SURVEY OF HEALTH COMPLAINTS
NEAR GEMS LANDFILL
1985

NEW JERSEY DEPARTMENT OF HEALTH

ENVIRONMENTAL HEALTH PROTECTION PROGRAM

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

SUMMARY

In 1982, the New Jersey State Department of Health (DOH) surveyed respiratory symptoms in the vicinity of Gloucester Environmental Management Services (GEMS) landfill in response to complaints about odors and health problems. An increase in respiratory tract symptoms was found. A subsequent clinical evaluation of lung function did not demonstrate deficits of function in this population.

In December, 1984, the DOH received complaints about an increased prevalence of nosebleeds from GEMS area residents. On February 13, 1985, the Environmental Health Program of the New Jersey Department of Health conducted a house-to-house survey to assess the prevalence of health problems in that area, compared to another community in Gloucester Township as the control population. The survey was designed to determine and document if there were more health problems experienced during the past twelve months near GEMS than expected, as a follow up on the previous investigation of respiratory symptoms.

Eighty households participated in this survey, involving over 300 individuals. Both this survey and the 1982 investigation were conducted with the help of the Camden County Department of Health.

Results indicated that the GEMS area residents reported an increased prevalence of respiratory symptoms, nosebleeds, headaches, nausea, and bleeding gums compared to the control population. The excess of nosebleeds appeared localized in the area of the Fox Chase

development, especially among those residents who had originally informed the Department of Health about these symptoms. Investigation of other factors in the survey revealed some additional factors which were also associated with some of these complaints, but did not constitute plausible explanations for the presence near GEMS of the increased health problems. Air monitoring in and near homes has not identified any toxic substances at concentrations high enough to be expected to produce acute symptoms. The etiology of the health complaints of these residents may include continued exposure to odors and very low levels of volatile organic chemicals.

Available data does not suggest that any excess risk of chronic health effects exists as a result of residing near GEMS.

Clinical examination of the individuals with nosebleeds is recommended to attempt to elucidate the cause of this condition. The data already collected will facilitate the selection, contact, and analysis of the follow-up, clinical study.

I. INTRODUCTION

A. Background

The GEMS landfill is located in Gloucester Township, Camden County. It covers about sixty acres and rises up to 100 feet above the immediate area. Although originally designated as a municipal sanitary landfill when opened approximately 25 years ago, according to information assembled by the New Jersey Department of Environmental Protection (DEP), chemical wastes, including pesticides, were deposited there between 1970 and 1974.

Potential routes of chemical contamination from GEMS include movement of chemicals into groundwater, surface water and air. Although some groundwater contamination has been documented in the area, the drinking water quality of most nearby residents is not at issue, because most are served by municipal water supplies. However, air quality in the vicinity has been adversely affected. Bare places on top of the landfill itself are thought to permit volatilization of contaminants directly into the air. In addition to persistent and severe odors in the area, air monitoring conducted by DOH, DEP, and by the U.S. Environmental Protection Agency (EPA) has documented low levels of contaminants from GEMS [DEP, 1982 and 1984; NUS, 1985].

In 1982, in response to numerous health complaints and odor complaints from residents near the landfill, the New Jersey Department of Health carried out a cross-sectional health study in the area. Residents living immediately north, northwest, and northeast of the landfill

were interviewed concerning health complaints, focusing on respiratory symptoms. A community in Winslow Township, Camden County, served as a control group. The results indicated that there were increased rates of respiratory symptoms in the landfill area when controlling for age, sex, and smoking. However, a follow-up pulmonary function study did not show excess abnormalities of lung function in the landfill area residents. No nosebleeds were reported at that time in either group, but this symptom was not specifically queried at that time [DOH, 1983].

B. Rationale for the 1985 Survey

In late November 1984, DOH and DEP received numerous reports of excessive nosebleeds from several families in the Fox Chase community directly north of GEMS. The sampling results of past investigations by various agencies (the Emergency Response Unit of DOH, and other previous monitoring by DOH, DEP, and EPA) were re-examined for substances known or suspected to cause nosebleeds in other settings. The medical literature on nosebleeds was also reviewed; no previous reports of a similar nature were found.

To systematically approach the questions of extent, severity, and possible cause of nosebleeds, to determine appropriate actions by DOH on behalf of residents in the area, and to provide needed data to state and federal agencies, a second cross-sectional health survey was planned and conducted in the winter of 1985.

C. Objectives of 1985 Survey

The objectives of this survey were fivefold:

(1) Document the prevalence of nosebleeds in the landfill vicinity and a comparable neighborhood;

(2) Investigate the prevalence of other common bleeding problems, of gastrointestinal symptoms, and of neurological symptoms in the same communities;

(3) Investigate the contribution of other factors to the experience of all these symptoms;

(4) Compare current prevalence of respiratory complaints with those reported in the 1982 survey; and

(5) Determine on the basis of the above information if an intensive clinical study and/or the provision of special clinical or counseling services to the residents near the landfill are indicated.

It was intended that the results also be coordinated with past and future air quality monitoring data by DEP and that the experience of conducting the survey contribute to the body of knowledge on methods for studying communities who are subject to all the stresses involved in living near hazardous waste sites.

II. METHODS

The investigation was designed, organized, and conducted in less than two weeks' time. A house-to-house survey during one day was selected as the most effective method, given the available time and personnel.

A. Selection of the Exposed population

The housing developments just north of the landfill plus the houses on the street at the northern toe of the site were selected for intensive coverage because (1) nosebleed complaints were concentrated there, (2) the number of homes involved suggested that a majority of these residents could be visited within one day, and (3) the 1982 survey included these areas. Only homeowners were included for the survey.

The locations comprising the landfill area are indicated in Table 1 and in the accompanying map. (Figure 1.) Since all landfill area residents approached in the survey were in the immediate vicinity of the site, the locations of participating households do not readily lend themselves to subclassification with respect to proximity to the landfill. (In the 1982 study, by contrast, such a distinction was feasible because of the wider area covered by the GEMS vicinity subjects.)

FIGURE 1

Location of GEMS Landfill,
Adjacent Residential Areas, and
Comparison Area

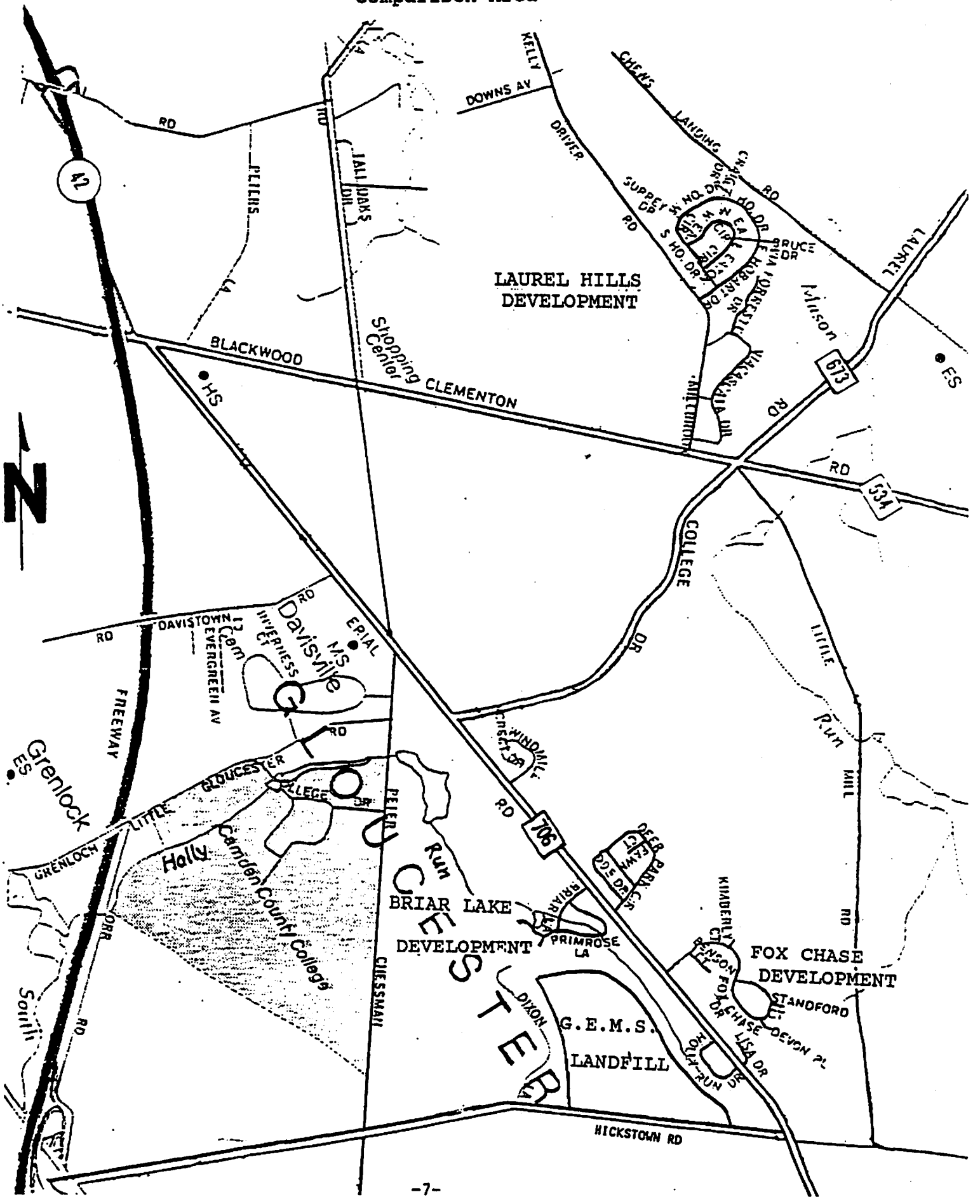

Table 1

Participating Households from The Landfill Area

Location	Street Address	Number of Participating Households
Fox Chase	Fox Chase Drive	22
Briar Lake	Briar Lane	6
	Primrose Lane	3
Lisa Drive	Lisa Drive	6
Other	Holly Run Drive	2
	Erial Road	4
		43

B. Selection of the comparison population

The comparison population was selected to maximize the likelihood that it resembled the population described above in as many demographic and as many other environmental factors as possible. Since time constraints did not allow systematic investigation of each of those variables, a recently built community of homes with similar tax assessment values in the same township and with similar ethnic composition to the landfill vicinity subjects was sought.

It was important that the comparison group live close enough to the landfill to be aware of the health, economic, and quality of life issues. It was also planned that one location serve as headquarters for the field staff and that both residential areas be accessible quickly from that location. The Laurel Hills development, two miles north of GEMS, was chosen as best fitting these criteria. Prior to the survey, this community was determined to have about 150 units which are assessed at values closely approximating those of Fox Chase and Briar Lake homes.

C. Procedure of the Survey

Staff of the Environmental Health Program of DOH and five members of the Camden County Department of Health were mobilized for the intensive survey effort. The survey was conducted simultaneously in both the landfill area and comparison community on one day between approximately 12:30 p.m. and 8:30 p.m. Staff were assigned up to twenty homes each (ten priority and ten alternate) for door-to-door interviews. Each staff member was requested to complete ten

interviews within the time period. This strategy was selected for the following reasons: there was not time for previous contact and appointments via mail, and telephone interviews would not have permitted demonstration (by official badge) that the interviewers were legitimately representing themselves as health department staff. Simultaneous interviewing of both populations were planned because it was important to carry out the interviews of both areas under identical weather conditions.

D. Interviews

The questionnaire was designed to be administered by interview and to take about one half hour for typical families of four individuals. It elicited all information about the household and about each family member from one respondent. The female head of household was the preferred respondent on the basis of her greatest likely familiarity with health complaints of all family members. After fifteen questions regarding number, sex, and age of household members, length of residence, use of household fuels, and loss of smelling ability, the specific exposures of each family member was queried and the experience by each family member of some twenty symptoms during the past twelve months was elicited. (See Appendix for a copy of the questionnaire.) Two complaints, nervousness and fatigue, were queried because of their potential to be a result of various stresses of living near the landfill. Although these symptoms are subjective, it was believed that they might be contributors toward the experience of other symptoms as well.

E. Questions on anosmia (loss of sense of smell)

Previous findings by this agency and other investigators suggest that respiratory irritants may temporarily or permanently damage the sense of smell of exposed persons (Goodspeed et al, 1985; Zagraniski et al, 1985). In anticipation that objective testing of olfactory capacity of this population might be conducted, questions on smelling ability were asked of the respondent in each participating household.

F. Multivariate Analyses Procedure

Multiple logistic analyses were undertaken to examine the effect of living in the landfill vicinity while controlling for other variables. The logistic model fits data to a logistic curve rather than to a straight line.* The SAS Logist program estimates the contribution of each independent variable in the model to the outcome (positive or negative) of the dependent variable. Beta values yielded by the program are proportional to the effect on the dependent variable of increasing the independent variable by one unit. The odds ratio, a measure of the strength of their association and the predictive power of the independent variable on the dependent variable, increases by 2.72 raised to the beta power, that is, exp (Beta), for each increment of the independent variable.

---

* $P_y = \frac{1}{1 + e^{-y}}$ where $y = B_o + B_1x_1 + B_2x_2 + \ldots + B_kx_k$

The logistic analyses were carried out in two tiers -- first, all of the queried complaints were analyzed by logistic regression with salient symptoms or symptom groups defined as dependent variables for the following independent factors:

- landfill vicinity
- current smoking
- age
- sex.

In the second tier of logistic analyses, the following independent variables were explored for each selected symptom or symptom groups:

Continuous variables:

- age
- years of residence at current home

Categorical variables (presence or absence):

- residence area:
  (a) GEMS vicinity vs Laurel Hills or
  (b) Fox Chase vs all other localities
- sex
- current smoking
- exposure to other chemicals in home or occupation
- passive smoking exposure
- odors from landfill
- use of humidifier in home
- use of kerosene heater in home
- use of wood (fireplace) in home as space heating
- use of electric space heater in home
- homemaker
- unemployed or retired

Categorical variables (ordered):

- level of education
- average number of hours spent away from home per week.

In each run of the program, the variable for residence location was forced into the model, while the program selected other factors which were of at least borderline statistical significance (probability equal to or less than 0.1). Subsequently, the logistic program was run again with the addition of the two symptoms which were also

surveyed as possible contributors to the experience of other health complaints, i.e. nervousness and fatigue. Another set of models are presented and discussed whenever one or both of these two symptoms were significantly related to the symptom in question.

Landfill odor may be considered a surrogate for exposure to emissions from GEMS, and could arguably be substituted for residence location as an index of "exposed" population. The "landfill odor" variable was scored positive if a respondent reported that odors were perceptable and more than slightly annoying or if a family member of a respondent complained of the odors. Occasional odors which were perceived only outdoors was not scored as positive.

Either GEMS vicinity or Fox Chase development location were included in the model in each trial, whether or not they would have been chosen by the program as significant predictors.

III. RESULTS

The staff were able to interview eighty families on February 13th, forty-three in the landfill area and thirty-seven in the control community. Information on 316 individuals was gathered, 164 from the GEMS area and 152 from Laurel Hills. Of the households approached by the survey staff, a smaller proportion of those in Laurel Hills agreed to be interviewed than in the GEMS vicinity as indicated in Table 2. The demographic distribution of the two populations is presented in Table 3. The respondent families were similar with respect to sex and racial distribution. However, the comparison group was older and, on the average, had resided longer at its present home.

A. Interim Results of the Survey

Based upon presence or absence of nosebleeds only, it was calculated on the day after the survey that the GEMS area participants displayed a greater prevalence of nosebleeds than the comparison group at a borderline level of statistical significance. No adjustment for age or sex distribution was reflected in this calculation. Four families among the participants who originally made the nosebleed problem known were included. Members of these four families accounted for about half of the reported nosebleeds in the landfill group. No conclusions could be drawn without taking into account many other factors about which information had been collected. In ensuing weeks, all the data was coded, keypunched and entered into the computer. Subsequently, univariate frequencies of reported symptoms were derived, controlling for age. Finally, exhaustive multiple regression analyses were conducted using combinations of models suggested by earlier runs of

Table 2

Households Approached by Interview Staff

	Landfill Area		Comparison Area	
	%	(n)	%	(n)
Interviews Completed	64	(43)	37	(37)
Refused	9	(6)	25	(25)
Not home or not available	27	(18)	38	(38)
Total		67		100

Table 3

Demographic Distribution of the Two Populations

	Landfill		Control	
	%	(n)	%	(n)
Age				
0-9	31	(51)	16	(25)
10-19	13	(22)	24	(36)
20-29	8	(13)	11	(16)
30-39	32	(52)	13	(20)
40-49	9	(15)	21	(32)
50 and over	7	(11)	15	(23)
Total		164		152
Sex				
Male	48	(78)	47	(72)
Female	52	(86)	53	(80)
Total		164		152
Race				
White	97	(159)	93	(142)
Nonwhite	3	(5)	7	(10)
Total		164		152
Year Residence Began at Current Home				
1984-85	12	(20)	11	(17)
1978-83	70	(113)	16	(24)
1970-77	16	(26)	42	(64)
Before 1970	2	(3)	31	(47)
Unknown		(2)		
Total		164		152

the program and by plausible associations. The following results and accompanying tables were generated using the logistic regression programs of the Statistical Analysis System (SAS) package.

B. Inclusion of index families in analysis

As noted above, the house-to-house survey included the four families who originally notified DOH about their nosebleed symptoms. If the survey results are viewed without including these households, the frequencies of nosebleeds are approximately equivalent in the landfill area and the control group. However, all tables and discussions in this report include these index families.

C. Inclusion of symptoms experienced prior to current residence

Symptoms which were reported to begin before moving to the current residence were not deleted in this analysis because (a) usable information on year of onset of many reported symptoms was not provided, and (b) the mean number of years of residence was greater for the comparison population: eliminating pre-existing symptoms would therefore bias the result toward equal prevalence in both groups since symptoms in the Laurel Hills subjects would have a smaller chance of being excluded. In addition, previous experience of intermittent conditions would not rule out a possible contribution toward their recurrence by some factors associated with the current location.

D. Frequencies and Age-adjusted ratios of symptoms

Table 4 presents the number of reported symptoms in the GEMS area and the control area. In this table, the former group is also divided into Fox Chase versus all other locations in order to illustrate the concentration of symptom reports in that neighborhood. Dry coughs were presented separately.

In Table 5, ratios of prevalence rates with their associated chi squares and probabilities are shown. Five symptoms were significantly elevated near the landfill (sore throat, tight chest, nervousness, headache, and nausea) while two others were found at borderline excess (colds, and bleeding gums). Only two respondents reported that they perceived loss of olfaction in themselves or a family member.

The following symptoms or symptom groups were selected for detailed analysis in the second tier of logistic regression:

1. nosebleeds
2. bleeding gums
3. nausea
4. headaches
5. respiratory symptom group, including:
   - cough
   - colds (frequent)
   - sore throat
   - wheezing
   - tight chest
   - short of breath.

All variables listed in the methods section were investigated by these symptoms. The factors homemaker, unemployed/retired, education, and hours away from home were not significant in preliminary exploration and not pursued further.

Table 4

Number of Individuals with Symptoms Reported in the GEMS Vicinity and the Comparison Group *

Symptom	GEMS Area						Laurel Hills	
	Fox Chase		Other		Total			
	%	(n)	%	(n)	%	(n)	%	(n)
nosebleeds	27	(24)	8	(6)	19	(30)	11	(16)
coughs	28	(24)	26	(19)	27	(43)	24	(36)
dry cough	8	(7)	3	(2)	6	(9)	1	(1)
bruising	9	(8)	8	(6)	9	(14)	10	(15)
allergy	27	(22)	22	(16)	24	(38)	33	(50)
asthma	8	(7)	4	(3)	6	(10)	6	(9)
sore throat	54	(47)	32	(23)	44	(70)	32	(48)
wheezing	17	(15)	7	(5)	13	(20)	12	(18)
tight chest	21	(18)	10	(7)	16	(25)	8	(12)
short of breath	19	(16)	11	(8)	15	(24)	11	(17)
colds	55	(48)	29	(21)	43	(69)	32	(48)
nasal congestion	44	(39)	40	(29)	42	(68)	47	(71)
eye irritation	22	(19)	18	(13)	20	(32)	17	(26)
bleeding gums	11	(10)	10	(7)	11	(17)	5	(7)
skin rash	22	(19)	25	(18)	23	(37)	43	(28)
nervousness	21	(18)	21	(17)	22	(35)	11	(17)
fatigue	18	(15)	15	(12)	17	(27)	13	(19)
diarrhea/ constipation	24	(21)	14	(10)	20	(31)	17	(26)
headache	44	(38)	26	(19)	36	(57)	26	(38)
nausea	12	(10)	14	(10)	13	(20)	26	(7)
dizziness	7	(6)	7	(5)	7	(11)	6	(8)

* only positive or negative replies are included in totals on which percentages are based.

Table 5

Age-Adjusted Rate Ratios for Reported Symptoms
of GEMS Residents Compared to Controls

Symptom	Rate Ratio	Chi Square (p)
nosebleeds	1.6	2.0 (0.2)
coughs	1.2	0.49 (0.5)
bruising	0.82	0.36 (0.6)
allergy	0.77	1.4 (0.2)
asthma	1.0	0.026 (0.9)
sore throat	1.4	4.3 (0.04)
wheezing	1.3	0.45 (0.5)
tight chest	2.7	6.5 (0.01)
short of breath	1.7	2.1 (0.1)
colds	1.3	2.9 (0.09)
nasal congestion	0.93	0.13 (0.7)
eye irritation	1.5	1.7 (0.2)
bleeding gums	2.0	3.0 (0.09)
skin rash	1.2	0.24 (0.6)
nervousness	2.1	7.3 (0.007)
fatigue	1.5	1.7 (0.2)
diarrhea/constipation	1.5	2.2 (0.1)
headache	1.5	3.8 (0.05)
nausea	2.4	4.9 (0.03)
dizziness	1.2	0.006 (0.9)

It was found that all the homes of the Fox Chase, Lisa Drive, and Holly Run Drive locales use oil heat and electric cooking facilities. The Briar Lake homes, also near the landfill, are equipped with gas heating and gas stoves. The comparison area, Laurel Hills, also uses gas for both heating and cooking. It is not possible to use the survey data to separate the effects of these fuels from any other effects of living in a particular developments. These factors were therefore not included in the logistic analyses. However, any contribution by these factors to the experience of symptoms in question are believed to be minimal.

E. Outcomes of Logistic Regression Analyses

The following are the variables which were predictive of the reporting of the symptoms which were analyzed by logistic regression.

Nosebleeds

Age was an important factor, with younger people more likely to experience this symptom. Use of humidifiers at home was marginally associated with the reported nosebleeds in some models. Other reported chemical exposures unrelated to GEMS (such as pesticides, metal dusts, acid fumes, and industrial cleaning products or solvents used in occupational settings or homes) appeared to be predictive as well. When all these other factors were in the model, living in the GEMS vicinity per se was not statistically significant, but living in Fox Chase homes was still strongly associated with nosebleeds. In some models, nasal congestion was included as a possible antecedent to

nosebleeds, and the effect was to strengthen the significance of the model in general and the residence area effect in particular. (See Table 6.) Reports of nervousness or fatigue did not contribute to predicting nosebleeds and therefore do not appear in the models of Table 6.

Chemical Exposures: For ten of the forty six people with nosebleeds (22%) chemical exposure was also reported. Of the seven of these near the landfill, all but one had pesticide exposure in the home. Of these, four were in the same household, while two had occupational contact with refrigerants or with metal dusts and industrial cleaners. This data does not appear to implicate any specific chemical as an explanation of the nosebleeds experienced near the landfill.

Headaches

This complaint was in excess in the GEMS area when controlling for age. The multivariate analysis indicated that landfill odors were highly predictive of this symptom (Table 7). The use of kerosene space heaters was associated with the absence of reported headaches. Likelihood of the symptom was related to increasing number of years of residence at the current home. Although living in the landfill vicinity was weakly associated, living in the Fox Chase community was more strongly predictive of headaches, although not as clearly associated as the landfill odors or duration of residence. (The coefficient for residence duration (Beta = 0.1) applies to one year of residence; the formula for the excess odds due to this factor, (exp .1) predicts that each year of residence beyond one year increases by about 10% the odds that headaches would be reported in the survey for

Table 6

Nosebleeds

Estimates of Beta and (p) for Independent Variables

Variable	Model 1 Beta (p)	Model 2 Beta (p)	Model 3 Beta (p)	Model 4 Beta (p)
Age	-0.03 (0.003)	-0.03 (0.006)	-0.03 (0.006)	-0.03 (0.01)
Humidifier	0.61 (0.09)	0.47 (0.2)	0.69 (0.05)	0.58 (0.1)
Other Chemical Exposures *	0.87 (0.05)	0.87 (0.05)	0.83 (0.05)	0.84 (0.05)
Nasal Congestion	0.77 (0.03)	0.78 (0.03)	-	-
GEMS Vicinity	0.59 (0.1)	-	0.50 (0.2)	-
Fox Chase	-	1.1 (0.002)	-	1.0 (0.003)
Model X^2 (p)	26.01 (0.0001)	32.63 (0.0000)	19.50 (0.006)	26.08 (0.000)

* unrelated to landfill

Table 7

Headaches

Estimate of Beta and (p) for Independent Variables

Variable	Model 1 Beta (p)	Model 2 Beta (p)	Model 3 Beta (p)	Model 4 Beta (p)
Landfill Odors	1.1 (0.001)	1.1 (0.0001)	0.65 (0.05)	0.70 (0.02)
Years of Residence	0.10 (0.006)	0.09 (0.002)	0.09 (0.01)	0.09 (0.005)
Kerosene Spaceheater	-0.82 (0.01)	-0.71 (0.03)	-	-
Nervousness	-	-	0.66 (0.1)	0.62 (0.08)
Fatigue	-	-	1.7 (0.0000)	1.7 (0.0000)
GEMS Vicinity	0.51 (0.2)	-	0.62 (0.2)	-
Fox Chase	-	0.77 (0.01)	-	1.02 (0.002)
Model X^2 (p)	36.2 (0.0000)	40.5 (0.0000)	54.30 (0.0)	61.97 (0.0)

Table 8

Respiratory Symptom Group

Estimates of Beta and (p) of Independent Variables

variable	Model 1 Beta (p)	Model 2 Beta (p)	Model 3 Beta (p)	Model 4 Beta (p)
Humidifier	0.64 (0.01)	0.60 (0.02)	0.61 (0.02)	0.58 (0.02)
Landfill Odors	0.54 (0.07)	0.68 (0.009)	0.44 (0.2)	0.60 (0.03)
Passive Smoking	0.70 (0.006)	0.74 (0.004)	0.69 (0.007)	0.70 (0.007)
Fatigue	-	-	0.97 (0.01)	0.94 (0.02)
Other Chemical Exposure *	0.54 (0.1)	0.56 (0.1)	-	-
GEMS Vicinity	0.49 (0.09)	-	0.51 (0.08)	-
Fox Chase	-	0.64 (0.04)	-	0.60 (0.06)
Model X^2 (p)	28.69 (0.0000)	30.38 (0.0000)	31.08 (0.0000)	31.59 (0.0000)

* unrelated to landfill

Table 9

Bleeding Gums

Estimates of Beta and (p) for Independent Variables

Variable	Model 1 Beta (p)	Model 2 Beta (p)	Model 3 Beta (p)	Model 4 Beta (p)
Other Chemical Exposures *	1.4 (0.004)	1.1 (0.003)	1.1 (0.02)	1.1 (0.02)
Landfill Odors	1.1 (0.05)	1.2 (0.02)	0.79 (0.2)	0.87 (0.09)
Nervousness	-	-	1.1 (0.02)	1.1 (0.02)
GEMS Vicinity	0.53 (0.4)	-	0.34 (0.5)	-
Fox Chase	-	0.73 (0.1)	-	0.36 (0.4)
Model X^2 (p)	19.91 (0.0002)	21.68 (0.0001)	22.81 (0.0001)	23.24 (0.0001)

* other than landfill

Table 10

Nausea

Estimates of Beta and (p) for Independent Variables

Variable	Model 1 Beta (p)	Model 2 Beta (p)	Model 3 Beta (p)	Model 4 Beta (p)
Wood Space-heating	1.2 (0.1)	1.3 (0.1)	1.3 (0.05)	1.3 (0.05)
Fatigue	-	-	1.8 (0.0001)	1.7 (0.0001)
GEMS Vicinity	0.8 (0.1)	-	1.0 (0.03)	-
Fox Chase	-	0.32 (0.6)	-	0.34 (0.4)
Model X^2 (p)	8.54 (0.04)	4.08 (0.1)	27.21 (0.0000)	23.66 (0.0000)

that individual, given the other factors in this model. When nervousness and fatigue were added as independent variables, the latter was found to be very strongly associated with headaches while the former was marginally predictive.

Respiratory Symptom Group

The reported symptoms of cough, sore throat, shortness of breath, wheezing, tightness in the chest, and frequent colds were combined into a general group of respiratory symptoms (Table 8). In the 1982 investigation, respiratory complaints were documented to be elevated in the GEMS area residents, as discussed above. The presence of any one of these complaints was scored as positive in the analysis of this symptom group. Multivariate analysis demonstrated that use of humidifiers, perception of unpleasant odors from the landfill, and passive smoking were significantly correlated with one or more of these respiratory complaints. Other chemical exposures were not significantly predictive. When all the foregoing variables were included in the model, living in the GEMS vicinity in general or in the Fox Chase community specifically was associated with respiratory symptoms with marginal significance. Reports of fatigue were also associated with respiratory symptoms.

Bleeding Gums

The multivariate analysis eliminated all factors except other chemical exposures and landfill odors as being related to reporting this symptom. When the latter two factors were accounted for, living in the GEMS or Fox Chase area per se did not have statistical

significance as a predictor. Nervousness as an independent variable was associated with bleeding gums when residence near GEMS was included, but not when Fox Chase was substituted in the model.

Chemical Exposures: Among the twenty four subjects for whom this symptom was reported, nine (38%) also reported some chemical exposure. Of these, three were from Laurel Hills and had occupational contact with widely divergent toxic substances (asbestos, industrial solvents, industrial cleaners). From the landfill area, two homemakers had occasional pesticide applications at home. One veteran reported being exposed to herbicides in the service. The three remaining GEMS area residents had occupations which brought them into contact with automotive fumes or industrial solvents/cleaners. No consistant pattern of specific chemicals is evident.

Nausea

Annoying landfill odors was not predictive for this complaint. The logistic regression program did not produce strongly significant models. Residence near the landfill or in Fox Chase was forced into the models, but was not significantly associated with this symptom as outcome. When fatigue was added as an independent variable, it was found to be significantly associated and to replace Fox Chase as a predictor of reports of nausea.

F. Analyses by Household

The same logistic regression procedure was also carried out using household instead of individual as the unit of observation in order to control for similarity of genetic and environmental factors for family

members. In this procedure, any occurrence of a symptom in a household was scored as a positive outcome. Only household factors could be tested in such a manner, that is:

- years of residence
- landfill odor complaints by any household member
- passive smoking exposure
- space heating
- humidification.

The greatly reduced number of observations (eighty instead of 316) drastically decreased the power to distinguish significant differences. However, the following associations were still observed when controlling for household:

1. Nosebleeds were significantly more prevalent in Fox Chase than all other neighborhoods surveyed. When comparing the overall landfill with Laurel Hills areas, no difference was seen in nosebleed prevalence.
2. Tight chest was tested as a surrogate for all respiratory symptoms. This complaint had the highest rate ratio for the GEMS area (Table 5). When all respiratory complaints together were tested by household, there was insuffecient variability between GEMS and Laurel Hills residences.
3. Headaches were associated with families where landfill odors were found annoying.
4. Nausea was associated with residences near the landfill (all GEMS vicinity and Fox Chase alone) and with annoying landfill odors.

IV. DISCUSSION

A. Expectations from Previous Observations

The appearance of nosebleeds near GEMS was surprising because no air monitoring had indicated elevated concentrations of any substance previously associated with these symptoms.

Although the true incidence of nosebleeds (epistaxis) is unknown, since most episodes go untreated and unreported, it has been observed that this symptom is most frequent in autumn and winter [Juselius, 1974]. Stress and respiratory infections, including colds, were associated with nosebleeds, particularly frequent nosebleeds, in young people in a Swedish study [Petruson & Rudin, 1975]. Cardiovascular disorders account for about half of a reported series of clinical cases of epistaxis, but the cause of almost a third was not determined [Juselius, 1974]. Trauma to the nose and use of medications are common causes. Fumes of chromic acid, exposure to some heavy metals such as arsenic, and other acid fumes are known to induce nosebleeds. Nosebleeds are often regarded to be prevalent in dusty industries [Allardice et al, 1983; Barnes & Simpson, 1972]. Exposure to over 20 ppm of sulfur dioxide has been shown to cause nosebleeds [Normandy et al, 1981]. Nosebleeds accompanying runny nose, cough, shortness of breath, and wheezing has followed exposure to fumes of trimellitic anhydride (TMA) in occupational settings [Davies et al, 1977]. In a case report, toluene was measured at 2 ppm in the home of an individual who was hospitalized for central nervous system toxicity and whose clinical picture included nosebleeds and liver enzyme

elevations. Dry, warm indoor air and naphtha and xylene fumes may also have contributed [MMWR, 1982]. Rosaniline dyes such as gentian violet have been shown to cause nosebleed epidemics in dye workers and in apple pickers whose packing trays contained these substances. Nasal irritation and watering of the eyes generally preceeded the symptoms. Irritation of the throat, larynx, and bronchi often accompanied the epistaxis. The dust forms of gentian violet were especially potent agents [Quinby, 1968]. Finally, ingestion of medications such as aspirin and warfarin are know to induce side effects of epistaxis under some circumstances [Petruson & Ruden, 1975; Jim et al, 1981].

In a recent occurrence in New York State, school children experienced an elevation of nosebleeds during the period that odors from a waste water treatment plant were emitted in high concentration. In this instance, other symptoms, notably headache and eye irritation, were also in excess with equal prominence [Nassau County Department of Health, 1984]. At GEMS, complaints of respiratory symptoms are also increased.

B. Limitations of the Survey

Several limitations of the completeness and objectivity of the information that can be collected by a prevalence survey under these conditions also restrict the conclusions which can be legitimately drawn from the data:

(1) Bias in the subject ascertainment.

The participating families were self-selected in their willingness to be interviewed. As noted above, (Table 2) a large proportion of residents in the control area refused to be interviewed. In addition, the availability at home of the participants on the afternoon or evening of the survey date may have introduced some bias. The direction of these biases, however, is not known.

(2) Non-objectivity of the health complaints.

The symptoms about which residents initially complained to the DOH and the other symptoms about which it was also appropriate to inquire are not readily verified under survey conditions. Even clinical examination and collection of medical records are not guaranteed to result in complete and objective information on health complaints such as nosebleeds, bleeding gums, nervousness nausea, and headaches.

(3) Recall and reporting bias.

A survey of this nature is inherently limited by (a) the accuracy of recall by respondents and (b) the <u>equal</u> accuracy for groups being compared in the investigation. The scope of the survey did not include verification of recall between or within participants. The focus on the symptoms experienced only during the past year was intended to maximize accuracy and minimize under-reporting due to lack of recall.

(4) Noncomparability in fuel use.

The patterns of heating and cooking facilities between the two communities were different. This factor could not be seperated

from possible exposures around the landfill.

(5) Cross-sectional design.

Since this investigation was cross-sectional in design, it can serve to document the degree of association between reporting of symptoms and proximity to GEMS. However, it cannot demonstrate causality. The models tested with logistic regression, however, include the assumption that the dependent variables are <u>not antecedent</u> to the independent variables. Although it would be expected that some symptoms would occur in combination with each other, either as results of a common cause or as sequential links in the manifestation of health problems, only two health complaints have been placed in models as independent variables for other symptoms, i.e., nervousness and fatigue.

C. <u>Inferences</u>

The age-adjusted analyses, in combination with the logistic modeling, indicate that if the GEMS area participants were representative of all residents near the landfill, then certain symptoms (notably bleeding gums, respiratory ailments, nervousness, headaches, and nausea) are more frequent in families near the landfill. It is evident that the concentration of nosebleeds has been focused in the Fox Chase community and that the other developments and streets which were surveyed did not report similar clustering, either within or among households. However, no single factor has been identifed through this survey or previous monitoring which explains the occurrence of the nosebleeds in these families of Fox Chase Drive. While specific causal factors of nosebleeds and other symptoms found in excess near

GEMS cannot be inferred from this survey, it is possible that various other exposures, which were predictive in the logistic modeling results described above, could have contributed to the symptoms. For example, other chemical exposures in the home or occupational settings were associated with several symptoms, although no particular type of chemicals were consistently found in combination with any of the complaints which were in excess near the landfill. None of these other chemical exposures, nor other factors such as use of home humidifiers or the presence of unpleasant landfill odors, are in themselves sufficient to explain the clustering of any of these health complaints in the Fox Chase community specifically or the GEMS vicinity in general.

Available data does not suggest that any excess risk of chronic health effects exists as a result of residing near GEMS.

D. Recommendations for follow-up

It is possible that a medical evaluation of individuals with nosebleeds might prove valuable for elucidating the specific cause of excessive reports in Fox Chase, or might produce useful information for alleviation or prevention of symptoms.

The following clinical study is proposed:

Examination by an otorhinolaryngologist of the following groups of residents:

(1) All individuals in all landfill area survey households in which nosebleeds were reported;
(2) All individuals in a sample of survey control households with nosebleeds.

The study would include:

a) clinical examination,
b) pertinent medical history, and
c) test of anosmia (loss of sense of smell).

Information collected through the present survey would be used to identify and contact participants in the clinical study.

BIBLIOGRAPHY

Allardice J T, Clarke E C, and Jones R D. A study of the prevalence of epistaxis and respiratory symptoms in carpet backwinders. J Soc Occup Med. 33: 36-41 1983.

Barnes R and Simpson G R. A byssinosis survey. Med J Austral. 2: 238-242 1972.

Davies R J, Butcher B T and Salvaggio J E. Occupational asthma caused by low molecular weight chemical agencts. J Allergy Clin. Immunol. 60 (2): 93-95 1977.

Goodspeed R B, Catalanotto F A, Gent J F, et al. Clinical characteristics of patients with taste and smell disorders. H L Meiselman & R S Rivlin, eds. Clinical Measurement of Taste and Smell N Y MacMillan Publ. Co. 1985. In Press.

Jim L K, Hyneck M L, Gee J P et al. Evaluation of a warfarin dosing protocol in treating pulmonary embolism. Am J Hosp Pharm. 38: 1520-1521 1981.

Juselius H. Epistaxis, a clinical study of 1,724 patients. J Laryngol Otol. 88:317-327 1974.

MMWR. Epistaxis and liver - function abnormalities associated with exposure to "butyl" caulk - Kentucky. MMWR 31 (19):251-252 1982.

Nassau County Department of Health. Report summarizing symptoms of children attending school in the vicinity of the Cedar Creek sewage treatment plant. 1984.

New Jersey Department of Environmental Protection. "Summary of surface and ground water monitoring in the vicinity of GEMS Landfill". 1982.

New Jersey Department of Environmental Protection. "A preliminary assessment of the air quality in the vicinity of GEMS Landfill". 1984.

New Jersey Department of Health. "Health studies conducted at GEMS Landfill in Camden County". 1983.

NUS Corporation. Risk Assessment for Gloucester Environmental Managements Services Inc. (GEMS) Landfill Site. June 1985 draft.

Normandy M J, Szlyk P, and Brienza B. Biological effects of short, high-level exposure to gases: sulfur dioxide. Gov't Reports Announcements & Index Issue 10, 1981.

Petruson B and Rudin R. The frequency of epistaxis in a male population sample. Rhinology 13 (3):129-133 1975.

Quinby G E. Gentian violet as a cause of epidemic occupational nosebleeds. Arch Environ Health 16:485-489 1968.

Zagraniski R T, Cummings C E, Gent J F, et al. Clinical olfactory testing in a health survey of workers in and residents near a sewage plant. Presented at Annual Conference of American Public Health Association 1985.

APPENDIX

SURVEY FORM

CAMDEN COUNTY SURVEY

February 1985

HOUSE I.D. NO. _____

INTERVIEWER _____

Date _____ Time start _____ Time finished _____

A. IDENTIFICATION OF HOUSEHOLD AND OCCUPANTS

101. Address _____

102. Response to knock: Nobody home time: _____)

_____

_____

Refuses interview time: _____

Consent to interview time: _____

103. Respondent's Name _____

Sex (observation) M 1
F 2

Race (observation) White 1
Black 2
Other 3

How old were you on your last birthday? _____

104. How many years have you lived in this house? _____ years

105. How many other people live here with your? (At least 9 months per year)
_____ people

Going from the oldest to the youngest male, and then the oldest to the youngest female, please tell me the first name and age of each resident besides you.

	Name	Sex (M,F)	Age
a)	(Respondent)		
b)			
c)			
d)			
e)			
f)			

B. INDOOR AIR AND OLFACTION

106. What type of fuel do you primarily use to heat your home?

Oil	1
Natural gas	2
Electricity	3
Other (specify)	4
Don't Know	8
No answer	9

107. What type of fuel do you use for cooking?

Gas	1
Electric	2
Other (spec.)	3
	8
	9

108. a) Do you use a space heater? Yes 1 (continue)
No 2 (go to Q. 109)
8
9

b) What fuel do you use for space heating?

kerosene	1	dont know	8
wood stove	2	no answer	9
electric	3		
other(specify)	4		

109. Do you use a humidifier?

yes	1	don't know	8
no	2	no answer	9

SMELL

110. Would you characterize your sense of smell now as:

Normal	1 (go to Q 115)
Decreased but not absent	2 (go to Q. 111)
Completely absent	3 (go to Q. 111)
don't know	8 (go to Q. 115)
no answer	9 (go to Q. 115)

111. For how many years have you had this smell loss? _____years

112. In what year did the loss begin? 19_____

113. Does your sense of smell ever return under special conditions (such as after exercise or medication?)

yes (specify)	1
no	2
	8
	9

114. Does this loss affect your appetite?

yes	1
no	2
	8
	9

115. Has anyone (else) in your family experienced a loss in their sense of smell?

yes (specify)_____	1
no	2
	8
	9

D Answers MEDICAL DATA FOR EACH INDIVIDUAL RESIDENT

	Y/N/DK/NA	Freq, in past yr S/M/W/D	Seen by Dr,? Y/N/DK/NA	Medication? Y/N/DK/NA	If applicable: Onset	
251. Allergies						H W Oth(s:
						H W Oth(s
252. Asthma						
253. Coughs with phlegm? Y N DK NA if Y: color:						
254. Sore throats						
255. Wheezing						
256. Tight chest						
257. Short of breath						
258. Colds, runny nose, sneezing						
259. Nasal congestion						
260. Nosebleeds (details cont. below).						
261. Eye irritation						
262. Bruising: if female: arms & legs only? Y N DK NA						
263. Gums bleed						
264. Skin rashes						
265. Nervous						
266. Fatigue						
267. Diarrhea/ constipation						
268. Headaches						
269. Nausea						
270. Dizziness						

260. Nosebleeds cont.: Accomp. by colds, nasal congestion? Y N DK NA
Trauma? ___ if yes: when? _____
Hypertension? _____ Bleeding ever stopped by cauteriz,etc? ____ when? _____

271. Other remarks: (may cont. on separate sheet)

State of New Jersey
DEPARTMENT OF HEALTH
JOHN FITCH PLAZA
CN 360, TRENTON, N.J. 08625

J. RICHARD GOLDSTEIN, M.D.
COMMISSIONER

CONSENT FORM

I have been informed that the New Jersey State Department of Health with the cooperation of the Camden County Department of Health is conducting a survey of air pollution and its effect on the health of people. This survey involves obtaining information from me about my residence and the health of my family, as well as some information about other substances members of my family may be exposed to. The interview will require approximately one-half hour of my time. I understand it may be necessary to contact me again.

I have agreed to take part in this study and to give information to the interviewer understanding that:

1. My responses will be kept completely confidential.
2. My participation is voluntary and I am free to discontinue participation at any time.
3. The information in this study will be summarized by the New Jersey State Department of Health to determine whether air pollution in this area may be contributing to health problems.

Name (Print) _____

Participant Signature _____

Date: _____

C.Ans DEMOGRAPHIC AND EXPOSURE DATA ON EACH RESIDENT

200. I.D. No. _____

201. Address; _____

202. Name, and relationship to Respondent _____

_____

203. Sex M 1
F 2

204. Age: _____ Yrs. or

205. Years completed school (K-12, Coll 1-4, Grad. 1-4) _____

206. Employed Y 1 DK 8
N 2 NA 9

207. If not employed: Homemaker 1 8
Student 2 9
Unemployed 3
Retired 4

208. Business type; _____

209. Job/role(specific) _____

210. Average number hours away from immediate neighborhood per day:
a) Mon.-Fri. _____
b) Sat-Sun. _____

ODORS

211. Odors perception (Respondent only) Y 1 DK 8
N 2 NA 9

212. Odors annoyance (Respondent only) Very 1
Somewhat 2 8
Little 3 9
None 4

213. Odor complaints (Other than respondent) Y 1 8
N 2 9

SMOKING

214. Ever used tobacco? Y 1 8
N 2 9

215. Age started: _____ (8 9)

216. Current user? Y 1 8
N 2 9

217. Age quit? _____ (8 9)

218. What use currently?

		219. Amount per day		
Cigarettes	1	_____packs	8	9
Cigars	2	_____no.	8	9
Pipes	3	_____pipefuls	8	9
Chewing tob.	4	_____oz.	8	9
Snuff	5	_____oz.	8	9
	8			
	9			

220. (passive smoking in the home: 1 2 8)

221. Chemicals (circle all)

Metal dusts	1	Herbicides/p'cides	5
Acid fumes	2	Other (spec)	7
Industrial solvents	3	None	8
Industr. cleaning products	4		9

Circumstances _____