

**NRL**  
National Radiation Laboratory

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

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

The National Radiation Laboratory (NRL) was commissioned by Vodafone to measure exposures to radiofrequency (RF) fields in areas around 5% of their cellsites. 40 sites were to be measured before 31 March 2004, and a further 50 in the following twelve months. This report presents the results of measurements carried out to 31 March 2004.

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](http://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 randomly 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.*

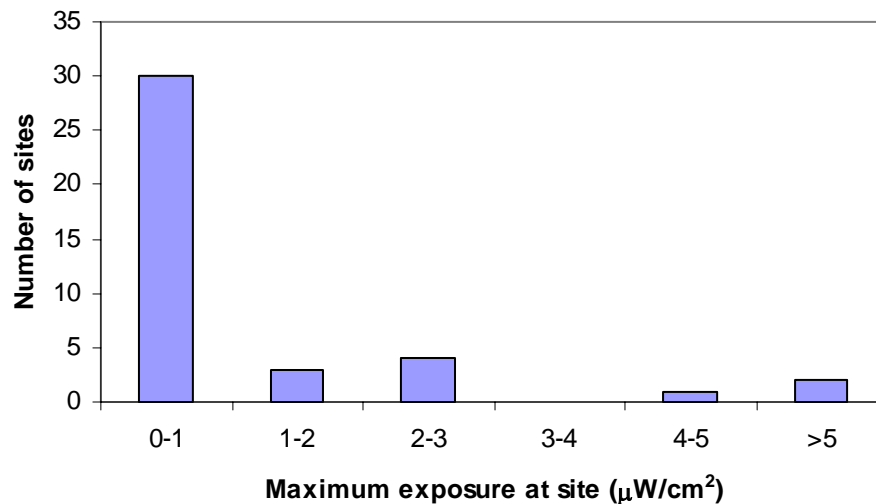
Vodafone had no say in the choice of sites to be tested, or when testing would be undertaken. Selection of sites and testing times was entirely at the discretion of the NRL. In general, the approach taken was to ensure:

- 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.

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



At most of the sites tested, the maximum exposure was less than 1 microwatt per square centimetre ( $\mu\text{W}/\text{cm}^2$ ). Two sites had a maximum exposure greater than  $5 \mu\text{W}/\text{cm}^2$ . At one of these (Oamaru), which housed a number of other transmitters, it is probable that the maximum exposure measured included contributions from other transmitters as well as the Vodafone equipment. The maximum exposure measured along the beam axis of any of the three transmitting Vodafone panel antennas was  $36 \mu\text{W}/\text{cm}^2$ , and the maximum measured at any point on the site was  $77 \mu\text{W}/\text{cm}^2$ . Along the Vodafone antenna beam axis which appeared to have least influence from the other (non-Vodafone) transmitters at the site, the maximum exposure was  $3.5 \mu\text{W}/\text{cm}^2$ .

At Orewa, the other site with a maximum exposure greater than  $5 \mu\text{W}/\text{cm}^2$ , this was recorded between the tower and an adjacent substation.

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](http://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 cellsites, 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 cellsite 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.

#### Holiday HI 3004 and HSE Probe

Manufacturer:	Holiday 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 – 1GHz, -0.8/+3.6 dB
Calibration:	by NMI, January 2004 Recommended interval: 2 years
Dates of response checks:	July 2003, March 2004

(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 $\pm 1$ dB, 100 MHz to 3 GHz $\pm 2.4$ dB
Isotropy:	$\pm 1$ dB, $f > 1$ MHz
Calibration:	by manufacturer, April 2003 Uncertainty $\pm 1$ dB Recommended interval: 2 years
Date response checks:	August 2003, October 2003, January 2004

### 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.



## Table of results

Name of the site	Date measured	Type of site	Maximum exposure measured during survey *	Typical exposure around the site	Additional comments
Alexandra - Springvale	20/01/04	Rural Tower	0.76 $\mu\text{W}/\text{cm}^2$ (0.17%)	<0.60 $\mu\text{W}/\text{cm}^2$	
Ashburton	19/01/04	Industrial Tower	0.48 $\mu\text{W}/\text{cm}^2$ (0.11%)	<0.35 $\mu\text{W}/\text{cm}^2$	
Auckland - Birkdale	08/03/04	Urban, rooftop	2.2 $\mu\text{W}/\text{cm}^2$ (0.49%)	<1.1 $\mu\text{W}/\text{cm}^2$	
Auckland - Ellerslie	04/02/04	Urban, side of building	0.6 $\mu\text{W}/\text{cm}^2$ (0.13%)	<0.30 $\mu\text{W}/\text{cm}^2$	Telecom site nearby
Auckland - Half Moon Bay	18/03/04	Urban, lamp post	2.4 $\mu\text{W}/\text{cm}^2$ (0.53%)	<2.0 $\mu\text{W}/\text{cm}^2$	
Auckland - Jervois Rd	03/02/04	Urban, lamp post	0.6 $\mu\text{W}/\text{cm}^2$ (0.13%)	<0.30 $\mu\text{W}/\text{cm}^2$	
Auckland - Manurewa	03/02/04	Urban, tower	0.8 $\mu\text{W}/\text{cm}^2$ (0.18%)	<0.60 $\mu\text{W}/\text{cm}^2$	Telecom site nearby
Auckland - Milford	05/03/04	City, rooftop	1.4 $\mu\text{W}/\text{cm}^2$ (0.31%)	<0.60 $\mu\text{W}/\text{cm}^2$	
Auckland - Mission Bay	03/02/04	Urban, roof top	0.6 $\mu\text{W}/\text{cm}^2$ (0.06%)	<0.30 $\mu\text{W}/\text{cm}^2$	
Auckland - New Lynn	18/03/04	Urban, tower	0.7 $\mu\text{W}/\text{cm}^2$ (0.16%)	<0.40 $\mu\text{W}/\text{cm}^2$	

Name of the site	Date measured	Type of site	Maximum exposure measured during survey *	Typical exposure around the site	Additional comments
Auckland - Orewa	17/03/04	Rural, tower	7.5 $\mu\text{W}/\text{cm}^2$ (1.7 %)	<2.0 $\mu\text{W}/\text{cm}^2$	
Auckland -The Strand	04/03/04	City, side of building	2.2 $\mu\text{W}/\text{cm}^2$ (0.49%)	<1.0 $\mu\text{W}/\text{cm}^2$	
Auckland - West Harbour	24/03/04	Urban, tower	0.96 $\mu\text{W}/\text{cm}^2$ (0.21%)	<0.80 $\mu\text{W}/\text{cm}^2$	Telecom site nearby
Christchurch - Beckenham	11/4/03	Urban Lamp post	0.68 $\mu\text{W}/\text{cm}^2$ (0.15%)	<0.50 $\mu\text{W}/\text{cm}^2$	
Christchurch - Hagley Ave	14/04/04	City Tower	0.32 $\mu\text{W}/\text{cm}^2$ (0.07%)	<0.10 $\mu\text{W}/\text{cm}^2$	
Christchurch - Mona Vale	22/11/03	Urban Lamp post	0.89 $\mu\text{W}/\text{cm}^2$ (0.20)	<0.50 $\mu\text{W}/\text{cm}^2$	
Christchurch - Warrington	20/11/03	Urban Lamp post	0.90 $\mu\text{W}/\text{cm}^2$ (0.2%)	<0.40 $\mu\text{W}/\text{cm}^2$	Telecom site nearby
Cromwell	20/01/04	Rural Tower	0.06 $\mu\text{W}/\text{cm}^2$ (0.01%)	<0.03 $\mu\text{W}/\text{cm}^2$	Telecom site nearby
Dunedin - Kaikorai Valley	20/01/04	Urban/Rural Tower	2.0 $\mu\text{W}/\text{cm}^2$ (0.44%)	<1.50 $\mu\text{W}/\text{cm}^2$	
Dunedin - London Street	20/01/04	Urban Roof top	0.95 $\mu\text{W}/\text{cm}^2$ (0.21%)	<0.20 $\mu\text{W}/\text{cm}^2$	
Dunedin - Octagon	20/01/04	City Roof top	0.29 $\mu\text{W}/\text{cm}^2$ (0.06%)	<0.20 $\mu\text{W}/\text{cm}^2$	

Name of the site	Date measured	Type of site	Maximum exposure measured during survey *	Typical exposure around the site	Additional comments
Fairlie	21/01/04	Rural Tower	0.15 $\mu\text{W}/\text{cm}^2$ (0.03%)	<0.12 $\mu\text{W}/\text{cm}^2$	Telecom site nearby
Hamilton - Chartwell Square	30/01/04	Urban, side of structure	0.5 $\mu\text{W}/\text{cm}^2$ (0.11%)	<0.3 $\mu\text{W}/\text{cm}^2$	
Hamilton - central city	30/01/04	City, roof top	0.7 $\mu\text{W}/\text{cm}^2$ (0.16%)	<0.20 $\mu\text{W}/\text{cm}^2$	
Invercargill - Esk Street	27/2/04	City Roof top	0.12 $\mu\text{W}/\text{cm}^2$ (0.03%)	<0.04 $\mu\text{W}/\text{cm}^2$	
Lower Hutt - Waterloo	14/08/03	Urban Roof top	1.02 $\mu\text{W}/\text{cm}^2$ (0.23%)	<0.40 $\mu\text{W}/\text{cm}^2$	Telecom site nearby
Milton	20/01/04	Rural Tower	0.69 $\mu\text{W}/\text{cm}^2$ (0.15%)	<0.50 $\mu\text{W}/\text{cm}^2$	Telecom site nearby
Northland - Snells Beach	10/03/04	Rural, tower	0.13 $\mu\text{W}/\text{cm}^2$ (0.03%)	<0.07 $\mu\text{W}/\text{cm}^2$	
Oamaru	19/01/04	Rural Tower	36 $\mu\text{W}/\text{cm}^2$ (8%)	<5.0 $\mu\text{W}/\text{cm}^2$	Telecom site nearby as well as many other mobile services. Max at site 77 $\mu\text{W}/\text{cm}^2$
Palmerston North - central city	10/02/04	City, roof top	0.32 $\mu\text{W}/\text{cm}^2$ (0.07%)	<0.20 $\mu\text{W}/\text{cm}^2$	
Palmerston North - Kelvin Grove	16/02/04	Urban/Industrial, tower	0.7 $\mu\text{W}/\text{cm}^2$ (0.15%)	<0.50 $\mu\text{W}/\text{cm}^2$	Telecom site nearby
Rotorua - central city	29/01/04	City, roof top	0.5 $\mu\text{W}/\text{cm}^2$ (0.11%)	<0.40 $\mu\text{W}/\text{cm}^2$	

Name of the site	Date measured	Type of site	Maximum exposure measured during survey *	Typical exposure around the site	Additional comments
Taupo	29/01/04	Urban, tower	2.4 $\mu\text{W}/\text{cm}^2$ (0.53%)	<1.5 $\mu\text{W}/\text{cm}^2$	
Timaru	19/01/04	Urban Tower	0.87 $\mu\text{W}/\text{cm}^2$ (0.13)	<0.60 $\mu\text{W}/\text{cm}^2$	
Wellington - Courtenay place	10/02/04	City Lamp post	0.56 $\mu\text{W}/\text{cm}^2$ (0.12%)	<0.30 $\mu\text{W}/\text{cm}^2$	
Wellington - Molesworth St	10/02/04	City roof top	0.16 $\mu\text{W}/\text{cm}^2$ (0.04%)	<0.10 $\mu\text{W}/\text{cm}^2$	
Wellington - Seatoun South	10/02/04	Urban Lamp post	0.32 $\mu\text{W}/\text{cm}^2$ (0.07%)	<0.20 $\mu\text{W}/\text{cm}^2$	
Wellington - Wadestown	10/02/04	Urban, side of building	4.4 $\mu\text{W}/\text{cm}^2$ (0.98%)	<0.30 $\mu\text{W}/\text{cm}^2$	
Whangarei	10/03/04	City, roof top	0.52 $\mu\text{W}/\text{cm}^2$ (0.12%)	<0.30 $\mu\text{W}/\text{cm}^2$	
Whangarei	10/03/04	City, roof top	0.32 $\mu\text{W}/\text{cm}^2$ (0.07%)	<0.20 $\mu\text{W}/\text{cm}^2$	Telecom site nearby

\* 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.