Traffic-Related Pollutants and Human Health Within the I-10 Claiborne Corridor, New Orleans, LA: Land Use Implications

Report presented to the
Claiborne Avenue Alliance and the
American Geophysical Union's Thriving Earth Exchange Program

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This study was conducted by students and faculty of Louisiana State University Health- New Orleans, School of Public Health (LSUHSC-SPH), Environmental and Occupational Health Sciences Program for the American Geophysical Union's Thriving Earth Exchange (AGU-TEX) Program.

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Introduction

Louisiana State University Health Sciences Center (LSUHSC) School of Public Health (LSUHSC-SPH) faculty and students were tasked by the American Geophysical Union's Thriving Earth Exchange (AGU-TEX) Program to conduct an evaluation of environmental conditions, population exposures and disease rates for neighborhoods along the I-10 Claiborne Corridor in New Orleans, Louisiana (LA). The goal of this work is to address concerns expressed by the neighborhood group Claiborne Reborn (CR) as they relate to health and environmental impacts of recently proposed land use plans for the Interstate-10 (I-10) overpass structure.

Before we can make assumptions about how the environment and health will be impacted by different scenarios for the I-10 overpass, we must have a clear understanding of how the I-10 overpass is impacting these conditions now. We need to develop a baseline; and we need to demonstrate or provide supporting evidence that these conditions are either caused or aggravated by pollution emanating from the traffic.

This is an evolving body of work which is meant to be presented in phases to the community and city officials as a way to spur stakeholder dialogue on I-10 land use plans and present a body of evidence upon which science-based policies can emerge.

- In **Phase I,** potential and prevailing environmental health conditions were characterized based on reviews of available site-specific environmental and health data, limited site-specific air quality and noise pollution monitoring, and a review of published studies investigating health impacts of high traffic conditions. This is the first report by the LSUHSC-SPH study team- it outlines the methodology undertaken to characterize current environmental and health conditions at the site, presents the preliminary results and conclusions of the investigation, and discusses the potential health implications of proposed land use plans for the I-10 corridor. Results will be communicated to the community and government officials, as requested, with the intention of assisting diverse parties in reaching a unified vision for future development of the area, which minimizes adverse health impacts, while supporting economic, cultural and community growth.
- In **Phase II**, the researchers will address stakeholder needs for more in-depth analyses as requested. The final report is meant to address stakeholder concerns; delve deeper into potential policy outcomes and implications; and present the evidence to needed to make science-based land use decisions.

The aim of this project is not to lend weight to any specific agenda or viewpoint, but to provide data upon which stakeholders can base decisions. This report aims to spur city planners into considering the unintended consequences of specific aspects of their land use plans, and to stimulate discussions early on as to how to amend plans to avoid adverse impacts and develop solutions to achieve common goals.

Study Goals:

1. Evaluate and characterize prevailing environmental conditions, exposure pathways, and disease rates that may be associated with pollution from the "Claiborne Corridor" area of the I-10 in New Orleans, Louisiana (LA)

2. Evaluate proposals related to Claiborne Corridor's future land use within the context of their potential environmental and health implications.

This report begins by summarizing data that characterizes the area proximal to the Claiborne Corridor area of the I-10 - i.e., the environment, potential exposures, and adverse health outcomes. Activities undertaken for this section of the report include reviews of the literature and archived data, site visits and environmental monitoring.

- Literature reviews of traffic emissions and associated health impacts were conducted to identify contaminants, exposure pathways and health impacts of potential concern to the I-10 Claiborne Corridor. Specific exposure measures that were significantly associated with adverse health impacts from traffic emissions in the literature were documented.
- Third party data characterizing traffic-specific contaminant levels and traffic-associated health outcomes were obtained, analyzed, and summarized.
- Site assessments were conducted to document potential exposure pathways, and measure noise levels and particulate matter concentrations.

This report ends by discussing different aspects of land use policy recommendations made by third parties. Land use recommendations are evaluated and discussed within the context of their potential implications on the prevailing environmental, exposure and health conditions.

Summary of Results

Environmental issues of greatest potential concern which already exist at the site include:

- Air contaminants from continuous traffic, including particulate matter (PM), nitrogen oxides (NOx), carbon monoxide (CO), volatile organic compounds (VOCs), and ozone (O_3);
- Legacy soil lead (Pb) from historical automobile emissions; and
- Traffic-related noise pollution.

The levels of these air, soil and noise pollutants were estimated or measured to occur at levels exceeding health-based standards for children, residents or workers.

Exposures to pollutants are occurring to children, residents and workers who reside or regularly work within the area. Exposure routes of greatest potential concern, based on the available data, include:

- Inhalation of fine particulate air emissions from I-10 and road traffic by residents, workers, children and homeless;
- Inhalation and ingestion of soil lead by children frequenting nearby parks, homes, daycares or schools;
- Regular noise pollution impacting area residents, workers, children and homeless.

Adverse health impacts that are significantly associated with existing levels of hazards that were either measured or modeled in the area include: 1) respiratory diseases, 2) cardiovascular diseases, 3) adverse birth and developmental outcomes, 4) immune system diseases, 5) cancer, 6) deafness, 7) stress-associated diseases, and 8) dementia. Site-specific health outcomes that occur in the I-10 corridor at rates exceeding city, state or national rates include disease which have both been shown to be significantly associated with traffic-related particulate matter (PM):

- Respiratory diseases such as 1) asthma, and 2) chronic obstructive pulmonary disease (COPD); and
- Cardiovascular diseases such as 1) high blood pressure, and 2) coronary heart disease.

Vulnerable populations include individuals who regularly live or attend daycares, schools or work in the area, including:

- Children
- Seniors
- Pregnant or lactating women
- Adults with cancer or disorders of the respiratory, cardiovascular, immune, auditory or nervous systems;
- Homeless individuals residing under the I-10.

Implications of land use policies made by third parties, which would increase car, bike, foot traffic in the area, or locate markets, vegetable gardens or parks under or proximal to the I-10, pose a further threat to health, due to potential increases in pollution as the economy grows, and more widespread and longer exposures due to increased community use of the Claiborne Corridor underpass. It is anticipated that unless contaminant remediation and exposure reduction efforts are made in conjunction with proposals to increase community usage of the area directly underneath the I-10 overpass, rates of adverse health conditions in the area would increase over time in relation to contaminant dose, exposure frequency, and disease latency. Further development under or near the I-10 also poses a potential environmental injustice problem given that the population residing within a 2-3 block radius of the I-10 consists largely of minority and low-income residents. Title VI of the Civil Rights Act of 1964 prohibits federal government funding from being used to create or aggravate a disproportionate impact on minorities.

Recommendations were developed to reduce potential impacts that were derived based on data available at the time of this report. It was decided to base preliminary policy recommendations on the overarching themes of each proposal, rather than getting into the details of each, given the likelihood that plans have changed since they were last drafted. More detailed scenarios can be considered in the development of the second paper. With the exceptions of scenarios 0 and 6, all of these scenarios and their impacts on traffic were laid out in the "Livable Claiborne Communities" (LCC) study.

1) **Scenario 0** (not in LCC report): Maintain the status quo → Traffic expected to increase in relation to the city's economic growth, continued use of underpass by community
    a. Traffic pollution increases
    b. Adverse health impacts increase due to natural growth in city's economic activity
2) **Scenario 1:** Keep the I-10 structure and use, take down some of the ramps, increase public transportation alternatives, and increase use of underpass space → Traffic expected to increase in some areas and decrease in other areas, increased use of underpass by community
    a. Traffic pollution increases/decreases
    b. Adverse health impacts increase due to increased use of underpass by community
3) **Scenario 2:** Keep the I-10 structure and use, remove all access ramps, increase public transportation alternatives→ Traffic expected to increase in some areas and decrease in other areas, continued use of underpass by community
    a. Traffic pollution increases/decreases
    b. Adverse health impacts increase due to increased use of underpass by community

4) **Scenario 3a:** Remove the Claiborne corridor's portion of the I-10, divert truck traffic, restore section to its historic form as a tree-line parkway street, increase public transportation alternatives→Traffic increases but most diesel-emitting traffic is diverted, neutral ground goes back to historical use
    a. Traffic pollution increases/decreases
    b. Adverse health impacts decrease due to substantial decrease in diesel emissions
5) **Scenario 3b:** Take down the entire downtown interchange of I-10 and US-90 Business, divert truck traffic, increase public transportation alternatives→Traffic increases, but in a more balanced distribution onto local streets, neutral ground goes back to historical use
    a. Traffic pollution increases/decreases
    b. Adverse health impacts decrease due to substantial decrease in diesel emissions
6) **Scenario 4** (not in LCC report): Keep the I-10 overpass in place but divert highway traffic and repurpose the structure for above ground walkway/park→Traffic increases, but increased use of underpass by community
    a. Traffic pollution increases/decrease
    b. Adverse health impacts decrease due to substantial decrease in diesel emissions

Approach

This is an exploratory study that used a mixed-methods approach involving both qualitative and quantitative analyses of primary and secondary data. The area targeted for this investigation- the I-10 Claiborne Corridor- is presented in **Figure 1**.

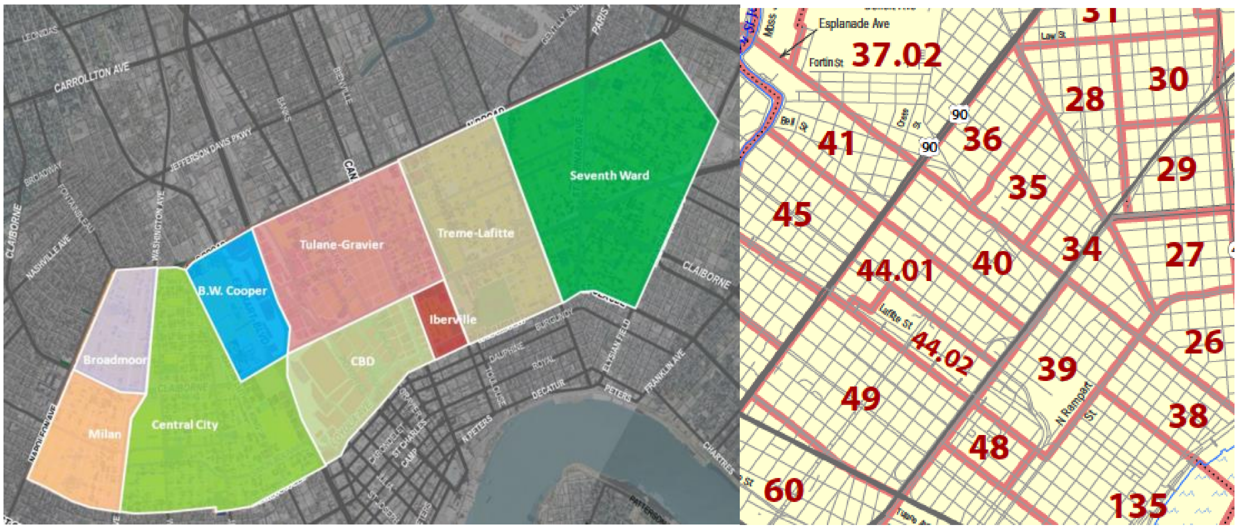


Figure 1. Claiborne Corridor: Study area and census tracts evaluated (Source: Map on left from Livable Claiborne Communities, Final Report. LINK)

To prioritize traffic-related environmental issues of concern in the I-10 Corridor area, scientific literature was reviewed to identify traffic-associated pollutants, exposure levels of concern (traffic volume, interstate proximity and air pollutant concentrations), and adverse health outcomes that are significantly related to interstate traffic and automobile emissions (see **Appendix A** for list of journal articles reviewed, and **Appendix D** for the review summary). Multiple site visits were conducted to measure noise, air concentrations of particulate matter and to document potential exposure routes. Monitoring and emissions modeling data for the area from multiple third-party sources were requested and/or summarized (see **Appendix B** for data sets reviewed).

To evaluate the potential health implications of current environmental conditions, interstate proximities, traffic volumes and contaminant concentrations or levels were derived based on existing and available monitoring and emissions modeling data, and traffic volume data. Estimates of interstate proximity were conducted using Google Earth distance measurement tool. Measurements were made in meters to enable comparison with proximities reported in the literature. Interstate traffic volume estimates were obtained from the LA Department of

Transportation (LDOT). Air concentrations, either measured of modeled, were derived from either the US EPA or the LA Department of Environmental Quality (LDEQ) databases (see Appendix B for data used). **Figure 2** presents the locations of LDEQ air monitors). These site-specific “exposure” measures were then compared to those measures in the literature that were found to be significantly associated with traffic-related health impacts, and available health-based standards (**Appendix D**). Health risks or hazard index estimates derived from federal studies of site-specific traffic-related emissions modeling were also evaluated to flag health conditions of potential concern.

Figure 2. Satellite image of LDEQ air monitor (red flag) near I-10 (monitors were 1 and 2 blocks away).

To assess ambient particulate matter (PM) levels, we conducted limited monitoring of particulate matter (PM) levels within the Claiborne Corridor- either directly under the overpass, across the street, and at some further distance to evaluate proximity impacts on PM levels. To conduct the particulate air monitoring assessment, a Dylos DC 1170 air quality monitor was used. The Dylos monitor can generate two reports. The first report is a particle count of large particles (any particles greater than 2.5 microns in diameters); pollutants such as pollen, dust, and fibers would fall into this category. The second report is a measure is a total particle count of all particles greater than .5 microns in diameter. Fine particulate levels (0.5 to 2.5 microns) are equal to the difference of these two measures (particles >2.5 microns minus particles >0.5 microns). Fine particles include pollutants found in smog, tobacco smoke, car emissions, and some bacteria and mold spores. One limitation in the technology used to measure particulates is that there is a possible decrease in precision or accuracy of readings when the relative humidity (RH) in the environment is at or above 60%.[1] Our readings were taken when the RH was at 68%. While this limitation was only reported for Dylos model #1100 PRO, and not the model we used (#1170), this is a typical issue with low-cost PM meters. Other limitations include a small sample size and the fact that most air measurements were not taken at peak traffic times (rush hours), thus readings represent normal conditions as opposed to peak exposure conditions. Available disease rate data for this area were obtained from various health surveillance databases, and compared to the list of flagged priority traffic-related emissions and associated health outcomes. Site-specific disease rates which exceeded rates of the city, state or nation were identified as having a potential association with current traffic conditions. Land use scenarios and their impacts on traffic were derived from the Livable Claiborne Corridor study (LCC). Impacts on all traffic and diesel-related traffic were considered as the driving factor in charactering the potential impact of each scenario on environmental and health conditions for the area (see Appendix C for reports reviewed). Recommendations to reduce contaminant exposures were derived from prevailing public health guidelines.

Results

Identification of Traffic-Related Emissions of Potential Health Concern

A study published in the Annals of the American Thoracic Society estimates that approximately 9,320 excess deaths occur each year due to air pollution. In New Orleans, the study estimated approximately 21 excess deaths and over 50 increased health events are due to pollution.[2] Adverse health conditions that are significantly associated with traffic in the scientific literature are presented in **Figure 3.** A list of the studies reviewed is in **Appendix A**; and a summary of related study findings is in **Appendix D**.

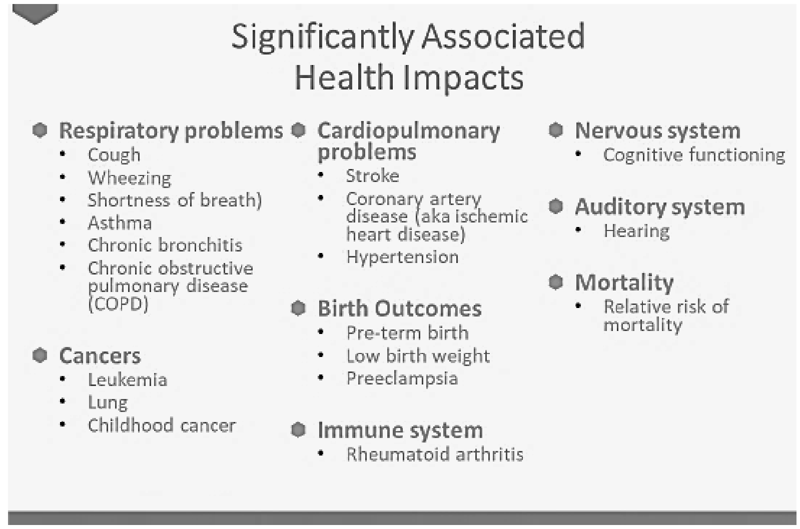


Figure 3. Adverse health conditions that are significantly associated with traffic in peer-reviewed scientific papers

Traffic-associated diseases of potential concern include the respiratory, cardiovascular, nervous, auditory and immune systems; as well as cancer, adverse birth and developmental outcomes, and increased risk of mortality or dementia.

Emissions associated with these outcomes include: 1) particulate matter (PM); 2) nitrogen oxides; 3) carbon monoxide (CO); 4) volatile organic contaminants (VOCs), like benzene; and 5) ozone. **Table 1** presents significantly associated health impacts of each of these pollutants, their detection limits in the environment (lowest concentration of a pollutant that a sensor or other instrument can detect), the range you can expect to see them in the environment, and their US Environmental Protection Agency (US EPA) standard. The standards are a level of airborne pollutant concentration that has been identified at or above which health impacts are known to occur after exposure for a defined period of time (1 hour, etc.). A complete list of air toxic values of concern is available at http://www.epa.gov/ttn/atw/hlthef/hapindex.html.

[2] Lipinski, Jed. "Air Pollution Causes 21 Deaths per Year in New Orleans, Study Says." NOLA.com, NOLA.com, 10 Aug. 2016, www.nola.com/health/index.ssf/2016/08/air_pollution_new_orleans.html.

Table 1. Traffic-related air emissions and significantly associated health impacts

Air Pollutant	System Impacted	Health Impacts	Useful Detection Limits	Range to Expect	US EPA Standard
Particulate Matter (PM)	Respiratory, cardiovascular, neurological, reproductive, systemic	Asthma exacerbation, COPD, decreased lung function growth, ischemic heart disease, hypertension, autism, impaired cognition, preterm delivery, premature mortality, cancer	Fine $PM_{2.5}$ = 5 ug/m^3 (24 hr)	0-40 ug/m^3 (24 hr)	35 ug/m^3 (24 hr) 12 ug/m^3 (1 yr)
			PM10 = 10 ug/m^3 (24 hr)	0-100 ug/m^3 (24 hr)	150 ug/m^3 (24 hr)
Nitrogen dioxides (NO2)	Immune, respiratory, reproductive	Increased allergen sensitivity, asthma exacerbation, preeclampsia, low birth weight	10 ppb	0-50 ppb	100 ppb (1 hr) 53 ppb (1 yr)
Carbon Monoxide (CO)	Cardiovascular, neurological, systemic	Chest pain, headaches, nausea, impaired cognition	0.1 ppm	0-0.3 ppm	9 ppm (8 hr) 35 ppm (1 hr)
Volatile Organic Compound (VOC)	Systemic, immune	Cancer, including childhood leukemia	1 ug/m^3	5-100 ug/m^3 (total VOCs)	None
Benzene (example of a Volatile Organic Compound (VOC))	Systemic, immune	Cancer, including childhood leukemia	0.1 – 10 ug/m^3	0-3 ug/m^3	None
Ozone (not directly emitted- forms via UV (sunlight)) (O3)	Respiratory	Asthma exacerbation, chronic respiratory symptoms (cough, wheeze, phlegm), lung inflammation	10 ppb	0-150 ppb	75 ppb (8 hr)

Notes: µg/m3 = microgram per cubic meter; ppm = parts per million; ppb = parts per billion; (1 hr) = one hour averaging time period; (8 hr) = one eight hour averaging time period; (24 hr) = one 24 hr averaging time period; (3 mo) = one three month averaging time period; (1 yr) = one year averaging time period

Estimation of Exposure Measures in the Claiborne I-10 Corridor

To determine whether contaminant exposures are at levels high enough to cause disease, measures of exposure have to be derived and compared to those measures in the literature that are significantly associated with a disease. Traffic-related adverse health outcomes were evaluated in past studies in relation to certain measures of exposure- these include traffic proximity (**Figure 4**), traffic volume, lab measurements of air and soil pollutant concentrations, and modeled estimates of air pollutant concentrations based on automobile emissions. Those values which were significantly associated with diseases were compared to measures or estimates of exposure derived for the Claiborne Corridor community residing proximal to the I-10. Values of comparison included: 1) traffic proximity and volume; 2) air concentrations; 3) soil lead levels, and 4) noise levels- these are described in the subsequent sections.

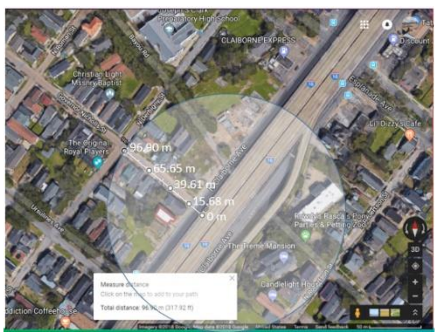


Figure 4. Estimating residential proximity to I-10. Note: The picture on the right shows how close houses are to I-10. Other houses were observed to be even closer to the interstate.

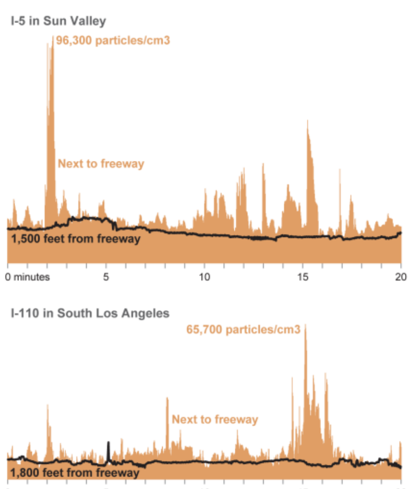


Figure 5. PM spikes near CA freeway. Source: Ultrafine Particle Counter 8525 readings on Aug. 20, 2015 and Sept. 24, 2015. Data

Traffic Proximity and Volume

Public health officials have long warned that traffic pollution can drift well over 1,000 feet from traffic. It is generally common to see the highest exposures at closer distances, though some ultrafine particulates can travel much further before the settle. **Figure 5** presents ultrafine PM readings near two Los Angeles freeways- readings near the freeway were three to four times higher than in neighborhoods further from traffic. A comprehensive study of urban air toxics concluded that motor vehicles and other mobile sources accounted for about 90 percent of the cancer risk from toxic air pollution.[3] The majority of that risk is attributed to diesel soot (70%), which comes predominantly from commercial trucks transporting goods long distances.

[3] The Children's Health Study (CHS) by the University of Southern California (USC) is one of the largest and most detailed studies of the long-term effects of air pollution on the respiratory health of children. More than 12,000 school children living in southern California are involved in this ongoing study. Data on their health, exposure to air pollution, and factors that affected their responses to air pollution were gathered annually from elementary through senior high school. Findings from these studies have led to changes in state and federal guidelines to improve air quality standards and urban planning decisions and better protect and improve everyone's health.

Residents within the Claiborne Corridor are in the top 95th to 100th percentiles in the state terms of traffic proximity (**Figure 6**). Residential proximity to the I-10 highway is 15-200 meters within the first two blocks of the I-10. This translates into 49 feet for the first block to 656 feet for the second block (or 0.1 miles) (**Figures 4 and 6**). It should be noted that in 2017, the California Air Resources Board (CARB) advised cities to avoid putting new homes within 500 feet of freeways based on years of research. The average traffic volume is 130,000 vehicles/day based on 2016 data (**Table 2**).[4]

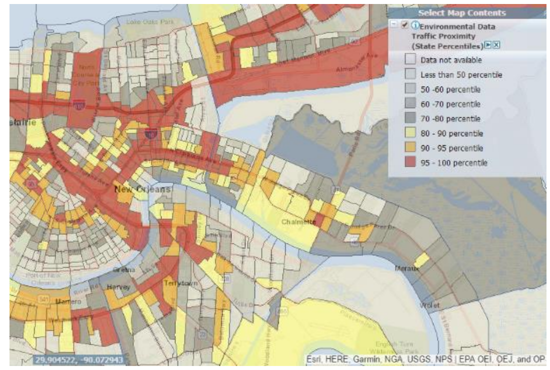


Figure 6. Traffic proximity (Source: US EPA EJ Screen)

These estimates are a potential concern, as children living within 250 feet of a highway that sees > 20,000 cars per day are 8 times more likely to develop leukemia, and 6 times more likely to develop all other cancers; while children living within 220 yards of a highway which experiences heavy truck traffic are more likely to be hospitalized for asthma (see **Appendix D**). In the case of leukemia, more robust studies are needed. But there are years of research linking traffic pollution to asthma, heart attacks and other health problems.

Table 2. Average daily traffic in the corridor (Source: LA Department of Transportation and Development)

Traffic Station	Location	Latitude & Longitude	Milepoint	Avg. Daily Traffic (ADT) (Vehicles/Day): 2001	ADT: 2004	ADT: 2008	ADT: 2010	ADT: 2013	ADT: 2016	Avg for all data
222531	I-10 between Iberville & Bienville Streets	(29.604, -90.0765)	235.953	121464	99531	91600	69466	109923	147578	106593.6667
223051	I-10 between Esplanade Ave. & Kerlerec St.	(29.9698, -90.0681)	236.764	96782	113847	67633	100329	137820	137348	108959.8333

[4] Roadway traffic in this area is an average of 25,684 vehicles per day; and I-10 traffic in this area is an average of 130,002 vehicles per day based on traffic monitoring data from the LA Dept. of Transportation and Development (LDODT 2016).

223061	I-10 between N. Johnson and N. Prieur	(29.997, -90.0617)	237.38	94599	121700	57278	83978	96675	109159	93898.16667
222521	US-90 just uptown from Poydras	(29.95334, -90.0831)	257.509	121367	101467	66343	95844	125924	125924	106144.8333
Annual Average for the Corridor				108553	109136	70714	87404	117586	**130002**	103899

Particulate Matter

In addition to other pollutant gases, vehicles produce soot and other byproducts of combustion which can be lumped together under the term "particulate matter" (PM). Fine particulate matter is a particular concern as it can be inhaled deep into the respiratory system and enter the blood stream, where they are not easily removed and are known to cause adverse health effects (**Figure 7**). Recent research has uncovered another category of PM known as ultrafine PM. Ultrafine PM are so small that they are often hard to capture with control technologies or filters. Ultrafine PM are currently unregulated by state or federal authorities. It is also widely acknowledged that current air quality regulations are not strict enough to sufficiently protect human health.

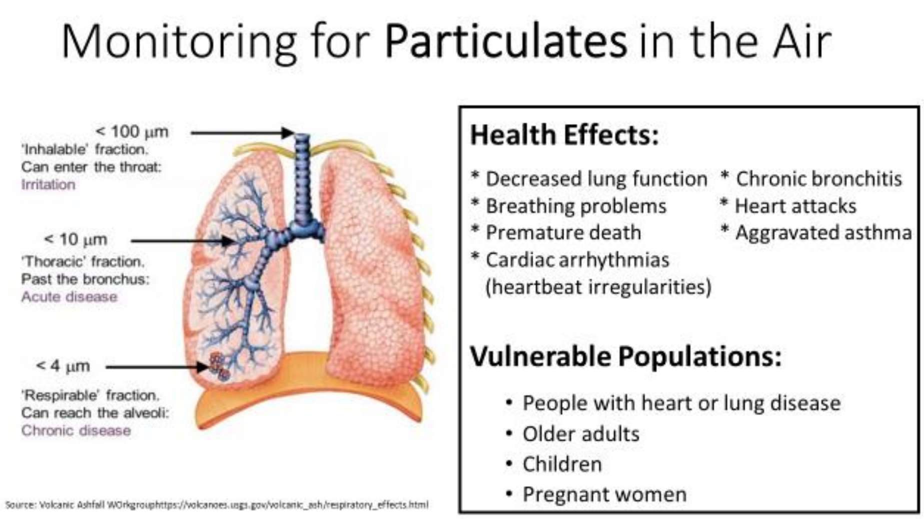


Figure 7. Particulate matter impacts and vulnerable populations

The U.S. Environmental Protection Agency's (EPA) National Air Toxics Assessment (NATA) database houses exposure estimates by census tract for a variety of specific sources, such as benzene and diesel particulate matter. Exposures are presented as chemical or chemical-group specific air concentrations and are based on source-specific estimated emissions. NATA also houses their associated estimated health risks, and estimated health risks for the entire panel of air pollutants tested by the National Air Toxics Assessment. The EPA uses data reported by sources in the National Emissions Inventory as input to models to generate ambient concentrations; which are then used as input to an inhalation exposure model to generate exposure concentrations; which were then used with health-benchmark information to estimate risks or hazards. Highway-specific sources of emissions in the Claiborne Corridor were evaluated for this assessment. Another EPA database reviewed was EJ Screen. EJ Screen provides similar estimates of environmental exposure and risk measurements (much of which are based on other EPA datasets such as NATA). In addition, EJ Screen provides environmental justice indexes (expressed as percentiles). Users can define the area they want to evaluate- in this case it included the area within 200 meters of the I-10 within the Claiborne Corridor. **Table 3** presents the results of these analyses.

Table 3. Review of US EPA's NATA and EJScreen data for Claiborne Corridor and comparison to Louisiana, EPA Region and US averages

Selected Variables	Claiborne Corridor Avg.	Max	Louisiana State Avg.	Percentile in State	EPA Region Avg.	Percentile in EPA Region	USA Avg.	Percentile in USA
EJ Index for Particulate Matter (PM 2.5)				70		60		72
EJ Index for Ozone				71		60		74
EJ Index for Lead Paint Indicator				**93**		**91**		**89**
Particulate Matter (PM 2.5 in ug/m^3)	7.89	22.4	8.67	18	9.15	16	9.14	20
NATA Diesel PM (ug/m^3)	1.74	427	0.889	**88**	0.721	**95-100th**	0.938	**90-95th**
NATA Air Toxics Cancer Risk (risk per MM)	50		49	66	42	**80-90th**	40	**80-90th**
NATA Respiratory Hazard Index	2.1		1.9	73	1.8	**70-80th**	1.8	**70-80th**
Traffic Proximity and Volume (daily traffic count/distance to road)	2100		250	**97**	320	**97**	590	**93**
Demographic Index (minority and low-income)	69%		40%	**84**	45%	**80**	36%	**87**
Minority Population	75%		41%	**81**	50%	72	38%	**81**
Low Income Population	63%		40%	**84**	39%	**83**	34%	**88**
Linguistically Isolated Population	1%		2%	64	6%	38	5%	46
Population with Less Than High School Education	21%		17%	69	17%	68	13%	**78**
Population under Age 5	5%		7%	37	7%	32	6%	41
Population over Age 64	11%		13%	43	12%	53	14%	43

Note: Bold variables indicate Claiborne Corridor is within the top 25th percentile of the area indicated for this indicator.

A preliminary review of EPA's NATA and EJ Screen data revealed potential problems with levels of diesel particulate matter (PM) concentrations in the air surrounding the I-10 corridor (Table 3). Diesel PM consists of a mixture of particulates of different sizes and a wide variety of chemicals which adsorb to PM surfaces. These particles are emitted by diesel-fueled vehicles such as large semi-trucks or tractor trailers carrying cargo across the US. Large and small PM have been shown to be associated with adverse health outcomes. The most damaging type of particulate matter are the smallest ones, fine and ultrafine PM. These tiny particles have an aerodynamic diameter of 2.5 microns or less and are invisible to the naked eye. Exposure to fine PM is associated with cardiovascular and respiratory diseases (arrhythmias, heart attacks, asthma, and bronchitis)[5]. Particulates may be irritating to sensitive groups such as seniors, the immune-compromised, children, and those suffering from a respiratory infection such as the common cold. Children growing up near major roadways have higher rates of asthma and other respiratory illnesses, including deficits in lung function that can be permanent and lead to a lifetime of health problems (**Figure 8**) .[6]

Figure 8. Living in freeway pollution
Children who live close to freeways are among those who most frequently visit the emergency room for asthma and other respiratory diseases. (Source: Mel Melcon / Los Angeles Times; LINK)

Table 3 presents the results of some of the indicators for air contaminants evaluated in the Corridor. Indicators in bold are estimated to be in the highest 25th percentile either in the state, EPA region or the US. These include indicators for diesel PM, air toxics cancer risk, air toxics respiratory hazard, traffic volume and proximity, and lead paint (discussed in subsequent section).

[5] "Health and Environmental Effects of Particulate Matter (PM)." EPA, Environmental Protection Agency, 20 June 2018, www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm.

[6] The Children's Health Study (CHS) by the University of Southern California (USC) is one of the largest and most detailed studies of the long-term effects of air pollution on the respiratory health of children. More than 12,000 school children living in southern California are involved in this ongoing study. Data on their health, exposure to air pollution, and factors that affected their responses to air pollution were gathered annually from elementary through senior high school. Findings from these studies have led to changes in state and federal guidelines to improve air quality standards and urban planning decisions and better protect and improve everyone's health.

Because the values in **Table 3** are largely based on estimates, we wanted to further evaluate PM levels near the I-10 by monitoring air at select points along the Claiborne Corridor (**Figure 9**). This air assessment focused on measuring the levels of fine and total particulates (large plus small PM) at various distances from the I-10.

Figure 9. Map of air sampling locations at LSUHSC and the Lafitte Greenway (New Orleans, LA), and the average particle count. Note: Source of background map is Google Maps.

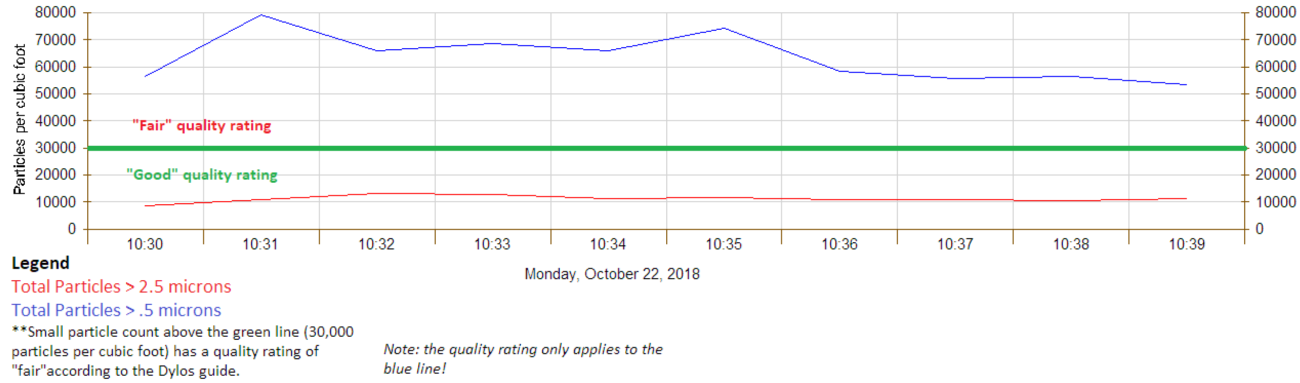
Fine PM is of concern when ambient levels surpass the National Ambient Air Quality Standard (NAAQS), which is a 24-hour average of 12 µg/m^3. Because the monitor used (Dylos) gives a total particle count per square foot instead of mass, the concentration could not be determined, thus the number cannot be compared to any air existing quality standard. However, the Dylos monitor categories particulate counts by the anticipated quality of air. Due to this limitation, it is important to note that the data collected by the air quality sensor cannot be used to make any assumptions about human health. **Table 4** presents the Dylos interpretation of the particle counts.

Based on the reports generated, the average particle counts were between 500 and 700 particles per 100 cubic feet, which has a rating of "fair" according to the air quality chart (**Table 4**). It should be noted that these readings were not taken during peak travel hours. **Figure 10** displays measures of total large particles (> 2.5 microns in red) and total large and fine particles (> 0.5 microns in blue) for areas under the I-10 (A) and in the Lafitte Greenway (B). The average difference between these two measures is an estimate of the levels of fine particulates which along with ultrafine particulates, are the particles of greatest concern (between 0.5 and 2.5 microns). Fine particulates are roughly estimated to be between 500 and 700 particles per 100 cubic feet; while at the Greenway, they are estimated to be between 400 and 600- both estimates fall into the "fair" air quality category.

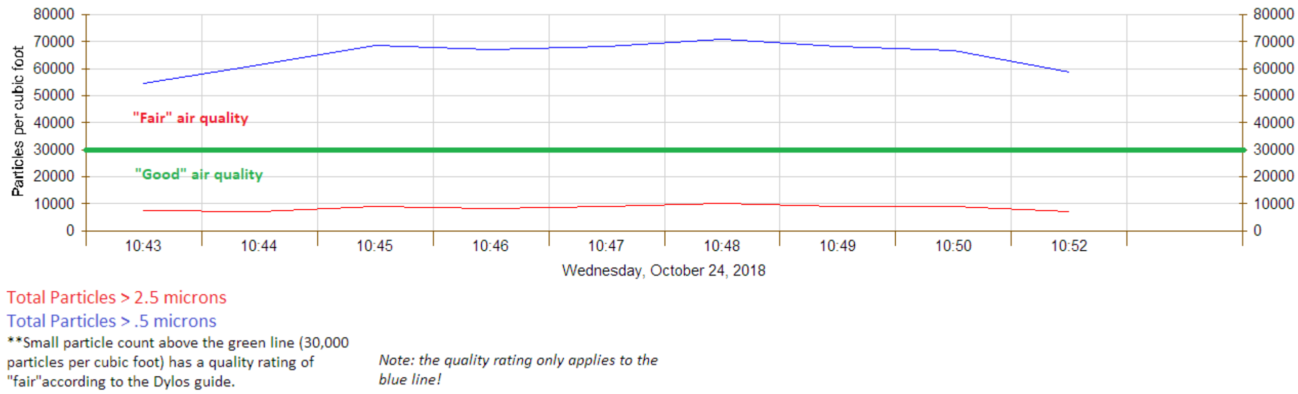
Table 4. Air Quality Interpretation

Particles per 100 cubic feet	Reading
>3000+	Very poor
>1050-3000	Poor
>300-1050	**Fair**
>150-300	Good
>75-150	Very good
0-75	Excellent

Notes: Air Quality for Dylos DC 1170 results as published in the user manual.



A.



B.

Figure 10. Particulate levels (particles per cubic foot) from: A) Student Lot 1 at LSUHSC's campus. Samples were taken between 10:30-10:40 am at coordinates N 29° 57.29' - W 90° 4.97'' Temperature was 66.2 °F and relative humidity was 68.2%. B) Under the I-10 at the Lafitte Greenway. Samples were taken between 10:40-10:50 am at coordinates N 29° 57.82' - W 90° 4.46'. Temperature was 71.2°F and relative humidity was 68.3%.

Another source of data evaluated included actual air monitoring data collected by two LA Dept. of Environmental Quality (LDEQ) monitors within one block of the I-10 (at City Park) and two blocks from the I-610 (at I-10 intersection) (2015). Average annual measures did not exceed NAAQS standards; however, it was not unusual to get random spikes of PM in the air, which - given the distance of the monitors from the highways (1-2 blocks estimated) - suggests a need to further evaluate PM levels at areas closer to the Claiborne Corridor (**Table 5**).

Table 5. LDEQ data from PM monitoring stations near I-10 (2015)

Location	PM	Annual Average (ug/m3)	Annual Max (ug/m3)	NAAQS Standard (Average)(ug/m3))		n
I-610	PM2.5	9	22	12	1-yr	121
City Park	PM10	19	427	150	24-hr	8500

Based on site-specific air monitoring data, modeled air concentrations, and NATA risks and hazard estimates, health impacts of potential concern could include diseases of the respiratory and cardiovascular systems, cancer, and premature mortality (**Appendix D**).

Soil Lead Levels

Between the late 1970s and 1990s, lead was phased out or banned from use in paint and gasoline. By that point, however, much of the damage had already been done. Today most cities have a persistent legacy hazard of lead in the environment which can be found inside the home as dust (often from paint or outside soil) and outside in the soil. Two risk factors for lead exposure are traffic proximity (**Figures 4 and 6)** and housing age (**Figure 11**) - both of which are met by Claiborne Corridor residents. Lead particles emitted by vehicles fueled with lead containing petrol over several decades resulted in a massive quantity of lead dust that accumulated in proportion to patterns of traffic flows through cities. A strong association is evident between lead in the exterior environment and children's biomarkers of lead. Lead is a particular concern when children are present in an area, as there is no none safe level of lead exposure. Lead's impact on children includes developmental delays, attention-deficit disorder, learning-disabilities and lack of impulse control. Lead exposure during early childhood is recognized clinically as having lifelong and multiple negative health influences on morbidity and wellness. Lead also bio-accumulates as one ages, and early life exposures can impact reproductive and developmental outcomes.

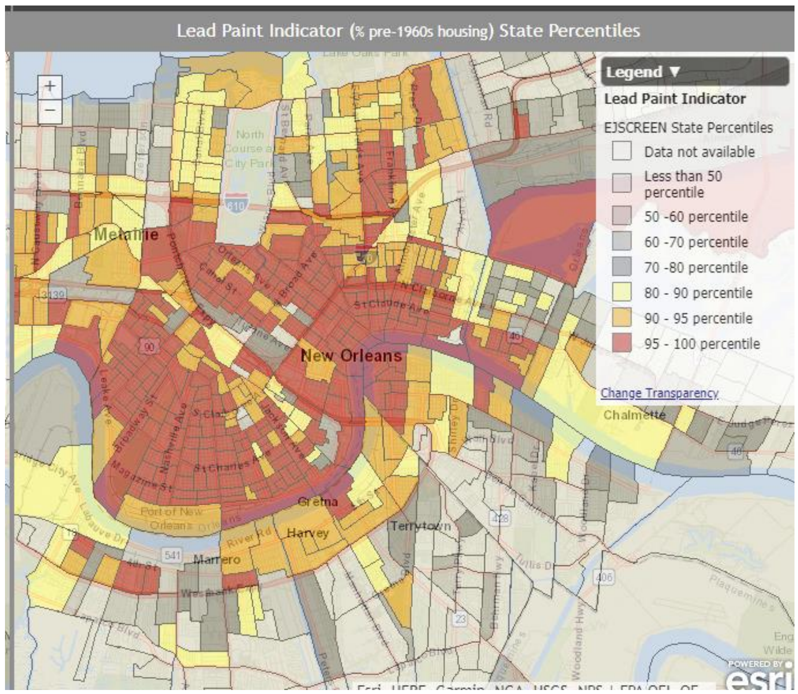
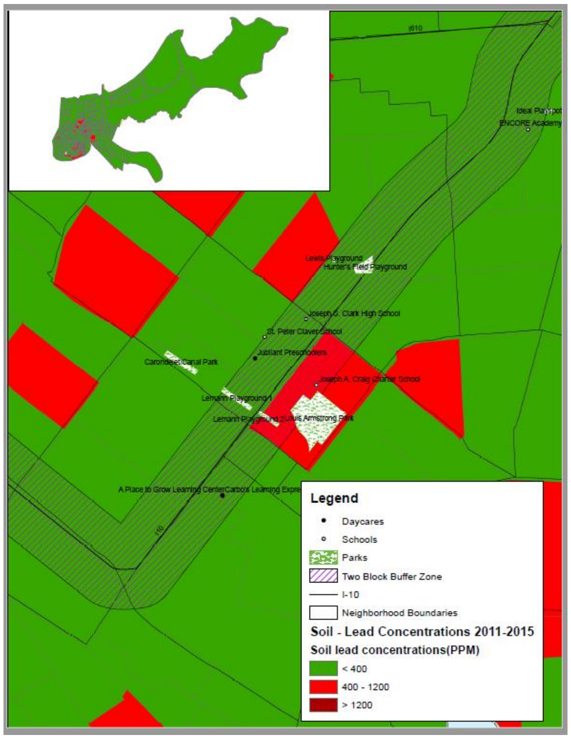
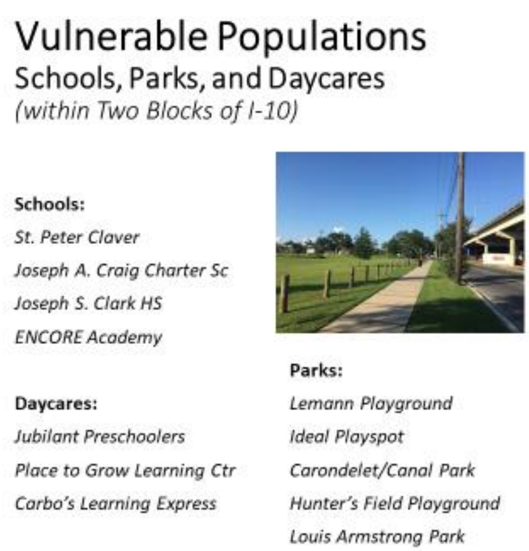


Figure 11. Lead paint indicator (State percentile for pre-1960 housing) (Source: EJ Screen)



The US EPA lead soil standard is 400 micrograms of lead per gram of soil (µg/g) for playgrounds or 1200 micrograms of lead per square foot of space (µg/ft^2) in other areas. This playground soil standard is 38 times higher than the US Housing and Urban Development's lead dust standard for homes, though both are meant to protect children from dangerous levels of lead exposure. If the soil lead standard was updated to be as protective as the dust standard, the soil standard would not exceed 6 µg/g. It is rare to find soil in the city of New Orleans that does not exceed this level. Lead is a particular concern in this area given the fact that soil lead concentrations can be found within the area of the I-10 at levels which exceed health-based standards for children (Figure 12); and the fact that several schools, daycares and playgrounds are within a block or two of the I-10 **(Figures 13-14, Table 6).**

Figure 12. Soil lead levels (parts per million or ppm) Source: Dr. Howard Mielke, Tulane University, Department of Pharmacology



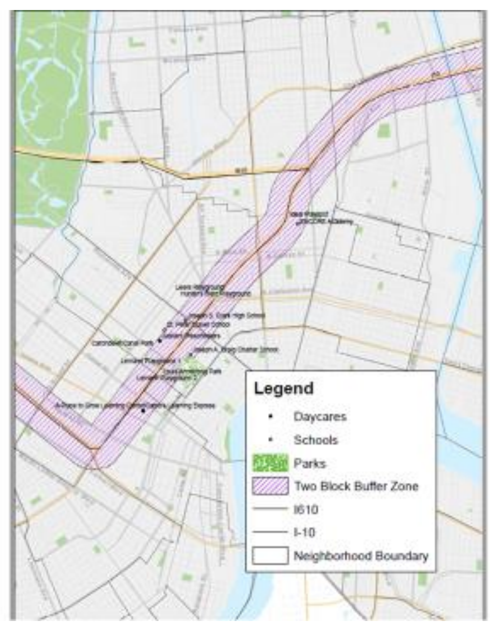


Figure 13. Vulnerable populations within two blocks of the I-10: Schools, daycares and park

A.

B.

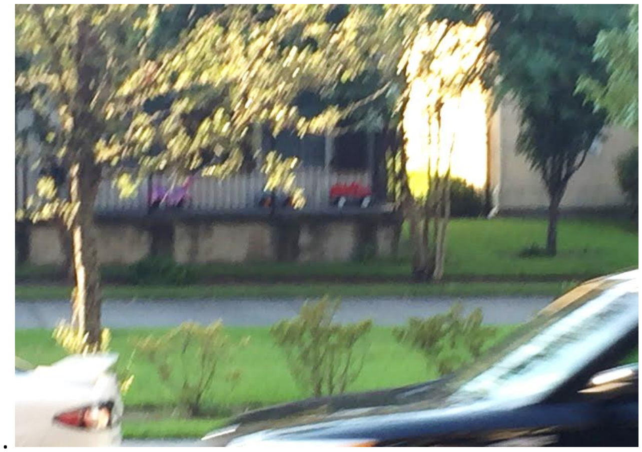


Figure 14. Picture of A) parks and B) home with child's toys on porch of home directly across the street from I-10

Table 6. List of vulnerable populations in the area of the I-10

Institution	Name	Address
Daycares	A Place to Grow Learning Center	3138 Annette St
	Carbo's Learning Express	6210 Franklin Avenue
	Jubilant Preschoolers	1938 Dumaine Street
Schools	St. Peter Claver School	1020 N. Prieur St
	ENCORE Academy	2518 Arts St
	Joseph A. Craig Charter School	1423 St Philip St
	Joseph S. Clark High School	1301 N Derbigny St
Parks	Carondelet/Canal Park	Lafitte St. & N Rocheblave
	Hunter's Field Playground	1600 N. Claiborne & St. Bernard
	Lemann Playground(2)	1600 and 2022 Lafitte Street
	Lemann Playground(1)	2022 Lafitte Street
	Lewis Playground	N. Roman Street & Lapeyrouse
	Louis Armstrong Park	701 N. Rampart St. , Orleans Ave.
	Ideal Playspot	2650 Franklin Ave.
Hospitals and Healthcare Clinics	Kids First TigerCARE	1661 Canal St.
	University Medical Center New Orleans	2000 Canal St.
	Tulane Medical Center	1415 Tulane Ave.
	Southeast Veterans Health Care System	2400 Canal St.
	Veterans Affairs Hospital	119 S. Galvez St.
	LSU Medical Center	2021 Perdido St.
	Tulane Pediatrics	275 Lasalle St.
	Tulane Cancer Center	150 S. Liberty St.

Noise Pollution

One issue of concern that warranted more information was noise pollution in the area. While many people are aware that vehicles cause air pollution, noise pollution due to heavy traffic is often not considered. According to the National Institute on Deafness and Other Communication Disorders, noise induced hearing loss can occur due to long or repeated exposure to sounds at or above 85 decibels.[7] Other adverse health effects associated with excess noise exposure include: headaches, dizziness, high blood pressure, increased stress, problems sleeping, heart disease, myocardial infarctions and loss of concentration (**Appendix D**).[8] **Figure 15** presents the typical sources of noise associated with various sound levels.

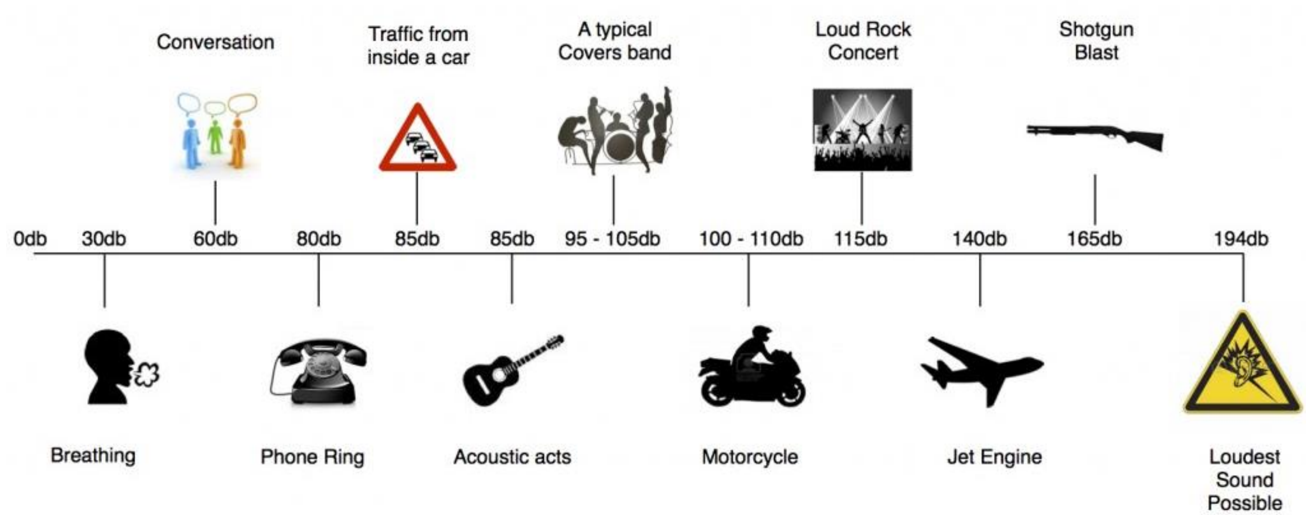


Figure 15. Impacts by noise level in decibels (dBA) (Source: yourdj.co.uk)

Seven noise samples were taken along South Claiborne Avenue, either underneath or proximal to the I-10. Four sets of samples were taken on the campus of LSU Health Sciences Center New Orleans, and three sets of samples were taken along the Lafitte Greenway. Noise measurements were recorded for one minute each for the LSU samples and five minutes each for the Greenway Samples. All samples were taken by a TACKLife Sound Level Meter (**Figure 16, Appendix E**). **Figure 16** also presents a video of what the noise levels are like which occur on a regular basis while an emergency vehicle is passing. **Figures 17 and 18** presents maps of areas where the noise monitoring was conducted. **Table 7** presents the results of noise measurements.

[7] "Noise-Induced Hearing Loss." National Institute of Deafness and Other Communication Disorders, U.S. Department of Health and Human Services, 8 Oct. 2018, www.nidcd.nih.gov/health/noise-induced-hearing-loss.

[8] "Noise: Health Effects and Controls." Western Region Universities Consortium (WRUC), Labor Occupational Health Program, UC Berkeley. **https://web.archive.org/web/20070925221754/http://ist-socrates.berkeley.edu/~lohp/graphics/pdf/hw24en08.pdf**

Residential noise standards developed by the U.S. Dept. of Housing and Urban Development (HUD) consider dBA levels above 65-75 dBA normally unacceptable; while levels above 75 dBA are unacceptable. Damage to hearing is known to occur at 85 decibels (A-weighting, dBA).

While average noise levels did not reach 85 decibels, occasionally maximum noise levels reached or exceed that level indicating there is a likelihood for noise-related adverse health outcomes for individuals either residing or working near the I-10. Noise levels increased as proximity to the interstate increased (**Figure 16**). Directly underneath the I-10 the average noise from a 5-minute sample was 84 dB, but there were many instances during the sample where the noise level was at or above 85 dBA. Noise frequently surpasses 85 dBA when emergency vehicles pass. **Figure 16** presents a reading of 102 dBA as an emergency vehicle passes. NIOSH recommends that exposures last <15 minutes when noise levels are this loud due to health impacts. The passing of emergency vehicles is a regular occurrence in this area, as it is surrounded by three hospitals [VA Hospital, University Medical Center Hospital, and Tulane Medical Center (see **Table 7**)].

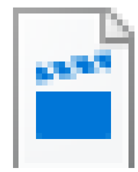
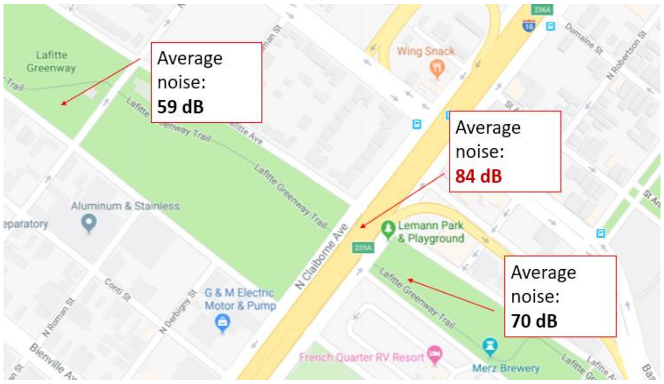
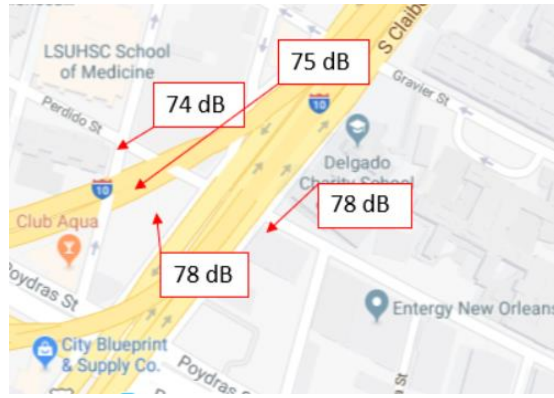


Figure 16. *Above:* TACKLife Sound Level Meter **at** 102 dBA *Below:* Video of emergency vehicles driving down Claiborne Avenue.

There are some limitations to the data collected as noise measurements were not always taken at the peak travel times (**Table 7 and Figures 17 and 18**). Further noise sampling is needed to determine the average noise levels throughout the entire day, specifically at times where activity under the I-10 is expected to be the highest. Based on the current data, it is reasonable to assume that the current levels of noise in the area around the Interstate-10 pose a potential health risk to those exposed for sustained periods of time. Sound levels are expected to be greatest during peak traffic hours, such as morning or evening rush hour, when there is an increase in vehicles traveling along the adjacent road or interstate. It is also worth noting that University Medical Center and Tulane Medical Center are located near this area- we can expect a greater than average number of emergency vehicles on this road, and higher noise levels proximal to these sites (**Figure 17**).

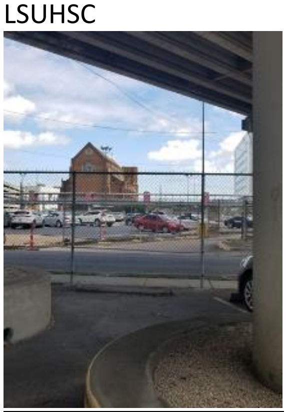




B. B.

Figure 17. Map of average noise levels measured along the A) Lafitte Greenway, and B) the South Claiborne/I-10 split near LSUHSC's Campus (New Orleans, LA). (Source of background map: Google Maps)

Table 7. Results of I-10 noise assessment

I-10 Location	Sample Location (Latitude - Longitude)	Date (Time)	Avg. Noise Level (dBA)	Max. Noise Level (dBA)
LSUHSC 	S Claiborne and Perdido (N 29° 57.29' - W 90° 4.92')	9/5/18 11:12 AM	78.39	94.2
	S Roman and Perdido (N 29° 57.3' - W 90° 4.96')	9/5/18 11:25 AM	74.21	85.2
	Under I-10 LSU Student Lot (N 29° 57.29' - W 90° 4.95')	9/5/18 11:18 AM	75.77	81.0
	S Claiborne and Perdido (N 29° 57.27' - W 90° 4.88')	9/5/18 11:30 AM	78.28	93.0
Greenway 	Lemann Park (N 29° 57.77' - W 90° 4.42')	9/13/18 2:17 PM	69.5	81.1
	Fitness Zone (N 29° 57.87' - W 90° 4.66')	10/2/18 2:30 PM	58.95	73.0
	Under 1-10 at Greenway (N 29° 57.79' - W 90° 4.45')	10/2/18 2:45 PM	83.68	99.6

Notes: Noise measurements were collected between 11:00 am and 12:00 pm, which is typically a time of high traffic. The Greenway samples were taken between 2:00 pm and 3:00 pm, which is a time of medium traffic. All samples were taken during the working week. To give readers an idea of where samples were collected, pictures with identifiable landmarks are shown near where the samples were taken.

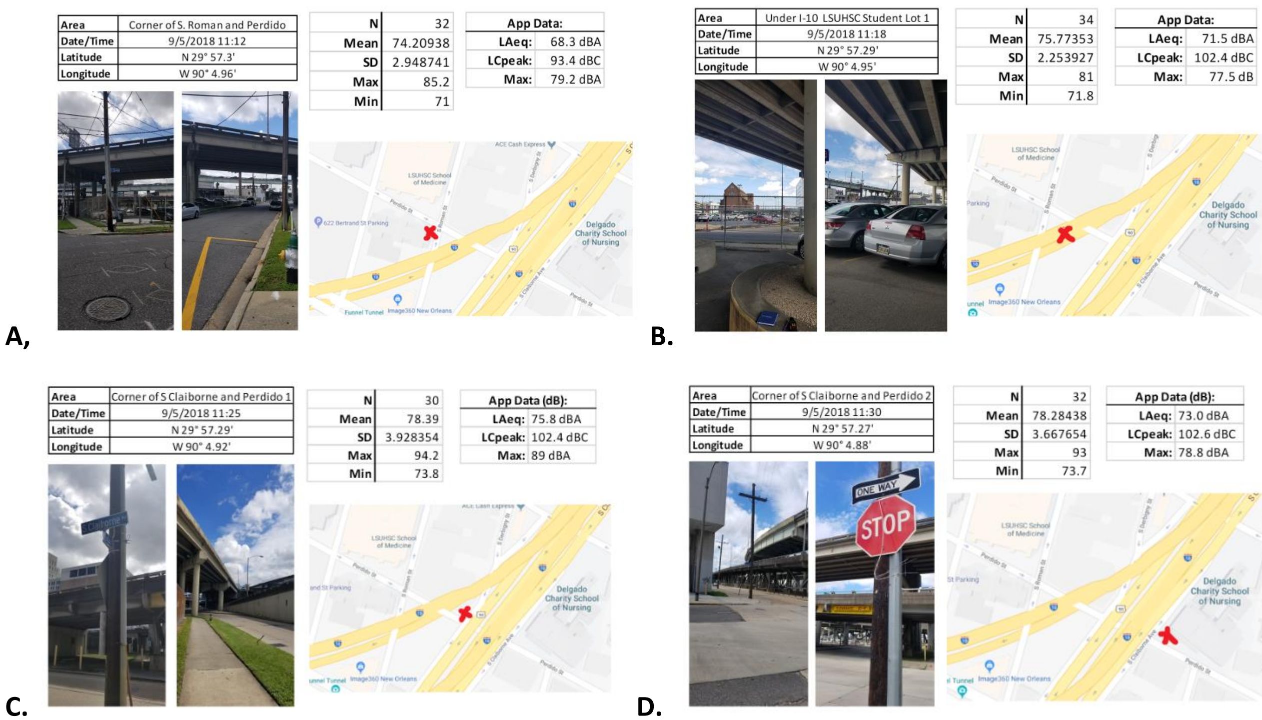


Figure 18. Examples of noise sampling locations and results: A) Corner of Roman and Perdido Streets. B) Under I-10 at LSUHSC Student Parking Lot 1. C) Corner of Claiborne and Perdido Streets. D) Corner of Claiborne and Perdido Streets (opposite side of I-10 from C).

Health Assessment

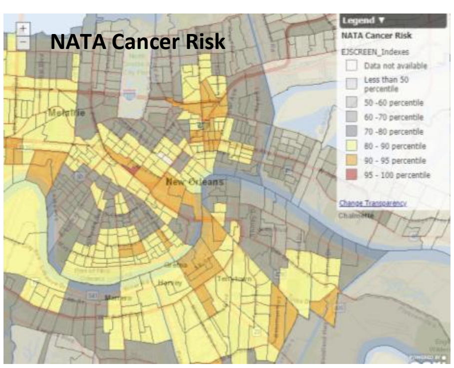
Based on a literature review, health risks of residents living near major roads or freeways include increased risk of asthma, autism, miscarriage, stroke, cardiovascular disease, cancer, lung disease, heart attack, memory and cognitive decline (leading to dementia and Alzheimer's disease), lifelong lung impairment, stress, and hypertension. Health impacts of particular concern that have been significantly associated with exposure levels found at the I-10 include respiratory disease, cancer, cardiovasular disease, nervous system disorders, immunological complications, adverse reproductive and developmental outcomes, and premature mortality. To evaluate the hypothesis that these diseases would be found at higher rates in the I-10 compared to the city of New Orleans, the state or the nation, we obtained disease prevalence data for this area.

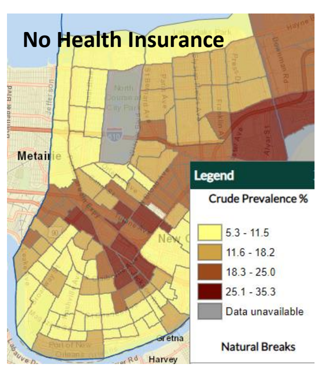
The average crude prevalence rates for for athma, high blood pressure, chronic obstructive pulmonary disease (COPD), and coronary artery disease occur exceed those of the city (**Table 8**).

Table 8. Crude prevalence rates for New Orleans and Claiborne Corridor census tracts (Source: Trust for Public Land 2016)

Health Outcome	Average crude prevalence in corridor census tracts	Crude prevalence in new orleans
Asthma	29.1%	19.9%
High blood pressure	45.8%	38.0%
COPD	9.5%	6.7%
Coronary heart disease	8.2%	6.4%

One limitation of this comparison is the lack of age-adjusted rate data; thus, we are unable to conclude whether any differences is disease rates were significant. If some areas have a higher senior population, it follows then that this might push disease rates up; but in general, Claiborne Corridor has a lower proportion of seniors (11%) than state, region and national averages (**Table 3**). There are other factors involved as well that impact disease rates. For example, the risk of getting cancer may be higher, but rates of cancer diagnoses may be lower than expected due to the lower rates of health insurance in the area, lack of regular check ups, or shorter life expectancies- all of these socio-demographic conditions that have been documented for the area **(Figure 19).** Life expectancy of people living in the Claiborne Corridor is much lower than in the surrounding areas (Mielke 2016, Place Matters). Life expectancy is lowest near the Treme, Marigny, Bywater, and Lower 9th Ward neighborhoods (55-58 years). The 70112 zip code next to the I-10 had the lowest life expectancy of any area of the city, with an average life expectancy of 55-56 years. Meanwhile, the life expectancy for outlying areas of the city is 77-78 years.

A.


B.


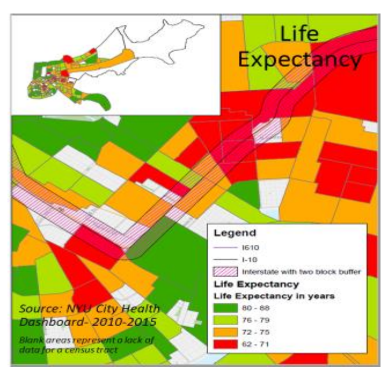
C.


Figure 19. A. Cancer Risk (Source: EPA National Air Toxics Assessment (NATA), 2014) B. Model-based estimates of crude prevalence rates for current lack of health insurance among adults aged 16-64 years (2016) (Source: 500 Cities Project, LINK). C. Life Expectancy (Source: NYU City Health Dashboard 2010-2015).

Figure 20 presents maps of rates of athma, high blood pressure, chronic obstructive pulmonary disease (COPD), and coronary artery disease – diseases for which Claiborne Corridor's rates exceed those of the city.

A. B. C. D.

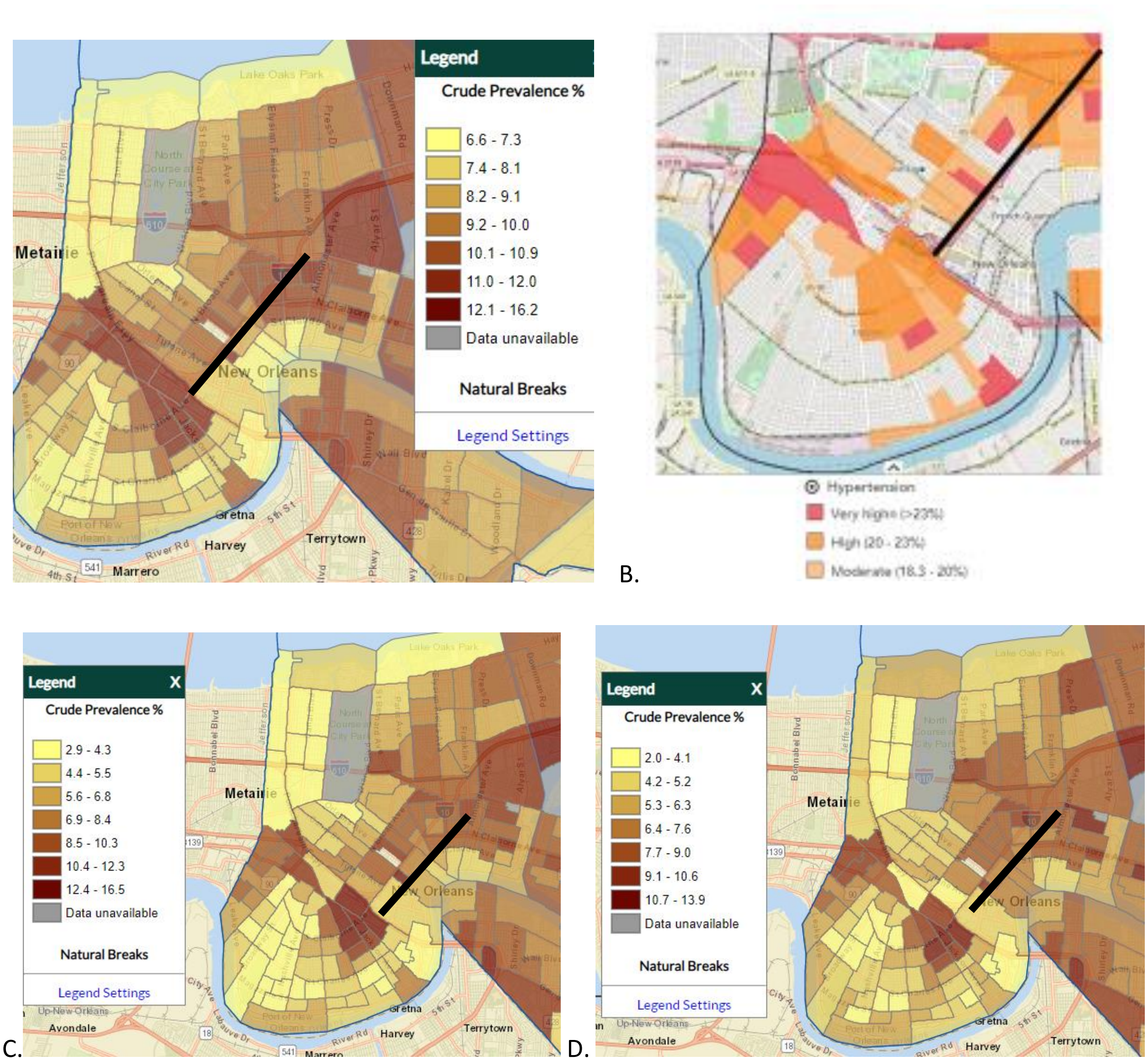


Figure 20. A. Model based estimates for current asthma among adults ages >= 18 yrs (2016) (Source: 500 Cities Project, LINK). B. Rates of hypertension (high blood pressure). (Source: Trust for Public Land 2016). C. Crude prevalence rates of COPD (Source: 500 Cities Project, LINK). D. Crude prevalence rates of coronary artery disease (Source: 500 Cities Project, LINK).

Figure 21 presents rates of other traffic-associated diseases, especially respiratory and cardiovascular diseases.

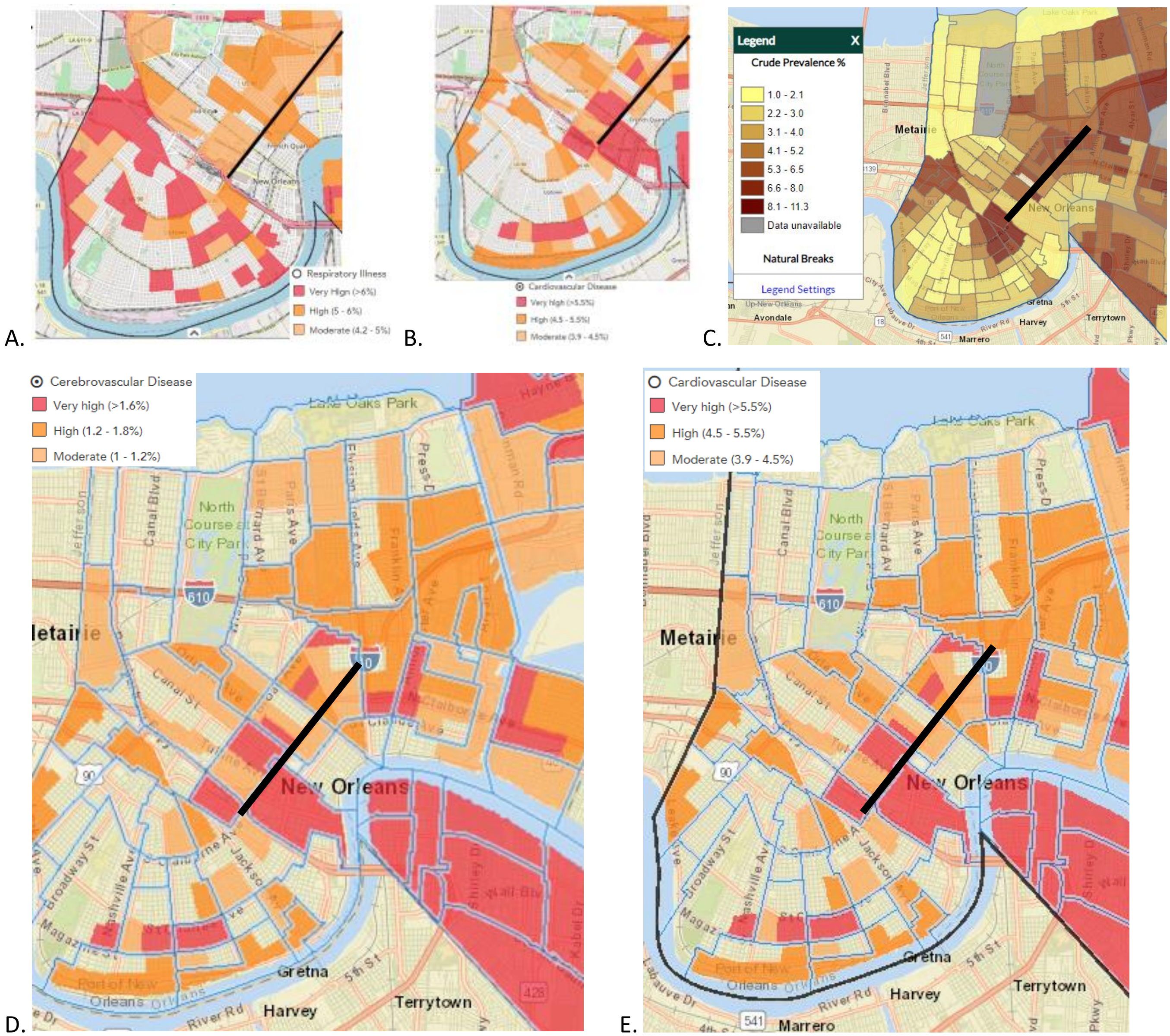


Figure 21. A) Rates of respiratory diseases; and B. Rates of cardiovascular disease and hypertension (high blood pressure). (Source: Trust for Public Land 2016). C. Crude prevalence of stroke (Source: 500 Cities Project, LINK). D. Rates of cerebrovascular disease (Source: Trust for Public Land 2016). E. Rates of cardiovascular disease. (Source: Trust for Public Land 2016).

Inhalation exposures will be highest in the direction in which the wind is blowing. In general, the wind blows north from March to July; west from August to November; and south from mid-November to the end of February. Respiratory conditions like asthma events may be higher north of the I-10 between March and July. However, due to the city’s proximity to the Gulf of Mexico, wind shifts can be frequent and in random directions at times, so this is a generalization.

Based on all of the data collected, potential health impacts of concern in the I-10 Claiborne Corridor include diseases of the respiratory, cardiovascular, nervous and immune systems, cancer, adverse reproductive and developmental outcomes, and premature mortality.

More data are needed for this area at the tract level for childhood cancers (i.e., leukemia), reproductive and developmental impacts, neurological deficits (i.e., autism), and immunological impacts (i.e. allergies), but data exists which are suggestive of higher trends along the Claiborne Corridor for adverse birth outcomes (**Figure 22**).

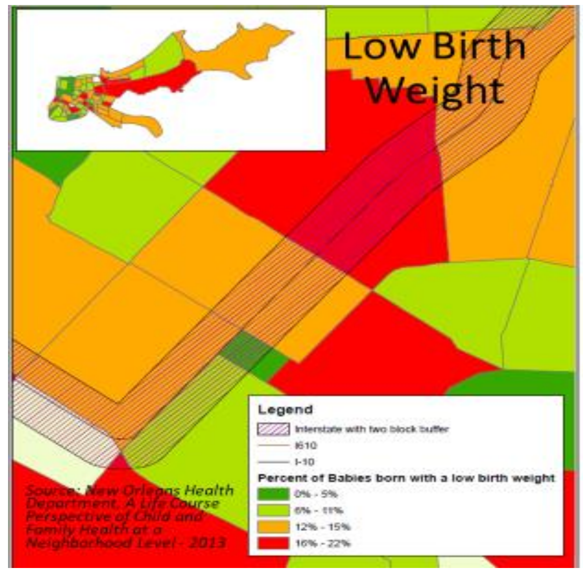


Figure 22. Percent of babies born with a low birth weight. (Source: New Orleans Health Department, 2013).

Vulnerable Populations

Air pollution affects some groups more severely than others. For example, children are more susceptible to the effects of air pollution because they breathe more body weight per unit mass (and thus, receive a higher dose of pollutants) compared to adults. They also have underdeveloped immune systems.[9] A 2001 study in the Journal of the American Medical Association (JAMA) found that an increase in public transportation along with other traffic control measures during the 1996 Olympics in Atlanta decreased acute asthma attacks by up to 44% in children. To address traffic-associated health risks in schools located next to highways, California passed a law in 2003 prohibiting the construction of new public schools within 500 feet of freeways out of concern for children's health.

Socio-demographic data were analyzed to identify locations of susceptible populations. Other vulnerable groups include the elderly, sick or immune-compromised, and pregnant or lactating women. Women living near heavy traffic areas in Los Angeles County had a 19% higher risk of giving birth to an infant with low birth weight, and an 11% chance of giving birth prematurely.[10]

Two conditions must be met to qualify as a community suffering an environmental injustice: 1) the community consists of a majority minority, low-income or under-served population; and 2) the community is disproportionately burdened by environmental pollutions. The population surrounding the corridor is largely minority- 75% of households are minority. While it is easy to show that this population meets the first criteria (see **Figure 23A**- US EPA's Demographic Index), the second is harder to prove.

[9] Schwartz, Joel. "Air Pollution and Children's Health." Pediatrics, American Academy of Pediatrics, 1 Apr. 2004, http://pediatrics.aappublications.org/content/113/Supplement_3/1037.

[10] Wilhelm and Ritz 2003

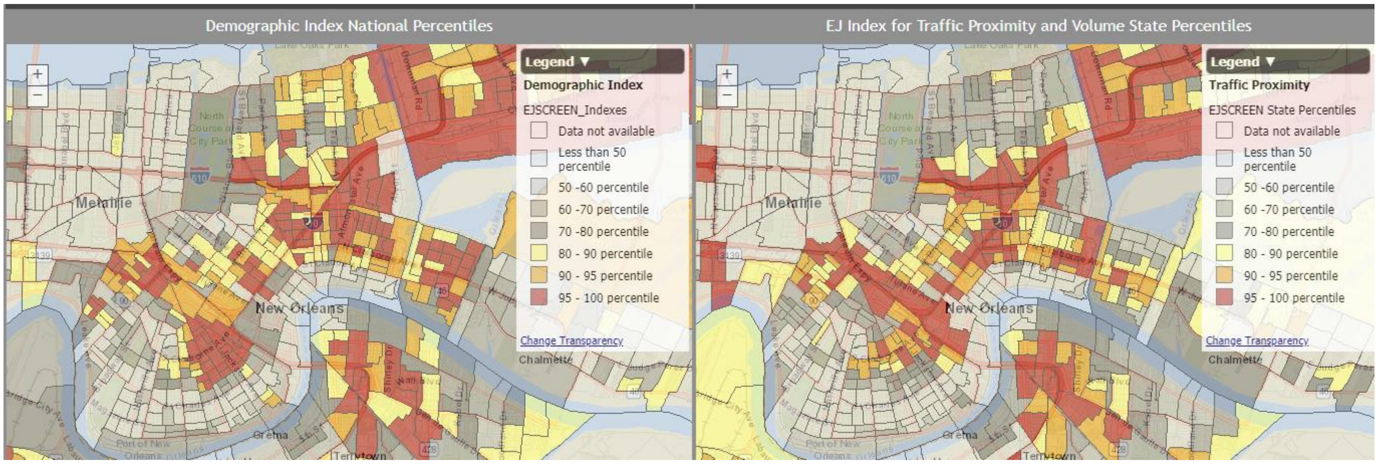


Figure 23. A) Demographic index (combination of percent low income and percent minority). B) EJ Index for traffic proximity and volume (daily traffic count/distance to road) state percentiles (Source: US EPA's Environmental Justice Database, EJScreen).

However, it is highly likely that the community near the I-10 already suffers from a disproportionate health impact brought on by traffic-related pollution given the community's proximity to the I-10 (**Figure 23B-** US EPA's EJ Index). This population is also burdened by factors which make addressing health conditions more difficult. They are largely low-income; 90% have annual household incomes below $75,000 and a large proportion of households lack health insurance (**Figure 19**). Over 70% of the residential units in the Claiborne Corridor are rentals, with only 29% being owner-occupied. In 2010, 28% of the households within the study area included children, and 17% of households were single-parent households. Residents near the I-10 also suffer the cost of externalities associated with the I-10. Residents experience impacts from highway-associated air, noise and soil pollution, but the majority do not benefit from its use due to the lack of vehicles (**Figure 24**).

A. B. C.

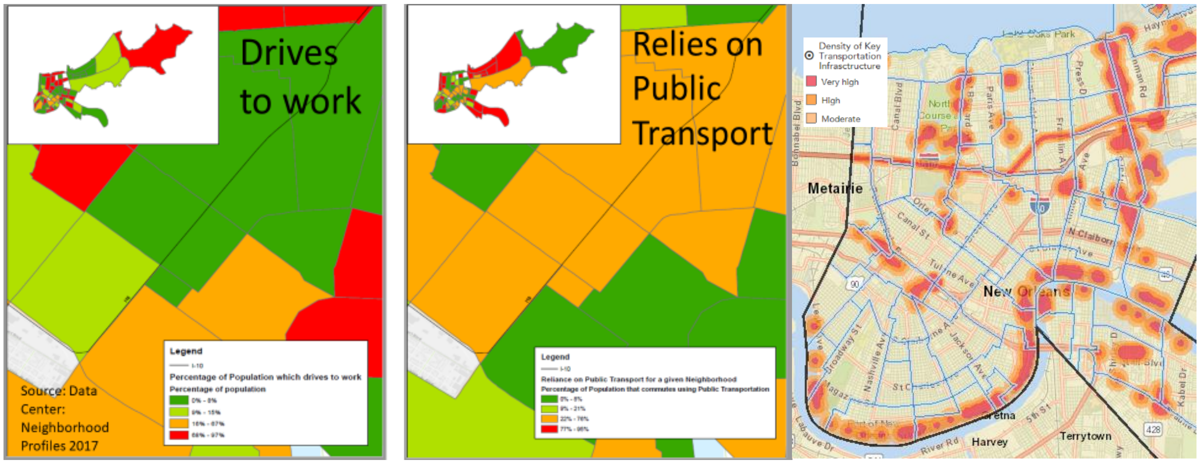


Figure 24. A) Percent of the population that drives to work (Source: Data Center's Neighborhood Profiles 2017). B) Percent of the population that relies on public transport (Source: Data Center's Neighborhood Profiles 2017). C) Density of transportation infrastructure. (Source: Trust for Public Land 2016).

This stretch of the I-10 was constructed in 1968, before the passage of environmentally-protective legislations, such as NEPA (1969), the Clean Air Act (1970), and the Environmental Justice Executive Order (1994). The latter order requires the government to consider the environmental impacts of building or citing projects on nearby minority or low-income populations, and seek their input on such projects. If community input is surveyed, it probably won't deviate from the Renne 2011 survey results (see **Appendix G**), in which *"the vast majority of respondents (82%) predicted that removing the expressway would positively impact the area by fostering economic and community revitalization"*. It is not unusual to see highways sited in the 1950's and 1960's in inner city areas with low-income and minority populations, either due to the lack of political power to prevent construction in these neighborhoods, or the impact these structures have on land value, which plummets and may be the only affordable areas for low-income residents to rent in, due to the noise, traffic, and air pollution. Another vulnerable population are groups which spend a lot of time underneath the I-10 for shelter, work, or play. This includes the homeless, many of which have created tent cities directly underneath the I-10 (**Figure 25**). The city's homeless population has increased by 70% between 2005 and 2017.[11] Other groups include workers. **Figure 26** shows a small local shop that operates under the I-10. Depending on the hours of operation, these employees may be at risk for noise-induced hearing loss and higher exposures to traffic-related air emissions, as would any other people who spend a lot of time underneath or near the I-10**.**

[11] Imanni K. Sheppard. *Health Impact Assessment (HIA) of the Claiborne Corridor Cultural Innovation District* Report. New Orleans, Louisiana: The Network for Economic Opportunity, 2017.

Figure 25. Colonies of the displaced and homeless live underneath the I-10.

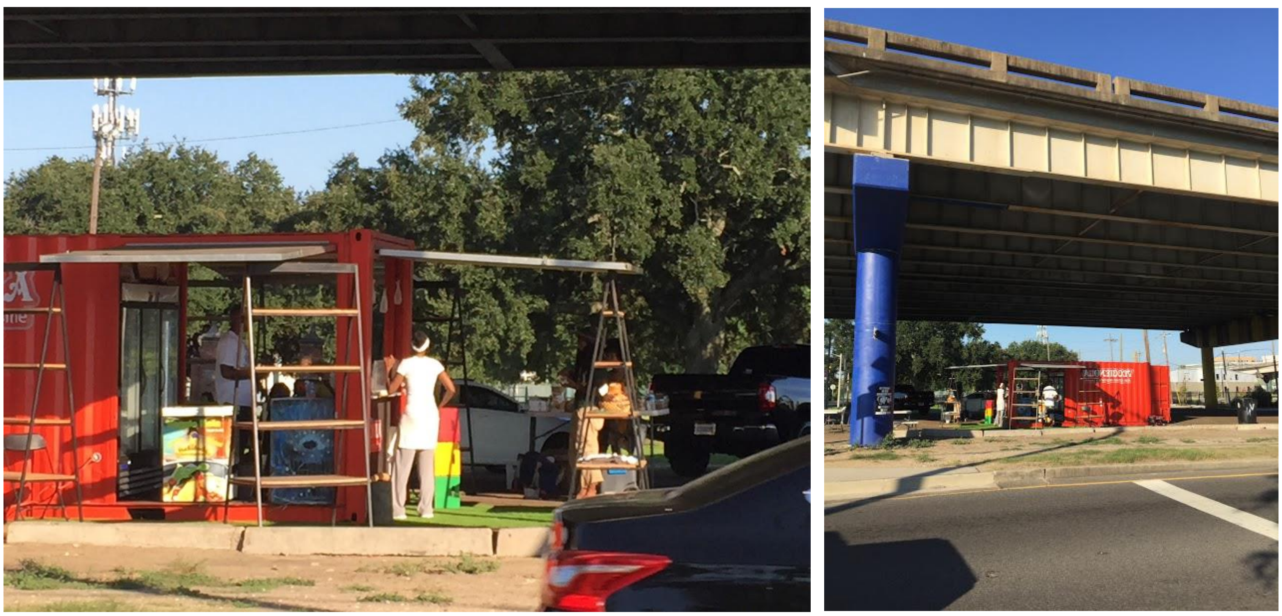
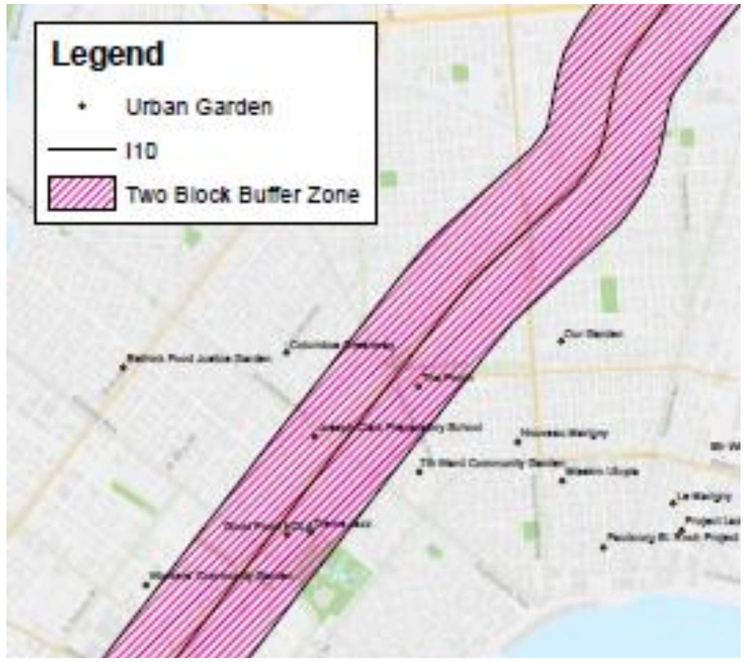


Figure 26. Photograph of Veggie Nola, a small shop in operation underneath the I-10 next to the Lafitte Greenway in New Orleans, LA.

Another population that may be exposed includes those residents who eat from nearby community gardens, though this would depend on a lot of factors which would have to be evaluated through monitoring different variables, including: types of edible produce grown, and the frequency and volume of consumption. **Figure 27** presents a picture of a community garden directly across the street from the I-10 and a map of community gardens in the area.

Figure 27. Picture of community garden located directly across the street from I-10



Policy Implications

The data presented here allows a rough determination of the health impacts that prevailing land use policy recommendations will have on the I-10 community based on the impacts each scenario is predicted to have as predicted in the "Livable Claiborne Communities" report (LCC). **Table 9** and **Figure 28** present a simplified view of those recommendations with anticipated impacts.

1. **Scenario 0** (not in LCC report): Maintain the status quo → Traffic expected to increase in relation to the city's economic growth, continued use of underpass by community
    a. Traffic pollution increases
    b. Adverse health impacts increase due to natural growth in city's economic activity.

2. **Scenario 1:** Keep the I-10 structure and use, take down some of the ramps, increase public transportation alternatives, and increase use of underpass space → Traffic expected to increase in some areas and decrease in other areas, increased use of underpass by community
    a. Traffic pollution increases due to use of more buses/decreases due to less ramp access
    b. Adverse health impacts increase due to increased use of underpass by community

3. **Scenario 2:** Keep the I-10 structure and use, remove all access ramps, increase public transportation alternatives→ Traffic expected to increase in some areas and decrease in other area, continued use of underpass by community
    a. Traffic pollution increases due to use of more buses/decreases due to less ramp access
    b. Adverse health impacts increase due to increased use of underpass by community

4. **Scenario 3a:** Remove the Claiborne corridor's portion of the I-10, divert truck traffic, restore section to its historic form as a tree-line parkway street, increase public transportation alternatives→Traffic increases but most diesel-emitting traffic is diverted, neutral ground goes back to historical use
    a. Traffic pollution increases due to use of more buses/decreases substantially due to I-10 removal
    b. Adverse health impacts decrease due to substantial decrease in traffic

5. **Scenario 3b:** Take down the entire downtown interchange of I-10 and US-90 Business, divert truck traffic, increase public transportation alternatives→Traffic increases, but in a more balanced distribution onto local streets, neutral ground goes back to historical use
    a. Traffic pollution increases due to use of more buses/decreases due to less ramp access
    b. Adverse health impacts decrease due to substantial decrease in traffic

7) **Scenario 4** (not in LCC report): Keep the I-10 overpass in place but divert highway traffic and repurpose the structure for above ground walkway/park→Traffic increases, but increased use of underpass by community
    a. Traffic pollution increases due to use of more buses/decreases due to less ramp access
    b. Adverse health impacts decrease due to substantial decrease in traffic

Scenarios can be summarized into those which do not lessen traffic (0), and those for which the impacts are ambiguous (1, 2 3a, 3b, 4). Of these scenarios, some will have an increase in adverse health outcomes (0, 1, and 2). If policy choices were to be based on health alone, scenarios 3a and b, and 4 would be the most appropriate.

Table 9. Anticipated scenario impacts (Livable Claiborne Community report)

Scenario	I-10	Corridor traffic	Exposure to diesel traffic	Exposures and Health
0	Status quo	>	>	>
1	Increase underpass use	</>	>	>
2	Increase underpass use	</>	>	>
3a	Removed- section	</>	<	<
3b	Removed- entire interchange	</>	<	<
4 (not in report)	Repurpose I-10 interchange	</>	<	<

Symbols: < Decrease; > Increase; </> Either increases or decreases

Maintaining the status quo is not likely to improve the environmental and health conditions for the community. This creates an environmental injustice situation. It could also get worse if traffic increases in proportion to citywide economic growth. While decreasing traffic in this area is expected to improve conditions, using underpass space for community events or markets is ill-advised due to the potential for exposures, which - whether chronic or acute - can lead to debilitating diseases and episodes like asthma attacks. Removing or repurposing the structure would undoubtedly have the best health impacts. Prior studies have evaluated pre- and post-highway removal conditions in several cities, including Boston, Milwaukee, Oakland and San Francisco. All of these cities reported mitigation of negative impacts brought on by the highway (see **Appendix F**).

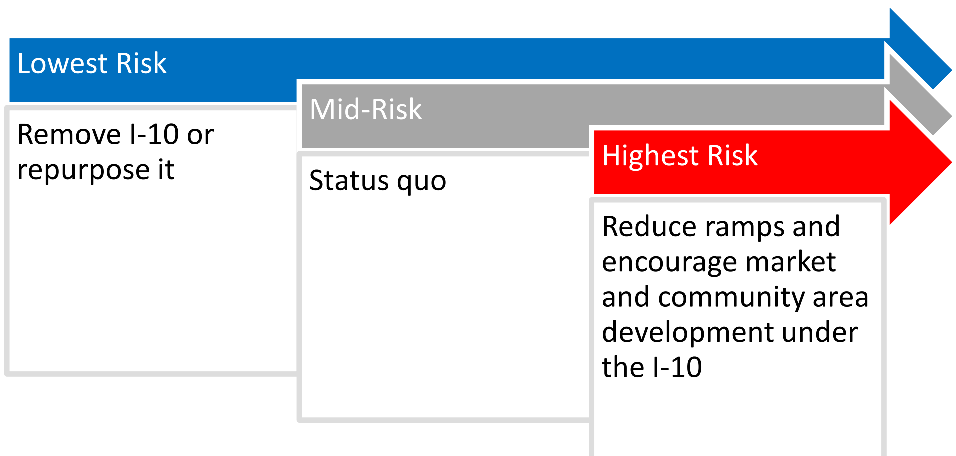


Figure 28. Potential health impacts of proposed I-10 Claiborne Corridor land use scenarios

Conclusions and Recommendations

The information presented in this report should be considered before implementing proposed development underneath the I-10 in the Claiborne Corridor, as plans could pose a further risk to area residents and workers unless exposure reduction measures are taken.

Conclusions:

- Environmental conditions that are significantly associated with adverse health outcomes in scientific studies, have been documented in the I-10 corridor.
- While we cannot make a direct association between existing environmental conditions and increased rates of disease in the area based on this preliminary review of the limited data that was available, traffic-associated diseases are already occurring at higher rates in the area.
- Populations working or residing near the I-10 can be impacted by exposure to traffic emissions and stress-inducing noise pollution
- Vulnerable groups that may be most impacted include children, the elderly, the immune-compromised, people with respiratory disorders and heart conditions, and pregnant or lactating women.
- Residents near the I-10, consisting of largely minority and low-income populations, suffer the cost of externalities associated with the I-10 and are subject to environmental injustices as they rely primarily on public transportation, but pay the toll of environmental damage and health costs for those who rely on it.
- Potential impacts of the I-10 merit a long-term health study of residents and workers in the area.
- Policies which recommend use of space underneath the I-10 for markets, food stands, parks, etc., will increase population exposures to traffic pollution, as well as adverse health outcomes.
- The best policies involve scenarios which are aimed at removing or repurposing the I-10 structure.

Recommendations to Policy Makers

If maintaining the status quo or retaining the I-10 structure and current use, the following recommendations should be considered given the fact that the environmental conditions necessary for adverse health impacts exist, and current health outcomes data suggest that traffic-related health impacts are already occurring:

- **Build:** 1) Build high sound-proof walls surrounding overpass to capture emissions and muffle sounds; AND 2) invest in a large open outdoor covered area with stage for outdoor cultural activities, or supplement existing nearby spaces with benches, picnic tables, restrooms, drinking water fountains and garden fountains to divert residents way from underpass space to greenspaces.

- **Relocate:** 1) Relocate community gardens or ensure residents are trained in safe growing practices (clean soil and greenhouses; 2) move markets and mobile food carts from underneath I-10 to healthier locations, such as nearby parks/ green spaces; 3) encourage more residential use of nearby parkways for celebrations and community gatherings, like Louis Armstrong by opening and maintaining back door entries; 4) divert bike and foot traffic to less busy streets and greenways; and 5) move homeless to nearby shelters to reduce their exposures to traffic related noise and pollution.
- **Repurpose:** Only use the underpass area for short term activities, such as parking cars or storage;
- **Educate:** Educate residents on how to sign up for air quality alerts from the Louisiana Department of Environmental Quality (LDEQ) or the U.S. Environmental Protection Agency (US EPA), how to install noise apps and interpret noise measurements, and how to protect themselves from both types of exposures;
- **Provide:** Consider free installation of air filtration systems for residents within the first two blocks of the I-10 that rates at least 13 on the industry's 16-point effectiveness scale and educate residents on how to change filters.

If retaining the I-10 structure, but diverting traffic to another throughway:

- **Repurpose:** Consider reuse of I-10 overpass space for elevated garden, market, walking path, and park; and revert underpass to greenways, rain gardens, green infrastructure, and bike paths.

Regardless of the land use decision the following recommendations will benefit the public:

- **Grow:** 1) Grow specific trees, thick vegetation, or non-edible/bioremediation plants to degrade, adsorb, sequester, stabilize or immobilize traffic emission-related pollutants in the area between the I-10 and residences; and 2) grow grass over new soil or geotextile in playgrounds to reduce exposures to lead.
- **Sustainability:** 1) Increase distribution of solar-powered trash receptacles and compactors; 2) invest in low-cost, low-emissions and low-impact transportation alternatives or infrastructure; and 3) replace concrete under I-10 with a permeable ground covering to absorb flood waters and manage runoff;
- **Regulations**: Mandate 1) change of all public buses switch to battery or fuel cell technology by select date; and 2) vehicle air emission inspections for select registered cars and trucks (e.g., diesel, by age or model) and an emissions limit which triggers repairs.
- **Education:** Encourage pregnant or lactating women, or parents of young children in the area to see their doctors for lead testing; and evaluate indoor and outdoor exposures for asthmatic children.

Further research is needed to fill in existing data gaps which would support more informed stakeholder decision-making; and to explore, or maintain ongoing surveillance of, traffic-related impacts of potential concern.

- **Exposures:** 1) Characterize I-10 related traffic emissions, contaminant and byproduct fate and transport, their occurrence in air, soil, dust, plants, and biological samples; and epigenetic changes in new residents; and 2) Survey residents and observe exposure-impacting behaviors, practices and outdoor activities (gardening, exercise, air ventilation systems, pet/child activities, etc.).
- **Diseases**: Epidemiological studies to evaluate significance of associations between traffic contaminant exposure and diseases of potential concern for the I-10 community (i.e., respiratory and cardiovascular diseases).
- **Interventions:** Evaluate interventions and intervention barriers to reduce contaminant transport and population exposures.
- **Remediation:** Evaluate soil conditions and identify appropriate cheap bioremediation methods to increase contaminant degradation, adsorption, or immobilization of traffic emission-related pollutants.
- **Education:** Evaluate best practices to educate, motivate, and support hard-to-reach citizens who are culturally, linguistically, socially, or physically isolated.
- **Surveillance:** Set up systems to support ongoing surveillance of under-tracked or under-reported conditions to assess rates of diseases with known associations with traffic pollution in the literature (e.g., cancer, stroke, neurological deficits, immunological impacts, and reproductive/developmental outcomes).

Appendix A. Literature Reviewed

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Appendix B. Major Data Sources Reviewed

	National Air Toxics Assessment (NATA)	Average Daily Traffic Counts	Environmental Justice Indices	Neighborhood Statistical Area Data Profiles	Monitored NAAQS	Climate Smart Cities mapping portal	American Community Survey (Census)
Source name	Environmental Protection Agency	Louisiana Department of Transportation and Development	Environmental Protection Agency's EJSCREEN	The Data Center	Louisiana Department of Environmental Quality's Ambient Air Quality Monitoring Program	Trust for Public Land	American Census Summary
Contents	Exposure estimates for a variety of sources of benzene, diesel particulate matter, and their associated estimated health risks, and estimated health risks for the entire panel of air pollutants tested by the National Air Toxics Assessment.	Average daily traffic in vehicles/day from monitors throughout Orleans Parish ("OP"), 4 monitors along I-10 within the Corridor (red in OP sheet), and 4 monitors along roads within the Corridor (blue in OP sheet), plus a map of monitor locations.	EPA-provided environmental justice indexes (expressed as percentiles), environmental exposure and risk measurements, and demographic information	Demographic data for New Orleans neighborhoods, including detailed income, household structure, age, and other socioeconomic data. This file is our most up-to-date source of sociodemographic information, but it organized according to neighborhoods that do	Ambient air concentrations of CO, NO, NO2, PM 2.5, and PM 10, recorded in parts per million, parts per billion, or micrograms per cubic meter on I-610 or near City Park. Raw data sets, plus a compilation of pollutants at the relevant sites, are available.	Maps of the Claiborne Corridor showing the national percentiles of exposure to air pollutants, health outcome rates/hazard indexes/risk ratios, and demographic indices.	Summary of American Community Survey (Census) estimates for demographic descriptors of the population living within the Claiborne Corridor, including age, race, education, linguistic isolation, and income distributions.
Time period	2011	Collection years: 2001, 2004, 2008, 2010, 2013, 2016	2011, 2013, 2014, 2015, 2016, 2017	2017	2015 and/or 2016 (as available)	2011	2011-2015
Location(s)	All available census tracts in Orleans Parish, plus state and parish averages, and a page containing the data for census	See map in "Monitor locations" sheet. Interstate monitors are on I-10 between Iberville & Bienville Streets, on I-10 between Esplanade Ave. &	An approximately 200 m radius around the I-10 from Canal St. to St. Bernard Ave.	Algiers Point, Audubon, BW Cooper, Bayou St. John, Behrman, Black Pearl, Broadmoor, Bywater, CBD, Central City, City Park, Desire, Dillard, Dixon, East Carrollton, East Riverside, Fairgrounds, Filmore, Fischer Dev, Florida Area, Florida Dev, French Quarter, Freret, Garden	On Interstate 610 near West End Boulevard (for most pollutants), near City Park on Florida Boulevard and Orleans Avenue (PM10).	A self-defined, approximately 1-mile radius around the I-10 from around Canal Street to around St. Bernard	A self-defined, approximately 200-m radius around the I-10 from around Canal Street to around St. Bernard Avenue.

	National Air Toxics Assessment (NATA)	Average Daily Traffic Counts	Environmental Justice Indices	Neighborhood Statistical Area Data Profiles	Monitored NAAQS	Climate Smart Cities mapping portal	American Community Survey (Census)
	tracts within the Claiborne Corridor (22071002700, 22071002800, 22071002900, 22071003000, 22071003400, 22071003500, 22071003900, 22071004000, 22071004401, 22071004402, 22071004800, 22071004900, 22071006000)	Kerlerec St., on I-10 between N. Johnson and N. Prieur, and on US-90 just uptown from Poydras. Non-Interstate road monitors are on Claiborne Ave. between Touro and Pauger Streets, on Elysian Fields Ave. between N. Galvez and N. Johnson Streets, on Tulane Ave. between S. Derbigny and S. Roman Streets, and on Esplanade between Villere and Marais Streets.		District, Gentilly Terrace, Gentilly Woods, Gert Town, Hollygrove, Holy Cross, Iberville Dev, Irish Channel, Lake Catherine, Lake Terrace & Oaks, Lakeshore/Lake Vista, Lakeview, Lakewood, Leonidas, Little Woods, Lower Garden District, Lower Ninth Ward, Marigny, Maryville Fountainbleau, McDonough, Mid-City, Milan, Milneburg, Navarre, New Aurora English Turn, Old Aurora, Pines Village, Plum Orchard, Ponchartrain Park, Read Blvd East, Read Blvd West, Seventh Ward, St. Anthony, St. Bernard Area, St. Claude, St. Roch, St. Thomas Dev, Tall Timbers Brechtel, Touro, Treme Lafitte, Tulane Gravier, US Naval Support Area, Uptown, Viavant Venetian Isles, Village de l'est, West End, West Lake Forest, West Riverside, Whitney neighborhoods		Avenue.	
Source URL	https://www.epa.gov/national-air-toxics-assessment/2011-nata-assessment-results#pollutant	http://wwwapps.dotd.la.gov/engineering/tatv/	https://www.epa.gov/ejscreen/	https://www.datacenterresearch.org/data-resources/neighborhood-data/	http://deq.louisiana.gov/page/ambient-air-monitoring-data-reports	https://web.tplgis.org/nolasecure/	ejscreen.epa.gov (Generate Reports)

Appendix C. Outreach Flyers

Link: https://drive.google.com/drive/folders/1suNxdz7BY05kfp4z8sMEyTlOWGKKtH7M

Air Pollution Along Interstate 10

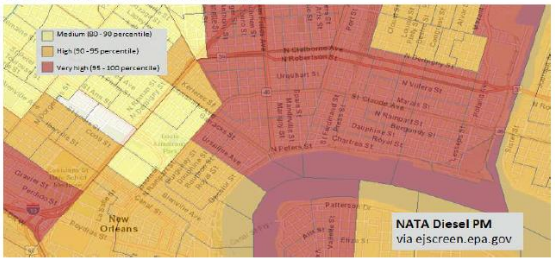
Air Pollution Impacts in New Orleans

A review of 63 studies showed significant associations between exposure to traffic-related air pollution and diseases such as cardiovascular disease, stroke, and respiratory illnesses such as asthma.

Rates of cardiovascular disease, stroke, asthma, and hypertension (high blood pressure) along the I-10 are higher than the Orleans parish averages. [1] These outcomes are linked to high exposures to particulate matter, which is produced by vehicles.

Map of estimated diesel emissions as modeled by the Environmental Protection Agency. (2014) Areas in red have the highest estimated exposures.

Map can be accessed at ejscreen.epa.gov



Take action against air pollution!

- Sign up for air pollution alerts from **EnviroFlash** at neworleansarea.enviroflash.info
- Download State of the Air app through iTunes
- Check out airnow.gov for info
- Avoid exercising outside when air pollution is high
- Limit time kids spend outside
- Avoid high-traffic areas
- Change air filters often
- Clean indoor surfaces frequently
- Minimize indoor air pollution from cigarettes, candles & cleaning products
- Check out American Lung Association's Fighting for Air website which has more info about what you can do.

What's in our air?

A recent study [2] stated that air pollution causes up to 21 excess deaths in New Orleans. Two pollutants of concern are **ozone** and **fine particulate matter**. These pollutants are especially dangerous to people with pre-existing lung conditions such as asthma, emphysema, and chronic bronchitis.

Ozone

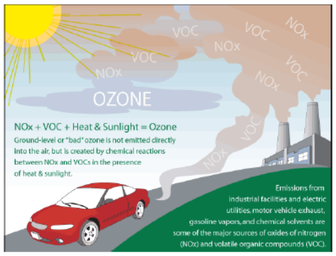
Ozone can form at ground-level due to interactions with compounds emitted by cars. Ozone can be irritating in people with pre-existing conditions. Symptoms associated with ozone exposure include: coughing, painful breathing, lung and throat irritation, wheezing, and difficulty breathing when exercising outdoors. Ozone also needs sunlight to form, so it is more likely to be a problem during the summertime when days are longer. [3]

Particulate Matter

Particulate matter is a mixture of solid and liquid particles and is directly emitted from cars. It can include things like smoke, soot, and dust. The smallest particles, or fine particulate matter, are the most dangerous particles. These particles can enter deep into your lungs. The particles can even enter your bloodstream and spread through your body. Health effects associated with fine particulate matter include: premature death in people with heart or lung disease, nonfatal heart attacks, irregular heartbeat, decreased lung function, and increased respiratory symptoms (coughing, airway irritation, difficulty breathing). [4]

Graphic explaining how ozone is formed.

Image from the National Park Service (www.nps.gov)



Sources

[1] Available upon request. Contact Dr. Adrienne Katner at akatn1@lsuhsc.edu
[2] https://www.nola.com/health/index.ssf/2016/08/air_pollution_new_orleans.html
[3] https://www.cdc.gov/air/ozone.html
[4] https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm

Photo by Jessica Yoon

Impacts of Noise Pollution

WHY MEASURE SOUND?

Sound is measured to get an idea of how intense the sound is. More intense sounds are louder and can cause damage to your hearing if they happen often enough. Sound is measured in a unit called a ***decibel*, or dB**. The image to the right shows the sound levels of common community noises.

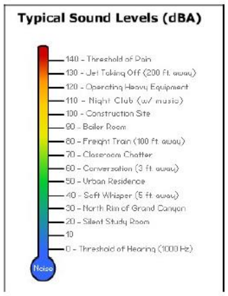


Image from the OSHA Technical Manual of March 2012

NOISE INDUCED HEARING LOSS

Research has shown that hearing loss due to noise can occur through repeated exposures to sound levels equal to or greater than **85 dB**. Noises from heavy traffic, such as traffic from the I-10, are capable of reaching 85 dB during peak hours. The damage caused by repeated exposure to loud noise is **irreversable**, so it is important to recognize your exposures to noise before hearing loss becomes a serious issue.

OTHER HEALTH EFFECTS OF NOISE POLLUTION

Besides hearing loss, repeated exposure to noise can also lead to other health problems including:

- headaches
- dizziness
- high blood pressure
- nervousness and anxiety
- sleeping problems
- heart disease
- loss of concentration
- stress

Sources

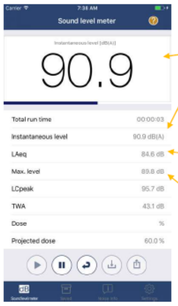
1. https://www.nidcd.nih.gov/health/noise-induced-hearing-loss
2. https://web.archive.org/web/20070925221754/http://ist-socrates.berkeley.edu/~lohp/graphics/pdf/hw24en08.pdf

HOW CAN YOU GET INVOLVED?

MEASURE YOUR SURROUNDINGS

If you have a smartphone, you can download an app that uses your phone's microphone to take sound level measurements. If you have an iPhone, the National Institute of Occupational Safety and Health (NIOSH) has an app that is fairly accurate in measuring sound. The app can collect noise data over a period of time and report a summary of your data to you. You can also purchase a low-cost sound level meter online, although some of these may only show instantaneous noise data.

Here is a preview of the **NIOSH Sound Level** app with basic information about the data.



PROTECT YOURSELF

If you suspect you are being exposed to excess noise in your home due to traffic, construction, or another source, here are a few steps you can take to reduce or limit your exposures:

- **Limit time outside**: Most buildings offer adequate protection from noise. Going inside when the noise is the loudest can limit damage.
- **Wear protection**: Ear protection can reduce the impacts of noise exposure when you cannot avoid being near the noise.
- **Have your hearing tested**: Having your hearing tested and routinely checked can help you determine if you are experiencing hearing loss that may be attributable to noise.

Foam earplugs such as these are an affordable and reliable way to reduce the impacts of loud noises.

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Appendix D. Health Effects with Significant Associations to Exposure Measures

Reference	Study Design	Study Population (n)	Exposure Metric	Health Effects with Significant Associations	Model	Distance to Traffic	Traffic Density	Adjusted Odds Ratios	95% C.I.	Study Limitations	Conclusions
Nitta et al, 1993	Cross Sectional	Adult females (n=1517 for 1979, 2413 for 1982, and 2389 for 1983)	Proximity to roadway (0-20 m away, 20-50 m, or 50-150 m)	1979: chronic cough, phlegm, wheezing, chest cold with phlegm. 1982: chronic phlegm. 1983: shortness of breath.	Logistic regression adjusting for age, smoking status, years at residence, education, occupation, and type of home heating	<20 m vs 20-50, 20-150, or 50-150 m	**88,000 vehicles/day**	• 1979: ORs of 1.62, 1.47, 2.75, and 1.35 (<20 m v. **20-150 m away**) • 1982: <20 m v. **50-150m**: OR=1.87; 20-50 m v. **50-150 m**: OR=1.85. • 1983: OR=1.66 (<20 m v. **20-150 m** away)	1979: (1.07, 2.46), (1.03, 2.11), (1.65, 4.73), (1.04, 1.77). 1982: (1.31, 2.68), (1.30, 2.64). 1983: (1.12, 2.48)	Exposure misclassification with bias toward no effect	Exposure to automobile exhaust may be associated with increased risk of certain **respiratory conditions** involving mucus hypersecretion
English et al, 1999	Case-control	Children under 14 years old with asthma (n=5996)	Average daily traffic and distance to residence	Asthma doctor visits	GIS-based exposure modeling where Y=[1/(0.4√[2π])]*e*-(0.5[D/500^2]/(0.4)^2), and multivariate logistic regression checked y Hosmer-Lemeshow test of fit	**550 ft.**	5500-9000 vehicles/day or **>41,000 vehicles/day**	2.14 and 2.91	(1.10, 4.16), (1.28, 6.91)	Potential exposure misclassification (modeling rather than monitoring, no consideration of duration), lack of residential history and history of secondhand smoke exposure, limited availability of study covariates.	Proximity to dense traffic may be associated with **asthma exacerbation**
Wilkinson et al, 1999	Case-control	5-14 year olds with asthma and respiratory illnesses (n=9214)	Postal code centroid distance to road and peak hourly traffic	None	Single and multiple logistic regression models, and the non-linear binary regression model of Diggle and Rowlingson	**150 m**	**>1000 vehicles/hour**	N/A	N/A	Potential exposure misclassification due to lack of dispersal information; lack of information on indoor air pollution, parental smoking, and other personal exposures; potential selection bias of parents of asthmatic children who choose to live farther away from roads.	**No association** was found between **traffic flow and respiratory hospitalizations** in 5 to 14 year olds.
Pearson et al, 2000	Case-control	Children under 14 years with cancer (n=579)	Daily distance-weighted traffic density--vehicles/day and distance to residence	All cancers and leukemia	Gaussian curve of distance-weighted traffic density, standard stratified statistical analysis	**750 ft.**	5000-9999 vehicles/day and >20,000 vehicles/day	All cancers: **5000-9999 vehicles/day**: 1.68, >20,000 vehicles/day: 5.90. Leukemia: 5000-9999 vehicles/day: 2.04, >20,000 vehicles/day: 8.28.	(1.02, 2.80), (1.69, 20.56), (1.05, 3.95), (2.09, 32.80)	Small sample size due to relative rarity of cases, possible exposure misclassification due to lack of residential history and use of distance-weighted traffic density as an exposure index	Heavy traffic flow near residences is associated with increased risk of childhood cancers, especially leukemia.

Reference	Study Design	Study Population (n)	Exposure Metric	Health Effects with Significant Associations	Model	Distance to Traffic	Traffic Density	Adjusted Odds Ratios	95% C.I.	Study Limitations	Conclusions
Venn et al, 2001	Case-control	4-11 year olds (n=6147) and 11-15 year olds (n=3709)	Postal code distance and daily traffic vehicles/day	Parent-reported wheeze prevalence	Logistic regression controlled for age and sex interactions	**150 m**	**10,000-100,000 vehicles/day**	4-11 year olds: 1.08. 11-15 year olds: 1.16	(1.00,1.16), (1.02, 1.32)	Potential exposure misclassification due to lack of traffic density data and specific pollutant data	Proximity to traffic may be associated with increased prevalence of **chronic wheezing** in children.
Lin et al, 2002	Case-control	Children with asthma 14 years or younger (n=417)	Average vehicle miles traveled and distance to residence, residential distance to heavy truck traffic	Asthma hospital admissions	Logistic regression	**200 m**	>4043 vehicle miles traveled, 1+% heavy trucks	1.93 (vehicle miles traveled), 1.43 (proximity to truck traffic)	(1.13, 3.29), (1.03, 1.99)	Potential exposure misclassification (residential proximity and vehicles/day), hospitalization may be a misleading outcome because of acute/emergent nature of incidents	**Number of vehicle miles travelled and residential proximity** to dense truck traffic are associated with increased hospital admissions of **asthma** patients under 14 years of age.
Hoek et al, 2002	Retrospective cohort	A random sample from the 120,852-participant Netherlands Cohort Study on Diet and Cancer (NCLS) (aged 55-69 in 1986-1994) (n=4492)	Long-term average NO2 and black smoke concentration exposure estimated from 1986 home address using monitoring data and an indicator variable for living near major roads	Relative risk of mortality due to cardiopulmonary, non-cardiopulmonary non-long cancer, and all causes	Cox's proportional hazard models with adjustment for potential confounders	**50 m**	N/A	Black smoke exposure: 1.95. NO2 exposure: 1.94.	(1.09, 3.51), (1.08, 3.48)	Possible confounding interactions with living near a major road (noise, BMI, others) might bias results in either direction, exposure misclassification toward null (indoor air quality not considered)	Long-term exposure to traffic-related air pollution may **shorten life expectancy**
Reynolds et al, 2002	Case-control	Cancer patients 15 years or younger (n=6988)	Vehicles per square mile and miles of road per square mile within block group of residence	All cancers and leukemia	Poisson regression adjusted for age, sex, and race/ethnicity	N/A	All cancers: 6081-8530 vehicles/square mile, 21.7-24.8 miles/square mile. Leukemia: **6081-8530 v/square mile.**	All cancers: 1.10 (vehicles/square mile), 1.11 (miles of road/square mile). Leukemia: 1.18.	(1.01. 1.19), (1.02, 1.20), (1.03, 1.35)	Potential exposure misclassification due to lack of residential history and concentration measurements	Traffic density in proximity to residence is associated with increased risk for **leukemia and all cancers.**
Crosignani et al, 2003	Case-control	Childhood leukemia patients 14 years and younger (n=120)	Distance to residence plus Caline model to estimate benzene concentration	Childhood leukemia	Caline model	**300 m**	**Benzene over 10 µg/m3** estimated annual average	3.91	(1.36, 11.27)	Selection bias due to death/emigration of controls, lack of parental hydrocarbon occupational exposure data	**Childhood leukemia** risk is associated with exposure to benzene near roadways.
Garshick et al, 2003	Retrospective cohort	U.S. veterans 60.6 +/- 12.8 years old (n=2628)	Average daily traffic count & distance to residence	Self-reported persistent wheeze	Multiple logistic regression model adjusted for age, cigarette smoking, and occupational dust exposure	**50 m**	9,351 vehicles/day median, **>10,000 vehicles/day**	1.31, 1.71	(1.00, 1.71), (1.22, 2.40)	Lack of data on exposure duration, concurrent home exposure to NOxs from cooking and heating, possible bias towards null due to the lack of information on	Exposure to air pollution from dense traffic is associated with increased risk of **chronic wheezing** in older men.

Reference	Study Design	Study Population (n)	Exposure Metric	Health Effects with Significant Associations	Model	Distance to Traffic	Traffic Density	Adjusted Odds Ratios	95% C.I.	Study Limitations	Conclusions
										non-responders' health statuses.	
Janssen et al, 2003	Retrospective cohort	7-12 year olds (n=2083)	Residential distance to truck traffic, trucks/day	Conjunctivitis, itchy rash, current wheeze, cough prevalence	Random intercept model (due to clustering within schools) adjusted for age, sex, non-Dutch nationality, cooking on gas, current parental smoking, current pet possession, parental education level, number of persons in household, presence of unvented water heater, questionnaire not completed by mother, presence of mold stains in home	**500 m**, 500 m, 50 m, **50 m**	5190-22,326 trucks/day, 5190-22,326 trucks/day, >99,500 vehicles/day, **>99,500 vehicles/day**	2.57, 2.08, 1.67, 1.62	(1.00, 6.58), (1.20, 5.58), (1.07, 2.58), (1.62, 2.27)	Experimental bias in measurement of lung function, imprecise/potentially inaccurate exposure classification	Residence near dense traffic may increase risk of **childhood conjunctivitis, rash, and respiratory** symptoms.
Maheswaran and Elliott, 2003	Ecological	Residents (45+ yrs of age) of 113,465 census enumeration districts in England and Wales (n=19,083,979)	Proximity of census district centroid to main road	Stroke mortality	Log-linear Poisson regression analysis	**200 m**	N/A	Men: 1.07, Women: 1.04	(1.04, 1.09), (1.02, 1.06)	Possible confoundings (residual SES effects, smoking, hypertension, noise), exposure misclassification biasing toward null, ecological bias away from null	Living near major roads may increase risk of **stroke mortality.** The risks diminished with decreasing proximity to major roads. Assuming causality, an **estimated 990 stroke deaths per year are attributable to road traffic** pollution.
Nicolai et al, 2003	Retrospective cohort	4-6 year olds and 9-11 year olds (n=7508)	Average daily traffic count & distance to residence	Asthma prevalence, current wheeze, cough prevalence	Multiple logistic regression analyses adjusted for age, sex, tobacco exposure, SES, family history of asthma/eczema/hay fever	**50 m**	**>99,500 vehicles/day**	1.79 (asthma), 1.67 (wheeze and cough)	(1.05, 3.05), (1.07, 2.58)	Potential exposure misclassification (lack of complete traffic data, modeled home pollutant concentrations), reporting/participation bias	Living near dense traffic is associated with increased risk of **respiratory symptoms** in children.
Wilhelm & Ritz, 2003	Case-control	Live births, 1994-1996 (n=50,933)	Distance-weighted traffic density, and one or more freeways and distance to residence	Preterm births, low birth weight	Logistical regression analyses adjusted for maternal age, race/ethnicity, education, parity, interval since live birth; level of prenatal care; infant sex; previous LBW or preterm infant; birth season; birth year	**750 ft.**	Preterm births: highest-quintile DWTD. Low birth weight: 40th to 59th percentile DWTD and 60th to 79th	Preterm births: 1.08. Low birth weight: 1.16, 1.15.	(1.01, 1.15), (1.03, 1.30), (1.02, 1.29)	Crude exposure model for large population size (exposure misclassification), lack of residential history, lack of small street traffic density data, reliance on birth certificate address reporting, possible	Living near dense traffic is associated with a higher rate of **preterm births and low birth weights.**

Reference	Study Design	Study Population (n)	Exposure Metric	Health Effects with Significant Associations	Model	Distance to Traffic	Traffic Density	Adjusted Odds Ratios	95% C.I.	Study Limitations	Conclusions
							percentile DWTD			residual confounding due to SES	
Yang et al, 2003	Retrospective cohort	Live births, 1992-1997 (n=6,251)	Residential distance to a major freeway with average daily traffic count (vehicles/day)	Preterm delivery	Unconditional multiple logistic regression model, adjusted for maternal age, season, marital status, maternal education, and infant gender	**500 m**	**93,000 vehicles/day**	1.3	(1.03, 1.65)	Exposure misclassification (extreme point contrast assessment, unknown mobility during pregnancy, unknown indoor exposures), lack of data on known risk factors (prepregnancy weight, weight gain, nutritional status, cigarette smoking, and intrauterine infections)	Residential proximity to dense freeway traffic may be associated with increased risk of **preterm birth.**
Finkelstein et al, 2004	Prospective cohort	Residents of Hamilton, Ontario metro area who underwent pulmonary function testing at a clinic there between 1985 and 1999 (n=5228)	Proximity of residence to major roads	Mortality rate advancement period and relative risk of mortality	Log (hazard) = b1 x exposure + b2 x age + covariates , where b1/b2 = point estimate of rate advancement period per unit increase in exposure	**<50 m** from a major road or <100 m from a highway	N/A	Mortality rate advancement period: 2.5 years. RR of mortality: 1.18.	(0.2, 4.8), (1.02, 1.38)	Exposure misclassification, selection bias (patients had respiratory symptoms)	Living near highways may **shorten life by an average of 2.5 years**, only a little less than the mortality advancement associated with chronic diseases like chronic pulmonary disease and diabetes.
Gaudermann at al, 2004	Prospective cohort	10-18 year olds from schools in 12 communities (n=1759)	Monitored ambient air pollution concentrations by stations in each of the 12 communities	Deficits in FEV1 growth	Linear regression adjusted for log values of height; BMI; BMI squared; race; ethnicity; doctor-diagnosed asthma; tobacco smoking in past year; exposure to tobacco smoke; exercise or respiratory tract infection during study; indicator variables for spirometer and field technician.	N/A	N/A	N/A; P values for positive linear correlation (P=0.005 for low FEV1 and NO2, P=0.01 for low FEV1 and acid vapor, P=0.02 for low FEV1 and PM10, P=0.002 for low FEV1 and PM2.5, P=0.006 for low FEV1 and elemental carbon)	See P values	Possible residual confounding, loss to follow up.	Exposure to ambient air pollutants associated with primary fuel combustion is correlated with functionally significant **respiratory growth deficits.**

Reference	Study Design	Study Population (n)	Exposure Metric	Health Effects with Significant Associations	Model	Distance to Traffic	Traffic Density	Adjusted Odds Ratios	95% C.I.	Study Limitations	Conclusions
Kim et al, 2004	Cross Sectional	Children in 64 grade 3-5 classes attending schools in 10 neighborhoods along a busy traffic corridor (n=1109)	Monitored concentrations of PM10, PM2.5, black carbon, nitrogen oxides, and NO2 at school sites over 11 weeks in spring and 8 weeks in fall	Bronchitis symptoms in past 12 months and physician-confirmed asthma in past 12 months	Two-stage multiple logistic regression model	**60 m**	**90,000 vehicles/day**	Bronchitis/Nox: 1.05, bronchitis/NO: 1.02, bronchitis/PM2.5: 1.02, bronchitis/BC: 1.04. Asthma/Nox: 1.08, asthma/NO: 1.08.	(1.01, 1.08), (1.02, 1.09), (1.00, 1.05), (1.00, 1.08), (1.00, 1.17), (1.00, 1.17)	Lack of residential and indoor exposure data, inability to make causa; inference due to cross sectional design, potential residual confounding due to underreported parental smoking	Elevated concentrations of ambient traffic-related air pollutants at schools may be associated with increased rates of **asthma and bronchitis** symptoms.
Lwebuga-Mukasa et al, 2004	Retrospective cohort	Adults (18+) (n=13,910)	Pre- and post-NAFTA traffic volumes	None	Simple linear regression	N/A	N/A	No statistically significant results	N/A	Exposure misclassification (traffic volume alone), lack of personal exposure data, lack of outpatient care use data	Despite increased asthma prevalence in high-density traffic areas, there was **not a statistically significant association.**
Steffen et al, 2004	Case-control	Children 14 years old or younger with leukemia (n=567)	Self-reported exposure to heavy traffic roads & neighboring businesses	None	Unconditional logistic regression adjusted for age, sex, city Centre, and ethnic origin	N/A	N/A	**No statistically significant results**	N/A	Selection bias (hospital-based selection), reporting bias (over-declaration of exposures by cases' mothers), exposure misclassification (self-reported residential proximity with no objective exposure measurements)	The only factor that had a significant association with childhood **leukemia was dwelling next to a repair garage or petrol station**
Zmirou et al, 2004	Case-control	0-3 year olds (n=434)	Lifetime average time weighted traffic density (vehicles/meter)	Diagnosed asthma incidence	Conditional logistic regression	**300 m**	**>30 vehicles per day per meter**	2.28	(1.14, 4.56)	Selection bias due to hospital catchment confounding, differential ascertainment due to disclosed disease status.	Exposure to traffic-related air pollution may be associated with increased risk of being diagnosed with **asthma.**
Gaudermann at al, 2005	Prospective cohort	Children from 10 southern California communities enrolled in the Children's Health Study (n=208)	Traffic pollution exposures represented by outdoor NO2 concentrations, residential distance from nearest freeway, traffic volume on nearby roadways, and model-based estimates	Incidence of childhood asthma	Logistic regression with natural-log transformations of each traffic indicator variable	**150 m**	**50,000-270,000 vehicles/day**	1.83 per 1 IQR increase (5.7 ppb) in exposure to outdoor NO2, 1.89 per IQR decrease in proximity to a freeway, 2.22 per IQR increase in model-based pollutant concentration estimated	(1.04, 3.22), (1.19, 3.02), (1.36-3.63)	Assessment of asthma by questionnaire (diagnostic bias, unequal access to care), extrapolation of measured home NO2 concentrations to earlier in life for later incident asthma	Respiratory health in children is adversely affected by local exposure to NO2 (a reliable indicator of other types of automobile-related pollutants), as evidenced by its association with increased risk of **asthma onset and wheezing.**

Reference	Study Design	Study Population (n)	Exposure Metric	Health Effects with Significant Associations	Model	Distance to Traffic	Traffic Density	Adjusted Odds Ratios	95% C.I.	Study Limitations	Conclusions
Heinrich et al, 2005	Cross Sectional	18-79 year olds (n=6896)	Self-reported residential proximity to traffic intensity	Self-reported chronic bronchitis	Multiple logistic regression analysis, adjusted for age, gender, education, community size, and pack-years	Street of residence (?)	Self-reported extremely or considerably busy roads	1.36	(1.01, 1.83)	Exposure misclassification, especially in smaller communities (less traffic, less heterogeneity), residual confounding by SES, lack of selective migration data, reporting bias	Perceived proximity to intense traffic is associated with increased risk of **chronic bronchitis**.
Jerrett et al, 2005	Retrospective cohort	Subjects extracted from the American Cancer Society cohort study (n=22,905)	Traffic pollution exposures interpolated from fixed-site $PM_{2.5}$ and O_3 monitors and proximity to expressways	All-cause mortality, ischemic heart disease mortality, lung cancer mortality	Standard and spatial multilevel Cox regression models (hij s(t) = h0 s(t) ŋj exp(βxij s))	**500-1000 m**	N/A	All-cause: 1.17 for an increase of 10 µg/m^3 $PM_{2.5}$. Corresponding RRs for ischemic heart disease and lung cancer mortality ranged from 1.24 to 1.6 depending on which covariates were controlled for in the model.	(1.05, 1.30)	Potential uncontrolled confounding factors (endocrine deaths, higher than average education in LA subcohort of ACS cohort)	Exposure to fine particulate matter may be associated with an increased risk of **all-cause, IHD, and lung disease mortality**. These PM results were robust to adjustment for expressway exposure.
Ponce et al, 2005	Spatial variation study	Live births, 1994-1996 (n=37,347)	Residential zip codes distance intersected by freeways and major arterials, and DWTD	Low birth weight during winter	Multivariate logistic models of preterm birth, stratified by neighborhood SES and third pregnancy trimester season	**3.2-km buffer**	DWTD 80th percentile	1.3	(1.07, 1.58)	Potential sampling bias (112 of 269 L.A. zip codes, inability to map all eligible subjects), definition of neighborhood by census tract, omission of exposure data (e.g. maternal smoking, household pollution, etc.), residual confoundings of neighborhood characteristics (e.g. presence of community health center)	Risk for **preterm birth** is associated with traffic-related pollution exposure factors, especially in low SES mothers and those whose third trimester is in winter.
Ryan et al, 2005	Prospective cohort	Infants 1 year or under (n=622)	Residential distance to freeway, state route with speed >50 mph, bus or state route with speed <50 mph	Wheeze	Conditional logistic regression adjusted for sex, race, breastfeeding, pet ownership, income, child care outside home, number of siblings, visible mold in home, parental self-report of asthma, and number of monthly logs returned	**100 m from bus/state route <50 mph**	N/A	2.5	(1.15, 5.42)	Wide variation in traffic density unaccounted for; wheezing in first year of life is not a strong predictor of asthma later in life.	Residential proximity to traffic routes with speeds less than 50 mph may be associated with increased prevalence of **chronic wheezing.**

Reference	Study Design	Study Population (n)	Exposure Metric	Health Effects with Significant Associations	Model	Distance to Traffic	Traffic Density	Adjusted Odds Ratios	95% C.I.	Study Limitations	Conclusions
Schikowski et al, 2005	Cross Sectional	Women 54-55 years old (n=4,757)	Average daily traffic count & distance to residence	COPD and frequent cough	Linear and logistic regressions	**100 m**	**>10,000 vehicles/day**	COPD: 1.79, frequent cough: 1.24	(1.06, 3.02), (1.03, 1.49)	Exposure misclassification due to movement of major roads in long study period; no migration data due to cross sectional design.	Living near roadways may expose female residents to air pollution that increases their risk of **COPD and frequent cough**.
Gordian et al, 2006	Retrospective cohort	5-7 year olds (n=756)	Average daily traffic per meter vehicle within buffer around residence	Asthma prevalence in children with no family asthma history	Logistic regression with adjustment for gender, parental asthma, household smoker, and income	**100 m**	**40,000-80,000 vehicle meters, >80,000 vehicle meters**	2.43, 5.43	(1.23, 5.28), (2.08, 13.74)	Possible unmeasured confounders, selection bias, derived semiecological exposure.	Traffic density around homes may increase risk of asthma in children who have no family history of **asthma.**
McConnell et al, 2006	Retrospective cohort	5-7 year olds (n=4,762)	Residential distance to freeways, highways, & arterial roads	Lifetime asthma, asthma prevalence, asthma prevalence with no family asthma history, current wheeze with no family asthma history	Logistic regression adjusted for child's age, sex, race, community, and language of questionnaire completion	75 m, 75 m, **75-150 m,** 75 m, 75 m	N/A	1.29, 1.50, 1.33, 2.46, 2.74	(1.01, 1.86), (1.16, 1.95), (1.02, 1.72), (1.48, 4.09), (1.71, 4.39)	Exposure misclassification due to model imprecision, differential migration bias (for parents with asthma history), selection bias (higher than average SES participants), potential confounders (tobacco exposure, housing characteristics, sociodemographic factors)	Living near roadways is associated with increased risk of childhood **asthma and wheezing**, especially in those with no family history of asthma.
Bae, Sandlin, and Bassok, 2007	GIS cluster analysis / environmental justice case study?	N/A	Proximity to limited-access freeway roads	Property values (as proxy for socioeconomic status of at-risk neighborhoods)	Sales price of single-family housing inside freeway-adjacent areas = sales price outside areas – 100{exp[β – (var β/2)]-1}	**100 m**	**100,000 vehicles/day**	Cluster analysis and hedonic pricing model, Moran's I value (I=0.1253) and z=383.02	N/A	Exposure misclassification	Minority and low-income households, in comparison to white and middle-income households, are significantly clustered disproportionately near freeways, and the **environmental burdens are reflected in lower property values**

Reference	Study Design	Study Population (n)	Exposure Metric	Health Effects with Significant Associations	Model	Distance to Traffic	Traffic Density	Adjusted Odds Ratios	95% C.I.	Study Limitations	Conclusions
Brugge, Durant, and Rioux, 2007	Review	18 epidemiological studies reporting cardiac and respiratory health outcomes and vehicle-related pollutant concentrations	Pollutant concentration	N/A	N/A	Varies by study (review)	Varies by study (review)	N/A	N/A	Did not include birth outcome effects, did not produce summary or pooled effect estimates	The literature as a whole suggests elevated risk for development of **asthma and reduced lung function in children who live near highways**, an association between elevated **particulate matter concentrations near highways and elevated cardiac and pulmonary mortality risk, and, less robustly, elevated risk of lung cancer** associated with highway-related pollution.
Samet, 2007	Review	Publications on emerging information about exposure to air pollution from traffic and health (n=17); not intended to be a systematic review	Source strength, geographical information, dispersion models, stationary modeling and interpolation, questionnaires and interviews, personal monitoring, and human samples	Asthma, allergic diseases, cardiac effects, respiratory symptoms, reduced lung function growth, adverse reproductive outcomes, premature mortality, lung cancer, premature death	N/A	N/A	N/A	N/A	N/A	Intentional non-systematic approach in order to examine presence and magnitude of public health priority of traffic-related pollution	Though we lack knowledge on how the particular air pollutants mediate health effects, the associations between traffic-related exposure and a number of adverse health outcomes have been repeatedly identified in the epidemiological body of work. The author **calls for more precise exposure assessment research, as well as policy changes to address the public health impacts of traffic**, which should decrease emissions and increase people's distance from those emissions.
Zhou and Levy, 2007	Quantitative meta-analysis	33 studies (monitoring, air dispersion modeling, land use regression, biomonitoring, and epidemiological) yielding 63 estimates of the spatial extent of automobile-related air pollution	Pollutant of interest (NO_2, PM2.5, elemental carbon)	Pollutant type, effect of upwind/downwind conditions	$C = 2Q/\sqrt{(2\pi)}U\sigma_z$ for downwind pollutant concentration	**100-500 m**	N/A	One-way and factorial ANOVAs: $P < 0.0001$, significant difference in spatial extent by pollutant type. $P = 0.01$, significant upwind/downwind condition effects on spatial extent.	N/A	Small sample size, between-study differences and lack of focus on spatial extent	The spatial extent of mobile source impact of elemental carbon or **particulate matter mass concentration is 100-400 m, of NO_2 is 200-500 m, and of ultrafine particulate matter counts is 100-300 m.**

Reference	Study Design	Study Population (n)	Exposure Metric	Health Effects with Significant Associations	Model	Distance to Traffic	Traffic Density	Adjusted Odds Ratios	95% C.I.	Study Limitations	Conclusions
Boothe and Shendell, 2008	Review	29 peer-reviewed epidemiological studies on adverse health effects and residential proximity to traffic	Residential proximity to traffic and other exposure metrics	Summary of studies showed statistically significant associations between residential proximity to traffic and at least one of these effects: increased prevalence/severity of asthma/respiratory disease, diminished lung function, adverse birth outcomes, childhood cancer, and increased mortality risks. Particularly consistent associations were found between exposure and childhood cancer, adverse birth outcomes, and cardiopulm./CV/stroke mortality.	N/A	Varies by study (review)	Varies by study (review)	N/A	N/A	Inability of epidemiological studies to establish causality, exposure misclassification due to lack of individual exposure assessments, inability to identify specific pollutant responsible for health outcomes	**25 of 29 epidemiological studies** (from diverse regions and using a range of exposure metrics) reported **statistically significant associations** between a wide variety of **adverse health outcomes.** More research is needed to identify specific contributing pollutants and mechanisms of action.
Brauer et al, 2008	Retrospective cohort	Single births with complete covariate data and maternal residential history in Vancouver, BC, Canada (n=70,249)	Proximity of residence to highways, inverse-distance weighting of study area pollutant monitors, and land use regression models	Small gestational age (SGA), low birth weight (LBW)	Land use and linear regression models	**50 m**	**21,000 vehicles/day**	SGA: 1.26, LBW: 1.11	(1.07, 1.49), (1.01, 1.23)	Exposure misclassification due to subject mobility, rarity of pre-term births and associated altered exposure time (early vs. late term exposure)	**Maternal residence near highways** and resultant traffic-related air pollution may be associated with babies born **small for gestational age, low birth weight, and pre-term.**
Jerrett et al, 2008	Prospective cohort	Participants in the Southern California Children's Health Study aged 10-18 years of age (n=217)	Outdoor home NO2 concentrations	Asthma onset	Multilevel Cox proportional hazards models: hij(t) = h0s(t) çj exp(âXij + äTZij)	N/A	N/A	After control of confounding, asthma HR for average community IQR (6.2 ppb NO2/yr)=1.29	(1.07, 1.56)	Inability to identify specific pollution constituents responsible for health impacts, small sample size, questionnaire case ascertainment (self-reported physician diagnosis)	Markers of **traffic-related air pollution** were associated with **asthma** incidence, indicating that exposure to such pollution may contribute to the onset of asthma.
Kim et al, 2008	Cross Sectional	Children living at varying distances from high-traffic roads (n=1080)	Residential proximity to traffic (traffic within a given radius and distance to major roads determined by GIS)	Asthma episodes within past 12 months	Univariate regression and stepwise logistic regression, plus Spearman correlation to determine whether traffic metrics were representative of actual pollutant levels	**75, 150, 300 m**	**67,000-245,000 vehicles/day**	Adjusted odds ratio: For several traffic metrics (density, distance to major road, and others), children who were in the highest quintile of exposure had approximately twice the adjusted odds of an asthma episode in the preceeding 12 months compared with children who were within the	(1.20, 11.71)	Relatively low traffic volume on Bay Area freeways may have biased results toward null	Residential **proximity to roadways,** especially those with dense traffic patterns, may be associated with childhood **asthma** incidence and exacerbation, and other respiratory health impacts.

Reference	Study Design	Study Population (n)	Exposure Metric	Health Effects with Significant Associations	Model	Distance to Traffic	Traffic Density	Adjusted Odds Ratios	95% C.I.	Study Limitations	Conclusions
								lowest quintile, with the highest risks (e.g. 3.80 for asthma) posed on those living within 75 m of a freeway. Most traffic metrics correlated moderately well with actual pollutant measurements according to Spearman's test.			
Thorpe and Harrison, 2008	Review	Papers on traffic-related, non-emissions air pollution constituents' source materials, resultant particles, and measurement methods (n=71)	N/A (varies by study)	N/A	N/A	N/A	N/A	N/A	N/A	Differences among pollution constituents from different regions	More **research is needed on reliable methods to measure pollutants from non-emissions traffic sources,** like tire particles and brake dust. Copper and antimony content can be used to measure brake dust deposition reliably.
Allen et al, 2009	Cross Sectional	Black, Chinese, Hispanic, and white adults 45-84 without clinical CVD enrolled in the Multi-Ethnic Study of Atherosclerosis (MESA) (n=1147)	Estimated PM2.5 exposure and residential proximity to major roads	None	First log link and Gaussian error model regression, then a multiple linear regression of the log-transformed Agatston score among those with calcification	**100 m from highway or 50 m from centerline of a major arterial road**	N/A	N/A (none significant)	N/A	Exposure misclassification (estimated PM exposure and lack of traffic volume data), outcome misclassification (use of notably different CT scanners between field centers)	There was **not a strong association between PM2.5 exposure or residential roadway proximity and aortic calcification,** potentially due to crude exposure estimates; in participants who had less exposure misclassification tendency due to working inside the home and living near PM2.5 monitors for 20+ years, significant associations existed.
Hart et al, 2009	Prospective cohort	U.S. female nurses age 30-55 from the Nurses' Health Study (n=90,297)	Residential proximity to roadway	Rheumatoid arthritis	Time-varying Cox proportional hazards model with adjustment for many confounding factors	**Within 50 m of roadway vs. >200 m away**	N/A	1.62	(1.04, 2.52)	Exposure misclassification due to lack of traffic density and exposure time window data (bias towards null), lack of dose-response establishment, unequal access to RA care	Exposure to traffic pollution may be a newly identified risk factor for **rheumatoid arthritis**
Selander et al, 2009	Case-control	Adults 45-70 living in Stockholm county 1992-1994, from the Stockholm Heart Epidemiology Program study (n=3666)	Noise, via residential history combined with information on traffic intensity and distance to nearby roads, with some	Myocardial infarction	Unconditional logistic regression analysis, plus two sound level estimation models	**50 dBA**	**</> 20,000**	1.38 for a subsample excluding subjects with hearing loss or noise exposure from other sources	(1.11, 1.71)	Exposure misclassification due to imprecise estimation, mediation of MI by hypertension, selection bias(?), difficulty	**Noise exposure** from residential traffic may be associated with **elevated risk of myocardial infarction.**

Reference	Study Design	Study Population (n)	Exposure Metric	Health Effects with Significant Associations	Model	Distance to Traffic	Traffic Density	Adjusted Odds Ratios	95% C.I.	Study Limitations	Conclusions
			consideration to noise annoyance and other factors							distinguishing effects of noise vs. air pollution	
Wu et al, 2009	Retrospective cohort	Single births from four hospitals, 1997-2006 (n=81,186)	Estimated individual maternal traffic pollution exposure from line-source dispersion model and detailed traffic and residential data	Preeclampsia and very preterm delivery	Logistic regression	N/A	N/A	Preeclampsia: Highest NOx quartile: 1.33, Highest PM2.5 quartile: 1.42. VPTD: Highest Nox quartile: 2.28, Highest PM2.5 quartile: 1.81.	(1.18, 1.49), (1.26, 1.59), (2.15, 2.42), (1.71, 1.92)	Exposure misclassification due to maternal mobility, residual confounding due to unknown risk factor data (e.g. maternal smoking), exclusion of certain traffic-related pollutant exposures (ultrafine particles, polyaromatic hydrocarbons)	**Maternal exposure** to local traffic pollution during pregnancy is associated with increased risk of **preeclampsia and preterm birth** in Southern California women.
McConnell et al, 2010	Prospective cohort	Kindergarten and first-grade children who were asthma- and wheezing-free at start of the Southern California Children's Health Study (n=2497)	Modeled traffic-related pollution (O3, NO2, and PM2.5) exposure from roadways near homes and schools	New-onset asthma and wheezing	Multilevel Cox proportional hazards model: hijl (t)= h0s(t) uij exp(βXijl + δTZijl),	**150 m**	N/A	Homes: 1.51. Schools: 1.45.	(1.25, 1.82), (1.06, 1.92)	Lack of data on children's exposure to air pollution in other locations and on their relative level of activity at school, exposure misclassification for buildings nearer roadways than the center of the property (bias toward null), clinical nature of asthma diagnosis biased towards null due to unequal access to care	Traffic-related air pollution at both homes and schools may contribute to incidence of childhood **asthma**
Fuks et al, 2011	Cross Sectional	Adults 45-75 years of age who participated in the Heinz Nixdorf Recall Study (n=4291)	Residential proximity to roadway from distance to major road and daily traffic counts, and dispersion-modeled PM2.5 concentration using official emissions data, meteorology, and topography	Increase in mean systolic and diastolic blood pressure	Generalized additive models adjusted for short-term PM, meteorology, traffic proximity, and individual risk factors	**50 m, 200 m**	**>22,980 vehicles/day**	1 IQR increase in PM2.5 (2.4 µg/m3) was associated with a mean systolic BP increase of 1.4 and a mean diastolic increase of 0.9. Long-term exposure to traffic noise >65 dB yielded an OR of 1.28 for prevalence of hypertension.	(0.5, 2.3), (0.4, 1.4), (1.04, 1.59)	Cross sectional design precludes causal interpretations, selection bias toward less susceptible individuals (participants could not take BP medications), lack of data on specific PM constituents.	**Long-term** exposure to **particulate matter** may promote **atherosclerosis.** Exposure to long-term road traffic noise **>65 decibels** was associated with higher prevalence of **hypertension.**

Reference	Study Design	Study Population (n)	Exposure Metric	Health Effects with Significant Associations	Model	Distance to Traffic	Traffic Density	Adjusted Odds Ratios	95% C.I.	Study Limitations	Conclusions
Gan et al, 2011	Prospective cohort	Residents 45-85 years of age without known CHD at baseline (n=445,868)	Individual estimates of exposures to noise (via noise prediction model) and air pollutant concentrations of black carbon, PM2.5, NO2, and NO	Coronary heart disease mortality	Cox proportional hazards regression model with age, sex, preexisting comorbid conditions, and neighborhood SES as covariates	N/A	N/A	CHD death and 1 IQR black carbon exposure: 1.06, CHD death and 1 IQR noise exposure: 1.04, CHD death and highest decile noise exposure: 1.22	(1.01, 1.11), (1.01, 1.08), (1.04, 1.43)	Potential exposure misclassification due to imprecise assessment based on residential zip codes, lack of data on traffic speed, volume, and operating conditions or meteorological factors; residual confounding due to lack of data on cardiovascular risk factors and individual SES factors; limits of noise exposure model given continuous noise	**Coronary heart disease mortality** risk increased in association with increased exposure to traffic-related air **pollution and road traffic noise.**
Power et al, 2011	Retrospective cohort	Men (mean age 71, SD +/- 7 yrs) in the U.S. Dept. of Veterans Affairs Normative Aging Study (n=680)	Long-term exposure to traffic-related air pollution via a validated spatiotemporal land-use regression model for black carbon	MMSE and global cognitive functioning (6-test battery)	Multivariable-adjusted model for log-transformed black carbon estimates	**50 m**	N/A	For each doubling of ln (BC), MMSE≤25 OR=1.3. For each doubling of ln(BC), global cognitive function OR=-0.054 SD.	(1.1, 1.6), (0.103, -0.006)	Exposure misclassification, nondifferential cognitive function misclassification, incomplete follow-up, inability to attribute findings to single traffic pollutant	Air pollution exposure due to traffic is associated with **lower cognitive function** in older men.
Spira-Cohen et al, 2011	Prospective cohort	Inner-city fifth graders (10-12 years old) with asthma, referred by nurses from four South Bronx schools (n=40)	Daily 24-hour personal samples of PM2.5 and elemental carbon (EC) fraction	Wheeze, shortness of breath, total symptoms	Mixed effects models	**173-2419 ft.**	**100,230-112,051 vehicles/day**	RR for EC/wheeze: 1.45, EC/SOB: 1.41, EC/total symptoms: 1.30	(1.03, 2.04), (1.01, 1.99), (1.04, 1.62)	Small sample size, lack of adequate data on daily medication use, exposure confoundings due to other EC contributors (dust, etc.)	**School exposure** to the carbonaceous fraction of **particulate matter** due to traffic is associated with elevated risk of **same-day asthma** symptoms, particularly **wheezing and shortness of breath**
Laumbach and Kipen, 2012	Review	Papers on traffic pollution's respiratory impacts (n=91)	Biomass and traffic-related air pollution monitoring and modeling (varies with study)	COPD, asthma, respiratory tract infection	N/A	N/A	N/A	N/A	N/A	Not completely generalizable due to the sparse use of biomass fuels in the developed world	Due to the well-documented associations between **traffic-related air pollution and asthma, COPD, and respiratory tract infections,** the authors **recommend that physicians advise patients about health risks associated with living, working, and exercising near major roadways.** They also recommend **policy changes to intervene with air pollution,** like that in Beijing

Reference	Study Design	Study Population (n)	Exposure Metric	Health Effects with Significant Associations	Model	Distance to Traffic	Traffic Density	Adjusted Odds Ratios	95% C.I.	Study Limitations	Conclusions
											in preparation for the 2008 Olympics.
Sorenson et al, 2012	Prospective cohort	Residents aged 50-64 years without a history of cancer enrolled in the Diet, Cancer, and Health cohort study (n=57,053)	Noise prediction model using residential proximity to roadway, traffic counts, road type, amd building height	Myocardial infarction	Cox proportional hazards regression model with adjustment for Nox air pollution, age, sex, education, lifestyle confounders, and railway and airport noise	N/A	N/A	1.12 per 10 dB	(1.02, 1.23)	Restriction to urban areas; censoring due to non-MI cardiovascular deaths (e.g. stroke); potential exposure misclassification due to inaccurate input data and uncertainty of noise prediction modeling; lack of data on non-residential exposure, bedroom location, other residential noise sources (e.g. neighbors, ventilation), hearing impairment, and family history of MI	There is a positive association with a clear **dose-response effect** between **residential exposure to traffic-related noise** and **risk of myocardial infarction** in a Danish population.
Hoek et al, 2013	Review/Meta-analysis	Review of 25 cohort studies on air pollution and mortality in adults	PM2.5, PM10, elemental carbon, NO2 average long-term exposure concentration estimates	All-cause and cardiovascular mortality	N/A	Varies by study (review)	Varies by study (review)	N/A	N/A	Inability to assess exposure measurement validity for most studies	The results **of 25 cohort studies** indicate **significant associations** between **traffic-related air pollution (PM2.5, elemental carbon, NO2, and others)** and **all-cause and cardiovascular mortality**
Volk et al, 2013	Case-control	Children with autism (n=279) and with typical development (n=245) enrolled in the Childhood Autism Risks from Genetics and the Environment study (total n=524)	Line-source air-quality dispersion modeled estimates of traffic-related air pollution according to birth certificate address and residential history questionnaire	Autism with the highest quartile exposure to traffic-related air pollution, NO2, PM2.5, and PM10 during gestation and first year of life	Spearman correlations and logistic regression	N/A	N/A	Highest quartile traffic exposure during gestation: 1.98, highest quartile traffic exposure during first year: 3.10, NO2 during gestation: 1.81, PM2.5 during gestation: 2.08, PM10 during gestation: 2.17, NO2 during first year: 2.06, PM2.5 during first year: 2.12, PM10 during first year: 2.14.	(1.20, 3.31), (1.76, 5.57), (1.37, 3.09), (1.93, 2.25), (1.49, 3.16), (1.37, 3.09), (1.45, 3.10), (1.46, 3.12)	Unmeasured residual confoundings (lifestyle, nutrition, other residential exposures, indoor pollution contributions, proximity to healthcare providers), lack of data on other susceptibility risk factors	Exposures to traffic-related air pollution, **NO2, PM2.5, and PM10 during pregnancy** and the first year of life are associated with an **increased risk of autism.**

Reference	Study Design	Study Population (n)	Exposure Metric	Health Effects with Significant Associations	Model	Distance to Traffic	Traffic Density	Adjusted Odds Ratios	95% C.I.	Study Limitations	Conclusions
Dorans et al, 2017	Cohort	Framingham Offspring and Third Generation participants (n=3506)	Residential proximity to roadway and residential exposure to fine particulate matter	None	Logistic regression for TAC; generalized estimating equation regression for AAC, adjusted for demographic variables, socioeconomic position indicators, and time	**50 m**	N/A	N/A (none significant)	N/A	Potential residual/unmeasured confounding, potential outcome misclassification due to indirect correlate measure (TAC and AAC), lack of data on time activity patterns or year-to-year variability, lack of generalizability (mainly white middle-aged adults in the Northeastern US)	There **were no strong associations between residential proximity to a major roadway or PM2.5** with the presence, extent, or progression of **aortic calcification** in this cohort, but more research is required due to the lack of older subjects and resultant lack of sufficient time for calcification to occur.

Appendix E. Low-Cost Air Monitoring Technologies for Citizen Scientists

Having the tools available to provide rough estimates of air or noise quality is important for communities that want to assess or document their exposure. Communities should be encouraged to regularly document and house any data on their neighborhood exposures as these data can support or form the basis of future health studies and policy decisions.

Low-Cost Air Quality Sensor Technologies

Low-cost air sensors may not be as accurate as more expensive laboratory equipment but because they can provide users with real-time data, they allow communities to evaluate the impacts of sources on air quality and the outcomes of exposure reduction interventions. Below is a table compiling air quality sensors based on cost, the pollutants they sample for, and pros and cons. Only the lowest-cost sensors with acceptable levels of accuracy, precisions and sensitivity are presented here. The Dylos and Wynd sensors were used to sample particulate matter (PM) for this report (**Figure 29**). While Dylos collects quantitative data in the form of particles per cubic feet, it cannot be used to collect concentration data (mass/volume) which is required for comparison to health-based standards. However, it does indicate whether air quality is good, fair, or poor. As the Wynd sensor does not specify PM size or amounts, it is also inadequate for evaluating health effects but it can be used to evaluate. Both only provide qualitative data.

Figure 29. Above: Dylos sensor; Below: Wynd sensor

Name of Monitor	Pollutants Sampled	Approximate Cost	Notes
Dylos 1100 Dylos 1100 PRO Dylos 1170	Particulates 1 micron and above (Dylos 1100) Particulates .5 micron and above (Dylos 1100 PRO and Dylos 1170)	\$200 (1100) \$260 (PRO) \$400 (1170)	The Dylos comes in multiple versions: 1100 is the base model; 1100 PRO has additional features; 1170 is the 1100 PRO with an attached battery. Equipment precision and accuracy are rated higher than most low-cost sensors.
Wynd (clip) Wynd (purifier)	Particulates (all)	\$80 (clip) \$200 (purifier)	The Wynd samplers do not give numerical data, only an analysis on air quality based on particulate counts, and qualitative assessment of air quality. The Wynd filter cleans your air as it samples and is recommended for indoor use.
Air Quality Egg	Nitrogen dioxide (NO_2) Carbon dioxide (CO_2) Carbon monoxide (CO) Ozone (O_3) Sulfur Dioxide (SO_2) Volatile Organic Compounds (VOCs)	\$270-300	Each Air Quality Egg can hold up to three sensors for the listed pollutants. Each sensor varies by price. The egg can also be made for indoor or outdoor use, which also affects price The precision of readings vary by model and contaminant but ratings are generally poor.
Purple Air	Particulate Matter 2.5 Particulate Matter 10	\$200	Relatively new sensor; more info can be found at https://publiclab.org/wiki/purpleair

Appendix F. Impacts of Other Highway Removal Projects

The source of the following evaluation of large-scale projects to remove interstates by other cities is: Henry, Kim Tucker, "Deconstructing elevated expressways: An evaluation of the proposal to remove the Interstate 10 Claiborne Avenue Expressway in New Orleans, Louisiana" (2009). *University of New Orleans Theses and Dissertations*. Paper 1016. LINK

The necessary conditions for removal of the interstate *"were compiled from relevant theory on large public projects (i.e. mega projects) and freeway removals. These conditions are 1) Integrity and safety concerns, 2) A Window of Opportunity-Decreased Value of Mobility, 4) Power Brokers Value Freeways Less and Other Benefits More, 5) Support of Business Community, 6) Public Entrepreneurship, 7) Do No Harm Principle, and 8) Mitigation of Negative Impacts. All conditions were present in the majority of the selected case cities and were unanimously consistent across all cases for some conditions (See Table 3)…. The condition of a defined concern for the integrity and safety of the elevated structure is common to all removal case cities. In the Milwaukee case, it was more economical to demolish the underutilized spur than to perform the required maintenance. In the San Francisco and Oakland cases, earthquake damage forced a discussion of the future of the expressway. In Boston, severe traffic concerns from exceeding roadway capacity were the justification for a review of alternatives. Based on this unanimous consensus in all cases, integrity and safety concerns must be identified for the I-10 Claiborne Expressway removal proposal to obtain further consideration…. Based on the findings in this research, the I-10 Claiborne Expressway removal proposal has the potential to become a viable option for the future of the elevated structure…. All removal proposals request that a feasibility study be conducted as a first step in the process. These studies will generate the data and information regarding the traffic impacts, cost versus benefits, and economic development potential of the removal alternative for the aging structure. Technical reports and studies were instrumental in obtaining the support of the business community and when combined with community support offers a broad base support for the removal alternative. The environmental justice and socio-economic impacts must be clearly established in the context of the NEPA legislation and Executive Order No. 12898 and other legislation that is protective of minority and low income populations."*

Location- City, State	New Orleans, LA	Boston, MA	Milwaukee, WI	Oakland, CA	San Francisco, CA	San Francisco, CA
Name of Freeway	Claiborne Ave Expressway	Central Artery/Tunnel	Park East Freeway	Cypress Freeway	Embarcadero Freeway	Central Freeway
Interstate Designation	I-10	I-93	I-43	I-880	I-480	I-80 Spur
Year Built/Opened to Traffic	1968	1959	1971	1957	1959	1959
Year Demolished/ Removed	?	2004	2002	1989	1991	2003
Age of Freeway when Demolished (yrs.)	50 (as of 2018)	42	31	32	32	44
Integrity and Safety Concerns?	No. Imminent integrity and safety concerns not present.	Yes. Traffic congestion and accident data .Exceeded design capacity.	Yes. Aging structure. Needed $80 million in repairs. No imminent concerns	Yes. Damaged by earthquake	Yes. Damaged by earthquake	Yes. Damaged by earthquake
Window of Opportunity?	Yes Katrina Recovery to address structural deficiencies	Yes. Generous interstate funding. Inclusion in ICE guaranteed federal funding that no longer exists.	Yes. Tenure of Mayor Norquist.	Yes. Earthquake	Yes. Earthquake	Yes. Earthquake
Decreased Value of Mobility?	Yes. Demolition proposal will not replace I-10 –need to expand Pontchartrain Expwy.	No. No decrease in value of mobility. Increased Interstate capacity.	Yes. Mayor & others wanted economic growth and downtown revitalized.	No. The freeway replaced. No decreased value of mobility.	Yes. Freeway replaced with multi-modal boulevard.	Yes. Partial demolition after Quake empowered residents - value other issues like economic development, quality of life.
Power Brokers Value of Freeway Less than other Benefits?	No. Power brokers not driving this effort. Idea appears to be driven by public and planning community.	No, Freeway replaced with Larger underground structure.	Yes. Mayor & others lead effort fueled by positive outcomes in other city that removed freeways.	Yes. Freeway rerouted to more industrial area to allow for other uses and benefits to community.	Yes. Value of waterfront & its economic potential.	Yes. Power brokers valued will of people who began to value issues other than mobility.

Location- City, State	New Orleans, LA	Boston, MA	Milwaukee, WI	Oakland, CA	San Francisco, CA	San Francisco, CA
Support of Business Enterprises?	No. Business leaders not currently promoting the demolition idea.	Yes, Salvucci sold idea to businesses.	Yes. Business community supported idea after report concluded minimal negative traffic impacts expected.	Yes. Local business Community awarded contracts and direct access to Port.	Yes. Except Chinatown merchants who wanted to keep the freeway.	NA. Walkup, Leavitt & Hayes Valley Area supported demolition. Role of business community not as clearly defined.
Public Entrepreneurship?	No. Community planning originated removal idea. Not officially supported or spearheaded by public entities.	Yes, Idea conceived by public officials and sold to constituents.	Yes, Idea conceived by public officials and sold to constituents.	No. Community Organized immediately forced public entity to Consider alternatives.	Yes. Public officials Supported demolition as early as 1985, but citizens rejected at ballot box.	No. Idea spearheaded by Neighborhood leaders.
"Do No Harm" Principle?	Yes. All proposals identify need to minimize impacts to communities in area of rerouted traffic.	Yes, Committed to no homes displaced and kept city open during construction years.	Yes. Traffic was major concern. Two studies showed impacts to be minimal.	Yes. Job training and other economic benefits to local community.	Yes. Freeway closure due to earthquake Inadvertently answered Congestion concerns. No gridlock occurred.	Yes. Freeway closure due to Earthquake inadvertently Answered congestion concerns. No gridlock occurred.
"Mitigated" Negative Impacts?	Yes. All proposals acknowledge the need to consider the impacts to Communities affected by traffic reroute as well as reparations to historical areas impacted by original I-10 structure.	Yes. Mitigation agreements were nearly one-third of project budget.	Yes. EIS and other studies found impacts minimal.	Yes. New industrial Alignment. Replaced with Mandela Parkway to mitigate years of negative impacts to the minority community.	Yes. Major traffic impacts did not occur when freeway was out of service. No additional mitigation needed. Removal option most economical option.	Yes. Major traffic impacts did not occur when freeway was out of service. No additional mitigation needed.

Appendix G. Public Opinion Survey for Claiborne Redevelopment (Renne 2011)

The following test and data were referenced from the following source: Renne, John L., "New Orleans Claiborne Avenue Redevelopment Study: A University of New Orleans Analysis of Best Practices and Public Opinion" (2011). *UNOTI Publications.* Paper 9. http://scholarworks.uno.edu/unoti_pubs/9

"The purpose of this study is to examine the potential implications of the removal of the Claiborne Expressway segment of Interstate 10 (I-10)… Interviews were conducted with 25 stakeholders, including representatives of adjacent neighborhoods, the business community, real estate interests, city and state elected officials, commuters, and urban planners. Moreover, an online survey was completed by more than 800 residents from across the city…. Of the survey respondents, 58% supported removal and 16% were opposed. Twenty-one percent of respondents said they were uncertain of their stance on removal, while the remainder indicated indifference toward the proposal. Other key findings:

- *The vast majority of respondents (82%) predicted that removing the expressway would positively impact the area by fostering economic and community revitalization.*
- *Only 28% of drivers who use the expressway four or more days a week oppose the removal.*
- *Respondents rated the following elements as "very important" to the successful revitalization of the corridor: sidewalks (87%), bike lanes (67%), a tree-planted neutral ground (63%), and light rail/streetcar (56%).*
- *Interviews revealed concern that gentrification could occur from the removal of the Expressway and revitalization of the corridor; however, only 31% of survey respondents "Agreed" or "Somewhat Agreed" that removal of Expressway would result in fewer housing options for lower income residents.*
- *Respondents "Agreed" or "Somewhat Agreed" that the removal of the Expressway would revitalize the following neighborhoods: Tremé (75%), the 7th Ward (70%), Tulane-Gravier (67%), the Central Business District (64%), Iberville Public Housing (63%), and the French Quarter (51%).*
- *Unknown impacts on travel patterns during and after removal were a significant concern of survey respondents.*

Based on these concerns we recommend the following:

- *Incorporate transit and bikeable/walkable infrastructure into any redevelopment designs.*
- *Consider providing convenient interchanges from I-10 to I-610 to facilitate additional capacity for motorists as part of a follow-up traffic study.*
- *Educate the public concerning transportation alternatives.*
- *Address fears of housing and gentrification within the redevelopment of the Claiborne corridor as part of the ongoing planning process.*
- *Reach out to residents of the Claiborne corridor to better gauge resident stakeholder opinion."*

Appendix H. Other Resources

The following resources are from the US EPA's Air Sensor Guidebook (EPA 600/R-14-159, June 2014).

Air Quality

- EPA criteria pollutants: http://www.epa.gov/air/urbanair/
- Criteria pollutants overview and standards: http://www.epa.gov/airtrends/sixpoll.html
- Air pollutant information: http://www.epa.gov/air/airpollutants.html
- Black carbon health effects: http://www.epa.gov/research/airscience/air-blackcarbon.htm
- Carbon dioxide emissions page: http://www.epa.gov/climatechange/ghgemissions/gases/co2.html
- Sources of greenhouse gas emissions: http://www.epa.gov/climatechange/ghgemissions/sources.html
- Air quality trends: http://www.epa.gov/airtrends/aqtrends.html
- Weather effects on trends in ozone pollution: http://www.epa.gov/airtrends/weather.html
- Local area trends for criteria air pollutants: http://www.epa.gov/airtrends/where.html
- Atmospheric science and the formation of pollutants: http://www.epa.gov/airscience/airatmosphericscience.htm#chemistry
- EPA toxics website: http://www.epa.gov/air/toxicair/newtoxics.html

Sensors

- EPA's Air Sensors 2013 and Next Generation Air Monitoring Workshop Series homepage: https://sites.google.com/site/airsensors2013/final-materials
- EPA Next Generation Air Monitoring website: http://www.epa.gov/research/airscience/air-sensor-research.htm
- A forum for the air sensors community to share and collaborate: http://citizenair.net/
- Citizen science opportunities for monitoring air quality fact sheet: http://www.epa.gov/research/priorities/docs/citizen-science-fact-sheet.pdf

Data Sources

- Multiple links to air quality data sources: http://www.epa.gov/air/airpolldata.html
- Access to real-time air quality maps and forecasts from EPA's AirNow system: http://www.airnow.gov
- AirNow Gateway for obtaining real-time data via files and web services: http://airnowapi.org/
- Access to historical air quality data from EPA's Air Quality System (AQS): http://www.epa.gov/airdata/

• Portal to download detailed AQS data:

http://www.epa.gov/ttn/airs/airsaqs/detaildata/downloadaqsdata.htm

Health Effects

• EPA's Air Quality Index: A Guide to Air Quality and Your Health: http://www.epa.gov/airnow/aqi brochure 08-09.pdf D Air Sensor Guidebook Additional Resources 43

• EPA's Guide to Particle Pollution and Your Health: http://www.epa.gov/airnow/particle/pm-color.pdf

• EPA's Guide to Ozone and Your Health: http://www.epa.gov/airnow/ozone-c.pdf

• EPA's Risk Assessment for Toxic Air Pollutants: A Citizen's guide: http://www.epa.gov/ttn/atw/3 90 024.html

Other

• General Air Research/Air Science: http://www.epa.gov/research/airscience/

• EPA's "plain English guide" to the Clean Air Act: http://www.epa.gov/air/caa/peg/

• Near roadway research and pollutant effects: http://www.epa.gov/airscience/airhighwayresearch.htm

• Role of vegetation in mitigating air quality impacts of air pollution:

http://www.epa.gov/nrmrl/appcd/nearroadway/workshop.html

• Air Pollution Training Institute (APTI) Learning Management System: http://www.aptilearn.net

• CDC Agency for Toxic Substances and Disease Registry (ATSDR) Toxic Substance FAQ (ToxFAQ):

http://www.atsdr.cdc.gov/toxfaqs/index.asp

• CDC The NIOSH Pocket Guide to Chemical Hazards: http://www.cdc.gov/niosh/npg/

Appendix I. Recommendations for Residents

1. **To reduce exposures to noise from traffic:**
   - Download free noise monitoring applications on mobile phones from the National Institute of Occupational Safety and Health (NIOSH) that alerts residents when noise levels exceed health–based standards (see NIOSH's Noise Meter app (**Figure I-1**)
     - See also: *Vibe Sensor, DecibelX*

Table I-1. NIOSH Recommended Exposure Limits (RELs) for Noise

Max time	**Noise level (dBA)**
8 hours	85 dB(A)
4 hours	88 dB(A)
2 hours	91 dB(A)
60 minutes	94 dB(A)
30 minutes	97 dB(A)
15 minutes	100 dB(A)

Figure I-1. The NIOSH Noise Meter App

   - Stay inside during peak traffic rush hours & minimize time you spend outdoors based on noise level (**Table I-1**).
   - If you must be outside, wear foam earplugs to reduce noise impacts
   - Change meeting places from under the I-10 to nearby parks or green spaces
   - If exercise along the corridor, start using parks and greenways, instead.

2. **To reduce exposures to air pollution:**
   - Monitor or track the air quality daily.
     - Keeping track of these reports will increase your awareness of the current air quality; and alerts you to high pollution days. If respiratory issues occur on high traffic days or alert days, minimize your time spent outdoors
     - The Louisiana Department of Environmental Quality (LDEQ) monitors the air quality and uploads the data to their website (https://deq.louisiana.gov/page/ambient-air-monitoring-data-reports). LDEQ also issues alerts when levels of a certain pollutant are high. Alerts can be accessed via the internet or via phone apps (access link: https://itunes.apple.com/us/app/niosh-sound-level-meter/id1096545820).
   - Vulnerable populations should avoid outdoor activities at, and shortly after, peak traffic times
     - Exposures to air and noise pollution peak during mornings and late afternoons (particulate matter, NOx, VOCs, noise), while ozone increases after the traffic peaks.
     - Exposures decrease as the distance from the I-10 increases.

- Children should not be allowed to play 1-2 blocks from the I-10.
- Install an air filtration system that rates at least 13 on the industry's 16-point effectiveness scale, and change your home filters as often as recommended.
- Avoid generating particulates inside your home by limiting activities such as burning candles and smoking cigarettes, which could further exacerbate respiratory conditions
- Consider planting trees or other vegetative barriers in front of the home to reduce transport of pollution and muffle sounds.
  - Grow produce in clean soil and/or greenhouses, or incorporate non-edible or bioremediation plants to degrade, absorb or immobilize traffic emission-related pollutants;

3. To reduce exposure to lead in soil and homes:

- Plant grass or vegetation; cover bare soil with clean soil; lay a geotextile down over the soil and clean soil, grass or vegetation
- Limit childhood activity in bare soil
- Clean children's hands, faces and everyone should take shoes off at the door to keep from tracking dirt in the home. Conduct similar activities with outdoor/indoor pets to limit soil transport inside.
- HEPA vacuum the home and wet dust to reduce inhalable lead levels
- Use EPA-certified "3M Lead Check" sticks to test for the presence of lead (walls, plumbing, pottery, any solid surface- see directions for exceptions (**Figure I-2**)
- Monitor lead and asthma-triggering exposures, by talking to your doctor, getting tested for lead and take exposure reduction precautions.

Figure I-2. EPA certified 3M Lead Check sticks

Appendix J. Policy Brief: Claiborne Corridor Health Assessment

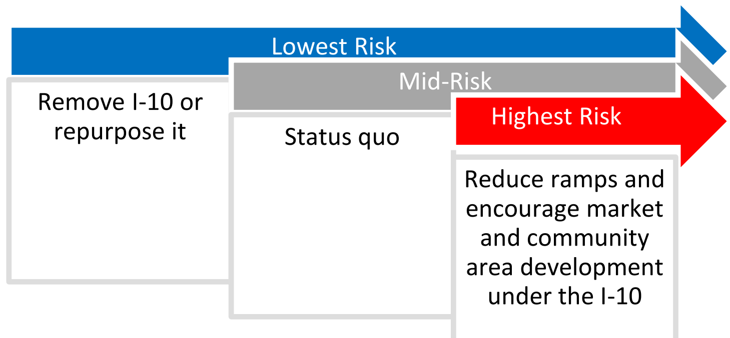
LSUHSC researchers evaluated potential health impacts of traffic in the I-10 Claiborne Corridor.

Environmental Issues of potential concern:

- Traffic-related air contaminants
- Traffic-related noise pollution
- Legacy soil lead

Health impacts of greatest potential concern:

- Respiratory diseases such as 1) asthma, 2) and chronic obstructive pulmonary disease (COPD);
- Cardiovascular diseases such as 1) high blood pressure, and 2) coronary heart disease.



Anticipated scenario impacts as presented in the Livable Claiborne Community report

Scenario	I-10	Corridor traffic	Exposure to diesel traffic	Exposures and Health
0	Status quo	>	>	>
1	Keep I-10, take down some ramps, increase public transportation, increase use of underpass	</>	>	>
2	Keep I-10 structure, remove all ramps, increase public transportation	</>	>	>
3a	Remove Claiborne corridor I-10, restore section to historic form, increase public transportation	</>	<	<
3b	Take down entire downtown interchange (I-10 and US-90), increase public transportation	</>	<	<
4 (not in report)	Keep I-10 but divert highway traffic and repurpose the structure for above ground walkway/park	</>	<	<

Symbols: < Decrease; > Increase; </> Either increases or decreases

Land use scenario impacts:
I-10 scenarios that were presented in the city's Livable Claiborne Corridor report were evaluated, based on projected traffic changes.

In terms of health impacts, the best scenarios involve removal or repurposing the I-10 structure.

Status quo or other scenarios which increase use of underpass area for community gatherings will increase population exposures, and may increase adverse health outcomes over time.

Vulnerable populations

- Children
- Seniors
- Pregnant or lactating women
- Adults with cancer or disorders of respiratory, cardiovascular, immune, auditory or nervous systems;
- Homeless individuals residing under I-10.