Final Report

Vancouver 2005 Ambient Air Toxics Monitoring Review

January 26, 2007

Southwest Clean Air Agency

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1. Executive Summary

The Oregon Department of Environmental Quality (ODEQ) operated a network of toxic air monitoring sites within the Portland/Vancouver Metro area during 2005. As part of this network, one monitoring site was located in Vancouver, Washington.

The Southwest Clean Air Agency's (SWCAA) mission is to preserve and enhance air quality in southwest Washington. Since this monitor was located in SWCAA's jurisdiction, SWCAA performed a review of the ambient monitoring data. The air toxics found in Vancouver in 2005 were consistent with the type of compounds and concentrations found in the other areas.

2. Monitoring Site Location

The 2005 Vancouver monitoring site was located at West 27th Street and Kauffman Avenue in Vancouver, Washington. The site was chosen with the assistance of local citizens concerned with the impact of aircraft emissions in their neighborhood. The location is near residential neighborhoods and is in a flight path of aircraft from Portland International Airport. The site is also near automobile and truck traffic along Fourth Plain Boulevard and Interstate 5, near railroad traffic along the railroad, near a gasoline station and near some small industrial sources including a flexographic printing operation. Figure 2-1 and Figure 2-2 show the location of the monitor. Figure 2-2 also shows the location of a 2001 toxic monitoring site.

Figure 2-1 Vancouver Air Toxics Monitoring Site Location (Street View)

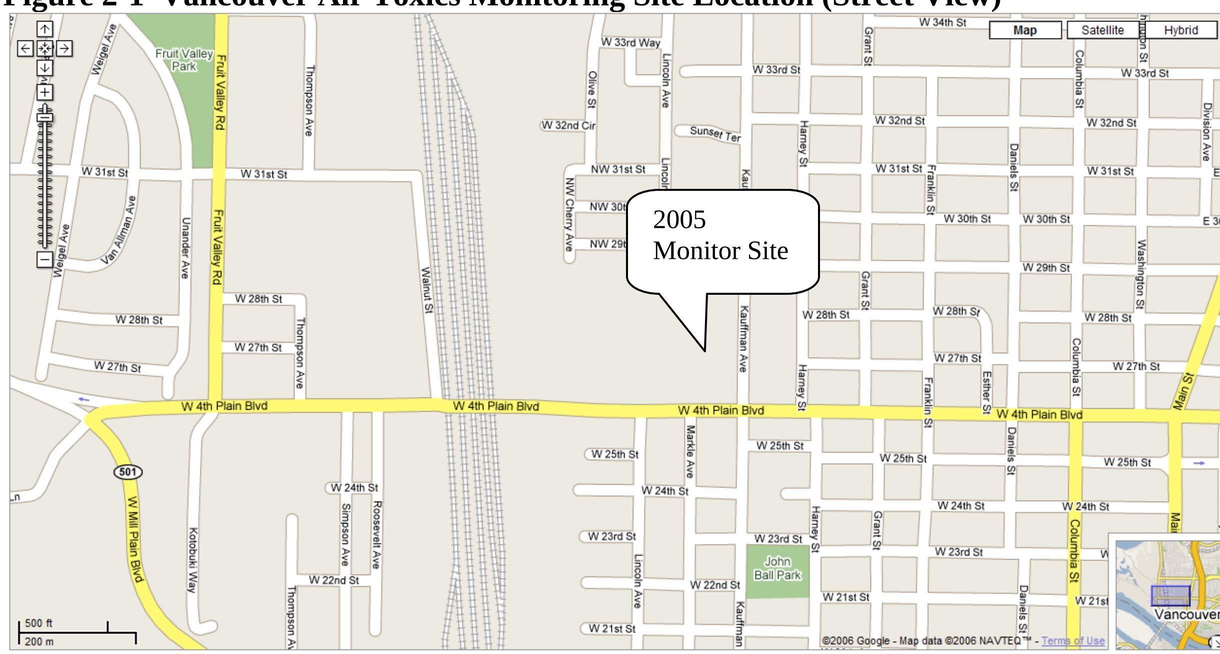

Figure 2-2 Vancouver Air Toxics Monitoring Site Location (City View)

3. Study Design

ODEQ's Toxics Monitoring Network study was patterned after other toxics studies. Integrated 24-hour samples were collected on the EPA established one-in-six-day monitoring schedule. This was accomplished by using five separate sampling/analytical methods shown below:

- Toxic metals were measured by Compendium Method IO-3 using high volume sampling of particulate matter smaller than 10 microns in diameter (PM_{10}) onto 8" x 10" quartz glass filters;
- Volatile organic compounds (VOCs) were measured by EPA Compendium Method TO-15 using passivated stainless steel (SUMMA) canisters;
- Carbonyls (i.e., aldehydes and ketones) were measured by Compendium Method TO-11 using dinitrophenylhydrazine (DNPH) coated solid sorbent cartridges;
- Semi-volatile organic compounds (SVOCs) were measured by Compendium Method TO-13A using polyurethane foam (PUF) cartridges with a 4" quartz glass filter.
- Hexavalent Chromium was measured using a custom detection method.

All monitoring site operation and sample analyses were performed by ODEQ.   Sampling was performed between February 9, 2005 and February 16, 2006.

The target compounds for this study are shown in Table 3-1. The target compounds that are on the EPA Urban Air Toxics list are marked with an asterisk; the seven Polyaromatic Hydrocarbons (PAHs) are italicized.

Table 3-1: Study Target Air Toxics					
	Compound Name	CAS No.		Compound Name	CAS No;
	Volatile Organic Compound			Metals	
	1,1,1-Trichloroethane	71-55-6	*	Arsenic	7440-38-2
*	1,1,2,2-Tetrachloroethane	79-34-5	*	Beryllium	7440-41-7
*	1,1,2,2-Tetrachloroethylene	127-18-4	*	Cadmium	7440-43-9
	1,1,2-Trichloroethane	79-00-5		Chromium	7440-47-3
*	1,1-Dichloroethane	75-34-3		Cobalt	7440-48-4
	1,1-Dichloroethylene	75-35-4	*	Lead	7439-92-1
	1,2,4-Trichlorobenzene	120-82-1		Manganese	7439-96-5
	1,2,4-Trimethylbenzene	95-63-6	*	Nickel	7440-02-0
*	1,2-Dibromoethane	106-93-4		Selenium	7782-49-2
	1,2-Dichlorobenzene	95-50-1		Semi-Volatiles	
	1,2-Dichloroethane	107-06-2		Acenaphthene	83-32-9
*	1,2-Dichloropropane (propylene dichloride)	78-87-5		Acenaphthylene	208-96-8
	1,2-Dimethylbenzene	95-47-6		Anthracene	120-12-7
	1,3,5-Trimethylbenzene	108-67-8		Benzo[e]pyrene	192-97-2
*	1,3-Butadiene	106-99-0		Benzo[g,h,i]perylene	191-24-2
	1,3-Dichlorobenzene	541-73-1		*Benzo[k]fluoranthene*	*207-08-9*
	1,4-Dichlorobenzene	106-46-7		*Chrysene*	*218-01-9*
	1,4/1,3-Dimethylbenzene	108-38-3		Coronene	191-07-1
	2,2,4-Trimethylpentane	540-84-1		*Dibenz[a,h]anthracene*	*53-70-3*
	2-Butanone (MEK)	78-93-3		Dibenzofuran	132-64-9
	2-Hexanone	591-78-6		Dibenzothiophene	132-65-0
	3-Chloropropene	107-05-1		Fluoranthene	206-44-0
	4-Ethyltoluene	622-96-8		Fluorene	86-73-7
	4-Methyl-2-Pentanone (MIBK)	108-10-1		*Indeno[1,2,3-cd]pyrene*	*193-39-5*
	Acetone	67-64-1		Naphthalene	91-20-3
*	Acrylonitrile	107-13-1		Perylene	198-55-0
*	Benzene	71-43-2		Phenanthrene	85-01-8
	Bromodichloromethane	75-27-4		Pyrene	129-00-0
	Bromoform	75-25-2		*Benzo[a]anthracene*	*56-55-3*
	Bromomethane	74-83-9		*Benzo[b]fluoranthene*	*205-99-2*
	Carbon Disulfide	75-15-0		*Benzo[a]pyrene*	*50-32-8*
	Carbon Tetrachloride	56-23-5		Carbonyls	
	Chlorobenzene	108-90-7		2,5-Dimethylbenzaldehyde	5779-94-2
	Chloroethane	75-00-3		2-Butanone (MEK)	78-93-3
*	Chloroform	67-66-3	*	Acetaldehyde	75-07-0
	Chloromethane	74-87-3		Acetone	67-64-1
	cis-1,2-Dichloroethylene	156-59-2		Benzaldehyde	100-52-7
*	cis-1,3-Dichloropropene	10061-01-5		Butyraldehyde	123-72-8
	Cyclohexane	110-82-7		Crotonaldehyde	4170-30-3
	Dibromochloromethane	124-48-1	*	Formaldehyde	50-00-0
	Dichlorodifluoromethane	75-71-8		Hexaldehyde	66-25-1
	Dichlorotetrafluoroethane	1320-37-2		Isovaleraldehyde	590-86-3
	Ethyl Benzene	100-41-4		m-Tolualdehyde	620-23-5
	Hexachloro-1,3-Butadiene	87-68-3		o-Tolualdehyde	529-20-4
	Isopropanol	67-63-0		p-Tolualdehyde	104-87-0

Table 3-1: Study Target Air Toxics				
	Compound Name	CAS No.	Compound Name	CAS No;
	Methyl-Tert-Butyl Ether (MTBE)	1634-04-4	Propionaldehyde	123-38-6
*	Methylene Chloride	75-09-2	Valeraldehyde	110-62-3
	n-Heptane	142-82-5		
	n-Hexane	110-54-3		
	Styrene	100-42-5		
	Tetrahydrofuran	109-99-9		
	Toluene	108-88-3		
	trans-1,2-Dichloroethene	156-60-5		
	trans-1,3-Dichloropropene	10061-02-6		
	Trichloroethylene	79-01-6		
	Trichlorofluoromethane	75-69-4		
	Trichlorotrifluoroethane	26523-64-8		
	Vinyl bromide	593-60-2		
*	Vinyl Chloride	75-01-4		

4. Data Reduction and Results

SWCAA performed reduction of the air toxics data collected and analyzed by ODEQ. The data collected by ODEQ were 24-hour samples taken on a once every six day schedule. An annual average of this data was calculated by first obtaining the average of each consecutive three-month quarter and then averaging the four quarters. By first taking the average of a quarter it ensures that when sampling results are missing, the seasonal variability of the pollutants are given equal weight in calculating the annual average. Occasionally sample results were not obtained for a particular sampling date possibly due to equipment malfunction, operator error, power problems or some other event.

In addition to missing samples, some toxic air pollutants may not be detected in the laboratory analysis in some or all of the samples but yet may be present in the ambient air in some concentration below what the laboratory can detect. If the 24-hour result for a particular compound was not detected by the laboratory, ½ of the Method Reporting Limit (MRL) was used as the 24-hour result used to calculate the quarterly and annual averages. The MRL is the lowest reported concentration that the laboratory can measure taking into account laboratory equipment and sample dilution. If the annual average was calculated to be less than the MRL, the MRL was listed in this report. The full list of compounds and their results is shown in Appendix A of this report. Those compounds with an annual average value above the MRL are shown in Table 4-1. In addition, three compounds associated with aircraft exhausts which were not calculated to have an annual average above the MRL are also shown in Table 4-1.

Table 4-1 2005 Vancouver Toxic Monitoring Results		
Compound	CAS No.	Annual Average Concentration ($\mu g/m^3$)
1,2,4-Trimethylbenzene	95-63-6	1.01
1,2-Dimethylbenzene	95-47-6	0.63
1,4/1,3-Dimethylbenzene	108-38-3	1.72
1,3-Butadiene	106-99-0	<0.23
2,2,4-Trimethylpentane	540-84-1	<0.47
Benzene	71-43-2	0.98[1]
Chlorobenzene	108-90-7	0.99
Chloromethane	74-87-3	0.94
Dichlorodifluoromethane	75-71-8	1.59
Isopropanol	67-63-0	22.1[2]
Methylene Chloride	75-09-2	0.47
Styrene	100-42-5	<0.44
Toluene	108-88-3	3.45
Trichlorofluoromethane	75-69-4	0.58
Arsenic 10µm	7440-38-2	0.0011
Cobalt 10µm	7440-48-4	0.00014
Lead 10µm	7439-92-1	0.0039
Manganese 10µm	7439-96-5	0.0080
Nickel 10µm	7440-02-0	0.0011
Selenium 10µ	7782-49-2	0.00025
Acenaphthene	83-32-9	0.0012[1]
Acenaphthylene	208-96-8	0.0015[1]
Anthracene	120-12-7	0.0011[1]
Benzo[b]fluoranthene	205-99-2	0.00063[1]
Chrysene	218-01-9	0.00031[1]
Dibenzofuran	132-64-9	0.0021[1]
Dibenzothiophene	132-65-0	0.00068[1]
Fluoranthene	206-44-0	0.0029[1]
Fluorene	86-73-7	0.0029[1]
Indeno[1,2,3-cd]pyrene	193-39-5	0.00031[1]
Naphthalene	91-20-3	0.0019[1]
Phenanthrene	85-01-8	0.013[1]
Pyrene	129-00-0	0.0016[1]
2-Butanone (MEK)	78-93-3	0.46
Acetaldehyde	75-07-0	1.43
Acetone	67-64-1	1.51
Benzaldehyde	100-52-7	0.13
Butyraldehyde	123-72-8	0.20
Formaldehyde	50-00-0	1.95
Hexaldehyde	66-25-1	0.22
Isovaleraldehyde	590-86-3	0.14
Propionaldehyde	123-38-6	0.26
Valeraldehyde	110-62-3	0.088

[1] Not enough valid sampling days for a statistically meaningful average
[2] Several sampling days removed from annual average calculation

As noted in the above table, benzene did not have enough sampling days with results to allow a meaningful ambient average to be calculated. 26 benzene samples out of 54 were determined by ODEQ to be uncontaminated. The data is shown for informational purposes only. Polycyclic organic compounds (POM) which consist of Acenaphthene through Pyrene in Table 4-2 consisted of only 17 samples over the entire sampling period. Also, several 24-hour average results for isopropanol appear to have been contaminated and were removed from the annual average calculations. Isopropanol is a solvent used in cleaning the equipment. Dates with very high isopropanol values which occurred directly after equipment maintenance were removed.

Compounds with an annual average concentration below the MRL are shown in Table 4-2.

Table 4-2
2005 Vancouver Monitoring Data
Compounds Below Method Reporting Limit

Compound	CAS No.	Compound	CAS No.
1,1,1-Trichloroethane	71-55-6	Dichlorotetrafluoroethane	76-14-2
1,1,2,2-Tetrachloroethane	79-34-5	Ethyl Benzene	100-41-4
1,1,2,2-Tetrachloroethylene	127-18-4	Hexachloro-1,3-Butadiene	87-68-3
1,1,2-Trichloroethane	79-00-5	Methyl-Tert-Butyl Ether (MTBE)	1634-04-4
1,1-Dichloroethane	75-34-3	n-Heptane	142-82-5
1,1-Dichloroethylene	75-35-4	n-Hexane	110-54-3
1,2,4-Trichlorobenzene	120-82-1	Styrene	100-42-5
1,2-Dibromoethane (EDB)	106-93-4	Tetrahydrofuran	109-99-9
1,2-Dichlorobenzene	95-50-1	trans-1 2-Dichloroethene	156-60-5
1,2-Dichloroethane	107-06-2	trans-1 3-Dichloropropene	10061-02-6
1,2-Dichloropropane	78-87-5	Trichloroethylene	79-01-6
1,3,5-Trimethylbenzene	108-67-8	Trichlorotrifluoroethane	76-13-1
1,3-Butadiene	106-99-0	Vinyl bromide	593-60-2
1,3-Dichlorobenzene	541-73-1	Vinyl Chloride	75-01-4
1,4-Dichlorobenzene	106-46-7	Chromium hexavalent	18540-29-9
2,2,4-Trimethylpentane	540-84-1	Beryllium 10µm	7440-41-7
2-Hexanone	591-78-6	Cadmium 10µm	7440-43-9
3-Chloropropene	107-05-1	Chromium 10µm	7440-47-3
4-Ethyltoluene	622-96-8	Benzo[a]anthracene	56-55-3
4-Methyl-2-Pentanone (MIBK)	108-10-1	Benzo[a]pyrene	50-32-8
Acrylonitrile	107-13-1	Benzo[e]pyrene	192-97-2
Bromodichloromethane	75-27-4	Benzo[g h i]perylene	191-24-2
Bromoform	75-25-2	Benzo[k]fluoranthene	207-08-9
Bromomethane	74-83-9	Coronene	191-07-1
Carbon Disulfide	75-15-0	Dibenz[a h]anthracene	53-70-3
Carbon Tetrachloride	56-23-5	Perylene	198-55-0
Chloroethane	75-00-3	2,5-Dimethylbenzaldehyde	5779-94-2
Chloroform	67-66-3	Crotonaldehyde (2-Butenal (E))	4170-30-3
cis-1,2-Dichloroethylene	156-59-2	m-Tolualdehyde	620-23-5
cis-1,3-Dichloropropene	10061-01-5	o-Tolualdehyde	529-20-4

Table 4-2 2005 Vancouver Monitoring Data Compounds Below Method Reporting Limit			
Compound	CAS No.	Compound	CAS No.
Cyclohexane	110-82-7	p-Tolualdehyde	104-87-0
Dibromochloromethane	124-48-1		

5. Comparison to Other Studies

SWCAA compared the results of this study to results from similar studies. Similar studies include a 2001 Vancouver, Washington study, a 2004 Longview, Washington study and a 2005 Beaverton, Oregon study. The 2001 Vancouver study was performed at the Moose Lodge at 8205 East 4th Plain Boulevard in Vancouver (See Figure 2-2). Although this study was not in the exact location of the 2005 Vancouver study, it does give some indication of toxic trends in the area. The 2005 Beaverton study data was collected at Beaverton Highland Park Middle School in Beaverton, Oregon. This study was conducted by ODEQ concurrently with the 2005 Vancouver data. The Beaverton site was chosen by SWCAA for comparison as opposed to the Portland sites because Beaverton is a suburban area similar to Vancouver. The 2004 Longview study data was collected at 254 Oregon Way, in Longview, Washington by SWCAA. In all studies the ODEQ laboratory performed the analysis and SWCAA performed the data reduction as discussed in Section 4 of this report.

The results from the 2005 Vancouver study for compounds with annual averages measured above the method reporting limit and three additional compounds associated with aircraft emissions are shown in Table 5-1 along with the results from the other studies. The ambient concentration for the site with the highest annual average concentration is indicated in bold.

The metals analyses for the 2001 Vancouver study were determined using Total Suspended Particulate (TSP). This means that all the dust and particles in the air with an aerodynamic diameter of less than or equal to 30 micrometers were collected and analyzed. Since the 2001 study EPA has directed metals analysis to be performed using PM_{10}, which is particulate matter with an aerodynamic diameter less than or equal to 10 micrometers. PM_{10} particles pose the greatest health concern because they can pass through the nose and throat and get into the lungs. The metals concentrations from the 2001 Vancouver study are shown in the table but they are not directly comparable with metals data from the other sites because of the different data collection method used.

Table 5-1
Comparison of Data -Annual Average Concentrations (µg/m³)

Compound	2005 Vancouver	2001 Vancouver	2004 Longview	2005 Beaverton
1,2,4-Trimethylbenzene	1.01	**3.15**	1.01	0.74
1,2-Dimethylbenzene	0.63	**1.68**	0.74	0.47
1,4/1,3-Dimethylbenzene	1.72	**5.53**	2.98	1.20
1,3-Butadiene	<0.23	<0.23	<0.23	<0.23
2,2,4-Trimethylpentane	<0.47	---	<0.47	<0.47
Benzene	0.98[2]	**2.05**	1.06	0.72[2]
Chlorobenzene	**0.99**	<0.47	<0.23	<0.47
Chloromethane	**0.94**	0.37	0.78	0.89
Dichlorodifluoromethane	1.59	**2.16**	1.82	1.62
Isopropanol	**22.1**	---	1.36	21.8
Methylene Chloride	0.47	**0.65**	0.60	<0.35
Styrene	<0.44	**0.44**	<0.44	<0.44
Toluene	3.45	**6.20**	3.24	2.57
Trichlorofluoromethane	0.58	**1.12**	0.69	<0.57
Arsenic 10µm	0.0011	0.0019[1]	**0.0012**	0.0011
Cobalt 10µm	0.00014	<0.02[1]	**0.00028**	<0.000075
Lead 10µm	0.0039	0.0049[1]	**0.0052**	0.0033
Manganese 10µm	**0.0080**	0.015[1]	0.0078	0.0038
Nickel 10µm	0.0011	<0.002[1]	**0.0017**	<0.001
Selenium 10µ	0.00025	<0.0008[1]	0.00016	**0.00026**
Acenaphthene	**0.0012**[2]	<0.0008	0.0011	0.00042[2]
Acenaphthylene	0.0015[2]	**0.0040**	0.00096	0.0011[2]
Anthracene	0.0011[2]	**0.0015**	0.0011	0.00066[2]
Benzo[b]fluoranthene	0.00063[2]	**0.0014**	0.00061	0.00062[2]
Chrysene	0.00031[2]	<0.0008	**0.00036**	<0.0003[2]
Dibenzofuran	0.0021[2]	**0.0023**	0.0014	0.0014[2]
Dibenzothiophene	**0.00068**[2]	<0.0008	0.00045	<0.0003[2]
Fluoranthene	**0.0029**[2]	0.0020	0.0020	0.00099[2]
Fluorene	0.0029[2]	**0.0031**	0.0025	0.0015[2]
Indeno[1,2,3-cd]pyrene	0.00031[2]	<0.0008	**0.00040**	0.00031[2]
Naphthalene	0.0019[2]	**0.0027**	0.0016	0.0018[2]
Phenanthrene	**0.013**[2]	0.010	0.0088	0.0057[2]
Pyrene	0.0016[2]	**0.0019**	0.0015	0.00085[2]
2-Butanone (MEK)	**0.46**	0.39	0.27	0.36
Acetaldehyde	1.43	**2.26**	1.05	1.23
Acetone	1.51	**3.57**	1.14	1.51
Benzaldehyde	0.13	**0.26**	0.14	0.095
Butyraldehyde	0.20	**0.24**	0.17	0.17
Formaldehyde	1.95	**2.55**	0.79	1.58
Hexaldehyde	0.22	**0.25**	0.15	0.19
Isovaleraldehyde	0.14	<0.06	0.12	**0.16**
Propionaldehyde	0.26	**0.30**	0.18	0.24
Valeraldehyde	0.088	**0.11**	0.059	0.078

[1] Data is for Total Suspended Particulate Matter and is shown for information only
[2] Not enough valid sampling days for a statistically meaningful average

As shown in Table 5-1, many of the highest annual average concentrations were located at the 2001 Vancouver monitoring location. Although both monitoring sites in Vancouver were located in areas with mobile traffic sources, the 2001 site was located in an area with slightly higher traffic volumes.

6. Health Risk Screening Analysis

While a comprehensive health risk assessment is beyond the scope of this study a health risk screening analysis is useful for identifying pollutants of potential health concern. In order to determine pollutants of potential concern, the concentrations of those pollutants with annual averages above the MRL were compared with established health risk screening values. Not all of the pollutants have published health standards or screening guidelines which may be used for comparison but available information from several sources was considered.

The Oregon DEQ has recently established Ambient Benchmark Concentrations (ABCs) for a number of air toxic compounds that can be used for these screening comparisons. The Oregon ABCs are based on a thorough review of all the health based standards and guidance currently available and were recently enacted into rule (OAR 340-246-0090, 8-16-06). Each ABC is based on either a cancer or a non-cancer risk, whichever is lower. The cancer health risks are based on a risk level of one in one million which implies that up to one person, out of one million equally exposed people would contract cancer if exposed continuously (24 hours per day) to the specific concentration over 70 years (an assumed lifetime). The non-cancer health risks are based on the lowest concentration at which non-cancer symptoms would appear.

The Washington Department of Ecology's (WDOE) Air Toxics Rule (WAC 173-460, 7-21-98) establishes Acceptable Source Impact Levels (ASIL) for many toxic air pollutants (TAP). The ASILs are not ambient air quality standards per se. Rather they are regulatory levels that establish the maximum incremental air quality impact that a new source of TAP may cause that will not unreasonably endanger human health in the surrounding community. The ASILs were established in 1994 considering cancer and non-cancer health risk information current at that time. WDOE is currently reviewing all ASILs considering the most current health risk information and the rule will be revised accordingly.

The US Environmental Protection Agency (EPA) has recently (February 2006) published a risk based screening approach for air toxics monitoring data. This publication establishes Chronic Screening Values for a number of hazardous air pollutants (HAP). These Chronic Screening Values are used to indicate a concentration of a HAP in the air to which a person could be continually exposed for a lifetime (assumed 70 years) and which would be unlikely to result in a deleterious effect, considering both cancer and non-cancer risks. As with the Oregon ABCs, the cancer-based screening values accept a one in one million excess cancer risk.

The concentrations of those pollutants analyzed in this study with annual averages above the MRL and the three additional compounds associated with aircraft emissions were compared with the established health risk screening values from the sources discussed above. Table 6-1 shows the 2005 Vancouver annual average and the respective health risk screening values for those pollutants that also have a health risk screening values from any of the three of the sources discussed above.

<table>
<tr><th colspan="6">Table 6-1
2005 Vancouver Toxic Monitoring Health Risk Screening Assessment</th></tr>
<tr><th>Compound</th><th>CAS No.</th><th>Annual Average Concentration ($\mu g/m^3$)</th><th>Oregon Benchmark Concentration ($\mu g/m^3$)</th><th>Washington ASIL ($\mu g/m^3$)</th><th>EPA Chronic Screening Value ($\mu g/m^3$)</th></tr>
<tr><td>1,2-Dimethylbenzene</td><td>95-47-6</td><td>0.63</td><td rowspan="2">700</td><td rowspan="2">1500</td><td rowspan="2">10</td></tr>
<tr><td>1,4/1,3-Dimethylbenzene</td><td>108-38-3</td><td>1.72</td></tr>
<tr><td>1,3-Butadiene</td><td>106-99-0</td><td><0.23</td><td>0.03</td><td>0.0036</td><td>0.03</td></tr>
<tr><td>**Benzene**</td><td>**71-43-2**</td><td>**0.98**[2]</td><td>**0.13**</td><td>**0.12**</td><td>**0.13**</td></tr>
<tr><td>Chlorobenzene</td><td>108-90-7</td><td>0.99</td><td>---</td><td>150[3]</td><td>100</td></tr>
<tr><td>Chloromethane</td><td>74-87-3</td><td>0.94</td><td>90</td><td>340[3]</td><td>9</td></tr>
<tr><td>Dichlorodifluoromethane</td><td>75-71-8</td><td>1.59</td><td>---</td><td>16000[3]</td><td>---</td></tr>
<tr><td>Isopropanol</td><td>67-63-0</td><td>22.1</td><td>---</td><td>3300[3]</td><td>---</td></tr>
<tr><td>Methylene Chloride</td><td>75-09-2</td><td>0.47</td><td>2.1</td><td>0.56</td><td>2.1</td></tr>
<tr><td>Styrene</td><td>100-42-5</td><td><0.44</td><td>---</td><td>1000[3]</td><td>100</td></tr>
<tr><td>Toluene</td><td>108-88-3</td><td>3.45</td><td>400</td><td>400[3]</td><td>40</td></tr>
<tr><td>Trichlorofluoromethane</td><td>75-69-4</td><td>0.58</td><td>---</td><td>19000[3]</td><td>---</td></tr>
<tr><td>**Arsenic 10µm**</td><td>**7440-38-2**</td><td>**0.0011**</td><td>**0.0002**</td><td>**0.00023**</td><td>**0.00023**</td></tr>
<tr><td>Cobalt 10µm</td><td>7440-48-4</td><td>0.00014</td><td>0.1</td><td>0.17[3]</td><td>0.01</td></tr>
<tr><td>Lead 10µm</td><td>7439-92-1</td><td>0.0039</td><td>0.5</td><td>0.5[3]</td><td>0.15</td></tr>
<tr><td>**Manganese 10µm**</td><td>**7439-96-5**</td><td>**0.0080**</td><td>0.2</td><td>0.4[3]</td><td>**0.005**</td></tr>
<tr><td>Nickel 10µm</td><td>7440-02-0</td><td>0.0011</td><td>0.002[1]</td><td>0.0021[1]</td><td>0.0021</td></tr>
<tr><td>Selenium 10µ</td><td>7782-49-2</td><td>0.00025</td><td>---</td><td>0.67[3]</td><td>2.0</td></tr>
<tr><td>Acenaphthene</td><td>83-32-9</td><td>0.0012[2]</td><td rowspan="10">See Table 6-2</td><td>---</td><td>0.3</td></tr>
<tr><td>Acenaphthylene</td><td>208-96-8</td><td>0.0015[2]</td><td>---</td><td>0.3</td></tr>
<tr><td>Anthracene</td><td>120-12-7</td><td>0.0011[2]</td><td>---</td><td>0.3</td></tr>
<tr><td>**Benzo[b]fluoranthene**</td><td>**205-99-2**</td><td>**0.00063**[2]</td><td rowspan="3">**0.00048**</td><td>0.0091</td></tr>
<tr><td>**Chrysene**</td><td>**218-01-9**</td><td>**0.00031**[2]</td><td>0.091</td></tr>
<tr><td>**Indeno[1,2,3-cd]pyrene**</td><td>**193-39-5**</td><td>**0.00031**[2]</td><td>0.0091</td></tr>
<tr><td>Fluoranthene</td><td>206-44-0</td><td>0.0029[2]</td><td>---</td><td>0.3</td></tr>
<tr><td>Fluorene</td><td>86-73-7</td><td>0.0029[2]</td><td>---</td><td>0.3</td></tr>
<tr><td>Phenanthrene</td><td>85-01-8</td><td>0.013[2]</td><td>---</td><td>0.3</td></tr>
<tr><td>Pyrene</td><td>129-00-0</td><td>0.0016[2]</td><td>---</td><td>0.3</td></tr>
<tr><td>Naphthalene</td><td>91-20-3</td><td>0.0019</td><td>0.03</td><td>170[3]</td><td>0.029</td></tr>
<tr><td>2-Butanone (MEK)</td><td>78-93-3</td><td>0.46</td><td>---</td><td>1000[3]</td><td>500</td></tr>
<tr><td>**Acetaldehyde**</td><td>**75-07-0**</td><td>**1.43**</td><td>**0.45**</td><td>**0.45**</td><td>**0.45**</td></tr>
<tr><td>Acetone</td><td>67-64-1</td><td>1.51</td><td>---</td><td>5900[3]</td><td>---</td></tr>
<tr><td>**Formaldehyde**</td><td>**50-00-0**</td><td>**1.95**</td><td>3</td><td>**0.077**</td><td>**0.98**</td></tr>
<tr><td>Valeraldehyde</td><td>110-62-3</td><td>0.088</td><td>---</td><td>590[3]</td><td>---</td></tr>
<tr><td colspan="6">[1] Nickel risk based on nickel subsulfide
[2] Not enough valid sampling days for a statistically meaningful average
[3] 24-hour average concentration</td></tr>
</table>

Table 6-2 shows the detailed polyaromatic hydrocarbon (PAH) health risk screening assessment with Oregon's ABC. PAHs consist of 32 compounds, 10 of which were detected above the MRL in the 2005 Vancouver study. Toxic equivalency factors (TEFs) are an order of magnitude estimate of the toxicity of a compound relative to benzo(a)pyrene. The sum of each PAH multiplied by its TEF is compared with Oregon's ABC.

Table 6-2
2005 Vancouver Toxic Monitoring Polyaromatic Hydrocarbon Health Risk Assessment

Compound	CAS No.	Annual Average Concentration (μg/m^3)	Toxic Equivalency Factor[1]	Weighted Concentration (μg/m^3)	Benchmark Concentration (μg/m^3)
Acenaphthene	83-32-9	0.0012[2]	0.001	0.0000012	---
Acenaphthylene	208-96-8	0.0015[2]	0.001	0.0000015	---
Anthracene	120-12-7	0.0011[2]	0.0005	0.00000055	---
Benzo[b]fluoranthene	205-99-2	0.00063[2]	0.1	0.000063	---
Chrysene	218-01-9	0.00031[2]	0.03	0.0000093	---
Fluoranthene	206-44-0	0.0029[2]	0.0005	0.0000015	---
Fluorene	86-73-7	0.0029[2]	0.001	0.0000029	---
Indeno[1,2,3-cd]pyrene	193-39-5	0.00031[2]	0.1	0.000031	---
Phenanthrene	85-01-8	0.013[2]	0.0005	0.0000065	---
Pyrene	129-00-0	0.0016[2]	0.001	0.0000016	---
Total PAHs	---	---	---	0.00012	0.0009

[1] TEF with respect to benzo(a)pyrene
[2] Not enough valid sampling days for a statistically meaningful average

As shown in Table 6-1, those pollutants whose annual average concentration likely exceeded all of the health risk screening values include benzene, arsenic and acetaldehyde. The formaldehyde ambient concentration exceeds Washington's ASIL and EPA's chronic screening value. The Washington formaldehyde ASIL is based on an older EPA cancer unit risk estimate that EPA no longer considers valid. EPA's chronic screening value for formaldehyde is based on EPA's Integrated Risk Information System's non-cancer value, which has been removed by EPA, with an additional safety factor of ten. The health risks associated with formaldehyde are currently under much debate. The sum of benzo[b]fluoranthene, chrysene and indeno[1,2,3-cd]pyrene also likely exceeded Washington's polyaromatic hydrocarbon ASIL however the ASIL is also based on older data, uses a very conservative approach and is expected to be updated by the Washington Department of Ecology. The annual average concentration of manganese also exceeded EPA's chronic screening value which is based on EPA's Integrated Risk Information System's non-cancer value with an additional safety factor of ten. The MRL for 1,3-Butadiene is above all three health risk screening values, however this compound was only detected once during the entire study period.

7. Aircraft Emissions and Possible Impacts

Toxic emissions from aircraft are currently not well studied. EPA's *Documentation for Aircraft, Commercial Marine Vessels, Locomotive, and Other Nonroad Components of the National Emission Inventory, Volume I, October 7, 2003* lists toxic speciation profiles for commercial, air taxis, general aviation and military aircraft. The following table lists the speciation factors for commercial aircraft listed as the pounds of the toxic compound per pound of total volatile organic compounds (VOCs) in aircraft exhaust.

Table 7-1 Toxic Speciation Factors for Commercial Aircraft	
Compound	Factor (lbs/ lb VOCs)
Formaldehyde	0.168
Acetaldehyde	0.0519
Acrolein	0.0253
Benzene	0.022
1,3-Butadiene	0.020
Propionaldehyde	0.011
Toluene	0.006
Naphthalene	0.0057
Dimethylbenzene	0.005
Styrene	0.0044
2,2,4-Trimethylpentane	0.0005

All of the compounds listed in Table 7-1 were included in the study with the exception of acrolein. Measurement methods for ambient concentrations of acrolein are still being developed by EPA. The Vancouver 2005 annual averages for 1,3-butadiene, styrene and 2,2,4-trimethylpentane were below the MRL. 1,3-butadiene, styrene and 2,2,4-trimethylpentane were detected at levels above the MRL once, three times and five times, respectively, during the entire sampling period. The following table shows the ambient concentration of the top compounds identified from commercial aircraft exhaust and their typical emission sources.

Table 7-2
Comparison of Typical Aircraft Exhaust Compounds
Annual Average Concentrations (µg/m^3)

Compound	2005 Vancouver	2001 Vancouver	2004 Longview	2005 Beaverton	Typical Sources
Formaldehyde	1.95	**2.55**	0.79	1.58	Vehicle exhaust, wood burning
Acetaldehyde	1.43	**2.26**	1.05	1.23	Vehicle exhaust, wood burning
Benzene	0.98[1]	**2.05**	1.06	0.72[1]	Vehicle exhaust, vehicle refueling
1,3-Butadiene	<0.23	<0.23	<0.23	<0.23	Vehicle exhaust, wood burning
Propionaldehyde	0.26	**0.30**	0.18	0.24	Vehicle exhaust, wood burning
Toluene	3.45	**6.20**	3.24	2.57	Vehicle exhaust, paints
Naphthalene	0.0019[1]	**0.0027**	0.0016	0.0018	wood burning, fossil fuel burning, vehicle exhaust
1,2-Dimethylbenzene	0.63	**1.68**	0.74	0.47	Vehicle exhaust, vehicle refueling, paints
1,4/1,3-Dimethylbenzene	1.72	**5.53**	2.98	1.20	Vehicle exhaust, vehicle refueling, paints
Styrene	<0.44	**0.44**	<0.44	<0.44	Vehicle exhaust, fiberglass production
2,2,4-Trimethylpentane	<0.47	**----**	<0.47	<0.47	Vehicle exhaust, petroleum refining

[1] Not enough valid sampling days for a statistically meaningful average

As shown in Table 7-2, the types of compounds emitted from aircraft engines are also emitted from automobiles and woodstoves. Automobile traffic and woodstove use are common sources of emissions near the monitors.

Previous airport studies have included a 2000 monitoring project at Chicago's O'Hare Airport titled *"Final Report – Chicago O'Hare Airport Air Toxic Monitoring Program, June – December 2000, May 2002."* This project consisted of five sampling sites with two sites near O'Hare Airport and three additional sites located throughout the Chicago Metropolitan Area. Although the Illinois EPA reported that overall average concentrations measured near the airport were comparable with concentrations at the other Chicago area sites, the study noted that downwind concentrations from O'Hare Airport had a measurable increase of acetaldehyde, benzene, formaldehyde, polycyclic organics, toluene and lead. The following table shows the project reported average concentration at the two sites (Bensenville and Schiller Park) located adjacent to Chicago's O'Hare Airport along with the 2005 Vancouver data. Only those compounds that were included in the Chicago report and that were also included in the 2005 Vancouver study are shown in the table.

Table 7-3 2000 Chicago O'Hare Airport Monitoring Results and 2005 Vancouver Toxic Monitoring Results			
Compound	2005 Vancouver Concentration (µg/m³)	2000 Bensenville Concentration (µg/m³)	2000 Schiller Park Concentration (µg/m³)
1,3-Butadiene	<0.23	0.18	**0.25**
Total Dimethylbenzene	2.35	**3.67**	2.69
Benzene	0.98[1]	**1.79**	1.63
Methylene Chloride	0.47	**1.62**	0.25
Toluene	3.45	**7.62**	3.91
Arsenic 10µm	0.0011	0.0011[2]	0.0010[2]
Lead 10µm	0.0039	0.023[2]	0.017[2]
Manganese 10µm	0.0080	0.026[2]	0.032[2]
Nickel 10µm	0.0011	0.007[2]	0.0086[2]
Acetaldehyde	1.43	**1.96**	1.61
Formaldehyde	1.95	2.70	**4.43**
[1] Not enough valid sampling days for a statistically meaningful average [2] Data is for Total Suspended Particulate Matter and is shown for information only			

As shown in Table 7-3, ambient concentrations measured at the two Chicago O'Hare sites, Bensenville and Schiller Park, are higher than those measured in Vancouver.

Other airport studies such as the *Ted Stevens Anchorage International Airport Air Toxics Monitoring Study* Draft Dated February 10, 2003 did not find any links between airports and ambient toxic concentrations.

8. Conclusions

Ambient air toxics levels in Vancouver are similar to levels in other urban areas. Many compounds measured in Vancouver in 2005 were lower than those measured during 2001; however the two monitoring sites were located in different areas within Vancouver.

Compounds that likely exceed benchmark concentrations include benzene, arsenic and acetaldehyde. Benzene and acetaldehyde concentrations were relatively constant throughout the sampling period and likely the result of mobile sources in the area. Arsenic concentrations were noticeably higher during wintertime and may be due to emissions from building heating as it is a trace element in both natural gas and fuel oil and also is present in treated wood. However, ambient concentrations of these compounds were similar to those found in other toxic studies in the Pacific Northwest.

Some compounds of concern, such as diesel particulate matter and acrolein, were not analyzed in this study. In addition, some compounds with an annual average below the

MRL may still be a health risk however measured concentrations were not accurate enough to perform a health risk analysis.

There is currently not much information available on aircraft emissions of toxic air pollutants differentiated from other sources of these same pollutants. The Federal Aviation Administration (FAA) is currently working on collecting more data on toxic emissions from aircrafts and is producing revised emission factors. Current information indicates that toxic pollutants emitted from aircraft are also emitted from automobiles and other mobile sources which are in closer proximity to the monitoring location than aircraft making it impossible to determine the relative contribute of aircrafts from monitoring results alone. However, ambient concentrations of these pollutants at the 2005 Vancouver monitoring site were consistent with other locations indicating that aircraft emissions are not likely to be a major contributor.

Appendix A

2005 Vancouver Monitoring Project Quarterly Average Concentrations

Pollutant	Q1	Q2	Q3	Q4	MRL		Annual Average	Units:
1 1 1-Trichloroethane	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
1 1 2 2-Tetrachloroethane	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
1 1 2 2-Tetrachloroethylene	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
1 1 2-Trichloroethane	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
1 1-Dichloroethane	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
1 1-Dichloroethylene	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
1 2 4-Trichlorobenzene	0.08	0.05	0.05	0.14	<0.10	<	0.10	ppbV
1 2 4-Trimethylbenzene	0.39	0.10	0.20	0.12	<0.10		0.20	ppbV
1 2-Dibromoethane (EDB)	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
1 2-Dichlorobenzene	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
1 2-Dichloroethane	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
1 2-Dichloropropane	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
1 2-Dimethylbenzene	0.27	0.06	0.15	0.09	<0.10		0.14	ppbV
1 3 5-Trimethylbenzene	0.11	0.05	0.05	0.05	<0.10	<	0.10	ppbV
1 3-Butadiene	0.05	0.06	0.05	0.05	<0.10	<	0.10	ppbV
1 3-Dichlorobenzene	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
1 4-Dichlorobenzene	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
1 4/1 3-Dimethylbenzene	0.76	0.19	0.31	0.31	<0.10		0.39	ppbV
2 2 4-Trimethylpentane	0.07	0.05	0.07	0.05	<0.10	<	0.10	ppbV
2-Hexanone	0.07	0.05	0.05	0.05	<0.10	<	0.10	ppbV
3-Chloropropene	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
4-Ethyltoluene	0.06	0.07	0.08	0.05	<0.10	<	0.10	ppbV
4-Methyl-2-Pentanone (MIBK)	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
Acrylonitrile	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
Benzene	0.28	0.23	0.37	0.32	<0.10		0.30	ppbV
Bromodichloromethane	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
Bromoform	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
Bromomethane	0.07	0.21	0.06	0.05	<0.10	<	0.10	ppbV
Carbon Disulfide	0.05	0.18	0.10	0.05	<0.10	<	0.10	ppbV
Carbon Tetrachloride	0.05	0.06	0.08	0.05	<0.10	<	0.10	ppbV
Chlorobenzene	0.05	0.36	0.39	0.05	<0.10		0.21	ppbV
Chloroethane	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
Chloroform	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
Chloromethane	0.43	0.42	0.45	0.49	<0.10		0.45	ppbV

Appendix A

2005 Vancouver Monitoring Project Quarterly Average Concentrations

Pollutant	Q1	Q2	Q3	Q4	MRL		Annual Average	Units:
cis-1 2-Dichloroethylene	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
cis-1 3-Dichloropropene	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
Cyclohexane	0.07	0.05	0.06	0.05	<0.10	<	0.10	ppbV
Dibromochloromethane	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
Dichlorodifluoromethane	0.34	0.31	0.36	0.26	<0.10		0.32	ppbV
Dichlorotetrafluoroethane	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
Ethyl Benzene	0.20	0.05	0.05	0.05	<0.10	<	0.10	ppbV
Hexachloro-1 3-Butadiene	0.06	0.05	0.05	0.14	<0.10	<	0.10	ppbV
Isopropanol	23.9	1.11	6.61	3.76	<0.10		8.84	ppbV
Methyl-tert-Butyl Ether (MTBE)	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
Methylene Chloride	0.14	0.08	0.12	0.20	<0.10		0.13	ppbV
n-Heptane	0.11	0.05	0.06	0.07	<0.10	<	0.10	ppbV
n-Hexane	0.14	0.05	0.08	0.08	<0.10	<	0.10	ppbV
Styrene (ppbV)	0.10	0.05	0.05	0.05	<0.10	<	0.10	ppbV
Tetrahydrofuran	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
Toluene	1.36	0.41	1.03	0.80	<0.10		0.90	ppbV
trans-1 2-Dichloroethene	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
trans-1 3-Dichloropropene	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
Trichloroethylene	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
Trichlorofluoromethane	0.09	0.09	0.16	0.07	<0.10		0.10	ppbV
Trichlorotrifluoroethane	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
Vinyl bromide	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
Vinyl Chloride	0.05	0.05	0.05	0.05	<0.10	<	0.10	ppbV
Chromium hexavalent	0.024	0.021	0.027	0.050	<0.042	<	0.042	ng/m^3
Arsenic 10µm	1.18	0.37	1.02	1.69	<0.10		1.06	ng/m^3
Beryllium 10µm	0.01	0.01	0.01	0.01	<0.010	<	0.010	ng/m^3
Cadmium 10µm	0.52	0.13	0.41	0.98	<0.10	<	0.10	ng/m^3
Chromium 10µm	1.60	1.60	1.60	1.60	<3.2	<	3.2	ng/m^3
Cobalt 10µm	0.24	0.13	0.11	0.08	<0.075		0.14	ng/m^3
Lead 10µm	4.54	2.22	3.10	5.82	<1.0		3.92	ng/m^3
Manganese 10µm	10.14	6.30	6.73	8.95	<1.0		8.03	ng/m^3
Nickel 10µm	1.27	1.02	1.01	1.06	<1.0		1.09	ng/m^3
Selenium 10µ	0.23	0.23	0.27	0.28	<0.12		0.25	ng/m^3

Appendix A

2005 Vancouver Monitoring Project Quarterly Average Concentrations

Pollutant	Q1	Q2	Q3	Q4	MRL		Annual Average	Units:
Acenaphthene	0.00124	0.00080	0.00153	0.00114	<0.0003		0.0012	µg/m³
Acenaphthylene	0.00144	0.00038	0.00048	0.00370	<0.0003		0.0015	µg/m³
Anthracene	0.00106	0.00100	0.00088	0.00149	<0.0003		0.0011	µg/m³
Benzo[a]anthracene	0.00047	0.00015	0.00015	0.00030	<0.0003	<	0.0003	µg/m³
Benzo[a]pyrene	0.00033	0.00015	0.00015	0.00039	<0.0003	<	0.0003	µg/m³
Benzo[b]fluoranthene	0.00110	0.00015	0.00015	0.00111	<0.0003		0.00063	µg/m³
Benzo[e]pyrene	0.00015	0.00015	0.00015	0.00029	<0.0003	<	0.0003	µg/m³
Benzo[g h i]perylene	0.00051	0.00015	0.00015	0.00034	<0.0003	<	0.0003	µg/m³
Benzo[k]fluoranthene	0.00019	0.00015	0.00015	0.00015	<0.0003	<	0.0003	µg/m³
Chrysene	0.00055	0.00015	0.00015	0.00040	<0.0003		0.00031	µg/m³
Coronene	0.00031	0.00030	0.00030	0.00030	<0.0006	<	0.0006	µg/m³
Dibenz[a h]anthracene	0.00015	0.00015	0.00015	0.00015	<0.0003	<	0.0003	µg/m³
Dibenzofuran	0.00231	0.00125	0.00183	0.00305	<0.0003		0.0021	µg/m³
Dibenzothiophene	0.00066	0.00080	0.00090	0.00038	<0.0003		0.0007	µg/m³
Fluoranthene	0.00196	0.00485	0.00270	0.00200	<0.0003		0.0029	µg/m³
Fluorene	0.00326	0.00185	0.00255	0.00380	<0.0003		0.0029	µg/m³
Indeno[1 2 3-cd]pyrene	0.00060	0.00015	0.00015	0.00034	<0.0003		0.0003	µg/m³
Naphthalene	0.00380	0.00015	0.00063	0.00315	<0.0003		0.0019	µg/m³
Perylene	0.00015	0.00015	0.00015	0.00015	<0.0003	<	0.0003	µg/m³
Phenanthrene	0.01176	0.01700	0.01450	0.01020	<0.0003		0.013	µg/m³
Pyrene	0.00164	0.00205	0.00128	0.00134	<0.0003		0.002	µg/m³
2 5-Dimethylbenzaldehyde	0.03	0.03	0.04	0.04	<0.07	<	0.07	µg/m³
2-Butanone (MEK)	0.42	0.38	0.38	0.64	<0.07		0.46	µg/m³
Acetaldehyde	1.46	1.41	1.44	1.41	<0.07		1.43	µg/m³
Acetone	1.77	1.23	1.11	1.93	<0.07		1.51	µg/m³
Benzaldehyde	0.14	0.11	0.14	0.12	<0.07		0.13	µg/m³
Butyraldehyde	0.20	0.22	0.24	0.13	<0.07		0.20	µg/m³
Crotonaldehyde (2-Butenal (E))	0.02	0.02	0.02	0.03	<0.05	<	0.05	µg/m³
Formaldehyde	1.57	2.49	2.03	1.71	<0.07		1.95	µg/m³
Hexaldehyde	0.28	0.28	0.23	0.09	<0.07		0.22	µg/m³
Isovaleraldehyde	0.17	0.12	0.15	0.13	<0.07		0.14	µg/m³
m-Tolualdehyde	0.03	0.04	0.03	0.04	<0.07	<	0.07	µg/m³
o-Tolualdehyde	0.03	0.03	0.03	0.03	<0.07	<	0.07	µg/m³

Appendix A

2005 Vancouver Monitoring Project Quarterly Average Concentrations

Pollutant	Q1	Q2	Q3	Q4	MRL		Annual Average	Units:
p-Tolualdehyde	0.03	0.03	0.03	0.03	<0.07	<	0.07	$\mu g/m^3$
Propionaldehyde	0.26	0.26	0.26	0.26	<0.07		0.26	$\mu g/m^3$
Valeraldehyde	0.10	0.11	0.09	0.05	<0.05		0.09	$\mu g/m^3$

MRL = Method Reporting Limit