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ELEVATED RADON AREA EVALUATION PROGRAM

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ABSTRACT

The New Jersey Department of Environmental Protection (NJDEP) discovered that homes with elevated radon levels often occur in clusters. The Elevated Radon Area Evaluation Program (ERAEP) project, funded by the EPA's State Indoor Radon Grant, combines the time and talents of staff from the New Jersey Geological Survey (NJGS), the Radon Program and local health officers to confirm reports of residences in the surrounding area. The ERAEP is the outgrowth of the Radon Program's earlier Cluster Study. The Cluster Study was begun in 1986.

The goals of this project are to (1) develop detailed protocols for identifying and studying areas where a significant number of homes with elevated radon levels may be located, (2) expand the participation of the local health officers and sanitarians, by training them to conduct such studies and (3) to try to develop an effective methodology and protocol to predict elevated sites based on outdoor gamma levels, geology, and airborne radiometric signatures.

A total of 55 cluster investigations were conducted since 1986. Data collected through this study showed that approximately 75% of the homes surrounding the target home (radon concentration equal to or greater than 150 pCi/L) had radon levels exceeding 4 pCi/L.

Using DEP confirmatory data, the NJGS generated a location map and radon potential map by geologic unit for Hunterdon, Mercer, and Morris counties. The geologic units were ranked according to the median radon values from confirmatory tests taken in houses located on those units.

INTRODUCTION

The existence of high radon level homes in Clinton, New Jersey led to the need for the development of a program to identify similar, health threatening clusters in other areas of the state.

In response to this need, the NJDEP, in December of 1986 developed and implemented a Radon Cluster Identification Program. Through this program, screening of homes was conducted within the vicinity of a home confirmed by DEP to have radon levels of 200 pCi/L or greater. A geologic evaluation of the "target" area was also performed to gain an understanding of the source of high indoor radon levels.

A more streamlined protocol for identifying and studying target areas was developed. The participation of local health officers and sanitarians was expanded by training them to conduct the geological field surveys, under the program that is now known as the ERAEP. The ERAEP is now funded through the EPA State Indoor Radon Grant Program. In the two years of the ERAEP, a training manual was assembled by in-house staff and four, two day training sessions for health officers were conducted. In all, 53 health officers and sanitarians in 13 New jersey counties have been trained. Each session included a half day field trip for students to learn to operate a Ludlum

micro-R meter and conduct a gamma survey. In addition to the training manual, each health officer was supplied with charcoal canisters, a radon in water sampling kit and a micro-R meter.

RADON SURVEY DESIGN

Briefly, the ERAEP works in this manner. The Radon Program receives information about a home with radon reading of 150 pCi/L or greater. The trigger level was lowered to 150 pCi/L in January 13, 1993 as suggested by the EPA. If the home is located in a county with a trained health officer, he/she is contacted and in turn visits the home within 24 hours and 1) draws a floor plan of the lowest level, 2) conducts a gamma survey of that level, 3) deploys several charcoal canisters throughout the home and 4) takes water samples, if the water supply is a private well. After the home visit the health officer/sanitarian forwards his/her drawing, gamma survey results and water samples to the Radon Program. In four (4) days the health officer/sanitarian retrieves the charcoal canisters and sends them to the Bureau of Radiological and Inorganic Analysis (BRIAS) laboratory for analysis. Upon receipt of the canister results and confirmation of a 150 pCi/L or greater reading, the Radon Program staff instruct the health officer/sanitarian to contact the homeowner and discuss the results and actions they should be taking to mitigate the house. Then Radon Program project manager determines whether or not the home is located in an area already surveyed as part of another cluster site; if it is not, a new study area is initiated. If a new study area is declared, the health officer/sanitarian is informed and in turn informs the local administration and provides copies of updated tax maps to NJGS staff who develop a composite map. Using the composite map, the health officer/sanitarian conducts a gamma survey of the area. Using the gamma survey results and the composite maps, New Jersey Geological Survey staff then prepare the working area evaluation survey map. Radon Program staff review the survey map and select 30 homes which the health/sanitarian should visit in order to deploy charcoal canisters and take water samples. The health officer/ sanitarian contacts the residents prior to the visits to discuss the screening procedure and the health risk associated with radon exposure. Following analysis of all the radon in air and water samples, the Radon Progam staff send results to homeowners, and then prepare a report on the cluster results which is sent to the health officer/sanitarian.

The radon test locations were grouped by geologic formation using the digitized geologic coverage that is currently in the Geographic Information System (GIS). Using the ARC-INFO GIS software on a SUN workstation, the test location data was grouped by geologic formation for three counties Hunterdon, Mercer, and Morris.

RESULTS-DISCUSSION

Through this program, a total of 55 cluster targeted homes have been studied to date. The distribution of radon in the 55 targeted areas is shown in Table 1. In the targeted areas, 1040 homes tested had radon levels equal to or greater than 4 pCi/L. 91 of the 1,383 homes tested in targeted areas had radon levels greater than 200 pCi/L. There are several targeted areas, where 30 canisters were not deployed as required by the cluster protocol. The possible explanations are that the homes were tested before, homeowners declined to test, houses were unoccupied or houses were not available within the one mile radius. In some cases, multiple cluster investigations were conducted in the same township. For example Clinton and Princeton have six and three clusters respectively due to the repeated discovery of new target homes (greater than 150 pCi/L houses) which were not in a previously defined cluster area. The distribution of radon air and water concentrations measured in homes in the target area of one of the cluster investigations is shown in Table 2. In this example, 20 of the 26 homes tested had air radon levels equal to or greater than 4 pci/L. Twenty-five of the 26 homes tested had water radon levels equal to or greater than 300 pCi/L (the EPA's proposed Maximum Contaminated Level in public drinking water supplies). Figure 1 shows no correlation between radon in air and radon in water (ATTACHMENT I).

A detailed geological description on the radon potential of Hunterdon, Mercer, and Morris Counties in New Jersey ranked by geologic unit is available upon request. Figure 2 shows the radon potential map of Hunterdon, Mercer, and Morris counties (ATTACHMENT II).

CONCLUSIONS

The ERAEP has shown that adequately trained and equipped local health officers and sanitarians can perform elevated radon area investigations with minimum assistance from the state. We have learned that when radon occurs at these high levels, approximately 75% of the surrounding homes have radon levels exceeding 4 pCi/L. The radon potential map developed through this study for three counties (Morris, Hunterdon and Mercer) can be used by the trained health officer during any future elevated radon area investigation in New Jersey.

Table 1. List of clusters with radon distribution since the radon program began

		1986 - 1993 (Radon Concentrations - pCi/L)				
County	Municipality	<4	4 - 19	20 - 199	>200	Total # Houses
Hunterdon	Bethlehem	16	26	16	7	65 (3)*
Hunterdon	Clinton	28	40	61	41	170 (6)
Hunterdon	Cokesbury	9	12	6	0	27 (1)
Hunterdon	Delaware	45	34	8	2	89 (3)
Hunterdon	Flemington	3	7	2	0	12 (1)
Hunterdon	Franklin	13	34	8	0	55 (2)
Hunterdon	Hampton	0	5	14	2	21 (1)
Hunterdon	High Bridge	3	22	4	1	30 (1)
Hunterdon	Lebanon	25	20	8	1	54 (1)
Hunterdon	Tewksbury	7	19	0	0	26 (1)
Hunterdon	Stockton	6	11	9	0	26 (1)
Mercer	Ewing	18	30	28	4	80 (3)
Mercer	Lawrenceville	14	12	4	1	31 (2)
Mercer	Princeton	15	27	18	1	61 (3)
Morris	Chester	2	12	4	4	22 (1)
Morris	Long Valley	3	10	12	1	26 (1)
Morris	Randolph	34	50	9	1	94 (3)
Morris	Rockaway	7	17	8	0	32 (1)
Somerset	Bernardsville	7	21	26	4	58 (2)
Somerset	Montgomery	5	6	3	1	15 (1)
Somerset	Raritan	8	34	25	7	74 (3)
Somerset	Warren	5	1	1	0	7 (1)
Sussex	Byram	10	14	6	3	33 (1)
Sussex	Sparta	3	2	0	0	5 (1)
Warren	Allamucy	4	14	8	1	27 (1)
Warren	Great Meadows	8	10	0	0	18 (1)
Warren	Mansfield	5	10	25	3	43 (2)
Warren	Oxford	3	7	4	0	14 (1)
Warren	Stewartsville	7	14	9	0	30 (1)
Warren	Washington	4	9	13	4	30 (1)
Warren	White	26	48	32	2	108 (4)
Total		343	578	371	91	1,383 (55)

* Total number of cluster(s) investigation conducted in each Municipality

Table 2. Radon screening measurement

Radon Level (pCi/L)	AIR Number of Houses	Percent
<4	6	23
4 - 19.9	11	42
20 - 99.9	9	35
100 - 150	0	0
>150	0	0
	26	100

Radon Level (pCi/L)	WATER Number of Houses	
<300	1	4
300 - 10,000	25	96
10,001 - 40,000	0	0
>40,000	0	0
	26	100

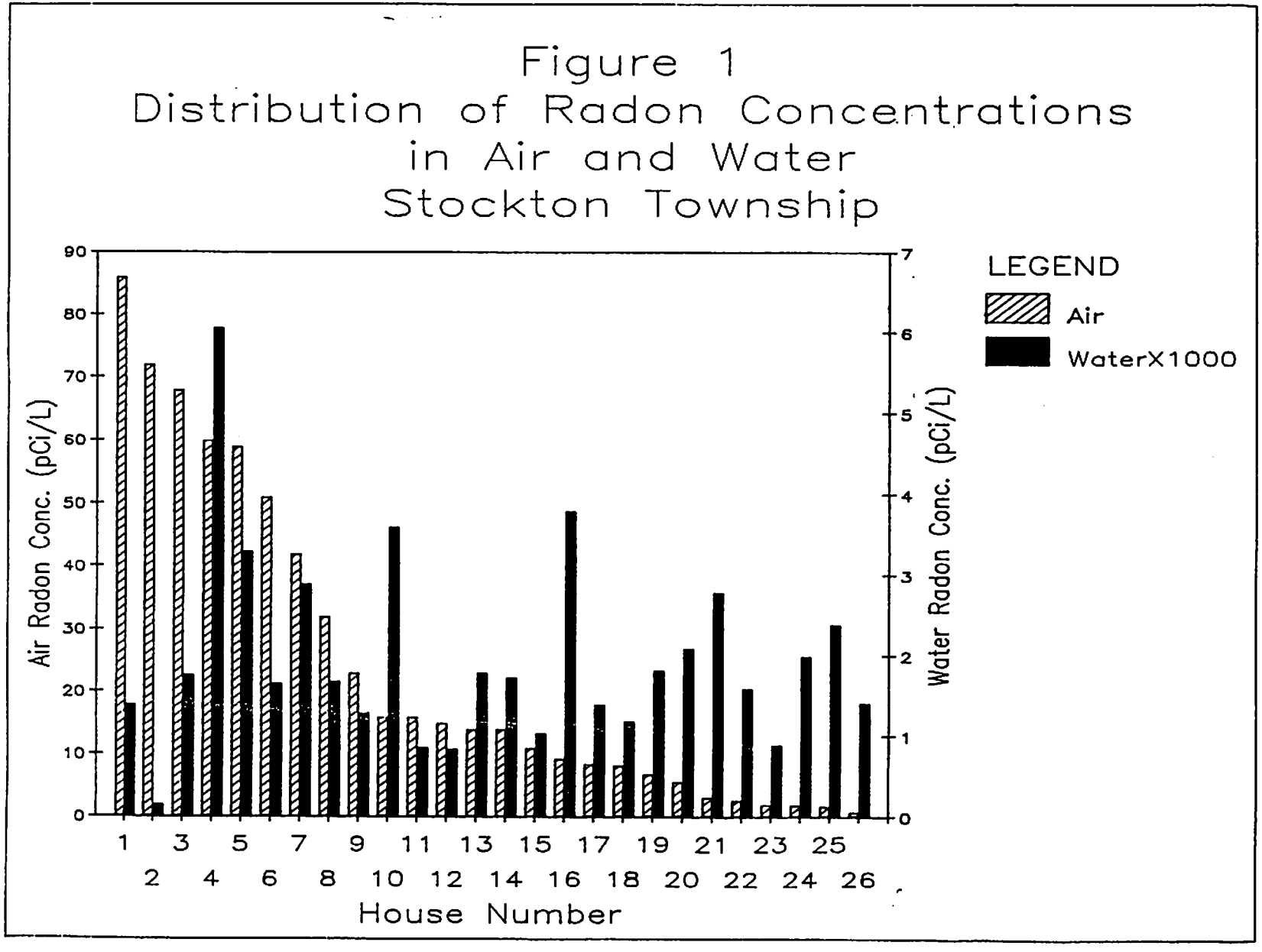


Figure 1
Distribution of Radon Concentrations
in Air and Water
Stockton Township
Air Radon Conc. (pCi/L)
Water Radon Conc. (pCi/L)
LEGEND
Air
WaterX1000
House Number
0
10
20
30
40
50
60
70
80
90
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26

FIGURE 2

ATTACHMENT #II

DEPARTMENT OF ENVIRONMENTAL PROTECTION AND ENERGY
DIVISION OF SCIENCE AND RESEARCH
NEW JERSEY GEOLOGICAL SURVEY

RADON POTENTIAL OF HUNTERDON, MERCER AND MORRIS COUNTIES, NEW JERSEY RANKED BY GEOLOGIC UNIT

Explanation

Geologic units with high radon potential (>20 pCi/L)*

Martinsburg Formation (Omb) [48.0 (19)]**
Hardyston Quartzite (Ch) [35.0 (16)]

Geologic units with medium - high radon potential (12-20 pCi/L)

Lockatong Formation (Trl) [17.0 (211)]
Stockton Formation (Trs) [14.0 (334)]
Kittatinny Supergroup (COk) [18.0 (110)]

Geologic units with medium radon potential (4-11.9 pCi/L)

Raritan and Magothy Formations (Kmr) [5.1 (7)]
Basalt (Trba) [9.9 (36)]
Diabase (Jdb) [10.8 (16)]
Brunswick Group (Trb) [8.4 (320)]
Conglomerate Formation (Tro) [5.6 (36)]
Bellvale Sandstone (Db) [7.6 (4)]
Pequest Island Formation (Sp) [11.0 (2)]
Gneiss (undifferentiated) (Pog) [11.0 (655)]

Geologic units with low radon potential (<4 pCi/L)

Green Pond Conglomerate (Bgp) [3.2 (9)]

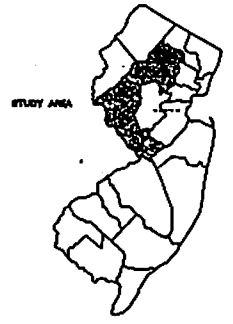
Geologic units with insufficient radon data for analysis

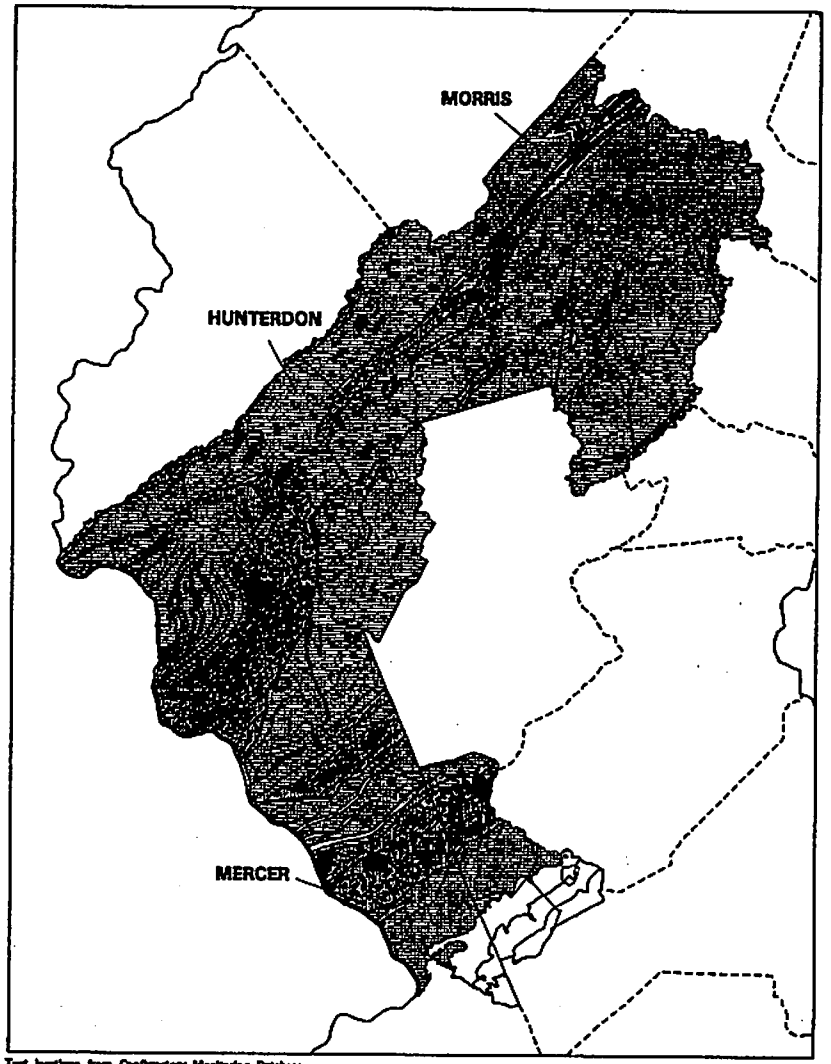
County Boundary

Test Location

* Picocuries per liter

** [x (n)]: x is the median value of indoor radon tests from houses located in the geologic unit; (n) is the number of radon test values on which statistical analyses were performed.





Test locations from Confirmatory Monitoring Database, NJDEPE Bureau of Environmental Radiation, 1992. Data are analyzed to rank levels of radon potential by geologic unit.

Base map from NJDEPE Geographic Information System.

Geology from NJ Geological Survey Geologic Map Series 22-30, scale 1:63,360.

GIS Application and Cartography by M. Gay.

RADON POTENTIAL OF HUNTERDON, MERCER, AND MORRIS COUNTIES NEW JERSEY RANKED BY GEOLOGIC UNIT

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