

**NRL**  
National Radiation Laboratory

**Measurements  
of exposures  
around Vodafone cellsites:  
summary of results  
April 2005 to March 2006**

**National Radiation Laboratory**

108 Victoria Street, Christchurch, New Zealand  
P O Box 25 099, Christchurch, New Zealand  
Telephone: 64 3 366 5059 Fax: 64 3 366 1156

Email: [enquiry@nrl.moh.govt.nz](mailto:enquiry@nrl.moh.govt.nz)  
<http://www.nrl.moh.govt.nz>

This report was prepared for:

Vodafone NZ Ltd  
Private Bag 92161  
Auckland

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Rev. no.	Author	Reviewed by	Approved for issue		
			Name	Signature	Date
-	O Kilgour	M Gledhill	M Gledhill	MG	31 July 2006

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This is an electronic copy of an original report signed by Martin Gledhill on 31 July 2006.

## Measurements of exposures around Vodafone cellsites: summary of results April 2005 to March 2006

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 2005 and 31 March 2006.

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).*

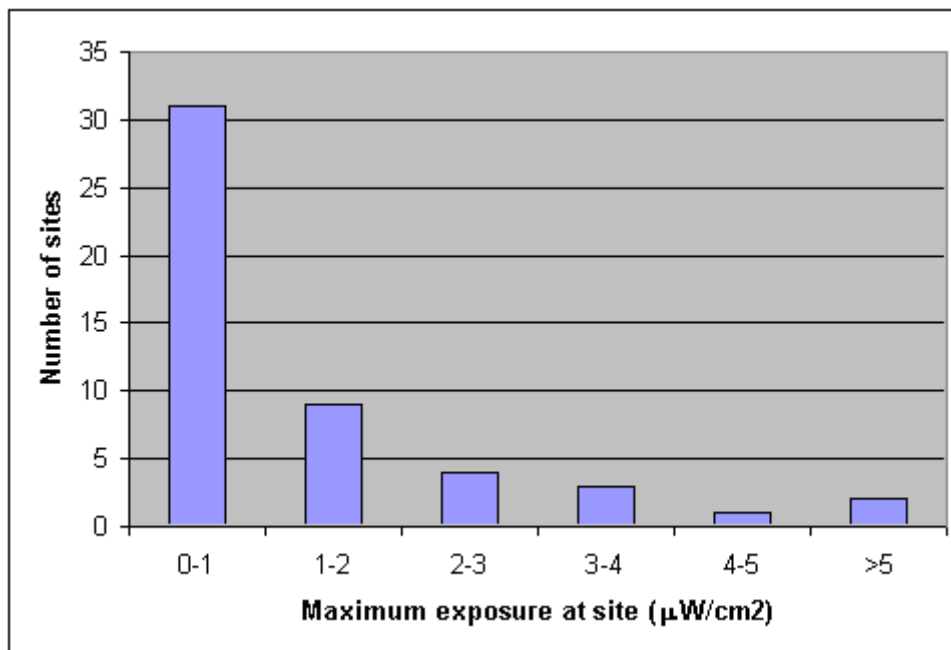
*In order to preserve the transparency and validity of information provided, as well as the ongoing updating thereof, Vodafone has requested that NRL (National Radiation Laboratory - a division of the Ministry of Health) assume the programme's overall scientific management. As an independent organisation NRL 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  $5 \mu\text{W}/\text{cm}^2$ , exposures at these sites were all below  $8 \mu\text{W}/\text{cm}^2$ .

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](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.

#### 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, July 2005 Uncertainty $\pm 1$ dB Recommended interval: 2 years
Date response checks:	July 05, November 05, February 06

### 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 also operate at 1800 MHz and 2100 MHz, at which the reference levels are  $900 \mu\text{W}/\text{cm}^2$  and  $1000 \mu\text{W}/\text{cm}^2$  respectively. 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
Auckland Airport	12/10/2005	Industrial monopole	0.56 $\mu\text{W}/\text{cm}^2$ (0.12%)	<0.4 $\mu\text{W}/\text{cm}^2$	
Auckland - Belmont	23/2/2006	Urban monopole	3.73 $\mu\text{W}/\text{cm}^2$ (0.83)	<1.0 $\mu\text{W}/\text{cm}^2$	Telecom site close by
Auckland - Blockhouse Bay	2/3/2006	Urban rooftop	1.17 $\mu\text{W}/\text{cm}^2$ (0.26)	<0.8 $\mu\text{W}/\text{cm}^2$	
Auckland - Broadway South Capcity	8/3/2006	Lamp post	2.08 $\mu\text{W}/\text{cm}^2$ (0.46)	<1.0 $\mu\text{W}/\text{cm}^2$	
Auckland - Carlton Gore Road	8/3/2006	Lamp post	1.28 $\mu\text{W}/\text{cm}^2$ (0.28)	<0.8 $\mu\text{W}/\text{cm}^2$	
Auckland - Dressmart Relocate	29/11/2005	Urban monopole	0.52 $\mu\text{W}/\text{cm}^2$ (0.12%)	<0.4 $\mu\text{W}/\text{cm}^2$	
Auckland - Eastern Beach	14/10/2005	Residential light pole	1.79 $\mu\text{W}/\text{cm}^2$ (0.40%)	<1.0 $\mu\text{W}/\text{cm}^2$	
Auckland - Ellice Road	23/2/2006	Urban rooftop	2.63 $\mu\text{W}/\text{cm}^2$ (0.58)	<3.0 $\mu\text{W}/\text{cm}^2$	
Auckland - Hauraki Corner	3/2/2006	Urban roof top	7.17 $\mu\text{W}/\text{cm}^2$ (1.59%)	<3.0 $\mu\text{W}/\text{cm}^2$	Site shared with Telecom
Auckland - Hillsborough Road	27/2/2006	Urban rooftop	1.17 $\mu\text{W}/\text{cm}^2$ (0.27)	<0.4 $\mu\text{W}/\text{cm}^2$	
Auckland - Manly	22/2/2006	Urban rooftop	3.63 $\mu\text{W}/\text{cm}^2$ (0.81)	<1.0 $\mu\text{W}/\text{cm}^2$	
Auckland - Massey West	9/3/2006	Industrial monopole	3.83 $\mu\text{W}/\text{cm}^2$ (0.84)	<3.5 $\mu\text{W}/\text{cm}^2$	Site shared with Telecom
Auckland - McLaren Park	9/3/2006	Industrial monopole	1.2 $\mu\text{W}/\text{cm}^2$ (0.27)	<0.6 $\mu\text{W}/\text{cm}^2$	
Auckland - Nelson Nicholas microcell	1/3/2006	Microcell	6.9 $\mu\text{W}/\text{cm}^2$ (1.53)	<4.0 $\mu\text{W}/\text{cm}^2$	
Auckland - Papakura	17/1/2006	Industrial monopole	0.56 $\mu\text{W}/\text{cm}^2$ (0.12)	<0.4 $\mu\text{W}/\text{cm}^2$	
Auckland - Papakura/Red Hill	17/1/2006	Industrial monopole	0.52 $\mu\text{W}/\text{cm}^2$ (0.12)	<0.3 $\mu\text{W}/\text{cm}^2$	
Auckland - Pitt Street microcell	1/3/2006	Microcell	1.3 $\mu\text{W}/\text{cm}^2$ (0.29)	<1.0 $\mu\text{W}/\text{cm}^2$	Telecom site close by
Auckland - R'n'R Sports MS	10/11/2005	Urban rooftop	0.77 $\mu\text{W}/\text{cm}^2$ (0.18%)	<0.4 $\mu\text{W}/\text{cm}^2$	



Name of the site	Date measured	Type of site	Maximum exposure measured during survey*	Typical exposure around the site	Additional comments
Auckland - Silverdale	22/2/2006	Urban rooftop	1.06 $\mu\text{W}/\text{cm}^2$ (0.24)	<0.7 $\mu\text{W}/\text{cm}^2$	
Auckland - Te Atatu Central	9/3/2006	Lamp post	2.55 $\mu\text{W}/\text{cm}^2$ (0.57)	<2.5 $\mu\text{W}/\text{cm}^2$	
Cambridge	11/8/2005	Industrial monopole	0.38 $\mu\text{W}/\text{cm}^2$ (0.08%)	<0.3 $\mu\text{W}/\text{cm}^2$	Telecom site close by
Christchurch - Aranui	12/1/2006	Urban monopole	0.21 $\mu\text{W}/\text{cm}^2$ (0.05%)	<0.1 $\mu\text{W}/\text{cm}^2$	
Christchurch - Cashel Mall West	14/3/2006	Microcell	0.03 $\mu\text{W}/\text{cm}^2$ (0.01)	<0.03 $\mu\text{W}/\text{cm}^2$	
Christchurch - Heathcote Valley	20/2/2006	Residential roof top	4.18 $\mu\text{W}/\text{cm}^2$ (0.93%)	<2 $\mu\text{W}/\text{cm}^2$	
Christchurch - Hillmorton	14/3/2006	Urban lamp post	0.15 $\mu\text{W}/\text{cm}^2$ (0.03%)	<0.1 $\mu\text{W}/\text{cm}^2$	
Christchurch - Manchester & Lichfield Sts Cnr	14/3/2006	Microcell	0.04 $\mu\text{W}/\text{cm}^2$ (0.01%)	<0.03 $\mu\text{W}/\text{cm}^2$	
Christchurch - McCormacks Bay	20/2/2006	Urban monopole	1.74 $\mu\text{W}/\text{cm}^2$ (0.34%)	<0.3 $\mu\text{W}/\text{cm}^2$	Site shared with Telecom
Christchurch - Pioneer	14/3/2006	Urban lamp post	0.32 $\mu\text{W}/\text{cm}^2$ (0.07%)	<0.2 $\mu\text{W}/\text{cm}^2$	
Christchurch - Westmorland	14/3/2006	Urban lamp post	0.31 $\mu\text{W}/\text{cm}^2$ (0.07%)	<0.2 $\mu\text{W}/\text{cm}^2$	
Christchurch - Wigram	17/3/2006	Rural monopole	0.7 $\mu\text{W}/\text{cm}^2$ (0.16%)	<0.1 $\mu\text{W}/\text{cm}^2$	
Hamilton - Whitiara	30/11/2005	Urban monopole	1.53 $\mu\text{W}/\text{cm}^2$ (0.34%)	<0.5 $\mu\text{W}/\text{cm}^2$	
Hawera	3/8/2005	Urban tower	0.04 $\mu\text{W}/\text{cm}^2$ (0.01%)	<0.04 $\mu\text{W}/\text{cm}^2$	
Levin - central	4/8/2005	Urban monopole	0.06 $\mu\text{W}/\text{cm}^2$ (0.01%)	<0.04 $\mu\text{W}/\text{cm}^2$	
Mt Maunganui - Arataki	28/9/2005	Industrial monopole	0.77 $\mu\text{W}/\text{cm}^2$ (0.17%)	<0.6 $\mu\text{W}/\text{cm}^2$	Telecom site close by
New Plymouth	3/8/2005	Urban roof top	0.09 $\mu\text{W}/\text{cm}^2$ (0.02%)	<0.08 $\mu\text{W}/\text{cm}^2$	
New Plymouth - Bell Block	3/8/2005	Industrial	0.07 $\mu\text{W}/\text{cm}^2$ (0.02%)	<0.05 $\mu\text{W}/\text{cm}^2$	

Name of the site	Date measured	Type of site	Maximum exposure measured during survey*	Typical exposure around the site	Additional comments
Palmerston North	4/8/2005	Urban roof top	0.06 $\mu\text{W}/\text{cm}^2$ (0.01%)	<0.05 $\mu\text{W}/\text{cm}^2$	
Palmerston North - central	4/8/2005	Urban roof top	0.06 $\mu\text{W}/\text{cm}^2$ (0.01%)	<0.05 $\mu\text{W}/\text{cm}^2$	
Palmerston North - Kelvin Grove	4/8/2005	Urban monopole	0.28 $\mu\text{W}/\text{cm}^2$ (0.06%)	<0.2 $\mu\text{W}/\text{cm}^2$	
Paraparaumu	4/8/2005	Rural monopole	0.57 $\mu\text{W}/\text{cm}^2$ (0.13%)	<0.2 $\mu\text{W}/\text{cm}^2$	Site shared with Telecom and others
Stratford	3/8/2005	Rural/residential	0.01 $\mu\text{W}/\text{cm}^2$ (0.002%)	<0.01 $\mu\text{W}/\text{cm}^2$	Single measurement made at point of nearest public access
Tauranga Bridge	28/9/2005	Industrial monopole	0.96 $\mu\text{W}/\text{cm}^2$ (0.22%)	<0.3 $\mu\text{W}/\text{cm}^2$	
Upper Hutt	4/8/2005	Urban roof top	0.09 $\mu\text{W}/\text{cm}^2$ (0.02%)	<0.07 $\mu\text{W}/\text{cm}^2$	
Wanganui	3/8/2005	Urban roof top	0.08 $\mu\text{W}/\text{cm}^2$ (0.02%)	<0.08 $\mu\text{W}/\text{cm}^2$	
Wanganui - Castlecliff	3/8/2005	Urban monopole	0.22 $\mu\text{W}/\text{cm}^2$ (0.05%)	<0.05 $\mu\text{W}/\text{cm}^2$	
Wellington - Khandallah	4/8/2005	Urban monopole	2.26 $\mu\text{W}/\text{cm}^2$ (0.5%)	<1.0 $\mu\text{W}/\text{cm}^2$	Large broadcast facility nearby
Wellington - Lyall Bay	5/8/2005	Industrial monopole	0.28 $\mu\text{W}/\text{cm}^2$ (0.06%)	<0.2 $\mu\text{W}/\text{cm}^2$	
Wellington - Mirimar North	5/8/2005	Industrial monopole	0.81 $\mu\text{W}/\text{cm}^2$ (0.18%)	<0.8 $\mu\text{W}/\text{cm}^2$	Telecom site closeby
Wellington - Seatoun	5/8/2005	Urban monopole	0.86 $\mu\text{W}/\text{cm}^2$ (0.19%)	<0.3 $\mu\text{W}/\text{cm}^2$	
Whakatane Central	29/9/2005	Urban monopole	0.89 $\mu\text{W}/\text{cm}^2$ (0.20%)	<0.4 $\mu\text{W}/\text{cm}^2$	

\* The number in brackets gives the maximum exposure presented as a percentage of the limit for public exposures recommended in New Zealand Standard NZS 2772.1:1999.