American Petroleum Institute

STEP Strategies for Today's Environmental Partnership

Service Station Personnel Exposures to Oxygenated Fuel Components - 1994

Health and Environmental Sciences Department
Publication Number 4625
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EXECUTIVE SUMMARY

This study measures service station refueling attendant and mechanic exposures to fuel oxygenate species, selected aromatics and total fuel vapor hydrocarbons during normal activities at service stations dispensing oxyfuels during the winter season and conventional gasoline during the summer of 1994. Sixteen service stations in four geographical areas were selected for inclusion in the study (a seventeenth station [NY3] was monitored for one day during the winter season). Each station was located in a winter CO non-attainment area to assure the presence of oxygenated fuels. The locations included six stations in the northeast (New York City area-NY), three stations in the midwest (Minnesota-MN), four stations in the southwest (Arizona-AZ) and three stations in the northwest (Oregon-OR).

Additional station-specific data recorded during the exposure monitoring included volume of fuel dispensed, station traffic density, meteorology, presence of dispensing pump vapor emission controls, and miscellaneous "notable events" that might be reflected in the measurements. In order to determine the effects of weather conditions and the different seasonal amounts of oxygenate present, the study was conducted in two phases with sampling during the winter (February-April) oxyfuel season and in the summer (July-August) non-oxyfuel season. During each phase, monitoring was usually conducted on at least two people (one mechanic and one refueling attendant) per day per service station over three days. Long-term/shift (generally 8 hours) and short-term/task samples (approximately 15 minutes) were collected during the monitoring. Bulk liquid samples of each dispensed gasoline octane grade were collected at each station. Volatility (Reid Vapor Pressure-RVP), oxygenate speciation and aromatic content of each bulk liquid sample were analyzed.

During the winter, MTBE was detected in fuels at eight of the stations (7 NY and 1 AZ) in approximate amounts ranging from 10-17 wt%. TAME, ranging up to 3.7 wt%, was detected mixed with MTBE in fuels, at four NY stations. Ethanol was detected in the remaining stations' fuels (3 AZ, 3 MN, 3 OR) in amounts ranging from 4.6-10 wt%. During the summer sampling, MTBE was detected in gasoline at seven stations (6 NY, 1 OR) in amounts ranging from

0.1-8.8 wt %. TAME (up to 2.2%) was found mixed with MTBE in three of the NY stations. Ethanol was detected in two MN stations in amounts ranging from 9.5-11 wt%. No oxygenates (> 0.1%) were detected in seven of the service stations (4 AZ, 1 MN, 2 OR) during the summer. Neither ETBE nor TBA were detected in liquid fuel samples during either the winter or summer phases of the study.

Four hundred and one personal service station worker exposure samples were collected during the study. This total includes 104 long-term and 120 short-term samples on refueling attendants, 86 long-term and 88 short-term samples on mechanics and 3 short-term samples on truck drivers during bulk fuel deliveries. Samples were evenly split between the winter (200) and summer (201) sampling phases and were analyzed for benzene, toluene, xylene, ethylbenzene, total hydrocarbons, ethanol, MTBE and TAME. Descriptive and distributional statistics were determined for long-/short-term samples of refueling attendant and mechanic exposures. Geometric mean exposures and ranges of exposure were computed by job category, season, fuel component, control technology and sample duration.

LONG-TERM AVERAGE SAMPLES

Long-term sample durations ranged from 93-570 minutes with most sampling durations longer than 6 hours. All individual refueling attendant long-term MTBE exposure concentrations were 0.5 ppm or less. The winter and summer geometric mean (GM) exposures were 0.2 ppm and 0.08 ppm, respectively.

Winter and summer mechanic GM exposures to MTBE were 0.12 ppm and 0.03 ppm, respectively, with only four individual MTBE samples exceeding 0.5 ppm. These four samples (0.63, 0.86, 1.3, 2.6 ppm) were taken during shifts where mechanic duties included fuel line servicing.

Excluding the three outlier samples discussed at pages 1-10 & 1-11, all individual attendant and mechanic long-term benzene values were below 1.2 ppm, with winter and summer GM exposures of 0.06 ppm or less. Only two long-term benzene samples exceeded 1 ppm (1.2, 1.1 ppm) and

only another five exceeded 0.3 ppm. Stage II vapor controls appeared to reduce the winter and summer long-term GM exposures for attendants.

SHORT-TERM AVERAGE SAMPLES

Short-term sample durations ranged between 8-35 minutes with all but 17 sample durations within the 15-20 minute range. Such samples were often taken during tasks thought potentially prone to higher peak exposures, for example, during storage tank gauging by attendants or during repair of automobile fuel systems by mechanics. Individual attendant MTBE samples remained below 2.1 ppm with winter and summer GM exposures of 0.6 ppm and 0.31 ppm, respectively. The GM of all short-term attendant samples was 0.41 ppm. Individual mechanic short-term MTBE exposures ranged up to 32 ppm with winter and summer GM exposures of 1.04 ppm and 0.42 ppm, respectively. The GM of all short-term mechanic MTBE samples was 0.74 ppm.

Individual attendant benzene short-term exposures remained below 0.91 ppm, with winter and summer GM exposures of 0.21 ppm. Although one short-term mechanic benzene sample reached 8.7 ppm, all other values remained below 5 ppm. Winter and summer GM mechanic benzene exposures were 0.29 ppm and 0.22 ppm, respectively. The GM of all short-term mechanic benzene values was 0.25 ppm.

Section 1
SCOPE OF STUDY AND RESULTS

INTRODUCTION

The Clean Air Act Amendments (CAAA) of 1990 mandated the addition of 2.7% oxygen from oxygenated organic species (oxygenates) to automotive fuels during the winter season in areas not attaining the National Ambient Air Quality Standards for carbon monoxide (CO). Oxygenates are added to gasoline to increase the octane rating and minimize incomplete combustion, reducing air pollutants including carbon monoxide and unburned hydrocarbons. Anecdotal reports of health complaints (e.g., headaches, irritation, nausea) allegedly associated with oxyfuel use led to a variety of research efforts in 1993 (EPA, 1995). These included measurements of customer fuel oxygenate additive exposure during commuting (Lioy et al., 1994) and refueling (IT, 1995a). A survey of oil company occupational exposure records (IT, 1995b) provided adequate numbers of exposure measurements for employees in most sectors of the petroleum refining and marketing industry. However, relatively few measurements were available to document the exposure of attendants refueling cars (Hartle, 1993) or auto mechanics repairing vehicles in service stations. This study measured service station refueling attendant and mechanic exposures to oxygenated species [methyl tertiary butyl ether (MTBE), tertiary amyl methyl ether (TAME), ethyl tertiary butyl ether (ETBE), tertiary butyl alcohol (TBA), ethanol (ETOH), selected aromatics (benzene-B, toluene-T, xylenes-X, ethylbenzene-EB) and total hydrocarbons (THC)] during normal activities at service stations dispensing oxyfuels during the winter season and non-oxyfuels during the summer of 1994. Characterizations of dispensed liquid fuel compositions and local meteorology during sampling were also undertaken.

SAMPLING AND ANALYSIS

Personal exposure results are grouped into four categories: refueling attendant long-term, refueling attendant short-term, mechanic long-term and mechanic short-term. Long-term samples were taken to approximate full-shift (8 hour) averaged exposures; sampling durations ranged between 93 and 570 minutes with most durations longer than 6 hours. Short-term samples were taken to approximate peak exposures and ranged between 8 and 35 minutes with most sample durations within the 15-20 minute range.

The long-term and short-term samples were often collected concurrently. Therefore, if a significant exposure occurred during a specific task or special event, such as during carburetor repair or a fuel spill, the exposure is also included within the full-shift sample for those individuals also undergoing full-shift sampling. Table 1-1 presents the numbers of samples collected during the Winter Phase from mid-February to mid-April and during the Summer Phase from mid-July to mid-August. The air samples were collected according to the method described in Appendix H. Following collection the samples were shipped to the analytical laboratory for analysis according to the methods described in Appendix I.

During both Winter and Summer sampling studies, there were a few cases when data from two employees were combined to represent an approximate 8-hour full-shift exposure. These cases resulted when the first employee completed a partial shift and was relieved by a second employee or, in a couple of cases, declined to participate during the second part of the day. In most cases, the sampling pump was transferred to a second station employee who completed the shift and a second sampling tube was attached to the second employee. Each set of these samples was combined in a time-weighted manner prior to use in statistical calculations to generate a full-shift equivalent exposure that was comparable with other data. In several other cases, a single sampling tube was used to measure the exposure of two employees. After completing the sampling on the first employee, the same sampling train was transferred to the second employee for the remainder of the shift.

During the Winter Phase, 95 long-term exposures and 105 short-term exposures were sampled. One of the long-term exposures, represented by samples AZ4-02A & AZ4-07A, was measured using consecutive samples collected on two employees. During the Summer Phase, 95 long-term exposures and 106 short-term exposures were sampled. Four of the long-term exposure measurements, represented by samples AZ1S-13A & -20A, AZ1S-15A & -19A, AZ3S-15A & -19A and AZ4S-01A & -07A were measured using consecutive samples collected on two employees. Although 16 stations were initially included in the study, a seventeenth station was sampled during the Winter Phase. After arriving at NY3, it was discovered that no mechanic was working there. A nearby station (NY9), owned by the proprietor, was identified and the second and third day of sampling were conducted there.

TABLE 1-1

NUMBER OF PERSONAL EXPOSURES MONITORED DURING WINTER PHASE

Geographic Area	Total	Refueling Attendant		Mechanic		Drivers[e]
		Long-Term	Short-Term	Long-Term	Short-Term	Short-Term
Southwest[a]	73	13	24	12	24	0
Midwest[b]	23	9	3	9	2	0
Northeast[c]	55	18	11	17	7	2
Northwest[d]	49	11	21	6	11	0
TOTAL	200	51	59	44	44	2

NUMBER OF PERSONAL EXPOSURES MONITORED DURING SUMMER PHASE

Geographic Area	Total	Refueling Attendant		Mechanic		Drivers[e]
		Long-Term	Short-Term	Long-Term	Short-Term	Short-Term
Southwest[a]	73	12	24	12	25	0
Midwest[b]	24	9	2	9	4	0
Northeast[c]	60	19	16	16	8	1
Northwest[d]	44	13	19	5	7	0
TOTAL	201	53	61	42	44	1

[a] 4 Service Stations in Arizona

[b] 3 Service Stations in Minnesota

[c] In the winter, 7 Service Stations; 5 stations in Northern New Jersey and 2 in Connecticut. In the summer, 6 service stations; 4 stations in Northern New Jersey and 2 in Connecticut.

[d] 3 Service Stations in Oregon

[e] 3 truck drivers were monitored during bulk fuel deliveries. The results of these samples are not included in the statistical analysis.

OXYGENATE AND AROMATIC CONTENT OF BULK LIQUID FUELS

At each station, two samples of each octane grade of dispensed gasoline were collected. One bulk sample set was submitted to determine volatility by determining the Reid Vapor Pressure (RVP). The second set was initially analyzed by mass spectrophotometry (MS) to identify the species of oxygenate and the aromatic content and subsequently analyzed by gas chromatography (GC) to determine the percentage of each component. Table 1-2 summarizes the Winter and Summer data on oxygenate content. The bulk analysis data is presented in Appendix A.

The bulk sample analysis was used to determine which oxygenates were present and which should be subject to analysis in the air samples. Although the percent of the oxygenate was measured, the purpose of this analysis was only to determine which oxygenate was present. Since the oxygenates are more volatile than the remainder of the gasoline, this analysis should not be considered a definitive quantitative indicator of the amount of oxygenate which had been added to the fuel. In two cases during the Winter Phase, OR1 (88 octane) and MN2 (92 octane), the bulk sample submitted to the laboratory had leaked into the shipment case. However, a sufficient quantity of fuel remained to conduct the GC/MS analysis. The loss of part of the sample may have affected the character of the sample. Although 16 stations were initially included in the study, an additional station was added (as discussed on page 1-2) and a bulk sample was analyzed from this station during the Winter Phase.

TABLE 1-2

Service Stations	Bulk Liquid Samples - Oxygenate Content (%) Winter Phase[a]		
	Ethanol	MTBE	TAME
AZ-1	6.7 - 7.6	ND[b]	ND
AZ-2	ND	11 - 12	ND
AZ-3	7.2 - 8.0	ND	ND
AZ-4	8.4 - 8.7	ND	ND
MN-2	10	ND	ND
MN-3	6.6 - 7.1	ND	ND
MN-4	6.2 - 7.3	ND	ND
NY-1	ND	11 - 14	1.4 - 3.7
NY-2	ND	10 - 13	<0.12 - 3.4
NY-3	ND	14 - 16	ND
NY-4	ND	14 - 17	ND
NY-6	ND	13 - 15	<0.11 - 1.1
NY-7	ND	12 - 13	<0.11 - 0.52
NY-9	ND	13 - 14	ND
OR-1	6.4 - 7.4	ND	ND
OR-2	6.9 - 7.1	ND	ND
OR-3	4.6 - 8.2	ND	ND
Service Stations	**Bulk Liquid Samples - Oxygenate Content (%) Summer Phase[a]**		
	Ethanol	**MTBE**	**TAME**
AZ-1S	ND	ND[b]	ND
AZ-2S	ND	ND	ND
AZ-3S	ND	ND	ND
AZ-4S	ND	ND	ND
MN-2S	9.5 - 9.7	ND	ND
MN-3S	ND	ND	ND
MN-4S	10 - 11	ND	ND
NY-1S	ND	0.1 - 5.2	<0.1 - 0.30
NY-2S	ND	<0.1 - 8.8	<0.1 - 1.0
NY-4S	ND	<0.1 - 1.3	ND
NY-6S	ND	<0.1 - 0.97	ND
NY-7S	ND	<0.1 - 3.3	ND
NY-9S	ND	0.34 - 1.7	<0.1 - 2.2
OR-1S	ND	ND	ND
OR-2S	ND	<0.1 - 0.71	ND
OR-3S	ND	ND	ND

[a] % denotes percent by weight

[b] ND denotes "not detected" at a limit of 0.1%

For the Winter Phase, the bulk fuel analysis identified fuels from nine service stations which contained ethanol and fuels from eight service stations which contained MTBE. In addition to ethanol and MTBE, the fuels of three service stations contained TAME in relatively low amounts (<0.11 - 3.7%). Where TAME was detected, MTBE was the main oxygenate present.

The results of the bulk fuel analysis for the Summer Phase identified fuels from two service stations which contained ethanol and fuels from seven service stations which contained MTBE. Again, fuels from three service stations contained TAME in relatively low amounts (<0.1 - 2.2%). Where TAME was detected, MTBE was the main oxygenate present.

As expected with the end of the winter CO oxyfuel program, generally lower oxygenate concentrations and fewer numbers of stations with oxygenated fuels were present in the summer months, although ethanol levels in gasohol fuels increased. Oxygenates are used during the summer season to increase fuel octane.

The results of the aromatic analyses are summarized by geographical area in Table 1-3. The complete bulk analysis data is provided as Appendix A. Oxygenates and aromatic components detected in the bulk liquid fuels were assayed in the air samples with the exception of p-xylene, which is included in the total xylene result.

TABLE 1-3

Geographic Area	Bulk Liquid Samples - Aromatic Content (%) Winter Phase[a]				
	B	T	EB	X	p-X
Southwest	0.95 - 2.7	5.4 - 11	1.5 - 2.6	6.6 - 12	1.8 - 3.0
Midwest	0.79 - 3.2	7.5 - 11	1.3 - 2.4	6.0 - 12	1.7 - 3.0
Northeast	0.57 - 2.4	3.2 - 13	0.93 - 2.6	5.8 - 13	1.4 - 3.9
Northwest	0.24 - 3.5	7.1 - 18	1.5 - 3.2	7.0 - 15	1.9 - 3.8
Geographic Area	**Bulk Liquid Samples - Aromatic Content (%) Summer Phase[a]**				
	B	**T**	**EB**	**X**	**p-X**
Southwest	1.3 - 2.7	7.0 - 14	1.8 - 3.5	9.8 - 16	2.6 - 4.5
Midwest	0.29 - 1.9	6.7 - 8.7	0.64 - 2.0	2.2 - 9.7	0.63- 2.7
Northeast	0.75 - 2.2	5.7 - 17	1.3 - 4.0	7.2 - 16	2.1 - 4.9
Northwest	1.8 - 3.0	5.2 - 11	1.4 - 2.6	8.1 - 12	2.2 - 3.5

[a] % denotes percent by weight

METEOROLOGICAL CONDITIONS

Meteorological conditions including temperature, wind speed, wind direction, relative humidity and barometric pressure were recorded at each station on each day of the study. An electronic weather station was set up on the service station property. Temperature and relative humidity measurements were recorded both inside (T_i, H_i) near the mechanic and outside (T_o, H_o) near the refueling attendants. For the outside measurements, the temperature and relative humidity probes were placed out of direct sunlight (a radiant energy source). The

windspeed and direction were recorded, as was the average barometric pressure (inches of mercury). Barometric pressures during the winter phase were obtained from the National Weather Service for the date and location of sampling. During the summer sampling phase the barometric pressure was recorded on site. The meteorological data are summarized in Table 1-4. The daily averages are presented in Appendix B.

NATLSCO staff also noted the type and quantity of precipitation (rain and snow) during the study. Early in the study, NATLSCO was requested to discontinue air sampling if heavy

TABLE 1-4

SUMMARY OF METEOROLOGICAL DATA WINTER PHASE

Geographic Area	Date	Temperature (°F)		% RH		Wind Speed (MPH)
		Inside	Outside	Inside	Outside	
Southwest	2/17-26	45-90	44-79	13-45	17-57	0-11
Midwest	2/15-24	30-88	10-51	20-56	28-78	0-18
Northeast	2/21-4/14	39-87	30-81	19-81	19-93	0-16
Northwest	2/14-24	38-73	37-62	28-85	37-84	0-10

SUMMARY OF METEOROLOGICAL DATA SUMMER PHASE

Geographic Area	Date	Temperature (°F)		% RH		Wind Speed (MPH)
		Inside	Outside	Inside	Outside	
Southwest	7/11-23	84-110	80-112	21-61	16-75	0-6
Midwest	7/19-28	66-103	61-96	26-72	28-92	0-10
Northeast	7/20-8/18	67-92	63-97	38-83	28-100	0-6
Northwest	8/8-17	68-102	61-97	21-58	17-71	0-8

precipitation (rain or snow) occurred. The only instance where this affected the study was during sampling at location NY9 on February 23. A steady rain was reported in the late morning and air sampling was halted after 260 minutes. However, the results of this sample were considered to be representative of the entire day and were included in the statistical analysis.

STAGE II VAPOR RECOVERY SYSTEMS

To help control gasoline vapor emissions, many service station pump nozzles are equipped with Stage II vapor recovery systems. Stage II vapor recovery systems capture vapors displaced from the vehicle fuel tank during refueling (Stage I systems capture vapors displaced from service station storage tanks during tank truck fuel deliveries). The presence of "Stage II Vapor Recovery Systems" was recorded (Table 1-5) during the study. The presence of Stage II systems would be expected to lower potential exposure in refueling attendants since they often work in close proximity to the dispensing pump nozzle. The refueling attendants exposure data for Stage II stations are analyzed separately in Appendix E and discussed later in this section.

TABLE 1-5

Stage II Vapor Recovery Systems at Service Stations	
With	**Without**
AZ-1	MN-2
AZ-2	MN-3
AZ-3	MN-4
AZ-4	OR-1
NY-1	OR-2
NY-2	
NY-3	
NY-4	
NY-6	
NY-7	
NY-9	
OR-3	

EXPOSURE MONITORING

As described above, 198 service station personal exposures were sampled during the Winter Phase of the study and 200 personal exposures during the Summer Phase. Three additional samples were collected on truck drivers during fuel deliveries. A review of Appendix C for both the Winter & Summer data shows that in the majority of samples, non-detectable or low levels of oxygenates and aromatics were detected in the personal air samples. The total exposure database, combining Winter and Summer Phases, is summarized in Table 1-6. The data collected for attendants at stations with Stage II emission controls are also separately summarized in Table 1-6. Tables 1-7 & 1-8 summarize the Winter Phase exposure data and Tables 1-9 & 1-10 summarize the Summer Phase data for attendants and mechanics, respectively. Both long-term and short-term sample data summaries are presented.

Tables 1-6 to 1-10 summarize 394 of the 398 collected service station worker exposures. Four samples collected during the study are not included in the statistical analysis. Three samples, collected during the Winter Phase in the Northwest, provide exposure values an order of magnitude higher than the rest and do not appear to result from typical operations observed during the study. As footnoted in Tables 1-6 and 1-7, these samples (OR2-06A, OR2-07 and OR2-16) are not included in the statistical analysis. The results from these samples can be found in Appendix C. The three samples were collected on two attendants during normal refuelling activities. Samples OR2-06A (full-shift) and OR2-07 (15 minutes) were taken concurrently on the same individual. Exposure during the short-term sample is incorporated into the long-term sample. During the short-term sample, the subject refueled two vehicles. Activities observed by NATLSCO staff during the sampling indicated that the attendant may have affected the outcome of the sampling. Additional sampling on this individual provided more typical results on subsequent days. The third sample, OR2-16, was a short-term sample collected on a different attendant at the same station while refueling vehicles. In this case, the attendant was observed to turn the fuel dispensing nozzle up to his chest, near the sampling tube, following each refueling. This sample did not affect the full-

shift sampling statistics, since this attendant did not undergo full-shift sampling. No exposures approaching these apparent outliers occurred during the Summer Phase.

The fourth sample (AZ4S-15A), collected during the Summer Phase in the Southwest was observed to have fallen off the subject into a puddle of oil. Since the charcoal absorbent could have been contaminated with oil, it was not included in the statistical analysis. The attendant's exposure is represented by sample AZ4S-17A.

Refueling attendants were sometimes observed setting a trigger on the refueling nozzle handle so that fuel was automatically dispensed until the automobile fuel tank was filled. This "latching" procedure sets a nozzle trigger in an open position that is released by the back pressure from the vehicle fuel tank when full. This practice allows the attendant to perform duties away from the gas tank inlet while dispensing gasoline. In busy stations, latching allows the attendant to service multiple vehicles simultaneously. In either case, the attendant spends less time near the nozzles while gasoline is being dispensed and thus reduces the potential gasoline vapor exposure.

TABLE 1-6

SUMMARY OF EXPOSURE DATA RANGES FOR ALL SEASONS AND LOCATIONS

Exposure Period	Concentration							
	ppm							mg/M³
	B	T	X	EB	ETOH	MTBE	TAME	THC
REFUELING ATTENDANTS								
Long-Term[a]	<0.01-1.2	<0.01-2.1	<0.01-<1	<0.01-<1	<0.15-2.8	<0.03-0.50	<0.02-<0.08	<0.37-110
Short-Term[b]	0.09-0.91	0.1-3.4	<0.06-7.7	<0.07-2.1	<1-<2.4	<0.19-2.1	<0.24-<0.46	<1.9-170
MECHANICS								
Long-Term	<0.01-0.38	<0.01-4.3	<0.01-2.2	<0.01-<1	<0.15-2.1	<0.02-2.6	<0.02-0.03	<0.22-60
Short-Term	<0.1-8.7	<0.09-20	<0.08-30	<0.08-8.7	<1.5-6.5	<0.22-32	<0.24-0.27	<1.6-490
REFUELING ATTENDANTS WITH STAGE II EMISSIONS CONTROLS								
Long-Term	<0.01-1.1	0.02-2.1	0.01-<1	<0.01-<1	<1	<0.03-0.5	<0.02-<0.08	<0.37-91
Short-Term	0.09-<0.42	0.1-<1	<0.06-7.7	<0.07-2.1	<1-<2.4	<0.24-2.1	<0.24-<0.46	<1.9-60

[a] These entries do not include two samples for which the results are very high compared to the remaining samples, see Appendix C, sample #OR2-06A and AZ4S-15A. The text at page 1-10 & 1-11 provides an explanation.

[b] These entries do not include two samples for which the results are very high compared to the remaining samples, see Appendix C, sample #OR2-07 and #OR2-16 and text at page 1-10.

TABLE 1-7

SUMMARY OF REFUELING ATTENDANTS EXPOSURE DATA RANGES - WINTER PHASE

Exposure Period	Concentration							
	ppm							mg/M³
	B	T	X	EB	ETOH	MTBE	TAME	THC
SOUTHWEST								
Long-Term	<0.01-0.04	<1	<1	<1	<1	0.38-0.5[a]	NA[b]	1.8 - 14
Short-Term	<0.12-0.24	<1	<1	<1	<1.3-<2.4	<0.33-2.1	NA	<1.9 - 60
MIDWEST								
Long-Term	0.02-0.15	<1	<1	<1	<1	NA	NA	7.5 - 46
Short-Term	<0.21	<1	<1	<1	<2.2-<2.4	NA	NA	<3.1 - 5.6
NORTHEAST								
Long-Term	<0.01-<0.07	<1	<1	<1	NA	<0.03-0.5	<0.02-<0.08	<0.37 - 15
Short-Term	<0.20-<0.42	<1	<1	<1	NA	<0.32-1.9	<0.24-<0.46	<3 - 20
NORTHWEST								
Long-Term[c]	0.02-0.49	<1	<1	<1	<1	NA	NA	<4.2 - 63
Short-Term[d]	<0.13-0.61	<1-3.4	<1-1.3	<1	<1.0-<2.2	NA	NA	2.8 - 100

[a] One service station in the southwest had MTBE. The other three had EtOH.

[b] NA denotes "not analyzed". This species was not detected in the analysis of the bulk fuel samples. Refer to Table 1-2 above.

[c] These entries do not include one sample for which the results are very high compared to the remaining samples, see Appendix C, sample #OR2-06A and text at page 1-10.

[d] These entries do not include two samples for which the results are very high compared to the remaining samples, see Appendix C, sample #OR2-07 and #OR2-16 and text at page 1-10.

TABLE 1-8

SUMMARY OF AUTOMOBILE MECHANICS EXPOSURE DATA RANGES- WINTER PHASE								
Exposure Period	Concentration							
	ppm							mg/M³
	B	T	X	EB	ETOH	MTBE	TAME	THC
SOUTHWEST								
Long-Term	<0.01-0.34	<1-4.3	<1	<1	<1	<0.02-1.3	NA[a]	1.6 - 58
Short-Term	<0.15-1.3	<1-20	<1-1.7	<1	<1.6-<2.4	<0.26-5.3	NA	<2.2 - 280
MIDWEST								
Long-Term	<0.02-0.19	<1-1.1	<1	<1	<1	NA	NA	<0.22 - 51
Short-Term	<0.21-0.47	<1	<1	<1	<2.2-<2.4	NA	NA	6.6 - 32
NORTHEAST								
Long-Term	<0.01-0.3	<1	<1-2.2	<1	NA	0.02-2.6	<0.02-<0.03	<0.42 - 60
Short-Term	<0.21-3.3	<1-6.2	<1-6.3	<1-1.5	NA	<0.32-32	<0.24-0.27	<3.0 - 490
NORTHWEST								
Long-Term	<0.01-0.38	<1-1	<1	<1	<1	NA	NA	1.0 - 43
Short-Term	<0.16-8.7	<1-19	<1-6.4	<1-1.6	<1.5-6.5	NA	NA	<2.5 - 470

[a] NA denotes "not analyzed".

TABLE 1-9

SUMMARY OF REFUELING ATTENDANTS EXPOSURE DATA RANGES - SUMMER PHASE

Exposure Period	Concentration							
	ppm							mg/M³
	B	T	X	EB	ETOH	MTBE	TAME	THC
SOUTHWEST								
Long-Term[a]	<0.02-0.15	0.02-0.27	0.01-0.34	<0.01-0.10	NA[b]	NA	NA	1.7-23
Short-Term	0.09-0.35	0.1-0.96	<0.06-7.7	<0.07-2.1	NA	NA	NA	<1.9-49
MIDWEST								
Long-Term	<0.01-0.05	<0.01-0.12	<0.01-0.14	<0.01-0.03	<0.15-2.8	NA	NA	1.3-14
Short-Term	<0.21	<0.18	<0.16	<0.16	<0.24	NA	NA	<3.1
NORTHEAST								
Long-Term	0.02-1.1	0.03-2.1	0.01-0.83	<0.01-0.19	NA	0.03-0.21	<0.02-<0.04	3.3-91
Short-Term	<0.16-<0.21	<0.18-0.55	0.12-0.94	<0.12-0.25	NA	<0.24-<0.33	<0.24	<3-29
NORTHWEST								
Long-Term	0.04-1.2	0.07-1.7	0.02-0.60	<0.01-0.13	NA	0.07-0.42	NA	4.7-110
Short-Term	<0.12-0.91	<0.1-0.99	<0.11-0.25	<0.09-<0.16	NA	<0.19-<0.33	NA	<2.6-170

[a] These entries do not include one sample for which the results are very high compared to the remaining samples, see Appendix C, AZ4S-15A. The text at page 1-11 provides an explanation.

[b] NA denotes "not analyzed".

TABLE 1-10

SUMMARY OF AUTOMOBILE MECHANICS EXPOSURE DATA RANGES - SUMMER PHASE

Exposure Period	Concentration							
	ppm							mg/M³
	B	T	X	EB	ETOH	MTBE	TAME	THC
SOUTHWEST								
Long-Term	<0.01-0.18	<0.01-0.9	<0.01-0.31	<0.01-0.09	NA[a]	NA	NA	0.90-19
Short-Term	<0.1-0.26	<0.09-3.0	<0.08-4.2	<0.08-1.2	NA	NA	NA	<1.6-29
MIDWEST								
Long-Term	<0.01-0.07	0.02-0.09	0.02-0.38	<0.01-0.09	<0.15-2.1	NA	NA	1.6-7.6
Short-Term	0.31-0.49	0.28-2.1	<0.16-1.0	<0.16-0.19	5.7	NA	NA	29-59
NORTHEAST								
Long-Term	<0.01-0.1	<0.02-0.34	<0.01-1.6	<0.01-0.45	NA	<0.02-0.18	<0.02-0.02	0.41-22
Short-Term	<0.13-2.3	<0.18-9.8	<0.15-30	<0.1-8.7	NA	<0.22-4.2	<0.24	<3.0-350
NORTHWEST								
Long-Term	<0.02-0.26	<0.02-1.8	<0.02-0.38	<0.02-0.08	NA	NA	NA	0.71-30
Short-Term	<0.16-0.39	<0.13-0.89	<0.11-0.73	<0.12-<0.16	NA	NA	NA	<2.3-20

[a] NA denotes "not analyzed"

TABLE 1-11

STATIONS WITH STAGE II EMISSION CONTROLS
SUMMARY OF REFUELING ATTENDANTS EXPOSURE DATA RANGES - WINTER PHASE

Exposure Period	Concentration							
	ppm							mg/M³
	B	T	X	EB	ETOH	MTBE	TAME	THC
SOUTHWEST								
Long-Term	<0.01-0.04	<1	<1	<1	<1	0.38-0.5	NA[a]	1.8-14
Short-Term	<0.12-0.24	<1	<1	<1	<1.3-<2.4	<0.33-2.1	NA	<1.9-60
NORTHEAST								
Long-Term	<0.01-0.07	<1	<1	<1	NA	<0.03-0.5	<0.02-<0.08	<0.37-15
Short-Term	<0.20-<0.42	<1	<1	<1	NA	<0.32-1.9	<0.24-<0.46	<3-20
NORTHWEST								
Long-Term	0.02-0.03	<1	<1	<1	<1	NA	NA	7.8-11
Short-Term	<0.13-<0.21	<1	<1	<1	<1.0-<1.9	NA	NA	<3.0-16

[a] NA denotes "not analyzed."

TABLE 1-12

STATIONS WITH STAGE II EMISSION CONTROLS
SUMMARY OF REFUELING ATTENDANTS EXPOSURE DATA RANGES - SUMMER PHASE

Exposure Period	Concentration							
	ppm							mg/M³
	B	T	X	EB	ETOH	MTBE	TAME	THC
SOUTHWEST								
Long-Term[a]	<0.02-0.15	0.02-0.27	0.01-0.34	<0.01-0.10	NA[b]	NA	NA	1.7-23
Short-Term	0.09-0.35	0.1-0.96	<0.06-7.7	<0.07-2.1	NA	NA	NA	<1.9-49
NORTHEAST								
Long-Term	0.02-1.1	0.03-2.1	0.01-0.83	<0.01-0.19	NA	0.03-0.21	<0.02-0.04	3.3-91
Short-Term	<0.16-<0.21	<0.18-0.55	0.12-0.94	<0.12-0.25	NA	<0.24-<0.33	<0.24	<3-29
NORTHWEST								
Long-Term	0.04-0.1	0.07-0.09	0.02-0.04	<0.01	NA	NA	NA	4.7-13
Short-Term	<0.17-0.37	<0.15-0.47	0.12-<0.15	<0.13-<0.16	NA	NA	NA	2.8-31

[a] These entries do not include one sample for which the results are very high compared to the remaining samples, see Appendix C, AZ4S-15A. The text at page 1-11 provides an explanation.

[b] NA denotes "not analyzed."

Section 2

STATISTICAL ANALYSIS

Individual personal sample concentration data by date, location, job type/task description and gallons pumped (for attendants) are presented in Appendix C. The descriptive (total number of samples, number of samples below the limit of detection, minimum, maximum, median, geometric mean, geometric standard deviation, limits of detection) and distributional (number of samples within decade concentration intervals) statistics for personal data by analyte, sample duration, job type, and season are presented in Appendix D. Appendix E presents the descriptive and distributional statistics for the attendants at service stations equipped with Stage II vapor recovery systems. A comparison of the attendant data from Appendices D & E shows the relative effect on personal exposure values of Stage II Vapor Recovery Systems.

In Appendix C for the analytes benzene, MTBE, TAME and total hydrocarbons, sample concentration values below the measurement method limit of detection (LOD) were reported as "less than" values at the sample-specific limit of detection. Note that in the winter concentration data for toluene, xylene, ethyl benzene and ethanol, small detected concentrations were reported as "<1 ppm" in accord with a long-standing NATLSCO laboratory practice of so reporting values less than one part per million for these compounds. However, this practice was changed for the summer data and the "less than" values reported there for toluene, xylene, ethylbenzene and ethanol correspond to the sample-specific LODs for the analytical method.

In the statistical analysis reported in Appendix D, concentrations reported as "less than" values are valued at that limit. For example, in the Winter data, mean values for xylene, toluene, ethylbenzene and ethanol, were computed by equating <1 ppm values to 1 ppm. This conservative approach provides statistical geometric mean (GM) values that overestimate actual mean exposures. Since a majority of the reported organic vapor concentrations are either "<1 ppm" or less than an analytical method LOD, the computed geometric means are higher than the actual mean concentrations. For example, if exposure to a specific compound was not detected, e.g., all values were below a 0.24 ppm method LOD, then the GM estimate of exposure by this approach would be calculated as 0.24 ppm.

The descriptive mean exposure statistics are summarized in Tables 2-1 & 2-2 for the long-term and short-term samples, respectively. The descriptive statistics for attendant exposure data at service stations with

Stage II Vapor Recovery Systems are presented separately in Table 2-3. A summary of combined winter and summer data are provided in Table 2-4 for the four oxyfuel components (B, THC, MTBE, TAME) that were consistently quantified to the analytical method LOD for both seasons.

TABLE 2-1

SUMMARY OF DESCRIPTIVE STATISTICS - LONG-TERM SAMPLES								
Conc (ppm)	Winter				Summer			
	Attendant[a]		Mechanic		Attendant[b]		Mechanic	
	Range	GM[c]	Range	GM	Range	GM	Range	GM
Ben	0.01-0.49	0.04	0.01-0.38	0.03	0.01-1.2	0.06	0.01-0.26	0.02
Tol	1	1	1-4.3	1.04	0.01-2.1	0.09	0.01-1.8	0.06
Xyl	1	1	1-2.2	1.03	0.01-0.83	0.05	0.01-1.6	0.07
EB	1	1	1	1	0.01-0.19	0.02	0.01-0.45	0.03
THC[d]	0.37-63	8.9	0.22-60	8.6	1.3-110	9.2	0.41-30	3.7
ETOH	1	1	1	1	0.15-2.8	0.48	0.15-2.1	0.42
MTBE	0.03-0.5	0.2	0.02-2.6	0.12	0.03-0.42	0.08	0.02-0.18	0.03
TAME	0.02-0.08	0.02	0.02-0.03	0.02	0.02-0.04	0.02	0.02	0.02

[a] These entries do not include one sample for which the results are very high compared to the remaining samples, see Appendix C, sample #OR2-06A and text at page 1-10.

[b] These entries do not include one sample for which the results may have been influenced when the sampling tube was contaminanted with oil. See Appendix C, sample #AZ4S-15A and text at page 1-11.

[c] Geometric Mean

[d] Concentrations of THC are reported in mg/M^3.

TABLE 2-2

SUMMARY OF DESCRIPTIVE STATISTICS - SHORT-TERM SAMPLES								
Conc (ppm)	Winter				Summer			
	Attendant[a]		Mechanic		Attendant		Mechanic	
	Range	GM[b]	Range	GM	Range	GM	Range	GM
Ben	0.12-0.61	0.21	0.15-8.7	0.29	0.09-0.91	0.21	0.1-2.3	0.22
Tol	1-3.4	1.02	1-20	1.5	0.10-0.99	0.22	0.09-9.8	0.26
Xyl	1-1.3	1.02	1-6.4	1.2	0.06-7.7	0.18	0.08-30	0.27
EB	1	1	1-1.6	1.0	0.07-2.1	0.16	0.08-8.7	0.19
THC[c]	1.9-100	8.5	2.2-490	10.8	1.9-170	6.4	1.6-350	6.2
ETOH	1.0-2.4	1.9	1.5-6.5	2.0	2.4	2.4	5.7	5.7
MTBE	0.32-2.1	0.6	0.26-32	1.04	0.19-0.33	0.31	0.22-4.2	0.42
TAME	0.24-0.46	0.28	0.24-0.27	0.25	0.24	0.24	0.24	0.24

[a] These entries do not include two samples for which the results are very high compared to the remaining samples, see Appendix C, sample #OR2-07 and #OR2-16 and text at page 1-10.

[b] Geometric Mean

[c] Concentrations of THC are reported in mg/M^3.

TABLE 2-3

SUMMARY OF DESCRIPTIVE STATISTICS - ALL ATTENDANT EXPOSURE DATA FOR SERVICE STATIONS WITH STAGE II VAPOR RECOVERY SYSTEMS								
Conc (ppm)	Winter				Summer			
	Long-Term		Short-Term		Long-Term[a]		Short-Term	
	Range	GM[b]	Range	GM	Range	GM	Range	GM
Ben	0.01-0.07	0.02	0.12-0.42	0.21	0.02-1.1	0.05	0.09-0.37	0.21
Tol	1	1	1	1	0.02-2.1	0.09	0.1-0.96	0.23
Xyl	1	1	1	1	0.01-0.83	0.05	0.06-7.7	0.18
EB	1	1	1	1	0.01-0.19	0.02	0.07-2.1	0.16
THC[c]	0.37-15	5.54	1.9-60	6.42	1.7-91	8.72	1.9-49	6.2
ETOH	1	1	1.0-2.4	1.88	ETOH NOT DETECTED[d]			
MTBE	0.03-0.5	0.20	0.32-2.1	0.60	0.03-0.21	0.07	0.24-0.33	0.32
TAME	0.02-0.08	0.02	0.24-0.46	0.28	0.02-0.04	0.02	0.24	0.24

[a] These entries do not include one sample for which the results are suspect. See Appendix C, sample #AZ45-15A and text at page 1-11.

[b] Geometric Mean

[c] Concentrations of THC are reported in mg/M^3.

[d] ETOH was not detected in the bulk fuel samples of any service stations equipped with Stage II Vapor Recovery Systems during the Summer Phase.

TABLE 2-4

SUMMARY OF DESCRIPTIVE STATISTICS - ALL SEASONS AND LOCATIONS								
Conc (ppm)	Long-Term Samples				Short-Term Samples			
	Attendant[a]		Mechanic		Attendant[b]		Mechanic	
	GM[c]	GSD[c]	GM	GSD	GM	GSD	GM	GSD
Ben	0.05	2.65	0.03	2.79	0.21	1.30	0.25	2.09
THC[d]	9.06	2.61	5.70	3.47	7.39	2.83	8.15	4.91
MTBE	0.12	2.33	0.06	3.99	0.41	1.75	0.74	4.54
TAME	0.02	1.38	0.02	1.09	0.25	1.21	0.24	1.04

[a] These entries do not include two samples for which the results are very high compared to the remaining samples, see Appendix C, sample #OR2-06A and AZ4S-15A. The text at page 1-10 & 1-11 provides an explanation.

[b] These entries do not include two samples for which the results are very high compared to the remaining samples, see Appendix C, sample #OR2-07 and #OR2-16 and text at page 1-10.

[c] Geometric Mean and Geometric Standard Deviation.

[d] Concentrations of THC are reported in mg/M^3.

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APPENDIX A

NOMINAL OXYGENATE AND AROMATIC CONTENT OF BULK FUEL SAMPLES

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

WINTER & SUMMER 1994

APPENDIX A

APPROXIMATE OXYGENATE AND AROMATIC CONTENT (WT %) OF BULK FUEL SAMPLES

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE
WINTER & SUMMER 1994

Location	Octane	°F[a]	RVP	B	T	X	EB	p-X	EtOH	MTBE	TAME
					WINTER						
AZ-1	87	77.4	10.2	1.3	5.9	7.5	1.7	2.1	7.6	-	-
	88	76.0	10.1	2.2	10.0	10.0	2.5	2.7	6.8	-	-
	92	80.4	10.3	1.3	9.6	9.9	1.9	2.8	6.7	-	-
AZ-2	87	69.4	9.5	1.2	5.8	9.1	1.7	2.5	-	11	-
	88	77.4	9.1	1.9	8.9	9.0	2.3	2.4	-	11	-
	92	80.4	9.0	1.7	10.0	12.0	2.1	3.0	-	12	-
AZ-3	87	63.5	9.5	1.6	6.4	7.7	1.5	2.3	8.0	-	-
	88	62.3	10.2	2.7	11.0	11.0	2.6	2.9	7.2	-	-
	92	66.4	10.6	1.0	8.9	9.7	1.6	2.4	7.9	-	-
AZ-4	87	67.8	9.4	0.95	5.4	8.2	1.8	2.2	8.4	-	-
	88	68.0	10.3	1.6	7.2	6.6	2.0	1.8	8.7	-	-
	92	70.2	9.8	1.3	8.0	8.8	2.3	2.4	8.4	-	-
MN-2	89	51.2	14.2	2.4	10.0	8.7	1.6	2.2	10.0	-	-
	92	49.1	14.4	-[b]	-[b]	-[b]	-[b]	-[b]	-[b]	-	-
MN-3	87	24.4	14.5	2.7	9.8	11.0	2.0	2.9	7.1	-	-
	92	22.8	14.6	1.2	7.9	8.0	1.4	2.0	6.6	-	-

APPENDIX A

APPROXIMATE OXYGENATE AND AROMATIC CONTENT (WT %) OF BULK FUEL SAMPLES

WINTER & SUMMER 1994

Location	Octane	°F	RVP	B	T	X	EB	p-X	EtOH	MTBE	TAME
					WINTER (Continued)						
MN-4	87	42.6	14.8	3.2	11.0	12.0	2.4	3.0	7.3	-	-
	92	26.6	15.3	0.79	7.5	6.0	1.3	1.7	6.2	-	-
NY-1	87	43.7	12.69	1.1	3.8	5.9	1.0	1.6	-	14.0	1.4
	89	56.8	12.1	0.82	3.3	6.1	1.1	1.7	-	11.0	1.4
	93	45.7	10.72	1.1	7.2	13.0	2.6	3.7	-	13.0	3.7
NY-2	87	50.5	11.4	0.78	4.3	5.8	1.1	1.4	-	13.0	<0.12
	89	55.7	11.2	0.90	5.2	8.0	1.6	2.1	-	12.0	1.5
	93	56.1	10.7	1.0	6.8	12.0	2.5	3.4	-	10.0	3.4
NY-3	87	48.4	11.5	1.2	4.2	5.9	1.3	1.6	-	14.0	-
	89	49.1	11.9	0.57	4.0	6.9	1.6	2.0	-	16.0	-
	93	48.9	13.6	0.75	5.8	10.0	2.6	3.0	-	15.0	-
NY-4	87	69.1	11.14	0.88	4.6	6.0	1.2	1.6	-	14.0	-
	89	70.3	12.13	1.0	6.2	8.5	1.5	2.4	-	14.0	-
	93	68.4	12.08	0.83	5.3	7.0	1.1	2.2	-	17.0	-
NY-6	87	55.2	10.53	2.3	3.2	6.0	0.93	1.7	-	15.0	0.16
	89	55.4	11.79	1.4	13.0	11.0	2.3	3.2	-	14.0	1.1
	93	61.0	8.18	2.4	7.3	11.0	1.7	3.9	-	13.0	<0.11

APPENDIX A

APPROXIMATE OXYGENATE AND AROMATIC CONTENT (WT %) OF BULK FUEL SAMPLES

WINTER & SUMMER 1994

Location	Octane	°F	RVP	B	T	X	EB	p-X	EtOH	MTBE	TAME
					WINTER (Continued)						
NY-7	87	55.4	8.0	1.5	3.8	7.4	1.2	2.2	-	13.0	0.52
	89	55.8	8.0	0.99	5.9	8.0	1.2	2.3	-	12.0	<0.11
	93	55.6	9.6	1.4	13.0	12.0	2.4	3.5	-	12.0	0.19
NY-9	87	45.9	11.4	1.0	4.2	6.1	1.4	1.7	-	14.0	-
	89	44.9	11.9	0.74	4.7	7.9	1.4	2.2	-	13.0	-
	93	45.6	13.7	0.72	5.5	10.0	2.5	3.0	-	14.0	-
OR-1	87	56.5	14.1	3.4	11.0	10.0	1.8	2.7	7.4	-	-
	88	57.2	14.9	-[a]	-[a]	-[a]	-[a]	-[a]	-[a]	-	-
	92	56.8	14.0	0.24	14.0	14.0	2.6	3.7	6.4	-	-
OR-2	87	59.0	14.6	2.8	9.6	9.4	1.7	2.4	7.1	-	-
	88	58.0	14.3	3.1	11.0	9.8	1.7	2.5	7.1	-	-
	92	58.9	13.3	3.5	18.0	15.0	2.7	3.8	6.9	-	-
OR-3	87	39.4	14.6	2.3	7.4	7.7	1.7	2.1	8.2	-	-
	88	37.2	15.4	2.2	7.1	7.0	1.5	1.9	7.0	-	-
	92	36.7	15.0	2.3	11.0	14.0	3.2	3.8	4.6	-	-

APPENDIX A

APPROXIMATE OXYGENATE AND AROMATIC CONTENT (WT %) OF BULK FUEL SAMPLES

WINTER & SUMMER 1994

Location	Octane	°F	RVP	B	T	X	EB	p-X	EtOH	MTBE	TAME
					SUMMER						
AZ-1	87	93.5	7.31	1.7	7.0	10	1.8	2.7	-	-	-
	88	96.2	7.35	2.7	12	11	2.7	3.3	-	-	-
	92	92.4	7.46	2.3	12	15	2.7	4.3	-	-	-
AZ-2	87	88.6	6.74	1.3	7.5	10	2.0	2.6	-	-	-
	88	88.4	6.98	2.0	11	10	2.6	2.8	-	-	-
	92	88.9	7.14	1.4	12	14	2.5	3.5	-	-	-
AZ-3	87	105.6	7.28	2.1	8.6	11	1.9	2.9	-	-	-
	88	95.6	7.18	2.5	10	10	2.7	2.8	-	-	-
	92	89.3	7.60	2.7	13	16	2.9	4.5	-	-	-
AZ-4	87	82	7.37	2.6	10	11	2.4	2.9	-	-	-
	88	83.8	7.41	2.7	9.8	9.8	3.2	2.8	-	-	-
	92	86.7	7.35	2.5	14	13	3.5	3.5	-	-	-
MN-2	89	78.4	9.57	1.5	7.0	7.0	1.4	1.8	9.7	-	-
	92	78.4	9.65	0.79	7.2	4.6	1.0	1.2	9.5	-	-
MN-3	87	72.5	8.88	1.9	8.3	9.7	2.0	2.7	-	-	-
	92	70.7	8.83	0.29	8.7	2.2	0.64	0.63	-	-	-

APPENDIX A

APPROXIMATE OXYGENATE AND AROMATIC CONTENT (WT %) OF BULK FUEL SAMPLES

WINTER & SUMMER 1994

Location	Octane	°F	RVP	B	T	X	EB	p-X	EtOH	MTBE	TAME
					SUMMER (Continued)						
MN-4	87	80.5	9.75	1.7	6.7	8.6	1.6	2.2	11	-	-
	92	80.3	9.63	1.1	7.1	5.6	1.0	1.4	10	-	-
NY-1	87	79.5	7.98	2.0	8.1	9.0	1.7	2.7	-	0.10	<0.1
	89	79.7	7.98	2.2	12	9.8	2.1	2.9	-	2.6	0.12
	93	79.1	8.96	1.9	16	9.6	2.2	2.9	-	5.2	0.30
NY-2	87	76.1	7.35	1.7	7.6	8.7	1.7	2.6	-	<0.1	<0.1
	89	75.5	8.05	2.0	9.1	10	2.2	3.1	-	2.5	0.51
	93	76.1	9.20	2.1	10	12.0	2.7	3.5	-	8.8	1.0
NY-4	87	76.5	8.40	0.98	5.7	7.2	1.3	2.1	-	<0.1	-
	89	75.1	8.46	0.99	9.7	11	2.2	3.2	-	0.80	-
	93	76.6	8.77	0.75	12	14	3.1	4.0	-	1.3	-
NY-6	87	84.2	8.66	1.8	6.8	7.6	1.4	2.2	-	<0.1	-
	89	84.6	8.83	1.0	12	14	3.2	4.1	-	0.97	-
	93	83.8	8.85	1.8	17	16	4.0	4.9	-	0.46	-
NY-7	87	81.0	8.67	1.8	7.0	9.1	1.7	2.6	-	<0.1	-
	89	82.8	8.70	0.93	10	12	2.8	3.6	-	0.24	-
	93	82.2	8.75	2.2	15	14	3.1	4.1	-	3.3	-

APPENDIX A

APPROXIMATE OXYGENATE AND AROMATIC CONTENT (WT %) OF BULK FUEL SAMPLES

WINTER & SUMMER 1994

Location	Octane	°F	RVP	B	T	X	EB	p-X	EtOH	MTBE	TAME
					SUMMER (Continued)						
NY-9	87	75.4	8.79	2.0	8.6	8.2	1.9	2.3	-	0.34	<0.1
	89	74.1	8.92	1.5	7.8	9.6	2.0	2.7	-	1.3	0.58
	93	76.9	9.14	0.77	10	12	2.7	3.7	-	1.7	2.2
OR-1	87	88.5	7.66	1.8	8.6	11	2.2	2.9	-	-	-
	88	87.6	7.21	2.4	7.2	8.4	1.7	2.2	-	-	-
	92	89.1	7.46	1.9	11	12	2.4	3.3	-	-	-
OR-2	87	81.3	7.09	2.8	9.9	11	2.1	3.1	-	0.71	-
	88	75.6	7.06	2.1	5.2	8.1	1.4	2.4	-	<0.1	-
	92	78.3	6.96	2.9	9.6	12	2.1	3.4	-	<0.1	-
OR-3	87	81.6	7.06	3.0	8.3	10	2.1	2.6	-	-	-
	88	80.9	7.22	2.7	7.5	8.3	1.7	2.2	-	-	-
	92	79.9	6.99	2.0	7.8	12	2.6	3.5	-	-	-

°F	Degrees Fahrenheit	X	Xylene	MTBE	Methyl-Tert-Butyl Ether
RVP	Reid Vapor Pressure	EB	Ethyl Benzene	TAME	t-Amyl Methyl Ether
B	Benzene	p-X	p-Xylene		
T	Toluene	EtOH	Ethanol		

[a] Temperature of fuel dispensed for bulk sample; see discussion Appendix H.

[b] Bulk fuel samples MN2 - 92 octane and OR1 - 88 octane during the Winter Phase were partially lost during shipment. Due to the volatilization of the lower boiling compounds these results are considered nonrepresentative.

APPENDIX B

SUMMARY OF METEOROLOGICAL DATA

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

WINTER & SUMMER 1994

APPENDIX B

SUMMARY OF METEOROLOGICAL DATA

SERVICE STATION PERSONNEL EXPOSURE
AMERICAN PETROLEUM INSTITUTE

WINTER & SUMMER 1994

Location	Date	T_i (°F)	T_o (°F)	WS (mph)	WD	H_i (%RH)	H_o (%RH)	Bar ("Hg)	P_{in}
				WINTER					
AZ1	2-17-94	64-85	60-79	0-3	ESE	26-45	33-52	29.87	None
	2-18-94	56-67	54-69	0-6	WSW	26-40	25-53	29.74	None
	2-19-94	56-62	56-65	0-5	SW	30-45	33-51	29.89	None
AZ2	2-14-94	58-88	52-76	0-3	NE	15-30	21-33	30.03	None
	2-15-94	53-90	48-67	0	N/SE	21-44	33-52	30.01	None
	2-16-94	56-79	51-69	0	N/E	27-41	30-57	30.11	None
AZ3	2-21-94	53-69	51-70	0-4	SW/SE	29-42	36-52	29.99	None
	2-22-94	46-72	44-74	0-11	NE	14-43	19-55	30.00	None
	2-23-94	47-60	44-59	0-1	NE	13-23	20-33	30.12	None

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SERVICE STATION PERSONNEL EXPOSURE
AMERICAN PETROLEUM INSTITUTE

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Location	Date	T_i (°F)	T_o (°F)	WS (mph)	WD	H_i (%RH)	H_o (%RH)	Bar ("Hg)	P_{in}
				WINTER (Continued)					
AZ4	2-24-94	52-67	52-70	0	N/NW	14-28	17-34	30.01	None
	2-25-94	45-67	44-71	0	N/NE	20-36	23-49	29.95	None
	2-26-94	48-69	48-71	0	N/NE	21-31	24-42	30.02	None
MN2	2-15-94	54-80	25-38	0-5	NE/NW	21-38	43-64	29.90	None
	2-16-94	45-82	28-48	0-10	SE/NW	30-41	41-67	29.68	None
	2-17-94	49-66	25-51	0-2	NE/SE	40-55	43-76	29.70	None
MN3	2-22-94	30-41	10-25	0-4	SW	20-23	34-47	29.64	None
	2-23-94	31-45	12-21	2-12	S/SW	27-34	61-71	29.26	Trace (<0.25"-S)
	2-24-94	35-67	10-30	0-2	S/SW	23-31	28-70	29.12	None

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SERVICE STATION PERSONNEL EXPOSURE
AMERICAN PETROLEUM INSTITUTE

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Location	Date	T_i (°F)	T_o (°F)	WS (mph)	WD	H_i (%RH)	H_o (%RH)	Bar ("Hg)	P_{in}
				WINTER (Continued)					
MN4	2-18-94	54-88	43-50	6-18	SE	33-49	55-74	29.22	None
	2-19-94	55-59	38-47	0-7	S/NW	43-56	68-78	29.00	None
	2-21-94	30-40	13-26	2-7	NW	21-26	28-48	29.86	None
NY1	3-22-94	58-63	41-53	0-10	S/SE	34-45	38-75	29.95	None
	3-23-94	61-65	43-68	0-4	SW	31-37	34-59	30.25	None
	3-24-94	56-63	44-56	0-1	E	37-45	60-72	30.28	None
NY2	3-29-94	47-59	39-41	0-2	N	46-55	78-82	30.40	0.30-R
	3-30-94	48-56	39-53	0-3	N	31-41	38-67	30.58	None
	3-31-94	56-59	39-70	1-4	SW	27-33	27-58	30.73	None

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Location	Date	T_i (°F)	T_o (°F)	WS (mph)	WD	H_i (%RH)	H_o (%RH)	Bar ("Hg)	P_{in}
				WINTER (Continued)					
NY3	2-21-94	54-59	50-54	0	N/SE	61-75	80-87	30.50	0.24-R
NY9	2-22-94	50-53	51-58	0-6	NW	31-43	27-40	30.61	None
	2-23-94	39-53	30-33	2-13	NE	47-57	81-85	30.79	1.5-S
NY4	3-22-94	72-83	46-65	8-16	S	19-33	19-51	29.95	None
	3-23-94	67-85	51-74	1-8	E/SE	21-27	19-39	30.29	None
	3-24-94	68-87	53-74	0-2	E/SE	23-33	24-48	30.28	None
NY6	4-4-94	50-57	44-56	0	ESE	31-41	33-53	30.37	None
	4-5-94	50-63	44-63	0-4	ESE/SE	-	37-48	30.46	None
	4-6-94	60-62	54-60	0	SE/E	44-65	65-85	30.31	0.05-R

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SERVICE STATION PERSONNEL EXPOSURE
AMERICAN PETROLEUM INSTITUTE

WINTER & SUMMER 1994

Location	Date	T_i (°F)	T_o (°F)	WS (mph)	WD	H_i (%RH)	H_o (%RH)	Bar ("Hg)	P_{in}
				WINTER (Continued)					
NY7	4-12-94	54-59	46-52	0-5	SSW	60-69	72-85	30.36	0.25-R
	4-13-94	53-60	47-53	0-2	SE	66-73	87-93	29.94	0.30-R
	4-14-94	60-73	69-81	0-3	W/WNW	40-81	29-69	29.89	None
OR1	2-14-94	46-66	42-62	0-3	N/NW	41-73	48-80	30.20	None
	2-15-94	43-70	41-59	0-4	N/NE	32-75	46-60	30.04	Trace
	2-16-94	38-60	53-59	0-1	NW/SE	40-79	38-54	29.71	None
OR2	2-17-94	47-58	45-53	0-6	NW	50-65	53-74	29.22	0.15-R
	2-18-94	44-73	40-57	0-4	S/SW	31-63	45-77	29.64	Trace
	2-19-94	42-73	37-62	0-2	W/NW	28-61	37-76	29.75	Trace

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SERVICE STATION PERSONNEL EXPOSURE
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Location	Date	T_i (°F)	T_o (°F)	WS (mph)	WD	H_i (%RH)	H_o (%RH)	Bar ("Hg)	P_{in}
				WINTER (Continued)					
OR3	2-22-94	50-67	46-52	0-10	SSW	37-53	66-71	30.22	Trace
	2-23-94	51-60	49-53	0-7	WSW	58-68	78-84	29.99	0.25-R
	2-24-94	42-55	39-44	0-1	NE	48-85	70-83	29.93	1.0-R

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SUMMARY OF METEOROLOGICAL DATA

SERVICE STATION PERSONNEL EXPOSURE
AMERICAN PETROLEUM INSTITUTE

WINTER & SUMMER 1994

Location	Date	T_i (°F)	T_o (°F)	WS (mph)	WD	H_i (%RH)	H_o (%RH)	Bar ("Hg)	P_{in}
				SUMMER					
AZ1S	7-21-94	88-101	88-104	0-3	NNE	29-41	20-43	29.89	None
	7-22-94	93-101	96-105	0	WSW	31-37	29-31	29.86	None
	7-23-94	91-103	96-104	0-5	NW	29-39	27-37	29.92	None
AZ2S	7-11-94	92-98	95-107	0-1	NE	34-41	27-30	29.89	None
	7-12-94	92-98	93-112	0-2	SW	28-34	21-30	28.63	None
	7-13-94	89-98	91-107	0-3	SE	26-30	20-25	29.93	None
AZ3S	7-14-94	92-110	90-107	0-4	NNW	21-28	17-27	28.69	None
	7-15-94	94-101	86-101	0-1	NW/SW	24-28	16-24	29.97	None
	7-16-94	88-102	87-100	0-2	SW	25-30	21-26	29.83	None

SUMMARY OF METEOROLOGICAL DATA

SERVICE STATION PERSONNEL EXPOSURE
AMERICAN PETROLEUM INSTITUTE

WINTER & SUMMER 1994

Location	Date	T_i (°F)	T_o (°F)	WS (mph)	WD	H_i (%RH)	H_o (%RH)	Bar ("Hg)	P_{in}
				SUMMER (Continued)					
AZ4S	7-18-94	86-93	80-90	0-6	NW	42-61	46-75	30.01	0.05-R
	7-19-94	84-99	80-94	0-4	NW	36-55	49-65	29.98	None
	7-20-94	91-94	89-92	0	NE	38-42	42-47	29.94	None
MN2S	7-19-94	75-96	71-96	0-6	ESE	49-66	49-79	29.78	None
	7-20-94	68-103	66-92	0-6	WSW	32-64	33-73	28.96	None
	7-21-94	71-95	65-79	0-2	SW	42-71	67-92	28.87	0.30-R
MN3S	7-26-94	66-79	63-70	6-9	NNW	44-56	51-76	29.05	Trace-R
	7-27-94	67-82	61-82	0-7	NNW	31-65	28-75	29.12	None
	7-28-94	71-86	67-85	0-5	NNW	40-59	40-63	29.14	None

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SERVICE STATION PERSONNEL EXPOSURE
AMERICAN PETROLEUM INSTITUTE

WINTER & SUMMER 1994

Location	Date	T_i (°F)	T_o (°F)	WS (mph)	WD	H_i (%RH)	H_o (%RH)	Bar ("Hg)	P_{in}
				SUMMER (Continued)					
MN4S	7-22-94	72-81	71-79	1-6	NNE	56-72	59-68	28.97	None
	7-23-94	71-93	74-84	0-6	NW	34-65	39-60	29.04	None
	7-25-94	67-83	63-77	0-10	NNW	26-58	37-67	29.03	None
NY1S	8-02-94	80-86	77-88	0	None	55-74	59-82	30.04	None
	8-03-94	79-86	73-90	0	None	53-83	53-90	30.03	Trace (<0.05-R)
	8-04-94	80-86	73-89	0-2	NW	60-75	60-86	30.00	None
NY2S	8-16-94	67-80	63-82	0-1	NE	47-63	44-75	30.18	None
	8-17-94	71-76	69-76	0	None	64-75	66-81	30.18	Trace (<0.05-R)
	8-18-94	77-84	75-84	0-4	SW	65-80	69-88	29.90	None

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SUMMARY OF METEOROLOGICAL DATA

SERVICE STATION PERSONNEL EXPOSURE
AMERICAN PETROLEUM INSTITUTE

WINTER & SUMMER 1994

Location	Date	T_i (°F)	T_o (°F)	WS (mph)	WD	H_i (%RH)	H_o (%RH)	Bar ("Hg)	P_{in}
				SUMMER (Continued)					
NY9S	8-04-94	84-92	80-97	0-4	NNE	49-68	36-68	29.90	None
	8-05-94	86-80	85-79	0-4	NNE	66-76	61-100	29.71	1.45-R
	8-08-94	79-83	73-89	0-3	WSW	38-49	28-50	30.08	None
NY4S	8-09-94	71-88	65-86	0-4	NW/SE	41-60	38-72	29.97	None
	8-10-94	74-81	71-79	0-3	NNW	47-52	45-57	30.01	None
	8-11-94	72-80	70-78	0-2	N	40-55	39-58	30.05	None
NY6S	7-20-94	80-89	80-96	0-3	ENE	62-79	46-78	29.99	None
	7-21-94	82-91	82-95	0-6	SSW	51-72	39-68	29.93	None
	7-22-94	84-92	82-93	0-6	SW/SE	55-73	46-68	29.79	None

APPENDIX B

SUMMARY OF METEOROLOGICAL DATA

SERVICE STATION PERSONNEL EXPOSURE
AMERICAN PETROLEUM INSTITUTE

WINTER & SUMMER 1994

Location	Date	T_i (°F)	T_o (°F)	WS (mph)	WD	H_i (%RH)	H_o (%RH)	Bar ("Hg)	P_{in}
				SUMMER (Continued)					
NY7S	7-27-94	82-89	77-84	0-1	NE	47-58	45-59	29.78	None
	7-28-94	78-83	79-94	0-3	SSW	66-80	45-75	29.75	0.25-R
	7-29-94	79-86	76-97	0-4	WSW	44-71	29-65	30.02	None
OR1S	8-11-94	71-91	64-95	0-5	SSW	22-41	17-54	30.02	None
	8-12-94	68-91	61-96	0-6	SSW	24-49	19-58	29.83	None
	8-13-94	70-95	63-97	0-6	SSW	26-49	22-57	29.83	None
OR2S	8-08-94	78-91	65-86	0-8	SW	23-41	21-52	29.97	None
	8-09-94	75-102	68-93	0-3	S/SW	24-44	21-51	29.99	None
	8-10-94	71-100	68-95	0-7	SSW	21-48	18-50	29.87	None

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SUMMARY OF METEOROLOGICAL DATA

SERVICE STATION PERSONNEL EXPOSURE
AMERICAN PETROLEUM INSTITUTE

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Location	Date	T_i (°F)	T_o (°F)	WS (mph)	WD	H_i (%RH)	H_o (%RH)	Bar ("Hg)	P_{in}
				SUMMER (Continued)					
OR3S	8-15-94	72-83	67-81	0-4	N	33-51	35-61	30.13	None
	8-16-94	71-90	67-82	0-3	NW	31-53	33-61	30.05	None
	8-17-94	68-83	64-82	0-5	WNW	33-58	33-71	30.05	None

T_i	indoor temperature near mechanic	BAR	barometric pressure in inches of Mercury
T_o	temperature outside near pumping attendant	°F	temperature in degrees fahrenheit
WS	wind speed	mph	miles per hour
WD	predominant wind direction	%RH	percent relative humidity
H_i	indoor humidity near mechanic	P_{in}	precipitation in inches: R=Rain, S=Snow
H_o	outdoor humidity near pumping attendant		

APPENDIX C

AIR SAMPLING RESULTS

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

WINTER & SUMMER 1994

APPENDIX C

AIRBORNE ORGANIC VAPOR CONCENTRATIONS
WINTER & SUMMER 1994

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

*	Emergency at home, employee had to leave early.
•	Where no values are given in the oxygenates columns, compound was not present in the fuel and therefore not analyzed.
a	Since these sample blanks were contaminated with toluene, the toluene results from these samples are not included in any of the statistical analyses.
b	Since there was apparent breakthrough greater than 25% on the back sampling tube section, these results may underestimate the true concentration.
LOC.CODE	Location Code
SAMPLE #	Individual sample number
DATE	Date the sample was collected
JOB	A - refueling attendant, M - mechanic, D - fuel truck delivery. The number following A or M distinguishes among the individual employees being monitored.
DESCRIPTION	Activities conducted during the sampling period
GAL	Approximate volume of gasoline in gallons pumped during the sampling period
ST/MIN	Sampling Time in Minutes. The concentrations are averaged over the sampling duration.
ppm	Parts per million
mg/M^3	Milligrams per cubic meter of air
BEN	Benzene
TOL	Toluene
XYL	Xylene
EB	Ethyl Benzene
ETOH	Ethanol
MTBE	Methyl Tertiary Butyl Ether
TAME	Tertiary Amyl Methyl Ether
THC	Total hydrocarbons

APPENDIX C

AIRBORNE ORGANIC VAPOR CONCENTRATIONS
WINTER & SUMMER 1994

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

LOC CODE SAMPLE #	DATE	JOB	DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	*MTBE ppm	THC mg/M³
			WINTER 1994 SOUTHWEST									
AZ1-01A	17-Feb-93	A1	HELP SELF-SERVE CUSTOMERS STORAGE TANKS GAUGING, IN STORE, IN OFFICE, REPAIR TIRE, REFUELING 14 CARS	132	360	0.02	<1	<1	<1	<1		5.1
AZ1-02A	17-Feb-93	M1	IN OFFICE ON PHONE AND COMPUTER, 2 OIL CHANGES, TEST DRIVE CAR	-	390	<0.02	<1	<1	<1	<1		1.6
AZ1-03	17-Feb-93	A1	GAUGING STORAGE TANKS REFUELING, 1 CAR	11	15	<0.21	<1	<1	<1	<2.2		<3.1
AZ1-04	17-Feb-93	A1	REFUELING, 2 CARS	29	15	<0.21	<1	<1	<1	<2.2		<3.1
AZ1-05	17-Feb-93	M1	TUNE-UP 1 CAR	-	21	<0.15	<1	<1	<1	<1.6		<2.2
AZ1-06	17-Feb-93	M1	OPEN HOOD ON IDLING CAR	-	17	<0.18	<1	<1	<1	<1.9		<2.8
AZ1-07A	18-Feb-94	A2	CLEAN FLOORS, CHANGED SET OF TIRES PAINT SIDEWALK, PICK UP TRASH WORK IN STORE, PARK A TRUCK, REFUELING 11 CARS	95	420	0.02	<1	<1	<1	<1		5.6
AZ1-08A	18-Feb-94	M2	MISC. IN GARAGE, GAUGING STORAGE TANKS, PHONE CALL, WORKING ON AND TEST DRIVING CARS	-	420	<0.01	<1	<1	<1	<1		2.2
AZ1-09	18-Feb-94	M2	GAUGING STORAGE TANK	-	18	<0.17	<1	<1	<1	<1.8		<2.6
AZ1-10	18-Feb-94	A2	REFUELING 1 CAR	14	15	<0.21	<1	<1	<1	<2.2		<3.1
AZ1-11	18-Feb-94	M2	TRY TO FIND LEAK ON CAR	-	18	<0.17	<1	<1	<1	<1.8		<2.6
AZ1-12	18-Feb-94	A2	REFUELING 1 CAR	5	15	<0.21	<1	<1	<1	<2.2		<3.1
AZ1-13A	19-Feb-94	M3	WORK ON BRAKES, COOLING SYSTEM REMOVE BATTERY, WORK ON WINDSHIELD WIPERS	-	410	<0.01	<1	<1	<1	<1		4
AZ1-14A	19-Feb-94	A2	IN STORE, GARAGE & PUMP ISLAND, REFUELING 7 CARS	65	360	0.02	<1	<1	<1	<1		3.4

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APPENDIX C

AIRBORNE ORGANIC VAPOR CONCENTRATIONS
WINTER & SUMMER 1994

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

LOC CODE SAMPLE #	DATE	JOB	DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	*MTBE ppm	THC mg/M³
			WINTER 1994 SOUTHWEST									
AZ1-15	19-Feb-94	A2	REFUELING 3 CARS	36	15	<0.21	<1	<1	<1	<2.2		<3.1
AZ1-16	19-Feb-94	A2	REFUELING 2 CARS	15	20	<0.16	<1	<1	<1	<1.6		<2.4
AZ1-17	19-Feb-94	M3	1 OIL CHANGE	-	16	<0.2	<1	<1	<1	<1.9		<3
AZ1-18	19-Feb-94	M3	WORK ON COOLING SYSTEM	-	15	<0.21	<1	<1	<1	<2.1		<3.2
AZ2-01A	14-Feb-94	A1	CASHIER'S AREA & PUMP ISLAND, REFUELING 15 CARS	171	475	0.03	<1	<1	<1		0.38	11
AZ2-02A	14-Feb-94	M1	PHONE CALLS, REMOVE RADIATOR, BALANCE WHEELS, 1 OIL CHANGE, TUNE-UP, MISC.	-	466	<0.01	<1	<1	<1		0.03	4
AZ2-03	14-Feb-94	A1	REFUELING 2 CARS	16	16	<0.2	<1	<1	<1		0.58	5.8
AZ2-04	14-Feb-94	A1	REFUELING, 2 CARS	23	15	<0.21	<1	<1	<1		1.2	21
AZ2-05	14-Feb-94	M1	TUNE-UP 1 CAR	-	15	<0.21	<1	<1	<1		<0.32	<3.2
AZ2-06	14-Feb-94	M1	1 OIL CHANGE	-	15	<0.21	<1	<1	<1		<0.32	<3.2
AZ2-07A	15-Feb-94	A1	REFUELING 14 CARS	135	430	0.04	<1	<1	<1		0.5	14
AZ2-08A	15-Feb-94	M1	1 OIL CHANGE, REPLACE COMPRESSOR MISC. DUTIES	-	445	<0.01	<1	<1	<1		<0.02	8.4
AZ2-09	15-Feb-94	A1	REFUELING 2 CARS	26	20	<0.16	<1	<1	<1		0.57	9.4
AZ2-10	15-Feb-94	A1	REFUELING, 3 CARS, NOZZLE LEAKED GAS (ABOUT 1 QUART)	27	15	0.24	<1	<1	<1		2.1	60
AZ2-11	15-Feb-94	M1	IN GARAGE AREA	-	19	<0.16	<1	<1	<1		<0.26	<2.5
AZ2-12	15-Feb-94	M1	GARAGE, PHONE CALLS, PAPERWORK	-	16	<0.2	<1	<1	<1		<0.31	<2.9
AZ2-13A	16-Feb-94	A1	CASHIER AREA & PUMP ISLAND, REFUELING 11 CARS	120	420	0.04	<1	<1	<1		0.5	12

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APPENDIX C

AIRBORNE ORGANIC VAPOR CONCENTRATIONS
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SERVICE STATION PERSONNEL EXPOSURE STUDY
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LOC CODE SAMPLE #	DATE	JOB	DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	*MTBE ppm	THC mg/M³
			WINTER 1994 SOUTHWEST									
AZ2-14A	16-Feb-94	M1	PHONE CALLS, DRAIN GAS TANK TUNE-UP CAR, REPAIR TAIL LIGHT WORK ON COMPRESSOR, MISC./GARAGE	-	420	0.34	<1	<1	<1		1.3	58
AZ2-15	16-Feb-94	M1	DRAIN GAS TANK, TUNE-UP 1 QUART GAS LEAKED ON FLOOR	-	20	0.27	<1	<1	<1		1.2	97
AZ2-16	16-Feb-94	M1	REMOVE GAS TANK FROM CAR (GASOLINE MAY HAVE DUMPED NEAR/ON CHARCOAL TUBE)	-	18	1.3	3.8	1.7	<1		5.3	280
AZ2-17	16-Feb-94	A1	REFUELING 1 CAR	10	16	<0.2	<1	<1	<1		0.79	6.6
AZ2-18	16-Feb-94	A1	REFUELING 1 CAR	12	15	<0.21	<1	<1	<1		<0.33	<3.1
AZ3-01A	21-Feb-94	A1	IN GARAGE AREA AND SELF SERVICE, REFUELING 2 CARS	18	345	<0.02	<1	<1	<1	<1		7.5
AZ3-02A	21-Feb-94	M1	IDLING CAR, 1 OIL CHANGE, CHANGE, EMISSIONS MODULE, FIX AIR COND.	-	476	<0.01	<1	<1	<1	<1		2.4
AZ3-03	21-Feb-94	M1	CHECKING CAR ENGINE	-	20	<0.16	<1	<1	<1	<1.8		<2.3
AZ3-04	21-Feb-94	A1	HELPING MECHANIC IN GARAGE	-	15	<0.21	<1	<1	<1	<2.4		41
AZ3-05	21-Feb-94	A1	REFUELING 1 CAR, USING TRICHLOROETHANE TO CLEAN TIRE	13	15	<0.21	<1	<1	<1	<2.4		27
AZ3-06	21-Feb-94	M1	CHECKING CAR AIR CONDITIONER	-	15	<0.21	<1	<1	<1	<2.4		<3.1
AZ3-07A	22-Feb-94	M1	CAR IDLING, OIL CHANGE, REPAIR TIRE, EMISSION TEST, TEST DRIVE	-	490	0.02	<1	<1	<1	<1		9
AZ3-08A	22-Feb-94	A1	PUMP ISLAND, HELP MECHANICS IN GARAGE, DRAIN COOLANT, CHANGE TIRE, REFUELING 5 CARS	47	420	0.02	<1	<1	<1	<1		1.8
AZ3-09	22-Feb-94	M1	1 OIL CHANGE	-	15	<0.21	<1	<1	<1	<2.4		14

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APPENDIX C

AIRBORNE ORGANIC VAPOR CONCENTRATIONS
WINTER & SUMMER 1994

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

LOC CODE SAMPLE #	DATE	JOB	DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	*MTBE ppm	THC mg/M³
			WINTER 1994 SOUTHWEST									
AZ3-10	22-Feb-94	A2	IN GARAGE, CHECK CAR EMISSION	-	15	<0.21	<1	<1	<1	<2.4		<3.1
AZ3-11	22-Feb-94	M1	EMISSION TEST	-	15	<0.21	<1	<1	<1	<2.4		<3.1
AZ3-12	22-Feb-94	A2	REFUELING 3 CARS	39	19	<0.16	<1	<1	<1	<1.7		<2.5
AZ3-13A	23-Feb-94	A1	OPEN GARAGE, USE TRICHLOROETHANE CHANGE TIRES, IN GARAGE AREA, REFUELING 2 CARS	23	427	<0.01	<1	<1	<1	<1		2.6
AZ3-14A	23-Feb-94	M1	WASH TOOLS IN SAFETY KLEEN SOLVENT, CHARGE BATTERY, CHECK OIL, BELTS, IDLING CAR, MISC.	-	420	<0.01	<1	<1	<1	<1		4.3
AZ3-15	23-Feb-94	A1	CHANGE TIRE	-	25	<0.12	<1	<1	<1	<1.3		<1.9
AZ3-16	23-Feb-94	M1	REFUELING 1 CAR	10	15	<0.21	<1	<1	<1	<2.2		<3.1
AZ3-17	23-Feb-94	M1	CHECK CAR	-	19	<0.16	<1	<1	<1	<1.7		<2.5
AZ3-18	23-Feb-94	A1	REFUELING 1 CAR	8	15	<0.21	<1	<1	<1	<2.2		<3.1
AZ4-01A	24-Feb-94	M1	BRAKE JOB, 2 OIL CHANGES, FIX COOLANT LEAK, INSIDE DASHBOARD	-	455	<0.01	<1	<1	<1	<1		6.8
AZ4-02A	24-Feb-94	A1	HELP CUSTOMERS SELF SERVE ISLAND, REFUELING 1 CAR	14	244	<0.03	<1	<1	<1	<1		3.6
AZ4-03	24-Feb-94	A1	HELP CUSTOMER SELF SERVE ISLAND	-	15	<0.21	<1	<1	<1	<2.2		6.2
AZ4-04	24-Feb-94	M1	1 OIL CHANGE	-	15	<0.21	<1	<1	<1	<2.2		<3.1
AZ4-05	24-Feb-94	A1	HELP CUSTOMER SELF SERVE ISLAND	-	15	<0.21	<1	<1	<1	<2.2		11
AZ4-06	24-Feb-94	M1	FIX COOLANT LEAK PROBLEM	-	20	<0.16	<1	<1	<1	<1.6		4.7
AZ4-07A	24-Feb-94	A2	HELP CUSTOMERS SELF SERVE AND GARAGE	-	185	<0.03	<1	<1	<1	<1		2.2

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SERVICE STATION PERSONNEL EXPOSURE STUDY
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LOC CODE SAMPLE #	DATE	JOB	DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	*MTBE ppm	THC mg/M³
			WINTER 1994 SOUTHWEST									
AZ4-08A	25-Feb-94	A1	GAUGING STORAGE TANKS, SELF SERVE ISLAND, REFUELING 4 CARS	40	440	0.04	<1	<1	<1	<1		10
AZ4-09	25-Feb-94	A1	GARAGE AREA/PUMP ISLAND CLEAN UP	-	20	<0.16	<1	<1	<1	<1.6		6.2
AZ4-10A	25-Feb-94	M1	REPAIR TIRE, BRAKE JOB, CLEAN BRAKES WITH TRICHLORETHANE	-	420	<0.02	4.3	<1	<1	<1		29
AZ4-11	25-Feb-94	A1	REFUELING 1 CAR, GAUGING STORAGE TANKS	20	15	<0.21	<1	<1	<1	<2.2		6.9
AZ4-12	25-Feb-94	M1	CLEANING BRAKES WITH SOLVENT	-	15	<0.21	20	<1	<1	<2.2		180
AZ4-13	25-Feb-94	M1	FIX CAR USING CARBURETOR SOLVENT	-	15	<0.21	<1	<1	<1	<2.2		<3
AZ4-14A	26-Feb-94	A1	HELP CUSTOMERS SELF SERVE ISLAND	-	435	0.03	<1	<1	<1	<1		5.4
AZ4-15A	26-Feb-94	M1	BRAKE JOB, REPLACE FUEL PUMP	-	420	0.02	<1	<1	<1	<1		4
AZ4-16	26-Feb-94	A1	HELP CUSTOMER SELF SERVE ISLAND	-	20	<0.16	<1	<1	<1	<1.6		<2.2
AZ4-17	26-Feb-94	M1	BRAKE JOB	-	19	<0.17	<1	<1	<1	<1.7		<2.4
AZ4-18	26-Feb-94	M1	REPLACE FUEL PUMP	-	15	<0.21	<1	<1	<1	<2.2		24
AZ4-19	26-Feb-94	A1	HELP CUSTOMER SELF SERVE ISLAND	-	15	<0.21	<1	<1	<1	<2.2		8

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AIRBORNE ORGANIC VAPOR CONCENTRATIONS
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SERVICE STATION PERSONNEL EXPOSURE STUDY
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LOC CODE SAMPLE #	DATE	JOB	DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	ETOH ppm	THC mg/M3
			WINTER 1994 MIDWEST								
MN2-01A	15-Feb-94	A1	CHECK VEHICLE FLUIDS, REPAIR TIRE, CHANGE TIRE, CASHIER OFFICE	12	460	0.02	<1	<1	<1	<1	10
MN2-02A	15-Feb-94	M1	ROTATE TIRES, ADJ. TIMING BELT, OIL CHANGE, TEST DRIVE, TURN DRUMS	-	445	0.03	<1	<1	<1	<1	19
MN2-04A	16-Feb-94	A1	REFUELING 7 VEHICLES, REPAIR TIRES, CHECK OIL CASHIER OFFICE, CLEAN SHOP AREA	70	470	0.14	<1	<1	<1	<1	46
MN2-05A	16-Feb-94	M1	CHANGE OIL, ENGINE DIAGNOSTICS, GASKET REPAIR, TEST DRIVE, REPLACE MUFFLER, BRAKE JOB	-	463	0.19	1.1	<1	<1	<1	51
MN2-07A	17-Feb-94	A1	CASHIER OFFICE, REPAIR TIRES CHECK OIL, CUST. BROKE OFF NOZZLE, REFUELING 2 VEHICLES	20	459	0.09	<1	<1	<1	<1	23
MN2-08A	17-Feb-94	M1	REFUELING, REPAIR TAIL LIGHT, 1 OIL CHANGE TUNE-UP, ENGINE WORK, ADJ.CLUTCH	-	453	0.11	<1	<1	<1	<1	27
MN2-08C	17-Feb-94	M1	ADJUST CARBURETOR	-	15	<0.21	<1	<1	<1	<2.4	6.6
MN4-01A	18-Feb-94	A1/2	CASHIER AREA, REPAIR TIRE, TOW, REFUELING 4 VEHICLES	36	425	0.11	<1	<1	<1	<1	26
MN4-02A	18-Feb-94	M1	EXHAUST WORK, ENGINE WORK, TEST DRIVE, DISMANTLE/REPLACE ENGINE, 1 OIL CHANGE	-	417	<0.02	<1	<1	<1	<1	<0.22
MN4-04A	19-Feb-94	A3	CASHIER AREA, ADD BRAKE FLUID REPLACE WASHER PUMP, HEADLIGHT, REFUELING 4 VEHICLES	44	448	0.15	<1	<1	<1	<1	15

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			WINTER 1994 MIDWEST								
MN4-04C	19-Feb-94	A3	GAUGING STORAGE TANKS	-	15	<0.21	<1	<1	<1	<2.2	<3.1
MN4-05A	19-Feb-94	M1	MISC CASHIER OFFICE, ENGINE WORK, 1 OIL CHANGE, PAPER WORK	-	388	0.17	<1	<1	<1	<1	15
MN4-05C	19-Feb-94	M1	REPLACE FUEL FILTER	-	15	0.47	<1	<1	<1	<2.2	32
MN4-07A	21-Feb-94	A1/2	CASHIER AREA, WHEEL ALIGNMENT, USED ETHER TO START VEHICLE LEAKING GAS TANK BROUGHT IN, REFUELING 8 VEHICLES	71	490	0.12	<1	<1	<1	<1	31
MN4-08A	21-Feb-94	M1	REPLACE BRAKE LINE, ADD COOLANT, TUNE-UP, PAPERWORK, USED ETHER TO START VEHICLE, REPLACE TIMING BELT	-	490	0.1	<1	<1	<1	<1	20
MN3-01A	22-Feb-94	A1	TUNE-UP, BRAKES, WORK ON BATTERY, CASHIER AREA, REFUELING 17 VEHICLES	154	450	0.07	<1	<1	<1	<1	29
MN3-02A	22-Feb-94	M1	REPAIR BRAKES, USED BRAKE CLEANER, REPLACE POWER STEERING HOSE, REPLACE THERMOSTAT	-	450	0.07	<1	<1	<1	<1	32
MN3-04A	23-Feb-94	M1	REPAIR:BLOWER MOTOR, BELTS, EMERGENCY BRAKE, REPL.THERMOSTAT, TIRE REPAIR, 1 OIL CHANGE	-	460	0.11	<1	<1	<1	<1	25
MN3-05A	23-Feb-94	A1	CLEAN SHOP, INSTALL EXHAUST SYSTEM, OIL CHANGE, TURN BRAKE DRUMS, REPACK WHEEL BEARINGS, REFUELING 8 VEHICLES, PLUS 73 GALLONS DIESEL	72	459	<0.04	<1	<1	<1	<1	7.5

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			WINTER 1994 MIDWEST								
MN3-05C	23-Feb-94	A1	REFUELING 2 VEHICLES	23	15	<0.21	<1	<1	<1	<2.4	<3.2
MN3-07A	24-Feb-94	A1	CASHIER AREA, GAUGING STORAGE TANKS, USED BRAKE CLEANING FLUID, 1 OIL CHANGE, REFUELING 11 VEHICLES, PLUS 30 GALLONS DIESEL	136	424	0.05	<1	<1	<1	<1	17
MN3-07C	24-Feb-94	A1	GAUGING STORAGE TANKS, REFUELING 2 VEHICLES, PLUS A THIRD WITH 30 GALLONS DIESEL	28	15	<0.21	<1	<1	<1	<2.4	5.6
MN3-08A	24-Feb-94	M1	ENGINE WORK, WATER PUMP, POWER STEERING HOSE, THERMOSTAT ALTERNATOR	-	472	0.06	<1	<1	<1	<1	18

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			WINTER 1994 NORTHEAST										
NY1-02A	22-Mar-94	A1	REFUELING, CHECK FLUIDS, 67 CARS	690	437	0.02	<1	<1	<1		0.09	<0.02	5.8
NY1-03A	22-Mar-94	M1	PAPERWORK, HOUSEKEEPING, 1 OIL CHANGE, REPLACE RADIATOR, SPRAY CLEAN ENGINE, ELEC PROBLEM	-	393	0.02	<1	<1	<1		0.08	<0.02	8.3
NY1-04	22-Mar-94	A1	REFUELING 2 CARS, SPOKE TO GASOLINE TANK TRUCK DRIVER UNLOADING FUEL	20	15	<0.21	<1	<1	<1		<0.32	<0.24	13
NY1-05	22-Mar-94	D1	DRIVER DISPENSED 4,400 GALLONS REG.UNLEAD, 4,300 GAL. PREM. TO UNDERGROUND STORAGE TANKS, GAUGING SAME TANKS	-	25	<0.12	<1	<1	<1		0.3	0.24	14
NY1-06	22-Mar-94	M1	DUMP 20 GALLONS GAS INTO UNDERGROUND WASTE TANK	20	15	<0.21	<1	<1	<1		<0.32	<0.24	32
NY1-07	22-Mar-94	A1	REFUELING 3 CARS	38	15	<0.21	<1	<1	<1		<0.32	<0.24	10
NY1-08A	23-Mar-94	A2	REFUELING 63 CARS	660	454	<0.01	<1	<1	<1		0.14	<0.02	4.3
NY1-09A	23-Mar-94	M1	PAPERWORK, DRIVE CUST. TO WORK, TIMING BELT, TEST DRIVE, BRAKE JOB	-	449	0.02	<1	<1	<1		0.16	<0.02	4.2
NY1-10	23-Mar-94	A2	REFUELING 3 CARS	23	15	<0.21	<1	<1	<1		<0.32	<0.24	11

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				WINTER 1994 NORTHEAST									
NY1-11	23-Mar-94	M1	ADJUST TIMING BELT, ENGINE RUNNING	-	15	<0.21	<1	<1	<1		<0.32	<0.24	4.3
NY1-12	23-Mar-94	A2	REFUELING 1 CAR	12	15	<0.21	<1	<1	<1		<0.32	<0.24	<3
NY1-13A	24-Mar-94	A3	REFUELING 66 CARS	690	423	<0.01	<1	<1	<1		0.27	<0.02	6.4
NY1-14A	24-Mar-94	M1	OUTSIDE: FLAT TIRE, RADIATOR REPAIR; INSIDE: 1 OIL CHANGE, THERMOSTAT TIMING BELT	-	422	<0.01	<1	<1	<1		0.18	<0.02	3.4
NY1-15	24-Mar-94	A3	REFUELING 2 CARS	23	15	<0.21	<1	<1	<1		<0.32	<0.24	<3
NY1-16	24-Mar-94	M1	OUTSIDE: ENGINE DIAGNOSTICS WHILE ENGINE RUNNING	-	15	<0.21	<1	<1	<1		<0.32	<0.24	<3
NY1-23	24-Mar-94	A3	REFUELING, 2 CARS	23	15	<0.21	<1	<1	<1		<0.32	<0.24	11
NY2-02A	29-Mar-94	M1	OIL CHANGE, TIMING BELT, FUEL FILTER WATER HOSE, BRAKE REPAIR, ENGINE ADJUSTMENTS W/SPRAY CLEANER TRANSMISS.SERV., MECHANIC SMOKES, 6 CARS SERVICED	-	420	0.05	<1	1	<1		0.63	<0.02	22
NY2-03	29-Mar-94	M1	CHANGE FUEL FILTER	-	15	0.45	2.6	1.4	<1		8.7	<0.24	130
NY2-04A	29-Mar-94	A1	REFUELING 5 CARS	56	93	<0.07	<1	<1	<1		<0.11	<0.08	6.6

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AIRBORNE ORGANIC VAPOR CONCENTRATIONS
WINTER & SUMMER 1994

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

LOC CODE SAMPLE #	DATE	JOB	DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	MTBE ppm	*TAME ppm	THC mg/M³
			WINTER 1994 NORTHEAST										
NY2-05A	30-Mar-94	A2	REFUELING APPROXIMATELY 18 CARS	186	403	0.02	<1	<1	<1		0.12	<0.02	8.4
NY2-07A	30-Mar-94	M1	TRANSMISSION, OIL-CHANGE, BRAKES USED BRAKE CLEANER, REPLACE ALTERNATOR	-	265	<0.02	<1	<1	<1		0.13	<0.03	18
NY2-15A	31-Mar-94	M1	REPLACE BRAKES, CHANGE TIRES, USED AEROSOL CLEANER, OIL FILTER GASKET, SERVICES 4 CARS	-	420	<0.02	<1	<1	<1		0.02	<0.02	5.4
NY2-16A	31-Mar-94	A3	REFUELING 12 CARS	161	330	<0.02	<1	<1	<1		<0.03	<0.02	1.8
NY2-17	31-Mar-94	M1	USING BRAKE CLEANER CONTAINING A MIX OF SOLVENTS	-	15	<0.21	<1	<1	<1		<0.35	<0.24	68
NY3-01A	21-Feb-94	A1	REFUELING 111 CARS	1146	491	<0.01	<1	<1	<1		0.2		5.4
NY3-02A	21-Feb-94	A1	REFUELING 10 CARS, DRAIN NOZZLE INTO CONTAINER, REPLACE HOSE	98	23	<0.27	<1	<1	<1		<0.44		<4
NY9-01A	22-Feb-94	A1	REFUELING 290 CARS, CHECKING ENGINE FLUIDS	3189	436	<0.01	<1	<1	<1		0.31		8.8
NY9-02A	22-Feb-94	M1	CLEAN AREA, 5 OIL-CHANGES, TIRE REPAIR, RADIATOR & MISC REPAIR, CHECK BATTERY, SERVICE 11 CARS	-	425	<0.02	<1	<1	<1		0.38		9.3

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APPENDIX C

AIRBORNE ORGANIC VAPOR CONCENTRATIONS
WINTER & SUMMER 1994

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

LOC CODE SAMPLE #	DATE	JOB	DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	MTBE ppm	*TAME ppm	THC mg/M³
				WINTER 1994 NORTHEAST									
NY9-03	22-Feb-94	A1	REFUELING, DELIVERY 4,300 GALLONS NEARBY	-	16	<0.2	<1	<1	<1		1.1		20
NY9-04A	23-Feb-94	A1	REFUELING 127 CARS, RAIN, SAMPLING STOPPED	1397	260	<0.02	<1	<1	<1		<0.04		<0.37
NY9-05A	23-Feb-94	M1	ENGINE WORK, CAR RUNNING, BRAKE LINE BLED, SWEEP, 1 OIL CHANGE, RAIN - SAMPLING STOPPED, SERVICES 3 CARS	-	229	<0.03	<1	<1	<1		<0.05		<0.42
NY4-01	23-Mar-94	A1	REFUELING, DELIVERY 9100 GALLONS, NEARBY	-	15	<0.42	<1	<1	<1		<0.66		<6.2
NY4-02A	22-Mar-94	M1	4 OIL CHANGES, TIRE CHANGE, TEST DRIVE CAR, BRAKE JOB, TUNE-UP	-	420	0.03	<1	<1	<1		0.05		5.5
NY4-03A	22-Mar-94	A1	REFUELING APPROXIMATELY 138 CARS	1524	410	<0.02	<1	<1	<1		0.06		1.7
NY4-04A	23-Mar-94	A1	REFUELING APPROXIMATELY 120 CARS	1310	450	<0.01	<1	<1	<1		0.17		6.2
NY4-05A	23-Mar-94	M1	CLEAN SHOP, 6 OIL CHANGES, CHARGE BATTERY, TUNE-UP, OFFICE	-	450	<0.01	<1	<1	<1		0.03		4.4
NY4-06A	24-Mar-94	A2	REFUELING APPROXIMATELY 122 CARS	1340	430	0.01	<1	<1	<1		0.33		8.5

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APPENDIX C

AIRBORNE ORGANIC VAPOR CONCENTRATIONS
WINTER & SUMMER 1994

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

LOC CODE SAMPLE #	DATE	JOB	DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	MTBE ppm	*TAME ppm	THC mg/M³
			WINTER 1994 NORTHEAST										
NY4-07A	24-Mar-94	M2	4 OIL CHANGES, CLEAN GARAGE, FIX TV, RADIATOR REPAIR, REPLACE FAN BELT ALTERNATOR WORK, STATE INSPECTION	-	425	<0.01	<1	<1	<1		0.03		3.3
NY4-02	23-Mar-94	D1	DELIVERY, 4,350 GALLONS, 87 OCTANE, 4,750 GALLONS, 93 OCTANE	-	15	<0.42	<1	<1	<1		1		24
NY7-01A	12-Apr-94	M1	2 OIL CHANGES, BRAKE REPAIR, STATE INSP. TUNE-UP, BELT REPL. OIL LEAK REPAIR	-	367	0.02	<1	<1	<1		0.1	<0.02	16
NY7-02A	12-Apr-94	A1	REFUELING APPROXIMATELY 104 CARS	1557	322	0.04	<1	<1	<1		0.44	<.020	11
NY7-03	12-Apr-94	A1	GAUGING STORAGE TANKS	-	8	<0.39	<1	<1	<1		1.9	<0.46	18
NY7-04A	13-Apr-94	A1	REFUELING APPROXIMATELY 98 CARS	1274	358	0.04	<1	<1	<1		0.34	<0.02	7.2
NY7-05A	13-Apr-94	M1	TIRE REPAIR, ENGINE DIAGNOSIS ELECTRICAL REPAIR, FUEL FILTER	-	354	0.19	<1	<1	<1		0.86	<0.02	23
NY7-06	13-Apr-94	M1	CHANGING FUEL PUMP AND FILTER	-	14	1.4	1.3	1.2	<1		9.9	<0.26	160
NY7-07A	14-Apr-94	A1	REFUELING APPROXIMATELY 100 CARS	1347	365	<0.02	<1	<1	<1		0.18	<0.02	3.9

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APPENDIX C

AIRBORNE ORGANIC VAPOR CONCENTRATIONS
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SERVICE STATION PERSONNEL EXPOSURE STUDY
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LOC CODE SAMPLE #	DATE	JOB	DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	MTBE ppm	*TAME ppm	THC mg/M³
			WINTER 1994 NORTHEAST										
NY7-08A	14-Apr-94	M1	BRAKE REPAIR, STATE INSPECTION, 1 OIL CHANGE, ENGINE DIAGNOSIS, TUNE-UP, REPLACE ALTERNATOR, BLOWER MOTOR	-	364	<0.02	<1	<1	<1		0.07	<0.02	3.8
NY7-09	14-Apr-94	A1	REFUELING CARS/GALLONS NOT RECORDED	-	8	<0.39	<1	<1	<1		1.3	<0.46	17
NY6-01A	04-Apr-94	A1	REFUELING APPROXIMATELY 99 CARS	1282	340	0.02	<1	<1	<1		0.31	<0.02	11
NY6-02A	04-Apr-94	M1	BRAKE REPAIR, TUNE-UP, FILL FLUIDS STATE INSPECTION, TIRE REPAIR, OFFICE	-	398	<0.02	<1	<1	<1		<0.03	<0.02	16
NY6-04A	05-Apr-94	A1	REFUELING APPROXIMATELY 92 CARS	1192	352	0.06	<1	<1	<1		0.5	<0.02	7.9
NY6-05A	05-Apr-94	M1	TIRE REPAIR, BRAKES, TUNE-UP CHANGE FUEL FILTER, OIL CHANGE	-	355	0.3	<1	1.7	<1		2.6	0.02	59
NY6-06A	06-Apr-94	A1	REFUELING APPROXIMATELY 105 CARS	1367	355	0.03	<1	<1	<1		0.44	<0.02	15
NY6-07A	06-Apr-94	M1	BRAKE REPAIR, TIRE REPAIR, OFFICE AT END OF DAY, REFUELING	-	440	0.02	<1	2.2	<1		0.46	<0.02	60
NY6-03A	05-Apr-94	M1	CHANGE FUEL FILTER	-	23	3.3	6.2	6.3	1.5		32	0.27	490

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AIRBORNE ORGANIC VAPOR CONCENTRATIONS
WINTER & SUMMER 1994

SERVICE STATION PERSONNEL EXPOSURE STUDY
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LOC CODE SAMPLE #	DATE	JOB	DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	ETOH ppm	THC mg/M³
			WINTER 1994 NORTHWEST								
OR1-01	14-Feb-94	M1	ENGINE TEST IN SHOP	-	20	<0.16	<1	<1	<1	<1.7	18
OR1-02A	14-Feb-94	M1	PARTS WASH TANK, USE BRAKE CLEAN, ENGINE TEST, TEST DRIVE, CHECK OIL LEAK, CHANGE TRANSMISSION LINE	-	530	0.31	<1	<1	<1	<1	43
OR1-03A	14-Feb-94	A1	REFUELING, 74 CARS	845	380	0.12	<1	<1	<1	<1	29
OR1-04	14-Feb-94	A1	NO ACTIVITY ISLAND PUMPS	-	15	<0.21	<1	<1	<1	<2.2	54
OR1-05	14-Feb-94	M1	OUTSIDE WORKING ON DIESEL	-	16	3	11	6	1.4	6.5	270
OR1-06	14-Feb-94	A1	REFUELING 3 VEHICLES	35	15	<0.21	<1	<1	<1	<2.2	77
OR1-07A	15-Feb-94	M1	WORK ON DIESEL TRACTOR, WASH PARTS, OIL LEAK, BRAKES, TRANSMISSION	-	480	0.04	<1	<1	<1	<1	10
OR1-08	15-Feb-94	M1	TESTING CAR BRAKES	-	15	<0.21	9.1	<1	<1	<2.2	72
OR1-09A	15-Feb-94	A1	REFUELING, 81 CARS	702	450	0.07	<1	<1	<1	<1	17
OR1-10	15-Feb-94	A1	REFUELING, 5 CARS	41	15	<0.21	<1	<1	<1	<2.2	43
OR1-11	15-Feb-94	M1	WORKING ON TRANSMISSION IN A VAN	-	15	0.58	2.4	1.4	<1	<2.2	52
OR1-12	15-Feb-94	A1	REFUELING, 2 CARS	14	17	<0.19	<1	<1	<1	<2	29
OR1-13A	16-Feb-94	M1	TRANSMISSION (OUTSIDE), ROTATE TIRES, REPLACE ENGINE, TEST DRIVE	-	530	0.38	1	<1	<1	<1	35
OR1-14	16-Feb-94	M1	REMOVING ENGINE FROM VEHICLE	-	18	8.7	19	6.4	1.6	<1.5	470
OR1-15A	16-Feb-94	A2	REFUELING 118 CARS	652	460	0.11	<1	<1	<1	<1	37
OR1-16	16-Feb-94	A3	REFUELING 3 CARS	52	15	<0.21	<1	<1	<1	<1.8	<2.9
OR1-17	16-Feb-94	A2	REFUELING 1 CAR	5	15	<0.21	<1	<1	<1	<1.8	3.7

TAME and MTBE were not present in fuel and therefore not analyzed.

APPENDIX C

AIRBORNE ORGANIC VAPOR CONCENTRATIONS
WINTER & SUMMER 1994

SERVICE STATION PERSONNEL EXPOSURE STUDY
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LOC CODE SAMPLE #	DATE	JOB	DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	ETOH ppm	THC mg/M³
			WINTER 1994 NORTHWEST								
OR1-18	16-Feb-94	M1	TESTING ENGINE IN SHOP	-	16	<0.2	<1	<1	<1	<1.7	3.2
OR2-01A	17-Feb-94	A1	REFUELING 75 CARS	849	465	0.49	1	<1	<1	<1	60
OR2-02A	17-Feb-94	A2	REFUELING 71 CARS, 1 OIL CHANGE	669	469	0.46	<1	<1	<1	<1	63
OR2-03	17-Feb-94	A3	REFUELING 8 CARS	90	23	<0.14	<1	<1	<1	<1.2	12
OR2-04	17-Feb-94	A1	REFUELING 3 CARS	44	16	<0.2	<1	<1	<1	<1.7	74
OR2-05A	18-Feb-94	A4	REFUELING 97 CARS	874	485	0.11	<1	<1	<1	<1	29
OR2-06A	18-Feb-94	A5	REFUELING 90 CARS	671	450	4	11	3.4	1.5	9	420
OR2-07	18-Feb-94	A5	REFUELING 2 CARS	21	15	9.5	33	23	4.8	10	800
OR2-08	18-Feb-94	A4	REFUELING 12 CARS	69	16	0.61	3.4	1.3	<1	<1.8	100
OR2-09	18-Feb-94	A4	REFUELING 1 CAR	11	20	<0.16	<1	<1	<1	<1.4	9.1
OR2-10	18-Feb-94	A5	REFUELING 2 CARS	27	18	<0.18	<1	<1	<1	<1.6	40
OR2-11A	19-Feb-94	A4/8	REFUELING 129 CARS	1019	505	0.08	<1	<1	<1	<1	32
OR2-12A	19-Feb-94	A2/6	REFUELING 112 CARS	555	485	0.11	<1	<1	<1	<1	42
OR2-13	19-Feb-94	A8	REFUELING 3 CARS	41	17	<0.18	<1	<1	<1	<1.7	2.8
OR2-14	19-Feb-94	A6	REFUELING 4 CARS	44	15	<0.21	<1	<1	<1	<1.9	41
OR2-15	19-Feb-94	A5	REFUELING 3 CARS	58	17	0.33	<1	<1	<1	<1.7	92
OR2-16	19-Feb-94	A7	REFUELING 2 CARS	20	16	22	34	14	3	46	3300
OR3-01A	22-Feb-94	M1	OIL CHANGE, FUEL ISLAND, BRAKE INSPECTIONS, DRAIN ANTIFREEZE, INSTALL WATER PUMP, TIMING BELT	-	510	<0.01	<1	<1	<1	<1	1
OR3-02A	22-Feb-94	A1/2	REFUELING 175 CARS	1307	502	0.02	<1	<1	<1	<1	8

TAME and MTBE were not present in fuel and therefore not analyzed.

APPENDIX C

AIRBORNE ORGANIC VAPOR CONCENTRATIONS
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LOC CODE SAMPLE #	DATE	JOB	DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	ETOH ppm	THC mg/M³
			WINTER 1994 NORTHWEST								
OR3-03	22-Feb-94	A1	REFUELING 4 CARS	29	16	<0.2	<1	<1	<1	<1.8	3.6
OR3-04	22-Feb-94	M1	SERVICE WATER PUMP	-	16	<0.2	<1	<1	<1	<1.8	<2.8
OR3-05	22-Feb-94	A2	REFUELING 7 CARS	51	15	<0.21	<1	<1	<1	<1.9	<3
OR3-06	22-Feb-94	M1	MISCELLANEOUS	-	18	<0.17	<1	<1	<1	<1.6	2.6
OR3-07A	23-Feb-94	A3/1	REFUELING 149 CARS	1137	570	0.03	<1	<1	<1	<1	11
OR3-08A	23-Feb-94	M1	INSTALL TIRES, BRAKE WORK, 4 OIL CHANGE/LUBES, EMISSIONS CHECK, ENGINE TEARDOWN, REPLACE HEAD GASKET	-	530	0.06	<1	<1	<1	<1	7.9
OR3-09	23-Feb-94	M1	IN SHOP, REPLACE HEAD GASKET	-	17	<0.18	<1	<1	<1	<1.7	<2.6
OR3-10	23-Feb-94	A3	REFUELING 7 CARS	48	17	<0.18	<1	<1	<1	<1.7	8.3
OR3-11	23-Feb-94	A4	REFUELING 4 CARS	15	15	<0.21	<1	<1	<1	<1.9	16
OR3-12	23-Feb-94	M1	IN SHOP, ENGINE TEARDOWN	-	16	0.68	2.1	<1	<1	<1.8	45
OR3-13A	24-Feb-94	A4	REFUELING 144 CARS	1000	432	0.03	<1	<1	<1	<1	7.8
OR3-14A	24-Feb-94	M1	REFUELING, ROTATE TIRES, INSTALL RADIATOR, OIL CHANGE/LUBE HEAD GASKET	-	495	0.02	<1	<1	<1	<1	4
OR3-15	24-Feb-94	M1	NO WORK TO DO	-	18	<0.18	<1	<1	<1	<1.6	<2.5
OR3-16	24-Feb-94	A4	REFUELING 9 CARS	69	25	<0.13	<1	<1	<1	<1.1	3.1
OR3-17	24-Feb-94	A4	REFUELING	NR	20	<0.16	<1	<1	<1	<1.4	4.5
OR3-18	24-Feb-94	A4	REFUELING	NR	15	<0.21	<1	<1	<1	<1.9	7.7

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AIRBORNE ORGANIC VAPOR CONCENTRATIONS
WINTER & SUMMER 1994

SERVICE STATION PERSONNEL EXPOSURE STUDY
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LOC.CODE SAMPLE #	DATE	JOB	DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	*MTBE ppm	*TAME ppm	THC mg/M³
				SUMMER 1994 SOUTHWEST									
AZ1S-01A	21-Jul-94	M-1	REPAIRING CARS INCLUDING A FLYWHEEL, FRONT DISC BRAKES, CHANGED FAN BELT, A BROKEN HOSE AND A SECOND SET OF BRAKES	0	450	0.02	0.14[a]	0.01	<0.01				6.1
AZ1S-02	21-Jul-94	M-1	WORK ON CAR FLYWHEEL	0	25	<0.12	0.53[a]	0.11	<0.1				<1.9
AZ1S-03A	21-Jul-94	A-1	REFUELED 6 CARS	65	380	0.05	0.12[a]	0.02	<0.01				9
AZ1S-04	21-Jul-94	A-1	IN & OUT OF SELF SERVE AREA, ALSO IN GARAGE	0	25	<0.12	0.63[a]	<0.09	<0.1				<1.9
AZ1S-05	21-Jul-94	A-1	REFUEL, 1 CAR	15	15	0.35	1.1[a]	<0.15	<0.16				31
AZ1S-06	21-Jul-94	M-1	FRONT BRAKES OF CAR	0	15	<0.21	0.80[a]	<0.15	<0.16				<3.1
AZ1S-07A	22-Jul-94	M-1	REMOVE ALTERNATOR, REPLACE FUEL FILTER, REMOVE CARBURETOR, REMOVE AND WORKED ON A RADIATOR	0	450	0.18	0.78[a]	0.22	0.06				19
AZ1S-08	22-Jul-94	M-1	REMOVE AN ALTERNATOR	0	15	<0.21	0.30[a]	<0.15	<0.16				<3.1
AZ1S-09A	22-Jul-94	A-1	REFUELED 9 CARS	94	423	0.11	0.23[a]	0.08	0.02				15
AZ1S-10	22-Jul-94	A-1	GAUGING STORAGE TANKS	0	15	<0.21	0.92[a]	<0.15	<0.16				<3.1

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LOC.CODE SAMPLE #	DATE	JOB	DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	*MTBE ppm	*TAME ppm	THC mg/M³
					SUMMER 1994 SOUTHWEST								
AZ1S-11	22-Jul-94	M-1	CHANGE FUEL FILTER/OIL	0	15	<0.21	0.90[a]	<0.15	<0.16				<3.1
AZ1S-12	22-Jul-94	A-1	REFUELED 2 CARS AT FULL SERVICE	18	15	<0.2	0.71[a]	<0.14	<0.14				4.5
AZ1S-13A & 20A	23-Jul-94	M-1	WORKED ON 6 CARS INCLUDING 3 OIL AND OIL FILTER CHANGES, MISCELLANEOUS ON 2 CARS, ROTATED TIRES.	0	430	<0.03	0.098[a]	<0.02	<0.02				3.5
AZ1S-14	23-Jul-94	M-1	OIL CHANGE	0	15	<0.2	0.73[a]	<0.14	<0.14				<2.9
AZ1S-15A & 19A	23-Jul-94	A-1/2	REFUELED 10 CARS	115	408	0.03	0.05[a]	0.02	<0.02				8.8
AZ1S-16	23-Jul-94	A-1	GAUGING STORAGE TANKS	0	15	<0.2	0.99[a]	<0.14	<0.14				<2.9
AZ1S-17	23-Jul-94	A-1	REFUELED 2 CARS	18	15	<0.2	0.42[a]	<0.14	<0.14				<2.9
AZ1S-18	23-Jul-94	M-1	OIL CHANGE		15	<0.2	0.92[a]	<0.14	<0.14				<2.9
AZ2S-01A	11-Jul-94	A-1	HELP CUSTOMERS AT SELF-SERVICE AREA. REFUELED 14 CARS	118	447	0.15	0.19	0.08	0.02				23
AZ2S-02	11-Jul-94	A-1	REFUEL, 1 CAR	10	22	0.16	0.36	0.21	<0.1				19

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APPENDIX C

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SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

LOC.CODE SAMPLE #	DATE	JOB	DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	*MTBE ppm	*TAME ppm	THC mg/M^3
					SUMMER 1994 SOUTHWEST								
AZ2S-03	11-Jul-94	M-1	REMOVED TRANSMISSION FROM A SMALL TRUCK, ADD COOLANT, CHECK TIRE PRESSURE. MOST OF DAY CUSTOMER SERVICE.	0	450	<0.01	<0.01	<0.01	<0.01				3.3
AZ2S-04	11-Jul-94	M-1	GARAGE MISCELLANEOUS	0	25	<0.13	<0.11	<0.09	<0.09				<1.6
AZ2S-05	11-Jul-94	A-1	REFUEL, 2 CARS	24	15	<0.21	<0.18	<0.16	<0.15				<2.7
AZ2S-06	11-Jul-94	M-1	CHECKING ENGINE OF A CAR	0	15	<0.21	0.19	<0.16	<0.15				6.6
AZ2S-07A	12-Jul-94	M-1	BALANCE TIRES, OIL CHANGE, MISC. GARAGE, CHECK COOLING SYSTEM, CHANGE OIL FILTER, TEST DRIVE CAR	0	445	<0.01	0.11	0.12	0.03				7.5[b]
AZ2S-08	12-Jul-94	M-1	CHECKING ENGINE OF A CAR	0	20	<0.16	<0.14	<0.12	<0.12				<2.0
AZ2S-09A	12-Jul-94	A-1	REFUELED 27 CARS, ASSISTED CUSTOMERS NEAR SELF SERVICE AREA	266	425	0.02	0.02	0.01	<0.01				1.7
AZ2S-10	12-Jul-94	A-1	REFUELED 1 CAR	10	15	0.23	<0.18	<0.16	<0.15				7.7
AZ2S-11	12-Jul-94	A-1	REFUELED 1 CAR	13	15	<0.21	0.43	0.23	<0.15				5.3

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APPENDIX C

AIRBORNE ORGANIC VAPOR CONCENTRATIONS
WINTER & SUMMER 1994

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

LOC.CODE SAMPLE #	DATE	JOB	DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	*MTBE ppm	*TAME ppm	THC mg/M³
					SUMMER 1994 SOUTHWEST								
AZ2S-12	12-Jul-94	M-1	SERVICING 2 CARS	0	15	<0.21	<0.18	<0.16	<0.15				<2.7
AZ2S-13A	12-Jul-94	A-1	REFUELED 7 CARS, ASSISTED CUSTOMERS IN FULL SERVICE	76	460	0.07	0.19	0.13	0.02				13
AZ2S-14	13-Jul-94	A-1	REFUELED 1 CAR	15	25	0.29	0.96	0.69	0.11				49
AZ2S-15A	13-Jul-94	M-1	SUPERVISE SERVICE: TIRE & OIL CHANGE, CHECK COMPUTER BOX, ASSIST. MISC. REPAIRS, ADD OIL, MISC. PHONE CALLS	0	449	<0.01	0.09	0.11	0.03				14
AZ2S-16	13-Jul-94	M-1	SUPERVISE SERVICING OF CARS	0	15	<0.21	<0.18	0.26	<0.15				29
AZ2S-17	13-Jul-94	A-1	REFUELED 1 CAR	20	15	<0.21	0.40	0.27	0.16				8.5
AZ2S-18	13-Jul-94	M-1	SUPERVISE MECHANICS CHECKING COMPUTER IN A CAR	0	15	<0.21	<0.18	0.17	<0.15				<2.7
AZ3S-01A	14-Jul-94	A-1	WORK ON COOLING SYSTEM, TIRE, BRAKES, REPAIR AIR CONDITIONING, REFUELED 1 CAR	15	340	<0.02	0.02	0.07	0.03				2.1
AZ3S-02	14-Jul-94	A-1	REFUELED 1 CAR	15	35	0.09	0.1	<0.06	<0.07				11

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SERVICE STATION PERSONNEL EXPOSURE STUDY
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LOC.CODE SAMPLE #	DATE	JOB	DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	*MTBE ppm	*TAME ppm	THC mg/M³
					SUMMER 1994 SOUTHWEST								
AZ3S-03A	14-Jul-94	M-1	WORK ON 2 AIR CONDITIONING SYSTEM, BRAKE SYSTEM, TOOK MASTER CYLINDER OF BRAKE SYSTEM OUT, CHECK COOLING SYSTEM	0	460	<0.01	<0.01	0.22	0.06				0.9
AZ3S-04	14-Jul-94	M-1	WORKING ON AIR CONDITIONING SYSTEM	0	28	<0.11	<0.09	<0.08	<0.08				<1.6
AZ3S-05	14-Jul-94	M-1	IN GARAGE	0	15	<0.2	<0.18	<0.15	<0.16				<3
AZ3S-06	14-Jul-94	A-1	INSIDE GARAGE, WORKED ON CARS	0	15	<0.2	<0.18	<0.15	<0.16				<3
AZ3S-07A	15-Jul-94	A-1	REFUELED 3 CARS AND SERVICE CARS IN GARAGE	28	400	0.03	0.04	0.34	0.1				2.4
AZ3S-08	15-Jul-94	A-1	REFUELED 1 CAR	8	20	<0.15	<0.13	<0.11	<0.12				4.7
AZ3S-09	15-Jul-94	A-1	IN GARAGE, NO REFUELING	0	15	<0.2	<0.18	7.7	2.1				14
AZ3S-10A	15-Jul-94	M-1	WORK ON 2 AIR CONDITIONING SYSTEMS, FLUSH RADIATOR, DRAIN COOLANT, PICK UP PARTS	0	430	0.02	0.02	0.31	0.09				1
AZ3S-11	15-Jul-94	M-1	WORKING ON AIR CONDITIONING SYSTEM	0	20	<0.15	<0.13	4.2	1.2				6.6

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LOC.CODE SAMPLE #	DATE	JOB	DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	*MTBE ppm	*TAME ppm	THC mg/M³
					SUMMER 1994 SOUTHWEST								
AZ3S-12	15-Jul-94	M-1	DRAIN COOLANT	0	16	<0.19	<0.16	<0.14	<0.15				<2.8
AZ3S-13A	16-Jul-94	A-1	2 OIL CHANGES, CHANGE GAS FILTER, BALANCE TIRE, WASH PART IN PARTS-WASHER	0	355	0.03	0.06	0.16	0.05				3.2
AZ3S-14	16-Jul-94	A-1	WORKED IN SELF SERVE AREA	0	15	<0.2	<0.18	0.32	<0.16				<3.0
AZ3S-15A & 19A	16-Jul-94	M-1/2	REFUELING 1 CAR AT FULL SERVICE, IN SELF-SERVICE AREA, 2 OIL CHANGES, TIRE CHANGE, OIL CHANGE AND CHARGE FREON	5	425	<0.03	0.03	0.16	0.05				2.5
AZ3S-16	16-Jul-94	M-1	WATCH OTHER MECHANIC CHANGE FUEL FILTER	0	15	0.26	0.46	2.0	0.54				17
AZ3S-17	16-Jul-94	A-1	CHANGE GAS FILTER		15	<0.2	<0.18	<0.15	<0.16				<3
AZ3S-18	16-Jul-94	M-1	CHANGE OIL, CHARGE FREON		15	<0.2	<0.18	<0.15	<0.16				<3
AZ4S-01A & 07A	18-Jul-94	A-1/2	REFUELING 1 CAR, WORKED AT SELF-SERVICE ISLAND	10	440	0.05	0.08	0.04	<0.02				3.3
AZ4S-02	18-Jul-94	A-1	GAUGING STORAGE TANKS	0	20	<0.16	<0.14	<0.12	<0.12				7.1

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LOC.CODE SAMPLE #	DATE	JOB	DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	*MTBE ppm	*TAME ppm	THC mg/M³
					SUMMER 1994 SOUTHWEST								
AZ4S-03A	18-Jul-94	M-1	WORKING ON CARBURETOR, RECHARGE FREON, WORK ON COOLING SYSTEM	0	442	0.03	0.05	0.05	0.01				2
AZ4S-04	18-Jul-94	M-1	WORKING ON CAR	0	30	<0.1	<0.09	<0.08	<0.08				<1.6
AZ4S-05	18-Jul-94	A-1	AT SELF-SERVICE ISLAND	0	19	<0.17	<0.14	<0.12	<0.13				<2.5
AZ4S-06	18-Jul-94	M-1	WORKING ON CARBURETOR	0	20	<0.16	<0.14	<0.12	<0.12				<2.4
AZ4S-08A	19-Jul-94	A-1	REFUELING 8 CARS, GAGING TOOLS HELPED OUT AT HOLIDAY INN.	78	430	0.04	0.09	0.05	0.02				4.5
AZ4S-09	19-Jul-94	A-1	HELP CUSTOMERS AT SELF-SERVICE	0	15	<0.21	<0.18	<0.16	<0.16				<3.1
AZ4S-10	19-Jul-94	A-1	GAUGING STORAGE TANKS	0	18	0.28	0.54	0.2	<0.14				21
AZ4S-11A	19-Jul-94	M-1	2 OIL CHANGES, CHANGE FUEL FILTER	0	420	0.04	0.14	0.19	0.05				5
AZ4S-12	19-Jul-94	M-1	MISC GARAGE WORK	0	18	<0.18	0.26	0.14	<0.14				4.5
AZ4S-13	19-Jul-94	M-1	OIL CHANGE	0	16	<0.2	<0.17	<0.15	<0.15				<2.9
AZ4S-14	19-Jul-94	M-1	REPLACE FUEL FILTER	0	16	<0.2	<0.17	<0.15	<0.15				<2.9

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LOC.CODE SAMPLE #	DATE	JOB	DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	*MTBE ppm	*TAME ppm	THC mg/M³
					SUMMER 1994 SOUTHWEST								
AZ4S-15A	20-Jul-94	A-1	SAMPLE TUBE CONTAMINATED WITH MOTOR OIL. NOT CONSIDERED REPRESENTATIVE OF EXPOSURE	0	70	0.18	68	23	5.6				450
AZ4S-16	20-Jul-94	A-1	GAUGING STORAGE TANKS	0	15	0.27	0.46	0.21	<0.16				16
AZ4S-17A	20-Jul-94	A-1	REFUELING 11 CARS	97	350	0.06	0.27	0.10	0.02				8.5
AZ4S-18	20-Jul-94	A-1	GARAGE & SELF-SERVICE ISLAND	0	20	<0.16	0.15	<0.12	<0.12				2.5
AZ4S-19A	20-Jul-94	M-1	REMOVE EXHAUST PIPES, CHECK EMISSIONS, WORK ON U-JOINT, ENGINE WORK	0	420	0.02	0.9	0.28	0.07				8.8
AZ4S-20	20-Jul-94	M-1	REMOVE EXHAUST PIPES, CHECK EMISSIONS	0	15	<0.21	3	2.1	0.44				28
AZ4S-21	20-Jul-94	M-1	WORK ON U-JOINT	0	15	<0.21	<0.18	<0.16	<0.16				<3.1

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LOC.CODE SAMPLE #	DATE	JOB	SUBJECT/DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	*MTBE ppm	*TAME ppm	THC mg/M³
				SUMMER 1994 MIDWEST									
MN2S-01A	19-Jul-94	M-1	REPAIR/RECHARGE A/C, CHANGE STRUTS, OMISSIONS TEST, ADJUST TRANSMISSION, TEST DRIVE	0	457	<0.01	0.18[a]	0.02	<0.01	0.53			1.6
MN2S-02A	19-Jul-94	A-1	REFUELING 2 CARS, CHANGE & REPAIR FLAT (USED RUBBER CEMENT), ROAD SERVICE CALL, INSTALL BATTERY	29	457	<0.01	0.19[a]	0.06	0.02	0.73			3.4
MN2S-04A	20-Jul-94	M-1	WORK ON RADIATOR, REPLACE COOLANT SENSOR, EMISSIONS TEST, REPLACE THERMOSTAT, DIAGNOSTIC TESTING, REPLACE ENGINE COMPUTER, OIL & FUEL FILTER CHANGE	0	482	0.07	0.27[a]	0.08	0.02	1.1			7.6
MN2S-05A	20-Jul-94	M-1	FUEL FILTER CHANGE	0	15	0.35	2.1[a]	0.26	<0.18	5.7			30
MN2S-06A	20-Jul-94	A-1	REFUELING 4 CARS, CHANGE TIRE, REPAIR FLAT, TOW VEHICLE	45	479	0.02	0.12[a]	0.01	<0.01	1.3			2.8
MN2S-08A	21-Jul-94	M-1	SPRAY CARBURETOR CLEANER, EMISSIONS TEST, TEST DRIVE, DIAGNOSTIC TESTING, OIL CHANGE, RECHARGE A/C, MISC ADJUSTMENTS	0	480	0.03	0.17[a]	0.05	0.01	2.1			6

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LOC.CODE SAMPLE #	DATE	JOB	SUBJECT/DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	*MTBE ppm	*TAME ppm	THC mg/M³
					SUMMER 1994 MIDWEST								
MN2S-09A	21-Jul-94	A-1	REFUELING 7 CARS, CHANGE/REPAIR FLAT TIRE	52	462	0.03	0.18[a]	0.03	0.01	2.8			5.5
MN3S-01A	26-Jul-94	M-1	BRAKES, REPLACE CV JOINT, CHANGE PLUGS, OIL CHANGE, REPAIR ANTIFREEZE LEAK, ADJUST CARB., REPAIR TIRE, ALIGNMENT	0	473	0.04	0.09	0.12	0.03				6.4
MN3S-01C	26-Jul-94	M-1	CHANGE FUEL FILTER	0	15	0.49	1.2	0.53	<0.16				46
MN3S-02A	26-Jul-94	A-1	REFUELING 12 CARS, CHANGE SPARK PLUGS, ASSIST WITH CARB., REPAIR TIRE, REPLACE INVENTORY	142	477	0.02	0.03	0.02	<0.01				2.4
MN3S-03A	27-Jul-94	A-1	REFUELING 8 CARS, OIL CHANGE, REPAIR TIRE	101	382	0.02	0.04	0.09	<0.01				6.6
MN3S-03C	27-Jul-94	A-1	CHECKING FUEL LEVELS IN UNDERGROUND STORAGE TANKS	0	15	<0.21	<0.18	<0.16	<0.16				<3.1
MN3S-04A	27-Jul-94	M-1	ALIGNMENT, FUEL FILTER, SPARK PLUGS, TUNE UP, CHANGE OIL FILTER, REGRIND BRAKE ROTORS, REFUELED 1 CAR	15	484	0.02	0.07	0.02	<0.01				1.6
MN3S-04C	27-Jul-94	M-1	CHANGE FUEL FILTER	0	15	0.31	0.38	<0.16	<0.16				29
MN3S-04D	27-Jul-94	M-1	CHANGE FUEL FILTER	0	15	0.36	0.28	1.0	0.19				59

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LOC.CODE SAMPLE #	DATE	JOB	SUBJECT/DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	*MTBE ppm	*TAME ppm	THC mg/M³
					SUMMER 1994 MIDWEST								
MN3S-06A	28-Jul-94	M-1	REFUELING 2 CARS WHEEL ALIGNMENT, WIRING REPAIR, REMOVE HEAD BOLT, BRAKE JOB, CHANGE FUEL FILTER, INSTALL SPARK PLUGS	20	450	0.02	0.04	0.06	0.02				4.3
MN3S-07A	28-Jul-94	A-1	REFUELING CARS, REPAIR AND REMOUNT TIRES, REMOVE RADIATOR, RADIATOR WORK	108	450	0.03	0.09	0.02	<0.01				7.7
MN4S-01A	22-Jul-94	M-1	ADJUST TIMING, TURN ROTORS, REPLACE BRAKES, ADJUST DISTRIBUTOR, TIMING ADJUSTMENTS, TUNE-UP, REMOVE FUEL FILTER	0	473	0.02	0.06	0.38	0.09	<0.15			6.9
MN4S-02A	22-Jul-94	A-1/2	REFUELING 3 CARS, DUMP USED OIL, INSTALL RADIATOR, REPAIR TIRE	30	472	<0.01	<0.01	<0.01	<0.01	<0.15			1.3
MN4S-04A	23-Jul-94	M-1	CHANGE SPARK PLUGS, WIRES, TIMING, SENSOR, THERMOSTAT, TEST DRIVE, REPLACE HEAD GASKET, EXHAUST SYSTEM	0	415	<0.02	0.04	0.31	0.08	<0.18			7

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					SUMMER 1994 MIDWEST								
MN4S-05A	23-Jul-94	A-2	REFUELING 5 CARS, REASSEMBLE RADIATOR, FILL PROPANE TANK, REPLACE HEAD GASKET & SPARK PLUGS, CHANGE TIRE & FUEL FILTER, REPAIR FLAT, FILL RADIATOR.	54	465	0.05	0.12	0.14	0.03	0.21			14
MN4S-07A	25-Jul-94	M-1	REPLACE LIGHT SWITCH, MISC. SHOP, REPLACE A/C GASKET, TRANSMISSION SERVICE, OIL CHANGE, SPRAYED BRAKE CLEANER, TEST DRIVE, GREASE/LUBE	0	439	<0.01	0.02	0.03	<0.01	<0.16			5.7
MN4S-08A	25-Jul-94	A-1/2	REFUELING 9 CARS, PUMP PROPANE, MOWED GRASS, REPAIR FLAT TIRE, DUMP OIL INTO TANK, REMOUNT TIRES, REPAIR LAWN MOWER	116	469	0.02	0.03	0.01	<0.01	<0.15			5.8
MN4S-09A	25-Jul-94	A-2	GAUGING STORAGE TANKS	0	15	<0.21	<0.18	<0.16	<0.16	<2.4			<3.1

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					SUMMER 1994 NORTHEAST								
NY1S-24A	02-Aug-94	A-1	REFUELING, 76 CARS	720	428	0.06	0.11	0.04	<0.01		0.12	<0.02	12
NY1S-25A	02-Aug-94	M-1	ELECTRICAL DIAGNOSIS, RECHARGE A/C, MOVED CARS AROUND STATION	0	431	<0.01	0.04	<0.01	<0.01		<0.02	<0.02	0.41
NY1S-26	02-Aug-94	A-1	REFUELING, 2 CARS	28	15	<0.21	<0.18	<0.15	<0.16		<0.33	<0.24	7.8
NY1S-27	02-Aug-94	A-1	REFUELING, 4 CARS	34	15	<0.21	0.55	<0.15	<0.16		<0.33	<0.24	14
NY1S-28	02-Aug-94	D-1	DELIVERY DRIVER, DISPENSED 5,100 GALLONS REG., 3,600 GAL. PREMIUM TO UNDERGROUND STORAGE TANKS.	8700	25	0.3	0.66	0.1	<0.1		0.86	<0.15	43
NY1S-29A	03-Aug-94	A-2	REFUELING, 56 CARS	685	432	0.04	0.07	0.01	<0.01		0.05	<0.02	6.6
NY1S-30A	03-Aug-94	M-1	REPLACE WATER PUMP	0	440	<0.01	0.1	0.02	<0.01		<0.02	<0.02	1.5
NY1S-31	03-Aug-94	A-2	REFUELING, 2 CARS	24	15	<0.21	<0.18	<0.15	<0.16		<0.33	<0.24	<3.1
NY1S-32	03-Aug-94	A-2	REFUELING, 2 CARS	20	15	<0.21	<0.18	<0.15	<0.16		<0.33	<0.24	4.2
NY1S-33A	04-Aug-94	A-3	REFUELING, 55 CARS	490	433	0.04	0.06	0.02	<0.01		0.05	<0.02	5.7
NY1S-34A	04-Aug-94	A-1	REFUELING, 50 CARS	475	433	0.03	0.07	0.01	<0.01		0.06	<0.02	5.2
NY1S-35	04-Aug-94	A-1	REFUELING, 2 CARS	22	15	<0.21	<0.18	<0.15	<0.16		<0.33	<0.24	<3.1
NY1S-36	04-Aug-94	A-3	REFUELING, 3 CARS	21	15	<0.21	<0.18	<0.15	<0.16		<0.33	<0.24	6.8
NY1S-43	04-Aug-94	A-3	REFUELING, 2 CARS	24	15	<0.21	<0.18	<0.15	<0.16		<0.33	<0.24	<3.1

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LOC.CODE SAMPLE #	DATE	JOB	DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	MTBE ppm	*TAME ppm	THC mg/M³
					SUMMER 1994 NORTHEAST								
NY1S-44	04-Aug-94	A-1	REFUELING, 2 CARS	16	15	<0.21	<0.18	<0.15	<0.16		<0.33	<0.24	<3.1
NY2S-19A	16-Aug-94	M-1	OIL CHANGE, SHOCK ABSORBERS, RECHARGE A/C, CHECK BRAKES (USED AEROSOL BRAKE CLEANER), TIRE REPAIR		420	<0.01	0.02	<0.01	<0.01		<0.02	<0.02	1.7
NY2S-20A	16-Aug-94	A-1	REFUELING, 10 CARS	93	292	1.1	2.1	0.83	0.19		0.21	<0.02	91
NY2S-21	16-Aug-94	M-1	RECHARGE A/C SYSTEM	0	15	<0.21	<0.18	<0.15	<0.16		<0.32	<0.24	<3
NY2S-22	16-Aug-94	A-1	NO GAS DISPENSED	0	15	<0.21	<0.18	<0.15	<0.16		<0.32	<0.24	<3
NY2S-29	16-Aug-94	M-1	CHECK FOR VACUUM SYSTEM LEAKS, RECHARGE A/C	0	15	<0.21	<0.18	<0.15	<0.16		<0.32	<0.24	<3
NY2S-30	16-Aug-94	A-1	REFUELING, 1 CAR	3	15	<0.21	<0.18	<0.15	<0.16		<0.32	<0.24	<3
NY2S-31A	17-Aug-94	M-1	ENGINE COMPARTMENT, CHECKED WIRING, BRAKE JOB, WINDSHIELD WIPER MOTOR REPAIR, REPLACED HORN, REMOVED FUEL LINE, CHECKED FILTER	0	422	0.01	0.04	0.16	0.04		<0.02	<0.02	2.2
NY2S-32A	17-Aug-94	A-1/2	REFUELING, 3 CARS, AND DIAGNOSING ELECTRICAL PROBLEM REFUELING, 5 VEHICLES.	97		289	0.15	0.3	0.12	0.03		0.2	<0.02	19

Note: * Where no values are given, oxygenate was not present in fuel and therefore not analyzed.

APPENDIX C

AIRBORNE ORGANIC VAPOR CONCENTRATIONS
WINTER & SUMMER 1994

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

LOC.CODE SAMPLE #	DATE	JOB	DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	MTBE ppm	*TAME ppm	THC mg/M³
			SUMMER 1994 NORTHEAST										
NY2S-33	17-Aug-94	M-1	WORKED IN ENGINE COMPARTMENT AND CHECKED WIRING, ENGINE NOT RUNNING	0	15	<0.21	<0.18	2.9	0.72		<0.32	<0.24	23
NY2S-34	17-Aug-94	A-1	REFUELING, 1 CAR	10	15	<0.21	<0.18	<0.15	<0.16		<0.32	<0.24	<3
NY2S-35	17-Aug-94	A-2	REFUELING, 2 CARS	26	15	<0.21	<0.18	<0.15	<0.16		<0.32	<0.24	14
NY2S-36	17-Aug-94	M-1	REMOVED FUEL LINE, CHECKED FUEL FILTER	0	15	<0.21	0.18	0.18	<0.16		<0.32	<0.24	3.8
NY2S-37A	18-Aug-94	M-1	REPLACE BROKEN FUEL PUMP (8 OZ. FUEL DRAINED INTO CONTAINER), REMOVED CARB., USED AEROSOL CLEANER, CHANGED FUEL FILTER (8 OZ FUEL DRAINED INTO CONTAINER)	0	429	0.1	0.34	1.6	0.45		0.18	<0.02	22
NY2S-38	18-Aug-94	M-1	REPLACE BROKEN FUEL PUMP (8 OZ. FUEL DRAINED INTO CONTAINER)	0	15	2.3	9.8	8.7	2.3		4.2	<0.24	270
NY2S-39A	18-Aug-94	A-1	REFUELING, 7 CARS	89	191	<0.03	0.06	0.34	0.09		<0.05	<0.04	3.3
NY2S-40	18-Aug-94	M-1	REMOVED CARB., USED AEROSOL CLEANER	0	15	<0.21	0.34	30	8.7		<0.32	<0.24	350
NY2S-41	18-Aug-94	A-1	REFUELING, 1 CAR	18	15	<0.21	0.25	0.94	0.25		<0.32	<0.24	5.8

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AIRBORNE ORGANIC VAPOR CONCENTRATIONS
WINTER & SUMMER 1994

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

LOC.CODE SAMPLE #	DATE	JOB	DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	MTBE ppm	*TAME ppm	THC mg/M³
					SUMMER 1994 NORTHEAST								
NY2S-42	18-Aug-94	M-1	CHANGED FUEL FILTER (8 OZ FUEL DRAINED INTO CONTAINER)	0	15	0.25	0.73	0.32	<0.16		<0.32	<0.24	25
NY2S-43	18-Aug-94	A-1	REFUELING, 2 CARS	20	15	<0.21	<0.18	<0.15	<0.16		<0.32	<0.24	<3
NY4S-01A	09-Aug-94	A-1	REFUELING, APPROXIMATELY 212 CARS	2543	450	0.02	0.04	0.01	<0.01		0.04		7.3
NY4S-02A	09-Aug-94	M-1	CHANGE TIRE, OUTSIDE-PUMPS, WORK ON CRANKSHAFT, 3 OIL CHANGES	0	435	<0.01	0.02	<0.01	<0.01		<0.02		1.5
NY4S-03A	10-Aug-94	A-2	REFUELING APPROXIMATELY 198 CARS	2372	480	0.03	0.09	0.02	<0.01		0.07		13
NY4S-04A	10-Aug-94	M-2	3 OIL CHANGES, TUNE-UP, REMOVE OIL PAN, RECHARGE A/C		470	<0.01	0.05	0.02	0.02		<0.02		2.3
NY4S-04X	10-Aug-94	A-2	CHANGING GASOLINE NOZZLES & HOSES		15	<0.21	0.49	0.41	<0.16		<0.32		29
NY4S-05A	11-Aug-94	A-2	REFUELING APPROXIMATELY 223 CARS	2683	470	0.05	0.1	0.02	<0.01		0.07		21
NY4S-05X	11-Aug-94	A-2	FILL 1 GALLON CONTAINER	1	20	<0.16	0.28	0.12	<0.12		<0.24		29

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APPENDIX C

AIRBORNE ORGANIC VAPOR CONCENTRATIONS
WINTER & SUMMER 1994

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

LOC.CODE SAMPLE #	DATE	JOB	DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	MTBE ppm	*TAME ppm	THC mg/M³
					SUMMER 1994 NORTHEAST								
NY4S-06A	11-Aug-94	M-3	4 OIL CHANGES, CHANGE 4 TIRES, EMISSION INSPECTION, TUNE UP		445	0.01	0.03	0.02	<0.01		<0.02		2
NY6S-01A	20-Jul-94	A-1	REFUELING, APPROXIMATELY 105 CARS	1265	426	0.22	0.19	0.09	0.02		0.15		32
NY6S-02A	20-Jul-94	M-1	RADIATOR REPAIR, REPAIR FLAT, TUNE-UP		410	<0.02	0.02	0.22	0.04		<0.02		3
NY6S-03	21-Jul-94	M-1	REPLACED GAS FILTER		24	<0.13	0.21	0.2	<0.1		<0.22		7.2
NY6S-04A	21-Jul-94	A-1	REFUELING APPROXIMATELY 96 CARS	1148	430	0.08	0.12	0.06	0.01		0.13		22
NY6S-05A	21-Jul-94	M-1	CHARGE BATTERY/REPLACE ALTERNATOR, REPLACE TAIL LIGHT BULB,TUNE-UP/OIL CHANGE, A/C RECHARGE, FUEL PUMP, BRAKE JOB		420	0.02	0.33	0.15	0.03		<0.02		3.1
NY6S-06A	22-Jul-94	A-1	REFUELING APPROXIMATELY 102 CARS	1227	415	0.07	0.12	0.07	0.02		0.12		16

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AIRBORNE ORGANIC VAPOR CONCENTRATIONS
WINTER & SUMMER 1994

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

LOC.CODE SAMPLE #	DATE	JOB	DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	MTBE ppm	*TAME ppm	THC mg/M³
					SUMMER 1994 NORTHEAST								
NY6S-07A	22-Jul-94	M-2	TUNE-UP, OIL CHANGE, A/C RECHARGE, BRAKE JOB, ENGINE DIAGNOSIS, ELECTRICAL TROUBLESHOOT		300	<0.02	0.02	0.02	<0.02		<0.04		0.94
NY7S-02A	27-Jul-94	A-1	REFUELING APPROXIMATELY 105 CARS	1259	425	0.07	0.11	0.07	0.02		0.09		21
NY7S-04A	28-Jul-94	A-2	REFUELING APPROXIMATELY 107 CARS	1289	380	0.03	0.05	0.04	<0.01		0.03		6.1
NY7S-05A	28-Jul-94	M-1	ENGINE DIAGNOSIS, REPLACE BATTERY, TUNE-UP, VALVE COVER GASKET, SPARK PLUGS/WIRES, OIL CHANGE, ENGINE DIAGNOSIS		360	<0.02	0.12	0.26	0.07		<0.03		9.7
NY7S-06A	29-Jul-94	A-2	REFUELING APPROXIMATELY 152 CARS	1820	410	0.04	0.09	0.05	0.01		0.07		12
NY7S-07A	29-Jul-94	M-1	REPAIR FLAT, CHECK TIRES AND SUSPENSION, REPLACE STARTER, ENGINE DIAGNOSIS, TUNE-UP		380	0.02	0.04	0.47	0.11		<0.02		14

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APPENDIX C

AIRBORNE ORGANIC VAPOR CONCENTRATIONS
WINTER & SUMMER 1994

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

LOC.CODE SAMPLE #	DATE	JOB	DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	MTBE ppm	*TAME ppm	THC mg/M³
					SUMMER 1994 NORTHEAST								
NY9S-01A	04-Aug-94	M-1	CLEAN GARAGE, CHECK TIRE PRESSURE, 3 OIL CHANGES/LUBES, SPRAY PAINTING AIR FILTER COVER, PUMPED GAS, STOCK SUPPLIES		420	0.03	0.18	0.14	0.03		0.05	0.02	11
NY9S-02A	04-Aug-94	A-1	REFUELING 191 CARS	2292	410	0.02	0.03	0.01	<0.01		0.04	<0.02	3.7
NY9S-04A	05-Aug-94	M-1	TIRE REPAIR, CLEANING BAY, REFUELING, ENGINE TUNE-UP, OIL CHANGE		350	<0.02	0.02	<0.01	<0.01		<0.03	<0.02	0.61
NY9S-05A	05-Aug-94	A-1	REFUELING 108 CARS	1294	425	0.04	0.06	0.03	<0.01		0.05	<0.02	10
NY9S-06A	08-Aug-94	M-1	REFUELING, REPLACE AUTO LAMP, CHECK & FILL TIRES, REPLACE MUFFLER, 3 OIL CHANGES, TUNE-UP, TIRE REPAIR, SWEEP BAY		420	0.02	0.02	0.02	<0.01		<0.02	<0.02	3.1
NY9S-07A	08-Aug-94	A-1	REFUELING 63 CARS	753	415	0.04	0.05	0.02	<0.01		0.05	<0.02	7.9

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APPENDIX C

AIRBORNE ORGANIC VAPOR CONCENTRATIONS
WINTER & SUMMER 1994

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

LOC.CODE SAMPLE #	DATE	JOB	SUBJECT/DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	*MTBE ppm	*TAME ppm	THC mg/M^3
			SUMMER 1994 NORTHWEST										
OR1S-01A	11-Aug-94	M-1	TUNE-UP, REBUILD CARB, TEST DRIVE, BRAKE JOB	0	480	0.23	1.8	0.38	0.08				30
OR1S-02A	11-Aug-94	A-1	REFUELING,137 CARS	922	450	0.12	0.18	0.05	<0.01				20
OR1S-03	11-Aug-94	A-2	REFUELING, 5 CARS	29	15	<0.21	<0.18	<0.15	<0.16				<3.1
OR1S-04	11-Aug-94	A-2	REFUELING, 5 CARS	49	15	<0.21	<0.18	<0.15	<0.16				<3.1
OR1S-05	11-Aug-94	M-1	BRAKE JOB	0	15	<0.21	<0.18	<0.15	<0.16				<3.1
OR1S-06A	12-Aug-94	A-3	REFUELING, 170 CARS	1091	465	0.10	0.18	0.10	0.02				13
OR1S-07A	12-Aug-94	M-1	TUNE UP, RADIATOR REPAIR, INSTALL FUEL PUMP, REBUILD CARB, A/C REPAIR, PULL HEAD ON CAR (OUTSIDE), A/C CHARGE, COMPRESSION TEST	0	465	0.26	0.61	0.32	0.07				22
OR1S-08	12-Aug-94	M-1	A/C REPAIR	0	15	0.39	0.89	0.73	<0.16				20
OR1S-09	12-Aug-94	A-3	REFUELING 17 CARS	86	15	0.91	0.99	0.20	<0.16				170
OR1S-10	12-Aug-94	M-1	TUNE-UP/TRANSMISSION SERVICE	0	15	<0.21	<0.18	<0.15	<0.16				<3.1
OR1S-11	12-Aug-94	A-3	REFUELING NO CARS	0	15	<0.21	<0.18	<0.15	<0.16				20
*OR1S-12A	13-Aug-94	M-2	OIL CHANGE, CHANGE THROW-OUT CABLE, LUBE/OIL/PUMP	0	250	<0.02	<0.02	<0.02	<0.02				0.71

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APPENDIX C

AIRBORNE ORGANIC VAPOR CONCENTRATIONS
WINTER & SUMMER 1994

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

LOC.CODE SAMPLE #	DATE	JOB	SUBJECT/DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	*MTBE ppm	*TAME ppm	THC mg/M^3
					SUMMER 1994 NORTHWEST								
OR1S-13A	13-Aug-94	A-3	REFUELING 135 CARS	400	480	0.06	0.07	0.02	<0.01				10
OR1S-14	13-Aug-94	M-2	LUBE/OIL/PUMP	0	20	<0.16	<0.13	<0.11	<0.12				<2.3
OR1S-15	13-Aug-94	A-3	REFUELING 2 CARS	39	18	<0.17	<0.15	<0.13	<0.14				<2.6
OR1S-16	13-Aug-94	A-3	REFUELING	NR	16	<0.2	<0.16	<0.14	<0.15				<2.9
OR2S-01A	08-Aug-94	A-1/2	REFUELING 139 CARS	965	480	1.2	1.7	0.6	0.13		0.42		110
OR2S-02A	08-Aug-94	A-3	REFUELING 220 CARS	1426	475	0.22	0.24	0.08	0.02		0.11		34
OR2S-03	08-Aug-94	A-2	REFUELING 6 CARS	41	26	<0.12	<0.10	0.25	<0.09		<0.19		5.4
OR2S-04	08-Aug-94	A-4	REFUELING 12 CARS	78	20	<0.16	<0.13	<0.11	<0.12		<0.25		9.1
OR2S-05A	09-Aug-94	A-1/3	REFUELING 165 CARS	1420	480	0.22	0.21	0.06	0.01		0.12		33
OR2S-06A	09-Aug-94	A-5/2	REFUELING, 142 CARS	936	480	0.15	0.16	0.13	0.02		0.08		27
OR2S-07	09-Aug-94	A-7	REFUELING 2 CARS	29	15	0.24	0.33	<0.15	<0.16		<0.33		22
OR2S-08	09-Aug-94	A-3	REFUELING	NR	15	<0.21	<0.18	<0.15	<0.16		<0.33		9.3
OR2S-09A	10-Aug-94	A-5/2	REFUELING 94 CARS	883	470	0.16	0.15	0.05	0.01		0.08		22
OR2S-10A	10-Aug-94	A-1/6	REFUELING 93 CARS	780	470	0.11	0.12	0.04	<0.01		0.07		15
OR2S-11	10-Aug-94	A-6	REFUELING	NR	15	<0.21	<0.18	<0.15	<0.16		<0.33		14
OR2S-12	10-Aug-94	A-4	REFUELING	NR	15	<0.21	<0.18	<0.15	<0.16		<0.33		<3.1
OR3S-01A	15-Aug-94	A-1	REFUELING 97 CARS	875	436	0.1	0.09	0.04	<0.01				13
OR3S-02A	15-Aug-94	A-2/3	REFUELING 134 CARS	881	470	0.08	0.08	0.03	<0.01				10

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AIRBORNE ORGANIC VAPOR CONCENTRATIONS
WINTER & SUMMER 1994

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

LOC.CODE SAMPLE #	DATE	JOB	SUBJECT/DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	*MTBE ppm	*TAME ppm	THC mg/M³
				SUMMER 1994 NORTHWEST									
OR3S-03	15-Aug-94	A-2	REFUELING 2 CARS	32	15	0.24	<0.18	<0.15	<0.16				8.6
OR3S-04	15-Aug-94	A-3	REFUELING 4 CARS	38	15	<0.21	<0.18	<0.15	<0.16				8.4
OR3S-05	15-Aug-94	A-3	REFUELING	NR	15	<0.21	<0.18	<0.15	<0.16				12
OR3S-06A	16-Aug-94	M-1	REFUELING, TUNE-UP, REPLACE ALTERNATOR, BRAKE JOB, REPLACE THERMOSTAT, REPLACE HEATER CORE, OIL CHANGE	NR	420	0.06	0.09	0.1	0.03				6.1
OR3S-07A	16-Aug-94	A-2/4	REFUELING 109 CARS	815	450	0.06	0.07	0.02	<0.01				6.4
OR3S-08	16-Aug-94	A-2	"MILKING" HOSES	0	19	0.37	0.47	0.12	<0.13				31
OR3S-09	16-Aug-94	M-1	REPLACE THERMOSTAT	0	15	<0.21	<0.18	<0.15	<0.16				<3.1
OR3S-10	16-Aug-94	A-4	"MILKING" HOSES	0	18	<0.17	<0.15	<0.13	<0.14				2.8
OR3S-11A	17-Aug-94	M-1	REFUELING, BRAKE INSPECTION, LUBE/OIL, TRANS. SERVICE, TUNE-UP, HEATER CORE REPLACEMENT, REPAIR FUEL TANK INTAKE (EPOXY), CHECK ELECTRICAL SYSTEM	0	460	0.1	0.25	0.1	0.03				1.1
OR3S-12A	17-Aug-94	A-4	REFUELING 139 CARS	944	435	0.04	0.07	0.03	<0.01				4.7
OR3S-13	17-Aug-94	M-1	LUBE/OIL CHANGE	0	15	<0.21	<0.18	<0.15	<0.16				<3.1

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APPENDIX C

AIRBORNE ORGANIC VAPOR CONCENTRATIONS
WINTER & SUMMER 1994

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

LOC.CODE SAMPLE #	DATE	JOB	SUBJECT/DESCRIPTION	GAL	ST MIN	BEN ppm	TOL ppm	XYL ppm	EB ppm	*ETOH ppm	*MTBE ppm	*TAME ppm	THC mg/M³
					SUMMER 1994 NORTHWEST								
OR3S-14	17-Aug-94	A-4	"MILKING" HOSES	0	15	<0.21	0.22	<0.15	<0.16				14
OR3S-15	17-Aug-94	A-4	REFUELING 5 CARS	29	15	<0.21	<0.18	<0.15	<0.16				<3.1
OR3S-16	17-Aug-94	M-1	OIL/LUBE, TRANS SERVICE	0	15	0.22	0.66	0.16	<0.16				<3.1

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APPENDIX D

STATISTICAL ANALYSIS BY ANALYTE

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

WINTER & SUMMER 1994

APPENDIX D

STATISTICAL ANALYSIS BY ANALYTE FOR ATTENDANT - WINTER 1994

Descriptive Statistics								
Exposure Type	Number of Values		Benzene - Concentration, ppm					
	ALL	ND	MIN.	MAX.	MEDIAN	GM	GSD	LOD
SHORT TERM	59	56	0.12	0.61	0.21	0.21	1.30	<0.12 - <0.42
LONG TERM	51	15	0.01	0.49	0.03	0.04	2.58	<0.01 - <0.07

Distributional Statistics									
Exposure Type	Number of Values		Benzene - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	59	56	0	0	59	0	0	0	0
LONG TERM	51	15	0	41	10	0	0	0	0

Descriptive Statistics								
Exposure Type	Number of Values		Toluene - Concentration, ppm					
	ALL	ND	MIN.	MAX.	MEDIAN	GM	GSD	LOD
SHORT TERM	59	58	1	3.4	1	1.02	1.17	<0.12 - <0.36
LONG TERM	51	50	1	1	1	1	1	<0.01 - <0.02

Distributional Statistics									
Exposure Time	Number of Values		Toluene - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	59	58	0	0	58	1	0	0	0
LONG TERM	51	50	0	0	50	1	0	0	0

APPENDIX D
STATISTICAL ANALYSIS BY ANALYTE FOR ATTENDANT - WINTER 1994

Descriptive Statistics

	Number of Values		Xylene - Concentration, ppm					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	59	58	1	1.3	1	1.0	1.03	<0.01 - <0.30
LONG TERM	51	51	1	1	1	1	1	<0.01 - <0.03

Distributional Statistics

Exposure Time	Number of Values		Xylene - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	59	58	0	0	58	1	0	0	0
LONG TERM	51	51	0	0	51	0	0	0	0

Descriptive Statistics

Exposure Time	Number of Values		Ethyl Benzene - Concentration, ppm					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	59	59	1	1	1	1	1	<0.10 - <0.31
LONG TERM	51	51	1	1	1	1	1	<0.01 - <0.03

Distributional Statistics

Exposure Time	Number of Values		Ethyl Benzene - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	59	59	0	0	59	0	0	0	0
LONG TERM	51	51	0	0	51	0	0	0	0

APPENDIX D
STATISTICAL ANALYSIS BY ANALYTE FOR ATTENDANT - WINTER 1994

Descriptive Statistics								
Exposure Time	Number of Values		Total Hydrocarbons - Concentration, mg/M^3					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	59	20	1.9	100	6.60	8.54	3.05	<1.9 - <6.2
LONG TERM	51	2	0.37	63	8.4	8.88	2.72	<0.37 - <4.2

Distributional Statistics									
Exposure Time	Number of Values		Total Hydrocarbons - Concentration Range, mg/M^3						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	59	20	0	0	0	37	21	1	0
LONG TERM	51	2	0	0	1	29	21	0	0

Descriptive Statistics								
Exposure Time	Number of Values		Ethanol - Concentration, ppm					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	42	41	1	2.4	1.9	1.87	1.24	<1.0 - <2.4
LONG TERM	30	30	1	1	1	1	1	<0.14 - <0.33

Distributional Statistics									
Exposure Time	Number of Values		Ethanol - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	42	41	0	0	1	41	0	0	0
LONG TERM	30	30	0	0	30	0	0	0	0

APPENDIX D
STATISTICAL ANALYSIS BY ANALYTE FOR ATTENDANT - WINTER 1994

Descriptive Statistics

Exposure Time	Number of Values		MTBE - Concentration, ppm					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	17	8	0.32	2.1	0.57	0.60	1.96	<0.32 - <0.66
LONG TERM	21	3	0.03	0.5	0.27	0.20	2.33	<0.03 - <0.11

Distributional Statistics

Exposure Time	Number of Values		MTBE - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	17	8	0	0	12	5	0	0	0
LONG TERM	21	3	0	4	17	0	0	0	0

Descriptive Statistics

Exposure Time	Number of Values		TAME - Concentration, ppm					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	8	7	0.24	0.46	0.24	0.28	1.35	<0.24 - <0.46
LONG TERM	12	12	0.02	0.08	0.02	0.02	1.49	<0.02 - <0.08

Distributional Statistics

Exposure Time	Number of Values		TAME - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	8	7	0	0	8	0	0	0	0
LONG TERM	12	12	0	12	0	0	0	0	0

APPENDIX D
STATISTICAL ANALYSIS BY ANALYTE FOR MECHANIC - WINTER 1994

Descriptive Statistics								
Exposure Type	Number of Values		Benzene - Concentration, ppm					
	ALL	ND	MIN.	MAX.	MEDIAN	GM	GSD	LOD
SHORT TERM	44	34	0.15	8.7	0.21	0.29	2.49	<0.15 - <0.21
LONG TERM	44	20	0.01	0.38	0.02	0.03	3.10	<0.01 - <0.03

Distributional Statistics									
Exposure Type	Number of Values		Benzene - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	44	34	0	0	39	5	0	0	0
LONG TERM	44	20	0	35	9	0	0	0	0

Descriptive Statistics								
Exposure Type	Number of Values		Toluene - Concentration, ppm					
	ALL	ND	MIN.	MAX.	MEDIAN	GM	GSD	LOD
SHORT TERM	44	34	1	20	1	1.46	2.29	<0.13 - <0.18
LONG TERM	44	41	1	4.3	1	1.04	1.25	<0.01 - <0.01

Distributional Statistics									
Exposure Time	Number of Values		Toluene - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	44	34	0	0	34	7	3	0	0
LONG TERM	44	41	0	0	41	3	0	0	0

APPENDIX D
STATISTICAL ANALYSIS BY ANALYTE FOR MECHANIC - WINTER 1994

Descriptive Statistics								
	Number of Values		Xylene - Concentration, ppm					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	44	37	1	6.4	1	1.17	1.60	<0.09 - <0.15
LONG TERM	44	41	1	2.2	1	1.03	1.15	<0.01 - <0.02

Distributional Statistics									
Exposure Time	Number of Values		Xylene - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	44	37	0	0	37	7	0	0	0
LONG TERM	44	41	0	0	41	3	0	0	0

Descriptive Statistics								
Exposure Time	Number of Values		Ethyl Benzene - Concentration, ppm					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	44	41	1	1.6	1	1.03	1.11	<0.09 - <0.15
LONG TERM	44	44	1	1	1	1	1	<0.01 - <0.02

Distributional Statistics									
Exposure Time	Number of Values		Ethyl Benzene - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	44	41	0	0	41	3	0	0	0
LONG TERM	44	44	0	0	44	0	0	0	0

APPENDIX D
STATISTICAL ANALYSIS BY ANALYTE FOR MECHANIC - WINTER 1994

Descriptive Statistics								
Exposure Time	Number of Values		Total Hydrocarbons - Concentration, mg/M³					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	44	22	2.2	490	3.2	10.81	5.95	<2.2 - <3.2
LONG TERM	44	2	0.22	60	8.7	8.62	3.59	<0.22 - <0.42

Distributional Statistics									
Exposure Time	Number of Values		Total Hydrocarbons - Concentration Range, mg/M³						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	44	22	0	0	0	27	10	3	4
LONG TERM	44	2	0	0	2	23	19	0	0

Descriptive Statistics								
Exposure Time	Number of Values		Ethanol - Concentration, ppm					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	30	28	1.5	6.5	1.85	2.01	1.31	<1.5 - <2.4
LONG TERM	24	24	1	1	1	1	1	<0.12 - <0.15

Distributional Statistics									
Exposure Time	Number of Values		Ethanol - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	30	28	0	0	0	30	0	0	0
LONG TERM	24	24	0	0	24	0	0	0	0

APPENDIX D
STATISTICAL ANALYSIS BY ANALYTE FOR MECHANIC - WINTER 1994

Descriptive Statistics								
Exposure Time	Number of Values		MTBE - Concentration, ppm					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	13	8	0.26	32	0.32	1.04	5.59	<0.26 - <0.35
LONG TERM	20	3	0.02	2.6	0.09	0.12	4.37	<0.02 - <0.05

Distributional Statistics									
Exposure Time	Number of Values		MTBE - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	13	8	0	0	8	4	1	0	0
LONG TERM	20	3	0	11	7	2	0	0	0

Descriptive Statistics								
Exposure Time	Number of Values		TAME - Concentration, ppm					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	7	5	0.24	0.27	0.24	0.25	1.05	<0.24 - <0.26
LONG TERM	12	10	0.02	0.03	0.02	0.02	1.12	<0.02 - <0.03

Distributional Statistics									
Exposure Time	Number of Values		TAME - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	7	5	0	0	7	0	0	0	0
LONG TERM	12	10	0	12	0	0	0	0	0

APPENDIX D
STATISTICAL ANALYSIS BY ANALYTE FOR ATTENDANT - SUMMER 1994

Descriptive Statistics

Exposure Type	Number of Values		Benzene - Concentration, ppm					
	ALL	ND	MIN.	MAX.	MEDIAN	GM	GSD	LOD
SHORT TERM	60	50	0.12	0.91	0.21	0.21	1.31	<0.12 - <0.21
LONG TERM	54	4	0.01	1.2	0.05	0.06	2.63	<0.01 - <0.03

Distributional Statistics

Exposure Type	Number of Values		Benzene - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	60	50	0	0	60	0	0	0	0
LONG TERM	54	4	0	42	10	2	0	0	0

Descriptive Statistics

Exposure Type	Number of Values		Toluene - Concentration, ppm					
	ALL	ND	MIN.	MAX.	MEDIAN	GM	GSD	LOD
SHORT TERM	54	39	0.10	0.99	0.18	0.22	1.62	<0.1 - <0.18
LONG TERM	48	1	0.01	2.1	0.09	0.09	2.61	<0.01

Distributional Statistics

Exposure Time	Number of Values		Toluene - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	54	39	0	1	53	0	0	0	0
LONG TERM	48	1	0	29	17	2	0	0	0

APPENDIX D
STATISTICAL ANALYSIS BY ANALYTE FOR ATTENDANT - SUMMER 1994

Descriptive Statistics

	NUMBER OF VALUES		Xylene - Concentration, ppm					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	60	16	0.09	7.70	0.15	0.18	1.87	<0.09 - <0.16
LONG TERM	54	2	0.01	0.83	0.05	0.05	2.87	<0.01 - <0.06

Distributional Statistics

Exposure Time	Number of Values		Xylene - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	60	46	0	1	58	1	0	0	0
LONG TERM	54	2	0	45	9	0	0	0	0

Descriptive Statistics

Exposure Time	Number of Values		Ethyl Benzene - Concentration, ppm					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	60	57	0.09	2.10	0.16	0.16	1.46	<0.09 - <0.16
LONG TERM	54	28	0.01	0.19	0.01	0.02	2.10	<0.01 - <0.07

Distributional Statistics

Exposure Time	Number of Values		Ethyl Benzene - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	60	56	0	3	56	1	0	0	0
LONG TERM	54	29	0	52	2	0	0	0	0

APPENDIX D
STATISTICAL ANALYSIS BY ANALYTE FOR ATTENDANT - SUMMER 1994

Descriptive Statistics

Exposure Time	Number of Values		Total Hydrocarbons - Concentration, mg/M³					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	60	26	1.90	170	4.6	6.41	2.58	<1.9 - <3.1
LONG TERM	54	0	1.30	110	9.5	9.24	2.53	None

Distributional Statistics

Exposure Time	Number of Values		Total Hydrocarbons - Concentration Range, mg/M³						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	60	26	0	0	0	43	16	1	0
LONG TERM	54	0	0	0	0	30	23	1	0

Descriptive Statistics

Exposure Time	Number of Values		Ethanol - Concentration, ppm					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	1	1	2.40	2.40	2.40	2.40	N/A	<2.4
LONG TERM	6	2	0.15	2.80	0.47	0.48	3.45	<0.15

Distributional Statistics

Exposure Time	Number of Values		Ethanol - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	1	1	0	0	0	1	0	0	0
LONG TERM	6	2	0	0	4	2	0	0	0

APPENDIX D
STATISTICAL ANALYSIS BY ANALYTE FOR ATTENDANT - SUMMER 1994

Descriptive Statistics

Exposure Time	Number of Values		MTBE - Concentration, ppm					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	22	22	0.19	0.33	0.33	0.31	1.15	<0.019 - <0.33
LONG TERM	25	1	0.03	0.42	0.07	0.08	1.84	<0.05

Distributional Statistics

Exposure Time	Number of Values		MTBE - Concentration Range, ppm						
	ALL	ND	<0.01	0.01<-0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	22	22	0	0	22	0	0	0	0
LONG TERM	25	1	0	16	9	0	0	0	0

Descriptive Statistics

Exposure Time	Number of Values		TAME - Concentration, ppm					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	14	14	0.24	0.24	0.24	0.24	1.00	<0.24
LONG TERM	10	10	0.02	0.04	0.02	0.02	1.25	<0.02 - <0.04

Distributional Statistics

Exposure Time	Number of Values		TAME - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	14	14	0	0	14	0	0	0	0
LONG TERM	10	10	0	10	0	0	0	0	0

APPENDIX D
STATISTICAL ANALYSIS BY ANALYTE FOR MECHANIC - SUMMER 1994

Descriptive Statistics

Exposure Type	Number of Values		Benzene - Concentration, ppm					
	ALL	ND	MIN.	MAX.	MEDIAN	GM	GSD	LOD
SHORT TERM	44	35	0.1	2.30	0.21	0.22	1.61	<0.1 - <0.21
LONG TERM	42	19	0.01	0.26	0.02	0.02	2.42	<0.01 - <0.03

Distributional Statistics

Exposure Type	Number of Values		Benzene - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	44	35	0	1	42	1	0	0	0
LONG TERM	42	19	0	39	3	0	0	0	0

Descriptive Statistics

Exposure Type	Number of Values		Toluene - Concentration, ppm					
	ALL	ND	MIN.	MAX.	MEDIAN	GM	GSD	LOD
SHORT TERM	37	23	0.09	9.80	0.18	0.26	2.60	<0.09 - <0.18
LONG TERM	36	3	0.01	1.80	0.05	0.06	3.50	<0.01 - <0.02

Distributional Statistics

Exposure Time	Number of Values		Toluene - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	37	23	0	2	32	3	0	0	0
LONG TERM	36	3	0	26	9	1	0	0	0

APPENDIX D
STATISTICAL ANALYSIS BY ANALYTE FOR MECHANIC - SUMMER 1994

Descriptive Statistics

	Number of Values		Xylene - Concentration, ppm					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	44	26	0.08	30.0	0.15	0.27	3.71	<0.08 - <0.16
LONG TERM	42	7	0.01	1.60	0.10	0.07	3.89	<0.01 - <0.02

Distributional Statistics

Exposure Time	Number of Values		Xylene - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	44	26	0	3	34	6	1	0	0
LONG TERM	42	7	0	22	19	1	0	0	0

Descriptive Statistics

Exposure Time	Number of Values		Ethyl Benzene - Concentration, ppm					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	44	37	0.08	8.70	0.16	0.19	2.39	<0.08 - <0.18
LONG TERM	42	15	0.01	0.45	0.03	0.03	2.51	<0.01 - <0.02

Distributional Statistics

Exposure Time	Number of Values		Ethyl Benzene - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	44	37	0	5	36	3	0	0	0
LONG TERM	42	15	0	40	2	0	0	0	0

APPENDIX D
STATISTICAL ANALYSIS BY ANALYTE FOR MECHANIC - SUMMER 1994

Descriptive Statistics

Exposure Time	Number of Values		Total Hydrocarbons - Concentration, mg/M³					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	44	27	1.60	350.0	3.10	6.15	3.79	<1.6 - <3.1
LONG TERM	42	0	0.41	30.0	3.40	3.69	2.88	None

Distributional Statistics

Exposure Time	Number of Values		Total Hydrocarbons - Concentration Range, mg/M³						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	44	27	0	0	0	32	10	0	2
LONG TERM	42	0	0	0	5	30	7	0	0

Descriptive Statistics

Exposure Time	Number of Values		Ethanol - Concentration, ppm					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	1	0	5.70	5.70	5.70	5.70	N/A	None
LONG TERM	6	3	0.15	2.10	0.36	0.42	3.07	<0.15 - <0.18

Distributional Statistics

Exposure Time	Number of Values		Ethanol - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	1	0	0	0	0	1	0	0	0
LONG TERM	6	3	0	0	4	2	0	0	0

APPENDIX D
STATISTICAL ANALYSIS BY ANALYTE FOR MECHANIC - SUMMER 1994

Descriptive Statistics

Exposure Time	Number of Values		MTBE - Concentration, ppm					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	8	7	0.22	4.20	0.32	0.42	2.56	<0.22 - <0.32
LONG TERM	16	14	0.02	0.18	0.02	0.03	1.80	<0.02 - <0.04

Distributional Statistics

Exposure Time	Number of Values		MTBE - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	8	7	0	0	7	1	0	0	0
LONG TERM	16	14	0	15	1	0	0	0	0

Descriptive Statistics

Exposure Time	Number of Values		TAME - Concentration, ppm					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	7	7	0.24	0.24	0.24	0.24	1.0	<0.24
LONG TERM	8	7	0.02	0.02	0.02	0.02	1.0	<0.02

Distributional Statistics

Exposure Time	Number of Values		TAME - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	7	7	0	0	7	0	0	0	0
LONG TERM	8	7	0	8	0	0	0	0	0

APPENDIX E

STATISTICAL ANALYSIS BY VAPOR RECOVERY SYSTEM

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

WINTER & SUMMER 1994

APPENDIX E
STATISTICAL ANALYSIS FOR STATIONS WITH STAGE II VAPOR RECOVERY SYSTEMS FOR ATTENDANT - WINTER 1994

Descriptive Statistics

Exposure Type	Number of Values		Benzene - Concentration, ppm					
	ALL	ND	MIN.	MAX.	MEDIAN	GM	GSD	LOD
SHORT TERM	42	41	0.12	0.42	0.21	0.21	1.27	<0.12 - <0.42
LONG TERM	34	14	0.01	0.07	0.02	0.02	1.70	<0.01 - <0.07

Distributional Statistics

Exposure Type	Number of Values		Benzene - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	42	41	0	0	42	0	0	0	0
LONG TERM	34	14	0	34	0	0	0	0	0

Descriptive Statistics

Exposure Type	Number of Values		Toluene - Concentration, ppm					
	ALL	ND	MIN.	MAX.	MEDIAN	GM	GSD	LOD
SHORT TERM	42	42	1.0	1.0	1.0	1.0	1.0	<1
LONG TERM	34	34	1.0	1.0	1.0	1.0	1.0	<1

Distributional Statistics

Exposure Time	Number of Values		Toluene - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	42	42	0	0	42	0	0	0	0
LONG TERM	34	34	0	0	34	0	0	0	0

APPENDIX E
STATISTICAL ANALYSIS FOR STATIONS WITH STAGE II VAPOR RECOVERY SYSTEMS FOR ATTENDANT - WINTER 1994

Descriptive Statistics

	Number of Values		Xylene - Concentration, ppm					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	42	42	1.0	1.0	1.0	1.0	1.0	<1
LONG TERM	34	34	1.0	1.0	1.0	1.0	1.0	<1

Distributional Statistics

Exposure Time	Number of Values		Xylene - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	42	42	0	0	42	0	0	0	0
LONG TERM	34	34	0	0	34	0	0	0	0

Descriptive Statistics

Exposure Time	Number of Values		Ethyl Benzene - Concentration, ppm					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	42	42	1.0	1.0	1.0	1.0	1.0	<1.0
LONG TERM	34	34	1.0	1.0	1.0	1.0	1.0	<1.0

Distributional Statistics

Exposure Time	Number of Values		Ethyl Benzene - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-0.1	0.1-1.0	1.0-10	10-100	100-200	>200
SHORT TERM	42	42	0	0	42	0	0	0	0
LONG TERM	34	34	0	0	34	0	0	0	0

APPENDIX E
STATISTICAL ANALYSIS FOR STATIONS WITH STAGE II VAPOR RECOVERY SYSTEMS FOR ATTENDANT - WINTER 1994

Descriptive Statistics

Exposure Time	Number of Values		Total Hydrocarbons - Concentration, mg/M³					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	42	17	1.90	60.0	6.20	6.42	2.34	<1.9 - <6.2
LONG TERM	34	1	0.37	15.0	6.50	5.54	2.14	<0.37

Distributional Statistics

Exposure Time	Number of Values		Total Hydrocarbons - Concentration Range, mg/M³						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	42	17	0	0	0	30	12	0	0
LONG TERM	34	1	0	0	1	26	7	0	0

Descriptive Statistics

Exposure Time	Number of Values		Ethanol - Concentration, ppm					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	25	25	1.0	2.40	2.20	1.88	1.27	<1 - <2.4
LONG TERM	13	13	1.0	1.0	1.0	1.0	1.0	1.0

Distributional Statistics

Exposure Time	Number of Values		Ethanol - Range Concentration, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	25	25	0	0	1	24	0	0	0
LONG TERM	13	13	0	0	13	0	0	0	0

APPENDIX E
STATISTICAL ANALYSIS FOR STATIONS WITH STAGE II VAPOR RECOVERY SYSTEMS FOR ATTENDANT - WINTER 1994

Descriptive Statistics

Exposure Time	Number of Values		MTBE - Concentration, ppm					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	17	8	0.32	2.10	0.57	0.60	1.96	<0.32 - <0.66
LONG TERM	21	3	0.03	0.50	0.27	0.20	2.33	<0.03 - <0.11

Distributional Statistics

Exposure Time	Number of Values		MTBE - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-0.1	0.1-1.0	1.0-10	10-100	100-200	>200
SHORT TERM	17	8	0	0	12	5	0	0	0
LONG TERM	21	3	0	4	17	0	0	0	0

Descriptive Statistics

Exposure Time	Number of Values		TAME - Concentration, ppm					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	8	7	0.24	0.46	0.24	0.28	1.35	<0.24 - <0.46
LONG TERM	12	12	0.02	0.08	0.02	0.02	1.49	<0.02 - <0.08

Distributional Statistics

Exposure Time	Number of Values		TAME - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	8	7	0	0	8	0	0	0	0
LONG TERM	12	12	0	12	0	0	0	0	0

APPENDIX E
STATISTICAL ANALYSIS FOR STATIONS WITH STAGE II VAPOR RECOVERY SYSTEMS FOR ATTENDANT - SUMMER 1994

Descriptive Statistics

Exposure Type	Number of Values		Benzene - Concentration, ppm					
	ALL	ND	MIN.	MAX.	MEDIAN	GM	GSD	LOD
SHORT TERM	46	38	0.12	0.37	0.21	0.21	1.21	<0.12 - <0.21
LONG TERM	36	2	0.02	1.10	0.04	0.05	2.21	<0.02 - <0.03

Distributional Statistics

Exposure Type	Number of Values		Benzene - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	46	38	0	0	46	0	0	0	0
LONG TERM	36	2	0	31	4	1	0	0	0

Descriptive Statistics

Exposure Type	Number of Values		Toluene - Concentration, ppm					
	ALL	ND	MIN.	MAX.	MEDIAN	GM	GSD	LOD
SHORT TERM	40	27	0.13	0.96	0.18	0.23	1.60	<0.13 - <0.18
LONG TERM	33	0	0.02	2.1	0.08	0.09	2.34	N/A

Distributional Statistics

Exposure Time	Number of Values		Toluene - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	40	27	0	0	40	0	0	0	0
LONG TERM	33	0	0	23	9	1	0	0	0

APPENDIX E
STATISTICAL ANALYSIS FOR STATIONS WITH STAGE II VAPOR RECOVERY SYSTEMS FOR ATTENDANT - SUMMER 1994

Descriptive Statistics

	Number of Values		Xylene - Concentration, ppm					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	46	35	0.09	7.70	0.15	0.18	2.03	<0.09 - <0.16
LONG TERM	36	0	0.01	0.83	0.04	0.05	2.89	<0.02 - <0.06

Distributional Statistics

Exposure Time	Number of Values		Xylene - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	46	34	0	1	44	1	0	0	0
LONG TERM	36	1	0	30	6	0	0	0	0

Descriptive Statistics

Exposure Time	Number of Values		Ethyl Benzene - Concentration, ppm					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	46	43	0.10	2.10	0.16	0.16	1.52	<0.10 - <0.16
LONG TERM	36	19	0.01	0.19	0.01	0.02	2.18	<0.01 - <0.07

Distributional Statistics

Exposure Time	Number of Values		Ethyl Benzene - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	46	42	0	2	43	1	0	0	0
LONG TERM	36	20	0	35	1	0	0	0	0

APPENDIX E
STATISTICAL ANALYSIS FOR STATIONS WITH STAGE II VAPOR RECOVERY SYSTEMS FOR ATTENDANT - SUMMER 1994

Descriptive Statistics

Exposure Time	Number of Values		MTBE - Concentration, ppm					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	16	16	0.24	0.33	0.33	0.32	1.08	<0.24 - <0.33
LONG TERM	19	1	0.03	0.21	0.07	0.07	1.76	<0.05

Distributional Statistics

Exposure Time	Number of Values		MTBE - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	16	16	0	0	16	0	0	0	0
LONG TERM	19	1	0	13	6	0	0	0	0

Descriptive Statistics

Exposure Time	Number of Values		TAME - Concentration, ppm					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	14	14	0.24	0.24	0.24	0.24	1.00	<0.24
LONG TERM	10	10	0.02	0.04	0.02	0.02	1.25	<0.02 - <0.04

Distributional Statistics

Exposure Time	Number of Values		TAME - Concentration Range, ppm						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	14	14	0	0	14	0	0	0	0
LONG TERM	10	10	0	10	0	0	0	0	0

APPENDIX E
STATISTICAL ANALYSIS FOR STATIONS WITH STAGE II VAPOR RECOVERY SYSTEMS FOR ATTENDANT - SUMMER 1994

Descriptive Statistics								
Exposure Time	Number of Values		Total Hydrocarbons - Concentration, mg/M³					
	ALL	ND	MIN.	MAX	MEDIAN	GM	GSD	LOD
SHORT TERM	46	19	1.9	49	4.6	6.19	2.39	<1.9 - <3.1
LONG TERM	36	0	1.7	91	8.9	8.72	2.30	N/A

Distributional Statistics									
Exposure Time	Number of Values		Total Hydrocarbons - Concentration Range, mg/M³						
	ALL	ND	<0.01	0.01-<0.1	0.1-<1.0	1.0-<10	10-<100	100-<200	≥200
SHORT TERM	46	19	0	0	0	33	13	0	0
LONG TERM	36	0	0	0	0	21	15	0	0

APPENDIX F

NOTABLE EVENTS

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

WINTER & SUMMER 1994

APPENDIX F

NOTABLE EVENTS

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

WINTER 1993 - SUMMER 1994

Location	Date	Time	Event	Description	Vapor Recovery
WINTER 1993					
AZ1	2/17	1115/1135	Delivery	8,000 gallons 92 octane, 6,500 gallons 87 octane	Stage II
	2/18	0945/1005	Attendant	Paint sidewalk with water-based paint.	Stage II
AZ2	2/15	1045	Spill	Approximately 1 liter, see sample AZ2-10.	Stage II
AZ3	2/21-23	N/A	Attendant	This station is mostly self serve, the attendant pumps gas a few times per hour. Remainder of the time helps the mechanic.	Stage II
AZ4	2/24-26	N/A	Attendant	Mostly self serve as above	Stage II
	2/25	0835/0850	Mechanic	Using perchloroethylene, 1,1,1-trichloroethane to clean brakes and carburetor cleaner containing toluene, acetone and methanol.	Stage II
MN2	2/16	0815	Spill	Approximately 1/4 liter, spilled from nozzle during fill-up. No clean-up.	None

APPENDIX F

NOTABLE EVENTS

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

WINTER 1993 - SUMMER 1994

Location	Date	Time	Event	Description	Vapor Recovery
MN2	2/17	1130	Attendant	Customer broke off nozzle. No spill reported.	None
MN3	2/24	1015	Delivery	2,000 gallons #1 diesel, 4,000 gallons 87 octane, 1,000 gallons 92 octane.	None
MN4	2/18	1230	Delivery	3,700 gallons 87 octane.	None
NY1	3/22	1203/1228	Delivery	4,400 gallons 87 octane, 4,300 gallons 93 octane.	Stage II
	3/22	1400/1415	Mechanic	Manually transferred 20 gallons of gasoline waste into underground storage tank located outside, see sample NY1-06	
	3/24	0835/0900	Delivery	5,100 gallons 87 octane, 3,600 gallons 89 octane.	
NY2	3/29	0924/0958	Delivery	4,400 gallons 87 octane, 1,700 gallons 89 octane, 2,600 gallons 93 octane	Stage II

APPENDIX F

NOTABLE EVENTS

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

WINTER 1993 - SUMMER 1994

Location	Date	Time	Event	Description	Vapor Recovery
MN2	3/29	0758/1516	Weather	Rain started before sampling with light drizzle all day, 0.3 inches rain all day	Stage II
	3/30		Attendant	Attendant estimated approximately 10% of fuel sales were full service, rest is self serve	
	3/31	0700	Delivery	Prior to air sampling	
NY3	2/21	1209	Weather	Rain started around noon, 0.24 inches until end of day	Stage II
NY9	2/22	0947/1002	Delivery	4,300 gallons 87 octane	Stage II
	2/23	1230	Weather	Snow started, API representative requested NATLSCO to stop sampling, 1.5 inches snow by 1230.	
NY4	3/23	1340/1410	Delivery	4,350 gallons 87 octane, 4,750 gallons 93 octane	Stage II
		1050	Spill	1 liter, washed off with a bucket of water	
NY6	4/6	1042/1536	Weather	Light drizzle, 0.05 inches	Stage II

APPENDIX F

NOTABLE EVENTS

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

WINTER 1993 - SUMMER 1994

Location	Date	Time	Event	Description	Vapor Recovery
NY7	4/12	0900/1500	Weather	Rain, 0.25 inches	Stage II
	4/13	0800/1440	Weather	Rain, 0.30 inches	
OR1	2/14	1120/1738	Spills	Several small spills totaling approximately 1 liter.	None
	2/15	1050/1607	Spills	Three small spills totaling 0.5 liters.	
	2/15	0828/1700	Weather	Trace of rain, not measurable.	
OR2	2/17	0941/1656	Weather	Rain, 0.15 inches	None
	2/18	0912/1631	Weather	Trace of rain, not measurable	
	2/18	0940 & 1225	Spills	Small amounts, totaling 0.4 liters	
	2/19	0835/1635	Weather	Trace of rain, not measurable	
OR3	2/22	0853/1716	Weather	Trace of rain, not measurable	Stage II
	2/23	0800/1648	Weather	Rain, 0.25 inches	
	2/23	0825	Spill	0.1 liters	
	2/24	0715/1630	Weather	Rain, 1.0 inch	
	2/24	1401	Spill	0.2 liters	

APPENDIX F

NOTABLE EVENTS

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

WINTER 1993 - SUMMER 1994

Location	Date	Time	Event	Description	Vapor Recovery
OR3	2/24	0745	Delivery	7,450 gallons 87 octane, 2,296 gallons 92 octane, 1,550 gallons diesel.	State II
SUMMER 1994					
MN2	7/20	1405	Spill	0.4 liters fuel spilled during fuel filter change by mechanic	None
MN4	7/23	1245	Spill	0.1 liters fuel spilled during fuel filter change by attendant	None
NY1	8/2	1000/1025	Delivery	5,100 gallons regular, 3,600 gallons premium	Stage II
	8/2	1000/1025	Station	Replaced pressure relief valves for underground storage tanks since winter phase. Vents opened several times during filling with noticeable odor.	
OR1	8/11	1020	Spill	0.1 liter fuel spill. No cleanup.	None
	8/11	1140	Spill	0.2 liter fuel spill. No cleanup.	

APPENDIX F

NOTABLE EVENTS

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

WINTER 1993 - SUMMER 1994

Location	Date	Time	Event	Description	Vapor Recovery
OR1	8/11	1320	Spill	0.5 liter fuel spill. Washed off with water.	None
	8/12	1009	Spill	0.1 liter fuel spill. No cleanup.	
	8/12	1230	Spill	0.1 liter fuel spill. No cleanup.	
	8/12	1320	Spill	0.2 liter fuel spill. Washed off with water.	
	8/12	1510	Spill	0.1 liter fuel spill. No cleanup.	
	8/13	0820	Spill	0.2 liter fuel spill. No cleanup.	
OR2	8/8	1055	Spill	1 liter fuel spill. No cleanup.	None
	8/8	1606	Spill	1 liter fuel spill. Washed off with water.	
	8/9	0940	Spill	0.5 liter fuel spill. No cleanup.	
	8/9	1110	Spill	0.1 liter fuel spill. No cleanup.	

APPENDIX F

NOTABLE EVENTS

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

WINTER 1993 - SUMMER 1994

Location	Date	Time	Event	Description	Vapor Recovery
OR2	8/9	0940	Delivery	5,000 gallons 87 octane, 900 gallons 88 octane, 2,800 gallons 92 octane. Driver used vapor recovery hoses.	None
	8/10	1330	Spill	0.5 liter fuel spill. Washed off with water.	None
	8/10	1350	Delivery	5,700 gallons 87 octane, 2,800 gallons 92 octane. Driver used vapor recovery hoses.	None
OR3	8/15	0840	Spill	0.5 liter fuel spill. Washed off with water.	Stage II
	8/16	1200	Delivery	7,022 gallons 87 octane, 1,730 gallons 88 octane, 2,615 gallons 92 octane. Driver used vapor recovery hoses.	
	8/16	0920	Spill	0.5 liter fuel spill. Washed off with water.	
	8/16	1230	Spill	0.05 liter fuel spill. No cleanup.	

APPENDIX F

NOTABLE EVENTS

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

WINTER 1993 - SUMMER 1994

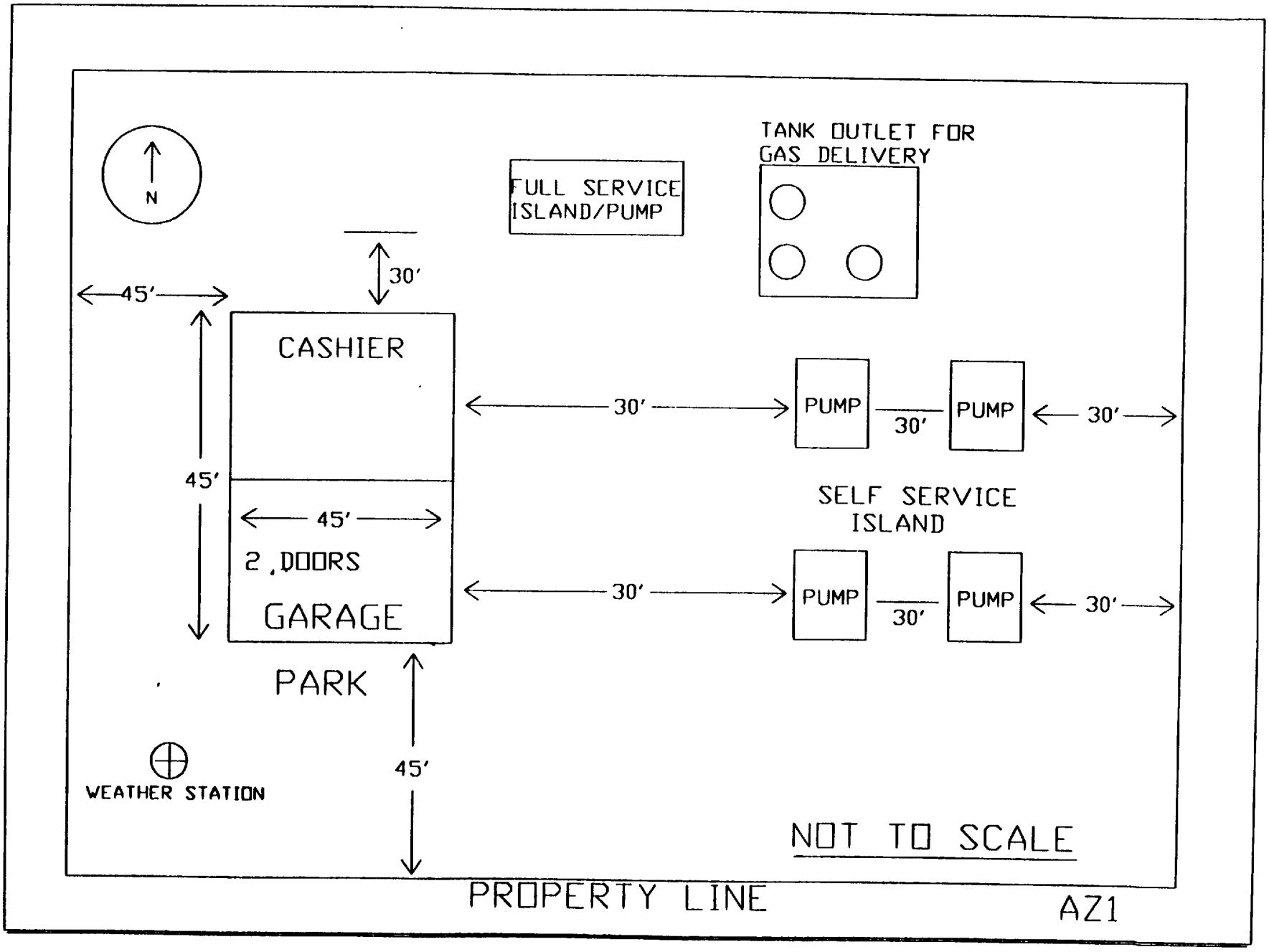
Location	Date	Time	Event	Description	Vapor Recovery
OR3	8/17	1010	Spill	0.1 liter fuel spill. No cleanup.	Stage II
	8/17	1125	Spill	0.05 liter fuel spill. No cleanup.	
	8/17	1500	Spill	0.1 liter fuel spill. No cleanup.	

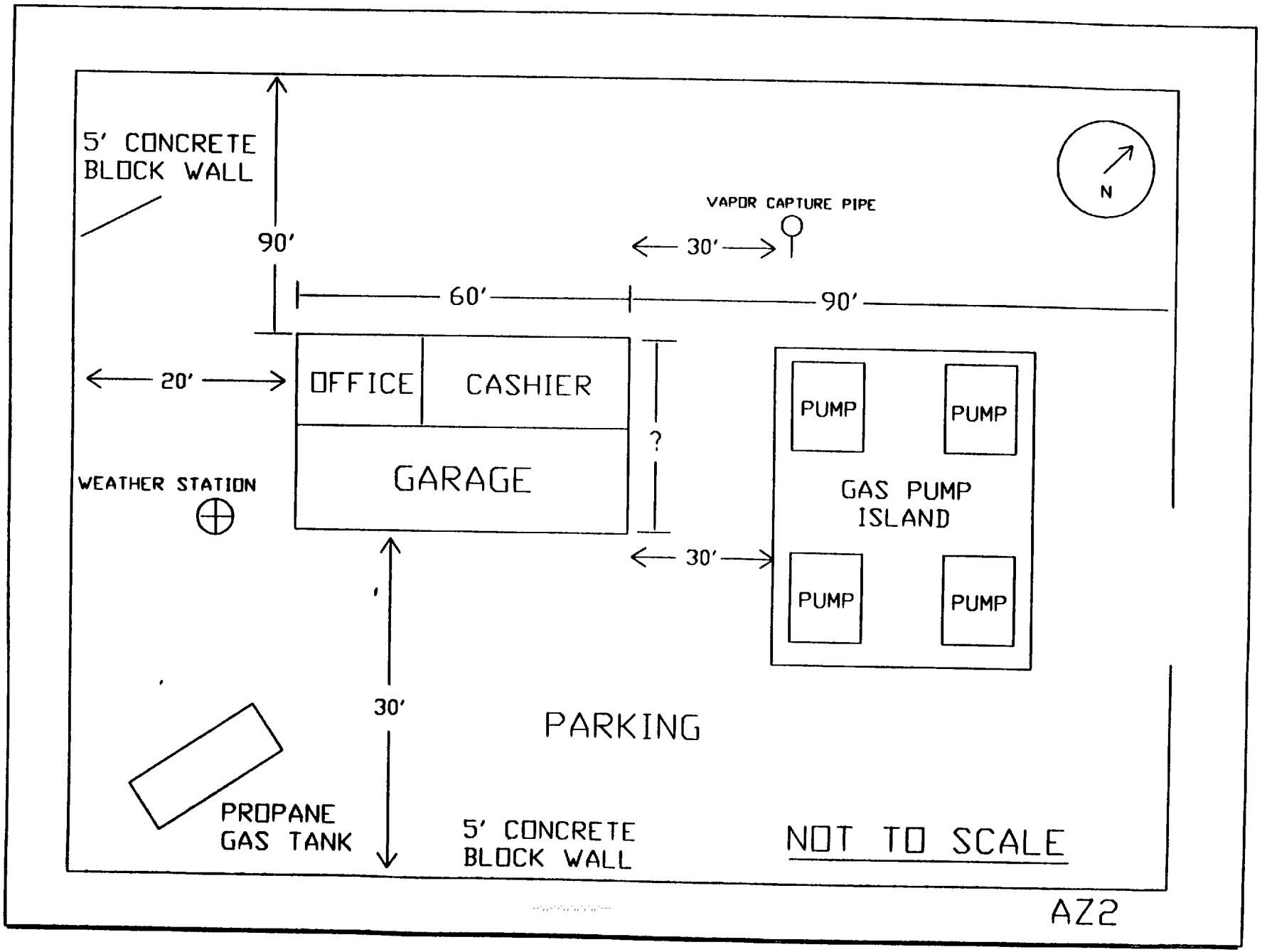
APPENDIX G

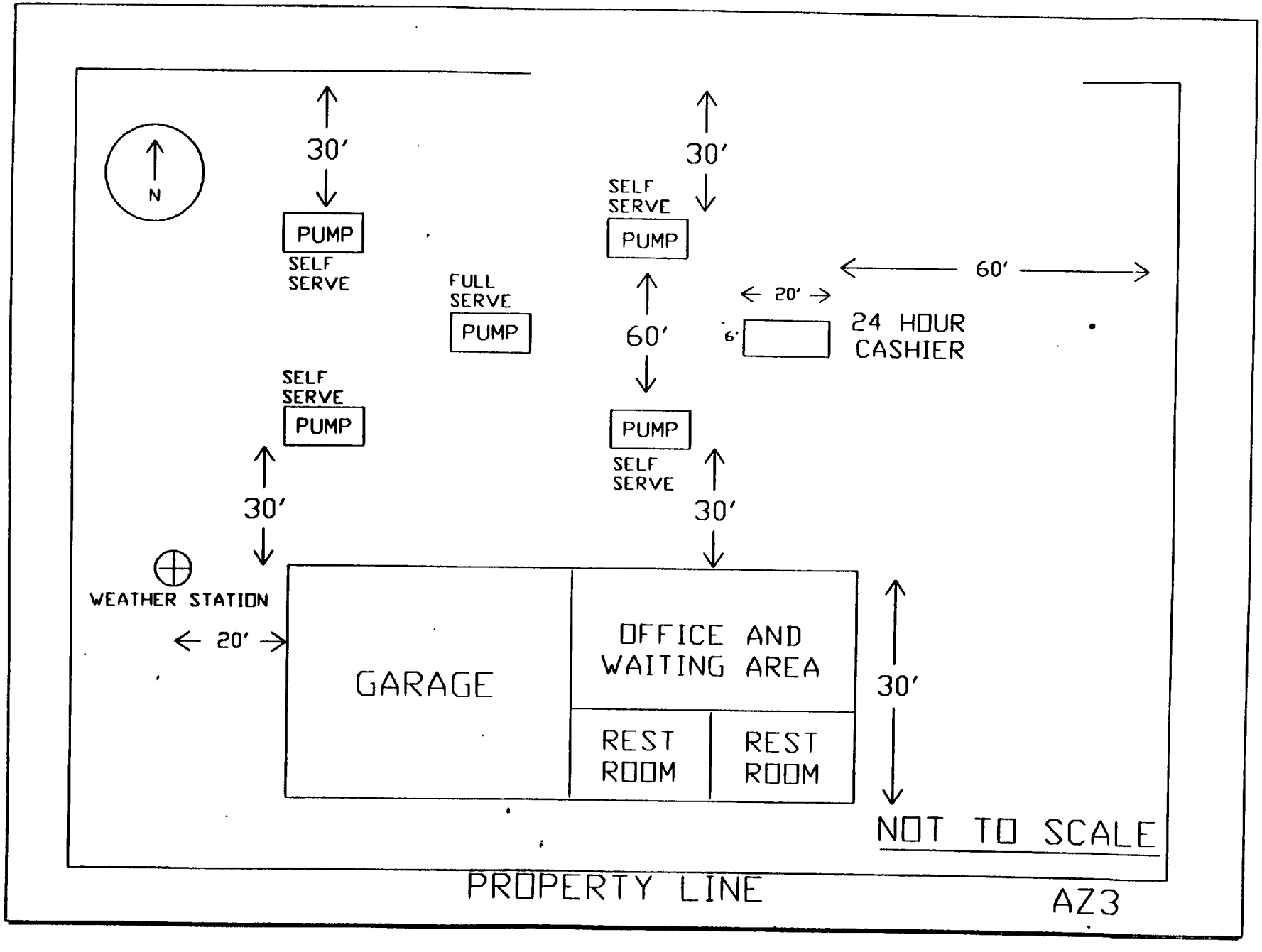
STATION DIAGRAMS

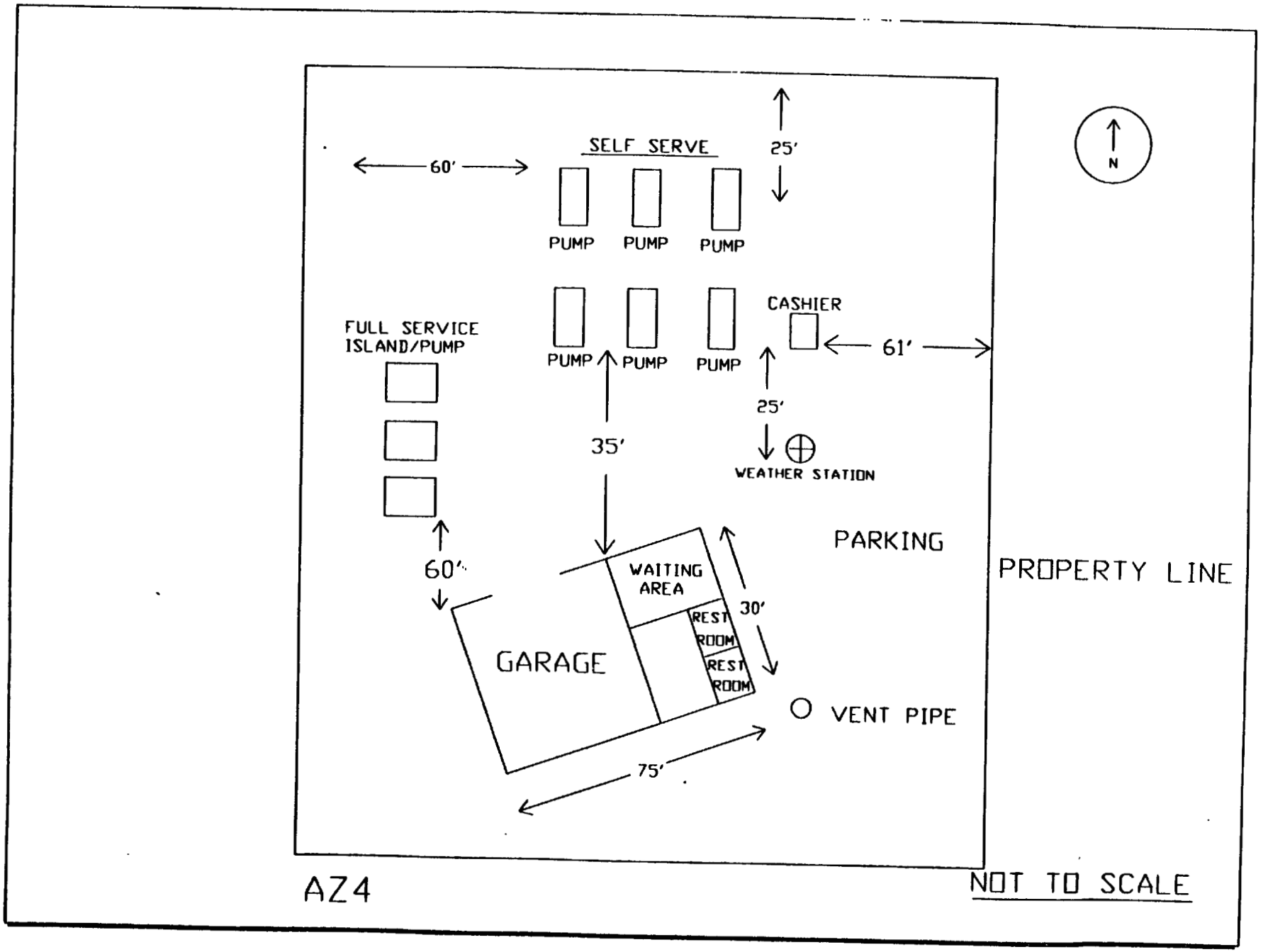
SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

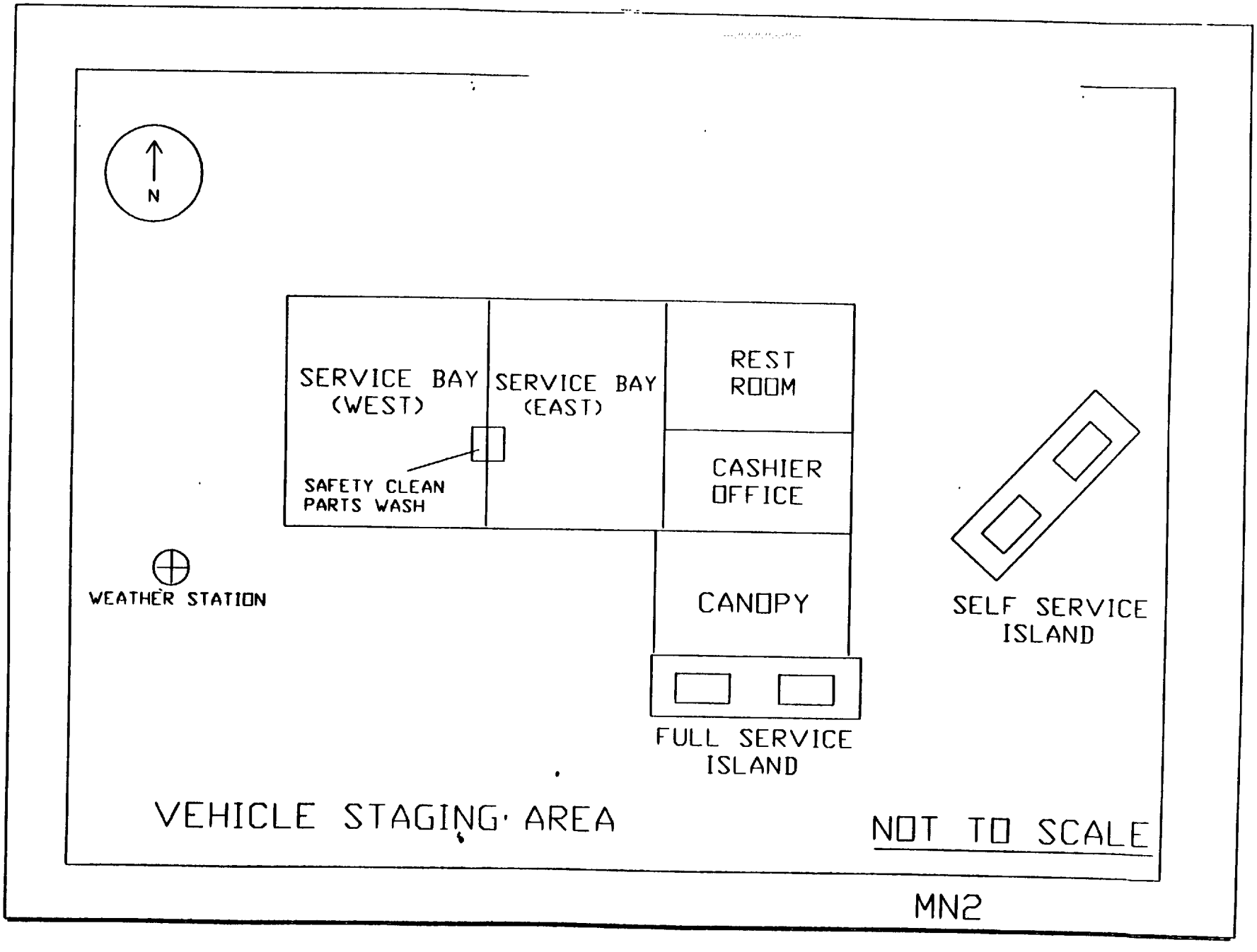
WINTER, 1993/94

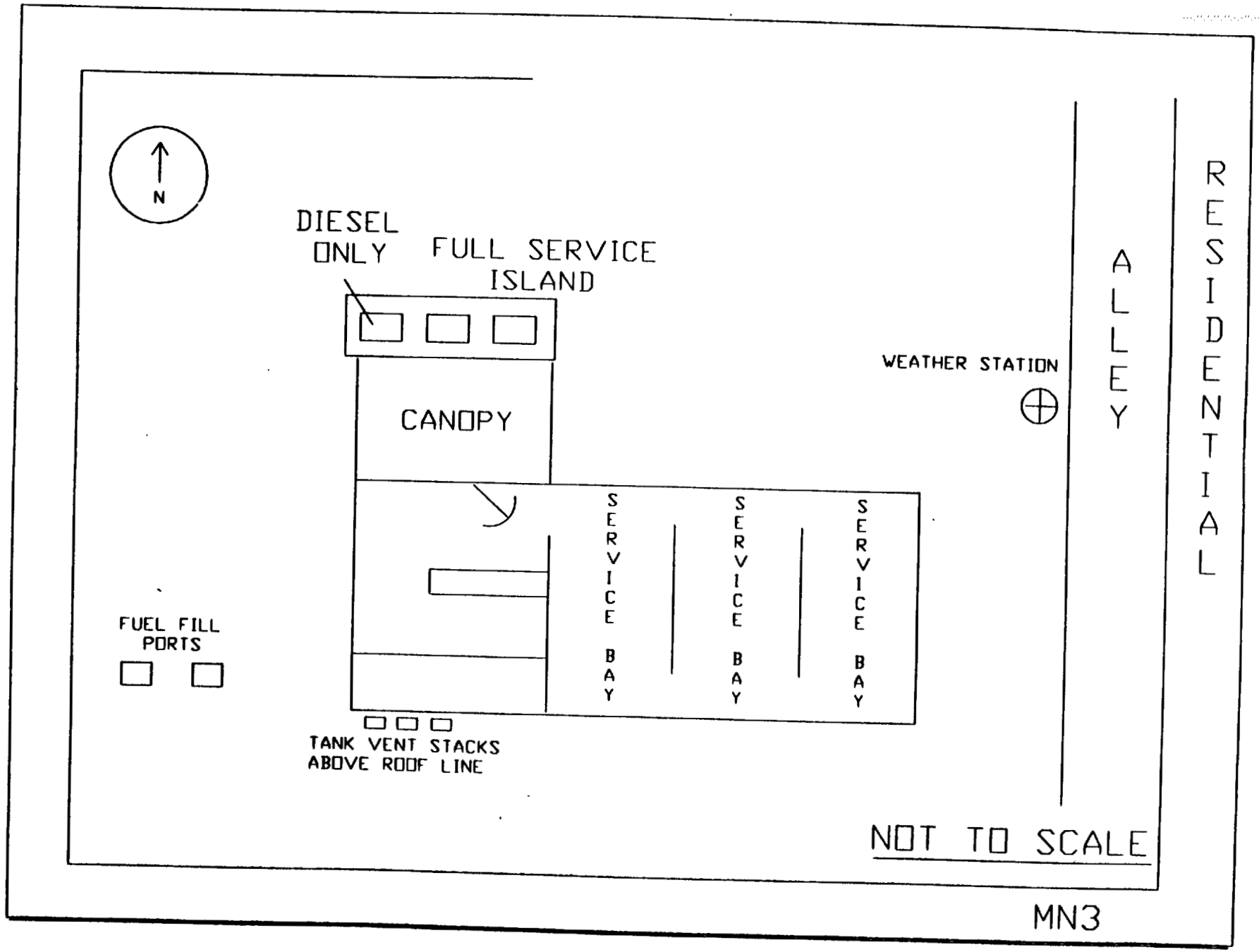


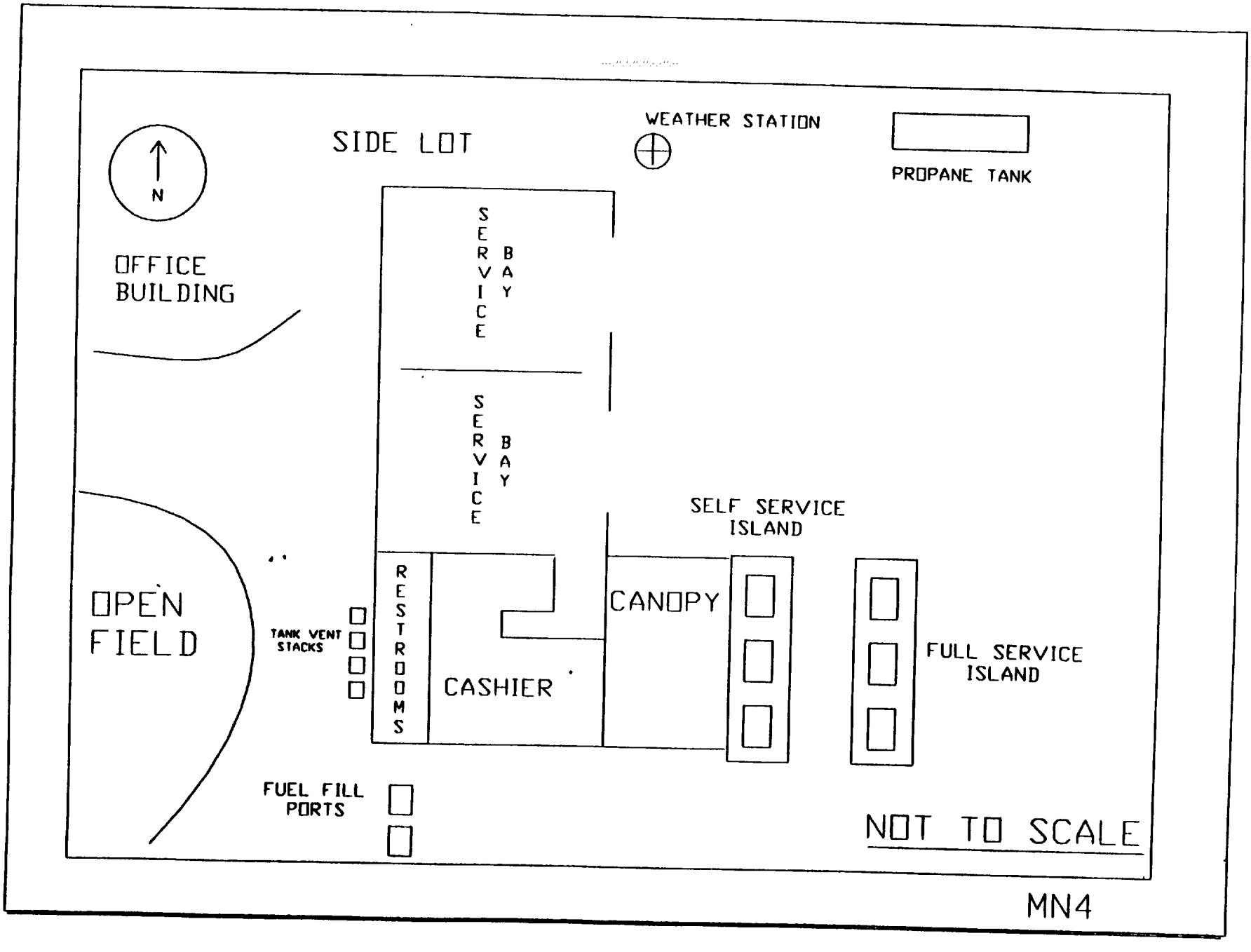


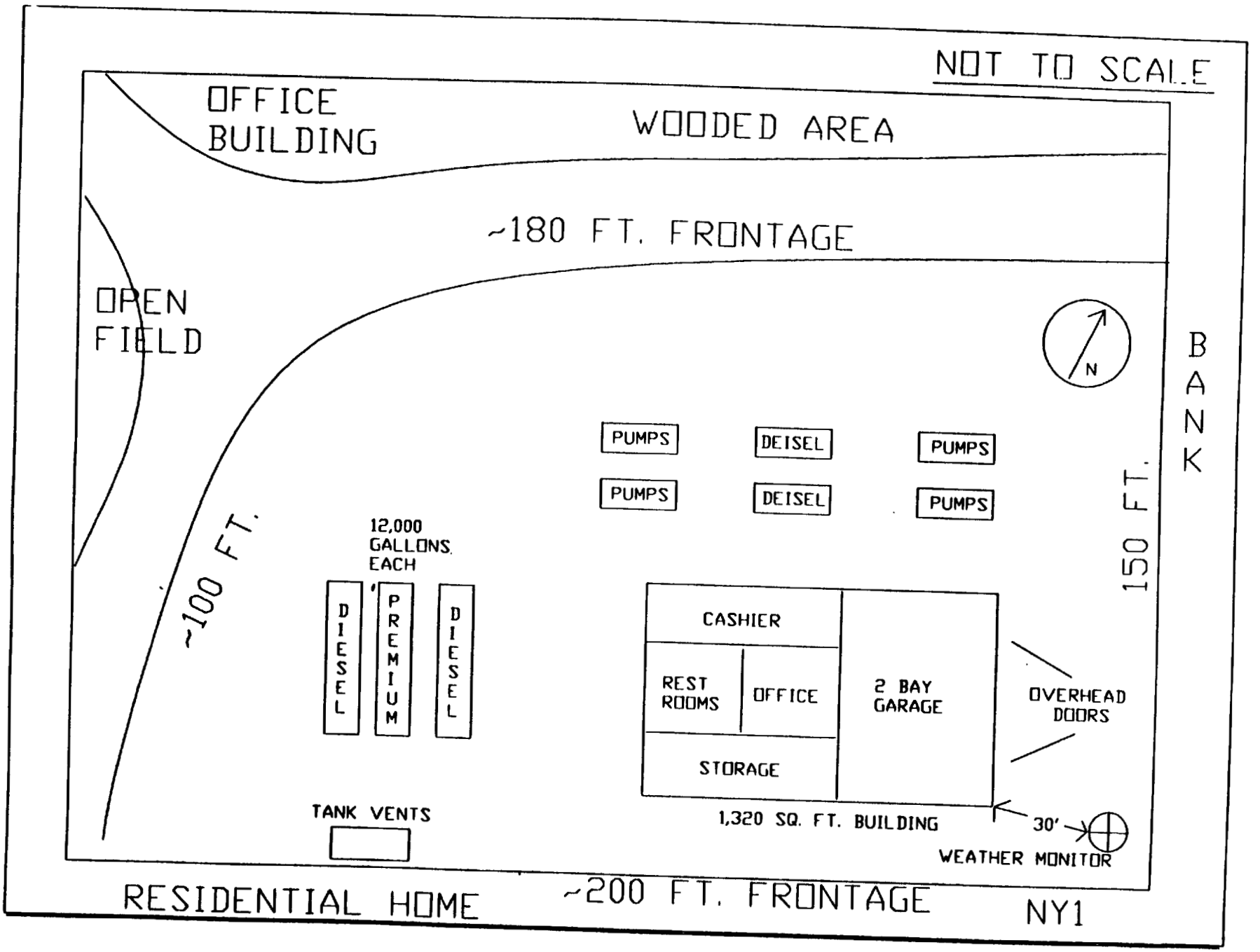


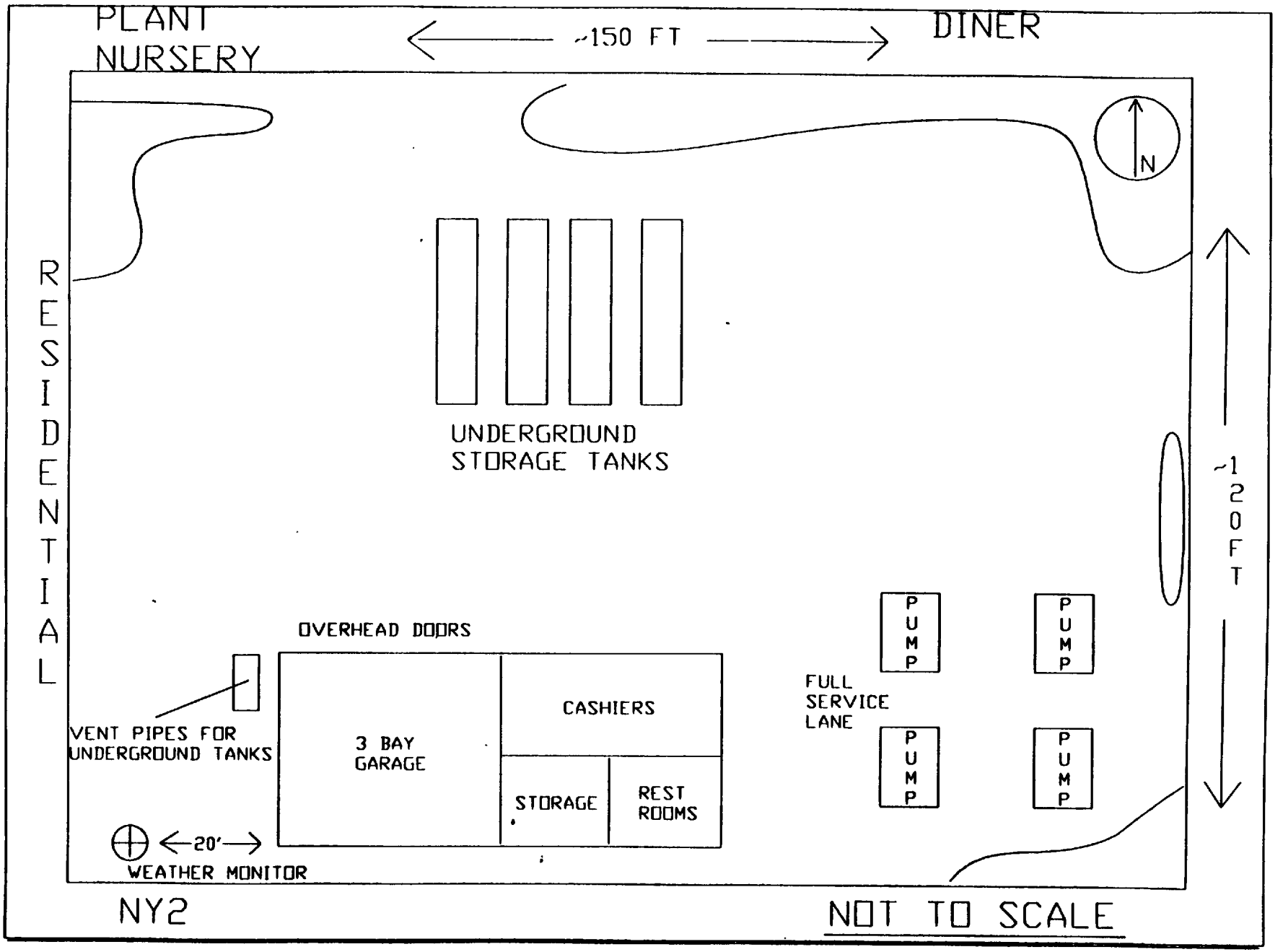


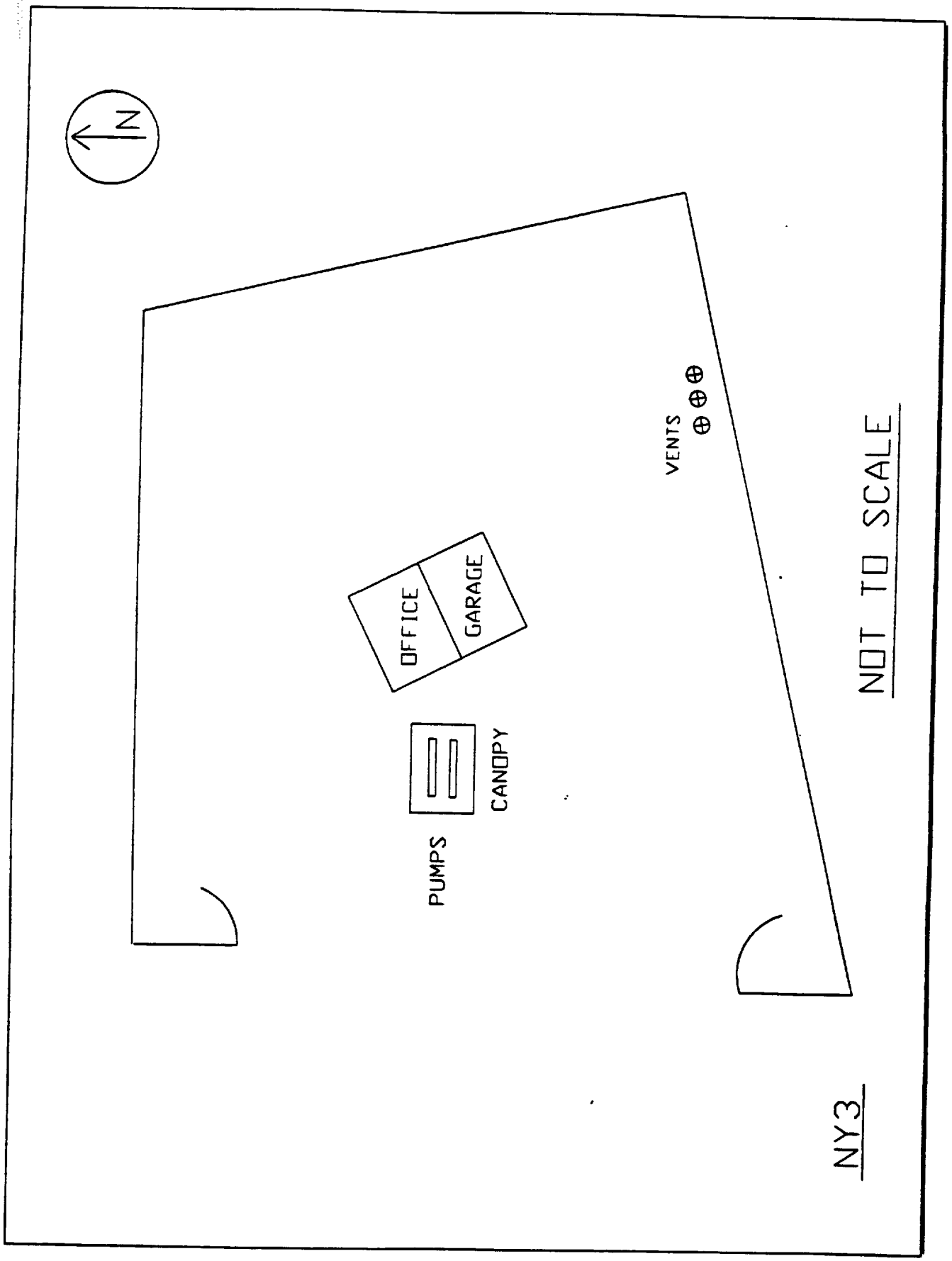












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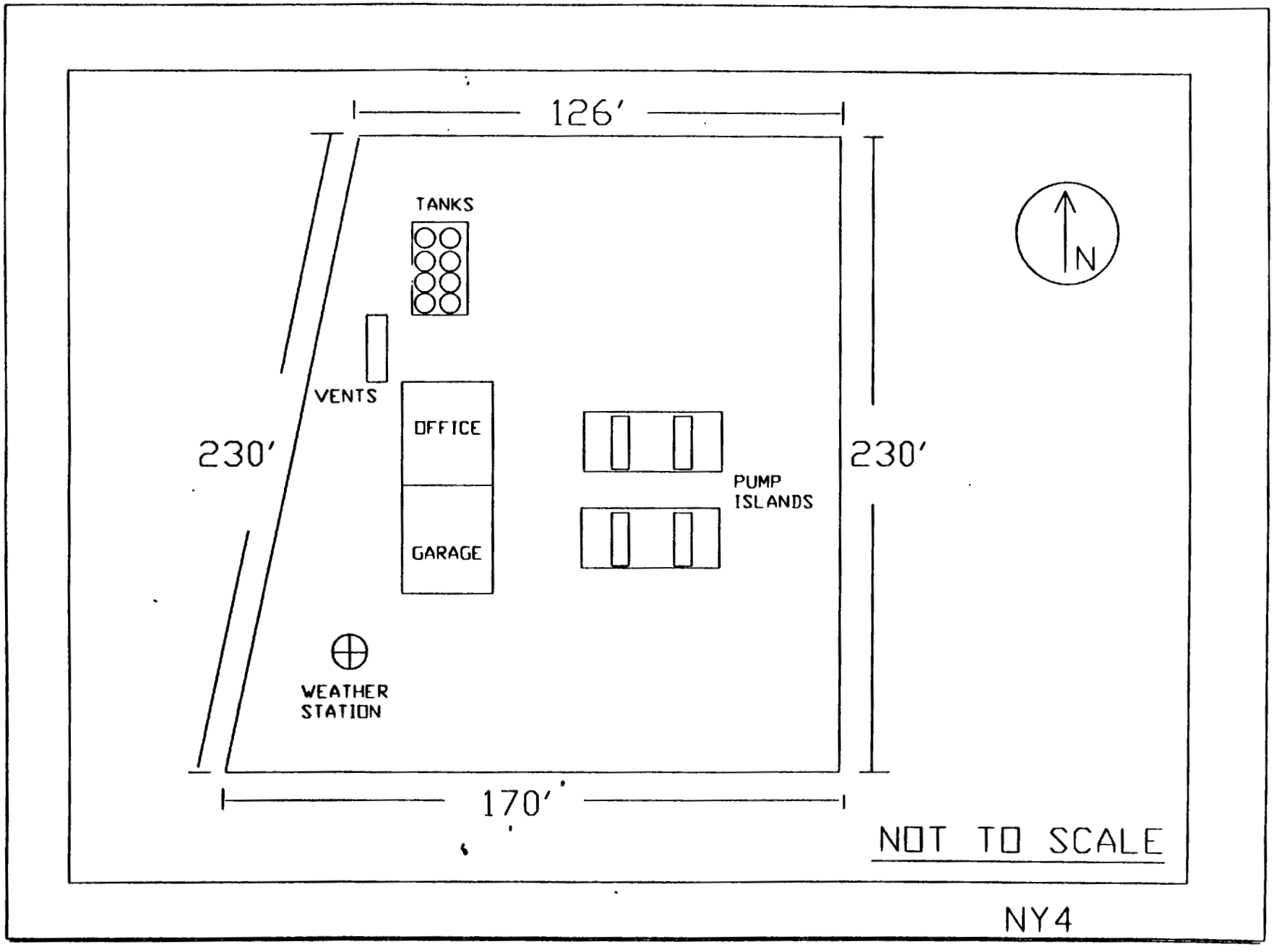

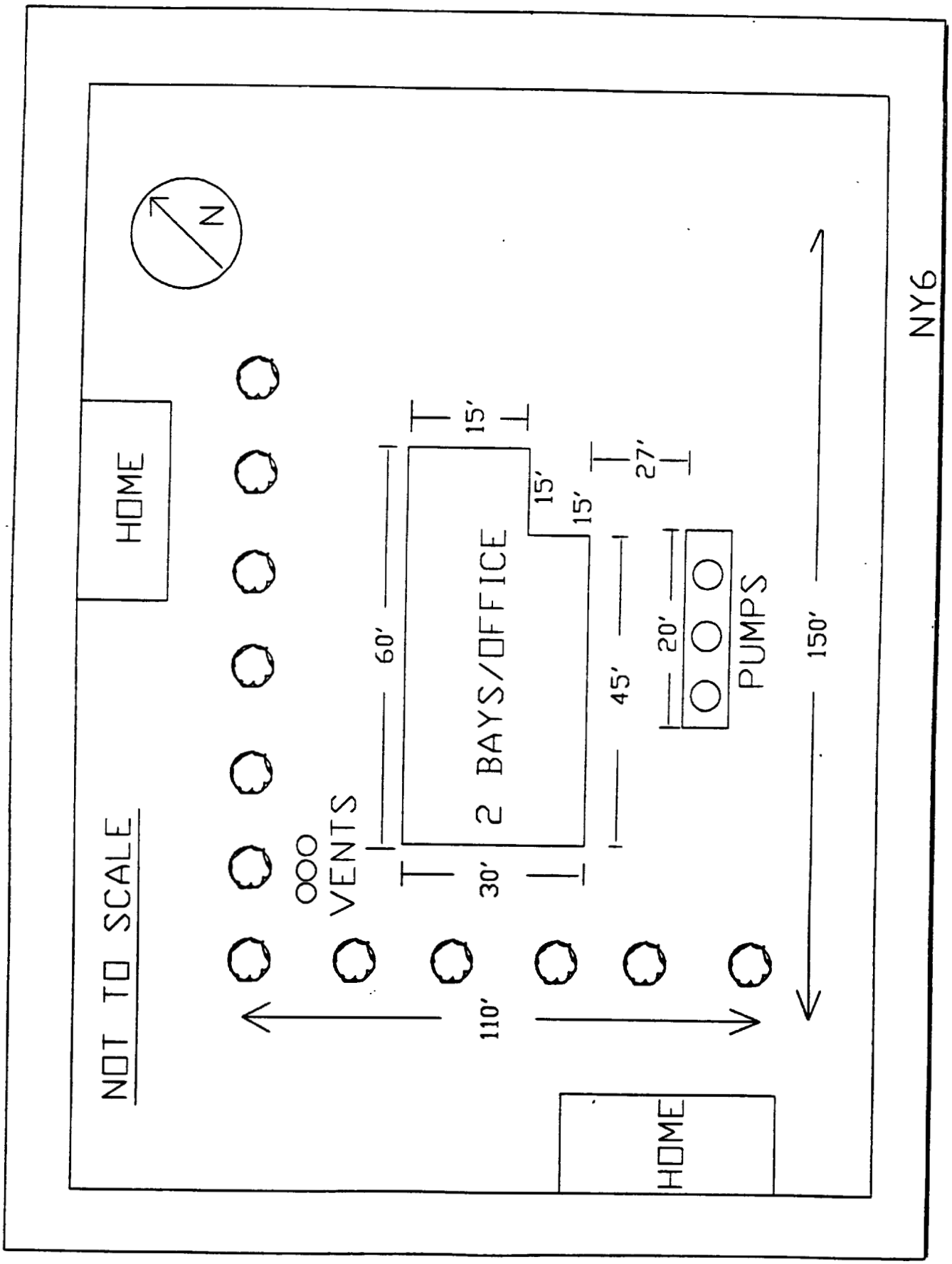

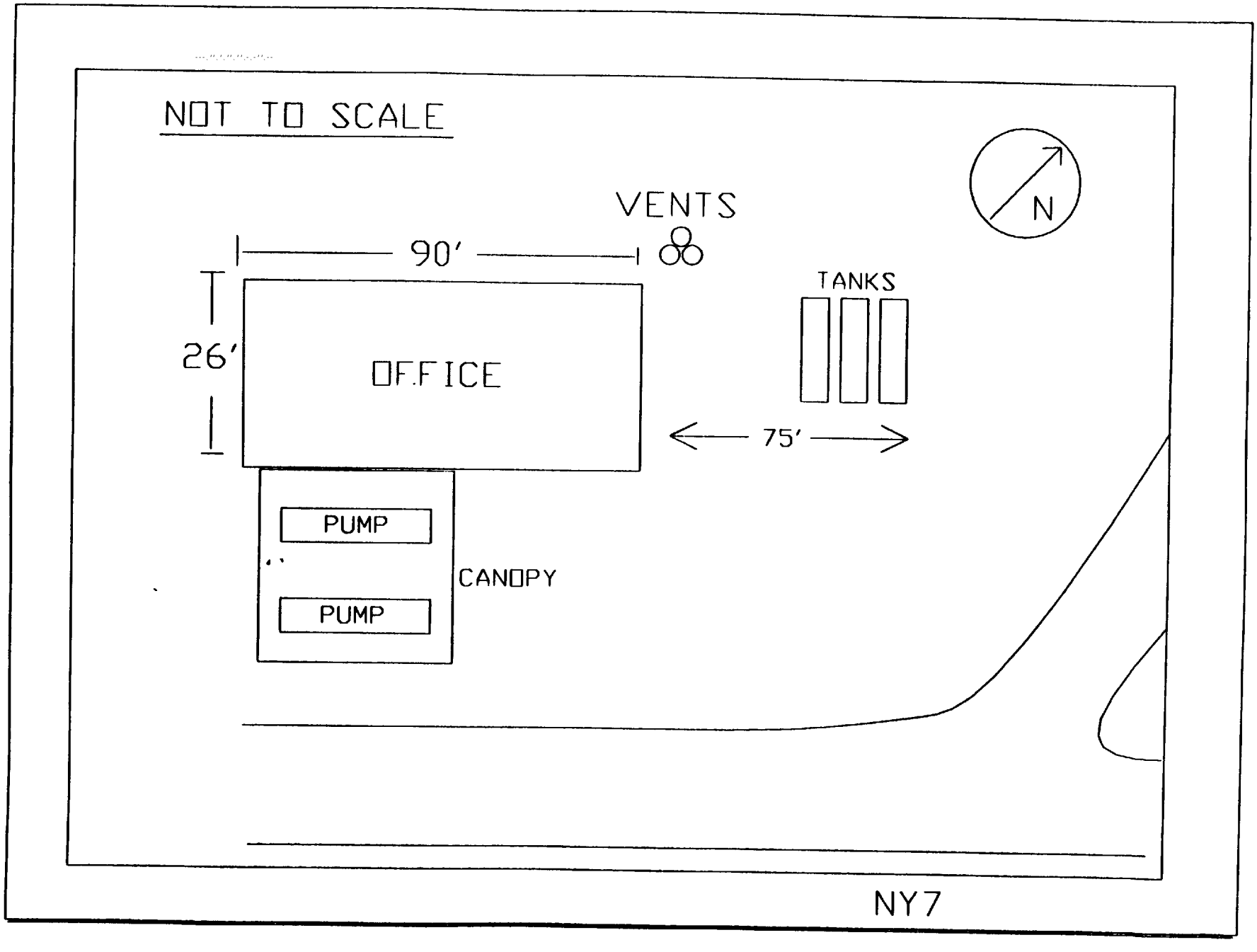

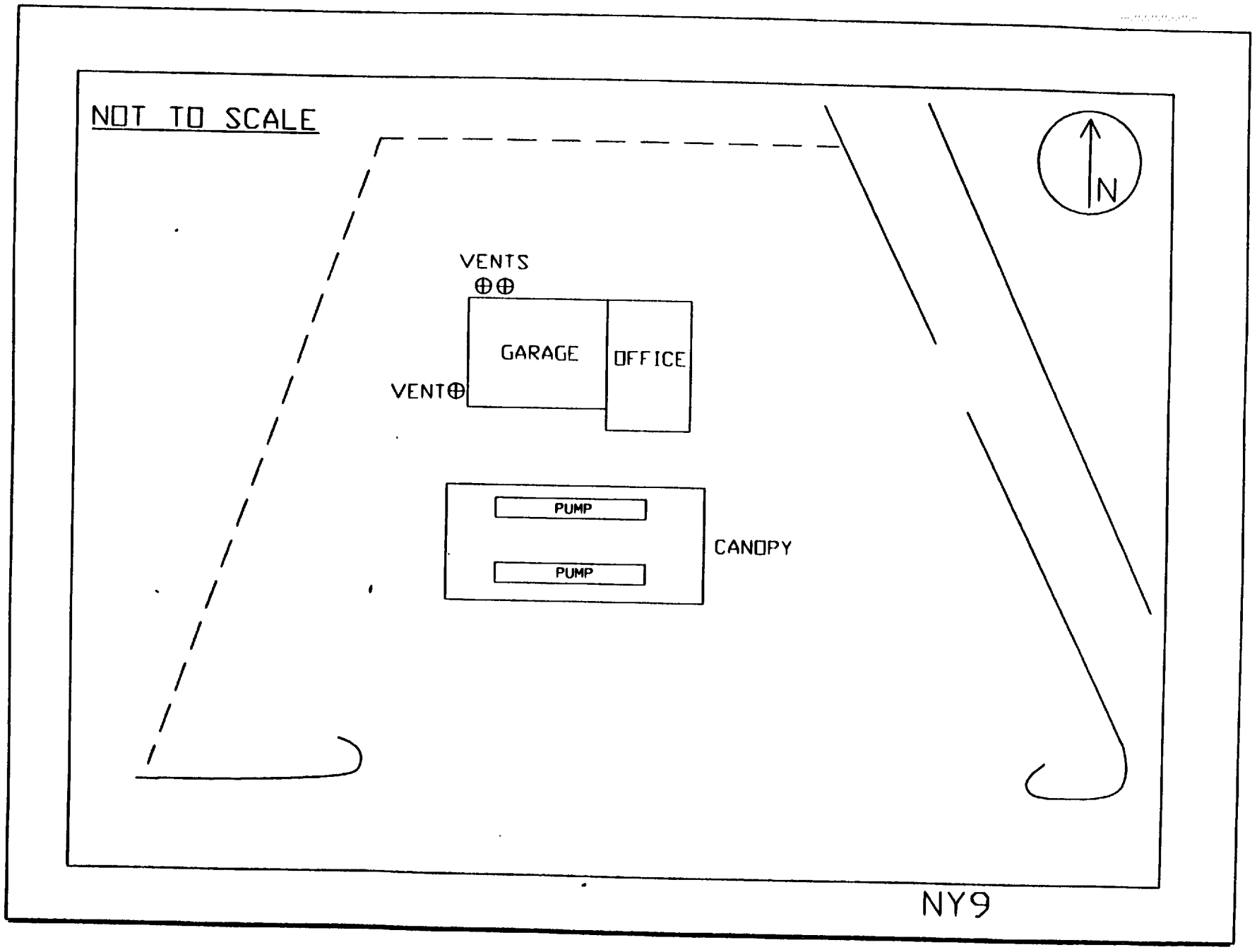

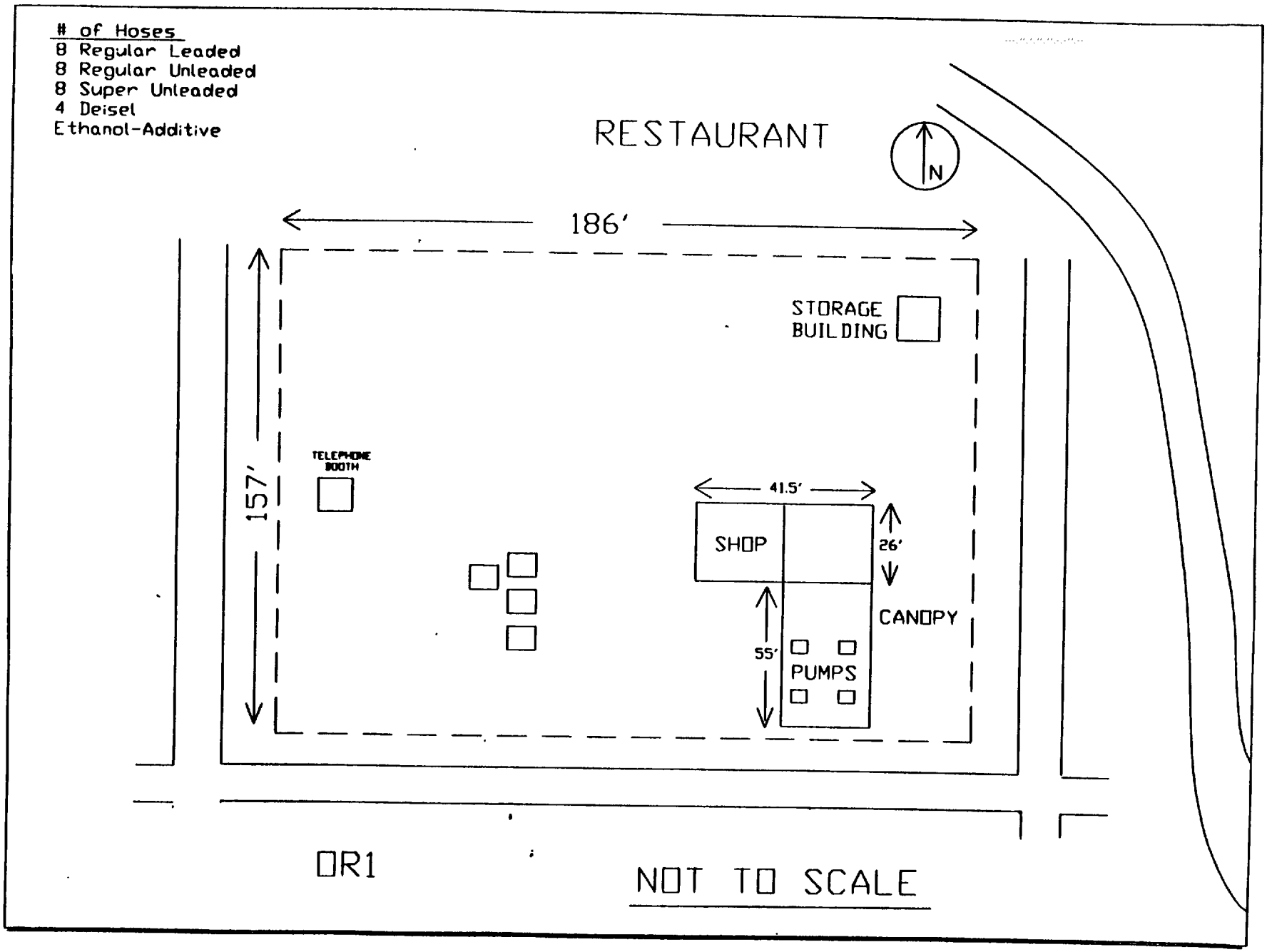

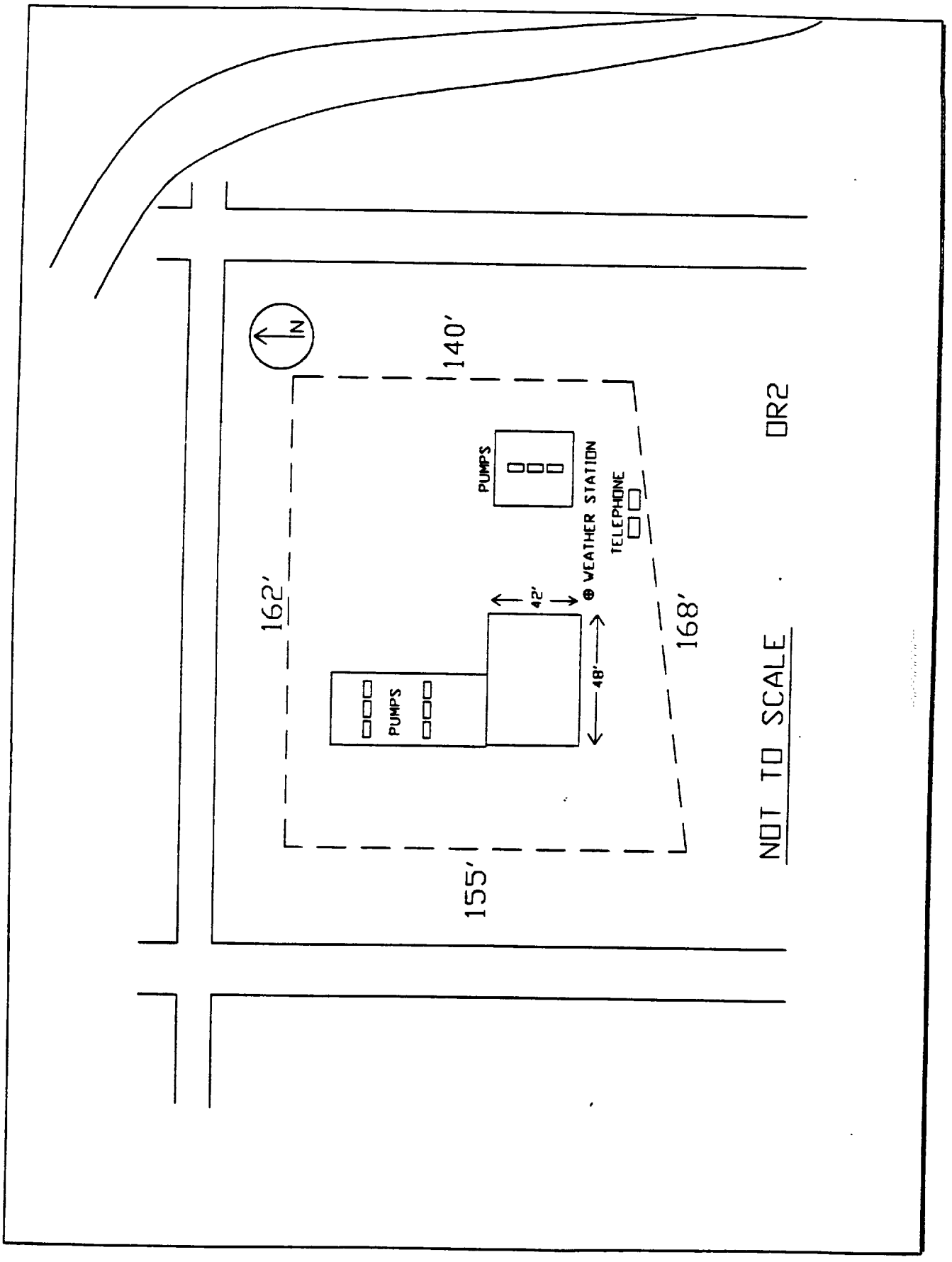

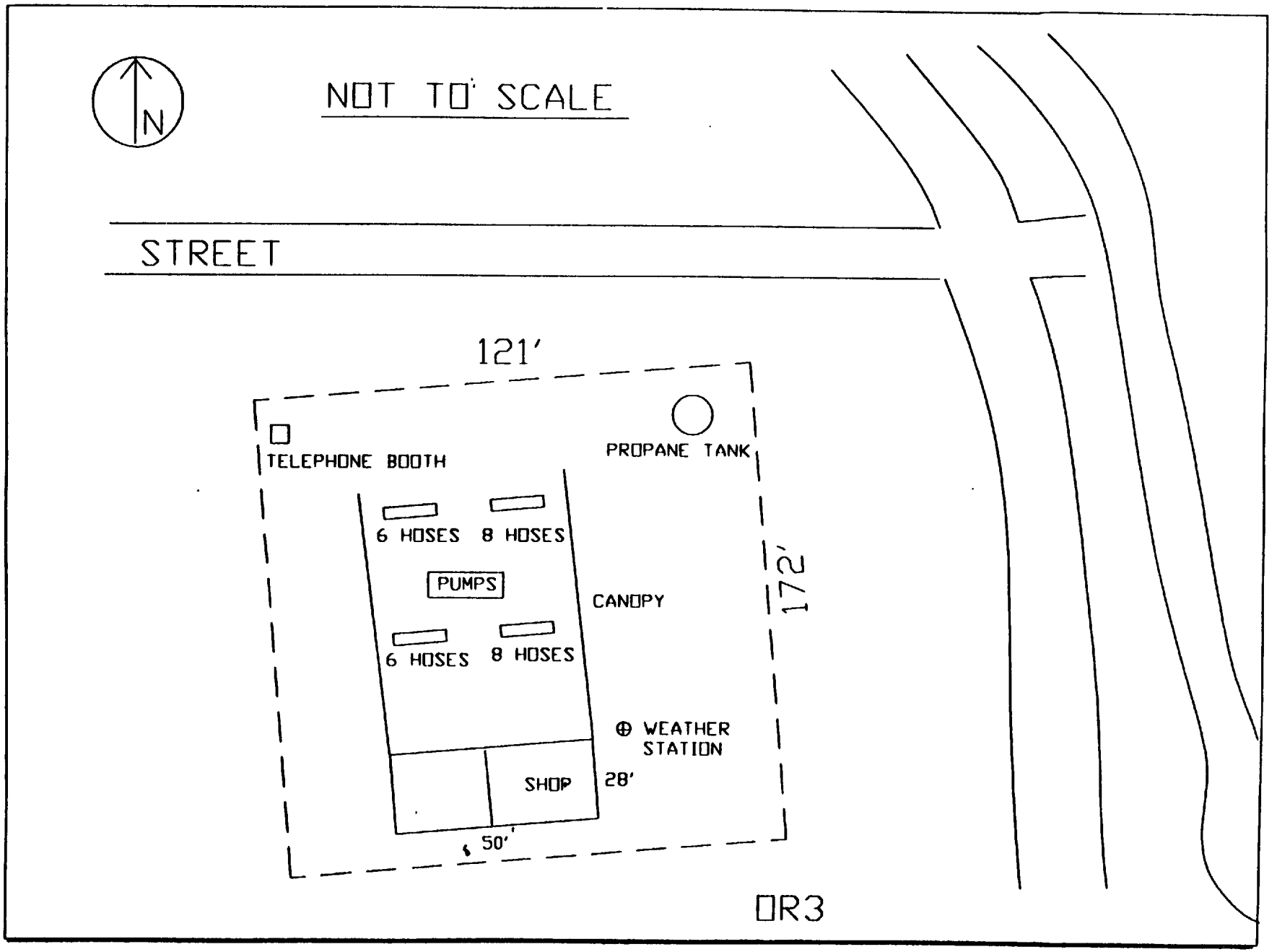

APPENDIX H

EQUIPMENT AND STUDY PROCEDURES

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

WINTER & SUMMER 1994

APPENDIX H

EQUIPMENT AND STUDY PROCEDURES

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

WINTER, 1993/94

Organic vapor samples [methyl tertiary butyl ether (MTBE), tertiary amyl methyl ether (TAME), ethyl tertiary butyl ether (ETBE), tertiary butyl alcohol (TBA), ethanol, benzene, toluene, ethyl benzene, xylene and gasoline as total hydrocarbons] were collected on large bed SKC, Inc. charcoal tubes (400 mg front section, 200 mg back section, lot number 120) using personal sampling pumps. Long term samples were collected at a flow rate of 0.05 liters per minute (lpm) and short term samples were collected at a flow rate of 0.10 lpm for the time periods reported in Appendix C. The air samples were analyzed by gas chromatographic techniques in accordance with accepted industrial hygiene procedures as detailed in Appendix I.

Front and back sections of the charcoal tubes were analyzed separately. Following collection, the charcoal tubes were refrigerated during the 3 day study at each service station until shipped. All samples were shipped to the laboratory via overnight express package shipment. For the long term samples, each sampling train included 2 charcoal tubes in series. The first tube was submitted for analysis. The second tube was kept until analysis was completed in case breakthrough was noted on the back section of the first charcoal tube. None of the second tubes were analyzed since no breakthrough occurred.

Breathing zone samples were collected by attaching the sampler in the "breathing zone" of the operator(s) being monitored. The "breathing zone" is defined as a hemisphere forward of the shoulders centered on the nose with a radius of approximately 6 to 9 inches.

Sample flow rates were initially set and periodically checked during the sampling periods with Brooks Precision Rotameters. These rotameters are calibrated against a bubble flow meter, which serves as a primary standard. If necessary, the flow rates were adjusted during the shift to maintain the original setting of either 0.05 lpm or 0.10 lpm.

The sample results in this report have been corrected to account for charcoal desorption efficiencies of less than 100 percent for some of the target compounds. These desorption efficiencies were determined in the NATLSCO Environmental Sciences Laboratory.

Following removal of the charcoal tubes at the end of the day, bulk fuel samples were collected. Two sets of bulk gasoline samples were collected at each station for each dispensed gasoline octane grade used during the monitoring periods. One sample was submitted to Texas Research International (TRI) for volatility testing to determine the Reid Vapor Pressure (RVP). The second sample was submitted to the NATLSCO Environmental Sciences Laboratory to determine the oxygenate species and aromatic content. All bulk samples were packaged and shipped separately from the charcoal tubes.

Samples destined for TRI were decanted to one-liter containers. After the containers were filled, the temperature of the fuel was recorded. After filling, approximately 20 milliliters of each sample grade was transferred into a separate glass vial for submission to the NATLSCO Environmental Sciences Lab using disposable pipets. A separate pipet was used for each octane grade of fuel.

Where two or more samples were collected to evaluate an employee's exposure, the time-weighted average exposure was determined from the formula:

$$TWAE = \frac{C_1T_1 + C_2T_2 + \ldots + C_nT_n}{T_s}$$

Where C_1 denotes the concentration of contaminant number 1 during time period T_1, and T_s is the total duration of sampling ($T_1 + T_2 + \ldots T_n$).

APPENDIX I

ANALYTICAL METHODS

SERVICE STATION PERSONNEL EXPOSURE STUDY
AMERICAN PETROLEUM INSTITUTE

WINTER & SUMMER 1994

APPENDIX I

ANALYSIS OF AIR SAMPLES AND BULK SAMPLES FOR BTX AND OXYGENATED COMPOUNDS GAS CHROMATOGRAPHY (OSHA METHOD 07 EQUIVALENT)

PRINCIPLE OF METHOD

The samples are analyzed using a Gas Chromatograph equipped with a Flame Ionization Detector (GC-FID). With the Flame Ionization Detector, burning of the compounds eluting from the chromatographic column produces ions and electrons which enter into a electrode gap in the detector, decreasing the gap resistance and permitting a current flow. Samples are normally collected on 600 milligram charcoal tubes, except in cases where other media have been specified for collection. The solvent desorption list should be referenced prior to analysis to determine the appropriate desorbing solvent and media.

SENSITIVITY

Lower limits of detection are calculated and reported based on a sample volume of 10 liters. Based on a volume of 10 liters, the laboratory tries to report all values at 1\10 TLV or better.

The actual mass detectable amount is a function of the type of hydrocarbon analyzed. Normally alkyl and aryl compounds show the greatest responses using Flame Ionization Detection, with response progressively decreasing for ketones, alcohols, and chlorinated compounds. We normally see mass detectable amounts of 1 microgram per tube section for benzene.

Relative Listing of Detection Limits

Solvent Type	Relative Lower Limit of Detection Total Milligrams
Benzene	0.0010
Methyl Ethyl Ketone	0.0020
Isopropanol	0.0025
Perchloroethylene	0.0060
Methyl tertiary Butyl Ether	0.0018

These are approximate detection limits which will generally vary a small amount from day to day.

INTERFERENCES

Any compound which has the same retention time as the specific compound analyzed could be an interference. The gas chromatographic column and temperature conditions should be chosen in such a way that all components are effectively resolved from each other and any other solvents mentioned in the report comments.

It is extremely important to evaluate the chromatography, noting any shoulders or unusual symmetry which could be indicative of a co-eluting compound. If an interference is indicated, the solvent should be reanalyzed using a slower oven ramp on the same column or rerun on a second column of a different polarity.

Since GC-FID analyses can be confounded by coelutants, identification can only be definitively established through Gas Chromatography using mass spectrometry detection (GC/MS), however, this is not considered a routine analysis.

QUALITY CONTROL

Chromatography conditions were optimized for the following analytes:

Benzene
Ethyl Benzene
Toluene
Xylene (all isomers)
Methyl Tertiary Butyl Ether (MTBE)
Ethyl Tertiary Butyl Ether (ETBE)
Tertiary Amyl Methyl Ether (TAME)

Fresh standards were prepared daily for the above analytes and ethanol. A four point standard calibration curve was analyzed for all analytes over the range of 0.1 milligram/milliliter to 2 milligrams/milliliter. All standard curves were evaluated against the "least squares" statistical program. The following parameters govern the acceptability of the curves:

a) The response factor must be within two standard deviations of the mean.
b) The intercept can not be higher than 10% of the lowest standard.
c) "Best fit" curves must be within 10% of the statistical value.
d) The square of the correlation coeficient (R^2) must be 0.998 or better.

Spiked samples for all analytes listed above were analyzed on a daily basis. A minimum of one sample spike for every 10 samples or one spike per set was used, whichever was greater. Spike recoveries (%) must be within two standard deviations of the mean as determined by the individual control charts. Any spike not meeting this criteria is immediately reported to the QA Coordinator, with additional spikes added for analysis to determine the source of error.

Control charts plotting % recoveries were prepared for the analytes listed below. Average % recoveries and acceptable ranges (2 sigma) are also given:

Analyte	% Recoveries	Acceptable Range
Benzene	95.7%	83.7-107.8
Ethyl Benzene	97.1%	83.1-111.2
Toluene	97.2%	85.8-108.7
Xylene	96.9%	85.4-108.3
MTBE	94.2%	81.1-107.2
ETBE	98.0%	85.14-110.9
TAME	94.6%	82.7-106.4

Spikes were prepared in the range of 25 micrograms to 200 micrograms.

SAMPLING RATES AND MEDIA

Samples are normally taken on 600 milligram charcoal tubes unless otherwise specified in the Field Sampling Guide or Solvent Desorption Efficiency Listing. We are recommending a 0.05 to 0.10 liter/minute flow rate for charcoal tube collection. Short term sampling can be performed at 0.10 Lpm to 1.0 Lpm for 15 minutes depending on the volatility of the compounds.

Consideration should be given to breakthrough. The NIOSH manual states "When a sample value obtained for the back section of the charcoal tube exceeds 25% of that found on the front section, the possibility of sample loss exists." It is also possible, upon storage, for the more volatile components to migrate from the front to the back tube section until an equilibrium is achieved. Exposured tube storage time should be minimized.

Sampling for TWA concentrations should be performed at 0.05 to 0.10 Lpm using two 600 milligram charcoal tubes connected in series. Only the first tube will be submitted for analysis initially. If the back section of the tube exhibits more than 10% breakthrough, the second tube will be submitted for analysis.

INSTRUMENTATION

Sample tubes are analyzed using a gas chromatograph equipped with a flame ionization detector along with an integrator and data handling system.

ANALYTICAL COLUMN - RTx-1: ELUTION ORDER: PARTIAL LIST

ETOH
PENTANE
tert-BUTANOL
MTBE
CYCLOPENTANE
HEXANE
ETBE
BENZENE
CYCLOHEXANE
TAME
TOLUENE
m,o,p-XYLENES

REAGENTS

All chemical reagents used as standards should be of purities in excess of 90%. Solvents used for desorption should meet or exceed ACS reagent grade.

1) Carbon Disulfide - Chromatographic quality or better.*

* Special Precautions: Carbon Disulfide is toxic and a serious fire and explosion hazard (flash point -30 °C). Always work with these materials in a well-ventilated hood and within the constraints of the laboratory's safety plan.

When benzene is being analyzed, Carbon Disulfide used to elute the charcoal tubes should be purified by passing it through Molecular Sieve to remove residual benzene impurity which may interfere with the benzene analysis.

STANDARD PREPARATION

A series of standards are prepared with levels of 2.0, 1.0, 0.5, and 0.1 milligrams/milliliter. The lower standard level of 0.1 milligrams/milliliter is only required if the compound being analyzed has a TLV of 25 PPM or less. These standards are prepared by adding microliter amounts of the pure material to a 10 milliliter volumetric flask containing Carbon Disulfide and then bringing it up to volume. These standards are then diluted one to three in Carbon Disulfide to account for the three milliliters of Carbon Disulfide used to elute the charcoal tube. Three microliters of the standards are then injected either by hand or by autosampler and a linear regression curve is prepared of the concentration versus area response. The linear regression analysis should be used to judge the suitability of the curve and samples should not be desorbed until an appropriate curve is obtained. Parameters which determine the suitability of the curves are discussed under Quality Control above.

SAMPLE ANALYSIS

1) The 600 milligram tube (400 mg front section/ 200 mg back section) sections are placed into separate 7 dram glass vials with Teflon septa.

2) Using the appropriate desorption technique, slowly add three milliliters of Carbon Disulfide to the vial.

3) Allow the desorption process to proceed for a period of 30 minutes, occasionally agitating the sample during this interval.

4) Three microliters of the desorbed solution are then injected into the Gas Chromatograph for analysis.

5) A minimum of 10% charcoal tube spike samples will be prepared for every set of samples received. A standard and spike will be analyzed after every 10 samples analyzed. In addition, every autosampler run will begin and end with a standard.

6) One sample from each set of gas station samples screened by GC/FID will be confirmed by GC/MS.

7) All bulk gasoline samples screened by GC/FID will be confirmed by GC/MS.

CALCULATIONS

1) Using the response factor* generated through the least squares analysis of the standards data, convert the intergrator area data obtained for each sample into a comparable mass of each component. These values should be corrected for their respective desorption efficiencies.

   * We define the response factor as 1/Slope (determined from the least squares analysis). This response factor, for our laboratory's purposes, is called the "A-Factor".

   Total Milligrams = Area x "A- Factor"

   Corrected Total Milligrams = Total Milligrams x (100/DE)

   DE = Desorption Efficiency

2) To convert Corrected Total Milligrams to parts per million (PPM) concentration units, take the sample volume into account by using the following formula:

   PPM = (Total Corrected Milligrams)(24450)/[Air Volume(liters)](MW)

   where MW = Molecular Weight

BULK SOLVENT ANALYSIS

Use the following procedure to analyze a bulk solvent for a particular component (result expressed as percent by weight):

STANDARDS PREPARATION

Follow the preparation instructions set forth on page 4 for Standard Preparation. A suitable curve, as governed by the Quality Control Plan should be obtained prior to sample analysis.

SAMPLE PREPARATION AND ANALYSIS

1) Weigh a 10 milliliter volumetric flask containing two milliliters of Carbon Disulfide, capped, on a five place balance. Record this initial value directly into your analytical notebook.

2) Add one drop of the bulk solvent to this volumetric flask, being careful not to get any solvent on the sides of the flask.

3) Reweigh the volumetric flask and record this value in your laboratory notebook.

4) Immediately dilute the volumetric flask to the 10 milliliter mark with Carbon Disulfide. This is now the bulk stock solution.

5) Obtain the weight difference between the initial and final weights.

Example:
11.31546
-11.30142
0.01404 = 14.04 mg/10 ml = 1.404 mg/ml

6) Since your standards were diluted 1 to 3 it is necessary to dilute the bulk stock 1 to 3 with carbon disulfide. If the original standards had not been diluted 1 to 3, it would be possible to run the bulk stock directly against the standard stocks.

7) Inject three microliters of the diluted bulk stock into the Gas Chromatograph for analysis.

BULK SAMPLES CALCULATIONS

To determine the percent by weight of a particular component in a bulk sample use the following calculation formula:

Total Milligrams = Area x "A-Factor"

Note: No desorption efficiency correction is required.

Divide this Total Milligrams value by the stock concentration and multiply by 100 to obtain a weight percent.

Weight Percent = [(Total Milligrams)/(Stock Concentration)] x 100%

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