WATER LINES AND THEIR EPIDEMIOLOGICAL RELEVANCE IN DIFFERENTIATING RURAL FROM URBAN MAGNETIC FIELD EXPOSURE. D. Lanera,* J. E. Zapotosky, and J. A. Colby,* IIT Research Institute, 10 West 35th Street, Chicago, Illinois 60616-3799, U.S.A.

There are indications from published data that the electrical environment and the accompanying magnetic fields are substantially different between rural and urban settings. This is suggested, for example, by the data released from the Electric Power Research Institute (EPRI) about a nationwide survey of residential magnetic field levels ("the thousand homes survey"), completed recently: 0.3 mG-rural and 0.8 mG-urban. Such a difference, if proven to be nonrandom and mechanistically explainable, would have significant ramifications and implications for epidemiological studies and possible mitigation approaches.

HYPOTHESIS: Of the many intrastructural differences between rural and urban environments, the presence of a municipal water system in an urban area versus its absence in a rural area is suspected to be the major factor that can account for differences in magnetic field levels and other electrical parameters. Power line ground currents are just a manifestation of basic and deep-rooted differences in the electrical grounding system of these two environments.

OBJECTIVE: Analyze in detail the differences that exist between rural and urban environments with respect to power line operating configurations and associated magnetic field levels; assess the size and statistical significance of differences; and investigate the electrical parameters of the power line that may be responsible for any statistically significant difference.

METHOD: Assemble and analyze data on magnetic fields and power line parameters from an outdoor field survey conducted in a small town. Residences on the municipal water system are classified as urban; others not on the system are classified as rural. All other factors are considered to be equal, including wiring configuration and individual residence power consumption.

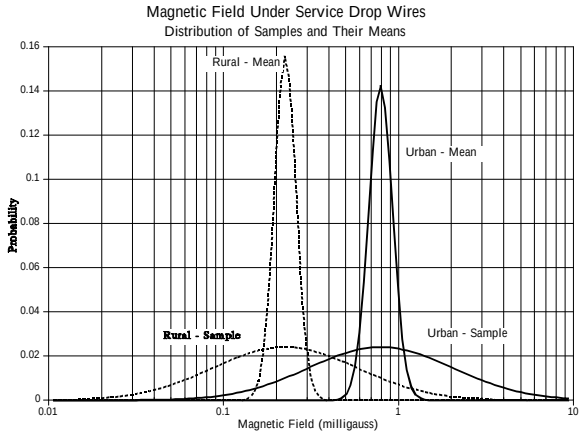
RESULTS: The table outlines magnetic field sample means for different outdoor locations. The figures show the probability distribution of these means. The figures indicate, quite clearly, that there are substantial and statistically significant differences between rural and urban outdoor residential environments. Power consumption level is identical for both types of residences. Grounding appears to be 10 times more effective in urban environments as compared to rural environments.

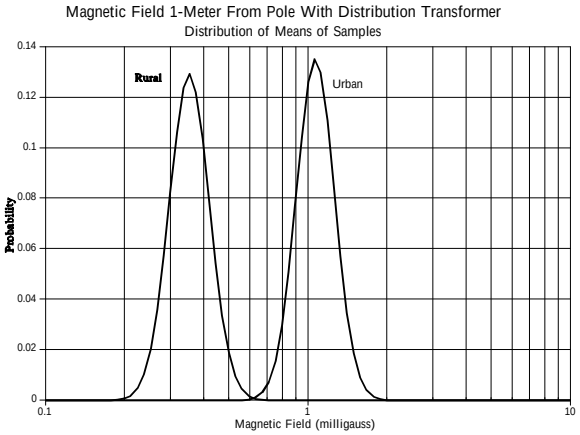
LOCATION	MAGNETIC FIELD (mG)	
	RURAL	URBAN
Service transformer pole	0.35	1.00
Midway under power drop wires	0.25	0.74
Near kilowatt power meter	0.33	1.64
Over fire hydrant	—	0.75

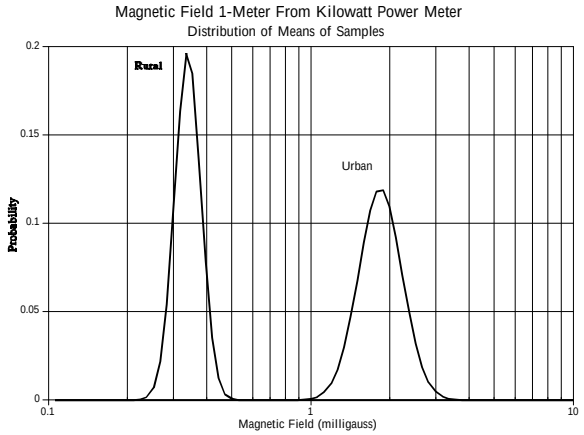
DISCUSSION: This study indicates that there is a statistically significant difference between rural and urban magnetic fields just outside the residence. The difference seems to be caused primarily by the presence of a municipal water system. The study also points out that this difference may extend to inside the residence, but offers no supporting evidence other than data from EPRI. Wire code, socioeconomic conditions, housing, power consumption, and lifestyles are very uniform in a small town, whether on a municipal water system or not. Urban transformers handle more power than rural transformers; however, it is the superiority of the water system in electrical grounding and the interconnectivity that it provides that explains most of the difference in magnetic field levels. The connection of a residence to a community water line as opposed to the use of a well may represent, as a dichotomous variable for urbanization, another surrogate means for magnetic field exposure in the epidemiological study of health effects. The concept needs to be researched further.

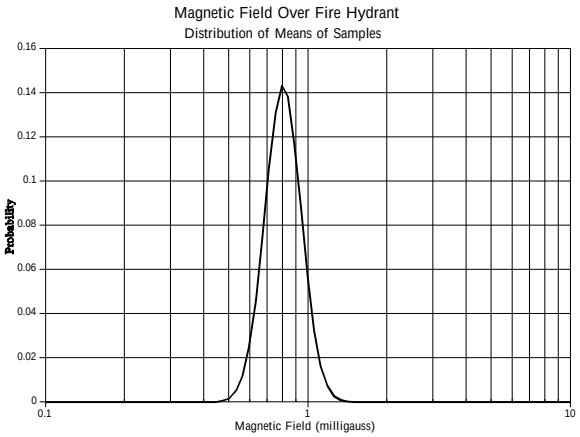
Study sponsored by IIT Research Institute

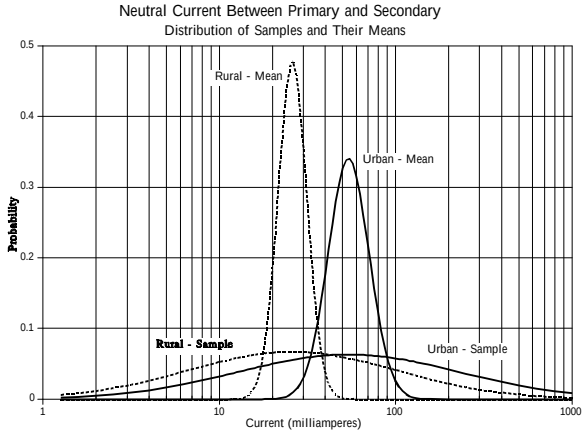
Figures

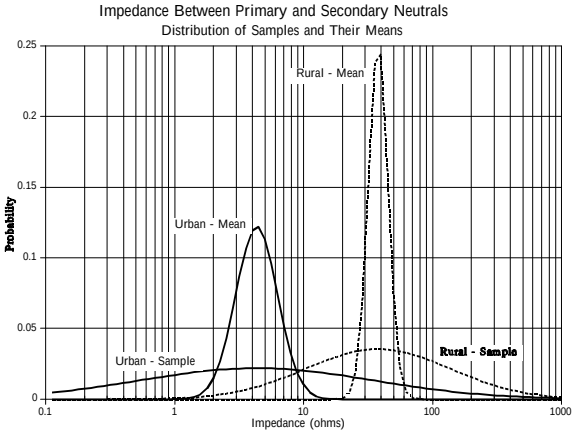

Magnetic Field Under Service Drop Wires
Distribution of Samples and Their Means
Rural - Mean
Urban - Mean
Rural - Sample
Urban - Sample
Probability
Magnetic Field (milligauss)


Magnetic Field 1-Meter From Pole With Distribution Transformer
Distribution of Means of Samples
Rural
Urban
Probability
Magnetic Field (milligauss)


Magnetic Field 1-Meter From Kilowatt Power Meter
Distribution of Means of Samples
Rural
Urban
Probability
Magnetic Field (milligauss)


Magnetic Field Over Fire Hydrant
Distribution of Means of Samples
Probability
Magnetic Field (milligauss)


Neutral Current Between Primary and Secondary
Distribution of Samples and Their Means
Rural - Mean
Urban - Mean
Rural - Sample
Urban - Sample
Probability
Current (milliamperes)


Impedance Between Primary and Secondary Neutrals
Distribution of Samples and Their Means
Rural - Mean
Urban - Mean
Urban - Sample
Rural - Sample
Probability
Impedance (ohms)