CANCER RISKS AND NON-CANCER HAZARDS FROM AIR TOXICS IN BIRMINGHAM, ALABAMA

LAW OFFICE OF
DAVID A. LUDDER
A Professional Limited Liability Company

CANCER RISKS AND NON-CANCER HAZARDS FROM AIR TOXICS IN BIRMINGHAM, ALABAMA[1]

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Introduction

Birmingham residents are exposed to multiple air toxics from multiple sources, both stationary and non-stationary. Although the Jefferson County Department of Health published the Birmingham Air Toxics Study in 2009, the results were not shared with or debated by the public. The analysis contained in this report seeks to characterize the magnitude of the cancer risks and non-cancer hazards presented by different air toxics in the ambient air of Birmingham between July 2005 and June 2006, to identify the sources of those air toxics as they existed in 2005, and to offer recommendations for acceptable levels of cancer risks and non-cancer hazards for the public to consider.

Methods

Cancer Risk is expressed as a probability – for example, 1.0 in one million (1.0E-06), 3.4 in 100,000 (3.4E-05), or 2.5 in 10,000 (2.5E-04). Cancer Risk is calculated using the following equation:

$$CR = EC \times IUR$$

Where:

CR = Cancer Risk = estimated incremental lifetime cancer risk for an individual as a result of exposure to a specific air toxic (unitless, expressed as a probability (*e.g.*, 1.0 in one million or 1.0E-06))

EC = Exposure Concentration = an estimate of continuous lifetime inhalation exposure to an individual air toxic) (expressed in units of $\mu g/m^3$). ECs used in this analysis are the 95% Upper Confidence Limit of ambient air concentrations of air toxics published in the Birmingham Air Toxics Study (JCDH, 2009).

IUR = Inhalation Unit Risk = the upper-bound of the excess cancer risk estimated to result from continuous exposure to a concentration of 1 microgram of a substance per cubic meter of air, over a 70-year lifetime and assuming a daily inhalation rate of about 20 m^3/day (expressed in units of $(\mu g/m^3)^{-1}$). IURs are published in EPA's Integrated Risk Information System or in EPA's Office of Air Quality Planning and Standards' "A Dose-Response Assessment for Assessing

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[1] Prepared by David A. Ludder, B.S., J.D., and published by the Law Office of David A. Ludder, Tallahassee, Florida (http://www.enviro-lawyer.com).

Health Risks Associated with Exposure to Hazardous Air Pollutants, Table 1. Prioritized Chronic Dose-Response Values (05-21-12)."

Non-cancer hazard is expressed as a number – for example, 1.0, 5.8, or 0.9. This number represents a ratio of the concentration of a toxic in the air to the concentration of a toxic that is considered safe. Non-cancer hazard is calculated using the following equation:

$$HQ = \frac{EC}{RfC}$$

Where:

HQ = Hazard Quotient = the ratio of the Exposure Concentration to the Reference Concentration (unitless). If the ratio exceeds 1.0, there is a risk of deleterious non-cancer health effects.

EC = Exposure Concentration = an estimate of the continuous inhalation exposure to an individual air toxic (expressed in units of mg/m^3). ECs used in this analysis are the 95% Upper Confidence Limit of ambient air concentrations of air toxics published in the Birmingham Air Toxics Study (JCDH, 2009).

RfC = Reference Concentration = an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure concentration for a chronic duration (up to a 70-year lifetime) that is likely to be without an appreciable risk of deleterious non-cancer health effects. The population considered in the derivation of RfCs includes sensitive subgroups (*i.e.*, children, asthmatics, and the elderly (expressed in units of mg/m^3). RfCs are published in EPA's Integrated Risk Information System or in EPA's Office of Air Quality Planning and Standards' "A Dose-Response Assessment for Assessing Health Risks Associated with Exposure to Hazardous Air Pollutants, Table 1. Prioritized Chronic Dose-Response Values (05-21-12)."

Stationary and non-stationary source emissions estimates for specific air toxics in Jefferson County are published in EPA's 2005 Point Source National Emissions Inventory. These estimates are used in this analysis to estimate that portion of each exposure concentration which is attributable to stationary and non-stationary sources. These may be *under*-estimates of actual emissions.

Data Sources

Exposure Concentrations: Birmingham Air Toxics Study (JCDH, 2009). A one year (July 2005 to June 2006) effort to sample air toxics at four monitoring sites by the Jefferson County Department of Health. Calculated the 95% Upper Confidence Limit (UCL) of ambient air concentrations ($\mu g/m^3$) of air toxics. Published at http://www.enviro-lawyer.com/BATS.pdf and http://www.jcdh.org/misc/ViewBLOB.aspx?BLOBId=182.

Toxicity Values (RfCs and IURs): EPA's Integrated Risk Information System (IRIS), http://www.epa.gov/iris/index.html, and "A Dose-Response Assessment for Assessing Health Risks Associated with Exposure to Hazardous Air Pollutants, Table 1. Prioritized Chronic Dose-Response Values (05-21-12)," EPA's Office of Air Quality Planning and Standards (OAQPS), http://www.epa.gov/ttn/atw/toxsource/summary.html.

Emission Estimates: EPA's 2005 Point Source National Emissions Inventory included in the National Air Toxics Assessment (2005). Includes an inventory of air toxic emission estimates from stationary and non-stationary sources at the county level. http://www.epa.gov/ttn/atw/nata2005/tables.html. These may be *under*-estimates of actual emissions.

Summary of Findings

General

- Of the three Birmingham monitoring sites, Shuttlesworth had the highest aggregate cancer risk (Σ CR=2.07E-04 or 2.07 in 10,000). Table 1. This aggregate risk is twice that of the aggregate cancer risk recommended below (Σ CR=1.0E-04).

- The aggregate cancer risk at East Thomas (Σ CR=1.43E-04 or 1.43 in 10,000) and North Birmingham (Σ CR=1.46E-04 or 1.46 in 10,000) were essentially equivalent. Tables 3 and 5. These aggregate cancer risks are 1.4 times the aggregate cancer risk recommended below (Σ CR=1.0E-04).

- The aggregate cancer risk at Providence - in rural Jefferson County - was the lowest (Σ CR=1.09E-04 or 1.09 in 10,000). Table 7. This aggregate cancer risk is essentially equivalent to the aggregate cancer risk recommended below (Σ CR=1.0E-04).

- Of the three urban Birmingham monitoring sites, Shuttlesworth had the highest non-cancer hazard (Σ HQ=60.0). Table 2. This aggregate non-cancer hazard is certainly in excess of the aggregate non-cancer hazard recommended below (HI=1.0).

- The aggregate non-cancer hazard at East Thomas (Σ HQ=43.3) and North Birmingham (Σ HQ=44.5) were essentially equivalent. Tables 4 and 6. This aggregate non-cancer hazard is certainly in excess of the aggregate non-cancer hazard recommended below (HI=1.0).

- The aggregate non-cancer hazard at Providence - in rural Jefferson County - was the lowest (Σ HQ=26.4). Table 8. This aggregate non-cancer hazard is certainly in excess of the aggregate non-cancer hazard recommended below (HI=1.0).

Findings by Site

- **Cancer Risks at Shuttlesworth.** The aggregate cancer risk at Shuttlesworth was 2.07E-04 (2.07 in 10,000). Table 1. The four largest cancer risk drivers at Shuttlesworth were

Benzene (30.1%, CR=6.23E-05)), Formaldehyde (25.8%, CR=5.34E-05), Arsenic (16.8%, CR=3.48E-05), and Naphthalene (9.4%, CR=1.94E-05). Table 1 & Figures 3, 19. Each of these individual toxicant cancer risk levels exceeds the cancer risk level recommended for individual toxicants below (CR=1.0E-06). The aggregate cancer risk attributable to toxics from stationary sources alone was approximately 7.71E-05. Figure 4. The four largest cancer risk drivers attributable to stationary sources were Arsenic (16.8%, CR=3.48E-05), Naphthalene (5.8%, CR=1.20E-05), Benzene (5.6%, CR=1.15E-05), and Formaldehyde (4.4%, CR=9.02E-06). Figure 4.

- **Non-cancer hazards at Shuttlesworth.** The aggregate non-cancer hazard at Shuttlesworth was 60.0. Table 2. The two largest non-cancer hazard drivers at Shuttlesworth were Acrolein (88.4%, HQ=53.1) and Manganese (6.3%, HQ=3.8). Table 2 & Figures 5, 29. Each of these individual toxicant non-cancer hazard levels exceeds the non-cancer hazard level recommended for individual toxicants below (HQ=1.0). The aggregate non-cancer hazard attributable to toxics from stationary sources alone was approximately 20.7. Figure 6. The two largest non-cancer hazard drivers attributable to stationary sources were Acrolein (25.2%, HR=15.1) and Manganese (6.3%, HR=3.8). Figure 6.

- **Cancer risks at East Thomas.** The aggregate cancer risk at East Thomas was 1.46E-04 (1.43 in 10,000). Table 3. The three largest cancer risk drivers at East Thomas were Formaldehyde (46.9%, CR=6.87E-05), Benzene (17.8%, CR=2.60E-05), and Naphthalene (7.9%, CR=1.16E-05). Table 3 & Figures 7, 19. Each of these individual toxicant cancer risk levels exceeds the cancer risk level recommended for individual toxicants below (CR=1.0E-06). The aggregate cancer risk attributable to toxics from stationary sources alone was approximately 3.97E-05. Figure 8. The four largest cancer risk drivers attributable to stationary sources were Formaldehyde (8.0%, CR=1.16E-05), Arsenic (5.0%, CR=7.31E-06), Naphthalene (4.9%, CR=7.15E-06), and Benzene (3.3%, CR=4.81E-06). Figure 8.

- **Non-cancer hazards at East Thomas.** The aggregate non-cancer hazard at East Thomas was 43.3. Table 4. The two largest non-cancer hazard drivers at East Thomas were Acrolein (92.2%, HQ=39.9) and Manganese (2.9%, HQ=1.2). Table 4 & Figures 9, 29. Each of these individual toxicant non-cancer hazard levels exceeds the non-cancer hazard level recommended for individual toxicants below (HQ=1.0). The aggregate non-cancer hazard attributable to toxics from stationary sources alone was approximately 13.3. Figure 10. The two largest non-cancer hazard drivers attributable to stationary sources were Acrolein (26.3%, HQ=11.4) and Manganese (2.8%, HQ=1.2). Figure 10.

- **Cancer risks at North Birmingham.** The aggregate cancer risk at North Birmingham was 1.46E-04 (1.46 in 10,000). Table 5. The four largest cancer risk drivers at North Birmingham were Formaldehyde (38.5%, CR=5.62E-05), Benzene (22.7%, CR=3.31E-05), Naphthalene (8.4%, CR=1.23E-05), and Arsenic (7.1%, CR=1.03E-05). Table 5 & Figures 11, 19. Each of these individual toxicant cancer risk levels exceeds the cancer risk level recommended for individual toxicants below (CR=1.0E-06). The aggregate

cancer risk attributable to toxics from stationary sources alone was approximately 4.45E-05. Figure 12. The four largest cancer risk drivers attributable to stationary sources were Arsenic (7.1%, CR=1.03E-05), Formaldehyde (6.5%, CR=9.50E-06), Naphthalene (5.2%, CR=7.58E-06), and Benzene (4.2%, CR=6.12E-06). Figure 12.

- **Non-cancer hazards at North Birmingham.** The aggregate non-cancer hazard at North Birmingham was 44.5. Table 6. The two largest non-cancer hazard drivers at North Birmingham were Acrolein (92.7%, HQ=41.2) and Manganese (2.9%, HQ=1.3). Table 6 & Figures 13, 29. Each of these individual toxicant non-cancer hazard levels exceeds the non-cancer hazard level recommended for individual toxicants below (HQ=1.0). The aggregate non-cancer hazard attributable to toxics from stationary sources alone was approximately 13.7. Figure 14. The two largest non-cancer hazard drivers attributable to stationary sources were Acrolein (26.4%, HQ=11.7) and Manganese (2.9%, HQ=1.3). Figure 14.

- **Cancer risks at Providence.** The aggregate cancer risk at Providence was 1.09E-04 (1.09 in 10,000). Table 7. The four largest cancer risk drivers at Providence were Formaldehyde (75%, CR=8.18E-05), Acetaldehyde (4.8%, CR=5.24E-06), Benzene (4.5%, CR=4.87E-06), and Carbon Tetrachloride (3.6%, CR=3.97E-06). Table 7 & Figures 15, 19. Each of these individual toxicant cancer risk levels exceeds the cancer risk level recommended for individual toxicants below (CR=1.0E-06). The aggregate cancer risk attributable to toxics from stationary sources alone was approximately 2.87E-05. Figure 16. The largest cancer risk driver attributable to stationary sources was Formaldehyde (12.7%, CR=1.38E-05). Figure 16.

- **Non-cancer hazards at Providence.** The aggregate non-cancer hazard at Providence was 26.4. Table 8. The largest non-cancer hazard driver at Providence was Acrolein (94.7%, HQ=25.0). Table 8 & Figures 17, 29. The non-cancer hazard level of Acrolein exceeds the non-cancer hazard level recommended for individual toxicants below (HQ=1.0). The aggregate non-cancer hazard attributable to toxics from stationary sources alone was approximately 7.5. Figure 18. The largest non-cancer hazard driver attributable to stationary sources was Acrolein (27%, HQ=7.1). Figure 18.

Findings by Toxicant

- **Acrolein** was the dominant non-cancer hazard driver at all four sites (88.4%, 92.2%, 92.7%, 94.7%). Tables 2, 4, 6, 8 & Figures 5, 9, 13, 17, 29. On a national scale, Acrolein accounts for 75% of the non-cancer hazard. The non-cancer hazard level of Acrolein at every monitoring site exceeds the non-cancer hazard level recommended for individual toxicants below (HQ=1.0). 71.5% of Acrolein emissions in Jefferson County are from non-stationary sources. Figures 30, 32. 28.5% of Acrolein emissions in Jefferson County are from stationary sources. Figures 30, 32. Stationary (major and area) sources of Acrolein are mapped and listed in http://batchgeo.com/map/03caa2cdfe6251216d21f9c061fc0e27.

- **Manganese** was the second largest non-cancer hazard driver at all three urban Birmingham monitoring sites (6.3%, 2.9%, 2.9%). Tables 2, 4, 6 & Figures 5, 9, 13, 29. The non-cancer hazard levels of Manganese at all three urban monitoring sites exceed the non-cancer hazard level recommended for individual toxicants below (HQ=1.0). 100% of Manganese emissions in Jefferson County are from stationary sources. Figures 31, 33. Stationary (major and area) sources of Manganese are mapped and listed in http://batchgeo.com/map/1aae5e58fd83dce4dc61ddf0b281bf0a.

- **Formaldehyde** was the dominant cancer risk driver at East Thomas (48.0%, CR=6.87E-05), North Birmingham (38.5%, CR=5.62E-05) and Providence (75%, CR=8.18E-05). Tables 3, 5, 7 & Figures 7, 11, 15, 19. Formaldehyde was the second largest cancer risk driver at Shuttlesworth (25.8%, CR=5.34E-05). Table 1 & Figures 3, 19. The cancer risk levels of Formaldehyde at all monitoring sites exceed the cancer risk level recommended for individual toxicants below (CR=1.0E-06). On a national scale, Formaldehyde has been identified as a dominant cancer risk driver. 83.1% of Formaldehyde emissions in Jefferson County are from non-stationary sources. Figures 21, 35. 16.9% of Formaldehyde emissions in Jefferson County are from stationary sources. Figures 21, 35. Stationary (major and area) sources of Formaldehyde are mapped and listed in http://batchgeo.com/map/ba8441d2a070a15b1a0052d34242e754.

- **Benzene** was the dominant cancer risk driver at Shuttlesworth (30.1%, CR=6.23E-05). Table 1 & Figures 3, 19. Benzene was the second largest cancer risk driver at North Birmingham (22.7%, CR=3.31E-05) and East Thomas (18.2%, CR=2.60E-05). Tables 3, 5 & Figures 7, 11, 19. Benzene was the third largest cancer risk driver at Providence (4.5%, CR=4.87E-06). The cancer risk levels of Benzene at all monitoring sites exceed the cancer risk level recommended for individual toxicants below (CR=1.0E-06). 81.5% of Benzene emissions in Jefferson County are from non-stationary sources. Figures 20, 34. 18.5% of Benzene emissions in Jefferson County are from stationary sources. Figures 20, 34. Stationary (major and area) sources of Benzene are mapped and listed in http://batchgeo.com/map/49cef5b455f3408120fe9735f0236e71.

- **Arsenic** was the third largest cancer risk driver at Shuttlesworth (16.8%, CR=3.48E-05). Table 1 & Figures 3, 19. Arsenic was the fourth largest cancer risk driver at North Birmingham (7.1%, CR=1.03E-05). Table 5 & Figures 11, 19. Arsenic was the fifth largest cancer risk driver at East Thomas (5%, CR=7.31E-06). Table 3 & Figures 7, 19. Arsenic was the fifth largest cancer risk driver at Providence (3.6%, CR=3.87E-06). Table 7 & Figures 15, 19. The cancer risk levels of Arsenic at all monitoring sites exceed the cancer risk level recommended for individual toxicants below (CR=1.0E-06). 100% of Arsenic emissions in Jefferson County are from stationary sources. Figures 21, 36. Stationary (major and area) sources of Arsenic are mapped and listed in http://batchgeo.com/map/781a53ae8634f40846bb879df4494561.

- **Naphthalene** was the fourth largest cancer risk driver at Shuttlesworth (9.4%, CR=1.94E-05). Table 1 & Figures 3, 19. Naphthalene was the third largest cancer risk driver at North Birmingham (8.4%, CR=1.23E-05). Table 5 & Figures 11, 19.

Naphthalene was the third largest cancer risk driver at East Thomas (7.9%, CR=1.16E-05). Table 3 & Figures 7, 19. The cancer risk levels of Naphthalene at all three urban monitoring sites exceed the cancer risk level recommended for individual toxicants below (CR=1.0E-06). 38.4% of Naphthalene emissions in Jefferson County are from non-stationary sources. Figures 22, 37. 61.6% of Naphthalene emissions in Jefferson County are from stationary sources. Figures 22, 37. Stationary sources of Naphthalene are mapped and listed in http://batchgeo.com/map/8e463e344f80d6847e756f9d72df13c8.

- **1,3-Butadiene** was the fourth largest cancer risk driver at Shuttlesworth (9.4%, CR=1.94E-05). Table 1 & Figures 3, 19. 1,3-Butadiene was the third largest cancer risk driver at North Birmingham (8.4%, CR=1.23E-05). Table 5 & Figures 11, 19. 1,3-Butadiene was the fourth largest cancer risk driver at East Thomas (5.8%, CR=8.54E-06). Table 3 & Figures 7, 19. 1,3-Butadiene was the eighth largest cancer risk driver at Providence (1.0%, CR=1.10E-06). Table 7 & Figures 15, 19. The cancer risk levels of 1,3-Butadiene at all monitoring sites exceed the cancer risk level recommended for individual toxicants below (CR=1.0E-06). 92.3% of 1,3-Butadiene emissions in Jefferson County are from non-stationary sources. Figures 23, 38. 7.7% of 1,3-Butadiene emissions in Jefferson County are from stationary sources. Figures 23, 38. Stationary (major and area) sources of 1,3-Butadiene are mapped and listed in http://batchgeo.com/map/19556f00e38852b37e09743361b6d872.

- **p-Dichlorobenzene** was the sixth largest cancer risk driver at Shuttlesworth (2.6%, CR=5.30E-06). Table 1 & Figures 3, 19. p-Dichlorobenzene was the seventh largest cancer risk driver at North Birmingham (2.6%, CR=3.86E-06). Table 5 & Figures 11, 19. p-Dichlorobenzene was the eighth largest cancer risk driver at East Thomas (2.4%, CR=3.44E-06). Table 3 & Figures 7, 19. p-Dichlorobenzene was the sixth largest cancer risk driver at Providence (2.9%, CR=3.17E-06). Table 7 & Figures 15, 19. The cancer risk levels of p-Dichlorobenzene at all monitoring sites exceed the cancer risk level recommended for individual toxicants below (CR=1.0E-06). 100% of p-Dichlorobenzene emissions in Jefferson County are from stationary sources. Figures 24, 39. Stationary (major and area) sources of p-Dichlorobenzene are mapped and listed in http://batchgeo.com/map/7313db8eb409cca4afb64e972011f6cd.

- **Carbon tetrachloride** was the seventh largest cancer risk driver at East Thomas (2.8%, CR=4.15E-06). Table 3 & Figures 7, 19. Carbon tetrachloride was the sixth largest cancer risk driver at North Birmingham (2.8%, CR=4.07E-06). Table 5 & Figures 11, 19. Carbon tetrachloride was the seventh largest cancer risk driver at Shuttlesworth (1.9%, CR=3.93E-06). Table 1 & Figures 3, 19. Carbon tetrachloride was the fourth largest cancer risk driver at Providence (3.6%, CR=3.97E-06). Table 7 & Figures 15, 19. The cancer risk levels of p-Dichlorobenzene at all monitoring sites exceed the cancer risk level recommended for individual toxicants below (CR=1.0E-06). 100% of Carbon tetrachloride emissions in Jefferson County are from stationary sources. Figures 25, 40. Stationary (major and area) sources of Carbon tetrachloride are mapped and listed in http://batchgeo.com/map/9b05c6444707ddcb5a8232b116f6bb28.

- **Acetaldehyde** was the second largest cancer risk driver at Providence (4.8%, CR=5.24E-06). Table 7 & Figures 15, 19. Acetaldehyde was the ninth largest cancer risk driver at Shuttlesworth (CR=3.56E-06). Table 9. Acetaldehyde was the sixth largest cancer risk driver at East Thomas (3.2%, CR=4.62E-06). Table 3 & Figures 7, 19. Acetaldehyde was the ninth largest cancer risk driver at North Birmingham (2.5%, CR=3.70E-06). Table 5 & Figures 11, 19. The cancer risk levels of Acetaldehyde at all monitoring sites exceed the cancer risk level recommended for individual toxicants below (CR=1.0E-06). 86.4% of Acetaldehyde emissions in Jefferson County are from non-stationary sources. Figures 26, 42. 13.6% of Acetaldehyde emissions in Jefferson County are from stationary sources. Figures 26, 42. Stationary (major and area) sources of Acetaldehyde are mapped and listed in http://batchgeo.com/map/46f22359a2fbf743080f1762dba49f5c.

- **Ethylbenzene** was the eighth largest cancer risk driver at North Birmingham (2.6%, CR=3.80E-06). Table 5 & Figures 11, 19. Ethylbenzene was the ninth largest cancer risk driver at East Thomas (CR=3.42E-06). Table 9 & Figure 19. Ethylbenzene was the tenth largest cancer risk driver at Shuttlesworth (CR=2.81E-06). Table 9 & Figure 19. The cancer risk levels of Ethylbenzene at the three urban Birmingham monitoring sites exceed the cancer risk level recommended for individual toxicants below (CR=1.0E-06). 81.1% of Ethylbenzene emissions in Jefferson County are from non-stationary sources. Figures 27, 41. 18.9% of Ethylbenzene emissions in Jefferson County are from stationary sources. Figures 27, 41. Stationary (major and area) sources of Ethylbenzene are mapped and listed in http://batchgeo.com/map/9041c0d81ae23be097b3e572ef2888b3.

- **Benzo(a)pyrene** was the ninth largest cancer risk driver at Shuttlesworth (CR=3.30E-06). Table 9 & Figure 19. Benzo(a)pyrene was the tenth largest cancer risk driver at North Birmingham (2.3%, CR=3.41E-06). Table 5 & Figures 11, 19. The cancer risk levels of Benzo(a)pyrene at the three urban Birmingham monitoring sites exceed the cancer risk level recommended for individual toxicants below (CR=1.0E-06). 58.6% of Benzo(a)pyrene emissions in Jefferson County are from non-stationary sources. Figures 28, 43. 41.4% of Benzo(a)pyrene emissions in Jefferson County are from stationary sources. Figures 28, 43. Stationary (major and area) sources of Benzo(a)pyrene are mapped and listed in http://batchgeo.com/map/bc6602a25ef87f9fa0ba7541e63daf7a.

- **1,3-Hexachlorobutadiene** was the eleventh largest cancer risk driver at Shuttlesworth (CR=1.70E-06). Table 9 & Figure 19. 1,3-Hexachlorobutadiene was the tenth largest cancer risk driver at East Thomas (CR=2.50E-06). Table 9 & Figure 19. 1,3-Hexachlorobutadiene was the eleventh largest cancer risk driver at North Birmingham (CR=2.31E-06). Table 9 & Figure 19. 1,3-Hexachlorobutadiene was the seventh largest cancer risk driver at Providence (CR=2.18E-06). Tables 7, 9 & Figures 15, 19. The cancer risk levels of 1,3-Hexachlorobutadiene at all monitoring sites exceed the cancer risk level recommended for individual toxicants below (CR=1.0E-06). 100% of 1,3-Hexachlorobutadiene emissions in Jefferson County are from stationary sources.

Risk and Hazard Management Recommendations

- Acceptable cancer risk and non-cancer hazard levels should be determined by the exposed community, not bureaucrats and not industry.

- Individual air toxic concentrations should not exceed a Hazard Quotient of 1.0. This means that reductions in emissions of Acrolein and Manganese should be implemented to protect human health. Figure 29.

- Multiple air toxics that may affect the same target organ/system should not exceed an aggregate non-cancer hazard of 1.0 (Hazard Index=1.0). If, after reductions of individual air toxic concentrations exceeding a Hazard Quotient of 1.0 the Hazard Index still exceeds 1.0, additional emission reductions should be implemented to protect human health.

- Individual air toxic concentrations should not exceed a Cancer Risk Level of 1.0E-06 (1 in one million). This means that reductions in emissions of Benzene, Formaldehyde, Arsenic, Naphthalene, 1,3-Butadiene, p-Dichlorobenzene, Carbon Tetrachloride, Acetaldehyde, Ethylbenzene, Benzo(a)pyrene, and 1,3-Hexachlorobutadiene should be implemented to protect human health. Figure 19.

- Multiple air toxic concentrations should not exceed an aggregate Cancer Risk Level of 1.0E-04 (1 in 10,000). If, after reductions of individual air toxic concentrations exceeding CR=1.0E-06 the aggregate cancer risk still exceeds 1.0E-04, additional emission reductions should be implemented to protect human health.

Figure 1

THREE BIRMINGHAM AIR TOXICS MONITORS

LAW OFFICE OF
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CANCER RISKS AND NON-CANCER HAZARDS FROM AIR TOXICS IN BIRMINGHAM, ALABAMA

Figure 2

DISTANT AIR TOXICS MONITOR

LAW OFFICE OF
DAVID A. LUDDER
A Professional Limited Liability Company

CANCER RISKS AND NON-CANCER HAZARDS
FROM AIR TOXICS IN BIRMINGHAM, ALABAMA

Table 1

CANCER RISK FROM AIR TOXICS

4113 Shuttlesworth Drive – Birmingham

Chemical	Cancer Risk	Contribution to Aggregate Risk	Contribution from Stationary Sources
Benzene	6.23E-05	30.1%	18.5%
Formaldehyde	5.34E-05	25.8%	16.9%
Arsenic	3.48E-05	16.8%	100%
Naphthalene	1.94E-05	9.4%	61.6%
1,3-Butadiene	7.35E-06	3.6%	7.7%
p-Dichlorobenzene	5.30E-06	2.6%	100%
Carbon Tetrachloride	3.93E-06	1.9%	100%
Others	2.05E-05	9.8%	
AGGREGATE CANCER RISK	**2.07E-04**	100%	

Figure 3

CANCER RISK FROM AIR TOXICS

4113 Shuttlesworth Drive – Birmingham

AGGREGATE CANCER RISK = 2.07E-04

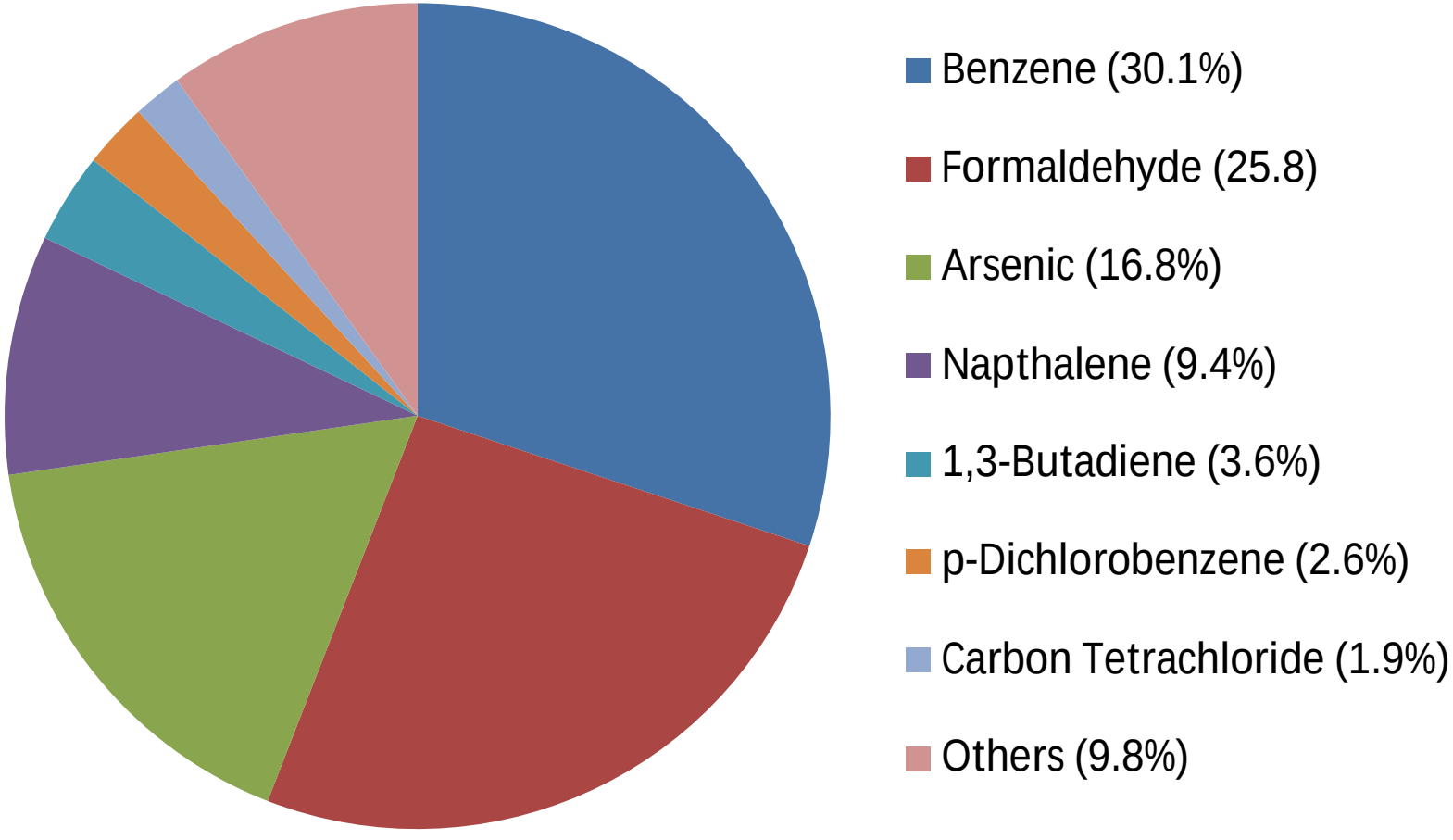


Figure 4

CANCER RISK FROM AIR TOXICS

4113 Shuttlesworth Drive – Birmingham

AGGREGATE CANCER RISK FROM STATIONARY SOURCES ≥ 7.71E-05

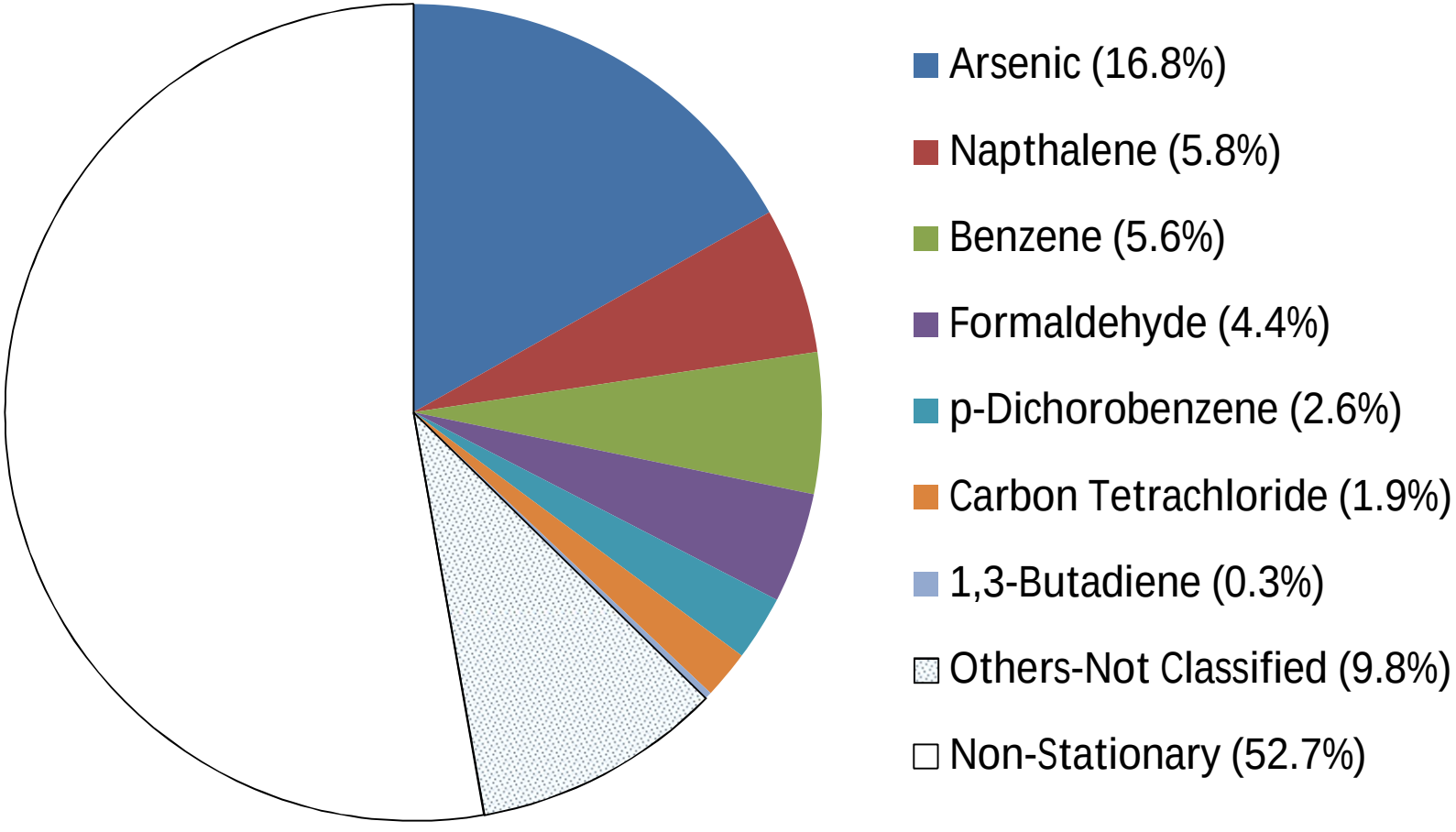


Table 2

NON-CANCER HAZARD FROM AIR TOXICS

4113 Shuttlesworth Drive – Birmingham

Chemical	Hazard Quotient	Contribution to Aggregate Hazard	Contribution from Stationary Sources
Acrolein	53.1	88.4%	28.5%
Manganese	3.8	6.3%	99.7%
Acetonitrile	1.0	1.6%	100%
Arsenic	0.5	0.9%	100%
Formaldehyde	0.4	0.7%	16.9%
Benzene	0.3	0.4%	18.5%
Lead	0.2	0.4%	99.8%
Others	0.7	1.2%	
AGGREGATE NON-CANCER HAZARD	**60.0**	100%	

Figure 5

NON-CANCER HAZARD FROM AIR TOXICS

4113 Shuttlesworth Drive – Birmingham

AGGREGATE NON-CANCER HAZARD = 60.0

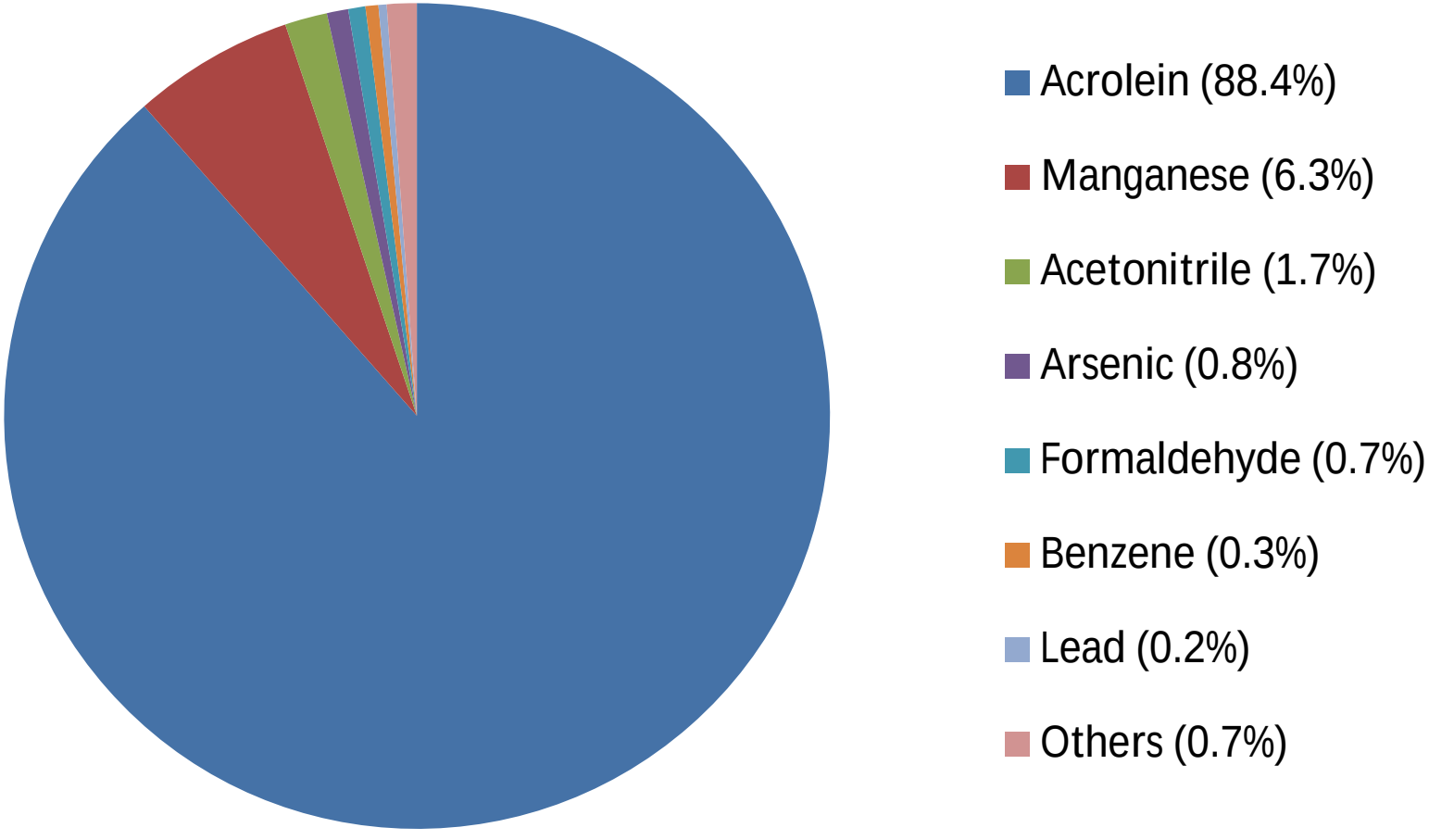


Figure 6

NON-CANCER HAZARD FROM AIR TOXICS

4113 Shuttlesworth Drive – Birmingham

AGGREGATE NON-CANCER HAZARD FROM STATIONARY SOURCES ≥ 20.7

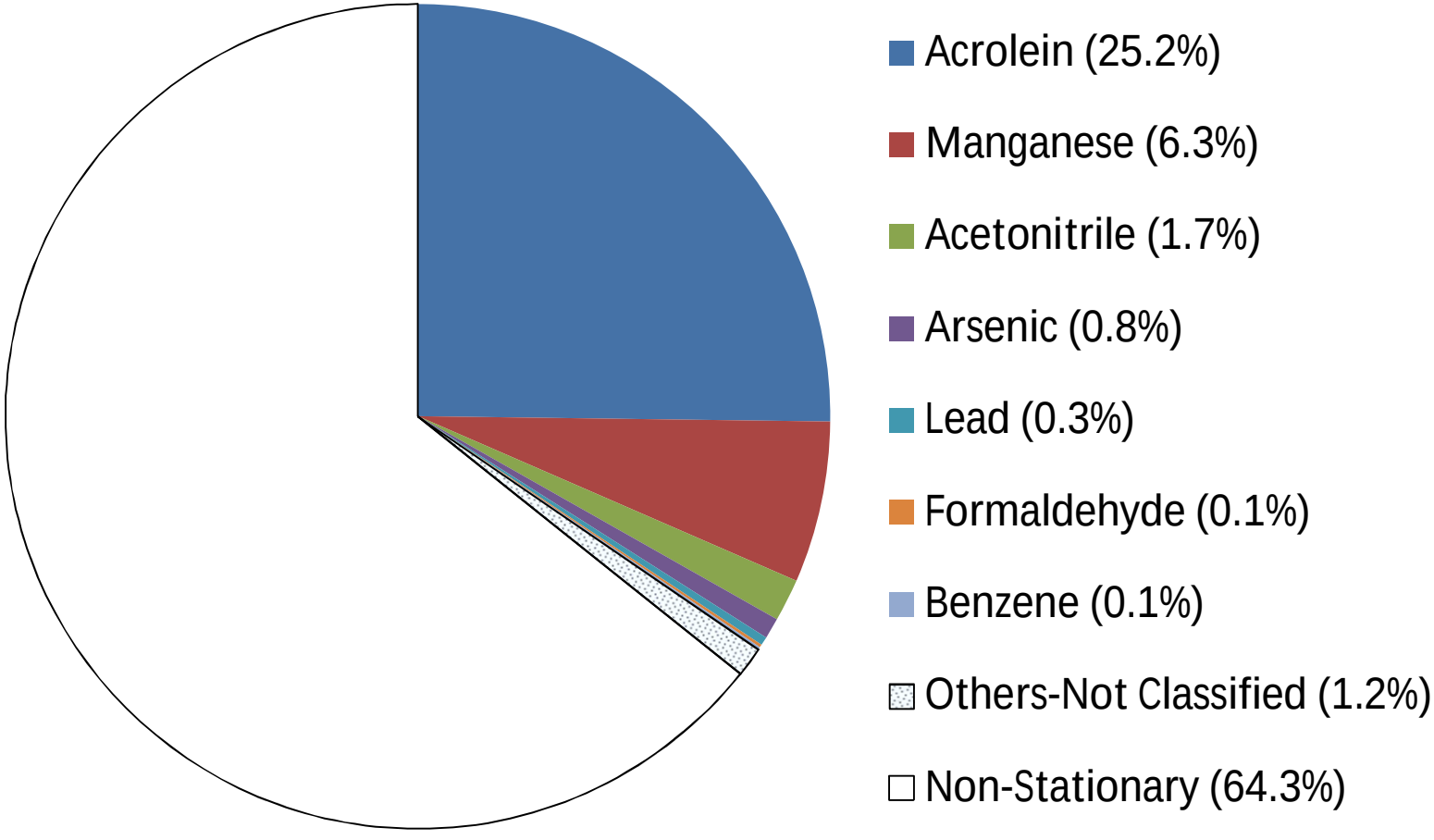


Table 3

CANCER RISK FROM AIR TOXICS

841 Finley Avenue - East Thomas

Chemical	Cancer Risk	Contribution to Aggregate Risk	Contribution from Stationary Sources
Formaldehyde	6.87E-05	46.9%	16.9%
Benzene	2.60E-05	17.8%	18.5%
Naphthalene	1.16E-05	7.9%	61.6%
1,3-Butadiene	8.54E-06	5.8%	7.7%
Arsenic	7.31E-06	5.0%	100%
Acetaldehyde	4.62E-06	3.2%	13.6%
Carbon Tetrachloride	4.15E-06	2.8%	100%
p-Dichlorobenzene	3.44E-06	2.4%	100%
Others	1.20E-05	8.2%	
AGGREGATE CANCER RISK	**1.46E-04**	100%	

Figure 7

CANCER RISK FROM AIR TOXICS

841 Finley Avenue - East Thomas

AGGREGATE CANCER RISK = 1.46E-04

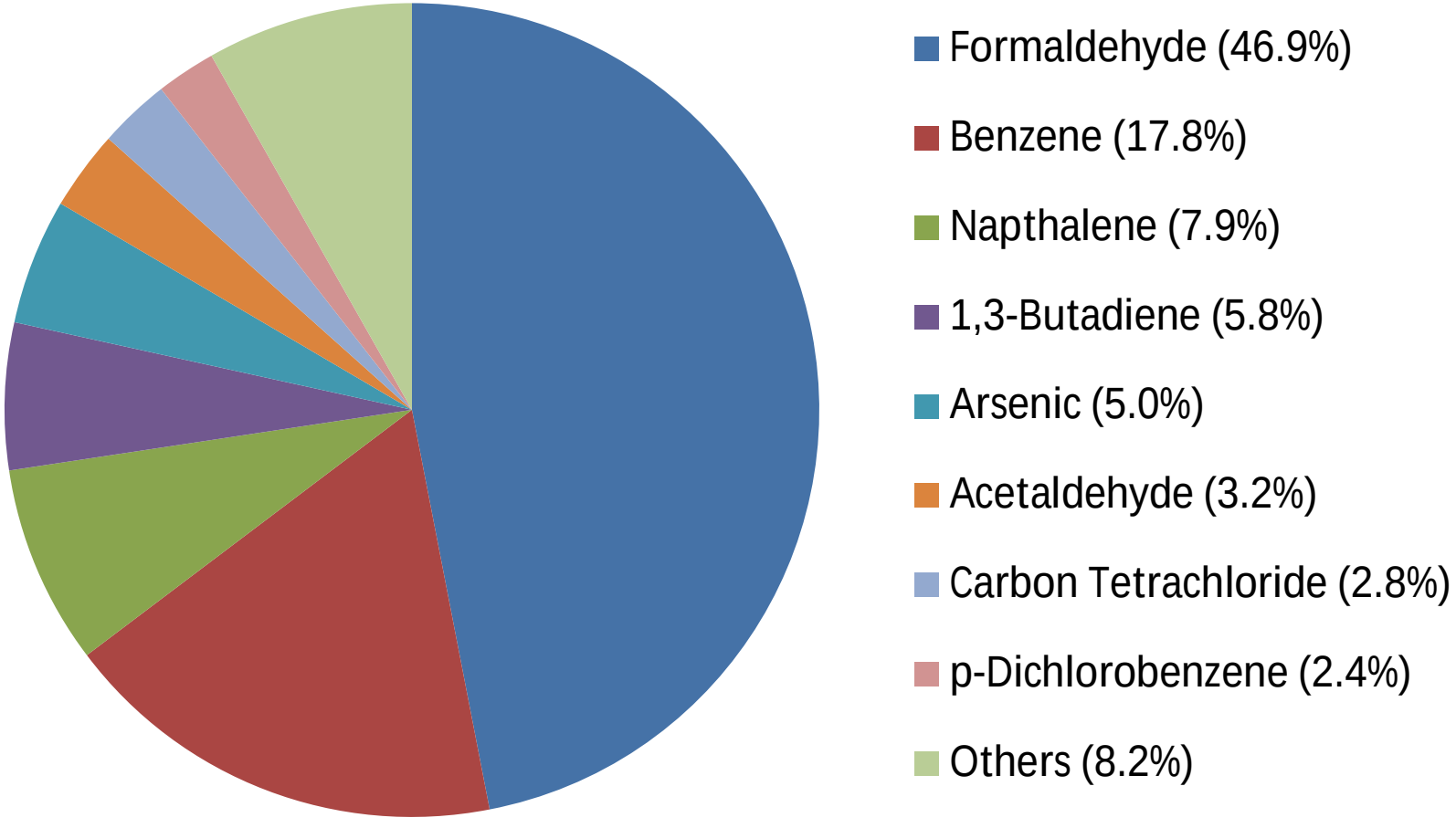


Figure 8

CANCER RISK FROM AIR TOXICS

841 Finley Avenue - East Thomas

AGGREGATE CANCER RISK FROM STATIONARY SOURCES ≥ 3.97E-05

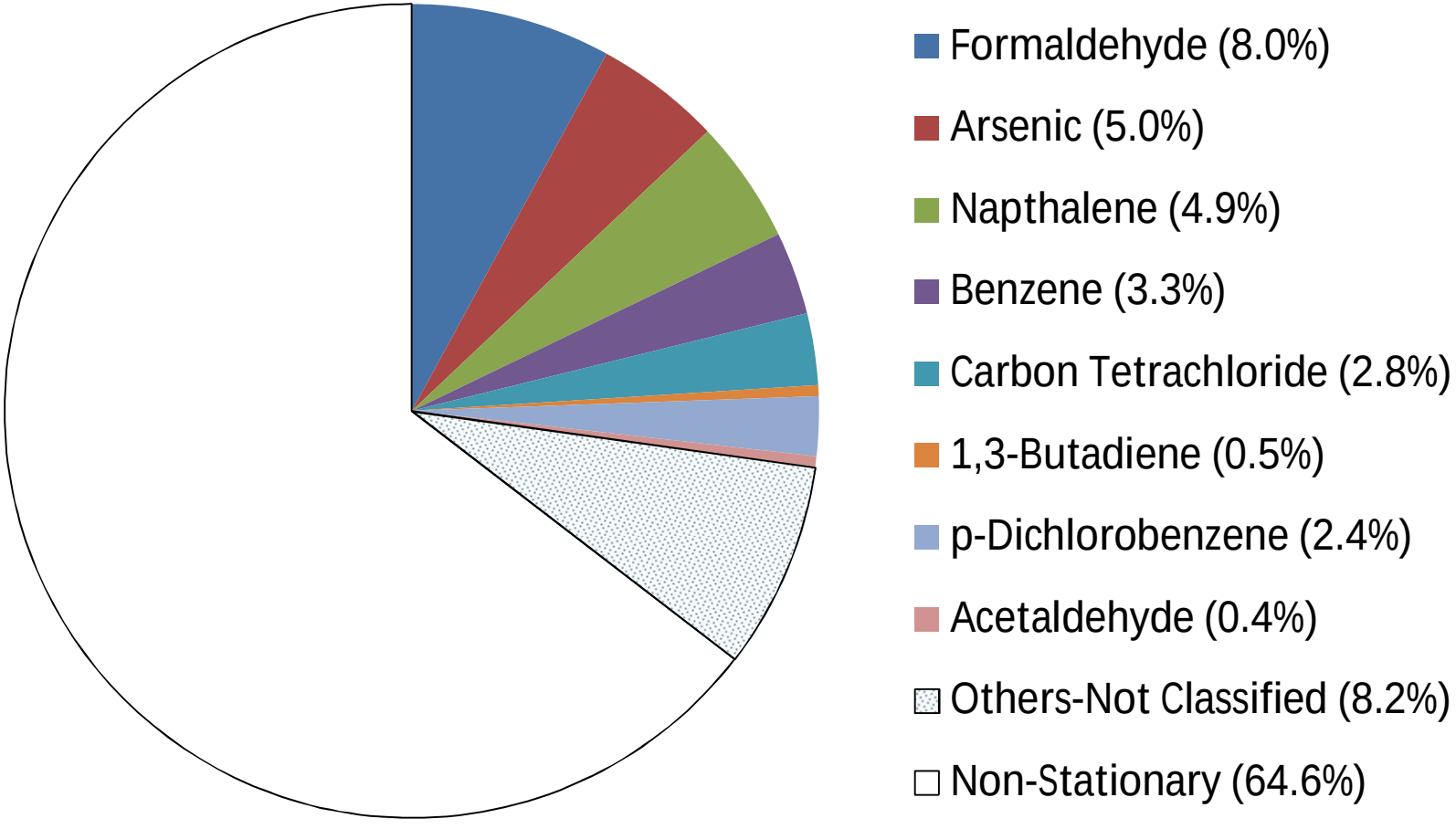


Table 4

NON-CANCER HAZARD FROM AIR TOXICS

841 Finley Avenue - East Thomas

Chemical	Hazard Quotient	Contribution to Aggregate Hazard	Contribution from Stationary Sources
Acrolein	39.9	92.2%	28.5%
Manganese	1.2	2.9%	99.7%
Acetonitrile	0.6	1.2%	100%
Formaldehyde	0.5	1.2%	16.9%
Acetaldehyde	0.2	0.3%	13.6%
1,3-Butadiene	0.1	0.3%	7.7%
Others	0.6	1.5%	
AGGREGATE NON-CANCER HAZARD	**43.3**	100%	

Figure 9

NON-CANCER HAZARD FROM AIR TOXICS

841 Finley Avenue - East Thomas

AGGREGATE NON-CANCER HAZARD = 43.3

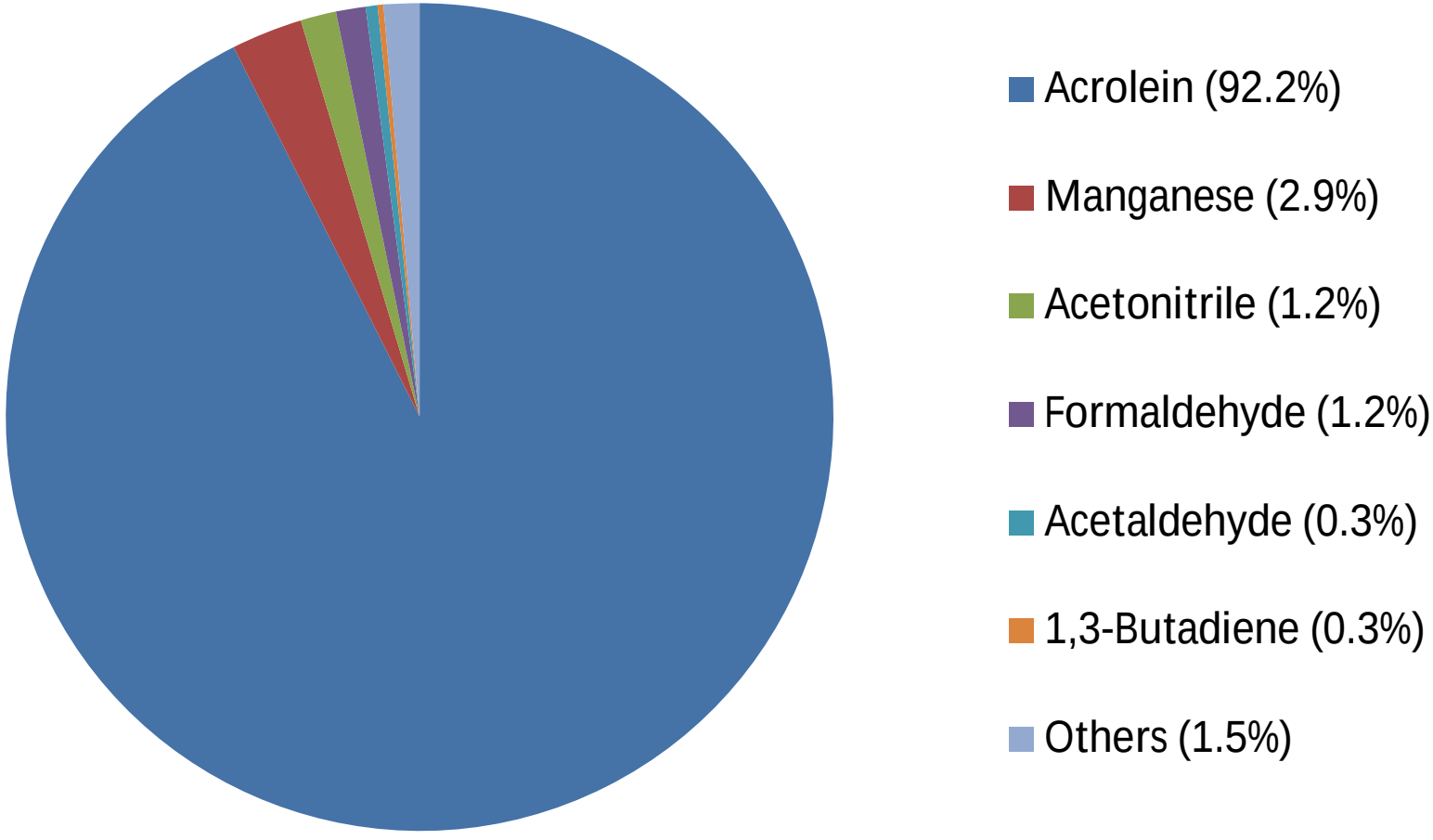


Figure 10

NON-CANCER HAZARD FROM AIR TOXICS

841 Finley Avenue - East Thomas

AGGREGATE NON-CANCER HAZARD FROM STATIONARY SOURCES ≥ 13.3

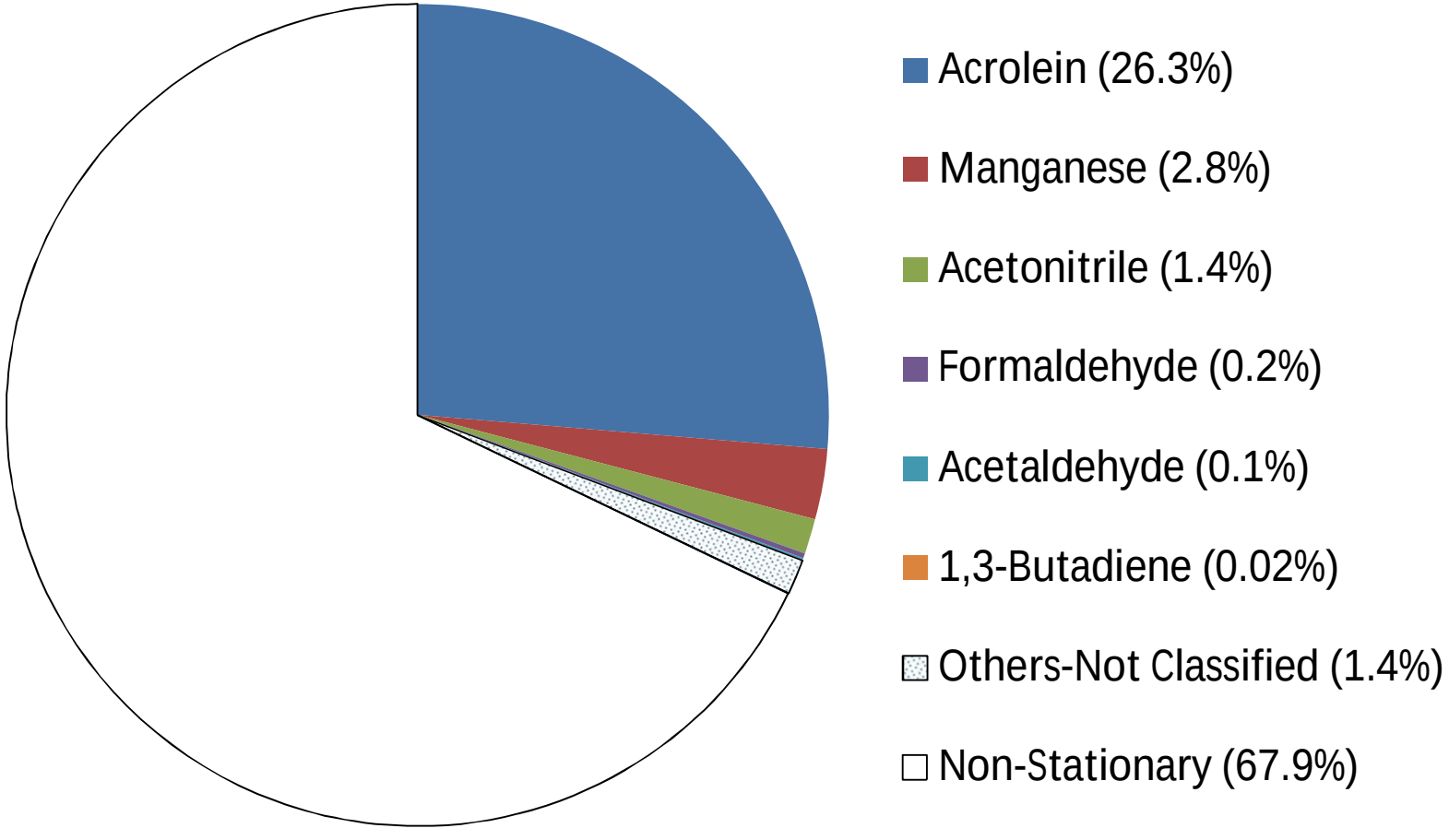


Table 5

CANCER RISK FROM AIR TOXICS

3009 28th Street North – North Birmingham

Chemical	Cancer Risk	Contribution to Aggregate Risk	Contribution from Stationary Sources
Formaldehyde	5.62E-05	38.5%	16.9%
Benzene	3.31E-05	22.7%	18.5%
Naphthalene	1.23E-05	8.4%	61.6%
Arsenic	1.03E-05	7.1%	100%
1,3-Butadiene	5.46E-06	3.7%	7.7%
Carbon Tetrachloride	4.07E-06	2.8%	100%
p-Dichlorobenzene	3.86E-06	2.6%	100%
Ethylbenzene	3.80E-06	2.6%	18.9%
Acetaldehyde	3.70E-06	2.5%	13.6%
Benzo(a)pyrene	3.41E-06	2.3%	41.4%
Others	9.80E-06	6.7%	
AGGREGATE CANCER RISK	**1.46E-04**	100%	

Figure 11

CANCER RISK FROM AIR TOXICS

3009 28th Street North – North Birmingham

AGGREGATE CANCER RISK = 1.46E-04

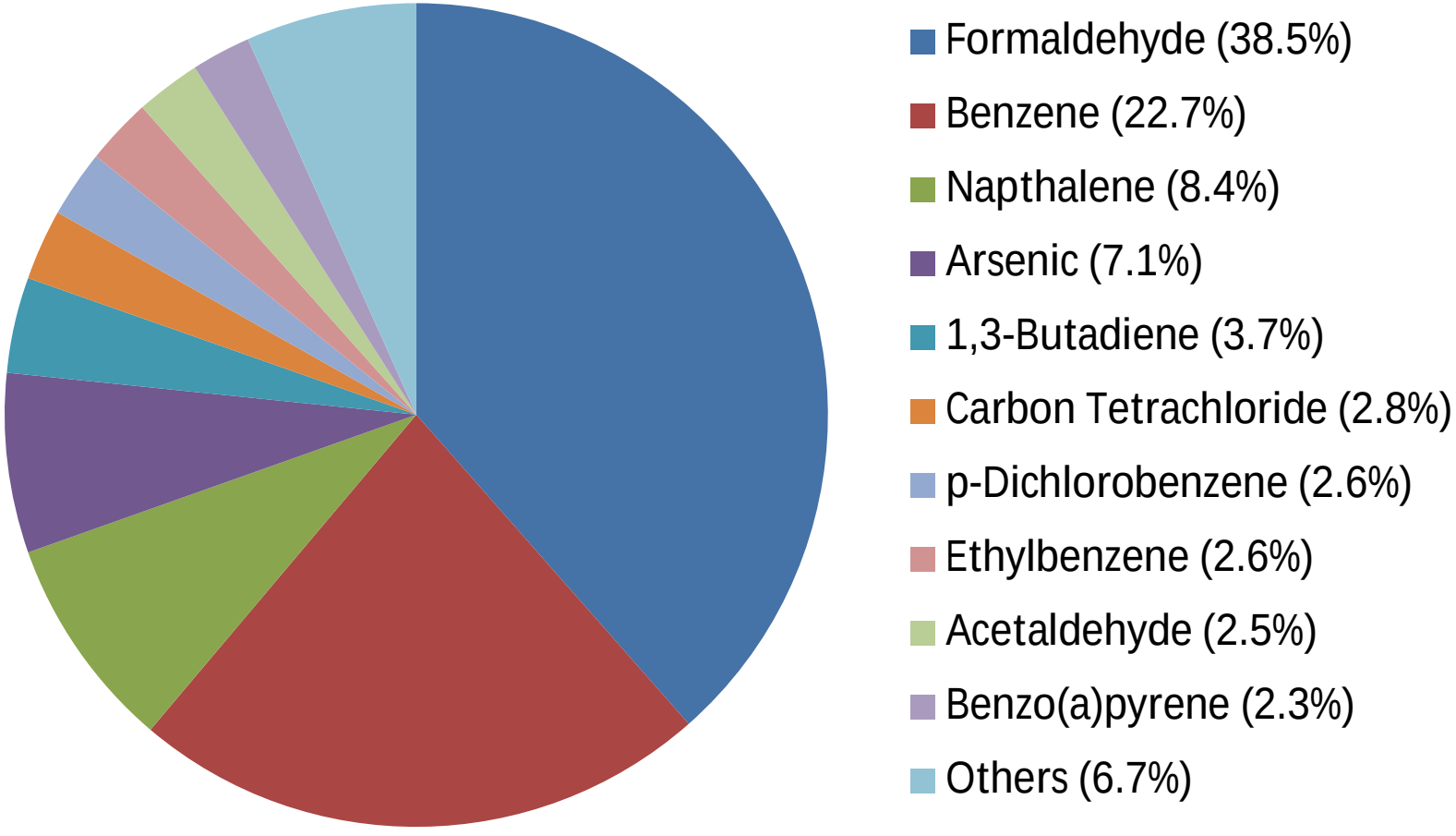


Figure 12

CANCER RISK FROM AIR TOXICS

3009 28th Street North – North Birmingham

AGGREGATE CANCER RISK FROM STATIONARY SOURCES ≥ 4.45E-05

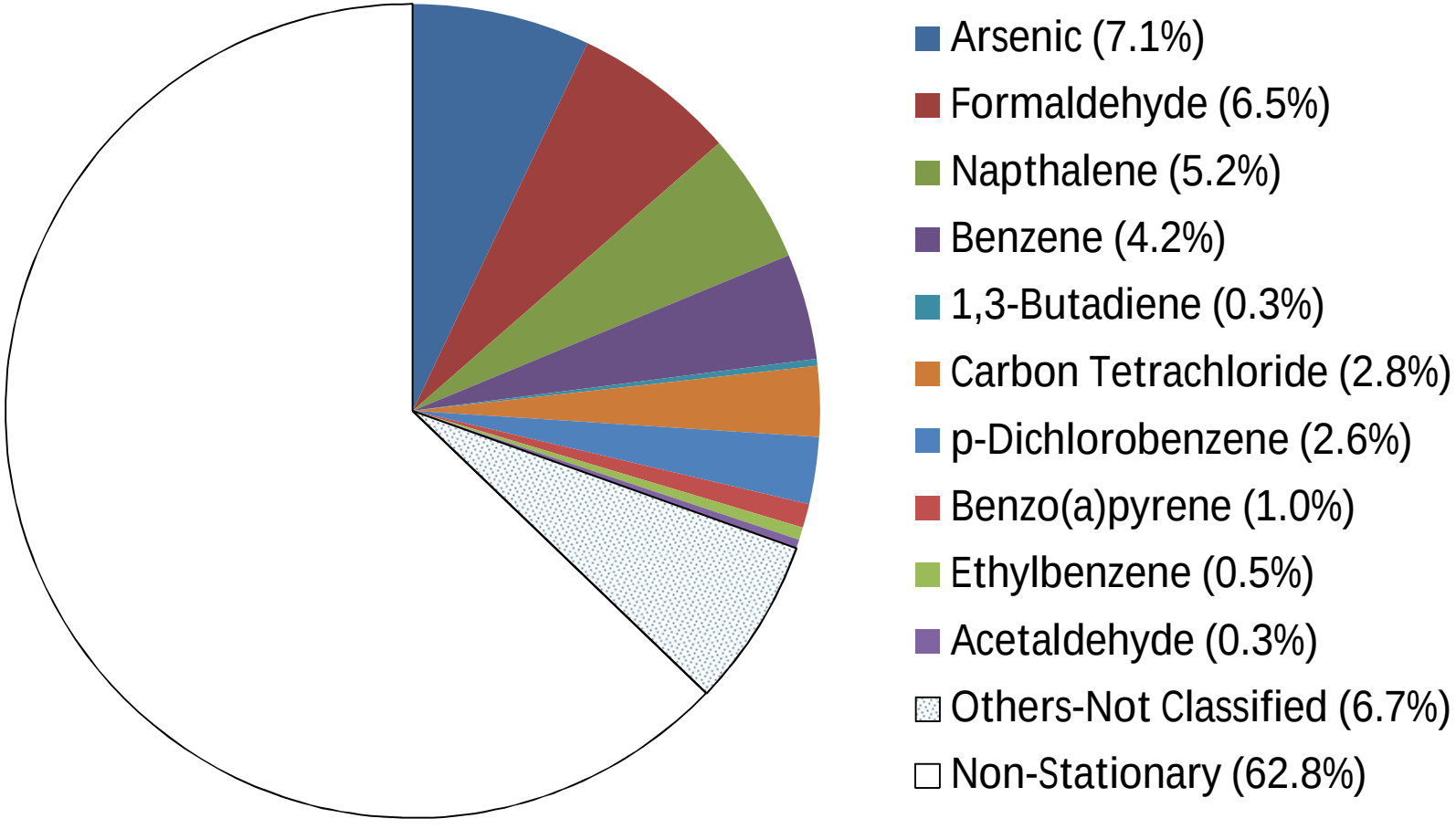


Table 6

NON-CANCER HAZARD FROM AIR TOXICS

3009 28th Street North – North Birmingham

Chemical	Hazard Quotient	Contribution to Aggregate Hazard	Contribution from Stationary Sources
Acrolein	41.2	92.7%	28.5%
Manganese	1.3	2.9%	99.7%
Formaldehyde	0.4	1.0%	16.9%
Acetonitrile	0.4	0.8%	100%
Lead	0.2	0.4%	99.8%
Acetaldehyde	0.2	0.4%	13.6%
Others	0.8	1.8%	
AGGREGATE NON-CANCER HAZARD	**44.5**	100%	

Figure 13

NON-CANCER HAZARD FROM AIR TOXICS

3009 28th Street North – North Birmingham

AGGREGATE NON-CANCER HAZARD = 44.5

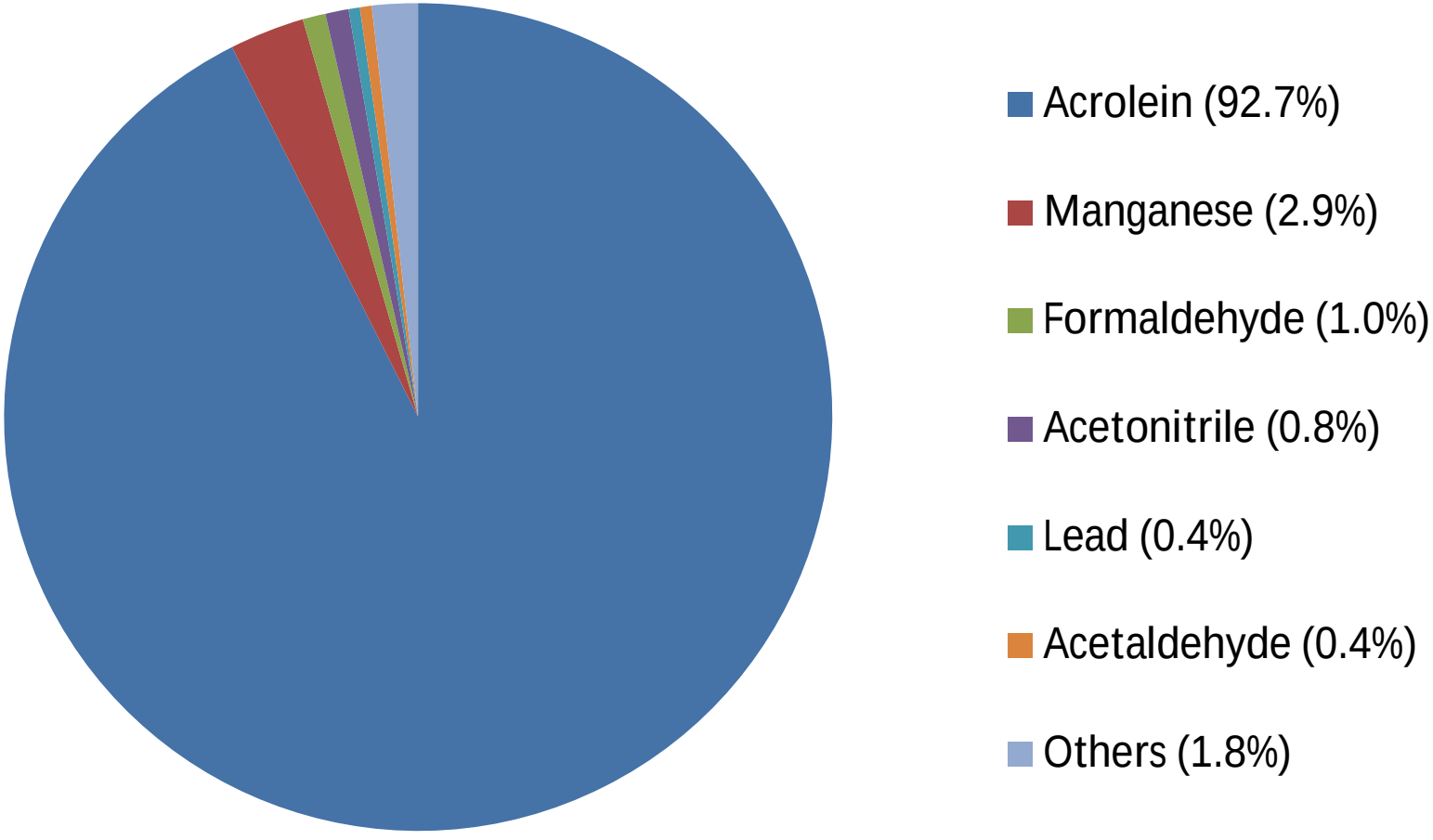


Figure 14

NON-CANCER HAZARD FROM AIR TOXICS

3009 28th Street North – North Birmingham

AGGREGATE NON-CANCER HAZARD FROM STATIONARY SOURCES ≥ 13.7

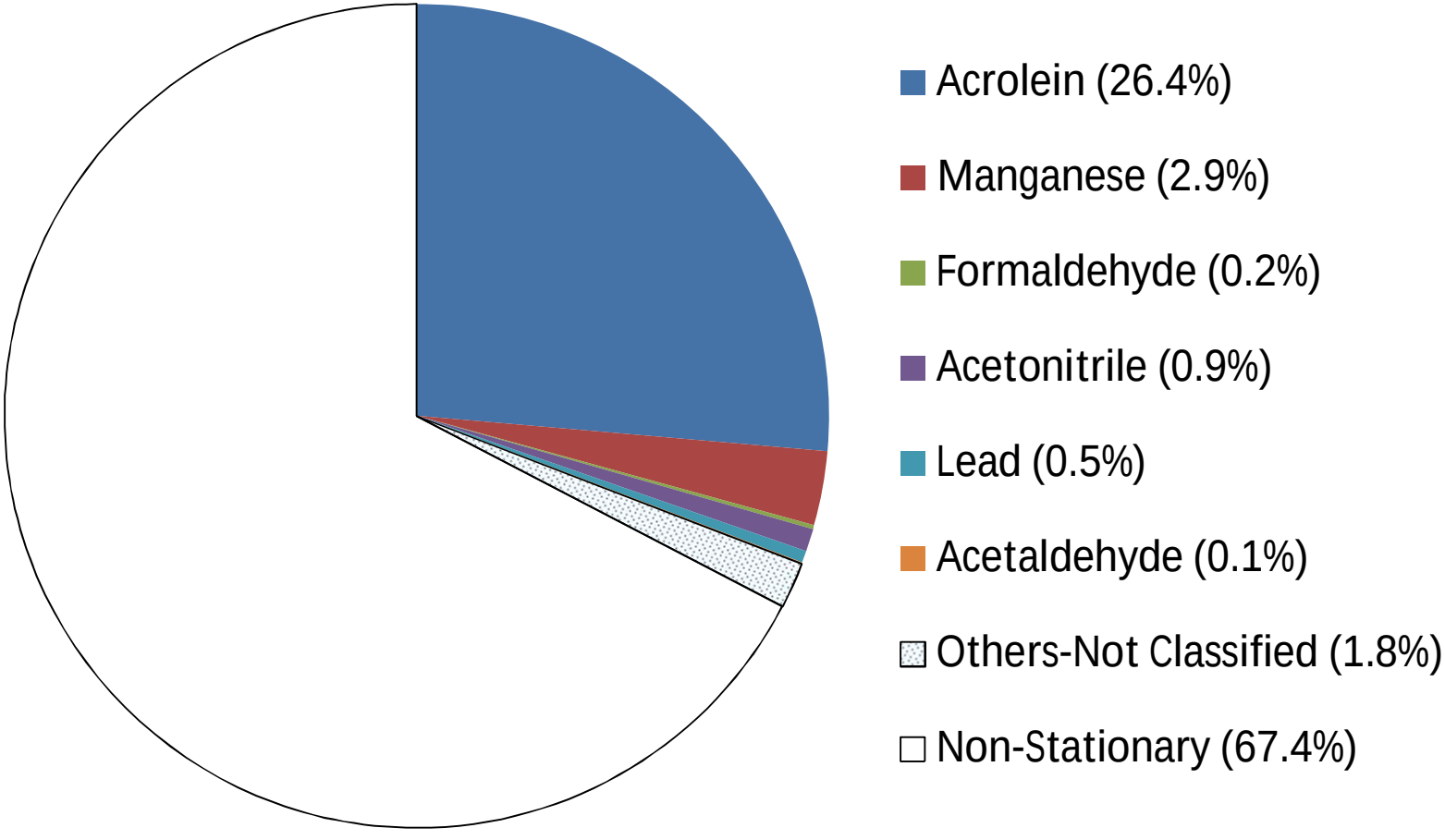


Table 7

CANCER RISK FROM AIR TOXICS

1801 Bruce Shaw Road, Providence

Chemical	Cancer Risk	Contribution to Aggregate Risk	Contribution from Stationary Sources
Formaldehyde	8.18E-05	75.0%	16.9%
Acetaldehyde	5.24E-06	4.8%	13.6%
Benzene	4.87E-06	4.5%	18.5%
Carbon Tetrachloride	3.97E-06	3.6%	100%
Arsenic	3.87E-06	3.6%	100%
p-Dichlorobenzene	3.17E-06	2.9%	100%
1,3-Hexachlorobutadiene	2.18E-06	2.0%	100%
1,3-Butadiene	1.10E-06	1.0%	7.7%
Others	2.80E-06	2.6%	
AGGREGATE CANCER RISK	**1.09E-04**	100%	

Figure 15

CANCER RISK FROM AIR TOXICS

1801 Bruce Shaw Road, Providence

AGGREGATE CANCER RISK = 1.09E-04

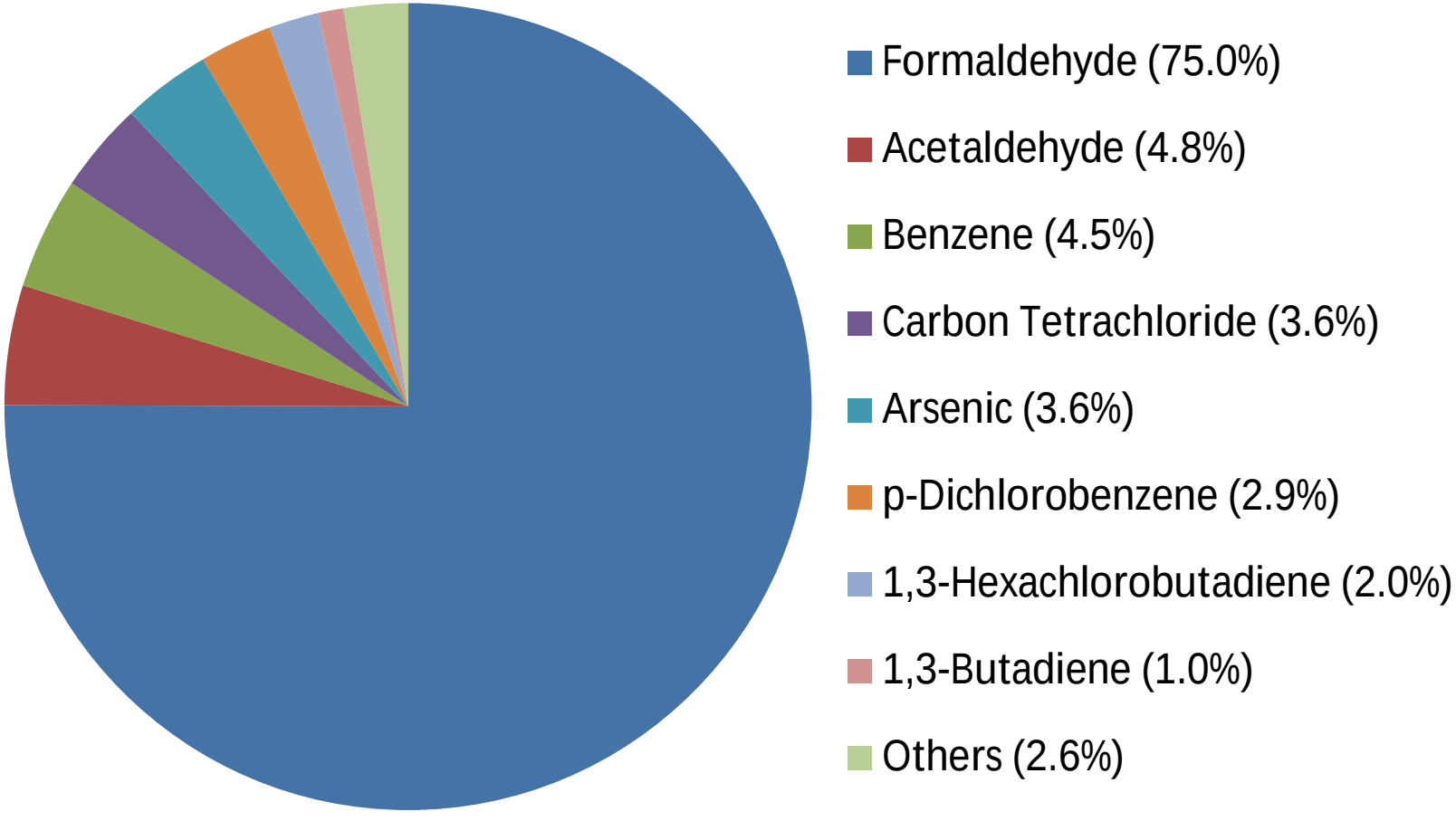


Figure 16

CANCER RISK FROM AIR TOXICS

1801 Bruce Shaw Road, Providence

AGGREGATE CANCER RISK FROM STATIONARY SOURCES ≥ 2.87E-05

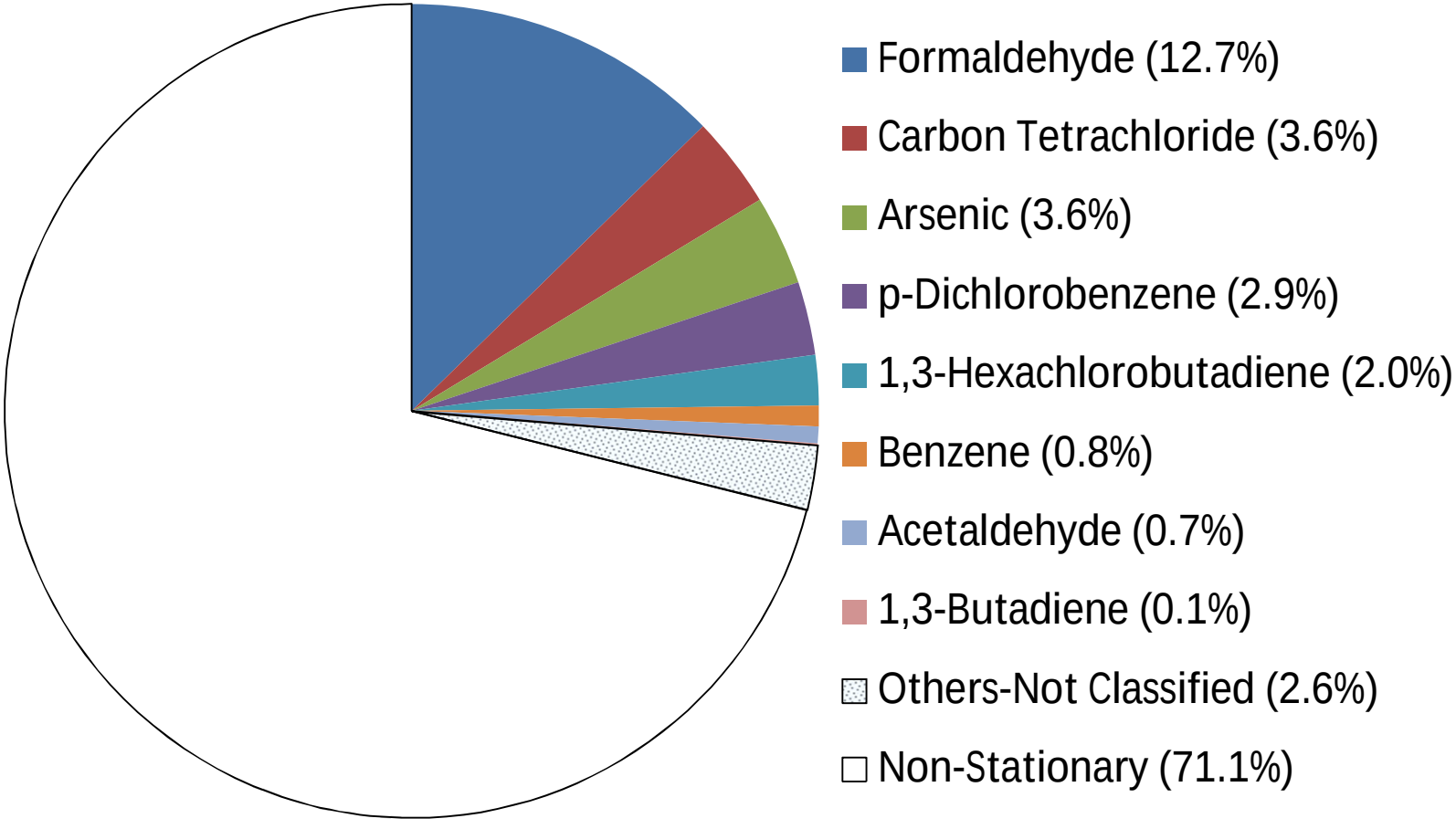


Table 8

NON-CANCER HAZARD FROM AIR TOXICS

1801 Bruce Shaw Road, Providence

Chemical	Hazard Quotient	Contribution to Aggregate Hazard	Contribution from Stationary Sources
Acrolein	25.0	94.7%	28.5%
Formaldehyde	0.6	2.4%	16.9%
Acetaldehyde	0.3	1.0%	13.6%
Manganese	0.2	0.6%	99.7%
Others	0.4	1.3%	
AGGREGATE NON-CANCER HAZARD	**26.4**	100%	

Figure 17

NON-CANCER HAZARD FROM AIR TOXICS

1801 Bruce Shaw Road, Providence

AGGREGATE NON-CANCER HAZARD = 26.4

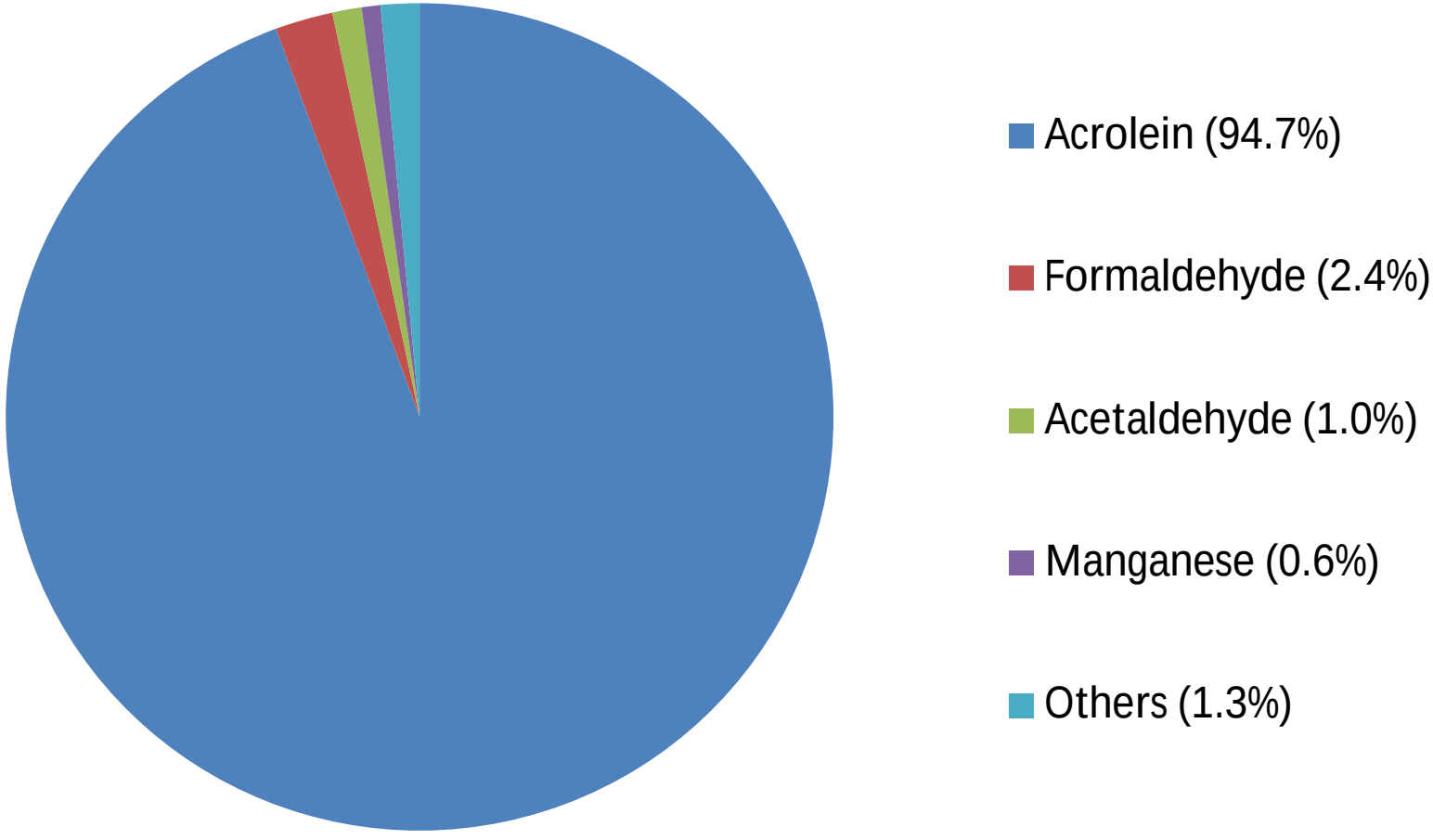


Figure 18

NON-CANCER HAZARD FROM AIR TOXICS

1801 Bruce Shaw Road, Providence

AGGREGATE NON-CANCER HAZARD FROM STATIONARY SOURCES ≥ 7.5

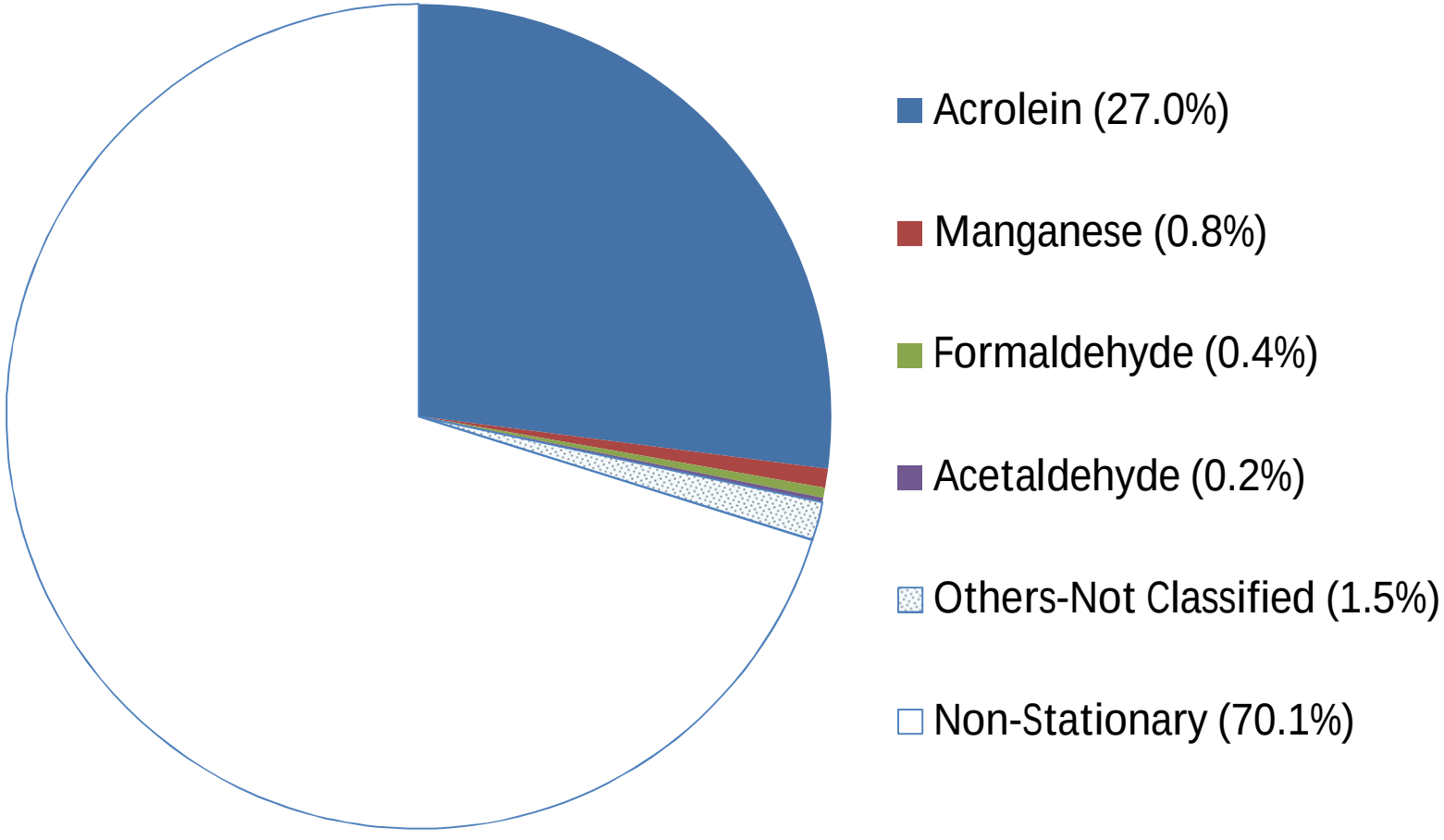


Table 9

CHEMICALS THAT EXCEED CANCER RISK LEVEL OF 1.0E-06

Chemical	Shuttlesworth	E. Thomas	N. Birmingham	Providence
Benzene	6.23E-05	2.60E-05	3.31E-05	4.87E-06
Formaldehyde	5.34E-05	6.87E-05	5.62E-05	8.18E-05
Arsenic	3.48E-05	7.31E-06	1.03E-05	3.87E-06
Naphthalene	1.94E-05	1.16E-05	1.23E-05	-
1,3-Butadiene	7.35E-06	8.54E-06	5.46E-06	1.10E-06
p-Dichlorobenzene	5.30E-06	3.44E-06	3.86E-06	3.17E-06
Carbon Tetrachloride	3.93E-06	4.15E-06	4.07E-06	3.97E-06
Ethylbenzene	2.81E-06	3.42E-06	3.80E-06	-
Acetaldehyde	3.56E-06	4.62E-06	3.70E-06	5.24E-06
Benzo(a)pyrene	3.30E-06	-	3.41E-06	-
1,3-Hexachlorobutadiene	1.70E-06	2.50E-06	2.31E-06	2.18E-06

Figure 19

CHEMICALS THAT EXCEED CANCER RISK LEVEL OF 1.0E-06

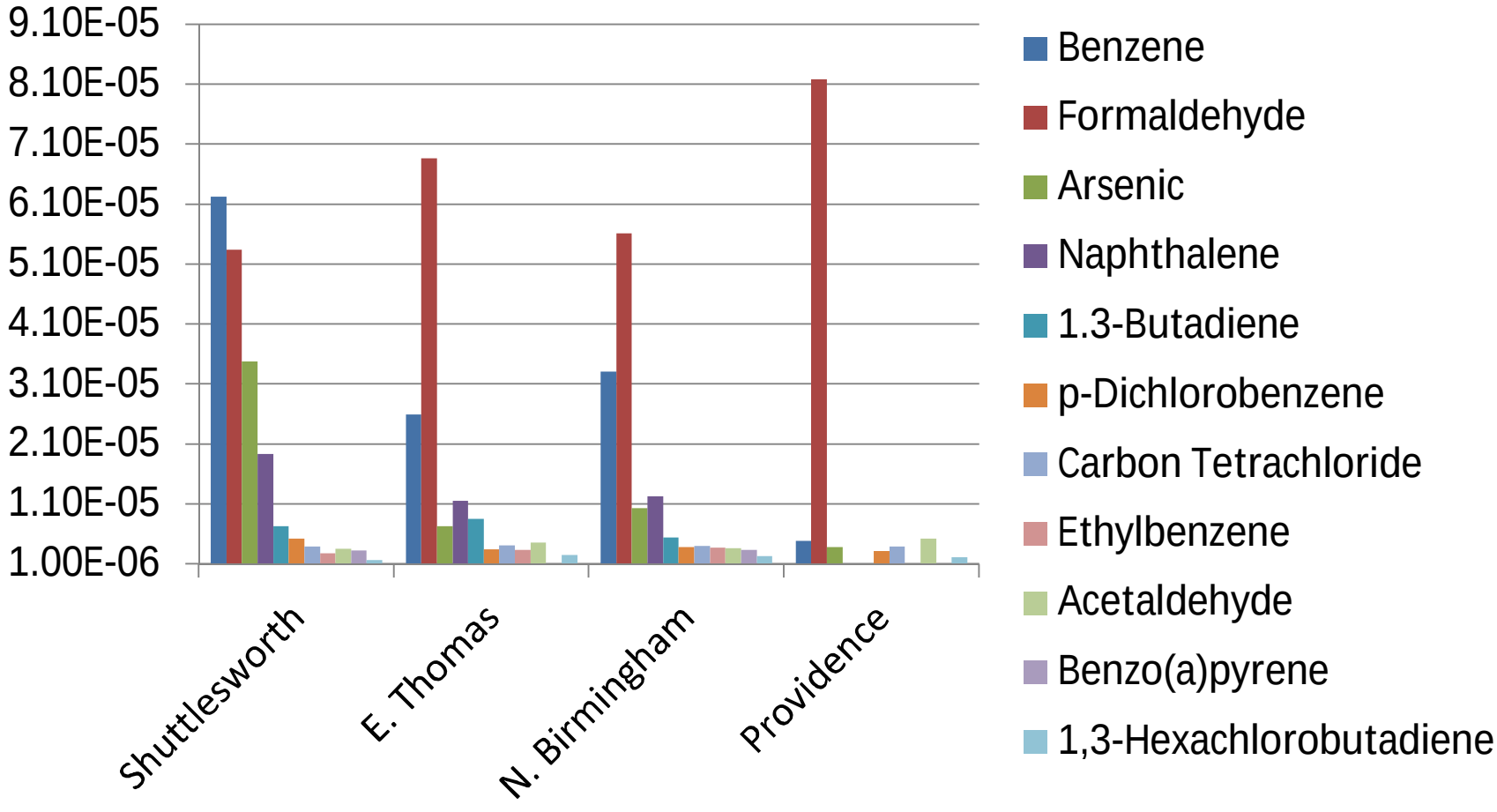
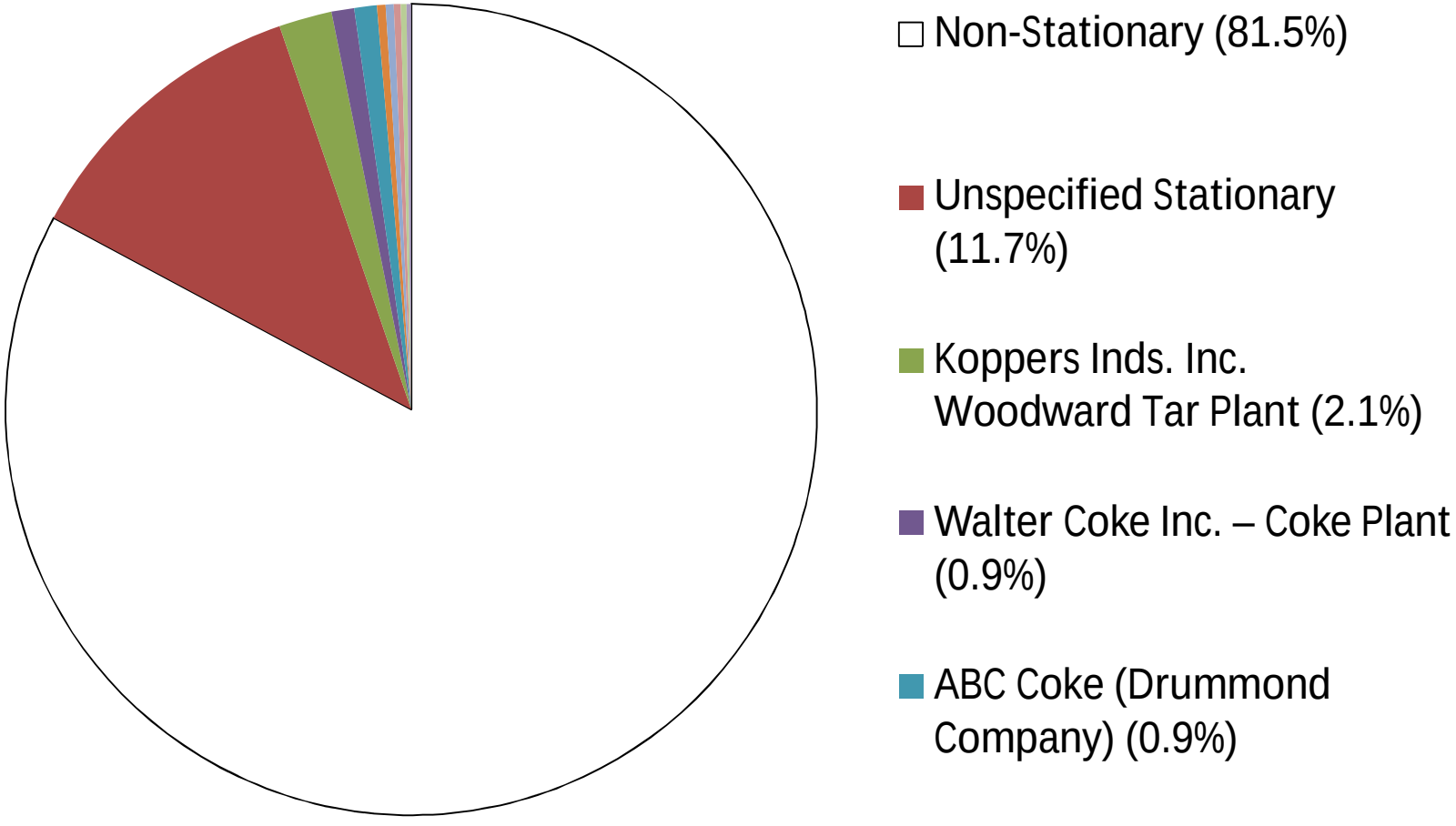


Figure 20

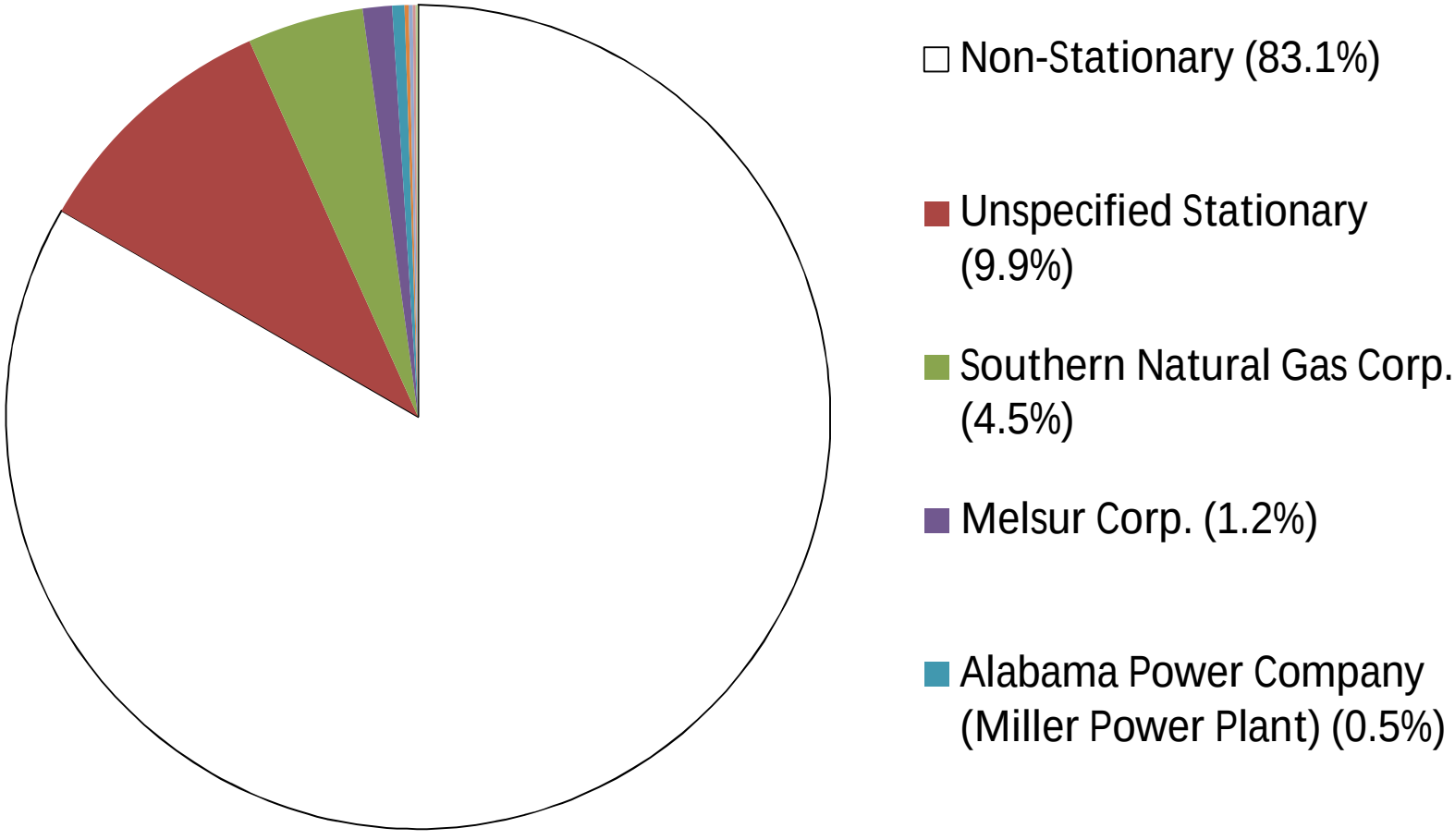
Benzene Emissions in Jefferson County



Map and list of sources: http://batchgeo.com/map/49cef5b455f3408120fe9735f0236e71

Figure 21

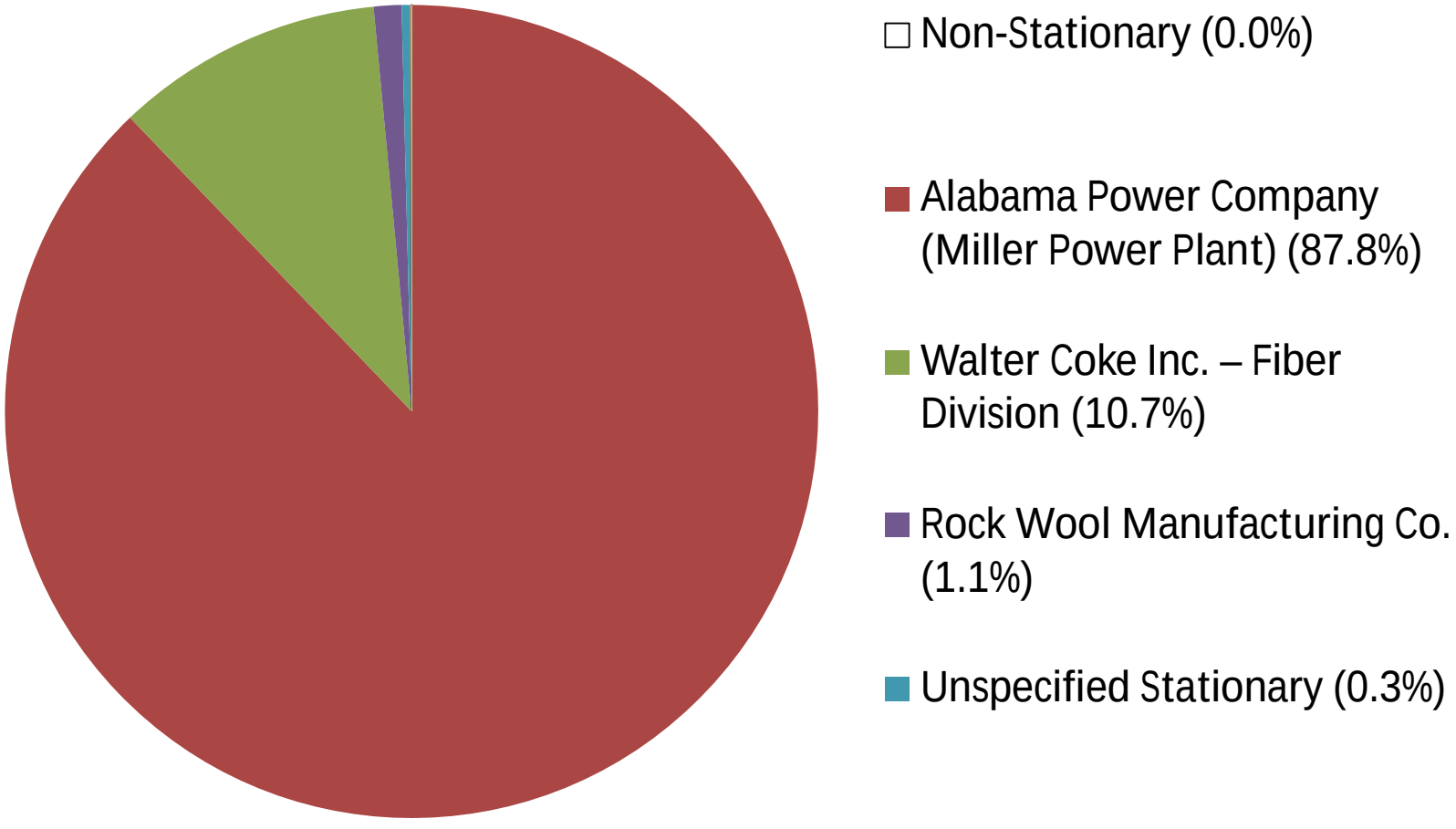
Formaldehyde Emissions in Jefferson County



Map and list of sources: http://batchgeo.com/map/ba8441d2a070a15b1a0052d34242e754

Figure 21

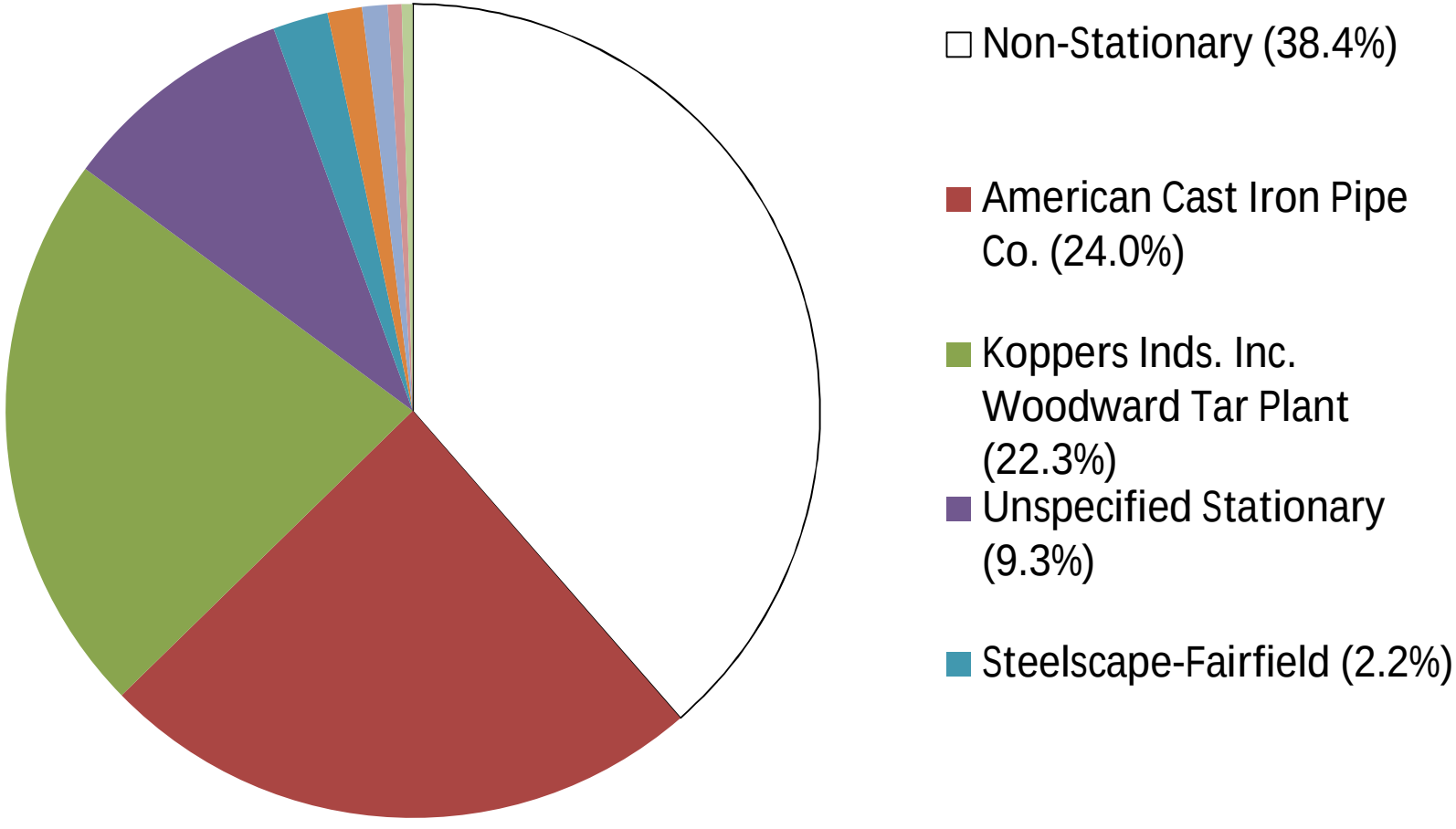
Arsenic Emissions in Jefferson County



Map and list of sources: http://batchgeo.com/map/781a53ae8634f40846bb879df4494561

Figure 22

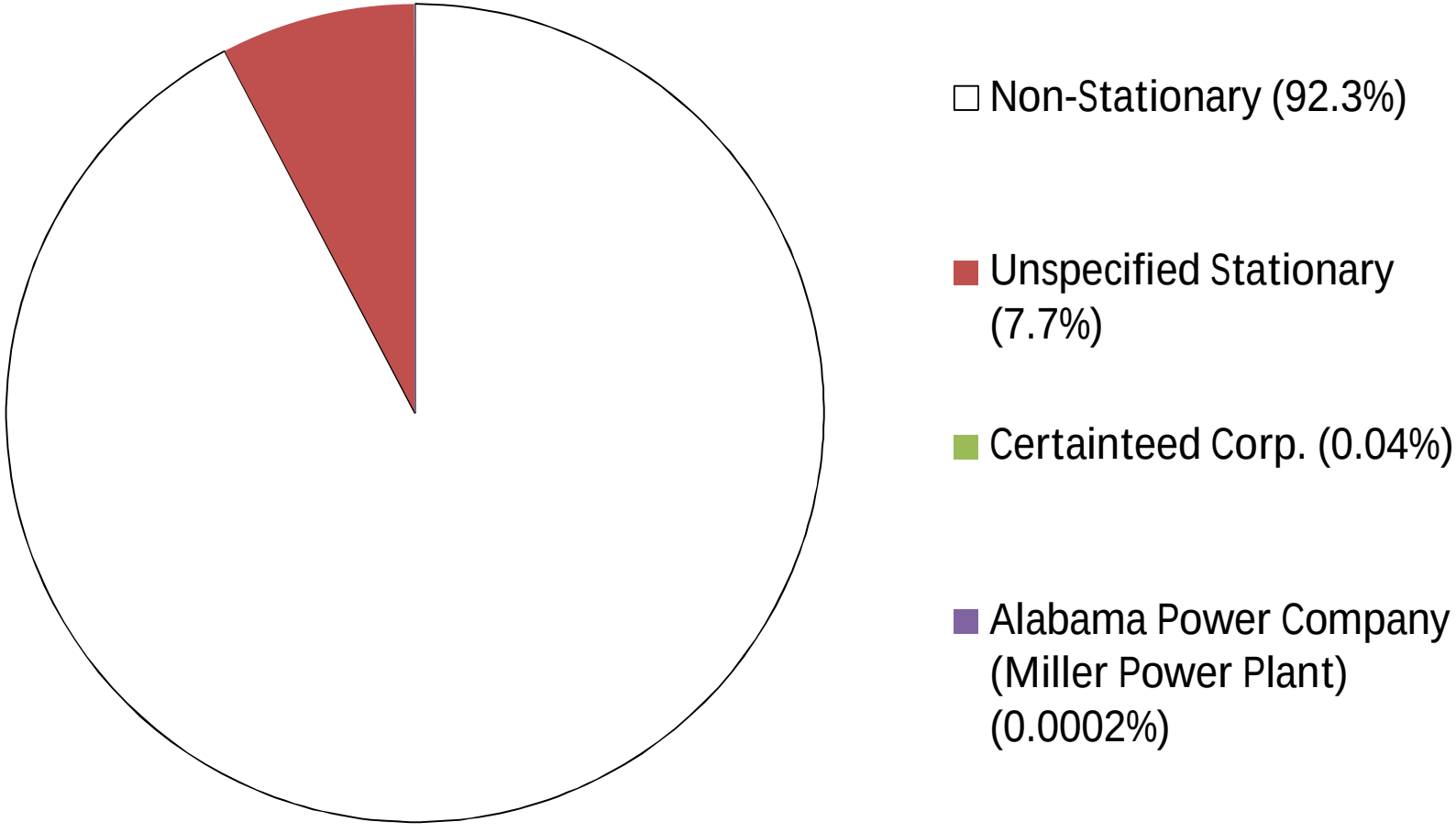
Naphthalene Emissions in Jefferson County



Map and list of sources: http://batchgeo.com/map/8e463e344f80d6847e756f9d72df13c8

Figure 23

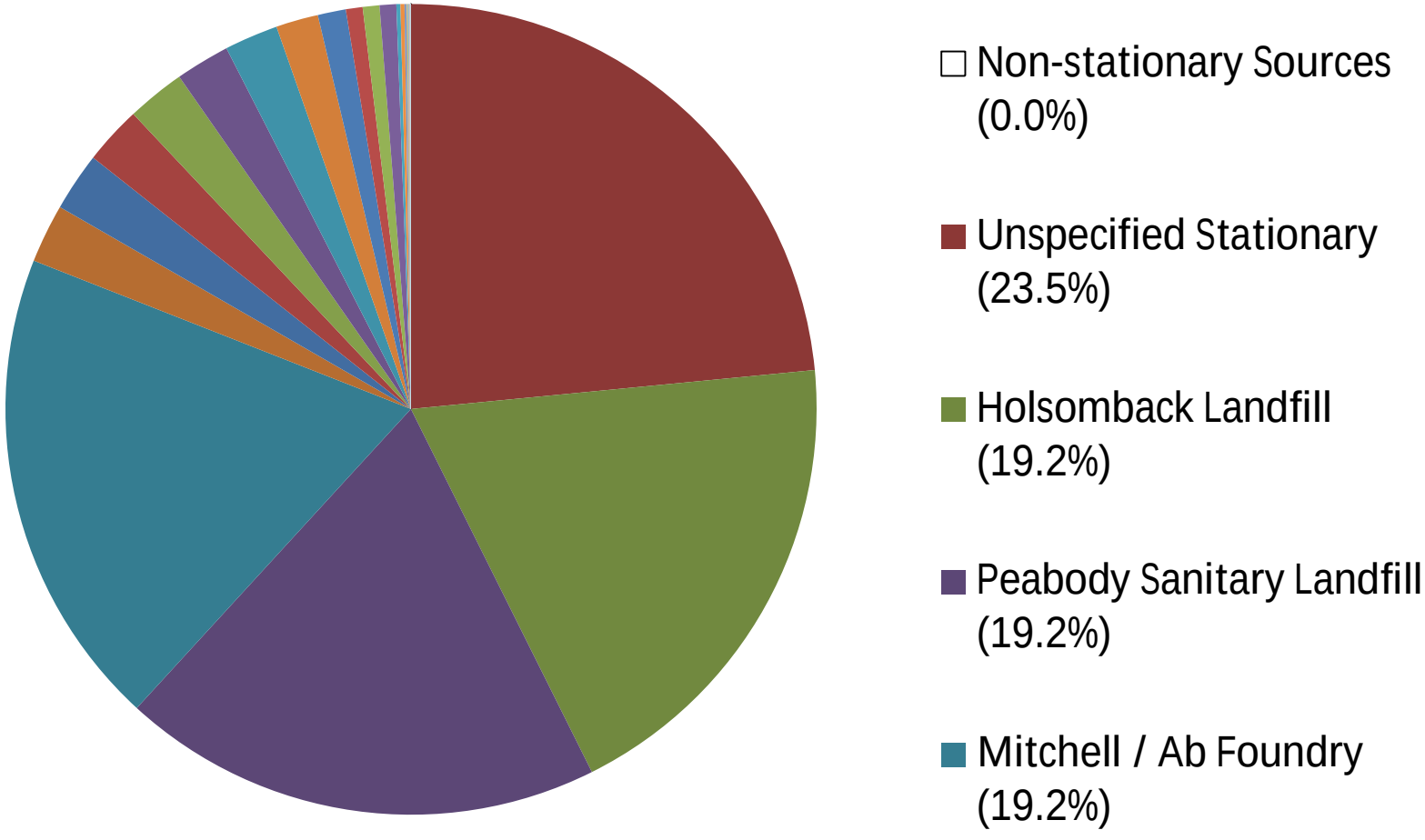
1,3-Butadiene Emissions in Jefferson County



Map and list of sources: http://batchgeo.com/map/19556f00e38852b37e09743361b6d872

Figure 24

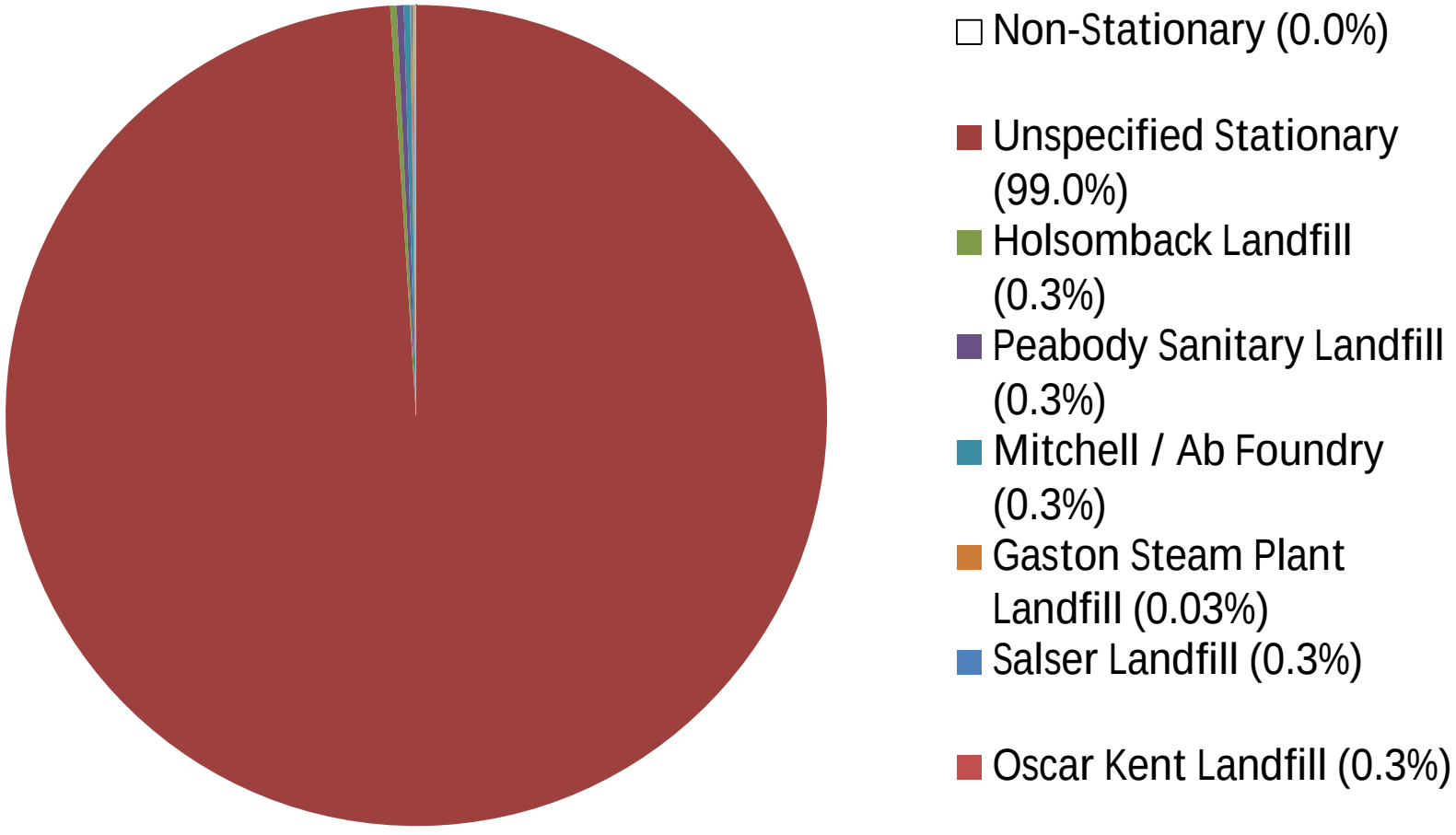
p-Dichlorobenzene Emissions in Jefferson County



Map and list of sources: http://batchgeo.com/map/7313db8eb409cca4afb64e972011f6cd

Figure 25

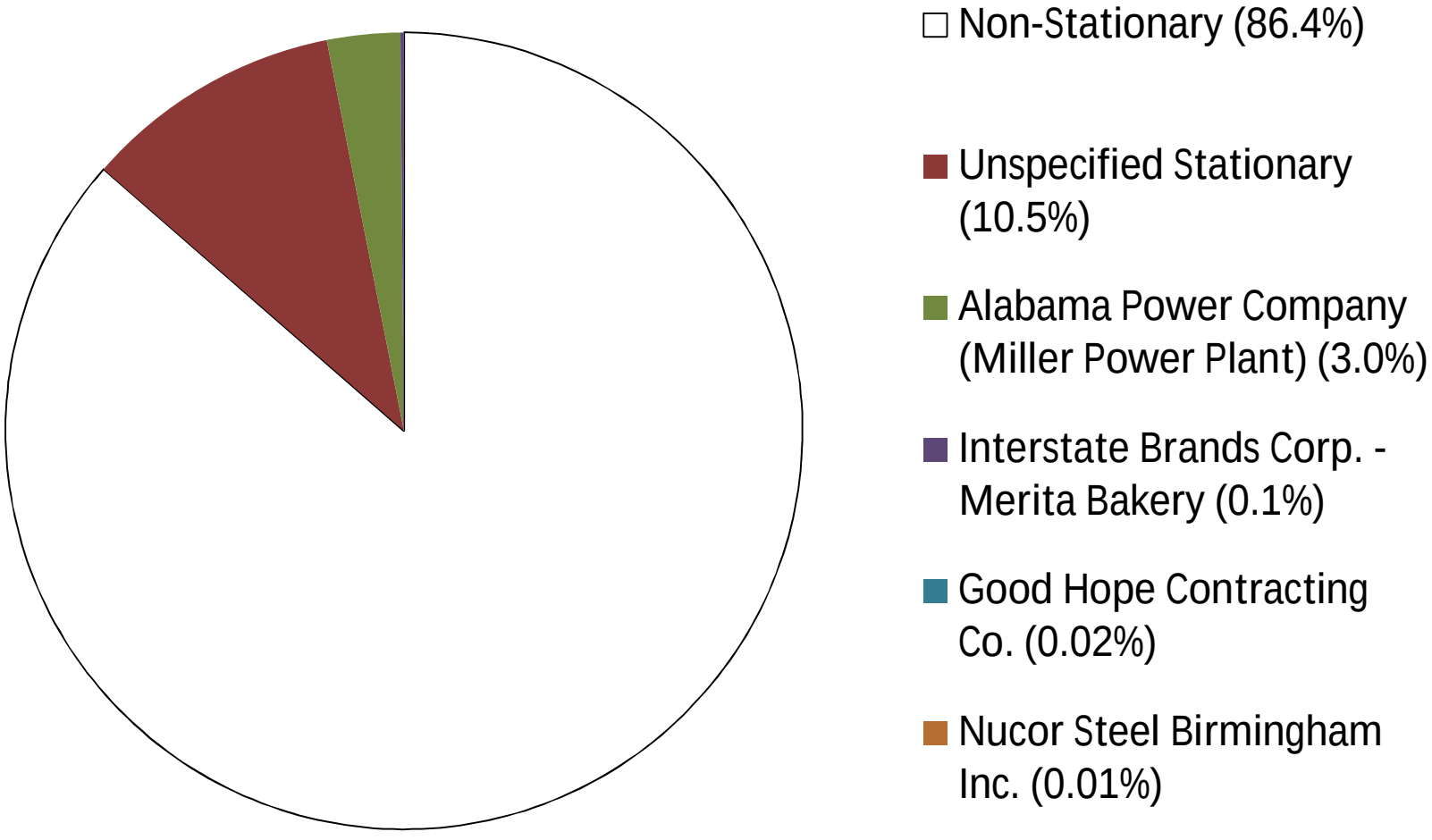
Carbon Tetrachloride Emissions in Jefferson County



Map and list of sources: http://batchgeo.com/map/9b05c6444707ddcb5a8232b116f6bb28

Figure 26

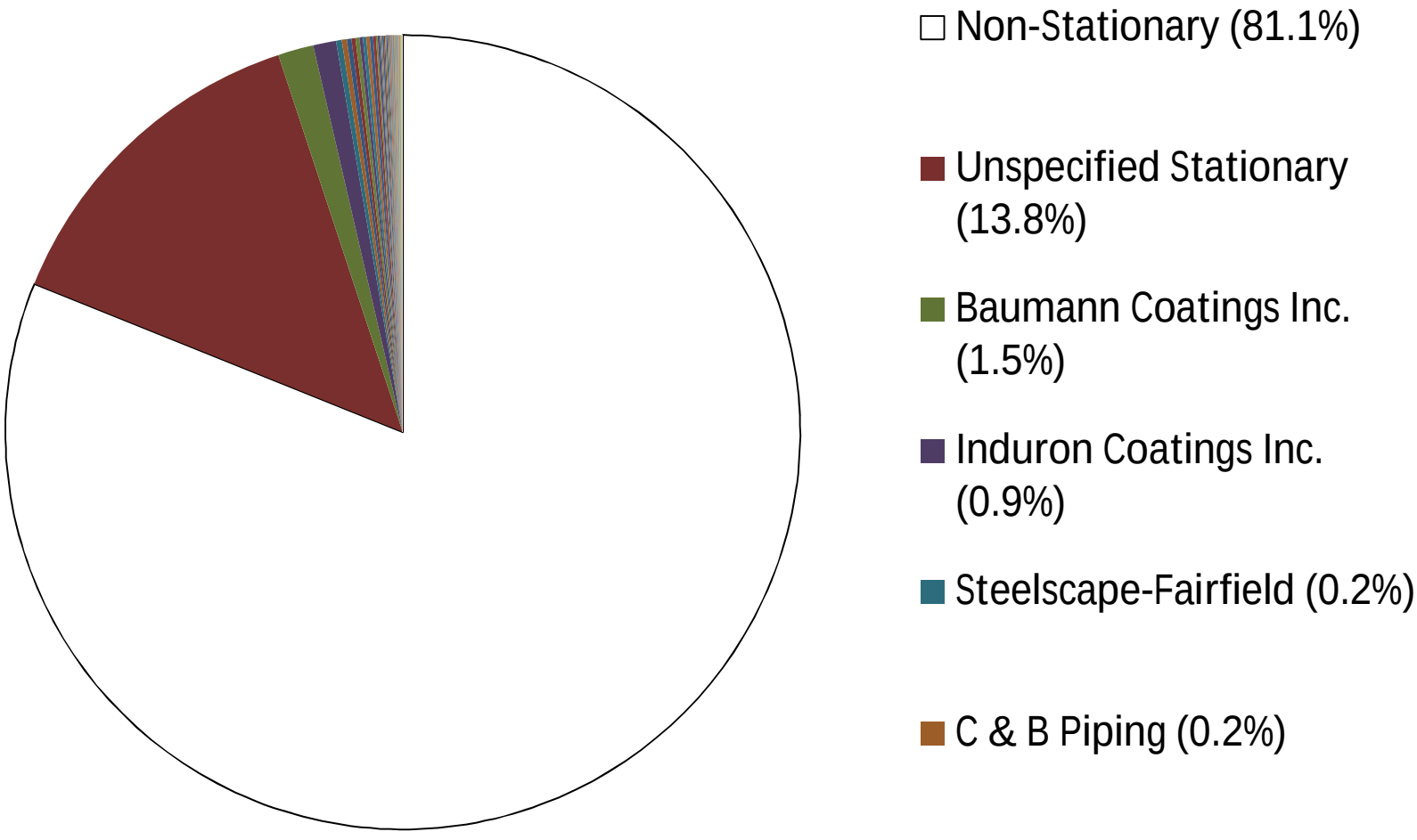
Acetaldehyde Emissions in Jefferson County



Map and list of sources: http://batchgeo.com/map/46f22359a2fbf743080f1762dba49f5c

Figure 27

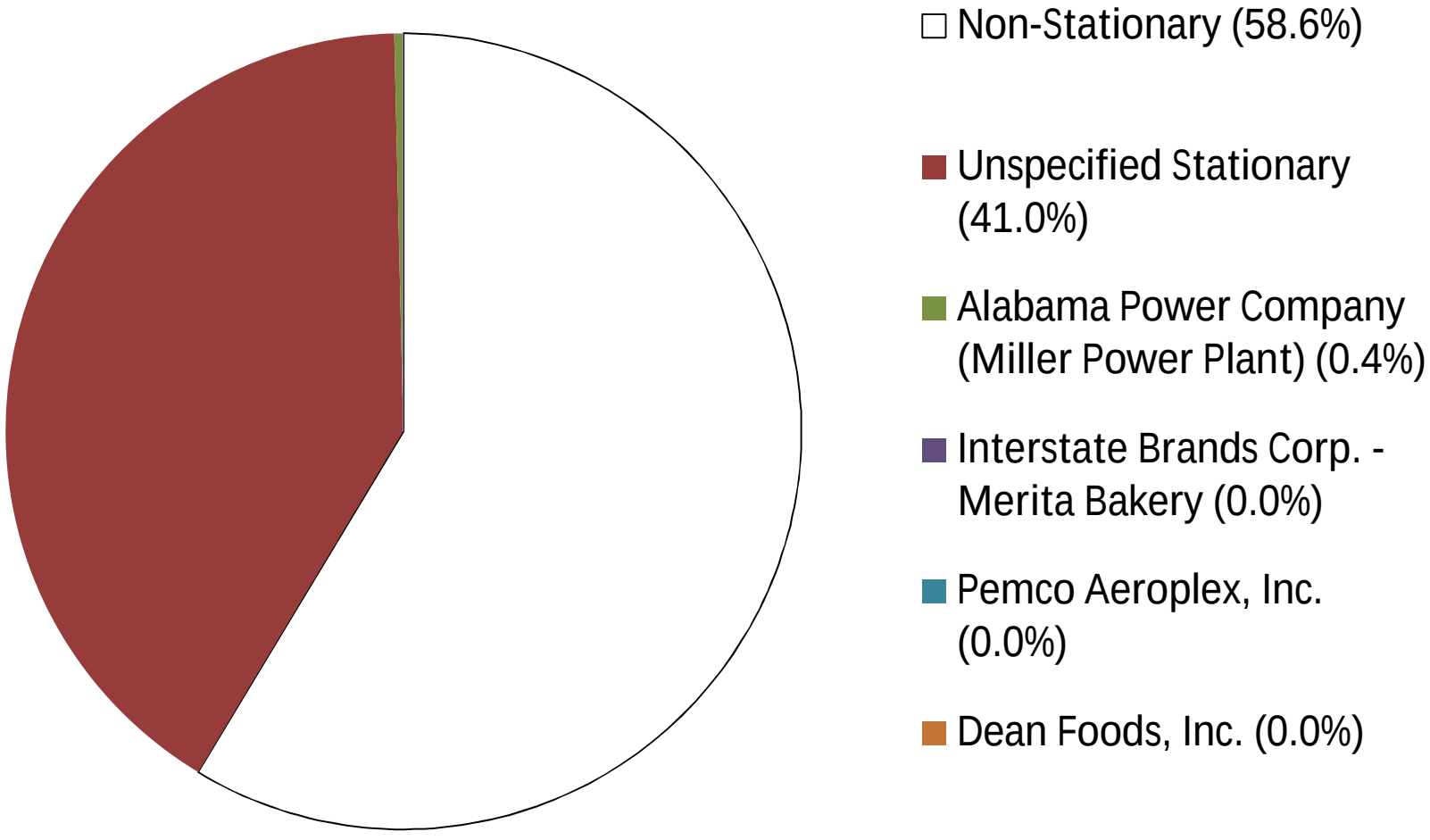
Ethylbenzene Emissions in Jefferson County



Map and list of sources: http://batchgeo.com/map/9041c0d81ae23be097b3e572ef2888b3

Figure 28

Benzo(a)pyrene Emissions in Jefferson County



Map and list of sources: http://batchgeo.com/map/bc6602a25ef87f9fa0ba7541e63daf7a

Figure 28A

1,3-Hexachlorobutadiene Emissions in Jefferson County

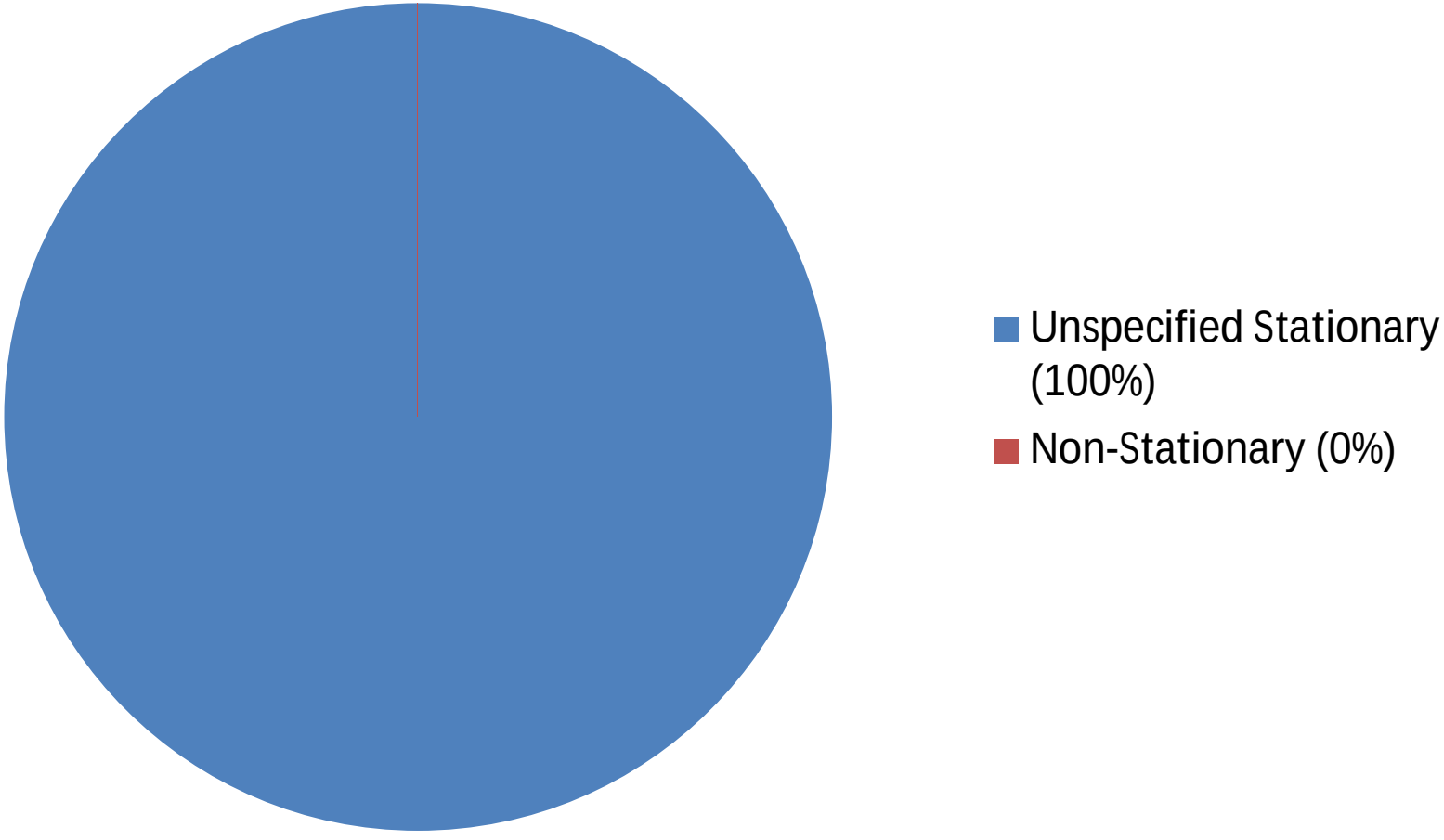


Table 10

Chemicals that Exceed HQ of 1.0

Chemical	Shuttlesworth	East Thomas	N. Birmingham	Providence
Acrolein	53.1	39.9	41.2	25.0
Manganese	3.8	1.2	1.3	

Figure 29

Chemicals that Exceed HQ of 1.0

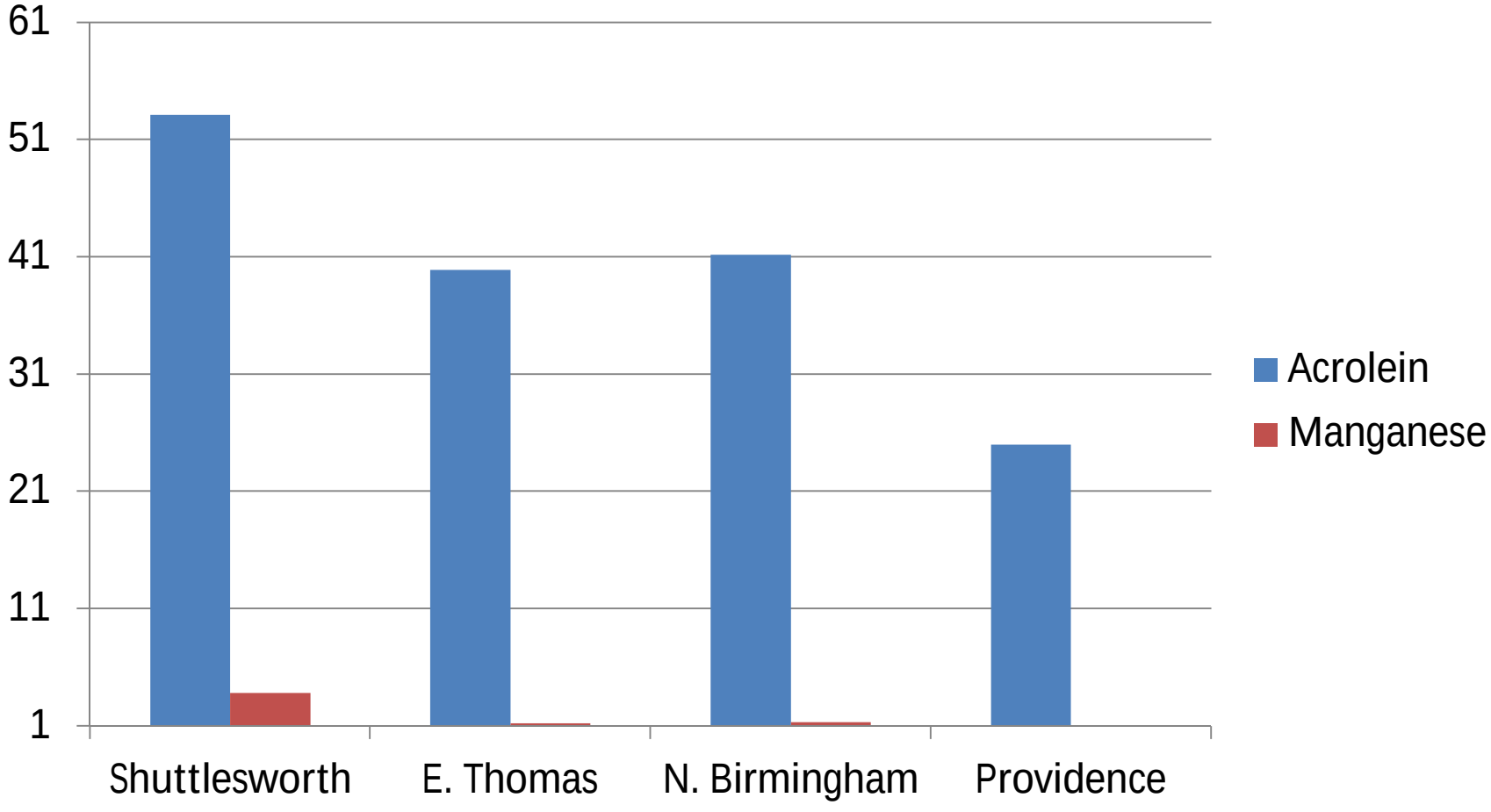
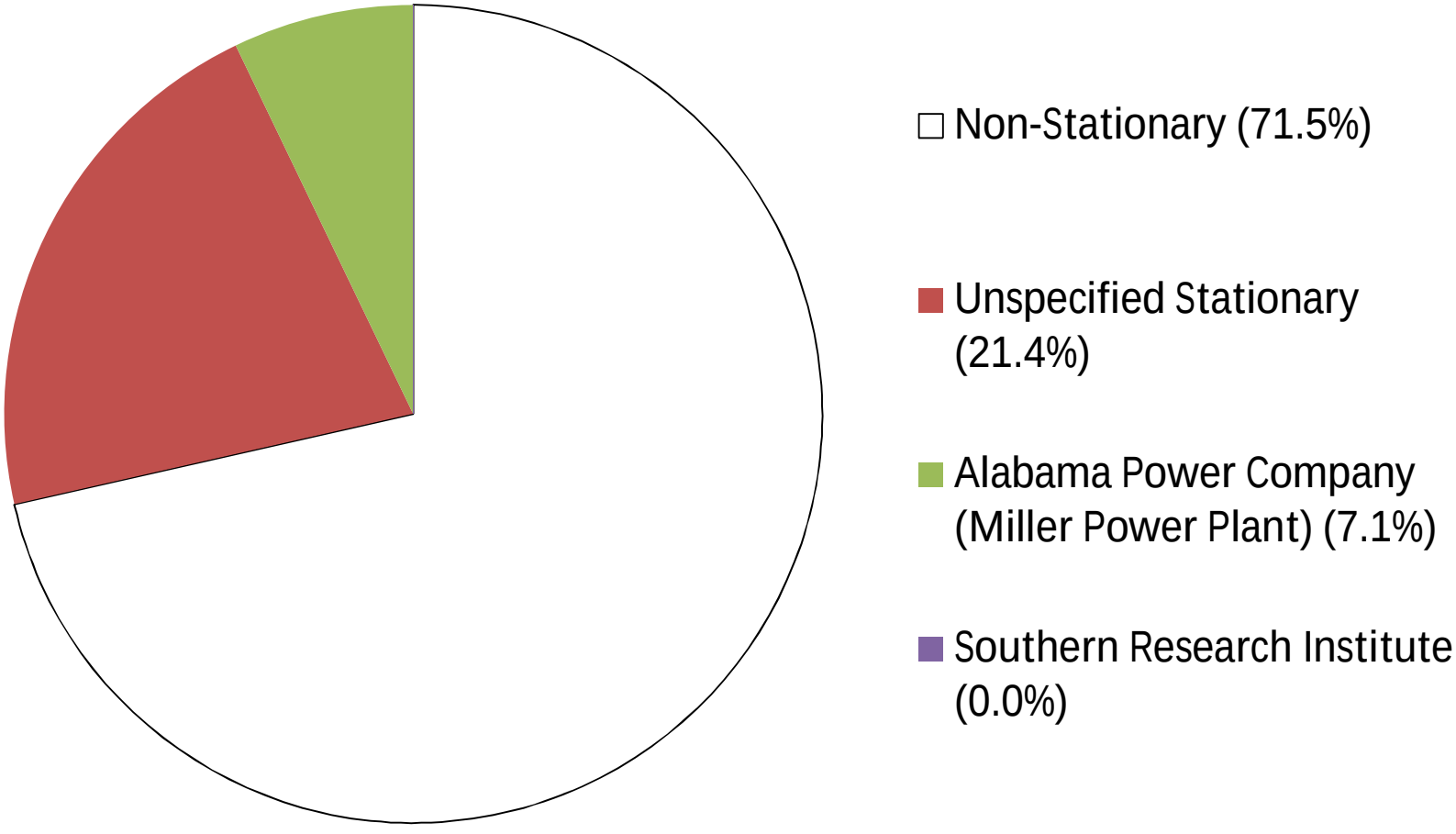


Figure 30

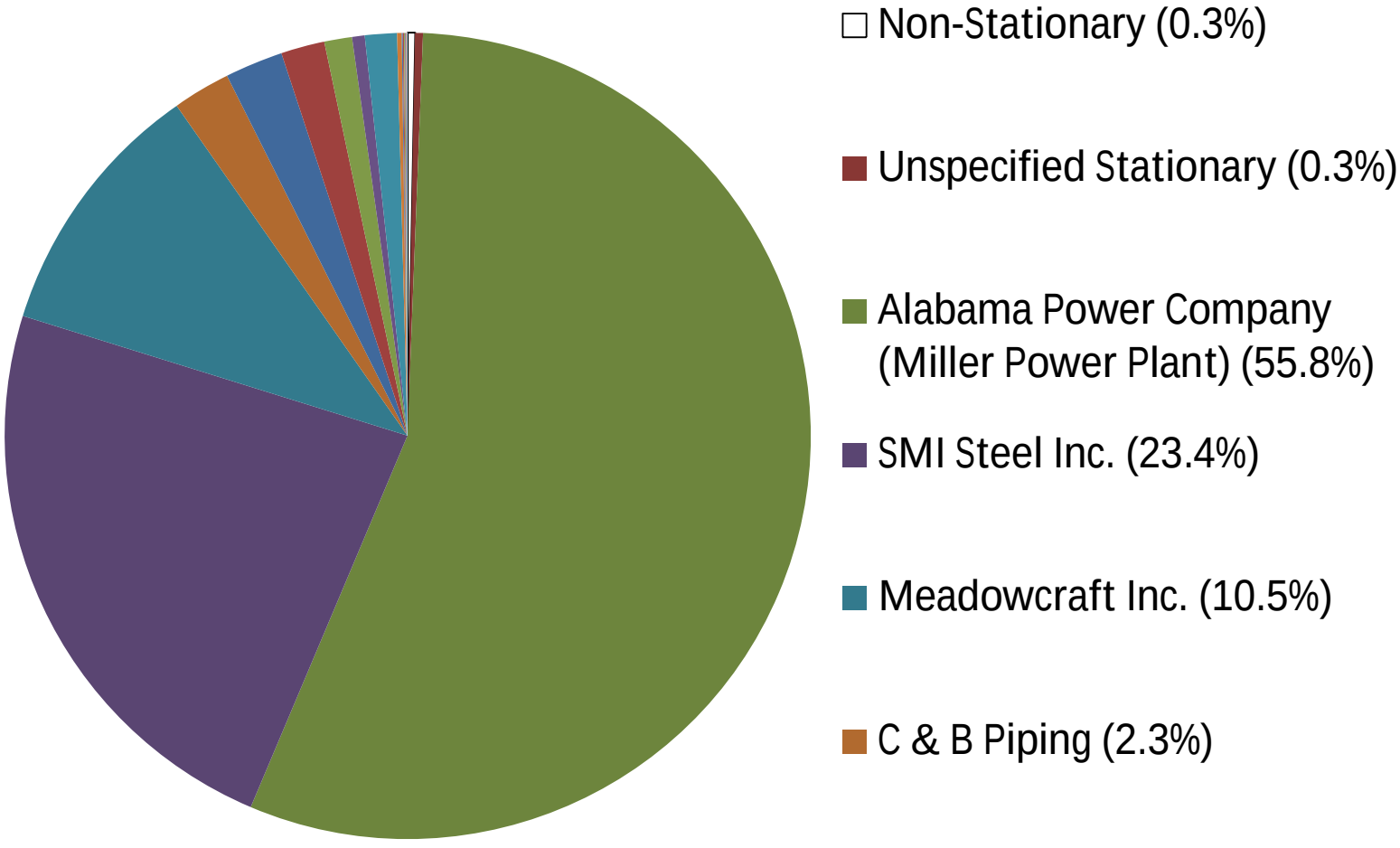
Acrolein Emissions in Jefferson County



Map and list of sources: http://batchgeo.com/map/03caa2cdfe6251216d21f9c061fc0e27

Figure 31

Manganese Emissions in Jefferson County



Map and list of sources: http://batchgeo.com/map/1aae5e58fd83dce4dc61ddf0b281bf0a

Figure 32

Excess Acrolein Hazard By Source Category

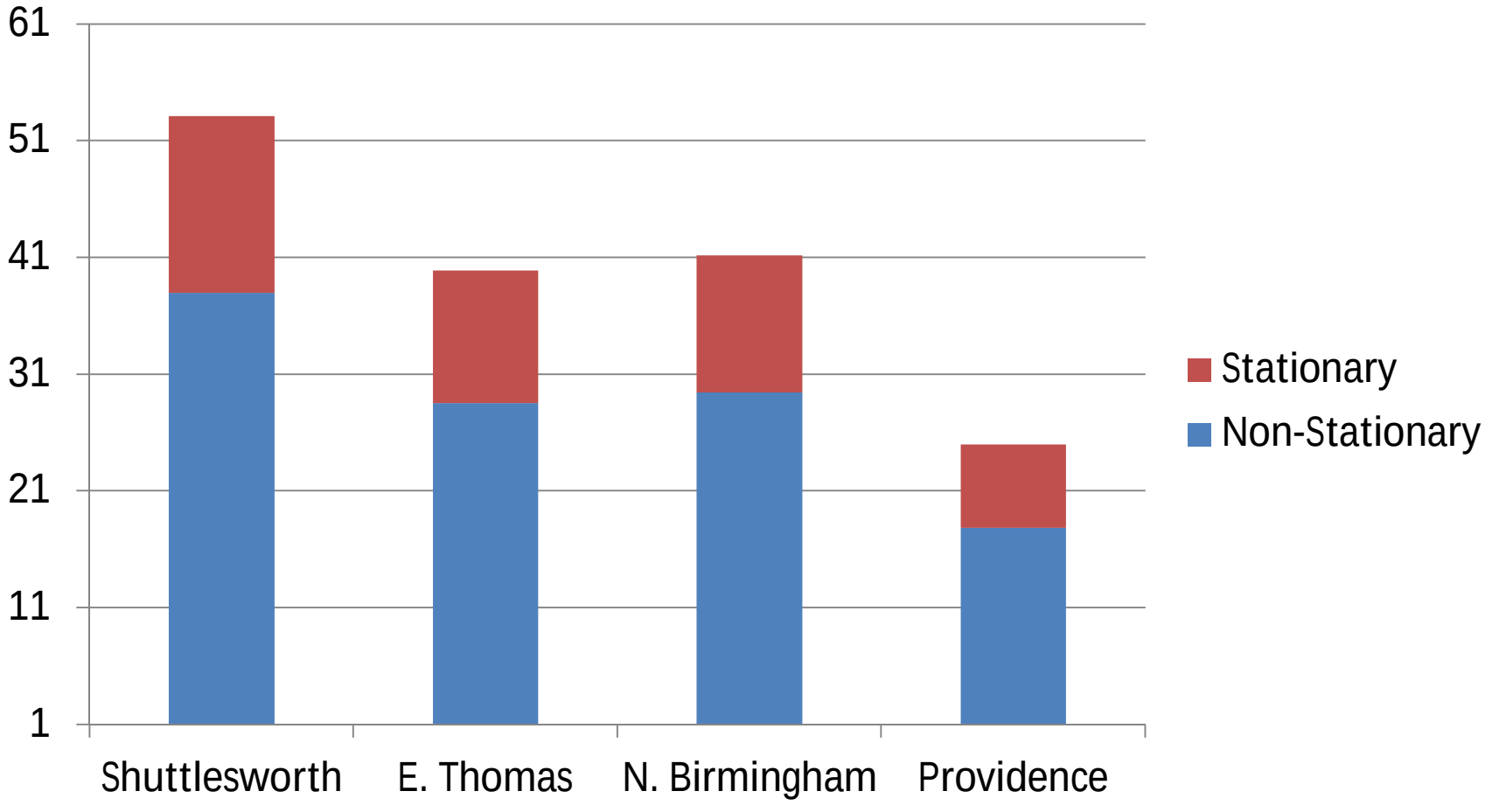


Figure 33

Excess Manganese Hazard by Source Category

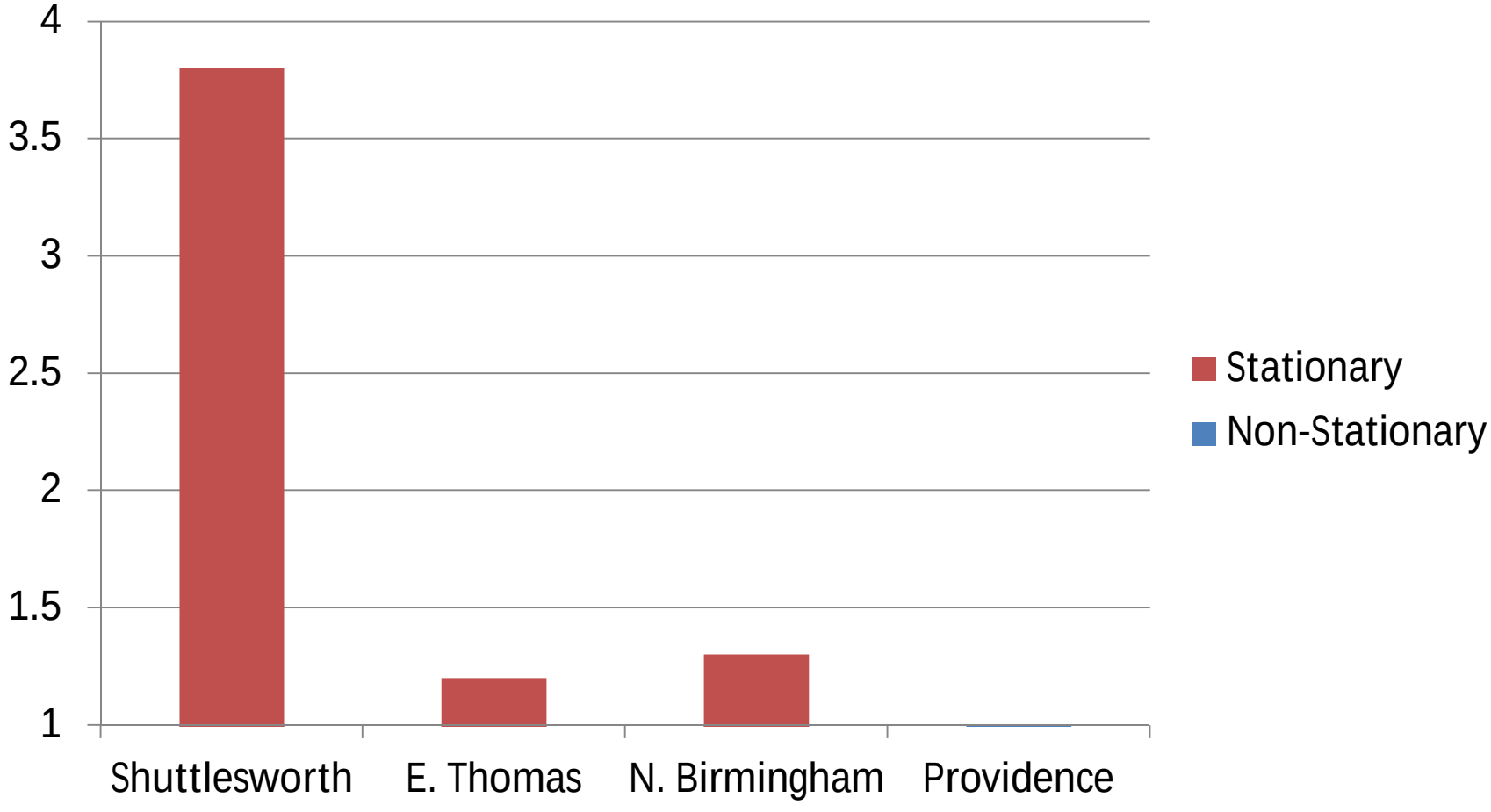


Figure 34

Excess Benzene Cancer Risk By Source Category

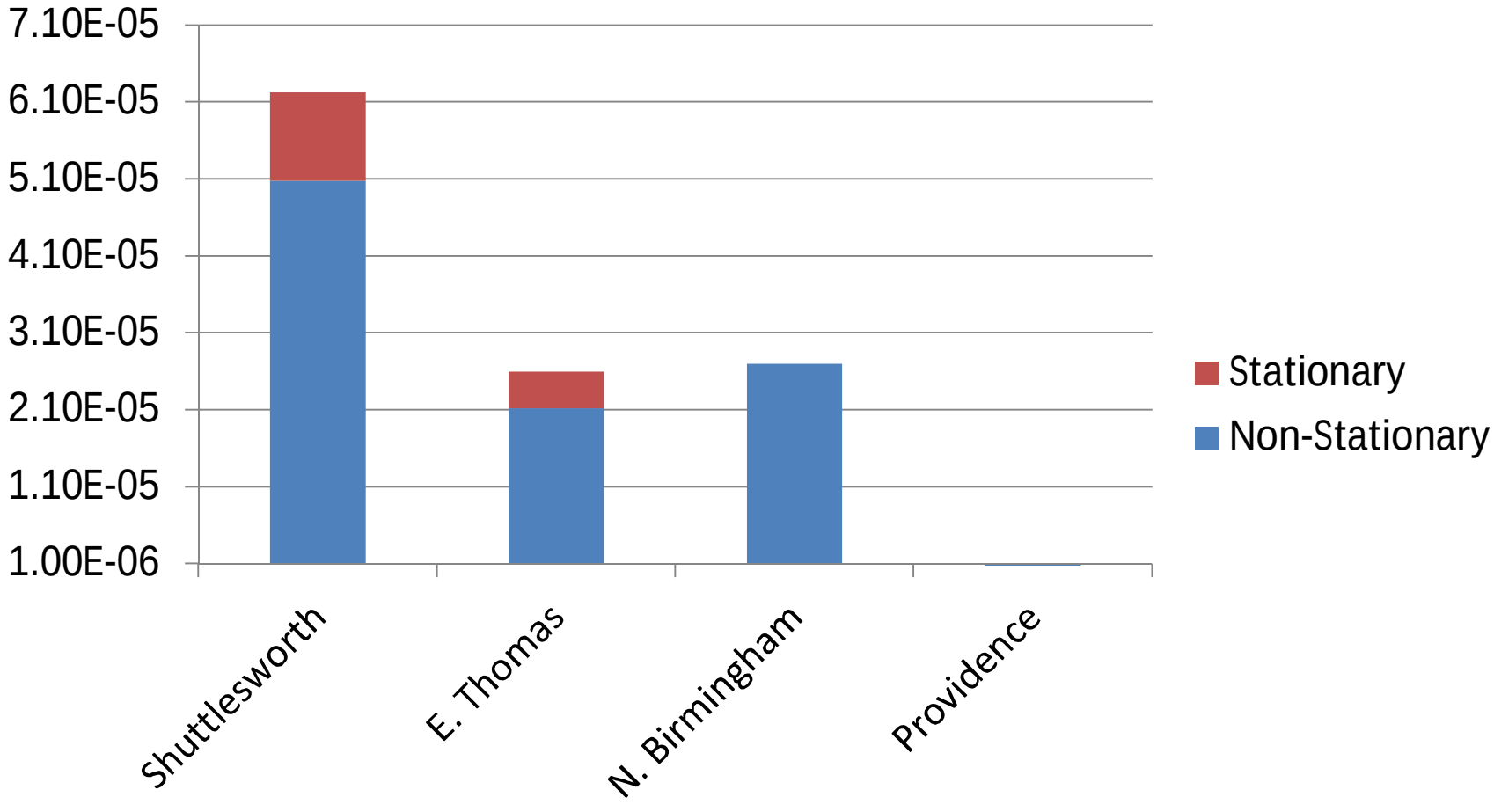


Figure 35

Excess Formaldehyde Cancer Risk By Source Category

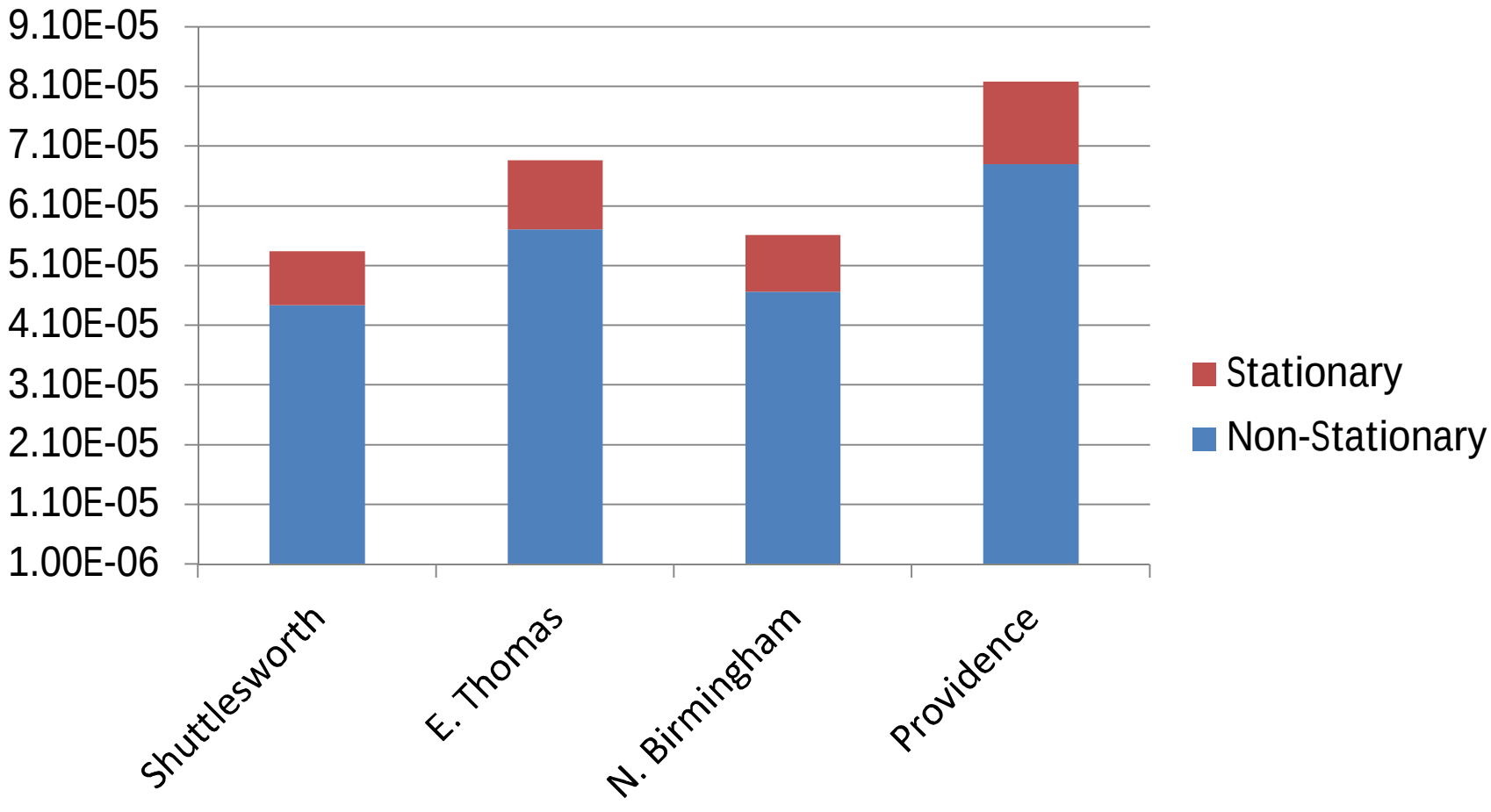


Figure 36

Excess Arsenic Cancer Risk By Source Category

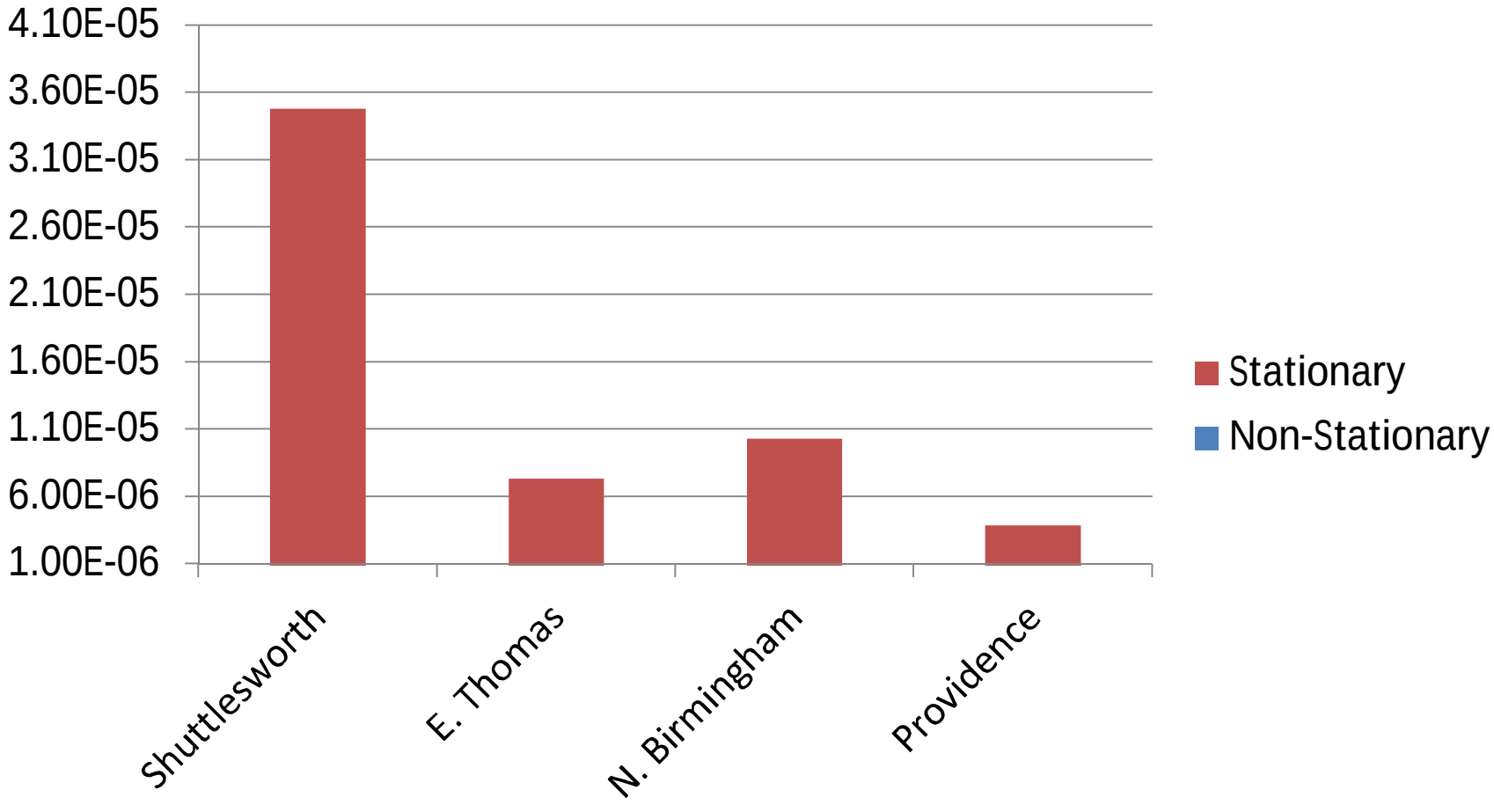


Figure 37

Excess Naphthalene Cancer Risk By Source Category

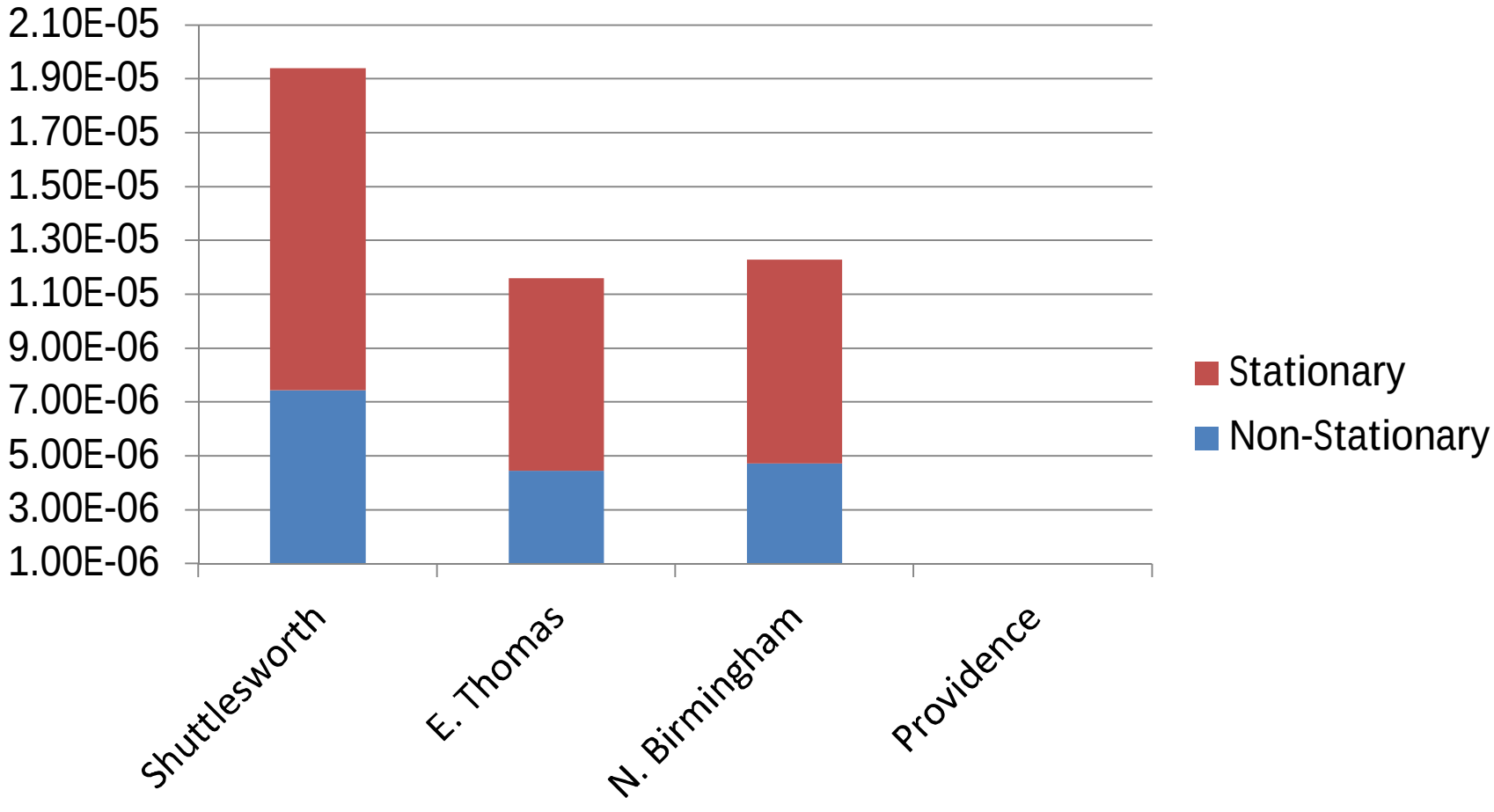


Figure 38

Excess 1,3-Butadiene Cancer Risk By Source Category

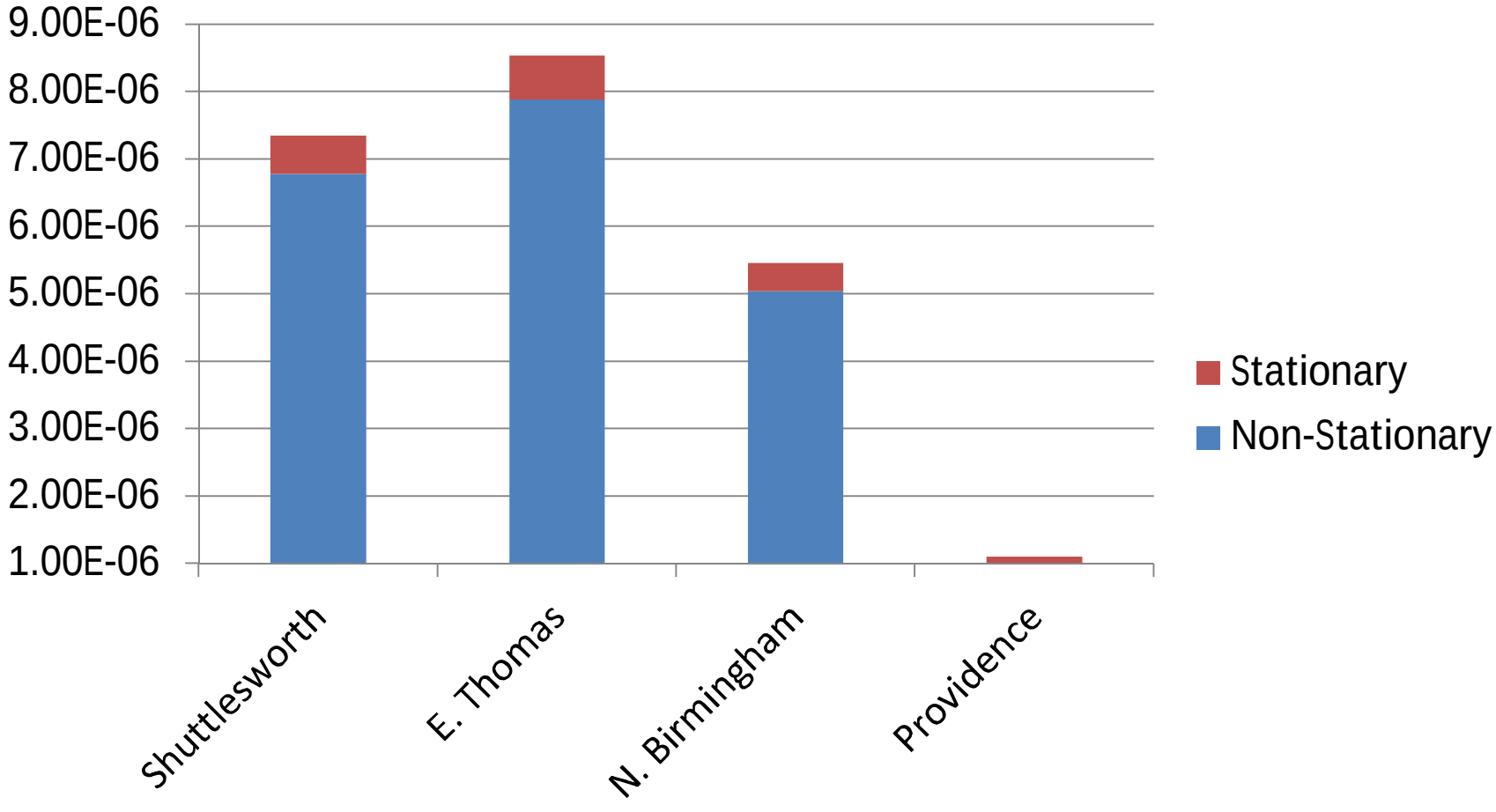


Figure 39

Excess p-Dichlorobenzene Cancer Risk By Source Category

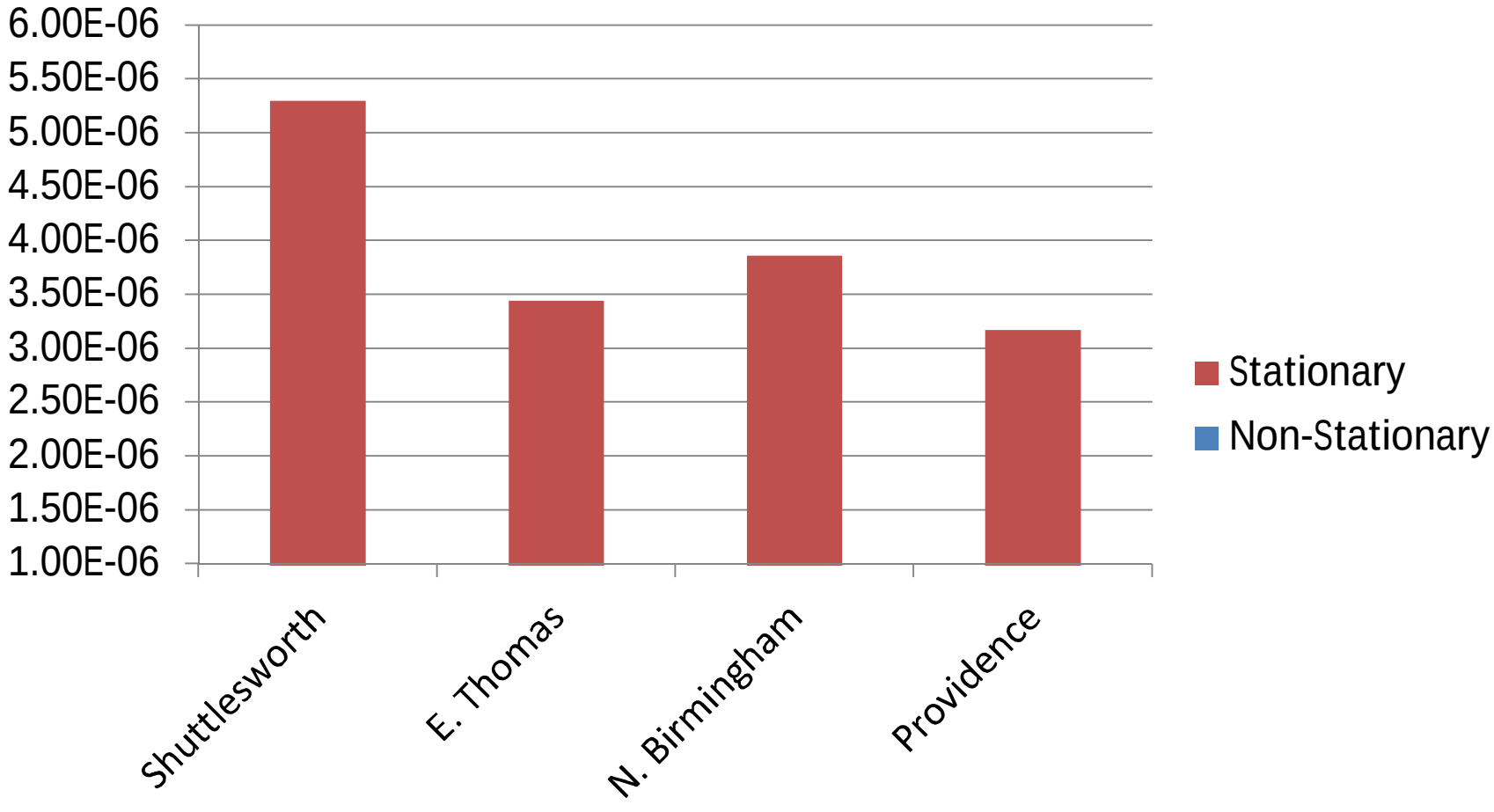


Figure 40

Excess Carbon Tetrachloride Cancer Risk By Source Category

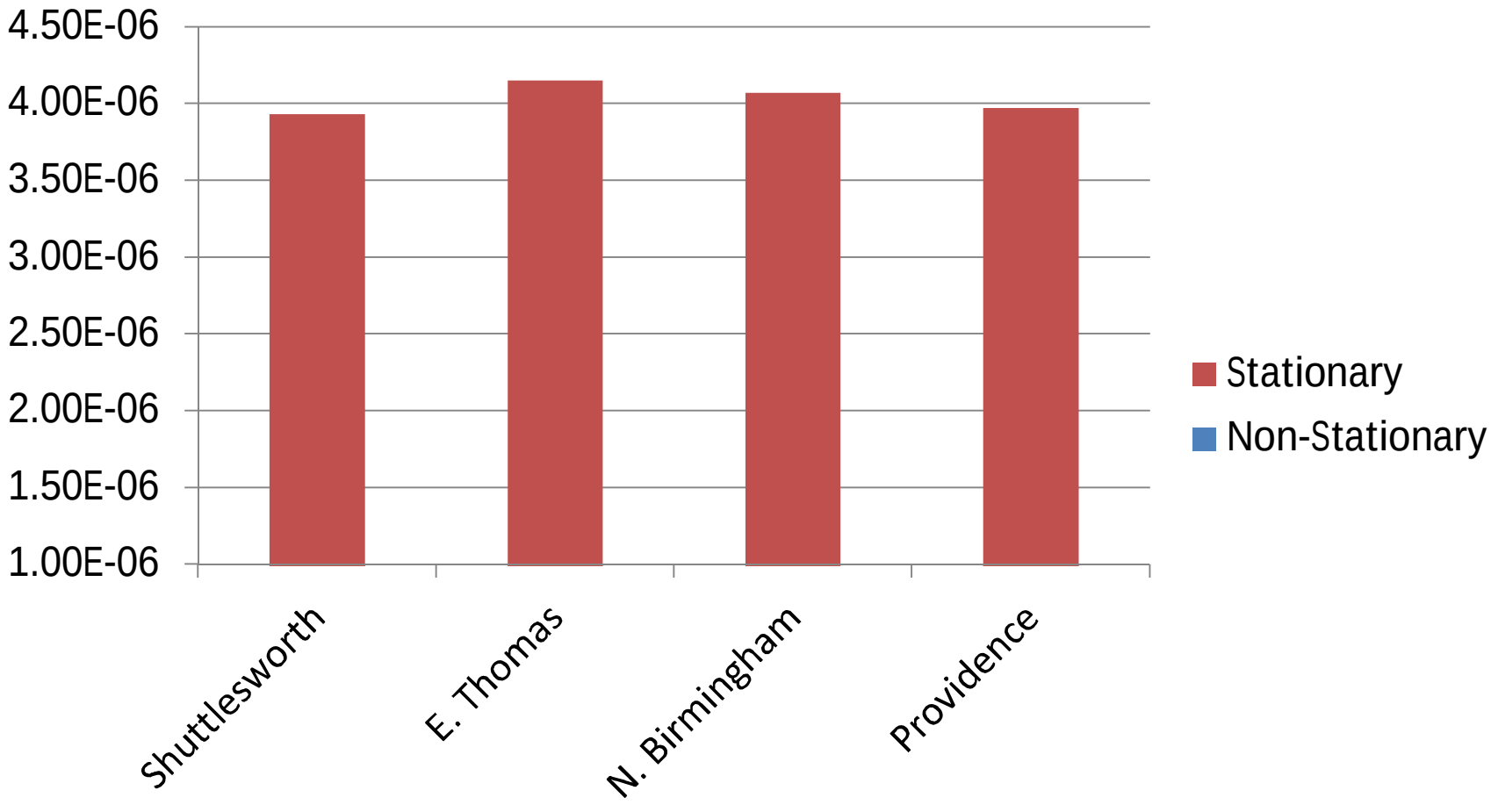


Figure 41

Excess Ethylbenzene Cancer Risk By Source Category

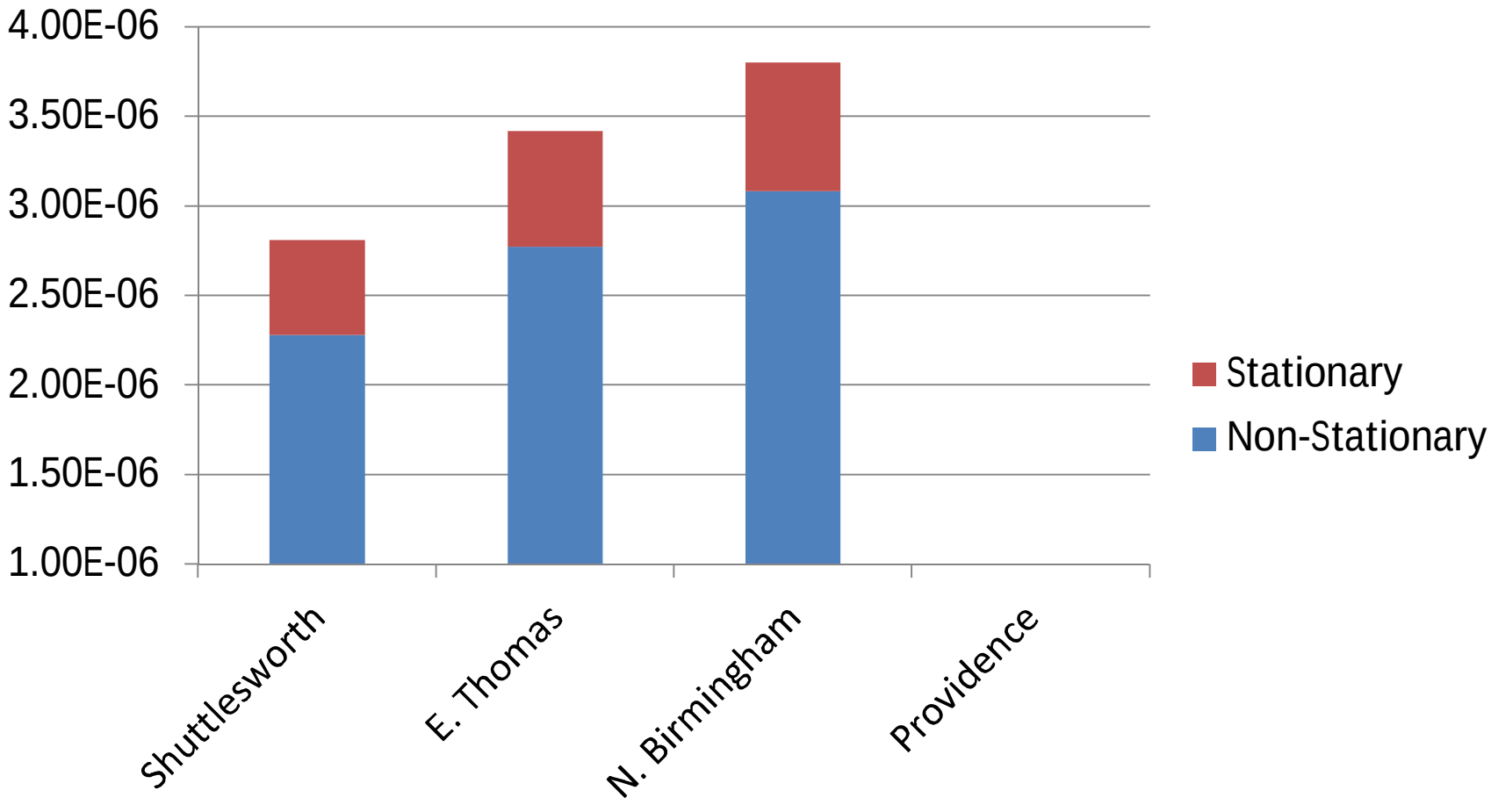


Figure 42

Excess Acetaldehyde Cancer Risk By Source Category

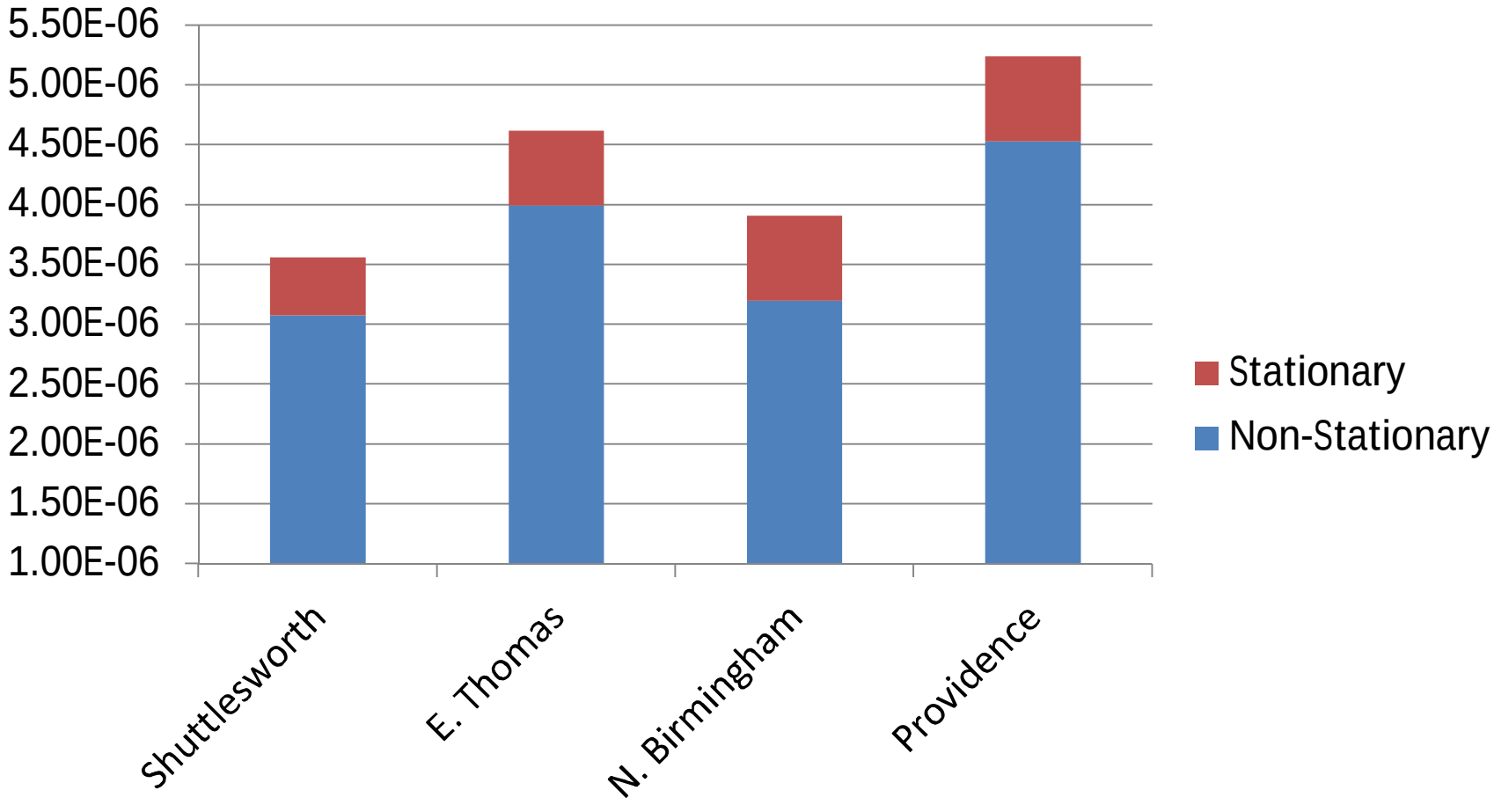


Figure 43

Excess Benzo(a)pyrene Cancer Risk By Source Category

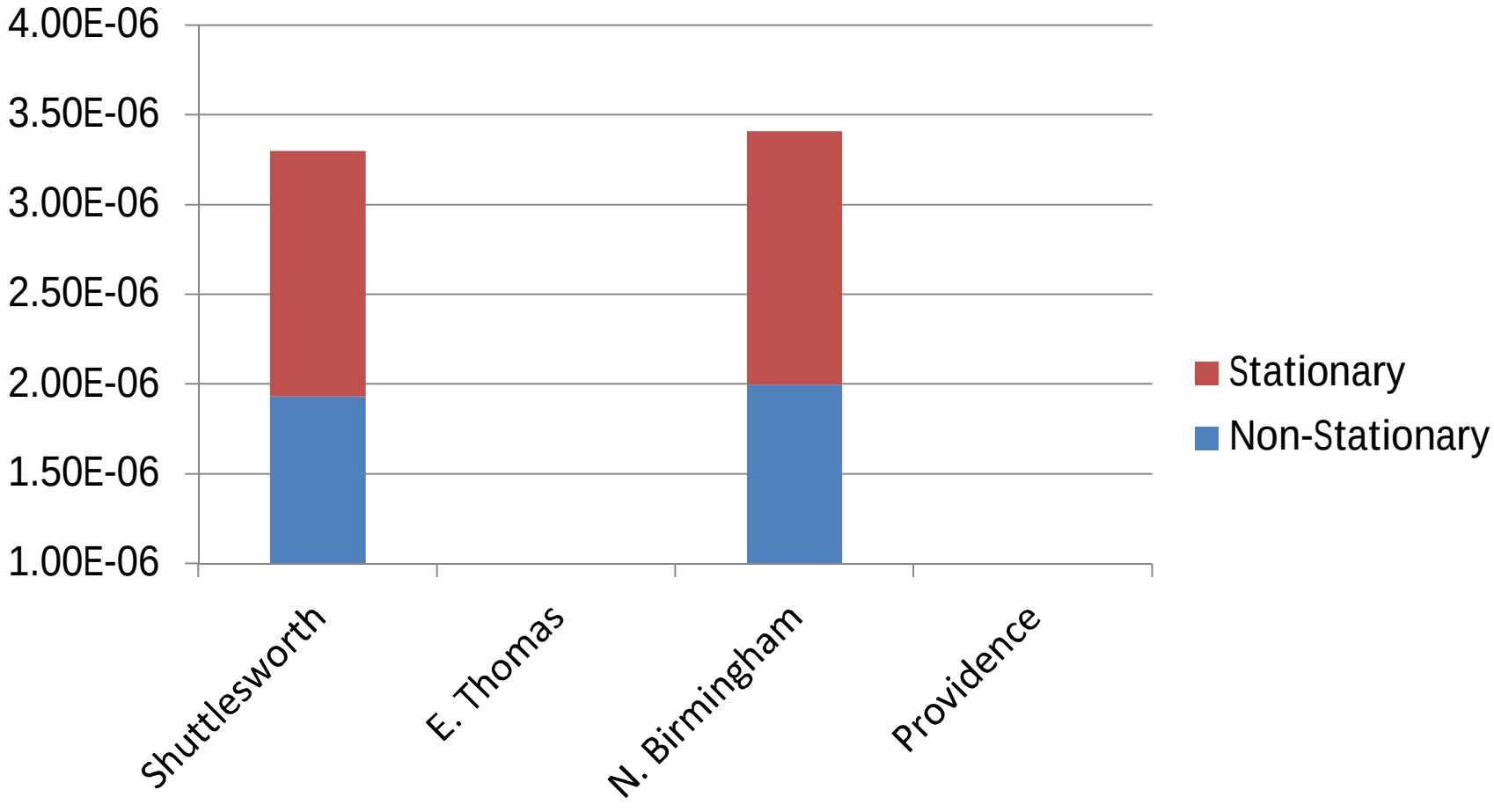


Figure 44

Excess 1,3-Hexachlorobutadiene Cancer Risk By Source Category

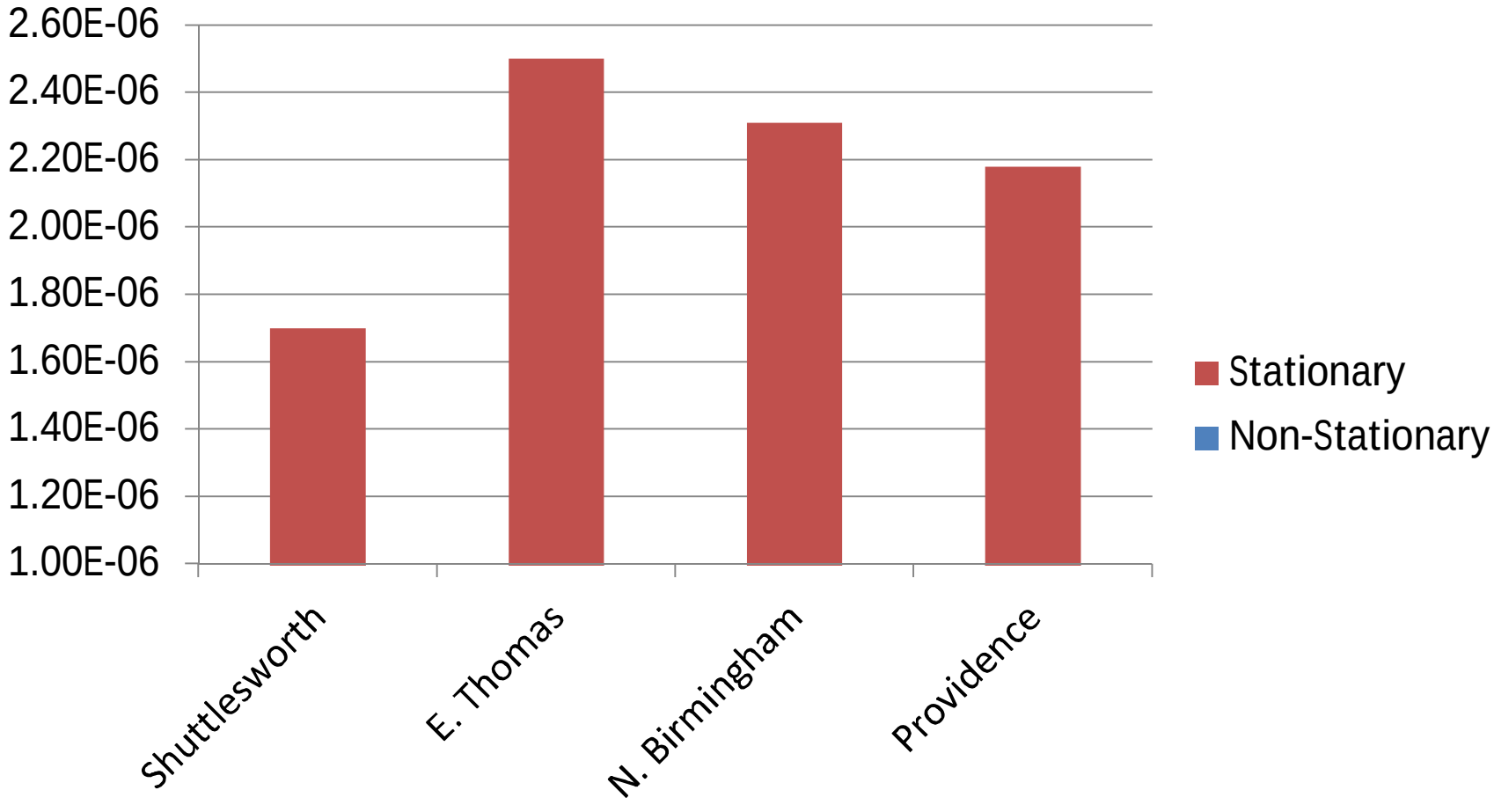


Figure 45

EXCESS CANCER RISK AT SHUTTLESWORTH MONITOR

Aggregate Cancer Risk =2.07E-04

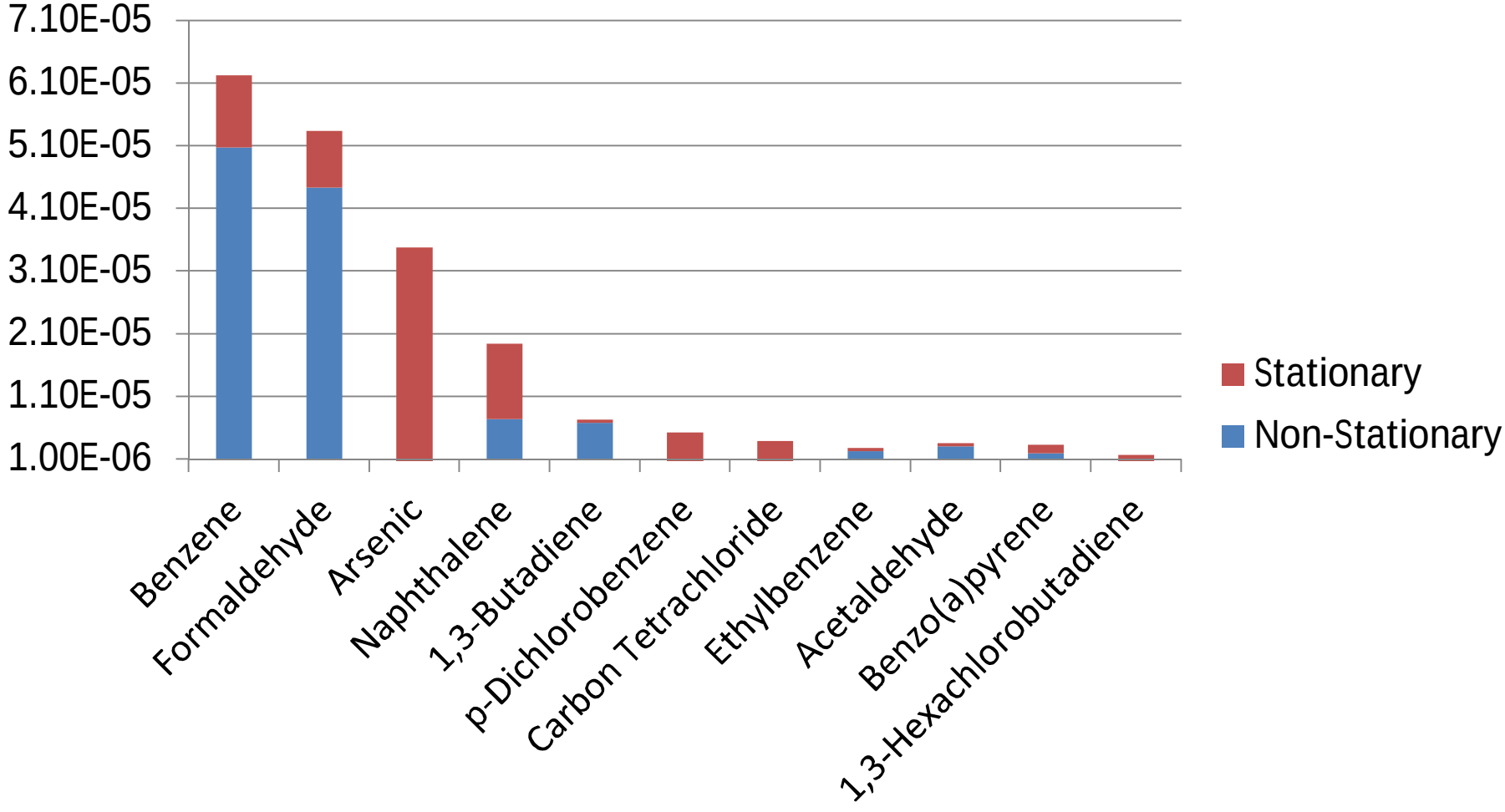


Figure 46

EXCESS CANCER RISK AT EAST THOMAS MONITOR

Aggregate Cancer Risk =1.46E-04

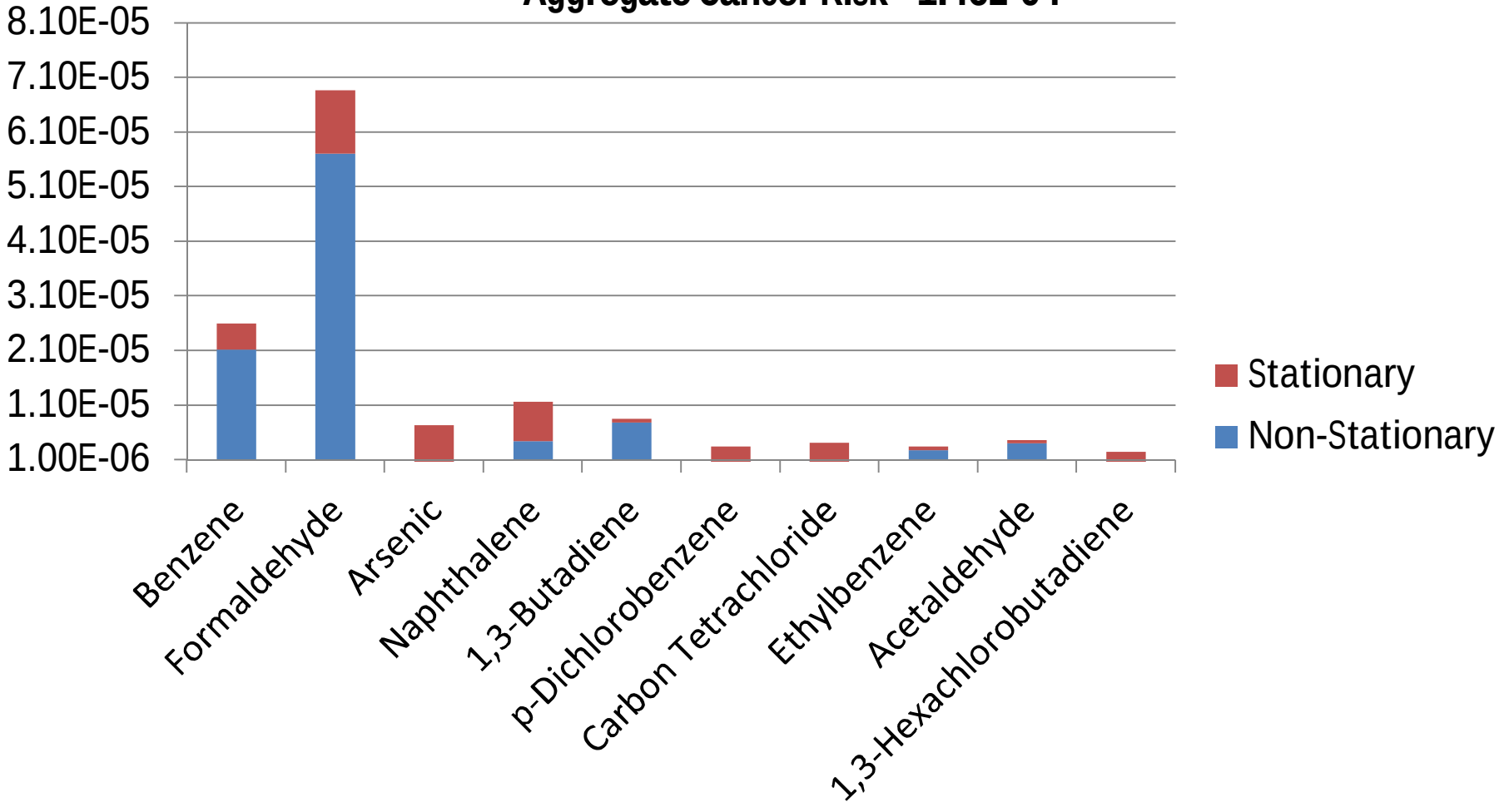


Figure 47

EXCESS CANCER RISK AT NORTH BIRMINGHAM MONITOR

Aggregate Cancer Risk =1.46E-04

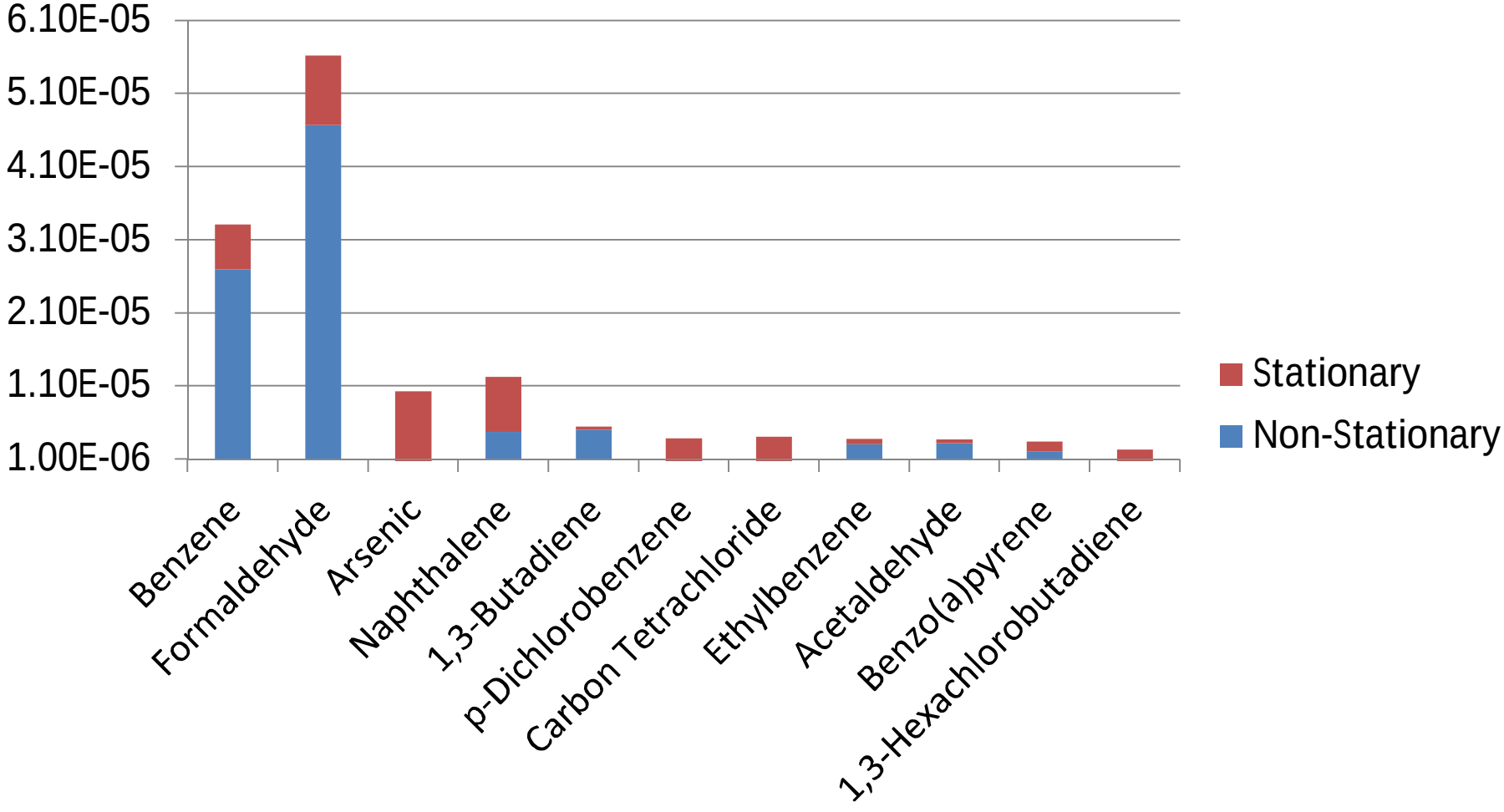
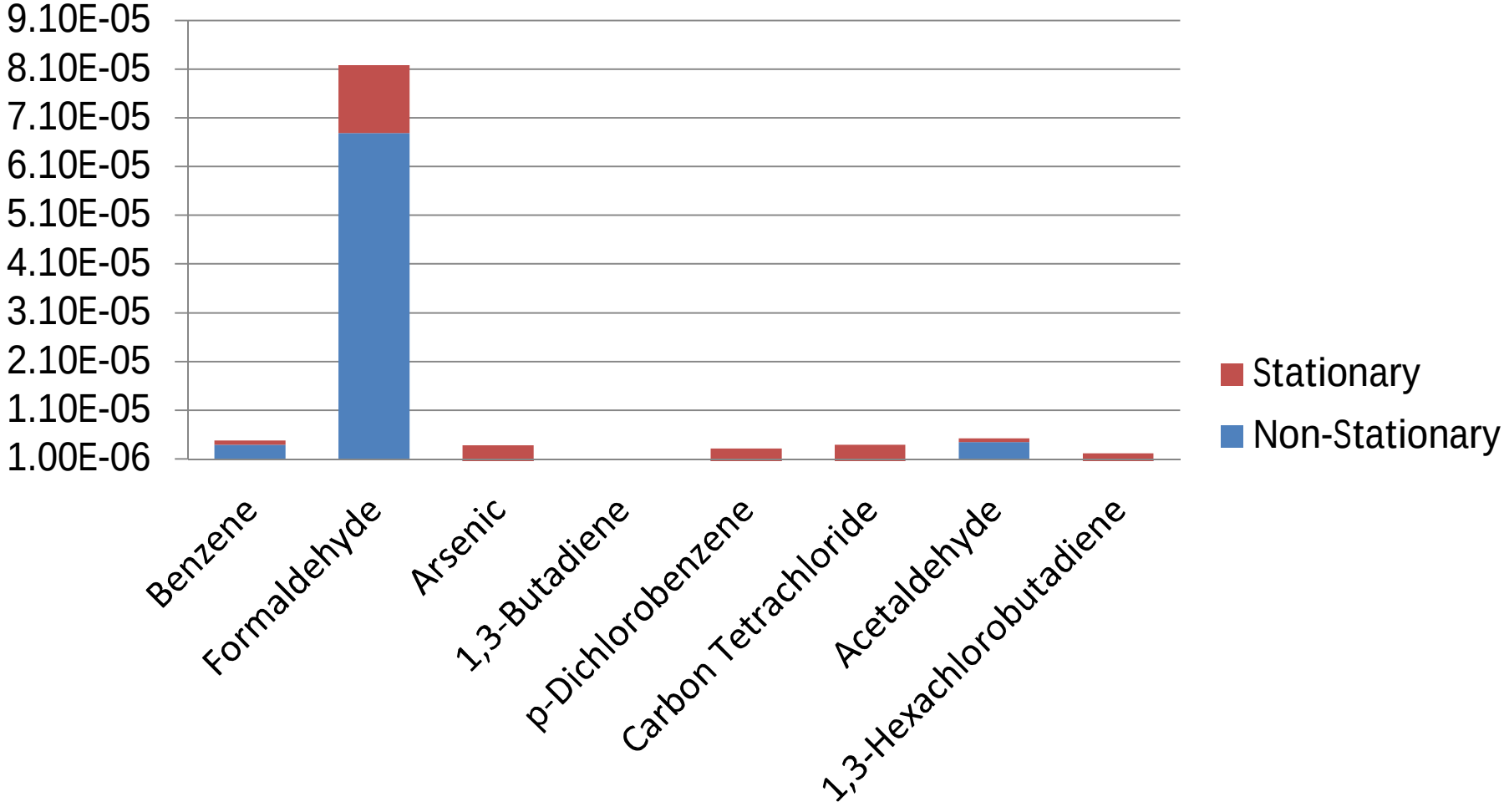


Figure 48

EXCESS CANCER RISK AT PROVIDENCE MONITOR

Aggregate Cancer Risk =1.09E-04



Recommended Ambient Air Toxic Thresholds to Trigger Air Toxic Emission Reductions

- *Cancer Risk Level* of an individual air toxic (95% UCL) exceeds 1.0E-06 (1 in one million).

$$EC \times IUR > 1.0E\text{-}06$$

- *Aggregate Cancer Risk Level* of all air toxics (95% UCL) exceeds 1.0E-04 (1 in ten thousand).

$$\sum(EC_1 \times IUR_1) + (EC_2 \times IUR_2) + \ldots (EC_n \times IUR_n) > 1.0E\text{-}04$$

- *Hazard Quotient* of an individual air toxic (95% UCL) exceeds 1.0.

$$\frac{EC}{RfC} > 1.0$$

- *Hazard Index* of all air toxics (95% UCL) that may affect the same target organ or system exceeds 1.0.

$$\sum\left(\frac{EC_1}{RfC_1}\right) + \left(\frac{EC_2}{RfC_2}\right) + \cdots \left(\frac{EC_n}{RfC_n}\right) > 1.0$$

APPENDICES

Appendix A. Cancer Risk 4113 Shuttlesworth Drive - Birmingham (33.56516 -86.79637)							
Chemical	**CAS**	**95% UCL Ambient Air Concentration (µg/m3)**	**Inhalation Unit Air Risk (per µg/m3)**	**Inhalation Concentration (µg/m3) @ 1.0E-06 Risk**	**Cancer Risk**	**EPA Classification**	**Basis for Inhalation Unit Risk**
1,3-Butadiene	106-99-0	0.2451	3.00E-05	0.0300	7.35E-06	Carcinogenic to humans	IRIS: Leukemia (humans)
Acetaldehyde	75-07-0	1.6162	2.20E-06	0.5000	3.56E-06	Probable human carcinogen	IRIS: Nasal squamous cell carcinoma or adenocarcinoma (rats)
Arsenic	7440-38-2	0.0081	4.30E-03	0.0002	3.48E-05	Human Carcinogen	IRIS: Lung cancer (humans)
Benzene	71-43-2	7.9900	7.80E-06	0.4500	6.23E-05	Human Carcinogen	IRIS: Leukemia (humans)
Benzo(a)anthracene	56-55-3	0.0046	1.10E-04	0.0091	5.06E-07	Probable human carcinogen	OAQPS (CAL): Lung adenomas (mice)
Benzo(a)pyrene	50-32-8	0.0030	1.10E-03	0.0009	3.30E-06	Probable human carcinogen	OAQPS (CAL): Tumors in respiratory tract (hamsters)
Benzo(b)fluoranthene	205-99-2	0.0046	1.10E-04	0.0091	5.06E-07	Probable human carcinogen	OAQPS (CAL): Lung tumors (rats)
Benzo(k)fluoranthene	207-08-9	0.0036	1.10E-04	0.0091	3.96E-07	Probable human carcinogen	OAQPS (CAL): Lung tumors (rats)
Beryllium	7440-41-7	0.0004	2.40E-03	0.0004	9.60E-07	Probable human carcinogen	IRIS: Lung cancer (humans)
Cadmium	7440-43-9	0.0004	1.80E-03	0.0006	7.20E-07	Probable human carcinogen	IRIS: Lung, trachea, bronchus cancer deaths (humans)
Carbon Tetrachloride	56-23-5	0.6544	6.00E-06	0.1700	3.93E-06	Likely to be carcinogenic to humans	IRIS: Pheochromocytoma (mice)
Chloroform	67-66-3	0.1221	2.30E-05	0.0400	2.81E-06	Likely to be carcinogenic to humans	IRIS: Hepatocellular carcinoma (mice)
Chrysene	218-01-9	0.0061	1.10E-05	0.0909	6.71E-08	Probable human carcinogen	OAQPS (CAL): Skin tumors (mice)
Dibenz(a,h)anthracene	53-70-3	0.0006	1.20E-03	0.0008	7.20E-07	Probable human carcinogen	OAQPS (CAL): alveolar carcinomas of the lung (mice)
p-Dichlorobenzene	106-46-7	0.4814	1.10E-05	0.0909	5.30E-06	Not classified	OAQPS (CAL): hepatocellular carcinomas or adenomas, kidney adenomas and mononuclear cell leukemia (rats)
Dichloromethane	75-09-2	0.3475	1.00E-08	100.0000	3.48E-09	Likely to be carcinogenic to humans	IRIS: Hepatocellular carcinomas or adenomas, bronchoalveolar carcinomas or adenomas (mice)
Ethylbenzene	100-41-4	1.1233	2.50E-06	0.4000	2.81E-06	Not classifiable	OAQPS (CAL): Renal tumors (rats)
Formaldehyde	50-00-0	4.1074	1.30E-05	0.0800	5.34E-05	Probable human carcinogen	IRIS: Squamous cell carcinoma (rats)
1,3-Hexachlorobutadiene	87-68-3	0.0772	2.20E-05	0.0500	1.70E-06	Possible human carcinogen	IRIS: Renal tubular adenomas and adenocarcinomas (rats)
Hexavalent Chromium	18540-29-9	0.0001	1.20E-02	0.0001	1.20E-06	Human carcinogen	IRIS: Lung cancer (humans)
Indeno(1,2,3-cd)pyrene	193-39-5	0.0028	1.10E-04	0.0091	3.08E-07	Probable human carcinogen	OAQPS (CAL): Lung tumors (rats)
Methyl tert-Butyl Ether	1634-04-4	0.5450	2.60E-07	3.8462	1.42E-07	Not classified	OAQPS (CAL): Kidney adenomas and carcinomas, interstitial cell tumors, leukemia, lymphomas (rats)
Naphthalene	91-20-3	0.5707	3.40E-05	0.0294	1.94E-05	Possible human carcinogen	OAQPS (CAL): nasal respiratory epithelial adenomas and nasal olfactory epithelial neuroblastomas (rats)
Tetrachloroethylene	127-18-4	0.3006	2.60E-07	4.0000	7.82E-08	Likely to be carcinogenic to humans	IRIS: Hepatocellular adenomas or carcinomas (mice)
Trichloroethylene	79-01-6	0.0835	4.10E-06	0.2439	3.42E-07	Carcinogenic to humans	IRIS: Renal cell carcinoma, non-Hodgkin's lymphoma, and liver tumors (humans)
				AGGREGATE CANCER RISK=	**2.07E-04**		

Appendix B. Non-Cancer Hazard 4113 Shuttlesworth Drive - Birmingham (33.56516 -86.79637)						
Chemical	**CAS**	**Reference Concentration (RfC) (mg/m3)**	**95% UCL Ambient Air Concentration (µg/m3)**	**Hazard Quotient (HQ)**	**Target Organ/System**	**Basis for RfC**
1,1,1-Trichloroethane	71-55-6	5.000000	0.1414	0.0000	Cardiovascular (Heart and Blood Vessels), Neurological (Nervous System)	IRIS: Liver histopathologic changes (rats, mice)
1,2,4-Trichlorobenzene	120-82-1	0.200000	0.0713	0.0004	Hepatic (Liver)	OAQPS (HEAST)
1,3-Butadiene	106-99-0	0.002000	0.2451	0.1226	Dermal (Skin), Neurological (Nervous System), Ocular (Eyes), Reproductive (Producing Children)	IRIS: Ovarian atrophy (mice)
Acetaldehyde	75-07-0	0.009000	1.6162	0.1796	Respiratory (From the Nose to the Lungs)	IRIS: Degeneration of olfactory epithelium (rats)
Acetonitrile	107-13-1	0.060000	58.2217	0.9704	Developmental (effects during periods when organs are developing), Hematological (Blood Forming), Neurological (Nervous System), Reproductive (Producing Children), Respiratory (From the Nose to the Lungs)	IRIS: Mortality (mice)
Acrolein	107-02-8	0.000020	1.0617	53.0850	Cardiovascular (Heart and Blood Vessels), Hematological (Blood Forming), Ocular (Eyes), Respiratory (From the Nose to the Lungs)	IRIS: Nasal lesions (rats)
Arsenic	7440-38-2	0.000015	0.0081	0.5400	Dermal (Skin), Gastrointestinal (Digestive), Hepatic (Liver), Neurological (Nervous System), Respiratory (From the Nose to the Lungs), Developmental (effects during periods when organs are developing)	OAQPS (CAL)
Benzene	71-43-2	0.030000	7.9900	0.2663	Hematological (Blood Forming), Immunological (Immune System), Neurological (Nervous System)	IRIS: Decreased lymphocyte count (humans)
Beryllium	7440-41-7	0.000020	0.0004	0.0200	Gastrointestinal (Digestive), Immunological (Immune System), Respiratory (From the Nose to the Lungs)	IRIS: Beryllium sensitization and progression to CBD (humans)
Bromomethane	74-83-9	0.005000	0.0543	0.0109	Cardiovascular (Heart and Blood Vessels), Dermal (Skin), Gastrointestinal (Digestive), Neurological (Nervous System), Respiratory (From the Nose to the Lungs)	IRIS: Degenerative and proliferative lesions of the olfactory epithelium of the nasal cavity (rats)
Cadmium	7440-43-9	0.000010	0.0004	0.0400	Cardiovascular (Heart and Blood Vessels), Developmental (effects during periods when organs are developing) , Gastrointestinal (Digestive), Neurological (Nervous System), Renal (Urinary System or Kidneys), Reproductive (Producing Children), Respiratory (From the Nose to the Lungs)	OAQPS (ATSDR)
Carbon Tetrachloride	56-23-5	0.100000	0.6544	0.0065	Cardiovascular (Heart and Blood Vessels), Hepatic (Liver), Neurological (Nervous System)	IRIS: Fatty changes in the liver (rats)
Chlorobenzene	108-90-7	1.000000	0.1022	0.0001	Hepatic (Liver), Neurological (Nervous System), Renal (Urinary System or Kidneys), Reproductive (Producing Children)	OAQPS (CAL)

Chloroethane	75-00-3	10.000000	0.3453	0.0000	Cardiovascular (Heart and Blood Vessels), Developmental (effects during periods when organs are developing)	IRIS: Delayed fetal ossification (mice)
Chloroform	67-66-3	0.098000	0.1221	0.0012	Cardiovascular (Heart and Blood Vessels), Developmental (effects during periods when organs are developing) , Hepatic (Liver), Neurological (Nervous System), Renal (Urinary System or Kidneys), Reproductive (Producing Children)	OAQPS (ATSDR)
Chloromethane	74-87-3	0.090000	1.3693	0.0152	Cardiovascular (Heart and Blood Vessels), Hepatic (Liver), Neurological (Nervous System)	IRIS: Cerebellar lesions (mice)
Cobalt	7440-48-4	0.000100	0.0008	0.0080	Cardiovascular (Heart and Blood Vessels), Developmental (effects during periods when organs are developing) , Hematological (Blood Forming), Respiratory (From the Nose to the Lungs)	OAQPS (ATSDR)
Dichloromethane	75-09-2	0.600000	0.3475	0.0006	Cardiovascular (Heart and Blood Vessels), Hepatic (Liver), Neurological (Nervous System)	IRIS: Hepatic effects (hepatic vacuolation) (rats)
Ethylbenzene	100-41-4	1.000000	1.1233	0.0011	Developmental (effects during periods when organs are developing) , Neurological (Nervous System)	IRIS: Developmental toxicity (rats, rabbits)
Formaldehyde	50-00-0	0.009800	4.1074	0.4191	Dermal (Skin), Gastrointestinal (Digestive), Immunological (Immune System), Respiratory (From the Nose to the Lungs)	OAQPS (ATSDR)
1,3-Hexachlorobutadiene	87-68-3	0.090000	0.0772	0.0009	Reproductive (Producing Children), Renal (Urinary System or Kidneys)	OAQPS (CAL)
Hexavalent Chromium	18540-29-9	0.000100	0.0001	0.0010	Immunological (Immune System), Renal (Urinary System or Kidneys), Respiratory (From the Nose to the Lungs)	IRIS: Lactate dehydrogenase in bronchioalveolar lavage fluid (rats)
Lead	7439-92-1	0.000150	0.0362	0.2413	Cardiovascular (Heart and Blood Vessels), Developmental (effects during periods when organs are developing) , Gastrointestinal (Digestive), Hematological (Blood Forming), Musculoskeletal (Muscles and Skeleton), Neurological (Nervous System), Ocular (Eyes), Renal (Urinary System or Kidneys), Reproductive (Producing Children)	OAQPS
Manganese	7439-96-5	0.000050	0.1894	3.7880	Cardiovascular (Heart and Blood Vessels), Hepatic (Liver), Neurological (Nervous System), Respiratory (From the Nose to the Lungs)	IRIS: NImpairment of neurobehavioral function (humans)
Mercury	7439-97-6	0.000300	0.0001	0.0003	Developmental (effects during periods when organs are developing) , Gastrointestinal (Digestive), Neurological (Nervous System), Ocular (Eyes), Renal (Urinary System or Kidneys)	IRIS: Hand tremor; increases in memory disturbances; slight subjective and objective evidence of autonomic dysfunction

Methyl Ethyl Ketone	78-93-3	5.000000	2.5928	0.0005	Developmental (effects during periods when organs are developing), Ocular (Eyes), Respiratory (From the Nose to the Lungs)	IRIS: Developmental toxicity (skeletal variations) (mice)
Methyl Isobutyl Ketone	108-10-1	3.000000	0.3750	0.0001	Developmental (effects during periods when organs are developing)	IRIS: Reduced fetal body weight, skeletal variations, and increased fetal death in mice, and skeletal variations (rats)
Methyl tert-Butyl Ether	1634-04-4	3.000000	0.5450	0.0002	Hepatic (Liver), Neurological (Nervous System), Renal (Urinary System or Kidneys)	IRIS: Increased absolute and relative liver and kidney weights and increased severity of spontaneous renal lesions (females), increased prostration (females), and swollen periocular tissue (males and females) (rats)
Naphthalene	91-20-3	0.003000	0.5707	0.1902	Hematological (Blood Forming), Hepatic (Liver), Neurological (Nervous System), Ocular (Eyes), Respiratory (From the Nose to the Lungs)	IRIS: Nasal effects: hyperplasia and metaplasia in respiratory and olfactory epithelium, respectively (mice)
Nickel	7440-02-0	0.000090	0.0023	0.0256	Cardiovascular (Heart and Blood Vessels), Dermal (Skin), Immunological (Immune System), Respiratory (From the Nose to the Lungs)	OAQPS (ATSDR)
p-Dichlorobenzene	106-46-7	0.800000	0.4814	0.0006	Dermal (Skin), Developmental (effects during periods when organs are developing) , Hepatic (Liver), Ocular (Eyes), Renal (Urinary System or Kidneys)	IRIS: Increased liver weights (rats)
Propionaldehyde	123-38-6	0.008000	0.2879	0.0360	Respiratory (From the Nose to the Lungs)	IRIS: Atrophy of olfactory epithelium (rats)
Selenium	7782-49-2	0.020000	0.0028	0.0001	Dermal (Skin), Developmental (effects during periods when organs are developing) , Reproductive (Producing Children), Neurological (Nervous System), Cardiovascular (Heart and Blood Vessels), Hepatic (Liver)	OAQPS (CAL)
Styrene	100-42-5	1.000000	0.9724	0.0010	Hepatic (Liver), Neurological (Nervous System), Ocular (Eyes)	IRIS: Central nervous system effects (humans)
Tetrachloroethylene	127-18-4	0.040000	0.3006	0.0075	Developmental (effects during periods when organs are developing) , Neurological (Nervous System), Respiratory (From the Nose to the Lungs), Renal (Kidneys), Hepatic (Liver)	IRIS: Neurotoxicity (reaction time, cognitive effects) (color vision) (humans)
Toluene	108-88-3	5.000000	5.4393	0.0011	Cardiovascular (Heart and Blood Vessels), Neurological (Nervous System), Respiratory (From the Nose to the Lungs)	IRIS: Neurological effects (humans)
Trichloroethylene	79-01-6	0.002000	0.0835	0.0418	Developmental (effects during periods when organs are developing), Neurological (Nervous System), Ocular (Eyes)	IRIS: Decreased thymus weight (immunotoxicity), increased fetal cardiac malformations (heart malformations) (mice, rats)

AGGREGATE NON-CANCER HAZARD= 60.0232

Appendix C. Cancer Risk

841 Finley Avenue - East Thomas (33.52944 Long. -86.8503)

Chemical	CAS	95% UCL Ambient Air Concentration (µg/m3)	Inhalation Unit Air Risk (per µg/m3)	Inhalation Concentration (µg/m3) @ 1.0E-06 Risk	Cancer Risk	EPA Classification	Basis for Inhalation Unit Risk
1,3-Butadiene	106-99-0	0.2846	3.00E-05	0.0300	8.54E-06	Carcinogenic to humans	IRIS: Leukemia (humans)
Acetaldehyde	75-07-0	2.1019	2.20E-06	0.5000	4.62E-06	Probable human carcinogen	IRIS: Nasal squamous cell carcinoma or adenocarcinoma (rats)
Arsenic	7440-38-2	0.0017	4.30E-03	0.0002	7.31E-06	Human Carcinogen	IRIS: Lung cancer (humans)
Benzene	71-43-2	3.3378	7.80E-06	0.4500	2.60E-05	Human Carcinogen	IRIS: Leukemia (humans)
Benzo(a)anthracene	56-55-3	0.0012	1.10E-04	0.0091	1.32E-07	Probable human carcinogen	OAQPS (CAL): Lung adenomas (mice)
Benzo(a)pyrene	50-32-8	0.0007	1.10E-03	0.0009	7.70E-07	Probable human carcinogen	OAQPS (CAL): Tumors in respiratory tract (hamsters)
Benzo(b)fluoranthene	205-99-2	0.0010	1.10E-04	0.0091	1.10E-07	Probable human carcinogen	OAQPS (CAL): Lung tumors (rats)
Benzo(k)fluoranthene	207-08-9	0.0010	1.10E-04	0.0091	1.10E-07	Probable human carcinogen	OAQPS (CAL): Lung tumors (rats)
Beryllium	7440-41-7	0.0000	2.40E-03	0.0004	0.00E+00	Probable human carcinogen	IRIS: Lung cancer (humans)
Cadmium	7440-43-9	0.0005	1.80E-03	0.0006	9.00E-07	Probable human carcinogen	IRIS: Lung, trachea, bronchus cancer deaths (humans)
Carbon Tetrachloride	56-23-5	0.6909	6.00E-06	0.1700	4.15E-06	Likely to be carcinogenic to humans	IRIS: Pheochromocytoma (mice)
Chloroform	67-66-3	0.1230	2.30E-05	0.0400	2.83E-06	Likely to be carcinogenic to humans	IRIS: Hepatocellular carcinoma (mice)
Chrysene	218-01-9	0.0019	1.10E-05	0.0909	2.09E-08	Probable human carcinogen	OAQPS (CAL): Skin tumors (mice)
Dibenz(a,h)anthracene	53-70-3	0.0001	1.20E-03	0.0008	1.20E-07	Probable human carcinogen	OAQPS (CAL): alveolar carcinomas of the lung (mice)
p-Dichlorobenzene	106-46-7	0.3128	1.10E-05	0.0909	3.44E-06	Likely to be carcinogenic to humans	IRIS: Hepatocellular carcinomas or adenomas, bronchoalveolar carcinomas or adenomas (mice)
Dichloromethane	75-09-2	0.3846	1.00E-08	100.0000	3.85E-09	Not classifiable	OAQPS (CAL): Renal tumors (rats)
Ethylbenzene	100-41-4	1.3663	2.50E-06	0.4000	3.42E-06	Probable human carcinogen	IRIS: Squamous cell carcinoma (rats)
Formaldehyde	50-00-0	5.2811	1.30E-05	0.0800	6.87E-05	Possible human carcinogen	IRIS: Renal tubular adenomas and adenocarcinomas (rats)
1,3-Hexachlorobutadiene	87-68-3	0.1138	2.20E-05	0.0500	2.50E-06	Human carcinogen	IRIS: Lung cancer (humans)
Hexavalent Chromium	18540-29-9	0.0000	1.20E-02	0.0001	0.00E+00	Probable human carcinogen	OAQPS (CAL): Lung tumors (rats)
Indeno(1,2,3-cd)pyrene	193-39-5	0.0006	1.10E-04	0.0091	6.60E-08	Not classified	OAQPS (CAL): Kidney adenomas and carcinomas, interstitial cell tumors, leukemia, lymphomas (rats)
Methyl tert-Butyl Ether	1634-04-4	0.8464	2.60E-07	3.8462	2.20E-07	Possible human carcinogen	OAQPS (CAL): nasal respiratory epithelial adenomas and nasal olfactory epithelial neuroblastomas (rats)
Naphthalene	91-20-3	0.3415	3.40E-05	0.0294	1.16E-05	Not classified	OAQPS (CAL): hepatocellular carcinomas or adenomas, kidney adenomas and mononuclear cell leukemia (rats)
Tetrachloroethylene	127-18-4	0.4666	2.60E-07	4.0000	1.21E-07	Likely to be carcinogenic to humans	IRIS: Hepatocellular adenomas or carcinomas (mice)
Trichloroethylene	79-01-6	0.1374	4.10E-06	0.2439	5.63E-07	Carcinogenic to humans	IRIS: Renal cell carcinoma, non-Hodgkin's lymphoma, and liver tumors (humans)
				AGGREGATE CANCER RISK=	**1.46E-04**		

Appendix D. Non-Cancer Hazard 841 Finley Avenue - East Thomas (Lat. 33.52944 Long. -86.8503)						
Chemical	**CAS**	**Reference Concentration (RfC) (mg/m3)**	**95% UCL Ambient Air Concentration (µg/m3)**	**Hazard Quotient (HQ)**	**Target Organ/System**	**Basis for RfC**
1,1,1-Trichloroethane	71-55-6	5.000000	0.1611	0.0000	Cardiovascular (Heart and Blood Vessels), Neurological (Nervous System)	IRIS: Liver histopathologic changes (rats, mice)
1,2,4-Trichlorobenzene	120-82-1	0.200000	0.0859	0.0004	Hepatic (Liver)	OAQPS (HEAST)
1,3-Butadiene	106-99-0	0.002000	0.2846	0.1423	Dermal (Skin), Neurological (Nervous System), Ocular (Eyes), Reproductive (Producing Children)	IRIS: Ovarian atrophy (mice)
Acetaldehyde	75-07-0	0.009000	2.1019	0.2335	Respiratory (From the Nose to the Lungs)	IRIS: Degeneration of olfactory epithelium (rats)
Acetonitrile	107-13-1	0.060000	33.3629	0.5560	Developmental (effects during periods when organs are developing), Hematological (Blood Forming), Neurological (Nervous System), Reproductive (Producing Children), Respiratory (From the Nose to the Lungs)	IRIS: Mortality (mice)
Acrolein	107-02-8	0.000020	0.7988	39.9400	Cardiovascular (Heart and Blood Vessels), Hematological (Blood Forming), Ocular (Eyes), Respiratory (From the Nose to the Lungs)	IRIS: Nasal lesions (rats)
Arsenic	7440-38-2	0.000015	0.0017	0.1133	Dermal (Skin), Gastrointestinal (Digestive), Hepatic (Liver), Neurological (Nervous System), Respiratory (From the Nose to the Lungs), Developmental (effects during periods when organs are developing)	OAQPS (CAL)
Benzene	71-43-2	0.030000	3.3378	0.1113	Hematological (Blood Forming), Immunological (Immune System), Neurological (Nervous System)	IRIS: Decreased lymphocyte count (humans)
Beryllium	7440-41-7	0.000020	0.0000	0.0000	Gastrointestinal (Digestive), Immunological (Immune System), Respiratory (From the Nose to the Lungs)	IRIS: Beryllium sensitization and progression to CBD (humans)
Bromomethane	74-83-9	0.005000	0.0482	0.0096	Cardiovascular (Heart and Blood Vessels), Dermal (Skin), Gastrointestinal (Digestive), Neurological (Nervous System), Respiratory (From the Nose to the Lungs)	IRIS: Degenerative and proliferative lesions of the olfactory epithelium of the nasal cavity (rats)
Cadmium	7440-43-9	0.000010	0.0005	0.0500	Cardiovascular (Heart and Blood Vessels), Developmental (effects during periods when organs are developing) , Gastrointestinal (Digestive), Neurological (Nervous System), Renal (Urinary System or Kidneys), Reproductive (Producing Children), Respiratory (From the Nose to the Lungs)	OAQPS (ATSDR)
Carbon Tetrachloride	56-23-5	0.100000	0.6909	0.0069	Cardiovascular (Heart and Blood Vessels), Hepatic (Liver), Neurological (Nervous System)	IRIS: Fatty changes in the liver (rats)
Chlorobenzene	108-90-7	1.000000	---	---	Hepatic (Liver), Neurological (Nervous System), Renal (Urinary System or Kidneys), Reproductive (Producing Children)	OAQPS (CAL)
Chloroethane	75-00-3	10.000000	0.0273	0.0000	Cardiovascular (Heart and Blood Vessels), Developmental (effects during periods when organs are developing)	IRIS: Delayed fetal ossification (mice)

Chloromethane	74-87-3	0.090000	1.3326	0.0148	Cardiovascular (Heart and Blood Vessels), Developmental (effects during periods when organs are developing) , Hepatic (Liver), Neurological (Nervous System), Renal (Urinary System or Kidneys), Reproductive (Producing Children)	OAQPS (ATSDR)
Cobalt	7440-48-4	0.000100	0.0003	0.0030	Cardiovascular (Heart and Blood Vessels), Hepatic (Liver), Neurological (Nervous System)	IRIS: Cerebellar lesions (mice)
Dichloromethane	75-09-2	0.600000	0.3846	0.0006	Cardiovascular (Heart and Blood Vessels), Developmental (effects during periods when organs are developing) , Hematological (Blood Forming), Respiratory (From the Nose to the Lungs)	OAQPS (ATSDR)
Ethylbenzene	100-41-4	1.000000	1.3663	0.0014	Cardiovascular (Heart and Blood Vessels), Hepatic (Liver), Neurological (Nervous System)	IRIS: Hepatic effects (hepatic vacuolation) (rats)
Formaldehyde	50-00-0	0.009800	5.2811	0.5389	Developmental (effects during periods when organs are developing) , Neurological (Nervous System)	IRIS: Developmental toxicity (rats, rabbits)
1,3-Hexachlorobutadiene	87-68-3	0.090000	0.1138	0.0013	Dermal (Skin), Gastrointestinal (Digestive), Immunological (Immune System), Respiratory (From the Nose to the Lungs)	OAQPS (ATSDR)
Hexavalent Chromium	18540-29-9	0.000100	0.0000	0.0000	Reproductive (Producing Children), Renal (Urinary System or Kidneys)	OAQPS (CAL)
Lead	7439-92-1	0.000150	0.0172	0.1147	Immunological (Immune System), Renal (Urinary System or Kidneys), Respiratory (From the Nose to the Lungs)	IRIS: Lactate dehydrogenase in bronchioalveolar lavage fluid (rats)
Manganese	7439-96-5	0.000050	0.0621	1.2420	Cardiovascular (Heart and Blood Vessels), Developmental (effects during periods when organs are developing) , Gastrointestinal (Digestive), Hematological (Blood Forming), Musculoskeletal (Muscles and Skeleton), Neurological (Nervous System), Ocular (Eyes), Renal (Urinary System or Kidneys), Reproductive (Producing Children)	OAQPS
m-Dichlorobenzene	541-73-1		0.0208		Cardiovascular (Heart and Blood Vessels), Hepatic (Liver), Neurological (Nervous System), Respiratory (From the Nose to the Lungs)	IRIS: NImpairment of neurobehavioral function (humans)
Mercury	7439-97-6	0.000300	0.0002	0.0007	Developmental (effects during periods when organs are developing) , Gastrointestinal (Digestive), Neurological (Nervous System), Ocular (Eyes), Renal (Urinary System or Kidneys)	IRIS: Hand tremor; increases in memory disturbances; slight subjective and objective evidence of autonomic dysfunction
Methyl Ethyl Ketone	78-93-3	5.000000	1.5443	0.0003	Developmental (effects during periods when organs are developing), Ocular (Eyes), Respiratory (From the Nose to the Lungs)	IRIS: Developmental toxicity (skeletal variations) (mice)
Methyl Isobutyl Ketone	108-10-1	3.000000	0.2586	0.0001	Developmental (effects during periods when organs are developing)	IRIS: Reduced fetal body weight, skeletal variations, and increased fetal death in mice, and skeletal variations (rats)

Methyl tert-Butyl Ether	1634-04-4	3.000000	0.8464	0.0003	Hepatic (Liver), Neurological (Nervous System), Renal (Urinary System or Kidneys)	IRIS: Increased absolute and relative liver and kidney weights and increased severity of spontaneous renal lesions (females), increased prostration (females), and swollen periocular tissue (males and females) (rats)
Naphthalene	91-20-3	0.003000	0.3415	0.1138	Hematological (Blood Forming), Hepatic (Liver), Neurological (Nervous System), Ocular (Eyes), Respiratory (From the Nose to the Lungs)	IRIS: Nasal effects: hyperplasia and metaplasia in respiratory and olfactory epithelium, respectively (mice)
Nickel	7440-02-0	0.000090	0.0022	0.0244	Cardiovascular (Heart and Blood Vessels), Dermal (Skin), Immunological (Immune System), Respiratory (From the Nose to the Lungs)	OAQPS (ATSDR)
p-Dichlorobenzene	106-46-7	0.800000	0.3128	0.0004	Dermal (Skin), Developmental (effects during periods when organs are developing) , Hepatic (Liver), Ocular (Eyes), Renal (Urinary System or Kidneys)	IRIS: Increased liver weights (rats)
Propionaldehyde	123-38-6	0.008000	0.4022	0.0503	Respiratory (From the Nose to the Lungs)	IRIS: Atrophy of olfactory epithelium (rats)
Selenium	7782-49-2	0.020000	0.0008	0.0000	Dermal (Skin), Developmental (effects during periods when organs are developing) , Reproductive (Producing Children), Neurological (Nervous System), Cardiovascular (Heart and Blood Vessels), Hepatic (Liver)	OAQPS (CAL)
Styrene	100-42-5	1.000000	0.5389	0.0005	Hepatic (Liver), Neurological (Nervous System), Ocular (Eyes)	IRIS: Central nervous system effects (humans)
Tetrachloroethylene	127-18-4	0.040000	0.4666	0.0117	Developmental (effects during periods when organs are developing) , Neurological (Nervous System), Respiratory (From the Nose to the Lungs), Renal (Kidneys), Hepatic (Liver)	IRIS: Neurotoxicity (reaction time, cognitive effects) (color vision) (humans)
Toluene	108-88-3	5.000000	6.0991	0.0012	Cardiovascular (Heart and Blood Vessels), Neurological (Nervous System), Respiratory (From the Nose to the Lungs)	IRIS: Neurological effects (humans)
Trichloroethylene	79-01-6	0.002000	0.1374	0.0687	Developmental (effects during periods when organs are developing), Neurological (Nervous System), Ocular (Eyes)	IRIS: Decreased thymus weight (immunotoxicity), increased fetal cardiac malformations (heart malformations) (mice, rats)

AGGREGATE NON-CANCER HAZARD= 43.3526

Appendix E. Cancer Risk 3009 28th Street North – North Birmingham (33.55303 -86.81485)							
Chemical	**CAS**	**95% UCL Ambient Air Concentration (µg/m3)**	**Inhalation Unit Air Risk (per µg/m3)**	**Inhalation Concentration (µg/m3) @ 1.0E-06 Risk**	**Cancer Risk**	**EPA Classification**	**Basis for Inhalation Unit Risk**
1,3-Butadiene	106-99-0	0.1819	3.00E-05	0.0300	5.46E-06	Carcinogenic to humans	IRIS: Leukemia (humans)
Acetaldehyde	75-07-0	1.6832	2.20E-06	0.5000	3.70E-06	Probable human carcinogen	IRIS: Nasal squamous cell carcinoma or adenocarcinoma (rats)
Arsenic	7440-38-2	0.0024	4.30E-03	0.0002	1.03E-05	Human Carcinogen	IRIS: Lung cancer (humans)
Benzene	71-43-2	4.2377	7.80E-06	0.4500	3.31E-05	Human Carcinogen	IRIS: Leukemia (humans)
Benzo(a)anthracene	56-55-3	0.0052	1.10E-04	0.0091	5.72E-07	Probable human carcinogen	OAQPS (CAL): Lung adenomas (mice)
Benzo(a)pyrene	50-32-8	0.0031	1.10E-03	0.0009	3.41E-06	Probable human carcinogen	OAQPS (CAL): Tumors in respiratory tract (hamsters)
Benzo(b)fluoranthene	205-99-2	0.0038	1.10E-04	0.0091	4.18E-07	Probable human carcinogen	OAQPS (CAL): Lung tumors (rats)
Benzo(k)fluoranthene	207-08-9	0.0035	1.10E-04	0.0091	3.85E-07	Probable human carcinogen	OAQPS (CAL): Lung tumors (rats)
Beryllium	7440-41-7	0.0000	2.40E-03	0.0004	0.00E+00	Probable human carcinogen	IRIS: Lung cancer (humans)
Cadmium	7440-43-9	0.0010	1.80E-03	0.0006	1.80E-06	Probable human carcinogen	IRIS: Lung, trachea, bronchus cancer deaths (humans)
Carbon Tetrachloride	56-23-5	0.6777	6.00E-06	0.1700	4.07E-06	Likely to be carcinogenic to humans	IRIS: Pheochromocytoma (mice)
Chloroform	67-66-3	0.0947	2.30E-05	0.0400	2.18E-06	Likely to be carcinogenic to humans	IRIS: Hepatocellular carcinoma (mice)
Chrysene	218-01-9	0.0065	1.10E-05	0.0909	7.15E-08	Probable human carcinogen	OAQPS (CAL): Skin tumors (mice)
Dibenz(a,h)anthracene	53-70-3	0.0007	1.20E-03	0.0008	8.40E-07	Probable human carcinogen	OAQPS (CAL): alveolar carcinomas of the lung (mice)
p-Dichlorobenzene	106-46-7	0.3508	1.10E-05	0.0909	3.86E-06	Possible human carcinogen	OAQPS (CAL): nasal respiratory epithelial adenomas and nasal olfactory epithelial neuroblastomas (rats)
Dichloromethane	75-09-2	0.3152	1.00E-08	100.0000	3.15E-09	Likely to be carcinogenic to humans	IRIS: Hepatocellular carcinomas or adenomas, bronchoalveolar carcinomas or adenomas (mice)
Ethylbenzene	100-41-4	1.5186	2.50E-06	0.4000	3.80E-06	Not classifiable	OAQPS (CAL): Renal tumors (rats)
Formaldehyde	50-00-0	4.3259	1.30E-05	0.0800	5.62E-05	Probable human carcinogen	IRIS: Squamous cell carcinoma (rats)
1,3-Hexachlorobutadiene	87-68-3	0.1051	2.20E-05	0.0500	2.31E-06	Possible human carcinogen	IRIS: Renal tubular adenomas and adenocarcinomas (rats)
Hexavalent Chromium	18540-29-9	0.0000	1.20E-02	0.0001	0.00E+00	Human carcinogen	IRIS: Lung cancer (humans)
Indeno(1,2,3-cd)pyrene	193-39-5	0.0024	1.10E-04	0.0091	2.64E-07	Probable human carcinogen	OAQPS (CAL): Lung tumors (rats)
Methyl tert-Butyl Ether	1634-04-4	0.4612	2.60E-07	3.8462	1.20E-07	Not classified	OAQPS (CAL): Kidney adenomas and carcinomas, interstitial cell tumors, leukemia, lymphomas (rats)
Naphthalene	91-20-3	0.3606	3.40E-05	0.0294	1.23E-05	Not classified	OAQPS (CAL): hepatocellular carcinomas or adenomas, kidney adenomas and mononuclear cell leukemia (rats)
Tetrachloroethylene	127-18-4	0.3013	2.60E-07	4.0000	7.83E-08	Likely to be carcinogenic to humans	IRIS: Hepatocellular adenomas or carcinomas (mice)
Trichloroethylene	79-01-6	0.1515	4.10E-06	0.2439	6.21E-07	Carcinogenic to humans	IRIS: Renal cell carcinoma, non-Hodgkin's lymphoma, and liver tumors (humans)

AGGREGATE CANCER RISK= 1.46E-04

Appendix F. Non-Cancer Hazard 3009 28th Street North – North Birmingham (33.55303 -86.81485)						
Chemical	**CAS**	**Reference Concentration (RfC) (mg/m3)**	**95% UCL Ambient Air Concentration (µg/m3)**	**Hazard Quotient (HQ)**	**Target Organ/System**	**Basis for RfC**
1,1,1-Trichloroethane	71-55-6	5.000000	0.1350	0.0000	Cardiovascular (Heart and Blood Vessels), Neurological (Nervous System)	IRIS: Liver histopathologic changes (rats, mice)
1,2,4-Trichlorobenzene	120-82-1	0.200000	0.0789	0.0004	Hepatic (Liver)	OAQPS (HEAST)
1,3-Butadiene	106-99-0	0.002000	0.1819	0.0910	Dermal (Skin), Neurological (Nervous System), Ocular (Eyes), Reproductive (Producing Children)	IRIS: Ovarian atrophy (mice)
Acetaldehyde	75-07-0	0.009000	1.6832	0.1870	Respiratory (From the Nose to the Lungs)	IRIS: Degeneration of olfactory epithelium (rats)
Acetonitrile	107-13-1	0.060000	22.5157	0.3753	Developmental (effects during periods when organs are developing), Hematological (Blood Forming), Neurological (Nervous System), Reproductive (Producing Children), Respiratory (From the Nose to the Lungs)	IRIS: Mortality (mice)
Acrolein	107-02-8	0.000020	0.8241	41.2050	Cardiovascular (Heart and Blood Vessels), Hematological (Blood Forming), Ocular (Eyes), Respiratory (From the Nose to the Lungs)	IRIS: Nasal lesions (rats)
Arsenic	7440-38-2	0.000015	0.0024	0.1600	Dermal (Skin), Gastrointestinal (Digestive), Hepatic (Liver), Neurological (Nervous System), Respiratory (From the Nose to the Lungs), Developmental (effects during periods when organs are developing)	OAQPS (CAL)
Benzene	71-43-2	0.030000	4.2377	0.1413	Hematological (Blood Forming), Immunological (Immune System), Neurological (Nervous System)	IRIS: Decreased lymphocyte count (humans)
Beryllium	7440-41-7	0.000020	0.0000	0.0000	Gastrointestinal (Digestive), Immunological (Immune System), Respiratory (From the Nose to the Lungs)	IRIS: Beryllium sensitization and progression to CBD (humans)
Bromomethane	74-83-9	0.005000	0.0535	0.0107	Cardiovascular (Heart and Blood Vessels), Dermal (Skin), Gastrointestinal (Digestive), Neurological (Nervous System), Respiratory (From the Nose to the Lungs)	IRIS: Degenerative and proliferative lesions of the olfactory epithelium of the nasal cavity (rats)
Cadmium	7440-43-9	0.000010	0.0010	0.1000	Cardiovascular (Heart and Blood Vessels), Developmental (effects during periods when organs are developing) , Gastrointestinal (Digestive), Neurological (Nervous System), Renal (Urinary System or Kidneys), Reproductive (Producing Children), Respiratory (From the Nose to the Lungs)	OAQPS (ATSDR)
Carbon Tetrachloride	56-23-5	0.100000	0.6777	0.0068	Cardiovascular (Heart and Blood Vessels), Hepatic (Liver), Neurological (Nervous System)	IRIS: Fatty changes in the liver (rats)

Chlorobenzene	108-90-7	1.000000	0.0653	0.0001	Hepatic (Liver), Neurological (Nervous System), Renal (Urinary System or Kidneys), Reproductive (Producing Children)	OAQPS (CAL)
Chloroethane	75-00-3	10.000000	0.1383	0.0000	Cardiovascular (Heart and Blood Vessels), Developmental (effects during periods when organs are developing)	IRIS: Delayed fetal ossification (mice)
Chloroform	67-66-3	0.098000	0.0947	0.0010	Cardiovascular (Heart and Blood Vessels), Developmental (effects during periods when organs are developing) , Hepatic (Liver), Neurological (Nervous System), Renal (Urinary System or Kidneys), Reproductive (Producing Children)	OAQPS (ATSDR)
Chloromethane	74-87-3	0.090000	1.3861	0.0154	Cardiovascular (Heart and Blood Vessels), Hepatic (Liver), Neurological (Nervous System)	IRIS: Cerebellar lesions (mice)
Cobalt	7440-48-4	0.000100	0.0002	0.0020	Cardiovascular (Heart and Blood Vessels), Developmental (effects during periods when organs are developing) , Hematological (Blood Forming), Respiratory (From the Nose to the Lungs)	OAQPS (ATSDR)
Dichloromethane	75-09-2	0.600000	0.3152	0.0005	Cardiovascular (Heart and Blood Vessels), Hepatic (Liver), Neurological (Nervous System)	IRIS: Hepatic effects (hepatic vacuolation) (rats)
Ethylbenzene	100-41-4	1.000000	1.5186	0.0015	Developmental (effects during periods when organs are developing) , Neurological (Nervous System)	IRIS: Developmental toxicity (rats, rabbits)
Formaldehyde	50-00-0	0.009800	4.3259	0.4414	Dermal (Skin), Gastrointestinal (Digestive), Immunological (Immune System), Respiratory (From the Nose to the Lungs)	OAQPS (ATSDR)
1,3-Hexachlorobutadiene	87-68-3	0.090000	0.1051	0.0012	Reproductive (Producing Children), Renal (Urinary System or Kidneys)	OAQPS (CAL)
Hexavalent Chromium	18540-29-9	0.000100	0.0000	0.0000	Immunological (Immune System), Renal (Urinary System or Kidneys), Respiratory (From the Nose to the Lungs)	IRIS: Lactate dehydrogenase in bronchioalveolar lavage fluid (rats)
Lead	7439-92-1	0.000150	0.0254	0.1693	Cardiovascular (Heart and Blood Vessels), Developmental (effects during periods when organs are developing) , Gastrointestinal (Digestive), Hematological (Blood Forming), Musculoskeletal (Muscles and Skeleton), Neurological (Nervous System), Ocular (Eyes), Renal (Urinary System or Kidneys), Reproductive (Producing Children)	OAQPS
Manganese	7439-96-5	0.000050	0.0645	1.2900	Cardiovascular (Heart and Blood Vessels), Hepatic (Liver), Neurological (Nervous System), Respiratory (From the Nose to the Lungs)	IRIS: NImpairment of neurobehavioral function (humans)

Mercury	7439-97-6	0.000300	0.0001	0.0003	Developmental (effects during periods when organs are developing) , Gastrointestinal (Digestive), Neurological (Nervous System), Ocular (Eyes), Renal (Urinary System or Kidneys)	IRIS: Hand tremor; increases in memory disturbances; slight subjective and objective evidence of autonomic dysfunction
Methyl Ethyl Ketone	78-93-3	5.000000	2.4392	0.0005	Developmental (effects during periods when organs are developing), Ocular (Eyes), Respiratory (From the Nose to the Lungs)	IRIS: Developmental toxicity (skeletal variations) (mice)
Methyl Isobutyl Ketone	108-10-1	3.000000	0.3132	0.0001	Developmental (effects during periods when organs are developing)	IRIS: Reduced fetal body weight, skeletal variations, and increased fetal death in mice, and skeletal variations (rats)
Methyl tert-Butyl Ether	1634-04-4	3.000000	0.4612	0.0002	Hepatic (Liver), Neurological (Nervous System), Renal (Urinary System or Kidneys)	IRIS: Increased absolute and relative liver and kidney weights and increased severity of spontaneous renal lesions (females), increased prostration (females), and swollen periocular tissue (males and females) (rats)
Naphthalene	91-20-3	0.003000	0.3606	0.1202	Hematological (Blood Forming), Hepatic (Liver), Neurological (Nervous System), Ocular (Eyes), Respiratory (From the Nose to the Lungs)	IRIS: Nasal effects: hyperplasia and metaplasia in respiratory and olfactory epithelium, respectively (mice)
Nickel	7440-02-0	0.000090	0.0018	0.0200	Cardiovascular (Heart and Blood Vessels), Dermal (Skin), Immunological (Immune System), Respiratory (From the Nose to the Lungs)	OAQPS (ATSDR)
p-Dichlorobenzene	106-46-7	0.800000	0.3508	0.0004	Dermal (Skin), Developmental (effects during periods when organs are developing) , Hepatic (Liver), Ocular (Eyes), Renal (Urinary System or Kidneys)	IRIS: Increased liver weights (rats)
Propionaldehyde	123-38-6	0.008000	0.3203	0.0400	Respiratory (From the Nose to the Lungs)	IRIS: Atrophy of olfactory epithelium (rats)
Selenium	7782-49-2	0.020000	0.0011	0.0001	Dermal (Skin), Developmental (effects during periods when organs are developing) , Reproductive (Producing Children), Neurological (Nervous System), Cardiovascular (Heart and Blood Vessels), Hepatic (Liver)	OAQPS (CAL)
Styrene	100-42-5	1.000000	0.5466	0.0005	Hepatic (Liver), Neurological (Nervous System), Ocular (Eyes)	IRIS: Central nervous system effects (humans)
Tetrachloroethylene	127-18-4	0.040000	0.3013	0.0075	Developmental (effects during periods when organs are developing) , Neurological (Nervous System), Respiratory (From the Nose to the Lungs), Renal (Kidneys), Hepatic (Liver)	IRIS: Neurotoxicity (reaction time, cognitive effects) (color vision) (humans)
Toluene	108-88-3	5.000000	5.4225	0.0011	Cardiovascular (Heart and Blood Vessels), Neurological (Nervous System), Respiratory (From the Nose to the Lungs)	IRIS: Neurological effects (humans)
Trichloroethylene	79-01-6	0.002000	0.1515	0.0758	Developmental (effects during periods when organs are developing), Neurological (Nervous System), Ocular (Eyes)	IRIS: Decreased thymus weight (immunotoxicity), increased fetal cardiac malformations (heart malformations) (mice, rats)

AGGREGATE NON-CANCER HAZARD= 44.4665

Appendix G. Cancer Risk 1801 Bruce Shaw Road, Providence (33.45981 -87.30618)							
Chemical	**CAS**	**95% UCL Ambient Air Concentration (µg/m3)**	**Inhalation Unit Risk**	**Inhalation Concentration (µg/m3) @ 1.0E-06 Risk**	**Cancer Risk**	**EPA Classification**	**Basis for Inhalation Unit Risk**
1,3-Butadiene	106-99-0	0.0366	3.00E-05	0.0300	1.10E-06	Carcinogenic to humans	IRIS: Leukemia (humans)
Acetaldehyde	75-07-0	2.3797	2.20E-06	0.5000	5.24E-06	Probable human carcinogen	IRIS: Nasal squamous cell carcinoma or adenocarcinoma (rats)
Arsenic	7440-38-2	0.0009	4.30E-03	0.0002	3.87E-06	Human Carcinogen	IRIS: Lung cancer (humans)
Benzene	71-43-2	0.6241	7.80E-06	0.4500	4.87E-06	Human Carcinogen	IRIS: Leukemia (humans)
Benzo(a)anthracene	56-55-3	0.0000	1.10E-04	0.0091	0.00E+00	Probable human carcinogen	OAQPS (CAL): Lung adenomas (mice)
Benzo(a)pyrene	50-32-8	0.0001	1.10E-03	0.0009	1.10E-07	Probable human carcinogen	OAQPS (CAL): Tumors in respiratory tract (hamsters)
Benzo(b)fluoranthene	205-99-2	0.0000	1.10E-04	0.0091	0.00E+00	Probable human carcinogen	OAQPS (CAL): Lung tumors (rats)
Benzo(k)fluoranthene	207-08-9	0.0001	1.10E-04	0.0091	1.10E-08	Probable human carcinogen	OAQPS (CAL): Lung tumors (rats)
Beryllium	7440-41-7	0.0000	2.40E-03	0.0004	0.00E+00	Probable human carcinogen	IRIS: Lung cancer (humans)
Cadmium	7440-43-9	0.0001	1.80E-03	0.0006	1.80E-07	Probable human carcinogen	IRIS: Lung, trachea, bronchus cancer deaths (humans)
Carbon Tetrachloride	56-23-5	0.6623	6.00E-06	0.1700	3.97E-06	Likely to be carcinogenic to humans	IRIS: Pheochromocytoma (mice)
Chloroform	67-66-3	0.0409	2.30E-05	0.0400	9.41E-07	Likely to be carcinogenic to humans	IRIS: Hepatocellular carcinoma (mice)
Chrysene	218-01-9	0.0001	1.10E-05	0.0909	1.10E-09	Probable human carcinogen	OAQPS (CAL): Skin tumors (mice)
Dibenz(a,h)anthracene	53-70-3	---	1.20E-03	0.0008	0.00E+00	Probable human carcinogen	OAQPS (CAL): alveolar carcinomas of the lung (mice)
Dichloromethane	75-09-2	0.2258	1.00E-08	100.0000	2.26E-09	Likely to be carcinogenic to humans	IRIS: Hepatocellular carcinomas or adenomas, bronchoalveolar carcinomas or adenomas (mice)
Ethylbenzene	100-41-4	0.2353	2.50E-06	0.4000	5.88E-07	Not classifiable	OAQPS (CAL): Renal tumors (rats)
Formaldehyde	50-00-0	6.2910	1.30E-05	0.0800	8.18E-05	Probable human carcinogen	IRIS: Squamous cell carcinoma (rats)
1,3-Hexachlorobutadiene	87-68-3	0.0992	2.20E-05	0.0500	2.18E-06	Possible human carcinogen	IRIS: Renal tubular adenomas and adenocarcinomas (rats)
Hexavalent Chromium	18540-29-9	0.0000	1.20E-02	0.0001	0.00E+00	Human carcinogen	IRIS: Lung cancer (humans)
Indeno(1,2,3-cd)pyrene	193-39-5	0.0000	1.10E-04	0.0091	0.00E+00	Probable human carcinogen	OAQPS (CAL): Lung tumors (rats)
Methyl tert-Butyl Ether	1634-04-4	---	2.60E-07	3.8462	0.00E+00	Not classified	OAQPS (CAL): Kidney adenomas and carcinomas, interstitial cell tumors, leukemia, lymphomas (rats)
Naphthalene	91-20-3	0.0196	3.40E-05	0.0294	6.66E-07	Possible human carcinogen	OAQPS (CAL): nasal respiratory epithelial adenomas and nasal olfactory epithelial neuroblastomas (rats)
p-Dichlorobenzene	106-46-7	0.2882	1.10E-05	0.0909	3.17E-06	Not classified	OAQPS (CAL): hepatocellular carcinomas or adenomas, kidney adenomas and mononuclear cell leukemia (rats)
Tetrachloroethylene	127-18-4	0.0537	2.60E-07	4.0000	1.40E-08	Likely to be carcinogenic to humans	IRIS: Hepatocellular adenomas or carcinomas (mice)
Trichloroethylene	79-01-6	0.0370	4.10E-06	0.2439	1.52E-07	Carcinogenic to humans	IRIS: Renal cell carcinoma, non-Hodgkin's lymphoma, and liver tumors (humans)
				AGGREGATE CANCER RISK=	**1.09E-04**		

Appendix H. Non-Cancer Hazard 1801 Bruce Shaw Road, Providence (33.45981 -87.30618)						
Chemical	**CAS**	**Reference Concentration (RfC) (mg/m3)**	**95% UCL Ambient Air Concentration (µg/m3)**	**Hazard Quotient (HQ)**	**Target Organ/System**	**Basis for RfC**
1,1,1-Trichloroethane	71-55-6	5.000000	0.1301	0.0000	Cardiovascular (Heart and Blood Vessels), Neurological (Nervous System)	IRIS: Liver histopathologic changes (rats, mice)
1,2,4-Trichlorobenzene	120-82-1	0.200000	0.0757	0.0004	Hepatic (Liver)	OAQPS (HEAST)
1,3-Butadiene	106-99-0	0.002000	0.0366	0.0183	Dermal (Skin), Neurological (Nervous System), Ocular (Eyes), Reproductive (Producing Children)	IRIS: Ovarian atrophy (mice)
Acetaldehyde	75-07-0	0.009000	2.3797	0.2644	Respiratory (From the Nose to the Lungs)	IRIS: Degeneration of olfactory epithelium (rats)
Acetonitrile	107-13-1	0.060000	5.5904	0.0932	Developmental (effects during periods when organs are developing), Hematological (Blood Forming), Neurological (Nervous System), Reproductive (Producing Children), Respiratory (From the Nose to the Lungs)	IRIS: Mortality (mice)
Acrolein	107-02-8	0.000020	0.4994	24.9700	Cardiovascular (Heart and Blood Vessels), Hematological (Blood Forming), Ocular (Eyes), Respiratory (From the Nose to the Lungs)	IRIS: Nasal lesions (rats)
Arsenic	7440-38-2	0.000015	0.0009	0.0600	Dermal (Skin), Gastrointestinal (Digestive), Hepatic (Liver), Neurological (Nervous System), Respiratory (From the Nose to the Lungs), Developmental (effects during periods when organs are developing)	OAQPS (CAL)
Benzene	71-43-2	0.030000	0.6241	0.0208	Hematological (Blood Forming), Immunological (Immune System), Neurological (Nervous System)	IRIS: Decreased lymphocyte count (humans)
Beryllium	7440-41-7	0.000020	0.0000	0.0000	Gastrointestinal (Digestive), Immunological (Immune System), Respiratory (From the Nose to the Lungs)	IRIS: Beryllium sensitization and progression to CBD (humans)
Bromomethane	74-83-9	0.005000	0.0475	0.0095	Cardiovascular (Heart and Blood Vessels), Dermal (Skin), Gastrointestinal (Digestive), Neurological (Nervous System), Respiratory (From the Nose to the Lungs)	IRIS: Degenerative and proliferative lesions of the olfactory epithelium of the nasal cavity (rats)
Cadmium	7440-43-9	0.000010	0.0001	0.0100	Cardiovascular (Heart and Blood Vessels), Developmental (effects during periods when organs are developing) , Gastrointestinal (Digestive), Neurological (Nervous System), Renal (Urinary System or Kidneys), Reproductive (Producing Children), Respiratory (From the Nose to the Lungs)	OAQPS (ATSDR)
Carbon Tetrachloride	56-23-5	0.100000	0.6623	0.0066	Cardiovascular (Heart and Blood Vessels), Hepatic (Liver), Neurological (Nervous System)	IRIS: Fatty changes in the liver (rats)

Chlorobenzene	108-90-7	1.000000	---	---	Hepatic (Liver), Neurological (Nervous System), Renal (Urinary System or Kidneys), Reproductive (Producing Children)	OAQPS (CAL)
Chloroethane	75-00-3	10.000000	0.1415	0.0000	Cardiovascular (Heart and Blood Vessels), Developmental (effects during periods when organs are developing)	IRIS: Delayed fetal ossification (mice)
Chloroform	67-66-3	0.098000	0.0409	0.0004	Cardiovascular (Heart and Blood Vessels), Developmental (effects during periods when organs are developing) , Hepatic (Liver), Neurological (Nervous System), Renal (Urinary System or Kidneys), Reproductive (Producing Children)	OAQPS (ATSDR)
Chloromethane	74-87-3	0.090000	1.3026	0.0145	Cardiovascular (Heart and Blood Vessels), Hepatic (Liver), Neurological (Nervous System)	IRIS: Cerebellar lesions (mice)
Cobalt	7440-48-4	0.000100	0.0001	0.0010	Cardiovascular (Heart and Blood Vessels), Developmental (effects during periods when organs are developing) , Hematological (Blood Forming), Respiratory (From the Nose to the Lungs)	OAQPS (ATSDR)
Dichloromethane	75-09-2	0.600000	0.2258	0.0004	Cardiovascular (Heart and Blood Vessels), Hepatic (Liver), Neurological (Nervous System)	IRIS: Hepatic effects (hepatic vacuolation) (rats)
Ethylbenzene	100-41-4	1.000000	0.2353	0.0002	Developmental (effects during periods when organs are developing) , Neurological (Nervous System)	IRIS: Developmental toxicity (rats, rabbits)
Formaldehyde	50-00-0	0.009800	6.2910	0.6419	Dermal (Skin), Gastrointestinal (Digestive), Immunological (Immune System), Respiratory (From the Nose to the Lungs)	OAQPS (ATSDR)
1,3-Hexachlorobutadiene	87-68-3	0.090000	0.0992	0.0011	Reproductive (Producing Children), Renal (Urinary System or Kidneys)	OAQPS (CAL)
Hexavalent Chromium	18540-29-9	0.000100	0.0000	0.0000	Immunological (Immune System), Renal (Urinary System or Kidneys), Respiratory (From the Nose to the Lungs)	IRIS: Lactate dehydrogenase in bronchioalveolar lavage fluid (rats)
Lead	7439-92-1	0.000150	0.0040	0.0267	Cardiovascular (Heart and Blood Vessels), Developmental (effects during periods when organs are developing) , Gastrointestinal (Digestive), Hematological (Blood Forming), Musculoskeletal (Muscles and Skeleton), Neurological (Nervous System), Ocular (Eyes), Renal (Urinary System or Kidneys), Reproductive (Producing Children)	OAQPS
Manganese	7439-96-5	0.000050	0.0076	0.1520	Cardiovascular (Heart and Blood Vessels), Hepatic (Liver), Neurological (Nervous System), Respiratory (From the Nose to the Lungs)	IRIS: Impairment of neurobehavioral function (humans)

Mercury	7439-97-6	0.000300	0.0001	0.0003	Developmental (effects during periods when organs are developing) , Gastrointestinal (Digestive), Neurological (Nervous System), Ocular (Eyes), Renal (Urinary System or Kidneys)	IRIS: Hand tremor; increases in memory disturbances; slight subjective and objective evidence of autonomic dysfunction
Methyl Ethyl Ketone	78-93-3	5.000000	1.6154	0.0003	Developmental (effects during periods when organs are developing), Ocular (Eyes), Respiratory (From the Nose to the Lungs)	IRIS: Developmental toxicity (skeletal variations) (mice)
Methyl Isobutyl Ketone	108-10-1	3.000000	0.2114	0.0001	Developmental (effects during periods when organs are developing)	IRIS: Reduced fetal body weight, skeletal variations, and increased fetal death in mice, and skeletal variations (rats)
Methyl tert-Butyl Ether	1634-04-4	3.000000	---	---	Hepatic (Liver), Neurological (Nervous System), Renal (Urinary System or Kidneys)	IRIS: Increased absolute and relative liver and kidney weights and increased severity of spontaneous renal lesions (females), increased prostration (females), and swollen periocular tissue (males and females) (rats)
Naphthalene	91-20-3	0.003000	0.0196	0.0065	Hematological (Blood Forming), Hepatic (Liver), Neurological (Nervous System), Ocular (Eyes), Respiratory (From the Nose to the Lungs)	IRIS: Nasal effects: hyperplasia and metaplasia in respiratory and olfactory epithelium, respectively (mice)
Nickel	7440-02-0	0.000090	0.0010	0.0111	Cardiovascular (Heart and Blood Vessels), Dermal (Skin), Immunological (Immune System), Respiratory (From the Nose to the Lungs)	OAQPS (ATSDR)
p-Dichlorobenzene	106-46-7	0.800000	0.2882	0.0004	Dermal (Skin), Developmental (effects during periods when organs are developing) , Hepatic (Liver), Ocular (Eyes), Renal (Urinary System or Kidneys)	IRIS: Increased liver weights (rats)
Propionaldehyde	123-38-6	0.008000	0.3854	0.0482	Respiratory (From the Nose to the Lungs)	IRIS: Atrophy of olfactory epithelium (rats)
Selenium	7782-49-2	0.020000	0.0008	0.0000	Dermal (Skin), Developmental (effects during periods when organs are developing) , Reproductive (Producing Children), Neurological (Nervous System), Cardiovascular (Heart and Blood Vessels), Hepatic (Liver)	OAQPS (CAL)
Styrene	100-42-5	1.000000	0.2750	0.0003	Hepatic (Liver), Neurological (Nervous System), Ocular (Eyes)	IRIS: Central nervous system effects (humans)
Tetrachloroethylene	127-18-4	0.040000	0.0537	0.0013	Developmental (effects during periods when organs are developing) , Neurological (Nervous System), Respiratory (From the Nose to the Lungs), Renal (Kidneys), Hepatic (Liver)	IRIS: Neurotoxicity (reaction time, cognitive effects) (color vision) (humans)
Toluene	108-88-3	5.000000	1.8042	0.0004	Cardiovascular (Heart and Blood Vessels), Neurological (Nervous System), Respiratory (From the Nose to the Lungs)	IRIS: Neurological effects (humans)
Trichloroethylene	79-01-6	0.002000	0.0370	0.0185	Developmental (effects during periods when organs are developing), Neurological (Nervous System), Ocular (Eyes)	IRIS: Decreased thymus weight (immunotoxicity), increased fetal cardiac malformations (heart malformations) (mice, rats)

AGGREGATE NON-CANCER HAZARD= 26.3789