

Assessment of the exposure of the general public to 5G electromagnetic waves – Part 1

Summary of results
November 2021

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Disclaimer

The presentation of the material in this publication includes the EMF measurements as present at the time of the measurement activity, as well as the interpolation of the EMF measurements to cover the entire geographic areas of interest for this analysis.

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Executive Summary

Following the deployment of the first 5G network in Malta, the Malta Communications Authority carried out a 5G EMF measurement campaign. The purpose of this exercise was to further warrant the compliance of 5G-enabled mobile base stations to the existing EMF obligations. In addition, the measurements ensured that the cumulative EMF emission levels have remained within the reference limits in the ICNIRP Guidelines for the protection of the general public. The measurement campaign was also intended to provide assurance to the general public on 5G EMF exposure and address any related concerns.

For the scope of this measurement campaign, the 5G radio base stations were configured at 100% artificial loading to portray the maximum possible EMF exposure generated by this type of wireless transmitting technology. EMF measurements were carried out using both broadband as well as frequency selective EMF measurement equipment. A sample of three in-situ EMF audits were carried out on selected 5G radio base stations. In addition, real-time EMF measurements were carried across 95Km of carriage ways in the area of Valletta, Floriana, Msida, Gzira, Sliema, Pembroke and St. Julians.

What we found

- Approximately sixteen thousand (16,618) real-time EMF measurements were carried out. These covered ninety-five kilometres (95 Km) of carriage ways across the area of Valletta, Floriana, Msida, Gzira, Sliema, Pembroke and St. Julians. The EMF levels were, in general, found to be at a small percentage of the EMF reference level for exposure to the general public in the ICNIRP Guidelines¹.

¹ EMF reference level for exposure to the general public in the ICNIRP Guidelines refers to the lowest reference level of 2W/m²

- Almost all real-time EMF measurements were recorded at well below 1% of the ICNIRP Guidelines reference exposure limit for the general public¹. The mean EMF exposure level recorded was 0.123% of the ICNIRP Guidelines reference exposure limit for the general public¹.
- The highest EMF level recorded at specific points was 5.35% of the ICNIRP Guidelines reference exposure limit for the general public¹.
- The real-time EMF measurements third inter quartile was 0.13% of the ICNIRP Guidelines reference exposure limit for the general public².
- All of the real-time EMF measurements were taken in publicly accessible carriage ways. This was done to confirm that the public exposure levels attributed to emissions from the radio transmitting apparatus, including 5G, were well within the EMF reference level for exposure to the general public established in the ICNIRP Guidelines².
- For the in-situ measurements, the 5G EMF component (3.6GHz – 3.7GHz) was measured at an approximate value of 9% of the ICNIRP reference levels for exposure to the general public applicable at the respective frequency³. In addition, the EMF contribution from the 5G signal was approximately equal to 11% of the total cumulative EMF exposure value (extrapolated) as measured on site.

² EMF reference level for exposure to the general public in the ICNIRP Guidelines refers to the lowest reference level of 2W/m²

³ EMF reference level for exposure to the general public at 3.6 GHz is set to a reference level of 10W/m²

Background

As the regulator, the MCA is responsible to ensure that the operators' radio transmitting apparatus complies with EMF standards. To this effect, the Authority undertakes a range of compliance activities.

At present, the Authority undertakes three different types of compliance activities, namely.

- i. In-situ EMF audits at pre-set test points around the Maltese islands,
- ii. EMF audits in specific locations following requests by the general public,
- iii. Wideband EMF audits at street level.

For the scope of this measurement campaign, the 5G radio base stations in the area under investigation were configured at 100% artificially loading during such a measurement exercise. This approach was adopted to portray the maximum possible EMF exposure generated by such wireless transmitting technology. EMF measurements were carried out using both a broadband as well as frequency selective EMF measurement equipment. A sample of three in-situ EMF audits were carried out on selected 5G radio base stations. No significant issues were reported during the exercise. The EMF exposure to the general public was well within the safe limits as prescribed at law.

During 2020, the Authority conducted a wideband EMF audit at street level in almost all the carriage and pathways found in Malta and Gozo. The findings of the 2020 audit were used to analyse the EMF contribution by the deployment of 5G technology

This report presents the results of the 5G EMF measurements. The exercise was carried out during the period May 2021 and June 2021.

Methodology

Sampling method

The wideband EMF measurements were taken in real time, over ninety-five kilometres (95Km) of carriageways and pathways in the respective area. The measurement sample consisted of more than sixteen thousand real time measurements (a total of 16,618 measurements). Every measurement covers the level of EMF present within the frequency range 100 KHz to 7 GHz.

In-situ frequency selective measurements were carried out on 5G radio base station installations situated in Floriana and Paceville accordingly.

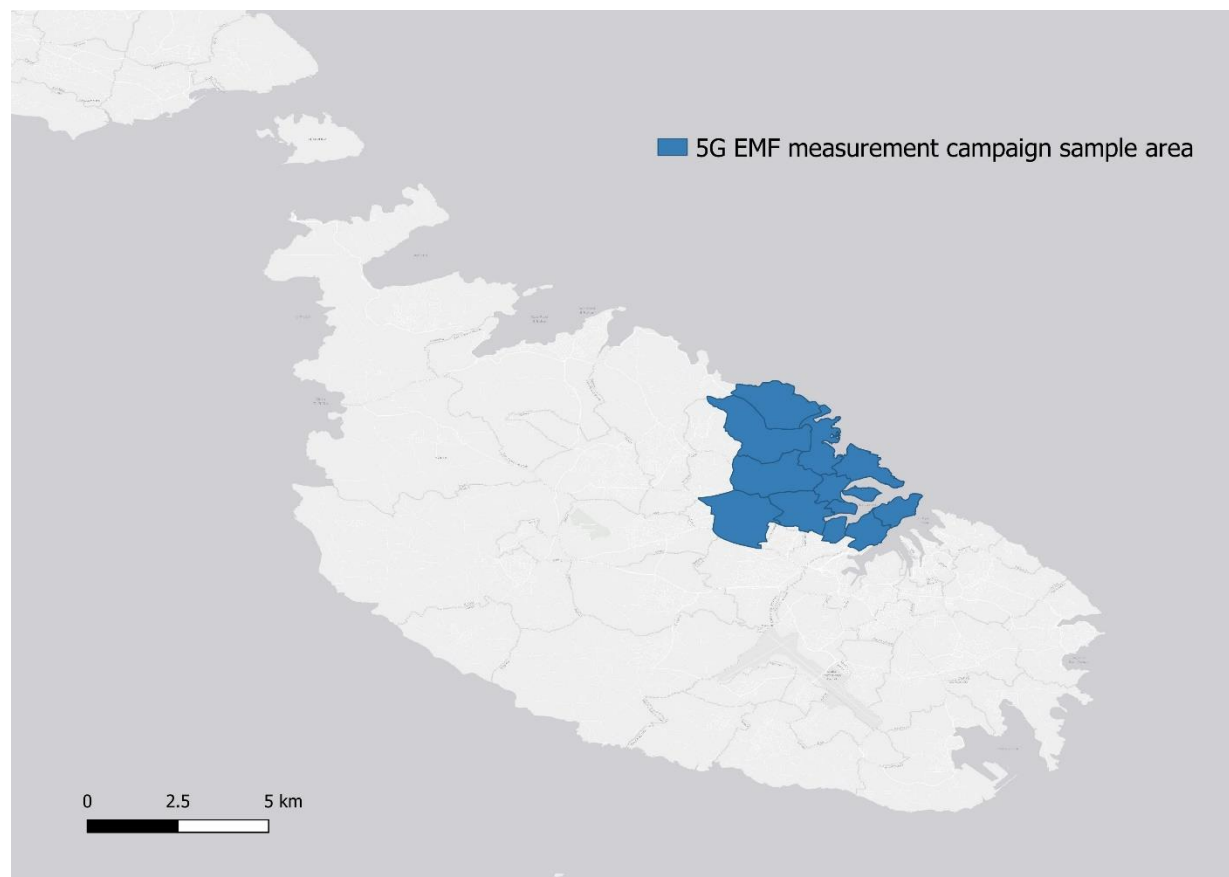


Figure1: Area of investigation encompassed in the 5G EMF measurement campaign

Measurement method

The wideband EMF measurement program was conducted in accordance with the ITU-T K.113 Recommendation and the IEC 62232 Standard.

Recommendation ITU-T K.113 provides guidance on how to make radio-frequency electromagnetic field (RF-EMF) maps for assessing existing exposure levels over large areas of cities or territories and for an appropriate public disclosure of the results, in a simple and understandable way. The measurement method employed was the drive test measurement method as identified in Section 6.1 of the ITU-T K.113 Recommendation.

The wideband measurements were carried out using a Narda AMB – 8059 Multi-band EMF area monitor. This instrument is equipped with a calibrated wide band measurement probe (Narda EP-1B-03) covering the radio frequency spectrum from 100KHz to 7GHz; the radio frequency spectrum in which all radio transmitting equipment (including 5G) deployed in Malta operates. The measuring equipment provided an overall E Field exposure level in V/m; the total EMF exposure level may then be expressed as a relative value in terms of percentage of the permitted reference levels established in the 2020 ICNIRP Guidelines.

With regards to in-situ frequency selective measurements, all readings, except for those related to 5G signals, were conducted in accordance with the EN 62232 standard. In the case of 5G, the MCA adopted an interim procedure which is based on the processes as defined in the EN 62232 standard. In this case, 6-



Figure 2: Wideband EMF Measurement Setup

minute, measurement intervals were taken with the 5G signals transmitted at maximum transmit capacity. This approach, therefore, avoids the extrapolation process of the received signal. This methodology ensures that the 5G measurements are conducted considering the worst case scenario in terms of EMF emissions. A point worth noting is that the 5G deployments under investigation do not include any active beam forming technologies.

The in-situ frequency selective measurements were carried out using a Narda SRM-3006 selective meter. The instrument was equipped with calibrated measurement E- field probes (Narda 3501/01 and 3502/01) covering the radio frequency spectrum from 75MHz up to 6GHz. The 5G frequency selective measurements were carried out using both the spectral analysis mode (RBW 20MHz) as well as in safety evaluation mode (RBW 5MHz). (Until such time dedicated 5G measurement functionalities are made available by the equipment manufacturers, the MCA shall carry out its 5G measurements using the safety evaluation mode.)

All EMF measurements were taken during daylight hours. During both the real-time EMF measurements as well as the in-situ EMF measurements, the 5G radio base stations were artificially loaded at 100% of their transmit capacity.



Figure 3: In-Situ EMF Measurement Site #1



Figure 4: In-Situ EMF Measurement Site #2 (co-hosted)



Figure 5: In-Situ EMF Measurement Site #3

Measurement Results

This section provides a summary of the EMF measurements collated during the real-time EMF measurements as well as the in-situ EMF measurements. A comparative analysis between the real-time EMF measurements carried out in 2020 (for the respective area) and those carried out during the 5G EMF measurement campaign is also being presented. The full set of the real-time EMF measurement data is made available to the public as open data on the MCA website.

Table 1 – Overview of the EMF real-time measurement in the area of investigation	With 5G deployment	Without 5G deployment
Total number of real-time measurements	16618	101710
Mean EMF measured value in V/m	0.73 V/m	0.508 V/m
Median EMF measured value in V/m	0.61 V/m	0.38 V/m
Maximum EMF value registered in V/m	6.48 V/m	7.73 V/m
Q1 for EMF values at V/m	0.31V/m	0.11 V/m
Q3 for EMF values at V/m	0.101V/m	0.74 V/m
Mean EMF exposure level as a % of ICNIRP Guidelines	0.123%	0.069%
Median EMF exposure level as a % of ICNIRP Guidelines	0.047%	0.018%
Maximum EMF exposure level as a % of ICNIRP Guidelines	5.35%	7.62%
Q1 for EMF exposure level as a % of ICNIRP Guidelines	0.012%	0.0015%
Q3 for EMF exposure level as a % of ICNIRP Guidelines	0.13%	0.068%

Note 1 - The EMF exposure levels reported above are relative to the ICNIRP lowest public exposure limit of 2 W/m²

Note 2 - The results depicted in the table are based on the real-time EMF measurements

Table 2 – Overview of the EMF measurement for the in-situ frequency selective investigation	
Site #1	
Maximum 5G EMF value registered in V/m	15.78V/m
Maximum 5G EMF exposure level as a % of ICNIRP Guidelines	6.69%
5G EMF component of the total cumulative EMF emissions	11%
Site #2 (co-hosted)	
Maximum 5G EMF value registered in V/m	16.09 V/m
Maximum 5G EMF exposure level as a % of ICNIRP Guidelines	9.957%
5G EMF component of the total cumulative EMF emissions	0.13%
Site #3	
Maximum 5G EMF value registered in V/m	19.45V/m
Maximum 5G EMF exposure level as a % of ICNIRP Guidelines	10.16%
5G EMF component of the total cumulative EMF emissions	11.48%

Note 1 -The EMF exposure levels reported above are relative to the ICNIRP public exposure limit at 3.6GHz of 10 W/m²

Note 2 - The results depicted in the table are based on the extrapolated EMF measurements

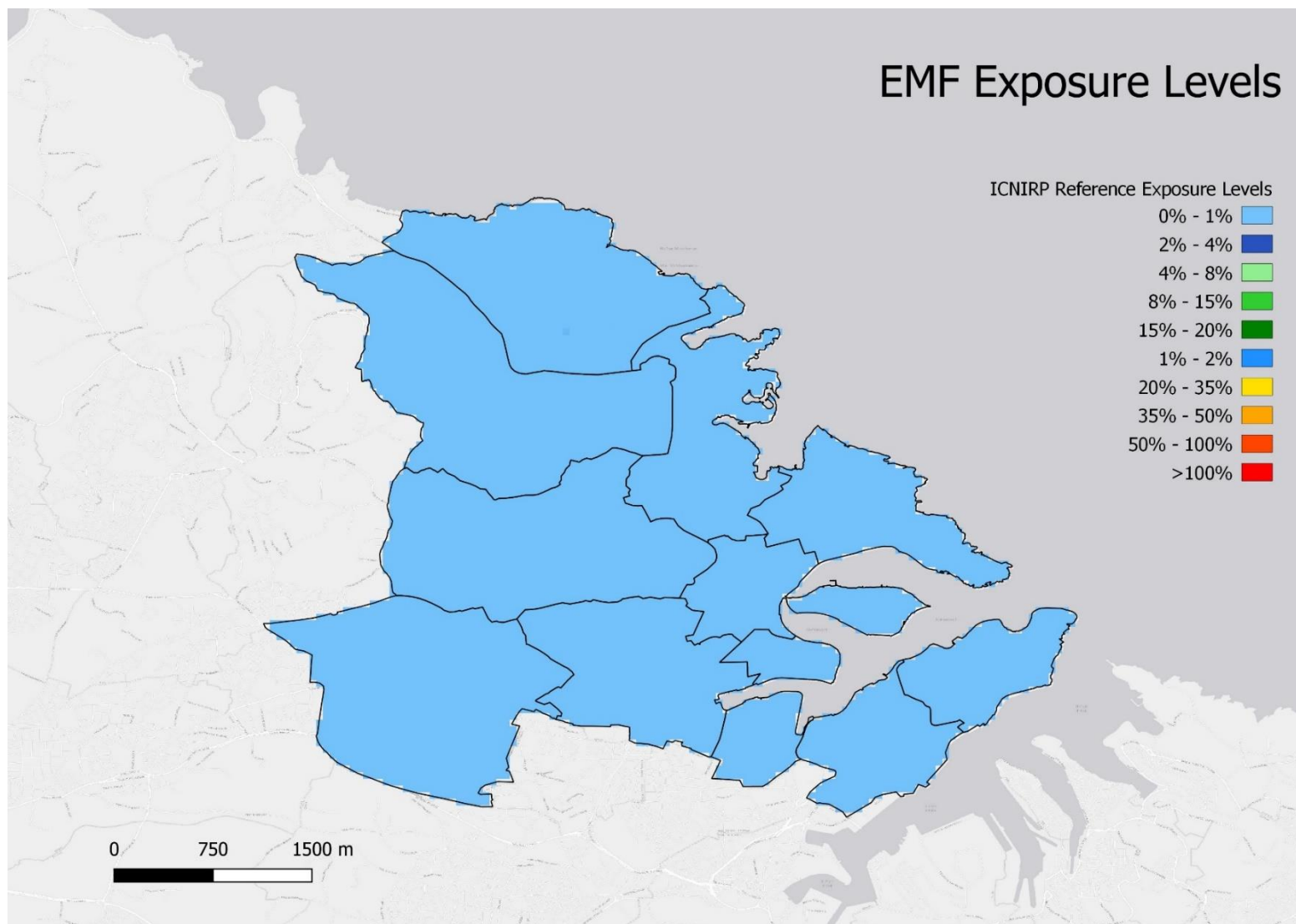


Figure 6: EMF Exposure Levels relative to the ICNIRP lowest public exposure limit of 2W/m² (May 2021)

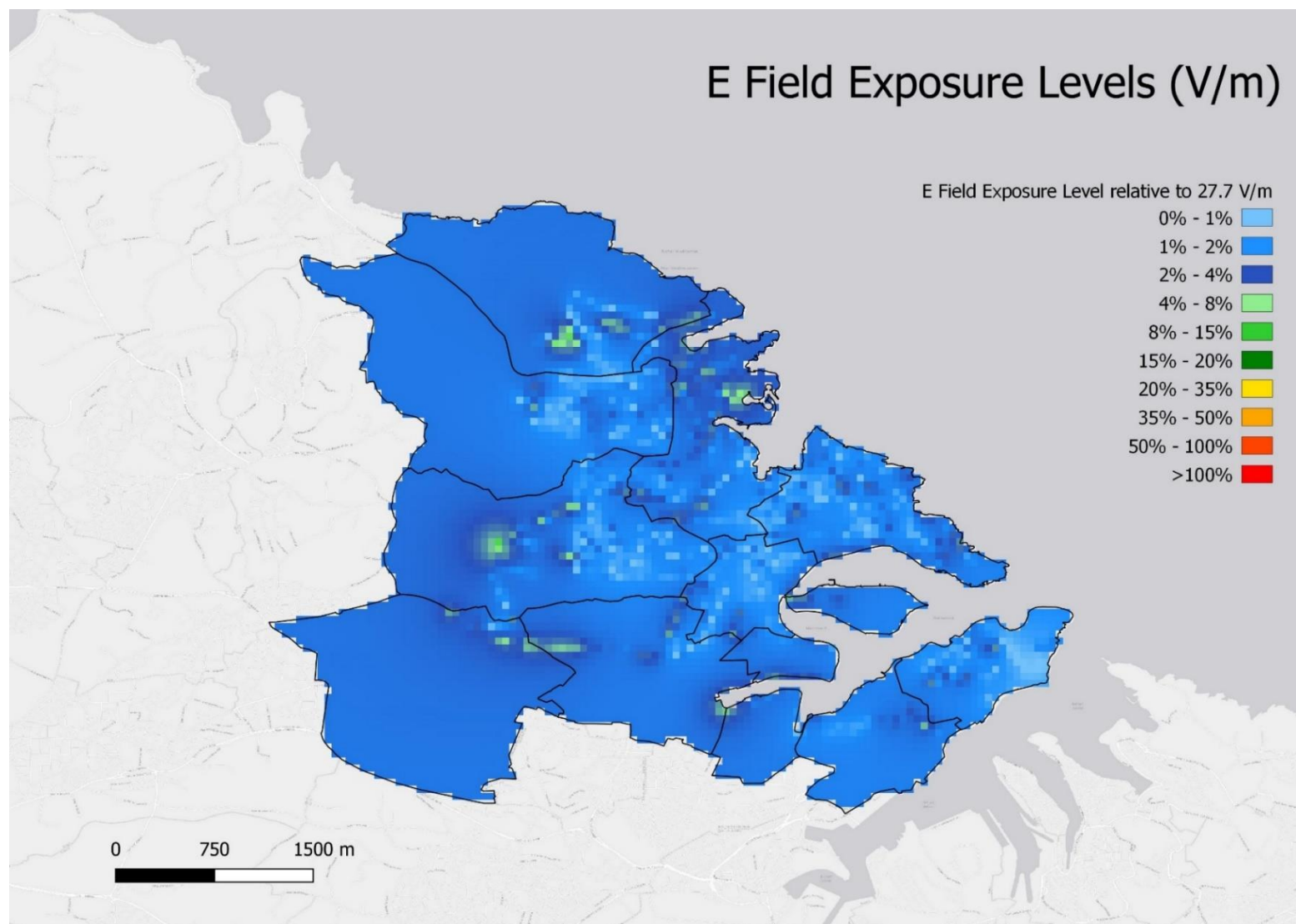


Figure 7: E Field Exposure Levels relative to the ICNIRP lowest public exposure limit of 27.7 V/m (May 2021)

Summary of the Measurement Results

As depicted in Table 1 above, the EMF exposure at street level is, for almost all of area under investigation, less the 1% of the lowest reference exposure level as identified in the ICNIRP Guidelines. The ICNIRP general public reference exposure levels vary according to the radio transmission frequency: 27.7V/m or 2W/m² for radio transmission at frequencies between 30MHz to 400MHz (used primarily for radio broadcasting) and up to 61V/m or 10W/m² for radio transmissions at frequencies above 400MHz (used primarily for TV broadcasting and mobile services).

75% of the real-time EMF street level measurements fell below 0.13% of the ICNIRP reference exposure level of 2W/m². This resulted in a calculated mean EMF exposure level of 0.123% of the ICNIRP reference exposure level of 2W/m². The highest EMF level recorded at a specific point at street level was 5.35% of the ICNIRP reference exposure level of 2W/m².

A total of 16618 real-time EMF measurements, covering 95 Km of carriage ways in the area under investigation, provided an appropriate measurement sample. To predict the EMF exposure levels across the entire area under investigation, the measurement sample was extrapolated using the Inverse Distance Weighting extrapolation technique. Such an algorithm was selected since it reflects the propagation characteristics of electromagnetic waves. Figure 6 above depicts the extrapolated EMF exposure levels in W/m² while Figure 7 illustrates the extrapolated E Field real-time measurements. The extrapolated E Field exposure levels are below 15% of the ICNIRP reference exposure level of 27.7 V/m, with the majority of the extrapolated E Field exposure levels well within 2% of the ICNIRP reference exposure level of 27.7 V/m.

As represented in Table 2 above, the in-situ EMF exposure from 5G signals was measured at an approximate value of 9% of the ICNIRP reference levels for exposure to the general public applicable at the respective frequency. The ICNIRP general public reference exposure levels for the 5G transmission frequencies (3.6 GHz) are set to 61V/m or 10W/m². In addition, the EMF contribution from the 5G signal was approximately equal to 11% of the total cumulative EMF exposure value (extrapolated) emanating from the respective radio base station installation. Such findings clearly show that the major contributors of EMF emissions are primarily the older mobile technologies.

The 5G EMF measurement campaign therefore reconfirms and provides the necessary assurance, that the EMF public exposure levels at street level are well within the EMF reference level for exposure to the general public as established in the ICNIRP Guidelines. In addition, while taking into consideration that at the time of the measurement campaign the 5G network was artificially loaded at 100% transmit capacity, the increase in emissions from the new deployments of 5G radio transmitting apparatus can be considered as minimal. For the purposes of the street level real-time measurements, all other mobile technologies under consideration were carrying only day to day commercial traffic.

Annex 1- 2020 EMF Exposure Levels

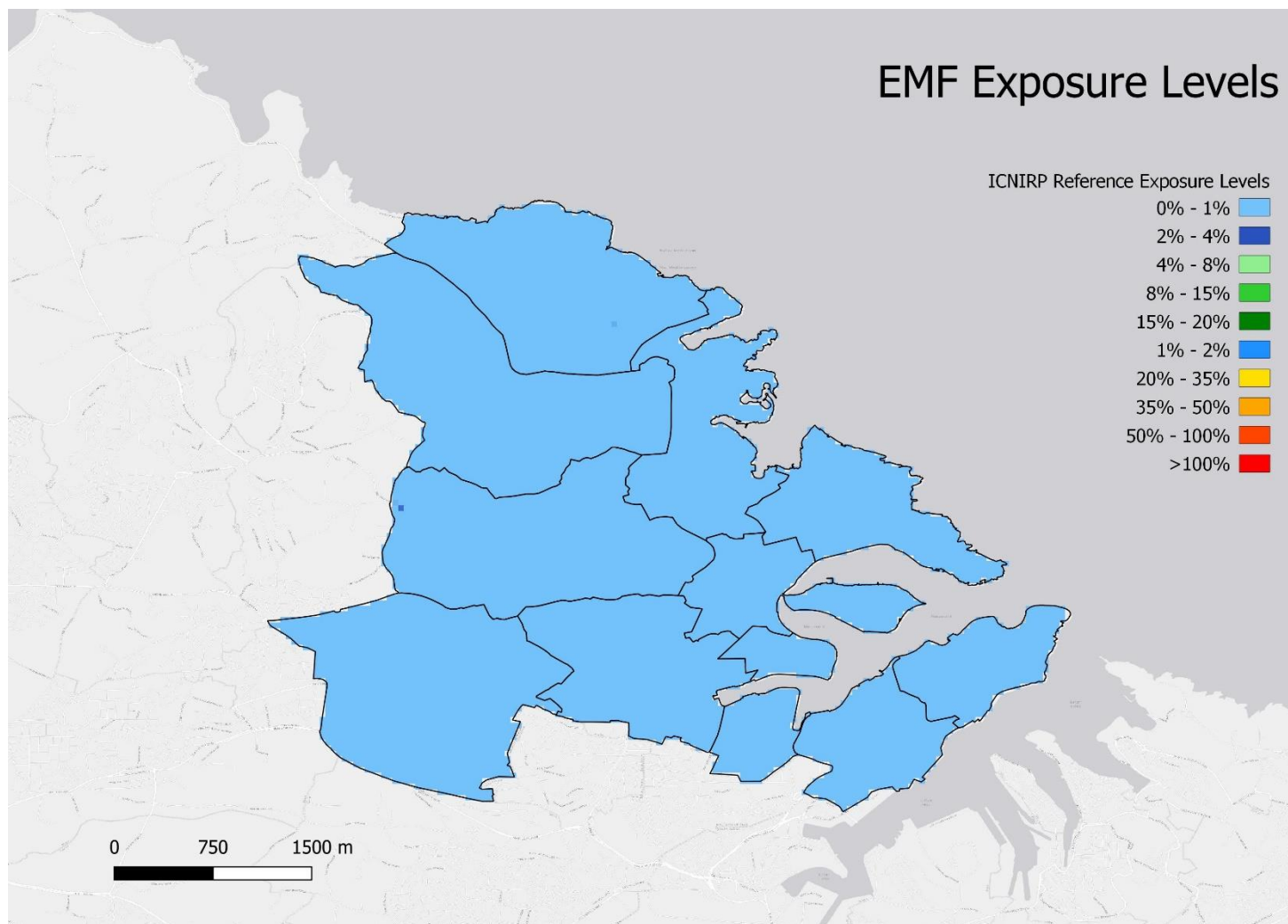


Figure 8: EMF Exposure Levels relative to the ICNIRP lowest public exposure limit of $2W/m^2$ (2020)

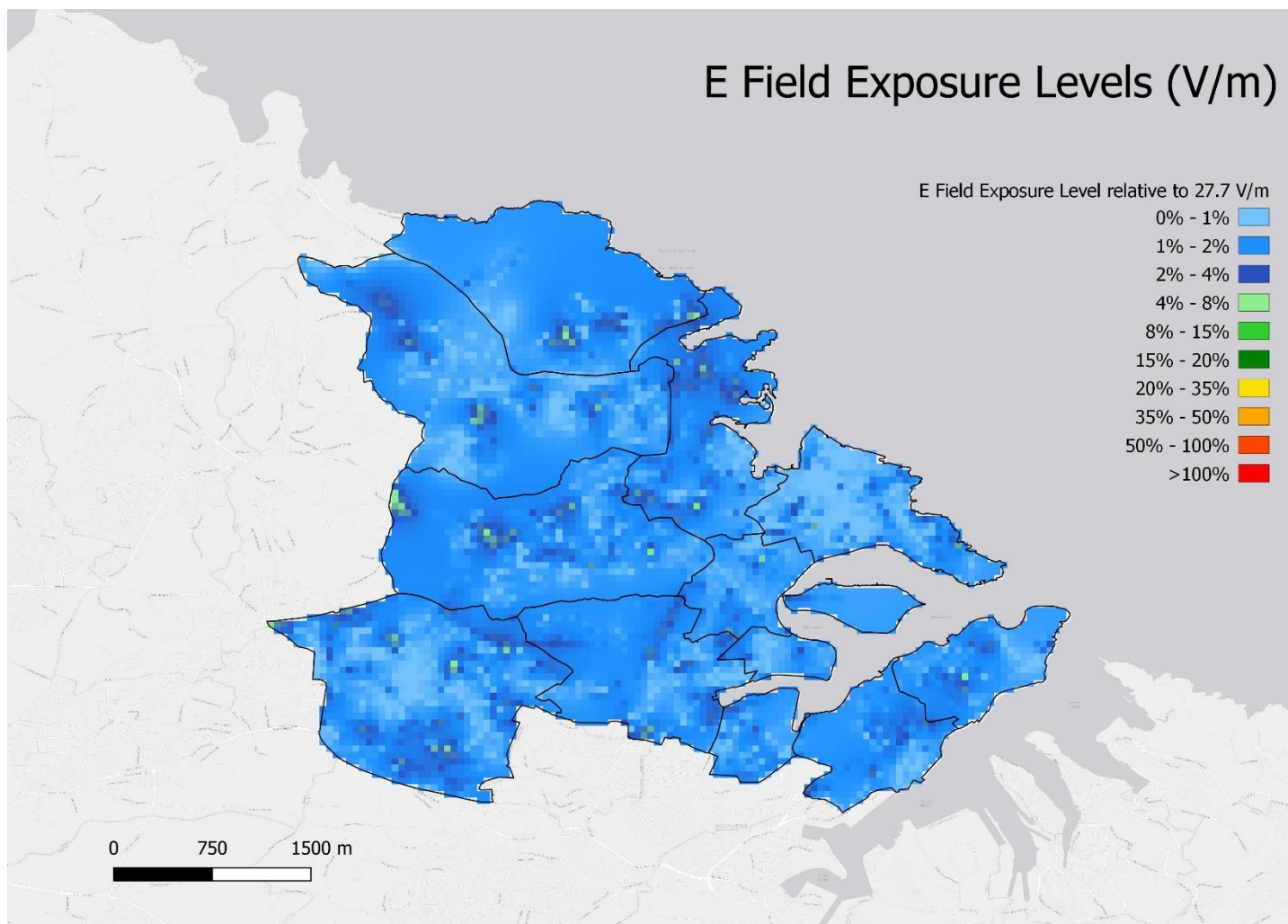


Figure 9: E Field Exposure Levels relative to the ICNIRP lowest public exposure limit of 27.7 V/m (2020)

