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NORTECH *Environmental & Engineering Consultants*
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April 9, 2002

Rockwell Engineering and Construction Services, Inc.
913 College Road
Fairbanks, Alaska 99701

ATTN: Mark Rockwell

RE: Indoor Air Quality/VOC Monitoring
239 Ina Street, Fairbanks

Dear Mr. Rockwell:

In accordance with your request, ***NORTECH*** is pleased to provide the results of our evaluation of the indoor air quality (IAQ) of the residence at 239 Ina Street in Fairbanks. Tables, figures, and graphs of the monitoring data are attached. The following is a synopsis of the background, methodology, findings and working hypothesis as well as conclusions and recommendations developed from our investigation.

Background

Rockwell Engineering and Construction Services, Inc (Rockwell E&C) has been performing corrective action and remediation activities at the residence since a fuel release in December of 1999. Most of the contaminated soil from this release was excavated in August of 2000, but some contaminated soil was left in place under the building foundation due to structural concerns. A limited soil vapor extraction, which included a passive line under the foundation footing and an actively ventilated line inside the building crawlspace, was installed in August 2000. A vapor barrier was installed in the crawlspace to increase the efficiency of the system and reduce the likelihood of fuel vapors accumulating in the crawlspace. In addition to the soil vapor extraction system, a groundwater monitoring well has been installed on the property.

NORTECH was contacted in October 2001 to provide an industrial hygienist's evaluation of the indoor air quality of the building as part of the overall effort to meet the cleanup goals of the Alaska Department of Environmental Conservation (ADEC). At that time, a fan had also been installed on the foundation footer line to actively extract vapors from the contaminated soils in that area. The goal of the investigation was to identify and evaluate the potential sources of indoor air contaminants, including the potential impacts from the contaminated soil beneath the building.

Methodology

In accordance with our proposed scope of work, the investigation consisted of the following:

- Internal and external visual inspections of the building and remediation system
- Discussions with Rockwell E&C personnel regarding the remediation system operation and previous air quality monitoring activities
- Discussions with the occupants of the building regarding activities in the residence and IAQ concerns at the residence
- Walkthrough monitoring in and around the house and crawlspace for Total Volatile Organic Compounds (TVOC) with a real-time meter sensitive to the parts-per-billion range
- Walkthrough monitoring in and around the house and crawlspace for ultrafine particles with a real-time ultrafine particle meter
- Smoke tube pressurization testing of living spaces and seals for air leakage and pressurization characteristics
- Multi-day monitoring for carbon monoxide (CO), carbon dioxide (CO2), temperature, relative humidity and TVOCs using real-time monitoring equipment inside the living space
- Concurrent multi-day monitoring for benzene, toluene, ethylbenzene, and xylenes (BTEX) and total VOCs using passive charcoal badges at two locations in the living space and one location in the crawlspace

A RAE Systems PPB VOC Monitor PGM-7240, with data-logging capabilities was used for TVOC measurements. The instrument is a photo-ionization detector (PID) sensitive to parts per billion (ppb) levels. Individual compounds cannot be identified and concentrations are compared with non-suspect and outside (background) areas and are considered qualitative. The meter is primarily used to detect significant variations in different living spaces and patterns or spikes during long term monitoring. The calibration of the meter was checked at the beginning and end of sampling by using a known gas (isobutylene) at 10 ppm concentration. The instrument was set up for automatic data collection every 10 seconds during the walk through the structure and every minute during the multi-day collection period.

Ultrafine particles are defined as particles in the range of 0.01 to 3 microns. While there are currently no established levels for negative health effects of ultrafine particles, elevated levels may be an indicator of possible IAQ problems and often can assist in identifying specific generators. Concentrations reported are compared with non-suspect areas and outside (background). Examples of ultrafine particulate sources are boilers, furnaces, vehicles, gas ranges/ovens, and personal printers. For this study, the real-time instrument collected data every 10 seconds during the walkthroughs of the building.

Field measurements of indoor air quality were collected using a Solomat Surveyor II Indoor Air Quality Monitor (Zellweger Analytics) with a monitoring probe for CO, CO2,

temperature, and relative humidity. The equipment was calibrated in accordance with manufacturer's recommendations and set up for automatic data collection every 15 minutes during the multi-day data collection periods.

Passive Diffusion Monitors (charcoal badges) were used in this study to quantify the concentration of specific fuel related compounds in the air, including BTEX and TVOCs. The badges are exposed in a space and then sent to a laboratory for analysis and an average concentration for each specified compound during the monitoring period is returned. Patterns and individual peak events are not identifiable with charcoal badges.

Field Activities

November 28, 2001
NORTECH and Rockwell E&C personnel conducted an inspection of the exterior and crawlspace inspection while the homeowner was out of town and the system was turned off. The ppb meter and a standard PID were used to evaluate TVOCs in the crawlspace and around the exterior of house. Crawlspace and crawlspace vent readings (150-250 ppb) were about the same as exterior/background (100-200 ppb). The outlet of footer vent was slightly elevated (500-1200 ppb) and a very limited area near the fuel line penetration of the foundation was also slightly elevated (200-400 ppb). A charcoal badge was installed in the crawlspace to establish baseline concentrations and verify the qualitative ppb results.

December 4, 2001
NORTECH personnel returned to the site and retrieved the charcoal badge for laboratory analysis. Crawlspace and exterior/background ppb readings were about the same (100-250 ppb). Both active venting systems were still turned off and the crawlspace and footer vents were also in this range.

January 10, 2002
NORTECH and Rockwell E&C personnel conducted an interior/exterior site visit with the ppb and ultrafine meters and the results are shown in Figure 1. The homeowners had installed new vinyl flooring on the previous day and the odor from the mastic was observed. Downstairs interior VOC readings (2500-3000 ppb) were about 10 times higher than outside (200-300 ppb) and slightly lower than upstairs readings (3500-4000 ppb). Crawlspace readings (900-1000 ppb) were slightly higher than background. The footer vent was running at the time and the concentration inside the vent pipe was 26.5 ppm (26,500 ppb).

Ultrafine particle concentrations inside the house (15,000-34000 pt/cc) were about about five times lower than outside (110,000-120,000 pt/cc) and crawlspace concentrations (35,000-45,000) were also lower than outside. Interior readings were highest in the attached garage (28,000-34,000), where the furnace and a vehicle were located, and generally decreased across the first floor with distance from the garage. The lowest reading in the house (15,000-17,000 pt/cc) was in the office area, which had the door closed at the time of the inspection. Upstairs readings were 16,000-18,000 pt/cc in all spaces.

March 7, 2002
NORTECH and Rockwell E&C personnel conducted an interior/exterior site visit with the ppb, ultrafine, and smoke tube equipment and the results are shown in Figure 2. VOC concentrations upstairs (500-650 ppb) were slightly higher than downstairs (300-500 ppb) and both were slightly higher than outside (150-250 ppb).

Ultrafine concentrations outside the house were about 26,000-27,000 pt/cc. The garage (40,000-45,000 pt/cc) was higher than outside and had a cigarette odor. Particle concentrations near the kitchen/garage door were about 20,000-24,000 pt/cc. Particle concentrations inside the remainder of the house (13,000-16,000) were lower than outside with no other interior areas significantly higher or lower than others.

A gap of approximately one inch was observed under the door between the kitchen and the garage. Smoke tube testing around the kitchen/garage door indicated that air is flowing from the garage to the house while the furnace is off. Airflow from the kitchen to the garage was observed while the furnace is running. All other exterior doors and windows appear well sealed with little or no observed draft around the frames or seals. Smoke tube testing in the middle of most rooms indicated limited air movement within the house.

The ppb and Solomat meters were installed for a multiday test to identify diurnal or patterns within the house prior to running laboratory tests.

March 11, 2002
NORTECH personnel collected the multiday testing equipment and conducted a site walkthrough with the ppb meter. Interior (500-650 ppb) and exterior (150-250 ppb) readings were generally consistent with the March 7 walkthrough (see Figure 3), although the garage had slightly lower readings (430-460 ppb) than the rest of the interior spaces.

March 14, 2002
NORTECH personnel conducted another walkthrough with the ppb meter prior to setting up multiday equipment, including charcoal badges (see Figure 4). The walkthrough data was consistent with previous events (interior 500-650 ppb, crawl space 175-200 ppb, exterior 175-225 ppb). Three charcoal badges were installed at the residence. One badge was installed in the crawlspace at the same location as the previous crawlspace monitoring. The other two badges were installed in the two rooms on the southeast corner of the house (above the contaminated soil and near the vents) as shown in Figure 4. The continuous monitoring equipment was setup near the badge in the office area.

March 19, 2002
NORTECH personnel conducted a brief walkthrough of the house and collected the monitoring equipment and badges for laboratory analysis. As seen in Figure 4, the walkthrough results were similar to previous events, (interior 500-650 ppb, exterior 175-225 ppb), although the crawlspace was slightly higher (325-375 ppb).

Interviews and Observations

The occupants of the house were not formally interviewed as part of this IAQ investigation. However, during the course of the investigation, the occupants expressed concerns about the safety of living in the residence, especially for their children. They also indicated that they had used the office area as a bedroom earlier in the winter while renovating the upstairs and had experience nose bleeds and congestion while sleeping in that room. These symptoms reportedly decreased upon moving upstairs into the renovated bedroom. An extended overnight visitor to the house reportedly experienced colds and other symptoms that the occupants suspected might have been related to the indoor air quality of the house.

The house is currently undergoing a variety of interior renovations. Many of the windows have recently been replaced in an effort to make the house more energy efficient. New drywall, flooring, and paint are also evident in many parts of the house. Some portions of the house, particularly the north section of the upstairs (near and above the garage), are mostly unfinished. Other areas, including the office area, are in use but the drywall has not been taped and mudded.

The occupants also reported a petroleum odor in early March 2002 when the soil vapor extraction system was turned on. Upon notification by the occupants, Rockwell E&C personnel turned off the system. The odor reportedly dissipated and was not observed by ***NORTECH*** personnel upon inspection of the house on March 7.

Laboratory Results

A total of four exposed charcoal badges and two field blanks have been sent to the laboratory for analysis during two laboratory sampling events. The charcoal badges were analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX) and all other VOCs measured as hexane. The first sampling event was in the crawlspace of the building during December 2001 while the system was off to identify an initial concentration of these compounds. The second sampling event in March 2002 consisted of concurrent badge installation in the crawlspace and the two rooms on the first floor of the building immediately above the contaminated soil remaining in place below the footer. The laboratory results are summarized and compared to OSHA and other safety guidelines in the Table 1, which is attached.

The results indicate that individual BTEX compounds were not detected at a level of 0.01 ppm, which is the detection limit of the analysis, except for xylenes, which were detected at a level of 0.012 ppm in the crawlspace during the second monitoring event. This concentration is about four orders of magnitude below the OSHA and ACGIH action levels of 100 ppm. All other VOCs, quantified as hexane, were measured at a concentration of 0.043 ppm in the crawlspace in December and ranged from 0.257 ppm to 0.326 ppm in March. The highest reading was in the office area and the lowest was in the adjacent room. Although total VOCs

are not regulated by any agencies, these concentrations are within the background levels documented in local and international studies for a residential structure (0.05-0.40 ppm).

Walkthrough Data Analysis

Walkthrough inspections and of the interior living spaces have been conducted five times and the crawlspace has been inspected to some extent seven times. Three walkthroughs were done with the ppb and ultrafine meters, while the other four were done with the ppb meter only. Smoke tube testing of the living spaces was performed once.

The initial two site visits consisted of crawlspace inspection only during December 2001. During these inspections, the crawlspace was found to have approximately the same ppb readings as the outside air (100-200 ppb). The area near the fuel line penetration of the foundation was slightly higher (200-400 ppb) when specifically investigated during the first event. The footing vent line was also found to have a slightly elevated reading during the first event. These results suggest that the vapors from the contaminated soil beneath the foundation were not accumulating appreciably in the crawlspace of the house during that time.

The walkthrough on January 10, 2002 was conducted a day after new linoleum was installed in the kitchen of the residence. The linoleum mastic odor was immediately identifiable upon entering the house. TVOC concentrations inside the house were at least 10 times the outside level and ultrafine particle concentrations were lower inside the house than outside. The TVOC data suggested that the kitchen (and new linoleum) was acting as a source for the rest of the house, although the second floor had consistently higher levels than the kitchen. Lower TVOC levels and higher ultrafine levels in the garage indicated that air from the house might be leaking into the garage and mixing with some air from outside. Higher ultrafine levels in the living room might also be associated with the outside air from the nearby doorway. Increased VOCs and lower ultrafine levels in the crawlspace suggest that air exchange might be occurring from the house to the crawlspace. The vapor extraction system may increase this effect, but this hypothesis was not tested.

A walkthrough was conducted on March 7, 2002, after mastic odors were expected to have dissipated significantly. No odor was detected upon entering the residence. TVOC readings were consistent on the first and second floors, with the second floor slightly higher than the first. The crawlspace reading was again higher than background, but below the interior level, suggesting that vapors are not accumulating in the crawlspace. Ultrafine readings were higher in the garage than elsewhere in the house and outside, suggesting an ultrafine source in the garage. The furnace, a vehicle, and the odor of cigarettes, are all ultrafine sources that were observed in the garage. Smoke tube testing indicated little air movement within the house and air exchange with the outside primarily occurring through the garage (under the kitchen/garage door) with airflow from the house to the garage while the furnace was running and from the garage to the house while the furnace was off.

Additional walkthroughs on March 11, March 14, and March 19, 2002 involved only the ppb meter. The ultrafine meter was not included because the meter had not identified high levels or unexpected sources in the house. Each of these walkthroughs showed levels similar to those on March 7. No specific TVOC sources were identified during the walkthroughs and observed levels were consistent with those found in other residential and office buildings.

Multi-day Monitoring Results

Two multi-day monitoring events were run during March 2002. The first started in the afternoon of March 7 and concluded in the afternoon of March 11. The second event started in the afternoon of March 14 and concluded on March 19. The temperature, carbon dioxide, carbon monoxide, ppb TVOC, and relative humidity results are shown in Figures 5 and 6 for the two events. The meters were setup in the office area in the southeast corner of the house during both monitoring events based on the use of the room and proximity of the room to the contaminated soil and remediation system vents.

Two instrument problems were encountered during the multi-day monitoring events. The ppb meter stopped recording after 24 hours during the first event and approximately 84 hours during the second event due to configuration and memory problems so the TVOC data is somewhat limited. Additionally, the CO instrument recorded negative values for substantial portions of the two monitoring events although it had been calibrated before the first monitoring event. A negative CO value is essentially meaningless and the negative values are not shown, although the overall shape of the CO data is similar to the CO2 data.

Temperature

The American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Standard 55-1981 recommendation for human comfort is between 68 and 76 degrees Fahrenheit (°F). During the first monitoring event the temperature ranged from 65-71 °F and the range was 61-69 °F during the second monitoring event. The lowest temperatures were generally recorded during the night and the highest temperatures were recorded in the late afternoon. Although these temperatures are slightly lower than those recommended, the occupants of the building have not complained about the temperature. The stabilized temperatures during periods of inactivity in the house appear to be 63-67 °F, which is a common thermostat setting in Fairbanks. However, the lower temperatures appear to be associated with activities in the house that generate CO2 and other compounds. An activity that might cause this is burning food and opening the windows to ventilate the house. Another possibility is that the thermostat for the office area (where the instruments were setup) may be in a different room with more activity (and therefore warmer) so that the heat did not come on in the office area

Carbon Dioxide (CO2)

CO2 is a byproduct of vehicle exhaust and human respiration. In indoor air quality investigations CO2, is often found to be indicative of occupancy and the "tightness" of the structure. Typically, background concentrations are in the range of 300-600 ppm. Accepted standards recommend that CO2 levels should be maintained below a level of 800-1,300 ppm, depending on the reference. Carbon dioxide levels in the office area during the monitoring periods generally stabilized at levels below the recommended limits during periods of inactivity in the house. However, during periods of activity in the house CO2 concentrations climbed into the upper levels, 900-1,200 ppm, of the recommended range. During one event on March 16, the CO2 level climbed steadily from below 600 ppm to over 1900 ppm during a fourteen hour period. The CO2 level then returned to the background level over the next eight hours. Lack of ventilation during periods of human activity in the house is probably responsible for most of the rapid buildup of CO2 observed during the monitoring events.

Carbon Monoxide (CO)

CO levels never exceeded the State of Alaska Occupational Safety and Health Program (AKOSH) Personnel Exposure Limit (PEL) of 50 ppm for eight-hour time-weighted average (TWA) for healthy workers. EPA guidelines indicate a maximum threshold of 9 ppm CO for an eight-hour TWA for ambient or community conditions. CO levels were rarely above 0 ppm and the highest peak was about 2.5 ppm, so eight-hour averages were not calculated. The CO levels measured during this study are well below the AKOSH PEL. The results indicate rapid spikes to peak levels from an unknown source and then gradual dissipation over many hours, again indicating the limited air exchange in the house. During this monitoring, area measurements were collected, while the AKOSH PEL regulatory limits are set for personal breathing zone exposure. However, area measurements observed are representative and do not indicate exposures requiring additional personal monitoring.

Total Volatile Organic Compounds (TVOCs)

TVOC values recorded during the monitoring events suggest that the stabilized background reading in the residence during the events is between 400 and 600 ppb, three to four times the outside concentrations. The highest recorded value for the two monitoring events is about 900 ppb. Peak events generally appear to increase suddenly and then return to background over a longer period of time. Peak events also occur at the same time as CO and CO2 peak events, suggesting a common source or activity for these events. This again points to limited air exchange in the house. The peak values and patterns suggest internal sources for the increases instead of the slow accumulation of vapors in the house over time.

Relative Humidity (RH)

For optimum human comfort, ASHRAE recommends relative humidity between 30 to 60%. Typically in Alaska, a more appropriate goal is 30-40 percent. While this is generally attainable during the summer months it is not uncommon for relative humidity to be much lower (15-20 percent) in the winter due to the typical cold dry arctic air. The relative humidity in this residence was typically in the range of 15-25% during the monitoring events. The data shows the same patterns as the CO2, CO, and TVOC readings.

Summary

Overall, these results are consistent with results from other residential and office buildings. The data show and overall diurnal (24-hour) pattern that correlates with human activity in the house. The increase of the different monitored contaminant levels appears to be a reflection of respiration and human activities and the level of ventilation of the area. CO, CO2, temperature, relative humidity and VOCs patterns measured during the monitoring periods followed the same trend with a small increase in the concentrations around 10AM and a second, larger, increase in the evening. The peak readings for the compounds all occur at about the same time of day (during human activities), suggesting an internal source. While all measured contaminants remained below recommended levels, this pattern indicates they are passively flushed out of the room, but that the natural passive ventilation is not sufficient to avoid accumulation when the residence is occupied.

Working Hypothesis

Based on the investigation findings, contaminant compounds from the fuel-contaminated soil beneath the footing do not appear to be collecting in either the crawlspace or the house. BTEX compounds were not detected in the interior living space samples and only a trace of xylene, well below any standard, was detected in one of two samples from the crawl space. The TVOC data from the laboratory indicates indoor and crawlspace TVOC concentrations ranged from 43 to 326 ppb. While there are no established regulatory criteria for TVOCs in the US, local experience and international references indicates that TVOC concentrations in dwellings are typically in the range of 50-400 ppb. This residence is within the expected TVOC range. The continuous monitoring of TVOCs during the multiday events indicates that the sampling period was probably representative of the normal usage of the house.

The effort to increase the energy efficiency of the house through replacement of windows and doors appears to have successfully reduced the draftiness of the house. As a consequence, this house has very little air movement within the house and minimal air exchange with the outside air (primarily through the garage). IAQ contaminants, including CO, CO2, TVOCs, particles, and other compounds that are generated within the house, through cooking, cleaning, and renovations may remain in the house for an extended period of time. Substances released during many of these activities can cause the symptoms observed by the occupants. The occupants should consider opening doors and windows and supplying active air movement during all future interior work including painting, staining, sanding, and any other dust or contaminant generating activity. An active ventilation system, including an air-to-air heat exchanger, should also be considered as part of future renovations.

Additionally, vehicle exhaust, the furnace, and smoking in the attached garage have been shown to have an impact on indoor air quality. This house has a hot water baseboard system, so the furnace is not distributing contaminants from the garage through the house directly, but the large gap under the door between the kitchen and the garage acts as a significant

pathway for potentially contaminated air to reach the interior living spaces. Air movement through the door gap into the house is occurring when the furnace is not running, allowing vehicle exhaust to migrate into the kitchen. In addition, the occupants of the house appear to smoke in the garage on the steps next to the door leading to the kitchen. This is also drawn into the kitchen due to the pressure differential when the furnace is not running.

Although the effect of contaminant volatilization and transport through the crawlspace and into the living spaces appears to be minimal at this time, the active soil vapor extraction system has been releasing vapors at ground level outside the residence. This report does not evaluate any previous configuration of the vapor extraction system while in operation. After notification by the occupants that a petroleum odor was observed in the house while the system was running in March, Rockwell E&C personnel added a stack to the system that will release the vapors above the roofline of the residence when the system is in operation.

Conclusions and Recommendations

NORTECH performed indoor air quality monitoring of the residence at 239 Ina Street to evaluate possible effects from petroleum contaminated soil that is located beneath the footing of the house. Based on the investigation findings and working hypothesis, ***NORTECH*** had developed the following conclusions:

- Specific petroleum related compounds (BTEX) were not observed inside the house during the monitoring period and only a trace of xylenes was detected in one of two crawlspace samples while the soil vapor system was turned off.
- TVOC concentrations are within the expected range for a residential dwelling.
- Other IAQ indicators (CO, CO2, temperature, and relative humidity) are also in the expected range for a dwelling
- Multi-day monitoring indicates that measured IAQ compounds increase with activity in the house and decrease slowly when activity is reduced.
- Passive ventilation is not sufficient to prevent the accumulation of measured IAQ compounds during normal use of the house.
- The primary air exchange with outside air is under the kitchen door and through the garage, which contains the furnace and is used for vehicle parking and as a smoking area.

Based on these conclusions, ***NORTECH*** has the following recommendations:

- The soil vapor extraction system should be turned on and occupants should contact Rockwell E&C/***NORTECH*** if a petroleum odor is observed inside the house.
- A properly fitted and closing door should be installed between the kitchen and garage to prevent furnace and vehicle contaminants from entering the living spaces.
- An active ventilation system should be considered for proper air exchange in the house.

NORTECH further recommends distributing this report to all interested parties, including ADEC and building occupants. We trust this information is sufficient for your needs at the present time. Please contact us if you have any questions or comments about this report. We appreciate the opportunity to work with you on this project.

Sincerely,
NORTECH

John Hargesheimer, CIH, PE
Principal

Peter Beardsley, EIT
Environmental Engineer

Attachments:

Table 1	Laboratory Results and Potential Contaminant Info
Figure 1	January 10, 2002 - Interior Monitoring Results
Figure 2	March 7, 2002 - Interior Monitoring Results
Figure 3	March 11, 2002 - Interior Monitoring Results
Figure 4	March 14 and 19, 2002 - Interior Monitoring Results
Figure 5	March 7-11, 2002 - Continuous Monitoring Results
Figure 6	March 14-19, 2002 - Continuous Monitoring Results
Copies of Laboratory Reports	

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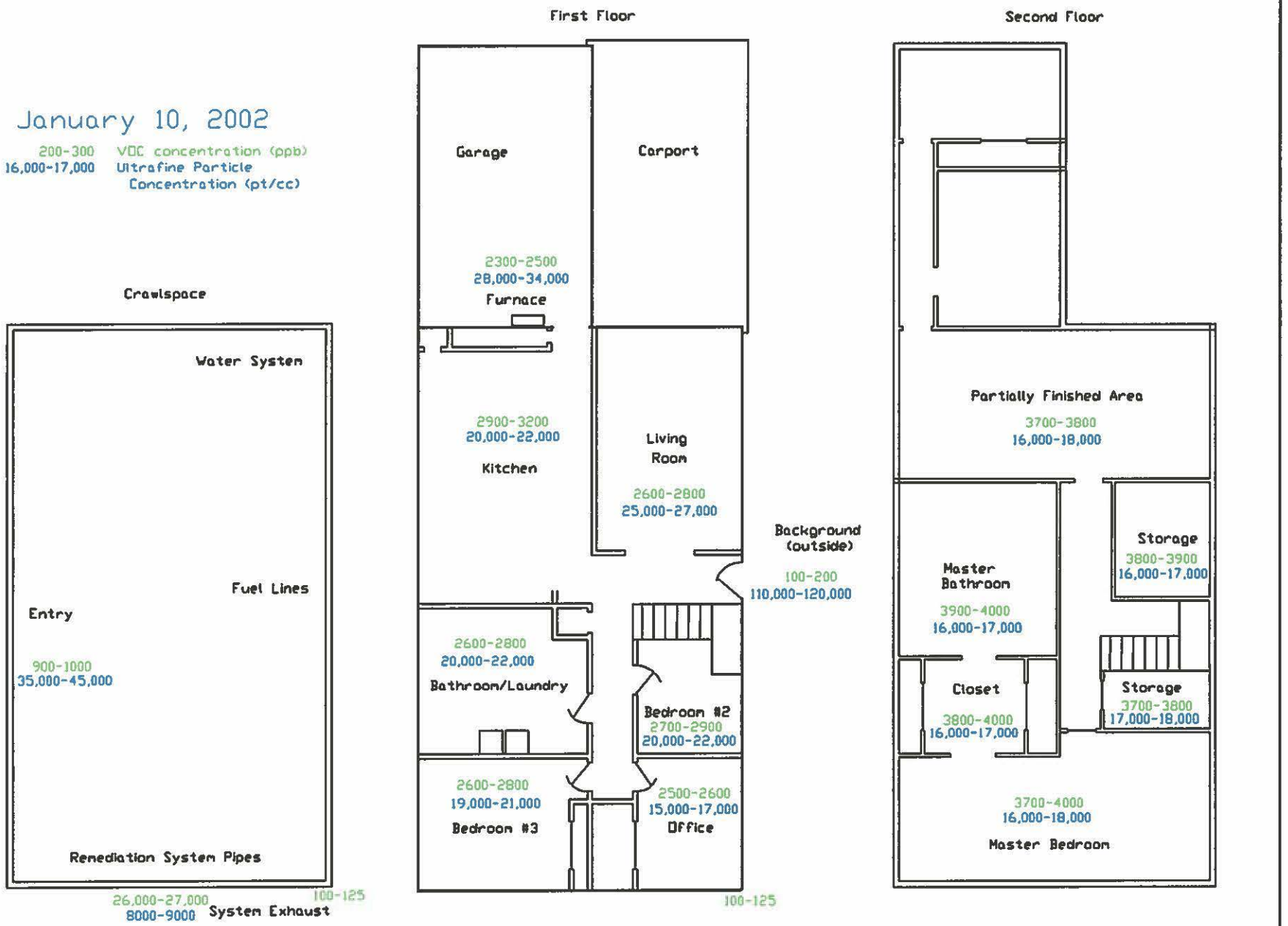
TABLE ONE
LABORATORY RESULTS

Badge ID	Location	Start Date	End Date	Total Run	Benzene	Toluene	Ethyl Benz	Xylene	Total Other VOC
Units				Minutes	ppm	ppm	ppm	ppm	ppm
SW5745	Crawlspace	11/28	12/4	8659	<0.01	<0.01	<0.01	<0.01	0.043
RB2920	Crawlspace	3/14	3/19	7303	<0.01	<0.01	<0.01	0.012	0.269
RB2872	Bedroom	3/14	3/19	7294	<0.01	<0.01	<0.01	<0.01	0.257
RB2429	Office Area	3/14	3/19	7288	<0.01	<0.01	<0.01	<0.01	0.326

POTENTIAL CONTAMINANTS OF CONCERN
REGULATIONS AND OTHER INFORMATION

CONTAMINANT	AKOSH TWA PEL	ACGIH	SYMPTOMS	COMMENT
Carbon Monoxide	50 ppm	25 ppm	Headache, weakness, dizziness, anoxia	9 ppm Ambient Threshold
Carbon Dioxide	5000 ppm	5000 ppm	Headache, restlessness, dizziness, paresthesia	600-1200 ppm normal indoors
Diesel Exhaust	None	0.15 mg/m^3 particulates	Eye irrit, pulmonary function changes	ACGIH prop. '98; >40 haz air comp
Diesel Fuel	None	100 mg/m^3	Irritation, dermatitis, lung	Proposed change in '98
Gasoline	None	300 ppm	Irrit eyes, skin, headaches, dizziness, blurred vision	CA STEL 500 ppm
Benzene	1 ppm	0.5 ppm	Irrit eyes, skin, nose, resp sys, giddiness; headaches, nausea	Irritation, eyes, skin, noise
Toluene	200 ppm	50 ppm	Irrit eyes, nose, weak, dizz, headaches etc.	Skin, Central Nervous System
Ethylbenzene	100 ppm	100 ppm	Irrit Eyes, skin, mucus membrane, headaches, CNS,	
Xylene	100 ppm	100 ppm	Irrit. eyes, skin, nose, dizziness.	



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Ultrafine and ppb Measurements
January 10, 2002 Walkthrough
239 Ina Street, Fairbanks, Alaska

N

DATE: 03/29/02	SCALE: 1" = 12'	FIGURE 1
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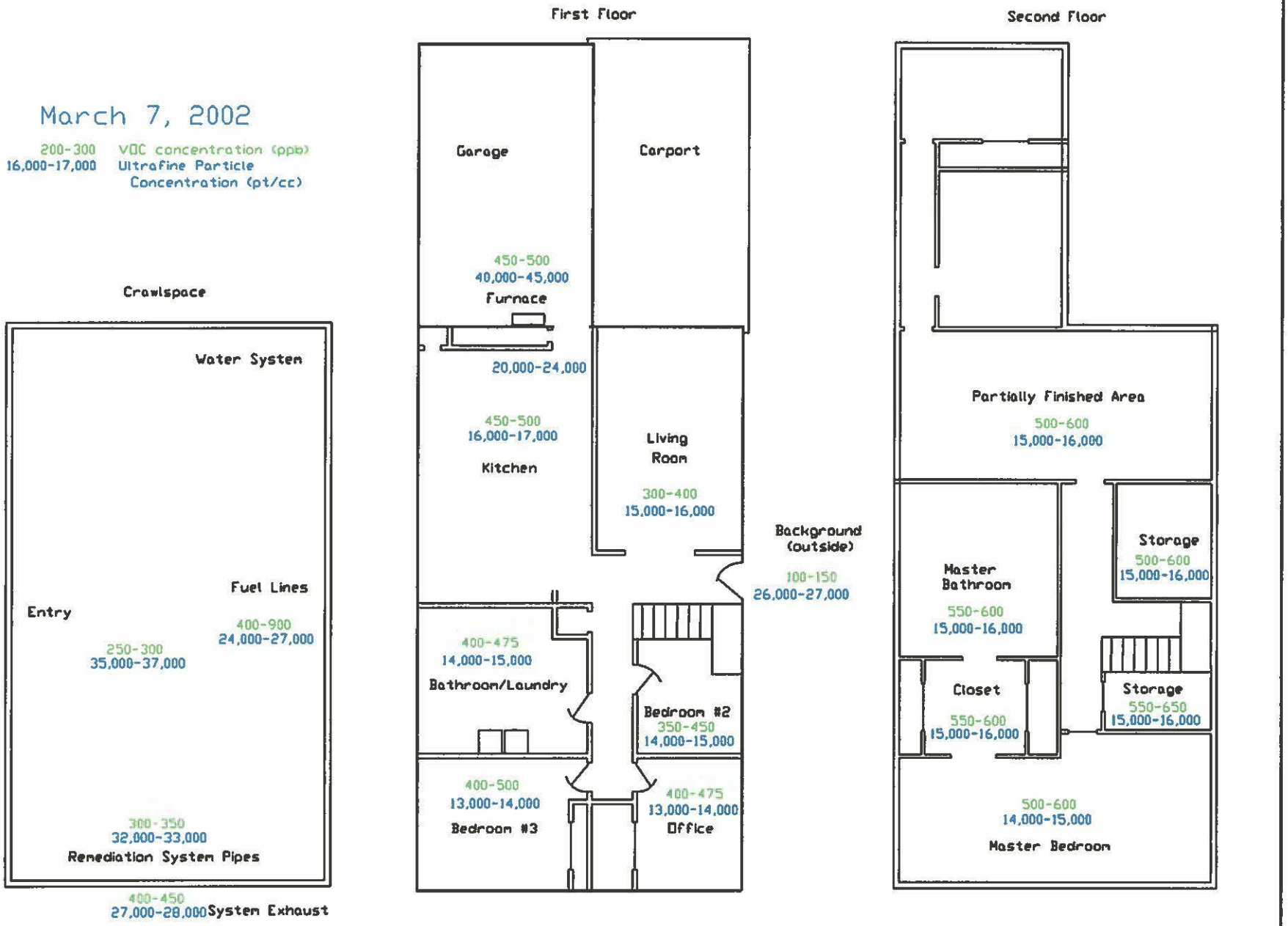

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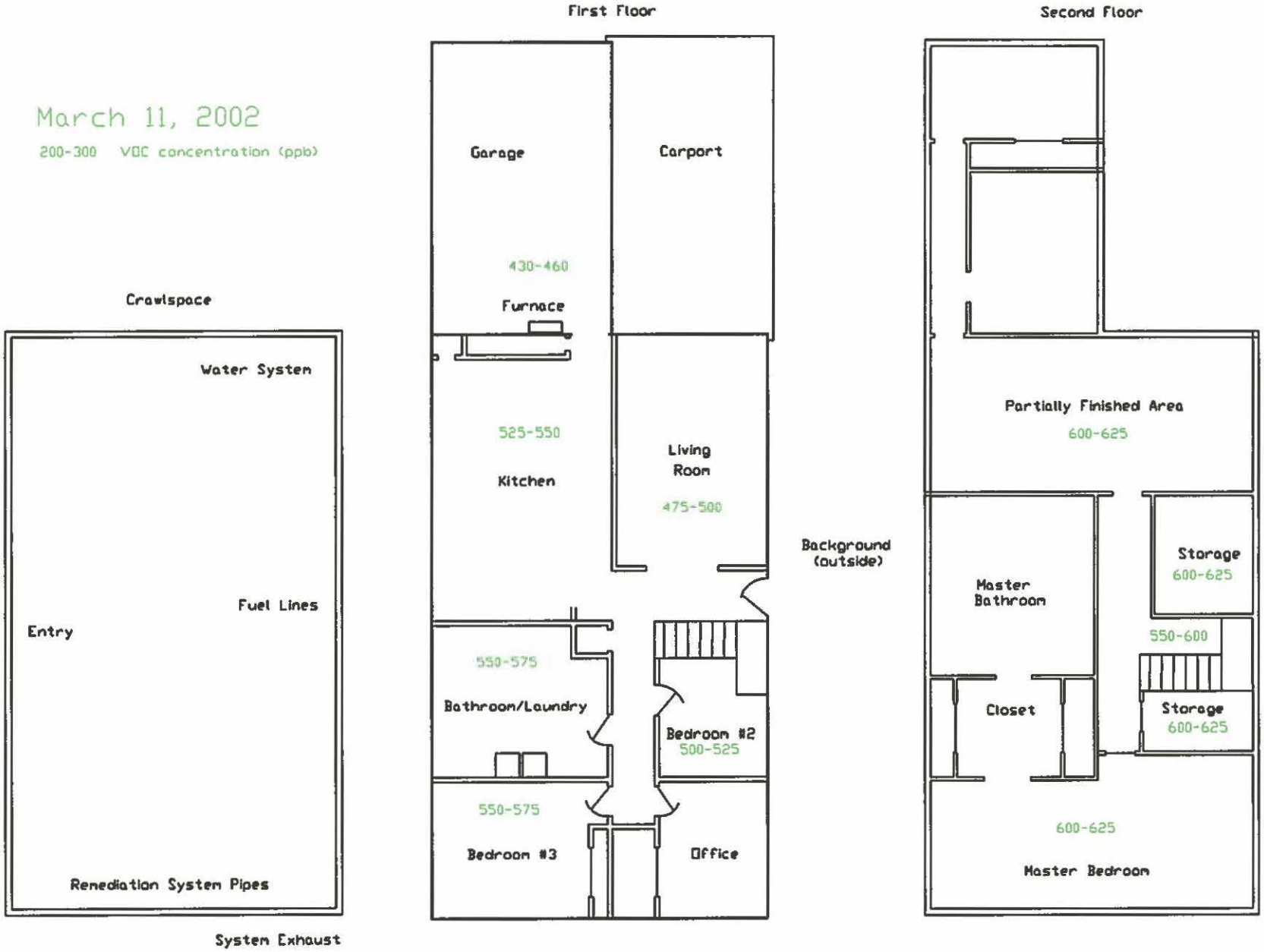
Ultrafine and ppb Measurements
March 7, 2002 Walkthrough
239 Ina Street, Fairbanks, Alaska

N

DATE: 03/29/02	SCALE: 1" = 12'	FIGURE 2
DESIGN: PLB	PROJECT: 01191.1	
DRAWN: PLB	DWG: 01191a(02)	

March 11, 2002

200-300 VOC concentration (ppb)



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Ultrafine and ppb Measurements
March 11, 2002 Walkthrough
239 Ina Street, Fairbanks, Alaska

N

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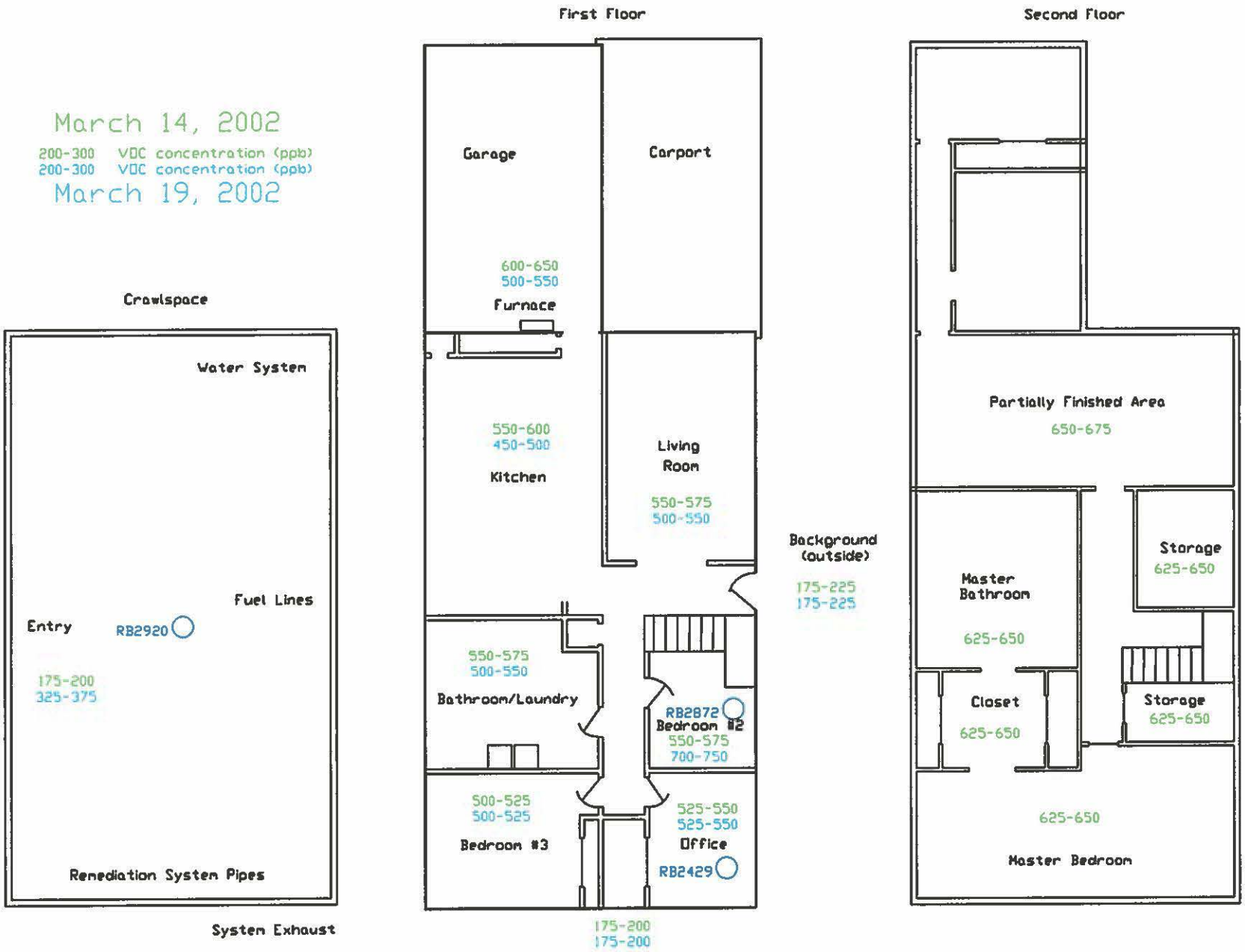
FIGURE 3



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Sample Locations and ppb Measurements
March 14 – 19, 2002 Sampling Event
239 Ina Street, Fairbanks, Alaska

N

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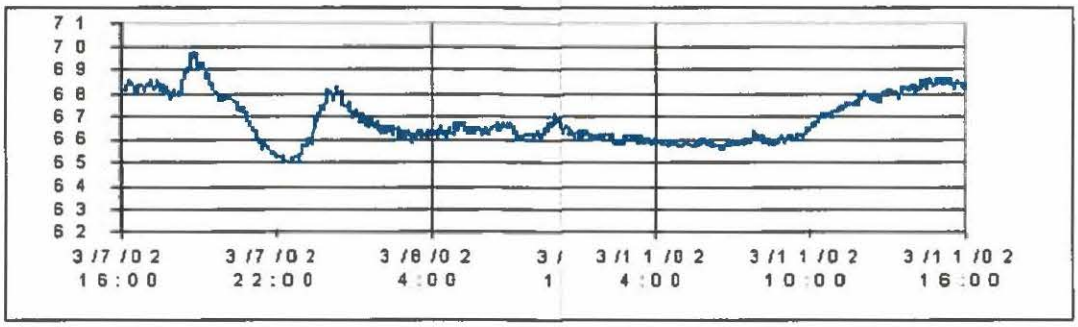
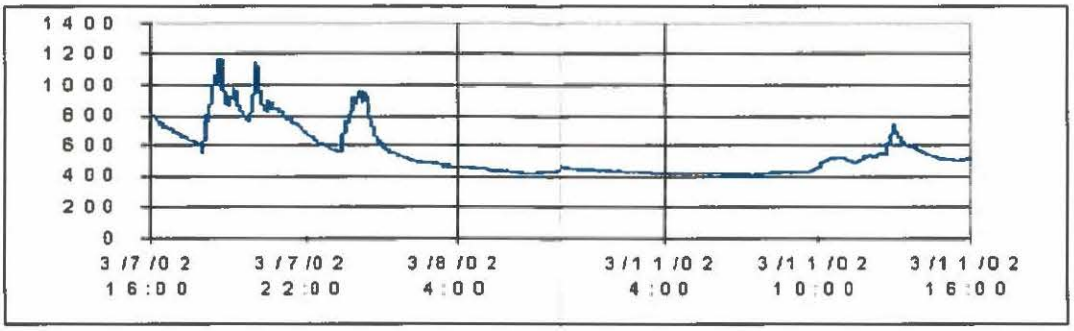
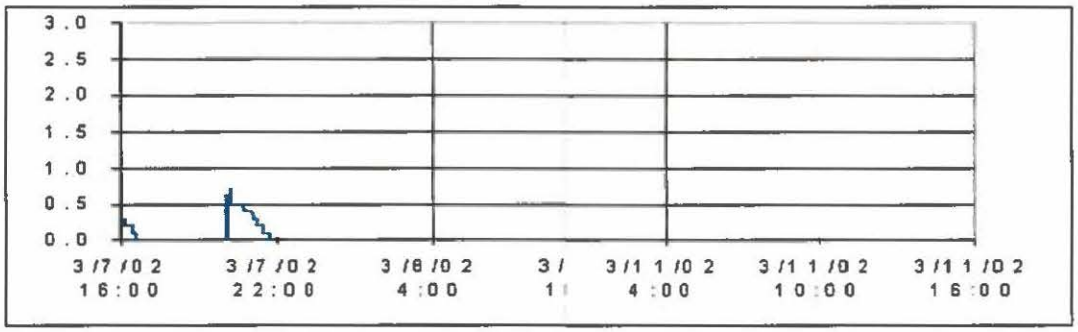
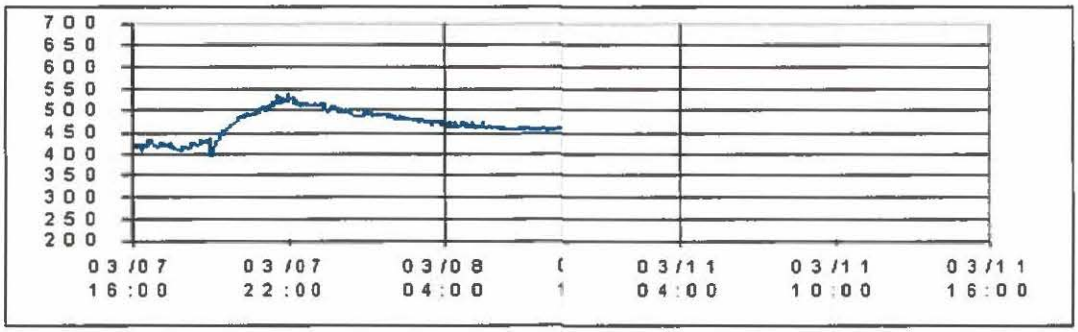
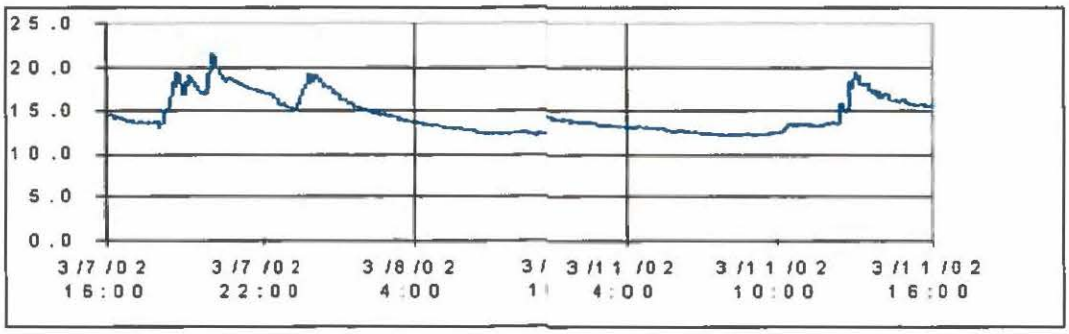
FIGURE 4











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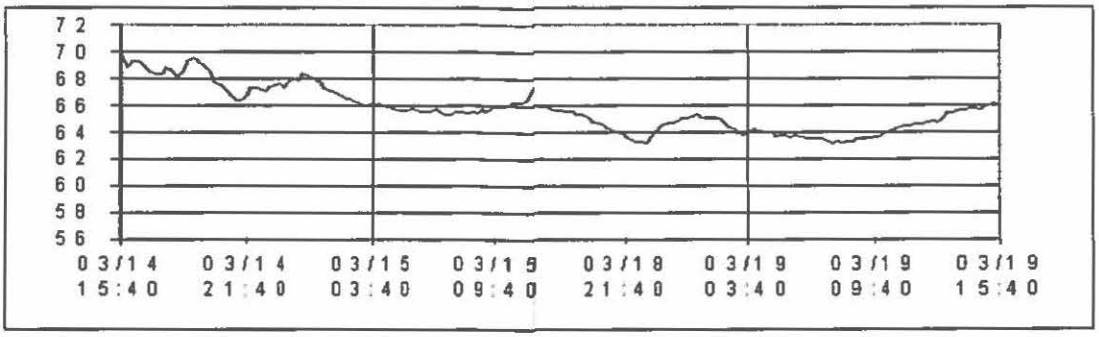
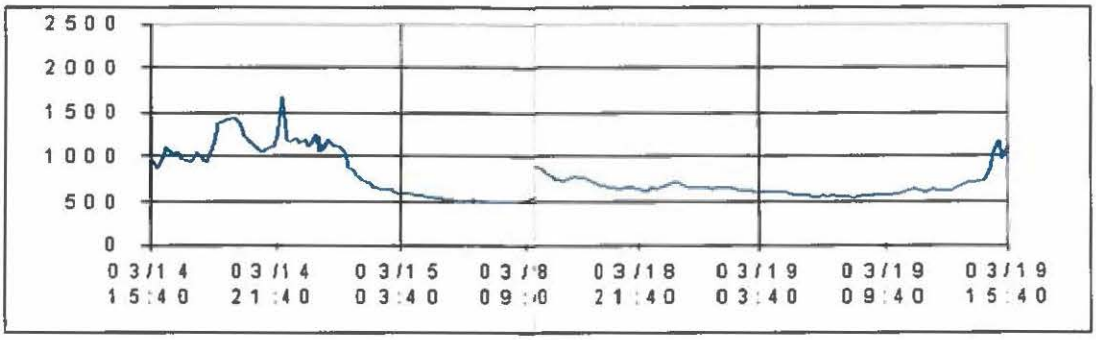
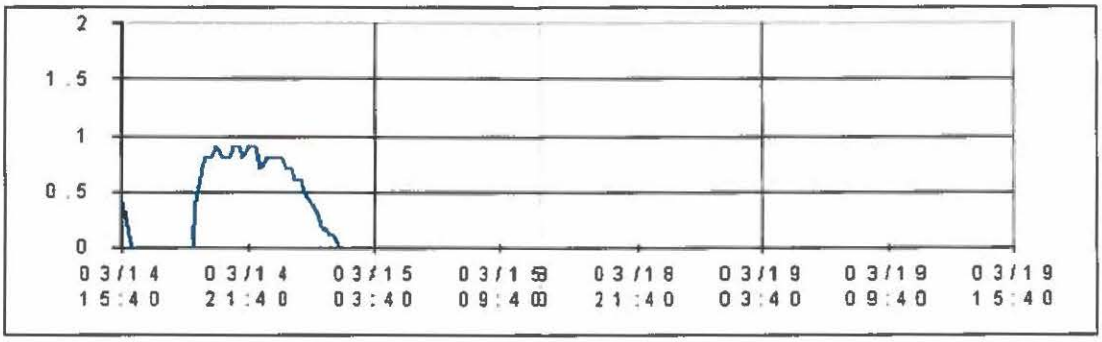
ENVIRONMENTAL & EN
CONSULTANTS
2400 College Road, Fairbanks,
(907) 452-5688 FAX: (90

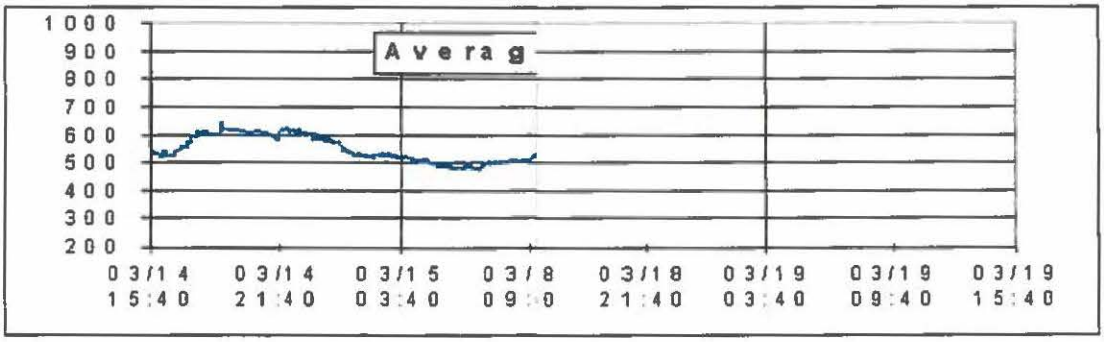
	04/03/02	SCALE:	No Scale
GR:	PLB	PROJECT:	01191.1
	PLB	DWG. NO.:	011911q(05)

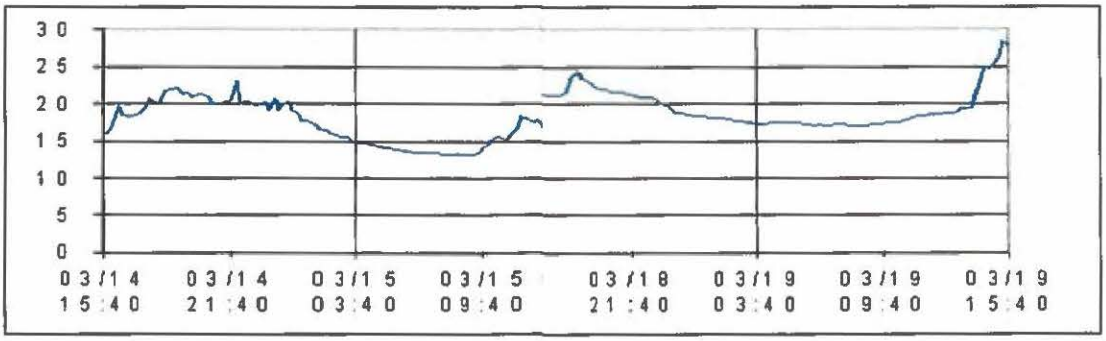
FIGURE
5











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	04/03/02	SCALE:	No Scale
AGR:	PLB	PROJECT:	01191.1
	PLB	DWG. NO.:	011911q(06)

FIGURE 6

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LABORATORY ANALYSIS REPORT

LABORATORY, K-2

1 Kemper Drive
Long Grove, IL 60049-0075
Phone (847) 320-2488
Fax (847) 320-4331
Toll Free (888) 576-7522

REPORT DATE DEC 11, 2001
SAMPLES REC'D DEC 06, 2001
REQUEST NUMBER 381333

TO: PETER BEARDSLEY
NORTECH
2400 COLLEGE ROAD
FAIRBANKS AK 99707
USA

SAMPLE	AIR VOLUME / ANALYSIS REQUESTED	MEDIA TYPE / RESULTS			ANALYZED DATE
SW5745	**8659 Minutes**	**3M Double Section Passive Dosimeter**			**DEC 11, 2001**
		micrograms		PPM	
		Front	Back	Front	Back
	BENZENE (DE = 97%)	3.5	< 1.0	< 0.01	< 0.01
	TOLUENE (DE = 100%)	5.3	< 1.1	< 0.01	< 0.01
	ETHYL BENZENE (DE = 96%)	< 1.1	< 1.1	< 0.01	< 0.01
	XYLENE (DE = 97%)	7.0	< 1.1	< 0.01	< 0.01
	REST AS HEXANE (DE = 100%)	42	< 4.5	0.043	< 0.01

COMMENTS:

IF PRESENT, DE MEANS DESORPTION EFFICIENCY

Respectfully submitted,

William M. Walsh, CIH, ROH
Director Environmental Health Services
Environmental Sciences Laboratory

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SAMPLES REC'D DEC 06, 2001
REQUEST NUMBER 381333

TO: PETER BEARDSLEY
NORTECH
2400 COLLEGE ROAD
FAIRBANKS AK 99707
USA

SAMPLE	AIR VOLUME / ANALYSIS REQUESTED	MEDIA TYPE / RESULTS	ANALYZED DATE
FIELD BLANK		3M Double Section Passive Dosimeter	DEC 11, 2001
		micrograms Front / Back	
	BENZENE (DE = 97%)(BLANK)	< 1.0 / < 1.0 NONE DETECTED	
	TOLUENE (DE = 100%)(BLANK)	< 1.1 / < 1.1 NONE DETECTED	
	ETHYL BENZENE (DE = 96%)(BLANK)	< 1.1 / < 1.1 NONE DETECTED	
	XYLENE (DE = 97%)(BLANK)	< 1.1 / < 1.1 NONE DETECTED	
	REST AS HEXANE (DE = 100%)(BLANK)	8.3 / < 4.5 SUBTRACTED	

COMMENTS:

IF PRESENT, DE MEANS DESORPTION EFFICIENCY

Respectfully submitted,

William M. Walsh, CIH, ROH
Director Environmental Health Services
Environmental Sciences Laboratory

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SAMPLES REC'D DEC 06, 2001
REQUEST NUMBER 381333

TO: PETER BEARDSLEY
NORTECH
2400 COLLEGE ROAD
FAIRBANKS AK 99707
USA

LLD *	ANALYSIS REQUESTED	METHODOLOGY	CAS #
1	BENZENE OVM2	OSHA 12 GAS CHROMATOGRAPHY	71-43-2
1	ETHYL BENZENE OVM2	OSHA 07 GAS CHROMATOGRAPHY	100-41-4
4	REST AS HEXANE OVM2	OSHA 07 GAS CHROMATOGRAPHY	110-54-3
1.1	TOLUENE OVM2	OSHA 07 GAS CHROMATOGRAPHY	108-88-3
1.1	XYLENE OVM2	OSHA 07 GAS CHROMATOGRAPHY	1330-20-7

COMMENTS:

CONCENTRATION CALCULATED USING AIR VOLUMES SUPPLIED BY CLIENT
* LLD IS THE REPORTING LIMIT IN MICROGRAMS
* MODIFICATIONS MAY BE MADE TO ABOVE METHODS TO OPTIMIZE RESULTS
* UNLESS OTHERWISE NOTED, SAMPLES RECEIVED IN GOOD CONDITION
* RESULTS ARE STRICTLY LIMITED TO SAMPLES ANALYZED

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REPORT DATE MAR 28, 2002
SAMPLES REC'D MAR 21, 2002
REQUEST NUMBER 385314

TO: PETER BEARDSLEY
NORTECH
2400 COLLEGE ROAD
FAIRBANKS AK 99707
USA

SAMPLE	AIR VOLUME / ANALYSIS REQUESTED	MEDIA TYPE / RESULTS				ANALYZED DATE
RB2920	7303 Minutes	3M Double Section Passive Dosimeter				MAR 28, 2002
		micrograms		PPM		
		Front	Back	Front	Back	
	BENZENE (DE = 97%)	1.4	< 1.0	< 0.01	< 0.01	
	TOLUENE (DE = 100%)	4.7	1.6	< 0.01	< 0.01	
	ETHYL BENZENE (DE = 96%)	2.0	< 1.1	< 0.01	< 0.01	
	XYLENE (DE = 97%)	11	< 1.1	0.012	< 0.01	
	REST AS HEXANE (DE = 100%)	200	11	0.24	0.029	

COMMENTS:

IF PRESENT, DE MEANS DESORPTION EFFICIENCY

Respectfully submitted,

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FAIRBANKS AK 99707
USA

SAMPLE	AIR VOLUME / ANALYSIS REQUESTED	MEDIA TYPE / RESULTS				ANALYZED DATE
RB2872	7294 Minutes	3M Double Section Passive Dosimeter				MAR 28, 2002
		micrograms		PPM		
		Front	Back	Front	Back	
	BENZENE (DE = 97%)	1.8	< 1.0	< 0.01	< 0.01	
	TOLUENE (DE = 100%)	7.9	< 1.1	< 0.01	< 0.01	
	ETHYL BENZENE (DE = 96%)	1.5	< 1.1	< 0.01	< 0.01	
	XYLENE (DE = 97%)	8.0	< 1.1	< 0.01	< 0.01	
	REST AS HEXANE (DE = 100%)	200	6.4	0.24	0.017	

COMMENTS:

IF PRESENT, DE MEANS DESORPTION EFFICIENCY

Respectfully submitted,

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Director Environmental Health Services
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REQUEST NUMBER 385314

TO: PETER BEARDSLEY
NORTECH
2400 COLLEGE ROAD
FAIRBANKS AK 99707
USA

SAMPLE	AIR VOLUME / ANALYSIS REQUESTED	MEDIA TYPE / RESULTS				ANALYZED DATE
RB2429	7288 Minutes	3M Double Section Passive Dosimeter				MAR 28, 2002
		micrograms		PPM		
		Front	Back	Front	Back	
	BENZENE (DE = 97%)	2.0	< 1.0	< 0.01	< 0.01	
	TOLUENE (DE = 100%)	7.3	< 1.1	< 0.01	< 0.01	
	ETHYL BENZENE (DE = 96%)	2.7	< 1.1	< 0.01	< 0.01	
	XYLENE (DE = 97%)	8.0	< 1.1	< 0.01	< 0.01	
	REST AS HEXANE (DE = 100%)	190	32	0.24	0.086	

COMMENTS:

IF PRESENT, DE MEANS DESORPTION EFFICIENCY

Respectfully submitted,

William M. Walsh, CIH, ROH
Director Environmental Health Services
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REPORT DATE MAR 28, 2002
SAMPLES REC'D MAR 21, 2002
REQUEST NUMBER 385314
PAGE NUMBER 4 OF 6

TO: PETER BEARDSLEY
NORTECH
2400 COLLEGE ROAD
FAIRBANKS AK 99707
USA

SAMPLE	AIR VOLUME / ANALYSIS REQUESTED	MEDIA TYPE / RESULTS	ANALYZED DATE
FB		3M Double Section Passive Dosimeter micrograms Front Back	MAR 28, 2002
	BENZENE (DE = 97%)(BLANK)	< 1.0 < 1.0 NONE DETECTED	
	TOLUENE (DE = 100%)(BLANK)	1.1 < 1.1 DETECTED, NOT SUBTRACTED	
	ETHYL BENZENE (DE = 96%)(BLANK)	< 1.1 < 1.1 NONE DETECTED	
	XYLENE (DE = 97%)(BLANK)	< 1.1 < 1.1 NONE DETECTED	
	REST AS HEXANE (DE = 100%)(BLANK)	9.1 < 4.0 SUBTRACTED	

COMMENTS:

IF PRESENT, DE MEANS DESORPTION EFFICIENCY

Respectfully submitted,

William M. Walsh

William M. Walsh, CIH, ROH
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1	ETHYL BENZENE OVM2	OSHA 07 GAS CHROMATOGRAPHY	100-41-4
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1.1	TOLUENE OVM2	OSHA 07 GAS CHROMATOGRAPHY	108-88-3
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REQUEST NUMBER 385314

TO: PETER BEARDSLEY
NORTECH
2400 COLLEGE ROAD
FAIRBANKS AK 99707
USA

	REQUEST CLIENT COMMENTS:	
		REF: P.O. #0119101.

Respectfully submitted,

William M. Walsh, CIH, ROH
Director Environmental Health Services
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