ABSTRACT

Title of Thesis:	AIRING GRIEVANCES: A CHARACTERIZATION OF KNOWLEDGE, DISSATISFACTION, AND SELF-EFFICACY REGARDING AIR POLLUTION IN AN ENVIRONMENTALLY OPPRESSED REGION OF WEST ATLANTA, GEORGIA, USA
	Jan-Michael J. Archer, Master of Science, 2024
Thesis Directed By:	Professor Devon C. Payne-Sturges, Department of Global, Environmental, and Occupational Health

Community-based air quality monitoring (CBAQM) has become a popular approach to addressing environmental injustice in communities exposed to multiple air pollutant stressors. In addition to collecting novel data on toxic emissions, successful CBAQM programs increase participants' environmental health literacy (EHL; knowledge, attitudes, and behaviors) regarding air pollution. This thesis details the results of a cross-sectional study of community residents participating in the AQEarth: West Atlanta CBAQM program. The study characterized participants' knowledge of, satisfaction with and self-efficacy toward local air pollution. Survey respondents' (n=33) knowledge assessment scores averaged at 56 percent. In response to the statement "I am satisfied with air quality in West Atlanta," 96% of respondents (n=32) did not agree. Finally, responses to self-efficacy survey items (n=29) averaged a score of -2.3 (on a scale

from -8 to 7). This research provides baseline information to guide future CBAQM programming and other EHL interventions in West Atlanta.

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by

Jan-Michael J. Archer

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Advisory Committee:
Associate Professor Devon C. Payne-Sturges, Chair
Associate Professor Robin Puett
Assistant Professor Rianna T. Murray
Associate Professor Robert H. Sprinkle
Associate Professor Craig S. Fryer

Preface

"When you see a river that is polluted, you see a community that is oppressed. When you see young people incarcerated, you find their parks and yards contaminated. When the people are brown, all too often, so is the air. In short, environmental justice reminds us, in language for our times, that an injustice anywhere is an injustice everywhere, an injustice to anything is an injustice to every thing and every being."

—Dr. Michel Gelobter, Executive Director

Yale Center for Environmental Justice

Dedication

This work is dedicated to my sister, Nirvana, my mother, Myra, and my father, Michael.

It is also dedicated to the countless graduate students who, like me, struggled against anxiety, depression, and suicidal ideation while in pursuit of an academic degree. It's not you, it's capitalism. You are enough and you are not as alone as you feel. Please seek help before it is too late.

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Table of Contents

List of Tables

List of Figures

- List of Abbreviations

AQ	Air Quality
AQI	Air Quality Index
BC	Black Carbon
CAA	Clean Air Act
CBAQM	Community-Based Air Quality Monitoring
CE	Cumulative Exposure
CHARRS	Community Health Aligning Revitalization Resilience and Sustainability
CI	Cumulative Impact
CIA	Cumulative Impact Assessment
CR	Cumulative Risk
CRA	Cumulative Risk Assessment
EH	Environmental Health
EHL	Environmental Health Literacy
EJ	Environmental Justice
EJI	Environmental Justice Index
EJSCREEN	Environmental Justice Screening and Mapping Tool
FEM	Federal Equivalence Method
FRM	Federal Reference Method
GA EPD	Georgia Environmental Protection Division
IRB	Institutional Review Board

LCS	Low-cost Sensor
NAAQS	National Ambient Air Quality Standards
NIEHS	National Institute of Environmental Health Sciences
NO2	Nitrogen Dioxide
NO_X	Nitrogen Oxides
O3	Ozone
PM	Particulate Matter
$PM_{2.5}$	Particulate Matter 2.5 microns or smaller in size
PM_{10}	Particulate Matter 10 microns or smaller and larger than 2.5 microns
RMP	Risk Management Plan
tVOC	Total Volatile Organic Compound
UMCP	University of Maryland-College Park
USEPA	United Stated Environmental Protection Agency
WAWA	West Atlanta Watershed Alliance

Chapter 1: Introduction

Community-based air quality monitoring (CBAQM) is a participatory action research practice where community stakeholders (typically residents) directly engage in measuring, analyzing, and interpreting local air pollutant concentrations, often with the goal of reducing pollution through policy regulation and enforcement action. CBAQM are providing vast quantities of data on air pollution concentrations in areas that have historically lacked suitable regulatory monitoring, for example, environmentally oppressed communities where residents are more likely encounter cumulative exposures to mixtures of chemical and non-chemical stressors while also suffering from limited access to adequate healthcare, housing, and nutrition. This type of "hyperlocal" monitoring encourages collaboration amongst community organizers, neighborhood associations, academic institutions, governments and other public stakeholders. As such, CBAQM programs have also been proven to serve as successful vehicles for community organizing and increasing participants' environmental health literacy, both of which are longstanding pillars of public health and environmental justice action.

In Atlanta, Georgia a host of permitted facilities are centralized west of the downtown area, where several rail lines and highways intersect, creating an economically advantageous location for the manufacturing and distribution of chemicals. Notably, many of these operations are Risk Management Plan (RMP) facilities, dealing in quantities of hazardous chemicals that require disclosure of up-to-date safety practices and protocols for preventing and mitigating accidental releases. Concerned about longstanding impacts to local air quality and a lack of intervention from air quality management government agencies at the state and federal levels, stakeholders established the AQEarth: West Atlanta CBAQM program, a partnership between private, public, and residential stakeholders to conduct fine-scale, high-grade air quality assessments in the communities nearest to this industrial corridor and to train participants as community air quality scientists and activists.

This thesis provides an overview of the AQEarth: West Atlanta CBAQM program as well as in-depth coverage of the development, delivery, and analysis of a co-occurring cross-sectional survey research study on the environmental health literacy of a small sample of the program's participants. The overall objective of the survey research was to provide a baseline characterization of participants' knowledge and attitudes regarding air pollution and risk management in their West Atlanta neighborhoods, which would in turn inform AQEarth: West Atlanta program leaders in developing an air pollution training curriculum for participants. *The specific aim of the research was to identify the baseline level of program participants' environmental health literacy by using a survey questionnaire to census West Atlanta residents on their knowledge, satisfaction, and self-efficacy regarding local air pollution and risk management.*

The work that follows is divided into seven chapters, the first of which being this brief introduction and outline (Chapter 1). Chapter 2 covers the background information which grounds this work, including definitions of the concepts of cumulative exposures and risk management regarding air pollution, environmental justice and oppression, community-based participatory research, and environmental health literacy. Chapter 3 provides in-depth information on the AQEarth: West Atlanta program activities. Chapter 4 details the methods and rationale used to develop, administer, and analyze the cross-sectional survey research. Chapter 5 provides the results of the survey analysis and Chapter 6 discusses these results in the context of the local population as well as the broader environmental health field. Chapter 6 also highlights discussion of the study's strengths, limitations, and lessons learned. Finally, Chapter 7 includes a brief synopsis of the study's findings and projections for future research.

Chapter 2: Background

2.1 Cumulative Exposures, Risks, and Impacts

In 2019, there were more than 350,000 chemicals and mixtures registered for commerce worldwide with 86,000 listed in the United States Environmental Protection Agency's (USEPA) Toxic Substance Control Act (TSCA) Toxic Chemical Substance Inventory and 40,000 estimated to be in active production and use in the USA (Wang, Walker, Muir, & Nagatani-Yoshida, 2020). These substances exist across air, water, and soil media. Importantly, TSCA does not regulate pesticides, food additives, drugs, cosmetics, tobacco products, nuclear materials, or munitions and therefore these chemicals are not included in the Chemical Substance Inventory (USEPA, 2024a).

Several decades of environmental health research have shown that cumulative exposures—i.e., multi-pollutant doses occurring simultaneously via multiple routes (e.g., inhalation, dermal, oral) and pathways (e.g., food, drinking water, residential environment)—both initiate and complicate disease (Fox, Brewer, & Martin, 2017; Gallagher et al., 2015; Reitze, 2004; Valavanidis, Vlachogianni, Fiotakis, & Loridas, 2013). For example, progressive neurodegenerative disorders like Parkinson's disease are often triggered by the interactions of genetic and environmental risk factors, including multi-pollutant exposures to pesticides and heavy metals (Huang et al., 2022). Phthalates and other endocrine disrupting chemicals (aka "EDCs") represent whole classes of chemicals that are omnipresent across environmental media and have critically damaging cumulative exposure consequences (Kortenkamp, 2007).

Additionally, cumulative exposures are particularly relevant to investigations of environmental injustice as evidence shows that non-chemical stressors and socioeconomic context can dramatically modify the near-term effects and long-term impacts of compound exposures (Sexton & Linder, 2010; Fox, 2002; Morello-Frosch, Pastor, & Sadd, 2001). Communities dealing with environmental injustice suffer the most from the CRA implementation gap and, therefore, stand to gain the most from its closure. When federal policies target the "national average population", Black, Indigenous, and other People of Color (BIPOC); people of low wealth; and other marginalized peoples—who are significantly more likely to endure multi-pollutant exposures than their White or more affluent counterparts (Tessum et al., 2019; Tessum et al. 2021), —are left without data, without protection, and without recourse.

For decades, federal environmental regulators have primarily focused on assessing exposure risk using a single pollutant model. As outlined in Archer and Payne-Sturges (2024), the first concerns of cumulative and multi pollutant exposures were brought forth in the 1970s, However, USEPA has championed an approach that dismissed the severity importance of investigating how different chemical and non-chemical exposures interact in multiplicative ways to endanger human health.

Several policy tools exist for rulemaking and standard-setting based on cumulative exposures, risk, and impact. These include, for example, the 1947 Federal Insecticide, Fungicide, and Rodenticide Act of 1947 (FIFRA); the 1976 Toxic Substances Control Act (TSCA; particularly the 2016 Lautenberg Amendment), and the 1996 Food Quality Act (FQA). Notably, the latter established and authorized the USEPA Office of Pesticide Programs to specifically investigate classes (i.e., mixtures) of, rather than individual chemicals.6 The 1994 Clinton Administration Executive Order 12898, which mandated a whole-of-government approach to environmental justice, accelerated information-gathering for cumulative exposure policymaking in the 1990s. Federal interagency and advisory councils (e.g., National Environmental Justice Advisory Council, NEJAC; National Research Council, NRC) convened to specifically discuss and develop recommendations for implementation of a unified governmental strategy to reducing cumulative exposures (USEPA, 1996; Fineberg & Stern, 1996).

These efforts culminated in USEPA's publication of its 2003 Framework for Cumulative Risk Assessment, a report outlining guidance, metrics and methodologies for conducting cumulative risk assessment (CRA). This Framework analyzes, characterizes, and quantifies the combined risks to health or the environment from multiple agents or stressors, including non-chemical stressors. However, neither the 2003 report, nor its 2008 follow-up "Concepts, Methods, and Data Sources for Cumulative Health Risk Assessment of Multiple Chemicals, Exposures, and Effects: A Resource Document", represent rules or standards and provide no requirements for agencies to implement CRA in their organizational practice. The USEPA does account for repeated single-pollutant exposures through different routes and pathways over time with its aggregate exposure assessment model, but this approach still fails to consider the effects of interactions between chemical compounds co-occurring in air, water, and soil media (Moretto et al., 2017). Jill Lindsay Harrison points to a generally risk-averse internal culture at government agencies as a key barrier to addressing cumulative exposure (Harrison, 2019). Drawing on more than 150 interviews with USEPA staff for her 2020 book From the Inside Out: The Fight for Environmental Justice Within Government, Harrison notes a reluctance to adopt frameworks that are characterized as belonging to the realm of environmental justice over historically used methods that are characterized as "pure" and "apolitical" science.

While many environmental health stakeholders considered the framework a first step that would provide a basis for more concrete action toward reducing cumulative exposures, federal action stalled (Payne-Sturges, Sangaramoorthy, & Mittmann, 2021). Between 2003 and 2020, federal implementation of CRA was narrow (Payne-Sturges et al., 2018). For example, the National Air Toxics Assessment (NATA), beginning in 2005 and last updated in 2018, communicates cancer risk based on exposures to various air pollutants, but not pollutants from other media. The USEPA's Office of Environmental Justice, a rare example of the federal agency using the CRA framework, launched the now popular field of GIS-based risk mapping with the Environmental Justice Screening and Mapping Tool (EJSCREEN) in 2011, which overlays exposure factors to produce a cumulative risk ranking. This tool has been implemented in grantmaking and funding pathways but not rulemaking or standard-setting.

Meanwhile, in the research community, comprehensive techniques for CRA have proliferated (Moretto et al., 2017; Blakely & Russell, 2022). Critiques, drawing from academic and governmental published literature, provide various explanations for the USEPA's non-delivery of effective, holistic cumulative risk policy and implementation. Sprinkle & Payne-Sturges (2021) point to the environmental-health regulatory establishment's agency siloing, self-imposition of roadblocks to navigate political partisanship, resulting in a general reluctance to engage in the complexity of moving some a single-chemical risk assessment approach to a cumulative exposure one. Payne-Sturges, Sangaramoorthy, & Mittman (2021) acknowledge that a lack of data, analytical tools, and methodologies for CRA exists but that policy-relevant actors, drawing from surrounding social, economic and political climates, have historically understated the importance of cumulative exposures, resulting in their deplatforming, disinvestment, and deprioritization by federal agencies.

In contrast to the USEPA, state and local authorities have substantively advanced cumulative exposure policy (Ma, Becker, Kilgore, 2009). In 2008, Minnesota was the first state legislature to consider the harmful effects from air pollution in the permitting and construction processes for newly built industrial facilities (Lee, 2020). An updated bill passed in 2023 expanded what was originally a single designated protected area to all environmental justice communities within the Twin Cities metropolitan area and surrounding cities of Rochester and Duluth (Bakkensen, Ma, Muehlenbachs, & Benitez, 2024). California's Assembly Bill 617, passed in 2017, required the California Air Resource Board to reduce emissions in communities experiencing highest cumulative exposure risk (Boda et al., 2023). New York and New Jersey have also passed legislation on cumulative impacts, with the latter provisioning for the outright dismissal of permits where disproportionate impacts presented by a regulated facility cannot be avoided (Ellickson et al., 2024). Rhode Island, Illinois, and other states have put forth similar measures (Smith, 2024; UCS, 2024).

2.2 Risk Management Plan Facilities

Risk management plan (RMP) facilities store, handle, or process hazardous substances in quantities that would pose significant risk to public and environmental health in the event of a release. The RMP Rule, passed as part of the 1996 Amendments to the United States Clean Air Act (CAA), mandates that these facilities develop and implement a risk management plan that details how accidental releases will be prevented or how adverse consequences will be mitigated in the event of a release (USEPA, 2020).

RMPs play a critical role in cumulative risk assessment as they must evaluate the broader impact of multiple facilities or releases on a population or region, particularly one that is overburdened by overlapping environmental hazards (Ma, Mengersen, & Martin, 2018). Additionally, RMP facilities are required to assess the potential risks of various accident scenarios (e.g., toxic chemical releases, fires, explosions). These scenarios might not only affect people near the facility but could also contribute to cumulative exposure if other nearby facilities have similar risks or if there are other sources of hazardous emissions (such as transportation routes or industrial areas) (Abt, 2011; Breheny & Edwards, 2016).

Over time, the accumulation of pollutants—in air, water, and soil—from various sources increases the total exposure risk for individuals, especially for vulnerable populations. This can result in more severe health consequences due to prolonged or repeated exposure. Studies conducted by USEPA and other agencies have emphasized understanding the synergistic effects of multiple pollutants when assessing public health risks (USEPA, 2019; Lee et al., 2017).

RMP facilities are required to analyze the potential for offsite consequences of an accident, which includes understanding how other facilities, activities, and environmental factors could contribute to cumulative risk. This might involve modeling scenarios where multiple incidents could occur, adding to the total risk faced by nearby populations (Johnson & Weiner, 2013). Such assessments are vital for understanding potential public health impacts, especially for communities near industrial zones (Miller et al., 2015).

Facilities are required to develop mitigation measures (such as safety equipment, emergency response plans, and public communication strategies) to minimize the consequences of a release. However, managing cumulative exposure risk involves coordinating across different facilities and sectors to ensure that risk reduction efforts are effective and take into account the combined impacts of various hazards. Coordination between facilities and regional authorities is essential for comprehensive risk management (Pidgeon et al., 2011; Schwartz, 2018).

Despite this need for coordination and transparency, complexity and limited accessibility of RMPs puts them largely out of the general public's reach. RMPs often contain highly technical language and data that require specialized knowledge to interpret. This complexity serves as a barrier for community members and advocacy groups, reducing their ability to engage critically with the documents (Duong and MacAlister, 2021).

Although RMPs are mandated to be publicly accessible, logistical and bureaucratic obstacles can make obtaining them challenging. Facilities may rely on limited dissemination practices, restricting community awareness of potential hazards

(Rangwala et al., 2022). Moreover, accessibility issues are exacerbated when public records systems are outdated or when digital access is not widely available in marginalized communities (White & Jones, 2020). Facilities also abuse the designation of certain information as "Sensitive Security Information" (SSI), a federal category of information meant to safeguard public safety and infrastructure (Kosnik et al., 2020). RMP facilities may interpret SSI designations broadly to withhold details that might otherwise be publicly accessible. This includes information on specific chemicals stored on-site, detailed maps of facility layouts, or descriptions of risk mitigation measures. Such broad applications can obscure the scope of risks, limiting the community's ability to assess and challenge potential hazards.

By making RMPs complex and hard to access, facilities can avoid extensive public oversight. This minimizes the likelihood of community challenges to their operations or safety practices. As noted by Johnson and Taylor (2019), limited scrutiny often correlates with fewer calls for stricter regulatory enforcement, allowing facilities to operate with minimal disruption. Furthermore, facilities may exploit ambiguities in the regulatory framework to comply with minimal requirements rather than addressing broader risks. For example, Moynihan et al. (2020) highlight that some organizations prioritize meeting procedural benchmarks over substantive safety improvements, using the complexity of compliance rules to shield against accountability.

Environmentally oppressed communities are disproportionately affected by the inaccessibility of RMPs. These groups frequently lack the resources and technical expertise to interpret complex risk documents. As a result, they are unable to effectively advocate for safer environmental conditions (Bullard et al., 2018). Furthermore, limited access to these plans prevents these communities from identifying potential hazards or engaging in informed dialogue with policymakers and facility operators (Sze & London, 2021).

2.3 Focus on Particulate Matter as a Multi-Pollutant, Cumulative Class

While an important feature of cumulative risk framing is its emphasis on exposure to both physical and non-physical harms, overburden from multiple physical (and especially chemical) pollutants is still highly relevant to addressing cumulative exposures. In the context of cumulative exposure research, much focus has been placed on ingestion and dermal routes of exposure (e.g., food and water contaminants). The present study adds to this literature by considering inhalation of air pollutants. Compound exposures to multiple air pollutants present critical opportunities for public health intervention, such as traffic emissions, fugitive dust from a rock crushing facility, and fossil fuel combustion from energy plants all located in the same area.

The global excess mortality attributable to air pollution is estimated at 8.9 million (CI: 7.1 – 10.3) deaths per year (Burnett et al., 2018). Reducing cumulative exposures to toxic air pollutant mixtures is a critical environmental health goal as these exposures are directly linked to adverse health outcomes related to cardiovascular disease(Morello-Frosch, Zuk, Jerrett, Shamasunder, & Kyle, 2011; Koton et al., 2013); perinatal, pregnancy, and maternal morbidity (Bekkar, Pacheco, Basu, DeNicola, 2020; Coker et al., 2016; Klepac, Locatelli, Korošec, Künzli, &

Kukec, 2018), children's health outcomes (Perera, 2017), and premature death (Khomenko et al., 2021; Matus et al., 2022; Muller & Mendelsohn, 2007; Deryugina, Heutel, Miller, Molitor, & Reif, 2019).

Regarding reducing cumulative exposures, particulate matter is of special concern because it represents a *class* of multiple air pollutants and is regulated as such under the US Clean Air Act. The National Ambient Air Quality Standards set thresholds for the environmental management of six criteria air pollutants, including particulate matter. The World Health Organization defines particulate matter as any "inhalable particles composed of sulfate, nitrates, ammonia, sodium chloride, black carbon, mineral dust or water" (WHO, n.d.). In the United States, 280 thousand deaths per year are attributable to long-term PM2.5 exposure (Vodonos &Schwartz, 2021). Critically, PM2.5 exposure has been associated with excess burden of death due to cardiovascular disease, the number one cause of death and disability globally, resulting in an estimated 56,070 more CVD-related deaths [95% CI: 51,940.2–60,318.3] per year (Bowe, Xie, Yan, Al-Aly, 2019).

Generally, particulate matter is organized (and regulated) based on size, not species composition. This is because the size of a particle determines where it deposits in the human body. Particles 10 micrometers in aerodynamic diameter or larger (PM_{10} or "coarse particulate matter") typically impact upon the conducting zone (including the nose, larynx, pharynx, trachea, and bronchi) of the respiratory system where mucosal secretions and ciliated epithelium act to remove foreign contaminants from the body. However, particles between 10 and 2.5 micrometers in aerodynamic diameter ($PM_{2.5}$ or "fine particulate matter") are small enough to penetrate the respiratory zone, where gas exchange transports oxygen and particulates throughout the body via the alveolar sacs and circulatory system.

2.4 Reducing Multi-Pollutant Exposure Risk

2.4.1 Defining Environmental Justice, Injustice, and Oppression

Gelobter (1993) succinctly provides several relevant definitions in his essay "The Meaning of Urban Environmental Justice":

> "**Environmental justice** is redress for the structures and situations arising from environmental discrimination and, particularly, environmental racism. **Environmental discrimination** is actions and practices, arising from both individual ideologies and social structures, that preserve and reinforce domination of subordinate groups with respect to the environment, *while such discrimination with respect to race is* ***environmental racism***. **Environmental injustice** is a three-dimensional nexus of economic injustice, social injustice and an unjust incidence of environmental quality, all of which overwhelmingly assures the continued oppression of communities of color and low-income communities on environmental matters."

Furthermore, environmental racism is motivated by racial capitalism, which establishes structural barriers to political and decision-making power for Black, Indigenous, Latiné, Asian, and Pacific Islander people–especially those who are also members of the working class (Pulido, 2017). Other examples of environmental injustice operate on axes of sexism, heterosexism, transphobia, xenophobia, Islamophobia, anti-Semitism, and other forms of bigotry.

Environmental justice, by contrast, is a state of existence where social hierarchies do not dictate or influence a person or people's exposure to environmental hazards, if indeed these hierarchies exist at all. Bryant (1995) describes this further using several examples:

> "Environmental justice (EJ) ... refers to those cultural norms and values, rules, regulations, behaviors, policies, and decisions to support sustainable communities where people can interact with confidence that the environment is safe, nurturing, and productive. Environmental justice is served when people can realize their highest potential. ... EJ is supported by decent paying safe jobs; quality schools and recreation; decent housing and adequate health care; democratic decision-making and personal empowerment; and communities free of violence, drugs, and poverty. These are communities where both cultural and biological diversity are respected and highly revered and where distributed justice prevails."

The terms "environmental justice" and "environmental injustice" have been used interchangeably in both popular and technical contexts; particularly when describing the populations who suffer from a lack of environmental justice. In this way, the term "environmental justice community" has become a neoliberalized euphemism that fails to accurately associate the material conditions of environmental injustice with the deliberate political violence exercised to create those conditions.

The environmental justice movement, at its core, is a radical political movement. To recenter and resensitize discourse on the harm(s) being committed to those suffering from environmental injustice, I follow the example of Freire's (1968) *Pedagogy of the Oppressed*, I avoid using euphemisms and instead refer to these people as being "environmentally oppressed."

Similarly, I use the term "frontline community" to describe areas abutting industrial zones or heavily trafficked roads that are often the first to experience toxic ambient air pollution emissions emanating from these sources (Mohai, Pellow, Roberts, 2009). Typically, these areas also lack health-promoting infrastructure (e.g., green space, comprehensive healthcare facilities, grocery stores) but these conditions are secondary to the physical proximity to environmental hazard and harm.

2.4.2 Community-Based Air Quality Monitoring

The recent proliferation of consumer-grade air sensing technology has provided numerous opportunities for community residents to engage policymakers in the air pollution monitoring and management arenas through the process of community-based air quality monitoring (CBAQM). Historically, air quality monitoring data was primarily collected by industrial and governmental stakeholders, but in recent decades, “low-cost sensors” (LCS) removed a significant barrier to local community stakeholders’ ability to collect emissions data. Peer-reviewed studies have shown how LCS technology is demystifying regulatory monitoring for the public good (Haynes, 2019).

Typically, LCS air monitoring networks are established by partnership groups comprising community organizers, academic researchers, and government agency staff (Snyder et al., 2013; Lu et al., 2022; Mahajan et al., 2022). Through this model, community residents receive knowledge and skills training on air pollution science as well as a more accurate picture of their exposure risks. Academic researchers and institutions are granted access to areas and communities for developing research projects. Government agencies receive more granular supplemental data for better understanding of environmental conditions and, ultimately, insights for better air pollution management. This is critical as requirements for high data quality, established by the Clean Air Act, can make it financially infeasible for dense regulatory networks of expensive monitoring equipment to be sited across jurisdictions (Zou, 2021; Clements et al., 2017). Most notably, LCS networks often provide hyperlocal profiles of air pollution including the occurrence and timing of emissions spikes. Additionally, CBAQM programs serve as successful vehicles for community organizing and participatory science in and of themselves (Mahajan et al., 2022). The value of community-generated data extends beyond these applications though, as many researchers have shown participatory research methods provide non-scientist participants with a series of personal, social, and civic benefits (Shirk et al., 2012; Dickinson, Zuckerberg, & Bonter, 2010; Den Broeder, Devilee, Van Oers, Schuit, & Wagemakers, 2018; Bela et al., 2016).

However, there are critiques of CBAQM. One of the main obstacles to the expansion and implementation of community-generated data in regulatory practice is the prevailing notion that data collected by non-scientists is, by default, more error-prone (Hunter, Alabri, & van Ingen, 2013; Alabri & Hunter, 2010). Over decades, community-engaged researchers, nonprofit advocacy groups, and activists have developed myriad field-specific procedures and protocols to guide the training of laypeople in rigorous research conduct and data collection (Kosmala, Wiggins, Swanson, Simmons, 2016; Lukyanenko, Parsons, & Wiersma, 2016; Wiggins, Newman, Stevenson, & Crowston, 2011; Crall et al., 2011). Examples of widely-used quality assurance and quality control (QA/QC) measures for CBAQM range from technological equipment assessments (e.g., sensor calibration, collocation with regulatory monitors, data output conversions) to field siting best practices (e.g., replication and duplication, considerations of meteorological factors) to data processing (e.g., standardized statistical software and analysis code) to data management and storage (e.g., methods for recordkeeping, data custody, database indexing and processing, and maintenance).

Certain government agencies have embraced providing the participatory research community with reference materials for validating community-generated data. In California, South Coast Air Management District agency has undertaken the task of utilizing laboratory methods to verify manufacturer claims regarding LCS product capabilities and subsequently providing consumer reports to the public (Polidori, Papapostolou, Collier-Oxandale, Hafner, and Blakey, 2021). At the federal level, the USEPA has disseminated several QA/QC resources for CBAQM. For example, the Air Sensor Toolbox (USEPA, 2022a), Enhanced Air Sensor Guidebook (Clements, Duvall, Greene, Dye, 2022), and Quality Assurance Handbook and Toolkit for Participatory Science Projects (USEPA, 2022b) represent a suite of online resources with step-by-step instructions, documentation, and templates for developing, validating, and launching CBAQM protocols.

Finally, through funding made available by the American Rescue Plan Act of 2021 and Inflation Reduction Act of 2022, the USEPA issued grants totaling more than $53 million to 132 CBAQM projects, including 17 that implement LCS networks (USEPA, n.d.). Such investments reinforce the high value of validated community-generated data, further calling into question why more efforts are not being made to use these data for regulatory action.

Notably, despite the advantages, QA/QC measures, and investments, securing credible community-generated data requires overcoming interpersonal and relational barriers that arise from forming short-term and long-term partnerships. These barriers are often grounded in power and positionality (Minkler, 2005). Insider-outsider bias is exemplified when community members are "insiders" in their neighborhoods and may object to institutional researchers coming from without direct project priorities and goals (Lantz, Viruell-Fuentes, Israel, Softley, & Guzman, 2001). Reflexively, community members are often "outsiders" to institutional systems (e.g., academia and government) and be met with bias from "insider" researchers who are reluctant to share decision-making power. Prejudice against community-generated data can also reflect entrenched knowledge-based hierarchies and subsequent elitist views held by academic and other institutional researchers (Freire, 2018). Lack of commitment to trust-building is another often-cited source of partnership conflict and can lead to dissolution. For these reasons and more, participatory research frameworks (e.g., community-based participatory research, participatory action research, community engaged research), which center relationship building and power-sharing have become the dominant paradigm for environmental health partnerships involving community-academic-government— including CBAQM programs (Israel, Schulz, Parker, & Becker, 1998).

2.4.3 Environmental Health Literacy

Environmental health literacy (EHL)—defined as the knowledge, awareness, and skills needed to reduce one's environmental health risk (Hoover, 2019)—is one of several frameworks and methodologies that have been used for examining risk reduction concerning air pollution. EHL integrates environmental and health concepts, helping people "seek out, comprehend, evaluate, and use environmental health information to make informed choices, reduce health risks, improve quality of life, and protect the environment" (Finn & O'Fallon, 2019). With its emphasis on risk communication, EHL has been shown to provide statistically significant improvements in asthma health outcomes, reducing both hospitalization and emergency department visits (Robinson Jr., & Calmes, 2008; Apter, et al., 2013). Higher EHL is also correlated with lower self-reporting of household air pollution symptoms (Raufman, 2020).

Gray (2018) theorized EHL as having three dimensions, conceptualized as overlapping, concentric circles (Fig. 2.1). In the innermost circle, "Awareness and

Understanding", learners broadly recognize that environmental exposures and socio-cultural dynamics influence health and, presumably, that poor environmental conditions can lead to poor health outcomes. Learners' familiarity with different environmental exposures may vary widely at this stage, perhaps being highest only regarding the exposures occurring in their daily lives. The next circle, "Skills & Self-Efficacy", incorporates social cognitive theory and sees learners adopting skills that enable health protective decision-making and experiencing an increased sense of influence over reducing harmful health outcomes. The final circle, "Community Change", incorporates the facets of the two inner circles and applies them beyond the self. "In this dimension, both individuals and groups apply their knowledge and skills, in the context of self-efficacy for the desired behavior change, to reduce harmful environmental exposures and improve health.

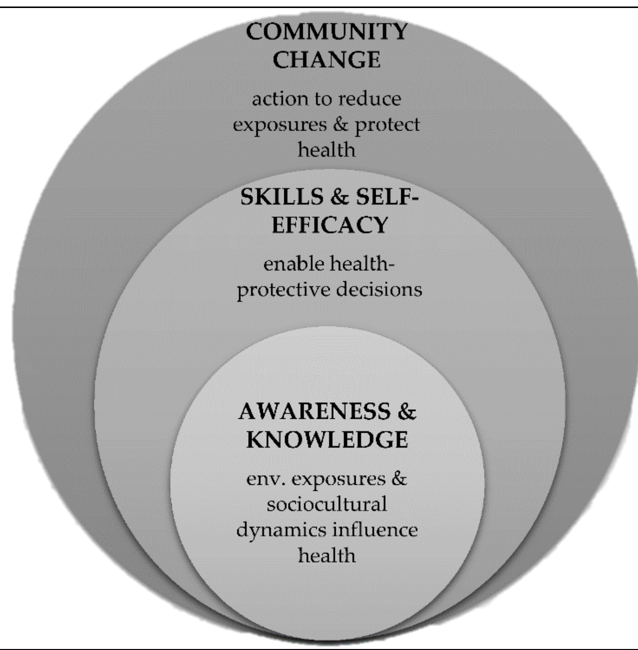


Fig 2.1. Three dimensions of environmental health literacy (EHL; reproduced from Gray, 2018).

Capacity-building, a key tenet of EHL, allows community members to leverage their knowledge and skills in minimizing environmental exposures that may cause adverse health effects. Thus, research that engages residents directly in data collection, bi-directional learning, and community advocacy is intended to build EHL, leading to improvements in health status and health promotion (Gray, 2018). This is crucial to avoiding the pitfalls of CBAQM that arise from not following a community-based participatory model.

Importantly, while research has been conducted at the intersection of air pollution exposure and environmental health literacy, there have been no published studies applying the framework to concepts of cumulative exposures, risks, and impacts. As such, this study explores an opportunity to bridge the gap between established insights regarding air pollution literacy in isolation and within the context of cumulative exposures.

Research on EHL has shown that participants in air quality-related citizen science and community-engaged research projects exhibit statistically significant increases in knowledge regarding local pollution emissions and sources (Robinson Jr., & Calmes, 2008; Apter, et al., 2013). Additionally, these increases in knowledge directly translated to the adoption of harm avoidance and risk reduction behaviors; both in the short- and long-term.

Chapter 3: Environmental Health Intervention and Praxis—AQEarth: West Atlanta

This study was conducted in partnership with the AQEarth: West Atlanta program which took place in the Collier Heights neighborhood of Atlanta, Georgia, USA from July 2023 to June 2024. The program's members included non-profit organizations Community Health Aligning Revitalization Resilience & Sustainability (CHARRS) and the West Atlanta Watershed Alliance (WAWA); private sector consultants in air quality monitoring 2B Technologies, TD Environmental Services, Montrose Environmental; personnel from the USEPA's Region 4 Air and Radiation Division as well as the Georgia Environmental Protection Division's Air Protection Branch Ambient Monitoring Program; and academic researchers from Georgia State University, University of Georgia, and the University of Maryland-College Park.

The goal of AQEarth was to establish community-based air quality monitoring (CBAQM) programs that would supplement existing regional monitoring efforts and inform existing knowledge of air pollution exposure risks in communities suffering from environmental injustice. The program established local air monitoring (fixed site, mobile, and handheld equipment) with a range of supporting services including educational and public outreach efforts provided to community stakeholders. West Atlanta was selected as one of five North American locations. AQEarth: West Atlanta was funded by a National Institutes of Health Small Business Innovation Research grant via the National Institute of Environmental Health Services (Award Number: R44ES024031) as part of the AQEarth parent project, which spanned five communities across North America in total. More information on AQEarth can be found on the program's website: https://www.aqearth.com/about.

Monitoring priorities, especially, were developed through bi-directional conversations between CHARRS and community residents as well as between the project team and CHARRS. At the onset of the program, CHARRS invited community organizers and residents (West Atlanta Watershed Alliance, Collier Heights Neighborhood Association; Neighborhood Planning Units I, G, H), academic researchers and staff from Spelman College, University of Georgia, Agnes Scott College, and Georgia State University, industry professionals (e.g., Argos Concrete, Norfolk Southern Rail), and government agency personnel (e.g., Atlanta Office of the City Council, Georgia Environmental Protection Division, USEPA Region 4 Office) to participate.

3.1 Community-Based Air Quality Monitoring Using Stationary and Handheld Devices

We took guidance from Commodore et al (2017) on establishing CBAQM programs using community-based participatory research framework (see Fig 3.1). Initially, the project team held regular meetings to co-design: an air quality monitoring plan (detailing the "who, what, when, where, why, and how" of data collection), a quality assurance plan (detailing how data validity would be ensured), and a memorandum of understanding (detailing how partners' responsibilities and rules for engaging each other). These documents were also informed by community member input given at stakeholder meetings hosted in the Collier Heights neighborhood in Summer 2023.

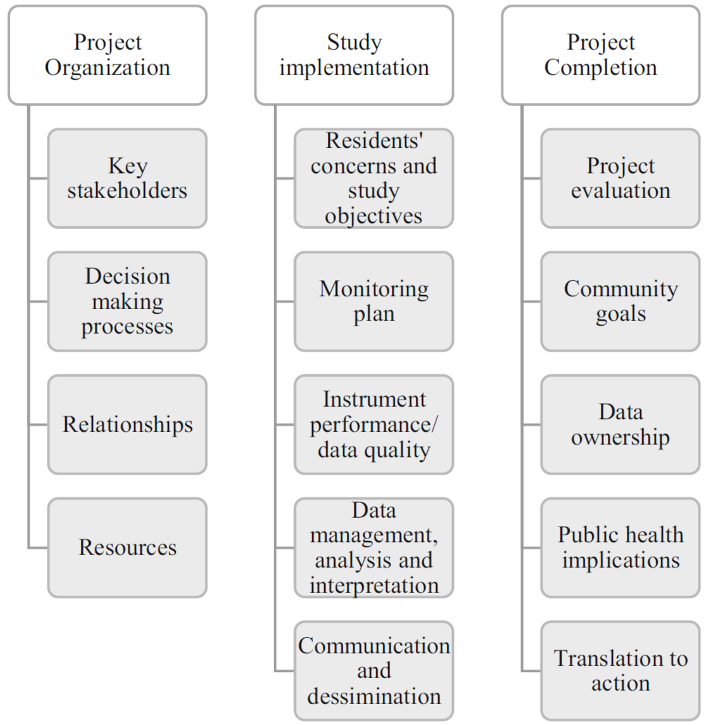


FIG 3.1 Overview of some of the anticipated challenges of air pollution monitoring at the community level. This framework was used in developing the AQEarth: West Atlanta project's air quality monitoring plan, quality assurance plan, and partnership memorandum of understanding. Reprinted from "Community-based participatory research for the study of air pollution: a review of motivations, approaches, and outcomes," by A. Commodore et. al, 2017, *Environmental Monitoring and Assessment*, 189(378),16. Copyright 2017 by Springer International Publishing AG. Reprinted with permission.

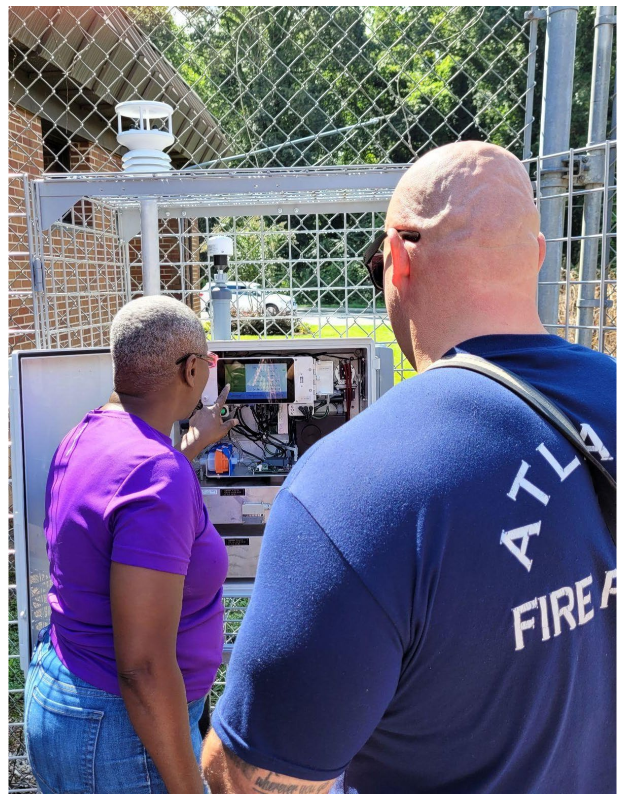
Personnel from 2BTechnologies, Inc. and TD Environmental Services, LLC were air pollution monitoring experts for this project and responsible for the production and installation of air quality sensors. Non-profit organizations CHAARS and WAWA were primarily responsible for direct community engagement. Leveraging previous experiences in designing and developing CBAQM programs using LCS networks and community-based participatory research methods in Maryland, Alabama (Ravichandran, et al., 2024), New Jersey, and South Carolina, I joined the AQEarth: West Atlanta project team as an academic research partner to provide technical assistance to CHARRS. State and federal governmental agency personnel (staff from GA EPD Air Monitoring Program and USEPA Region 4 Office) were instrumental in providing access to sites for equipment calibration and monitor collocation.

An AQSync federal-equivalent-method (FEM) grade stationary air quality monitor was collocated at the Georgia Environmental Protection Division Ambient Air Monitoring Site in South Dekalb (2300-C Wildcat Road, Decatur, DeKalb County, Georgia 30034) for a period of three weeks to ensure proper calibration prior to field deployment. The AQSync was then deployed at Fire Station #38 (2911 Donald Lee Hollowell Pkwy NW, Atlanta, GA 30318) for a 12-month period from August 2023 to September 2024. This site was selected as the most central location within the study area that met technological installation requirements (e.g., WiFi access, secure from theft and vandalism). Figure 3.2 illustrates the stages of preparing and deploying the AQSync.

A. AQSync at South Dekalb Collocation Site

B. Project team assembles sensor cage.

C. Relocating AQSync for final deployment



D. Powering on AQSync in Collier Heights

Fig 3.2. Photographs from the establishment phase of the AQSync air monitor. The AQSync was the first ever federal-equivalent-method (FEM) -grade air quality monitor deployed in the West Atlanta, GA region.

The AQSync monitor collected continuous measurements of particulate matter 1-micrometer and smaller (PM_1), $PM_{2.5}$), ozone (O_3), nitrogen dioxide (NO_2), carbon monoxide (CO), and total volatile organic compounds (tVOCs). Time-lagged data and interpretations were reported to CHARRS and WAWA for subsequent dissemination to the public via an AirSense online dashboard. In addition to stationary air quality monitoring, an air sensor loan program was established where community members could borrow personal air monitors (PAMs) for use in their homes or while completing planned walks (called "AQTreks") throughout the community.

3.2 Environmental Justice Tour and Community Listening Workshop

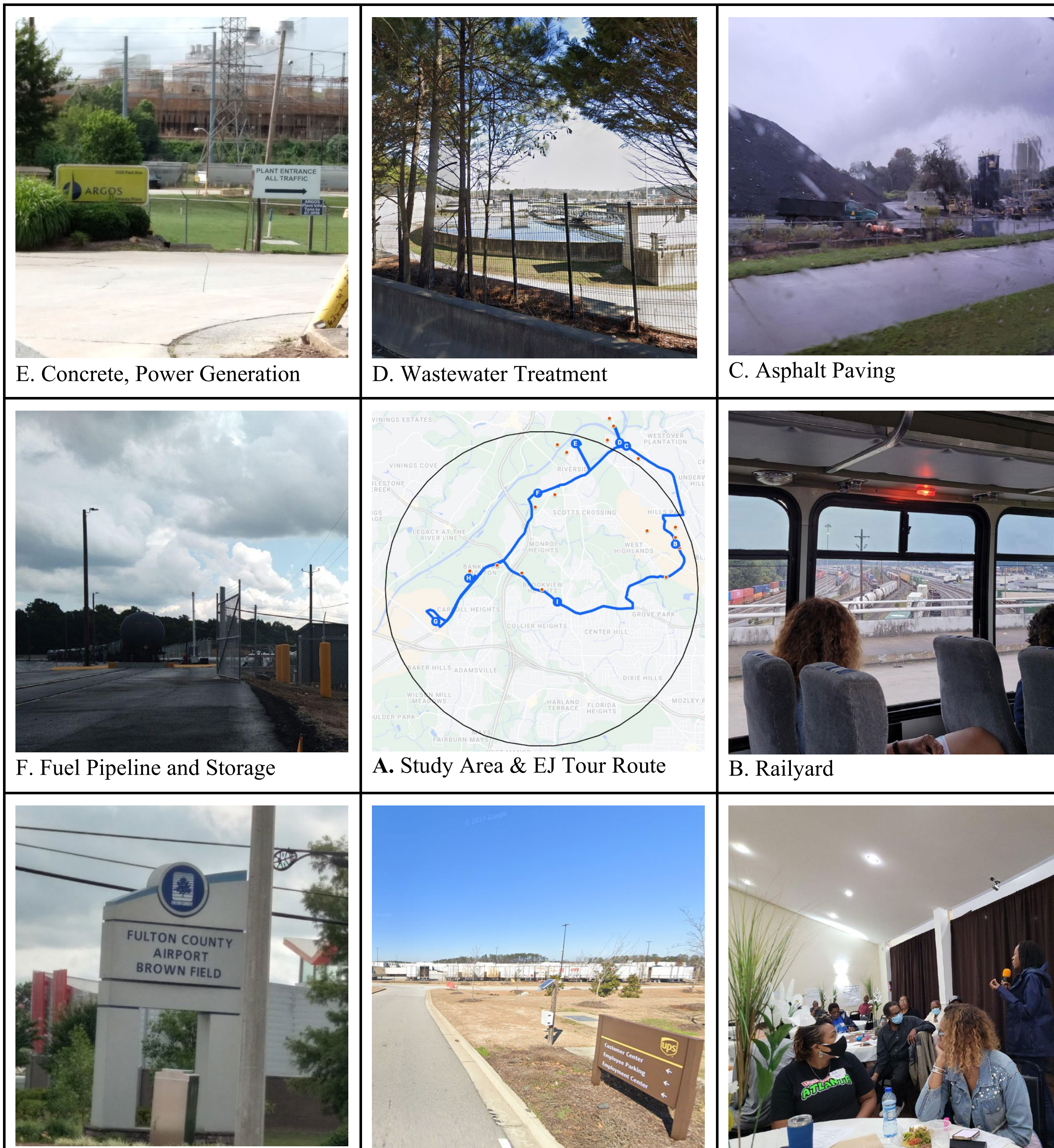
CHARRS personnel led the project team in developing and hosting community engagement events throughout the project period. One of these events was an environmental justice (EJ) driving tour of industrial sites and permitted facilities within the study area which took place in September 2023. The EJ Tour or "toxic tour" model has been used successfully in many communities oppressed by environmental hazards as a means for familiarizing community members and other stakeholders on local environmental hazards and the risks they present (Pulido, Barraclough, & Cheng, 2012; Razee, 2009; Baptista, 2023).

Tour participants were recruited from existing stakeholder networks associated with the community-based organization partners CHARRS and WAWA. These networks include Atlanta Public Schools organizations, residents who previously participated in community outreach programs, and academic partners from nearby Georgia colleges and universities. Representatives from Argos USA LLC, Norfolk Southern Corporation and other local industrial facilities were also invited to participate as City of Atlanta and Fulton County government representatives. Participants from Neighborhood Planning Units (NPU) within the study area were prioritized for recruitment (Table 3.1).

Table 3.1. Neighborhood Planning Units (NPU) and Communities Included in Study Recruitment.

NPU Code	Communities Included
NPU-D	Berkeley Park, Blandtown, Bolton, Hills Park, Riverside, Underwood Hills, Whittier Mill Village
NPU-G	Almond Park, Atlanta Industrial Park, Bolton Hills, Brookview Heights, Carey Park, Carver Hills, Chattahoochee, English Park, Lincoln Homes, Monroe Heights, Rockdale, Scotts Crossing, West Highlands
NPU-H	Adamsville, Baker Hills, Bakers Ferry, Bankhead Courts, Bankhead/Bolton, Boulder Park, Carroll Heights, Fairburn Heights, Fairburn Road/Wisteria Lane, Fairburn Mays, Mays, Oakcliff, Old Gordon, Ridgecrest Forest, Wildwood, Wilson Mill Meadows, Wisteria Gardens
NPU-I	Audobon Forest, Audobon Forest West, Beecher Hills, Cascade Heights, Chalet Woods, Collier Heights, East Ardley Road, Florida Heights, Green Acres Valley, Green Forest Acres, Harland Terrace, Horseshoe Community, Ivan Hill, Magnum Manor, Peyton Forest, Rosalie H. Wright Community Council, West Manor, Westhaven, Westwood Terrace
NPU-J	Center Hill, Dixie Hills, Grove Park, Harvel Homes, Penelope Neighbors, West Lake

The AQEarth: West Atlanta EJ bus tour traveled near key sites contributing to air pollution in West Atlanta (Figure 3.3). During the tour, passengers learned from CHARRS personnel and academic researcher partners on topics of air quality management, pollution dynamics, environmental justice, and more. Dialog and sharing of stories between passengers was encouraged. Discussions continued after the tour at a community listening session and workshop held at Greater New Life Ministry. Attendees (including those who did not participate in the EJ bus tour) described their experiences with air pollution and health. In addition to debriefing, this session also provided an opportunity for participants to sign-up for upcoming AQEarth: West Atlanta programming.



E. Concrete, Power Generation

D. Wastewater Treatment

C. Asphalt Paving

F. Fuel Pipeline and Storage

A. Study Area & EJ Tour Route

B. Railyard

G. County Airport

H. Shipping and Distribution

I. Community Listening Session

FIG 3.3. Route Map and Photographs from the AQEarth: West Atlanta Environmental Justice Bus Tour and Community Workshop. The tour began and ended at Greater New Life Ministry Church, a well-known community gathering space, moved counterclockwise through Collier Heights and its surrounding neighborhoods (A). CHARRS staff and academic partners highlighted permitted facilities that were both apparent and nondescript (B through H, sequentially), explaining the environmental health hazards and risks posed by these facilities. Afterward, participants joined a community listening session and workshop to debrief and discuss future opportunities to engage with the AQEarth: West Atlanta project (I).

Chapter 4: Study Design and Methodology

The objective of this study was to evaluate the relationship between cumulative air pollution exposure knowledge and self-efficacy in reducing air pollution exposure risk amongst community stakeholders in West Atlanta, Georgia. Using a cross-sectional population-based approach, West Atlanta residents and stakeholders who participated in a 2023 AQEarth: West Atlanta Environmental Justice Bus Tour & Workshop environmental health intervention program were asked to take an environmental health literacy survey. It was hypothesized that participants exhibiting more knowledge of air pollution exposure would also exhibit higher levels of self-efficacy in managing their exposure risk.

4.1 Study Setting

Collier Heights and its surrounding neighborhoods served as an ideal study area due to the demographic characteristics of its population (Table 4.1) and the numerous local air pollution risk factors facing this community. A preliminary assessment of local environmental hazards was conducted using the USEPA Environmental Justice Screening and Mapping Tool (EJSCREEN v2.3). A circular area of 28.27 square miles, drawn with a 3-mile radius from the geographic center of Collier Heights, was used to bound the study zone (Figure 4.1). Within this zone, US EPA EJSCREEN reported three hazardous waste, treatment, storage, and disposal facilities; 388 facilities with permits for water discharge; 37 facilities with permits to release air emissions; 12 brownfield sites, and 14 Toxic Release Inventory sites. Additionally, Collier Heights proper is bounded by two interstate highways (I-20 and

I-285) as well as two local highways (US Route 278 and Georgia State Route 280) and a truck stop, exposing this community to ample traffic-related air pollution. The occurrences of several environmental health hazard indicators were measured for the area of interest and compared to state and national percentile rankings (Figure 4.2).

Table 4.1. Demographic Profile of the AQEarth: West Atlanta Study Area (Excerpt from USEPA EJSCREEN analysis report. See APPENDIX A for a full report.)

SELECTED VARIABLES	VALUE	STATE AVERAGE	PERCENTILE IN STATE	USA AVERAGE	PERCENTILE IN USA
SOCIOECONOMIC INDICATORS					
Demographic Index USA	2.76	N/A	N/A	1.34	92
Supplemental Demographic Index USA	2.16	N/A	N/A	1.64	80
Demographic Index State	2.74	1.55	89	N/A	N/A
Supplemental Demographic Index State	1.93	1.46	77	N/A	N/A
People of Color	94%	49%	89	40%	91
Low Income	54%	33%	81	30%	85
Unemployment Rate	9%	6%	78	6%	79
Limited English Speaking Households	2%	3%	73	5%	63
Less Than High School Education	14%	12%	65	11%	70
Under Age 5	7%	6%	69	5%	72
Over Age 64	15%	16%	55	18%	47

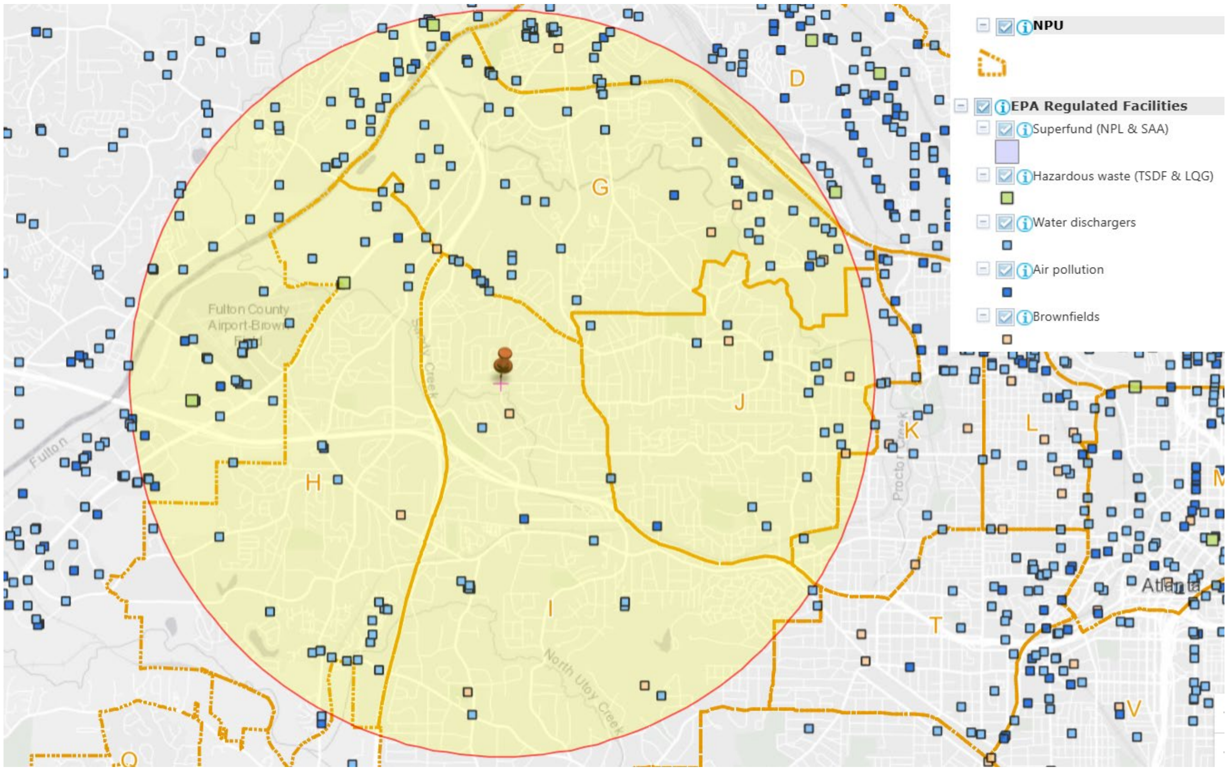


FIGURE 4.1. The AQEarth: West Atlanta study area. This included all land within a 3-mile radius of the geographic middle of the Collier Heights neighborhood. The area includes four neighborhood planning units (NPUs) including D, G, H, I, and J. Additionally, the area included more than 450 regulated sites, including 37 facilities permitted to emit air pollutants.

USEPA EJ SCREEN EJ INDICES FOR AQEarth: West Atlanta Study Area

(Collier Heights and Surrounding Neighborhoods)

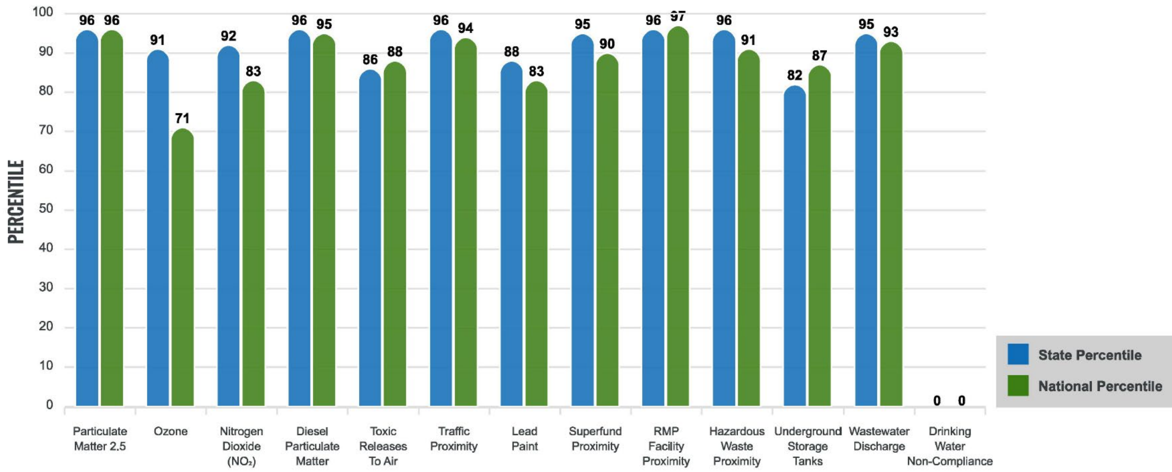


FIGURE 4.2. USEPA Environmental Justice Index (EJI) data for the study area. USEPA's EJI combine data on low income and people of color populations with a single environmental indicator and ranks the identified area against the state and national averages for that environmental indicator (excluding Drinking Water Non-Compliance, for which there was no available state or national percentile data). The chart shows that the AQEarth: West Atlanta study area ranks in the 90th percentile or above for 9 of the 12 indicators compared to the rest of the State of Georgia. Similarly, the study area ranked 90th or above for 7 of 12 indicators compared to the rest of the United States.

4.2 Survey Design

This study adopted a cross-sectional population-based approach to survey AQEarth: West Atlanta participants. The participant pool's proximity to environmental hazards and previous engagement with community-engaged environmental health programming provided rationale for their inclusion as a population of interest. Following community-based participatory research principles, survey design and item generation was conducted with direct input from community-based partner organizations CHARRS and WAWA to ensure that expected data outcomes were mutually desired and beneficial.

The survey pool drew from a subsection of community members already interested and engaged in conversations of air pollution exposure and risk. Participants of 2023 AQEarth: West Atlanta programming (including the EJ Bus Tour and community listening session and workshop) were invited to take the survey. The survey was administered in both paper and online forms. Survey respondents provided written consent to being involved in this study and were financially compensated for their participation. Approval for human participant research was provided from the University of Maryland-College Park Institutional Review Board (Project #: 2077589-1).

The survey's goal was to identify participants' environmental health literacy, with questionnaire items pertaining to (a) knowledge of air pollution and cumulative exposure sources and impacts; (b) satisfaction with local air quality; and (c) self-efficacy in mitigating exposure risks. These focus areas were derived directly from the aforementioned three dimensions of EHL described by Gray (2018): Awareness & Knowledge, Skills & Self-Efficacy, and Community Change. Additionally, specific item language was modeled from two existing validated measures: the Environmental Health Engagement Profile (EHEP) (See: Dixon et al., 2009) and the General Environmental Health and Environmental Media-Specific Knowledge, Attitudes, and Behaviors Scales (GEH-EM) (See: Lichtveld et al., 2019).

CHARRS and WAWA leaders' interest in self-efficacy reagrding emergency response was highlighted in the survey questionnaire. Demographic items pertaining to participants' neighborhood of residence, gender identity, racial and ethnic heritage, age, education level, and individual annual income were also included.

Table 4.2. Survey Questionnaire Outline

Item Category	**Item Number**	**Relevant EHL Dimension**
Consent	Q1	n/a
Knowledge	Q2-Q13	Awareness & Knowledge
Satisfaction	Q14	Skills & Self Efficacy
Self-efficacy	Q15-Q19	Skills & Self Efficacy, Community Change
Demographic	Q20-28	n/a

Table 4.2 provides an outline of the survey questionnaire categories and items. The first category (Consent) included a single item that provided conditions of research participation and ethical considerations, requiring respondents to provide informed consent before proceeding. The second category (Knowledge) included 12 assessment items—with an assortment of multiple choice, multiple selection ("choose all that apply"), and true/ false question types —pertaining to air pollution and cumulative exposure. The third section (Satisfaction) included a single Likert scale item that asked respondents to provide their level of agreement with the following statement: "I am satisfied with the air quality in West Atlanta." The fourth section (Self-efficacy) included five Likert scale items that asked respondents to provide their level of agreement with statements on how to respond to air pollution in their community (e.g., "I know how to…", "I feel capable of…"). Specifically, these items were framed in the context of responding to an accidental release related to a RMP

facility. The final section included demographic items pertaining to West Atlanta residency, race and ethnicity, gender identity, age, education level, and income. Note that a Screening item (Q22. In which of the following West Atlanta Neighborhood Planning Units (NPUs) do you live or most frequently visit?") was provided solely to characterize the program's outreach success and was omitted from survey analysis.

4.3. Construction of Environmental Health Literacy Scores

4.3.1 Air Pollution Knowledge Scores

All participants were assigned a knowledge score, with 1 point awarded for each correct answer on the knowledge questions (Q2-13). On questions with multiple possible correct answers, 1 point was awarded for each correct answer. No points were deducted for incorrect answers, leaving the question unanswered, or selecting "I don't know." The range of possible scores was 0 to 25.

4.3.2 Air Quality Satisfaction Scores

Question 14 asked survey participants about their satisfaction with the air quality in West Atlanta on a Likert Scale. Participants were assigned a score of 2 for selecting "strongly agree," 1 for "somewhat agree," 0 for "neither agree nor disagree," -1 for "somewhat disagree," and -2 for "strongly disagree."

4.3.3 Self-Efficacy in Mitigating Exposure and Risk Scores

Questions 15-19 asked survey participants about their self-efficacy to take protective health behaviors and community action against air pollution risk and exposure on a Likert Scale. Scores for each question were assigned in the same manner as for the satisfaction score described above, and with four questions the possible scores ranged from -8 to 8. Blank responses were assigned 0 points.

4.4 Statistical Analysis Methodology

Both paper and online responses were entered into a single consolidated dataset using QualtricsXM software (Version 2024; Provo, UT, USA; https://www.qualtrics.com) which was then exported for analysis. Tables and charts were generated for each survey item in Microsoft Excel 365 (Version 2407) (Microsoft Corporation, 2018). Descriptive statistics and relevant plots were calculated and generated using STATA 18 software (StataCorp, 2023).

Chapter 5: Results

5.1 Descriptive Statistics Air Pollution Knowledge

Table 5.1 below shows the demographics of the survey participants and the average knowledge score of each category of participants. (See Section 5.2.1 below for knowledge score calculations.) There were 33 survey respondents, the vast majority of whom (91%) were residents of West Atlanta and most of whom (63%) having lived in the area for 10 years or longer. A majority of respondents (63%) also owned residential property in West Atlanta. Individuals who identified as "Woman" comprised 70% of the sample. The largest racial demographic, "Black or African American", represented 90% of the sample. Those aged 18-30 accounted for 6%, those aged 31 - 40 years old accounted for 12%, those aged 41 - 50 years old accounted for 12%, those aged 51 - 60 years old accounted for 15%, and those older than 60 years old accounted for 39% of the sample. Those with at least a high school degree, some college completed, a two-year college degree, a four-year college degree, and an advanced or professional degree represented 3%, 15%, 15%, 24%, and 30% of the sample, respectively.

Table 5.1 Sample Characteristics and level of environmental health literacy in participants (n=33)

		n	*μ*
Entire sample		33	14.1
West Atlanta resident	Yes	30	13.8
	No	3	17.7
Time living in West Atlanta	1+ year	4	18.3
	5+ years	4	11.3
	10+ years	19	14.7

Connection to West Atlanta	Resident	28	13.9
	School	3	13.0
	Work	6	13.3
	Own residential property	19	14.8
	Own commercial property	1	20.0
	Visit multiple times a week	5	15.2
	Visit multiple times a month	3	13.0
Gender	woman	23	13.7
	man	3	15.7
Race/Ethnicity	Black or African American	30	13.8
	Hispanic or Latino	1	23.0
	Native American or Alaskan Native	2	14.5
	White or Caucasian	4	16.3
	Some other race	1	9.0
Age	18 - 30 years old	2	16.5
	31 - 40 years old	4	13.3
	41 - 50 years old	4	15.3
	51 - 60 years old	5	18.4
	Older than 60 years old	13	13.2
Education	High School	1	8.0
	Some College	5	12.0
	Two-year College Degree	5	11.4
	Four-year College Degree	8	17.5
	Advanced College Degree	10	16.5
Income	Less than $20,000/year	4	12.3
	$20,000 - 34,999/year	6	12.5
	$35,000 - $49,999/year	7	13.4
	$50,000 - $74,999/year	8	16.1
	$75,000 - $99,999/year	3	17.3
	More than $100,000/year	1	10.0

5.2 Distribution of EHL Scores

5.2.1 Air Pollution and Knowledge Scores

Participant scores for air pollution knowledge (n=33 responses) ranged between the minimum of 8 and maximum of 23 points (Table 5.1). This distribution was nearly symmetrical with the mean score of 14.1 points approximating the median score of 13, however this was slight skewness toward the lower end of the range (Figure 5.1).

Table 5.2. Summary Statistics for air pollution knowledge scores.

Knowledge Score

	Percentiles	Smallest		
1%	8	8		
5%	8	8		
10%	8	8	Obs	33
25%	10	8	Sum of wgt.	33
50%	13		Mean	14.12121
		Largest	Std. dev.	4.628428
75%	19	20		
90%	20	21	Variance	21.42235
95%	21	21	Skewness	.2940273
99%	23	23	Kurtosis	1.782272

Figure 5.1. Boxplot distribution of participants' air pollution knowledge scores (mean shown as "+" symbol).

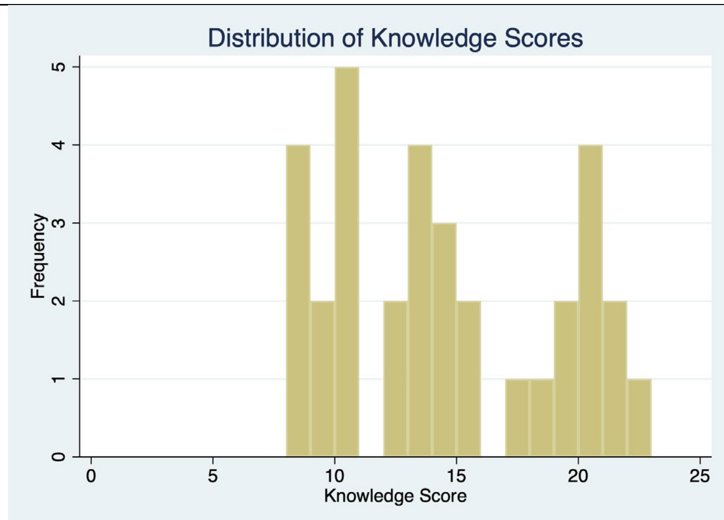


Figure 5.2. Frequency distribution of participants' air pollution knowledge scores.

The air pollution score data, converted to a continuous integer with possible range from 0 to 25, had a non-normal trimodal distribution. The true mode was 10 points with as many as five respondents receiving this score (Figure 5.2).

5.2.2 Air Quality Satisfaction Scores

Participant scores for air pollution satisfaction (n=33 responses) ranged between -2 and 1 (Table 5.2). This distribution was not symmetrical about 0, with the strong skewness toward the negative end of the scoring range, as shown by the median being equal to the minimum value (Figure 5.3). There was one outlier with one respondent selecting "Somewhat Agree" in response to the statement "I am satisfied with air quality in West Atlanta" (Figure 5.4).

Table 5.3. Summary statistics for air pollution satisfaction.

Satisfaction Score

	Percentiles	Smallest		
1%	-2	-2		
5%	-2	-2		
10%	-2	-2	Obs	33
25%	-2	-2	Sum of wgt.	33
50%	-2		Mean	-1.30303
		Largest	Std. dev.	.8833476
75%	-1	0		
90%	0	0	Variance	.780303
95%	0	0	Skewness	.9032163
99%	1	1	Kurtosis	2.632847

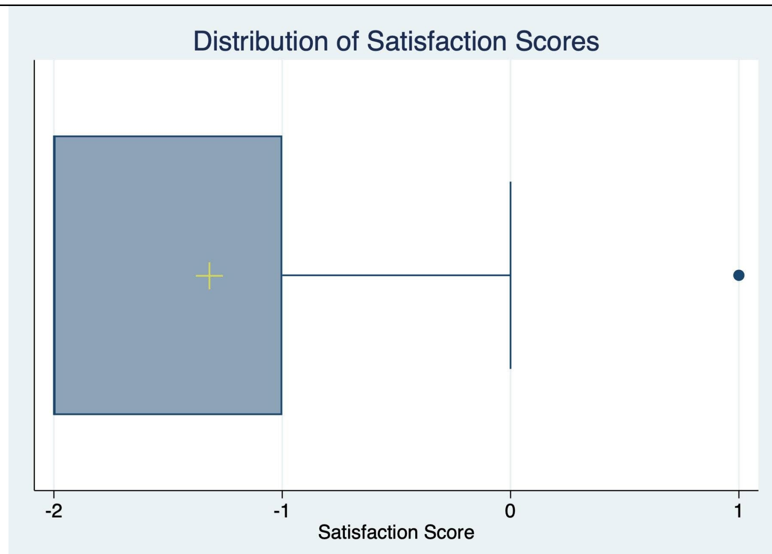


Figure 5.3. Boxplot distribution of participants' air pollution satisfaction scores (mean shown as "+" symbol).

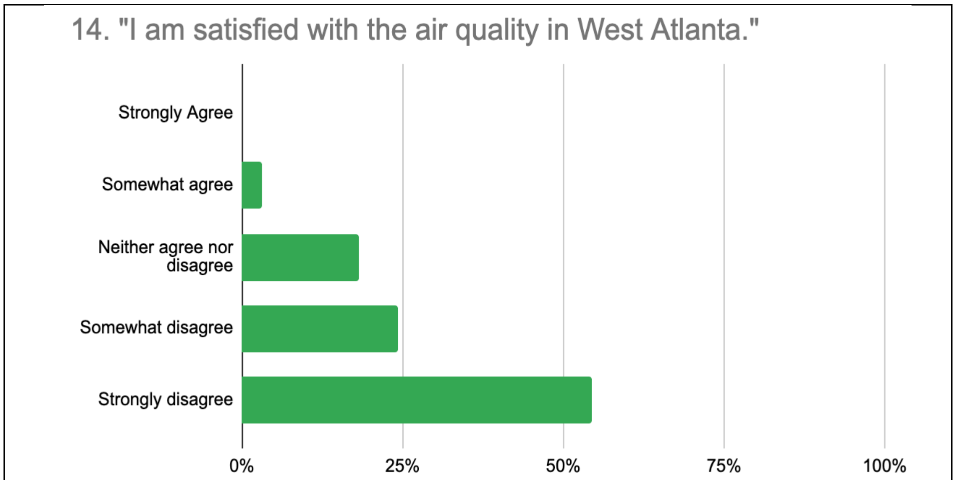


Figure 5.4. Bar chart distribution of participant's responses to the item "I am satisfied with the air quality in West Atlanta."

None of the participants selected "Strongly Agree" in response to the statement "I am satisfied with the air quality in West Atlanta." Additionally, only one respondent selected "Somewhat Agree", meaning 97% of respondents did not agree with the statement.

5.2.3 Self-Efficacy in Mitigating Exposure and Risk Scores

Participant scores (n=29 responses) ranged between -8 and 7, with a mean score of -2.3 and a median score of -4 (Table 5.3). For each of the five statements in this section of the questionnaire, the distribution of these scores was heavily skewed toward disagreement. This distribution was not symmetrical about 0, with the strong skewness toward the negative end of the scoring range, as shown by the median being one value from the 25th quartile (Figure 5.3). There was one outlier with one respondent selecting "Somewhat Agree" in response to the statement "I am satisfied with air quality in West Atlanta" (Figure 5.4).

Table 5.4. Summary statistics for air pollution and risk management self-efficacy.

Self-Efficacy Score

	Percentiles	Smallest		
1%	-8	-8		
5%	-8	-8		
10%	-8	-8	Obs	29
25%	-5	-8	Sum of wgt.	29
50%	-4		Mean	-2.344828
		Largest	Std. dev.	4.219647
75%	2	3		
90%	3	3	Variance	17.80542
95%	5	5	Skewness	.4919553
99%	7	7	Kurtosis	2.212223

Figure 5.5. Boxplot distribution of participants' air pollution and risk management self-efficacy scores (mean shown as "+" symbol).

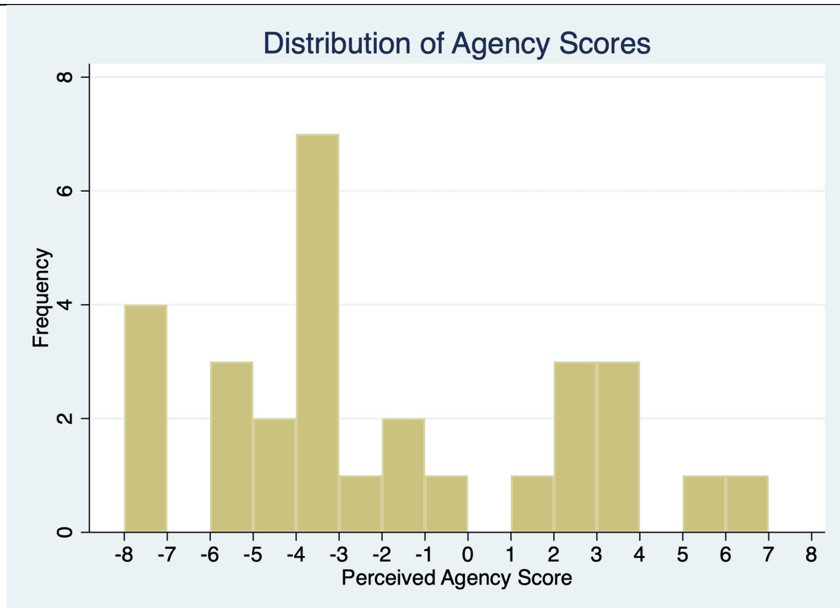


Figure 5.6. Frequency distribution of participants' air pollution and risk management self-efficacy scores.

Chapter 6: Discussion

This cross-sectional case study characterizes the environmental health literacy of community stakeholders who participated in a community-based air quality monitoring program, AQEarth: West Atlanta. Survey respondents (n=33) answered questions pertaining to their (a) knowledge of air pollution sources and impacts, (b) satisfaction with local air quality, (c) self-efficacy in reducing risk and harm related to air pollution exposure, as well as (d) demographic information.

The results of the knowledge scores of the survey (mean score=14 out of 25 points possible or 56%) indicate a low level of awareness regarding factors contributing to, and impacts resulting from, air pollution exposure. There are several potential reasons for this. For one, air pollution is practically invisible, and the permitted facility emission sources are often hidden out of sight in industrial warehouse districts or behind tree-lined setback areas. A case study on the relationship between public communication and public awareness of air pollution conducted by Ramírez et al. (2019) attributed low environmental health literacy in California's San Joaquin Valley to deficiencies in information sources (i.e., lack of clarity on whose responsibility it was to communicate air quality information), information quality (i.e., lack of critical information including risk mitigation behaviors and long-term health impacts), and information reach (i.e., air quality communications failed to reach vulnerable populations). The last point is of critical importance to the present study because, as shown in Table 4.1, the AQEarth: West Atlanta study area (including Collier Heights and surrounding neighborhoods) hosts several communities with intersecting vulnerabilities. Nevertheless, our findings indicate great opportunity and rationale for further developing education-based environmental health programming in the communities studied.

The results of the air quality satisfaction portion of the survey—with only 3% of the sample agreeing to the statement “I am satisfied with the air quality in West Atlanta”—indicate a high level of dissatisfaction with air quality in West Atlanta. This, in conjunction with the low level of air pollution knowledge found by this study, shows that residents do not need to be technically educated on environmental health hazards to feel their adverse impacts. While our investigation did not include measures for quality of life, several publications have shown air pollution exposure’s negative impact on self-reported life satisfaction. Measuring health related quality of life (HRQOL) may be critical to health literacy assessments (and interventions) in cumulative exposure contexts because this framing captures both physical and non-physical impacts of air pollution (Yamazaki, Nitta, Murakami, & Fukuhara, 2005; Shepherd, 2015). For example, Orru et al. (2016) infer from their regression of PM_{10} levels on life satisfaction that even relatively low levels of air pollution may lower subjective well-being assessments due to the possible effects of elevated physical stress, irritation and annoyance.

Self-efficacy, defined as an individual’s belief in their ability to accomplish tasks and achieve goals, is critical for effectively engaging in protective behaviors against air pollution (Araban et al., 2013; Bandura, 1982). EJ advocates highlight that people who are environmentally oppressed often lack the resources or political power to address environmental harms. In this context, it is not surprising that, across all five self-efficacy items, respondents reported very low self-efficacy regarding responding to air pollution exposures. Surprising or not, empirically characterizing this finding adds important context. Recalling Gelobter's explanation that there is a "three-dimensional nexus of economic injustice, social injustice and an unjust incidence of environmental quality…which overwhelmingly assures the continued oppression of communities of color and low-income communities on environmental matters," the low level of self-efficacy seen across this study's population rings an alarm and call to action for more EHL intervention and capacity building in Collier Heights and its surrounding neighborhoods.

While statistical analyses to identify the influence of knowledge of air pollution on feelings of satisfaction with air quality or self-efficacy in addressing exposure risk were not performed, previous studies have shown a connection between the two. Research conducted regarding youth satisfaction and self-efficacy in the face of the ongoing climate crisis (Stevenson & Petersen, 2015; Pfautsch & Gray 2017) as well as disempowerment of communities suffering in the wake of natural disasters (Benight, 2004) has shown that increasing knowledge and awareness do not necessarily increase self-efficacy. And indeed, movements for environmental justice and climate justice are interwoven and reinforcing of each other. This critically indicates that increasing knowledge of exposure risk and harm alone may not positively impact self-efficacy or even collective efficacy in the context of environmental justice. Environmental health programming must provide a pathway from knowledge gain to civic engagement in order for EHL to truly be a vehicle for empowerment and liberation.

6.1 Strengths

An unexpected benefit of our sampling approach was our survey respondent pool was skewed heavily toward persons identifying as women and persons identifying as Black or African American. In fact, there were no self-reported Black or African American respondents who did not also report identifying as a woman. As such, while not representative of the demographics of the general population of West Atlanta, our pool represents a key segment of the population, and indeed, one that our community organizer partners in CHARRS and WAWA are excited to continue working with. As our screening and survey processes did not intentionally interrogate the overrepresentation of Black women in our sample, more research is needed to identify if this participation aspect is a reliable trend.

Another strength of our methodology was the opportunity to collaborate with the AQEarth: West Atlanta program. This provided access to a population of nominally engaged community stakeholders with interest in air pollution monitoring who can be followed up with at future timepoints to further evaluate environmental health literacy of residents.

6.2 Limitations

This case study adopted a purposive sampling method, wherein survey respondents were recruited from the larger AQEarth: West Atlanta community-based air quality monitoring program's participant pool. This limited the study's sample size, and subsequently its statistical power and generalizability. Other factors limiting recruitment included project team availability, inclement weather on the day of the EJ bus tour and community workshop, and available project funding to provide compensation, childcare, and food for the participant pool.

Finally, a common limitation of utilizing survey questionnaires for data collection is the respondents' susceptibility to recall bias (where respondents do not remember the correct answer) as well as participant fatigue. These may manifest as respondents not completing the entire questionnaire or marking answers that do not necessarily represent their knowledge of the subject, but rather their memory at that point in time. Additionally, Likert scale items have their own biases including central tendency bias (where respondents avoid answer choices at the extremes), acquiescence bias (where respondent agree with statements presented), and social desirability bias (where respondents attempt to portray themselves more favorably than not).

We were able to mitigate some but not all of these influences. To avoid recall bias and participant fatigue, we kept our main survey content to fewer than 20 questions (approximately 20 minutes to complete) and only used close-ended items on our questionnaire. However, this, in turn, removes rich detail and context from the responses.

6.3 Lessons Learned

Coordinating and carrying out this survey research alongside the nascent AQEarth: West Atlanta CBAQM program was challenging but critically important to the development of this research. Scoping and subsequently executing the environmental justice bus tour created the necessary context and space for engaging the community—both on the part of the project team as well as for peer interactions amongst residents. In the initial phases, organizing outreach and recruitment was particularly difficult as all community engagement personnel were otherwise occupied in administrating the project's grant ramp-up. Additionally, with partners based across the United States, managing research operations remotely and across state lines could have hindered quality assurance and quality control in data collection. However, the EJ bus tour became the foundational ground upon which all partners could work together, in-person.

Chapter 7: Conclusion

This study assessed environmental health literacy amongst a small population of stakeholders (n=33) in West Atlanta who were engaged in a community-based air quality monitoring program. Our findings indicate low levels of (a) knowledge regarding environmental sources and health impacts of air pollution, (b) satisfaction with local air quality, and (c) feelings of self-efficacy toward addressing toxic exposures to air pollutants.

This baseline assessment can help provide public health practitioners, advocates, and community organizers with a starting point from which to develop specific programming to increase air pollution exposure knowledge and self-efficacy in reducing exposure risk and harm. Future research should include open-ended items and measures for health-related quality of life to better characterize the non-physical stressor context that is critical to both environmental health literacy and cumulative risk assessment. Additionally, if future EJ bus tours are conducted, researchers should administer surveys both before and after (a pre-/post-test approach) these events in order to evaluate the specific impact that the tours have on environmental health literacy.

Appendices

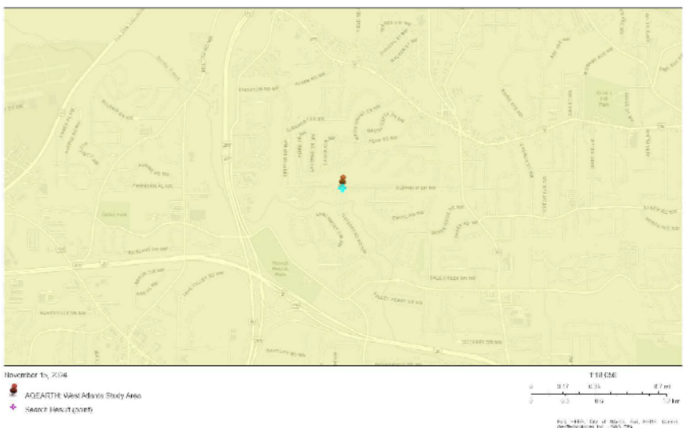
Appendix A. USEPA Environmental Justice Screening Tool Report for AQEarth: West Atlanta Study Area

EJScreen Community Report

This report provides environmental and socioeconomic information for user-defined areas, and combines that data into environmental justice and supplemental indexes.

AQEARTH: West Atlanta Study Area

3 miles Ring Centered at 33.771779,-84.484977
Population: 60,019
Area in square miles: 28.27



COMMUNITY INFORMATION

- Low income: 54 percent
- People of color: 94 percent
- Less than high school education: 14 percent
- Limited English households: 2 percent
- Unemployment: 8 percent
- Persons with disabilities: 16 percent
- Male: 44 percent
- Female: 56 percent
- 73 years — Average life expectancy
- N/A — Per capita income
- Number of households: 24,387
- Owner occupied: 47 percent

LANGUAGES SPOKEN AT HOME

LANGUAGE	PERCENT
English	93%
Spanish	5%
Other Indo-European	1%
Other and Unspecified	1%
Total Non-English	7%

BREAKDOWN BY RACE

- White: 6%
- Black: 82%
- American Indian: 0%
- Asian: 2%
- Hawaiian/Pacific Islander: 0%
- Other race: 1%
- Two or more races: 2%
- Hispanic: 7%

BREAKDOWN BY AGE

From Ages 1 to 4	7%
From Ages 1 to 18	24%
From Ages 18 and up	76%
From Ages 65 and up	15%

LIMITED ENGLISH SPEAKING BREAKDOWN

Speak Spanish	88%
Speak Other Indo-European Languages	0%
Speak Asian-Pacific Island Languages	12%
Speak Other Languages	0%

Notes: Numbers may not sum to totals due to rounding. Hispanic population can be of any race. Source: U.S. Census Bureau, American Community Survey (ACS) 2018-2022. Life expectancy data comes from the Centers for Disease Control.

Report for 3 miles Ring Centered at 33.771779,-84.484977
Report produced November 15, 2024 using EJScreen Version 2.3

EJScreen Environmental and Socioeconomic Indicators Data

HEALTH INDICATORS					
INDICATOR	VALUE	STATE AVERAGE	STATE PERCENTILE	US AVERAGE	US PERCENTILE
Low Life Expectancy	21%	21%	52	20%	68
Heart Disease	6.8	5.4	75	5.8	73
Asthma	12.2	10.4	91	10.3	90
Cancer	5.5	5.7	41	6.4	29
Persons with Disabilities	15.5%	13.4%	67	13.7%	67

CLIMATE INDICATORS					
INDICATOR	VALUE	STATE AVERAGE	STATE PERCENTILE	US AVERAGE	US PERCENTILE
Flood Risk	10%	9%	77	12%	67
Wildfire Risk	0%	4%	0	14%	0

CRITICAL SERVICE GAPS					
INDICATOR	VALUE	STATE AVERAGE	STATE PERCENTILE	US AVERAGE	US PERCENTILE
Broadband Internet	20%	14%	73	13%	78
Lack of Health Insurance	17%	13%	74	9%	88
Housing Burden	Yes	N/A	N/A	N/A	N/A
Transportation Access Burden	Yes	N/A	N/A	N/A	N/A
Food Desert	Yes	N/A	N/A	N/A	N/A

Report for 3 miles Ring Centered at 33.771779,-84.484977

Report produced November 15, 2024 using EJScreen Version 2.3

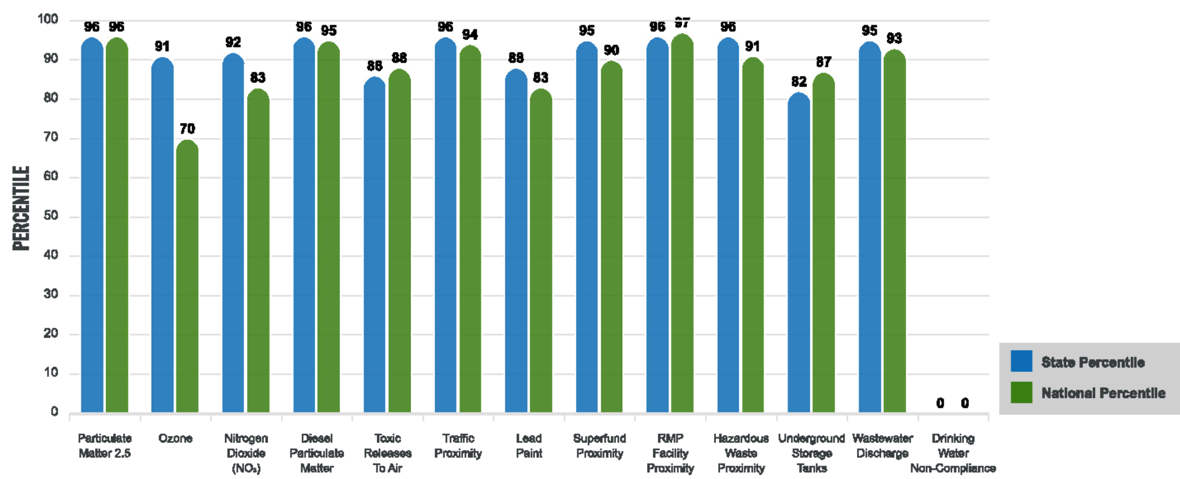
Environmental Justice & Supplemental Indexes

The environmental justice and supplemental indexes are a combination of environmental and socioeconomic information. There are thirteen EJ indexes and supplemental indexes in EJScreen reflecting the 13 environmental indicators. The indexes for a selected area are compared to those for all other locations in the state or nation. For more information and calculation details on the EJ and supplemental indexes, please visit the EJScreen website.

EJ INDEXES

The EJ indexes help users screen for potential EJ concerns. To do this, the EJ index combines data on low income and people of color populations with a single environmental indicator.

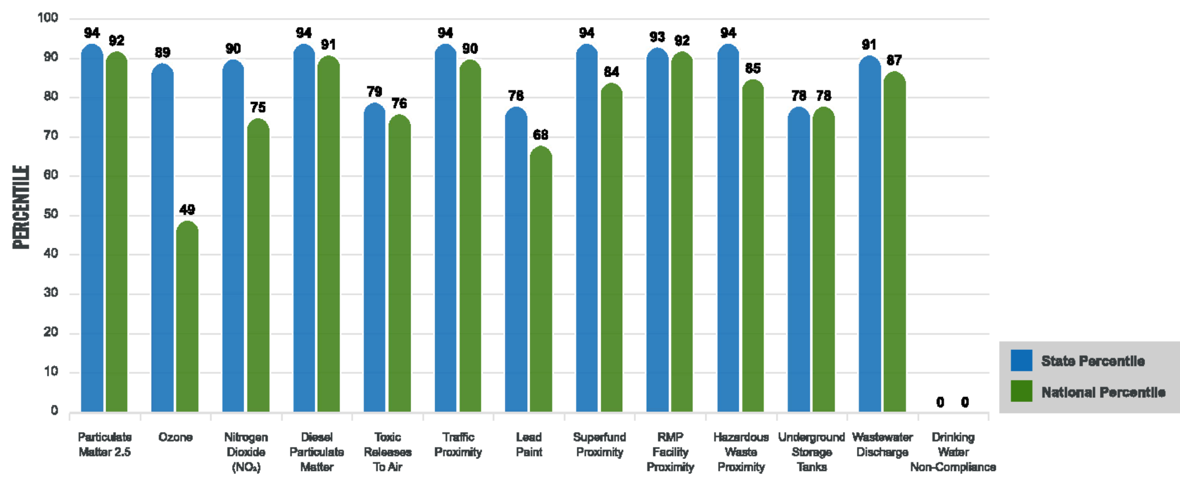
EJ INDEXES FOR THE SELECTED LOCATION



SUPPLEMENTAL INDEXES

The supplemental indexes offer a different perspective on community-level vulnerability. They combine data on percent low income, percent persons with disabilities, percent less than high school education, percent limited English speaking, and percent low life expectancy with a single environmental indicator.

SUPPLEMENTAL INDEXES FOR THE SELECTED LOCATION



Report for 3 miles Ring Centered at 33.771779,-84.484977

Report produced November 15, 2024 using EJScreen Version 2.3

EJScreen Environmental and Socioeconomic Indicators Data

SELECTED VARIABLES	VALUE	STATE AVERAGE	PERCENTILE IN STATE	USA AVERAGE	PERCENTILE IN USA
ENVIRONMENTAL BURDEN INDICATORS					
Particulate Matter 2.5 ($\mu g/m^3$)	9.55	8.91	88	8.45	83
Ozone (ppb)	56.8	55.3	69	61.8	31
Nitrogen Dioxide (NO_2) (ppbv)	8	5.7	84	7.8	55
Diesel Particulate Matter ($\mu g/m^3$)	0.325	0.166	95	0.191	86
Toxic Releases to Air (toxicity-weighted concentration)	1,400	1,600	74	4,600	65
Traffic Proximity (daily traffic count/distance to road)	2,800,000	880,000	91	1,700,000	80
Lead Paint (% Pre-1960 Housing)	0.26	0.14	81	0.3	55
Superfund Proximity (site count/km distance)	0.15	0.068	89	0.39	66
RMP Facility Proximity (facility count/km distance)	2.1	0.52	97	0.57	95
Hazardous Waste Proximity (facility count/km distance)	3.2	0.84	95	3.5	69
Underground Storage Tanks (count/km^2)	3.2	2.3	74	3.6	71
Wastewater Discharge (toxicity-weighted concentration/m distance)	1200	1300	88	700000	74
Drinking Water Non-Compliance (points)	0	0.6	0	2.2	0
SOCIOECONOMIC INDICATORS					
Demographic Index USA	2.75	N/A	N/A	1.34	92
Supplemental Demographic Index USA	2.15	N/A	N/A	1.64	79
Demographic Index State	2.74	1.55	89	N/A	N/A
Supplemental Demographic Index State	1.92	1.46	77	N/A	N/A
People of Color	94%	49%	89	40%	91
Low Income	54%	33%	80	30%	84
Unemployment Rate	9%	6%	78	6%	79
Limited English Speaking Households	2%	3%	73	5%	63
Less Than High School Education	14%	12%	64	11%	69
Under Age 5	7%	6%	69	5%	72
Over Age 64	15%	16%	55	18%	47

*Diesel particulate matter index is from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update.

Sites reporting to EPA within defined area:

Superfund 0
Hazardous Waste, Treatment, Storage, and Disposal Facilities 3
Water Dischargers ....
. 389
Air Pollution 38
Brownfields 12
Toxic Release Inventory 14

Other community features within defined area:

Schools 24
Hospitals 3
Places of Worship 40

Other environmental data:

Air Non-attainment .... Yes
Impaired Waters .... Yes

Selected location contains American Indian Reservation Lands* .... No
Selected location contains a "Justice40 (CEJST)" disadvantaged community .... Yes
Selected location contains an EPA IRA disadvantaged community .... Yes

Report for 3 miles Ring Centered at 33.771779,-84.484977
Report produced November 15, 2024 using EJScreen Version 2.3

Appendix B. EJ Tour/Workshop Flyer

Appendix C. IRB Waiver Letter

UNIVERSITY OF MARYLAND

INSTITUTIONAL REVIEW BOARD

1204 Marie Mount Hall
College Park, MD 20742-5125
TEL 301.405.4212
FAX 301.314.1475
irb@umd.edu
www.umresearch.umd.edu/IRB

DATE:	October 9, 2023
TO:	Jan Michael Archer, MS
FROM:	University of Maryland College Park (UMCP) IRB
PROJECT TITLE:	[2077589-1] Identifying Stakeholder Perceptions of Cumulative Air Pollution Exposure and Risk in West Atlanta Environmental Justice Communities
SUBMISSION TYPE:	New Project
ACTION:	DETERMINATION OF EXEMPT STATUS
DECISION DATE:	October 9, 2023
REVIEW CATEGORY:	Exemption category # 45CFR46.104(d)(2)(i-ii)

Thank you for your submission of New Project materials for this project. The University of Maryland College Park (UMCP) IRB has determined this project is EXEMPT FROM IRB REVIEW according to federal regulations.

We will retain a copy of this correspondence within our records.

If you have any questions, please contact the IRB Office at 301-405-4212 or irb@umd.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within University of Maryland College Park (UMCP) IRB's records.

- 1 -

Generated on IRBNet

Appendix D. Survey Questionnaire

AQEarth West Atlanta - Pre-Tour Participant Survey

Study Purpose

Community Health Aligning Revitalization Resilience and Sustainability (CHARRS) is interested in better understanding how West Atlanta stakeholders experience air pollution. This survey will ask questions about:

1. your knowledge of air pollution exposure and its effects on your health,
2. your perceptions of risks posed by exposure to air pollution West Atlanta, and
3. your attitudes toward maintaining a safe and healthy outdoor environment in West Atlanta.

Important details:

- Your responses will be kept completely confidential.
- This survey should take you around **15 minutes** to complete.
- You will receive **$20** for participating.
- Your participation in this research is voluntary.
- You have the right to withdraw at any point during the study.

By clicking the button below, you acknowledge the following:

1. You are registered for the AQEarth West Atlanta Bus Tour
2. Your participation in the study is voluntary.
3. You are at least eighteen (18) years of age.
4. You are a resident or frequent visitor of neighborhood planning units (NPUs) D, G, H, I, or J.
5. You are aware that you may choose to terminate your participation at any time for any reason.

* Indicates required question

1. Will you participate in this study? *

Mark only one oval.

- Yes, I have read and fully understood the above information and I consent to participate in this study.
- No, I do not consent and I do not wish to participate

Pre-Tour Survey Questions

2. Which of the following health impacts are associated with air pollution exposure? (Check all that apply.)

   Check all that apply.

   - [ ] High blood pressure
   - [ ] Fatty liver disease
   - [ ] Hazy weather conditions
   - [ ] Cardiovascular disease
   - [ ] Acid rain
   - [ ] None of the above
   - [ ] I don't know

3. Which of the following are effective methods for personally addressing personal air pollution exposure (Check all that apply.)

   Check all that apply.

   - [ ] Wearing a cloth mask
   - [ ] Wearing an N95 mask
   - [ ] Wearing a respirator
   - [ ] Limiting time outdoors
   - [ ] Using an air purifier indoors
   - [ ] I don't know

4. Which of the following are potential components of air pollution? (Check all that apply.)

   Check all that apply.

   - [ ] Gases
   - [ ] Solids
   - [ ] Liquids
   - [ ] Particles
   - [ ] I don't know

5. Which of the following stationary air pollution sources currently exist in West Atlanta? (Check all that apply.)

Check all that apply.

- [ ] Concrete manufacturing facilities
- [ ] Water treatment facilities
- [ ] Power plants
- [ ] Restaurants
- [ ] Parks
- [ ] I don't know

6. **True or False:** Airplanes, cars, trucks, trains, and other vehicles are examples of mobile sources of air pollution in West Atlanta.

Mark only one oval.

- True
- False
- I don't know

7. **True or False:** The term "cumulative exposure" refers to the total exposures faced from various sources of pollution at any given time.

Mark only one oval.

- True
- False
- I don't know

8. **True or False:** Particulate matter (PM) size is important because exposure to different particle sizes can result in different health impacts.

Mark only one oval.

- True
- False
- I don't know

9. **True or False:** Both short-term and long-term air pollution exposure can negatively impact your health, depending on the color of the pollutant.

Mark only one oval.

- True
- False
- I don't know

10. **True or False:** A "permitted facility" is typically an industrial location that has been given permission to release a certain quantity of certain chemicals into the environment as part of their regular business operations.

Mark only one oval.

- True
- False
- I don't know

11. **True or False:** If I believe a facility is operating beyond its permitted activities, I should always call 911 first.

Mark only one oval.

- True
- False
- I don't know

12. **True or False:** Permitted facilities are required to develop and make public a Risk Management Plan that outlines procedures for dealing with on-site emergencies (example: an unintentional spill releasing hazardous levels of chemicals).

Mark only one oval.

- True
- False
- I don't know

13. **True or False:** Up-to-date risk management plans can be viewed and acquired via a simple keyword search using an internet search engine (e.g., Google, Bing, DuckDuckGo)

Mark only one oval.

- True
- False
- I don't know

14. **<u>Rate your agreement with the following statement:</u>** "I know how to find detailed information about where permitted facilities exist in West Atlanta and what they are permitted to do."

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly Agree

15. **<u>Rate your agreement with the following statement:</u>** "I know ***what I should do*** to protect my health, the health of my loved ones, and/or the health of my community in the event of an emergency (e.g., an unintentional spill releasing hazardous levels of chemicals) at a West Atlanta facility."

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly Agree

16. **<u>Rate your agreement with the following statement:</u>** "I know ***where I should go*** to find shelter to protect my health, the health of my loved ones, and/or the health of my community in the event of an emergency (e.g., an unintentional spill releasing hazardous levels of chemicals) at a West Atlanta facility."

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly Agree

Demographic Questions

17. Are you a West Atlanta resident?

Mark only one oval.

- Yes
- No
- Prefer not to answer

18. If you live in West Atlanta, how long have you lived in West Atlanta?

Mark only one oval.

- Less than a year
- More than a year
- More than 5 years
- More than 10 years
- I do not live in West Atlanta
- Prefer not to answer

19. In which of the following West Atlanta Neighborhood Planning Units (NPUs) do you live or most frequently visit?

Mark only one oval.

- D - Berkeley Park, Blandtown, Bolton, Hills Park, Riverside, Underwood Hills, Whittier Mill Village
- G - Almond Park, Atlanta Industrial Park, Bolton Hills, Brookview Heights, Carey Park, Carver Hills, Chattahoochee, English Park, Lincoln Homes, Monroe Heights, Rockdale, Scotts Crossing, West Highlands
- H - Adamsville, Baker Hills, Bakers Ferry, Bankhead Courts, Bankhead/Bolton, Boulder Park, Carroll Heights, Fairburn Heights, Fairburn Road/Wisteria Lane, Fairburn Mays, Mays, Oakcliff, Old Gordon, Ridgecrest Forest, Wildwood, Wilson Mill Meadows, Wisteria Gardens
- I - Audobon Forest, Audobon Forest West, Beecher Hills, Cascade Heights, Chalet Woods, Collier Heights, East Ardley Road, Florida Heights, Green Acres Valley, Green Forest Acres, Harland Terrace, Horseshoe Community, Ivan Hill, Magnum Manor, Peyton Forest, Rosalie H. Wright Community Council, West Manor, Westhaven, Westwood Terrace
- J - Center Hill, Dixie Hills, Grove Park, Harvel Homes, Penelope Neighbors, West Lake
- I don't know
- Prefer not to answer

20. Which of the following are true for you? (Check all that apply.)

Check all that apply.

- [ ] I reside in West Atlanta
- [ ] I attend school in West Atlanta
- [ ] I go to work in West Atlanta
- [ ] I own residential property in West Atlanta
- [ ] I own commercial or business property in West Atlanta
- [ ] I visit West Atlanta multiple times per week
- [ ] I visit West Atlanta multiple times per month
- [ ] Prefer not to answer
- [ ] Other: ____________________

21. What is your gender identity? (ex: Man, Woman, Non-Binary, Trans Woman,...)

Even though there is not a "Prefer not to answer" option, you can still skip this question if you like.

____

22. Which of the following options represent your racial or ethnic heritage? (Check all that apply.)

Check all that apply.

- [ ] Asian or Pacific Islander
- [ ] Black of African American
- [ ] Hispanic or Latino
- [ ] Native American or Alaskan Native
- [ ] White or Caucasian
- [ ] Prefer not to answer
- [ ] Other: ____________________

23. What is your age group?

Mark only one oval.

- 18 -30 years old
- 31 -40 years old
- 41-50 years old
- 51-60 years old
- Older than 60 years old
- Prefer not to answer

24. What is the highest level of education you have completed?

Mark only one oval.

- Elementary School
- Middle School
- High School
- Some College
- Two-year College Degree
- Four-year College Degree
- Advanced College Degree (Master's, Doctorate, Law, etc.)
- Prefer not to answer

25. Approximately how much is your individual annual income?

Mark only one oval.

- Less than $20,000
- $20,000 – 34,999
- $35,000 - $49,999
- $50,000 - $74,999
- $75,000 - $99,999
- Over $100,000
- Prefer not to answer

Post-Tour and Workshop Follow-Up Survey

POST-WORKSHOP FOLLOW-UP

In addition to the survey you just filled out, we would like to send you a follow-up survey after you have participated in the AQEarth Environmental Justice Bus Tour and Community Workshop.

You will be paid an additional $30 via electronic gift card for completing the follow-up survey.

26. If you would like to participate in the follow-up survey, please give your email address (preferred) or phone number where you can be reached.

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