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Soil Radon Gas Study of Southern Ontario

1993

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ONTARIO GEOLOGICAL SURVEY

Open File Report 5847

Soil Radon Gas Study of Southern Ontario

By

J.E.Tilsley, H. Veldhuyzen and P.R. Nicholls

1993

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M A P S (in back pocket)

1. Soil Radon Gas Study of Southern Ontario-Wallaceburg

2. Soil Radon Gas Study of Southern Ontario-Windsor

3. Soil Radon Gas Study of Southern Ontario-Prince Edward County

4. Soil Radon Gas Study of southern Ontario-Markham-Stouffville

Abstract

Radon concentrations in soil gas were studied in the Belleville–Prince Edward County, Markham–Stouffville, Wallaceburg and Windsor areas of southern Ontario. These localities were selected to represent differing combinations of surficial and bedrock geology. Within the four study areas, 11 sampling environments based on the geologic combinations were identified.

The purpose of the program is to generate a database of radon soil gas concentrations that will be of value in determining geological controls on the occurrence and migration of radon in the overburden. Such information has value in a wide variety of environmental surveys. During the 1991 field work data from the Wallaceburg area indicated the radon survey method may prove to be a useful tool in exploration for oil and natural gas.

Field work began on September 27, 1991 and was completed by December 15th. During this time period 495 sampling sites were established and approximately 1350 radon and 85 thoron determinations were made. Gamma dose measurements were done at 40 of the sampling sites. Three radon concentration determinations were made at most sampling locations, excepting for a small number of stations where detector packages were vandalized or stolen, dug up by animals, or had to be removed due to impending construction.

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO

by

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INTRODUCTION

The Engineering and Terrain Geology Section of the Ontario Geological Survey initiated a regional radon soil gas study in September of 1991. Aurora Environmental Surveys Limited was contracted to complete out this survey.

The survey examined the distribution and concentration of radon gas in soils in 4 areas of Southern Ontario: Windsor, Wallaceburg, Markham–Stouffville, and Belleville–Prince Edward County. The survey areas were divided into environments which are subdivisions of the areas based on differing surficial and bedrock conditions. Within an area each environment has a different composite stratigraphy. For example, in an area each of the following would be separate environments: till overlying limestone; sand and till over limestone; and till overlying shale.

The initial program was to consider a total of 10 environments in 4 study areas across southern Ontario. Early results in the Wallaceburg area suggested a strong correlation between elevated radon concentrations in soil gas and known deposits of oil and natural gas. A third "environment" was added in this study area.

The first detectors were placed on September 27, 1991, and all radon determinations completed before December 15th. Total sampling time in the first 10 environments was generally 60 days or more. Wallaceburg Environment 3, the sites over oil and gas deposits, had exposure times from 9 to 25 days. The early part of the sampling period was very dry and the usually heavy clay soils of the Windsor–Wallaceburg area were notably friable and permeable. Later in the survey, heavy rains saturated the soils and some detectors were recovered from standing water.

The radon measuring equipment used for all determinations was supplied by Rad Elec. Inc. of Frederick, Maryland, USA. The radon concentration at most sample locations was determined by at least 3 readings, producing a database that shows short and long term radon averages. This permits comparison of several results from each sample point and provides one sort of quality control.

Data collected during the field program are discussed and interpreted in the body of this report. Raw measurements and calculated radon concentrations are presented in appendices, and average radon concentrations for the full exposure time are shown on the accompanying 1:50 000 scale plans.

The information generated during this study will be valuable in assessing regional radon background levels in areas of varying geological conditions. Survey results will help clarify the role geologic structures, lineaments and surface stress release features, glacial (surficial) material, bedrock lithology and material properties (saturation, porosity, etc.) have on radon soil gas levels. this information will form a basis for designing further regional radon studies and developing site study protocols.

RADON SURVEYS

Sampling and Interpretation Criteria

Characteristics of Radon

Radon is naturally occurring radioactive gas formed during spontaneous disintegration of atoms belonging to the three radioactive decay series listed below.

The Uranium Series — parent U^{238}

The Thorium Series — parent Th^{232}

The Actinium Series — parent Ac^{227}

A fourth radioactive series, the Neptunium Series, (Np^{239}) has existed naturally, but has now decayed completely to its final, non-radioactive element, Bi^{209}.

The radioactive gasses from these three series are all known as radon, but Rn^{222}, the radon of the uranium series, is the only one with a significant half-life. Rn^{220} or thoron, belongs to the thorium series and has a half-life of 55.6 seconds. Rn^{219} of the actinium series exists more briefly, having a half-life of only 3.92 seconds. Therefore, Rn^{222} is the most important natural radioactive gas from an exploration or health perspective.

Rn^{222} is a transient element with a half-life of 3.825 days. This means that if 100 units of radon are present at the beginning of day one, only 50 units will remain at the end of 3.825 days or about 92 hours later. Ninety-nine of the original 100 units will have spontaneously decayed to radon daughters in 550 hours. During its rather brief life, radon is a noble gas, that is, it carries no electrical charge and does not enter into chemical combinations. While radon is 9.958 times heavier than air, it is usually present in comparatively low concentrations and moves by apparently free diffusion through the air. It may be transported in moving air or other gases (advection) both above and below ground. Radon can dissolve in water but it is much more soluble in air. Therefore, normal movement of the gas is from water to the air. Most waters that contain elevated radon levels are usually found to contain elevated radium contents as well.

The immediate parent of radon is the trans-uranic element Ra^{226}. Radium has a half-life of 1622 years, and is geochemically quite mobile. The parent of radium is U^{238}. This, the most common isotope of uranium has a half-life of 4.5×10^9 years.

The relationship between uranium concentration and radon concentration is direct, providing that uranium and radium are in secular equilibrium. This is not always the case since radium may behave differently, (e.g., it is often more mobile), than uranium in some chemical environments. See Thompkins (1982) for a discussion of radioactive equilibrium.

Both planning of radon surveys and interpretation of results must take the physical characteristics of radon gas into consideration.

Mobility of Radon Gas

Extensive studies of radon mobility have been made during the past thirty years. Tanner (1980, 1985) calculates that radon movement by combined diffusion and advection is usually less than 3 m in most rocks and sediments.

Thompkins (1982) gives a calculation for radon diffusion in air and another for diffusion in water. Results of these calculations indicate diffusion distances of 2.18 m in air and 0.0218 m in water. Further, he calculates an average diffusion length of 1.65 m in coarse-grained sand with 40% porosity, and an average of 1.15 m in "loose deposits" having 20% porosity.

Other workers suggest that, under favourable conditions of soil dryness and porosity, radon migration may be 10 m or more. In any case, radon gas measured at specific locations in soils and rocks is most likely generated from its parent Ra^{226} within less than 20 m of the sampling point. In the experience of the authors, under most conditions in southern Ontario, radon transport distances are most likely in the order suggested by Tanner.

Apparent long distance movement of radon gas is most likely explained by geochemical movement of parent elements uranium and radium. Water is the prime transportation medium of metals in rocks and overburden. Volatile hydrocarbons also appear to be very effective transport agents, particularly in areas underlain by Paleozoic age and younger petroliferous sediments.

Source of Radon Gas in Soils

Radon can be expected in soils and rocks which contain U^{238} and Ra^{226}. Uranium may be concentrated in igneous, metamorphic and sedimentary rocks.

Extensive studies of uraniferous rocks have been made during exploration for uranium deposits, and in some countries (e.g., Sweden) regional surveys have been conducted for public health reasons.

Granites frequently carry 10 to 40 ppm U, and in some areas are the source of pronounced radon and gamma radiation anomalies. Pegmatites are also often uranium and thorium enriched. Neither rock type outcrop in the areas studied, although they are present in basement underlying the Paleozoic sediments, and outcrop extensively throughout the Grenville Province of Precambrian Shield in Ontario.

Pegmatites, some of which appear to be the result of metamorphism (anatexis) of sediments, have been mined for their uranium content in the Bancroft area of Ontario. Uranium contents ranged from a few hundred to several thousand parts per million (grams per tonne).

Paleozoic and younger sandstones host economic uranium deposits in the western United States. Small occurrences of uranium minerals have been identified in Paleozoic sandstones in Ontario, where uranium content over short intersections reach 2500 ppm (Dyck 1976).

Carbonaceous (black) shales are noted for heavy metal content. The Alum shales of Sweden carry 10 to 350 ppm U, and underlie large areas of the southern and central part of the country (Wilson 1982). The Gassaway Member of the Chattanooga shale of Tennessee and adjacent states carries an average of about 60 ppm U (Mutschler et al. 1976). The Kettle Point Formation in Southwestern Ontario has similar uranium content, ranging from nil to 75 ppm and averaging 32.4 ppm U, (Armstrong 1986) and the Ohio Shale, which is the Appalachian Basin equivalent of the Kettle Point Formation, is reported to carry 10 to 40 ppm U (Harrell et al. 1991). Black shales are the most common uranium-radium-radon source rocks in southern Ontario, and the more petroliferous sections of the shales appear to provide a mechanism for long-range transport of radon parents to surface through substantial thicknesses of cover rocks and glacial overburden (Sikka 1959, Ghahremani 1984).

Soils (surficial materials) derived wholly or in part from uranium-bearing rocks can be expected to contain uranium. Results of this survey suggest that uranium and radium can be introduced to overburden and soils by migrating volatile hydrocarbons as well as by moving groundwaters.

Factors Influencing Radon Concentrations in Soil Gas

In addition to the radium concentration in the soils (surficial materials) adjacent to a radon detector, there are other influences on the radon concentrations which may develop in soil gas.

The physical and chemical nature of the local soils must always be considered when reviewing results of radon sampling. Throughout the areas studied, porous sands and gravels generally show low radon concentrations at the standard sampling depth, due in large part to high permeability and consequent greater ease of dilution by atmospheric air. The low radon concentrations in the soil gas of sands and gravels also reflects a greater air/radium ratio. The air/radium ratio influences radon concentration since, for any given radium content there is a corresponding radon production. The porosity of sands and gravels may be as much as 40% compared to as little as 10% in some heavy clay soils. Assuming equal quantities of radium in both cases, a soil which has 40% porosity would show radon concentrations only 25% of those generated in a soil that has 10% porosity, due to simple dilution. Furthermore, porosity and permeability of any soil change with moisture content. Therefore, direct comparison of radon concentrations can be done only if the soil type, porosity, permeability, and moisture contents are similar.

Short term variations in radon concentration reflect changes in air pressure that, in turn, may be related to passage of storm fronts, wind direction and velocity, temperature, soil moisture, et cetera. The shape of the land is an often overlooked factor. Topographic features, especially abrupt ones, may act as airfoils at some wind directions and speeds. Low pressure zones will exhale radon, while high pressure zones will tend to force fresh atmospheric air into the soil. In the former case radon concentrations measured will be higher than average, while in the latter case, lower concentrations can be expected due to dilution of soil gas by atmospheric air.

The presence of a shallow water table will tend to produce depressed radon concentrations due to the restricted rate at which radon is able to migrate through water (Thompkins 1982) and the generally slow movement of groundwater (Akerblom and Wilson 1982). The authors are aware of some exceptions to this general rule, (outside the survey areas), where groundwater discharge is significant and where pH and Eh changes permit precipitation of locally stable uranium and radium minerals. However, in most cases, a shallow, slow-moving water table will tend to result in low radon background, largely because most of the ambient soil gas radon is derived from unsaturated soil within several meters of the detector, and a shallow water table will reduce the effective volume of the radon source.

Radon Detection Equipment

The radon survey used equipment obtained from Rad Elec Inc. of Frederick, Maryland, USA. The E-PERM™ system consists of an ionization chamber and an electret. An electret is a charged Teflon™ disk that carries a quasi-permanent electric charge. Radon enters the ion chamber through a small filtered hole. The filter removes airborne radon progeny and dust. Spontaneous radioactive decay of radon within the ion chamber creates ions which are attracted by the surface charge on the electret. When ions strike the electret the static charge is reduced. The voltage drop caused by ions striking the electret is proportional to the concentration of radon in the ion chamber. Voltage on the electret is measured before and after exposure using a dedicated surface voltage meter. The voltage drop can be converted to average radon concentration during the period of exposure by relatively simple calculation.

The manufacturer produces a variety of ion chambers and electrets. Since relatively long term exposure is necessary for evaluation of soil gas radon, 50 mL ion chambers and "long term" electrets were chosen as the prime radon detectors. This combination gives a dynamic range of approximately 15000 pCi/L days before the electret is discharged below a useful voltage. This range permits placement of a detector in an environment with an average radon concentration of 200 pCi/L for between 85 and 90 days or in 1000 pCi/L for about 16 days.

The E-PERM™ system has been developed for indoor radon measurement, and requires minor modification to permit use in the relatively hostile environment characteristic of most surficial materials. The detectors must be protected from wetness and dirt, since either can cause voltage discharge if they contact the electret. The voltage readers must also be kept free of dust, moisture, and dirt.

Protection of the detectors was achieved by first placing each one in a radon transparent Tyvek™ envelope which was folded around the detector and then pushed to the bottom of a 750 mL plastic (ice cream) container. The envelope and detector were secured in the container by a small plastic drinking cup which, in turn, was held by a glass fibre tape pulled across the mouth of the container. This arrangement permits the "package" to be inverted when placed in an excavation in the soil. The inverted plastic container acts as a "diving bell" and prevents the detector becoming wet if the sample location floods. The Tyvek™ envelope keeps the detector clean and relatively dry under

most conditions. Tyvek™ is waterproof while capable of allowing water vapour (and radon gas) to pass through. It had been suggested that the Tyvek™ envelopes would be adequate protection for detectors placed in the ground. However, it was found that the glue used to hold the envelopes together is not waterproof and that, in any case, commercially available envelopes are incompletely sealed and will leak.

Thirty of the detector packages included ion chambers specially designed to measure the concentration of thoron gas in the soil. Also, an equal number of gamma dose detectors were prepared for the initial program. Three thoron detectors and 3 gamma dose detectors were installed in each of the environments within each test area. Both these types of detectors are special configurations of the E-PERM™ system used for radon detection.

The thoron detectors are 50 mL ion chambers fitted with three large filtered openings (1 cm diameter) to admit thoron, which due to its very short half-life decays almost totally during passage through the purposely designed small filtered opening of radon ion chambers. If a radon and a thoron detector are exposed in the same package, the difference between voltage drops measured by the 2 detectors can be used to calculate thoron concentration.

The gamma dose configuration uses the 50 mL ion chamber fitted with a short term electret. The detector is heat sealed in a radon-proof anti-static plastic bag. Gamma rays passing through the chamber produce ions that are attracted to the electret and reduce the voltage in the same way as ions from spontaneous radioactive decay of radon. Since the detectors are sealed against entry of radon, voltage drop is be due to gamma radiation-induced ionization only. The observed voltage drop can be converted to uR/hr. Calibration of the radon detectors was done in known gamma fields by the manufacturer, and a correction routine established for adjusting apparent radon values for gamma contribution.

Placement of Detectors

Preparation for Field Work

The general location of each sample point was determined on the basis of the surficial and bedrock geology prior to the start of work in each study area. Detector packages were assembled the night before deployment. The plastic containers were marked with detector serial numbers and initial electret voltage , placed in a large box and stored in a low radon environment overnight.

Selection of Sample Sites

Sample locations were determined in the field based on the surficial and bedrock geology, access, topography, and anthropogenic factors. The detector package was placed in a 15 cm diameter excavation made with a post hole auger or a narrow blade peat spade. The peat spade proved to be the most versatile tool since holes could be dug beneath fence lines and in other tight quarters where the auger handle could not be turned. Installation was at the bottom of the "B" soil horizon except in soils (surficial material) that had been altered by construction or other disturbance. Placement depth ranged from 20 cm to 50 cm, with the average being between 35 cm and 40 cm.

Most of the sample sites chosen for this study were located on public lands. Usually this was within the limits of provincial and municipal highway rights-of-way. One site study was done in Stouffville on the residential property of one of the authors since this was within one of the study areas and was convenient for a series of short term readings (Site MS2-24).

Deployment of Detector Packages

Detectors were deployed by crews consisting of 2 persons. One person was responsible for digging the sample hole, placing the detector package and plastic cover sheet, and for re-filling and marking the location. The other crew member selected the detector package and entered all pertinent data on an individual data sheet, including the: detector serial number(s); initial voltage; date and time of placement; geological observations; location sketch; drainage; topographic; vegetation; and anthropogenic information. The actual sample site was then marked on the appropriate 1:50 000 scale base map.

The detector packages were placed in the excavation with the open end of the inverted container pressed into the soil. A 5 mil (vapour barrier) plastic sheet approximately 80 cm square was used to line the sample holes above the detector. It was filled with soil that had been previously removed from the hole and placed on a second plastic sheet. The plastic was allowed to protrude above the ground surface so that the corners made easily gripped 15 cm "ears". This allowed for tidy sample sites and easy removal of the soil plug and recovery of the detectors for short term radon determinations. The plastic sheeting was also found to be a critical factor in making possible the final recovery of detectors from frozen ground.

Sample locations were indicated by a small piece of flagging tape attached to a fence, shrub, weeds or grass beside or above the detector. This discreet marking was intended to reduce the possibility of detector loss to curious passers by. Interestingly, there were no detectors lost in built-up areas. The only disturbances recorded were from urban skunks which appear to have learned to associate plastic with food. All of the detectors tampered with or removed by others were located in rural and semi-rural areas. Since the surveys were of a reconnaissance nature, sample locations were chosen within specific environments adjacent to some easily identified feature, such as: the intersection of highways or lot lines and township roads: near a telephone or electric utility pole; notable tree or clump of shrubs; fence corner; etc. In most areas the property line termination at a local highway was a preferred location since these points tended to be less disturbed by agricultural activities, and often were marked by local growth of trees or shrubs. Utility poles often bear identification numbers that are particularly useful for locating sample sites, especially in topographically featureless portions of the Windsor–Wallaceburg till plains.

Radon Measurements

Timing

Radon measurements were taken 7 to 15 days after initial placement of detectors to determine the electret discharge rate and the length of time the detector could be left in the ground before reading and replacement would be necessary.

Second readings were taken after about an additional 20 days, and final radon measurements were made 60 to 70 days after initial placement. Environment 3 in the Wallaceburg area, sample sites over known oil and gas pools, was identified during the early part of the reconnaissance program. The environment was included in the study with less than 30 days available before detectors had to be recovered due to winter conditions. Some of the sample locations in the Windsor and Wallaceburg areas required more frequent readings and replacement of electrets to avoid having electrets fully discharged due to the elevated radon concentrations characteristic of these study areas.

Field Procedures

The data collection procedure involved a division of labour. One crew member was assigned the task of detector retrieval, while the other recorded and operated the voltage reader, entered voltage, date, time and other pertinent information on the field record form for each station. This reduced the potential for measurement error and damage to sensitive equipment.

The detector retriever removed the soil plug in its plastic sheet, and lifted the detector package from the ground. Then the retaining cup was removed and the container held outside the vehicle pointed toward the recorder who carefully removed the envelope and detector in an effort to minimize the amount of soil and moisture that entered the vehicle. The recorder then wiped the Tyvek™ envelope with a paper towel to remove any moisture and soil, opened the folded envelope and removed the detector. The detector serial number marked on the container was read aloud by the retriever and repeated by the recorder, and cross checked with the number on the electret and the sample site and serial number which had been entered on the data sheet at the time of deployment.

The envelope was placed on the dashboard of the vehicle away from the voltage reader and the detector housing wiped with a paper towel to remove any dirt or moisture. The electret was unscrewed from the ion chamber and placed in the reading holder of the pre-zeroed voltage meter. The reader was activated and the voltage recorded. The detector was reassembled, put back into the Tyvek™ envelope which was folded again and inserted in the 750 mL container. The retriever replaced the retaining cup and taped it in place. The detector package was returned to the sampling site and the soil plug replaced. This procedure was repeated during each reading sequence except the

last, when the detectors were recovered. The plastic sheets were collected from each sampling site, the sample holes refilled with soil and the sod returned to its original location. Marking tapes were collected and disposed of.

DATA HANDLING AND INTERPRETATION

Calculation of Radon Concentrations

Field data were entered into a spreadsheet program set up with formulae for determination of exposure time, voltage drop, calculation of radon concentration, et cetera. Two calculations were done. One to show average radon concentration for each sample location from initial detector deployment to final retrieval, and the second to give station by station average radon concentration for each reading period. Gamma dose background corrections have been applied. Correction for additional gamma dose which appears to relate to ambient radon concentration was not applied for reasons discussed below. Calculation formula and tabulated raw and processed data for each sampling environment are presented in Appendix 1 Sample site locations and listed in Appendix 2.

Gamma Dose Corrections

The radon determination calculations also include adjustment for gamma dose influence on apparent radon concentrations, but no adjustment has been made for what appears to be an increase in gamma dose that correlates with increasing radon concentration. Although the information collected during the regional study suggests this factor should be taken into consideration, our database is not sufficiently strong to support a general correction formula.

Since gamma dose apparently increases with calculated radon concentration, the gamma determinations measured in each environment within the areas studied are not true measures of the gamma background since there is an "anomaly component" included in each measurement. Therefore, a simple average of the apparent gamma doses is an inappropriate estimator of the general gamma dose background. To remove bias related to ambient radon, gamma versus radon plots were prepared and the intersection of the regression line with the Y-axis was taken as "radon-free" gamma background. Corrections applied to calculated radon values used these gamma dose values. Plots and brief discussion of the problem appear in Appendix 3. In any case, the calculated correction necessary to

compensate for background gamma dose amounts to less than 5 pCi/L in most cases, and the radon-related gamma dose correction would appear to be in the order of 1 to 2%.

The ambient gamma dose at any sampling point will be influenced by several natural factors. Elevation above sea level controls the cosmic gamma dose; the greater the elevation the less atmosphere is available to attenuate incoming gamma rays, and consequently, the gamma dose rises. The potassium content of the rocks and soils is another contributor to the total gamma dose. The potassium isotope K^{40} is the source of gamma radiation, which rises sympathetically with any increase in total potassium. Clay-rich soils, for example, are likely to have a higher background gamma count than soils composed mostly of quartz sand. Soils that are formed from granitic or pegmatitic rocks will also tend to have elevated K^{40} gamma radiation dose. Often granitic rocks are also enriched in thorium, another natural source of gamma radiation.

The gamma dose is also influenced by the density of the soil and its moisture content. These factors, in combination, control the bulk density of the soil which, in turn, governs the distance gamma rays can travel before being attenuated. Therefore, any changes in bulk density (effectively, any change in the moisture content) will be reflected in the gamma dose for the sampling period.

Another factor to be taken into account when considering the ambient gamma dose in soils and rocks is the energy of the gamma rays contributing. The characteristic gamma ray of thorium, for example, has an energy of 2.62 MeV compared to 1.46 MeV for K^{40}, and 1.76 MeV from Bi^{214}, which is taken as the characteristic gamma energy for uranium. The high energy gamma rays will penetrate proportionally more mass than weaker ones. Therefore, if thorium minerals are present, the gamma dose sample is effectively larger than the K^{40} sample.

Gamma dose influences are significant in determination of low radon concentrations using electret technology. The errors introduced to results of soil gas surveys where the average radon concentrations are 100 pCi/L to 1000 pCi/L or more, are usually less than 5 to 10 pCi/L. This is less than 10% at 100 pCi/L and less than 1% at 1000 pCi/L.

In addition to these natural gamma sources, phosphate and potash fertilizers can be significant gamma contributors. Most natural phosphates also carry uranium, sometimes as much as 100 to 180 ppm U, and potash fertilizers contain K^{40}.

Thoron Influences

Thoron gas is produced in the radioactive decay of thorium, and has a half-life of 55.6 seconds. Thoron gas in a radon detector chamber also produces ions that are attracted to the electret and will reduce its surface voltage. If thoron is present in the soil gas in any quantity, apparent radon concentrations must be corrected for the thoron contribution. The radon configuration detectors are designed so that diffusion of thoron into the ion chamber is slow enough that less than 15% of the thoron present can enter. The thoron configuration allows for less restricted thoron access and the difference in voltage drop between the radon and thoron paired detectors can be converted into thoron concentration, and a correction made for its 15% contribution to the apparent radon concentration. The short half-life of thoron (Rn^{220}) governs its diffusion length in both air and water. Under most conditions, thoron is not expected to introduce a large error to radon measurements.

Voltage drop data for paired radon and thoron detectors collected in the geological environments in each of the study areas have been subjected to trend analysis. Results of calculations show a correlation coefficient of 0.996 and a slope of 1.015. These results suggest that, on average, there is little or no thoron contribution to the calculated apparent radon concentrations.

In the data collected during this study, correction for such contribution appears unnecessary, and none has been made. However, there are several individual voltage differences which suggest that there may be some small contribution from thoron locally.

The Paleozoic rocks of southern Ontario are not likely to contain elevated quantities of thorium, and the survey results are not unexpected. Many of the granites and some of the metamorphic rocks of the Grenville Province of the Canadian Shield are known to be thorium enriched. Radon studies on or near Grenville Province should make

allowances for a possible thoron contribution. The same caution applies to similar studies in other areas of Precambrian rock.

Since the thoron detectors showed voltage drops very close to those recorded by the accompanying radon detector, most of the radon/thoron combinations can be considered radon/radon pairs. These data have been used in quality control studies and are reported along with radon/radon pair data in Appendix 4.

DISCUSSION OF DATA OBTAINED

Gas Pulses

The 3 radon determinations at each sample site permitted comparison of results as a means of quality control. Most sites returned radon values which were within the limits of variation that could be expected for the local conditions.

Several locations, however, showed 1 individual determination that was notably higher than the others. This was first suspected to be due to some sort of instrumental or procedural error. Random occurrences of the phenomenon were observed in all study areas and in every sampling period. Doubling of detectors and comparison of results from adjacent sample points established for control purposes suggested no detector instability and no obvious instrumental errors. None of the more than 50 detector pairs deployed during the study recorded statistically significant differences in voltage drop. The possibility of some kind of gas pulse, perhaps driven by moisture "fronts" related to heavy rains, for example, must be considered. Confirmation could be provided if 1 of a series of readings at a sample site showed a large voltage drop recorded by both detectors of a pair. Full proof would require observation of the same sort of results for a significant number of detector pairs.

Soil Moisture

Particularly toward the end of the program, heavy rains resulted in flooding of some sample sites. The detector "packages" prevented damage to the ion chambers and electrets, but the radon concentration indicated by the device was much reduced from the concentrations indicated before the soils became saturated. Saturation, which begins at surface and progresses to depth, appears to severely limit the mobility of radon and effectively reduces the volume

of soil contributing to the soil gas radon concentration at the detector. This illustrates that sampling for soil gas radon will experience problems of understatement in permanently wet soils and during temporary flooding or saturation of other sites.

Influence of Soil Type

Radon concentration in glacial material (soil) was observed to vary with soil type as discussed earlier. Interpretation of radon values from station to station must take into consideration the effective porosity of the soil (surficial material) at each location. The measured radon concentration is the result of a combination of factors, including the radon generating capacity of the soil, the volume of soil gas available to receive the radon, and the permeability of the soil to atmospheric air. For example, if a certain volume of soil contains sufficient radium to produce 100 units of radon per time unit, the concentration of the gas in a soil that has 10% porosity will be 3 times the concentration possible in a soil having 30% air-filled voids. Since the permeability of most soils is directly related to porosity, the more open soils will experience many more atmospheric air changes per time unit than would be expected for less porous soil types. Radon dilution by atmospheric air is therefore greater in the porous soils, and the effect of atmospheric air dilution will extend to greater depth than in less porous materials.

Geochemical Controls on Uranium and Radium

The mobility of radium and uranium in the near-surface soils may vary from one location to another. The variation may be due to the difference in clay content. Clay-rich soils tend to have greater ability to immobilize metal ions than silica-rich soils, since clay minerals have many easily accessed binding sites. Many sandy soils have little ability to adsorb metals, in part due to the lack of suitable (clay) minerals. Since radon concentrations relate quite directly to the local radium content, any characteristic or process that tends to maintain a low radium content will be reflected in low radon measurements. Both leaching and accumulation processes are indicated by the appearance of the soil. Decaying organic material in soils tends to be a good metal-collecting medium. Humic soils tend to be more metal rich than sandy soils, and consequently, often carry more radon than simple mineral soils in the same area.

Works of Man

Anthropogenic influences are widespread in most of the areas sampled. Agriculture is the activity most likely to bias results. However, tile drainage systems were not difficult to avoid, and fertilizer destroyed data in only 1 instance. Disturbance due to the trenching for the installation of water and sewer lines prevented sampling in several sections of the Markham–Stouffville area. Elsewhere, construction activity which began after detector deployment made it necessary to relocate several packages. In general, it was possible to avoid most anthropogenic influences, and little data were lost due to human activity.

Reliability of Method

The reliability of the radon detection method was tested by deployment of pairs of detectors. In almost all cases the voltage drop and/or radon concentration indicated by each unit of the pairs were very nearly identical. Linear regression calculations produced correlation coefficients of 0.97 or better. These data are presented in Appendix 4.

Relationship of Soil Gas Radon to Oil and Natural Gas

Data from the Wallaceburg area leads to the conclusion that there is a strong relationship between presence of hydrocarbon accumulations in the Paleozoic bedrock and elevated radon concentrations is the overlying glacial material and soils. Such relationships have been reported as early as 1925 by Gubkin in the producing zone of the Maikopsy Oil Field, (then) U.S.S.R. (Gubkin and Bogoiavlenski 1928, [in] Sikka 1959, Sikka personal communication 1992). Sikka dealt with the application of gamma ray detection and spectrometry as applied to exploration for oil and natural gas in his thesis titled "A Radiometric Survey of Redwater Oilfield, Alberta, Canada". In his interpretation of gamma ray results from the Redwater Oilfield, Sikka suggested that corrections must be made for soil type and moisture content when interpreting gamma ray intensity data. Since surface gamma radiation surveys are indirect radon and radium measurements, similar corrections will be required for radon soil gas data interpretation. His observations and interpretations appear pertinent to the measured radon concentrations in the Wallaceburg area.

Table I in Sikka (1959) shows 14 of 42 oil fields in U.S.S.R., U.S.A., and Canada, for which data were available in 1959, to have strong gamma radiation anomalies at surface. The strongest gamma radiation responses appear to come from fields that are faulted. Others followed the same line of investigation in North America, with a series of papers published by Lundberg (1952), and Lundberg et. al. (1953) discussing Canadian application of radiation measurement to petroleum exploration.

Ghahremani (1984) observed both volatile hydrocarbon and coincident radon anomalies near surface in soils, often adjacent to present or former gas wells. These observations were in areas underlain by the Ohio Shale. He concluded that radon measurements could be used as a simple and rapid tool for petroleum exploration. He used Alpha Meter™, Alpha Card™, and C-39 plastic strip alpha track detectors in his work.

In the Wallaceburg area, the background level of radon is relatively elevated due to the presence of black shale clasts in the tills. The average radon concentration in soil gas in Environment 2 of the Wallaceburg area is about 260 pCi/L. However, results from all detectors over and adjacent to known oil and natural gas fields (designated Environment 3), including several detectors which were inundated during heavy rains, returned a mean radon concentration of approximately 450 pCi/L. The greatest radon concentration recorded was 1876.85 pCi/L during an exposure time of 6.97 days. This is about 4 times the mean for Environment 3 and about 7 times the mean for the till plain outside the oil and natural gas fields.

Radon soil gas anomalies within Environment 3 are clearly evident. Preliminary evidence suggests that hydrocarbon (and radon) "leakage" does not extend a great distance from the boundaries of the individual fields. There is some suggestion that highest radon values may be toward 1 boundary of some fields, particularly those controlled by a regional fault. There also appear to be well defined anomalies above petroleum-bearing reef structures as well as above fault-controlled traps.

Classifying Study Results

Results of the soil radon gas studies reported herein suggest that there are broad areas of southwestern Ontario in which elevated radon concentrations in soil gas can be expected.

In Canada there are no official standards for radon concentrations in soil gas as far as building codes are concerned. The Swedish Building Code (1980) sets out the following categories for radon concentrations in soil:

High Risk Areas >1350 pCi/L or >50 000 Bq/m^3

Normal Risk Areas 270 to 1350 pCi/L or <10 000 to 50 000 Bq/m^3

Low Risk Areas <270 pCi/L or 10 000 Bq/m^3

The Swedish standards have proven to be helpful guidelines, however, site-specific testing is required to establish actual indoor radon levels.

Data from Belleville–Prince Edward County and the Markham–Stouffville areas, show generally low soil gas radon concentrations. However, local highs are evident, particularly over subcrop of the Collingwood Member of the Lindsay Formation, and in the area of faults in the bedrock.

The Windsor area returned averages higher than Belleville and Markham–Stouffville, but somewhat lower than Environments 2 and 3 of the Wallaceburg area.

Environment 1 in the Wallaceburg study area illustrates that generally lower radon concentration can occur in response to certain geological conditions, even within areas where the radon background is elevated.

The data suggest that generally radon risk, judged by the Swedish standards, is low to normal in most of the areas studied.

In the Wallaceburg area radon in soil gas concentrations give means from 180 pci/L to 453.7 pCi/L and range to 1876 pCi/L. These values equal or exceed the values commonly found at Elliot Lake, Ontario where most observations were in the 200 to 800 pCi/L range (Scott 1978).

The data generated during study of the Wallaceburg area show a close correlation between the known limits of oil and natural gas fields and elevated radon concentrations. The conditions characteristic of Wallaceburg Environment 3 can be expected throughout much of southwestern Ontario, particularly in those areas where oil and natural gas are produced. Similar situations must be expected to occur locally and sporadically in other areas of the province underlain by Paleozoic rocks.

The apparent relationship between radon concentration and volatile hydrocarbons is important in assessing the potential for local radon anomalies. The data generated during this study is supported by observations dating from about 1925, and recent studies over black shales in the American states bordering southern Ontario. This correlation helps explain the source of many local anomalous radon concentrations and provides a logical transportation mechanism for moving radon parents long distances to produce radon anomalies remote from the original uranium and radium source.

Radon in soil gas data may also prove useful in defining natural gas leakage related to abandoned and lost oil and gas wells. Leakage from natural oil and gas traps can also be detected. Such "methane" leaks may be of concern particularly in petroleum producing areas of the province.

DISCUSSION OF STUDIES AND RESULTS

WESTERN ESSEX COUNTY, WINDSOR AREA

Western Essex County – Windsor Area 480km^2: 2 environments

Environment 1:

Clay till above dolostones and limestones. Radon Mean = 230.8 pCi/L; Range = 106.5 pCi/L to 435.9 pCi/L.

Environment 2:

Clay till or glaciolacustrine clays above buried sand. Radon Mean = 217.1 pCi/L; Range = 73.6 pCi/L to 658.2 pCi/L.

Bedrock Geology

The study area is underlain by limestones and dolostones of the Middle Devonian Hamilton Group, the Dundee Formation, and the Detroit River Group. Natural gamma logs from brine wells in the Windsor area show low natural radioactivity, suggesting a low uranium and thorium content for these chemical sediments.

The total thickness of the Paleozoic section in the east part of the area is less than 1000 m. Basement is made up of Proterozoic metamorphic and intrusive rocks of the Grenville Province. The Paleozoic section thickens to the west into the Michigan Basin and the subcrop rocks become progressively younger.

Overburden cover is generally thick and little outcrop is available for study of structural patterns. Remote sensing studies suggest that there is a fracture/faulting pattern which trends in a northeasterly direction.

Surficial Geology

Moderate to thick sequences (10 m to 100 m+) of clay-silt till and glaciolacustrine sediments overlie the bedrock. Two surficial environments were identified. Environment 1 includes the till plain, while Environment 2 is restricted to those areas of known buried and surface sand and gravel deposits.

The soils of the till plain (Environment 1) show 2 cm to 6 cm of organic material lying upon grey-brown to light brown clay. The colour of the clay often lightens with depth, sometimes showing a mottled appearance beginning 15 cm to 20 cm below surface. The clays tend to be silty in some areas. The underlying till varies in composition from heavy clay to silty, moderately sandy, material. The till is often dense and relatively impermeable. The depth of active soil forming process varies from 20 cm to 45 cm.

Environment 2 soils, those developed over sand and gravel deposits are a silty to sandy loam, medium to light brown in colour. In forested areas the upper portion of the soils are often grey to black because of organic content. Occasionally the soils are clay-rich and similar to those of Environment 1, reflecting the nature of the till from which they were derived. The till in this environment often incorporate pebbles and sand from the buried coarse clastic deposits. The soils occasionally contain pebbles and stones, but generally these do not appear until 30 cm to 40 cm depth.

Hydrogeology

Topographic relief is generally low, 9 to 15 m (Vagners et al. 1973). Surface drainage is slow and the area is ditched extensively. Tile drainage of the fields is necessary. The water table is relatively shallow except in the buried sand deposits. Recharge of the esker sands and gravels is by rapid groundwater flow through fractured till (Sklash and Ibrahim 1991). The eskers and related sand and gravels are important, although rather restricted, aquifers in the area. Since more rapid groundwater flow was expected in these areas, they were designated a separate environment for the purposes of radon sampling.

Anthropogenic Features

The area has been cleared of almost all large stands of trees, and has been cultivated continuously for over 100 years. The top portion of the soil profile has been overturned repeatedly, so that the original horizons are not identifiable except where redeveloped along uncultivated margins of roads or where preserved in small wooded areas. Depth of cultivation is usually 30 to 35 cm. Some transportation of soil by wind and water is noted; such deposits being particularly notable on vegetated verges of highways and along ditches. This has resulted in a thickening of the upper soil horizon by as much as 10 cm to 20 cm.

The fields are often tile drained due to the relatively impermeable nature of the clay-rich tills, and buried service lines are common. Both were reasonably easily identified and avoided. Fertilizer is applied regularly on most areas, but in only one case was there evidence of interference with the radon sampling.

Radon in Soil Gas

Raw data and calculated radon concentrations for each sampling location are given in Appendix 1-1.

The radon values obtained over the sands and gravel deposits show a wider range than those from the till plain proper. This environment was investigated since enhanced groundwater flow in the more porous sediments may serve as a transportation mechanism for radium and radon, and the porous nature of the coarse clastic sediments can permit a greater radon flux than is likely in the heavy clay tills. The data show the measured radon concentrations are, on average, only slightly less over the sand and gravel deposits than in the till plain. Radon dilution by soil gas is a function of soil porosity. Sand and gravels may have as much as 3 times greater porosity than heavy clay soils. Radon concentrations in Environment 2 which are only slightly less than in Environment 1. This suggest preferential movement and precipitation of radium in Environment 2.

The radon concentrations found in sample sites within the clay till plain are similar to those from the black shale till of the Wallaceburg area. Both are about 125 pCi/L higher than the averages for the Markham–Stouffville and Belleville areas. Average radon values are in the low risk category using the Swedish criteria, and values in some local areas fall in the mid to upper part of the normal risk range.

It has been noted that the water table is relatively shallow in most of the study area. This would normally tend to depress radon values in soil gas, as discussed earlier. This suggests either a higher uranium content of the till or volatiles hydrocarbon transport of uranium and radium into the soils, or a combination of both. Volatile hydrocarbons appear capable of passing through ground water, and carrying adsorbed heavy metals through to near surface soils where, perhaps due to reduced confining pressure, uranium and radium are deposited. Since some individual sample points returned values notably higher than results from adjacent sites, local volatile hydrocarbon transport of parent elements is indicated.

Geological Inferences from Radon Concentration Data

Sample density in the study area is adequate for purposes of reconnaissance, but insufficient for detailed interpretation. The data do, however, indicate a general trend of high values from the southwest toward the northeast parallel to what is believed to be the orientation of faults in the bedrock.

Although there is not a great amount of petroleum production within the study area, the underlying formations are Paleozoic sediments in which minor accumulations of natural gas are common. It is possible that volatile hydrocarbons are being channelled along faults to surface and that these hydrocarbons are transporting small quantities of uranium and radium into the soils of the region. Such channelled volatile transport may be responsible for the apparent alignment of higher values.

The relationship of radon to faults in this area could be defined by several lines of samples across suspected structures. Sample spacing should be less than 50 m and extend to either side of the interpreted axis 200 m to 300 m.

KENT AND LAMBTON COUNTIES, WALLACEBURG AREA

Kent to Southern Lambton Counties – Wallaceburg Area 680 km^2 3 environments

Environment 1:

Glaciolacustrine clays, silts, and sands overlying black shale till above Kettle Point Formation black shales and minor Hamilton Group carbonates. Radon Mean = 180.4 pCi/L; Range = 47.5 pCi/L to 689.4 pCi/L.

Environment 2:

Black shale till overlying Kettle Point Formation black shales and minor Hamilton Group carbonates.

Radon Mean = 261.4 pCi/L; Range = 84.86 pCi/L to 1057.9 pCi/L.

Environment 3:

Glaciolacustrine sediments on black shale till, black shale till, et cetera, within limits of known oil and natural gas fields. Radon Mean = 453.7 pCi/L; Range = 26.1 pCi/L to 1539.0 pCi/L.

Bedrock Geology

The Wallaceburg study area is underlain by the Upper Devonian Kettle Point Formation black shales, and less extensively, by upper Middle Devonian limestones and dolostones of the Hamilton Group (OGS 1991). The Kettle Point Formation black shales outcrop on the shore of Lake Huron at Kettle Point where they derive their name from large calcareous concretions known locally as "kettles" (Russell 1985).

The Kettle Point Formation black shales in the study area lie on the Algonquin Arch between the Michigan Basin and the Appalachian Basin. Thickness is up to about 70 m in this locality. The shales are organic carbon-rich and bituminous. The upper 20 m has a potential oil yield of approximately 38 L per tonne. Total organic carbon content ranges from nearly zero to slightly more than 15% (Delitala 1984). Natural gamma ray logs of selected stratigraphic holes through the shales suggest that uranium concentration and total organic carbon content correlate closely. Armstrong (1986) reports an average uranium content for the Kettle Point Formation black shales of 34.2 ppm with a maximum of 71 ppm and a minimum of 10 ppm for 45 samples from drill hole OGS-82-1. Delitala (1984) reported an average of 21.3 ppm U for samples from drill holes KP-14 and KP-16. Average uranium concentration for samples from KP-14, KP-16, and KP-24 is 14.6 ppm with a maximum of 36.8 ppm U.

The Kettle Point Formation black shales extend into Ohio south of Lake Erie where they are known as the Ohio Shales. Harrell and Kumar (1989) indicate the Ohio Shales carry 10 ppm to 40 ppm U, and show uranium in soils in central and western Ohio to range to >4 ppm, with the highest values confined to areas directly underlain by the Ohio Shale (Harrell et al. in press).

The Paleozoic section in the Wallaceburg area is generally less than 1000 m thick and rests on Grenville Province, late Proterozoic metamorphic and igneous rocks. The Paleozoic sediments range in age from Ordovician, lying unconformably on the Grenville basement to Upper Devonian, represented by the Kettle Point Formation.

Oil and natural gas are produced from Silurian and Devonian rocks in the area, from both reefs and structural traps. East oriented faults cut the bedrock in the study area and form structures that locally trap economic

quantities of oil and natural gas. A strong association between elevated concentrations of radon in soil gas and the limits of known oil and natural gas occurrences is indicated by the data (Appendix 1-2).

Surficial Geology

The relief in the Wallaceburg area is low, but marginally greater than observed in Essex County. Overburden thickness ranges from about 15 m to over 50 m. Over the Dawn Township oil fields measured overburden thicknesses are in the order of 20 m.

Clayey tills that are derived, in part, from the underlying black shales of the Kettle Point Formation extend through the survey area (Environment 2). The clay tills are overlain by discontinuous to extensive patches of glaciolacustrine silts and sands (Environment 1).

The surficial materials are similar to those in the Windsor area, clay-silt tills overlain by varying thicknesses of glaciolacustrine clays and silts. However, clasts of Kettle Point Formation black shale make up more than 5% of the clay-silt till (Fitzgerald 1979). If the average uranium content of the shale clasts is 20 ppm, this would imply 1 ppm U in the soils. Grasty (personal communication 1992) calculates approximately 800 pCi/L of radon per part per million U in soil with 20% porosity. The observed mean radon concentration was approximately 260 pCi/L in the black shale till, with local average values for the entire sampling period reaching approximately 1000 pCi/L.

Superimposed on both Environment 1 and Environment 2 is the influence of underlying oil and natural gas deposits; these areas comprise Environment 3. There is no obvious visual evidence of this influence on the ground surface, although there may be indications that can be detected by remote sensing techniques especially during the growing season. There is some suggestion that corn grows more vigorously in areas where "methane" levels in the soil are enhanced.

Radon soil gas concentrations in Environment 3 are clearly elevated. The limits of Environment 3 are arbitrarily set coincident with the surface trace of the known limits of oil and natural gas fields.

Soils throughout Environment 1 have developed from glaciolacustrine silts and clays. The organic layer ranges from 2 cm to 5 cm and averages about 3.5 cm. The upper portion of the soil is usually light to medium brown lying on a mottled grey and brown clay that begins about 20 cm below surface. Occasionally the soils are light to medium grey and, rarely, almost black. Below 30 cm the soil grades into unweathered silt-clay that is light to medium brown, sometimes mottled.

The soils developed on the black shale till are usually grey to dark grey or black. The humic layer is 3 cm to 5 cm thick underlain by 20 cm to 30 cm of developed soil which grades into relatively unweathered till at approximately 40 cm. Occasionally black shale clasts can be identified in the lower part of the soil section. In several locations a grey-brown stony till is exposed below 35 cm.

Soil profiles in Environment 3 are brown to tan with some yellow-brown coloration extending from the bottom of the 2 cm to 5 cm thick humic layer to about 40 cm below surface. The soils are sometimes dark brown, particularly where black shale clasts, in some stage of decomposition, can be identified. Light brown to yellow brown colorations in the deeper part of many of the soil profiles studied in areas above oil and natural gas fields may be indicative of influences relating to presence of volatile hydrocarbons. The light brown to yellowish mottling would suggest oxidation of reduced iron. If hydrocarbons were present in quantity in the soils, it would be reasonable to expect more reducing conditions as opposed to an enhanced oxidizing environment. The role of soil microorganisms that are encouraged by volatile hydrocarbons, perhaps a variety of ferrobacteria, might be considered.

Hydrogeology

Topographic relief through the study area is gentle, although somewhat more pronounced than in Essex County. Surface drainage is naturally sluggish. Temporary surface flooding is common. Ditching and tile drainage systems are necessary for efficient large-scale cultivation.

The area is drained by the Sydenham and North Sydenham rivers and their tributaries. Flow is generally southward in the tributaries of the Sydenham River, then west to the St. Clair River. The North Sydenham River

flows generally east to west in the northern part of the study area, then south to Wallaceburg and, eventually, to the St. Clair River.

The natural water table is shallow, usually within several meters of the surface. Groundwater movement is generally slow due to the relatively impermeable black shale till and low hydraulic head related to the gentle relief. No extensive zones of enhanced groundwater flow were identified.

Anthropogenic Features

Agriculture is less intensive than in the Windsor study area but farming is extensive and much of the area is ditched and tile drained. Phosphate and potash fertilizers are widely used but their influences on survey results were minimized by selection of sampling points in non-cultivated locations.

The northern part of the area has a history of oil and natural gas production from Silurian and Devonian age sediments. Both production and storage fields are present. Collection and transmission pipe lines extend through the much of the northern half of the area. Slight thickening of the upper soil profile due to collection of wind-blown soil was observed in some headlands and grassed verges of roadways.

Buried telephone lines often interfered with initially chosen sampling locations. Other underground service lines were encountered occasionally.

The towns of Wallaceburg and Dresden lie just south of the area sampled, and presented no technical or logistics problems.

Radon in Soil Gas

Raw data and calculated radon concentrations for each sampling location are given in Appendix 1-2.

Measurements of radon soil gas concentration in the Wallaceburg area indicate that general background levels in the black shale till are the highest of all the areas investigated during the 1991 program. This is interpreted to relate to the presence of Kettle Point Formation black shale clasts in the tills, as discussed earlier.

Results from glaciolacustrine silts and clays overlying the black shale till show the same trend toward lower radon levels as is observed in other study areas. This is interpreted to reflect both a lower uranium content in the glaciolacustrine sediment veneer and also the slightly greater porosity of these materials compared to the heavy clay tills.

Both the tills and glaciolacustrine deposits show local, superimposed influence caused by the underlying deposits of oil and natural gas. The highest concentrations of radon in soil gas were obtained in areas of oil and natural gas production or storage. This indicates a strong relationship between hydrocarbons in the soil and elevated uranium and radium content. This has been discussed in more detail in a previous section.

Geological Inferences from Radon Concentration Data

Two geological implications become evident from study of the radon concentration data collected in the Wallaceburg area.

1. There is a strong correlation between radon concentration in soils and oil and natural gas in the underlying Paleozoic sediments.
2. Elevated radon concentrations in soils can be expected throughout southwestern Ontario where oil and natural gas are being produced, or have been produced in the past.

The correlation between radon levels and the limits of oil and natural gas deposits suggests radon surveys may be useful for several purposes.

1. Exploration for oil and natural gas;

2. Location of "leaking" abandoned and "lost" oil and gas wells.

The apparent ability of volatile hydrocarbons to carry uranium and radium to surface from deeply buried hydrocarbon-related sources, even through groundwater saturated rocks and unconsolidated sediments, is of interest as a plausible explanation for localized radon anomalies in environments where low radon levels are expected on the basis of local surficial and subcrop geological conditions.

Many faults in Paleozoic rocks of southern Ontario would appear to be traceable by radon surveying at surface, since they are likely to act as channel-ways for volatile hydrocarbons. Radon surveys could prove useful in studies of geological structures hidden by overburden, neo-tectonic investigations and in tracing faults which might be important in localizing oil and gas deposits.

Experience in Precambrian terrain has shown that many major and some minor faults can be followed beneath overburden cover by radon surveying. Primordial "methanes" may be acting as uranium and radium transportation media and creating easily and inexpensively traceable "signatures" useful in structural, geochemical, and environmental studies.

MARKHAM–STOUFFVILLE AREA

York County – Markham–Stouffville–Vaughan Area 290 km^2: 4 environments

Environment 1:

Sand and gravel veneer on Halton Till overlying Collingwood Member black shales. Radon Mean = 161.5 pCi/L; Range = 59.4 pCi/L to 370.3 pCi/L.

Environment 2:

Halton Till overlying Collingwood Member black shales. Radon Mean = 149.3 pCi/L; Range = 32.3 pCi/L to 362.6 pCi/L.

Environment 3:

Sand and gravel veneer on Halton Till overlying Blue Mountain Formation shales and Georgian Bay Formation limestones and dolostones. Radon Mean = 143.9 pCi/L; Range = 60.0 pCi/L to 353.3 pCi/L.

Environment 4:

Halton Till overlying Blue Mountain Formation shales and Georgian Bay Formation limestones and dolostones. Radon Mean = 143.4 pCi/L; Range = 61.9 pCi/L to 276.8 pCi/L.

Bedrock Geology

The bedrock in the area consists of Upper Ordovician limestones and shales of the Lindsay, Blue Mountain, and Georgian Bay formations. The Collingwood Member of the Lindsay Formation, which lies at the top of the Lindsay just below the base of the Georgian Bay Formation, is a bituminous, calcareous shale unit that contains above average concentrations of heavy metals including uranium.

Middle Ordovician limestones underlie the Upper Devonian rocks and subcrop in parts of eastern King Township, but are not known to be present in the areas studied.

The nearest oil and gas field is in Halton Region to the west of the study area. However, natural gas is commonly found in small quantities in both the overburden and in the Upper Ordovician shales and limestones. The source of the natural gas is usually taken to be the Collingwood Member, since this is the best developed "oil shale" in the area. The Collingwood Member extends from the shore of Lake Ontario northwest to Manitoulin Island. Brown (1985) states that the Collingwood Member is identified in subcrop beneath the northern part of Lake Huron, the western part of Nottawasaga Bay, and the west-central part of Lake Ontario. Thickness of the shale is about 12 m on St. Joseph's Island, just east of Sault Ste. Marie, thinning to less than one meter at Bolton, pinching out to only 10 cm at Milton, and thickening to several meters at Pickering (Churcher, 1984).

Although Brown (1985) studied the major oxides of the Collingwood Member, and 15 selected trace elements, uranium content was not reported. Other trace elements were found to be present in above crustal abundance levels and most trace element concentrations increased with total organic carbon content.

Total organic carbon determinations for the Collingwood Member range from 0.5% to 11.2% (Churcher 1984). Oil yields for samples from the Collingwood Member range from 0 to 58.8 L/tonne (Barker 1985).

The overlying Blue Mountain Formation shales are distinguished from the Collingwood Member by a distinctly grey colour, and a more homogeneous appearance than the oil shale unit. The Collingwood Member is a petroliferous black calcareous shale that contains cubes of pyrite, coarse calcite grains, and fossil fragments (Churcher 1985).

The underlying Lindsay Formation limestones are fossiliferous buff to grey-white rock with crinoids and shell fragments.

There are no notable structural features known in the study area.

Surficial Geology

The Markham–Stouffville area is covered by a complex sequence of lower proglacial to glaciolacustrine sands and silts overlain by an older till which is recognized in drill holes and indicated by geophysical surveys.

The older till is overlain by relatively impermeable silt-clays of variable thickness and texture that may contain infrequent and discontinuous gravel lenses. This material is capped by the regionally extensive Halton Till (Barlow and Lockhard 1989, Sharpe 1980, Duckworth 1979).

Overlying the Halton Till, local surficial units such as sands and gravels become thin and less extensive away from the Oak Ridges Kame Moraine, but still comprise an aggregate resource for the region (OGS 1984a,

1984b). To the south of the area, relatively impermeable units of deep and shallow water facies of marginal or proglacial lake sediments are present (Peel Ponds of Sharpe 1979).

The Halton Till in the Vaughan area has a more pronounced topography with local relief of 15 m to 30 m, often related to modern streams. The till is composed of fine silts and clays with occasional cobbles and small stones. Some sandy phases and gravel layers were encountered.

The relatively flat plain formed by the till and glaciolacustrine sediments is cut by modern streams in which some Recent sediments have been deposited (Westgate 1978, 1979; Sharpe 1979). Depth of overburden ranges from approximately 10 m to over 100 m.

Low areas with poor drainage have developed deep organic clay soils, while higher, better-drained locations have produced medium to light sandy loams. Wooded areas also show an organic soil 15 cm to 30 cm deep, usually resting on a mottled medium to light brown layer developed on the parent material.

Soil development in the Markham–Stouffville study area is quite variable, since both parent material and drainage can change abruptly. Medium to dark brown loam predominates in Environments 1 and 2, with dark grey to black loam developed on medium to heavy clay soils in low damp areas. Environment 3 also has medium brown-grey loam developed on a light brown compact silty till which often contains pebbles of local limestone and far transported igneous and metamorphic (Grenville) rocks. In Vaughan Township, the soils are usually a dark grey-brown loam developed on a light brown to buff silty till, with occasional areas underlain by grey-brown clay silt till.

Hydrogeology

The water table varies from being at surface in much of the area parallel to the southern limit of the Oak Ridges Kame Moraine north and west of Stouffville to 20 m to 50 m below surface in parts of Vaughan Township and along the Oak Ridges Moraine.

Surface drainage is generally to the south from the high ground of the Oak Ridges Moraine, eventually arriving at Lake Ontario. On the moraine there are no major streams and most of the smaller water ways tend to be intermittent. South of the Oak Ridges Moraine natural ponds and dugouts abound.

Water well records show a complex ground water pattern and suggest discontinuous aquifers are common in much of the area.

There are few agricultural drainage ditches and only the occasional field is tile drained.

Anthropogenic Features

Much of the southern part of the Markham–Stouffville study area is urban or undergoing urban development; a portion of this development is on former farmlands. Some of the area is still wooded. Golf courses occupy both former agricultural lands and wooded areas along streams.

Agricultural activities include dairy farming; raising corn and grains; some limited market gardening; and, a few greenhouse operations. The soil is often light and wind erosion of fields has lowered the surface of many as much as 15 cm to 40 cm below their original levels. Much of the eroded material has collected in headlands, along fence lines and shrub and grass-covered verges of local roads. The lower strands of some Page wire fences were found to lie 10 cm to 20 cm below the present sod. This local topographic feature restricted sample location in some cases because placing a detector on a hummock between the highway ditch and the eroded field is not advisable. Such a location allows for soil gas diffusion and mixing with atmospheric air laterally as well as vertically, and radon determinations tend to underestimate the true local radon concentration.

Many fields have shrubs and small trees along the fence lines and roadways. These areas are little disturbed by recent farming and provided convenient sample sites.

Major construction projects precluded sampling in some of the areas chosen originally. The most recent topographic maps failed to show much of this activity, especially to the north of the Town of Richmond Hill. Consequently sampling of the Halton Till where it overlies Blue Mountain Formation and Georgian Bay Formation rocks in Vaughan Township was substituted for work in the originally planned area.

Radon in Soil Gas

Raw data and calculated radon values are shown in Appendix 1-3.

Direct influence of bedrock radon sources on near-surface radon concentrations are limited to areas of shallow cover. Elsewhere, radon concentration appears to reflect the composition of the till and the position of the water table. "Spot highs" may relate to channelled movement of volatile hydrocarbons from Collingwood Member rocks at depth.

The contribution of Collingwood Formation bituminous shale to glacial tills in the study area is not usually great, due to the restricted thickness of the Formation.

Areas where the water table is close to surface generally returned radon values that were anomalously low.

Light sandy or gravel soils also tend to give radon values that are low, due to porosity and permeability features discussed previously.

Geological Inferences from Radon Concentration Data

The radon concentrations indicated by survey results suggest a relatively low uranium content of the soils, tills and glaciolacustrine sediments in the Markham–Stouffville area. Most of the radon in the soil gas appears to be derived directly from the soil and parent material in the immediate vicinity of the detectors.

The few values greater than 300 pCi/L may be related to channelled movement of hydrocarbon volatiles rising from the Collingwood Member bituminous shales that subcrop in the eastern part of the area and underlie younger Ordovician shales and limestones in the west. There are no obvious alignments of high values such as would suggest traceable structural features in bedrock, but sample density may be inadequate to permit this sort of interpretation.

There is some suggestion of clustering of higher values that may relate to a local thickening of the Collingwood Member, or an increase in its volatile hydrocarbon content.

BELLEVILLE–PRINCE EDWARD COUNTY

Prince Edward County – Belleville Area 280 km^2 2 environments

Environment 1:

Shallow till above fault zones in Middle Ordovician limestones and dolostones of the Simcoe Group and the Shadow Lake Formation. Radon Mean = 144.4 pCi/L; Range = 16.5 pCi/L to 531.6 pCi/L.

Environment 2:

Shallow till over unfaulted Middle Ordovician limestones and dolostones of the Simcoe Group and the Shadow Lake Formation. Radon Mean = 111.8 pCi/L; Range = 24.1 pCi/L to 338.2 pCi/L.

Bedrock Geology

Prince Edward County is underlain by approximately 210 m of Middle Ordovician limestones and dolostones of the Simcoe Group and the Shadow Lake Formation (Carson 1981, OGS 1991). In the majority of the study area, outcropping bedrock is the lower member of the Lindsay Formation (Carson 1980). East of the Picton Bay–East Lake fault the upper member of the Lindsay Formation outcrops. The upper member of the Lindsay Formation is estimated to be about 60 m thick, and the lower member approximately 30 m. Near Picton, east of the fault exposures Verulam Formation thinly-bedded limestones and shales are present.

Two zones of faulting cut the flat-lying limestones in the Belleville–Prince Edward County area. The strongest zone is the Salmon River Fault Zone which meets the Bay of Quinte about 4 km east of Belleville. This zone lies just outside the area sampled. Within the study area lies the second strongest fault zone. It extends from Picton Bay on the Bay of Quinte south to the head of East Lake, then to the east side of South Harbour (Carson 1980; McFall et al. 1988, 1989). This fault is interpreted to branch at the east end of East Lake, the branch following the south shore of the lake to Salmon Point. Displacement on this normal fault is reported by Carson to be in the order of 30 m, west side down.

Surficial Geology

Overburden cover is generally thin in Prince Edward County with bedrock knobs and areas of flat outcrop common. The till and drumlins have a relatively uniform composition, and were being deposited by the Lake Ontario ice lobe. The drumlins are small, low-amplitude features (Leyland 1979).

Surficial deposits in the Prince Edward County area are generally thin, 1 m to 3 m, with occasional low amplitude drumlins (Environment 2), and generally thicker, 3 m to 6 m, till deposits in topographical lows associated with faulting of the bedrock (Environment 1).

Soils in Environment 1 show 2 cm to 8 cm of organic material overlain by sandy to stony silty material derived from the underlying till. The soil below the organic layer was usually found to be medium to dark brown in well drained areas with dark brown to black colour in damp, less well drained locations.

The soils throughout Environment 2 often tend to be stony and frequently less than 35 cm thick before bedrock was encountered. Soils on the small drumlins were not found to be much deeper, the till being very dense. The organic layer is best developed in wooded areas, reaching thicknesses as much as 10 cm, but almost absent in some of the actively or recently cultivated lands. The upper part of the soil section is usually brown to dark brown, and varies in texture from sandy loam to, occasionally, clay-silt.

Hydrogeology

There are 2 components important to the local hydrogeology. A shallow perched water table which forms local ponds having seasonal recharge, and a second deep aquifer well down in the jointed limestone, at approximately the level of Lake Ontario. Occasionally the water from this lower, "bedrock" level is salty. This is interpreted to reflect very long groundwater residence time and slow movement, which would appear to be reasonable, considering limited topographic relief in the area and the low hydraulic head available to drive a discharge system.

Anthropogenic Features

Intensive agricultural activity since about 1850 has disrupted the natural soil profile and permitted both wind and water erosion. Some areas that originally had relatively shallow soil cover now show broad exposures of flat limestone bedrock. Removal of stones from fields and dumping along fence rows and edges of fields created artificial "soils" which were avoided during sampling.

The area is not heavily populated and the activities of humans were not often the source of sampling problems.

Radon in Soil Gas

Raw data and results of sampling are given in Appendix 1-4.

Radon soil gas levels were found to be generally low in the areas of shallow overburden. This is interpreted to reflect the generally porous nature of the soils, their obvious permeable nature, and the low uranium and radium content expected of limestones.

The areas tested along the fault zone, extending from Picton Bay south to Lake Ontario; showed 8 individual radon concentration values in excess of 400 pCi/L. There was only 1 value from Environment 2 greater than 350 pCi/L.

Geological Inferences from Radon Concentration Data

The elevated radon values in the vicinity of the Picton Bay–East Lake fault zone suggest movement of radon parents from depth. There have been some limited attempts at natural gas production from the Paleozoic rocks of the area. Small quantities of hydrocarbons can be expected throughout the section in southern Ontario. There is also a possibility that "primordial methanes" may be escaping from the underlying Grenville rocks.

Groundwater circulation in the fractured rocks has also been proposed as a mechanism for bringing uranium and radium close enough to surface to permit development of elevated radon concentrations in the soil.

REGIONAL AND SITE RADON SURVEY PROTOCOLS

General

Radon concentration in soil gas is influenced by the following:

1. The concentration of Ra^{226} in geologic materials usually within 3 to 5 m of the sampling point; 2. The porosity of the soil; and 3. The permeability of the soil.

The quantity of radium in geologic materials is related to the composition of those materials and the geological and geochemical history of the parent material. Anthropogenic sources may contribute uranium and radium. Application of phosphate fertilizers is an example. Industrial processes have contributed radium to soils in several local areas in Ontario.

The mobility of radon in soil gas is limited by its relatively short half-life. It is likely to move less than 3 m by diffusion alone. Radon travel distance by advection is restricted, in almost all cases, to less than 5 m by soil permeability.

Porosity and permeability are often influenced by moisture content and can be variable from time to time.

Porosity controls the total volume of soil gas into which radon can be evolved from its parent element, radium. This can be considered primary dilution.

Permeability controls the rate at which soil gas and atmospheric air mix. This may be considered secondary dilution. The dilution rate is, in turn, influenced by several factors including: changes in barometric pressure; wind speed and direction; and temperature differences.

Regional Surveys

Geological Conditions and Defining Sampling Environments

Regional surveys must be done with full recognition and understanding of the surficial geology. Changes in the nature of overburden and the soils developed thereon will be reflected by the radon concentrations observed. Bedrock geology must be considered from the perspective of direct contribution of radon gas and the contribution of the bedrock clasts in the overburden.

Survey areas must be divided into "environments" based on both surficial and bedrock conditions. A light sandy till, for example, overlying a subcropping unit of black shales, would constitute one sampling environment. An area in which the same till is underlain by a massive limestone must be considered a second sampling environment.

Sample Density

When the sampling environments have been established, the frequency of sample points must be chosen. There should be at least 30 sampling points in each environment to provide a statistically reliable database. Since there will likely be data losses due to the hostile environment in which detectors are placed and to other anthropogenic influences, it is advisable to plan for approximately 40 sampling sites per environment.

Consistent geological conditions over a large area will permit wide spacing of sample sites, perhaps as much as 1 per 20 km^2. In areas of more complicated surficial and bedrock geology, sample density may be as high as 1 to 5 per km^2.

Radon Measuring Equipment

There are many radon measuring devices on the market today. Radon detection methods which employ "grab sample" techniques suffer from the small sample size possible, and inability to obtain time integrated results at a competitive cost. Portable electronic alpha event counters have been used effectively as reconnaissance tools, but tend to suffer from calibration problems and sensitivity drift. They are particularly prone to statistical problems if the expected number of decay events in the scintillation chamber falls below 10 per sampling period.

Alpha track systems suffer from variation in sensitivity from 1 part of a C-39 sheet to another, and must be developed and tracks counted in a laboratory. This results in delays in obtaining results that range usually average several weeks.

The E-PERM™ system used in this study gave excellent results and was easy to adapt for deployment in soils. This system was chosen since it has proven to give the most reliable results of any field-deployable system tested by the US EPA under controlled conditions (Lyon et al. 1990). In most cases the data collected using the E-PERM™ system showed a standard deviation of less than 10% from the known concentration, while C-39 plastic alpha tract systems returned results having a standard deviation of 25% or more.

The E-PERM™ system equipment and its adaptation for use in soil gas radon sampling has been described fully earlier. The following discussions assume use of this system.

Detector Packages

The detector must be protected from water and dirt. Therefore, it should be placed in an inverted container, suitably wrapped to keep it clean and supported so that the detector is held firmly against the closed end. The

inverted container, for example, a 750 mL plastic ice cream tub, acts as a diving bell to prevent water entering the detector, so it must not be perforated during handling. The open end can be pressed into the soil at the bottom of the sampling hole and held in place by the weight of soil back-filled upon it.

There are several sizes of E-PERM™ ion chambers. Soil gas work requires a relatively long period exposures to collect reliable radon concentration estimators. A small 50 mL chamber is most suited to the measurement period and is a convenient size for deployment in the ground. The small ion chamber fitted with a "long term" electret serves as the radon detector.

Gamma radiation makes a positive contribution to the apparent radon concentration indicated by this system. Correction for this gamma contribution requires measurement of the ambient gamma radiation in the environment sampled. This is accomplished by placing an ion chamber fitted with a short term electret in a radon proof container (a heat-sealed anti-static plastic pouch) in the detector package. This configuration permits measurement of the ambient gamma dose. When the gamma dose is known, a correction can be made during the radon concentration calculation.

The spontaneous radioactive decay of thoron gas in an ion chamber produces the same effect as a radon disintegration. In some environments, such as parts of the Grenville Province, thorium minerals are relatively common and thoron gas can bias radon determinations. If this influence is likely, placement of thoron configuration detectors is advisable. Appropriate adjustments must be made during the calculation of radon concentrations.

If geological conditions require, some of the detector packages could contain a pair of radon configuration detectors, a gamma detector, and a thoron configuration detector.

Detector Placement

Each detector package should be placed, as much as is possible, at a depth and in topographic conditions similar to all other detectors in an environment. Any differences in conditions should be noted carefully and considered during interpretation of results.

During regional reconnaissance surveys detectors should be placed at the bottom of the active soil horizon. This is usually 25 cm to 40 cm below surface in most of the soils in southern Ontario. The sample holes should be back-filled with soil from the excavation, otherwise there will be variable circulation of atmospheric air and results will be difficult to compare.

It must be remembered that light sandy or gravelly soils are often quite porous and permeable. Shallow detector placement will yield low average radon concentrations. This may result in reduced statistical reliability for results if deployment times are short.

Excavation can be done using manual or power augers, spades or other digging devices. A narrow blade "peat" spade is recommended as the most versatile tool for regional work.

A plastic sheet lining in the sample holes is recommended to hold the back-fill material. This provides protection of the detector packages from puncturing during recovery and makes the operation quick and efficient.

The moisture content of all soils is a strong controlling factor on the movement and concentration of radon. Careful observation of this factor is necessary in any radon sampling program.

Sample sites should be chosen carefully to avoid having the detectors disturbed during the sampling period. Anthropogenic influences, including agricultural activities, construction, landscaping, et cetera, should be avoided, as much as is possible. Low ground should be avoided, since sudden rains might temporarily flood the sample site and cause unrepresentative results.

Deployment Time

The length of time detectors are deployed will depend on the estimating precision required. Reconnaissance surveys intended only to locate areas of abnormally high radon concentration can be done in several days. Detailed work requiring a reliable estimate of the average radon level on an annual basis will require long term measurement, or a series of measurements if ambient levels are high.

Deployment of detectors must be long enough to allow for stabilization of the soil gas after disruption caused by excavating the sample hole. Since there are many weather-related influence on the radon concentration in soils, the longer the time of deployment, the more secure the data.

Radon determination with the E-PERM™ system requires that the voltage drop on the electret be measured. It was found that the precision of this measurement was, on average, +2 volts. This is within 4% if the voltage drop is 100 volts, but 16% if the drop is only 25 volts. Therefore, deployment should be long enough to satisfy the precision requirements of the survey.

Radon Soil gas levels are usually high enough that small voltage drop is not a problem. Often the concentrations are so high that deployment can be for only 5 to 10 days, otherwise the electret will be fully discharged.

Radon determinations will be valid averages for the time of deployment. The relation between the measured radon level and the annual average is a matter for interpretation, or may require long term detector deployment.

Frequency of Measurements

During reconnaissance surveying the radon concentration at any sampling point is initially unknown. The rate at which the electret will be discharged must be established by a short term measurement, otherwise a totally discharged electret may be recovered at the end of the sampling period and the data produced by the detector may be of limited value.

First measurements are normally made within 7 to 10 days of deployment. This establishes the discharge rate and permits calculation of possible exposure times.

The second measurements are scheduled on the basis of the discharge rate and may be 10 to 30 days later. Final measurements can be made within the expected life of the electret under the conditions indicated by the first and second measurements. The length of the final measurement period will depend on the requirements of the study and be limited by the expected life of the electret. This may be several days to several months.

While a survey might be done with only 1 voltage measurement made after an arbitrary sampling time, this is not recommended. The first reading of the detector establishes the maximum exposure time possible. The second determination yields data to confirm the initial measurements and the final reading provides the long-term average. The third measurement allows for a threeway comparison of values which is often critical in interpreting results that show large variation between 2 measurements.

It is recommended that a minimum of 2 radon measurements at each sample location, and strongly suggest that at least 3 determinations be specified for any surveys that require scientifically or legally defendable data.

Data Quality

Data quality control requires that 2 radon detectors be placed in about 15% to 20% of the sampling sites. Variation between calculated radon concentrations indicated by detector pairs will be a measure of system reliability.

Any factors that influence the apparent radon concentration, such as the presence of thoron, for example, must be identified and measured so that appropriate corrections can be made.

Detailed Site Studies

Some Features of Detailed Surveys

The same general principles that apply to regional surveys also govern detailed site studies. The principal difference lies in the purpose of the investigation which is to develop a precise understanding of the radon distribution in the soils in a restricted area. Site studies often require more attention to details of radon variation and the database may have to be defended legally. Therefore more attention is paid to establishing the reliability of the database through extensive use of paired detectors, and multiple radon determinations at each sample site.

Sample Spacing

Each detector will sample a relatively restricted volume of soil, overburden and rock. In most cases it is not likely that radon can travel more than 5 m to the detector. Total coverage of an area will require detectors placed at not more than 10 m centres. A wider pattern will be adequate for most purposes, since the volume of material related to a natural radon source will likely have dimensions greater than 20 m by 20 m. Narrow fault zones or perhaps a "lost" natural gas well might give radon anomalies of smaller size. If this sort of target is anticipated the sampling pattern would be modified. Narrow linear targets, such as faults, require closely spaced sampling points laid out on lines at 900 to the strike of the feature. Sample spacing should be less than the expected width of the anomaly.

Number of Sample Sites

An ideal database should include no less than 30 samples. It is possible to be reasonably secure with fewer samples, particularly if the radon estimator for each location is based on duplicate determinations.

In no case is it recommended that less than 16 sample locations be deployed even on a small site of less than an acre. Larger sites having unfaulted bedrock and no naturally occurring hydrocarbons may be covered at a sample density of 16 per acre or a sample site every 20 m, providing all packages contain a pair of radon detectors.

In areas underlain by natural hydrocarbon-bearing rocks, additional sample points may be required if any of the 20 m spaced sample sites indicate elevated radon levels.

If abandoned or "lost" oil or natural gas wells may be present, special care is advised, since the anomaly width may be only several meters if the overburden is shallow. Two potential risks exist in such cases; radon and methane. Sample spacing must be close enough to prevent any oversight.

Deployment Time

Minimum deployment must be long enough to measure stabilized radon concentration, and to permit a voltage drop of not less than 50 volts if paired detectors are used and about 100 volts if single detectors are used. The longer the detectors are in place the more secure the estimator of average radon content will be.

Care should be taken that the sampling period included average conditions of soil moisture and atmospheric conditions. A flooded work site, for example, cannot be sampled properly.

Frequency of Measurements

The comments regarding frequency of measurements during regional surveys apply equally well during site studies.

Screening studies may require only 1 short-term measurement, but a low level of reliability must be assumed.

Since site studies usually are designed to provide detailed information on the radon content of a relatively restricted area, and these data must be defendable scientifically and legally, extra care is indicated. It is recommended that no fewer than 3 separate radon measurements, taken at relatively short intervals, say 7 to 10 days, repeated through a period of not less than 30 days, and preferably extending over 60 days or more, if elevated radon values exist.

The importance of paired detectors for this sort of work has been mentioned earlier. Use of paired detectors provides a strong database, but does not reduce the need for multiple readings.

Other Data

The gamma dose for the area should be determined using gamma configuration detectors and tests run for thoron gas. Appropriate corrections should be made during calculation of radon levels.

SURVEY RESULTS

The surveys discussed herein are essentially reconnaissance in nature. Results are average concentrations of radon in the soil gas for the exposure periods noted. The data show that both radon concentration and flux vary with time, moisture content of the soil, atmospheric pressure, et cetera. Short term surveys lasting 30 to 60 days will be successful in identifying areas of anomalous radon concentration under most sampling conditions. Detailed site surveys will require increased sample density but no modification of sampling technique. While annual radon concentration averages would be satisfying from a research point of view, results of short term surveys are adequate for most regional geochemical purposes. The radon anomalies related to oil and natural gas occurrences of the Wallaceburg area were clearly defined by measurements that lasted only 6 to 7 days.

There are no soil gas radon concentration standards set for Canada. However, the results of the surveys reported herein can be compared with the 1983 Swedish standards of: <270 pCi/L — Low risk areas; 270 to 1350 pCi/L — Normal risk areas; >1350 pCi/L — High risk areas.

Measured concentrations of radon in soil gas within the Wallaceburg study area, specifically in soils above known oil and natural gas "pools" in Paleozoic sedimentary rocks, range to >1500 pCi/L, values of the same order as measured in soils of the Elliot Lake.

These Wallaceburg data indicate elevated soil gas radon concentrations can be expected in those parts of southern Ontario where oil and natural gas deposits occur, in particular, throughout the area which lies between the north shore of Lake Erie and a line extending from Sarnia to Hamilton.

The area underlain by the Kettle Point Formation extends from the south end of Lake Huron to the north shore of Lake Erie between Wallaceburg and London. This area has both radon-producing uraniferous shales clasts in the soil and an apparent petroleum volatile-related radon transport mechanisms working in concert to produce radon soil gas concentrations equal to the highest measured to date in Ontario.

Other isolated areas of elevated radon in soils can be expected in those parts of Ontario that are underlain by black shales which are locally petroliferous. This includes the Ottawa area and the Bruce Peninsula through Manitoulin Island to Sault Ste. Marie. These areas are underlain by the Collingwood Member of the Lindsay Formation, or related bituminous limestones and black shales. The Marcellus Formation which subcrops along Lake Erie in the Port Stanley–Port Burwell area, may also be a radon source locally.

The strong correlation between elevated radon concentration in soil gas and known oil and natural gas accumulations in the underlying Paleozoic sediments of the Wallaceburg area suggests that radon soil gas measurements can be used in prospecting for hydrocarbon accumulations.

If it can be confirmed that naturally occurring hydrocarbon volatiles are acting as solvents and transportation media for uranium and radium, this may provide an answer to the perplexing question of apparent long distance movement of radon gas from source to surface, a mobility which requires unlikely transportation rates in view of the short half-life of the gas.

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APPENDIX 1 Sampling Data

SAMPLING DATA

The radon measuring system used during the Soil Radon Gas Study of southern Ontario has been described at length in the body of the report. The data collection and processing routines are discussed in some detail in the following pages.

The detector uses the surface voltage drop on an electret which has been given an initial quasi-permanent voltage charge in the order of 700 to 750 volts, as a measure of the radon concentration.

Formation of ions within the ion chamber when radon disintegrates spontaneously. The ions formed are attracted to the electret and reduce the voltage as they collect on the surface of the electret.

The sensitivity of electrets is controlled by the manufacturing process and each type (short term, long term, et cetera) responds differently, but predictably, to the number of ionizing events.

The reading procedure is simple. The voltage on the electret is measured when the detector is installed, and again after the period of exposure. The following information is recorded:

1. date and time of deployment
2. initial voltage
3. date and time of reading
3. voltage at time of reading

This information allows calculation of exposure time and voltage drop.

In simple terms, the calculation involves determining the voltage drop per time period (volts per day) and computing the radon concentration by applying a "pCi/L per volt" factor.

The actual calculation is slightly more involved: A calibration factor is computed using the mid-point of the voltage spread and constants supplied by the manufacturer.

EXAMPLE:

The following calculation assumes use of an "L"-type ion chamber of 50 mL and a red label long term electret. Exposure has been 90 days and 8 hours. Gamma dose is 10 uR/h.

Assume an initial voltage of 700 V (V1) and a final voltage of 650 V (V2).

Step 1. Calculate the calibration factor.

$$CF = 0.02723 + (0.000012795*((700 + 650)/2) = 0.035866$$

Step 2. Calculate the radon concentration.

[Rn = ((V1-V2)/(Cal. Factor * Time in days)/2 - (Gamma dose * Gamma dose factor for 50mL ion Chamber)]

$$Rn = ((700-650)/(0.035866*90.33)) - (10*0.12) = 14.233pCi/L.$$

NOTE: These calculations are specifically for the 50 mL ion chamber and the red label long term electret exposed in a gamma dose environment of 10 uR/h. Other chambers and gamma backgrounds will use other specific factors.

RAW DATA

Time and voltage data shown on the first spread sheet in the following Appendices observe these conventions:

1. Days are calendar days from January 1.

2. Time is given in 24 hour format plus elapsed minutes.

(This precision is not required but is convenient for field purposes; the nearest hour is more than adequate)

3. Voltage: V(i) is initial voltage; V(2), et cetera is voltage after first exposure period, V(3) is voltage after the second period, et cetera.

SPREAD SHEETS

The first spread sheet following the raw data gives calculated average radon concentrations from the time of initial emplacement.

The third spread sheet shows the average radon concentration for each measurement period.

SYMBOLS

In some cases, the original electret was discharged to the point that it had to be replaced. The following code is used to signify electret replacement:

first replacement

@ second replacement

! third replacement

!! fourth replacement

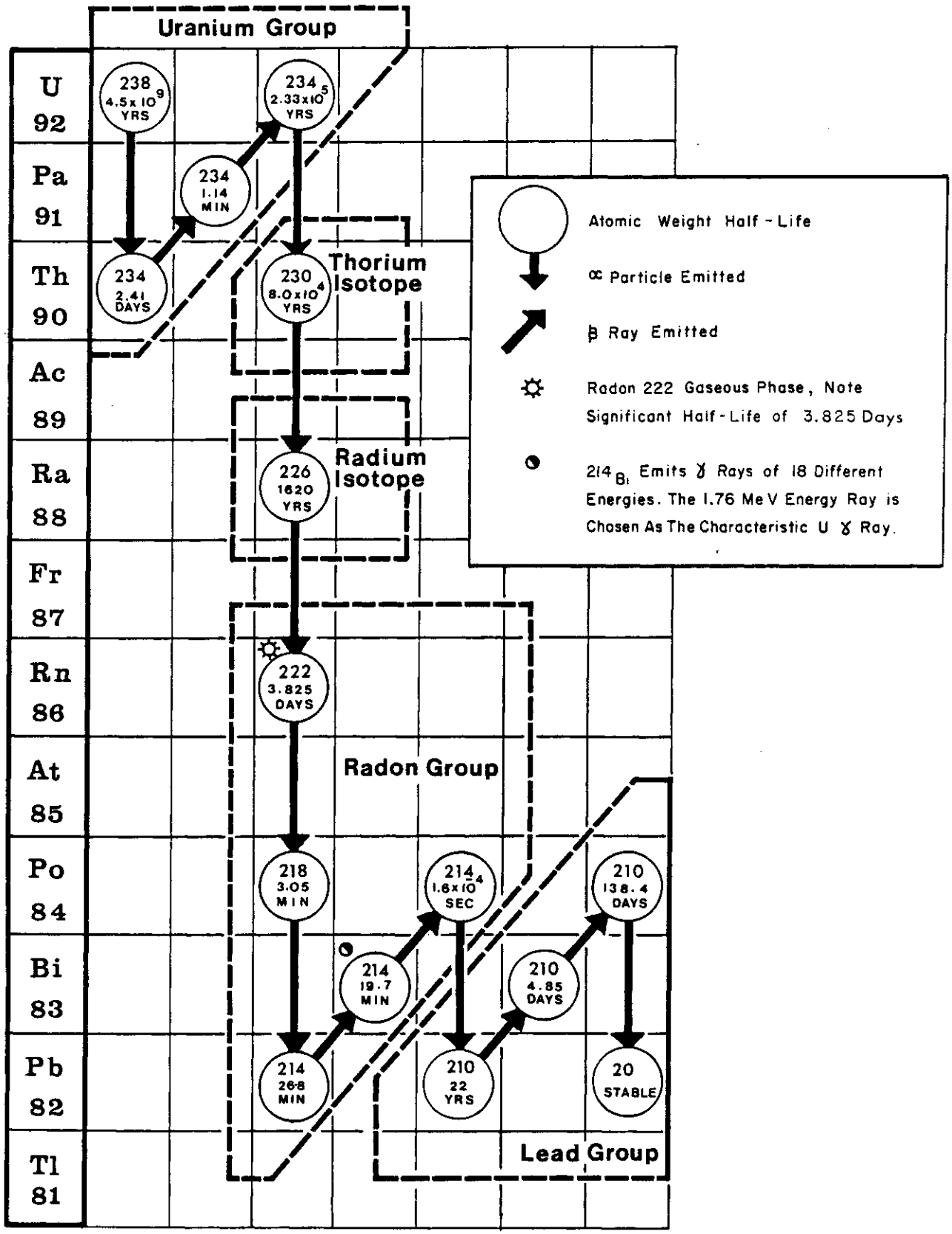
Doubled detectors at any sample site will show a lower case "d" after the sample number: e.g. WAL2-43d.

Sample numbers followed by a "*" indicate tampering at some time during deployment, e.g. WIN1-24*. Sample sites from which detector packages were stolen are noted on the data sheets.

GLOSSARY

Becquerel	Unit of radioactive decay; 1 disintegration per second.
Becquerel per cubic meter	1 disintegration per second per cubic meter of air, ...
Bq/m^3	Becquerel per cubic meter.
Curie	3.70×10^{10} disintegrations per second. (approximately the activity of one gram of radium)
1 pico Curie	10^{-12} Curie; 0.037 disintegrations per second, or 2.22 disintegrations per minute.
1 pico Curie per litre	0.037 disintegrations per second per litre of air, water, ...
pCi/L	pico Curie per litre.
Electret	A disc carrying a quasi-permanent surface voltage.
Half-life	The time required for a radioactive element to decay to 1/2 its original concentration, e.g., 100 radon atoms at T1 will have decayed to 50 atoms at T2 which is 3.825 days later.
Roentgen	That quantity of gamma radiation that produces in 1mL of dry air at 0^0 and 760 mm Hg, ions carrying 1 statcoulomb of electricity of either sign.
uR	10^{-6} Roentgen.
uR/h	10^{-6} Roentgen per hour.

NATURAL RADIOACTIVE SERIES URANIUM 238



AURORA ENVIRONMENTAL SURVEYS LIMITED

Detector LC5401

Station MS2-2

Radon Study of Southern Ontario

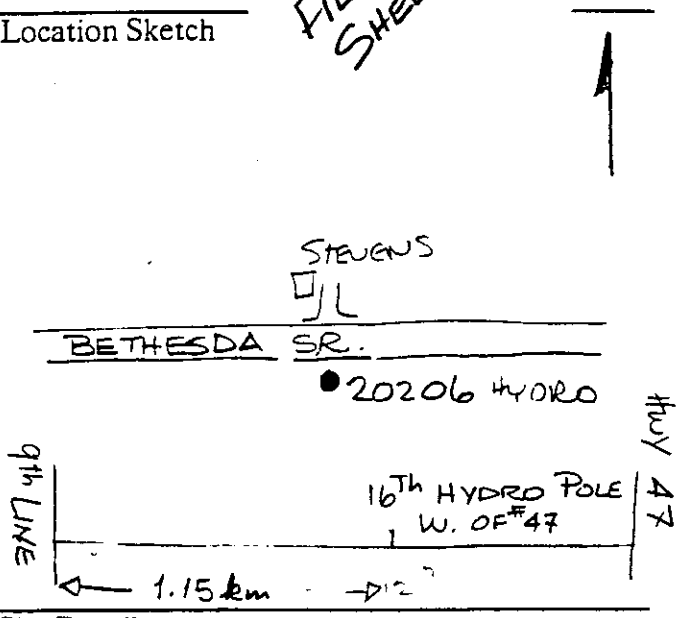
MARKHAM - STOUFFVILLE AREA

TYPICAL FIELD DATA SHEET

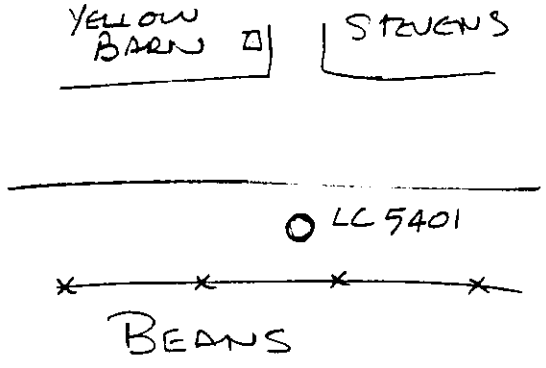
Reader # 521 Operator JT|PN

Readings (Volts)	Date	Time
730	[illegible]	[illegible]
698	04/10/91	09:20
562	04/10/91	11:41
435	02/12/91	14:09
____	__/__/__	____
____	__/__/__	____

Location Sketch



Site Detail



Bedrock

COLLINGWOOD Mb.

Surficial

HALTON TILL

Soil Profile

0-5cm SOD

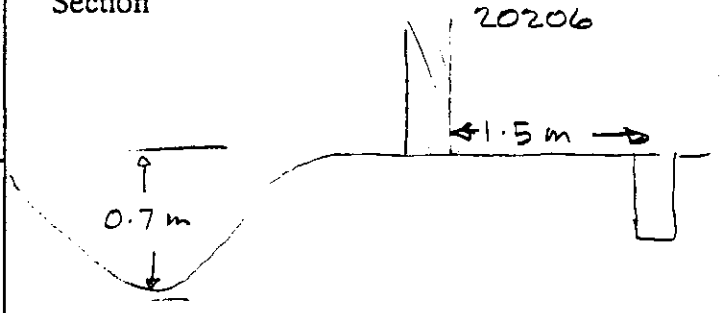
GRAY-BROWN LOAM

25cm

MED. BROWN CLAY-LOAM

35cm

Section



Agriculture

BEANS - 2m SOUTH

Drainage

~ DIVIDE - ± 2% SLOPE TO BOTH E & W.

APPENDIX 1 - 1

Raw Data and Calculations

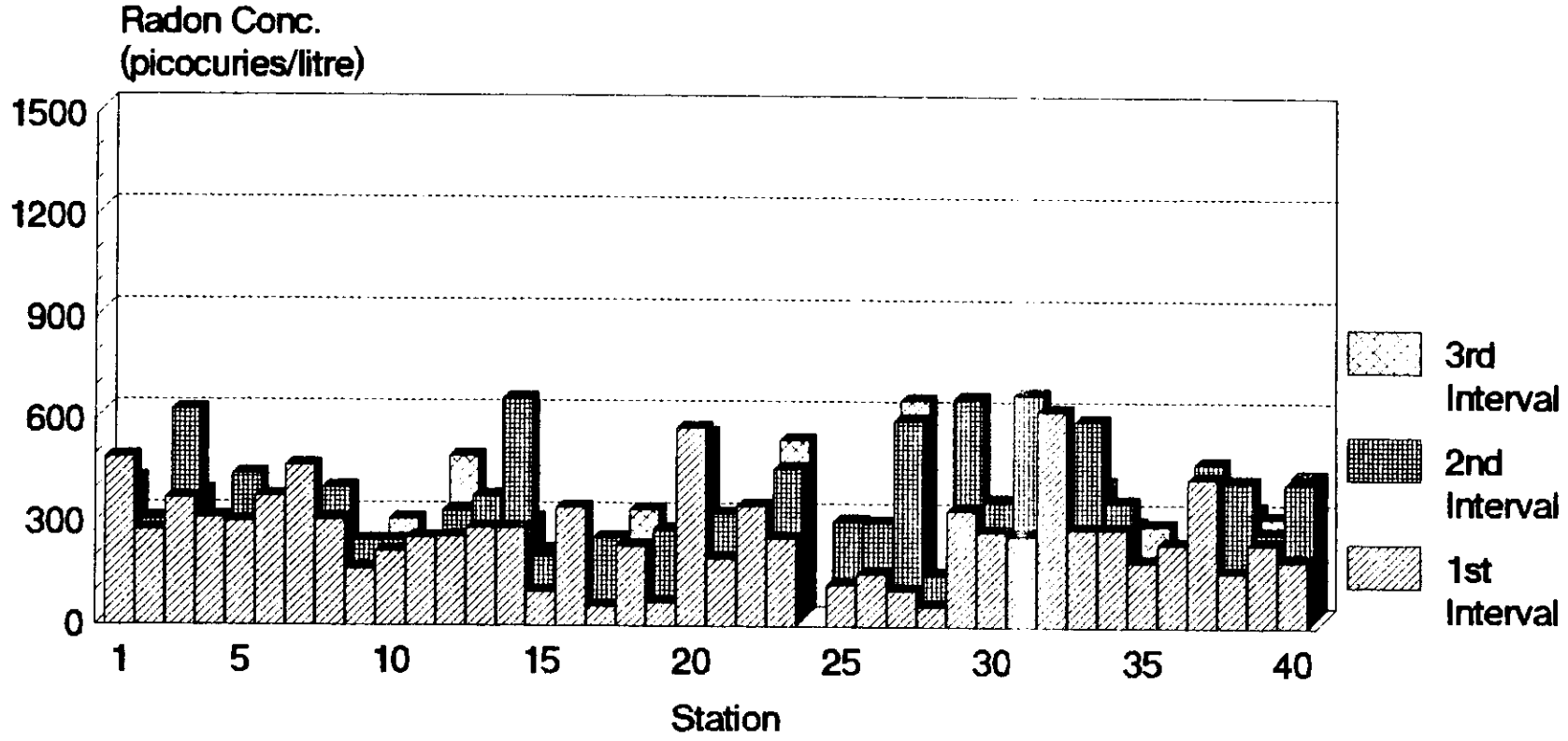
WESTERN ESSEX COUNTY, WINDSOR AREA

SOIL RADON GAS STUDY of SOUTHERN ONTARIO

WINDSOR AREA ENVIRONMENT # 1

Sample #	Electret	Day	Time Hrs	Minutes	V(i)	Day	Time Hrs	Minutes	V(2)	Day	Time Hrs	Minutes	V(3)	Day	Time Hrs	Minutes	V(4)
WIN1-1	LC 5676	278	14	15	735	292	9	45	496	310	12	38	258	312	14	55	247
WIN1-2	LC 5378	278	14	40	709	292	10	10	574	310	12	49	398	341	8	25	232
WIN1-3	LB 4136	278	17	20	716	292	10	32	536	311	10	6	168				
WIN1-4	LC 2921	277	15	40	755	292	10	50	589	311	9	34	499	341	8	55	271
WIN1-5	LB 4382	278	18	15	715	292	9	35	569	310	12	38	316	330	8	49	188
WIN1-6	LC 5616	279	10	10	727	291	16	45	563	312	13	33	405	341	9	54	321
WIN1-7	LC 5674	279	10	45	746	291	16	7	543	312	9	57	336				
WIN1-8	LC 5725	279	11	0	730	291	16	18	596	312	9	48	333	341	9	18	195
WIN1-9	LC 5619	278	11	15	734	291	15	50	656	312	10	6	492	341	16	19	343
WIN1-10	LC 4586	279	11	30	731	291	15	15	636	312	10	35	473	341	16	6	220
WIN1-11	LC 3662	279	11	50	731	291	16	33	619	312	9	37	513	342	9	27	416
WIN1-12	LB 4959	278	12	10	743	291	17	15	620	312	9	23	399	341	12	8	0
WIN1-13	LB 4666	279	13	30	718	291	8	52	598	311	11	2	357	340	13	6	174
WIN1-14	LB 6062	279	14	50	711	292	9	25	581	311	10	41	185				
WIN1-15	LB 4013	279	15	10	734	291	8	45	692	311	11	10	562	341	12	47	378
WIN1-16	LB 4663	279	16	10	716	291	9	24	572	311	12	3	458	340	13	27	370
WIN1-17	LB 4308	278	16	50	718	291	17	42	692	311	11	36	528	341	13	3	345
WIN1-18	LB 4375	279	17	10	717	291	8	35	620	311	11	18	492	341	12	56	204
WIN1-19	LB 4456	279	17	30	709	291	18	0	680	312	10	56	492	342	9	45	337
WIN1-20	LC 3606	279	17	50	718	291	15	7	477	312	10	47	123				
WIN1-21	LC 5622	279	18	25	753	291	14	40	668	311	17	11	454	341	15	32	214
WIN1-22	LC 3625	279	18	45	742	291	10	42	595	311	16	34	411	340	15	57	398
WIN1-23	LC 5676	280	8	0	702	291	8	5	601	311	10	54	308	312	14	33	288
WIN1-24*	LC 3645	280	8	20	728	291	9	45	116								
WIN1-25	LC 3612	280	8	50	720	291	11	25	671	311	12	18	471	340	13	41	323
WIN1-26	LC 5605	280	9	15	728	291	11	15	666	311	12	28	470	340	13	52	366
WIN1-27	LC 3649	280	9	35	729	291	9	53	687	311	11	50	294	312	13	17	287
WIN1-28	LC 3632	280	10	20	734	291	10	10	710	311	11	29	614	341	13	10	501
WIN1-29	LB 5127	280	10	40	706	291	10	25	574	311	16	22	154				
WIN1-30	LB 4052	280	11	10	733	291	10	50	624	311	16	16	386	341	14	9	326
WIN1-31	LC 5686	280	11	30	730	291	11	2	625	311	12	38	195	312	13	2	193
WIN1-32	LB 2045	280	11	55	723	291	11	40	480	311	12	48	314	330	9	29	202
WIN1-33	LB 5209	280	16	0	724	291	13	50	613	311	15	57	231	312	12	19	228
WIN1-34	LC 5687	280	16	20	712	291	14	0	601	311	16	7	369	341	14	37	126
WIN1-35	LC 5431	280	16	35	725	291	14	12	650	311	16	42	585	341	15	4	328
WIN1-36	LC 3634	280	17	15	710	291	14	28	616	311	17	0	511	341	15	19	322
WIN1-37	LB 5454	280	17	40	733	291	15	31	565	312	10	21	254				
WIN1-38	LC 3652	280	18	0	736	291	15	23	673	312	10	29	386	341	15	49	110
WIN1-39	LC 3650	280	18	30	728	291	14	50	633	311	17	21	458	341	15	39	192
WIN1-40	LC 3682	280	9	30	708	292	11	55	624	312	15	4	355	342	8	51	0
WIN1-1#	LC 5342	312	14	55	738	341	8	12	573								
WIN1-3#	LC 5238	311	10	6	310	312	15	45	300								
WIN1-3a	LC 5271	312	15	45	739	341	8	45	386								
WIN1-7#	LC 0682	312	9	57	757	342	9	10	508								
WIN1-14#	LC 5455	311	10	42	290	312	8	18	281								
WIN1-14a	LC 4146	312	8	18	744	342	10	26	457								
WIN1-20#	LC 4210	312	10	50	713	342	9	37	532								
WIN1-23#	LC 5527	312	14	35	707	340	12	57	240								
WIN1-27#	LC 5564	312	13	17	730	340	16	17	139								
WIN1-29#	LB 4613	311	16	23	300	312	12	7	297								
WIN1-29a	LC 4144	312	12	7	722	340	16	7	570								
WIN1-31#	LC 4203	312	13	2	725	340	13	59	490								
WIN1-33#	LC 5263	312	12	20	708	341	14	49	319								
WIN1-37#	LC 2950	312	15	31	737	341	15	57	468								
WIN1-5#	LC 8277	330	8	49	382	342	8	39	367								
WIN1-32#	LC 1984	330	9	29	316	340	14	9	292								

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO
WINDSOR
Soil Radon Gas Concentration
Environment 1



AURORA ENVIRONMENTAL SURVEYS LIMITED

01-21-92

AURORA ENVIRONMENTAL SURVEYS LIMITED

Radon Concentration -from date of placement

SOIL RADON GAS STUDY of SOUTHERN ONTARIO — WINDSOR AREA — ENVIRONMENT # 1
(gamma corrected for 16.68 uR/hr)

Sample #	(1) Rn pCi/L	Days	(2) Rn pCi/L	Days	(3) Rn pCi/L	Days	(4) Rn pCi/L	Days	Summary Rn pCi/L	Days
WIN1-1	490.89	13.81	442.80	31.93	425.94	34.03	159.30	28.72	303.90	62.75
WIN1-2	273.80	13.81	281.93	31.92	226.66	62.74	.00	.00	226.66	62.74
WIN1-3	370.38	13.72	507.62	32.70	432.81	62.65	.00	.00	432.81	62.65
WIN1-4	311.08	14.80	213.19	33.75	222.77	63.72	.00	.00	222.77	63.72
WIN1-5	300.01	13.64	369.33	31.77	307.38	51.61	.00	.00	307.38	51.61
WIN1-6	374.55	12.27	279.85	33.14	191.00	61.99	.00	.00	191.00	61.99
WIN1-7	486.12	12.22	362.16	32.97	300.77	62.94	.00	.00	300.77	62.94
WIN1-8	305.03	12.22	352.05	32.95	258.62	61.93	.00	.00	258.62	61.93
WIN1-9	161.70	13.19	201.22	33.95	179.29	63.21	.00	.00	179.29	63.21
WIN1-10	215.23	12.16	222.07	32.96	244.64	62.19	.00	.00	244.64	62.19
WIN1-11	254.03	12.20	186.26	32.91	142.87	62.90	.00	.00	142.87	62.90
WIN1-12	256.97	13.21	291.96	33.88	366.75	63.00	.00	.00	366.75	63.00
WIN1-13	283.10	11.81	329.82	31.90	268.84	60.98	.00	.00	268.84	60.98
WIN1-14	284.70	12.77	499.39	31.83	386.06	63.63	.00	.00	386.06	63.63
WIN1-15	96.47	11.73	150.11	31.83	165.46	61.90	.00	.00	165.46	61.90
WIN1-16	344.45	11.72	231.33	31.83	164.27	60.89	.00	.00	164.27	60.89
WIN1-17	53.02	13.04	162.65	32.78	172.41	62.84	.00	.00	172.41	62.84
WIN1-18	230.83	11.64	200.64	31.76	248.52	61.82	.00	.00	248.52	61.82
WIN1-19	64.80	12.02	187.92	32.73	172.97	62.68	.00	.00	172.97	62.68
WIN1-20	579.35	11.89	555.87	32.71	371.29	62.66	.00	.00	371.29	62.66
WIN1-21	195.59	11.84	265.76	31.95	258.66	61.88	.00	.00	258.66	61.88
WIN1-22	350.18	11.66	297.75	31.91	161.66	60.88	.00	.00	161.66	60.88
WIN1-23	256.08	11.00	380.20	32.27	435.90	60.20	.00	.00	435.90	60.20
WIN1-24*	1693.99	11.06	Fertilized							
WIN1-25	120.10	11.11	227.41	31.14	192.51	60.20	.00	.00	192.51	60.20
WIN1-26	152.75	11.08	235.48	31.13	173.70	60.19	.00	.00	173.70	60.19
WIN1-27	103.10	11.01	405.54	32.15	514.42	60.28	.00	.00	514.42	60.28
WIN1-28	57.86	10.99	105.80	31.05	106.52	61.12	.00	.00	106.52	61.12
WIN1-29	337.12	10.99	537.87	31.24	337.00	60.23	.00	.00	337.00	60.23
WIN1-30	274.28	10.99	321.28	31.21	193.81	61.12	.00	.00	193.81	61.12
WIN1-31	264.37	10.98	503.44	32.06	379.36	60.10	.00	.00	379.36	60.10
WIN1-32	631.10	10.99	387.14	31.04	312.99	49.90	73.65	10.19	272.28	60.09
WIN1-33	282.33	10.91	465.42	31.85	431.05	60.95	.00	.00	431.05	60.95
WIN1-34	283.74	10.90	322.13	30.99	293.10	60.93	.00	.00	293.10	60.93
WIN1-35	188.98	10.90	124.80	31.00	189.80	60.94	.00	.00	189.80	60.94
WIN1-36	239.83	10.88	181.25	30.99	186.25	60.92	.00	.00	186.25	60.92
WIN1-37	431.33	10.91	448.53	31.70	360.01	60.72	.00	.00	360.01	60.72
WIN1-38	157.60	10.89	319.02	31.69	312.85	60.91	.00	.00	312.85	60.91
WIN1-39	241.70	10.85	248.54	30.95	263.85	60.88	.00	.00	263.85	60.88
WIN1-40	192.17	12.10	319.82	32.23	357.71	61.97	.00	.00	357.71	61.97
WIN1-1#	159.30	28.72	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-3#	258.00	1.24	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-3a	355.16	28.71	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-7#	233.23	29.97	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-14#	321.80	.90	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-14a	271.20	30.09	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-20#	169.71	29.95	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-23#	500.25	27.93	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-27#	638.86	28.13	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-29#	115.51	.82	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-29a	150.03	28.17	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-31#	237.44	28.04	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-33#	393.44	29.10	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-37#	263.32	29.02	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-5#	37.06	11.99	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-32#	73.65	10.19	.00	.00	.00	.00	.00	.00	.00	.00

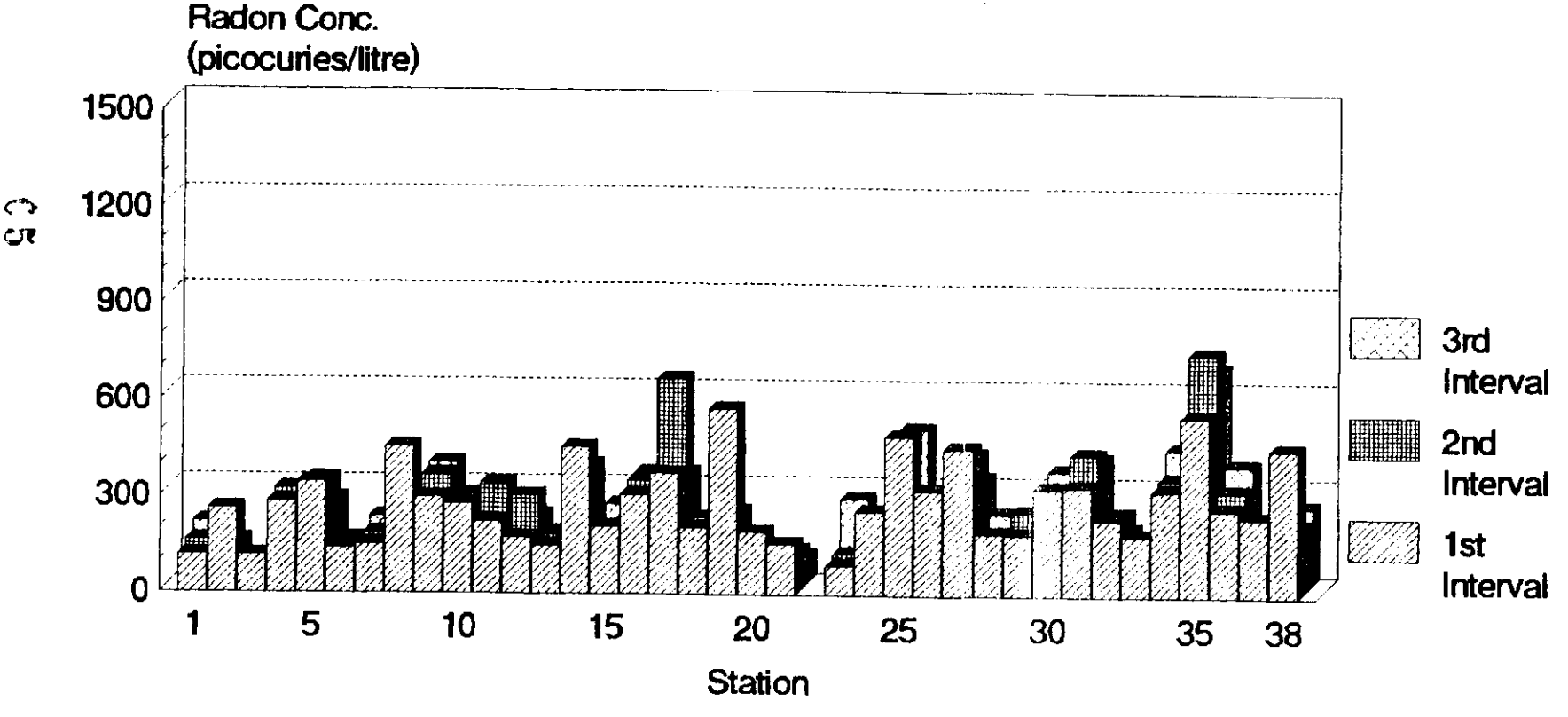
Radon Concentrations - (Incremental)

SOIL RADON GAS STUDY of SOUTHERN ONTARIO — WINDSOR AREA — ENVIRONMENT # 1

(gamma corrected for 16.68 uR/hr)

Sample #	(1) Rn pCi/L	Days	(2) Rn pCi/L	Days	(3) Rn pCi/L	Days	(4) Rn pCi/L	Days	(5) Rn pCi/L	Days
WIN1-1	490.89	13.81	407.77	18.12	170.36	2.10	159.30	28.72	.00	.00
WIN1-2	273.80	13.81	288.54	18.11	170.32	30.82	.00	.00	.00	.00
WIN1-3	370.38	13.72	608.92	18.98	258.00	1.24	355.16	28.71	.00	.00
WIN1-4	311.08	14.80	136.93	18.95	234.56	29.97	.00	.00	.00	.00
WIN1-5	300.01	13.64	422.33	18.13	209.83	19.84	37.06	11.99	.00	.00
WIN1-6	374.55	12.27	224.55	20.87	89.35	28.85	.00	.00	.00	.00
WIN1-7	466.12	12.22	301.75	20.74	233.23	29.97	.00	.00	.00	.00
WIN1-8	305.03	12.22	380.46	20.73	153.58	28.98	.00	.00	.00	.00
WIN1-9	161.70	13.19	226.47	20.76	154.34	29.26	.00	.00	.00	.00
WIN1-10	215.23	12.16	226.24	20.81	271.36	29.23	.00	.00	.00	.00
WIN1-11	254.03	12.20	146.47	20.71	95.49	29.99	.00	.00	.00	.00
WIN1-12	256.97	13.21	314.77	20.67	458.15	29.11	.00	.00	.00	.00
WIN1-13	283.10	11.81	357.81	20.09	203.43	29.09	.00	.00	.00	.00
WIN1-14	284.70	12.77	644.87	19.05	321.80	.90	271.20	30.09	.00	.00
WIN1-15	96.47	11.73	181.46	20.10	182.08	30.07	.00	.00	.00	.00
WIN1-16	344.45	11.72	165.62	20.11	91.10	29.06	.00	.00	.00	.00
WIN1-17	53.02	13.04	235.06	19.75	183.52	30.06	.00	.00	.00	.00
WIN1-18	230.83	11.64	183.30	20.11	300.32	30.07	.00	.00	.00	.00
WIN1-19	64.80	12.02	259.45	20.71	157.07	29.95	.00	.00	.00	.00
WIN1-20	579.35	11.89	545.28	20.82	169.71	29.95	.00	.00	.00	.00
WIN1-21	195.59	11.84	307.35	20.10	252.52	29.93	.00	.00	.00	.00
WIN1-22	350.18	11.66	267.97	20.24	11.84	28.97	.00	.00	.00	.00
WIN1-23	256.08	11.00	438.74	20.12	557.22	1.15	500.25	27.93	.00	.00
WIN1-24*	1693.99	11.06	Fertilized							
WIN1-25	120.10	11.11	287.02	20.04	155.64	29.06	.00	.00	.00	.00
WIN1-26	152.75	11.08	281.36	20.05	107.86	29.06	.00	.00	.00	.00
WIN1-27	103.10	11.01	582.09	20.08	211.30	1.06	638.86	28.13	.00	.00
WIN1-28	57.86	10.99	132.08	20.05	107.36	30.07	.00	.00	.00	.00
WIN1-29	337.12	10.99	648.50	20.25	115.51	.82	150.03	28.17	.00	.00
WIN1-30	274.28	10.99	347.25	20.23	61.11	29.91	.00	.00	.00	.00
WIN1-31	264.37	10.98	657.83	20.07	64.21	1.02	237.44	28.04	.00	.00
WIN1-32	631.10	10.99	254.28	20.05	192.49	18.86	73.65	10.19	.00	.00
WIN1-33	282.33	10.91	580.79	20.09	115.19	.85	393.44	29.10	.00	.00
WIN1-34	283.74	10.90	343.41	20.09	265.03	29.94	.00	.00	.00	.00
WIN1-35	188.98	10.90	90.03	20.10	257.63	29.93	.00	.00	.00	.00
WIN1-36	239.83	10.88	149.64	20.11	191.95	29.93	.00	.00	.00	.00
WIN1-37	431.33	10.91	458.83	20.78	263.32	29.02	.00	.00	.00	.00
WIN1-38	157.60	10.89	403.85	20.80	308.65	29.22	.00	.00	.00	.00
WIN1-39	241.70	10.85	252.44	20.10	281.15	29.93	.00	.00	.00	.00
WIN1-40	192.17	12.10	396.95	20.13	402.61	29.74	.00	.00	.00	.00
WIN1-1#	159.30	28.72	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-3#	258.00	1.24	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-3a	355.16	28.71	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-7#	233.23	29.97	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-14#	321.80	.90	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-14a	271.20	30.09	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-20#	169.71	29.95	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-23#	500.25	27.93	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-27#	638.86	28.13	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-29#	115.51	.82	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-29a	150.03	28.17	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-31#	237.44	28.04	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-33#	393.44	29.10	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-37#	263.32	29.02	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-5#	37.06	11.99	.00	.00	.00	.00	.00	.00	.00	.00
WIN1-32#	73.65	10.19	.00	.00	.00	.00	.00	.00	.00	.00

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO
WINDSOR
Soil Radon Gas Concentration
Environment 2



AURORA ENVIRONMENTAL SURVEYS LIMITED

01-21-92

AURORA ENVIRONMENTAL SURVEYS LIMITED

SOIL RADON GAS STUDY of SOUTHERN ONTARIO

WINDSOR AREA **ENVIRONMENT # 2**

Sample #	Electret	Day	Time Hrs	Minutes	V (i)	Day	Time Hrs	Minutes	V(2)	Day	Time Hrs	Minutes	V(3)	Day	Time Hrs	Minutes	V(4
WIN2-1	LC 5606	278	16	0	736	290	16	25	685	311	9	0	583	341	9	36	405
WIN2-2	LC 3653	278	16	20	728	290	16	7	616	311	8	46	517	341	9	14	452
WIN2-3	LB 3042	278	16	40	734	290	15	54	683	311	8	30	614	341	9	6	570
WIN2-4	LC 5666	278	17	0	739	290	16	30	617	311	9	11	407	341	9	46	223
WIN2-5	LC 5277	277	17	20	714	290	16	47	556	311	9	21	331	330	10	52	190
WIN2-6	LC 2908	278	17	40	726	292	11	35	657	311	8	4	561	341	10	10	482
WIN2-7	LB 4689	276	18	0	749	290	17	11	672	311	10	28	554	341	10	23	363
WIN2-8	LB 3752	279	8	15	722	290	17	17	540	312	13	42	345	341	10	29	193
WIN2-9	LC 3691	279	8	35	714	290	17	30	593	312	13	46	343	330	10	36	105
WIN2-10	LB 4982	279	8	50	706	290	17	53	593	312	13	53	386	341	10	47	179
WIN2-11	LB 3033	279	9	5	711	290	18	3	620	312	14	2	386	341	11	6	188
WIN2-12	LB 3037	279	9	25	735	290	18	34	663	312	14	6	452	341	11	19	267
WIN2-13	LB 3083	279	9	40	752	290	18	15	691	312	14	14	576	341	11	24	431
WIN2-14	LC 0946	279	9	55	750	291	17	23	551	312	14	22	295				
WIN2-15	LC 5707	279	10	30	734	290	17	0	649	311	8	14	542	341	9	53	312
WIN2-16	LC 5632	279	12	30	754	291	8	22	623	312	9	17	391	341	12	34	98
WIN2-17	LB 4246	279	12	55	734	291	8	15	577	312	9	5	145				
WIN2-18	LC 3633	279	13	15	725	291	8	28	638	312	9	9	555	341	12	22	366
WIN2-19	LB 4245	279	15	30	727	291	9	5	491	312	8	41	330	340	13	12	213
WIN2-20	LC 5626	279	15	50	702	291	9	14	620	312	8	50	562	340	13	20	530
WIN2-21	LB 3071	279	16	30	727	291	9	33	661	311	12	9	579	340	13	34	500
WIN2-23	LB 6222	280	9	50	736	291	10	0	700	311	11	43					
WIN2-24	LB 5816	280	12	20	739	291	11	55	637	311	13	0	627	340	16	22	378
WIN2-25	LB 5117	280	12	40	745	291	12	3	553	311	13	11	513	340	14	22	422
WIN2-26	LB 2658	280	14	0	737	291	12	58	610	311	14	50	409	340	14	30	0
WIN2-27	LB 2692	280	14	15	726	291	13	5	550	311	15	2	411	340	15	7	281
WIN2-28	LB 4040	280	14	30	726	291	13	12	650	311	15	9	291	312	12	34	282
WIN2-29	LB 2994	280	14	45	727	291	13	20	653	311	15	24	555	340	15	18	355
WIN2-30	LB 4669	280	15	5	742	291	13	27	612	311	15	34	498	340	15	27	330
WIN2-31	LB 5898	280	15	30	726	291	13	31	595	311	15	40	411	340	15	34	109
WIN2-32	LB 5226	280	15	45	724	291	13	43	632	311	15	48	320	330	10	11	85
WIN2-33	LC 5582	280	16	50	735	291	14	20	662	311	16	53	474	340	15	45	321
WIN2-34	LC 3617	281	10	0	733	290	16	18	625	311	8	59	558	341	15	10	428
WIN2-35	LB 2983	281	11	15	755	291	12	12	556	311	14	7	390	341	9	29	21
WIN2-36	LC 5595	281	11	35	747	291	12	16	650	311	14	15	97				
WIN2-37	LB 4687	281	11	50	712	291	12	22	625	311	14	19	442	340	14	40	119
WIN2-38	LC 5641	281	12	15	740	291	12	26	577	311	14	25	548	340	14	45	488
WIN2-14#	LC 4177	312	14	22	719								444	340	14	48	230
WIN2-17#	LC 4149	312	9	6	733	341	12	39	399								
WIN2-27#	LC 5477	312	12	34	718	340	15	14	411								
WIN2-35#	LB 9827	311	14	7	344	312	12	47	328								
WIN2-35@	LC 4161	312	12	48	723	330	9	53	250								
WIN2-5#	LC 4157	330	10	52	278	341	10	3	193								
WIN2-9#	LC 8375	330	10	36	310	341	10	42	231								
WIN2-31#	LC 6908	330	10	11	724	340	15	41	613								
WIN2-35!	LC 6955	330	9	53	750	340	14	35	566								

AURORA ENVIRONMENTAL SURVEYS LIMITED

Radon Concentration -from date of placement

SOIL RADON GAS STUDY of SOUTHERN ONTARIO — WINDSOR AREA — ENVIRONMENT # 2

(gamma corrected for 16.68 uR/hr)

Sample #	(1) Rn pCi/L	Days	(2) Rn pCi/L	Days	(3) Rn pCi/L	Days	(4) Rn pCi/L	Days	Summary Rn pCi/L	Days
WIN2-1	114.84	12.02	131.14	32.71	152.81	62.73	.00	.00	152.81	62.73
WIN2-2	258.70	11.99	183.42	32.68	126.56	62.70	.00	.00	126.56	62.70
WIN2-3	115.41	11.97	102.48	32.66	73.55	62.68	.00	.00	73.55	62.68
WIN2-4	281.65	11.98	293.99	32.67	246.52	62.70	.00	.00	246.52	62.70
WIN2-5	342.37	12.98	335.42	33.67	301.01	52.73	292.97	63.70	292.97	63.70
WIN2-6	137.13	13.75	142.72	32.60	111.34	62.69	.00	.00	111.34	62.69
WIN2-7	149.80	13.97	158.07	34.69	173.76	64.68	.00	.00	173.76	64.68
WIN2-8	451.15	11.38	333.16	33.23	257.51	62.09	.00	.00	257.51	62.09
WIN2-9	296.96	11.37	328.59	33.22	367.16	51.08	343.20	62.08	343.20	62.08
WIN2-10	277.46	11.38	281.61	33.21	258.08	62.08	.00	.00	258.08	62.08
WIN2-11	221.83	11.37	285.78	33.21	255.42	62.08	.00	.00	255.42	62.08
WIN2-12	172.88	11.38	244.81	33.20	224.10	62.08	.00	.00	224.10	62.08
WIN2-13	145.30	11.36	148.43	33.19	148.61	62.07	.00	.00	148.61	62.07
WIN2-14	452.65	12.31	404.27	33.19	.00	.00	.00	.00	404.27	33.19
WIN2-15	207.04	11.27	170.03	31.91	200.73	61.97	.00	.00	200.73	61.97
WIN2-16	305.32	11.83	319.63	32.87	323.74	62.00	.00	.00	323.74	62.00
WIN2-17	371.38	11.81	545.92	32.84	444.58	61.99	.00	.00	444.58	61.99
WIN2-18	203.07	11.80	146.20	32.83	169.36	61.96	.00	.00	169.36	61.96
WIN2-19	572.34	11.73	356.99	32.72	253.87	60.90	.00	.00	253.87	60.90
WIN2-20	193.97	11.73	121.20	32.71	80.44	60.90	.00	.00	80.44	60.90
WIN2-21	154.08	11.71	130.71	31.82	106.29	60.88	.00	.00	106.29	60.88
WIN2-23	87.81	11.01	97.56	31.08	172.88	60.27	.00	.00	172.88	60.27
WIN2-24	255.75	10.98	206.69	31.03	152.23	60.08	.00	.00	152.23	60.08
WIN2-25	490.36	10.97	312.93	31.02	387.57	60.08	.00	.00	387.57	60.08
WIN2-26	321.34	10.96	303.82	31.03	225.06	60.05	.00	.00	225.06	60.05
WIN2-27	452.07	10.95	412.89	31.93	367.05	60.04	.00	.00	367.05	60.04
WIN2-28	190.69	10.95	155.58	31.03	180.99	60.03	.00	.00	180.99	60.03
WIN2-29	185.57	10.94	210.47	31.03	194.56	60.03	.00	.00	194.56	60.03
WIN2-30	329.32	10.93	308.34	31.02	322.78	60.02	.00	.00	322.78	60.02
WIN2-31	334.29	10.92	386.00	31.01	397.21	49.78	380.85	60.01	380.85	60.01
WIN2-32	232.74	10.92	231.10	31.00	198.04	60.00	.00	.00	198.04	60.00
WIN2-33	183.24	10.90	160.82	31.00	145.33	60.93	.00	.00	145.33	60.93
WIN2-34	322.63	9.26	332.70	29.96	370.34	59.98	.00	.00	370.34	59.98
WIN2-35	554.52	10.04	668.48	30.12	723.79	48.00	685.31	58.20	685.31	58.20
WIN2-36	265.43	10.03	290.76	30.11	324.10	59.13	.00	.00	324.10	59.13
WIN2-37	240.59	10.02	154.37	30.10	108.54	59.12	.00	.00	108.54	59.12
WIN2-38	454.80	10.01	282.64	30.09	258.06	59.11	.00	.00	258.06	59.11
WIN2-14#	stolen									
WIN2-17#	330.41	29.15	.00	.00	.00	.00	.00	.00		
WIN2-27#	314.98	28.11	.00	.00	.00	.00	.00	.00	.00	.00
WIN2-35#	535.32	.94	.00	.00	.00	.00	.00	.00	.00	.00
WIN2-35@	788.81	17.88	.00	.00	.00	.00	.00	.00	.00	.00
WIN2-5#	254.30	10.97	.00	.00	.00	.00	.00	.00	.00	.00
WIN2-9#	231.91	11.00	.00	.00	.00	.00	.00	.00	.00	.00
WIN2-31#	301.25	10.23	.00	.00	.00	.00	.00	.00	.00	.00
WIN2-35!	504.23	10.20	.00	.00	.00	.00	.00	.00	.00	.00

AURORA ENVIRONMENTAL SURVEYS LIMITED

Radon Concentrations - (Incremental)

SOIL RADON GAS STUDY of SOUTHERN ONTARIO — WINDSOR AREA — **ENVIRONMENT # 2**
(gamma corrected for 16.68 uR/hr)

Sample #	(1) Rn pCi/L	Days	(2) Rn pCi/L	Days	(3) Rn pCi/L	Days	(4) Rn pCi/L	Days	(5) Rn pCi/L	Days
WIN2-1	114.84	12.02	137.48	20.69	174.70	30.03	.00	.00	.00	.00
WIN2-2	258.70	11.99	136.75	20.69	62.77	30.02	.00	.00	.00	.00
WIN2-3	115.41	11.97	91.86	20.69	40.10	30.03	.00	.00	.00	.00
WIN2-4	281.65	11.98	298.38	20.70	194.04	30.02	.00	.00	.00	.00
WIN2-5	342.37	12.98	328.49	20.69	240.00	19.06	.00	.00	.00	.00
WIN2-6	137.13	13.75	143.39	18.85	75.45	30.09	.00	.00	.00	.00
WIN2-7	149.80	13.97	160.37	20.72	190.39	30.00	254.30	10.97	.00	.00
WIN2-8	451.15	11.38	269.32	21.85	169.68	28.87	.00	.00	.00	.00
WIN2-9	296.96	11.37	342.53	21.84	440.58	17.87	231.91	11.00	.00	.00
WIN2-10	277.46	11.38	281.07	21.83	230.45	28.87	.00	.00	.00	.00
WIN2-11	221.83	11.37	316.36	21.83	219.88	28.88	.00	.00	.00	.00
WIN2-12	172.88	11.38	279.48	21.81	199.22	28.88	.00	.00	.00	.00
WIN2-13	145.30	11.36	147.06	21.83	147.10	28.88	.00	.00	.00	.00
WIN2-14	452.65	12.31	373.70	20.87						
WIN2-15	207.04	11.27	146.79	20.63	231.96	30.07	.00	.00	.00	.00
WIN2-16	305.32	11.83	325.06	21.04	329.24	29.14	.00	.00	.00	.00
WIN2-17	371.38	11.81	642.84	21.03	330.41	29.15	.00	.00	.00	.00
WIN2-18	203.07	11.80	111.22	21.03	193.86	29.13	.00	.00	.00	.00
WIN2-19	572.34	11.73	234.21	20.98	133.18	28.19	.00	.00	.00	.00
WIN2-20	193.97	11.73	77.45	20.98	31.18	28.19	.00	.00	.00	.00
WIN2-21	154.08	11.71	113.97	20.11	77.65	29.06	.00	.00	.00	.00
WIN2-23	87.81	11.01	99.82	20.07	251.40	29.19	.00	.00		
WIN2-24	255.75	10.98	176.85	20.05	92.30	29.06	.00	.00	.00	.00
WIN2-25	490.36	10.97	213.16	20.05	469.64	29.05	.00	.00	.00	.00
WIN2-26	321.34	10.96	291.57	20.08	139.54	29.01	.00	.00	.00	.00
WIN2-27	452.07	10.95	393.51	20.08	322.67	.90	314.98	28.11	.00	.00
WIN2-28	190.69	10.95	133.40	20.08	206.61	29.01	.00	.00	.00	.00
WIN2-29	185.57	10.94	221.07	20.09	176.09	29.00	.00	.00	.00	.00
WIN2-30	329.32	10.93	294.25	20.09	338.80	29.00	.00	.00	.00	.00
WIN2-31	334.29	10.92	411.76	20.09	417.80	18.77	301.25	10.23	.00	.00
WIN2-32	232.74	10.92	227.29	20.09	161.27	29.00	.00	.00	.00	.00
WIN2-33	183.24	10.90	145.64	20.11	127.51	29.93	.00	.00	.00	.00
WIN2-34	322.63	9.26	334.72	20.70	409.64	30.02	.00	.00	.00	.00
WIN2-35	554.52	10.04	725.81	20.08	535.32	.94	788.81	17.88	.00	.00
WIN2-36	265.43	10.03	300.70	20.08	359.18	29.02	.00	.00	504.23	10.20
WIN2-37	240.59	10.02	108.39	20.08	59.07	29.02	.00	.00	.00	.00
WIN2-38	454.80	10.01	194.16	20.08	231.82	29.02	.00	.00	.00	.00
WIN2-14#	stolen								.00	.00
WIN2-17#	330.41	29.15	.00	.00	.00	.00	.00	.00		
WIN2-27#	314.98	28.11	.00	.00	.00	.00	.00	.00	.00	.00
WIN2-35#	535.32	.94	.00	.00	.00	.00	.00	.00	.00	.00
WIN2-35@	788.81	17.88	.00	.00	.00	.00	.00	.00	.00	.00
WIN2-5#	254.30	10.97	.00	.00	.00	.00	.00	.00	.00	.00
WIN2-9#	231.91	11.00	.00	.00	.00	.00	.00	.00	.00	.00
WIN2-31#	301.25	10.23	.00	.00	.00	.00	.00	.00	.00	.00
WIN2-35!	504.23	10.20	.00	.00	.00	.00	.00	.00	.00	.00

APPENDIX I - 2

Raw Data and Calculations

KENT AND LAMBTON COUNTIES, WALLACEBURG AREA

AURORA ENVIRONMENTAL SURVEYS LIMITED

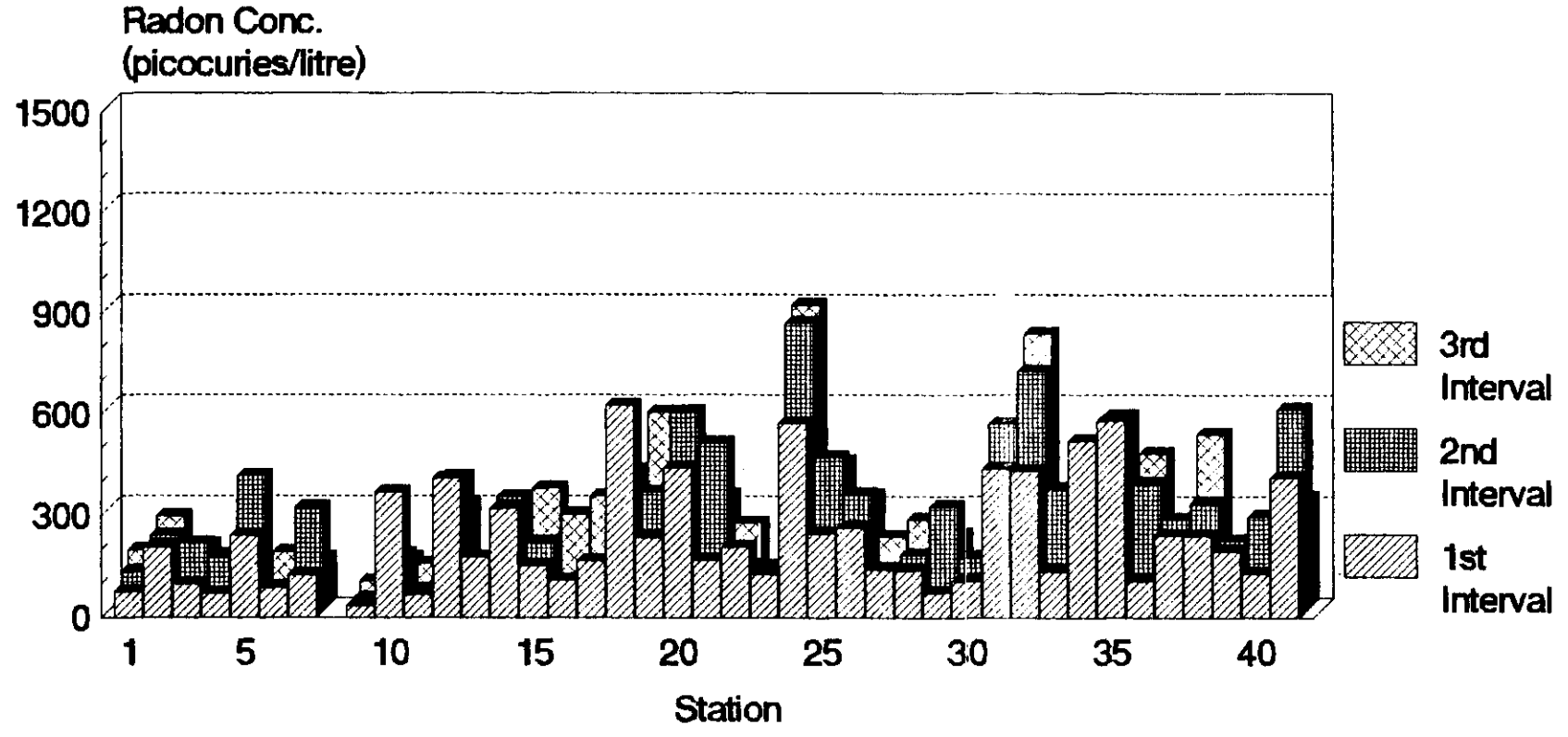
SOIL RADON GAS STUDY of SOUTHERN ONTARIO

WALLACEBURG AREA ENVIRONMENT # 1

Sample #	Electret	Day	Time Hrs	Minutes	V(1)	Day	Time Hrs	Minutes	V(2)	Day	Time Hrs	Minutes	V(3)	Day	Time Hrs	Minutes	V(4)
WAL1-1	LB 1724	275	8	25	713	289	7	58	674	308	9	48	595	338	16	2	429
WAL1-2	LC 2985	275	9	0	757	289	8	31	652	308	9	29	506	338	15	30	252
WAL1-3	LC 5312	275	8	40	744	282	9	45	724	289	8	18	693	308	9	40	558
WAL1-4	LC 4137	275	9	45	724	289	8	25	689	308	10	23	583	338	15	10	432
WAL1-5	LC 0673	275	10	45	765	289	9	26	642	308	10	42	384				
WAL1-6	LB 8714	275	11	10	759	282	8	55	737	308	11	55	671	338	14	0	508
WAL1-7	LC 5473	275	11	30	707	289	9	37	645	308	12	0	445	338	13	50	311
WAL1-8																	
WAL1-9	LC 4283	275	16	25	733	289	10	44	717	308	9	11	692	338	16	57	618
WAL1-10	LC 5319	275	16	40	717	289	11	4	537	308	9	19	431	338	16	46	296
WAL1-11	LC 2882	275	16	55	737	289	11	12	703	308	8	32	662	338	16	14	533
WAL1-12	LC 5238	275	17	25	757	289	11	19	556	308	8	22	310				
WAL1-13	LC 2928	275	17	45	759	289	11	27	670	Stolen							
WAL1-14	LC 4167	275	18	15	734	289	11	36	576	308	7	57	364				
WAL1-15	LC 5493	276	8	30	723	290	8	25	646	308	17	30	517	339	8	21	181
WAL1-16	LC 5338	276	8	55	715	289	11	45	663	308	8	7	610	339	8	40	334
WAL1-17	LB 0949	276	9	20	725	289	11	53	646	308	8	44	550	339	9	17	228
WAL1-18	LC 5462	276	10	10	710	289	12	10	426	308	8	54	181				
WAL1-19	LC 1984	276	10	35	755	290	9	34	636	308	16	57	418				
WAL1-20	LC 5395	276	11	50	733	290	9	3	516	309	11	50	161				
WAL1-21	LC 4304	276	13	20	736	290	13	35	650	309	12	18	334	329	8	44	94
WAL1-22	LC 2831	276	13	50	723	290	8	25	620	309	16	4	526	339	11	2	291
WAL1-23	LC 4293	276	14	5	740	281	17	5	717	290	8	35	676	309	11	40	577
WAL1-24	LB 3201	276	14	35	754	289	15	35	490	308	13	10	0				
WAL1-25	LC 5308	276	18	20	736	289	16	7	621	309	12	49	320				
WAL1-26	LC 5412	277	8	30	702	290	10	54	579	309	12	28	360	329	8	58	98
WAL1-27	LC 4152	277	9	30	724	290	11	8	659	309	13	1	573	339	15	33	372
WAL1-28	LC 2945	277	9	45	730	290	11	18	664	309	13	7	553	339	15	45	303
WAL1-29	LC 5531	277	10	5	729	290	11	44	694	309	14	2	490	340	8	12	284
WAL1-30	LC 4131	277	10	25	743	290	11	52	692	309	14	18	585	340	9	18	457
WAL1-31	LC 5459	277	10	40	702	290	11	36	502	309	13	55	168				
WAL1-32	LC 5379	277	10	55	731	289	16	18	543	309	13	18	101				
WAL1-33	LC 2855	277	12	15	734	289	18	10	674	309	15	30	427	340	10	28	317
WAL1-34*	LC 2907	277	12	30	736	289	18	19	511	309	15	17	339				
WAL1-35	LC 4101	277	12	50	716	289	18	25	469	309	15	9	112				
WAL1-36	LC 5429	277	13	5	708	290	12	32	658	309	14	47	413	340	10	4	0
WAL1-37	LC 4124	277	13	25	717	290	12	23	605	309	14	40	429	340	9	56	288
WAL1-38	LC 5470	277	13	45	736	290	12	16	623	309	14	32	417	329	9	21	128
WAL1-39	LC 4154	277	14	5	734	290	11	58	643	309	14	24	506	340	8	51	321
WAL1-40	LC 5351	277	14	25	711	290	12	45	651	309	14	10	467	340	9	36	222
WAL1-41	LC 4220	277	14	45	724	290	13	0	535	309	14	55	172				
WAL1-5#	LC 2955	308	10	42	759	338	14	43	623								
WAL1-12#	LC 5247	308	8	23	706	339	8	59	387								
WAL1-14#	LC 5359	308	7	58	744	339	8	52	521								
WAL1-18#	LC 4287	308	8	55	720	339	9	34	323	348	9	53	145				
WAL1-19#	LC 4150	308	16	57	717	339	9	50	142								
WAL1-20#	LC 0673	309	11	50	384	313	10	46	376								
WAL1-20@	LC 5260	313	10	46	703	339	10	16	562	348	8	57	538				
WAL1-24#	LC 4244	308	13	10	737	329	15	20	0								
WAL1-25#	LC 4202	313	11	11	705	339	15	37	327								
WAL1-31#	LC 5306	309	13	55	407	313	11	20	357								
WAL1-31@	LC 4314	313	11	20	745	340	8	29	503								
WAL1-32#	LC 4157	309	13	19	369	313	11	18	278								
WAL1-32@	LC 4233	313	11	18	734	339	15	25	45								
WAL1-34#	LB 8795	313	12	16	735	340	10	23	552								
WAL1-35#	LB 3123	309	15	9	331	313	12	9	306								
WAL1-35@	LC 5368	313	12	30	734	340	10	13	452								
WAL1-41#	LC 4230	309	14	55	304	313	11	58	240								
WAL1-41@	LC 4236	313	11	58	713	340	10	48	445								
WAL1-38#	LC 5238	329	9	21	300	340	9	47	110								
WAL1-26#	LB 9822	329	8	57	328	339	11	24	292								
WAL1-24@	LC 6905	329	15	20	710	339	12	16	549								
WAL1-21#	LC 5647	329	8	44	336	339	11	13	295								

Sample #	Electret	Day	Time Hrs	Minute	V(5)
WAL1-3	LC 5312	338	15	45	379
WAL1-23	LC 4293	339	10	48	459

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO
WALLACEBURG
Soil Radon Gas Concentration
Environment 1



AURORA ENVIRONMENTAL SURVEYS LIMITED

01-20-92

Radon Concentrations - Average from date of emplacement

SOIL GAS RADON STUDY of SOUTHERN ONTARIO

WALLACEBURG AREA ENVIRONMENT # 1
(gamma corrected for 19.13 uR/hr)

Sample #	(1) Rn pCi/L	Days	(2) Rn pCi/L	Days	(3) Rn pCi/L	Days	(4) Rn pCi/L	Days	Summary Rn pCi/L	Days
WAL1-1	74.97	13.98	95.89	33.76	126.16	64.02	126.16	64.02	126.16	64.02
WAL1-2	204.93	13.98	208.20	33.77	231.88	64.02	231.88	64.02	231.88	64.02
WAL1-3	75.22	7.05	92.91	14.71	152.62	33.76	163.38	64.02	163.38	64.02
WAL1-4	66.91	13.94	114.78	33.84	129.39	64.04	129.39	64.04	129.39	64.04
WAL1-5	241.15	13.95	322.77	33.89	228.53	64.06	228.53	64.06	228.53	64.06
WAL1-6	84.27	6.91	68.93	33.96	108.61	64.05	108.61	64.05	108.61	64.05
WAL1-7	121.83	13.92	220.55	33.98	180.92	64.06	180.92	64.06	180.92	64.06
WAL1-8										
WAL1-9	29.55	13.76	30.82	34.07	47.49	64.39	47.49	64.39	47.49	64.39
WAL1-10	368.60	13.77	240.41	34.08	191.65	64.39	191.65	64.39	191.65	64.39
WAL1-11	65.50	13.76	58.57	34.06	87.33	64.38	87.33	64.38	87.33	64.38
WAL1-12	408.11	13.75	382.90	34.07	342.52	65.12	342.52	65.12	342.52	65.12
WAL1-13	175.83	13.74	stolen				175.83	13.74	175.83	13.74
WAL1-14	321.02	13.72	314.54	34.09	260.48	65.13	260.48	65.13	260.48	65.13
WAL1-15	150.57	14.00	174.79	33.08	255.43	63.70	255.43	63.70	255.43	63.70
WAL1-16	107.68	13.12	87.61	32.71	173.84	63.73	173.84	63.73	173.84	63.73
WAL1-17	165.13	13.11	148.69	32.75	231.54	63.78	231.54	63.78	231.54	63.78
WAL1-18	626.94	13.08	487.55	32.79	454.63	73.75	454.63	73.75	454.63	73.75
WAL1-19	233.69	13.96	290.41	33.15	424.83	63.85	424.83	63.85	424.83	63.85
WAL1-20	441.47	13.88	508.50	33.99	313.61	69.81	313.61	69.81	313.61	69.81
WAL1-21	167.75	14.01	343.99	34.07	363.61	53.92	326.36	64.02	326.36	64.02
WAL1-22	206.45	13.77	161.03	34.25	197.79	64.04	197.79	64.04	197.79	64.04
WAL1-23	120.49	5.13	115.72	14.94	131.87	34.07	123.44	64.04	123.44	64.04
WAL1-24	572.97	13.04	707.16	33.16	795.42	64.09	795.42	64.09	795.42	64.09
WAL1-25	245.80	12.91	354.59	34.30	380.90	61.10	380.90	61.10	380.90	61.10
WAL1-26	262.75	13.10	303.47	32.87	351.82	52.73	313.26	62.83	313.26	62.83
WAL1-27	135.57	13.07	126.74	32.94	160.76	63.04	160.76	63.04	160.76	63.04
WAL1-28	137.46	13.06	149.27	32.95	197.80	63.06	197.80	63.06	197.80	63.06
WAL1-29	71.41	13.07	204.43	33.00	204.73	63.76	204.73	63.76	204.73	63.76
WAL1-30	104.95	13.06	131.60	33.03	126.08	63.82	126.08	63.82	126.08	63.82
WAL1-31	436.80	13.04	490.75	33.02	385.04	63.79	385.04	63.79	385.04	63.79
WAL1-32	432.39	12.22	584.01	33.01	689.39	63.10	689.39	63.10	689.39	63.10
WAL1-33	132.90	12.25	264.87	33.16	189.76	63.95	189.76	63.95	189.76	63.95
WAL1-34*	519.72	12.24	348.75	33.16	277.34	60.08	277.34	60.08	277.34	60.08
WAL1-35	577.75	12.23	557.59	33.17	427.24	63.95	427.24	63.95	427.24	63.95
WAL1-36	104.82	12.98	256.30	33.16	346.22	63.96	346.22	63.96	346.22	63.96
WAL1-37	239.92	12.96	248.92	33.17	196.93	63.97	196.93	63.97	196.93	63.97
WAL1-38	240.82	12.94	275.53	33.18	348.15	52.96	387.28	63.98	387.28	63.98
WAL1-39	193.26	12.91	193.09	33.19	187.75	63.96	187.75	63.96	187.75	63.96
WAL1-40	126.80	12.93	209.16	33.19	227.85	64.00	227.85	64.00	227.85	64.00
WAL1-41	412.06	12.93	501.57	33.24	412.42	64.07	412.42	64.07	412.42	64.07
WAL1-5#	122.68	30.17								
WAL1-12#	298.15	31.03								
WAL1-14#	201.11	31.04								
WAL1-18#	375.12	31.03	428.02	40.78						
WAL1-19#	569.97	30.70								
WAL1-20#	60.73	3.96								
WAL1-20@	151.36	25.98	128.68	35.82						
WAL1-24#	1091.62	21.09								
WAL1-25#	424.40	26.18								
WAL1-31#	397.66	3.89								
WAL1-31@	253.36	26.88								
WAL1-32#	738.50	3.92								
WAL1-32@	814.95	26.17								
WAL1-34#	189.38	26.92								
WAL1-35#	203.79	3.88								
WAL1-35@	298.74	26.90								
WAL1-41#	535.22	3.88								
WAL1-41@	284.78	26.95								
WAL1-38#	575.35	11.02								
WAL1-26#	111.94	10.10								
WAL1-24@	459.90	9.87								
WAL1-21#	127.49	10.10								

AURORA ENVIRONMENTAL SURVEYS LIMITED

Radon Concentrations - (Incremental)

SOIL GAS RADON STUDY of SOUTHERN ONTARIO

WALLACEBURG AREA ENVIRONMENT # 1
(gamma corrected for 19.13 uR/hr)

Sample #	(1) Rn pCi/L	Days	(2) Rn pCi/L	Days	(3) Rn pCi/L	Days	(4) Rn pCi/L	Days	(5) Rn pCi/L	Days
WAL1-1	74.97	13.98	114.86	19.08	160.10	30.26	.00	.00	.00	.00
WAL1-2	204.93	13.98	219.08	19.04	259.45	30.25	.00	.00	.00	.00
WAL1-3	75.22	7.05	120.78	6.94	198.77	19.06	175.79	30.25	.00	.00
WAL1-4	66.91	13.94	154.77	19.08	145.97	30.20	.00	.00	.00	.00
WAL1-5	241.15	13.95	398.41	19.05	122.68	30.17	.00	.00	.00	.00
WAL1-6	84.27	6.91	67.42	26.13	153.51	30.09	.00	.00	.00	.00
WAL1-7	121.83	13.92	303.86	19.10	136.64	30.08	.00	.00	.00	.00
WAL1-8										
WAL1-9	29.55	13.76	34.13	18.94	66.23	30.32	.00	.00	.00	.00
WAL1-10	368.60	13.77	165.27	18.93	137.41	30.31	.00	.00	.00	.00
WAL1-11	65.50	13.76	58.06	18.89	119.70	30.32	.00	.00	.00	.00
WAL1-12	408.11	13.75	395.37	18.88	298.15	31.03	.00	.00	.00	.00
WAL1-13	175.83	13.74								
WAL1-14	321.02	13.72	336.05	18.85	201.11	31.04	.00	.00	.00	.00
WAL1-15	150.57	14.00	200.16	18.38	343.93	30.62	.00	.00	.00	.00
WAL1-16	107.68	13.12	77.19	18.85	265.12	31.02	.00	.00	.00	.00
WAL1-17	165.13	13.11	143.56	18.87	319.97	31.02	.00	.00	.00	.00
WAL1-18	626.94	13.08	415.14	18.86	375.12	31.03	.00	.00	.00	.00
WAL1-19	233.69	13.96	348.21	18.31	569.97	30.70	.00	.00	.00	.00
WAL1-20	441.47	13.88	586.11	19.12	60.73	3.96	151.36	25.98	76.00	8.95
WAL1-21	167.75	14.01	495.20	18.95	401.13	19.85	127.49	10.10	.00	.00
WAL1-22	206.45	13.77	138.49	19.32	240.75	29.79	.00	.00	.00	.00
WAL1-23	120.49	5.13	128.91	8.65	144.54	19.13	114.02	29.96	.00	.00
WAL1-24	572.97	13.04	851.55	18.90	1091.62	21.09	459.90	9.87	.00	.00
WAL1-25	245.80	12.91	453.47	19.86	424.40	26.18	.00	.00	.00	.00
WAL1-26	262.75	13.10	343.31	19.07	435.24	19.85	111.94	10.10	.00	.00
WAL1-27	135.57	13.07	126.09	19.08	198.35	30.11	.00	.00	.00	.00
WAL1-28	137.46	13.06	163.88	19.08	251.57	30.11	.00	.00	.00	.00
WAL1-29	71.41	13.07	304.65	19.10	205.83	30.76	.00	.00	.00	.00
WAL1-30	104.95	13.06	155.95	19.10	120.34	30.79	.00	.00	.00	.00
WAL1-31	436.80	13.04	552.66	19.10	397.66	3.89	253.36	26.88	.00	.00
WAL1-32	432.39	12.22	707.08	19.88	738.50	3.92	814.95	26.17	.00	.00
WAL1-33	132.90	12.25	360.05	19.89	109.38	30.79	.00	.00	.00	.00
WAL1-34*	519.72	12.24	262.63	19.87	189.38	26.92	.00	.00	.00	.00
WAL1-35	577.75	12.23	578.45	19.86	203.79	3.88	298.74	26.90	.00	.00
WAL1-36	104.82	12.98	374.19	19.09	446.54	30.80	.00	.00	.00	.00
WAL1-37	239.92	12.96	270.03	19.10	141.57	30.80	.00	.00	.00	.00
WAL1-38	240.82	12.94	316.10	19.09	473.27	19.78	575.35	11.02	.00	.00
WAL1-39	193.26	12.91	205.11	19.10	182.59	30.77	.00	.00	.00	.00
WAL1-40	126.80	12.93	278.49	19.06	249.05	30.81	.00	.00	.00	.00
WAL1-41	412.06	12.93	596.87	19.08	535.22	3.88	284.78	26.95	.00	.00
WAL1-5#	122.68	30.17								
WAL1-12#	298.15	31.03								
WAL1-14#	201.11	31.04								
WAL1-18#	375.12	31.03	651.12	9.01						
WAL1-19#	569.97	30.70								
WAL1-20#	60.73	3.96								
WAL1-20a	151.36	25.98	76.00	8.95						
WAL1-24#	1091.62	21.09								
WAL1-25#	424.40	26.18								
WAL1-31#	397.66	3.89								
WAL1-31a	253.36	26.88								
WAL1-32#	738.50	3.92								
WAL1-32a	814.95	26.17								
WAL1-34#	189.38	26.92								
WAL1-35#	203.79	3.88								
WAL1-35a	298.74	26.90								
WAL1-41#	535.22	3.88								
WAL1-41a	284.78	26.95								
WAL1-38#	575.35	11.02								
WAL1-26#	111.94	10.10								
WAL1-24a	459.90	9.87								
WAL1-21#	127.49	10.10								

AURORA ENVIRONMENTAL SURVEYS LIMITED

SOIL RADON GAS STUDY of SOUTHERN ONTARIO

WALLACEBURG AREA **ENVIRONMENT # 2**

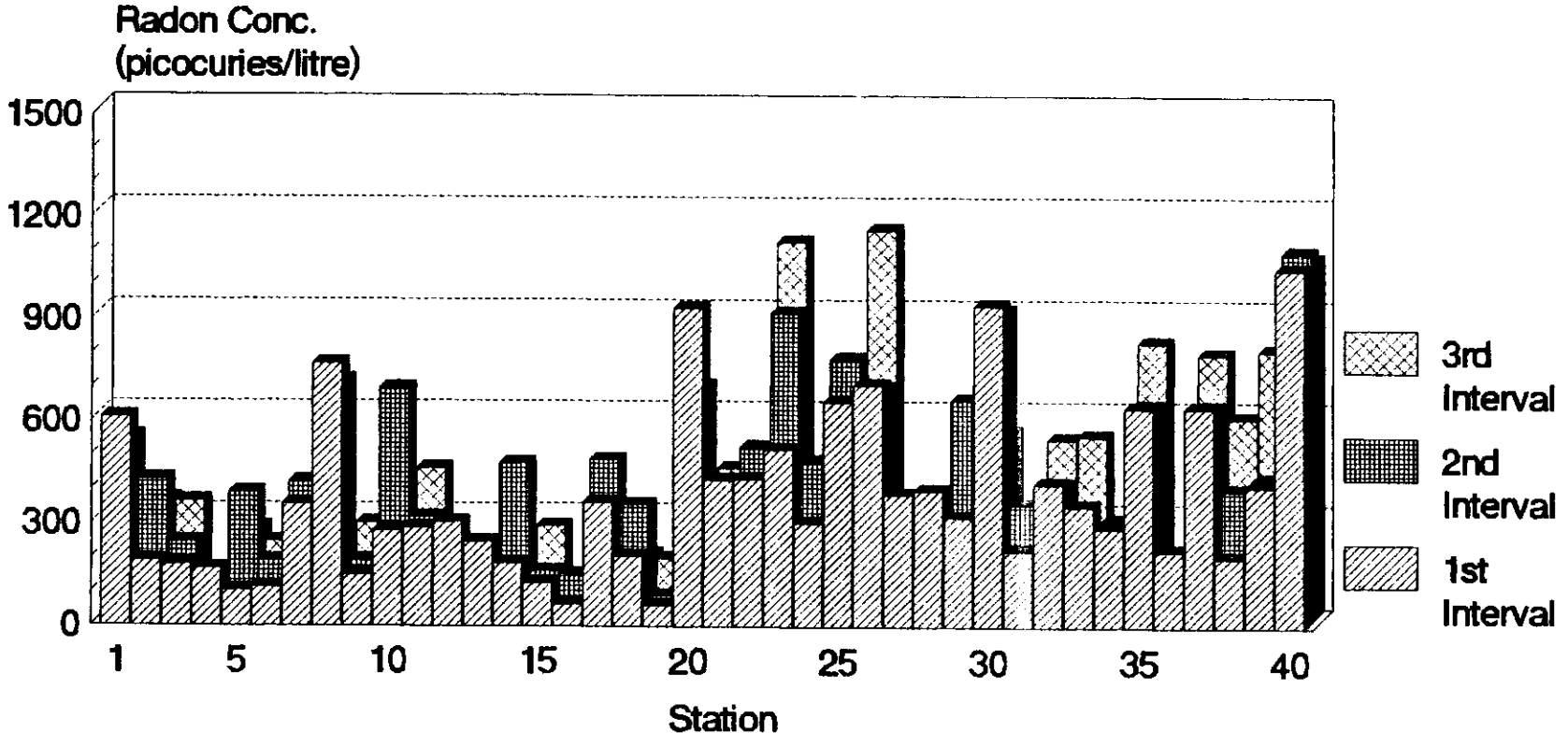
Sample #	Electret	Day	Time Hrs	Minutes	V(i)	Day	Time Hrs	Minutes	V(2)	Day	Time Hrs	Minutes	V(3)	Day	Time Hrs	Minutes	V(4)
WAL2-1	LB 8668	275	9	25	749	289	8	45	451	308	10	0	136				
WAL2-2	LC 4157	275	10	5	726	289	9	3	631	308	10	15	369				
WAL2-3	LB 8770	275	10	25	760	282	8	40	734	289	9	10	667	308	10	33	515
WAL2-4	LC 0510	275	11	50	762	289	9	45	677	308	12	7	590	338	13	43	465
WAL2-5	LC 4256	275	12	10	725	289	13	0	672	308	12	26	430	338	13	33	196
WAL2-6	LC 4132	275	13	0	678	289	13	10	622	308	12	18	511	338	12	5	307
WAL2-7	LC 5535	275	13	15	707	289	13	15	531	307	17	12	293				
WAL2-8	LC 2994	275	13	30	751	289	13	28	380								
WAL2-9	LC 1327	275	13	45	748	289	13	50	671	307	16	54	560	338	11	33	295
WAL2-10	LC 2957	275	14	5	752	289	13	58	612	307	16	43	212				
WAL2-11	LC 5306	275	14	20	743	289	15	14	598	308	13	27	407				
WAL2-12	LC 4187	275	14	40	722	289	12	52	571	308	12	33	450	338	12	54	358
WAL2-13	LC 1802	275	14	55	752	289	12	43	627	308	12	43	499	338	13	2	397
WAL2-14	LB 1717	275	15	10	755	282	9	15	734	289	12	30	659	308	12	53	363
WAL2-15	LC 5370	275	15	35	736	289	10	9	673	308	11	37	577	338	14	16	323
WAL2-16	LC 2867	275	15	55	748	289	10	13	716	308	10	55	626	338	14	31	549
WAL2-17	LC 5502	275	16	10	711	289	10	22	535	308	11	3	248				
WAL2-18	LC 4190	276	9	45	733	289	12	5	636	308	9	2	420	339	9	28	247
WAL2-19	LC 5520	276	11	0	746	290	9	30	715	308	17	0	669	339	10	1	497
WAL2-20	LC 5444	276	11	25	710	290	9	17	274								
WAL2-21	LC 2801	276	13	35	697	290	10	40	490	309	11	58	393	339	10	27	14
WAL2-22	LC 5481	276	14	20	737	289	15	47	537	308	16	47	227				
WAL2-23	LB 2346	276	14	50	758	289	15	25	519	308	13	15	0				
WAL2-24	LC 5455	276	15	10	718	289	15	0	578	308	13	38	290				
WAL2-25	LC 2911	276	15	30	730	289	14	56	434	308	13	46	0				
WAL2-26	LB 1181	276	16	5	749	289	14	25	431	307	16	19	58				
WAL2-27	LC 4757	276	16	25	732	289	14	10	556	307	16	28	468	339	13	14	248
WAL2-28	LC 5456	276	16	45	711	289	17	18	529	307	16	9	357				
WAL2-29	LC 2798	276	17	0	734	289	14	18	587	307	16	33	211				
WAL2-30	LC 5499	276	17	15	718	289	17	5	304								
WAL2-31	LC 5426	276	17	30	741	289	17	40	637	307	15	49	431	339	14	26	334
WAL2-32	LC 5329	276	17	50	713	289	17	45	523	307	15	35	292				
WAL2-33*	LC 4153	276	18	5	749	289	17	40	586	309	13	27	504	339	15	15	24
WAL2-34	LC 4127	277	8	50	738	290	10	29	603	309	12	8	416	339	11	36	210
WAL2-35	LC 5380	277	9	10	726	281	17	15	632	289	16	0	451	309	12	38	68
WAL2-36	LC 1415	277	11	15	752	290	11	28	648	309	13	48	555	340	8	39	376
WAL2-37	LC 4103	277	11	35	711	289	16	30	440	309	13	35	62				
WAL2-38	LC 4211	277	11	55	739	289	18	0	649	309	15	39	392	329	10	23	0
WAL2-39	LC 4230	277	15	25	734	289	16	55	558	308	14	8	304				
WAL2-40	LC 4181	277	15	50	741	289	14	40	315								
WAL2-8#	LB 4613	289	13	30	730	307	17	2	300								
WAL2-8A	LB 3998	289	13	31	724	307	17	1	504	329	14	36	0				
WAL2-30#	LC 4165	289	17	9	743	307	16	0	200								
WAL2-20#	LC 4197	290	9	18	723	308	17	13	297								
WAL2-40#	LC 5339	289	14	41	713	308	13	55	54								
WAL2-26#	LC 3648	307	16	20	728	329	13	5	24								
WAL2-20@	LC 4097	308	17	13	737	329	15	38	446	336	15	32	415	348	9	5	376
WAL2-1#	LC 4139	308	10	10	731	329	16	36	613	338	15	20	527				

AURORA ENVIRONMENTAL SURVEYS LIMITED

WAL2-2#	LC 5464	308	10	16	700	338	15	4	356								
WAL2-8@	LC 3658	307	17	3	747	329	14	38	579	336	11	45	542	347	15	42	468
WAL2-10#	LC 5512	307	16	45	727	338	11	29	425								
WAL2-11#	LC 4240	308	13	27	705	339	12	32	265								
WAL2-14#	LC 5392	308	12	53	712												
WAL2-17#	LC 5354	308	11	4	743	338	14	26	433								
WAL2-22#	LC 4295	308	16	47	728	339	12	6	273								
WAL2-23#	LC 4261	308	13	15	734	329	15	9	0								
WAL2-24#	LC 4203	308	13	38	736	339	12	40	400	347	15	17	384				
WAL2-25#	LC 5248	308	13	46	750	329	13	54	282	336	14	2	175				
WAL2-28#	LB 5777	307	16	11	736	339	12	58	541								
WAL2-29#	LB 4543	307	16	35	744	339	14	9	287								
WAL2-30@	LC 3626	307	16	3	719	329	11	44	472	347	10	53	40				
WAL2-32#	LB 9912	308	15	38	733	339	14	35	206								
WAL2-35#	LC 5456	309	12	39	357	313	10	57	256								
WAL2-35@	LC 4156	313	11	29	728	339	1	48	72								
WAL2-37#	LB 1717	309	13	35	363	313	11	29	298								
WAL2-37@	LC 5285	313	11	29	709	329	11	35	370	339	15	8	43				
WAL2-39#	LC 2784	308	14	8	741	329	12	23	179								
WAL2-40@	LC 5336	308	13	55	714	329	13	38	0								
WAL2-40!	LC 6904	329	13	38	723	336	12	34	468								
WAL2-39@	LB 8362	329	12	23	725	336	12	10	567	347	14	8	283				
WAL2-38#	LB 8543	329	10	23	706	339	14	54	563								
WAL2-26@	LB 8392	329	13	5	705	339	13	8	243								
WAL2-26!d	LC 5359	339	13	8	521	347	13	12	363								
WAL2-25@	LC 5386	336	14	2	441	347	14	42	257								
WAL2-23@	LB 8448	329	15	9	728	339	12	25	564	348	10	10	424				
WAL2-17#	LC 5354	308	11	4	743	338	14	26	433								
WAL2-8A#	LB 6893	329	14	36	724	338	11	43	345	347	15	40	249				
WAL2-7#	LC 5259	307	17	13	738	338	11	50	540								
WAL2-26!	LC 5327	339	13	8	428	347	13	12	262								
WAL2-40!!	LC 5249	336	12	34	550	348	13	31	159								

Sample #	Electret	Day	Time Hrs	Minutes	V(5)
WAL2-3	LB 8770	338	14	54	200

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO
WALLACEBURG
Soil Radon Gas Concentration
Environment 2



AURORA ENVIRONMENTAL SURVEYS LIMITED

01-20-92

AURORA ENVIRONMENTAL SURVEYS LIMITED

Radon Concentration (Average from placement date)

SOIL GAS RADON STUDY of SOUTHERN ONTARIO — WALLACEBURG AREA — **ENVIRONMENT # 2**

(gamma corrected for 19.16 uR/ hr)

Sample #	(1) Rn pCi/L	Days	(2) Rn pCi/L	Days	(3) Rn pCi/L	Days	(4) Rn pCi/L	Days	Summary Rn pCi/L	Days
WAL2-1	608.70	13.97	562.04	33.02	383.82	63.24			383.82	63.24
WAL2-2	187.24	13.96	313.63	33.01	322.82	63.21			322.82	63.21
WAL2-3	99.73	6.93	181.08	13.95	202.09	33.87	261.97	64.05	261.97	64.05
WAL2-4	165.37	13.91	142.92	33.01	129.86	64.06			129.86	64.06
WAL2-5	102.11	14.03	255.84	33.01	246.97	64.07			246.97	64.07
WAL2-6	110.17	14.01	143.10	32.97	170.46	64.05			170.46	64.05
WAL2-7	355.35	14.00	380.46	32.16	282.14	62.94			282.14	62.94
WAL2-8	766.66	14.00	432.68	40.05	409.42	72.21			409.42	72.21
WAL2-9	149.14	14.00	162.06	32.13	206.30	64.05			206.30	64.05
WAL2-10	275.91	14.00	501.26	32.11	393.59	62.89			393.59	62.89
WAL2-11	286.16	14.04	292.41	32.96	355.53	63.92			355.53	63.92
WAL2-12	303.14	13.93	235.68	32.91	163.91	64.15			163.91	64.15
WAL2-13	246.99	13.91	215.90	32.91	157.69	64.16			157.69	64.16
WAL2-14	82.30	6.75	188.24	13.89	331.37	34.17			331.37	34.17
WAL2-15	123.90	13.77	133.61	32.83	186.75	64.24			186.75	64.24
WAL2-16	61.24	13.76	100.99	32.79	84.86	64.27			84.86	64.27
WAL2-17	361.10	13.76	420.94	32.79	359.98	62.93			359.98	62.93
WAL2-18	203.49	13.10	280.61	31.97	225.09	63.80			225.09	63.80
WAL2-19	58.51	13.94	63.51	32.25	108.50	63.88			108.50	63.88
WAL2-20	932.58	13.91	792.50	32.24	490.40	73.34			490.40	73.34
WAL2-21	426.00	13.88	267.59	32.93	333.51	64.00			333.51	64.00
WAL2-22	430.52	13.06	473.39	32.10	455.50	62.90			455.50	62.90
WAL2-23	516.08	13.02	737.63	31.93	877.11	53.01	769.33	71.80	769.33	71.80
WAL2-24	301.04	12.99	395.63	31.94	320.81	71.01			320.81	71.01
WAL2-25	655.51	12.98	714.44	31.93	668.90	59.94			668.90	59.94
WAL2-26	704.82	12.93	685.61	31.01	816.68	52.87	907.08	62.87	878.42	70.87
WAL2-27	382.16	12.91	241.65	31.00	222.62	64.24			222.62	64.24
WAL2-28	395.15	13.02	333.22	30.98	250.74	62.85			250.74	62.85
WAL2-29	317.38	12.89	505.01	30.98	462.51	62.88			462.51	62.88
WAL2-30	941.28	12.99	921.42	30.94	701.03	70.72			701.03	70.72
WAL2-31	219.52	13.01	286.31	30.93	183.19	64.33			183.19	64.33
WAL2-32	413.76	13.00	402.40	30.91	456.19	61.87			456.19	61.87
WAL2-33*	348.69	12.98	209.58	32.81	347.65	64.39			347.65	64.39
WAL2-34	286.17	13.07	287.17	32.14	250.02	62.85			250.02	62.85
WAL2-35	601.16	4.34	641.71	12.28	616.55	32.91	638.56	36.84	700.64	62.44
WAL2-36	218.62	13.01	170.10	32.11	168.71	63.83			168.71	63.83
WAL2-37	639.56	12.20	626.40	32.08	615.47	35.99	689.97	62.14	689.97	62.14
WAL2-38	201.10	12.25	310.80	32.16	434.59	52.93	428.16	63.12	434.59	52.93
WAL2-39	408.76	12.06	407.94	30.95	569.60	51.88	609.45	69.95	569.60	51.88
WAL2-40	1046.50	11.95	1066.30	30.92	1066.81	51.91	1064.79	58.87	1057.58	70.91
WAL2-8#	698.34	18.15								
WAL2-8A	343.25	18.15	565.14	40.05					565.14	40.05
WAL2-30#	907.04	17.95								
WAL2-20#	686.20	18.33								
WAL2-40#	1078.78	18.97								
WAL2-26#	1002.61	21.86								
WAL2-20@	397.17	20.93	330.91	27.93	253.43	41.10				
WAL2-1#	152.56	21.27	189.08	30.22						
WAL2-2#	332.86	30.20								

WAL2-8@	212.51	21.90	198.49	28.78	190.40	41.36
WAL2-10#	281.27	30.78				
WAL2-11#	422.73	30.96				
WAL2-14#	stolen					
WAL2-17#	293.65	30.14				
WAL2-22#	436.85	30.80				
WAL2-23#	1088.39	21.08				
WAL2-24#	312.30	30.96	259.65	39.07		
WAL2-25#	656.24	21.01	616.98	28.01		
WAL2-28#	170.57	31.87				
WAL2-29#	421.24	31.90				
WAL2-30@	322.52	21.82	529.62	39.78		
WAL2-32#	509.90	30.96				
WAL2-35#	822.86	3.93				
WAL2-35@	789.97	25.60				
WAL2-37#	525.80	3.91				
WAL2-37@	618.27	16.00	792.51	26.15		
WAL2-39#	808.65	20.93				
WAL2-40@	1067.56	20.99	(>than 1067.56)			
WAL2-40!	1049.69	6.96				
WAL2-39@	634.42	6.99	723.87	18.07		
WAL2-38#	394.77	10.19				
WAL2-26@	1385.01	10.00				
WAL2-26!d	598.06	8.00				
WAL2-25@	524.12	11.03				
WAL2-23@	465.05	9.89	465.24	18.79		
WAL2-17#	293.65	30.14				
WAL2-8A#	1250.48	8.88	784.55	18.04		
WAL2-7#	179.41	30.78				
WAL2-26!	653.20	8.00				
WAL2-40!!	1022.36	12.04				

AURORA ENVIRONMENTAL SURVEYS LIMITED

Radon Concentrations - (Incremental)

SOIL GAS RADON STUDY of SOUTHERN ONTARIO

WALLACEBURG AREA **ENVIRONMENT # 2**
(gamma corrected for 19.16 uR/hr)

Sample #	(1) Rn pCi/L	Days	(2) Rn pCi/L	Days	(3) Rn pCi/L	Days	(4) Rn pCi/L	Days	(5) Rn pCi/L	Days
WAL2-1	608.70	13.97	531.30	19.05	152.56	21.27	278.42	8.95		
WAL2-2	187.24	13.96	406.69	19.05	332.86	30.20				
WAL2-3	99.73	6.93	261.37	7.02	226.94	19.06	325.86	30.18		
WAL2-4	165.37	13.91	126.62	19.10	120.05	30.07				
WAL2-5	102.11	14.03	369.72	18.98	247.04	30.05				
WAL2-6	110.17	14.01	167.47	18.96	207.23	29.99				
WAL2-7	355.35	14.00	400.83	18.16	179.41	30.78				
WAL2-8	766.66	14.00	698.34	18.15	212.51	21.90	156.33	6.88	196.73	11.16
WAL2-9	149.14	14.00	172.12	18.13	261.01	30.78				
WAL2-10	275.91	14.00	677.10	18.11	281.27	30.78				
WAL2-11	286.16	14.04	297.53	18.93	422.73	30.96				
WAL2-12	303.14	13.93	186.46	18.99	92.31	30.01				
WAL2-13	246.99	13.91	193.35	19.00	100.80	30.01				
WAL2-14	82.30	6.75	288.53	7.14	458.66	19.02				
WAL2-15	123.90	13.77	140.67	19.06	253.42	30.11				
WAL2-16	61.24	13.76	129.76	19.03	71.20	30.15				
WAL2-17	361.10	13.76	465.54	19.03	293.65	30.14				
WAL2-18	203.49	13.10	334.46	18.87	174.78	31.02				
WAL2-19	58.51	13.94	67.31	18.31	159.16	30.71				
WAL2-20	932.58	13.91	686.20	18.33	397.17	20.93	135.35	7.00	102.95	11.73
WAL2-21	426.00	13.88	152.53	19.05	422.05	29.94				
WAL2-22	430.52	13.06	504.59	19.04	436.85	30.80				
WAL2-23	516.08	13.02	896.09	18.91	1088.39	30.80	465.05	9.89	468.52	8.91
WAL2-24	301.04	12.99	461.46	18.94	312.30	30.96	61.19	8.11	.00	.00
WAL2-25	655.51	12.98	760.89	18.95	656.24	21.01	506.53	7.01	524.12	11.03
WAL2-26	704.82	12.93	677.30	18.08	1002.61	21.86	1385.01	10.00	653.20	8.00
WAL2-27	382.16	12.91	141.66	18.10	214.74	31.87				
WAL2-28	395.15	13.02	288.93	17.95	170.57	31.87				
WAL2-29	317.38	12.89	640.36	18.09	421.24	31.90				
WAL2-30	941.28	12.99	907.04	17.95	322.52	21.82	788.29	17.96		
WAL2-31	219.52	13.01	335.13	17.92	92.23	31.94				
WAL2-32	413.76	13.00	395.25	17.91	509.90	30.96				
WAL2-33*	348.69	12.98	118.63	19.82	519.14	30.08				
WAL2-34	286.17	13.07	288.28	19.07	217.70	29.98				
WAL2-35	601.16	4.34	664.39	7.95	628.96	19.86	822.86	3.93	789.97	25.60
WAL2-36	218.62	13.01	137.13	19.10	172.91	30.79				
WAL2-37	639.56	12.20	622.36	19.88	525.80	3.91	618.27	16.00	1078.71	10.15
WAL2-38	201.10	12.25	378.74	19.90	664.11	19.78	394.77	10.19		
WAL2-39	408.76	12.06	408.47	18.88	808.65	20.93	634.42	6.99	784.48	11.08
WAL2-40	1046.50	11.95	1078.78	18.97	1067.56	20.99	1049.69	6.96	1020.06	12.04
WAL2-8A	343.25	18.15	753.40	21.90	1250.48	8.88	337.58	9.16		
WAL2-1#	152.56	21.27	278.42	8.95						
WAL2-2#	332.86	30.20								
WAL2-7#	179.41	30.78								
WAL2-8#	698.34	18.15								
WAL2-8@	212.51	21.90	156.33	6.88	196.73	11.16				
WAL2-8A#	1250.48	8.88	337.58	9.16						
WAL2-10#	281.27	30.78								
WAL2-11#	422.73	30.96								

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WAL2-14#	stolen					
WAL2-17#	293.65	30.14				
WAL2-20#	686.20	18.33				
WAL2-20@	397.17	20.93	135.35	7.00	102.95	11.73
WAL2-22#	436.85	30.80				
WAL2-23#	1088.39	21.08				
WAL2-23@	465.05	9.89	468.52	8.91		
WAL2-24#	312.30	30.96	61.19	8.11		
WAL2-25#	656.24	21.01	506.53	7.01		
WAL2-25@	524.12	11.03				
WAL2-26#	1002.61	21.86				
WAL2-26@	1385.01	10.00				
WAL2-26!	653.20	8.00				
WAL2-26!d	598.06	8.00				
WAL2-28#	170.57	31.87				
WAL2-29#	421.24	31.90				
WAL2-30#	907.04	17.95				
WAL2-30@	322.52	21.82	788.29	17.96		
WAL2-32#	509.90	30.96				
WAL2-35#	822.86	3.93				
WAL2-35@	789.97	25.60				
WAL2-37#	525.80	3.91				
WAL2-37@	618.27	16.00	1078.71	10.15		
WAL2-38#	394.77	10.19				
WAL2-39#	808.65	20.93				
WAL2-39@	634.42	6.99	784.48	11.08		
WAL2-40#	1078.78	18.97				
WAL2-40@	1067.56	20.99				
WAL2-40!	1049.69	6.96				
WAL2-40!!	1020.06	12.04				

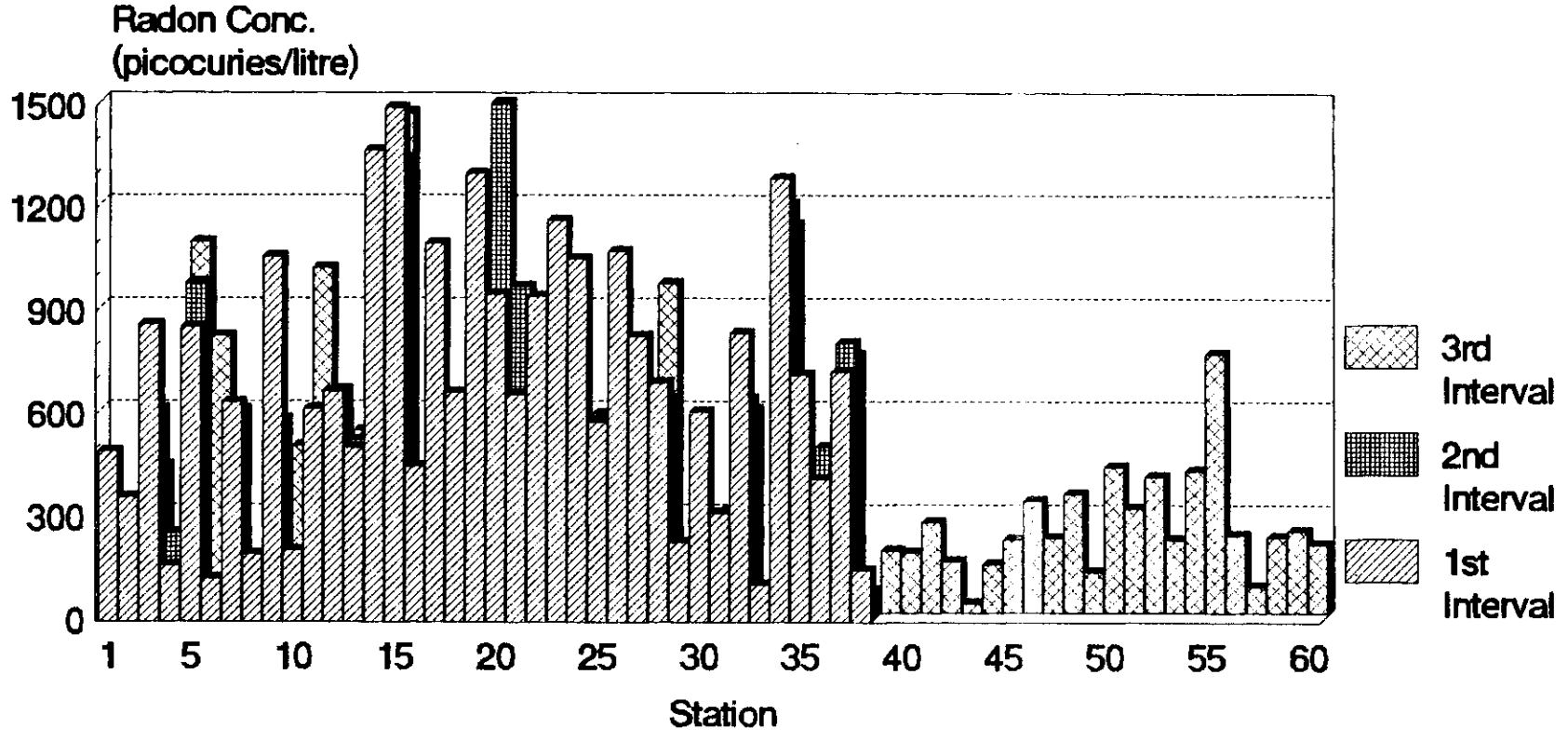
SOIL RADON GAS STUDY of SOUTHERN ONTARIO

WALLACEBURG **ENVIRONMENT # 3** (Oil and Gas Fields)

Sample #	Electret	Day	Time Hrs	Minutes	V(i)	Day	Time Hrs	Minutes	V(2)	Day	Time Hrs	Minutes	V(3)	Day	Time Hrs	Minutes	V(4)
WAL3-1	LC 8264	322	9	16	705	329	9	33	582	336	8	40	526	347	9	37	441
WAL3-2	LC 8363	322	9	33	753	329	9	37	661	336	8	53	609	347	9	32	564
WAL3-3	LC 8325	322	9	42	727	329	9	44	514	336	8	58	375				
WAL3-4	LB 6151	322	9	54	753	329	9	50	711	336	9	36	650	347	9	7	618
WAL3-5	LC 8337	322	10	5	742	329	9	56	530	336	9	45	308				
WAL3-6	LC 8328	322	10	12	739	329	10	1	707	336	9	52	690	347	8	46	389
WAL3-7	LC 8329	322	10	24	736	329	10	8	577	336	10	0	434	347	8	35	389
WAL3-8	LC 8357	322	10	37	754	329	10	14	704	336	10	8	676	347	8	35	623
WAL3-9	LC 8267	322	10	50	730	329	10	40	470	336	10	27	339				
WAL3-10	LC 8320	322	11	5	732	329	10	47	679	336	10	37	634	347	10	12	452
WAL3-11	LC 8280	322	11	12	742	329	10	53	587	336	10	42	517	347	10	22	169
WAL3-12	LB 4898	322	11	30	746	329	11	3	579	336	10	57	423	347	10	25	310
WAL3-13	LC 8374	322	11	38	750	329	11	7	623	336	11	0	499	347	10	25	310
WAL3-14	LC 8277	322	11	48	714	329	11	10	386								
WAL3-15	LC 8375	322	12	4	756	329	11	21	310								
WAL3-16	LB 6221	322	12	12	723	329	11	48	610	336	11	24	528	347	11	1	451
WAL3-17	LC 8273	322	12	27	730	329	11	54	462	336	11	27	355				
WAL3-18	LC 8279	322	12	36	725	329	11	58	560	336	11	35	463	347	11	27	337
WAL3-19	LC 8311	322	12	53	753	329	12	6	436	336	11	49	244				
WAL3-20	LB 4341	322	13	7	731	329	12	12	498	336	11	55	129				
WAL3-21	LC 8265	322	13	19	737	329	12	18	573	336	12	5	350				
WAL3-22	LB 6431	322	13	34	738	329	13	48	504	336	12	20	303				
WAL3-23	LC 3628	322	13	50	748	329	13	34	462	336	12	40	372	347	13	24	305
WAL3-24	LC 8377	322	13	58	752	329	13	44	492	336	12	26	453	347	13	37	257
WAL3-25	LC 8343	322	14	6	726	329	13	27	581	336	12	46	442	347	13	19	267
WAL3-26	LB 5674	322	14	23	744	329	14	0	480	336	14	8	346				
WAL3-27	LC 5344	322	14	33	704	329	14	4	501	336	14	16	356				
WAL3-28	LC 8322	322	14	41	737	329	14	8	564	336	14	35	415	347	15	8	93
WAL3-29	LC 4123	322	14	55	718	329	14	19	660	336	14	35	621	347	15	26	559
WAL3-30	LB 5304	322	15	14	734	329	14	24	582	336	14	40	550	347	15	29	505
WAL3-31	LC 5282	322	15	40	714	329	14	44	635	336	14	54	584	347	15	48	473
WAL3-32	LC 8288	322	15	46	724	329	14	47	518	336	14	59	371				
WAL3-33	LC 3681	322	15	58	750	329	14	55	722	336	15	7	706	347	15	56	686
WAL3-34	LC 4193	322	16	8	720	329	15	0	410	336	15	13	150				
WAL3-35	LC 8269	322	16	36	759	329	16	1	579	336	15	54	523	348	9	34	486
WAL3-36	LB 6761	322	17	0	758	329	15	56	653	336	15	49	532	348	9	43	432
WAL3-37	LC 8299	322	17	8	751	329	15	52	571	336	15	46	385				
WAL3-38	LB 5224	322	17	15	756	329	15	44	717	336	15	36	696	348	9	14	668
WAL3-3d	LC 8372	322	9	42	756	329	9	44	534	336	8	58	390				
WAL3-14#	LC 8282	329	11	10	754	336	11	4	541	347	10	34	160				
WAL3-15#	LB 8226	329	11	21	701	336	11	9	382								
WAL3-16d	LB 7537	322	12	12	741	329	11	48	652	336	11	24	585				
WAL3-39	LC 5634	337	14	5	537	348	9	38	471								
WAL3-40	LC 5575	337	14	20	621	348	9	31	555								
WAL3-41	LC 5580	337	14	30	589	348	9	22	492								
WAL3-42	LB 4611	337	14	40	599	348	9	18	543								
WAL3-43	LC 3622	337	14	50	686	348	9	7	675								
WAL3-43d	LC 5718	337	14	50	629	348	9	7	622								

WAL3-44	LC 3624	337	14	56	592	348	9	2	540				
WAL3-45	LB 5582	337	15	30	578	347	14	47	506				
WAL3-45d	LC 5661	337	15	30	650	347	14	47	574				
WAL3-46	LB 4870	337	15	42	535	347	15	4	427				
WAL3-47	LC 0677	337	15	56	710	347	13	41	633				
WAL3-47d	LB 4616	337	15	56	502	347	13	41	437				
WAL3-48	LC 5629	337	16	10	539	347	13	26	425				
WAL3-49	LC 5601	338	8	21	516	347	9	16	480				
WAL3-50	LC 5642	338	8	32	533	347	9	12	406				
WAL3-51	LC 5450	338	8	43	606	347	8	58	512				
WAL3-52	LC 5729	338	9	14	705	347	9	58	578				
WAL3-52d	LB 3097	338	9	14	540	347	9	58	410				
WAL3-53	LC 5651	338	9	38	566	347	10	29	501				
WAL3-54	LC 5649	338	9	46	698	347	10	37	566				
WAL3-55	LC 5710	338	9	57	583	347	10	42	357				
WAL3-56	LB 4637	338	10	12	528	347	11	47	459				
WAL3-57	LC 5690	338	10	21	520	347	11	58	497				
WAL3-58	LC 5711	338	10	46	634	347	14	20	564				
WAL3-59	LC 2018	338	10	56	550	347	14	26	477				
WAL3-60	LB 4573	338	11	8	675	347	14	31	610				
WAL3-34#	LC 5719	336	15	13	475	347	16	0	90				
WAL3-3#	LC 8372	322	9	42	756	329	9	44	534	336	8	58	390
WAL3-3a	LC 5659	336	8	58	570	347	9	24	411				
WAL3-3ad	LB 2715	336	8	58	532	347	9	24	369				
WAL3-5#	LB 5486	336	9	45	550	347	9	3	173				
WAL3-9#	LC 5675	336	10	27	511	347	9	45	365				
WAL3-14#	LC 8282	329	11	10	754	336	11	4	541	347	10	34	160
WAL3-15#	LB 8226	329	11	21	701	336	11	9	382				
WAL3-15a	LC 5608	336	11	9	702	347	10	46	176				
WAL3-17#	LC 5570	336	11	27	528	347	11	12	480				
WAL3-19#	LC 5673	336	11	49	573	347	14	34	193				
WAL3-20#	LC 5667	336	11	55	648	347	14	0	343				
WAL3-21#	LB 4665	336	12	5	589	347	14	5	265				
WAL3-22#	LB 4452	336	12	20	467	347	13	46	190				
WAL3-26#	LC 6904	336	14	8	468	347	14	52	307				
WAL3-27#	LC 5715	336	14	16	468	347	15	2	379				
WAL3-32#	LC 5598	336	14	59	453	347	15	53	245				
WAL3-34#	LC 5719	336	15	13	475	347	16	0	90				
WAL3-37#	LC 5684	336	15	46	461	348	9	28	185				

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO
WALLACEBURG
Radon Soil Gas Concentration
Environment 3



AURORA ENVIRONMENTAL SURVEYS LIMITED

01-21-92

AURORA ENVIRONMENTAL SURVEYS LIMITED

Radon Concentrations - Average from placement date

SOIL RADON GAS STUDY of SOUTHERN ONTARIO

WALLACEBURG **ENVIRONMENT # 3** (Oil and Gas)
(gamma corrected for 19.86 uR/hr)

Sample #	(1) Rn pCi/L	Days	(2) Rn pCi/L	Days	(3) Rn pCi/L	Days	(4) Rn pCi/L	Days	(5) Rn pCi/L	Days
WAL3-1	492.26	7.01	362.48	13.98	302.98	25.01	.00	.00	302.98	25.01
WAL3-2	359.78	7.00	284.35	13.97	209.65	25.00	.00	.00	209.65	25.00
WAL3-3	862.65	7.00	732.68	13.97	598.87	24.99	.00	.00	598.87	24.99
WAL3-4	161.64	7.00	201.00	13.99	147.81	24.97	.00	.00	147.81	24.97
WAL3-5	854.70	6.99	911.70	13.99	984.07	24.96	.00	.00	984.07	24.96
WAL3-6	123.07	6.99	93.94	13.99	405.02	24.94	.00	.00	405.02	24.94
WAL3-7	636.14	6.99	619.74	13.98	402.01	24.92	.00	.00	402.01	24.92
WAL3-8	193.45	6.98	150.99	13.98	143.51	24.92	.00	.00	143.51	24.92
WAL3-9	1062.73	6.99	818.32	13.98	635.68	24.95	.00	.00	635.68	24.95
WAL3-10	206.82	6.99	192.50	13.98	319.89	24.96	.00	.00	319.89	24.96
WAL3-11	618.48	6.99	453.78	13.98	691.91	24.97	.00	.00	691.91	24.97
WAL3-12	667.55	6.98	663.42	13.98	511.70	24.95	.00	.00	511.70	24.95
WAL3-13	502.95	6.98	507.62	13.97	516.14	24.95	.00	.00	516.14	24.95
WAL3-14	1370.20	6.97	1112.00	13.97	1100.57	24.95	.00	.00	1100.57	24.95
WAL3-15	1876.85	6.97	1604.70	13.96	1539.02	24.94	.00	.00	1539.02	24.94
WAL3-16	450.14	6.98	393.88	13.97	311.41	24.95	.00	.00	311.41	24.95
WAL3-17	1099.63	6.98	783.82	13.96	494.64	24.95	.00	.00	494.64	24.95
WAL3-18	665.04	6.97	536.55	13.96	454.64	24.95	.00	.00	454.64	24.95
WAL3-19	1303.65	6.97	1082.85	13.96	1154.97	25.07	.00	.00	1154.97	25.07
WAL3-20	951.33	6.96	1316.03	13.95	1095.06	25.04	.00	.00	1095.06	25.04
WAL3-21	659.53	6.96	809.24	13.95	845.77	25.03	.00	.00	845.77	25.03
WAL3-22	946.63	7.01	917.83	13.95	863.25	25.01	.00	.00	863.25	25.01
WAL3-23	1167.79	6.99	781.18	13.95	519.68	24.98	.00	.00	519.68	24.98
WAL3-24	1054.63	6.99	611.69	13.94	585.76	24.99	.00	.00	585.76	24.99
WAL3-25	581.88	6.97	584.51	13.94	545.04	24.97	.00	.00	545.04	24.97
WAL3-26	1075.77	6.98	829.40	13.99	662.61	25.02	.00	.00	662.61	25.02
WAL3-27	830.03	6.98	729.08	13.99	515.55	25.02	.00	.00	515.55	25.02
WAL3-28	695.04	6.98	662.56	14.00	788.67	25.02	.00	.00	788.67	25.02
WAL3-29	228.31	6.98	191.36	13.99	177.13	25.02	.00	.00	177.13	25.02
WAL3-30	609.77	6.97	369.05	13.98	258.06	25.01	.00	.00	258.06	25.01
WAL3-31	314.09	6.96	259.53	13.97	274.38	25.01	.00	.00	274.38	25.01
WAL3-32	839.16	6.96	735.84	13.97	672.43	25.01	.00	.00	672.43	25.01
WAL3-33	107.45	6.96	83.84	13.96	67.92	25.00	.00	.00	67.92	25.00
WAL3-34	1291.51	6.95	1242.46	13.96	1192.37	24.99	.00	.00	1192.37	24.99
WAL3-35	718.60	6.98	474.38	13.97	299.36	25.71	.00	.00	299.36	25.71
WAL3-36	413.98	6.96	454.17	13.95	361.72	25.70	.00	.00	361.72	25.70
WAL3-37	723.63	6.95	758.53	13.94	753.43	25.68	.00	.00	753.43	25.68
WAL3-38	151.01	6.94	115.55	13.93	91.97	25.67	.00	.00	91.97	25.67
WAL3-39	178.83	10.81	.00	.00	.00	.00	.00	.00	178.83	10.81
WAL3-40	173.47	10.80	.00	.00	.00	.00	.00	.00	173.47	10.80
WAL3-41	260.99	10.79	.00	.00	.00	.00	.00	.00	260.99	10.79
WAL3-42	148.09	10.78	.00	.00	.00	.00	.00	.00	148.09	10.78
WAL3-43	26.06	10.76	.00	.00	.00	.00	.00	.00	26.06	10.76
WAL3-43d	16.08	10.76	.00	.00	.00	.00	.00	.00	16.08	10.76
WAL3-44	137.89	10.75	.00	.00	.00	.00	.00	.00	137.89	10.75
WAL3-45	208.99	9.97	.00	.00	.00	.00	.00	.00	208.99	9.97
WAL3-45d	215.04	9.97	.00	.00	.00	.00	.00	.00	215.04	9.97
WAL3-46	321.98	9.97	.00	.00	.00	.00	.00	.00	321.98	9.97

WAL3-47	214.60	9.91	.00	.00	.00	.00	.00	.00	214.60	9.91
WAL3-47d	195.03	9.91	.00	.00	.00	.00	.00	.00	195.03	9.91
WAL3-48	342.90	9.89	.00	.00	.00	.00	.00	.00	342.90	9.89
WAL3-49	116.16	9.04	.00	.00	.00	.00	.00	.00	116.16	9.04
WAL3-50	420.87	9.03	.00	.00	.00	.00	.00	.00	420.87	9.03
WAL3-51	301.04	9.01	.00	.00	.00	.00	.00	.00	301.04	9.01
WAL3-52	394.46	9.03	.00	.00	.00	.00	.00	.00	394.46	9.03
WAL3-52d	429.82	9.03	.00	.00	.00	.00	.00	.00	429.82	9.03
WAL3-53	208.85	9.04	.00	.00	.00	.00	.00	.00	208.85	9.04
WAL3-54	411.28	9.04	.00	.00	.00	.00	.00	.00	411.28	9.04
WAL3-55	750.37	9.03	.00	.00	.00	.00	.00	.00	750.37	9.03
WAL3-56	224.51	9.07	.00	.00	.00	.00	.00	.00	224.51	9.07
WAL3-57	72.81	9.07	.00	.00	.00	.00	.00	.00	72.81	9.07
WAL3-58	216.89	9.15	.00	.00	.00	.00	.00	.00	216.89	9.15
WAL3-59	233.76	9.15	.00	.00	.00	.00	.00	.00	233.76	9.15
WAL3-60	198.20	9.14	.00	.00	.00	.00	.00	.00	198.20	9.14
WAL3-3d	891.23	7.00	755.69	13.97	.00	.00	.00	.00	.00	.00
WAL3-14#	854.91	7.00	996.67	17.98	.00	.00	.00	.00	.00	.00
WAL3-15#	1333.33	6.99	0.00	.00	.00	.00	.00	.00	.00	.00
WAL3-16d	350.25	6.98	310.37	13.97	.00	.00	.00	.00	.00	.00
WAL3-34#	1128.98	11.03	.00	.00						
WAL3-3#	891.23	7.00	758.07	13.97						
WAL3-3@	428.31	11.02	.00	.00						
WAL3-3@d	446.00	11.02	.00	.00						
WAL3-5#	1076.36	10.97	.00	.00						
WAL3-9#	402.93	10.97	.00	.00						
WAL3-14#	854.91	7.00	999.05	17.98						
WAL3-15#	1333.33	6.99	.00	.00						
WAL3-15@	1455.52	10.98	.00	.00						
WAL3-17#	127.31	10.99	.00	.00						
WAL3-19#	1061.70	11.11	.00	.00						
WAL3-20#	817.11	11.09	.00	.00						
WAL3-21#	891.77	11.08	.00	.00						
WAL3-22#	794.41	11.06	.00	.00						
WAL3-26#	451.07	11.03	.00	.00						
WAL3-27#	244.72	11.03	.00	.00						
WAL3-32#	592.18	11.04	.00	.00						
WAL3-34#	1128.98	11.03	.00	.00						
WAL3-37#	747.37	11.74	.00	.00						

AURORA ENVIRONMENTAL SURVEYS LIMITED

Radon Concentrations - (Incremental)

SOIL RADON GAS STUDY of SOUTHERN ONTARIO

WALLACEBURG **ENVIRONMENT #3** (Oil and Gas Fields)
(gamma corrected for 19.86 uR/hr)

Sample #	(1) Rn pCi/L	Days	(2) Rn pCi/L	Days	(3) Rn pCi/L	Days	(4) Rn pCi/L	Days	(5) Rn pCi/L	Days
WAL3-1	492.26	7.01	231.96	6.96	228.03	11.04	.00	.00	.00	.00
WAL3-2	359.77	7.00	208.65	6.97	115.10	11.03	.00	.00	.00	.00
WAL3-3	862.65	7.00	603.62	6.97	428.31	11.02	.00	.00	.00	.00
WAL3-4	161.63	7.00	240.44	6.99	80.08	10.98	.00	.00	.00	.00
WAL3-5	854.69	6.99	971.78	6.99	1076.36	10.97	.00	.00	.00	.00
WAL3-6	123.06	6.99	64.83	6.99	802.65	10.95	.00	.00	.00	.00
WAL3-7	636.14	6.99	604.33	6.99	124.19	10.94	.00	.00	.00	.00
WAL3-8	193.45	6.98	108.61	7.00	133.99	10.94	.00	.00	.00	.00
WAL3-9	1062.73	6.99	575.86	6.99	402.93	10.97	.00	.00	.00	.00
WAL3-10	206.82	6.99	178.22	6.99	482.48	10.98	.00	.00	.00	.00
WAL3-11	618.47	6.99	289.54	6.99	999.44	10.99	.00	.00	.00	.00
WAL3-12	667.55	6.98	660.48	7.00	320.10	10.98	.00	.00	.00	.00
WAL3-13	502.95	6.98	512.81	7.00	529.00	10.98	.00	.00	.00	.00
WAL3-14	1370.19	6.97	854.91	7.00	1091.82	10.98	.00	.00	.00	.00
WAL3-15	1876.85	6.97	1333.32	6.99	1455.52	10.98	.00	.00	.00	.00
WAL3-16	450.14	6.98	337.87	6.98	206.92	10.98	.00	.00	.00	.00
WAL3-17	1099.63	6.98	469.84	6.98	127.31	10.99	.00	.00	.00	.00
WAL3-18	665.04	6.97	408.84	6.98	351.90	10.99	.00	.00	.00	.00
WAL3-19	1303.65	6.97	867.62	6.99	1061.69	11.11	.00	.00	.00	.00
WAL3-20	951.33	6.96	1687.80	6.99	817.11	11.09	.00	.00	.00	.00
WAL3-21	659.53	6.96	960.30	6.99	891.77	11.08	.00	.00	.00	.00
WAL3-22	946.63	7.01	891.86	6.94	794.41	11.06	.00	.00	.00	.00
WAL3-23	1167.79	6.99	394.55	6.96	190.07	11.03	.00	.00	.00	.00
WAL3-24	1054.62	6.99	166.36	6.95	555.92	11.05	.00	.00	.00	.00
WAL3-25	581.88	6.97	587.95	6.97	497.40	11.02	.00	.00	.00	.00
WAL3-26	1075.77	6.98	585.90	7.01	451.07	11.03	.00	.00	.00	.00
WAL3-27	830.03	6.98	630.08	7.01	244.72	11.03	.00	.00	.00	.00
WAL3-28	695.04	6.98	631.44	7.02	956.01	11.02	.00	.00	.00	.00
WAL3-29	228.31	6.98	154.64	7.01	159.16	11.04	.00	.00	.00	.00
WAL3-30	609.76	6.97	130.02	7.01	117.64	11.03	.00	.00	.00	.00
WAL3-31	314.09	6.96	205.40	7.01	293.47	11.04	.00	.00	.00	.00
WAL3-32	839.16	6.96	634.82	7.01	1333.32	11.04	.00	.00	.00	.00
WAL3-33	107.45	6.96	60.40	7.01	47.78	11.03	.00	.00	.00	.00
WAL3-34	1291.51	6.95	1201.51	7.01	1128.98	11.03	.00	.00	.00	.00
WAL3-35	718.60	6.98	231.15	7.00	91.21	11.74	.00	.00	.00	.00
WAL3-36	413.98	6.96	494.52	7.00	252.54	11.75	.00	.00	.00	.00
WAL3-37	723.63	6.95	794.93	7.00	747.37	11.74	.00	.00	.00	.00
WAL3-38	151.00	6.94	80.40	6.99	63.98	11.73	.00	.00	.00	.00
WAL3-3d	891.23	7.00	621.18	6.97	.00	.00	.00	.00	.00	.00
WAL3-14#	854.91	7.00	1091.81	10.98	.00	.00	.00	.00	.00	.00
WAL3-15#	1333.32	6.99	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-16d	350.25	6.98	270.62	6.98	.00	.00	.00	.00	.00	.00
WAL3-39	178.83	10.81	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-40	173.47	10.80	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-41	260.99	10.79	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-42	148.08	10.78	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-43	26.06	10.76	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-43d	16.08	10.76	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-44	137.89	10.75	.00	.00	.00	.00	.00	.00	.00	.00

WAL3-45	208.99	9.97	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-45d	215.03	9.97	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-46	321.98	9.97	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-47	214.60	9.91	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-47d	195.03	9.91	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-48	342.90	9.89	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-49	116.15	9.04	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-50	420.87	9.03	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-51	301.04	9.01	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-52	394.46	9.03	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-52d	429.82	9.03	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-53	208.85	9.04	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-54	411.28	9.04	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-55	750.37	9.03	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-56	224.51	9.07	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-57	72.81	9.07	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-58	216.89	9.15	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-59	233.76	9.15	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-60	198.20	9.14	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-34#	1128.98	11.03	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-3#	891.23	7.00	623.56	6.97	.00	.00	.00	.00	.00	.00
WAL3-3a	428.31	11.02	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-3ad	446.00	11.02	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-5#	1076.36	10.97	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-9#	402.93	10.97	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-14#	854.91	7.00	1094.20	10.98	.00	.00	.00	.00	.00	.00
WAL3-15#	1333.32	6.99	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-15a	1455.52	10.98	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-17#	127.31	10.99	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-19#	1061.69	11.11	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-20#	817.11	11.09	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-21#	891.77	11.08	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-22#	794.41	11.06	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-26#	451.07	11.03	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-27#	244.72	11.03	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-32#	592.18	11.04	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-34#	1128.98	11.03	.00	.00	.00	.00	.00	.00	.00	.00
WAL3-37#	747.37	11.74	.00	.00	.00	.00	.00	.00	.00	.00

APPENDIX 1 - 3

Raw Data and Calculation

MARKHAM-STOUFFVILLE-VAUGHAN AREA

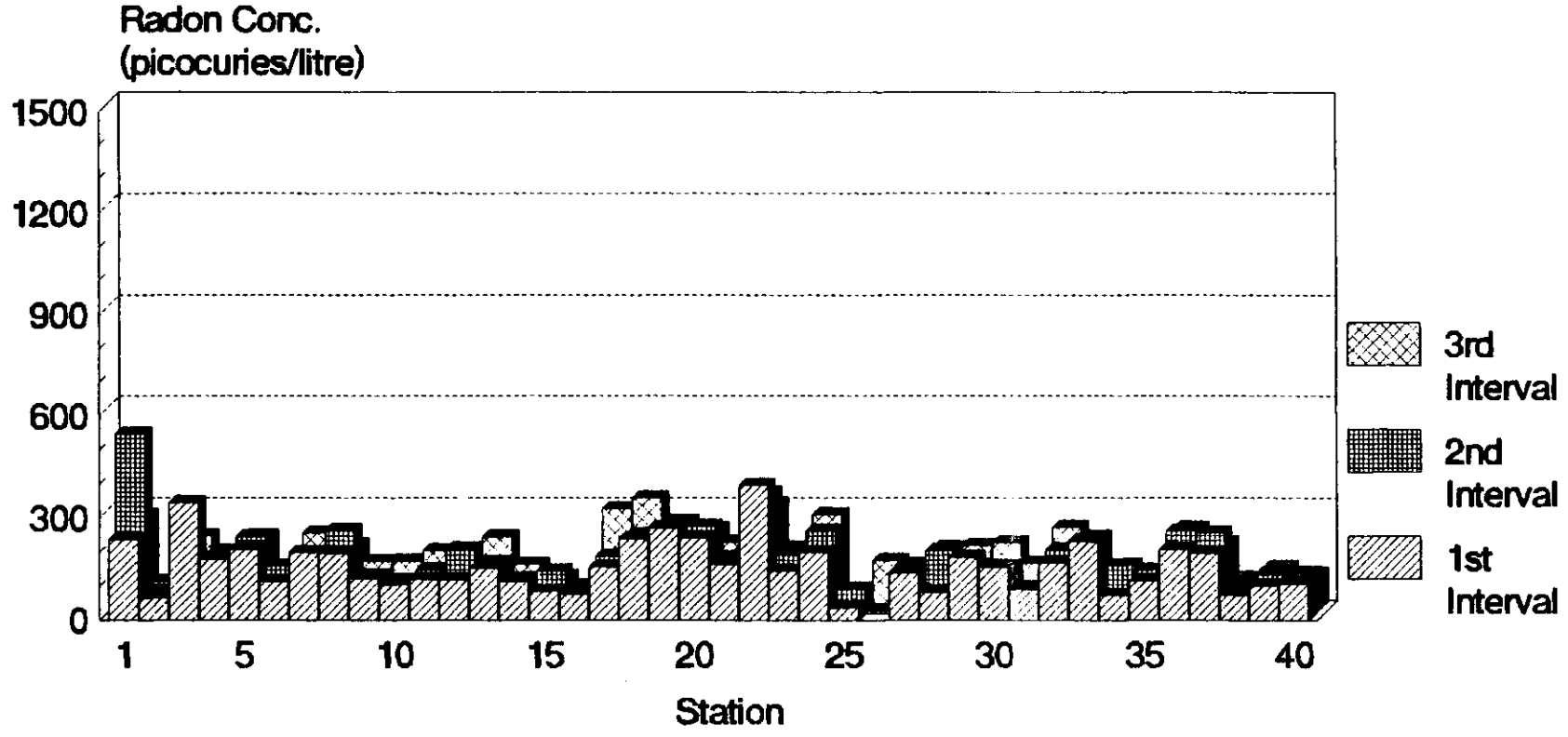
AURORA ENVIRONMENTAL SURVEYS LIMITED

SOIL RADON GAS STUDY of SOUTHERN ONTARIO

MARKHAM-STOUFFVILLE AREA **ENVIRONMENT # 1**

Sample #	Electret	Day	Time Hrs	Minutes	V(i)	Day	Time Hrs	Minutes	V(2)	Day	Time Hrs	Minutes	V(3)	Day	Time Hrs	Minutes	V(4)
MS1-1	LC 5311	273	14	5	738	282	14	20	661	308	15	31	210				
MS1-2	LC 5307	273	13	50	737	282	14	15	716	308	15	24	655	336	16	22	583
MS1-3	LC 4189	273	13	45	717	282	11	45	607	308	15	18	463	336	16	17	275
MS1-4	LC 5244	273	13	35	740	282	12	29	682	308	15	13	524	336	16	12	372
MS1-5	LC 5399	273	13	30	719	282	12	26	652	308	15	9	451	336	16	9	265
MS1-6	LC 4275	273	14	15	738	282	14	46	701	308	15	43	572	336	16	29	473
MS1-7	LC 4249	273	14	50	729	282	14	7	664	310	14	39	493	338	12	34	297
MS1-8	LC 3630	274	9	0	735	282	12	33	677	310	14	50	439	338	12	42	276
MS1-9	LC 4252	273	13	15	725	282	12	19	685	310	15	23	574	338	13	20	447
MS1-10	LC 4136	270	16	0	730	277	12	13	704	308	14	28	597	336	15	48	468
MS1-11	LC 5369	273	10	10	744	282	10	30	705	310	11	31	579	336	17	21	432
MS1-12	LC 5270	273	10	20	724	282	10	34	685	310	11	24	499	336	17	19	356
MS1-13	LC 4254	273	10	35	742	282	10	39	692	310	10	5	545	338	11	15	355
MS1-14	LB 4407	273	12	55	737	282	12	2	700	310	9	49	598	336	17	4	485
MS1-15	LC 4166	273	13	5	692	282	12	14	665	310	15	19	543	338	13	16	457
MS1-16	LC 5511	273	12	45	734	282	11	44	709	310	9	43	641	336	17	0	584
MS1-17	LC 2917	273	15	45	719	282	12	48	669	308	16	25	515	336	16	56	254
MS1-18	LB 4609	273	15	35	747	282	12	44	670	308	16	23	463	336	16	52	182
MS1-19	LC 4140	273	15	25	730	282	12	38	643	308	16	17	435	336	16	50	214
MS1-20	LC 4296	273	15	15	726	282	13	43	648	308	16	10	419	336	16	46	216
MS1-21	LC 2829	273	15	10	722	282	13	41	669	308	16	6	518	336	16	43	341
MS1-22	LC 5275	273	15	1	740	282	13	51	612	310	14	31	284				
MS1-23	LC 4311	273	14	30	728	282	14	35	681	308	15	58	521	336	16	38	360
MS1-24	LC 5264	273	14	20	743	282	14	30	678	308	15	52	460	336	16	33	220
MS1-25	LB 4758	274	10	40	732	282	13	34	721	310	14	26	648	338	12	26	596
MS1-26 *	*LC 5618	274	9	10	728	282	12	58	724	310	14	58	613	338	12	48	482
MS1-27	LC 2763	273	12	20	737	282	11	39	692	310	15	12	550	338	13	12	444
MS1-28	LC 5982	274	10	20	699	282	13	30	675	310	14	16	496	338	12	19	338
MS1-29	LB 5521	274	11	0	752	282	15	26	697	312	15	11	547	340	11	48	381
MS1-30	LB 4511	274	11	10	733	288	12	32	653	312	15	17	537	340	11	52	364
MS1-31	LC 5628	274	10	50	744	282	15	31	717	312	15	1	635	340	11	41	512
MS1-32	LC 5263	274	10	10	723	282	13	25	674	310	14	10	491	338	11	10	281
MS1-33	LC 0625	274	9	55	764	282	13	20	695	310	14	4	476	338	12	9	375
MS1-34	LB 4012	274	9	20	752	282	13	2	730	310	13	59	588	338	12	58	495
MS1-35	LC 3673	274	9	45	723	282	13	12	689	310	13	45	563	338	12	3	461
MS1-36	LC 5694	274	11	30	735	288	12	37	630	312	15	23	431	340	11	56	228
MS1-37	LC 5266	274	14	10	712	282	14	50	655	312	14	53	413	340	11	35	248
MS1-38	LB 5029	274	9	35	740	282	13	6	718	310	13	51	639	338	12	54	554
MS1-39	LC 0562	273	10	55	753	282	10	49	719	310	11	13	599	338	11	5	486
MS1-40	LC 4114	273	11	0	736	282	10	55	701	310	11	8	583	338	11	1	491
MS1-1#	LC 4138	308	15	38	728	336	16	26	464								
MS1-22#	LC 3618	310	14	35	732	338	12	29	438								

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO
MARKHAM – STOUFFVILLE
Soil Radon Gas Concentration
Environment 1



AURORA ENVIRONMENTAL SURVEYS LIMITED

01-17-92

AURORA ENVIRONMENTAL SURVEYS LIMITED

Average Rn from date of emplacement

SOIL RADON GAS STUDY of SOUTHERN ONTARIO

MARKHAM STOUFFVILLE AREA - **ENVIRONMENT # 1**
(gamma corrected for 10.62 uR/hr)

Sample #	(1) Rn pCi/L	Days	(2) Rn pCi/L	Days	(3) Rn pCi/L	Days	Summary Rn pCi/L	Days	Rn pCi/L	Days
MS1-1	234.92	9.01	451.05	35.06	370.32	62.97	370.32	62.97	.00	.00
MS1-2	62.48	9.02	63.44	35.07	68.41	63.11	68.41	63.11	.00	.00
MS1-3	344.28	8.92	207.01	35.06	208.60	63.11	208.60	63.11	.00	.00
MS1-4	177.03	8.95	173.13	35.07	169.79	63.11	169.79	63.11	.00	.00
MS1-5	206.54	8.96	218.86	35.07	214.58	63.11	214.58	63.11	.00	.00
MS1-6	111.29	9.02	131.68	35.06	120.08	63.09	120.08	63.09	.00	.00
MS1-7	199.22	8.97	180.75	36.99	196.95	64.91	196.95	64.91	.00	.00
MS1-8	195.02	8.15	233.81	36.24	212.32	64.15	212.32	64.15	.00	.00
MS1-9	121.86	8.96	113.28	37.09	123.15	65.00	123.15	65.00	.00	.00
MS1-10	103.11	6.84	96.88	37.94	113.78	65.99	113.78	65.99	.00	.00
MS1-11	117.26	9.01	123.47	37.06	141.83	63.30	141.83	63.30	.00	.00
MS1-12	118.16	9.01	171.99	37.04	170.31	63.29	170.31	63.29	.00	.00
MS1-13	151.29	9.00	148.95	36.98	173.77	65.03	173.77	65.03	.00	.00
MS1-14	112.06	8.96	104.12	36.87	113.82	63.17	113.82	63.17	.00	.00
MS1-15	82.59	8.96	113.07	37.09	104.54	65.01	104.54	65.01	.00	.00
MS1-16	75.27	8.96	68.73	36.87	66.58	63.18	66.58	63.18	.00	.00
MS1-17	154.71	8.88	164.53	35.03	220.45	63.05	220.45	63.05	.00	.00
MS1-18	237.60	8.88	230.53	35.03	270.12	63.05	270.12	63.05	.00	.00
MS1-19	270.65	8.88	241.49	35.04	245.96	63.06	245.96	63.06	.00	.00
MS1-20	241.05	8.94	252.29	35.04	243.17	63.06	243.17	63.06	.00	.00
MS1-21	162.85	8.94	164.30	35.04	177.53	63.06	177.53	63.06	.00	.00
MS1-22	397.27	8.95	363.76	36.98	133.86	64.89	133.86	64.89	.00	.00
MS1-23	142.75	9.00	166.35	35.06	170.60	63.09	170.60	63.09	.00	.00
MS1-24	197.42	9.01	229.81	35.06	248.26	63.09	248.26	63.09	.00	.00
MS1-25	35.81	8.12	63.15	36.16	59.41	64.07	59.41	64.07	.00	.00
MS1-26 *	12.15	8.16	87.34	36.24	109.65	64.15	109.65	64.15	.00	.00
MS1-27	136.63	8.97	140.78	37.12	129.51	65.04	129.51	65.04	.00	.00
MS1-28	80.66	8.13	159.68	36.16	166.35	64.08	166.35	64.08	.00	.00
MS1-29	182.83	8.18	149.82	38.17	162.95	66.07	162.95	66.07	.00	.00
MS1-30	156.39	14.06	143.96	38.17	163.18	66.03	163.18	66.03	.00	.00
MS1-31	88.80	8.20	77.93	38.17	99.62	66.03	99.62	66.03	.00	.00
MS1-32	165.26	8.14	182.02	36.17	205.09	64.04	205.09	64.04	.00	.00
MS1-33	230.49	8.14	225.15	36.17	175.84	64.09	175.84	64.09	.00	.00
MS1-34	72.22	8.15	125.29	36.19	113.79	64.15	113.79	64.15	.00	.00
MS1-35	113.86	8.14	123.49	36.17	117.44	64.10	117.44	64.10	.00	.00
MS1-36	206.58	14.05	228.37	38.16	230.00	66.03	230.00	66.03	.00	.00
MS1-37	196.09	8.03	227.10	38.03	211.01	65.89	211.01	65.89	.00	.00
MS1-38	72.60	8.15	76.16	36.18	81.67	64.14	81.67	64.14	.00	.00
MS1-39	101.86	9.00	114.69	37.01	116.83	65.01	116.83	65.01	.00	.00
MS1-40	105.54	9.00	114.64	37.01	107.45	65.00	107.45	65.00	.00	.00
MS1-1#	268.91	28.03	.00	.00	.00	.00			.00	.00
MS1-22#	302.14	27.91	.00	.00	.00	.00			.00	.00

AURORA ENVIRONMENTAL SURVEYS LIMITED

Radon Concentrations - (Incremental)

SOIL RADON GAS STUDY of SOUTHERN ONTARIO

MARKHAM-STOUFFVILLE AREA - **ENVIRONMENT # 1**
(Gamma corrected for 10.62 uR/hr)

Sample #	(1) Rn pCi/L	Days	(2) Rn pCi/L	Days	(3) Rn pCi/L	Days	(4) Rn pCi/L	Days	(5) Rn pCi/L	Days
MS1-1	234.92	9.01	526.54	26.05	268.91	28.03	.00	.00	.00	.00
MS1-2	62.48	9.02	63.77	26.05	71.78	28.04	.00	.00	.00	.00
MS1-3	344.28	8.92	160.34	26.15	208.56	28.04	.00	.00	.00	.00
MS1-4	177.03	8.95	171.86	26.11	163.18	28.04	.00	.00	.00	.00
MS1-5	206.54	8.96	223.22	26.11	207.24	28.04	.00	.00	.00	.00
MS1-6	111.29	9.02	138.77	26.04	102.86	28.03	.00	.00	.00	.00
MS1-7	199.22	8.97	174.93	28.02	216.23	27.91	.00	.00	.00	.00
MS1-8	195.02	8.15	245.20	28.10	182.35	27.91	.00	.00	.00	.00
MS1-9	121.86	8.96	110.57	28.13	133.48	27.91	.00	.00	.00	.00
MS1-10	103.11	6.84	95.52	31.09	133.79	28.06	.00	.00	.00	.00
MS1-11	117.26	9.01	125.49	28.04	164.95	26.24	.00	.00	.00	.00
MS1-12	118.16	9.01	189.35	28.03	165.34	26.25	.00	.00	.00	.00
MS1-13	151.29	9.00	148.24	27.98	204.07	28.05	.00	.00	.00	.00
MS1-14	112.06	8.96	101.58	27.91	124.50	26.30	.00	.00	.00	.00
MS1-15	82.59	8.96	122.80	28.13	90.34	27.91	.00	.00	.00	.00
MS1-16	75.27	8.96	66.64	27.92	60.52	26.30	.00	.00	.00	.00
MS1-17	154.71	8.88	167.93	26.15	288.44	28.02	.00	.00	.00	.00
MS1-18	237.60	8.88	228.30	26.15	318.55	28.02	.00	.00	.00	.00
MS1-19	270.65	8.88	231.78	26.15	250.03	28.02	.00	.00	.00	.00
MS1-20	241.05	8.94	256.34	26.10	230.20	28.03	.00	.00	.00	.00
MS1-21	162.85	8.94	164.86	26.10	191.71	28.03	.00	.00	.00	.00
MS1-22	397.27	8.95	353.76	28.03	302.14	27.91	.00	.00	.00	.00
MS1-23	142.75	9.00	174.56	26.06	173.50	28.03	.00	.00	.00	.00
MS1-24	197.42	9.01	241.15	26.06	269.87	28.03	.00	.00	.00	.00
MS1-25	35.81	8.12	71.08	28.04	51.66	27.92	.00	.00	.00	.00
MS1-26 *	12.15	8.16	109.18	28.08	135.83	27.91	.00	.00	.00	.00
MS1-27	136.63	8.97	142.14	28.15	111.77	27.92	.00	.00	.00	.00
MS1-28	80.66	8.13	182.63	28.03	172.51	27.92	.00	.00	.00	.00
MS1-29	182.83	8.18	140.87	29.99	178.38	27.86	.00	.00	.00	.00
MS1-30	156.39	14.06	136.78	24.11	186.95	27.86	.00	.00	.00	.00
MS1-31	88.80	8.20	74.96	29.98	126.44	27.86	.00	.00	.00	.00
MS1-32	165.26	8.14	186.96	28.03	232.92	27.88	.00	.00	.00	.00
MS1-33	230.49	8.14	223.74	28.03	109.44	27.92	.00	.00	.00	.00
MS1-34	72.22	8.15	140.73	28.04	96.11	27.96	.00	.00	.00	.00
MS1-35	113.86	8.14	126.32	28.02	106.84	27.93	.00	.00	.00	.00
MS1-36	206.58	14.05	241.31	24.12	230.47	27.86	.00	.00	.00	.00
MS1-37	196.09	8.03	235.53	30.00	186.97	27.86	.00	.00	.00	.00
MS1-38	72.60	8.15	77.20	28.03	85.93	27.96	.00	.00	.00	.00
MS1-39	101.86	9.00	118.83	28.02	116.85	27.99	.00	.00	.00	.00
MS1-40	105.54	9.00	117.59	28.01	95.10	28.00	.00	.00	.00	.00
MS1-1#	268.91	28.03	.00	.00	.00	.00	.00	.00	.00	.00
MS1-22#	302.14	27.91	.00	.00	.00	.00	.00	.00	.00	.00

AURORA ENVIRONMENTAL SURVEYS LIMITED

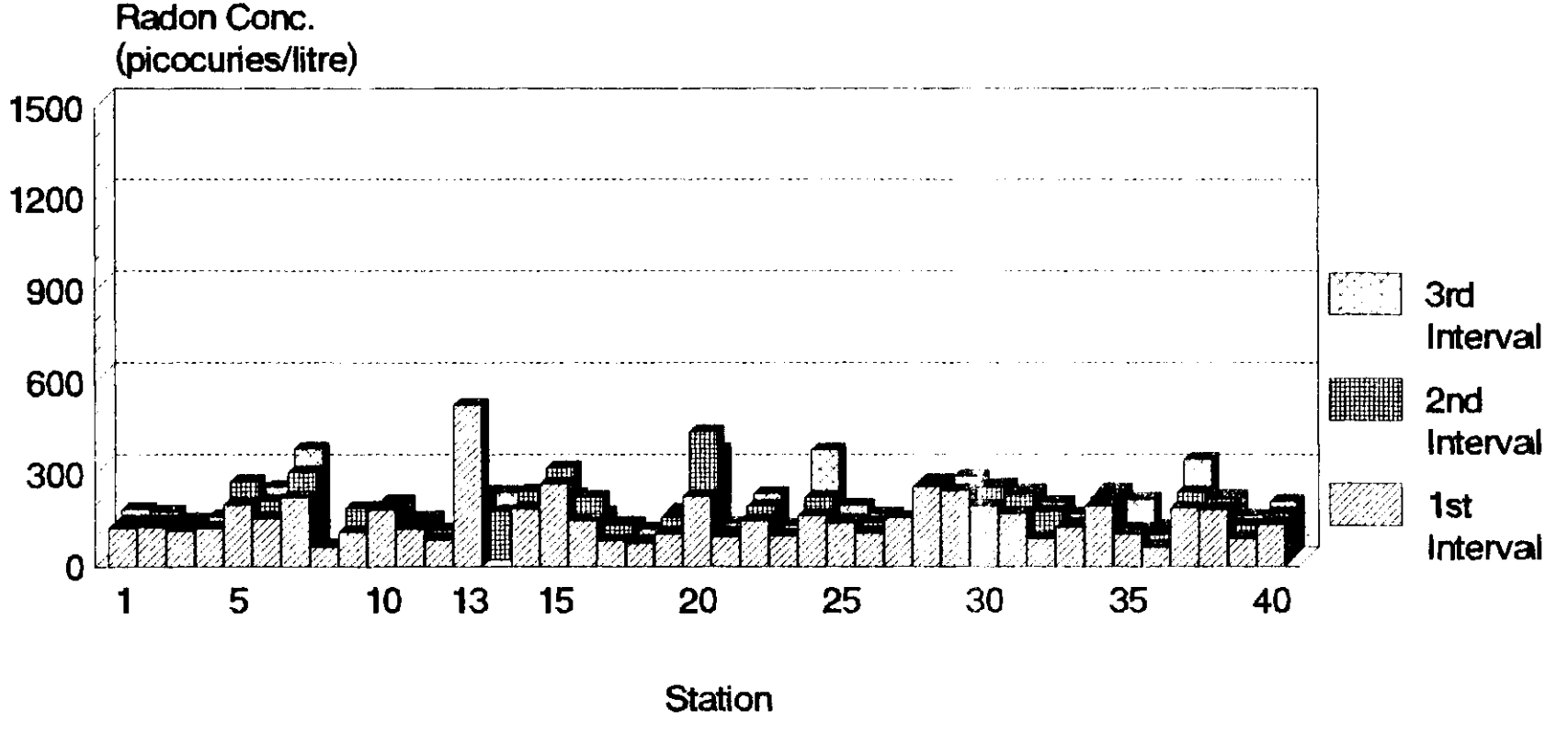
SOIL RADON GAS STUDY of SOUTHERN ONTARIO

MARKHAM-STOUFFVILLE AREA **ENVIRONMENT # 2**

Sample #	Electret	Day	Time Hrs	Minutes	V(i)	Day	Time Hrs	Minutes	V(2)	Day	Time Hrs	Minutes	V(3)	Day	Time Hrs	Minutes	V(4)
MS2-1	LC 5358	270	10	10	711	277	9	15	680	308	11	34	546	336	14	6	411
MS2-2	LC 5401	270	10	20	730	277	9	20	698	308	11	41	562	336	14	9	435
MS2-3	LC 4148	270	10	35	740	277	9	25	711	308	11	45	591	336	14	13	486
MS2-4	LC 5532	270	10	50	740	277	9	32	709	308	11	50	610	336	14	19	495
MS2-5	LB 2815	270	10	55	740	277	9	36	690	308	11	58	419	336	14	25	235
MS2-6	LC 4226	270	11	20	735	277	9	42	696	308	12	5	490	336	14	29	293
MS2-7	LC 2810	270	11	25	734	277	9	46	678	308	12	11	378	336	14	32	89
MS2-8	LC 5255	270	11	40	710	277	9	50	695	308	12	18	656	336	14	37	631
MS2-9	LC 2948	270	11	55	737	277	9	55	709	308	12	23	527	336	14	41	393
MS2-10	LC 4185	270	12	20	719	277	10	3	673	308	12	28	488	336	14	46	333
MS2-11	LC 4247	270	12	30	717	277	10	8	687	308	12	33	565	336	14	49	455
MS2-12	LC 0670	270	12	40	759	277	10	16	737	308	12	41	629	336	14	54	569
MS2-13*	LC 5303	270	12	50	707	277	10	23	578	289	11	59	493	308	12	46	372
MS2-13A	LC 5258	277	10	50	728	289	11	57	657	308	12	49	553	336	14	59	370
MS2-14	LC 5240	270	13	35	741	277	11	8	694	308	13	18	452	336	15	5	278
MS2-15	LC 4200	270	14	0	732	277	11	15	665	308	13	29	352	336	15	12	188
MS2-16	LC 5250	270	19	10	715	277	11	25	679	308	13	34	462	336	15	19	344
MS2-17	LC 4168	270	14	25	744	277	11	30	723	308	13	41	598	336	15	23	506
MS2-18	LC 2825	270	14	35	704	277	11	40	686	308	13	46	621	336	15	27	546
MS2-19	LC 4118	270	15	0	733	277	11	50	707	308	15	3	556	336	16	5	424
MS2-20	LC 4299	270	15	15	723	277	11	57	667	308	14	56	237				
MS2-21	LC 5517	270	15	30	734	277	12	2	710	308	14	41	614	336	15	57	519
MS2-22	LC 5297	270	15	40	757	277	12	9	720	308	14	31	530	336	15	52	351
MS2-23	LC 5442	270	16	15	699	277	12	20	675	308	14	19	591	336	15	43	504
MS2-24	LC 2768	270	16	30	742	277	12	36	701	308	16	47	482	348	16	50	253
MS2-25	LC 5287	273	8	45	725	282	9	45	679	308	14	11	562	336	15	39	416
MS2-26	LC 2054	273	9	0	757	282	9	50	721	310	10	29	600	338	10	41	477
MS2-27	LC 5283	273	10	55	726	282	10	21	679	310	10	38	553	338	11	26	469
MS2-28	LC 5497	273	9	10	723	282	9	56	639	310	10	14	395	338	10	47	192
MS2-29	LC 3676	273	9	50	705	282	10	15	626	310	10	43	423	338	11	30	203
MS2-30	LC 5252	273	12	50	718	282	12	8	655	310	9	56	433	336	17	11	249
MS2-31	LC 5566	273	12	5	725	282	11	34	670	310	15	7	465	338	13	4	283
MS2-32	LC 5274	273	10	45	705	282	10	45	676	310	11	19	525	338	11	13	372
MS2-33	LC 5366	273	9	40	690	282	10	10	649	310	10	53	537	338	11	35	416
MS2-34	LC 5340	273	9	15	756	282	9	59	692	310	10	11	496	338	10	51	308
MS2-35	LC 4292	273	11	50	735	282	11	29	701	310	13	39	602	338	11	58	435
MS2-36	LC 5241	273	11	45	748	282	11	24	728	310	13	33	648	338	11	55	561
MS2-37	LC 4106	273	11	35	733	282	11	15	671	310	13	27	461	338	11	51	193
MS2-38	LC 2472	273	11	20	749	282	11	10	689	310	13	22	497	338	11	46	328
MS2-39	LC 5257	273	11	15	731	282	11	5	702	310	13	16	591	338	11	43	475
MS2-40	LC 4174	273	9	35	732	282	10	5	687	310	11	1	542	338	10	55	385
MS2-20#	LC 4321	308	14	56	731	336	16	2	405								

Sample #	Electret	Day	Time Hrs	Minutes	V(5)
MS2-13	LC 5303	336	14	58	219

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO
MARKHAM -STOUFFVILLE
Soil Radon Gas Concentration
Environment 2



AURORA ENVIRONMENTAL SURVEYS LIMITED

02-21-92

AURORA ENVIRONMENTAL SURVEYS LIMITED

Radon Concentrations - Average from installation date

SOIL RADON GAS STUDY of SOUTHERN ONTARIO

MARKHAM-STOUFFVILLE AREA **ENVIRONMENT # 2**
(gamma corrected for 9.027 uR/hr)

Sample #	(1) Rn pCi/L	Days	(2) Rn pCi/L	Days	(3) Rn pCi/L	Days	Summary Rn pCi/L	Summary Days		
MS2-1	122.17	6.96	121.83	38.06	130.69	66.16	130.69	66.16	.00	.00
MS2-2	125.38	6.96	123.28	38.06	127.48	66.16	127.48	66.16	.00	.00
MS2-3	113.17	6.95	108.47	38.05	108.39	66.15	108.39	66.15	.00	.00
MS2-4	121.19	6.95	94.19	38.04	104.35	66.15	104.35	66.15	.00	.00
MS2-5	196.82	6.95	242.46	38.04	227.04	66.15	227.04	66.15	.00	.00
MS2-6	153.55	6.93	182.62	38.03	196.62	66.13	196.62	66.13	.00	.00
MS2-7	221.71	6.93	271.47	38.03	299.07	66.13	299.07	66.13	.00	.00
MS2-8	58.73	6.92	38.40	38.03	32.28	66.12	32.28	66.12	.00	.00
MS2-9	109.88	6.92	155.32	38.02	149.91	66.12	149.91	66.12	.00	.00
MS2-10	183.28	6.90	172.82	38.01	170.87	66.10	170.87	66.10	.00	.00
MS2-11	118.96	6.90	111.80	38.00	113.06	66.10	113.06	66.10	.00	.00
MS2-12	85.56	6.90	93.66	38.00	79.38	66.09	79.38	66.09	.00	.00
MS2-13	526.45	6.90	322.18	18.96	257.21	38.00	221.63	66.09	.00	.00
MS2-13A	162.22	12.05	157.85	31.08	175.54	59.17	175.54	59.17	.00	.00
MS2-14	186.05	6.90	217.14	37.99	206.58	66.06	206.58	66.06	.00	.00
MS2-15	267.96	6.89	291.78	37.98	247.63	66.05	247.63	66.05	.00	.00
MS2-16	148.07	6.68	191.64	37.77	164.63	65.84	164.63	65.84	.00	.00
MS2-17	82.30	6.88	106.28	37.97	101.22	66.04	101.22	66.04	.00	.00
MS2-18	71.36	6.88	60.14	37.97	66.84	66.04	66.84	66.04	.00	.00
MS2-19	102.80	6.87	130.21	38.00	134.01	66.05	134.01	66.05	.00	.00
MS2-20	224.82	6.86	382.29	37.99	362.57	66.04	362.57	66.04	.00	.00
MS2-21	94.91	6.86	87.07	37.97	91.31	66.02	91.31	66.02	.00	.00
MS2-22	146.10	6.85	167.58	37.95	178.14	66.01	178.14	66.01	.00	.00
MS2-23	96.37	6.84	79.19	37.92	83.54	65.98	83.54	65.98	.00	.00
MS2-24	163.37	6.84	194.01	38.01	185.49	78.01	185.49	78.01	.00	.00
MS2-25	139.41	9.04	129.39	35.23	140.32	63.29	140.32	63.29	.00	.00
MS2-26	107.53	9.03	116.88	37.06	121.43	65.07	121.43	65.07	.00	.00
MS2-27	143.48	8.98	130.99	36.99	112.25	65.02	112.25	65.02	.00	.00
MS2-28	257.67	9.03	256.44	37.04	245.59	65.07	245.59	65.07	.00	.00
MS2-29	244.01	9.02	219.96	37.04	232.42	65.07	232.42	65.07	.00	.00
MS2-30	193.92	8.97	222.31	36.88	221.06	63.18	221.06	63.18	.00	.00
MS2-31	168.35	8.98	199.91	37.13	200.70	65.04	200.70	65.04	.00	.00
MS2-32	88.26	9.00	137.43	37.02	149.02	65.02	149.02	65.02	.00	.00
MS2-33	125.89	9.02	116.63	37.05	121.64	65.08	121.64	65.08	.00	.00
MS2-34	193.12	9.03	198.11	37.04	201.20	65.07	201.20	65.07	.00	.00
MS2-35	102.82	8.99	99.17	37.08	131.86	65.01	131.86	65.01	.00	.00
MS2-36	59.61	8.99	73.51	37.08	79.71	65.01	79.71	65.01	.00	.00
MS2-37	189.45	8.99	209.30	37.08	249.45	65.01	249.45	65.01	.00	.00
MS2-38	182.06	8.99	191.96	37.08	188.69	65.02	188.69	65.02	.00	.00
MS2-39	87.51	8.99	104.70	37.08	111.59	65.02	111.59	65.02	.00	.00
MS2-40	136.31	9.02	143.82	37.06	154.08	65.06	154.08	65.06	.00	.00
MS2-20#	335.86	28.05								

AURORA ENVIRONMENTAL SURVEYS LIMITED

Radon Concentrations - (Incremental)

SOIL RADON GAS STUDY of SOUTHERN ONTARIO

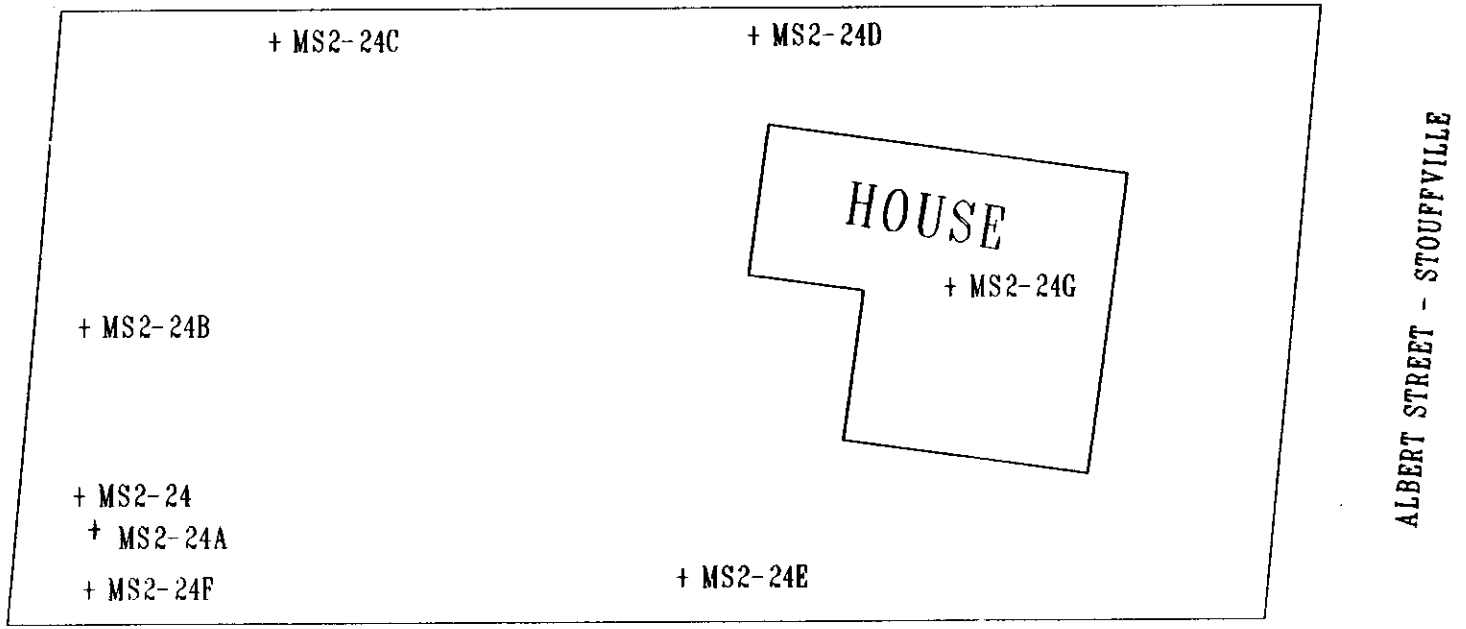
MARKHAM-STOUFFVILLE AREA **ENVIRONMENT # 2**
(gamma corrected for 9.027 uR/hr)

Sample #	(1) Rn pCi/L	Days	(2) Rn pCi/L	Days	(3) Rn pCi/L	Days	(4) Rn pCi/L	Days	(5) Rn pCi/L	Days
MS2-1	122.17	6.96	121.43	31.10	142.58	28.11	.00	.00	.00	.00
MS2-2	125.02	6.96	122.49	31.10	133.03	28.10	.00	.00	.00	.00
MS2-3	112.82	6.95	107.08	31.10	108.07	28.10	.00	.00	.00	.00
MS2-4	120.84	6.95	87.82	31.10	117.87	28.10	.00	.00	.00	.00
MS2-5	196.46	6.95	252.44	31.10	206.99	28.10	.00	.00	.00	.00
MS2-6	153.19	6.93	188.81	31.10	216.02	28.10	.00	.00	.00	.00
MS2-7	221.36	6.93	282.39	31.10	338.94	28.10	.00	.00	.00	.00
MS2-8	58.38	6.92	33.52	31.10	23.66	28.10	.00	.00	.00	.00
MS2-9	109.53	6.92	165.10	31.10	142.59	28.10	.00	.00	.00	.00
MS2-10	182.93	6.90	170.20	31.10	168.41	28.10	.00	.00	.00	.00
MS2-11	118.61	6.90	109.88	31.10	114.56	28.09	.00	.00	.00	.00
MS2-12	85.20	6.90	95.11	31.10	59.77	28.09	.00	.00	.00	.00
MS2-13*	526.09	6.90	205.25	12.07	192.60	19.03	198.80	28.09	.00	.00
MS2-13A			161.87	12.05	154.79	19.04	195.18	28.09	.00	.00
MS2-14	185.70	6.90	223.78	31.09	192.85	28.07	.00	.00	.00	.00
MS2-15	267.61	6.89	296.95	31.09	188.96	28.07	.00	.00	.00	.00
MS2-16	147.72	6.68	200.71	31.09	128.35	28.07	.00	.00	.00	.00
MS2-17	81.95	6.88	111.24	31.09	94.14	28.07	.00	.00	.00	.00
MS2-18	71.01	6.88	57.31	31.09	75.57	28.07	.00	.00	.00	.00
MS2-19	102.44	6.87	135.92	31.13	139.08	28.04	.00	.00	.00	.00
MS2-20	224.47	6.86	417.05	31.12	335.51	28.05	.00	.00	.00	.00
MS2-21	94.56	6.86	85.00	31.11	96.79	28.05	.00	.00	.00	.00
MS2-22	145.75	6.85	172.00	31.10	192.69	28.06	.00	.00	.00	.00
MS2-23	96.02	6.84	75.06	31.08	89.13	28.06	.00	.00	.00	.00
MS2-24	163.02	6.84	200.44	31.17	335.51	28.05	.00	.00	.00	.00
MS2-25	139.06	9.04	125.61	26.18	153.94	28.06	.00	.00	.00	.00
MS2-26	107.18	9.03	119.56	28.03	127.27	28.01	.00	.00	.00	.00
MS2-27	143.13	8.98	126.67	28.01	87.30	28.03	.00	.00	.00	.00
MS2-28	257.31	9.03	255.93	28.01	232.36	28.02	.00	.00	.00	.00
MS2-29	243.66	9.02	212.02	28.02	249.82	28.03	.00	.00	.00	.00
MS2-30	193.57	8.97	231.22	27.91	219.99	26.30	.00	.00	.00	.00
MS2-31	168.00	8.98	209.72	28.15	202.21	27.91	.00	.00	.00	.00
MS2-32	87.91	9.00	152.90	28.02	164.33	28.00	.00	.00	.00	.00
MS2-33	125.53	9.02	113.33	28.03	128.10	28.03	.00	.00	.00	.00
MS2-34	192.76	9.03	199.48	28.01	205.76	28.03	.00	.00	.00	.00
MS2-35	102.47	8.99	97.66	28.09	175.13	27.93	.00	.00	.00	.00
MS2-36	59.26	8.99	77.60	28.09	87.65	27.93	.00	.00	.00	.00
MS2-37	189.10	8.99	215.42	28.09	303.98	27.93	.00	.00	.00	.00
MS2-38	181.71	8.99	194.87	28.09	184.68	27.93	.00	.00	.00	.00
MS2-39	87.16	8.99	109.87	28.09	120.52	27.94	.00	.00	.00	.00
MS2-40	135.96	9.02	145.93	28.04	167.68	28.00	.00	.00	.00	.00
MS2-20#	335.51	28.05	.00	.00	.00	.00	.00	.00	.00	.00

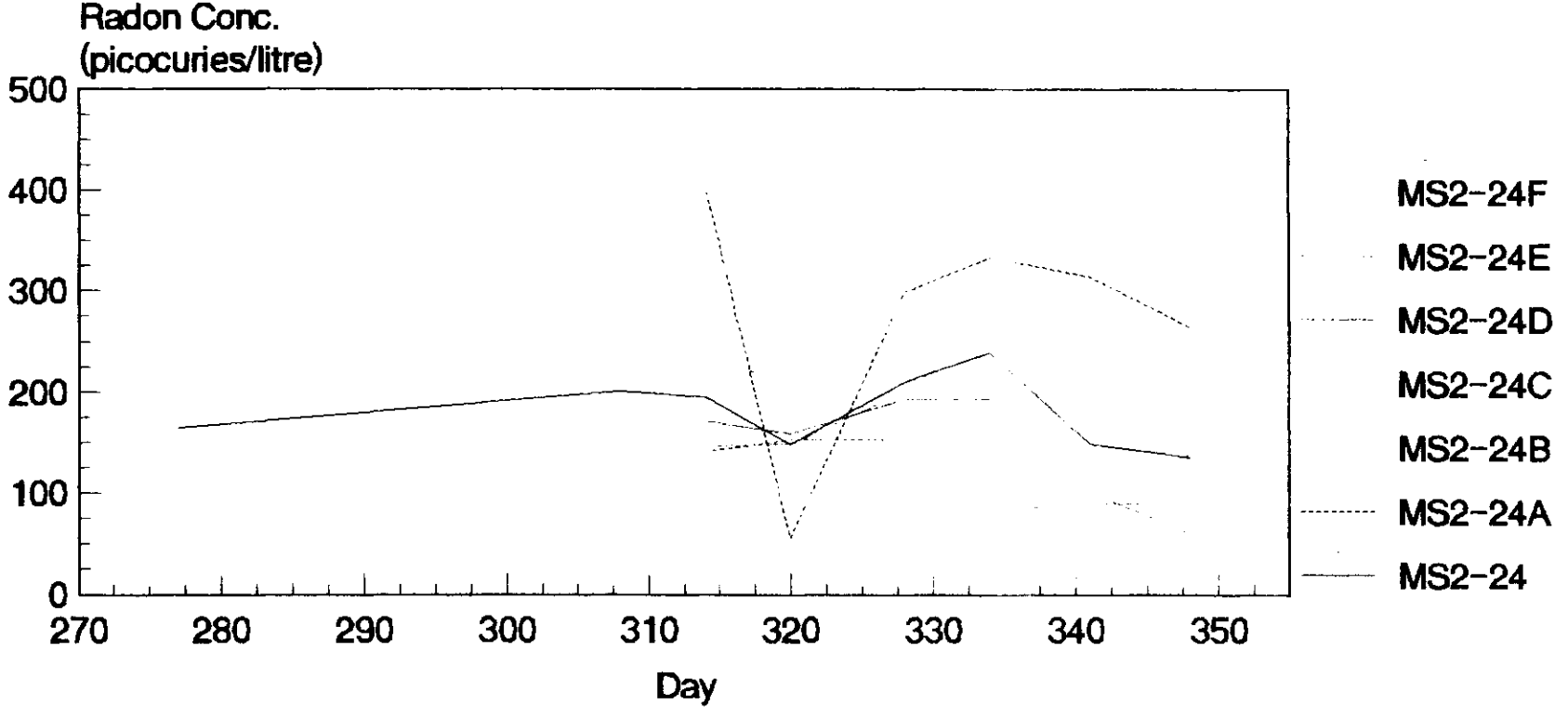
SOIL RADON GAS STUDY of SOUTHERN ONTARIO

SITE MS2 - 24

Scale 1:250



SOIL RADON GAS STUDY OF SOUTHERN ONTARIO
MARKHAM - STOUFFVILLE
Variation of Radon Concentration over Time at Station MS2-24



AURORA ENVIRONMENTAL SURVEYS LIMITED

01-21-92

AURORA ENVIRONMENTAL SURVEYS LIMITED

SOIL RADON GAS STUDY of SOUTHERN ONTARIO

MARKHAM-STOUFFVILLE AREA **ENVIRONMENT # 2 - DETAIL MS2-24 SITE**

Sample #	Electret	Day	Time Hrs	Minutes	V(i)	Day	Time Hrs	Minutes	V(2)	Day	Time Hrs	Minutes	V(3)	Day	Time Hrs	Minutes	V(4)
MS2-24	LC 2768	270	16	30	742	277	12	36	701	308	16	47	482	314	8	40	445
MS2-24A	LC 5345	304	15	30	709	314	8	35	569	320	12	17	557	328	11	30	476
MS2-24B	LC 3611	304	15	34	736	314	8	25	684	320	12	10	651	328	11	15	594
MS2-24C	LC 4242	304	15	38	733	314	8	20	651	320	12	10	605	328	11	12	539
MS2-24D	LB 5245	304	15	42	712	314	8	15	652	320	12	5	617	328	11	10	563
MS2-24E	LC 5288	304	15	45	721	314	8	10	671	320	11	55	637	328	11	5	594
MS2-24F	LC 4119	314	8	45	729	320	12	15	718	328	11	25	705	334	12	13	689

Sample #	Electret	Day	Time Hrs	Minutes	V(5)	Day	Time Hrs	Minutes	V(6)	Day	Time Hrs	Minutes	V(7)	Day	Time Hrs	Minutes	V(8)
MS2-24	LC 2768	320	12	25	420	328	11	35	366	334	12	20	320	341	12	50	287
MS2-24A	LC 5345	334	12	15	421	341	12	46	350	348	16	45	284				
MS2-24B	LC 3611	334	12	10	550	341	12	44	498	348	16	39	464				
MS2-24C	LC 4242	334	12	6	486	341	12	39	430	348	16	35	398				
MS2-24D	LB 5245	334	12	3	531	341	12	38	507	348	16	30	492				
MS2-24E	LC 5288	334	11	59	580	341	12	58	558	348	16	25	536				
MS2-24F	LC 4119	341	12	53	675	348	16	47	670								

Sample #	Electret	Day	Time Hrs	Minutes	V(8)
MS2-24	LC 2768	348	16	50	253

Radon Concentrations - Average from installation date

SOIL RADON GAS STUDY of SOUTHERN ONTARIO

MARKHAM-STOUFFVILLE AREA **ENVIRONMENT # 2 - DETAIL MS2-24 SITE**
(gamma corrected for 9.027 uR/hr)

Sample #	(1) Rn pCi/L	Days	(2) Rn pCi/L	Days	(3) Rn pCi/L	Days	(4) Rn pCi/L	Days	(5) Rn pCi/L	Days	(6) Rn pCi/L	Days	(7) Rn pCi/L	Days
MS2-24	163.37	6.84	194.01	38.01	194.20	43.67	185.34	49.83	188.49	57.80	193.24	63.83	188.85	70.85
MS2-24A	406.06	9.71	270.09	15.87	279.75	23.83	278.77	29.86	285.13	36.89	286.20	44.05		
MS2-24B	146.51	9.70	147.38	15.86	165.72	23.82	174.61	29.86	182.64	36.88	175.83	44.05		
MS2-24C	233.29	9.70	224.48	15.86	229.24	23.82	235.12	29.85	235.91	36.88	219.62	44.04		
MS2-24D	171.13	9.69	166.66	15.85	175.75	23.81	171.28	29.85	157.64	36.87	141.94	44.03		
MS2-24E	141.80	9.68	146.56	15.84	148.59	23.81	131.81	29.84	123.71	36.88	118.05	44.03		
MS2-24F	47.97	6.15	45.64	14.11	53.62	20.14	53.80	27.17	46.41	34.33				

AURORA ENVIRONMENTAL SURVEYS LIMITED

Radon Concentrations - (Incremental)

SOIL RADON GAS STUDY of SOUTHERN ONTARIO

MARKHAM-STOUFFVILLE AREA **ENVIRONMENT # 2** **MS2-24 SITE**
(gamma corrected for 9.027 uR/hr)

Sample #	(1) Rn pCi/L	Days	(2) Rn pCi/L	Days	(3) Rn pCi/L	Days	(4) Rn pCi/L	Days	(5) Rn pCi/L	Days	(6) Rn pCi/L	Days	(7) Rn pCi/L	Days
MS2-24	163.37	6.84	200.44	31.17	195.64	5.66	148.44	6.16	210.16	7.97	239.78	6.03	149.64	7.02
MS2-24A	405.71	9.71	55.19	6.15	299.00	7.97	333.09	6.03	314.40	7.02	292.95	7.17		
MS2-24B	146.16	9.70	148.42	6.16	201.98	7.96	266.17	6.04	218.17	7.02				
MS2-24C	232.94	9.70	210.33	6.16	238.57	7.96	320.65	6.04	240.98	7.02				
MS2-24D	170.78	9.69	159.31	6.16	193.58	7.96	193.62	6.04	100.88	7.02				
MS2-24E	141.45	9.68	153.71	6.16	152.34	7.97	84.72	6.04	90.54	7.04				
MS2-24F			47.62	6.15	43.48	7.97	71.93	6.03	72.75	7.03	19.48	7.16		

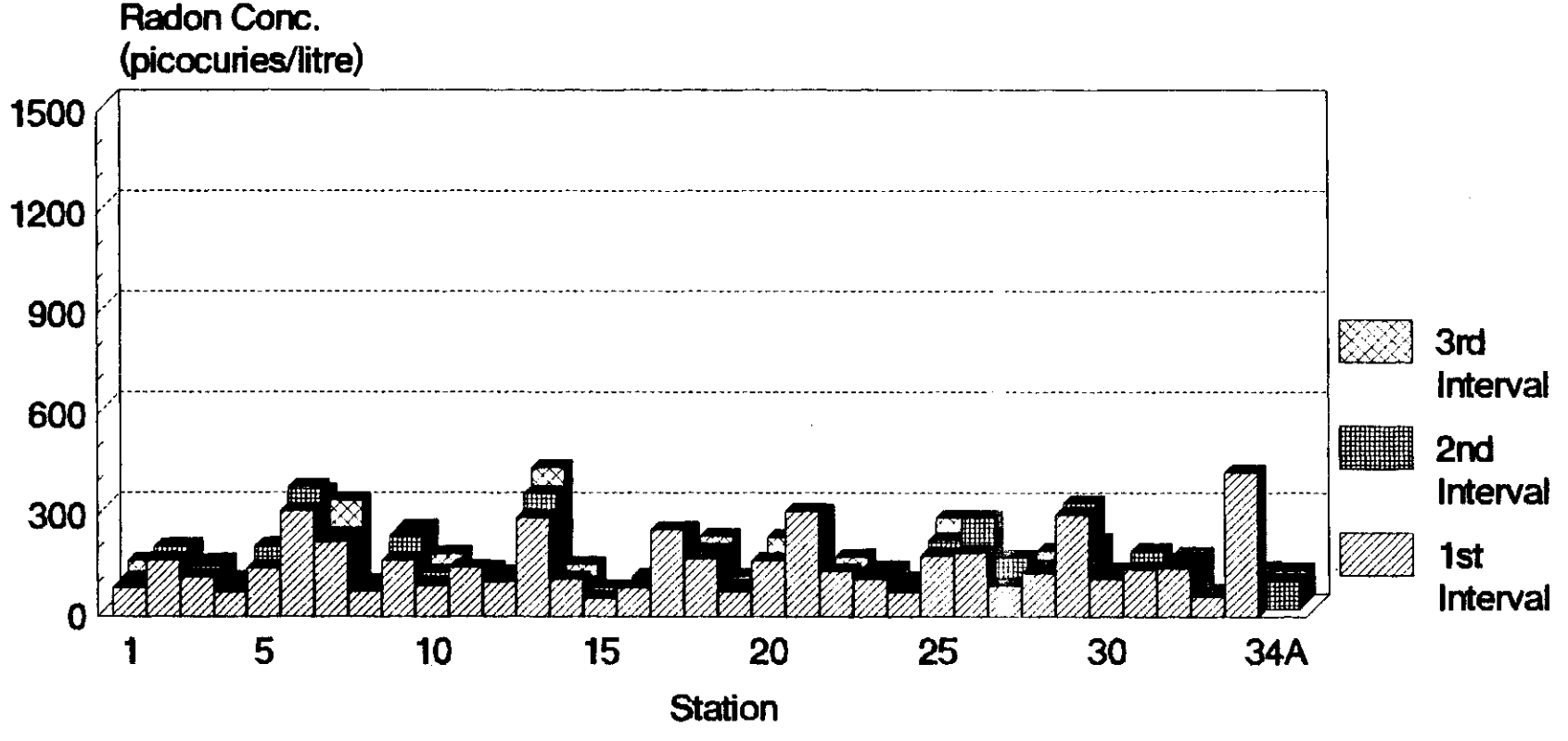
AURORA ENVIRONMENTAL SURVEYS LIMITED

SOIL RADON GAS STUDY of SOUTHERN ONTARIO

MARKHAM-STOUFFVILLE AREA **ENVIRONMENT # 3**

Sample #	Electret	Day	Time Hrs	Minutes	V(i)	Day	Time Hrs	Minutes	V(2)	Day	Time Hrs	Minutes	V(3)	Day	Time Hrs	Minutes	V(4)
MS3-1	LC 4141	274	14	35	733	282	14	58	708	312	14	40	615	340	11	24	500
MS3-2	LC 3639	274	11	40	714	288	12	43	630	312	15	29	478	340	12	8	330
MS3-3	LC 5639	274	13	45	730	282	15	10	696	312	16	9	564	340	13	35	452
MS3-4	LC 5318	274	13	15	719	282	15	5	698	312	16	2	624	340	13	22	561
MS3-5	LC 5656	274	13	55	735	282	15	20	693	312	16	26	497	340	13	44	345
MS3-6	LC 5353	274	14	25	725	282	14	53	635	312	14	44	276				
MS3-7	LC 4269	274	16	10	731	288	11	40	621	312	14	18	443	340	12	34	182
MS3-8	LC 5712	275	10	25	739	288	11	17	704	312	13	10	649	338	16	21	597
MS3-9	LC 5363	274	15	25	712	289	11	22	624	312	12	28	456	338	15	57	274
MS3-10	LC 2937	274	15	5	728	289	11	15	679	312	12	22	592	338	15	53	467
MS3-11	LC 5337	274	14	55	712	289	11	8	635	312	12	16	539	338	15	48	454
MS3-12	LC 3981	274	11	55	741	288	12	50	688	312	15	35	599	340	12	13	518
MS3-13	LC 5636	274	12	10	712	288	12	56	567	312	15	41	298				
MS3-14	LB 3800	274	12	15	727	288	13	2	671	312	15	48	608	340	12	26	503
MS3-15	LC 5589	275	13	10	748	288	12	20	723	340	13	8	605				
MS3-16	LC 3644	275	13	0	738	288	12	12	698	315	9	10	632	340	13	4	567
MS3-17	LC 3672	274	12	55	729	288	11	46	600	312	14	32	408	340	11	18	296
MS3-18	LC 5479	274	12	40	708	288	11	56	622	312	14	26	480	340	11	12	307
MS3-19	LC 5321	275	9	50	712	288	10	56	677	312	12	38	622	338	16	5	555
MS3-20	LB 4153	274	16	30	738	288	11	36	656	312	14	11	558	340	11	5	381
MS3-21	LC 5700	275	9	55	729	288	11	0	584	312	12	44	354				
MS3-22	LC 5276	274	16	30	716	288	11	31	649	312	14	6	568	340	11	2	444
MS3-23	LC 0695	275	10	35	747	288	11	22	694	312	13	18	594	340	10	48	500
MS3-24	LB 3840	275	10	45	740	288	11	25	707	312	13	22	648	340	10	51	583
MS3-25	LC 4158	275	10	5	727	288	11	4	643	312	12	49	475	338	16	9	267
MS3-26	LC 5709	275	10	15	750	288	11	8	661	312	12	56	439	338	16	14	330
MS3-27	LC 5242	275	10	55	722	288	10	25	679	312	12	2	550	338	15	29	459
MS3-28	LC 5643	275	11	10	735	288	10	39	675	312	11	54	572	338	15	23	441
MS3-29	LC 5692	275	11	20	739	288	10	35	599	312	11	40	349				
MS3-30	LC 3686	275	11	50	724	288	10	26	672	312	11	32	576	338	15	9	499
MS3-31	LC 4273	275	11	40	730	288	10	21	665	312	11	28	521	338	15	5	422
MS3-32	LC 4176	275	12	5	727	288	10	14	660	312	11	19	541	338	14	58	420
MS3-33	LC 3674	275	12	15	720	288	9	53	693	312	11	1	664	338	14	43	637
MS3-34	LB 3722	275	12	30	735	288	10	4	539	312	11	9	466	338	14	48	382
MS3-34A	LB 5350	288	10	6	702	312	11	10	630	338	14	52	545				
MS3-6#	LC 4328	312	14	46	730	340	11	32	417								
MS3-13#	LC 4108	312	15	45	733	340	12	19	353								
MS3-29#	LC 5420	312	11	45	736	338	15	18	569								

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO
MARKHAM – STOUFFVILLE
Soil Radon Gas Concentration
Environment 3



AURORA ENVIRONMENTAL SURVEYS LIMITED

01-17-92

AURORA ENVIRONMENTAL SURVEYS LIMITED

Radon Concentration - Average from date of installation

SOIL RADON GAS STUDY of SOUTHERN ONTARIO

MARKHAM-STOUFFVILLE AREA **ENVIRONMENT # 3**
(gamma corrected for 10.68 uR/hr)

Sample #	(1) Rn pCi/L	Days	(2) Rn pCi/L	Days	(3) Rn pCi/L	Days	(4) Rn pCi/L	Days	(5) Rn pCi/L	Days
MS3-1	84.28	8.02	85.32	38.00	99.45	65.87	.00	.00	.00	.00
MS3-2	165.66	14.04	176.15	38.16	170.25	66.02	.00	.00	.00	.00
MS3-3	114.77	8.06	121.42	38.10	119.80	65.99	.00	.00	.00	.00
MS3-4	70.36	8.08	68.30	38.12	66.30	66.00	.00	.00	.00	.00
MS3-5	142.03	8.06	176.61	38.10	171.83	65.99	.00	.00	.00	.00
MS3-6	311.06	8.02	349.90	38.01	338.80	65.88	.00	.00	.00	.00
MS3-7	220.68	13.81	217.32	37.92	250.82	65.85	.00	.00	.00	.00
MS3-8	72.35	13.04	65.87	37.11	61.47	63.25	.00	.00	.00	.00
MS3-9	164.56	14.83	193.48	37.88	202.71	64.02	.00	.00	.00	.00
MS3-10	89.85	14.84	99.34	37.89	115.59	64.03	.00	.00	.00	.00
MS3-11	143.44	14.84	128.31	37.89	114.86	64.04	.00	.00	.00	.00
MS3-12	102.52	14.04	102.67	38.15	94.46	66.01	.00	.00	.00	.00
MS3-13	290.52	14.03	320.84	38.15	353.34	66.01	.00	.00	.00	.00
MS3-14	109.04	14.03	85.92	38.15	95.40	66.01	.00	.00	.00	.00
MS3-15	51.34	12.97	60.03	65.00	60.03	65.00	.00	.00	.00	.00
MS3-16	83.43	12.97	72.64	39.84	72.66	65.00	.00	.00	.00	.00
MS3-17	257.47	13.95	243.11	38.07	193.09	65.93	.00	.00	.00	.00
MS3-18	170.98	13.97	170.65	38.07	179.05	65.94	.00	.00	.00	.00
MS3-19	73.00	13.05	66.52	37.12	68.95	63.26	.00	.00	.00	.00
MS3-20	163.15	13.80	132.41	37.90	156.55	65.77	.00	.00	.00	.00
MS3-21	310.68	13.05	294.49	37.12	294.49	37.12	(removed early due to construction)			
MS3-22	133.80	13.79	108.89	37.90	118.06	65.77	.00	.00	.00	.00
MS3-23	110.29	13.03	113.84	37.11	106.63	65.01	.00	.00	.00	.00
MS3-24	68.14	13.03	67.38	37.11	66.38	65.00	.00	.00	.00	.00
MS3-25	177.67	13.04	193.16	37.11	215.23	63.25	.00	.00	.00	.00
MS3-26	187.01	13.04	239.27	37.11	193.23	63.25	.00	.00	.00	.00
MS3-27	90.26	12.98	129.99	37.05	118.37	63.19	.00	.00	.00	.00
MS3-28	126.25	12.98	122.39	37.03	132.62	63.18	.00	.00	.00	.00
MS3-29	300.35	12.97	306.89	37.01	253.62	63.16	.00	.00	.00	.00
MS3-30	109.83	12.94	111.28	36.99	100.38	63.14	.00	.00	.00	.00
MS3-31	137.60	12.95	159.08	36.99	139.70	63.14	.00	.00	.00	.00
MS3-32	142.32	12.92	141.08	36.97	139.42	63.12	.00	.00	.00	.00
MS3-33	56.42	12.90	40.72	36.95	35.35	63.10	.00	.00	.00	.00
MS3-34	428.21	12.90	207.27	36.94	161.47	63.10	.00	.00	.00	.00
MS3-34A	82.48	24.04	87.55	50.20	87.55	50.20	.00	.00	.00	.00
MS3-13#	397.84	27.86	.00	.00	.00	.00	.00	.00	.00	.00
MS3-29#	178.23	26.15	.00	.00	.00	.00	.00	.00	.00	.00

AURORA ENVIRONMENTAL SURVEYS LIMITED

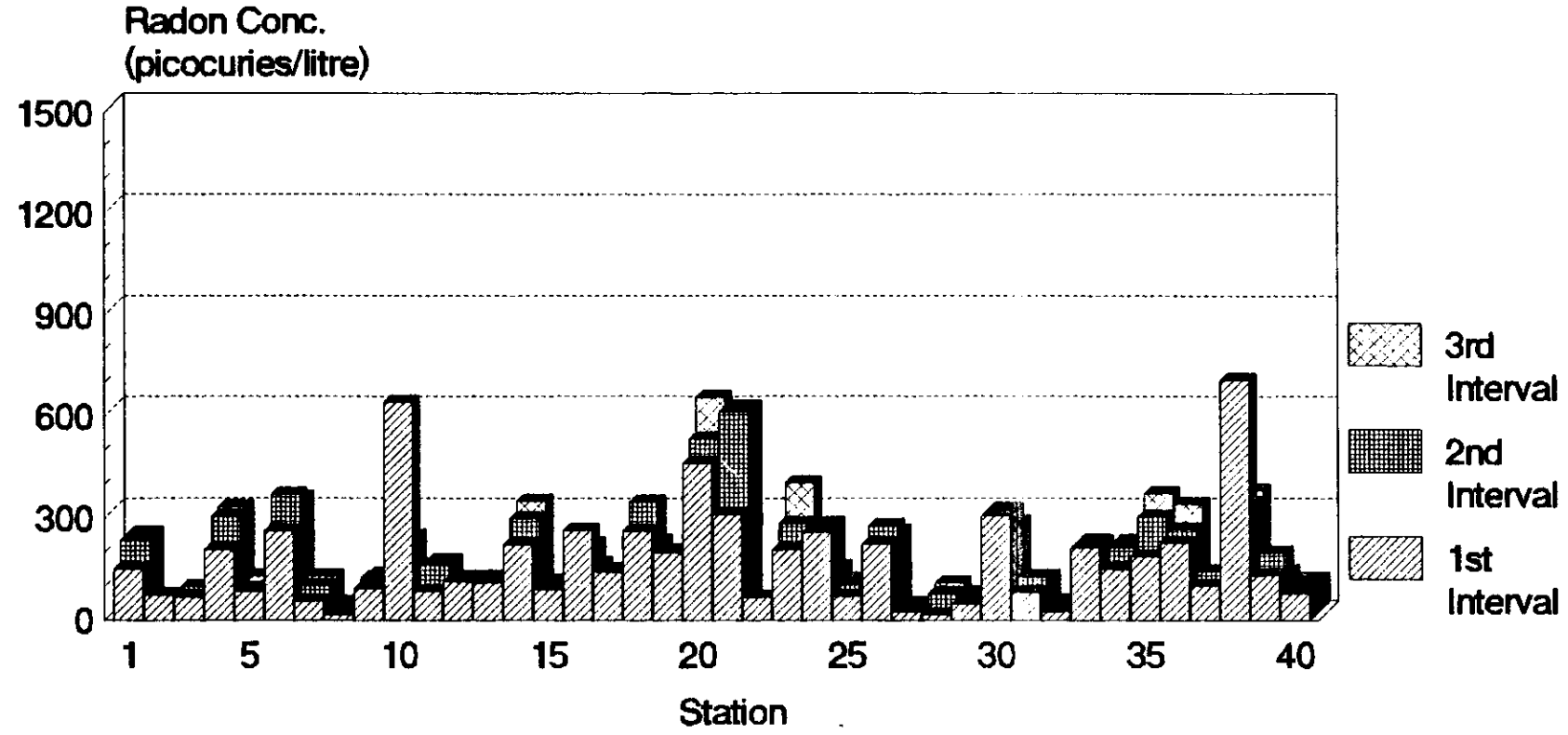
Radon Concentrations - (Incremental)

SOIL RADON GAS STUDY of SOUTHERN ONTARIO

MARKHAM-STOUFFVILLE AREA ENVIRONMENT # 3
(gamma corrected for 10.68 uR/hr)

Sample #	(1) Rn pCi/L	Days	(2) Rn pCi/L	Days	(3) Rn pCi/L	Days	(4) Rn pCi/L	Days	(5) Rn pCi/L	Days
MS3-1	84.28	8.02	85.60	29.99	118.82	27.86	.00	.00	.00	.00
MS3-2	165.66	14.04	182.38	24.12	162.68	27.86	.00	.00	.00	.00
MS3-3	114.77	8.06	123.23	30.04	117.76	27.89	.00	.00	.00	.00
MS3-4	70.36	8.08	67.75	30.04	63.61	27.89	.00	.00	.00	.00
MS3-5	142.03	8.06	185.94	30.05	165.83	27.89	.00	.00	.00	.00
MS3-6	311.06	8.02	360.78	29.99	323.66	27.87	.00	.00	.00	.00
MS3-7	220.68	13.81	215.63	24.11	297.98	27.93	.00	.00	.00	.00
MS3-8	72.35	13.04	62.37	24.08	55.25	26.13	.00	.00	.00	.00
MS3-9	164.56	14.83	212.25	23.05	216.93	26.15	.00	.00	.00	.00
MS3-10	89.85	14.84	105.47	23.05	139.31	26.15	.00	.00	.00	.00
MS3-11	143.44	14.84	118.62	23.05	95.52	26.15	.00	.00	.00	.00
MS3-12	102.52	14.04	102.79	24.11	83.30	27.86	.00	.00	.00	.00
MS3-13	290.52	14.03	339.19	24.11	397.84	27.86	.00	.00	.00	.00
MS3-14	109.04	14.03	72.49	24.12	108.48	27.86	.00	.00	.00	.00
MS3-15	51.34	12.97	62.20	52.03			.00	.00	.00	.00
MS3-16	83.43	12.97	67.44	26.87	72.73	25.16	.00	.00	.00	.00
MS3-17	257.47	13.95	235.12	24.12	125.38	27.87	.00	.00	.00	.00
MS3-18	170.98	13.97	170.57	24.10	191.14	27.87	.00	.00	.00	.00
MS3-19	73.00	13.05	63.01	24.07	72.45	26.14	.00	.00	.00	.00
MS3-20	163.15	13.80	114.88	24.11	189.79	27.87	.00	.00	.00	.00
MS3-21	310.68	13.05	286.24	24.07			.00	.00	.00	.00
MS3-22	133.80	13.79	94.67	24.11	130.72	27.87	.00	.00	.00	.00
MS3-23	110.29	13.03	115.80	24.08	97.16	27.90	.00	.00	.00	.00
MS3-24	68.14	13.03	66.97	24.08	65.09	27.90	.00	.00	.00	.00
MS3-25	177.67	13.04	201.69	24.07	247.57	26.14	.00	.00	.00	.00
MS3-26	187.01	13.04	267.81	24.08	128.43	26.14	.00	.00	.00	.00
MS3-27	90.26	12.98	151.46	24.07	102.05	26.14	.00	.00	.00	.00
MS3-28	126.25	12.98	120.35	24.05	147.35	26.15	.00	.00	.00	.00
MS3-29	300.35	12.97	310.99	24.05	178.23	26.15	.00	.00	.00	.00
MS3-30	109.83	12.94	112.09	24.05	85.05	26.15	.00	.00	.00	.00
MS3-31	137.60	12.95	170.71	24.05	112.53	26.15	.00	.00	.00	.00
MS3-32	142.32	12.92	140.47	24.05	137.34	26.15	.00	.00	.00	.00
MS3-33	56.42	12.90	32.30	24.05	27.75	26.15	.00	.00	.00	.00
MS3-34	428.21	12.90	88.91	24.05	97.08	26.15	.00	.00	.00	.00
MS3-34A	82.48	24.04	92.25	26.15						
MS3-6#	323.66	27.87								
MS3-13#	397.84	27.86								
MS3-29#	178.23	26.15								

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO
PRINCE EDWARD COUNTY
Soil Radon Gas Concentration
Environment 1



AURORA ENVIRONMENTAL SURVEYS LIMITED

01-19-92

AURORA ENVIRONMENTAL SURVEYS LIMITED

Radon Concentrations (from date of placement)

SOIL RADON GAS STUDY of SOUTHERN ONTARIO

PRINCE EDWARD COUNTY ENVIRONMENT # 1
(gamma corrected for 12.37 uR/hr)

Sample #	(1) Rn pCi/L	Days	(2) Rn pCi/L	Days	(3) Rn pCi/L	Days	(4) Rn pCi/L	Days	(5) Rn pCi/L	Days
PEC1-1	148.74	14.77	191.74	43.88	198.70	60.99	.00	.00	.00	.00
PEC1-2	71.01	14.77	41.29	43.86	39.85	60.98	.00	.00	.00	.00
PEC1-3	64.83	15.76	73.16	44.86	66.41	61.97	.00	.00	.00	.00
PEC1-4	205.75	14.75	256.42	43.85	266.60	60.96	.00	.00	.00	.00
PEC1-5	82.28	14.74	75.92	43.84	80.07	60.95	.00	.00	.00	.00
PEC1-6	261.52	14.75	320.42	43.84	322.87	60.59				
PEC1-7	53.12	15.73	70.04	44.82	75.56	61.92	.00	.00	.00	.00
PEC1-8	15.14	14.75	17.86	43.82	16.50	60.92	.00	.00	.00	.00
PEC1-9	91.57	14.73	99.27	43.82	98.15	60.91	.00	.00	.00	.00
PEC1-10	44.91	14.74	65.14	43.73	75.92	60.91	.00	.00	.00	.00
PEC1-11	84.24	14.73	123.35	43.81	126.73	60.90	.00	.00	.00	.00
PEC1-12	112.25	14.73	107.20	43.78	90.48	60.89	.00	.00	.00	.00
PEC1-13	109.18	14.73	106.84	43.68	88.70	60.86	.00	.00	.00	.00
PEC1-14	221.22	14.78	257.66	43.63	272.12	60.87	.00	.00	.00	.00
PEC1-15	89.89	14.29	81.14	42.98	79.20	60.95	.00	.00	.00	.00
PEC1-16	265.08	14.24	224.13	42.97	195.43	60.94	.00	.00	.00	.00
PEC1-17	140.58	14.24	127.04	42.97	121.78	60.94	.00	.00	.00	.00
PEC1-18	262.25	14.19	304.83	42.95	271.81	60.92	.00	.00	.00	.00
PEC1-19	196.85	14.18	187.62	42.93	176.84	60.90	.00	.00	.00	.00
PEC1-20*	462.38	14.12	495.44	42.95	531.64	60.90	.00	.00	.00	.00
PEC1-21	310.05	14.12	497.96	42.93	524.58	60.89	.00	.00	.00	.00
PEC1-22	67.09	14.08	51.62	42.94	41.55	60.88	.00	.00	.00	.00
PEC1-23	205.32	14.02	244.94	42.93	279.91	60.88	.00	.00	.00	.00
PEC1-24	256.77	14.02	260.88	42.93	218.68	60.87	.00	.00	.00	.00
PEC1-25	69.14	13.96	77.60	42.89	78.78	60.83	.00	.00	.00	.00
PEC1-26	224.53	13.92	247.23	42.87	239.86	60.81	.00	.00	.00	.00
PEC1-27	24.05	13.86	23.99	42.94	19.69	60.79	.00	.00	.00	.00
PEC1-28*	14.49	13.86	43.49	42.92	51.13	60.81	.00	.00	.00	.00
PEC1-29	46.51	13.82	49.89	42.90	47.79	60.80	.00	.00	.00	.00
PEC1-30	305.66	13.79	305.06	42.88	288.47	60.80	.00	.00	.00	.00
PEC1-31	80.03	13.77	97.52	42.87	95.01	60.79	.00	.00	.00	.00
PEC1-32	22.24	13.79	19.60	42.82	19.72	60.79	.00	.00	.00	.00
PEC1-33	211.85	13.83	211.34	42.80	200.72	60.78	.00	.00	.00	.00
PEC1-34	149.08	13.92	177.67	42.88	181.80	60.78	.00	.00	.00	.00
PEC1-35	187.15	13.90	252.62	42.72	276.08	60.77	.00	.00	.00	.00
PEC1-36	226.86	13.88	240.62	42.72	258.76	60.76	.00	.00	.00	.00
PEC1-37	98.95	13.90	115.30	42.68	100.66	60.77	.00	.00	.00	.00
PEC1-38*	708.50	13.89	446.92	42.68	416.11	60.67	.00	.00	.00	.00
PEC1-39	131.84	13.90	162.68	42.64	145.05	60.75	.00	.00	.00	.00
PEC1-40	77.62	13.92	83.17	42.61	82.63	60.75	.00	.00	.00	.00
PEC1-6#	322.35	17.11	.00	.00	.00	.00	.00	.00	.00	.00
PEC1-18#	192.90	17.97	.00	.00	.00	.00	.00	.00	.00	.00
PEC1-20#	618.26	17.95	.00	.00	.00	.00	.00	.00	.00	.00
PEC1-21#	588.21	17.96	.00	.00	.00	.00	.00	.00	.00	.00
PEC1-28#	69.47	17.89	.00	.00	.00	.00	.00	.00	.00	.00
PEC1-29#	42.79	17.90	.00	.00	.00	.00	.00	.00	.00	.00
PEC1-38#	343.37	18.08	.00	.00	.00	.00	.00	.00	.00	.00

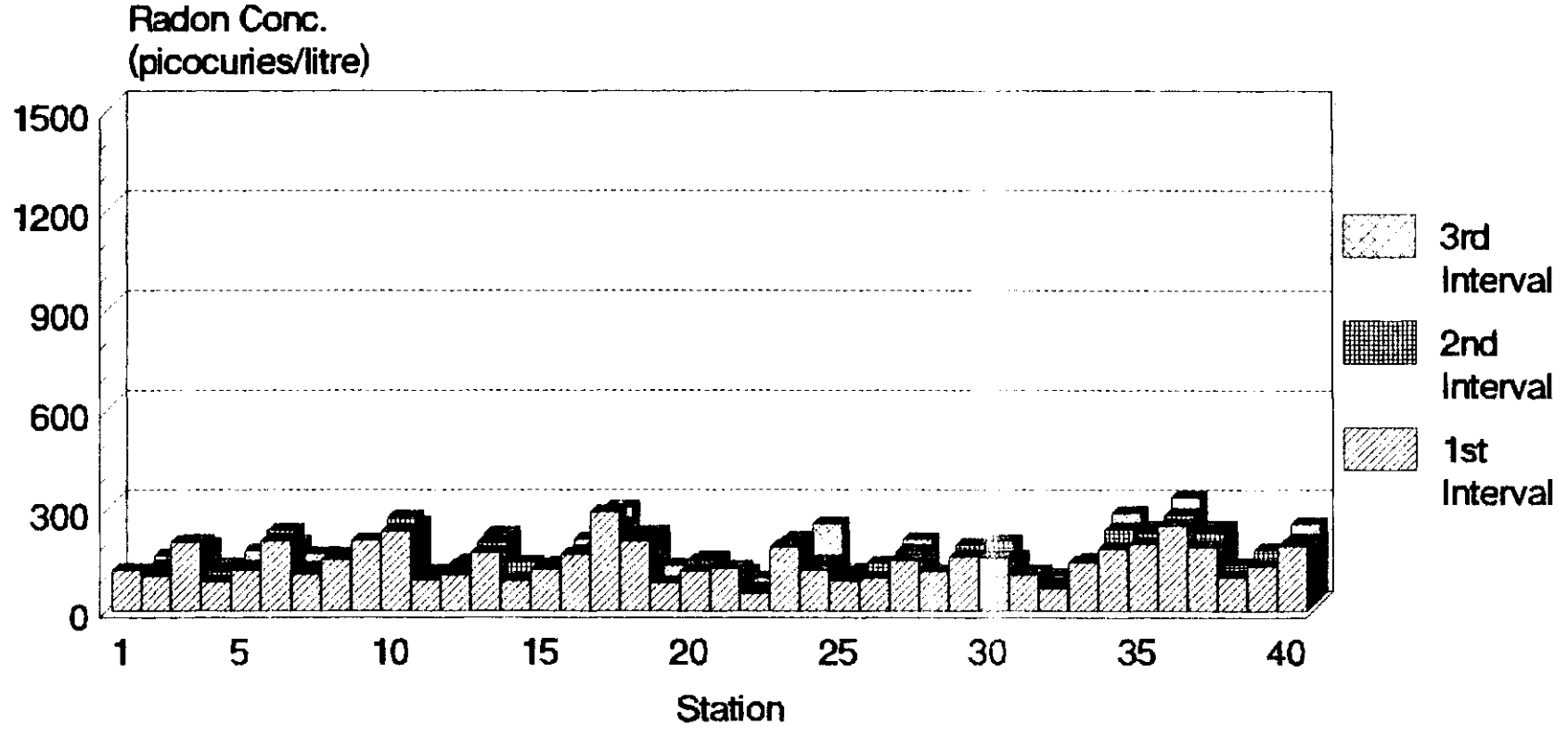
AURORA ENVIRONMENTAL SURVEYS LIMITED

SOIL RADON GAS STUDY of SOUTHERN ONTARIO

MARKHAM-STOUFFVILLE AREA **ENVIRONMENT # 4**

Sample #	Electret	Day	Time Hrs	Minutes	V(i)	Day	Time Hrs	Minutes	V(2)	Day	Time Hrs	Minutes	V(3)	Day	Time Hrs	Minutes	V(4)
MS4-1	LB 1791	275	15	35	702	288	14	25	645	315	10	12	549	340	15	16	491
MS4-2	LB 3986	275	15	45	736	288	14	32	687	315	10	17	580	340	15	29	472
MS4-3	LC 5646	275	13	58	741	288	14	42	644	315	10	21	470	340	15	37	340
MS4-4	LB 2835	275	16	5	709	288	14	46	668	315	10	26	573	340	15	43	489
MS4-5	LC 3688	275	16	15	725	288	14	52	668	315	10	31	565	340	16	4	447
MS4-6	LC 4129	275	16	25	732	288	14	50	634	315	10	37	431	340	16	9	298
MS4-7	LC 5261	275	16	35	745	288	15	2	693	315	10	42	591	340	16	13	479
MS4-8	LC 5698	275	16	45	728	288	15	7	656	315	10	47	535	340	16	19	428
MS4-9	LC 3671	275	16	50	734	288	15	12	635	315	10	51	479	340	16	25	391
MS4-10	LC 5286	276	13	0	730	288	15	18	627	315	10	56	391	340	16	31	216
MS4-11	LC 5332	276	9	10	722	288	15	33	681	315	11	2	587	347	9	20	508
MS4-12	LB 4007	276	9	0	702	288	15	28	654	315	11	7	545	347	9	12	429
MS4-13	LC 5617	276	9	20	739	288	15	37	662	315	11	13	490	347	9	22	294
MS4-14*	LC 5633	276	13	20	736	289	14	8	693	315	12	48	579	347	11	57	489
MS4-15	LC 4238	276	9	25	727	288	15	43	672	315	11	17	563	347	9	27	452
MS4-16	LC 1088	276	9	35	736	288	15	47	661	315	11	26	514	347	9	32	331
MS4-17	LC 3680	276	9	45	734	288	15	52	604	315	11	31	387	347	9	35	125
MS4-18	LC 5328	276	14	40	751	289	15	2	653	315	11	52	474	347	9	41	274
MS4-19	LB 3668	276	9	55	724	288	16	2	687	315	11	37	626	347	9	49	520
MS4-20	LC 3623	276	10	35	720	288	16	29	667	315	12	12	544	347	10	13	416
MS4-21	LC 5256	276	13	15	704	289	14	14	644	315	12	53	545	347	12	1	462
MS4-22	LB 6172	276	10	20	742	288	16	25	719	315	12	0	676	347	10	9	610
MS4-23	LC 5347	276	14	20	734	288	16	13	650	315	11	58	482	347	9	59	300
MS4-24	LC 5668	276	10	40	751	288	16	36	696	315	12	21	574	347	10	20	342
MS4-25	LB 5985	276	10	50	754	288	16	42	713	315	12	26	636	347	10	29	546
MS4-26	LC 4173	276	13	45	740	289	14	35	693	315	12	34	580	347	11	46	467
MS4-27	LC 5361	276	10	55	742	288	16	49	675	315	13	5	525	347	10	34	342
MS4-28	LC 5610	276	11	10	731	288	15	53	678	315	13	17	604	347	10	40	530
MS4-29	LC 5278	276	12	45	732	289	13	54	655	315	13	12	495	347	11	32	335
MS4-30	LC 5714	276	11	20	740	288	16	50	669	315	14	18	492	347	10	46	366
MS4-31	LB 4192	276	11	25	747	288	17	2	699	315	14	22	604	347	10	49	532
MS4-32	LC 5333	276	14	10	738	288	16	18	708	315	12	3	653	347	10	4	579
MS4-33	LB 5577	276	11	40	729	288	17	11	665	315	14	28	539	347	10	56	424
MS4-34	LC 5621	276	11	57	734	289	13	26	647	315	14	12	447	347	11	1	194
MS4-35	LC 5293	276	12	5	712	289	13	31	618	315	14	6	427	347	10	3	219
MS4-36	LB 4128	276	12	15	728	289	13	39	609	315	13	31	377	347	11	20	88
MS4-37	LC 5677	276	12	30	743	289	13	47	653	315	13	22	464	347	11	26	251
MS4-38	LC 0667	276	13	55	760	289	14	43	712	315	12	29	603	347	11	40	503
MS4-39	LB 5510	276	13	25	757	289	14	22	693	315	12	46	544	347	11	54	422
MS4-40	LC 4121	276	13	35	716	289	14	29	625	315	12	39	455	347	11	49	233
MS4-1d	LC 2994	315	10	12	382	340	15	16	321								
MS4-2d	LC 5308	315	10	17	298	340	15	29	187								
MS4-3d	LC 4167	315	10	22	298	340	15	38	169								
MS4-4d	LB 4613	315	10	26	300	340	15	43	204								
MS4-5d	LB 2692	315	10	31	283	340	16	5	173								
MS4-6d	LC 5499	315	10	37	306	340	16	9	173								
MS4-7d	LC 4181	315	10	42	315	340	16	14	214								
MS4-9d	LC 5535	315	10	15	295	340	16	26	215								
MS4-15d	LB 1717	315	11	17	300	347	9	28	201								
MS4-17d	LC 5275	315	11	31	284	347	9	37	43								
MS4-19d	LC 4197	315	11	37	295	347	9	51	195								
MS4-21d	LC 5444	315	12	53	275	347	12	2	195								
MS4-24d	LC 0946	315	12	21	298	347	10	21	125								
MS4-27d	LC 5692	315	13	5	351	347	10	34	181								
MS4-28d	LC 5353	315	13	17	276	347	10	41	203								
MS4-32d	LC 5676	315	12	3	290	347	10	4	214								
MS4-35d	LC 5636	315	14	6	299	347	10	3	104								
MS4-38d	LC 3649	315	12	29	289	347	11	41	192								
MS4-40d	LC 5329	315	12	39	295	347	11	49	75								
MS4-10d	LC 5955	315	10	56	284	340	16	32	112								

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO
MARKHAM - STOUFFVILLE
Soil Radon Gas Concentration
Environment 4



AURORA ENVIRONMENTAL SURVEYS LIMITED

02-21-92

AURORA ENVIRONMENTAL SURVEYS LIMITED

SOIL RADON GAS STUDY of SOUTHERN ONTARIO — MARKHAM-STOUFFVILLE AREA — ENVIRONMENT # 4
(gamma corrected for 9.095 uR/)

Sample #	(1) Rn pCi/L	Days	(2) Rn pCi/L	Days	(3) Rn pCi/L	Days	(4) Rn pCi/L	Days	(5) Rn pCi/L	Days
MS4-1	121.68	12.95	108.08	39.78	92.04	64.99	.00	.00	.00	.00
MS4-2	103.05	12.95	108.93	39.77	115.11	64.99	.00	.00	.00	.00
MS4-3	205.17	13.03	193.34	39.85	179.39	65.07	.00	.00	.00	.00
MS4-4	86.79	12.95	95.44	39.76	95.93	64.98	.00	.00	.00	.00
MS4-5	120.77	12.94	112.32	39.76	122.08	64.99	.00	.00	.00	.00
MS4-6	209.56	12.93	217.27	39.76	196.37	64.99	.00	.00	.00	.00
MS4-7	109.26	12.94	107.18	39.75	115.66	64.98	.00	.00	.00	.00
MS4-8	153.20	12.93	136.41	39.75	132.24	64.98	.00	.00	.00	.00
MS4-9	211.63	12.93	182.25	39.75	152.23	64.98	.00	.00	.00	.00
MS4-10	236.03	12.10	252.14	38.91	239.67	64.15	.00	.00	.00	.00
MS4-11	91.23	12.27	95.94	39.08	84.77	71.01	.00	.00	.00	.00
MS4-12	107.87	12.27	112.99	39.09	110.46	71.01	.00	.00	.00	.00
MS4-13	172.41	12.26	180.48	39.08	184.13	71.00	.00	.00	.00	.00
MS4-14*	89.62	13.03	111.92	38.98	98.20	70.94	.00	.00	.00	.00
MS4-15	122.88	12.26	117.18	39.08	110.29	71.00	.00	.00	.00	.00
MS4-16	168.07	12.26	160.18	39.08	166.41	71.00	.00	.00	.00	.00
MS4-17	295.31	12.25	257.06	39.07	261.04	70.99	.00	.00	.00	.00
MS4-18	206.84	13.02	202.06	38.88	198.33	70.79	.00	.00	.00	.00
MS4-19	82.18	12.25	68.84	39.07	80.57	71.00	.00	.00	.00	.00
MS4-20	118.79	12.25	126.47	39.07	123.05	70.98	.00	.00	.00	.00
MS4-21	127.23	13.04	114.71	38.98	97.24	70.95	.00	.00	.00	.00
MS4-22	50.23	12.25	45.44	39.07	50.73	70.99	.00	.00	.00	.00
MS4-23	191.64	12.08	183.94	38.90	179.98	70.82	.00	.00	.00	.00
MS4-24	121.99	12.25	125.78	39.07	167.27	70.99	.00	.00	.00	.00
MS4-25	90.36	12.24	82.53	39.07	81.34	70.99	.00	.00	.00	.00
MS4-26	97.97	13.03	114.05	38.95	109.05	70.92	.00	.00	.00	.00
MS4-27	149.65	12.25	156.01	39.09	163.84	70.99	.00	.00	.00	.00
MS4-28	118.80	12.20	89.74	39.09	79.14	70.98	.00	.00	.00	.00
MS4-29	162.37	13.05	172.06	39.02	163.21	70.95	.00	.00	.00	.00
MS4-30	159.09	12.23	179.44	39.12	152.51	70.98	.00	.00	.00	.00
MS4-31	106.46	12.23	100.80	39.12	84.45	70.98	.00	.00	.00	.00
MS4-32	66.93	12.09	59.37	38.91	61.87	70.83	.00	.00	.00	.00
MS4-33	143.68	12.23	136.34	39.12	123.09	70.97	.00	.00	.00	.00
MS4-34	183.59	13.06	209.95	39.09	228.35	70.96	.00	.00	.00	.00
MS4-35	200.31	13.06	210.17	39.08	208.39	70.92	.00	.00	.00	.00
MS4-36	253.58	13.06	260.95	39.05	276.84	70.96	.00	.00	.00	.00
MS4-37	189.58	13.05	203.40	39.04	205.34	70.96	.00	.00	.00	.00
MS4-38	99.40	13.03	111.06	38.94	101.56	70.91	.00	.00	.00	.00
MS4-39	133.35	13.04	152.63	38.97	134.72	70.94	.00	.00	.00	.00
MS4-40	193.83	13.04	191.84	38.96	203.40	70.93	.00	.00	.00	.00
MS4-1d	75.17	25.21	.00	.00	75.17	25.21	.00	.00	.00	.00
MS4-2d	144.03	25.22	.00	.00	144.03	25.22	.00	.00	.00	.00
MS4-3d	168.18	25.22	.00	.00	168.18	25.22	.00	.00	.00	.00
MS4-4d	123.90	25.22	.00	.00	123.90	25.22	.00	.00	.00	.00
MS4-5d	143.52	25.23	.00	.00	143.52	25.23	.00	.00	.00	.00
MS4-6d	172.91	25.23	.00	.00	172.91	25.23	.00	.00	.00	.00
MS4-7d	129.67	25.23	.00	.00	129.67	25.23	.00	.00	.00	.00
MS4-9d	102.78	25.26	.00	.00	102.78	25.26	.00	.00	.00	.00
MS4-15d	100.80	31.92	.00	.00	100.80	31.92	.00	.00	.00	.00
MS4-17d	256.39	31.92	.00	.00	256.39	31.92	.00	.00	.00	.00
MS4-19d	102.06	31.93	.00	.00	102.06	31.93	.00	.00	.00	.00
MS4-21d	81.68	31.96	.00	.00	81.68	31.96	.00	.00	.00	.00
MS4-24d	179.97	31.92	.00	.00	179.97	31.92	.00	.00	.00	.00
MS4-27d	172.90	31.90	.00	.00	172.90	31.90	.00	.00	.00	.00
MS4-28d	74.47	31.89	.00	.00	74.47	31.89	.00	.00	.00	.00
MS4-32d	77.10	31.92	.00	.00	77.10	31.92	.00	.00	.00	.00
MS4-35d	204.42	31.83	.00	.00	204.42	31.83	.00	.00	.00	.00
MS4-38d	99.03	31.97	.00	.00	99.03	31.97	.00	.00	.00	.00
MS4-40d	231.45	31.97	.00	.00	231.45	31.97	.00	.00	.00	.00
MS4-10d	227.93	25.23	.00	.00	227.93	25.23	.00	.00	.00	.00

AURORA ENVIRONMENTAL SURVEYS LIMITED

Radon Concentrations - (Incremental)

SOIL RADON GAS STUDY of SOUTHERN ONTARIO

MARKHAM-STOUFFVILLE AREA **ENVIRONMENT # 4**
(gamma corrected for 9.095 uR/hr)

Sample #	(1) Rn pCi/L	Days	(2) Rn pCi/L	Days	(3) Rn pCi/L	Days	(4) Rn pCi/L	Days	(5) Rn pCi/L	Days
MS4-1	121.68	12.95	101.55	26.82	66.81	25.21	.00	.00	.00	.00
MS4-2	103.05	12.95	111.80	26.82	125.02	25.22	.00	.00	.00	.00
MS4-3	205.17	13.03	187.75	26.82	157.95	25.22	.00	.00	.00	.00
MS4-4	86.79	12.95	99.63	26.82	96.80	25.22	.00	.00	.00	.00
MS4-5	120.77	12.94	108.27	26.82	137.67	25.23	.00	.00	.00	.00
MS4-6	209.56	12.93	221.21	26.82	164.19	25.23	.00	.00	.00	.00
MS4-7	109.26	12.94	106.21	26.82	129.18	25.23	.00	.00	.00	.00
MS4-8	153.20	12.93	128.37	26.82	125.92	25.23	.00	.00	.00	.00
MS4-9	211.63	12.93	168.21	26.82	105.25	25.23	.00	.00	.00	.00
MS4-10	236.03	12.10	259.71	26.82	221.82	25.23	.00	.00	.00	.00
MS4-11	91.23	12.27	98.11	26.81	71.18	31.93	.00	.00	.00	.00
MS4-12	107.87	12.27	115.36	26.82	107.51	31.92	.00	.00	.00	.00
MS4-13	172.41	12.26	184.28	26.82	189.32	31.92	.00	.00	.00	.00
MS4-14*	89.62	13.03	123.15	25.94	81.57	31.96	.00	.00	.00	.00
MS4-15	122.88	12.26	114.61	26.82	102.01	31.92	.00	.00	.00	.00
MS4-16	168.07	12.26	156.66	26.82	174.57	31.92	.00	.00	.00	.00
MS4-17	295.31	12.25	239.94	26.82	267.98	31.92	.00	.00	.00	.00
MS4-18	206.84	13.02	199.83	25.87	194.68	31.91	.00	.00	.00	.00
MS4-19	82.18	12.25	62.75	26.82	94.98	31.93	.00	.00	.00	.00
MS4-20	118.79	12.25	130.02	26.82	119.08	31.92	.00	.00	.00	.00
MS4-21	127.23	13.04	108.45	25.94	76.02	31.96	.00	.00	.00	.00
MS4-22	50.23	12.25	43.26	26.82	57.22	31.92	.00	.00	.00	.00
MS4-23	191.64	12.08	180.60	26.82	175.82	31.92	.00	.00	.00	.00
MS4-24	121.99	12.25	127.56	26.82	218.58	31.92	.00	.00	.00	.00
MS4-25	90.36	12.24	78.96	26.82	79.95	31.92	.00	.00	.00	.00
MS4-26	97.97	13.03	122.17	25.92	103.10	31.97	.00	.00	.00	.00
MS4-27	149.65	12.25	158.98	26.84	173.96	31.90	.00	.00	.00	.00
MS4-28	118.80	12.20	76.57	26.89	66.20	31.89	.00	.00	.00	.00
MS4-29	162.37	13.05	177.03	25.97	152.90	31.93	.00	.00	.00	.00
MS4-30	159.09	12.23	188.80	26.89	119.81	31.85	.00	.00	.00	.00
MS4-31	106.46	12.23	98.25	26.89	64.43	31.85	.00	.00	.00	.00
MS4-32	66.93	12.09	55.97	26.82	64.94	31.92	.00	.00	.00	.00
MS4-33	143.68	12.23	133.06	26.89	107.03	31.85	.00	.00	.00	.00
MS4-34	183.59	13.06	223.36	26.03	252.31	31.87	.00	.00	.00	.00
MS4-35	200.31	13.06	215.31	26.02	207.26	31.83	.00	.00	.00	.00
MS4-36	253.58	13.06	265.02	25.99	298.76	31.91	.00	.00	.00	.00
MS4-37	189.58	13.05	210.51	25.98	208.73	31.92	.00	.00	.00	.00
MS4-38	99.40	13.03	116.95	25.91	90.10	31.97	.00	.00	.00	.00
MS4-39	133.35	13.04	162.39	25.93	113.15	31.96	.00	.00	.00	.00
MS4-40	193.83	13.04	191.00	25.92	218.47	31.97	.00	.00	.00	.00

AURORA ENVIRONMENTAL SURVEYS LIMITED

Comparison of results - paired detectors Rn/Rn

SOIL RADON GAS STUDY of SOUTHERN ONTARIO — MARKHAM-STOUFFVILLE AREA — **ENVIRONMENT # 4**
(gamma corrected for 9.095 uR/hr)

Sample #	(1) Rn pCi/L	Days	(2) Rn pCi/L	Days	(3) Rn pCi/L	Days	(4) Rn pCi/L	Days	(5) Rn pCi/L	Days
MS4-1	121.68	12.95	101.55	26.82	66.81	25.21	.00	.00	.00	.00
MS4-1d					75.17	25.21				
MS4-2	103.05	12.95	111.80	26.82	125.02	25.22	.00	.00	.00	.00
MS4-2d					144.03	25.22				
MS4-3	205.17	13.03	187.75	26.82	157.95	25.22	.00	.00	.00	.00
MS4-3d					168.18	25.22				
MS4-4	86.79	12.95	99.63	26.82	96.80	25.22	.00	.00	.00	.00
MS4-4d					123.90	25.22				
MS4-5	120.77	12.94	108.27	26.82	137.67	25.23	.00	.00	.00	.00
MS4-5d					143.52	25.23				
MS4-6	209.56	12.93	221.21	26.82	164.19	25.23	.00	.00	.00	.00
MS4-6d					172.91	25.23				
MS4-7	109.26	12.94	106.21	26.82	129.18	25.23	.00	.00	.00	.00
MS4-7d					129.67	25.23				
MS4-9	211.63	12.93	168.21	26.82	105.25	25.23	.00	.00	.00	.00
MS4-9d					102.78	25.26				
MS4-10	236.03	12.10	259.71	26.82	221.82	25.23	.00	.00	.00	.00
MS4-10d					227.93	25.23				
MS4-15	122.88	12.26	114.61	26.82	102.01	31.92	.00	.00	.00	.00
MS4-15d					100.80	31.92				
MS4-17	295.31	12.25	239.94	26.82	267.98	31.92	.00	.00	.00	.00
MS4-17d					256.39	31.92				
MS4-19	82.18	12.25	62.75	26.82	94.98	31.93	.00	.00	.00	.00
MS4-19d					102.06	31.93				
MS4-21	127.23	13.04	108.45	25.94	76.02	31.96	.00	.00	.00	.00
MS4-21d					81.68	31.96				
MS4-24	121.99	12.25	127.56	26.82	218.58	31.92	.00	.00	.00	.00
MS4-24d					179.97	31.92				
MS4-27	149.65	12.25	158.98	26.84	173.96	31.90	.00	.00	.00	.00
MS4-27d					172.90	31.90				
MS4-28	118.80	12.20	76.57	26.89	66.20	31.89	.00	.00	.00	.00
MS4-28d					74.47	31.89				
MS4-32	66.93	12.09	55.97	26.82	64.94	31.92	.00	.00	.00	.00
MS4-32d					77.10	31.92				
MS4-35	200.31	13.06	215.31	26.02	207.26	31.83	.00	.00	.00	.00
MS4-35d					204.42	31.83				
MS4-38	99.40	13.03	116.95	25.91	90.10	31.97	.00	.00	.00	.00
MS4-38d					99.03	31.97				
MS4-40	193.83	13.04	191.00	25.92	218.47	31.97	.00	.00	.00	.00
MS4-40d					231.45	31.97				

APPENDIX 1 - 4

Raw Data and Calculations

BELLEVILLE-PRINCE EDWARD COUNTY

AURORA ENVIRONMENTAL SURVEYS LIMITED

SOIL RADON GAS STUDY of SOUTHERN ONTARIO

PRINCE EDWARD COUNTY **ENVIRONMENT # 1**

Sample #	Electret	Day	Time Hrs	Minutes	V(i)	Day	Time Hrs	Minutes	V(2)	Day	Time Hrs	Minutes	V(3)	Day	Time Hrs	Minutes	V(4)
PEC1-1	LC 3669	270	14	40	729	285	9	14	649	314	11	43	435	331	14	27	315
PEC1-2	LC 5667	270	15	0	739	285	9	22	700	314	11	36	671	331	14	35	648
PEC1-3	LC 5710	269	15	20	733	285	9	29	695	314	11	52	613	331	14	42	583
PEC1-4	LC 5726	270	15	40	740	285	9	35	630	314	12	1	353	331	14	49	197
PEC1-5	LC 5651	270	16	0	743	285	9	45	698	314	12	6	621	331	14	54	566
PEC1-6	LC 5664	270	16	20	722	285	10	13	584	314	12	26	250				
PEC1-7	LB 3097	269	16	50	708	285	10	22	677	314	12	36	594	331	15	0	540
PEC1-8	LC 5729	270	17	15	745	285	11	8	736	314	12	52	714	331	15	20	705
PEC1-9	LC 5642	270	17	30	748	285	10	59	698	314	13	5	590	331	15	27	533
PEC1-10	LC 5673	270	17	50	741	285	11	40	716	314	11	21	636	331	15	35	573
PEC1-11	LC 5715	270	18	10	741	285	11	48	695	314	13	40	547	331	15	40	468
PEC1-12	LB 5486	270	18	30	749	285	11	54	688	314	13	18	579	331	15	47	550
PEC1-13	LC 5634	270	18	50	731	285	12	15	672	314	11	7	563	331	15	34	537
PEC1-14	LC 5627	270	19	10	733	285	13	50	615	314	10	19	347	331	16	4	182
PEC1-15	LB 4870	271	9	15	708	285	16	16	661	314	8	40	582	332	8	0	535
PEC1-16	LB 5592	271	9	35	740	285	15	21	604	314	8	52	405	332	8	14	331
PEC1-17	LB 4452	271	9	55	729	285	15	37	656	314	9	9	534	332	8	23	467
PEC1-18	LC 5722	271	10	35	738	285	15	3	604	314	9	21	293				
PEC1-19	LC 2012	271	10	55	758	285	15	10	656	314	9	17	473	332	8	32	383
PEC1-20	LB 4184	271	11	15	756	285	14	9	524	314	10	3	63				
PEC1-21	LB 5465	271	11	30	740	285	14	21	583	314	9	55	48				
PEC1-22	LC 5718	271	11	50	723	285	13	42	688	314	10	26	641	332	9	1	629
PEC1-23	LB 2970	271	12	10	727	285	12	40	623	314	10	35	365	332	9	13	163
PEC1-24	LC 5612	271	12	25	721	285	12	53	592	314	10	43	338	332	9	22	271
PEC1-25	LC 5659	271	13	30	744	285	12	30	708	314	10	49	622	332	9	29	570
PEC1-26	LC 1383	271	14	5	761	285	12	8	647	314	11	0	392	332	9	37	265
PEC1-27	LC 5608	271	14	20	749	285	10	57	736	314	13	0	709	332	9	15	702
PEC1-28	LC 3616	271	14	40	700	285	11	15	692	314	12	45	631				
PEC1-29	LC 5586	271	14	55	713	285	10	29	689	314	12	32	634				
PEC1-30	LC 5648	271	15	10	753	285	10	5	601	314	12	20	306	332	10	18	169
PEC1-31	LC 5629	271	15	25	747	285	9	55	706	314	12	12	595	332	10	28	539
PEC1-32	LC 5649	271	15	45	745	285	10	37	733	314	11	29	712	332	10	41	698
PEC1-33	LC 5620	271	16	0	732	285	12	0	626	314	11	13	417	332	10	50	315
PEC1-34	LC 5696	271	16	20	743	285	14	31	667	314	13	27	474	332	11	0	361
PEC1-35	LC 5647	271	16	40	721	285	14	14	627	314	9	50	351	332	11	5	166
PEC1-36	LC 5652	271	16	55	740	285	14	2	626	314	10	11	384	332	11	12	213
PEC1-37	LB 2715	271	17	15	752	285	14	55	701	314	9	34	574	332	11	37	532
PEC1-38	LC 5670	271	17	30	737	285	14	47	397	314	9	42	112				
PEC1-39	LC 5600	271	17	45	730	285	15	28	663	314	9	0	485	332	11	45	422
PEC1-40	LC 2018	271	18	0	731	285	16	5	691	314	8	45	602	332	11	53	550
PEC1-6#	LC 2907	314	12	26	311	331	15	4	144								
PEC1-18#	LC 5450	314	9	21	731	332	8	39	606								
PEC1-20#	LC 5505	314	10	4	717	332	8	47	339								
PEC1-21#	LC 4191	314	9	55	717	332	8	51	356								
PEC1-28#	LC 5727	314	12	45	293	332	10	3	254								
PEC1-29#	LC 5664	314	12	32	250	332	10	13	226								
PEC1-38#	LC 5306	314	9	42	375	332	11	32	183								

Note: # indicates first replacement of an electret.

AURORA ENVIRONMENTAL SURVEYS LIMITED

Radon Concentrations - (Incremental)

SOIL RADON GAS STUDY of SOUTHERN ONTARIO — PRINCE EDWARD COUNTY — ENVIRONMENT # 1
(gamma corrected for 12.37 uR/hr)

Sample #	(1) Rn pCi/L	Days	(2) Rn pCi/L	Days	(3) Rn pCi/L	Days	(4) Rn pCi/L	Days	(5) Rn pCi/L	Days
PEC1-1	148.74	14.77	213.74	29.10	217.44	17.11	.00	.00	.00	.00
PEC1-2	71.01	14.77	26.20	29.09	36.17	17.12	.00	.00	.00	.00
PEC1-3	64.83	15.76	77.68	29.10	48.76	17.12	.00	.00	.00	.00
PEC1-4	205.75	14.75	282.49	29.10	294.92	17.12	.00	.00	.00	.00
PEC1-5	82.28	14.74	72.71	29.10	90.79	17.12	.00	.00	.00	.00
PEC1-6	261.52	14.75	351.06	29.09	322.35	17.11	.00	.00	.00	.00
PEC1-7	53.12	15.73	79.19	29.09	90.09	17.10	.00	.00	.00	.00
PEC1-8	15.14	14.75	19.24	29.07	13.01	17.10	.00	.00	.00	.00
PEC1-9	91.57	14.73	103.19	29.09	95.38	17.10	.00	.00	.00	.00
PEC1-10	44.91	14.74	75.44	28.99	103.42	17.18	.00	.00	.00	.00
PEC1-11	84.24	14.73	143.21	29.08	135.64	17.08	.00	.00	.00	.00
PEC1-12	112.25	14.73	104.67	29.06	47.73	17.10	.00	.00	.00	.00
PEC1-13	109.18	14.73	105.68	28.95	42.67	17.19	.00	.00	.00	.00
PEC1-14	221.22	14.78	276.74	28.85	311.15	17.24	.00	.00	.00	.00
PEC1-15	89.89	14.29	76.80	28.68	74.59	17.97	.00	.00	.00	.00
PEC1-16	265.08	14.24	204.14	28.73	127.42	17.97	.00	.00	.00	.00
PEC1-17	140.58	14.24	120.39	28.73	109.38	17.97	.00	.00	.00	.00
PEC1-18	262.25	14.19	326.49	28.76	192.90	17.97				
PEC1-19	196.85	14.18	183.24	28.75	151.66	17.97	.00	.00	.00	.00
PEC1-20*	462.38	14.12	514.59	28.83	618.26	17.95				
PEC1-21	310.05	14.12	592.33	28.82	588.21	17.96				
PEC1-22	67.09	14.08	44.09	28.86	17.43	17.94	.00	.00	.00	.00
PEC1-23	205.32	14.02	264.48	28.91	366.32	17.94	.00	.00	.00	.00
PEC1-24	256.77	14.02	263.32	28.91	118.48	17.94	.00	.00	.00	.00
PEC1-25	69.14	13.96	81.69	28.93	81.65	17.94	.00	.00	.00	.00
PEC1-26	224.53	13.92	258.50	28.95	223.70	17.94	.00	.00	.00	.00
PEC1-27	24.05	13.86	23.97	29.09	9.34	17.84	.00	.00	.00	.00
PEC1-28*	14.49	13.86	57.32	29.06	69.47	17.89				
PEC1-29	46.51	13.82	51.49	29.09	42.79	17.90				
PEC1-30	305.66	13.79	305.47	29.09	251.16	17.92	.00	.00	.00	.00
PEC1-31	80.03	13.77	105.82	29.10	89.10	17.93	.00	.00	.00	.00
PEC1-32	22.24	13.79	18.34	29.04	20.01	17.97	.00	.00	.00	.00
PEC1-33	211.85	13.83	211.33	28.97	176.24	17.98	.00	.00	.00	.00
PEC1-34	149.08	13.92	191.55	28.96	192.35	17.90	.00	.00	.00	.00
PEC1-35	187.15	13.90	284.53	28.82	334.11	18.05	.00	.00	.00	.00
PEC1-36	226.86	13.88	247.58	28.84	303.76	18.04	.00	.00	.00	.00
PEC1-37	98.95	13.90	123.23	28.78	66.21	18.09	.00	.00	.00	.00
PEC1-38*	708.50	13.89	323.25	28.79	343.37	18.08				
PEC1-39	131.84	13.90	177.71	28.73	103.80	18.11	.00	.00	.00	.00
PEC1-40	77.62	13.92	85.88	28.69	81.41	18.13	.00	.00	.00	.00
PEC1-6#	322.35	17.11	.00	.00	.00	.00	.00	.00	.00	.00
PEC1-18#	192.90	17.97	.00	.00	.00	.00	.00	.00	.00	.00
PEC1-20#	618.26	17.95	.00	.00	.00	.00	.00	.00	.00	.00
PEC1-21#	588.21	17.96	.00	.00	.00	.00	.00	.00	.00	.00
PEC1-28#	69.47	17.89	.00	.00	.00	.00	.00	.00	.00	.00
PEC1-29#	42.79	17.90	.00	.00	.00	.00	.00	.00	.00	.00
PEC1-38#	343.37	18.08	.00	.00	.00	.00	.00	.00	.00	.00

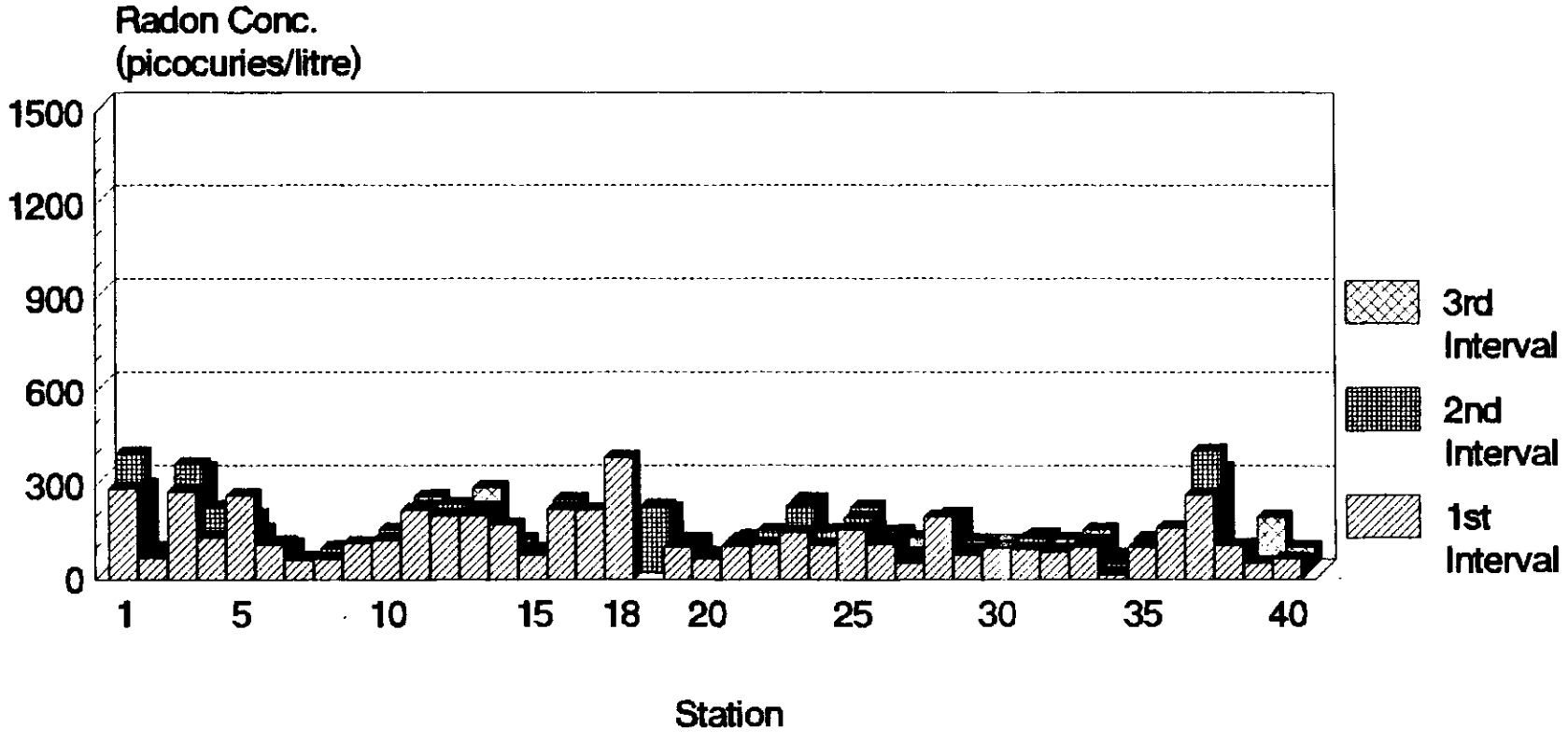
AURORA ENVIRONMENTAL SURVEYS LIMITED

SOIL RADON GAS STUDY of SOUTHERN ONTARIO

PRINCE EDWARD COUNTY **ENVIRONMENT # 2**

Sample #	Electret	Day	Time Hrs	Minutes	V(i)	Day	Time Hrs	Minutes	V(2)	Day	Time Hrs	Minutes	V(3)	Day	Time Hrs	Minutes	V(4)
PEC2-1	LC 1372	271	18	25	759	285	16	33	614	314	8	25	257				
PEC2-2	LC 5580	271	18	40	735	285	16	42	701	314	14	30	634	332	13	3	598
PEC2-3	LC 5723	271	19	0	738	285	16	54	599	314	14	40	271				
PEC2-4	LC 5695	271	19	20	744	285	18	20	677	314	8	11	471	332	13	21	389
PEC2-5	LC 6003	272	8	50	743	286	10	51	607	314	7	35	433	332	13	38	364
PEC2-6	LC 5690	272	9	5	712	286	10	42	656	314	7	43	563	332	13	45	520
PEC2-7	LC 5661	272	9	25	745	286	10	35	714	314	7	54	667	332	13	55	650
PEC2-8	LB 4011	272	9	45	748	285	18	11	717	314	8	4	637	332	14	10	599
PEC2-9	LC 5601	272	10	5	704	285	17	49	650	314	14	51	561	332	14	20	516
PEC2-10	LC 5689	272	10	35	724	285	17	4	665	314	15	0	529	332	14	30	461
PEC2-11	LC 5607	272	10	55	725	285	17	16	620	314	15	12	416	332	14	42	289
PEC2-12	LC 5625	272	11	15	750	286	10	20	648	314	16	55	438	332	14	55	333
PEC2-13	LB 3725	272	11	35	705	286	11	33	605	314	16	30	411	332	15	5	269
PEC2-14	LC 5675	272	11	55	723	286	11	42	635	314	16	34	563	332	15	15	511
PEC2-15	LB 4665	272	12	15	736	286	11	55	697	314	16	14	623	332	15	21	589
PEC2-16	LB 4877	272	13	15	749	285	17	36	643	314	15	20	415	332	15	32	337
PEC2-17	LB 2916	272	13	30	732	285	17	26	628	314	15	29	433	332	15	40	336
PEC2-18	LB 3527	272	13	50	751	286	12	10	557	314	15	40	466	332	15	52	412
PEC2-18A	LC 3670	286	12	44	730	314	13	42	520	332	15	57	411				
PEC2-19	LC 5570	272	14	10	726	286	12	29	674	314	15	52	581	332	16	7	528
PEC2-20	LC 5711	272	14	25	740	286	12	35	707	314	16	20	659	332	16	15	634
PEC2-21	LB 4637	272	14	45	745	286	13	11	691	314	16	0	586	332	16	26	528
PEC2-22	LB 4616	272	14	55	734	286	13	20	678	314	16	10	546	332	16	40	502
PEC2-23	LC 5587	272	15	15	747	286	9	9	672	315	10	34	460	332	9	17	344
PEC2-24	LC 5645	272	15	30	736	286	9	26	682	315	10	25	545	333	9	6	478
PEC2-25	LC 5599	272	15	50	738	286	9	38	659	315	10	17	486	333	8	55	376
PEC2-26	LC 5719	272	16	5	710	286	11	18	655	315	10	8	541	333	8	42	475
PEC2-27	LC 5713	272	16	10	737	286	11	14	711	315	10	1	652	333	8	33	594
PEC2-28	LB 4394	272	16	25	713	286	9	18	616	315	10	41	444	333	9	31	348
PEC2-29	LB 4929	272	16	45	730	286	9	0	692	315	10	48	618	333	9	45	568
PEC2-30	LC 5604	272	17	5	716	286	13	53	667	315	11	18	587	333	9	54	536
PEC2-31	LB 2999	272	17	20	749	286	14	2	701	315	11	13	589	333	10	0	528
PEC2-32	LC 3641	272	17	35	727	286	14	21	683	315	11	43	612	333	10	19	559
PEC2-33	LB 2702	272	17	50	757	286	13	34	706	315	11	34	603	333	10	33	532
PEC2-34	LC 0677	272	18	10	767	286	13	42	760	315	11	28	732	333	10	44	710
PEC2-35	LC 1451	273	8	40	736	286	11	3	688	315	9	53	578	333	12	4	542
PEC2-36	LC 5598	273	9	5	727	286	8	41	650	315	9	43	525	333	11	50	453
PEC2-37	LB 3659	273	9	35	707	286	8	26	583	315	9	30	218				
PEC2-38	LC 3687	273	10	0	714	286	8	50	664	315	10	56	578	333	11	22	538
PEC2-39	LC 1425	273	10	20	751	286	14	9	726	315	11	5	694	333	11	13	594
PEC2-40	LC 5575	273	10	40	729	286	14	29	699	315	11	52	658	333	11	1	621
PEC2-1#	LC 5249	314	8	25	718	332	12	51	550								
PEC2-3#	LC 3616	314	14	40	613	332	13	12	423								
PEC2-37#	LC 5586	315	9	30	634	333	11	32	441								

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO
PRINCE EDWARD COUNTY
Soil Radon Gas Concentration
Environment 2



AURORA ENVIRONMENTAL SURVEYS LIMITED

01-20-92

AURORA ENVIRONMENTAL SURVEYS LIMITED

Radon Concentrations - Average from placement date

SOIL GAS RADON STUDY of SOUTHERN ONTARIO

PRINCE EDWARD COUNTY **ENVIRONMENT # 2**
(gamma corrected for 12.37 uR/hr)

Sample #	(1) Rn pCi/L	Days	(2) Rn pCi/L	Days	(3) Rn pCi/L	Days	(4) Rn pCi/L	Days	(5) Rn pCi/L	Days
PEC2-1	287.71	13.92	348.02	42.58	321.66	60.76	.00	.00	.00	.00
PEC2-2	65.60	13.92	64.05	42.83	61.57	60.77	.00	.00	.00	.00
PEC2-3	277.72	13.91	322.29	42.82	319.06	60.76	.00	.00	.00	.00
PEC2-4	130.67	13.96	181.88	42.54	168.00	60.75	.00	.00	.00	.00
PEC2-5	267.74	14.08	211.16	41.95	182.00	60.20	.00	.00	.00	.00
PEC2-6	109.15	14.07	98.90	41.94	89.36	60.19	.00	.00	.00	.00
PEC2-7	58.87	14.05	49.81	41.94	42.17	60.19	.00	.00	.00	.00
PEC2-8	61.95	13.35	71.87	41.93	67.58	60.18	.00	.00	.00	.00
PEC2-9	111.45	13.32	94.45	42.20	87.69	60.18	.00	.00	.00	.00
PEC2-10	121.62	13.27	129.67	42.18	124.09	60.16	.00	.00	.00	.00
PEC2-11	219.41	13.26	210.68	42.18	213.47	60.16	.00	.00	.00	.00
PEC2-12	200.48	13.96	210.60	42.24	201.46	60.15	.00	.00	.00	.00
PEC2-13	199.12	14.00	201.20	42.20	215.16	60.15	.00	.00	.00	.00
PEC2-14	173.63	13.99	105.46	42.19	98.88	60.14	.00	.00	.00	.00
PEC2-15	75.13	13.99	73.11	42.17	66.98	60.13	.00	.00	.00	.00
PEC2-16*	221.06	13.18	227.37	42.09	199.11	60.10	.00	.00	.00	.00
PEC2-17	218.40	13.16	203.37	42.08	191.99	60.09	.00	.00	.00	.00
PEC2-18	389.72	13.93	191.95	42.08	161.25	60.08	.00	.00	.00	.00
PEC2-18A	211.12	28.04	198.77	46.13	198.77	46.13	.00	.00	.00	.00
PEC2-19	101.68	13.93	95.35	42.07	92.00	60.08	.00	.00	.00	.00
PEC2-20	63.47	13.92	51.72	42.08	47.50	60.08	.00	.00	.00	.00
PEC2-21	104.93	13.93	104.29	42.05	100.64	60.07	.00	.00	.00	.00
PEC2-22	109.34	13.93	124.74	42.05	108.43	60.07	.00	.00	.00	.00
PEC2-23	148.79	13.75	190.35	42.80	195.67	59.75	.00	.00	.00	.00
PEC2-24	106.72	13.75	124.52	42.79	119.90	60.73	.00	.00	.00	.00
PEC2-25	157.47	13.74	166.57	42.77	172.06	60.71	.00	.00	.00	.00
PEC2-26	109.33	13.80	110.71	42.75	109.74	60.69	.00	.00	.00	.00
PEC2-27	50.16	13.79	53.58	42.74	64.44	60.68	.00	.00	.00	.00
PEC2-28	196.61	13.70	180.16	42.76	175.25	60.71	.00	.00	.00	.00
PEC2-29	75.00	13.68	71.58	42.75	73.61	60.71	.00	.00	.00	.00
PEC2-30	96.46	13.87	83.34	42.76	82.66	60.70	.00	.00	.00	.00
PEC2-31	93.36	13.86	103.10	42.75	101.38	60.69	.00	.00	.00	.00
PEC2-32	86.06	13.87	73.66	42.76	76.58	60.70	.00	.00	.00	.00
PEC2-33	99.36	13.82	98.80	42.74	103.01	60.70	.00	.00	.00	.00
PEC2-34*	12.21	13.81	20.77	42.72	24.12	60.69	.00	.00	.00	.00
PEC2-35	99.35	13.10	103.95	42.05	89.62	60.14	.00	.00	.00	.00
PEC2-36	163.08	12.98	134.91	42.03	129.57	60.11	.00	.00	.00	.00
PEC2-37*	268.33	12.95	349.79	42.00	338.16	60.08	.00	.00	.00	.00
PEC2-38	105.62	12.95	89.66	42.04	81.68	60.06	.00	.00	.00	.00
PEC2-39	50.31	13.16	35.70	42.03	71.49	60.04	.00	.00	.00	.00
PEC2-40	61.21	13.16	45.28	42.05	48.69	60.01	.00	.00	.00	.00
PEC2-1#	259.92	18.18	.00	.00	.00	.00	.00	.00	.00	.00
PEC2-3#	311.34	17.94	.00	.00	.00	.00	.00	.00	.00	.00
PEC2-37#	311.41	18.08	.00	.00	.00	.00	.00	.00	.00	.00

AURORA ENVIRONMENTAL SURVEYS LIMITED

Radon Concentrations - (Incremental)

SOIL GAS RADON STUDY of SOUTHERN ONTARIO

PRINCE EDWARD COUNTY **ENVIRONMENT # 2**
(gamma corrected for 12.37 uR/hr)

Sample #	(1) Rn pCi/L	Days	(2) Rn pCi/L	Days	(3) Rn pCi/L	Days	(4) Rn pCi/L	Days	(5) Rn pCi/L	Days
PEC2-1	287.71	13.92	378.24	28.66	259.92	18.18	.00	.00	.00	.00
PEC2-2	65.60	13.92	63.31	28.91	55.67	17.94	.00	.00	.00	.00
PEC2-3	277.72	13.91	344.50	28.91	311.34	17.94	.00	.00	.00	.00
PEC2-4	130.67	13.96	207.01	28.58	136.05	18.22	.00	.00	.00	.00
PEC2-5	267.74	14.08	182.81	27.86	115.45	18.25	.00	.00	.00	.00
PEC2-6	109.15	14.07	93.76	27.88	67.49	18.25	.00	.00	.00	.00
PEC2-7	58.87	14.05	45.25	27.89	24.64	18.25	.00	.00	.00	.00
PEC2-8	61.95	13.35	76.51	28.58	57.76	18.25	.00	.00	.00	.00
PEC2-9	111.45	13.32	86.63	28.88	71.87	17.98	.00	.00	.00	.00
PEC2-10	121.62	13.27	133.41	28.91	111.20	17.98	.00	.00	.00	.00
PEC2-11	219.41	13.26	206.90	28.91	221.06	17.98	.00	.00	.00	.00
PEC2-12	200.48	13.96	215.83	28.27	180.73	17.92	.00	.00	.00	.00
PEC2-13	199.12	14.00	202.43	28.21	249.14	17.94	.00	.00	.00	.00
PEC2-14	173.63	13.99	71.68	28.20	83.49	17.95	.00	.00	.00	.00
PEC2-15	75.13	13.99	72.12	28.18	52.62	17.96	.00	.00	.00	.00
PEC2-16	221.06	13.18	230.52	28.91	133.70	18.01	.00	.00	.00	.00
PEC2-17	218.40	13.16	196.74	28.92	166.06	18.01	.00	.00	.00	.00
PEC2-18	389.72	13.93	94.24	28.15	89.81	18.01	.00	.00	.00	.00
PEC2-18A			211.12	28.04	180.04	18.09			.00	.00
PEC2-19	101.68	13.93	92.24	28.14	84.25	18.01	.00	.00	.00	.00
PEC2-20	63.47	13.92	45.91	28.16	37.64	18.00	.00	.00	.00	.00
PEC2-21	104.93	13.93	104.01	28.12	92.21	18.02	.00	.00	.00	.00
PEC2-22	109.34	13.93	132.41	28.12	70.47	18.02	.00	.00	.00	.00
PEC2-23	148.79	13.75	210.15	29.06	209.96	16.95	.00	.00	.00	.00
PEC2-24	106.72	13.75	132.99	29.04	109.06	17.95	.00	.00	.00	.00
PEC2-25	157.47	13.74	170.99	29.03	185.74	17.94	.00	.00	.00	.00
PEC2-26	109.33	13.80	111.40	28.95	107.58	17.94	.00	.00	.00	.00
PEC2-27	50.16	13.79	55.21	28.95	90.36	17.94	.00	.00	.00	.00
PEC2-28	196.61	13.70	172.55	29.06	164.10	17.95	.00	.00	.00	.00
PEC2-29	75.00	13.68	69.99	29.08	78.49	17.96	.00	.00	.00	.00
PEC2-30	96.46	13.87	77.06	28.89	81.11	17.94	.00	.00	.00	.00
PEC2-31	93.36	13.86	107.80	28.88	97.38	17.95	.00	.00	.00	.00
PEC2-32	86.06	13.87	67.71	28.89	83.59	17.94	.00	.00	.00	.00
PEC2-33	99.36	13.82	98.56	28.92	113.15	17.96	.00	.00	.00	.00
PEC2-34	12.21	13.81	24.85	28.91	32.10	17.97	.00	.00	.00	.00
PEC2-35	99.35	13.10	106.06	28.95	56.37	18.09	.00	.00	.00	.00
PEC2-36	163.08	12.98	122.38	29.04	117.38	18.09	.00	.00	.00	.00
PEC2-37	268.33	12.95	386.93	29.04	311.41	18.08				
PEC2-38	105.62	12.95	82.57	29.09	63.11	18.02	.00	.00	.00	.00
PEC2-39	50.31	13.16	29.04	28.87	155.09	18.01	.00	.00	.00	.00
PEC2-40	61.21	13.16	38.03	28.89	56.68	17.96	.00	.00	.00	.00
PEC2-1#	259.92	18.18	.00	.00	.00	.00	.00	.00	.00	.00
PEC2-3#	311.34	17.94	.00	.00	.00	.00	.00	.00	.00	.00
PEC2-37#	311.41	18.08	.00	.00	.00	.00	.00	.00	.00	.00

APPENDIX 2

Sample Locations

UTM Co-ordinates

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO
Radon Detector Locations : WINDSOR
ENVIRONMENT #1

Sample #	Electrets	U.T.M. Coordinates Easting	Northing
WIN1-1	LC 5676, LC 5342	345400	4677700
WIN1-2	LC 5378	346350	4686875
WIN1-3	LB 4136, LC 5238, LC 5271	341625	4680450
WIN1-4	LC 2921	339425	4679700
WIN1-5	LB 4382	344550	4677025
WIN1-6	LC 5616	337750	4674100
WIN1-7	LC 5674, LC 0682	333225	4676600
WIN1-8	LC 5725	334800	4673250
WIN1-9	LC 5619	332025	4672450
WIN1-10	LC 4586	333200	4669650
WIN1-11	LC 3662	336075	4671050
WIN1-12	LB 4959	340825	4670775
WIN1-13	LB 4666	344725	4669100
WIN1-14	LB 6062, LC 5455, LC 4146	345075	4672950
WIN1-15	LB 4013	343025	4667825
WIN1-16	LB 4663	347100	4665350
WIN1-17	LB 4308	339375	4666425
WIN1-18	LB 4375	340325	4668050
WIN1-19	LB 4456	336250	4669425
WIN1-20	LC 3606, LC 4210	334600	4668525
WIN1-21	LC 5622	334200	4663500
WIN1-22	LC 3625	336850	4661800
WIN1-23	LC 5676, LC 5527	344800	4670800
WIN1-24	LC 3645	342800	4665375
WIN1-25	LC 3612	344300	4663100
WIN1-26	LC 3605	341750	4661800
WIN1-27	LC 3649, LC 5564	341000	4664300
WIN1-28	LC 3632	338150	4666875
WIN1-29	LB 5127, LC 4613, LC 4144	339150	4663400
WIN1-30	LB 4052	339200	4660400
WIN1-31	LC 5686, LC 4203	342100	4659725
WIN1-32	LB 2045	345725	4658550
WIN1-33	LB 5209, LC 5263	343325	4657850
WIN1-34	LC 5687	338475	4658700
WIN1-35	LC 5431	334275	4660300
WIN1-36	LC 3634	329225	4661275
WIN1-37	LB 5454, LC 2950	329325	4667475
WIN1-38	LC 3652	331700	4667200
WIN1-39	LC 3650	335625	4665125
WIN1-40	LC 3682	341350	4678300

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO
Radon Detector Locations : WINDSOR
ENVIRONMENT #2

Sample #	Electrets	U.T.M. Coordinates Easting	Northing
WIN2-1	LC 5606	338100	4679650
WIN2-2	LC 3653	337275	4680575
WIN2-3	LB 3042	337750	4680475
WIN2-4	LC 5666	338000	4678700
WIN2-5	LC 5277, LC 4157	338550	4676875
WIN2-6	LC 2908	338825	4676375
WIN2-7	LB 4689	339700	4675475
WIN2-8	LB 3752	339300	4674950
WIN2-9	LC 3691, LC 8375	339500	4674000
WIN2-10	LB 4982	339575	4673750
WIN2-11	LB 3033	339850	4673100
WIN2-12	LB 3037	340100	4672650
WIN2-13	LB 3083	340375	4672400
WIN2-14	LC 0946, LC 4177	341100	4671425
WIN2-15	LC 5707	337700	4676775
WIN2-16	LC 5632	342300	4669475
WIN2-17	LB 4246, LC 4149	342275	4669300
WIN2-18	LC 3633	341875	4669225
WIN2-19	LB 4245	344450	4666825
WIN2-20	LC 5626	345100	4666350
WIN2-21	LB 3071	346100	4664525
WIN2-22	LC 5481		
WIN2-23	LB 6222	340450	4665900
WIN2-24	LB 5816	345800	4656125
WIN2-25	LB 5117	343400	4655700
WIN2-26	LB 2658	341925	4652870
WIN2-27	LB 2692, LC 5477	340600	4652675
WIN2-28	LB 4040	339225	4653200
WIN2-29	LB 2994	337750	4655150
WIN2-30	LB 4669	336700	4656250
WIN2-31	LB 5898, LC 6908	335350	4656875
WIN2-32	LB 5226	334700	4656950
WIN2-33	LC 5582	332950	4660400
WIN2-34	LC 3617	337500	4680500
WIN2-35	LB 2983, LB 9827, LC 4161, LC 6955	343150	4654900
WIN2-36	LC 5595	342650	4654625
WIN2-37	LB 4687	342975	4654200
WIN2-38	LC 5641	342625	4654000

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO
Radon Detector Locations : WALLACEBURG
ENVIRONMENT #1

Sample #	Electrets	U.T.M. Coordinates Easting	Northing
WAL1-1	LB 1724	378600	4727650
WAL1-2	LC 2985	382675	4728825
WAL1-3	LC 5312	379575	4727975
WAL1-4	LC 4137	380150	4733050
WAL1-5	LC 0673, LC 2955	384500	4735500
WAL1-6	LB 8714	388625	4733950
WAL1-7	LC 5473	388950	4735350
WAL1-8			
WAL1-9	LC 4283	388975	4728625
WAL1-10	LC 5319	386600	4728325
WAL1-11	LC 2882	385675	4727250
WAL1-12	LC 5238, LC 5245	385500	4726000
WAL1-13	LC 2928	387500	4727775
WAL1-14	LC 4167, LC 5349	385825	4724650
WAL1-15	LC 5493	392400	4720075
WAL1-16	LC 5338	388675	4724500
WAL1-17	LB 0949	391175	4727100
WAL1-18	LC 5462, LC 4287	394200	4728375
WAL1-19	LC 1984, LC 4150	396750	4726850
WAL1-20	LC 5395, LC 0673 LC 5260	397600	4722650
WAL1-21	LC 4304	401275	4717200
WAL1-22	LC 2831	400575	4718825
WAL1-23	LC 4293	397900	4718400
WAL1-24	LB 3201, LC 4244	401025	4729600
WAL1-25	LC 5308, LC 4203	407400	4723500
WAL1-26	LC 5412	403800	4720025
WAL1-27	LC 4152	408900	4719125
WAL1-28	LC 2945	409100	4721625
WAL1-29	LC 5531	410250	4719125
WAL1-30	LC 4131	411825	4719625
WAL1-31	LC 5459, LC 5306, LC 4314	410350	4721000
WAL1-32	LC 5379, LC 4157, LC 0423	409150	4724350
WAL1-33	LC 2855	416500	4725550
WAL1-34	LC 2907, LB 8795	416750	4724000
WAL1-35	LC 4101, LB 3123, LC 5368	416200	4720925
WAL1-36	LC 5429	414625	4719625
WAL1-37	LC 4124	414625	4722150
WAL1-38	LC 5470	413300	4721525
WAL1-39	LC 4154	411750	4720850
WAL1-40	LC 5351	412550	4717725
WAL1-41	LC 4220, LC 4330, LC 4236	413650	4716525

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO
Radon Detector Locations : WALLACEBURG
ENVIRONMENT #2

Sample #	Electret	U.T.M. Coordinates Easting	Northing
WAL2-1	LB 8668, LC 4139	381150	4731650
WAL2-2	LC 4157, LC 5464	383025	4732800
WAL2-3	LB 8770	382825	4734350
WAL2-4	LC 0510	390900	4735300
WAL2-5	LC 4256	393850	4733875
WAL2-6	LC 4132	396025	4735025
WAL2-7	LC 5535	398500	4734875
WAL2-8	LC 2994, LB 4613, LC 3658	400625	4734850
WAL3-8A	LB 3998	400625	4734850
WAL2-9	LC 1327	401225	4734800
WAL2-10	LC 2957, LC 5512	402675	4734700
WAL2-11	LC 5306, LC 4240	402675	4732600
WAL2-12	LC 4187	395475	4732325
WAL2-13	LC 1802	398500	4731925
WAL2-14	LB 1717, LC 5392	397725	4731000
WAL2-15	LC 5370	388425	4732650
WAL2-16	LC 2867	386325	4732700
WAL2-17	LC 5502, LC 5354	386250	4731450
WAL2-18	LC 4190	392225	4728325
WAL2-19	LC 5520	396625	4725500
WAL2-20	LC 5444, LC 4197, LC 4097	395200	4724075
WAL2-21	LC 2801	399500	4722675
WAL2-22	LC 5480, LC 4295	400925	4726325
WAL2-23	LB 2346, LC 4261	402425	4730500
WAL2-24	LC 5455, LC 4203	405325	4730475
WAL2-25	LC 2911, LC 5258	405250	4728875
WAL2-26	LB 1181, LC 3648	406850	4732400
WAL2-27	LC 4757	406850	4734100
WAL2-28	LC 5456, LB 5777	408000	4731150
WAL2-29	LC 2798, LB 4543	408250	4734500
WAL2-30	LC 5499, LC 4165, LC 3626	409500	4729200
WAL2-31	LC 5426	413750	4731750
WAL2-32	LC 5329, LB 9912	414975	4730500
WAL2-33	LC 4153	408600	4726125
WAL2-34	LC 4127	402125	4722175
WAL2-35	LC 5380, LC 5456, LC 4156	403825	4723250
WAL2-36	LC 1415	410425	4722900
WAL2-37	LC 4103, LB 1717, LC 5285	410625	4726450
WAL2-38	LC 4211	413500	4726650
WAL2-39	LC 4230, LC 2784	407850	4727800
WAL2-40	LC 4181, LC 5339, LC 5336	406575	4729800

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO
Radon Detector Locations : WALLACEBURG
ENVIRONMENT #3

Sample #	Electret	U.T.M. Coordinates Easting	Northing
WAL3-1	LC 8264	414800	4725700
WAL3-2	LC 8363	414775	4725275
WAL3-3	LC 8325, LC 5659	414775	4725100
WAL3-3d	LC 8372, LB 2715	414775	4725100
WAL3-4	LB 6151	414775	4724850
WAL3-5	LC 8337, LB 5486	414775	4724725
WAL3-6	LC 8328	414750	4724250
WAL3-7	LC 8329	414750	4724100
WAL3-8	LC 8357	414750	4723450
WAL3-9	LC 8267, LC 5675	416250	4727425
WAL3-10	LC 8320	415025	4728325
WAL3-11	LC 8280	415025	4728450
WAL3-12	LB 4898	410750	4729000
WAL3-13	LC 8374	410700	4728650
WAL3-14	LC 8277, LC 8282	410800	4728325
WAL3-15	LC 8375, LC 8226 LC 5608	410700	4727750
WAL3-16	LB 6221	409325	4728625
WAL3-16d	LB 7537	409325	4728625
WAL3-17	LC 8273, LC 5570	409300	4728325
WAL3-18	LC 8279	409275	4728000
WAL3-19	LC 8311, LC 5673	408025	4729250
WAL3-20	LB 4341, LC 5667	407900	4728875
WAL3-21	LC 8265, LB 4665	407900	4728400
WAL3-22	LB 6431, LB 4452	406550	4729325
WAL3-23	LC 3628	406600	4730075
WAL3-24	LC 8377	406575	4729650
WAL3-25	LC 8343	406625	4730350
WAL3-26	LB 5674, LC 6904	405250	4728550
WAL3-27	LC 5344, LC 5715	405200	4728200
WAL3-28	LC 8322	405100	4727700
WAL3-29	LC 4123	403900	4732750
WAL3-30	LB 5304	403950	4733200
WAL3-31	LC 5282	399775	4734525
WAL3-32	LC 8288, LC 5598	399750	4734050
WAL3-33	LC 3681	399750	4733350
WAL3-34	LC 4193, LC 5719	399700	4732800
WAL3-35	LC 8269	392050	4724350
WAL3-36	LB 6761	392400	4724250
WAL3-37	LC 8299, LC 5689	393150	4724225
WAL3-38	LB 5224	394525	4724150
WAL3-39	LC 5634	392250	4724250
WAL3-40	LC 5575	392975	4724200
WAL3-41	LC 5580	393550	4724200
WAL3-42	LB 4611	393700	4724200
WAL3-43	LC 3622	395100	4723875
WAL3-43d	LC 5718	395100	4723875
WAL3-44	LC 3624	395325	4724175
WAL3-45	LB 5582	405200	4728625
WAL3-45d	LC 5661	405200	4728625
WAL3-46	LB 4870	405150	4728050
WAL3-47	LC 0677	406650	4729700
WAL3-47d	LB 4616	406650	4729700
WAL3-48	LC 5629	406600	4729950
WAL3-49	LC 5601	414750	4725000
WAL3-50	LC 5642	414775	4724925
WAL3-51	LC 5450	414775	4724550
WAL3-52	LC 5729	416350	4727950
WAL3-52d	LB 3097	416350	4727950
WAL3-53	LC 5651	410700	4728375
WAL3-54	LC 5649	410700	4728100
WAL3-55	LC 5710	410700	4727925
WAL3-56	LB 4637	409375	4728150
WAL3-57	LC 5690	409350	4728750
WAL3-58	LC 5711	408025	4727800
WAL3-59	LC 2018	408025	4728950
WAL3-60	LB 4573	408025	4729075

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO
Radon Detector Location : MARKHAM - STOUFFVILLE
ENVIRONMENT #1

Sample #	Electret	U.T.M. Coordinates Easting	Northing
MS1-1	LC 5311, LC 4138	630350	4864250
MS1-2	LC 5307	632150	4864850
MS1-3	LC 4189	633125	4865300
MS1-4	LC 5244	634200	4865675
MS1-5	LC 5399	634750	4865850
MS1-6	LC 4275	630450	4863550
MS1-7	LC 4249	632300	4864550
MS1-8	LC 3630	634325	4864800
MS1-9	LC 4252	636375	4865700
MS1-10	LC 4136	640500	4867800
MS1-11	LC 5369	640300	4866950
MS1-12	LC 5270	640475	4866350
MS1-13	LC 4254	640625	4865425
MS1-14	LB 4407	637575	4864725
MS1-15	LC 4166	636550	4864950
MS1-16	LC 5511	636725	4864425
MS1-17	LC 2917	636000	4864100
MS1-18	LB 4609	635275	4863900
MS1-19	LC 4140	634650	4863625
MS1-20	LC 4296	633925	4863400
MS1-21	LC 2829	633500	4863275
MS1-22	LC 5275, LC 3618	632575	4863175
MS1-23	LC 4311	631825	4862650
MS1-24	LC 5264	630600	4863075
MS1-25	LB 4758	632825	4862225
MS1-26	LC 5618	634750	4862725
MS1-27	LC 2763	636800	4863675
MS1-28	LC 5982	633000	4861450
MS1-29	LB 5521	629850	4859825
MS1-30	LB 4511	630125	4859600
MS1-31	LC 5628	630975	4860275
MS1-32	LC 5263	633650	4861225
MS1-33	LC 0625	634300	4861375
MS1-34	LB 4012	635025	4861625
MS1-35	LC 3673	636000	4861975
MS1-36	LC 5694	630300	4858800
MS1-37	LC 5266	631175	4859875
MS1-38	LB 5029	635075	4861200
MS1-39	LC 0562	641100	4863650
MS1-40	LC 4114	641950	4864000

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO
Radon Detector Location : MARKHAM - STOUFFVILLE
ENVIRONMENT #2

Sample #	Electret	U.T.M. Coordinates Easting	Northing
MS2-1	LC 5358	641300	4872360
MS2-2	LC 5401	640625	4872130
MS2-3	LC 4148	639550	4871750
MS2-4	LC 5532	638650	4871050
MS2-5	LB 2815	637400	4871075
MS2-6	LC 4226	636360	4870740
MS2-7	LC 2810	635900	4870575
MS2-8	LC 5255	634800	4870200
MS2-9	LC 2948	633625	4869850
MS2-10	LC 4185	632625	4869500
MS2-11	LC 4247	631920	4869300
MS2-12	LC 0670	630825	4868870
MS2-13	LC 5303	629725	4868500
MS2-13A	LC 5258	629735	4868500
MS2-14	LC 5240	632000	4868000
MS2-15	LC 4200	633900	4868825
MS2-16	LC 5250	634150	4867875
MS2-17	LC 4168	635850	4868250
MS2-18	LC 2825	637050	4868775
MS2-19	LC 4118	635300	4866000
MS2-20	LC 4299	636425	4866390
MS2-21	LC 5517	637225	4866750
MS2-22	LC 5297, LC 4321	639550	4867525
MS2-23	LC 5442	642200	4868300
MS2-24	LC 2768	640235	4869690
MS2-24A	LC 5345	640234	4869691
MS2-24B	LC 3611	640234	4869696
MS2-24C	LC 4242	640239	4869712
MS2-24D	LC 5245	640254	4869712
MS2-24E	LC 5288	640254	4869689
MS2-24F	LC 4119	640233	4869692
MS2-24G	SH 0599	640260	4869702
MS2-25	LC 5287	643000	4868575
MS2-26	LC 2054	643350	4867900
MS2-27	LC 5283	642360	4867400
MS2-28	LC 5497	643660	4866650
MS2-29	LC 3676	642440	4866775
MS2-30	LC 5252	638725	4865050
MS2-31	LC 5566	636910	4863075
MS2-32	LC 5274	640775	4864675
MS2-33	LC 5366	642700	4865350
MS2-34	LC 5340	644100	4865675
MS2-35	LC 4292	637075	4862425
MS2-36	LC 5241	637725	4862675
MS2-37	LC 4106	638350	4862800
MS2-38	LC 2472	639425	4863225
MS2-39	LC 5257	640275	4863525
MS2-40	LC 4174	643000	4864350

RADON SOIL GAS STUDY OF SOUTHERN ONTARIO
Radon Detector Location : MARKHAM - STOUFFVILLE
ENVIRONMENT #3

Sample #	Electret	U.T.M. Coordinates Easting	Northing
MS3-1	LC 4141	631400	4858675
MS3-2	LC 3639	630400	4858225
MS3-3	LC 5639	629450	4858250
MS3-4	LC 5318	629725	4858225
MS3-5	LC 5656	629475	4858425
MS3-6	LC 5353, LC 4328	631275	4859475
MS3-7	LC 4269	632275	4856350
MS3-8	LC 5712	633910	4856900
MS3-9	LC 5363	633125	4858825
MS3-10	LC 2937	633425	4859075
MS3-11	LC 5337	633375	4859400
MS3-12	LC 3981	630650	4857050
MS3-13	LC 5636, LC 4108	639750	4856475
MS3-14	LB 3800	630675	4856000
MS3-15	LC 5589	631175	4855500
MS3-16	LC 3644	631275	4855200
MS3-17	LC 3672	631825	4857125
MS3-18	LC 5479	631575	4856175
MS3-19	LC 5321	633925	4856650
MS3-20	LB 4153	632850	4856675
MS3-21	LC 5700	634000	4856225
MS3-22	LC 5276	633375	4856775
MS3-23	LC 0695	634225	4857050
MS3-24	LB 3840	634800	4857200
MS3-25	LC 4158	634150	4855600
MS3-26	LC 5709	634175	4855350
MS3-27	LC 5242	635900	4856850
MS3-28	LC 5643	635750	4856475
MS3-29	LC 5692, LC 5420	636150	4856150
MS3-30	LC 3686	638050	4857375
MS3-31	LC 4273	638125	4856950
MS3-32	LC 4176	640110	4857475
MS3-33	LC 3674	641875	4857460
MS3-34	LB 3733	642350	4855575
MS3-34A	LB 3722	642350	4855575

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO
Radon Detector Location : MARKHAM - STOUFFVILLE
ENVIRONMENT #4

Sample #	Electret	U.T.M. Coordinates Easting	Northing
MS4-1	LB 1719	606825	4859100
MS4-1d	LC 2994	606825	4859100
MS4-2	LB 3986	607925	4859425
MS4-2d	LC 5308	607925	4859425
MS4-3	LC 5646	608725	4859700
MS4-3d	LC 4167	608725	4859700
MS4-4	LB 2835	609400	4859875
MS4-4d	LB 4613	609400	4859875
MS4-5	LC 3688	610850	4860000
MS4-5d	LB 2692	610850	4860000
MS4-6	LC 4129	611700	4860625
MS4-6d	LC 5499	611700	4860625
MS4-7	LC 5261	612525	4860875
MS4-7d	LC 4181	612525	4860875
MS4-8	LC 5698	613375	4861150
MS4-9	LC 3671	614375	4861475
MS4-9d	LC 5535	614375	4861475
MS4-10	LC 5286	614750	4860650
MS4-10d	LC 5455	614750	4860650
MS4-11	LC 5332	614975	4859525
MS4-12	LB 4007	616350	4859850
MS4-13	LC 5617	613950	4859225
MS4-14	LC 5633	612750	4859750
MS4-15	LC 4238	612925	4858875
MS4-15d	LB 1717	612925	4858875
MS4-16	LC 1088	611850	4858500
MS4-17	LC 3680	611100	4858250
MS4-17d	LC 5275	611100	4858250
MS4-18	LC 5328	610775	4859150
MS4-19	LB 3668	608250	4857225
MS4-19d	LC 4197	608250	4857225
MS4-20	LC 3623	611425	4855775
MS4-21	LC 5256	612575	4860350
MS4-21d	LC 5444	612575	4860350
MS4-22	LB 6172	611300	4856150
MS4-23	LC 5347	611125	4857400
MS4-24	LC 5668	612300	4856525
MS4-24d	LC 0946	612300	4856525
MS4-25	LB 5985	613200	4856800
MS4-26	LC 4173	613125	4857525
MS4-27	LC 5361	614250	4857125
MS4-27d	LC 5692	614250	4857125
MS4-28	LC 5610	615350	4857400
MS4-28d	LC 5353	615350	4857400
MS4-29	LC 5278	615125	4858425
MS4-30	LC 5714	615400	4857675
MS4-31	LB 4192	617125	4857900
MS4-32	LC 5333	611250	4856725
MS4-32d	LC 5676	611250	4856725
MS4-33	LB 5577	617700	4858175
MS4-34	LC 5621	617400	4857025
MS4-35	LC 5293	617500	4856475
MS4-35d	LC 5636	617500	4856475
MS4-36	LB 4128	616075	4855425
MS4-37	LC 5677	615525	4856525
MS4-38	LC 0667	613450	4856150
MS4-38d	LC 3649	613450	4856150
MS4-39	LB 5510	612800	4859325
MS4-40	LC 4121	613000	4858150
MS4-40d	LC 5329	613000	4858150

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO
Radon Detector Locations : PRINCE EDWARD COUNTY
ENVIRONMENT #1

Sample #	Electret	U.T.M. Coordinates Easting	Northing
PEC1-1	LC 3669	326400	4857450
PEC1-2	LC 5667	326550	4857900
PEC1-3	LC 5710	326450	4858250
PEC1-4	LC 5726	326875	4859250
PEC1-5	LC 5651	326800	4859400
PEC1-6	LC 5664, LC 2907	327175	4860050
PEC1-7	LB 3097	327150	4860250
PEC1-8	LC 5729	327475	4862325
PEC1-9	LC 5642	327750	4862450
PEC1-10	LC 5673	328325	4864000
PEC1-11	LC 5715	328225	4864800
PEC1-12	LB 5486	328075	4865000
PEC1-13	LC 5634	328225	4865250
PEC1-14	LC 5627	327700	4868800
PEC1-15	LB 4870	327125	4872950
PEC1-16	LB 5592	327000	4872425
PEC1-17	LB 4452	328600	4874000
PEC1-18	LC 5722, LC 5450	327175	4871400
PEC1-19	LC 2012	327400	4871550
PEC1-20	LB 4184, LC 5505	327150	4870000
PEC1-21	LB 5465, LC 4191	327075	4869950
PEC1-22	LC 5718	327300	4868525
PEC1-23	LB 2970	327200	4867475
PEC1-24	LC 5612	326950	4867375
PEC1-25	LC 5659	326825	4866950
PEC1-26	LC 1383	328625	4865225
PEC1-27	LC 5608	327650	4862400
PEC1-28	LC 3616, LC 5727	327225	4861550
PEC1-29	LC 5586, LC 5664	327450	4860125
PEC1-30	LC 5648	326850	4859775
PEC1-31	LC 5629	326700	4859575
PEC1-32	LC 5649	327875	4861400
PEC1-33	LC 5620	327775	4865025
PEC1-34	LC 5696	326750	4868800
PEC1-35	LC 5647	326475	4869475
PEC1-36	LC 5652	327150	4870675
PEC1-37	LB 2715	326600	4871075
PEC1-38	LC 5670, LC 5306	326425	4870600
PEC1-39	LC 5600	327500	4872450
PEC1-40	LC 2018	327175	4873175

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO
Radon Detector Locations : PRINCE EDWARD COUNTY
ENVIRONMENT #2

Sample #	Electret	U.T.M. Coordinates Easting	Northing
PEC2-1	LC 1372	318550	4872425
PEC2-2	LC 5580	317175	4871925
PEC2-3	LC 5723	315400	4873425
PEC2-4	LC 5695	315950	4875675
PEC2-5	LC 6003	308200	4880850
PEC2-6	LC 5690	309875	4878100
PEC2-7	LC 5661	309575	4876550
PEC2-8	LB 4011	313575	4875975
PEC2-9	LC 5601	312225	4874750
PEC2-10	LC 5689	313550	4871625
PEC2-11	LC 5607	310225	4870850
PEC2-12	LC 5625	308550	4873125
PEC2-13	LB 3725	305175	4874750
PEC2-14	LC 5675	305525	4873425
PEC2-15	LB 4665	306525	4872400
PEC2-16	LB 4877	307900	4871225
PEC2-17	LB 2916	306900	4869875
PEC2-18	LB 3527	305200	4869350
PEC2-18A	LC 3670	305200	4869350
PEC2-19	LC 5570	302025	4870100
PEC2-20	LC 5711	303025	4873400
PEC2-21	LB 4637	301325	4872425
PEC2-22	LB 4616	299100	4871450
PEC2-23	LC 5587	300925	4877225
PEC2-24	LC 5645	303000	4877200
PEC2-25	LC 5599	304900	4876250
PEC2-26	LC 5719	306325	4877925
PEC2-27	LC 5713	306000	4879000
PEC2-28	LB 4394	303550	4878875
PEC2-29	LB 4929	302250	4879075
PEC2-30	LC 5604	299450	4878675
PEC2-31	LB 2999	298850	4879425
PEC2-32	LC 3641	296450	4881500
PEC2-33	LB 2702	296000	4877350
PEC2-34	LC 0677	297150	4877400
PEC2-35	LC 1451	304400	4881575
PEC2-36	LC 5598	302675	4881400
PEC2-37	LB 3659	300950	4882800
PEC2-38	LC 3687	301225	4881100
PEC2-39	LC 1425	299125	4880575
PEC2-40	LC 5575	296475	4881675

APPENDIX 3

Gamma Dose Studies

AURORA ENVIRONMENTAL SURVEYS LIMITED

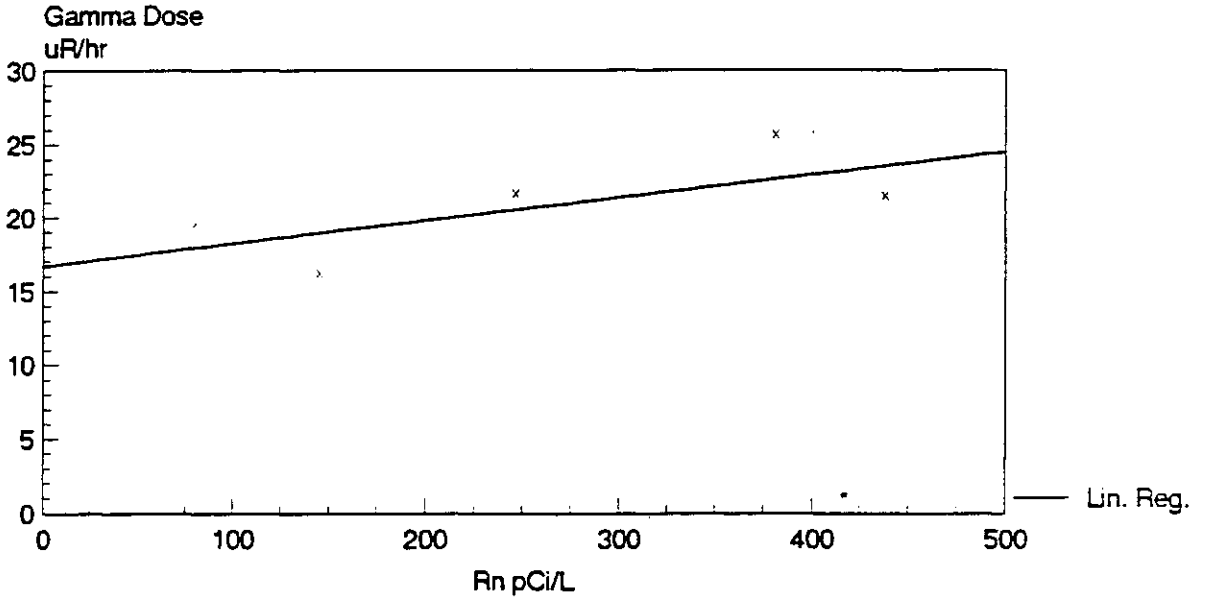
SOIL RADON GAS CONCENTRATION STUDY for SOUTHERN ONTARIO

GAMMA RADIATION DETERMINATIONS

Sample #	Electret	Day	Hr.	Min.	V (i)	Day	Hr.	Min.	V (f)	Volts	Days	Hrs	Dose uR	Dose Rate uR/hr	CF	Correction pCi/L		
MS1-18	SE 7944	273	15	35	744	336	16	52	695	49	63.05	1513.28	24380.3	14.51	2.010	1.74	270.12	268.38
MS1-33	SH 0644	274	9	55	762	338	12	9	707	55	64.09	1538.23	27306.8	16.15	2.014	1.94	175.84	173.90
MS1-40	SE 8386	273	11	0	718	338	11	1	678	40	65.00	1560.02	19965.4	11.20	2.003	1.34	107.45	106.11
MS2-9	SF 6734	270	11	55	711	336	14	52	668	43	66.12	1586.95	21490.4	11.94	2.001	1.43	150.99	149.56
MS2-20	SE 8502	270	15	15	706	336	16	2	639	67	66.03	1584.78	33572.9	19.58	1.996	2.35	363.65	361.30
MS2-33	SE 8535	273	9	40	708	338	11	35	660	48	65.08	1561.92	24009.5	13.77	1.999	1.65	122.73	121.08
MS3-17	SH 0766	273	12	55	758	340	11	18	696	62	66.93	1606.38	30815.1	17.58	2.012	2.11	194.37	192.26
MS3-20	SH 0733	273	16	30	760	340	11	5	656	104	66.77	1602.58	51833.0	30.74	2.006	3.69	157.83	154.14
MS3-26	SF 5017	275	10	15	739	338	16	14	683	56	63.25	1517.98	27897.7	16.78	2.007	2.01	194.51	192.50
MS4-8	SG 6761	274	16	45	726	340	16	20	676	50	65.98	1583.58	24945.6	14.15	2.004	1.70	124.14	122.44
MS4-31	SF 4902	275	11	25	736	347	10	51	685	51	71.98	1727.43	25408.7	13.11	2.007	1.57	85.54	83.97
MS4-37	SF 2462	275	12	30	738	347	16	20	669	69	72.16	1731.83	34412.1	18.27	2.005	2.19	206.43	204.24
PEC1-15	SF 9229	271	9	15	705	332	8	0	656	49	60.95	1462.75	24522.8	15.16	1.998	1.82	80.68	78.86
PEC1-23	SH 0806	271	12	10	766	332	9	13	701	65	60.88	1461.05	32276.3	20.49	2.014	2.46	281.39	278.93
PEC1-27	SH 0773	271	14	20	761	332	9	51	720	41	60.81	1459.52	20338.8	12.34	2.016	1.48	21.18	19.70
PEC2-7	SH 0806	272	9	25	743	332	13	35	698	45	60.17	1444.17	22386.8	13.90	2.010	1.67	43.66	41.99
PEC2-18	SF 9235	272	13	50	738	332	15	32	688	50	60.07	1441.70	24901.4	15.67	2.008	1.88	162.73	160.85
PEC2-36	SG 6843	273	9	5	740	333	11	50	686	54	60.11	1442.75	26893.5	17.04	2.008	2.04	131.05	129.01
WIN1-10	SE 8339	279	11	30	727	341	16	5	658	69	62.19	1492.58	34468.9	21.49	2.002	2.58	246.64	244.06
WIN1-23	SF 8763	280	8	0	702	340	13	0	636	66	60.21	1445.00	33090.0	21.30	1.995	2.56	437.90	435.34
WIN1-31	SF 6717	280	11	30	714	340	13	59	636	78	60.10	1442.48	39069.6	25.48	1.996	3.06	381.03	377.97
WIN2-10	SE 8432	279	8	50	732	341	10	47	622	110	62.08	1489.95	55081.1	35.37	1.997	4.24	258.08	253.84
WIN2-20	SF 8605	279	15	50	681	340	13	20	620	61	60.90	1461.50	30673.6	19.39	1.989	2.33	80.44	78.11
WIN2-33	SH 0121	280	16	50	762	341	15	10	710	52	60.93	1462.33	25811.9	16.05	2.015	1.93	145.33	143.40
WAL1-3	SE 8427	275	8	40	719	342	18	17	645	74	67.40	1617.62	37025.9	21.29	1.999	2.55	165.67	163.12
WAL1-6	SE 7830	275	11	10	736	342	18	16	663	73	67.30	1615.10	36428.8	20.96	2.004	2.51	110.91	108.40
WAL1-15	SH 0795	276	8	30	737	342	18	18	660	77	66.41	1593.80	38430.6	22.51	2.004	2.70	257.72	255.02
WAL1-23	SH 0767	276	14	5	762	342	18	14	692	70	66.17	1588.15	34791.3	20.31	2.012	2.44	125.73	123.29
WAL2-35	SG 6668	277	9	10	710	339	11	48	629	81	62.11	1490.63	40607.2	25.64	1.995	3.08	702.94	699.86
WAL2-39	SH 0712	277	15	25	756	347	23	7	644	112	70.32	1687.70	55886.5	31.51	2.004	3.78	611.75	607.97
WAL3-3	SH 1293	322	8	58	699	347	23	20	678	21	25.60	614.37	10496.9	15.49	2.001	1.86	598.87	597.01
WAL3-9	SH 1243	336	10	27	704	347	23	29	682	22	11.54	277.03	10989.3	30.07	2.002	3.61	830.70	827.09
WAL3-14	SH 2378	329	11	10	752	347	23	12	732	20	18.50	444.03	9919.3	19.14	2.016	2.30	1103.40	1101.10
WAL3-17	SH 1319	329	11	54	746	347	23	8	724	22	18.47	443.23	10921.9	21.44	2.014	2.57	786.21	783.64
WAL3-40	SF 9235	337	14	20	688	348	9	7	665	23	10.78	258.78	11517.8	33.51	1.997	4.02	175.85	171.83
WAL3-43	SG 6843	337	14	50	686	348	9	10	665	21	10.76	258.33	10517.9	29.71	1.997	3.57	150.47	146.90
WAL3-45	SH 0773	337	14	20	720	348	11	56	682	38	10.90	261.60	18958.7	61.37	2.004	7.36	214.40	207.04
WAL3-47	SH 0721	337	15	56	701	347	13	45	675	26	9.91	237.82	12997.2	43.45	2.000	5.21	207.20	201.99
WAL3-52	SH 0806	338	9	14	698	347	9	58	680	18	9.03	216.73	8996.7	29.71	2.001	3.57	396.84	393.27
WAL3-59	SF 9229	338	10	56	656	347	23	4	641	15	9.51	228.13	7545.1	21.47	1.988	2.58	236.15	233.57

GAMMA DOSE vs Rn conc.

Windsor - Environments 1&2



Aurora Environmental Surveys Limited 01-10-92

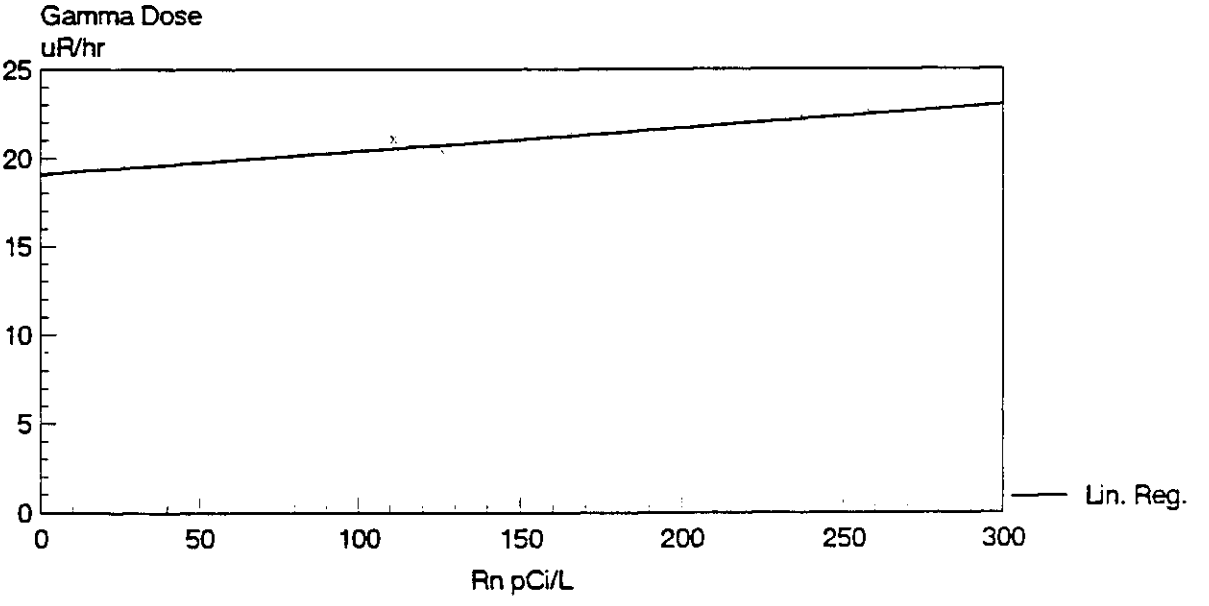
Statistics for: Lin. Reg.
WIN-1&2

----------A-------

Axis	LEFT Y	X AXIS
Sum	103.71	1291.34
Var. proportion(%)	100	100
Number of obs.	5	5
Quadratic sum	2198.3151	425362.963
Mean value	20.742	258.268
Largest value	25.48	437.9
Smallest value	16.05	80.44
Stand. deviation	3.43373994	151.534785
Type	1ST	1ST
Trend (a)	16.6831207	
Trend (b)	0.01571577	
Trend (c)		
Trend (d)		
Trend (e)		
Trend (f)		
Corr. coeff. (r)	0.69355452	
Residual var. (s)	2.85636044	

GAMMA DOSE vs Rn conc.

Wallaceburg - Environment 1



Aurora Environmental Surveys Limited

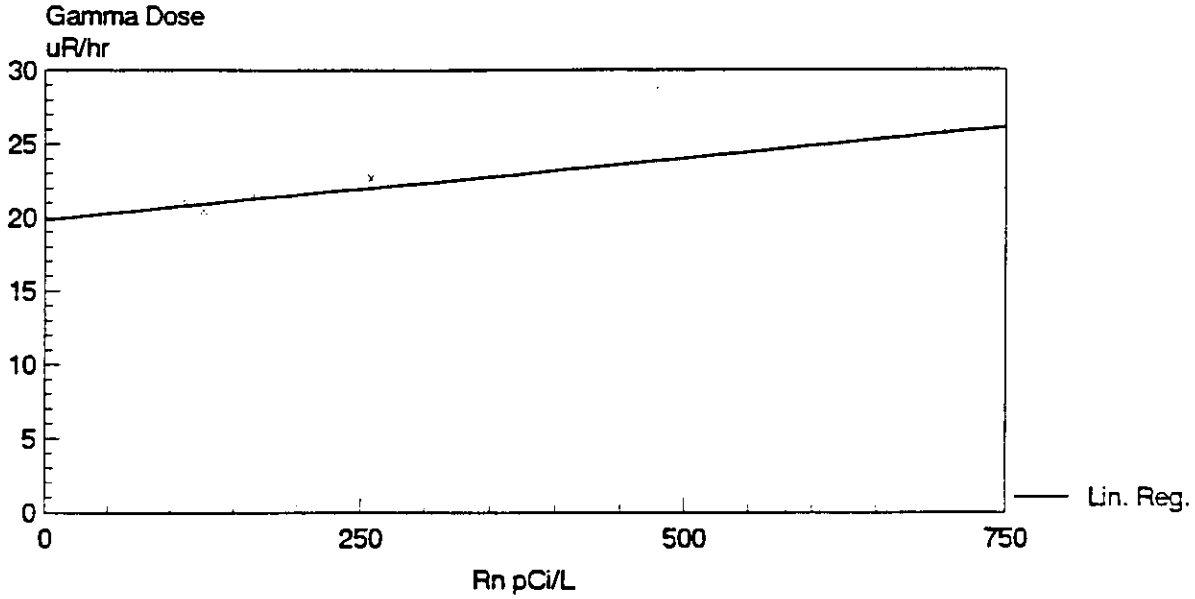
01-10-92

Statistics for: Lin. Reg.
WAL-1

Axis	LEFT Y	X AXIS
Sum	85.07	660.03
Var. proportion(%)	100	100
Number of obs.	4	4
Quadratic sum	1811.7819	121975.208
Mean value	21.2675	165.0075
Largest value	22.51	257.72
Smallest value	20.31	110.91
Stand. deviation	0.92297978	65.9932019
Type	1ST	1ST
Trend (a)	19.1273975	
Trend (b)	0.01296973	
Trend (c)		
Trend (d)		
Trend (e)		
Trend (f)		
Corr. coeff. (r)	0.92733705	
Residual var. (s)	0.4230321	

GAMMA DOSE vs Rn conc.

Wallaceburg - Environments 1&2



Aurora Environmental Surveys Limited 01-09-92

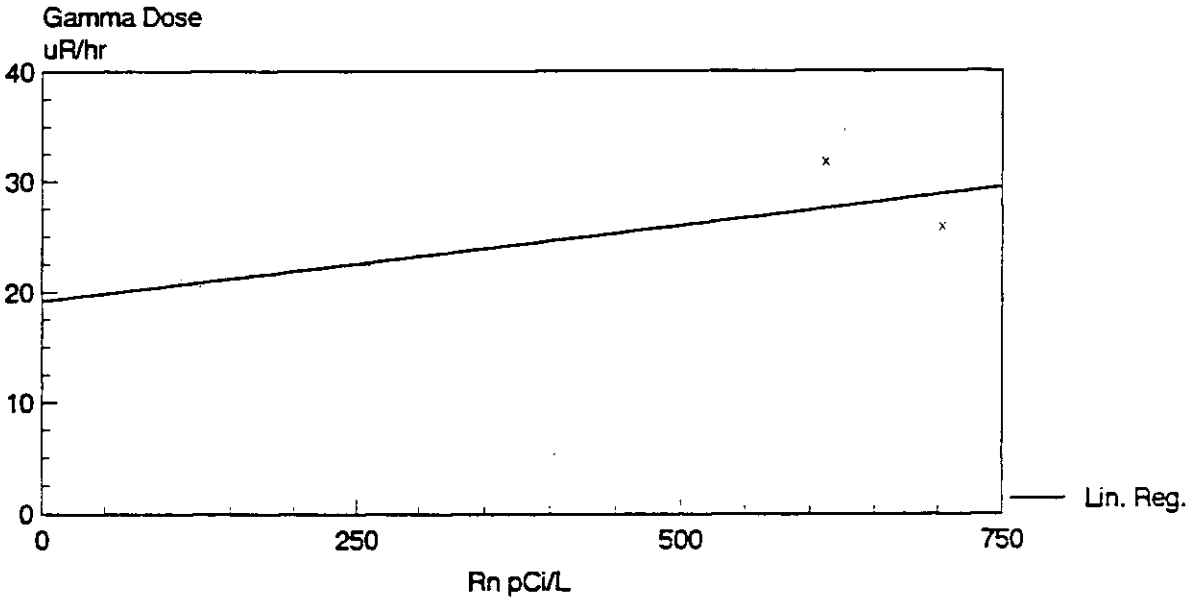
Statistics for: Lin. Reg.
WAL-1

----------A-------

Axis	LEFT Y	X AXIS
Sum	110.71	1362.97
Var. proportion(%)	100	100
Number of obs.	5	5
Quadratic sum	2469.1915	616099.852
Mean value	22.142	272.594
Largest value	25.64	702.94
Smallest value	20.31	110.91
Stand. deviation	2.11250325	247.266257
Type	1ST	1ST
Trend (a)	19.8557587	
Trend (b)	8.38698E-3	
Trend (c)		
Trend (d)		
Trend (e)		
Trend (f)		
Corr. coeff. (r)	0.98168761	
Residual var. (s)	0.46468282	

GAMMA DOSE vs Rn conc.

Wallaceburg - Environments 1&2



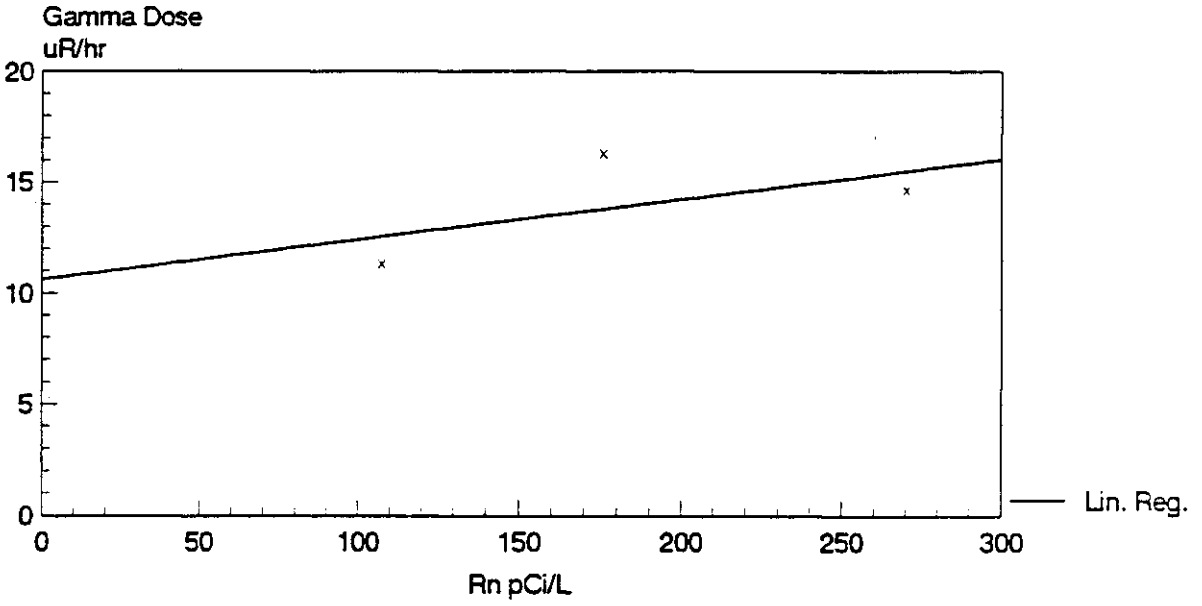
Aurora Environmental Surveys Limited 01-09-92

Statistics for: Lin. Reg.
WAL-1

Axis	LEFT Y	X AXIS
Sum	142.22	1974.72
Var. proportion(%)	100	100
Number of obs.	6	6
Quadratic sum	3462.0716	990337.914
Mean value	23.7033333	329.12
Largest value	31.51	702.94
Smallest value	20.31	110.91
Stand. deviation	4.2657598	260.928369
Type	1ST	1ST
Trend (a)	19.1604614	
Trend (b)	0.01380308	
Trend (c)		
Trend (d)		
Trend (e)		
Trend (f)		
Corr. coeff. (r)	0.8443082	
Residual var. (s)	2.55564785	

GAMMA DOSE vs Rn conc.

Markham-Stouffville Environment 1



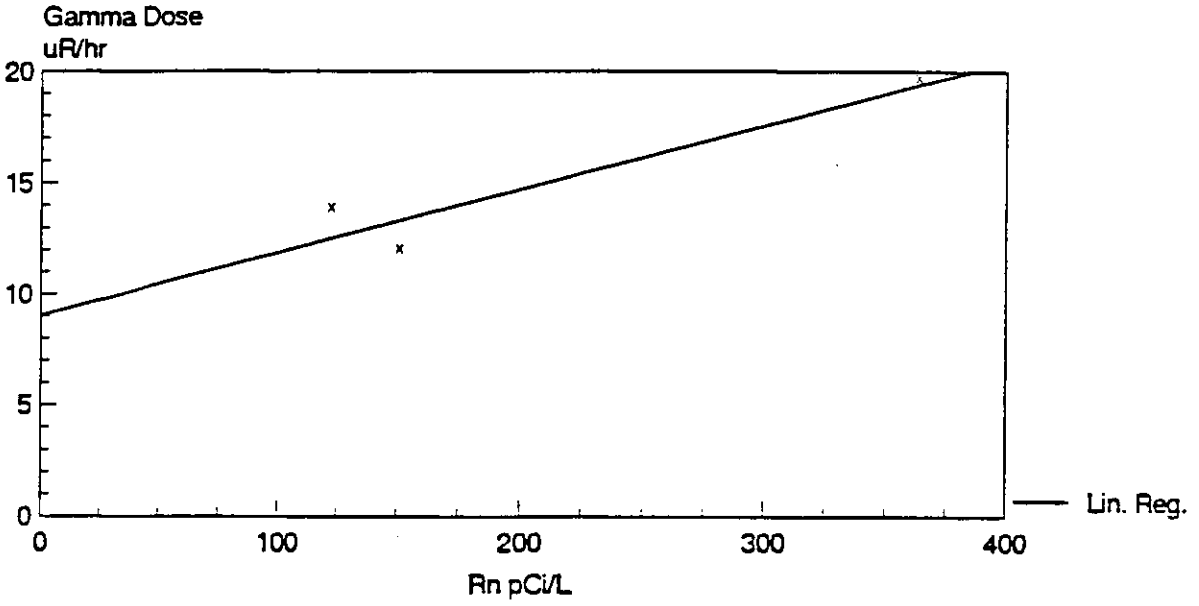
Aurora Environmental Surveys Limited 01-09-92

Statistics for: Lin. Reg.
G-MS

	A	
Axis	LEFT Y	X AXIS
Sum	41.86	553.41
Var. proportion(%)	100	100
Number of obs.	3	3
Quadratic sum	596.8026	115430.023
Mean value	13.9533333	184.47
Largest value	16.15	270.12
Smallest value	11.2	107.45
Stand. deviation	2.5215141	81.6776585
Type	1ST	1ST
Trend (a)	10.6243238	
Trend (b)	0.01804635	
Trend (c)		
Trend (d)		
Trend (e)		
Trend (f)		
Corr. coeff. (r)	0.5845629	
Residual var. (s)	2.89323545	

GAMMA DOSE vs Rn conc.

Markham-Stouffville Environment 2



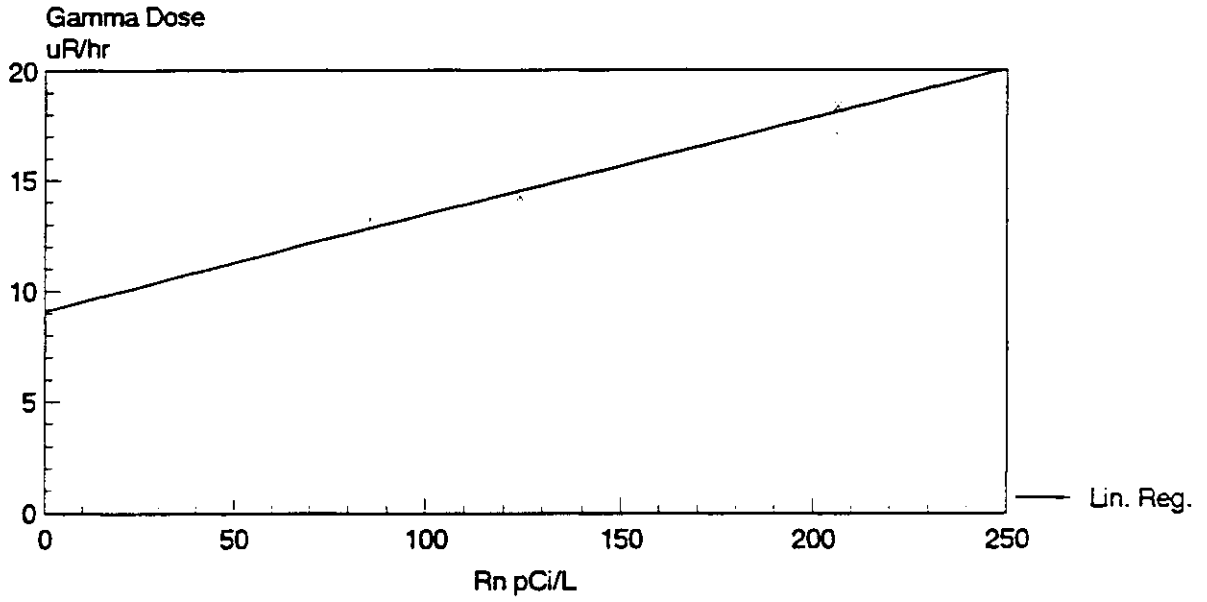
Aurora Environmental Surveys Limited 01-09-92

Statistics for: Lin. Reg.
G-MS

Axis	LEFT Y	X AXIS
Sum	45.29	637.37
Var. proportion(%)	100	100
Number of obs.	3	3
Quadratic sum	715.5529	170101.956
Mean value	15.0966667	212.456667
Largest value	19.58	363.65
Smallest value	11.94	122.73
Stand. deviation	3.98903915	131.697475
Type	1ST	1ST
Trend (a)	9.02758694	
Trend (b)	0.0285662	
Trend (c)		
Trend (d)		
Trend (e)		
Trend (f)		
Corr. coeff. (r)	0.94310856	
Residual var. (s)	1.87566543	

GAMMA DOSE vs Rn conc.

Markham-Stouffville Environment 4



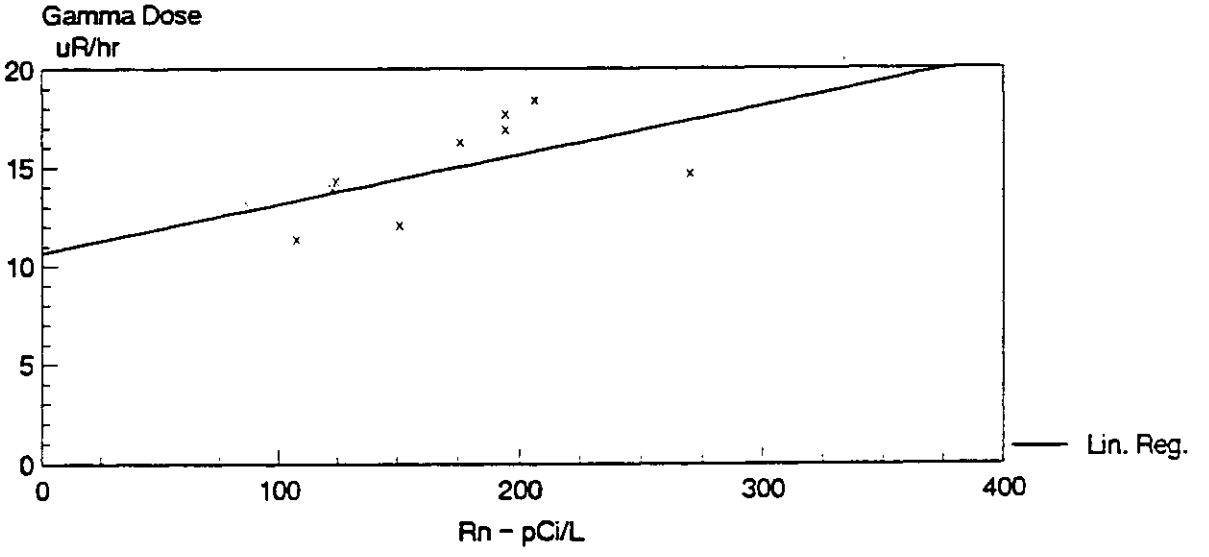
Aurora Environmental Surveys Limited 01-09-92

Statistics for: Lin. Reg.
G-MS4___

Axis	LEFT Y	X AXIS
Sum	45.53	416.11
Var. proportion(%)	100	100
Number of obs.	3	3
Quadratic sum	705.8875	65341.1761
Mean value	15.1766667	138.703333
Largest value	18.27	206.43
Smallest value	13.11	85.54
Stand. deviation	2.72890699	61.7467897
Type	1ST	1ST
Trend (a)	9.09538078	
Trend (b)	0.04384384	
Trend (c)		
Trend (d)		
Trend (e)		
Trend (f)		
Corr. coeff. (r)	0.99205118	
Residual var. (s)	0.48562953	

GAMMA DOSE vs Rn conc.

Markham-Stouffville
(all environments)



Aurora Environmental Surveys Limited

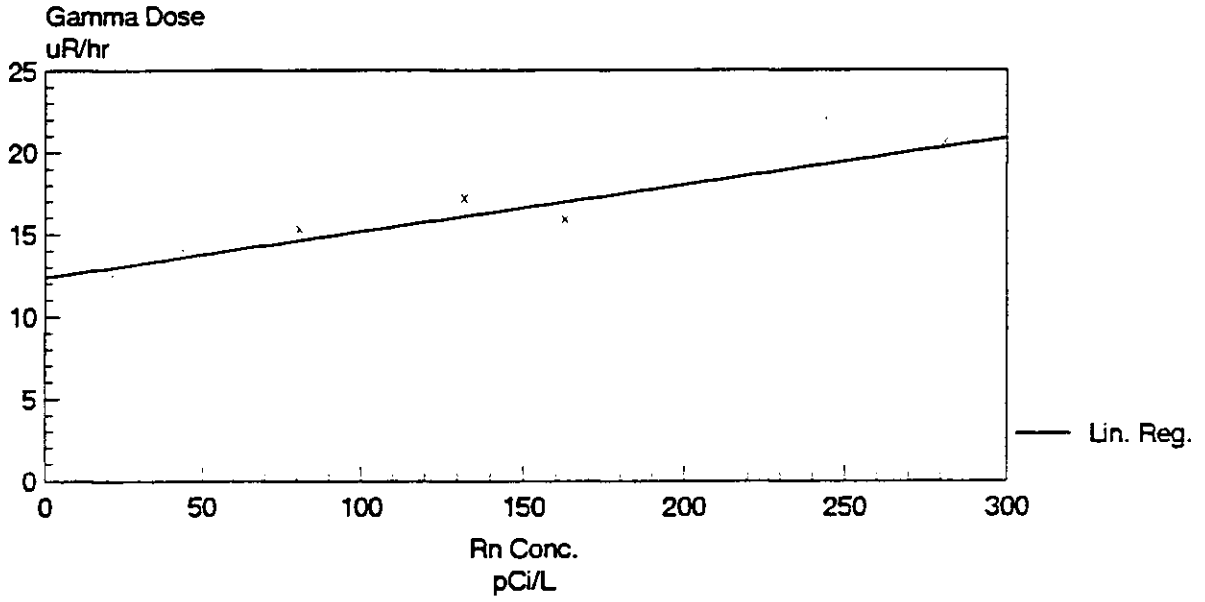
01-09-92

Statistics for: Lin. Reg.
GMS(ALL)

	A	
Axis	LEFT Y	X AXIS
Sum	167.04	1995.77
Var. proportion(%)	100	100
Number of obs.	11	11
Quadratic sum	2608.8678	426486.991
Mean value	15.1854545	181.433636
Largest value	19.58	363.65
Smallest value	11.2	85.54
Stand. deviation	2.68867017	80.2416243
Type	1ST	1ST
Trend (a)	10.6783218	
Trend (b)	0.02484177	
Trend (c)	-	
Trend (d)		
Trend (e)		
Trend (f)		
Corr. coeff. (r)	0.74138641	
Residual var. (s)	1.90190828	

GAMMA DOSE vs Rn conc.

Belleville - PEC



Aurora Environmental Surveys Limited 01-09-92

Statistics for: Lin. Reg.
PEC

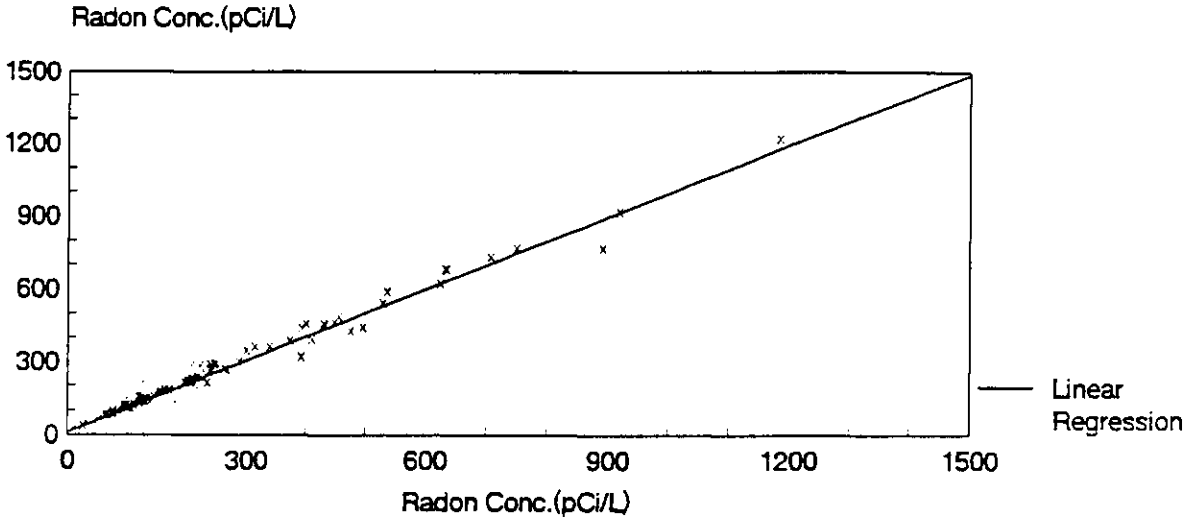
	A	
Axis	LEFT Y	X AXIS
Sum	94.69	721.49
Var. proportion(%)	100	100
Number of obs.	6	6
Quadratic sum	1533.8905	131909.858
Mean value	15.7816667	120.248333
Largest value	20.49	281.39
Smallest value	12.34	21.18
Stand. deviation	2.81156481	95.0282988
Type	1ST	1ST
Trend (a)	12.3672924	
Trend (b)	0.02839436	
Trend (c)		
Trend (d)		
Trend (e)		
Trend (f)		
Corr. coeff. (r)	0.95970333	
Residual var. (s)	0.88334978	

APPENDIX 4

Comparison of Duplicate Radon Measurements

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO

Trend Analysis of Duplicate Results
All Detector Pairs

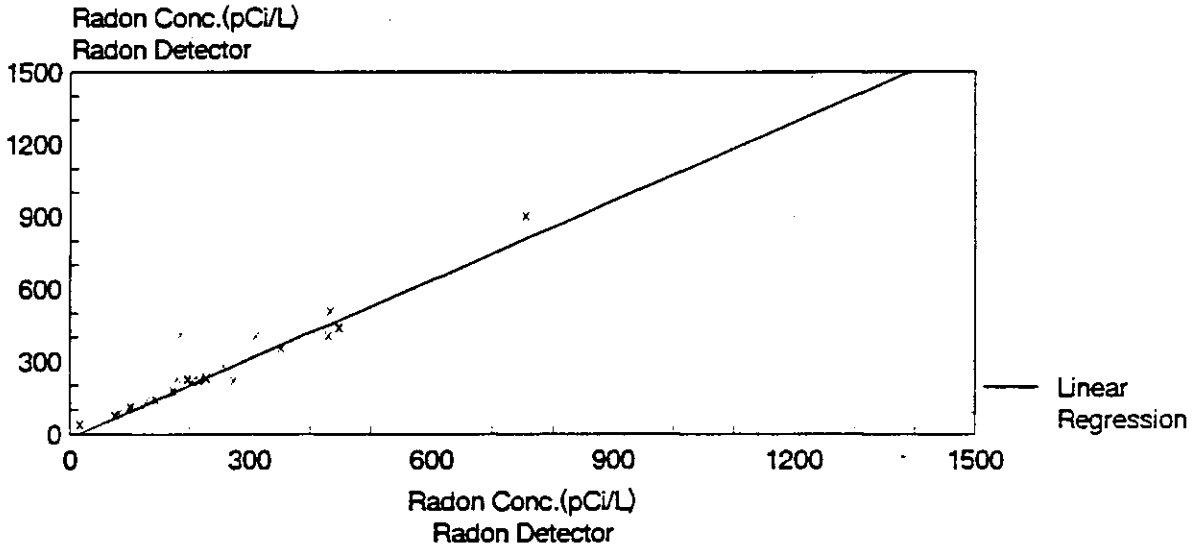


Aurora Environmental Surveys Limited 01-31-92

Statistics for: ALLDUPTR	Linear Regression	
	A	B
Axis	X AXIS	LEFT Y
Sum	26909.2849	27343.9463
Var. proportion(%)	100	100
Number of obs.	112	112
Quadratic sum	11813368.1	11993153.5
Mean value	240.261472	244.142378
Largest value	1184	1208
Smallest value	10.8888889	10.8888889
Stand. deviation	219.501969	218.86969
Type	1ST	1ST
Trend (a)		6.30658817
Trend (b)		0.98990399
Trend (c)		
Trend (d)		
Trend (e)		
Trend (f)		
Corr. coeff. (r)		0.99276364
Residual var. (s)		26.4020805

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO

Trend Analysis of Duplicate Results
All Radon - Radon Detector Pairs



Aurora Environmental Surveys Limited 02-04-92

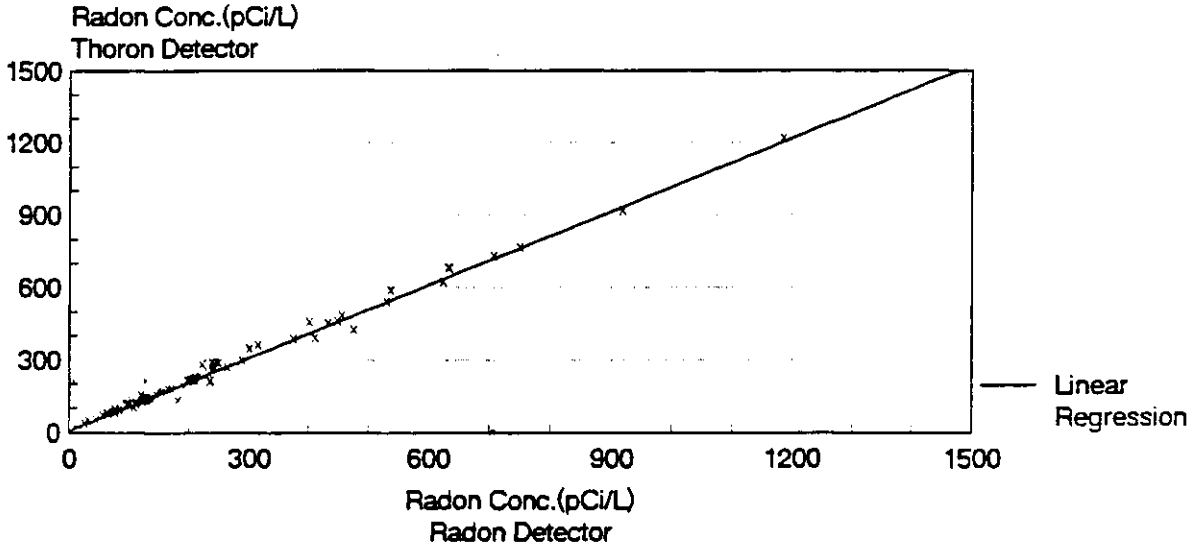
Statistics for: DUPALRNT	Linear Regression	
	A	B
Axis	LEFT Y	X AXIS
Sum	7812.78	7786.96
Var. proportion(%)	100	100
Number of obs.	36	36
Quadratic sum	2676897.13	2472520.13
Mean value	217.021667	216.304444
Largest value	891	755
Smallest value	26	16
Stand. deviation	167.447612	150.063422
Type	1ST	1ST
Trend (a)	-19.693537	
Trend (b)	1.09436119	
Trend (c)		
Trend (d)		
Trend (e)		
Trend (f)		
Corr. coeff. (r)	0.98074609	
Residual var. (s)	33.1778107	

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO

All Environments

Trend Analysis of Duplicate Results

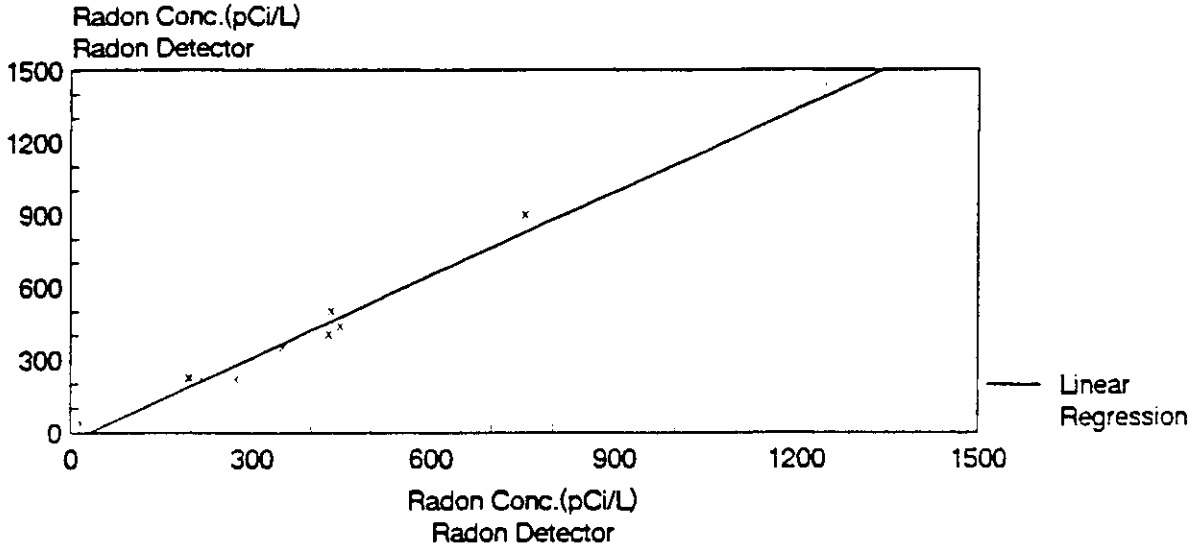
Radon – Thoron Detector Pairs



Aurora Environmental Surveys Limited 01-31-92

Statistics for: RNTHDUPT	Linear Regression	
	A	B
Axis	X AXIS	LEFT Y
Sum	20834.2849	21350.9463
Var. proportion(%)	100	100
Number of obs.	85	85
Quadratic sum	9622233.11	10049330.5
Mean value	245.109234	251.187604
Largest value	1184	1208
Smallest value	10.8888889	10.8888889
Stand. deviation	231.854776	236.195982
Type	1ST	1ST
Trend (a)		2.45405245
Trend (b)		1.0147866
Trend (c)		
Trend (d)		
Trend (e)		
Trend (f)		
Corr. coeff. (r)		0.99613518
Residual var. (s)		20.8705711

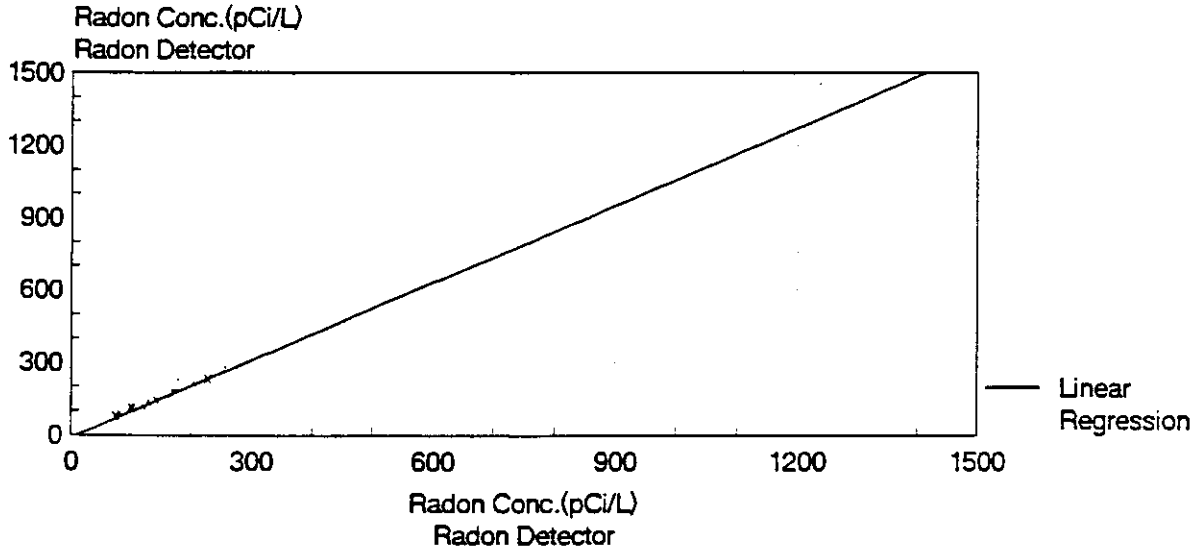
SOIL RADON GAS STUDY OF SOUTHERN ONTARIO
WALLACEBURG - Environment 3
Trend Analysis of Duplicate Results
Radon - Radon Detector Pairs



Aurora Environmental Surveys Limited 01-31-92

Statistics for: DUTWALRN	Linear Regression	
	A	B
Axis	LEFT Y	X AXIS
Sum	3425.64	3317.5
Var. proportion(%)	100	100
Number of obs.	10	10
Quadratic sum	1672588.68	1464596.61
Mean value	342.564	331.75
Largest value	891	755
Smallest value	28.44	18.5
Stand. deviation	235.487139	201.112457
Type	1ST	1ST
Trend (a)	-38.234314	
Trend (b)	1.14784729	
Trend (c)		
Trend (d)		
Trend (e)		
Trend (f)		
Corr. coeff. (r)	0.98029304	
Residual var. (s)	49.3421593	

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO
MARKHAM – STOUFFVILLE – Environment 4
Trend Analysis of Duplicate Results
Radon – Radon Detector Pairs



Aurora Environmental Surveys Limited 01-31-92

Statistics for: DUTMSRN	Linear Regression	
	A	B
Axis	LEFT Y	X AXIS
Sum	2776.14	2857.46
Var. proportion(%)	100	100
Number of obs.	20	20
Quadratic sum	457111.379	467993.523
Mean value	138.807	142.873
Largest value	267.6	256
Smallest value	64.6	74.12
Stand. deviation	61.4576078	56.0730916
Type	1ST	1ST
Trend (a)	-14.618259	
Trend (b)	1.07385755	
Trend (c)		
Trend (d)		
Trend (e)		
Trend (f)		
Corr. coeff. (r)	0.97977316	
Residual var. (s)	12.635376	

CONVERSION FACTORS FOR MEASUREMENTS IN ONTARIO GEOLOGICAL SURVEY PUBLICATIONS

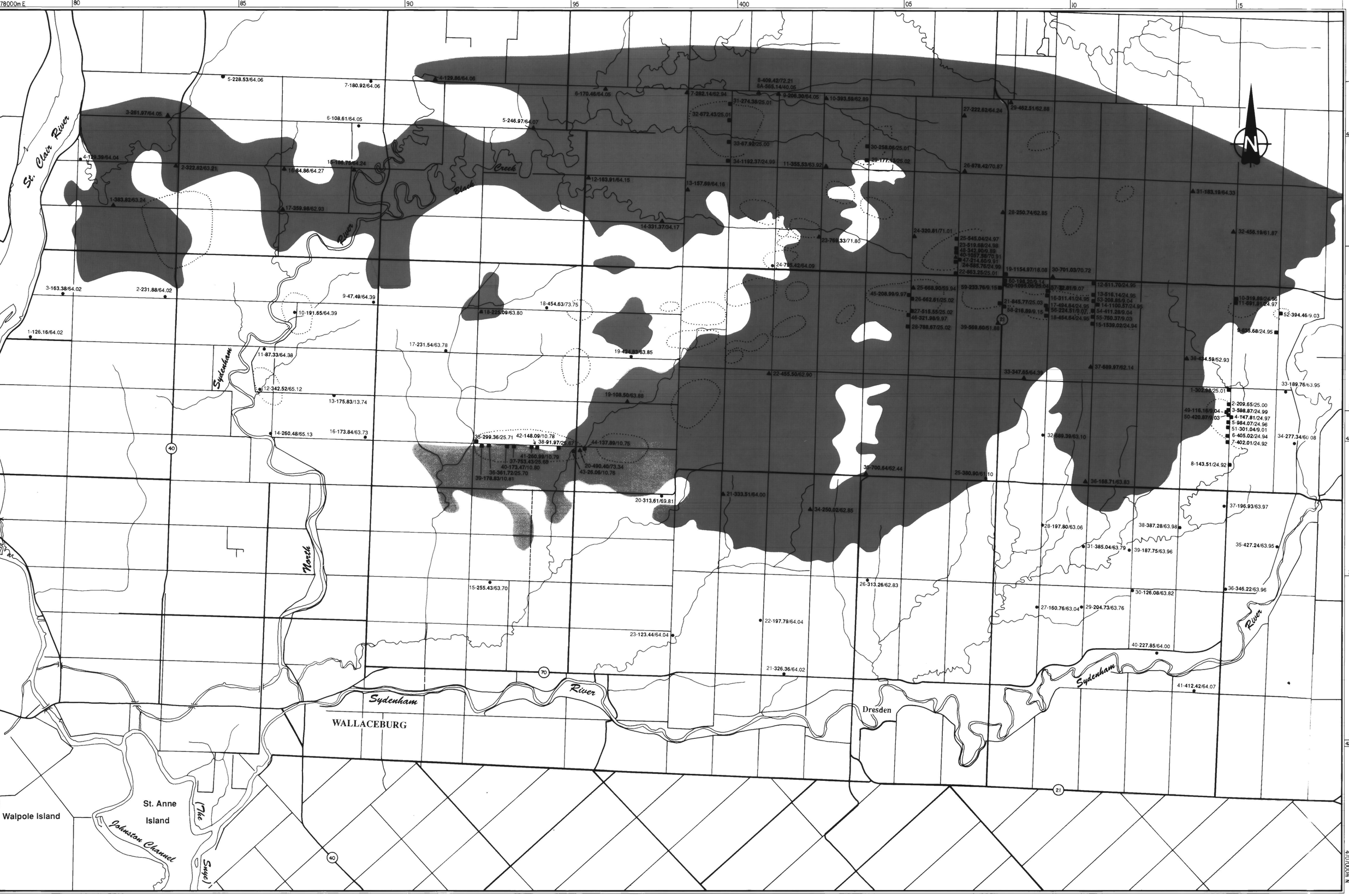
Conversion from SI to Imperial			Conversion from Imperial to SI		
SI Unit	*Multiplied by*	*Gives*	*Imperial Unit*	*Multiplied by*	*Gives*
		LENGTH			
1 mm	0.039 37	inches	1 inch	**25.4**	mm
1 cm	0.393 70	inches	1 inch	**2.54**	cm
1 m	3.280 84	feet	1 foot	**0.304 8**	m
1 m	0.049 709 7	chains	1 chain	20.116 8	m
1 km	0.621 371	miles (statute)	1 mile (statute)	**1.609 344**	km
		AREA			
1 cm^2	0.155 0	square inches	1 square inch	**6.451 6**	cm^2
1 m^2	10.763 9	square feet	1 square foot	**0.092 903 04**	m^2
1 km^2	0.386 10	square miles	1 square mile	2.589 988	km^2
1 ha	2.471 054	acres	1 acre	0.404 685 6	ha
		VOLUME			
1 cm^3	0.061 02	cubic inches	1 cubic inch	16.387 064	cm^3
1 m^3	35.314 7	cubic feet	1 cubic foot	0.028 316 85	m^3
1 m^3	1.308 0	cubic yards	1 cubic yard	0.764 555	m^3
		CAPACITY			
1 L	1.759 755	pints	1 pint	0.568 261	L
1 L	0.879 877	quarts	1 quart	1.136 522	L
1 L	0.219 969	gallons	1 gallon	**4.546 090**	L
		MASS			
1 g	0.035 273 96	ounces (avdp)	1 ounce (avdp)	28.349 523	g
1 g	0.032 150 75	ounces (troy)	1 ounce (troy)	**31.103 476 8**	g
1 kg	2.204 62	pounds (avdp)	1 pound (avdp)	**0.453 592 37**	kg
1 kg	0.001 102 3	tons (short)	1 ton (short)	**907.184 74**	kg
1 t	1.102 311	tons (short)	1 ton (short)	**0.907 184 74**	t
1 kg	0.000 984 21	tons (long)	1 ton (long)	**1016.046 908 8**	kg
1 t	0.984 206 5	tons (long)	1 ton (long)	**1.016 046 908 8**	t
		CONCENTRATION			
1 g/t	0.029 166 6	ounce (troy)/ ton (short)	1 ounce (troy)/ ton (short)	34.285 714 2	g/t
1 g/t	0.583 333 33	pennyweights/ ton (short)	1 pennyweight/ ton (short)	1.714 285 7	g/t

OTHER USEFUL CONVERSION FACTORS

	Multiplied by	
1 ounce (troy) per ton (short)	20.0	pennyweights per ton (short)
1 pennyweight per ton (short)	0.05	ounces (troy) per ton (short)

Note: Conversion factors which are in bold type are exact. The conversion factors have been taken from or have been derived from factors given in the Metric Practice Guide for the Canadian Mining and Metallurgical Industries, published by the Mining Association of Canada in co-operation with the Coal Association of Canada.

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LEGEND

- ENVIRONMENT 1 Clay and silt over black shale till on Kettle Pt. black shales
- ENVIRONMENT 2 Black shale till overlying Kettle Pt. Shales
- ENVIRONMENT 3 Environments 1 & 2 underlain by known oil and gas fields
- 22-**965.3**/70.02 Station Number-**Rn (pCi/L)**/Exposure Time (days)
- Known oil and gas fields (not all shown)
- Black shale till

NOTES:

1. In Report all station numbers prefixed by WAL and Environment Number (eg. WAL1-39).
2. Rad-Elec Inc. E-PERM System used to determine Radon Concentration.

ONTARIO GEOLOGICAL SURVEY

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO

WALLACEBURG

by Aurora Environmental Surveys Limited

0 1 2 3 4 Miles

0 1000 2000 3000 4000 Metres

Scale 1:50 000

N.T.S. 40 J/16, J/9

OFR5847 Map 1

EAST WINDSOR

WINDSOR

LASALLE

FIGHTING ISLAND

AMHERSTBURG

ESSEX

HARROW

Detroit River

Detroit River

Lake Erie

2-226.66/62.74

2-126.56/62.70

34-370.34/59.98

1-152.81/62.73

3-73.55/62.68

4-222.77/63.72

3-432.81/62.65

40-357.71/61.97

1-303.90/62.75

5-307.38/51.61

4-296.52/62.70

5-292.97/63.70

15-200.72/61.97

6-111.34/62.69

7-300.77/62.94

7-173.76/64.68

8-257.51/62.09

6-191.00/61.99

9-343.29/62.08

10-258.09/62.08

11-255.42/62.08

12-224.10/62.09

13-148.61/62.07

14-386.06/63.63

8-258.62/61.93

9-179.29/63.21

14-404.27/63.19

12-368.75/63.00

23-435.90/60.20

11-142.87/62.90

19-172.97/62.68

16-323.74/62.00

17-444.58/61.99

18-169.36/61.96

13-268.84/60.98

10-244.64/62.19

20-371.29/62.66

18-248.52/61.82

15-165.46/61.90

37-360.01/60.72

38-312.85/60.91

28-106.52/61.12

19-253.87/60.90

17-172.41/62.84

20-80.44/60.90

23-172.88/60.27

24-1693.99/11.06

16-164.27/60.89

21-106.29/60.88

39-263.85/60.88

27-514.42/60.28

21-258.66/61.88

29-337.00/60.23

25-192.51/60.20

26-173.70/60.19

22-161.66/60.88

36-186.25/60.92

33-145.33/60.93

35-189.80/60.94

30-193.81/61.12

31-379.36/60.10

34-293.10/60.93

32-272.28/60.09

33-331.05/60.95

32-199.04/60.00

31-309.85/60.01

30-322.78/60.02

24-152.23/60.08

25-387.57/60.08

29-194.56/60.03

35-685.31/59.20

36-324.10/59.13

37-108.54/59.12

38-258.06/59.14

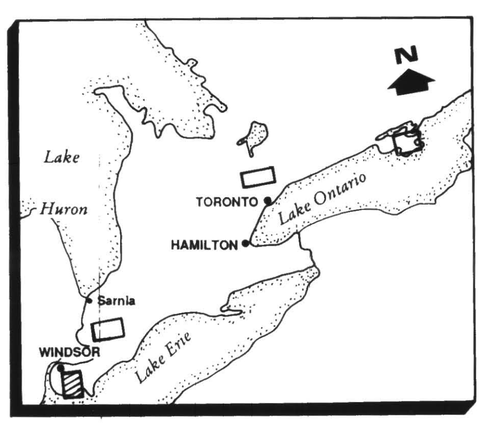
28-180.96/60.03

27-367.63/60.04

26-223.06/60.05

85
80
42°15'
75
70
42°10'
65
60
42°05'
55
4653000mN

25
83°05'
30
35
83°00'
40
80°55'
45
80°50'
50



LEGEND

- ENVIRONMENT 1 — Clay Till overlying dolostones and limestones of the Dundee Fm. and Detroit River Group
- ENVIRONMENT 2 — Clays or Clay Till above buried eskers overlying dolostones and limestones
- 22-965.3/70.02 — Station Number-**Rn (pCi/L)**/Exposure Time (days)
- Buried eskers and glaciofluvial sands (not all shown)

NOTE:

In Report all Station Numbers prefixed by WIN and Environment Number (eg. WIN1-39)

Rad-Elec Inc. E-PERM System used to determine Radon Concentration.

ONTARIO GEOLOGICAL SURVEY

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO

WINDSOR

by Aurora Environmental Surveys Limited

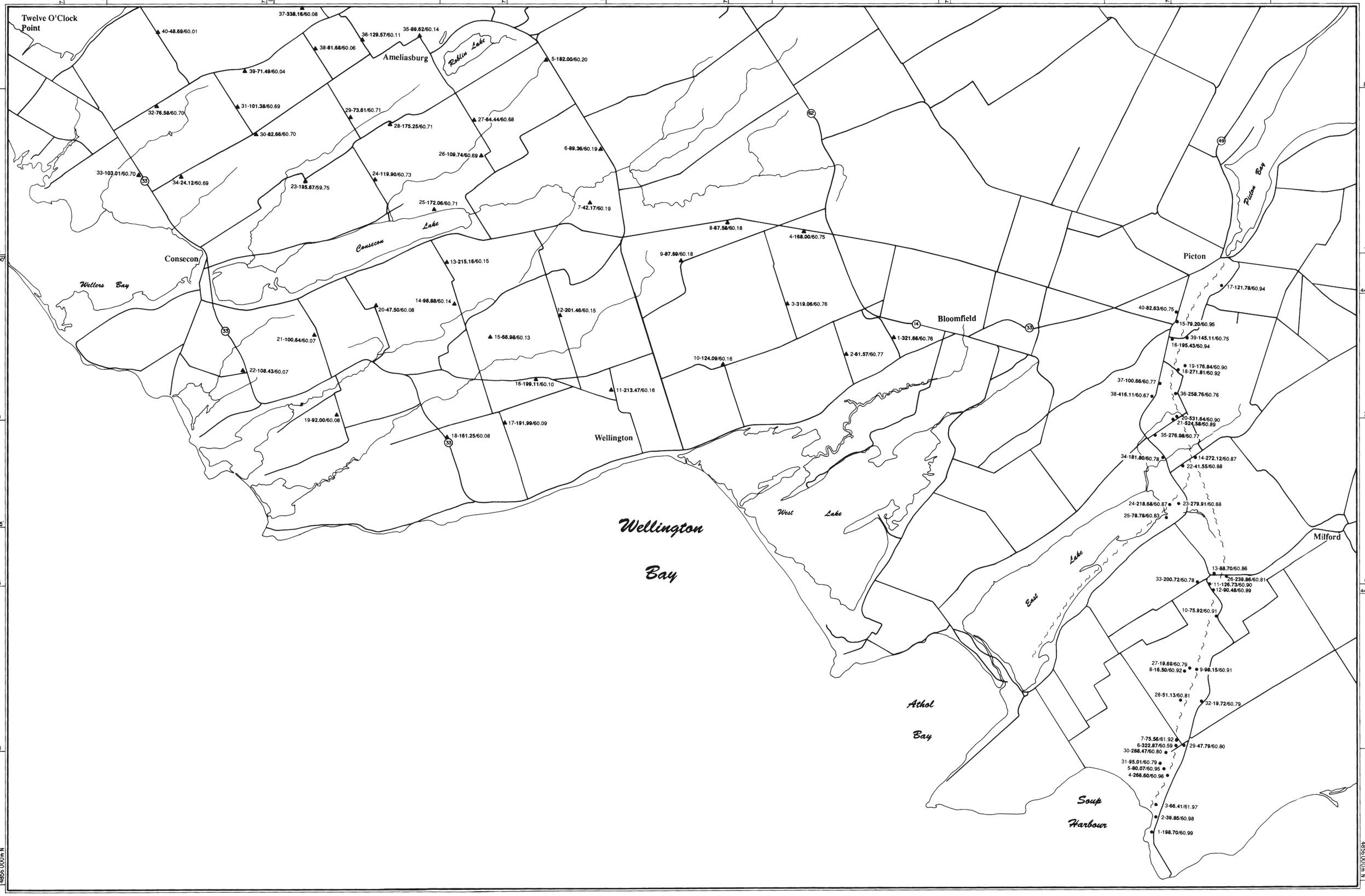
0 1 2 3 4 Miles

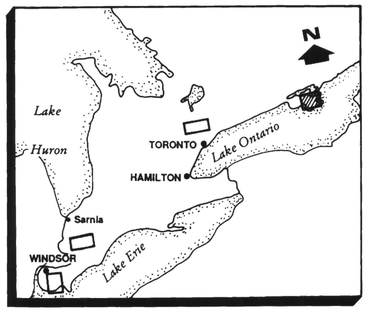
0 1000 2000 3000 4000 Metres

Scale 1:50 000

N.T.S. 40J/6/7, 40J/3/2

OFR5847 Map 2





LEGEND

•	ENVIRONMENT 1	Thin to moderately thick overburden overlying Simcoe Group limestones and dolostones
▲	ENVIRONMENT 2	Thin overburden overlying Simcoe Group limestones and dolostones
~ ~ ~		Fault Zone
22-965.3/70.02		Station Number-Rn (pCi/L)/Exposure Time (days)
NOTE:		In Report all Station Numbers prefixed by PEC and Environment Number (eg. PEC2-1)
		Rad-Elec Inc. E-PERM System used to determine Radon Concentration.

ONTARIO GEOLOGICAL SURVEY

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO

PRINCE EDWARD COUNTY

by Aurora Environmental Surveys Limited

0 1 2 3 4 Miles

0 1000 2000 3000 4000 Metres

Scale 1:50 000

N.T.S. 31C/4/3/; 30N/13/14

AURORA

Oak Ridges

King City

Nobleton

RICHMOND HILL

WHITCHURCH STOUFFVILLE

Stouffville

MARKHAM

Collingwood Member (Lindsay Fm)

Georgian Bay/Blue Mountain Fm.

Yongehurst

Maple

Richvale

VAUGHAN

Kleinburg

Langstaff

Hillcrest Village

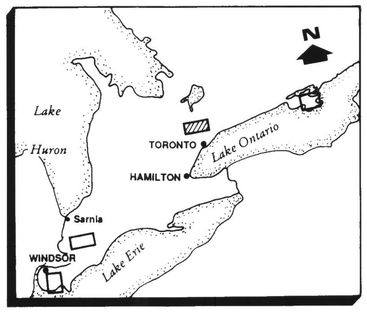
SCARBOROUGH

Woodbridge

Willowdale

NORTH YORK

Woburn



LEGEND

- ENVIRONMENT 1 — Sand and Gravel veneer on the Halton Till overlying Collingwood Member (Lindsay Fm) shales
- ENVIRONMENT 2 — Halton Till overlying Collingwood Member shales
- ENVIRONMENT 3 — Sand and gravel veneer on the Halton Till overlying Georgian Bay Fm limestone and dolostone
- ENVIRONMENT 4 — Halton Till overlying Georgian Bay Fm limestone and dolostone
- 22-**965.3**/70.02 — Station Number-**Rn (pCi/L)**/Exposure Time (days)
- Approximate bedrock geology contact
- Sand and gravel veneer on Halton till

NOTE: In Report all station numbers prefixed by MS and Environment Number (eg. MS1-39)

Rad-Elec Inc. E-PERM System used to determine Radon Concentration.

ONTARIO GEOLOGICAL SURVEY

SOIL RADON GAS STUDY OF SOUTHERN ONTARIO

MARKHAM-STOUFFVILLE

by Aurora Environmental Surveys Limited

0 1 2 3 4 Miles

0 1000 2000 3000 4000 Metres

Scale 1:50 000

N.T.S. 40 J/16, J/9

OFR5847 Map 4