AIR QUALITY

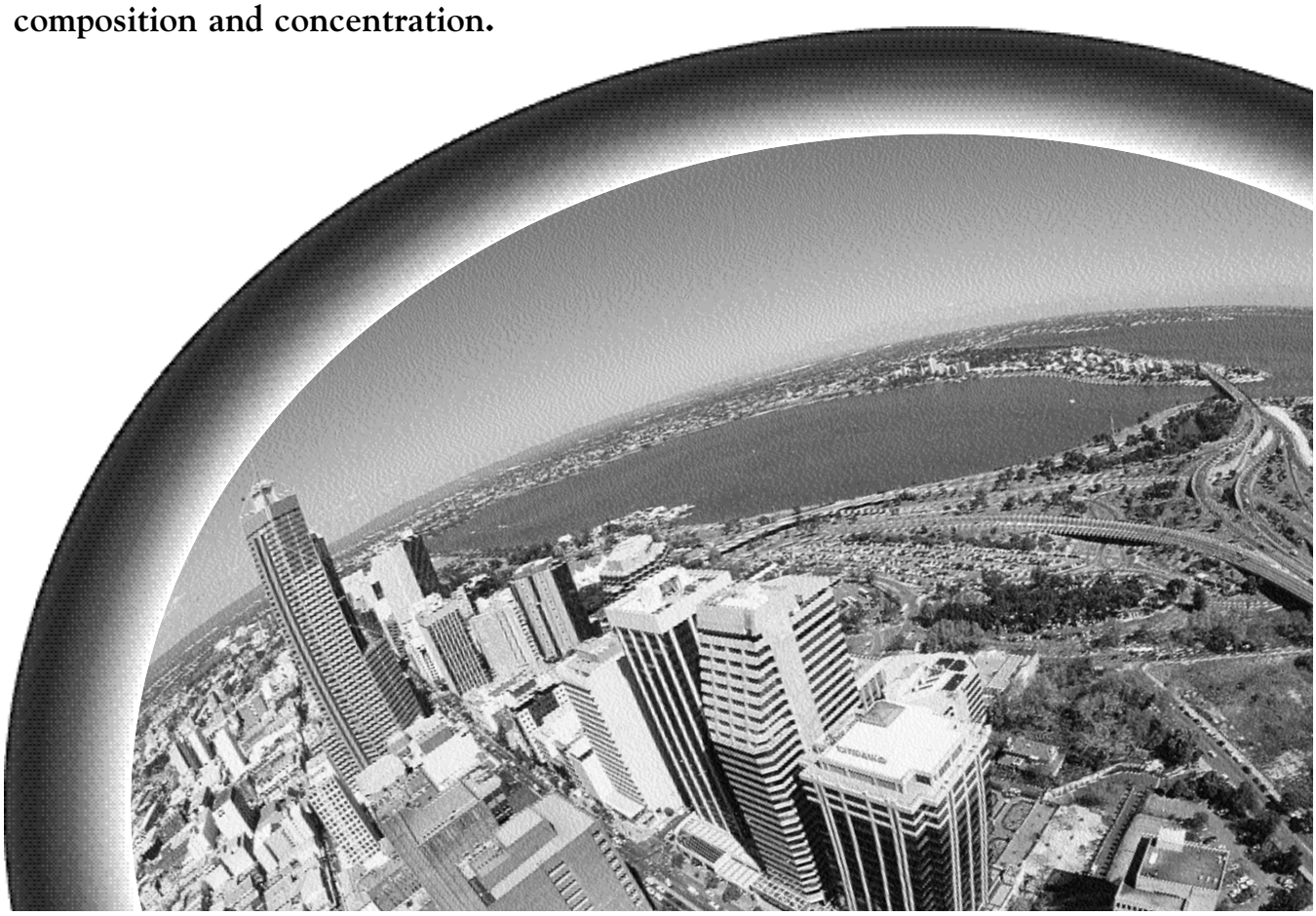
Enviro-Note 2

Department of Environmental Protection

Volatile Organic Compounds Monitoring in Perth

Volatile organic compounds (VOC's) are a group of carbon containing compounds, emitted from a range of sources, that are present in the air in small concentrations. VOC's are produced from combustion and are emitted from motor vehicles and a variety of industrial and domestic sources. VOC's are also known as air toxics or hazardous air pollutants, with some contributing to the formation of photochemical smog, ozone depletion and some posing risks to human health.

The Department of Environmental Protection conducted a study of airborne VOC's in Perth from March 1997 to November 1998. The principal aim of the project was to assess Perth's ambient air for VOC composition and concentration.



The VOC Sampling Program

Department of Environmental Protection monitoring sites at Queen's Buildings and Duncraig were selected for intensive year round sampling. Swanbourne and Hope Valley were selected for less intensive sampling, and were supplemented with a few samples collected at North Fremantle and Gooseberry Hill (Figure 1).

Figure 1: VOC monitoring sites.

Queen's Buildings site is situated in a heavily trafficked area of the CBD and is principally affected by emissions from motor vehicles.

Duncraig is a suburb to the north of Perth about 500 metres from the Mitchell Freeway and is affected by motor vehicle emissions from the nearby freeway and wood fire heater emissions during winter.

Hope Valley is south of Perth and downwind of the Kwinana industrial area on the afternoon sea breeze. Hope Valley monitors industrial emissions, such as sulphur dioxide and oxides of nitrogen, from the Kwinana industrial area.

Swanbourne site is in a coastal location, close to the West Coast highway and downwind of the CBD, where it picks up motor vehicle emissions on the morning easterly breeze.

North Fremantle is a site on Harvest Street. The 1992 Perth emissions inventory showed that significant amounts of organic compounds were emitted from petroleum storage tanks situated in North Fremantle. In order to monitor these emissions, samples were collected at a site downwind of the storage tanks, on the southwesterly wind.

Gooseberry Hill is a residential area on the Darling Scarp. These samples were expected to contain emissions from natural vegetation and very little industrial emissions. Though not considered toxic pollutants, emissions from natural vegetation are of interest since they also contribute to photochemical smog formation.

VOC Levels in Perth

A total of 157 samples were taken and analysed during the course of the study from March 1997 to November 1998 with a total of twenty three VOC's detected in the air samples taken around Perth. Table 1 shows the annual average, maximum and 90th percentile of 24-hour concentrations for these twenty three compounds for the combined sites. The 90th percentile is the concentration level below which ninety percent of the measurements lie. The 90th percentile gives an indication of the typical upper concentrations that are likely to occur.

Of the twenty three VOC's detected, fifteen had annual average 24 hour concentrations well below 0.2 parts per billion. Eight VOC's (shown in bold print in Table 1) had higher than typical background level concentrations.

Benzene, toluene and the xylenes were the most abundant compounds at all the sites as shown in Figure 2. Freon-12 and 1,2,4-trimethylbenzene were also present at significant levels at all the sites. The remaining compounds had low average 24-hour concentrations.

Queen's Buildings had the highest annual average VOC concentrations, though Duncraig tended to have higher benzene, toluene and xylene concentrations during the winter season. Duncraig and Queen's Buildings are both affected by motor vehicle emissions all year round but Duncraig is also impacted by wood fire smoke in winter, known to contain some VOC's. Lower VOC concentrations were obtained at

Table 1: Annual average, maximum and 90th percentile of 24 hour concentrations of VOC's detected in Perth.

Volatile Organic Compound	Concentration (parts per billion)		
	Annual Average	Maximum	90th Percentile
Freon-12	**1.00**	**11.7 (**QB)	**1.46**
Methyl chloride	0.18	5.6 (QB)	0.10
Freon-114	0.18	0.78 (DU, QB)	0.44
Freon-11	**0.54**	**3.00** (QB)	**1.22**
Dichloromethane	0.21	1.72 (DU)	0.61
Freon-113	0.26	1.14 (DU)	0.74
cis-1,2-Dichloroethylene	0.18	2.06 (DU, HV)	0.10
Methyl chloroform	0.19	0.84 (DU)	0.33
Benzene	**1.44**	**17.6** (DU)	**2.95**
Carbon tetrachloride	0.26	1.06 (QB)	0.67
Toluene	**2.56**	**30.0** (DU)	**5.00**
Tetra-chlorethylene	0.22	1.57 (QB)	0.35
Chlorobenzene	0.21	1.16 (DU, QB, SW)	0.32
Ethylbenzene	**0.44**	**4.84** (DU)	**0.82**
(m+p)-Xylene	**1.46**	**16.7** (DU)	**2.81**
Styrene	0.28	2.10 (DU)	0.63
o-Xylene	**0.63**	**5.86** (DU)	**1.25**
1,3,5-Trimethylbenzene	0.27	1.92 (DU)	0.60
1,2,4-Trimethylbenzene	**0.63**	**5.02** (DU)	**1.65**
1,3-Dichlorobenzene	0.21	1.06 (DU)	0.37
1,4-Dichlorobenzene	0.24	1.34 (DU)	0.52
1,2-Dichlorobenzene	0.19	1.23 (DU)	0.36
1,2,4-Trichlorobenzene	0.22	2.10 (QB)	0.66

QB = Queen's Buildings, DU = Duncraig, SW = Swanbourne, HV = Hope Valley

Note: It was not possible to undertake a comprehensive sampling program at all sites, and for all seasons, hence all data were included in the calculation of the annual average. Inclusion of this data may over or under estimate annual averages for Perth.

Swanbourne and Hope Valley. The petroleum storage facilities in North Fremantle were probably the most likely sources contributing significantly to benzene and toluene concentrations in that area. Comparatively very low VOC concentrations were measured on the Darling Scarp.

There are no ambient standards in Australia against which the air toxics concentrations found in the Perth Study can be compared. The World Health Organisation (WHO), the Swedish Government and The Expert Panel on Air Quality Standards in the United Kingdom (EPAQS) have provided guidelines for assessing health impacts of some air toxic compounds. The annual average toluene concentration of 2.56 parts per billion (ppb) is well within the 10 – 100 ppb guideline recommended by the Swedish Government. The annual average benzene concentration in Perth of 1.44 ppb is also below the 5 ppb annual average standard recommended by EPAQS. Similarly, the annual average concentrations of the most abundant air toxics in Perth (Table 1), are below these quoted guideline values. Thus, it appears that the ambient air toxic concentrations in Perth are all well within currently accepted guidelines, although they are relatively high for a city of Perth's population.

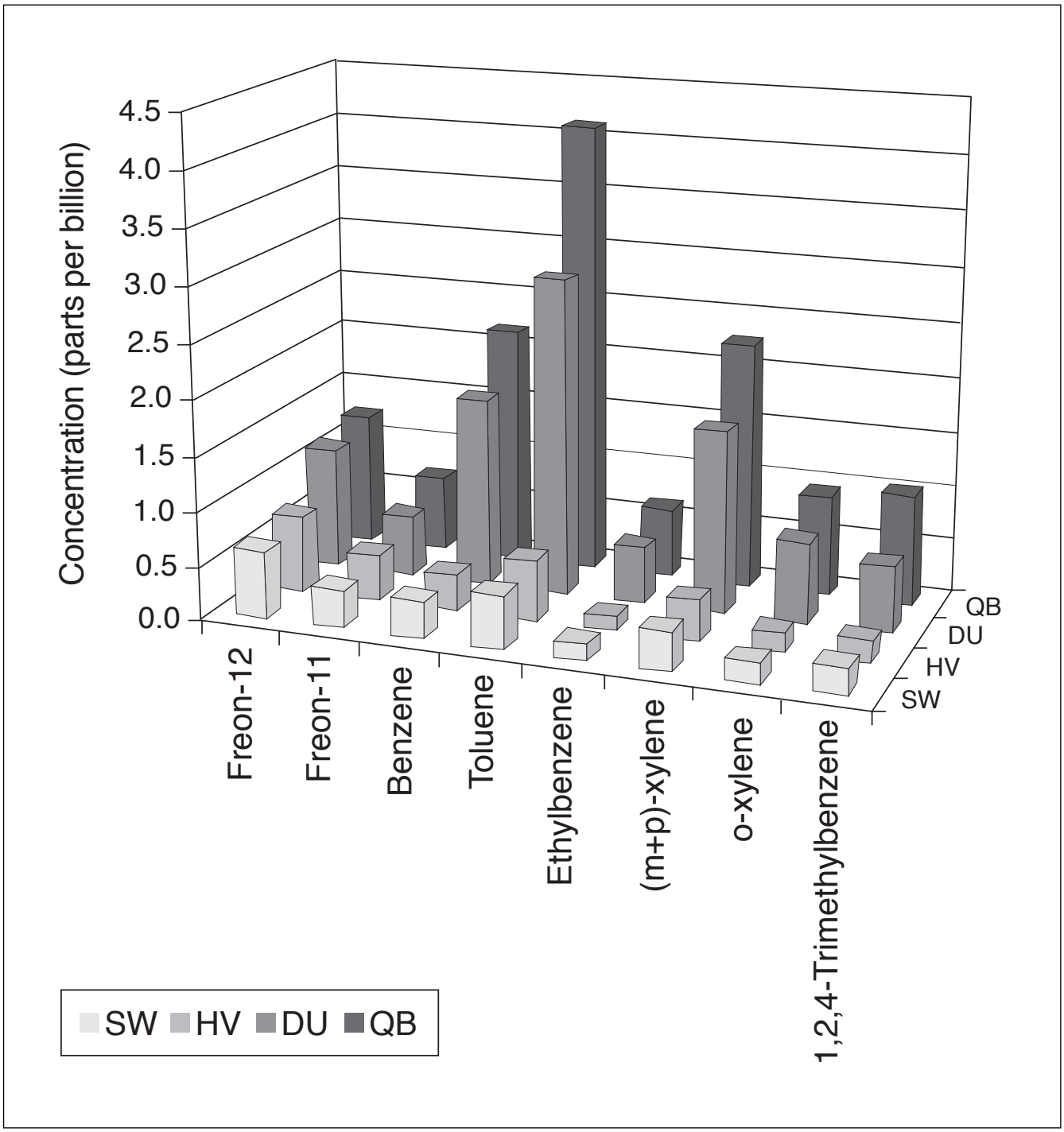


Figure 2: Average 24 hour VOC concentrations for Swanbourne (SW), Hope Valley (HV), Duncraig (DU) and Queen's Buildings (QB).

Ongoing Air Toxics Monitoring in Perth

The Department is continuing to monitor air toxics in Perth.

Monitoring is occurring monthly at the Queen's Buildings, Duncraig and Hope Valley sites. Two additional monitoring sites have been established; one site downwind of the Osborne Park industrial area and one site downwind of the Welshpool industrial area, where monthly monitoring for VOC's will also occur.

The Department is also conducting "finger printing" of VOC emissions from motor vehicles and wood smoke to determine the components of the emissions from these sources.

For further information on VOC's in Perth, please refer to *"Volatile Organic Compounds Monitoring in Perth – Baseline Air Toxics Project"* published by the Department of Environmental Protection and available to view at the Department of Environmental Protection library, 8th Floor, Westralia Square, 141 St Georges Terrace, Perth WA 6000. Alternatively, view our website at www.environ.wa.gov.au