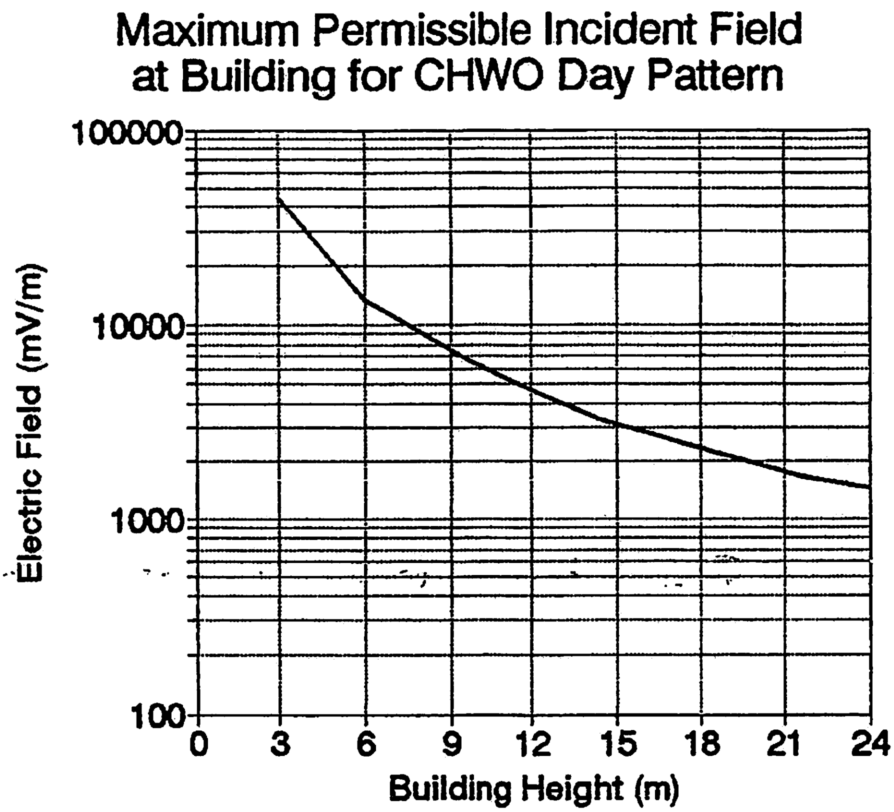
250.000	.070	.129	.203	.256	.316	.367	.441	.511
255.000	.067	.126	.193	.246	.305	.357	.431	.501
260.000	.064	.140	.183	.235	.294	.346	.420	.489
265.000	.063	.148	.179	.225	.283	.335	.409	.484
270.000	.063	.110	.180	.225	.288	.343	.423	.500
275.000	.064	.115	.187	.236	.300	.357	.440	.520
280.000	.065	.160	.196	.247	.314	.373	.459	.541
285.000	.067	.162	.207	.260	.329	.391	.480	.565
290.000	.142	.165	.219	.273	.345	.409	.502	.591
295.000	.142	.190	.246	.288	.363	.430	.526	.619
300.000	.158	.212	.271	.313	.382	.452	.553	.650
305.000	.172	.229	.292	.336	.404	.477	.584	.686
310.000	.182	.243	.311	.361	.428	.506	.619	.727
315.000	.188	.255	.332	.388	.456	.539	.660	.775
320.000	.193	.269	.357	.422	.497	.577	.707	.831
325.000	.198	.286	.390	.468	.558	.639	.763	.897
330.000	.203	.308	.432	.527	.638	.736	.879	1.015
335.000	.219	.354	.519	.632	.781	.914	1.106	1.288
340.000	.242	.420	.636	.780	.967	1.133	1.369	1.593
345.000	.271	.495	.761	.935	1.159	1.355	1.635	1.898
350.000	.302	.571	.882	1.084	1.343	1.568	1.888	2.186
355.000	.331	.640	.992	1.218	1.506	1.756	2.109	2.438

TABLE 4

Primary and Secondary Contours (1000 and 250 mV/m) of Interference to RF Devices and Radio-Sensitive Equipment for CHWO and CJMR Day and Night Patterns Combined

Distance to Contour (km):

Bearing degrees	1000 mV/m	250 mV/m	Bearing degrees	1000 mV/m	250 mV/m
.000	2.858	8.285	180.000	.769	2.537
5.000	2.994	8.601	185.000	.819	2.720
10.000	3.038	8.701	190.000	.851	2.849
15.000	2.983	8.573	195.000	.865	2.925
20.000	2.825	8.202	200.000	.861	2.949
25.000	2.570	7.592	205.000	.841	2.925
30.000	2.228	6.752	210.000	.807	2.861
35.000	2.087	6.412	215.000	.762	2.765
40.000	2.058	6.320	220.000	.712	2.647
45.000	2.008	6.169	225.000	.659	2.517
50.000	1.936	5.963	230.000	.610	2.385
55.000	1.844	5.702	235.000	.569	2.261
60.000	1.735	5.390	240.000	.564	2.152
65.000	1.610	5.029	245.000	.562	2.065
70.000	1.472	4.624	250.000	.555	2.004
75.000	1.325	4.181	255.000	.546	1.972
80.000	1.170	3.706	260.000	.534	1.968
85.000	1.014	3.207	265.000	.532	1.989
90.000	.859	2.698	270.000	.550	2.031
95.000	.723	2.245	275.000	.571	2.088
100.000	.673	2.044	280.000	.594	2.157
105.000	.638	1.891	285.000	.620	2.236
110.000	.613	1.782	290.000	.647	2.323
115.000	.596	1.703	295.000	.678	2.420
120.000	.581	1.637	300.000	.712	2.531
125.000	.564	1.572	305.000	.751	2.658
130.000	.543	1.496	310.000	.796	2.807
135.000	.516	1.407	315.000	.849	2.982
140.000	.484	1.308	320.000	.911	3.186
145.000	.446	1.206	325.000	.983	3.420
150.000	.406	1.119	330.000	1.103	3.703
155.000	.366	1.068	335.000	1.405	4.603
160.000	.432	1.383	340.000	1.735	5.499
165.000	.531	1.718	345.000	2.064	6.356
170.000	.294	2.029	350.000	2.375	7.131
175.000	.703	2.304	355.000	2.646	7.787


Maximum Permissible Incident Field
at Building for CHWO Day Pattern
Electric Field (mV/m)
100000
10000
1000
100
0
3
6
9
12
15
18
21
24
Building Height (m)

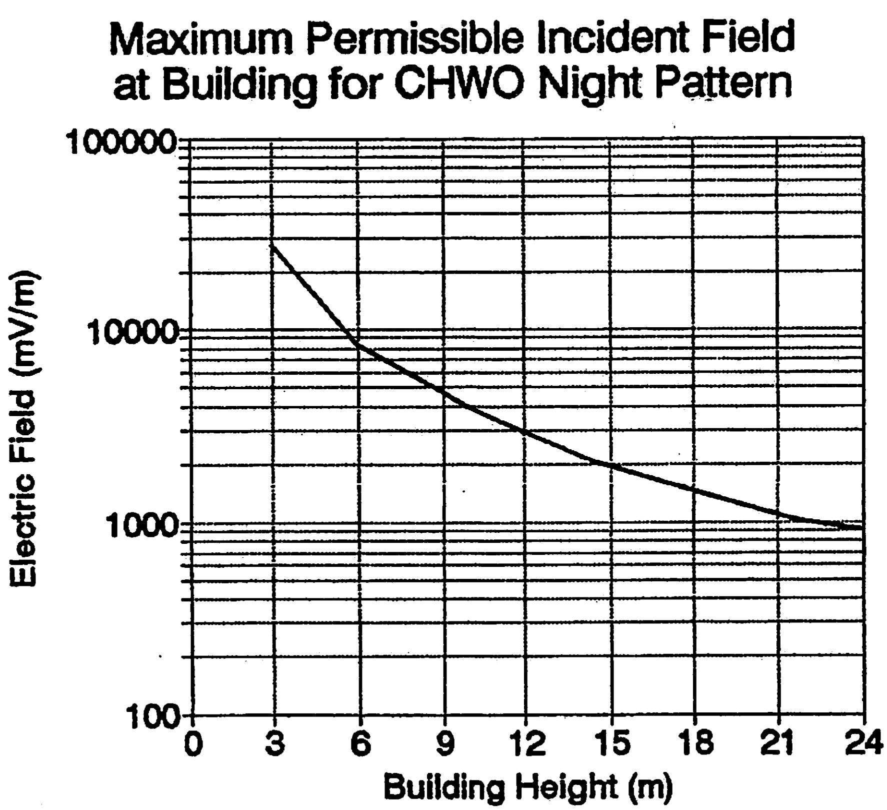
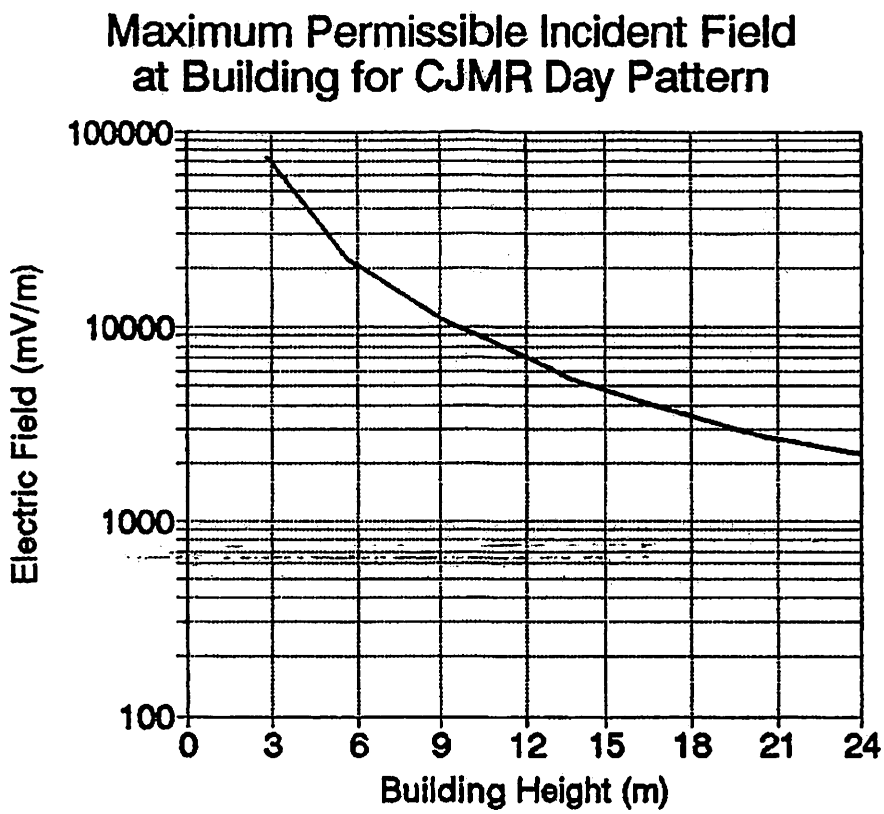

Maximum Permissible Incident Field
at Building for CHWO Night Pattern
Electric Field (mV/m)
100000
10000
1000
100
0
3
6
9
12
15
18
21
24
Building Height (m)

FIGURE 1-2


Maximum Permissible Incident Field
at Building for CJMR Day Pattern
Electric Field (mV/m)
100000
10000
1000
100
0
3
6
9
12
15
18
21
24
Building Height (m)

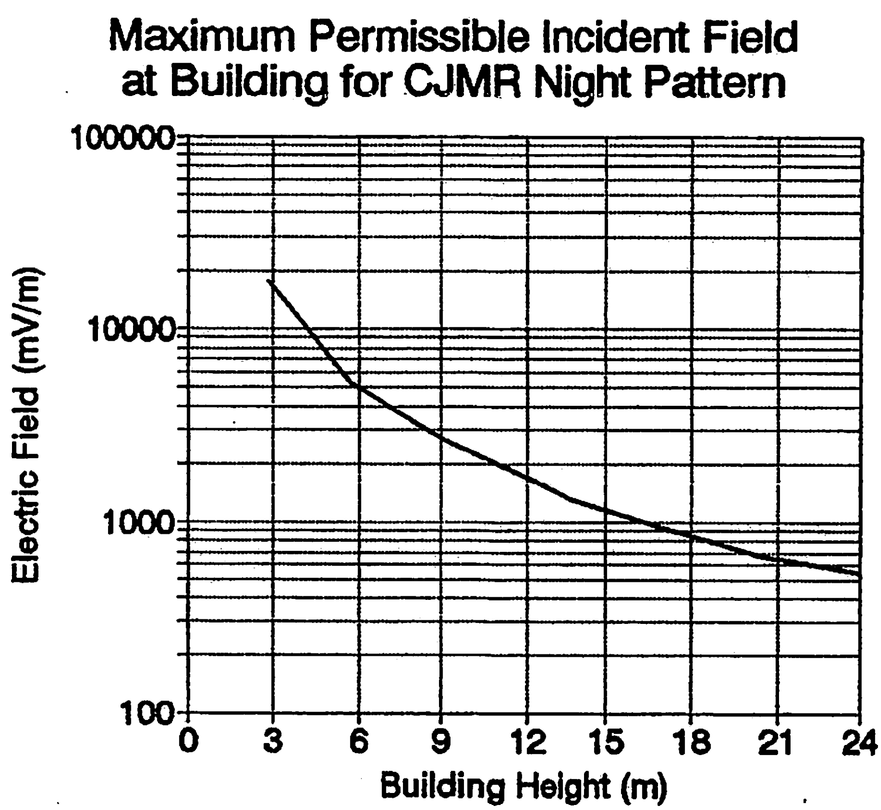
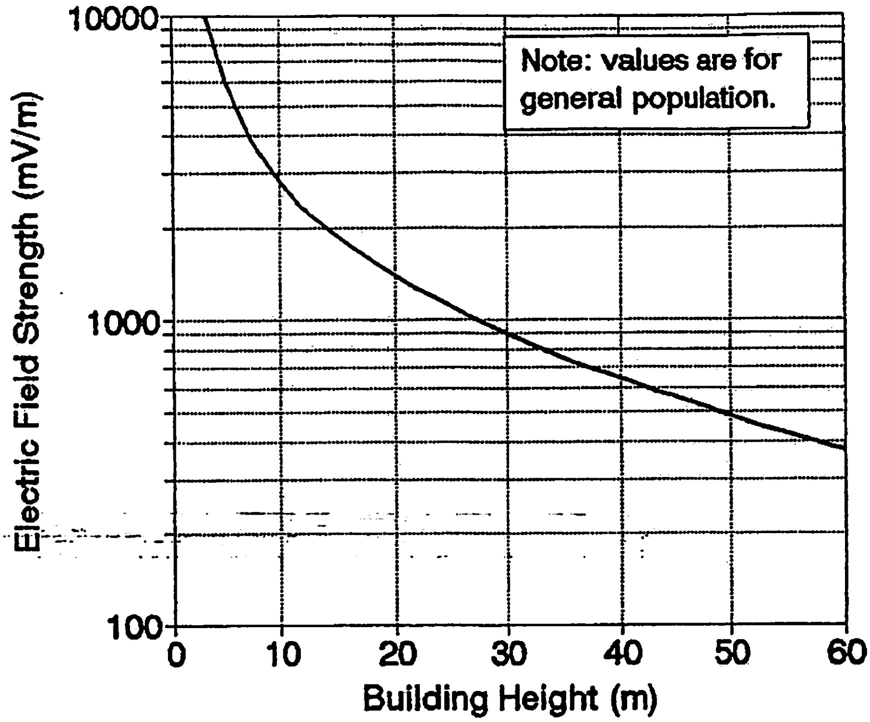
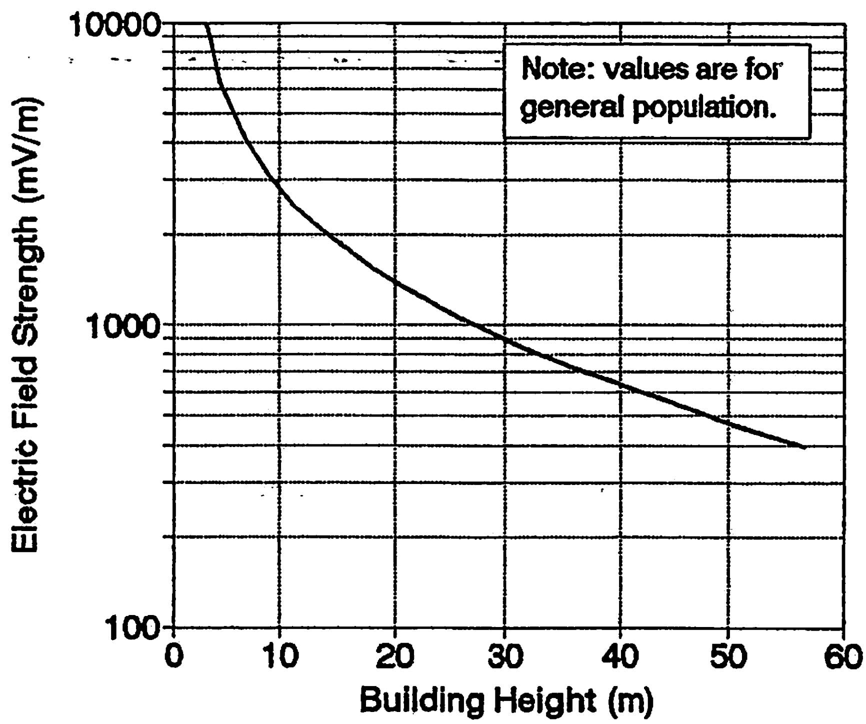

Maximum Permissible Incident Field
at Building for CJMR Night Pattern
Electric Field (mV/m)
100000
10000
1000
100
0
3
6
9
12
15
18
21
24
Building Height (m)

FIGURE 3

Maximum Incident Electric Field
from CHWO for Safe RF Contact Current



Maximum Incident Electric Field
from CJMR for Safe RF Contact Current



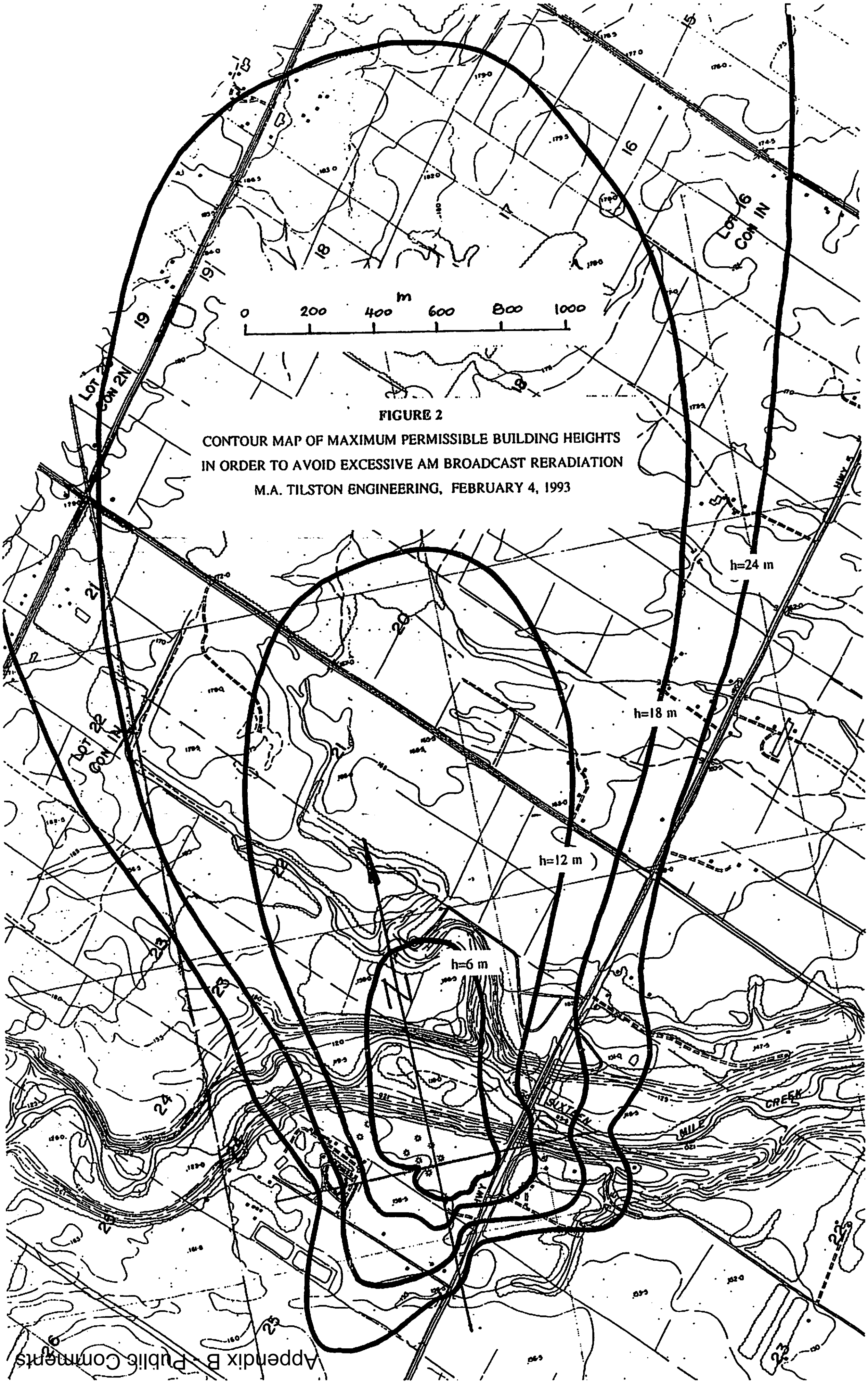


FIGURE 2

CONTOUR MAP OF MAXIMUM PERMISSIBLE BUILDING HEIGHTS
IN ORDER TO AVOID EXCESSIVE AM BROADCAST RERADIATION
M.A. TILSTON ENGINEERING, FEBRUARY 4, 1993

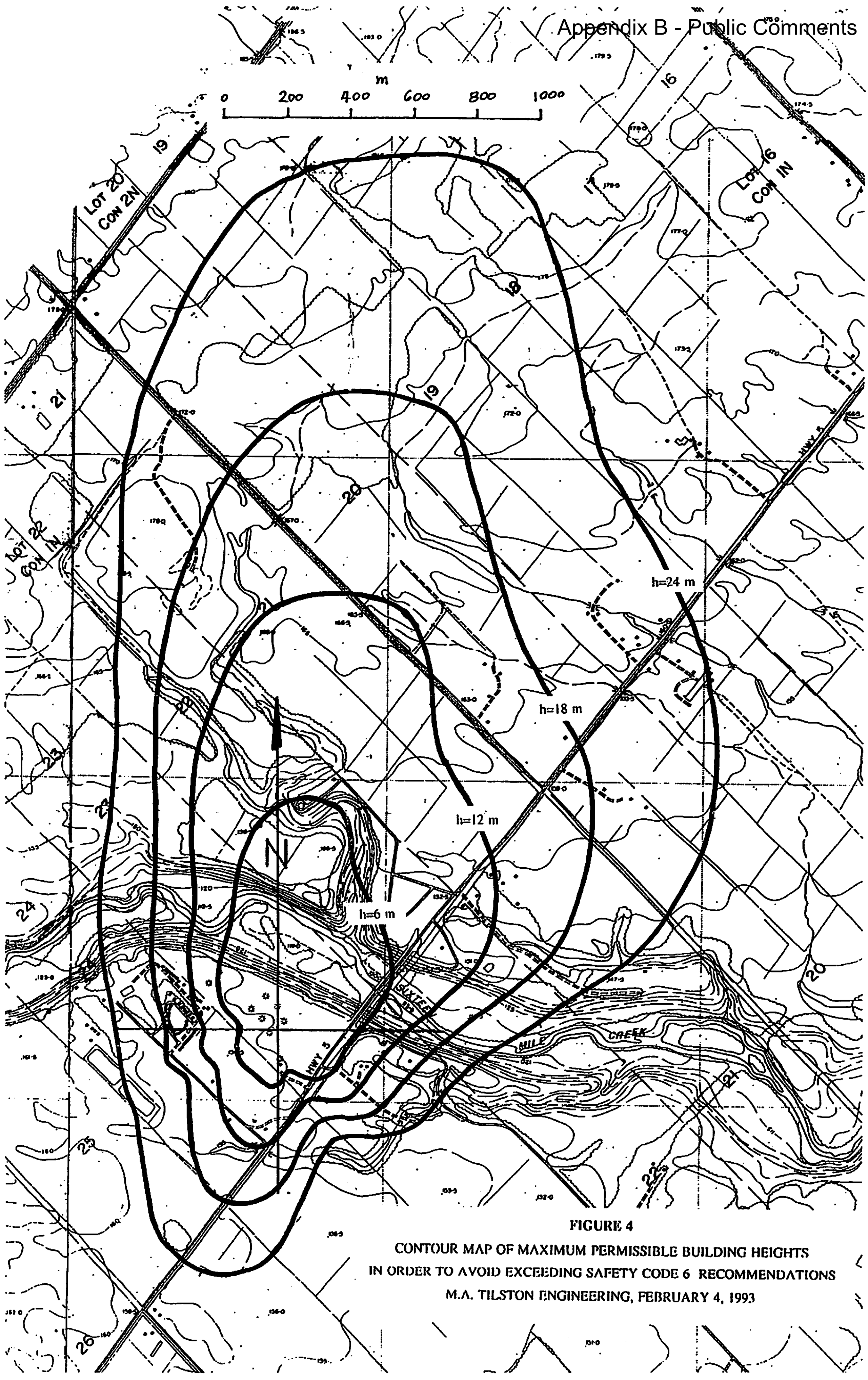
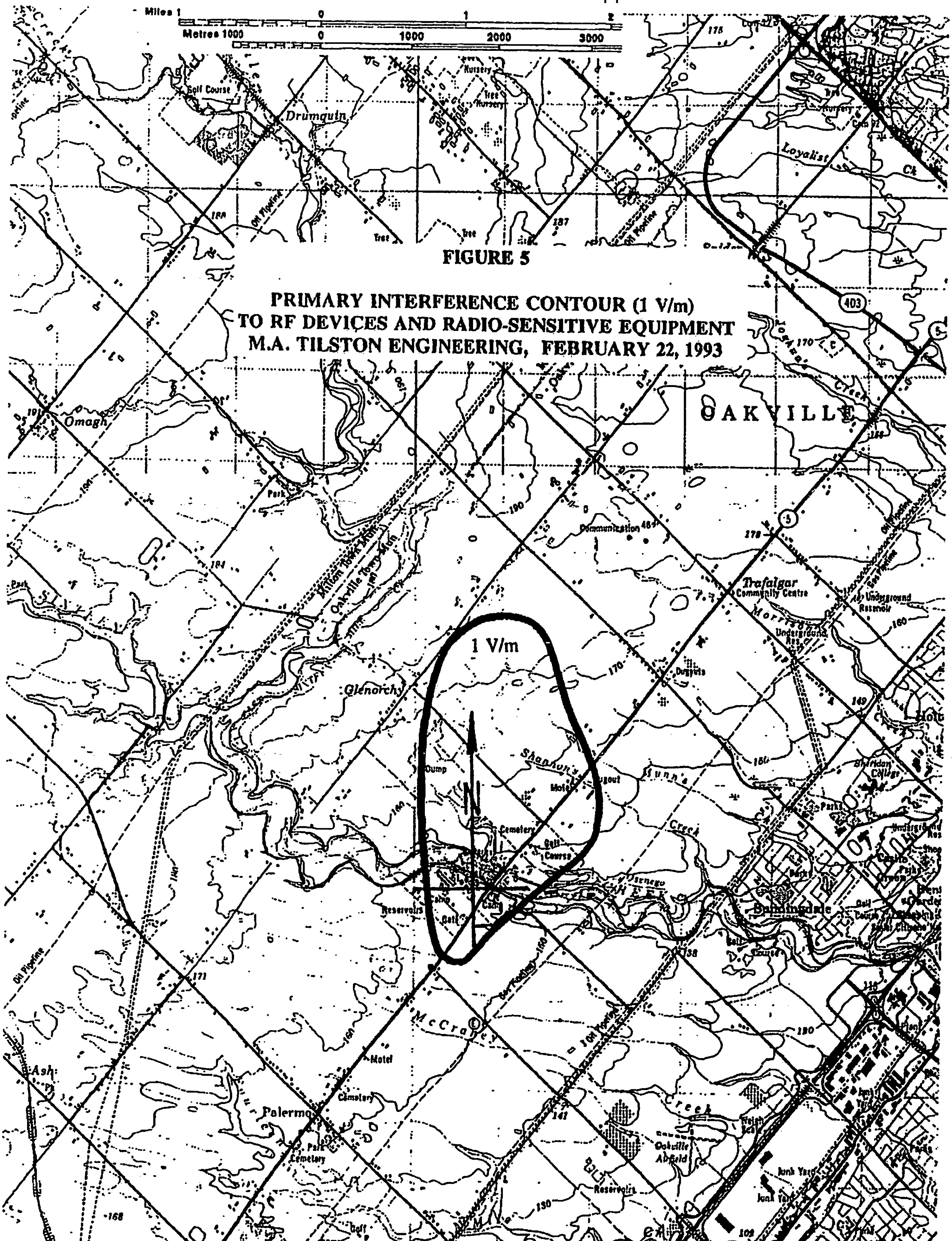


FIGURE 4

CONTOUR MAP OF MAXIMUM PERMISSIBLE BUILDING HEIGHTS
IN ORDER TO AVOID EXCEEDING SAFETY CODE 6 RECOMMENDATIONS
M.A. TILSTON ENGINEERING, FEBRUARY 4, 1993

FIGURE 5

PRIMARY INTERFERENCE CONTOUR (1 V/m) TO RF DEVICES AND RADIO-SENSITIVE EQUIPMENT M.A. TILSTON ENGINEERING, FEBRUARY 22, 1993



GLOSSARY OF TERMS
(Simplified)

λ or lambda. The symbol for *wavelength.*

Ω or ohms. A unit of impedance.

A/m or amperes per metre. A unit of *magnetic field* strength.

array, AM broadcast. A group of towers comprising an AM broadcast antenna.

contact current, RF. Electric current that passes through the skin when a metallic object is touched in the presence of an electromagnetic field at radio frequencies.

electric field. A field whose force upon a charged particle (e.g. electron) is independent of the particle velocity. The field is emitted by any electric current. The strength of the field is called electric field strength.

electromagnetic wave. A wave whose peaks and valleys correspond to positive and negative values of *electric* and *magnetic field* strength. Any alternating electric current produces outward travelling electromagnetic waves.

electromagnetic field. The combination of *electric* and *magnetic fields* that are emitted by any electric current.

exposure, RF. Exposure of the human body to an *electromagnetic field* at *radio frequencies.* Some of the field is absorbed by the body, thereby producing heat.

far field region. The region far enough away from an electric current that its *electromagnetic field* is primarily wave-like (see *electromagnetic wave*).

general population. Anyone other than an *RF worker.*

GHz or gigahertz. 1,000,000,000 (10^9) *Hz.*

ground conductivity. A measure of how conductive the ground is to electric current, measured in millisiemens per metre (mS/m).

human body impedance. The amount by which a human body resists the flow of electric current, measured in ohms (Ω).

Hz or hertz. A unit of frequency meaning cycles per second.

kHz or kilohertz. 1,000 *Hz.*

magnetic field. A field whose force upon a charged particle (e.g. electron) is proportional to the particle velocity. The field is emitted by any electric current. The strength of the field is called magnetic field strength.

MBC. A *moment method program* by Tilston and Balmain.

MHz or megahertz. 1,000,000 *Hz.*

moment method program. A computer program used to compute electric currents in objects and their resultant *electromagnetic fields.*

near field region. The region near an electric current in which its *electromagnetic field* is only partially wave-like.

NEC. A *moment method program* by Burke and Poggio.

radio wave. An *electromagnetic wave* at *radio frequencies.*

radio-sensitive equipment. Electronic equipment that unintentionally reacts to strong electric currents or *electromagnetic fields* at *radio frequencies* (e.g. a VCR).

reradiation. The part of a wave that is scattered in all directions when an *electromagnetic wave* strikes an object containing metal.

RF device. A device that is intended to manipulate electric currents or *electromagnetic fields* at *radio frequencies* (e.g. a radio receiver).

RF or radio frequency. Any frequency that is useful for communication through *electromagnetic waves* and antennas, presently 10 kHz to 300 GHz.

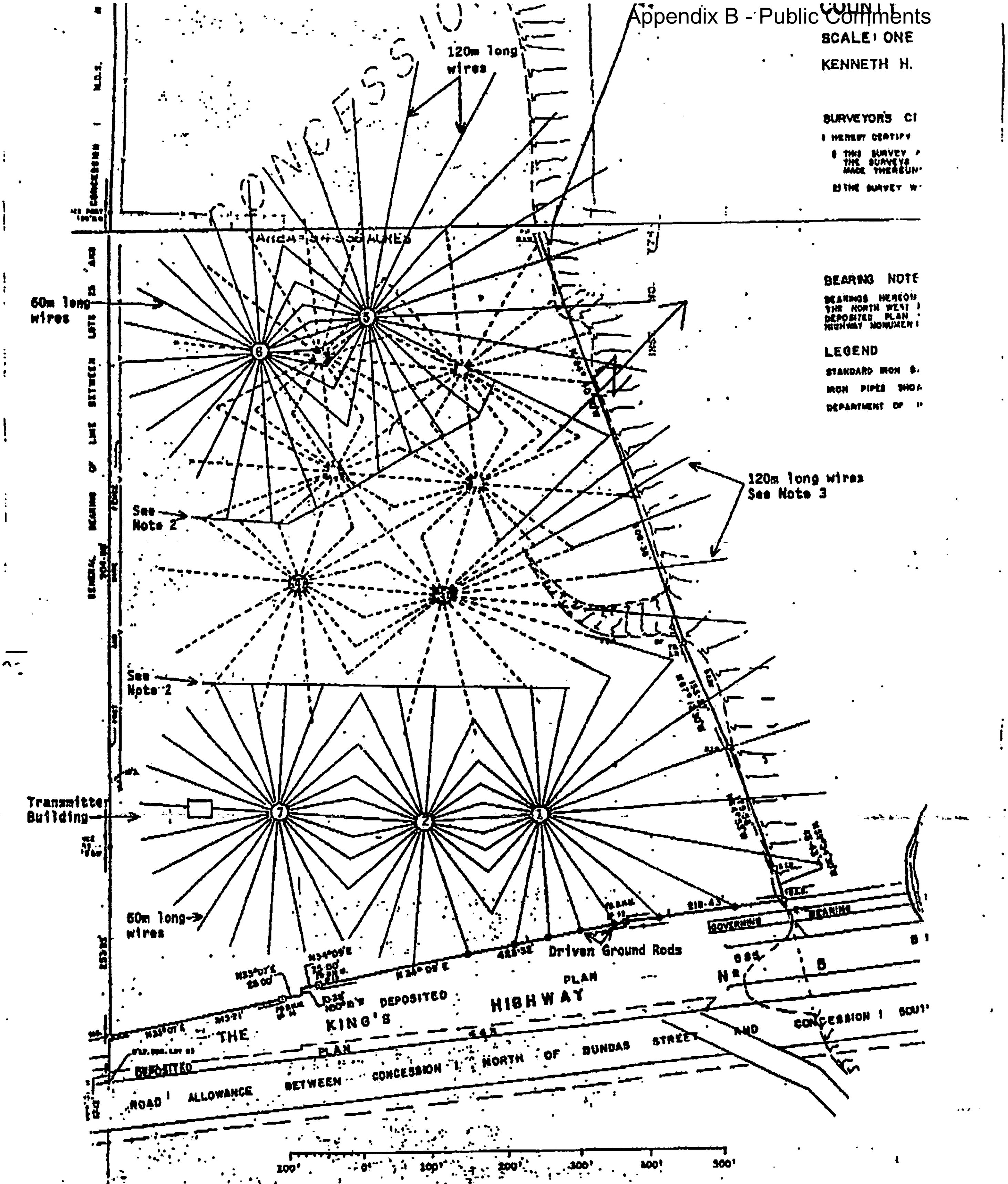
RF worker. A worker who is aware of the possible dangers of RF *exposure and contact current* within his particular job situation.

V/m or volts per metre. A unit of *electric field* strength.

wavelength. The distance between two adjacent peaks of an *electromagnetic wave.* In air, it can be computed in metres by dividing 299,800 by the frequency in *kHz.*

APPENDIX A

CURRENT CHWO/CJMR DATA OBTAINED FROM ELDER ENGINEERING INC.



NOTES:

1 - GROUND SYSTEM TO CONSIST OF 120 RADIALS PER TOWER, #10 AWG COPPER, BURIED APPROXIMATELY 20cm, LENGTH UP TO 120m (0.5 λ) NORTHERLY UNDER MAJOR LOBE, 60 m (0.25 λ) ELSEWHERE.

2 - NEW GROUND WIRES (——) TO BE CONNECTED TO OLD GROUND WIRES (---) ALONG THIS LINE. A COMMON CORD MAY BE USED TO CONNECT THEM.

CHWO/CJMR OAKVILLE, ONTARIO

REVISED SKETCH OF SITE

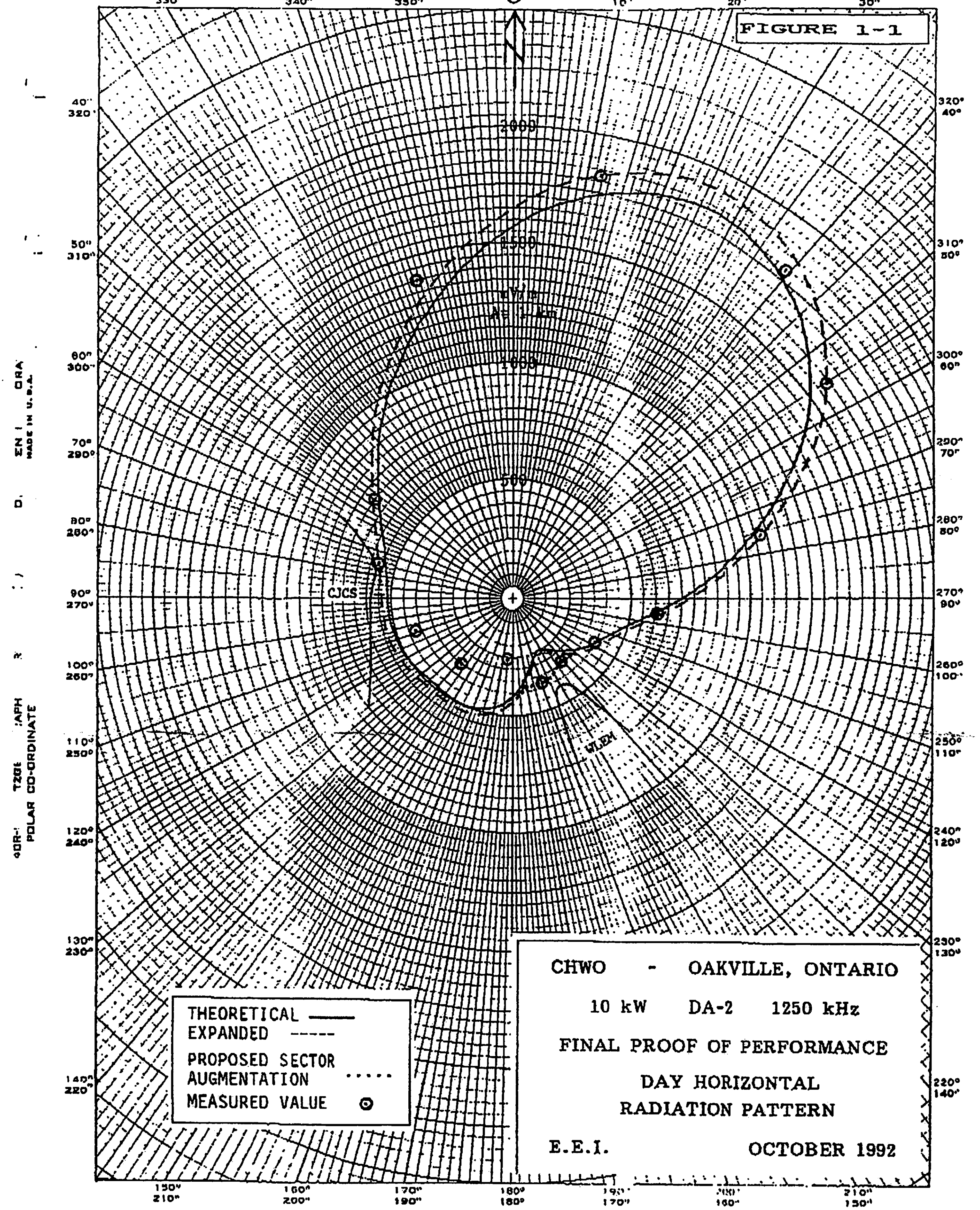


FIGURE 1-1
2000
1500
1000
500
CJCS
WLEM
POLAR CO-ORDINATE
THEORETICAL
EXPANDED
PROPOSED SECTOR AUGMENTATION
MEASURED VALUE
CHWO - OAKVILLE, ONTARIO
10 kW DA-2 1250 kHz
FINAL PROOF OF PERFORMANCE
DAY HORIZONTAL RADIATION PATTERN
E.E.I. OCTOBER 1992

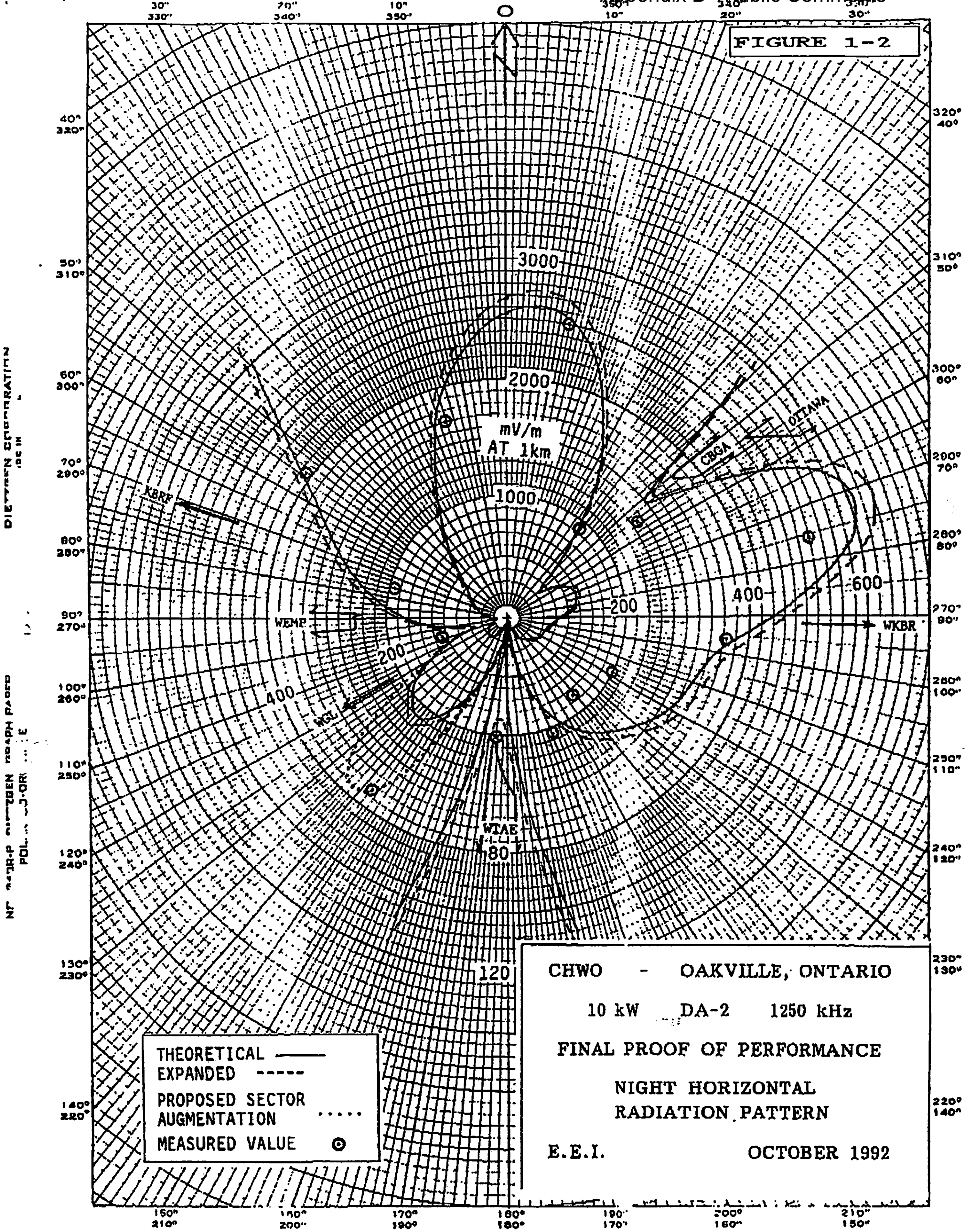
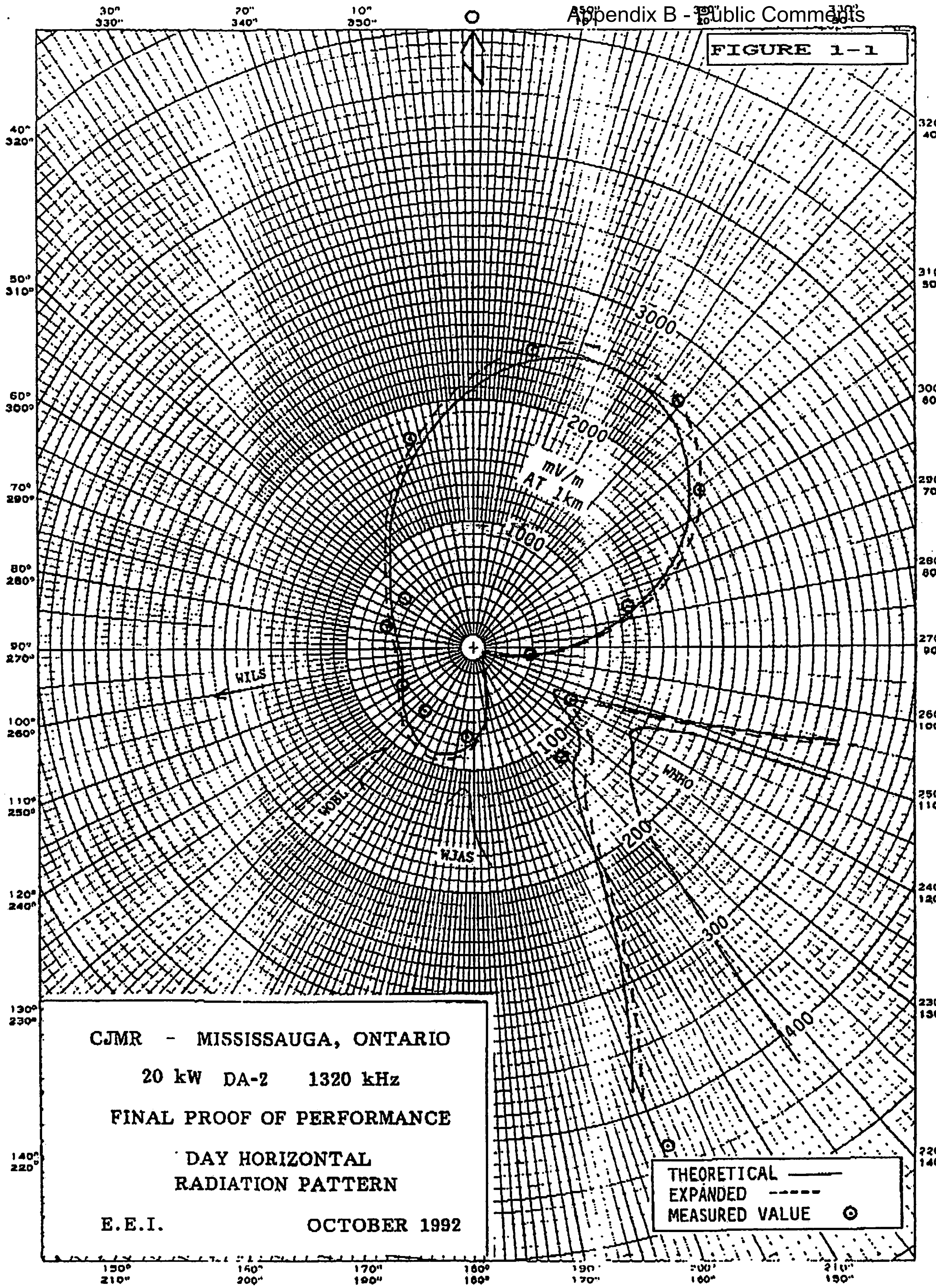


FIGURE 1-2
mV/m
AT 1km
3000
2000
1000
600
400
200
120
80
KBRF
WEMP
WKBR
WGL
WTAE
CBGA
OTTAWA
THEORETICAL
EXPANDED
PROPOSED SECTOR AUGMENTATION
MEASURED VALUE
CHWO - OAKVILLE, ONTARIO
10 kW DA-2 1250 kHz
FINAL PROOF OF PERFORMANCE
NIGHT HORIZONTAL
RADIATION PATTERN
E.E.I.
OCTOBER 1992



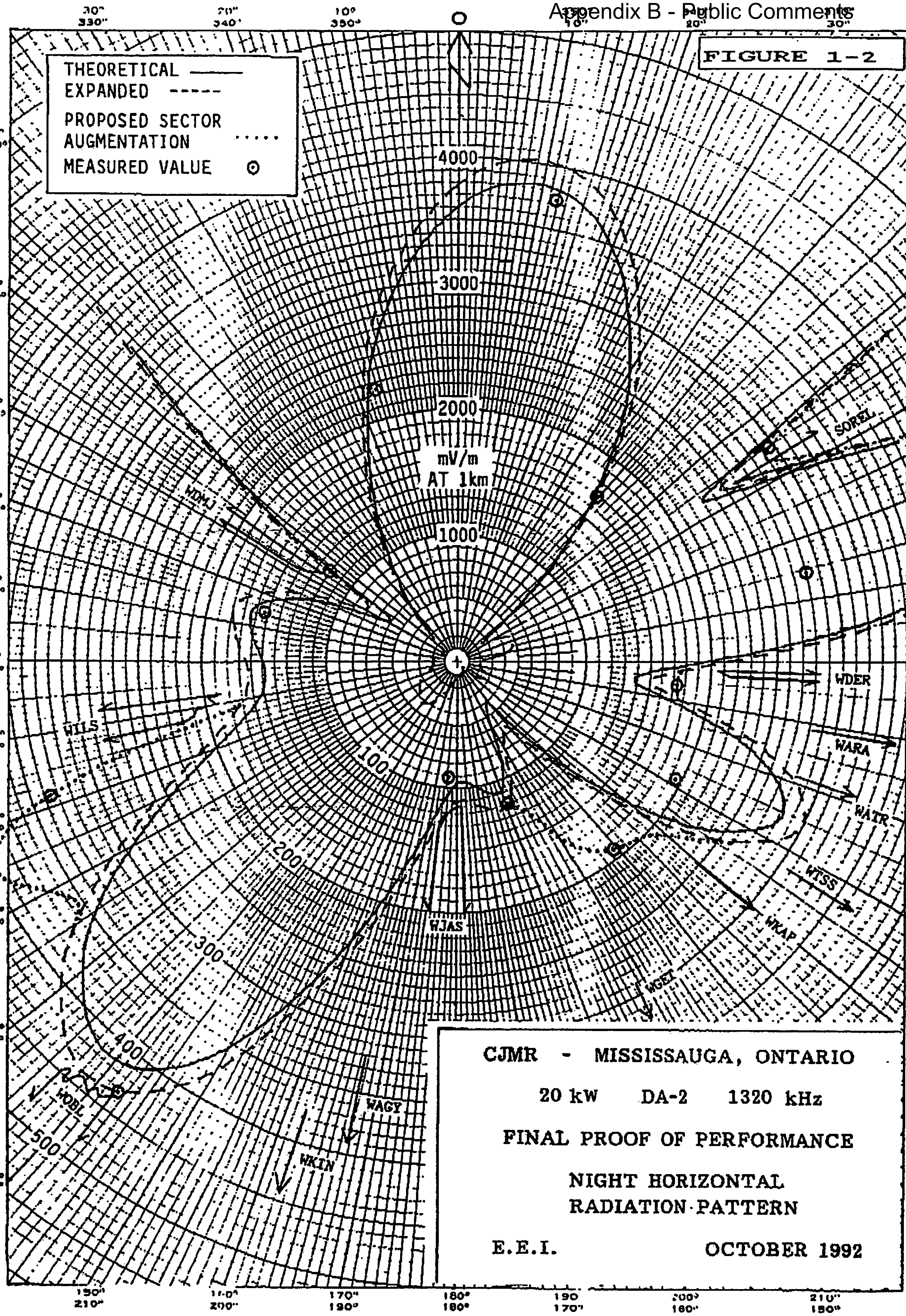
CJMR - MISSISSAUGA, ONTARIO

20 kW DA-2 1320 kHz

FINAL PROOF OF PERFORMANCE

DAY HORIZONTAL
RADIATION PATTERN

E.E.I. OCTOBER 1992



CJMR - MISSISSAUGA, ONTARIO

20 kW DA-2 1320 kHz

FINAL PROOF OF PERFORMANCE

NIGHT HORIZONTAL RADIATION PATTERN

E.E.I. OCTOBER 1992

GRAM FIELD - REVISION 1.1 DECEMBER 1987
-14-1992 16:14:00

HWO DAY

ODIFIED RADIATION

AUG RAD @ BRG D.	mV/m 1km	BRG (DEG)	SPAN (DEG)	AUG RAD @ BRG NO.	mV/m 1km	BRG (DEG)	SPAN (DEG)	AUG RAD @ BRG NO.	mV/m 1km	BRG (DEG)	SPA (DEG
1	377.00	155.0	45.0								

TOWER NUMBER	ON PLOT	HEIGHT DEGREES	SPACING DEGREES	BEARING DEGREES	FIELD RATIO	PHASE DEGREES
1	7	90.000	90.000	230.000	1.600	0.000
2	2	90.000	0.000	0.000	1.400	-81.000
3	3	90.000	143.999	319.992	0.400	-136.000
4	4	90.000	169.812	287.995	1.400	-55.000

DG

Q FACTOR = 3.2212 %

CALED TO RMS OF 951.12 MV/M AT 1 KM
CALE FACTOR = 380.9754
RSS = 981.7049 MV/M
SS/RMS = 1.032157

SINGLE POINTS

BEARING DEGREES	ELEVATION DEGREES	FIELD MV/M @1KM	MEASURED FIELD MV/M @1KM
11.80	0.00	1823.20	1820
39.50	0.00	1853.20	1790
55.20	0.00	1591.59	1590
75.70	0.00	1078.16	1070
96.30	0.00	622.40	610
118.60	0.00	422.79	400
140.90	0.00	340.13	340
159.40	0.00	379.75	380
184.70	0.00	476.88	260
217.80	0.00	520.57	350
251.50	0.00	544.76	420
284.60	0.00	574.03	570
305.80	0.00	719.58	700
343.50	0.00	1317.79	1400

 TABLE 1-2

GRAM FIELD - REVISION 1.1 DECEMBER 1987
-14-1992 19:14:41

HWO NIGHT

ODIFIED RADIATION

AUG RAD @ BRG O.	mV/m 1km	BRG (DEG)	SPAN (DEG)	AUG RAD @ BRG NO.	mV/m 1km	BRG (DEG)	SPAN (DEG)	AUG RAD @ BRG NO.	mV/m 1km	BRG (DEG)	SPA (DEG
1	385.00	222.0	40.0	2	105.00	251.0	20.0				

TOWER NUMBER	HEIGHT DEGREES	SPACING DEGREES	BEARING DEGREES	FIELD RATIO	PHASE DEGREES
1	90.000	70.663	41.080	67.400	46.400
2	90.000	0.000	0.000	65.900	159.200
3	90.000	143.999	319.992	100.000	0.000
4	90.000	169.812	287.995	88.200	111.100
5	90.000	320.928	308.920	103.700	-75.900
6	90.000	315.265	296.500	100.600	35.400

FACTOR = 2.658 %

SCALED TO RMS OF 960 MV/M AT 1 KM
PCALE FACTOR = 5.456988
1 3S = 1189.809 MV/M
kSS/RMS = 1.239385

JINGLE POINTS

BEARING DEGREES	ELEVATION DEGREES	FIELD MV/M @1KM	MEASURED FIELD MV/M @1KM
11.80	0.00	2677.69	2500
39.50	0.00	920.20	920
55.20	0.00	371.75	270
75.70	0.00	631.54	520
96.30	0.00	397.53	365
118.60	0.00	334.91	200
140.90	0.00	270.01	170
.59.40	0.00	182.27	210
84.70	0.00	34.36	41
217.80	0.00	369.53	370
251.50	0.00	105.14	105
84.60	0.00	280.37	190
305.80	0.00	454.24	~~380~~ 410
343.50	0.00	1930.73	1700

GRAM FIELD - REVISION 1.1 DECEMBER 1987
-14-1992 16:09:13

4R DAY

OVISIONAL RULE 16 EXPANDED RADIATION

TOWER JMBER	PLOT	HEIGHT DEGREES	SPACING DEGREES	BEARING DEGREES	FIELD RATIO	PHASE DEGREES
1	1	95.040	95.040	230.000	70.300	112.500
2	2	95.040	0.000	0.000	147.300	33.100
3	3	95.040	152.063	319.992	100.000	0.000
4	4	95.040	179.321	287.995	118.000	52.700

FACTOR = 3.357 %

CALED TO RMS OF 1270 MV/M AT 1 KM
ALE FACTOR = 5.924744
LJ = 1332.256 MV/M
SS/RMS = 1.04902

SINGLE POINTS

ARING DEGREES	ELEVATION DEGREES	FIELD MV/M @1KM	MEASURED FIELD MV/M @1KM
1.80	0.00	2457.37	2450
39.50	0.00	2564.75	2560
55.20	0.00	2205.20	2190
5.70	0.00	1428.67	1280
6.30	0.00	596.37	488
118.60	0.00	90.90	90
140.90	0.00	141.18	115
1 9.40	0.00	382.05	432
1?4.70	0.00	860.17	720
217.80	0.00	894.85	640
2 1.50	0.00	647.31	640
2 4.60	0.00	707.96	704
305.80	0.00	877.51	672
3 3.50	0.00	1664.97	1760

RAM FIELD - REVISION 1.1 DECEMBER 1987
14-1992 14:20:38

HR NIGHT

ODIFIED RADIATION

AUG NO.	RAD @ BRG mV/m 1km	BRG (DEG)	SPAN (DEG)	AUG NO.	RAD @ BRG mV/m 1km	BRG (DEG)	SPAN (DEG)	AUG NO.	RAD @ BRG mV/m 1km	BRG (DEG)	SPAN (DEG)
1	296.00	57.5	12.0	3	190.50	142.0	35.0				
2	173.00	96.0	10.0	4	393.40	247.0	26.0				

TOWER NUMBER	HEIGHT DEGREES	SPACING DEGREES	BEARING DEGREES	FIELD RATIO	PHASE DEGREES
1	95.040	74.620	41.080	61.000	50.100
2	95.040	0.000	0.000	72.900	157.900
3	95.040	152.063	319.992	100.000	0.000
4	95.040	179.321	287.995	90.400	114.500
5	95.040	338.900	308.920	58.800	-60.000
6	95.040	332.920	296.500	67.200	51.400

Q FACTOR = 2.5814 %

SCALED TO RMS OF 1350 MV/M AT 1 KM
S ALE FACTOR = 9.2365
RSS = 1732.449 MV/M
RSS/RMS = 1.283296

SINGLE POINTS

EARING DEGREES	ELEVATION DEGREES	FIELD MV/M @1KM	MEASURED FIELD MV/M @1KM
11.80	0.00	4013.56	3730
39.50	0.00	1697.00	1680
55.20	0.00	296.08	296
75.70	0.00	500.78	280
96.30	0.00	172.99	173
118.60	0.00	293.21	194
40.90	0.00	191.99	192
59.40	0.00	122.96	120
184.70	0.00	120.96	91
217.80	0.00	434.16	432
51.50	0.00	336.03	336
84.60	0.00	174.06	152
305.80	0.00	124.36	120
43.50	0.00	2449.65	2240

APPENDIX B

MAXIMUM TOLERABLE RERADIATION OF CHWO AND CJMR DETERMINED BY ELDER ENGINEERING INC.

From : P01

M.A. Tilston Engineering
90 Lawrence Avenue East/ Toronto, Ontario/ Canada M4N 1S6
Tel. (416) 488-1938 Fax. (416) 488-0429

FAX MEMO

To: Gordon Elder, Stewart Hahn
Company: Elder Engineering Inc.
Fax no: (416) 833-2101

Date: November 20, 1992
From: Mark Tilston
Pages: (including this one) 1

Re: CHWO Oakville and CJMR Mississauga

Michael Caine has asked me to study the proposed development called the West Oak Trails Secondary Plan, which includes a high density zoning located across Dundas Street from the transmitter site.

I will need to propose to the municipality maximum safe building heights to avoid excessive reradiation and touch potential of metallic structures.

I want to make sure that the reradiation does not exceed what you feel comfortable with regarding tuning up the array and meeting protection requirements. Could you please fill in the blanks below and add any additional information that seems relevant.

A = Worst case protection requirement
B = Maximum permissible reradiation

D/N	From Call	To Call	Brg.	Elev.	A 1 km-mV/m	B 1 km-mV/m	Q
D	CHWO	CJCS	282°	---	570	32	31.6
N	CHWO	WTAE	182°	31°	41.6	20	31.6
D	CJMR	WHHO	119°	---	143	50	44.7
N	CJMR	WDER	92°	14°	227	16	44.7
		WJAS	183°	31°	44.2	30	
		WOBL	218°	30°	79.2	18	
		WILS	260°	26°	117.5	12	
		WDMJ	302°	14°	173	32	

Filled in by Elder Engin. Inc., Nov 20/92

antenna analysis
reradiation studies
software development

M. A. TILSTON ENGINEERING

AM FM TV broadcasting
frequency allocation
engineering briefs

90 Lawrence Avenue E./ Toronto, Ontario/ Canada M4N 1S6
tel. (416) 488-1938

CURRICULUM VITAE

Mark A. Tilston, Ph.D., P.Eng
(February 1993)

EDUCATION:

Ph.D. University of Toronto, Department of Electrical Engineering, 1989, thesis title "Thin-Wire Reciprocal Multiradius Implementation of the Electromagnetic Moment Method".

M.Eng. University of Toronto, Department of Electrical Engineering, 1983, thesis title "AM Broadcast Reradiation from Steel Tower Power Lines".

B.A.Sc. University of Toronto, Department of Electrical Engineering, 1974, thesis title "UHF TV Receiving Antennas - Swept Frequency Testing".

The theses included antenna measurements, physical scale modelling of scattering structures, moment-method analysis of antennas and scattering structures, and fundamental improvements to moment-method formulation and implementation.

PROFESSIONAL QUALIFICATIONS: professional engineer since 1976 (APEO), currently designated consulting engineer (APEO).

EMPLOYMENT HISTORY:

1982- M.A. Tilston Engineering (formerly M.A. Tilston, P.Eng.) - Consultant: AM, FM and TV broadcast antenna consulting involving interference and compatibility, biological hazards, system design, coverage, frequency allocation, and DOC applications.

1982- University of Toronto - Research Assistant to Prof. K.G. Balmain: Electromagnetic analysis of radiating structures and their environment, with an emphasis on use of, and improvements to, the moment method for EMC problems of antennas, power lines, and circuit boards.

1974-1981 Elder Engineering Inc. - Broadcast Consultant: Broadcast frequency allocation studies, related DOC briefs, AM broadcast phased array design, tune-up and pattern adjustment.

PAST RESEARCH PROJECTS: thesis work described above; microwave heating of food in microwave ovens (Alcan International Limited); circuit board radiation (University of Toronto and Bell Canada); lens antennas (University of Toronto); AM broadcast reradiation from buildings, towers and power lines (Ontario Hydro Corporation, Bell Cellular, DOC, CHUM Toronto); phased array antenna design (AM broadcast stations); cavity filter analysis (Til-Tek).

PAST PROFESSIONAL ENGINEERING PROJECTS: frequency allocation studies and engineering submissions to the DOC for AM, FM, and TV broadcast stations (CHUM and CHUM-FM Toronto, CFRA Ottawa); design of AM broadcast antenna tuning and phasing systems (CKEY Toronto, CFRA Ottawa); airborne measurements of FM broadcast antenna patterns (CHAY-FM Barrie); design of point-to-point radio links (CHYM Kitchener); assessment of radiation hazards to human health from transmitting antennas (City of Nepean); assessment of obstruction to transmitting antennas by nearby buildings and structures (City of Nepean).

EXAMPLES OF AM BROADCAST WORK AND REFERENCES:

- References at DOC, Ottawa: Mr. Doug Forde, Head, Spectrum Engineering; Mr. Jean-Marie Boilard, Head, AM Broadcast Engineering

- author of the Final Report of the Working Group on Reradiation Problems in AM Broadcasting (see partial list of reports)

- antenna adjustment and "Final Proof of Performance" submission to the DOC in 1979 for CFGM - Richmond Hill, Ontario (50 kW DA-2 1320 kHz); contact Mr. Bruce Carnegie, Chief Engineer, CHUM, (416) 926-4070 (formerly chief engineer for CFGM)

- antenna design in 1981 for CKEY - Toronto, Ontario (50 kW DA-1 590 kHz); contact Mr. Bill Onn, President, BES Electronics, (416) 624-5624 (formerly chief engineer for CKEY)

- antenna phasing system (feed system) design in 1984 for CKEY - Toronto, Ontario (50 kW DA-1 590 kHz); contact Mr. Bill Onn, President, BES Electronics, (416) 624-5624 (formerly chief engineer for CKEY)

- antenna adjustment and "Supplementary Proof of Performance" submission to the DOC in 1989 for CHUM - Toronto, Ontario (50 kW DA-2 1050 kHz); contact Mr. Bruce Carnegie, Chief Engineer, CHUM, (416) 926-4070 (formerly chief engineer for CFGM)

- "Engineering Brief for Change of Facilities" submission to the DOC in 1990 for CFRA - Ottawa, Ontario (50D/10N kW DA-2 580 kHz); contact Mr. George Roach, Director of Engineering, CFRA, (613) 738-2372

- phasing system design and specifications in 1990 for CFRA - Ottawa, Ontario (50D/10N kW DA-2 580 kHz); contact Mr. George Roach, Director of Engineering, CFRA, (613) 738-2372

PUBLICATIONS AND REPORTS CONTRIBUTED TO

(partial listing)

PUBLICATIONS:

[1] M.A. Tilston and K.G. Balmain, "A multiradius, reciprocal implementation of the thin-wire moment method", IEEE Trans. Antennas Propagat., vol. AP-38, no. 10 pp. 1636-1644, Oct. 1990.

[2] M.A. Tilston and K.G. Balmain, "On the suppression of asymmetric artifacts arising in an implementation of the thin-wire method of moments", IEEE Trans. Antennas Propagat., vol. AP-38, no. 2, pp. 281-285, Feb. 1990.

[3] M. Hilbert, M.A. Tilston and K.G. Balmain, "Resonance phenomena of logperiodic antennas: characteristic-mode analysis", IEEE Trans. Antennas Propagat., vol. AP-37, no. 10, pp. 1224-1234, Oct. 1989.

[4] M.A. Tilston and K.G. Balmain, "A microcomputer program for predicting AM broadcast reradiation from steel tower power lines", IEEE Trans. Broadcasting, vol. BC-30, no. 2, pp. 50-56, June 1984.

[5] M.A. Tilston and K.G. Balmain, "Medium frequency reradiation from a steel tower power line with and without a detuner", IEEE Trans. Broadcasting, vol. BC-30, no. 1, pp. 17-26, March 1984.

[6] M.A. Tilston and K.G. Balmain, "Medium frequency reradiation from an unstrung steel power line tower", IEEE Trans. Broadcasting, vol. BC-29, no. 3, pp. 93-100, September 1983.

[7] M.A. Tilston, S.E. Tilston and W.V. Tilston, "The coupling and decoupling of closely spaced antennas", Conference Record of the 33rd IEEE Vehicular Technology Conference, Toronto, Ontario, Canada, pp. 219-222, May 25-27, 1983.

REPORTS:

[1] M.A. Tilston, "Modification of a moment method electromagnetic analysis program to allow efficient use with an optimizer", Prepared for the Department of National Defence, Defence Research Establishment Ottawa, Shirley Bay, Ontario, under DSS contract no. W7714-8-5853/01-ST, March 30, 1990.

[2] M.A. Tilston, "Final report of the Working Group on Reradiation Problems in AM broadcasting", Prepared for the Department of Communications, Ottawa, Ontario, under DSS contract no. 36100-4-4195, July 12, 1985.

Tab D

Lawrence Behr Associates INC
www.lbagroup.com

Two-way impacts relative to proposed urban developments on the radiation patterns of CJMR and CJYE and potential hazards during construction and its use once built

AM Modeling Report

LOCATION:
Oakville, Ontario, Canada

Requested by:
Whiteoaks Communications Group

DATE:
March 11, 2019

3400 Tupper Drive | Greenville, NC 27834
252-317-2123 | 800-522-4464 | lbagrp@lbagroup.com

NOTICE

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Lawrence Behr Associates INC

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252 317 2123 | 800 522 4464 | lbagrp@lbagroup.com

Executive Summary

Whiteoaks Communications Group Limited owns and operates an AM radio transmission facility in Oakville, Ontario on Dundas Street West near Sixteen Mile Creek, with two licensed and operating radio stations, CJYE 1250 kHz and CJMR 1320 kHz. Both are DA-1 at 10 kW.

There are two proposed urban development projects adjacent to or near the above referenced AM facility. They are referred to as Martillac and Graydon-Banning.

At this time, Whiteoaks Communications has requested Lawrence Behr Associates, Inc. (LBA) evaluate the potential two-way impacts (impacts of the developments on the radio stations and impacts of the radio stations on the developments) as a result of the proposed urban developments of Martillac and Graydon-Banning.

LBA has conducted modeling based on publicly available information to analyze the two-way interaction between the CJMR-CJYE radiation patterns and typical cranes and buildings that would be present during and after the construction process in the denominated Martillac and Graydon-Banning sectors of the subject development projects. The following conclusions have been found.

The study has assessed and provided recommended mitigation approaches to four types of negative impacts that will arise as a result of the developments:

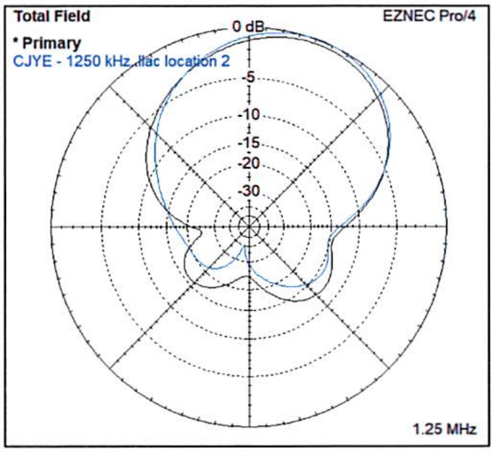
- interference with the signals of CJMR and CJYE
- safety hazards
- interference with construction equipment
- interference with consumer electronic devices

Impact Assessment

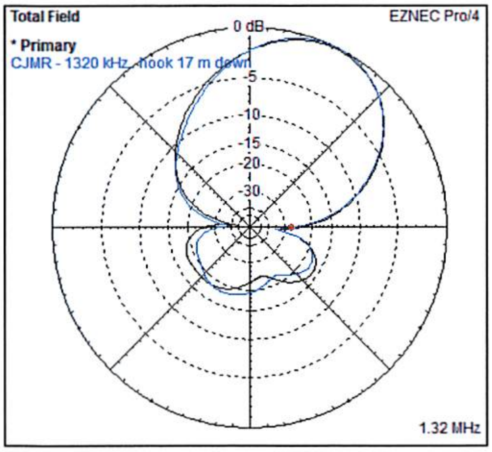
Interference with signals of CJMR and CJYE

This study demonstrates that the AM stations' federally regulated patterns will be seriously affected during the construction activities and the presence of the buildings afterwards, causing both stations to be out of compliance with their strict, federally regulated and licensed parameters and potentially interfering with the signals of other AM radio stations.

This will happen in greater degree to CJYE because the distances relative to its longer wavelength at 1250 kHz are shorter (see figure below):



CJYE Radiation pattern



CJMR Radiation pattern

Above figures illustrate signal pattern distortion of the respective radio stations caused by a tower crane placed at Martillac. The distorted pattern is represented in blue and the original licensed pattern in black. CJYE shows distortions in some directions that are equivalent to vary the power ten times and CJMR, four times the power.

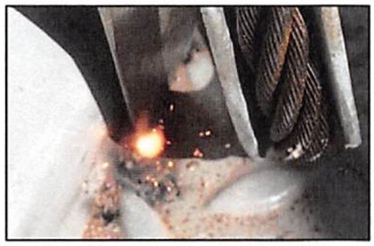
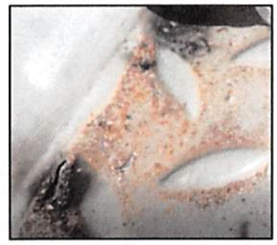
The AM signal level will be increased or decreased in certain directions depending on the phase of the reradiated signal and its relationship to the primary AM signal. In directions where the AM signal is increased there is risk of interference to other AM stations that operate on the same frequency. In directions where the AM signal is decreased there is risk of losing coverage to important portions of the listening audience. Causing the distortion of AM licensed parameters can bring legal and financial consequences regarding coverage and interference with other services and broadcast station license suspension.

Safety Hazards

Diverse levels of radiofrequency (RF) field strength intensities are present on the project zone. The presence of two transmitters, each using 10 kW and a small frequency separation will cause random additions of the individual field intensities.

The RF intensities modeled on the development site present a significant risk to the safety of anyone on-site during construction. These risks include:

- contact current burns and shocks as well as arcing (sparks flying). These discharges can cause severe burns and other damage to the human body depending on the entry and exit points

Arcing from energized cable **Burn marks on the steel**
(Please, see Annex 1 for more detailed pictures of the above)

- accidents resulting from shocks to construction workers while handling equipment, carrying heavy objects or operating at elevations above ground level

- electric sparks causing materials to combust

- physical injury to persons and property as a result of malfunctioning equipment

- arcing caused by the currents induced on metal structures and cables. The danger of sparks near combustible material is obvious. Static discharges can startle a person and cause the loss of grip on a handrail or an object with the risk of losing balance

Post-construction hazards include:

- exterior metal railings and other long metal elements (such as aluminum window frames) can result in contact burns and shocks

- compromised integrity of elevator cables

- malfunctioning garage door equipment

Construction Equipment and Consumer Electronics

Impacts include:

- RF interference with construction equipment, especially cranes, causing equipment to be difficult to operate, inoperable or to malfunction potentially resulting in catastrophic failure and damage to property and bodily injury

- arcing can damage cranes and elevator hoisting cables, rendering them useless

- household devices like entertainment systems and the like, alarms, monitoring systems, intercoms, and garage doors will be subject of malfunction or interference, especially the ones connected to cables or cable networks that are long enough to act as antennas at the frequencies involved

Mitigation Approaches

At this stage it is not possible to design mitigation for Graydon Banning and Martillac developments for four main reasons as detailed design of buildings and structures has not been completed or is not publicly available. Mitigation design must be through an iterative and adaptive process using a combination of modeling and ongoing monitoring, due to the dynamic and complex construction environment. To maximize the effectiveness of mitigation, a mitigation plan should be developed with the following features:

- initial mitigation design based on modeling of the detailed design of the development, based on an iterative modeling and design process

- an RF engineer available on-site during the construction phase to adapt mitigation

- on-going monitoring of both the construction site and the AM radiation pattern during construction to assess mitigation effectiveness

- an emergency response plan for the construction phase to address any issues before they result in serious negative impacts to either the construction workers or the AM radiation pattern

- post-construction availability of an RF engineer to address issues on a case-by-case basis

- periodic monitoring of the AM radiation pattern and adaptive mitigation as required

However, it should be noted that, given the complexity and the dependence on many factors of the efficiency of the mitigation solutions, the only guaranteed successful mitigation is moving the AM stations away from the area.

Contents

Background	1
MOM Modeling Software	1
About the decibel	2
Radiation Pattern Variation Limits	4
MOM Modeling – Antenna Pattern Distortion	5
Block 43 Locations for MOM modeling	5
Block 43 – CJMR 1320 kHz Pattern	6
Block 43 – CJYE 1250 kHz Pattern	14
Martillac Locations for MOM Modeling	20
Martillac - CJMR 1320 kHz Pattern L1	21
Martillac - CJMR 1320 kHz Pattern L2	23
Martillac - CJYE 1250 kHz Pattern	27
Martillac – CJYE 1250 kHz Pattern L1	27
Martillac - CJMR 1250 kHz Pattern L2	32
Martillac – Mobile Crane MOM Modeling	36
Martillac – CJMR 1320 kHz Mobile Crane Modeling L1	36
Martillac – CJMR 1320 kHz Mobile Crane Modeling L2	39
Martillac – CJMR 1250 kHz Mobile Crane Modeling L1	40
Martillac – CJMR 1250 kHz Mobile Crane Modeling L2	43
Effects of RF on Human Body, animals and devices	45
MOM – Field Strength Contours Maps	46-48
Human Body Hazards and Devices Potentially Affected	49
Conclusions and Recommendations	49
IC regulations on AM pattern distortion – Tolerance	49
Modeled Patterns Distortion Evaluation	49
Impact on safety and devices	50
Mitigation Options	53
Mitigation for patterns protection	54
Mitigation for human body hazards and devices	56
Annex 1: Pictures and Schematics	57
Annex 2: Correctly visualizing radiation pattern differences	61
References	62

Background

Whiteoaks Communications Group Limited owns and operates an AM radio transmission facility in Oakville, Ontario on Dundas Street West near Sixteen Mile Creek in the regional municipality of Halton. Licensed and operating diplexed at this site are CJYE 1250 kHz, DA-1 at 10 kW and CJMR 1320 kHz, DA-1 at 10 kW. The site coordinates are 43° 27' 29'' North latitude, 79° 45' 17" West longitude.

There are three proposed urban development projects adjacent to or near the above referenced AM facility. They are referred to as Martillac, Graydon-Banning and Oakville Green Life Sciences and Technology District.

At this time, Whiteoaks Communications has requested Lawrence Behr Associates, Inc. (LBA) evaluate the potential two-way impacts of the proposed urban developments of Martillac and Graydon-Banning on the CJYE and CJMR radiation patterns and potential hazards from the two AM signals during the development construction and its use once built.

MOM Modeling Software

The software used for the AM modeling is EZNEC Pro 4, ver. 6.0, based on the Method of Moments (MOM), widely used in the industry for RF antenna analysis.

CJMR and CJYE are two AM stations sharing six antennas in array. Both transmitters use the same set of antennas by means of a diplexer. CJMR uses all six antennas while CJYE uses four antennas to transmit. Both radio stations have a transmitting power of 10 kW and each uses the same antenna configuration for daytime and night time.

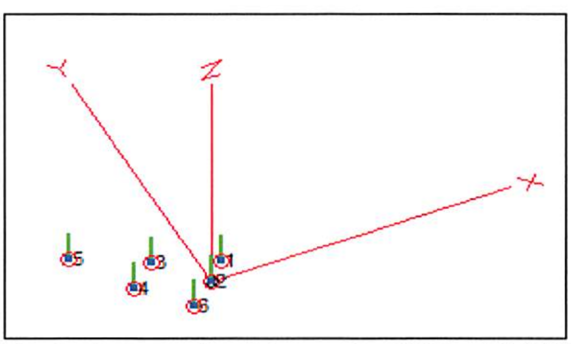


Fig. 1a: Antenna Array Layout for CJMR – 1320 kHz

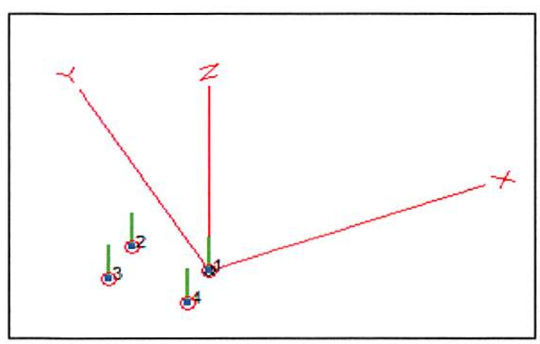


Fig. 1b: Antenna Array Layout for CJYE – 1250 kHz

As reference for the modeling, the Y-axis is oriented with the North (0° or 360°) as shown in Figures 1a and 1b. Both array configurations have a similar radiation pattern with the main lobe maxima aligned with an azimuth of 22° (NNE) approximately (Figures 2a and 2b below). All the locations on this report are referred to the origin (0, 0) and in polar form, with distance and azimuth information. The patterns shown below are in dBi, or decibels (dB) referenced to an isotropic radiator.

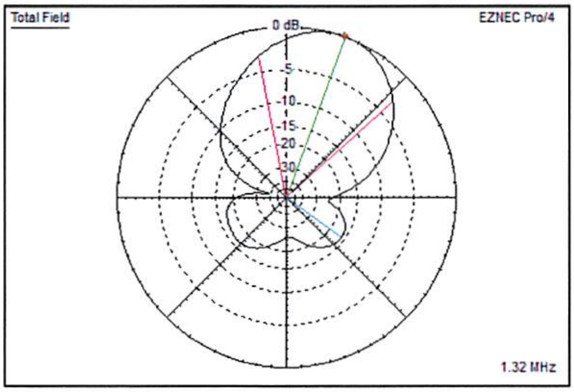


Fig. 2a: CJMR – 1320 kHz radiation pattern

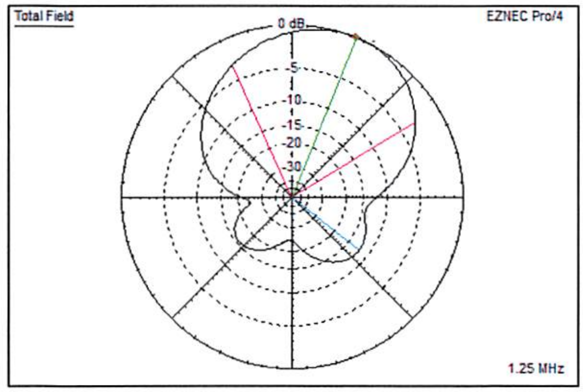


Fig. 2b: CJYE – 1250 kHz radiation pattern

About the decibel (dB)

The dB is a unitless (non-dimensional) parameter. It is used to compare power levels to measure gain or loss of a receiving or transmitting system. It is associated to a logarithmic scale. To compare two power levels P1 and P1, if a transmitter has initially a power level of P1 and is increased to P2 the following formula applies to calculate the gain (G) in dB:

$$G\ (dB) = 10 \times LOG\ (P2/P1)$$

From the same equation we can solve for the power ratio (P2/P1) that a given number of decibels represent:

$$\text{Power ratio} = P2/P1 = 10^{(G/10)}$$

Expressed in words, the power ratio is equal to ten (10) to the power of one tenth the gain in decibels (G(dB)/10). Thus, an increase of 1 dB is equivalent to a power ratio of:

$$P2/P1 = 10^{0.1} = 1.2589$$

This shows that when there is an increment of 1 dB in a transmitting system, this is equivalent to multiplying the power by a factor of 1.2589 or an increment of nearly 26%. This can be achieved by increasing the power output of the transmitter 26% or by increasing the gain of the antenna system by 1 dB. If a system has power output of 1 watt, to increase 1 dB, it will require an increase of the power to 1.26 watts. Because the dB scale is based on ratio, to obtain the same 1 dB increment on a 10,000 W (10 kW) system, it would need to increase its power to 12,600 W (12.6 kW). On the opposite scenario, if a decrement or loss of 1 dB is needed, the same formula applies but the dB is expressed with a negative sign:

$$P2/P1 = 10^{-0.1} = 0.7943$$

or

$$P2/P1 = 1/1.2589$$

Putting it in words, when there is a loss of 1 dB in a transmitting system, it is equivalent to multiplying the power by a factor of 0.7973 or reducing it to nearly 80% of its level.

The decibel (dB) can be used as a voltage ratio (V2/V1) instead of a power or watts ratio. The equation is similar to the power ratio, but the gain in dB is divided by 20 instead of 10:

$$(V2/V1) = 10^{(G/20)}$$

In voltage ratio, an increment (gain) of 1 dB is a voltage factor of 1.12 or a 12% increment. A decrement (loss) of 1 dB is a voltage factor of 0.89 or an 11% reduction of the field intensity. Table 1 shows the ratios for power and voltage for gain and loss expressed in decibels (dB):

Decibels (dB) as ratio of Power and Voltage				
Change (dB)	Power Factor (Watts)		Electric Field Factor (V/m)	
	As gain	As loss	As gain	As loss
0.445	1.11	0.90	1.05	0.95
0.5	1.12	0.89	1.06	0.94
0.75	1.19	0.84	1.09	0.92
1	1.26	0.79	1.12	0.89
2	1.58	0.63	1.26	0.79
3	2.00	0.50	1.41	0.71
4	2.51	0.40	1.58	0.63
5	3.16	0.32	1.78	0.56
6	3.98	0.25	2.00	0.50
7	5.01	0.20	2.24	0.45
8	6.31	0.16	2.51	0.40
9	7.94	0.13	2.82	0.35
10	10.00	0.10	3.16	0.32
20	100.00	0.01	10.00	0.10
30	1,000.00	0.00	31.62	0.03

Table 1: The dB as power and voltage factor

If on a transmitting antenna a radiation pattern decrement (loss) of 4 dB on a given direction takes place, it would be equivalent to decreasing the transmitter power to 40% of its level (0.4x), on a 10,000 watts system this means reducing power to 4,000 watts. The opposite, if an increment (gain) of 4 dB is detected on the pattern, it is the same as increasing the transmitter power to 250% of its level (2.5x), on a 10,000 watts system is like increasing the power to 25,000 watts. **The above concepts are key to understand the magnitude of the changes on the radiation patterns plotted on this study report.** The power authorized by Innovation, Science and Economic Development (ISED), formerly Industry Canada (IC), to be used by CJMR and CJYE is 10,000 W or 10 kW.

Radiation Pattern Variation Limits

The limits are outlined on the ISED document **"Broadcasting Procedures and Spectrum Management and Telecommunications, Part 2" - BPR-2 Issue 3, February 2016** on its **Section 2.6.2.** establishes the specifics on tolerance as follows:

Lower Limit

The figures in red in Table 1 above indicate the lower limit established for a negative variation or loss on the theoretical radiation pattern authorized by the AM license. The rule states that a change not greater than 5% on Voltage ratio (10% on power ratio or 0.445 dB) is permitted when there is a decrement on the radiation pattern. **Even a decrement of just 0.45 dB from the nominal or theoretical radiation pattern would set the radiation pattern below the lower limit permitted.**

Upper Limit

After an AM antenna system is installed and transmitting with its authorized power, the field pattern measurements are performed to verify the actual radiation pattern. This pattern will be compared to the theoretical radiation pattern which is a calculated pattern on flat terrain, in ideal conditions and without the presence of any structure in its surroundings that could have an effect on the radiation pattern. The actual radiation pattern exceedances beyond the nominal radiation pattern are called "Extensions", these extensions are reviewed by the competent authority before issuing the License for the AM station and it will be clearly specified on the station's license technical information. **This authorized extended radiation pattern is the higher limit. Exceeding this limit requires an extensive study to verify that no interference is caused by the increments above the limit to any other service.**

[*MOM Modeling – Antenna Pattern Distortion Page Follows*]

MOM Modeling – Antenna Pattern Distortion

Block 43 Locations

To evaluate the effect of the urban development during its construction and use after being built, a "typical" building has been modeled with a square footprint of 27 m x 27 m and a height of 30 m. The structure has been placed on two locations in what is currently labeled as Block 43 on the NE quadrant of the intersection of Street "J" and William Halton Parkway. Two locations, L1 and L2, have been selected to place the building as shown in Fig. 3.

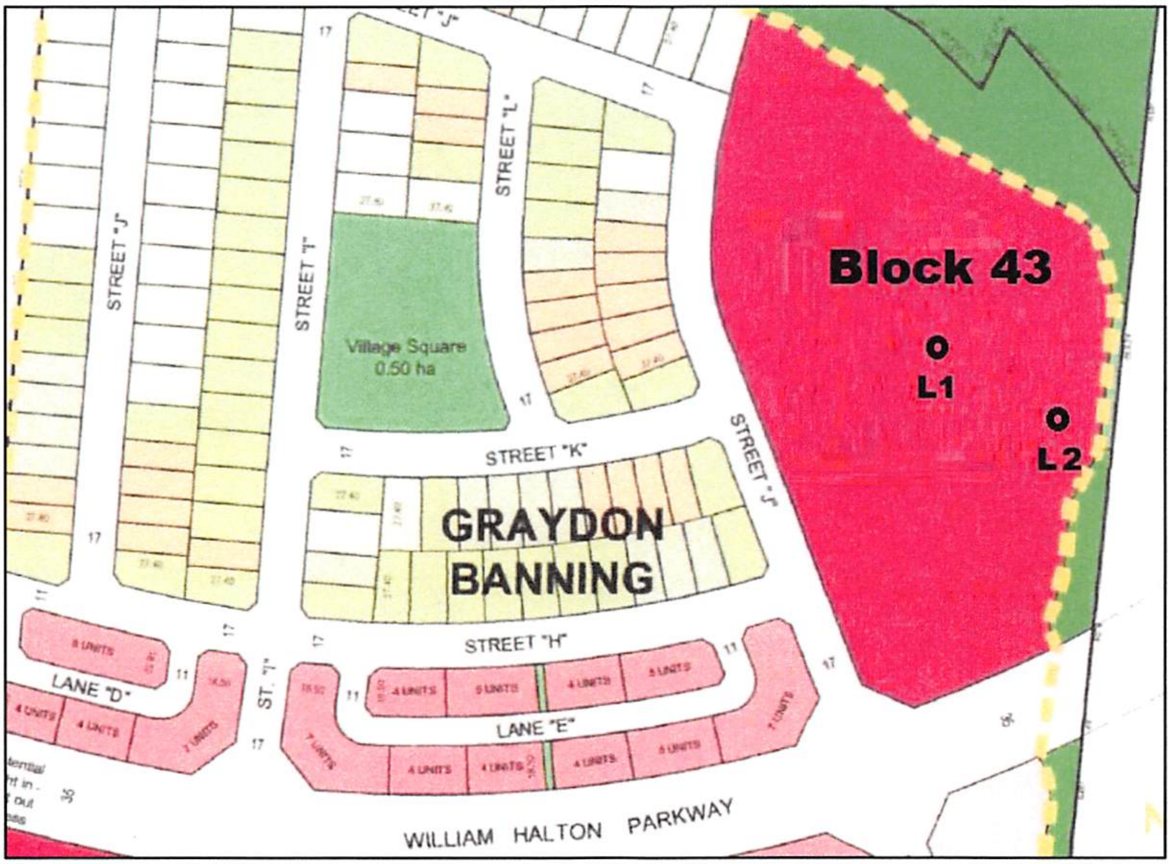


Fig. 3: Locations L1 and L2 on Block 43.

A 50 m high tower crane with a 40 m long boom and a 15 m long rear boom structure has been attached to the building to evaluate its effect during the construction phase.

Simulations of the building with and without the tower crane have been performed to evaluate its effect on both CJMR and CJYE radiation patterns.

Block 43 – CJMR 1320 kHz Pattern

Ten-story building at Location 1 in Block 43 - CJMR 1320 kHz

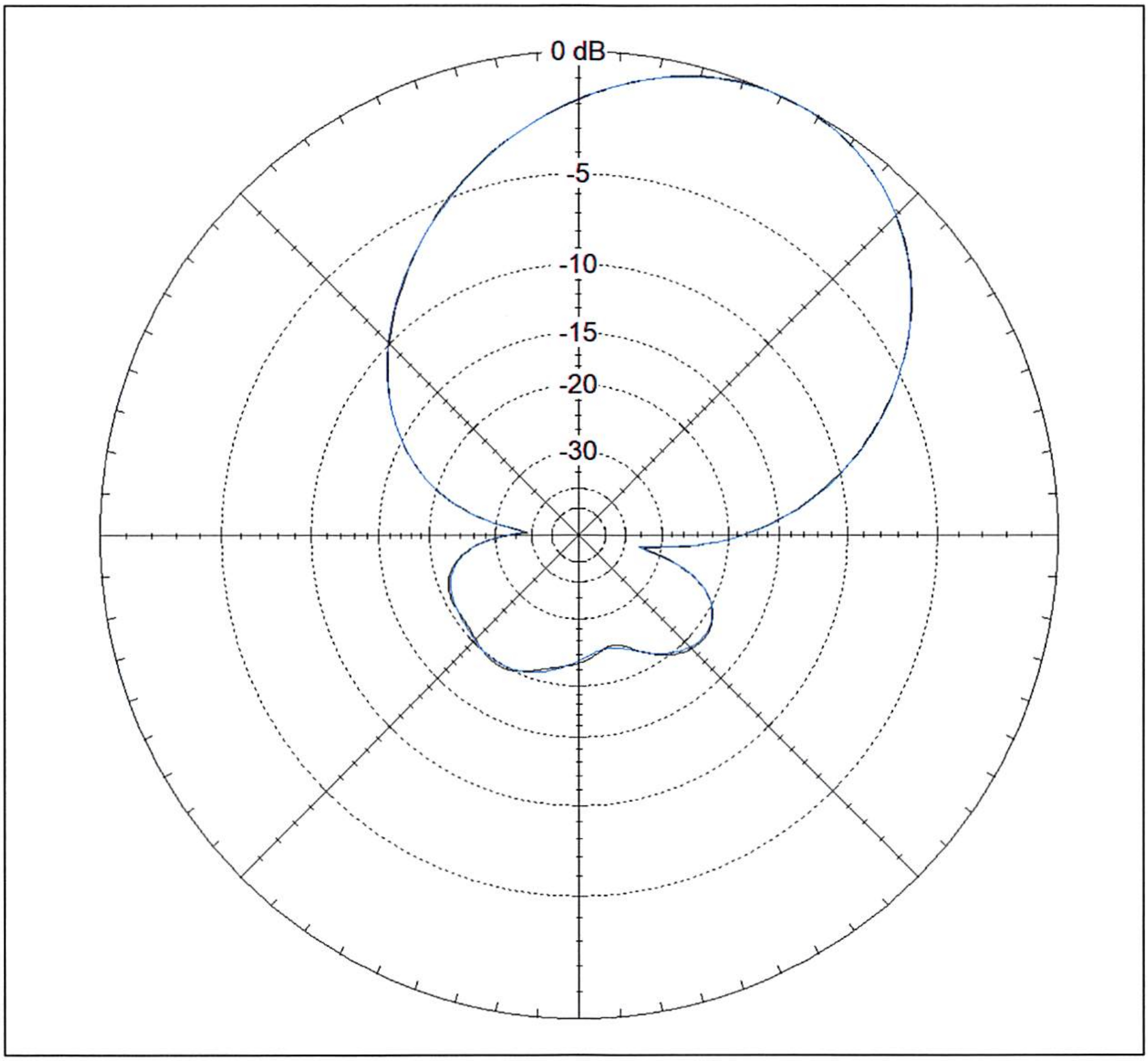


Fig. 4: Building Location 1 at block 43 CJMR 1320 kHz pattern comparison. Original CJMR pattern is in blue. A slight variation can be seen at the rear lobes of the pattern.

Figure 5 on next page shows a magnified view of the antenna patterns focusing on the rear lobes, the blue trace is the pattern of CJMR – 1320 kHz without the building and the black trace is the antenna radiation pattern modeled with the presence of the building.

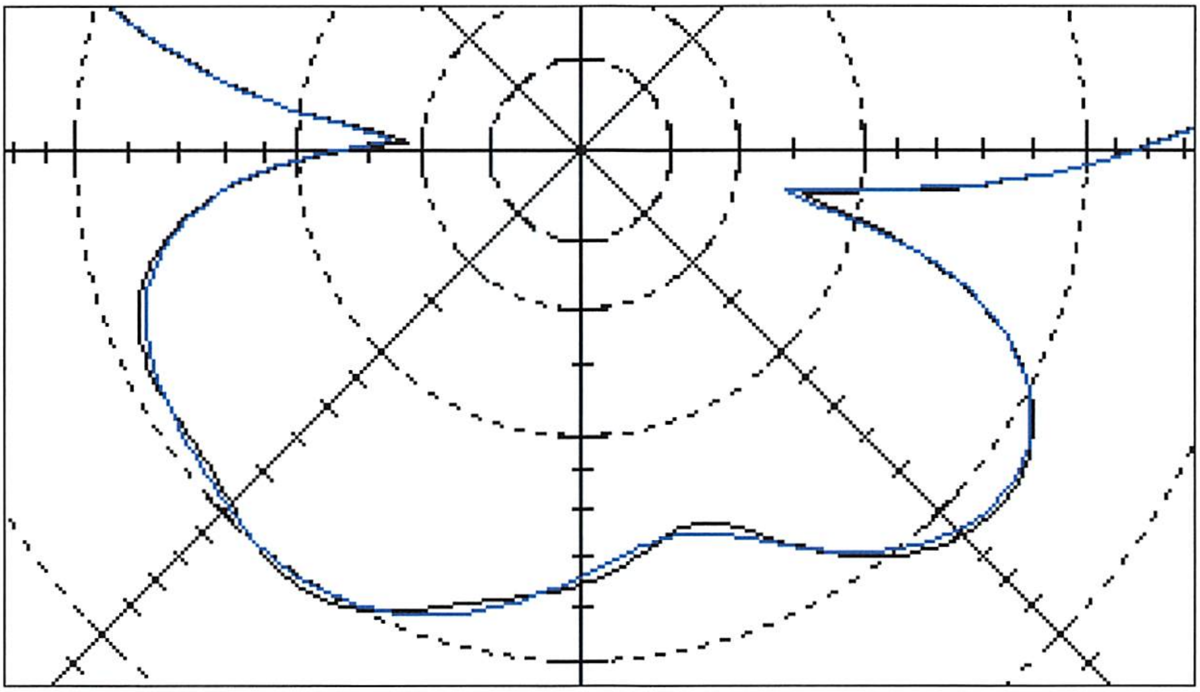


Fig. 5: Building at Location 1, block 43, detail of rear lobes of pattern. The black trace pattern is with the building present. The blue trace is the original CJMR 1320 kHz undisturbed pattern without the building. Pattern variations of almost one dB can be seen. There is 10 dB of difference between the reference circles, the small divisions are 2 dB after the third circle and 5 dB between the third and second one.

Ten-story building, 50 m high tower crane at Location 1, Block 43 – CJMR 1320 kHz.

A tower crane 50 m high with a 40 m boom length and 15 m long counterweight boom is attached to the building to study its effect on the radiation patterns.

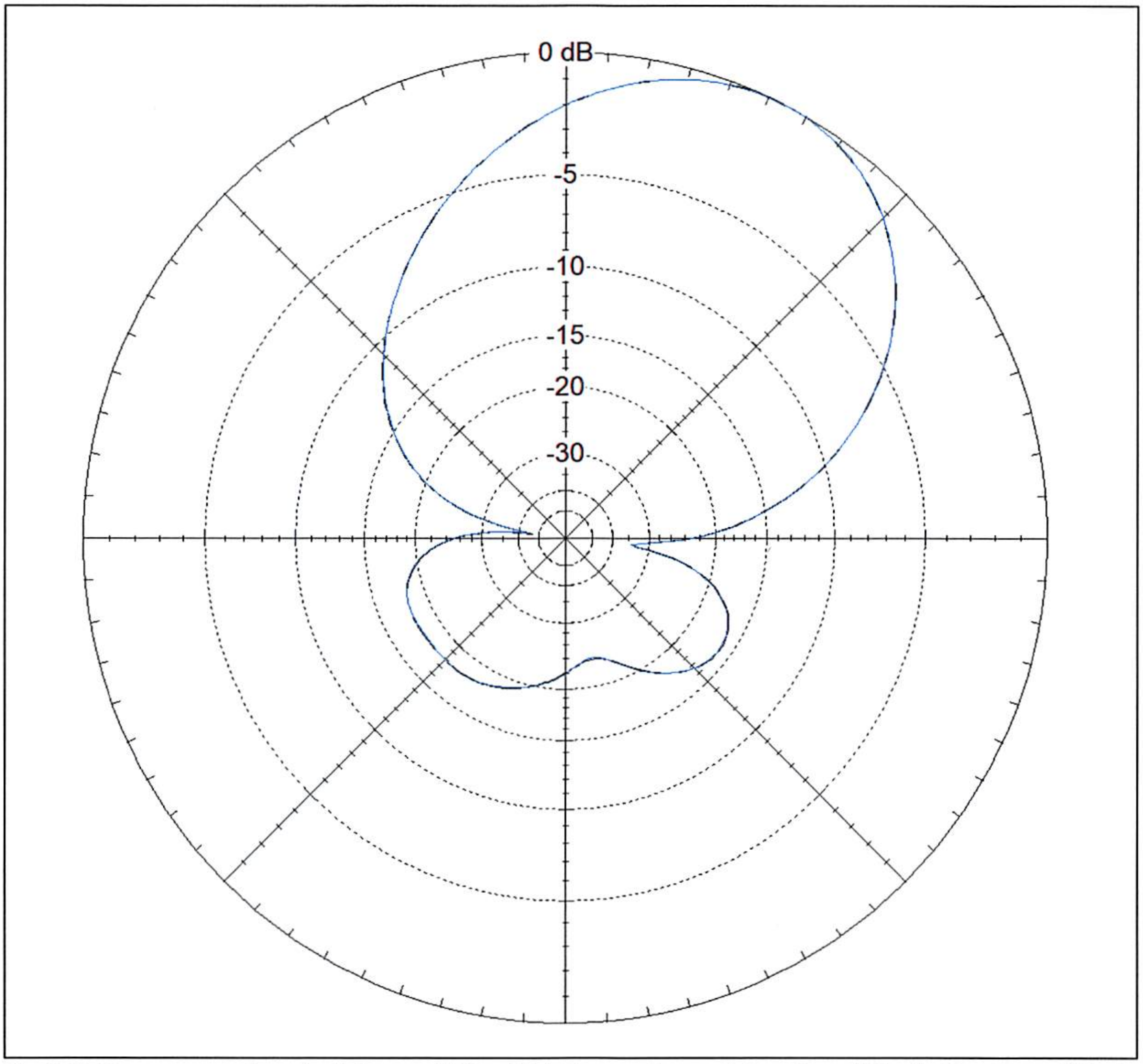


Fig. 6: Pattern comparison building and 50 m high Tower Crane at Location 1 Block 43 pattern (blue), original CJMR pattern (no building or tower crane) in black. Apparently, there is no noticeable augmentation or variation is detected except for the pattern null to the West (275° - 280), its depth has increased at least 8 dB

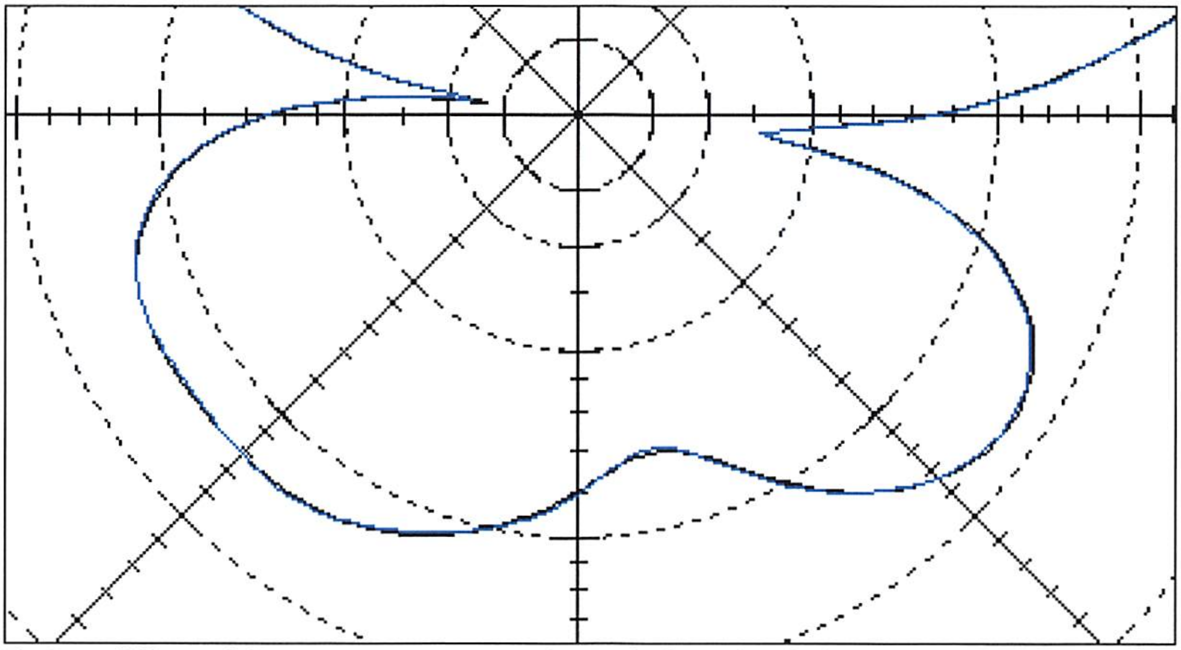


Fig 7a: Building and 50 m tower crane at Location 1, Block 43, detail of rear lobes of pattern. The blue trace pattern is with the building present, black is the original CJMR 1320 kHz pattern. There is 10 dB of difference between reference circles. The null to the West depth has increased about 9 dB, from the -38 dB to -47 dB reference. Please refer to Figure 7b, which is Figure 5 recalled here below, where the West null is the same for both patterns plotted, while on Figure 7a the null is deeper and narrower. The pattern has an increase of 7.5 dB (more than 5 times the power) on the azimuth 270° (West). Notice where the trace crosses the left-hand side horizontal axis on both plots. Notice also that the null to the East changes position shifting upwards on the plot and loses about 2 dB of depth.

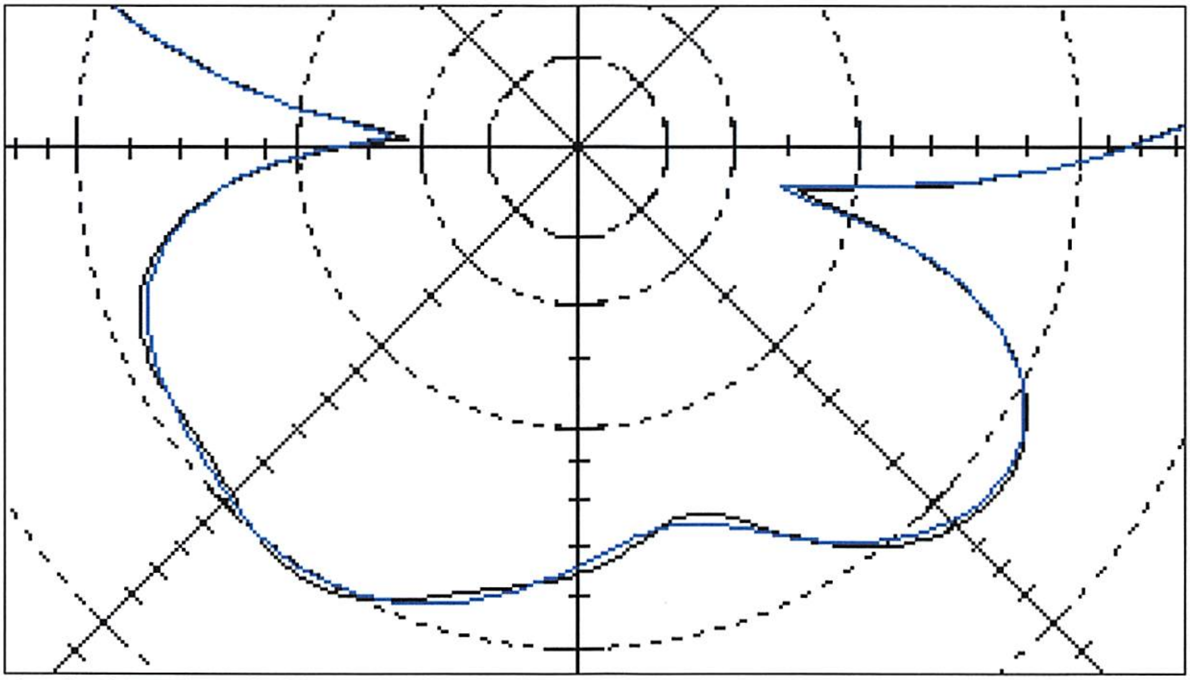


Fig. 7b: Figure 5 recalled for comparison with 7a.

Ten-story building at Location 2 in Block 43 – CJMR 1320 kHz

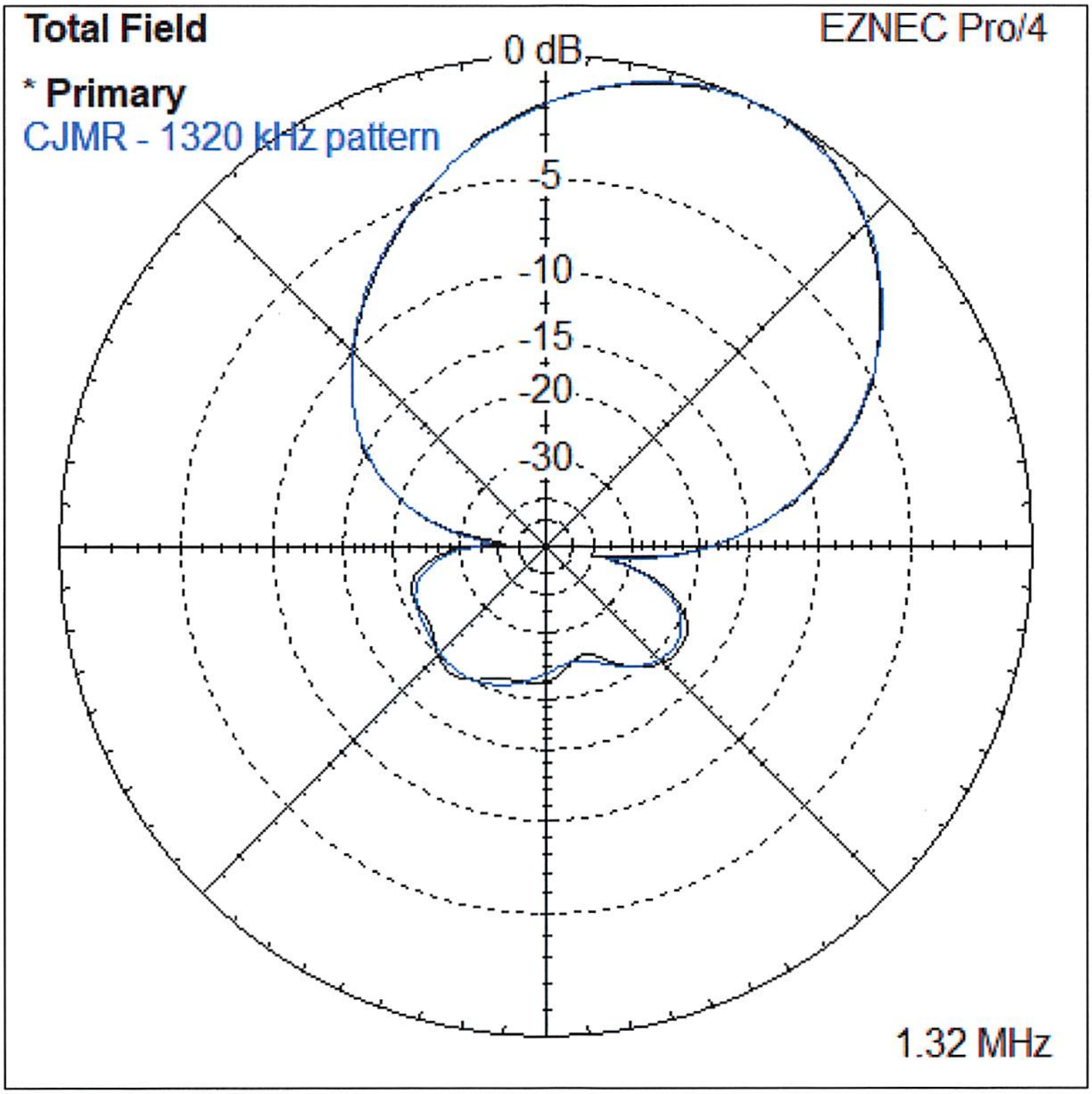


Fig. 8: Building at Location 2 Block 43 CJMR pattern (black) compared with CJMR original pattern (blue). Extensions or augmentations of almost 2 dB can be seen on the rear lobes and the West null depth has increased.

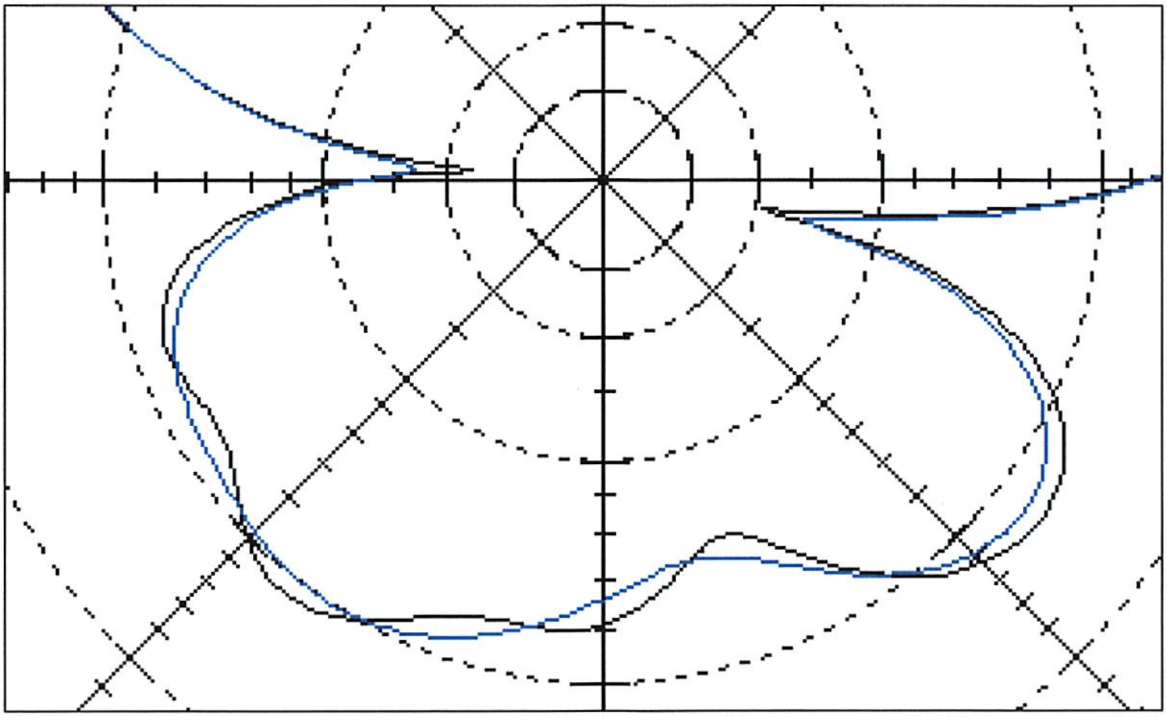


Fig. 9: Magnified view of rear lobes of CJMR 1320 kHz pattern (blue) compared with its pattern in the presence of the 10-story building (black) at Location 2 in Block 43. Augmentations of more than one dB can be seen. West Null depth is 5 dB deeper and East null loses 5 dB of depth (null fill). Please, refer to Figure 4 and see that the West null does not invade the second circle, while on the figure above the circle is invaded about 3 dB by the null "wedge".

Ten-story building, 50 m high tower crane at Location 2 in Block 43 – CJMR 1320 kHz

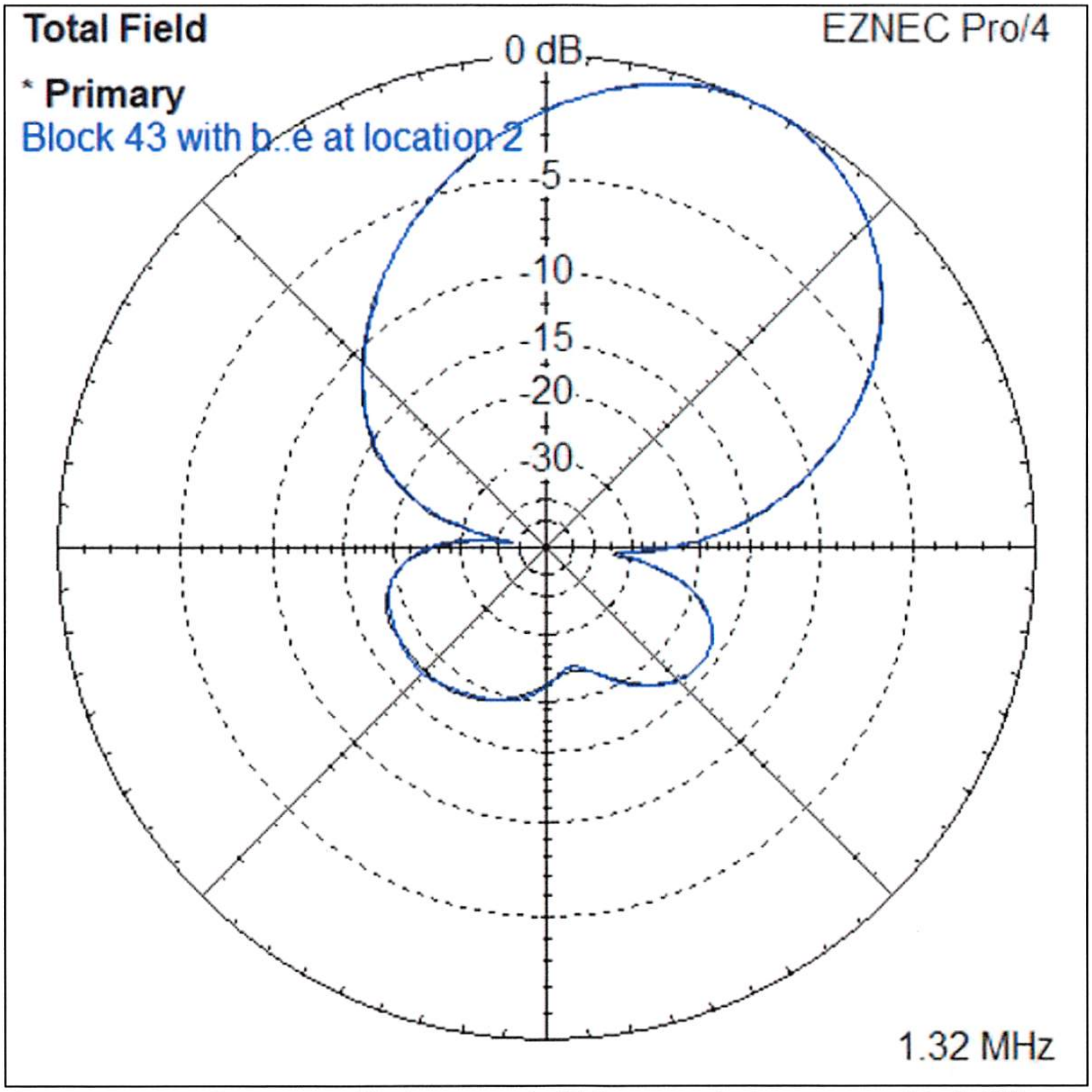


Fig. 10: CJMR 1320 kHz pattern (blue) compared with its pattern in the presence of the building and the 50 m high tower crane at location 2 in block 43. Small augmentations can be seen at the rear lobes.

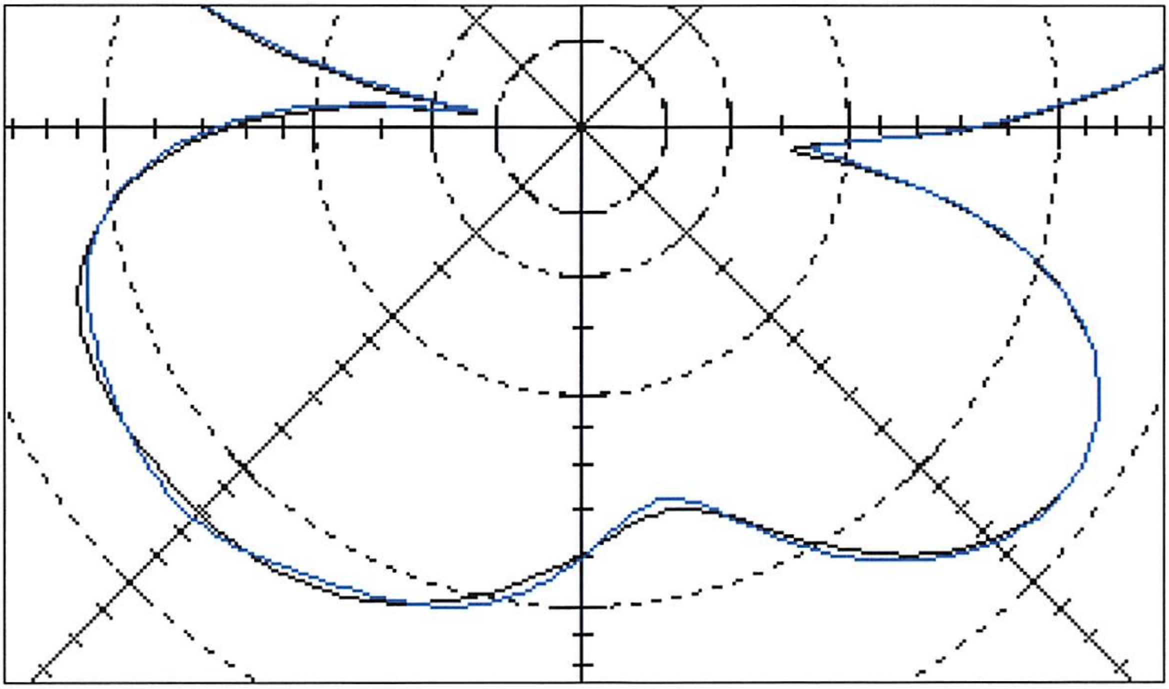


Fig. 11: Magnified view on rear lobes of CJMR 1320 kHz pattern (blue) compared with its pattern in the presence of the building and 50 m high tower crane at location 2 in block 43. Augmentations and loss of almost 1 dB can be seen.

Block 43 – CJYE 1250 kHz

The same positions, Locations 1 and 2, the same building and tower crane configurations, are modeled with the CJYE 1250 kHz pattern and the reradiation effects are shown below:

Ten-story building at Location 1 in Block 43 – CJYE 1250 kHz

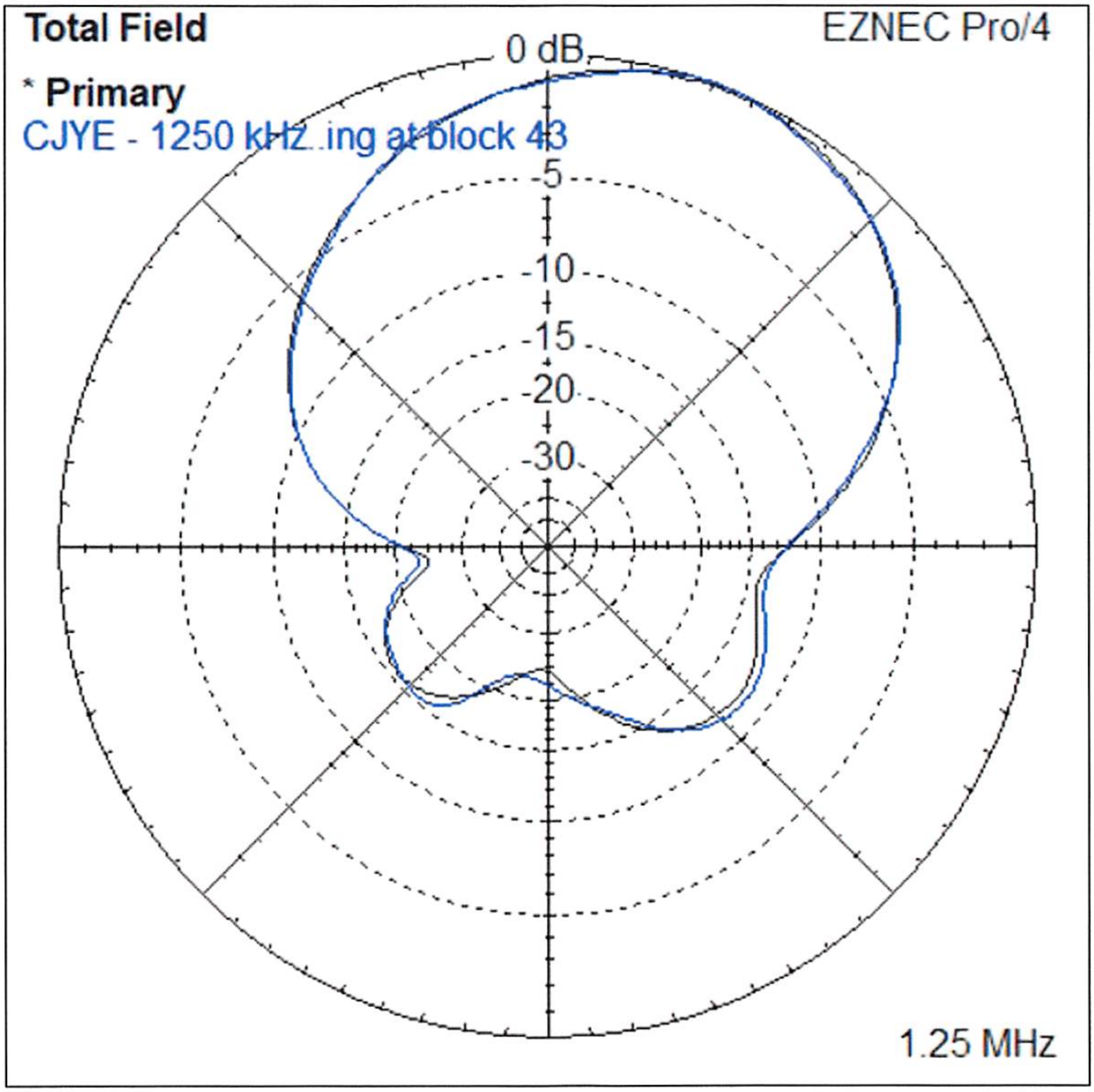


Fig. 12: CJYE radiation pattern comparison with (blue) and without (black), the 10-story building at Location 1 in Block 43. Changes of up to 2 dB can be seen. The null depth to the West loses more than 1 dB, the null depth to the South loses 2 dB and its location changes. There is an augmentation of near 2 dB to a great portion of the ESE octant and around azimuth 220°. There are also fluctuations on the main lobe intensities.

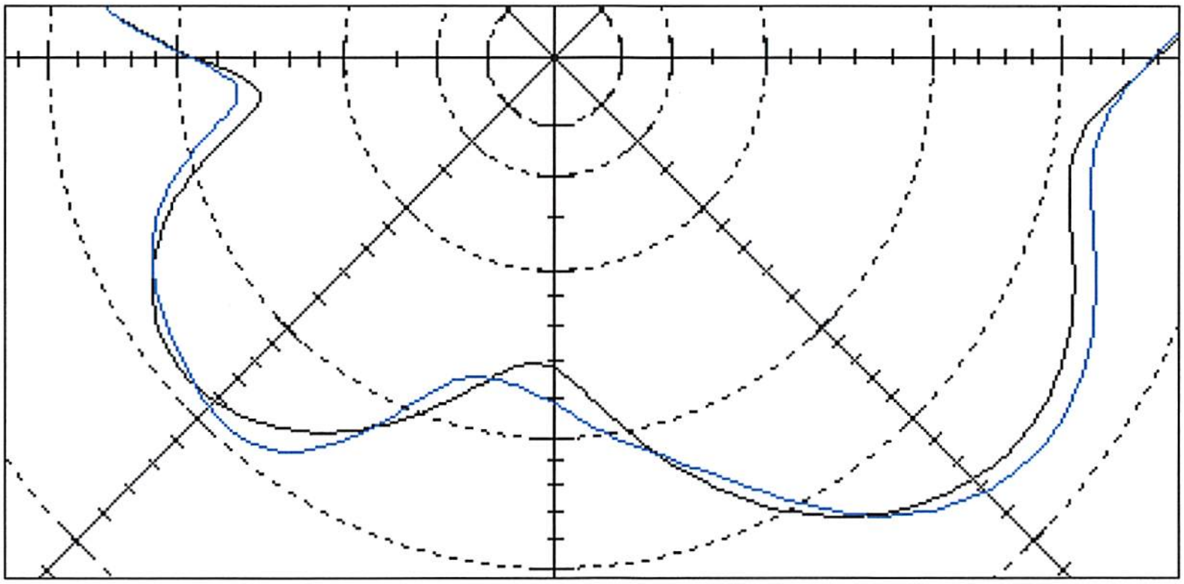


Fig. 13: Detail of the rear lobes of the pattern comparison with building at location 1, rear lobes detail. The black trace is the undisturbed pattern, the blue trace is the pattern in the presence of the building. The illustrate increments and decrements of up to 2 dB. These are variations of +26% and -21% respectively.

Ten-story building, 50 m high tower crane at Location 1, Block 43 – CJYE 1250 kHz

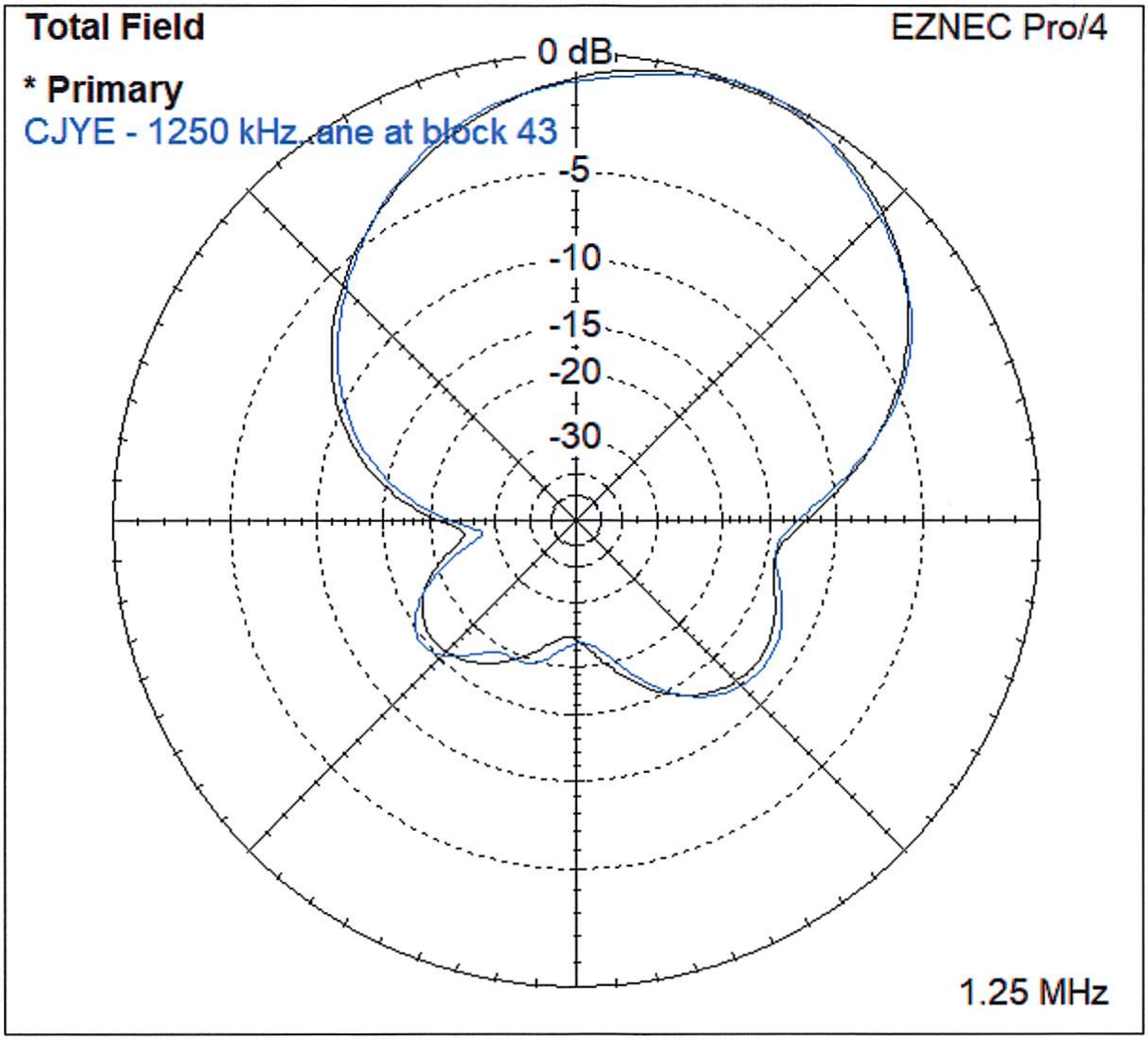


Fig. 14: CJYE radiation pattern comparison with (blue) and without (black), the 10-story building with 50 m tower crane at Location 1 in Block 43. Changes of up to +3 dB can be seen on azimuth 190°. The null depth to the West deepens more than 3 dB, the null depth to the South losses 2 dB and its azimuthal position shifts. There is an augmentation greater than 1 dB on a great portion of the ESE octant and around azimuth 230° as well. There are also fluctuations (alternating increments and decrements) on the main lobe intensities of 1 dB and greater.

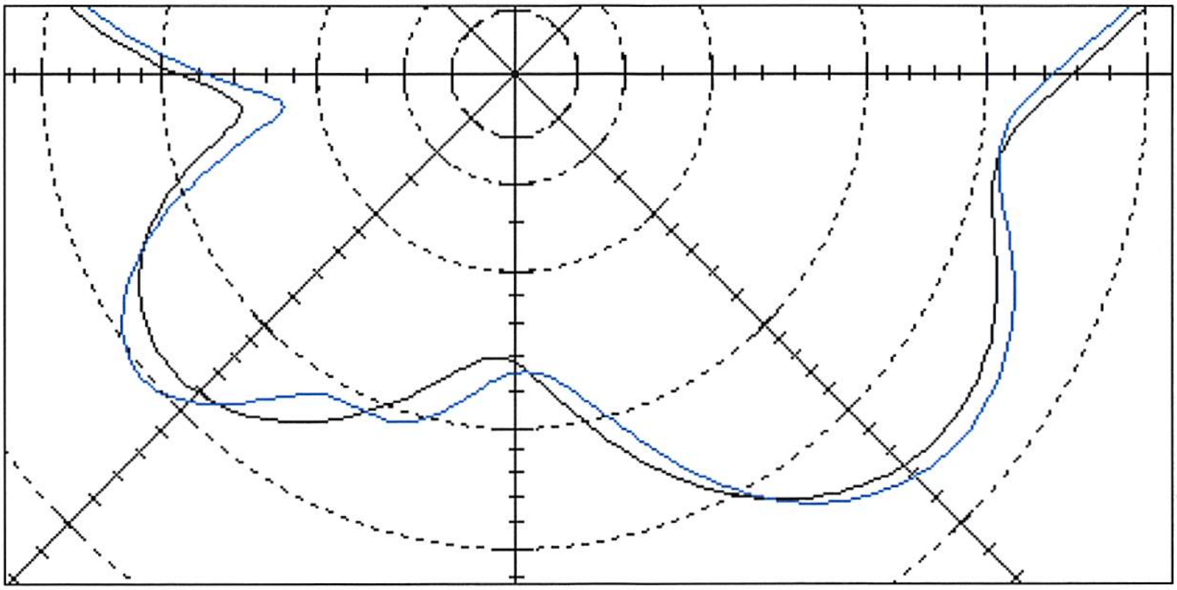


Fig. 15: Detail of the rear lobes of the CJYE 1250 kHz pattern comparison with the building and the 50 meters high tower crane at Location 1, rear lobes detail. The black trace is the undisturbed pattern, the blue trace is the pattern in the presence of the building. Fluctuations of 2 dB to 3 dB can be seen.

Ten-story building at Location 2 in Block 43 – CJYE 1250 kHz

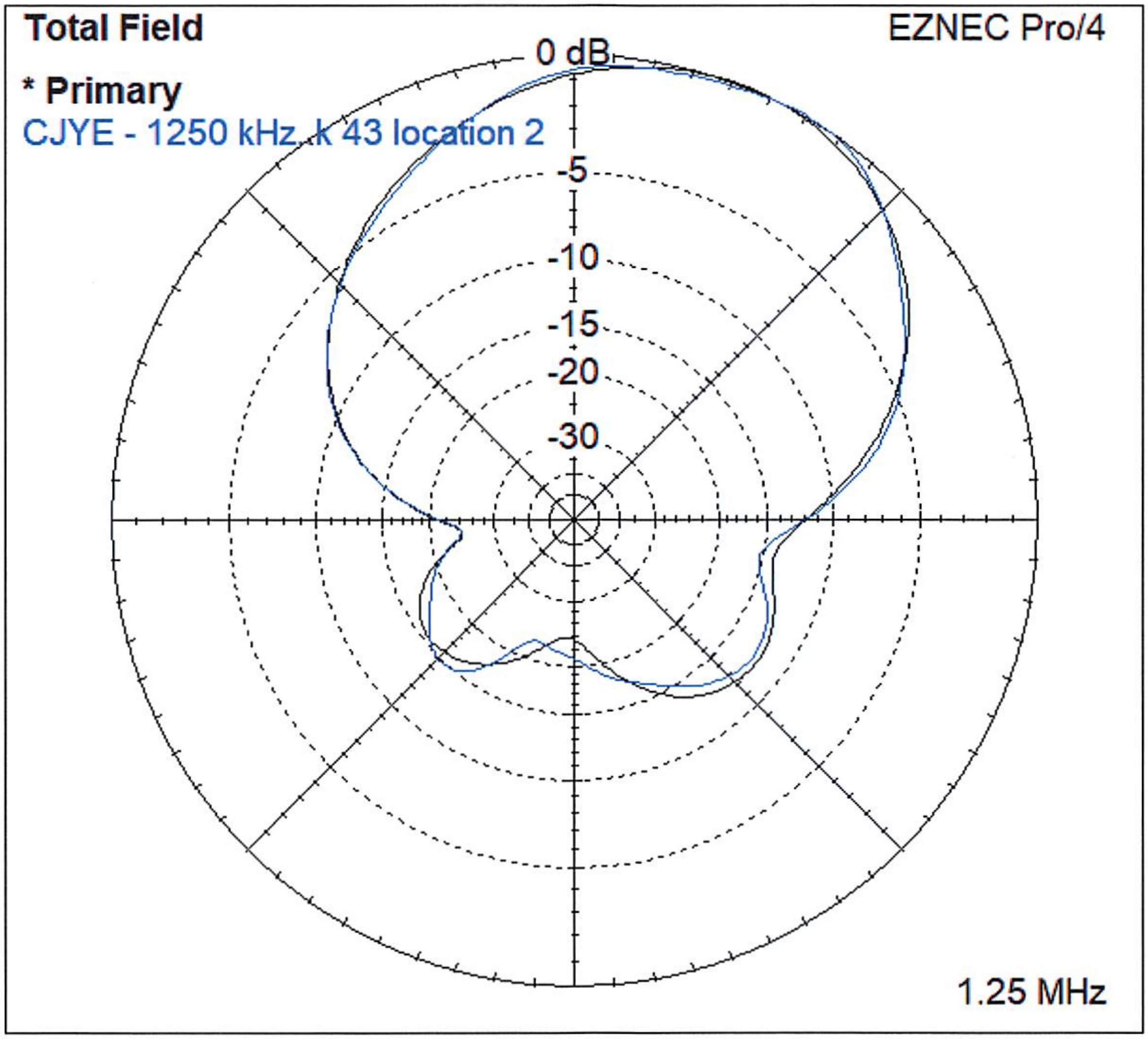


Fig. 16: CJYE radiation pattern comparison with (blue) and without (black), the 10-story building at Location 2 in Block 43. Changes of up to +3 dB (increment of 100% in power factor or 41% on field intensity or V/m) can be seen around azimuth 180°. The null depth to the East deepens more than 2 dB, changes of 1 dB or more on some sectors of the main lobe.

Ten-story building, 50 m high tower crane at Location 2, Block 43 – CJYE 1250 kHz

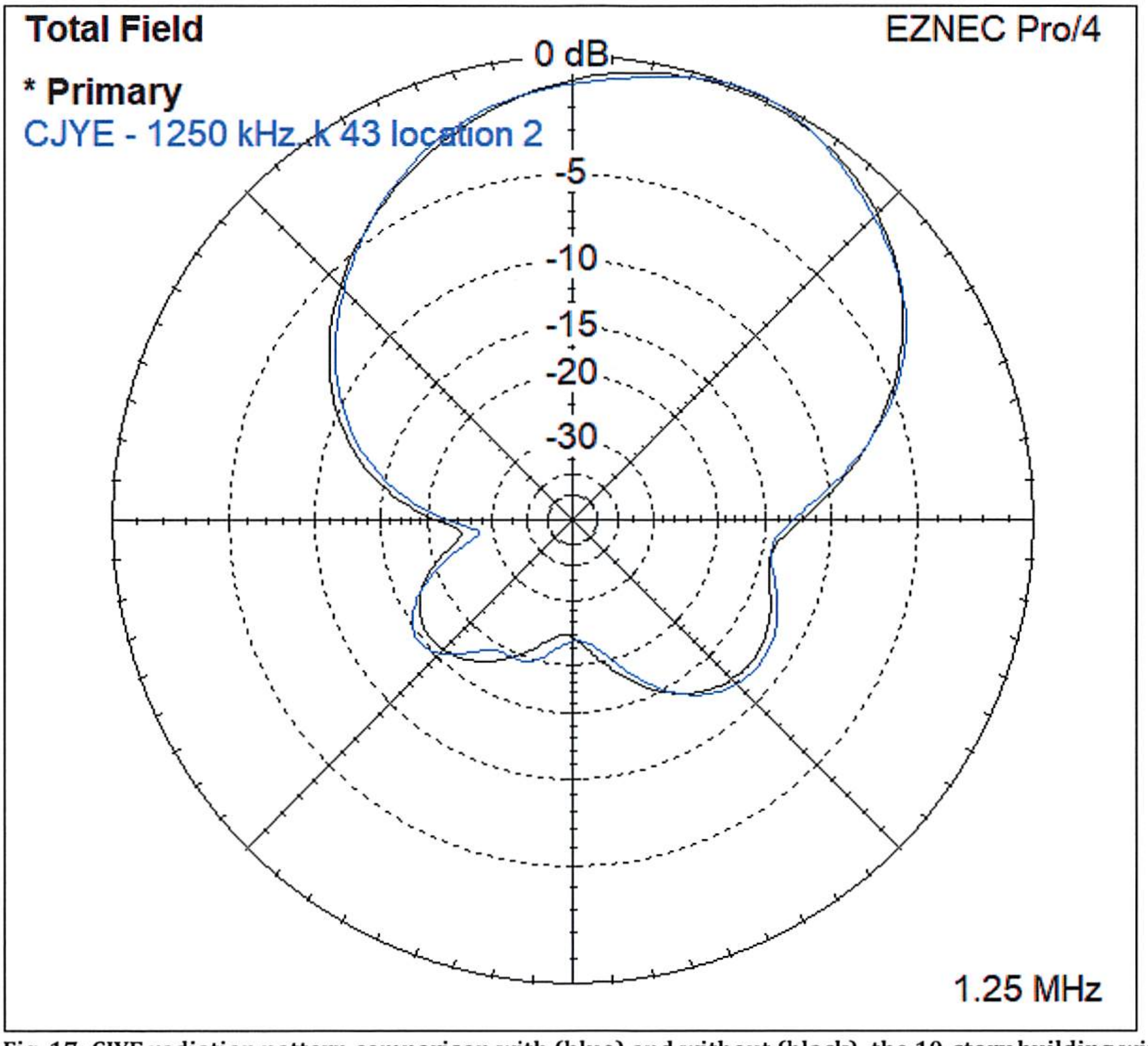


Fig. 17: CJYE radiation pattern comparison with (blue) and without (black), the 10-story building with 50 m tower crane at Location 2 in Block 43. Changes of up to +2 dB can be seen around azimuth 180°. The West null gains more than 3 dB of depth (decrease). Changes of 1 dB or more on some sectors of the main lobe.

Martillac Locations for MOM Modeling

At Martillac, the two locations shown in Figure 18 were selected to evaluate the effect on the radiation patterns of CJMR 1320 kHz and CJYE 1250 kHz.

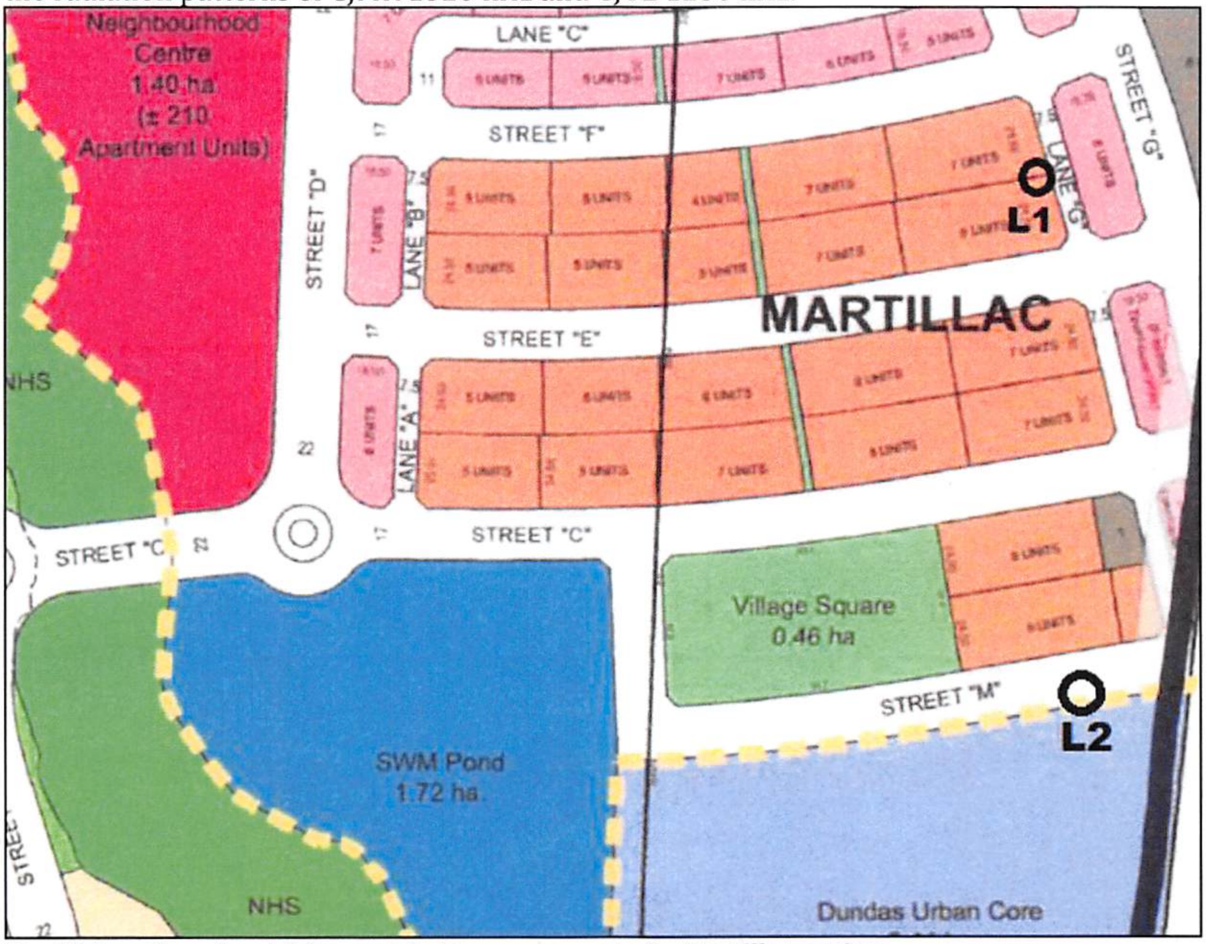


Fig. 18: Locations 1 and 2 for modeled tower cranes in the Martillac section.

Tower cranes were modeled for these locations with different heights between 23 and 30 meters, with fixed lengths of 30 meters for the boom and 10 meters for the rear boom. Location 1 is on Lane "G" between Streets "E" and "C". Location 2 is on the East end of Street "M", north from the Dundas Urban Core section. A mobile crane was modeled at the same two locations. Its 40 m long boom was set at an elevation of 60 degrees, which is a typical position easily achieved while in normal operation of the crane.

Martillac – CJMR 1320 kHz Pattern

At the two locations selected in Martillac, several configurations of tower cranes with heights ranging from 23 m to 30 m were modeled, the boom length was fixed at 30 m and the counterweight boom 10 m long.

Martillac Location 1 – CJMR 1320 kHz

Martillac – Location 1 - Tower Crane 23 m high – CJMR 1320 kHz

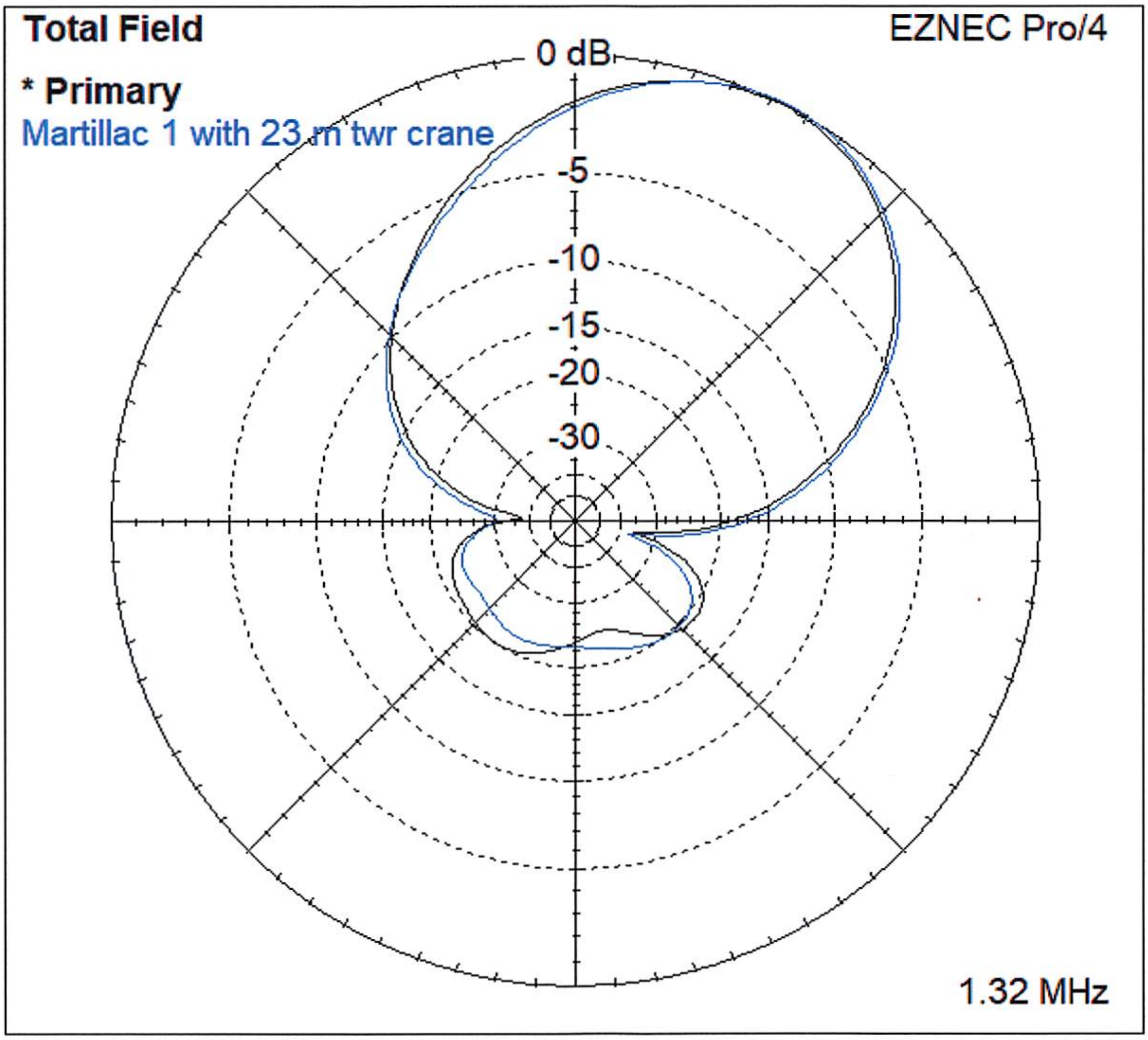


Fig. 19: Pattern comparison of CJMR with and without the presence of a 23 m high tower crane at Martillac Location 1. The blue trace is the pattern with the presence of the tower crane. Fluctuations of up to 4 dB can be seen between the patterns. Fluctuations of up to 2 dB on the main lobe.

Martillac – Location 1 – 30 m high tower crane – CJMR 1320 kHz

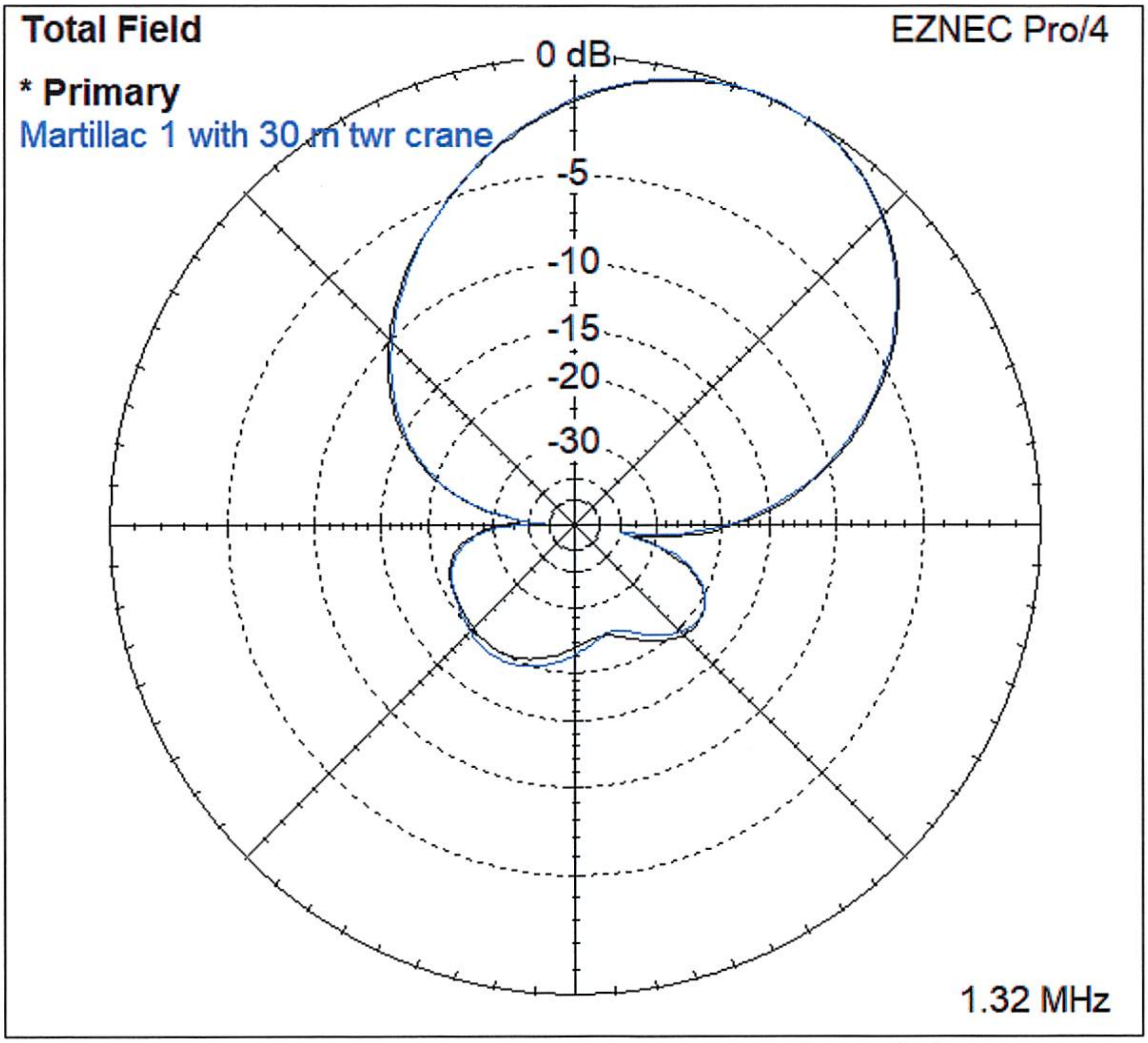


Fig. 20: Pattern comparison of CJMR with and without the presence of a 30 m high tower crane at Martillac Location 1. The blue trace is the pattern with the presence of the tower crane. Augmentations or extensions of more than 1 dB are seen in the SSW octant. The opposite happens around azimuth 150°.

Martillac -Location 2

Martillac – Location 2 – 23 m high tower crane – CJMR 1320 kHz

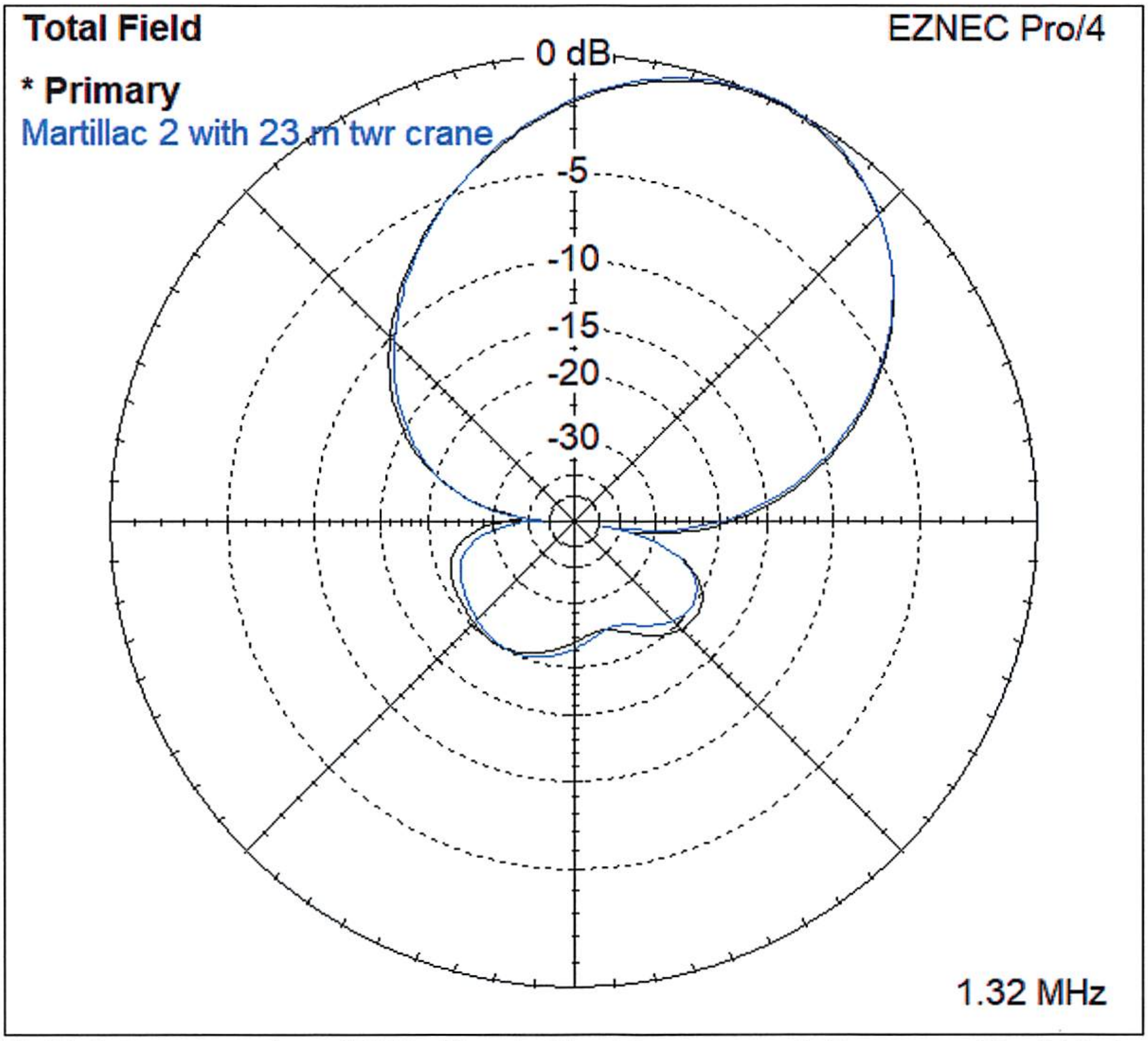


Fig. 21: Pattern comparison of CJMR with and without the presence of a Tower crane 23 m high at Martillac Location 2. The blue trace is the pattern with the presence of the tower crane. Both nulls at the West and East have their depths increased. Variations of more than 1 dB can be seen around 80° and 305° azimuths on the main lobe. Variations of up to 4 dB can be seen on the rear lobes

Martillac – Location 2 – 30 m high tower crane – CJMR 1320 kHz

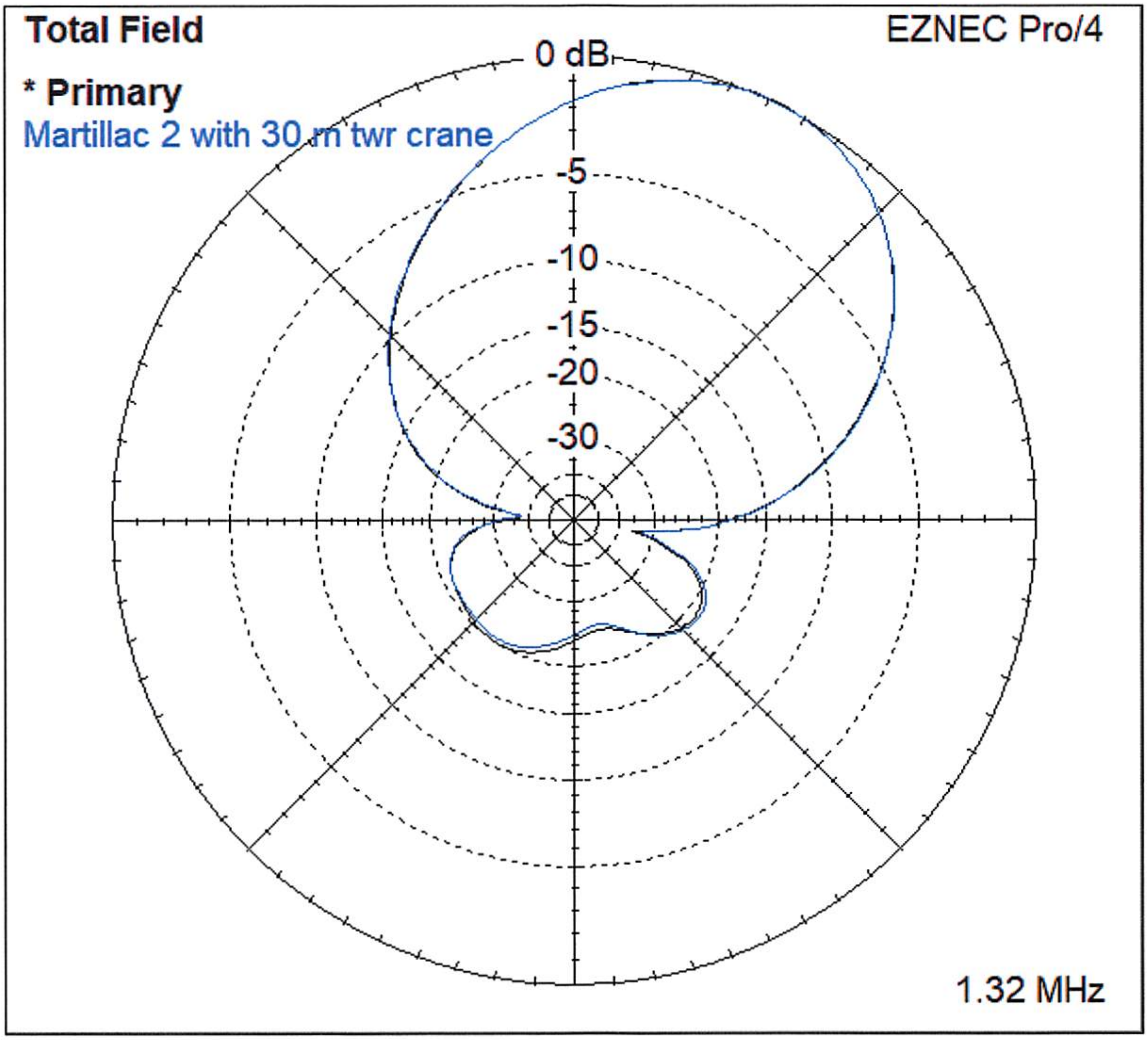


Fig. 22: Pattern comparison of CJMR with and without the presence of a Tower crane 30 m high at Martillac Location 2. The blue trace is the pattern with the presence of the tower crane. Reduction of 1 dB on the sector between 160° and 225°.

Martillac – Location 2 – 27 m high tower crane – CJMR 1320 kHz

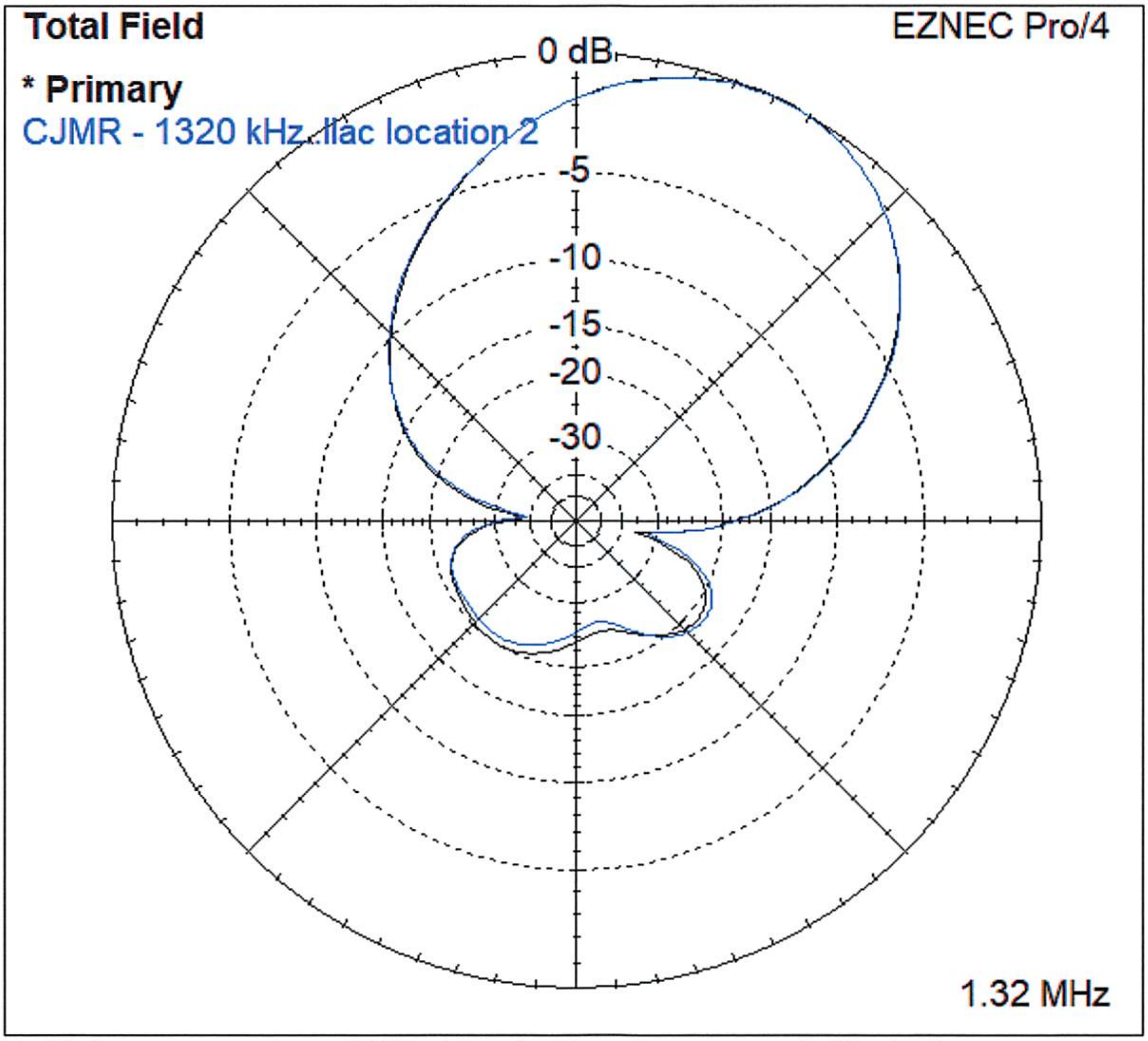


Fig. 23: Pattern comparison of CJMR with and without the presence of a 30 m high tower crane at Martillac Location 2. The blue trace is the pattern with the presence of the tower crane. Pattern reduction of 2 dB at the quadrant centered around the South. The opposite -augmentations- on ESE octant.

Martillac – Location 2 - 24 m high tower crane – CJMR 1320 kHz

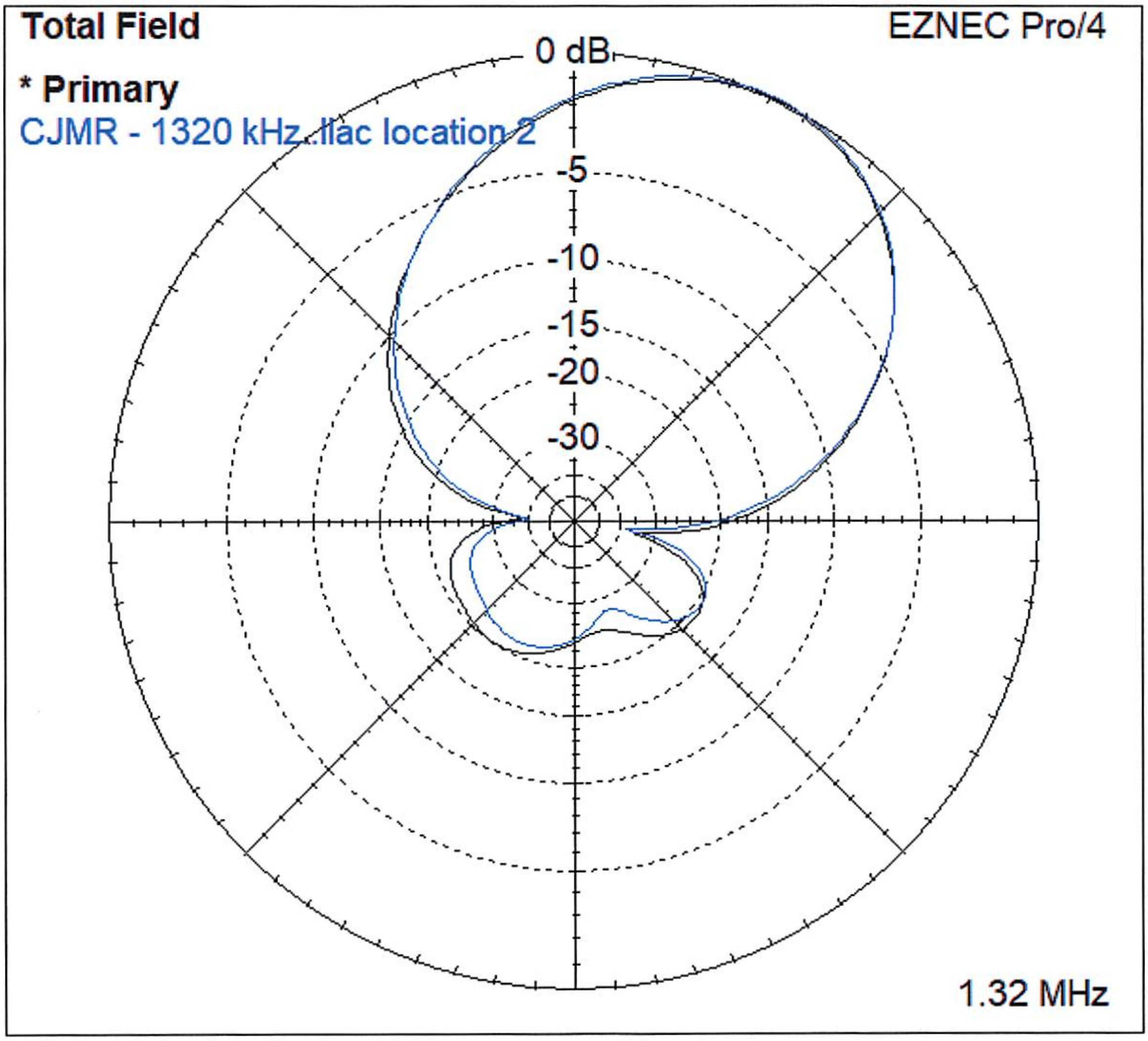


Fig. 24: Pattern comparison of CJYE 1250 kHz with and without the presence of a 24m high tower crane at Martillac Location 2. The blue trace is the pattern with the presence of the tower crane, the black without. The SW rear lobe loses up to 4 dB of intensity and reaches more than 6 dB to the SSE. Variations of up to 2 dB on the main lobe at the WNW octant.

Martillac – CJYE 1250 kHz Pattern

Same configurations and locations used for CJMR 1320 kHz will be used to model the radiation patterns for CJYE 1250 kHz. The radiation pattern comparisons showing the reradiation effects are below.

Martillac – Location 1 – Tower Crane Modeling CJYE 1250 kHz

Martillac – Location 1 - 23 m high tower crane – CJYE 1250 kHz

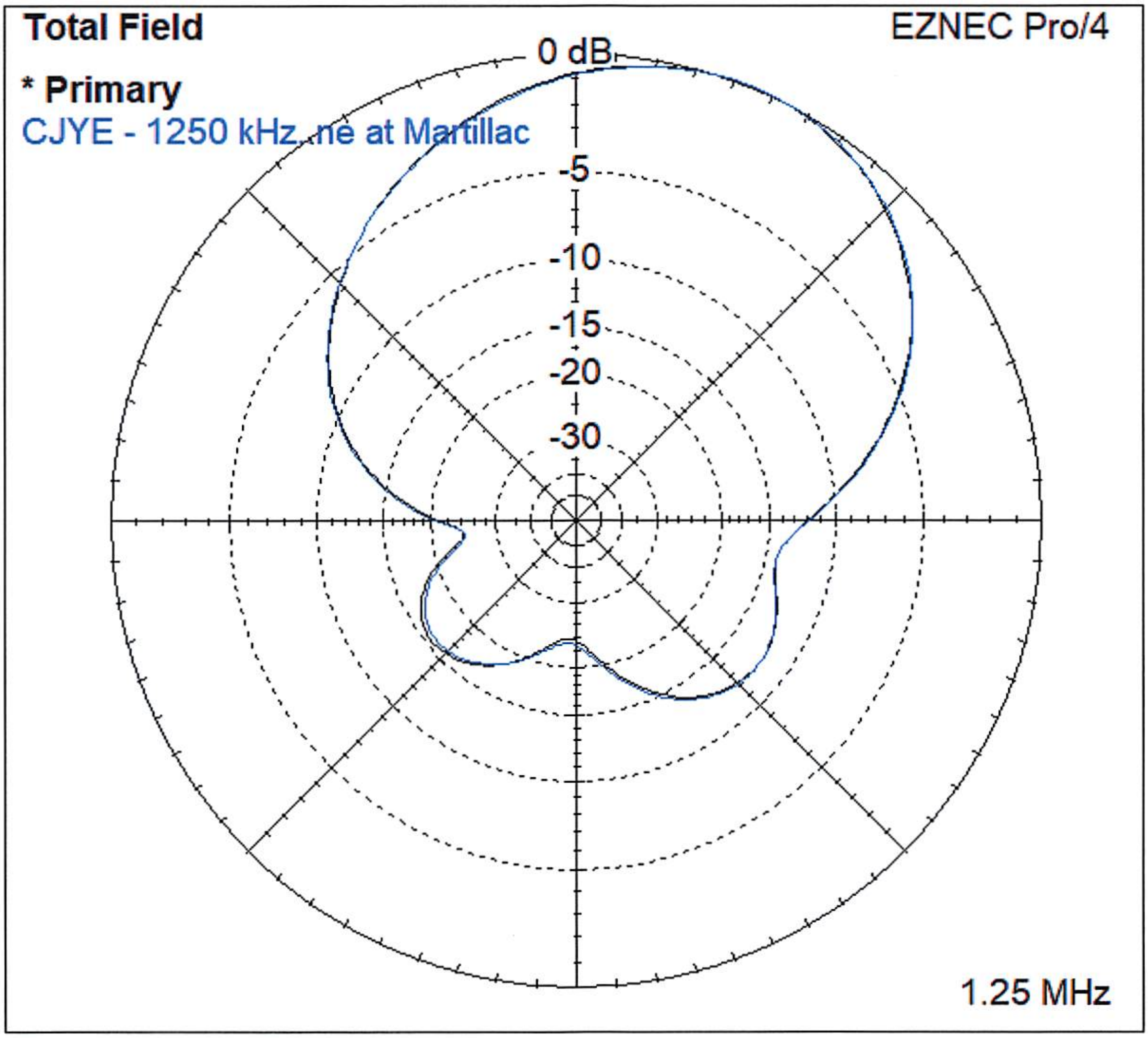


Fig. 25: Pattern comparison of CJYE 1250 kHz with and without the presence of a 23 m high tower crane at Martillac Location 1. The blue trace is the pattern with the presence of the tower crane, the black without. See Figure 25 for comments.

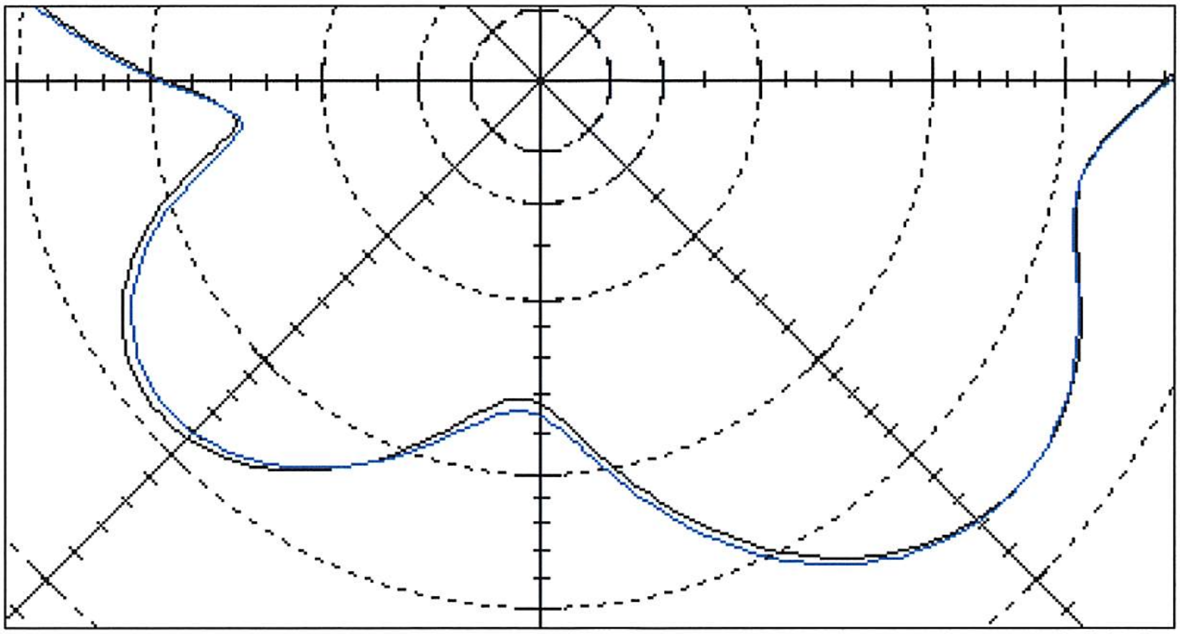


Fig. 26: Magnification of rear lobes of CJYE 1250 kHz pattern shown on previous figure, with (blue) and without (black) a 23 m high tower crane placed at Martillac Location 1. Small variations of almost 1 dB to the south and almost 2 dB to the WSW.

Martillac – Location 1 - 30 m high tower crane – CJYE 1250 kHz

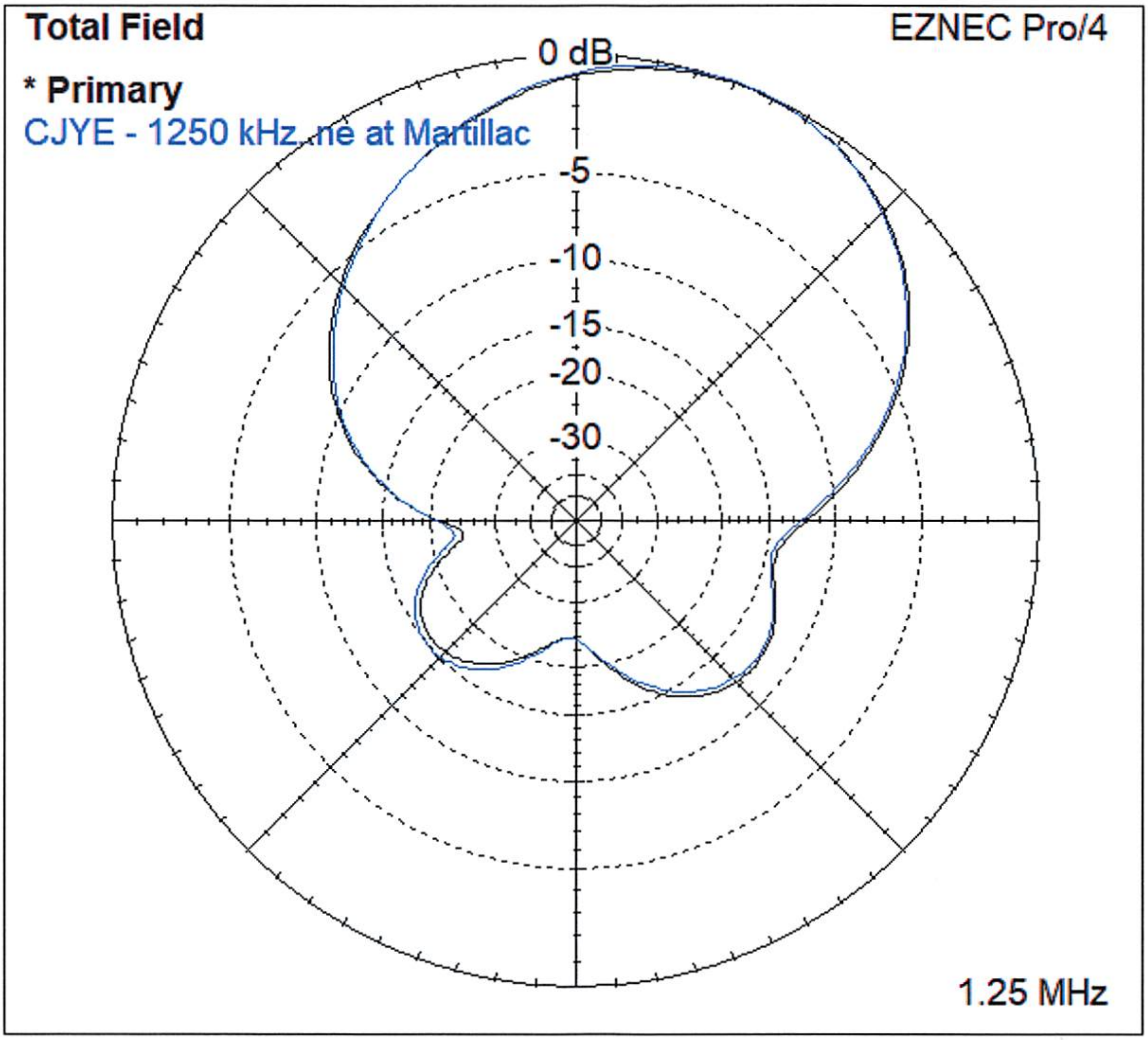


Fig. 27: Pattern comparison of CJYE 1250 kHz with and without the presence of a 30 m high tower crane at Martillac Location 1. The blue trace is the pattern with the presence of the tower crane, black is without. See Figure 28 for comments.

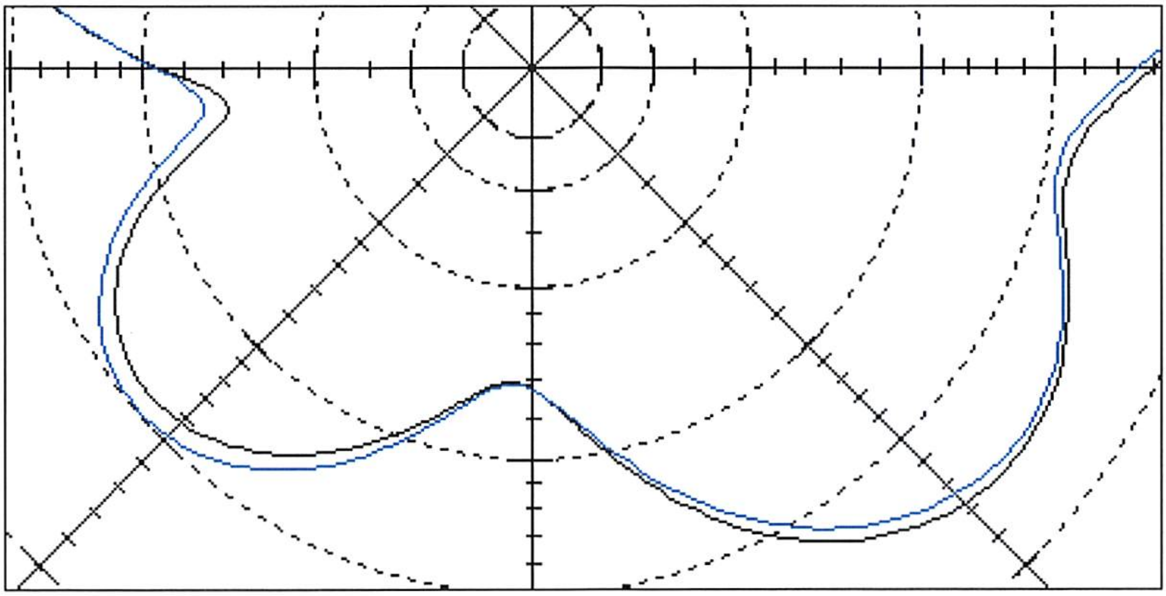


Fig. 28: Detail of rear lobes of CJYE 1250 kHz shown on Figure 27, with (blue) and without (black) a 30 m high tower crane at Martillac Location 1. Fluctuations between 1 and 2 dB can be seen. West null depth losses 1.5 dB.

Martillac – Location 1 - 27 m high tower Crane– CJYE 1250 kHz

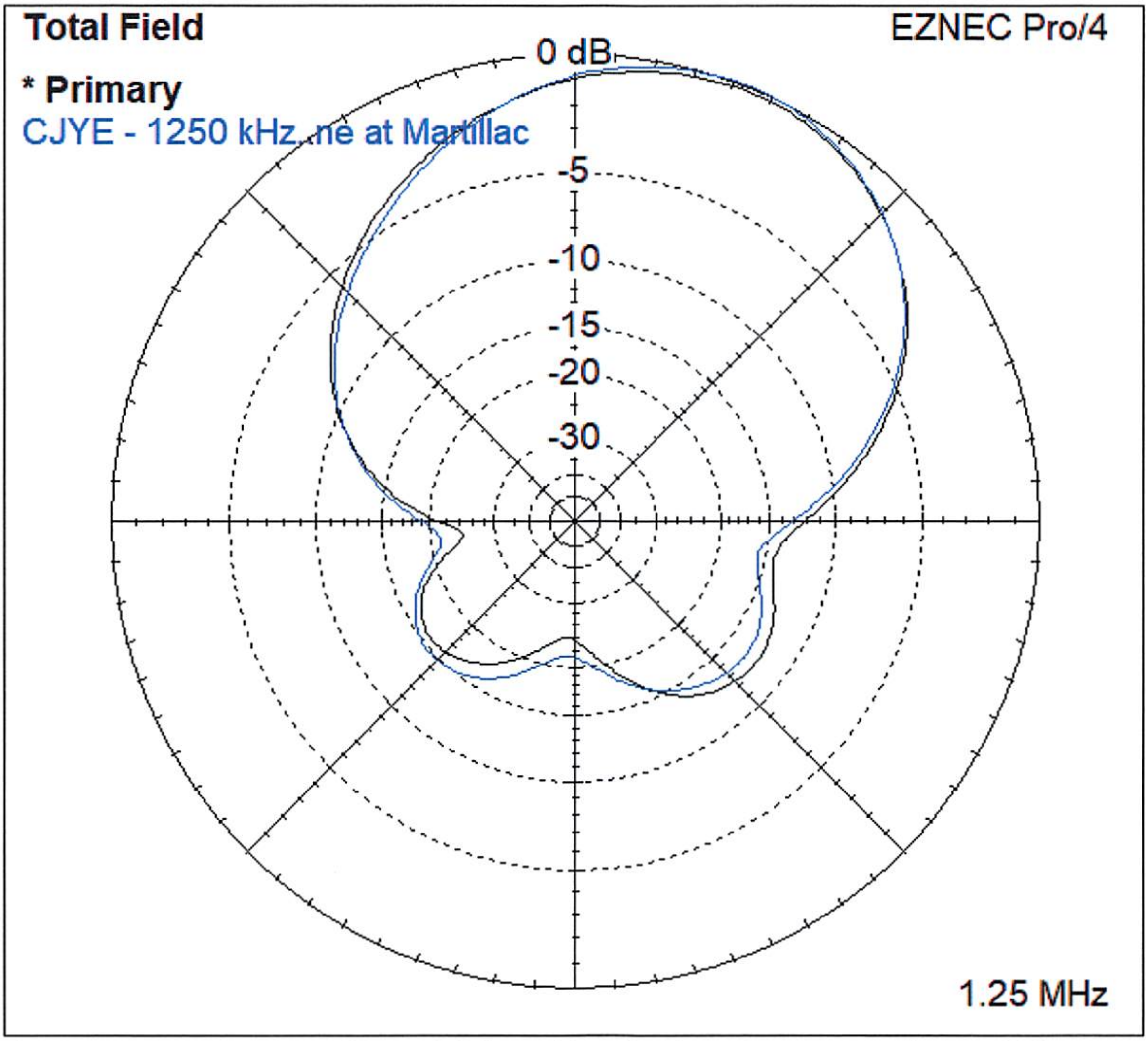


Fig. 29: Pattern comparison of CJYE 1250 kHz with and without the presence of a 27 m high tower crane at Martillac Location 1. The blue trace is the pattern with the presence of the tower crane, black is without. Fluctuations of 5 to 6 dB can be seen on the rear lobes and nulls. On the main lobe, 2 dB fluctuations to the NW-NNW area.

Martillac Location 2 - Tower Crane Modeling

The same tower crane with heights ranging from 23 to 30 meters and fixed boom dimensions are modeled at Location 2 in Martillac.

Martillac – Location 2 - 23 m high Tower Crane – CJYE 1250 kHz

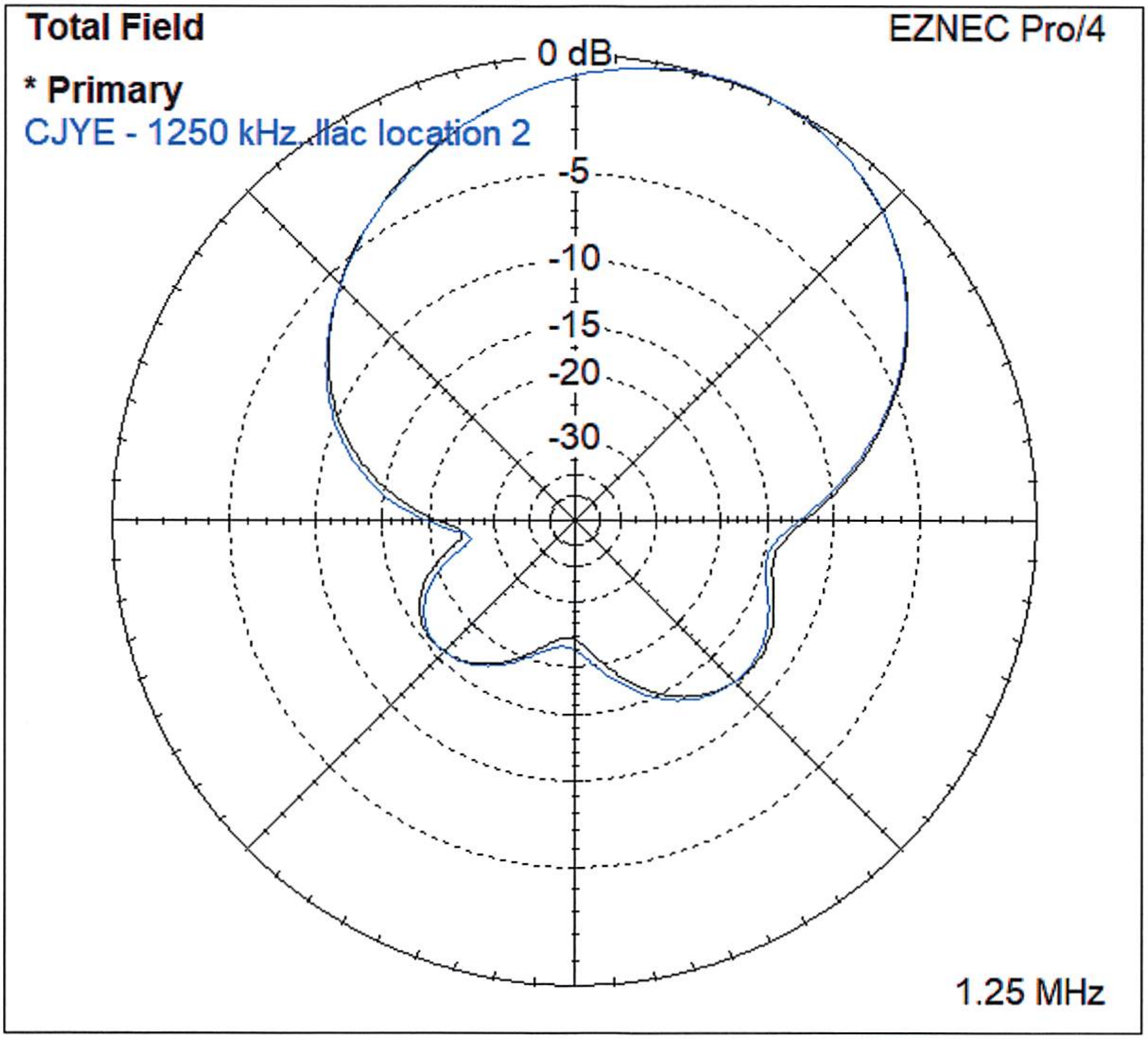


Fig. 30a: Pattern comparison of CJYE 1250 kHz with and without the presence of a 23 m high tower crane at Martillac Location 2. The blue trace is the pattern with the presence of the tower crane, black is without. Illustrated are fluctuations of almost 2 dB around azimuth range 270° to 285° and around 1 dB on 165° to 195° azimuths.

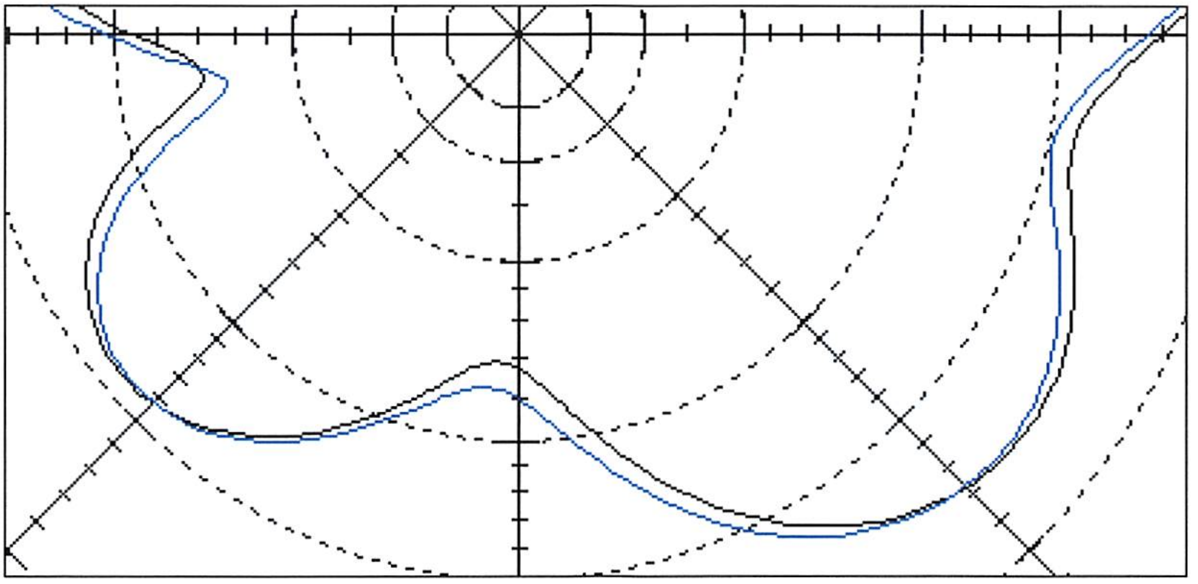


Fig. 30b: Magnification of rear lobes of CJYE 1250 kHz from Figure 30a, with (blue) and without (black) a 23 m high tower crane at Martillac Location 2. Augmentation of 2 dB on the South null, shift and more depth on West null.

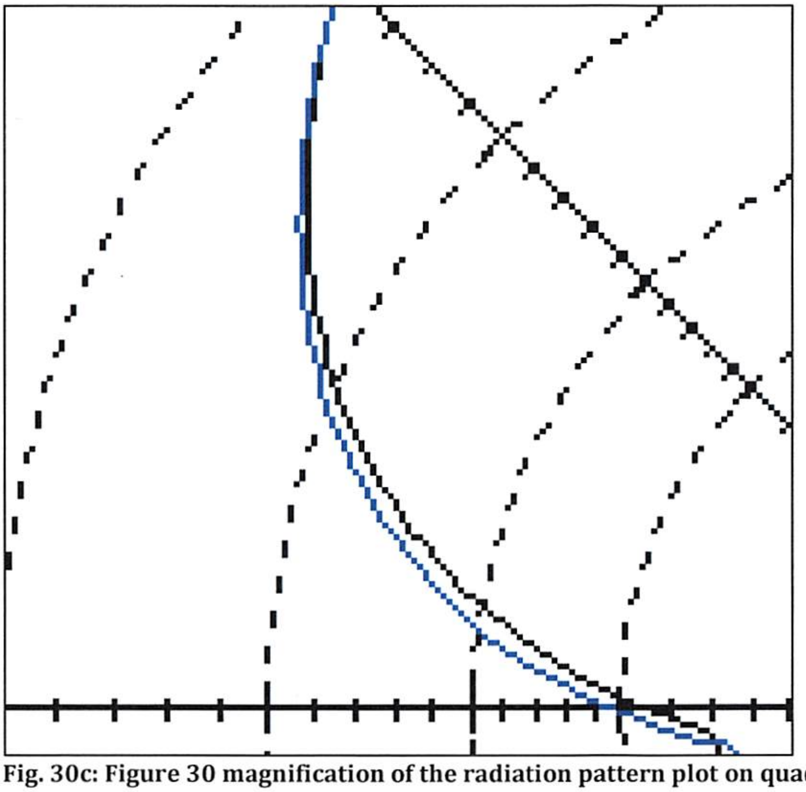


Fig. 30c: Figure 30 magnification of the radiation pattern plot on quadrant WNW (270° - 315°). Augmentations of 2 dB can be seen on the main lobe.

Martillac – Location 2 - 30 m high Tower Crane– CJYE 1250 kHz

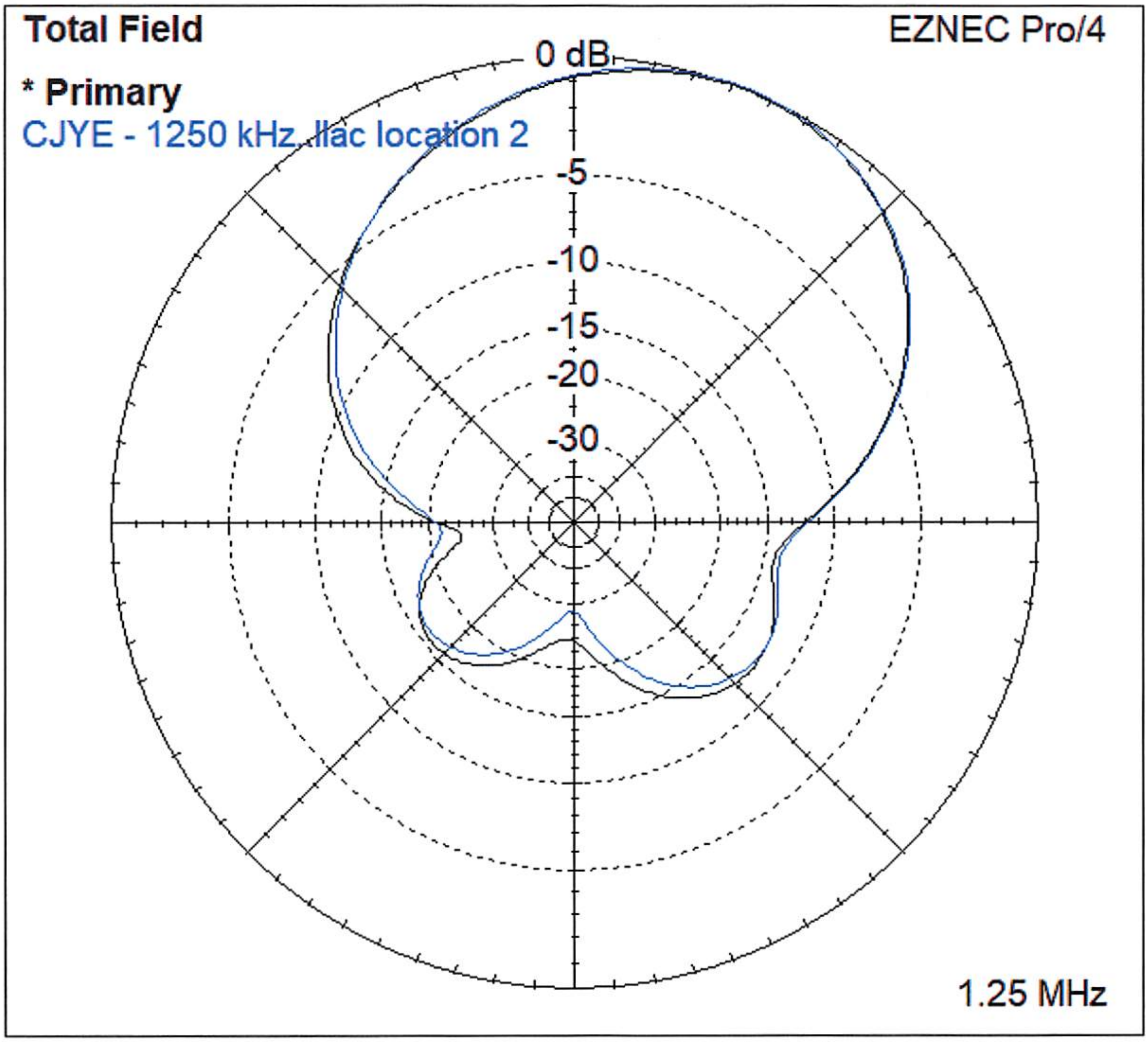


Fig. 31: Up to 4 dB variations can be seen on this pattern comparison. The blue trace is the disturbed pattern.

Martillac – Location 2 - 27 m high tower Crane – CJYE 1250 kHz

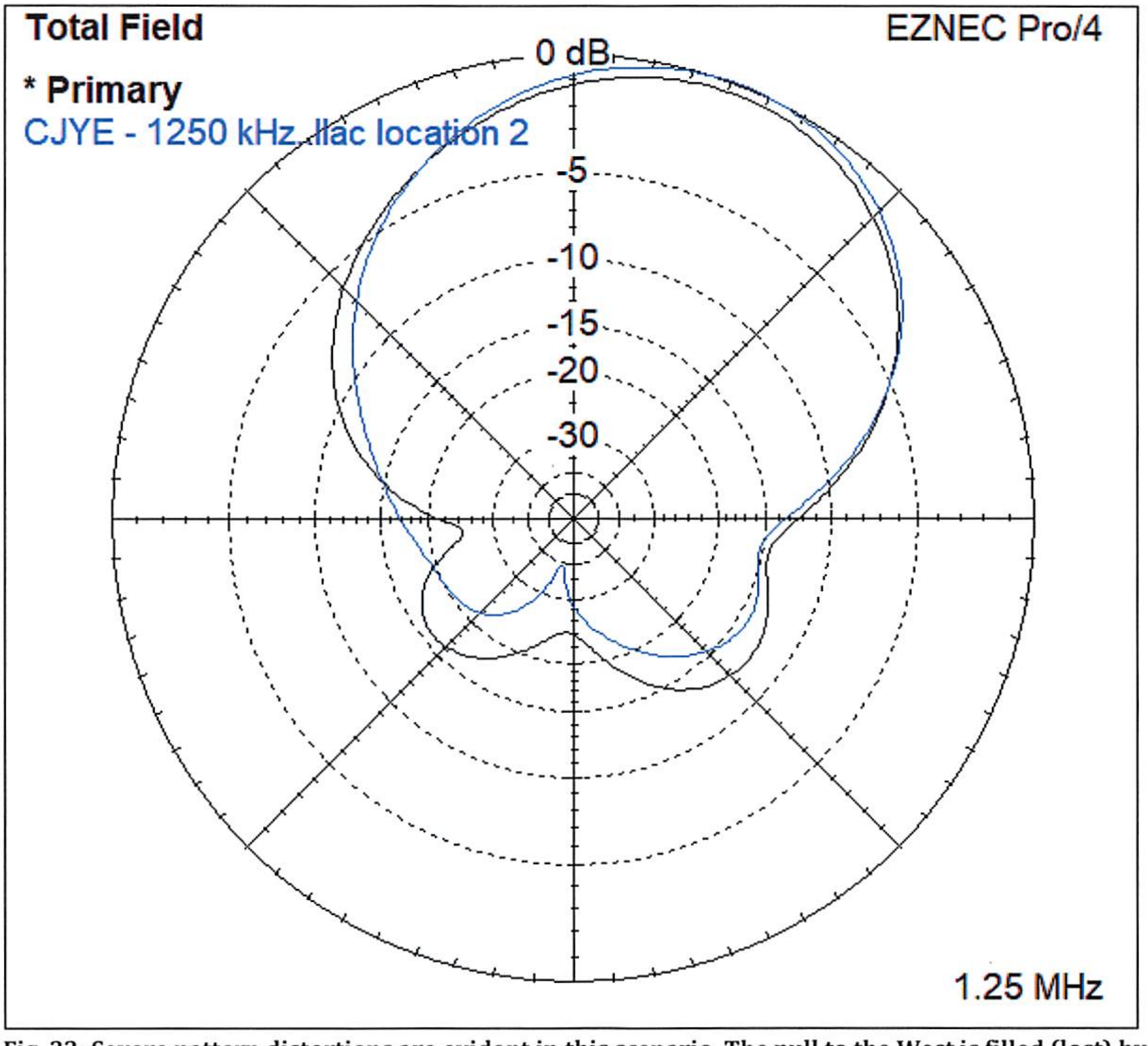


Fig. 32: Severe pattern distortions are evident in this scenario. The null to the West is filled (lost) by an increment of 10 dB. The null to the South is displaced and made 15 dB deeper. There is a reduction of more than 4 dB on the main lobe at the WNW octant. The blue trace is distorted pattern.

Martillac – Mobile Crane MOM Modeling

A mobile (truck) crane is more likely to be used for low rise, 3-4 story buildings. Shown here are three configurations at Martillac Location 1. The 40 m long boom is at 60 degrees elevation and three different hook positions are selected for the modeling; hook at 1 m above ground, hook at 17 m below boom tip and hook fully up. On Martillac Location 2, only the 17 m below boom tip hook position was modeled, given that at Location 1 it caused the greatest pattern distortion.

Martillac - Location 1 - CJMR 1320 kHz

Martillac – Location 1 – Mobile Crane with 40 m boom at 60° elevation, hook 1 m above ground – CJMR 1320 kHz

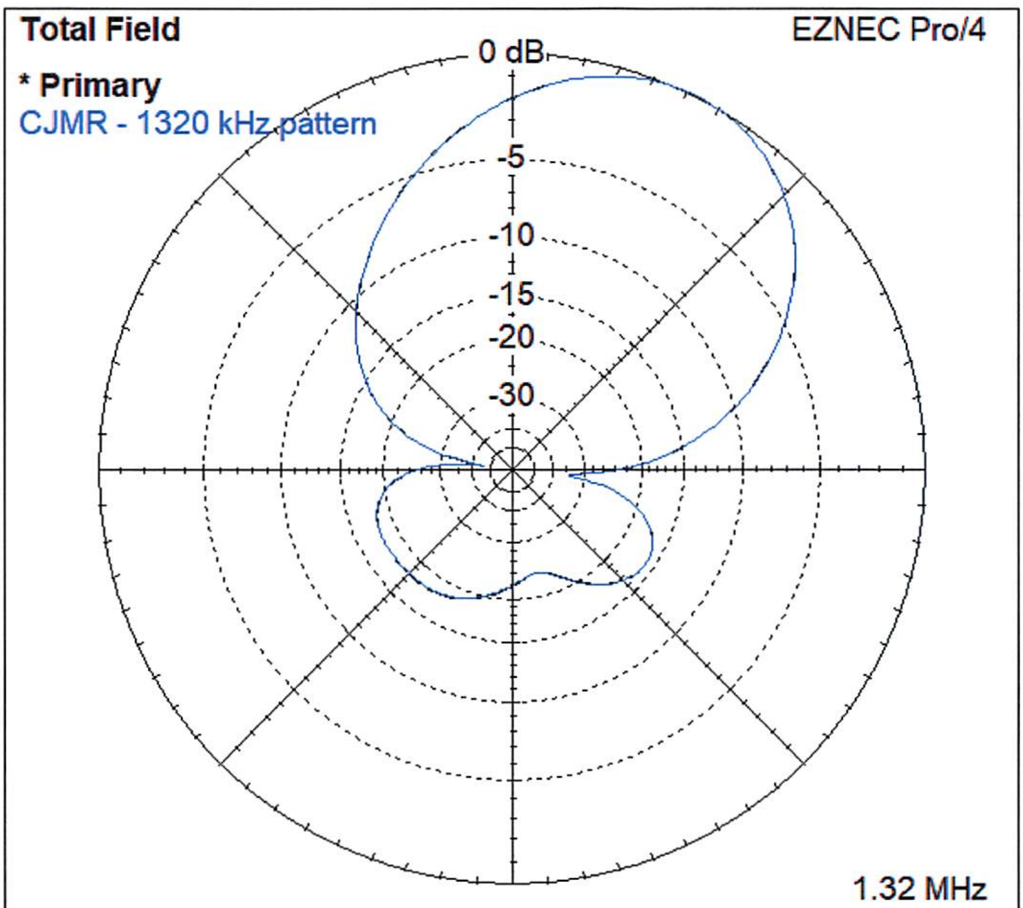


Fig. 33: CJMR 1320 kHz radiation pattern comparison in the presence of a mobile crane with a 40 m boom at 60 degrees elevation and hook 1 m above ground at Martillac Location 1. No pattern distortion caused.

Martillac – Location 1 – Mobile Crane with 40 m boom at 60° elevation, hook 17 m down – CJMR 1320 kHz

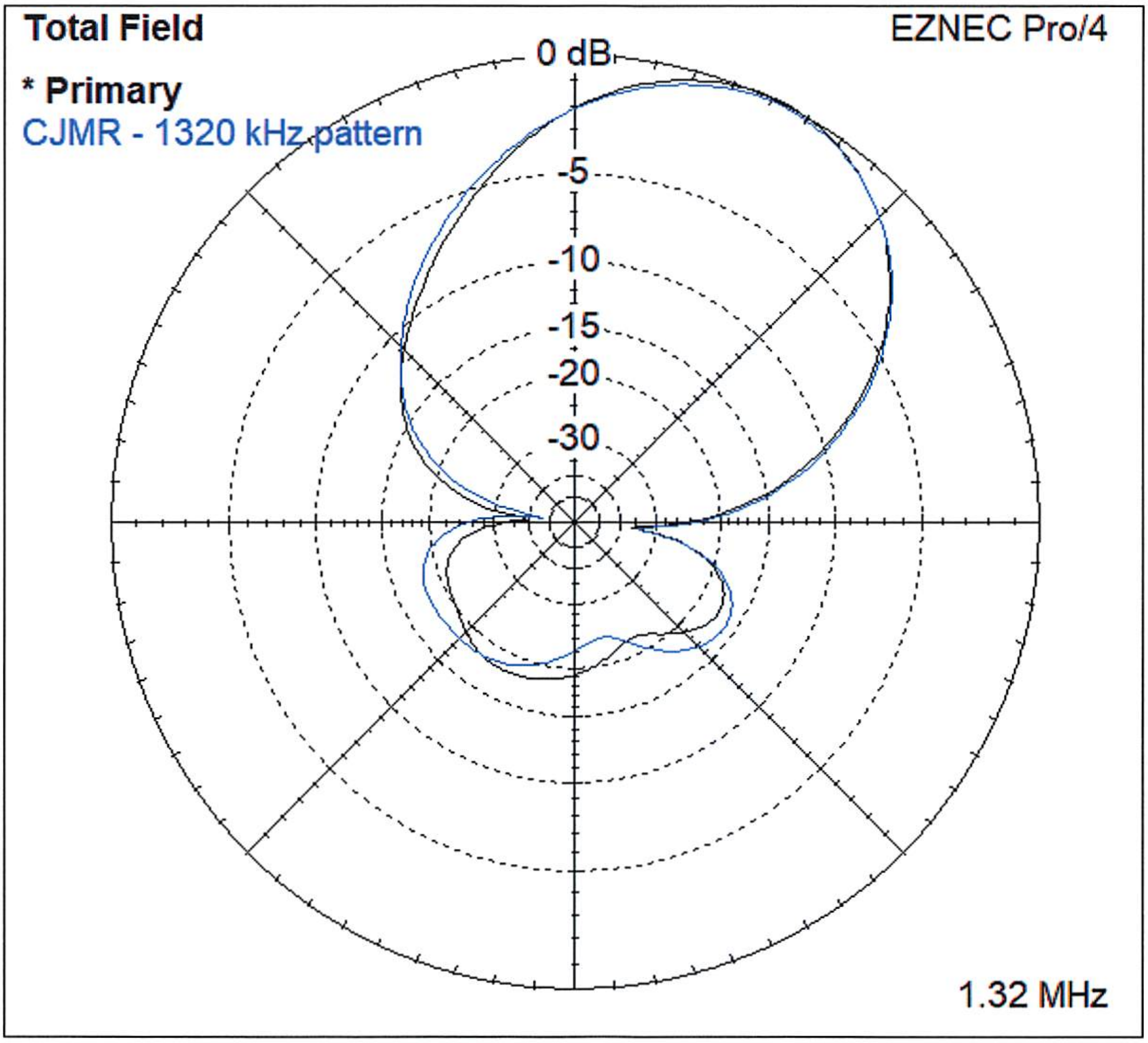


Fig. 34: CJMR 1320 kHz radiation pattern comparison in the presence of a mobile crane with a 40 m boom at 60 degrees elevation and hook 17 m from the top at Martillac Location 1. Evident distortions of pattern, rear lobes up to 5 to 6 dB and front lobe has 2 to 4 dB variations on the NW quadrant.

Martillac – Location 1 – Mobile Crane with 40 m boom at 60° elevation, hook at top of boom – CJMR 1320 kHz

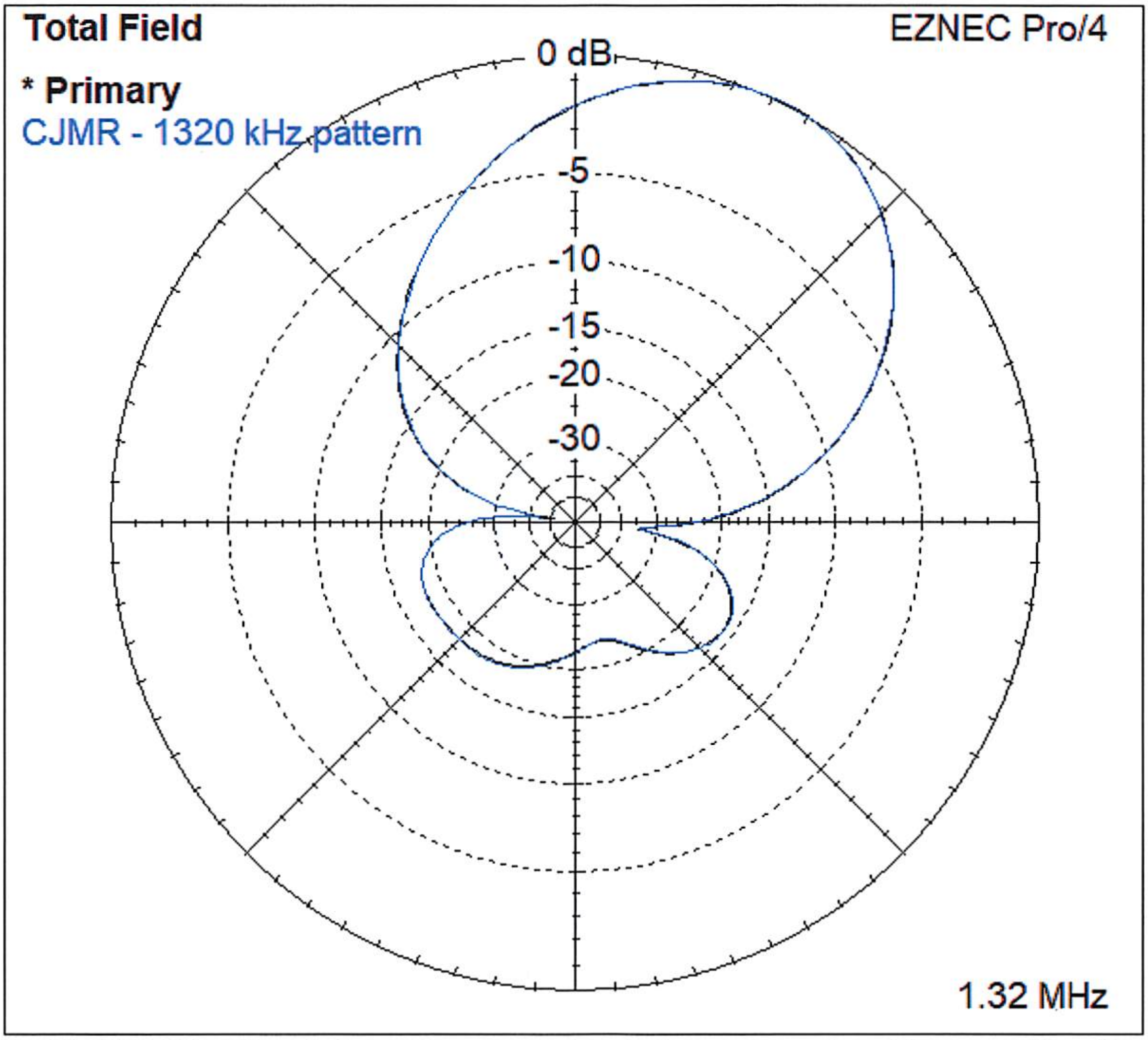


Fig. 35: CJMR 1320 kHz radiation pattern comparison in the presence of a mobile crane with a 40 m boom at 60 degrees elevation and hook full up at Martillac Location 1. Little or no pattern variation caused.

On Figures 33, 34 and 35 when the same crane at the same position changes its geometry by moving the hook up and down, varying the length of the cable that moves the hook, the electrical length of the whole crane structure also varies. Practically no pattern change is detected when the hook is at the top or at the bottom of its race, but in a certain range centered around 17 m under the top, the effect on the radiation pattern is of several dB difference compared with the undisturbed pattern. Next modeling will be only performed using the same hook height at Martillac Location 2, given that this height produces greater effects on the patterns.

Martillac – Location 2 – Mobile Crane with 40 m boom at 60° elevation, hook 17 m from top of boom – CJMR 1320 kHz

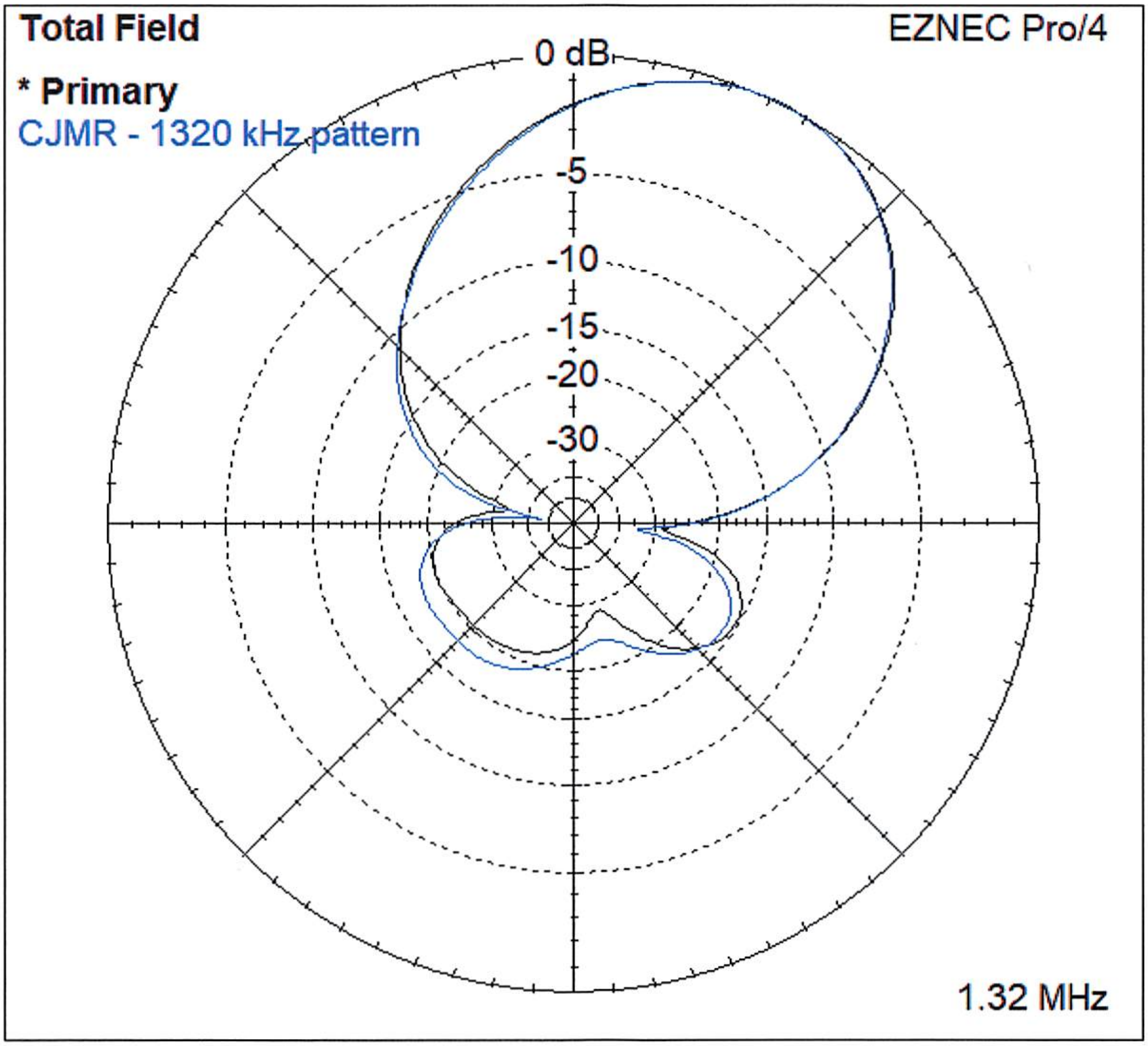


Fig. 36: CJMR 1320 kHz radiation pattern comparison in the presence of a mobile crane with a 40 m boom at 60 degrees elevation and hook 17 m from the top at Martillac Location 2. Evident distortions of pattern, the rear lobes show increments of up to 7 dB (7dB is a factor of 2.25 times on field intensity. This is the same as multiplying the power in watts by a factor of) at about 100° and 165° azimuths and front lobe has 2 to 4 dB variations (26% to 58% field intensity increment) on the NW quadrant.

CJYE – 1250 kHz Mobile Crane MOM Modeling

Similar configurations of the mobile crane will be used to model it at 1250 kHz and show the effects on the CJYE station radiation pattern at Martillac locations 1 and 2.

Martillac – Location 1 – CJYE 1250 kHz

Martillac – Location 1 – Mobile Crane with 40 m boom at 60° elevation, hook 1 m above ground – CJYE – 1250 kHz

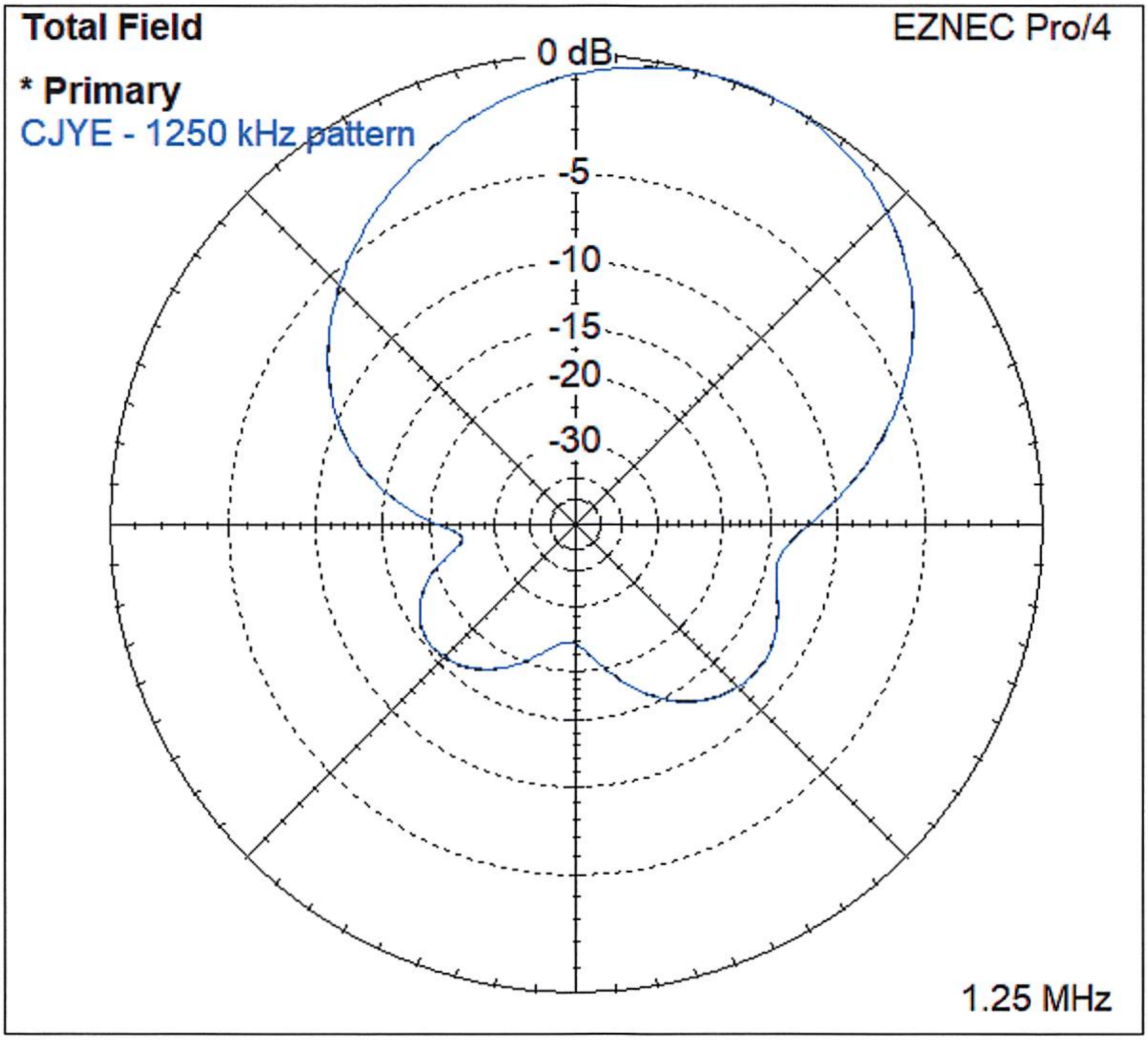


Fig. 37: CJYE 1250 kHz radiation pattern comparison in the presence of a mobile crane with a 40 m boom at 60 degrees elevation and hook 1 m above ground at Martillac Location 1. Little or no pattern distortion caused.

Martillac – Location 1 – Mobile Crane with 40 m boom at 60° elevation, hook 20 m from top of boom – CJYE – 1250 kHz

At 1250 kHz the wavelength is longer (240 m) than the wavelength at 1320 kHz (227.27 m), the resonant length represented by the body, boom and hook cable length is to be longer than the resonant length for 1320 kHz, instead of 17 m under the top, the hook has been set 3 meters lower at 20 m under the top, increasing the body, boom and hook cable length by that amount.

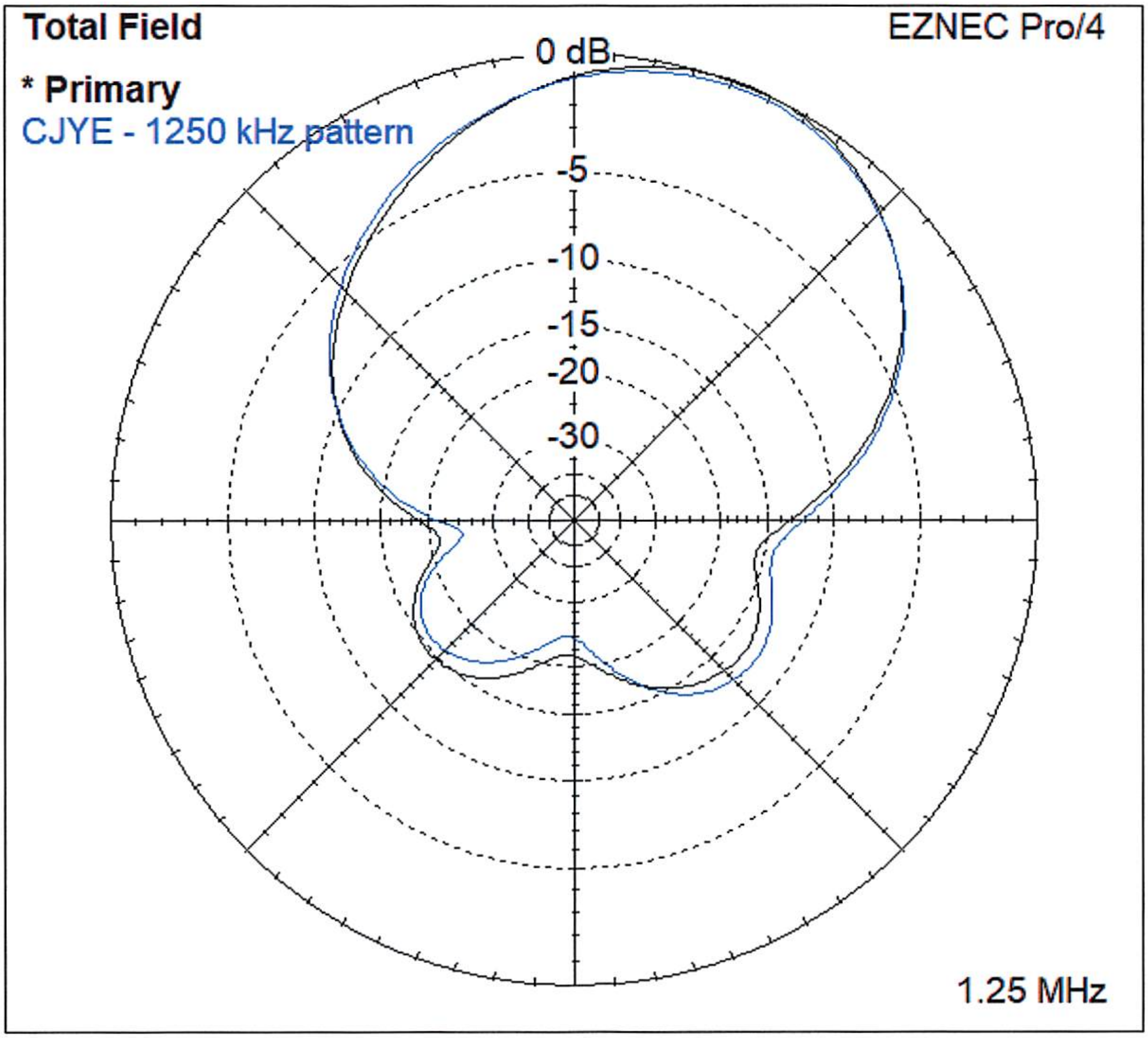


Fig. 38: CJYE 1250 kHz radiation pattern comparison in the presence of a mobile crane with a 40 m boom at 60 degrees elevation and hook 20 m from the top at Martillac Location 1. Evident distortions of pattern, rear lobes up to 3 to 4 dB and front lobe has up to 2 dB variations on the NW quadrant. Null fill to the East losing 3 dB of depth. Depth loss of 3 dB on the South null.

Martillac – Location 1 – Mobile Crane with 40 m boom at 60° elevation, hook at top of boom – CJYE – 1250 kHz

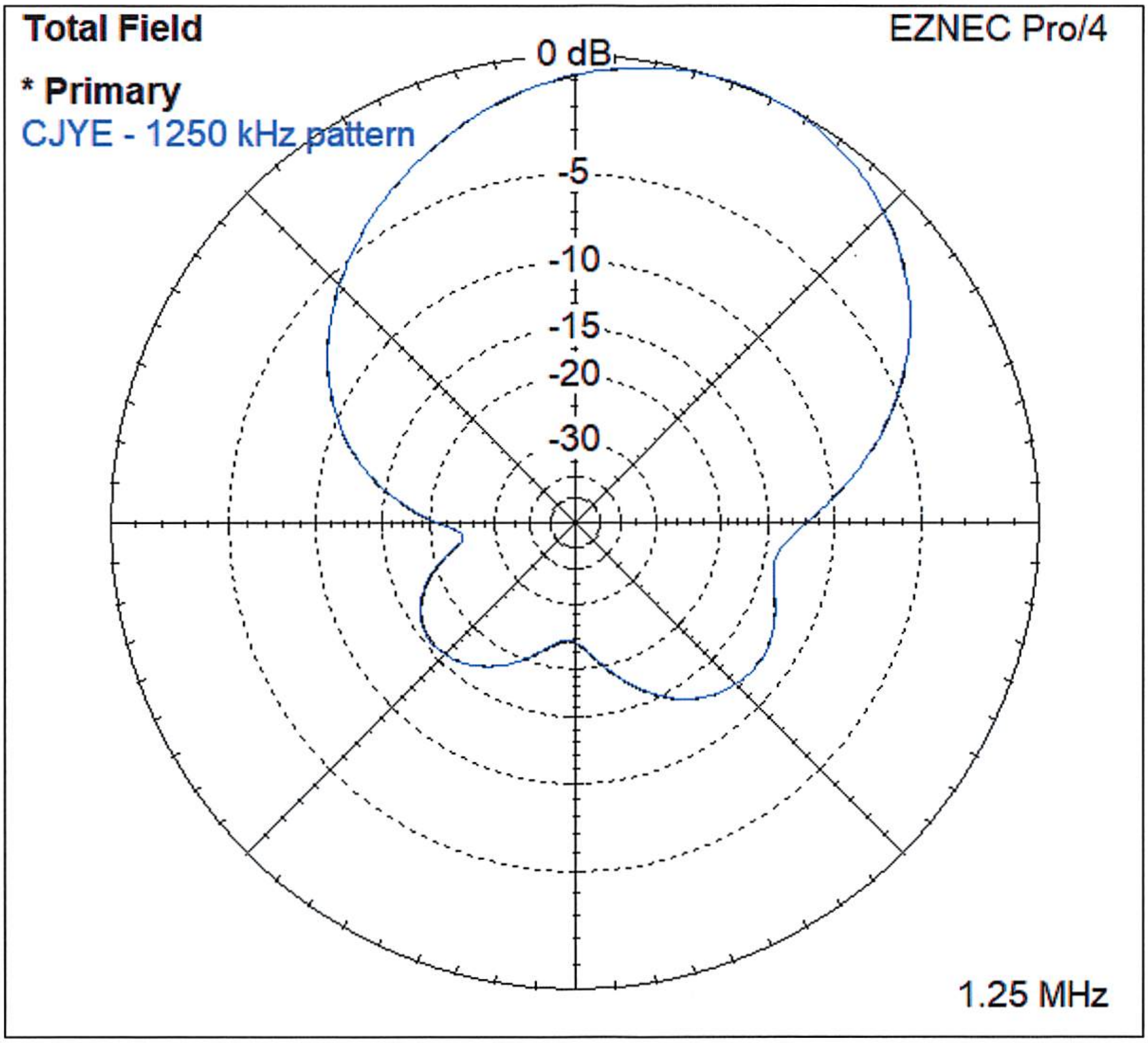


Fig. 39: CJYE 1250 kHz radiation pattern comparison in the presence of a mobile crane with a 40 m boom at 60 degrees elevation and hook full up at Martillac Location 1. Little or no pattern distortion caused.

Martillac – Location 2 CJYE 1250 kHz

Martillac – Location 2 – Mobile Crane with 40 m boom at 60° elevation, hook 20 m down – CJYE – 1250 kHz

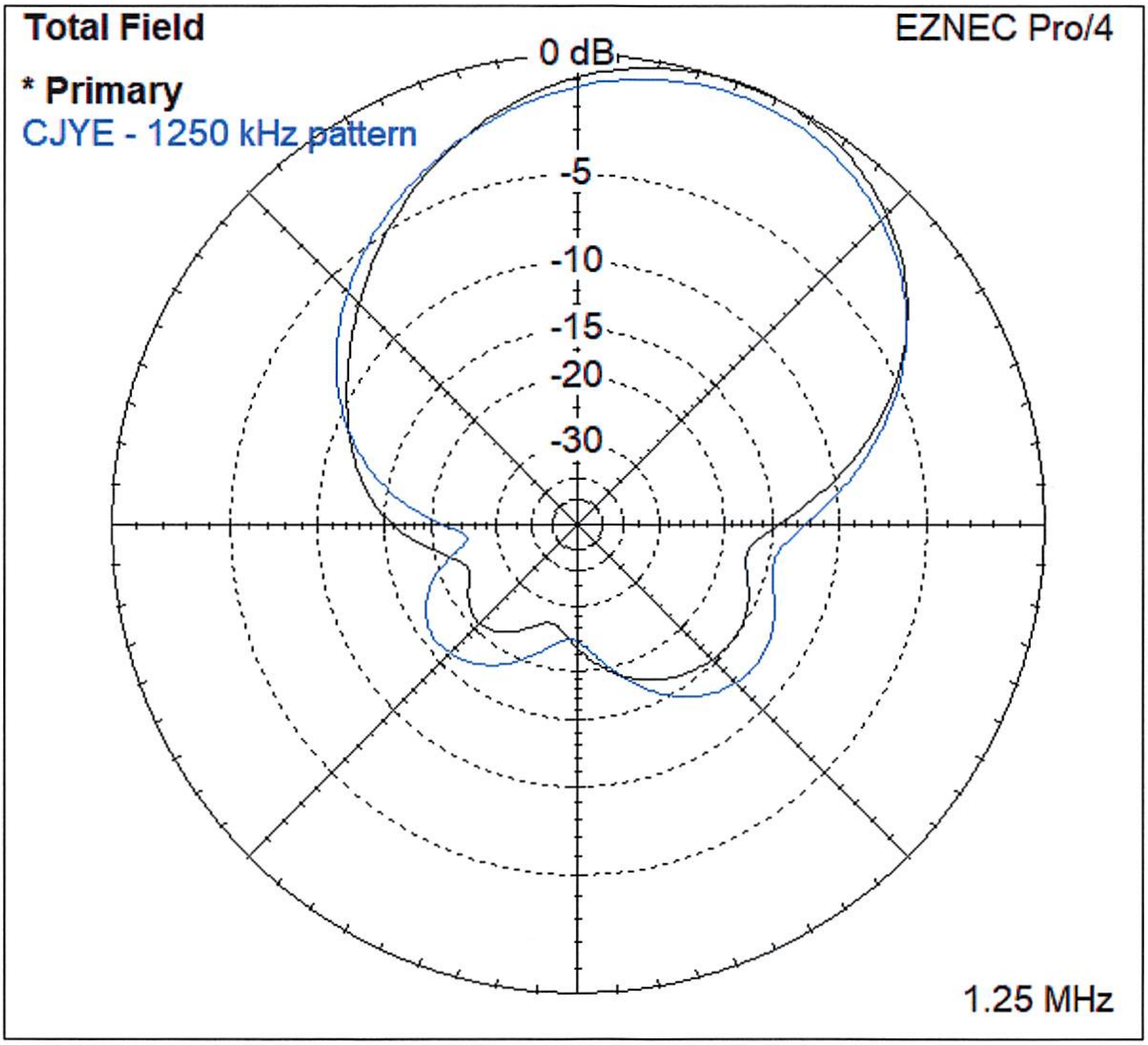


Fig. 40: CJYE 1250 kHz radiation pattern comparison in the presence of a mobile crane with a 40 m boom at 60 degrees elevation and hook 20 m from the top at Martillac Location 2. Evident distortions of radiation pattern in all directions, rear lobe up to 10 dB loss (at about 230° azimuth) and front lobe has 2 to 6 dB variations. The blue trace is undisturbed pattern. Increment of 11 dB to the West (null fill).

This concludes the modeling on how the two AM stations licensed patterns can be affected. These are not necessarily the worst-case scenarios as specific construction methods and specific details of proposed buildings are not yet known.

The next section is about how the human body, animals, buildings, structures, machinery, electronics and other devices can be affected by the RF electromagnetic fields generated by the two AM stations with their 10 kW RF output power.

[*Effects of the RF Electromagnetic Fields on Human Body, Animals, Electronic Devices and Similar Page Follows*]

Assessing the Effects of the RF Electromagnetic Fields on Human Body, Animals, Electronic Devices and Similar

To determine the effects of the RF fields on persons, animals and devices, it is necessary to first calculate the Field Intensity of said fields. The intensity of these RF fields diminishes almost in a linear fashion with the distance.

MOM–Field Strength (FS) Contours

Field Strength contours were calculated and plotted for both CJMR 1320 kHz and CJYE 1250 kHz. To assesses the cumulative impacts of both radio stations operating concurrently, a contour map was created by arithmetically adding the contribution of the calculated RF fields for each station at every point calculated. This shows how high the level of field strength could be if the conditions of phase of both fields and their reflections are favorable to maximize the resultant level of their addition.

Contour maps showing levels of 1 V/m, 2 V/m, 3 V/m, 4 V/m, 5 V/m and 10 V/m were plotted. Numbers at or near the intersections of the radials (azimuths) and the distance circles are in millivolts per meter, mV/m. One volt per meter, 1 V/m is the same as 1,000 mV/m. Numbers in yellow font are distances in meters and degrees of azimuth (radials) as well, referenced to the selected origin used for all the calculations on this study.

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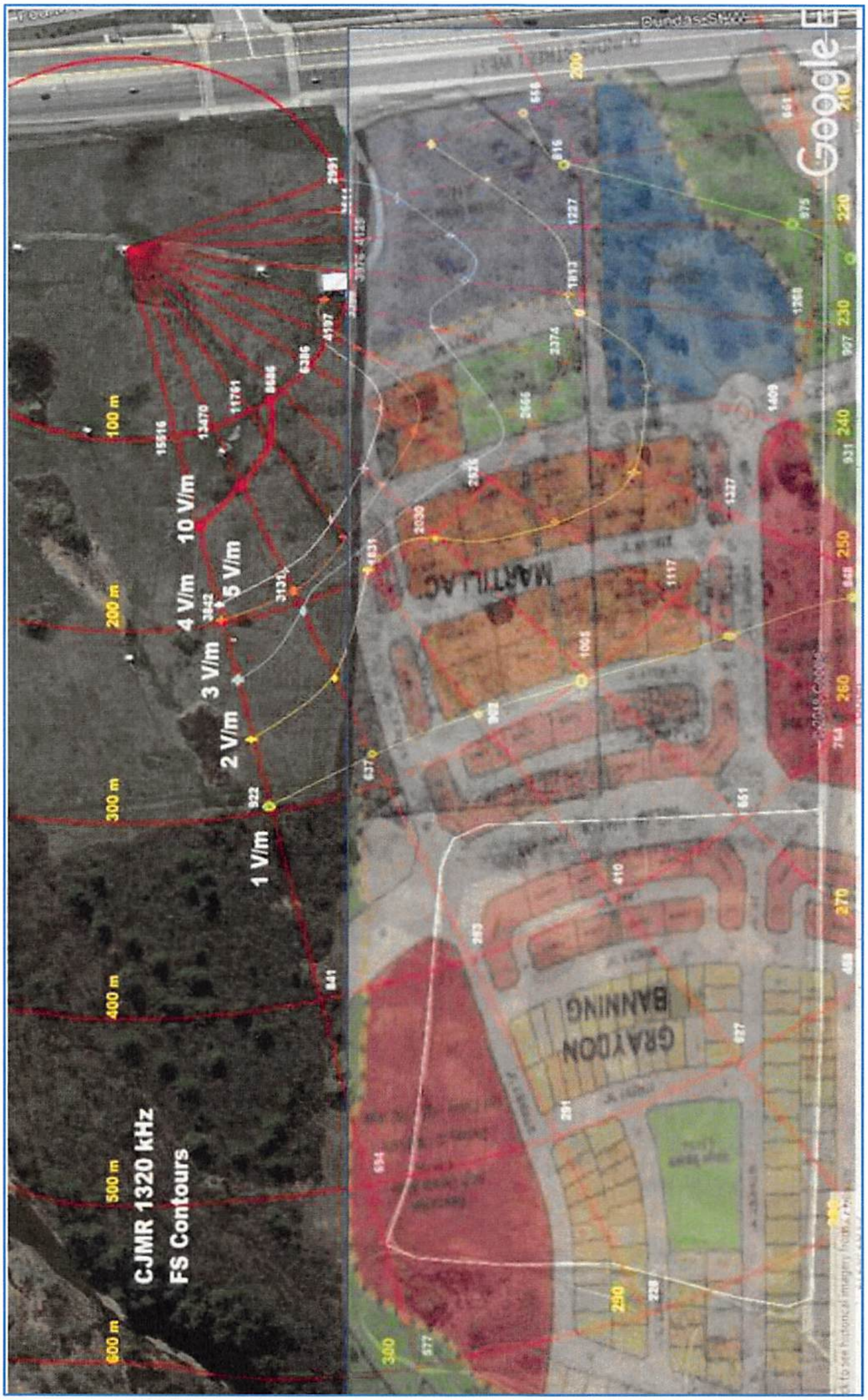

Fig. 41a: FS contour map for CJMR – 1320 kHz.

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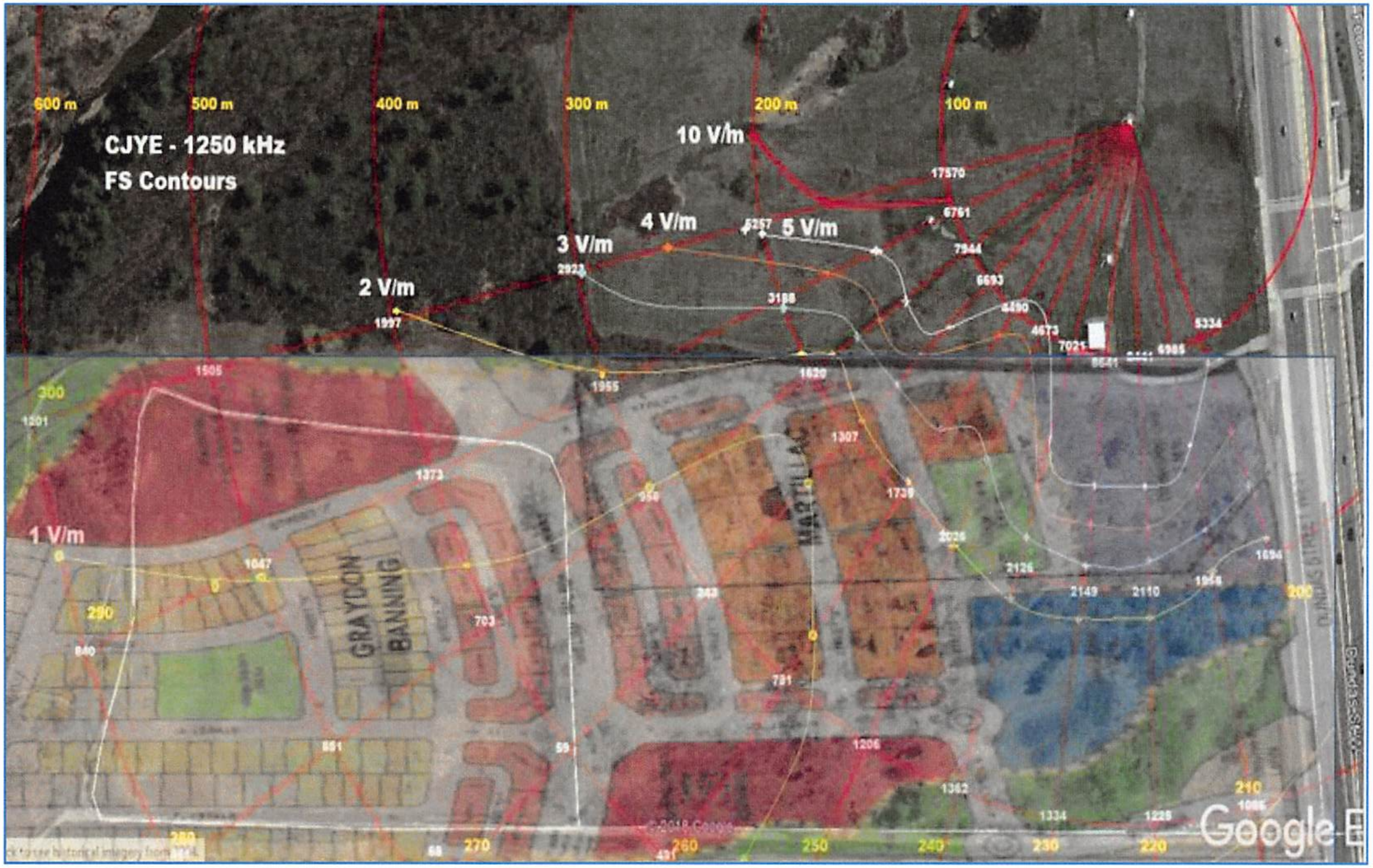

Fig. 41b: FS Contours map for CJYE – 1250 kHz.

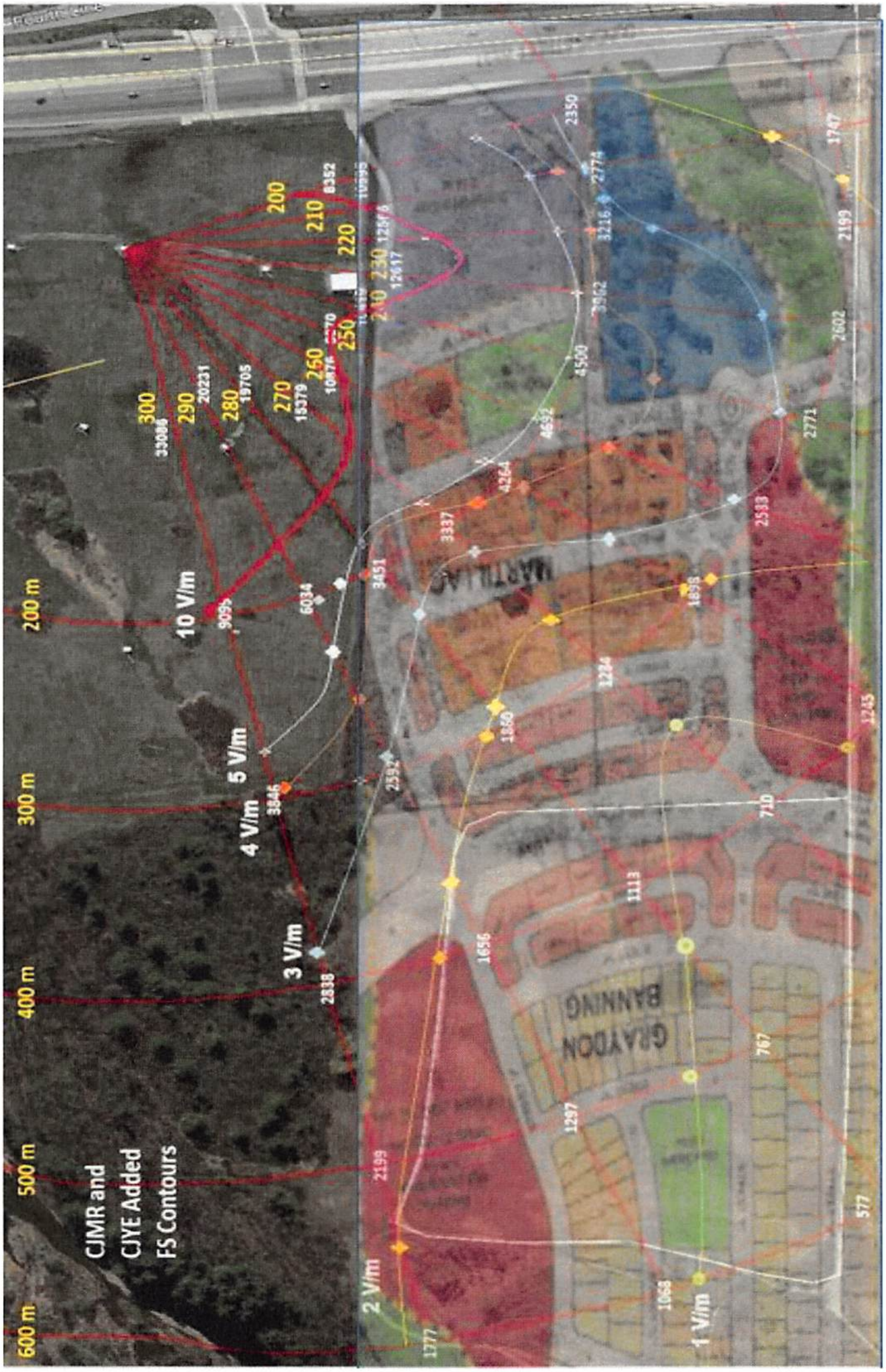

Fig. 41c: Contours map for field intensities arithmetical addition of both CJYE and CJMR

Conclusions and Recommendations

Impacts on AM Broadcasting Operations

ISED Regulation Pattern Limits

As per ISED regulations, the upper limit (extensions or augmentations) is the extended pattern, which is the real pattern product of on the field measurements. The theoretical or nominal radiation pattern is the reference product of the idealistic conditions on terrain without obstacles or any object that may cause pattern distortion.

Part 2: Application Procedures and Rules for AM Broadcasting Undertakings BPR-2

2.6.2 Tolerance

The normal upper limit is the expanded pattern and the normal lower limit is 5% below the theoretical pattern. Any deviation beyond these limits should be justified. Also, if the upper limit is exceeded but this would not lead to interference, the pattern may be modified in accordance with Annex 2, Appendix 3 of *Canada/USA Agreement, 1984*. The upper limit may not be exceeded if interference would result.

Fig. 43: Snapshot from the ISED Document that sets the regulations for Broadcasting Procedures and Spectrum Management and telecommunications, part 2, section 2.6.2 gives the specifics on tolerance. BPR-2 Issue 3, February 2016.

Lower Limit: The regulation above is referenced to variations of the Field Intensity measured in V/m and it should be no greater than -5% from the nominal pattern. Referring to the Table 1, it can be seen that a decrement of 0.5 dB corresponds to a variation of -6% exceeding the allowed change, minus 5% or 0.445 dB less than the theoretical pattern on a given direction. Therefore, any decrease of 0.45 dB or greater is considered out of limits.

Upper Limit: The authorized extended radiation pattern is the higher limit. Before exceeding this limit, an extensive study must be conducted to verify that no interference is caused by the increments to any other service.

Modeled Patterns Distortion Evaluation

Construction Phase Impacts: During construction, any metallic equipment like tower cranes, truck cranes and other machinery and structures with dimensions that are at least one tenth of wavelength or greater as stipulated by the FCC and widely accepted by the industry (this lower limit can be less when distances are shorter), will potentially affect the pattern on varying levels ranging from negligible to severe, as can be seen on some of the cases modeled.

It should be noted that the modeling examples are not necessarily the worst-case scenarios. On the Figures 33, 34 and 35, generated from the same mobile crane on the same location and orientation at Martillac, it can be seen how changing the conducting structure dimensions when the hook is moved as it would during normal operation, it changes the amount of interaction with the RF fields. Other geometric combinations will produce pattern distortion that could have a greater impact than the ones found here. There is no pattern distortion when the hook is at the top or at the bottom of its race, but somewhere in between there is a range of heights that causes severe distortion of the radiation patterns.

Post Construction Impacts: The modeling used arbitrary configurations of building shape, crane geometry, placement at average and extreme locations. The information on the final shape of the buildings proposed, their location and quantity is not available, thus it is not possible yet to accurately quantify how the new construction will affect the performance of the AM stations. There is no question that both patterns will be affected, the question is to what extent it will be exceeding the limits set by the Federally regulated licenses of the AM stations.

The patterns comparisons have shown on most of the cases modeled, with few exceptions, that there are several radiation pattern perturbations ranging from 0.5 dB to 10 dB. In the case of the field intensity decrements, this exceeds the lower 5% variation limit in a range of factors that go from 1 to 20 times the 5% limit. As for the upper limit, which regulation admits no variation, it has been registered positive variations (increments) of up to 10 dB which is tenfold the equivalent power or more than three times (3.2x) voltage field.

In lay terms, this means that the Federally regulated patterns of CJYE and CJMR will be seriously affected, causing both stations to be out of licensed operating parameters. CJYE 1250 kHz will be impacted to a greater degree because being at a lower frequency, its wavelength is longer. This makes the relative distances measured in wavelengths are shorter for this frequency. This is also demonstrated on the FS contour plots.

Impacts on Safety, Construction Equipment and Consumer Electronics

Summary of MOM–Field Strength (FS) Results

When CJMR 1320 kHz is operating alone, approximately 15% to 20% of the area containing the sections Graydon-Manning and Martillac would be under a permanent FS intensity of 1.83 V/m or greater (see Fig. 41A). When CJYE 1250 kHz is operating alone, approximately 25% to 30 % of the area containing the sections Graydon-Manning and Martillac would be under a permanent FS intensity of 1.83 V/m or greater (see Fig. 41B).

When both CJYE 1250 kHz and CJMR 1320 kHz are operating concurrently, about 70 % of the Graydon-Manning and Martillac developments would be in a permanent FS intensity of 1.83 V/m or greater and about 30% of the area would be at 3 V/m or greater (see Fig 41C).

The presence of two transmitters, each using 10 kW and a small frequency separation will cause random additions of their individual field intensities. The maximum possible of these levels is shown on Figure 41c earlier in this report. The development schematic is superimposed on the Google Earth image. The red radials show azimuth and the circles are the distance from the antenna array reference center.

Safety Hazards

The RF electromagnetic fields would induce the current onto a metal structure. Acting like an antenna, the structure would be energized and the voltage levels would vary along the lengths of the structure. Normally the voltage can be high at the ends of a long metal piece. When the human body comes into contact with an RF energized object, such as a metal cable or element, current flows at the point of contact (known as contact current) which can cause the heating of human tissues. This is known as contact current. The current will depend on the voltage at the contact point and the body's resistance which depends on factors like water content, skin sweat and points of entry and exit of the current and the contact area at these two points. Further information may be found at the LBA Group website: https://www.lbagroup.com/resources/rf-shock-and-burn-radio-frequency-radiation-technical-note-124

During construction, any metal object that has a dimension long enough to behave like an antenna at the frequencies involved can be a source of contact current. For example, the column of a construction elevator and its cables, provisional safety railings, the steel rebars placed before the concrete mix is poured.

The hazards of contact current, contact voltage levels are defined on the Health Canada's Safety Code 6. Any intensity above 1 V/m could cause RF contact currents to exceed the safety limits. The RF intensities that will be present at the development site (from 0.5 V/m to well in excess of 5 V/m) will cause a contact current safety issue at most locations on the site. In addition, depending on the amount of energy induced, objects such as a cable of a crane or even a crane's whole structure, could cause RF arcing – a phenomenon caused by the currents induced on metal structures and cables whereby electrical current travels or jump across a gap in surfaces, creating sparks.

The arcing shown in Figures A1-1a and A1-1b in Annex 1 was caused in a 2.5 V/m intensity RF field from an AM station. This arcing can happen in a lower intensity RF field if the structure's geometry makes a better and more efficient "antenna" for the wavelength involved. This would cause more energy from the RF fields getting induced onto the structure.

Depending on which body parts close the electrical circuit, that sets the route for entry and exit of the energy. A wide range of consequences is possible. The effects of contact current to the human body can range from not noticeable, light tingling sensation to muscle contractions (electrostimulation) to severe burns.

During construction, there will also be an increased risk of accidents, due to three distinct causes:

- shocks to construction workers while handling equipment, carrying heavy objects or operating at elevations above ground level. A worker can be startled and lose a grip on equipment, a railing, etc.
- arcing sparks / static discharges igniting combustible materials on the site
- malfunctioning construction equipment (discussed below) with the potential for catastrophic failure

Post construction sources of contact current can include metal railings, a row of aluminum window frames, or any other exposed metal piece that is part of the building finish on outer surfaces that is of sufficient length. Air conditioning structures can also be a source of hazard (usually to maintenance personnel as they are normally installed on the roof) as they have tubes and metallic covers of considerable lengths and size. These can be a source of shock/burn hazard.

In addition, the RF intensities on the site can compromise the integrity of elevator cables or cause garage doors to malfunction, resulting in additional safety and operational risks.

Construction Equipment

Construction equipment most notably construction cranes, are likely to be impacted by the levels of FS intensities that will be present on the Graydon-Manning and Martillac sites. The consequences for any type of crane being affected by these fields could range from being difficult to operate, to being rendered inoperable to malfunctioning in a manner that presents dangers to life and property (catastrophic failure).

The cranes and other accessory hoisting cables can be damaged by the arcing which would damage a cable to an extent that would prohibit its use. Arcing can be dangerous in the presence of combustible materials for the obvious reasons. The amount of energy induced will vary with the geometry and relative position to the transmitting array. Most likely, not one but several configurations will reach the peak of highest amount of energy induced onto them.

Electronic Devices

ISED establishes three types of equipment that can be affected while subject to different RF field intensity levels:

Broadcasting receivers, like AM, FM and medium wave radio receivers (as might be found in a typical home entertainment system), should have a protection good enough to function properly in a Field Strength of 1.83 V/m.

Associated Equipment, equipment that normally may be connected to or at the same place as the broadcasting receivers such as component devices of entertainment systems, its protection should be enough for a FS of 1.83 V/m

Radio-Sensitive Equipment: Electronics such as alarms, RF remote controls, electronic equipment of machinery, control devices, garage doors, UHF handheld radios used for voice communications for tower cranes and hoisting devices, etc. These devices should be protected enough for a FS environment of 3.16 V/m.

Given the level of RF intensities expected at the development site, household devices, like entertainment systems and the like, alarms, monitoring systems, intercoms, and garage doors will be subject of malfunction or interference, especially the ones connected to cables or cable networks that are long enough to act as antennas at the frequencies involved.

Mitigation Options

This part of the report identifies potential mitigation options. At this stage it is not possible to design mitigation for Graydon Banning and Martillac developments for four main reasons:

- detailed design of buildings and structures are not publicly available. Once detailed design is available, modeling will need to be conducted as part of the mitigation design process

- mitigation modeling will not be 100% predictive: it must be kept in mind that many assumptions and simplifications are used to create a model with a complexity and accuracy within practical limits established by data handling capability, the software capabilities and computer simulation time. It can't be guaranteed 100% that a simulated solution will be effective enough to mitigate the impact in a satisfactory manner. Any designed solutions may need to be adapted based on ongoing impact assessments.

- during construction, the ground geometry of RF conducting equipment and materials at the site will be dynamic and changing. An on-site RF engineer will need to be present to provide adaptive mitigation to address issues as they arise

- even if a good result is achieved by mitigation, its efficiency can later be degraded by seasonal changes, new structures in the area, changes to the original structure, etc. A plan of periodic checks during and after construction is recommended by an experienced RF engineer to ensure that the mitigation system performs efficiently over time.

To maximize the effectiveness of mitigation, a mitigation plan should be developed with the following features:

- initial mitigation design based on modeling of the detailed design of the development, based on an iterative modeling and design process

- an RF engineer available on-site during the construction phase to adapt mitigation

- on-going monitoring of both the construction site and the AM radiation pattern during construction to assess mitigation effectiveness

- an emergency response plan for the construction phase to address any issues before they result in serious negative impacts to either the construction workers or the AM radiation pattern

- post-construction availability of an RF engineer to address issues on a case-by-case basis

- periodic monitoring of the AM radiation patterns and adaptive mitigation as required

Given the complexity and the dependence on many factors of the efficiency of the mitigation solutions, the only guaranteed successful mitigation measures for all two-way impacts noted in this report would be to either not construct the developments or to relocate the stations, CJMR and CJYE, to another location.

Mitigation for Pattern Protection During Construction

Mitigation may be theoretically possible but, in practice, with the varying geometry of the buildings during the construction process, and the machines used, it will be difficult to maintain an efficient mitigation to protect the licensed radiation patterns at all times.

Mitigation options may include:

- grounding connections at strategic places on the structure that can disrupt the electrical effective length (detuning) of the structure that causes it to act as an antenna and reradiate the RF transmitted by the AM;

- insulation at strategic places for the same purpose as above, structure detuning;

- insertion or addition of inductors (inductance coils) to detune the structure; and

- ground connection of loads being hoisted by cranes.

The mitigation systems efficiency for cranes and other machines depend on their structures' geometry, the range of movements of its parts, and the load requirements for normal operation. The conductivity of the soil or material where these machines are placed at a given moment and the resistance between the soil and the machine is also a key factor. In the case of the buildings, as soon as a given height is reached during the construction process that starts reradiating the AM signals, the mitigation must be implemented and readjusted as the dimensions of the building grow. For this, an RF Expert Engineer would be needed on-site during this entire phase of construction.

These issues will require the presence of an expert RF engineer to constantly address situations that may deteriorate the efficiency of the mitigation measures due to the changing geometries, location and conductivity of the soil. Also, frequent monitoring of the field strength intensity on both frequencies are advised.

Mitigation for Pattern Protection for Buildings

The mitigation systems efficiency depends on the building structure, its materials and shape, frequency and RF field intensity. The design process through MOM modeling would be comprised of the following steps:

- obtain fairly accurate information on the building architecture, like its geometry, materials and location. Generally final construction drawings are necessary. IMPORTANT: a description of the geometry of the building and how it varies during its construction would also be necessary to simulate the evolution of the building and its evolving mitigation system. Also, the dimensions of tower cranes involved, height above the building, positions, operating radii and operating angles as well.

- based on the above, a model will be created using the MOM software and analyze its impact on the AM stations radiation patterns;

- a model of a mitigation structure is developed through an iterative process to find a solution that is efficient enough to reduce the radiation patterns distortion until the licensed patterns don't exceed the limits established by the law;

- before implementing the mitigation solution in the real world, extensive sets of field strength measurements need to be recorded for the two AM stations;

- implementation of the **dual mitigation system** for both AM stations, which is more complex to adjust and maintain than doing it for only one frequency;

- repeat the set of field strength measurements when construction is complete to compare with the pre-construction baseline reference

- periodic post-construction monitoring/adaptation.

Mitigation options may include:

- using wires running vertically along the building sides (detuning skirt) have been a proved solution for telecom structures (See Figure A1-2 in Annex 1);

- a capacitive "hat" network at the building top is another solution option (See Figure A1-3 in Annex 1);

Mitigation Options for Human Health and Safety and Construction Equipment

Some of the solutions mentioned above for reradiation mitigation also apply here in order to protect the human body or equipment structures and electronics as well.

- PPE (Personal Protection Equipment) like insulating gloves and boots, anti-static clothing, grounding straps, personal fall arrest systems

- insulated crane controls

- insulated tool grips

- insulator insertion on hoisting cables and other cables handled by the workers

- inductor or conductor insertion or addition to detune the structure

- Faraday cages or shielding

- on-site presence of an RF engineer

Building design, to avoid exposed external metal surfaces, and shield elevator cables and protect the operations of garage doors will also be important to prevent post-construction hazards.

Mitigation Options for Consumer Electronics

Mitigation will need to be part of design, construction and post-construction, including:

- ensuring all electrical cabling is shielded and properly grounded

- availability of an RF engineer to conduct ongoing case-by-case mitigation. Mitigation will be device and configuration specific and thus change over time with new occupants or as occupants make changes to their electronic device and configurations. While many electronic devices will not be impacted, it is impossible to predict or control what consumer devices will be used and how they will be impacted.

Annex 1: Pictures and Schematics.

Fig. A1-1a: Arcing cable termination in a hoisting system in a 2.5 V/m field intensity environment. Molten bits of material can be seen expelled away from the contact point.

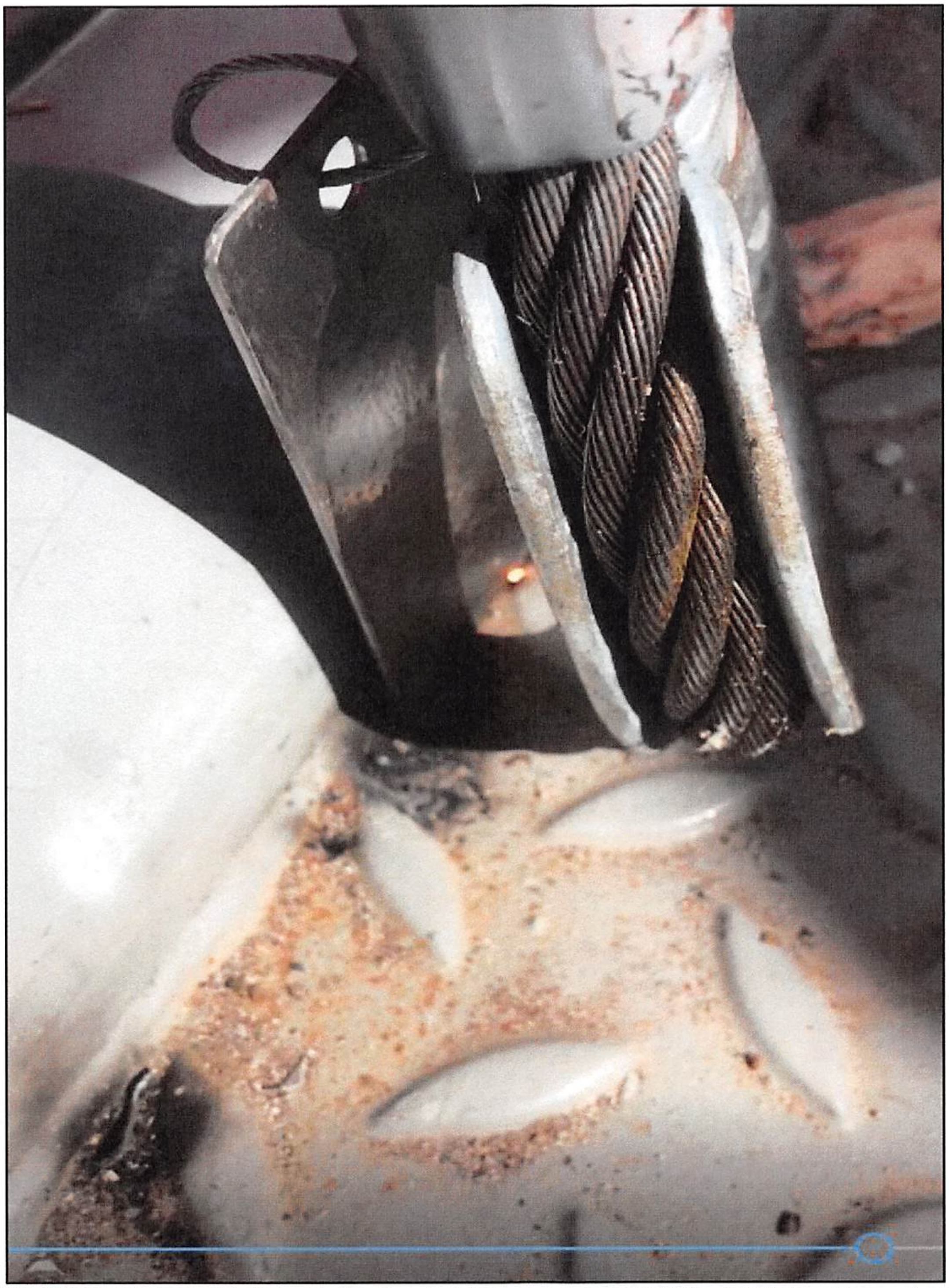

Fig. A1-1b: Arcing cable termination in a hoisting system in a 2.5 V/m field intensity environment. Burn marks can be seen on other places from previous contact.

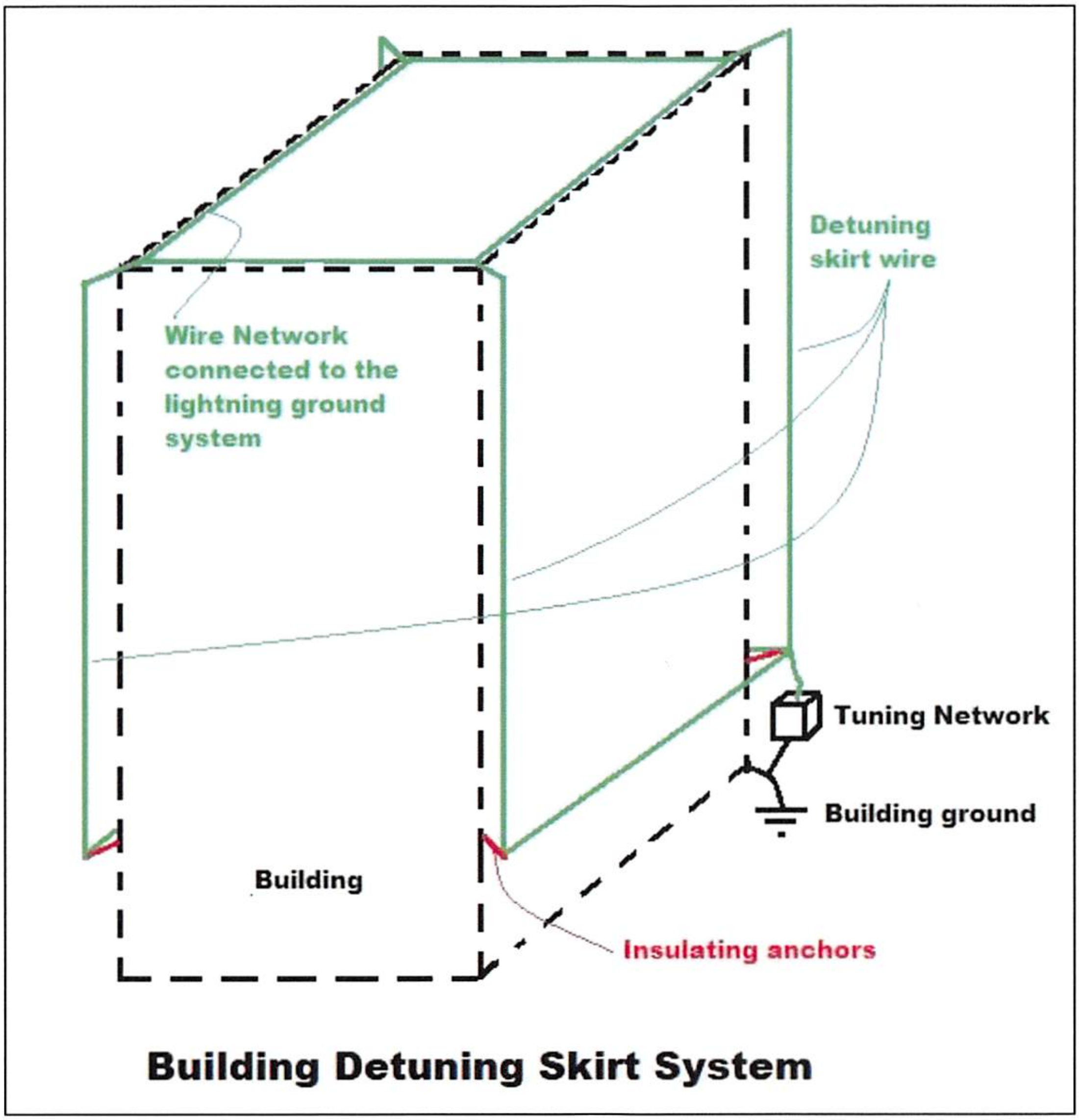

Fig. A1-2: Building detuning skirt system

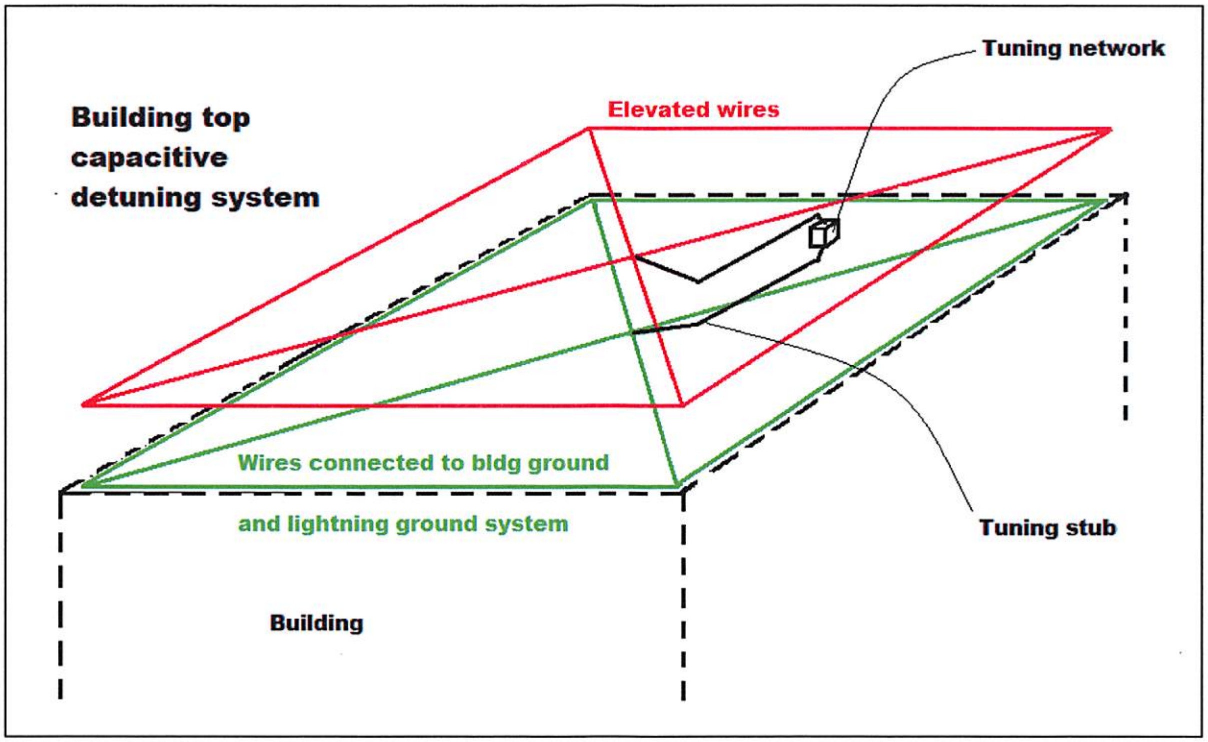

Fig. A1-3: Building top detuning system

Annex 2: Correctly visualizing contours differences on a pattern plot.

Here is a tip on how to correctly visualize the differences between one radiation pattern and the other. It may not seem much on some but is important to measure the differences in the right direction.

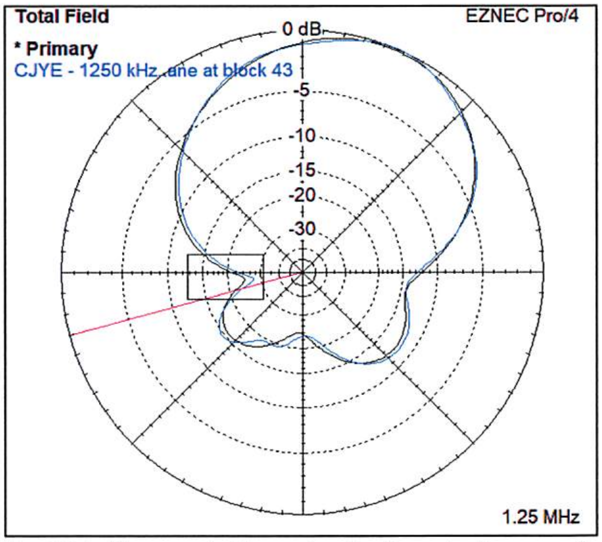

Fig. A2-1: The area in the rectangle above is chosen and a magnification is shown on Fig. A2-2.

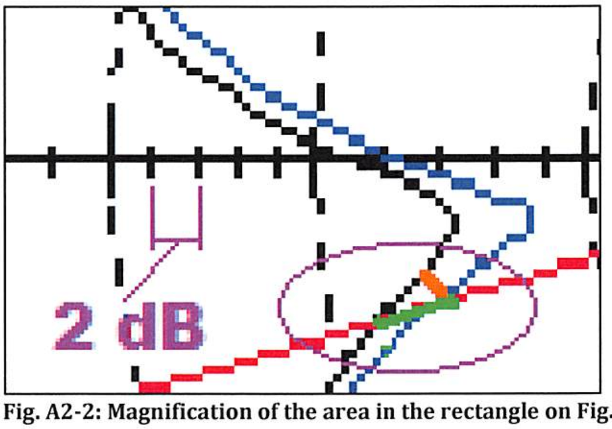

Fig. A2-2: Magnification of the area in the rectangle on Fig. A2-1.

Please refer to Fig. A2-2. The right way to measure the difference between two patterns (green) is moving along the radial (red) or azimuth line on a given direction and not looking for the shortest distance between the two patterns described by a line perpendicular (orange) to both patterns. On the figure above, the correct one is twice the size of the wrong one. The small divisions on the horizontal axis are 2 dB increments. This shows that the difference between the blue and the black pattern is about 3 dB and not 1.5 dB.

References

-Broadcasting Procedures and Spectrum Management and telecommunications, Part 2. BPR-2 Issue 3, February 2016. Published by ISED.

-Electromagnetic Interference between Cranes and Broadcasting Antennas. July 22 2015. V. Javor. Faculty of Electronic Engineering, University of Nis, A. Medvedeva 14, 18000 Nis, Serbia.
International Journal of Antennas and Propagation, Volume 2015, Article ID 452962, 10 pages. http://dx.doi.org/10.1155/2015/452962

- OSHA standard 29 CFR §1926.550 (a) (15) (vii), Cranes and Derricks.

-EMCAB-2, Criteria for immunity complaints involving fundamental emissions of radiocommunications transmitters. – Issue 1, June 1994
https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf01005.html

Health Canada's Safety Code 6 (2015)
LIMITS OF HUMAN EXPOSURE TO RADIOFREQUENCY ELECTROMAGNETIC ENERGY IN THE FREQUENCY RANGE FROM 3 kHz TO 300 GHz.
Consumer and Clinical Radiation Protection Bureau Environmental and Radiation Health Sciences Directorate Healthy Environments and Consumer Safety Branch
Health Canada
https://www.canada.ca/content/dam/hc-sc/migration/hc-sc/ewh-semt/alt_formats/pdf/consult/_2014/safety_code_6-code_securite_6/final-finale-eng.pdf

NORTH CAROLINA
PROFESSIONAL
C.K.H.
SEAL
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ENGINEER
CHRISTOPHER K. HORNE

Tab E

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Mr. Kevin Dent

Director of Engineering & I.T.

Whiteoaks Communications Group Limited

284 Church St. Oakville Ontario L6J 7N2

November 28, 2018

Mr. Kevin Dent

RE: North Dundas Encroachment & Development

Pursuant to your request to review the Lehman & Associates – M.A. Tilston Engineering Planning Report dated 1993, in light of proposed developments at 1357 and 1359 Dundas Street West, Town of Oakville (the "proposed developments"), I have provided a short comments letter, to reflect both updates to the 1993 reports and specific concerns arising from the proposed developments.

The Lehman and Tilston report filed with the Town of Oakville in 1993 was developed pursuant to a request to review the impact of adjacent land use on two existing radio stations. The report remains relevant to this day and well describes the potential impacts of mixed development especially mid-high commercial and residential buildings, on the operation of these two radio stations, as well as the impacts of the radio stations on new development, if located close to the stations. The report outlines:

- potential operational impacts, including possible signal loss, multipath distortion and even loss of license to operate
- impacts on adjacent properties, including equipment failures due to RF emissions
- impact to nearby construction operations
- potential impacts to compliance with safety code 6

What follows is some additional comments on impacts to electronic equipment, the modeling conducted by Dr. M.A. Tilston to construction operations and the occupation of constructed buildings.

Susceptible Equipment Impacts:

The Tilston reports provides a list of "Susceptible Equipment" that would be impacted by RF emissions from the radio stations. This list can be updated to include:

- WiFi Routers
- Medical Lab Equipment
- Diagnostic Apparatus
- Computer Networks
- Wireless Phones
- Baby Monitors
- Security Systems
- Digital Cameras
- Most other types of electronic devices and office equipment

Modeling

Dr. Mark Tilston conducted modeling of:

- "maximum permissible building heights in order to avoid excessive AM broadcast reradiation" (displayed in contour map form as figure 2);
- "maximum permissible building heights in order to avoid exceeding Safety code 6" (displayed in contour map form as Figure 4); and
- The "Primary interference contour (1v/m to RF devices and radio sensitive equipment" (displayed in contour map form as figure 5

While these contour maps can still serve to provide a general idea of impacts and areas to be avoided, it should be noted that Dr. Mark Tilston's report is about 25 years old and based upon a modeling the impacts of a single 13 storey building. Newer and more accurate methods of field and computer modeling is now available which can, take into account multiple reradiators and structures. There have also been changes to the radio stations since that time. To update the assessment of impacts, I recommend that these models be updated using current methods and operations.

Furthermore, whether computations or measurements are utilized, they would need to be redone every time a significant reradiator was added to or near the transmitting array. In other words for every piece of conductive material of significant size, measurements would have to be taken and the results analyzed and a treatment method determined to eliminate its reradiation influence. During construction for each building as its being erected a constant state of monitoring would be required, logging and analysis would have to occur to either identify a source of reradiation and to determine its effects on the stations radiation patterns. This would be a very costly and an ongoing expense considering the number of proposed buildings planned for these developments.

Impacts on Construction Operations

Dr. Mark Tilston discusses the impacts of RF on nearby construction. The developers should be made aware of non-ionizing RF shocks or an RF burn—electrostimulation that can occur when someone comes into contact with either an RF radiator or a re-radiator. RF radiators are usually some type of antenna. Many antenna designs cause RF current to flow in their metallic components, which in turn, is radiated into space. Touch one of these surfaces, and the energy will flow through your body to ground. Similarly, the same thing can happen if you touch a re-radiator. Any *ungrounded,* conductive (usually metal) object that is in the field of a strong RF source can be illuminated by the RF field and re-radiate the energy back into space. These metallic objects can have high RF voltages present on them unless they are well grounded. It is often very difficult to make a good RF ground, so objects that appear to be well grounded are often "floating." When a person touches a re-radiator, the individual provides a path to ground, and a surge of energy occurs at the point of contact. This results in a shock and, in many cases, an RF burn.

Recent construction of a bridge adjacent to the broadcast transmission site of CJMR/CJYE along Dundas Street and known as the 16 Mile Creek Bridge, took about 4 years to design and commission. During the construction several employees received contact burns, while the PLC controlled crane lost several expensive electronic control boards and the project was halted by Health & Safety personal. A manual lift crane had to be brought in to complete the project. At one point as the rebar cage was being constructed in the caisson about 50 ft. below grade, a DVM recorded 40 RMS volts, which could be a few hundred RF volts. A great deal of grounding was applied to the bridge structure and hand railings, and remember this was basically at or below ground level.

Should the proposed development be permitted to proceed, the Ministry of Labour may require workers to wear protective clothing and wear a personal alert monitor and limit the time on site. However, as Dr. Mark Tilston also suggested in his report, these measures could be impractical.

It has also been suggested in some quarters that maybe a Faraday cage or Faraday shield which is an enclosure used to block electromagnetic fields should be considered. This is based on the common misconception is that a Faraday cage provides full blockage or attenuation; is simply not true. The reception or transmission of radio waves, a form of nonionizing electromagnetic radiation, to or from an antenna within a Faraday cage is heavily attenuated or blocked by the cage; however, a Faraday cage has varied attenuation depending on wave form, frequency or distance from transmitter, and transmitter power. Near-field high-powered frequency transmissions like the transmitters of the CJMR/CJYE stations, RF are more likely to penetrate. The Faraday in this case would most likely act as a re-radiator and cause additional problems and create extreme complications of null fill and reflectivity. Further, given the scale of the proposed development, a Faraday of any type is likely not technically possible and would almost assuredly cause extreme harm to the transmission systems array of CJMR/CJYE.

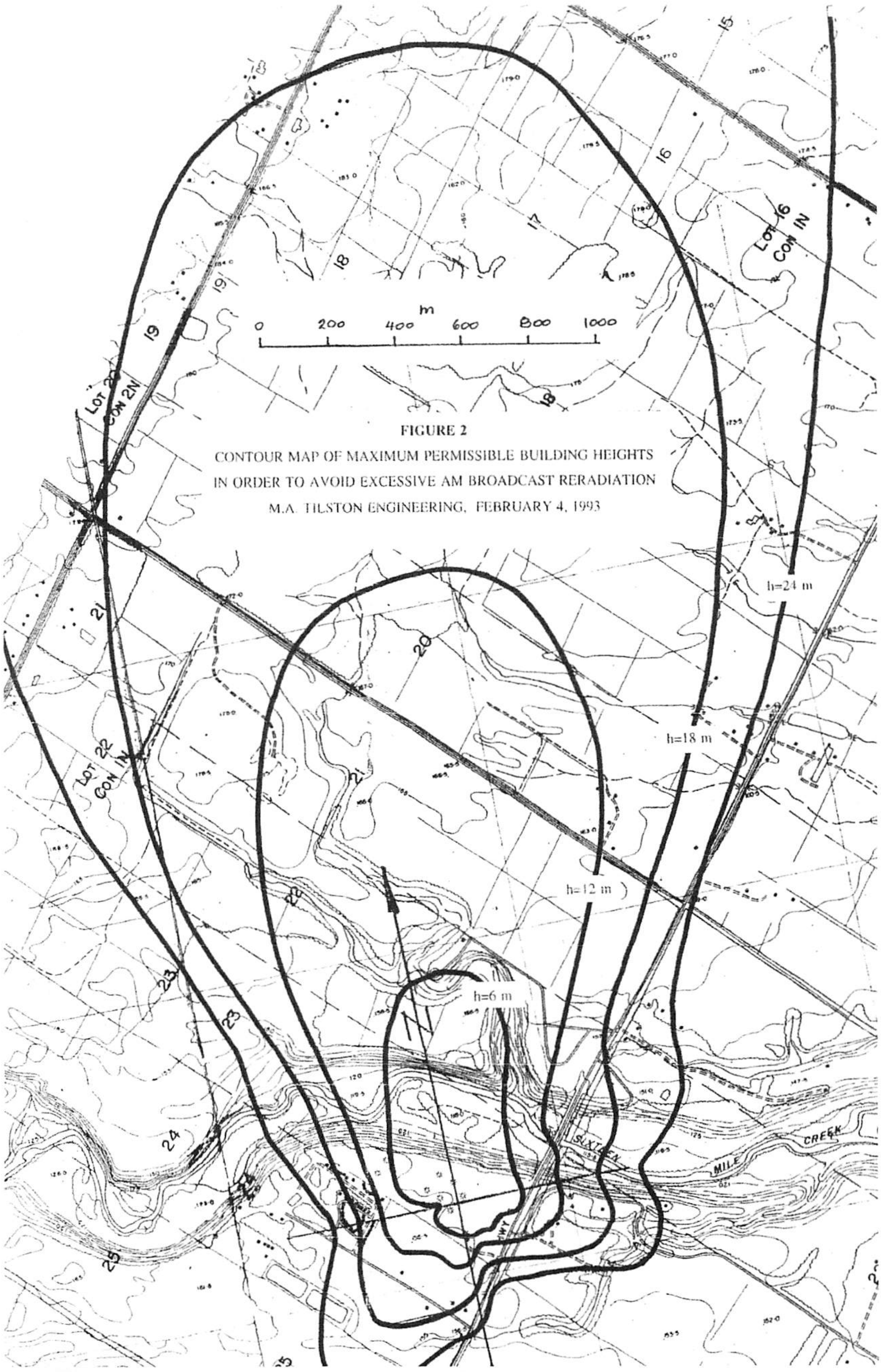
Conclusion

In my opinion, the Town of Oakville should not approve the proposed developments without resolving the issues identified in the Lehman and Tilston reports and this letter report. Approving the developments would likely have significant negative impacts on the developments themselves from construction right through to habitation and the CJMR/CJYE radio stations.

Regards

J. Paul Firminger CPBE
Firmin & Associates
Broadcast & Multimedia Engineering
3 Jasmine Drive
Paris, Ontario
N3L3P7

SBE CERTIFIED
The Association for Broadcast and
Multimedia Technology Professionals



m
0 200 400 600 800 1000
FIGURE 2
CONTOUR MAP OF MAXIMUM PERMISSIBLE BUILDING HEIGHTS
IN ORDER TO AVOID EXCESSIVE AM BROADCAST RERADIATION
M.A. TILSTON ENGINEERING, FEBRUARY 4, 1993
h=24 m
h=18 m
h=12 m
h=6 m
LOT 16 CON 1N
LOT 20 CON 2N
LOT 22 CON 1N
SIXTEEN
MILE
CREEK

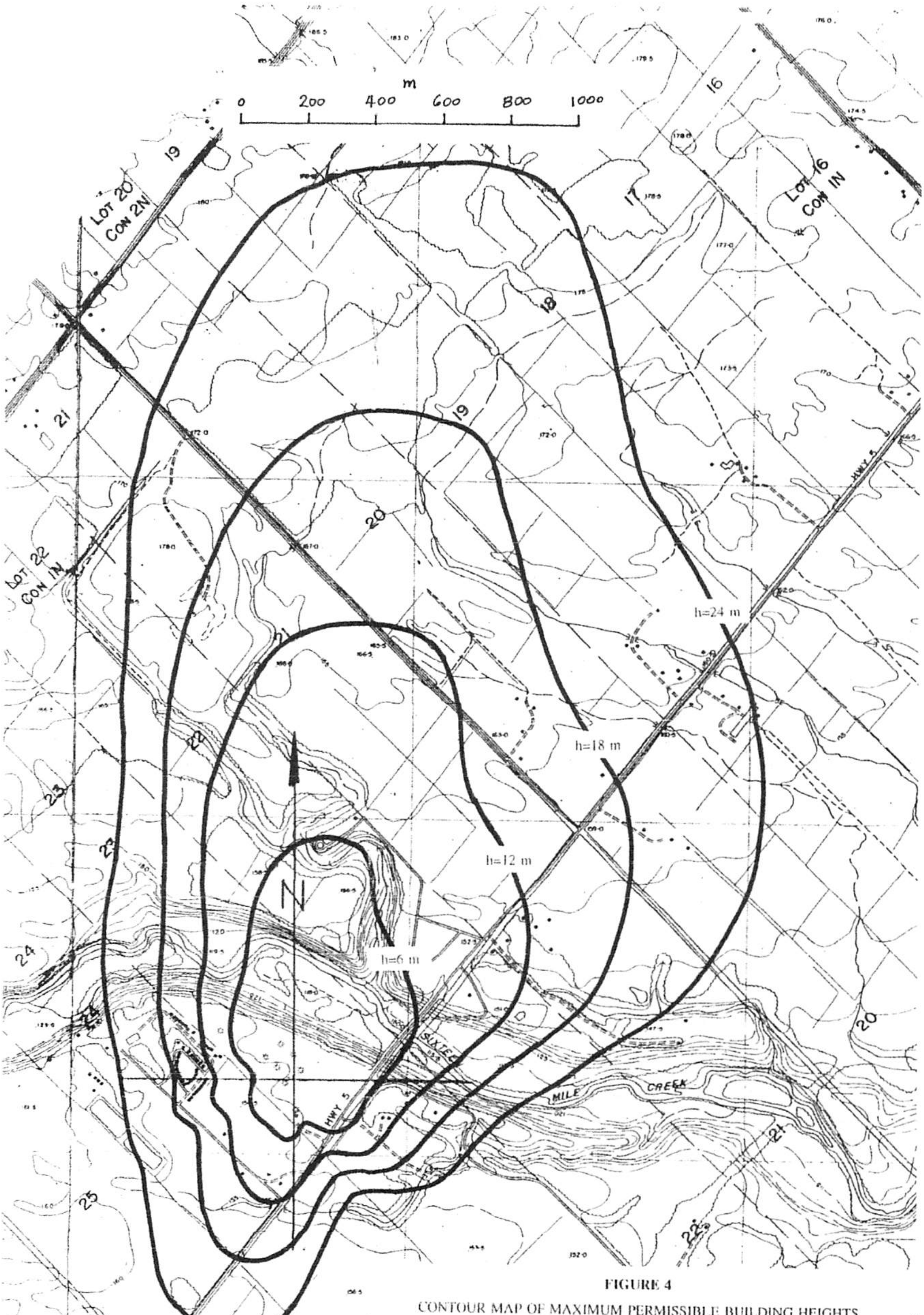


FIGURE 4

CONTOUR MAP OF MAXIMUM PERMISSIBLE BUILDING HEIGHTS
IN ORDER TO AVOID EXCEEDING SAFETY CODE 6 RECOMMENDATIONS
M.A. TILSTON ENGINEERING, FEBRUARY 4, 1993

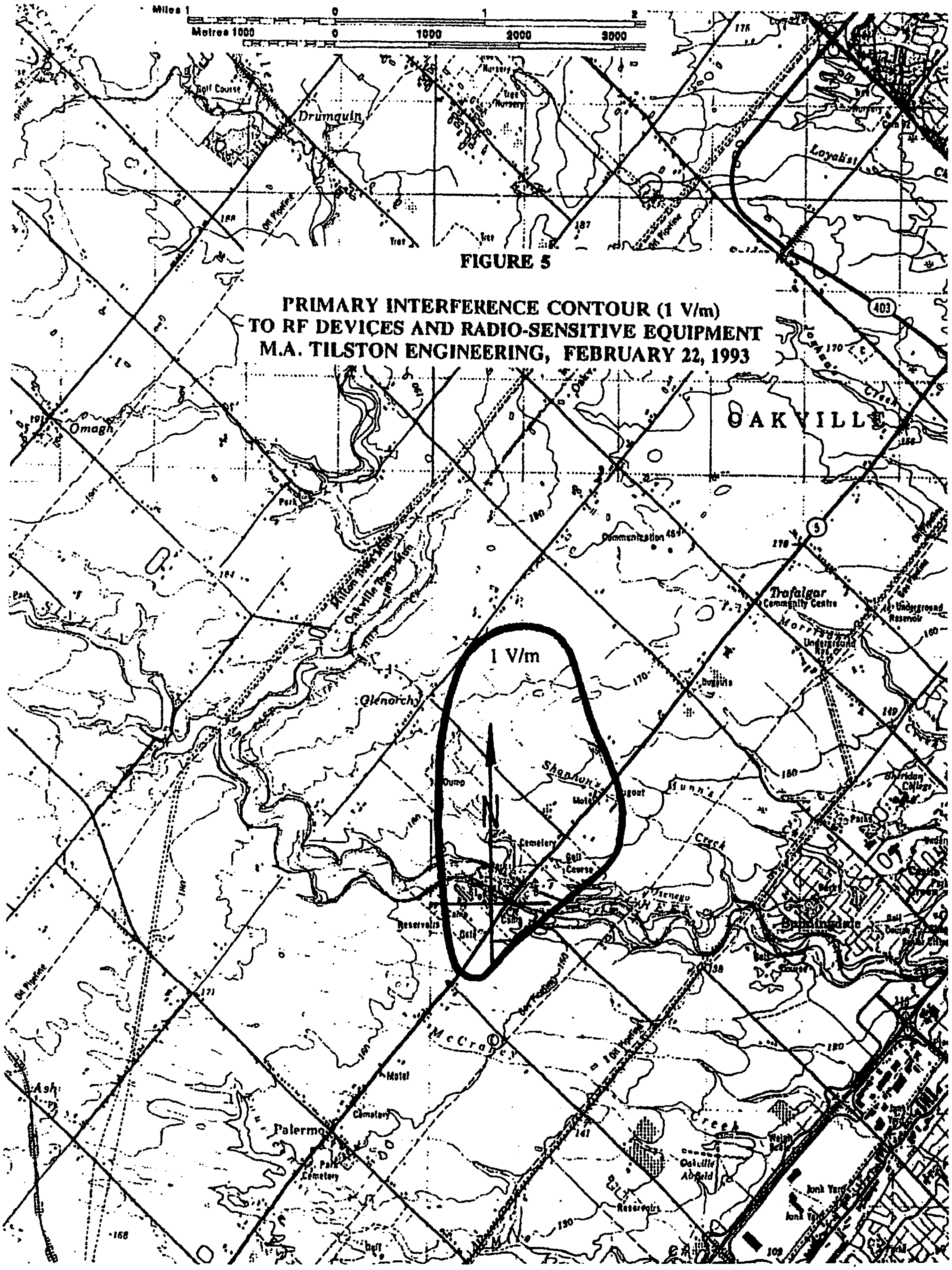


FIGURE 5

PRIMARY INTERFERENCE CONTOUR (1 V/m)
TO RF DEVICES AND RADIO-SENSITIVE EQUIPMENT
M.A. TILSTON ENGINEERING, FEBRUARY 22, 1993

Firmin & Associates

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(519) 442.1898
E-mail: jpfirminger@hotmail.com

Firmin & Associates is a division of **Sound Reinforcement Limited** and was formed to facilitate communication and broadcast engineering "Project Management" across North America.

Firmin & Associates can provide the corporate and project continuity while providing Design-build, and assist with equipment procurement for Studios, Microwave and Transmission facilities. This professional and experienced over sight provides the specialty of professional Broadcast and Communication Engineering personal which provides reduced construction and installation costs while assuring the client complies with local and ISED regulations. Clients with medium to large portfolios (group O & O's) can now engage contractual professionals without burdensome staffing overhead, by using experienced Broadcast professionals. Furthermore, our field experience has introduced and developed new concepts for frequency co-ordination and market swamping in order to appropriately introduce efficient spectrum management.

Firmin & Associates is owned and operated by J. Paul Firminger CPBE who is a hands on engineering professional manager and facilitator, and has managed well over 300 million dollars in high tech commercial broadcast and communication construction projects.

If your company is looking for new or additional engineering facilities and project management overview with corporate design and control, then we should explore your needs to see how *Firmin & Associates* can provide the services you require.

As you can see from the following list of design/construction projects, we have had many clients with various needs and have managed them all in a professional and work-man like manner.

Construction Projects

- Construct & Commission new Broadcast transmission facilities in Ashgrove Ontario
- Design, Construct & Commission new Studio facilities in Brampton Ontario
- Design, Construct & Commission new AM transmission facilities in Owen Sound
- Design, Construct & Commission new AM transmission facilities in Port Elgin
- Design, Construct & Commission new AM transmission facilities in Kitchener/Glen Morris Ontario
- Design, Construct & Commission new 100kw FM transmission facilities in Kitchener/Baden Ontario
- Design, renovate Broadcast studio facilities in 12 storey commercial building in Kitchener Ontario
- Design, construct & Commission new Broadcasting studio building, and AM & FM transmission sites in Sarnia Ontario
- Design & Construct & Commission studio building and FM transmission site in Leamington Ontario (CHYR-FM)
- Worked alongside Dr. Mark Tilston re: AM Broadcast Reradiation from Steel Towers and Power Lines. Field work and test results along the Langstaff Ontario Hydro corridor
- Design and construct new 12 million dollar TV/Radio building in Mississauga/Toronto
- Design, construct new studio facilities in PEI <Cap Radio>
- Design, construct new studio facilities in Calgary <Cap Radio)
- Design, construct new AM transmission facilities in Toronto/Grimsby Ontario
- Design, construct new studio facilities in Toronto, Ontario <Cap Radio>
- Design, Construction & Renovations of AM/FM facilities in Ottawa On.
- Install 3000 seat auditorium sound system in California
- Design & Install Sound Systems in a number of roller rinks in Ontario
- Design & install large venue Sound Systems through-out Canada & USA
- Project manage CN Tower steerable microwave antenna system installations for Rogers, Bell & Metro Police
- Project Manage for Rockwell Rail the multi-site microwave link construction for CSX rail line from Georgia to North Carolina USA **(7 tower sites)**
- Project manage the design and roll out of the NOAA early warning system for the US Government Weather alert system (400+ sites) – Al Gore VP.
- Consultant to Broadcast & Communication companies in North America.
- Project managed construction of the new manufacturing facility for Crown Broadcast USA. Site acquisition, Purchase, Renovations, Installation of production lines
- Design & build of AVR's (Aboriginal Voices Radio) national FM Radio service. (2005 – 2012) (7 transmission sites across Canada) Montreal, Ottawa, Toronto, Kitchener, Winnipeg, Calgary, Edmonton
- Field studies and report of TV reception interference for Enbridge Wind Turbine Farm (Wind Farm contained 110 Wind Turbines in a 10 Km square geographical area)
- 2015 – 2016 Retainer/Contract with Whiteoaks Communications Group Limited for CRTC & ISED applications, and DA-2 conversion to DA-1 for two co-sited AM radio stations.
- Various Site acquisitions, co-ordinations, approvals, leases, project management and commissioning.

Employment History and Memberships of J. Paul Firminger

Station Manager & Director of Engineering - All Can Holdings Ltd - CHIC Radio AM/FM (1963 –73)

Vice President Engineering - KEY Radio Ltd, A division on Maclean Hunter (1973- 1985) (21 radio & TV stations)

Board Director of KEY Radio Limited

Vice President Sales & Marketing & Senior Project Manager - Abroyd Communications (1986 – 1989)

Vice President & General Manager of - Jovin Communications Limited (1989-1998)
Cellular projects including Building Roof tops, Water Towers, & turn Key Tower sites

Vice President & Project Manager - Crown Broadcast USA (1999 - 2001)

Engineering & Management consulting for various radio applications 2002 - 2011

ZoomerMedia Television 12 month contract – NTSC – to – ATSC Conversions
2010 – 2011 (Winnipeg, Victoria, Vancouver/Abbotsford)

Serving on LifeNet Ministries Inc. board member since 2016 - (youth crisis response)

Graduate of DeVry University - Electrical Engineering

Life Member DeVry Alumni Association

Life Member 5627 of Audio Engineering Society (AES)

Member 2537 of Society of Broadcast Engineers (SBE) since 1974

Life Member 2537 of Society of Broadcast Engineers (SBE) since 1990

SBE Certified Professional Broadcast Engineer (CPBE)

Inducted into the CAB Quarter Century Club in 1991 "Canadian Association of Broadcasters"

Charter Member – Central Canada Broadcast Engineers & Technologists - CCBE (served in various capacities (Membership chair, Treasure, Secretary, President (1974 -1984) Still active 1985 –

Received the CCBE **"Engineering Lifetime Achievement Award"** September 17, 2016

Tab F

APPENDIX "F"

Provincial Policy Statement, 2014 Excerpts

Part I: Preamble

....

The Provincial Policy Statement provides for appropriate development while protecting resources of provincial interest, public health and safety, and the quality of the natural and built environment. The Provincial Policy Statement supports improved land use planning and management, which contributes to a more effective and efficient land use planning system.

Part IV: Vision for Ontario's Land Use Planning System

...

The Provincial Policy Statement focuses growth and development within urban and rural settlement areas while supporting the viability of rural areas. It recognizes that the wise management of land use change may involve directing, promoting or sustaining development. Land use must be carefully managed to accommodate appropriate development to meet the full range of current and future needs, while achieving efficient development patterns and avoiding significant or sensitive resources and areas which may pose a risk to public health and safety.

Efficient development patterns optimize the use of land, resources and public investment in infrastructure and public service facilities. These land use patterns promote a mix of housing, including affordable housing, employment, recreation, parks and open spaces, and transportation choices that increase the use of active transportation and transit before other modes of travel. They also support the financial well-being of the Province and municipalities over the long term, and minimize the undesirable effects of development, including impacts on air, water and other resources. Strong, liveable and healthy communities promote and enhance human health and social well-being, are economically and environmentally sound, and are resilient to climate change.

....

It is equally important to protect the overall health and safety of the population. The Provincial Policy Statement directs development away from areas of natural and human-made hazards. This preventative approach supports provincial and municipal financial well-being over the long term, protects public health and safety, and minimizes cost, risk and social disruption.

1.0 Building Strong Healthy Communities

Ontario is a vast province with urban, rural, and northern communities with diversity in population, economic activities, pace of growth, service levels and physical and natural conditions. Ontario's long-term prosperity, environmental health and social well-being depend on wisely managing change and promoting efficient land use and development patterns. Efficient land use and development patterns support sustainability by promoting strong, liveable, healthy and resilient communities, protecting the environment and public health and safety, and facilitating economic growth.

1.1 Managing and Directing Land Use to Achieve Efficient and Resilient Development and Land Use Patterns

1.1.1 Healthy, liveable and safe communities are sustained by:

....

c. avoiding development and land use patterns which may cause environmental or public health and safety concerns;

1.1.3 Settlement Areas

1.1.3.3 Planning authorities shall identify appropriate locations and promote opportunities for *intensification* and *redevelopment* where this can be accommodated taking into account existing building stock or areas, including *brownfield sites*, and the availability of suitable existing or planned *infrastructure* and *public service facilities* required to accommodate projected needs.

Intensification and *redevelopment* shall be directed in accordance with the policies of Section 2: Wise Use and Management of Resources and Section 3: Protecting Public Health and Safety.

1.1.3.4 Appropriate development standards should be promoted which facilitate *intensification*, *redevelopment* and compact form, while avoiding or mitigating risks to public health and safety.

1.2 Coordination

1.2.1 A coordinated, integrated and comprehensive approach should be used when dealing with planning matters within municipalities, across lower, single and/or upper-tier municipal boundaries, and with other orders of government, agencies and boards including:

d. *infrastructure*, electricity generation facilities and transmission and distribution systems, *multimodal transportation systems*, *public service facilities* and *waste management systems*;

1.4 Housing

1.4.3 Planning authorities shall provide for an appropriate range and mix of housing types and densities to meet projected requirements of current and future residents of the *regional market area* by:

e. establishing development standards for residential intensification, redevelopment and new residential development which minimize the cost of housing and facilitate compact form, while maintaining appropriate levels of public health and safety.

1.7 Long-Term Economic Prosperity

1.7.1 Long-term economic prosperity should be supported by:

k. encouraging efficient and coordinated communications and telecommunications infrastructure.

3.0 Protecting Public Health and Safety

Ontario's long-term prosperity, environmental health and social well-being depend on reducing the potential for public cost or risk to Ontario's residents from natural or human-made hazards.

Development shall be directed away from areas of natural or human-made hazards where there is an unacceptable risk to public health or safety or of property damage, and not create new or aggravate existing hazards.

....

6.0 Definitions

Infrastructure:

means physical structures (facilities and corridors) that form the foundation for development. *Infrastructure* includes: sewage and water systems, septage treatment systems, stormwater management systems, waste management systems, electricity generation facilities, electricity transmission and distribution systems, communications/telecommunications, transit and transportation corridors and facilities, oil and gas pipelines and associated facilities.

Major facilities:

means facilities which may require separation from *sensitive land uses*, including but not limited to airports, transportation infrastructure and corridors, *rail facilities, marine facilities*, sewage treatment facilities, *waste management systems*, oil and gas pipelines, industries, energy generation facilities and transmission systems, and resource extraction activities.

REGION OF HALTON OFFICIAL PLAN EXCERPTS

77 (5) Require the Local Municipalities to prepare *Area-Specific Plans* or policies for major growth areas, including the *development* or redevelopment of communities. The area may contain solely employment lands without residential uses or solely an *Intensification Area*. Such plans or policies shall be incorporated by amendment into the Local Official Plan and shall demonstrate how the *goals* and *objectives* of this Plan are being attained and shall include, among other things:

....

f) location, types and density of residential and employment lands that contribute to creating healthy communities through:

f.1) consideration for land use compatibility in accordance with Regional and Ministry of the Environment guidelines,

....

78. The *objectives* of the *Intensification Areas* are:

....

(4) To provide a diverse and compatible mix of land uses, including residential and employment uses, to support neighbourhoods.

....

143. It is the *policy* of the *Region* to:

(10) Develop, in consultation with the Local Municipalities, the Province, Federal government and the railway agencies, Land Use Compatibility Guidelines to minimize the *adverse effects* of noise, vibration, odour and air pollution from industrial, transportation and *utility* sources on *sensitive land uses*, including the application of separation distance between these non-compatible uses.

(12) Require the proponent of *sensitive land uses* in proximity to industrial, transportation and *utility* sources of noise, vibration, odour and air pollutants to complete appropriate studies and undertake necessary mitigating actions, in accordance with the *Region*'s Land Use Compatibility Guidelines, Air Quality Impact Assessment Guidelines, and any applicable Ministry of the Environment guidelines. Specifically, an air quality study based on guidelines under Section 143(2.1) is required for such *development* proposals within 30m of a Major Arterial or Provincial Highway, or 150m of a Provincial Freeway, as defined by Map 3 of this Plan.

2006 TOWN OFFICIAL PLAN

7. Plan Concept

The Plan is intended to enhance the quality of life and to provide for and to promote identify and vitality in the Oakville environment by providing for a settlement pattern which:

....

- recognizes and protects existing residents and communities by ensuring that new development is compatible with and complements existing land uses;

Part B Goals And Objectives

2. Population And Housing

....

- To ensure that new residential development is generally compatible with adjacent existing development patterns and designed to maximize its compatibility with other land uses.

10. Environmental Management

....

10.8 Noise And Vibration

....

e) Industrial, Commercial, and Utility Noise The Town may require, in the case of new residential proposals within areas subject to the impact of utility, commercial or noise or vibration, that the siting of dwellings, structural design of dwellings and subdivision features shall contain noise attenuation features which shall be developed in consultation with the Ministry of the Environment and Energy and qualified consultants.

f) The Town shall establish employment areas which are reserved for non-noise sensitive uses while discouraging residential and other noise sensitive land uses from locating adjacent to such areas.

NORTH OAKVILLE EAST SECONDARY PLAN

7.4.2 DEVELOPMENT FORM

The North Oakville East Secondary Plan has been based on a conceptual design which maximizes the potential for sustainable development through such features as mixed use development, a modified grid road system which enhances the opportunity to provide transit, and a Natural Heritage and Open Space System.

In addition to the general direction implicit in the Plan, the Town will actively encourage development which is specifically based on the principle of sustainable development, including the development of Town facilities. The Town will also work with other public agencies to encourage them to follow these principles. Such development will be designed to:

...

c) create livable, healthy and productive environments

NORTH OAKVILLE WEST SECONDARY PLAN

8.4.2 DEVELOPMENT FORM

The North Oakville West Secondary Plan has been based on a conceptual design which, when combined with North Oakville East, maximizes the potential for sustainable development through such features as a modified grid road system which enhances the opportunity to provide transit, and a Natural Heritage and Open Space System.

In addition to the general direction implicit in the Plan, the Town will actively encourage development which is specifically based on the principle of sustainable development, including the development of Town facilities. The Town will also work with other public agencies to encourage them to follow these principles. Such development will be designed to:

...

c) create livable, healthy and productive environments; and,