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Mobile Source Hazardous Air Pollutant Emissions in the Seattle-Tacoma Urban Area

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ABSTRACT

Mobile sources have been identified as significant contributors to hazardous air pollutant (HAP) emissions in urban areas. EPA's Air and Energy Engineering Research Laboratory is working in partnership with the Puget Sound Air Pollution Control Agency to develop a HAP emission inventory for the Seattle-Tacoma, Washington, area. Included in this inventory are mobile source emissions from both on-road (e.g., highway vehicles) and non-road (e.g., agricultural equipment) mobile sources. These mobile source emission estimates, summarized in this paper, were developed based on volatile organic compound (VOC) emissions and activity level data from the Seattle-Tacoma 1990 base year State Implementation Plan (SIP) emission inventory. On-road mobile source HAP emissions were developed using the VOC emissions data and speciation profiles for diesel and gasoline vehicles. Non-road mobile source HAP emissions were developed using VOC emissions data and speciation profiles, supplemented by the use of SIP activity level data with HAP-specific emission factors. The contribution of mobile source HAP emissions was compared to that of stationary area sources in the Seattle-Tacoma area. Mobile sources were estimated to contribute approximately 83 percent of the benzene, 74 percent of the formaldehyde, and 88 percent of the 1,3-butadiene emissions from stationary area and mobile sources combined (major stationary point sources excluded). The emission estimation methodologies and the information sources of emission factor and speciation profile data are described.

INTRODUCTION

The U.S. Environmental Protection Agency's (EPA's) Air and Energy Engineering Research Laboratory has selected several areas as pilot areas--one of which is the Seattle-Tacoma region in the State of Washington--for improving and/or developing HAP emissions inventories to respond to the mandates of the 1990 Clean Air Act Amendments. The Puget Sound Air Pollution Control Agency (PSAPCA) regulates new and existing sources of HAPs, and has had an emissions inventory program in place since 1988 for many HAP sources. Four counties are included in PSAPCA's jurisdiction: King, Kitsap, Pierce, and Snohomish. As part of the study described below, procedures and methodologies were developed to update and improve upon the existing HAP emission inventory for mobile sources, and a 1990 base year HAP emissions inventory of mobile sources was compiled. The methodologies reflect a "top down" approach in that they rely on area-wide estimates of VOC emissions and/or activity levels from which HAP emissions are derived. Topics to be discussed include the methods used to calculate toxic air emissions from on-road vehicles, aircraft, and other non-road vehicles and equipment. It should be noted that locomotives and commercial marine

vessels, which are non-road source categories, are not included in this study since there are not adequate HAP speciation profiles or emission factors available in order to calculate HAP emissions for these sources.

ON-ROAD MOBILE SOURCES

The category of on-road mobile sources is a significant contributor to HAP emissions in urban areas. Of particular concern are formaldehyde, 1,3-butadiene, toluene, and benzene emissions, which have been identified as major components of the exhaust and evaporative emissions from highway vehicles.[1] Because of the development of new guidance and emission estimation tools since the last update to the PSAPCA inventory, a preliminary estimate of 1990 base year toxic air pollutants was developed using the most current procedures available.

The on-road mobile emissions were calculated for the base year 1990 for the Seattle-Tacoma four-county area using the most current methodologies available in EPA guidance documents and databases.[1,2] The procedures used in this update estimate emissions for a broader range of pollutants than in the previous PSAPCA inventory, and represent the most current EPA and industry testing data of exhaust, evaporative, and running loss emissions from vehicles.[2]

Methodology for Estimating Toxic Emissions from On-road Vehicles. Toxic emissions from on-road mobile sources were calculated by speciating VOC emissions from the 1990 Seattle-Tacoma SIP inventory.[3] These emissions were available for King, Snohomish, Pierce, and Kitsap Counties. The VOC emissions obtained from the SIP inventory were calculated using the EPA's MOBILE5a emission factor model.[4] These emissions are based on vehicle-miles of travel (VMT) within each of the counties.

Volatile organic compound emissions were speciated using emissions profiles in the EPA's SPECIATE Database.[2] For gasoline-powered vehicles, the species fractions in SPECIATE were updated by EPA in 1992 and provide the most current and complete estimate of the toxic emission components of VOC emissions.

The species fractions that are listed for diesel-powered vehicles are based on older test data from the early 1980s and need to be re-evaluated; however, in the absence of other EPA-recognized speciation profiles for diesel vehicles, the existing profiles for diesel vehicles were used in this study.

The procedure for using the SPECIATE files for gasoline-powered vehicles involved a number of preliminary steps before the species fractions were applied:

- For gasoline-powered vehicles, the profiles for "Industry Average Fuel" were used. Industry Average Fuel is equivalent to a typical 1990+ baseline gasoline that would be found at most service stations (this selection assumes that there is no widespread market share of oxygenated fuels). Profile numbers 1305 (composite evaporative), 1308 (running loss), and 1313 (exhaust) were used.

- In order to apply the three species fractions identified above, the VOC emissions totals for gasoline-powered vehicles in each area had to be split between exhaust, composite evaporative, and running loss emissions. An average split of 50 percent exhaust, 30 percent composite evaporative, and 20 percent running loss was applied. These percentages were then applied to the total VOC emissions estimates prior to application of the SPECIATE profiles.

- The weight fractions of methane and ethane were removed from the profiles because these compounds are not part of the VOC emissions total reported in the SIP inventory.

- The contribution of diesel-powered vehicles to the VOC emissions estimates from the SIP inventory was subtracted from the VOC emissions total to which the gasoline-based speciate profiles were applied; the single profile available for diesel vehicles was then applied to the remaining VOC emissions, which represent the contribution from diesel-powered vehicles.

In order to estimate toxic emissions for the base year 1990, the weight percentage of each species in the pertinent profiles was multiplied by the adjusted VOC emissions totals from the SIP inventory. The following equation illustrates how emissions from this category were estimated:

$$(\text{VOC emissions}) * (\text{Component fraction}) * \left(\frac{\text{HAP \% weight}}{100} \right) \quad (1)$$

For example, the calculation of benzene emissions for the composite evaporative component of on-road mobile emissions for King County was performed as follows:

$$\text{Benzene Emissions} = \left[60{,}142 \left(\frac{\text{tons VOC}}{\text{year}} \right) \right] * (0.3) * (0.0195) = 352 \frac{\text{tons}}{\text{year}} \quad (2)$$

In this example, 60,142 tons of VOC is the annual amount of VOC emissions for gasoline vehicles in King County as reported for the year 1990 in the Seattle-Tacoma SIP inventory. The fraction 0.3 is the portion of that VOC emissions total that is included in the composite evaporative component. The fraction 0.0195 is the species fraction for benzene from the SPECIATE profile for composite evaporative emissions. The emissions from all three components for gasoline vehicle emissions (exhaust, composite evaporative, and running loss) and diesel vehicle exhaust for all four counties are included in the summary of mobile toxic emissions for the Seattle-Tacoma area in Table 1.

AIRCRAFT

Toxic air emissions estimates were developed for the four main categories of aircraft operating in the Seattle-Tacoma region: commercial, military, air taxi, and general aviation. These are the same categories identified in the Seattle-Tacoma SIP inventory for non-road mobile sources. Aircraft emissions can be a significant local source of toxic emissions depending on the size and location of the airport facilities.

Methodology for Estimating Toxic Emissions from Aircraft. There is a limited amount of information or guidance on estimating toxic emissions from aircraft engines. The majority of the EPA guidance relates to the estimation of ozone precursor and carbon monoxide (CO) emissions for the preparation of SIP emissions inventories. In order to estimate toxic emissions from aircraft engines, the EPA's latest version of the SPECIATE database[2] was used. The species fractions for

aircraft category profiles were used to fractionate the VOC emissions totals that were obtained from the Seattle-Tacoma 1990 base year non-road inventory.[3]

Two sets of speciation profiles were used: one to represent the combined military, commercial, and air taxi aircraft category and one for the general aviation category. This was done mainly because the profiles for military, commercial, and air-taxi aircraft, as listed in SPECIATE, are very similar, and were derived from the same test data. The general aviation profile was kept separate because the engines typically used on these aircraft are not similar to the ones on jet aircraft in the other three categories. General aviation aircraft typically are smaller aircraft that have a piston type engine as opposed to a jet turbine engine.

The speciation profiles for the different categories of aircraft were modified to exclude the methane and ethane fractions, as these are not included in the reactive VOC emissions estimates in the Seattle-Tacoma non-road inventory. After the non-reactive fractions were removed, the adjusted species fractions were multiplied by the VOC emissions estimates for the aircraft categories, for each of the four counties in the Seattle-Tacoma area. The HAP emissions for all aircraft categories combined, for the entire four-county area, are shown in Table 1.

OTHER NON-ROAD VEHICLES AND EQUIPMENT

The "Other Non-Road Vehicles and Equipment" category includes a diverse collection of equipment ranging from lawn mowers and chain saws to recreational equipment, farm equipment, and construction machinery. A limited study[5] to find the "best currently available" criteria and toxics emission factors for non-road source categories was used as a source of HAP emission factor data for all of the non-road source categories. This study provided the supporting analyses for another EPA effort which resulted in the main reference for information on non-road sources study.[6] In this effort (hereafter referred to as the Non-Road Study) emissions from non-road engines and vehicles were analyzed to determine whether emissions from such sources cause, or significantly contribute to, air pollution that may be reasonably anticipated to endanger public health or welfare. The EPA collected extensive data on activity levels for a variety of non-road source categories for specific ozone and CO nonattainment areas across the country. In addition, the EPA prepared emission inventories (hereafter referred to as the Non-Road Study inventories) for each of the nonattainment areas included in the study. Emissions from locomotives were not included, while those from commercial marine vessels were, though they did not include HAPs. Currently, there are no HAP speciation profiles for these two categories. For this reason, emissions from these sources were not included in this study.

The information collected in the EPA's Non-Road Study for the Seattle-Tacoma nonattainment area was used as the basis for the activity data and VOC emissions used in preparing the air toxic emission estimates for non-road sources in the Puget Sound area. Kitsap County is not classified as a nonattainment county, therefore it was not included in the Non-Road Study or the Seattle-Tacoma SIP inventory. In this study, non-road activity data and VOC emissions estimates were provided by PSAPCA.[7] These emission estimates were derived from the approach provided in the EPA's SIP emission estimating guidance for 1989.[8] This approach was used because of the major difficulty and expense of obtaining the detailed local data required to duplicate the Non-Road Study as recommended in the 1990 SIP inventory guidance. The 1989 procedures may underestimate emissions compared to those derived from the Non-Road Study because the emission factors used in the Non-Road Study take into consideration "in-use" factors, such as the increase in emissions associated with the increase in the age of the equipment. Any future revisions to this inventory should focus on evaluating and updating the Kitsap County emissions data to bring them in line with the methodologies used in the EPA's Non-Road Study.

The following is a brief summary of how EPA collected and prepared emissions information for its Non-Road Study. The methodology used to estimate HAP emissions is also summarized.

The EPA's Non-Road Study. As part of the Non-Road Study, the EPA evaluated more than 80 different types of equipment. To facilitate analysis and reporting, EPA grouped the equipment types into the eight major equipment categories listed below:

- Lawn and Garden;
- Agricultural;
- Logging;
- Industrial/Light Commercial;
- Construction;
- Airport Service;
- Recreational (non-marine); and
- Recreational Marine.

Emission inventories were developed for each of the above categories for 24 ozone and CO nonattainment areas across the country (including the Seattle-Tacoma ozone nonattainment area). The pollutants considered in the inventory included VOCs, CO, particulate matter (PM), benzene, aldehydes, and 1,3-butadiene, along with other pollutants believed to cause health effects in humans.

Activity data (for use with specific air toxic emission factors) and VOC emissions estimates (for use with specific air toxics speciation profiles) contained in the EPA Non-Road Study inventory were used, since this is the inventory EPA recommends that State agencies use in preparing their SIP emission inventories.[6]

To construct the EPA non-road inventory, several factors were estimated: (1) equipment populations in the given nonattainment area; (2) annual hours of use of each type of equipment, adjusted for geographic region and for the season of interest for each pollutant studied; (3) average rated horsepower of each type of equipment; (4) typical load factor for each type of equipment; and (5) an emission factor for each of the 79 subcategories of equipment. The EPA identified a total of 79 subcategories that fall under the eight main equipment groupings listed at the beginning of this section. In developing emission inventories for non-road engines and vehicles, the EPA used the following equation to calculate emissions for most of the 79 non-road categories:

$$M_i = N * HRS * HP * LF * EF_i \quad (3)$$

where:

M_i	=	mass of emissions of i^{th} pollutant during inventory period;
N	=	source population;
HRS	=	annual hours of use;
HP	=	average rated horsepower;
LF	=	typical load factor; and
EF_i	=	average emissions of i^{th} pollutant per unit of use (e.g., emission factor in grams per horsepower-hour).

The product of the annual hours of use, the average rated horsepower, and the load factor is referred to as the per-source usage rate. The product of the equipment population and the per-source usage rate is referred to as the activity level, and is estimated in units of horsepower-hours. This activity level information was used in conjunction with the emission factors for formaldehyde, acetaldehyde, and total aldehydes in order to prepare the air toxic emission estimates for this study.

The EPA Non-Road Study also provides VOC emission estimates for each non-road category. These VOC emissions were speciated to prepare the emission estimates for benzene and 1,3-butadiene.

Methodology for Estimating HAP Emissions from Non-Road Engines and Vehicles.
EPA's Non-Road Study is the primary source of available information for estimating HAP emissions from these sources; this study was supplemented by a second study by Ingalls,[5] who provided supporting analyses and compiled emission factors. These studies contain the few HAP non-road emission factors currently available. Because of the limited number of non-road emission factors, it is uncertain how representative these factors are. Such concerns have been noted by the EPA and precautions made regarding EPA's confidence in the HAP emission estimates.[6] It should be noted, however, that this study currently has the best emission factor data for estimating HAP emissions from non-road sources.

To estimate emissions of formaldehyde, acetaldehyde, and total aldehydes for each of the non-road engine and vehicle types, emission factors from another study of non-road sources were used.[5]

The Ingalls study did not include a comprehensive list of toxic pollutants, but instead focussed on a prioritized list of toxics that are known to be emitted in sufficient quantities in engine exhaust and have been identified as possible human carcinogens.[5] The pollutants which were included in this study, are:

- Benzene;
- Acetaldehyde;
- Formaldehyde; and
- 1,3-Butadiene.

For some categories of non-road engines and vehicles there was no differentiation between the formaldehyde and acetaldehyde contributions and therefore only one "aldehydes" emissions estimate is reported, identified in the Ingalls study as "total aldehydes" expressed as formaldehyde.[5]

The emission factors from the Ingalls study were multiplied by the appropriate activity data reported for each category in the EPA's Non-Road Study for the Seattle-Tacoma area. The Ingalls study does not contain the same detailed level of source category subdivisions as the EPA's Non-Road Study [e.g., there are 14 subdivisions of lawn and garden equipment in the EPA's Non-Road Study while the Ingalls study contains only emission factors for the overall category of lawn and garden equipment]. For this reason, the categories of non-road engines and vehicles in the EPA's Non-Road Study were aggregated to the eight major equipment groupings listed above. Emission factors for HAPs from the Ingalls study were then matched to these eight major groupings. The factors were also separated into the different engine types (gasoline 2-stroke, gasoline 4-stroke, and diesel) to match the engine types for each of the eight main categories in the EPA's Non-Road Study.

The Ingalls study sometimes contained more than one emission factor for a particular equipment category/engine combination. In these cases, an average of the available emission factors was calculated and used in this inventory. In some cases where the engine test data information were clearly outdated (e.g., engines using leaded gasoline), these emission factors were excluded from the averaging.

The benzene and 1,3-butadiene emissions estimates were developed from average species fractions provided for gasoline and diesel non-road engines in the EPA air toxics study report[1]. These fractions are based on percentages of total hydrocarbon emissions. The VOC emissions from the EPA's Non-Road Study inventory for the Seattle-Tacoma ozone nonattainment area were adjusted

using the inverse of the factors that were used in the original PSAPCA non-road inventory report[7] to calculate relative VOC emissions from total hydrocarbon emissions. After adjusting the VOC emission estimates to total hydrocarbon emissions, the benzene and 1,3-butadiene fractions were applied based on gasoline or diesel engine use. In addition, if a gasoline engine was used, the total hydrocarbon emissions were split between evaporative and exhaust components, because the species fraction for benzene is different for these two components. For the purposes of this study, it was assumed that 91 percent of the VOC emissions were from the exhaust and 9 percent were evaporative. This assumption is based on relative VOC emission factors for exhaust and evaporative components of emissions from non-road vehicles as reported in the EPA's Non-Road Study.[6]

SUMMARY

A summary of the 1990 base year mobile toxic emissions for the Seattle-Tacoma area, as calculated by the methodologies described above, is provided in Table 1. The table presents the pollutant and the annual emission totals for the Seattle-Tacoma four-county area. Many more pollutants were actually included in the final calculated inventories for the on-road mobile and aircraft source categories, but only the commonly reported exhaust and evaporative HAPs are presented here.

The on-road mobile category as shown in Table 1 includes the total of each component of the gasoline vehicle emissions and the diesel vehicle emissions. The aircraft category in Table 1 includes the emissions from all categories of aircraft combined. Finally, the non-road category includes all eight subcategories of non-road vehicles and equipment as described above.

Figures 1, 2, and 3 show the relative contribution of each of the mobile source categories and stationary area sources to the combined area and mobile source benzene, formaldehyde, and 1,3-butadiene emissions totals for King, Pierce, and Snohomish counties. HAP emissions from major stationary point sources are incomplete and are not included in Figures 1, 2, and 3. Stationary area source HAP emissions were obtained from an EPA study prepared for the Seattle-Tacoma area. This EPA study is scheduled for publication in early 1995. Kitsap County was excluded because stationary area source totals were not available for this county. As shown in Figures 1 and 2, on-road mobile accounts for the highest percentage of benzene and formaldehyde emissions. The EPA has estimated that motor vehicles account for approximately 60 percent of the total benzene and 33 percent of the total formaldehyde emissions in ambient air.[1] The contribution of non-road mobile sources, particularly to 1,3-butadiene emissions, however, may be unexpected since this category has historically received less attention from inventory preparers than other source categories. The population of equipment and vehicles included in this category is quite diverse, and generally uncontrolled. The need to take a closer look at this category of sources is exemplified by the potentially significant HAP emissions that it may contribute.

CONCLUSIONS

The methods used to estimate HAP emissions from mobile sources are based on the SIP emission inventory methods. Therefore, the accuracy of the HAP emissions estimates depends on the accuracy of the SIP data. If the SIP method over- or underestimates activity or VOC emissions, then the HAP emissions estimates will also be over- or underestimated. The primary benefits of using the SIP emissions inventory as the basis for estimating HAP emissions, however, is that there are specific procedures from the EPA for data-gathering methods, thus ensuring consistency between different areas of the country, and the emissions data are regularly updated, which in turn keeps the HAP inventory relatively current.

Based on the estimates of HAP emissions made in this study, on-road vehicles are a primary source of urban area HAP emissions. Non-road vehicles and equipment are potentially important sources of HAP emissions that need closer evaluation. This inventory resulted in nearly equivalent

annual benzene emissions attributed to stationary area and non-road mobile sources. Results for aircraft indicate that this is not a significant area-wide source; however, at a more localized level, airport facilities may be more significant contributors to overall HAP emissions.

Future improvements to the HAP emission inventory can be made, particularly regarding aircraft and non-road area source emission estimates, as well as the development of HAP point source emission estimates. If more refined aircraft-specific speciation factors are developed, they should be applied to the VOC emission estimates. Similarly, for other non-road equipment emissions estimates, if equipment-specific HAP emission factors are developed, these should be applied to the activity data in the Non-Road Study. For Kitsap County, activity data could be collected to allow for the use of the approach used in the Non-Road Study.

The on-road mobile HAP emissions estimates were estimated using VOC emissions based on EPA's MOBILE5a emission factor model; it is possible that this model will be revised in the future as new test data become available.[4] Any continued use of the speciation approach will have to account for changes in the VOC emissions base.

REFERENCES

1. *Motor Vehicle-Related Air Toxics Study.* EPA-420-R-93-005; U.S. Environmental Protection Agency (U.S. EPA) Office of Mobile Sources: Ann Arbor, MI, 1993.
2. *Air Species Manual, Volume I, Volatile Organic Compounds (VOC) Species Profiles.* U.S. Environmental Protection Agency (U.S. EPA): Office of Air Quality Planning and Standards, 1992.
3. *Seattle-Tacoma Ozone Nonattainment Area, King, Pierce, and Snohomish Counties, Washington. Base Year Emissions Inventory.* Puget Sound Air Pollution Control Agency and Washington State Department of Ecology, 1994.
4. *MOBILE5a Emission Factor Model.* U.S. Environmental Protection Agency (U.S. EPA), Office of Mobile Sources, Ann Arbor, MI, March 26, 1993.
5. Ingalls, M.N. *Non-Road Emission Factors of Air Toxics.* Prepared for U.S. Environmental Protection Agency, Office of Mobile Sources (OMS), Ann Arbor, MI, by Southwest Research Institute: SWRI 08-3426-005, 1991 [Available through OMS; Reference Non-Road Study Docket A-91-24II-A-1]
6. *Non-Road Engine and Vehicle Emission Study - Report and Appendices.* U.S. Environmental Protection Agency (U.S. EPA), Office of Air and Radiation. Washington, D.C.: 21A-2001, 1991.
7. Agyei, T.K. *Nonhighway Mobile Sources Emission Inventory for Carbon Monoxide and Precursors of Ozone, Base Year 1990.* Puget Sound Air Pollution Control Agency, 1992.
8. *Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources.* U.S. Environmental Protection Agency (U.S. EPA), Office of Air Quality Planning and Standards, Research Triangle Park, NC: EPA-450/4-81-026d (1989 Revision).

Table 1. Seattle-Tacoma Mobile Source HAP Emissions (Tons/Year)

Pollutant	Mobile Source Category			Mobile Source Total
	On-Road Vehicles	Aircraft	Non-Road Vehicles & Equipment	
1,3-Butadiene	309	57	454	820
Acetaldehyde	474	148	ND*	622
Acrolein	37	72	ND	109
Benzene	3,438	62	994	4,494
Ethyl Benzene	1,209	5	ND	1,214
Formaldehyde	1,169	477	423	2,069
Hexane	1,653	ND	ND	1,653
M-Xylene	3,242	9	ND	3,251
Naphthalene	136	18	ND	154
O-Xylene	1,215	6	ND	1,221
Styrene	210	12	ND	222
Toluene	8,060	17	ND	8,077

*ND = no data available

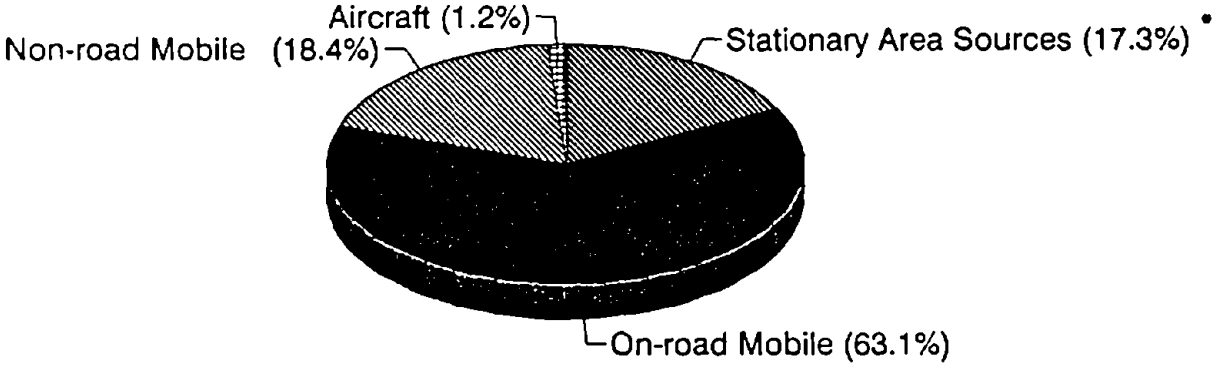

Figure 1. Percent Contribution to Benzene Emissions in Seattle-Tacoma Metropolitan Area from Mobile and Other Area Sources

* Source: EPA report scheduled for publication in early 1995.

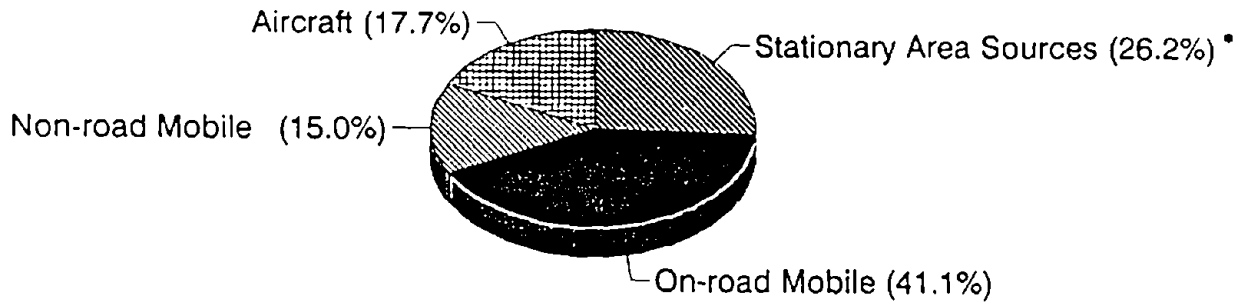

Figure 2. Percent Contribution to Formaldehyde Emissions in Seattle-Tacoma Metropolitan Area from Mobile and Other Area Sources

* Source: EPA report scheduled for publication in early 1995.

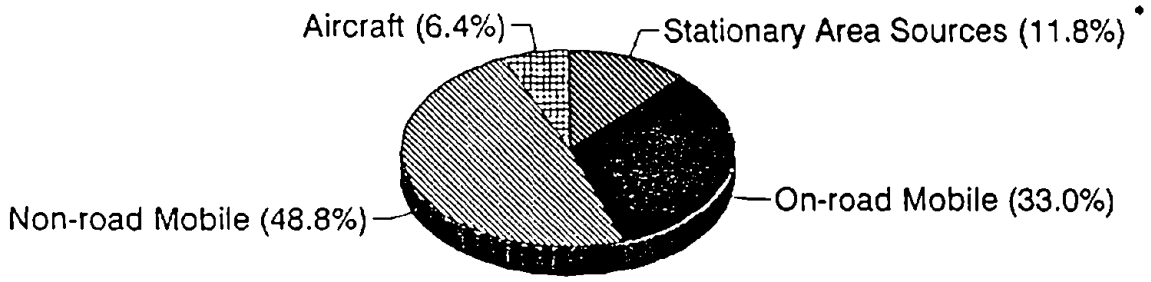

Figure 3. Percent Contribution to 1,3-Butadiene Emissions in Seattle-Tacoma Metropolitan Area from Mobile and Other Area Sources

* Source: EPA report scheduled for publication in early 1995.

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16. ABSTRACT

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17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Pollution	Pollution Control	13B
Toxicity	Mobile Sources	06T
Emission	Hazardous Air Pollutants	14G
Inventories	Volatile Organic Compounds (VOCs)	15E
Organic Compounds		07C
Volatility		20M

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