Air Quality Profile Of Curtis Bay, Brooklyn and Hawkins Point, Maryland

ENVIRONMENTAL INTEGRITY PROJECT

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Revised June 2012

About the Environmental Integrity Project

The Environmental Integrity Project (EIP) is a nonpartisan, nonprofit organization dedicated to the enforcement of the nation's anti-pollution laws and to the prevention of political interference with those laws. EIP provides objective analysis of how the failure to enforce or implement environmental laws increases pollution and harms public health. We also help local communities obtain the protection of environmental laws.

Acknowledgement

Environmental Integrity Project Research Analyst Robbie Orvis and Attorneys Abel Russ and Leah Kelly contributed to this report.

Data Limitations

EIP's analysis of toxic emissions and potential health impacts is based on publicly available data retrieved and analyzed from EPA, state agencies and private companies. Occasionally, government data may contain errors, either because information is inaccurately reported by the regulated entities or incorrectly transcribed by government agencies. In addition, this report is based on data retrieved between August 2011 and February 2012, and subsequent data retrievals may differ slightly as some companies and agencies correct prior reports.

EIP is committed to ensuring that the data we present are as accurate as possible. We will correct any errors that are verifiable.

June 2012 Revision

EIP revised this report in June of 2012 in order to exclude fine particulate matter (PM2.5) data recorded at the FMC Fairfield monitor in Curtis Bay during the year 2008. We did this because we were informed by the Maryland Department of the Environment that this monitor was removed in August of 2008, meaning that the average PM2.5 concentration for that year did not take into account the fall months, during which PM2.5 concentrations tend to be lower than in the summer. We also added language to further distinguish between emissions of toxic air pollutants and concentrations of those pollutants in the ambient air.

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EXECUTIVE SUMMARY

The South Baltimore neighborhoods of Curtis Bay, Brooklyn and Hawkins Point (referred to in this report as the Baybrook Area or Baybrook) have a long history as the focal point of industrialization in Baltimore City. This includes two events in which residents were relocated from the most industrial part of this area because of health concerns. The Baybrook community presently has high mortality (death) rates from heart disease, chronic lower respiratory disease and lung cancer, which are diseases that have been associated with air pollution exposure. Furthermore, 2010 census statistics show approximately 20% of families living below the poverty line in Baybrook, raising environmental justice concerns.

The Environmental Integrity Project (EIP) is issuing this report in order to provide more information to the community and to decision-makers about air pollution and health in Baybrook. However, there is still a great deal of information that is not known, particularly about the cumulative impacts on residents' health of the multiple source of pollution to which they are exposed.

In conducting the research for this report, EIP reviewed air quality information from a number of different sources, including data recorded by ambient (outside) air monitors and models and databases developed by the United States Environmental Protection Agency (EPA) [a].

Key findings are summarized below:

Quantity of Toxic Air Pollution Released in Baybrook[b]

- Each year, from 2005 to 2009, the Curtis Bay zip code was among the top ten zip codes in the country for highest quantity of toxic air pollutants released by stationary (non-mobile) facilities.
- In 2007 and 2008, Curtis Bay ranked *first in the entire country* for quantity of these releases, with 20.6 and 21.6 million pounds released respectively each year. In 2009, it ranked second in the nation after the quantity decreased to 13.8 million pounds.
- In 2010, due to pollution control technology upgrades at two coal-fired power plants, this number decreased to 2.2 million pounds, dropping the Curtis Bay zip code to 74th in the nation out of 8,949[c] zip codes reporting toxic emissions.

[a] This report includes a Data Limitations section at Appendix A that addresses limitations of the different EPA tools used for analysis.
[b] Findings in this section are based on EPA's Toxic Release Inventory (TRI).
[c] This figure does not include emissions from U.S. Territories.

- Even with these reductions, Curtis Bay ranks first in Maryland for emissions of air toxics from stationary sources. The emissions from this area constitute 37% of the toxic emissions in the state and more than 87% of all toxic stationary source emissions in Baltimore City. While emissions of toxic air pollution are not the same thing as the concentrations of those pollutants in the air, the two may be related, depending on a number of factors, including wind and whether the emissions are released from a tall stack.

Pollution Contributing To Heart Disease and Death

- It is likely that an important pollutant contributing to risk of death from heart disease or other causes in Baybrook, is fine particulate matter, or $PM_{2.5}$, which is a criteria pollutant.
- A monitor located in Baybrook recorded the third highest $PM_{2.5}$ concentrations in Baltimore City in 2007, out of six monitors. That monitor was removed in 2008 and has not been replaced
- $PM_{2.5}$ concentrations generally decreased in Baltimore City and in Baybrook between 2003 and 2007. However, average concentrations in Baybrook over that five-year period were among the highest in Baltimore City.
- Based on the most recent emissions data available, from 2008, primary sources of $PM_{2.5}$ in Baltimore City were the Fort Smallwood coal-fired power plants and Sparrows Point Steel Mill. [d] Pollution technology upgrades installed at Fort Smallwood in 2010, as a result of the Maryland Healthy Air Act, have significantly reduced $PM_{2.5}$ emissions, although this facility remains a major source of $PM_{2.5}$ pollution in Baltimore City. The Sparrows Point Steel Mill has reduced its operations recently, which has also reduced its $PM_{2.5}$ emissions.

Pollution Contributing To Non-Cancer Respiratory Effects[e]

Ozone

- Ground-level ozone is likely contributing to risk of adverse respiratory effects in Baybrook.
- Monitoring data is available for ozone from one monitor located in Northeast Baltimore but there is no ozone monitor located in Baybrook.
- The Baltimore City ozone monitor has recorded increasing concentrations of ozone in recent years. In 2011, these levels were higher than air quality standards set by EPA.

[d] Our discussion of PM2.5 includes PM2.5 and PM filterable and condensable emissions.
[e] This section does not address risk for lung cancer, which is addressed in the Cancer section of this report.

Air Toxics

EPA's National Air Toxics Assessment (NATA) estimates different kinds of health risks from exposure to toxic air pollution and indicates the following based on 2005 emissions information, which is the most recent available through NATA:

- Each of the four census tracts within Baybrook ranks between the 87^{th} and the 92^{nd} percentiles in Maryland for highest risk of developing respiratory effects from toxic air pollution. Of the three residential census tracts, two are within the top 90^{th} percentile for respiratory risk. In other words, between 87 and 92 percent of the census tracts in Maryland have less risk of developing respiratory effects from toxic air pollution than those in Baybrook
- Compared with the rest of the United States, each of the four census tracts ranks between the 89^{th} and the 92^{nd} percentiles for highest respiratory risk.
- When looking at which pollutants are contributing to respiratory risk, the primary driver is acrolein, which is contributing nearly 80% of toxic respiratory risk in Baybrook. Other pollutants that are significant contributors to respiratory risk include diesel engine emissions (5%), formaldehyde (5%), acetaldehyde (4%) and chlorine (4%).

<u>Pollution Contributing to Cancer</u>

EPA's National Air Toxics Assessment suggests the following based on 2005 data, which is the most recent available through NATA:

- One of the residential census tracts in Baybrook (250401) ranks in the 91^{st} percentile in the state for risk of developing cancer from toxic air pollution, and another (250402) ranks in the 81^{st} percentile.
- Compared to cancer risk in the United States, all four census tracts in Baybrook rank above the 83^{rd} percentile, and tracts 250401 and 250402 rank in the 89^{th} and 86^{th} percentiles respectively,.
- Over half of the cancer risk in Baybrook is attributable to two chemicals: formaldehyde (38%) and benzene (16%).

It appears that diesel particulate matter (diesel PM) may be the most important carcinogen in ambient air in Baybrook. However, diesel PM is not modeled as part of cancer risk under NATA because EPA has not adopted a value for its strength as a carcinogen (i.e. a cancer potency value). Based on NATA, Baybrook appears to have some of the highest concentrations of diesel PM both nationally and within Maryland. The health effects of diesel PM are discussed on pages 31-32 of this report, and likely sources of diesel PM concentrations in Baybrook are discussed on page 35.

Sources of Air Pollution in Baltimore City

EPA's 2008 National Emissions Inventory (NEI) database, which is the most recent emissions data available, indicates that the emissions that appear to be driving cancer and respiratory risk in Baybrook (acrolein, formaldehye and benzene) are primarily coming from passenger cars, residential wood-burning, and cargo ships, while $PM_{2.5}$ is coming primarily from large stationary sources. Additionally, of the on-road mobile sources of diesel PM, heavy-duty trucks appear to be significant contributors.

Data Limitations

A full discussion of the limitations of the EPA databases and model used to create this report is included in Appendix A. There are a few basic principles that should be kept in mind. First, usually the best kind of information that can be obtained about air quality in a particular neighborhood is data recorded by ambient air monitors. In the present case, because the only monitor recently located in Baybrook was taken down in 2008, we did not have access to this kind of data. Second, two of the EPA tools that we used, NATA and NEI, are based on emissions information gathered in 2005 and 2008 respectively. These are the most recent versions available, and we have noted the likely effect of significant events that have occurred since the information was gathered. Additionally, emissions databases are calculated using emissions factors, which can dramatically underrepresent actual emissions, as has been shown, for example, in studies on emissions from chemical and petroleum tanks, which exist in large numbers near Baybrook. Third, information obtained from NATA is based on modeling of pollutant concentrations and associated health risks. With modeled information, there is always some uncertainty, particularly when analyzing information for a small geographic area like Baybrook.

Recommendations

Residents of Baybrook deserve the same quality of life and health as other communities within Maryland. Steps must be taken to improve the air quality in Baybrook and to fill in the information gaps about air pollution and health in this area of Baltimore.

The final section of this report sets forth EIP's recommendations as steps toward achieving these goals. Briefly, these recommendations are the following:

- Increase ambient air monitoring in the Baybrook Area. This should include replacement of the $PM_{2.5}$ monitor that was removed from the area in 2008, and additional monitors for ozone, acrolein, formaldehyde, and benzene.

- State agencies, such as the Maryland Department of the Environment (MDE) and the Maryland Public Service Commission, that issue environmental permits to large industrial sources of pollution, should consider the cumulative health impacts from multiple sources of pollution in permitting decisions and should prioritize enforcement actions in environmentally overburdened communities like Baybrook. EPA has made clear that state environmental agencies have the legal authority to account for disproportionate environmental and health impacts in permitting and enforcement.

- The Maryland Port Authority (MPA) should produce a comprehensive updated emissions inventory which includes emissions from ships, port equipment and vehicles, and fugitive coal dust emissions. The MPA should also work with MDE to develop a clean air action plan that sets short and long-term goals for reducing emissions, and identifies methods for achieving those goals.

- Industrial facilities located in Baybrook should be required to include, as a term of any new contracts entered into with trucking companies, that all trucks be fitted with diesel particulate filters, which can routinely remove more than 90% of diesel PM emissions from truck tailpipes.[1] The City and State can and should condition any public subsidies flowing to such companies on the inclusion of such a term in new trucking contracts.

- City officials should work with residents and community leaders to re-direct heavy truck traffic away from the residential neighborhoods of Curtis Bay. A key part of this project should be the conversion of Pennington Avenue in Curtis Bay to a 2-way street on which heavy truck traffic is prohibited. This will aid community goals to turn Pennington Avenue into a "Main Street" area where small businesses can flourish and provide badly needed jobs outside of heavy industry.

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Introduction

EIP became interested in the Curtis Bay, Brooklyn and Hawkins Point neighborhoods in South Baltimore while working to reduce pollution on a state-wide basis in Maryland. A large number of pollution sources are located or proposed in these areas, and we were concerned by data showing that very large quantities of toxic air pollutants are released there. Further investigation revealed that there are comparatively high rates of chronic lower respiratory disease, cancer and heart disease, which are diseases that have been associated with exposure to air pollution, in these neighborhoods

Additionally, when working class neighborhoods like Curtis Bay, Brooklyn and Hawkins Point, are disproportionately exposed to pollution, it is often because individuals in those communities have not historically had a voice in decisions that affect their immediate surroundings and their lives. In addition to receiving equal protection under environmental and land use laws, all communities, regardless of affluence, should be made equal partners in environmental decision-making.[2]

As discussed in the history section of this report, it appears that the residents of Curtis Bay, Brooklyn and Hawkins Point have not historically had a voice in many of the decisions that now affect their environment, health and well-being.

On February 2, 2012, EIP held a forum, in coordination with partner groups Chesapeake Climate Action Network and Clean Water Action, in Curtis Bay to listen to residents' concerns about air pollution in their neighborhoods. One problem raised at this forum, which we discuss in this report, was diesel exhaust and other impacts of heavy trucks traveling through residential neighborhoods in Curtis Bay. We will hold another forum during the spring to address potential tools that residents can use to address this and other concerns.

We hope that these community events, as well as this report, will serve as steps toward a sustained partnership with leaders, residents and workers in these communities.

This report is organized into two parts, a community profile and an air quality profile. We have also set forth some preliminary recommendations for gathering additional pertinent information and beginning to improve air quality and health in these neighborhoods.

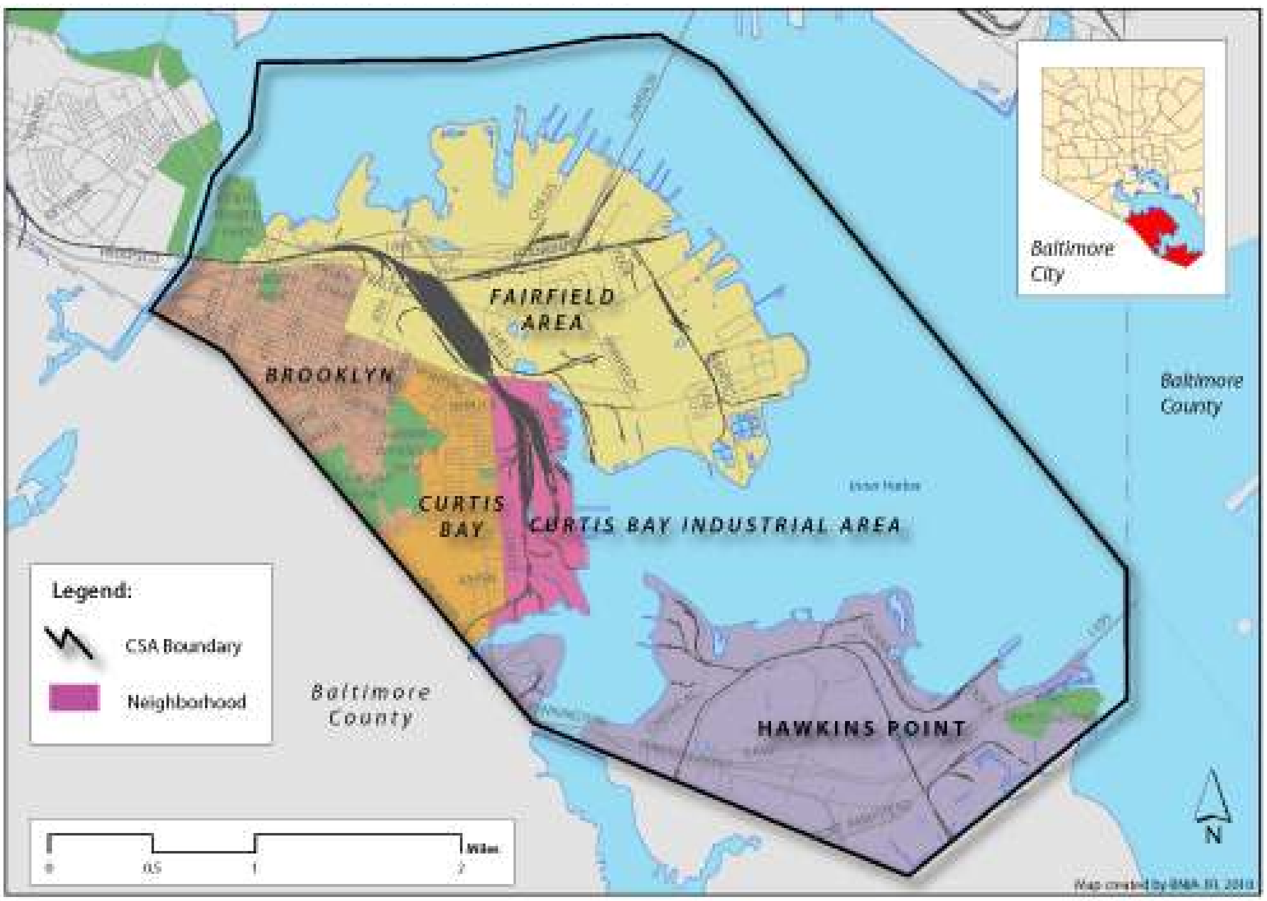
PART 1 – BAYBROOK COMMUNITY PROFILE

Geography

The neighborhoods that are the focus of this report are located in the southernmost part of Baltimore City. These neighborhoods, known as Curtis Bay, Brooklyn, Hawkins Point, Fairfield, and Wagner's Point are collectively referred to in this report as the Baybrook Area or Baybrook. This area can be identified by the four census tracts (250600, 250500, 250401, 250402) or two zip codes: 21225 and 21226. Fairfield, Wagner's Point, and Hawkins Point are primarily industrial areas while Curtis Bay and Brooklyn are primarily residential areas.

Baltimore City, in which Baybrook is located, is not part of any county and is treated as its own county for a number of purposes.

Figure 1: Baybrook Area



History of Industry in the Baybrook Area

The history of Baybrook as the center of industry and manufacturing in Baltimore is long and fraught with conflict.

Up until the early 1800s, Baybrook was primarily farm land due to its separation from the rest of Baltimore City by water. In 1956, the construction of the Light Street Bridge connected Baybrook directly to the rest of the city, paving the way for industry.[3] The bridge was underutilized for several years because of the steep tolls its owners charged for passage. However, the State purchased the bridge in 1878 and eliminated the tolls, significantly increasing the Baybrook Area's connection to the city.[4]

Additionally, in 1882 the Baltimore and Ohio Railroad was extended into Baybrook, allowing railroad access into these neighborhoods. In 1892, a streetcar line was installed across the Light Street Bridge into the area,[5] allowing a large work force to commute there and encouraging industry to locate in the region. These changes led numerous companies to set up shop in or near the Baybrook Area, including the Baltimore Sugar Refinery, the Monarch Engineering and Supply Company, which built smelting furnaces, the National Supply Company, which manufactured bolts and hardware fittings, the Ryan McDonald Manufacturing Company, which built railway construction supplies, and the Baltimore and Ohio Railroad coal and ore shipping facility. This was once the largest such facility in the world and is still in operation today, although it is now owned by CSX Transportation. As these projects were built in the Baybrook Area, workers settled near the facilities, and the population swelled.[6]

The population continued to increase in the early 20th century as the area became a primary manufacturing and industrial center during World War I. In 1918, Baybrook was annexed into Baltimore City as part of a larger annexation of land surrounding the city.[7] An earlier bill put forth in 1912 had been defeated because opponents believed that the residents of the area being annexed should approve the annexation, which was considered unlikely.[8] In 1918, the Maryland legislature passed the Annexation Act of 1918 in response to arguments by Baltimore City leaders that the annexation would keep Baltimore in the top ten urban areas in the 1920 census and would help the City to address increasing industrial needs. The Annexation Act of 1918 allowed annexation of lands surrounding Baltimore City, including Baybrook, without the consent of residents.[9]

When the United States entered World War II, the Baybrook Area became one of the major shipbuilding centers on the East Coast. The immense demand for labor to construct ships for the War – the Baybrook Area alone employed more than 47,000 people and produced over 384 ships by the end of the War – further industrialized, and dramatically increased the population of, the area.[10] By 1943, federally subsidized and private home construction spurred by wartime labor demands led to nearly construction on nearly every square inch of available land.[11]

In the years following World War II, Baybrook gradually became the focal point of industry in Baltimore. In addition to the manufacturing infrastructure left in place after the War, it is also likely that companies flocked to the area because of the construction of the Harbor Tunnel in 1957[12] and Francis Scott Key Bridge in 1977.[13]

In 1966, relocation of residents from an area within Baybrook was proposed for the first time by the City because of a nine-alarm fire at the Continental Oil Company. Thirty two people were injured in this event. Shortly thereafter, City officials proposed to relocate residents of the industrial peninsula, but this proposal did not come to fruition.[14]

In 1971, the City again took steps toward relocating some of the residents living on the Fairfield Peninsula, by budgeting for the relocation after the City designated Fairfield an "Urban Renewal Area." However, this plan was abandoned and the relocation was called off. [15] The trend of disinvestment in the community continued in the 1970s, with the Fairfield community losing access to water in 1972, despite being located adjacent to the Patapsco Wastewater Treatment Plant, and not regaining this access until 1976.[16] While residents continued to wait for the City to agree to help them relocate, [17] a series of accidents and spills took place, which included the overturning of a CSX railroad car in May of 1979, resulting in a spill of 9,000 gallons of sulfuric acid and forcing the evacuation of 700 people.[18] In July of 1979, there was an explosion at the BP Oil Company, and, in 1988, chromium-contaminated soil was discovered at the Patapsco Wastewater Treatment Plant.[19]

Finally, the City agreed to an initial relocation of approximately 100 residents in 1988. This relocation was of the Fairfield Homes community and part of the Old Fairfield community, but did not include any funding for the residents of Wagner's Point, a community located on the southernmost part of the Fairfield Peninsula and also exposed to industrial pollution. Additionally, the values received for the residents' homes tended to be low, the residents were often required to move to an area defined by the City, and many were sent to public housing instead of their own homes.[20]

The inadequacy of the City's relocation policies combined with the continued pollution drove Baybrook Area residents to petition to reverse Baybrook's annexation to Baltimore City in 1991, but the residents were unsuccessful. In the ensuing years, the Baybrook Area continued to bear the brunt of industrial accidents and uncontrolled pollution. Spills and accidents during this time include a 1996 explosion at the FMC plant, a 1997 spill of 100 gallons of toluene (a toxic pollutant) by the FMC Corporation, the 1998 release of a toxic cloud of gas from FMC, a tank explosion at FMC in May of 1998, and an explosion and fireball at a Condea Vista Company plant in October of 1998.[21]

Between 1996 and 1998, the relocation movement picked up steam as residents formed the Fairfield and Wagner's Point Neighborhood Coalition, which was strengthened by collaboration with clinical programs at the University of Maryland Law School. Despite suffering a terrible setback when the Neighborhood Coalition's leader, a woman named Jeannette Skrzecz, passed away from cancer in 1998, residents ultimately obtained a seat at the negotiating table with the City in 1998. In 1999, a deal was struck for residents to receive funds to relocate. The deal included up to $30,000 for each homeowner to relocate and residents of both the Fairfield and Wagner's Point communities were eligible to receive funds. This resettlement has only just concluded, with the last residents moving out in March of 2011.[22]

Today, the list of facilities located in the Baybrook Area includes oil and petroleum processors, two coal-fired power plants, a chemical manufacturing facility, a wastewater-treatment plant, a medical waste incinerator, a major coal shipping terminal, as well as many others. Furthermore, new or expanded facilities continue to be sited here. Examples of modern industrial facilities recently or soon-to-be added to the area include the Energy Answers trash incinerator (which will be one of the largest trash burning incinerators in the country), a coal ash landfill (currently owned by Constellation Power Source Generation, Inc.) and two dredge handling facilities (one in Masonville, the other in Hawkins Point). See Figure 2 below for active facilities with major air permits.

Community groups are still working to address impacts of industrialization in the Baybrook area. To counter heavy truck traffic in residential neighborhoods in Curtis Bay, some community members started a campaign in 2008 to reduce or eliminate the large diesel trucks that are traveling through these neighborhoods to and from the industrial area on the Fairfield Peninsula. Based on counts by residents, these trucks, primarily gas tankers, are traveling through these neighborhoods at a rate of 400 trucks per day, and often up to twenty per hour, or one truck every three minutes. The trucks emit significant exhaust fumes, the health effects of which are discussed below in our report, and also damage roads, cause excessive levels of noise and create serious safety hazards for pedestrians, especially children. Additionally, the presence of the trucks is impeding community goals to convert Pennington Avenue, currently a route used by the trucks, back to a "Main Street" area where small, non-industrial, businesses can flourish, and improve the economies of Curtis Bay and Brooklyn by providing badly-needed jobs that are not associated with heavy industry.

Residents met with representatives of the Baltimore City Department of Transportation in late November of 2011 to discuss these goals and how to achieve re-routing of the trucks and conversion of Pennington Avenue into a main street. The City agreed to perform studies to count the number of trucks traveling along Curtis Avenue, which is another problem route, and to record their speed. At the time that this report was published, the City was planning to survey residents who live along the truck routes as part of their initial investigation into plans to calm traffic. [23]

Figure 2: Active Facilities in Curtis Bay with Major Air Permits[f]

NO.	FACILITY NAME
1	BP PRODUCTS NORTH AMERICA INC CURTIS BAY TERMINAL
2	CITGO PETROLUEM CORP
3	CONSTELLATION - BRANDON SHORES STATION
4	CONSTELLATION - WAGNER STATION
5	CURTIS BAY ENERGY
6	ERACHEM COMILOG INCORPORATED
7	HESS CORP BALTIMORE TERMINAL
8	MOTIVA ENTERPRISES
9	QUARANTINE ROAD LANDFILL
10	SUNOCO PARTNERS MARKETING & TERMINALS LP BALTIMORE TERMINAL
11	US COAST GUARD YARD
12	US GYPSUM CO
13	W.R. GRACE - DAVISON CHEMICAL

[f] This list was created using EPA's Enforcement and Compliance History Online (ECHO) database. Each facility shown is registered with ECHO as having a Major Air Permit, meaning it is classified as a major source of air pollution under the Clean Air Act. Additionally, each facility shown was listed as active in ECHO as of February 27, 2012. Additionally, the Millennium Inorganic Chemicals plant, located on Hawkins Point, was idled in 2009 and, in 2011, announced plans to close by 2013. In 2009, this facility reported 429,317 pounds of toxic air releases. While there were no TRI reported toxic air emissions from this facility in 2010, this facility renewed its Title V air permit in 2010, had an air permit compliance certification test in April of 2011, and continues to discharge waste in water and into a landfill, with numerous violations in the past few years. See endnote 23 for citations.

Racial and Socio-Economic Makeup

In 2010, the Baybrook population was 14,243. 52.1% of Baybrook residents were White, 36.5% were Black or African, 9.8%, were Latino or Hispanic, 1.9% Asian, and approximately 2.3% were at least 2 races or "some other race." This is markedly different from the racial composition of Baltimore City as a whole, which, in 2000, was comprised of almost two thirds Black or African American residents, less than one third White residents a little less than 5% Hispanic or Latino residents, 2.3% Asian residents, and 5.5% at least 2 races or "some other race."[24]

The median household income of the four census tracts within Baybrook was $32,192 in 2010. This was slightly lower than that of than the median household income level in Baltimore City, $32,675, and significantly lower than the United States median income of $51,914 and the Maryland median income of $70,647. In 2010, the percentage of families in Baybrook living below the poverty level was almost twice as high as in the United States, more than three times higher than in Maryland, and also significantly higher than in Baltimore City. Lastly, unemployment in Baybrook was also higher than in the United States, Maryland, and Baltimore City, although not significantly higher than in the City as a whole.[25]

Figure 3: Comparison of Median Household Income

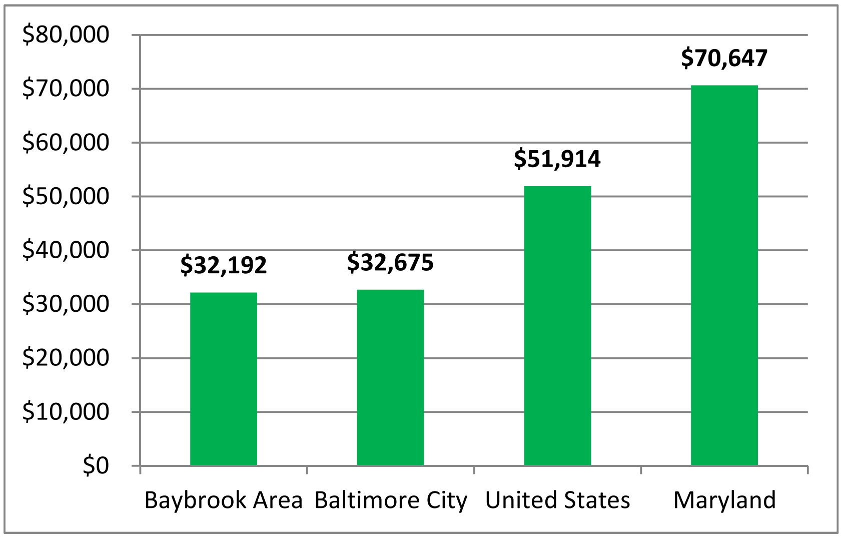
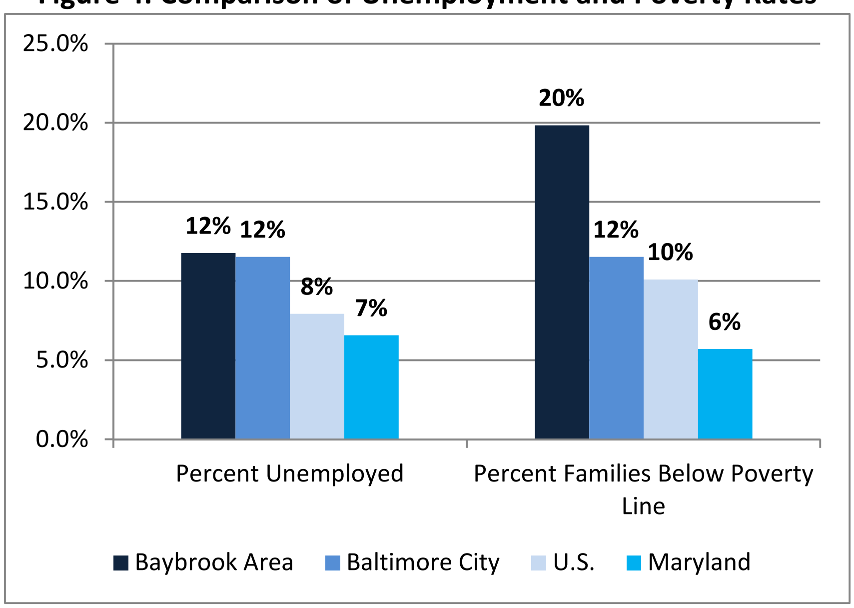


Figure 4: Comparison of Unemployment and Poverty Rates



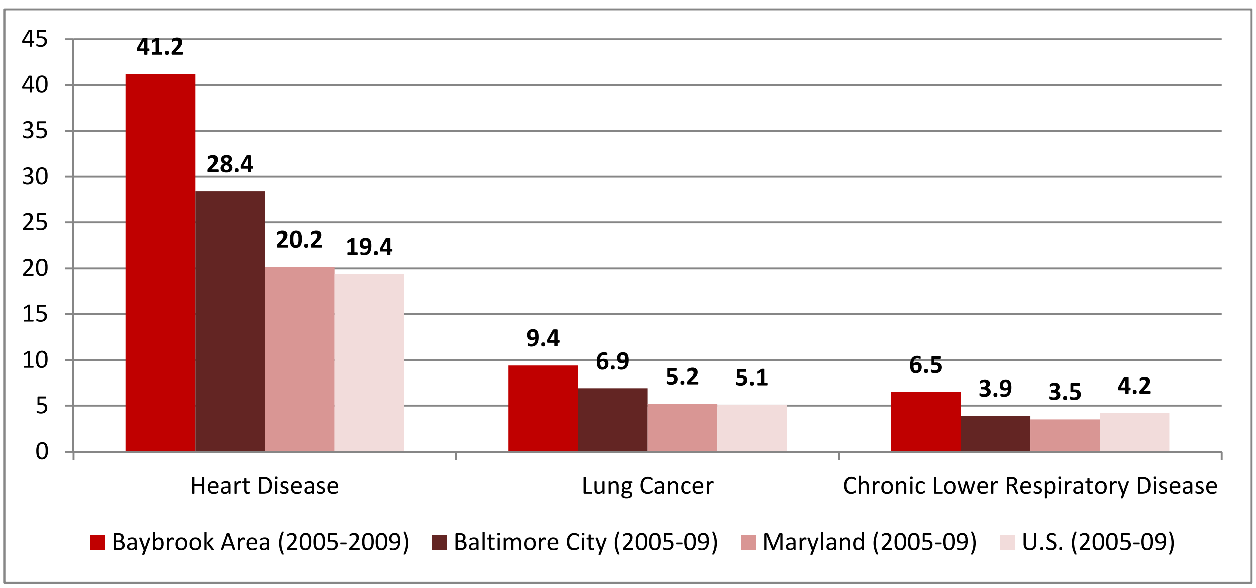
In terms of educational attainment, approximately 3/4 of Baybrook's residents 25 years and older had a high school degree or less, and approximately 6% of Baybrook residents 25 years and older had a bachelor's degree or more. [26]

However, education statistics indicate that the schools in the Baybrook Area are fairly good compared with the rest of the city. While significantly fewer kindergarteners in Baybrook are assessed as "fully ready to learn" compared with the city overall, reading proficiency levels measured in 3rd and 8th grade were higher in Baybrook than city-wide. The juvenile arrest rate among 10-17 year-olds is also substantially lower in Baybrook, approximately 2/3 of the rate in Baltimore City as a whole.[27]

Health

According to a health profile recently released by the Baltimore City Health Department, the Baybrook Area has notably high rates of mortality (death) from certain diseases that have been linked[28] with exposure to air pollution.[29] The profile reveals that the rates of mortality in Baybrook between 2005 and 2009 from heart disease, lung cancer, and chronic lower respiratory disease[g] were among the highest mortality rates for these diseases in Baltimore City.[30] These results are particularly troubling in light of the fact that Baltimore generally fares worse than the rest of the state and the rest of the country in the same health outcomes. Figure 5 below compares the mortality rates set forth in the Baybrook Area Health Profile with

Figure 5: Comparison of Baybrook Area Specific Mortality Rates per 10,000 to Baltimore City, Maryland, and United States



[g] Chronic lower respiratory disease is a category of diseases that affect the lower respiratory tract and includes asthma, emphysema, chronic bronchitis and Chronic Obstructive Pulmonary Disease (COPD).

city, state and national mortality statistics.[31] This figure shows that the rate of heart disease mortality in the Baybrook Area is more than twice the national and state rates. Mortality rates from lung cancer and chronic lower respiratory disease were also notably higher in Baybrook.

Additionally, while we could not locate asthma statistics for smaller areas within Baltimore City, statistics from the Maryland Asthma Control Program show that the City, as a whole, has the highest rates of adult asthma prevalence, asthma-related hospitalization and asthma-related mortality in the state.[32] Asthma-related hospitalization in Baltimore City in 2009 was more than double the Maryland rate of hospitalization. Asthma-related mortality in Baltimore City in 2005-2009 was also more than double the Maryland mortality rate over the same time period. Adult asthma prevalence (the number of adults with asthma divided by the adult population) in 2007-09 was 12.4% in Baltimore City, compared to a statewide average prevalence of 9%. We assume that asthma prevalence in the Baybrook area is similar to that in Baltimore City as a whole.

Past Studies Of Air Pollution and Health in Baybrook

Two studies of air pollution and health in Baybrook have been conducted in the past. One is a Johns Hopkins study of exposure to Volatile Organic Compounds (VOCs), and the other is an EPA study of large point sources.

Volatile organic compounds, or VOCs, are a group of chemicals from natural and man-made sources that easily change from liquid to gas at room temperature. Benzene and formaldehyde are familiar examples. The study conducted by Johns Hopkins University researchers looked at exposure to 15 VOCs in the Baybrook Area and in the central Baltimore neighborhood of Hampden.[33] The researchers compared measured and modeled outdoor concentrations to indoor concentrations and "personal exposures," which were measured by personal badges worn by local residents for 72 hours. The results of the study were published in 2005. In general, this study found that exposure to VOCs in the Baybrook Area was similar to exposure in the Hampden neighborhood. The study also found that indoor exposures to the measured VOCs were higher than outdoor exposures, which suggests that there are significant indoor sources of VOCs in both Baybrook and Hampden. These indoor sources include secondhand smoke, paints and varnishes, and drinking water disinfection byproducts, among others. Finally, the study estimated the cumulative cancer risk of the 15 VOCs in Baybrook. The risk estimate based on measured outdoor concentrations was roughly 4 in 100,000. The risk based on personal exposure was roughly 18 in 100,000. The principle limitation of this study is that it did not assess exposure to any pollutants other than VOCs. In fact, it did not even assess all VOCs, omitting formaldehyde, which the NATA model estimates to be a major cancer risk driver (discussed fully below in the Air Quality Profile section of our report).

In the late 1990s the U.S. EPA conducted a community-based air quality screening project in the Brooklyn/Baybrook Area[h] as a case-study for further community-based air quality research.[34] The project was similar in some ways to the National Air Toxics Assessment (NATA), which we discuss in detail below, but was much more limited in scope. Specifically, the project only evaluated emissions of twenty-nine chemicals from 125 facilities in the neighborhood. Of these twenty-nine, EPA concluded that only benzene posed a significant health risk by itself. The study did not find, however, that other chemicals and other sources were not a problem, and it left critical questions unanswered: First, the study did not include many important pollutants. Polycyclic aromatic hydrocarbons and acrolein, for example, both appear to present significant risks based on newer information. Second, the study did not examine all sources of

[h] The EPA project focused on the neighborhoods of Brooklyn/Brooklyn Park, Cherry Hill, Curtis Bay, and Wagner's Point.

pollution, notably omitting mobile sources and sources outside of the study area. Third, the study did not estimate the cumulative impact of multiple chemicals, which is a crucial issue affecting health in an area exposed to multiple sources of pollution. The NATA model, discussed in detail below, helps to address many of these lingering questions.

PART 2 - AIR QUALITY PROFILE

Introduction

EIP has reviewed information from a number of different sources in order to paint a picture of the air quality in Baybrook. We have presented our findings based on the likely health effects of the pollutants for which information was available to us. The first section of this profile addresses the amount of toxic air pollution released in the Baybrook area. We then discuss what we know about pollutants that contribute to heart disease and death, pollutants that can cause harmful respiratory effects, and pollutants that can cause cancer. At the end of this profile, we identify activities in Baltimore that are likely contributing large amounts of key pollutants affecting health in Baybrook, and we set forth recommendations for improving air quality and gathering additional information.

In general, we have found that, when we are able to rank Baybrook against other areas of the state and the country, it has some of the worst air quality in both. This is true when it comes to the quantity of toxic air pollutants released by stationary sources in Baybrook and also true when it comes to respiratory and cancer risks attributable to toxic air pollution. Additionally, Baybrook was registering some of the higher levels of fine particulate matter ($PM_{2.5}$), a pollutant which can have significant health effects, in Baltimore City before the $PM_{2.5}$ monitor was removed from the neighborhood in 2008. Although city-wide $PM_{2.5}$ concentrations have decreased since 2008 due in part to reduced emissions from two major industrial sources, a monitor should still be located in Baybrook because levels recorded there were in the top half of those recorded in the City before the monitor was removed, and even small differences in $PM_{2.5}$ levels can have significant health impacts.

It should also be noted that Baltimore City air quality is generally poor. Perhaps one indicator of poor quality is the fact that, as discussed in the health section of our report above, Baltimore City asthma hospitalization and death rates are the highest in Maryland, and have been twice the Maryland rates in recent years. EPA has found that Baltimore is not attaining federal air quality standards for ground-level ozone, and, as discussed in the ozone section below, ozone levels in Baltimore City have been generally increasing in the past several years. Fine particulate matter levels have generally been decreasing, and EPA has recently proposed to find the Baltimore Area in attainment with federal standards for fine particulate matter.[35,i] However, studies have shown that even levels below the federal air quality standards can cause harm.[36]

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[i] Earthjustice and EIP have objected to this proposal because of the insufficiency of the monitoring data on which it is based.

An important fact to keep in mind while reading this profile is that there are two groups of pollutants: toxic air pollutants and criteria pollutants. Toxic air pollutants are emitted in smaller amounts, and, therefore, are generally measured in pounds. Criteria pollutants, on the other hand, are emitted in greater amounts and measured in tons.[j] The EPA develops federal air quality standards[k] for criteria pollutants based on concentrations that have been found harmful to human health. EPA does not establish legally enforceable health-based air quality standards for most toxic air pollutants. Because of this, less ambient air monitoring is generally done for air toxics, and we rely more heavily on EPA tools and models to assess the effects of air toxics on Baybrook.[l]

QUANTITY OF TOXIC AIR EMISSIONS RELEASED IN BAYBROOK

One of the first databases that EIP reviewed when looking into air quality in Baybrook was EPA's Toxic Release Inventory (TRI),[37] which stores annual estimates of toxic emissions from stationary sources and can be searched by zip code and by facility.

One way to evaluate an area using TRI is to simply add up the pounds of chemicals released in the zip codes within that area. While this does not provide concentrations of pollutants in the air over time, it can be related to such concentrations, depending on how much the emissions disperse, and may influence the likelihood that the zip code will be exposed to "spikes" in pollution, i.e. high levels of pollution for short time periods. When adding up the pounds of chemicals released, we can see that, in recent years, Baybrook has had some of the highest quantities of toxic emissions from facilities in the nation. From 2005 to 2009, the Curtis Bay zip code, 21226, ranked among the top ten zip codes in the country for quantity of air toxics released. In fact, in 2007 and 2008, Curtis Bay ranked *first in the entire country* for toxic air pollution from stationary sources, with 20.6 and 21.6 million pounds released respectively each year. More recently, the quantity of toxic releases has decreased to 13.8 million pounds in 2009, dropping 21226 to second in the nation for that year. In 2010, this number dropped to 2.2 million, dropping the Curtis Bay zip code to 74th in the nation. However, Curtis Bay remains the top zip code in Maryland, even with the recent reductions in 2010.

[j] While there are only six criteria pollutants (particulate matter, ozone, carbon monoxide, lead, nitrogen dioxide and sulfur dioxide), there are over 180 toxic air pollutants.

[k] These federal standards are called National Ambient Air Quality Standards or NAAQS.

[l] Two HAP monitors are located in Baltimore – one in downtown and one slightly north of downtown. However, of the three pollutants we have identified as contributing most to cancer and respiratory, only one, benzene, is measured by these monitors.

Figure 6: Map of 21225 and 21226 Zip Codes

These reductions are primarily the result of upgrades to the pollution control technology at the Fort Smallwood Complex, two coal-fired power plants located immediately south of Baybrook in Anne Arundel County. However, even with these reductions, emissions from this zip code constitute 37% of the toxic emissions in the state and *more than 87% of all toxic stationary source emissions in Baltimore City*[m]*.* Furthermore, even with the 2010 reductions, Curtis Bay still ranks first in Maryland for most toxic releases from stationary sources. It also ranks 74th in the nation– out of a total of 8,949[n] zip codes reporting toxic emissions – and is therefore above the 99th percentile in the country for highest quantity of toxic releases.

Another way of evaluating toxic releases in an area is to use TRI in conjunction with toxicity weights, which measure how toxic a pollutant is to human health, as each pollutant is not equally toxic to people.[o]

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[m] Our calculation of toxic emissions from stationary sources in Baltimore City includes toxic emissions from two facilities, the Ft. Smallwood Complex (two coal fired-power plants) and the Sparrows Point steel mill, which are not technically located in Baltimore City but which are significant sources of toxic pollution and located immediately adjacent to the City borders.

[n] This number does not include U.S. Territories.

[o] Toxicity weights are numerical weights assigned to chemicals based on each chemical's most sensitive health effect, and provide a rough ranking of toxicity. For example, the toxicity weights for acrolein and benzene, both very toxic, are 180,000 and 28,000, respectively, while many other chemicals have weights of less than 100. "Toxicity-weighted emissions" are chemical-specific emissions multiplied by chemical-specific toxicity weights.

When accounting for toxicity in this way, Curtis Bay still ranks among the top zip codes in the country for toxic air emissions. From 2005 to 2009, Curtis Bay was consistently above the 98th percentile for toxicity-weighted emissions, with this number dropping slightly to the 96th percentile in 2010. In other words, despite a nearly 90% reduction in releases of toxic air pollution, and a 77% reduction in toxicity-weighted emissions from peak levels in the last five years, stationary sources in Curtis Bay still emit more toxic air pollution than 99% of the zip codes in the country, and more toxicity-weighted air pollution than 96% of the zip codes in the country.

Table 1: Stationary Source Toxic Air Emissions Reported to the Toxics Release Inventory in 21226 Zip Code Relative to Other Zip Codes in the U.S.

Year	Total Air Emissions		Toxicity-Weighted Air Emissions	
	Rank	Percentile	Rank	Percentile
2005	7	99.93%	70	99.27%
2006	9	99.91%	135	98.58%
2007	1	99.99%	72	99.24%
2008	1	99.99%	104	98.88%
2009	2	99.98%	108	98.80%
2010	74	99.17%	289	96.77%

HEART DISEASE AND DEATH

It is likely that an important pollutant contributing to risk of death from heart disease or other causes in Baybrook is fine particulate matter, or $PM_{2.5}$, which is a criteria pollutant. Air monitoring data from Baltimore City shows $PM_{2.5}$ concentrations decreasing throughout the city, although, in 2007, a monitor located in Baybrook recorded the third highest average concentration, out of six monitors located in the city. That monitor was removed in August of 2008, and there is currently no $PM_{2.5}$ monitor located in Baybrook.[p]

Fine Particulate Matter

Health Effects of Fine Particulate Matter

Particulate matter (PM) is a "mixture of solid particles and liquid droplets found in the air . . . and can be composed of many types of materials and chemicals."[38] PM is produced in many industrial processes, primarily during combustion (e.g. the burning of coal to produce electricity or the burning of gasoline in cars). Recent studies have shown that PM exposure in the U.S. may cause excess deaths that number in the tens of thousands per year, and many more cases of illness.[39]

While PM ranges in size, $PM_{2.5}$, meaning PM no larger than 2.5 micrometers in diameter (also known as "fine particulate matter" or "fine PM"), is of particular concern because it can lodge deep in the lungs. For the purposes of this report, emissions of $PM_{2.5}$ includes condensable particulate matter, which is usually formed by the cooling and condensing of non-particulate compounds and is often reported separately from, or as a subcategory of, $PM_{2.5}$.[40] Condensable PM is important because it is almost entirely a form of $PM_{2.5}$.[41] Fine PM has been linked to a range of symptoms like premature mortality, reduced lung function, and aggravation of respiratory and cardiovascular disease like asthma and heart attacks.[42] Children and older adults are particularly susceptible to suffering these health effects when exposed to fine PM.[43]

Two ongoing epidemiological studies[q] have attempted to calculate the impact of increasing concentrations of $PM_{2.5}$ on mortality, or rates of death. A recent analysis of one of

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[p] The FMC Fairfield monitor was located in Curtis Bay at the site of the old FMC Fairfield chemical plant, and was removed in August of 2008 due to demolition of the plant. Because readings were available for only part of 2008, we have not used data from this year.

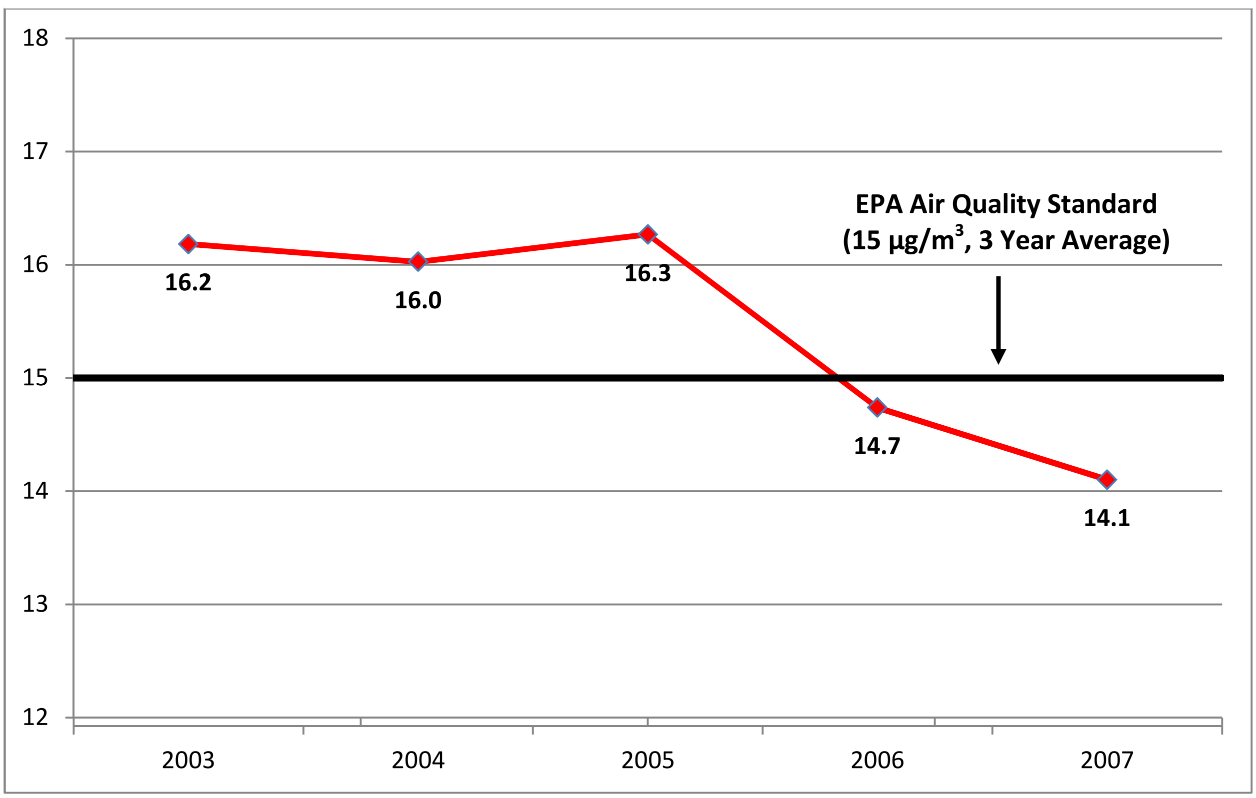
[q] These studies are particularly useful because they were conducted with a prospective cohort design. A prospective cohort study selects a group of people to study (a cohort), collects vital information about each individual in the cohort, and tracks the cohort over time in order to collect information about health outcomes

these studies, known as the American Cancer Society Study, found that an increase of 10 μg/m^3 (micrograms per cubic meter) in $PM_{2.5}$ was associated with increases of 4% in mortality from all causes, 6% in mortality from cardiopulmonary disease, and 8% in mortality from lung cancer.[44] A follow-up analysis determined that the largest cardiopulmonary risk estimate was for mortality from ischemic heart disease (including heart attacks).[45] The second study, known as the Six Cities Study, estimated that the same increase in $PM_{2.5}$ is associated with increases of 16% in mortality from all causes, 28% in mortality from cardiovascular disease, and 27% in mortality from lung cancer.[46]

Concentrations of Fine Particulate Matter in Baybrook

The most recent ambient air monitoring data available for $PM_{2.5}$ show concentrations that were gradually decreasing. However, recorded concentrations were higher in Baybrook

Figure 7: 2003-2007 Average Annual $PM_{2.5}$ Concentrations at FMC Fairfield Monitor[r]



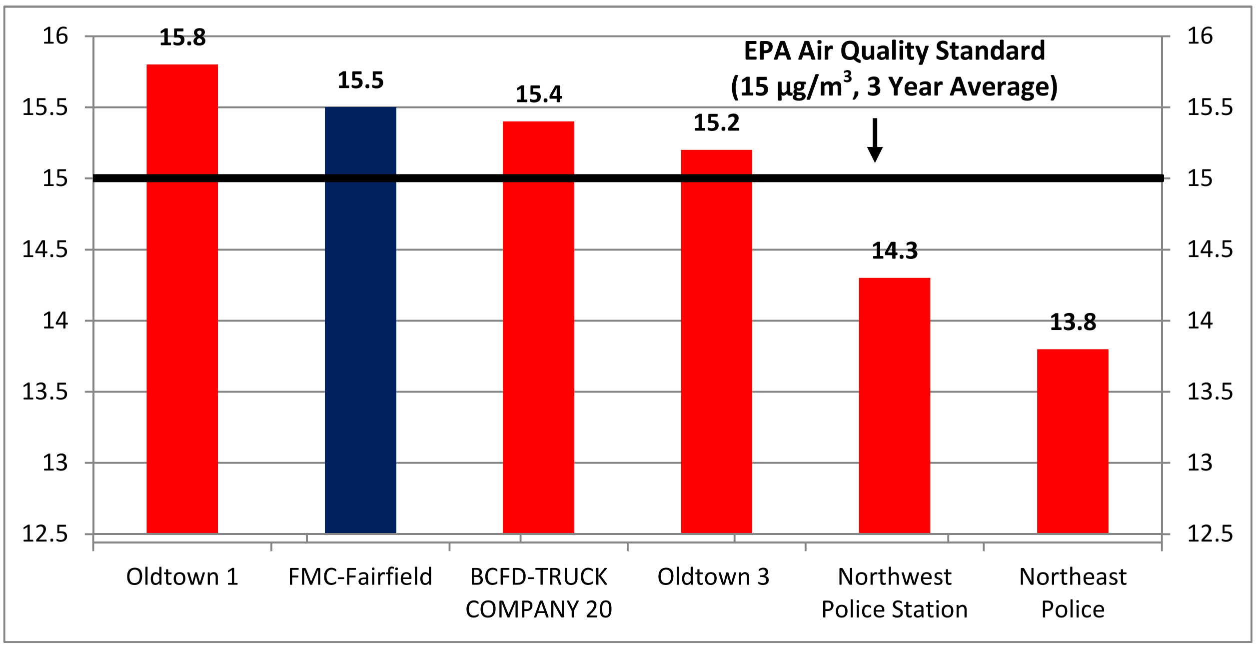
(e.g., disease incidence or mortality) and risk factors (e.g., exposure to air pollution). The two studies discussed here have been following their cohorts since the late 1970s and early 1980s.

[r] The EPA's air quality standard is based on annual averages which are then averaged over a 3-year period. Our chart at Figure 7 shows the annual average not averaged over 3 years, in order to provide the most recent information about trends in recorded PM2.5 levels in Baybrook.

than other areas of Baltimore City.[47]

Annual ambient air monitoring data for $PM_{2.5}$ in the Baybrook Area is available only through 2007. This is because, in August of 2008, the Baybrook monitor, which was located at the FMC Chemical Corporation on the Fairfield Peninsula, was taken down due to demolition of the FMC facility and was not replaced. We have omitted the 2008 data from our analysis because we do not have an entire year's worth of data from the FMC-Fairfield monitor.[s]

Figure 8: 2003-2007 Five-Year Average $PM_{2.5}$ Concentrations in Baltimore City



In 2007, before it was removed, this monitor recorded $PM_{2.5}$ concentrations that met federal air quality standards. However, the $PM_{2.5}$ concentrations measured in Baybrook that year were the third highest of any area in Baltimore City.[t] Similarly, the Baybrook monitor recorded a higher five-year average $PM_{2.5}$ concentration than all but one other monitor in the city.[u] Lastly, it is important to note that studies have shown adverse health effects below the federal air quality standard of 15 µg/m^3. The Clean Air Scientific Advisory Committee, an

[s] We have also excluded from our analysis the data that was recorded by a second PM2.5 monitor located at the FMC-Fairfield site until August of 2008. Although this monitor was recording higher levels of PM2.5 in 2007, it was taking substantially fewer readings per year than the other monitors located in Baltimore City.

[t] PM2.5 air monitors from 2003-2007 include the following: FMC-Fairfield (24-510-0035), Oldtown 1 and Oldtown 3 (24-510-0040), BCFD – Truck Company (24-510-0008), Northwest Police Station (24-510-0007), and Northeast Police (24-510-0006)

[u] Five year averages include data from 2003-2007. Data represents the five most recent years for which we have complete annual data in Baybrook.

independent panel of scientists that provides EPA with advice on setting federal air quality standards, after considering new evidence, determined that $PM_{2.5}$ may cause adverse health effects at annual average concentrations below 15 $\mu g/m^3$. Based on the new information, they asked EPA to set a lower annual average standard.[48]

To illustrate the real-world health effects of the differences in $PM_{2.5}$ levels within the City, we can compare the average $PM_{2.5}$ concentrations measured by the Baybrook monitor from 2003 through 2007 to average concentrations recorded at the Northeast Police monitor (located in Northeast Baltimore) during the same time period. Over five years, the difference in average ambient $PM_{2.5}$ was 1.7 $\mu g/m^3$. Based on the American Cancer Society Study and Six Cities Study, described above, a difference of 1.7 $\mu g/m^3$ results in a change in the overall mortality rate of roughly 1-3 deaths per 10,000 people.[v]

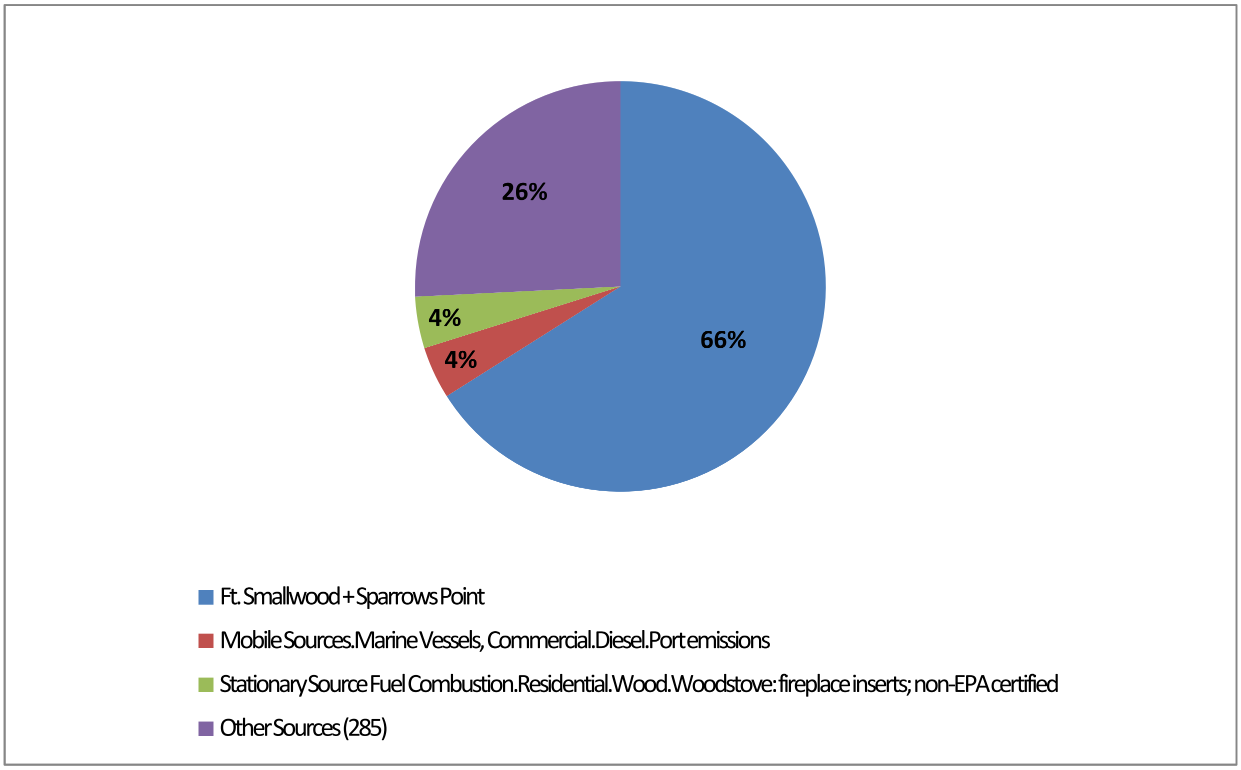
Despite the fact that it was registering among the higher $PM_{2.5}$ concentrations in the City, the Baybrook monitor was removed in August of 2008. The air monitoring network in Baltimore City is now insufficient to provide the kind of information needed to understand the impacts of $PM_{2.5}$ on health in the Baybrook community. The closest $PM_{2.5}$ monitor to the Baybrook Area is now the BCFD – Truck Company 20 monitor, which is more than 4 miles from the FMC site, and the remaining Baltimore City $PM_{2.5}$ monitors are located 4.5-9.5 miles from the FMC Site. This monitoring network does not presently provide adequate information about $PM_{2.5}$ levels in Baybrook, and a $PM_{2.5}$ monitor should be placed in Baybrook again.

[v] Estimates based on changes in mortality of 0.4%/ug/m^3 (Pope et al. 2002) and 1.6% ug/m^3 (Laden et al. 2006).

Sources of Fine Particulate Matter in Baltimore City

In order to provide information about sources of $PM_{2.5}$ that are likely affecting concentrations of $PM_{2.5}$ measured in Baybrook, we used an EPA emissions database called the National Emissions Inventory (NEI), which contains estimates of the quantities of pollutants emitted by every outdoor air pollution source in the country.[49] The latest version of NEI, which was published in 2011, was last updated using 2008 emissions information. Additionally, the NEI only provides information down to the county level, and does not have more specific information for smaller geographic units (such as town or zip code). Thus, estimates of sources of Baltimore City emissions are available, but this information is not available for emissions in Baybrook specifically. Figure 9, below, shows the breakdown of sources emitting $PM_{2.5}$ in Baltimore City in 2008.[w]

Figure 9: Sources of $PM_{2.5}$ (2008 NEI)



Based on NEI, it appears that fine particulate matter[x] emissions in Baltimore City in 2008 were being driven by large stationary sources, primarily the Fort Smallwood Complex and the

[w] As with any database or model, there are a number of caveats that must be kept in mind with respect to analyses based on NEI. Our Data Limitations section, in Appendix A, sets forth limitations with respect to NEI.

[x] Fine particulate matter or $PM_{2.5}$ includes $PM_{2.5}$ and PM condensable.

Sparrows Point steel mill. Together, in 2008, Fort Smallwood and the Sparrows Point steel mill accounted for a total of 66% of $PM_{2.5}$ emissions in or immediately adjacent to Baltimore City[y]. Commercial diesel marine vessels (4%), residential wood burning (4%), and 285 "other" sources made up the rest.

It should be noted that the 2010 upgrades at Fort Smallwood have significantly reduced the amount of particulate matter, as well as particulate matter precursors such as sulfur oxides and nitrogen oxides, being emitted from this plant and will likely reduce ambient concentrations of $PM_{2.5}$ in Baybrook and in Baltimore City as a whole. These upgrades are an important step in improving air quality in this area, and are to be applauded. However, this does not change the fact that a $PM_{2.5}$ monitor should be located in Baybrook, given that $PM_{2.5}$ concentrations recorded in Baybrook were the highest in the City before the Baybrook monitor was removed and that even small differences in $PM_{2.5}$ levels can have significant health impacts.

It should also be noted that the NEI analysis of $PM_{2.5}$ emissions sources located in Baltimore City does not account for all sources of $PM_{2.5}$ that may be affecting Baltimore City and/or the Baybrook Area. $PM_{2.5}$ is known for travelling long distances. In fact, some of the $PM_{2.5}$ in the air in Baltimore has been shown to travel from as far away as the Ohio River Valley, where it is produced by combustion of coal to generate electricity.[50] It is not clear how much of the ambient $PM_{2.5}$ in Baltimore City or Baybrook specifically is from local sources.

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[y] $PM_{2.5}$ emissions include emissions from facilities along the border of Baltimore City, specifically the Ft. Smallwood Complex coal-fired power plant and Sparrows Point steel mill. While these are not located within in the borders of Baltimore City, they are directly adjacent to the city, and in the case of the Fort Smallwood plant, immediately adjacent to the Baybrook community. Because they are such large sources and likely contribute to the concentration of $PM_{2.5}$ in Baybrook, we have included them in our analysis.

RESPIRATORY EFFECTS (NON-CANCER)

There are a few types of information available regarding risk in Baybrook from harmful respiratory effects of air pollution. The first is monitoring data from Baltimore City for ground-level ozone, a criteria pollutant. This data shows that concentrations of ozone are increasing each year and are above health-based federal air quality standards. For air toxics, there is limited monitoring data[z], and we have relied on tools and databases developed by the EPA. These tools indicate how Baybrook compares to other areas in terms of toxic respiratory risk and where that risk is coming from. They suggest that toxic respiratory risk is very high in Baybrook compared to the rest of Maryland and to the rest of the country, and that it is being driven by the chemical acrolein.

Lung cancer, which affects the respiratory tract, is not addressed in this section but is addressed in the following section on cancer. Additionally, it should be kept in mind that chemicals discussed in the other sections of this report, including $PM_{2.5}$ (discussed in the heart disease and death section), diesel PM, and formaldehyde (discussed in the cancer section) can also have adverse respiratory effects.

Ozone

Health Effects of Ozone

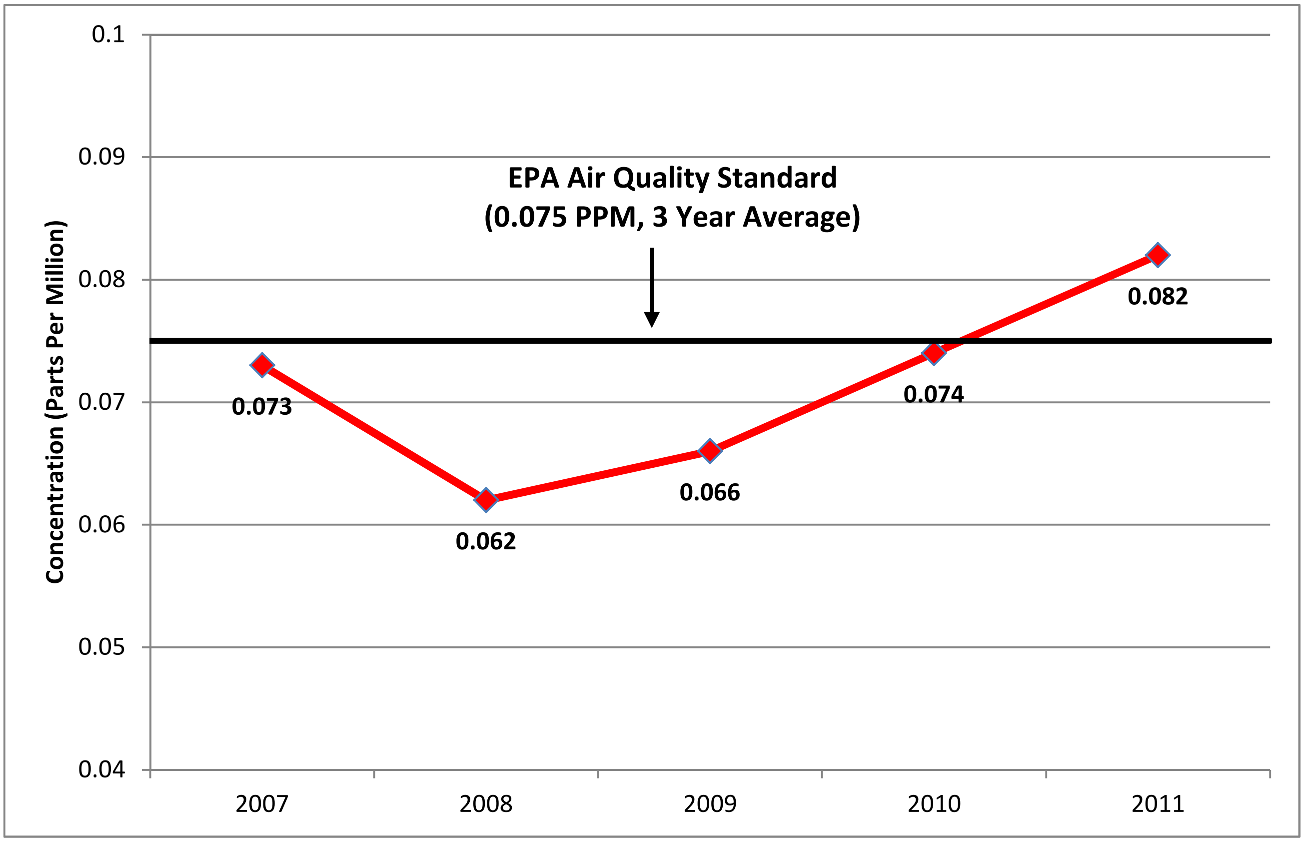
Ground-level ozone, which is the type that is harmful to human health, is formed by the reaction of nitrogen oxides (NO_x) and volatile organic chemicals (VOCs) in the presence of sunlight.[51] Because of this, ozone is more problematic in the summer. "Motor vehicle exhaust and industrial emissions, gasoline vapors, and chemical solvents as well as natural sources emit NO_x and VOC[s] that help form ozone."[52]

The health effects of ground-level ozone include aggravation of chronic lung diseases (such as asthma, emphysema and bronchitis), increased susceptibility to respiratory illnesses (including bronchitis and pneumonia), airway irritation, coughing, pain when breathing deeply, and even permanent lung damage after repeated exposures. The people most vulnerable to ozone exposure are children, older adults, people who are active outside, and people with lung disease (especially children with asthma).[53]

[z] There are two air toxics monitors in Baltimore City. However, they do not measure for two of the three toxic pollutants that appear to be of most concern in Baybrook: formaldehyde and acrolein.

Ambient Air Levels of Ozone

Figure 10: Peak Ozone Concentrations at Baltimore City Ozone Monitor



Concentrations of ground-level ozone have been increasing in Baltimore City. The larger Baltimore Area that EPA looks at when it assesses compliance with federal air quality standards, which consists of Baltimore City and five counties, is not attaining those standards for ozone.[54] Surprisingly, the one ozone monitor in this area that is located within the Baltimore City limits has recorded the lowest ozone concentrations in the Baltimore Area and, up until 2011, those levels were below air quality standards. This monitor, located a little over 4 miles northeast of the city center and 6.8 miles from the Baybrook Area (from the old FMC $PM_{2.5}$ monitor site), has recorded annual average ozone concentrations that have been gradually increasing. In 2011, the Baltimore City monitor registered an ozone concentration of 0.082 parts per million (ppm), which is above the 2008 ozone air quality standard of 0.075 ppm.[aa]

[aa] The ozone air quality standard is expressed as the 3-year average of the annual fourth-highest daily maximum 8-hour concentration recorded. In other words, 8-hour concentrations of ozone are measured, and the maximum level recorded each day is logged. The fourth highest such reading is then used to represent each year and is averaged with other years within a 3-year block. The 0.082 ppm figure for 2011 is the 4th highest daily maximum

As stated above, there is no ambient air monitor for ozone in or near the Baybrook Area so it was not possible to assess exposure to ozone in the Baybrook neighborhoods for this report. However, given that ozone levels are generally increasing in the Baltimore Area, including in Baltimore City, it appears likely that ground-level ozone levels are also increasing in Baybrook. Additionally, on February 1, 2012, EPA reclassified the Baltimore Area (which also includes concentrations from monitors in five other counties) from a moderate nonattainment area to a serious nonattainment area for the 1997 8-hour ozone air quality standard, which is 0.080 ppm.[55] As with $PM_{2.5}$, location of an air quality monitor in, or closer to, the Baybrook Area, would help to assess ozone levels in that neighborhood with more accuracy.

Figure 11: Baltimore City Ozone Monitor, 2011

Air Toxics

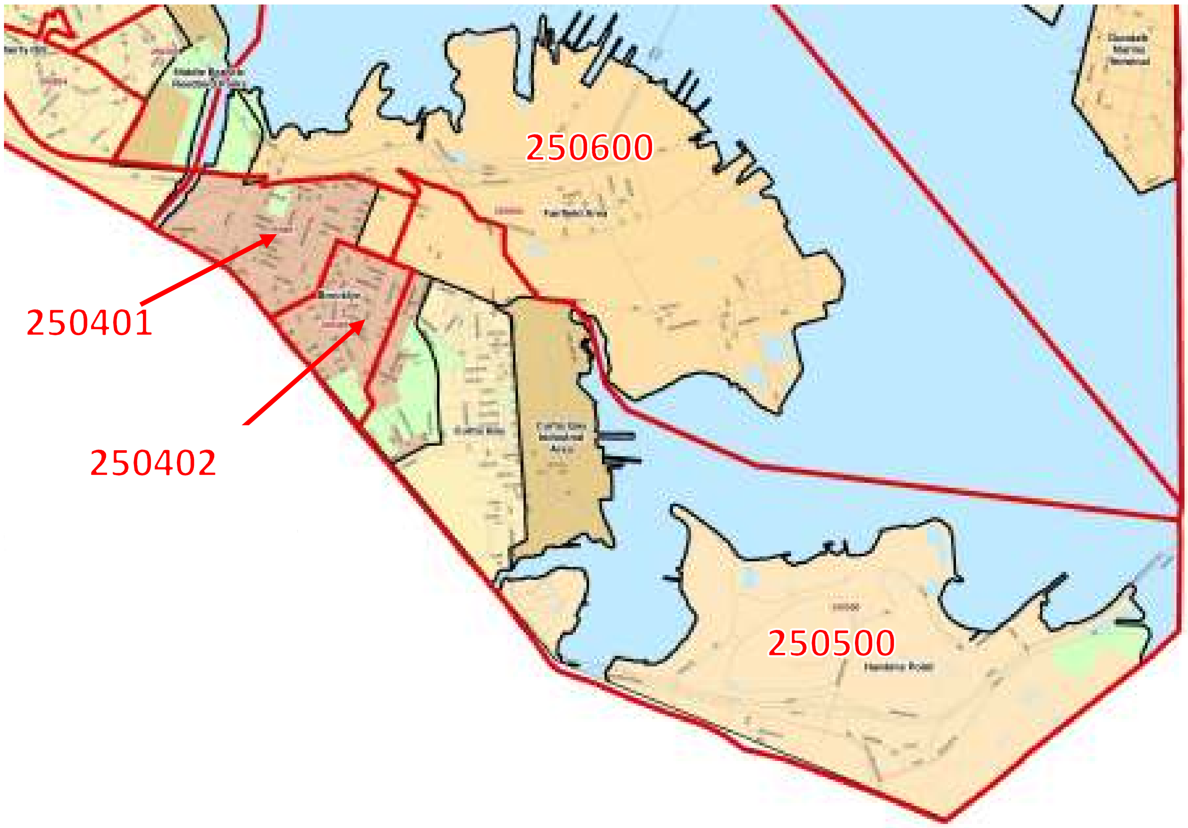
EIP has assessed the possible health effects of toxic air pollution in Baybrook by using an EPA tool, called the National Air Toxics Assessment (NATA), which models air quality and associated health risks in different census tracts based on an inventory of air emissions.[56]

One type of risk modeled by NATA is the threat of developing a respiratory disease, which can include health impacts like reduced lung function and tissue damage in the lungs and upper airways. NATA allows for a comparison of the risk of developing these effects within a certain census tract against the risk in other census tracts. NATA also allows for a breakdown of the pollutants and emissions sources that are contributing to respiratory risk. There are a number of limitations that must be kept in mind with respect to the NATA model. For example,

daily 8-hour reading taken in 2011 but has not been averaged with figures for 2010 and 2009 (which are 0.074 and 0.066 respectively). Peak concentrations in Figure 10 represent annual fourth-highest daily maximum 8-hour concentrations

NATA is not meant to give a precise risk estimate, but allows a rough ranking of census tracts.[bb] Additional limitations of NATA are listed in detail in Appendix A.

Figure 12: Map of Baybrook Census Tracts



Respiratory Risk in Baybrook Compared To Maryland and The United States

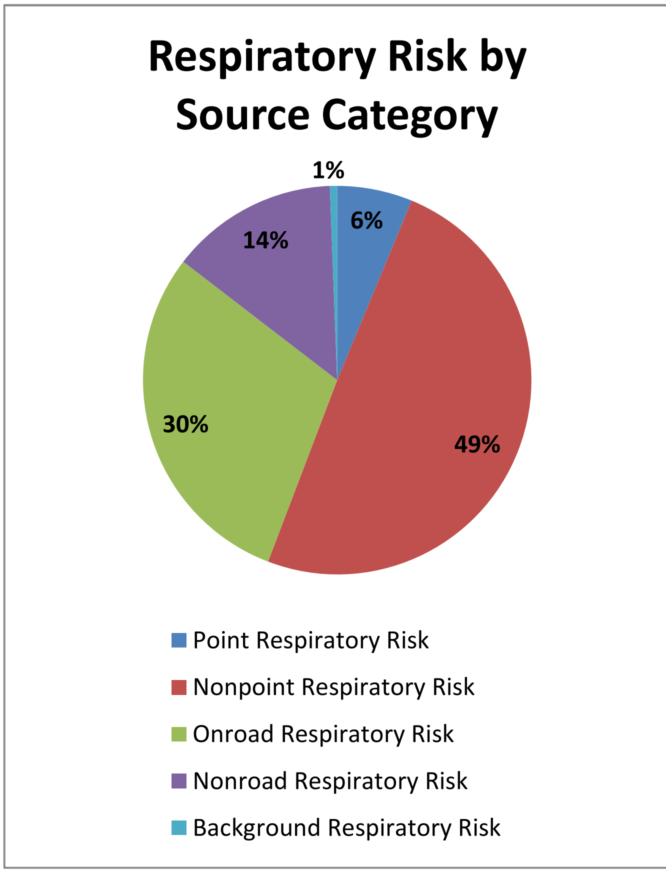
NATA shows the Baybrook Area as being among the worst in the state and the country for respiratory risk caused by concentrations of toxic air pollutants. There are four census tracts within Baybrook, three of which are primarily residential (250401, 250402, 250500) and one of which is entirely industrial (250600). NATA shows two of the residential census tracts (250401 and 250402) as being in the 92nd and 90th percentile for highest respiratory risk from toxic air pollutants, when compared with the other census tracts in Maryland. Each of the four census tracts within Baybrook ranks between the 87th and the 92nd percentiles for highest respiratory risk in Maryland. In other words, between 87 and 92 percent of the census tracts in Maryland have a lower risk of developing a respiratory disease from toxic air pollution.

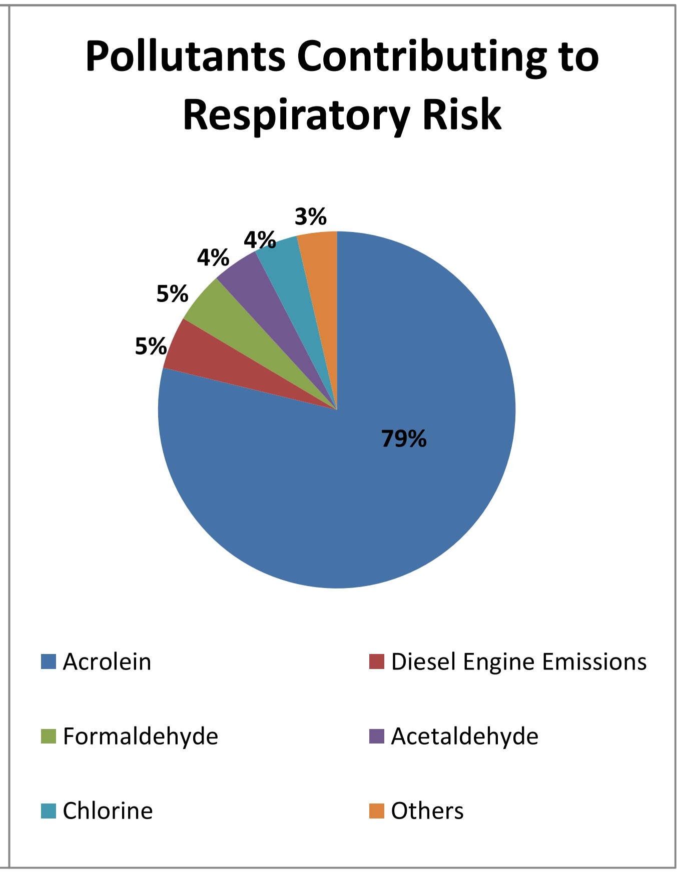
[bb] Based on conversations with EPA, EIP decided to compare census tracts within Maryland and to the national average. EPA specifically advised against comparing risk estimates to other states, as states have varying methodologies for reporting emissions to the National Emissions Inventory, which is the basis for the NATA.

Baybrook has some of the highest respiratory risk in the nation as well, with its four census tracts ranging from the 89th to the 92nd percentile for highest respiratory risk nationally.

Pollutants Contributing to Respiratory Risk in Baybrook

Figure 13: NATA Breakdown of Respiratory Risk by Source Category and Pollutant





As shown in Figure 13 above, NATA indicates that nearly 80% of the respiratory risk in Baybrook is attributable to the chemical acrolein. The acrolein concentration in Baybrook modeled by NATA is between three and four times the Reference Concentration, which is essentially the amount determined likely to be without appreciable risk of harmful effects.[cc]

Acrolein is produced in the burning of organic matter such as tobacco, wood, and gasoline. It is also used in industrial chemical production and as a biocide. Health effects of acrolein exposure include eye, nose, and throat irritation, and a decrease in respiratory rate.[57]

[cc] EPA's Integrated Risk Information System (IRIS) defines reference concentration (RfC) as: "An estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime." The reference concentration for acrolein is of 2.0×10^{-5} mg/m^3.

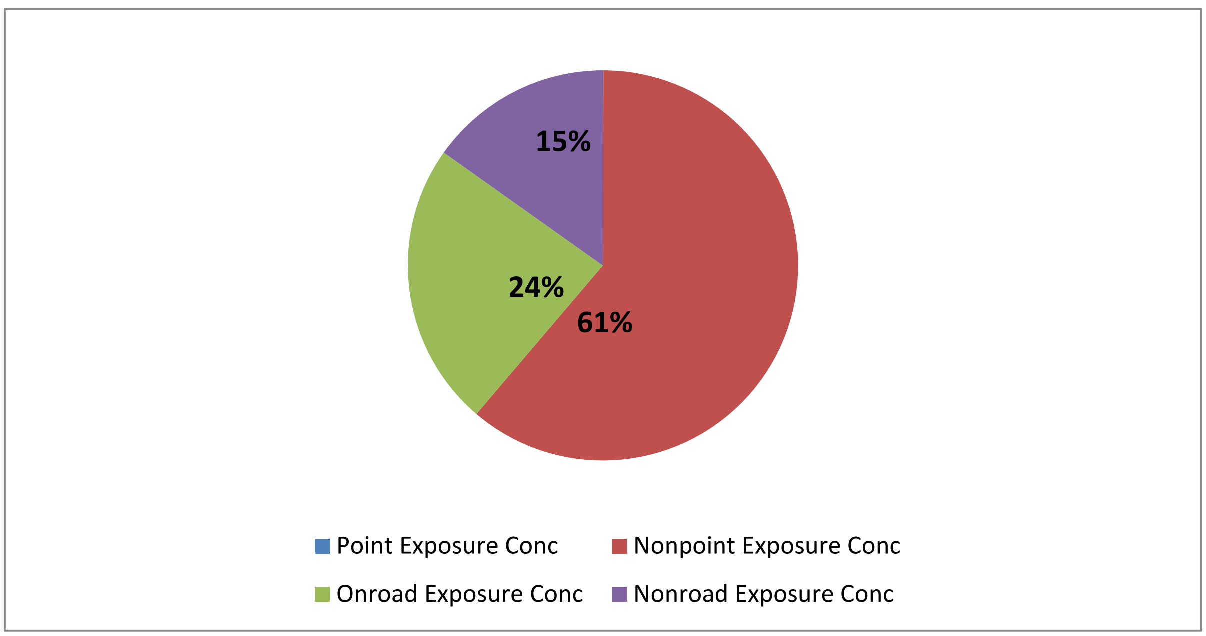
Other pollutants that are significant contributors to respiratory risk include formaldehyde (5%), acetaldehyde (4%), diesel engine emissions (5%) and chlorine (4%).

Sources Contributing to Respiratory Risk in Baybrook

In terms of what sources are contributing to the overall respiratory risk in the Baybrook Area, as shown on Figure 13 on the previous page, NATA attributes 6% to pollutants emitted from large point sources, 49% to non-point sources, 30% to on-road mobile sources, 14% to non-road mobile sources, and 1% to background sources.

- **Point sources** are large stationary sources of pollution, including, for example, coal plants.
- **Non-point sources** are smaller stationary sources of emissions. They might be better thought of as small point sources. [dd]
- **On-road mobile sources** include cars and trucks.
- **Non-road mobile sources** include planes, trains, ships, and other off-road vehicles.
- **Background** includes pollutants that were emitted over a year ago or travel from distant sources.

Figure 14: NATA Sources of Acrolein Exposure Concentrations

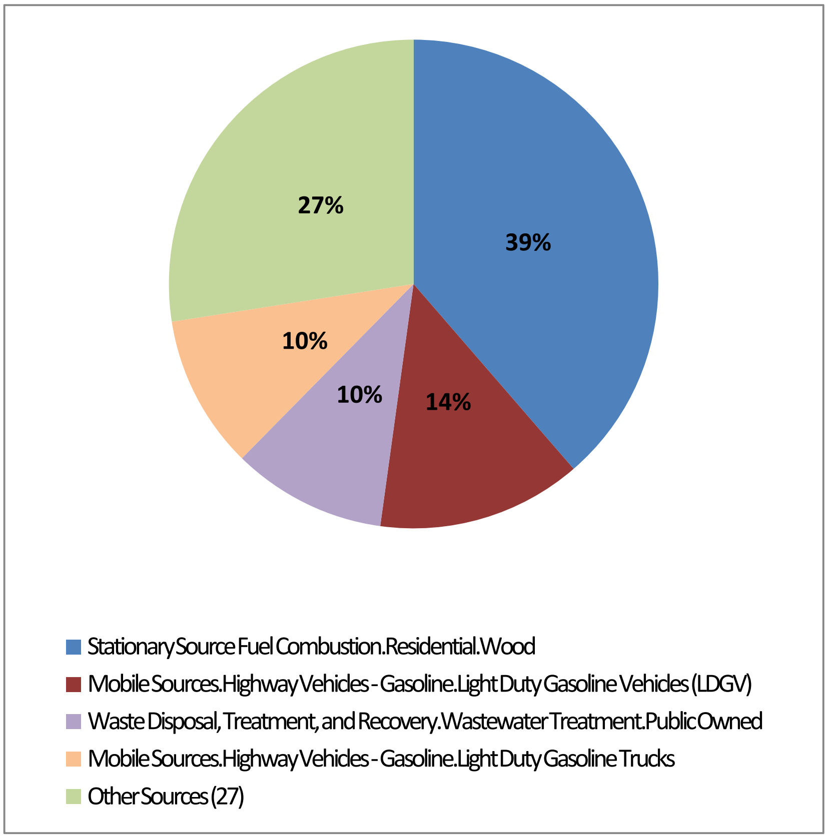


[dd] More specifically, non-point sources are stationary (non-mobile) sources for which EPA does not have a precise location, such as address or latitude and longitude, and has therefore identified by county. Emissions from these sites are modeled across the county based on several factors, and, therefore, the correlation between nonpoint sources and specific census tracts is more attenuated than for point sources.

To further investigate which sources are contributing to respiratory risk in Baybrook, we looked at sources of acrolein in and near Baybrook because NATA suggests that acrolein is the main driver of respiratory risk from toxics in Baybrook. As shown on Figure 14 on the previous page, when using NATA, it appears that over half of the acrolein exposure in the Baybrook Area can be attributed to nonpoint sources. The rest can be attributed to on-road and non-road mobile sources.

We also analyzed source contribution using the National Emissions Inventory (NEI) database, which estimates the quantities of pollutants emitted by every outdoor air pollution source in the country.[58] Because NATA suggests that the chemical acrolein is a major driver (79%) of respiratory risk from hazardous air pollutants in Baybrook, we used NEI to analyze which sources in Baltimore City were emitting acrolein. There are several limitations that must be kept in mind with respect to this analysis, discussed fully in the Data Limitations Section at Appendix A.[ee]

Figure 15: NEI Sources of Acrolein Emissions >10%



According to the NEI analysis, shown in Figure 15, it appears that emissions of acrolein in Baltimore City are primarily coming from residential wood-burning (38.66%), light-duty gasoline vehicles (passenger cars) (13.53%), commercial diesel marine vessels (10.18%), and light-duty gasoline trucks (10.17%).

[ee] Appendix A sets forth the full discussion of the limitations in our analysis using NEI data to further flesh out what NATA tells us about acrolein as a driver of respiratory risk in Baybrook. Briefly, those limitations are as follows: (1) NATA models at the census tract and NEI provides information at the county level, or, in the present case, down to the level of Baltimore City; (2) NATA models concentrations of pollutants in the ambient air and NEI data is for emissions of pollutants into the air; and (3) NATA was created based on a prior version of NEI, gathered in 2005, and our analysis uses the most recent NEI data available, gathered in 2008 (and published in 2011).

CANCER

Our information about cancer risk in Baybrook comes primarily from the NATA model and the NEI database discussed above. Based on NATA, it appears that cancer risk in Baybrook is very high compared with the rest of Maryland and with the United States. NATA suggests that cancer risk in Baybrook is being driven primarily by formaldehyde and benzene. Additionally, when using the risk estimate developed by the California EPA, diesel particulate matter (diesel PM) concentrations in NATA appear to contribute heavily to total cancer risk.

Cancer Risk in Baybrook Compared To Maryland and The United States

The risk of developing cancer from toxic air pollution is significantly higher in Baybrook than in Maryland and the United States. Of Baybrook's three residential census tracts, two (250401 and 250402) ranked in the 91st and 81st percentile[ff], respectively, for highest cancer risk in the state from toxic air pollution. Compared to cancer risk in the United States, tracts 250401 and 250402 rank in the 89th and 86th percentiles respectively, and all four census tracts in the Baybrook Area rank above the 83rd percentile.

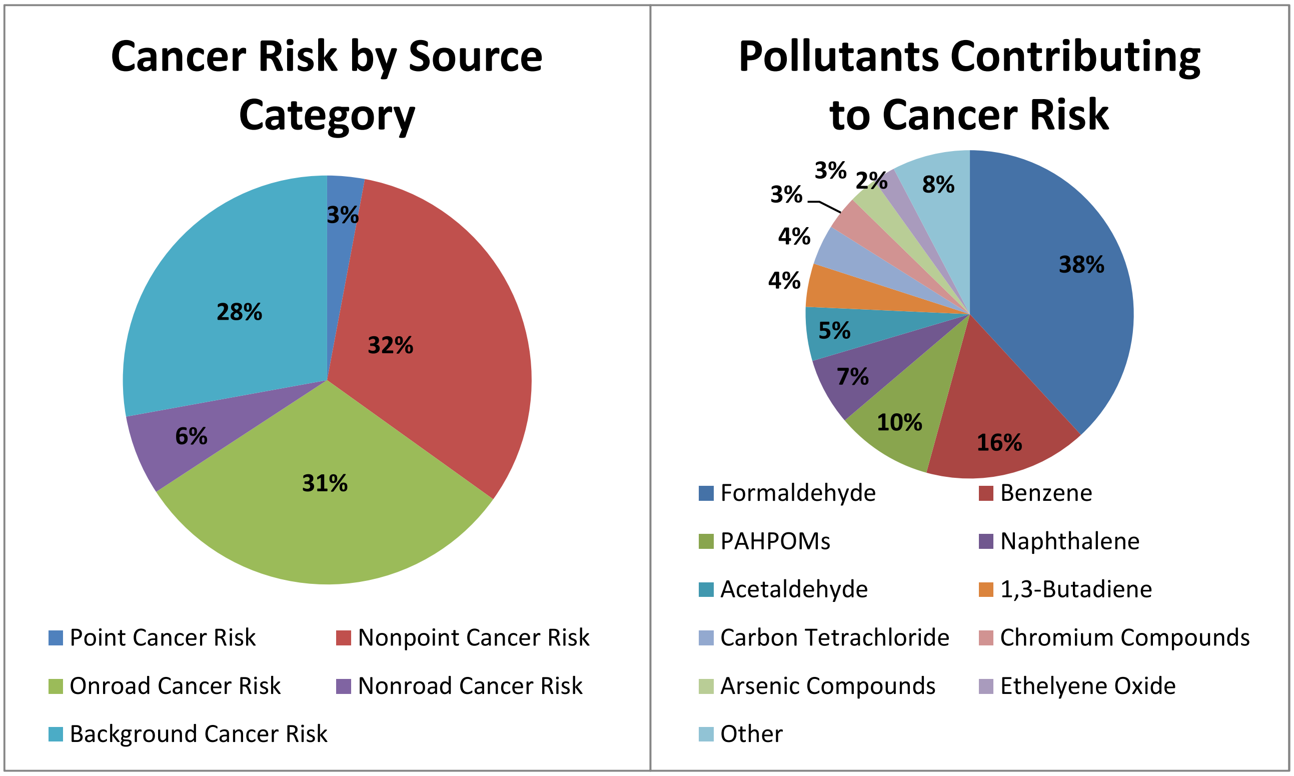
Pollutants Contributing to Cancer Risk in Baybrook

As shown in Figure 16 on the next page, of the cumulative cancer risk in census tracts 250401 and 250402, NATA indicates that over half of the risk (54%) is coming from just two chemicals: formaldehyde (38%) and benzene (16%).

Formaldehyde is used in resin and particleboard production as well as in the synthesis of certain chemicals. It is also a byproduct of automobile exhaust, cigarette smoke, paints, varnishes, and certain fabrics. Human exposure can occur from contaminated indoor air, tobacco smoke, or ambient urban air. Short- and long-term exposure to formaldehyde can lead to respiratory symptoms, reduced lung function, and eye, nose, and throat irritation. Formaldehyde has also been associated with nasopharyngeal cancer, lymphoma, and leukemia.[59] It is currently categorized by EPA as a "probable human carcinogen," but this description is outdated and will be soon be revised to reflect that formaldehyde is known to cause cancer.[60]

[ff] These rankings reflect the area's high cancer risk estimates of 68.1 and 68.2 in a million.

Figure 16: NATA Breakdown of Cancer Risk by Source Category and Pollutant



Benzene is a carcinogen that is both naturally occurring and produced in industrial processes. Major sources of human exposure include cigarette smoke, gasoline vapors at service stations, and motor vehicle exhaust. Short-term exposure to benzene emissions can cause drowsiness, dizziness and headaches, as well as eye, skin, and respiratory tract irritation. Long-term exposure has a range of impacts including reduced red blood cell and lymphocyte counts, reproductive effects in women, and an increased incidence of leukemia and other cancers.[61]

Finally, **diesel particulate matter (diesel PM)** may be the most important carcinogen in ambient air in Baybrook. Diesel exhaust is often treated as a single pollutant for purposes of risk assessment. In fact, diesel exhaust is a complex mixture of very small particles, pollutants attached to these particles, and pollutants in a gaseous form. Most estimates of the health effects of diesel exhaust are expressed in reference to diesel PM. Diesel PM is generally made up of particles smaller than 2.5 µm (micrograms). Many of these particles are even smaller (less than 0.1 µm).

The primary health effect associated with diesel PM is lung cancer. There have been many studies of workers exposed to diesel PM, including railroad workers, truck drivers, and heavy equipment operators, and these have consistently found an increased risk of lung cancer.

The U.S. EPA determined that this evidence was "strongly supportive" of a cause-and-effect relationship.[62] Other types of evidence support this conclusion. For example, there is a likely mechanism—since diesel particles are so small, they can travel deep into the lungs. They carry with them many cancer-causing pollutants that might otherwise be trapped in the upper airways. After considering all of this evidence, the EPA defined diesel PM as a "likely" human carcinogen in 2002.[63] The EPA did not, however, establish a value for how potent diesel PM is as a carcinogen, known as a cancer potency estimate.

The 2005 NATA results include estimates of diesel PM exposure, but since the EPA did not have a cancer potency estimate, it did not estimate cancer risks. However, a cancer potency estimate was derived by the California EPA.[64] If we apply the California EPA cancer potency estimate to the NATA exposure results, we find that the cancer risk of diesel PM in Baybrook is roughly 3 in 10,000. This is about four to five times greater than the cancer risk of the rest of the NATA-modeled pollutants combined. Cleaner engines and fuels have likely reduced exposure since 2005, but the diesel PM cancer risk is in all likelihood still substantial.

Because we know that diesel PM truck exhaust is of concern to some residents of Baybrook and that is likely a significant contributor to cancer risk from toxic air pollution, we have also compared exposure to diesel PM in Baybrook to Maryland and the United States. Baybrook has some of the highest concentrations of diesel PM both nationally and within Maryland. Table 2 below shows that, based on NATA, the air concentration of diesel PM in Baybrook is higher than between 90% and 79% of other census tracts in the country. Within Maryland, these tracts are higher than between 93% and 72% of the state.

Table 2: Comparison of Diesel PM Concentrations to the U.S. and Maryland

Tract	Percentile in US	Percentile in Maryland
250401	90%	93%
250500	86%	86%
250600	85%	85%
250402	79%	72%

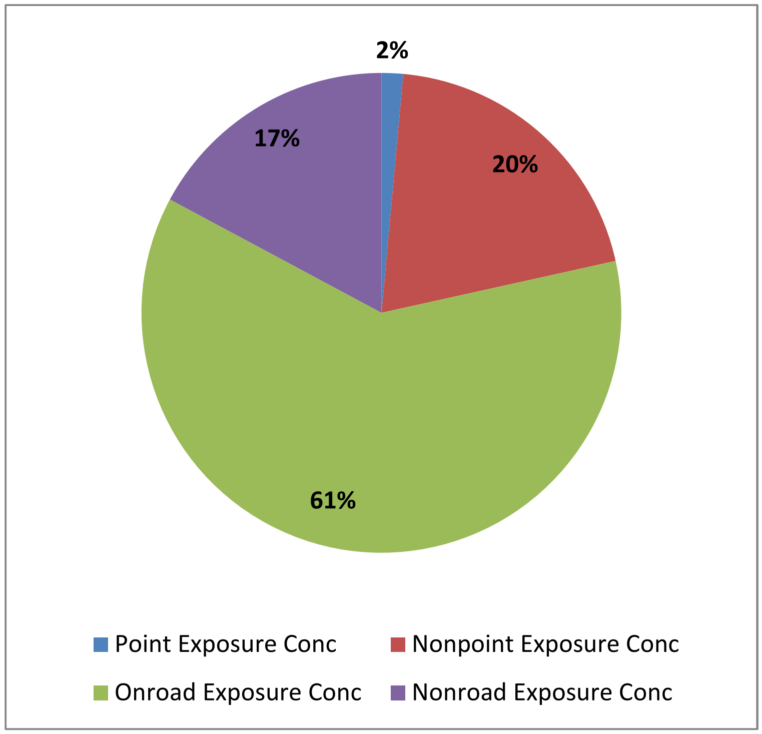
Our Conclusion and Recommendations below sets forth a few recommendations, one of which is to reduce the effects of diesel exhaust, as well as other impacts, from heavy trucks on residential neighborhoods in Curtis bay by re-routing truck traffic away from residences. A community effort to achieve this goal has been ongoing since 2008.

Sources Contributing to Cancer Risk in Baybrook

As shown on Figure 16 in the previous section, when we used NATA to break down cancer risk by the sources contributing to it, NATA attributes 3% to large point sources, 32% to non-point sources, 31% to on-road mobile sources such as cars and trucks, 6% to non-road mobile sources, and 28% to background sources, which include natural sources and emissions from previous years.

As we did with respiratory risk, we also analyzed the likely sources contributing to cancer risk in Baybrook by looking at sources of key pollutants - formaldehyde, benzene and diesel PM – using NEI and NATA.

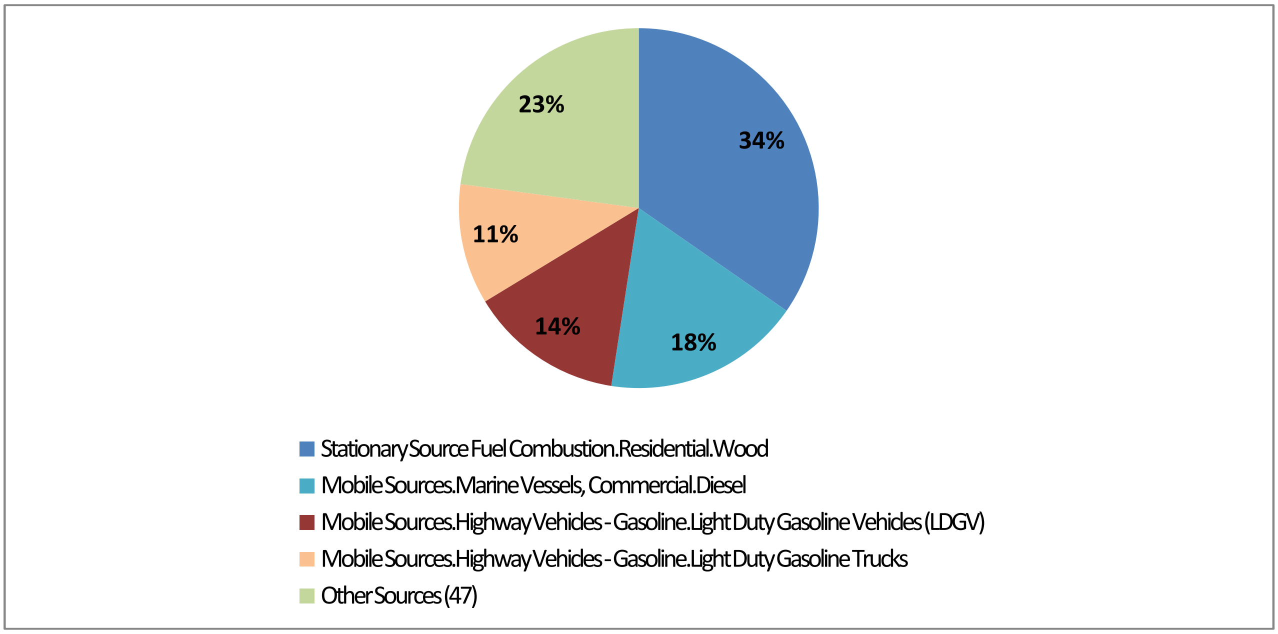
Figure 17: NATA Sources of Formaldehyde Exposure Concentrations



NATA indicates that formaldehyde is the primary contributor, at 38%, of overall cancer risk in Baybrook not including diesel PM. As shown on Figure 17, NATA also suggests that roughly three-fifths of the formaldehyde concentrations in the Baybrook Area can be attributed to on-road vehicles.

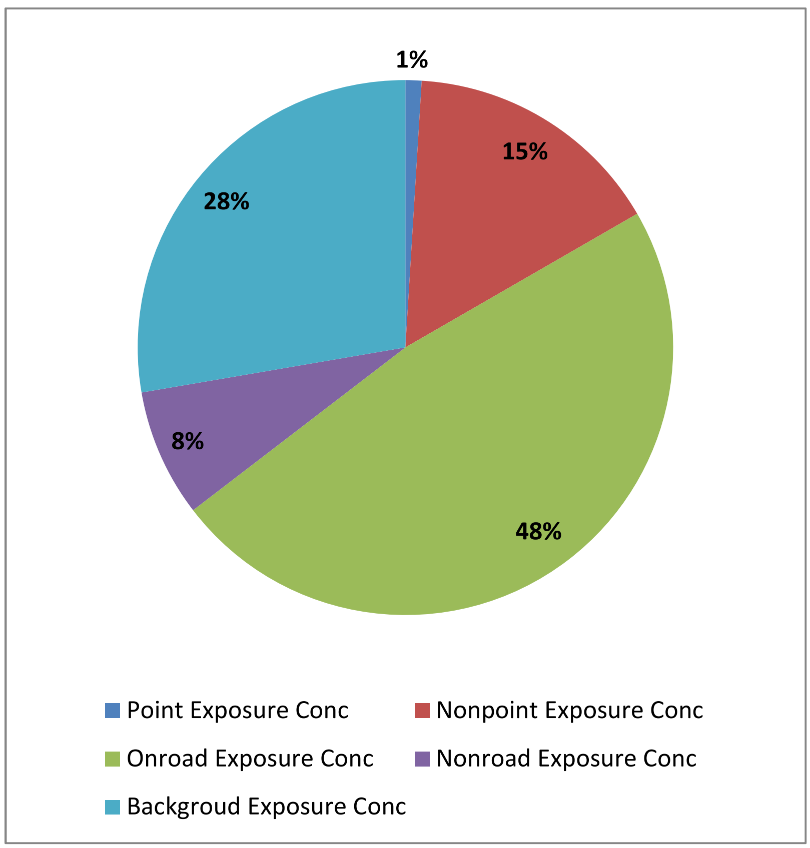
We also used NEI to break down emissions of formaldehyde in Baltimore City by source contribution, subject to the same limitations discussed above and set forth in Appendix A. NEI suggests that emissions of formaldehyde in Baltimore City are primarily coming from residential wood-burning (34.67%), commercial diesel marine vessels (17.49%), light-duty gasoline vehicles (passenger cars) (13.87%), and light-duty gasoline trucks (10.81%). Figure 18, showing this break-down, is on the next page.

Figure 18: 2008 NEI Sources of Formaldehyde Emissions >10%



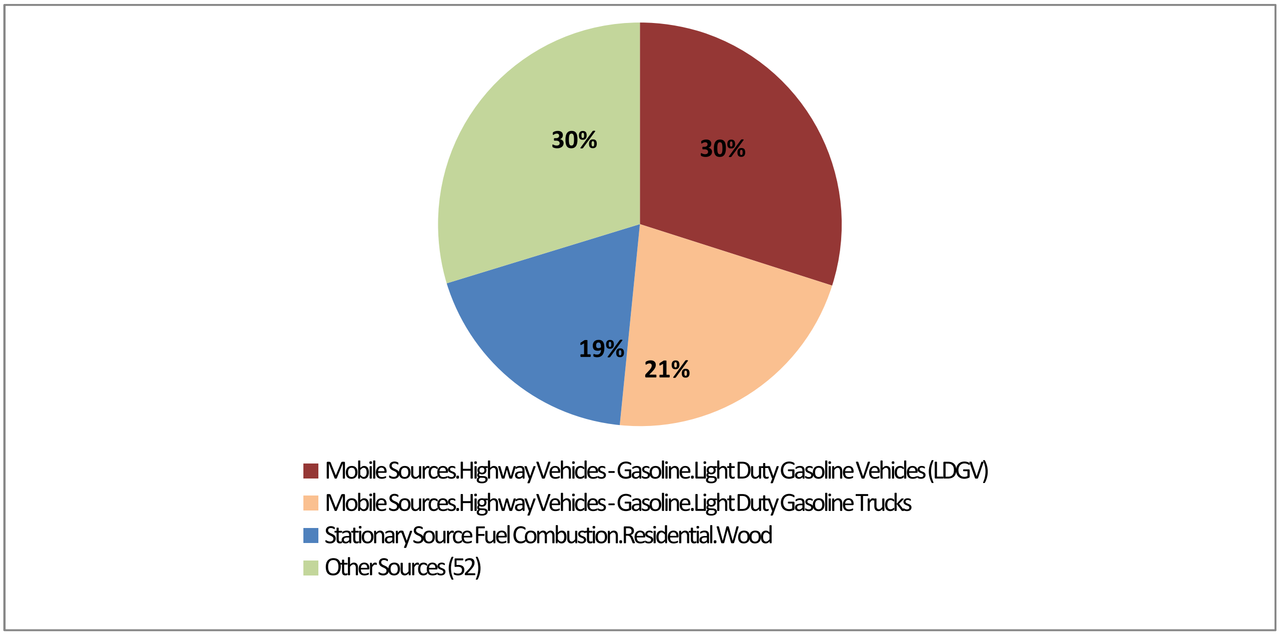
NATA also indicates that benzene is responsible for 16% of cancer risk from toxic air pollution concentrations, not including diesel PM, in Baybrook. As shown on Figure 19, NATA suggests that roughly half of the benzene exposure in the Baybrook Area comes from on-road vehicles, with non-point and background sources also providing significant contributions. One thing that must be kept in mind about contributions of benzene from mobile sources is that, in 2007, EPA passed a strict new fuel standard which will require a 38% reduction in the amount of benzene in gasoline. These standards took effect in 2011.[65] Thus, gasoline-powered mobile sources likely contribute a smaller portion of benzene concentrations at the time of this report's publication.

Figure 19: NATA Sources of Benzene Exposure Concentrations



NEI indicates that emissions of benzene in Baltimore City are primarily coming from residential wood-burning (34.67%), commercial diesel marine vessels (17.49%), light-duty gasoline vehicles (passenger cars) (13.87%), and light-duty gasoline trucks (10.81%). This is shown on Figure 20 below.

Figure 20: NEI Sources of Benzene Emissions >10%



Lastly, in the case of diesel PM, NEI indicates that commercial diesel marine vessels (78.3%) and Class 8A/8B (over 33,001 pounds) heavy-duty diesel vehicles (7.35%) contribute the most to overall emissions of diesel PM. In terms of on-road emissions of diesel PM, or emissions from cars, trucks, and buses, Class 8A/8B heavy-duty diesel vehicles are driving much of the pollution, and make up 64.29% of emissions.

SOURCES OF AIR POLLUTION IN BALTIMORE CITY

As discussed in the respiratory effects and cancer sections above, in 2008, which is the most recent year for which we have emissions information, emissions in Baltimore City of the three toxic pollutants most driving cancer and respiratory risk – acrolein, benzene and formaldehyde - were all primarily coming from three sources. These are light-duty gasoline vehicles (passenger cars), residential wood-burning (fireplaces and woodstoves), and commercial diesel marine vessels (cargo ships). $PM_{2.5}$ emissions are coming primarily from large stationary sources.

In our discussion of which specific sources in and near Baybrook may be emitting these pollutants, we have focused on passenger cars, commercial marine diesel vessels and stationary sources. Residential wood burning, which NATA estimates is a significant contributor of pollutants driving health risks in Baybrook, is largely in the control of private citizens[66], and so it is not addressed below. We have also added a section addressing heavy-duty trucks because of their contribution to diesel particulate matter concentrations in Baybrook, and because we know that they are of concern to the community.

1. *Passenger Cars*

Light-duty gasoline vehicles, better known as passenger cars, contribute significantly to pollution in Baltimore City. Baltimore has many major roadways that run either through the city or encircle it, including the 895, 395, 83, 195, 70 and 95 interstate freeways. In addition to the volume of cars passing through Baltimore City, it is also among the most heavily congested cities in the country for traffic. A recent report by INRIX, a consulting firm that specializes in traffic management, listed Baltimore City as 14th in the nation out of the 100 most congested metro areas in the country.[67] The Baybrook Area, in particular, contains a part of Interstate 895 which continues into the Harbor Tunnel, and the Baltimore Beltway, which continues onto the Francis Scott Key Bridge. These two thoroughfares are heavily travelled and likely contribute to vehicle pollution in the Baybrook Area.

2. *Commercial Diesel Marine Vessels*

Commercial diesel marine vessels, such as cargo ships, are a significant source of pollution in Baltimore City. The emissions from ships alone, and not from port operations such as trucking and freight unloading, are on par with that of a major coal fired plant. The Port of Baltimore has 20 terminals, including six on the Fairfield Peninsula and one closer to the residential area of Curtis Bay. The terminals in the Baybrook Area include a major coal export terminal, four automobile shipping terminals, and two chemical and oil shipping terminals. Because ships are continuously docking, unloading, and loading cargo in this area, it is not surprising that emissions from commercial diesel marine vessels are such significant contributors to air pollution in Baltimore.

3. Major Stationary Sources

Major stationary sources contribute much of the $PM_{2.5}$ emitted in the Baltimore City area. Two sites in particular, the Fort Smallwood Complex coal-fired power plant and the Sparrows Point steel mill make up the majority of major stationary source emissions. Since the 2008 NEI, the Fort Smallwood Complex has undergone significant pollution upgrades that have cut its emissions of fine particulate matter by roughly 50%[gg] as well as reducing emissions of fine PM precursors like SO_x and NO_x. Nevertheless, this facility is still a major contributor to the $PM_{2.5}$[hh] emissions produced in the Baltimore City area. Additionally, the Sparrows Point steel mill, which was shut down for a few weeks in December of 2011, is now reportedly running at limited capacity.[68]

4. Heavy-Duty Diesel Trucks

Class 8A/8B heavy-duty diesel trucks (those weighing over 33,000 pounds) are contributors to diesel PM in Baltimore City. These trucks are also by far the largest contributor to diesel PM of any of the on-road mobile sources. Much of this traffic is likely associated with the Port of Baltimore and with the industrial facilities located in and around the Baybrook Area.

As discussed above in the history section, residents report an average of 400 heavy-duty trucks per day using Curtis and Pennington Avenues to travel in or near the residential area on the way to the Fairfield industrial area. The use of this road for truck routes is of immediate concern to the community because of exhaust from the trucks and because of safety problems, excessive noise levels and damage by the vehicles to adjacent homes and roadways. In 2011, the City made significant repairs to Curtis Avenue to address this damage. The Community of Curtis Bay Association has raised the problem of truck traffic and the truck routes a number of times over the past 4 year with City officials.

[gg] The 2008 NEI showed total fine particulate matter (PM2.5+PM Condensable) emissions from Ft. Smallwood of 2,574 tons. 2010 Emissions Certification Reports, submitted by the owners of this facility to the Maryland Department of the Environment, show that emissions of fine particulate matter in 2010 had dropped 54% to 1,185 tons. The Maryland Department of the Environment emissions inventory shows that emissions from the Sparrows Point steel mill have remained relatively constant since 2008.

[hh] $PM_{2.5}$ includes $PM_{2.5}$+PM condensable

CONCLUSION AND RECOMMENDATIONS

The most recent available data shows that the air quality in Baybrook is among the worst in Maryland and the country in terms of cancer and respiratory risks from toxic air pollution, and quantity of air toxics released by stationary sources. It also registered among the highest average levels of $PM_{2.5}$ in Baltimore City during the five-year period before its monitor was taken down in 2008, and it is located in a non-attainment area for ground-level ozone in which ozone levels are increasing. Additionally, mortality rates in Baybrook for heart disease, lung cancer and chronic lower respiratory disease, all conditions associated with air pollution exposure, are significantly higher than city, state and country rates for those diseases.

Residents of Baybrook deserve the same quality of life and health as other communities in Maryland. Steps must be taken to improve the air quality in Baybrook and to fill in gaps in the available information about air pollution and health in that area.

EIP recommends the actions listed below as steps toward achieving these goals. We are also continuing to investigate options for addressing emissions from the Port of Baltimore, passenger cars, and chemical and petroleum tanks located in and near Baybrook.

Increase direct monitoring of ambient air quality in Baybrook. The best kind of information for evaluating air quality and assessing likely health impacts is direct monitoring data.

- Replace the $PM_{2.5}$ monitor that was removed from Baybrook in 2008.

  There is currently no ambient air quality monitor located within the Baybrook Area. In 2008, the Maryland Department of the Environment (MDE) shut down a $PM_{2.5}$ monitor that was located on the Fairfield Peninsula in Baybrook, and has not replaced it. A $PM_{2.5}$ monitor should be located in Baybrook. We recommend placing such a monitor at Benjamin Franklin High School, where it will also be near to Curtis Bay Elementary School. This placement will record levels that have the greatest health impacts on children, who are particularly susceptible to health impacts from $PM_{2.5}$, and may also be educational for students.

- Place an ozone monitor in Baybrook

  There is only one ozone monitor currently located within the Baltimore City limits, and it is over 7 miles from the residential portions of the Baybrook Area. Car exhaust is a known contributor of two precursors to ground-level ozone: NO_x and VOCs. Given our finding that emissions from cars and trucks contribute significantly to respiratory and cancer risks in

Baybrook, and that ozone levels have been generally increasing in Baltimore City, we recommend that an ozone monitor be placed in Baybrook. Because children are also particularly susceptible to health effects of ground-level ozone, we also recommend placement of the monitor at Benjamin Franklin High School.

- Monitor for key air toxics in Baybrook

  There is no monitor for air toxics in Baybrook, and the air toxics monitors in Baltimore City do not measure acrolein and formaldehyde, two of the three toxics that NATA suggests are driving cancer and respiratory risk in Baybrook. A monitor that records concentrations of these pollutants should be located in Baybrook. At the very least, air toxics monitors in Baltimore City should measure for these pollutants.

Additionally, shrinking budgets have made it harder for MDE to maintain local monitoring networks. Therefore, the Maryland General Assembly should support a modest increase in the emission fees paid by the largest polluters to cover the cost of monitoring the pollution they cause.

Account for cumulative impacts from multiple pollution sources in permitting and enforcement.

EPA has made clear that state environmental agencies have the legal authority to address environmental justice concerns in permitting and enforcement actions.[69] MDE and other agencies, such as the Maryland Public Service Commission, that issue environmental permits to large industrial sources of pollution, should consider the cumulative impacts from multiple sources of pollution when reviewing permit applications, as well as prioritize enforcement actions, for environmentally overburdened communities like Baybrook.

Reduce emissions from commercial marine vessels and other sources at the Port of Baltimore.

Commercial marine vessels are significant contributors of formaldehyde and diesel PM, which NATA[ii] indicates are two main drivers of cancer risk in Baybrook. Total emissions associated with the Port of Baltimore, including commercial marine vessel emissions and emissions from trucks, trains and equipment used at the port, are likely substantial. The Maryland Port Authority (MPA), as part of its Greening the Port program, has taken a number of positive steps toward reducing its air emissions, including use of ultra-low sulfur diesel fuel in

[ii] Diesel PM cancer potency determined using California EPA estimate.

vehicles and equipment, and installation of pollution control technology on cranes.[70] It last completed an air emissions inventory in 2006. However, this inventory does not appear to have accounted for emissions from cargo ships, tugboats or fugitive dust emissions from coal-handling processes[jj].

The MPA should produce an updated comprehensive emissions inventory, which should be made available to the public on its website, as many other ports have done[kk]. This inventory should account for emissions from port-related ships, trains, trucks, terminal equipment and harbor craft as well as fugitive coal dust emissions. The MPA should also work with MDE to develop a Clean Air Action Plan committing to near-term and long-term emissions reduction goals, and identifying and implementing methods for obtaining those reductions. A plan like this was adopted in 2006 by the ports of Long Beach and Los Angeles in California and established emissions reduction goals of 45% for the nitrogen oxides (NO_x), diesel particulate matter (diesel PM) and sulfur oxides (SO_x) by the end of 2011. This program has been tremendously successful in reducing air pollution from these ports. Improvements at the Port of Los Angeles from 2005 to 2010 include a 69% reduction in diesel PM emissions, a 70% reduction in $PM_{2.5}$ emissions, a 50% reduction in NO_x emissions, and a 75% reduction in SO_x emissions.[71] In particular, this has helped to reduce measured average ambient air concentrations of $PM_{2.5}$ by 37%.[72]

Additionally, the MPA should provide for participation by the public in the development of its Clean Air Action Plan, as the ports of Los Angeles and Long Beach did.[73]

Reduce emissions from heavy diesel trucks.

Industrial facilities located in Baybrook should be required to include, as a term of any new contracts entered into with trucking companies, that all trucks be fitted with diesel particulate filters, which can routinely remove more than 90% of diesel PM emissions from truck tailpipes.[74] The City and State can and should condition any public subsidies flowing to such companies on the inclusion of such a term in new trucking contracts.

Address heavy truck traffic through residential neighborhoods of Curtis Bay in order to improve quality of life in Curtis Bay and increase job opportunities with service and retail business.

[jj] Coal-handling facilities, such as the CSX coal terminal at the Port of Baltimore are known to produce fugitive emissions of coal dust, and EIP is aware that coal dust has been a problem in Baybrook.

[kk] Examples of ports with emissions inventories and climate action plans include the Port of Long Beach and Los Angeles, the Port of Houston, and the Port of New York and New Jersey

Community leaders in Curtis Bay have identified heavy truck traffic on residential roads as a major health, safety and environmental problem. Officials in the Baltimore City Department of Transportation should promptly begin working with residents and community leaders to implement a plan to remove heavy diesel truck traffic from the residential Curtis Bay neighborhoods located closest to the industrial area on the Fairfield Peninsula. Specifically, the City Transportation Department should take the following actions, which have been identified by community leaders and are supported by EIP, to achieve this goal:

1) Work with the community to convert Pennington Avenue from a one-way street to a two-way street for cars and delivery trucks.

2) Prohibit industrial truck traffic on Pennington Avenue. This has proven effective in improving conditions on the part of East Patapsco Avenue that runs through the Brooklyn neighborhood.

3) Either prohibit industrial traffic on Curtis Avenue or take steps to reduce the speed of heavy truck traffic on Curtis Avenue.

Taking these steps will promote the conversion of Pennington Avenue into a Main Street which can attract small, non-industrial businesses and provide badly needed job opportunities. It will also increase overall quality of life in the residential neighborhoods closest to the Fairfield industrial area by reducing the diesel exhaust to which residents are exposed and alleviating the noise, safety concerns and road impacts caused by these trucks.

Appendix A

Data Limitations

Toxic Release Inventory (TRI)

TRI likely underestimates, possibly by a significant amount, total toxic emissions from stationary sources, because of the rules governing whether or not a facility must report to TRI. Specifically, facilities are required to report to TRI only if they: 1) have ten or more full-time employees or the equivalent; 2) have an NAICS code included in Section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) or are a Federal Facility; and 3) manufacture, process, or otherwise use EPCRA Section 313 chemicals and chemical categories or exceed any non-PBT chemical reporting threshold by manufacturing or processing 25,000 pounds per toxic chemical or category per year, or otherwise use 10,000 pounds per toxic chemical or category per year (with the exception of 10 pollutants with very low thresholds).

National Air Toxics Assessment (NATA)

The NATA modeling results are only rough estimates of exposure and risk, and there are several important limitations and uncertainties that should be kept in mind, including but not limited to the following:

A limited number of pollutants were modeled. NATA modeled 179 pollutants, and this is only a subset of the air pollution in the Baybrook area. The estimates of risk would be higher if the model were to include nitrogen dioxide, sulfur dioxide, ozone, and particulate matter. In addition, not all of the 179 modeled pollutants could be modeled for health risk because only 140 had sufficient dose-response information. An important pollutant in this regard is diesel PM—although NATA modeled exposure to diesel PM and was able to estimate a noncancer respiratory risk, it did not assign diesel PM a cancer slope factor. This means that the cancer risk of diesel PM was not accounted for in the model.

Dispersion modeling under predicts ambient concentrations for some pollutants. The models used to predict the movement of pollutants from emissions sources to points of possible exposure are complicated, involving assumptions about many variables including weather and chemical transformations in the air. Where it was possible to do so, the EPA compared NATA predictions to measured pollutant concentrations in order to check the accuracy of the model.[75] For some pollutants, like benzene and formaldehyde, the model makes reasonably accurate predictions. For other pollutants, including some metals like manganese, arsenic, and mercury, the model tends to moderately underpredict exposure concentrations. Other pollutants, for example chlorine, were dramatically underpredicted, with every monitor showing much higher concentrations than the model predicted. Sources of underprediction are likely to include, among other things, emissions sources that are missing from the National Emissions Inventory.

Modeling to the census tract is uncertain. Exposure estimates at the census tract level are uncertain for a couple of reasons. First, NATA estimates exposure at the centroid of each census tract, and individuals living in a census tract may be closer to or farther from a particular source of pollution than the centroid. Second, nonpoint emissions are not directly modeled at the census tract level; instead, these sources are inventoried at the county level, and allocated to census tracts using "surrogates" like land use or population.[76] In part for these reasons, EPA cautions that NATA results should not be used "to characterize or compare risks at local levels such as between neighborhoods."[77] In following EPA's advice, we have provided only rankings of risk estimates in this report and have not included specific risk levels in different communities.

Indoor air was not addressed. The NATA model estimates outdoor air concentrations and adjusts these concentrations for normal human lifestyles and the movement of outdoor air pollution to enclosed spaces like homes and cars. The model does not, however, estimate indoor sources of air pollution. This can be an important source of exposure—a study of VOCs in the Baybrook area, for example, found that indoor VOC exposures were much higher than outdoor exposures, and some of this indoor exposure is undoubtedly coming from indoor sources of VOCs.[78]

Health effects estimates are uncertain*.* As described in some detail below, there is considerable uncertainty in estimating the risk of a given exposure. Some assumptions used in the model may overestimate risk, while others may underestimate risk. Taken together, there is no systematic bias in either direction—the true risk may be higher or lower than what NATA predicts.

Cancer risks were estimated using upper-bound estimates of the cancer-causing potency of each chemical, also known as "unit risks." These estimates are uncertain, but they are derived in a way that errs on the side of health protection. As EPA puts it, "the true risk is likely to be less, but could be greater."[79]

The cumulative cancer risk from multiple pollutants was estimated by adding the pollutant-specific cancer risks. This is a simplification that is likely to overestimate risks in some ways and underestimate risks in others. Adding upper-bound pollutant-specific cancer slope estimates tends to overestimate risk. On the other hand, many pollutants may affect the risk of cancer in a common target organ, for example the lung, in a multiplicative or synergistic way. Additive risk estimates would in this case underestimate the true risk. Finally, as noted above, not all carcinogens were modeled.

Non-cancer risks were estimated by comparing exposure concentrations to "safe" concentrations, more specifically defined by EPA as concentrations "likely to be without an appreciable risk of deleterious effects during a lifetime."[80] For inhalation exposure, these are known as "reference concentrations." Reference concentrations are based on human or animal studies and incorporate "uncertainty factors" to account for uncertainty in extrapolating from study conditions (e.g., genetically identical animals in a short-term study) to real-life situations (e.g., a diverse human population exposed over a lifetime).

Each pollutant-specific non-cancer risk was expressed as a "hazard quotient," or a ratio of exposure concentration to reference concentration. Pollutant-specific hazard quotients were summed for target organ systems (e.g., the respiratory tract) to produce a "hazard index." A respiratory hazard index greater than 1 indicates that the total exposure to respiratory irritants may result in adverse effects. The assumption of additive risks is simplistic and may not accurately represent the true combined effects, which may be less than additive or more than additive. Moreover, the estimated cumulative impact of the NATA-modeled pollutants does not account for the contribution of the criteria pollutants particulate matter, nitrogen oxides, sulfur oxides, or ozone, all of which have respiratory health effects. There are undoubtedly combined effects of the NATA-modeled respiratory irritants and these additional pollutants. Studies of acrolein and carbon black, for example, found that exposure to either pollutant alone had no effect on lung defenses, but combined exposures did impair lung defenses. This was likely due, in part, to the ability of carbon black to carry acrolein into the deep lung.[81]

Comparison of NATA with 2008 National Emissions Inventory (NEI)

NATA models at the census tract level and NEI models at the county level. NEI provides emissions data at the county-wide level but does not provide emissions information for smaller geographic units, such as zip codes or census tracts, within a county. In the present case, we can use NEI to look at emissions in Baltimore City because it is not part of a county and is, therefore, treated as its own county. NATA, on the other hand, models contributions to risk at the census-tract level. Because the geographic units for which information is available are different, it is not possible to do a direct comparison of NATA findings to the NEI emissions information on source contribution of pollutants. All 2008 NEI estimates are at a city-wide level and do not necessarily represent the profile of emissions in Baybrook alone.

NATA models concentrations of pollutants whereas NEI data is for emissions. Emissions are the pollutants being discharged into the air by sources such as cars, trucks and power plants, whereas concentrations are the levels of the pollutants in the ambient, or outside, air. Because air pollution can travel, concentrations can reflect emissions from sources located many miles away. Similarly, emissions from sources located in a certain area may not travel to other areas and so emissions data for a geographic area does not necessarily correlate to pollutant concentrations in the same area. In simpler terms, because pollution travels, at least some of the air pollution concentrations in the Baybrook Area come from sources outside of Baltimore City that are not included in the NEI information we are using. However, the NEI provides additional information about sources that contribute pollution to the ambient air in Baltimore City, and can help us understand where pollutants that are driving cancer and respiratory risk and are produced in Baltimore City are coming from.

NATA is based on 2005 NEI data, and our NEI section uses 2008 NEI data. The most recent NATA database is the 2005 NATA, and it was created using data from the 2005 National Emissions Inventory (2005 NEI). However, the NEI has since been updated. The 2008 NEI was released in 2011, as it took EPA approximately three years to assemble the 2008 emissions data, and is the most recent NEI available. For the purposes of this report, we have used the most recent NATA, which uses 2005 NEI information, to identify the pollutants driving cancer and respiratory risk in Baybrook (acrolein, benzene and formaldehyde) and to compare the Baybrook Area to the rest of Maryland in terms of health risks from toxic air pollution. However, we have used the 2008 NEI, because it is the most recent set of information available, to evaluate where emissions of the risk-driving pollutants (acrolein, benzene and formaldehyde) are coming from.

Problems with the NEI emission factors. We recognize that the NEI is not perfect and is based mostly on calculations and models using what available data exists. Where possible, we have tried to identify emissions sources that we believe may not be accurately represented in the NEI. In particular, EIP believes that the NEI may underestimate emissions of toxic chemicals from petroleum and chemical storage tanks. Several studies have shown EPA's emissions factors for fugitive emissions from storage tanks to be drastically lower than actual emissions. EPA itself has, on multiple occasions, noted problems with emissions factors, specifically those pertaining to fugitive emissions from storage tanks. Given the high number of tanks in the Baybrook area, we believe it is likely that the NEI estimates for toxic emissions from storage tanks is likely underestimated.

Age of NEI and NATA Data

Our analyses in this report are based on emissions data that, in most cases, is not current. Specifically, NATA uses information from the 2005 NEI, and, therefore, our NATA information is based on 2005 emissions. Additionally, our use of the 2008 NEI to illustrate the NATA breakdown of certain pollutants by source category is based on data that is three years old.

In order to assess how emissions in the Baybrook Area may have changed in the interim, we have compared the number of facilities that report to the Toxic Release Inventory (TRI) for the years 2005 through 2010. TRI includes a list of facilities that report toxic releases on an annual basis and can be searched by zip code. Thus, we were able to view the change in the total number of facilities located in the two zip codes within the Baybrook Area between 2005 and 2010 that report to TRI. Additionally, we were able to view the differences in the total quantity of toxic releases, and releases of certain key pollutants such as acrolein, benzene and formaldehyde, during this time period.

NUMBER OF FACILITIES IN BAYBROOK AND AIR EMISSIONS OF KEY POLLUTANTS IN TRI 2005-2010						
Year	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
# Facilities	17	15	15	16	15	14
Benzene	4,386	4,443	2,768	1,532	1,373	1,304
Formaldehyde	0	0	0	0	0	0
Acrolein	0	0	0	0	0	0
Total Air Releases	13,736,701	11,939,949	20,670,032	21,650,018	13,798,727	2,205,260
Hydrochloric Acid	10,033,684	8,232,881	17,033,939	18,031,256	11,013,195	1,517,929

The number of facilities reporting to TRI has decreased from 17, in 2005, to 14, in 2010, representing a difference in the total quantity of toxic air releases being reported from 13,736,701 pounds to 2,205,260 pounds. This represents a slight, but not substantial, change in the number of facilities reporting. The difference in the quantity of releases is substantial. However, this appears to be primarily driven by the upgrades to control technology at the Fort Smallwood plant in March of 2010, as demonstrated by the large difference in releases between 2009 and 2010 and in particular, the reduced hydrochloric acid emissions, resulting from installation of as new scrubber at Fort Smallwood. It is also noteworthy that total releases increased significantly from 2006 to 2007.

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