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HEALTH-BASED RISK ASSESSMENT BUILDING NO. 3 ARMY AMMUNITION PLANT ST. LOUIS, MISSOURI

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EXECUTIVE SUMMARY

Woodward-Clyde Consultants (WCC) has prepared this risk assessment for World Wide Terminal Services Inc. (WWTS, doing business as Universal Engineering, on behalf of the Aviation Troop Command, or ATCOM), for Building No. 3 of the St. Louis Army Ammunition Plant (SLAAP). This report has been prepared in accordance with Woodward-Clyde Consultants' (WCC) scope of work for a health-based risk assessment, as presented in the proposal dated May 1995.

Based on the results and assumptions of this risk assessment, the following conclusions were made:

- The overall non-carcinogenic hazard indices posed by exposures to the COPCs in the basement, first level, and second level of Building No. 3 are below the threshold value of 1, indicating that exposures to the COPCs are at acceptable levels; and

- The overall cancer risks posed by exposures to the COPCs in the basement, first level, and second level of Building No. 3 are at or within the U.S. EPA's acceptable cancer risk range of 10^{-4} to 10^{-6}, indicating that exposures to the COPCs are at acceptable levels.

Based on the limits, assumptions, and conclusions of this risk assessment, there is no unacceptable health impact posed by the interior of Building No. 3 and further remediation of Building No. 3 interior is not indicated.

The risk assessment examined the potential exposure of adult workers to interior surfaces and basement soil of Building No. 3 through four exposure pathways: inhalation, dermal contact with interior surfaces, ingestion of soil, and dermal contact with soil (the latter two pathways for the basement only). A reasonable maximum exposure was assumed to occur, assuming exposure for 5 days per week, 50 weeks per year, for 25 years. The chemicals of potential concern (COPCs) assessed in the risk assessment included total polychlorinated biphenyls (PCBs) on all levels and the pesticides 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, dieldrin,

endrin, gamma-BHC, and heptachlor epoxide in the basement. The risk assessment evaluated the basement, first level, and second level separately.

Cancer risk levels on the first and second level (less so in the basement) were largely driven by inhalation of PCBs. Limited air sampling conducted at representative areas within Building No. 3 did not detect the presence of PCBs in air at quantitation limits ranging from 0.7 to 0.8 $\mu g/m^3$. In addition, proposed revisions to the cancer slope factor for PCBs suggest that the current slope factor used in this assessment over-predicts cancer risks by 4 to 25 times. For these reasons, PCB risk estimates in this assessment are likely to have been over-estimated.

The risk assessment required development of an innovative approach to assess the risk associated with dermal contact to interior surfaces, since U.S. EPA has not developed guidelines or preferred approaches for quantifying this exposure pathway. In addition, fate and transport modeling was applied to estimate the volatilization of PCBs and pesticides from interior surfaces and soil to the air, requiring assumptions to be made for several factors.

Despite the fact that the risk levels derived were within acceptable levels, many of the surface wipe samples and core samples collected from the building exceeded the U.S. EPA PCB Spill Cleanup Policy standards for non-restricted access areas, namely, 10 $\mu g/100\ cm^2$ for surface wipe samples and 10 mg/kg for soils (applied to evaluate concrete core samples). An evaluation was made of these standards. The wipe sample standard, developed in 1986, is based on outdated factors and is somewhat arbitrary. The risk level to which this standard was intended to correspond is not clear from its documentation. When using the methodology developed in this risk assessment, the standard of 10 $\mu g/100\ cm^2$ corresponds to a risk level of 10^{-6}. The soil standard of 10 mg/kg is associated with a risk level of about 10^{-4}. Many of the regulatory levels or guidance values set for PCBs by the U.S. EPA have adopted higher-than-baseline risk levels (i.e., higher than 10^{-6}). Based on this precedence, the risk levels calculated in the risk assessment (10^{-5} to 10^{-4}) are typical of acceptable risk levels previously adopted for PCBs.

The sample representativeness in the chip chute area was also examined and was ju be low because 1) not all surface types were sampled, 2) the PCB concentrations ranged widely, and 3) PCB concentrations substantially higher than the comparison standards were detected in two samples. Additional sampling of surfaces around the chip chute area could improve the understanding of the PCB levels in this area.

Asbestos is known to be present in portions of Building No. 3. The risk assessment did not examine the potential health impacts associated with the presence of asbestos. It is recommended that a qualified asbestos inspector examine the presence and condition of the asbestos, and that the results of that inspection be considered along with the results of this risk assessment in developing long-term management decisions regarding Building No. 3.

1.1 INTRODUCTION

Woodward-Clyde Consultants (WCC) has prepared this risk assessment for World Wide Terminal Services Inc. (WWTS, doing business as Universal Engineering, on behalf of the Aviation Troop Command, or ATCOM), for Building No. 3 of the St. Louis Army Ammunition Plant (SLAAP). This report has been prepared in accordance with WCC's scope of work for a health-based risk assessment, as presented in the proposal dated May 1995, and is based on information contained in the Request for Proposal (RFP) and the following documents:

- St. Louis Army Ammunition Plant, PCB Decontamination and Testing of Building 3 Project, St. Louis, Missouri (RUST Remedial Services, Inc., 1994);
- Building 3 Basement Characterization Report (Dames & Moore, 1994a); and,
- Remediation Design and Development Report (Dames & Moore, 1994b).

The objectives of the human health risk assessment are to evaluate the potential health risks posed by the present-day contamination of the building and to evaluate the need for further remedial activities.

The risk assessment was prepared in general accordance with currently accepted guidance for conducting human health risk assessments. U.S. EPA does not provide specific guidance for assessing the majority of the media (concrete and other surfaces) or the data form (primarily wipe and core samples) available for Building No. 3. Therefore, a technical approach to use these data was developed for this assessment. The primary guidance document used in preparation of the risk assessment was *Risk Assessment Guidance for Superfund - Volume I: Human Health Evaluation Manual (Part A)* (U.S. EPA, 1989a). Additional guidance was sought from the following documents:

- U.S. EPA Memorandum from Karen Hammerstrom to Jane Kim, Cleanup of PCB Spills Located Indoors, Office of Pesticides and Toxic Substances, dated February 5, 1986.
- U.S. EPA (1992). *Dermal Exposure Assessment: Principles and Applications, Interim Report*, Office of Research and Development, EPA/600/8-91/011B, January.
- U.S. EPA (1990b). *Guidance on Remedial Actions for Superfund Sites with PCB Contamination*. EPA/540-G-90-007, August.

The risk assessment is organized into the following sections:

- Basis of Existing Cleanup Standards (Section 2.0)
- Data Review and Selection of Chemicals of Potential Concern (Section 3.0)
- Exposure Assessment (Section 4.0)
- Toxicity Assessment (Section 5.0)
- Risk Characterization (Section 6.0)
- Results and Discussion (Section 7.0)
- Uncertainty Evaluation (Section 8.0)
- Chip Chute Area (Section 9.0)
- Summary and Conclusions (Section 10.0)

1.2 SUMMARY OF EXISTING CONDITIONS

From September 1991 through August 1994, Chemical Waste Management (now RUST Remedial Services) performed PCB testing and decontamination on the first and second levels of Building No. 3 of the SLAAP. Cutting oil containing PCBs was historically used in the upper levels of this building. Wipe and/or core samples were obtained from various materials, including the floor, walls, ceiling, and other structures (elevator doors, panel boxes, floor grates, metal pipes, windows). PCBs were found on various materials, but were most prevalent in the concrete floor and walls. Concentrations were detected above the U.S. EPA cleanup standard of 10 mg/kg (ppm) for porous surfaces and 10 $\mu g/100\ cm^2$ for non-porous surfaces, as specified in the U. S. EPA PCB Spill Cleanup Policy (40 CFR 761, Subpart G) and discussed in Section 2.0.

In July 1994, Dames and Moore conducted wipe and soil sampling in the basement of Building No. 3. Soil and surfaces of the basement (floor, horizontal beams, vertical columns, walls, and

ceiling) were characterized to identify the presence of PCBs from cutting oil use in upper levels of the building, as well as to identify the presence of pesticides and ammonia from the historic use of pesticides and storage of urea in the basement. PCBs were not found in the soil samples, but were detected in other basement surfaces. Several pesticides were detected from basement surface and soil samples: 4,4'-DDD, 4,4'-DDT, gamma-BHC (lindane), endrin (and endrin aldehyde), heptachlor epoxide, dieldrin, methoxychlor, and beta-BHC. Ammonia, which was analyzed as a surrogate for urea, was also detected in most of the samples. Dames and Moore concluded that the ammonia concentrations were only slightly above those typically found in soil.

During the preparation of this report, additional PCB decontamination was performed on a section of the first level concrete (the "P3Z1" area) where higher concentrations of PCBs were detected by earlier sampling. The section has been cleaned to a composite level of 5.3 mg/kg. This section of the building was not included in the risk assessment as the decontamination was in process and the area was considered clean (< 10 mg/kg) upon completion.

The chemical results of the previous testing performed in the basement, first level, and second level of Building No. 3 are presented in Appendices A, B, and C, respectively, and summarized in the following subsections.

1.2.1 Basement

Media sampled in the basement included soil and wipe samples of various surfaces (the floor, walls and other vertical surfaces, and the ceiling). Samples were analyzed for PCBs and various pesticides. Figure 1-1 identifies the basement sampling locations. The results of the basement sampling are summarized in Appendix A.

Eight soil samples were collected from the floor of the basement. PCBs were not detected in any soil sample. Four pesticides were detected in four samples: 4,4'-DDD, 4,4'-DDT, endrin, and gamma-BHC.

Fifteen floor wipe samples were collected. PCBs[1], 4,4'-DDD, 4,4'-DDT, dieldrin, endrin, gamma-BHC, and heptachlor epoxide were detected. 4,4'-DDD, 4,4'-DDT, and gamma-BHC were most frequently detected (in 15, 14, and 13 samples, respectively). PCBs were detected in seven samples, six of which exceeded the PCB Spill Cleanup Policy Standard for surfaces of 10 $\mu g/100\ cm^2$. Heptachlor epoxide was detected in four samples and dieldrin and endrin in one sample each.

Twenty vertical wipe samples were collected from vertical basement surfaces, which include walls and columns. The following chemicals were detected in wipe samples: PCBs (in five samples, three of which exceeded the standard of 10 $\mu g/100\ cm^2$) 4,4'-DDD (in 19 samples), 4,4'-DDT (in 19 samples), beta-BHC (2 samples), endrin aldehyde (1 sample), gamma-BHC (13 samples), and heptachlor epoxide (4 samples).

Fourteen horizontal beam samples were collected from the top surface of the bottom flange of the horizontal steel beams in the basement. PCBs were detected in 5 of the 14 samples. Pesticides were detected in all horizontal wipe samples. The pesticides detected include 4,4'-DDD (13 samples), 4,4'-DDE (1 sample), 4,4'-DDT (14 samples), gamma-BHC (9 samples), heptachlor epoxide (1 sample), and methoxychlor (1 sample). Nine ceiling wipe samples were collected. PCBs were detected in 1 sample; pesticides were detected in 8 wipe samples. The pesticides detected include 4,4'-DDD (8 samples), 4,4'-DDT (7 samples), gamma-BHC (2 samples), and heptachlor epoxide (1 sample). All of the PCB concentrations detected in horizontal beam or ceiling samples exceeded the standard of 10 $\mu g/100\ cm^2$.

1.2.2 First and Second Levels

Sampling of the first and second levels of Building No. 3 was conducted in seven phases: Phase 1 through Phase 7 (P1 through P7 samples). Analysis of samples was performed for PCBs only. All samples from the second level were collected during Phase 1. The first floor sampling was

[1] PCBs were reported as Aroclor mixtures, most typically Aroclor 1260, Aroclor 1254, or Aroclor 1248. In this risk assessment, PCBs are referred to as total PCBs, and a discussion on the Aroclor mixture to which the PCB analysis was reported is not presented. The original sampling reports should be referred to for further information.

divided into six area-specific phases: Phases 2 through 7. Analytical results for the first level and second level are presented in Appendix B and Appendix C, respectively. Figures 1-2 through 1-7 identify the sample locations from the first and second levels.

A total of 164 floor core samples were collected from the first and second level of Building No. 3. One hundred seven (107) core samples were collected from the first level and 57 core samples were collected from the second level. PCBs were detected in 70 of the 164 floor samples: 53 on the first level and 17 on the second level. Detected PCB concentrations in the floor core samples ranged from 2 mg/kg to 60 mg/kg on the first level (27 exceeding the standard of 10 $\mu g/100\ cm^2$) and from 2 mg/kg to 32 mg/kg on the second level (9 exceeding the standard of 10 $\mu g/100\ cm^2$).

A total of 418 ceiling samples were collected from the first and second levels: 181 wipe samples and 69 core samples were collected from the first level, and 126 wipe samples and 42 core samples were collected from the second level. Of the 111 core samples, only 4 samples had detectable concentrations of PCBs (2 on each level, all below the soil cleanup standard of 10 mg/kg) Of the 307 ceiling wipe samples, 146 had detectable concentrations of PCBs: 92 on the first level (34 exceeding 10 $\mu g/100\ cm^2$) and 53 on the second level (17 exceeding 10 $\mu g/100\ cm^2$). PCB concentrations ranged from 1.11 $\mu g/100\ cm^2$ to 111 $\mu g/100\ cm^2$ on the first level and from 1.2 $\mu g/100\ cm^2$ to 108.1 $\mu g/100 cm^2$ on the second level.

A total of 284 samples were collected from vertical surfaces of the first and second level, which include columns, walls, doors, electrical panels, and windows. Sixty three (63) wipe samples and 112 core samples were collected from the first level, and 52 wipe and 57 core samples were collected from the second level. Of all samples, only 12 samples had detectable concentrations of PCBs. PCBs were detected in 3 wipe samples on the first level (all below 10 $\mu g/100\ cm^2$), 8 core samples on the first level (2 exceeding 10 mg/kg), 1 wipe sample on the second level (below 10 $\mu g/100\ cm^2$), and no core samples on the second level.

1.2.3 Air Sampling

Eight air samples were collected for analysis of PCBs at representative locations throughout Building No. 3 in May, 1992. The results of the air sampling and analysis are presented in Appendix D. None of the air samples collected contained detectable concentrations of PCBs at quantitation limits ranging from 0.7 to 0.8 $\mu g/m^3$. Despite the absence of detectable levels of PCBs in the indoor air, this risk assessment has conservatively assessed the inhalation pathway, using modeled estimates of indoor air concentrations. Nonetheless, this air sampling indicates that PCBs are not present at detectable concentrations in the indoor air of Building No. 3.

1.2.4 Asbestos-Containing Material

ATCOM identified the presence of asbestos-containing material in Building No. 3 and adjacent buildings and expressed concern regarding the possible health impacts associated with its presence. No information was available on the presence or condition of the asbestos-containing material, so this issue is not addressed in the risk assessment. The conclusions of the risk assessment do not consider the potential health impacts associated with the presence of asbestos and this omission should be kept in mind when developing long-term management actions of the building. It is recommended that individuals qualified in the inspection of asbestos evaluate these areas and make recommendations as to the need for asbestos removal.

2.0
BASIS OF EXISTING CLEANUP STANDARDS

The current cleanup standards by which PCB contamination is evaluated were derived under the PCB Cleanup Spill Policy (40 CFR Subpart G (Parts 761.120 to 761.135)). This spill cleanup policy applies to spills that occurred after 4 May 1987 and, therefore, does not strictly apply to the SLAAP Building No. 3. In 40 CFR 761.120 (a)(1)(ii), it is stated:

> "EPA recognizes that old spills which are discovered after the effective date of this policy will require site-by-site evaluation because of the likelihood that the site involves more pervasive PCB contamination than fresh spills and because old spills are generally more difficult to clean up than fresh spills (particularly on porous surfaces such as concrete). Therefore, spills which occurred before the effective date of this policy are to be decontaminated to requirements established at the discretion of EPA, usually through its regional offices."

This exclusion aside, the general PCB cleanup standards for non-restricted access areas are:

- A surface PCB concentration of 10 $\mu g/100\ cm^2$ for indoor solid surfaces, high- and low-contact outdoor solid surfaces; and
- A soil concentration of 10 mg/kg, (ppm), provided that the soil is excavated to a minimum depth of 10 inches and covered with clean soil.

In this assessment, a value of 10 $\mu g/100\ cm^2$ is used to evaluate all wipe samples and a bulk (mass) concentration of 10 mg/kg is used to evaluate core samples of concrete. Note that there is no PCB Spill Cleanup Policy Standard for cored concrete.

To evaluate the risk levels associated with the PCB Spill Cleanup Policy standards, the basis of the standards was examined. A U.S. EPA memorandum from Karen Hammerstrom to Jane Kim, Office of Pesticides and Toxic Substances, dated February 5, 1986, presents the theoretical exposure model and parameters that were used to derive the surface cleanup standards for PCB.

Exposures in this model are given by the following equation:

$$LADD = \frac{C \times SA \times T \times A}{BW \times L}$$

where	LADD	=	Lifetime Average Daily Dose (mg/kg-day)
	C	=	Surface concentration of contaminant (mg/cm^2)
	SA	=	Contaminant-containing surface area contacted by worker during work life (cm^2)
	T	=	Fraction of contaminant transferred from contaminated surface to skin (unitless)
	A	=	Fraction of contaminant absorbed through skin (unitless)
	BW	=	Body weight (kg)
	L	=	Human lifetime (dy)

Exposures were modeled for both worker and residential exposure to low and high contact surfaces. Workers in a low contact exposure scenario were assumed to make light contact with 10 percent of the walls and floors of their work areas during their careers. The work area was assumed to be 10 feet x 12 feet x 8 feet. One percent (1%) of the PCBs were assumed to be transferred to skin and absorbed. For the high-contact exposure scenario, workers contact an area approximately equal to a desktop with 25 percent transfer of the PCBs due to firmer contact.

The assumptions used to develop the acceptable surface concentration of PCB are arbitrary and in some cases outdated, limiting use of this model in other situations. As the exposure model was presented in the memorandum, the percentage of surface contact is a function of room size, suggesting that the degree of exposure increases as the room size increases (i.e., a person working in a 200 m^2 room would contact the surfaces 10 times more frequently than a person working in a 20 m^2 room). While the surface area potentially contacted in a larger room is greater than a smaller room, it is not reasonable to assume that the *frequency* with which the surfaces would be contacted is any greater in a larger room. This character of the model makes it difficult to extrapolate to room sizes that are different from that used in the model. In addition to this limitation of the model, the model also makes an assumption regarding the toxicity of

PCBs that is now outdated. The slope factor used in the model was 4 $(mg/kg\text{-}dy)^{-1}$ versus current value of 7.7 $(mg/kg\text{-}dy)^{-1}$. Note, however, that the slope factor for PCBs is undergoing revision by the U.S. EPA and is anticipated to be reduced to a value in the range of 0.3 to 2.0 $(mg/kg\text{-}dy)^{-1}$. This is discussed further in Section 5.0. Furthermore, the assumption made in the model of a 100% dermal absorption rate of PCBs is also outdated. The absorption rate of PCBs from soil has been shown in experimental studies to range from 0.63 percent to 2.1% percent (U.S. EPA, 1992). Moreover, the model is not clear with what risk level the concentration of 10 $\mu g/100\ cm^2$ is supposedly associated. Other aspects of the approach to deriving the acceptable concentration were not clearly presented in the memorandum.

Because of the assumptions, limitations, and errors in the model, the acceptable PCB surface concentration of 10 $\mu g/100\ cm^2$ is not a supportable risk-based value by current day risk assessment standards. Since the U.S. EPA has not defined preferred or default exposure parameters or approaches for assessing contact with surfaces in this type of exposure, there is no defined method for revising the standard or proposing an alternative level. For these reasons, this risk assessment has developed its own approach for evaluating surface exposures.

The PCB cleanup standard for soil that is applied in this assessment to bulk (i.e., core) samples of 10 mg/kg is actually a range of acceptable concentrations of 10-25 mg/kg for occupational or "remote" areas. It is based on the derivation of an acceptable PCB concentration of 1 mg/kg in residential soils, and upwardly adjusted by an unknown method (the guidance is not specific as to how the value was derived) (U.S. EPA, 1990b). The residential value of 1 mg/kg is based on child and adult residential exposure to PCB-contaminated soil by multiple exposure pathways (ingestion, dermal contact, inhalation) and is associated with a risk level of about $1x10^{-5}$. The acceptable occupational range of 10-25 mg/kg is stated as being associated with a risk level of about $1x10^{-4}$.

Application of this standard to building material is insupportable from a risk basis, since the assumed exposure pathways upon which the standard is based are unlikely to occur (for example, daily ingestion of concrete is not a reasonable expectation).

These standards are not necessarily applicable regulatory standards for Building No. 3 since the building pre-dates the Spill Policy. Therefore, a basis exists for negotiating a variance from these standards or proposing an alternate value. This risk assessment has attempted to develop a more site-specific assessment of the chemical contamination in Building No. 3 that can be used as a basis for negotiating alternate standards.

3.0 DATA REVIEW AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

3.1 DATA REVIEW

The objective of the data review is to evaluate the quality of the available data and identify any limitations or uncertainties of the data that could potentially impact the risk assessment.

The following activities were performed in the data review:

- Review of the representativeness of the data
- Review of analytical methods and attained quantitation limits
- Review of level of data validation and assigned qualifiers
- Review of quality assurance/quality control (QA/QC) samples

3.1.1 Review of the Representativeness of the Data

Two approaches were used to select sampling locations in previous investigations: systematic random sampling and purposive sampling. In the systematic random sampling, sampling areas were identified through the development of sampling grids, and random samples were collected from within those grids. Systematic random sampling provides an unbiased sampling of chemical concentrations throughout the building; however, may have resulted in limited samples in areas of suspected contamination. In the purposive sampling, areas that appeared visibly stained or impacted were sampled. Purposive sampling intentionally skews the collection of data to areas of higher chemical concentrations. This may have resulted in a biased representation of chemical concentrations in the building. Use of both sampling schemes provides an adequate distribution of sampling locations throughout the building, which further provides an adequate basis for using the data in a risk assessment. One area, the chip chute area (shown on Figure 1-1) may have had less than an optimal number of samples collected, given that it was an area of suspected high concentrations of PCBs. This is discussed further in Section 9.0.

3.1.2 Review of Sampling and Analytical Methods and Attained Quantitation Limits.

The methodologies used to collect and analyze wipe and core samples are appropriate for obtaining chemical concentrations for comparison with the acceptable porous media and surface wipe concentrations specified in the PCB Spill Cleanup Policy. The adequacy of the methods for risk assessment use is unclear owing to the lack of specific guidance for assessing these types of data in a risk assessment. Alternate types of data collection and analysis for use in a risk assessment are not available, so these data are accepted as adequate for risk assessment purposes.

3.1.3 Review of Level of Data Validation and Assigned Qualifiers

The analytical data were presented without qualifiers, and the level of data validation is not known. Thus, the degree of certainty of the concentrations detected cannot be evaluated. Due to the lack of validation guidance specific for wipe sampling results, the data are accepted as valid for purposes of the risk assessment.

3.1.4 Review of Quality Assurance/Quality Control (QA/QC) Samples

Evaluation of field blank samples from the basement indicated detectable levels of pesticides. The concentrations were low and were not significant enough to discredit the data. Duplicate samples were collected in the basement from side-by-side locations. Comparison of the duplicate samples with original samples indicated significant variations. The variation in concentrations was attributed to the physical difference of sample locations.

4.0
EXPOSURE ASSESSMENT

The exposure assessment describes the exposure potential posed by the building interior, identifies people (receptors) who may be exposed and through what pathways, estimates chemical concentrations to which receptors may be exposed, and calculates resultant chemical intakes. These topics are discussed individually in the sections below.

4.1 SETTING DESCRIPTION AND BUILDING USE

Building No. 3 is part of a large governmental complex located in St. Louis, Missouri. The general setting of the site is shown on Figure 4-1. The complex is located between Riverview Boulevard and Goodfellow Boulevard, adjacent to Interstate Highway 70. Most of the land use surrounding the complex is commercial. Some low income residential areas are located to the west of the complex. Access to the governmental complex is controlled through security measures including a manned entrance gate and fencing.

Currently, Building No. 3 is largely vacant except for a few office areas on the first and second levels used by ATCOM and the Veterans Administration (VA). These areas in use have been fitted with suspended ceiling tiles, wall coverings, and carpeting or other floor cover, and the original interior surfaces are not available for direct contact. Access to the basement is controlled, and the windows to the basement have been sealed. The potential future use of Building No. 3 will likely remain similar to that for which it has been used in the recent past, i.e., for administrative and storage use.

4.2 IDENTIFICATION OF POTENTIAL RECEPTORS

The human receptor groups that have the potential to be exposed to the interior of Building No. 3 include maintenance personnel performing periodic inspections and other worker populations that may be employed in the building. Maintenance workers may be exposed to the basement as well as upper levels of the building, whereas other general worker populations are potentially only exposed to the first or second level of the building. Although the degree of exposure of

Modeling parameters for the above equations are provided in Table 4-1.

In general, the Hwang and Falco model describes the desorption of chemicals from a medium such as soil and the vapor phase diffusion of the chemicals to the surface to replace that lost by volatilization. The following conditions and assumptions are inherent in the model:

- The model assumes an exponential decay curve over time once steady-state conditions are achieved;
- The model does not account for the high initial rate of volatilization before equilibrium is attained and will tend to underpredict emissions during this initial period;
- The equation assumes that vapor phase diffusion is the only transport mechanism moving contaminants from the column to the surface; and
- The model is applicable only to single chemical compounds fully incorporated into isotropic medium.

The validation study conducted by U.S. EPA indicated that the Hwang and Falco model should make reasonable estimates of loss by vapor diffusion (U.S. EPA, 1994). An example of the loss curve predicted for PCBs at a starting concentration of 10 $\mu g/100\ cm^2$ is shown on Figure 4-3.

4.4.2 Dermal Exposures to Interior Surfaces

The volatilization rate estimated by the Hwang Falco model was also used to estimate average surface concentrations over the exposure period, to which receptors may be exposed dermally, accounting for the losses that occur as a result of the volatilization. The mass of chemical per unit area (g/cm^2) lost to volatilization each year was estimated by the following expression:

$$Mass\ Lost = N_A \times t \times Fi$$

EQ. 7

and

$$\textit{Mass at End} = \textit{Initial Mass} - \textit{Mass Lost}$$

EQ. 8

where:	Mass Lost	=	Chemical mass lost during the time interval (g/cm^2)
	Initial Mass	=	Chemical mass at beginning at time interval (g/cm^2)
	Mass at End	=	Chemical mass at end on time interval (g/cm^2)
	N_A	=	Volatilization (emission) rate (g/cm^2-s)
	t	=	Time interval (s)
	Fi	=	Inefficiency factor (unitless)

The initial mass at the start of a time interval, mass lost during that time interval, and the resultant mass at the end of the time interval were calculated for one year time intervals over the exposure period (25 years) using the emission rate for that time interval (i.e., Equation 1 was applied at one-year intervals with t = 1 yr). The mass remaining at the end of one time interval became the initial mass for the next time period. Through this process, chemical concentrations remaining in the surface at the end of each year were identified. These concentrations were averaged to identify the mean surface concentration to which receptors are potentially exposed over the exposure period.

An inefficiency factor (Fi) was applied to account for less than ideal volatilization occurring in real life situations and reduces the predicted emission rate by a factor of 10. In some cases, without the inefficiency factor, the model predicted that complete volatilization would occur over a short period of time (e.g., 1-5 years). However, since it is known that the use of the COPCs occurred in the early to mid-1900's, and are still present, the model apparently overpredicts volatilization. In a limited number of instances, the model with the inefficiency factor predicted complete loss of chemical sometime within the 25 year exposure period. In these instances, the average concentration over the time the chemical was predicted to be present was used as the exposure point concentration. Note that the inefficiency factor was used only to estimate the mass remaining on surfaces for purposes of assessing dermal contact and ingestion exposure, but was not used to estimate air concentrations for the purposes of assessing

inhalation exposure. This approach has 'double counted' the presence of chemicals in air and surfaces to a degree, adding a level of conservatism to the risk assessment.

Calculation of exposure point concentrations for the inhalation, ingestion, and the dermal exposure pathways are presented in Appendix E, Appendix F, and Appendix G for the basement, first level, and second level of the building, respectively. A summary of the chemicals of potential concern and the associated exposure point concentrations applied to the risk assessment is provided in Table 4-2.

4.4.3 Dermal Exposure to Soil

Exposure point concentrations used for dermal exposures to soil were the lower of either the maximum detected concentration or 95% UCL concentration of measured soil concentrations. The average concentration over the 25 year exposure period was not derived.

4.4.4 Ingestion Exposure to Soil

Exposure point concentrations used for ingestion exposures to soil were lower of either the maximum detected or 95% UCL concentration of measured soil concentrations. The average concentration over the 25 year exposure period was not derived.

4.5 ESTIMATION OF CHEMICAL INTAKES

Chemical intakes were calculated according to the conventional methods outlined in U.S. EPA (1989a) and through the approach used to derive the acceptable surface concentration of PCBs for the PCB Spill Cleanup Policy. The chemical exposure point concentrations, derived as described in the preceding section, were combined with exposure or intake parameters to estimate chemical intake. The exposure and intake factors used in the risk assessment are consistent with U.S. EPA guidance (U.S. EPA, 1992b), or are based on professional judgment, and represent a reasonable maximum exposure scenario.

The exposure pathways assessed in the risk assessment are incidental ingestion of soils in the basement, dermal contact with soil in the basement, dermal contact with interior surfaces, and

inhalation. Methods for estimating chemical intakes for each pathway are discussed below. Calculation of chemical intakes for the ingestion, inhalation, and dermal exposure pathways are presented in Appendix E, Appendix F, and Appendix G for the basement, first level, and second level of the building, respectively.

4.5.1 Ingestion Intake

Intake of COPCs through ingestion of soil in the basement was estimated by the following equation:

$$Intake = \frac{C_s \times IR \times FI \times CF \times EF \times ED}{BW \times AT}$$

EQ. 9

where:	Intake	=	Chemical intake rate (mg/kg-dy)
	Cs	=	Chemical concentration in soil (mg/kg)
	IR	=	Soil ingestion rate (mg/dy)
	FI	=	Fraction ingested that is contaminated (unitless)
	CF	=	Unit conversion factor (kg/mg)
	EF	=	Exposure frequency (dy/yr)
	ED	=	Exposure duration (yr)
	BW	=	Body weight (kg)
	AT	=	Averaging time (dy)

Exposure parameters used to assess ingestion exposures representative of a typical worker exposure and are presented in Table 4-3.

4.5.2 Dermal Intake

U.S. EPA has not developed a methodology for assessing dermal exposure to non-soil or building interior surfaces. U.S. EPA's conventional equation for estimating dermal exposure to soil is presented below and is based on the premise that soil, when contacted, adheres to the skin's surface promoting dermal absorption.

$$Intake = \frac{C_s \times SA \times AF \times AB \times CF \times EF \times ED}{BW \times AT}$$

EQ. 10

where:	Intake	=	Chemical intake rate (mg/kg-dy)
	Cs	=	Chemical concentration in soil (mg/kg)
	SA	=	Skin surface area available for contact (cm^2/event)
	AF	=	Soil-to-skin adherence factor (mg/cm^2)
	AB	=	Absorption factor (unitless)
	CF	=	Unit conversion factor (kg/mg)
	EF	=	Exposure frequency (events/yr)
	ED	=	Exposure duration (yr)
	BW	=	Body weight (kg)
	AT	=	Averaging time (dy)

In this risk assessment, contact with interior structures is under also consideration. These types of exposures are not assumed to result in adherence of the interior structure to the skin. Rather, the assumption is that chemicals will be absorbed from the structure's surface directly into skin during contact. To account for this difference, the conventional intake equation for dermal exposure to soil was modified to assess dermal exposure to non-soil surfaces. Chemical intake from dermal exposure to interior surfaces was estimated by the following equation:

$$Intake = \frac{C_W \times SA \times CR \times AB \times CF}{BW \times AT}$$

EQ. 11

where:	Intake	=	Chemical intake rate (mg/kg-dy)
	Cw	=	Chemical concentration on structure surface (µg/cm^2)
	SA	=	Total impacted surface area of the interior (cm^2)
	CR	=	Lifetime contact rate with interior surfaces (decimal %)
	AB	=	Dermal absorption extent (unitless)
	CF	=	Unit conversion factor (mg/µg)
	BW	=	Body weight (kg)
	AT	=	Averaging time (dy)

The chemical concentration on the interior structure surface was the average concentration over the exposure period, as discussed in Section 4.2.2, calculated from the 95% UCL or the

maximum detected concentration in the wipe samples. For structures that were cored and analyzed in mass/mass terms, an additional step was used to convert the coring sample result to a mass/surface area form:

$$C_w = C_c \times \rho \times CF \times D$$

EQ. 12

where:	C_w	=	Chemical concentration per surface area (μg/cm^2)
	C_c	=	Chemical concentration in cored sample (μg/kg)
	ρ	=	Density of material (g/cm^3)
	CF	=	Unit conversion factor (kg/g)
	D	=	Depth of chemical distribution in surface (cm)

The resultant chemical concentration is expressed in mass/surface area and can be used to estimate dermal absorption by the previous equation.

An estimate of the percentage of the surface area of the interior structures that would be contacted over a worker lifetime (i.e., the lifetime contact rate or CR) was based on the method used to derive the acceptable PCB surface concentration of 10 μg/100 cm^2 in the PCB Spill Cleanup Policy memorandum (U.S. EPA, 1986). In the U.S. EPA approach, 140,000 cm^2 was assumed to be the total interior structure to which exposure could potentially occur. Of this surface area, some types of interior structures were assumed "high contact" structures and others were assumed "low contact" structures. U.S. EPA assumed that 25% of high contact surfaces were contacted over a worker lifetime (i.e., 35,000 cm^2) and 10% of the low contact surfaces (i.e., 14,000 cm^2) were contacted over a worker lifetime. As discussed previously,, the approach used by the U.S. EPA to define the amount of surface contacted as a percentage of the room size has the effect of increasing the extent of exposure as the room size increases. To circumvent this situation, the approximate surface areas that were assumed contacted by the U.S. EPA, expressed as a percentage of the total interior surface area in Building No. 3, were used to estimate the surface areas of Building No. 3 that might be contacted. The floor and ceiling were assessed as low contact structures and the walls were assessed as high contact structures.

Dermal absorption values (AB) were derived from information presented in *Dermal Exposure Assessment: Principles and Applications* (U.S. EPA, 1992c). This document presents experimentally derived values for dermal absorption of PCBs from soil based data for 3,3',4,4'-tetrachlorobiphenyl (TCB). Figure 4-4 provides the dermal absorption curve of TCB as a function of time using the results of the studies presented in the U.S. EPA document. Based on these data, the percent TCB absorbed from soil ranges from 0.63% to 2.1%. For this risk assessment, a value of 1.36% was used for PCBs, which represents the arithmetic average of these values Dermal absorption of DDT was reported in the U.S. EPA document as 1.04% in human skin and 3.3% in rhesus monkeys. A central value of 2% has been assumed for DDT and all other pesticides in this assessment.

Other exposure parameters used in the above equations are presented in Table 4-3.

4.5.3 Inhalation Intake

Intake of COPCs through inhalation was estimated by the following equation:

$$Intake = \frac{C_a \times IH \times ET \times EF \times ED}{BW \times AT}$$

EQ. 13

where:	Intake	=	Intake (mg/kg-dy)
	Ca	=	Modeled chemical concentration in air (mg/m^3)
	IH	=	Inhalation rate (m^3/hr)
	ET	=	Exposure time (hr/dy)
	EF	=	Exposure frequency (dy/yr)
	ED	=	Exposure duration (yr)
	BW	=	Body weight (kg)
	AT	=	Averaging time (dy)

Exposure parameters used to assess inhalation exposures are presented in Table 4-3.

5.0
TOXICITY ASSESSMENT

The objectives of the toxicity assessment are to select the appropriate toxicity values to use in the risk characterization and to develop toxicity profiles that describe the potential toxicity of the COPCs.

Two types of potential toxicity were assessed: carcinogenicity and systemic toxicity (non-carcinogenicity). Toxicity values describing potential carcinogenic effects are termed Slope Factors (SF) (expressed in [mg/kg-dy]$^{-1}$) and toxicity values expressing potential non-carcinogenic effects are termed Reference Doses (RfD, in mg/kg-dy) and Reference Concentrations (RfC, in mg/m^3).[2]

A SF represents an upper bound estimate of the probability that cancer will be incurred as a result of a lifetime exposure to a carcinogenic chemical. SFs are usually derived from animal toxicological testing, but sometimes also use human data, such as epidemiological studies. A weight of evidence category is also assigned to chemicals, describing the likelihood that the chemical is a human carcinogen. Weight of evidence categories are A (known human carcinogen), B (B1 and B2, probable carcinogen, with varying degrees of evidence of human carcinogenicity), C (possible human carcinogen), D (no or insufficient evidence of human carcinogenicity) and E (positive evidence of non-carcinogenicity in humans). Chemicals assigned a weight of evidence category of A, B1, or B2 (and sometimes C) are customarily assessed as carcinogens.

RfDs are conservative intake levels (or concentrations) that are considered protective of human health. RfDs are usually derived from animal toxicological testing, but sometimes also use human data, such as epidemiological studies. An RfD is typically derived by dividing an intake level that does not result in adverse effects (a "no observed adverse effect level" or NOAEL) by uncertainty factors of ten each to account, when appropriate, for (1) use of animal studies, (2)

[2] Reference Concentrations (RfC, mg/m^3) are also non-carcinogenic toxicity values that are used in assessing air chemical concentrations. However, the RfC has certain assumptions regarding exposure that are not necessarily applicable to this site.

variation in human responses, (3) studies of short (subchronic) duration, and (4) use of an intake value associated with a minimal response ("lowest observed adverse effect level" or LOAEL), and a modifying factor of 0-10 to account for other pertinent factors. RfDs are assigned a confidence level of low, medium, and high, reflecting the confidence of the value.

Toxicity values are combined with chemical intake estimates to derive estimates of excess lifetime cancer risks or non-carcinogenic health hazards. The methodology for combining these values is discussed in Section 6.0.

Toxicity values for each COPC are provided in Table 5-1. These toxicity values were obtained from U.S. EPA's on-line Integrated Risk Information System (IRIS). Chemical and physical properties of the COPCs are provided in Table 5-2. Toxicity profiles for the COPCs are included in Appendix H.

The current PCB slope factor, based on Aroclor 1260, is 7.7 mg/kg/day. Recently, the U.S. EPA has completed a re-evaluation of the cancer potency estimates for PCBs and will be revising the current cancer slope factor. The draft U.S. EPA report evaluates several commercial PCB mixtures, rather than employing U.S. EPA's historical practice of basing all PCB risk estimates on data from one commercial mixture. The draft assessment indicates a range of new slopes for different PCB commercial mixtures from 0.3 to 2.0 mg/kg/day. The new cancer potency range is lower than U.S. EPA's current estimate by a factor of about 4 to 25. The draft report is being reviewed by a peer review panel, but has not yet been adopted as U.S. EPA policy. However, if adopted, the reduced slope factor would have a direct effect on the cancer risk estimates calculated for this risk assessment by reducing cancer risks by a factor of about 4 to 25..

6.0
RISK CHARACTERIZATION

This section discusses the general approach to characterizing potential health risks and presents the results of the risk characterization for the receptors assessed. Risk characterization calculations are presented in Appendix E, Appendix F and Appendix G for the basement, first level, and second level of the building, respectively.

Quantitation of potential cancer risks and non-carcinogenic health hazards is performed using equations presented in U.S. EPA (1989a). Quantitation of the potential lifetime incremental, upper bound cancer risk associated with exposure to a specific chemical is derived by multiplying the estimated chemical intake by the chemical's SF:

$$Risk_{(chemical\ i)} = Intake_{(chemical\ i)} \times SF_{(chemical\ i)}$$

EQ. 14

Cancer risks associated with exposure to multiple chemicals within a given exposure pathway are derived by summing the chemical-specific cancer risks:

$$Risk_{(pathway\ j)} = Risk_{(chemical\ 1)} + Risk_{(chemical\ 2)} + Risk_{(chemical\ n)}$$

EQ. 15

Overall cancer risks associated with exposure through multiple exposure pathways are estimated by summing the pathway-specific cancer risk estimates:

$$Overall\ Risk_{(all\ pathways)} = Risk_{(ingestion)} + Risk_{(dermal\ contact)} + Risk_{(inhalation)}$$

EQ. 16

Acceptability of the overall cancer risk is typically gauged by comparing the risk estimate with the risk range of 1×10^{-4} to 1×10^{-6} (risks of one-in-ten thousand to one-in-one-million). This risk

range is the target risk range for remedial decisions under U.S. EPA's Superfund program, and are considered acceptable risks (U.S. EPA, 1990a).

Quantitation of non-carcinogenic health hazards posed by exposure to a specific chemical is performed by dividing the intake estimate by the RfD to derive a value termed a Hazard Quotient (HQ):

$$HQ_{(chemical\ i)} = \frac{Intake_{(chemical\ i)}}{RfD_{(chemical\ i)}}$$

EQ. 17

Non-carcinogenic health hazards associated with exposure to multiple chemicals within a given exposure pathway are derived, as a screening method, by summing the chemical-specific HQs to derive a Hazard Index (HI):

$$HI_{pathway\ j} = HQ_{chemical\ 1} + HQ_{chemical\ 2} + HQ_{chemical\ n}$$

EQ. 18

The overall health hazard potentially posed by exposure through multiple exposure pathways is estimated by summing the individual pathway-specific HIs:

$$HI_{(all\ pathways)} = HI_{(ingestion)} + HI_{(dermal\ contact)} + HI_{(inhalation)}$$

EQ. 19

Acceptability of the overall HI is made by comparing the HI with the benchmark hazard threshold value of 1 (U.S. EPA, 1990a). If the HI does not exceed 1, it indicates that intakes have not exceeded acceptable levels when potential non-carcinogenic health effects are considered additive and are unlikely to pose adverse health effects. If the HI value exceeds 1, there is the potential for adverse health impacts to occur as a result of exposure and it is appropriate to examine whether the assumption of additivity is valid. If the assumption of additivity is not valid because the chemicals affect different organ systems in the body, separate

HIs can be derived for chemicals affecting the same organ system and again be compared to the benchmark of 1. It should be noted that the hazard index approach is not a probabilistic approach as is the cancer risk approach, and as such, there is no range of acceptable HIs as with cancer risk estimates. Because the HI approach does not represent a dose-response relationship, the degree of increased hazard at HIs exceeding 1 is not constant among chemicals. Since RfDs incorporate uncertainty factors and modifying factors typically ranging from 10 to 10,000, HIs slightly over 1 do not usually represent a potential health concern.

7.0
RESULTS AND DISCUSSION

The results of the risk assessment are discussed in this section for the three subareas assessed: the basement, the first level, and the second level. First, the numerical risk and hazard estimates derived by the assessment are presented and compared with U.S. EPA's acceptable risk and hazard levels. Following this presentation, the risk estimates are discussed in light of various relevant factors. Table 7-1 presents a summary of the cancer risks and hazard indices for the exposure pathways assessed in the risk assessment.

The potential health impacts associated with the presence of asbestos in Building No. 3 have not been considered in this risk assessment. The presence and potential impacts of asbestos in the building should be evaluated by a qualified asbestos inspector, and the results integrated with this assessment when making final decisions regarding future management of the building.

7.1 BASEMENT

Exposure of adult workers to interior surfaces in the basement of Building No. 3 was assessed for the inhalation, ingestion, and dermal contact pathways. A reasonable maximum exposure was assumed to occur for 5 days per week, 50 weeks per year, for 25 years, although current day exposure is substantially less than this extent. COPCs for the basement were total PCBs, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, dieldrin, endrin, gamma-BHC, and heptachlor epoxide.

The overall cancer risk posed by exposure to the COPCs is 6×10^{-5}. This risk estimate is within U.S. EPA's acceptable cancer risk range of 10^{-4} to 10^{-6}. This risk level is primarily a result of dermal contact exposure to dieldrin, which was detected in the floor wipe samples only. Inhalation of the COPCs contributed to about one-third of the overall risk estimate, contributed primarily by heptachlor epoxide.

The overall non-carcinogenic hazard index posed by exposure to the COPCs is 0.3. This value is below the threshold comparison value of 1, indicating that exposure to the COPCs should not

is also approximately at a $1x10^{-4}$ risk level (U.S. EPA, 1990b). This indicates that U.S. EPA has accepted risk levels at the upper end of the acceptable risk range for PCBs in several situations.

Efforts were made to identify the level of risk associated with the U.S. EPA's PCB Spill Policy surface cleanup concentration of 10 μg/100 cm^2. Because the original risk basis for its derivation is outdated in some regards and unclear in others, it is not known at what risk level, if any, the concentration was intended to be based .

It is perhaps more important to understand to what risk level the acceptable surface concentration of 10 μg/100 cm^2 translates, using the assumptions of this assessment. From this information, the resultant risk values for the three levels of Building No. 3 can be compared and evaluated. A surface concentration of 10 μg/100 cm^2 was used to assess potential dermal and inhalation exposure under the methodology of this risk assessment; these calculations are contained in Appendix I . According to this methodology, a surface concentration of 10 μg/100 cm^2 is associated with an upper bound cancer risk level of $1x10^{-6}$. Since this value is a function of site-specific parameters such as room size, it is coincidental that this risk level is the "point of departure" for U.S. EPA's risk-based decision-making and at the lower (i.e., more protective) end of the acceptable risk range.

A number of uncertainties are associated with the methodology used to estimate potential health risks. A full understanding of the uncertainties associated with the assessment is necessary to appropriately interpret the risk assessment. Some of the more notable uncertainties are discussed in Section 8.

The human health risk assessment is a reasonable assessment of potential health risks posed by exposure to site-related chemicals. As with all health risk assessments, use of assumptions and the inherent conservative nature of the risk assessment process has produced uncertainties in the resultant health risk and hazard estimates. An exhaustive description of the uncertainties is not provided in this assessment, but the primary sources of uncertainty are discussed below.

8.1 UNCERTAINTIES ASSOCIATED WITH THE DATA

All real-life data contain some uncertainties associated with their collection, representativeness, and use. The primary factors that have contributed uncertainties to this assessment include the following:

- Chemical Analysis

  Total PCBs were analyzed for during the investigation of the first and second levels of Building No. 3. During the investigation of the basement, samples were analyzed for PCBs and pesticides. It is not known whether other chemicals are present in the building that could have an impact upon the risk assessment. Because of the focused chemical analysis, the uncertainty associated with the chemical analysis is moderate.

- Spatial Representativeness of Samples

  Samples were collected from potential source areas or stained areas based on a purposive sampling design, and from unstained areas throughout the building, based on a randomized grid sampling. The presence of PCBs or pesticides do not show a strong general trend. The combination of purposive and randomized grid sampling has probably provided an adequate characterization of chemical presence in the building. One area, the chip chute area, was identified by ATCOM as being of concern with regard to the representativeness of the samples. This issue is discussed in Section 9.0.

- Type of Data

  Surface wipe samples and core samples are not the optimal data for use in a risk assessment since they do not equate well with the exposure pathways. Surface wipes are infused with hexane or other solvent, and are likely to pick up higher concentrations from surfaces that are likely to be absorbed by skin. Core samples provide information on chemical concentrations throughout a depth interval that may not be contacted by skin, and represent a total concentration rather than a portion that may be available for absorption. Use of data from these sampling methods may provide a moderate degree of uncertainty and may result in an over-estimation of risks for dermal exposure.

8.2 UNCERTAINTIES ASSOCIATED WITH THE EXPOSURE ASSESSMENT

The exposure assessment applies numerous assumptions or estimation techniques (e.g., modeling) to describe the magnitude and nature of exposure. Primary uncertainties associated with the exposure assessment include the following:

- Assumed potentially exposed receptors

  The receptors selected for assessment are reasonable given the current and anticipated future use of the area. The assumptions made in the assessment provide a low degree of uncertainty based on the current land use.

- Selected exposure pathways and extent of exposure

  Given the receptors assessed, the exposure pathways are reasonable pathways through which exposure may occur. The exposure pathways selected are judged to provide a low degree of uncertainty to the assessment.

  Assumptions were made regarding the degree to which exposure occurs. There is no generally accepted methodology for assessing dermal contact with concrete or other building interiors, so a method was developed based on (but not identical to) the approach used to derive the acceptable surface PCB concentration in the PCB Spill Cleanup Policy. Use of this method contributes a moderate degree of uncertainty to the assessment.

- Calculation of exposure point concentrations

  Exposure point concentrations for direct exposure to site media were based on the lower of the 95% upper confidence limit of the mean or the maximum detected concentration. Using this approach is consistent with U.S. EPA guidance, but provides a conservative estimate of exposure point concentrations that may overestimate risks. The uncertainty associated with this approach is moderate. The uncertainty on the exposure point concentration provided by use of the volatilization modeling is discussed separately.

- Use of the volatilization model

  Exposure point concentrations for both the inhalation exposure (based on what volatilized) and dermal exposure (based on what did not volatilize) were derived by use of a volatilization model. The model used in this evaluation is designed to be used to estimate emissions from soil. The model was used to predict the average emission rate of chemical from the materials to the air over the 25 year exposure period, which was then input into the air model. The volatilization model was also used to predict the average concentration of the remaining chemical in the concrete, which was used to assess dermal exposures.

  There are no commonly accepted models in use to estimate emissions from porous concrete surfaces or non-porous interior structures, such as steel beams. In the risk assessment, all surfaces were assumed to be concrete, since this medium constitutes the largest surface area in the building interior. Three parameters that were input to the model were assumed values: porosity and density of the interior surfaces or soil and the fraction of organic carbon. The remaining input parameters were chemical/physical properties or defined values (such as exposure period). Use of the soil model for this purpose has provided a moderate to high degree of uncertainty to the prediction of exposure point concentrations.

  In general, volatilization models of the kind used in the risk assessment are conservative, i.e., are likely to predict a higher degree of volatilization than what might actually occur. Use of the model may have resulted in an over-estimate of potential air exposure point concentrations and an under-estimate of the remaining surface concentrations. To compensate for the latter non-conservatism, an inefficiency factor of 10 was used in the estimation of remaining chemicals on surfaces (i.e., volatilization was assumed to occur at a rate one-

tenth of that estimated by the volatilization model). Air sampling conducted in Building No. 3 (8 samples from various locations throughout the building) did not identify the presence of PCBs at detectable concentrations with quantitation limits ranging from 0.7 to 0.8 $\mu g/m^3$.

- Use of the air model

  Simple air modeling was used to estimate the indoor air concentrations resulting from emission of PCBs and pesticides. The air model assumed a "room" area and volume (which was based on the building site plan), and an air exchange rate (based on a U.S. EPA recommendation). It should be noted that the basement is currently sealed up, and does not currently have the degree of ventilation assumed in the modeling. The assumption was made that, if the basement were to be used in the future, some ventilation (passive or active) would exist.

- Exposure Factors

  The exposure factors used to describe the magnitude and duration of exposure were, for the most part, based on U.S. EPA standard default exposure factors for workers (U.S. EPA, 1991). These default exposure factors are conservative and describe a reasonable maximum exposure. For dermal contact with interior surfaces, an approach was developed to be consistent with the approach used to derive the U.S. EPA's PCB Spill Cleanup Policy. Whether this approach, or the approach used by U.S. EPA, appropriately describes the extent of dermal contact of interior surfaces by workers is not unknown, and may have underestimated or overestimate potential health risks.

8.3 UNCERTAINTIES ASSOCIATED WITH THE TOXICITY ASSESSMENT

The toxicity values applied in this risk assessment were derived by U.S. EPA, and are accepted values for use in regulatory risk assessments in environmental programs. The methodology by which toxicity values are derived is intentionally conservative. Use of the toxicity values has likely resulted in an overestimate of potential health risks. EPA's recent reassessment of the PCB slope factor suggests that an alternate PCB slope factor ranging from 0.3 to 2 $(mg/kg\text{-}dy)^{-1}$ may be supportable. Use of this alternate slope factor is associated with a decrease in the PCB

cancer risk estimate derived in this assessment by a factor of between about 4 to 25, further highlighting the conservatism of the current toxicity value.

8.4 UNCERTAINTIES ASSOCIATED WITH THE RISK CHARACTERIZATION

The risk characterization procedures applied in the assessment were obtained from U.S. EPA guidance and are the accepted procedures for use in regulatory risk assessments in environmental programs. These procedures are conservative and have generally result in an overestimate of potential health risks.

CHIP CHUT

The chip chute area in Building No. 3 is a small area on the northern side of the building that previously housed a chute in which "chips" of materials were disposed. The chute extended from the first level to the basement. Higher concentrations of PCBs were expected in this area because of the manner in which the area was used. The adequacy of the number and locations of samples collected in this area was examined to evaluate whether the extent of PCB presence has been adequately characterized.

The following are samples that were collected from the vicinity of the chip chute area:

Location	Sample Number and Type	PCB concentration
Basement	SLAP-7 (horizontal beam wipe)	92.23 µg/100 cm^2
	SLAP-34 (chip chute wipe)	0.5 U µg/100 cm^2
	SLAP-35 (chip chute wipe)	0.5 U µg/100 cm^2
	SLAP-36 (chip chute wipe)	0.5 U µg/100 cm^2
First Floor	P4W009 (wall core)	730 mg/kg
	P4C003 (vertical wipe)	4 µg/100 cm^2
	P41B17-1A/B/C (ceiling wipes)	1U - 2.1 µg/100 cm^2

U = Undetected at quantitation limit presented

The sample representativeness is limited with respect to sample location and type. Except for SLAP-34, SLAP-35, SLAP-36, these samples are located on the periphery of the chute, several feet out into the main room. The basement has one ceiling (horizontal beam) and three vertical (assuming that the "chip chute" samples are vertical samples) samples, but does not have any floor samples. The first level has 2 vertical and 1 ceiling sample, but no floor samples.

The PCB concentrations detected in this area range from not detected in the chip chute samples to a high concentrations of 730 mg/kg in a wall core on the first floor. Two of the available samples exceeded U.S. EPA Spill Cleanup Policy cleanup levels: the aforementioned wall core

(when compared with the *soil* cleanup level of 10 mg/kg) and a horizontal beam wipe in the basement (exceeding the surface standard of 10 μg/100 cm^2).

Due to the high concentrations detected in two samples, the wide variation in concentrations detected, and the lack of floor samples on either level, the representativeness of the data to characterize the chip chute area is low. Additional wipe samples in the area of the chip chute would improve characterization of the area.

10.0
SUMMARY AND CONCLUSIONS

Exposure of adult workers to interior surfaces and basement soil of Building No. 3 was assessed for the inhalation, ingestion, and dermal contact pathways. A reasonable maximum exposure was assumed to occur, based on 5 days per week, 50 weeks per year, for 25 years. The COPCs assessed in the risk assessment included total PCBs on all levels and the pesticides 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, dieldrin, endrin, gamma-BHC, and heptachlor epoxide in the basement.

Results of the risk assessment for the three subareas assessed, the basement, the first level, and the second level, were discussed in Section 7.0. Based on the results and assumptions of this assessment, the following conclusions were made:

- The overall non-carcinogenic hazard indices posed by exposures to the COPCs in the basement, the first level, and the second level are all below the threshold value of 1, indicating that exposures to the COPCs are at acceptable levels.

- The overall cancer risks posed by exposures to the COPCs in the basement, the first level, and the second level are all at or within the U.S. EPA's acceptable cancer risk range of 10^{-4} to 10^{-6}, indicating that exposures to the COPCs are at acceptable levels.

Cancer risks for the first and second levels were primarily driven by inhalation of PCBs, air concentrations for which were derived by modeling. Limited air sampling conducted at representative locations throughout the building did not detected measurable levels of PCBs in air. In addition, proposed revisions to the cancer slope factor for PCBs suggests that the current slope factor used in this assessment over-predicts cancer risks by 4 to 25 times. Therefore, PCB risk estimates in this assessment are likely to have been over-estimated as well.

Many of the surface wipe samples and core samples collected from the building exceeded the U.S. EPA PCB Spill Cleanup Policy standards for non-restricted access areas, namely,

10 μg/100 cm^2 for surface wipe samples and 10 mg/kg for soils (applied to evaluate concrete core samples). An evaluation was made of these standards. The wipe sample standard, developed in 1986, is based on outdated factors and is somewhat arbitrary. The risk level to which this standard was intended to correspond is not clear from its documentation. When using the methodology developed in this risk assessment, the standard of 10 μg/100 cm^2 corresponds to a risk level of 10^{-6}. The soil standard of 10 mg/kg is associated with a risk level of about 10^{-4}. Many of the regulatory levels or guidance values set for PCBs by the U.S. EPA have adopted higher-than-baseline risk levels (i.e., higher than 10^{-6}). Based on this precedence, the risk levels calculated in the risk assessment (10^{-5} to 10^{-4}) are typical of acceptable risk levels previously adopted for PCBs.

The sample representativeness in the chip chute area was examined and was judged to be low because 1) not all surface types were sampled, 2) the PCB concentrations ranged widely, and 3) PCB concentrations substantially higher than the comparison standards were detected in two samples. Additional sampling of surfaces around the chip chute area could improve the understanding of the PCB levels in this area.

Asbestos is known to be present in portions of Building No. 3. No asbestos data or inspection reports were available. Therefore, this risk assessment did not examine the potential health impacts associated with the presence of asbestos. It is recommended that a qualified asbestos inspector examine the presence and condition of the asbestos, and that the results of the inspection be considered along with the results of this risk assessment in developing long-term management decisions regarding Building No. 3.

Based on these results, risks posed to workers having regular, long term exposure to the first level under the assumptions of this assessment are at acceptable levels.

11.0
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TABLES

TABLE 4-1
SUMMARY OF PARAMETERS USED IN THE VOLATILIZATION MODEL

PARAMETER	VALUE	REFERENCE/RATIONALE
Henry's Law Constant (H)	Chemical-specific	See Table 5-2
Soil/water partition coefficient (Kd)	Chemical-specific	Calculated value (Section 4, Equation 3)
Organic carbon water partition coefficient (Koc)	Chemical-specific	See Table 5-2
Chemical concentration in bulk soil, concrete, or other surface (C_s)	Chemical-specific	Estimated from the measured concentration, derived as "mass remaining" from the volatilization model, or estimated from wipe concentration (Section 4, Equation 4).
Chemical concentration in air (C_a)	Chemical-specific	Calculated value (Section 4, Equation 6)
Fraction of organic carbon in material (foc)	0.001 g/g (concrete) 0.006 g/g (soil)	Assumed value. Default value (U.S. EPA, 1994)
Diffusion coefficient in air (D_i)	Chemical-specific	See Table 5-2.
Depth of contamination in the material (d)	1 cm (for converting surface to bulk) 0.5 cm (for converting bulk to surface)	Assumed values. Because of the aggressiveness of the solvent-based wipe sampling technique, it was assumed that wipes could remove chemicals from 1 cm in depth, although all of that may not realistically be available for dermal contact/volatilization. Bulk samples represent a chemical concentration throughout the thickness of the core sample. It was assumed that only chemicals contained in the top 0.5 cm were available for volatilization/direct contact. Bulk samples were expressed as surface concentrations in two instances only: PCB concentrations in the floor of the first and second levels.
Porosity of material (E)	0.1 (concrete) 0.2 (soil)	Default total porosity value for building foundation material used in RESRAD (DOE, 1993). Total soil porosity is assumed value, corresponding to fine sands.
Bulk density of material (ρ)	2.4 g/cm^3	Default bulk density value for building foundation material used in RESRAD (DOE, 1993).

TABLE 4-1(Continued)
SUMMARY OF PARAMETERS USED IN THE VOLATILIZATION MODEL

PARAMETER	VALUE	REFERENCE
Air exchange rate in room (t_e)	4.3 air changes per hour (0.233 days)	Recommended value (U.S. EPA, 1986).
Emission Flux (Na)	Chemical-specific	Calculated value (Section 4, Equations 1 and 5)
Effective Diffusivity (Dei)	Chemical-specific	Calculated value (Section 4, Equation 1)
Surface Area of assumed work area (SA)	Ceiling (all level) 1.35×10^8 cm^2 Walls (basement) 1.47×10^7 cm^2 Walls (1st & 2nd level) 2.58×10^7 cm^2 Floor (basement) 2.70×10^7 cm^2 Soil Floor (basement) 1.08×10^8 cm^2 Floor (1st & 2nd level) 1.38×10^8 cm^2	Based on site plan. 80% of the basement floor is soil. Ceiling height on the 1st and 2nd levels assumed to be 14 feet; ceiling height in the basement assumed to be 8 feet.
Time for sampling or exposure period (t)	25 yr (7.88×10^8 sec) or 1 yr (3.15×10^7 sec)	Worker exposure period of 25 yr; One year increments were used in evaluating "mass lost."
Particle density of medium (Ps)	Soil 2.65 g/cm^3 Concrete 2.4 g/cm^3	Soil value is default value for soils (U.S. EPA, 1994). Value for concrete is assumed to be equivalent to bulk density.
Dispersivity factor (α)	Calculated value	Section 4, Equation 2
Volume of assumed work area (V)	Basement: 3.29×10^{10} cm^3 1st & 2nd levels: 5.8×10^{10} cm^3	Based on site plan of whole building. Ceiling heights assumed: 14 feet (1st and 2nd level); 8 feet (basement)

References

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TABLE 4-2
SUMMARY OF EXPOSURE POINT CONCENTRATIONS

Location	Chemical	Exposure Point Concentrations									
		Floor Surfaces (mg/cm^2)		Vertical Surfaces (mg/cm^2)		Ceiling Surfaces (mg/cm^2)		Soil (mg/kg)		Air (mg/m^3)	
Basement	PCB	0.941	[1]	0.237	[1]	1.51	[1]	-		4.6×10^{-5}	[4]
	4,4'-DDD	0.393	[1]	1.99	[1]	0.432	[1]	6.611	[3]	1.25×10^{-5}	[4]
	4,4'-DDE	-		-		0.00107	[1]	-		1.92×10^{-9}	[4]
	4,4'-DDT	0.966	[1]	0.614	[1]	0.33	[1]	0.648	[3]	3.18×10^{-5}	[4]
	Dieldrin	0.0047	[1]	-		-		-		2.00×10^{-7}	[4]
	Endrin	0.216	[1]	-		-		1.188	[3]	2.09×10^{-6}	[4]
	gamma-BHC	0.077	[1]	0.041	[1]	0.039	[1]	0.486	[3]	2.68×10^{-5}	[4]
	Heptachlor epoxide	0.393	[1]	0.055	[1]	0.0004	[1]	-		4.72×10^{-5}	[4]
First Level	PCB	8.43	[2]	0.011	[1]	0.063	[1]	-		4.01×10^{-4}	[4]
Second Level	PCB	3.11	[2]	0.00817	[1]	0.0431	[1]	-		1.45×10^{-5}	[4]

[1] Exposure point concentration derived from maximum detected/95% upper confidence limit of measured wipe data. Average concentration over 25 years estimated considering loss due to volatilization.

[2] Exposure point concentrationon surfaces estimated from maximum detected/95% upper confidence limit of measured core data, assuming chemical contained only in top 0.5 cm is available for contact/volatilization and a surface density of 2.4 g/cm^3. Average concentration over 25 years estimated considering loss due to volatilization.

[3] Exposure point concentration derived from maximum detected/95% upper confidence limit of measured bulk soil data. Average concentration over 25 years considering loss was not derived; values represent measured maximum/95% upper confidence limit.

[4] Exposure point concentrations derived from the sum of emissions from all surfaces, using the average emission rate over 25 years and estimated or measured maximum detected/95% upper confidence limit mass/mass concentrations as an input. Wipe data (in mass/area) were converted to a corresponding mass/mass form.

"-" = Not Detected

TABLE 4-3
EXPOSURE PARAMETERS

EXPOSURE PARAMETER	VALUE	REFERENCE/RATIONALE
Wipe/Core/Soil chemical concentration (Cw) (Ce)(Cs)	Chemical-specific	Lower of either the 95% upper confidence limit on the mean or the maximum value measured or estimated from site data. See Table 4-2.
Air chemical concentration (Ca)	Chemical-specific	Estimated from the appropriate wipe or core exposure point concentration using volatilization models. See Table 4-2.
Surface area of assumed work area (SA)	Ceiling (all levels) 1.35×10^8 cm^2 Walls (basement): 1.47×10^7 cm^2 Walls (1st & 2nd levels) 2.58×10^7 cm^2 Floor (basement): 2.70×10^7 cm^2 Soil Floor: (basement): 1.08×10^8 cm^2 Floor (1st & 2nd levels): 1.35×10^8 cm^2	Estimated from site plan. According to ATCOM, soil floor is approximately 80% of total area in the basement. A 14 foot ceiling is assumed on the 1st and 2nd levels; an 8 foot ceiling is assumed in the basement.
Exposed skin surface area (SA)	2,000 cm^2/event	Corresponds to exposure of hands and forearms (U.S.EPA, 1989)
Dermal chemical absorption (AB)	PCBs 1.36% Beta-BHC 2% 4,4-DDD 2% 4,4-DDT 2% Dieldrin 2% Endrin 2% Gamma-BHC 2% Heptachlor Epoxide 2%	Based on information presented in U.S. EPA, 1992. Refer to discussion in Section 4.5.2.
Soil Ingestion Rate (IR)	50 mg/dy	Default value for worker receptors (U.S. EPA, 1991)
Inhalation rate (IH)	0.83 m^3/hr	Value equivalent to 20 m^3/hr, USEPA's default inhalation rate for adults (U.S. EPA, 1991).
Fraction Ingested that is contaminated (FI)	1 (unitless)	Default value (U.S EPA, 1991). Assumes all soil ingested contains COPCs.
Adherence Factor (AF)	1 mg/cm^2	Default high end value (U.S EPA, 1991).
Exposure Time for inhalation exposure (ET)	8 hr/dy	Assumed 8 hour work day.

TABLE 4-3 (Continued)
EXPOSURE PARAMETERS

EXPOSURE PARAMETER	VALUE		REFERENCE/RATIONALE
Contact Rate for dermal contact with surfaces (CR)	Floors: Vertical surfaces: Ceiling:	0.05% 0.1% 0.05%	Assumed value based on U.S. EPA PCB Spill Cleanup Memo (1986). See discussion in Section 4.5.2. Floors /Ceiling: Low contact surfaces; Vertical Surfaces: High Contact Surfaces
Exposure Frequency (EF)	250 dy/yr		Default value for worker receptors (U.S. EPA, 1991).
Exposure Duration (ED)	25 yr		Default value for worker receptors (U.S. EPA, 1991).
Body weight (BW)	70 kg		Default body weight for adults (U.S. EPA, 1991).
Averaging time (AT)	Carcinogens: Noncarcinogens:	25,550 dy 9,125 dy	Conventional averaging times. AT = 365 dy/yr x 70 yr for carcinogens; and 365 dy/yr x ED (i.e., 25 yr) for non-carcinogens.

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TABLE 5-1
SUMMARY OF TOXICITY VALUES FOR
CHEMICALS OF POTENTIAL CONCERN[1]

Chemical	Weight-of-Evidence Category	Oral Slope Factor $(mg/kg\text{-}dy)^{-1}$	Chronic Oral Reference Dose (mg/kg-dy)	Uncertainty/ Modifying Factor	Level of Confidence
PCBs	B2	7.7	-	-	-
4,4'-DDD	B2	0.24	-	-	-
4,4'-DDE	-	-	-	-	-
4,4'-DDT	B2	0.34	5E-4	100/1	Medium
Dieldrin	B2	16	5E-5	100/1	Medium
Endrin	-	-	3E-4	100/1	Medium
Gamma-BCH	-	-	3E-4	1000/1	Medium
Heptachlor Epoxide	B2	9.1	1.3E-5	1000/1	Low

1. Values obtained from U.S. EPA's Integrated Risk Information System (IRIS), accessed 11/14/95 and 12/20/95.

TABLE 5-2
SELECT CHEMICAL AND PHYSICAL PROPERTIES FOR CHEMICALS OF POTENTIAL CONCERN

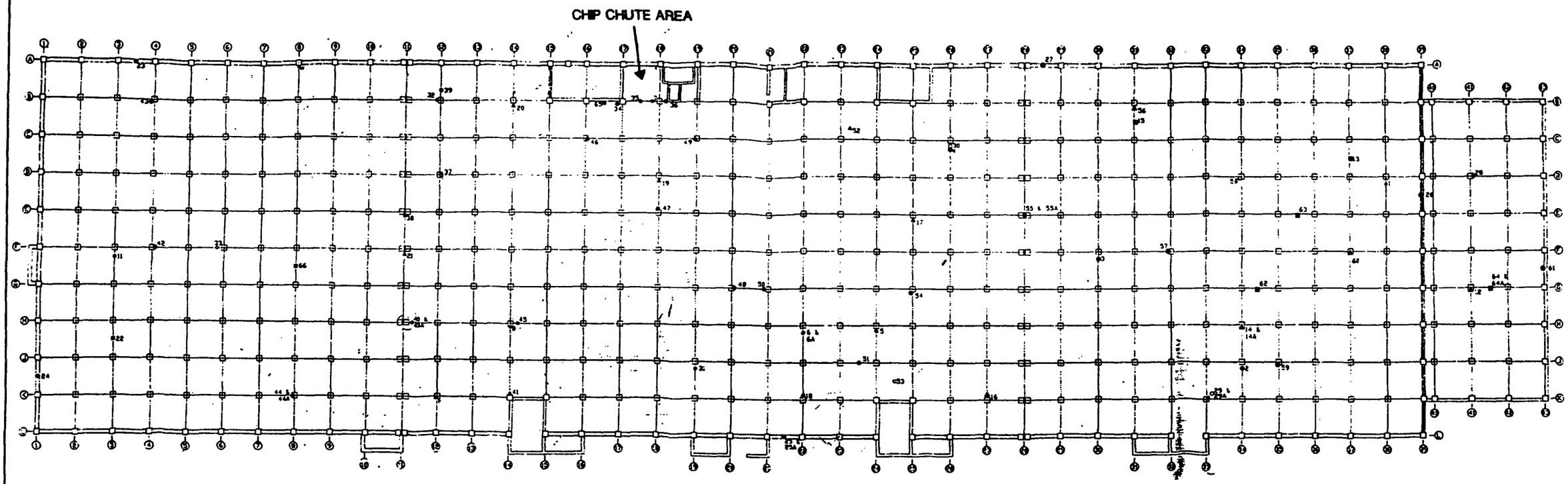
Chemical	Diffusion Coefficient in Air (cm^2/s)	Henry's Law Constant ($atm\text{-}m^3/mole$)	Henry's Law Constant (unitless)	Carbon/Water Partition Coefficient (g/g)	Log Octanol/Water Partition Coefficient (cm^3/g)
PCBs	0.0175 [1]	8.64E-04	3.53E-02 [1]	5.30E+05 [4]	6.04 [4]
gamma-BHC	0.0142 [1]	7.80E-06	3.19E-04 [1]	1.08E+03 [4]	3.9 [4]
4,4'-DDD	0.014 [2]	7.96E-06	3.26E-04 [4]	7.70E+05 [4]	6.2 [4]
4,4'-DDE	0.0144 [1]	6.80E-05	2.78E-03 [1]	4.40E+06 [4]	7 [4]
4,4'-DDT	0.0137 [1]	5.13E-04	2.10E-02 [4]	2.43E+05 [4]	6.19 [4]
Dieldrin	0.0125 [1]	5.84E-05	2.39E-03 [1]	1.70E+03 [4]	3.5 [4]
Endrin	0.0125 [1]	4.00E-07	1.64E-05 [1]	3.40E+04 [5]	4.56 [5]
Heptachlor Epoxide	0.0112 [1,3]	4.39E-04	1.80E-02 [4]	2.20E+02 [4]	2.7 [4]

[1] USEPA (1994). ChemDat8 User's Guide. EPA-453/C-94-080B. November.
[2] Based on values for DDE and DDT.
[3] Value for Heptachlor
[4] USEPA (1986a). Exhibit A-1, Superfund Public Health Evaluation Manual. EPA/540/1-86/060.
[5] Howard (1991). Handbook of Environmental Fate and Exposure Data for Organic Chemicals. Volume 3: Pesticides

TABLE 7-1
SUMMARY OF EXCESS LIFETIME CANCER RISKS
AND NON-CARCINOGENIC HAZARD INDICES
ALL LEVELS

LOCATION	EXPOSURE PATHWAY	EXCESS CANCER RISK	PRIMARY CHEMICAL	HAZARD INDEX	PRIMARY CHEMICAL
Basement	Dermal Contact with Interior Surfaces	$4x10^{-5}$	Dieldrin	0.04	Heptachlor Epoxide
	Dermal Contact with Soil	$3x10^{-7}$	4,4'DDD	0.003	Endrin
	Inhalation	$2x10^{-5}$	Heptachlor Epoxide	0.2	Heptachlor Epoxide
	Soil Ingestion	$3x10^{-7}$	4,4'DDD	0.003	Endrin
	All Pathways	**$6x10^{-5}$**	**Dieldrin**	**0.3**	**Heptachlor Epoxide**
First Level	Dermal Contact with Interior Surfaces	$3x10^{-5}$	PCB	-	-
	Inhalation	$7x10^{-5}$	PCB	-	-
	All Pathways	**$1x10^{-4}$**	**PCB**	-	-
Second Level	Dermal Contact with Interior Surfaces	$1x10^{-5}$	PCB	-	-
	Inhalation	$3x10^{-5}$	PCB	-	-
	All Pathways	**$4x10^{-5}$**	**PCB**	-	-

FIGURES



LEGEND

- ■ SOIL (FLOOR)
- ▲ FLOOR WIPE
- ● HORIZONTAL BEAM
- ⬢ VERTICAL WIPE
- ○ CEILING

SOURCE: DAMES & MOORE, INC. ST. LOUIS, MO.

NOT TO SCALE

Woodward-Clyde Consultants
ENGINEERS, GEOLOGISTS, AND ENVIRONMENTAL SCIENTISTS

BUILDING NO. 3
BASEMENT SAMPLING LOCATIONS
ST. LOUIS ARMY AMMUNITION PLANT
ST. LOUIS, MO.

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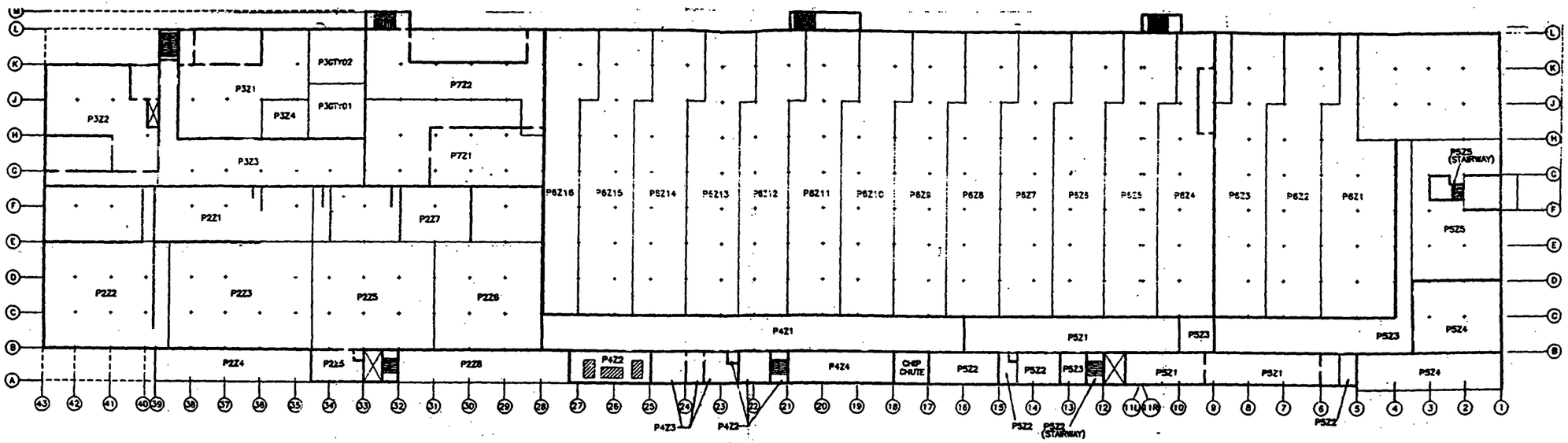

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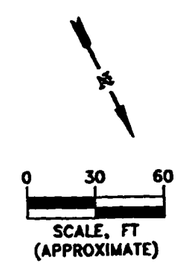

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ENGINEERS, GEOLOGISTS, AND ENVIRONMENTAL SCIENTISTS

FLOOR SAMPLE LOCATIONS
FIRST FLOOR
ST. LOUIS ARMY AMMUNITION PLANT
ST. LOUIS, MO.

DESIGN:	LAT	SCALE:	SHOWN	PROJECT NO. 5E03549	FIG. NO. 1-2
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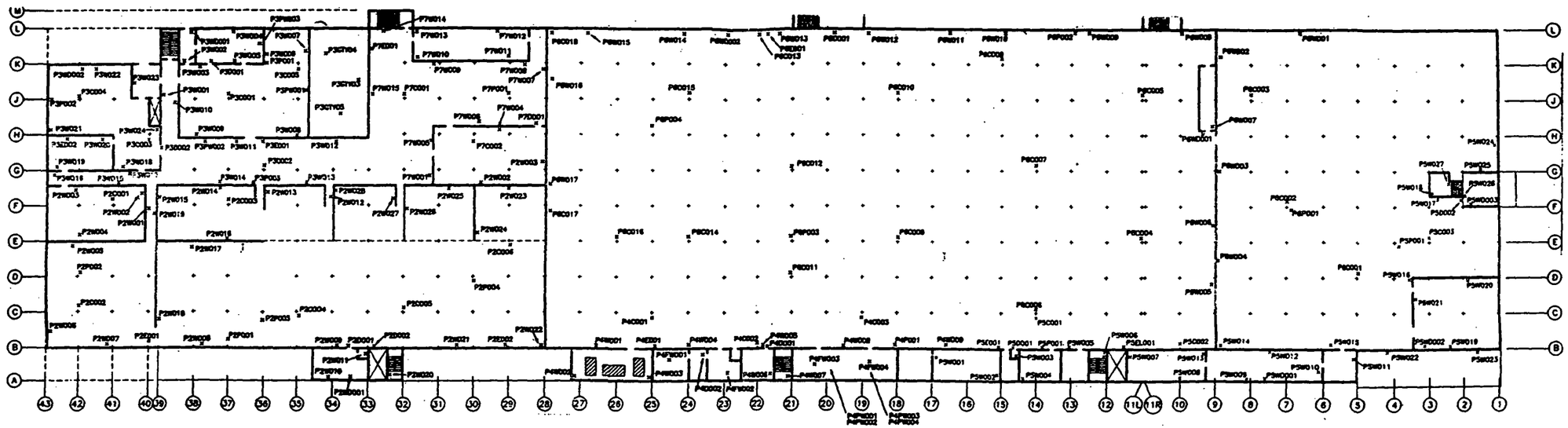

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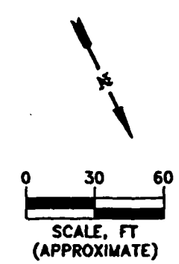

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VERTICAL SAMPLE LOCATIONS
FIRST FLOOR
ST. LOUIS ARMY AMMUNITION PLANT
ST. LOUIS, MO.

DESIGN: LAT	SCALE: SHOWN	PROJECT NO.	FIG. NO.
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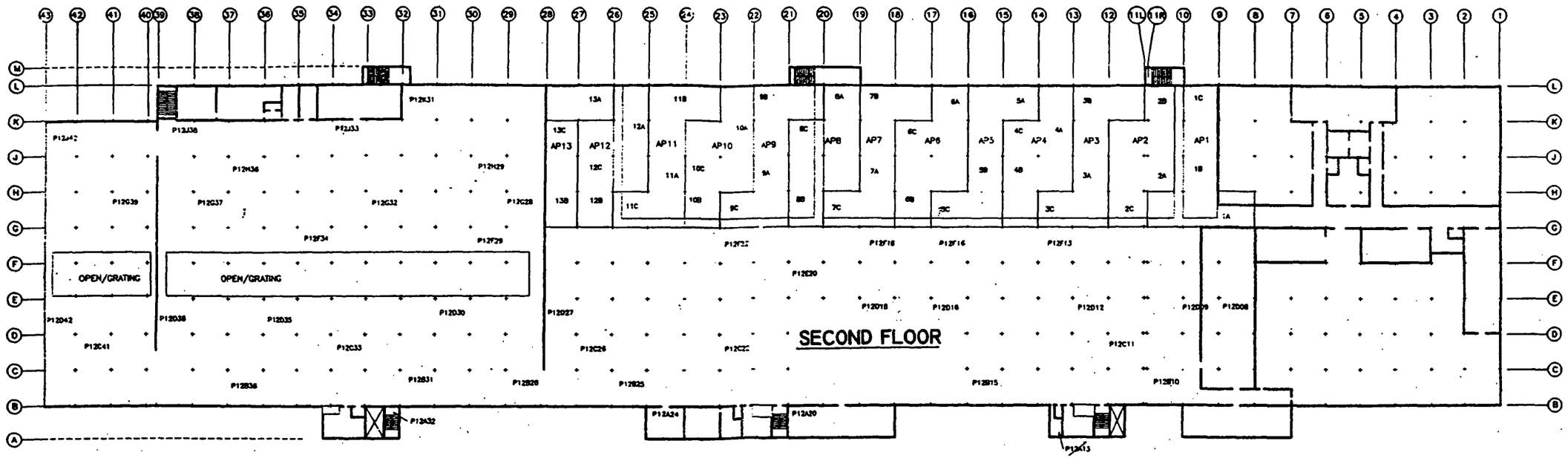

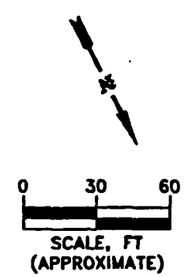

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CEILING SAMPLE LOCATIONS
SECOND FLOOR
ST. LOUIS ARMY AMMUNITION PLANT
ST. LOUIS, MO.

DESIGN: LAT	SCALE: SHOWN	PROJECT NO.	FIG. NO.
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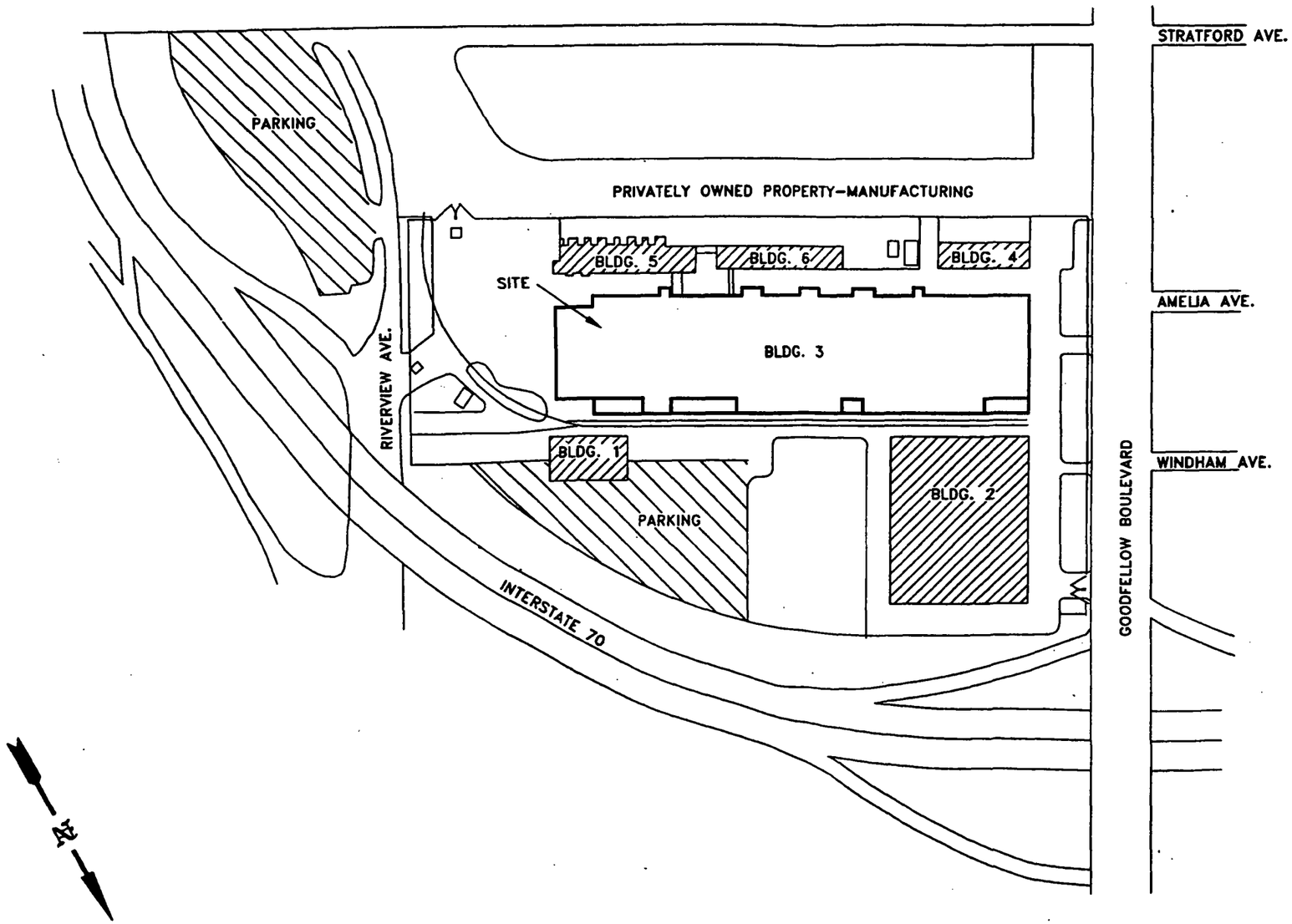

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SITE SETTING
ST. LOUIS ARMY AMMUNITION PLANT
ST. LOUIS, MO

DESIGN: LAT	CHK'D CLF	PROJECT NO.	FIG. NO
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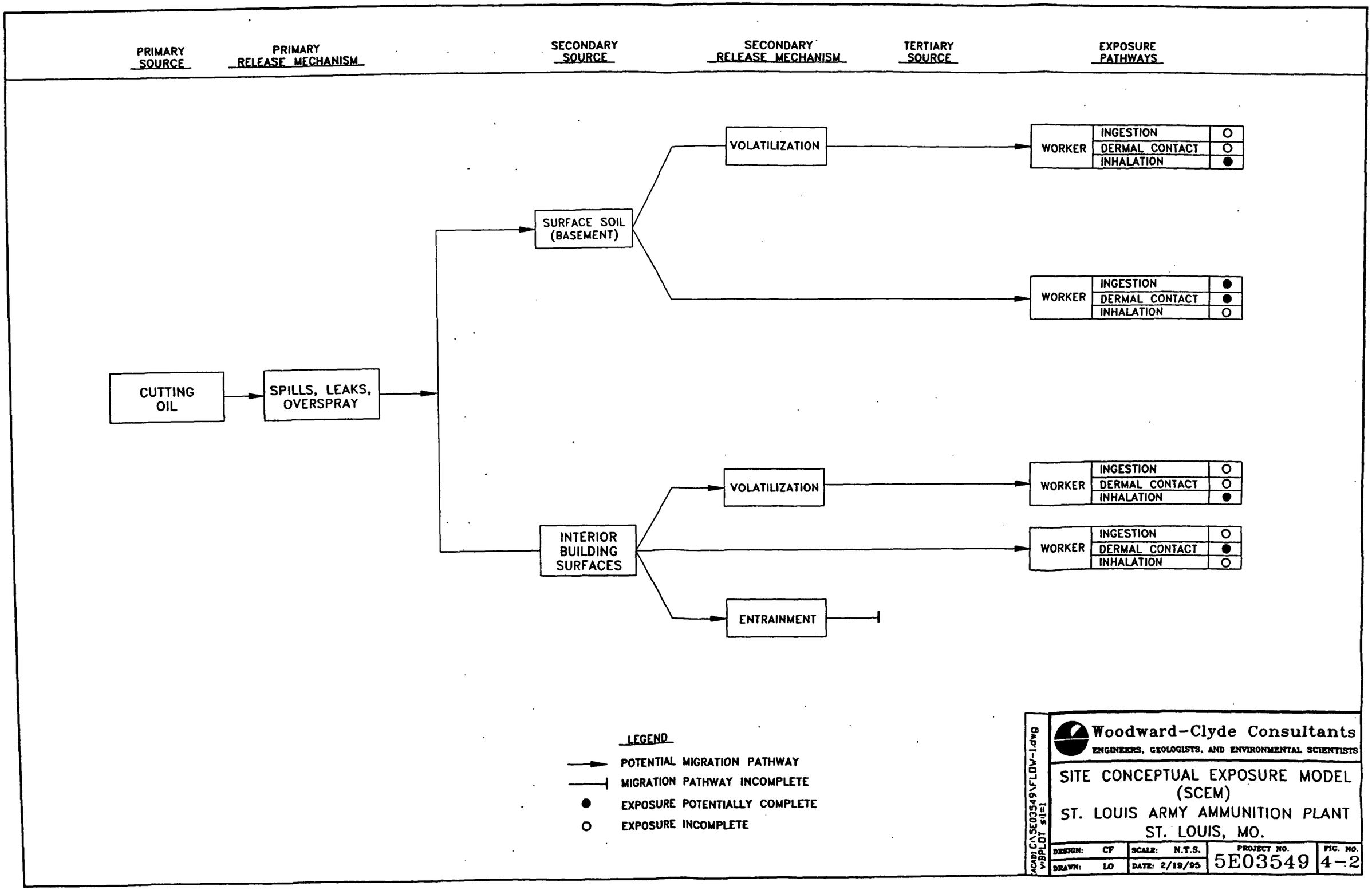
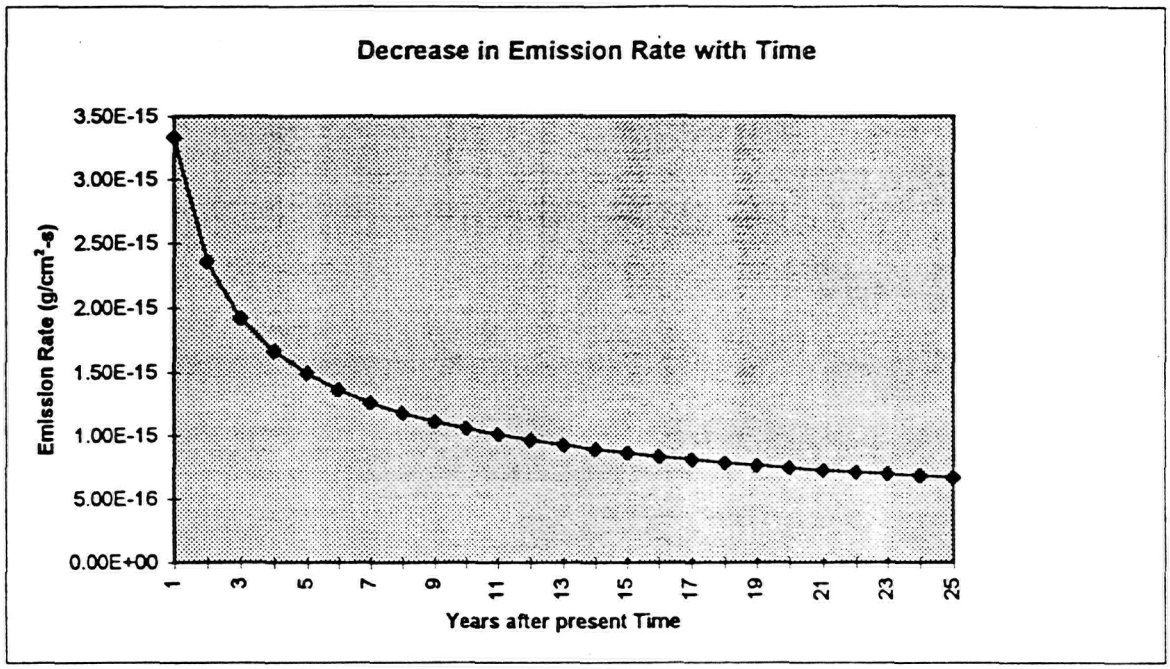
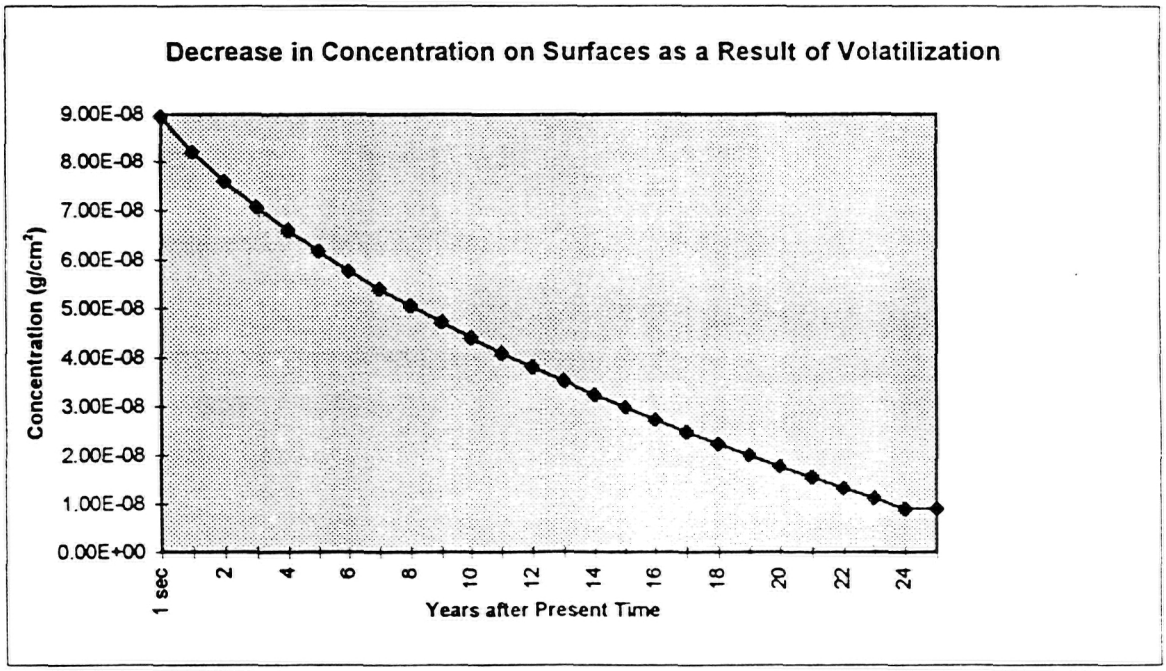

PRIMARY SOURCE
PRIMARY RELEASE MECHANISM
SECONDARY SOURCE
SECONDARY RELEASE MECHANISM
TERTIARY SOURCE
EXPOSURE PATHWAYS
CUTTING OIL
SPILLS, LEAKS, OVERSPRAY
SURFACE SOIL (BASEMENT)
VOLATILIZATION
WORKER
INGESTION O
DERMAL CONTACT O
INHALATION ●
WORKER
INGESTION ●
DERMAL CONTACT ●
INHALATION O
INTERIOR BUILDING SURFACES
VOLATILIZATION
WORKER
INGESTION O
DERMAL CONTACT O
INHALATION ●
WORKER
INGESTION O
DERMAL CONTACT ●
INHALATION O
ENTRAINMENT
LEGEND
POTENTIAL MIGRATION PATHWAY
MIGRATION PATHWAY INCOMPLETE
● EXPOSURE POTENTIALLY COMPLETE
O EXPOSURE INCOMPLETE
Woodward-Clyde Consultants
ENGINEERS, GEOLOGISTS, AND ENVIRONMENTAL SCIENTISTS
SITE CONCEPTUAL EXPOSURE MODEL (SCEM)
ST. LOUIS ARMY AMMUNITION PLANT
ST. LOUIS, MO.
DESIGN: CF
DRAWN: LO
SCALE: N.T.S.
DATE: 2/19/95
PROJECT NO. 5E03549
FIG. NO. 4-2

FIGURE 4-3
Hwang and Falco Volatilization Model
Loss Curve for PCBs at a Starting Concentration of 10 ug/100cm^2





BUILDING No.3
BASEMENT LEVEL
Floor Wipe Samples

Sample Number	Sample Description	Units	4,4'-DDD	4,4'-DDT	Aroclor-1260	Dieldrin	Endrin	Gamma-BHC	Heptachlor Epoxide
SLAP-12	Random wipe	µg/100 cm²	7.29	1.54	0.500 U	0.020 U	0.020 U	0.740	0.010 U
SLAP-14	Random wipe	µg/100 cm²	26.4	130.5	0.500 U	0.020 U	0.020 U	0.250	0.010 U
SLAP-16	Random wipe	µg/100 cm²	26.9	54.5	0.500 U	0.020 U	0.020 U	1.19	0.010 U
SLAP-17	Random wipe	µg/100 cm²	10.6	13.0	0.500 U	0.020 U	0.020 U	0.310	0.010 U
SLAP-18	Random wipe	µg/100 cm²	68.19	90.94	0.500 U	0.020 U	0.020 U	2.768	0.010 U
SLAP-19	Random wipe	µg/100 cm²	13.1	18.1	20.0	0.020 U	0.020 U	1.02	0.010 U
SLAP-20	Random wipe	µg/100 cm²	14.6	9.19	5.30	0.020 U	0.020 U	0.420	0.010 U
SLAP-21	Random wipe	µg/100 cm²	14.0	6.80	0.500 U	0.020 U	0.020 U	0.010 U	0.010 U
SLAP-44	Biased Wipe	µg/100 cm²	55.0	19.2	88.8	21.1	27.8	1.67	39.3
SLAP-41	Biased Wipe	µg/100 cm²	11.3	1.97	19.4	0.020 U	0.020 U	4.88	0.670
SLAP-46	Biased Wipe	µg/100 cm²	29.6	16.3	45.4	0.020 U	0.020 U	15.1	1.11
SLAP-49	Biased Wipe	µg/100 cm²	50.8	79.2	126.8	0.020 U	0.020 U	4.21	14.5
SLAP-52	Biased Wipe	µg/100 cm²	31.7	26.8	0.500 U	0.020 U	0.020 U	1.80	0.010 U
SLAP-56	Biased Wipe	µg/100 cm²	23.2	0.010 U	17.6	0.020 U	0.020 U	0.010 U	0.010 U
SLAP-60	Biased Wipe	µg/100 cm²	16.6	3.70	0.500 U	0.020 U	0.020 U	1.50	0.010 U
Frequency of Detection			15/15	14/15	7/15	1/15	1/15	13/15	4/15
Minimum Detected Concentration (µg/100 cm²)			7.29	1.54	5.30	21.1	27.8	0.25	0.67
Maximum Detected Concentration (µg/100 cm²)			68.19	130.5	126.8	21.1	27.8	15.1	39.3
Maximum Detected Concentration (µg/cm²)			0.6819	**1.305**	**1.268**	0.211	0.278	**0.151**	**0.393**
Number of Samples			15	15	15	15	15	15	15
Lognormal Statistical Distribution									
Mean of ln value			-1.526	-2.372	-3.768	-8.700	-8.682	-4.996	-8.087
Standard Deviation of ln value			0.656	2.474	2.560	1.976	2.048	2.264	3.248
H			2.242	5.557	6.061	4.564	5.027	5.557	7.082
95%UCL - Log normal Dist. (µg/cm²)			**0.400**	78.410	38.750	**0.013**	**0.022**	2.534	28.113
Exposure Point Concentration (µg/cm²)			0.4	1.305	1.268	0.013	0.022	0.151	0.393

U = Undetected at the quantitation limit indicated; assumed to be present at 1/2 the quantitation limit for calculations.
Exposure point concentration is lower of either maximum detected concentration or 95% upper confidence limit (UCL)

BUILDING No. 3
BASEMENT LEVEL
Vertical Wipe Samples

Sample Number	Sample Descriptio	Units	4,4'-DDD	4,4'-DDT	Aroclor-1260	Beta-BHC	Endrin Aldehyde	Gamma-BHC	Heptachlor-Epoxide
SLAP-23	Random wipe	µg/100 cm^2	8.94	5.22	0.500 U	0.040 U	0.700 U	0.360	0.010 U
SLAP-24	Random wipe	µg/100 cm^2	0.040 U	0.010 U	0.500 U	0.040 U	0.700 U	0.010 U	0.010 U
SLAP-25	Random wipe	µg/100 cm^2	3.988	5.629	0.500 U	0.040 U	0.700 U	0.2536	0.010 U
SLAP-26	Random wipe	µg/100 cm^2	3.405	4.363	0.500 U	0.040 U	0.700 U	0.010 U	0.010 U
SLAP-27	Random wipe	µg/100 cm^2	1.373	11.722	0.500 U	0.040 U	0.700 U	0.010 U	0.010 U
SLAP-34	Chip chute wipe	µg/100 cm^2	15.8	6.24	0.500 U	0.040 U	2.87	0.010 U	5.50
SLAP-35	Chip chute wipe	µg/100 cm^2	22.4	7.54	0.500 U	0.040 U	0.700 U	1.05	3.53
SLAP-36	Chip chute wipe	µg/100 cm^2	27.9	10.6	0.500 U	0.040 U	0.700 U	3.64	3.00
SLAP-38	Biased wipe	µg/100 cm^2	4.29	0.670	0.500 U	0.040 U	0.700 U	0.980	0.090 U
SLAP-39	Biased wipe	µg/100 cm^2	8.25	12.7	4.73	0.040 U	0.700 U	5.55	0.010 U
SLAP-42	Biased wipe	µg/100 cm^2	11.3	1.97	19.4	0.040 U	0.700 U	4.88	0.670
SLAP-43	Biased wipe	µg/100 cm^2	0.960	0.520	0.500 U	0.040 U	0.700 U	0.150	0.010 U
SLAP-47	Biased wipe	µg/100 cm^2	44.0	21.4	82.4	0.040 U	0.700 U	8.01	0.010 U
SLAP-48	Biased wipe	µg/100 cm^2	13.95	1.0167	1.790	0.040 U	0.700 U	0.8269	0.010 U
SLAP-50	Biased wipe	µg/100 cm^2	3.35	2.75	0.500 U	0.850	0.700 U	0.010 U	0.010 U
SLAP-51	Biased wipe	µg/100 cm^2	13.3	3.86	0.500 U	0.860	0.700 U	0.010 U	0.010 U
SLAP-54	Biased wipe	µg/100 cm^2	27.9	7.14	55.3	0.040 U	0.700 U	5.86	0.010 U
SLAP-57	Biased wipe	µg/100 cm^2	14.7	6.40	0.500 U	0.040 U	0.700 U	1.40	0.010 U
SLAP-59	Biased wipe	µg/100 cm^2	202.3	82.9	0.500 U	0.040 U	0.700 U	2.16	0.010 U
SLAP-61	Biased wipe	µg/100 cm^2	0.740	0.077	0.500 U	0.040 U	0.700 U	0.010 U	0.010 U
Frequency of Detection			19/20	19/20	5/20	2/20	1/20	13/20	4/20
Minimum Detected Concentration (µg/100cm^2)			0.740	0.077	1.790	0.850	2.87	0.150	0.670
Maximum Detected Concentration (µg/100cm^2)			202.3	82.9	82.4	0.860	2.87	8.01	5.50
Maximum Detected Concentration (µg/cm^2)			**2.023**	**0.829**	0.824	0.0086	0.0287	**0.0801**	**0.055**
Number of Samples			20	20	20	20	20	20	20
Loognormal Statistical Distribution									
Mean of ln value			-2.725	-3.530	-4.969	-8.142	-5.550	-6.205	-8.551
Standard Deviation of ln value			1.916	2.115	1.964	1.156	0.470	2.966	2.567
H			4.210	4.625	4.210	2.962	2.002	6.015	5.556
95%UCL - Log normal Dist. (µg/cm^2)			2.617	2.592	**0.319**	**0.0012**	**0.005**	9.850	0.138
Exposure Point Concentration (µg/cm^2)			2.023	0.829	0.319	0.0012	0.005	0.0801	0.055

U = Undetected at the quantitation limit indicated; assumed to be present at 1/2 the quantation limit for calculations.
Vertical surfaces include walls and columns.
Exposure point concentration is lower of either maximum detected concentration or 95% upper confidence limit (UCL)

BUILDING No. 3
BASEMENT LEVEL
Ceiling Wipe Samples

Sample Numbe	Sample Description	Units	4,4'-DDD	4,4'-DDE	4,4'-DDT	Aroclor-1260	Gamma-BHC	Heptachlor Epoxide	Methoxychlor
SLAP 28	Random ceiling wipe	µg/100 cm²	0.068	0.013 U	0.099	0.500 U	0.010 U	0.010 U	0.100 U
SLAP-29	Random ceiling wipe	µg/100 cm²	0.259	0.013 U	0.2513	0.500 U	0.010 U	0.010 U	0.100 U
SLAP-30	Random ceiling wipe	µg/100 cm²	0.359	0.013 U	0.5423	0.500 U	0.010 U	0.010 U	0.100 U
SLAP-31	Random ceiling wipe	µg/100 cm²	2.456	0.013 U	2.936	0.500 U	0.010 U	0.010 U	0.100 U
SLAP-32	Random ceiling wipe	µg/100 cm²	0.363	0.013 U	0.6813	0.500 U	0.010 U	0.010 U	0.100 U
SLAP-33	Random ceiling wipe	µg/100 cm²	0.04 U	0.013 U	0.010 U	0.500 U	0.010 U	0.010 U	0.100 U
SLAP-37	Biased ceiling wipe	µg/100 cm²	0.9	0.013 U	0.610	0.500 U	0.160	0.033	0.100 U
SLAP-53	Biased ceiling wipe	µg/100 cm²	23.2	0.013 U	0.010 U	17.6	0.010 U	0.010 U	0.100 U
SLAP-58	Biased ceiling wipe	µg/100 cm²	9.54	0.013 U	3.64	0.500 U	0.190	0.010 U	0.100 U
SLAP-1	Random horizontal beam wipe	µg/100 cm²	3.919	0.013 U	4.8178	0.500 U	0.010 U	0.010 U	0.100 U
SLAP-2	Random horizontal beam wipe	µg/100 cm²	7.256	0.013 U	8.015	0.500 U	0.010 U	0.010 U	0.100 U
SLAP-3	Random horizontal beam wipe	µg/100 cm²	1.898	0.013 U	3.027	0.500 U	0.010 U	0.010 U	0.100 U
SLAP-4	Random horizontal beam wipe	µg/100 cm²	5.113	0.013 U	7.965	0.500 U	0.010 U	0.010 U	0.100 U
SLAP-5	Random horizontal beam wipe	µg/100 cm²	37.049	0.013 U	44.58	0.500 U	0.5902	0.010 U	0.6726
SLAP-6	Random horizontal beam wipe	µg/100 cm²	44.022	0.013 U	41.28	209.93	3.316	0.010 U	0.100 U
SLAP-7	Random horizontal beam wipe	µg/100 cm²	0.04 U	14.966	29.813	92.230	0.4739	0.010 U	0.100 U
SLAP-8	Random horizontal beam wipe	µg/100 cm²	12.681	0.013 U	21.842	37.89	0.3755	0.010 U	0.100 U
SLAP-9	Random horizontal beam wipe	µg/100 cm²	4.521	0.013 U	4.372	0.500 U	0.3472	0.010 U	0.100 U
SLAP-0	Random horizontal beam wipe	µg/100 cm²	4.523	0.013 U	5.282	0.500 U	0.3297	0.010 U	0.100 U
SLAP-1	Random horizontal beam wipe	µg/100 cm²	0.37	0.013 U	0.4049	0.500 U	0.010 U	0.010 U	0.100 U
SLAP-40	Biased horizontal beam wipe	µg/100 cm²	13.6	0.013 U	1.51	10.6	5.49	2.21	0.100 U
SLAP-45	Biased horizontal beam wipe	µg/100 cm²	50.4	0.013 U	19.2	58.2	7.62	0.010 U	0.100 U
SLAP-55	Biased horizontal beam wipe	µg/100 cm²	11.7	0.013 U	13.8	0.500 U	1.39	0.010 U	0.100 U
Frequency of Detection			21/23	1/23	21/23	6/23	11/23	2/23	1/23
Minimum Detected Concentration (µg/100 cm²)			0.068	14.966	0.099	10.6	0.160	0.033	0.6726
Maximum Detected Concentration (µg/100 cm²)			44.022	14.966	44.58	209.93	7.62	2.21	0.6726
Maximum Detected Concentration (µg/cm²)			0.44	0.1497	0.446	2.099	0.076	0.022	0.007
Number of Samples			23	23	23	23	23	23	23
Lognormal Statistical Distribution									
Mean of ln value			-3.785	-9.305	-3.925	-4.639	-7.485	-9.557	-7.488
Standard Deviation of ln value			2.321	1.614	2.518	2.386	2.738	1.312	0.542
H			4.920	3.456	4.920	4.920	5.355	3.088	2.021
95%UCL - Log normal Dist. (µg/cm²)			3.832	0.0011	6.607	2.034	0.544	0.0004	0.0008
Exposure Point Concentration (µg/cm²)			0.44	0.0011	0.446	2.034	0.076	0.0004	0.007

U = Undetected at the quantitation limit indicated; assumed to be present at 1/2 the quantation limit for calculations.
Exposure point concentration is lower of either maximum detected concentration or 95% upper confidence limit (UCL)

BUILDING NO. 3
BASEMENT LEVEL
Soil Samples (Floor)

Sample Number	Sample Description	Units	4,4'-DDD	4,4'-DDT	Endrin	Gamma-BHC
SLAP-22	Soil	mg/kg	0.040 U	0.010 U	0.020 U	0.010 U
SLAP-15	Soil	mg/kg	0.1108	0.1985	0.020 U	0.010 U
SLAP-13	Soil	mg/kg	0.040 U	0.0467	0.020 U	0.010 U
SLAP-62	Soil	mg/kg	4.00 U	1.00 U	2.00 U	1.00 U
SLAP-63	Soil	mg/kg	6.611	1.00 U	2.00 U	1.00 U
SLAP-64	Soil	mg/kg	0.040 U	0.010 U	0.020 U	0.010 U
SLAP-65	Soil	mg/kg	0.916	0.648	0.200 U	0.376
SLAP-66	Soil	mg/kg	1.537	0.602	1.188	0.486
Frequency of Detection			4/8	4/8	1/8	2/8
Minimum Detected concentration			0.1108	0.0467	1.188	0.376
Maximum Detected Concentration			6.611	0.648	1.188	0.486
Number of Samples			8	8	8	8
Lognormal Statistical Distribution						
Mean of ln value			-1.377	-2.201	-2.569	-3.035
Standard Deviation of ln value			2.385	2.098	2.311	2.421
H			7.616	6.850	7.616	7.616
95%UCL - Log normal Distribution (mg/kg)			4,169.5	228.58	855.2	959.840
Exposure Point Concentration (mg/kg)			**6.611**	**0.648**	**1.188**	**0.486**

U = Undetected at the quantitation limit indicated; assumed to be present at 1/2 the quantation limit for calculations.
Exposure point concentration is lower of either maximum detected concentration or 95% upper confidence limit (UCL)

APPENDIX B
ANALYTICAL DATA FOR BUILDING NO. 3
FIRST LEVEL

BUILDING NO. 3
FIRST LEVEL
FLOOR CORE DATA

Sample Number	Analyte	Units	Sample Type	Results
P2Z1A-012893	PCB	mg/kg	Core	2 U
P2Z1B-012893	PCB	mg/kg	Core	2 U
P2Z1C012893	PCB	mg/kg	Core	2 U
P2Z2A-012893	PCB	mg/kg	Core	2 U
P2Z2B-012893	PCB	mg/kg	Core	2 U
P2Z2C-012893	PCB	mg/kg	Core	2 U
P2Z3A-012893	PCB	mg/kg	Core	2 U
P2Z3B-012893	PCB	mg/kg	Core	2 U
P2Z3C-012893	PCB	mg/kg	Core	2 U
P2Z4A-081893	PCB	mg/kg	Core	4
P2Z4B-081893	PCB	mg/kg	Core	4
P2Z4C-081893	PCB	mg/kg	Core	3
P2Z5A-062894	PCB	mg/kg	Core	2 U
P2Z5B-062894	PCB	mg/kg	Core	2 U
P2Z5C-062894	PCB	mg/kg	Core	2 U
P2Z6A-062894	PCB	mg/kg	Core	2 U
P2Z6B-062894	PCB	mg/kg	Core	2 U
P2Z6C-062894	PCB	mg/kg	Core	2 U
P2Z7A-062894	PCB	mg/kg	Core	2 U
P2Z7B-062894	PCB	mg/kg	Core	2 U
P2Z7C-062894	PCB	mg/kg	Core	3
P2Z8A-062894	PCB	mg/kg	Core	2 U
P2Z8B-062894	PCB	mg/kg	Core	2 U
P2Z8C-062894	PCB	mg/kg	Core	2 U
P3GTY01-120392	PCB	mg/kg	Core	2
P3GTY02-120392	PCB	mg/kg	Core	2 U
P4Z1A-110992	PCB	mg/kg	Core	49
P4Z1B-110992	PCB	mg/kg	Core	41
P4Z1C-110992	PCB	mg/kg	Core	8
P4Z2A-110992	PCB	mg/kg	Core	23
P4Z2B-110992	PCB	mg/kg	Core	60
P4Z2C-110992	PCB	mg/kg	Core	10
P4Z3A-121792	PCB	mg/kg	Core	2 U
P4Z3B-121792	PCB	mg/kg	Core	5
P4Z3C-121792	PCB	mg/kg	Core	2 U
P4Z4A-121792	PCB	mg/kg	Core	13
P4Z4B-121792	PCB	mg/kg	Core	12
P4Z4C-121792	PCB	mg/kg	Core	14
P5Z1A-111092	PCB	mg/kg	Core	2 U
P5Z1B-111092	PCB	mg/kg	Core	2 U
P5Z1C-111092	PCB	mg/kg	Core	2 U
P5Z2A-111092	PCB	mg/kg	Core	4
P5Z2B-111092	PCB	mg/kg	Core	9
P5Z2C-111092	PCB	mg/kg	Core	2 U
P5Z03A-060193	PCB	mg/kg	Core	2
P5Z03B-060193	PCB	mg/kg	Core	8
P5Z03C-060193	PCB	mg/kg	Core	3
P5Z04A-060193	PCB	mg/kg	Core	2
P5Z04B-060193	PCB	mg/kg	Core	2 U
P3Z04C-060193	PCB	mg/kg	Core	2
P5Z05A-062493	PCB	mg/kg	Core	2 U
P5Z05B-062493	PCB	mg/kg	Core	2 U
P5Z05C-062493	PCB	mg/kg	Core	2 U
P6Z01A-052693	PCB	mg/kg	Core	2 U
P6Z01B052693	PCB	mg/kg	Core	2 U
P6Z01C-052693	PCB	mg/kg	Core	2 U

BUILDING NO. 3
FIRST LEVEL
FLOOR CORE DATA

Sample Number	Analyte	Units	Sample Type	Results
P6Z02A-052693	PCB	mg/kg	Core	2 U
P6Z02B-052693	PCB	mg/kg	Core	2 U
P6Z02C-052693	PCB	mg/kg	Core	2 U
P6Z03A-052693	PCB	mg/kg	Core	2 U
P6Z03B-052693	PCB	mg/kg	Core	2 U
P6Z03C-052693	PCB	mg/kg	Core	2 U
P6Z4A-081893	PCB	mg/kg	Core	10
P6Z4B-081893	PCB	mg/kg	Core	18
P6Z4C-081893	PCB	mg/kg	Core	17
P6Z5A-081893	PCB	mg/kg	Core	19
P6Z5B-081893	PCB	mg/kg	Core	25
P6Z5C-081893	PCB	mg/kg	Core	23
P6Z6A-081893	PCB	mg/kg	Core	21
P6Z6B-081893	PCB	mg/kg	Core	21
P6Z6C-081893	PCB	mg/kg	Core	14
P6Z7A-081893	PCB	mg/kg	Core	19
P6Z7B-081893	PCB	mg/kg	Core	28
P6Z7C-081893	PCB	mg/kg	Core	26
P6Z8A-081893	PCB	mg/kg	Core	52
P6Z8B-081893	PCB	mg/kg	Core	51
P6Z8C-081893	PCB	mg/kg	Core	30
P6Z9A-081893	PCB	mg/kg	Core	14
P6Z9B-081893	PCB	mg/kg	Core	25
P6Z9C-081893	PCB	mg/kg	Core	34
P6Z10A-081893	PCB	mg/kg	Core	4
P6Z10B-081893	PCB	mg/kg	Core	13
P6Z10C-081893	PCB	mg/kg	Core	2 U
P6Z11A-081893	PCB	mg/kg	Core	2 U
P6Z11B-081893	PCB	mg/kg	Core	2 U
P6Z11C-081893	PCB	mg/kg	Core	2 U
P6Z12A-081893	PCB	mg/kg	Core	2 U
P6Z12B-081893	PCB	mg/kg	Core	2 U
P6Z12C-081893	PCB	mg/kg	Core	4
P6Z13A-081893	PCB	mg/kg	Core	17
P6Z13B-081893	PCB	mg/kg	Core	30
P6Z13C-081893	PCB	mg/kg	Core	23
P6Z14A-081893	PCB	mg/kg	Core	18
P6Z14B-081893	PCB	mg/kg	Core	16
P6Z14C-081893	PCB	mg/kg	Core	15
P6Z15A-081893	PCB	mg/kg	Core	2 U
P6Z15B-081893	PCB	mg/kg	Core	2 U
P6Z15C-081893	PCB	mg/kg	Core	4
P6Z16A-081893	PCB	mg/kg	Core	2 U
P6Z16B-081893	PCB	mg/kg	Core	2 U
P6Z16C-081893	PCB	mg/kg	Core	2 U
P7Z1A-100793	PCB	mg/kg	Core	26
P7Z1B-100793	PCB	mg/kg	Core	39
P7Z1C-100793	PCB	mg/kg	Core	33
P7Z2A-100793	PCB	mg/kg	Core	2 U
P7Z2B-100793	PCB	mg/kg	Core	2 U
P7Z2C-100793	PCB	mg/kg	Core	2 U
Frequency of Detection				53/107
Minimum Concentration Detected				2
Maximum Concentration Detected				60
Number of Samples				107
Lognormal Statistical Distribution				
Arithmetic Mean				9.6
Mean of ln values				1.25
Standard Deviation of ln values				1.441
H(95)				2.713
95%UCL - Lognormal Distribution				14.5
Exposure Point Concentration (mg/kg)				**14.5**

U = Undetected at quantitation limit presented;
assumed to be present at 1/2 the quantitation limit for calculation
Exposure point concentration is lower of maximum detected concentration or 95% upper confidence limit (UCL).

BUILDING NO. 3
FIRST LEVEL
FLOOR CORE DATA

Sample Number	Analyte	Units	Sample Type	Results
P3Z1A-062294	PCB	mg/kg	Core	6
P3Z1B-062294	PCB	mg/kg	Core	23
P3Z1C-062294	PCB	mg/kg	Core	9
P3Z1I01-120192	PCB	mg/kg	Core	2
P3Z1I02-120492	PCB	mg/kg	Core	2 U
P3Z1I03-120492	PCB	mg/kg	Core	2 U
P3Z1I04-120492	PCB	mg/kg	Core	2 U
P3Z1I05-120492	PCB	mg/kg	Core	2 U
P3Z1I06-120492	PCB	mg/kg	Core	16
P3Z1I07-120492	PCB	mg/kg	Core	493
P3Z1I08-120492	PCB	mg/kg	Core	8
P3Z1I09-120492	PCB	mg/kg	Core	7
P3Z1S15-041394	PCB	mg/kg	Core	6
P3Z1S16-041394	PCB	mg/kg	Core	6
P3Z1S21-060794	PCB	mg/kg	Core	6
P3Z1S22-041394	PCB	mg/kg	Core	10
P3Z1S27-060794	PCB	mg/kg	Core	7
P3Z1S28-060794	PCB	mg/kg	Core	34
P3Z4A-062294	PCB	mg/kg	Core	8
P3Z4B-062294	PCB	mg/kg	Core	7
P3Z4C-062294	PCB	mg/kg	Core	436

The above samples from P3Z1 and P3Z4 were previously reported but have since been remediated.

BUILDING NO. 3
FIRST LEVEL
VERTICAL SURFACE WIPE DATA

	Analyte	Units	Sample Type	Result
P2C001-012693	PCB	µg/100cm²	Swab/Wipe	2 U
P2C002-012693	PCB	µg/100cm²	Swab/Wipe	2 U
P2C003-012693	PCB	µg/100cm²	Swab/Wipe	2 U
P2C004-012693	PCB	µg/100cm²	Swab/Wipe	2 U
P2C005-063094	PCB	µg/100cm²	Swab/Wipe	1 U
P2C006-063094	PCB	µg/100cm²	Swab/Wipe	1 U
P2D001-012693	PCB	µg/100cm²	Swab/Wipe	2 U
P2D002-063094	PCB	µg/100cm²	Swab/Wipe	1 U
P2E001-012693	PCB	µg/100cm²	Swab/Wipe	2 U
P2WD001-012693	PCB	µg/100cm²	Swab/Wipe	2 U
P2E002-063094	PCB	µg/100cm²	Swab/Wipe	1 U
P3C002-091792	PCB	µg/100cm²	Swab/Wipe	2 U
P3C003-091792	PCB	µg/100cm²	Swab/Wipe	2 U
P3C004-091792	PCB	µg/100cm²	Swab/Wipe	2 U
P3D002-091792	PCB	µg/100cm²	Swab/Wipe	2 U
P3E001-091792	PCB	µg/100cm²	Swab/Wipe	2 U
P3E002-091792	PCB	µg/100cm²	Swab/Wipe	2 U
P3PW002-102192	PCB	µg/100cm²	Swab/Wipe	2 U
P3WD002-091792	PCB	µg/100cm²	Swab/Wipe	2 U
P4C001-110992	PCB	µg/100cm²	Swab/Wipe	2 U
P4C002110992	PCB	µg/100cm²	Swab/Wipe	2 U
P4C003-110992	PCB	µg/100cm²	Swab/Wipe	4
P4D001110992	PCB	µg/100cm²	Swab/Wipe	2 U
P4D002-011892	PCB	µg/100cm²	Swab/Wipe	2 U
P4E001-110992	PCB	µg/100cm²	Swab/Wipe	2 U
P4PW001-011892	PCB	µg/100cm²	Swab/Wipe	2 U
P4PW002-011892	PCB	µg/100cm²	Swab/Wipe	2 U
P4PW003-011892	PCB	µg/100cm²	Swab/Wipe	2 U
P4PW004-011892	PCB	µg/100cm²	Swab/Wipe	2 U
P5C001-111092	PCB	µg/100cm²	Swab/Wipe	2 U
P5C002-111092	PCB	µg/100cm²	Swab/Wipe	2 U
P5D001-111092	PCB	µg/100cm²	Swab/Wipe	2 U
P5E001-111092	PCB	µg/100cm²	Swab/Wipe	2 U
P5EL001-111092	PCB	µg/100cm²	Swab/Wipe	2 U
P5WD001111092	PCB	µg/100cm²	Swab/Wipe	2 U
P5WD002-081893	PCB	µg/100cm²	Swab/Wipe	2 U
P5WD003-062493	PCB	µg/100cm²	Swab/Wipe	2 U
P6C001-052493	PCB	µg/100cm²	Swab/Wipe	2 U
P6C002052493	PCB	µg/100cm²	Swab/Wipe	2 U
P6C003-052493	PCB	µg/100cm²	Swab/Wipe	2 U
P6C004-081693	PCB	µg/100cm²	Swab/Wipe	2 U
P6C005-081693	PCB	µg/100cm²	Swab/Wipe	2 U
P6C006-081693	PCB	µg/100cm²	Swab/Wipe	2 U
P6C007-081693	PCB	µg/100cm²	Swab/Wipe	2 U
P6C008-081693	PCB	µg/100cm²	Swab/Wipe	2 U
P6C009-081693	PCB	µg/100cm²	Swab/Wipe	2 U
P6C010-081693	PCB	µg/100cm²	Swab/Wipe	2 U
P6C011-081693	PCB	µg/100cm²	Swab/Wipe	2 U
P6C012-081693	PCB	µg/100cm²	Swab/Wipe	2 U
P6C013-081693	PCB	µg/100cm²	Swab/Wipe	2 U
P6C014-081693	PCB	µg/100cm²	Swab/Wipe	2 U
P6C015-081693	PCB	µg/100cm²	Swab/Wipe	2
P6C016-081693	PCB	µg/100cm²	Swab/Wipe	2 U

BUILDING NO. 3
FIRST LEVEL
VERTICAL SURFACE WIPE DATA

	Analyte	Units	Sample Type	Result
P6C017-081693	PCB	µg/100cm²	Swab/Wipe	2 U
P6C018-081693	PCB	µg/100cm²	Swab/Wipe	2 U
P6D001-081693	PCB	µg/100cm²	Swab/Wipe	2 U
P6E001-081693	PCB	µg/100cm²	Swab/Wipe	2 U
P6WD001-081693	PCB	µg/100cm²	Swab/Wipe	2 U
P6WD002-081693	PCB	µg/100cm²	Swab/Wipe	2
P7C001-100793	PCB	µg/100cm²	Swab/Wipe	2 U
P7C002-100793	PCB	µg/100cm²	Swab/Wipe	2 U
P7D001-100793	PCB	µg/100cm²	Swab/Wipe	2 U
P7E001-100793	PCB	µg/100cm²	Swab/Wipe	2 U

Frequency of Detection	3/63
Minimum Detected Concentration (µg/100 cm²)	2
Maximum Detected Concentration (µg/100 cm²)	4
Maximum Detected Concentration (µg/cm²)	0.04
Number of samples	63
Lognormal Statistical Distribution	
Arithmetic Mean	1.05
Mean of ln values	0.00E+00
Standard Deviation of ln values	0.278
H(.95)	1.761
95%UCL - Lognormal Distribution (µg/100 cm²)	1.106
95%UCL - Lognormal Distribution (µg/cm²)	0.011

Samples previously reported from locations that have since been remediated.

P3C001-073092	PCB	µg/100cm²	Swab/Wipe	2 U
P3C005-091792	PCB	µg/100cm²	Swab/Wipe	2 U
P3D001-073092	PCB	µg/100cm²	Swab/Wipe	2 U
P3PW003-102192	PCB	µg/100cm²	Swab/Wipe	2 U
P3WD001-073092	PCB	µg/100cm²	Swab/Wipe	2 U
P3PW001-102192	PCB	µg/100cm²	Swab/Wipe	2 U

U = Undetected at quantitation limit presented; assumed to be present at one-half the quantitation limit for calculations.
Exposure point concentration is lower of maximum detected concentration or 95% upper confidence limit (UCL).

BUILDING NO. 3
FIRST LEVEL
WALL CORE SAMPLES

Sample number	Analyte	Units	Sample Type	Result
P2W001-012693	PCB	mg/kg	Wall core	2 U
P2W002-012693	PCB	mg/kg	Wall core	2 U
P2W003-012693	PCB	mg/kg	Wall core	2 U
P2W004-012693	PCB	mg/kg	Wall core	2 U
P2W005-012693	PCB	mg/kg	Wall core	2 U
P2W006-012693	PCB	mg/kg	Wall core	2 U
P2W007-012693	PCB	mg/kg	Wall core	2 U
P2W008-012693	PCB	mg/kg	Wall core	2 U
P2W009-012693	PCB	mg/kg	Wall core	2 U
P2W010-012693	PCB	mg/kg	Wall core	2 U
P2W011-012693	PCB	mg/kg	Wall core	2 U
P2W012-012693	PCB	mg/kg	Wall core	2 U
P2W013-012693	PCB	mg/kg	Wall core	2 U
P2W014-012693	PCB	mg/kg	Wall core	2 U
P2W015-012693	PCB	mg/kg	Wall core	2 U
P2W016-012693	PCB	mg/kg	Wall core	2 U
P2W017-012693	PCB	mg/kg	Wall core	2 U
P2W018-012693	PCB	mg/kg	Wall core	2 U
P2W019-012693	PCB	mg/kg	Wall core	2 U
P2W020-062894	PCB	mg/kg	Wall core	2 U
P2W021-062894	PCB	mg/kg	Wall core	2 U
P2W022-062894	PCB	mg/kg	Wall core	2 U
P2W023-062894	PCB	mg/kg	Wall core	2 U
P2W024-062894	PCB	mg/kg	Wall core	2 U
P2W025-062894	PCB	mg/kg	Wall core	2 U
P2W026-062894	PCB	mg/kg	Wall core	2 U
P2W027-062894	PCB	mg/kg	Wall core	2 U
P2W028-062894	PCB	mg/kg	Wall core	2 U
P3W001-100892	PCB	mg/kg	Wall core	2 U
P3W010-100892	PCB	mg/kg	Wall core	2 U
P3W011-091792	PCB	mg/kg	Wall core	2 U
P3W012-091792	PCB	mg/kg	Wall core	2 U
P3W013-091792	PCB	mg/kg	Wall core	2 U
P3W014-091792	PCB	mg/kg	Wall core	2 U
P3W015-091792	PCB	mg/kg	Wall core	2 U
P3W016-091792	PCB	mg/kg	Wall core	2 U
P3W017-091792	PCB	mg/kg	Wall core	2 U
P3W018-091792	PCB	mg/kg	Wall core	2 U
P3W019-091792	PCB	mg/kg	Wall core	2 U
P3W020-091792	PCB	mg/kg	Wall core	2 U
P3W021-091792	PCB	mg/kg	Wall core	2 U
P3W022-091792	PCB	mg/kg	Wall core	2 U
P3W023-091792	PCB	mg/kg	Wall core	2 U
P3W024-091792	PCB	mg/kg	Wall core	2 U
P4W001110992	PCB	mg/kg	Wall core	31
P4W002110992	PCB	mg/kg	Wall core	2 U
P4W003110992	PCB	mg/kg	Wall core	2 U
P4W004110992	PCB	mg/kg	Wall core	3
P4W005110992	PCB	mg/kg	Wall core	6
P4W006110992	PCB	mg/kg	Wall core	5
P4W007110992	PCB	mg/kg	Wall core	7

BUILDING NO. 3
FIRST LEVEL
WALL CORE SAMPLES

Sample number	Analyte	Units	Sample Type	Result
P4W008110992	PCB	mg/kg	Wall core	6
P4W009110992	PCB	mg/kg	Wall core	730
P5W001-111092	PCB	mg/kg	wall core	2 U
P5W002-111092	PCB	mg/kg	wall core	2 U
P5W003-111092	PCB	mg/kg	wall core	2 U
P5W004-111092	PCB	mg/kg	wall core	2 U
P5W005-111092	PCB	mg/kg	wall core	2 U
P5W006-111092	PCB	mg/kg	wall core	2 U
P5W007-111092	PCB	mg/kg	wall core	2 U
P5W008-111092	PCB	mg/kg	wall core	2
P5W009-111092	PCB	mg/kg	wall core	2 U
P5W010-111092	PCB	mg/kg	wall core	2 U
P5W011-111092	PCB	mg/kg	wall core	2 U
P5W012-111092	PCB	mg/kg	wall core	2 U
P5W013-111092	PCB	mg/kg	wall core	2 U
P5W014-052493	PCB	mg/kg	wall core	2 U
P5W015-052493	PCB	mg/kg	wall core	2 U
P5W016-052493	PCB	mg/kg	wall core	2 U
P5W017-052493	PCB	mg/kg	wall core	2 U
P5W018-052493	PCB	mg/kg	wall core	2 U
P5W019-062593	PCB	mg/kg	wall core	2 U
P5W020-062593	PCB	mg/kg	wall core	2 U
P5W021-062593	PCB	mg/kg	wall core	2 U
P5W022-062493	PCB	mg/kg	wall core	2 U
P5W023-062493	PCB	mg/kg	wall core	2 U
P5W024-062493	PCB	mg/kg	wall core	2 U
P5W025-062493	PCB	mg/kg	wall core	2 U
P5W026-062493	PCB	mg/kg	wall core	2 U
P5W027-062493	PCB	mg/kg	wall core	2 U
P6W001052493	PCB	mg/kg	Wall core	2 U
P6W002052493	PCB	mg/kg	Wall core	2 U
P6W003052493	PCB	mg/kg	Wall core	2 U
P6W004052493	PCB	mg/kg	Wall core	2 U
P6W005081793	PCB	mg/kg	Wall core	2 U
P6W006081793	PCB	mg/kg	Wall core	2 U
P6W007081793	PCB	mg/kg	Wall core	2 U
P6W008081793	PCB	mg/kg	Wall core	2 U
P6W009081793	PCB	mg/kg	Wall core	2 U
P6W010081793	PCB	mg/kg	Wall core	2 U
P6W011081793	PCB	mg/kg	Wall core	2 U
P6W012081793	PCB	mg/kg	Wall core	2 U
P6W013081793	PCB	mg/kg	Wall core	2 U
P6W014081793	PCB	mg/kg	Wall core	2 U
P6W015081793	PCB	mg/kg	Wall core	2 U
P6W016081793	PCB	mg/kg	Wall core	2 U
P6W017081793	PCB	mg/kg	Wall core	2 U
P7W001-100793	PCB	mg/kg	Wall core	2 U
P7W002-100793	PCB	mg/kg	Wall core	2 U
P7W003-100793	PCB	mg/kg	Wall core	2 U
P7W004-100793	PCB	mg/kg	Wall core	2 U
P7W005-100793	PCB	mg/kg	Wall core	2 U
P7W006-100793	PCB	mg/kg	Wall core	2 U
P7W007-100793	PCB	mg/kg	Wall core	2 U
P7W008-100793	PCB	mg/kg	Wall core	2 U
P7W009-100793	PCB	mg/kg	Wall core	2 U
P7W010-100793	PCB	mg/kg	Wall core	2 U
P7W011-100793	PCB	mg/kg	Wall core	2 U
P7W012-100793	PCB	mg/kg	Wall core	2 U
P7W013-100793	PCB	mg/kg	Wall core	2 U
P7W014-100793	PCB	mg/kg	Wall core	2 U
P7W015-100793	PCB	mg/kg	Wall core	2 U

BUILDING NO. 3
FIRST LEVEL
WALL CORE SAMPLES

Sample number	Analyte	Units	Sample Type	Result
Frequency of Detection				8/112
Minimum Detected Concentration (mg/kg)				2
Maximum Detected Concentration (mg/kg)				730
Number of samples				112
Log-normal Distribution				
Arithmetic Mean				7.98
Mean of ln value				0.169
Standard Deviation of ln value				0.774
H(0.95)				2.035
95% UCL - Lognormal Distribution (mg/kg)				1.85
Exposure Point Concentration (mg/kg)				1.85

Samples previously reported from areas that have since been remediated

P3W002-100892	PCB	mg/kg	Wall core	2 U
P3W003-100892	PCB	mg/kg	Wall core	2 U
P3W004-100892	PCB	mg/kg	Wall core	2 U
P3W005-100892	PCB	mg/kg	Wall core	2 U
P3W006-100892	PCB	mg/kg	Wall core	2 U
P3W007-100892	PCB	mg/kg	Wall core	2 U
P3W008-100892	PCB	mg/kg	Wall core	2 U
P3W009-100892	PCB	mg/kg	Wall core	2 U

U = Undetected at quantitation limit presented; assumed to be present at one-half the quantitation limit for calculations.
Exposure point concentration is lower of maximum detected concentration or 95% upper confidence limit (UCL).

BUILDING NO. 3
FIRST LEVEL
CEILING WIPE SAMPLES

Sample Number	Analyte	Units	Sample Type	Results
P21B29-1A-062994	PCB	µg/100cm²	Swab/Wipe	1 U
P21B29-1B-062994	PCB	µg/100cm²	Swab/Wipe	1 U
P21B29-1C-062994	PCB	µg/100cm²	Swab/Wipe	3.8
P21B33-1A-102892	PCB	µg/100cm²	Swab/Wipe	2 U
P21B33-1B-102892	PCB	µg/100cm²	Swab/Wipe	2 U
P21B33-1C-102892	PCB	µg/100cm²	Swab/Wipe	2 U
P21C31-1A-062994	PCB	µg/100cm²	Swab/Wipe	1 U
P21C31-1B-062994	PCB	µg/100cm²	Swab/Wipe	1 U
P21C31-1C-062994	PCB	µg/100cm²	Swab/Wipe	1 U
P21C35-1A-102992	PCB	µg/100cm²	Swab/Wipe	2 U
P21C35-1B-102992	PCB	µg/100cm²	Swab/Wipe	2 U
P21C35-1C-102992	PCB	µg/100cm²	Swab/Wipe	2 U
P21C37-1A-102992	PCB	µg/100cm²	Swab/Wipe	2 U
P21C37-1B-102992	PCB	µg/100cm²	Swab/Wipe	2 U
P21C37-1C-102992	PCB	µg/100cm²	Swab/Wipe	2 U
P21D28-1A-062994	PCB	µg/100cm²	Swab/Wipe	1 U
P21D28-1B-062994	PCB	µg/100cm²	Swab/Wipe	1 U
P21D28-1C-062994	PCB	µg/100cm²	Swab/Wipe	3.1
P21E30-1A-062994	PCB	µg/100cm²	Swab/Wipe	1 U
P21E30-1B-062994	PCB	µg/100cm²	Swab/Wipe	1 U
P21E30-1C-062994	PCB	µg/100cm²	Swab/Wipe	2.7
P21E36-1A-102992	PCB	µg/100cm²	Swab/Wipe	2 U
P21E36-1B-102992	PCB	µg/100cm²	Swab/Wipe	4
P21E36-1C-102992	PCB	µg/100cm²	Swab/Wipe	4
P21F32-1A-062994	PCB	µg/100cm²	Swab/Wipe	4.1
P21F32-1B-062994	PCB	µg/100cm²	Swab/Wipe	5.9
P21F32-1C-062994	PCB	µg/100cm²	Swab/Wipe	1 U
P21F34-1A-102992	PCB	µg/100cm²	Swab/Wipe	2 U
P21F34-1B-102992	PCB	µg/100cm²	Swab/Wipe	4
P21F34-1C-102992	PCB	µg/100cm²	Swab/Wipe	6
P2P001012693	PCB	µg/100cm²	Swab/Wipe	2 U
P2P002012693	PCB	µg/100cm²	Swab/Wipe	2 U
P2P003012693	PCB	µg/100cm²	Swab/Wipe	2 U
P2P004-063094	PCB	µg/100cm²	Swab/Wipe	3.5
P4A22-1A-051094	PCB	µg/100cm²	Swab/Wipe	1.3
P4A22-1B-051094	PCB	µg/100cm²	Swab/Wipe	2.7
P4A22-1C-051094	PCB	µg/100cm²	Swab/Wipe	24.2
P41B17-1A-050594	PCB	µg/100cm²	Swab/Wipe	2.1
P41B17-1B-050594	PCB	µg/100cm²	Swab/Wipe	1 U
P41B17-1C-050594	PCB	µg/100cm²	Swab/Wipe	1 U
P41B20-1A-050594	PCB	µg/100cm²	Swab/Wipe	111
P41B20-1B-050594	PCB	µg/100cm²	Swab/Wipe	7.1
P41B20-1C-050594	PCB	µg/100cm²	Swab/Wipe	13.7
P41B26-1A-050594	PCB	µg/100cm²	Swab/Wipe	28.5
P41B26-1B-050594	PCB	µg/100cm²	Swab/Wipe	1 U
P41B26-1C-050594	PCB	µg/100cm²	Swab/Wipe	3.1
P51A08-1A-050594	PCB	µg/100cm²	Swab/Wipe	1 U
P51A08-1B-050594	PCB	µg/100cm²	Swab/Wipe	3.1
P51A08-1C-050594	PCB	µg/100cm²	Swab/Wipe	15.9
P51A12-1A-051094	PCB	µg/100cm²	Swab/Wipe	1 U
P51A12-1B-051094	PCB	µg/100cm²	Swab/Wipe	15.9
P51A12-1C-051094	PCB	µg/100cm²	Swab/Wipe	5.1
P51B06-1A-031093	PCB	µg/100cm²	Swab/Wipe	2 U
P51B06-1B-031093	PCB	µg/100cm²	Swab/Wipe	2
P51B06-1C-031093	PCB	µg/100cm²	Swab/Wipe	3
P51B14-1A-050594	PCB	µg/100cm²	Swab/Wipe	1 U
P51B14-1B-050594	PCB	µg/100cm²	Swab/Wipe	1.1
P51B14-1C-050594	PCB	µg/100cm²	Swab/Wipe	1 U
P51E01-1A-031093	PCB	µg/100cm²	Swab/Wipe	2 U
P51E01-1B-031093	PCB	µg/100cm²	Swab/Wipe	2 U

BUILDING NO. 3
FIRST LEVEL
CEILING WIPE SAMPLES

Sample Number	Analyte	Units	Sample Type	Results
P51E01-1C-031093	PCB	µg/100cm²	Swab/Wipe	2 U
P51E02-1A-031093	PCB	µg/100cm²	Swab/Wipe	2 U
P51E02-1B-031093	PCB	µg/100cm²	Swab/Wipe	2 U
P51E02-1C-031093	PCB	µg/100cm²	Swab/Wipe	2
P51G03-1A-031093	PCB	µg/100cm²	Swab/Wipe	2 U
P51G03-1B-031093	PCB	µg/100cm²	Swab/Wipe	2
P51G03-1C-031093	PCB	µg/100cm²	Swab/Wipe	2
P5P001-111092	PCB	µg/100cm²	Swab/Wipe	2 U
P61C18-1A-050994	PCB	µg/100cm²	Swab/Wipe	1 U
P61C18-1B-050994	PCB	µg/100cm²	Swab/Wipe	1 U
P61C18-1C-050994	PCB	µg/100cm²	Swab/Wipe	17.7
P61C27-1A-050594	PCB	µg/100cm²	Swab/Wipe	2.4
P61C27-1B-050594	PCB	µg/100cm²	Swab/Wipe	6.6
P61C27-1C-050594	PCB	µg/100cm²	Swab/Wipe	3.7
P61D07-1A-112092	PCB	µg/100cm²	Swab/Wipe	3
P61D07-1B-112092	PCB	µg/100cm²	Swab/Wipe	2
P61D07-1C-112092	PCB	µg/100cm²	Swab/Wipe	2
P61D10-1A-050994	PCB	µg/100cm²	Swab/Wipe	1 U
P61D10-1B-050994	PCB	µg/100cm²	Swab/Wipe	1 U
P61D10-1C-050994	PCB	µg/100cm²	Swab/Wipe	34.9
P61D13-1A-050994	PCB	µg/100cm²	Swab/Wipe	4.1
P61D13-1B-050994	PCB	µg/100cm²	Swab/Wipe	14.1
P61D13-1C-050994	PCB	µg/100cm²	Swab/Wipe	36.2
P61D15-1A-050994	PCB	µg/100cm²	Swab/Wipe	1 U
P61D15-1B-050994	PCB	µg/100cm²	Swab/Wipe	19.5
P61D15-1C-050994	PCB	µg/100cm²	Swab/Wipe	29
P61D21-1A-050594	PCB	µg/100cm²	Swab/Wipe	3.9
P61D21-1B-050594	PCB	µg/100cm²	Swab/Wipe	1 U
P61D21-1C-050594	PCB	µg/100cm²	Swab/Wipe	11.5
P61D24-1A-050594	PCB	µg/100cm²	Swab/Wipe	11.6
P61D24-1B-050594	PCB	µg/100cm²	Swab/Wipe	45.7
P61D24-1C-050594	PCB	µg/100cm²	Swab/Wipe	1.4
P61E06-1A-112092	PCB	µg/100cm²	Swab/Wipe	2 U
P61E06-1B-112092	PCB	µg/100cm²	Swab/Wipe	2 U
P61E06-1C-112092	PCB	µg/100cm²	Swab/Wipe	3
P61E12-1A-050994	PCB	µg/100cm²	Swab/Wipe	5.8
P61E12-1B-050994	PCB	µg/100cm²	Swab/Wipe	6.8
P61E12-1C-050994	PCB	µg/100cm²	Swab/Wipe	5.9
P61E19-1A-050594	PCB	µg/100cm²	Swab/Wipe	4.3
P61E19-1B-050594	PCB	µg/100cm²	Swab/Wipe	4.2
P61E19-1C-050594	PCB	µg/100cm²	Swab/Wipe	64.2
P61F04-1A-112092	PCB	µg/100cm²	Swab/Wipe	2 U
P61F04-1B-112092	PCB	µg/100cm²	Swab/Wipe	2 U
P61F04-1C-112092	PCB	µg/100cm²	Swab/Wipe	3
P61F09-1A-050994	PCB	µg/100cm²	Swab/Wipe	1 U
P61F09-1B-050994	PCB	µg/100cm²	Swab/Wipe	30.4
P61F09-1C-050994	PCB	µg/100cm²	Swab/Wipe	15.8
P61F18-1A-050994	PCB	µg/100cm²	Swab/Wipe	4
P61F18-1B-050994	PCB	µg/100cm²	Swab/Wipe	9.2
P61F18-1C-050994	PCB	µg/100cm²	Swab/Wipe	97
P61F23-1A-050594	PCB	µg/100cm²	Swab/Wipe	13.5
P61F23-1B-050594	PCB	µg/100cm²	Swab/Wipe	8.8
P61F23-1C-050594	PCB	µg/100cm²	Swab/Wipe	1 U
P61F26-1A-050594	PCB	µg/100cm²	Swab/Wipe	1 U
P61F26-1B-050594	PCB	µg/100cm²	Swab/Wipe	1 U
P61F26-1C-050594	PCB	µg/100cm²	Swab/Wipe	11.8
P61G07-1A-122192	PCB	µg/100cm²	Swab/Wipe	2 U
P61G07-1B-122192	PCB	µg/100cm²	Swab/Wipe	2 U
P61G07-1C-122192	PCB	µg/100cm²	Swab/Wipe	3
P61G10-1A-050994	PCB	µg/100cm²	Swab/Wipe	2.2
P61G10-1B-050994	PCB	µg/100cm²	Swab/Wipe	3.2
P61G10-1C-050994	PCB	µg/100cm²	Swab/Wipe	5
P61G13-1A-050994	PCB	µg/100cm²	Swab/Wipe	1 U

BUILDING NO. 3
FIRST LEVEL
CEILING WIPE SAMPLES

Sample Number	Analyte	Units	Sample Type	Results
P61G13-1B-050994	PCB	µg/100cm²	Swab/Wipe	4.4
P61G13-1C-050994	PCB	µg/100cm²	Swab/Wipe	39.3
P61G21-1A-050594	PCB	µg/100cm²	Swab/Wipe	6
P61G21-1B-050594	PCB	µg/100cm²	Swab/Wipe	1 U
P61G21-1C-050594	PCB	µg/100cm²	Swab/Wipe	27.8
P61G26-1A-050594	PCB	µg/100cm²	Swab/Wipe	1 U
P61G26-1B-050594	PCB	µg/100cm²	Swab/Wipe	1 U
P61G26-1C-050594	PCB	µg/100cm²	Swab/Wipe	9.6
P61H15-1A-050994	PCB	µg/100cm²	Swab/Wipe	1 U
P61H15-1B-050994	PCB	µg/100cm²	Swab/Wipe	27.9
P61H15-1C-050994	PCB	µg/100cm²	Swab/Wipe	37.1
P61H18-1A-050994	PCB	µg/100cm²	Swab/Wipe	1 U
P61H18-1B-050994	PCB	µg/100cm²	Swab/Wipe	5.6
P61H18-1C-050994	PCB	µg/100cm²	Swab/Wipe	56.1
P61H23-1A-050594	PCB	µg/100cm²	Swab/Wipe	33.3
P61H23-1B-050594	PCB	µg/100cm²	Swab/Wipe	86.3
P61H23-1C-050594	PCB	µg/100cm²	Swab/Wipe	1.2
P61J06-1A-122192	PCB	µg/100cm²	Swab/Wipe	2 U
P61J06-1B-122192	PCB	µg/100cm²	Swab/Wipe	2 U
P61J06-1C-122192	PCB	µg/100cm²	Swab/Wipe	2
P61J19-1A-050594	PCB	µg/100cm²	Swab/Wipe	7
P61J19-1B-050594	PCB	µg/100cm²	Swab/Wipe	12.6
P61J19-1C-050594	PCB	µg/100cm²	Swab/Wipe	10.7
P61J25-1A-050594	PCB	µg/100cm²	Swab/Wipe	1 U
	PCB	µg/100cm²	Swab/Wipe	13.2
P61J25-1C-050594	PCB	µg/100cm²	Swab/Wipe	1 U
P61K05-1A-122192	PCB	µg/100cm²	Swab/Wipe	2 U
P61K05-1B-122192	PCB	µg/100cm²	Swab/Wipe	2 U
P61K05-1C-122192	PCB	µg/100cm²	Swab/Wipe	2 U
P61K09-1A-050994	PCB	µg/100cm²	Swab/Wipe	1 U
P61K09-1B-050994	PCB	µg/100cm²	Swab/Wipe	1 U
P61K09-1C-050994	PCB	µg/100cm²	Swab/Wipe	1.9
P61K12-1A-050994	PCB	µg/100cm²	Swab/Wipe	1 U
P61K12-1B-050994	PCB	µg/100cm²	Swab/Wipe	1.5
P61K12-1C-050994	PCB	µg/100cm²	Swab/Wipe	11.3
P61K17-1A-050994	PCB	µg/100cm²	Swab/Wipe	12.6
P61K17-1B-050994	PCB	µg/100cm²	Swab/Wipe	1 U
P61K17-1C-050994	PCB	µg/100cm²	Swab/Wipe	38
P61K22-1A-050594	PCB	µg/100cm²	Swab/Wipe	10.6
P61K22-1B-050594	PCB	µg/100cm²	Swab/Wipe	1 U
P61K22-1C-050594	PCB	µg/100cm²	Swab/Wipe	1 U
P6P001-081893	PCB	µg/100cm²	Swab/Wipe	2 U
P6P002-081893	PCB	µg/100cm²	Swab/Wipe	2 U
P6P003-081893	PCB	µg/100cm²	Swab/Wipe	2 U
P6P004-081893	PCB	µg/100cm²	Swab/Wipe	2 U
P71G29-1A-051994	PCB	µg/100cm²	Swab/Wipe	1 U
P71G29-1B-051994	PCB	µg/100cm²	Swab/Wipe	1 U
P71G29-1C-051994	PCB	µg/100cm²	Swab/Wipe	1.7
P71G32-1A-051994	PCB	µg/100cm²	Swab/Wipe	1 U
P71G32-1B-051994	PCB	µg/100cm²	Swab/Wipe	1 U
P71G32-1C-051994	PCB	µg/100cm²	Swab/Wipe	1 U
P71J30-1A-051994	PCB	µg/100cm²	Swab/Wipe	1 U
P71J30-1B-051994	PCB	µg/100cm²	Swab/Wipe	1 U
P71J30-1C-051994	PCB	µg/100cm²	Swab/Wipe	1 U
P71K28-1A-051994	PCB	µg/100cm²	Swab/Wipe	1 U
P71K28-1B-051994	PCB	µg/100cm²	Swab/Wipe	1 U
P71K28-1C-051994	PCB	µg/100cm²	Swab/Wipe	2.4
P7P001-100793	PCB	µg/100cm²	Swab/Wipe	2 U

BUILDING NO. 3
FIRST LEVEL
CEILING WIPE SAMPLES

Sample Number	Analyte	Units	Sample Type	Results
Frequency of Detection				92/181
Minimum Concentration Detected (µg/100 cm^2)				1.1
Maximum Concentration Detected (µg/100 cm^2)				111
Maximum Concentration Detected (µg/cm^2)				1.11
Number of Samples				181
Lognormal Statistical Distribution				
Arithmetic Mean				7.5
Mean of ln values				0.80
Standard Deviation of ln values				1.449
H(.95)				2.713
95%UCL - Lognormal Distribution (µg/100 cm^2)				8.529
95%UCL - Lognormal Distribution (µg/cm^2)				0.085
Exposure Point Concentration (µg/cm^2)				0.085

U = Undetected at quantitation limit presented; assumed to be present at one-half the quantitation limit for calculations.

Exposure point concentration is lower of maximum detected concentration or 95% upper confidence limit (UCL).

BUILDING NO. 3
FIRST LEVEL
CEILING CORE SAMPLES

Sample Number	Units	Sample Type	Result
P21B29-2A-102892	mg/kg	ceiling core	2 U
P21B33-2A-102892	mg/kg	ceiling core	2 U
P21B38-2A-102992	mg/kg	ceiling core	2 U
P21B41-2A-102992	mg/kg	ceiling core	2 U
P21C31-2A-102892	mg/kg	ceiling core	2 U
P21C35-2A-102992	mg/kg	ceiling core	2 U
P21C37-2A-102992	mg/kg	ceiling core	2 U
P21C42-2A-102992	mg/kg	ceiling core	2 U
P21D28-2A-102892	mg/kg	ceiling core	2 U
P21D39-2A-102992	mg/kg	ceiling core	2 U
P21E30-2A-102892	mg/kg	ceiling core	2 U
P21E36-2A-102992	mg/kg	ceiling core	2 U
P21F32-2A-102892	mg/kg	ceiling core	2
P21F34-2A-102992	mg/kg	ceiling core	2 U
P31G34-2A-101692	mg/kg	ceiling core	2 U
P31G37-2A-101692	mg/kg	ceiling core	2 U
P31H39-2A-101692	mg/kg	ceiling core	2 U
P31J37-2A-101692	mg/kg	ceiling core	2 U
P31J42-2A-101692	mg/kg	ceiling core	2 U
P31K35-2A-101692	mg/kg	ceiling core	2 U
P3GTY01-120392	mg/kg	ceiling core	2
P3GTY02-120392	mg/kg	ceiling core	2 U
P41A22-2A-111192	mg/kg	ceiling core	2 U
P41B17-2A-111192	mg/kg	ceiling core	2 U
P41B20-2A-111192	mg/kg	ceiling core	2 U
P41B26-2A-111192	mg/kg	ceiling core	2 U
P51A08-2A-111192	mg/kg	ceiling core	2 U
P51A12-2A-111192	mg/kg	ceiling core	2 U
P51B06-2A-031093	mg/kg	ceiling core	2 U
P51B14-2A-111192	mg/kg	ceiling core	2 U
P51E01-2A-031093	mg/kg	ceiling core	2 U
P51E02-2A-031093	mg/kg	ceiling core	2 U
P51G03-2A-031093	mg/kg	ceiling core	2 U
P61C18-2A-112092	mg/kg	ceiling core	2 U
P61C27-2A-111992	mg/kg	ceiling core	2 U
P61D07-2A-112092	mg/kg	ceiling core	2 U
P61D10-2A-112092	mg/kg	ceiling core	2 U
P61D13-2A-112092	mg/kg	ceiling core	2 U
P61D15-2A-112092	mg/kg	ceiling core	2 U
P61D21-2A-111992	mg/kg	ceiling core	2 U
P61D24-2A-111992	mg/kg	ceiling core	2 U
P61E06-2A-112092	mg/kg	ceiling core	2 U
P61E12-2A-112092	mg/kg	ceiling core	2 U
P61E19-2A-111992	mg/kg	ceiling core	2 U
P61F04-2A-112092	mg/kg	ceiling core	2 U
P61F09-2A-112092	mg/kg	ceiling core	2 U
P61F18-2A-111992	mg/kg	ceiling core	2 U
P61F23-2A-111992	mg/kg	ceiling core	2 U
P61F26-2A-111992	mg/kg	ceiling core	2 U
P61G07-2A-122192	mg/kg	ceiling core	2 U
P61G10-2A-122192	mg/kg	ceiling core	2 U
P61G13-2A-122192	mg/kg	ceiling core	2 U
P61G21-2A-121892	mg/kg	ceiling core	2 U
P61G26-2A-121892	mg/kg	ceiling core	2 U
P61H15-2A-122192	mg/kg	ceiling core	2 U
P61H18-2A-122192	mg/kg	ceiling core	2 U
P61H23-2A-121892	mg/kg	ceiling core	2 U
P61J06-2A-122192	mg/kg	ceiling core	2 U
P61J19-2A-121892	mg/kg	ceiling core	2 U
P61J25-2A-121892	mg/kg	ceiling core	2 U
P61K05-2A-122192	mg/kg	ceiling core	2 U
P61K09-2A-122192	mg/kg	ceiling core	2 U
P61K12-2A-122192	mg/kg	ceiling core	2 U
P61K17-2A-122192	mg/kg	ceiling core	2 U
P61K22-2A-121892	mg/kg	ceiling core	2 U
P71G29-2A-092493	mg/kg	ceiling core	2 U

BUILDING NO. 3
FIRST LEVEL
CEILING CORE SAMPLES

Sample Number	Units	Sample Type	Result
P71G32-2A-092493	mg/kg	ceiling core	2 U
P71J30-2A-092493	mg/kg	ceiling core	2 U
P71K28-2A-092493	mg/kg	ceiling core	2 U
Frequency of Detection			2/69
Minimum Concentration Detected (mg/kg)			2.0
Maximum Concentration Detected (mg/kg)			2.0
Arithmetic Mean Concentration (mg/kg)			0.010
Number of Samples			69
Lognormal Statistical Distribution			
Mean of ln values			0.020
Standard Deviation of ln values			0.117
H(.95)			1.684
95%UCL - Lognormal Distribution (mg/kg)			1.052
Exposure Point Concentration (mg/kg)			1.052

U = Undetected at quantitation limit presented; assumed to be present at one-half the quantitation limit for calculations.

Exposure point concentration is lower of maximum detected concentration or 95% upper confidence limit (UCL).

APPENDIX C
ANALYTICAL DATA FOR BUILDING NO. 3
SECOND LEVEL

BUILDING NO. 3
SECOND LEVEL
FLOOR CORE SAMPLES

Sample Number	Analyte	Units	Sample Type	Results
P1Z1A-052992	PCB	mg/kg	floor core	2 U
P1Z1B-052992	PCB as Aroclor-1248	mg/kg	floor core	2
P1Z1C-052992	PCB	mg/kg	floor core	2 U
P1Z2A-042993	PCB as Aroclor-1248	mg/kg	floor core	17
P1Z2B-042993	PCB as Aroclor-1248	mg/kg	floor core	7
P1Z2C-042993	PCB as Aroclor-1248	mg/kg	floor core	12
P1Z3A-042993	PCB as Aroclor-1248	mg/kg	floor core	27
P1Z3B-042993	PCB as Aroclor-1248	mg/kg	floor core	27
P1Z3C-042993	PCB as Aroclor-1248	mg/kg	floor core	32
PZ41A-060192	PCB	mg/kg	floor core	2 U
P1Z4B-060192	PCB	mg/kg	floor core	2 U
P1Z4C-060192	PCB	mg/kg	floor core	2 U
P1Z5A-072292	PCB	mg/kg	floor core	2 U
P1Z5B-072292	PCB	mg/kg	floor core	2 U
PZ51C-072292	PCB as Aroclor-1248	mg/kg	floor core	3
P1Z6A-042993	PCB as Aroclor-1248	mg/kg	floor core	6
P1Z6B-042993	PCB as Aroclor 1248/1254	mg/kg	floor core	15
P1Z6C-042993	PCB as Aroclor-1248	mg/kg	floor core	2
P1Z7A-100692	PCB as Aroclor-1248	mg/kg	floor core	6
P1Z7B-100692	PCB as Aroclor-1248	mg/kg	floor core	7
P1Z7C-100692	PCB as Aroclor-1248	mg/kg	floor core	5
P1Z8A-042993	PCB as Aroclor 1248/1254	mg/kg	floor core	18
P1Z8B-042993	PCB as Aroclor 1248/1254	mg/kg	floor core	20
P1Z8C-042993	PCB as Aroclor 1248/1254	mg/kg	floor core	11
P1Z9A-072292	PCB	mg/kg	floor core	2 U
P1Z9B-072292	PCB	mg/kg	floor core	2 U
P1Z9C-072292	PCB	mg/kg	floor core	2 U
P1Z10A-082192	PCB	mg/kg	floor core	2 U
P1Z10B-082192	PCB	mg/kg	floor core	2 U
P1Z10C-082192	PCB	mg/kg	floor core	2 U
P1Z11A-082192	PCB	mg/kg	floor core	2 U
P1Z11B-082192	PCB	mg/kg	floor core	2 U
P1Z11C-082192	PCB	mg/kg	floor core	2 U
P1Z12A-082192	PCB	mg/kg	floor core	2 U
P1Z12B-082192	PCB	mg/kg	floor core	2 U
P1Z12C-082192	PCB	mg/kg	floor core	2 U
P1Z13A-082792	PCB	mg/kg	floor core	2 U
P1Z13B-082792	PCB	mg/kg	floor core	2 U
P1Z13C-082792	PCB	mg/kg	floor core	2 U
P1Z14A-082792	PCB	mg/kg	floor core	2 U
P1Z14B-082792	PCB	mg/kg	floor core	2 U
P1Z14C-082792	PCB	mg/kg	floor core	2 U
P1Z15A-082792	PCB	mg/kg	floor core	2 U
P1Z15B-082792	PCB	mg/kg	floor core	2 U
P1Z15C-082792	PCB	mg/kg	floor core	2 U
P1Z16A-082792	PCB	mg/kg	floor core	2 U
P1Z16B-082792	PCB	mg/kg	floor core	2 U
P1Z16C-082792	PCB	mg/kg	floor core	2 U
P1Z17A-082792	PCB	mg/kg	floor core	2 U
P1Z17B-082792	PCB	mg/kg	floor core	2 U
P1Z17C-082792	PCB	mg/kg	floor core	2 U
P1Z18A-082792	PCB	mg/kg	floor core	2 U
P1Z18B-082792	PCB	mg/kg	floor core	2 U
P1Z18C-082792	PCB	mg/kg	floor core	2 U
P1Z19A-082792	PCB	mg/kg	floor core	2 U
P1Z19B-082792	PCB	mg/kg	floor core	2 U
P1Z19C-082792	PCB	mg/kg	floor core	2 U

BUILDING NO. 3
SECOND LEVEL
FLOOR CORE SAMPLES

Sample Number	Analyte	Units	Sample Type	Results
Number of Samples				57
Frequency of Detection				17/57
Minimum Concentration Detected				2
Maximum Concentration Detected				32
Lognormal Statistical Distribution				
Arithmetic Mean				4.51
Mean of ln values				0.67
Standard Deviation of ln values				1.133
H(.95)				2.43
95%UCL - Lognormal Distribution				5.34
Exposure Point Concentration (mg/kg)				5.34

Additional Data Points

Sample Number	Analyte	Units	Sample Type	Result
P1EL005-062994	PCB as Aroclor 1254	mg/kg	Solids	3.4

U = Undetected at quantitation limit presented; assumed to be present at 1/2 the quantitation limit for calculations.
Exposure point concentration is lower of either the maximum detected concentration
or the 95% upper confidence limit (UCL

BUILDING NO.3
SECOND LEVEL
VERTICAL CORE SAMPLES

Sample Number	Analyte	Units	Sample Type	Results
P1W001-100192	PCB	mg/kg	wall core	2 U
P1W002-100192	PCB	mg/kg	wall core	2 U
P1W003-100192	PCB	mg/kg	wall core	2 U
P1W004-100192	PCB	mg/kg	wall core	2 U
P1W005-100192	PCB	mg/kg	wall core	2 U
P1W006-100192	PCB	mg/kg	wall core	2 U
P1W007-100192	PCB	mg/kg	wall core	2 U
P1W008-100192	PCB	mg/kg	wall core	2 U
P1W009-060992	PCB	mg/kg	wall core	2 U
P1W010-100192	PCB	mg/kg	wall core	2 U
P1W011-100192	PCB	mg/kg	wall core	2 U
P1W012-100192	PCB	mg/kg	wall core	2 U
P1W013-100192	PCB	mg/kg	wall core	2 U
P1W014-100192	PCB	mg/kg	wall core	2 U
P1W015-100192	PCB	mg/kg	wall core	2 U
P1W016-100192	PCB	mg/kg	wall core	2 U
P1W017-100192	PCB	mg/kg	wall core	2 U
P1W018-100192	PCB	mg/kg	wall core	2 U
P1W019-100192	PCB	mg/kg	wall core	2 U
P1W020-100192	PCB	mg/kg	wall core	2 U
P1W021-100192	PCB	mg/kg	wall core	2 U
P1W022-100192	PCB	mg/kg	wall core	2 U
P1W023-100192	PCB	mg/kg	wall core	2 U
P1W024-100192	PCB	mg/kg	wall core	2 U
P1W025-100192	PCB	mg/kg	wall core	2 U
P1W026-100192	PCB	mg/kg	wall core	2 U
P1W027-100692	PCB	mg/kg	wall core	2 U
P1W028-100692	PCB	mg/kg	wall core	2 U
P1W029-100692	PCB	mg/kg	wall core	2 U
P1W030-100692	PCB	mg/kg	wall core	2 U
P1W031-100692	PCB	mg/kg	wall core	2 U
P1W032-100692	PCB	mg/kg	wall core	2 U
P1W033-100692	PCB	mg/kg	wall core	2 U
P1W034-100692	PCB	mg/kg	wall core	2 U
P1W035-100692	PCB	mg/kg	wall core	2 U
P1W036-100692	PCB	mg/kg	wall core	2 U
P1W037-100692	PCB	mg/kg	wall core	2 U
P1W038-100692	PCB	mg/kg	wall core	2 U
P1W039-100692	PCB	mg/kg	wall core	2 U
P1W040-100692	PCB	mg/kg	wall core	2 U
P1W041-100692	PCB	mg/kg	wall core	2 U
P1W042-081892	PCB	mg/kg	wall core	2 U
P1W043-081892	PCB	mg/kg	wall core	2 U
P1W044-081892	PCB	mg/kg	wall core	2 U
P1W045-081892	PCB	mg/kg	wall core	2 U
P1W046-081892	PCB	mg/kg	wall core	2 U
P1W047-081892	PCB	mg/kg	wall core	2 U
P1W048-100692	PCB	mg/kg	wall core	2 U
P1W049-100792	PCB	mg/kg	wall core	2 U
P1W050-100792	PCB	mg/kg	wall core	2 U
P1W051-100792	PCB	mg/kg	wall core	2 U
P1W052-100792	PCB	mg/kg	wall core	2 U
P1W053-100792	PCB	mg/kg	wall core	2 U
P1W054-100792	PCB	mg/kg	wall core	2 U
P1W055-100792	PCB	mg/kg	wall core	2 U
P1W056-100792	PCB	mg/kg	wall core	2 U
P1W057-100792	PCB	mg/kg	wall core	2 U
Number of samples				57
Frequency of detection				0/57

BUILDING NO. 3
SECOND LEVEL
VERTICAL WIPE SAMPLES

Sample Number	Analyte	Units	Sample Type	Result
P1C001-061092	PCB	µg/100cm²	Swab/Wipe	2 U
P1C002-061092	PCB	µg/100cm²	Swab/Wipe	2 U
P1C003-061092	PCB	µg/100cm²	Swab/Wipe	2 U
P1C004-061092	PCB	µg/100cm²	Swab/Wipe	2 U
P1C005-061092	PCB	µg/100cm²	Swab/Wipe	2 U
P1C006-061092	PCB	µg/100cm²	Swab/Wipe	2 U
P1C007-070992	PCB	µg/100cm²	Swab/Wipe	2 U
P1C008-070992	PCB	µg/100cm²	Swab/Wipe	2 U
P1C009-070992	PCB	µg/100cm²	Swab/Wipe	2 U
P1C010-070992	PCB	µg/100cm²	Swab/Wipe	2 U
P1C011-070992	PCB	µg/100cm²	Swab/Wipe	2 U
P1C012-070992	PCB	µg/100cm²	Swab/Wipe	2 U
P1C013-081792	PCB	µg/100cm²	Swab/Wipe	2 U
P1C014-081792	PCB	µg/100cm²	Swab/Wipe	2 U
P1C015-081792	PCB	µg/100cm²	Swab/Wipe	2 U
P1C016-081792	PCB	µg/100cm²	Swab/Wipe	2 U
P1C017-081792	PCB	µg/100cm²	Swab/Wipe	2 U
P1C018-081792	PCB	µg/100cm²	Swab/Wipe	2 U
P1C019-081792	PCB	µg/100cm²	Swab/Wipe	2 U
P1C020-081792	PCB	µg/100cm²	Swab/Wipe	2 U
P1C021-081792	PCB	µg/100cm²	Swab/Wipe	2 U
P1C022-081792	PCB	µg/100cm²	Swab/Wipe	2 U
P1C023-081792	PCB	µg/100cm²	Swab/Wipe	2 U
P1C024-081792	PCB	µg/100cm²	Swab/Wipe	2 U
P1C025-081792	PCB	µg/100cm²	Swab/Wipe	2 U
P1C026-081792	PCB	µg/100cm²	Swab/Wipe	2 U
P1C027-081792	PCB	µg/100cm²	Swab/Wipe	2 U
P1C028-081792	PCB	µg/100cm²	Swab/Wipe	2 U
P1C029-081792	PCB	µg/100cm²	Swab/Wipe	2 U
P1C030-081792	PCB	µg/100cm²	Swab/Wipe	2 U
P1D001-061092	PCB	µg/100cm²	Swab/Wipe	2 U
P1D002-061092	PCB	µg/100cm²	Swab/Wipe	2 U
P1D003-061092	PCB	µg/100cm²	Swab/Wipe	2 U
P1E001-061092	PCB	µg/100cm²	Swab/Wipe	2 U
P1E002-061092	PCB	µg/100cm²	Swab/Wipe	2 U
P1EL001-061192	PCB	µg/100cm²	Swab/Wipe	2 U
P1EL002-062994	PCB	µg/100cm²	Swab/Wipe	1 U
P1EL004-062994	PCB as Aroclor-1254	µg/100cm²	Swab/Wipe	5.5
P1PW001-102192	PCB	µg/100cm²	Swab/Wipe	2 U
P1PW002-102192	PCB	µg/100cm²	Swab/Wipe	2 U
P1PW003-102192	PCB	µg/100cm²	Swab/Wipe	2 U
P1PW004-102192	PCB	µg/100cm²	Swab/Wipe	2 U
P1PW005-102192	PCB	µg/100cm²	Swab/Wipe	2 U
P1PW006-102192	PCB	µg/100cm²	Swab/Wipe	2 U
P1PW007-102192	PCB	µg/100cm²	Swab/Wipe	2 U
P1PW008-102192	PCB	µg/100cm²	Swab/Wipe	2 U
P1PW009-102192	PCB	µg/100cm²	Swab/Wipe	2 U
P1WD001-061092	PCB	µg/100cm²	Swab/Wipe	2 U
P1WD002-061092	PCB	µg/100cm²	Swab/Wipe	2 U
P1WD003-070992	PCB	µg/100cm²	Swab/Wipe	2 U
P1WD004-081792	PCB	µg/100cm²	Swab/Wipe	2 U
P1WD005-081792	PCB	µg/100cm²	Swab/Wipe	2 U
Number of samples				52
Frequency of Detection				1/52
Minimum concentration detected (µg/100 cm²)				5.5
Maximum concentration detected (µg/100 cm²)				5.5
Maximum concentration detected (µg/cm²)				0.055
Arithmetic mean concentration (µg/cm²)				0.0108
Lognormal Statistical Distribution				
Mean of ln value				0.0195
Standard deviation of ln value				0.2569
H(0.95)				1.761
95% Upper Confidence Limit (µg/100 cm²)				1.1
95% Upper Confidence Limit (µg/cm²)				0.011
Exposure Point Concentration (µg/cm²)				**0.011**

U = Undetected at quantitation limit presented; assumed to be present at 1/2 quantitation limit for calculations.
Exposure point concentration is lower of either the maximum detected concentration or the 95% upper confidence limit (UCL

BUILDING NO. 3
SECOND LEVEL
CEILING WIPE SAMPLES

Sample Number	Units	Sample Type	Result
P12A13-1A-031694	µg/100cm²	Swab/Wipe	1 U
P12A13-1B-031694	µg/100cm²	Swab/Wipe	1 U
P12A13-1C-031694	µg/100cm²	Swab/Wipe	1 U
P12A20-1A-031694	µg/100cm²	Swab/Wipe	1 U
P12A20-1B-031694	µg/100cm²	Swab/Wipe	1.8
P12A20-1C-031694	µg/100cm²	Swab/Wipe	2.3
P12A24-1A-031694	µg/100cm²	Swab/Wipe	32.7
P12A24-1B-031694	µg/100cm²	Swab/Wipe	45.3
P12A24-1C-031694	µg/100cm²	Swab/Wipe	2.4
P12A32-1A-051094	µg/100cm²	Swab/Wipe	2
P12A32-1B-051094	µg/100cm²	Swab/Wipe	4
P12A32-1C-051094	µg/100cm²	Swab/Wipe	1 U
P12B10-1A-031694	µg/100cm²	Swab/Wipe	1 U
P12B10-1B-031694	µg/100cm²	Swab/Wipe	8.8
P12B10-1C-031694	µg/100cm²	Swab/Wipe	3.8
P12B15-1A-031694	µg/100cm²	Swab/Wipe	1 U
P12B15-1B-031694	µg/100cm²	Swab/Wipe	7.2
P12B15-1C-031694	µg/100cm²	Swab/Wipe	13.7
P12B25-1A-031694	µg/100cm²	Swab/Wipe	1.2
P12B25-1B-031694	µg/100cm²	Swab/Wipe	8.5
P12B25-1C-031694	µg/100cm²	Swab/Wipe	1 U
P12B28-1A-051094	µg/100cm²	Swab/Wipe	1.5
P12B28-1B-051094	µg/100cm²	Swab/Wipe	1 U
P12B28-1C-051094	µg/100cm²	Swab/Wipe	7.7
P12B31-1A-051094	µg/100cm²	Swab/Wipe	1.9
P12B31-1B-051094	µg/100cm²	Swab/Wipe	5.7
P12B31-1C-051094	µg/100cm²	Swab/Wipe	8.3
P12B36-1A-101392	µg/100cm²	Swab/Wipe	2 U
P12B36-1B-101392	µg/100cm²	Swab/Wipe	2 U
P12B36-1C-101392	µg/100cm²	Swab/Wipe	5
P12C11-1A-031694	µg/100cm²	Swab/Wipe	1 U
P12C11-1B-031694	µg/100cm²	Swab/Wipe	1 U
P12C11-1C-031694	µg/100cm²	Swab/Wipe	9.3
P12C22-1A-031694	µg/100cm²	Swab/Wipe	1 U
P12C22-1B-031694	µg/100cm²	Swab/Wipe	67
P12C22-1C-031694	µg/100cm²	Swab/Wipe	1.8
P12C26-1A-031694	µg/100cm²	Swab/Wipe	11.2
P12C26-1B-031694	µg/100cm²	Swab/Wipe	41.9
P12C26-1C-031694	µg/100cm²	Swab/Wipe	3.4
P12C33-1A-101392	µg/100cm²	Swab/Wipe	2 U
P12C33-1B-101392	µg/100cm²	Swab/Wipe	2 U
P12C33-1C-101392	µg/100cm²	Swab/Wipe	2 U
P12C41-1A-101492	µg/100cm²	Swab/Wipe	2 U
P12C41-1B-101492	µg/100cm²	Swab/Wipe	2 U
P12C41-1C-101492	µg/100cm²	Swab/Wipe	2 U
P12D08-1A-031694	µg/100cm²	Swab/Wipe	1 U
P12D08-1B-031694	µg/100cm²	Swab/Wipe	1 U
P12D08-1C-031694	µg/100cm²	Swab/Wipe	2.3
P12D09-1A-031694	µg/100cm²	Swab/Wipe	1 U
P12D09-1B-031694	µg/100cm²	Swab/Wipe	7.9
P12D09-1C-031694	µg/100cm²	Swab/Wipe	12.4
P12D12-1A-031694	µg/100cm²	Swab/Wipe	1 U
P12D12-1B-031694	µg/100cm²	Swab/Wipe	7.9
P12D12-1C-031694	µg/100cm²	Swab/Wipe	14.5
P12D16-1A-031694	µg/100cm²	Swab/Wipe	3
P12D16-1B-031694	µg/100cm²	Swab/Wipe	10.7
P12D16-1C-031694	µg/100cm²	Swab/Wipe	4.2
P12D18-1A-031694	µg/100cm²	Swab/Wipe	1 U
P12D18-1B-031694	µg/100cm²	Swab/Wipe	11.4
P12D18-1C-031694	µg/100cm²	Swab/Wipe	18.5
P12D27-1A-031694	µg/100cm²	Swab/Wipe	3.5
P12D27-1B-031694	µg/100cm²	Swab/Wipe	14.9
P12D27-1C-031694	µg/100cm²	Swab/Wipe	1 U

BUILDING NO. 3
SECOND LEVEL
CEILING WIPE SAMPLES

Sample Number	Units	Sample Type	Result
P12D30-1A-051094	µg/100cm²	Swab/Wipe	1 U
P12D30-1B-051094	µg/100cm²	Swab/Wipe	1 U
P12D30-1C-051094	µg/100cm²	Swab/Wipe	5
P12D35-1A-101392	µg/100cm²	Swab/Wipe	2 U
P12D35-1B-101392	µg/100cm²	Swab/Wipe	2 U
P12D35-1C-101392	µg/100cm²	Swab/Wipe	3
P12D38-1A-101492	µg/100cm²	Swab/Wipe	2 U
P12D38-1B-101492	µg/100cm²	Swab/Wipe	2 U
P12D38-1C-101492	µg/100cm²	Swab/Wipe	4
P12D42-1A-101492	µg/100cm²	Swab/Wipe	2 U
P12D42-1B-101492	µg/100cm²	Swab/Wipe	2 U
P12D42-1C-101492	µg/100cm²	Swab/Wipe	2 U
P12E20-1A-031694	µg/100cm²	Swab/Wipe	2.5
P12E20-1B-031964	µg/100cm²	Swab/Wipe	4.8
P12E20-1C-031694	µg/100cm²	Swab/Wipe	10.3
P12F13-1A-031694	µg/100cm²	Swab/Wipe	1 U
P12F13-1B-031694	µg/100cm²	Swab/Wipe	16.6
P12F13-1C-031694	µg/100cm²	Swab/Wipe	108.1
P12F16-1A-031694	µg/100cm²	Swab/Wipe	1 U
P12F16-1B-031694	µg/100cm²	Swab/Wipe	3
P12F16-1C-031694	µg/100cm²	Swab/Wipe	9.7
P12F18-1A-031694	µg/100cm²	Swab/Wipe	6.9
P12F18-1B-031694	µg/100cm²	Swab/Wipe	4.7
P12F18-1C-031694	µg/100cm²	Swab/Wipe	23.2
P12FZ2-1A-031694	µg/100cm²	Swab/Wipe	1.2
P12FZ2-1B-031694	µg/100cm²	Swab/Wipe	24.4
P12FZ2-1C-031694	µg/100cm²	Swab/Wipe	1 U
P12F29-1A-051094	µg/100cm²	Swab/Wipe	1 U
P12F29-1B-051094	µg/100cm²	Swab/Wipe	1 U
P12F29-1C-051094	µg/100cm²	Swab/Wipe	1 U
P12F34-1A-101392	µg/100cm²	Swab/Wipe	2 U
P12F34-1B-101392	µg/100cm²	Swab/Wipe	2 U
P12F34-1C-101392	µg/100cm²	Swab/Wipe	2 U
P12G28-1A-051094	µg/100cm²	Swab/Wipe	4 U
P12G28-1B-051094	µg/100cm²	Swab/Wipe	1 U
P12G28-1C-051094	µg/100cm²	Swab/Wipe	1 U
P12G32-1A-051094	µg/100cm²	Swab/Wipe	1 U
P12G32-1B-051094	µg/100cm²	Swab/Wipe	1 U
P12G32-1C-051094	µg/100cm²	Swab/Wipe	1 U
P12G37-1A-101492	µg/100cm²	Swab/Wipe	2 U
P12G37-1B-101492	µg/100cm²	Swab/Wipe	2 U
P12G37-1C-101492	µg/100cm²	Swab/Wipe	2 U
P12G39-1A-101492	µg/100cm²	Swab/Wipe	2 U
P12G39-1B-101492	µg/100cm²	Swab/Wipe	2 U
P12G39-1C-101492	µg/100cm²	Swab/Wipe	2 U
P12H29-1A-051094	µg/100cm²	Swab/Wipe	1 U
P12H29-1B-051094	µg/100cm²	Swab/Wipe	1 U
P12H29-1C-051094	µg/100cm²	Swab/Wipe	1 U
P12H36-1A-101392	µg/100cm²	Swab/Wipe	2 U
P12H36-1B-101392	µg/100cm²	Swab/Wipe	2 U
P12H36-1C-101392	µg/100cm²	Swab/Wipe	2 U
P12J33-1A-101392	µg/100cm²	Swab/Wipe	2 U
P12J33-1B-101392	µg/100cm²	Swab/Wipe	2 U
P12J33-1C-101392	µg/100cm²	Swab/Wipe	2 U
P12J38-1A-101492	µg/100cm²	Swab/Wipe	2 U
P12J38-1B-101492	µg/100cm²	Swab/Wipe	2
P12J38-1C-101492	µg/100cm²	Swab/Wipe	2 U
P12J42-1A-101492	µg/100cm²	Swab/Wipe	2 U
P12J42-1B-101492	µg/100cm²	Swab/Wipe	2 U
P12J42-1C-101492	µg/100cm²	Swab/Wipe	2 U
P12K31-1A-051094	µg/100cm²	Swab/Wipe	1 U
P12K31-1B-051094	µg/100cm²	Swab/Wipe	1 U
P12K31-1C-051094	µg/100cm²	Swab/Wipe	1 U

BUILDING NO. 3
SECOND LEVEL
CEILING WIPE SAMPLES

Sample Number	Units	Sample Type	Result
Frequency of Detection			53/126
Minimum Concentration Detected (µg/100 cm²)			1.2
Maximum Concentration Detected (µg/100 cm²)			108.1
Maximum Concentration Detected (µg/cm²)			1.081
Arithmetic Mean Concentration (µg/cm²)			0.055
Number of Samples			126
Lognormal Statistical Distribution			
Mean of ln values			0.583
Standard Deviation of ln values			1.325
H(.95)			2.577
95%UCL - Lognormal Distribution (µg/100 cm²)			5.850
95%UCL - Lognormal Distribution (µg/cm²)			0.058
Exposure Point Concentration (µg/cm²)			0.058

Additional Data Points

Sample Number	Units	Sample Type	Result
P1P001081192	µg/100cm²	Swab/Wipe	2 U
P1P002081792	µg/100cm²	Swab/Wipe	2 U
P1P003081792	µg/100cm²	Swab/Wipe	2 U
P1P004081792	µg/100cm²	Swab/Wipe	2 U

U = Undetected at quantitation limit presented; assumed to be present at 1/2 the quantitation limit for calculations.
Exposure point concentration is lower of either the maximum detected concentration or the 95% upper confidence limit (UCL

BUILDING NO. 3
SECOND LEVEL
CEILING CORE SAMPLES

Sample Number	Units	Sample Type	Result
P12A13-2A-100892	mg/kg	ceiling core	2 U
P12A20-2A-101292	mg/kg	ceiling core	2 U
P12A24-2A-101292	mg/kg	ceiling core	2 U
P12A32-2A-101392	mg/kg	ceiling core	2 U
P12B10-2A-100792	mg/kg	ceiling core	2 U
P12B15-2A-100892	mg/kg	ceiling core	2 U
P12B25-2A-101292	mg/kg	ceiling core	2
P12B28-2A-101292	mg/kg	ceiling core	2 U
P12B31-2A-101392	mg/kg	ceiling core	2 U
P12B36-2A-101392	mg/kg	ceiling core	2 U
P12C11-2A-100892	mg/kg	ceiling core	2 U
P12C22-2A-101292	mg/kg	ceiling core	2 U
P12C26-2A-101292	mg/kg	ceiling core	2 U
P12C33-2A-101392	mg/kg	ceiling core	2 U
P12C41-2A-101492	mg/kg	ceiling core	2 U
P12D08-2A-100792	mg/kg	ceiling core	2 U
P12D09-2A-100792	mg/kg	ceiling core	2 U
P12D12-2A-100892	mg/kg	ceiling core	2 U
P12D16-2A-100892	mg/kg	ceiling core	2 U
P12D18-2A-100892	mg/kg	ceiling core	2 U
P12D27-2A-101292	mg/kg	ceiling core	2 U
P12D30-2A-101392	mg/kg	ceiling core	2 U
P12D35-2A-101392	mg/kg	ceiling core	2 U
P12D38-2A-101492	mg/kg	ceiling core	2 U
P12D42-2A-101492	mg/kg	ceiling core	2 U
P12E20-2A-101292	mg/kg	ceiling core	2 U
P12F13-2A-100892	mg/kg	ceiling core	2 U
P12F16-2A-100892	mg/kg	ceiling core	2 U
P12F18-2A-101292	mg/kg	ceiling core	2 U
P12F22-2A-101292	mg/kg	ceiling core	2
P12F29-2A-101292	mg/kg	ceiling core	2 U
P12F34-2A-101392	mg/kg	ceiling core	2 U
P12G28-2A-101292	mg/kg	ceiling core	2 U
P12G32-2A-101392	mg/kg	ceiling core	2 U
P12G37-2A-101492	mg/kg	ceiling core	2 U
P12G39-2A-101492	mg/kg	ceiling core	2 U
P12H29-2A-101392	mg/kg	ceiling core	2 U
P12H36-2A-101392	mg/kg	ceiling core	2 U
P12J33-2A-101392	mg/kg	ceiling core	2 U
P12J38-2A-101492	mg/kg	ceiling core	2 U
P12J42-2A-101492	mg/kg	ceiling core	2 U
P12K31-2A-101392	mg/kg	ceiling core	2 U
Frequency of Detection			2/42
Minimum Concentration Detected (mg/kg)			2.0
Maximum Concentration Detected (mg/kg)			2.0
Arithmetic Mean Concentration (mg/kg)			0.010
Number of Samples			42
Lognormal Statistical Distribution			
Mean of ln values			0.033
Standard Deviation of ln values			0.149
H(.95)			1.728
95%UCL - Lognormal Distribution (mg/kg)			1.068
Exposure Point Concentration (mg/kg)			1.068

U = Undetected at quantitation limit presented; assumed to be present at 1/2 the quantitation limit for calculations.

Exposure point concentration is lower of either the maximum detected concentration or the 95% upper confidence limit (UCL

APPENDIX D
AIR SAMPLING RESULTS

TABLE D-1
SUMMARY OF PCB AIR SAMPLING
CONDUCTED IN BUILDING No. 3

Sample Identification No.	Sample Date	Sample Type	Air Volume Samples (L)	PCB (µg)	PCB (µg/m^3)
10	1-May-92	Air Cassette	480	< 0.4	< 0.8
11	1-May-92	Air Cassette	480	< 0.4	< 0.8
12	1-May-92	Air Cassette	480	< 0.4	< 0.8
13	1-May-92	Air Cassette	NR	< 0.4	-
14	4-May-92	Air Cassette	560	< 0.4	< 0.7
15	4-May-92	Air Cassette	560	< 0.4	< 0.7
16	4-May-92	Air Cassette	560	< 0.4	< 0.7
17	4-May-92	Air Cassette	NR	< 0.4	-

Analysis of PCB conducted by Industrial Testing Laboratories (St. Louis, MO) by NIOSH Method 5503 (Lab Report No. 92-05-02120).

NR = Not reported
" - " Air concentration cannot be calculated without air sample volume.

INDUSTRIAL TESTING LABORATORIES inc.

Chemical Analysis
Materials Testing
Environmental Evaluation

2350 S. Seventh Street • St. Louis, Missouri 63104-4296

314/771-7111
314/771-9573 FAX

Report No. 92-05-02120

May 15, 1992
(Corrected Report 5/7/96)

Examination of twenty-two (22) samples submitted.

J.D. Chelan
P.O. Box 12405
St. Louis, MO 63132

Attn: Mr. Norm Jones

TEST REPORT

I. Initial Phase of Project:

Sample Collection By: D. Schau & Associates
Date of Collection: 01 May 92
Status of Analysis: Rush Turnaround

A. PCB Analysis

Sample Identification	Sample Type	Reported Air Volume Sampled (L)	PCB, µg	PCB, µg/m^3
10	Air Cassette	488	<0.4	<0.8
11	Air Cassette	488	<0.4	<0.8
12	Air Cassette	488	<0.4	<0.8
13	Air Cassette	--------	<0.4	--------
20	Wipe Sample	--------	<3	--------
21	Wipe Sample	--------	<3	--------
23	Wipe Sample	--------	<3	--------

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B. Lead Analysis

Sample Identification	Sample Type	Reported Air Volume Sampled (L)	Lead, µg	Lead, µg/m^3
1	Air Cassette	488	<2.5	<5.1
2	Air Cassette	488	<2.5	<5.1
3	Air Cassette	488	<2.5	<5.1
4	Air Cassette	--------	<2.5	--------

II. Secondary Phase of Project:

Sample Collection By: D. Schau & Associates
Date of Collection: 04 May 92
Status of Analysis: Normal Turnaround

A. PCB Analysis

Sample Identification	Sample Type	Reported Air Volume Sampled (L)	PCB, µg	PCB, µg/m^3
14	Air Cassette	560	<0.4	<0.7
15	Air Cassette	560	<0.4	<0.7
16	Air Cassette	560	<0.4	<0.7
17	Air Cassette	--------	<0.4	--------
23	Wipe Sample	--------	<3	--------
24	Wipe Sample	--------	<3	--------
25	Wipe Sample	--------	<3	--------

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inc.

B. Lead Analysis

Sample Identification	Sample Type	Reported Air Volume Sampled (L)	Lead, µg	Lead, µg/m^3
5	Air Cassette	560	<2.5	<4.5
6	Air Cassette	560	<2.5	<4.5
7	Air Cassette	560	<2.5	<4.5
8	Air Cassette	--------	<2.5	--------

Notes: Concentration reported are based on sampling data provided by D. Schau & Associates.
PCB data reported is based on standard responses of PCB 1248
Symbol "µg" denotes Micrograms
Symbol "L" denotes liters
Symbol "µg/m^3" denotes Micrograms per cubic meter

Method Reference: PCB - NIOSH 5503
Lead - NIOSH 7300

Industrial Testing Laboratories is accredited by the American Industrial Hygiene Association No. 344.

Respectfully Submitted,

INDUSTRIAL TESTING LABORATORIES, INC.

By: William A. Rorie

William A. Rorie

LN - 219359 - 369, 219447 - 457
LB - 44781, 44790, 45570, 45572
MM/DTS/kg

Inv. 57902

APPENDIX E
EXPOSURE AND RISK CALCULATIONS
BASEMENT

TABLE E-1
RISK AND HAZARD CALCULATIONS
EXPOSURE TO BASEMENT

Dermal contact with Interior Surfaces

Equation

C_{low} = $(C_{floor} + C_{ceiling})$

C_{high} = C_{wall}

Intake = $((C_{low} \times SA_{low} \times CR_{low}) + (C_{high} \times SA_{high} \times CR_{high}) \times AB \times CF)/(BW \times AT)$

Risk = Intake x SF

HQ = Intake/RfD

where:

C_{floor} = Chemical concentration on floor surfaces (µg/cm²)
$C_{ceiling}$ = Chemical concentration on ceiling surfaces (µg/cm²)
SA_{low} = Surface area of low contact surfaces (cm²)
CR_{low} = Percentage of contact with low contact surfaces (unitless)
SA_{high} = Surface area of high contact surfaces (cm²)
CR_{high} = Percentage of contact with high contact surfaces (unitless)
AB = Dermal absorption extent (unitless)
CF = Unit conversion factor (mg/µg)
BW = Body weight (kg)
ATc = Averaging time, carcinogens (dy)
ATnc = Averaging time, noncarcinogens (dy)
SF = Cancer slope factor (mg/kg-dy⁻¹)
RfD = Non-carcinogenic Reference Dose (mg/kg-dy)
Risk = Excess lifetime cancer risk (unitless)
HQ = Non-carcinogenic Hazard Quotient

Chemical	C_{floor} (µg/cm²)	$C_{ceiling}$ (µg/cm²)	C_{low} (µg/cm²)	SA_{low} (cm²)	CR_{low} (unitless)	C_{high} (ug/cm²)	SA_{high} (cm²)	CR_{high} (unitless)	AB (unitless)	CF (mg/µg)	BW (kg)	ATnc (dy)	ATc (dy)	Intake$_{ca}$ (mg/kg-dy)	SF (mg/kg-dy)⁻¹	Risk (unitless)	Intake$_{nc}$ (mg/kg-dy)	RfD (mg/kg-dy)	Hazard Quotient (unitless)
Total PCBs	0.941	1.51	1.226	1.62E+08	0.0005	0.237	1.47E+07	0.001	0.0136	1E-03	70	25550		7.81E-07	7.7	6E-06			
4,4-DDD	0.393	0.432	0.413	1.62E+08	0.0005	1.99	1.47E+07	0.001	0.02	1E-03	70	25550		7.01E-07	0.24	2E-07			
4,4-DDE	0	0.00107	0.001	1.62E+08	0.0005	0	1.47E+07	0.001	0.02	1E-03	70	25550		4.65E-10	0.34	2E-10			
4,4-DDT	0.966	0.33	0.648	1.62E+08	0.0005	0.614	1.47E+07	0.001	0.02	1E-03	70	25550	9125	6.66E-07	0.34	2E-07	1.93E-06	5.00E-04	0.004
Dieldrin	0.00487	0	0.002	1.62E+08	0.0005	0	1.47E+07	0.001	0.02	1E-03	70	25550	9125	2.12E-09	16	3E-05	5.92E-09	5.00E-05	0.0001
Endrin	0.0216	0	0.011	1.62E+08	0.0005	0	1.47E+07	0.001	0.02	1E-03	70		9125				2.74E-08	3.00E-04	0.00009
gamma-BHC	0.077	0.039	0.058	1.62E+08	0.0005	0.041	1.47E+07	0.001	0.02	1E-03	70		9125				1.86E-07	3.00E-04	0.0006
Heptachlor epoxide	0.393	0.0004	0.197	1.62E+08	0.0005	0.055	1.47E+07	0.001	0.02	1E-03	70	25550	9125	1.67E-07	9.1	2E-06	5.24E-07	1.30E-05	0.04
														Cancer Risk (dermal)		4E-05	Hazard Index (dermal)		0.04

Dermal contact with Soil

Equation

Intake = $(Csoil \times CF \times AF \times SA_{skin} \times ABS \times EF \times ED) / (BW \times AT)$

Risk = Intake x SF

HQ = Intake/RfD

where:

C_{soil} = Chemical concentration in soil (mg/kg)
CF = Unit conversion factor (kg/mg)
AF = Soil-to-skin adherence factor (mg/cm²)
SAskin = Exposed skin surface area (cm²/event)
ABS = Dermal absorption factor (unitless)
EF = Exposure frequency (events/year)
ED = Exposure duration (yr)
BW = Body weight (kg)
AT = Averaging time (dy)

Chemical	Csoil (mg/kg)	CF (kg/mg)	AF (mg/cm²)	SA_{skin} (cm²/event)	ABS (unitless)	EF (events/yr)	ED (yr)	BW (kg)	ATc (dy)	ATnc (dy)	Intake$_{ca}$ (mg/kg-dy)	SF (mg/kg-dy)⁻¹	Risk (unitless)	Intake NonCA (mg/kg-dy)	RfD (mg/kg-dy)	Hazard Quotient (unitless)
4,4-DDD	0.611	1E-06	1.0	2000	0.02	250	25	70	25550		9.24E-07	0.24	2E-07			
4,4-DDT	0.648	1E-06	1.0	2000	0.02	250	25	70	25550	9125	9.06E-08	0.34	3E-08	2.54E-07	5.00E-04	0.001
Endrin	1.188	1E-06	1.0	2000	0.02	250	25	70		9125				4.65E-07	3.00E-04	0.002
gamma-BHC	0.486	1E-06	1.0	2000	0.02	250	25	70		9125				1.90E-07	3.00E-04	0.001
													3E-07			0.003

TABLE E-1
RISK AND HAZARD CALCULATIONS
EXPOSURE TO BASEMENT

Inhalation

Equation

Intake = (C_{air} x IH x ET x EF x ED) / (BW x AT)

Risk = Intake x SF

HQ = Intake/RfD

where:

Cair = Chemical concentration in air (mg/m^3)
IH = Inhalation rate (m^3/hr)
ET = Exposure time (hr/dy)
EF = Exposure frequency (events/year)
ED = Exposure duration (yr)
BW = Body weight (kg)
AT = Averaging time (dy)

Chemical	C_{air} (mg/m^3)	IH (m^3/hr)	ET (hr/dy)	EF (dy/yr)	ED (yr)	BW (kg)	ATc (dy)	ATnc (dy)	Intake ca (mg/kg-dy)	SF (mg/kg-dy)$^{-1}$	Risk (unitless)	Intake nc (mg/kg-dy)	RfD (mg/kg-dy)	Hazard Quotient (unitless)
Total PCBs	4.60E-05	0.83	8	250	25	70	25550	9125	1.07E-06	7.7	8E-06			
4,4-DDD	1.25E-05	0.83	8	250	25	70	25550	9125	2.90E-07	0.24	7E-08			
4,4-DDE	1.92E-09	0.83	8	250	25	70	25550	9125	4.46E-11	0.34	2E-11			
4,4-DDT	3.18E-05	0.83	8	250	25	70	25550	9125	7.38E-07	0.34	3E-07	2.07E-06	5.00E-04	0.004
Dieldrin	2.00E-07	0.83	8	250	25	70	25550	9125	4.64E-09	16	7E-08	1.30E-06	5.00E-05	0.0003
Endrin	2.09E-06	0.83	8	250	25	70	25550	9125				1.36E-07	3.00E-04	0.000453
gamma-BHC	2.68E-05	0.83	8	250	25	70	25550	9125				1.74E-06	3.00E-04	0.006
Heptachlor epoxide	4.72E-05	0.83	8	250	25	70	25550	9125	1.10E-06	9.1	1E-05	3.07E-06	1.30E-06	0.2
									Cancer Risk (inhalation)		2E-05	Hazard Index (inhalation)		0.2

Soil Ingestion

Equation

Intake = (C_{soil} x CF x IR x EF x ED)/(BW x AT)

where:

C_{soil} = Chemical concentration in soil (mg/kg)
CF = Unit conversion factor (kg/mg)
IR = Soil ingestion rate (mg/dy)
EF = Exposure frequency (dy/yr)
ED = Exposure duration (yr)
BW = Body weight (kg)
AT = Averaging time (dy)

Chemical	C_{soil} (mg/kg)	CF (kg/mg)	IR (mg/dy)	EF (dy/yr)	ED (yr)	BW (kg)	ATc (dy)	Averaging Time (AT) (NonCA) (dy)	Intake CA (mg/kg-dy)	SF (mg/kg-dy)$^{-1}$	Risk (unitless)	Intake NonCA (mg/kg-dy)	RfD (mg/kg-dy)	Hazard Quotient (unitless)
4,4-DDD	6.61	1.00E-06	50	250	25	70	25550		1.15E-06	2.40E-01	3E-07			
4,4-DDT	0.648	1.00E-06	50	250	25	70	25550	9125	1.13E-07	3.40E-01	4E-08	3.17E-07	5.00E-04	0.0006
Endrin	1.166	1.00E-06	50	250	25	70		9125				5.81E-07	3.00E-04	0.002
gamma-HCH	0.466	1.00E-06	50	250	25	70		9125				2.36E-07	3.00E-04	0.0006
											3E-07			0.003

Pathway	Cancer Risk	Hazard Index
Dermal Contact - Interior Surfaces	4E-05	0.04
Dermal Contact - Soil	3E-07	0.003
Inhalation	2E-05	0.2
Ingestion	3E-07	0.003
TOTAL	6E-05	0.3

APPENDIX E
TABLES

APPENDIX E
4,4'-DDD

BUILDING NO. 3
BASEMENT
CALCULATION OF AIR CONCENTRATION
4,4-DDD

Equation $Ca = (E \times CF1 \times t_e \times CF2) / (V \times CF3)$

Where:

Ca =	Predicted air concentration in building (mg/m^3)
E=	Average emission rate from all sources (g/s)
CF1 =	Unit conversion factor (s/hr)
t_e =	Air exchange rate (hr)
CF2 =	Unit conversion factor (mg/g)
V =	Volume of room (cm^3)
CF3 =	Unit conversion factor (m^3/cm^3)

Source	Average Na (g/cm^2-s)	Applicable Area (cm^2)	Emission Rate (g/s)
Floor	1.64E-16	2.70E+07	4.42E-09
Wall	8.29E-16	1.47E+07	1.22E-08
Ceiling	1.80E-16	1.35E+08	2.43E-08
Soil	4.17E-15	1.08E+08	4.50E-07
Total			**4.91E-07**

Chemical	E (g/s)	CF1 (s/hr)	t_e (hr)	CF2 (mg/g)	CF3 (m^3/cm^3)	V (cm^3)	Ca (mg/m^3)
4,4'-DDD	4.91E-07	3600	0.233	1000	1.00E-06	3.29E+10	**1.25E-05**

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF 4,4'-DDD
FROM FLOOR SURFACES

Hwang DeFalco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where: Na =	Instantaneous emission flux rate (g/cm^2-s)		
E =	Soil (or medium) porosity) (unitless)		0.1
Del =	Effective diffusivity in soil (cm^2/s) = Di x $E^{0.33}$		
Di =	Diffusion coefficient in air (cm^2/s)		1.40E-02
π =	Pi (3.14)		
t =	Time from sampling (s)		
H =	Henry's Law Constant (dimensionless form)		3.26E-04
Kd =	Soil/water partition coefficient (cm^3/g) =		770
Koc =	Organic carbon water partition coefficient (cm^3/g)		7.70E+05
foc =	Fraction of organic carbon in material (g/g)		0.001
Cs =	Initial concentration in soil or medium (g/g)		
Cwipe (Floor)		(μg/cm^2)	0.4
Cwipe (Floor)		(g/cm^2)	0.0000004

Calculation of Del Del = Di x $E^{0.33}$

Di (cm^2/s)	E (unitless)	Del (cm^2/s)
1.40E-02	0.1	6.55E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$$

Del (cm^2/s)	E (unitless)	Ps (g/cm^3)	Kd (cm^3/g)	H (unitless)	α (cm^2/s)
6.55E-03	0.1	2.4	770	3.26E-04	1.28E-10

Calculation of Cs Cs = Cwipe x CF/ρ_s x d

Cwipe (μg/cm^2)	CF (g/μg)	d (cm)	ρ (g/cm^3)	Cs (g/g)
0.4	1.00E-06	1	2.4	1.67E-07

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

E (unitless)	Del (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Cs (g/g)	Na (g/cm^2-s)
0.1	6.55E-03	3.14	1.28E-10	7.88E+08	3.26E-04	770	1.67E-07	8.19E-17

Calculation of Avg Na Avg Na (T = 25yr) =2 Na (T yr)

Na g/cm^2-s	AvgNa g/cm^2-s
8.19E-17	1.64E-16

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF 4,4'-DDD
FROM FLOOR SURFACES

Year	E (unitless)	Del (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Cs (g/g)	Ns (g/cm²-s)	Initial Conc (g/cm³)	Ns (g/cm²-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm³)	Mass Remaining (g/cm³)
1 sec	0.1	6.55E-03	3.14	1.28E-10	1.00E+00	3.26E-04	770	1.67E-07	2.30E-12	4.00E-07	4.10E-16	10	3.15E+07	1.292E-09	3.99E-07
1	0.1	6.55E-03	3.14	1.28E-10	3.15E+07	3.26E-04	770	1.67E-07	4.10E-16	3.99E-07	2.90E-16	10	3.15E+07	9.133E-10	3.98E-07
2	0.1	6.55E-03	3.14	1.28E-10	6.31E+07	3.26E-04	770	1.67E-07	2.90E-16	3.98E-07	2.36E-16	10	3.15E+07	7.457E-10	3.97E-07
3	0.1	6.55E-03	3.14	1.28E-10	9.46E+07	3.26E-04	770	1.67E-07	2.36E-16	3.97E-07	2.05E-16	10	3.15E+07	6.458E-10	3.96E-07
4	0.1	6.55E-03	3.14	1.28E-10	1.26E+08	3.26E-04	770	1.67E-07	2.05E-16	3.96E-07	1.83E-16	10	3.15E+07	5.777E-10	3.96E-07
5	0.1	6.55E-03	3.14	1.28E-10	1.58E+08	3.26E-04	770	1.67E-07	1.83E-16	3.96E-07	1.67E-16	10	3.15E+07	5.273E-10	3.95E-07
6	0.1	6.55E-03	3.14	1.28E-10	1.89E+08	3.26E-04	770	1.67E-07	1.67E-16	3.95E-07	1.55E-16	10	3.15E+07	4.882E-10	3.95E-07
7	0.1	6.55E-03	3.14	1.28E-10	2.21E+08	3.26E-04	770	1.67E-07	1.55E-16	3.95E-07	1.45E-16	10	3.15E+07	4.567E-10	3.94E-07
8	0.1	6.55E-03	3.14	1.28E-10	2.52E+08	3.26E-04	770	1.67E-07	1.45E-16	3.94E-07	1.37E-16	10	3.15E+07	4.306E-10	3.94E-07
9	0.1	6.55E-03	3.14	1.28E-10	2.84E+08	3.26E-04	770	1.67E-07	1.37E-16	3.94E-07	1.30E-16	10	3.15E+07	4.085E-10	3.94E-07
10	0.1	6.55E-03	3.14	1.28E-10	3.15E+08	3.26E-04	770	1.67E-07	1.30E-16	3.94E-07	1.23E-16	10	3.15E+07	3.885E-10	3.93E-07
11	0.1	6.55E-03	3.14	1.28E-10	3.47E+08	3.26E-04	770	1.67E-07	1.23E-16	3.93E-07	1.18E-16	10	3.15E+07	3.729E-10	3.93E-07
12	0.1	6.55E-03	3.14	1.28E-10	3.78E+08	3.26E-04	770	1.67E-07	1.18E-16	3.93E-07	1.14E-16	10	3.15E+07	3.582E-10	3.92E-07
13	0.1	6.55E-03	3.14	1.28E-10	4.10E+08	3.26E-04	770	1.67E-07	1.14E-16	3.92E-07	1.09E-16	10	3.15E+07	3.452E-10	3.92E-07
14	0.1	6.55E-03	3.14	1.28E-10	4.42E+08	3.26E-04	770	1.67E-07	1.09E-16	3.92E-07	1.06E-16	10	3.15E+07	3.335E-10	3.92E-07
15	0.1	6.55E-03	3.14	1.28E-10	4.73E+08	3.26E-04	770	1.67E-07	1.06E-16	3.92E-07	1.02E-16	10	3.15E+07	3.229E-10	3.91E-07
16	0.1	6.55E-03	3.14	1.28E-10	5.05E+08	3.26E-04	770	1.67E-07	1.02E-16	3.91E-07	9.93E-17	10	3.15E+07	3.133E-10	3.91E-07
17	0.1	6.55E-03	3.14	1.28E-10	5.36E+08	3.26E-04	770	1.67E-07	9.93E-17	3.91E-07	9.65E-17	10	3.15E+07	3.044E-10	3.91E-07
18	0.1	6.55E-03	3.14	1.28E-10	5.68E+08	3.26E-04	770	1.67E-07	9.65E-17	3.91E-07	9.40E-17	10	3.15E+07	2.963E-10	3.90E-07
19	0.1	6.55E-03	3.14	1.28E-10	5.99E+08	3.26E-04	770	1.67E-07	9.40E-17	3.90E-07	9.16E-17	10	3.15E+07	2.888E-10	3.90E-07
20	0.1	6.55E-03	3.14	1.28E-10	6.31E+08	3.26E-04	770	1.67E-07	9.16E-17	3.90E-07	8.94E-17	10	3.15E+07	2.819E-10	3.90E-07
21	0.1	6.55E-03	3.14	1.28E-10	6.62E+08	3.26E-04	770	1.67E-07	8.94E-17	3.90E-07	8.73E-17	10	3.15E+07	2.754E-10	3.90E-07
22	0.1	6.55E-03	3.14	1.28E-10	6.94E+08	3.26E-04	770	1.67E-07	8.73E-17	3.90E-07	8.54E-17	10	3.15E+07	2.693E-10	3.89E-07
23	0.1	6.55E-03	3.14	1.28E-10	7.25E+08	3.26E-04	770	1.67E-07	8.54E-17	3.89E-07	8.36E-17	10	3.15E+07	2.637E-10	3.89E-07
24	0.1	6.55E-03	3.14	1.28E-10	7.57E+08	3.26E-04	770	1.67E-07	8.36E-17	3.89E-07	8.19E-17	10	3.15E+07	2.583E-10	3.89E-07
25	0.1	6.55E-03	3.14	1.28E-10	7.88E+08	3.26E-04	770	1.67E-07	8.19E-17	3.89E-07	8.03E-17	10	3.15E+07	2.533E-10	3.89E-07
26	0.1	6.55E-03	3.14	1.28E-10	8.20E+08	3.26E-04	770	1.67E-07	8.03E-17	AVERAGE					3.93E-07

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF 4,4'-DDD
FROM VERTICAL SURFACES

Hwang DeFalco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where:	Na =	Instantaneous emission flux rate (g/cm²-s)	
	E =	Soil (or medium) porosity) (unitless)	0.1
	Del =	Effective diffusivity in soil (cm²/s) = Di x E^0.33	
	Di =	Diffusion coefficient in air (cm²/s)	1.40E-02
	π =	Pi (3.14)	
	t =	Time from sampling (s)	
	H =	Henry's Law Constant (dimensionless form)	3.26E-04
	Kd =	Soil/water partition coefficient (cm³/g) = Koc x f	7.70E+02
	Koc =	Organic carbon water partition coefficient (cm³/	7.70E+05
	foc =	Fraction of organic carbon in material (g/g)	0.001
	Cs =	Initial concentration in soil or medium (g/g)	
	Cwipe (Wall)	(µg/cm²)	2.023
	Cwipe (Wall)	(g/cm²)	0.000002023

Calculation of Del Del = Di x E^0.33

Di (cm²/s)	E (unitless)	Del (cm²/s)
1.40E-02	0.1	6.55E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$$

Del (cm²/s)	E (unitless)	Ps (g/cm³)	Kd (cm³/g)	H (unitless)	α (cm²/s)
6.55E-03	0.1	2.4	7.70E+02	3.26E-04	1.28E-10

Calculation of Cs Cs = Cwipe x CF/ρs x d

Cwipe (µg/cm²)	CF (g/µg)	d (cm)	ρ (g/cm³)	Cs (g/g)
2.023	1.00E-06	1	2.4	8.43E-07

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

E (unitless)	Del (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Cs (g/g)	Na (g/cm²-s)
0.1	6.55E-03	3.14	1.28E-10	7.88E+08	3.26E-04	7.70E+02	8.43E-07	4.14E-16

Calculation of Avg Na Avg Na (T = 25yr) =2 Na (T yr)

Na g/cm²-s	AvgNa g/cm²-s
4.14E-16	8.29E-16

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF 4,4'-DDD
FROM VERTICAL SURFACES

Year	E (unitless)	Del (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Cs (g/g)	Ns (g/cm^2-s)	Initial Conc (g/cm^2)	Ns (g/cm^2-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm^2)	Mass Remaining (g/cm^2)
1 sec	0.1	6.55E-03	3.14	1.28E-10	1.00E+00	3.26E-04	7.70E+02	8.43E-07	1.18E-11	2.02E-06	2.07E-15	10	3.15E+07	6.53E-09	2.02E-06
1	0.1	6.55E-03	3.14	1.28E-10	3.15E+07	3.26E-04	7.70E+02	8.43E-07	2.07E-15	2.02E-06	1.46E-15	10	3.15E+07	4.62E-09	2.01E-06
2	0.1	6.55E-03	3.14	1.28E-10	6.31E+07	3.26E-04	7.70E+02	8.43E-07	1.46E-15	2.01E-06	1.20E-15	10	3.15E+07	3.77E-09	2.01E-06
3	0.1	6.55E-03	3.14	1.28E-10	9.46E+07	3.26E-04	7.70E+02	8.43E-07	1.20E-15	2.01E-06	1.04E-15	10	3.15E+07	3.27E-09	2.00E-06
4	0.1	6.55E-03	3.14	1.28E-10	1.26E+08	3.26E-04	7.70E+02	8.43E-07	1.04E-15	2.00E-06	9.26E-16	10	3.15E+07	2.92E-09	2.00E-06
5	0.1	6.55E-03	3.14	1.28E-10	1.58E+08	3.26E-04	7.70E+02	8.43E-07	9.26E-16	2.00E-06	8.46E-16	10	3.15E+07	2.67E-09	2.00E-06
6	0.1	6.55E-03	3.14	1.28E-10	1.89E+08	3.26E-04	7.70E+02	8.43E-07	8.46E-16	2.00E-06	7.83E-16	10	3.15E+07	2.47E-09	2.00E-06
7	0.1	6.55E-03	3.14	1.28E-10	2.21E+08	3.26E-04	7.70E+02	8.43E-07	7.83E-16	2.00E-06	7.32E-16	10	3.15E+07	2.31E-09	1.99E-06
8	0.1	6.55E-03	3.14	1.28E-10	2.52E+08	3.26E-04	7.70E+02	8.43E-07	7.32E-16	1.99E-06	6.90E-16	10	3.15E+07	2.18E-09	1.99E-06
9	0.1	6.55E-03	3.14	1.28E-10	2.84E+08	3.26E-04	7.70E+02	8.43E-07	6.90E-16	1.99E-06	6.55E-16	10	3.15E+07	2.07E-09	1.99E-06
10	0.1	6.55E-03	3.14	1.28E-10	3.15E+08	3.26E-04	7.70E+02	8.43E-07	6.55E-16	1.99E-06	6.25E-16	10	3.15E+07	1.97E-09	1.99E-06
11	0.1	6.55E-03	3.14	1.28E-10	3.47E+08	3.26E-04	7.70E+02	8.43E-07	6.25E-16	1.99E-06	5.96E-16	10	3.15E+07	1.89E-09	1.99E-06
12	0.1	6.55E-03	3.14	1.28E-10	3.78E+08	3.26E-04	7.70E+02	8.43E-07	5.96E-16	1.99E-06	5.75E-16	10	3.15E+07	1.81E-09	1.98E-06
13	0.1	6.55E-03	3.14	1.28E-10	4.10E+08	3.26E-04	7.70E+02	8.43E-07	5.75E-16	1.98E-06	5.54E-16	10	3.15E+07	1.75E-09	1.98E-06
14	0.1	6.55E-03	3.14	1.28E-10	4.42E+08	3.26E-04	7.70E+02	8.43E-07	5.54E-16	1.98E-06	5.35E-16	10	3.15E+07	1.69E-09	1.98E-06
15	0.1	6.55E-03	3.14	1.28E-10	4.73E+08	3.26E-04	7.70E+02	8.43E-07	5.35E-16	1.98E-06	5.16E-16	10	3.15E+07	1.63E-09	1.98E-06
16	0.1	6.55E-03	3.14	1.28E-10	5.05E+08	3.26E-04	7.70E+02	8.43E-07	5.16E-16	1.98E-06	5.02E-16	10	3.15E+07	1.58E-09	1.98E-06
17	0.1	6.55E-03	3.14	1.28E-10	5.36E+08	3.26E-04	7.70E+02	8.43E-07	5.02E-16	1.98E-06	4.88E-16	10	3.15E+07	1.54E-09	1.98E-06
18	0.1	6.55E-03	3.14	1.28E-10	5.68E+08	3.26E-04	7.70E+02	8.43E-07	4.88E-16	1.98E-06	4.75E-16	10	3.15E+07	1.50E-09	1.97E-06
19	0.1	6.55E-03	3.14	1.28E-10	5.99E+08	3.26E-04	7.70E+02	8.43E-07	4.75E-16	1.97E-06	4.63E-16	10	3.15E+07	1.46E-09	1.97E-06
20	0.1	6.55E-03	3.14	1.28E-10	6.31E+08	3.26E-04	7.70E+02	8.43E-07	4.63E-16	1.97E-06	4.52E-16	10	3.15E+07	1.43E-09	1.97E-06
21	0.1	6.55E-03	3.14	1.28E-10	6.62E+08	3.26E-04	7.70E+02	8.43E-07	4.52E-16	1.97E-06	4.42E-16	10	3.15E+07	1.39E-09	1.97E-06
22	0.1	6.55E-03	3.14	1.28E-10	6.94E+08	3.26E-04	7.70E+02	8.43E-07	4.42E-16	1.97E-06	4.32E-16	10	3.15E+07	1.36E-09	1.97E-06
23	0.1	6.55E-03	3.14	1.28E-10	7.25E+08	3.26E-04	7.70E+02	8.43E-07	4.32E-16	1.97E-06	4.23E-16	10	3.15E+07	1.33E-09	1.97E-06
24	0.1	6.55E-03	3.14	1.28E-10	7.57E+08	3.26E-04	7.70E+02	8.43E-07	4.23E-16	1.97E-06	4.14E-16	10	3.15E+07	1.31E-09	1.97E-06
25	0.1	6.55E-03	3.14	1.28E-10	7.88E+08	3.26E-04	7.70E+02	8.43E-07	4.14E-16	1.97E-06	4.06E-16	10	3.15E+07	1.28E-09	1.97E-06
26	0.1	6.55E-03	3.14	1.28E-10	8.20E+08	3.26E-04	7.70E+02	8.43E-07	4.06E-16	AVERAGE					1.99E-06

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF4,4'-DDD
FROM CEILING SURFACES

Hwang DeFelco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where:	Na =	Instantaneous emission flux rate (g/cm²-s)	
	E =	Soil (or medium) porosity) (unitless)	0.1
	Del =	Effective diffusivity in soil (cm²/s) = Di x E^0.33	
	Di =	Diffusion coefficient in air (cm²/s)	1.40E-02
	π =	PI (3.14)	
	t =	Time from sampling (s)	
	H =	Henry's Law Constant (dimensionless form)	3.26E-04
	Kd =	Soil/water partition coefficient (cm³/g) = Koc x foc	770
	Koc =	Organic carbon water partition coefficient (cm³/g)	7.70E+05
	foc =	Fraction of organic carbon in material (g/g)	0.001
	Cs =	Initial concentration in soil or medium (g/g)	
	Cwipe (Ceiling)	(µg/cm²)	0.44
	Cwipe (Ceiling)	(g/cm²)	0.00000044

Calculation of Del Del = Di x E^0.33

Di (cm²/s)	E (unitless)	Del (cm²/s)
1.40E-02	0.1	6.55E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$$

Del (cm²/s)	E (unitless)	Ps (g/cm³)	Kd (cm³/g)	H (unitless)	α (cm²/s)
6.55E-03	0.1	2.4	770	3.26E-04	1.28E-10

Calculation of Cs Cs = Cwipe x CF/ρ x d

Cwipe (µg/cm²)	CF (g/µg)	d (cm)	ρ (g/cm³)	Cs (g/g)
0.44	1.00E-06	1	2.4	1.83E-07

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

E (unitless)	Del (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Cs (g/g)	Na (g/cm²-s)
0.1	6.55E-03	3.14	1.28E-10	7.88E+08	3.26E-04	770	1.83E-07	9.01E-17

Calculation of Avg Na Avg Na (T = 25yr) =2 Na (T yr)

Na g/cm²-s	AvgNa g/cm²-s
9.01E-17	1.80E-16

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF4,4'-DDD
FROM CEILING SURFACES

Year	E (unitless)	Del (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Ce (g/g)	Ns (g/cm^2-s)	Initial Conc (g/cm^3)	Ns (g/cm^2-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm^3)	Mass Remaining (g/cm^3)
1 sec	0.1	6.55E-03	3.14	1.28E-10	1.00E+00	3.26E-04	770	1.83E-07	2.53E-12	4.40E-07	4.51E-16	10	3.16E+07	1.42E-09	4.39E-07
1	0.1	6.55E-03	3.14	1.28E-10	3.15E+07	3.26E-04	770	1.83E-07	4.51E-16	4.39E-07	3.19E-16	10	3.16E+07	1.00E-09	4.38E-07
2	0.1	6.55E-03	3.14	1.28E-10	6.31E+07	3.26E-04	770	1.83E-07	3.19E-16	4.38E-07	2.60E-16	10	3.16E+07	8.20E-10	4.37E-07
3	0.1	6.55E-03	3.14	1.28E-10	9.46E+07	3.26E-04	770	1.83E-07	2.60E-16	4.37E-07	2.25E-16	10	3.16E+07	7.10E-10	4.36E-07
4	0.1	6.55E-03	3.14	1.28E-10	1.26E+08	3.26E-04	770	1.83E-07	2.25E-16	4.36E-07	2.01E-16	10	3.16E+07	6.35E-10	4.35E-07
5	0.1	6.55E-03	3.14	1.28E-10	1.58E+08	3.26E-04	770	1.83E-07	2.01E-16	4.35E-07	1.84E-16	10	3.16E+07	5.80E-10	4.35E-07
6	0.1	6.55E-03	3.14	1.28E-10	1.89E+08	3.26E-04	770	1.83E-07	1.84E-16	4.35E-07	1.70E-16	10	3.16E+07	5.37E-10	4.34E-07
7	0.1	6.55E-03	3.14	1.28E-10	2.21E+08	3.26E-04	770	1.83E-07	1.70E-16	4.34E-07	1.59E-16	10	3.16E+07	5.02E-10	4.34E-07
8	0.1	6.55E-03	3.14	1.28E-10	2.52E+08	3.26E-04	770	1.83E-07	1.59E-16	4.34E-07	1.50E-16	10	3.16E+07	4.74E-10	4.33E-07
9	0.1	6.55E-03	3.14	1.28E-10	2.84E+08	3.26E-04	770	1.83E-07	1.50E-16	4.33E-07	1.42E-16	10	3.16E+07	4.49E-10	4.33E-07
10	0.1	6.55E-03	3.14	1.28E-10	3.15E+08	3.26E-04	770	1.83E-07	1.42E-16	4.33E-07	1.36E-16	10	3.16E+07	4.26E-10	4.32E-07
11	0.1	6.55E-03	3.14	1.28E-10	3.47E+08	3.26E-04	770	1.83E-07	1.36E-16	4.32E-07	1.30E-16	10	3.16E+07	4.10E-10	4.32E-07
12	0.1	6.55E-03	3.14	1.28E-10	3.78E+08	3.26E-04	770	1.83E-07	1.30E-16	4.32E-07	1.25E-16	10	3.16E+07	3.94E-10	4.32E-07
13	0.1	6.55E-03	3.14	1.28E-10	4.10E+08	3.26E-04	770	1.83E-07	1.25E-16	4.32E-07	1.20E-16	10	3.16E+07	3.80E-10	4.31E-07
14	0.1	6.55E-03	3.14	1.28E-10	4.42E+08	3.26E-04	770	1.83E-07	1.20E-16	4.31E-07	1.16E-16	10	3.16E+07	3.67E-10	4.31E-07
15	0.1	6.55E-03	3.14	1.28E-10	4.73E+08	3.26E-04	770	1.83E-07	1.16E-16	4.31E-07	1.13E-16	10	3.16E+07	3.55E-10	4.31E-07
16	0.1	6.55E-03	3.14	1.28E-10	5.05E+08	3.26E-04	770	1.83E-07	1.13E-16	4.31E-07	1.09E-16	10	3.16E+07	3.45E-10	4.30E-07
17	0.1	6.55E-03	3.14	1.28E-10	5.36E+08	3.26E-04	770	1.83E-07	1.09E-16	4.30E-07	1.06E-16	10	3.16E+07	3.36E-10	4.30E-07
18	0.1	6.55E-03	3.14	1.28E-10	5.68E+08	3.26E-04	770	1.83E-07	1.06E-16	4.30E-07	1.03E-16	10	3.16E+07	3.26E-10	4.30E-07
19	0.1	6.55E-03	3.14	1.28E-10	5.99E+08	3.26E-04	770	1.83E-07	1.03E-16	4.30E-07	1.01E-16	10	3.16E+07	3.18E-10	4.29E-07
20	0.1	6.55E-03	3.14	1.28E-10	6.31E+08	3.26E-04	770	1.83E-07	1.01E-16	4.29E-07	9.83E-17	10	3.16E+07	3.10E-10	4.29E-07
21	0.1	6.55E-03	3.14	1.28E-10	6.62E+08	3.26E-04	770	1.83E-07	9.83E-17	4.29E-07	9.61E-17	10	3.16E+07	3.03E-10	4.29E-07
22	0.1	6.55E-03	3.14	1.28E-10	6.94E+08	3.26E-04	770	1.83E-07	9.61E-17	4.29E-07	9.39E-17	10	3.16E+07	2.96E-10	4.28E-07
23	0.1	6.55E-03	3.14	1.28E-10	7.25E+08	3.26E-04	770	1.83E-07	9.39E-17	4.28E-07	9.20E-17	10	3.16E+07	2.90E-10	4.28E-07
24	0.1	6.55E-03	3.14	1.28E-10	7.57E+08	3.26E-04	770	1.83E-07	9.20E-17	4.28E-07	9.01E-17	10	3.16E+07	2.84E-10	4.28E-07
25	0.1	6.55E-03	3.14	1.28E-10	7.88E+08	3.26E-04	770	1.83E-07	9.01E-17	4.28E-07	8.84E-17	10	3.16E+07	2.79E-10	4.27E-07
26	0.1	6.55E-03	3.14	1.28E-10	8.20E+08	3.26E-04	770	1.83E-07	8.84E-17	AVERAGE					4.32E-07

Building No. 3
Basement
Volatilization of 4,4'-DDD
From Basement Soil

Hwang DeFalco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where:	Na =	Instantaneous emission flux rate (g/cm²-s)	
	E =	Soil (or medium) porosity (unitless)	0.2
	Del =	Effective diffusivity in soil (cm²/s) = Di x $E^{0.33}$	
	Di =	Diffusion coefficient in air (cm²/s)	1.40E-02
	π =	PI (3.14)	
	t =	Time from sampling (s)	
	H =	Henry's Law Constant (dimensionless form)	3.26E-04
	Kd =	Soil/water partition coefficient (cm³/g) = Koc x foc	4620
	Koc =	Organic carbon water partition coefficient (cm³/g)	7.70E+05
	foc =	Fraction of organic carbon in material (g/g)	0.006
	Cs =	Initial concentration in soil or medium (mg/kg)	6.61

Calculation of Del Del = Di x $E^{0.33}$

Di (cm²/s)	E (unitless)	Del (cm²/s)
1.40E-02	0.2	8.23E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$$

Del (cm²/s)	E (unitless)	Ps (g/cm³)	Kd (cm³/g)	H (unitless)	α (cm²/s)
8.23E-03	0.2	2.65	4620	3.26E-04	5.47E-11

Calculation of Cw Cs = Cs x CF1 x CF2

Csoil (mg/kg)	CF1 (g/mg)	CF2 (kg/g)	Cs (g/g)	ρs (g/cm³)	d (cm)	Cw (g/cm³)
6.61	1.00E-03	1.00E-03	6.61E-06	2.65	1	1.7517E-05

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

E (unitless)	Del (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Cs (g/g)	Na (g/cm²-s)
0.2	8.23E-03	3.14	5.47E-11	7.88E+08	3.26E-04	4620	6.61E-06	2.08E-15

Calculation of Avg Na Avg Na (T = 25yr) =2 Na (T yr)

Na g/cm²-s	AvgNa g/cm²-s
2.08E-15	4.17E-15

Building No. 3
Basement
Volatilization of 4,4'-DDD
From Basement Soil

Year	E (unitless)	Del (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Cs (g/g)	Ns (g/cm^2-s)	Initial Conc (g/cm^3)	Ns (g/cm^2-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm^3)	Mass Remaining (g/cm^3)
1 sec	0.2	8.23E-03	3.14	5.47E-11	1.00E+00	3.26E-04	4620	6.61E-06	5.85E-11	1.75E-05	1.04E-14	10	3.15E+07	3.2851E-08	1.75E-05
1	0.2	8.23E-03	3.14	5.47E-11	3.15E+07	3.26E-04	4620	6.61E-06	1.04E-14	1.75E-05	7.37E-15	10	3.15E+07	2.3229E-08	1.75E-05
2	0.2	8.23E-03	3.14	5.47E-11	6.31E+07	3.26E-04	4620	6.61E-06	7.37E-15	1.75E-05	6.01E-15	10	3.15E+07	1.8967E-08	1.74E-05
3	0.2	8.23E-03	3.14	5.47E-11	9.46E+07	3.26E-04	4620	6.61E-06	6.01E-15	1.74E-05	5.21E-15	10	3.15E+07	1.6426E-08	1.74E-05
4	0.2	8.23E-03	3.14	5.47E-11	1.26E+08	3.26E-04	4620	6.61E-06	5.21E-15	1.74E-05	4.66E-15	10	3.15E+07	1.4692E-08	1.74E-05
5	0.2	8.23E-03	3.14	5.47E-11	1.58E+08	3.26E-04	4620	6.61E-06	4.66E-15	1.74E-05	4.25E-15	10	3.15E+07	1.3412E-08	1.74E-05
6	0.2	8.23E-03	3.14	5.47E-11	1.89E+08	3.26E-04	4620	6.61E-06	4.25E-15	1.74E-05	3.94E-15	10	3.15E+07	1.2417E-08	1.74E-05
7	0.2	8.23E-03	3.14	5.47E-11	2.21E+08	3.26E-04	4620	6.61E-06	3.94E-15	1.74E-05	3.68E-15	10	3.15E+07	1.1615E-08	1.74E-05
8	0.2	8.23E-03	3.14	5.47E-11	2.52E+08	3.26E-04	4620	6.61E-06	3.68E-15	1.74E-05	3.47E-15	10	3.15E+07	1.095E-08	1.74E-05
9	0.2	8.23E-03	3.14	5.47E-11	2.84E+08	3.26E-04	4620	6.61E-06	3.47E-15	1.74E-05	3.29E-15	10	3.15E+07	1.0389E-08	1.74E-05
10	0.2	8.23E-03	3.14	5.47E-11	3.15E+08	3.26E-04	4620	6.61E-06	3.29E-15	1.74E-05	3.14E-15	10	3.15E+07	9.9051E-09	1.73E-05
11	0.2	8.23E-03	3.14	5.47E-11	3.47E+08	3.26E-04	4620	6.61E-06	3.14E-15	1.73E-05	3.01E-15	10	3.15E+07	9.4834E-09	1.73E-05
12	0.2	8.23E-03	3.14	5.47E-11	3.78E+08	3.26E-04	4620	6.61E-06	3.01E-15	1.73E-05	2.89E-15	10	3.15E+07	9.1113E-09	1.73E-05
13	0.2	8.23E-03	3.14	5.47E-11	4.10E+08	3.26E-04	4620	6.61E-06	2.89E-15	1.73E-05	2.78E-15	10	3.15E+07	8.7799E-09	1.73E-05
14	0.2	8.23E-03	3.14	5.47E-11	4.42E+08	3.26E-04	4620	6.61E-06	2.78E-15	1.73E-05	2.69E-15	10	3.15E+07	8.4822E-09	1.73E-05
15	0.2	8.23E-03	3.14	5.47E-11	4.73E+08	3.26E-04	4620	6.61E-06	2.69E-15	1.73E-05	2.60E-15	10	3.15E+07	8.2129E-09	1.73E-05
16	0.2	8.23E-03	3.14	5.47E-11	5.05E+08	3.26E-04	4620	6.61E-06	2.60E-15	1.73E-05	2.53E-15	10	3.15E+07	7.9676E-09	1.73E-05
17	0.2	8.23E-03	3.14	5.47E-11	5.36E+08	3.26E-04	4620	6.61E-06	2.53E-15	1.73E-05	2.46E-15	10	3.15E+07	7.7432E-09	1.73E-05
18	0.2	8.23E-03	3.14	5.47E-11	5.68E+08	3.26E-04	4620	6.61E-06	2.46E-15	1.73E-05	2.39E-15	10	3.15E+07	7.5366E-09	1.73E-05
19	0.2	8.23E-03	3.14	5.47E-11	5.99E+08	3.26E-04	4620	6.61E-06	2.39E-15	1.73E-05	2.33E-15	10	3.15E+07	7.3468E-09	1.73E-05
20	0.2	8.23E-03	3.14	5.47E-11	6.31E+08	3.26E-04	4620	6.61E-06	2.33E-15	1.73E-05	2.27E-15	10	3.15E+07	7.1668E-09	1.73E-05
21	0.2	8.23E-03	3.14	5.47E-11	6.62E+08	3.26E-04	4620	6.61E-06	2.27E-15	1.73E-05	2.22E-15	10	3.15E+07	7.0039E-09	1.73E-05
22	0.2	8.23E-03	3.14	5.47E-11	6.94E+08	3.26E-04	4620	6.61E-06	2.22E-15	1.73E-05	2.17E-15	10	3.15E+07	6.85E-09	1.72E-05
23	0.2	8.23E-03	3.14	5.47E-11	7.25E+08	3.26E-04	4620	6.61E-06	2.17E-15	1.72E-05	2.13E-15	10	3.15E+07	6.7058E-09	1.72E-05
24	0.2	8.23E-03	3.14	5.47E-11	7.57E+08	3.26E-04	4620	6.61E-06	2.13E-15	1.72E-05	2.08E-15	10	3.15E+07	6.5703E-09	1.72E-05
25	0.2	8.23E-03	3.14	5.47E-11	7.88E+08	3.26E-04	4620	6.61E-06	2.08E-15	1.72E-05	2.04E-15	10	3.15E+07	6.4427E-09	1.72E-05
26	0.2	8.23E-03	3.14	5.47E-11	8.20E+08	3.26E-04	4620	6.61E-06	2.04E-15	AVERAGE					1.73E-05

APPENDIX E
4,4'-DDE

BUILDING NO.3
BASEMENT
VOLATILIZATION OF 4,4'-DDE
FROM CEILING SURFACES

Hwang DeFalco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where: Na =	Instantaneous emission flux rate (g/cm²-s)		
E =	Soil (or medium) porosity) (unitless)		0.1
Del =	Effective diffusivity in soil (cm²/s) = Di x E^0.33		
Di =	Diffusion coefficient in air (cm²/s)		1.44E-02
π =	PI (3.14)		
t =	Time from sampling (s)		
H =	Henry's Law Constant (dimensionless form)		2.78E-03
Kd =	Soil/water partition coefficient (cm³/g) = Koc x foc		4400
Koc =	Organic carbon water partition coefficient (cm³/g)		4.40E+06
foc =	Fraction of organic carbon in material (g/g)		0.001
Cs =	Initial concentration in soil or medium (g/g)		
Cwipe (Ceiling)		(µg/cm²)	0.0011
Cwipe (Ceiling)		(g/cm²)	1.1E-09

Calculation of Del

$$Del = Di \times E^{0.33}$$

Di (cm²/s)	E (unitless)	Del (cm²/s)
1.44E-02	0.1	6.74E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$$

Del (cm²/s)	E (unitless)	Ps (g/cm³)	Kd (cm³/g)	H (unitless)	α (cm²/s)
6.74E-03	0.1	2.4	4400	2.78E-03	1.97E-10

Calculation of Cs

$$Cs = Cwipe \times CF/\rho_s \times d$$

Cwipe (µg/cm²)	CF (g/µg)	d (cm)	ρ (g/cm³)	Cs (g/g)
0.0011	1.00E-06	1	2.4	4.58E-10

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

E (unitless)	Del (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Cs (g/g)	Na (g/cm²-s)
0.1	6.74E-03	3.14	1.97E-10	7.88E+08	2.78E-03	4400	4.58E-10	2.79E-19

Calculation of Avg Na

Avg Na (T = 25yr) = 2 Na (T yr)

Na g/cm²-s	AvgNa g/cm²-s
2.79E-19	5.58E-19

BUILDING NO.3
BASEMENT
VOLATILIZATION OF 4,4'-DDE
FROM CEILING SURFACES

Calculation or Air Conc $Ca = (Na \times CF1 \times A \times t_e \times CF2 \times CF3) / V$

Where:

	Ca =	Predicted air concentration in building (mg/m^3)
	Na =	Average emission flux (g/cm^2-s)
	A =	Area of room (cm^2)
	t_e =	Air exchange rate (s)
	V =	Volume of room (cm^3)
	CF1 =	Unit conversion factor (s/hr)
	CF2 =	Unit conversion factor (mg/g)
	CF3 =	Unit conversion factor (cm^3/m^3)

Chemical	Material	Avg Na (g/cm^2-s)	CF1 (s/hr)	A (cm^2)	t_e (hr)	CF2 (mg/g)	CF3 (cm^3/m^3)	V (cm^3)	Ca (mg/m^3)
4,4-DDE	Ceiling	5.59E-19	3600	1.35E+08	0.233	1000	1.00E+06	3.29E+10	1.92E-09

Year	E (unitless)	Dei (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Cs (g/g)	Na (g/cm^2-s)	Initial Conc (g/cm^3)	Na (g/cm^2-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm^3)	Mass Remaining (g/cm^3)
1 sec	0.1	6.74E-03	3.14	1.97E-10	1.00E+00	2.78E-03	4400	4.58E-10	7.84E-15	1.10E-09	1.40E-18	10	3.15E+07	4.40E-12	1.10E-09
1	0.1	6.74E-03	3.14	1.97E-10	3.15E+07	2.78E-03	4400	4.58E-10	1.40E-18	1.10E-09	9.88E-19	10	3.15E+07	3.11E-12	1.09E-09
2	0.1	6.74E-03	3.14	1.97E-10	6.31E+07	2.78E-03	4400	4.58E-10	9.88E-19	1.09E-09	8.06E-19	10	3.15E+07	2.54E-12	1.09E-09
3	0.1	6.74E-03	3.14	1.97E-10	9.46E+07	2.78E-03	4400	4.58E-10	8.06E-19	1.09E-09	6.98E-19	10	3.15E+07	2.20E-12	1.09E-09
4	0.1	6.74E-03	3.14	1.97E-10	1.26E+08	2.78E-03	4400	4.58E-10	6.98E-19	1.09E-09	6.25E-19	10	3.15E+07	1.97E-12	1.09E-09
5	0.1	6.74E-03	3.14	1.97E-10	1.58E+08	2.78E-03	4400	4.58E-10	6.25E-19	1.09E-09	5.70E-19	10	3.15E+07	1.80E-12	1.08E-09
6	0.1	6.74E-03	3.14	1.97E-10	1.89E+08	2.78E-03	4400	4.58E-10	5.70E-19	1.08E-09	5.28E-19	10	3.15E+07	1.66E-12	1.08E-09
7	0.1	6.74E-03	3.14	1.97E-10	2.21E+08	2.78E-03	4400	4.58E-10	5.28E-19	1.08E-09	4.94E-19	10	3.15E+07	1.56E-12	1.08E-09
8	0.1	6.74E-03	3.14	1.97E-10	2.52E+08	2.78E-03	4400	4.58E-10	4.94E-19	1.08E-09	4.66E-19	10	3.15E+07	1.47E-12	1.08E-09
9	0.1	6.74E-03	3.14	1.97E-10	2.84E+08	2.78E-03	4400	4.58E-10	4.66E-19	1.08E-09	4.42E-19	10	3.15E+07	1.39E-12	1.08E-09
10	0.1	6.74E-03	3.14	1.97E-10	3.15E+08	2.78E-03	4400	4.58E-10	4.42E-19	1.08E-09	4.21E-19	10	3.15E+07	1.33E-12	1.08E-09
11	0.1	6.74E-03	3.14	1.97E-10	3.47E+08	2.78E-03	4400	4.58E-10	4.21E-19	1.08E-09	4.03E-19	10	3.15E+07	1.27E-12	1.08E-09
12	0.1	6.74E-03	3.14	1.97E-10	3.78E+08	2.78E-03	4400	4.58E-10	4.03E-19	1.08E-09	3.87E-19	10	3.15E+07	1.22E-12	1.07E-09
13	0.1	6.74E-03	3.14	1.97E-10	4.10E+08	2.78E-03	4400	4.58E-10	3.87E-19	1.07E-09	3.73E-19	10	3.15E+07	1.18E-12	1.07E-09
14	0.1	6.74E-03	3.14	1.97E-10	4.42E+08	2.78E-03	4400	4.58E-10	3.73E-19	1.07E-09	3.61E-19	10	3.15E+07	1.14E-12	1.07E-09
15	0.1	6.74E-03	3.14	1.97E-10	4.73E+08	2.78E-03	4400	4.58E-10	3.61E-19	1.07E-09	3.49E-19	10	3.15E+07	1.10E-12	1.07E-09
16	0.1	6.74E-03	3.14	1.97E-10	5.05E+08	2.78E-03	4400	4.58E-10	3.49E-19	1.07E-09	3.38E-19	10	3.15E+07	1.07E-12	1.07E-09
17	0.1	6.74E-03	3.14	1.97E-10	5.36E+08	2.78E-03	4400	4.58E-10	3.38E-19	1.07E-09	3.29E-19	10	3.15E+07	1.04E-12	1.07E-09
18	0.1	6.74E-03	3.14	1.97E-10	5.68E+08	2.78E-03	4400	4.58E-10	3.29E-19	1.07E-09	3.20E-19	10	3.15E+07	1.01E-12	1.07E-09
19	0.1	6.74E-03	3.14	1.97E-10	5.99E+08	2.78E-03	4400	4.58E-10	3.20E-19	1.07E-09	3.12E-19	10	3.15E+07	9.85E-13	1.07E-09
20	0.1	6.74E-03	3.14	1.97E-10	6.31E+08	2.78E-03	4400	4.58E-10	3.12E-19	1.07E-09	3.05E-19	10	3.15E+07	9.61E-13	1.07E-09
21	0.1	6.74E-03	3.14	1.97E-10	6.62E+08	2.78E-03	4400	4.58E-10	3.05E-19	1.07E-09	2.98E-19	10	3.15E+07	9.38E-13	1.06E-09
22	0.1	6.74E-03	3.14	1.97E-10	6.94E+08	2.78E-03	4400	4.58E-10	2.98E-19	1.06E-09	2.91E-19	10	3.15E+07	9.16E-13	1.06E-09
23	0.1	6.74E-03	3.14	1.97E-10	7.26E+08	2.78E-03	4400	4.58E-10	2.91E-19	1.06E-09	2.85E-19	10	3.15E+07	8.95E-13	1.06E-09
24	0.1	6.74E-03	3.14	1.97E-10	7.57E+08	2.78E-03	4400	4.58E-10	2.85E-19	1.06E-09	2.79E-19	10	3.15E+07	8.81E-13	1.06E-09
25	0.1	6.74E-03	3.14	1.97E-10	7.88E+08	2.78E-03	4400	4.58E-10	2.79E-19	1.06E-09	2.74E-19	10	3.15E+07	8.64E-13	1.06E-09
26	0.1	6.74E-03	3.14	1.97E-10	8.20E+08	2.78E-03	4400	4.58E-10	2.74E-19	AVERAGE					1.07E-09

APPENDIX E
4,4'-DDT

BUILDING NO. 3
BASEMENT
CALCULATION OF AIR CONCENTRATIONS
4,4'-DDT

Equation $Ca = (E \times CF1 \times t_e \times CF2) / (V \times CF3)$

Where:

Ca =	Predicted air concentration in building (mg/m^3)
E =	Average emission rate from all sources (g/s)
t_e =	Air exchange rate (hr)
V =	Volume of room (cm^3)
CF1 =	Unit conversion factor (s/hr)
CF2 =	Unit conversion factor (mg/g)
CF3 =	Unit conversion factor (m^3/cm^3)

Source	Average Na (g/cm^2-s)	Applicable Area (cm^2)	Emission Rate (g/s)
Floor	7.56E-15	2.70E+07	2.04E-07
Wall	4.80E-15	1.47E+07	7.06E-08
Ceiling	2.58E-15	1.35E+08	3.49E-07
Soil	5.78E-15	1.08E+08	6.24E-07
Total			**1.25E-06**

Chemical	E (g/s)	CF1 (s/hr)	t_e (hr)	CF2 (mg/g)	CF3 (m^3/cm^3)	V (cm^3)	Ca (mg/m^3)
4,4'DDT	1.25E-06	3600	0.233	1000	1.00E-06	3.29E+10	3.18E-05

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF 4,4'-DDT
FROM FLOOR SURFACES

Hwang DeFalco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where:

Na =	Instantaneous emission flux rate (g/cm^2-s)		
E =	Soil (or medium) porosity) (unitless)		0.1
Del =	Effective diffusivity in soil (cm^2/s) = Di x $E^{0.33}$		
Di =	Diffusion coefficient in air (cm^2/s)		1.37E-02
π =	PI (3.14)		
t =	Time from sampling (s)		
H =	Henry's Law Constant (dimensionless form)		2.10E-02
Kd =	Soil/water partition coefficient (cm^3/g) =		243
Koc =	Organic carbon water partition coefficient (cm^3/g)		2.43E+06
foc =	Fraction of organic carbon in material (g/g)		0.001
Cs =	Initial concentration in soil or medium (g/g)		
Cwipe (Floor)		(μg/cm^2)	1.305
Cwipe (Floor)		(g/cm^2)	1.305E-06

Calculation of Del Del = Di x $E^{0.33}$

Di (cm^2/s)	E (unitless)	Del (cm^2/s)
1.37E-02	0.1	6.41E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$$

Del (cm^2/s)	E (unitless)	Ps (g/cm^3)	Kd (cm^3/g)	H (unitless)	α (cm^2/s)
6.41E-03	0.1	2.4	243	2.10E-02	2.56E-08

Calculation of Cs Cs = Cwipe x CF/ρ_s x d

Cwipe (μg/cm^2)	CF (g/μg)	d (cm)	ρ (g/cm^3)	Cs (g/g)
1.305	1.00E-06	1	2.4	5.44E-07

Calculation of Na Na =

$$\frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

E (unitless)	Del (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Cs (g/g)	Na (g/cm^2-s)
0.1	6.41E-03	3.14	2.56E-08	7.88E+08	2.10E-02	243	5.44E-07	3.78E-15

Calculation of Avg Na Avg Na (T = 25yr) =2 Na (T yr)

Na g/cm^2-s	AvgNa g/cm^2-s
3.78E-15	7.56E-15

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF 4,4'-DDT
FROM FLOOR SURFACES

Year	E (unitless)	Del (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Cs (g/g)	Ns (g/cm^2-s)	Initial Conc (g/cm^3)	Ns (g/cm^2-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm^2)	Mass Remaining (g/cm^2)
1 sec	0.1	6.41E-03	3.14	2.56E-06	1.00E+00	2.10E-02	243	5.44E-07	1.06E-10	1.31E-06	1.89E-14	10	3.15E+07	5.967E-08	1.25E-06
1	0.1	6.41E-03	3.14	2.56E-06	3.15E+07	2.10E-02	243	5.44E-07	1.89E-14	1.25E-06	1.34E-14	10	3.15E+07	4.212E-08	1.20E-06
2	0.1	6.41E-03	3.14	2.56E-06	6.31E+07	2.10E-02	243	5.44E-07	1.34E-14	1.20E-06	1.09E-14	10	3.15E+07	3.439E-08	1.17E-06
3	0.1	6.41E-03	3.14	2.56E-06	9.46E+07	2.10E-02	243	5.44E-07	1.09E-14	1.17E-06	9.45E-15	10	3.15E+07	2.979E-08	1.14E-06
4	0.1	6.41E-03	3.14	2.56E-06	1.26E+08	2.10E-02	243	5.44E-07	9.45E-15	1.14E-06	8.45E-15	10	3.15E+07	2.664E-08	1.11E-06
5	0.1	6.41E-03	3.14	2.56E-06	1.58E+08	2.10E-02	243	5.44E-07	8.45E-15	1.11E-06	7.71E-15	10	3.15E+07	2.432E-08	1.09E-06
6	0.1	6.41E-03	3.14	2.56E-06	1.89E+08	2.10E-02	243	5.44E-07	7.71E-15	1.09E-06	7.14E-15	10	3.15E+07	2.252E-08	1.07E-06
7	0.1	6.41E-03	3.14	2.56E-06	2.21E+08	2.10E-02	243	5.44E-07	7.14E-15	1.07E-06	6.68E-15	10	3.15E+07	2.106E-08	1.04E-06
8	0.1	6.41E-03	3.14	2.56E-06	2.52E+08	2.10E-02	243	5.44E-07	6.68E-15	1.04E-06	6.30E-15	10	3.15E+07	1.986E-08	1.02E-06
9	0.1	6.41E-03	3.14	2.56E-06	2.84E+08	2.10E-02	243	5.44E-07	6.30E-15	1.02E-06	5.97E-15	10	3.15E+07	1.884E-08	1.01E-06
10	0.1	6.41E-03	3.14	2.56E-06	3.15E+08	2.10E-02	243	5.44E-07	5.97E-15	1.01E-06	5.70E-15	10	3.15E+07	1.796E-08	9.88E-07
11	0.1	6.41E-03	3.14	2.56E-06	3.47E+08	2.10E-02	243	5.44E-07	5.70E-15	9.88E-07	5.45E-15	10	3.15E+07	1.72E-08	9.71E-07
12	0.1	6.41E-03	3.14	2.56E-06	3.78E+08	2.10E-02	243	5.44E-07	5.45E-15	9.71E-07	5.24E-15	10	3.15E+07	1.662E-08	9.54E-07
13	0.1	6.41E-03	3.14	2.56E-06	4.10E+08	2.10E-02	243	5.44E-07	5.24E-15	9.54E-07	5.05E-15	10	3.15E+07	1.602E-08	9.38E-07
14	0.1	6.41E-03	3.14	2.56E-06	4.42E+08	2.10E-02	243	5.44E-07	5.05E-15	9.38E-07	4.88E-15	10	3.15E+07	1.539E-08	9.23E-07
15	0.1	6.41E-03	3.14	2.56E-06	4.73E+08	2.10E-02	243	5.44E-07	4.88E-15	9.23E-07	4.72E-15	10	3.15E+07	1.489E-08	9.08E-07
16	0.1	6.41E-03	3.14	2.56E-06	5.05E+08	2.10E-02	243	5.44E-07	4.72E-15	9.08E-07	4.56E-15	10	3.15E+07	1.445E-08	8.94E-07
17	0.1	6.41E-03	3.14	2.56E-06	5.36E+08	2.10E-02	243	5.44E-07	4.56E-15	8.94E-07	4.45E-15	10	3.15E+07	1.404E-08	8.80E-07
18	0.1	6.41E-03	3.14	2.56E-06	5.68E+08	2.10E-02	243	5.44E-07	4.45E-15	8.80E-07	4.33E-15	10	3.15E+07	1.367E-08	8.66E-07
19	0.1	6.41E-03	3.14	2.56E-06	5.99E+08	2.10E-02	243	5.44E-07	4.33E-15	8.66E-07	4.22E-15	10	3.15E+07	1.332E-08	8.53E-07
20	0.1	6.41E-03	3.14	2.56E-06	6.31E+08	2.10E-02	243	5.44E-07	4.22E-15	8.53E-07	4.12E-15	10	3.15E+07	1.3E-08	8.40E-07
21	0.1	6.41E-03	3.14	2.56E-06	6.62E+08	2.10E-02	243	5.44E-07	4.12E-15	8.40E-07	4.03E-15	10	3.15E+07	1.27E-08	8.27E-07
22	0.1	6.41E-03	3.14	2.56E-06	6.94E+08	2.10E-02	243	5.44E-07	4.03E-15	8.27E-07	3.94E-15	10	3.15E+07	1.242E-08	8.14E-07
23	0.1	6.41E-03	3.14	2.56E-06	7.26E+08	2.10E-02	243	5.44E-07	3.94E-15	8.14E-07	3.86E-15	10	3.15E+07	1.216E-08	8.02E-07
24	0.1	6.41E-03	3.14	2.56E-06	7.57E+08	2.10E-02	243	5.44E-07	3.86E-15	8.02E-07	3.78E-15	10	3.15E+07	1.191E-08	7.90E-07
25	0.1	6.41E-03	3.14	2.56E-06	7.88E+08	2.10E-02	243	5.44E-07	3.78E-15	7.90E-07	3.70E-15	10	3.15E+07	1.166E-08	7.78E-07
26	0.1	6.41E-03	3.14	2.56E-06	8.20E+08	2.10E-02	243	5.44E-07	3.70E-15	AVERAGE					9.66E-07

BULDING NO. 3
BASEMENT
VOLATILIZATION OF 4,4'-DDT
FROM VERTICAL SURFACES

Hwang DeFelco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where: Na =	Instantaneous emission flux rate (g/cm^2-s)		
E =	Soil (or medium) porosity) (unitless)		0.1
Del =	Effective diffusivity in soil (cm^2/s) = Di x $E^{0.33}$		
Di =	Diffusion coefficient in air (cm^2/s)		1.37E-02
π =	PI (3.14)		
t =	Time from sampling (s)		
H =	Henry's Law Constant (dimensionless form)		2.10E-02
Kd =	Soil/water partition coefficient (cm^3/g) = Koc x foc		243
Koc =	Organic carbon water partition coefficient (cm^3/g)		2.43E+05
foc =	Fraction of organic carbon in material (g/g)		0.001
Cs =	Initial concentration in soil or medium (g/g)		
Cwipe (Wet)		($\mu g/cm^2$)	0.829
Cwipe (Wet)		(g/cm^2)	0.000000829

Calculation of Del

Del = Di x $E^{0.33}$

Di (cm^2/s)	E (unitless)	Del (cm^2/s)
1.37E-02	0.1	6.41E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$$

Del (cm^2/s)	E (unitless)	Ps (g/cm^3)	Kd (cm^3/g)	H (unitless)	α (cm^2/s)
6.41E-03	0.1	2.4	243	2.10E-02	2.56E-06

Calculation of Cs

Cs = Cwipe x CF/ρ_s x d

Cwipe ($\mu g/cm^2$)	CF ($g/\mu g$)	d (cm)	ρ (g/cm^3)	Cs (g/g)
0.829	1.00E-06	1	2.4	3.45E-07

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

E (unitless)	Del (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Cs (g/g)	Na (g/cm^2-s)
0.1	6.41E-03	3.14	2.56E-06	7.88E+08	2.10E-02	243	3.45E-07	2.40E-15

Calculation of Avg Na

Avg Na (T = 20yr) =2 Na (T yr)

Na g/cm^2-s	AvgNa g/cm^2-s
2.40E-15	4.80E-15

BULDING NO. 3
BASEMENT
VOLATILIZATION OF 4,4'-DDT
FROM VERTICAL SURFACES

Year	E (unitless)	Del (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Cs (g/g)	Na (g/cm^2-s)	Initial Conc (g/cm^3)	Ns (g/cm^2-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm^2)	Mass Remaining (g/cm^2)
1 sec	0.1	6.41E-03	3.14	2.56E-08	1.00E+00	2.10E-02	243	3.45E-07	6.74E-11	8.29E-07	1.20E-14	10	3.15E+07	3.78E-08	7.91E-07
1	0.1	6.41E-03	3.14	2.56E-08	3.16E+07	2.10E-02	243	3.45E-07	1.20E-14	7.91E-07	8.49E-16	10	3.15E+07	2.68E-08	7.64E-07
2	0.1	6.41E-03	3.14	2.56E-08	6.31E+07	2.10E-02	243	3.45E-07	8.49E-16	7.64E-07	6.93E-16	10	3.15E+07	2.18E-08	7.43E-07
3	0.1	6.41E-03	3.14	2.56E-08	9.46E+07	2.10E-02	243	3.45E-07	6.93E-16	7.43E-07	6.00E-16	10	3.15E+07	1.89E-08	7.24E-07
4	0.1	6.41E-03	3.14	2.56E-08	1.26E+08	2.10E-02	243	3.45E-07	6.00E-16	7.24E-07	5.37E-16	10	3.15E+07	1.69E-08	7.07E-07
5	0.1	6.41E-03	3.14	2.56E-08	1.58E+08	2.10E-02	243	3.45E-07	5.37E-16	7.07E-07	4.90E-16	10	3.15E+07	1.54E-08	6.91E-07
6	0.1	6.41E-03	3.14	2.56E-08	1.89E+08	2.10E-02	243	3.45E-07	4.90E-16	6.91E-07	4.54E-16	10	3.15E+07	1.43E-08	6.77E-07
7	0.1	6.41E-03	3.14	2.56E-08	2.21E+08	2.10E-02	243	3.45E-07	4.54E-16	6.77E-07	4.24E-16	10	3.15E+07	1.34E-08	6.64E-07
8	0.1	6.41E-03	3.14	2.56E-08	2.52E+08	2.10E-02	243	3.45E-07	4.24E-16	6.64E-07	4.00E-16	10	3.15E+07	1.26E-08	6.51E-07
9	0.1	6.41E-03	3.14	2.56E-08	2.84E+08	2.10E-02	243	3.45E-07	4.00E-16	6.51E-07	3.79E-16	10	3.15E+07	1.20E-08	6.39E-07
10	0.1	6.41E-03	3.14	2.56E-08	3.15E+08	2.10E-02	243	3.45E-07	3.79E-16	6.39E-07	3.62E-16	10	3.15E+07	1.14E-08	6.28E-07
11	0.1	6.41E-03	3.14	2.56E-08	3.47E+08	2.10E-02	243	3.45E-07	3.62E-16	6.28E-07	3.46E-16	10	3.15E+07	1.09E-08	6.17E-07
12	0.1	6.41E-03	3.14	2.56E-08	3.78E+08	2.10E-02	243	3.45E-07	3.46E-16	6.17E-07	3.33E-16	10	3.15E+07	1.05E-08	6.06E-07
13	0.1	6.41E-03	3.14	2.56E-08	4.10E+08	2.10E-02	243	3.45E-07	3.33E-16	6.06E-07	3.21E-16	10	3.15E+07	1.01E-08	5.96E-07
14	0.1	6.41E-03	3.14	2.56E-08	4.42E+08	2.10E-02	243	3.45E-07	3.21E-16	5.96E-07	3.10E-16	10	3.15E+07	9.77E-09	5.86E-07
15	0.1	6.41E-03	3.14	2.56E-08	4.73E+08	2.10E-02	243	3.45E-07	3.10E-16	5.86E-07	3.00E-16	10	3.15E+07	9.46E-09	5.77E-07
16	0.1	6.41E-03	3.14	2.56E-08	5.05E+08	2.10E-02	243	3.45E-07	3.00E-16	5.77E-07	2.91E-16	10	3.15E+07	9.16E-09	5.68E-07
17	0.1	6.41E-03	3.14	2.56E-08	5.36E+08	2.10E-02	243	3.45E-07	2.91E-16	5.68E-07	2.83E-16	10	3.15E+07	8.92E-09	5.59E-07
18	0.1	6.41E-03	3.14	2.56E-08	5.68E+08	2.10E-02	243	3.45E-07	2.83E-16	5.59E-07	2.75E-16	10	3.15E+07	8.68E-09	5.50E-07
19	0.1	6.41E-03	3.14	2.56E-08	5.99E+08	2.10E-02	243	3.45E-07	2.75E-16	5.50E-07	2.68E-16	10	3.15E+07	8.46E-09	5.42E-07
20	0.1	6.41E-03	3.14	2.56E-08	6.31E+08	2.10E-02	243	3.45E-07	2.68E-16	5.42E-07	2.62E-16	10	3.15E+07	8.26E-09	5.33E-07
21	0.1	6.41E-03	3.14	2.56E-08	6.62E+08	2.10E-02	243	3.45E-07	2.62E-16	5.33E-07	2.56E-16	10	3.15E+07	8.07E-09	5.25E-07
22	0.1	6.41E-03	3.14	2.56E-08	6.94E+08	2.10E-02	243	3.45E-07	2.56E-16	5.25E-07	2.50E-16	10	3.15E+07	7.88E-09	5.17E-07
23	0.1	6.41E-03	3.14	2.56E-08	7.26E+08	2.10E-02	243	3.45E-07	2.50E-16	5.17E-07	2.46E-16	10	3.15E+07	7.72E-09	5.10E-07
24	0.1	6.41E-03	3.14	2.56E-08	7.57E+08	2.10E-02	243	3.45E-07	2.46E-16	5.10E-07	2.40E-16	10	3.15E+07	7.57E-09	5.02E-07
25	0.1	6.41E-03	3.14	2.56E-08	7.88E+08	2.10E-02	243	3.45E-07	2.40E-16	5.02E-07	2.36E-16	10	3.15E+07	7.42E-09	4.95E-07
26	0.1	6.41E-03	3.14	2.56E-08	8.20E+08	2.10E-02	243	3.45E-07	2.36E-16	AVERAGE					6.14E-07

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF 4,4'-DDT
FROM CEILING SURFACES

Hwang DeFalco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where: Na =	Instantaneous emission flux rate (g/cm²-s)		
E =	Soil (or medium) porosity) (unitless)		0.1
Del =	Effective diffusivity in soil (cm²/s) = Di x $E^{0.33}$		
Di =	Diffusion coefficient in air (cm²/s)		1.37E-02
π =	PI (3.14)		
t =	Time from sampling (s)		
H =	Henry's Law Constant (dimensionless form)		2.10E-02
Kd =	Soil/water partition coefficient (cm³/g) = Koc x foc		243
Koc =	Organic carbon water partition coefficient (cm³/g)		2.43E+05
foc =	Fraction of organic carbon in material (g/g)		0.001
Cs =	Initial concentration in soil or medium (g/g)		
Cwipe (Ceiling)		(µg/cm²)	0.446
Cwipe (Ceiling)		(g/cm²)	0.000000446

Calculation of Del Del = Di x $E^{0.33}$

Di (cm²/s)	E (unitless)	Del (cm²/s)
1.37E-02	0.1	6.41E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$$

Del (cm²/s)	E (unitless)	Ps (g/cm³)	Kd (cm³/g)	H (unitless)	α (cm²/s)
6.41E-03	0.1	2.4	243	2.10E-02	2.56E-06

Calculation of Cs Cs = Cwipe x CF/ρ_s x d

Cwipe (µg/cm²)	CF (g/µg)	d (cm)	ρ (g/cm³)	Cs (g/g)
0.446	1.00E-06	1	2.4	1.86E-07

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

E (unitless)	Del (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Cs (g/g)	Na (g/cm²-s)
0.1	6.41E-03	3.14	2.56E-06	7.88E+08	2.10E-02	243	1.86E-07	1.29E-15

Calculation of Avg Na Avg Na (T = 25yr) = 2 Na (T yr)

Na g/cm²-s	AvgNa g/cm²-s
1.29E-15	2.58E-15

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF 4,4'-DDT
FROM CEILING SURFACES

Year	E (unitless)	Del (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Co (g/g)	Ne (g/cm^2-s)	Initial Conc (g/cm^2)	Ne (g/cm^2-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm^2)	Mass Remaining (g/cm^2)
1 sec	0.1	6.41E-03	3.14	2.56E-08	1.00E+00	2.10E-02	243	1.86E-07	3.63E-11	4.46E-07	6.46E-15	10	3.15E+07	2.04E-08	4.26E-07
1	0.1	6.41E-03	3.14	2.56E-08	3.15E+07	2.10E-02	243	1.86E-07	6.46E-15	4.26E-07	4.57E-15	10	3.15E+07	1.44E-08	4.11E-07
2	0.1	6.41E-03	3.14	2.56E-08	6.31E+07	2.10E-02	243	1.86E-07	4.57E-15	4.11E-07	3.73E-15	10	3.15E+07	1.18E-08	3.99E-07
3	0.1	6.41E-03	3.14	2.56E-08	9.46E+07	2.10E-02	243	1.86E-07	3.73E-15	3.99E-07	3.23E-15	10	3.15E+07	1.02E-08	3.89E-07
4	0.1	6.41E-03	3.14	2.56E-08	1.26E+08	2.10E-02	243	1.86E-07	3.23E-15	3.89E-07	2.89E-15	10	3.15E+07	9.11E-09	3.80E-07
5	0.1	6.41E-03	3.14	2.56E-08	1.58E+08	2.10E-02	243	1.86E-07	2.89E-15	3.80E-07	2.64E-15	10	3.15E+07	8.31E-09	3.72E-07
6	0.1	6.41E-03	3.14	2.56E-08	1.89E+08	2.10E-02	243	1.86E-07	2.64E-15	3.72E-07	2.44E-15	10	3.15E+07	7.70E-09	3.64E-07
7	0.1	6.41E-03	3.14	2.56E-08	2.21E+08	2.10E-02	243	1.86E-07	2.44E-15	3.64E-07	2.28E-15	10	3.15E+07	7.20E-09	3.57E-07
8	0.1	6.41E-03	3.14	2.56E-08	2.52E+08	2.10E-02	243	1.86E-07	2.28E-15	3.57E-07	2.15E-15	10	3.15E+07	6.79E-09	3.50E-07
9	0.1	6.41E-03	3.14	2.56E-08	2.84E+08	2.10E-02	243	1.86E-07	2.15E-15	3.50E-07	2.04E-15	10	3.15E+07	6.44E-09	3.44E-07
10	0.1	6.41E-03	3.14	2.56E-08	3.15E+08	2.10E-02	243	1.86E-07	2.04E-15	3.44E-07	1.95E-15	10	3.15E+07	6.14E-09	3.38E-07
11	0.1	6.41E-03	3.14	2.56E-08	3.47E+08	2.10E-02	243	1.86E-07	1.95E-15	3.38E-07	1.86E-15	10	3.15E+07	5.85E-09	3.32E-07
12	0.1	6.41E-03	3.14	2.56E-08	3.78E+08	2.10E-02	243	1.86E-07	1.86E-15	3.32E-07	1.79E-15	10	3.15E+07	5.65E-09	3.26E-07
13	0.1	6.41E-03	3.14	2.56E-08	4.10E+08	2.10E-02	243	1.86E-07	1.79E-15	3.26E-07	1.73E-15	10	3.15E+07	5.44E-09	3.21E-07
14	0.1	6.41E-03	3.14	2.56E-08	4.42E+08	2.10E-02	243	1.86E-07	1.73E-15	3.21E-07	1.67E-15	10	3.15E+07	5.26E-09	3.15E-07
15	0.1	6.41E-03	3.14	2.56E-08	4.73E+08	2.10E-02	243	1.86E-07	1.67E-15	3.15E-07	1.61E-15	10	3.15E+07	5.09E-09	3.10E-07
16	0.1	6.41E-03	3.14	2.56E-08	5.05E+08	2.10E-02	243	1.86E-07	1.61E-15	3.10E-07	1.57E-15	10	3.15E+07	4.94E-09	3.05E-07
17	0.1	6.41E-03	3.14	2.56E-08	5.36E+08	2.10E-02	243	1.86E-07	1.57E-15	3.05E-07	1.52E-15	10	3.15E+07	4.80E-09	3.01E-07
18	0.1	6.41E-03	3.14	2.56E-08	5.68E+08	2.10E-02	243	1.86E-07	1.52E-15	3.01E-07	1.48E-15	10	3.15E+07	4.67E-09	2.96E-07
19	0.1	6.41E-03	3.14	2.56E-08	5.99E+08	2.10E-02	243	1.86E-07	1.48E-15	2.96E-07	1.44E-15	10	3.15E+07	4.55E-09	2.91E-07
20	0.1	6.41E-03	3.14	2.56E-08	6.31E+08	2.10E-02	243	1.86E-07	1.44E-15	2.91E-07	1.41E-15	10	3.15E+07	4.44E-09	2.87E-07
21	0.1	6.41E-03	3.14	2.56E-08	6.62E+08	2.10E-02	243	1.86E-07	1.41E-15	2.87E-07	1.38E-15	10	3.15E+07	4.34E-09	2.83E-07
22	0.1	6.41E-03	3.14	2.56E-08	6.94E+08	2.10E-02	243	1.86E-07	1.38E-15	2.83E-07	1.36E-15	10	3.15E+07	4.25E-09	2.78E-07
23	0.1	6.41E-03	3.14	2.56E-08	7.26E+08	2.10E-02	243	1.86E-07	1.36E-15	2.78E-07	1.32E-15	10	3.15E+07	4.16E-09	2.74E-07
24	0.1	6.41E-03	3.14	2.56E-08	7.57E+08	2.10E-02	243	1.86E-07	1.32E-15	2.74E-07	1.29E-15	10	3.15E+07	4.07E-09	2.70E-07
25	0.1	6.41E-03	3.14	2.56E-08	7.88E+08	2.10E-02	243	1.86E-07	1.29E-15	2.70E-07	1.27E-15	10	3.15E+07	3.99E-09	2.66E-07
26	0.1	6.41E-03	3.14	2.56E-08	8.20E+08	2.10E-02	243	1.86E-07	1.27E-15	AVERAGE					3.30E-07

Building No. 3
Basement
Volatilization of 4,4'-DDT
From Basement Soil

Hwang DeFalco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where:	Na =	Instantaneous emission flux rate (g/cm²-s)	
	E =	Soil (or medium) porosity) (unitless)	0.2
	Del =	Effective diffusivity in soil (cm²/s) = Di x $E^{0.33}$	
	Di =	Diffusion coefficient in air (cm²/s)	1.37E-02
	π =	Pi (3.14)	
	t =	Time from sampling (s)	
	H =	Henry's Law Constant (dimensionless form)	2.10E-02
	Kd =	Soil/water partition coefficient (cm³/g) =	1458
	Koc =	Organic carbon water partition coefficient (cm³/g)	2.43E+05
	foc =	Fraction of organic carbon in material (g/g)	0.006
	Cs =	Initial concentration in soil or medium (mg/kg)	0.648

Calculation of Del Del = Di x $E^{0.33}$

Di (cm²/s)	E (unitless)	Del (cm²/s)
1.37E-02	0.2	8.05E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$$

Del (cm²/s)	E (unitless)	Ps (g/cm³)	Kd (cm³/g)	H (unitless)	α (cm²/s)
8.05E-03	0.2	2.65	1458	2.10E-02	1.09E-08

Calculation of Cs Cs = Csoil x CF1 x CF2

Csoil (mg/kg)	CF1 (g/mg)	CF2 (kg/g)	Cs (g/g)	ρs (g/cm³)	d (cm)	Cw (g/cm³)
0.648	1.00E-03	1.00E-03	6.48E-07	2.65	1	1.72E-06

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

E (unitless)	Del (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Cs (g/g)	Na (g/cm²-s)
0.2	8.05E-03	3.14	1.09E-08	7.88E+08	2.10E-02	1458	6.48E-07	2.89E-15

Calculation of Avg Na Avg Na (T = 25yr) =2 Na (T yr)

Na g/cm²-s	AvgNa g/cm²-s
2.89E-15	5.78E-15

Building No. 3
Basement
Volatilization of 4,4'-DDT
From Basement Soil

Year	E (unitless)	Del (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Cs (g/g)	Na (g/cm^2-s)	Initial Conc (g/cm^2)	Na (g/cm^2-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm^2)	Mass Remaining (g/cm^2)
1 sec	0.2	8.05E-03	3.14	1.09E-08	1.00E+00	2.10E-02	1458	6.48E-07	8.11E-11	1.72E-06	1.44E-14	10	3.15E+07	4.55E-08	1.67E-06
1	0.2	8.05E-03	3.14	1.09E-08	3.15E+07	2.10E-02	1458	6.48E-07	1.44E-14	1.67E-06	1.02E-14	10	3.15E+07	3.22E-08	1.64E-06
2	0.2	8.05E-03	3.14	1.09E-08	6.31E+07	2.10E-02	1458	6.48E-07	1.02E-14	1.64E-06	8.33E-15	10	3.15E+07	2.63E-08	1.61E-06
3	0.2	8.05E-03	3.14	1.09E-08	9.46E+07	2.10E-02	1458	6.48E-07	8.33E-15	1.61E-06	7.22E-15	10	3.15E+07	2.28E-08	1.59E-06
4	0.2	8.05E-03	3.14	1.09E-08	1.26E+08	2.10E-02	1458	6.48E-07	7.22E-15	1.59E-06	6.46E-15	10	3.15E+07	2.04E-08	1.57E-06
5	0.2	8.05E-03	3.14	1.09E-08	1.58E+08	2.10E-02	1458	6.48E-07	6.46E-15	1.57E-06	5.89E-15	10	3.15E+07	1.86E-08	1.55E-06
6	0.2	8.05E-03	3.14	1.09E-08	1.89E+08	2.10E-02	1458	6.48E-07	5.89E-15	1.55E-06	5.46E-15	10	3.15E+07	1.72E-08	1.53E-06
7	0.2	8.05E-03	3.14	1.09E-08	2.21E+08	2.10E-02	1458	6.48E-07	5.46E-15	1.53E-06	5.10E-15	10	3.15E+07	1.61E-08	1.52E-06
8	0.2	8.05E-03	3.14	1.09E-08	2.52E+08	2.10E-02	1458	6.48E-07	5.10E-15	1.52E-06	4.81E-15	10	3.15E+07	1.52E-08	1.50E-06
9	0.2	8.05E-03	3.14	1.09E-08	2.84E+08	2.10E-02	1458	6.48E-07	4.81E-15	1.50E-06	4.57E-15	10	3.15E+07	1.44E-08	1.49E-06
10	0.2	8.05E-03	3.14	1.09E-08	3.15E+08	2.10E-02	1458	6.48E-07	4.57E-15	1.49E-06	4.35E-15	10	3.15E+07	1.37E-08	1.47E-06
11	0.2	8.05E-03	3.14	1.09E-08	3.47E+08	2.10E-02	1458	6.48E-07	4.35E-15	1.47E-06	4.17E-15	10	3.15E+07	1.31E-08	1.46E-06
12	0.2	8.05E-03	3.14	1.09E-08	3.78E+08	2.10E-02	1458	6.48E-07	4.17E-15	1.46E-06	4.00E-15	10	3.15E+07	1.26E-08	1.45E-06
13	0.2	8.05E-03	3.14	1.09E-08	4.10E+08	2.10E-02	1458	6.48E-07	4.00E-15	1.45E-06	3.86E-15	10	3.15E+07	1.22E-08	1.44E-06
14	0.2	8.05E-03	3.14	1.09E-08	4.42E+08	2.10E-02	1458	6.48E-07	3.86E-15	1.44E-06	3.73E-15	10	3.15E+07	1.18E-08	1.43E-06
15	0.2	8.05E-03	3.14	1.09E-08	4.73E+08	2.10E-02	1458	6.48E-07	3.73E-15	1.43E-06	3.61E-15	10	3.15E+07	1.14E-08	1.41E-06
16	0.2	8.05E-03	3.14	1.09E-08	5.05E+08	2.10E-02	1458	6.48E-07	3.61E-15	1.41E-06	3.50E-15	10	3.15E+07	1.10E-08	1.40E-06
17	0.2	8.05E-03	3.14	1.09E-08	5.36E+08	2.10E-02	1458	6.48E-07	3.50E-15	1.40E-06	3.40E-15	10	3.15E+07	1.07E-08	1.39E-06
18	0.2	8.05E-03	3.14	1.09E-08	5.68E+08	2.10E-02	1458	6.48E-07	3.40E-15	1.39E-06	3.31E-15	10	3.15E+07	1.04E-08	1.38E-06
19	0.2	8.05E-03	3.14	1.09E-08	5.99E+08	2.10E-02	1458	6.48E-07	3.31E-15	1.38E-06	3.23E-15	10	3.15E+07	1.02E-08	1.37E-06
20	0.2	8.05E-03	3.14	1.09E-08	6.31E+08	2.10E-02	1458	6.48E-07	3.23E-15	1.37E-06	3.15E-15	10	3.15E+07	9.93E-09	1.36E-06
21	0.2	8.05E-03	3.14	1.09E-08	6.62E+08	2.10E-02	1458	6.48E-07	3.15E-15	1.36E-06	3.08E-15	10	3.15E+07	9.71E-09	1.35E-06
22	0.2	8.05E-03	3.14	1.09E-08	6.94E+08	2.10E-02	1458	6.48E-07	3.08E-15	1.35E-06	3.01E-15	10	3.15E+07	9.49E-09	1.34E-06
23	0.2	8.05E-03	3.14	1.09E-08	7.25E+08	2.10E-02	1458	6.48E-07	3.01E-15	1.34E-06	2.95E-15	10	3.15E+07	9.29E-09	1.33E-06
24	0.2	8.05E-03	3.14	1.09E-08	7.57E+08	2.10E-02	1458	6.48E-07	2.95E-15	1.33E-06	2.89E-15	10	3.15E+07	9.11E-09	1.32E-06
25	0.2	8.05E-03	3.14	1.09E-08	7.88E+08	2.10E-02	1458	6.48E-07	2.89E-15	1.32E-06	2.83E-15	10	3.15E+07	8.93E-09	1.31E-06
26	0.2	8.05E-03	3.14	1.09E-08	8.20E+08	2.10E-02	1458	6.48E-07	2.83E-15	AVERAGE					1.48E-06

APPENDIX E
DIELDRIN

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF DIELDRIN
FROM FLOOR SURFACES

Hwang DeFalco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where: Na =	Instantaneous emission flux rate (g/cm²-s)		
E =	Soil (or medium) porosity) (unitless)		0.1
Del =	Effective diffusivity in soil (cm²/s) = Di x E^0.33		
Di =	Diffusion coefficient in air (cm²/s)		1.26E-02
π =	PI (3.14)		
t =	Time from sampling (s)		
H =	Henry's Law Constant (dimensionless form)		2.39E-03
Kd =	Soil/water partition coefficient (cm³/g) =		1.7
Koc =	Organic carbon water partition coefficient (cm³/g)		1.70E+03
foc =	Fraction of organic carbon in material (g/g)		0.001
Cs =	Initial concentration in soil or medium (g/g)		
Cwipe (Floor)		(µg/cm²)	0.013
Cwipe (Floor)		(g/cm²)	1.3E-08

Calculation of Del Del = Di x E^0.33

Di (cm²/s)	E (unitless)	Del (cm²/s)
1.26E-02	0.1	5.85E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$$

Del (cm²/s)	E (unitless)	Ps (g/cm³)	Kd (cm³/g)	H (unitless)	α (cm²/s)
5.85E-03	0.1	2.4	1.7	2.39E-03	3.81E-07

Calculation of Cs Cs = Cwipe x CF/ρ_s x d

Cwipe (µg/cm²)	CF (g/µg)	d (cm)	ρ (g/cm³)	Cs (g/g)
0.013	1.00E-06	1	2.4	5.42E-09

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

E (unitless)	Del (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Cs (g/g)	Na (g/cm²-s)
0.1	5.85E-03	3.14	3.81E-07	7.88E+08	2.39E-03	1.7	5.42E-09	1.45E-16

Calculation of Avg Na Avg Na (T = 25yr) =2 Na (T yr)

Na g/cm²-s	AvgNa g/cm²-s
1.45E-16	2.90E-16

APPENDIX E
ENDRIN

BUILDING NO. 3
BASEMENT
CALCULATION OF AIR CONCENTRATION
ENDRIN

Calculation of Air Conc $Ca = (Na \times CF1 \times A \times t_e \times CF2)/(CF3 \times V)$

Where:

	Ca =	Predicted air concentration in building (mg/m^3)
	Na =	Average emission flux (g/cm^2-s)
	A =	Area of room (cm^2)
	t_e =	Air exchange rate (s)
	V =	Volume of room (cm^3)
	CF1 =	Unit conversion factor (s/hr)
	CF2 =	Unit conversion factor (mg/g)
	CF3 =	Unit conversion factor (cm^3/m^3)

Source	Average Na (g/cm^2-s)	Applicable Area (cm^2)	Emission Rate (g/s)
Floor	9.10E-18	2.70E+07	2.46E-10
Soil	7.56E-16	1.08E+08	8.17E-08
Total			8.19E-08

Chemical	E (g/s)	CF1 (s/hr)	t_e (hr)	CF2 (mg/g)	CF3 (m^3/cm^3)	V (cm^3)	Ca (mg/m^3)
Endrin	8.19E-08	3600	0.233	1000	1.00E-06	3.29E+10	2.09E-06

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF ENDRIN
FROM FLOOR SURFACES

Hwang DeFelco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where:	Na =	Instantaneous emission flux rate (g/cm²-s)	
	E =	Soil (or medium) porosity) (unitless)	0.1
	Del =	Effective diffusivity in soil (cm²/s) = Di x E^0.33	
	Di =	Diffusion coefficient in air (cm²/s)	1.25E-02
	π =	PI (3.14)	
	t =	Time from sampling (s)	
	H =	Henry's Law Constant (dimensionless form)	1.64E-05
	Kd =	Soil/water partition coefficient (cm³/g) =	34
	Koc =	Organic carbon water partition coefficient (cm³/g)	3.40E+04
	foc =	Fraction of organic carbon in material (g/g)	0.001
	Cs =	Initial concentration in soil or medium (g/g)	
	Cwipe (Floor)	(µg/cm²)	0.022
	Cwipe (Floor)	(g/cm²)	2.2E-08

Calculation of Del Del = Di x E^0.33

Di (cm²/s)	E (unitless)	Del (cm²/s)
1.25E-02	0.1	5.85E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$$

Del (cm²/s)	E (unitless)	Ps (g/cm³)	Kd (cm³/g)	H (unitless)	α (cm²/s)
5.85E-03	0.1	2.4	34	1.64E-05	1.31E-10

Calculation of Cs Cs = Cwipe x CF/ρ_s x d

Cwipe (µg/cm²)	CF (g/µg)	d (cm)	ρ (g/cm³)	Cs (g/g)
0.022	1.00E-06	1	2.4	9.17E-09

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

E (unitless)	Del (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Cs (g/g)	Na (g/cm²-s)
0.1	5.85E-03	3.14	1.31E-10	7.88E+08	1.64E-05	34	9.17E-09	4.55E-18

Calculation of Avg Na Avg Na (T = 25yr) =2 Na (T yr)

Na g/cm²-s	AvgNa g/cm²-s
4.55E-18	9.10E-18

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF ENDRIN
FROM FLOOR SURFACES

Year	E (unitless)	Del (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Cs (g/g)	Ns (g/cm^2-s)	Initial Conc (g/cm^3)	Ns (g/cm^2-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm^3)	Mass Remaining (g/cm^3)
1 sec	0.1	5.85E-03	3.14	1.31E-10	1.00E+00	1.64E-05	34	9.17E-09	1.28E-13	2.20E-06	2.27E-17	10	3.15E+07	7.17E-11	2.19E-06
1	0.1	5.85E-03	3.14	1.31E-10	3.15E+07	1.64E-05	34	9.17E-09	2.27E-17	2.19E-06	1.61E-17	10	3.15E+07	5.07E-11	2.19E-06
2	0.1	5.85E-03	3.14	1.31E-10	6.31E+07	1.64E-05	34	9.17E-09	1.61E-17	2.19E-06	1.31E-17	10	3.15E+07	4.14E-11	2.18E-06
3	0.1	5.85E-03	3.14	1.31E-10	9.46E+07	1.64E-05	34	9.17E-09	1.31E-17	2.18E-06	1.14E-17	10	3.15E+07	3.585E-11	2.18E-06
4	0.1	5.85E-03	3.14	1.31E-10	1.26E+08	1.64E-05	34	9.17E-09	1.14E-17	2.18E-06	1.02E-17	10	3.15E+07	3.206E-11	2.18E-06
5	0.1	5.85E-03	3.14	1.31E-10	1.58E+08	1.64E-05	34	9.17E-09	1.02E-17	2.18E-06	9.28E-18	10	3.15E+07	2.927E-11	2.17E-06
6	0.1	5.85E-03	3.14	1.31E-10	1.88E+08	1.64E-05	34	9.17E-09	9.28E-18	2.17E-06	8.59E-18	10	3.15E+07	2.71E-11	2.17E-06
7	0.1	5.85E-03	3.14	1.31E-10	2.21E+08	1.64E-05	34	9.17E-09	8.59E-18	2.17E-06	8.04E-18	10	3.15E+07	2.535E-11	2.17E-06
8	0.1	5.85E-03	3.14	1.31E-10	2.52E+08	1.64E-05	34	9.17E-09	8.04E-18	2.17E-06	7.58E-18	10	3.15E+07	2.39E-11	2.17E-06
9	0.1	5.85E-03	3.14	1.31E-10	2.84E+08	1.64E-05	34	9.17E-09	7.58E-18	2.17E-06	7.19E-18	10	3.15E+07	2.267E-11	2.16E-06
10	0.1	5.85E-03	3.14	1.31E-10	3.15E+08	1.64E-05	34	9.17E-09	7.19E-18	2.16E-06	6.86E-18	10	3.15E+07	2.162E-11	2.16E-06
11	0.1	5.85E-03	3.14	1.31E-10	3.47E+08	1.64E-05	34	9.17E-09	6.86E-18	2.16E-06	6.56E-18	10	3.15E+07	2.07E-11	2.16E-06
12	0.1	5.85E-03	3.14	1.31E-10	3.78E+08	1.64E-05	34	9.17E-09	6.56E-18	2.16E-06	6.31E-18	10	3.15E+07	1.989E-11	2.16E-06
13	0.1	5.85E-03	3.14	1.31E-10	4.10E+08	1.64E-05	34	9.17E-09	6.31E-18	2.16E-06	6.08E-18	10	3.15E+07	1.916E-11	2.16E-06
14	0.1	5.85E-03	3.14	1.31E-10	4.42E+08	1.64E-05	34	9.17E-09	6.08E-18	2.16E-06	5.87E-18	10	3.15E+07	1.851E-11	2.15E-06
15	0.1	5.85E-03	3.14	1.31E-10	4.73E+08	1.64E-05	34	9.17E-09	5.87E-18	2.15E-06	5.68E-18	10	3.15E+07	1.792E-11	2.15E-06
16	0.1	5.85E-03	3.14	1.31E-10	5.05E+08	1.64E-05	34	9.17E-09	5.68E-18	2.15E-06	5.51E-18	10	3.15E+07	1.739E-11	2.15E-06
17	0.1	5.85E-03	3.14	1.31E-10	5.36E+08	1.64E-05	34	9.17E-09	5.51E-18	2.15E-06	5.36E-18	10	3.15E+07	1.69E-11	2.15E-06
18	0.1	5.85E-03	3.14	1.31E-10	5.68E+08	1.64E-05	34	9.17E-09	5.36E-18	2.15E-06	5.22E-18	10	3.15E+07	1.645E-11	2.15E-06
19	0.1	5.85E-03	3.14	1.31E-10	5.99E+08	1.64E-05	34	9.17E-09	5.22E-18	2.15E-06	5.08E-18	10	3.15E+07	1.603E-11	2.15E-06
20	0.1	5.85E-03	3.14	1.31E-10	6.31E+08	1.64E-05	34	9.17E-09	5.08E-18	2.15E-06	4.96E-18	10	3.15E+07	1.565E-11	2.14E-06
21	0.1	5.85E-03	3.14	1.31E-10	6.62E+08	1.64E-05	34	9.17E-09	4.96E-18	2.14E-06	4.85E-18	10	3.15E+07	1.529E-11	2.14E-06
22	0.1	5.85E-03	3.14	1.31E-10	6.94E+08	1.64E-05	34	9.17E-09	4.85E-18	2.14E-06	4.74E-18	10	3.15E+07	1.495E-11	2.14E-06
23	0.1	5.85E-03	3.14	1.31E-10	7.26E+08	1.64E-05	34	9.17E-09	4.74E-18	2.14E-06	4.64E-18	10	3.15E+07	1.464E-11	2.14E-06
24	0.1	5.85E-03	3.14	1.31E-10	7.57E+08	1.64E-05	34	9.17E-09	4.64E-18	2.14E-06	4.55E-18	10	3.15E+07	1.434E-11	2.14E-06
25	0.1	5.85E-03	3.14	1.31E-10	7.88E+08	1.64E-05	34	9.17E-09	4.55E-18	2.14E-06	4.46E-18	10	3.15E+07	1.406E-11	2.14E-06
26	0.1	5.85E-03	3.14	1.31E-10	8.20E+08	1.64E-05	34	9.17E-09	4.46E-18	AVERAGE					2.16E-06

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF ENDRIN
FROM BASEMENT SOIL

Hwang DeFalco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where:

Na =	Instantaneous emission flux rate (g/cm²-s)	
E =	Soil (or medium) porosity) (unitless)	0.2
Del =	Effective diffusivity in soil (cm²/s) = Dl x $E^{0.33}$	
Dl =	Diffusion coefficient in air (cm²/s)	1.25E-02
π =	PI (3.14)	
t =	Time from sampling (s)	
H =	Henry's Law Constant (dimensionless form)	1.64E-05
Kd =	Soil/water partition coefficient (cm³/g) =	204
Koc =	Organic carbon water partition coefficient (cm³/g)	3.40E+04
foc =	Fraction of organic carbon in material (g/g)	0.006
Cs =	Initial concentration in soil or medium (mg/kg)	1.188

Calculation of Del Del = Dl x $E^{0.33}$

Dl (cm²/s)	E (unitless)	Del (cm²/s)
1.25E-02	0.2	7.35E-03

Calculation of α $\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$

Del (cm²/s)	E (unitless)	Ps (g/cm³)	Kd (cm³/g)	H (unitless)	a (cm²/s)
7.35E-03	0.2	2.65	204	1.64E-05	5.67E-11

Calculation of Cs Cs = Csoil x CF1 x CF2

Csoil (mg/kg)	CF1 (g/mg)	CF2 (kg/g)	Cs (g/g)	ρs (g/cm³)	d (cm)	Cw (g/cm³)
1.188	1.00E-03	1.00E-03	1.19E-06	2.65	1	3.15E-06

Calculation of Na $Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$

E (unitless)	Del (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Cs (g/g)	Na (g/cm²-s)
0.2	7.35E-03	3.14	5.67E-11	7.88E+08	1.64E-05	204	1.19E-06	3.78E-16

Calculation of Avg Na Avg Na (T = 25yr) =2 Na (T yr)

Na g/cm²-s	AvgNa g/cm²-s
3.78E-16	7.56E-16

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF ENDRIN
FROM BASEMENT SOIL

Year	E (unitless)	Dei (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Cs (g/g)	Ns (g/cm^3-s)	Initial Conc (g/cm^3)	Ns (g/cm^3-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm^3)	Mass Remaining (g/cm^3)
1 sec	0.2	7.35E-03	3.14	5.57E-11	1.00E+00	1.64E-05	204	1.19E-08	1.06E-11	3.15E-06	1.89E-15	10	3.15E+07	5.96E-09	3.14E-06
1	0.2	7.35E-03	3.14	5.57E-11	3.15E+07	1.64E-05	204	1.19E-08	1.89E-15	3.14E-06	1.34E-15	10	3.15E+07	4.21E-09	3.14E-06
2	0.2	7.35E-03	3.14	5.57E-11	6.31E+07	1.64E-05	204	1.19E-08	1.34E-15	3.14E-06	1.09E-15	10	3.15E+07	3.44E-09	3.13E-06
3	0.2	7.35E-03	3.14	5.57E-11	9.46E+07	1.64E-05	204	1.19E-08	1.09E-15	3.13E-06	9.45E-16	10	3.15E+07	2.98E-09	3.13E-06
4	0.2	7.35E-03	3.14	5.57E-11	1.26E+08	1.64E-05	204	1.19E-08	9.45E-16	3.13E-06	8.45E-16	10	3.15E+07	2.66E-09	3.13E-06
5	0.2	7.35E-03	3.14	5.57E-11	1.58E+08	1.64E-05	204	1.19E-08	8.45E-16	3.13E-06	7.71E-16	10	3.15E+07	2.43E-09	3.13E-06
6	0.2	7.35E-03	3.14	5.57E-11	1.89E+08	1.64E-05	204	1.19E-08	7.71E-16	3.13E-06	7.14E-16	10	3.15E+07	2.25E-09	3.12E-06
7	0.2	7.35E-03	3.14	5.57E-11	2.21E+08	1.64E-05	204	1.19E-08	7.14E-16	3.12E-06	6.68E-16	10	3.15E+07	2.11E-09	3.12E-06
8	0.2	7.35E-03	3.14	5.57E-11	2.52E+08	1.64E-05	204	1.19E-08	6.68E-16	3.12E-06	6.30E-16	10	3.15E+07	1.98E-09	3.12E-06
9	0.2	7.35E-03	3.14	5.57E-11	2.84E+08	1.64E-05	204	1.19E-08	6.30E-16	3.12E-06	5.98E-16	10	3.15E+07	1.88E-09	3.12E-06
10	0.2	7.35E-03	3.14	5.57E-11	3.15E+08	1.64E-05	204	1.19E-08	5.98E-16	3.12E-06	5.70E-16	10	3.15E+07	1.80E-09	3.12E-06
11	0.2	7.35E-03	3.14	5.57E-11	3.47E+08	1.64E-05	204	1.19E-08	5.70E-16	3.12E-06	5.45E-16	10	3.15E+07	1.72E-09	3.11E-06
12	0.2	7.35E-03	3.14	5.57E-11	3.78E+08	1.64E-05	204	1.19E-08	5.45E-16	3.11E-06	5.24E-16	10	3.15E+07	1.65E-09	3.11E-06
13	0.2	7.35E-03	3.14	5.57E-11	4.10E+08	1.64E-05	204	1.19E-08	5.24E-16	3.11E-06	5.05E-16	10	3.15E+07	1.59E-09	3.11E-06
14	0.2	7.35E-03	3.14	5.57E-11	4.42E+08	1.64E-05	204	1.19E-08	5.05E-16	3.11E-06	4.88E-16	10	3.15E+07	1.54E-09	3.11E-06
15	0.2	7.35E-03	3.14	5.57E-11	4.73E+08	1.64E-05	204	1.19E-08	4.88E-16	3.11E-06	4.72E-16	10	3.15E+07	1.49E-09	3.11E-06
16	0.2	7.35E-03	3.14	5.57E-11	5.05E+08	1.64E-05	204	1.19E-08	4.72E-16	3.11E-06	4.58E-16	10	3.15E+07	1.45E-09	3.11E-06
17	0.2	7.35E-03	3.14	5.57E-11	5.36E+08	1.64E-05	204	1.19E-08	4.58E-16	3.11E-06	4.45E-16	10	3.15E+07	1.40E-09	3.11E-06
18	0.2	7.35E-03	3.14	5.57E-11	5.68E+08	1.64E-05	204	1.19E-08	4.45E-16	3.11E-06	4.33E-16	10	3.15E+07	1.37E-09	3.10E-06
19	0.2	7.35E-03	3.14	5.57E-11	5.99E+08	1.64E-05	204	1.19E-08	4.33E-16	3.10E-06	4.23E-16	10	3.15E+07	1.33E-09	3.10E-06
20	0.2	7.35E-03	3.14	5.57E-11	6.31E+08	1.64E-05	204	1.19E-08	4.23E-16	3.10E-06	4.12E-16	10	3.15E+07	1.30E-09	3.10E-06
21	0.2	7.35E-03	3.14	5.57E-11	6.62E+08	1.64E-05	204	1.19E-08	4.12E-16	3.10E-06	4.03E-16	10	3.15E+07	1.27E-09	3.10E-06
22	0.2	7.35E-03	3.14	5.57E-11	6.94E+08	1.64E-05	204	1.19E-08	4.03E-16	3.10E-06	3.94E-16	10	3.15E+07	1.24E-09	3.10E-06
23	0.2	7.35E-03	3.14	5.57E-11	7.25E+08	1.64E-05	204	1.19E-08	3.94E-16	3.10E-06	3.86E-16	10	3.15E+07	1.22E-09	3.10E-06
24	0.2	7.35E-03	3.14	5.57E-11	7.57E+08	1.64E-05	204	1.19E-08	3.86E-16	3.10E-06	3.78E-16	10	3.15E+07	1.19E-09	3.10E-06
25	0.2	7.35E-03	3.14	5.57E-11	7.88E+08	1.64E-05	204	1.19E-08	3.78E-16	3.10E-06	3.71E-16	10	3.15E+07	1.17E-09	3.10E-06
26	0.2	7.35E-03	3.14	5.57E-11	8.20E+08	1.64E-05	204	1.19E-08	3.71E-16	AVERAGE					3.11E-06

APPENDIX E
gamma-BHC

BUILDING NO. 3
BASEMENT
CALCULATION OF AIR CONCENTRATION
gamma-BHC

Equation Ca = (E x CF1 te x CF2) / (Vx CF3)

Where:

Ca =	Predicted air concentration in building (mg/m^3)
E =	Average emission rate from all sources (g/s)
t_e =	Air exchange rate (hr)
V =	Volume of room (cm^3)
CF1 =	Unit conversion factor (s/hr)
CF2 =	Unit conversion factor (mg/g)
CF3 =	Unit conversion factor (m^3/cm^3)

Source	Average Na (g/cm^2-s)	Applicable Area (cm^2)	Emission Rate (g/s)
Floor	1.65E-15	2.70E+07	4.45E-08
Wall	8.74E-16	1.47E+07	1.28E-08
Ceiling	8.29E-16	1.35E+08	1.12E-07
Soil	8.16E-15	1.08E+08	8.81E-07
Total			**1.05E-06**

Chemical	E (g/s)	CF1 (s/hr)	t_e (hr)	CF2 (mg/g)	CF3 (m^3/cm^3)	V (cm^3)	Ca (mg/m^3)
gamma-BHC	1.05E-06	3600	0.233	1000	1.00E-06	3.29E+10	**2.68E-05**

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF gamma-BHC
FROM FLOOR SURFACES

Hwang DeFalco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where: Na =	Instantaneous emission flux rate (g/cm^2-s)		
E =	Soil (or medium) porosity) (unitless)		0.1
Del =	Effective diffusivity in soil (cm^2/s) = Di x $E^{0.33}$		
Di =	Diffusion coefficient in air (cm^2/s)		1.42E-02
π =	PI (3.14)		
t =	Time from sampling (s)		
H =	Henry's Law Constant (dimensionless form)		3.19E-04
Kd =	Soil/water partition coefficient (cm^3/g) =		1.08
Koc =	Organic carbon water partition coefficient (cm^3/g)		1.08E+03
foc =	Fraction of organic carbon in material (g/g)		0.001
Cs =	Initial concentration in soil or medium (g/g)		
Cwipe (Floor)		($\mu g/cm^2$)	0.151
Cwipe (Floor)		(g/cm^2)	1.51E-07

Calculation of Del Del = Di x $E^{0.33}$

Di (cm^2/s)	E (unitless)	Del (cm^2/s)
1.42E-02	0.1	6.64E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$$

Del (cm^2/s)	E (unitless)	Ps (g/cm^3)	Kd (cm^3/g)	H (unitless)	α (cm^2/s)
6.64E-03	0.1	2.4	1.08	3.19E-04	9.08E-08

Calculation of Cs Cs = Cwipe x CF/ρ_s x d

Cwipe ($\mu g/cm^2$)	CF ($g/\mu g$)	d (cm)	ρ (g/cm^3)	Cs (g/g)
0.151	1.00E-06	1	2.4	6.29E-08

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

E (unitless)	Del (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Cs (g/g)	Na (g/cm^2-s)
0.1	6.64E-03	3.14	9.08E-08	7.88E+08	3.19E-04	1.08	6.29E-08	8.23E-16

Calculation of Avg Na Avg Na (T = 25yr) =2 Na (T yr)

Na g/cm^2-s	AvgNa g/cm^2-s
8.23E-16	1.65E-16

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF gamma-BHC
FROM FLOOR SURFACES

Year	E (unitless)	Del (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Ce (g/g)	Ne (g/cm^2-s)	Initial Conc (g/cm^3)	Ne (g/cm^2-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm^3)	Mass Remaining (g/cm^3)
1 sec	0.1	6.64E-03	3.14	9.08E-06	1.00E+00	3.19E-04	1.06	6.29E-06	2.31E-11	1.61E-07	4.12E-15	10	3.15E+07	1.30E-06	1.38E-07
1	0.1	6.64E-03	3.14	9.08E-06	3.15E+07	3.19E-04	1.06	6.29E-06	4.12E-15	1.38E-07	2.91E-15	10	3.15E+07	9.18E-09	1.29E-07
2	0.1	6.64E-03	3.14	9.08E-06	6.31E+07	3.19E-04	1.06	6.29E-06	2.91E-15	1.29E-07	2.38E-15	10	3.15E+07	7.49E-09	1.21E-07
3	0.1	6.64E-03	3.14	9.08E-06	9.46E+07	3.19E-04	1.06	6.29E-06	2.38E-15	1.21E-07	2.06E-15	10	3.15E+07	6.49E-09	1.15E-07
4	0.1	6.64E-03	3.14	9.08E-06	1.26E+08	3.19E-04	1.06	6.29E-06	2.06E-15	1.15E-07	1.84E-15	10	3.15E+07	5.80E-09	1.09E-07
5	0.1	6.64E-03	3.14	9.08E-06	1.58E+08	3.19E-04	1.06	6.29E-06	1.84E-15	1.09E-07	1.68E-15	10	3.15E+07	5.30E-09	1.04E-07
6	0.1	6.64E-03	3.14	9.08E-06	1.89E+08	3.19E-04	1.06	6.29E-06	1.68E-15	1.04E-07	1.56E-15	10	3.15E+07	4.91E-09	9.88E-08
7	0.1	6.64E-03	3.14	9.08E-06	2.21E+08	3.19E-04	1.06	6.29E-06	1.56E-15	9.88E-08	1.46E-15	10	3.15E+07	4.59E-09	9.43E-08
8	0.1	6.64E-03	3.14	9.08E-06	2.52E+08	3.19E-04	1.06	6.29E-06	1.46E-15	9.43E-08	1.37E-15	10	3.15E+07	4.33E-09	8.99E-08
9	0.1	6.64E-03	3.14	9.08E-06	2.84E+08	3.19E-04	1.06	6.29E-06	1.37E-15	8.99E-08	1.30E-15	10	3.15E+07	4.10E-09	8.58E-08
10	0.1	6.64E-03	3.14	9.08E-06	3.15E+08	3.19E-04	1.06	6.29E-06	1.30E-15	8.58E-08	1.24E-15	10	3.15E+07	3.91E-09	8.19E-08
11	0.1	6.64E-03	3.14	9.08E-06	3.47E+08	3.19E-04	1.06	6.29E-06	1.24E-15	8.19E-08	1.19E-15	10	3.15E+07	3.75E-09	7.82E-08
12	0.1	6.64E-03	3.14	9.08E-06	3.78E+08	3.19E-04	1.06	6.29E-06	1.19E-15	7.82E-08	1.14E-15	10	3.15E+07	3.60E-09	7.46E-08
13	0.1	6.64E-03	3.14	9.08E-06	4.10E+08	3.19E-04	1.06	6.29E-06	1.14E-15	7.46E-08	1.10E-15	10	3.15E+07	3.47E-09	7.11E-08
14	0.1	6.64E-03	3.14	9.08E-06	4.42E+08	3.19E-04	1.06	6.29E-06	1.10E-15	7.11E-08	1.06E-15	10	3.15E+07	3.35E-09	6.77E-08
15	0.1	6.64E-03	3.14	9.08E-06	4.73E+08	3.19E-04	1.06	6.29E-06	1.06E-15	6.77E-08	1.03E-15	10	3.15E+07	3.24E-09	6.45E-08
16	0.1	6.64E-03	3.14	9.08E-06	5.05E+08	3.19E-04	1.06	6.29E-06	1.03E-15	6.45E-08	9.96E-16	10	3.15E+07	3.15E-09	6.14E-08
17	0.1	6.64E-03	3.14	9.08E-06	5.36E+08	3.19E-04	1.06	6.29E-06	9.96E-16	6.14E-08	9.70E-16	10	3.15E+07	3.06E-09	5.83E-08
18	0.1	6.64E-03	3.14	9.08E-06	5.68E+08	3.19E-04	1.06	6.29E-06	9.70E-16	5.83E-08	9.44E-16	10	3.15E+07	2.98E-09	5.53E-08
19	0.1	6.64E-03	3.14	9.08E-06	5.99E+08	3.19E-04	1.06	6.29E-06	9.44E-16	5.53E-08	9.20E-16	10	3.15E+07	2.90E-09	5.24E-08
20	0.1	6.64E-03	3.14	9.08E-06	6.31E+08	3.19E-04	1.06	6.29E-06	9.20E-16	5.24E-08	8.96E-16	10	3.15E+07	2.83E-09	4.96E-08
21	0.1	6.64E-03	3.14	9.08E-06	6.62E+08	3.19E-04	1.06	6.29E-06	8.96E-16	4.96E-08	8.77E-16	10	3.15E+07	2.77E-09	4.68E-08
22	0.1	6.64E-03	3.14	9.08E-06	6.94E+08	3.19E-04	1.06	6.29E-06	8.77E-16	4.68E-08	8.58E-16	10	3.15E+07	2.71E-09	4.41E-08
23	0.1	6.64E-03	3.14	9.08E-06	7.26E+08	3.19E-04	1.06	6.29E-06	8.58E-16	4.41E-08	8.40E-16	10	3.15E+07	2.65E-09	4.15E-08
24	0.1	6.64E-03	3.14	9.08E-06	7.57E+08	3.19E-04	1.06	6.29E-06	8.40E-16	4.15E-08	8.23E-16	10	3.15E+07	2.60E-09	3.89E-08
25	0.1	6.64E-03	3.14	9.08E-06	7.88E+08	3.19E-04	1.06	6.29E-06	8.23E-16	3.89E-08	8.07E-16	10	3.15E+07	2.55E-09	3.63E-08
26	0.1	6.64E-03	3.14	9.08E-06	8.20E+08	3.19E-04	1.06	6.29E-06	8.07E-16	AVERAGE					7.72E-08

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF gamma-BHC
FROM VERTICAL SURFACES

Hwang DeFalco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where: Na =	Instantaneous emission flux rate (g/cm²-s)		
E =	Soil (or medium) porosity) (unitless)		0.1
Del =	Effective diffusivity in soil (cm²/s) = Di x $E^{0.33}$		
Di =	Diffusion coefficient in air (cm²/s)		1.42E-02
π =	Pi (3.14)		
t =	Time from sampling (s)		
H =	Henry's Law Constant (dimensionless form)		3.19E-04
Kd =	Soil/water partition coefficient (cm³/g) = Koc x foc		1.08E+00
Koc =	Organic carbon water partition coefficient (cm³/g)		1.08E+03
foc =	Fraction of organic carbon in material (g/g)		0.001
Cs =	Initial concentration in soil or medium (g/g)		
Cwipe (Wall)		(µg/cm²)	0.0801
Cwipe (Wall)		(g/cm²)	8.01E-08

Calculation of Del Del = Di x $E^{0.33}$

Di (cm²/s)	E (unitless)	Del (cm²/s)
1.42E-02	0.1	6.64E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$$

Del (cm²/s)	E (unitless)	Ps (g/cm³)	Kd (cm³/g)	H (unitless)	α (cm²/s)
6.64E-03	0.1	2.4	1.08E+00	3.19E-04	9.08E-06

Calculation of Cs Cs = Cwipe x CF/ρ_c x d

Cwipe (µg/cm²)	CF (g/µg)	d (cm)	ρ (g/cm³)	Cs (g/g)
0.0801	1.00E-06	1	2.4	3.34E-08

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

E (unitless)	Del (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Cs (g/g)	Na (g/cm²-s)
0.1	6.64E-03	3.14	9.08E-06	7.88E+08	3.19E-04	1.08E+00	3.34E-08	4.37E-16

Calculation of Avg Na Avg Na (T = 25yr) =2 Na (T yr)

Na g/cm²-s	AvgNa g/cm²-s
4.37E-16	8.74E-16

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF gamma-BHC
FROM VERTICAL SURFACES

Year	E (unitless)	Del (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Cs (g/g)	Ns (g/cm^2-s)	Initial Conc (g/cm^2)	Ns (g/cm^2-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm^2)	Mass Remaining (g/cm^2)
1 sec	0.1	6.64E-03	3.14	9.08E-08	1.00E+00	3.19E-04	1.08E+00	3.34E-08	1.23E-11	8.01E-08	2.18E-15	10	3.15E+07	6.89E-09	7.32E-08
1	0.1	6.64E-03	3.14	9.08E-08	3.15E+07	3.19E-04	1.08E+00	3.34E-08	2.18E-15	7.32E-08	1.54E-15	10	3.15E+07	4.87E-09	6.83E-08
2	0.1	6.64E-03	3.14	9.08E-08	6.31E+07	3.19E-04	1.08E+00	3.34E-08	1.54E-15	6.83E-08	1.26E-15	10	3.15E+07	3.98E-09	6.44E-08
3	0.1	6.64E-03	3.14	9.08E-08	9.46E+07	3.19E-04	1.08E+00	3.34E-08	1.26E-15	6.44E-08	1.09E-15	10	3.15E+07	3.44E-09	6.09E-08
4	0.1	6.64E-03	3.14	9.08E-08	1.26E+08	3.19E-04	1.08E+00	3.34E-08	1.09E-15	6.09E-08	9.76E-16	10	3.15E+07	3.08E-09	5.78E-08
5	0.1	6.64E-03	3.14	9.08E-08	1.58E+08	3.19E-04	1.08E+00	3.34E-08	9.76E-16	5.78E-08	8.91E-16	10	3.15E+07	2.81E-09	5.50E-08
6	0.1	6.64E-03	3.14	9.08E-08	1.89E+08	3.19E-04	1.08E+00	3.34E-08	8.91E-16	5.50E-08	8.25E-16	10	3.15E+07	2.60E-09	5.24E-08
7	0.1	6.64E-03	3.14	9.08E-08	2.21E+08	3.19E-04	1.08E+00	3.34E-08	8.25E-16	5.24E-08	7.72E-16	10	3.15E+07	2.43E-09	5.00E-08
8	0.1	6.64E-03	3.14	9.08E-08	2.52E+08	3.19E-04	1.08E+00	3.34E-08	7.72E-16	5.00E-08	7.28E-16	10	3.15E+07	2.30E-09	4.77E-08
9	0.1	6.64E-03	3.14	9.08E-08	2.84E+08	3.19E-04	1.08E+00	3.34E-08	7.28E-16	4.77E-08	6.90E-16	10	3.15E+07	2.18E-09	4.55E-08
10	0.1	6.64E-03	3.14	9.08E-08	3.15E+08	3.19E-04	1.08E+00	3.34E-08	6.90E-16	4.55E-08	6.56E-16	10	3.15E+07	2.08E-09	4.35E-08
11	0.1	6.64E-03	3.14	9.08E-08	3.47E+08	3.19E-04	1.08E+00	3.34E-08	6.56E-16	4.35E-08	6.30E-16	10	3.15E+07	1.99E-09	4.15E-08
12	0.1	6.64E-03	3.14	9.08E-08	3.78E+08	3.19E-04	1.08E+00	3.34E-08	6.30E-16	4.15E-08	6.06E-16	10	3.15E+07	1.91E-09	3.96E-08
13	0.1	6.64E-03	3.14	9.08E-08	4.10E+08	3.19E-04	1.08E+00	3.34E-08	6.06E-16	3.96E-08	5.84E-16	10	3.15E+07	1.84E-09	3.77E-08
14	0.1	6.64E-03	3.14	9.08E-08	4.42E+08	3.19E-04	1.08E+00	3.34E-08	5.84E-16	3.77E-08	5.64E-16	10	3.15E+07	1.78E-09	3.59E-08
15	0.1	6.64E-03	3.14	9.08E-08	4.73E+08	3.19E-04	1.08E+00	3.34E-08	5.64E-16	3.59E-08	5.46E-16	10	3.15E+07	1.72E-09	3.42E-08
16	0.1	6.64E-03	3.14	9.08E-08	5.05E+08	3.19E-04	1.08E+00	3.34E-08	5.46E-16	3.42E-08	5.30E-16	10	3.15E+07	1.67E-09	3.25E-08
17	0.1	6.64E-03	3.14	9.08E-08	5.36E+08	3.19E-04	1.08E+00	3.34E-08	5.30E-16	3.25E-08	5.15E-16	10	3.15E+07	1.62E-09	3.09E-08
18	0.1	6.64E-03	3.14	9.08E-08	5.68E+08	3.19E-04	1.08E+00	3.34E-08	5.15E-16	3.09E-08	5.01E-16	10	3.15E+07	1.58E-09	2.93E-08
19	0.1	6.64E-03	3.14	9.08E-08	5.99E+08	3.19E-04	1.08E+00	3.34E-08	5.01E-16	2.93E-08	4.88E-16	10	3.15E+07	1.54E-09	2.78E-08
20	0.1	6.64E-03	3.14	9.08E-08	6.31E+08	3.19E-04	1.08E+00	3.34E-08	4.88E-16	2.78E-08	4.76E-16	10	3.15E+07	1.50E-09	2.63E-08
21	0.1	6.64E-03	3.14	9.08E-08	6.62E+08	3.19E-04	1.08E+00	3.34E-08	4.76E-16	2.63E-08	4.65E-16	10	3.15E+07	1.47E-09	2.48E-08
22	0.1	6.64E-03	3.14	9.08E-08	6.94E+08	3.19E-04	1.08E+00	3.34E-08	4.65E-16	2.48E-08	4.55E-16	10	3.15E+07	1.44E-09	2.34E-08
23	0.1	6.64E-03	3.14	9.08E-08	7.26E+08	3.19E-04	1.08E+00	3.34E-08	4.55E-16	2.34E-08	4.46E-16	10	3.15E+07	1.41E-09	2.20E-08
24	0.1	6.64E-03	3.14	9.08E-08	7.57E+08	3.19E-04	1.08E+00	3.34E-08	4.46E-16	2.20E-08	4.37E-16	10	3.15E+07	1.38E-09	2.06E-08
25	0.1	6.64E-03	3.14	9.08E-08	7.88E+08	3.19E-04	1.08E+00	3.34E-08	4.37E-16	2.06E-08	4.28E-16	10	3.15E+07	1.36E-09	1.93E-08
26	0.1	6.64E-03	3.14	9.08E-08	8.20E+08	3.19E-04	1.08E+00	3.34E-08	4.28E-16	AVERAGE					4.19E-08

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF gamma-BHC
CEILING SURFACES

Hwang DeFalco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where: Na =	Instantaneous emission flux rate (g/cm^2-s)		
E =	Soil (or medium) porosity) (unitless)		0.1
Del =	Effective diffusivity in soil (cm^2/s) = Di x $E^{0.33}$		
Di =	Diffusion coefficient in air (cm^2/s)		1.42E-02
π =	PI (3.14)		
t =	Time from sampling (s)		
H =	Henry's Law Constant (dimensionless form)		3.19E-04
Kd =	Soil/water partition coefficient (cm^3/g) = Koc x f		1.08E+00
Koc =	Organic carbon water partition coefficient (cm^3/g)		1.08E+03
foc =	Fraction of organic carbon in material (g/g)		0.001
Cs =	Initial concentration in soil or medium (g/g)		
Cwipe (Ceiling)		(μg/cm²)	0.076
Cwipe (Ceiling)		(g/cm²)	0.000000076

Calculation of Del Del = Di x $E^{0.33}$

Di (cm^2/s)	E (unitless)	Del (cm^2/s)
1.42E-02	0.1	6.64E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$$

Del (cm^2/s)	E (unitless)	Ps (g/cm^3)	Kd (cm^3/g)	H (unitless)	α (cm^2/s)
6.64E-03	0.1	2.4	1.08E+00	3.19E-04	9.06E-06

Calculation of Cs Cs = Cwipe x CF/ρ_s x d

Cwipe (μg/cm²)	CF (g/μg)	d (cm)	ρ (g/cm^3)	Cs (g/g)
0.076	1.00E-06	1	2.4	3.17E-08

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

E (unitless)	Del (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Cs (g/g)	Na (g/cm^2-s)
0.1	6.64E-03	3.14	9.06E-06	7.88E+08	3.19E-04	1.08E+00	3.17E-08	4.14E-16

Calculation of Avg Na Avg Na (T = 20yr) =2 Na (T yr)

Na g/cm^2-s	AvgNa g/cm^2-s
4.14E-16	8.29E-16

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF gamma-BHC
CEILING SURFACES

Year	E (unitless)	Del (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Cs (g/g)	Ns (g/cm^2-s)	Initial Conc (g/cm^2)	Ns (g/cm^2-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm^2)	Mass Remaining (g/cm^2)
1 sec	0.1	6.64E-03	3.14	9.08E-06	1.00E+00	3.19E-04	1.08E+00	3.17E-06	1.16E-11	7.60E-06	2.07E-15	10	3.15E+07	6.53E-09	6.95E-06
1	0.1	6.64E-03	3.14	9.08E-06	3.15E+07	3.19E-04	1.08	3.17E-06	2.07E-15	6.95E-06	1.46E-15	10	3.15E+07	4.62E-09	6.48E-06
2	0.1	6.64E-03	3.14	9.08E-06	6.31E+07	3.19E-04	1.08	3.17E-06	1.46E-15	6.48E-06	1.20E-15	10	3.15E+07	3.77E-09	6.11E-06
3	0.1	6.64E-03	3.14	9.08E-06	9.46E+07	3.19E-04	1.08	3.17E-06	1.20E-15	6.11E-06	1.04E-15	10	3.15E+07	3.27E-09	5.78E-06
4	0.1	6.64E-03	3.14	9.08E-06	1.26E+08	3.19E-04	1.08	3.17E-06	1.04E-15	5.78E-06	9.26E-16	10	3.15E+07	2.92E-09	5.49E-06
5	0.1	6.64E-03	3.14	9.08E-06	1.58E+08	3.19E-04	1.08	3.17E-06	9.26E-16	5.49E-06	8.46E-16	10	3.15E+07	2.67E-09	5.22E-06
6	0.1	6.64E-03	3.14	9.08E-06	1.89E+08	3.19E-04	1.08	3.17E-06	8.46E-16	5.22E-06	7.83E-16	10	3.15E+07	2.47E-09	4.98E-06
7	0.1	6.64E-03	3.14	9.08E-06	2.21E+08	3.19E-04	1.08	3.17E-06	7.83E-16	4.98E-06	7.32E-16	10	3.15E+07	2.31E-09	4.74E-06
8	0.1	6.64E-03	3.14	9.08E-06	2.52E+08	3.19E-04	1.08	3.17E-06	7.32E-16	4.74E-06	6.91E-16	10	3.15E+07	2.18E-09	4.53E-06
9	0.1	6.64E-03	3.14	9.08E-06	2.84E+08	3.19E-04	1.08	3.17E-06	6.91E-16	4.53E-06	6.55E-16	10	3.15E+07	2.07E-09	4.32E-06
10	0.1	6.64E-03	3.14	9.08E-06	3.15E+08	3.19E-04	1.08	3.17E-06	6.55E-16	4.32E-06	6.25E-16	10	3.15E+07	1.97E-09	4.12E-06
11	0.1	6.64E-03	3.14	9.08E-06	3.47E+08	3.19E-04	1.08	3.17E-06	6.25E-16	4.12E-06	5.98E-16	10	3.15E+07	1.88E-09	3.93E-06
12	0.1	6.64E-03	3.14	9.08E-06	3.78E+08	3.19E-04	1.08	3.17E-06	5.98E-16	3.93E-06	5.76E-16	10	3.15E+07	1.81E-09	3.75E-06
13	0.1	6.64E-03	3.14	9.08E-06	4.10E+08	3.19E-04	1.08	3.17E-06	5.76E-16	3.75E-06	5.54E-16	10	3.15E+07	1.75E-09	3.58E-06
14	0.1	6.64E-03	3.14	9.08E-06	4.42E+08	3.19E-04	1.08	3.17E-06	5.54E-16	3.58E-06	5.35E-16	10	3.15E+07	1.69E-09	3.41E-06
15	0.1	6.64E-03	3.14	9.08E-06	4.73E+08	3.19E-04	1.08	3.17E-06	5.35E-16	3.41E-06	5.18E-16	10	3.15E+07	1.63E-09	3.25E-06
16	0.1	6.64E-03	3.14	9.08E-06	5.05E+08	3.19E-04	1.08	3.17E-06	5.18E-16	3.25E-06	5.02E-16	10	3.15E+07	1.58E-09	3.09E-06
17	0.1	6.64E-03	3.14	9.08E-06	5.36E+08	3.19E-04	1.08	3.17E-06	5.02E-16	3.09E-06	4.88E-16	10	3.15E+07	1.54E-09	2.93E-06
18	0.1	6.64E-03	3.14	9.08E-06	5.68E+08	3.19E-04	1.08	3.17E-06	4.88E-16	2.93E-06	4.75E-16	10	3.15E+07	1.50E-09	2.78E-06
19	0.1	6.64E-03	3.14	9.08E-06	5.99E+08	3.19E-04	1.08	3.17E-06	4.75E-16	2.78E-06	4.63E-16	10	3.15E+07	1.46E-09	2.64E-06
20	0.1	6.64E-03	3.14	9.08E-06	6.31E+08	3.19E-04	1.08	3.17E-06	4.63E-16	2.64E-06	4.52E-16	10	3.15E+07	1.43E-09	2.50E-06
21	0.1	6.64E-03	3.14	9.08E-06	6.62E+08	3.19E-04	1.08	3.17E-06	4.52E-16	2.50E-06	4.42E-16	10	3.15E+07	1.39E-09	2.36E-06
22	0.1	6.64E-03	3.14	9.08E-06	6.94E+08	3.19E-04	1.08	3.17E-06	4.42E-16	2.36E-06	4.32E-16	10	3.15E+07	1.36E-09	2.22E-06
23	0.1	6.64E-03	3.14	9.08E-06	7.26E+08	3.19E-04	1.08	3.17E-06	4.32E-16	2.22E-06	4.23E-16	10	3.15E+07	1.33E-09	2.09E-06
24	0.1	6.64E-03	3.14	9.08E-06	7.57E+08	3.19E-04	1.08	3.17E-06	4.23E-16	2.09E-06	4.14E-16	10	3.15E+07	1.31E-09	1.96E-06
25	0.1	6.64E-03	3.14	9.08E-06	7.88E+08	3.19E-04	1.08	3.17E-06	4.14E-16	1.96E-06	4.06E-16	10	3.15E+07	1.28E-09	1.83E-06
26	0.1	6.64E-03	3.14	9.08E-06	8.20E+08	3.19E-04	1.08	3.17E-06	4.06E-16	AVERAGE					3.89E-06

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF gamma-BHC
FROM BASEMENT SOIL

Hwang DeFalco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where:	Na =	Instantaneous emission flux rate (g/cm²-s)	
	E =	Soil (or medium) porosity) (unitless)	0.2
	Del =	Effective diffusivity in soil (cm²/s) = Di x $E^{0.33}$	
	Di =	Diffusion coefficient in air (cm²/s)	1.42E-02
	π =	Pi (3.14)	
	t =	Time from sampling (s)	
	H =	Henry's Law Constant (dimensionless form)	3.19E-04
	Kd =	Soil/water partition coefficient (cm³/g)	6.48
	Koc =	Organic carbon water partition coefficient (cm³/g)	1.08E+03
	foc =	Fraction of organic carbon in material (g/g)	0.006
	Cs =	Initial concentration in soil or medium (mg/kg)	0.486

Calculation of Del Del = Di x $E^{0.33}$

Di (cm²/s)	E (unitless)	Del (cm²/s)
1.42E-02	0.2	8.35E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$$

Del (cm²/s)	E (unitless)	Ps (g/cm³)	Kd (cm³/g)	H (unitless)	α (cm²/s)
8.35E-03	0.2	2.65	6.48	3.19E-04	3.88E-08

Calculation of Cw Cw = Csoil x CF1 x CF2 x ρs x d

Cs (mg/kg)	CF1 (g/mg)	CF2 (kg/g)	Cs (g/g)	ρs (g/cm³)	d (cm)	Cw (g/cm³)
0.486	1.00E-03	1.00E-03	4.86E-07	2.65	1	1.29E-06

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

E (unitless)	Del (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Cs (g/g)	Na (g/cm²-s)
0.2	8.35E-03	3.14	3.88E-08	7.88E+08	3.19E-04	6.48	4.86E-07	4.08E-15

Calculation of Avg Na Avg Na (T = 25yr) =2 Na (T yr)

Na g/cm²-s	AvgNa g/cm²-s
4.08E-15	8.16E-15

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF gamma-BHC
FROM BASEMENT SOIL

Year	E (unitless)	Del (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Ca (g/g)	Na (g/cm^2-s)	Initial Conc (g/cm^3)	Na (g/cm^2-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm^2)	Mass Remaining (g/cm^2)
1 sec	0.2	8.35E-03	3.14	3.88E-08	1.00E+00	3.19E-04	6.48	4.86E-07	1.14E-10	1.29E-06	2.04E-14	10	3.15E+07	6.43E-08	1.22E-06
1	0.2	8.35E-03	3.14	3.88E-08	3.15E+07	3.19E-04	6.48	4.86E-07	2.04E-14	1.22E-06	1.44E-14	10	3.15E+07	4.55E-08	1.18E-06
2	0.2	8.35E-03	3.14	3.88E-08	6.31E+07	3.19E-04	6.48	4.86E-07	1.44E-14	1.18E-06	1.18E-14	10	3.15E+07	3.71E-08	1.14E-06
3	0.2	8.35E-03	3.14	3.88E-08	9.46E+07	3.19E-04	6.48	4.86E-07	1.18E-14	1.14E-06	1.02E-14	10	3.15E+07	3.21E-08	1.11E-06
4	0.2	8.35E-03	3.14	3.88E-08	1.26E+08	3.19E-04	6.48	4.86E-07	1.02E-14	1.11E-06	9.12E-15	10	3.15E+07	2.88E-08	1.08E-06
5	0.2	8.35E-03	3.14	3.88E-08	1.58E+08	3.19E-04	6.48	4.86E-07	9.12E-15	1.08E-06	8.32E-15	10	3.15E+07	2.62E-08	1.05E-06
6	0.2	8.35E-03	3.14	3.88E-08	1.89E+08	3.19E-04	6.48	4.86E-07	8.32E-15	1.05E-06	7.71E-15	10	3.15E+07	2.43E-08	1.03E-06
7	0.2	8.35E-03	3.14	3.88E-08	2.21E+08	3.19E-04	6.48	4.86E-07	7.71E-15	1.03E-06	7.21E-15	10	3.15E+07	2.27E-08	1.01E-06
8	0.2	8.35E-03	3.14	3.88E-08	2.52E+08	3.19E-04	6.48	4.86E-07	7.21E-15	1.01E-06	6.80E-15	10	3.15E+07	2.14E-08	9.85E-07
9	0.2	8.35E-03	3.14	3.88E-08	2.84E+08	3.19E-04	6.48	4.86E-07	6.80E-15	9.85E-07	6.45E-15	10	3.15E+07	2.03E-08	9.65E-07
10	0.2	8.35E-03	3.14	3.88E-08	3.15E+08	3.19E-04	6.48	4.86E-07	6.45E-15	9.65E-07	6.15E-15	10	3.15E+07	1.94E-08	9.46E-07
11	0.2	8.35E-03	3.14	3.88E-08	3.47E+08	3.19E-04	6.48	4.86E-07	6.15E-15	9.46E-07	5.89E-15	10	3.15E+07	1.86E-08	9.27E-07
12	0.2	8.35E-03	3.14	3.88E-08	3.78E+08	3.19E-04	6.48	4.86E-07	5.89E-15	9.27E-07	5.65E-15	10	3.15E+07	1.78E-08	9.09E-07
13	0.2	8.35E-03	3.14	3.88E-08	4.10E+08	3.19E-04	6.48	4.86E-07	5.65E-15	9.09E-07	5.45E-15	10	3.15E+07	1.72E-08	8.92E-07
14	0.2	8.35E-03	3.14	3.88E-08	4.42E+08	3.19E-04	6.48	4.86E-07	5.45E-15	8.92E-07	5.26E-15	10	3.15E+07	1.66E-08	8.76E-07
15	0.2	8.35E-03	3.14	3.88E-08	4.73E+08	3.19E-04	6.48	4.86E-07	5.26E-15	8.76E-07	5.10E-15	10	3.15E+07	1.61E-08	8.59E-07
16	0.2	8.35E-03	3.14	3.88E-08	5.05E+08	3.19E-04	6.48	4.86E-07	5.10E-15	8.59E-07	4.94E-15	10	3.15E+07	1.56E-08	8.44E-07
17	0.2	8.35E-03	3.14	3.88E-08	5.36E+08	3.19E-04	6.48	4.86E-07	4.94E-15	8.44E-07	4.81E-15	10	3.15E+07	1.52E-08	8.29E-07
18	0.2	8.35E-03	3.14	3.88E-08	5.68E+08	3.19E-04	6.48	4.86E-07	4.81E-15	8.29E-07	4.68E-15	10	3.15E+07	1.48E-08	8.14E-07
19	0.2	8.35E-03	3.14	3.88E-08	5.99E+08	3.19E-04	6.48	4.86E-07	4.68E-15	8.14E-07	4.56E-15	10	3.15E+07	1.44E-08	8.00E-07
20	0.2	8.35E-03	3.14	3.88E-08	6.31E+08	3.19E-04	6.48	4.86E-07	4.56E-15	8.00E-07	4.45E-15	10	3.15E+07	1.40E-08	7.86E-07
21	0.2	8.35E-03	3.14	3.88E-08	6.62E+08	3.19E-04	6.48	4.86E-07	4.45E-15	7.86E-07	4.35E-15	10	3.15E+07	1.37E-08	7.72E-07
22	0.2	8.35E-03	3.14	3.88E-08	6.94E+08	3.19E-04	6.48	4.86E-07	4.35E-15	7.72E-07	4.25E-15	10	3.15E+07	1.34E-08	7.58E-07
23	0.2	8.35E-03	3.14	3.88E-08	7.25E+08	3.19E-04	6.48	4.86E-07	4.25E-15	7.58E-07	4.16E-15	10	3.15E+07	1.31E-08	7.45E-07
24	0.2	8.35E-03	3.14	3.88E-08	7.57E+08	3.19E-04	6.48	4.86E-07	4.16E-15	7.45E-07	4.08E-15	10	3.15E+07	1.29E-08	7.32E-07
25	0.2	8.35E-03	3.14	3.88E-08	7.88E+08	3.19E-04	6.48	4.86E-07	4.08E-15	7.32E-07	4.00E-15	10	3.15E+07	1.26E-08	7.20E-07
26	0.2	8.35E-03	3.14	3.88E-08	8.20E+08	3.19E-04	6.48	4.86E-07	4.00E-15	AVERAGE					9.22E-07

APPENDIX E
HEPTACHLOR EPOXIDE

BUILDING NO. 3
BASEMENT
CALCULATION OF AIR CONCENTRATIONS
HEPTACHLOR EPOXIDE

Calculation of Air Concentration $Ca = (E \times CF1 \times t_e \times CF2) / (V \times CF3)$

Where:

	Ca =	Predicted air concentration in building (mg/m^3)
	E =	Average emission rate from all sources (g/s)
	CF1 =	Unit conversion factor (s/hr)
	t_e =	Air exchange rate (hr)
	CF2 =	Unit conversion factor (mg/g)
	V =	Volume of room (cm^3)
	CF3 =	Unit conversion factor (m^3/cm^3)

Source	Average Na (g/cm^2-s)	Applicable surface area (cm^2)	Weighted Emission Rate (g/s)
Floor	6.35E-14	2.70E+07	1.71E-06
Wall	8.88E-15	1.47E+07	1.31E-07
Ceiling	6.46E-17	1.35E+08	8.72E-09
Total			**1.85E-06**

Chemical	E (g/s)	CF1 (s/hr)	t_e (hr)	CF2 (mg/g)	CF3 (m^3/cm^3)	V (cm^3)	Ca (mg/m^3)
Heptachlor epoxide	1.85E-06	3600	0.233	1000	1.00E-06	3.29E+10	**4.72E-05**

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF HEPTACHLOR EPOXIDE
FROM FLOOR SURFACES

Hwang DeFalco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where:	Na =	Instantaneous emission flux rate (g/cm²-s)	
	E =	Soil (or medium) porosity) (unitless)	0.1
	Del =	Effective diffusivity in soil (cm²/s) = Di x E^0.33	
	Di =	Diffusion coefficient in air (cm²/s)	1.12E-02
	π =	PI (3.14)	
	t =	Time from sampling (s)	
	H =	Henry's Law Constant (dimensionless form)	1.80E-02
	Kd =	Soil/water partition coefficient (cm³/g) =	0.22
	Koc =	Organic carbon water partition coefficient (cm³/g)	2.20E+02
	foc =	Fraction of organic carbon in material (g/g)	0.001
	Cs =	Initial concentration in soil or medium (g/g)	
	Cwipe (Floor)	(µg/cm²)	0.393
	Cwipe (Floor)	(g/cm²)	3.93E-07

Calculation of Del Del = Di x E^0.33

Di (cm²/s)	E (unitless)	Del (cm²/s)
1.12E-02	0.1	5.24E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$$

Del (cm²/s)	E (unitless)	Ps (g/cm³)	Kd (cm³/g)	H (unitless)	α (cm²/s)
5.24E-03	0.1	2.4	0.22	1.80E-02	1.98E-05

Calculation of Cs Cs = Cwipe x CF/ρ_s x d

Cwipe (µg/cm²)	CF (g/µg)	d (cm)	ρ (g/cm³)	Cs (g/g)
0.393	1.00E-06	1	2.4	1.64E-07

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

E (unitless)	Del (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Cs (g/g)	Na (g/cm²-s)
0.1	5.24E-03	3.14	1.98E-05	7.88E+08	1.80E-02	0.22	1.64E-07	3.17E-14

Calculation of Avg Na Avg Na (T = 26yr) =2 Na (T yr)

Na g/cm²-s	AvgNa g/cm²-s
3.17E-14	6.35E-14

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF HEPTACHLOR EPOXIDE
FROM FLOOR SURFACES

Year	E (unitless)	Del (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Cs (g/g)	Na (g/cm^2-s)	Initial Conc (g/cm^3)	Na (g/cm^2-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm^2)	Mass Remaining (g/cm^2)
1 sec	0.1	5.24E-03	3.14	1.98E-05	1.00E+00	1.80E-02	0.22	1.64E-07	8.91E-10	3.93E-07	1.58E-13	10	3.15E+07	5.00E-07	-1.07E-07
1	0.1	5.24E-03	3.14	1.98E-05	3.15E+07	1.80E-02	0.22	1.64E-07	1.59E-13	-1.07E-07	1.12E-13	10	3.15E+07	3.54E-07	-4.61E-07
2	0.1	5.24E-03	3.14	1.98E-05	6.31E+07	1.80E-02	0.22	1.64E-07	1.12E-13	-4.61E-07	9.16E-14	10	3.15E+07	2.89E-07	-7.50E-07
3	0.1	5.24E-03	3.14	1.98E-05	9.46E+07	1.80E-02	0.22	1.64E-07	9.16E-14	-7.50E-07	7.93E-14	10	3.15E+07	2.50E-07	-1.00E-06
4	0.1	5.24E-03	3.14	1.98E-05	1.26E+08	1.80E-02	0.22	1.64E-07	7.93E-14	-1.00E-06	7.09E-14	10	3.15E+07	2.24E-07	-1.22E-06
5	0.1	5.24E-03	3.14	1.98E-05	1.58E+08	1.80E-02	0.22	1.64E-07	7.09E-14	-1.22E-06	6.48E-14	10	3.15E+07	2.04E-07	-1.43E-06
6	0.1	5.24E-03	3.14	1.98E-05	1.89E+08	1.80E-02	0.22	1.64E-07	6.48E-14	-1.43E-06	6.00E-14	10	3.15E+07	1.89E-07	-1.62E-06
7	0.1	5.24E-03	3.14	1.98E-05	2.21E+08	1.80E-02	0.22	1.64E-07	6.00E-14	-1.62E-06	5.61E-14	10	3.15E+07	1.77E-07	-1.79E-06
8	0.1	5.24E-03	3.14	1.98E-05	2.52E+08	1.80E-02	0.22	1.64E-07	5.61E-14	-1.79E-06	5.29E-14	10	3.15E+07	1.67E-07	-1.96E-06
9	0.1	5.24E-03	3.14	1.98E-05	2.84E+08	1.80E-02	0.22	1.64E-07	5.29E-14	-1.96E-06	5.02E-14	10	3.15E+07	1.58E-07	-2.12E-06
10	0.1	5.24E-03	3.14	1.98E-05	3.15E+08	1.80E-02	0.22	1.64E-07	5.02E-14	-2.12E-06	4.78E-14	10	3.15E+07	1.51E-07	-2.27E-06
11	0.1	5.24E-03	3.14	1.98E-05	3.47E+08	1.80E-02	0.22	1.64E-07	4.78E-14	-2.27E-06	4.56E-14	10	3.15E+07	1.44E-07	-2.41E-06
12	0.1	5.24E-03	3.14	1.98E-05	3.78E+08	1.80E-02	0.22	1.64E-07	4.56E-14	-2.41E-06	4.40E-14	10	3.15E+07	1.39E-07	-2.55E-06
13	0.1	5.24E-03	3.14	1.98E-05	4.10E+08	1.80E-02	0.22	1.64E-07	4.40E-14	-2.55E-06	4.24E-14	10	3.15E+07	1.34E-07	-2.69E-06
14	0.1	5.24E-03	3.14	1.98E-05	4.42E+08	1.80E-02	0.22	1.64E-07	4.24E-14	-2.69E-06	4.10E-14	10	3.15E+07	1.29E-07	-2.82E-06
15	0.1	5.24E-03	3.14	1.98E-05	4.73E+08	1.80E-02	0.22	1.64E-07	4.10E-14	-2.82E-06	3.97E-14	10	3.15E+07	1.25E-07	-2.94E-06
16	0.1	5.24E-03	3.14	1.98E-05	5.05E+08	1.80E-02	0.22	1.64E-07	3.97E-14	-2.94E-06	3.85E-14	10	3.15E+07	1.21E-07	-3.06E-06
17	0.1	5.24E-03	3.14	1.98E-05	5.36E+08	1.80E-02	0.22	1.64E-07	3.85E-14	-3.06E-06	3.74E-14	10	3.15E+07	1.18E-07	-3.18E-06
18	0.1	5.24E-03	3.14	1.98E-05	5.68E+08	1.80E-02	0.22	1.64E-07	3.74E-14	-3.18E-06	3.64E-14	10	3.15E+07	1.15E-07	-3.29E-06
19	0.1	5.24E-03	3.14	1.98E-05	5.99E+08	1.80E-02	0.22	1.64E-07	3.64E-14	-3.29E-06	3.55E-14	10	3.15E+07	1.12E-07	-3.41E-06
20	0.1	5.24E-03	3.14	1.98E-05	6.31E+08	1.80E-02	0.22	1.64E-07	3.55E-14	-3.41E-06	3.46E-14	10	3.15E+07	1.09E-07	-3.52E-06
21	0.1	5.24E-03	3.14	1.98E-05	6.62E+08	1.80E-02	0.22	1.64E-07	3.46E-14	-3.52E-06	3.36E-14	10	3.15E+07	1.07E-07	-3.62E-06
22	0.1	5.24E-03	3.14	1.98E-05	6.94E+08	1.80E-02	0.22	1.64E-07	3.36E-14	-3.62E-06	3.31E-14	10	3.15E+07	1.04E-07	-3.73E-06
23	0.1	5.24E-03	3.14	1.98E-05	7.25E+08	1.80E-02	0.22	1.64E-07	3.31E-14	-3.73E-06	3.24E-14	10	3.15E+07	1.02E-07	-3.83E-06
24	0.1	5.24E-03	3.14	1.98E-05	7.57E+08	1.80E-02	0.22	1.64E-07	3.24E-14	-3.83E-06	3.17E-14	10	3.15E+07	1.00E-07	-3.93E-06
25	0.1	5.24E-03	3.14	1.98E-05	7.88E+08	1.80E-02	0.22	1.64E-07	3.17E-14	-3.93E-06	3.11E-14	10	3.15E+07	9.81E-08	-4.03E-06
26	0.1	5.24E-03	3.14	1.98E-05	8.20E+08	1.80E-02	0.22	1.64E-07	3.11E-14	AVERAGE					-2.45E-06

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF HEPTACHLOR EPOXIDE
FROM VERTICAL SURFACES

Hwang DeFelco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where:

Na =	Instantaneous emission flux rate (g/cm^2-s)		
E =	Soil (or medium) porosity) (unitless)		0.1
Del =	Effective diffusivity in soil (cm^2/s) = Di x $E^{0.33}$		
Di =	Diffusion coefficient in air (cm^2/s)		1.12E-02
π =	PI (3.14)		
t =	Time from sampling (s)		
H =	Henry's Law Constant (dimensionless form)		1.80E-02
Kd =	Soil/water partition coefficient (cm^3/g) = Koc x foc		0.22
Koc =	Organic carbon water partition coefficient (cm^3/g)		2.20E+02
foc =	Fraction of organic carbon in material (g/g)		0.001
Cs =	Initial concentration in soil or medium (g/g)		
Cwipe (Wall)		(μg/cm²)	0.056
Cwipe (Wall)		(g/cm²)	0.000000056

Calculation of Del Del = Di x $E^{0.33}$

Di (cm^2/s)	E (unitless)	Del (cm^2/s)
1.12E-02	0.1	6.24E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$$

Del (cm^2/s)	E (unitless)	Ps (g/cm^3)	Kd (cm^3/g)	H (unitless)	α (cm^2/s)
6.24E-03	0.1	2.4	0.22	1.80E-02	1.98E-05

Calculation of Cs Cs = Cwipe x CF/ρ_s x d

Cwipe (μg/cm²)	CF (g/μg)	d (cm)	ρ (g/cm^3)	Cs (g/g)
0.056	1.00E-06	1	2.4	2.29E-08

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

E (unitless)	Del (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Cs (g/g)	Na (g/cm^2-s)
0.1	6.24E-03	3.14	1.98E-05	7.88E+08	1.80E-02	0.22	2.29E-08	4.44E-15

Calculation of Avg Na Avg Na (T = 25yr) =2 Na (T yr)

Na g/cm^2-s	AvgNa g/cm^2-s
4.44E-15	8.88E-15

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF HEPTACHLOR EPOXIDE
FROM VERTICAL SURFACES

Year	E (unitless)	Del (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Cs (g/g)	Ns (g/cm^3-s)	Initial Conc (g/cm^3)	Ns (g/cm^3-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm^3)	Mass Remaining (g/cm^3)
1 sec	0.1	5.24E-03	3.14	1.98E-05	1.00E+00	1.80E-02	0.22	2.29E-08	1.26E-10	5.50E-06	2.22E-14	10	3.15E+07	7.00E-08	-1.50E-06
1	0.1	5.24E-03	3.14	1.98E-05	3.15E+07	1.80E-02	0.22	2.29E-08	2.22E-14	-1.50E-06	1.57E-14	10	3.15E+07	4.95E-08	-6.45E-06
2	0.1	5.24E-03	3.14	1.98E-05	6.31E+07	1.80E-02	0.22	2.29E-08	1.57E-14	-6.45E-06	1.26E-14	10	3.15E+07	4.04E-08	-1.05E-07
3	0.1	5.24E-03	3.14	1.98E-05	9.46E+07	1.80E-02	0.22	2.29E-08	1.26E-14	-1.05E-07	1.11E-14	10	3.15E+07	3.50E-08	-1.40E-07
4	0.1	5.24E-03	3.14	1.98E-05	1.26E+08	1.80E-02	0.22	2.29E-08	1.11E-14	-1.40E-07	9.93E-15	10	3.15E+07	3.13E-08	-1.71E-07
5	0.1	5.24E-03	3.14	1.98E-05	1.58E+08	1.80E-02	0.22	2.29E-08	9.93E-15	-1.71E-07	9.06E-15	10	3.15E+07	2.86E-08	-2.00E-07
6	0.1	5.24E-03	3.14	1.98E-05	1.89E+08	1.80E-02	0.22	2.29E-08	9.06E-15	-2.00E-07	8.39E-15	10	3.15E+07	2.65E-08	-2.26E-07
7	0.1	5.24E-03	3.14	1.98E-05	2.21E+08	1.80E-02	0.22	2.29E-08	8.39E-15	-2.26E-07	7.85E-15	10	3.15E+07	2.48E-08	-2.51E-07
8	0.1	5.24E-03	3.14	1.98E-05	2.52E+08	1.80E-02	0.22	2.29E-08	7.85E-15	-2.51E-07	7.40E-15	10	3.15E+07	2.33E-08	-2.74E-07
9	0.1	5.24E-03	3.14	1.98E-05	2.84E+08	1.80E-02	0.22	2.29E-08	7.40E-15	-2.74E-07	7.02E-15	10	3.15E+07	2.21E-08	-2.97E-07
10	0.1	5.24E-03	3.14	1.98E-05	3.15E+08	1.80E-02	0.22	2.29E-08	7.02E-15	-2.97E-07	6.69E-15	10	3.15E+07	2.11E-08	-3.18E-07
11	0.1	5.24E-03	3.14	1.98E-05	3.47E+08	1.80E-02	0.22	2.29E-08	6.69E-15	-3.18E-07	6.41E-15	10	3.15E+07	2.02E-08	-3.38E-07
12	0.1	5.24E-03	3.14	1.98E-05	3.78E+08	1.80E-02	0.22	2.29E-08	6.41E-15	-3.38E-07	6.16E-15	10	3.15E+07	1.94E-08	-3.57E-07
13	0.1	5.24E-03	3.14	1.98E-05	4.10E+08	1.80E-02	0.22	2.29E-08	6.16E-15	-3.57E-07	5.93E-15	10	3.15E+07	1.87E-08	-3.76E-07
14	0.1	5.24E-03	3.14	1.98E-05	4.42E+08	1.80E-02	0.22	2.29E-08	5.93E-15	-3.76E-07	5.73E-15	10	3.15E+07	1.81E-08	-3.94E-07
15	0.1	5.24E-03	3.14	1.98E-05	4.73E+08	1.80E-02	0.22	2.29E-08	5.73E-15	-3.94E-07	5.55E-15	10	3.15E+07	1.75E-08	-4.12E-07
16	0.1	5.24E-03	3.14	1.98E-05	5.05E+08	1.80E-02	0.22	2.29E-08	5.55E-15	-4.12E-07	5.38E-15	10	3.15E+07	1.70E-08	-4.29E-07
17	0.1	5.24E-03	3.14	1.98E-05	5.36E+08	1.80E-02	0.22	2.29E-08	5.38E-15	-4.29E-07	5.23E-15	10	3.15E+07	1.65E-08	-4.46E-07
18	0.1	5.24E-03	3.14	1.98E-05	5.68E+08	1.80E-02	0.22	2.29E-08	5.23E-15	-4.45E-07	5.09E-15	10	3.15E+07	1.61E-08	-4.61E-07
19	0.1	5.24E-03	3.14	1.98E-05	5.99E+08	1.80E-02	0.22	2.29E-08	5.09E-15	-4.61E-07	4.96E-15	10	3.15E+07	1.57E-08	-4.77E-07
20	0.1	5.24E-03	3.14	1.98E-05	6.31E+08	1.80E-02	0.22	2.29E-08	4.96E-15	-4.77E-07	4.84E-15	10	3.15E+07	1.53E-08	-4.92E-07
21	0.1	5.24E-03	3.14	1.98E-05	6.62E+08	1.80E-02	0.22	2.29E-08	4.84E-15	-4.92E-07	4.73E-15	10	3.15E+07	1.49E-08	-5.07E-07
22	0.1	5.24E-03	3.14	1.98E-05	6.94E+08	1.80E-02	0.22	2.29E-08	4.73E-15	-5.07E-07	4.63E-15	10	3.15E+07	1.46E-08	-5.22E-07
23	0.1	5.24E-03	3.14	1.98E-05	7.25E+08	1.80E-02	0.22	2.29E-08	4.63E-15	-5.22E-07	4.53E-15	10	3.15E+07	1.43E-08	-5.36E-07
24	0.1	5.24E-03	3.14	1.98E-05	7.57E+08	1.80E-02	0.22	2.29E-08	4.53E-15	-5.36E-07	4.44E-15	10	3.15E+07	1.40E-08	-5.50E-07
25	0.1	5.24E-03	3.14	1.98E-05	7.88E+08	1.80E-02	0.22	2.29E-08	4.44E-15	-5.50E-07	4.35E-15	10	3.15E+07	1.37E-08	-5.64E-07
26	0.1	5.24E-03	3.14	1.98E-05	8.20E+08	1.80E-02	0.22	2.29E-08	4.35E-15	AVERAGE					-3.43E-07

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF HEPTACHLOR EPOXIDE
FROM CEILING SURFACES

Hwang DeFalco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where: Na =	Instantaneous emission flux rate (g/cm²-s)		
E =	Soil (or medium) porosity) (unitless)		0.1
Del =	Effective diffusivity in soil (cm²/s) = Di x $E^{0.33}$		
Di =	Diffusion coefficient in air (cm²/s)		1.12E-02
π =	Pi (3.14)		
t =	Time from sampling (s)		
H =	Henry's Law Constant (dimensionless form)		1.80E-02
Kd =	Soil/water partition coefficient (cm³/g) = Koc x f		0.22
Koc =	Organic carbon water partition coefficient (cm³/g)		2.20E+02
foc =	Fraction of organic carbon in material (g/g)		0.001
Cs =	Initial concentration in soil or medium (g/g)		
Cwipe (Ceiling)		(µg/cm²)	0.0004
Cwipe (Ceiling)		(g/cm²)	4E-10

Calculation of Del

Del = Di x $E^{0.33}$

Di (cm²/s)	E (unitless)	Del (cm²/s)
1.12E-02	0.1	5.24E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$$

Del (cm²/s)	E (unitless)	Ps (g/cm³)	Kd (cm³/g)	H (unitless)	α (cm²/s)
5.24E-03	0.1	2.4	0.22	1.80E-02	1.98E-05

Calculation of Cs

Cs = Cwipe x CF/ρ_s x d

Cwipe (µg/cm²)	CF (g/µg)	d (cm)	ρ (g/cm³)	Cs (g/g)
0.0004	1.00E-06	1	2.4	1.67E-10

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

E (unitless)	Del (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Cs (g/g)	Na (g/cm²-s)
0.1	5.24E-03	3.14	1.98E-05	7.88E+08	1.80E-02	0.22	1.67E-10	3.23E-17

Calculation of Avg Na

Avg Na (T = 25yr) =2 Na (T yr)

Na g/cm²-s	AvgNa g/cm²-s
3.23E-17	6.46E-17

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF HEPTACHLOR EPOXIDE
FROM CEILING SURFACES

Year	E (unitless)	Del (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Cs (g/g)	Ns (g/cm^2-s)	Initial Conc (g/cm^3)	Ns (g/cm^2-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm^2)	Mass Remaining (g/cm^2)
1 sec	0.1	5.24E-03	3.14	1.98E-05	1.00E+00	1.80E-02	0.22	1.67E-10	9.07E-13	4.00E-10	1.61E-16	10	3.15E+07	5.08E-10	-1.09E-10
1	0.1	5.24E-03	3.14	1.98E-05	3.15E+07	1.80E-02	0.22	1.67E-10	1.61E-16	-1.09E-10	1.14E-16	10	3.15E+07	3.60E-10	-4.69E-10
2	0.1	5.24E-03	3.14	1.98E-05	6.31E+07	1.80E-02	0.22	1.67E-10	1.14E-16	-4.69E-10	9.32E-17	10	3.15E+07	2.84E-10	-7.53E-10
3	0.1	5.24E-03	3.14	1.98E-05	9.46E+07	1.80E-02	0.22	1.67E-10	9.32E-17	-7.53E-10	8.07E-17	10	3.15E+07	2.55E-10	-1.02E-09
4	0.1	5.24E-03	3.14	1.98E-05	1.26E+08	1.80E-02	0.22	1.67E-10	8.07E-17	-1.02E-09	7.22E-17	10	3.15E+07	2.28E-10	-1.25E-09
5	0.1	5.24E-03	3.14	1.98E-05	1.58E+08	1.80E-02	0.22	1.67E-10	7.22E-17	-1.25E-09	6.59E-17	10	3.15E+07	2.08E-10	-1.46E-09
6	0.1	5.24E-03	3.14	1.98E-05	1.89E+08	1.80E-02	0.22	1.67E-10	6.59E-17	-1.46E-09	6.10E-17	10	3.15E+07	1.92E-10	-1.65E-09
7	0.1	5.24E-03	3.14	1.98E-05	2.21E+08	1.80E-02	0.22	1.67E-10	6.10E-17	-1.65E-09	5.71E-17	10	3.15E+07	1.80E-10	-1.83E-09
8	0.1	5.24E-03	3.14	1.98E-05	2.52E+08	1.80E-02	0.22	1.67E-10	5.71E-17	-1.83E-09	5.38E-17	10	3.15E+07	1.70E-10	-2.00E-09
9	0.1	5.24E-03	3.14	1.98E-05	2.84E+08	1.80E-02	0.22	1.67E-10	5.38E-17	-2.00E-09	5.11E-17	10	3.15E+07	1.61E-10	-2.16E-09
10	0.1	5.24E-03	3.14	1.98E-05	3.15E+08	1.80E-02	0.22	1.67E-10	5.11E-17	-2.16E-09	4.87E-17	10	3.15E+07	1.54E-10	-2.31E-09
11	0.1	5.24E-03	3.14	1.98E-05	3.47E+08	1.80E-02	0.22	1.67E-10	4.87E-17	-2.31E-09	4.66E-17	10	3.15E+07	1.47E-10	-2.46E-09
12	0.1	5.24E-03	3.14	1.98E-05	3.78E+08	1.80E-02	0.22	1.67E-10	4.66E-17	-2.46E-09	4.46E-17	10	3.15E+07	1.41E-10	-2.60E-09
13	0.1	5.24E-03	3.14	1.98E-05	4.10E+08	1.80E-02	0.22	1.67E-10	4.46E-17	-2.60E-09	4.32E-17	10	3.15E+07	1.36E-10	-2.73E-09
14	0.1	5.24E-03	3.14	1.98E-05	4.42E+08	1.80E-02	0.22	1.67E-10	4.32E-17	-2.73E-09	4.17E-17	10	3.15E+07	1.31E-10	-2.87E-09
15	0.1	5.24E-03	3.14	1.98E-05	4.73E+08	1.80E-02	0.22	1.67E-10	4.17E-17	-2.87E-09	4.04E-17	10	3.15E+07	1.27E-10	-2.99E-09
16	0.1	5.24E-03	3.14	1.98E-05	5.05E+08	1.80E-02	0.22	1.67E-10	4.04E-17	-2.99E-09	3.92E-17	10	3.15E+07	1.23E-10	-3.12E-09
17	0.1	5.24E-03	3.14	1.98E-05	5.36E+08	1.80E-02	0.22	1.67E-10	3.92E-17	-3.12E-09	3.81E-17	10	3.15E+07	1.20E-10	-3.24E-09
18	0.1	5.24E-03	3.14	1.98E-05	5.68E+08	1.80E-02	0.22	1.67E-10	3.81E-17	-3.24E-09	3.70E-17	10	3.15E+07	1.17E-10	-3.36E-09
19	0.1	5.24E-03	3.14	1.98E-05	5.99E+08	1.80E-02	0.22	1.67E-10	3.70E-17	-3.36E-09	3.61E-17	10	3.15E+07	1.14E-10	-3.47E-09
20	0.1	5.24E-03	3.14	1.98E-05	6.31E+08	1.80E-02	0.22	1.67E-10	3.61E-17	-3.47E-09	3.52E-17	10	3.15E+07	1.11E-10	-3.58E-09
21	0.1	5.24E-03	3.14	1.98E-05	6.62E+08	1.80E-02	0.22	1.67E-10	3.52E-17	-3.58E-09	3.44E-17	10	3.15E+07	1.09E-10	-3.69E-09
22	0.1	5.24E-03	3.14	1.98E-05	6.94E+08	1.80E-02	0.22	1.67E-10	3.44E-17	-3.69E-09	3.37E-17	10	3.15E+07	1.06E-10	-3.79E-09
23	0.1	5.24E-03	3.14	1.98E-05	7.25E+08	1.80E-02	0.22	1.67E-10	3.37E-17	-3.79E-09	3.30E-17	10	3.15E+07	1.04E-10	-3.90E-09
24	0.1	5.24E-03	3.14	1.98E-05	7.57E+08	1.80E-02	0.22	1.67E-10	3.30E-17	-3.90E-09	3.23E-17	10	3.15E+07	1.02E-10	-4.00E-09
25	0.1	5.24E-03	3.14	1.98E-05	7.88E+08	1.80E-02	0.22	1.67E-10	3.23E-17	-4.00E-09	3.17E-17	10	3.15E+07	9.99E-11	-4.10E-09
26	0.1	5.24E-03	3.14	1.98E-05	8.20E+08	1.80E-02	0.22	1.67E-10	3.17E-17	AVERAGE					-3.49E-09

APPENDIX E
PCBs

BUILDING NO. 3
BASEMENT
CALCULATION OF AIR CONCENTRATIONS
PCBs

Equation $Ca = (E \times CF1 \times t_e \times CF2) / (V \times CF3)$

Where:

Ca =	Predicted air concentration in building (mg/m^3)
E =	Average emission rate from all sources (g/s)
t_e =	Air exchange rate (hr)
V =	Volume of room (cm^3)
CF1 =	Unit conversion factor (s/hr)
CF2 =	Unit conversion factor (mg/g)
CF3 =	Unit conversion factor (m^3/cm^3)

Source	Average Na (g/cm^2-s)	Applicable Area (cm^2)	Emission Rate (g/s)
Floor	7.29E-15	2.70E+07	1.97E-07
Wall	1.83E-15	1.47E+07	2.70E-08
Ceiling	1.17E-14	1.35E+08	1.58E-06
Total			**1.80E-06**

Chemical	E (g/s)	CF1 (s/hr)	t_e (hr)	CF2 (mg/g)	CF3 (m^3/cm^3)	V (cm^3)	Ca (mg/m^3)
Total PCBs	1.80E-06	3600	0.233	1000	1.00E-06	3.29E+10	**4.60E-05**

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF PCBs
FROM FLOOR SURFACES

Hwang DeFelco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where: Na =	Instantaneous emission flux rate (g/cm²-s)		
E =	Soil (or medium) porosity) (unitless)		0.1
Del =	Effective diffusivity in soil (cm²/s) = Dl x E^0.33		
Dl =	Diffusion coefficient in air (cm²/s)		1.75E-02
π =	PI (3.14)		
t =	Time from sampling (s)		
H =	Henry's Law Constant (dimensionless form)		3.63E-02
Kd =	Soil/water partition coefficient (cm³/g) =		630
Koc =	Organic carbon water partition coefficient (cm³/g)		5.30E+05
foc =	Fraction of organic carbon in material (g/g)		0.001
Cs =	Initial concentration in soil or medium (g/g)		
Cwipe (Floor)		(µg/cm²)	1.268
Cwipe (Floor)		(g/cm²)	1.268E-06

Calculation of Del Del = Dl x E^0.33

Dl (cm²/s)	E (unitless)	Del (cm²/s)
1.75E-02	0.1	8.19E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$$

Del (cm²/s)	E (unitless)	Ps (g/cm³)	Kd (cm³/g)	H (unitless)	α (cm²/s)
8.19E-03	0.1	2.4	630	3.63E-02	2.62E-06

Calculation of Cs Cs = Cwipe x CF/ρ_s x d

Cwipe (µg/cm²)	CF (g/µg)	d (cm)	ρ (g/cm³)	Cs (g/g)
1.268	1.00E-06	1	2.4	5.28E-07

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

E (unitless)	Del (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Cs (g/g)	Na (g/cm²-s)
0.1	8.19E-03	3.14	2.62E-06	7.88E+08	3.63E-02	630	5.28E-07	3.84E-15

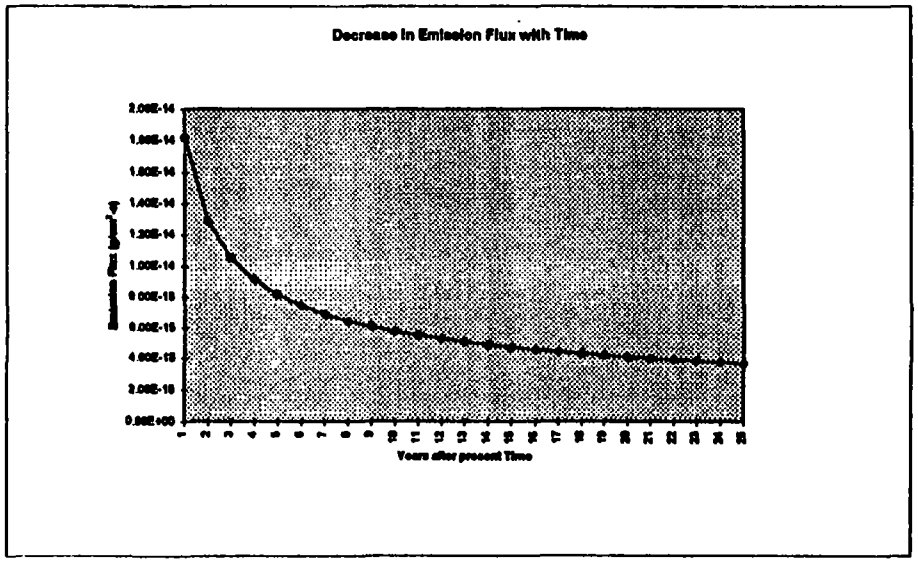
Calculation of Avg Na Avg Na (T = 25yr) =2 Na (T yr)

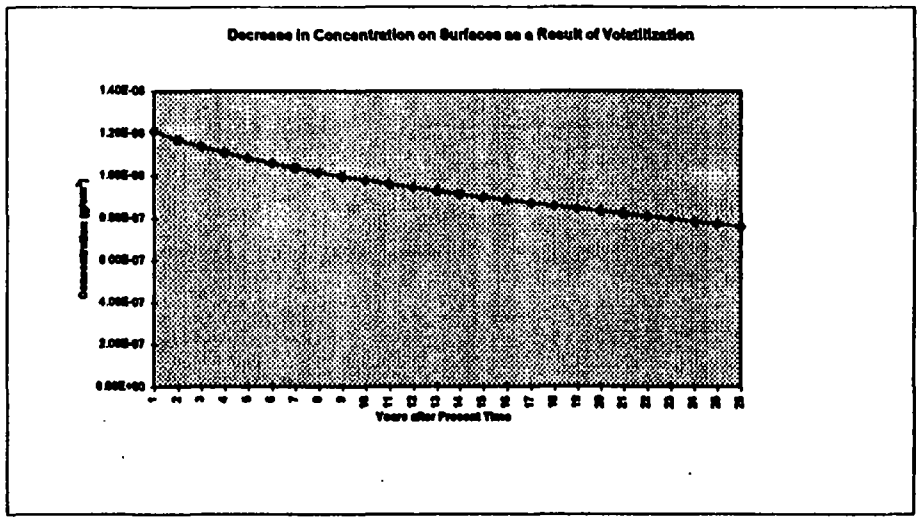
Na g/cm²-s	AvgNa g/cm²-s
3.84E-15	7.29E-15

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF PCBs
FROM FLOOR SURFACES

Year	E (unitless)	Dei (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Ce (g/g)	Ns (g/cm²-s)	Initial Conc (g/cm²)	Ns (g/cm²-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm²)	Mass Remaining (g/cm²)
1 sec	0.1	8.19E-03	3.14	2.52E-08	1.00E+00	3.53E-02	530	5.28E-07	1.02E-10	1.27E-06	1.82E-14	10	3.15E+07	5.746E-08	1.21E-06
1	0.1	8.19E-03	3.14	2.52E-08	3.15E+07	3.53E-02	530	5.28E-07	1.82E-14	1.21E-06	1.29E-14	10	3.15E+07	4.063E-08	1.17E-06
2	0.1	8.19E-03	3.14	2.52E-08	6.31E+07	3.53E-02	530	5.28E-07	1.29E-14	1.17E-06	1.05E-14	10	3.15E+07	3.317E-08	1.14E-06
3	0.1	8.19E-03	3.14	2.52E-08	9.46E+07	3.53E-02	530	5.28E-07	1.05E-14	1.14E-06	9.11E-15	10	3.15E+07	2.873E-08	1.11E-06
4	0.1	8.19E-03	3.14	2.52E-08	1.26E+08	3.53E-02	530	5.28E-07	9.11E-15	1.11E-06	8.15E-15	10	3.15E+07	2.57E-08	1.08E-06
5	0.1	8.19E-03	3.14	2.52E-08	1.58E+08	3.53E-02	530	5.28E-07	8.15E-15	1.08E-06	7.44E-15	10	3.15E+07	2.346E-08	1.06E-06
6	0.1	8.19E-03	3.14	2.52E-08	1.89E+08	3.53E-02	530	5.28E-07	7.44E-15	1.06E-06	6.89E-15	10	3.15E+07	2.172E-08	1.04E-06
7	0.1	8.19E-03	3.14	2.52E-08	2.21E+08	3.53E-02	530	5.28E-07	6.89E-15	1.04E-06	6.44E-15	10	3.15E+07	2.031E-08	1.02E-06
8	0.1	8.19E-03	3.14	2.52E-08	2.52E+08	3.53E-02	530	5.28E-07	6.44E-15	1.02E-06	6.07E-15	10	3.15E+07	1.915E-08	9.98E-07
9	0.1	8.19E-03	3.14	2.52E-08	2.84E+08	3.53E-02	530	5.28E-07	6.07E-15	9.98E-07	5.76E-15	10	3.15E+07	1.817E-08	9.80E-07
10	0.1	8.19E-03	3.14	2.52E-08	3.15E+08	3.53E-02	530	5.28E-07	5.76E-15	9.80E-07	5.49E-15	10	3.15E+07	1.732E-08	9.62E-07
11	0.1	8.19E-03	3.14	2.52E-08	3.47E+08	3.53E-02	530	5.28E-07	5.49E-15	9.62E-07	5.26E-15	10	3.15E+07	1.658E-08	9.46E-07
12	0.1	8.19E-03	3.14	2.52E-08	3.78E+08	3.53E-02	530	5.28E-07	5.26E-15	9.46E-07	5.06E-15	10	3.15E+07	1.594E-08	9.30E-07
13	0.1	8.19E-03	3.14	2.52E-08	4.10E+08	3.53E-02	530	5.28E-07	5.06E-15	9.30E-07	4.87E-15	10	3.15E+07	1.536E-08	9.14E-07
14	0.1	8.19E-03	3.14	2.52E-08	4.42E+08	3.53E-02	530	5.28E-07	4.87E-15	9.14E-07	4.70E-15	10	3.15E+07	1.484E-08	8.99E-07
15	0.1	8.19E-03	3.14	2.52E-08	4.73E+08	3.53E-02	530	5.28E-07	4.70E-15	8.99E-07	4.55E-15	10	3.15E+07	1.436E-08	8.85E-07
16	0.1	8.19E-03	3.14	2.52E-08	5.05E+08	3.53E-02	530	5.28E-07	4.55E-15	8.85E-07	4.42E-15	10	3.15E+07	1.394E-08	8.71E-07
17	0.1	8.19E-03	3.14	2.52E-08	5.36E+08	3.53E-02	530	5.28E-07	4.42E-15	8.71E-07	4.29E-15	10	3.15E+07	1.354E-08	8.58E-07
18	0.1	8.19E-03	3.14	2.52E-08	5.68E+08	3.53E-02	530	5.28E-07	4.29E-15	8.58E-07	4.16E-15	10	3.15E+07	1.318E-08	8.44E-07
19	0.1	8.19E-03	3.14	2.52E-08	5.99E+08	3.53E-02	530	5.28E-07	4.16E-15	8.44E-07	4.07E-15	10	3.15E+07	1.285E-08	8.32E-07
20	0.1	8.19E-03	3.14	2.52E-08	6.31E+08	3.53E-02	530	5.28E-07	4.07E-15	8.32E-07	3.98E-15	10	3.15E+07	1.254E-08	8.19E-07
21	0.1	8.19E-03	3.14	2.52E-08	6.62E+08	3.53E-02	530	5.28E-07	3.98E-15	8.19E-07	3.88E-15	10	3.15E+07	1.225E-08	8.07E-07
22	0.1	8.19E-03	3.14	2.52E-08	6.94E+08	3.53E-02	530	5.28E-07	3.88E-15	8.07E-07	3.80E-15	10	3.15E+07	1.198E-08	7.95E-07
23	0.1	8.19E-03	3.14	2.52E-08	7.26E+08	3.53E-02	530	5.28E-07	3.80E-15	7.95E-07	3.72E-15	10	3.15E+07	1.173E-08	7.83E-07
24	0.1	8.19E-03	3.14	2.52E-08	7.57E+08	3.53E-02	530	5.28E-07	3.72E-15	7.83E-07	3.64E-15	10	3.15E+07	1.149E-08	7.72E-07
25	0.1	8.19E-03	3.14	2.52E-08	7.88E+08	3.53E-02	530	5.28E-07	3.64E-15	7.72E-07	3.57E-15	10	3.15E+07	1.127E-08	7.60E-07
26	0.1	8.19E-03	3.14	2.52E-08	8.20E+08	3.53E-02	530	5.28E-07	3.57E-15	AVERAGE					8.41E-07

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF PCBs
FROM FLOOR SURFACES





BUILDING NO. 3
BASEMENT
VOLATILIZATION OF PCBs
FROM VERTICAL SURFACES

Hwang DeFalco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where: Na =	Instantaneous emission flux rate (g/cm²-s)		
E =	Soil (or medium) porosity) (unitless)		0.1
Del =	Effective diffusivity in soil (cm²/s) = Di x E^0.33		
Di =	Diffusion coefficient in air (cm²/s)		1.75E-02
π =	PI (3.14)		
t =	Time from sampling (s)		
H =	Henry's Law Constant (dimensionless form)		3.63E-02
Kd =	Soil/water partition coefficient (cm³/g) = Koc x foc		630
Koc =	Organic carbon water partition coefficient (cm³/g)		6.30E+05
foc =	Fraction of organic carbon in material (g/g)		0.001
Cs =	Initial concentration in soil or medium (g/g)		
Cwipe (Wall)		(µg/cm²)	0.319
Cwipe (Wall)		(g/cm²)	0.000000319

Calculation of Del

$$Del = Di \times E^{0.33}$$

Di (cm²/s)	E (unitless)	Del (cm²/s)
1.75E-02	0.1	8.19E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$$

Del (cm²/s)	E (unitless)	Ps (g/cm³)	Kd (cm³/g)	H (unitless)	α (cm²/s)
8.19E-03	0.1	2.4	630	3.63E-02	2.52E-08

Calculation of Cs

$$Cs = Cwipe \times CF/\rho_c \times d$$

Cwipe (µg/cm²)	CF (g/µg)	d (cm)	ρ (g/cm³)	Cs (g/g)
0.319	1.00E-06	1	2.4	1.33E-07

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

E (unitless)	Del (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Cs (g/g)	Na (g/cm²-s)
0.1	8.19E-03	3.14	2.52E-08	7.88E+08	3.63E-02	630	1.33E-07	9.17E-16

Calculation of Avg Na

Avg Na (T = 25yr) =2 Na (T yr)

Na g/cm²-s	AvgNa g/cm²-s
9.17E-16	1.83E-15

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF PCBs
FROM VERTICAL SURFACES

Year	E (unitless)	Del (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Cs (g/g)	Ns (g/cm^2-s)	Initial Conc (g/cm^3)	Ns (g/cm^2-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm^2)	Mass Remaining (g/cm^2)
1 sec	0.1	8.19E-03	3.14	2.62E-06	1.00E+00	3.63E-02	630	1.33E-07	2.67E-11	3.19E-07	4.68E-15	10	3.15E+07	1.46E-08	3.06E-07
1	0.1	8.19E-03	3.14	2.62E-06	3.15E+07	3.63E-02	630	1.33E-07	4.68E-15	3.06E-07	3.24E-15	10	3.15E+07	1.02E-08	2.94E-07
2	0.1	8.19E-03	3.14	2.62E-06	6.31E+07	3.63E-02	630	1.33E-07	3.24E-15	2.94E-07	2.65E-15	10	3.15E+07	8.36E-09	2.86E-07
3	0.1	8.19E-03	3.14	2.62E-06	9.46E+07	3.63E-02	630	1.33E-07	2.65E-15	2.86E-07	2.29E-15	10	3.15E+07	7.23E-09	2.79E-07
4	0.1	8.19E-03	3.14	2.62E-06	1.26E+08	3.63E-02	630	1.33E-07	2.29E-15	2.79E-07	2.05E-15	10	3.15E+07	6.46E-09	2.72E-07
5	0.1	8.19E-03	3.14	2.62E-06	1.58E+08	3.63E-02	630	1.33E-07	2.05E-15	2.72E-07	1.87E-15	10	3.15E+07	5.90E-09	2.66E-07
6	0.1	8.19E-03	3.14	2.62E-06	1.89E+08	3.63E-02	630	1.33E-07	1.87E-15	2.66E-07	1.73E-15	10	3.15E+07	5.46E-09	2.61E-07
7	0.1	8.19E-03	3.14	2.62E-06	2.21E+08	3.63E-02	630	1.33E-07	1.73E-15	2.61E-07	1.62E-15	10	3.15E+07	5.11E-09	2.56E-07
8	0.1	8.19E-03	3.14	2.62E-06	2.52E+08	3.63E-02	630	1.33E-07	1.62E-15	2.56E-07	1.53E-15	10	3.15E+07	4.82E-09	2.51E-07
9	0.1	8.19E-03	3.14	2.62E-06	2.84E+08	3.63E-02	630	1.33E-07	1.53E-15	2.51E-07	1.45E-15	10	3.15E+07	4.57E-09	2.46E-07
10	0.1	8.19E-03	3.14	2.62E-06	3.15E+08	3.63E-02	630	1.33E-07	1.45E-15	2.46E-07	1.38E-15	10	3.15E+07	4.36E-09	2.42E-07
11	0.1	8.19E-03	3.14	2.62E-06	3.47E+08	3.63E-02	630	1.33E-07	1.38E-15	2.42E-07	1.32E-15	10	3.15E+07	4.17E-09	2.38E-07
12	0.1	8.19E-03	3.14	2.62E-06	3.78E+08	3.63E-02	630	1.33E-07	1.32E-15	2.38E-07	1.27E-15	10	3.15E+07	4.01E-09	2.34E-07
13	0.1	8.19E-03	3.14	2.62E-06	4.10E+08	3.63E-02	630	1.33E-07	1.27E-15	2.34E-07	1.23E-15	10	3.15E+07	3.86E-09	2.30E-07
14	0.1	8.19E-03	3.14	2.62E-06	4.42E+08	3.63E-02	630	1.33E-07	1.23E-15	2.30E-07	1.18E-15	10	3.15E+07	3.73E-09	2.26E-07
15	0.1	8.19E-03	3.14	2.62E-06	4.73E+08	3.63E-02	630	1.33E-07	1.18E-15	2.26E-07	1.15E-15	10	3.15E+07	3.61E-09	2.23E-07
16	0.1	8.19E-03	3.14	2.62E-06	5.05E+08	3.63E-02	630	1.33E-07	1.15E-15	2.23E-07	1.11E-15	10	3.15E+07	3.51E-09	2.19E-07
17	0.1	8.19E-03	3.14	2.62E-06	5.36E+08	3.63E-02	630	1.33E-07	1.11E-15	2.19E-07	1.08E-15	10	3.15E+07	3.41E-09	2.16E-07
18	0.1	8.19E-03	3.14	2.62E-06	5.68E+08	3.63E-02	630	1.33E-07	1.08E-15	2.16E-07	1.05E-15	10	3.15E+07	3.32E-09	2.12E-07
19	0.1	8.19E-03	3.14	2.62E-06	5.99E+08	3.63E-02	630	1.33E-07	1.05E-15	2.12E-07	1.02E-15	10	3.15E+07	3.23E-09	2.09E-07
20	0.1	8.19E-03	3.14	2.62E-06	6.31E+08	3.63E-02	630	1.33E-07	1.02E-15	2.09E-07	1.00E-15	10	3.15E+07	3.15E-09	2.06E-07
21	0.1	8.19E-03	3.14	2.62E-06	6.62E+08	3.63E-02	630	1.33E-07	1.00E-15	2.06E-07	9.77E-16	10	3.15E+07	3.08E-09	2.03E-07
22	0.1	8.19E-03	3.14	2.62E-06	6.94E+08	3.63E-02	630	1.33E-07	9.77E-16	2.03E-07	9.56E-16	10	3.15E+07	3.01E-09	2.00E-07
23	0.1	8.19E-03	3.14	2.62E-06	7.25E+08	3.63E-02	630	1.33E-07	9.56E-16	2.00E-07	9.36E-16	10	3.15E+07	2.95E-09	1.97E-07
24	0.1	8.19E-03	3.14	2.62E-06	7.57E+08	3.63E-02	630	1.33E-07	9.36E-16	1.97E-07	9.17E-16	10	3.15E+07	2.89E-09	1.94E-07
25	0.1	8.19E-03	3.14	2.62E-06	7.88E+08	3.63E-02	630	1.33E-07	9.17E-16	1.94E-07	8.99E-16	10	3.15E+07	2.83E-09	1.91E-07
26	0.1	8.19E-03	3.14	2.62E-06	8.20E+08	3.63E-02	630	1.33E-07	8.99E-16	AVERAGE					2.37E-07

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF PCBs
FROM CEILING SURFACES

Hwang DeFalco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where: Na =	Instantaneous emission flux rate (g/cm²-s)		
E =	Soil (or medium) porosity) (unitless)		0.1
Del =	Effective diffusivity in soil (cm²/s) = Di x E^0.33		
Di =	Diffusion coefficient in air (cm²/s)		1.75E-02
π =	Pi (3.14)		
t =	Time from sampling (s)		
H =	Henry's Law Constant (dimensionless form)		3.53E-02
Kd =	Soil/water partition coefficient (cm³/g) = Koc x f		630
Koc =	Organic carbon water partition coefficient (cm³/g)		6.30E+05
foc =	Fraction of organic carbon in material (g/g)		0.001
Cs =	Initial concentration in soil or medium (g/g)		
Cwipe (Ceiling)		(µg/cm²)	2.034
Cwipe (Ceiling)		(g/cm²)	0.000002034

Calculation of Del

$$Del = Di \times E^{0.33}$$

Di (cm²/s)	E (unitless)	Del (cm²/s)
1.75E-02	0.1	8.19E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$$

Del (cm²/s)	E (unitless)	Ps (g/cm³)	Kd (cm³/g)	H (unitless)	α (cm²/s)
8.19E-03	0.1	2.4	630	3.53E-02	2.52E-06

Calculation of Cs

$$Cs = Cwipe \times CF/\rho_s \times d$$

Cwipe (µg/cm²)	CF (g/µg)	d (cm)	ρ (g/cm³)	Cs (g/g)
2.034	1.00E-06	1	2.4	8.48E-07

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

E (unitless)	Del (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Cs (g/g)	Na (g/cm²-s)
0.1	8.19E-03	3.14	2.52E-06	7.88E+08	3.53E-02	630	8.48E-07	5.85E-15

Calculation of Avg Na

Avg Na (T = 20yr) =2 Na (T yr)

Na g/cm²-s	AvgNa g/cm²-s
5.85E-15	1.17E-14

BUILDING NO. 3
BASEMENT
VOLATILIZATION OF PCBs
FROM CEILING SURFACES

Year	E (unitless)	Del (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Cs (g/g)	Na (g/cm^2-s)	Initial Conc (g/cm^3)	Na (g/cm^2-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm^3)	Mass Remaining (g/cm^3)
1 sec	0.1	8.19E-03	3.14	2.52E-06	1.00E+00	3.53E-02	530	8.48E-07	1.64E-10	2.03E-06	2.92E-14	10	3.15E+07	9.22E-08	1.94E-06
1	0.1	8.19E-03	3.14	2.52E-06	3.15E+07	3.53E-02	530	8.48E-07	2.92E-14	1.94E-06	2.07E-14	10	3.15E+07	6.52E-08	1.88E-06
2	0.1	8.19E-03	3.14	2.52E-06	6.31E+07	3.53E-02	530	8.48E-07	2.07E-14	1.88E-06	1.69E-14	10	3.15E+07	5.32E-08	1.82E-06
3	0.1	8.19E-03	3.14	2.52E-06	9.46E+07	3.53E-02	530	8.48E-07	1.69E-14	1.82E-06	1.46E-14	10	3.15E+07	4.61E-08	1.78E-06
4	0.1	8.19E-03	3.14	2.52E-06	1.26E+08	3.53E-02	530	8.48E-07	1.46E-14	1.78E-06	1.31E-14	10	3.15E+07	4.12E-08	1.74E-06
5	0.1	8.19E-03	3.14	2.52E-06	1.58E+08	3.53E-02	530	8.48E-07	1.31E-14	1.74E-06	1.19E-14	10	3.15E+07	3.76E-08	1.70E-06
6	0.1	8.19E-03	3.14	2.52E-06	1.89E+08	3.53E-02	530	8.48E-07	1.19E-14	1.70E-06	1.10E-14	10	3.15E+07	3.46E-08	1.66E-06
7	0.1	8.19E-03	3.14	2.52E-06	2.21E+08	3.53E-02	530	8.48E-07	1.10E-14	1.66E-06	1.03E-14	10	3.15E+07	3.26E-08	1.63E-06
8	0.1	8.19E-03	3.14	2.52E-06	2.52E+08	3.53E-02	530	8.48E-07	1.03E-14	1.63E-06	9.74E-15	10	3.15E+07	3.07E-08	1.60E-06
9	0.1	8.19E-03	3.14	2.52E-06	2.84E+08	3.53E-02	530	8.48E-07	9.74E-15	1.60E-06	9.24E-15	10	3.15E+07	2.91E-08	1.57E-06
10	0.1	8.19E-03	3.14	2.52E-06	3.15E+08	3.53E-02	530	8.48E-07	9.24E-15	1.57E-06	8.81E-15	10	3.15E+07	2.76E-08	1.54E-06
11	0.1	8.19E-03	3.14	2.52E-06	3.47E+08	3.53E-02	530	8.48E-07	8.81E-15	1.54E-06	8.44E-15	10	3.15E+07	2.66E-08	1.52E-06
12	0.1	8.19E-03	3.14	2.52E-06	3.78E+08	3.53E-02	530	8.48E-07	8.44E-15	1.52E-06	8.11E-15	10	3.15E+07	2.56E-08	1.49E-06
13	0.1	8.19E-03	3.14	2.52E-06	4.10E+08	3.53E-02	530	8.48E-07	8.11E-15	1.49E-06	7.81E-15	10	3.15E+07	2.46E-08	1.47E-06
14	0.1	8.19E-03	3.14	2.52E-06	4.42E+08	3.53E-02	530	8.48E-07	7.81E-15	1.47E-06	7.56E-15	10	3.15E+07	2.36E-08	1.44E-06
15	0.1	8.19E-03	3.14	2.52E-06	4.73E+08	3.53E-02	530	8.48E-07	7.56E-15	1.44E-06	7.31E-15	10	3.15E+07	2.30E-08	1.42E-06
16	0.1	8.19E-03	3.14	2.52E-06	5.05E+08	3.53E-02	530	8.48E-07	7.31E-15	1.42E-06	7.09E-15	10	3.15E+07	2.24E-08	1.40E-06
17	0.1	8.19E-03	3.14	2.52E-06	5.36E+08	3.53E-02	530	8.48E-07	7.09E-15	1.40E-06	6.89E-15	10	3.15E+07	2.17E-08	1.38E-06
18	0.1	8.19E-03	3.14	2.52E-06	5.68E+08	3.53E-02	530	8.48E-07	6.89E-15	1.38E-06	6.70E-15	10	3.15E+07	2.11E-08	1.36E-06
19	0.1	8.19E-03	3.14	2.52E-06	5.99E+08	3.53E-02	530	8.48E-07	6.70E-15	1.36E-06	6.54E-15	10	3.15E+07	2.06E-08	1.33E-06
20	0.1	8.19E-03	3.14	2.52E-06	6.31E+08	3.53E-02	530	8.48E-07	6.54E-15	1.33E-06	6.38E-15	10	3.15E+07	2.01E-08	1.31E-06
21	0.1	8.19E-03	3.14	2.52E-06	6.62E+08	3.53E-02	530	8.48E-07	6.38E-15	1.31E-06	6.23E-15	10	3.15E+07	1.97E-08	1.29E-06
22	0.1	8.19E-03	3.14	2.52E-06	6.94E+08	3.53E-02	530	8.48E-07	6.23E-15	1.29E-06	6.09E-15	10	3.15E+07	1.92E-08	1.27E-06
23	0.1	8.19E-03	3.14	2.52E-06	7.26E+08	3.53E-02	530	8.48E-07	6.09E-15	1.27E-06	5.97E-15	10	3.15E+07	1.88E-08	1.26E-06
24	0.1	8.19E-03	3.14	2.52E-06	7.57E+08	3.53E-02	530	8.48E-07	5.97E-15	1.26E-06	5.85E-15	10	3.15E+07	1.84E-08	1.24E-06
25	0.1	8.19E-03	3.14	2.52E-06	7.88E+08	3.53E-02	530	8.48E-07	5.85E-15	1.24E-06	5.73E-15	10	3.15E+07	1.81E-08	1.22E-06
26	0.1	8.19E-03	3.14	2.52E-06	8.20E+08	3.53E-02	530	8.48E-07	5.73E-15	AVERAGE					1.51E-06

APPENDIX F
EXPOSURE AND RISK CALCULATIONS
FIRST LEVEL

TABLE F-1
BUILDING NO. 3
FIRST LEVEL
CALCULATION OF RISKS

Dermal contact with Interior Surfaces

Equation
C_{low} = $(C_{floor} + C_{ceiling})$
C_{high} = Cwall
Intake = $((C_{low} \times SA_{low} \times CR_{low}) + (C_{high} \times SA_{high} \times CR_{high}) \times AB \times CF)/(BW \times AT)$
Risk = Intake x SF
HQ = Intake/RfD

where:
C_{floor} = Chemical concentration on floor surfaces (mg/cm^2)
$C_{ceiling}$ = Chemical concentration on ceiling surfaces (mg/cm^2)
SA_{low} = Surface area of low contact surfaces (cm^2)
CR_{low} = Percentage of contact with low contact surfaces (unitless)
SA_{high} = Surface area of high contact surfaces (cm^2)
CR_{high} = Percentage of contact with high contact surfaces (unitless)
AB = Dermal absorption extent (unitless)
CF = Unit conversion factor (mg/mg)
BW = Body weight (kg)
ATc = Averaging time, carcinogens (dy)
ATnc = Averaging time, noncarcinogens (dy)
SF = Cancer slope factor (mg/kg-dy^{-1})
RfD = Non-carcinogenic Reference Dose (mg/kg-dy)
Risk = Excess lifetime cancer risk (unitless)
HQ = Non-carcinogenic Hazard Quotient

Dermal contact with Surfaces

Chemical	C_{floor} (µg/cm^2)	$C_{ceiling}$ (µg/cm^2)	C_{low} (µg/cm^2)	SA_{low} (cm^2)	CR_{low}	C_{high} (µg/cm^2)	SA_{high} (events/year)	Cr_{high} (cm^2/event)	AB (unitless)	CF (mg/ug)	BW (kg)	ATc (dy)	Intake (mg/kg-dy)	SF (mg/kg-dy)$^{-1}$	Risk (unitless)
Total PCBs	8.43	0.063	4.247	2.70E+08	0.0005	0.011	2.58E+07	0.001	0.0136	1E-03	70	25550	4.36E-06	7.7	3E-05

Equation
Intake = $(C_{air} \times IR \times ET \times EF \times ED) / (BW \times AT)$
Risk = Intake x SF
HQ = Intake/RfD

where:
C_{air} = Chemical concentration in air (mg/m^3)
IR = Inhalation rate (m^3/hr)
ET = Exposure time (hr/dy)
EF = Exposure frequency (events/year)
ED = Exposure duration (yr)
BW = Body weight (kg)
AT = Averaging time (dy)

Inhalation

Chemical	Ca (mg/m^3)	IR (m^3/hr)	ET (hr/dy)	EF (dy/yr)	ED (yr)	BW (kg)	ATc (dy)	Intake (mg/kg-dy)	SF (mg/kg-dy)$^{-1}$	Risk (unitless)
Total PCBs	4.01E-04	0.83	8	250	25	70	25550	9.30E-06	7.7	7E-05

RISK SUMMARY

Dermal	3E-05
Inhalation	7E-05
TOTAL	1E-04

BUILDING NO. 3
FIRST LEVEL
CALCULATION OF AIR CONCENTRATIONS
PCBs

Equation $Ca = (E \times CF1 \times t_e \times CF2) / (V \times CF3)$

Where:

Ca =	Predicted air concentration in building (mg/m^3)
E =	Average emission rate from all sources (g/s)
t_e =	Air exchange rate (hr)
V =	Volume of room (cm^3)
CF1 =	Unit conversion factor (s/hr)
CF2 =	Unit conversion factor (mg/g)
CF3 =	Unit conversion factor (m^3/cm^3)

Source	Average Na (g/cm^2-s)	Applicable Area (cm^2)	Emission Rate (g/s)
Floor Core	2.00E-13	1.35E+08	2.70E-05
Wall Core	2.55E-14	2.58E+07	6.59E-07
Wall Wipes	6.32E-17	(not used)	
Ceiling Wipes	4.89E-16	1.35E+08	6.60E-08
Total			**2.77E-05**

Chemical	E (g/s)	CF1 (s/hr)	t_e (hr)	CF2 (mg/g)	CF3 (m^3/cm^3)	V (cm^3)	Ca (mg/m^3)
Total PCBs	2.77E-05	3600	0.233	1000	1.00E-06	5.80E+10	**4.01E-04**

BUILDING NO.3
FIRST LEVEL
VOLATILIZATION OF PCBs
FROM FLOOR SURFACES

Hwang DeFelco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where:	Na =	Instantaneous emission flux rate (g/cm²-s)	
	E =	Soil (or medium) porosity) (unitless)	0.1
	Del =	Effective diffusivity in soil (cm²/s) = Dl x $E^{0.33}$	
	Dl =	Diffusion coefficient in air (cm²/s)	1.76E-02
	π =	PI (3.14)	
	t =	Time from sampling (s)	
	H =	Henry's Law Constant (dimensionless form)	3.63E-02
	Kd =	Soil/water partition coefficient (cm³/g) = Koc x foc	630
	Koc =	Organic carbon water partition coefficient (cm³/g)	6.30E+05
	foc =	Fraction of organic carbon in material (g/g)	0.001
	Cs=	Concentration in core (g/g)	1.45E-05
	Cw=	Concentration on surface (μg/cm²)	
	Cw=	Concentrition on surface (g/cm²)	

Calculation of Del Del = Dl x $E^{0.33}$

Dl (cm²/s)	E (unitless)	Del (cm²/s)
1.76E-02	0.1	8.19E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (\rho \times (1-E) \times Kd/H)}$$

Del (cm²/s)	E (unitless)	ρ (g/cm³)	Kd (cm³/g)	H (unitless)	α (cm²/s)
8.19E-03	0.1	2.4	630	3.63E-02	2.62E-06

Calculation of Cwipe Cwipe = Cs x ρ_s x d

Cs (g/g)	d (cm)	ρ (g/cm³)	Cwipe (g/cm²)
1.45E-05	0.5	2.4	1.74E-05

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

E (unitless)	Del (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Cs (g/g)	Na (g/cm²-s)
0.1	8.19E-03	3.14	2.62E-06	7.88E+08	3.63E-02	630	1.45E-05	1.00E-13

Calculation of Avg Na Avg Na (T = 25yr) =2 Na (T yr)

Na g/cm²-s	AvgNa g/cm²-s
1.00E-13	2.00E-13

BUILDING NO 3
FIRST LEVEL
VOLATILIZATION OF PCBs
FROM FLOOR SURFACES

Year	E (unitless)	Del (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Cs (g/g)	Ns (g/cm^2-s)	Initial Conc (g/cm^2)	Ns (g/cm^2-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm^2)	Mass Remaining (g/cm^2)
1 sec	0.1	8.19E-03	3.14	2.52E-08	1.00E+00	3.53E-02	530	1.45E-05	2.81E-09	1.74E-05	5.00E-13	10	3.15E+07	1.58E-08	1.58E-05
1	0.1	8.19E-03	3.14	2.52E-08	3.15E+07	3.53E-02	530	1.45E-05	5.00E-13	1.58E-05	3.54E-13	10	3.15E+07	1.12E-08	1.47E-05
2	0.1	8.19E-03	3.14	2.52E-08	6.31E+07	3.53E-02	530	1.45E-05	3.54E-13	1.47E-05	2.89E-13	10	3.15E+07	9.10E-07	1.38E-05
3	0.1	8.19E-03	3.14	2.52E-08	9.46E+07	3.53E-02	530	1.45E-05	2.89E-13	1.38E-05	2.50E-13	10	3.15E+07	7.88E-07	1.30E-05
4	0.1	8.19E-03	3.14	2.52E-08	1.26E+08	3.53E-02	530	1.45E-05	2.50E-13	1.30E-05	2.24E-13	10	3.15E+07	7.05E-07	1.23E-05
5	0.1	8.19E-03	3.14	2.52E-08	1.58E+08	3.53E-02	530	1.45E-05	2.24E-13	1.23E-05	2.04E-13	10	3.15E+07	6.44E-07	1.17E-05
6	0.1	8.19E-03	3.14	2.52E-08	1.89E+08	3.53E-02	530	1.45E-05	2.04E-13	1.17E-05	1.89E-13	10	3.15E+07	5.96E-07	1.11E-05
7	0.1	8.19E-03	3.14	2.52E-08	2.21E+08	3.53E-02	530	1.45E-05	1.89E-13	1.11E-05	1.77E-13	10	3.15E+07	5.58E-07	1.05E-05
8	0.1	8.19E-03	3.14	2.52E-08	2.52E+08	3.53E-02	530	1.45E-05	1.77E-13	1.05E-05	1.67E-13	10	3.15E+07	5.26E-07	9.98E-06
9	0.1	8.19E-03	3.14	2.52E-08	2.84E+08	3.53E-02	530	1.45E-05	1.67E-13	9.98E-06	1.58E-13	10	3.15E+07	4.99E-07	9.48E-06
10	0.1	8.19E-03	3.14	2.52E-08	3.15E+08	3.53E-02	530	1.45E-05	1.58E-13	9.48E-06	1.51E-13	10	3.15E+07	4.75E-07	9.01E-06
11	0.1	8.19E-03	3.14	2.52E-08	3.47E+08	3.53E-02	530	1.45E-05	1.51E-13	9.01E-06	1.44E-13	10	3.15E+07	4.55E-07	8.55E-06
12	0.1	8.19E-03	3.14	2.52E-08	3.78E+08	3.53E-02	530	1.45E-05	1.44E-13	8.55E-06	1.39E-13	10	3.15E+07	4.37E-07	8.11E-06
13	0.1	8.19E-03	3.14	2.52E-08	4.10E+08	3.53E-02	530	1.45E-05	1.39E-13	8.11E-06	1.34E-13	10	3.15E+07	4.21E-07	7.69E-06
14	0.1	8.19E-03	3.14	2.52E-08	4.42E+08	3.53E-02	530	1.45E-05	1.34E-13	7.69E-06	1.29E-13	10	3.15E+07	4.07E-07	7.29E-06
15	0.1	8.19E-03	3.14	2.52E-08	4.73E+08	3.53E-02	530	1.45E-05	1.29E-13	7.29E-06	1.25E-13	10	3.15E+07	3.94E-07	6.89E-06
16	0.1	8.19E-03	3.14	2.52E-08	5.05E+08	3.53E-02	530	1.45E-05	1.25E-13	6.89E-06	1.21E-13	10	3.15E+07	3.82E-07	6.51E-06
17	0.1	8.19E-03	3.14	2.52E-08	5.36E+08	3.53E-02	530	1.45E-05	1.21E-13	6.51E-06	1.18E-13	10	3.15E+07	3.72E-07	6.14E-06
18	0.1	8.19E-03	3.14	2.52E-08	5.68E+08	3.53E-02	530	1.45E-05	1.18E-13	6.14E-06	1.15E-13	10	3.15E+07	3.62E-07	5.78E-06
19	0.1	8.19E-03	3.14	2.52E-08	5.99E+08	3.53E-02	530	1.45E-05	1.15E-13	5.78E-06	1.12E-13	10	3.15E+07	3.53E-07	5.42E-06
20	0.1	8.19E-03	3.14	2.52E-08	6.31E+08	3.53E-02	530	1.45E-05	1.12E-13	5.42E-06	1.09E-13	10	3.15E+07	3.44E-07	5.08E-06
21	0.1	8.19E-03	3.14	2.52E-08	6.62E+08	3.53E-02	530	1.45E-05	1.09E-13	5.08E-06	1.07E-13	10	3.15E+07	3.36E-07	4.74E-06
22	0.1	8.19E-03	3.14	2.52E-08	6.94E+08	3.53E-02	530	1.45E-05	1.07E-13	4.74E-06	1.04E-13	10	3.15E+07	3.29E-07	4.41E-06
23	0.1	8.19E-03	3.14	2.52E-08	7.25E+08	3.53E-02	530	1.45E-05	1.04E-13	4.41E-06	1.02E-13	10	3.15E+07	3.22E-07	4.09E-06
24	0.1	8.19E-03	3.14	2.52E-08	7.57E+08	3.53E-02	530	1.45E-05	1.02E-13	4.09E-06	1.00E-13	10	3.15E+07	3.15E-07	3.78E-06
25	0.1	8.19E-03	3.14	2.52E-08	7.88E+08	3.53E-02	530	1.45E-05	1.00E-13	3.78E-06	9.81E-14	10	3.15E+07	3.09E-07	3.47E-06
26	0.1	8.19E-03	3.14	2.52E-08	8.20E+08	3.53E-02	530	1.45E-05	9.81E-14						3.43E-06

BUILDING NO. 3
FIRST LEVEL
VOLATILIZATION OF PCBs
FROM VERTICAL SURFACES

Hwang DeFelco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where: Na =	Instantaneous emission flux rate (g/cm²-s)		
E =	Soil (or medium) porosity) (unitless)		0.1
Del =	Effective diffusivity in soil (cm²/s) = Di x $E^{0.33}$		
Di =	Diffusion coefficient in air (cm²/s)		1.75E-02
π =	PI (3.14)		
t =	Time from sampling (s)		
H =	Henry's Law Constant (dimensionless form)		3.63E-02
Kd =	Soil/water partition coefficient (cm³/g) = Koc x foc		530
Koc =	Organic carbon water partition coefficient (cm³/g)		6.30E+05
foc =	Fraction of organic carbon in material (g/g)		0.001
Cs =	Initial concentration in soil or medium (g/g)		1.85E-06
Cwipe (Wall)		(µg/cm²)	
Cwipe (Wall)		(g/cm²)	

Calculation of Del

$$Del = Di \times E^{0.33}$$

Di (cm²/s)	E (unitless)	Del (cm²/s)
1.75E-02	0.1	8.19E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$$

Del (cm²/s)	E (unitless)	Ps (g/cm³)	Kd (cm³/g)	H (unitless)	α (cm²/s)
8.19E-03	0.1	2.4	530	3.63E-02	2.52E-06

Calculation of Cwipe

$$Cwipe = Cs \times \rho_s \times d$$

Cs (g/g)	d (cm)	ρ (g/cm³)	Cwipe (g/cm²)
1.85E-06	0.5	2.4	2.22E-06

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

E (unitless)	Del (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Cs (g/g)	Na (g/cm²-s)
0.1	8.19E-03	3.14	2.52E-06	7.88E+08	3.63E-02	530	1.85E-06	1.28E-14

Calculation of Avg Na

Avg Na (T = 25yr) =2 Na (T yr)

Na g/cm²-s	AvgNa g/cm²-s
1.28E-14	2.56E-14

BUILDING NO. 3
FIRST LEVEL
VOLATILIZATION OF PCBs
FROM VERTICAL SURFACES

Year	E (unitless)	Del (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Cs (g/g)	Ns (g/cm^2-s)	Initial Conc (g/cm^2)	Ns (g/cm^2-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm^2)	Mass Remaining (g/cm^2)
1 sec	0.1	8.19E-03	3.14	2.52E-08	1.00E+00	3.53E-02	630	1.85E-06	3.58E-10	2.22E-06	6.38E-14	10	3.15E+07	2.01E-07	2.02E-06
1	0.1	8.19E-03	3.14	2.52E-08	3.15E+07	3.53E-02	630	1.85E-06	6.38E-14	2.02E-06	4.51E-14	10	3.15E+07	1.42E-07	1.88E-06
2	0.1	8.19E-03	3.14	2.52E-08	6.31E+07	3.53E-02	630	1.85E-06	4.51E-14	1.88E-06	3.68E-14	10	3.15E+07	1.16E-07	1.76E-06
3	0.1	8.19E-03	3.14	2.52E-08	9.46E+07	3.53E-02	630	1.85E-06	3.68E-14	1.76E-06	3.19E-14	10	3.15E+07	1.01E-07	1.66E-06
4	0.1	8.19E-03	3.14	2.52E-08	1.26E+08	3.53E-02	630	1.85E-06	3.19E-14	1.66E-06	2.85E-14	10	3.15E+07	9.00E-08	1.57E-06
5	0.1	8.19E-03	3.14	2.52E-08	1.58E+08	3.53E-02	630	1.85E-06	2.85E-14	1.57E-06	2.60E-14	10	3.15E+07	8.21E-08	1.49E-06
6	0.1	8.19E-03	3.14	2.52E-08	1.89E+08	3.53E-02	630	1.85E-06	2.60E-14	1.49E-06	2.41E-14	10	3.15E+07	7.60E-08	1.41E-06
7	0.1	8.19E-03	3.14	2.52E-08	2.21E+08	3.53E-02	630	1.85E-06	2.41E-14	1.41E-06	2.26E-14	10	3.15E+07	7.11E-08	1.34E-06
8	0.1	8.19E-03	3.14	2.52E-08	2.52E+08	3.53E-02	630	1.85E-06	2.26E-14	1.34E-06	2.13E-14	10	3.15E+07	6.71E-08	1.27E-06
9	0.1	8.19E-03	3.14	2.52E-08	2.84E+08	3.53E-02	630	1.85E-06	2.13E-14	1.27E-06	2.02E-14	10	3.15E+07	6.36E-08	1.21E-06
10	0.1	8.19E-03	3.14	2.52E-08	3.15E+08	3.53E-02	630	1.85E-06	2.02E-14	1.21E-06	1.92E-14	10	3.15E+07	6.07E-08	1.15E-06
11	0.1	8.19E-03	3.14	2.52E-08	3.47E+08	3.53E-02	630	1.85E-06	1.92E-14	1.15E-06	1.84E-14	10	3.15E+07	5.81E-08	1.09E-06
12	0.1	8.19E-03	3.14	2.52E-08	3.78E+08	3.53E-02	630	1.85E-06	1.84E-14	1.09E-06	1.77E-14	10	3.15E+07	5.56E-08	1.04E-06
13	0.1	8.19E-03	3.14	2.52E-08	4.10E+08	3.53E-02	630	1.85E-06	1.77E-14	1.04E-06	1.71E-14	10	3.15E+07	5.36E-08	9.82E-07
14	0.1	8.19E-03	3.14	2.52E-08	4.42E+08	3.53E-02	630	1.85E-06	1.71E-14	9.82E-07	1.65E-14	10	3.15E+07	5.19E-08	9.30E-07
15	0.1	8.19E-03	3.14	2.52E-08	4.73E+08	3.53E-02	630	1.85E-06	1.65E-14	9.30E-07	1.59E-14	10	3.15E+07	5.03E-08	8.79E-07
16	0.1	8.19E-03	3.14	2.52E-08	5.05E+08	3.53E-02	630	1.85E-06	1.59E-14	8.79E-07	1.55E-14	10	3.15E+07	4.88E-08	8.30E-07
17	0.1	8.19E-03	3.14	2.52E-08	5.36E+08	3.53E-02	630	1.85E-06	1.55E-14	8.30E-07	1.50E-14	10	3.15E+07	4.74E-08	7.83E-07
18	0.1	8.19E-03	3.14	2.52E-08	5.68E+08	3.53E-02	630	1.85E-06	1.50E-14	7.83E-07	1.46E-14	10	3.15E+07	4.62E-08	7.37E-07
19	0.1	8.19E-03	3.14	2.52E-08	5.99E+08	3.53E-02	630	1.85E-06	1.46E-14	7.37E-07	1.43E-14	10	3.15E+07	4.50E-08	6.92E-07
20	0.1	8.19E-03	3.14	2.52E-08	6.31E+08	3.53E-02	630	1.85E-06	1.43E-14	6.92E-07	1.39E-14	10	3.15E+07	4.39E-08	6.48E-07
21	0.1	8.19E-03	3.14	2.52E-08	6.62E+08	3.53E-02	630	1.85E-06	1.39E-14	6.48E-07	1.36E-14	10	3.15E+07	4.29E-08	6.06E-07
22	0.1	8.19E-03	3.14	2.52E-08	6.94E+08	3.53E-02	630	1.85E-06	1.36E-14	6.06E-07	1.33E-14	10	3.15E+07	4.20E-08	5.63E-07
23	0.1	8.19E-03	3.14	2.52E-08	7.25E+08	3.53E-02	630	1.85E-06	1.33E-14	5.63E-07	1.30E-14	10	3.15E+07	4.11E-08	5.22E-07
24	0.1	8.19E-03	3.14	2.52E-08	7.57E+08	3.53E-02	630	1.85E-06	1.30E-14	5.22E-07	1.28E-14	10	3.15E+07	4.02E-08	4.82E-07
25	0.1	8.19E-03	3.14	2.52E-08	7.88E+08	3.53E-02	630	1.85E-06	1.28E-14	4.82E-07	1.25E-14	10	3.15E+07	3.95E-08	4.42E-07
26	0.1	8.19E-03	3.14	2.52E-08	8.20E+08	3.53E-02	630	1.85E-06	1.25E-14						1.08E-06

BUILDING NO. 3
FIRST LEVEL
VOLATILIZATION OF PCBs FROM VERTICAL SURFACES
(FROM WIPE SAMPLES)

Hwang DeFalco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where: Na =	Instantaneous emission flux rate (g/cm²-s)		
E =	Soil (or medium) porosity) (unitless)		0.1
Del =	Effective diffusivity in soil (cm²/s) = Di x $E^{0.33}$		
Di =	Diffusion coefficient in air (cm²/s)		1.75E-02
p =	PI (3.14)		
t =	Time from sampling (s)		
H =	Henry's Law Constant (dimensionless form)		3.63E-02
Kd =	Soil/water partition coefficient (cm³/g) = Koc x foc		630
Koc =	Organic carbon water partition coefficient (cm³/g)		6.30E+05
foc =	Fraction of organic carbon in material (g/g)		0.001
Cs =	Initial concentration in soil or medium (g/g)		
Cwipe (Wall)		(µg/cm²)	1.10E-02
Cwipe (Wall)		(g/cm²)	0.000000011

Calculation of Del

Del = Di x $E^{0.33}$

Di (cm²/s)	E (unitless)	Del (cm²/s)
1.75E-02	0.1	8.19E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (\rho \times (1-E) \times Kd/H)}$$

Del (cm²/s)	E (unitless)	ρ (g/cm³)	Kd (cm³/g)	H (unitless)	α (cm²/s)
8.19E-03	0.1	2.4	630	3.63E-02	2.62E-06

Calculation of Cs

Cs = Cwipe x CF/ρ_s x d

Cwipe (µg/cm²)	CF (g/µg)	d (cm)	ρ (g/cm³)	Cs (g/g)
0.011	1.00E-06	1	2.4	4.58E-09

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

E (unitless)	Del (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Cs (g/g)	Na (g/cm²-s)
0.1	8.19E-03	3.14	2.62E-06	7.88E+08	3.63E-02	630	4.58E-09	3.16E-17

Calculation of Avg Na

Avg Na (T = 25yr) =2 Na (T yr)

Na g/cm²-s	AvgNa g/cm²-s
3.16E-17	6.32E-17

BUILDING NO. 3
FIRST LEVEL
VOLATILIZATION OF PCBs FROM VERTICAL SURFACES
(FROM WIPE SAMPLES)

Year	E (unitless)	Del (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Co (g/g)	Ne (g/cm^2-s)	Initial Conc (g/cm^2)	Ne (g/cm^2-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm^2)	Mass Remaining (g/cm^2)
1 sec	0.1	8.19E-03	3.14	2.52E-08	1.00E+00	3.63E-02	530	4.68E-09	8.88E-13	1.10E-08	1.68E-16	10	3.15E+07	4.98E-10	1.06E-08
1	0.1	8.19E-03	3.14	2.52E-08	3.15E+07	3.63E-02	530	4.68E-09	1.68E-16	1.05E-08	1.12E-16	10	3.15E+07	3.52E-10	1.01E-08
2	0.1	8.19E-03	3.14	2.52E-08	6.31E+07	3.63E-02	530	4.68E-09	1.12E-16	1.01E-08	9.13E-17	10	3.15E+07	2.88E-10	9.86E-09
3	0.1	8.19E-03	3.14	2.52E-08	9.46E+07	3.63E-02	530	4.68E-09	9.13E-17	9.86E-09	7.90E-17	10	3.15E+07	2.49E-10	9.61E-09
4	0.1	8.19E-03	3.14	2.52E-08	1.26E+08	3.63E-02	530	4.68E-09	7.90E-17	9.61E-09	7.07E-17	10	3.15E+07	2.23E-10	9.39E-09
5	0.1	8.19E-03	3.14	2.52E-08	1.58E+08	3.63E-02	530	4.68E-09	7.07E-17	9.39E-09	6.45E-17	10	3.15E+07	2.03E-10	9.19E-09
6	0.1	8.19E-03	3.14	2.52E-08	1.89E+08	3.63E-02	530	4.68E-09	6.45E-17	9.19E-09	5.97E-17	10	3.15E+07	1.88E-10	9.00E-09
7	0.1	8.19E-03	3.14	2.52E-08	2.21E+08	3.63E-02	530	4.68E-09	5.97E-17	9.00E-09	5.59E-17	10	3.15E+07	1.76E-10	8.82E-09
8	0.1	8.19E-03	3.14	2.52E-08	2.52E+08	3.63E-02	530	4.68E-09	5.59E-17	8.82E-09	5.27E-17	10	3.15E+07	1.66E-10	8.65E-09
9	0.1	8.19E-03	3.14	2.52E-08	2.84E+08	3.63E-02	530	4.68E-09	5.27E-17	8.65E-09	5.00E-17	10	3.15E+07	1.58E-10	8.50E-09
10	0.1	8.19E-03	3.14	2.52E-08	3.15E+08	3.63E-02	530	4.68E-09	5.00E-17	8.50E-09	4.77E-17	10	3.15E+07	1.50E-10	8.36E-09
11	0.1	8.19E-03	3.14	2.52E-08	3.47E+08	3.63E-02	530	4.68E-09	4.77E-17	8.36E-09	4.56E-17	10	3.15E+07	1.44E-10	8.20E-09
12	0.1	8.19E-03	3.14	2.52E-08	3.78E+08	3.63E-02	530	4.68E-09	4.56E-17	8.20E-09	4.36E-17	10	3.15E+07	1.38E-10	8.06E-09
13	0.1	8.19E-03	3.14	2.52E-08	4.10E+08	3.63E-02	530	4.68E-09	4.38E-17	8.06E-09	4.22E-17	10	3.15E+07	1.33E-10	7.93E-09
14	0.1	8.19E-03	3.14	2.52E-08	4.42E+08	3.63E-02	530	4.68E-09	4.22E-17	7.93E-09	4.08E-17	10	3.15E+07	1.29E-10	7.80E-09
15	0.1	8.19E-03	3.14	2.52E-08	4.73E+08	3.63E-02	530	4.68E-09	4.08E-17	7.80E-09	3.96E-17	10	3.15E+07	1.25E-10	7.68E-09
16	0.1	8.19E-03	3.14	2.52E-08	5.05E+08	3.63E-02	530	4.68E-09	3.96E-17	7.68E-09	3.83E-17	10	3.15E+07	1.21E-10	7.56E-09
17	0.1	8.19E-03	3.14	2.52E-08	5.36E+08	3.63E-02	530	4.68E-09	3.83E-17	7.56E-09	3.73E-17	10	3.15E+07	1.17E-10	7.44E-09
18	0.1	8.19E-03	3.14	2.52E-08	5.68E+08	3.63E-02	530	4.68E-09	3.73E-17	7.44E-09	3.63E-17	10	3.15E+07	1.14E-10	7.33E-09
19	0.1	8.19E-03	3.14	2.52E-08	5.99E+08	3.63E-02	530	4.68E-09	3.63E-17	7.33E-09	3.53E-17	10	3.15E+07	1.11E-10	7.21E-09
20	0.1	8.19E-03	3.14	2.52E-08	6.31E+08	3.63E-02	530	4.68E-09	3.53E-17	7.21E-09	3.45E-17	10	3.15E+07	1.08E-10	7.11E-09
21	0.1	8.19E-03	3.14	2.52E-08	6.62E+08	3.63E-02	530	4.68E-09	3.45E-17	7.11E-09	3.37E-17	10	3.15E+07	1.06E-10	7.00E-09
22	0.1	8.19E-03	3.14	2.52E-08	6.94E+08	3.63E-02	530	4.68E-09	3.37E-17	7.00E-09	3.30E-17	10	3.15E+07	1.04E-10	6.90E-09
23	0.1	8.19E-03	3.14	2.52E-08	7.25E+08	3.63E-02	530	4.68E-09	3.30E-17	6.90E-09	3.23E-17	10	3.15E+07	1.02E-10	6.79E-09
24	0.1	8.19E-03	3.14	2.52E-08	7.57E+08	3.63E-02	530	4.68E-09	3.23E-17	6.79E-09	3.16E-17	10	3.15E+07	9.97E-11	6.69E-09
25	0.1	8.19E-03	3.14	2.52E-08	7.88E+08	3.63E-02	530	4.68E-09	3.16E-17	6.69E-09	3.10E-17	10	3.15E+07	9.78E-11	6.60E-09
26	0.1	8.19E-03	3.14	2.52E-08	8.20E+08	3.63E-02	530	4.68E-09	3.10E-17						6.17E-09

BUILDING NO. 3
FIRST LEVEL
VOLATILIZATION OF PCBs
FROM CEILING SURFACES

Hwang DeFelco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where: Na =	Instantaneous emission flux rate (g/cm²-s)		
E =	Soil (or medium) porosity) (unitless)		0.1
Del =	Effective diffusivity in soil (cm²/s) = Di x $E^{0.33}$		
Di =	Diffusion coefficient in air (cm²/s)		1.76E-02
π =	Pi (3.14)		
t =	Time from sampling (s)		
H =	Henry's Law Constant (dimensionless form)		3.63E-02
Kd =	Soil/water partition coefficient (cm³/g) = Koc x f		630
Koc =	Organic carbon, water partition coefficient (cm³/g)		6.30E+05
foc =	Fraction of organic carbon in material (g/g)		0.001
Cs =	Initial concentration in soil or medium (g/g)		
Cwipe (Ceiling)		(µg/cm²)	0.085
Cwipe (Ceiling)		(g/cm²)	0.000000085

Calculation of Del

$$Del = Di \times E^{0.33}$$

Di (cm²/s)	E (unitless)	Del (cm²/s)
1.76E-02	0.1	8.19E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$$

Del (cm²/s)	E (unitless)	Ps (g/cm³)	Kd (cm³/g)	H (unitless)	α (cm²/s)
8.19E-03	0.1	2.4	630	3.63E-02	2.62E-08

Calculation of Cs

$$Cs = Cwipe \times CF/\rho_s \times d$$

Cwipe (µg/cm²)	CF (g/µg)	d (cm)	ρ (g/cm³)	Cs (g/g)
0.085	1.00E-06	1	2.4	3.54E-08

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

E (unitless)	Del (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Cs (g/g)	Na (g/cm²-s)
0.1	8.19E-03	3.14	2.62E-08	7.88E+08	3.63E-02	630	3.54E-08	2.44E-16

Calculation of Avg Na

Avg Na (T = 20yr) =2 Na (T yr)

Na g/cm²-s	AvgNa g/cm²-s
2.44E-16	4.89E-16

BUILDING NO. 3
FIRST LEVEL
VOLATILIZATION OF PCBs
FROM CEILING SURFACES

Year	E (unitless)	Del (cm^2/s)	n (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Cs (g/g)	Ns (g/cm^2-s)	Initial Conc (g/cm^2)	Ns (g/cm^2-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm^2)	Mass Remaining (g/cm^2)
1 sec	0.1	8.19E-03	3.14	2.62E-06	1.00E+00	3.63E-02	630	3.64E-08	6.66E-12	8.60E-08	1.22E-15	10	3.16E+07	3.85161E-09	8.11E-08
1	0.1	8.19E-03	3.14	2.62E-06	3.15E+07	3.63E-02	630	3.64E-08	1.22E-16	8.11E-08	8.64E-16	10	3.16E+07	2.72266E-09	7.84E-08
2	0.1	8.19E-03	3.14	2.62E-06	6.31E+07	3.63E-02	630	3.64E-08	8.64E-16	7.84E-08	7.05E-16	10	3.16E+07	2.22373E-09	7.62E-08
3	0.1	8.19E-03	3.14	2.62E-06	9.46E+07	3.63E-02	630	3.64E-08	7.05E-16	7.62E-08	6.11E-16	10	3.16E+07	1.92568E-09	7.43E-08
4	0.1	8.19E-03	3.14	2.62E-06	1.26E+08	3.63E-02	630	3.64E-08	6.11E-16	7.43E-08	5.46E-16	10	3.16E+07	1.72249E-09	7.26E-08
5	0.1	8.19E-03	3.14	2.62E-06	1.58E+08	3.63E-02	630	3.64E-08	5.46E-16	7.26E-08	4.99E-16	10	3.16E+07	1.57241E-09	7.10E-08
6	0.1	8.19E-03	3.14	2.62E-06	1.89E+08	3.63E-02	630	3.64E-08	4.99E-16	7.10E-08	4.62E-16	10	3.16E+07	1.46577E-09	6.95E-08
7	0.1	8.19E-03	3.14	2.62E-06	2.21E+08	3.63E-02	630	3.64E-08	4.62E-16	6.95E-08	4.32E-16	10	3.16E+07	1.36175E-09	6.82E-08
8	0.1	8.19E-03	3.14	2.62E-06	2.52E+08	3.63E-02	630	3.64E-08	4.32E-16	6.82E-08	4.07E-16	10	3.16E+07	1.26387E-09	6.69E-08
9	0.1	8.19E-03	3.14	2.62E-06	2.84E+08	3.63E-02	630	3.64E-08	4.07E-16	6.69E-08	3.86E-16	10	3.16E+07	1.21799E-09	6.57E-08
10	0.1	8.19E-03	3.14	2.62E-06	3.15E+08	3.63E-02	630	3.64E-08	3.86E-16	6.57E-08	3.68E-16	10	3.16E+07	1.16135E-09	6.45E-08
11	0.1	8.19E-03	3.14	2.62E-06	3.47E+08	3.63E-02	630	3.64E-08	3.68E-16	6.45E-08	3.53E-16	10	3.16E+07	1.11186E-09	6.34E-08
12	0.1	8.19E-03	3.14	2.62E-06	3.78E+08	3.63E-02	630	3.64E-08	3.53E-16	6.34E-08	3.39E-16	10	3.16E+07	1.06824E-09	6.23E-08
13	0.1	8.19E-03	3.14	2.62E-06	4.10E+08	3.63E-02	630	3.64E-08	3.39E-16	6.23E-08	3.26E-16	10	3.16E+07	1.02939E-09	6.13E-08
14	0.1	8.19E-03	3.14	2.62E-06	4.42E+08	3.63E-02	630	3.64E-08	3.26E-16	6.13E-08	3.15E-16	10	3.16E+07	9.94481E-10	6.03E-08
15	0.1	8.19E-03	3.14	2.62E-06	4.73E+08	3.63E-02	630	3.64E-08	3.15E-16	6.03E-08	3.05E-16	10	3.16E+07	9.62902E-10	5.93E-08
16	0.1	8.19E-03	3.14	2.62E-06	5.05E+08	3.63E-02	630	3.64E-08	3.05E-16	5.93E-08	2.96E-16	10	3.16E+07	9.34152E-10	5.84E-08
17	0.1	8.19E-03	3.14	2.62E-06	5.36E+08	3.63E-02	630	3.64E-08	2.96E-16	5.84E-08	2.88E-16	10	3.16E+07	9.07833E-10	5.75E-08
18	0.1	8.19E-03	3.14	2.62E-06	5.68E+08	3.63E-02	630	3.64E-08	2.88E-16	5.75E-08	2.80E-16	10	3.16E+07	8.83962E-10	5.66E-08
19	0.1	8.19E-03	3.14	2.62E-06	5.99E+08	3.63E-02	630	3.64E-08	2.80E-16	5.66E-08	2.73E-16	10	3.16E+07	8.61246E-10	5.57E-08
20	0.1	8.19E-03	3.14	2.62E-06	6.31E+08	3.63E-02	630	3.64E-08	2.73E-16	5.57E-08	2.67E-16	10	3.16E+07	8.4049E-10	5.49E-08
21	0.1	8.19E-03	3.14	2.62E-06	6.62E+08	3.63E-02	630	3.64E-08	2.67E-16	5.49E-08	2.60E-16	10	3.16E+07	8.21166E-10	5.41E-08
22	0.1	8.19E-03	3.14	2.62E-06	6.94E+08	3.63E-02	630	3.64E-08	2.60E-16	5.41E-08	2.55E-16	10	3.16E+07	8.03116E-10	5.33E-08
23	0.1	8.19E-03	3.14	2.62E-06	7.26E+08	3.63E-02	630	3.64E-08	2.55E-16	5.33E-08	2.49E-16	10	3.16E+07	7.85206E-10	5.25E-08
24	0.1	8.19E-03	3.14	2.62E-06	7.57E+08	3.63E-02	630	3.64E-08	2.49E-16	5.25E-08	2.44E-16	10	3.16E+07	7.70322E-10	5.17E-08
25	0.1	8.19E-03	3.14	2.62E-06	7.88E+08	3.63E-02	630	3.64E-08	2.44E-16	5.17E-08	2.40E-16	10	3.16E+07	7.56383E-10	5.10E-08
26	0.1	8.19E-03	3.14	2.62E-06	8.20E+08	3.63E-02	630	3.64E-08	2.40E-16	AVERAGE					6.31E-08

APPENDIX G
EXPOSURE AND RISK CALCULATIONS
SECOND LEVEL

TABLE G-1
BUILDING NO. 3
SECOND LEVEL
CALCULATION OF RISKS

Dermal contact with Interior Surfaces

Equation

C_{low} = $(C_{floor} + C_{ceiling})$
C_{high} = Cwall
Intake = $((C_{low} \times SA_{low} \times CR_{low}) + (C_{high} \times SA_{high} \times CR_{high}) \times AB \times CF)/(BW \times AT)$
Risk = Intake x SF
HQ = Intake/RfD

where:

C_{floor} = Chemical concentration on floor surfaces (mg/cm^2)
$C_{ceiling}$ = Chemical concentration on ceiling surfaces (mg/cm^2)
SA_{low} = Surface area of low contact surfaces (cm^2)
CR_{low} = Percentage of contact with low contact surfaces (unitless)
SA_{high} = Surface area of high contact surfaces (cm^2)
CR_{high} = Percentage of contact with high contact surfaces (unitless)
AB = Dermal absorption extent (unitless)
CF = Unit conversion factor (mg/mg)
BW = Body weight (kg)
ATc = Averaging time, carcinogens (dy)
ATnc = Averaging time, noncarcinogens (dy)
SF = Cancer slope factor (mg/kg-dy^{-1})
RfD = Non-carcinogenic Reference Dose (mg/kg-dy)
Risk = Excess lifetime cancer risk (unitless)
HQ = Non-carcinogenic Hazard Quotient

Chemical	C_{floor} (µg/cm^2)	$C_{ceiling}$ (µg/cm^2)	C_{low} (µg/cm^2)	SA_{low} (cm^2)	CR_{low}	C_{high} (ug/cm^2)	SA_{high} (cm^2)	CR_{high}	AB (unitless)	CF (mg/ug)	BW (kg)	ATc (dy)	Intake (mg/kg-dy)	SF (mg/kg-dy)$^{-1}$	Risk (unitless)
Total PCBs	3.11	0.0431	1.577	2.70E+08	0.0005	0.00817	2.58E+07	0.001	0.0136	1E-03	70	25550	1.62E-06	7.7	1E-05

Inhalation

Equation

Intake = $(C_{air} \times IR \times ET \times EF \times ED) / (BW \times AT)$
Risk = Intake x SF
HQ = Intake/RfD

where:

C_{air} = Chemical concentration in air (mg/m^3)
IR = Inhalation rate (m^3/hr)
ET = Exposure time (hr/dy)
EF = Exposure frequency (events/year)
ED = Exposure duration (yr)
BW = Body weight (kg)
AT = Averaging time (dy)

Chemical	C_{air} (mg/m^3)	IH (m^3/hr)	ET (hr/dy)	EF (dy/yr)	ED (yr)	BW (kg)	ATc (dy)	Intake (mg/kg-dy)	SF (mg/kg-dy)$^{-1}$	Risk (unitless)
Total PCBs	1.45E-04	0.83	8	250	25	70	25550	3.36E-06	7.7	3E-05

Overall Risk

Dermal	1E-05
Inhalation	3E-05
TOTAL	4E-05

BUILDING NO. 3
SECOND LEVEL
CALCULATION OF AIR CONCENTRATIONS
PCBs

Equation $Ca = (E \times CF1 \times t_e \times CF2) / (V \times CF3)$

Where:

Ca =	Predicted air concentration in building (mg/m^3)
E =	Average emission rate from all sources (g/s)
t_e =	Air exchange rate (hr)
V =	Volume of room (cm^3)
CF1 =	Unit conversion factor (s/hr)
CF2 =	Unit conversion factor (mg/g)
CF3 =	Unit conversion factor (m^3/cm^3)

Source	Average Na (g/cm^2-s)	Applicable Area (cm^2)	Emission Rate (g/s)
Floor	7.37E-14	1.35E+08	9.95E-06
Wall	6.32E-17	2.58E+07	1.63E-09
Ceiling	3.33E-16	1.35E+08	4.50E-08
Total			**9.99E-06**

Chemical	E (g/s)	CF1 (s/hr)	t_e (hr)	CF2 (mg/g)	CF3 (m^3/cm^3)	V (cm^3)	Ca (mg/m^3)
Total PCBs	9.99E-06	3600	0.233	1000	1.00E-06	5.80E+10	**1.45E-04**

BUILDING NO.3
SECOND LEVEL
VOLATILIZATION OF PCBs
FROM FLOOR SURFACES

Hwang DeFelco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Ca$$

where:	Na =	Instantaneous emission flux rate (g/cm²-s)	
	E =	Soil (or medium) porosity) (unitless)	0.1
	Del =	Effective diffusivity in soil (cm²/s) = Di x E^0.33	
	Di =	Diffusion coefficient in air (cm²/s)	1.75E-02
	p =	PI (3.14)	
	t =	Time from sampling (s)	
	H =	Henry's Law Constant (dimensionless form)	3.63E-02
	Kd =	Soil/water partition coefficient (cm³/g) =	530
	Koc =	Organic carbon water partition coefficient (cm³/g)	6.30E+06
	foc =	Fraction of organic carbon in material (g/g)	0.001
	Ca =	Initial concentration in material (g/g)	6.34E-06

Calculation of Cw in g/cm² Ca = (Ca x p x d)

where:
Cw = Concentration in core (g/g or g/cm³)
p = Bulk density of concrete (g/cm³)
d = Depth of available chemical (cm)

Ca (g/g)	p (g/cm³)	d (cm)	Cw (g/cm³)
6.34E-06	2.4	0.5	6.41E-06

Calculation of Del Del = Di x E^0.33

Di (cm²/s)	E (unitless)	Del (cm²/s)
1.75E-02	0.1	8.19E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$$

Del (cm²/s)	E (unitless)	p (g/cm³)	Kd (cm³/g)	H (unitless)	α (cm²/s)
8.19E-03	0.1	2.4	530	3.63E-02	2.52E-06

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Ca$$

E (unitless)	Del (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Ca (g/g)	Na (g/cm²-s)
0.1	8.19E-03	3.14	2.52E-06	7.88E+08	3.63E-02	530	6.34E-06	3.68E-14

Calculation of Avg Na Avg Na (T = 25yr) = 2 Na (T yr)

Na g/cm²-s	AvgNa g/cm²-s
3.68E-14	7.37E-14

BUILDING NO.3
SECOND LEVEL
VOLATILIZATION OF PCBs
FROM FLOOR SURFACES

Year	E (unitless)	Dal (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Ca (g/g)	Na (g/cm^2-s)	Initial Conc (g/cm^3)	Na (g/cm^2-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm^3)	Mass Remaining (g/cm^3)
1 sec	0.1	8.19E-03	3.14	2.62E-08	1.00E+00	3.63E-02	630	6.34E-06	1.03E-09	6.41E-06	1.84E-13	10	3.15E+07	5.81E-07	5.83E-06
1	0.1	8.19E-03	3.14	2.62E-08	3.15E+07	3.63E-02	630	5.34E-06	1.84E-13	5.83E-06	1.30E-13	10	3.15E+07	4.11E-07	5.42E-06
2	0.1	8.19E-03	3.14	2.62E-08	6.31E+07	3.63E-02	630	5.34E-06	1.30E-13	5.42E-06	1.06E-13	10	3.15E+07	3.36E-07	5.08E-06
3	0.1	8.19E-03	3.14	2.62E-08	9.46E+07	3.63E-02	630	5.34E-06	1.06E-13	5.08E-06	9.21E-14	10	3.15E+07	2.90E-07	4.79E-06
4	0.1	8.19E-03	3.14	2.62E-08	1.26E+08	3.63E-02	630	5.34E-06	9.21E-14	4.79E-06	8.24E-14	10	3.15E+07	2.60E-07	4.53E-06
5	0.1	8.19E-03	3.14	2.62E-08	1.58E+08	3.63E-02	630	5.34E-06	8.24E-14	4.53E-06	7.52E-14	10	3.15E+07	2.37E-07	4.29E-06
6	0.1	8.19E-03	3.14	2.62E-08	1.89E+08	3.63E-02	630	5.34E-06	7.52E-14	4.29E-06	6.96E-14	10	3.15E+07	2.19E-07	4.07E-06
7	0.1	8.19E-03	3.14	2.62E-08	2.21E+08	3.63E-02	630	5.34E-06	6.96E-14	4.07E-06	6.51E-14	10	3.15E+07	2.05E-07	3.87E-06
8	0.1	8.19E-03	3.14	2.62E-08	2.52E+08	3.63E-02	630	5.34E-06	6.51E-14	3.87E-06	6.14E-14	10	3.15E+07	1.94E-07	3.68E-06
9	0.1	8.19E-03	3.14	2.62E-08	2.84E+08	3.63E-02	630	5.34E-06	6.14E-14	3.68E-06	5.82E-14	10	3.15E+07	1.84E-07	3.49E-06
10	0.1	8.19E-03	3.14	2.62E-08	3.15E+08	3.63E-02	630	5.34E-06	5.82E-14	3.49E-06	5.55E-14	10	3.15E+07	1.75E-07	3.32E-06
11	0.1	8.19E-03	3.14	2.62E-08	3.47E+08	3.63E-02	630	5.34E-06	5.55E-14	3.32E-06	5.32E-14	10	3.15E+07	1.68E-07	3.15E-06
12	0.1	8.19E-03	3.14	2.62E-08	3.78E+08	3.63E-02	630	5.34E-06	5.32E-14	3.15E-06	5.11E-14	10	3.15E+07	1.61E-07	2.99E-06
13	0.1	8.19E-03	3.14	2.62E-08	4.10E+08	3.63E-02	630	5.34E-06	5.11E-14	2.99E-06	4.92E-14	10	3.15E+07	1.55E-07	2.83E-06
14	0.1	8.19E-03	3.14	2.62E-08	4.42E+08	3.63E-02	630	5.34E-06	4.92E-14	2.83E-06	4.75E-14	10	3.15E+07	1.50E-07	2.68E-06
15	0.1	8.19E-03	3.14	2.62E-08	4.73E+08	3.63E-02	630	5.34E-06	4.75E-14	2.68E-06	4.60E-14	10	3.15E+07	1.45E-07	2.54E-06
16	0.1	8.19E-03	3.14	2.62E-08	5.05E+08	3.63E-02	630	5.34E-06	4.60E-14	2.54E-06	4.47E-14	10	3.15E+07	1.41E-07	2.40E-06
17	0.1	8.19E-03	3.14	2.62E-08	5.36E+08	3.63E-02	630	5.34E-06	4.47E-14	2.40E-06	4.34E-14	10	3.15E+07	1.37E-07	2.26E-06
18	0.1	8.19E-03	3.14	2.62E-08	5.68E+08	3.63E-02	630	5.34E-06	4.34E-14	2.26E-06	4.22E-14	10	3.15E+07	1.33E-07	2.13E-06
19	0.1	8.19E-03	3.14	2.62E-08	5.99E+08	3.63E-02	630	5.34E-06	4.22E-14	2.13E-06	4.12E-14	10	3.15E+07	1.30E-07	2.00E-06
20	0.1	8.19E-03	3.14	2.62E-08	6.31E+08	3.63E-02	630	5.34E-06	4.12E-14	2.00E-06	4.02E-14	10	3.15E+07	1.27E-07	1.87E-06
21	0.1	8.19E-03	3.14	2.62E-08	6.62E+08	3.63E-02	630	5.34E-06	4.02E-14	1.87E-06	3.93E-14	10	3.15E+07	1.24E-07	1.75E-06
22	0.1	8.19E-03	3.14	2.62E-08	6.94E+08	3.63E-02	630	5.34E-06	3.93E-14	1.75E-06	3.84E-14	10	3.15E+07	1.21E-07	1.63E-06
23	0.1	8.19E-03	3.14	2.62E-08	7.26E+08	3.63E-02	630	5.34E-06	3.84E-14	1.63E-06	3.76E-14	10	3.15E+07	1.18E-07	1.51E-06
24	0.1	8.19E-03	3.14	2.62E-08	7.57E+08	3.63E-02	630	5.34E-06	3.76E-14	1.51E-06	3.68E-14	10	3.15E+07	1.16E-07	1.39E-06
25	0.1	8.19E-03	3.14	2.62E-08	7.88E+08	3.63E-02	630	5.34E-06	3.68E-14	1.39E-06	3.61E-14	10	3.15E+07	1.14E-07	1.28E-06
26	0.1	8.19E-03	3.14	2.62E-08	8.20E+08	3.63E-02	630	5.34E-06	3.61E-14	AVERAGE					3.11E-06

BUILDING NO. 3
SECOND LEVEL
VOLATILIZATION OF PCBs
FROM VERTICAL SURFACES

Hwang DeFalco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Ca$$

where: Na =	Instantaneous emission flux rate (g/cm²-s)		
E =	Soil (or medium) porosity) (unitless)		0.1
Del =	Effective diffusivity in soil (cm²/s) = Di x E^0.33		
Di =	Diffusion coefficient in air (cm²/s)		1.75E-02
p =	PI (3.14)		
t =	Time from sampling (s)		
H =	Henry's Law Constant (dimensionless form)		3.53E-02
Kd =	Soil/water partition coefficient (cm³/g) = Koc x foc		630
Koc =	Organic carbon water partition coefficient (cm³/g)		6.30E+05
foc =	Fraction of organic carbon in material (g/g)		0.001
Ca =	Initial concentration in soil or medium (g/g)		
Cwipe (Wall)		(µg/cm²)	0.011
Cwipe (Wall)		(g/cm²)	0.000000011

Calculation of Del

$$Del = Di \times E^{0.33}$$

Di (cm²/s)	E (unitless)	Del (cm²/s)
1.75E-02	0.1	8.19E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$$

Del (cm²/s)	E (unitless)	Ps (g/cm³)	Kd (cm³/g)	H (unitless)	α (cm²/s)
8.19E-03	0.1	2.4	630	3.53E-02	2.62E-08

Calculation of Ca

$$Ca = Cwipe \times CF/\rho_s \times d$$

Cwipe (µg/cm²)	CF (g/µg)	d (cm)	ρ (g/cm³)	Ca (g/g)
0.011	1.00E-06	1	2.4	4.58E-09

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Ca$$

E (unitless)	Del (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Ca (g/g)	Na (g/cm²-s)
0.1	8.19E-03	3.14	2.62E-08	7.88E+08	3.53E-02	630	4.58E-09	3.16E-17

Calculation of Avg Na

Avg Na (T = 25yr) =2 Na (T yr)

Na g/cm²-s	AvgNa g/cm²-s
3.16E-17	6.32E-17

BUILDING NO. 3
SECOND LEVEL
VOLATILIZATION OF PCBs
FROM VERTICAL SURFACES

Year	E (unitless)	Del (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Cs (g/g)	Ns (g/cm^3-s)	Initial Conc (g/cm^3)	Ns (g/cm^3-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm^3)	Mass Remaining (g/cm^3)
1 sec	0.1	8.19E-03	3.14	2.62E-08	1.00E+00	3.53E-02	630	4.68E-09	8.88E-13	1.10E-08	1.68E-16	10	3.15E+07	4.98E-10	1.06E-08
1	0.1	8.19E-03	3.14	2.62E-08	3.15E+07	3.53E-02	630	4.68E-09	1.68E-16	1.06E-08	1.12E-16	10	3.15E+07	3.52E-10	1.01E-08
2	0.1	8.19E-03	3.14	2.62E-08	6.31E+07	3.53E-02	630	4.68E-09	1.12E-16	1.01E-08	9.13E-17	10	3.15E+07	2.88E-10	9.86E-09
3	0.1	8.19E-03	3.14	2.62E-08	9.46E+07	3.53E-02	630	4.68E-09	9.13E-17	9.86E-09	7.90E-17	10	3.15E+07	2.49E-10	9.61E-09
4	0.1	8.19E-03	3.14	2.62E-08	1.26E+08	3.53E-02	630	4.68E-09	7.90E-17	9.61E-09	7.07E-17	10	3.15E+07	2.23E-10	9.39E-09
5	0.1	8.19E-03	3.14	2.62E-08	1.58E+08	3.53E-02	630	4.68E-09	7.07E-17	9.39E-09	6.45E-17	10	3.15E+07	2.03E-10	9.19E-09
6	0.1	8.19E-03	3.14	2.62E-08	1.89E+08	3.53E-02	630	4.68E-09	6.45E-17	9.19E-09	5.97E-17	10	3.15E+07	1.88E-10	9.00E-09
7	0.1	8.19E-03	3.14	2.62E-08	2.21E+08	3.53E-02	630	4.68E-09	5.97E-17	9.00E-09	5.59E-17	10	3.15E+07	1.76E-10	8.82E-09
8	0.1	8.19E-03	3.14	2.62E-08	2.52E+08	3.53E-02	630	4.68E-09	5.59E-17	8.82E-09	5.27E-17	10	3.15E+07	1.66E-10	8.65E-09
9	0.1	8.19E-03	3.14	2.62E-08	2.84E+08	3.53E-02	630	4.68E-09	5.27E-17	8.65E-09	5.00E-17	10	3.15E+07	1.58E-10	8.50E-09
10	0.1	8.19E-03	3.14	2.62E-08	3.15E+08	3.53E-02	630	4.68E-09	5.00E-17	8.50E-09	4.77E-17	10	3.15E+07	1.50E-10	8.35E-09
11	0.1	8.19E-03	3.14	2.62E-08	3.47E+08	3.53E-02	630	4.68E-09	4.77E-17	8.35E-09	4.56E-17	10	3.15E+07	1.44E-10	8.20E-09
12	0.1	8.19E-03	3.14	2.62E-08	3.78E+08	3.53E-02	630	4.68E-09	4.56E-17	8.20E-09	4.38E-17	10	3.15E+07	1.38E-10	8.06E-09
13	0.1	8.19E-03	3.14	2.62E-08	4.10E+08	3.53E-02	630	4.68E-09	4.38E-17	8.06E-09	4.22E-17	10	3.15E+07	1.33E-10	7.93E-09
14	0.1	8.19E-03	3.14	2.62E-08	4.42E+08	3.53E-02	630	4.68E-09	4.22E-17	7.93E-09	4.08E-17	10	3.15E+07	1.28E-10	7.80E-09
15	0.1	8.19E-03	3.14	2.62E-08	4.73E+08	3.53E-02	630	4.68E-09	4.08E-17	7.80E-09	3.95E-17	10	3.15E+07	1.26E-10	7.68E-09
16	0.1	8.19E-03	3.14	2.62E-08	5.05E+08	3.53E-02	630	4.68E-09	3.95E-17	7.68E-09	3.83E-17	10	3.15E+07	1.21E-10	7.56E-09
17	0.1	8.19E-03	3.14	2.62E-08	5.36E+08	3.53E-02	630	4.68E-09	3.83E-17	7.56E-09	3.73E-17	10	3.15E+07	1.17E-10	7.44E-09
18	0.1	8.19E-03	3.14	2.62E-08	5.68E+08	3.53E-02	630	4.68E-09	3.73E-17	7.44E-09	3.63E-17	10	3.15E+07	1.14E-10	7.33E-09
19	0.1	8.19E-03	3.14	2.62E-08	5.99E+08	3.53E-02	630	4.68E-09	3.63E-17	7.33E-09	3.53E-17	10	3.15E+07	1.11E-10	7.21E-09
20	0.1	8.19E-03	3.14	2.62E-08	6.31E+08	3.53E-02	630	4.68E-09	3.53E-17	7.21E-09	3.45E-17	10	3.15E+07	1.08E-10	7.11E-09
21	0.1	8.19E-03	3.14	2.62E-08	6.62E+08	3.53E-02	630	4.68E-09	3.45E-17	7.11E-09	3.37E-17	10	3.15E+07	1.06E-10	7.00E-09
22	0.1	8.19E-03	3.14	2.62E-08	6.94E+08	3.53E-02	630	4.68E-09	3.37E-17	7.00E-09	3.30E-17	10	3.15E+07	1.04E-10	6.90E-09
23	0.1	8.19E-03	3.14	2.62E-08	7.26E+08	3.53E-02	630	4.68E-09	3.30E-17	6.90E-09	3.23E-17	10	3.15E+07	1.02E-10	6.79E-09
24	0.1	8.19E-03	3.14	2.62E-08	7.57E+08	3.53E-02	630	4.68E-09	3.23E-17	6.79E-09	3.16E-17	10	3.15E+07	9.97E-11	6.69E-09
25	0.1	8.19E-03	3.14	2.62E-08	7.88E+08	3.53E-02	630	4.68E-09	3.16E-17	6.69E-09	3.10E-17	10	3.15E+07	9.78E-11	6.60E-09
26	0.1	8.19E-03	3.14	2.62E-08	8.20E+08	3.53E-02	630	4.68E-09	3.10E-17	AVERAGE					6.17E-09

BUILDING NO. 3
SECOND LEVEL
VOLATILIZATION OF PCBs
FROM CEILING SURFACES

Hwang DeFalco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where: Na =	Instantaneous emission flux rate (g/cm²-s)		
E =	Soil (or medium) porosity) (unitless)		0.1
Del =	Effective diffusivity in soil (cm²/s) = Di x $E^{0.33}$		
Di =	Diffusion coefficient in air (cm²/s)		1.75E-02
p =	PI (3.14)		
t =	Time from sampling (s)		
H =	Henry's Law Constant (dimensionless form)		3.53E-02
Kd =	Soil/water partition coefficient (cm³/g) = Koc x f		630
Koc =	Organic carbon water partition coefficient (cm³/g)		6.30E+05
foc =	Fraction of organic carbon in material (g/g)		0.001
Cs =	Initial concentration in soil or medium (g/g)		
Cwipe (Ceiling)		(µg/cm²)	0.058
Cwipe (Ceiling)		(g/cm²)	0.000000058

Calculation of Del Del = Di x $E^{0.33}$

Di (cm²/s)	E (unitless)	Del (cm²/s)
1.75E-02	0.1	8.19E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$$

Del (cm²/s)	E (unitless)	Ps (g/cm³)	Kd (cm³/g)	H (unitless)	α (cm²/s)
8.19E-03	0.1	2.4	630	3.53E-02	2.52E-08

Calculation of Cs Cs = Cwipe x CF/ρ_s x d

Cwipe (µg/cm²)	CF (g/µg)	d (cm)	ρ (g/cm³)	Cs (g/g)
0.058	1.00E-06	1	2.4	2.42E-08

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

E (unitless)	Del (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Cs (g/g)	Na (g/cm²-s)
0.1	8.19E-03	3.14	2.52E-08	7.88E+08	3.53E-02	630	2.42E-08	1.67E-16

Calculation of Avg Na Avg Na (T = 20yr) =2 Na (T yr)

Na g/cm²-s	AvgNa g/cm²-s
1.67E-16	3.33E-16

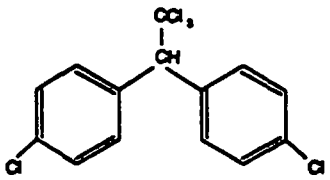
BUILDING NO. 3
SECOND LEVEL
VOLATILIZATION OF PCBs
FROM CEILING SURFACES

Year	E (unitless)	Del (cm^2/s)	π (unitless)	α (cm^2/s)	t (s)	H (unitless)	Kd (cm^3/g)	Ce (g/g)	Ns (g/cm^2-s)	Initial Conc (g/cm^2)	Ns (g/cm^2-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm^2)	Mass Remaining (g/cm^2)
1 sec	0.1	8.19E-03	3.14	2.62E-06	1.00E+00	3.63E-02	630	2.42E-06	4.68E-12	6.80E-06	8.33E-16	10	3.15E+07	2.62816E-09	6.64E-06
1	0.1	8.19E-03	3.14	2.62E-06	3.15E+07	3.63E-02	630	2.42E-06	8.33E-16	6.64E-06	5.89E-16	10	3.15E+07	1.85639E-09	6.36E-06
2	0.1	8.19E-03	3.14	2.62E-06	6.31E+07	3.63E-02	630	2.42E-06	5.89E-16	6.36E-06	4.81E-16	10	3.15E+07	1.51737E-09	6.20E-06
3	0.1	8.19E-03	3.14	2.62E-06	9.46E+07	3.63E-02	630	2.42E-06	4.81E-16	6.20E-06	4.17E-16	10	3.15E+07	1.31408E-09	6.07E-06
4	0.1	8.19E-03	3.14	2.62E-06	1.26E+08	3.63E-02	630	2.42E-06	4.17E-16	6.07E-06	3.73E-16	10	3.15E+07	1.17535E-09	4.95E-06
5	0.1	8.19E-03	3.14	2.62E-06	1.58E+08	3.63E-02	630	2.42E-06	3.73E-16	4.95E-06	3.40E-16	10	3.15E+07	1.07294E-09	4.84E-06
6	0.1	8.19E-03	3.14	2.62E-06	1.89E+08	3.63E-02	630	2.42E-06	3.40E-16	4.84E-06	3.15E-16	10	3.15E+07	9.9335E-10	4.74E-06
7	0.1	8.19E-03	3.14	2.62E-06	2.21E+08	3.63E-02	630	2.42E-06	3.15E-16	4.74E-06	2.95E-16	10	3.15E+07	9.29194E-10	4.65E-06
8	0.1	8.19E-03	3.14	2.62E-06	2.52E+08	3.63E-02	630	2.42E-06	2.95E-16	4.65E-06	2.76E-16	10	3.15E+07	8.76052E-10	4.56E-06
9	0.1	8.19E-03	3.14	2.62E-06	2.84E+08	3.63E-02	630	2.42E-06	2.76E-16	4.56E-06	2.64E-16	10	3.15E+07	8.31096E-10	4.48E-06
10	0.1	8.19E-03	3.14	2.62E-06	3.15E+08	3.63E-02	630	2.42E-06	2.64E-16	4.48E-06	2.51E-16	10	3.15E+07	7.92419E-10	4.40E-06
11	0.1	8.19E-03	3.14	2.62E-06	3.47E+08	3.63E-02	630	2.42E-06	2.51E-16	4.40E-06	2.41E-16	10	3.15E+07	7.56663E-10	4.33E-06
12	0.1	8.19E-03	3.14	2.62E-06	3.78E+08	3.63E-02	630	2.42E-06	2.41E-16	4.33E-06	2.31E-16	10	3.15E+07	7.26918E-10	4.26E-06
13	0.1	8.19E-03	3.14	2.62E-06	4.10E+08	3.63E-02	630	2.42E-06	2.31E-16	4.26E-06	2.23E-16	10	3.15E+07	7.02404E-10	4.18E-06
14	0.1	8.19E-03	3.14	2.62E-06	4.42E+08	3.63E-02	630	2.42E-06	2.23E-16	4.18E-06	2.15E-16	10	3.15E+07	6.78587E-10	4.11E-06
15	0.1	8.19E-03	3.14	2.62E-06	4.73E+08	3.63E-02	630	2.42E-06	2.15E-16	4.11E-06	2.08E-16	10	3.15E+07	6.57039E-10	4.05E-06
16	0.1	8.19E-03	3.14	2.62E-06	5.05E+08	3.63E-02	630	2.42E-06	2.08E-16	4.05E-06	2.02E-16	10	3.15E+07	6.37422E-10	3.99E-06
17	0.1	8.19E-03	3.14	2.62E-06	5.36E+08	3.63E-02	630	2.42E-06	2.02E-16	3.99E-06	1.96E-16	10	3.15E+07	6.19462E-10	3.92E-06
18	0.1	8.19E-03	3.14	2.62E-06	5.68E+08	3.63E-02	630	2.42E-06	1.96E-16	3.92E-06	1.91E-16	10	3.15E+07	6.0294E-10	3.86E-06
19	0.1	8.19E-03	3.14	2.62E-06	5.99E+08	3.63E-02	630	2.42E-06	1.91E-16	3.86E-06	1.86E-16	10	3.15E+07	5.87674E-10	3.80E-06
20	0.1	8.19E-03	3.14	2.62E-06	6.31E+08	3.63E-02	630	2.42E-06	1.86E-16	3.80E-06	1.82E-16	10	3.15E+07	5.73511E-10	3.76E-06
21	0.1	8.19E-03	3.14	2.62E-06	6.62E+08	3.63E-02	630	2.42E-06	1.82E-16	3.76E-06	1.78E-16	10	3.15E+07	5.60325E-10	3.69E-06
22	0.1	8.19E-03	3.14	2.62E-06	6.94E+08	3.63E-02	630	2.42E-06	1.78E-16	3.69E-06	1.74E-16	10	3.15E+07	5.48009E-10	3.64E-06
23	0.1	8.19E-03	3.14	2.62E-06	7.26E+08	3.63E-02	630	2.42E-06	1.74E-16	3.64E-06	1.70E-16	10	3.15E+07	5.3947E-10	3.58E-06
24	0.1	8.19E-03	3.14	2.62E-06	7.57E+08	3.63E-02	630	2.42E-06	1.70E-16	3.58E-06	1.67E-16	10	3.15E+07	5.26831E-10	3.53E-06
25	0.1	8.19E-03	3.14	2.62E-06	7.88E+08	3.63E-02	630	2.42E-06	1.67E-16	3.53E-06	1.63E-16	10	3.15E+07	5.15424E-10	3.48E-06
26	0.1	8.19E-03	3.14	2.62E-06	8.20E+08	3.63E-02	630	2.42E-06	1.63E-16	AVERAGE					4.31E-06

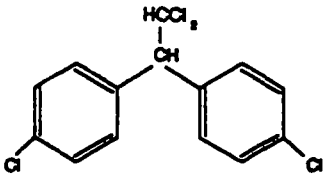
APPENDIX H
TOXICITY PROFILES

DDT, DDD, AND DDE

Dichlorodiphenyltrichloroethane (DDT) was one of the first of the organochlorine pesticides, being initially synthesized in 1874. However, it was not until 1939 that the insecticidal properties were recognized. DDT was extensively used during World War II for control of body lice, being directly applied to the skin of infested individuals. In addition, it was one of the most widely used pesticides in the world from the 1940s until the 1970s. However, evidence that DDT and its breakdown products DDD and DDE, impacted food chains and ecological systems eventually curtailed use of this pesticide. Application of DDT was banned in the United States in 1972, although its use continues in some parts of the world.

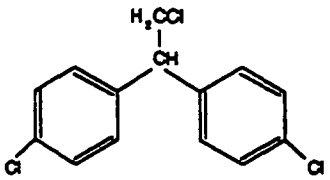


DDT



DDD

DDT, DDD, and DDE can be absorbed into the body via ingestion, inhalation, or direct dermal contact. Of these, ingestion is thought to represent the major uptake route. Once absorbed, these compounds partition into the fat, where they tend to bioconcentrate. Excretion occurs primarily in the urine, but may also occur in the breast milk and feces.



DDE

DDT is not a highly toxic compound in man. Animal studies indicate that the acute LD_{50} for DDT is relatively high, ranging from 100 to 500 mg/kg in rats (Hayes, 1959). The 90-day LD_{50} is considerably lower, at 46 mg/kg, due to bioaccumulation (Gaines, 1969). The onset of death in animals given lethal doses is 24 to 72 hours (Murphy, 1986). While some signs of toxicity have been reported in humans at 10 mg/kg, doses as high as 285 mg/kg have been found to be non-lethal (Hayes, 1982; Garrett, 1947). No toxicity has been observed among individuals dermally exposed to DDT as a louse control agent (Murphy, 1986), among factory workers chronically exposed to 5 to 18 mg/kg/day for 15 years (Laws et al., 1967), or among volunteers who were administered 35 μg/kg/day for 18 months (Hayes, et al., 1971).

The primary target organ of DDT appears to be the central nervous system (CNS). Effects related to CNS toxicity include parathesia of the tongue, lips, and face, apprehension, hyperexcitability, disturbances of motor functions, and tonic and clonic convulsions. Several animal studies have

indicated that the liver is also a target organ. DDT exposure has been reported to cause increased liver weight, increased blood levels of liver enzymes, and hepatocyte hypertrophy and necrosis (de Waziers and Azais, 1987; Hart and Fauts, 1965). In general, the effects produced by DDT display a dose-response relationship, with repeated dosing at 40 mg/kg/day (or more) required to induce most of the observed CNS and liver effects.

DDT does not appear to be a teratogen in any species tested. In an overview of several multigeneration studies, Hayes (1982) reported that DDT is not teratogenic in mice, rats, or beagles.

Reproductive effects have been reported for DDT in male cockerels, but only at doses which would be immediately lethal in rats (Hayes, 1982). Reproductive studies in rats suggest that DDT possesses little reproductive toxicity, even at dietary levels of 200 mg/kg (Wrenn et al., 1971). Studies in mice indicate that dosages ranging between 200 and 300 mg/kg of DDT are associated with decreased ovary and testis size (Cannon and Holcomb, 1968).

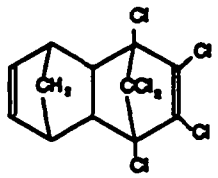
Potential mutagenic properties of DDT have been investigated by Shirasu et al. (1976) in a number of bacterial systems and have tested negative. Additional studies have shown that DDT is not mutagenic even when a metabolic activation system is included in the bacterial screens (Shirasu et al., 1977). DDT has also yielded negative results in the dominant lethal assay in mice (Epstein et al., 1972), although the authors reported that DDT was mutagenic in the same assay in rats.

DDT has not been demonstrated to be carcinogenic in man despite extensive exposure data. Available evidence suggests that DDT and its metabolites, DDD and DDE, may produce liver tumors in rats and mice (Fitzhugh and Nelson, 1947; Innes et al., 1969). Given the lack of association between exposure to DDT and cancer in humans, the significance of the findings in animals is questionable. The reported carcinogenic properties of DDT, DDD, and DDE are further complicated by the finding that these compounds produced hepatomas. Controversy currently exists regarding the significance of hepatomas. It is unclear whether this pathologic change is reversible or indicative of carcinogenesis (Murphy, 1986).

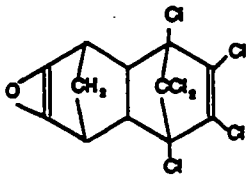
It has been suggested that DDT is an epigenetic carcinogen and induces tumor formation through mechanisms not involving heritable changes in DNA. Although this currently represents an area of active research in toxicology, it is not clear that this will alter the current status of DDT as non-carcinogenic in humans.

ALDRIN AND DIELDRIN

Aldrin and dieldrin are organochlorine insecticides belonging to a a family of chemicals known as the cyclodienes. Structurally, these two compounds are almost identical except that dieldrin is a photooxidation product of aldrin. When released into the environment, aldrin converts readily to dieldrin, which is the most stable form. Historically, these compounds were widely used for insect control from the 1950s through early 1970s. However, use of these compounds has decreased in recent years because of their relative environmental persistence. Currently, the approved uses of aldrin and dieldrin are limited to subsurface termite control, treatment of some non-food plants, and for use in mothproofing in some industrial settings. Neither of these compounds is currently produced in the United States.



Aldrin



Dieldrin

Aldrin and dieldrin can be absorbed via ingestion or inhalation. Once absorbed, aldrin is rapidly converted to dieldrin and distributed into the tissues. Dieldrin partitions to the fat and it is not readily excreted. The biological half-life in humans is approximately 266 days.

There are few data available on the acute lethality of aldrin/dieldrin in humans. Ingestion of approximately 8.2 mg/kg aldrin caused death in a 3-year-old child, but adults are known to have survived doses of 26 to 30 mg/kg, suggesting that children represent a sensitive population (Hayes, 1982). Animal studies indicate that the lethal doses of aldrin and dieldrin are similar. The LD_{50} for aldrin is reported to range from 33 mg/kg to 95 mg/kg, while the LD_{50} for dieldrin ranges from 38 mg/kg to 100 mg/kg (Borgman et al., 1952a, 1952b; Treon and Cleveland, 1955; Cabral et al., 1979). The primary target organ for acute aldrin/dieldrin exposure appears to be the central nervous system (CNS). The major symptoms of lethal intoxication include increased irritability, salivation, hyperexcitability, tremors, clonic/tonic convulsions, coma, and death. Death is usually due to either cardiac arrest or respiratory failure related to the CNS effects. The primary non-lethal effects are also CNS-related. Convulsions and electroencephalogram (EEG) abnormalities have been reported among individuals exposed to 25.6 mg/kg of aldrin (Spiotta, 1951). Studies with monkeys suggest that the EEG abnormalities may persist for up to 1 year after exposure (Burchfiel et al., 1976).

The primary target organs for chronic aldrin/dieldrin exposure include the immune system, CNS, and liver. Low doses of dieldrin (0.25 mg/kg/day) have been associated with microsomal enzyme

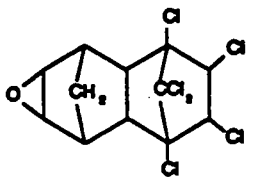
induction in the liver (Den Tonkelaar and Van Esch, 1974), and 0.75 mg/kg/day can induce immune suppression in mice (Loose, 1982). Neuronal necrosis has been reported in rats exposed to 5 mg/kg/day (NCI, 1978a), and histopathological changes have been seen in the livers of rats exposed to 3.75 mg/kg/day of dieldrin (Borgman et al., 1952b).

There are no human data available on either the reproductive or developmental effects of aldrin/dieldrin. Rodent studies suggest that these compounds are not teratogenic or fetotoxic unless the doses are high enough to also induce maternal toxicity (Chernoff et al., 1975). Reproductive studies in rats indicate that high doses (e.g. maternally toxic) do not affect mating behavior and have minimal effects on fertility and litter size. However, a marked increase in mortality was noted among nursing pups, possibly because of dieldrin in the mother's milk (Treon and Cleveland, 1955).

Aldrin and dieldrin do not appear to be genotoxic, having tested negative in numerous in vivo and in vitro assays (see ATSDR, 1989 for a detailed discussion).

Chronic inhalation exposure to dieldrin has not been linked to an increased incidence of cancer in humans, based on several epidemiological studies among industrial workers (Van Raalte, 1977; Ribbens, 1985). Results from animal studies are less definitive. In a major study by NCI (1978b), chronic oral exposure to both aldrin and dieldrin induced hepatocellular carcinomas in mice, but not in rats. Given that this tumor type is very common in mice, the relevance of this finding is questionable when extrapolation is made to humans. The U.S. Environmental Protection Agency (EPA) has identified both aldrin and dieldrin as Class B2 probable human carcinogens, based on animal data.

ENDRIN, ENDRIN KETONE, AND ENDRIN ALDEHYDE



Endrin

Endrin is an organochlorine pesticide belonging to a group known as the cyclodienes. Endrin aldehyde is a common contaminant of endrin, being co-produced during endrin synthesis. Endrin ketone is a degradation product of endrin which is typically formed by UV photo-oxidation or high temperature oxidation. Very little information is available regarding the toxic effects of either endrin ketone or endrin aldehyde, but they are expected to be similar to those produced by endrin. Historically, the primary use of endrin has been as an insecticide for cotton, sugarcane, tobacco, and apples. It has also been used as an avicide and rodenticide in grain storage areas. Use of this compound has declined in recent years, and production in the United States ceased in 1986.

Endrin can be readily absorbed via ingestion or inhalation, and to a lesser extent, by dermal contact. Wolfe et al. (1963) reported that in agricultural settings, dermal contact may be the most significant uptake route. The majority of absorbed endrin is excreted within 2 to 3 days after exposure, although a significant fraction may also partition to adipose tissue.

The acute lethality of endrin has been reported from animal studies and accidental human exposures. Twenty-six deaths were reported in an incident in which 1,300 to 1,600 people ingested bread containing 48 to 1,807 mg/kg of endrin (Curley et al., 1970). In a second mass poisoning, 19 people died (of 192 exposed) after ingesting an unknown quantity of endrin in food (Rowley et al., 1987). Twelve grams has been identified as a lethal dose in man, based on a suicide in an adult male (Runhaar et al., 1985). The oral LD_{50} for endrin in rats is 40 mg/kg (Speck and Maaske, 1958) and the dermal LD_{50} in rabbits is 94 mg/kg (Treon et al., 1955).

The primary target organ of endrin toxicity is the central nervous system (CNS). Acute endrin poisoning can induce CNS effects in man, including electroencephalogram (EEG) abnormalities, dizziness, mental confusion, jerking of the legs and arms, epileptiform seizures, sudden collapse, and death (Hoogendam et al., 1965; Curley et al., 1970). Recovery from non-lethal exposure is generally rapid (within a few hours), except for EEG abnormalities, which may persist for 1 to 6 months (Hoogendam et al., 1962). Other systemic effects, reported from animal studies, include pulmonary edema and liver necrosis (Treon et al, 1955) and hepatic microsomal enzyme induction (Hartgrove et al., 1977).

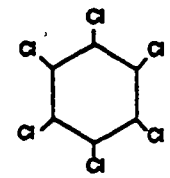
Few studies have reported on the effects of chronic endrin toxicosis. An epidemiological study among industrial workers occupationally exposed to endrin demonstrated an increase in the number of deaths due to pneumonia and other non-malignant respiratory diseases (Ditraglia et al., 1981). Chronic exposure to non-lethal doses of endrin has also been linked to liver and kidney damage in dogs (Treon et al., 1955) and to episodes of tremors and chronic convulsions in rats (Diechmann et al., 1970).

Several studies have implicated endrin as a teratogen/developmental toxicant. Ottolenghi et al. (1974) demonstrated that 5 mg/kg, a dose which was half the maternal LD_{50}, caused an increased incidence of cleft palate and fused ribs in hamster pups. Lower doses (1.5 mg/kg) have been linked to hyperactivity in hamster pups (Gray et al., 1981), and doses as low as 1 mg/kg are associated with reduced pup survival (Ottolenghi et al., 1974).

Endrin does not appear to be either mutagenic or genotoxic. Endrin exposure does not induce mutations in bacterial assays (Ames et al., 1975), does not induce unscheduled DNA synthesis in primary rat hepatocyte cultures (Probst et al., 1981), and does not cause an increase in the frequency of sister chromatic exchanges (SCEs) in human lymphoid cells (Sobti et al., 1983).

There is no evidence to suggest that endrin is a potential carcinogen. Epidemiological studies have not demonstrated any increased cancer rates among workers exposed to endrin during manufacture (Ribbens, 1985). A study by NCI (1978) reports that endrin is not carcinogenic to mice or rats.

HEXACHLOROCYCLOHEXANE



Hexachlorocyclohexane

Hexachlorocyclohexane (HCH), also known as benzene hexachloride (BHC), is an organochlorine insecticide with an extensive history of agricultural and medicinal use. Technical grade HCH is composed primarily of four HCH isomers, the alpha (α), beta (β), delta (δ), and gamma (γ) isomers. The gamma isomer is also known as lindane. The beta and gamma forms were detected in the basement samples. The physical, chemical, and toxicological properties of all four forms are similar, and they will be presented as a group in this profile.

Gastrointestinal absorption of ingested HCH in the rat is relatively complete, ranging from 90.7 to 99.4 percent, depending on the isomer (Albro and Thomas, 1974) whereas dermal absorption of γ-HCH is reported to be less than or equal to 9 percent (Feldmann and Maibach, 1974). The degree of absorption via respiration has not been quantified, but is likely to be higher than dermal absorption because of the higher membrane permeability of the respiratory tract.

While unusual, death has been reported in children exposed to γ-HCH in vaporizer fumes (Loge, 1965), in dust (Mobb, 1948), and to a whole-body application of a one percent lotion of γ-HCH (Davies, et al., 1983). Symptoms of γ-HCH poisoning include vomiting, nausea, diarrhea, seizures, and convulsions (Davies, et al., 1983). The oral LD_{50} for γ-HCH in rats is approximately 90 mg/kg, and the dermal LD_{50} in rats ranges from 900 to 1,000 mg/kg (Gaines, 1960).

A number of organ systems are affected by chronic HCH toxicosis, including the respiratory, cardiovascular, central nervous, immune, hepatic, renal, muscular, and hematopoietic (blood-forming) systems. Chronic uptake by inhalation of technical grade HCH by workers in the pesticide industry has been associated with parathesia of the face and extremities, headache and vertigo (Kashyap, 1986), and to abnormalities in electroencephalograms (EEG) (Czegledi-Janko and Avar, 1970). Subchronic oral exposure to γ-HCH has induced behavioral changes (Desi. 1974), and decreased nerve velocity in rats (Muller et al., 1981). Decreased nerve velocity was also noted in rats exposed to high levels of β-HCH (Muller et al., 1981). In contrast to the effects of γ- and β-HCH, studies by Muller et al. (1981) were unable to demonstrate any neurological effect for α-HCH.

Hematological effects have been reported for both chronic and acute HCH exposure. Morgan et al. (1980) reported that exposure to γ-HCH from a vaporizer (2.4 to 5.5 mg/m^3) resulted in anemia in a 2.5-year old child. Hematology studies of workers occupationally exposed to HCH at unknown concentrations via inhalation have demonstrated increased incidence of leukopenia, leukocytosis, granulocytopenia, granulocytosis, eosinophilia, monocytosis, and thrombocytopenia (Brassow et al., 1981). Oral studies in rats exposed to β-HCH at 12.5 mg/kg/day for 13 weeks have demonstrated decreases in red blood cells, white blood cells, hemoglobin and packed cell volume (Van Velsen et al., 1986).

The non-carcinogenic hepatic effects of HCH are limited to changes in enzyme levels and liver weight. Workers exposed to technical grade HCH in the air for periods in excess of 10 years display increases in blood levels of liver enzymes (Kashyap, 1986). Increased microsomal enzyme activity can be induced in rats at doses as low as 6.2 mg/kg/day for 3 days, and increased liver weight at 18 mg/kg/day for 3 months (Oesch, et al., 1982). Alpha and β-HCH produce hepatic effects similar to those produced by γ-HCH. Exposure to 0.5 mg/kg/day of β-HCH for 13 weeks caused increased liver weight in rats (Van Velsen et al., 1986), and exposure to 25 mg/kg/day for 24 weeks has been related to liver hypertrophy (Ito et al., 1975). In contrast to the α, β, and γ isomers, the δ isomer appears to be relatively non-toxic to the liver. No liver effects were noted among rats treated with 50 mg/kg/day for 24 to 48 weeks (Ito, et al., 1975).

The various HCH isomers have been reported to cause kidney damage in the rat. Exposure to 40 mg/kg/day of either β or γ-HCH for 2 weeks reportedly has caused kidney damage as indicated by increased glucose and creatinine excretion, and hypertrophy and degeneration of the renal tubular epithelia (Srinivasan et al., 1984). Chronic exposure to β-HCH may cause increased kidney weight and renal calcinosis (Van Velsen et al., 1986). Fitzhugh et al., (1950) have shown that chronic exposure to 40 mg/kg/day of γ-HCH can cause nephritis and basal vacuolation.

Several minor target organs of HCH have been identified, based on a limited number of studies. Chronic occupational exposure to technical grade HCH has been associated with abnormal electrocadiograms (ECGs) (Kashyap, 1986) and mucous membrane irritation (Conley, 1952). Accidental ingestion has been related to minor muscle damage (Munk and Nantel, 1977), and gastrointestinal (GI) effects, including vomiting and diarrhea (Nantel et al., 1977). Immune suppession has been reported from animal studies (Dewan et al., 1980; Desi et al., 1978), but not among workers exposed to technical grade HCH (Kashyap, 1986).

There is no evidence suggesting that any of the isomers of HCH are developmental toxicants, although reproductive effects have been reported for the γ and β isomers. Chronic exposure to

75 mg/kg/day of γ-HCH is reported to produce testicular atrophy, degeneration of the seminiferous tubules, and disruption of spermatogenesis in rats (Shivanandappa and Krishnakumari, 1982), and chronic exposure to 12.5 mg/kg/day of β-HCH is sufficient to produce atrophy of the uterus and ovaries, degeneration of the seminiferous tubules, and disruption of spermatogenesis in rats (Van Velsen et al., 1986).

There is limited evidence for the genotoxicity of HCH. Lakkad et al., (1982) have reported that technical grade HCH can induce dominant lethal mutations in mice, and Shimazu et al., (1972) have reported an increased incidence of chromosomal aberrations in rat bone marrow in response to β-HCH. In vitro mutagenicity tests utilizing bacteria have not demonstrated any mutagenic effect for γ-HCH (Moriya et al., 1983). There is some evidence that γ-HCH may induce a slight increase in chromosomal aberrations in mammalian-cell mutagenicity assays (Ishidate and Odashima, 1977).

Three HCH isomers (α, β, γ) have been implicated as potential human carcinogens based on animal studies. Work by Ito et al., (1973) demonstrated that mixtures of HCH isomers could induce hepatocellular carcinomas in mice, but that the mixtures were only carcinogenic when the α isomer was present. Other studies have implicated γ-HCH in the production of hepatocellular carcinomas in mice (NCI, 1977; Wolff et al., 1987), but not in rats (NCI, 1977). Thorpe and Walker (1973) have shown that β-HCH can cause hepatocellular carcinoma in mice. Several studies (Ito et al., 1973, 1975) have been unable to demonstrate any increased cancer rate in either mice or rats exposed to γ-HCH. Based on these studies, the USEPA has classified α-HCH as a Class B2, β-HCH as a Class C, and γ-HCH as a Class B2/C potential carcinogen. It should be noted that in all cases, the presumed potential human carcinogenicity of HCH is based on induction of liver cancer in rodents. This type of cancer is very rare in man, but relatively common in rodents. Under these conditions, the use of rodent hepatocellular carcinoma data may not be predictive of potential human carcinogenicity, and should be considered suspect.

Heptachlor & Heptachlor Epoxide

Heptachlor (CAS NO. 76-44-8, $C_{10}H_5Cl_7$) is a chlorinated cyclodiene with a molecular weight of 373.5, a melting point of 95-96° C, and boiling point of 135-145° C. It is a white or light tan, non-combustible, waxy solid or crystalline solid with a mild camphorlike odor. It has very low vapor pressure (0.0003 mm Hg at 25° C). Heptachlor is practically insoluble (56 mg/l @ 25-29° C) in water but readily soluble in most organic solvents (ATSDR 1989). The US Environmental Protection Agency (EPA) canceled the registration of pesticides containing heptachlor with the exception of its use through subsurface ground insertion for termite control and the dipping of roots or tops of non-food plants (Fed. Reg. 1975). Heptachlor epoxide (CAS NO. 1024-57-3, $C_{10}H_5Cl_7O$) is the oxidation product of heptachlor, biotransformed by microsomal enzymes, which occurs in soil and in or crops when treatments with heptachlor have been made. Humans can be exposed to these insecticides through food chains, drinking water or milk contaminated with the compounds. The cyclodiene such as heptachlor can be absorbed from the intact skin or by inhalation (ATSDR 1989). Limited data suggest that heptachlor is readily absorbed from the gastrointestinal tract, and a large portion of the absorbed heptachlor is slowly eliminated, primarily via the bile duct into the feces. Heptachlor epoxide can be stored in adipose tissue, and has been found in several human tissues including blood, milk, and amniotic fluid at concentrations of < 1 ppm (ATSDR 1989).

Acute exposures to heptachlor or its epoxide have been shown to cause effects on sensory, motor nerve fibers and the motor cortex in the central nervous system (CNS). Signs and symptoms of acute poisoning in humans and animals resulting from high doses of heptachlor include paresthesia of the tongue, lips, and face; apprehension; hypersusceptibility to stimuli; irritability; dizziness; disturbed equilibrium; tremor; and tonic and clonic convulsions (Hayes 1967). Persons who have been poisoned by cyclodiene insecticides reported headache, nausea, vomiting, dizziness, and mild chronic jerking. Unlike DDT, these compounds tend to produce convulsions before other less serious sings of illness have appeared (Hayes 1971). Heptachlor epoxide is equally or more toxic by acute exposure than the parent compound, and it has been suggested that epoxide formation represents an activation reaction (O'Brien 1967). Although they are considered as CNS stimulants, their precise site and mechanism of action are incompletely known. Biochemical studies have shown an alteration of brain amino acid rations and an increased level of ammonia in the brain (O'Brien 1967).

Major concern of chronic exposures to heptachlor or its epoxide include liver, CNS, and immune system. Several long-term feeding studies of heptachlor and heptachlor epoxide showed increased liver weights, indicating hepatotoxicity, and decreased effects on host defense mechanism by immune

system. There was a relationship between dose and increases in liver weights in both male and female mice and rats at the termination of the studies. A 2-fold increase over controls in the incidence of hepatic hyperplasia was observed in the test mice, and pathological examinations of tissue specimens revealed hepatic vein thrombosis and cirrhosis in treated but not in control mice (Davis 1965). Acceptable Daily Intake (ADI) of heptachlor was reported to be 0.0005 mg/kg/day (WHO 1973, cited in Klaassen et al. 1986). The reference dose (RfD) of heptachlor was reported to be 5E-4 mg/kg/day based on 2-year rat feeding study with critical effects of liver weight increases in male rats. A total uncertainty factor of 300 was used to account for inter- and intraspecies differences (factor of 100) and additional 3 was considered appropriate because of the lack of chronic toxicity data in a second species (IRIS 1992). The principal study was of low quality and was given a low confidence rating. There is a data gap to determine the RfD with higher confidence, and probably chronic dog feeding study may be needed (IRIS 1991). The RfD of heptachlor epoxide was determined to be 1.3E-5 mg/kg/day based on 60-week dog feeding study with critical effects of liver-to-body weight ration in both males and females (IRIS 1992). An uncertainty factor of 1000 was used to account for inter- and intraspecies differences and to account for the fact that a NOEL was not attained (IRIS 1992).

Teratogenicity and other reproductive effects of heptachlor and heptachlor epoxide were investigated. Mestitzova (1967) reported a marked reduction in the litter size in F1 generations among rats fed with heptachlor. Heptachlor epoxide has been found in tissues of stillborn infants. However, the data was considered inadequate to establish a relationship between exposure and human reproductive toxicity. Male and female mice that received heptachlor in the diet for 10 weeks were unable to produce a new generation. Decreased pregnancy rates were reported following oral administration of heptachlor to male and female rats for two generations. In male and female rats fed heptachlor, heptachlor epoxide, or a mixture of the two for three generations, the number of resorbed fetuses increased and fertility decreased with succeeding generations (ATSDR 1989). The two-generation reproduction study using dogs indicated NOEL of 1 ppm (0.025 mg/kg/day) and LOEL of 3 ppm (0.075 mg/kg/day) based on liver lesions in pups (Velsicol Chemical 1973 cited in IRIS 1992).

Potential mutagenic and carcinogenic effects of heptachlor and heptachlor epoxide have been studied. Several *in vitro* mutagenicity studies showed the positive results when tested with metabolic activation. DNA repair assays indicated that heptachlor was not genotoxic in rodent hepatocytes (Maslansky and Williams 1981, Probst et al. 1981) but showed positive results in other studies (Ahmed et al. 1977) when tested with liver microsome enzymes. Based on the some negative results of unscheduled DNA synthesis assays, heptachlor and heptachlor epoxide are considered to be epigenetic carcinogens of the promoter type. There are data that exposures to heptachlor and heptachlor epoxide increase the incidence of liver carcinomas (ATSDR 1989). Available

epidemiological studies on heptachlor are considered to be inadequate to establish a clear qualitative or quantitative assessment of the relationship between heptachlor exposure and the risk of developing cancer in humans (ATSDR 1989).

Heptachlor/heptachlor epoxide, is classified as a probable human carcinogen, Group B2, under the EPA's guidelines for carcinogen risk assessment based on inadequate human data and sufficient animal carcinogenicity data (IRIS 1992). The major finding in mice has been an increased incidence of liver carcinomas. Davis (1965) tested 100 male and female C3H mice by feeding 0 or 10 ppm heptachlor epoxide for 2 years. Survival rate was generally low, with 50% of controls and 9.5% of treated mice living 2 years. A 2-fold increase in benign liver lesions (hepatic hyperplasia and benign tumors) over the controls was reported. Reevaluation of heptachlor epoxide carcinogenicity study by Reuber (1977) showed a significant increase in liver carcinoma in the dosed group (77/81 in females and 73/79 in males) over the controls (2/53 in females and 22/73 in males).

POLYCHLORINATED BIPHENYLS (PCBS)

Polychlorinated biphenyls (PCBS) are semi-synthetic oils. They are made from biphenyl, a naturally occurring compound extracted from petroleum. The biphenyl is chlorinated at any or all of its carbon atoms resulting in a mixture of PCBs that consists of heavy, nonflammable, stable with high boiling points. These oils have been used as coolants, hydraulic fluids, stone-cutting oils, and heat transfer fluids. Polychlorinated biphenyls have also been used in plasticizer processes and as dye carriers.

Polychlorinated biphenyls are exceptionally persistent in the environment and are fairly ubiquitous in soils and waterways. Analysis of whole fish samples collected nationwide revealed PCB residues in 94 percent of all fish at a mean level of 0.53 ppm. (Schmitt et al. 1985) Waterfowl have also accumulated high concentrations of PCBS. Bioconcentration factors in aquatic species such as fish, shrimp, and oysters, range from 26,000 to 60,000 (Leifer et al. 1983).

A large body of knowledge about the toxicity of PCBs comes from an incident in Japan in 1968 (Higuchi 1976) when effects including chloracne, hyperpigmentation of the skin, nails, and conjunctual and raucous membranes, liver disease, and other findings. This incident is unique in that exposure to PCBs was unusually high, however, due to this incident, much information has been accumulated regarding the effects of PCBs in humans.

Other human health effects due to PCBs have been investigated in follow-up epidemiological studies, which include data on birth defects (Drotman 1985). Because PCBs are lipophilic and stable in the environment, they persist and bioaccumulate and have been found to cause, among other effects, tumor promotion and immunosuppression in mammals and birds (Bitman et al. 1972; Vos 1972).

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APPENDIX I
CALCULATION OF RISK ASSOCIATED WITH ACCEPTABLE PCB SURFACE CONCENTRATION OF 10 μg/100 cm^2

CALCULATION OF RISKS
ASSOCIATED WITH DERMAL AND INHALATION EXPOSURE TO
ACCEPTABLE PCB SURFACE CONCENTRATION OF
10 µg/100 cm²

At regulatory level of 10 µg/100 cm²
Dermal contact with Surfaces

Chemical	Floor Concentration (µg/cm²)	Ceiling Concentration (µg/cm²)	Mean Concentration Low Contact Surfaces (µg/cm²)	Surface Area of Low Contact Surfaces (cm²)	Percentage of Low Contact Surfaces Contacted	Vertical Surfaces Concentration (ug/cm²)	Surface Area of High Contact Surfaces (events/year)	Percentage of High Contact surfaces contacted (cm²/event)	Dermal Absorption Extent (unitless)	Unit Conversion Factor (mg/ug)	Body Weight (kg)	Averaging Time (CA) (dy)	Intake CA (mg/kg-dy)	SF (mg/kg-dy)⁻¹	Risk (unitless)
Total PCBs	0.074	0.074	0.074	2.70E+08	0.0005	0.074	2.58E+07	0.001	0.0136	1E-03	70	25550	9.07E-08	7.7	7E-07

Inhalation

Chemical	Average Air Concentration (Ca) (mg/m³)	Inhalation Rate (IR) (m³/hr)	Exposure Time (ET) (hr/dy)	Exposure Frequency (EF) (dy/yr)	Exposure Duration (ED) (yr)	Body Weight (BW) (kg)	Averaging Time (AT) carcinogens) (dy)	Intake CA (mg/kg-dy)	SF (mg/kg-dy)⁻¹	Risk (unitless)
Total PCBs	2.46E-06	0.83	8	250	25	70	25550	5.71E-08	7.7	4E-07

RISK SUMMARY

Dermal	7E-07
Inhalation	4E-07
TOTAL	1E-06

CALCULATION OF AIR CONCENTRATION ASSOCIATED WITH ACCEPTABLE PCB WIPE CONCENTRATION OF 10 μg/100 cm^2

Equation: Ca = (E x CF1 x te x CF2) / (V x CF3)

Where:

Ca =	Predicted air concentration in building (mg/m^3)
E =	Average emission rate from all sources (g/s)
t_e =	Air exchange rate (hr)
V =	Volume of room (cm^3)
CF1 =	Unit conversion factor (s/hr)
CF2 =	Unit conversion factor (mg/g)
CF3 =	Unit conversion factor (m^3/cm^3)

Source	Average Na (g/cm^2-s)	Applicable Area (cm^2)	Emission Rate (g/s)
Floor	5.75E-16	1.35E+08	7.76E-08
Wall	5.75E-16	2.58E+07	1.48E-08
Ceiling	5.75E-16	1.35E+08	7.76E-08
Total			1.70E-07

Chemical	E (g/s)	CF1 (s/hr)	t_e (hr)	CF2 (mg/g)	CF3 (m^3/cm^3)	V (cm^3)	Ca (mg/m^3)
Total PCBs	1.70E-07	3600	0.233	1000	1.00E-06	5.80E+10	2.46E-06

VOLATILIZATION OF PCBs
FROM FLOOR SURFACES
AT ACCEPTABLE SURFACE CONCENTRATION OF
10 µg/100 cm²

Hwang DeFalco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where,	Na =	Instantaneous emission flux rate (g/cm²-s)	
	E =	Soil (or medium) porosity) (unitless)	0.1
	Del =	Effective diffusivity in soil (cm²/s) = $Di \times E^{0.33}$	
	Di =	Diffusion coefficient in air (cm²/s)	1.75E-02
	p =	PI (3.14)	
	t =	Time from sampling (s)	
	H =	*Henry's Law Constant (dimensionless form)*	3.53E-02
	Kd =	Soil/water partition coefficient (cm³/g) =	630
	Koc =	Organic carbon water partition coefficient (cm³/g)	1.50E+06
	foc =	Fraction of organic carbon in material (g/g)	0.001
	Cw=	Concentrition on surface (µg/cm²)	0.1
	Cw=	Concentrition on surface (g/cm²)	0.0000001

Calculation of Del Del = $Di \times E^{0.33}$

Di (cm²/s)	E (unitless)	Del (cm²/s)
1.75E-02	0.1	8.19E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$$

Del (cm²/s)	E (unitless)	ρ (g/cm³)	Kd (cm³/g)	H (unitless)	α (cm²/s)
8.19E-03	0.1	2.4	630	3.53E-02	2.52E-06

Calculation of Cs Cs = Cwipe x CF/ρs x d

Cwipe (µg/cm²)	CF (g/µg)	d (cm)	ρ (g/cm³)	Cs (g/g)
0.1	1.00E-06	1	2.4	4.17E-08

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

E (unitless)	Del (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Cs (g/g)	Na (g/cm²-s)
0.1	8.19E-03	3.14	2.52E-06	7.88E+08	3.53E-02	630	4.17E-08	2.87E-16

Calculation of Avg Na Avg Na (T = 25yr) =2 Na (T yr)

Na g/cm²-s	AvgNa g/cm²-s
2.87E-16	5.75E-16

VOLATILIZATION OF PCBs
FROM FLOOR SURFACES
AT ACCEPTABLE SURFACE CONCENTRATION OF
10 µg/100 cm²

Year	E (unitless)	Del (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Cs (g/g)	Ns (g/cm²-s)	Initial Conc (g/cm²)	Ns (g/cm²-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm²)	Mass Remaining (g/cm²)
1 sec	0.1	8.19E-03	3.14	2.52E-06	1.00E+00	3.53E-02	530	4.17E-06	8.07E-12	1.00E-07	1.44E-15	10	3.15E+07	4.53E-09	9.55E-08
1	0.1	8.19E-03	3.14	2.52E-06	3.15E+07	3.53E-02	530	4.17E-06	1.44E-15	9.55E-08	1.02E-15	10	3.15E+07	3.20E-09	9.23E-08
2	0.1	8.19E-03	3.14	2.52E-06	6.31E+07	3.53E-02	530	4.17E-06	1.02E-15	9.23E-08	8.30E-16	10	3.15E+07	2.62E-09	8.96E-08
3	0.1	8.19E-03	3.14	2.52E-06	9.46E+07	3.53E-02	530	4.17E-06	8.30E-16	8.96E-08	7.18E-16	10	3.15E+07	2.27E-09	8.74E-08
4	0.1	8.19E-03	3.14	2.52E-06	1.26E+08	3.53E-02	530	4.17E-06	7.18E-16	8.74E-08	6.43E-16	10	3.15E+07	2.03E-09	8.54E-08
5	0.1	8.19E-03	3.14	2.52E-06	1.58E+08	3.53E-02	530	4.17E-06	6.43E-16	8.54E-08	5.87E-16	10	3.15E+07	1.85E-09	8.35E-08
6	0.1	8.19E-03	3.14	2.52E-06	1.89E+08	3.53E-02	530	4.17E-06	5.87E-16	8.35E-08	5.43E-16	10	3.15E+07	1.71E-09	8.18E-08
7	0.1	8.19E-03	3.14	2.52E-06	2.21E+08	3.53E-02	530	4.17E-06	5.43E-16	8.18E-08	5.08E-16	10	3.15E+07	1.60E-09	8.02E-08
8	0.1	8.19E-03	3.14	2.52E-06	2.52E+08	3.53E-02	530	4.17E-06	5.08E-16	8.02E-08	4.79E-16	10	3.15E+07	1.51E-09	7.87E-08
9	0.1	8.19E-03	3.14	2.52E-06	2.84E+08	3.53E-02	530	4.17E-06	4.79E-16	7.87E-08	4.54E-16	10	3.15E+07	1.43E-09	7.72E-08
10	0.1	8.19E-03	3.14	2.52E-06	3.15E+08	3.53E-02	530	4.17E-06	4.54E-16	7.72E-08	4.33E-16	10	3.15E+07	1.37E-09	7.59E-08
11	0.1	8.19E-03	3.14	2.52E-06	3.47E+08	3.53E-02	530	4.17E-06	4.33E-16	7.59E-08	4.15E-16	10	3.15E+07	1.31E-09	7.46E-08
12	0.1	8.19E-03	3.14	2.52E-06	3.78E+08	3.53E-02	530	4.17E-06	4.15E-16	7.46E-08	3.99E-16	10	3.15E+07	1.26E-09	7.33E-08
13	0.1	8.19E-03	3.14	2.52E-06	4.10E+08	3.53E-02	530	4.17E-06	3.99E-16	7.33E-08	3.84E-16	10	3.15E+07	1.21E-09	7.21E-08
14	0.1	8.19E-03	3.14	2.52E-06	4.42E+08	3.53E-02	530	4.17E-06	3.84E-16	7.21E-08	3.71E-16	10	3.15E+07	1.17E-09	7.09E-08
15	0.1	8.19E-03	3.14	2.52E-06	4.73E+08	3.53E-02	530	4.17E-06	3.71E-16	7.09E-08	3.59E-16	10	3.15E+07	1.13E-09	6.98E-08
16	0.1	8.19E-03	3.14	2.52E-06	5.05E+08	3.53E-02	530	4.17E-06	3.59E-16	6.98E-08	3.48E-16	10	3.15E+07	1.10E-09	6.87E-08
17	0.1	8.19E-03	3.14	2.52E-06	5.36E+08	3.53E-02	530	4.17E-06	3.48E-16	6.87E-08	3.39E-16	10	3.15E+07	1.07E-09	6.76E-08
18	0.1	8.19E-03	3.14	2.52E-06	5.68E+08	3.53E-02	530	4.17E-06	3.39E-16	6.76E-08	3.30E-16	10	3.15E+07	1.04E-09	6.66E-08
19	0.1	8.19E-03	3.14	2.52E-06	5.99E+08	3.53E-02	530	4.17E-06	3.30E-16	6.66E-08	3.21E-16	10	3.15E+07	1.01E-09	6.56E-08
20	0.1	8.19E-03	3.14	2.52E-06	6.31E+08	3.53E-02	530	4.17E-06	3.21E-16	6.56E-08	3.14E-16	10	3.15E+07	9.89E-10	6.46E-08
21	0.1	8.19E-03	3.14	2.52E-06	6.62E+08	3.53E-02	530	4.17E-06	3.14E-16	6.46E-08	3.06E-16	10	3.15E+07	9.66E-10	6.36E-08
22	0.1	8.19E-03	3.14	2.52E-06	6.94E+08	3.53E-02	530	4.17E-06	3.06E-16	6.36E-08	3.00E-16	10	3.15E+07	9.45E-10	6.27E-08
23	0.1	8.19E-03	3.14	2.52E-06	7.25E+08	3.53E-02	530	4.17E-06	3.00E-16	6.27E-08	2.93E-16	10	3.15E+07	9.25E-10	6.18E-08
24	0.1	8.19E-03	3.14	2.52E-06	7.57E+08	3.53E-02	530	4.17E-06	2.93E-16	6.18E-08	2.87E-16	10	3.15E+07	9.06E-10	6.09E-08
25	0.1	8.19E-03	3.14	2.52E-06	7.88E+08	3.53E-02	530	4.17E-06	2.87E-16	6.09E-08	2.82E-16	10	3.15E+07	8.89E-10	6.00E-08
26	0.1	8.19E-03	3.14	2.52E-06	8.20E+08	3.53E-02	530	4.17E-06	2.82E-16	AVERAGE					7.42E-08

VOLATILIZATION OF PCBs
FROM VERTICAL SURFACES
AT ACCEPTABLE SURFACE CONCENTRATION OF
10 μg/100 cm²

Hwang DeFalco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where: Na =	Instantaneous emission flux rate (g/cm²-s)		
E =	Soil (or medium) porosity) (unitless)		0.1
Del =	Effective diffusivity in soil (cm²/s) = Di x E^0.33		
Di =	Diffusion coefficient in air (cm²/s)		1.75E-02
p =	Pi (3.14)		
t =	Time from sampling (s)		
H =	Henry's Law Constant (dimensionless form)		3.53E-02
Kd =	Soil/water partition coefficient (cm³/g) = Koc x foc		530
Koc =	Organic carbon water partition coefficient (cm³/g)		5.30E+05
foc =	Fraction of organic carbon in material (g/g)		0.001
Cs =	Initial concentration in soil or medium (g/g)		
Cwipe (Wall)		(μg/cm²)	0.1
Cwipe (Wall)		(g/cm²)	0.0000001

Calculation of Del Del = Di x E^0.33

Di (cm²/s)	E (unitless)	Del (cm²/s)
1.75E-02	0.1	8.19E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$$

Del (cm²/s)	E (unitless)	Ps (g/cm³)	Kd (cm³/g)	H (unitless)	α (cm²/s)
8.19E-03	0.1	2.4	530	3.53E-02	2.52E-06

Calculation of Cs Cs = Cwipe x CF/ρs x d

Cwipe (μg/cm²)	CF (g/μg)	d (cm)	ρ (g/cm³)	Cs (g/g)
0.1	1.00E-06	1	2.4	4.17E-08

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

E (unitless)	Del (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Cs (g/g)	Na (g/cm²-s)
0.1	8.19E-03	3.14	2.52E-06	7.88E+08	3.53E-02	530	4.17E-08	2.87E-16

Calculation of Avg Na Avg Na (T = 25yr) = 2 Na (T yr)

Na g/cm²-s	AvgNa g/cm²-s
2.87E-16	5.75E-16

VOLATILIZATION OF PCBs
FROM VERTICAL SURFACES
AT ACCEPTABLE SURFACE CONCENTRATION OF
10 μg/100 cm²

Year	E (unitless)	Del (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Cs (g/g)	Ns (g/cm²-s)	Initial Conc (g/cm²)	Ns (g/cm²-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm²)	Mass Remaining (g/cm²)
1 sec	0.1	8.19E-03	3.14	2.52E-08	1.00E+00	3.53E-02	530	4.17E-08	8.07E-12	1.00E-07	1.44E-15	10	3.15E+07	4.53E-09	9.55E-08
1	0.1	8.19E-03	3.14	2.52E-08	3.15E+07	3.53E-02	530	4.17E-08	1.44E-15	9.55E-08	1.02E-15	10	3.15E+07	3.20E-09	9.23E-08
2	0.1	8.19E-03	3.14	2.52E-08	6.31E+07	3.53E-02	530	4.17E-08	1.02E-15	9.23E-08	8.30E-16	10	3.15E+07	2.62E-09	8.96E-08
3	0.1	8.19E-03	3.14	2.52E-08	9.46E+07	3.53E-02	530	4.17E-08	8.30E-16	8.96E-08	7.18E-16	10	3.15E+07	2.27E-09	8.74E-08
4	0.1	8.19E-03	3.14	2.52E-08	1.26E+08	3.53E-02	530	4.17E-08	7.18E-16	8.74E-08	6.43E-16	10	3.15E+07	2.03E-09	8.54E-08
5	0.1	8.19E-03	3.14	2.52E-08	1.58E+08	3.53E-02	530	4.17E-08	6.43E-16	8.54E-08	5.87E-16	10	3.15E+07	1.85E-09	8.35E-08
6	0.1	8.19E-03	3.14	2.52E-08	1.89E+08	3.53E-02	530	4.17E-08	5.87E-16	8.35E-08	5.43E-16	10	3.15E+07	1.71E-09	8.18E-08
7	0.1	8.19E-03	3.14	2.52E-08	2.21E+08	3.53E-02	530	4.17E-08	5.43E-16	8.18E-08	5.08E-16	10	3.15E+07	1.60E-09	8.02E-08
8	0.1	8.19E-03	3.14	2.52E-08	2.52E+08	3.53E-02	530	4.17E-08	5.08E-16	8.02E-08	4.79E-16	10	3.15E+07	1.51E-09	7.87E-08
9	0.1	8.19E-03	3.14	2.52E-08	2.84E+08	3.53E-02	530	4.17E-08	4.79E-16	7.87E-08	4.54E-16	10	3.15E+07	1.43E-09	7.72E-08
10	0.1	8.19E-03	3.14	2.52E-08	3.15E+08	3.53E-02	530	4.17E-08	4.54E-16	7.72E-08	4.33E-16	10	3.15E+07	1.37E-09	7.59E-08
11	0.1	8.19E-03	3.14	2.52E-08	3.47E+08	3.53E-02	530	4.17E-08	4.33E-16	7.59E-08	4.15E-16	10	3.15E+07	1.31E-09	7.46E-08
12	0.1	8.19E-03	3.14	2.52E-08	3.78E+08	3.53E-02	530	4.17E-08	4.15E-16	7.46E-08	3.99E-16	10	3.15E+07	1.26E-09	7.33E-08
13	0.1	8.19E-03	3.14	2.52E-08	4.10E+08	3.53E-02	530	4.17E-08	3.99E-16	7.33E-08	3.84E-16	10	3.15E+07	1.21E-09	7.21E-08
14	0.1	8.19E-03	3.14	2.52E-08	4.42E+08	3.53E-02	530	4.17E-08	3.84E-16	7.21E-08	3.71E-16	10	3.15E+07	1.17E-09	7.09E-08
15	0.1	8.19E-03	3.14	2.52E-08	4.73E+08	3.53E-02	530	4.17E-08	3.71E-16	7.09E-08	3.59E-16	10	3.15E+07	1.13E-09	6.96E-08
16	0.1	8.19E-03	3.14	2.52E-08	5.05E+08	3.53E-02	530	4.17E-08	3.59E-16	6.96E-08	3.48E-16	10	3.15E+07	1.10E-09	6.87E-08
17	0.1	8.19E-03	3.14	2.52E-08	5.36E+08	3.53E-02	530	4.17E-08	3.48E-16	6.87E-08	3.39E-16	10	3.15E+07	1.07E-09	6.76E-08
18	0.1	8.19E-03	3.14	2.52E-08	5.68E+08	3.53E-02	530	4.17E-08	3.39E-16	6.76E-08	3.30E-16	10	3.15E+07	1.04E-09	6.66E-08
19	0.1	8.19E-03	3.14	2.52E-08	5.99E+08	3.53E-02	530	4.17E-08	3.30E-16	6.66E-08	3.21E-16	10	3.15E+07	1.01E-09	6.56E-08
20	0.1	8.19E-03	3.14	2.52E-08	6.31E+08	3.53E-02	530	4.17E-08	3.21E-16	6.56E-08	3.14E-16	10	3.15E+07	9.88E-10	6.46E-08
21	0.1	8.19E-03	3.14	2.52E-08	6.62E+08	3.53E-02	530	4.17E-08	3.14E-16	6.46E-08	3.06E-16	10	3.15E+07	9.66E-10	6.36E-08
22	0.1	8.19E-03	3.14	2.52E-08	6.94E+08	3.53E-02	530	4.17E-08	3.06E-16	6.36E-08	3.00E-16	10	3.15E+07	9.45E-10	6.27E-08
23	0.1	8.19E-03	3.14	2.52E-08	7.25E+08	3.53E-02	530	4.17E-08	3.00E-16	6.27E-08	2.93E-16	10	3.15E+07	9.25E-10	6.18E-08
24	0.1	8.19E-03	3.14	2.52E-08	7.57E+08	3.53E-02	530	4.17E-08	2.93E-16	6.18E-08	2.87E-16	10	3.15E+07	9.06E-10	6.09E-08
25	0.1	8.19E-03	3.14	2.52E-08	7.88E+08	3.53E-02	530	4.17E-08	2.87E-16	6.09E-08	2.82E-16	10	3.15E+07	8.89E-10	6.00E-08
26	0.1	8.19E-03	3.14	2.52E-08	8.20E+08	3.53E-02	530	4.17E-08	2.82E-16	AVERAGE					7.42E-08

VOLATILIZATION OF PCBs
FROM CEILING SURFACES
AT ACCEPTABLE WIPE CONCENTRATION OF
10 µg/100 cm²

Hwang DeFalco Model

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

where: Na =	Instantaneous emission flux rate (g/cm²-s)		
E =	Soil (or medium) porosity) (unitless)		0.1
Del =	Effective diffusivity in soil (cm²/s) = Di x E^0.33		
Di =	Diffusion coefficient in air (cm²/s)		1.75E-02
p =	Pi (3.14)		
t =	Time from sampling (s)		
H =	Henry's Law Constant (dimensionless form)		3.63E-02
Kd =	Soil/water partition coefficient (cm³/g) = Koc x f		530
Koc =	Organic carbon water partition coefficient (cm³/g)		6.30E+05
foc =	Fraction of organic carbon in material (g/g)		0.001
Cs =	Initial concentration in soil or medium (g/g)		
Cwipe (Ceiling)		(µg/cm²)	0.1
Cwipe (Ceiling)		(g/cm²)	0.0000001

Calculation of Del Del = Di x E^0.33

Di (cm²/s)	E (unitless)	Del (cm²/s)
1.75E-02	0.1	8.19E-03

Calculation of α

$$\alpha = \frac{Del \times E}{E + (Ps \times (1-E) \times Kd/H)}$$

Del (cm²/s)	E (unitless)	Ps (g/cm³)	Kd (cm³/g)	H (unitless)	α (cm²/s)
8.19E-03	0.1	2.4	530	3.63E-02	2.52E-08

Calculation of Cs Cs = Cwipe x CF/ρ x d

Cwipe (µg/cm²)	CF (g/µg)	d (cm)	ρ (g/cm³)	Cs (g/g)
0.1	1.00E-06	1	2.4	4.17E-08

Calculation of Na

$$Na = \frac{E \times Del}{(\pi \alpha t)^{0.5}} \frac{H}{Kd} Cs$$

E (unitless)	Del (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Cs (g/g)	Na (g/cm²-s)
0.1	8.19E-03	3.14	2.52E-08	7.88E+08	3.53E-02	530	4.17E-08	2.87E-16

Calculation of Avg Na Avg Na (T = 25yr) = 2 Na (T yr)

Na g/cm²-s	AvgNa g/cm²-s
2.87E-16	5.75E-16

VOLATILIZATION OF PCBs
FROM CEILING SURFACES
AT ACCEPTABLE WIPE CONCENTRATION OF
10 µg/100 cm²

Year	E (unitless)	Dei (cm²/s)	π (unitless)	α (cm²/s)	t (s)	H (unitless)	Kd (cm³/g)	Cs (g/g)	Ne (g/cm²-s)	Initial Conc (g/cm²)	Na (g/cm²-s)	Inefficiency Factor (unitless)	Time (sec)	Mass Lost (g/cm²)	Mass Remaining (g/cm²)
1 sec	0.1	8.19E-03	3.14	2.52E-08	1.00E+00	3.53E-02	530	4.17E-08	8.07E-12	1.00E-07	1.44E-15	10	3.15E+07	4.5313E-09	9.55E-08
1	0.1	8.19E-03	3.14	2.52E-08	3.15E+07	3.53E-02	530	4.17E-08	1.44E-15	9.55E-08	1.02E-15	10	3.15E+07	3.20412E-09	9.23E-08
2	0.1	8.19E-03	3.14	2.52E-08	6.31E+07	3.53E-02	530	4.17E-08	1.02E-15	9.23E-08	8.30E-16	10	3.15E+07	2.81615E-09	8.96E-08
3	0.1	8.19E-03	3.14	2.52E-08	9.46E+07	3.53E-02	530	4.17E-08	8.30E-16	8.96E-08	7.18E-16	10	3.15E+07	2.26565E-09	8.74E-08
4	0.1	8.19E-03	3.14	2.52E-08	1.26E+08	3.53E-02	530	4.17E-08	7.18E-16	8.74E-08	6.43E-16	10	3.15E+07	2.02946E-09	8.54E-08
5	0.1	8.19E-03	3.14	2.52E-08	1.58E+08	3.53E-02	530	4.17E-08	6.43E-16	8.54E-08	5.87E-16	10	3.15E+07	1.8499E-09	8.35E-08
6	0.1	8.19E-03	3.14	2.52E-08	1.89E+08	3.53E-02	530	4.17E-08	5.87E-16	8.35E-08	5.43E-16	10	3.15E+07	1.71267E-09	8.18E-08
7	0.1	8.19E-03	3.14	2.52E-08	2.21E+08	3.53E-02	530	4.17E-08	5.43E-16	8.18E-08	5.08E-16	10	3.15E+07	1.60206E-09	8.02E-08
8	0.1	8.19E-03	3.14	2.52E-08	2.52E+08	3.53E-02	530	4.17E-08	5.08E-16	8.02E-08	4.79E-16	10	3.15E+07	1.51043E-09	7.87E-08
9	0.1	8.19E-03	3.14	2.52E-08	2.84E+08	3.53E-02	530	4.17E-08	4.79E-16	7.87E-08	4.54E-16	10	3.15E+07	1.43292E-09	7.72E-08
10	0.1	8.19E-03	3.14	2.52E-08	3.15E+08	3.53E-02	530	4.17E-08	4.54E-16	7.72E-08	4.33E-16	10	3.15E+07	1.36624E-09	7.59E-08
11	0.1	8.19E-03	3.14	2.52E-08	3.47E+08	3.53E-02	530	4.17E-08	4.33E-16	7.59E-08	4.15E-16	10	3.15E+07	1.30807E-09	7.46E-08
12	0.1	8.19E-03	3.14	2.52E-08	3.78E+08	3.53E-02	530	4.17E-08	4.15E-16	7.46E-08	3.99E-16	10	3.15E+07	1.25476E-09	7.33E-08
13	0.1	8.19E-03	3.14	2.52E-08	4.10E+08	3.53E-02	530	4.17E-08	3.99E-16	7.33E-08	3.84E-16	10	3.15E+07	1.21104E-09	7.21E-08
14	0.1	8.19E-03	3.14	2.52E-08	4.42E+08	3.53E-02	530	4.17E-08	3.84E-16	7.21E-08	3.71E-16	10	3.15E+07	1.16998E-09	7.09E-08
15	0.1	8.19E-03	3.14	2.52E-08	4.73E+08	3.53E-02	530	4.17E-08	3.71E-16	7.09E-08	3.59E-16	10	3.15E+07	1.13283E-09	6.96E-08
16	0.1	8.19E-03	3.14	2.52E-08	5.05E+08	3.53E-02	530	4.17E-08	3.59E-16	6.96E-08	3.48E-16	10	3.15E+07	1.0996E-09	6.87E-08
17	0.1	8.19E-03	3.14	2.52E-08	5.36E+08	3.53E-02	530	4.17E-08	3.48E-16	6.87E-08	3.39E-16	10	3.15E+07	1.06904E-09	6.78E-08
18	0.1	8.19E-03	3.14	2.52E-08	5.68E+08	3.53E-02	530	4.17E-08	3.39E-16	6.78E-08	3.30E-16	10	3.15E+07	1.03956E-09	6.68E-08
19	0.1	8.19E-03	3.14	2.52E-08	6.99E+08	3.53E-02	530	4.17E-08	3.30E-16	6.68E-08	3.21E-16	10	3.15E+07	1.01323E-09	6.58E-08
20	0.1	8.19E-03	3.14	2.52E-08	6.31E+08	3.53E-02	530	4.17E-08	3.21E-16	6.58E-08	3.14E-16	10	3.15E+07	9.88812E-10	6.48E-08
21	0.1	8.19E-03	3.14	2.52E-08	6.62E+08	3.53E-02	530	4.17E-08	3.14E-16	6.48E-08	3.06E-16	10	3.15E+07	9.66077E-10	6.38E-08
22	0.1	8.19E-03	3.14	2.52E-08	6.94E+08	3.53E-02	530	4.17E-08	3.06E-16	6.38E-08	3.00E-16	10	3.15E+07	9.44842E-10	6.27E-08
23	0.1	8.19E-03	3.14	2.52E-08	7.25E+08	3.53E-02	530	4.17E-08	3.00E-16	6.27E-08	2.93E-16	10	3.15E+07	9.24949E-10	6.16E-08
24	0.1	8.19E-03	3.14	2.52E-08	7.57E+08	3.53E-02	530	4.17E-08	2.93E-16	6.16E-08	2.87E-16	10	3.15E+07	9.06261E-10	6.06E-08
25	0.1	8.19E-03	3.14	2.52E-08	7.88E+08	3.53E-02	530	4.17E-08	2.87E-16	6.06E-08	2.82E-16	10	3.15E+07	8.88662E-10	6.00E-08
26	0.1	8.19E-03	3.14	2.52E-08	8.20E+08	3.53E-02	530	4.17E-08	2.82E-16	AVERAGE					7.42E-08

APPENDIX J
LIST OF ACRONYMS

LIST OF ACRONYMS

ATCOM	Aviation Troop Command
BHC	Benzenehexachloride
COPC	Chemicals of Potential Concern
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenylethane
DDT	Dichlorodiphenyltrichloroethane
HI	Hazard Index
HQ	Hazard Quotient
LADD	Lifetime Average Daily Dose
LOAEL	Lowest observed adverse effect level
MCL	Maximum Contaminant Level
NOAEL	No Observed Adverse Effect Level
PCB	Polychlorinated Biphenyls
ppm	parts per million
QA/QC	Quality Assurance/Quality Control
RfC	Reference Concentration
RfD	Reference Dose
RFP	Request For Proposal
SCEM	Site Conceptual Exposure Model
SF	Slope Factor
SLAAP	St. Louis Army Ammunition Plant
TCB	Tetrachlorinated Biphenyls
UCL	Upper Confidence Limit
USEPA	United States Environmental Protection Agency
WCC	Woodward-Clyde Consultants
WWTS	World Wide Terminal Services Inc.