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UNITED STATES DISTRICT COURT

DISTRICT OF OREGON

Portland Division

AHM, by and through her Guardian *ad litem* and father David Mark Morrison, and **DAVID MARK MORRISON**, individually,

Plaintiffs,

v.

PORTLAND PUBLIC SCHOOLS,

Defendant.

CV No. 11-739-MO

EXPERT REPORT OF DAVID SAVITZ, Ph.D.

1. My name is David Savitz, and I am currently Professor of Epidemiology and Obstetrics and Gynecology at Brown University. I have been retained by the Portland Public

Schools to evaluate plaintiffs' claim that wireless internet (or Wi-Fi) causes cancer and other adverse health effects.

2. I received my undergraduate training in psychology at Brandeis University, a master's degree in preventive medicine at Ohio State University in 1978, and a Ph.D. in epidemiology from the University of Pittsburgh Graduate School of Public Health in 1982. I began my academic career as an Assistant Professor in the Department of Preventive Medicine and Biometrics at the University of Colorado School of Medicine and moved to the University of North Carolina School of Public Health in 1985. I served as the Carey C. Boshamer Distinguished Professor and Chair of the Department of Epidemiology at the University of North Carolina School of Public Health until the end of 2005. From 2006 to 2010, I was the Charles W. Bluhdorn Professor of Community and Preventive Medicine and Director of Disease Prevention and Public Health Institute at Mount Sinai School of Medicine.

3. My teaching is focused on epidemiologic methods, and I authored a book entitled *Interpreting Epidemiologic Evidence*. I have directed 29 doctoral dissertations at the University of North Carolina and 13 master's theses. I served as editor at the *American Journal of Epidemiology* and as a member of the Epidemiology and Disease Control-1 study section of the National Institutes of Health and am currently an editor at *Epidemiology*. I was President of the Society for Epidemiologic Research, President of the Society for Pediatric and Perinatal Epidemiologic Research, and North American Regional Councilor for the International Epidemiological Association. I was elected to membership in the Institute of Medicine in 2007. My primary research activities and interests are in environmental, reproductive, and cancer epidemiology.

4. I have over 25 years of experience in conducting and evaluating epidemiologic research addressing health effects of non-ionizing radiation.

5. I was chosen to lead a study of residential electric and magnetic fields and childhood cancer by the New York State Power Lines Project in the early 1980s, and published a series of influential papers based on one of the first studies on this issue:

a. David A. Savitz et al., *Case-Control Study of Childhood Cancer and Exposure to 60-Hz Magnetic Fields*, 128 Am J Epidemiology 21-38 (1988).

b. F. Barnes et al., *Use of Wiring Configurations and Wire Codes for Estimating Externally Generated Electric and Magnetic Fields*, 10 Bioelectromagnetics 13-21 (1989).

c. David A. Savitz et al., *Methodological Issues in the Epidemiology of Electromagnetic Fields and Cancer*, 11 Epidemiologic Revs 59-78 (1989).

d. D. P. Loomis & David A. Savitz, *Mortality From Brain Cancer and Leukemia Among Electrical Workers*, 47 Brit J Indus Med 633-38 (1990).

e. David A. Savitz et al., *Magnetic Field Exposure From Electric Appliances and Childhood Cancer*, 131 Am J Epidemiology 763-73 (1990).

f. David A. Savitz & W. T. Kaune, *Childhood Cancer in Relation to a Modified Residential Wire Code*, 101 Envtl Health Persp 76-80 (1993).

g. David A. Savitz & D. P. Loomis, *Magnetic Field Exposure in Relation to Leukemia and Brain Cancer Mortality Among Electric Utility Workers*, 141 Am J Epidemiology 123-34 (1995).

h. David A. Savitz et al., *Lung Cancer in Relation to Employment in the Electrical Utility Industry and Exposure to Magnetic Fields*, 54 Occupational & Envtl Med 396-402 (1997).

i. David A. Savitz et al., *Magnetic Field Exposure and Neurodegenerative Disease Mortality Among Electric Utility Workers*, 9 Epidemiology 398-404 (1998).

j. David A. Savitz et al., *Magnetic Field Exposure and Cardiovascular Disease Mortality Among Electric Utility Workers*, 149 Am J Epidemiology 135-42 (1999).

6. My next major study in the area of non-ionizing radiation addressed risks of leukemia, brain cancer, and other diseases in electric utility workers, conducted starting in the late 1980s and completed in the mid-1990s. That study was one of the largest and most rigorous evaluations of this topic and remains an important contribution to the scientific literature.

7. I have written extensively on the research methods used in studies of health effects of electromagnetic fields and participated in several authoritative reviews, including a major assessment undertaken by the National Research Council, which I co-chaired. That generated a book that comprehensively evaluated the research pertaining to extremely low-frequency electromagnetic fields. *Possible Health Effects of Exposure to Residential Electric and Magnetic Fields* (1997).

8. I have served for the past ten years as a member of the Epidemiology Committee of the International Commission on Nonionizing Radiation Protection, an organization supported by the European Union. Our committee has evaluated and published on the evidence regarding power-frequency electric and magnetic fields. (A. Ahlbom et al., *Review of the Epidemiologic Literature on EMF and Health*, 109 Envtl Health Persp 911-33 (2001). The committee has more recently focused on radiofrequency radiation from mobile phones, considering both transmission towers and individual phone use. (A. Ahlbom et al., *Epidemiologic Evidence on Mobile Phones and Tumor Risk: A Review*, 20 Epidemiology 639-52 (2009); A. J. Swerlow et al., *Mobile Phones, Brain Tumours, and the Interphone Study: Where Are We Now?* Envtl Health Persp (2011); *available at* http://dx.doi.org/10.1289/ehp.1103693.

9. Through my own original research, evaluation of the work of others, and participation in evaluative reviews with many of the worlds' experts, I believe that I have a

comprehensive understanding of the epidemiologic evidence on health effects of non-ionizing radiation.

10. Epidemiology is the scientific discipline that examines the patterns of disease in human population in order to identify causes and methods of disease prevention. The strength of epidemiology is that it directly evaluates human experience in the real world rather than in a laboratory counterpart. Epidemiologic studies consist of comparisons between groups of people who have and have not been exposed to some potentially harmful or beneficial agent in order to determine whether the agent is associated with different rates of disease occurrence.

11. Epidemiologists apply statistical tools to evaluate associations between possible risk factors and the occurrence of disease and have developed an extensive set of methods to help inform our judgment about disease causation. For example, we discovered long ago that people who smoke have a markedly higher risk of developing lung cancer, heart disease, and many other health problems compared to those who do not smoke. The conduct of such studies consists of identifying a suitable population that includes people with and people without the exposure of interest, enrolling them to find out about other health risks that they might have, and following them over time to determine who does and who does not develop disease.

12. Once that process is completed, the data are analyzed to determine whether the exposure of interest is associated with disease. While experiments in the laboratory that examine the effect of different agents on cells or animals can be quite informative, the most direct assessment of human health effects comes from epidemiologic studies, which determine whether there is a link between exposure and disease in free-living human populations.

13. With regard to the issue of possible health effects of Wi-Fi in schools, a study might compare a large group of children who are taught in classrooms that have Wi-Fi with a large group of otherwise comparable children whose classrooms do not have Wi-Fi in order to determine whether those in the classrooms with Wi-Fi have more symptoms of illness of any kind, including those purported to be associated with Wi-Fi. It is important to note that

individual reports those of experiencing health problems that they believe are the result of Wi-Fi do not constitute epidemiologic evidence, in that a study requires a systematic evaluation of a sufficiently large number of subjects having different exposures in order to determine whether there is an association between the exposure and the outcome. Symptoms that are perceived to result from various forms of nonionizing radiation have been reported for many years, with some individuals claiming to be exceptionally sensitive to this exposure, but scientific evaluation of these claims has consistently failed to support them.

14. Wi-Fi in schools constitutes a distinctive pattern of exposure—the nature of the transmission, duration of exposure, age of the children, etc., are different than for other forms of non-ionizing radiation. Since this has not been directly evaluated in a scientific manner, assessment of the potential health consequences of exposure to Wi-Fi could be based only on extrapolation from research on other forms of non-ionizing and expert judgment regarding the applicability of those other circumstances to the issue of Wi-Fi in schools. Key considerations in making that judgment include the following:

a. Wi-Fi would not be expected to produce any biological effects based on the low energy and failure to identify pathways indicating harm in experimental studies. A World Health Organization working group (P. A. Valberg et al., *Base Stations and Wireless Networks—Radiofrequency (RF) Exposures and Health Consequences*, Envtl Health Persp 416-24) (2007)) found little support for the contention that radiofrequency exposures in general (including Wi-Fi) pose a threat to health based both on biological considerations and on a review of the empirical laboratory evidence. When the biological plausibility of health effects is low, as it is in the case of Wi-Fi, only strongly positive epidemiologic research would provide convincing evidence of a health hazard. In the case of Wi-Fi exposure, there is no epidemiologic evidence whatsoever that counters the lack of biological support for a potential health hazard.

b. Markedly higher levels of exposure to analogous forms of non-ionizing radiation in the same general range of frequencies as Wi-Fi, including use of cell

phones, have not, in my opinion, been proven to be harmful. This assessment is consistent with such scientifically based authorities as the U.S. National Cancer Institute (http://www.cancer.gov/cancertopics/factsheet/Risk/cellphones), the National Institute for Environmental Health Sciences (http://www.niehs.nih.gov/health/topics/agents/cellphones/index.cfm), the Food and Drug Administration (http://www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/HomeBusinessandEntertainment/CellPhones/ucm116335.htm), the American Cancer Society (http://www.cancer.org/Cancer/CancerCauses/OtherCarcinogens/AtHome/cellular-phones), the Institution of Electrical Engineers (IEE Position Statement 2004, *The Possible Harmful Effect of . . .*), the United Kingdom's National Radiological Protection Board *Health Effects From Radiofrequency Electromagnetic Fields, 14 NRPB (2003)*), the Swedish Radiation Safety Authority (*Recent Research on EMF and Health Risk*, 2010 SSM 44), the Netherlands environmental health agency (http://www.gezondheidsraad.nl/sites/default/files/200902.pdf), and the International Commission on Non-Ionizing Radiation Protection (P. Vecchia, et al. *Exposure to High Frequency Magnetic Fields, Biological Effects, and Health Consequences* (100 kHz-300GHz), 16 Int'l Comm'n on Non-Ionizing Radiation Protection (2009)). These assessments are made by agencies whose mission is to protect health, with opinions formed by leading researchers and policy experts, and maintained as up-to-date documents through their websites. All these assessments agree that health harm from use of cell phones not been demonstrated to occur.

c. Epidemiologic research that asks whether children exposed to Wi-Fi in schools experience a greater risk of health problems than children without such exposure would therefore be required to challenge the presumption of safety and overcome the strong reasons to believe that it is without harm, but such research has simply not been done. To my knowledge, no studies have been done to address whether children in classrooms with Wi-Fi

have any differences in their health experience than children in classrooms without Wi-Fi. Similarly, I am not aware of any studies of symptoms or disease in adults who have had exposure to Wi-Fi compared to those who have not had that exposure.

15. Identifying causes of disease using epidemiologic methods is challenging, and inferring cause-and-effect relationships is subject to uncertainty and error. Extensive work has been done to define the principles by which epidemiologic evidence is evaluated. One of the key considerations in the evaluation of epidemiologic research (or other scientific disciplines, for that matter) is the need for replication. Any one study, no matter how carefully designed and conducted, is subject to erroneous results. A careful review of the totality of scientific evidence considers the full range of studies and does not base conclusions on isolated findings. Stronger associations between exposure and disease are more readily identified as causal in nature than weaker associations. A gradient of increasing risk with increasing exposure supports a causal inference, i.e., as exposure increases, risk of disease increases. Ancillary support from laboratory studies and understanding the biological process by which exposure might cause disease adds to epidemiologic evidence of an association to strengthen the case for a causal association. These principles are covered in a number of textbooks and scholarly publications in the field, including in a book that I wrote. *Interpreting Epidemiologic Evidence: Strategies for Study Design and Analysis* (2003).

16. Literature concerning other forms of non-ionizing radiation, such as power lines and cell phones, drawn upon to help judge the potential health effects of Wi-Fi, calls for critically and carefully examining reports of association in order to make an informed judgment regarding whether exposure causes disease. A single report of an association or even sporadic findings of an association among a number of studies do not prove that exposure causes the disease.

17. There are many reasons that associations can arise without a cause-and-effect linkage. For example, random error yields sporadic false indications of association.

Erroneous reports of exposure can also distort findings. If adults with brain tumors inaccurately reported more cell phone use than healthy adults, any association that is observed would be founded on an erroneous premise. Inaccurate reporting would lead to the erroneous conclusion that there is an association between use of cell phones and the development of brain tumors. Similarly, those persons living in neighborhoods in which radio and television or cellular communications towers are located may well be more likely to perceive and report low-level health symptoms even if there is no direct effect of the nonionizing radiation. Not everyone we seek is willing to participate in studies, and the pattern of non-participation can result in invalid indication (or lack of indication) of an association. Other influences on disease risk may be correlated with the exposure of interest; for example, if those homes with higher magnetic field exposure are located near busy roads that are a source of air pollution, we may blame the magnetic fields for reported health effects when the air pollution is actually responsible.

18. It is quite challenging to isolate the exposure of interest and demonstrate a causal link to health outcomes, making a systematic, critical evaluation of the scientific evidence essential in order to draw valid inferences. This level of scientific rigor has not been applied to the evidence on health effects of non-ionizing radiation in the declarations that I reviewed.

19. I have prepared this report in response to a request to evaluate the scientific evidence bearing on possible health risks associated with Wi-Fi in schools and to comment on the expert declarations submitted by plaintiffs. I have been asked to consider the methods used by the declarants in drawing inferences regarding the potential health effects of Wi-Fi exposure and to evaluate those methods in light of the standards for assessment in the field of epidemiology.

20. In order to respond to this request, I have drawn upon my extensive previous work and familiarity with the research pertaining to potential health effects of non-ionizing radiation. I reviewed a series of publications specifically in preparing this declaration, in addition to the many papers I had already read, as well as news reports on

concerns with Wi-Fi in schools including allegations by concerned parents. I also reviewed the declarations of Dr. Carpenter, Mr. Morgan, Mr. Trower, Dr. Bennett, Dr. Havas, and Dr. Goldsworthy provided to me by Mr. Campbell. I reviewed the following documents specifically in preparing my report:

a. Cindy Sage & David O. Carpenter, *Public Health Implications of Wireless Technologies*, 6 Pathophysiology 233-46 (2009).

b. *Banning Wi-Fi From Schools*, Neurologica Blog, Aug. 16, 2010.

c. *Parents Complain That Wi-Fi Is Making Students Sick*, Canadian Press, Aug. 15, 2010.

d. *Electromagnetic Fields and Public Health. Base Stations and Wireless Technologies*, World Health Org, Fact Sheet N*304, May 2006.

e. Univ of Queensland, Austl, *Wireless Device Safety & Health Concerns.*, Feb. 15, 2011.

f. John Timmer, *Alarming Lack of Science Behind European Wireless Tech Health Alert* (undated).

g. *Even More Parents Worried About Wi-Fi in Schools*, Tech Vibes, Apr. 29, 2011.

h. James R. Jauchem, *Effects of Low-Level Radio-Frequency (3 Khz to 300 Ghz) Energy on Human Cardiovascular, Reproductive, Immune, and Other Systems: A Review of the Recent Literature*, 211 Int'l Hygiene & Envtl Health 1-29 (2008).

i. Phil Dotree, *Wi-Fi Does Not cause Cancer*, Yahoo Contributor Network, Dec. 18, 2006.

j. Clive Webster, *Wi-Fi Health Risk Report Based on "Alarming Lack of Science*," Custom PC Mag, May 27, 2011.

k. *Wireless Systems and RF Safety Issues*, Cisco Aironet 1200 Series (undated).

l. P. Frei et al., *Use of Mobile Phones and Risk of Brain Tumours: Update of Danish Cohort Study*, 343 Brit Med J d6387 (2011).

m. A. Ahlbom & M. Feychting, *Mobile telephones and brain tumors*. 343 Brit Med d6605 (2011).

21. Considered in the aggregate, plaintiffs' declarations address different aspects of the relationship between Wi-Fi exposure and health, but they have some features in common:

a. None of the declarations cite scientific evidence from studies of Wi-Fi exposure. Instead, they all rely on extrapolation from other forms of non-ionizing radiation or anecdotal claims regarding health effects from Wi-Fi without research support. Conclusions regarding Wi-Fi are all based solely on extrapolation from other forms of non-ionizing radiation.

b. The declarants' consideration of the scientific literature is highly selective, highlighting any results that might be indicative of adverse health effects from the form of non-ionizing radiation under discussion and neglecting to examine the methods of those studies or consistency of the findings in the scientific literature as a whole. The declarants' assertion that those with financial interests in these devices have suppressed evidence of harm is simply implausible given the motivation of such agencies as the National Institutes of Health, American Cancer Society, and others to discover causes of disease and protect the health of the public. Researchers, myself included, are motivated to conduct studies to evaluate putative causes of disease, funding agencies support research that they believe will be beneficial to science and public health, and scientific journals are motivated to disseminate important findings from such studies. There is simply no basis for an assertion that there is an organized suppression of research on this topic.

c. In building their case regarding the alleged hazard from Wi-Fi, the declarants mix consideration of research evidence with discussion of alternative technologies,

ethical obligations, psychological responses, and their personal intuition, blurring the distinction between evidence and how to assess and respond to that evidence.

22. The Amended Declaration of Dr. David Carpenter, who has had a very successful career as a laboratory scientist and administrator, but not as an epidemiologist, provides an assessment of the potential for health harm from exposure to Wi-Fi signals in the Portland Public Schools. Dr. Carpenter makes a series of claims regarding the scientific evidence bearing on the potential health effects of this form of radiofrequency radiation. Dr. Carpenter's suggestion that Wi-Fi signals in the schools pose a health hazard, however, is not based on established and well-accepted epidemiologic methods for evaluating scientific evidence to draw inferences about cause-and-effect relationships. Dr. Carpenter asserts that there is a clear biological basis for expecting health harm from radiofrequency radiation in the form of Wi-Fi and other commonly encountered sources from cell phones and transmission towers. This is counter to essentially all the scientific reports I reviewed, including statements from the Institution of Electrical Engineers (*The Possible Harmful Biological Effects of Low-Level Electromagnetic Fields of Frequencies up to 300 GHZ* (May 2004)), a working group of the World Health Organization (P. A. Valberg, et al., *Base Stations and Wireless Networks—Radiofrequency (RF) Exposures and Health Consequences*, 15 Envtl. Health Persp 416-24 (2007)), and the International Council on Non-Ionizing Radiation Protection International Commission on Non-Ionizing Radiation Protection (P. Vecchia, et al., *Exposure to High Frequency Magnetic Fields, Biological Effects, and Health Consequences (100 kHz-300GHz)*. These reports provide context for the assessment of the epidemiologic studies of radiofrequency radiation and health, making adverse health effects unlikely. *See, supra*, ¶¶ 14(a)-(c).

23. No scientific evidence whatsoever directly addresses the question whether children exposed to Wi-Fi have any increase in health problems of any sort as compared to children not so exposed. Thus, all the claims regarding health harm that are cited come from studies on other forms of non-ionizing radiation, ranging from power lines to cell phones, and

inferences regarding possible health effects of Wi-Fi communication signals are solely by extrapolation. This limitation in drawing inferences regarding Wi-Fi from forms of non-ionizing radiation that are quite different is not adequately considered.

24. The declarants' characterization of the evidence regarding the possible health effects of non-ionizing radiation from sources other than Wi-Fi represents an unconventional point of view, particularly as to their conclusion that such exposures cause health harm, which runs counter to essentially all the major scientific and public health agencies in North America and Europe. In the declarations, any suggestion of possible adverse effects of non-ionizing radiation is accepted as valid and reflective of a cause-and-effect relationship. In many cases, including studies that I have conducted, an early study with weaker methods is followed by superior studies, so that an overall assessment must take all the relevant research into account. In the declarations, however, reported findings from the laboratory are accepted as established facts even when the findings from the studies have not been and cannot be replicated. The declarants place an unwarranted degree of confidence in the studies linking power lines to cancer and other adverse health outcomes, and treat studies linking cell phones to cancer in a manner that goes far beyond what the empirical data support. Specific examples of purported health effects of non-ionizing radiation that are not justified based on the evidence follow.

25. The evidence linking extremely low frequency electromagnetic fields to childhood brain cancer has been systematically and carefully integrated by an international team of experts, and no support whatsoever was found for an association (L. Kheifets et al., *A Pooled Analysis of Extremely Low-Frequency Magnetic Fields and Childhood Brain Tumors*, 172 Am J Epidemiology 752-61 (2010). This study belies Dr. Carpenter's assertion that such an association has been established.

26. Extremely low-frequency electromagnetic fields as a possible cause of breast cancer in women has been repeatedly and thoroughly examined, with a clear consensus that there are no adverse effects. I. C. Ahlbom et al., *Review of the Epidemiologic Literature on*

EMF and Health, 109 Supp 6 Envtl Health Persp 911-33 (2001); M. Feychting et al., *EMF and Health*, 26 Ann Rev Pub Health 165-89 (2005).

27. The claim that cell phones cause brain cancer on the side of the head where the phone is regularly used is not true. *The American Journal of Epidemiology* recently published a detailed study that showed no correlation whatsoever between cell phone exposure and the location of brain tumors. S. Larjavaara et al., *Location of Gliomas in Relation to Mobile Telephone Use: A Case-Case and Case-Specular Analysis*, 174 Am J Epidemiology 2-11 (2011).

28. The only large, rigorously conducted study of cell phone use and childhood brain tumors shows no association whatsoever. D. Aydin et al., *Mobile Phone Use and Brain Tumors in Children and Adolescents: A Multicenter Case-Control Study*, 103 J Nat'l Cancer Inst 1264-76 (2011). Again, this study contradicts Dr. Carpenter's assertion that the research supports an enhanced adverse effect of cell-phone use on children.

29. The prediction of an epidemic of cancer resulting from exposure to non-ionizing radiation, specifically from cell phones, is simply not occurring, despite widespread use for over a decade. The latest evidence from careful monitoring in the United States and in Scandinavian countries, where cell phone use arose early, is that there is no increase whatsoever in brain tumors over a time frame in which the beginning of any increase should be detectable Isabelle Deltour et al., *Time Trends in Brain Tumor Incidence Rates in Denmark, Finland, Norway, and Sweden, 1974-2003*, 101 J Nat'l Cancer Inst 1721-24 (2009); Peter Inskip et al., *Brain Cancer Incidence Trends in Relation to Cellular Telephone Use in the United State,* 12 Neuro-Oncology 1147-51 (2010). The most recent and among the strongest studies to date of long-term cell phone use and brain cancer (Schulz et al., 2011) found no evidence of increased risk, even among the subset of individuals who started using cell phones at the earliest availability and thus have accumulated the longest duration of use. This nationwide cohort study in Denmark has strengths that are distinctive from other studies in assessing exposure based on records of use rather than self-report, and the long period identified a large number of

brain-tumor cases. As noted by the authors and in an accompanying editorial (Ahlbom & Feychting, 2011), this study adds considerable weight against an effect of cell-phone use on brain-tumor risk.

30. The most strongly supported contention of possible adverse health effects from non-ionizing radiation comes from the studies linking relatively high levels of residential extremely low-frequency electromagnetic fields to childhood leukemia. As Dr. Carpenter notes, he served as Executive Secretary of the New York State Powerlines Project, a research program that supported research I conducted on power lines and childhood cancer. While my study did suggest associations between elevated magnetic field exposure and risk of developing cancer in children, as Dr. Carpenter notes in his declaration, a number of subsequent, superior studies followed that indicated no association except for homes with unusually high levels of exposure. Specifically, several large studies showed that there was no association between electrical wiring and childhood leukemia. (Martha Linet et al., *Residential Exposure to Magnetic Fields and Acute Lymphoblastic Leukemia in Children*, 337 New Eng J Med 1-7 (1997); A. Ahlbom et al., *A Pooled Analysis of Magnetic Fields and Childhood Leukemia*, 83 Brit J Cancer 692–98 (2000). Below 3 or 4 milligauss, there was no evidence whatsoever of an association with childhood leukemia. Above 3 or 4 milligauss, an association was found with childhood leukemia with uncertain implications, neither well established nor well accepted as a causal relationship between exposure and health effects. Regardless, the form and level of exposure from residential exposure to magnetic fields from power lines, the age range of the children possibly affected (acute lymphocytic leukemia peaks in the age range of two to four years), and characteristics of the exposure are notably different from the circumstances for Wi-Fi in public schools.

31. As noted previously, expert groups that have evaluated the evidence on adverse health effects of cell phones consistently come to the conclusion that an association has not been established. Even if there were reliable evidence showing a correlation between cell-phone use and adverse health effects, the nature of the exposure characteristics makes cell-phone

studies of very limited relevance to an assessment of potential health effects of Wi-Fi on children. With cell phones, there is exposure directly to the head because the antenna is situated very close to the head during use so that the exposure comes in relatively short periods of more intense exposure rather than as a very low background exposure present throughout the school day.

32. Dr. Carpenter suggests that the briefer, more intense exposure from cell phones is not as pertinent to the assessment of potential health effects of Wi-Fi as the more prolonged, lower level exposure to radiofrequency radiation from living in proximity to communication towers used for radio, television, and cellular transmission. Furthermore, he contends that transmission-tower exposure studies demonstrate adverse health effects among those residing in proximity to such installations. Based on my review of the studies that he lists in his declaration as well as research reviewed as part of a report that I prepared (A. Ahlbom, et al., *Epidemiologic Evidence on Mobile Phones and Tumor Risk: A Review*, 20 Epidemiology 639-52 (2009)), I do not believe that the studies of health patterns related to transmission towers provide evidence of adverse health effects of radiofrequency radiation. I draw this conclusion based on several considerations:

a. Distance from transmission towers is not an accurate surrogate for exposure and thus the studies at most only indirectly assess any role of radiofrequency radiation. Many of the studies are therefore largely uninformative on the question of interest; namely, health effects of prolonged radiofrequency exposure.

b. Many of these reports came about from investigations that started with a perceived disease cluster, that is, an excess of some particular health problem noted in a given neighborhood or community. Given the many installations in place, some are bound to have unusually high disease rates in the vicinity (and others will have unusually low disease rates) by chance alone. When the perceived cluster of disease drives the investigation, it is not possible to make inferences regarding a causal impact of the exposure of concern.

c. The boundaries for defining "proximity" are quite variable and inconsistent across the studies. This raises the possibility that the geographic boundaries were defined in part based on the results, i.e., selecting those boundaries that generated the strongest evidence of increased disease.

d. Dozens of different diseases were considered across these studies, and there is little or no consistency as to which diseases are implicated. While several studies each found evidence for increased risk of some disease, there was no consistent support for any specific disease across multiple studies. Replication of results across studies must be evaluated for specific diseases, and there is not evidence of a positive association from multiple studies for the same outcome.

e. The location of transmission towers is not random, often a marker of increasing population and/or economic development of the area, so that separating non-specific effects of such changes from a specific impact of radiofrequency communications requires careful evaluation, which is not demonstrated in these reports.

Based on these considerations, the research does not provide evidence indicating an association between radiofrequency radiation exposure from transmission towers and adverse health effects.

33. Dr. Carpenter repeatedly makes claims about what is "generally accepted" or "established" regarding adverse effects from non-ionizing radiation to which I would take exception. There is a range of opinion, with a small number of scientists who are convinced, as Dr. Carpenter is, that the purported effects are present, but I am confident that most experts in the field would say that while we do not know with certainty whether there are adverse health effects, health effects are unlikely even if the possibility of weak effects has not been fully explored. This would be the case for power lines, cell phones, and the other forms of non-ionizing radiation considered. Those who have provided perspectives specifically on Wi-Fi, including the Environmental and Workplace Health program of Health Canada

(http://www.hc=sc=gc.ca/ewh=semt/radiation/cons/wifi/index-eng.php) and the University of California, Irvine, Radiation Safety Division (http://www.ehs.uci.edu/programs/radiation/Wi-Fi%20Safety.pdf), considered the evidence and determined that the low-level radiofrequency energy from Wi-Fi equipment is safe.

34. The perspective presented in the declarations goes far beyond a review and interpretation of the scientific evidence of possible relevance to the question at hand and reflects personal opinion about such issues as prudence, ethical responsibilities to children, the ease of eliminating exposure through alternative technologies, and the actions called for by the Portland Public Schools. As an informed citizen and public health physician, Dr. Carpenter is of course entitled to an opinion on these matters, but the judgments presented in his declaration go far beyond scientific evidence regarding health effects from this source of exposure.

35. Lloyd Morgan's declaration consists of a series of statements purporting to establish his expertise in the field and studies that he asserts demonstrate that Wi-Fi poses a health hazard. He has lent his expertise in electrical engineering to the evaluation of potential health effects of non-ionizing radiation, and collaborated with epidemiologists and other health scientists in the conduct and evaluation of those studies. As was the case with Dr. Carpenter, Mr. Morgan (a) does not cite any scientific research addressing health effects of Wi-Fi exposure; (b) considers a highly selected subset of research that is used to support his contention of adverse effects, not evaluating the quality of those studies or other studies that have different findings; (c) mixes considerations of ethics, prudence, and speculation with references to the research to support his overall contention that Wi-Fi poses a health hazard.

36. Barrie Trower approaches the issue of potential health effects of Wi-Fi in schools from a background in military applications of microwave technology, of little relevance to the question at hand. He considers early research on potential health effects of the use of microwaves for applications in the military and for espionage, and makes the assumption that such information applies to Wi-Fi exposure without support. All the concerns raised regarding

the declarations of Dr. Carpenter and Mr. Morgan apply here as well: Mr. Trower (a) does not cite any scientific research addressing health effects of Wi-Fi exposure; (b) considers a highly selected subset of research that is used to support his contention of adverse effects, not evaluating the quality of those studies or other studies that have different findings; and (c) mixes considerations of ethics, prudence, and speculation with references to the research to support his overall contention that Wi-Fi poses a health hazard.

37. Dr. Curtis Bennett presents his biophysical theories about how Wi-Fi signals may interact with human tissue and cause health harm. No evidence is presented to indicate that any of these hypothesized effects actually occur, i.e., tissue heating and the health harm that he believes would follow. As with the other declarations, his speculation about possibilities notwithstanding, there is no evidence cited to indicate that Wi-Fi in schools poses a threat to the health of children or others in its vicinity.

38. Dr. Magda Havas focuses on exposure guidelines applicable to Wi-Fi and the health implications of prolonged exposure. While some municipalities in Europe have adopted very stringent standards, these do not reflect the vast majority of agencies with expertise in environmental exposures and health. The distinctive exposure pattern associated with Wi-Fi has not been studied with regard to health effects, and the potentially analogous situation of living in proximity to radiofrequency communication towers has not generated evidence that supports a contention of adverse health effects.

39. Dr. Andrew Goldsworthy considers the biological pathways by which radiofrequency radiation might cause health harm. Based on what he claims is a strong foundation for the plausibility of adverse health effects, he believes that Wi-Fi exposure would pose a health hazard. The claims of biological harm are counter to a number of authoritative reviews cited previously and do not directly address the question whether there is, in fact, any association between Wi-Fi exposure and health.

40. In the last four years, I have provided expert opinions in two cases: a) on behalf of attorneys representing the Province of Nova Scotia, Canada, in the fall of 2008, I provided advice and testimony regarding potential health effects from environmental contamination from a coke plant and steel mill formerly operating in Sydney, Nova Scotia; and b) on behalf of attorneys representing Duke University, in the spring of 2011, I provided advice and testimony regarding potential health effects associated with use of contaminated surgical equipment in Duke health center facilities.

41. I am being compensated for my work in preparation and testifying in the amount of $400 per hour. This is consistent with my consulting fee in other cases in which I have testified.

DATED this 9th day of January, 2012.

David Savitz, Ph.D.

I hereby certify that I served the foregoing Expert Report of David Savitz, Ph.D. on:

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by the following indicated method or methods:

☒ **CM/ECF system transmission.**

☐ **E-mail.** As required by Local Rule 5.2, any interrogatories, requests for production, or requests for admission were e-mailed in Word or WordPerfect format, not in PDF, unless otherwise agreed to by the parties.

☐ **Facsimile communication device.**

☐ **First-class mail, postage prepaid.**

☐ **Hand-delivery.**

☐ **Overnight courier, delivery prepaid.**

DATED this 9th day of January, 2012.

s/ Bruce L. Campbell
Bruce L. Campbell, OSB No. 925377

Of Attorneys for Portland Public Schools