

NRL
National Radiation Laboratory

**Measurements
of exposures
around Vodafone cellsites:
summary of results
April 2004 to March 2005**

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Measurements of exposures around Vodafone cellsites: summary of results April 2004 to March 2005

The National Radiation Laboratory (NRL) was commissioned by Vodafone to measure exposures to radiofrequency (RF) fields in areas around 5% of their cellsites. This report presents the results of 50 measurements carried out between April 2004 and 31 March 2005.

The purpose of the survey is outlined in the following statement from Vodafone:

Vodafone is committed to providing greater transparency and access to information for all our stakeholders on the issues of mobile phones, masts and health. To proactively address these issues and to better inform and educate our customers, employees and the general public, Vodafone has established an independent field monitoring programme to measure and monitor the total electromagnetic radio-frequency (RF) field strength in the environment, from all sources (i.e., TV, radio, mobile telephony base stations etc), near our mobile base stations.

The aim of the program is to provide the public with independent, reliable and direct information on the total electromagnetic RF levels in the environment. Any interested party can easily access the measurement results from a specially developed web page by visiting the web site www.nrl.moh.govt.nz (Search: NRL Vodafone Monitoring project).

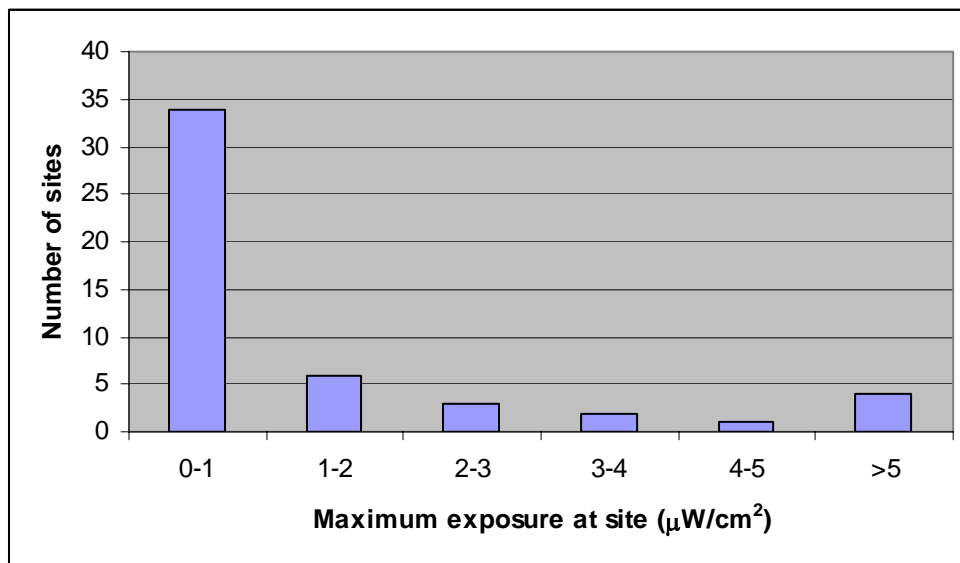
In order to preserve the transparency and validity of information provided, as well as the ongoing updating thereof, Vodafone has requested that NRL (National Radiation Laboratory - a division of the Ministry of Health) assume the programme's overall scientific management. As an independent organisation NRL selects the locations to undertake the monitoring and measurement of RF, and moreover, supervises and verifies the correctness of all information, entirely independent of Vodafone.

Vodafone had no say in the choice of sites to be tested, or when testing would be undertaken. Selection of sites and testing times was entirely at the discretion of the NRL. In general, the approach taken was to ensure:

- A good geographic spread of sites
- A range of types of sites (central city/urban/suburban, rural)
- Coverage of sites known to be of community interest

The overall intention was to obtain a spread of sites with regard to these three criteria. A greater weighting was given to monitoring sites in residential or city areas, as results from monitoring this type of site are more likely to be of interest to the public. Some weighting was also given to sites which NRL staff are aware have been of particular community interest.

The plot below presents a histogram of the maximum exposures at the fifty sites.



At most of the sites tested, the maximum exposure was less than 1 microwatt per square centimetre ($\mu\text{W}/\text{cm}^2$). Four sites had a maximum exposure greater than $5 \mu\text{W}/\text{cm}^2$. The Motueka cell site, located at Mt Campbell, had a maximum exposure of $21.49 \mu\text{W}/\text{cm}^2$. This exposure was measured in an area where there would also have been significant contributions from a number of television transmission antennas. Measurements made in directions away from television antennas were below $5 \mu\text{W}/\text{cm}^2$. At Westmere the maximum exposure was $8.3 \mu\text{W}/\text{cm}^2$. This site is located on the same roof as a Telecom cell site. Exposures at Auckland Blind Institute and Mountain Road, Auckland were both below $6 \mu\text{W}/\text{cm}^2$.

Exposures at all sites complied with the reference levels for the public in New Zealand Standard 2772.1:1999 *Radiofrequency Fields Part 1: - Maximum exposure levels 3 kHz - 300 GHz*. At most of the sites, the maximum exposure was less than 0.2% of the reference level. On this basis, no adverse health effects are anticipated for people who live, work or pass by close to the sites.

The results are also available on the NRL website www.nrl.moh.govt.nz (follow the menu choices FAQs and advice/Radiation in the environment/ELF and RF surveys). A listing of results is presented in an appendix to this report. Further appendices contain more information about the measurement technique and the New Zealand RF field exposure Standard.

Appendix A Measurement techniques

A1 Measuring equipment

Broadband electric field strength meters were used to carry out the measurements in these surveys. These instruments measure total exposure to radiofrequency (RF) fields across a wide range of frequencies, including those from cell sites, mobile radios, and TV and radio transmitters. The advantage of this approach is that the exposure recorded is that from all sources in an area, not just the site being measured. Hence, for example, if a cell site from the Telecom network is located close to a Vodafone site, the instrument measures the total exposure from both sites. However, the contribution from individual sources cannot be identified.

Summaries of the characteristics of the instruments used are presented below.

Holaday HI 3004 and HSE Probe

Manufacturer:	Holaday Industries Incorporated, 14825 Martin Drive, Eden Prairie, MN 55344, USA
Model:	HI 3004, Isotropic Broadband Field Strength Meter, serial no. 52310
Probe:	Model HSE, high sensitivity electric field strength, serial no. 556
Ranges:	0-1, 0-3, 0-10, 0-30 V/m
Spectrum:	1 MHz – 1 GHz, -0.8/+3.6 dB
Calibration:	by NMI, January 2004 Recommended interval: 2 years
Dates of response checks:	June 2004, October 2004, February 2005

(Note: Spectrum uncertainty includes calibration and isotropic uncertainty)

Wandel and Goltermann EMR-300 and Type 8.2 probe

Manufacturer:	Wandel and Goltermann
Model:	EMR-300, Isotropic Broadband Field Strength Meter serial no. P-0021
Probe:	E-field probe type 8.2, high sensitivity electric field strength. Serial no. M-0086
Ranges:	0.6 to 800 V/m
Spectrum:	100 kHz to 100 MHz ± 1 dB, 100 MHz to 3 GHz ± 2.4 dB
Isotropy:	± 1 dB, $f > 1$ MHz
Calibration:	by manufacturer, April 2003 Uncertainty ± 1 dB Recommended interval: 2 years
Date response checks:	October 2000, February 2005

A2 Measurement procedures

At each site tested, the person carrying out the survey walked around the area in the vicinity of the Vodafone transmitters, recording the signal strength on the meter. In most cases, the measurements are made in areas which are reasonably accessible to the public. If it appeared likely that exposures on private land may be greater than those on publicly accessible land, then efforts were made to get access to that land. The intention was to measure the greatest exposure at the time the survey is carried out, and also gain an idea of "typical" exposures in the area around the site.

Appendix B The New Zealand RF field exposure Standard

In April 1999, New Zealand adopted NZS 2772.1:1999 *Radiofrequency Fields Part 1: Maximum exposure levels – 3 kHz to 300 GHz*. The limits in this Standard are based on guidelines published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). ICNIRP is an international scientific body which has been recognised by the World Health Organisation for its expertise in this area, and their guidelines have formed the basis for many other international and national exposure standards.

The New Zealand Standard sets out limits for exposure to the RF radiation produced by all types of radio transmitters, for people exposed occupationally and for the general public. The limits are based on a careful review of the research into the health effects of exposure to RF radiation, and include wide margins for safety.

The Standard sets basic restrictions on the amount of RF power absorbed in the body. As RF power absorption is difficult to measure, the Standard also prescribes reference levels in terms of the more easily measured electric and magnetic field strengths, and power flux density. Reference levels for the general public are stricter than for occupational exposures, and are set at levels more than 50 times lower than the recognised threshold for established effects. Compliance with the reference levels ensures compliance with the basic restrictions, and in most situations can be effectively regarded as “exposure limits” (although this term is not used as such in the Standard).

Most Vodafone sites operate at frequencies around 900 MHz, at which the reference level for the public is $450 \mu\text{W}/\text{cm}^2$. Some sites, generally in CBD areas, also operate at 1800 MHz, at which the reference level is $900 \mu\text{W}/\text{cm}^2$. The most restrictive reference level at any frequency is $200 \mu\text{W}/\text{cm}^2$.

Appendix C Table of results

Results are presented in a table below. For each site, the following information is recorded:

Name of the site	
Date measured	
Type of site	<i>For example, whether the antennas are on a pole or a building, whether the site serves a large region or a smaller site covering a more restricted area, whether it is rural, urban/suburban, or CBD.</i>
Maximum exposure measured during survey	<i>Maximum exposure measured at any point</i>
Typical exposure around the site	<i>Upper limit for most exposures in the area immediately around the site (say up to 50-100 metres from the site).</i>
Additional comments	<i>For example, whether there are other transmitters nearby.</i>

The exposure measurements are a snapshot of the exposures at the time the measurement survey was carried out. Exposures vary over the day as more or less calls pass through the site. All Vodafone sites transmit a fixed minimum standby power, even if no calls are passing through it. Depending on the configuration of the site, the maximum output power may be 2 to 4 times the minimum.

A worst-case estimate of exposures around a site (assuming that the equipment is not changed) is obtained by assuming that the site was operating at the minimum standby power when the exposure measurements were made, and multiplying the measured exposure by four.

Name of the site	Date measured	Type of site	Maximum exposure measured during survey *	Typical exposure around the site	Additional comments
Arthurs Pass	21/02/2005	Rural, tower	0.52 $\mu\text{W}/\text{cm}^2$ (0.1%)	<0.20 $\mu\text{W}/\text{cm}^2$	
Auckland - Alcheme (College Hill)	24/02/2005	Urban, lamppost	0.95 $\mu\text{W}/\text{cm}^2$ (0.2%)	<0.4 $\mu\text{W}/\text{cm}^2$	
Auckland - Barry's Point	30/03/2005	Urban, rooftop	0.8 $\mu\text{W}/\text{cm}^2$ (0.13%)	<0.4 $\mu\text{W}/\text{cm}^2$	Telecom site nearby
Auckland - Blind Institute Microcell	30/03/2005	Urban, lamppost	5.4 $\mu\text{W}/\text{cm}^2$ (1.2%)	<2.0 $\mu\text{W}/\text{cm}^2$	
Auckland - Campbells Bay	21/01/2005	Urban, tower	2.1 $\mu\text{W}/\text{cm}^2$ (0.5%)	<0.80 $\mu\text{W}/\text{cm}^2$	
Auckland - Glenfield Road	3/02/2005	Urban, lamppost	4.5 $\mu\text{W}/\text{cm}^2$ (1.0%)	<2.0 $\mu\text{W}/\text{cm}^2$	
Auckland - Grange Road	15/02/2005	Urban, rooftop	1.8 $\mu\text{W}/\text{cm}^2$ (0.4%)	<1.0 $\mu\text{W}/\text{cm}^2$	
Auckland - Greenwoods Corner	18/02/2005	Urban, rooftop	2.1 $\mu\text{W}/\text{cm}^2$ (0.5%)	<1.5 $\mu\text{W}/\text{cm}^2$	Telecom site nearby
Auckland - Hobson Bay	4/03/2005	Urban, lamppost	3.1 $\mu\text{W}/\text{cm}^2$ (0.7%)	<2.4 $\mu\text{W}/\text{cm}^2$	
Auckland - Mountain Road	8/02/2005	Urban, lamppost	5.4 $\mu\text{W}/\text{cm}^2$ (1.2%)	<1.0 $\mu\text{W}/\text{cm}^2$	

Name of the site	Date measured	Type of site	Maximum exposure measured during survey *	Typical exposure around the site	Additional comments
Auckland - Otahuhu Central	30/03/2005	Urban, rooftop	0.7 $\mu\text{W}/\text{cm}^2$ (0.13%)	<0.35 $\mu\text{W}/\text{cm}^2$	
Auckland - Portage Road	18/02/2005	Industrial, tower	0.4 $\mu\text{W}/\text{cm}^2$ (0.01%)	<0.2 $\mu\text{W}/\text{cm}^2$	
Auckland - West Harbour	8/03/2005	Urban, tower	0.6 $\mu\text{W}/\text{cm}^2$ (0.13%)	<0.3 $\mu\text{W}/\text{cm}^2$	
Auckland - Westmere	24/02/2005	Urban, rooftop	8.3 $\mu\text{W}/\text{cm}^2$ (1.8%)	<5.0 $\mu\text{W}/\text{cm}^2$	Site is shared with Telecom
Auckland -Albany South and Albany South 1800	24/05/2004	Rural, tower	0.96 $\mu\text{W}/\text{cm}^2$ (0.2%)	<0.80 $\mu\text{W}/\text{cm}^2$	
Auckland -Glen Innes	20/10/2004	Urban, tower	1.7 $\mu\text{W}/\text{cm}^2$ (0.4%)	<0.25 $\mu\text{W}/\text{cm}^2$	Telecom site nearby
Auckland -Ihumatao	16/09/2004	Industrial, tower	0.77 $\mu\text{W}/\text{cm}^2$ (0.17%)	<0.27 $\mu\text{W}/\text{cm}^2$	
Auckland -Nurses Home Capacity	13/05/2004	Urban, lamppost	0.9 $\mu\text{W}/\text{cm}^2$ (0.2%)	<0.1 $\mu\text{W}/\text{cm}^2$	Telecom site nearby
Blenheim Central	23/02/2005	Urban, rooftop	0.10 $\mu\text{W}/\text{cm}^2$ (0.02%)	<0.02 $\mu\text{W}/\text{cm}^2$	
Christchurch - Centaurus Road	31/03/2005	Urban, lamppost	0.38 $\mu\text{W}/\text{cm}^2$ (0.1%)	<0.1 $\mu\text{W}/\text{cm}^2$	
Christchurch - Ferry Mead	31/03/2005	Urban, lamppost	0.45 $\mu\text{W}/\text{cm}^2$ (0.1%)	<0.2 $\mu\text{W}/\text{cm}^2$	

Name of the site	Date measured	Type of site	Maximum exposure measured during survey *	Typical exposure around the site	Additional comments
Christchurch - Princess Margaret Hospital	31/03/2005	Urban, lamppost	0.38 $\mu\text{W}/\text{cm}^2$ (0.1%)	<0.2 $\mu\text{W}/\text{cm}^2$	
Christchurch - Westmorland	31/03/2005	Urban, lamppost	0.52 $\mu\text{W}/\text{cm}^2$ (0.1%)	<0.2 $\mu\text{W}/\text{cm}^2$	
Clarence	23/02/2005	Rural, tower	1.06 $\mu\text{W}/\text{cm}^2$ (0.2%)	<0.2 $\mu\text{W}/\text{cm}^2$	
Gisborne	12/04/2004	Urban, rooftop	0.45 $\mu\text{W}/\text{cm}^2$ (0.1%)	<0.20 $\mu\text{W}/\text{cm}^2$	Telecom site nearby
Greymouth, MacKay St	21/02/2005	Urban, rooftop	1.66 $\mu\text{W}/\text{cm}^2$ (0.4%)	<0.5 $\mu\text{W}/\text{cm}^2$	
Greymouth Hospital	21/02/2005	Urban, tower	0.38 $\mu\text{W}/\text{cm}^2$ (0.1%)	<0.08 $\mu\text{W}/\text{cm}^2$	
Hamilton - Te Rapa North	22/03/2005	Urban, tower	0.6 $\mu\text{W}/\text{cm}^2$ (0.13%)	0.25 $\mu\text{W}/\text{cm}^2$	
Hamilton -Dinsdale South	15/07/2004	Industrial, tower	0.52 $\mu\text{W}/\text{cm}^2$ (0.12%)	<0.17 $\mu\text{W}/\text{cm}^2$	
Hasting- Flaxmere	16/04/2004	Industrial, tower	0.27 $\mu\text{W}/\text{cm}^2$ (0.1%)	<0.10 $\mu\text{W}/\text{cm}^2$	
Havelock North B	15/04/2004	Rural, rooftop	0.22 $\mu\text{W}/\text{cm}^2$ (0.05%)	<0.15 $\mu\text{W}/\text{cm}^2$	Miscellaneous antennas onsite
Hokitika	21/02/2005	Rural, tower	0.17 $\mu\text{W}/\text{cm}^2$ (0.04%)	<0.1 $\mu\text{W}/\text{cm}^2$	

Name of the site	Date measured	Type of site	Maximum exposure measured during survey *	Typical exposure around the site	Additional comments
Kaikoura Peninsula	23/02/2005	Rural, tower	0.38 $\mu\text{W}/\text{cm}^2$ (0.1%)	<0.15 $\mu\text{W}/\text{cm}^2$	Site shared with Telecom and others
Kaukapakapa	1/06/2004	Rural, tower	0.17 $\mu\text{W}/\text{cm}^2$ (0.04%)	<0.10 $\mu\text{W}/\text{cm}^2$	
Lake Karapiro	22/03/2005	Rural, tower	0.6 $\mu\text{W}/\text{cm}^2$ (0.13%)	0.35 $\mu\text{W}/\text{cm}^2$	
Motueka, Mt Campbell	22/02/2005	Rural, tower	21.49 $\mu\text{W}/\text{cm}^2$ (5.0%)	<5.0 $\mu\text{W}/\text{cm}^2$	Large broadcast facility
Murchison	22/02/2005	Rural, tower	0.6 $\mu\text{W}/\text{cm}^2$ (0.1%)	<0.1 $\mu\text{W}/\text{cm}^2$	
Napier	16/04/2004	Urban, tower	0.04 $\mu\text{W}/\text{cm}^2$ (0.01%)	<0.03 $\mu\text{W}/\text{cm}^2$	Antenna position is unusually elevated
Nelson, Airport	22/02/2005	Rural, tower	0.04 $\mu\text{W}/\text{cm}^2$ (0.01%)	<0.01 $\mu\text{W}/\text{cm}^2$	
Nelson, Central	22/02/2005	Urban, rooftop	0.21 $\mu\text{W}/\text{cm}^2$ (0.1%)	<0.2 $\mu\text{W}/\text{cm}^2$	
New Plymouth -Devon	20/09/2004	Industrial, tower	3.1 $\mu\text{W}/\text{cm}^2$ (0.7%)	<0.3 $\mu\text{W}/\text{cm}^2$	Elevated parking lot to the southeast
Ngarawahia	22/03/2005	Rural, tower	1.2 $\mu\text{W}/\text{cm}^2$ (0.3%)	0.2 $\mu\text{W}/\text{cm}^2$	
Picton, Kahikitia Hill	23/02/2005	Rural, tower	2.08 $\mu\text{W}/\text{cm}^2$ (0.5%)	<0.1 $\mu\text{W}/\text{cm}^2$	

Name of the site	Date measured	Type of site	Maximum exposure measured during survey *	Typical exposure around the site	Additional comments
Reefton	21/02/2005	Rural, tower	1.66 $\mu\text{W}/\text{cm}^2$ (0.4%)	<1.66 $\mu\text{W}/\text{cm}^2$	
Stratford	21/09/2004	Industrial, tower	0.27 $\mu\text{W}/\text{cm}^2$ (0.1%)	<0.15 $\mu\text{W}/\text{cm}^2$	
Tauranga Bridge	12/07/2004	Industrial, Tower	0.17 $\mu\text{W}/\text{cm}^2$ (0.04%)	<0.09 $\mu\text{W}/\text{cm}^2$	
Tauranga -Ngatai Road	12/07/2004	Urban, tower	0.86 $\mu\text{W}/\text{cm}^2$ (0.2%)	<0.40 $\mu\text{W}/\text{cm}^2$	Telecom site nearby
Waitara	19/09/2004	Rural, tower	0.38 $\mu\text{W}/\text{cm}^2$ (0.1%)	<0.20 $\mu\text{W}/\text{cm}^2$	
Waiuku	16/11/2004	Urban, tower	0.6 $\mu\text{W}/\text{cm}^2$ (0.13%)	<0.80 $\mu\text{W}/\text{cm}^2$	Telecom site nearby
Whakatane Central	13/07/2004	Urban, tower	0.86 $\mu\text{W}/\text{cm}^2$ (0.2%)	<0.60 $\mu\text{W}/\text{cm}^2$	

* The number in brackets gives the maximum exposure presented as a percentage of the limit for public exposures at 450 $\mu\text{W}/\text{cm}^2$ recommended in NZS 2772.1:1999.