Attachment #1
- Dr. M. Havas

REPORT NO. BF-I-7
APPENDIX A
FEBRUARY 9, 2011

RADIATION HEALTH and SAFETY CONSULTING
64 Donlea Drive, Toronto, Ontario, M4G 2M4

Evaluation of RF and Microwave Levels at Mountainview Elementary School and Collingwood Collegiate Institute Collingwood, Ontario

2010 11 25

Carried out for:

Mr. John Dance
Superintendent of Education, Area 3
Simcoe County District School Board
Education Centre
1170 Highway 26
Midhurst, Ontario, L0L 1X0

1. INTRODUCTION

Concerns about radiofrequency (RF) and microwave health and safety issues for students at Mountainview Elementary School (MES), Collingwood, Ontario were raised with the Simcoe County District School Board (SCDSB) as it began to roll out wireless local area network (LAN, also called WiFi) internet access services. The concerns focus on wireless routers used to provide connections to the Internet for computers on school property and about the exposure of computer (particularly laptop) users, especially children and young adults.

Early in April, 2010 Mr. John Dance, Superintendent of Education, Area 3 of the SCDSB, contacted Radiation Health and Safety Consulting (RHSC) for advice and assistance in addressing concerns about RF and microwave exposures. Initially, there was interest in making arrangements for a presentation to the members of the board regarding the safety of wireless access points (APs). On Wednesday, April 21, 2010 the author attended a meeting of the board at the Education Centre, 1170 Highway 26 and presented an overview of the occupational and environmental health and safety issues associated with non-ionizing radiation in general putting WiFi and the APs in the context of technological applications across the whole electromagnetic spectrum. In particular a number of important distinctions (specifically between ionizing and non-ionizing radiation) were emphasized, and other common applications of RF and microwave energy were cited (specifically cell phones and microwave ovens) as relevant by way of prevalence, exposure levels and operating frequencies.

Subsequently the board decided it wanted to proceed with RF and microwave measurements at MES. Because the necessary instrumentation had been returned to its manufacturer for re-calibration it was not possible to schedule the measurements until late fall. When arrangements were finally made, it was decided to include measurements at Collingwood Collegiate Institute (CCI) as well.

On Thursday, 2010 11 25, between approximately 1300 h and 1515 h, measurements of RF and microwave levels were made near wireless APs throughout MES including one in a pod of portable classrooms situated west of the main building. Measurements were made at CCI between approximately 1530 h and 1730 h. Both MES and CCI are situated in an urban setting within the town of Collingwood surrounded by relatively low density single family residential neighbourhoods with a scattering of small apartments and commercial properties in the immediate vicinity.

At the time the measurements were being carried out MES was operating in a normal manner with students, teachers and staff conducting routine activities while at CCI classes were finishing and students were dispersing although extracurricular activities were still under way. In attendance at MES while the measurements were being carried out were Greg Elliott (Manager of Information Technology Services, SCDSB), Robert Hollinger (Systems Engineer, SCDSB), Stephen Small (Systems Engineer, SCDSB), Doug Paul (Principal, MES) and, from time to time, Don Shackell (Vice-Principal, MES). John Dance (Superintendent, Area 3, SCDSB) was also in attendance for part of the

time. At CCI, Greg Elliott, Robert Hollinger and Stephen Small were in attendance. The author is grateful to all for their assistance in locating and providing access to the various WiFi access points in both schools.

2. BACKGROUND

The electromagnetic spectrum is a valuable and limited resource, not unlike air and water and land, with ever increasing demands put upon all of them by human activities. As soon as the electromagnetic spectrum began to be utilized during the first part of the last century it rapidly became obvious that one user's activities could adversely affect another user's activities unless certain conditions are met, again not unlike air, water and land. Consequently national governments around the world have established controls on the use of the electromagnetic spectrum.

The government of Canada is no exception[1]. It allocates specific frequency ranges within the electromagnetic spectrum for various civil and military uses. Most of the allocations provide for exclusive use of a specific range of frequencies and are subject to conditions specified in a licence. There are some ranges called the Industrial, Scientific and Medical (ISM) bands that are not subject to most of the conditions associated with licenced use. The only condition they must meet is that devices operating in the ISM bands must not interfere in any way with users outside the ISM bands. Two ISM bands, at 2.45 GHz and 5.8 GHz, are currently in use for unlicenced applications such as microwave ovens, residential portable (wireless) telephones and (wireless) routers for localized computer networks (wireless LANs or WiFi systems).

It is important to note that unlicenced does not mean unregulated. All installations and devices are subject to the limits specified in Health Canada SC-6. Furthermore all installations and devices take into account and meet local standards and guidelines to limit occupational and general public exposure.

AM and FM Radio, TV, police and emergency communications, air traffic control systems including radars, cellular telephone, pager and commercial data transmission systems all operate in specifically allocated and licenced bands. Their operating frequencies are spread over the whole spectrum and with the advent of lasers and fibre optics corresponding radio communications applications are moving to frequencies beyond the microwave range, into the infrared and visible regions of the spectrum. Towers scattered throughout the countryside accommodate one or many different antennas or dishes to serve the many needs of the communities.

It is also to be noted that the study and use of electricity, magnetism and the electromagnetic spectrum in general is not at all "new" as is so often claimed. Among the earliest work was that of Galvani and Volta in the late 1700s followed by Gauss, Maxwell, Hertz and Roentgen in the 1800s and then Einstein, Tesla, Townes and Schawlow and Gould in the 1900s. Each and every one of the associated advances in physics led to advances in engineering and technology to bring useful, truly "new,"

1 See <http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/h_sf01678.html>

applications into existence. Some exceptions notwithstanding (e.g. tobacco, CFCs, asbestos), it seems that each innovation, regardless of its provenance, also spawns its own wave of alarm and quackery (the proverbial purveyors of bear grease and snake oil, magic crystals, pyramid power, etc.) that, with the passage of time, in **almost all** cases is dispelled and discredited by results arising from more detailed scientific investigations.

3. MEASUREMENT RESULTS

Measurements were carried out with a Holaday Industries Broadband RF Field Strength Meter Model HI 4012. It provides a calibrated response to electric field levels over the frequency range of 500 kHz to 5 GHz. The meter was set to display far field equivalent power density. The smallest value that the meter can display is 0.001 mW/cm^2 which normally implies a detection limit of 0.0005 mW/cm^2. However, the manufacturer's specifications for the meter state that its detection limit is 0.040 mW/cm^2 for calibrated readings. Therefore recorded values of less than the manufacturer's stated detection limit are only to be interpreted as the barest indication of the presence of emissions from a source and not to be taken as precise or calibrated readings. Values recorded as N.D. or N.D.x indicate that there was not even an approximate indication of emissions detected, i.e. the display did not deviate from 0.000 mW/cm^2 (see also Section 4.2 below).

The probe incorporates an integral spacer such that the detector assembly cannot be placed closer than 5 cm from any source or other object.

Attention was focused on the APs themselves since it was anticipated that, even with the probe in contact, the emissions would be near the limits of detectability of the measurement system. At any given location the display was also closely observed as the probe was moved between adult head and waist level or to head and table level of a seated child.

For ease of reading, the meter, being digital, only updates its display approximately twice each second. However, it actually samples the field approximately twenty times each second. If the display were to show every reading it would usually be changing so rapidly as to be unintelligible. In order to ensure that short duration high readings are not missed the meter's MAX HOLD feature displays the highest detected value during a given time period at a fixed location or while the probe is moving along a certain path between two points, say walking along a corridor or scanning around an AP or over the surface of a microwave oven, computer or monitor. Such highest detected values are designated with an "x" in the tables of measured values below.

The values reported in Tables 1 and 2 below were noted at the specific locations indicated at MES and CCI respectively. For reference purposes the locations are numbered sequentially from 1 to 12 at MES and 13 to 21 at CCI. The reference number for each measurement location is shown on the floor plans of MES and CCI in Figures 1 and 2 respectively.

Table 1. Measured Power Densities, Mountainview ES

Location Ref. No.	Room	Description	Power Density mW/cm^2
1	104A	- numerous measurements - centre, near counters, head and waist levels	N.D.
		- Hollinger's laptop, download traffic	
		- keyboard, 60 s	0.022x
		- keyboard, 60 s, repeat	0.018x
		- head level	N.D.
		- in contact, display, bottom	1.342
2	104	E end, just outside Rm. 104A	
		- in contact with AP	N.D.
		- adult, head and waist levels	N.D.
		- seated child, head and table levels	N.D.
3	117	- entry, NW corner, waist level	N.D.
		- in contact, microwave oven	0.022
4	C102	S end, near door to Rm. 111	
		- in contact with AP	N.D.
		- along corridor between stage and Rm. 104A	0.011x
5	103	E end, Stage	
		- as close as possible (AP ~5 m above floor)	N.D.
6	119	- in contact with AP (30 s)	0.064x
7	120	- in contact with AP (30 s)	0.019x
8	118	- in contact with AP (30 s)	0.003x
9	108	- between Rm. 118 and Rm. 108	N.D.x
		- in contact with AP (30 s)	0.108x
10	123A	- in contact with AP (30 s)	0.001x
11	123A	- along windows, SE corner, waist level	N.D.x
12	Portables (pod of 6)	- between Rm. 123A and W entrance	0.012x
		- AP in NW portable (not accessible)	N/A
		- S centre portable, NW corner, ceiling (30 s)	0.013x

Table 2. Measured Power Densities, Collingwood CI

Location Ref. No.	Room	Description	Power Density mW/cm^2
13	C102	- near Rm. 105	
		- in contact with AP (30 s)	0.005x
		- waist level	N.D.
14	106B	- at entrance, waist and head level	0.015x
		- at server near floor, back wall	0.005x
		- near monitors back wall	0.038x
	104A	- near monitor, NE corner	0.015x
	104	- microwave oven, E wall, in contact	0.100
15	C102	- between Rm. 105 and Rm. 109	N.D.x
		- near Rm. 109	
		- in contact with AP (30 s)	0.004x
		- at waist level	N.D.
16	C103	- between Rm. 109 and Rm. 121	N.D.x
		- near Rm. 121	
		- in contact with AP (30 s)	0.016x
		- at waist level	N.D.
17	C105	- between Rm. 121 and Rm. 134	N.D.x
		- near Rm. 134	
		- in contact with AP (30 s)	0.009x
		- at waist level	N.D.
18	C111	- between Rm. 134 and Rm. 144	0.004x
		- near Rm. 144	
		- in contact with AP (30 s)	0.053x
		- at waist level	N.D.
19	C111	- between Rm. 144 and Rm. 148	N.D.x
		- near Rm. 148	
		- in contact with AP (30 s)	0.016x
		- at waist level	N.D.
20	178	- between Rm. 144 and Rm. 178	0.005x
		- in Rm. 178	
		- in contact with AP (30 s)	0.013x
		- at waist level	N.D.
21	175	- between Rm. 178 and Rm. 175	0.007x
		- in Rm. 175	
		- in contact with AP (30 s)	0.019x
		- at waist level	N.D.

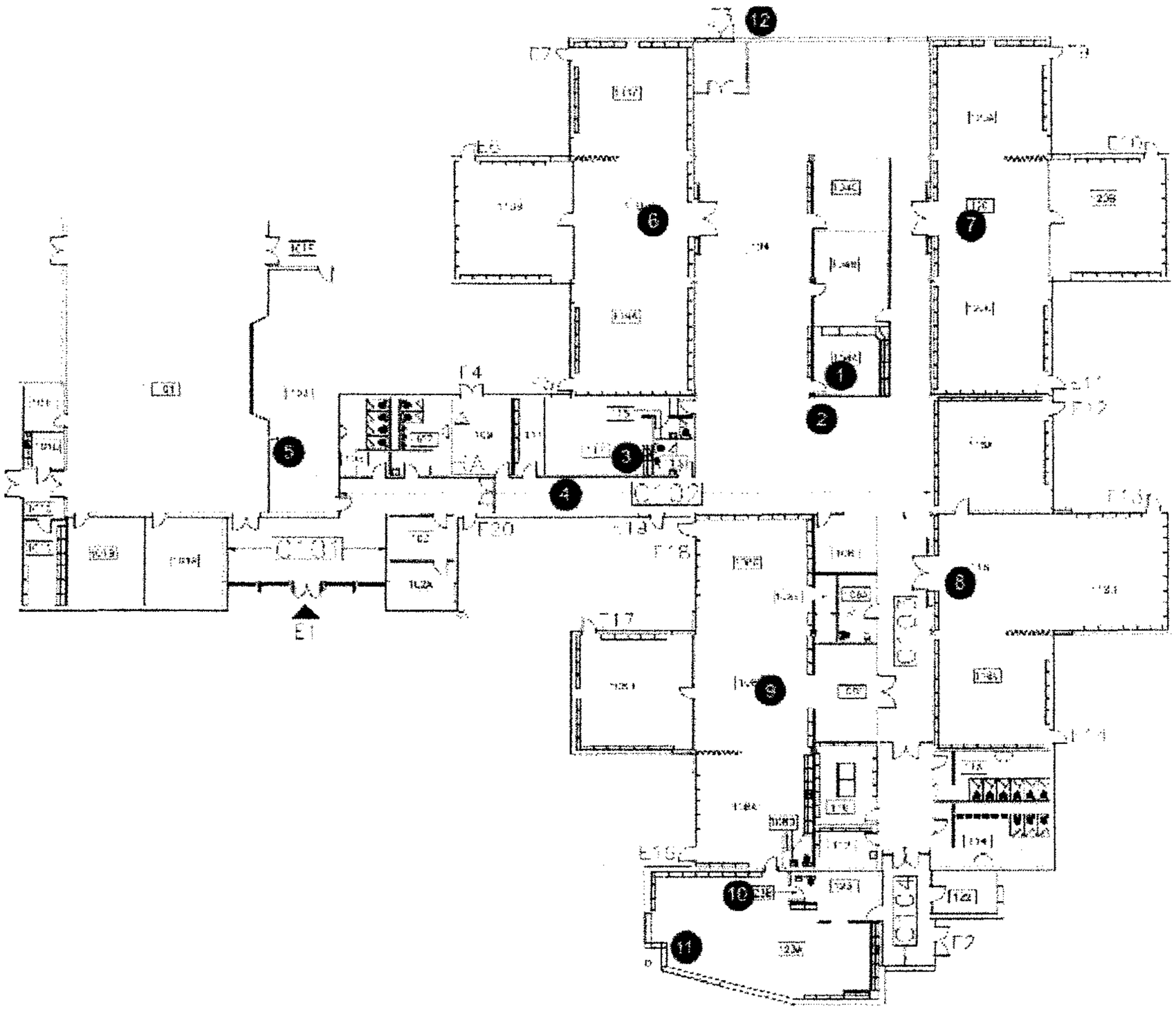

Figure 1. Measurement Locations, Mountainview School

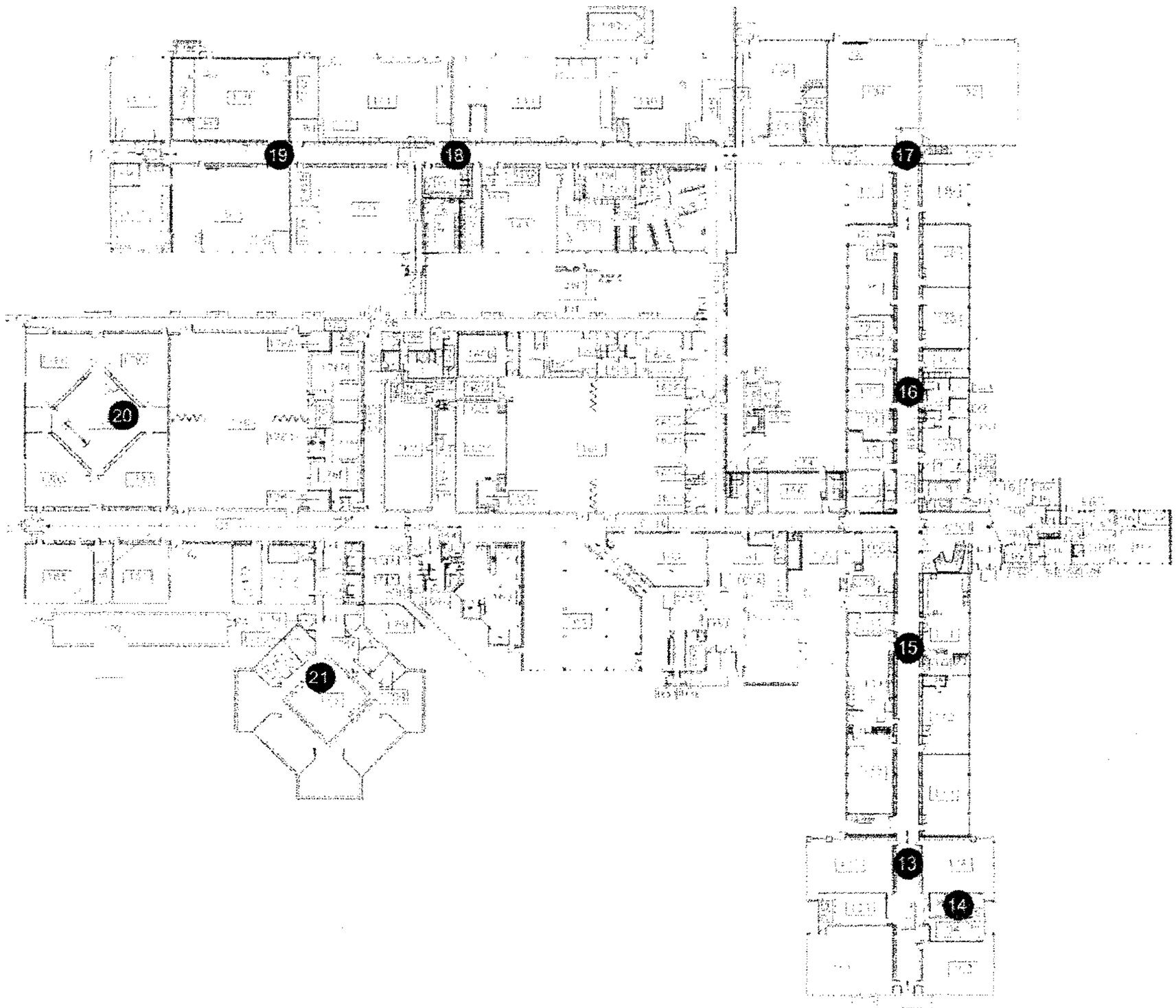

Figure 2. Measurement Locations, Collingwood CI

4. DISCUSSION

4.1 The Sources

The APs being used in SCDSB schools are designed to operate in one or both of the 2.4 GHz and 5 GHz ISM bands. The number and location of the APs in any given school depends on the expected volume of data, number of users anticipated, reliability and coverage requirements that the APs are intended to meet. At any given time only selected bands and selected channels within the bands are active in accordance with the needs of the users. Since the measurements were carried out with a broadband meter the reported values cannot be directly attributed to any specific band or channel and represent a total level arising from both the school and neighbouring areas. Of course when the probe is physically in contact with a source, one of the APs, a laptop or a microwave oven it is to be assumed (quite reasonably) that virtually all of the indicated emission level is attributable to that closest source.

4.2 The Measured Values

The underlined insertions (Ref. NN) or paragraph headings below refer to the Reference Numbers for the locations identified in the first column of Tables 1 and 2.

Ref. 1 - 4, 9, 11 - 21 Of 24 levels recorded at adult head or waist level (including one at seated child head and table level) 18 indicated no detectable emission (N.D.). Of the remaining 6, the highest level was 0.015 mW/cm^2 observed near the entrance to the server control and service room (Ref. 14) at CCI normally only accessed by authorized staff. The next highest level (recorded in areas normally accessed by students) was 0.012 mW/cm^2 recorded at MES (Ref. 12) as the maximum (at adult waist level) along a path from Rm. 123A, through Rms. 108A, 108 and 108F, along corridor C103 and across Rm. 104 to the west entrance of MES which is used for access to the schoolyard and the pod of portable classrooms. While these measured values indicate the presence of emissions, none of them exceeds the meter's calibrated measurement limit of 0.040 mW/cm^2.

Ref. 1 The highest level observed was 1.342 mW/cm^2 with the probe in contact with a laptop near the top edge, middle of the keyboard. The level was observed to be highly localized dropping off to below the detection limit of the meter at distances of about 10 cm from the high point and to N.D. at the user's head.

It is important to note that values reported as N.D. do not mean levels are absolutely 'zero' but rather that they are not only below the calibrated detection limit of the meter but also below its limit to display any reading at all. Clearly there is sufficient signal for the WiFi equipment to operate successfully and reliably. That is because, within their specific channels, the WiFi receivers are designed to be extremely sensitive and can work with levels many, many times (factors of thousands to millions) lower than the detection limit of the meter or the limits specified in Safety Code 6.

4.3 Limits for Exposure to RF and Microwave Fields

According to Health Canada Safety Code 6, for the frequency range from 1.5 GHz to 15 GHz, which includes the APs used in SCDSB Schools, levels less than 1 mW/cm^2 are considered acceptable "for Persons Not Classed as RF and Microwave Exposed Workers (Including the General Public)" regardless of exposure duration.

In the U.S., limits specified in the standards established by the American National Standards Institute (ANSI) in association with the Institute of Electrical and Electronic Engineers (IEEE) and the the Food and Drug Administration's Center for Devices and Radiological Health (USFDA – CDRH) are very similar (although not totally identical) to those of Health Canada Safety Code 6. The same can be said for the limits specified by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) which has brought together experts from across Europe and provides guidance to the Eurpoean Economic Community (EEC). On the broadest front, such a general consensus on limits flows from the EMF Project established by the World Health Organization (WHO) which has been working toward global harmonization of exposure standards and guidelines by promoting and facilitating interchange of the results of research among all the member nations.

5. CONCLUSIONS

The RF and microwave electromagnetic field levels in a representative sample of areas normally accessed by students at both MES and CCI are a factor of at least 25 below the exposure limits specified in Health Canada Safety Code 6 for "Persons Not Classed as RF and Microwave Exposed Workers (Including the General Public)." All the observed levels are far below exposure limits currently established or proposed by major international or national agencies or organizations for public (including children) or occupational exposures.

A.M. (Tony) Muc, Ph.D., P.Phys.
President and Chief Physicist