ABSTRACT

ENVIRONMENTAL JUSTICE EDUCATION AND ATMOSPHERIC PARTICULATE ANALYSIS IN URBAN ENVIRONMENTAL HEALTH POLICY DEVELOPMENT: INDOOR AIRBORNE PARTICULATE CONCENTRATIONS IN PRESCHOOLS OF ASTHMATIC CHILDREN IN NEWARK

by
Rita L. Thornton, J.D.

Analysis suggests that several residential areas in Newark, New Jersey (USA) have Black/African-American and Hispanic populations, which may be "at high risk" with respect to the adverse health effects of particulate air pollution. This study analyzes the community locations and evaluates literature and other available air pollution data for the target communities in the city of Newark. The study focuses on asthma or reactive airway diseases as a target health risk. It also performs data collection on particulate pollutants and levels of trace metals in particulate matter in target communities and schools of preschool children in two of the five Wards of Newark. In addition to the environmental issues, the analysis includes social issues related to the preschool communities-at-large. The data is used (data-driven approach) for environmental health policy recommendations, development and implementation of pollution abatement in the preschools.

The specific target communities are identified as the East and the South Wards because preliminary demographic research has shown that the East and South Wards of Newark are two old, densely populated communities of over 56,000 people each. And, the majority of this Newark population consists of Black/African-Americans, Hispanics, Portuguese, and low-income families who are experiencing the highest cumulative pollution burdens and environmental respiratory health risks in the State of New Jersey.

Data obtained and summarized include: historical literature on the inhalation toxicological effects of particulate matter (PM) on children, parent-reported histories and statistics on asthmatic preschool children, analysis for indoor levels of total airborne PM and selected trace metals in the particles. Moderate to low volume air particulate samplers were used for two sampling campaigns in the winter and spring months. Data results from microwave acid digestion and inductively coupled plasma mass spectrometry analysis of the filtered-collected PM_{10} samples determined that significant levels of some hazardous air pollutants were present in the indoor air of the pre-school classroom. Metal particulate species specifically analyzed included: zinc, lead, manganese, vanadium, and nickel, which are shown to significantly contribute to poor indoor air quality; and be associated with adverse health effects of asthmatic children.

Presentation of data to the preschool community has provided an urban environmental-health awareness regarding asthma triggers; and has identified a policy that creates an asthma-friendly preschool environment in the East and South Ward communities. The pre-school administrators have been made aware of the research study during Urban Environmental Health Fairs; and therefore, as part of a school intervention program, they have agreed to a policy on installation of air cleaners in classrooms where significant numbers of asthmatic children are in attendance. Their actions have created model environmental health policies for the indoor environment of urban children, and discussed an indoor air quality "Tools for Schools" Program.

The incorporation of an environmental science data analysis and evaluation along with social justice issues has resulted in an accepted community pre-school urban air pollution abatement model based on an environmental justice framework.

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Thornton, Rita L. "New Jersey Solid and Hazardous Waste Transporters' Quick Access Guide Book", New Jersey Department of Environmental Protection- Solid and Hazardous Waste Technical Manual for Waste Industry. 2003-2005.

Thornton, Rita L. "New Jersey's Urban Environmental Health PROTECTORS," four urban environmental health icons/characters. Copyrighted images represent an urban environmental health educational awareness trademark designed to educate New Jersey community about environmental health concerns in urban communities. Copyright © 2004, All Rights Reserved.

Thornton, Rita L. "New Jersey's Urban Environmental Health PROTECTORS," presented at New Jersey Department of Environmental Protection (DEP)'s first Urban Environmental Health Fair. February 3, 2004.

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Thornton, Rita L. "The City of Newark's first Urban Environmental Health Fair" introduced "New Jersey's Urban Environmental Health PROTECTORS™ " to the Newark preschool community; presented at Metropolitan Baptist Church, Newark, sponsored by Newark Preschool Council, Inc., EJECT-NJ, Inc. and New Jersey Institute of Technology (NJIT). June 18, 2004.

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TO MY SISTER JEANETTE
a.k.a. Dr. Jeanette F. Thornton, M.S., Ed.D., M.D.

In reading Romans 5:1-4 of my Bible (Revised Standard Version), I have come to realize that obtaining my Ph.D. degree would have remained only a dream and would never have become a reality if not for my faith in my Father God. So, I thank God for the love and understanding that unselfishly came from my older sister, Jeanette, which is why my doctoral dissertation and the following Poem are dedicated to her with love:

"*PRESS ON* BABY SIS, *PRESS ON*"

When all others thought it was ridiculous when I told them about my dream to go back to graduate school to obtain another doctorate degree, which would allow me to combine science with policy and law,

You told me to let my reach exceed my grasp and to aim high as I ... *PRESS ON.*

When long-time family pressures caused me to have my own personal doubts based upon my past academic capabilities,

You encouraged me not to look at the past, but to look to the future as I ... *PRESS ON.* *

When many people told me that it would be virtually impossible to complete this doctoral dissertation because of my physical disability, my age, my gender and my race,

You told me to ignore all those negative people and to ... *PRESS ON.*

Through it all, you were the rock that I tightly held on to; and the compass that guided me step by step through the forest fire of obstacles, not knowing that with your help and visualized love, I was turning those obstacles into stepping-stones because,

You always saw the best in me at each step, which gave me the courage to ... *PRESS ON.*

Love Always,

Rita

a.k.a. your "Baby Sis"

* Biblically supported by Philippians 3: 12-14 (Revised Standard Version)

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CHAPTER 1

DISSERTATION OVERVIEW

1.1 Introduction:
The Integration of Environmental Science with Policy-making

The purpose of this dissertation research was to perform environmental policy and science research in order to create a modeling framework that integrated the environmental and social sciences for the development of an effective environmental-health policy. In order to fulfill this purpose, the research was divided into three separate sections, which resulted in a three-tiered approach [Figure 1.1].

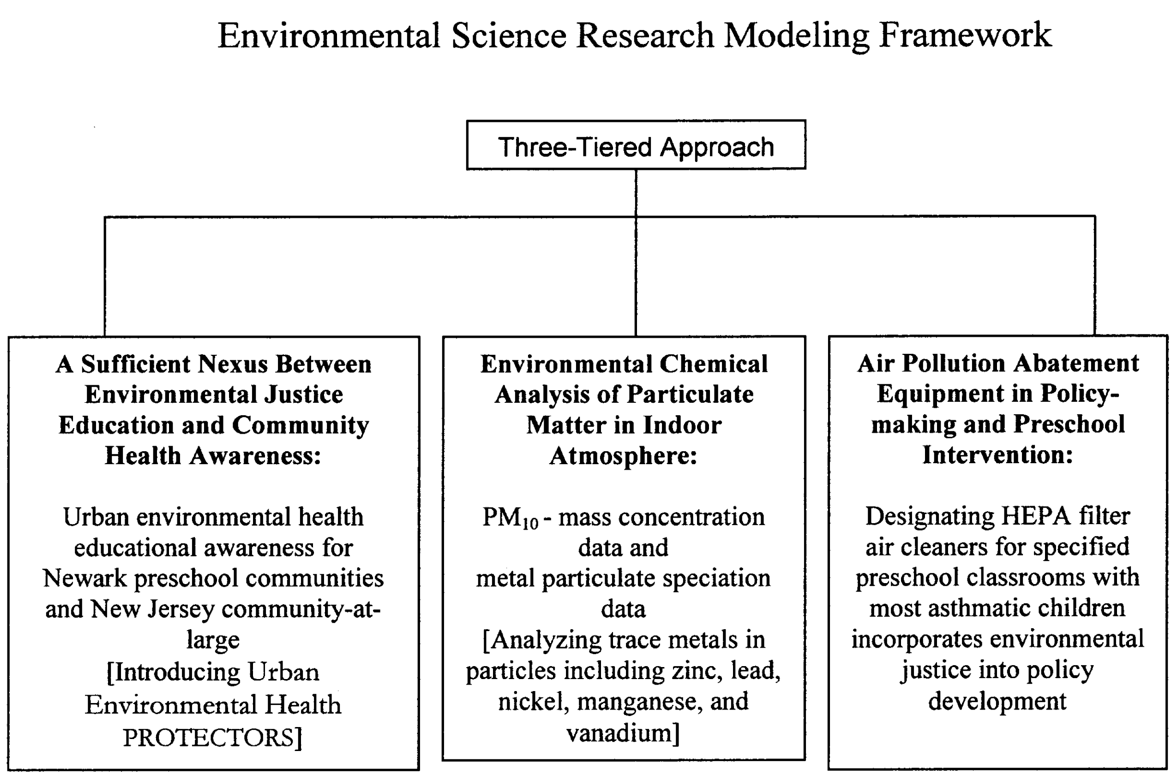


Figure 1.1 A three-tiered approach integrates environmental justice education, urban health of minority children, indoor air particulate analysis and school intervention for the development of an environmental health policy.

By using the three-tiered Environmental Science Research Modeling Framework as the basic conceptual foundation of the research, step-by-step methods for this case study developed into a Case Methodology Model (See Figure 1.2). This Model was created at the request of the Newark, New Jersey community-at-large to assist each Newark Ward preschool community with its children's environmental health concerns including asthma and reactive airway diseases.

Environmental Justice in Policy Development

Case Methodology Model for Data-Driven Policy Development

During Environmental Health Forums, share data collected and analyzed to develop a community school policy that introduces and discusses EPA's Tools for Schools Program as a way to establish asthma-friendly Newark preschools

► Based upon PM mass concentrations and chemical analysis, install HEPA filter air cleaners in classrooms with highest number of asthmatic children

► Report environmental factors that affect PM penetration, including temperature, meteorological conditions, daily classroom operations and activity of children

► Perform air sampling and chemical analysis of indoor PM_{10} mass concentrations, speciation data for Zn, Mn, Pb, V and Ni

► Prepare, distribute, collect Asthma Survey Sheets to determine universe of physician-diagnosed asthmatic children in targeted Wards

► Create GIS i-map of preschool sites, main highways, roads and mobile sources

► Obtain historical literature on Particulate Matter (PM) in New Jersey, Essex County and Newark; and inhalation toxicity data on PM and its adverse health affects on children

Develop urban environmental health education demonstrative project for New Jersey

Figure 1.2 Incorporating environmental justice into policy development required a step-by-step methodology to determine prevalence of physician-diagnosed asthmatic children, PM_{10} mass concentrations and chemical analysis of indoor air PM in preschools.

This community-based Case Methodology Model was used as a guide in the environmental health school policy-making, and accordingly required full integration of environmental science and environmental policy. Epidemiological research has increasingly confirmed that air pollution has a significant long-term impact on human health (Nicolas, J., et al, 2005). Therefore, in order for this Model to be used as an effective policy-making tool, it was tailored to address the resource and health problems that Newark Preschool Council's preschools were currently facing.

The USEPA- 1996 National Air Toxic Assessment (NATA) for New Jersey determined that 64% of New Jersey's air pollution comes from mobile sources (Figure 1.3). These mobile sources include on-road and non-road vehicles such as, cars, buses, trucks, motorcycles, and airplanes.

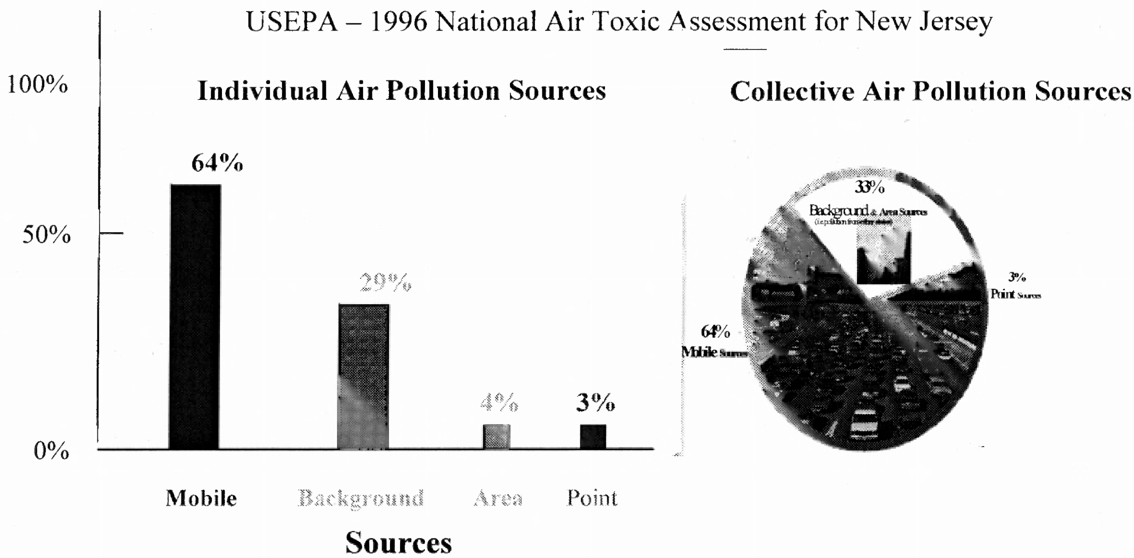


Figure 1.3 Individual and collective air Pollution Sources in New Jersey.

Whether it is individual or collective pollution sources, mobile sources such as, cars, buses, trucks and airplanes are the highest contributors to New Jersey's air pollution.

According to the Clean Air Act, there are six criteria pollutants: 1). Particulate Matter (PM); 2). Ozone (O_3); 3). Lead (Pb); 4). Carbon Monoxide (CO); 5). Nitrogen Dioxide (NO_2); and 6). Sulfur Dioxide (SO_2) (42 U.S.C. 7409 and 40 CFR Part 50). The Clean Air Act of 1971 authorized the EPA to identify and coin the term "criteria" air pollutants as being air pollutants that are associated with environmental and/or adverse human health effects for which National Ambient Air Quality Standards (NAAQS) exist. The NAAQS are divided into primary and secondary ambient air quality standards. The primary standards are defined as the levels of air quality that would be necessary to protect public health while the secondary standards are designed to protect the public welfare including plants and animals (40 CFR Part 50). These criteria pollutants may originate from individual tailpipe emissions that are directly released into the atmosphere. Of the six criteria pollutants, Particulate Matter (PM) being released as combustion products has been scientifically linked to exacerbating or increasing the symptoms in respiratory illnesses including asthma and/or respiratory airway diseases (Breysse, P., et al, 2005; and Samet, J., et.al, 1987).

Additionally, under the Clean Air Act, EPA initially identified and created a list of 189 potentially harmful Hazardous Air Pollutants (HAPs), which are prevalent in the environment and may be toxic to humans (42 U.S.C. 7412(b) and 40 CFR Part 61). The HAPs list contains metals, particles, gases adsorbed onto particles, vapors from duels and other sources. In reviewing the names of the chemicals on the HAPs list, all five of the targeted metals appeared on the HAPs list. Therefore, the purpose of the environmental chemical analysis portion of the dissertation research was to focus on the criteria air pollutant PM in fuel combustion products and tire-wear from mobile sources. Due to the acidity of PM, its heavy metal composition, and particle size in the atmosphere, PM poses a health risk to the human environment especially sensitive populations such as, children (Breysse, P.N., et al, 2005). Therefore, the purpose of the particulate air sampling and the use of Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) for the chemical analysis was to determine the air particle size (PM_{10}) mass concentrations, and the indoor metal particulate speciation concentrations in the targeted preschool classrooms having the highest number of asthmatic children.

There is a great deal of controversy concerning the relationship between environmental factors and asthma or asthma-like symptoms. Both the direction and outcome of these disputes are extremely critical because they influence the level of public health education and government regulation (Brown, P., et al, 2003). Minority communities in the United States have higher morbidity rates than white communities. Therefore, these minority communities are more affected than the white communities by these controversial debates concerning the association between environmental factors and public health (Brown, P., et al, 2003). This ultimately affects the need for government efforts, school intervention, health education and environmental policy development at the local and state levels. With health and social inequalities being linked to environmental pollution, this has introduced the environmental justice framework for the dissertation research.

Presentation of asthma literature to the community during Urban Environmental Health Fairs created a community-based environmental health awareness of asthma triggers. It also identified the need for an environmental-health policy that creates an asthma-friendly preschool environment in Newark's East and South Ward communities. The dissertation research analyzed community locations and evaluated literature and other available air pollution data for the target communities in the city of Newark. It identified asthma or reactive airway diseases as a target health risk. Air sampling, data collection of filtered-particulate pollutants, calculations for PM_{10} mass concentrations, and an ICP-MS chemical analysis of target trace metal particulate levels were performed on two preschool classrooms located in two of the five Wards of Newark. In addition to the environmental issues, the analysis included social issues related to the preschool communities-at-large. The data was used for policy recommendations, and for developing and implementing pollution abatement strategies in the Newark preschools (i.e. research case study used data-driven approach).

Data obtained and summarized included: 1) Historical literature environmental data on the inhalation toxicological effects of particulate pollutants on children as a subset of the population; 2) Parent-reported histories and statistics on asthmatic preschool children; and 3) Analysis of the indoor levels of airborne particulate pollutants and selected trace metals in the particulate matter. Moderate volume (20 to 30 liter per minute) air particulate samplers were used for two sampling campaigns in the winter and spring months of 2005. Since 64% of New Jersey's ambient (outdoor) air pollution is contributed by mobile sources (USEPA-NATA Report, 1996), a closer look was given to the identity and location of the major pollutants emitted from mobile sources.

According to USEPA (USEPA-National Air Quality and Emissions Report, 1999), there are 21 on-road and non-road Mobile Source Air Toxics (MSATs) emitted directly into the atmosphere (Figure 1.4). Out of the 21 on-road and non-road MSATs, there are six metal compounds: Arsenic (As), Chromium (Cr), Lead (Pb), Manganese (Mn), Mercury (Hg), and Nickel (Ni). Some of the heavy metals specifically analyzed in this research were Manganese (Mn), Lead (Pb) and Nickel (Ni) because they are known to be significant contributors to respiratory illnesses and poor indoor air quality.

EPA- On-Road and Non-Road Mobile Source Air Toxics (MSATs)

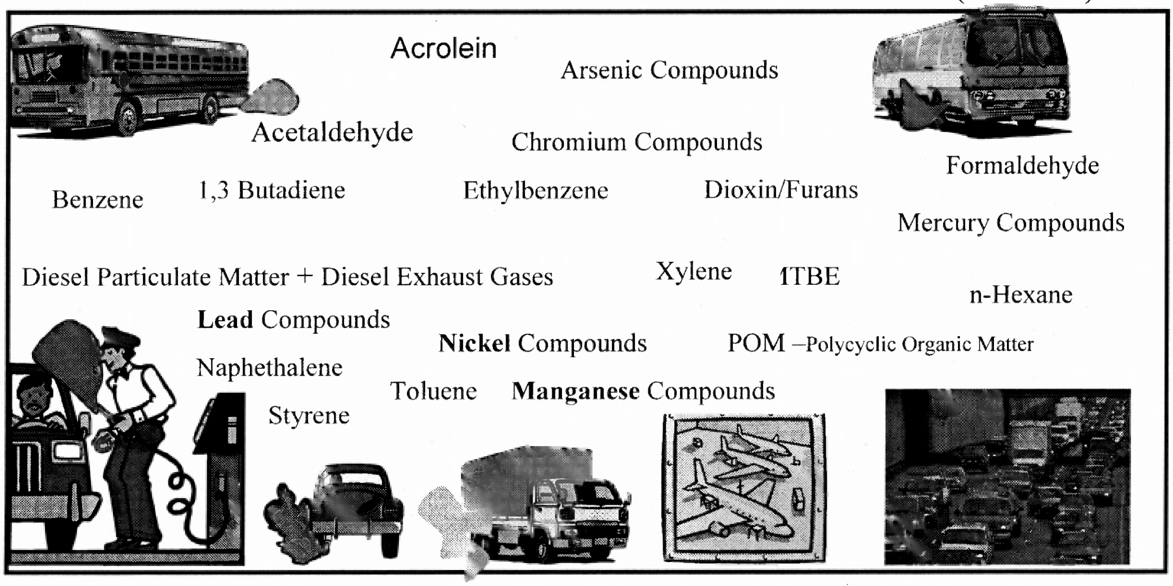


Figure 1.4 Among the 21 MSATs, three heavy metal particulate pollutants are emitted from on-road and non-road gas exhausts of mobile sources (**Bold**).
USEPA-NATA Report, 1996

The dissertation research included particulate collection, PM_{10}, total mass analysis microwave acid digestion of the particulate and inductively coupled plasma mass spectrometry (ICP-MS) chemical analysis on nickel, lead and manganese (See Figure 1.4 bold) because these three heavy metals often result from on-road and non-road mobile sources and are also on the USEPA's list of Hazardous Air Pollutants (National Air

Quality Trends Report, 1999). While the dissertation research's ICP-MS metals in the particulate chemical analysis focused on identifying the concentrations of Pb, Mn, and Ni as heavy metals from gas exhausts of mobile sources, it also evaluated Zinc (Zn) and Vanadium (V). Both the Federal Clean Air Act (1990) and the On-Road National Emissions Inventory (USEPA, 2004), show that all five of the target metal particulate pollutants are not only hazardous air pollutants but also criteria air pollutants.

Zinc (Zn) in the environment has both natural and anthropogenic sources. The largest anthropogenic sources of Zn in the atmosphere are as a result of metal production and transportation activities such as tire-wear or roadway abrasion of rubber tire tread material in tires for buses, trucks, cars and aircraft (Councell, T., 2004).

In addition to metal particulate pollutants released from on-road and non-road mobile sources, particulate matter can also be released from heating sources such as gas heating and kerosene space heaters (Triche, E., et al., 2002). While many chemicals and metals are present in the atmosphere, some of the more common chemical components in PM include elemental carbon and transition metals such as zinc, vanadium, nickel, lead and manganese (Brook, R., et al., 2004). This particulate matter is a criteria air pollutant found in the literature to be adversely related to respiratory symptoms in infants and children (Triche, E., et al., 2002), and the five metal particulate pollutants contain metal compounds that are on the list of hazardous air pollutants. These five metal particulate pollutants were targeted for further analysis and are identified as the target metals in this research work.

1.2 Hypothesis:

The hypothesis of this dissertation was to determine whether or not an indoor environmental policy for asthmatic preschool children could be developed and implemented if there was environmental scientific data to support the need for school intervention. Therefore, increasing the level of environmental health educational awareness at the Newark preschools should result in increasing preschool intervention.

In order for there to be a need for school intervention, the following questions were asked:

- Does poor indoor air quality present adverse health effects to asthmatic children in urban preschool classrooms?
- If yes, then does outdoor particulate air pollution contribute significantly to the poor indoor air quality of the classrooms to the extent that an environmental policy can be developed?
- If the Newark outdoor air particulate levels contribute significantly to the indoor air quality of the preschools, then this data would warrant the need for the school community to develop and implement a public environmental health policy.

Active meaningful community involvement as well as the input from school administrators, health professionals, parents and local governmental officials in the collection of scientific data is an approach that is known as "popular epidemiology" (Brown, P., and Mikkelsen, E.J., 1997).

By applying Interest-Based Negotiation (IBN) techniques to this approach, each of the aforementioned groups saw themselves as part of the same community. Each community group (i.e. businesses, local government and preschool parents and teachers) came to the Environmental Health Forums (i.e. Fairs and Seminars) with potentially incompatible positions and interests regarding the data. The researcher therefore attempted "pragmatic deconstruction" in order to achieve "pragmatic reconstruction" (Light, A., and Katz, E., 1996). These terms mean that the researcher had to take time to breakdown previous misperceptions about researchers and confront the suspicions and hostility about the use of the data results in this research study (i.e. pragmatic deconstruction). At the same time, there had to be a rebuilding of partnerships and a building of trust within those partnerships (i.e. pragmatic reconstruction) (Light, A., and Katz, E., 1996). The researcher used Interest-Based Negotiation (IBN) skills to successfully implement the pragmatic deconstruction and reconstruction.

The above approach and IBN techniques addressed the interests and health concerns of the community members, school administrators, health professionals, parents and local government officials by breaking down the communication barriers that existed between the different groups. Because this was done before and during the collection and analysis of the environmental data, an indoor air pollution improvement plan and indoor air quality preschool environmental health policy were developed and successfully implemented. The data collection and analysis were designed to have "community input up-front in a proactive manner" (Cooney, C.M., quoting R. Thornton, 1999).

Considering the above information, this environmental science and policy dissertation research had an overall two-fold purpose:

1) To establish a data collection process or model that would actually be used by a preschool community to address a classroom indoor air quality (IAQ) issue; and

2) To help a community develop and produce a product in the form of an indoor air pollution improvement plan or environmental health policy for developing an asthma-friendly preschool classroom.

1.3 Methodology

After completing the research on asthma and particulate matter as an asthma trigger, the case study methodology model involved a two-phase data collection design. There were three parts to Phase I. Phase I had a seven-month data collection period to, 1) identify the East Ward universe of physician-diagnosed asthmatic preschool children; and 2) to socially familiarize the researcher with parents and preschool council staff (October - December 2002 and April, May, July, September 2003). The third part of Phase I had a six-month data collection period to identify the South Ward universe of physician-diagnosed asthmatic preschool children (October, November and December 2003; and January, February, March 2004).

During Phase II, the environmental air sampling data collection of PM_{10}, microwave acid digestion of filtered samples and the ICP-MS chemical analysis of the indoor particulate levels were completed (March, April, May, June and July 2005). Between March 2004 and March 2005, the researcher worked to identify the appropriate air sampling equipment. Research on moderate-volume air samplers and air pumps resulted in air sampling equipment components being either purchased or rented from SKC, Inc.

A data-driven preschool community policy was developed for discussions and use in Environmental Health Forums (See Figure 1.2). This was based on the Case

Methodology Model, which provided the step-by-step methods for the environmental science and environmental health policy data collection and analysis.

1.3.1 Description of the Study Area or Population

The East and South Ward communities of Newark are two of the oldest and densely populated communities of over 56,000 people per Ward. The majority of this Newark population consists of Black/African-Americans, Hispanics, Portuguese, and low-income families who are experiencing the highest cumulative pollution burdens and environmental respiratory health risks in the State of New Jersey. Therefore, Newark's Department of Neighborhood Services requested and received an Environmental Justice Analysis, which was prepared by EJECT-NJ, Inc. (Cooper, H. and Thornton, R., 1999). This analysis included an Environmental Justice Assessment of the solid and hazardous waste industrial facilities in Newark, New Jersey. The Environmental Justice Assessment drew upon the USEPA's Right-to-Know Data, Toxic Release Inventory (TRI) data, the U.S. Census Bureau data, and the NJDEP's Geographic Information System (GIS) data and Right-to-Know Data. The assessment clearly showed that Newark was and still is the recipient of the largest number of NJDEP issued facility permits. Additionally, according to a NJDEP 1998 Environmental Equity Multimedia Assessment and Trend Analysis of On-Site Environmental Releases from New Jersey Permitted Facilities, Essex County carries one of the greatest cumulative pollution releases in the State of New Jersey (Thornton, R., et al., 1998). Newark with five Wards (East, South, West, North and Central Wards) has the largest population of people of color

(Black/African-American and Hispanic) and low-income families in New Jersey with 12.5% having incomes below the poverty level.

According to the New Jersey Department of Environmental Protection (NJDEP), Newark has the highest number of permitted facilities in New Jersey. In 1999, the Newark community had 1,689 facilities. Most of these facilities are located in the East Ward of Newark and are permitted under the NJDEP's Hazardous Waste and Air Permitting Programs. In addition, Newark's South Ward is in close proximity to the Newark-Liberty Airport. The East Ward is the host community for Newark's Penn Station and the greatest number of gasoline stations/facilities in Essex County as well as several Superfund Sites. In addition, Essex County is one of the counties with the largest number of older vehicles on the road and the highest incidence of asthma hospitalization rates in New Jersey (Figure 7.4 and 7.2; respectively). Therefore, vehicle air pollution in Essex County was determined to be the major contributor in identifying its environmentally burdened status.

In view of the aforementioned environmental data, it is not surprising that Newark, the largest city in Essex County, would have New Jersey's greatest cumulative pollution burdens and highest chronic respiratory health risks with respect to total on-site environmental releases. These environmental and demographic facts make Essex County's City of Newark a potentially identifiable "environmental justice" community.

1.3.2 Overview of Methods and Sampling Procedures

The following methods and procedural steps were used:

1) Provided a Demonstrative project and educational tool that explained environmental science and environmental health to urban communities of color;
2) Constructed Geographic Information Systems (GIS) I-Maps for the East and South Ward Preschool communities to determine which two of the five Newark Wards were experiencing the highest environmental burdens. These Wards were identified as the "targeted" Wards;
3) Obtained historical meteorological conditions for all five Newark Wards to determine "targeted" Wards;
4) Based upon parent-reported medical histories, identified the total universe of physician-diagnosed asthmatic preschool children in both the East and South Wards;
5) Respected the community culture and school environment by obtaining authorization before using moderate-volume air samplers to conduct indoor air sampling in the classrooms;
6) Collected used filters and weighed each filter before and after use to determine PM_{10} mass concentrations and after microwave acid digestion and an ICP-MS chemical analysis, identified concentrations of metal species in PM found in both "targeted" East and South Ward classrooms;
7) Shared data results with the community; and
8) An economic evaluation of costs per unit was reviewed with the installation of indoor air pollution abatement equipment in each of the "targeted" classrooms.

1.3.3 Model of Observation and Experimental Design:

Procedural Step 1 – This step created an urban environmental science and health educational tool that was appealing to the urban audience. The researcher developed and designed an educational and demonstrative tool entitled "*New Jersey's Urban Environmental Health PROTECTORS™*". The PROTECTORS are four environmental science and health icons/characters who represent the cultural diversity in urban communities. Each time it was necessary for the PROTECTORS to educate the community regarding urban environmental health issues, the researcher organized and sponsored an Urban Environmental Health Forum. Every Forum was either organized as a Health Fair or a Health Seminar depending on the culture of the community. During each Forum, the researcher worked with the community to discuss innovative ways to promote healthier preschool environments. The Health Fairs were mainly educational and the Health Seminars were designed to empower the school community while identifying the policy goals and objectives of the dissertation research.

This procedural health forum series also used an Interest-based Negotiation (IBN) approach during the Environmental Health Seminars. In understanding the sources of conflict that may be involved in environmental disputes, the researcher chose to apply the IBN approach because, the stakeholders came to the Environmental Health Seminars with different interests that had to be identified and addressed so that a policy could be developed.

Procedural Step 2 – A modified form of Geographic Information Systems (GIS) i-Map NJ and ArcView software was used to construct East Ward and South Ward aerial maps that identified the targeted preschools, the main highways and non-road mobile sources (i.e. Route 22, Route 1 and 9, Newark-Liberty Airport, etc.) located within or less than a five mile radius of the preschool sites (Figure 7.5 and 7.6). This step was performed with the assistance of the New Jersey Department of Environmental Protection Geographic Information Systems (GIS) staff.

Procedural Step 3 – In an effort to identify the meteorological conditions that had historically occurred in Newark for the past ten years, *Lakes* Environmental software was installed on researcher's home computer. This information and procedure was important because, as seen in research studies (Long, C.M., 2000), penetration of particulate pollutants into a room depends in part on the wind speed and air exchange rate.

Procedural Step 4 – Identified the total universe of physician-diagnosed asthmatic preschool children in the targeted East and South Wards based upon the parent-reported medical history of each preschool child. In order to achieve this step, the following actions were taken: Researcher began attending meetings with the Preschool Council staff and administrators in 2002. (October 24, October 28, October 30, November 18, and December 9); and during 2003 (April, May, July, September, October, November and December).

During the meeting on November 18, 2002, an Asthma Survey Sheet was developed by the Preschool Council administrators, parent coordinators and the health staff, while the researcher was an observer (Appendix A). One week later, the Asthma Survey Sheet was distributed to the East Ward parents by the Preschool Council parent coordinators and health staff. In an effort to get to know the East Ward parents and for the parents to get to know the researcher as an observer, the researcher visited five of the following six preschools in the East Ward: Hyatt Court Preschool on Roanoke Court; St.

Stephan's I and II Preschools on Ferry Street; Providence Preschool on Elm Avenue; Pennington Court Preschool on Pennington Court; and Terrell Homes Preschool on Riverview Court.

On October 23, 2003, the researcher-observer met with and helped the Parent Coordinators and Health staff from the Newark Preschool Council to distribute the Asthma Survey Sheet to the East Ward school parents and community members. On November 5, 2003, the researcher-observer began visiting the following preschools in the South Ward: Zion Hill I, II- Osborne Terrance, Alberta Bey I, II- Chancellor Avenue, Greater Abyssinian I, II- Lyons Avenue, Henrietta King- Bergen Street, and IGA I, II- Maple Avenue. The total number of South Ward preschools was 12. All of the South Ward Preschool teachers had submitted their Asthma Data Sheets by the requested due date with the exception of two preschools. St. Thomas I, II preschool and Beth Boyden preschool submitted their Sheets several months after the due date. Accordingly, nine of the twelve South Ward preschools (75%) were successful in their submissions and therefore became part of this research.

Procedural Step 5 – In order to enter the preschool classrooms to conduct the air sampling, authorization had to be obtained from the Newark Preschool Council Administrators and Board of Directors. The researcher understood that the City of Newark has its own community culture with respect to past researchers coming into the community, collecting data, and then leaving without either sharing the data results or trying to make any effort to empower the community. The researcher therefore made every effort to be a part of the community and to recognize and respect their culture.

This step involved getting to know the administrative hierarchy in the City of Newark and the policymakers at the Newark Preschool Council and Newark's Department of Health. This approach both ensured that the Asthma Survey Sheets reflected physician-diagnosed asthma in the East and South Wards. It also established the data collection process as a community-based research activity. This step assured that development of the environmental health policy was based upon the researcher and the community sharing the data collected and analyzed.

Procedural Step 6 - This step involved performing an environmental chemical analysis of the indoor (classroom) particulate air pollution in the targeted East and South Ward preschools, which included PM_{10} mass concentration and speciation data on the targeted metals in the PM (zinc, nickel, lead, manganese, and vanadium).

Procedural Step 7 – This step involved discussing the data results with the Newark Preschool Council Administrators and obtaining information from the Administrators regarding their air pollution abatement equipment preferences and previously used HEPA filter air cleaners. On September 19, 2005, the researcher shared the data results and discussed HEPA filter air cleaners with the Newark Preschool Council Administrators.

Procedural Step 8 – This step involved purchasing the HEPA cleaners and installing them in the targeted preschools.

1.4 Results

1.4.1 Literature on Outdoor and Indoor Particulate Air Pollution Data Results from an Environmental Assessment and Environmental Chemical Analysis

Ambient Particulate Air Pollution:

As illustrated in the 1996 USEPA's National Air Toxic Assessment (NATA) data for New Jersey, 43% of New Jersey's air pollution comes from on-road mobile sources (i.e.

vehicles) and 21% from non-road mobile sources (i.e. airplanes, construction cranes) while 3% of the State's air pollution is from point sources (Figure 2.3). This means that most of New Jersey's air pollution comes from mobile sources, with the transportation sector contributing to most of that percentage. Since transportation contributes to most of New Jersey's air pollution, this warrants a closer look at traffic-related pollution and the health risks associated with that air pollution.

An England study found that school-specific prevalence of recurrent wheezing and dyspnea were positively associated with traffic volume in the school district (Studnicka, M., et al., 1997). This England study reported that hospital admission of children younger than five years of age for asthma increased with traffic volume and decreased with distance from the nearest main road (Studnicka, M., et al., 1997).

When reviewing the mobile sources and traffic volume in New Jersey, there is a higher percentage of older used vehicles being purchased, registered and driven in "environmental justice" communities like Newark (Essex County) or communities in Hudson County, than in the more affluent communities such as Morris County (Figure 2.4). This may be because it is cheaper for people with low-incomes to purchase an old used vehicle with a less fuel-efficient engine that releases more particulate pollutants from its exhausts than to purchase a new vehicle that has a newer more fuel-efficient engine. This statement was supported by NJDOT's finding that Newark, Essex County as an environmental justice community, has one of the highest numbers of registered older vehicles (10-25 year old Model cars) traveling on the road (See Figure 7.4).

In addition to vehicle exhaust emissions, Zinc particles are released into the atmosphere from tire-wear or tire abrasion; and Zinc concentrations have increased with increased urbanization (Councell, T., et al., 2004). The data results in the literature showed that there was a strong relationship between anthropogenic Zinc (Zn) accumulation rates and average annual daily traffic. This suggests that there may be a causal relationship between anthropogenic Zn and traffic density (Councell, T., et al., 2004).

When researching literature on the other target metals, there were findings regarding methylcyclopentadienyl manganese tricarbonyl (MMT). This chemical has been used in non-aviation gasoline as a fuel additive since 1995 and can break down quickly on exposure to sunlight or within a car engine. Ultimately, it breaks down into compounds of Manganese (Mn). This metal is emitted from automobile tailpipes or exhausts as both coarse and fine particles that are carried to airways in the lungs. The inhalation of manganese particulate pollutants is toxic to the lungs and produces an inflammatory reaction, which increases susceptibility to bronchitis. Even low-level air exposures increase the prevalence of respiratory symptoms in school children (Solomon and GBPSR, 1996).

In addition to the metal Mn and carbon particles (Lee, P.K., et al., 2003), the presence of some other constituents, such as, Zinc in the atmosphere (Councell, T., et al., 2004) suggests emission during local motor vehicle traffic. Therefore, higher concentrations of these constituents are found in the atmosphere when traffic levels are also at their highest. For example, during the early morning to noon day period (8:00 a.m. - 12:00 p.m.} and late afternoon (approximately 4:00 p.m.), these time periods are considered peak periods (Manahan, 2001). Zn and Mn metals in the particulate matter can act as respiratory irritants. Inhalation of particulate matter (criteria pollutant) containing these metals (hazardous air pollutants) can exacerbate asthma symptoms (D'Amato, G., et al., 2002).

After one year, a vehicle's engine begins to lose its fuel efficiency and older tires begin to wear. Consequently, the trace metals in the air particulate matter (Zn and Mn compounds) are emitted at a higher rate from an older vehicle's exhaust, brake pads and worn tires (Councell, T., et al., 2004). Keeping all of this literature data in mind, we can conclude that the greater the on-road vehicle traffic, the greater the health risks to asthmatic children and children with other respiratory illnesses. Thus, there may be an association between the higher number of registered older vehicles in those counties like Essex and their higher numbers of asthma hospitalization rates (Figure 7.2). However, even if the association is positive, the school community has neither the authority, nor the power to remove these older polluting vehicles from the roads.

<u>Indoor Particulate Air Pollution</u>:

Children spend an averaged 20 hours of each day in indoor environments. Adults in general spend approximately 85-90% of their time indoors (Long, C.M., et al., 2001). There have been several research studies on "ambient infiltration penetration" with respect to particulate air pollution. The particulate data from these studies demonstrated that a significant portion of total personal exposures to ambient particles occurs in indoor environments (Long, C.M., et al., 2001).

Another research study looked at and compared particulate matter (PM) and manganese exposures in the city of Indianapolis, Indiana where MMT was not used; and in the city of Toronto, Canada were MMT was used. This study showed that for both PM_{10} and $PM_{2.5}$ data, there were <u>higher</u> <u>indoor</u> concentration levels than outdoor concentration levels (Pellizzari, E.D., et. al., 2001). There were no significant correlations seen in regard to the manganese.

When looking at the penetration of air particulate pollutants into Boston homes, a research study took a closer look at the relative contribution of outdoor and indoor particle sources to indoor concentrations (Abt, E, et al., 2000). The data showed that air exchange rates and indoor sources such as, cooking, cleaning, and movement of people have an important effect on indoor concentration levels (Abt, E, et al., 2000). This same study showed that outdoor particulate pollutants ranging in size from 0.02-0.5μm and 0.7-10μm also contributed significantly to indoor particulate concentration levels.

Since indicators allow us to track where we are and what direction we want to move toward, a moderate-volume air sampler was used inside the East and South Ward targeted preschool classrooms with the highest number of asthmatic children in attendance. The air sampling instruments helped the researcher identify the particulate air pollutants (PM_{10}) that the preschoolers are breathing while in a classroom environment.

The researcher focused on indoor air particulate concentrations and metal species specifically zinc, nickel, manganese, lead, and vanadium trace metals in the particulate matter. This was designed to identify how these particulate concentrations and metals in the PM may be contributing to the health conditions of the urban preschool children in the East and South Ward communities. The researcher used historical literature on the inhalation toxicological effects of these particulate pollutants. In order to establish an environmental indoor air quality improvement plan and/or environmental health policy, air sampling data was collected and filtered samples were weighed to determine the particulate matter (PM_{10}) mass concentrations. The target metals in the particulate pollutants were acid digested in a microwave system and chemically analyzed using Inductively Coupled Plasma Mass Spectrometry (ICP-MS). The chemical analysis was necessary to determine the concentrations of each of the metal particulate species currently present in the indoor classroom environment.

1.4.2 Findings of Previous Investigations regarding How Data Results are Used

Previous research and investigations generally used the environmental data results pertaining to childhood asthma and other childhood respiratory illnesses as a means of paying for the salaries of staff members in environmental organizations or hospitals so that they could complete further research. While there is nothing wrong with salary coverage per se, this use of the data results does not give immediate benefits to the community. In the Harlem, New York study, the environment-related asthma data results were the impetus for government funding. The funding was used to supplement the salaries of the hospital workers so that they could perform the screening of the Harlem children and visit the home environments of the asthmatic children in order to educate the parents about this disease and what exacerbates the disease in the home.

Using the data results in this manner would have community benefits occurring much later in time if there are no immediate interventions (Nicholas, S., et al., 2005). This study reported its own limitations in the use of the data results by stating that educating the parents about the disease did not constitute policy and visiting the homes did not guarantee that the parents would implement the recommendations specified by the Harlem hospital medical team and social workers. Furthermore, the use of the data results only allowed for an open dialogue to begin with the understanding that there would still be a need for the policy-makers to determine how to pay for any future community-based asthma services (Nicholas, S., et al., 2005).

Among inner-city children with asthma, the New England Journal of Medicine reported that comprehensive environmental intervention decreased exposure to indoor allergens and resulted in reduced asthma-associated morbidity (Morgan, W., et al., 2004). The environmental intervention included the use of HEPA filter air cleaners because an analysis of homes that received HEPA filters suggested that air filtration was associated with an improvement in asthma-related symptoms (Morgan, W., et al., 2004).

This literature supports the researcher's belief that installing air pollution control equipment such as HEPA filter air cleaners in the Newark Preschool Council classrooms would immediately improve the indoor air quality that the children are exposed to during the day. It would also be cost-effective to purchase this type of abatement equipment because installing the equipment would achieve an immediate improvement in the indoor air quality and serve as both an environmental and an educational intervention for the children and staff. The combination of environmental intervention and educational intervention encouraged the type of community empowerment that used the data results objectively to bring forth a more immediate community benefit.

In an Ontario Canada study, sentinel mice exposed to HEPA-filtered air at an urban-industrial site had mutation rates that were 52% lower than those mice that were exposed to ambient air at the same location without the HEPA-filters (Somers, C., et. al., 2004).

Use of Data Results for this Study

This Chapter illustrates in detail how and why the following results were implemented.

Unlike the Harlem study, this dissertation research and data results were used to evaluate the policy considerations regarding environmental indoor air quality and provide recommendations supporting the purchasing and installation of air pollution abatement equipment. The Newark Preschool Council administrators, as the policy-makers, determined that the air pollution abatement equipment would be HEPA (High Efficiency Particulate Air) filter air cleaners which would be installed in the preschool classrooms with the most asthmatic children and/or children with respiratory illnesses in attendance.

Like the Canadian study, this dissertation research resulted in installation of cost-efficient HEPA-filtered air cleaners in the preschool classrooms as an immediate path to improve the environmental indoor air quality. This strategy supplied a cost-effectiveness approach to the environmental problem. An alternate cost-benefit approach, which involves collecting data on "damage costs," would have too many uncertainties for an accurate environmental-health assessment. Performing a cost-benefit analysis would not have been an appropriate environmental economic approach for this type of urban children's environmental health problem.

Since the preschool community has neither the authority, nor the power to remove older polluting vehicles from the roads, the school community decided to install air pollution abatement equipment in the targeted preschool classrooms adversely affected by the ambient air.

The preschool administrators were made aware of the need for particulate air sampling, and therefore, agreed to implement a policy requiring the installation of air cleaners in classrooms where significant numbers of asthmatic children were in attendance. Their actions created model environmental health policies for indoor environments of urban children, and lead to a discussion on the feasibility of an indoor air quality "Tools for Schools" Program.

Incorporating an environmental data analysis and scientific evaluation with Newark's specific social justice issues resulted in an accepted local community preschool indoor pollution abatement model that had an environmental justice perspective.

CHAPTER 2

UNDERSTANDING ENVIRONMENTAL JUSTICE

2.1 Introduction: What is Environmental Justice? Findings of Previous Investigations on Environmental Justice Communities

There is a need to explain the term "environmental justice" in this introduction section because this researcher focused on "environmental justice" communities. The following is a brief introduction and discussion of the term "environmental justice" and how it applies to Essex County's Newark community (Thornton, 1998). Note: Based upon the preliminary research regarding what would constitute an environmental equity or "environmental justice" community in New Jersey, the DEP initially used the term "environmental equity" instead of the term "environmental justice" from 1997-2001.

The term "environmental justice" connects environmental pollution issues (i.e. air, water or land Pollution) with social justice issues, for example, racial discrimination, poverty and/or an unequal distribution of environmental health risks (Percival, R., 2000). However, according to the USEPA, the term "environmental justice" is defined as equal protection and equal justice regarding environmental pollution problems that include "fair treatment" under environmental statutes and regulations; and meaningful involvement of all people regardless of race, color, national origin, or income. The USEPA defines `fair treatment" as having no group of people, irrespective of race, ethnicity or socioeconomic status, bear the negative environmental consequences of industrial municipal, and commercial operations. (USEPA website: http://www.epa.gov/compliance/resources/faqs/ej).

In understanding the federal definition of environmental justice and the USEPA definition for "fair treatment," there appeared to be a question as to whether or not the City of Newark's community-at-large was receiving "fair treatment" in comparison to the non-minority communities within Essex County. This fair treatment would be in regards to the enforcement of federal and state environmental statutes and regulations. The researcher addressed the fair treatment issue by using data on vehicle air pollution and asthma prevalence in Essex County to develop possible indoor air pollution abatement equipment initiatives.

A 2003 "Asthma in New Jersey" Report published by the New Jersey Department of Health and Senior Services (NJDHSS) stated that "hospitalization rates are not indicators of asthma prevalence," however, health officials can use hospitalization rates "to identify those populations most at risk". The NJDHSS' health data results as seen in Figure 2.1, went on to confirm that the African-American (non-Hispanic) and Hispanic populations in Essex County are "most at risk" because, these Essex County populations had the highest hospitalization rates in New Jersey (NJDHSS Report, 2003).

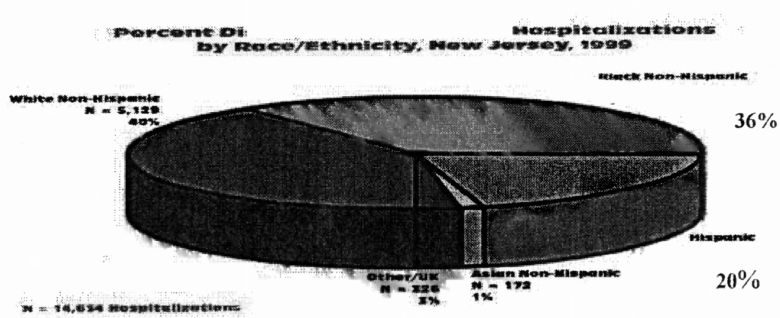


Figure 2.1 Black and Hispanic populations have the highest Asthma Hospitalization Rates in New Jersey – 56%. Using same asthma hospitalization rates with County correlations, Black and Hispanic populations in Essex County followed similar percentage rates. (Source: NJDHSS Report, 2003)

2.2 Environmental Justice in Planning and Permitting Decisions

When looking solely at the legal aspects of environmental justice, environmental justice represents an attempt to merge the goals of the social civil rights movement and the environmental law movement. Because the data results show that minority and low-income populations have been exposed disproportionately to environmental risks (NJDHSS Report, 2003), there is an understanding that African-American (non-Hispanic) and Hispanic populations are most affected by urban environmental pollution issues. Therefore, minority and low-income communities should be represented in decisions that affect their communities and environment (Environmental Law Advisory Report, 2000).

At the federal level, EPA Administrator Carol Browner, in 1993, made environmental justice a priority for the agency when she formed the Office of Environmental Justice to integrate this concept into the agency's policies and activities. In an effort to continue this federal concept of environmental justice, former President Bill Clinton promoted environmental justice through the development of several EPA policies and guidance documents, including President Clinton's 1994 Executive Order on Environmental Justice. Some of these EPA documents included the August 1997 "Environmental Justice Implementation Plan", the Council on Environmental Quality's December 1997 "Environmental Justice Guidance Under the National Environmental Policy Act (NEPA), and the April 1998 "Final Guidance for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses" (See Appendix B).

The legal tools for the implementation of environmental justice have an impact on any federal project or activity that is subjected to Environmental Impact Statement (EIS) requirements of the National Environmental Policy Act (NEPA) and associated regulations (Environmental Law Advisory Report, 2000).

Clinton's 1994 Executive Order mandated federal agencies to develop strategies to focus on the environmental human health conditions of low-income and minority communities. One of the strategies included issuing environmental justice grants that would support greater community involvement in the environmental decision-making process (EPA website: http://yosemite.epa.gov/oar/community/Assessment.nsf).

At the state and local levels, President Clinton's 1994 Executive Order on Environmental Justice affected any state project or activity that was subjected to a permit requirement issued by a state or local authority receiving federal funding (Environmental Law Advisory Report, 2000).

Because former President Clinton's Executive Order was designed to protect both minority and low-income populations, it was determined that consideration be given to environmental justice issues early on in the planning stages of permitting decisions in low-income communities and/or communities of color (Environmental Law Advisory Report, 2000).

2.3 The New Jersey State Law of Environmental Justice

On November 5, 1998, the New Jersey Department of Environmental Protection (DEP) was awarded a $100,000 USEPA grant to implement a model pilot project that addressed "environmental equity" in minority and urban areas. New Jersey was one of five states in the nation to receive an environmental equity award. EPA selected New Jersey because it had worked in partnership with EPA and local groups throughout the state to implement a proactive environmental justice program (NJDEP Press Release, 1998).

Under Governor Whitman, the former DEP Commissioner, Robert Shinn signed an administrative order that established permanent Advisory Council on environmental equity. The group advised the DEP as it began to implement its model pilot project. The Advisory Council included 45 representatives from business, environmental, minority and grassroots organizations, and local government officials. Commissioner Shinn designated Rita Thornton as the State and Tribal Environmental Justice Grant Administrator and manager for the pilot project (Appendix B).

The EPA funded pilot project was designed to introduce an environmental equity program in potentially environmentally burdened communities, and poor and urban areas where air or water pollution, trash incinerators and/or soil contamination may be disproportionately high. The grant was also awarded because the pilot project was tailored to solicit community involvement. The Department wanted its pilot project to provide "community input up front in a proactive manner". The DEP State and Tribal Environmental Justice Administrator also stated "the department did not want to wait until the end of the permitting process when emotions are high and things can get blown out of proportion" (Cooney, C., 1999, quoting Rita Thornton).

Shortly before the pilot project was to begin in 1999, Commissioner Shinn reassigned the state and tribal environmental justice grant administrator to another program. The environmental equity pilot program was therefore never fully implemented by New Jersey. In the following years, there was a change in the Governor administration from Christine Whitman to James McGreevey. There was also a change in commissioners from Robert Shinn in 1996 under former Governor Whitman to Bradley Campbell in 2001 under former Governor McGreevey. With a change in the governor administration and the DEP commissioners, the original environmental equity pilot project that was designed to implement community involvement up-front in the planning and permitting process was completely abandoned. By the end of 2000, the EPA funding for the environmental justice pilot project had been subsequently channeled to other DEP programs.

Four years later, on February 19, 2004, Governor James McGreevey signed an Executive Order that directed state agencies to address several environmental justice issues (Appendix C). The Order stated that environmental health quality of life issues in minority and low-income communities required a multi-agency response. Under the Order, the Department of Environmental Protection (DEP) must identify industrial facilities in environmental justice communities that should undergo a more aggressive compliance and enforcement of the environmental regulations, and site remediation and permitting strategies must be introduced to those residents exposed to hazardous materials in the air, water or land of environmental justice communities.

In response to the occurrence of asthma among children in minority and disadvantaged communities, the Order also required the Department of Transportation (DOT) to work with the DEP to develop a strategy to reduce particulate matter in those communities of color that are experiencing disproportionately high asthma hospitalization rates in New Jersey. The Governor's Executive Order was to take effect immediately and would be valid for the next five years (See Appendix C).

The McGreevey Executive Order requires a city to participate in the environmental justice evaluation. However, this was written into New Jersey law by McGreevey's administration in such a way that the city must designate itself as an environmental justice community. Unfortunately, the political result of this designation as an environmental justice community effectively eliminates that city or environmental justice community from any consideration for future economic investment by industry. The elimination occurs because the industry would be subjected to a more aggressive compliance and enforcement of the environmental regulations and permitting decisions within the environmental justice community. In actuality, any city wishing for industry to make an economic investment in its communities would not make this self-designation of an environmental justice community and thus the state of New Jersey politically eliminated environmental justice from its environmental protection legislation. With no federal or state funding currently being offered to implement the DEP and DOT strategies, the environmental justice deserving communities are once again abandoned at the federal and state levels, which means an environmental justice community is left to administer environmental improvement on its own.

2.4 Methodology for Implementing an Environmental Justice Assessment

Environmental justice has two components or issues that a community must address. The first component or issue is environmental pollution and the second component or issue is social justice. The research work focused on indoor air particulate pollution (PM_{10}) as the environmental pollution issue in Essex County, Newark preschools. The indoor air particulate matter was chosen because it is an asthma trigger. PM_{10} was furthered analyzed regarding its mass concentration levels and the trace metals found on the surface of PM_{10}. The African-American (non-Hispanic) and Hispanic populations in Essex County being "most at risk" and having the highest asthma hospitalization rates in New Jersey were collectively identified as the social justice issue (NJDHSS Asthma Report, 2003).

An environmental justice framework was established in the research methodology by the indoor air PM_{10} mass concentration levels being the environmental pollution issue and the prevalence of asthma in Newark preschool children being the social justice issue.

CHAPTER 3

URBAN AIR POLLUTION

3.1 Introduction:
Emission Factors Contributing to Chemical Composition of Urban Ambient Air

Air quality in inner cities is a function of geography, atmospheric conditions and the anthropogenic activities that occur in the area such as traffic density. Previous studies related to understanding the varied sources of pollutants and other chemicals or species in a city or town environment are discussed in this chapter.

In a London study, the meteorological variables such as wind speed, wind direction, and traffic intensity were parameters that considerably influenced the particle mass concentrations along a targeted road in an urban London site (Charron, A., and Harrison, R., 2005). Hourly concentrations of road dust emissions along the road measured from July 1998 to July 2000 were highly variable, but the PM_{10} concentrations in the atmosphere reached a maximum of 800μg m^{-3} (Charron, A., and Harrison, R., 2005). These measurements were taken during the midday period of the workdays when the heavy-duty traffic was at a maximum level. These levels may be related to total particulate levels measured and reported in chapter nine of this thesis.

Population density, traffic density, and total anthropogenic-derived heavy metal concentrations have indicated that population density is strongly related to traffic density. Traffic density is an environmental predictor of these heavy metal concentrations in the environment (Callender, E., and Rice, K., 2000). Mass concentrations of PM_{10} and heavy metals such as Zinc (Zn) in particulate matter tend to be higher in urban areas as opposed to suburban areas (Liu, Q., et al., 2003). Increased vehicular usage has kept Zn concentrations elevated in water runoff from population centers.

Within the water runoff from roads, there is an input of particulate sedimentation, which is related to the process of urbanization known as "street dust" (Callender, E., and Rice, K., 2000). On a highly traveled road or highway, street dust contains tire dust, which comes from rubber tire wear debris. A study in Japan determined that "tire dust" was an important pollutant because it was a significant source of Zn in the environment (Adachi, K., and Tainosho, Y., 2004). Tire debris (tire dust) is generated by the consistent rolling, shearing, or abrasion of tire tread against road surfaces. This study characterized the morphology and chemical composition of heavy metal particles embedded in tire dust and traffic-related materials such as rubber tire particles from used rubber tires with tire abrasions. The diameter of the particulate Zinc Oxide (ZnO) was approximately 1 μm while the morphology was multi-angular (Adachi, K., and Tainosho, Y., 2004).

Earlier studies also documented higher atmospheric concentrations of particle aerosols and metals in urban areas than in more remote areas (Pirrone, N., et. al., 1995). In a more recent study, high concentrations of metals were found in organic films on exterior window surfaces sampled in downtown and suburban Baltimore, Maryland (Liu, Q., et. al., 2003). In this more recent study, out of twenty-six metals and trace elements, Zn had the second highest concentration. It was suggested that higher concentrations of Zn were attributable to the emissions from a nearby medical waste incinerator and a greater amount of traffic in downtown Baltimore as opposed to the suburban site. The

Maryland study concluded that metal and trace element concentrations were consistently 3 to > 200 times higher at the urban sites than at the suburban sites (Liu, Q., et. al., 2003).

Anthropogenic sources of Zn in the atmosphere include waste incineration, rubber tires on vehicles, and combustion exhaust. Tire-wear particles have been recognized for several decades as a source of Zn to the environment (Councell, T., et. al., 2004). Tire debris is one component of the particulate matter produced by motor vehicles and originates from the wear of tires during traffic (Gualtieri, M., et. al., 2005). Using tire particles produced from new rubber and analyzed by Inductively Coupled Plasma-Atomic Emission Spectrometry, it was determined that tire debris contained significant quantities of Zn, which may be released by tire rubber (Gualtieri, M., et. al., 2005). Earlier studies calculated that 5-7% of tire debris is in the PM_{10} size range of the respirable fraction (Fauser, et al., 1999).

The chemical species of Zn in the natural rubber tire mixture is ZnO and ZnS compounds. Depending on the brand name of the tire and whether the tire was made for a car, truck, bus or aircraft, the Zn content in a tire can range from 2.9% maximum for a car to 3.8% maximum for a truck. It was also determined that 80% of Zn in a ZnO compound is released into the atmosphere (Councell, T., et. al., 2004).

A certain quantity of Zn is leached from tire debris when it rains. Accordingly, acid rain influences the Zn elution process. At the lowest pH value, the quantity of eluted Zn was higher and therefore the quantity of Zn eluted was dependent upon the pH (Gualtieri, M., et. al., 2005). This would result in no linear correlation between the initial particle quantity and the concentration of higher eluted Zn (Gualtieri, M., et. al., 2005).

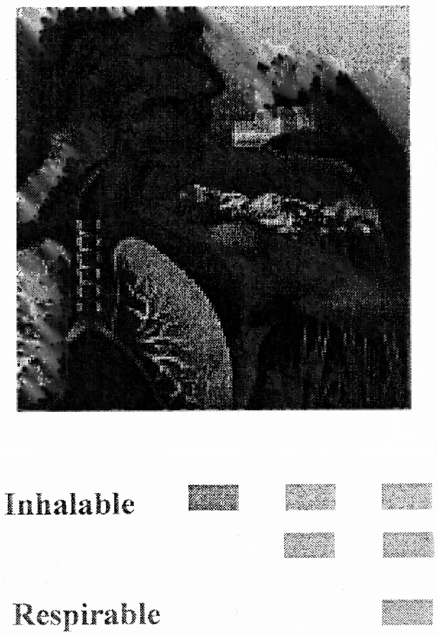
In addition to Zn emissions into the atmosphere from tire abrasion, the overall mass concentrations of air particulate matter and traces of other heavy metal particulate pollutants such as Ni, Pb, Mn and V collectively contribute to urban environmental air pollution.

3.2 Findings of Previous Research on Consequences of Poor Ambient Air Quality

Depending upon where the particle-size is deposited, ambient air particulate matter can exacerbate respiratory illnesses at different parts of the human respiratory system. Health consequences exist that are associated with particulate contributions to poor ambient air quality.

Particulate deposition with respect to particle-size occurs in three forms: 1) Inhalable; 2) Thoracic; and 3) Respirable (see Figure 3.1). Even though inhalable particulate matter can also be thoracic and respirable, inhalable particulate matter exacerbates asthmatic symptoms when it is deposited anywhere in the respiratory tract or throat cavity (i.e. PM $< 10\mu m$). As seen in Figure 3.1, thoracic particulate matter may exacerbate asthma when it is deposited in the thoracic airways; whereas, respirable particulate matter is problematic when it is deposited in the alveoli or gas exchange regions of the lungs (i.e. PM $< 2.5\mu m$).

Three Areas of Particle Deposition in the Respiratory Tract and Particle-Size



Inhalable when deposited anywhere in the respiratory tract (mainly throat cavity)

Thoracic when deposited within the thoracic lung airways and gas-exchange region

PM$_{10}$ < 10μm

Respirable when deposited in the gas-exchange region

PM$_{2.5}$ < 2.5μm

Figure 3.1 Based upon where particle-size is deposited, inhaled particulate matter has three deposition areas: inhalable, thoracic and respirable.

(Sources: http://enhs.umn.edu/5103/molds/absorption.html; and http://www.ishn.com/CDA/ArticleInformation/features/BNP)

A California study (Gilliland, Frank, et. al., 2001), investigated the relationship between ozone (0_3), nitrogen dioxide ($N0_2$), and particles less than 10μm in diameter (PM$_{10}$) and school absenteeism in fourth-grade children. A result of this California study was the "centering" or assumed a log-linear relation between the pollutants and school absences. This study was supported by the following agencies and organizations: California Air Resources Board, the National Institute of Environmental Health Sciences, and the USEPA.

In addition to the log-linear relation between air pollutants and school absences, findings from a recent study in Ontario Canada indicated that exposure to airborne particulate matter was a "principal factor" that contributed to the elevated "mutation rates" in sentinel mice, which has added to the accumulating evidence that air pollution may pose genetic risks to humans (Somers, C., et. al., 2004).

Understanding the data from the California study (Gilliland, F., et al., 2001), this dissertation research used an "Asthma Survey Sheet" and had an asthma survey taken; this was performed by the Newark Preschool Council administrators and staff. The Newark Preschool Council staff helped the parents complete the requested information on the Sheets (blind to the researcher). Similar to the California study, the dissertation research defined the subset of participants with asthma using a "parent-reported history" of physician-diagnosed asthma (Gilliland, F., et. al., 2001). Considering a broader outcome such as school absenteeism can provide a more comprehensive assessment of the adverse impact of ambient air pollution (Gilliland, F., et. al., 2001).

A New York, Harlem study, which resembled the aforementioned California study, determined the prevalence of asthma and estimated baseline asthma symptoms and asthma management strategies among children aged 0-12 years in Central Harlem (Nicholas, S., et al., 2005). This Harlem Children's Project was a community-based initiative designed for poor children with asthma who lived or went to school in the area of Central Harlem north to south from 123rd Street to 116th Street and east to west from

5th Avenue to 8th Avenue. The Harlem Hospital Center decided to perform the actual testing because, most of the previous investigations and attempts to measure asthma were based on asking people whether or not they had ever received a diagnosis of the disease, or suffered from obvious symptoms of the disease. Harlem Hospital screened for 1,982 children for asthma and determined that 30.3% of the children had asthma and 28.5% had been told by a doctor or nurse that they had asthma. There were 229 children enrolled in the Harlem Children's Zone Asthma initiative; and at baseline, 24% had missed school in the last 14 days because of asthma (Nicholas, S., et al., 2005). During the study, a series of medical, educational, environmental, social and legal interventions were delivered to program participants on the basis of their needs (Nicholas, S., et al., 2005). Educational interventions included reinforcing with parents and children "asthma basics 101," and informing the parents about effective ways to eliminate or reduce common asthma triggers. Environmental interventions included providing program participants with dust covers for their bed mattresses and pest remediation services for heavily infested homes. Social interventions included making services available such as Truancy Prevention, Reading and Technology assistance and introductions to Family Support Centers. Legal interventions involved providing free legal services for the asthma team social workers in their efforts to resolve problems that were referred to them regarding housing conditions and domestic violence in the homes of the asthmatic children (Nicholas, S., et al., 2005).

3.3 National versus State Contributors to Urban Air Pollution

The literature data on urban air pollution makes it clear that whether it is at the national or state level, airborne particulate matter (PM) is a major component of urban air pollution. Measurements of atmospheric concentrations of particulate trace metals such as lead (Pb), and vanadium (V) have been made since 1974 (Lee, D.S., Garland, J.A., and Fox, A.A., 1994).

In a United Kingdom study, concentrations of these particulate pollutants in urban areas were three to ten times higher than in rural areas (Lee, D.S., et al., 1994). There were also concentration differences between sites in the same urban area and a seasonal variability from the anthropogenic sources. These were explained in terms of increased fuel usage among mobile sources, the frequency of inversions and higher wind speeds in the various urban areas (Lee, D.S., et al., 1994).

According to the USEPA, the largest contributors to urban air pollution in the United States are mobile sources such as, cars, trucks, buses and aircraft (EPA, 1999). As seen in Figure 3.2, motor vehicles account for 49% of air pollution and other contributors include utilities at 27 percent and industrial or commercial point sources (i.e. power plants) at 19 percent (EPA, 1999) (See Figure 3.2).

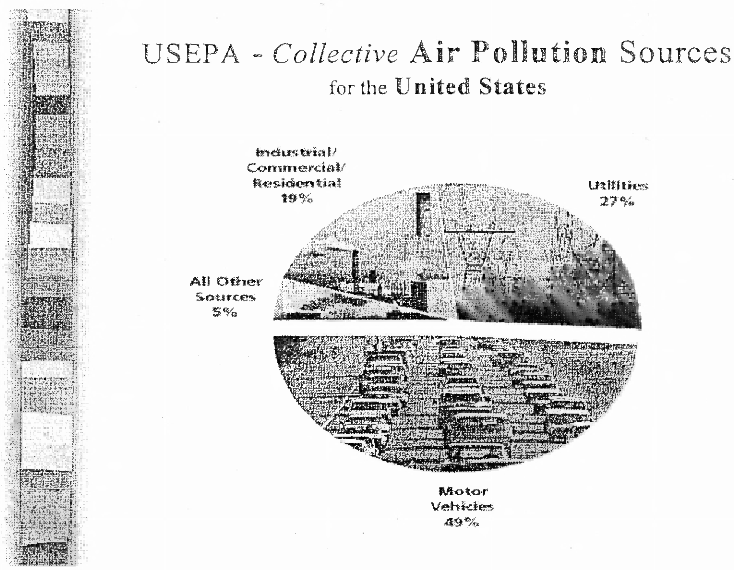


Figure 3.2 Motor vehicles (cars, buses, trucks, etc.) account for 49 percent of the ambient air pollution in the United States. (EPA, 1999)

According to the USEPA's 1996 National Air Toxic Assessment of New Jersey's air pollution, on-road and non-road mobile-sources (i.e. transportation sector) are the highest contributors of air toxics (See Figure 7.3). The transportation sector in the form of cars, trucks, buses and aircraft accounts for 64% of New Jersey's ambient air pollution from air toxic pollutants (See Figure 7.3).

By comparing national and state air pollution contributors, the USEPA determined that out of all of the collective air pollution sources in the United States, the largest contributor to air pollution is the transportation sector (49%). However, for New Jersey the transportation sector consisting of on-road and non-road mobile sources accounts for 64% of the air pollution in the state (See Figure 3.3).

Collective Air Pollution Sources for New Jersey

Figure 3.3 Mobile vehicles such as, cars, trucks, and aircraft account for 64 percent of the ambient air pollution in New Jersey. (EPA-NATA Report, 1996)

As seen in Figure 3.3, there are other contributors to New Jersey's air pollution. They include background sources with 33 percent (i.e. pollution from other states) and industrial point sources contributing 3 percent (i.e. power plants).

In the final analysis regarding the transportation sector and air pollution contributors at the national level versus the state level, mobile sources in New Jersey account for a much higher percentage (64%) of its air pollution than the mobile sources in the United States (49%).

It has been reported that in New Jersey the air pollution from mobile sources (64%) mainly includes Volatile Organic Compounds (VOCs) and not particulate matter. However, on road mobile sources such as diesel trucks, buses and cars account for 72% of the particulate ambient air pollution in New Jersey (See Figure 3.4). It should be noted that even though diesel vehicles emit both PM_{10} and $PM_{2.5}$, this research focused on PM_{10} and its adverse health effects on asthmatic children.

Particulate Air Pollution in New Jersey

Percent Contributions from On-road Mobile Sources

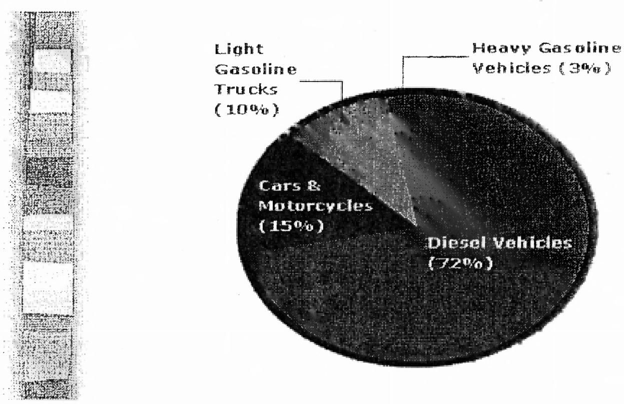


Figure 3.4 Diesel Vehicles account for 72 percent of particulate ambient air pollution in New Jersey. (EPA, 1999)

It is estimated that over 80% of inhalable particulate pollutants or particulate matter (PM_{10}) in the inner cities come from transportation activities. Depending on the urban area, tire and brake wear are responsible for 3-7% emission of particulate matter as indicators of the environmental impact of tire debris (Gualtieri, M., et al., 2005). Tire debris also contains trace metals such as, Zinc (Zn). Since the amount of Zn leached from tire debris is related to pH, the quantity of Zinc particulate matter present in the environment is dependent upon the atmospheric conditions. For example, after a rainfall (acid rain) there is a higher quantity of Zn particulate pollutants released in the atmosphere (Gualtieri, M., et al., 2005).

3.4 Contributors to Newark Air Pollution

The contributors to Newark's air pollution involve mobile sources traveling on Routes 1 and 9 and Route 22 and Route 78, the Garden State Parkway, and the New Jersey Turnpike. These roads are the major highways leading in and out of Newark. In addition to these major highways, there are other important contributors such as the Newark-Liberty Airport, the port and all the diesel trucks from port activities, and local roads and intersections traveled by many residential cars, trucks and buses. All of these anthropogenic transportation activities contribute to the high traffic density in Newark (See Figure 3.5).

It is important to note that the South Ward of Newark is the closest host to the Newark-Liberty Airport. As a major airport, the Newark-Liberty Airport typically includes not only on-road vehicles such as cars, buses and trucks, but non-road vehicles such as aircraft, cranes, trains, luggage transport vehicles and construction equipment.

Consequently, the Airport is a site that houses many on-road and non-road diesel vehicles on its property. Due to the Newark-Liberty Airport location in the South Ward, the South Ward community is exposed to all of the Airport's diesel vehicles, which are the major contributors to Newark's particulate air pollution.

Possible Contributions to Particulate Air Pollution in the Newark Community (Essex County)

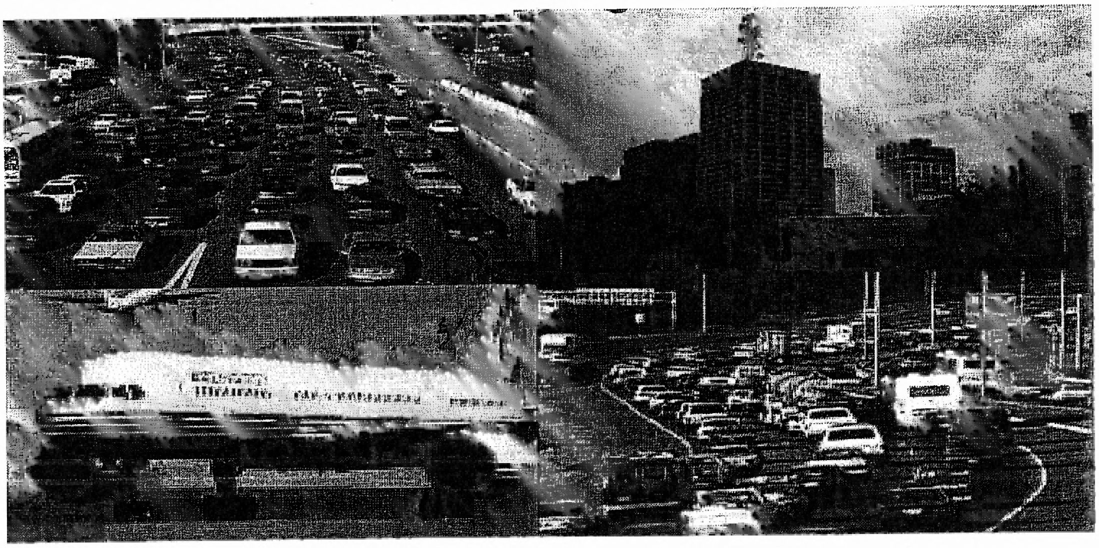


Figure 3.5 Depending on the particular Newark Ward, the school community is exposed to levels of particulate pollutants being released from cars, trucks, buses and aircraft traveling into and out of Newark. (Source: goNewark.com)

This paper focused on the possible contributors to Newark's particulate air pollution. The research data was initially collected and analyzed with respect to the North, South, East, West and Central Wards, which are the five Wards that make up the City of Newark. The adverse health effects experienced by the Ward community children determined which two of the five Wards would be further reviewed to identify the specific contributors to the targeted Wards' air pollution.

There appears to be a major environmental problem in New Jersey; and that problem is whether or not there is an association or possible correlation between the increase in on-road mobile source traffic and an increase in the health risks of those low-income minority asthmatic children or children with respiratory illnesses who live and play near these traffic areas. This dissertation research identified and discussed whether or not there was a possibility of developing a health-based environmental policy that educates the environmental justice community as to the environmental health consequences of driving vehicles, especially older less expensive vehicles, in this community. The discussion included incorporating innovative approaches to address improving the air quality of the preschool classrooms and/or the overall indoor air pollution in the East and South Ward communities.

The principal purpose of this dissertation case study was to provide the baseline data and scientific documentation to support the need to improve the environmental indoor air quality of preschools located in environmentally burdened urban areas such as Newark. It was also designed to foster partnerships that involve meaningful open dialogue between parents, local government officials, health-care educators, and community representatives. Through these partnerships, the scientific data obtained from this dissertation research was presented to the community during Environmental Forums in an effort to educate the environmental justice community-at-large so that its members were able to create alternative resolutions, innovative approaches and school intervention to address their environmental health concerns. Using education to empower the school community members allowed the Newark Preschool Council to develop an indoor air pollution improvement plan and environmental-health policy for the City of Newark's Preschool Council and its Head Start Programs.

CHAPTER 4

PARTICULATE MATTER IN THE ATMOSPHERE

4.1 Introduction: Findings of Previous Research on Air Particulate Matter and their Main Sources

Particulate air pollution consists of both solid particles and liquid-like droplet aerosols suspended in the atmosphere (New Jersey Department of Environmental Protection, 2001). Urban air is further polluted by organic and inorganic gases as well as these aerosols and solids; these pollutants emulate from many sources. These air particulate emissions and their atmospheric transformations damage the environment and public health (Samet, J., et al., 2004).

Airborne particulate matter is of particular concern because of epidemiological findings that have linked current levels of airborne particulate pollutants to a growing list of adverse health effects (Samet, J., & Cohen, J., 1999). These airborne particulate matter can be directly emitted (i.e. vehicle heavy metal containing soot, windblown road dust, tire dust, etc) or they can be formed in the atmosphere from reactions of gaseous emissions, such as, sulfur dioxide and nitrogen oxides (see Figures 4.1 and 4.2 respectively). Regardless of the formation mechanism, particulate pollutants are categorized according to the size.

Literature studies that are presented in this chapter are on the characterization and identification and health effects relating to different types and different classifications of particulate air pollution. Some specific studies relating to urban areas and weather data relating wind patterns in Newark are also presented and evaluated. Analysis of this data suggests target areas and particulate collection for further study in this thesis.

4.1.1 Background Information on Physical and Chemical Properties of Particulate Matter in the Environment

Total suspended particles (TSP) usually include particles that are less than or smaller than 10 microns, which means that they are inhalable so, they were the basis for the first federal health standards for particulate matter (USEPA-Compendium Method IO-2.1, 1999). Based upon this particulate matter (PM) rating, inhalable TSP would include both PM_{10} and $PM_{2.5}$ with no distinction being made between the two different morphological types of particulate matter being inhaled nor their source speciation (USEPA-Compendium Method IO-2.1, 1999). This fact becomes important in understanding the legal intent of the federal environmental laws, which continue to set the standards for the regulation of particulate matter and its release into the atmosphere.

The characterization of inhalable particles that are less than 10 microns in diameter (PM_{10}) are referred to as "coarse" particles. They come from windblown dust, tire dust or industrial grinding operations. Inhalable particles that are less than 2.5 microns in diameter ($PM_{2.5}$) are characterized as "fine" particles. Primarily, fine particles originate from fuel combustion (i.e. cars, buses, trucks, airplanes) power plants and diesel engines (New Jersey Department of Environmental Protection, 2001) (See Figure 4.1).

Mass Classification of Particulate Matter

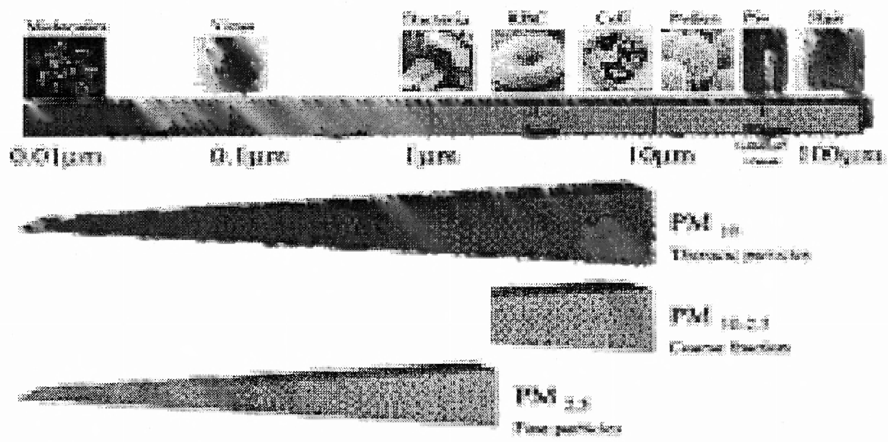


Figure 4.1 – Schematic of typical Total Suspended Particles (TSP) having a mass distribution that results in two classifications based upon particle size: Course particulate matter (particle size less than10μm and greater than 2.5μm) and Fine particulate matter (particle size less than 2.5μm). (Source: *Circulation*, 2004)

In addition to the distinction made between fine and coarse particles with respect to their mass distribution, there is a second distinction made between particles emitted directly into the atmosphere and those particles formed from gaseous emissions. Particulate matter that is directly emitted into the atmosphere is known as primary particles. Particles are formed in the atmosphere from gaseous emissions and chemical reactions are secondary particles (New Jersey Clean Air Council Report, 2004).

Particles can enter the atmosphere by either being directly emitted as primary particles or by being formed in the atmosphere by reaction (as a function of time) of gases that are/ were emitted, these are known as secondary particles. One question might be – which process (i.e. direct emissions or formation via chemical reaction) contributes a higher percentage of particulate matter in the atmosphere. Scientific research on urban areas has answered this question because it has determined that most trace metals and air particulate pollutants released during traffic have their origin from vehicle wear products as opposed to vehicle exhaust emissions (Harrison, R., et al., 2003). Therefore, a closer look was given to the particle content of vehicle exhausts and the particle content coming from traffic induced vehicle wear products such as rubber tires, tire dust and brake dust.

Particulate organic matter is a combination of many individual compounds. The organic constituents of atmospheric particulate matter include water soluble and insoluble organic compounds. They also include major components such as sulfate, nitrate, elemental and organic carbon (Turpin, B.J., et al., 2000). There are a variety of transition metals such as zinc, nickel, lead, manganese and vanadium detected in particulate matter (Brook, R., et al., 2004). All of these facts make the collection and analysis of speciation data complex.

To add to the complexity in obtaining speciation data, particulate matter occurs in the atmosphere by either being emitted as is (i.e. vehicle emissions, soot, and road-dust), or particulate matter is formed in the atmosphere through photochemical reactions (Turpin, B.J., et al., 2000) seen as photochemical smog (see Figure 4.2).

Particulate Matter (PM) in the Atmosphere

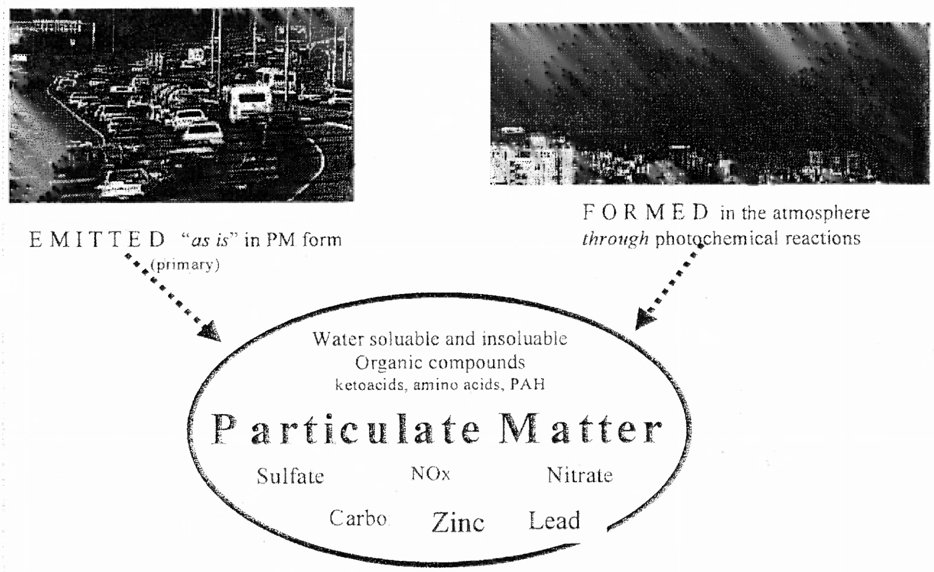
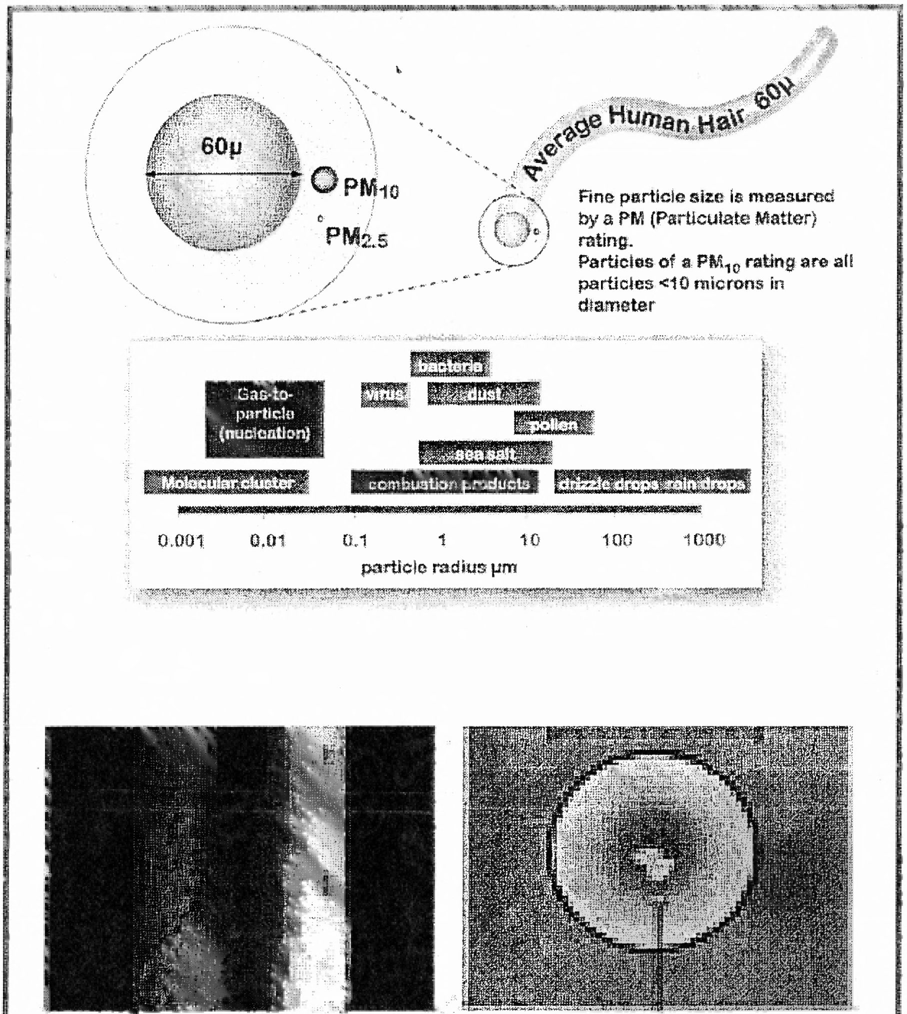


Figure 4.2 Particulate Matter enters the atmosphere by two different ways: 1) emission or 2) formation.

In addition to how particulate matter enters the atmosphere, the size of particulate pollutants is also important to human health. Because particles greater than 10μm in diameter are naturally filtered out, particulate matter has been identified as being associated with adverse health effects when the size of the particle has a particulate rating of PM_{10} or $PM_{2.5}$. In order to place the particle size rating into a natural understanding for comparisons, literature studies have established that the size of PM_{10} and $PM_{2.5}$ is significantly smaller than the diameter of one single strand of human hair (see Figure 4.3).

Specific details on the chemical and physical composition in particulate matter along with mobile source information are presented later in this chapter.

Particle Diameter for Air Particulate Matter and Human Hair



Human Hair
60µm diameter

Particulate matter (soot particle)
cross-section 10µm diameter

Figure 4.3 Particulate matter (PM) has a particle size PM rating of less than 10µm diameter (PM_{10}) or less than 2.5µm diameter ($PM_{2.5}$) in comparison to human hair 60µm diameter.

(Source: http://earthsciences.gsfc.nasa.gov/metadot/index.pl?d=2679)

4.1.2 Background Information on Relations of Particulate Matter to Health, Amplification in Children and Asthma Exacerbation

Since children represent a sensitive sub-population regardless of whether or not they are part of an urban population, adverse health effects of particulate matter may be seen in urban children even at particulate levels lower than the PM_{10} federal standards for particulate matter (Dockery, D.W., et al, 1999).

In order to assess exposure to air pollution from traffic of subjects living near motorways, traffic related air pollutants were measured indoors and outdoors in six city districts near motorways in the West of the Netherlands. PM_{10} concentrations in schools were found to be higher in comparison to outdoor concentrations (Roorda-Knape, M., et al., 1998).

New Jersey regulates ambient air particulate levels of total suspended particles (TSP), which may be emitted into the air and cause air pollution, under the state's Air Pollution Control Regulations Title 7, Chapter 27 of the New Jersey Administrative Code (N.J.A.C. 7:27).

Some epidemiological research and investigations that used panel data have documented an association of air particulate matter (PM_{10}) with asthma exacerbation (Pope, C.A., 1992). A Los Angles, California study that looked at the effect of ambient air pollution on African-American physician-diagnosed asthmatic children, found that several measures of asthma exacerbation were associated with particulate air pollution (Ostro, B., et al., 2001). This same Los Angeles study was among the first panel designs to focus specifically on the effect of ambient air pollution on inner-city African-American children (Ostro, B., et al., 2001). This study was consistent with other epidemiological studies, which suggest that acute exposure to ambient particulate pollutants is associated with the exacerbation of respiratory symptoms in asthmatics (Ostro, B., et al., 2001).

A Southern California study determined that one-year exposures to PM_{10} were associated with increasing bronchitis and coughing in asthmatic children. Exposure to PM_{10} had a greater effect on asthmatics than exposure to ozone (McConnell, R., et. al., 1999). Separately, in an Alpine, California panel study, the researchers reported associations of asthma symptoms in schoolchildren with ambient air pollutants. These pollutant associations were found even at relatively low concentrations (Defino, R., et al., 2002).

When looking at the synergistic effects of ambient air pollutants, a panel study of Seattle-Area children with asthma showed that an increased exposure to the air pollutants carbon monoxide (CO) and particulate matter (PM) was associated with an increased chance of at least one mild asthma symptom. However, there was no association between PM_{10} and respiratory symptoms in non-asthmatic children, which suggests that children with asthma are more susceptible to adverse health effects of this air pollutant (Yu, O., et. al., 2000). Even though the actual air pollutant exposure level and the ambient source pollutant loading for each child study was a function of the amount of time spent outdoors, building ventilation and pollutant-specific penetration, the PM was shown to easily penetrate into a sample of Seattle homes (Yu, O, et. al., 2000). This same panel study concluded that symptoms of asthma aggravation in children with asthma were associated with outdoor air pollutants emitted from various combustion sources (Yu, O., et al., 2000).

Indoor Air Particulate Matter and Specific Exacerbation in Children

Unlike ambient air particulate matter, indoor air particulate pollutants are not federally regulated. This presents several environmental problems with respect to establishing standards that may be used as environmental indicators to address indoor environmental health risks to children. While there is no regulation on indoor air particulate levels, it is generally considered by the USEPA and the NJDEP that indoor air levels should follow, that is, be less than or not greater than the levels set by these agencies for ambient (outdoor) air.

Indoor and outdoor airborne particulate pollutants may come from many different sources. Some sources are natural, such as, pollen or road dust. Other sources are anthropogenic, such as, fast food operations, vehicle gas exhausts (Liu, W., et al., 2003) or tire-wear (Councell, T., et al., (2004). Investigations in Los Angeles, California have found associations between respiratory symptom occurrences and environmental factors such as particulate air pollution (Ostro, B., et. al., 2001). Exposure to environmental factors such as indoor and outdoor air particulate matter has, therefore, been hypothesized as a partial explanation for the increased incidence of asthma in African-American children (Ostro, B., et. al., 2001).

Children spend on an average 20 hours a day indoors (Etzel, R., 1995). A significant portion of a child's total personal exposure to ambient particulate pollutants therefore, occurs in indoor environments along with particulate pollutants of indoor origin such as gas-fired ranges and ovens. Some physical activity by the children and teachers also occurs indoors in these situations and the pollutant loading is also relevant here (Long, C.M., 2000). Because of these indoor sources, indoor particulate concentrations are sometimes much higher than ambient concentrations (Long, C.M., 2000). Moreover, according to the Harvard School of Public Health, there is a significant possibility that exposures to indoor particles of ambient origin or indoor origin may be associated with adverse health effects (Long, C.M., 2000).

A 1999 Maryland study on the inner-city environment of asthmatic children, demonstrated that the prevalence and severity of asthma has increased in the last 20 years, with the greatest increase seen among children and young adults living in the United States' inner cities (Eggleston, P., et al., 1999). In this study, the rate of asthma among children six months to 11 years of age was only 3.0% in Whites, while being 7.2% in Blacks/African-Americans. The reasons for this increase included environmental exposures to pollutants and psychosocial stresses of living in poor inner-city neighborhoods (Eggleston, P., et al., 1999).

It was determined that the dosimetry of particulate pollutants in the human respiratory tract was very important in the evaluation of potential risks to health from inhaling particulate matter (Asgharian, B., et al., 1999). Note: A Chemical Industry Institute of Toxicology (CIIT) study defines the term "dosimetry" as referring to estimating or measuring the quantity/dose of particulate matter at a specific target site at a particular point in time (Asgharian, B., et al., 1999).

Airborne particulate matter is a major component of urban air pollution. Particulate Matter that is found in urban areas can induce bronchial inflammation by penetrating in airways. Furthermore, transition metals in particulate matter may damage the airways in the human respiratory system. Transition metals have caused lung injuries in animal experimentation (D'Amato, G, et al, 2002).

Literature pertaining to the particulate inhalation and toxicological effects on human tissues as target sites has shown that when it comes to inhaled particulate pollutants, it is important to identify the pathway from the emission source to the target site in order to know the effect. Therefore, the effect would be the link between the concentration and size of the air particulate matter and the dose of the particulate pollutants at the target site (Asgharian, B., et al., 1999). As stated earlier in this Section, because children are a <u>sensitive</u> subgroup, low PM concentrations, which are even lower than the NAAQS for PM, still may place children's health at risk. Consequently, this study relied upon the aforementioned literature data regarding particulate inhalation toxicity and its risks to children's health.

4.2 Legislative Intent of Clean Air Act

In 1971, the federal Clean Air Act (CAA) gave USEPA the authority to regulate levels of particulate matter. USEPA was mandated to establish National Ambient Air Quality Standards (NAAQS) in order to protect the public health. USEPA decided that these standards must allow for an adequate "margin of safety" (42 USC 7409(b)(1)). The USEPA implemented Congress' intent by establishing standards (NAAQS) that were based solely upon controlling total suspended particles (TSP).

The USEPA has established NAAQS for particulate matter because, as one of the six criteria air pollutants, particulate matter is regulated due to the overwhelming scientific evidence to support its association with respiratory illnesses and overall public health and welfare. In addition, lead has also been identified as a criteria air pollutant because of its possible association with human carcinogenicity (Holgate, S.T., et al., 1999).

Ambient air particulate pollutants are federally regulated by the EPA under the Clean Air Act (CAA) and have established National Ambient Air Quality Standards (NAAQS) (Clean Air Act, 1990). Under the CAA, the EPA promulgated the NAAQS for particulate matter (PM) with respect to total suspended particles (TSP). The ambient particulate pollutants with an aerodynamic diameter of 10 μm or less (PM_{10}) according to EPA have an average 24-hour NAAQS set at 150μg/m3 while ambient particulate pollutants 2.5 μm or less in aerodynamic diameter ($PM_{2.5}$) have the 24-hour standard set at 65μg/m3 (USEPA, 1997). The Health Effects Institute (HEI) has stated that the rationale for EPA's additional ambient standards for $PM_{2.5}$ was to provide increased protection against a range of health effects related to this particle-size (HEI, 1999).

A recent study in the Journal of the American Medical Association (JAMA), stated that asthmatic children who use maintenance medication are extremely vulnerable to outdoor fine air particulate pollutants even at levels below the USEPA standards (Gent, J., et al., 2003). This study demonstrated susceptibility and suggested that the standards for these particulate pollutants should be lower for these children.

4.3 Federal Regulation of Particulate Matter: Clean Air Act (CAA)

The USEPA set primary and secondary standards for total suspended particulate matter (TSP). **Primary** referred to those standards were "health-based" while **secondary** standards were "welfare-based". These standards consist of the following four elements, 1) An indicator, which in the case of particulate matter is a size-selective sample instead of a specific chemical; 2) A numerical concentration level; 3) An averaging time for the level; and 4) A statistical form (Holgate, S.T., et al., 1999).

By applying the four elements, the USEPA has established that a 24-hour average standard for TSP is based on the arithmetic average concentration from midnight to midnight. The **primary** 24-hour average standard for TSP (health-based) is set at 260 micrograms per cubic meter ($\mu g/m^3$) midnight to midnight. The **secondary** 24-hour average standard for TSP (welfare-based) is set at $150\mu g/m^3$, midnight to midnight (New Jersey Department of Environmental Protection, 2001). While these standards are federal and state standards for TSP, the **primary** 24-hour average standard for PM_{10} mass concentrations (health-based) is $150\mu g/m^3$ (Refer to Table 4.1).

4.4 Historical Overview of Ambient Particulate Matter Standards

In 1971, the USEPA further redefined its standards and set the **primary** and **secondary** 24-hour average standards for inhalable TSP as well as 12-month (annual) standards for inhalable TSP. In further actions, the USEPA later replaced the standards for TSP with standards for PM_{10} and $PM_{2.5}$.

In 1987, the USEPA replaced the TSP standards with standards for inhalable coarse particles, defined as particles less than 10 microns in diameter (PM_{10}). The NAAQS for the inhalable particulate matter (PM_{10}) for a **primary** 24-hour averaging period were set at 150μg/m3 (Table 4.1).

While maintaining the existing standards for PM_{10}, in 1997, the USEPA promulgated new standards for fine particulate pollutants, which were defined as particles less than 2.5 microns in diameter ($PM_{2.5}$). The NAAQS for the inhalable particulate matter (PM $_{2.5}$) for a **primary** 24-hour averaging period (health-based) were then set at 65µg/m3 (See Table 4.1). The USEPA stated that these new standards were necessary because more recent epidemiological studies, published in the 1990s, indicated a consistent association between small short-term increases in PM levels and increases in the morbidity rates from respiratory illnesses (Dockery, D.W., et al., 1993).

In addition to these finding, a mass distribution with long-term exposures to low levels of fine particles ($PM_{2.5}$) was associated with adverse health effects even at levels well below existing regulatory national ambient air quality short-term (24-hr) standards (Dockery, D.W., et al., 1993). Coarse particles (PM_{10}) have also been associated with adverse health effects at levels well below the existing regulatory national ambient air quality short-term (24-hr) standard of 150µg/m^3 (See Table 4.1).

Table 4.1 USEPA: Primary National Ambient Air Quality Standards (NAAQS) for Particulate Matter

Particulate Matter (PM)	**Health-based (NAAOS)** 24-hour averaging period
Total Suspended Particulate Matter (TSP)*	260µg/m^3
PM_{10}	150µg/m^3
PM $_{2.5}$	65µg/m^3

Between 1987 and 1997, as seen in Table 4.1 * USEPA replaced the TSP standard with "size-selective" standards for particulate matter (PM_{10} and PM $_{2.5}$ respectively).

According to the New Jersey Department of Environmental Protection 2001 Particulate Summary Report, the state does have twenty fine particulate ($PM_{2.5}$)

monitoring sites and nine PM_{10} monitoring sites. The air particulate mass concentration data results for this dissertation research were compared to the national standards for PM_{10} mass concentrations at a 24-hour averaging period (Table 4.1).

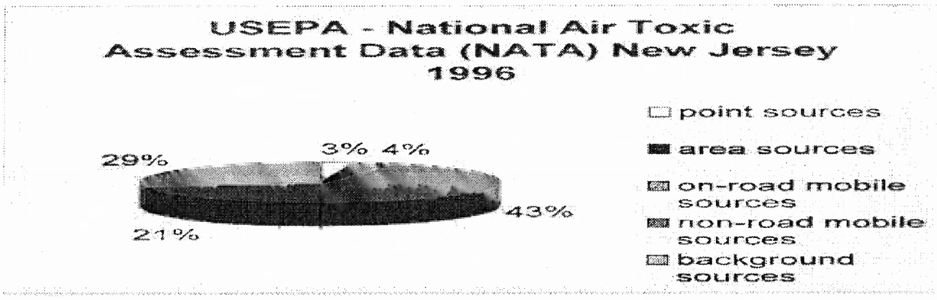
4.5 Single Pathway Analysis and Conceptual Framework for Particulate Matter

A single pathway is described as movement and exposure through one media (Bibler, G., and Mason, E., 2005). Vapors and particles have the ability to migrate or move from one point to another. Therefore, the single pathway of particulate matter depends upon whether particulate matter is directly emitted from mobile sources like tire dust, or is formed from reaction in the atmosphere by chemical pollutants released from vehicle exhausts. These reactions often generated aerosol particles initially, which then may further react to form more solid particulate matter. The later is evidenced by a brown haze formed as photochemical smog (See Figure 4.2).

Other environmental factors like seasonal variability, particle size, and meteorological conditions, also play a role in determining the single pathway of particulate matter. Studies have shown that the pathway for metals in particulate matter, especially Zn, Pb and V, has significant seasonal variability in urban areas (Lee, D., et al., 1994). The pathway for these metal particles ultimately varied with increases in traffic density, diesel fuel usage, and space heating from oil combustion; respectively (Lee, D., et al., 1994). The pathway for the Zn, Pb and V metal particulate pollutants was more stable during winter months than summer months. This was attributable to the greater frequency of stable atmospheric conditions during the winter months (Lee, D., et al., 1994). In this same study, however, the Ni metal particulate pollutants' seasonal variability was not established as being statistically significant at most of the sites.

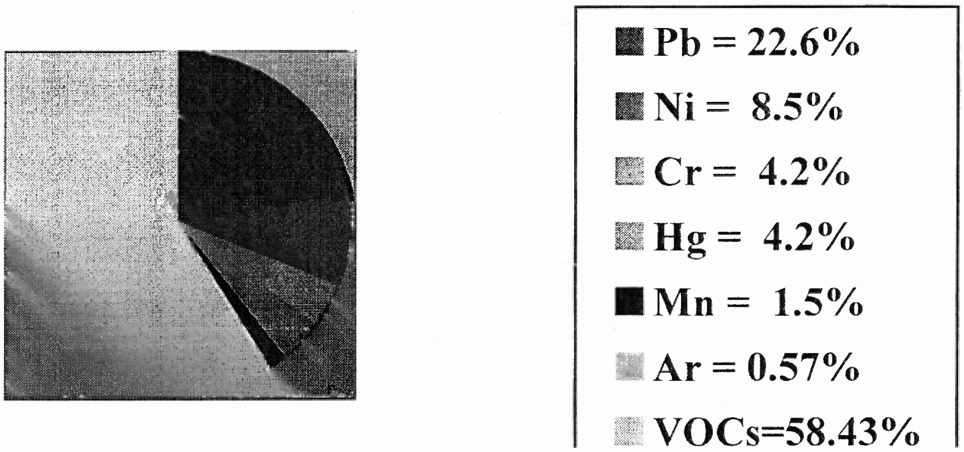
In further analyzing the single pathway for particulate matter, environmental data supports the position that 64% of the air pollution in New Jersey is created by the transportation sector with mobile sources releasing chemicals from vehicle exhausts (Figure 4.4A).

The more than half of the chemicals that make up the 64% transportation sector are Volatile Organic Compounds (VOCs) being released from on-road and non-road non-diesel mobile sources (See Figure 4.4B). Examples include small hydrocarbons like acetylene, and benzene in addition to carbon monoxide. This means that the pathway for the particulate matter formed from the chemical reactions with some of these VOCs would also be volatile and less stable dependent upon the season.



A

Total National Emissions of
On-Road & Non-Road Mobile Sources from Gas Exhausts



B

Figure 4.4 A and B - A). The Transportation sector in the form of mobile sources (i.e. vehicles, trucks, buses and airplanes) accounts for sixty-four percent (64%) of New Jersey's air pollution. (Source: USEPA, 1996)

B). Six of the 21 on-road and non-road mobile source air toxics emitted into the atmosphere are metal particulate compounds (lead, nickel, chromium, mercury, manganese and arsenic).
(Source: National Air Quality and Emissions Trends Report, 1999)

As seen in Figure 4.4B, the six metals in particulate matter contribute only 41.57% of the on-road and non-road total non-diesel mobile source air toxics, while Volatile Organic Compounds (VOCs) and other air pollutants account for the remaining 58.43% (National Air Quality and Emissions Trends Report, 1999). In contrast, on-road diesel vehicles, account for 72 percent (by mass) of New Jersey's air particulate pollution (See Figure 4.5).

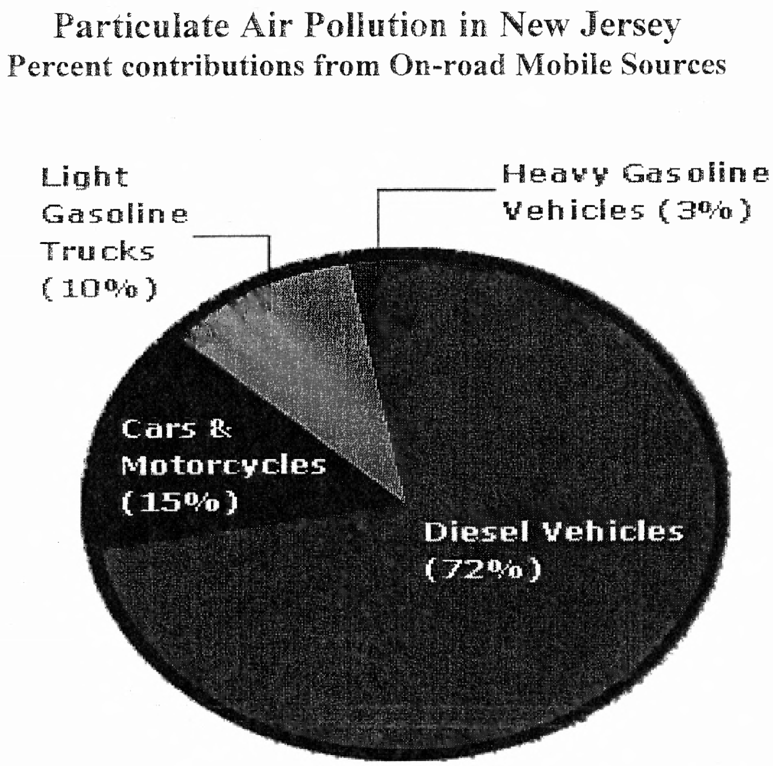


Figure 4.5 The major contributors to New Jersey's Particulate Air Pollution are cars, buses, and trucks with diesel engines. These diesel vehicles account for 72 percent (by mass) of the State's particulate air pollution. (Source: USEPA, 2001)

4.6 Physical Properties: Particle Size and Mass Concentrations of PM_{10}

The "suspended" portion of ambient particulate matter usually occurs in a particle size range up to approximately 40μm in diameter. Any particles greater than 40μm will be too heavy to be suspended. Therefore, they will settle out from the air. The remaining particles are termed "Total Suspended Particles" (TSP). Of the suspended portion of particulate matter still remaining in the atmosphere, any particles greater than 10μm in diameter will not be inhalable. This research work focused on thoracic and coarse particulate matter having a particle size of less than 10μm in diameter (PM_{10}) (Figure

4.6). TSP includes both PM_{10} and $PM_{2.5}$; and PM_{10} refers to all particles less than 10μm in diameter, as seen in Figure 4.6, where the PM_{10} class includes $PM_{2.5}$. The particulate air sampling for this research was completed specifically for PM_{10} as opposed to the TSP mass concentration because more PM_{10} would be deposited in the tracheal and thoracic regions, which are the respiratory regions of concern in this research.

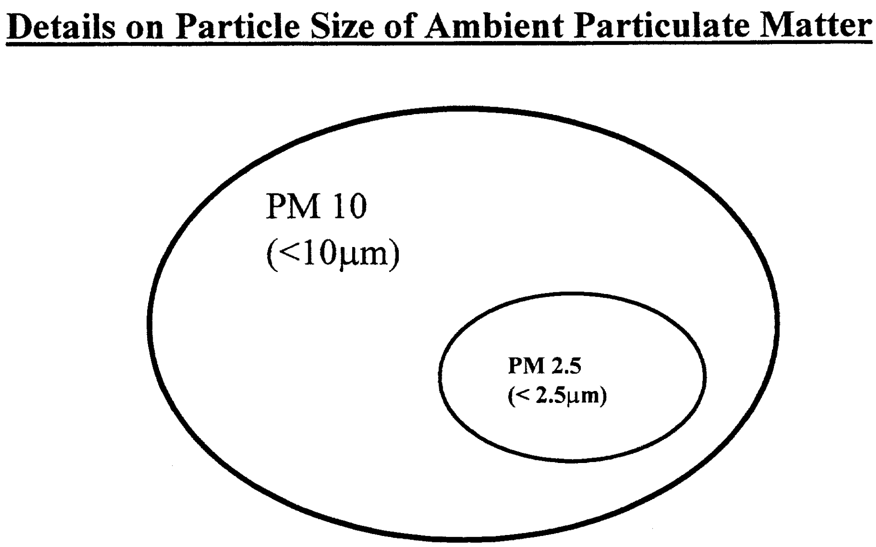


Figure 4.6 – Total Suspended Particles (TSP) found in ambient air consist of ambient particulate matter classified according to particle size. PM_{10} refers to all particles less than 10 μm in diameter resulting in $PM_{2.5}$ being a subset of PM_{10}.

4.7 Chemical Properties:
Chemical Composition of Particulate Matter (PM) and Direct Particle Emissions versus Particle Formation in the Atmosphere

Much of the particulate matter in the atmosphere is not visible to the naked eye. In addition, these very small particles or particulate matter (PM) are composed of different components and exist in different forms. Some particles exist as small solid carbon particles, some are spherical liquid particle aerosols made up of ammonium sulfate and water, while other particles are metals. The organic particles can be viscous and oily as a result of petroleum combustion processes while other particles condense and absorb onto pre-exiting particles existing as the coating on other particles (Turpin, B., 2004).

The chemical composition of particulate matter (PM) may affect its origin. It is therefore important to analyze this characteristic of particulate pollutants. The source of particulate matter is often determined by its chemical composition. That is the elemental composition of PM can be used to identify its source (Janssen, N.A.H., et al., 1999). For example, an Amsterdam study showed high indoor concentrations of particulate matter contained elements from the earth's crust. These included silicon (Si) and calcium (Ca), which were probably present due to re-suspension of particles brought in from the soil on the shoes of the children. Traces of chlorine (Cl), which probably resulted from indoor cleaning sources, were also noted (Janssen, N.A.H., et al., 1999). Note: The Newark preschools in this thesis are approximately one mile from the Newark Bay, which is tidal. Chlorine that could originate here could come from sea spray.

As stated in Section 4.1, particles that are emitted directly into the atmosphere are known as primary particles. Particles that are formed in the atmosphere through photochemical reactions involving gases and other particles already present in the atmosphere are known as secondary particles. The chemical composition of primary particles usually consists of elemental carbon. Secondary particles are usually composed of ammonium sulfate and nitrate (Holgate, S.T, et al, 1999).

Particulate matter that is emitted from various crustal (naturally occurring from the earth's crust) and anthropogenic sources (from human activities) will often differ in chemical composition. Primary particulate matter emitted directly into the atmosphere from the earth's crust contain Si and Ca elements and usually occur in the coarse fraction

(Janssen, N.A.H., et al., 1999) (See Figure 4.7). Particulate matter can also be emitted from fuel combustion in mobile sources like poorly maintained cars, trucks and airplanes. Particulate matter (PM) from combustion exits in the form of soot and smoke from gas exhausts. PM can also be emitted from fuel combustion in coal, oil and electrical power plants, industrial boilers, fast food restaurant operations that charcoal-broil their food and residential heating. This particulate from combustion can exist in the form of soot and or aerosols composed of hydrocarbon vapors. It can also contain hydrocarbon vapors which can react with other pollutants in the air to form aerosols and ultimately particulate. Heavy trace metals such as, zinc, manganese, lead, and nickel are part of the chemical composition of particulate pollutants that are emitted from the aforementioned sources (EPA-National Air Quality and Emissions Trends Report, 2001).

Organic particulate matter is also formed in the atmosphere when volatile organic compounds (VOCs) and NOx are present in the atmosphere along with acidic sulfate. The mixture undergoes a chemical reaction in sunlight to form aerosols and organic particulate matter. As a result of these chemical reactions that occur in the atmosphere, sulfate, nitrate and organic matter can drastically alter the chemical composition of these secondary ambient airborne particles formed in the atmosphere, (New Jersey Clean Air Council Report, 2004) (Figure 4.7). Note: NOx is formed in internal combustion engines, gasoline and diesel, as well as other combustion sources.

Diagram of Chemical Composition of Typical Urban Atmosphere

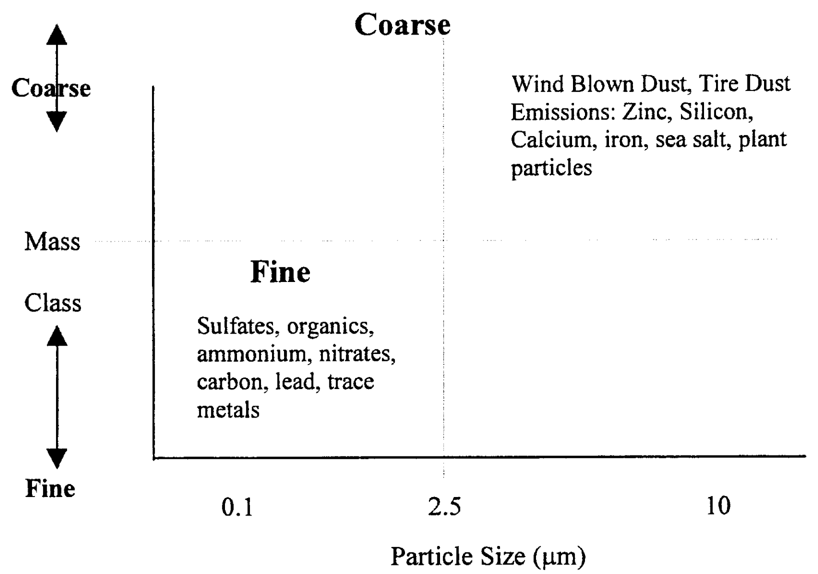


Figure 4.7 – Schematic for mass distribution of particulate species found in typical urban atmosphere. Listed in order of relative mass contribution. (Source: U.S. EPA, 2004).

Since the chemical composition of outdoor PM can undergo partial exchange with indoor air by transport of primary combustion particles (outdoor – indoor Turpin, B., 2004), it is, therefore, feasible that chemical composition of PM_{10} in classrooms (indoor air) could have similarities with the composition of PM_{10} in ambient (outdoor) air (Janssen, N.A.H., et al., 1999). The indoor air may also have some different chemical constituents resulting from indoor sources such as sheetrock or plaster dust, mold, etc.

During the spring and summer months, when the outdoor temperature is hot, the photochemistry occurs faster and much more may occur in a daylight period. Atmospheric kinetics researchers often use the general textbook rule that reactions are on the order of three times faster for every 10°C (18° F). Therefore, concentrations of all of the secondary particles formed in the atmosphere will increase. This causes $PM_{2.5}$ concentrations to also increase (New Jersey Clean Air Council Report, 2004).

Children, are obviously smaller in mass than adults and therefore, inhale more air per pound of body weight and hence more pollutants on a relative scale than adults. It is therefore not s surprise that this research has shown that during the warmer months, there are significant associations between the prevalence of lower respiratory symptoms and high concentrations of particulate matter inhaled by children (Schwartz, J., et al., 1994).

4.8 Single Medium Fate and Transport

The medium for PM in this research was the wind or atmosphere. The atmosphere is a medium that is characterized as having no borders. Therefore, when PM is transported by the prevailing winds, it transverses a number of boundaries; it is therefore termed a "transboundary" pollutant that disregards jurisdictional borders between nation- states and cities (Sundqvist, G., et al, 2002). Health risks posed by airborne particulate pollutants have placed pressure on environmental policy-makers to review safety measures and to develop pollution abatement strategies. Introducing pollution abatement strategies and effective abatement technologies that address transboundary air pollutants such as, particulate matter is a critical part in any successful merge between environmental science and policy.

4.9 Single Receptor Site

The single receptor site for this research work was the sub-population of children. As stated at Section 4.7, children inhale more air per pound of body weight than adults. This results in a significant association between the increased prevalence of lower respiratory symptoms and high concentrations of particulate matter inhaled by children

(Schwartz, J., et al., 1994). In addition, the lungs of children are still developing. These physiological and developmental factors make children a sensitive single receptor site with an increased prevalence of health risks.

4.10 Source of Metal Particulate Pollutants in the Atmosphere

It is reported by the USEPA that the major contributors to particulate air pollution are mobile sources (See Figure 4.4A and Figure 4.4B). However, these sources of particulate matter can be further divided into the exhausts of on-road and non-road mobile sources (Table 4.2) plus the products of vehicle wear such as, tire abrasion, brake dust, etc.

Table 4.2 EPA- List of 21 Mobile Source Air Toxics (MSATs)
[On-road and Non-road emissions]

Acetaldehyde	Diesel Particulate Matter + Diesel Exhaust Gases	MTBE
Acrolein	Ethylbenzene	Naphethalene
Arsenic Compounds	Formaldehyde	**Nickel** Compounds
Benzene	n-Hexane	POM –Polycyclic Organic Matter
1,3 Butadiene	**Lead** Compounds	Styrene
Chromium Compounds	**Manganese** Compounds	Toluene
Dioxin/Furans	**Mercury** Compounds	Xylene

(Source: EPA-National Air Quality and Emissions Trends Report, 1999)

According to the 1999 EPA-National Air Quality and Emissions Report, in addition to volatile organic compounds (VOCs), and other chemicals such as nickel, manganese, lead, chromium, arsenic, and mercury metal particulate pollutants (identified in **bold** in Table 4.2) are released from the exhausts of on-road and non-road mobile sources. These same metal air particulate pollutants were also found on the USEPA's Hazardous Air Pollutants (HAPs) list.

Harrison et. al. has reported that most of the trace metals in particulate matter, that are released during heavy traffic road use, originate from vehicle wear products as opposed to vehicle exhaust emissions (Harrison, R., et al., 2003). These vehicle wear products could be a significant source in an urban environment and consideration of vehicle wear products as a possible target source of particulate pollution is included in this study. Furthermore, coarse particulate matter and PM_{10} mass concentrations were found to be due to the suspension and re-suspension of soil material brought in by the children's shoes or brought in by windblown tire dusts, or road dusts (Janssen, N., et al., 1999). Some of the following literature results suggest specific targets in this type of particulate air pollution.

An Illinois study determined that an average urban vehicle emits between 30 and 40 milligrams of particulate matter per mile traveled (Lamorre, D., and Turner, J., (1999). In this study, motor vehicle-related particulate matter emissions included exhaust, tire wear, brake and clutch-wear. PM_{10} and $PM_{2.5}$ mass concentrations were measured near two major highways in a St. Louis area. The data showed PM concentrations decayed with increasing distance from the roadway. This implies that motor vehicle emission factors can be combined with vehicle fleet activity data to predict traffic-induced emissions (Lamorre, D., and Turner, J., (1999). As noted previously, studies show that the elemental composition of particles can be used to interpret what sources are important (Janssen, N., et al., 1999). The targeted metals (Zn, Ni, Pb, Mn and V) for this research, were studied because of their likely local source and to determine how these metals on particulate matter enter the urban atmosphere.

Zinc particles are released in the atmosphere from tire-wear or tire abrasion. Studies have reported that Zinc concentrations increase with increased urbanization (Councell, T., et al., 2004). These studies also demonstrated a strong relationship between anthropogenic Zn accumulation rates and average annual daily traffic. This finding suggests a causal relationship between anthropogenic Zn and traffic density (Councell, T., et al., 2004). Furthermore, one of the most abundant metals in diesel-soot is Zn (Wang, Y., et al., 2003).

Rubber tires release Zinc into the atmosphere from the tire tread during contact friction with roadways. Studies have determined that Zinc particles increase with an increase in traffic density (Breysse, P., et al., 2004); and about 20% of the total zinc found in urban air originates from tire particles. As seen in Figure 4.8, the tire tread is the outer most part of a rubber tire and depending on whether the rubber tire is for a car, truck, bus or aircraft, the percent of natural rubber used within the tire tread is different (See Figure 4.8).

Zinc Particulate Matter Emitted in the Environment

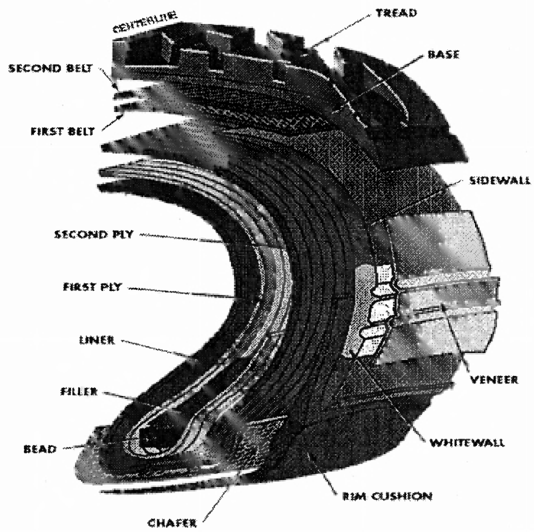


Figure 4.8 **Tire-Wear abrasion** on roadways: Rubber tires release Zinc into the atmosphere while making contact with roadways. Zinc particles increase with an increase in traffic density. Car tires use 30% natural rubber, Truck and Bus tires use 65% - 100% natural rubber and aircraft tires use 100% natural rubber. Breyse, P.M, et al, 2004; tire accidents.com

Zinc is released during tire-wear abrasion on roadways because the major component of zinc in tires is present as excess Zinc Oxide (ZnO) and Zinc Sulfide (ZnS) where these chemicals are used with a vulcaniser (Sulfur) during vulcanization. This makes Zn a major component in natural rubber, which has been vulcanized. Zinc becomes an embedded part of the isoprene rubber polymer through the rubber compounding process during the manufacturing of rubber tires.

In the manufacturing process, natural rubber undergoes compounding and curing. During this process, sulfur (S_8) is heated with rubber (isoprene) polymers and the sulfur opens up to form cross-links with the long-chain rubber polymers (elastomers). This process of forming sulfur bridges or cross-links is called "*vulcanization*" (Pauling, L., 1988) (See Figure 4.9).

Vulcanization of Rubber (Isoprene) Polymers

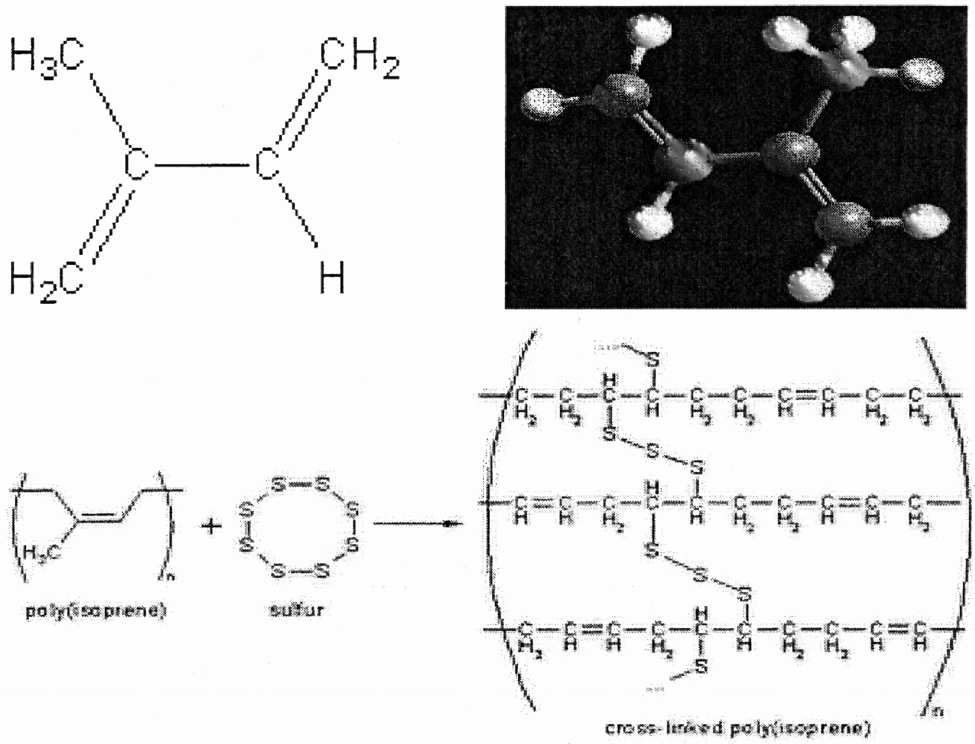


Figure 4.9 Natural Rubber consists of many long-chain polymers (elastomers) of (isoprene) arranged in a cis configuration around its double bonds. The long-chain polymers undergo cross-linking of sulfur bridges during a process called vulcanization. To reduce the time necessary for vulcanization, ZnO compound is added as an accelerator to speed up the vulcanization process. (Source: Pauling, L, 1988; and http//en.wikipeda.org)

Zinc Oxide is an accelerator that is used during vulcanization to *reduce* the time for this curing stage of rubber compounding (Kotz & Treichel, 1999 and Pauling, L., 1988). The Zinc Oxide (ZnO) abstracts the sulfur to form Zinc sulfide. In addition to using ZnO during vulcanization, Zinc Oxide is also used as a final sealant on tires to protect them against UV radiation (Pauling, L., 1988; Kotz & Treichel, 1999). Literature studies state that the Zinc content being released into the environment from ZnO is 80.3% (Smolder, E., and Degryse, F., 2002).

Re-suspended surface dusts make a large contribution to the total natural emission of trace metals to the atmosphere, accounting for greater than 50% of Mn and V, and greater than 20% of Ni, Pb and Zn (Allen, A., 2001). Combustion of fossil fuels, on the other hand, is the principal anthropogenic source of Ni and V. And, of the total Zn in urban air, 20% originates from tire particles.

In the tread material, the representative weighted average values of ZnO varied depending upon the brand name and type of tire (i.e. car tire, truck tire, etc.). For example, the weighted average value of ZnO for a car tire can have a maximum of 2.9%, and a truck tire can have a maximum of 4.3% (Smolder, E., and Degryse, F., 2002).

Methylcyclopentadienyl Manganese Tricarbonyl (MMT) has been used in non-aviation gasoline as a fuel additive since 1995. MMT can quickly break down on exposure to sunlight or within a car engine into metal manganese compounds. Manganese emitted from automobile tailpipes or exhausts in coarse and fine particles is carried to airways in the lungs. Inhalation of manganese particulate pollutants is toxic to the lungs and produces an inflammatory reaction, which increases susceptibility to bronchitis. Even low-level air exposures have been reported to increase the prevalence of respiratory symptoms in school children (Solomon & GBPSR, 1996). In addition to the metal manganese and carbon particles (Lee, P.K., et al., 2003), some other constituents such as, zinc in the atmosphere (Councell, T., et al., 2004) suggests emission during local motor vehicle traffic. As a consequence, higher concentrations of these constituents are found in the atmosphere when traffic levels are also at their highest. For example, during the early morning to noonday period (8:00 a.m. – 12:00 p.m.) and at late afternoon (approximately 4:00 p.m.) these time periods are considered peak periods (Manahan, 2001). In summary, PM_{10} is representative of essentially all of the particulate emissions from transportation sources.

4.11 Historical Meteorological Conditions for Newark

As stated in Section 4.8, airborne particulate matter is transported by the wind. This medium is characterized by its speed, direction and relative frequency of occurrence. In order to determine which of the five Wards would be targeted for this research study, a historical wind rose that is based upon the last ten years was analyzed (January 1993 through January 2003). All meteorological data input (from NJDEP Bureau of Air Monitoring) was collected regarding the city of Newark's historical wind rose and entered into researcher's computer using the USEPA Lakes Environmental software.

In reviewing the data, the wind rose depicts the relative frequency of wind direction on a 16-point compass. Projections are analyzed in a clockwise direction with four quadrants, referred to as "NorthEast," "SouthEast," "SouthWest" and "NorthWest." Each ring of the wind rose represents a frequency of 10 percent of the total. The width of the color bars represent the frequency of wind from a given direction within a certain speed range. As seen in Figure 4.10, the longest projections are in the northeast quadrant and the southwest quadrant. This means that the most common wind directions for Newark is in a northeast direction and a southwest direction. The wind comes from due northeast (blowing from east to west) more than 9% of the time. The wind comes from due southwest (blowing from west to east) approximately 12% of the time. Of the six

East Ward preschools, Terrell Homes is located most northeast in the city and is a receptor of wind blowing from south and west to the north and east (one of the major wind direction vectors). Of the twelve South Ward preschools, Greater Abyssinian –II is located southwest of the Newark industrial sector. More importantly, it is located west of the Newark-Liberty Airport and all of the major routes (New Jersey Turnpike, Route 78, Route 1 and 9, Route 22, and the Polaski Highway intersections). Both schools are east and downwind for southeast winds, of the New Jersey Garden State Parkway and the major intersection of the Parkway, Route 78 and Route 22.

As a result of this data input, Newark's five Wards were narrowed down to target the two Wards located in the areas where Newark had its strongest and most common wind direction. In the final analysis, the northeast and the southwest preschools were also chosen using this method for identifying the meteorological conditions in each Ward (See Figure 4.10).

City of Newark's Historical Wind Rose - 10 years

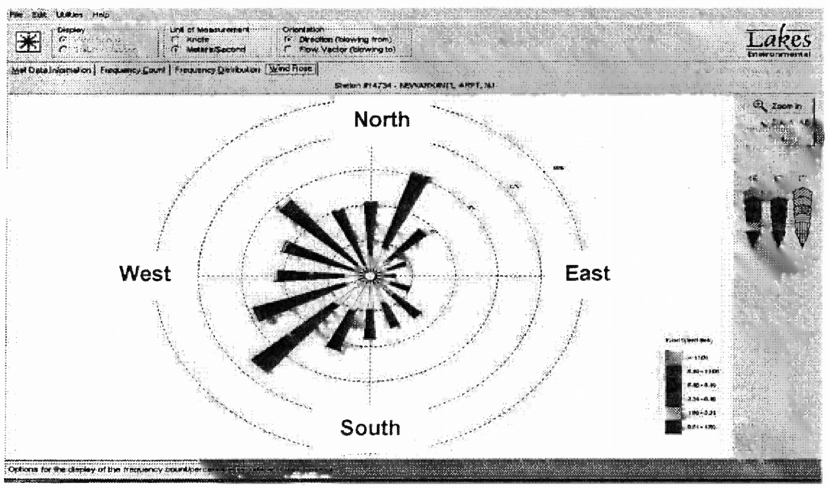


Figure 4.10 Meteorological conditions identified for each of the five Wards in the city of Newark. Over a ten-year period, winds expand the greatest in the South and East areas.

In a study, PM mass concentrations were measured upwind and downwind of major roadways. Upwind concentrations were subtracted from the downwind values to obtain traffic-induce (net) mass concentrations. The data showed all PM_{10} downwind mass concentrations greater than the upwind value (Lamorre, D., and Turner, J., (1999).

4.12 Exposure Route: Inhalation Toxicity for Particulate Pollutants

Zinc and manganese metals in particulate matter can act as respiratory irritants. Therefore, inhalation of these hazardous air pollutants can exacerbate asthma sufferers (D'Amato, G., et al., 2002). When particulate matter is found throughout the respiratory system it is referred to has being inhalable, thoracic, and/or respirable (Section 3.2). Even though inhalable particles can also be thoracic and respirable and therefore deposited throughout the respiratory tract, when they are deposited mainly in the head or throat airways they are referred to as being inhalable (i.e. $PM_{10} < 10\mu m$). As seen in Section 3.2, when particles are deposited in the thoracic airways they are referred to as being thoracic particles. When particles are deposited in the alveoli or gas ex exchange regions of the lungs, they are referred as respirable particles (i.e. $PM < 2.5\mu m$).

4.13 Ambient Particulate Pollutants and Indoor Air Quality (IAQ)

Two types of particles were involved in an indoor/outdoor environmental assessment. These particles were: 1) drawn in through the outdoor air-flow; and 2) particles generated indoors. Both types of particles may affect the quality of the indoor air because mass concentrations of PM_{10} found indoors are probably due to the re-suspension of the air particulate pollutants outdoors (Janssen, N., et al., 1999). Because of this interaction between ambient and indoor air particulate matter, ambient particulate pollutants significantly affect the quality of indoor air.

When looking at the penetration of air particulate pollutants into Boston homes, a research study took a closer look at the relative contribution of outdoor and indoor particle sources to indoor concentrations (Abt, E, et al., 2000). The data showed that air exchange rates and indoor sources such as, cooking, cleaning, and movement of people have an important effect on indoor concentration levels (Abt, E, et al., 2000). This study also reflected that outdoor particulate pollutants ranging in size from 0.02-0.5μm and 0.7-10μm contributed significantly to indoor particulate concentration levels.

Another research study compared particulate matter and manganese exposures in the city of Indianapolis, Indiana, where MMT was not used, and in the city of Toronto, Canada where MMT was used. This study showed that for PM_{10} data, there were higher indoor concentration levels than outdoor concentration levels. There were no significant correlations made for manganese exposures (Pellizzaxi, E.D., et. al., 2001).

Table 4.3, identifies some atmospheric concentrations of targeted trace metals in urban areas surrounding Newark, New Jersey (Lee, D., et al., 1994).

Table 4.3 Atmospheric Concentrations of Trace Metals in Surrounding States

City, State	Trace Metals (All units ng m^{-3})				
	V	**Zn**	**Ni**	**Pb**	**Mn**
Reading, Pennsylvania	6.75	48.3	2.91	174.7	7.1
Bronx, New York	80	289	311	1580	30.2

(Source: Lee, D., Garland, J., and Fox, A., 1994)

Summary:

The research in this (present) thesis is unique in that unlike many research studies, it focused on characterizing the main sources of indoor particulate pollutants for policy considerations. This is in addition to having the responsibility of combining environmental policy with environmental science in the data collection process and analysis. Indoor particulate matter was targeted and it required the collection of particulate mass concentration, speciation data, distribution, particle-size (Long, C.M., 2000 and Holgate, S.T., et al., 1999). It also identified children, specifically preschool children, as the main target and single receptor site.

Scientific data has determined that most of the trace metals in particulate matter, that are released during traffic, originate from vehicle wear products as opposed to vehicle exhaust emissions (Harrison, R., et al., 2003). Because wear products would be more of a total source, the researcher included a consideration on vehicle wear products as a possible target source of particulate pollution.

As a result of this meteorological analysis, Newark's five Wards were narrowed down to target the two Wards located in the areas where Newark had its strongest and most common wind direction. In the final analysis, the northeast and the southwest preschools in the East and South Wards were also chosen for data collection.

CHAPTER 5

ASTHMA AND REACTIVE AIRWAY DISEASE IN URBAN CHILDREN

5.1 Introduction: Vehicle Air Pollution and Asthma Health Risks

As discussed in Section 3.3, vehicular emissions contribute a great deal to urban air pollution at the national, state and local levels. It is now appropriate to try and review and evaluate the equation for environmental impact and changes (plausible improvements) with specific consideration of the human environment and whether or not the urban air pollution has any adverse health effects on mankind.

There have been many national and state studies regarding the possible association and scientific link between urban air pollutants and environmental health problems such as respiratory illnesses over the recent past decades (Brown, 1996). By focusing on the economic valuation of the impact of local air pollution, epidemiological research also confirmed that air pollution has a significant long-term impact on human health (Nicolas, J., et al., 2005).

This section investigates the effects of anthropogenic pollutants on asthma-specifically exacerbation directions. Literature review includes effects of particulate and chemical composition of inorganics (metals) with inclusion of both indoor and outdoor information.

5.1.1a Particulate Levels and Effects

A 1998 study of the relationship between vehicle emissions and respiratory health in an urban area of southeast Toronto presented findings supporting previous observations that vehicle emissions may adversely affect respiratory health in humans (Buckeridge, D., et al., 1998). In addition, the study showed that the level of the area exposure to particulate matter (being emitted directly from vehicles and/or being formed in the atmosphere from vehicular fuel composition products) was associated with an increased rate of respiratory hospital admissions (Buckeridge, D., et al., 1998).

Airborne particulate matter derives from a wide variety of sources. However, the major sources within most urban areas at the national, state and local levels are road traffic emissions (Harrison, R., et al., 2003). Since road traffic or busy roads are the main source of particulate matter in the urban environment, an accurate determination of the average emission factors that are involved with on-road vehicles is of major importance in evaluating the impact of vehicular pollution on human health and the environment (Gramotnev, G., et al., 2004).

An Amsterdam study determined that outdoor PM_{10} concentrations were 15 –20% higher at homes located in high traffic intensity streets compared to low traffic intensity homes even with the PM_{10} contributors remaining the same. It also supported the use of traffic-related pollution mapping as an exposure proxy in large-scale epidemiological studies into health effects of motorized traffic emission and policy development (Fischer, P., et al., 2000).

5.1.1b Specific Chemical Composition Relationships

In addition to the measurements of particle-size ($PM_{2.5}$ or PM_{10}) and their mass concentrations, the characterization of the chemical composition of particles may also be important for an assessment of health effects (Cyrys, J., et al., 2004)

Some early studies stated that repeated exposure to particulate matter and other air pollutants from traffic exhaust may aggravate asthmatic symptoms in individuals already diagnosed with asthma (English, P., et al., 1999). However, data from more recent studies supported the conclusion that most trace elements and particulate matter from traffic emissions or roadside aerosols have their origin from vehicle wear products instead of traffic exhaust emissions (Harrison, R., et al., 2003).

5.1.1c Particulate Pollutants and Relationship with Occurrence of Asthma

Whether urban air pollution involves particulate matter derived from vehicle wear products or exhaust emissions, the fact remains that an association between air pollution and asthma has been well established for more than a decade (Breysse, P., et al., 2005). Outdoor air pollution has also been associated with emergency room visits for asthma in numerous cities around the world (Schwartz, et al., 1993); but, indoor air pollutant concentrations, especially for particulate matter in inner-city or urban areas, have not been well characterized (Breysse, P., et al., 2005). Therefore, one objective of this dissertation research was to create and review the necessary scientific data on indoor air particulate matter in an urban area such as Newark.

There is an association between air pollution and asthma as recognized by the Institute of Medicine (IOM) – Division of Health Promotion and Disease Prevention when it published a Report in 2000 entitled "Clearing the Air: Asthma and Indoor Air Exposures". This Report stated that the Centers for Disease Control and Prevention (CDC) have estimated that asthma affects approximately 17.3 million individuals in the United States. It also noted that the self-reported prevalence rate for asthma increased

75% from 1980 to 1994; and that asthma is the leading chronic illness among children in the United States. The Report states that among those children, asthma mortality is disproportionately high among African-Americans in urban areas characterized by high levels of poverty and minority populations.

The premise of the IOM Report was that indoor environments may play a role in the increasing asthma problem. Since the USEPA is developing an outreach strategy that focuses on reducing asthma-related morbidity and mortality potentially associated with exposure to indoor environments, the USEPA charged the IOM committee to make an environmental heath assessment based upon two primary objectives: 1). Provide the scientific and technical basis for communication to the public on the health impacts of indoor pollutants related to asthma, and mitigation and prevention strategies to reduce these pollutants; and 2). Help determine what research would be needed in these areas.

A listing of some of the major asthma triggers is illustrated in Figure 5.1; this information has been obtained by reviewing the scientific literature regarding indoor air exposures and the environmental factors that are involved in the exacerbation of asthma. Here we find that particulate matter, which is a criteria pollutant, is on the list and has been identified by the USEPA as being an outdoor air pollutant potentially associated with asthma and other respiratory illnesses because it can penetrate the indoor environment.

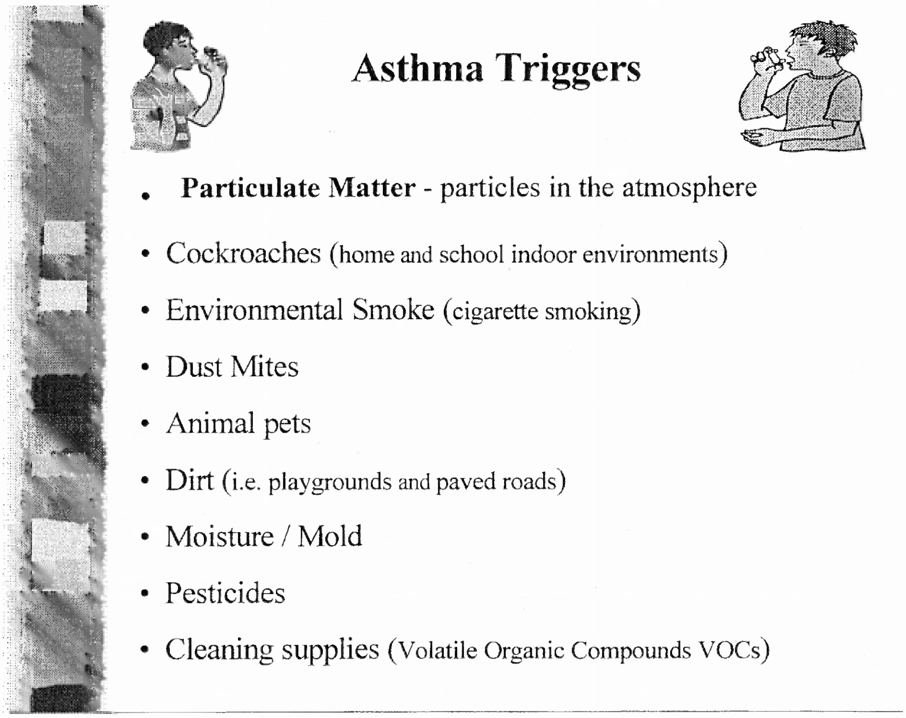


Figure 5.1 Asthma Triggers are those air pollutants that can exacerbate asthma and/or asthma-like symptoms. Particulate Matter has been identified as being associated with health risks and therefore, these particles are also referred to as "criteria pollutants". (Source: EPA and IOM Report, 2000; NJ Pediatric Asthma Coalition (PAC) Fact Sheet, 2004)

5.1.2 Primary Human Respiratory Health Effects

As stated in Sections 4.10 and 4.9; respectively, the greater the vehicle traffic density, the higher the concentrations of PM. The greater the concentrations of PM inhaled, the greater the health risks to asthmatic children or children with respiratory illnesses. This supports the conclusion that there may be an association between the higher number of registered older vehicles in such counties as Essex County and the high number of asthma hospitalization rates in Essex County (Figure 7.2). However, even if the association is positive, the school community has neither the authority, nor power to remove older vehicles from the roads. The school community therefore decided to install air pollution abatement equipment in the classrooms affected by the ambient air.

5.1.3 Asthmatic Children as a Sensitive Population for Air Particulate Matter

Since children are undergoing a developmental change that makes their lung capacity not the same as an adult. Children have been identified as representing a sensitive sub-population. As a sensitive population, children spend an average of 20 hours per day in indoor environments. In contrast, adults spend approximately 85-90% of their time indoors (Long, C.M., et al., 2001). Hence, there have been several research studies on "ambient infiltration penetration" with respect to particulate air pollution. The particulate data demonstrates that a significant portion of total personal exposures to ambient particles occurs in indoor environments (Long, C.M., et al., 2001).

5.2 Collection: Data Analysis for Essex County

A review and comparison of the New Jersey Department of Health and Senior Services' 1994-1999 data on the state's registered older vehicles and data on asthma hospitalization rates for New Jersey showed that Essex County had the second highest number of registered older vehicles while having the highest asthma hospitalization rates in New Jersey (See Figure 7.2 and 5.2).

Vehicle Air Pollution and Asthma Hospitalization Rates

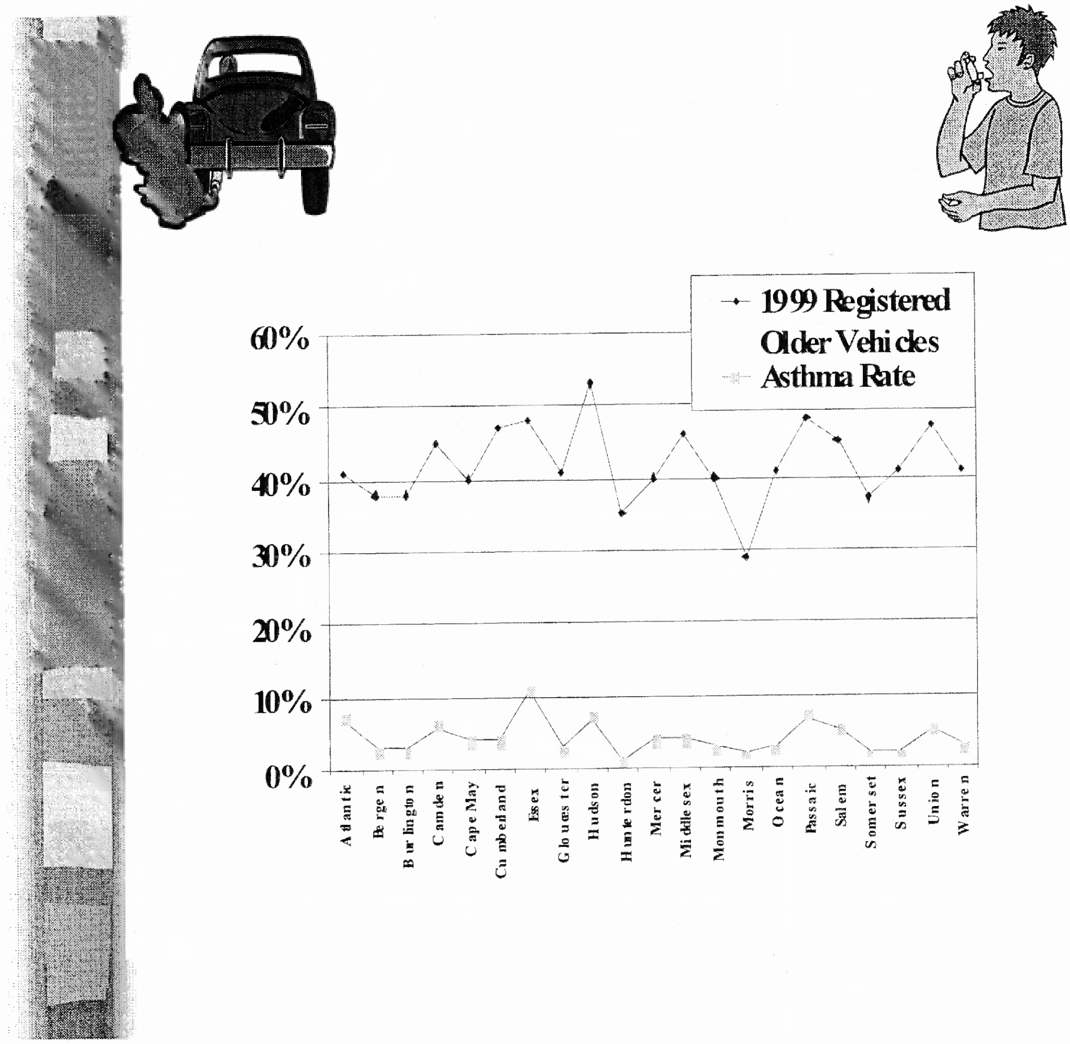


Figure 5.2 Essex County was second to Hudson County for the largest number of registered older vehicles from 1994-1999. Essex County has highest number of asthma hospitalization rates in the State of New Jersey. [180 hospitalizations per 100,000 population].

(Source: DHSS, 1999)

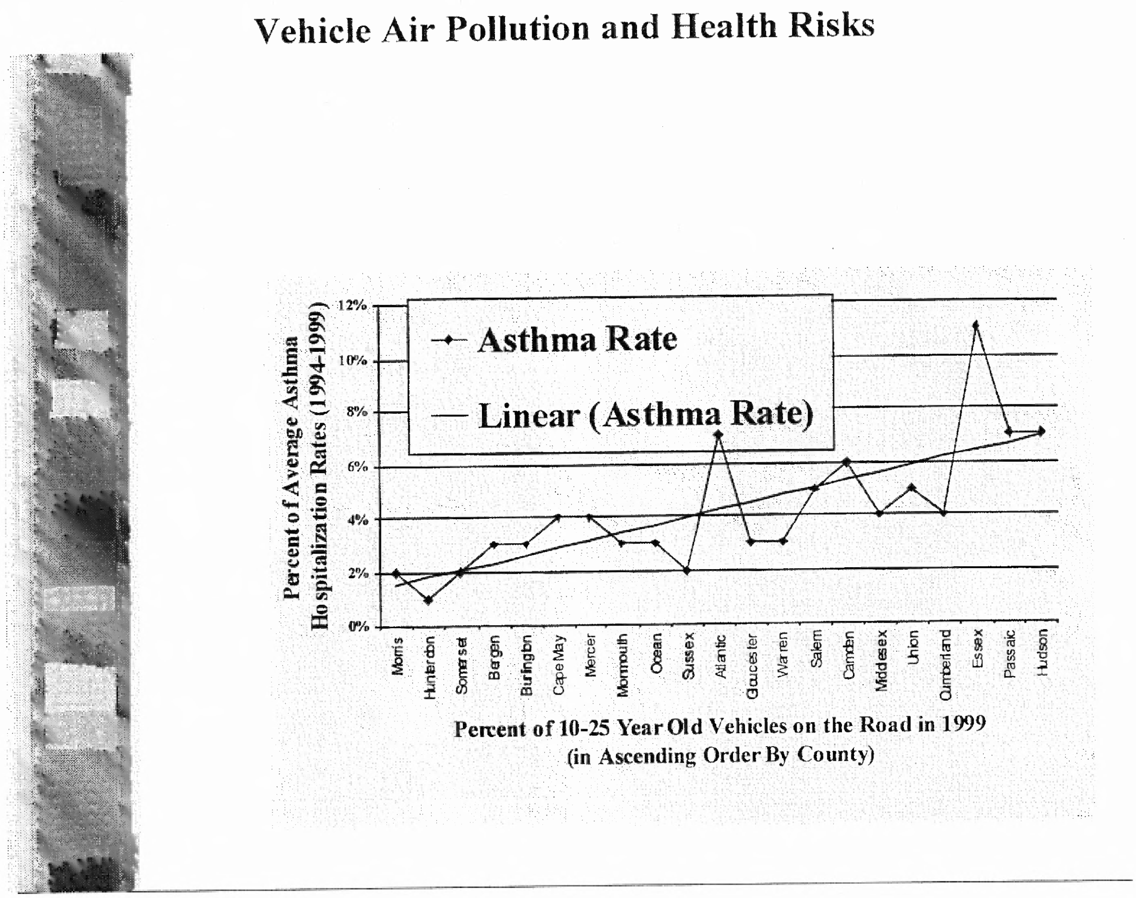


Figure 5.3 Plotting percent of 10-25 year old vehicles on road in 1999 in ascending order by counties against percent of average asthma hospitalization rates. Ascending order meaning counties having least number of older vehicles were first and counties having highest number older vehicles were last. Plotting the X-Y-axis with these variables gave a linear relationship and possible positive correlation between vehicle pollution and health risks. (Source: DHSS, 1999)

This environmental data on Essex County suggests a positive correlation between vehicle pollution and asthma health risks in Essex County. A similar correlation was also reported in a Maryland study that presented indoor air pollutant concentrations collected from the homes of 100 Baltimore asthmatic children. This study showed that the mean PM_{10} concentration was 25% higher than the $PM_{2.5}$ concentration (Breysse, P., et al., 2005). Similarly to Newark's analysis of asthma hospitalizations, the state of Maryland indicated that Baltimore had the highest asthma hospitalization rates of any other jurisdiction in the state and the African-American children in Baltimore had an annual asthma hospitalization rate (110/10,000) that was three times higher than that of Caucasian children (33.2/10,000) (Breysse, P., et al., 2005).

5.3 Data Results: Sharing Environmental Data with Newark Community

In order for an environmental health policy to be developed, all data on Essex County and possible correlation between vehicle pollution and health risks had to be shared with Newark Preschool Council Administrators, parents, teachers, health coordinators and parent coordinators. This information was shared during the initial health development meetings and Environmental Forums that took place from 2002 through 2005.

Since the City of Newark is the largest urban area in Essex County, the researcher identified which of the five Wards (North, South, East, West or Central) had the most possible contributors to Newark's air particulate pollution and the most asthmatic children attending the preschools under Newark Preschool Council's jurisdiction. After the environmental data was shared with the Newark school community, it was determined that the East and South Wards were eligible for the study.

In order to be eligible for the study, the preschools and the children met the following eligibility criteria: 1). Child was aged 3-6 years; 2). Child had physician-diagnosed asthma or current asthma symptoms; 3). Targeted classroom had the most asthmatic children in attendance; 4). Targeted classroom had at least five children in attendance who were physician-diagnosed with asthma or asthma-like symptoms; and 5).

All Asthma Survey Sheets were completed and submitted to Newark Preschool Council Administrators by identified due date.

5.3.1 Applying Data Results: The Significance of Asthma Symptoms in Health and School Policy

Asthma is a multifaceted chronic illness that has a high prevalence in the United States. Literature has shown that susceptibility and expression of asthma depends upon individuals inheriting a certain array of multiple alleles of susceptibility genes that add a higher risk from birth in developing asthma. However, once asthma is developed, environmental factors then play a role in the exacerbation of asthma (See Figure 5.4). Therefore, asthma can remit or progress depending upon the environmental exposures of an individual (Leikauf, G., 2002).

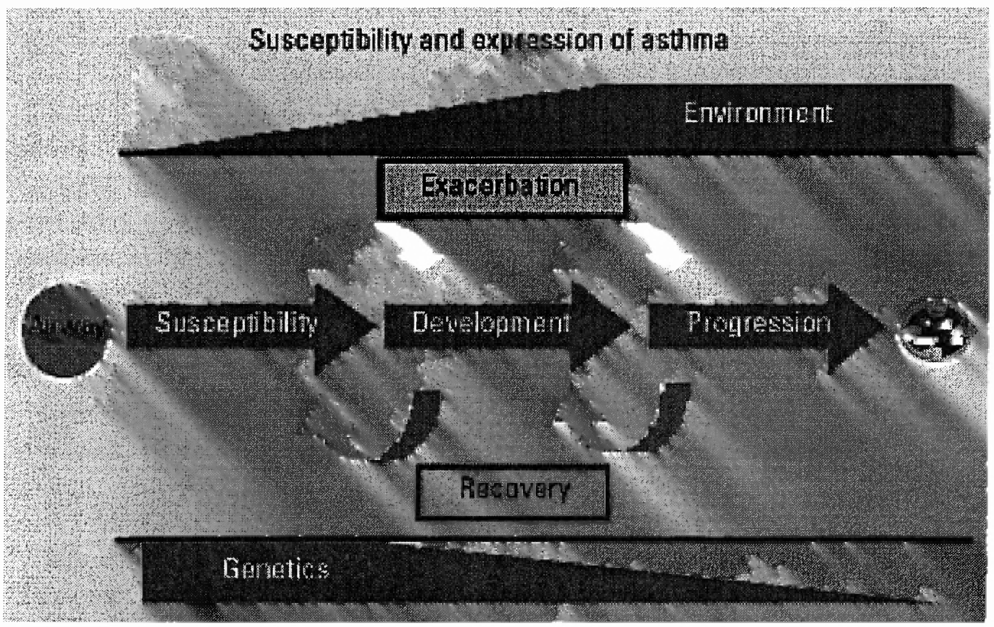


Figure 5.4 In the development of the lungs and airway susceptibility, genetics has a greater impact on developing asthma while the environment has a lesser impact on the initial development of asthma but a greater impact on the exacerbation and progression of asthma once it has been developed in an individual. (Leikauf, G., 2002)

Mobile sources were further studied to determine what part of this source emits a greater amount of particulate matter because particulate matter is not only a criteria pollutant but the trace metals found on the surface of particulate matter may be hazardous air pollutants that irritate the lining of the lungs and thereby increase the susceptibility and expression of asthma.

An air particulate matter analysis was therefore performed in this study; it involved the following three-point literature review:

(1) Under the federal Clean Air Act, the USEPA identified Particulate Matter as one of the six "criteria" pollutants (particulate matter, ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide and lead). These six pollutants are designated as "criteria pollutants" because they are strongly suspected of being harmful to public health and the environment (Suh, H., et al., 2000). Hence, as criteria pollutants, air particulate pollutants have health risks associated with them. The researcher focused on the health risk of asthma and/or reactive airway diseases;

(2) Under the federal Clean Air Act, USEPA initially identified and created a list of 189 potentially harmful Hazardous Air Pollutants (HAPs) that are prevalent in the environment. This list contains metals, particles, gases adsorbed onto particles, vapors from fuels and other sources. When reviewing the trace metals that may be on the surface of particulate matter, the researcher focused on Zinc (Zn), Nickel (Ni), Manganese (Mn), Lead (Pb) and Vanadium (V)

compounds because they appeared on the USEPA's original 189 HAPs List as well as the Agency's shorter List of 33 HAPs; and

(3) In 1996, the USEPA published a list of 21 On-Road and Non-Road Mobile Source Air Toxics (MSATs) (See Figure 1.4). Among the 21 MSATs, the researcher identified three of the targeted trace metals, which were Ni, Pb and Mn compounds.

The five metals Zn, Ni, Pb, Mn and V appear to be appropriate for a target analysis to further investigate the effects of local vehicle-generated particulate matter on a young population. (See Summary).

When examining the health factors associated with the different chemical particles in the atmosphere (i.e. air particulate pollutants), particle size and chemical composition must be reviewed. Particulate Matter differs in its particle size (PM_{10} or $PM_{2.5}$) and in its deposition characteristics (coarse particles or fine particles). Fine particles are usually less than 2.5μm in diameter and therefore have the ability to penetrate further into the alveoli of the lungs. Coarse particles are less than 10μm in diameter and first enter the mouth and nose as they penetrate into the trachea and primary bronchi of the lungs. Coarse particles of the PM_{10} size mainly consist of wind-blown dust from roads, and tire dust from tire abrasions. Fine particles consist of vehicle exhausts, chemical transformations acting on nitrogen oxides, and volatile organic compounds (VOCs) emitted from fuel combustion activities (Parr, R., and Smodix, B., 1999).

Evaluation of the above data suggests that particles of the PM_{10} size are an important class of particulate pollutants where exposure is associated with health effects even at low levels of exposure (less than $100\mu g/m^3$) (Parr, R., and Smodix, B., (1999). There is also a significant association between daily average PM_{10} concentrations and asthma morbidity at concentrations below the current U.S. standard of $150\mu g/m^3$ for short-term PM_{10} concentrations (Schwartz, J., et al., 1993).

In asthmatic children, either particle size (PM_{10} or $PM_{2.5}$) can exacerbate an asthma attack. However, since most trace elements and particulate matter from traffic emissions have their origin from vehicle wear products as opposed to traffic exhaust emissions (Harrison, R., et al., 2003), the researcher focused the environmental data collection and analysis on PM_{10} because these larger particles are emitted from vehicle wear as opposed to vehicle exhausts and they also had more available data on their health risks. Determining the PM_{10} mass concentrations and obtaining the metal particulate speciation data for the preschool classrooms having the most asthmatic children in attendance were necessary as part of a baseline assessment for policy development.

When discussing the chronic illness of asthma, it is important to distinguish between "prevalence" and "incidence". The incidence of a disease tracks the individuals that have developed the disease over a given period with respect to the general population that has not developed the disease over the same study period. Prevalence tracks those individuals who already have a disease and compares that number to the general population that does not have the disease without any given period of time.

Since this Newark case study identified individual preschool children who already had asthma and compared that to the general population of preschool children under the jurisdiction of the Newark Preschool Council, this research analyzed the "prevalence" of asthma in the Newark Preschool Council classrooms.

Particulate air pollution exposure among asthmatic children living in an urban environment is important in understanding how the prevalence of asthma and air particulate pollutants contribute to the health risks facing such a susceptible population. This is true for disadvantaged inner city or urban children where air pollution exposures tend to be the highest (Breysse, P., et al., 2005). Airborne particulate pollutants have been identified as risk factors for asthma morbidity because recent studies have suggested that air particulate exposure can enhance antibody responses to house dust mites and promote lung sensitization (Walters, D., et al., 2001 and Breysse, P., et al., 2005). Similar earlier studies were responsible for the USEPA and the New Jersey Pediatric Asthma Coalition (PAC) to place particulate (Particulate Matter) on the list of asthma triggers. As an asthma trigger, air particulate pollutants may induce the allergic phenotype by inducing airway hyper responsiveness, which occurs via the induction of a component of the complement system of the immune system (Walters, D., et al., 2002 and Breysse, P., et al., 2005).

5.4 Scientific Investigation of Environmental Correlations and Political Response

Within the political framework, there is a value placed on whether or not the environment has an impact on the health issues expressed by a community. Such an impact can be taken into account in the economic assessment of public projects (Nicolas, J., et al., 2005) and health care benefits.

A recent political response came from U.S. Congressman Frank Pallone, Jr., who stated on February 3, 2004, during the New Jersey Department of Environmental Protection's first Urban Environmental Health Fair that scientific investigations of environmental correlations are critical because "when working on environmental issues, a great concern is the impact of the environment on health" (Frank Pallone, Jr., United States Congress letter of intent, Appendix D).

Congressman Pallone went on to state that urban areas in particular are subject to disproportionate exposure to pollution. As a result, men, women and especially children around the country and in New Jersey are "experiencing diseases and illnesses that are completely preventable in most cases." Therefore, it is imperative that any political response must fully address urban air pollution by taking the necessary and "extraordinary steps to protect the urban communities" with respect to the health concerns associated with that pollution.

5.5 Summary

This study has focused on environmental factors that exacerbate or increase asthma symptoms or asthma-like symptoms; it has not focused on genetic factors that may cause asthma. The environmental factors chosen for this research study were the anthropogenic activities that were the highest contributors to air pollution in New Jersey which were determined to be mobile sources (64%). This research study further focused on particles of the PM_{10} size because there is persuasive evidence that variations in PM_{10} exposure are associated with health effects even at low levels of exposure (less than $100\mu g/m^3$). The air particulate analysis described in this chapter resulted in particulate matter levels and mass concentration of the five metals Zn, Ni, Pb, Mn, and V being targeted for detailed analysis and as the chemicals (metals) of concern in particulate matter.

A further refinement is the focus on indoor air particulate matter. The data collected and presented in this research provides the basis for testing the hypothesis that the combination of indoor air particulate matter and personal classroom exposures contribute to the increased asthma burden placed on the African-American and Hispanic children in Newark.

CHAPTER 6

URBAN ENVIRONMENTAL HEALTH EDUCATIONAL OUTREACH

6.1 Demonstrative Model: Urban Environmental Health PROTECTORS

The three-year environmental research findings and scientific documentation show that Essex County (City of Newark) has the highest prevalence of asthma in the State of New Jersey (New Jersey Department of Health and Senior Services (DHSS), 1999) (See Figure 2.2). It is also stated in the Asthma in New Jersey Report which was published by the (DHSS), that poor urban air pollution has Black/African-American and Hispanic populations "most at risk" at developing respiratory illnesses (Asthma in New Jersey Report, 2003).

The data suggests that a "demonstrative" plan (community action and education plan) could be developed to target this environmental justice issue that was raised by the administrative staff at Newark's Department of Neighborhood Services, Newark Preschool Council, grass-roots environmental organizations and the Black and Hispanic Newark community members.

This section describes the community action plan and illustrates the events that occurred over the time period.

6.1.1 Development of Community Action "Demonstrative Plan" and Creation of New Jersey's Urban Environmental Health PROTECTORS™

A framework for this "demonstrative" plan was established over a three-year period of time from January 2001 through February 2004, with the idea of introducing (re-introducing) the data to the community in an informative and hopefully an "action" generating way. The research data was collected and analyzed, and then it was re-introduced to the Newark community in an innovative way that would educate the school community about urban environmental health and environmental justice issues. Due to the paradigm common within the urban environment, the demonstrative model was especially designed to appeal to both urban children and adults. In addition, the research data was presented at all Environmental Forums, including the Urban Environmental Health Fairs, workshops, community meetings and seminars. Unlike the urban environmental workshops and seminars, the three Urban Environmental Health Fairs, were organized through local, state and federal government and community partnerships. At the request of the Newark community members, each Health Fair was named "Urban Environmental Health Fair".

A "demonstrative" model was created; it included several, attention getting 'Environmental 'Champion' Characters' who served as education tools on environmental health problems and who crusaded for environmental health improvement and education under the overall banner of "New Jersey's Urban Environmental Health PROTECTORS" (Figure 6.1). The crusading used these characters in varied power point presentations, on posters, in colorful handouts and in graphically illustrated texts distributed to the community and children.

The PROTECTORS presented a unique and innovative environmental health educational awareness tool designed especially for the urban community. Through local, state and federal government and community partnerships, the PROTECTORS were able to make their debut at three community Urban Environmental Health Fairs, which occurred on February 3, 2004 at the New Jersey Department of Environmental Protection

(NJDEP); February 18, 2004 at the Pilgrim Baptist Church; and June 18, 2004 at the Metropolitan Baptist Church in Newark (Appendix E).

For all three Environmental Health Fairs, the researcher worked with Newark community members in order to bring as many people to the forums as possible. Invitations were distributed to government officials, grassroots organizations, academic institutions, industrial facility owners, bus companies and community residents. Of the aforementioned invitees, approximately 200 participants attended each of the three Urban Environmental Health Fairs.

There has been much discussion over the significance of environmental factors and asthmatic symptoms. The outcome of these discussions influences the focus level of public health education and government regulation (Brown, P, et al, 2003). Therefore, during each of the three Urban Environmental Health Fairs, the PROTECTORS provided introduction and used education to empower the urban community members in Trenton and Newark.

Educational materials such as Asthma in New Jersey, air quality in New Jersey, asthma action plans, a listing of asthma triggers, etc. were discussed and distributed during each of the Environmental Health Fairs (See Appendix F).

New Jersey's Urban Environmental Health PROTECTORS ™

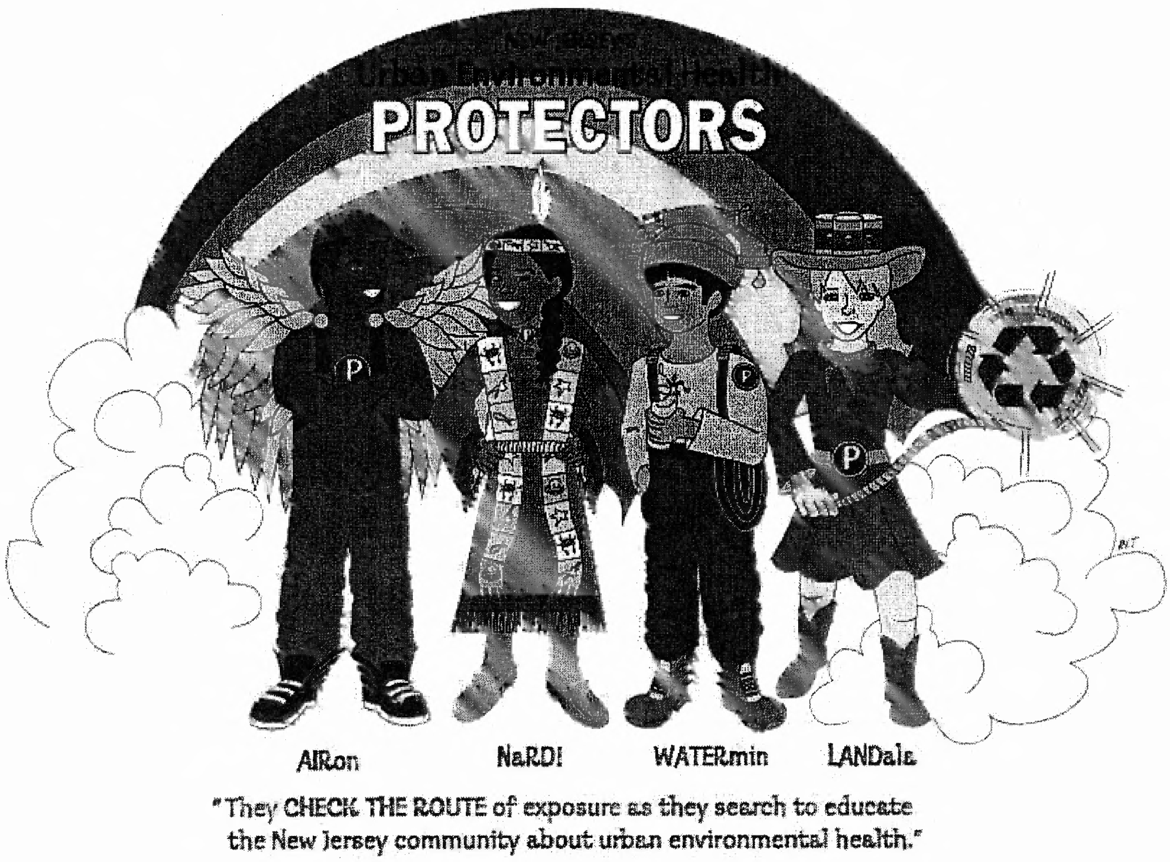


Figure 6.1 - The Urban Environmental Health PROTECTORS "***check the route***" of exposure as they each educate the New Jersey community about urban environmental health.

6.2 Methodology

The researcher created and designed the PROTECTORS to be a new innovative environmental health educational tool and demonstrative project that would increase health awareness by linking urban environmental health concerns with environmental science education. In understanding the culture and diversity of the Newark school community, the researcher determined that the method for introducing the environmental science information also had to address the culture and diversity of this urban community. The creation of the PROTECTORS was the first step in the methodology and therefore, they were designed in a unique way that would appeal to children, teachers and parents in an urban setting.

6.2.1 Creation and Overall Purpose of Demonstrative Project

The PROTECTORS were created to present the research findings and environmental health educational information, which included identifying the hazardous and criteria particulate pollutants released in the East and South Wards, asthma triggers, and the cumulative burdens experienced by these Newark communities. For example, the research data collected during 2002-2003 showed that one major environmental health concern and burden experienced by the East Ward and the South Ward was pediatric asthma. These research findings were distributed through the use of the "AIRon" character from the Urban Environmental Health PROTECTORS (Figure 6.1). Since the PROTECTORS are urban icons/characters with their own rap song entitled "Check the Route," they and their song served as communication tools, which outlined the research findings in a non-confrontational manner; thereby increasing the Newark community's environmental health educational awareness. In a new and unique manner, the PROTECTORS' research presentation and environmental educational materials were distributed at the Urban Environmental Health Fairs. See Figures 6.2, 6.3, 6.4 and 6.5 for urban children's environmental health issues that are associated with air pollution, damaged natural resources, water pollution and land contamination; respectively.

6.2.2 Goals and Objectives of PROTECTORS

The principal goal and objective of this demonstrative method and model was to provide an educational tool that could be used to identify and share the collected environmental science research data. The model was also designed to provide scientific documentation to support the need for air pollution abatement strategies in environmentally burdened urban areas such as Newark.

The PROTECTORS were especially designed to not only have an "urban" appeal but to also have their individual environmental messages be based upon a "scientific" background. This two-fold objective (i.e. combining an "urban" appeal with a "scientific" background) was necessary to foster community partnerships that involved meaningful open dialogues between the children, their parents and teachers, as well as the local and state government officials, bus companies, industrial facility owners and community residents (See Figures 6.2, 6.3, 6.4 and 6.5).

Urban Environmental Health PROTECTOR
Links Urban AIR Quality to Health

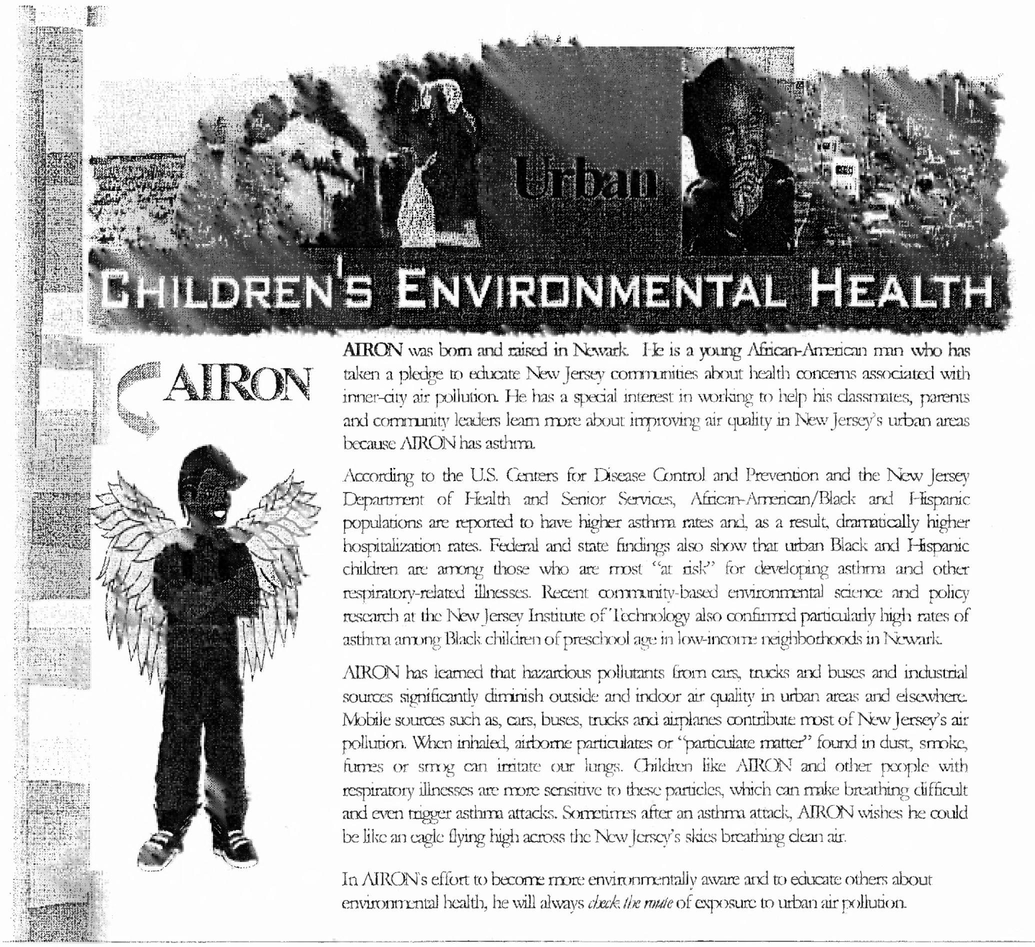


Figure 6.2 – As an Urban Environmental Health PROTECTOR, AIRon educates the Newark community regarding possible environmental health symptoms associated with urban air pollution.

Urban Environmental Health PROTECTOR
Links Natural Resource Damages to Health

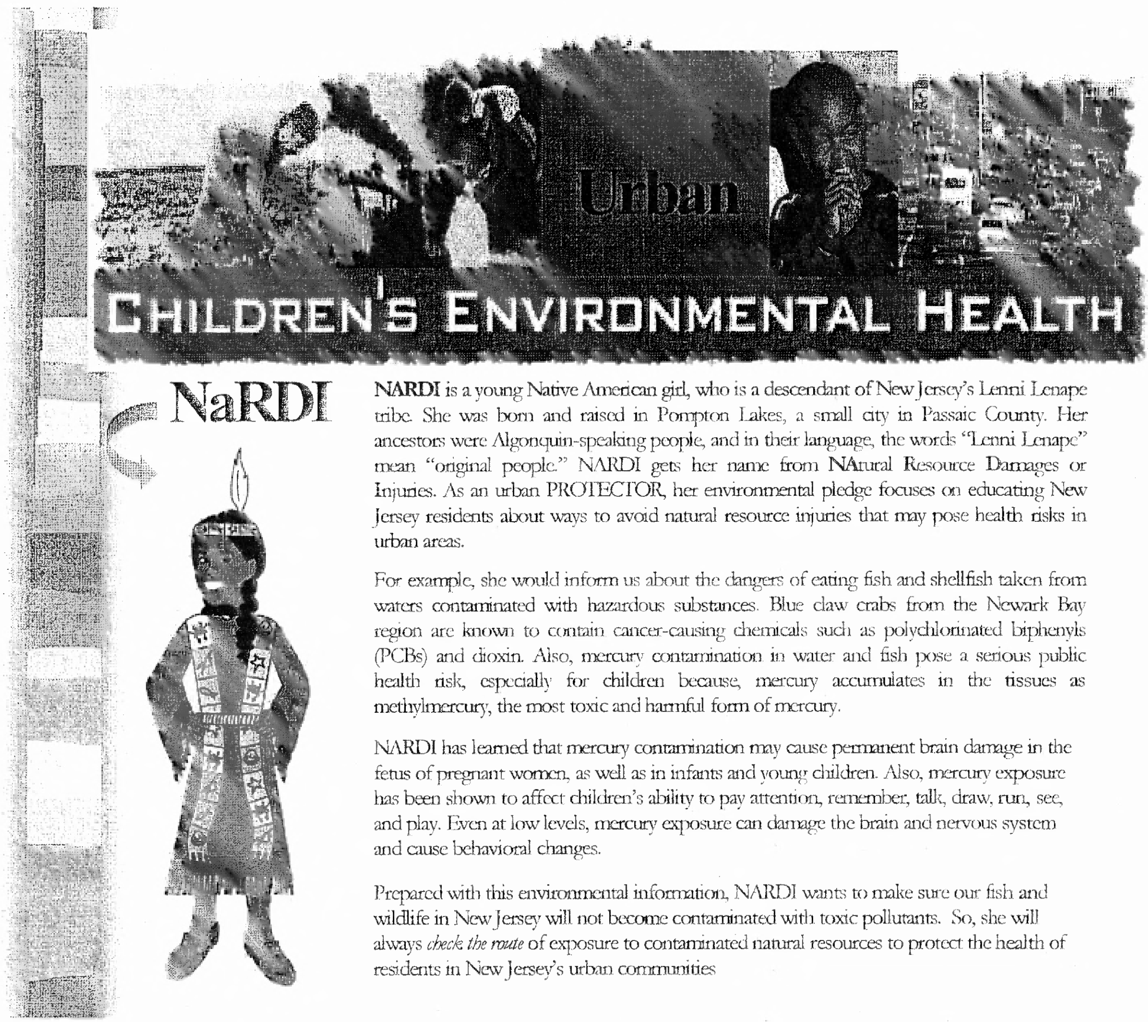


Figure 6.3 – As an Urban Environmental Health PROTECTOR, NaRDI educates the Newark community regarding possible environmental health symptoms associated with pollution caused by damaged natural resources such as contaminated Blue-claw crabs or contaminated fish. These are two examples of how New Jersey's natural resources have been damaged by contaminants such as the cancer-causing chemicals polychlorinated biphenyls (PCBs) or even low levels of mercury contaminants. These contaminants may cause central nervous system damage or cause behavioral changes in children. U.S. Environmental Protection Agency, 2003.

Urban Environmental Health PROTECTOR
Links WATER Quality to Health

WATERMIN is a young Hispanic-American man, who was born and raised in Perth Amboy, a small waterfront town positioned at the mouth of the Raritan River. His ancestors came to America from San Juan, Puerto Rico. Perth Amboy is home to one of New Jersey's largest Hispanic populations. The word "Amboy" is said to be derived from the language of NARDI's Lenni Lenape Native American ancestors, and it means "elbow of land."

WATERMIN has taken an environmental pledge to educate urban communities about sources of water pollution and associated health consequences. He has learned that increasing amounts of paved surfaces from new roads, scattered sites of housing and other poorly designed development seriously prevent rainfall from replenishing underground aquifers and create currents of stormwater runoff. So, when it rains or snows, contaminants from litter, motor oil, pesticides or dog waste left on sidewalks and grass are picked up by stormwater runoff and carried into our waterways. Contaminated stormwater runoff threatens our drinking water supplies, and accounts for nearly 60 percent of New Jersey's current water pollution. It is very important not to place waste that may contain toxic chemicals such as, mercury, petroleum or lead into our water pipes and storm drains. Exposure to relatively high levels of inorganic mercury salts, lead, or chromium in drinking water or in contaminated land sediments surrounding waterways may cause kidney damage, nervous system damage, learning disabilities or personality alterations if the water and/or fish are consumed.

Armed with this environmental health information, WATERMIN wants to make sure our water is clean and safe to drink and to use on the vegetable plants we eat. So, he will always *check the route* of exposure to water pollution to find out how it might affect our drinking water and the health of our residents.

Figure 6.4 – As an Urban Environmental Health PROTECTOR, WATERmin educates the Newark community regarding possible environmental health symptoms associated with urban water pollution. An example of this association is that research has found that high levels of mercury, lead or chromium in drinking water may cause kidney damage and learning disabilities in children if consumed. So, when it rains or snows, these chemical contaminants get into our storm drains and underground aquifers as a result of improper recycling of motor oil, improper use of pesticides or accumulated garbage. U.S. Environmental Protection Agency, 2003

Urban Environmental Health PROTECTOR
Links LAND Contamination to Health

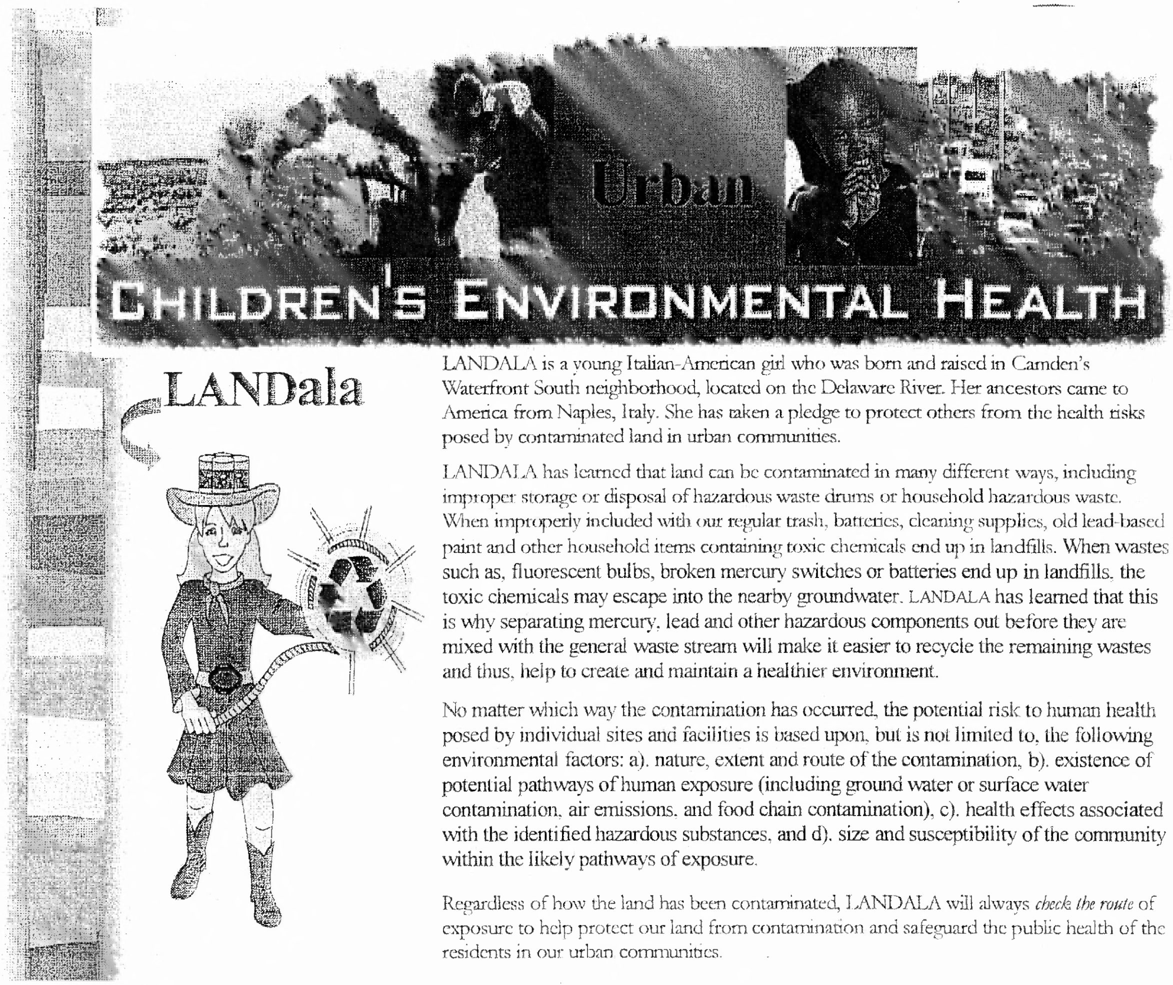


Figure 6.5 – As an Urban Environmental Health PROTECTOR, LANDala educates the Newark community regarding possible environmental health symptoms associated with urban land contamination.

6.3 Application and Conclusion: An Urban Environmental Health PROTECTOR Addresses Urban Air Quality and Health Problems

In response to the evaluated need for correction regarding Newark's Black/African-American and Hispanic populations being "most at risk" at developing respiratory illnesses, the researcher collected and used environmental data to support the need to improve and/ or introduce methods that reduce exposure to emissions. In addition, the

Newark school community and local government officials requested that some form of community-based research be performed to identify the quality of indoor air which the preschool children were breathing and to disclose environmental factors which may be triggering an increase in the asthmatic symptoms of their preschool children.

The Newark community members had agreed that whatever the environmental science research findings were, that environmental data would be shared with all interested parties who attended the Environmental Forums. However, after working with the Newark community-at-large, the researcher found that there was a serious disconnect between the low-income community members' understanding regarding their possible contributions to urban air pollution and the respiratory health problems experienced by their children. The action model above was further targeted to address the environmental justice pollution prevention issue, which was raised by the City of Newark's Department of Neighborhood Services and many Black/African-American and Hispanic Newark community members. The specific environmental justice issue was how to address the disproportionately high minority populations being most at risk for contracting respiratory illnesses such as asthma. In response to the environmental justice concerns that focused on health promotion of its preschool, elementary and middle school children, the researcher created AIRon to educate and demonstrate to the children, their teachers, health care providers, parents and governmental officials that the issue of urban air pollution and respiratory illnesses such as asthma or reactive airway disease can be addressed in a scientific manner through environmental health educational awareness at each of these levels (Figure 6.2).

Since the research findings and scientific documentation showed these Essex county Newark Black/African-American and Hispanic populations are significantly at risk for experiencing asthma (Figure 6.6); and that Essex County (City of Newark) had the highest prevalence of asthma in New Jersey (Figure 2.2), the Newark administrators, health managers, parent coordinators, business owners and East and South Ward parents at the Newark Preschool Council worked with the researcher and agreed to have a Newark Preschool Council Indoor Air Pollution School Policy that focused on this particular environmental science research finding which is discussed and graphically seen in Figure 6.2 and 6.6 respectively.

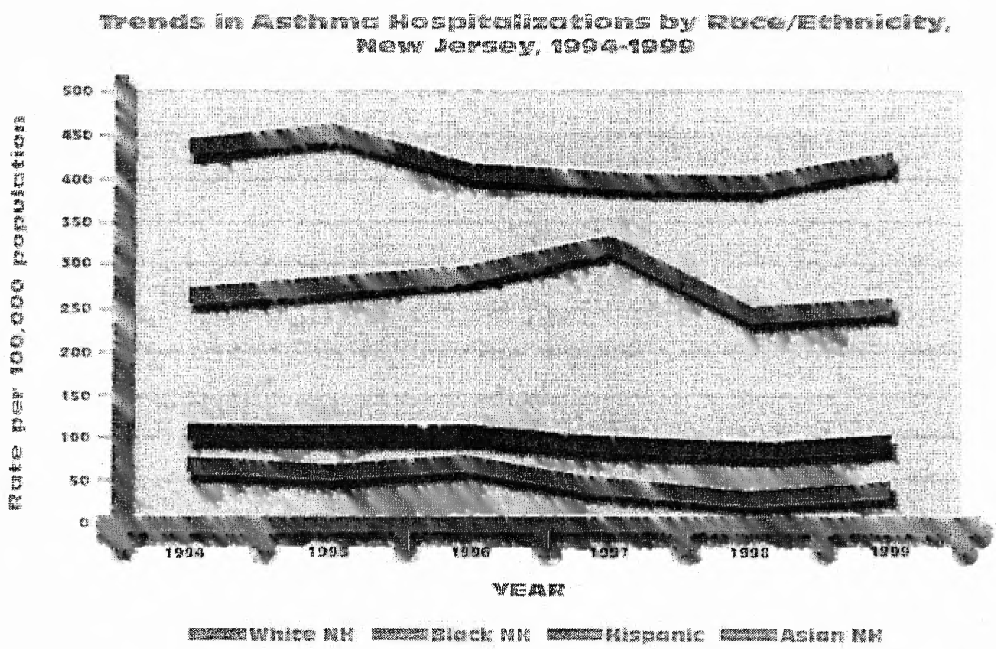


Figure 6.6 The African-American/Black and Hispanic populations had the highest asthma hospitalization rates in New Jersey from 1994 through 1999.
(Source: New Jersey Department of Health and Senior Services – Asthma in New Jersey Report, 2003).

Three Urban Environmental Health Fairs were completed with the understanding that the urban air pollution data that was presented and discussed during these *Fairs* would be used as part of the Case Methodology for Policy Development (hereinafter the Policy). The Environmental Forums were necessary to provide an open dialogue for discussions regarding the justification for the purchasing High Efficiency Particulate Air (HEPA) filter air Cleaners for the preschool classrooms with the most asthmatic children in attendance. (See Figure 1.2) The HEPA filter Air Cleaner was purchased after an environmental chemical analysis had been completed on the PM_{10} concentration levels and targeted metal particulate pollutants that the East and South Ward preschoolers were exposed to in their classroom environments.

The HEPA filter air cleaners were used to effect immediate improvement in the indoor air pollution that the asthmatic community children were breathing. The Newark Preschool Council administrators agreed that the Policy would be implemented and continued beyond the current efforts because it was a much valued and needed "work in progress".

USEPA approved Lakes Environmental software was used to create an air dispersion model, which showed that one of the criteria pollutants that is released at high concentrations in the East and South Wards of Newark is particulate matter (PM). According to the American Lung Association of New Jersey and the Pediatric/Adult Asthma Coalition of New Jersey, PM is a hazardous air pollutant that is one of the main asthma triggers in urban ambient air and indoor air pollution. While it should be made clear that this dissertation research is not stating that particulate matter (PM) causes asthma, this research does support the association between levels of PM and asthmatic symptoms. This means that the researcher is left with the responsibility of determining the best and quickest indoor air pollution abatement strategy and subsequent Policy for reducing the levels of indoor PM, which would ultimately improve the indoor air quality of the Newark children's preschool environment.

In a recent Ontario, Canada study, researchers found that exposure to airborne particulate matter was a principal factor contributing to elevated mutation rates in sentinel mice. This adds support to the hypothesis that air pollution poses genetic risks to humans (Somers, et al., 2004). The Canada study noted that the sentinel mice exposed to HEPA-filtered air at an urban-industrial site had paternal mutation rates that were 52% lower than those mice exposed directly to ambient air at the same urban-industrial site without HEPA filtration (Somers, C., et al, 2004). The HEPA filtration had substantially reduced levels down to the smaller air particulate pollutants of 0.01μm (Somers, C., et al, 2004).

*** Based upon the aforementioned lung and pediatric asthma authorities as well as the Canada research study, the researcher chose the HEPA filter air cleaner instead of an Electrostatic Air cleaner as a way to immediately remove ambient and indoor particulate matter. This was an immediate effort to improve the preschool children's health in their school environment.

<u>Further Presentations by the PROTECTORS</u>:

Although the PROTECTORS collectively made their debut at the first Urban Environmental Health Fair at the (DEP) in Trenton on February 3, 2004, the environmental science and health data presented by the air quality PROTECTOR "AIRon" became the major focus at the other Fairs and presentations (See Appendix E).

In addition to the DEP Health Fair, the August 2004 and August 2005 NJIT-FEMME presentations and workshops also focused mainly on AIRon and the environmental science and asthma health-related data (See NJIT-FEMME Program letters and Thank You cards from children, Appendix G). The researcher increased the educational awareness of the community by discussing air sampling and chemical analysis of the air particulate pollutants especially PM_{10} concentrations in the Newark preschool classrooms having the most asthmatic children in attendance.

6.4 Summary

A "demonstrative" model was created; it included several, attention getting 'Environmental 'Champion' Characters' who served as education tools on environmental health problems and who crusaded for environmental health improvement and education under the overall banner of "New Jersey's Urban Environmental Health PROTECTORS" (Figure 6.1). The crusading used these characters in varied power point presentations, on posters, in colorful handouts and in graphically illustrated texts distributed to the community and children.

A number of urban health fairs were held to educate the community, legislators, environmentally concerned state regulators, and NJDEP personnel. Children in the schools were also educated with separate age-appropriate information that was distributed to them and their teachers. The Urban Environmental Health PROTECTORS were presented in these interactions.

A specific methodology for classroom environment improvement in the preschools was targeted: 'reduction of airborne particulate pollutants'. HEPA filter air cleaners were considered the best technology for this air particulate level reduction. The community was educated, brought together on issues that were of concern to them and others, and all parties came to agreement on the desired classroom improvements.

CHAPTER 7

ENVIRONMENTAL POLICY

7.1 Introduction: Definition of Environmental Policy

According to the Glossary of Environmental Terms, which relies on definitions used by internationally recognized environmental agencies, 'environmental policy' is a "statement of intentions and principles in relation to overall measurable environmental results and performance" (Strum, A., 2003). This statement identifies intentions and principles that are measuring environmental performance and indicates that an "environmental policy" provides an inherent framework for action and the setting of environmental goals and objectives for implementation (Strum, A., 2003). The USEPA has taken portions of this basic definition and defined "environmental policy" at the federal level as "official statements of principles, intentions, values, and objectives which are based on legislation and governing authorities of a state which serve as a guide for governmental operations" in environmental affairs (USEPA, 2003).

This dissertation research work combined some concepts of the basic definition with some portions of the USEPA's definition in order to arrive at a working definition that can be applied not only to the federal and state levels, but also to the county, city, school district, and local community levels. Thus, for purposes of clarity, the term "environmental policy" in the context of this dissertation research was defined as mankind's environmental responsibility expressed in statements of intentions or principles that target an environmental objective for a community. This definition of "environmental policy" will be referred to throughout the text of this paper.

7.1.1a Level(s) at which Environmental Policy May Be Administered

Environmental policy operates at many levels. The World Health Organization (WHO) implements environmental policy at the national and international level. The USEPA and the New Jersey Department of Environmental Protection (DEP) create and implement environmental policy at the federal/regional levels as well as at the state and regional level, respectively. Environmental policy has also been developed at lower levels of the Environmental Responsibility Chain, such as the county, city, local/ward, school district and residential levels. (See Figure 7.1)

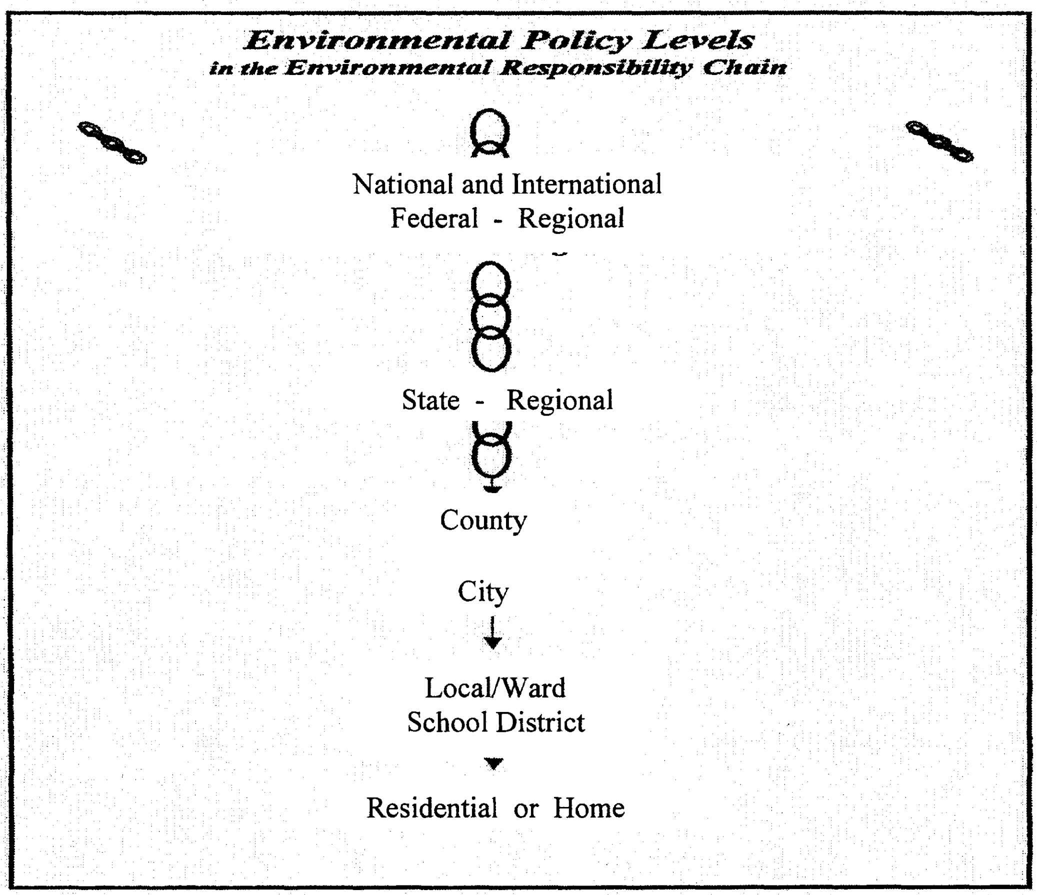


Figure 7.1 An environmental policy that addresses asthma would be seen at levels that range from environmental health policy at the national level to environmental health policy at the local or residential level. At any level, the policy would identify the environmental responsibilities regarding the issue of air pollution.

New Jersey's County Environmental Health Act (CEHA) was enacted in 1978 during the administration of Governor Brendan Byrne. In 2003, James E. McGreevey, former Governor of New Jersey, proclaimed October 13-17 as County Environmental Health Week in support of CEHA. The Proclamation stated "a clean, healthy environment is essential to preserving a high quality of life for all New Jersey citizens" (McGreevey, 2003). The Proclamation noted that the state lawmakers intended the CEHA to be a link between state and county levels of environmental regulation which are represented by the state Department of Environmental Protection (DEP) and each county health agency. Note: Refer to Chapter 2 where there is an extended discussion on the amplification of New Jersey environmental policy with respect to environmental justice.

Since the DEP has certified county (i.e. Essex County) health agencies to conduct various environmental health programs that address air pollution, this dissertation will discuss environmental policy, beginning at the county level, and then reviewing and developing environmental policy at the city and community/Ward levels (Figure 7.1). Generally, at the lower policy levels where the community members come together, there has been faster environmental policy implementation because they are closer to the issue and can see and experience the immediate benefit of meeting the environmental goals.

7.1.1b Data Driven Approach in Policy Development

An environmental policy can be developed through a data-driven approach and/or a theory-driven approach (Niemeijer, D., 2002). A "data-driven" approach involves utilizing all available data as the central criteria for developing an environmental indicator. Whereas, a "theory-driven" approach is defined as one that concentrates on choosing the best possible environmental indicator from a theoretical point of view with available data being one of several evaluated criteria (Niemeijer, D., 2002).

It is the hypothesis of this research study that states in order for a policy to be meaningful, effective, and implemented by a community, the basis of that policy should utilize the data-driven approach. Therefore, the initial part of this research followed the data-driven approach in the development of an environmental policy. An effective environmental health policy requires that the environmental system and health indicators that make up the data be clearly identified and understandable to the policymakers and general public. This way, after baseline data has been collected, analyzed and presented to the community by the researcher, the development of the environmental health policy can be efficiently measured and monitored in an objective manner by the community.

Data obtained or measurements performed in an objective manner can only promote health-behavioral changes in the primary care of the preschool children (Elder, J., et al., 1999). Additionally, if the measurements are performed in an objective manner, then it will also support the school community's efforts to improve the indoor air quality of its preschools and establish and maintain asthma-friendly classrooms (Elder, J., 1999).

The environmental system for this part of the research involved:

1) Analyzing the indoor air quality of the City of Newark's East and South Ward targeted preschool classrooms; and
2) Performing a comparative particulate analysis of the indoor air pollution with respect to the outdoor environmental systems.

A Harvard School of Public Health research study showed there was a significant possibility that exposure to indoor particles of ambient (outdoor) origin or indoor origin may be associated with adverse health effects (Long, C., et al., 2000). This indicates that environmental health issues specifically relating to children should be a significant part of any policy development. For example, a transportation policy required the removal of lead from gasoline due to the data and scientific evidence of adverse effects in children exposed to vehicular lead pollutants (World Health Organization, 2002). As a result of this data-driven approach (Niemeijer, D., 2002), the implemented policy gave rise to improved environmental conditions for child health.

7.1.1c Particulate Matter as an Indicator of Environmental Health Factors

Based upon the data analysis of the Particulate Matter (PM_{10}) concentrations, and types of metal particulate species found in each of the Ward classrooms, the origin and toxicity of the particulate matter can be recognized. Subsequently, the associated health effects in a child's day care center environment may place the asthmatic and non-asthmatic children at risk can be identified. For example, there is evidence that increased exposure of preschool children to other children may place the preschool children at increased risk for wheezing associated with respiratory infections (Ball, T.M., et al., 2000) and other asthma symptoms. More specifically, attendance at day care centers was found to be a risk factor for the recurrence of wheezing and asthma in children less than five years of age (Ball, T.M., et al., 2000).

7.1.1d Health Indicators that Trigger Asthma Symptoms

Identifying chemical environmental health indicators, which may trigger asthma symptoms in children was important for this research because, this type of data establishes the foundation for any valid environmental assessment and subsequent policy to improve the indoor air quality of the Newark preschools. In the opinion of the researcher, even in the face of resource problems, this environmental health policy can withstand scrutiny because it provides the basis and background for establishing healthier preschools and asthma-friendly preschool classrooms in the community. Using the particulate data and the metal speciation data, the dissertation research identified through historical toxicology literature, which indoor air-borne particles may cause toxicity. The toxicological effects of the indoor particulate matter are necessary to identify the indoor environmental health indicators, which were subsequently discussed with the school community members and used as a basis for their policymaking (Niemeijer, D., 2002).

There is evidence that the environment in which a child lives and plays in does contribute to that child's risk of experiencing ongoing exacerbations of asthma (Etzel, R., 1995). This evidence came from Swedish studies of monozygotic twins showing, when one twin had asthma, only 19% of the time the other twin had asthma; and therefore, the researcher of this study concluded that the remaining 81% was due to environmental factors (Etzel, R., 1995). Environmental factors may involve both indoor and outdoor pollution. However, indoor air exposures are more strongly linked to the increase in asthma prevalence (Etzel, R., 2003). Since most children spend an average of 20 hours a day indoors (Etzel, R., 1995), this dissertation research mainly focused on indoor air particulate pollution while also identifying the possible contributions and effects of outdoor air particulate pollution.

According to the American Academy of Pediatrics, a number of factors may contribute to higher asthma rates and severity of symptoms among urban children. These factors include such things as, lack of knowledge of asthma and asthma management skills, cultural issues, and the competition of the child's asthma with other basic life needs (Mansour, M.E., et. al., 2000). Environmental factors such as geographic location, transportation, and increased exposure to certain allergens may also function as barriers to good health outcomes (Mansour, M.E., et al., 2000).

7.1.2 Policy Goals and Objectives

Policy goals are the actions that a researcher takes or is "striving for" or, steps taken to achieve end results. Policy objectives are defined as "having actual existence" after the research has been completed (Boyer, M., et. al., 1983). This research had the following three policy goals:

1) Improve preschool community environmental health educational awareness regarding respiratory illnesses such as asthma in Newark preschool children,
2) Determine and analyze PM_{10} concentrations, speciation data and metal particulate pollutants for targeted preschool classrooms and
3) Utilize data to develop an environmental health policy for indoor air pollution abatement in order to reduce the asthma triggers in the classrooms with the highest asthmatic children in attendance so that these classrooms may be considered asthma-friendly.

The policy objective of this dissertation was to implement and subsequently have an urban environmental-health educational tool to be used to educate and empower the Newark school community regarding the health consequences associated with environmental pollution; and more specifically the health consequences of indoor air particulate levels and overall poor indoor air quality.

The motivation was to determine the basis for the aforementioned environmental policy goals and objectives. The collection of air particulate samples and the chemical analysis of the indoor air samples of the preschool classrooms were the vehicle for the researcher to:

1) Develop and implement a data-driven environmental health policy for urban preschool community empowerment;
2) Study historical environmental data on the environmental health disparities in New Jersey's communities of color;
3) Focus on the environmental health burdens experienced by asthmatic minority children in Newark; and
4) Utilize 2 and 3 above, to develop and implement a user-friendly environmental science and health educational tool that could be understood and used by Newark inner-city teachers, parents and children.

7.2 Methodology I: Establishing Baseline Data to Direct *Policy* Design:

According to the RAND Health Report, the number of persons with asthma in the United States has doubled in the past 15 years, with children being the most affected (Lara, et al, 2001). Cases of asthma in children under five years old have increased more than 160 percent between 1980 and 1994 (Lara, et al, 2001). The Institute of Medicine (IOM) reported that asthma mortality is disproportionately high among African-Americans and in urban areas that are characterized by high levels of poverty and minority populations (IOM Report, 2000).

In New Jersey, Essex County has the highest asthma hospitalization rates (New Jersey Department of Health and Senior Services Report, 2000). According to the USEPA's 1996 National Air Toxic Assessment for New Jersey, on-road and non-road mobile-sources (i.e. transportation sector) are the highest contributor to New Jersey's air pollution. Essex County was also one of the counties with the largest number of older vehicles on the road (New Jersey Department of Transportation Report, 1999, 2001). (Figures 4.4A, 7.3 and 7.4 respectively). The researcher collected and analyzed the information contained in these Figures in an effort to establish baseline data for the dissertation research study.

1994-1999 Average Asthma Hospitalization Rates by County

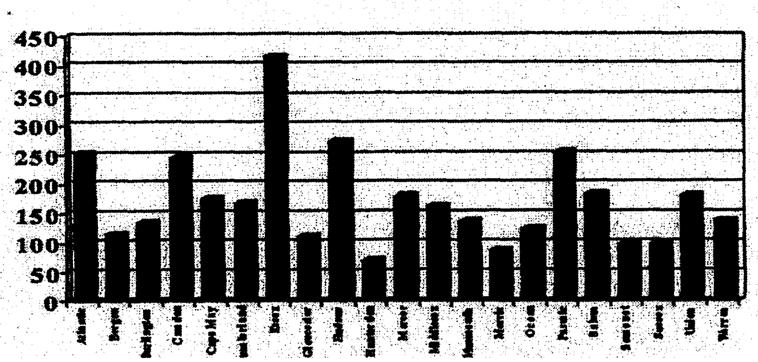


Figure 7.2 – A five- year trend analysis for asthma hospitalization rates per county. Hospitalization rates based upon primary diagnosis (180 hospitalizations per 100,000 population). Highest hospitalization rates occurring in Essex County.

(Source: NJ Dept. of Health and Senior Services)

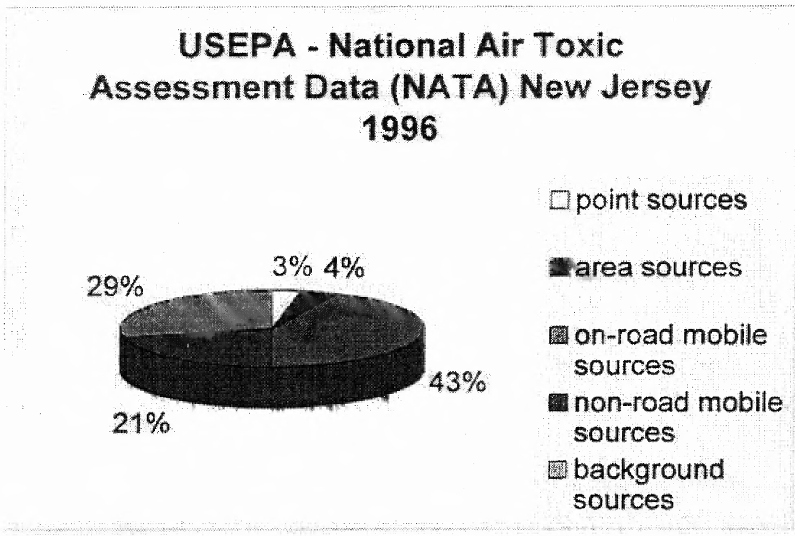


Figure 7.3 – The Transportation sector in the form of mobile sources (i.e. buses, trucks, cars, airplanes and trains) accounts for 64% of New Jersey's air pollution.

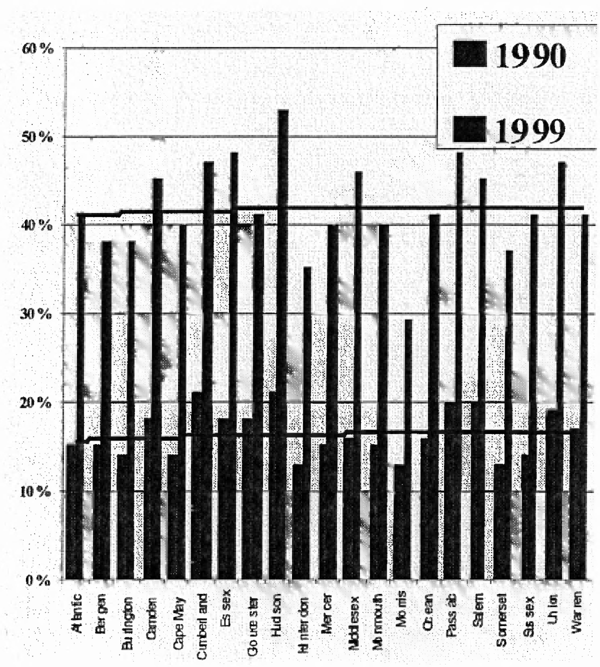
Vehicle Air Pollution:
New Jersey Registered Used Vehicles with 10-25 Year Old Models

Figure 7.4 Older used vehicles that are not well maintain have older engines performing fuel combustion in a less fuel-efficient manner. With longer use, older engines permit more hydrocarbons and particulate matter to be emitted from vehicle gas exhausts.

For each county in 1990, an average of 16% of the on-road mobile sources were 10-15 year old used vehicles.

For each county in 1999, an average of 43% of the mobile sources had Model years 10-25 years old. Also in 1999, Essex County had the second highest percentage of registered older vehicles.

For each county between 1990 and 1999, 30% more hydrocarbons and particulate were emitted into the atmosphere by older used vehicles.



Preliminary demographic research has shown that the East and South Wards of Newark are two of the oldest and more densely populated communities with populations over 56,000 people each. The majority of these populations consists of Black/African-Americans, Hispanics, Portuguese, and low-income families who are experiencing the highest cumulative pollution burdens and environmental respiratory health risks in the State of New Jersey. Approximately 12.5% of the residents have incomes below the poverty level; and 31% of the population has less than a ninth grade education, which is disproportionately higher than the New Jersey average (Cooper, et al., 1999).

The research in this study focused on determining how ambient particulate air pollution contributes significantly to the indoor air quality of the East and South Ward urban classrooms. The researcher identified several outdoor environmental contributors to the East and South Ward communities' poor indoor air quality.

In analyzing the ambient air pollution surrounding these Ward preschool classrooms, it was important to understand the main exposure pathways and mobile sources from which particulate matter may be released and transported to the human receptors (i.e. East and South Ward preschool children).

In order to obtain a clearer understanding of the possible sources or contributors of the outdoor particulate pollution, the researcher prepared a Geographic Information System (GIS) aerial i-map of the East and South Ward preschool locations, main highways and the locations of the main mobile sources of outdoor particulate pollution in the area (Figures 7.5 and 7.6).

East Ward Preschools: Names and Site Locations with Surrounding Main Highways and Mobile Sources

- Hyatt Court- 2 Roanoke Court
- St. Stephan's I,II - Ferry Street & Wilson Avenue
- Pennington Court - 173 Pennington Court
- Providence – Union Street & Elm Avenue
- Terrell Homes Court- 14 Riverview Court

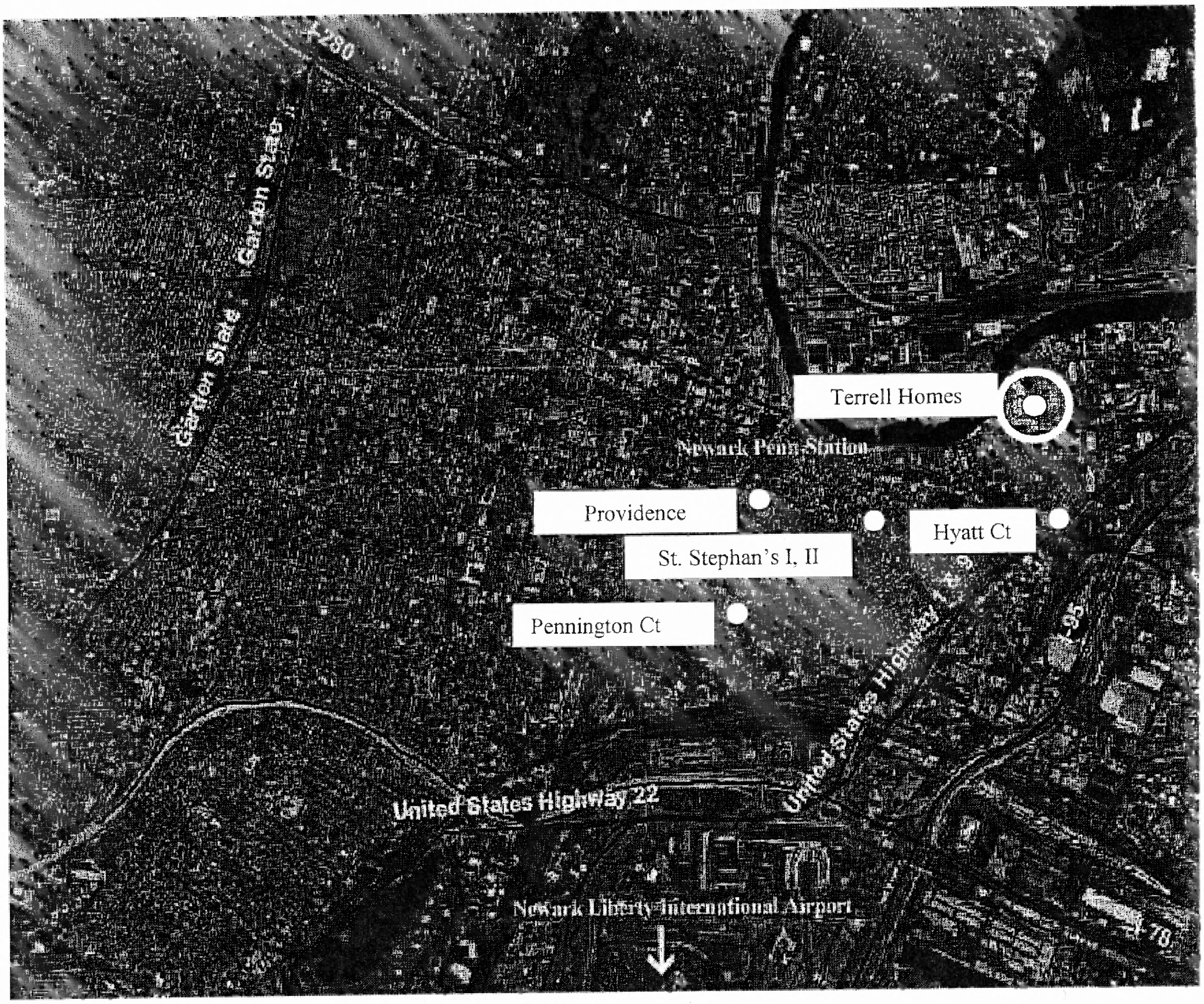


Figure 7.5 - A Geographical Information Systems (GIS) aerial NJ i-map of East Ward Preschool sites, main highways and mobile sources within a five-mile radius of the Newark Preschool Council preschools.

South Ward Preschools: (Active* and Inactive) Names and Site Locations with Surrounding Main Highways and Mobile Sources

- **Zion Hill I, II*** - 152 Osborne Terrance
- Clinton Hill
- First Zion Hill - 15 Leslie Street
- **Alberta Bey I, II** *- 300 Chancellor Avenue
- Carmel Towers I, II - 440 Elizabeth Avenue
- **Greater Abyssinian I, II** *- 88 Lyons Avenue
- **Henrietta King*** - 939 Bergen Street
- **IGA I, II** *- 94-104 Maple Avenue
- Mt. Calvary I, II- 231-51 Seymour Avenue
- **Seth Boyden*** -146 Seth Boyden Street
- **St. Thomas I, II*** - 34 Ludlow Street

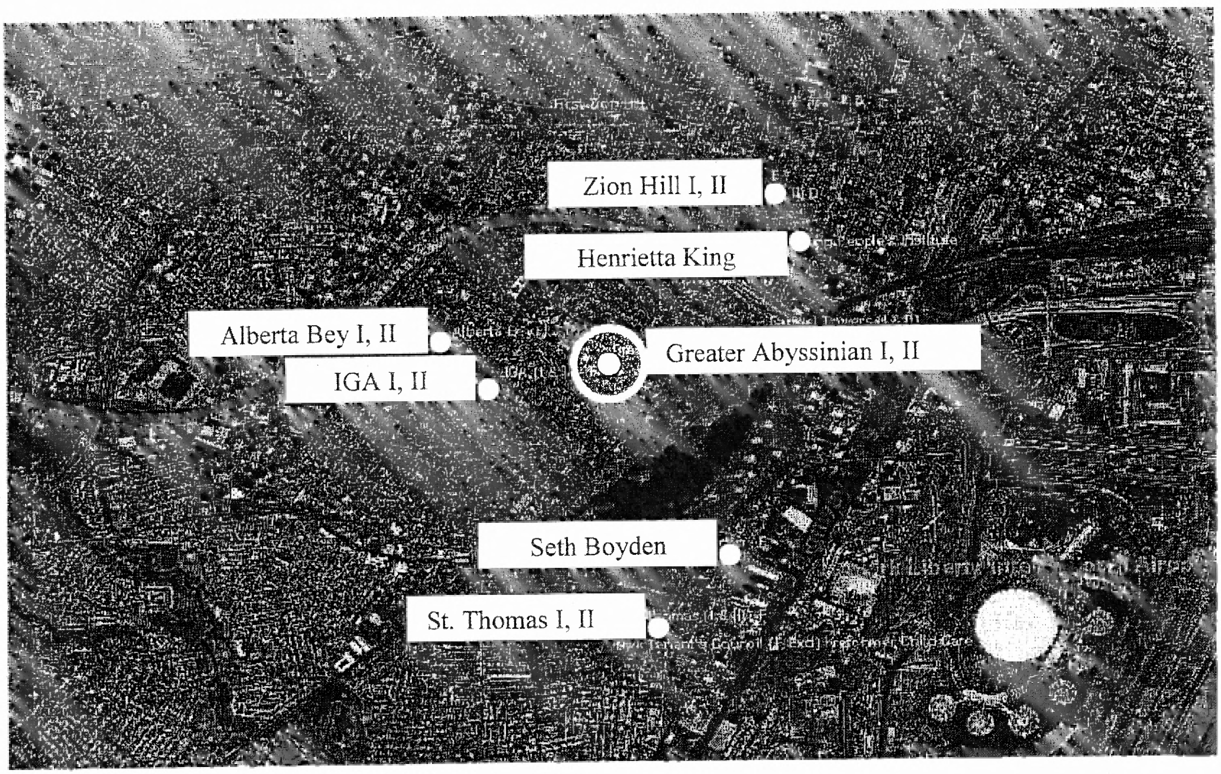


Figure 7.6 - Geographical Information Systems (GIS) aerial NJ i-map of the 12 active South Ward Preschool sites, and the surrounding main highways and mobile sources within a five-mile radius. Active preschools were those schools that submitted Asthma Survey Sheets.

7.3 Methodology II: Selection of Data-Driven Model Instead of Theory-Driven Approach

In developing an environmental health policy, a researcher often has the choice of taking either a "data-driven" or a "theory-driven" approach (Niemeijer, D., 2002). According to the literature, the "data-driven" approach involves utilizing all available data as the central criteria for developing an environmental health indicator. A "theory-driven" approach takes a theoretical point of view with data availability being only one of several criteria for choosing the best possible environmental health indicator (Niemeijer, D., 2002).

A community's environmental health interests can be based upon negative emotions, misperceptions and/or a value system that has the potential to undermine or breakdown a researcher's "theoretical point of view". Therefore, in order for the policy to withstand the possible misperceptions in the Newark community regarding health of asthmatic children and vehicle pollution, the researcher utilized all available data as the central criteria (i.e. the "data-driven" approach). The data results would determine whether or not there was an association between vehicle pollution and indoor air pollutants in classrooms with asthmatic children.

According to the American Lung Association, there are numerous asthma triggers including airborne particulate matter, dust-mites, mold, cigarette smoke, household cleaners, etc. However, this research focused on airborne particulate matter as an environmental indicator of poor indoor air quality, which can exacerbate asthmatic symptoms. The criteria for selection of particulate matter (PM) as an environmental health indicator was based upon literature data that identified airborne PM as the major component of urban pollution (D'Amato, G., et al., 2002). According to the Journal of the American Medical Association (JAMA), asthmatic poor urban children are extremely vulnerable to outdoor PM even at levels below the EPA standards (Gent, J., et al., 2003). All available data continues to support the position that heavy concentrations of automobile, bus and truck traffic may increase PM emissions from the exhausts and tire treads of these vehicles (Councell, T., et al., 2004). Since PM is one of many asthma triggers, an increase in PM emissions would exacerbate asthma-like symptoms or increase the environmental burdens experienced by asthmatic children. Environmental science data also shows that PM can be formed in the atmosphere through photochemical reactions (Turpin, B.J., et al., 2000).

An analysis of the national air pollution data on New Jersey, showed that 64% of New Jersey's air pollution comes from mobile sources such as, vehicles, buses, airplanes, and trucks (Figure 7.3). And, 72% of particulate air pollution comes from on-road diesel vehicles (National Air Toxics Assessment (NATA) Report, 1996 and EPA Mobile Source Toxics Report, 1999; respectively).

Since this community-focused dissertation research took the "data-driven" approach, all available data was shared with the Newark Preschool Council community members, local government officials, local businesses, and the Newark school community-at-large. In an effort to establish a meaningful dialogue that would address the community's interests and health concerns, the data was presented and discussed during Environmental Forums (i.e. Environmental Health Fairs, Workshops and Seminars).

USEPA ISC-AERMOD View Lakes Environmental software was purchased and utilized in order to identify the past and present cumulative air pollution burdens experienced by the targeted Newark Wards and preschool community children. This data was used to create a wind rose air dispersion model identifying the historical wind speeds and wind directions for Newark. A wind rose depicts the relative frequency of wind direction on a 16-point compass. The air dispersion model and a more detail discussion of the historical wind directions for Newark are found in Chapter 4. Several GIS aerial maps were also created to identify the main Routes and highways that host the mobile sources, which produce the 64% of air pollution in New Jersey. Since the data also showed that Essex County had the second highest number of older registered vehicles and the highest prevalence of asthma hospitalization rates, this dissertation research work focused on these mobile sources as being one of the major environmental burdens currently experienced by the individual Ward communities of Newark. This data was also shared and discussed at the Environmental Forums.

When the aforementioned information was presented to the Newark community members, they became interested in knowing the toxicological effects of airborne PM that comes from these vehicles. This resulted in actual clinical environmental-health data being collected in the form of an Asthma Survey Sheet for each Newark Preschool Council child by the Newark Preschool Council health staff and administrators. The information on the Sheet was necessary to assess the human environment and to determine the prevalence of physician-diagnosed asthmatic children in each preschool classroom (Gilliland, F., et al., 2001).

The air sampling, PM_{10} filter collection, microwave acid digestion of the targeted metal species in the PM_{10} samples with analysis using an analytical balance and an Inductively Coupled Plasma and Mass Spectrometry (ICP-MS) chemical analysis were deemed necessary for an accurate assessment of the indoor air environment. Data assessing human environment, environmental-health of the children, and indoor air quality were all collectively used as the driving forces and basis for making the Newark preschool's environmental health policy (Niemeijer, D., 2002).

7.4 Methodology III: Environmental Pragmatism- Using Community-Based Environmental Research and Interest-Based Negotiations to Achieve Practical Solutions

According to Andrew Light and Eric Katz, the term "environmental pragmatism" means that there should be "practical resolutions of environmental problems" as opposed to long, frustrating theoretical debates (Light, A., and Katz, E., 1996). These editors support Mark Sagoff's belief that the "theoretical debates" are the problem for the development of environmental policy. They state that environmental pragmatism is fostered by the following three concepts: 1) the "open-ended inquiry" into 2) "specific real-life problems" of 3) "humanity's relationship with the environment" (Light, A., and Katz, E., 1996).

Notwithstanding the definition of environmental pragmatism, these three concepts were used to create the Environmental Science Research Modeling Framework (Figure 1.1).

(i.) The first concept of having an "open-ended inquiry" was introduced at the school community meetings and Urban Environmental Health Forums (Fairs, Workshops and Seminars). This allowed the Newark Preschool Council community-at-large to openly ask questions and inquire about their children's environmental health issues.

(ii.) The second concept of identifying and addressing any "specific real-life problems" was accomplished through an earlier two-year open dialogue (years 2001-2003). Throughout the dialogue, the preschool community members voiced their concerns to the researcher about the increased prevalence of pediatric asthma and the increase of asthmatic symptoms occurring with their East Ward and South Ward preschool children. This was later documented as a specific real-life problem that the Newark community in Essex County was experiencing (See Figure 7.2).

(iii.) The third concept of "humanity's relationship with the environment," was initially a concept for the Newark preschool community to understand and utilize because the preschool community members had to observe their own personal relationship with the environment at a behavioral level. This behavioral level involved not only the school community members understanding that their children's health may be related to the indoor environment, but that they, as preschool parents, teachers, parent coordinators, health care providers and preschool administrators collectively could take a proactive approach to this environmental health issue.

The preschool community members were made aware that they had a definite personal relationship with their environment, which could either physically impair their quality of life or it could empower them to take charge and improve their quality of life. After many meetings with the researcher, the Newark Preschool Council community members understood that in order to realize all three concepts, there must be "community input up front in a proactive manner" (Cooney, C.M., quoting Rita Thornton, 1999).

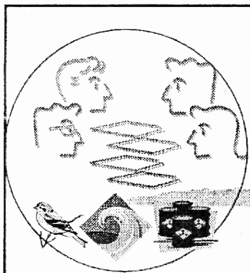
Community input is essential in understanding environmental pragmatism. Public policy pragmatists believe it is only through community that we as researchers, have a chance of meeting the crisis (Light, A., and Katz, E., 1996). Therefore, according to Andrew Light and Eric Katz, "community is needed because it is the method of science, and the basis for a pragmatic theory of truth" (Light, A., and Katz, E., 1996).

"Environmental pragmatism" entails designing "practical resolutions" to environmental problems, hence there must be a method that unifies the objectives and identifies the "interests" of many different actors (Sundqvist, G., et. al., 2002). Despite the fact that an essentialism approach has a linear development from science to public policy (Sundqvist, G., et. al., 2002), in order to successfully develop and implement the Newark Preschool Council's Environmental Health Policy, the researcher also had to identify the interests of the different actors.

In an effort to arrive at practical resolutions, the researcher applied Interest-Based Negotiation (IBN) techniques to identify the interests of the many different actors (i.e. parents of the asthmatic children, teachers, administrators, health care providers, parent coordinators, as well as the researcher). IBN techniques were used with the understanding that the interests of the many different actors had to be not only identified but also connected to each other. Although the actors had different fields of expertise and interests, each actor had to become a part of the same project, thereby focusing on the same objectives (Sundqvist, G., et. al., 2002).

IBN is a communication process that involves an educational aspect and a problem-solving aspect of a negotiation that occur among many different actors in a community meeting (See Figure 7.7). In regard to this particular research work, the educational aspect and the problem-solving aspect played an important part in getting to the interests of the many different actors. Even though the different actors came to the community meetings and Environmental Forums with different interests, they shared a common initial interest in understanding how to address Essex County's environmental health crisis of having the highest asthma hospitalization rates in New Jersey.

METHODOLOGY FOR INTEREST-BASED NEGOTIATIONS (IBN)



An *Interest* Based Negotiation ...

is a ***PROCESS*** that involves ...

An ***Educational*** Aspect

- **Educate** each other about Interests, standards & criteria, Value differences, and Data history

A ***Problem Solving*** Aspect

- Presenting Issues as **"*mutual*" problems to be *mutually* solved**
- Learning to separate the "*people*" from the "*problem*" (i.e. environmental, organizational, or policy)
- Identifying & Analyzing *Interests*
- Generating *options* to be selected later

Figure 7.7 An Interest-Based Negotiation (IBN) educates each of its participants while presenting community issues as mutual problems that can be mutually solved.

IBN played an important role in the dissertation research and the development of an environmental health policy because having an educational and problem-solving aspect built into the communication process allowed the researcher (IBN Mediator) to address the mind-set of the many different actors and the possible positions that each actor may take. The IBN techniques were chosen because each actor came to the school community meetings (i.e. the negotiation table) with different philosophical positions and interests that did not take into account any of the other actors' interests. It was useful for each group of actors to see themselves as part of the same community with respect to the development and implementation of the environmental health policy (Light, A., and Katz, E., 1996).

The use of IBN techniques during all community meetings allowed the researcher (mediator) to address and break down any initial philosophical positions (pragmatic deconstruction) or personal interests that were incompatible with the ultimate goal. Simultaneously, the researcher could address and build up the common interests (pragmatic reconstruction). Allowing pragmatic deconstruction and pragmatic reconstruction to occur during each meeting allowed the actors to see and experience for themselves that they had become a part of the same community (Light, A., and Katz, E., 1996).

IBN techniques were also helpful in addressing a genuine "Circle of Conflict" (CDR Associates, 1999) concerning the community-based research (See Figure 7.8). The "Circle of Conflict" (Circle) involves a top half and a bottom half. The top half of the Circle addresses the possible value differences, relationship problems and data problems that may exist when dealing with many different actors such as, the preschool parents, teachers, health care providers and the administrators.

Each actor had a different field of expertise or concern. This caused value differences and relationship problems to occur that later created some problems with the interpretation of the environmental health data. Only after the issues located in the top half of the Circle were successfully dealt with did the researcher observe the actors desire to move to the issues found within the bottom half of the circle, which are "structural problems" and the "triangle of interests".

Structural problems involved dealing with the chain of command in the school system. Psychological, procedural and substantive interests usually are not addressed until later. For example, seeking out organizations designed to help asthmatic children (See Figure 7.8).

During each meeting, the researcher observed conflict that occurred among the different actors as they moved from the top to the bottom half of the Circle (See Figure 7.8). In understanding the Newark preschool community's interests, the researcher had to use IBN to ultimately build in teamwork within the community-based research.

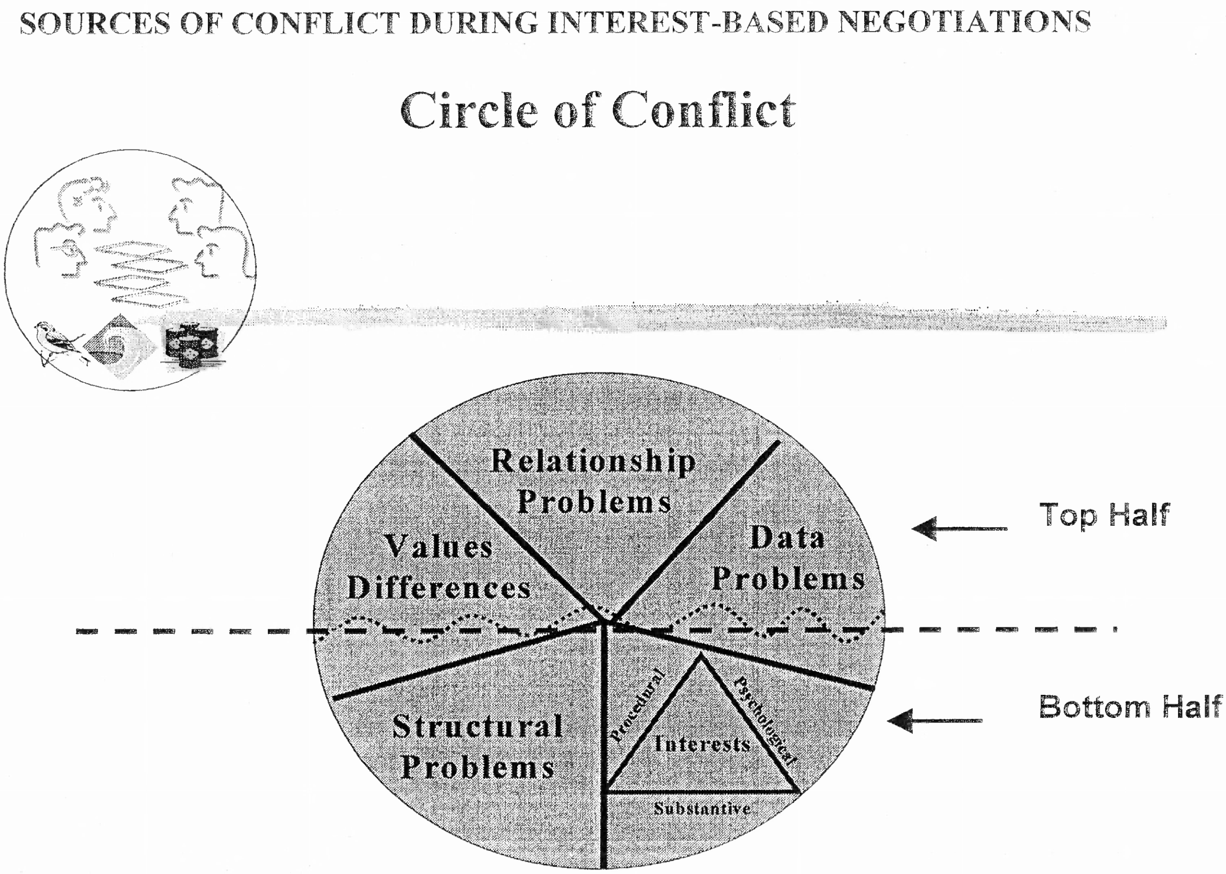


Figure 7.8 When addressing the sources of conflict in environmental, organizational and public policy disputes, a "Circle of Conflict" is created as the Interest-Based Negotiations (IBN) begin to target the "interests" of the different actors. CDR Associates, 1999

7.5 Studies Supporting Increased Awareness Hypothesis

Interestingly, a recent research article in the New England Journal of Medicine supported the above-mentioned hypothesis with the notion that increasing the educational awareness increases intervention (Morgan, W., et al., 2004). This particular Inner-City Asthma Study evaluated the effectiveness of a multifaceted, home-based, environmental intervention for inner-city children with asthma. The objective of the study was to determine whether an intervention tailored to urban children's sensitization and environmental risks could improve the symptoms of asthma and decrease the use of health care services (Morgan, W., et al., 2004). For every two-week period, the intervention group had fewer days with symptoms than the control group had both during the intervention year and the following year (Morgan, W., et al., 2004). Based upon clinical data, the study concluded that an increase in environmental health educational awareness along with an increase or comprehensive environmental intervention among inner-city children having asthma, decreased their exposure to indoor allergens. This resulted in reduced asthma-associated morbidity (Morgan, W.J., et. al., 2004).

7.6 The Relationship Between Environmental Science and Policy

Research has shown that the relationship between science and policy in the environmental arena can be divided into two different analytical approaches: "essentialism" and "constructivism" (Sundqvist, G., Letell, et al., 2002). The essentialism approach involves a theory of knowledge that scientists through observations and experiments establish the borders, which identify the problem in nature; and once those borders are scientifically established there is a "linear development from science to public policy" (Sundqvist, G., Letell, et al., 2002). Thus, within a scientific framework, there is a pointing out of the problem in nature whereby the policy-makers formulate abatement strategies as a way to identify their intentions to improve the environmental pollution problem (Sundqvist, G., Letell, et. al., 2002). In constructivism, however, identifying the problem in nature is based upon a construction according to social interactions and not based upon scientific experiments that use analytical methods.

Since constructivists believe the borders are socially established, the relationship between environmental science and policy mainly focuses on how the scientists and policy-makers act strategically by creating boundaries that go well with their own social interests. Consequently, according to the "constructivism" approach, science becomes local and not universal; pragmatic and strategic but not analytical or legislative; contingent and not principled; and constructive not essential (Sundqvist, G., Letell, et. al., 2002).

Notwithstanding the essentialism and constructivism approaches, there is still a community directive to merge environmental science with policy. And, like this dissertation research, any effort that aims at developing and implementing air pollution abatement strategies that are based upon scientific observations and chemical research would be an example of this merge between environmental science and policy (Sundqvist, G., Letell, et al., 2002).

Since this research study had a scientifically established framework as opposed to a socially established framework, the Newark Preschool Council's environmental health policy had a linear development from science to policy. Therefore, the Newark Preschool Council administrators and the researcher used the "essentialism" approach (Sundqvist, G., Letell, et al., 2002). The researcher and the administrators chose the essentialism approach because it best supported any practical resolutions to the poor indoor air quality within the classrooms and the environmental health burdens experienced by the asthmatic preschool children in the targeted Wards of Newark.

7.6.1 Complexities in Identifying the Environmental Science and Policy Relationship

When the environmental health problem involves asthma triggers such as Particulate Matter (PM), the merge between environmental science and policy becomes even more difficult since the particulate matter is an atmospheric contaminant that encompasses transboundary air pollution (Sundqvist, G., Letell, M. and Lidskog, R., 2002).

Airborne pollutants disregard jurisdictional borders between local communities, cities, counties and states. Long-range transboundary air pollution or airborne pollutants like particulate matter place additional pressure on environmental policy-makers to scientifically measure these pollutants and develop sound air pollution abatement strategies that can be implemented to reduce human exposure to these pollutants (Sundqvist, G., Letell, M. and Lidskog, R., 2002). For example, in the 1960's, sulfur dioxide was one of the first atmospheric contaminants considered as a long-range transboundary air pollutant. This finding triggered the debate at the international level (Sundqvist, G., Letell, et. al., 2002).

Like sulfur dioxide, air Particulate Matter (PM) is another example of a long-range transboundary air pollutant that challenges jurisdictional borders of New Jersey. Social, economic and cultural boundaries exist between counties like Essex and Hudson County, and individual communities within the same county, such as the Newark community versus the Montclair community. Therefore, introducing indoor air pollution abatement strategies and technologies is a critical part in any successful merge between environmental science and policy (Sundqvist, G., Letell, et. al., 2002).

7.6.2 Environmental Science and Policy: Can They Work Together for the Common Good?

There has always been a great deal of discussion, and in some cases, major disagreement on whether or not environmental science and environmental policy can work together for the common good. This research is an example of one important step toward merging environmental science with environmental policy in an effort to produce a common and meaningful community-based goal to increase urban environmental health awareness. This type of policy-making will lead to the kind of school intervention that creates an asthma-friendly preschool environment. The actual intervention was based upon the aforementioned environmental data and a school policy that supported that data to the extent an educational tool was created, and indoor air pollution abatement equipment (i.e. HEPA filter air cleaners) were purchased and ultimately installed in the targeted preschool classrooms that had the most asthmatic children in attendance.

As previously stated in this research (Section 7.1), the term "environmental policy" has been defined as "mankind's environmental responsibility expressed in statements of intentions or principles that target an environmental objective for a community". In following this definition, the Newark Preschool Council administrators met with the researcher to discuss their intention to target the prevalence of pediatric asthma in their preschools. They also wanted to address their environmental responsibility to improve the indoor air quality and environmental conditions faced by their asthmatic preschool children.

The environmental science literature on the inhalation toxicological effects of air particulate matter (PM) on children, and research studies which demonstrated that a significant portion of total personal exposures to ambient particulate occurs in indoor environments (Long, C.M., et al., 2001), were used to provide the scientific documentation. This allowed the researcher to create an urban environmental health educational tool that focused on air pollution and its effects on urban children's health (i.e. The PROTECTORS featuring AIRon) (See Chapter 6). The educational tool was specifically designed to not only address the environmental health problems faced by urban communities such as, Newark but to also be user-friendly enough for all grade levels to understand the subject matter. This allowed the Newark Preschool Council administrators and community members to understand the need for comprehensive preschool intervention in their Head Start Program.

7.7 Conclusion

The research hypothesis that 'increased urban environmental health education during community meetings would increase awareness within the preschool community' resulted in a positive and increased school intervention (See Figure 7.9). This hypothesis worked successfully in this study, with a positive correlation occurring between environmental science and health educational awareness and preschool policy intervention by the Newark Preschool Administrators (See Figure 7.9).

Newark Preschools: Environmental Health Educational Awareness and School Intervention Correlation

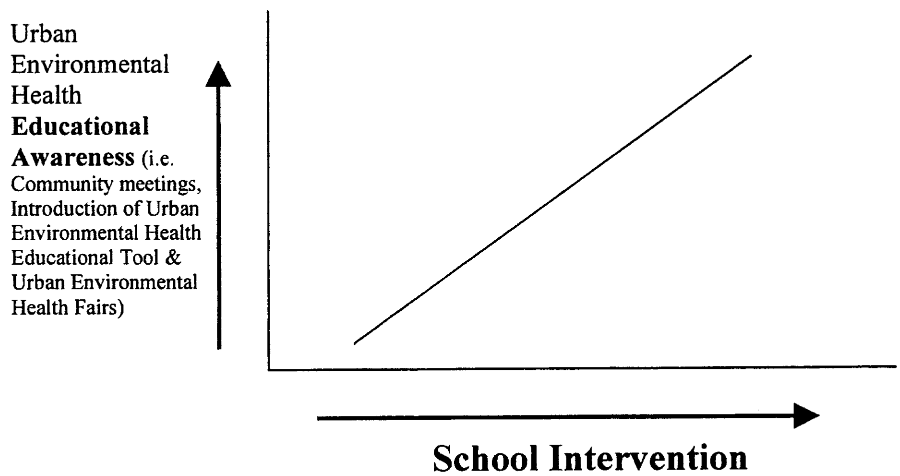


Figure 7.9 As number of preschool community meetings and Environmental Health Forums increased, the greater the interest for school policy intervention with efforts being made by school staff to complete Asthma Survey Sheets, understand air particulate pollution, counsel parents of asthmatic children and install air cleaners.

CHAPTER 8

ENVIRONMENTAL IMPACT ON A COMMUNITY

8.1 Introduction

In an effort to combine environmental science with policy and law, this research study was designed to closely follow and reflect the principles of the National Environmental Policy Act (NEPA). This Act is not only the basic national charter for protection of the environment, but it establishes policy, sets goals, and provides the means for carrying out the policy and identifying the environmental impact that the policy may have on a community (42 USC Sections 101 and 102 respectively).

8.1.1 Legal Overview and Regulatory Applicability of NEPA in New Jersey

The federal National Environmental Policy Act (NEPA) was enacted in 1969 and in subsequent years, amended accordingly (42 U.S.C. 4321-4347). This Act and its implementing regulations at 40 CFR Parts 1500 – 1508, require federal agencies to consider impacts to the human environment of all proposals for any "major federal action". For example, pursuant to 42 USC §4332 Section 102(2)(A) of the Act and 40 CFR §1508.9 of its implementing regulation, before a federal agency takes a major federal action like building an incinerator in a community, it must consider impacts to the human environment as follows: The agency must use a systematic and interdisciplinary approach that insures the integrated use of the natural and social sciences in its environmental assessment and the environmental design arts in the planning and in decision-making which may have an impact on man's environment. In accordance with the federal regulations, the Environmental Assessment (40 CFR §1508.9) must involve collecting environmental data and performing "an analysis" on that data to determine whether to prepare a more detailed Environmental Impact Statement (EIS) pursuant to 42 USC Section 102(2)(C) of the Act and 40 CFR §1508.11 of the federal regulations.

Many state and local governments have incorporated some form of NEPA into their regulations. Some governing bodies require that an Environmental Assessment (EA), and an Environmental Impact Statement (EIS) be performed before approving state and/or local permits to operate an incinerator, a landfill or any type of facility operations that will have an impact on or affect the community members in the area. Moreover, if a state agency fails to perform an EA and an EIS, that agency can be subject to a lawsuit by the aggrieving community (South Camden Citizens in Action vs. New Jersey Department of Environmental Protection, Commissioner Robert Shinn and St. Lawrence Cement Company, LLC, 145 F.Supp. 2d 446, 491-2, 505 (D.C.N.J. 2001)). In this landmark case, Federal District Court Judge Stephen Orlofsky granted a motion for a temporary injunction prohibiting the St. Lawrence Cement Co. from beginning operations of its $50 million cement manufacturing facility in Camden, New Jersey. Judge Orlofsky ordered the St. Lawrence Cement Group of Montreal to be closed for 30 days. During this time, the New Jersey Department of Environmental Protection (DEP) was required to complete an environmental assessment of the racial and ethnic composition of the Camden Waterfront South community and an environmental health impact statement which included a full review of the air pollution permits issued to the St. Lawrence Cement (SLC) facility.

The Court's legal basis for the temporary injunction was its finding that toxic emissions from the St. Lawrence Company's facility would harm nearby residents and violate their civil rights. The Court found that when the DEP issued a permit to the SLC plant, the DEP violated the civil rights of the African-American and Hispanic residents, who comprised 90 percent of the residents in the community where the SLC facility was located. Judge Orlofsky also stated that the state DEP failed to perform an environmental assessment which considered the cumulative threat posed by pollution from industrial sources already located in the primarily minority community. Moreover, the DEP not only failed to perform an environmental impact statement that considered the pre-existing poor health of the residents of Waterfront South, but it also failed to consider the cumulative environmental burdens already borne by the impoverished community that was living around the SLC facility.

Approximately one year later, after the DEP prepared an EA and an EIS that fully reviewed the "human environment" with respect to the air pollution permits issued to the facility, the SLC facility was opened based upon the subsequent Third Circuit Court of Appeals decision in South Camden Citizens in Action v. New Jersey Department of Environmental Protection, 274 F.3rd 771, 775 (3rd Cir. 2002).

8.1.2 Fundamental Purpose and Policy Considerations under NEPA

The fundamental purpose of NEPA is to provide guidance on how to incorporate into federal or state agency regulations the social sciences or human concerns that may be involved in a community with respect to its natural environment. The NEPA procedures and its federal regulations are designed to ensure that environmental information (i.e. an

EA and EIS) is available to public officials and citizens before decisions are made and before actions are taken (40 CFR §1500.1). For example, the EA and EIS must consider the "Human environment" in its analysis and impact statement (40 CFR §1508.14). In accordance with the aforementioned federal regulations, "human environment" shall be interpreted comprehensively to include the natural and physical environment and relationship of people with that environment. This means "economic or social effects are not intended by themselves to require preparation of an environmental impact statement. When an environmental impact statement is prepared and economic or social and natural or physical environmental effects are interrelated, then the environmental impact statement will have been successfully carried out because it would have been prepared to inherently "discuss all of these effects on the human environment" (40 CFR §1508.14).

NEPA has a fundamental policy, which is to "encourage productive and enjoyable harmony between man and his environment" (42 USC §4321). The Act provides that Congress "recognize that each person should enjoy a healthful environment and that each person has a responsibility to contribute to the preservation and enhancement of the environment (42 USC §4331(c)). NEPA sets forth the following four goals, which make it clear that attainment of environmental justice is wholly consistent with the purposes of the statute:

1) To "assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings" (42 USC §4331(b)(2));

2) To "attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences" (42 USC §4331(b)(3));

3) To "maintain, wherever possible, an environment which supports diversity and variety of individual choice" (42 USC §4331(b)(4); and

4) To "achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities" (42 USC §4331(b)(5).

8.2 NEPA Applicability to Environmental Justice

Environmental justice issues encompass a broad range of impacts or effects covered by the federal regulations that implement NEPA. In these regulations, the terms "effects" and "impacts" are used synonymously. Both direct effects and indirect effects, must be considered. They include, but are not limited to, the "health" effects on the human environment (40 CFR §1508.8).

Although NEPA establishes a fundamental policy and sets forth goals, the statute does not provide a standard formula for how environmental justice issues should be identified or addressed with respect to NEPA compliance. The Council on Environmental Quality therefore established the following five principles to provide NEPA guidance for any federal agency or state agency that incorporates NEPA into regulations that address environmental justice issues:

1) Consider the composition of the affected area to determine whether minority populations and/or low-income populations are present. If

that is the case, consider whether or not they constitute a disproportionately high population in that area and whether or not there may be disproportionately high adverse human health or environmental effects on the minority and/or low-income populations in that area;

2) Consider relevant public health data and industry data concerning the potential for multiple or cumulative exposure to human health or environmental hazards in the affected population and historical patterns of exposure to environmental hazards;

3) Recognize interrelated cultural, social, occupational, historical, or economic factors that may magnify the human environment as a direct and indirect effect of the federal action;

4) Develop effective public participation strategies while seeking to overcome the cultural, institutional, geographic, and other barriers to meaningful participation. This should incorporate active outreach to the affected groups; and

5) Assure meaningful and complete community representation by being aware of the diverse constituencies within the affected community and the entire community as a whole (CEQ Report, 1997).

The researcher notes that these five principles are only to be used as a "guide" because under NEPA, the identification of a disproportionately high adverse human health effects or environmental effects on a minority and/or low-income population does not preclude a proposed agency action from going forward with its action. However, the identification of such an effect should raise the agency's attention to find alternatives, mitigation strategies, educational tools, monitoring needs, innovative technology for pollution abatement, and preferences or interventions expressed by the affected community (Council on Environmental Quality Report, 1997). The fact that a state agency that incorporates NEPA into its regulations does not have its agency's action permanently barred or prohibited when there is an identification of disproportionately high and adverse health effects of a minority and/or low-income population was seen in the Third Circuit Court of Appeals decision in South Camden Citizens in Action v. New Jersey Department of Environmental Protection, 274 F.3rd 771, 775 (3rd Cir. 2002). However, a state agency that incorporates NEPA into its regulations can also have its agency's action either temporarily delayed or prohibited when it fails to perform an environmental assessment and an environmental health impact statement that considers the identification of disproportionately high and adverse health effects of a minority and/or low-income population (South Camden Citizens in Action vs. New Jersey Department of Environmental Protection, Commissioner Robert Shinn and St. Lawrence Cement Company, LLC, 145 F.Supp. 2d 446, 491-2, 505 (D.C.N.J. 2001)). Even though the St. Lawrence Cement case ultimately involved the legal issue of citizens having "private rights" to sue a state agency, it was this initial litigation that prevented the St. Lawrence Cement Plant from opening even after it had successfully obtained an air pollution permit from the New Jersey Department of Environmental Protection.

8.3 Methodology for an Environmental Assessment of the Newark Community

In identifying the affected population and its physical environment, GIS mapping of the mobile sources was prepared. The mapping of possible mobile sources and the highways and roads that would accommodate these sources reflected that most of the mobile sources were located in or near the East and South Ward communities of Newark. In addition, an air dispersion model was constructed based upon the historical meteorological conditions for Newark. The model also showed that the wind rose was more prevalent in the East and South Wards. This data was then compared with the data results from the Asthma Survey Sheets (Appendix A).

8.3.1 Health Effects on the Human Environment I: Essex County- Newark

The data seen in Figures 5.2 and 7.2, showed that Essex County had the highest prevalence of asthma in the State of New Jersey and that there is a disproportionately high African-American/Black and Hispanic population of residents living in Newark, which is the largest city in Essex County. State health data supports the fact that African-American children under the age of five experience the highest prevalence of asthma in New Jersey. This data was used to focus a study on the city of Newark and its asthmatic preschool children. When looking at the prevalence of asthma and the asthmatic children in Newark, there was also a focus on the criteria pollutant, Particulate Matter (PM_{10}), its presence in the urban atmosphere, and its function as a pediatric asthma trigger.

8.3.2 Health Effects on the Human Environment II: Newark Preschool Children

The Newark Preschool Council's administrators, health coordinators, parent coordinators and the researcher-observer collectively designed an Asthma Survey Sheet (Survey), and requested that each parent in a preschool under the jurisdiction of the Newark Preschool Council, Inc. complete the Asthma Survey Sheet (See Appendix A for more details).

With the assistance of a Newark Preschool Council parent and health coordinator, information on the Survey Sheet was discussed and reported. The purpose of the modified portion of the Survey was to identify which Head Start preschools under Newark Preschool Council had preschoolers with physician-diagnosed asthma or asthma-like symptoms. The researcher was given the data by the Newark Preschool Council Administrators and was allowed to use it to identify those preschool classrooms with the most asthmatic children in attendance.

8.3.3 Criteria Used to Determine Targeted Preschool Classrooms

In order to be eligible for the research study, the preschools and the children met the following eligibility criteria:

(1) Child was aged 3-6 years;

(2) Child had physician-diagnosed asthma or current asthma symptoms;

(3) Preschool classroom had at least five children in daily attendance;

(4) Targeted classrooms chosen for air sampling, ICP-MS chemical analysis of metals in particulate matter, and installation of HEPA filter air cleaners had the highest number of asthmatic children in attendance for the perspective Ward;

(5) All clinical classroom data (i.e. Asthma Survey Sheets) was submitted to the Newark Preschool Council Health Manager by the agreed upon due date; and

(6) Teachers and children in targeted classrooms agreed to undergo an environmental health education program for policy development.

Based upon the eligibility criteria, the East Ward's Pennington Court preschool classroom was not included in the analysis. During the time period for the research study, its classroom only had 4 children in daily attendance. The South Ward's Alberta Bey I, Henrietta King, Greater Abyssinian I, IGA I and Zion Hill I were not included in the percentage breakdown in Figure 8.6 because there were no asthmatics reported in these South Ward preschools. Additionally, St. Thomas I and II, and Seth Boyden preschools were not included in the analysis due to late entries that were submitted to the Newark Preschool Council Health Manager two months past the agreed upon due date.

8.3.4 Inspection of Targeted Preschool Classrooms

The researcher inspected the targeted preschool classrooms (Terrell Homes-East Ward and Greater Abyssinian II – South Ward) early in the study, later measured the size of each classroom, and reported the infrastructure and daily operations for each classroom.

The Terrell Homes preschool is located on Riverview Court, situated just off of Raymond Boulevard. Its classroom measures 25.5 feet in width and 28.3 feet in length. It has a community bathroom in the center with one work/play area on each side. It also has six windows that vary in size. During the winter months, the classroom heating was between 85-90 degrees; and teachers would open windows to cool off the classroom on a daily basis (See Figure 8.1).

Figure 8.1 Terrell Homes preschool indoor environment.

The researcher observed the entrance of the Terrell Holmes preschool and its outdoor playground area and picnic area. The outdoor playground and picnic areas have stored railroad containers located adjacent to and on the opposite side of the development complex and preschool play area. Some of these containers are stacked as high as 20 feet. In addition, airplanes arriving to and departing from the Newark-Liberty Airport often fly low and quite close to the low-income building complex (See Figure 8.2).

Terrell Homes Preschool Environment – EAST Ward

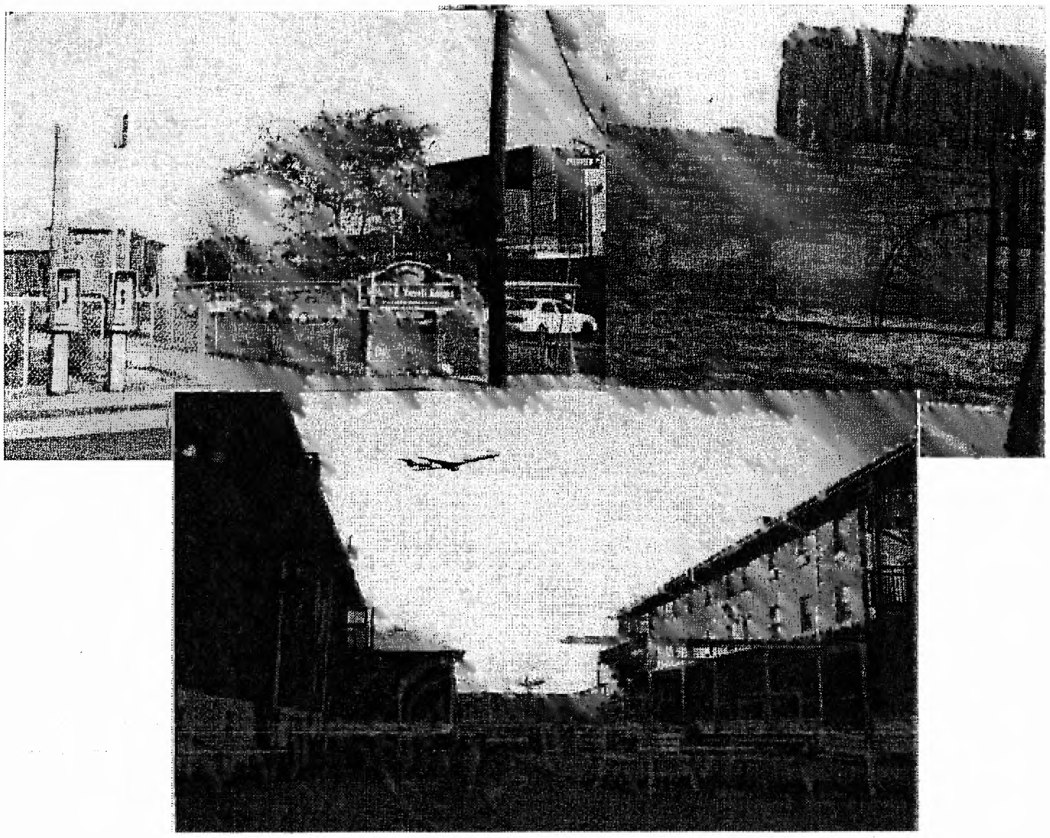


Figure 8.2 Outdoor environment for Terrell Homes includes a parking lot for Terrell Homes Project residents, storage of railroad waste containers behind playground and airplanes traveling very low to classroom's outdoor picnic area.

The Greater Abyssinian II preschool classroom measures 35.8 feet length by 23.9 feet in width. The preschool is located in the basement of the Greater Abyssinian Baptist Church on Lyons Avenue. Since the preschool is in the basement, it has no windows in the classroom (See Figure 8.3). While a two-door exit area leads directly up to the Greater Abyssinian Baptist Church, the only authorized entrance and exit area for the preschool teachers, parents, children and visitors is the one entrance door that leads in from and out to the street area of Lyons Avenue.

Greater Abyssinian II Preschool – SOUTH Ward

Figure 8.3 Greater Abyssinian-II indoor environment.

The main entrance of the Greater Abyssinian II preschool is only 68 feet from the intersection of Lyons Avenue and Bergen Street. This intersection is a major traffic area that changes depending upon the time of the day. For example, at 7:00 a.m. in the morning this intersection is not very busy, however, between 8:30 a.m. and 10:00 a.m. this intersection experiences a tremendous increase in traffic density (See Figure 8.4). The traffic density is mainly due to an increase in New Jersey Transit buses dropping off and picking up Newark residents on each of the four corners of Lyons Avenue and

Bergen Street. In addition, school buses, vans, trucks and cars also contribute to the increase in traffic density.

Greater Abyssinian II – SOUTH Ward

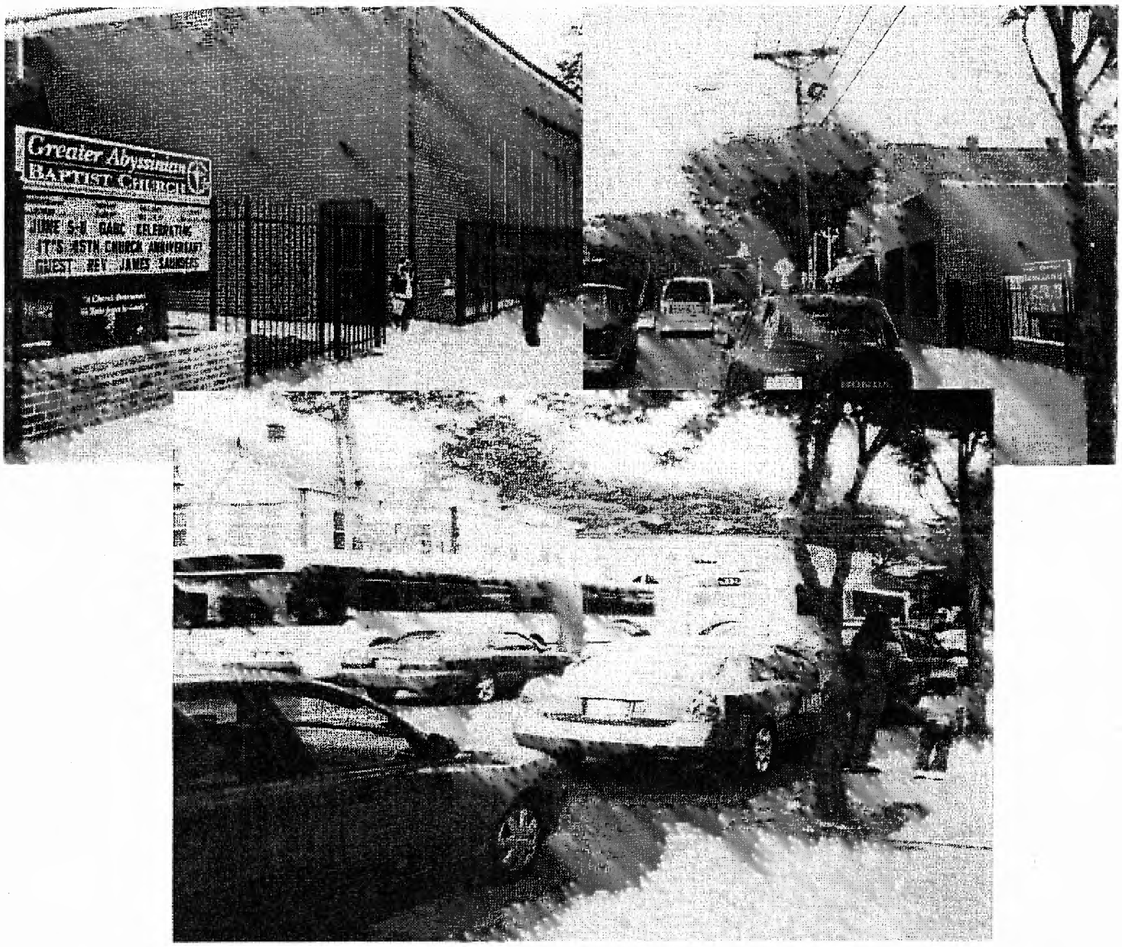


Figure 8.4 Outdoor environment of Greater Abyssinian-II drastically changes depending on the time of day and day of the week. Between 7:00 a.m. and 8:00 a.m., Monday through Friday, the traffic is mild at the intersection of Lyons Avenue and Bergen Street (upper photos). From 8:30 a.m. until approximately 10:00 a.m., Monday through Friday, the traffic density greatly increases with an increase in transit buses, vans and cars (center photo). The Preschool is closed on Saturday and Sunday.

8.4 Asthma Survey Data Results

The Asthma Survey data results showed that the East Ward had six preschool classrooms and a total of 51 children. The South Ward had twelve preschools and a total of 186 children. The total of preschool children who were surveyed was 237 from eighteen preschool classrooms. With the exception of three classrooms, each classroom had an average of 10-15 children in daily attendance. In analyzing the data from the Survey Sheets, the researcher determined that the Terrell Homes and Greater Abyssinian- II classrooms had the highest number of asthmatic children in attendance (See Figures 8.5 and 8.6).

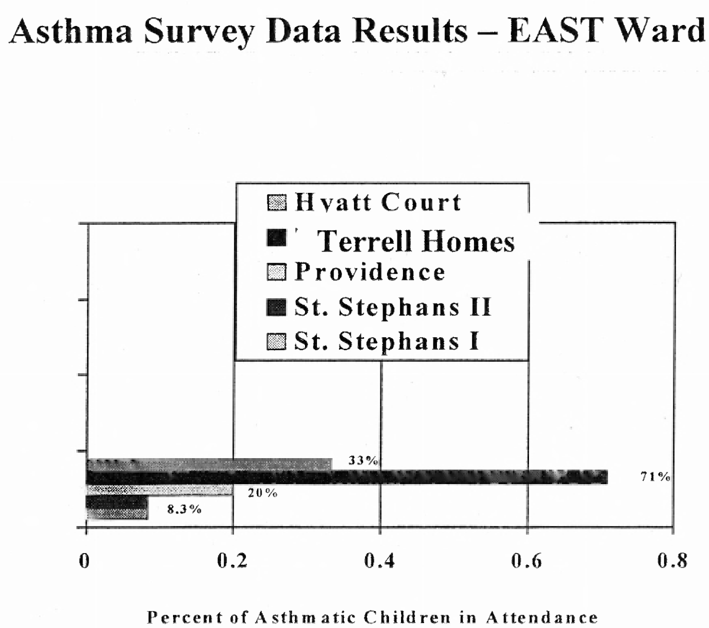
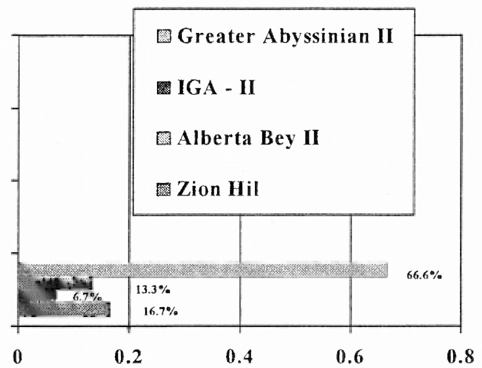


Figure 8.5 In analyzing the six Preschool classrooms in the East Ward, Terrell Homes had the highest number (71%) of asthmatic children in attendance.

Asthma Survey Data Results – SOUTH Ward



Clinical Classroom Data Note: No Asthmatics in Alberta Bey I, Henrietta King, Greater Abyssinnian I, IGA I and Zion Hill I; and No Data analysis on late entries submitted by St. Thomas I and II, and Seth Boyden preschools

Figure 8.6 In analyzing the 12 Preschool classrooms in the South Ward, Greater Abyssinian II had the highest number (66.6%) of asthmatic children in attendance.

8.5 Conclusion: Based upon Environmental Assessment and Environmental Health Impact in the Newark Preschool Classrooms

Both the Terrell Homes and the Greater Abyssinian II preschools have different outdoor and indoor environments. This means that the preschool asthmatic children attending these preschools also experience different environmental burdens because of the outdoor versus indoor environments. The combination of data on asthma, and the differences in indoor/outdoor environments at the two schools was considered in deciding the type of pollutants to collect and analyze. Therefore, the next phase of the research study was the particulate data collection and chemical analysis.

CHAPTER 9

AN ASSESSMENT OF THE ATMOSPHERIC PARTICULATE MATTER

9.1 Introduction

In order to determine the coarse particulate matter (PM_{10}) in the indoor air of the classrooms, a Personal Environmental Monitor (PEM) was used as the sampling device (See Figure 9.1). In addition to the PEM, a PEM Flow Calibration Cap, a Quick Take Air pump, and Calibrator were used (See Figure 9.2). As seen in Figure 9.2, the PEM is a single-state impactor with an after filter. The sampler assembly allows the particle-laden air to be accelerated through a number of nozzles and while the exiting jets impinge upon a ring (SKC, 2004). The particles larger than 10μm in diameter, impact onto the ring due to inertia. The particles having a diameter smaller than 10μm (PM_{10}) are carried along in the air-stream and are collected on a 37-mm quartz fiber filter. The PEM Flow Calibration Cap provides for a single inlet to the PEM to which a calibrator was attached. The Flow Calibration Cap was pressed onto the nozzle cap of the PEM and tubing from the Calibration Cap was connected to an inlet portion of the calibrator. The Quick Take Air pump was turned on and allowed to run (automatic) for one minute to stabilize the flow. After one minute, the calibrator automatically started counting down the minutes. The initial flow rate was recorded from the digital reading on the calibrator and recorded again at the end of the testing time period. Both start and end times were recorded. An average flow rate in L/min was calculated between the start time and the end time for each time period. The weight (in grams) of the sample collection filter paper was recorded before the air sampling and after sampling by the PEM. The size-specific PM levels were calculated from the weight gain of the filter and the total volume of air sampled for each day collected.

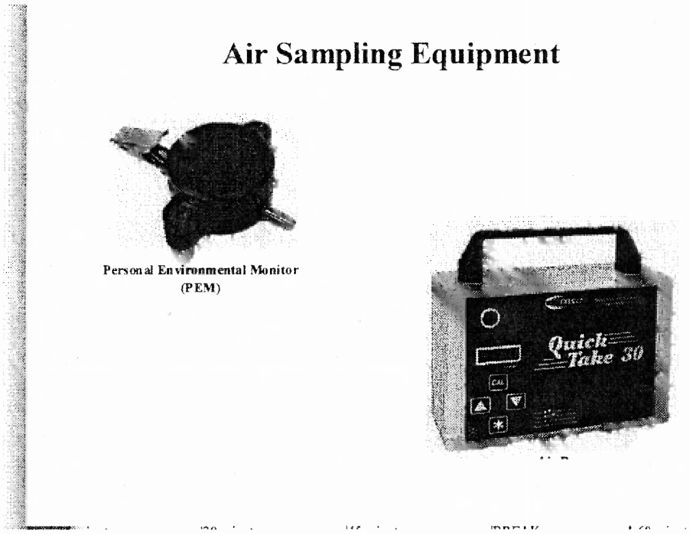


Figure 9.1 Air sampling equipment used to collect PM_{10} filtration samples in Terrell Homes and Greater Abyssinian II classrooms. The equipment was connected through tubing from inlet and outlet. SKC, Inc., 2004

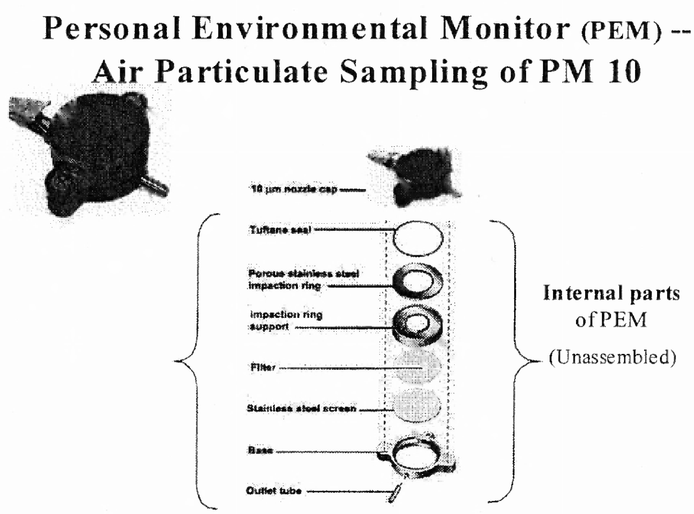


Figure 9.2 Personal Environmental Monitor (PEM) operates by size-specific impaction for the determination of particulate matter in indoor air (SKC, Inc. 2004)

9.2 Methodology

9.2.1 Air Sampling Methodology: Collection and Determination of Indoor Airborne PM_{10} Mass Concentrations from Targeted Preschool Classrooms

In determining the PM $_{10}$ mass concentration levels in both preschool classrooms, the researcher weighed each of the 28 quartz filters before air sampling was performed and after air sampling had been completed. Before sampling and initial weighing, all filters were placed in a dessicator for 30 days to have them achieve a common moisture content. Using chromium tip plastic tweezers, each filter was weighed. Filter weight in grams was recorded along with day, time and average flow rate. Each filter was placed in a paper envelope and marked accordingly. After all air sampling was completed, all filters in their envelopes were placed in a dessicator for 3-5 days. The dessicator allowed for moisture removal. After the moisture equilibration was allowed and after being used in the air sampling, the filters were weighed again to determine the net weight and (mass) gain (See Figure 9.3).

Handling of Air Filters:
Laboratory Methodology

Figure 9.3 Filter handling procedure: Using tweezers, each 37-mm quartz filter was weighed before and after air particulate sampling; placed in individual envelopes, then envelopes and filters were placed in a dessicator (*center*). Time, room temperature, filter weight and flow rate were recorded for each sample.

The methodology for the handling of air filters was taken from Compendium of Methods for the Determination of Inorganic Compounds in Ambient Air, Compendium Method IO-3.1: Selection, Preparation and Extraction of Filter Material. This standard method was prepared under the sponsorship of the U.S. Environmental Protection Agency (EPA) with the EPA Office of Research and Development being directly responsible for overseeing the preparation of this method. This Compendium was subjected to the EPA's peer and administrative review; and therefore, in 1999, it was approved for publication as an USEPA document and is referenced as such.

Utilizing the following equations (40 CFR, Part 50 App. M), the total volume of air sampled and the PM_{10} concentrations were calculated as follows:

$$\boxed{V = Q_a t}$$

Figure 9.4 V = Total air sampled at ambient temperature and pressure, m^3;
Q_a = average sample flow rate at ambient temperature and pressure, m^3/min;
t = sampling time period, minutes.

$$\boxed{PM_{10} = \frac{(W_f - W_i) \times 10^6}{V}}$$

Figure 9.5 PM_{10} = Mass concentration of PM_{10}, $\mu g/m^3$;
W_f W_i = final and initial weights of filter collecting PM particles, grams;
Conversions: µg = micrograms (10^{-6} grams) 10^{-6} g = 1µg 10^6 µg = 1 gram.

The data to calculate total mass and particulate mass concentration levels for each preschool classroom sample are summarized in Tables 9.1, 9.2, 9.3 and 9.4; respectively.

Table 9.1 **Terrell Homes** FILTER SAMPLES – Data for MASS

Sample Number:	1	2	3	4	5	6	7	
Initial Weight (gms) (W_i)	0.0952	0.0976	0.0950	0.0973	0.0974	0.1016	0.0970	
Final Weight (gms) (W_f)	0.0983	0.1005	0.0973	0.1069	0.1011	0.1059	0.1002	
Initial Flow (l/m) (Qi)	16.50	18.55	19.81	19.88	18.76	19.60	19.72	
Final Flow (l/m) (Qf)	17.33	18.74	18.82	19.76	19.79	19.69	18.79	
Average Flow (l/min)	16.92	18.65	19.32	19.82	19.28	19.65	19.26	
Sampling Time (minutes) (t)	4320	1440	960	960	960	600	960	
	8	9	10	11	12	13	14	15
Initial Weight (gms) (W_i)	0.0981	0.0949	0.0989	0.0971	0.0968	0.0978	0.0962	0.0511
Final Weight (gms) (W_f)	0.1008	0.0969	0.1011	0.1010	0.0986	0.0985	0.0992	0.0526
Initial Flow (l/m) (Qi)	19.67	18.41	19.09	19.69	18.99	18.48	18.16	18.15
Final Flow (l/m) (Qf)	18.85	18.89	19.16	20.59	18.43	19.17	18.54	19.14
Average Flow (l/min)	19.26	18.65	19.13	20.14	18.71	18.82	18.35	18.65
Sampling Time (minutes) (t)	1080	4320	1470	1440	1440	780	5760	3000

Table 9.2 **Greater Abyssinian – II** FILTER SAMPLES – Data for MASS

Sample Number:	16	17	18	19	20	21	22
Initial Weight (gms)(W_i)	0.0497	0.0977	0.0989	0.0984	0.0973	0.0985	0.0968
Final Weight (gms) (W_f)	0.0502	0.0981	0.0991	0.0994	0.0983	0.0996	0.0974
Initial Flow (l/m) (Qi)	18.65	18.34	18.99	19.30	19.78	18.73	17.79
Final Flow (l/m) (Qf)	19.39	19.43	18.38	19.25	18.96	19.19	16.52
Average Flow (l/min)	19.02	18.89	18.69	19.28	19.37	18.96	17.16
Sampling Time (minutes) (t)	3000	600	960	1440	4320	4320	960
	23	24	25	26	27	28	
Initial Weight (gms)(W_i)	0.0962	0.0951	0.0984	0.0992	0.0958	0.0978	
Final Weight (gms) (W_f)	0.0978	0.0956	0.0993	0.1000	0.0965	0.0984	
Initial Flow (l/m) (Qi)	18.26	19.19	20.19	19.83	19.18	16.68	
Final Flow (l/m) (Qf)	19.15	20.04	19.84	19.65	18.46	18.98	
Average Flow (l/min)	18.71	19.62	20.02	19.74	18.82	17.83	
Sampling Time (minutes) (t)	2880	780	1440	1440	1440	960	

Table 9.3 Terrell Homes - Total Volume Air Sampled and **PM_{10} Concentrations**

Sample Number:	1	2	3	4	5	6	7
Average (m^3/min) Flow (Q_a)	0.01692	0.01865	0.01932	0.01982	0.01928	0.01965	0.01926
Time (hrs)	72hr	24hr	16hr	16hr	16hr	10hr	16hr
Total Vol. (m^3) Air Sampled (V)	73.09	26.86	18.55	19.027	18.51	11.79	18.49
Mass Conc.($\mu g/m^3$) of PM (PM_{10})	42.41	107.98	123.99	504.55	199.89	364.72	173.07
Test Start Date (Month/day)	Mar.15	Mar.22	Mar.23	Apr.4	Apr.7	Apr.8	Apr.13

	8	9	10	11	12	13	14	15
Average (m^3/min) Flow Rate (Q_a)	0.01926	0.01865	0.01913	0.02014	0.01871	0.01882	0.01835	0.01865
Time (hrs)	18hr	72hr	24hr	24hr	24hr	13hr	96hr	50hr
Total Vol. (m^3) Air Sampled (V)	20.80	80.57	27.55	29 .0	26.94	14.68	105.7	55.95
Mass Conc.($\mu g/m^3$) of PM (PM_{10})	129.81	24.82	79.85	134.48	66.82	47.68	28.38	26.81
Test Start Date (Month/day)	Apr.14	Apr.15	Apr.18	Apr.19	Apr.20	Apr.21	Apr.22	Apr.26

Table 9.4 Greater Abyssinian II -Total Volume Air Sampled and **PM_{10} Concentrations**

Sample Number:	16	17	18	19	20	21	22
Average (m^3/min) Flow Rate (Q_a)	0.01902	0.01889	0.01869	0.01928	0.01937	0.01896	0.01716
Time (hrs)	50hr	10hr	16hr	24hr	72hr	72hr	16hr
Total Vol. (m^3) Air Sampled (V)	57.06	11.33	17.94	27.76	83.68	81.91	16.47
Mass Conc.($\mu g/m^3$) of PM (PM_{10})	8.76	35.31	11.15	36.02	11.95	13.43	36.43
Test Start Date (Month/day)	Apr.28	May 3	May 5	May 6	May10	May13	May16

	23	24	25	26	27	28
Average (m^3/min) Flow Rate (Q_a)	0.01871	0.01962	0.02002	0.01974	0.01882	0.01783
Time (hrs)	48hr	13hr	24hr	16hr	24hr	16hr
Total Vol. (m^3) Air Sampled (V)	53.89	15.30	28.83	28.43	27.10	17.12
Mass Conc.($\mu g/m^3$) of PM (PM_{10})	29.69	32.68	31.22	28.14	25.83	35.05
Test Start Date (Month/day)	May18	May20	May24	May25	May 26	May27

The 28 air samples were collected during eleven weeks and two campaigns from March 15, 2005 through May 27, 2005. Samples 1 through 15 were collected at the Terrell Holmes classroom; and Samples 16 through 28 were collected at the Greater Abyssinian – II classroom. For each sample, a new 37mm quartz filter was placed inside the Personal Environmental Monitor (PEM) (See Figure 9.2) at the start of the day. Depending on the sampled time period, the quartz filter was removed and placed in a paper envelope for the final weighing and chemical analysis.

Since there are no federal standards for indoor particulate air pollution, the indoor PM_{10} concentration levels in the preschools were compared to the federal ambient PM_{10} air pollution standards (See Figure 9.6). Other research studies like this one, have also found it appropriate to compare the indoor particulate air pollution levels with the federal ambient PM_{10} air pollution standards (Breysse, P., et al., 2005).

Federal Standards for Air Particulate Matter

Ambient (Outdoor) **Particulate Air Pollution:**

National **Ambient** Air Quality Standards [NAAQS for Particulate Matter (PM)]

PM_{10} average 24 hour NAAQS = **150 µg/m³**

$PM_{2.5}$ average 24 hour NAAQS = **65 µg/m³**

Indoor Particulate Air Pollution

Has **NO** **Federal Standards for *Indoor Air Quality (IAQ)***

Figure 9.6 With No federal standards for indoor particulate air pollution, the indoor PM_{10} concentration data results were compared to the federal ambient PM_{10} standards. The Data results were compared to the $150 \mu g/m^3$ National Ambient Air Quality Standards (NAAQS) for PM_{10} for an average 24-hour time period. (Breysse, P., et al., 2005)

As seen in Tables 9.3 and 9.4, the PM_{10} mass concentrations for Terrell Homes preschool classroom were consistently higher than the PM_{10} mass concentrations for the Greater Abyssinian– II classroom. The average PM_{10} mass concentration in the targeted East Ward classroom environment was 137μg/m^3, which was *five times higher than* the Greater Abyssinian classroom PM_{10} mass concentrations. As seen in Table 9.3, during the winter months of the first campaign, four of the samples from the Terrell Holmes classroom (Samples # 4, 5, 6, and 7) were collected using an average time period less than 24-hrs but, still had PM_{10} mass concentrations (504.55, 199.89, 364.72 and 173.07μg/m^3 respectively) which averaged *two times higher than* the EPA's 150ug/m^3 24-hour average National Ambient Air Quality short-term standard (NAAQS) for PM_{10}. This means that 27% of the samples from the Terrell Holmes classroom had PM_{10} concentrations *above* EPA's 24-hour average NAAQS of 150ug/m^3 (Figures 9.6 and 9.7).

The Terrell Homes preschool classroom is part of the Terrell Homes Projects/Development complex in the East Ward of the City of Newark. According to the Newark Preschool Council Administrators, the Projects occasionally experience random "black-outs" between the various buildings, where the electricity is shut-off temporarily as requested by the law enforcement's reasonable belief of criminal actions taking place within the projects. From April 22 to April 26, 2005, there were random "black-outs" reported. Therefore, the air pump would have been off for one or several periods during sample 14. This explains why the air sample particulate mass concentration was very low for the long sample time period (4 days) recorded.

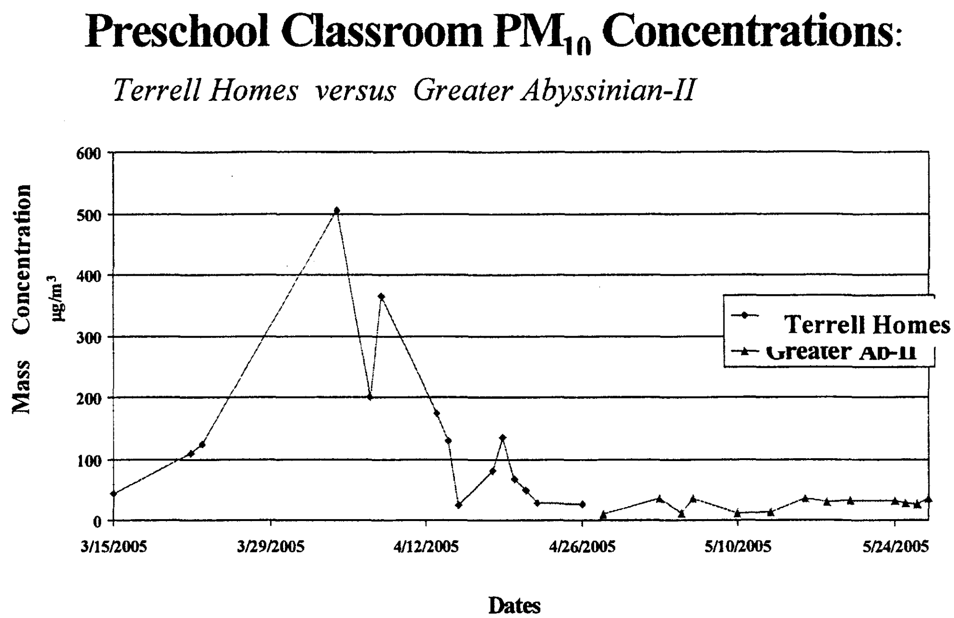


Figure 9.7 Terrell Homes classroom had 27% of its PM_{10} concentrations higher than the federal PM_{10} National Ambient Air Quality Standard (NAAQS) for 24-hour average period of 150 µug/m^3

9.2.2 Microwave Acid Digestion Methodology: Filter Material Acid Extraction Process

The following calculations were done using the equation Vi x Ci = Vf x Cf

to determine the final concentrations of the metal standards in solution:

V = Volume i = initial

C = Concentration in ppm f = final

Since ppm is by mass Units = gms/ml (H_2O)

1 ml = 1 g = ppm

Standard #41
Ni = compound is 100% metal
weighed out 0.248g
mass of metal/500ml = 0.248g/500=.000496gm = 496e-6gms   Ci = 496ppm
used equation Cf = Vi x Ci /Vf to calculate final conc. Diluted 1ml(exactly) of Ni solution into final volume of 500ml

Cf = 1ml x 496ppm / 500ml =0.992ppm
Cf = 0.992ppm Ni in H2O

Standard #42
Zn = compound is 100% metal
weighed out 0.238g
mass of metal/500ml = 0.238g/500=.000476gm = 476e-6 gms   Ci = 476ppm
used equation Cf = Vi x Ci /Vf to calculate final conc. Diluted 1ml(exactly) of Zn solution into final volume of 500ml

Cf = 1ml x 476ppm / 500ml =0.952ppm
Cf = 0.952ppm Zn in H2O

Standard #43
Pb = Pb(NO3)2 compound crystals
mass of Pb(NO3)2 compound = 331.2 at.wt.
The fraction of Pb is 207.2 / 331.2 = 0.625g
weighed out 0.210g   0.210g x 0.625g = 0.1314gm
0.1314gms of Pb in 500gms of soln = 0.1314 / 500 = 0.0002628 =262.8e-6gms = 262.6ug/ml or 262.8ppm

Ci = 262.8ppm

used equation Cf = Vi x Ci /Vf to calculate final conc. Diluted 1ml(exactly) of Pb solution into final volume of 500ml

Cf = 1ml x 262.8ppm / 500ml =0.526ppm
Cf = 0.526ppm Pb in H2O

Standard #44
V = V2O5 compound powder
mass of V2O5 compound = 188.88 at.wt.
The fraction of V is 50.94 / 188.88 = 0.2697g
weighed out 0.221g   0.221g x 0.2697g = 0.0596gm
0.0596gms of V in 500gms of soln = 0.0596 / 500 = 0.0001192 = 119.2e-6gms = 119.2ug/ml or 119.2ppm

Ci = 119.2ppm

used equation Cf = Vi x Ci /Vf to calculate final conc. Diluted 1ml(exactly) of V solution into final vol. of 500ml

Cf = 1ml x 119.2ppm / 500ml = 0.238ppm
Cf = 0.238ppm V in H2O

Standard #45
Mn = compound is 100% metal
weighed out 0.252g
mass of metal/500ml = 0.252g/500=.000504gm = 504e-6gms Ci = 504ppm
used equation Cf = Vi x Ci /Vf to calculate final conc. Diluted 1ml(exactly) of Mn solution into final vol. of 500ml

$$Cf = 1ml \times 504ppm / 500ml = 1.01ppm$$
$$Cf = 1.01ppm \text{ Mn in } H_2O$$

The above calculations are summarized in Table 9.5 below:

Table 9.5: Dilution of Metal Standards for ICP Analysis

Standard	Metal compound	Weighed amt	Final Conc. (Cf)
#41 ----------	Ni	0.248g	0.992ppm of Ni
#42 ----------	Zn	0.238g	0.952ppm of Zn
#43 ----------	$Pb(NO_3)_2$	0.210g	0.526ppm of Pb
#44 ----------	V_2O_5	0.221g	0.238ppm of V
#45 ----------	Mn	0.252g	1.01ppm of Mn

The above calculations were done to determine the concentrations of the dilute metal standards for the ICP analysis. However, even though these calculations were used for the five metal standards, they became a part of the "Semi-Quantitation Report" of many metals, which was not used by the researcher in the final analysis. In order to perform a more accurate analysis of the data, the researcher, chose to use the "Quantitation Report – Summary" raw data, which specifically analyzed the five targeted metals as opposed to the "Semi-Quantitation Report" which analyzed 71 metals (See Appendix H).

The Microwave Acid Digestion of the filtered-collected particulate matter allowed for the trace metals in the air particulate samples to be digested into solution and prepared for the Inductively-Coupled Plasma Mass Spectrometry (ICP-MS) chemical analysis of the targeted metal particulate pollutants.

All glassware used for the microwave digestion was acid-cleaned to reduce contamination. The acid used in the acid-cleaning was 1M HNO_3 solution which was diluted with distilled water (diluted 350ml 1M HNO_3 with 350ml distilled water). Each vial and each flask was initially cleaned with hot soapy water and a test tube brush. Each vial and flask was then rinsed with distilled water and diluted HNO_3. Each vial was double rinsed with pure Millipore super-water and labeled Sample #1 through #28.

The Compendium Method IO-3.1 for preparing the extraction solution was modified from its original 5.55% HNO_3/16.75% HCl ratio to a 11% HNO_3/2% HCl solution with 111ml HNO_3 and 21ml HCl. This modification was required for the ICP analysis (See below) because the ICP analysis could not tolerate the large interferences from the high concentration of chlorine. The modified extraction solution was then prepared by adding to 500ml Distilled Water (DW), 111ml HNO_3, and 21ml HCl, then diluted up to 1 Liter mark. The solution was mixed for a few minutes by inverting repetitiously. This extraction solution was used as the basic solution for each sample and blank.

The digestion procedure for the microwave process involved the following steps, which were taken from the Compendium Method IO-3.1:

1) Cut filters in ¼ pieces using a pizza cutter;
2) Placed pieces in bottom of centrifuge vessel;
3) Poured 10 ml extraction solution into each centrifuge vessel;
4) Made sure filters were submerged in solution at the bottom of each vessel;

5) Placed vessel caps with values and membrane on vessels and tighten securely;
6) Weighed and recorded capped vessel fully assembled to the nearest 0.01g with filters and extraction solution before placed in microwave oven and after being removed from the microwave oven. The Compendium Method states that the initial and final weights should compare within 0.1g. These data results were summarized in Table 9.6;

The microwave oven was programmed as follows: 1) Set for 35% power for 23 minutes. This final 35% power and 23 minutes were used after the calculated method of plotting power (watts) against the percent (calibration point) to determine that the appropriate setting for the microwave unit should have been 41%. The 41% power and 30-minute setting were too high at 41% and 30 minutes because there was break-though (i.e. loss of sample liquid) at these settings. The microwave oven was then set at 35% power for 23 minutes and no break-through occurred. This was another modification of the calibration procedure and microwave power evaluation specified in the Compendium Method IO-3.1.

Table 9.6 Initial and Final Vessel Weight Results: Determining Sample Loss

Weight = mass of microwave vessel + sample liquid (analyte)

Sample #	Vessel #	Initial Wt (g)	Final Wt (g)	Sample Loss (g)	
16	1	208.4	208.3	0.1	Run #1
17	2	208.03	207.96	.07	
18	3	207.96	207.94	.02	
19	4	207.5	207.48	.02	
20	5	209.9	209.8	0.1	
Blank#1	6	208.71	208.70	.01	
21	1	207.1	207.03	.07	Run #2
22	2	206.9	206.9	0	
23	3	206.79	206.77	.02	
24	4	208.48	208.45	.03	
25	5	208.9	208.9	0	
Blank #2	6	207.46	207.45	.01	
26	1	208.08	208.08	0	Run #3
27	2	208.49	208.49	0	
28	3	209.05	208.05	0	
1	4	208.21	208.21	0	
2	5	208.77	208.76	.01	
Blank #3	6	207.16	207.15	.01	
3	1	208.72	208.72	0	Run #4
4	2	208.98	208.98	0	
5	3	208.09	207.99	0.1	
6	4	207.89	207.89	0	
7	5	207.91	207.89	.02	
8	6	207.63	207.62	0	
9	1	208.45	208.45	0	Run #5
10	2	208.85	208.80	05	
11	3	209.54	209.54	0	
12	4	208.79	208.76	.03	
13	5	207.45	207.45	0	
14	6	208.21	208.19	.06	
15	1	206.69	206.68	.01	Run #6
Blank #4	2	208.79	208.78	.01	
Blank #5	3	207.45	207.44	.01	
Blank #6	4	209.54	209.53	.01	
10ml w/soln	5				
10ml w/soln	6				

After 23 minutes, the microwave oven heating was turned off and the carousel containing the samples/vessels was removed and placed in a water bath of tap water to cool for 10 minutes. Each capped vessel was weighed to the nearest 0.01g after checking for break-though. The final steps involved pouring 10 ml of the digestrate (sample liquid analyte) and 10 ml of distilled Millipore super-water into a 30ml marked vial. The final extraction volume was 20ml, which was then filtered.

Air Filter Material Extraction by
Microwave Acid Digestion

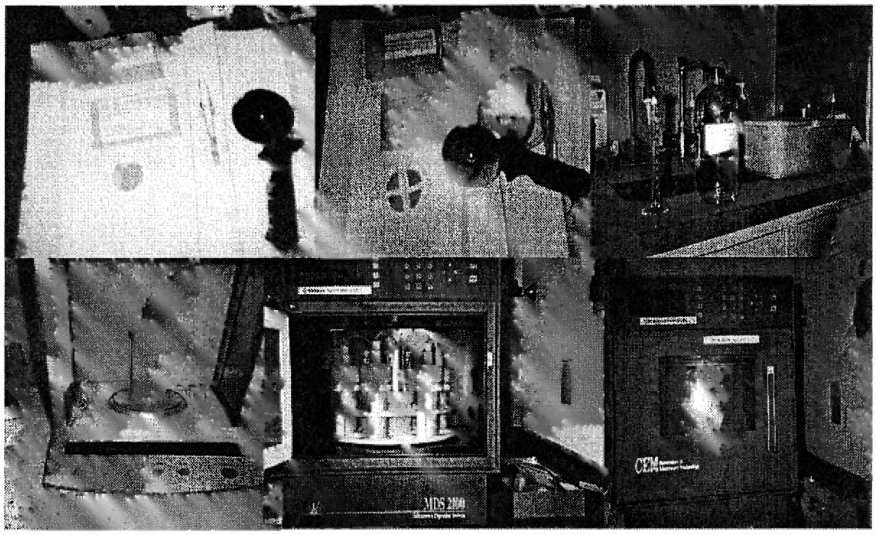


Figure 9.8 Each microwave vessel weighed emptied. Each filter sample cut into quarters with a pizza cutter then placed into vessel with tweezers. Poured 10ml extraction solution into vessel to emerge filters and vessel then weighed again. Each filled vessel was placed in carousel and placed in microwave at 32% power for 23 minutes.

9.2.3 Inductively Coupled Plasma/Mass Spectrometry (ICP/MS) Chemical Analysis of Filter-Collected PM_{10} and Target Metals

After filter-collected particulate matter was digested and solublized by the microwave acid digestion process, each sample was analyzed for metals by the Inductively-Coupled Plasma-Mass Spectrometry (ICP-MS) method.

When using the ICP-MS methodology, a sample solution is sprayed into flowing argon and passed into a torch, which is inductively heated to approximately 10,000°C. This is the temperature of the gaseous atoms and molecules and ions in the flow. The molecules in the flowing gas are excited using a plasma torch inside of a water cooled quartz tube, through which the neubulized gases are flowing. The molecules are broken down into atoms and ions by the plasma torch. Some of the ions are directed through a small opening that leads into the mass spectrometer. Once inside the mass spectrometer, the electromagnetic and electric fields of the instrument direct the ion flow, perform a mass separation and detection of the quantity of each mass. The actual physical property that a mass spectrometer monitors is mass-to-charge ratio (M/Q). In this case, the charge is almost all +1 so the reading is simply the mass of the atoms(s) (See Figure 9.9).

An ICP-MS can therefore be divided into four main processes, 1) Sample introduction and aerosol generation; 2) Ionization by an argon plasma source; 3) Mass discrimination or separation; and 4). Detection system.

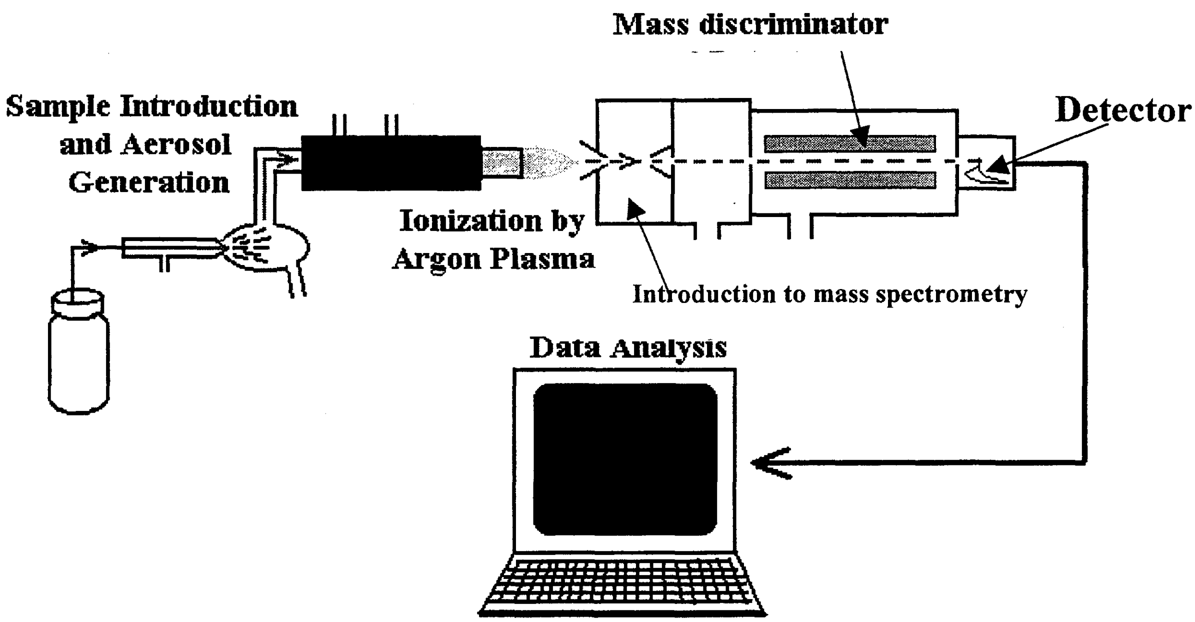


Figure 9.9 Schematic diagram of ICP-MS divided into 4 main processes: 1) Aerosol Sample introduction by a nebulizer; 2) Ionization by Argon plasma; 3) Mass discrimination or separation; and 4). Detection system.

Source: Steve Kvech; and http://ewr.cee.vt.edu/environmental/teach

During an ICP-MS analysis, aqueous samples, like the samples in this research, are introduced by way of a nebulizer, which aspirates the sample with high velocity argon, forming a fine mist. The aerosol than passes into a spray chamber where larger droplets are removed via a drain but the original mist passes through the spray chamber. This process is necessary to produce droplets small enough to be vaporized in the plasma torch (See Figure 9.9). The plasma torch is formed from a microwave of radio-frequency electric power waves (confined to the torch area in an Argon and sample solution gas stream). The plasma is used to atomize and ionize the elements in an aqueous sample. The resulting ions are then passed through a series of cones into the high vacuum analyzer. The elements are identified by their mass-to-charge ratio; and the intensity of a peak in the mass spectrum is proportional to the amount of element in the original aqueous sample (See Figure 9.9).

Because the ICP-MS method has superior sensitivity over the Atomic Absorption (AA) or atomic emission methods, the speciation data analysis used the ICP-MS method instead of the AA method in determining the concentrations of the targeted metals in the particulate matter.

As stated earlier, the analysis of the laboratory data results was done based upon the ICP-MS "Quantitation Report- Summary" instead of the Semi-Quantitation Report. In the Quantitation Report, the quantitative data results for concentrations of the targeted metals were in counts per second and parts per billion (ppb) so these figures were converted to ng/g (ng of metal per gram of solution), total nanograms of metal in the entire sample, and ng/m^3 (ng of metal per m^3 of air sample) (Appendix H). Therefore, the

9.3 Data Results

ppb = ng/g   1gm = 1ml   20ml represented the final extraction volume

Sample (ng/g) x 20 = Total Nanograms (ng) of metal in the entire sample

Concentration of Targeted Metals
per volume of air sampled was calculated as follows:

$$\frac{\text{Total Nanograms (ng) for Sample}}{\text{Vol. Air Sampled (m3) for Sample}} = \text{ng/m}^3$$

Table 9.7 ICP-MS Quantitative Report on BLANKS

BLANK	**Zn** (66)	**Pb** (208)	**Ni** (60)	**Mn** (55)	**V** (51)
#1					
(cps) Counts per sec.	3,459.7	157.69	90.4	43.24	0.9817
Concentration (ppb)	6,987	148.5	123.1	10.28	0.9098
(ng/g)	6,987	148.5	123.1	10.28	0.9098
Total Nanograms (ng)	139,740	2,970	2,460	205.6	18.196
#2					
(cps) Counts per sec.	954.25	18.899	61.43	27.61	0.7557
Concentration (ppb)	1,926	17.08	83.62	6.585	0.6435
(ng/g)	1,926	17.08	83.62	6.585	0.6435
Total Nanograms (ng)	38,520	341.6	16,724	131.7	12.87
#3					
(cps) Counts per sec.	2,266.88	9.54	38.66	39.75	0.4325
Concentration (ppb)	4,578	8.317	52.56	9.451	0.2624
(ng/g)	4,578	8.317	52.56	9.451	0.2624
Total Nanograms (ng)	91,560	166.34	10,512	189.02	5.24
#4					
(cps) Counts per sec.	11.72	4.267	29.46	8.63	0.2284
Concentration (ppb)	21.71	3.222	40.01	2.10	0.0219
(ng/g)	21.71	3.222	40.01	2.10	0.0219
Total Nanograms (ng)	**434.2**	**64.44**	**800.2**	**42.00**	**0.438**
#5					
(cps) Counts per sec.	62.18	4.57	63.81	31.60	0.3587
Concentration (ppb)	123.6	3.51	86.87	7.53	0.1755
(ng/g)	123.6	3.51	86.87	7.53	0.1755
Total Nanograms (ng)	**2,460**	**70.2**	**1,737.4**	**150.6**	**3.51**
#6					
(cps) Counts per sec.	41.84	3.73	23.06	14.38	0.266
Concentration (ppb)	82.56	2.72	31.28	3.46	0.066
(ng/g)	82.56	2.72	31.28	3.46	0.066
Total Nanograms (ng)	**1,651**	**54.4**	**625.60**	**69.2**	**1.32**

Note: There were 6 "Blanks" altogether; and each of the first 3 of the 6 Blanks were digested and placed in a vessel and run along with the actual individual Greater Abyssinian (Greater Ab.) Samples. The first 3 Blanks (Blanks # 1, 2, and 3) were observed to have unusually high spikes of Zinc, which is an indication that the high Zinc concentrations in the Greater Ab Samples were carried over into these Blanks by contamination of the first six Sample containers. However, the last 3 "Blanks" (Blanks # 4, 5 and 6) were digested and run with only one Terrell Homes Sample and three vessels containing 10ml of extraction solution to balance out the 6-member microwave carousel. The ICP-MS Quantitative Report shows that these Blanks (Blanks #4, 5 and 6) do not have high spikes of Zinc. Therefore, Blanks #1,2, and 3 were not used in the analysis; and Blanks #4,5,and 6 were used.

Table 9.8 ICP/MS Quantitative Report on TARGETED METALS (Samples 1-6)

SAMPLE	**Zn** (66)	**Pb** (208)	**Ni** (60)	**Mn** (55)	V (51)
#1					
(cps) Counts per sec.	173.75	30.4	63.07	152.09	9.03
Concentration (ppb)	350.3	27.27	88.45	36.91	10.19
(ng/g)	350.3	27.27	88.45	36.91	10.19
Total Nanograms (ng)	***7,006***	***545.4***	***1,769***	***738.2***	***203.8***
Vol. Air Sampled (m^3)	73.094	73.094	73.094	73.094	73.094
Concentration (ng/m3)	**95.8**	**7.46**	**24.2**	**10.1**	**2.79**
#2					
(cps) Counts per sec.	109.6	10.7	72.37	59.56	8.52
Concentration (ppb)	220.9	9.51	101.5	14.22	9.58
(ng/g)	220.9	9.51	101.5	14.22	9.58
Total Nanograms (ng)	***4,418***	***190.2***	***2,030***	***284.4***	***191.6***
Vol. Air Sampled (m^3)	26.856	26.856	26.856	26.856	26.856
Concentration (ng/m3)	**164.5**	**7.08**	**75.59**	**10.56**	**7.13**
#3					
(cps) Counts per sec.	73.1	8.47	53.79	27.59	1.69
Concentration (ppb)	147.3	7.49	75.43	6.38	1.45
(ng/g)	147.3	7.49	75.43	6.38	1.45
Total Nanograms (ng)	***2,946***	***149.8***	***1,508.6***	***127.6***	***29.0***
Vol. Air Sampled (m^3)	18.55	18.55	18.55	18.55	18.55
Concentration (ng/m3)	**158.8**	**8.08**	**81.33**	**6.88**	**1.56**
#4					
(cps) Counts per sec.	62.05	11.53	58.33	39.00	1.03
Concentration (ppb)	125.0	10.24	81.80	9.18	0.660
(ng/g)	125.0	10.24	81.80	9.18	0.660
Total Nanograms (ng)	***2,500***	***204.8***	***1,636***	***183.6***	***13.2***
Vol. Air Sampled (m^3)	19.027	19.027	19.027	19.027	19.027
Concentration (ng/m3)	**131.4**	**10.76**	**85.98**	**9.65**	**0.694**
#5					
(cps) Counts per sec.	712.3	24.03	49.06	216.0	2.73
Concentration (ppb)	1,436	21.52	68.80	52.58	2.69
(ng/g)	1,436	21.52	68.80	52.58	2.69
Total Nanograms (ng)	***28,720***	***430.4***	***1,376***	***1,052***	***53.8***
Vol. Air Sampled (m^3)	18.51	18.51	18.51	18.51	18.51
Concentration (ng/m3)	**1,552**	**23.25**	**74.34**	**56.81**	**2.91**
#6					
(cps) Counts per sec.	67.87	10.36	60.28	31.66	0.681
Concentration (ppb)	136.7	9.19	84.53	7.38	0.251
(ng/g)	136.7	9.19	84.53	7.38	0.251
Total Nanograms (ng)	***2,740***	***183.8***	***1,691***	***147.6***	***5.02***
Vol. Air Sampled (m^3)	11.79	11.79	11.79	11.79	11.79
Concentration (ng/m3)	**232.4**	**15.56**	**143.4**	**12.52**	**0.426**

Table 9.9 ICP/MS Quantitative Report on TARGETED METALS (Samples 7-12)

SAMPLE	**Zn** (66)	**Pb** (208)	**Ni** (60)	**Mn** (55)	**V** (51)
#7					
(cps) Counts per sec.	87.57	7.41	57.51	44.93	3.41
Concentration (ppb)	176.4	6.53	80.65	10.63	3.50
(ng/g)	176.4	6.53	80.65	10.63	3.50
Total Nanograms (ng)	***3,528***	***131***	***1,613***	***213***	***70***
Vol. Air Sampled (m^3)	18.49	18.49	18.49	18.49	18.49
Concentration (ng/m3)	**191**	**7.06**	**87.2**	**11.5**	**3.79**
#8					
(cps) Counts per sec.	72.28	8.24	54.09	46.45	2.05
Concentration (ppb)	145.6	7.29	75.86	11.00	1.89
(ng/g)	145.6	7.29	75.86	11.00	1.89
Total Nanograms (ng)	***2,912***	***146***	***1,517***	***220***	***37.8***
Vol. Air Sampled (m^3)	20.80	20.80	20.80	20.80	20.80
Concentration (ng/m3)	**140**	**7.01**	**72.9**	**10.6**	**1.82**
#9					
(cps) Counts per sec.	159.8	23.94	69.27	89.45	14.73
Concentration (ppb)	322.1	21.44	97.15	21.55	16.97
(ng/g)	322.1	21.44	97.15	21.55	16.97
Total Nanograms (ng)	***6,442***	***429***	***1,943***	***431***	***339***
Vol. Air Sampled (m^3)	80.57	80.57	80.57	80.57	80.57
Concentration (ng/m3)	**79.96**	**5.32**	**24.12**	**5.35**	**4.21**
#10					
(cps) Counts per sec.	102.3	18.26	59.04	74.26	12.23
Concentration (ppb)	206.2	16.32	82.80	17.82	14.07
(ng/g)	206.2	16.32	82.80	17.82	14.07
Total Nanograms (ng)	***4,124***	***326***	***1,656***	***356***	***281***
Vol. Air Sampled (m^3)	27.55	27.55	27.55	27.55	27.55
Concentration (ng/m3)	**149.7**	**11.85**	**139.8**	**12.94**	**10.2**
#11					
(cps) Counts per sec.	94.79	24.65	76.53	90.89	20.71
Concentration (ppb)	189.5	22.54	104.2	21.53	24.17
(ng/g)	189.5	22.54	104.2	21.53	24.17
Total Nanograms (ng)	***3,790***	***451***	***2,084***	***431***	***483***
Vol. Air Sampled (m^3)	29 .0	29 .0	29 .0	29 .0	29 .0
Concentration (ng/m3)	**130.7**	**15.5**	**71.9**	**14.9**	**16.7**
#12					
(cps) Counts per sec.	143.5	31.85	61.72	127.3	3.29
Concentration (ppb)	287.9	29.34	84.01	30.15	3.63
(ng/g)	287.9	29.34	84.01	30.15	3.63
Total Nanograms (ng)	***5,758***	***587***	***1,680***	***603***	***73***
Vol. Air Sampled (m^3)	26.94	26.94	26.94	26.94	26.94
Concentration (ng/m3)	**213.7**	**21.8**	**62.4**	**22.4**	**2.69**

Table 9.10 ICP/MS Quantitative Report on TARGETED METALS (Samples 13-18)

SAMPLE	**Zn** (66)	**Pb** (208)	**Ni** (60)	**Mn** (55)	**V** (51)
#13					
(cps) Counts per sec.	59.42	7.72	56.0	37.997	5.46
Concentration (ppb)	118.1	6.495	76.21	9.036	6.19
(ng/g)	118.1	6.495	76.21	9.036	6.19
Total Nanograms (ng)	***2,362***	***129.9***	***1,524***	***180.7***	***123.8***
Vol. Air Sampled (m^3)	14.68	14.68	14.68	14.68	14.68
Concentration (ng/m3)	**160.9**	**8.85**	**103.8**	**12.3**	**8.43**
#14					
(cps) Counts per sec.	80.23	27.13	75.05	97.26	25.16
Concentration (ppb)	160.1	24.88	102.2	23.03	29.41
(ng/g)	160.1	24.88	102.2	23.03	29.41
Total Nanograms (ng)	***3,202***	***497.6***	***2,044***	***460.6***	***588.2***
Vol. Air Sampled (m^3)	105.7	105.7	105.7	105.7	105.7
Concentration (ng/m3)	**30.3**	**4.7**	**19.3**	**4.36**	**5.56**
#15					
(cps) Counts per sec.	162.6	12.81	65.14	45.13	11.698
Concentration (ppb)	326.5	11.32	88.68	10.72	13.54
(ng/g)	326.5	11.32	88.68	10.72	13.54
Total Nanograms (ng)	***6,530***	***226***	***1,774***	***214***	***271***
Vol. Air Sampled (m^3)	55.95	55.95	55.95	55.95	55.95
Concentration (ng/m3)	**117**	**4.05**	**31.69**	**3.82**	**4.84**
#16					
(cps) Counts per sec.	388.2	13.90	68.52	61.43	12.38
Concentration (ppb)	782.2	12.35	93.29	14.57	14.35
(ng/g)	782.2	12.35	93.29	14.57	14.35
Total Nanograms (ng)	***15,644***	***247***	***1,866***	***291***	***287***
Vol. Air Sampled (m^3)	57.06	57.06	57.06	57.06	57.06
Concentration (ng/m3)	**274**	**4.33**	**32.7**	**5.1**	**5.03**
#17					
(cps) Counts per sec.	894.1	7.39	50.81	34.13	1.36
Concentration (ppb)	1,804	6.18	69.13	8.12	1.36
(ng/g)	1,804	6.18	69.13	8.12	1.36
Total Nanograms (ng)	***36,080***	***124***	***1,383***	***162***	***27***
Vol. Air Sampled (m^3)	11.33	11.33	11.33	11.33	11.33
Concentration (ng/m3)	**3,184**	**10.9**	**122**	**14.3**	**2.39**
#18					
(cps) Counts per sec.	1,433	10.19	55.43	27.7	1.86
Concentration (ppb)	2,893	8.837	75.43	6.61	1.94
(ng/g)	2,893	8.837	75.43	6.61	1.94
Total Nanograms (ng)	***57,860***	***177***	***1,509***	***132***	***39***
Vol. Air Sampled (m^3)	17.94	17.94	17.94	17.94	17.94
Concentration (ng/m3)	**3,225**	**9.87**	**84**	**7.36**	**2.17**

Table 9.11 ICP/MS Quantitative Report on TARGETED METALS (Samples 19-24)

SAMPLE	Zn (66)	Pb (208)	Ni (60)	Mn (55)	V (51)
#19					
(cps) Counts per sec.	1,454	116.2	61.24	66.64	5.63
Concentration (ppb)	2,937	109.3	83.36	15.80	6.39
(ng/g)	2,937	109.3	83.36	15.80	6.39
Total Nanograms (ng)	***58,740***	***2,186***	***1,667***	***316***	***128***
Vol. Air Sampled (m^3)	27.76	27.76	27.76	27.76	27.76
Concentration (ng/m3)	**2,116**	**78.75**	**60.06**	**11.38**	**4.60**
#20					
(cps) Counts per sec.	1,799	21.26	57.61	66.52	7.55
Concentration (ppb)	3,632	19.32	78.41	15.77	8.66
(ng/g)	3,632	19.32	78.41	15.77	8.66
Total Nanograms (ng)	***72,640***	***386***	***1,568***	***315***	***173***
Vol. Air Sampled (m^3)	83.68	83.68	83.68	83.68	83.68
Concentration (ng/m3)	**868**	**4.6**	**18.7**	**3.76**	**2.07**
#21					
(cps) Counts per sec.	68.62	18.1	66.18	44.56	12.46
Concentration (ppb)	136.7	16.32	90.09	10.59	14.44
(ng/g)	136.7	16.32	90.09	10.59	14.44
Total Nanograms (ng)	***2,734***	***326***	***1,802***	***212***	***289***
Vol. Air Sampled (m^3)	81.91	81.91	81.91	81.91	81.91
Concentration (ng/m3)	**33.38**	**3.98**	**22**	**2.59**	**3.53**
#22					
(cps) Counts per sec.	260.6	7.09	56.67	18.30	1.38
Concentration (ppb)	524.5	5.90	77.12	4.39	1.38
(ng/g)	524.5	5.90	77.12	4.39	1.38
Total Nanograms (ng)	***10,490***	***118***	***1,542***	***87.8***	***27.6***
Vol. Air Sampled (m^3)	16.47	16.47	16.47	16.47	16.47
Concentration (ng/m3)	**636.9**	**7.16**	**93.6**	**5.33**	**1.68**
#23					
(cps) Counts per sec.	56.12	11,62	56.00	49.13	5.22
Concentration (ppb)	111.4	10.19	76.21	11.67	5.91
(ng/g)	111.4	10.19	76.21	11.67	5.91
Total Nanograms (ng)	***2,228***	***204***	***1,524***	***233***	***118***
Vol. Air Sampled (m^3)	53.89	53.89	53.89	53.89	53.89
Concentration (ng/m3)	**41.34**	**3.79**	**28.28**	**4.32**	**2.19**
#24					
(cps) Counts per sec.	1,310	9.10	51.48	52.43	2.01
Concentration (ppb)	2,645	7.80	70.04	12.45	2.12
(ng/g)	2,645	7.80	70.04	12.45	2.12
Total Nanograms (ng)	***52,900***	***156***	***1,401***	***249***	***42.4***
Vol. Air Sampled (m^3)	15.30	15.30	15.30	15.30	15.30
Concentration (ng/m3)	**3,458**	**10.2**	**91.57**	**16.27**	**2.77**

Table 9.12 ICP/MS Quantitative Report on TARGETED METALS (Samples 25-28)

SAMPLE	Zn (66)	Pb (208)	Ni (60)	Mn (55)	V (51)
#25					
(cps) Counts per sec.	129.3	8.25	53.53	36.56	1.014
Concentration (ppb)	259.3	6.99	72.83	8.70	0.947
(ng/g)	259.3	6.99	72.83	8.70	0.947
Total Nanograms (ng)	***5,186***	***139.8***	***1,457***	***174***	***18.9***
Vol. Air Sampled (m^3)	28.83	28.83	28.83	28.83	28.83
Concentration (ng/m3)	**179.9**	**4.85**	**50.54**	**6.04**	**0.656**
#26					
(cps) Counts per sec.	1,082	10.58	57.03	49.21	0.953
Concentration (ppb)	2,184	9.01	77.62	11.68	9.876
(ng/g)	2,184	9.01	77.62	11.68	9.876
Total Nanograms (ng)	***43,680***	***180***	***1,552***	***234***	***198***
Vol. Air Sampled (m^3)	28.43	28.43	28.43	28.43	28.43
Concentration (ng/m3)	**1,536**	**6.33**	**54.59**	**8.23**	**6.96**
#27					
(cps) Counts per sec.	2,236	11.89	54.57	46.75	0.959
Concentration (ppb)	4,516	10.44	74.25	11.10	0.884
(ng/g)	4,516	10.44	74.25	11.10	0.884
Total Nanograms (ng)	***90,320***	***209***	***1,485***	***222***	***17.68***
Vol. Air Sampled (m^3)	27.10	27.10	27.10	27.10	27.10
Concentration (ng/m3)	**3,333**	**7.71**	**54.79**	**8.19**	**0.652**
#28					
(cps) Counts per sec.	146.6	9.83	52.74	49.68	0.940
Concentration (ppb)	294.2	8.50	71.76	11.80	0.861
(ng/g)	294.2	8.50	71.76	11.80	0.861
Total Nanograms (ng)	***5,884***	***170***	***1,435***	***236***	***17.22***
Vol. Air Sampled (m^3)	17.12	17.12	17.12	17.12	17.12
Concentration (ng/m3)	**344**	**9.93**	**83.8**	**13.79**	**1.01**

Table 9.13 Terrell Homes: TOTAL Nanograms per SAMPLE

(Total Nanograms (ng) - Mean Background = TOTAL Nanograms per Sample)

Sample Number:	1	2	3	4	5	6	7	8
Zinc (Zn)	5,491	2,903	1,431	985	27,205	1,225	2,013	1,397
Lead (Pb)	482.4	127.2	86.8	141.8	367.4	120.8	68	83
Nickel (Ni)	714.6	975.6	454.6	582	322	637	559	463
Manganese (Mn)	650.9	197.1	40.33	96.33	964.7	60.33	125.7	132.7
Vanadium (V)	202.0	189.8	27.24	11.44	52.04	3.26	68.24	36.04

	9	10	11	12	13	14	15	Mean Background
Zinc (Zn)	4,927	2,609	2,275	4,243	847	1,687	5,015	1,515
Lead (Pb)	366	263	388	524	66.9	434.6	163	63
Nickel (Ni)	889	602	1,030	626	470	990	720	1,054
Manganese (Mn)	343.7	268.7	343.7	515.7	93.4	373.3	126.7	87.27
Vanadium (V)	337.24	279.24	481.24	71.24	122.04	586	269.24	1.76

Table 9.14 Greater Abyssinian-II: TOTAL Nanograms per SAMPLE

(Total Nanograms (ng) - Mean Background = TOTAL Nanograms per Sample)

Sample Number:	16	7	18	19	20	21	22
Zinc (Zn)	14,129	34,565	56,345	57,225	71,125	1,219	8,975
Lead (Pb)	184	61	114	2,123	323	263	55
Nickel (Ni)	812	329	455	613	514	748	488
Manganese (Mn)	203.73	74.73	44.73	228.73	227.73	124.73	0.53
Vanadium (V)	285.24	25.24	37.24	126.24	171.24	287.24	25.84

	23	24	25	26	27	28	Mean Background
Zinc (Zn)	713	51,385	3,671	42,165	88,805	4,369	1,515
Lead (Pb)	141	93	76.8	117	146	107	63
Nickel (Ni)	470	347	403	498	431	381	1,054
Manganese (Mn)	145.73	161.73	86.73	146.73	134.73	148.73	87.27
Vanadium (V)	116.24	40.64	17.14	196.24	143.73	15.46	1.76

Table 9.15 Terrell Homes:
Metal Particulate Concentrations per Volume Air Sampled
(ng/m^3)

Sample Number:	1	2	3	4	5	6	7	8
Zinc (Zn)	95.8	164.5	158.8	131.4	1,552	232.4	191	140
Lead (Pb)	7.46	7.08	8.08	10.76	23.25	15.56	7.06	7.01
Nickel (Ni)	24.2	75.59	81.33	85.98	74.34	143.4	87.2	72.9
Manganese (Mn)	10.1	10.56	6.88	9.65	56.81	12.52	11.5	10.6
Vanadium (V)	2.79	7.13	1.56	0.694	2.91	0.426	3.79	1.82

	9	10	11	12	13	14	15
Zinc (Zn)	79.96	149.7	130.7	213.7	160.9	30.3	117
Lead (Pb)	5.32	11.85	15.5	21.8	8.85	4.7	4.05
Nickel (Ni)	24.12	139.8	71.9	62.4	103.8	19.3	31.69
Manganese (Mn)	5.35	12.94	14.9	22.4	12.3	4.36	3.82
Vanadium (V)	4.21	10.2	16.7	2.69	8.43	5.56	4.84

Table 9.16 Greater Abyssinian-II:
Metal Particulate Concentrations per Volume Air Sampled
(ng/m^3)

Sample Number:	16	17	18	19	20	21	22
Zinc (Zn)	274	3,184	3,225	2,116	868	33.38	636.9
Lead (Pb)	4.33	10.9	9.87	78.75	4.6	3.98	7.16
Nickel (Ni)	32.7	122	84	60.06	18.7	22	93.6
Manganese (Mn)	5.1	14.3	7.36	11.38	3.76	2.59	5.33
Vanadium (V)	5.03	2.39	2.17	4.60	2.07	3.53	1.68

	23	24	25	26	27	28
Zinc (Zn)	41.34	3,458	179.9	1,536	3,333	344
Lead (Pb)	3.79	10.2	4.85	6.33	7.71	9.93
Nickel (Ni)	28.28	91.57	50.54	54.59	54.79	83.8
Manganese (Mn)	4.32	16.27	6.04	8.23	8.19	13.79
Vanadium (V)	2.19	2.77	0.656	6.96	0.652	1.01

Table 9.17 Terrell Homes: MEAN Concentrations per Volume Air Sampled (ng/m^3)

	Analysis *A*	**Analysis *B***
Zinc (Zn)	236.5*	142.58*
Lead (Pb)	10.56	
Nickel (Ni)	73.20	
Manganese (Mn)	13.65	
Vanadium (V)	4.92	

*Analysis *A* calculates the Mean concentrations using all 15 samples. Analysis *B* calculates the Mean concentrations for Zn after excluding samples having concentrations exceeding 1,000 ng/m^3. With this analytical methodology for calculating the Mean concentration of Zn, the total number of Terrell Holmes samples used for Analysis *B* was 14 samples.

Table 9.18 Greater Abyssinian-II: MEAN Concentrations per Volume Air Sampled (ng/m^3)

	Analysis *A*	**Analysis *B***
Zinc (Zn)	1,479.19*	339.65*
Lead (Pb)	12.49	
Nickel (Ni)	61.28	
Manganese (Mn)	8.20	
Vanadium (V)	2.75	

*Analysis *A* calculates the Mean concentrations using all 15 samples. Analysis *B* calculates the Mean concentrations for Zn after excluding samples having concentrations exceeding 1,000 ng/m^3. With this analytical methodology for calculating the Mean concentration for Zn, the total number of Greater Abyssinian-II samples used for Analysis *B* was 7 samples.

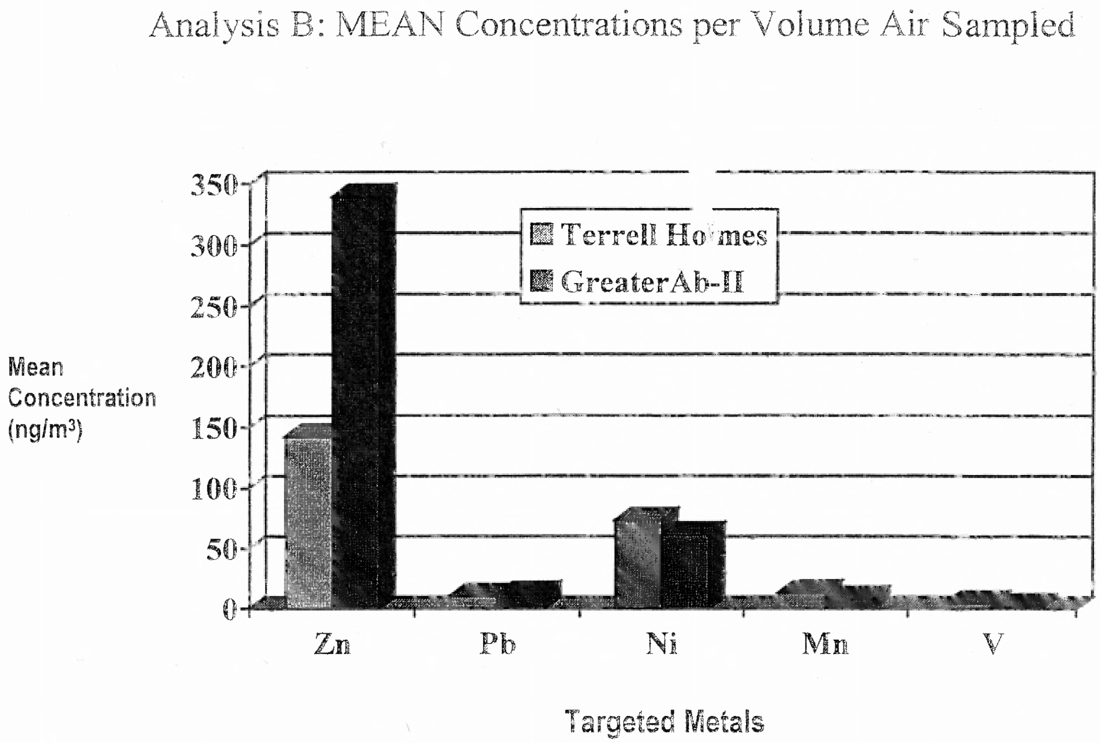


Figure 9.10 Comparison of mean concentrations of targeted metals in airborne particulate matter (PM_{10}). Analysis B calculated the Mean concentrations for Zinc (Zn) after excluding samples having concentrations exceeding 1,000ng/m^3. With this analytical methodology for calculating the Mean concentration for Zn, the total number of Terrell Homes samples used was 14 out of 15 samples; and total number of Greater Abyssinian-II samples used was 7 out of 13 samples.

The ICP-MS Quantitative Report showed that Blanks (Blanks #4, 5 and 6) did not have high spikes of Zinc). Blanks #1, 2, and 3 with high Zn, were not used in the final analysis due to possible contamination. Blanks #4, 5,and 6 were used (See Table 9.7). The laboratory Blanks of unused filter strips (Blanks #4, 5, and 6) also contained the targeted metals Zinc (Zn), Nickel (Ni), Manganese (Mn), Lead (Pb) and Vanadium (V). Therefore, to obtain the actual concentration of the metals in the air, a filter-Blank background subtraction was performed in the final calculations for total nanograms in

Terrell Homes classroom and Greater Abyssinian-II classroom (See equations at top of Table 9.13 and 9.14; respectively).

9.4 Discussion of Air Sampling Data Results: Sharing PM_{10} Mass Concentrations and ICP/MS Chemical Analysis with Newark Preschool Council Community

During a September 2005 meeting with the Newark Preschool Council Health Administrator, the following data results were discussed. It was determined that there were higher PM_{10} mass concentrations in the targeted East Ward preschool classroom than in the South Ward preschool classroom. The average PM_{10} mass concentration in the targeted East Ward classroom environment was *five times higher than* the South Ward classroom PM_{10} mass concentrations. During the winter months of the first campaign, four of the samples from the East Ward-Terrell Homes classroom were collected using an average time period less than 24-hrs; and yet the PM_{10} mass concentrations averaged *two times higher than* the EPA's 24-hour average National Ambient Air Quality Standard (NAAQS) for PM_{10}. 27% of the samples from the Terrell Homes classroom had PM_{10} concentrations *above* EPA's 24-hour average NAAQS of 150ug/m^3.

The ICP-MS chemical analysis determined the metal PM_{10} speciation data. The ICP-MS data results showed that there were significant levels of Zinc (Zn) concentrations found in both of the pre-school classroom indoor environments. However, the South Ward-Greater Abyssinian-II classroom had extremely higher levels of indoor Zn particulate pollutants than Terrell Homes Samples. The fact that the only outdoor/indoor entrance to the classroom is 68 feet from a major business intersection that has a high volume of bus and truck traffic in Newark, may account for the elevated Zn levels.

As stated earlier, Zn particulate pollutants are more likely to be released into the atmosphere by direct "emission" from anthropogenic activities as opposed to subsequent formation from chemical reactions with NOx and other gases. Research studies have confirmed that Zn particulate pollutants are emitted into the atmosphere at a greater rate by tire-wear or from vehicle wear products than from the gas exhausts of mobile sources (Harrison, R., et al., 2003). Hence, the question still existed as to where would the high levels of Zn particulate matter originate from with respect to this research study? The answer to that question is that the elevated Zn particulate levels probably came from the daily volume of bus, truck and car traffic that occurs at the intersection of Lyons Avenue and Bergen Street, which is 68 feet from the main entrance of the Greater Abyssinian –II preschool classroom. In addition to the local traffic at this intersection, there is also the vehicle wear products that may be released from the major surrounding highways (Route 22, Route 78, Route 1 and 9) and the Newark-Liberty Airport, is also located in the South Ward.

As discussed in Chapter 7, a common rubber automobile or truck tire would contain Zinc from the "vulcanization" process of rubber compounding and from its use as a sealant on tires to protect them from the UV light. The Zinc in particulate matter is also more likely to be the coarse PM_{10} particle-size as opposed to the fine $PM_{2.5}$ particle size. As a result, it was more likely than not that this research study, which focused on PM_{10} air sampling, would have data results that reflected elevated levels of Zinc in particulate matter in the indoor air of a classroom closely exposed to a high traffic area. Even though the larger particle size may cause the Zn particulate pollutants and windblown Zn dusts to settle out on the nearby roadways, the children still would be carrying in the particulate matter on their shoes and clothes and re-depositing them on the indoor carpet before and during playtime activities in the classroom.

PM_{10} mass concentrations being higher than the federal ambient PM_{10} standards were not the only important finding in this research study. Having determined that there were elevated Zn trace metals in the particulate matter was also a very important discovery because studies have identified that trace metals in the lungs could catalyze the formation of oxidants which in turn produce tissue damage (Espino, T., et al., 1998). In addition to producing tissue damage, metals found on the surface of particulate matter can also be more efficiently transferred to the lungs (Hughes, et al., 1998).

The researcher has made arrangements to have the above data results shared with the entire Newark Preschool Council community in October 2005.

Chapter 10

Conclusion

Higher PM_{10} mass concentrations were measured in the targeted East Ward preschool classroom than in the South Ward preschool classroom. The average PM_{10} mass concentration in the targeted East Ward–Terrell Homes classroom environment was five times higher than the South Ward- Greater Abyssinian classroom PM_{10} mass concentrations.

Four of the samples from the East Ward-Terrell Homes classroom were collected having a sampling time period less than 24-hrs yet the PM_{10} mass concentrations still averaged two times higher than the EPA's 24-hour average National Ambient Air Quality Standard (NAAQS) for PM_{10}. Overall 27% of the samples from the Terrell Homes classroom had PM_{10} concentrations above EPA's 24-hour average NAAQS of 150ug/m^3.

The ICP-MS chemical analysis determined that there were significant levels of Zinc (Zn) found in both of the pre-school classroom indoor environments. In using Analysis B to calculate the Zn mean concentrations per volume of air sampled, the South Ward-Greater Abyssinian-II classroom had 2.4% higher levels of Zn particulate matter than the Terrell Homes classroom (Terrell Homes =142.58ng/m^3 Greater Abyssinian-II = 339.65ng/m^3). The only outdoor/indoor entrance to the Greater Abyssinian-II classroom is 68 feet from a major business intersection that has a high volume of bus traffic in Newark, which may account for the elevated Zn levels that were seen in this South Ward classroom. In addition to the local traffic volume on Lyons Avenue and Bergen Street, Route 78 and Route 22 and Route 1 and 9 are all less than one mile way. The Newark-Liberty Airport and all of its arrival and departure traffic are also located in the South Ward within less than five miles away.

This research work supported the merge philosophy by developing a Newark Preschool Council Environmental Health Policy that included an environmental science part which performed air sampling with PM_{10} filtration, the weighing of filters to determine PM_{10} mass concentrations, microwave acid digestion, and an ICP-MS chemical analysis. The environmental policy part included having the policy-makers and stakeholders discuss how the data results would be used. They determined that the data results would be used to focus on implementing an abatement strategy or air improvement plan that involved the purchasing and installation of HEPA filter Air Cleaners in those classrooms with the highest asthmatic children in attendance.

The combination of indoor air particulate levels and asthmatic children's exposure to the particulate matter was the critical part in the development and implementation of the environmental health school policy.

10.1 Was Hypothesis Correct?

The original question was whether or not an indoor environmental policy for asthmatic preschool children could be developed and implemented if there were environmental scientific data to support the need for school intervention and implementation of indoor air pollution abatement strategies and equipment. This question was used as the framework in the hypothesis that an increased environmental health educational awareness level at the Newark Preschools, would increase preschool intervention with support for the installation of indoor air pollution abatement equipment.

The clinical classroom data results (i.e. medical information from Asthma Survey Sheets, inspection of the targeted preschool classrooms) and the experimental data (air sampling PM_{10} mass concentrations and ICP-MS chemical analysis) all provided scientific documentation that proved the hypothesis correct. Once the Newark Preschool Council Administrators were made aware of the particular environmental health problem, they actively participated in the environmental education project with health development staff meetings, parent coordination, and overall classroom participation from the preschool children.

10.2 How Can Research Data Results be used to Develop and Implement Environmental Health Policy?

Once the data results supported the original theory that outdoor particulate pollution does affect the indoor air quality of the two targeted preschool classroom, the Newark Preschool Council Administrators, health staff, and parent coordinators took a more active role in developing and implementing the environmental health policy. They all agreed upon a policy stating that the administration would support the installation of two HEPA filter air cleaners in the targeted East and South Ward preschool classrooms with the most asthmatic children in attendance.

Since the environmental health policy was data-driven, there was no objection to purchasing and installing the HEPA filter air cleaners in the Terrell Homes and Greater Abyssinian-II classrooms.

10.3 Preschool Intervention

The Newark Preschool Council, Inc., oversees many Newark Head Start Programs that concentrate solely on preschool age children. Therefore, the Newark Preschool Council administrators and staff had an understanding of the health issues of children and voiced a need for innovative research to successfully address the environmental burdens experienced by children. This research study focused on the sensitive sub-population of asthmatic children, and received immediate support from the Newark Preschool Council. This support included preschool intervention through the use of educational tools, and establishing a partnership with other non-profit organizations that would sponsor purchasing of HEPA filter air cleaners for the classrooms.

With the prevalence of self-reported physician-diagnosed asthma near 14% and a larger percentage of Head Start households reporting an asthmatic child in their family, it is clear that asthma is not uncommon among Head Start children (Slezak, J., et al., 1998). This research study was an encouraging starting point. Educational awareness regarding both asthma triggers and installing of indoor air pollution abatement equipment based upon the scientific data results, all played an important role in empowering the Head Start preschool community to not only identify the risk factors for children but find a means to lessen or eliminate those environmental risk factors that are within the control of the school community to remedy.

10.3.1 Purchasing of Cost-Effective HEPA filter Air Cleaners

The researcher relied upon the experience of the Newark Preschool Council administrators and health coordinators in the selection and purchasing of HEPA filter air cleaners. Their HEPA filter air cleaner of choice was the Allergy Solution – AS1000 Model (See Appendix I). This air cleaner was previously used by the Preschool and one is already installed in the Newark Preschool Council pediatric rooms that oversee infants.

The Allergy Solution air cleaner has a three-stage process for the air purifying of a room that has floor space of up to 1000 square feet (Appendix I).

10.3.2 Installation of Air Cleaners in Targeted Preschool Classrooms

In October 2005, the Allergy Solution Air Cleaner was installed in the Terrell Homes preschool classroom and in the Greater Abyssinian –II classroom (See Appendix H).

10.4 Milestones

The results presented in this research work indicate that African-American/Black and Hispanic asthmatic preschool children in Newark are exposed to elevated levels of indoor air mass particulate concentrations and elevated metal particulate levels. Moreover, this combination of an asthmatic health condition and elevated indoor air pollution may help to explain that there is a differential and increased asthma burden placed on Black and Hispanic children in environmentally-burdened communities of color. Understanding this combination was the driving force that incorporated environmental justice into the Newark Preschool Council's environmental health policy.

In urban areas like Newark, the association of indoor air quality with health issues of asthmatic minority children poses an environmental justice challenge. This challenge was the researcher's motivation. The environmental science research study was unique in its approach to modeling for urban community empowerment, and the data results were used to justify the purchasing and installation of two HEPA filter Air cleaners.

10.5 Where Do We Go From Here?

As a possible post-doctoral research project, the researcher would identify whether or not the presence of the HEPA filter Air cleaners did reduce the mass concentration levels of PM_{10} in the Terrell Homes preschool and the elevated Zn particulate concentration levels in the Greater Abyssinian –II classroom. In addition, the researcher would like to:

1) Study other targeted metals
2) Study organics in air (vapor phase)
3) Study organics in particles and rubber chemistry
4) Study other school districts in Newark, Essex County or New Jersey
5) Coordinate more preschool communities and share the data results
6) Discuss with other Newark preschools implementing an environmental health policy for installing HEPA air cleaners

APPENDIX A

ASTHMA SURVEY SHEET AND DATA RESULTS

Asthma Survey Sheets identified physician-diagnosed asthma children. Based upon the data results obtained from the Survey, Newark Preschool Council East and South Ward classrooms were determined to have the most asthmatic children in attendance.

Newark Preschool Council, Inc.
Environmental Evaluation Community Project
Asthma Survey Sheet*

* The following information was taken from the Asthma Survey Sheet and given to NJIT researcher to use for research project

Purpose of this Survey: Help is on the way to improve our community environment. And, it starts with you!

Please take a few minutes to answer the following questions:

1). Child #

2). Age of Child _________

3). Average years at home

4). Number of Diagnosed Asthmatics

5). Number of hospital visits due to asthma

6). Number of children with breathing problems

7). Number of children with problems during play

8). Number of people who smoke in the household

9). Number of children with a pediatrician

10). Number of other household members diagnosed with asthma

11). Number of children with an asthma specialist

12). Number of children on asthma medication

Newark Preschool Council, Inc.

Head Start Program
Ten Park Place • Newark, New Jersey 07102
E-mail Address: NPCouncil@AOL.com
PHONE: (973) 621-5760 • FAX: (973) 621-6051

BEVERLY LYNN
Executive Director

C. ALAN SIMMS
President

HEALTH SERVICES

FACSIMILE TRANSMITTAL SHEET

TO: Rita Thorton	FROM: Velda Font-Morris, Health Services Manager
COMPANY:	DATE: 7-2-03
FAX NUMBER:	TOTAL NO. OF PAGES INCLUDING COVER: 7
PHONE NUMBER:	PHONE NUMBER: (973) 848-5066
RE: EJECT Survey Summary	FAX NUMBER: (973) 621-3635

☐ URGENT ☐ FOR REVIEW ☐ PLEASE COMMENT ☐ PLEASE REPLY ☐ HARD COPY TO FOLLOW

NOTES/COMMENTS:

NEWARK PRESCHOOL COUNCIL, INC.
Head Start Program
10 Park Place - 4th Floor
Newark, New Jersey 07102

Asthma Survey Summary

Classroom: St. Stephans I

Child	Age
1.	3
2.	4
3.	4
4.	4
5.	4
6.	3
7.	5
8.	3
9.	3
10.	3
11.	5
12.	4

Average Years @ Home Address: 3.5 years

# of Diagnosed Asthmatics: 1

# of hospital visits due to asthma: none

# of children with breathing problems: none

# of children with breathing problems during play: none

# of people who smoke in the household: 2

# of children with a pediatrician: 11

# of other household members diagnosed with asthma: none

# of children with an asthma specialist: none

# of children on asthma medication: 1

Classroom: St. Stephans II

Child	Age
1.	4
2.	5
3.	5
4.	4
5.	4
6.	4
7.	5
8.	3
9.	5
10.	4
11.	5
12.	3 1/2

Average Years @ Home Address: 3.8 years

# of Diagnosed Asthmatics: 1

# of hospital visits due to asthma: 2

# of children with breathing problems: none

# of children with breathing problems during play: none

# of people who smoke in the household: 1

# of children with a pediatrician: 12

# of other household members diagnosed with asthma: none

# of children with an asthma specialist: 12

# of children on asthma medication: 1

<u>Classroom: Pennington Court</u>

Child	Age
1.	4
2.	4
3.	3
4.	4

Average Years @ Home Address: 3.5 years

# of Diagnosed Asthmatics: 4

# of hospital visits due to asthma: none

# of children with breathing problems: none

# of children with breathing problems during play: none

# of people who smoke in the household: 1

# of children with a pediatrician: 4

# of other household members diagnosed with asthma: 3

# of children with an asthma specialist: none

# of children on asthma medication: 1

Classroom: Providence

Child	Age
1.	3
2.	4
3.	4
4.	5
5.	5
6.	5
7.	3 1/2
8.	4
9.	3
10.	4

Average Years @ Home Address: 2.8 years

# of Diagnosed Asthmatics: none

# of hospital visits due to asthma:

# of children with breathing problems: 1

# of children with breathing problems during play: 1

# of people who smoke in the household: 2

# of children with a pediatrician: 8

# of other household members diagnosed with asthma: none

# of children with an asthma specialist: none

# of children on asthma medication: 1

Classroom: Terrell Homes

Child	Age
1.	3
2.	4
3.	3
4.	5
5.	4
6.	4
7.	4

Average Years @ Home Address: 5.2 years

# of Diagnosed Asthmatics: 3

# of hospital visits due to asthma: none

# of children with breathing problems: 1

# of children with breathing problems during play: 1

# of people who smoke in the household: 3

# of children with a pediatrician: 7

# of other household members diagnosed with asthma: 3

# of children with an asthma specialist: none

# of children on asthma medication: 3

Classroom: Hyatt Court

Child	Age
1.	4
2.	3
3.	5
4.	3
5.	4
6.	3

Average Years @ Home Address: 3 years

# of Diagnosed Asthmatics: 1

# of hospital visits due to asthma: none

# of children with breathing problems: 1

# of children with breathing problems during play: none

# of people who smoke in the household: none

# of children with a pediatrician: 5

# of other household members diagnosed with asthma: none

# of children with an asthma specialist: 1

# of children on asthma medication: 1

Note: Originally one parent put down on the survey that child had no asthma, but had difficulty breathing during play. After the parent workshop, the parent followed up with a specialist and now the child is being treated with medication for asthma.

NEWARK PRESCHOOL COUNCIL, INC.
Head Start Program
10 Park Place - 4th Floor
Newark, New Jersey 07102

EJECT-NJ
Asthma Survey Summary - South Ward

Total
150 children

10 preschools

Classroom: Greater Abysinnian 2 (12)

Child	Age
1.	3
2.	4
3.	3
4.	3
5.	4
6.	
7.	
8.	
9.	

Average Years @ Home Address: 2 years

# of Diagnosed Asthmatics:

# of hospital visits due to asthma: one

# of children with breathing problems: none

# of children with breathing problems during play: one

# of people who smoke in the household: 1

# of children with a pediatrician: 5

# of other household members diagnosed with asthma: none

# of children with an asthma specialist: none

# of children on asthma medication: 5

Classroom: Zion Hill (15)

Child	Age
1.	4
2.	5

Average Years @ Home Address: 3 years

# of Diagnosed Asthmatics: 2

# of hospital visits due to asthma: 2

# of children with breathing problems: none

# of children with breathing problems during play: none

# of people who smoke in the household: none

# of children with a pediatrician: 2

# of other household members diagnosed with asthma: none

# of children with an asthma specialist: none

# of children on asthma medication: 2

Classroom: Alberta Bey 2 (15)

Child	Age
1.	3

Average Years @ Home Address: 1 year

# of Diagnosed Asthmatics: 1

# of hospital visits due to asthma: none

# of children with breathing problems: none

# of children with breathing problems during play: none

# of people who smoke in the household: 1

# of children with a pediatrician: 1

# of other household members diagnosed with asthma: none

# of children with an asthma specialist: none

# of children on asthma medication: 1

Classroom: IGA 2 (15)

Child	Age
1.	3 1/2

| + |

Average Years @ Home Address: 2.8 years

# of Diagnosed Asthmatics: one

# of hospital visits due to asthma: one

# of children with breathing problems: one ← +1

# of children with breathing problems during play: none

# of people who smoke in the household: none

# of children with a pediatrician: 1

# of other household members diagnosed with asthma: none

# of children with an asthma specialist: none

# of children on asthma medication: 1

No Asthmatics
Alberta Bey 1 (15)
Henrietta King (18)
Greater Abysinnian 1 (15)
IGA 1 (15)
Zion Hill 1 (15)

APPENDIX B

FEDERAL AND STATE FINAL DECISIONS AND GUIDANCE DOCUMENTS ON ENVIRONMENTAL JUSTICE

USEPA Final Guidance Documents were used to provide direction to federal and state agencies that wished to address environmental justice in their regulations. New Jersey's decision to create a community-based environmental justice pilot project was federally funded by USEPA's State and Tribal Environmental Justice Grant. The New Jersey Department of Environmental Protection (DEP) prepared a Memorandum of Agreement to confirm the $100,000 Grant funding and the appointment of Rita Thornton as the DEP's State and Tribal Environmental Justice Grant Administrator and Project Manager for the pilot project.

Final Guidance For Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses

April 1998

DISCLAIMER AND ACKNOWLEDGMENTS

The mention of company or product names is not to be considered an endorsement by the U.S. Government or by the Environmental Protection Agency. With the technical assistance of Science Applications International Corporation (SAIC), this document was prepared in partial fulfillment of EPA Contract 68-WE-0026, Work Assignment 72-IV.

This guidance was prepared under the direction of an EPA Workgroup co-chaired by Arthur Totten and Bill Dickerson of the Office of Federal Activities and helped by Karen Norris. The Workgroup members included the following:

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Office of Solid Waste and Emergency Response: Kent Benjamin

This guidance is intended to improve the internal management of EPA with respect to environmental justice under NEPA. It will not be deemed to create any right, benefit or trust obligation either substantive or procedural, enforceable by any person, or entity in any court against the agency, its officers, or any other person. Compliance with this guidance will not be justiciable in any proceeding for judicial review of agency action.

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APPENDICES

1.0 PURPOSE

On February 11, 1994, President Clinton issued Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations." This Executive Order is designed to focus the attention of federal agencies on the human health and environmental conditions in minority communities and low-income communities. It requires federal agencies to adopt strategies to address environmental justice concerns within the context of agency operations. In an accompanying Presidential memorandum, the President emphasizes existing laws, including the National Environmental Policy Act (NEPA) should provide opportunities for federal agencies to address environmental hazards in minority communities and low-income communities. In April of 1995, the U.S. Environmental Protection Agency (EPA) released the document titled "Environmental Justice Strategy: Executive Order 12898." The document defines the approaches by which EPA will ensure that disproportionately high and adverse human health or environmental effects on minority communities and low-income communities are identified and addressed. It establishes Agency-wide goals for American Indian, Alaska Native, and other indigenous peoples (e.g., Native Hawaiian). It also establishes Agency-wide goals for environmental protection, and lists actions the EPA would take to incorporate environmental justice into its mission.

In August 1997, the EPA Office of Environmental Justice released the "Environmental Justice Implementation Plan." The Implementation Plan supplements the EPA environmental justice strategy. It provides estimated time frames for undertaking revisions, identifying the lead agents and determining the measures of success for each action item. Several EPA offices are developing more specific plans and guidance to implement Executive Order 12898 and this Agency-wide strategy.

This document serves as a guidance to incorporate environmental justice goals into EPA's preparation of environmental impact statements (EISs) and environmental assessments (EAs) under NEPA. The National Environmental Policy Act of 1969 (42 U.S.C. §4321 et seq.) serves as the Nation's basic environmental protection charter. A primary purpose of NEPA is to ensure that federal agencies consider the environmental consequences of their actions and decisions as they conduct their respective missions. For "major Federal actions significantly affecting the quality of the human environment," the federal agency must prepare a detailed environmental impact statement (EIS) that assesses the proposed action and all reasonable alternatives. EISs are required to be broad in scope, addressing the full range of potential effects of the proposed action on human health and the environment. Regulations established by both the Council on Environmental Quality (CEQ) and EPA require that socioeconomic impacts associated with significant physical environmental impacts be addressed in the EIS.

Environmental assessments have also become very important components of the NEPA process. Originally intended to serve as a mechanism for determining whether an agency's action was significant, thereby meriting an EIS, EAs are important analyses on their own. As a matter of policy, EAs completed by EPA regularly address socioeconomic effects associated with environmental impacts of Agency actions.

The purpose of this guidance is to assist EPA staff responsible for developing EPA NEPA compliance documentation, including EISs and EAs, in addressing a specific concern -- that of environmental justice. Because analyzing and addressing environmental justice may assist in determining the distributional effects of environmental impacts on certain populations, it is entirely consistent with the NEPA process. This guidance is intended to:

• heighten awareness of EPA staff in addressing environmental justice issues within NEPA analyses and considering the full potential for disproportionately high and adverse human health or environmental effects on minority populations and low-income populations;

• present basic procedures for identifying and describing junctures in the NEPA process where environmental justice issues may be encountered;

• present procedures for addressing disproportionately high and adverse effects to evaluate alternative actions, and;

• present methods for communicating with the affected population throughout the NEPA process.

As seen throughout this guidance document, environmental justice issues can be and should be analyzed and addressed using many of the same tools currently intrinsic to the NEPA process.

1.1 Background

1.1.1 What is Environmental Justice?

Environmental Justice has been defined by a variety of organizations interested in the topic. EPA's Office of Environmental Justice offers the following definition:

"The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people,

including racial, ethnic, or socioeconomic group should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies."

The goal of this "fair treatment" is not to shift risks among populations, but to identify potential disproportionately high and adverse effects and identify alternatives that may mitigate these impacts.

1.1.2 Executive Order 12898

Executive Order 12898 and its accompanying memorandum have the primary purpose of ensuring that "each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations ..."[(1)] The Executive Order also explicitly called for the application of equal consideration for Native American programs. To meet these goals, the Order specified that each agency develop an agency-wide environmental justice strategy.

The Presidential Memorandum that accompanied the Executive Order calls for a variety of actions. Four specific actions were directed at NEPA-related activities, including:

1. Each federal agency must analyze environmental effects, including human health, economic, and social effects, of federal actions, including effects on minority communities and low-income communities, when such analysis is required by NEPA.

2. Mitigation measures outlined or analyzed in EAs, EISs, or Records of Decision (RODs), whenever feasible, should address significant and adverse environmental effects of proposed federal actions on minority communities and low-income communities.

3. Each federal agency must provide opportunities for community input in the NEPA process, including identifying potential effects and mitigation measures in consultation with affected communities and improving

accessibility of public meetings, official documents, and notices to affected communities.

4. In reviewing other agencies' proposed actions under Section 309 of the Clean Air Act, EPA must ensure that the agencies have fully analyzed environmental effects on minority communities and low-income communities, including human health, social, and economic effects.

As noted earlier, the purpose of this guidance is to assist EPA personnel in identifying and evaluating disproportionately high and adverse human health or environmental effects in minority communities and low-income communities within the context of NEPA documents prepared by EPA for actions which EPA complies with the procedural requirements of NEPA (*e.g.*, research and development activities, facilities construction, wastewater treatment construction grants, EPA-issued National Pollutant Discharge Elimination System (NPDES) permits for new sources, and programs under the EPA Voluntary NEPA Compliance Policy), including instances where EPA satisfies its NEPA compliance obligation as a cooperating agency. It is also meant to improve the affected communities' access to the NEPA process.

1.2 Principles/Philosophy of this Guidance

This guidance highlights important ways in which EPA-prepared NEPA documentation may help to identify and address EJ concerns. The rationale and associated implications of the guidance will be described in the remainder of this document. This section provides a summary listing of the major implications.

EPA officials should be vigilant in identifying where EPA actions may have disproportionately high and adverse human health or environmental effects on minority and/or low-income communities.

Identification should occur as early as possible, preferably during any initial screening exercise. The screening exercise should identify the presence of minority or low-income communities and whether such communities are likely to experience adverse environmental or human health effects as a result of proposed EPA actions.

The sensitivity to environmental justice concerns should sharpen the focus of the analysis. While the analytical tools to be used are similar, the analysis should focus both on the overall affected area and population and on smaller areas and/or communities within the affected area.

It is desirable that EPA NEPA analysts tasked with identifying and addressing environmental justice issues work as a team. This team should be comprised of an interdisciplinary staff that includes individuals familiar with environmental justice issues, public participation mechanisms and outreach strategies, Native American concerns and issues and who are experienced in the risk assessment process. Additionally, the team should consult with EPA's Regional Environmental Justice coordinators (refer to Appendix A), who are valuable resources in identifying local community groups among other functions.

Where proposed actions may affect tribal lands or resources (e.g., treaty-protected resources[(2)], cultural resources and/or sacred sites[(3)]) EPA will request that the affected Indian Tribe[(4)] seek to participate as a cooperating agency (40 CFR 1508.5). Where differences occur regarding the preferred alternative or mitigation measures that will affect tribal lands or resources, the affected Indian Tribe may request that a dispute resolution process be initiated to resolve the conflict between the tribe and the Agency.

Environmental justice concerns may lead to more focused analyses, identifying significant effects that may otherwise have been diluted by examination of a larger population or area. Environmental justice concerns should always trigger the serious evaluation of alternatives as well as mitigation options.

Identifying the "affected community" is particularly important. The effects of the proposed action will often vary depending on the distance of the affected community from the action and the type of effect created by the action (*e.g.,* airborne or waterborne pollution, increased traffic, etc.). Effects on the community should be discussed in terms of reasonable increments from the site of the action.

Community involvement is particularly important in cases involving potential environmental justice issues. Early and sustained communications with the affected community throughout the NEPA process is an essential component of environmental justice.

For meaningful community involvement to be achieved in circumstances where environmental justice is an issue, technical assistance supplied by EPA should be available to the community to assist in their full participation (e.g., interpretation of scientific documents, development of alternatives or mitigation measures).

EISs and RODs, and EAs and FONSIs (Finding of No Significant Impact) should document the analyses used to identify the presence or absence of disproportionately high and adverse effects and present the results of those analyses. The ROD and the FONSI should document the conclusion of these analyses (i.e., whether the action will or will not have a disproportionately high and adverse effect on minority and/or low-income communities) and describe any mitigation that will be undertaken to avoid or minimize such effects.

1.2.1 EPA Actions Requiring NEPA Compliance

EPA is required to comply with NEPA for its research and development activities, facilities construction, wastewater treatment construction grants under Title II of the Clean Water Act and under certain Appropriations Acts, and EPA-issued National Pollutant Discharge Elimination System (NPDES) permits for new sources subject to new source performance standards. The Agency is exempted by statute for actions taken under the Clean Air Act and for most Clean Water Act programs. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), requires EPA to comply only with the substantive, not the procedural, requirements of other environmental laws for on-site responses. In the case of other EPA programs, the courts have found EPA procedures to be "functionally equivalent" to the NEPA process and therefore these EPA programs are exempt from NEPA procedural requirements. Also, EPA voluntarily prepares EISs for a number of actions pursuant to a long-standing statement of Agency policy.

Exhibit 1 identifies EPA's major program areas and indicates which actions are subject to NEPA, which Congress has exempted from NEPA, which have been found to be functionally equivalent to NEPA, and which receive NEPA-like analyses. This guidance is applicable solely to EPA programs and actions subject to NEPA and not those identified as "functionally equivalent" in Exhibit 1. However, this should not preclude its use as reference where "functionally equivalent" programs or actions processes may benefit from the information contained therein.

1.2.2 EPA Review of Proposed Actions Under Clean Air Act §309

As a result of §309 of the Clean Air Act, EPA has a key role in the overall implementation of NEPA. Specifically, §309 mandates that EPA "review and comment in writing on the environmental impact of any matter relating to duties and responsibilities granted pursuant to this chapter or other provisions of the authority of the Administrator, contained in any (1) legislation proposed by any federal department or agency, (2) newly authorized federal projects for construction and any major federal agency action (other than a project for construction) to which Section 4332(2)(C) of this title applies [subject to Section 102(2)(C) of NEPA], and (3) proposed regulations published by any department or agency of the Federal government. Such written comment shall be made public at the conclusion of any such review" (42 U.S.C. §7609(a)).

In conducting §309 reviews, EPA is further directed by the Presidential Memorandum that accompanied Executive Order 12898 to ensure that agencies fully analyze environmental effects of their proposed actions on minority and low-income communities, including human health, social, and economic effects. As a result of both §309 and the Presidential Memorandum, EPA is able to assist other federal agencies in evaluating proposed actions that are subject to NEPA by identifying possible environmental justice concerns that may result from such actions and by offering alternative solutions and mitigation measures for unavoidable impacts.

Although mention is made here of EPA's responsibilities under §309, this document is not intended to provide guidance for §309 reviews. EPA's §309 guidance should be used for that purpose. This guidance supplements the Council on Environmental Quality's *"Environmental*

Justice Guidance Under the National Environmental Policy Act" and is tailored to EPA's conduct in actions for which EPA must comply with NEPA and where EPA has jurisdiction as a cooperating agency. It does not provide guidance related to other federal agencies' actions or for EPA's review of other federal agencies' EISs.

1.3 Organization of this Guidance

The remainder of this guidance is organized as follows: **Chapter 2** describes key environmental justice terms and factors and the application of the key definitions and factors in the context of standard NEPA analyses; **Chapter 3** describes key steps in the NEPA process, including both EISs and EAs, where analyses of environmental justice concerns should be incorporated; **Chapter 4** discusses public participation approaches of direct relevance to minority and/or low-income communities; and **Chapter 5** provides a brief overview of methodological tools that can be used to identify and assess potential disproportionately high and adverse effects.

2.0 KEY TERMS AND FACTORS FOR CONSIDERATION IN EVALUATING

ENVIRONMENTAL JUSTICE CONCERNS

The purpose of this section is to introduce key terms and concepts to heighten the EPA analyst's awareness of how disproportionately high and adverse effects may be identified. The discussion is based on guidance prepared by a task force of the Interagency Working Group on Environmental Justice (IWG). The IWG was created by Executive Order 12898 and is comprised of the heads (or representatives) of 17 departments and agencies.

The identification and analysis of disproportionately high and adverse human health or environmental effects on minority communities and low-income communities should occur throughout the NEPA process, from the initial phases of the screening analysis through the consideration and communication of all alternatives and associated mitigation techniques.

In conducting an EPA NEPA analysis that is sensitive to environmental justice concerns, the inter-disciplinary team of EPA NEPA analysts should have an understanding of key terms central to environmental justice and should understand what factors need to be considered to ensure that all relevant concerns are identified and evaluated in a direct and explicit manner. The team should include experts familiar with available and appropriate public participation procedures and strategies and, where such concerns may arise, individuals familiar with the unique concerns of Native American Tribes and populations. Developing a keen sensitivity to potential environmental justice concerns and modifying the scope of the analysis can have a dramatic impact on whether environmental justice concerns are identified and addressed adequately and appropriately. Therefore, the EPA NEPA analyst must be sensitive to what issues and factors to look for to avoid the possibility that disproportionately high and adverse effects may be inadvertently missed, incorrectly characterized, or inappropriately minimized. So as to avoid potential oversights of environmental justice concerns, the EPA NEPA analyst should work closely with the affected community in drafting an EIS or EA, and where the community's concerns warrant, EPA should formalize this interaction (e.g., community advisory boards).

Appendix A includes the Council on Environmental Quality's (CEQ's) "Environmental Justice Guidance Under the National Environmental Policy Act" which incorporates the IWG-developed guidance on key terms in Executive Order 12898 that are pertinent to environmental justice analyses. That guidance was developed to assist federal agencies in conducting analyses of disproportionately high and adverse effects of their programs, policies, and activities. The guidance is not static but provides for informed judgment in every case; this means that EPA NEPA analysts will need to make careful decisions to ensure that environmental justice concerns are identified and addressed.

The remainder of this chapter is organized into two sections. The first section addresses terms that should be considered in identifying the existence of minority communities or low-income communities. The second section identifies factors that often are associated with disproportionately high and adverse effects, including cumulative and indirect impacts, on minority or low-income members of the larger community. Methodological approaches for conducting analyses appear in Chapter 5.

2.1 Defining Minority and/or Low-Income Population

The purpose of this section is to assist the analyst in determining whether there is a minority community or low-income community that may be addressed in the scope of EPA's NEPA analysis.

2.1.1 Minority and Minority Population

The first part of the guidance on minority population provided by the IWG provides a numeric measure: over 50 percent of the affected area. The remainder of the guidance calls for the analyst to use his or her best judgment in evaluating the potential for EJ concerns. It is important that the EPA NEPA analyst consider both the circumstances of any groups residing within the affected area, as well as the percentage of the affected community that is composed of minority peoples.

Within its guidance, the IWG explains that a minority population may be present if the minority population percentage of the affected area is "meaningfully greater" than the minority population percentage in the general population or other "appropriate unit of geographic analysis." The term "affected area," although not defined by the guidance, should be interpreted as that area which the proposed project will or may have an effect on. The IWG guidance also advises agencies not to "artificially dilute or inflate" the affected minority population when selecting the appropriate unit of geographic analysis. Clearly, a key element here is the selection of the appropriate level of geographic analysis; that is, selecting a comparison population to which the population in the affected area will be compared to identify if there are "meaningfully greater" percentages. The selection of the appropriate unit of geographic analysis may be a governing body's jurisdiction, a neighborhood census tract, or other similar unit. This is done to prevent artificial dilution or inflation of the affected minority population. In an EPA NEPA analyses, the analyst should use the potentially affected population under various alternatives as a benchmark for comparison wherever possible. In addition, a simple demographic comparison to the next larger geographic area or political jurisdiction should be presented to place population characteristics in context and allow the analyst to judge whether alternatives adequately distinguish among populations. For example, all preliminary locations for a project could fall in minority neighborhoods, therefore, a comparison among them would not reveal any population differences. Consequently, an additional alternative would be necessary to allow any disproportionately high and adverse effects to be identified.

The fact that census data can only be disaggregated to certain prescribed levels (*e.g.,* census tracts, census blocks) suggests that pockets of minority or low-income communities, including those that may be experiencing disproportionately high and adverse effects, may be missed in a traditional census tract-based analysis. Additional caution is called for in using census data due to the possibility of distortion of population breakdowns, particularly in areas of dense Hispanic or Native American populations. In addition to identifying the proportion of the population of individual census tracts that are composed of minority individuals, analysts should attempt to identify whether high concentration "pockets" of minority populations are evidenced in specific geographic areas.

The IWG guidance also advises agencies to consider both groups of individuals living in geographic proximity to one another, or a geographically dispersed/transient set of individuals, where either type of group "experiences common conditions" of environmental exposure or effect within the guidance provided for minority population. This can result from cultural practices, educational backgrounds, or the median age of community residents (*e.g.,* disproportionate numbers of elderly residents, children, or women of child bearing age may be more susceptible to environmental risks).

A factor that should be considered in assessing the presence of a minority community is that a minority group comprising a relatively small percentage of the total population surrounding the project may experience a disproportionately high and adverse effect. This can result due to the group's use of, or dependence on, potentially affected natural resources, or due to the group's daily or cumulative exposure to environmental pollutants as a result of their close proximity to the source. The data may show that a distinct minority population may be below the thresholds defined in the IWG key terms guidance on minority population. However, as a result of particular cultural practices, that population may experience disproportionately high and adverse effects. For example, the construction of a new treatment plant that will discharge to a river or stream used by subsistence anglers may affect that portion of the total population. Also, potential effects to on- or off-reservation tribal resources (e.g., treaty-protected resources, cultural resources and/or sacred sites) may disproportionately affect the local Native American community and implicate the federal trust responsibility to tribes.[(5)]

The EPA NEPA analyst should look at each situation on a case-by-case basis to determine if there may be disproportionately high and adverse effects on a minority population.

The EPA NEPA analyst should make every effort to identify the presence of distinct minority communities residing both within, and in close proximity to, the proposed project, and to identify those minority groups which utilize or are dependent upon natural resources that could be potentially affected by the proposed action. Non-traditional data gathering techniques, including outreach to community-based organizations and tribal governments early in the screening process, may be the best approach for identifying distinct minority communities and/or tribal interests within the study area. See Chapter 4 for a discussion of public outreach techniques.

2.1.2 Low-Income Population

This guidance recommends that pursuant to the CEQ guidance, low-income populations in an affected area (that area in which the proposed project will or may have an effect) should be identified with the annual statistical poverty thresholds from the Bureau of the Census' Current Population Reports, Series P-60 on Income and Poverty. In conjunction with census data, the EPA NEPA analyst should also consider state and regional low-income and poverty definitions as appropriate. In identifying low-income populations, agencies may consider as a community a group of individuals living in geographic proximity to one another or set of individuals (such as migrant workers or Native Americans) where either type of group experiences common conditions of environmental exposure.

As with the identification of minority communities, the level of aggregation of available data is an issue of concern when seeking to determine whether one or more low-income communities may be affected by a project. Also, as with minority communities, "pockets" of low-income individuals may be masked by aggregated data. The level of aggregation of data, as well as how current the available data are, should be taken into account by the EPA NEPA analyst.

Determining the existence and location of low-income and minority communities within the reaches of a projects' influence can be a difficult task. Several means of gathering this information are available; however, it is up to the EPA NEPA analyst to ascertain which techniques will best suit the project at hand. Further, the EPA NEPA analyst must be flexible and open to consider additional avenues which may be unique to select projects or geographic areas. The use of national decennial census data in depicting low-income/poverty and minority statistics is one of the most common methods used. While the census provides valuable information for the EPA NEPA analyst, there are often many gaps associated with the information. Therefore, it may be necessary for the EPA NEPA analyst to validate this information with the use of additional sources. The additional methods available in locating the populations of interest include contacting local resources, government agencies, commercial database firms, and the use of locational/distributional tools. (Please see Chapter 5 regarding the use of locational/distributional tools.)

Local resources should be sought for local and up-to-date knowledge of a given area and its inhabitants as well as a lead to other sources of information. Examples of local resources include: community and public outreach groups, community leaders, and state universities (i.e., economic departments).

State government agencies such as the Department of Economic Development, Planning and Development Department, State Minority Business Office, and State Enterprise Zone Offices are also valuable resources to contact. For example, if an area is designated as an "enterprise zone", unique economic and demographic data may exist in that particular area, access to which could enhance the EPA NEPA analyst's ability to assess the economic situation of a given area.

Local resources and state governments can both be contacted for information regarding factors that are characteristic of low-income communities and which may assist in identifying these communities. These factors may include: limited access to health care, an inadequate, overburdened or aged infrastructure, and particular dependence of the community, or components of the community, on subsistence living (*e.g.*, subsistence fishing, hunting, gathering or farming). In some cases, these factors can be evaluated directly from traditional information sources. For example, the age and condition of water treatment facilities and presence of lead service lines should be available from municipal utilities. Outreach to community groups may be the most reliable data collection method in other cases, such as those where the degree to which the cultural and dietary habits of low-income or minority families and their economic condition dictate subsistence living. Consequently, where the community median household income may exceed that of the poverty line, conditions generally associated with low-income communities may be present, resulting in cumulative effects that may meet the threshold for environmental justice concerns.

Commercial database firms are often capable of tailoring census data information of human communities and income/poverty level to specified areas of geographic detail. For example, by manipulating specified census bureau tract data with customized buffer areas, statistics can be generated to accommodate current growth estimates from local government agencies or planning departments. Locational/distributional tools are also capable of determining the locations of certain human communities. Examples include maps, aerial photographs, and geographical information systems (GIS). Further explanations of these tools are presented in Chapter 5.

2.2 Considering Effects

This section discusses the term "disproportionately high and adverse human health or environmental effects" and provides an overview of some factors that should be considered in assessing the presence of such effects. It also addresses how the concept of environmental justice plays in conducting cumulative and indirect impact analyses in support of NEPA.

2.2.1 Disproportionately High and Adverse Effects

Disproportionately high and adverse effects encompass both human health and environmental effects. The IWG's guidance suggests the need for the analyst to exercise informed judgments as to what constitutes "disproportionate" as well as "high and adverse." This, in turn, suggests some level of comparative analysis with the conditions faced by an appropriate comparison population. As noted in Section 2.1.1, alternatives need to be drawn so that the potentially affected populations under various alternatives are distinctive and allow disproportionality to be assessed.

2.2.2 Cumulative and Indirect Effects

EPA NEPA analyses must consider the cumulative effects on a community by addressing the full range of consequences of a proposed action as well as other environmental stresses which may be affecting the community. Cumulative impacts are defined in 40 CFR 1508.7, as "the incremental impact(s) of the action when added to other past, present, and reasonably foreseeable future actions...." For example, when considering a project that will have a permitted discharge to the surrounding surface waters, it may be of concern to populations who rely on subsistence living patterns (*i.e.,* fishing) and already receive public water through lead service lines; the cumulative effects associated with both the discharge and the lead service lines must be taken into account. In such cases, mitigation measures need to be developed and analyzed to reduce an adverse cumulative effect. In addition, minority populations and low-income populations are often located in areas or environments that may already suffer from prior degradation. EPA analysts need to place special emphasis on other sources of environmental stress within the region, including those that have historically existed, those that currently exist, and those that are projected for the future. Common variables of concern may include:

• Number/concentration of point and nonpoint release sources, including both permitted and non-permitted.

• Presence of listed or highly ranked toxic pollutants with high exposure potential (*e.g.*, presence of toxic pollutants included within EPA's 33/50 program).

• Multiple exposure sources and/or paths for the same pollutant.

• Historical exposure sources and/or pathways.

• Potential for aggravated susceptibility due to existing air pollution (in urban areas), lead poisoning, existence of abandoned toxic sites.

• Frequency of impacts.

Source data, including historical, existing, and projected sources, yielding projected effects in concert with that from the resulting proposed action should be analyzed with respect to minority or low-income receptors. As noted above, these include cultural, health and occupation-related variables such as:

• Health data reflective of the community (*e.g.*, abnormal cancer rates, infant and childhood mortality, low birth weight rate, blood-lead levels).

• Occupational exposures to environmental stresses which may exceed those experienced by the general population.

• Diets, or differential patterns of consumption of natural resources[(6)], which may suggest increased exposures to environmental pathways presenting potential health risk.

The EPA NEPA analyst may have difficulty in determining the point at which stress levels become too great, exceeding risk thresholds. This lack of a definitive threshold should encourage the EPA NEPA analyst to compare the cumulative effects of multiple actions with appropriate community, regional, state, or national goals, standards, etc. to determine whether the total effect is significant.

With respect to natural resources, analysts should look to the community's dependence on natural resources for its economic base (*e.g.*, tourism and cash crops) as well as the cultural values that the community and/or Indian Tribe may place on a natural resource at risk. Further, it is essential for the EPA NEPA analyst to consider the cumulative impacts from the perspective of these specific resources or ecosystems which are vital to the communities of interest.

Several methods for determining cumulative effects are described within CEQ's January 1997 handbook entitled, "Considering Effects Under the National Environmental Policy Act." The EPA NEPA analyst may wish to consider these methods in assessing cumulative effects on low-income and/or minority communities.

In the process of determining future actions, for example, it is essential for the EPA NEPA analyst to apply judgment and experience, to go beyond the number of projects that are funded in the area, and predict which of the actions in the early planning stage have realistic potential to move forward. The EPA NEPA analyst should use the best available information from similar projects in the region and also consult with local government planning agencies which may have master development plans in the region. In addition, private land-owners and organizations may be willing to disclose their future land use plans.

Although cumulative effects analyses commonly involve assumptions and uncertainties, exhausting all applicable analyses will provide the greatest likelihood of accurately depicting the possibility of disproportionately high and adverse effects on low-income and/or minority communities. Analysts should be as resourceful as possible in addition to seeking information from traditional sources. Decisions should be supported by the best data currently available and/or the best data gathering techniques in conjunction with all appropriate analyses.

EISs and EAs must also address indirect impacts [40 CFR 1502.16(b), 1508.8(b) 1508.9], which are characterized as those that are caused by the action and are reasonably foreseeable, but that occur later in time and/or at a distance. Indirect effects include growth effects related to induced changes in the pattern of land use; population density and/or changes to infrastructure; or growth rates and related effects to the air, water and other natural systems, including ecosystems.

Increased urbanization may occur around a new facility due to increased employment or due to transportation system upgrades. This may result in disproportionately high and adverse effects to low-income communities due to increased air pollution, lower housing values, and reduced access to fishing/farming locations. In addition, recreational lands and water may be indirectly affected by government actions. In the case of activities potentially affecting Native Americans, potential impacts, both direct and indirect, can occur to sacred sites and/or other natural resources used for cultural purposes. For example, the loss of a sacred site, or other impacts to larger areas of religious and spiritual importance may be so absolute that religious use of the site abruptly ceases--a direct impact. However, discontinued use may result in other indirect impacts. Proposed actions may also result in business failures, and associated unemployment, erosion of tax bases, and reduced public services. These types of effects may be exacerbated for low-income communities and minority communities due to an inability to relocate, to travel long distances to find alternative means of employment, or to attract new industry or commerce.

The potential for indirect impacts to affect a community is best understood when the analytical team is thoroughly familiar with the local community. It is important that the EPA NEPA analyst gain a full understanding of potential cultural impacts to the community. This is best accomplished through direct communication using effective public participation and consultation. A discussion of public participation approaches appears in Chapter 4.

2.2.3 Environmental Exposure

Executive Order 12898 provides that environmental human health research, whenever practicable and appropriate, shall include diverse segments of the population in epidemiological and clinical studies, including segments at high risk from environmental hazards, such as minority and low-income populations and workers who may be exposed to substantial environmental hazards. The Executive Order further states that environmental human health analyses, whenever practicable and appropriate, shall identify multiple and cumulative exposures.

In addressing the term "environmental hazard" for the purpose of research, data collection and analysis provisions in the Executive Order, the IWGKey Terms guidance states that it is "a chemical, biological, physical or radiological agent, situation, or source that has the potential for deleterious effects to the environment and/or human health." The IWG points out that the factors that may be important in defining a *substantial*[(7)] environmental hazard are the likelihood, seriousness, and the magnitude of the impact. The IWG Key Terms provides guidance for "multiple environmental exposure" and "cumulative environmental exposure."

The EPA NEPA analyst should include individuals who are familiar with collecting and analyzing data that assesses the potential environmental and human health risks potentially borne by minority and low-income communities as a result of the project or activity. EPA NEPA analysts gain a better understanding of potential environmental risks to the community by directly using effective public participation and consultation techniques. An assessment of such potential risks should then be used to determine whether disproportionately high and adverse effects may be borne by minority communities or low-income communities.

2.3 Summary of Factors to Consider in Environmental Justice Analyses

This section provides an overview of many of the factors that should be considered when identifying and evaluating environmental justice concerns. Given the subjective nature of some of the elements that are important to environmental justice analyses, some consideration of the *factors* or characteristics that may lead to disproportionately high and adverse effects to a community may prove to be useful when conducting such analyses. EPA's Office of Environmental Justice points out that an understanding of the underlying factors that contribute to environmental justice concerns allows for a more thorough identification of the concerns and the development of more effective mitigation measures.

In focusing the identification of environmental justice concerns, the EPA NEPA analyst may approach the analysis of environmental justice from three vantage points: 1) whether there exists a potential for disproportionate risk;

2) whether communities have been sufficiently involved in the decision-making process; and 3) whether communities currently suffer, or have historically suffered, from environmental and health risks or hazards. The factors listed in this section are provided within the context of these three approaches for identifying potential environmental justice concerns and provide the EPA NEPA analyst with a starting point in determining what factors to consider in an environmental justice assessment. However, almost every situation will have its own nuances. As such, the EPA NEPA analyst should be prepared to apply these factors flexibly to fit a specific situation, just as the IWG guidance provided above may require judgments to ensure that communities are defined in a fair manner (See Exhibit 3 for Summary of Factors).

Exhibit 3. SUMMARY OF FACTORS TO CONSIDER IN ENVIRONMENTAL JUSTICE ANALYSIS	
FACTORS ASSOCIATED WITH POTENTIAL EXPOSURE TO/AND RISKS FROM ENVIRONMENTAL HAZARDS **The general factors that should be considered include DEMOGRAPHIC factors, GEOGRAPHIC factors, ECONOMIC factors, and HUMAN HEALTH and RISK factors. For each of these, specific variables for consideration are listed.**	
DEMOGRAPHIC FACTORS Demographic factors are one of the key components of environmental justice. Race, ethnicity, and low-income status are some of the primary considerations of the environmental justice movement. However, numerous other demographic factors also may play vital roles in an environmental justice assessment. These include, but are not limited to:	
Population Age	Older or younger populations may be more susceptible to risks, when taking into account special health concerns of the elderly and potential for greater exposure in younger populations (*e.g.*, ingestion of soil). In addition, children's immature bodily defense systems may make them more susceptible to toxic effects.
Population Density	High population density may promote a synergistic effect between industrial pollutants and typical urban pollutants (*e.g.*, ground level ozone), especially if industry is located in close proximity (5 miles or less) to high density populations. Low population density may lead the NEPA analyst to underestimate the actual environmental harm to the affected population when conducting a risk assessment.
Population Literacy	If documents are technically complex and not adequately explained communities with lower levels of education may encounter difficulty in its ability to understand or sufficiently identify and interpret risk

<table>
<tr><td></td><td>and other factors.</td></tr>
<tr><td>Population / Economic Growth</td><td>Rapid or severe changes in population or economic growth rate may result in potential impacts to existing community or public services and infrastructure. Changes in growth rate may include: (1) an increase in low-income or minority population(s) in an area (e.g., migration), (2) high birth rates, and (3) cumulative impacts due to multiple sources of population increases.</td></tr>
<tr><td colspan="2">GEOGRAPHIC FACTORS

Certain communities may be at high risk from environmental hazards or exposed to substantial environmental hazards due to geographic factors that isolate them from other surrounding communities or that tend to allow pollutants to accumulate in the environment surrounding the community. Such factors include, but are not limited to:</td></tr>
<tr><td>Climate</td><td>Weather patterns (e.g., prevailing winds) that may concentrate pollutants in a certain area, allow pollutants to migrate, increase certain exposure pathways (such as respiration), or cause pollutants to behave in a manner that differs from that expected under normal weather conditions.</td></tr>
<tr><td>Geomorphic Features</td><td>Mountains, hills, or other surface features, natural or human in origin, that may affect pollutant dispersal and may focus or funnel pollutants in particular directions or to particular locations.</td></tr>
<tr><td>Hydrophic Features</td><td>Presence of surface water and/or aquifers that may provide drinking water, subsistence fisheries, cultural significance and use, and recreational use.</td></tr>
<tr><td colspan="2">ECONOMIC FACTORS

Economic factors can be divided into two categories: the economic condition of the individuals in the community in question, and the overall economic base of the community. The economic condition of the individuals in the population, if poor, may exacerbate risk factors and may preclude avoidance of risk factors. The economic condition of the community at large may result in situations that preclude the local government's ability to adequately protect the population or may promote the acceptance of disproportionately high and adverse effects. Such factors include, but are not limited to:</td></tr>
<tr><td><u>Individual Economic Conditions</u>

Income Level / Health Care Access</td><td>This includes such issues as whether affordable or free quality health care is available and, whether any cultural barriers exist to seeking health care. Many low-income and/or minority communities lack adequate levels and quality of health care, often due to lack of resources or lack of access to health care facilities.</td></tr>
<tr><td>Infrastructure Conditions</td><td>Consideration should be given to whether existing infrastructure provides sufficient protection from adverse impacts (e.g., protection of domestic water supply, especially if the community relies on</td></tr>
</table>

	public or non-public drinking wells or surface water; adequacy of sewage facilities) and the effect that new facilities may have on the ability of existing infrastructure to be reliable and provide adequate protection. In many low-income and/or minority communities, historic allocation of resources has resulted in inadequate infrastructure development and maintenance.
Life-Support Resources	This includes subsistence living situations (*e.g.*, subsistence fishing, hunting, gathering, farming), diet, and other differential patterns of consumption of natural resources. If a community is reliant on consumption of natural resources, such as subsistence fishing, an additional exposure pathway may be associated with the community that is not relevant to the population at large. Similarly, dietary practices within a community or ethnic group, such as a diet low in certain vitamins and minerals, may increase risk factors for that group.
Distribution of Costs	Consideration of the distribution of costs to pay for environmental projects to the extent that regulations and programs are paid for by user fees on necessary goods and services (e.g., sewer and water bills, garbage services, electric bills, gasoline taxes). These have a substantial negative effect on low-income families who must pay a disproportionate fraction of their income for these goods and services, the addition of user fees for another plant or facility may add to the disparate treatment of those individuals.
Community Economic Base **Industrial**	Reliance on polluting industries for jobs and economic development. If the community is reliant on polluting industries for jobs and tax revenue, there may be reluctance to take actions that would avoid risk to health and the environment at a cost to the industry. In addition, minority or low-income communities may not enjoy other benefits in proportion to the risks or impacts they bear.
Brownfields	Communities with low revenues may be unable to finance economic rehabilitation efforts that would improve the physical environment of a community.
Natural Resources	Reliance on natural resources for economic base (*e.g.*, tourism, crops; use of resources to create salable items, such as woven baskets among Native Americans; subsistence and commercial fisheries).
Other	Other indirect effects which a low-income or minority population, due to economic disadvantage, may not be able to avoid, that will have a synergistic effect with other risk factors (*e.g.*, vehicle pollution, lead-based paint poisoning, existence of abandoned toxic sites, dilapidated housing stock).
HUMAN HEALTH AND **RISK FACTORS**	

Evaluation of human health and risk factors relevant to environmental justice concerns may prove to be complicated when detailed technical analyses of risk factors and interaction of toxic chemicals are undertaken. However, the following include, but are not limited to, factors which allow for consideration of whether more detailed risk assessments or analyses specific to minority or low-income populations are appropriate:	
Emissions	Number of point and nonpoint sources of emissions including permitted and non-permitted (violations) releases.
Toxics	Presence of or exposure to highly toxic pollutants.
Exposures	Multiple exposure sources and/or paths for the same pollutant.
Pollutants	Exposure to multiple pollutants.
Pesticides	Exposure to pesticides by workers and to the misuse of pesticides.
Locations	Exposure through multiple locations (*e.g.,* workplace, home, school, ambient).
Concentrations	Exposure to emissions from concentrated locations of the same type of industry (or industries).
Health Data	Health data for population in question (*e.g.,* abnormal levels of cancers, asthma, emphysema, birth defects, low birth weight, infant and childhood mortality blood-lead levels asbestosis). This data could indicate historical hazards and health risks which, in concert with the effects of the proposed action could cumulatively or indirectly raise environmental justice issues.
Research Gaps	Research gaps (*e.g.,* subsistence consumption, demographics dietary effects, synergistic effects of chemicals).
Data Collection	Data collection/analysis reliability and validity.
FACTORS RELATED TO CULTURAL AND ETHNIC DIFFERENCES AND COMMUNICATIONS CONCERNS When determining whether communities have been afforded opportunity for meaningful involvement, broad factors for consideration include the following. Other considerations for public participation are discussed in Chapter 4 of the *" Guidance on Environmental Justice in EPA's NEPA Compliance Analyses."*	
Public Access	Whether community members have access to the decision-making process (*i.e.,* whether the community is fairly represented on commissions, boards, etc., and whether the community is fairly made aware of their role in the decision-making process).
Cultural Expectations	Cultural expectations and understanding of the decision-making process.
Meaningful Information	Access to meaningful and understandable information, such as clear presentation of what a facility produces, what pollutants it releases, how these are managed, and the potential risk to the population.
Job Security	Potential for fear within the community that participating in the process may jeopardize job security.

Literacy Rate	If a low literacy rate exists, consideration should be given to the clarity and accuracy of presentations to the community and whether non-written materials, such as videos, have been considered for use in presentations.
Translations	Consideration of non-English translations, both written and oral during community presentations or public meetings.
Community Representation	Consideration should be given to whether representatives were selected by community decree or by outside sources without proper consultation with the community.
Community Identification	Whether identification of minority and/or low-income communities took into account all potentially-impacted communities. If communities were geographically defined rather than culturally defined, certain communities that are impacted, given other cultural factors, may be unfairly excluded.
Indigenous Populations	In addition, when projects or activities may affect tribal lands or resources or Native American communities, the NEPA analytical team should include one or more analysts familiar with Native American issues and culture, and the Agency should formally request the affected Indian Tribe(s) to seek participation as a cooperating agency. Specific factors to consider in such situations include, but are not limited to: The trust responsibility to and treaties, statutes and executive orders with federally-recognized Indian Tribes. Effect of insufficient financial and technical resources for the development and implementation of tribal environmental programs.
FACTORS RELATED TO HISTORICAL AND POLICY ISSUES Environmental justice assessments may require looking at historical conditions, existing conditions, and the impact of future actions. Many of the factors discussed above, such as cumulative risk, will necessarily address this question, but certain other factors may also require consideration, including:	
Industrial Concentration	Concentration of industries that may create a high risk of exposure to environmental hazards for the community's economic base. Factors that may lead to such a result include government/industry arrangements that may reduce available public funding for adequate protection of low-income or minority populations (*e.g.*, tax breaks provided to certain industries to encourage the location of such industries to a certain area).
Inconsistent Standards	Non-uniformity in enforcement and site-selection standards across communities including methods for pursuing enforcement targeting, compliance actions and compliance initiatives.
Research Gaps	Research gaps and past data collection practices and validity. For

	example, data relevant to low-income communities may not be adequately collected and analyzed given the potential for inadequate resources within the community to collect and analyze data.
Program Gaps	Program gaps between tribal, state, and federal programs (such as asbestos worker protection programs) that may have subjected communities to high risk of exposure to environmental hazards. Such gaps include the lack of explicit Congressional authorization for tribal participation in and delegation/authorization of certain EPA programs and the sufficiency of funding and technical assistance for the development of tribal environmental programs.
Non-Inclusive Processes	Decision-making and documentation processes that were non-scientific, and/or non-inclusive in nature (*e.g.*, selection of community representatives by potentially-affected industry rather than by community decree).
Past Practices	Adequacy of past resource allocation practices.
Cultural Diversity	Past and present cultural diversity or lack thereof on decision-making boards, within agencies, commissions, etc.
Obligations	Adherence to prior agreements, such as treaties, statutes and executive orders with tribes. EPA should be particularly careful not to diminish tribal resources, including cultural and natural resources and treaty rights, without tribal concurrence and EPA should ensure the protection of such resources from environmental harm.

3.0 INCORPORATING ENVIRONMENTAL JUSTICE INTO THE NEPA PROCESS

3.1 Overview of the NEPA Process

A general framework for implementing NEPA requirements is presented in regulations (40 CFR Parts 1500 through 1508) promulgated by the Council on Environmental Quality (CEQ). Federal agencies, in turn, have developed their own rules for NEPA compliance that are consistent with the CEQ regulations while addressing the specific missions and program activities of each agency. EPA's regulations are found at 40 CFR Part 6. Over the past 25 years, the NEPA framework for environmental review of proposed federal actions has been substantially refined, based on further congressional directives, action by CEQ, and an extensive body of case law.

As stated in Section 1.0, an EIS is required for major federal actions significantly affecting the quality of the human environment. The basic analytical planning process for EISs required under NEPA and its implementing regulations for assessing the environmental impacts that may result from a government action includes:

1. **Definition:** Define the purpose and need for the action.

2. **Screening:** Preliminary delineation of potential impacts.

3. **Scoping:** Outline proposed action; define objectives; define scope; identify decisions that need to be made; focus resources; initiate public participation.

4. **Affected Resources:** Define the resources that may be affected if the action meets the proposed objectives.

5. **Alternatives:** Identify and define practical alternatives for meeting objectives.

6. **Mitigation**: Identify possible mitigation measures to minimize or avoid potential impacts.

7. **Consequences:** Predict the environmental impacts and other consequences of the proposed action and alternatives.

8. **Decisions:** Make decisions regarding a course of action, including mitigation measures developed to address environmental effects threatened by proposed actions.

9. **Monitoring:** Observing, recording, and documenting mitigation measures to evaluate their effectiveness.

CEQ regulations (40 CFR Part 1502) dictate the process that federal agencies must follow for all EISs, except where compliance with the regulations would be inconsistent with statutory requirements or where agency procedures allow for exceptions for national security reasons. Public participation and involvement is required throughout the NEPA process, beginning with scoping.

Proposed actions predicted to present less significant impacts often are analyzed in environmental assessments (EAs). As mentioned in Section 1.0, EAs are important analytical tools, originally intended to aid in the determination of significance of the effects of a proposed action. Compared to EISs, there are fewer detailed regulatory requirements for EAs as to content, format or public participation. The scale of EAs usually depends on the relative significance of the projected impacts.

Environmental justice issues encompass a broad range of impacts covered by NEPA, including impacts on the natural or physical environment and interrelated social and economic effects. The CEQ implementing regulations define "effects" or "impacts" to include those that are "ecological...aesthetic, historic, cultural, economic, social or health, whether direct, indirect or cumulative." In preparing EISs, NEPA requires EPA to consider both impacts on the natural or physical environment and interrelated social and economic impacts. In analyzing social and economic impacts, unique cultural aspects should also be reviewed. EPA, as a matter of policy, will consider interrelated social and economic impacts in EAs. This serves as a base to further the goals of the Executive Order. Environmental justice concerns may arise from impacts on the natural or physical environment, such as human health or ecological impacts on minority populations and low-income populations, or from interrelated social or economic impacts.

Moreover, EISs and EAs should document the extent to which environmental justice issues have been identified and addressed. The initial step in the analysis of potential effects is to assess whether there indeed will be potential physical or natural environmental impacts. If it is determined by the analytical team that there will be no environmental effects, and thus no disproportionately high and adverse effects, then this finding should be documented and no further analysis of effects is necessary.

If preliminary analysis indicates that there is a potential for environmental effects, then a more detailed assessment is conducted to estimate the level of those effects. There are occasions in which "grey areas" may be encountered. The EPA NEPA analyst may be unsure as to whether the environmental effects are *de minimis*, meaning when there are very small effects, or something greater than *de minimis* yet less than significant natural or physical impacts demanding an EIS. This guidance suggests that when the EPA NEPA analyst is unsure whether these environmental impacts are *de minimis* or something more than *de minimis* but less than significant, the EA should include an analysis of interrelated social and economic effects (and, as described in Section 3.2 below, there now should be an EIS-like scoping process if the screening analysis indicates that there may be disproportionately high and adverse effects on minority and/or low-income communities). The EA should include socioeconomic analyses scaled according to the severity of the impacts.

Following an EIS or EA, the Agency must announce its decision in a Record of Decision (ROD) or a FONSI. The ROD, and where appropriate the FONSIs, should document the conclusion of the findings presented in the EIS or EA (i.e., whether the action will or will not have a disproportionately high and adverse effect on minority and/or low-income communities) and include a description of those mitigation measures that the Agency is committing to implement to reduce or avoid environmental consequences associated with the proposed action.

3.2 Incorporating Environmental Justice Concerns into this Process

One of the most important means by which EPA can ensure that disproportionately high and adverse effects on minority and/or low-income communities are identified and analyzed, is to "institutionalize" the process of identification and analysis. The next sections of this Chapter describe the screening-level analysis that begins the process, and how environmental justice considerations can be integrated into later steps and activities required under CEQ and EPA regulations.

As noted in Chapter 1, one effect of incorporating environmental justice considerations into NEPA analyses will be to more sharply focus these analyses. To do this, it is necessary to assess the distribution of environmental impacts demographically and/or geographically, as well as to assess the overall impacts to the affected communities. As described in Chapter 5, the analytical tools commonly used for analyzing potential impacts may have to be modified to allow this more refined focus. Overall, the evaluation of environmental justice concerns raises a number of issues related to "significance" and to other NEPA procedures. The discussion below describes several issues that are relevant to the determination of significance and the consequent level of analysis; also included are discussions of how consideration of such issues should affect the determination and subsequent analyses. The analytical team should keep in mind that the presence of disproportionately high and adverse effects may or may not necessarily change the final decision, but will change the focus of the analysis and may result in additional mitigation measures.

3.2.1 Environmental Justice Screening Analysis

In preparing for any proposed action, one of the first actions is a preliminary delineation of potential impacts and of the potentially affected area. A screening for environmental justice concerns should be incorporated into this initial NEPA screening analysis. This section describes a two-step screening process, the results of which then guide subsequent actions related to environmental justice.

The first step in identifying potential environmental justice concerns should be a screening-level analysis to determine the existence of a low-income and/or minority population. Depending on the outcome, it may then be necessary to enhance public participation to gain a fuller understanding of the potential environmental justice issues (see Chapter 4), initiate development of alternatives and mitigation options, and/or initiate analyses to identify and assess disproportionately high and adverse human health or environmental effects (see Chapter 5). In addition, if the proposed project may affect tribal lands or resources, then EPA, in keeping with federal and EPA policies of government-to-government relations, will formally request that affected Indian Tribe(s) seek to participate as a cooperating agency.

The screening analysis should occur as soon as the proposed action is well understood, around the time planning for scoping begins for EISs and planning begins for EAs. Although neither the impacts nor the full area to be affected may be fully understood at this point, it is usually possible to make fair approximations. In the screening analysis, two questions should be addressed, as described below.

Question 1

Does the potentially affected community include minority and/or low-income populations?[(8)]

If yes, this should trigger both an enhanced outreach effort to assure that low-income and minority populations are engaged in public participation and analysis designed to identify and assess the impacts. Also, a positive response to this question should increase the team's sensitivity to the potential for cumulative impacts.

In general, census and other data should be used to characterize the population within the affected area, in terms of minority (*i.e.,* racial or ethnic), economic, and educational demographics. However, it should be noted that census data have been shown to be unreliable in some cases, in part because the level of aggregation may not offer a fine enough mesh to identify the existence of such communities. Also, census data are based on self-reporting. These data are not always consistent and are prone to undercounting minority populations and low-income populations due to a perceived reluctance for certain populations to divulge information (see Section 2.1.1). This is a screening-level analysis, so extensive efforts to validate census data should not be necessary at this stage, unless there is substantial uncertainty in (a) the answer to the screening question or (b) the ability to delineate the affected area at this early stage. Because the applicability of the census data can only be determined on a case-by-case basis, the EPA NEPA analyst should supplement this information with data from other sources. For example, additional information can be obtained from: local resources through questions, interviews, and research; geographical mapping system (GIS) or other similar overlay mapping systems; and economic impact analyses.

Environmental effects are often realized in inverse proportion to the distance from the location or site of the proposed action (i.e., the closer the population is to the action, the greater the potential impacts). As a result, an effort should be made to correlate the demographic analysis to the area most likely to bear environmental effects. On the other hand, depending on the resource affected, and the users of that resource, proximity to the site may not correlate with the likelihood of disproportionately high and adverse effects on minority communities or low-income communities.

It also is important during the initial screening stages to locate all minority communities or low-income communities within the region surrounding a proposed location. The analytical teams should keep in mind that sometimes distinct minority communities or low-income communities may be geographically located within another minority community or low-income community. In some cases, a minority community or low-income community that is surrounded by another minority community or low-income community may bear disproportionately high and adverse effects compared to the surrounding communities. In addition, the EPA NEPA analyst should be sensitive to situations where the affected community represents the majority population over the extended area. For example, locations along the United States-Mexico border include entire counties where minority populations represent a majority of the population in the county. These areas are predominantly Latino, although when the county population is compared to the population of the entire state, the proportion represents a much smaller percentage of the population. Similarly, counties in the Mississippi Delta region represent areas where African Americans comprise a majority of the total population.

<u>Question 2</u>

Are the environmental impacts likely to fall disproportionately on minority and/or low-income members of the community and/or tribal resources?

A positive response should trigger both an enhanced outreach effort to assure that low income and minority populations are engaged in public participation and an analysis designed to identify impacts on both the larger population and on minority and/or low-income members of the population. A positive response could result from any of several factors, including the following:

Within a potentially affected area, minority and/or low-income populations could be unevenly distributed, thus subject to different levels or intensity of impacts than the larger population. This pattern should cause concern for cumulative impacts. An example would be subsistence dependence on an affected resource by members of a community.

The impacts may affect a cultural, historical, or protected (*e.g.*, treaty) resource of value to an Indian Tribe or a minority population, even when the population is not concentrated in the vicinity.

If the answer to both screening questions is "no," then the environmental justice screening analysis should be documented in scoping notices and in EISs/EAs and RODs/FONSIs. In addition, certain unique cultural, geographic, or economic factors may exist within an area that could warrant additional investigation. Also, later information and analyses may show that the screening analysis was mistaken. Indeed, analysts should re-examine the screening questions (and the key factors identified in Chapter 2) at key steps in the NEPA process (*e.g.*, following scoping, in drafting the EIS/EA, in soliciting comments on draft EISs, in responding to comments, and in preparing RODs and FONSIs).

3.2.2 Environmental Justice and the Determination of Significance

CEQ regulations (40 CFR 1508.27) detail factors that should be considered in making a determination of whether a proposed action is significant, thereby requiring a "detailed statement" (*i.e.*, an EIS). Economic or social effects alone do <u>not</u> trigger an EIS [40 CFR 1508.14].

According to CEQ's *Guidance for Considering Environmental Justice under the National Environmental Policy Act*, the "...Executive Order does not change the prevailing legal thresholds and statutory interpretations under NEPA and existing case law. For example, for an EIS to be required, there must be a sufficient impact on the environment to be "significant' within the meaning of NEPA. Agency consideration of impacts on low-income populations, minority populations or Indian tribes may lead to the identification of disproportionately high and adverse human health or environmental effects that are significant and that otherwise would be overlooked." CEQ requires that significance be evaluated in terms of "intensity" or "severity of impact." Here too, the narrowed focus could affect the determination. Several factors that affect the evaluation of intensity are relevant to situations involving environmental justice issues. These include the degree of scientific controversy, uncertainty (since distributional analysis is relatively new in the NEPA context and this introduces an element of uncertainty in impact assessment), and cumulative significance of related actions.

Environmental justice concerns should sensitize EPA NEPA analysts to the need to focus analyses on relevant contexts. Focusing the analysis may show that potential impacts, which are not significant in the NEPA context, are particularly disproportionate or particularly severe on minority and/or low-income communities. As mentioned previously, disproportionately high and adverse effects should trigger the serious consideration of alternatives and mitigation actions in coordination with extensive community outreach efforts.

3.2.3 Scoping and Planning

Scoping consists of identifying and defining the range of actions, alternatives and impacts that will be considered in an environmental impact statement (40 CFR 1508.25). During the scoping phase of the EIS process, EPA must consider connected, cumulative and similar actions to the proposed action, identify alternatives to the proposed action that may mitigate or avoid potential environmental consequences, and assess potential impacts (direct, indirect, and cumulative). A similar planning process is used for EAs.

The identification of environmental justice concerns and the incorporation of these concerns into the scoping analysis can have implications for the nature and extent of the scoping analysis, the EIS and/or the EA.[9] Indian Tribe representation in the process should be sought in a manner that is consistent with the government-to-government relationship between the United States and tribal governments, the federal government's trust responsibility to federally-recognized tribes, and treaty rights. This will help to ensure that the NEPA process is fully utilized to address concerns identified by tribes and to enhance protection of tribal environments and resources. As defined by treaties, statutes, and executive orders, the federal trust responsibility may include the protection of tribal sovereignty, properties, natural and cultural resources, and tribal cultural practices.

3.2.3.1 Incorporating Environmental Justice Concerns into EA Development

If the environmental justice screening analysis does not identify minority communities or low-income communities, and suggests no disproportionately high and adverse effects on those communities and/or on tribal resources, then the EA and FONSI should describe the analysis and note the conclusion.

If the initial screening analysis identifies an affected community that is minority and/or low-income or identifies a disproportionately high and adverse effect upon a minority community, and/or on tribal resources, or on a low-income community, then a smaller scale scoping analysis (than that undertaken for an EIS) should be conducted and some level of public participation should be designed and implemented to solicit community involvement and input, and to develop alternatives and mitigation measures. Mitigation measures should be developed and alternatives should be crafted so as to allow an evaluation of the relative disproportionality of impacts across reasonable alternatives. The EA also should include a comparative socioeconomic analysis that is scaled and tailored to evaluate the potential effects to the minority and/or low-income community (*i.e.,* in the case of environmental justice concerns, the EA should include socioeconomic analyses scaled according to the severity of the impacts).

3.2.3.2 Incorporating Environmental Justice Concerns in EIS Scoping

If the environmental effects of a project are deemed significant, the scoping notices (including the notice of intent for the EIS) should include a description of the results of the environmental justice screening analysis. If the results of the screening analysis are negative (i.e., any potentially affected population is not a minority community or low-income community and the effects are not likely to fall disproportionately on a minority and/or low-income community, and/or on tribal resources), then the scoping notice should state this finding and request additional information on whether there may be disproportionately high and adverse effects that were overlooked during the screening analysis.

If the environmental justice screening analysis concludes that there is a potential for disproportionately high and adverse effects, then the EPA NEPA analyst should ensure that the EIS scoping process raises environmental justice concerns and that sufficient data and information are generated to evaluate these potential effects. Prior to the full-scale scoping process, public outreach strategies should be developed and implemented. The public participation process should be used to define and evaluate environmental justice concerns by:

Consulting with community leaders and members of the surrounding communities to seek their assistance in identifying all minority and/or low-income communities that may be affected by the proposed action.

Consulting with officials in tribal, state and/or local government agencies over the environmental and human health concerns within the region and who may be familiar with the demographics of the affected populations. Where environments of Indian tribes may be affected, agencies must consider pertinent treaty, statutory or executive order rights and consult with tribal governments in a manner consistent with the government-to-government relationship.

Soliciting information from the local community on potential environmental justice issues through public participation efforts (see Chapter 4 for a discussion of public participation).

• Soliciting public comment on environmental issues through formal public notice and comment procedures tailored to the community (see Chapter 4).

• If the proposed activity is deemed significant to warrant the development of an EIS, or if the community has raised significant concerns to be addressed in an EA, EPA should establish a community advisory board to work with EPA in the development of the respective NEPA documents.

The public participation efforts designed as part of the scoping effort for an EIS should clearly describe any environmental justice concerns identified by EPA, and should specifically ask the public to suggest alternatives and mitigation measures aimed at reducing or avoiding disproportionately high and adverse effects. The Agency also should design comparative socioeconomic, environmental and health analyses of all reasonable alternatives and mitigation measures that are tailored and/or scaled to evaluate the impacts to the affected minority and/or low-income community and/or tribal resources.

3.2.4 Identification of Affected Resources

CEQ regulations state that an EIS is required only when there is a significant impact on the physical or natural environment. Notwithstanding, early in the EA and/or EIS process, the EPA NEPA analyst should identify the physical environment and all natural resources that could be potentially affected by the proposed action and by alternative actions. The EPA NEPA analyst should develop a full understanding of baseline demographic, socioeconomic, and environmental conditions so that a comprehensive assessment of the types of impacts that may be imposed upon all human and natural resources (*e.g.*, air, water, soils, wildlife) can be conducted and an understanding of how these impacts may translate into human health concerns can be developed. For a detailed discussion on how effects to human health and natural resources might be determined, please reference Section 2.2.

To account for potential environmental justice concerns, EPA NEPA analysts should be sensitive to identifying whether affected resources are used by a minority or low-income community. In addition, analyses of potential effects on all surrounding resources should be focused narrowly or specifically toward how potential effects to these resources may translate into disproportionately high or adverse human health and/or environmental effects on minority and/or low income communities.

The EPA NEPA analyst should use all means available to identify particular natural resources that, if affected by the proposed action, could have a disproportionately high and adverse effect on minority and/or low-income communities. In particular, natural resources that support subsistence living (*e.g.*, hunting, fishing, gathering) should be identified. In addition, Indian Tribes may have treaty-protected resources on or off reservation lands and may hold some natural resources sacred due to religious beliefs and/or social/ceremonial ties. Alternatives and mitigation measures should be explicitly solicited from the affected community early in the process, such as during scoping.

Throughout the process, but especially beginning in this phase, the Agency should provide affected communities with technical assistance to ensure that the communities thoroughly understand the proposed action and have meaningful participation and input. All resources that could be affected should be thoroughly developed and documented. A discussion of all findings should be shared with potentially affected communities during public participation phases of the NEPA process to ensure full disclosure and to solicit additional public comment and input.

3.2.5 Identification of Alternatives

NEPA and the CEQ regulations require the identification and development of a reasonable array of alternatives. In addition, CEQ requires that all reasonable alternatives, including a "no action" alternative, must be analyzed rigorously and objectively. The selection of potential alternatives should begin early in the evaluation and, in fact, should be part of the scoping process. In addition, if environmental justice issues are identified, then alternatives should be drawn so as to allow an assessment of the disproportionate nature of the effects, as well as the magnitude of the effects, on the communities of concern.

An evaluation of potential environmental justice issues should be conducted for all reasonable alternatives. In addition, for each alternative that may result in potential environmental justice concerns, mitigation measures aimed specifically at those impacts should be identified and analyzed. The results of all analyses of environmental justice issues, including study results that identify no environmental justice issues, should be described fully in scoping documents, EISs and EAs. All results should be fully disclosed during public participation procedures, and public comment and input on the analyses and conclusions should be solicited. Chapter 2 provides an overview of the factors that should be evaluated to identify and define potential environmental justice concerns. These factors will also be helpful in understanding the need for mitigation or additional alternatives and identifying mitigation or alternative options.

The EPA NEPA analyst should keep in mind that the goal of identifying and developing alternatives for mitigating disproportionately high and adverse effects is not to distribute the impacts proportionally or divert them to a non-minority or higher-income community. Instead, alternatives should be developed that mitigate or avoid effects to both the population at large and any disproportionately high and adverse effects on minority or low-income communities. In other words, the goal of developing reasonable alternatives is not to move the impacts around, but to identify viable alternative actions that meet program goals and avoid or reduce the environmental, socioeconomic, human health and/or ecological effects associated with the preferred action. Generally, the types of alternatives that may potentially lead to the avoidance or reduction of effects include: a) the identification of alternate locations or sites where impacts to susceptible populations or environments will be avoided; b) altering the timing of planned activities or periodic emissions to account for seasonal dependencies on natural resources; c) the adoption of pollution prevention practices and policies to reduce or mitigate emissions and/or impacts; d) reducing the size or intensity of an action; and e) taking no action.

3.2.6 Prediction of Environmental Consequences

CEQ regulations require government agencies to identify, predict and describe reasonably foreseeable beneficial as well as adverse changes to existing conditions that may result from implementing either the proposed action or alternative actions. Impacts across alternatives must be compared. The prediction and description of potential disproportionately high and adverse effects must begin during the screening and scoping stages of the process, as noted above. Throughout the NEPA process, environmental justice concerns should be identified, disclosed, and discussed with affected communities.

In preparing an EIS or EA, ecological and human health risk assessments are conducted to identify and evaluate potential environmental and human health impacts that may be imposed. In addition, interrelated socioeconomic impacts that would result from a proposed action and alternatives are analyzed. Chapter 5 provides an overview of the types of analyses and analytical tools that may be used to analyze these issues and approaches that may be appropriate to assess disproportionately high and adverse effects. Again, throughout the development and public disclosure of EPA NEPA analyses and findings, full discussions of the analytical process undertaken to identify environmental justice concerns and all findings and conclusions should be disclosed to and discussed with all affected and interested parties.

In evaluating the environmental impacts of the proposed action and alternative actions in an EIS, CEQ regulations (40 CFR 1508.25) require EPA to consider: three types of actions (connected actions, cumulative actions, and similar actions); three types of alternatives (no action, other reasonable course(s) of actions, and mitigation measures not in the proposed action); and three types of impacts (direct, indirect, and cumulative). Environmental justice concerns should be identified and analyzed within the context of all actions, alternatives and impacts. Exhibit 4 provides examples of how environmental justice issues could arise and/or be considered for each of these variables.

3.2.7 Mitigation Measures

Regulations require that mitigation measures be developed to address environmental effects, including cumulative impacts, threatened by proposed actions (40 CFR 1502.14(f) and 1502.16(h)). In addition, mitigation measures should be developed specifically to address potential disproportionately high and adverse effects to minority and/or low-income communities. When identifying and developing potential mitigation measures to address environmental justice concerns, members of the affected communities should be consulted. Enhanced public participation efforts should also be conducted to ensure that effective mitigation measures are identified and that the effects of any potential mitigation measures are fully analyzed and compared (see Chapter 4). Mitigation measures may include a variety of approaches for addressing potential effects and balancing the needs and concerns of the affected community with the requirements of the action or activity. For example, potential mitigation measures for addressing disproportionately high and adverse effects could include:

1. Reducing pollutant loadings through changes in processes or technologies.

2. Reducing or eliminating other sources of pollutants or impacts to reduce cumulative effects.

3. Planning for and addressing indirect impacts prior to project initiation (*e.g.,* planning for alternative public transportation alternatives if the project may result in increased population growth).

4. Providing assistance to an affected community to ensure that it receives at least its fair (i.e., proportional) share of the anticipated benefits of the proposed action (*e.g.,* through job training, community infrastructure improvements).

5. Relocating affected communities, upon request or with concurrence from the affected individuals.

6. Establishment of a community oversight committee to monitor progress and identify potential community concerns.

7. Changing the timing of impact-causing actions (*e.g.,* noise, pollutant loadings) to reduce effects on minority communities or low-income communities.

8. Conducting medical monitoring on affected communities and providing treatment or other responses if necessary.

If mitigation measures are determined to be necessary to reduce disproportionately high and adverse effects on minority and/or low-income communities, and/or tribal resources, then the measures should be committed to in the FONSI or ROD. This provides an additional avenue for public notice and involvement. Other steps that can be considered to ensure that mitigation measures are effective and are implemented include the following:

• Establishing the mitigation measure as a requirement in the permit or authorizing document.

• Requiring financing at the outset of the project for both implementing the measure and monitoring its effectiveness. Ensure clearly defined monitoring guidelines are in place.

• Requiring monitoring reporting, which should be made available to the public.

• Identifying clear consequences and penalties for failure to implement effective mitigation measures.

3.2.8 Decisions

The two NEPA decision documents identified in CEQ regulations are: 1) a ROD following an EIS and, 2) a FONSI following an EA. All EPA NEPA decision documents should include a concise summary of all steps undertaken to identify environmental justice concerns and the results of those steps. In cases where environmental justice concerns are identified, the decision documents should fully discuss these concerns, explain all alternatives and mitigation options that were analyzed, and explain how environmental justice concerns factored into the decision. In cases where effects to tribal lands or resources have been identified and the Indian Tribe and EPA disagree as to the preferred alternative or mitigation measures, the Indian Tribe may request that the EPA initiate a dispute resolution process to resolve this conflict. In addition, public participation efforts related to environmental justice concerns should be documented in the decision document. Finally, mitigation measures that are evaluated, disclosed to the public, and chosen in conjunction with the alternative to be implemented should be identified and discussed. If no concerns are identified, this finding should be stated along with the basis of EPA's conclusion.

4.0 PUBLIC PARTICIPATION

Adequate public participation is crucial to incorporating environmental justice considerations into EPA's NEPA actions, both to enhance the quality of the analyses and to ensure that potentially affected parties are not overlooked and excluded from the process. Public participation under NEPA involves two-way communications, with EPA receiving information, comments, and advice, as well as disseminating information on possible approaches, analyses, and decisions. This is particularly important when there are potential environmental justice issues involved. To sufficiently and adequately address potential environmental justice concerns and communicate with potentially affected communities, the EPA NEPA analyst should include one or more persons who are familiar with environmental justice issues and appropriate communications strategies. It is important that EPA take steps to encourage and facilitate more active participation by low-income communities and minority communities in its NEPA process. This goal can be accomplished through careful identification of target audiences and aggressive community outreach beyond the traditional forms.

There are established procedures for public participation in NEPA actions and decision-making processes (as in other federal actions). However, these procedures have not always been successful in informing or gaining participation by minority communities and low-income communities. Although they may be most affected, they may be the least informed, simply because of the means of communications used; this can be for any number of obvious reasons, such as language, culture, educational level or geographic location. In most cases, relatively simple approaches--well within the purview of "standard" public participation techniques--can overcome most barriers to informing and seeking involvement of interested or affected communities. This in turn can ensure that federal decisions are consistent with Executive Order 12898 and enhance the actual and perceived fairness of federal actions.

The first subsection below briefly describes public participation that is required during the NEPA process by CEQ and EPA regulations. The next subsection then identifies a number of the special concerns and unique issues that may arise in addressing environmental justice issues, and identifies several mechanisms that may be used in EPA's NEPA process to address those special concerns and issues.

4.1 Public Participation Under NEPA

Public participation is one of the hallmarks of NEPA, and is reflected in CEQ's and EPA's NEPA regulations. According to 40 CFR 6.400(a), "EPA shall make diligent efforts to involve the public in the environmental review process...." There are several clearly defined steps in public participation under NEPA, and these are described below.

Scoping. CEQ regulations require "scoping" following the publication of a notice of intent to prepare an EIS, but before the EIS is prepared. CEQ regulations define scoping as "an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action" (40 CFR 1501.7). In general, scoping has three broad purposes: identifying public and agency concerns with a proposed action, defining issues and alternatives to be examined in detail, and saving time by ensuring that relevant issues are identified early and drive the analyses (see 40 CFR 1500.4(g), 1500.5(d)). A public meeting is held during scoping, with notice of the meeting made in the *Federal Register*, local newspapers, and utilizing other means of announcing public meetings, depending on case-specific circumstances.

Scoping for EAs is not addressed in either CEQ or EPA regulations. In practice, EA scoping can range from a process more or less identical to that used for EISs, to relatively minimal involvement of outside parties.

CEQ has indicated that the scoping process ends "once the issues and alternatives to be addressed in the EIS have been clearly identified," usually "during the final stages of preparing the draft EIS..." (CEQ "Guidance Regarding NEPA Regulations"). It is emphasized that public participation does not end here, but continues throughout the NEPA process, as described below, and even beyond.

Public review of EISs and EAs. As with scoping, CEQ and EPA NEPA regulations clearly specify the means by which the public is involved in reviewing draft and final EISs. EPA regulations require at least one public meeting on all draft EISs (40 CFR 6.400(c)). The meeting is generally announced in the *Federal Register* and in local newspapers and by other means. Regulations also provide other means of soliciting comments and information. Comments must be solicited from other appropriate federal, tribal, state, and local agencies, and from the public, specifically including a request for comments from "those persons or organizations who may be interested or affected" (40 CFR 1503.1(a)(4)).

EPA then has to consider and address all comments received on the draft EIS in preparing the final EIS, and final EISs must include responses to comments. As with draft EISs, final EISs are noticed in the *Federal Register* and elsewhere. Again, interested parties may submit comments on final EISs prior to EPA's final decisions.

EAs must be made available to the public (40 CFR 1506.6: C.E.Q. 40 Questions, #38). A combination of methods may be used to provide notice of availability; the methods should be tailored to the needs of particular cases. Traditionally there has been limited public involvement before and during EA preparation by EPA unless there is a question of significance (*i.e.,* some question as to whether an EIS is necessary) or some particular public interest.

Public review of RODs and FONSIs. Records of Decision on EISs must be disseminated to all those who commented on the draft or final EIS (40 CFR 6.400(e)). No public review is required prior to or after issuance of the ROD. Findings of No Significant Impact on EAs, in contrast, must be made available for public review before they become effective (40 CFR 6.400(d)), and this involves at least local notice and advertising. The FONSI and "attendant publication" must state that comments disagreeing with the decision may be submitted, and any such comments must be considered by EPA (40 CFR 6.400(d)).

4.2 Mechanisms to Enhance Participation

The public participation provision in Executive Order 12898 and its accompanying memorandum are designed to ensure that there is adequate and effective communication between federal decision makers and affected low-income communities and minority communities. This is consistent with the NEPA mandate to involve the public. The involvement of low-income communities and/or minority communities, however, presents some challenges to what has come to be the "normal" pattern of formal public participation under NEPA. In order to establish trust with all types of stakeholders, interaction with the affected community should:

- Encourage active community participation.

- Recognize community knowledge.

- Utilize cross-cultural formats and exchanges.

In all cases where EPA's initial screening indicates that there is a potential for disproportionately high and adverse effects on low-income and/or minority communities, the

Agency should make a concerted effort to identify stakeholders in the affected community and include the following groups and organizations in their outreach efforts:

- Environmental organizations and agencies

- Minority businesses, associations and trade organizations

- Civic associations and public interest groups

- Grassroots/community-based social service organizations

- Federal elected officials and agencies

- Homeowners' or tenants' associations, neighborhood watch groups and resident organizations

- Labor unions and organizations

- State and local elected officials and agencies

- News media, the Internet and other electronic media

- Tribal governments and Tribal organizations

- Religious groups and organizations

- Libraries, vocational and other schools, colleges and universities

- Medical community

- Legal aid providers

- Rural cooperatives

- Civil rights organizations

- Senior citizen's groups

Other sources of advice are ethnic and cultural-based environmental justice networks (*e.g.,* Indigenous Environmental Network, Southwest Network for Environmental and Economic Justice, Southern Organizing Committee). The *People of Color Environmental Groups*

Directory[(10)] is a valuable major source of information on such local groups and individuals. Similarly, Historically Black Colleges and Universities, Tribal Colleges and Universities or other higher education institutions located in areas with or serving predominantly minority or low-income areas, may be able to assist EPA in designing (and participating in) public participation strategies. Exhibit 5 identifies a number of particular communications challenges and possible approaches to overcoming these challenges in addressing environmental justice issues. These should be supplemented by case-specific advice--on challenges and on solutions--that are solicited from local experts and others familiar with both the proposed action and the affected community.

Exhibit 5. Communications Issues of Particular Concern in Low-Income and/or Minority Communities

Challenge	**Possible Approaches to Overcoming**
Language or Communication barriers	• Provide assistance to hearing or sight impaired individuals • Provide simultaneous translation of meetings • Use local translators where possible • Translate key documents in entirety (notices, summaries, etc.) • Establish "comment line" (*e.g.*, 800 number) for callers to leave recorded comments • Advertise meetings/process in alternative-language medium • Design communication strategy to reach all segments of population • Use facilitated meeting rather than conventional stand-up comments to encourage comments
Distance to meeting or inconvenient access (e.g., rural or cross-town)	• Arrange for "comment line" (*e.g.*, 800 number) to provide remote access to meeting or to allow callers to leave recorded comments • Arrange for telephone tie-in from several locations (*e.g.*, from several schools, religious centers)

	• Hold series of shorter meetings (down to 1-2 hours each) in multiple locations • Arrange for alternative transportation (possibly through proponent) • Ensure location is accessible to public transportation and identify itinerary in notices • Use local cable-channel broadcast with telephone call-in • Have proponent provide transportation vouchers • Seek advice of local groups/individuals • Arrange for satellite link-up (perhaps funded by proponent)
Unfamiliar surroundings (government buildings, luxury hotel, etc.)	• Use schools or other local facilities including religious centers, churches, temples, mosques • Have several smaller decentralized meetings, including open-air meetings (possibly with tent backup) in season • Seek advice from local groups/individuals • Use local facilitator • Establish "comment line" (*e.g.,* 800 number) for callers to leave recorded comments or to participate from remote locations
Outside normal EPA communications loops (i.e., *Federal Register*, newspapers)	• Use pro-active approach to identify stakeholder (both groups and affected individuals). Consult with local advocates/public interest groups to identify outreach mechanisms and refer to the *People of Color Environmental Groups Directory.* • Disseminate information through alternative media (neighborhood organization newsletters, religious centers, fliers, local cable access channel, local radio broadcasts, etc.). • Co-sponsor public meetings with local community groups to nurture trust and credibility. • Make announcements to those on the mailing list; make follow-up phone calls to encourage attendance. • Direct consultation with tribal governments and public

	meetings at tribal facilities or on/near tribal lands.
Format of Meetings	• Use town hall type meetings. • Avoid "panel of experts" • Use small focus-group seminars or workshops. • Use community "experts" and comments as part of communication strategy • Seek advice of local groups. • Use a trained facilitator who is sensitive to environmental justice issues.
Schedule conflicts (i.e., conflict with working hours, working days)	• Conduct personal interviews using audio or video recording devices • Hold after-hours and/or weekend meetings or sessions • Hold meetings on successive days • Hold multiple shorter meetings at diverse times/days • Establish "comment line" (*e.g.,* 800 number) for callers to leave recorded comments • Arrange for child-care (possibly funded by proponent)
Technically complex issues	• Provide sufficient background explanations beyond the usual means • Use plain language in meetings and printed material • Seek advice of local groups/individuals • Provide hands-on demonstrations/participation (*e.g.,* tours of similar facilities/locations) • Use visual presentations (*e.g.,*pictures, videos) • Provide two-way communication - Q & A • Use background summary reports, fact sheets, and abstracts • Provide technical and/or financial assistance to community, local organization, and/or tribal government to review,

	evaluate, and comment on the NEPA documents and provide meaningful input throughout the NEPA process.
Trust	• Clearly present goals of NEPA, the proposed action, the public involvement process, and what is expected to be gained from the process • Do not oversell: present uncertainties and limitations • Goals should be written and in clear language • Present experiences and track record, successes and failures

EPA-anticipated impacts and community perceptions of those impacts (and their fairness) can be very different, so both must be considered. When perceptions are the concern, an effort to involve and inform the community can go a long way toward building confidence that EPA's analyses and actions are well-intended and balanced. When actual impacts (i.e., disproportionately high and adverse human health or environmental effects) are the concern, the participation can serve to educate the Agency and help identify the means to identify alternatives and/or mitigate the impacts.

Although EPA and CEQ public participation regulations focus primarily on public meetings, there are other mechanisms that can also facilitate public input. Once community leaders and stakeholders have been identified and a dialogue established, a mailing list should be assembled so that information can be sent to this group, as well as formal announcements of a public meeting.

Another mechanism for providing information to the public is the establishment of information repositories which are accessible to members of the affected community. Locations can include libraries, churches, community centers, etc. Technical documents should contain a summary written to the lay public and translated, if necessary, into the dominant language of the affected community.

Meaningful public participation is based on the proposition that people should have a say in decisions which affect their lives in a significant way. Thus, for the public participation process to be effective, it must:

• Seek out and facilitate the involvement of those potentially affected;

• Contain the implicit commitment by decision makers to seriously consider the input of the public; and

• Communicate to participants how their advice was or was not utilized.

Minority communities and low-income communities are no different than any other in that there are nearly as many opinions as there are people. Thus, it is important not to focus exclusively on one mechanism (or one person or one group) for disseminating or soliciting information. Rather, it is important to use as many avenues as possible to solicit participation and to disseminate information. For example, when there are formal or informal representatives that purport to speak for a wider population, it is always advisable to seek divergent opinions.

Dr. Robert Bullard, Director of the School of Arts and Sciences at Clark Atlanta University, provides a framework for public participation when addressing environmental justice concerns during the NEPA process. Dr. Bullard points out that effective public involvement strategies have four common characteristics: inclusiveness, representation, parity, and communication. Inclusiveness refers to the assurance that all affected communities and stakeholders are represented and involved in the decision-making process. In terms of representation, he points out that it is crucial that the persons who are representing a specific community or stakeholder group truly reflect that community's, stakeholder's, and constituent's views, values, and norms. Parity involves all stakeholder groups having equal opportunity and capacity to provide input and full participation, as well as an equal voice in the decision-making process. Dr. Bullard further points out that an effective communications strategy accounts for different groups weighing and acting upon government actions and policies differently. An effective communications strategy recognizes, respects, and values cultural diversity of communities and stakeholders that represent a specific race, ethnic group, gender, age, geographic region, and a host of other characteristics.

As mentioned above, a recommended approach to ensure adequate public participation by minority and/or low-income communities when the screening analysis indicates there may be disproportionately high and adverse effects is to include a person familiar with environmental justice public participation issues on the "project review team." CEQ "Guidance Regarding NEPA Regulations" recommends that an interagency project review team be used when appropriate, with the team functioning as a source of information, a coordination mechanism, and an expert review team. When environmental justice issues must be faced, the review team should consult with the local community (including but not limited to organized groups concerned with environmental justice) during and following scoping, and should provide specialized expertise to EIS preparers.

The following are additional mechanisms for enhancing participation in the NEPA process: 1) allow public review of RODs; 2) government-to-government consultation with tribal governments, including formal requests for Indian Tribes to seek participation as cooperating agencies; 3) Community Advisory Boards for the development of NEPA documents; 4) community consultants; and 5) technical assistance to affected communities to enhance understanding of proposed action, technical documents. and full range of potential alternatives and mitigation measures.

In general, the effort expended in actively soliciting community involvement after the initial screening process should reflect the potential significance of the effects. As noted above, however, there should be some effort to communicate with stakeholders in all cases, including EAs, where the screening analysis identifies potential disproportionately high and adverse effects. Although the health or environmental impacts analyzed in EAs may not be "significant," from the NEPA standpoint, they may be perceived as significant by affected parties. Although this concern would not trigger an EIS, it should trigger more EIS-like scoping and public participation prior to and following EA preparation. To the extent practicable and consistent with regulations, an EIS-like public participation process should be undertaken for EAs when social or economic impacts will be or are perceived to be substantial, even when the impacts are not expected to be significant.

5.0 METHODS AND TOOLS FOR IDENTIFYING AND ASSESSING

DISPROPORTIONATELY HIGH AND ADVERSE EFFECTS

A fundamental step for incorporating environmental justice concerns into EPA NEPA compliance activities is identifying minority and/or low-income communities that may bear disproportionately high and adverse effects as a result of a proposed action. Once these minority and/or low-income communities are identified and located, the potential for disproportionately high and adverse effects to these communities must be assessed. It is important to understand where such communities are located and how the lives and livelihoods of members of these communities may be impacted by proposed and alternative actions. Minority communities and low-income communities are likely to be dependent upon their surrounding environment (*e.g.,* subsistence living), more susceptible to pollution and environmental degradation (*e.g.,* reduced access to health care), and are often less mobile or transient than other populations (*e.g.,* unable to relocate to avoid potential impacts). Each of these factors can contribute to minority and/or low-income communities bearing disproportionately high and adverse effects. Therefore, developing an understanding of where these communities are located and how they may be particularly impacted by government actions should be a fundamental aspect of the EA and EIS development process.

Currently, EAs and EISs generally evaluate and compare potential environmental, ecological, economic and/or human health risk impacts among and between broadly defined affected areas and populations. Potential impacts to smaller populations, individual communities, neighborhoods, census tracts, or environments (*e.g.,* single lake or watershed within a larger affected area) are not generally isolated, or disassociated from total impacts.

Minority and/or low-income communities are often concentrated in small geographical areas within the larger geographically and/or economically defined population center targeted for study. Minority communities and low-income communities may comprise a very small percentage of the total population and/or geographical area. Therefore, the assumptions and inputs used in conjunction with traditional analytical tools for studying potential impacts under NEPA, and the results of the analyses, may not fully reflect the impacts that may be borne by these smaller communities or populations. An analysis of disproportionate impacts will develop an understanding of how the total potential impacts vary across individual communities. This allows analysts to identify and understand what portion of the total impacts may be borne by minority or low-income communities, to assess whether they are disproportionately high and adverse, and to develop alternatives and mitigation measures if necessary.

As described in Chapter 3, the first step in identifying the potential for environmental justice concerns is to characterize the population affected by the proposed action in terms of racial and ethnic composition and in terms of relative income distribution. The composition of the population should then be compared to the characteristics of the population (*e.g.*, percentage of minority populations residing near a proposed project versus the percentage of minority populations located within a single or multiple-county area surrounding the proposed project). Populations surrounding the proposed project should be characterized in terms of income distribution levels, as well as in terms of racial and ethnic diversity.

Many of the potential effects that may be borne by minority and/or low-income communities may be analyzed or assessed using the same analytical tools that are currently used in the development of EAs and EISs. However, once a potential environmental justice issue is identified, these tools may need to be modified or more likely, the scope of the analyses may need to be narrowed to focus on a smaller affected area or population.

Several types of analytical tools are currently available and are being refined and/or modified to assist analysts and decision makers in identifying potential environmental justice concerns and assessing potentially disproportionately high and adverse effects on minority and low-income communities. The following sections provide an overview of some of the available tools and the types of analyses that may be useful for identifying and assessing disproportionately high and adverse effects (by evaluating both total effects and effects on a smaller scale). It is not an exhaustive listing of available tools, since many tools for identifying and assessing environmental justice concerns are still being developed, and it is not meant to promote or endorse one type of tool or analysis over any other. The application of any tool is dependent upon the type of study, the particular attributes of the area under study, and the data available to undertake the study.

5.1 Locational/Distributional Tools

Maps, aerial photographs, and geographical information systems (GIS) can be used to locate geographical areas where potential environmental justice issues may exist. Local maps and aerial photographs may provide a "snap shot," or general overview, of the locations of minority or low-income populations or communities and the proximity of the proposed project to these populations or communities. They also can identify key natural resources that may be affected. Although such tools are relatively simplistic, they may be useful for identifying distinct communities within a geographical area surrounding a candidate site, and for identifying clusters of facilities or sites that may contribute to cumulative impacts to a given region or community. By consulting maps or photographs that depict the locations of minority or low-income communities, as well as maps of the same geographical area that depict the locations of hazardous waste facilities, Superfund sites, Toxics Release Inventory facility sites, and/or wastewater discharges, analysts and EPA decision makers can gain a general understanding of the spatial relationships between the proposed project and the surrounding communities. These tools can assist the EPA NEPA analyst in identifying existing sources of environmental pollution and their proximity to minority and/or low-income communities.

By consulting maps or photographs that depict the locations of minority or low-income communities, as well as maps of the same geographical area that depict the locations of hazardous waste facilities, Superfund sites, Toxics Release Inventory facility sites, and/or wastewater discharges, analysts and EPA decision makers can gain a general understanding of the spatial relationships between the proposed project and the surrounding communities. Aerial photographs can be used to effectively depict the boundaries of an identified community and the spatial relationship that exists between the community and natural resources and known pollutant sources.

Geographic information systems provide a much more powerful tool for identifying and locating populations of concern. GIS technologies are useful for characterizing environmental justice issues by identifying the locations of minority communities that potentially may be affected by proposed actions and providing a visual understanding of how potential impacts may be distributed within a geographical area. GIS provides the technology for displaying and overlaying locational information and population and site characterization information on one or more maps. GIS allows for the visual display of vast amounts of spatially oriented information. In addition, GIS systems can be used to display alternative "what if" scenarios and provide for relatively quick and easy general comparisons of the potential impacts presented by alternative locations.

Several EPA Headquarters and Regional offices are using and/or investigating the use of GIS technologies for identifying and analyzing environmental justice issues. GIS systems such as ARCINFO and Landview II are geographic references or computerized atlases. These systems can create maps using digitized geographical boundary files such as the U.S. Census Bureau TIGER/Line '92 files, and other commercially available digitized boundary files (*e.g.*, zip code boundaries, county boundaries, water body boundaries) to display locational information and geographical areas. GIS systems also can incorporate, and graphically display on computer-generated maps, other population and demographic information that is available in digitized format. Landview II includes 1990 demographic and economic data from the Bureau of Census, including population and housing characteristics and summary information on income, education levels, employment, race, and age. The census data are available in two databases, STF1A and STF3A, which contain digitized data files. The census databases are then spatially linked to the TIGER files that contain geographic and political boundaries. Each county in the census database is divided into several census tracts that are subdivided into census blocks. The blocks are aggregated into block groups containing between 250 to 550 housing units. This level of data aggregation allows the user to identify locations of relatively small, homogeneous communities and to visualize, on the computer screen, the relative proximity of these communities to the proposed project and mitigation activities.

GIS allows users to easily display, on a single map, general locational and demographic information (*e.g.,* zip code boundaries, proposed facility site locations, pollutant concentrations, income level, ethnic background, population density). GIS also will allow a user to display data in terms of policy or decision criteria. For example, income distribution data for individual census tracts may be segregated by percent of population below the poverty level (*e.g.,* census blocks shaded differently to correspond to areas where 0 - 25 percent of the population is below the poverty level, 25 - 50 percent is below the poverty level, etc.). GIS also can integrate additional census information on education, employment, race, and age to produce graphic depictions of all of this information on a single map to obtain a comprehensive profile of the communities surrounding the proposed project. More than one project can be displayed on a single map to allow for a comparison of population characteristics surrounding the proposed project. Again, the maps generated by the GIS are useful tools for identifying minority and/or low-income communities that should be targeted for further study due to potential environmental justice concerns.

Although the availability of census demographic information in digitized format can significantly enhance NEPA analytical capabilities, and can be particularly useful for environmental justice analyses, the EPA NEPA analyst should keep in mind that there are limitations associated with the accuracy of census information due to the manner in which the data are collected and tabulated. Census data are useful for screening analyses, but results should always be validated through public participation mechanisms, other data sources, or by touring the community and talking with local officials and community leaders.

Many other types of information pertinent to NEPA project evaluations also are available for use in GIS systems. For example, EPA has made available portions of the Toxics Release Inventory (TRI) database (including facility locations), the Biennial Reporting System (BRS) database, the Aerometric Information Retrieval System (AIRS), the

CERCLA Information System (CERCLIS), and the Permit Compliance System (PCS), in digitized data files for use in GIS applications. DOT's chemicals in transit information is also available for GIS applications.

To enhance the applicability of GIS technologies to NEPA assessments, including the assessment of potential cumulative impacts from existing and proposed projects, the geographical and demographic information provided in Census databases can be integrated with other available EPA information (*e.g.,* facilities located within particular zip codes or counties that reported releases or emissions of a particular chemical in TRI reports, locations of NPL sites, etc.) and integrated with other NEPA factors using digitized data sets on soils, power lines, roads, streams, sources of electricity, locations of threatened and endangered species, and existing archaeological sites. These additional data sets are readily available from the U.S. Forest Service, the U.S. Geological Survey, the Department of Commerce, and state and local government agencies. Additional maps depicting community-specific issues (*e.g.,* locations of subsistence farmers and locations of water bodies supporting subsistence fishing activities) also can be compiled, digitized and incorporated into a GIS system to further depict and analyze more specific environmental justice issues and concerns.

Other GIS, or computer mapping, systems that may enhance NEPA analyses of environmental justice concerns include CAMEO (Computer-Aided Management of Emergency Operations), ALOHA (Aerial Locations of Hazardous Atmospheres) and AILESP (American Indian Lands Environmental Support Project). CAMEO includes chemical-specific information, facility-specific information from EPA's Chemical Inventory database and TRI database, and transportation information. CAMEO integrates MARPLOT, a mapping application tool that generates maps from U.S. Bureau of Census TIGER files. ALOHA is a modeling tool for estimating the movement and dispersion of gases and estimating pollutant concentrations downwind from the source of a potential spill or emission. ALOHA files can be saved and used in a format compatible with CAMEO. AILESP includes permitted facilities on or near Indian lands from various EPA databases (e.g., AIRS, BRS, NCDB, PCS, RCRIS, TRI, CERCLIS), pounds of chemicals released, 1994 spill and one time release data, pesticide use by county, toxic weighting factors for TRI chemicals, two year inspection and compliance information, 1990 population and census statistics, and stream reaches with fish advisories, contaminated sediments and contaminated fish tissue.

5.2 Ecological and Human Health Risk Assessments

Executive Order 12898 provides for agencies to determine if a proposed action will result in disproportionately high and adverse effects to minority or low-income populations. Due to the fact that the characteristics of these populations may differ significantly from the characteristics of the larger affected population, analyses should address both the minority or low-income population and the comparison populations. See Chapter 2 for a discussion of the environmental and socioeconomic factors that should be considered in identifying and assessing disproportionately high and adverse effects.

EPA has a formal risk analysis process which consists of two related, but separate, processes: risk assessment and risk management. Risk assessment characterizes the likelihood for a chemical or substance to cause adverse health effects to humans and can provide a means for assessing the possible impacts on a population, if exposure occurs. Risk assessment provides an estimate of the probability that human exposure to a chemical agent will result in an adverse health effect to the exposed individual, or an estimate of the incidence of the effect upon an exposed population. Risk management is the process whereby it is decided what actions are appropriate, given an estimate of potential risks and due consideration to other relevant factors. Information developed in the risk assessment process is used to guide decision makers in determining the appropriate action to take within the risk management process. When making risk management decisions in the context of environmental justice concerns, a number of factors should be considered along with human health risk calculations or evaluations. These include social concerns, economic concerns, and acceptance of the proposed action by the affected communities. Within the context of risk management, there is an opportunity to consider relevant environmental justice issues. In the risk management process, decisions are made regarding acceptable levels of exposure and risk.

Risk assessment, as conducted by EPA, conforms to the Agency's published guidelines that include four distinct parts: Hazard Identification, Dose-Response Analysis, Exposure Assessment, and Risk Characterization. These four parts provide the analytical tools for identifying disproportionately high and adverse effects. During the risk management process, criteria must be developed to guide the weighing of information. These criteria provide the basis for risk-based decisions with regard to disproportionately high and adverse effects. For example, risk assessments usually do not account for exposure traits of racial and ethnic groups or accurately account for actual environmental harm to human health where the population density is low (*e.g.*, rural communities, Indian Country). Human activity patterns governed by customs, social class, and ethnic and racial cultures may be introduced and considered during the risk management process to allow for the identification of disproportionately high and adverse effects.

To ensure that environmental justice concerns are considered within the risk management process, risk assessments should be conducted to determine exposure pathways and potential effects and the affected community should be involved in the development and implementation of the process. This can then be overlaid with information obtained from locational analyses using GIS and census data during the risk management process to identify minority or low-income populations that are located within the identified exposure pathways. Racial, ethnic, and cultural information can then be used to further refine the risk management process to account for disproportionately high and adverse effects.

To enhance the analysis of disproportionately high and adverse effects within EPA's health assessment studies, several efforts are underway to make relevant health and exposure information available to these studies. EPA's Office of Research and Development is currently developing the National Human Exposure Assessment Survey (NHEXAS). This survey is designed to generate a human exposure database to address some of the geographic and demographic questions relevant to environmental justice issues. NHEXAS will address exposure concerns by providing information on the magnitude, extent, and causes of human exposure.

EPA's Office of Policy, Planning, and Evaluation is currently developing an environmental justice database that will integrate health effects data from the National Health and Nutrition Examination Survey III (NHANES-III), demographic data from the 1990 Census, environmental data from air monitoring stations, and the Toxic Release Inventory database. This database integration will assist EPA staff in developing disease correlations with air exposure data in high impact populations.

Ecological assessments conducted as components of EAs and EISs generally involve identifying the natural resources (*e.g.,* air, water, soils) that will be used by proposed project or activity and the potentially affected environments (*e.g.,* watersheds, wetlands, wildlife habitats) that may be impacted by the proposed project (including alternatives). After a general cataloging and description of the surrounding environmental and ecological resources is compiled, the potential changes and impacts of the proposed action and alternative actions are assessed. Often, these analyses do not fully substantiate the beneficial or adverse effects on the surrounding geographical area or communities within the area. Instead, impacts may be described generally, with an assumption that they are distributed equally across all communities or residents within the affected region or area. As a consequence, the analysis may overlook or ignore environmental justice concerns. If adverse impacts are not quantified, then special consideration should be given to whether potential impacts could be borne by minority communities or low-income communities residing within the larger area and, if necessary, separate analyses should be designed and conducted to assess this. As discussed above, GIS systems can sometimes be used to identify such populations and to characterize the environments where the populations reside. In addition, county and state planning agencies and housing authorities may be useful sources of information for characterizing the unique aspects and vulnerabilities of these populations.

If environmental, ecological, or human health impacts to the affected geographical area are quantified, the distribution of such impacts should be assessed. The study should attempt to estimate the proportion of impacts borne by low-income and/or minority populations within the area of a project's impact compared to the general population in and around the project, or the project's region of influence. While traditional risk modeling may not always be used in the NEPA process, impact assessments and risk management tools should be tailored to reflect the characteristics of these communities and study assumptions should reflect the characteristics of the individuals residing in low-income communities and minority-populated communities (*i.e.,* model assumptions should reflect the general health of these individuals and their general living conditions and unique locations relative to pollutant sources). When tailoring risk management tools to consider the distribution of impacts to low-income and/or minority communities, differential patterns of subsistence consumption of natural resources should be considered, including differences in rates of consumption for fish, vegetation, water, and wildlife among ethnic groups and among cultures. Further, it should be recognized that land and water resources not predominantly used by the general population may be important sources of consumption , economy, cultural use, and/or recreation for minority and/or low-income communities. Degradation of these resources may result in direct and disproportionately high and adverse effects to minority and/or low-income communities.

5.3 Socioeconomic Analyses

The analysis and understanding of potential socioeconomic impacts is also important. CEQ regulations note that economic or social effects alone do <u>not</u> trigger an EIS (40 CFR §1508.14). However, if environmental justice concerns are identified during the screening analysis or during the development of an EA, the potential interrelated socioeconomic impacts to both the total affected population (or a "control" population) and to the low-income and/or minority communities of concern should be evaluated, to the extent practicable. Cultural or Social Impact Assessments are additional tools that can be used for analyzing specific socioeconomic impacts to a community that shares a common cultural or spiritual environment.

In the development of EAs and EISs, deterministic models are generally used to predict potential impacts that a particular action may have upon particular economic indicators (*e.g.,* the level of employment and changes to income distribution or property values) for the community surrounding the proposed project. Standard models provide for analyses of the potential effects that an action may have upon the local economy in both the short term, due to transient or temporary activities (*e.g.,* construction, facility planning and startup activities), and the long term, due to sustained impacts to the area (*e.g.,* permanent employment opportunities, reduction in housing quality, degradation of existing environment). Generally, NEPA modeling activities measure potential shifts in indicators such as income distribution and employment levels across general income distribution categories (*e.g.,* percentage change in annual income to portion of affected population earning less than $15,000, between $15,000 to $20,000, etc.). Standard socioeconomic models also can be used to predict impacts that proposed actions and alternatives may have upon available housing stock, housing quality, and property values.

Generally, standard socioeconomic models are employed to predict shifts and changes in particular socioeconomic indicators such as employment, income levels, and housing quality upon a large geographical area or population center, often a standard, pre-defined economic trade area. The data and information provided as inputs to the model and assumptions made in employing the model (including economic conditions and multipliers) broadly characterize the entire population of the large geographical area or population center surrounding the proposed project. The results of these modeling efforts may include potential impacts to various categories within the overall population characterized by income level or by housing category. However, these models generally do not allow (or at least have not been used so as to allow) for a distributional analysis of potential impacts to specific communities, individual populations, or to small geographical areas.

To predict or characterize more accurately the potential disproportionately high and adverse effects to minority or low-income communities and account for potential environmental justice concerns, standard socioeconomic models currently used for EAs and EISs may have to be modified or specifically tailored to account for an array of new variables, such as subsistence living, treaty-protected resources, cultural use of natural resources, sacred sites, dependence on public transit, community cohesion, and a relatively unskilled labor base. Environmental justice issues and concerns may be integrated into some traditional socioeconomic analyses by first employing scoping activities and screening tools to identify potential minority and/or low-income communities prior to the employment of specific modeling techniques. It then may be possible to tailor modeling assumptions and input data on specific populations or targeted communities, rather than apply standard modeling techniques to large economic trade areas or standard metropolitan areas and using average input parameters that may not reflect adequately the characteristics of minority or low-income communities (*i.e.,* alter model assumptions to characterize the population affected by the environmental justice concern, rather then characterize the average individual in the entire study area). As noted above, Census databases contain demographic information (*e.g.,* income levels, race, age, employment levels) at the census tract and census block levels. Other potential sources of information include tribal, state and local planning agencies, and state housing, commerce, and welfare agencies. EPA analysts should keep in mind that some information on the characteristics of local communities and environments may be available only from community leaders, local government offices, and/or members of the community. Some information may be available from transcripts of public concerns raised at hearings for other government projects within the same region. In some cases, analysts may need to conduct interviews of local community leaders and members of the targeted population.

One option for modifying or tailoring socioeconomic analyses to identify and evaluate environmental justice concerns is to develop index or ranking systems for identifying and scoring potential disproportionately high and adverse effects to minority and/or low-income communities. Such an index or ranking system could be applied to specifically defined or targeted areas and used as a screening tool to identify environmental justice concerns in communities surrounding one or more candidate locations. Candidate locations that result in high index scores or rankings can either be dropped from consideration, targeted for additional and more thorough socioeconomic and risk analyses to investigate further potential disproportionately high and adverse effects, or development of additional alternative actions or projects designed to mitigate identified impacts.

An environmental justice screening index may be as simple as defining several levels or categories of potential impacts (*e.g.*, changes in employment levels, changes in income levels, and changes in overall health levels) or defining and scoring several socioeconomic indicators (*e.g.*, dependence on subsistence farming or fishing, percent of population below poverty level, average property value) and weighing each category of impact as to its importance to contributing to environmental justice issues. Decision criteria (*e.g.*, undertake further detailed social impact analyses, drop candidate location from consideration) could then be set for different ranges of index scores or rankings. The index also may combine preliminary information on potential economic impacts with information on other potential impacts (*e.g.*, environmental degradation, air emissions) to assign decision criteria for additional targeted analyses or studies.

EPA Region 6[(11)] developed a relatively sophisticated ranking scheme to determine whether an environmental justice indicator exists. The formula provides a means for determining whether an environmental justice situation exists and includes factors such as population exposed, degree of impact and degree of vulnerability.

Region 6 evaluates sites using an environmental justice formula and ranks facilities or actions on a scale of 0 to 100. Regional officials point out that although higher scores can indicate greater potential environmental justice concerns, the population density, percent minority population, and percent of economically depressed household data are the more important analytical factors. When evaluated independently, they often provide greater insight into potential environmental justice concerns and can be used alone to rank sites. Also, the user should realize that even a location with an index ranking of zero can have significant environmental justice concerns. For example, an unpopulated area will rank a zero, but if owned and/or used by minority and/or low-income groups, the site may have significant environmental justice importance. Recent examples of EPA's use of the EJ index include the draft EIS for Eagle Pass Mine, in Maverick County, Texas, and the Supplemental Draft EIS for Expansion of the Oak Hill Surface Lignite Mine into the DIII Area, Rusk County, Texas. Utilizing the EJ index on a scale of 1 to 100 wherein higher values indicate more concern, neither EIS warranted a closer examination into EJ issues.

APPENDIX A

Council on Environmental Quality Guidance for Addressing Environmental Justice Under the National Environmental Policy Act

(not included on this Internet version of EPA's guidance)

APPENDIX B

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APPENDIX C

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1. [0] Throughout this guidance, the term "disproportionately high and adverse effects"is used interchangeably with the longer phrase "disproportionately high and adverse human health or environmental effects on minority populations and low-income populations." This is done purely for editorial ease.

2. The term 'treaty-protected resources,' as it is used in the guidance, includes those resources that are protected by treaty, statute and/or executive order.

3. On May 24, 1996, the President issued Executive Order 13007 on Indian Sacred Sites to 1) accommodate access to and ceremonial use of Indian sacred sites, and; 2) avoid adversely affecting the physical integrity of such sacred sites.

4. For consistency throughout the document, the guidance will use the term "Indian Tribe" when referring to federally recognized tribes and "indigenous population" or "community" when generally referring to Native American, American Indian, Alaska Native, and/or Native Hawaiian peoples. Under environmental justice, the Agency's policy is to interact with both the tribal government on a government-to-government basis, as well as with any affected or interested indigenous person(s) as public stakeholders.

5. A distinction must be made between Native American communities that live within their own governmental jurisdictions and those that do not. The CEQ regulations recognize the government-to-government relationship between the federal government and tribal governments, and encourage federal agencies to involve tribal governments in the NEPA process when a proposed project may affect a tribe or tribal lands. See sections 1501.2 [Apply NEPA Early In The Process]; 1501.7(a)(1) [Scoping]; 1502.16 [Environmental Consequences]; 1503.1(a)(2)(ii) [Inviting Comments]; 1506.6(b)(3)(ii) [Public Involvement]; and 1508.5 [Cooperating Agency]. Native American programs include those Federal programs which are to be guided, as appropriate, by the government-to-government relationship, the Federal trust responsibility to federally recognized Indian Tribes, and the role of tribes as governments within the Federal system.

NEPA Compliance Coordinators should consult with the regional Indian Program Coordinator and should request that the Indian Tribes seek participation as a cooperating agency when a tribal government, land, resources, or interest may be affected by a project. While such cases may or may not trigger an environmental justice review, EPA must act consistent with the federal government's trust responsibility to federally recognized Indian Tribes. Each case should be decided individually; if questions arise please consult with the American Indian Environmental Office and the Office of Federal Activities.

6. [0] The IWG key terms guidance describes differential patterns of consumption of natural resources as relating to "subsistence and differential patterns of subsistence, and means differences in rates and /or patterns of fish, water, vegetation and/or wildlife consumption among minority populations or low-income populations, as compared to the general population."

7. [0] It should be noted that the factors the IWG is providing for assessing environmental hazard were not necessarily developed in the context of NEPA analyses. These factors are, however, similar to the factors used in determining "significant" physical or natural environmental effects under NEPA.

8. Guidance on the terms "minority population" and "low-income population" is contained in Appendix A.

9. See CEQ "*Environmental Justice Guidance Under the National Environmental Policy Act*" page 10, Helpful Information to Inform the Public During the Scoping Process.

10. Environmental Justice Resource Center. *People of Color Environmental Groups: 1994 - 95 Directory.* Prepared by Dr. Robert D. Bullard, Clark Atlanta University, Atlanta, Georgia. 1994.

11. [0] U.S. EPA Region 6, Office of Planning and Analysis. "Computer Assisted Environmental Justice Index Methodology." July, 1994.

State of New Jersey

Department of Environmental Protection

Christine Todd Whitman
Governor

Robert C. Shinn, Jr.
Commissioner

MEMORANDUM OF AGREEMENT

This Agreement, signed by those individuals indicated below, is for the following purposes:

- Rita Thornton, Supervising Environmental Specialist, Division of Solid and Hazardous Waste will be transferred to the Office of Legal Affairs, effective October 19, 1998 Ms. Thornton will report to Richard McManus.
- It is understood that Ms. Thornton will maintain her title and her ~~funding source~~. On October 1, 1998 a federal grant "State and Tribal Environmental Justice Grant" will be awarded to the Department. Ms. Thornton was instrumental in obtaining that grant and has been assigned as Project Manager in working toward the Grant goals.
- It is also understood that a portion of the Grant will be used to reimburse Ms. Thornton's salary. That portion will be decided based upon the time sheet coding used to earn the Grant. The reimbursement will be made from the Grant to account number 4910-100-230000-12.

We agree to the above:

Michael J. Hogan,
Counselor to the Commissioner

Gary Sondermeyer
Gary Sondermeyer,
Assistant Commissioner
Environmental Regulation Program

John Castner, Director
Division of Solid and Hazardous Waste

Rita Thornton
Rita Thornton
Supervising Environmental Specialist

NJ DEPT. OF ENVIRONMENTAL PROTECTION NEWS RELEASE

RELEASE: 11/5/98
98/141

CONTACT: Amy Collings, NJDEP, 609-984-1795
Nina Habib Spencer, USEPA, 212-637-3670

NEW JERSEY SELECTED BY EPA TO DEVELOP MODEL PROGRAM FOR ENVIRONMENTAL JUSTICE

The New Jersey Department of Environmental Protection (DEP) today was awarded a $100,000 grant from the U.S. Environmental Protection Agency (EPA) to implement a model program promoting "environmental equity" in minority and urban areas.

New Jersey is one of five states to receive a grant for this purpose. EPA selected New Jersey because it has worked closely in partnership with EPA and local groups throughout the state and is prepared to implement a proactive environmental equity program.

"EPA's grant will extend President Clinton's initiative to empower neighborhoods that have borne the brunt of environmental pollution to New Jersey," said EPA Region 2 Administrator Jeanne Fox. "We are looking forward to working with DEP to bring tangible environmental improvements to cities and counties throughout the state."

EPA Region 2 will oversee the grant, which will be used to carry out an environmental equity pilot project over the next 12 months.

"New Jersey is proud to be a national leader in improving the quality of life for the residents of our low-income and urban communities by proactively addressing their environmental and health concerns," said New Jersey Governor Christie Whitman. "Creating a healthy environment is an important part of our plan to make our cities great places to live, work and raise a family."

"This grant will enable us to introduce an Environmental Equity Program in poor and urban areas where air pollution, water pollution or soil contamination may be disproportionately high," said DEP Commissioner Bob Shinn. "Our intent is to be proactive, to build partnerships, examine concerns and address problems before they escalate to crisis proportions."

DEP plans to integrate environmental equity strategies into its Performance Partnership Agreement with EPA to make this program an effective tool for needed environmental improvements.

EPA Administrator Carol Browner made environmental justice a priority for the agency when she formed the Office of Environmental Justice in 1993 to integrate this concept into the agency's policies and activities. In 1994, President Clinton signed an Executive Order, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," which mandated that all federal agencies develop strategies to focus on the environmental and human health conditions of low-income and minority communities. EPA's strategy includes its environmental justice grants program, which supports greater community involvement in the environmental decision-making process.

Commissioner Shinn last month signed an administrative order establishing a permanent advisory council on environmental equity. The group will advise DEP as it implements its model program, based on recommendations from a 45-member task force. The task force will include representatives from business, environmental, minority and grassroots organizations and local government officials.

Commissioner Shinn has designated Rita Thornton as project manager/grant administrator. DEP initiated outreach activities, contacting local organizations and city officials statewide, in February. The 45-member task force held its first meeting in May.

DEP's leadership in environmental equity was recognized this year at a meeting of the Environmental Council of States, a national organization of top-level state environmental officials. DEP Commissioner Shinn serves on an EPA advisory committee charged with developing a national environmental justice policy. At a recent meeting the advisory committee endorsed New Jersey's pilot program on environmental equity as a model for other states.

The award ceremony was held in downtown Perth Amboy, home to two community representatives on the state's task force. Regional Administrator Fox, Commissioner Shinn, Perth Amboy Mayor Joseph Vas and community representatives attended the event and planted a tree to commemorate the occasion.

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APPENDIX C

GOVERNOR JAMES MCGREEVEY EXECUTIVE ORDER ON ENVIRONMENTAL JUSTICE

Former Governor James McGreevey signed into law an Executive Order on Environmental Justice. This Order encourages cities, municipalities or communities to designate themselves as an environmental justice community. This self-designation would initiate stricter enforcement of the permitting laws and regulations as they apply to an environmental justice community. While state agencies are directed to develop strategies for the implementation of the Order, any economic investment by industry is virtually discouraged in a self-designated environmental justice community.

Environmental Justice Policy

EXECUTIVE ORDER
signed by Governor James E. McGreevey, February 19, 2004

WHEREAS, the State of New Jersey is committed to ensuring that all of its citizens receive equal protection under the law; enjoy a healthy environment; and given opportunities for consistent input into governmental decision-making; and

WHEREAS, New Jersey's communities of color and low-income communities have historically been located in areas of the State having a higher density of known contaminated sites as compared to other communities, with the accompanying potential for increased environmental and public health impacts; and

WHEREAS, studies by the Centers for Disease Control and Prevention (CDC) and other federal agencies have documented that the prevalence of childhood asthma is increasing, and that this increase is linked in part to poor air quality, and that prevalence is far higher for Black and Latino/Hispanic communities; and

WHEREAS, the Federal government has underscored the importance of Environmental Justice in Executive Order 12898 and created the National Environmental Justice Advisory Council to integrate environmental justice into the Environmental Protection Agency's policies, programs, initiatives and activities; and

WHEREAS, the State of New Jersey is committed to ensuring that communities of color and low-income communities are afforded fair treatment and meaningful involvement in decision-making regardless of race, color, ethnicity, religion, income or education level; and

WHEREAS, the State of New Jersey is further committed to promoting the protection of human health and the environment, empowerment via public involvement, and the dissemination of relevant information to inform and educate, especially in people of color and low-incomecommunities; and

WHEREAS, the State of New Jersey is committed to enabling our older urban and suburban centers to be made more attractive and vital, creating a broader range of choices and more livable communities for families and businesses in New Jersey, consistent with the State Development and Redevelopment Plan and principles of Smart Growth; and

WHEREAS, the cumulative impact of multiple sources of exposure to environmental hazards in low-income and people of color communities, and the roles of multiple agencies in addressing the causes and factors that compromise environmental health and quality of life in these communities require an interagency response; and

WHEREAS, the Department of Community Affairs (DCA), the Department of Environmental Protection (DEP), the Department of Health and Senior Services (DHSS), and the Department of Law and Public Safety (DL&PS) have entered into collaborative interagency work to address environmental health and quality of life issues in communities of color and low income, such as in the City of Camden and other urban, suburban, and rural communities;

NOW, THEREFORE, I, JAMES E. McGREEVEY, Governor of the State of New Jersey, by the virtue of the authority vested in me by the Constitution and by the Statutes of this State, do hereby ORDER and DIRECT:

1. All Executive Branch departments, agencies, boards, commissions and other bodies involved in decisions that may affect environmental quality and public health shall provide meaningful opportunities for involvement to all people regardless of race, color, ethnicity, religion, income, or education level. Programs and policies to protect and promote protection of human health and the environment shall be reviewed periodically to ensure that program implementation and dissemination of information meet the needs of low-income and communities of color, and seek to address disproportionate exposure to environmental hazards.

2. DEP and DHSS shall recognize the need to communicate significant public health and environmental information in languages other than English, by establishing Spanish-language websites.

3. The DEP will use available environmental and public health data to identify existing and proposed industrial and commercial facilities and areas in communities of color and low-income communities for which compliance, enforcement, remediation, siting and permitting strategies will be targeted to address impacts from these facilities.

4. Recognizing that there is greater reliance on subsistence fishing among communities of color and low-income communities, DEP, DHSS, and the Department of Agriculture, shall work together to develop and issue appropriately protective fish consumption advisories and provide effective risk communications, education programs and public information services with an objective of consistency with neighboring states, to the greatest extent possible.

5. Recognizing the significant health implications of fine particulate pollution, such as premature death and asthma, especially for urban communities, DEP and theDepartment of Transportation (DOT) shall develop a coordinated strategy for reducing the public's exposure to fine particulate pollution in affected communities, particularly from diesel emissions from stationary and mobile sources.

6. The Commissioner of DEP and Commissioner of DHSS, or their appointed designees, shall convene a multi-agency task force, to be named the Environmental Justice Task Force, which will include senior management designees, from the Office of Counsel to the Governor, the Attorney General's office, the Departments of Environmental Protection, Human Services, Community Affairs, Health and Senior Services, Agriculture, Transportation, and Education. The Task Force shall be an advisory body, the purpose of which is to make recommendations to State Agency heads regarding actions to be taken to address environmental justice issues consistent with agencies' existing statutory and regulatory authority. The Task Force is authorized to consult with, and expand its membership to, other State agencies as needed to address concerns raised in affected communities.

7. The Commissioner of DEP shall reconstitute the existing Environmental Justice Advisory Council to the DEP, whose mission shall be to make recommendations to the Commissioner and the Environmental Justice Task Force in fulfillment of this Executive Order. The Advisory Council shall consist of fifteen (15) individuals and shall meet quarterly. The Council shall annually

select a Chairperson from its membership and shall have a minimum composition of one third membership from grassroots or faith-based community organizations with additional membership to include membership from the following communities: academic public health, statewide environmental, civil rights and public health organizations; large and small business and industry; municipal and county officials, and organized labor.

8. Any community may file a petition with the Task Force that asserts that residents and workers in the community are subject to disproportionate adverse exposure to environmental health risks, or disproportionate adverse effects resulting fromthe implementation of laws affecting public health or the environment.

   a. Petitions shall be signed by fifty (50) or more residents or workers, provided that at least twenty-five (25) are residents, in the affected community;

   b. The Task Force shall identify a set of communities from the petitions filed, based on a selection criteria developed by the Task Force, including consideration of state agency resource constraints;

   c. The Task Force shall meet directly with the selected communities to understand their concerns. If desired by any of the selected communities, the DEP and DHSS Commissioners shall establish a public meeting in which the Environmental Justice Task Force shall hear from the petitioners and evaluate the petitioners' claims. Where the petitioners assert claims that lie predominantly within the jurisdiction of an agency other than the Task Force Chair, the chair shall include a senior management representative from the relevant agency as a member of the Task Force;

   d. The Task Force shall develop an Action Plan for each of the selected communities after consultation with the citizens, as well as local and county government as relevant, that will address environmental, social and economic factors that affect their health or environment. The Action Plan shall clearly delineate the steps that will be taken in each of the selected communities to reduce existing environmental burdens and avoid or reduce the imposition of additional environmental burdens through allocation of resources, exercise of regulatory discretion, and development of new standards and protections. The Action Plan, which shall be developed in consultation with the Environmental Justice Advisory Council, will specify community deliverables, a timeframe for implementation, and the justification and availability of financial and other resources to implement the Plan within the statutory and regulatory jurisdiction of the Departments of the State of New Jersey. The Task Force shall present the Action Plan to the relevant Departments, recommending its implementation;

   e. The Task Force shall monitor the implementation of each Action Plan in the selected communities, and shall make recommendations to the Departments as necessary to facilitate implementation of the Action Plans. Departments shall implement the strategy to the fullest extent practicable in light of statutory and resource constraints;

   f. As an integral part of each Action plan, DEP and DHSS shall jointly develop a strategy to identify and reduce the most significant environmental and public health risks facing each of the selected communities through chronic health disease surveillance, health monitoring, data gathering, community education and public participation;

g. The Task Force shall identify and make recommendations concerning legislative and regulatory changes appropriate to achieve the purposes of this Order as well as the purposes of any particular Action Plan; and

h. The Task Force shall prepare and publicly release a report concerning the status of the Action Plans within eighteen (18) months following the establishment of the Task Force.

9. All agencies will assist as appropriate in implementing this Order and achieving its purposes. The actions mandated as a result of this Executive Order shall be accomplished within the bounds of, and consistent with, the legislative purpose supporting the relevant agency's existing statutory and regulatory authority.

10. Nothing in this Executive Order is intended to create a private right of action to enforce any provision of this Order or any Action Plan developed pursuant to this Order; nor is this Order intended to diminish any existing legal rights or remedies.

11. This Executive Order shall be in effect for five years from its effective date.

12. This Executive Order shall take effect immediately.

APPENDIX D

U.S. CONGRESSMAN FRANK PALLONE, JR. LETTER OF INTENT

Congressman Pallone provides a written political response to the environmental justice issues in New Jersey's urban communities. He comments on the need to improve the environmental pollution and environmental health in our urban communities, especially with respect to our young urban children. His District Representative read the letter to the business representatives, DEP staff, grass-roots organization and community members who attended DEP's first Urban Environmental Health Fair, which was held on February 3, 2004.

Energy and Air Quality Subcommittee
Environment and Hazardous Materials Subcommittee
Health Subcommittee
Resources Committee:
Fisheries Conservation, Wildlife and Oceans Subcommittee
Ranking Member
Democratic Policy Committee:
Communications Chair
email:Frank.Pallone@mail.house.gov
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FRANK PALLONE, JR.
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CONGRESSMAN FRANK PALLONE, JR. "URBAN ENVIRONMENTAL HEALTH FAIR"

February 3, 2004

Thank you very much for inviting me to join you today. Although I am unfortunately unable to attend, I am honored to be able to express my support for improved urban environmental health and I am very pleased to see the NJ DEP and the community-at-large coming together to advocate for environmental justice. I would like to specially thank Rita Thornton who works tirelessly on behalf of the community and whose dedication is truly outstanding. Rita is a long-time friend, and her hard work is no surprise to me because even when we were high school classmates, I knew she would invariably make a huge impact on people. I wish Rita, and everyone participating today, much success with the Urban Environmental Health Fair and I look forward to working with all of you in the future on this very important issue.

When working on environmental issues, a great concern is the impact of the environment on health. Urban areas in particular are subject to disproportionate exposure to pollution, and as a result, men, women and especially children around the country and in New Jersey are experiencing diseases and illness that are completely preventable.

Children living in poverty, and children in racial and ethnic communities, are left extremely vulnerable in their developing years to environmental hazards. Exposure to lead, mercury, asbestos, pesticides and arsenic, to name but a few toxins, are known to seriously impact children's health. Unfortunately, children in urban communities suffer from physical problems such as asthma, cognitive development problems including inability to pay attention or learn in class, and in some cases premature death occurs due to SIDS or childhood cancers. Exposure to these toxics are extremely debilitating for the child and for families.

It is a tragedy that urban communities and communities of color are subject to environmental injustices that claim people's lives, and livelihoods, everyday. Although there has been increased awareness in Congress on environmental health, we still face great challenges to ensuring protection from environmental hazards and health prevention.

I would like you to know that I continue to fight for measures that will cleanup our environment by holding corporate polluters responsible, such as reinstatement of the Superfund tax, and by demanding funding for enforcement of key environmental laws. At a time when we see elevated levels of asthma and other environment related sicknesses growing in strength, it is imperative that we address urban pollution and take extraordinary steps to protect urban communities.

APPENDIX E

URBAN ENVIRONMENTAL HEALTH FAIRS AND SEMINARS

DEP's first Urban Environmental Health Fair Brochure, Urban Environmental Health Fair Flyers, Programs and Announcements providing information about the Environmental Health Fairs and Seminars.

New Jersey Department
of Environmental Protection
&
The Black Environmental Solidarity Team
(BEST)

present an

URBAN ENVIRONMENTAL HEALTH FAIR

introducing...

NEW JERSEY'S
Urban Environmental Health
PROTECTORS

"They CHECK THE ROUTE of exposure as they search to educate the New Jersey community about urban environmental health."

Dear Attendees:

Welcome to the Department of Environmental Protection's (DEP) first Urban Environmental Health Fair. In honor of Black History Month, this Fair is being presented by the Black Environmental Solidarity Team (BEST) members of the DEP.

As you may know, Governor James E. McGreevey and DEP Commissioner Bradley M. Campbell are committed to protecting our environment and strengthening environmental health awareness in New Jersey's urban communities.

Federal and state reports show African-American or Black children from low-income urban areas are among those most "at risk" for developing health problems associated with pollutants found in our air, natural resources, water and land.

The Urban Environmental Health PROTECTORS featured in this brochure were created to support the McGreevey Administration's environmental education effort.

On behalf of everyone at DEP, we hope you will learn from the PROTECTORS and take time to enjoy our Urban Environmental Health Fair because they were both designed with you in mind!

"They CHECK THE ROUTE of exposure as they search to educate the New Jersey community about urban environmental health."

The PROTECTORS were created by
Rita L. Thornton, J.D., Ph.D. (c)
doctoral candidate at NJIT

AiRon

AIRON, born and raised in Newark, is a young African-American man who has taken a pledge to educate New Jersey communities about health concerns associated with inner-city air pollution. He has a special interest in working to help classmates, parents and community leaders learn more about improving air quality in New Jersey's urban areas: **AIRON** has asthma.

According to the U.S. Centers for Disease Control and Prevention and the New Jersey Department of Health and Senior Services, African-American/Black populations are reported to have higher asthma rates and, as a result, dramatically higher hospitalization rates. Federal and state findings also show that urban Black children are among those who are most "at risk" for developing asthma and other respiratory-related illnesses. Recent community-based environmental science and policy research at the New Jersey Institute of Technology also confirmed particularly high rates of asthma among Black childrenof preschool age in low-income neighborhoods in Newark.

With help from friends at the New Jersey Department of Environmental Protection (DEP), **AIRON** learned that hazardous pollutants from cars, trucks and buses and industrial sources significantly diminish air quality in urban areas and elsewhere. Automobiles contribute most of New Jersey's air pollution. When inhaled, airborne particles or "particulate matter" found in dust, smoke, fumes or smog can irritate our lungs. Children like **AIRON** and other people with respiratory illnesses are more sensitive to these particles, which can make breathing difficult and even trigger asthma attacks. Sometimes after an asthma attack, **AIRON** wishes he could be like an eagle flying high across New Jersey's skies and breathing clean air. He has also learned that poor indoor air quality can cause health problems.

Governor McGreevey is taking action to help ensure **AIRON**, other asthmatic children, and all New Jerseyans can breathe cleaner air. The Governor recently signed "Clean Cars" legislation that establishes tougher emissions standards for all passenger cars, light-duty trucks and sport utility vehicles sold in New Jersey.

The Governor also set a goal to reduce soot and smog air pollution by 20 percent over the next decade, and asked the Legislature to pass new laws that will reduce the impact of diesel emissions on our air quality.

So, in **AIRON's** effort to become more environmentally aware and to educate others, he will always ***check the route*** of exposure to urban air pollution, which would help to protect our health.

NaRDi

NARDI is a young Native American girl, who is a descendant of New Jersey's Lenni Lenape tribe. She was born and raised in Pompton Lakes, a small city in Passaic County. Her ancestors were Algonquin-speaking people, and in their language, the words "Lenni Lenape" mean "original people." **NARDI** gets her name from **NA**tural **R**esource **D**amages or **I**njuries. As an urban PROTECTOR, her environmental pledge focuses on educating New Jerseyans about ways to avoid natural resource injuries that may pose health risks in urban areas.

For example, she would inform us about the dangers of eating fish and shellfish taken from waters contaminated with hazardous substances. Blue claw crabs from the Newark Bay region are known to contain cancer-causing chemicals such as polychlorinated biphenyls (PCBs) and dioxin. Also, mercury contamination in water and fish pose a serious public health risk, especially for children and pregnant women.

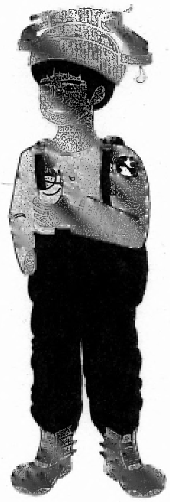
With the help of her DEP friends, **NARDI** learned that mercury contamination may cause permanent brain damage in the fetus, infants and young children. Also, mercury exposure has been shown to affect children's ability to pay attention, remember, talk, draw, run, see, and play. Even at low levels, mercury exposure can permanently damage the brain and nervous system and cause behavioral changes.

Mercury can contaminate waterbodies either directly through runoff or from air pollution that deposits in the water. It then accumulates in the tissues of animals and plants as methylmercury, the most toxic and harmful form of mercury.

Prepared with this environmental information, **NARDI** wants to make sure our fish and wildlife in New Jersey will not become contaminated with toxic pollutants. New Jersey Department of Environmental Protection Commissioner Bradley Campbell is helping **NARDI** protect our natural resources by proposing new rules that would reduce annual mercury emissions from power plants, iron and steel melters, and municipal solid waste incinerators by up to 1,500 pounds statewide.

NARDI will always ***check the route*** of exposure to contaminated natural resources to protect the health of residents in New Jersey's urban communities.

WATERmin



WATERMIN is a young Hispanic-American man, who was born and raised in Perth Amboy, a small waterfront town positioned at the mouth of the Raritan River. His ancestors came to America from San Juan, Puerto Rico. Perth Amboy is home to one of New Jersey's largest Hispanic populations. The word "Amboy" is said to be derived from the language of NARDI's Lenni Lenape Native American ancestors, and it means "elbow of land."

As a PROTECTOR, this young man takes to heart Governor McGreevey's statement: "Water is a shared blessing and a shared resource, but it is also a shared responsibility." So, **WATERMIN** has taken an environmental pledge to educate urban communities about sources of water pollution and associated health consequences.

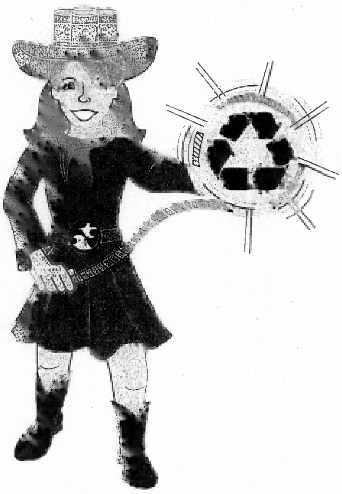
WATERMIN has learned that increasing amounts of paved surfaces from new roads, scattered sites of housing and other poorly designed development prevent rainfall from replenishing underground aquifers and create currents of stormwater runoff. When it rains or snows, contaminants from litter, motor oil, pesticides or dog waste left on sidewalks and grass are picked up by stormwater runoff and carried into our waterways. Contaminated stormwater runoff threatens our drinking water supplies, and accounts for nearly 60 percent of New Jersey's current water pollution. It is very important not to place waste that may contain toxic chemicals such as, mercury, petroleum or lead into our water pipes and storm drains. Exposure to relatively high levels of inorganic mercury salts, lead, or chromium in drinking water or in contaminated land sediments surrounding waterways may cause kidney damage, nervous system damage, learning disabilities or personality alterations if the water and/or fish are consumed. To protect the quality of our drinking water and the public health, Governor McGreevey adopted new stormwater rules that represent the strongest clean-water initiatives in the nation.

The Governor has also proposed the nation's most protective drinking water standard for arsenic, providing greater public health protection for New Jersey residents from this known carcinogen. Arsenic, a naturally occurring element found throughout New Jersey, can leach into the ground from eroding rock deposits that contain arsenic. Long-term exposure to arsenic through drinking water can cause cancer of the skin, lungs, urinary bladder, and other organs.

WATERMIN wants his urban community members to know that there are many things each of us can do to protect our water resources from pollution. Armed with this environmental health information, **WATERMIN** wants to make sure our water is clean and safe to drink and to use on the vegetable plants we eat.

WATERMIN will always ***check the route*** of exposure to water pollution to find out how it might affect drinking water and the health of residents in urban communities.

LANDala



LANDALA is a young Italian-American girl who was born and raised in Camden's Waterfront South neighborhood, located on the Delaware River. Her ancestors came to America from Naples, Italy. She has taken a pledge to protect others from the health risks posed by contaminated land in urban communities.

With help from friends at the DEP, **LANDALA** has learned that land can be contaminated in many different ways, including improper storage or disposal of hazardous waste drums or household hazardous waste. When improperly included with our regular trash, batteries, cleaning supplies, old lead-based paint and other household items containing toxic chemicals end up in landfills. When wastes such as, fluorescent bulbs, broken mercury switches or batteries end up in landfills, the toxic chemicals may escape into the nearby groundwater. **LANDALA** has learned that this is why separating mercury, lead and other hazardous components out before they are mixed with the general waste stream will make it easier to recycle the remaining wastes and thus, help to create and maintain a healthier environment.

No matter which way the contamination has occurred, the potential risk to human health posed by individual sites and facilities is based upon, but is not limited to, the following environmental factors: a). nature, extent and route of the contamination, b). existence of potential pathways of human exposure (including ground water or surface water contamination, air emissions, and food chain contamination), c). health effects associated with the identified hazardous substances, and d). size and susceptibility of the community within the likely pathways of exposure.

In some urban areas, old factories and other industrial facilities contaminated the land with hazardous substances and then shut down operations, leaving the properties abandoned or unused. Toxic contaminants, such as lead, chromium, mercury, polychlorinated biphenyls (PCBs), and asbestos, can find their way into the homes, schools and playgrounds of children living in urban neighborhoods. Significant exposure to some hazardous substances put urban children at risk for learning disabilities, kidney damage and other illnesses. And, this is why Governor McGreevey and New Jersey Department of Environmental Protection (DEP) Commissioner Bradley Campbell are committed to making our urban cities cleaner, safer and healthier places to live, work and play.

Regardless of how the land has been contaminated, **LANDALA** knows that each of us can make our environment cleaner and healthier by learning the proper way to dispose of our household waste as well as how to recycle. So, **LANDALA** will always ***check the route*** of exposure to help protect our land from contamination and safeguard the public health of the residents in our urban communities.

Acknowledgement & Special Thanks

As the author and coordinator of the Fair, I would like to give my heartfelt thanks to the following people for encouraging me in their own special way and for helping me to make the PROTECTORS come alive!

Lisa Jackson, *DEP Asst. Commissioner-Enforcement*

Laura Jaworski, *LJ Communication Design*

Lisa Jones, *DEP*

Beverly Broadway, *DEP*

James Harris, *New Jersey State N.A.A.C.P.*

Ann Zeloof, *DEP*

Vince Cannuli, *Office of Administrative Law*

Richard Johnson, *DEP*

Marlene Harper, *Harper's Copy Center Plus*

Maynard Banks, *Jersey City N.A.A.C.P.*

Carol Cannuli

Daniel Cannuli

Anthony Cannuli

McKenzie Bruch

Jeanette Thornton, Ed.D., M.D., *Behavior Med*

Joseph Bozzelli, Ph.D., *New Jersey Institute of Technology*

Joseph Ponessa, Ph.D., *Rutgers University*

Emile Powe, M.D., *Behavior Med*

Michael Calabrese, *USEPA-NSCEP*

Hope Cooper, Esq., *EJECT-NJ, Inc.*

Silvia Dellas, *Family Health Services*

Norine Binder, *DEP*

Kimberly Smith, *USEPA*

Velda Font-Morris, *Newark Preschool Council, Inc.*

Karoline Churna, *USEPA: The Cadmus Group*

Maris Chavenson, *Pediatric Asthma Coalition NJ*

Wanda Pettiford, *Office of Frank Pallone, Jr.*

Mary Helen Cervantes, *DEP Asst. Commissioner-Communications*

Tim O'Donovan, *DEP*

Darlene Yuhas, *DEP*

Tonya Oznowich, *DEP*

Fred Rush, *Johnson & Johnson, Inc.*

Sincerely,

Rita L. Thornton

Rita L. Thornton, J.D., Ph.D. (c)
doctoral candidate at NJIT

The Urban Environmental Health Fair was sponsored by the following Government & Community Partnerships:

EPA United States Environmental Protection Agency

USEPA: National Service Center for Environmental Publications (NSCEP)

N.A.A.C.P.
New Jersey State
Executive Committee

EJECT-NJ, Inc.

NJIT NEW JERSEY INSTITUTE OF TECHNOLOGY

Newark Preschool Council, Inc.
Head Start Program

BEHAVIOR MED
&
Medical Media Entertainment

Johnson & Johnson

New Jersey Department of Health & Senior Services

New Jersey Department of Environmental Protection

For more information about
DEP's Black Environmental Solidarity Team (BEST), please contact
Chairperson Lisa Jackson at Lisa.Jackson@dep.state.nj.us

BLACK HISTORY CELEBRATION AT PILGRIM BAPTIST CHURCH

<u>Wednesday, February 4</u>
Black Characters In The Bible - Part I

Black History Presentation
"African American Influence In The Military"
Facilitator: Lt. Colonel Vincent Amos
United States Military, Fort Monmouth

<u>Wednesday, February 11</u>
Black Characters In The Bible - Part II

Black History Presentation
"African American Sororities & Fraternities"
Facilitator: Ms. Brenda Thompson, President
Central Jersey Alumnae Chapter
Delta Sigma Theta Sorority, Inc.

<u>Wednesday, February 18</u>
Black Characters In The Bible - Part III

Black History Presentation
"Urban Environmental Health"
Facilitator: Ms. Rita L. Thornton
Environmental Forum:
Environmental Justice & Equity with Community-based Teamwork
(EJECT-NJ, Inc.)

<u>Wednesday, February 25</u>
Special Lenten Celebration Service
"The Beginning of a Journey"

All Activities Will Begin At 7:00pm Sharp. All Are Invited To Learn

Urban
Environmental Health
FAIR

For Children, Parents, Teachers & Community Leaders

Sponsored by:
Newark Preschool Council, Inc.
EJECT-NJ, Inc.
New Jersey Institute of Technology (NJIT)

Friday June 18, 2004
1:00pm - 3:00pm
Metropolitan Baptist Church

Come and Meet

Newark Preschool Council, Inc.
EJECT-NJ, Inc.
New Jersey Institute of Technology (NJIT)

Friday June 18, 2004
Metropolitan Baptist Church
Newark, New Jersey

The City of Newark's first

Urban Environmental Health FAIR

For Preschool and Kindergarten Children, Teachers, Parents, Doctors, Nurses and Community Leaders

introducing...

NEW JERSEY'S
Urban Environmental Health
PROTECTORS

T H E P R O T E C T O R S

AIRON has taken an environmental pledge to educate his New Jersey community regarding the possible environmental health concerns associated with urban **air pollution.** According to the Centers for Disease Control (CDC) and the New Jersey Department of Health and Senior Services (DHSS), African-American/Black children are among the most "at risk" population in the State of New Jersey. So, in AIRON's search to educate this New Jersey community, he will always ***check the route*** of exposure with urban air pollution to see how it may or may not be associated with the environmental health of our New Jersey residents.

NaRDI has taken an environmental pledge to focus on educating the New Jersey community regarding how to fix or improve the **damaged natural resources** that may effect the environmental health of urban children. For example, informing the community about any urban coastal areas where fish and/or shellfish may be contaminated with toxic pollutants. In NARDI's search to keep our fish and wildlife from being contaminated, she will always ***check the route*** of exposure regarding natural resource damages to see if there might be an association with the environmental health of our New Jersey residents.

WATERmin has learned that contaminants in our urban **drinking water and waterways** are varied and may cause a range of illnesses. But, whatever the range is, WATERMIN has found out that children are particularly sensitive to microbial contaminants because their immune systems are less developed than those of most adults; and that there are many potential sources of water pollution around our homes and schools. Therefore, he will always ***check the route*** of exposure to water pollution to find out how it might effect drinking water and the health of residents in urban communities.

LANDala has learned that the nature and route of **land contamination** may occur in different ways such as, improper disposal of hazardous waste drums, or improper recycling. Soil and dust that are contaminated with lead are important sources of exposure to children because they play outside, and frequently put their hands in their mouths, which may cause elevated blood lead levels. The CDC has reported that in addition to genetic disorders, exposure to lead and high levels of mercury can cause mental retardation. And, there are higher rates of mental retardation occurring in poor Black children. So, LANDALA will always ***check the route*** or pathway that hazardous chemicals travel to see if there is an association between the land contamination and the environmental health of the urban community members.

The Urban Environmental Health Fair

was made possible by the following Government & Community Partnerships:

Newark Preschool Council, Inc.
Head Start Program

Behavior Med
&
Medical Media Entertainment

EJECT-NJ, Inc.

NJIT NEW JERSEY INSTITUTE OF TECHNOLOGY

EPA United States Environmental Protection Agency

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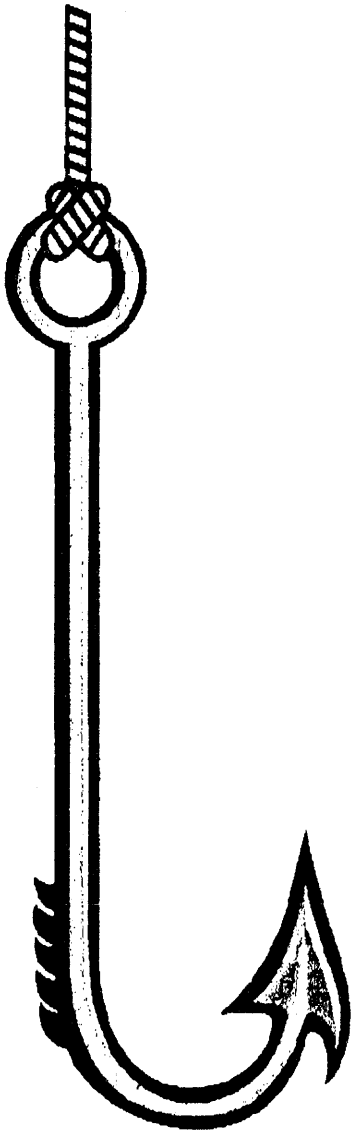
New Jersey State
Executive Committee

New Jersey Department of Environmental Protection

New Jersey Department of Health & Senior Services

The Pediatric/Adult Asthma Coalition of New Jersey



HOOKED ON HEALTH

a family community health fair

saturday, september 18
11:00 a.m. to 3:00 p.m.
red bank middle school

health screenings

- blood pressure
- body fat
- cholesterol
- glucose
- hearing
- vision
- height & weight
- depression
- drug & alcohol
- HIV

workshops

- Discussing Sexuality with Your Child
- Anger Management
- Safe Sitter
- Helping Your Child Succeed in School
- When to Take Your Child to the Hospital

children's activities

- nutrition bingo
- healthy poster contest
- face painting
- arts & crafts

sponsored by

Riverview Medical Center

rain or shine

entertainment / clowns / magician
refreshments / school supplies / giveaways / raffles

APPENDIX F

EDUCATIONAL MATERIALS DISTRIBUTED AT HEALTH FAIRS

Copies of some of the educational materials that were distributed at the Urban Environmental Health Fairs such as, an Asthma Plan for teachers, a summarized list of Asthma Triggers and tips on how to manage them, applicable statutes, regulations and guidelines regarding Asthma Management in New Jersey, the DEP's Air Quality Trends in New Jersey, and Executive Summary pages of the 2003 Asthma in New Jersey Report.

The Pediatric Asthma Coalition of New Jersey

"Your Pathway to Asthma Control"

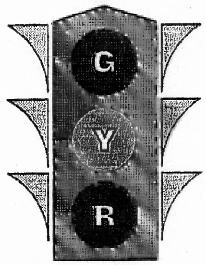
www.pacnj.org

Asthma Action Plan

(Press Firmly)

Name	Date of Birth	Effective Date / / to / /
Doctor		Parent/Guardian
Doctor's Office Phone Number		Parent's Phone
Emergency Contact After Parent		Contact Phone

The colors of a traffic light will help you use your asthma medicines.



Green means Go Zone! Use preventive medicine.

Yellow means Caution Zone! Add prescribed yellow zone medicine.

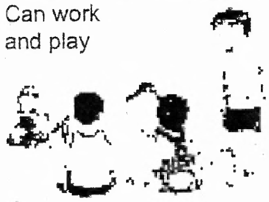
Red means Danger Zone! Get help from a doctor.

Pay Attention to Symptoms.

GO (Green)

You have *all* of these:
- Breathing is good
- No cough or wheeze
- Sleep through the night
- Can work and play

And/or Peak flow above ______



Use these medicines every day.

MEDICINE/DOSAGE	HOW MUCH TO TAKE	WHEN TO TAKE IT
COMMENTS:		

For asthma with exercise, take:

CAUTION (Yellow)

You have *any* of these:
- First sign of a cold
- Exposure to known trigger
- Cough
- Mild wheeze
- Tight chest
- Coughing at night

And/or Peak flow from ______ to ______

Continue with green zone medicine and ADD:

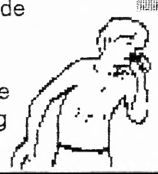
MEDICINE/DOSAGE	HOW MUCH TO TAKE	WHEN TO TAKE IT
FIRST ➡		
NEXT ➡		
COMMENTS:		

➡ IF QUICK RELIEVER/YELLOW ZONE MEDICINE IS NEEDED MORE THAN 2-3 TIMES A WEEK **THEN CALL YOUR DOCTOR.**

DANGER (Red)

Your asthma is getting worse fast:
- Medicine is not helping within 15-20 minutes
- Breathing is hard and fast
- Nose opens wide
- Ribs show
- Lips blue
- Fingernails blue
- Trouble walking and talking

And/or Peak flow below ______



Take these medicines and call your doctor

EMERGENCY MEDICINE/DOSAGE	HOW MUCH TO TAKE	WHEN TO TAKE IT
COMMENTS:		

Get help from a doctor now! It's Important!

Asthma is a potentially life threatening illness. If you cannot contact your doctor, go directly to the emergency room. DO NOT WAIT. Make an appointment with your primary care provider within two days of an ER visit or hospitalization.

Check all items that trigger your asthma and things that could make your asthma worse:

- ❑ Chalk dust
- ❑ Cigarette Smoke & second hand smoke
- ❑ Colds/Flu
- ❑ Dust mites, dust, stuffed animals, carpet
- ❑ Exercise
- ❑ Mold
- ❑ Ozone alert days
- ❑ Pests - rodents & cockroaches
- ❑ Pets - animal dander
- ❑ Plants, flowers, cut grass, pollen
- ❑ Strong odors, perfumes, cleaning products, scented products
- ❑ Sudden temperature change
- ❑ Wood Smoke
- ❑ Foods: ______ ______ ______
- ❑ Other: ______ ______ ______ ______

☐ This student is capable and has been instructed in the proper method of self-administering the medications named above (or attached prescription).

☐ This student is not approved to self-medicate.

Check asthma severity: ❑ Mild Intermittent ❑ Mild Persistent ❑ Moderate Persistent ❑ Severe Persistent

PHYSICIAN/IPA/APN SIGNATURE______________________________

PHYSICIAN STAMP

WHITE - School Nurse Copy PINK - Patient Copy YELLOW - Doctor Copy

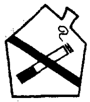
Approved by the New Jersey Thoracic Society, Medical Section of the American Lung Association of New Jersey.

Adapted from the NYC Childhood Asthma Initiative
Adapted from the NHLBI

Funding provided by the New Jersey Department of Health and Senior Services

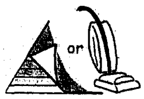
Printed 2002

Top Ten Actions to Control Asthma Triggers in Your Home



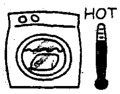
1. No smoking indoors (or in the car).

2. Cover mattress, box springs and pillows with special allergy-proof encasings.



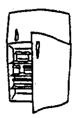
3. Remove carpet in the bedroom or vacuum often.

4. Regularly clean your home to remove dust.

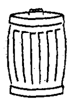


5. Wash bedding in hot water weekly.

6. Fix leaks and moisture problems.

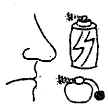


7. Store all food in air-tight containers or in the refrigerator.



8. Clean up crumbs and dirty dishes and remove garbage daily.

9. Keep cats, dogs, and caged pets out of your home.



10. Avoid using products with strong odors around family members with asthma.

These action steps can reduce asthma triggers. This can reduce asthma attacks. Remember, **Asthma Needs Action**.

The Pediatric/Adult Asthma Coalition of New Jersey
"Your Pathway to Asthma Control"

Sponsored by
AMERICAN LUNG ASSOCIATION.
of New Jersey

Call: 1-866-PACNJ-88 or Visit our Website at: www.pacnj.org

ARTWORK BY MARC ROBINSON 2002

Control These Asthma Triggers:

Tobacco Smoke   *Dust Mites*
Pests – Roaches & Rodents
Pet Dander   *Mildew & Mold*   *Strong Odors*

More on the Top Ten Actions:

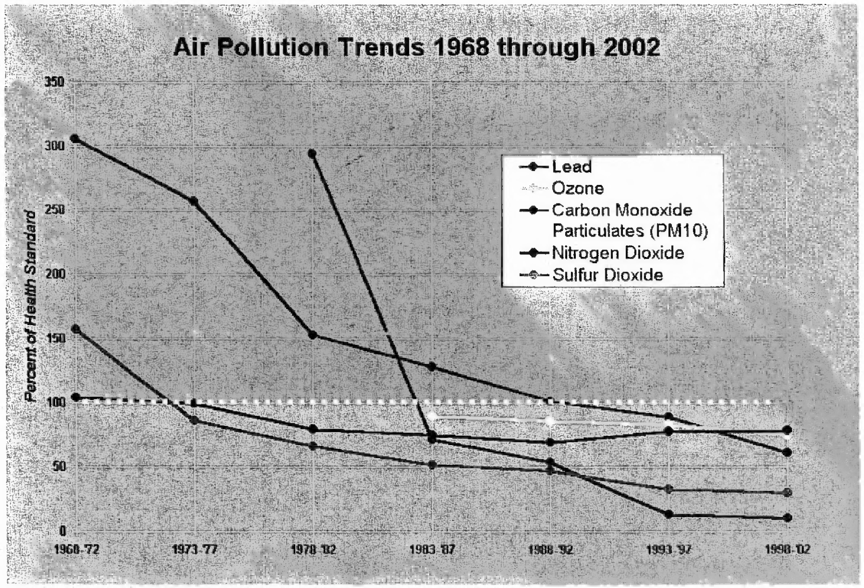
1. Smoke clings to your clothes. When smoking outside wear a shirt or outer covering that you can remove before going into your home.
2. Special allergy-proof encasings go completely around the mattress, pillow and boxspring and close with a zipper.
3. Carpet holds many asthma triggers. It is best to remove all carpeting in the bedroom. If this is not possible, vacuum weekly when the person with asthma is not in the room. Use a vacuum with special allergy-proof vacuum bags, HEPA filters, or central vacuum.
4. To clean, use a damp mop and damp dust cloth on hard surfaces and see above for vacuuming.
5. All bedding should be machine washable and washed in hot water and detergent at least once a week. This includes sheets, pillowcases, blankets, and mattress pad.
6. Search for wet spots or mold, especially around plumbing, and make repairs to reduce mold, roaches, and rodents. Fix leaky sinks.
7. Containers for storing food need to be hard plastic or glass to stop rodents and roaches. If you have a problem, put **all food** from the store into these containers.
8. Cleaning and storage should remove the food sources for roaches and rodents. If you need to do more, try using poison baits, boric acid (for cockroaches), or traps before using pesticide sprays.
9. Do not allow cats, dogs, and caged pets in your home because pet dander and saliva can be triggers.
10. Strong odors come from cleaning products, perfumes, scented candles, incense, room deodorizers, air fresheners, wood smoke, unvented space heaters, and pesticide sprays. When using these products, keep the person with asthma out of the room and air out the room before they return.

For more information call: 1-866-PACNJ-88 or Visit our Website at: www.pacnj.org

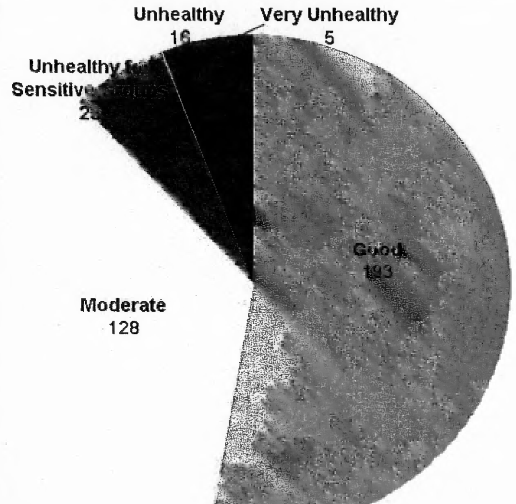
This publication was supported by a grant from the New Jersey Department of Health and Senior Services, with funds provided by the U.S. Centers for Disease Control and Prevention under operative Agreement U59/CCU21776. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the New Jersey Department of Health and Senior Services or the U.S. Centers for Disease Control and Prevention.

2002 Air Quality Summary

quality in New Jersey has improved dramatically since the passage of the Clean Air Act in 70. These improvements are the result of aggressive pollution control programs plemented in New Jersey and of regional emission reduction strategies involving other tes. Nevertheless, air quality problems remain. In addition to the state's persistent ground el ozone problem, fine particulates and air toxics are also forms of air pollution that may se significant health threats.



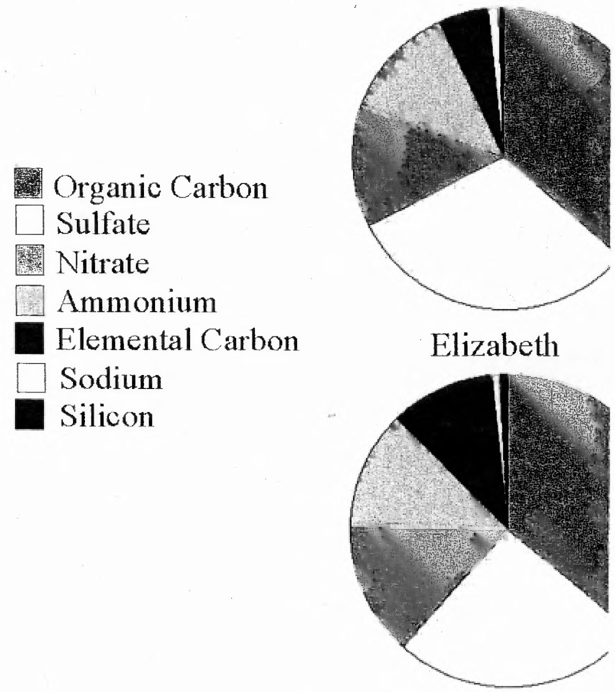
Air Quality Summary by Days



The pie chart to the left shows a summary of New Jersey's air quality in 2002. The chart is based on the national Air Quality Index (AQI), which rates each day based on several key air pollutants. For 2002, the AQI rated air quality in New Jersey good or moderate most of the time, but pollution was still high enough to adversely affect some people on about one day in ten and most people on about one day in twenty.

2002 Speciated P

At four of the PM 2.5 monitoring sites, DEP takes laboratory for a more detailed chemical analysis. Chester, New Brunswick and Elizabeth. The labora mixture of compounds and elements) and, using the amount present in the sample.



The charts above represent the 2002 annual av common components of fine particulates. The c elements and compounds found in the total san components at all sampling locations were sulfa primarily from secondary particulates that form is largely emitted by coal-fired power plants. O sources and is associated with both primary (di particulates. DEP is using this data to develop a New Jersey.

Asthma in New Jersey

THE GREAT SEAL OF THE STATE OF NEW JERSEY

NEW JERSEY DEPARTMENT OF HEALTH AND SENIOR SERVICES

James E. McGreevey
Governor

Clifton R. Lacy, M.D.
Commissioner

Introduction

What is Asthma?

Asthma is a chronic disease of airway inflammation that makes breathing difficult. Symptoms include shortness of breath, chest tightness, wheezing and coughing. Children and adults with asthma have episodes, or attacks, when it is difficult for them to breathe. The airway muscles tighten and the airway lining swells, making the airways very narrow. These episodes usually occur in response to a viral infection such as a cold or in response to other "triggers" such as allergens, irritants or exercise.

It is not understood why or how the airways become abnormally sensitive. The cause of asthma is not known, but it tends to run in families.

Impact and Severity of Asthma

Asthma is one of the most common chronic conditions in our nation and one of the most serious chronic illnesses of children. The U.S. Centers for Disease Control and Prevention has estimated that there are 540,000 persons with asthma in New Jersey.[1] The U.S. Department of Health and Human Services' *Healthy People 2010: Objectives for Improving Health* established a goal in the area of respiratory disease to "reduce asthma morbidity, as measured by a reduction in hospitalizations".[2]

Uncontrolled asthma can be expensive. The Asthma and Allergy Foundation of America estimated that asthma costs New Jersey more than $323 million each year.[3] Children use more medications when their asthma is not controlled than when it is stable. Adolescents may be more aware of their symptoms than are younger children, but they may underestimate the severity of their symptoms. Disturbed sleep from nighttime asthma symptoms can decrease productivity at school for children and at work for parents. In older people, asthma may be confused with other chronic lung diseases such as emphysema or chronic bronchitis.

Preventing Asthma Attacks

The number and severity of asthma attacks can be reduced by avoiding triggers and by taking prescribed preventive medicine every day. Furthermore, a written action plan outlining recommended medications and detailing proper self-management steps can reduce the number of severe attacks coupled with regular assessment and monitoring. The aim of asthma therapy is to maintain control of asthma with the least amount of medication and with minimal risk for adverse effects.

1 "Forecasted State-Specific Estimates of Self-Reported Asthma Prevalence –United States 1998", Morbidity and Mortality Weekly Report, December 14, 1998

2 "Healthy People 2010 Objectives", U.S. Department of Health and Human Services

3 Asthma and Allergy Foundation of America website. Estimates based on "Trends in the Costs of Asthma in the United States, 1985-1994", Journal of Allergy and Clinical Immunology, September 2000

Epidemiology of Asthma in New Jersey

The New Jersey Department of Health and Senior Services (NJDHSS) initiated the New Jersey Asthma Surveillance Project in the Fall of 2000 to develop a statewide asthma surveillance system. The Child and Adolescent Health Program within the Division of Family Health Services is establishing the New Jersey Asthma Surveillance Project. The project is funded by the Centers for Disease Control and Prevention grant "Addressing Asthma from a Public Health Perspective". The purpose of the project is to tabulate and report existing surveillance data concerning asthma and to develop new surveillance methods and reports. The asthma surveillance project has also included data from hospital discharges, vital records, and occupational disease reports. The surveillance data will support the coordination of resources for asthma treatment and measurement of progress toward achieving both the *Healthy New Jersey 2010* and the national *Healthy People 2010* goals of reduced asthma hospitalizations and reduced deaths.

Prevalence of Asthma in New Jersey

Results from the National Health Interview Survey indicate the prevalence of asthma in the United States increased 75% from 1980 to 1994.[4] However, New Jersey has little state-specific data on asthma prevalence among its residents. Accurate estimates of asthma incidence and prevalence are difficult to measure due to the problems in defining the disease among infants and young people.

In 2000, the Behavioral Risk Factor Surveillance Survey (BRFSS), a random digit dialing telephone survey, was revised to include questions about asthma. This survey of self-reported asthma provides an estimate on statewide prevalence of asthma. Estimates on the asthma status of New Jersey adults (aged 18 and over) were available for the first time in the 2000 New Jersey BRFSS. Among the adults answering the survey, 8.7 % said that they had ever been told by a doctor that they had asthma, and 6.2% said that they currently have asthma. Extrapolating the survey results to the entire population of the State, it is estimated that between 7.7 and 9.8% of adults in New Jersey have ever had asthma, and between 5.4 and 7.1% currently have asthma. Given that the State's population age 18 years and older in the 2000 Census was 6,326,792, the aforementioned percentages translate into 487,163 to 620,026 New Jersey residents as ever having asthma, and 341,647 to 449,202 New Jersey residents as currently having asthma.[5]

Nationally, the 2000 BRFSS indicates an estimated 14.6 million (7.2%) adults had current asthma in the United States.

4 "Self-Reported Asthma Prevalence Among Adults—United States, 2000", *MMWR*, August 17, 2001, 50(32), pp 682-6

5 U.S. Census Bureau, Census 2000 Profile of General Demographic Characteristics from www.wnjpin.state.nj.us/OneStopCareerCenter/LaborMarketInformation/lmi25/sf1/index.html

APPENDIX G

NJIT FEMME PRE-COLLEGE PROGRAM AND WORKSHOPS ON ENVIRONMENTAL SCIENCE AND HEALTH

NJIT's FEMME Program is designed for young men and women from inner-city schools who are interested in seeking a career in engineering and science. The Program's Assistant Coordinator requested Rita Thornton to be a guest speaker and presenter for the NJIT Pre-College Summer Workshops (August 2004 and 2005). The researcher narrowly tailored her presentations so that these 4^{th} 5^{th} 6^{th} and 7^{th} graders could understand the environmental science and health portions of her research work. The Urban Environmental Health PROTECTORS were introduced to the young people; and to show their appreciation, many of them created personalized Thank You cards and wrote letters to the researcher. Some copies are enclosed along with response letters from researcher's employer (the New Jersey Department of Environmental Protection).

NJIT
New Jersey Institute of Technology

A Public
Research University

PRE-COLLEGE PROGRAMS

August 9, 2004

Bureau Chief
Chief Norine Binder
Bureau of Hazardous Waste Regulations
401 E. State Street
Trenton, NJ 08625-0421

Re: 8/2/04 visit from Dr. Rita Thornton

Dear Chief Binder:

On behalf of N. J. I. T. Pre-College Programs, we thank you for facilitating our request for Dr. Rita Thornton to be guest speaker to our 4th grade environmental group.

After meeting Dr. Thornton at the Princeton Plasma Physics Laboratory conference this Spring I was sure our 4th grade environmental engineering group would greatly benefit from her presentation but even I could not foresee just what a powerful impact it had on our students.

I am enclosing the letters written by the children themselves in appreciation of her visit, I believe they speak volumes and sincerely hope this experience could be duplicated next summer for the next group of students.

Thank you once again and I will look forward to arranging this presentation next year.

Sincerely,

Ana J. Cortina

Ana J. Cortina
Assistant Coordinator

UNIVERSITY HEIGHTS
NEWARK, NJ 07102-1982
973. 596. 3550/3679
973. 642. 1847 FAX

State of New Jersey
Department of Environmental Protection
Division of Solid and Hazardous Waste
P.O. Box 414
Trenton, NJ 08625-0414
Tel. #609-984-6880
Fax #609-984-6874

Richard J. Codey
Acting Governor

Bradley M. Campbell
Commissioner

August 17, 2005

Ana J. Cortina, Assistant Coordinator
Center for Pre-College Programs NJIT
University Heights
Newark, NJ 07102-1982

Dear Ms. Cortina:

Thank you for your letter dated August 11, 2005 detailing the success of Dr. Thornton's participation in NJIT's summer workshops. I believe as you do that planting seeds for possible careers is something to which we should all aspire. I can think of no better-qualified person than Dr. Thornton to achieve that goal. The Division is pleased to encourage Dr. Thornton to continue her efforts in future presentations of NJIT Pre-College Programs.

Wishing you great success in future summer programs. If I can be of additional service, please do not hesitate to contact me or Assistant Director Frank Coolick at (609) 984-6880.

Sincerely,

Norine Binder

Norine Binder, Director
Division of Solid and Hazardous Waste

cc: Dr. Rita Thornton
Assistant Director Frank Coolick

NJIT
New Jersey Institute of Technology

*A Public
Research University*

PRE-COLLEGE PROGRAMS

August 11, 2005

Norine Binder, Director
NJ Department of Environmental Protection
Division of Solid and Hazardous Waste
P.O. Box 414
Trenton, NJ 08625-0414

Re: 8/2/05 visit from Dr. Rita Thornton

Dear Ms. Binder:

On behalf of NJIT Pre-College Programs, we thank you for facilitating our request for Dr. Rita Thornton to be guest speaker to our 4th grade environmental group again this year.

Just as last year we and the kids were thrilled, inspired and challenged to think of our environment in a more holistic way but better than what I could say I enclose thank you cards from the students themselves!

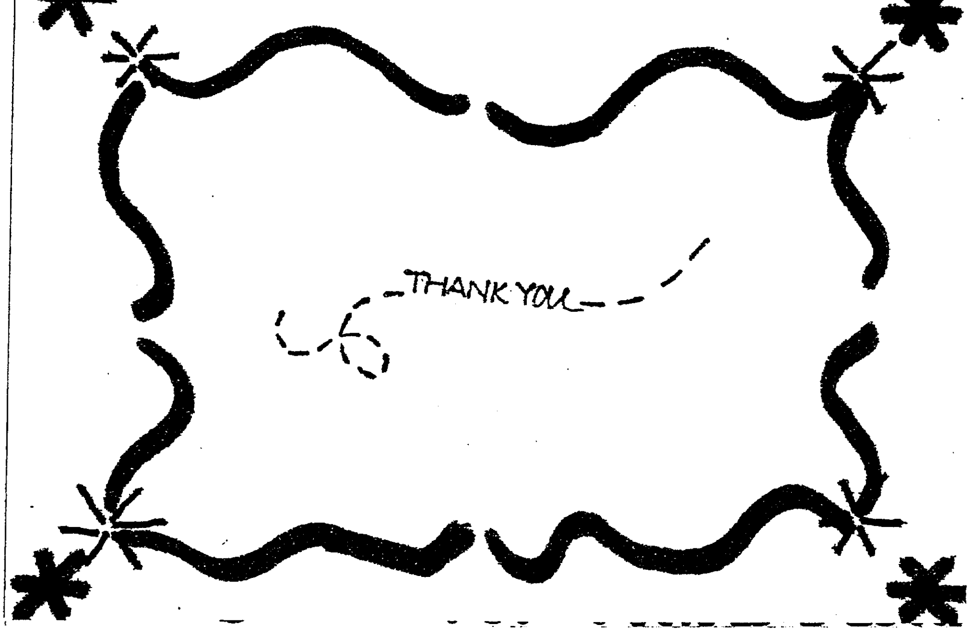
Thank you once again and I will look forward to arranging this presentation next year.

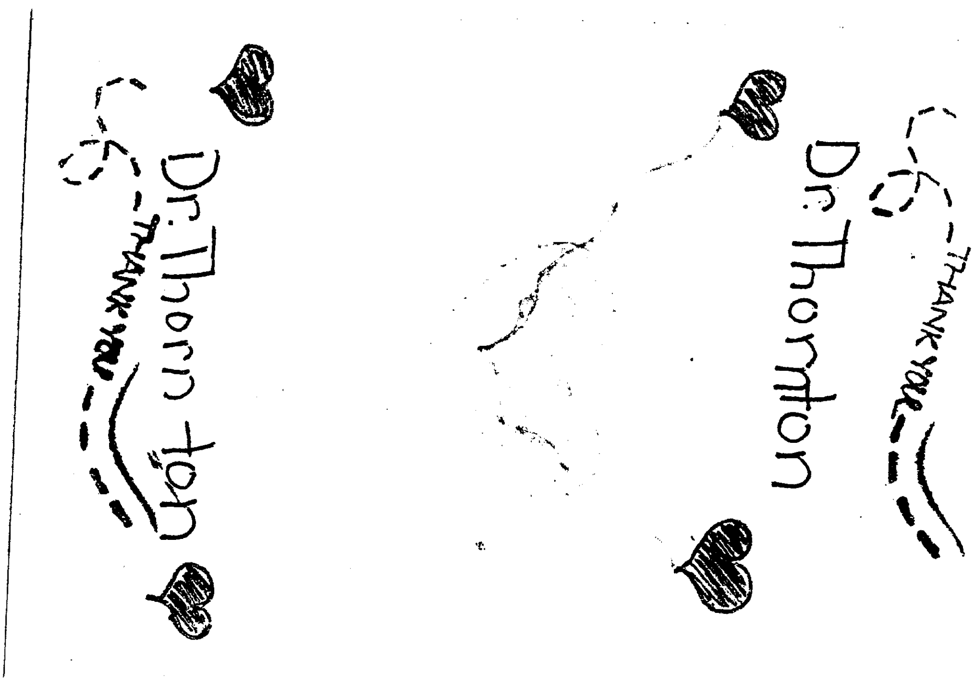
Sincerely,

Ana J. Cortina

Ana J. Cortina
Assistant Coordinator

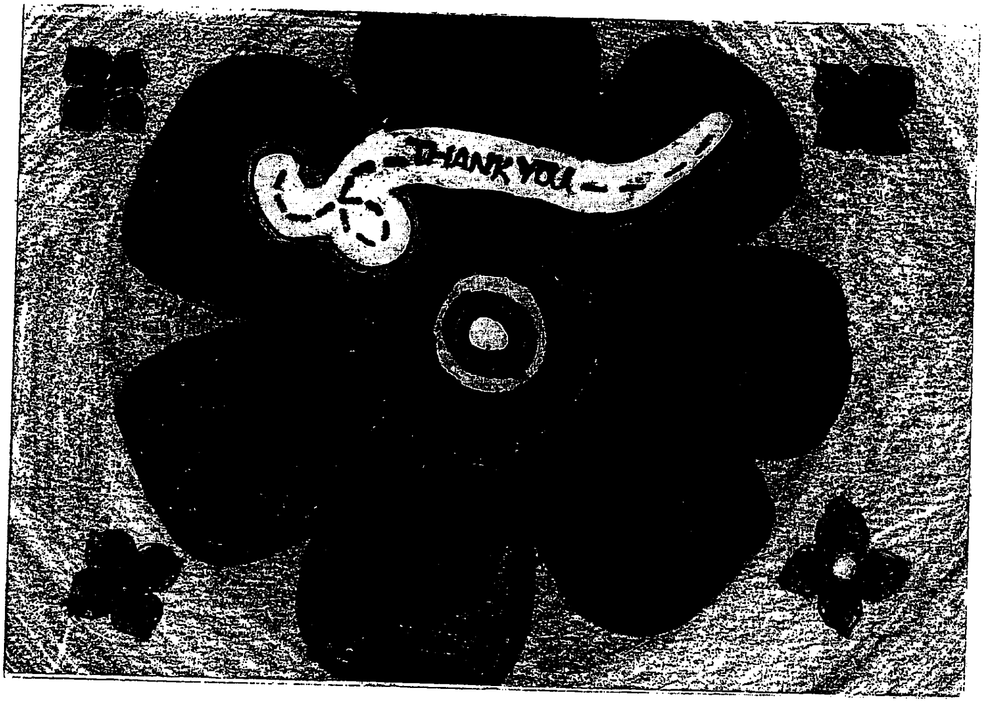
UNIVERSITY HEIGHTS
NEWARK, NJ 07102-1982
973. 596. 3550/3679
973. 596. 6461 FAX

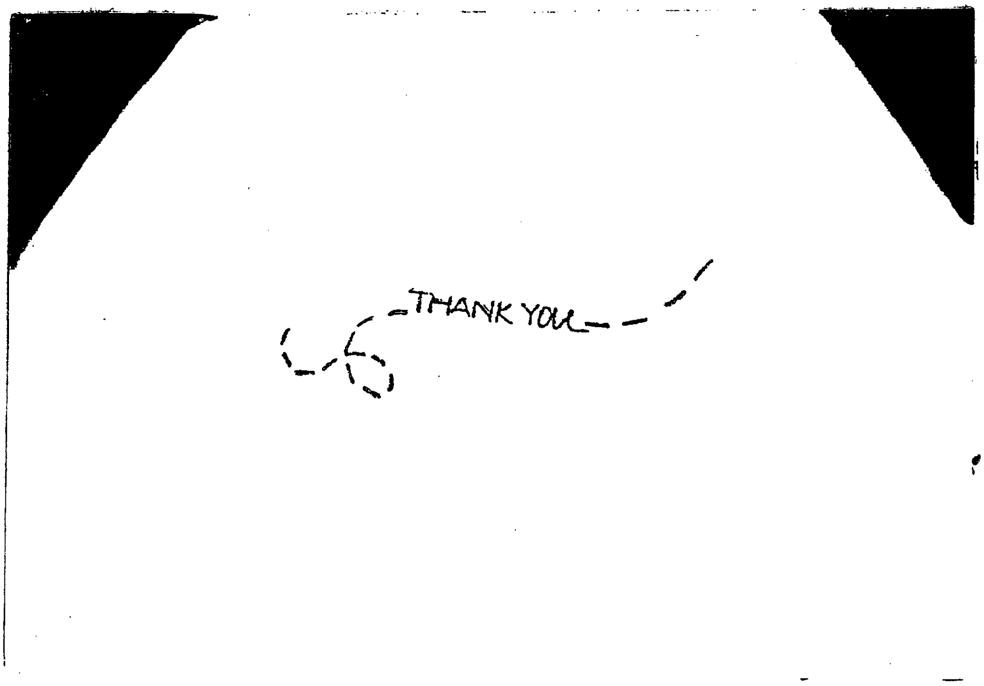

THANK YOU


Dr. Thornton
THANK YOU
Dr. Thorn ton
THANK YOU

Doctor
Responsible
.
Talented Tenacious
Helpful Outgoing
Original Nice
Right

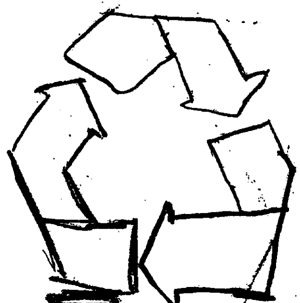
From: Kira Steven


THANK YOU


THANK YOU

Dear Dr. Thornton,

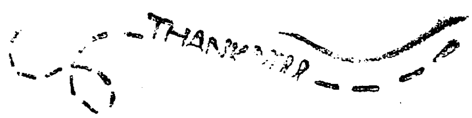
Thank You for coming to our class. We are very great full that you could come to visit us. I abo want to say Thank you for the book and piggybank. My sister is putting all her money in it. When I got home you were the only person I could talk about.



RECYCLE

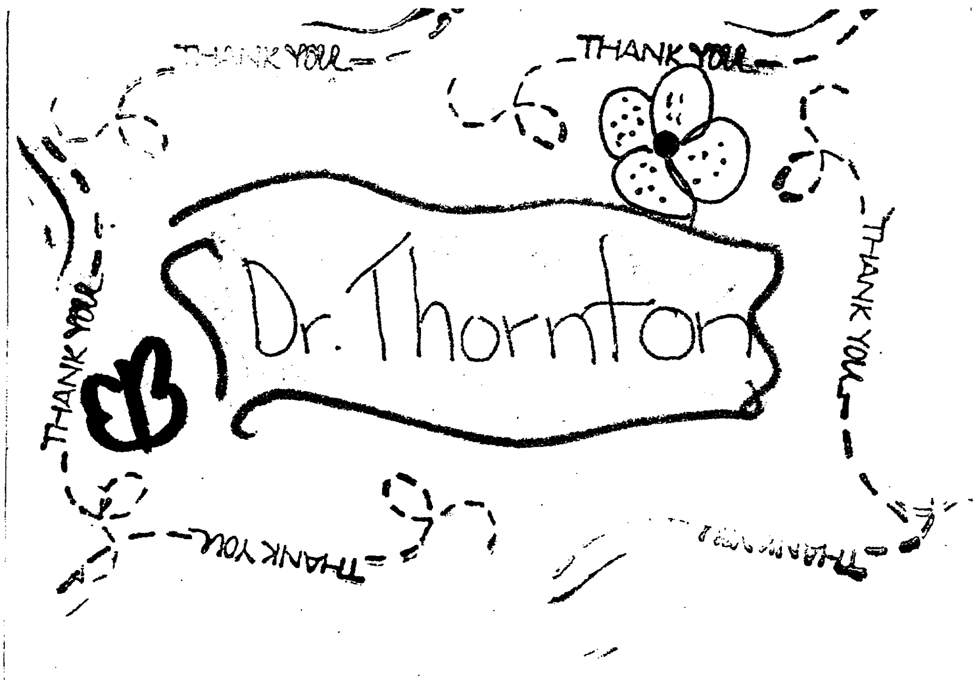
Dear Dr ThonTon

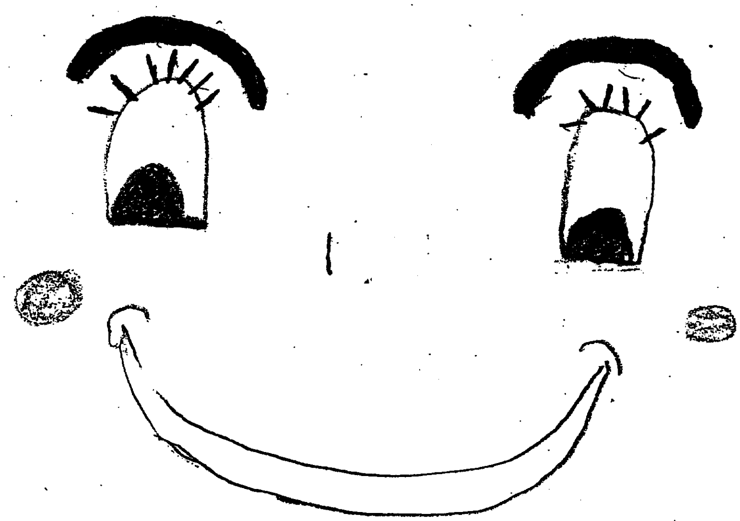
Thank you for takeing your time out of your busy schecle to tell us about Airon, NirDa, water min and Landala.



Your friend
Jenniah Lowe

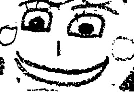

THANK YOU
Dr. Thornton

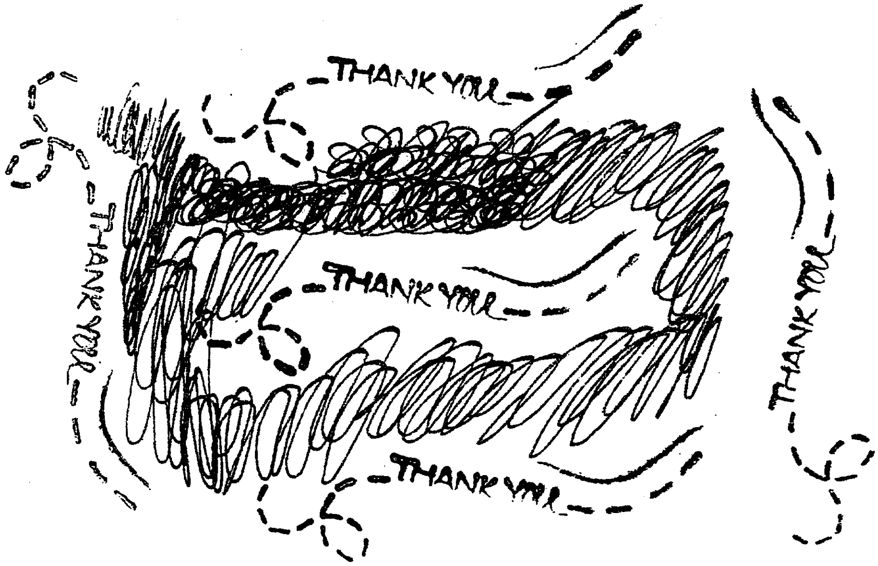

THANK YOU
THANK YOU
Dr. Thornton
THANK YOU
THANK YOU
THANK YOU



Dear Dr. Thornton,

I really appreciate you taking the time out of your schdule to teach us about our land and water and how we should keep it clean. You have tought me to recycle and keep the environment clean. Thank you for teaching me these things about our environment!!

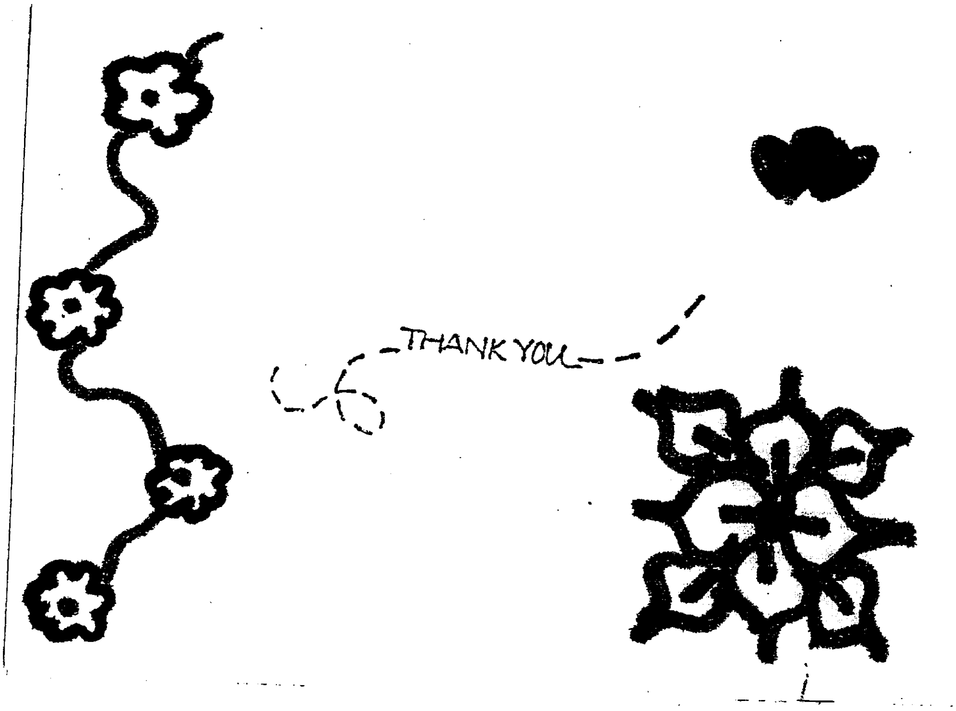
Love, Lauren 

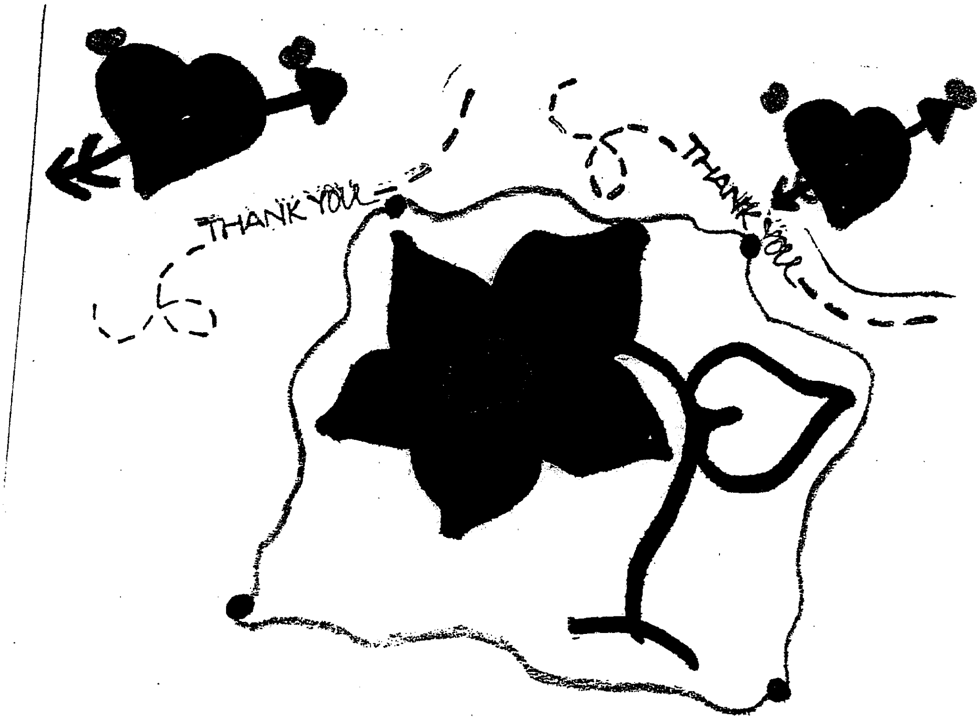


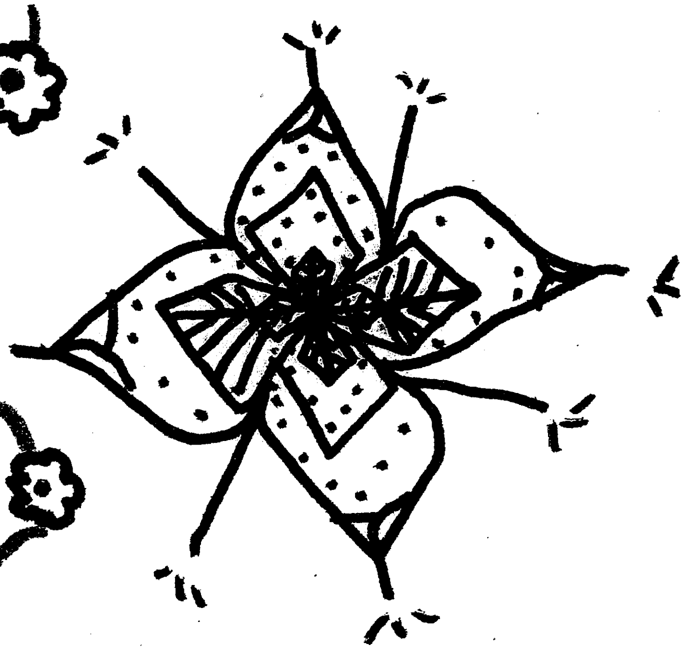
Dear Dr. Thornton

Thank you for all your help to understand more ~~the~~ community. I started to recycle how you said. It is really fun too. Thank you for the piggy and the boook !!

You friend,
Kimberly Z.


THANK YOU

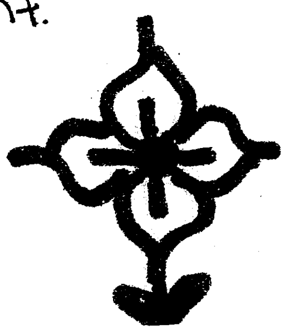

THANK YOU
THANK YOU



Dear Dr. Thornton, 8/3/05

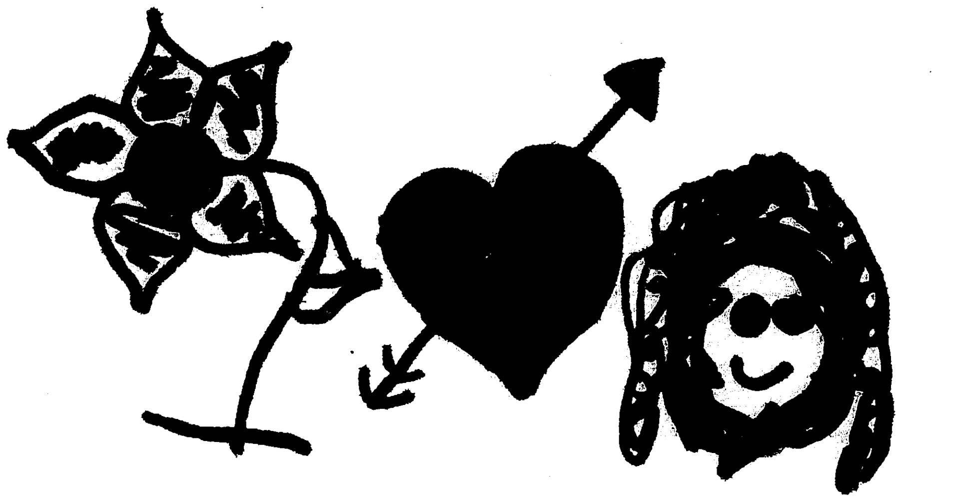
Thank you so much for comming here and talking so much about the environment. I learned so much from your visit of how to take care of the environment.

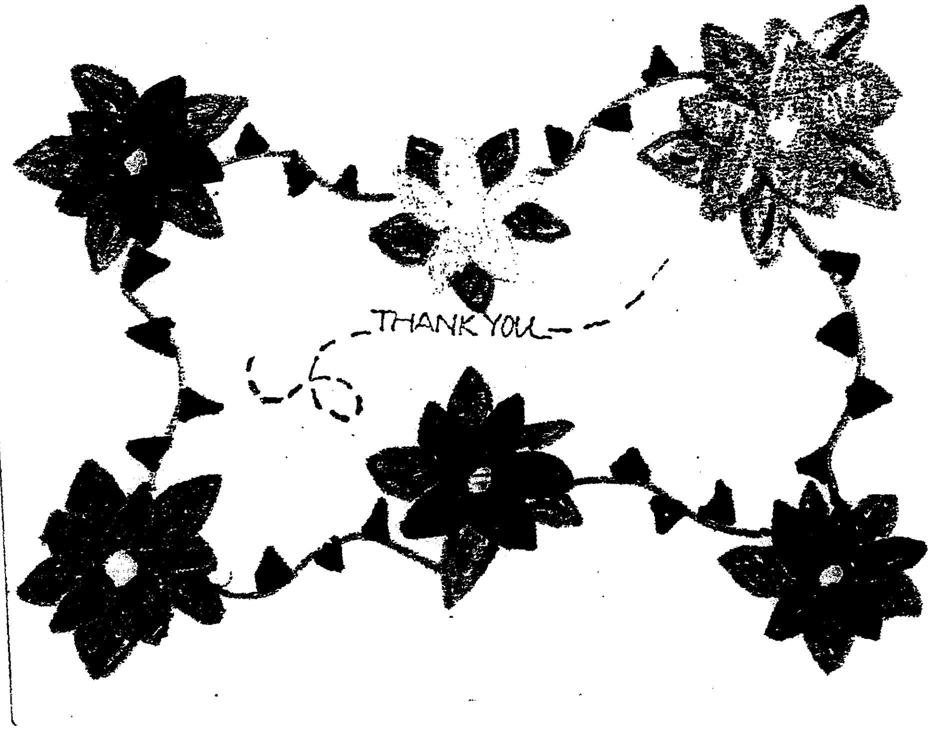
-Adriana Ruiz

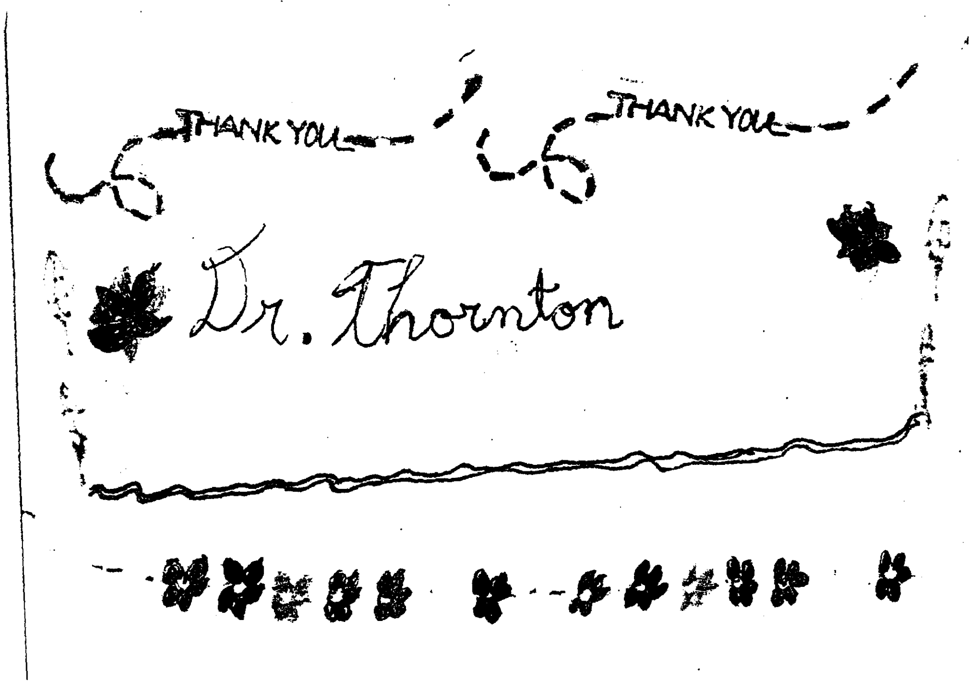


Dear Dr. Thornton,
Thank you for your great presentation. I really enjoyed it. I hope you come back next summer.

Sincerely,
Lorrain
Alicea




THANK YOU


THANK YOU
THANK YOU
Dr. Thornton

Thank you for coming in,
Dr. Thornton! You taught us
a lot. I already told my mom
not to throw away batteries.
Thanks again.

Sincerely,
Darria
Clance

Thank you for taking sometime off your busy scheduele. We loved your lesson. I wish you luck with your presentation. I read one bit of your book and I fell in love with it. Congrats!! You are a great author.

Sincerelsly,

Vania Durand

NJIT
New Jersey Institute of Technology

A Public
Research University

August 9, 2004

Bureau Chief
Chief Norine Binder
Bureau of Hazardous Waste Regulations
401 E. State Street
Trenton, NJ 08625-0421

Re: 8/2/04 visit from Dr. Rita Thornton

Dear Chief Binder:

On behalf of N. J. I. T. Pre-College Programs, we thank you for facilitating our request for Dr. Rita Thornton to be guest speaker to our 4th grade environmental group.

After meeting Dr. Thornton at the Princeton Plasma Physics Laboratory conference this Spring I was sure our 4th grade environmental engineering group would greatly benefit from her presentation but even I could not foresee just what a powerful impact it had on our students.

I am enclosing the letters written by the children themselves in appreciation of her visit, I believe they speak volumes and sincerely hope this experience could be duplicated next summer for the next group of students.

Thank you once again and I will look forward to arranging this presentation next year.

Sincerely,

Ana J. Cortina

Ana J. Cortina
Assistant Coordinator

UNIVERSITY HEIGHTS
NEWARK, NJ 07102-1982
973. 596. 3550/3679
973. 642. 1847 FAX

Dr. Rita Thornton
Evironmental Specialist
Trenton. N.J

8/3/04

Dear Dr. Thornton, Its me Priscilla the person that asked what a ditchdigger is. I love your book I started reading it. I hope you come to my new school in Perth Amboy it called Samuel E. Shull. Your Fans are waiting.

Your Fan

Priscilla

P.S. I Love Your Book.

8/3/04

Dear Dr. Rita Thornton,
I just wanted to say that I really enjoyed what you did yesterday. I had no Idea that people had to recycle batteries. I hope you come back soon again!

To: Dr. Rita Thornton

From:
Cintia Moya
PAS

8/3/04

Dear Dr. Rita Thornton Envrionmental Specialist, Trenton, N.J.

I had a great time with you. Thank you for spending your time with us and I hope to see you again.

Sincerly,
Angel
Sanchez
Pas
NJIT

8/3/04

Dear Dr Thornton,

Thank you so much for comming yesterday! It was really fun. Thank you for the book. It is great!

Sincerely,
Andrew
Gerena

Dear Miss Thornton

Thanks again for the book and pencil. I atmire your work. I hope you come again to NJIT. What you made do was rilly fun Thank you for siming my book.

Sencirally Jeyson Peña

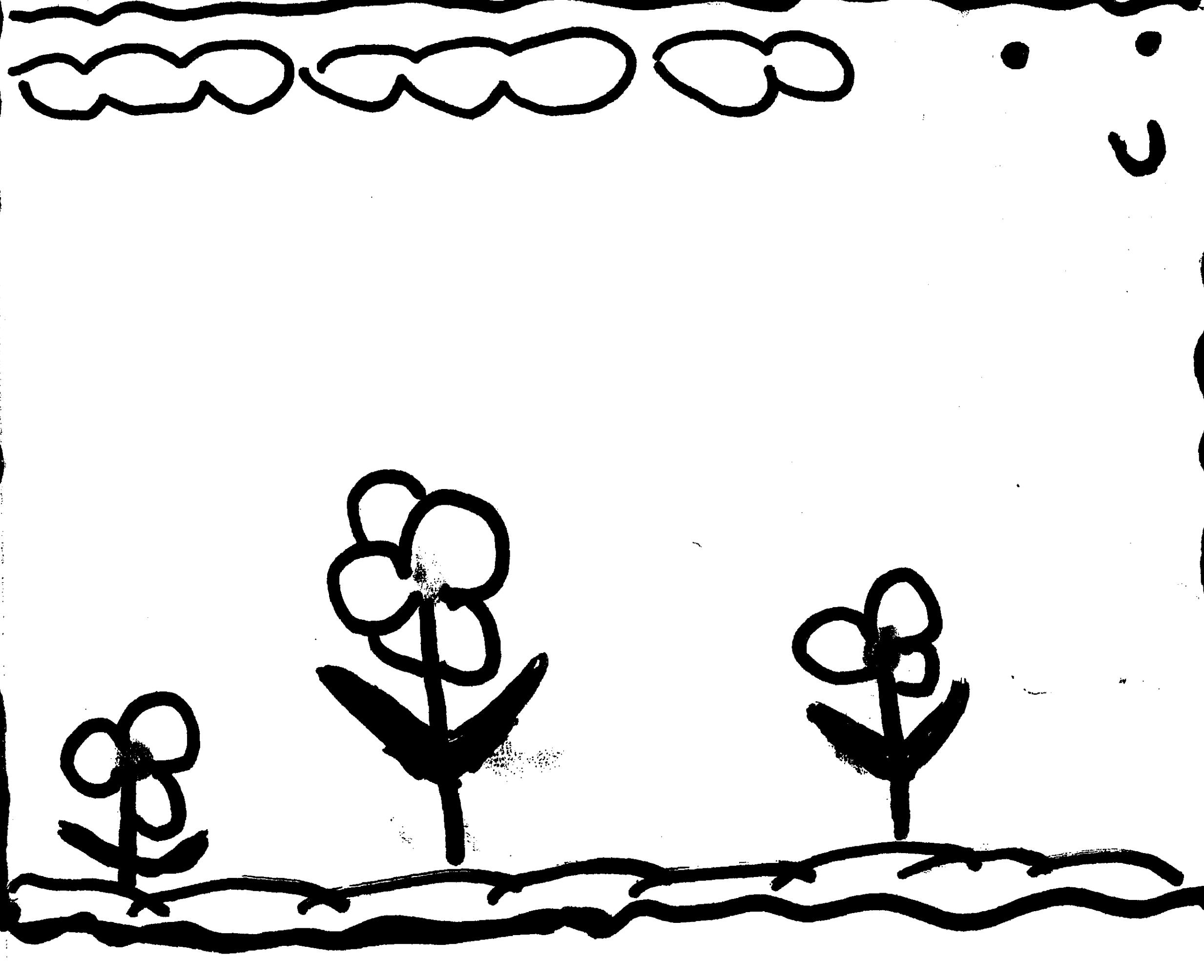
8-3-04

Doctor Rita Thomton
enviomental specialist
Trento NJ.

Dear Dr. Thornton

Thank you for coming and visiting us. I had alot of fun when you came, I alredy starte to read and so far it is very good.

Sincerely
Karina Mosquera
From NJIT.



8/3/04

Dear Drs Rita Thorton

Thank you very very much.
So far I have not used my pencil yet. But I will. I'm going to start my book you gave me yesterday. It seems very interesting. I like your job it is very cool. I told my mom about the batteries and now she has a seprate bag for the bateries, again Thank you very very much I enjoyed being with you.

sincerely

Kyra L.
PAS

8/3/04

Dear Dr Rita Thornton,

Thank you for coming to our class. it was geat morning you, and tanks you for giving us the books. Tha

Thank You very muck!!!

Sincerly,
Rosa L.

8-3-04

Dr. Rita Thornton...
Enviromental Specialist
Trenton, NJ

Dear Mrs Thornton,

Thank you for the books. They are very nice. I started reading it last night so far the books are good. The book is interesting. You have an interesting life. Thanks for comming to NJIT.

Sincerly,

Meghan S.

anthony auiles Pas

Dear, Dr. Thornton

I would like to thank you for telling us about air, Nardi, water, and land. I really leared alot from you. One more thing thank you for giving us Highland looks.

Sincerly your
Student anthony

8/3/04

Dr. Rita Thornton
enviromental especalist
Trenton N.J.

Dear Ms Thornton,

Thank you for coming here to the NJIT. We all apresheate it. The class also apresheated the books you brought us. I already read a couple of pages. Thank you so much.

Sincerely,
Amanda
Plata

8/3/04

Dear Dr Rita Thornton,

I thank you for coming yesterday I really enjoyed your book you gave me I am almost half way. I learned alot from environmental problems yesterday so I am going to do my part by not polluting.

Sincerely, Nadia Ortega

P.S.

Please come back next year.

Kevin Leiton
Dear Dr Thornton,
Thank you so much for your time and patience. I learned a lot from you and I had fun. I loved the pencils and books you gave us. Thank you!

Sincerely
Kevin Leiton

8/3/04

Dear, Dr. Thornton

Thank you for coming to NJIT and talking to us. It was a lot of fun. I learned about the earth and recycling to. I learned what to recycle. Thank you for letting us have lots of fun.

Sincerely,
Miranda
Femme 4
NJIT

Dear Dr. Thornton, August 3, 2004

My favorite part was the game we played. I don't have a least favorite because I liked everything. The way you named AIRon, NaRDY, WATERmin, and LANDala was very clever. Thank you very much for the book, my mom loved it.

Sincerely
Priya Dave
Femme 4
NJIT

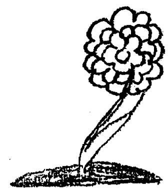
Dr. Rita Thorton
Environmental Specialist
Trenton, NJ

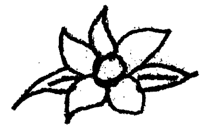
Dear Dr. Rita Thorton,

Thank you Ms. Thorton for sharing AIRon, NORDI, WATERmin and LANDala. You were very helpful because I didn't know that we had to recycle bateries. You were very nice to take some time out of your work. Oh I almost forgot thanks for the pencil and book.

P.S. Come back next year.

Sincerley,
Cynthia Cruz
FEMME 4
NJIT





Dear
Dr. Rita Thornton,

Thank you for comming to the Femme 4 & PAS program to teach us abart pollution, how we can help & it's effects. I think it's great that you put so much effort into helping the enviornment. I'll try to do the same now and hope fully the other girls in my class will. Thank you very much.

SINCERELY,
Amber

Femme 4

Dr. Rita Thornton
Environmental Specialist
Trenton, NJ

Dear Dr. Thornton,

Thankyou for a lovely presentation. I really learned so much about environmental Health. Now I know what not to do. Thank you for the pencil and the book. I read one chapter and it's really good. God BLESS you in your career and everything you do.

Sincerely,
DeAzah Davis
Femme 4
NJIT

Dear Dr. Rita Thorton

Thank you for many things. I started to read the book and it's great. Thank you for giving us the info about stopping pollution.

Sincerely, mervy

Feme 4 NJIT

8-3-04
Dr. Rita Thornton
Environmental
Specialist
Trenton NJ

Dear Rita Thornton,

Thank you for having time to teach us about the inportance of taking care of our earth. I learded alot when you came and made learning a fun experance. Thankyou for the wonderful book. I am already starting to read it. Did you know that I still have Airon, Nardi, watermin, and Landala In my head and I can't get rid of them. I hope you write me back soon. I also hope you come back and visit NJIT. God bless you for all you have done for not just us but the world.

Love
Jeniffer Paez

8-3-04
Dr. Rita Thornton
Envirometal
Specialist
Trenton, NJ

Dear Rita Thornton

Thank you for teaching us about saving our world. I learned a lot about recycling and taking care of our earth. I also had a pleasure to meat AIRon, NoRDI, WATERmin, and LANDala. The last thing I want to tell you is that thaks a lot for the book and pencil! I had a it was very nice of meeting you!

Sincerely
Michelle

Richard Ros NJ

Dear, Rita Thornton, J.D. Thank you for coming. I am glad happy that you giving us the book, Thank you for the pencils to. I hope you have a great life

Dear Dr. Reta L. Thorntan

Yesterday was great. I loved the book. I already started reading. I also liked the part where we splited in groups.

Sincerly,

Orlando Gonzalez J.R

Dr. Rita Thornton
Environmental Specialist
Trenton, NJ

Dear Dr. Rita Thornton,

Thank you for teaching us about saving our earth. And also I appreciated teaching us about AIRon, NaRDI, WATERmin, LANDada. Also those books you gave us were excellent. I hope to see you again!

Love
Ashelyn
Polonia

Dr. Rita Thornton .
Enviornmental Specialist
Trenton, NJ

8-3-04

Dear Dr. Thornton,

Thanks for coming to NJIT. I love your book. I wish my life was that famous. You are cool. I wish you were in my family. I like you.

Sincerely,

Jacquelyn

PAS

NJIT

Dear Dr. Rita Thornton,

Thanks for the books and pencils. Also for teaching us about our environment. I told some of my family members to recycle. I'll tell more family members. I liked playing the games, it was fun! Thank you!

Sincerely,
Emily Escobar

8/3/04

Dear Dr. Thornton

Dr. Rita Thornton
Environmental Specialist
Trenton, NJ

Thank you for the book and pencil. I learned alot from you coming over what I liked was when we did the things with what the kids job to take care of the earth. Also I now know not to throw batteries in the garbage.

Sincerely,
Carmen Velez

Dear Dr. Thornton,

So far your book is great. Thank you for signing it. I hope you come back. The game was cool and fun. Thank you for coming. I learned alot!

Sincerly,

Jessica Chavez

Dear Dr. Thornton 8/3/04

Thank you for coming to teach us about recycling. I really liked those little characters. I liked playing the game too. Thank you for giving us the book, I started reading it, I like it.

Sincerely,

Femme 4 NJIT

Dear Dr. Rita Thornton,

When you came here to NJII I was glad you came. Thank You for the books and for the pencils and the game it was readly fun thank you. Thank you for share and I liked ~~the~~ when you were talking about the protectoros.

Sincerely,
Tania H
Femme 4

Dear Dr. Rita Thorton,

I really appreciate you coming in off of your bussy skedual and talking to us about how importaint it is about recycoling,

sencerly,
Kyannah
Spencer

Communications.
Femme 4

Dear, Dr. Rita Thornton

When you came to NJIT to teach us things it was really fun. I really liked what you teached us about Airron, Naradi, Watermin, Landala. I thank you for the beatiful book A suitcase full of dreams it was really nice of you.

Sincerely
Ashley Balcazar

8-3-04

Dear Dr. Thorton,

Thank you for coming to NJIT! I learned a lot about your presentation the other day. I'm sure that FEMME 4 and I very grateful that you came. I can't thank you enough for the book, and the pencil. By the way, the book is sounding great! I can't wait to read the rest!

Sincerely,

Karen Loor

Dear Dr. Thorton,

Thank you for coming to NJIT. I learned a lot about the environment. I thought it was fun when we worked in groups. The book you gave us was nice. Your a good writer. I hope I meet you again.

Sincerely,

Niki ~~Lynn~~ Russo

8/3/04
Dr. Rita Thornton
Environmental Specialist,
Trenton NJ

Dear Dr. Rita Thornton,
Thank for spending some time with us yesterday. I learned a lot about keeping my environment safe, I hope you can come and visit us again. Oh and thank for the book and pencil.

Sincerely,
Shavonne.

Fanney
NJIT

Dear Dr. Rita Thornton,

Thank you for coming to NJIT to talk to us about your job. I learned a lot like air pollution can give you aisma. I can't wait to finish the book you gave us. I will always recycle and not pollute.

Sincerely,

Brianne Robertson!!

Dear Dr. Rita Thornton,

Thanks sooo much for coming, I thought The "Protecters" were cool looking. Also, I read your book, I really like it. Your mom was sooo courageous and strong. I will always recycle, never throw batteries in the trash can, among other things.

Sincerely,
Penny Hung

Dear Dr. Rita Thornton,

Thank you for coming yesterday. Further more, Thank you for the book. I also thank you for autographing our books.

Sincerely,
Mishella
Romo
femme 4
NJIT

8-3-04

Dr. Rita Thorton
Environmental Specialist
Trenton, NJ

Dear Dr. Thornton,

Thank you for coming over and teaching us more about the environment & it's problems. Thank you for giving us a suitcase full of dreams & autographing it. I think the book is really interestin Thank you so much. I hope you can teach me more if you come to femme 5.

Sincerely,

Vanessa Velasquez

Dr. Rita Thorton
Environmental Specialist
Trenton, NJ

8/3/04

Dear Dr. Thorton,

I read a little bit about your book. I like the tittle and the beginning. Thank you for giving me that great book.

Sincerely,
Briana Moncada

8/3/04

Dr Rita Thornton,
Enviromental Specialist
Trenton, NJ

Dear Dr. Thornton,
Thanks for your presentation. It was great! I really liked your presentation. It was really creative. I hope you have a great summer. I loved your book. I hope you keep writing books!

Sincerely,
Zoila Santos
NJFT

APPENDIX H

ICP-MS QUANTITATIVE REPORT: RAW DATA

The Raw Data on the five targeted metal particulate pollutants was submitted to the researcher by the NJIT York Center CEES laboratory analyst.

Quantitation Report - Summary

File Name : 019SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1211A.B\019SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71205.C
Acq Time : Jul 12 2005 12:13 pm
Sample Name : 1
Sample Type : Sample
Comments : Blank
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 12 2005 00:45 pm
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		217,703.0	P	---	---	---	-
V	51	45	0.9816635	P	0.9098 ppb	33.58	0.90	3
Mn	55	72	43.24284	P	10.28 ppb	5.76	0.90	3
Ni	60	72	90.41154	P	123.1 ppb	4.24	0.90	3
Zn	66	72	3,459.744	A	6,987 ppb	3.97	0.90	3
Ge	72		58,854.81	P	---	---	---	-
Pb	208	209	157.6908	A	148.5 ppb	2.00	0.90	3
Bi	209		404,053.5	M	---	---	---	-

End of Report

Wed Jul 13 09:59:42 2005

Quantitation Report - Summary

File Name : 020SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1211A.B\020SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71205.C
Acq Time : Jul 12 2005 12:17 pm
Sample Name : 2
Sample Type : Sample
Comments : Blank
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 12 2005 00:45 pm
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		218,944.4	P	---	---	---	-
V	51	45	0.7557710	P	0.6435 ppb	33.50	0.90	3
Mn	55	72	27.61796	P	6.585 ppb	5.26	0.90	3
Ni	60	72	61.43552	P	83.62 ppb	0.64	0.90	3
Zn	66	72	954.2515	A	1,926 ppb	4.17	0.90	3
Ge	72		58,398.89	P	---	---	---	-
Pb	208	209	18.89967	P	17.08 ppb	2.32	0.90	3
Bi	209		373,185.5	P	---	---	---	-

End of Report

Wed Jul 13 10:00:57 2005

Quantitation Report - Summary

File Name : 021SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1211A.B\021SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71205.C
Acq Time : Jul 12 2005 12:21 pm
Sample Name : 3
Sample Type : Sample
Comments : Blank
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 12 2005 00:45 pm
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		468,317.8	A	---	---	---	-
V	51	45	0.4324532	P	0.2624 ppb	66.77	0.90	3
Mn	55	72	39.75465	P	9.451 ppb	3.56	0.90	3
Ni	60	72	38.66445	P	52.56 ppb	5.19	0.90	3
Zn	66	72	2,266.878	A	4,578 ppb	5.05	0.90	3
Ge	72		116,468.1	P	---	---	---	-
Pb	208	209	9.540039	P	8.217 ppb	2.14	0.90	3
Bi	209		796,998.4	A	---	---	---	-

End of Report

Wed Jul 13 10:01:35 2005

Quantitation Report - Summary

File Name : 022SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1211A.B\022SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71205.C
Acq Time : Jul 12 2005 12:25 pm
Sample Name : 4
Sample Type : Sample
Comments : Blank
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 12 2005 00:45 pm
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		431,938.2	M	---	---	---	-
V	51	45	0.2284187	P	0.02193 ppb	792.98	0.90	3
Mn	55	72	8.627890	P	2.100 ppb	4.39	0.90	3
Ni	60	72	29.46492	P	40.01 ppb	1.58	0.90	3
Zn	66	72	11.72673	P	21.71 ppb	1.11	0.90	3
Ge	72		115,434.1	P	---	---	---	-
Pb	208	209	4.266913	P	3.222 ppb	0.29	0.90	3
Bi	209		767,111.6	A	---	---	---	-

End of Report

Wed Jul 13 10:02:20 2005

Quantitation Report - Summary

File Name : 023SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1211A.B\023SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71205.C
Acq Time : Jul 12 2005 12:29 pm
Sample Name : 5
Sample Type : Sample
Comments : Blank
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 12 2005 00:45 pm
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		438,416.3	A	---	---	---	-
V	51	45	0.3586674	P	0.1755 ppb	57.66	0.90	3
Mn	55	72	31.59819	P	7.525 ppb	0.59	0.90	3
Ni	60	72	63.81487	P	86.87 ppb	2.45	0.90	3
Zn	66	72	62.18392	P	123.6 ppb	4.41	0.90	3
Ge	72		114,379.6	P	---	---	---	-
Pb	208	209	4.566380	P	3.506 ppb	6.12	0.90	3
Bi	209		761,345.9	A	---	---	---	-

End of Report

Wed Jul 13 10:03:06 2005

Quantitation Report - Summary

File Name : 024SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1211A.B\024SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71205.C
Acq Time : Jul 12 2005 12:32 pm
Sample Name : 6
Sample Type : Sample
Comments : Blank
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 12 2005 00:45 pm
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		465,336.8	M	---	---	---	-
V	51	45	0.2661892	P	0.06645 ppb	56.36	0.90	3
Mn	55	72	14.38900	P	3.461 ppb	3.01	0.90	3
Ni	60	72	23.06391	P	31.28 ppb	3.01	0.90	3
Zn	66	72	41.84713	P	82.56 ppb	3.25	0.90	3
Ge	72		118,900.0	P	---	---	---	-
Pb	208	209	3.734205	P	2.718 ppb	3.46	0.90	3
Bi	209		788,268.6	A	---	---	---	-

End of Report

Wed Jul 13 10:03:41 2005

Quantitation Report - Summary

File Name : 010SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1117B.B\010SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71105.C
Acq Time : Jul 11 2005 06:02 pm
Sample Name : #1
Sample Type : Sample
Comments :
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 13 2005 10:10 am
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		251,266.7	P	---	---	---	-
V	51	45	9.031832	P	10.19 ppb	0.95	0.90	3
Mn	55	72	152.0980	P	36.91 ppb	3.58	0.90	3
Ni	60	72	63.06994	P	88.45 ppb	2.97	0.90	3
Zn	66	72	173.7536	P	350.3 ppb	4.28	0.90	3
Ge	72		68,146.30	P	---	---	---	-
Pb	208	209	30.40515	P	27.27 ppb	2.09	0.90	3
Bi	209		377,204.4	P	---	---	---	-

End of Report

Wed Jul 13 10:11:29 2005

Quantitation Report - Summary

File Name : 011SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1117B.B\011SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71105.C
Acq Time : Jul 11 2005 06:06 pm
Sample Name : #2
Sample Type : Sample
Comments :
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 13 2005 10:10 am
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		253,139.3	P	---	---	---	-
V	51	45	8.516711	P	9.578 ppb	3.49	0.90	3
Mn	55	72	59.55716	P	14.22 ppb	2.55	0.90	3
Ni	60	72	72.37474	P	101.5 ppb	3.43	0.90	3
Zn	66	72	109.6115	P	220.9 ppb	4.16	0.90	3
Ge	72		68,504.81	P	---	---	---	-
Pb	208	209	10.70982	P	9.509 ppb	0.84	0.90	3
Bi	209		376,477.0	P	---	---	---	-

End of Report

Wed Jul 13 10:12:13 2005

Quantitation Report - Summary

File Name : 012SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1117B.B\012SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71105.C
Acq Time : Jul 11 2005 06:09 pm
Sample Name : #3
Sample Type : Sample
Comments :
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 13 2005 10:10 am
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		265,793.0	P	---	---	---	-
V	51	45	1.686296	P	1.447 ppb	11.37	0.90	3
Mn	55	72	27.58948	P	6.380 ppb	1.39	0.90	3
Ni	60	72	53.78951	P	75.43 ppb	5.18	0.90	3
Zn	66	72	73.10797	P	147.3 ppb	6.21	0.90	3
Ge	72		69,110.74	P	---	---	---	-
Pb	208	209	8.470648	P	7.490 ppb	4.91	0.90	3
Bi	209		383,788.5	P	---	---	---	-

End of Report

Wed Jul 13 10:12:57 2005

Quantitation Report - Summary

File Name : 013SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1117B.B\013SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71105.C
Acq Time : Jul 11 2005 06:13 pm
Sample Name : #4
Sample Type : Sample
Comments :
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 13 2005 10:10 am
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS	Conc.	RSD(%)	Time(sec)	Rep
Sc	45		253,274.8 P	---	---	---	-
V	51	45	1.025119 P	0.6602 ppb	57.50	0.90	3
Mn	55	72	39.00367 P	9.178 ppb	4.67	0.90	3
Ni	60	72	58.33161 P	81.80 ppb	1.83	0.90	3
Zn	66	72	62.04921 P	125.0 ppb	3.12	0.90	3
Ge	72		66,964.81 P	---	---	---	-
Pb	208	209	11.52532 P	10.24 ppb	1.85	0.90	3
Bi	209		362,514.1 P	---	---	---	-

End of Report

Wed Jul 13 10:13:39 2005

Quantitation Report - Summary

File Name : 014SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1117B.B\014SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71105.C
Acq Time : Jul 11 2005 06:17 pm
Sample Name : #5
Sample Type : Sample
Comments :
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 13 2005 10:10 am
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		294,332.2	P	---	---	---	-
V	51	45	2.733634	P	2.694 ppb	6.07	0.90	3
Mn	55	72	216.0209	P	52.58 ppb	2.02	0.90	3
Ni	60	72	49.06436	P	68.80 ppb	4.30	0.90	3
Zn	66	72	712.2644	A	1,436 ppb	5.75	0.90	3
Ge	72		76,530.37	P	---	---	---	-
Pb	208	209	24.02545	P	21.52 ppb	4.77	0.90	3
Bi	209		416,345.9	P	---	---	---	-

End of Report

Wed Jul 13 10:14:19 2005

Quantitation Report - Summary

File Name : 015SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1117B.B\015SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71105.C
Acq Time : Jul 11 2005 06:21 pm
Sample Name : #6
Sample Type : Sample
Comments :
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 13 2005 10:10 am
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		259,850.7	P	---	---	---	-
V	51	45	0.6816541	P	0.2514 ppb	60.74	0.90	3
Mn	55	72	31.66061	P	7.378 ppb	4.42	0.90	3
Ni	60	72	60.28002	P	84.53 ppb	1.99	0.90	3
Zn	66	72	67.86940	P	136.7 ppb	2.89	0.90	3
Ge	72		71,970.00	P	---	---	---	-
Pb	208	209	10.35977	P	9.194 ppb	3.34	0.90	3
Bi	209		371,995.5	P	---	---	---	-

End of Report

Wed Jul 13 10:14:59 2005

Quantitation Report - Summary

File Name : 016SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1117B.B\016SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71105.C
Acq Time : Jul 11 2005 06:25 pm
Sample Name : #7
Sample Type : Sample
Comments :
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 13 2005 10:10 am
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		271,574.4	P	---	---	---	-
V	51	45	3.411101	P	3.500 ppb	5.99	0.90	3
Mn	55	72	44.93053	P	10.63 ppb	7.75	0.90	3
Ni	60	72	57.51213	P	80.65 ppb	3.83	0.90	3
Zn	66	72	87.57491	P	176.4 ppb	2.21	0.90	3
Ge	72		73,497.77	P	---	---	---	-
Pb	208	209	7.404788	P	6.529 ppb	2.14	0.90	3
Bi	209		385,379.3	P	---	---	---	-

End of Report

Wed Jul 13 10:15:41 2005

Quantitation Report - Summary

File Name : 017SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1117B.B\017SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71105.C
Acq Time : Jul 11 2005 06:29 pm
Sample Name : #8
Sample Type : Sample
Comments :
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 13 2005 10:10 am
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		267,775.2	P	---	---	---	-
V	51	45	2.055528	P	1.887 ppb	19.51	0.90	3
Mn	55	72	46.44951	P	11.00 ppb	2.91	0.90	3
Ni	60	72	54.09475	P	75.86 ppb	4.41	0.90	3
Zn	66	72	72.28409	P	145.6 ppb	1.57	0.90	3
Ge	72		71,470.37	P	---	---	---	-
Pb	208	209	8.247931	P	7.289 ppb	4.22	0.90	3
Bi	209		380,176.3	P	---	---	---	-

End of Report

Wed Jul 13 10:16:35 2005

Quantitation Report - Summary

File Name : 018SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1117B.B\018SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71105.C
Acq Time : Jul 11 2005 06:32 pm
Sample Name : #9
Sample Type : Sample
Comments :
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 13 2005 10:10 am
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		268,876.3	P	---	---	---	-
V	51	45	14.72681	P	16.97 ppb	0.38	0.90	3
Mn	55	72	89.44751	P	21.55 ppb	2.63	0.90	3
Ni	60	72	69.26938	P	97.15 ppb	0.59	0.90	3
Zn	66	72	159.7906	P	322.1 ppb	2.65	0.90	3
Ge	72		71,399.63	P	---	---	---	-
Pb	208	209	23.94284	P	21.44 ppb	1.78	0.90	3
Bi	209		390,605.5	P	---	---	---	-

End of Report

Wed Jul 13 10:17:15 2005

Quantitation Report - Summary

File Name : 019SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1117B.B\019SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71105.C
Acq Time : Jul 11 2005 06:36 pm
Sample Name : #10
Sample Type : Sample
Comments :
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 13 2005 10:10 am
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		274,062.6	P	---	---	---	-
V	51	45	12.28657	P	14.07 ppb	2.11	0.90	3
Mn	55	72	74.25657	P	17.82 ppb	1.24	0.90	3
Ni	60	72	59.04432	P	82.80 ppb	2.69	0.90	3
Zn	66	72	102.3525	P	206.2 ppb	2.97	0.90	3
Ge	72		72,730.37	P	---	---	---	-
Pb	208	209	18.25886	P	16.32 ppb	2.37	0.90	3
Bi	209		382,600.7	P	---	---	---	-

End of Report

Wed Jul 13 10:18:40 2005

Quantitation Report - Summary

File Name : 001SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1211A.B\001SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71205.C
Acq Time : Jul 12 2005 11:04 am
Sample Name : #11
Sample Type : Sample
Comments :
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 12 2005 00:45 pm
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		230,182.2	P	---	---	---	-
V	51	45	20.71834	P	24.17 ppb	3.47	0.90	3
Mn	55	72	90.89011	P	21.53 ppb	0.45	0.90	3
Ni	60	72	76.52648	P	104.2 ppb	1.67	0.90	3
Zn	66	72	94.78672	P	189.5 ppb	5.36	0.90	3
Ge	72		61,742.22	P	---	---	---	-
Pb	208	209	24.65764	P	22.54 ppb	2.57	0.90	3
Bi	209		412,086.3	P	---	---	---	-

End of Report

Tue Jul 12 17:19:40 2005

Quantitation Report - Summary

File Name : 002SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1211A.B\002SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71205.C
Acq Time : Jul 12 2005 11:08 am
Sample Name : #12
Sample Type : Sample
Comments :
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 12 2005 00:45 pm
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		223,092.6	P	---	---	---	-
V	51	45	3.290602	P	3.631 ppb	6.98	0.90	3
Mn	55	72	127.3908	P	30.15 ppb	3.20	0.90	3
Ni	60	72	61.72302	P	84.01 ppb	4.17	0.90	3
Zn	66	72	143.4697	P	287.9 ppb	3.78	0.90	3
Ge	72		58,243.33	P	---	---	---	-
Pb	208	209	31.84697	P	29.34 ppb	4.58	0.90	3
Bi	209		396,378.3	M	---	---	---	-

End of Report

Tue Jul 12 17:21:29 2005

Quantitation Report - Summary

File Name : 003SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1211A.B\003SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71205.C
Acq Time : Jul 12 2005 11:12 am
Sample Name : #13
Sample Type : Sample
Comments :
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 12 2005 00:45 pm
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS	Conc.	RSD(%)	Time(sec)	Rep
Sc	45		221,521.1 P	---	---	---	-
V	51	45	5.460914 P	6.190 ppb	2.54	0.90	3
Mn	55	72	37.99655 P	9.036 ppb	3.03	0.90	3
Ni	60	72	56.00207 P	76.21 ppb	0.64	0.90	3
Zn	66	72	59.42288 P	118.1 ppb	4.19	0.90	3
Ge	72		60,668.89 P	---	---	---	-
Pb	208	209	7.722404 P	6.495 ppb	3.86	0.90	3
Bi	209		386,507.8 P	---	---	---	-

End of Report

Tue Jul 12 17:22:26 2005

Quantitation Report - Summary

File Name : 004SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1211A.B\004SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71205.C
Acq Time : Jul 12 2005 11:16 am
Sample Name : #14
Sample Type : Sample
Comments :
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 12 2005 00:45 pm
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS	Conc.	RSD(%)	Time(sec)	Rep
Sc	45		218,491.5 P	---	---	---	-
V	51	45	25.16349 P	29.41 ppb	6.28	0.90	3
Mn	55	72	97.25501 P	23.03 ppb	6.98	0.90	3
Ni	60	72	75.04671 P	102.2 ppb	4.44	0.90	3
Zn	66	72	80.23073 P	160.1 ppb	1.71	0.90	3
Ge	72		59,316.30 P	---	---	---	-
Pb	208	209	27.13634 P	24.88 ppb	1.85	0.90	3
Bi	209		375,612.2 P	---	---	---	-

End of Report

Tue Jul 12 17:24:19 2005

Quantitation Report - Summary

File Name : 005SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1211A.B\005SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71205.C
Acq Time : Jul 12 2005 11:20 am
Sample Name : #15
Sample Type : Sample
Comments :
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 12 2005 00:45 pm
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		214,294.4	P	---	---	---	-
V	51	45	11.69820	P	13.54 ppb	8.45	0.90	3
Mn	55	72	45.12810	P	10.72 ppb	5.62	0.90	3
Ni	60	72	65.14263	P	88.68 ppb	2.92	0.90	3
Zn	66	72	162.5991	P	326.5 ppb	3.59	0.90	3
Ge	72		59,053.33	P	---	---	---	-
Pb	208	209	12.81257	P	11.32 ppb	4.39	0.90	3
Bi	209		365,188.9	P	---	---	---	-

End of Report

Tue Jul 12 17:25:04 2005

Quantitation Report - Summary

File Name : 006SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1211A.B\006SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71205.C
Acq Time : Jul 12 2005 11:24 am
Sample Name : #16
Sample Type : Sample
Comments :
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 12 2005 00:45 pm
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		214,787.4	P	---	---	---	-
V	51	45	12.38257	P	14.35 ppb	2.28	0.90	3
Mn	55	72	61.42659	P	14.57 ppb	2.46	0.90	3
Ni	60	72	68.52205	P	93.29 ppb	2.49	0.90	3
Zn	66	72	388.1668	M	782.2 ppb	2.47	0.90	3
Ge	72		61,270.74	P	---	---	---	-
Pb	208	209	13.90445	P	12.35 ppb	4.86	0.90	3
Bi	209		383,553.7	P	---	---	---	-

End of Report

Tue Jul 12 17:25:41 2005

Quantitation Report - Summary

File Name : 007SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1211A.B\007SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71205.C
Acq Time : Jul 12 2005 11:27 am
Sample Name : #17
Sample Type : Sample
Comments :
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 12 2005 00:45 pm
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		230,904.4	P	---	---	---	-
V	51	45	1.359711	P	1.355 ppb	13.85	0.90	3
Mn	55	72	34.13456	P	8.124 ppb	3.29	0.90	3
Ni	60	72	50.80973	P	69.13 ppb	2.67	0.90	3
Zn	66	72	894.1171	A	1,804 ppb	3.55	0.90	3
Ge	72		63,452.96	P	---	---	---	-
Pb	208	209	7.389104	P	6.180 ppb	3.61	0.90	3
Bi	209		375,998.9	P	---	---	---	-

End of Report

Tue Jul 12 17:26:17 2005

Quantitation Report - Summary

File Name : 008SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1211A.B\008SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71205.C
Acq Time : Jul 12 2005 11:31 am
Sample Name : #18
Sample Type : Sample
Comments :
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 12 2005 00:45 pm
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		235,609.6	P	---	---	---	-
V	51	45	1.858091	P	1.943 ppb	2.30	0.90	3
Mn	55	72	27.71217	P	6.607 ppb	2.84	0.90	3
Ni	60	72	55.43228	P	75.43 ppb	2.32	0.90	3
Zn	66	72	1,432.937	A	2,893 ppb	4.71	0.90	3
Ge	72		61,812.59	P	---	---	---	-
Pb	208	209	10.19447	P	8.837 ppb	1.46	0.90	3
Bi	209		405,981.8	P	---	---	---	-

End of Report

Tue Jul 12 17:27:36 2005

Quantitation Report - Summary

File Name : 009SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1211A.B\009SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71205.C
Acq Time : Jul 12 2005 11:35 am
Sample Name : #19
Sample Type : Sample
Comments :
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 12 2005 00:45 pm
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		231,698.9	P	---	---	---	-
V	51	45	5.627065	P	6.386 ppb	2.75	0.90	3
Mn	55	72	66.63667	P	15.80 ppb	2.39	0.90	3
Ni	60	72	61.24491	P	83.36 ppb	4.68	0.90	3
Zn	66	72	1,454.717	A	2,937 ppb	6.12	0.90	3
Ge	72		64,057.03	P	---	---	---	-
Pb	208	209	116.2315	A	109.3 ppb	5.14	0.90	3
Bi	209		432,561.8	M	---	---	---	-

End of Report

Tue Jul 12 17:28:09 2005

Quantitation Report - Summary

File Name : 010SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1211A.B\010SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71205.C
Acq Time : Jul 12 2005 11:39 am
Sample Name : #20
Sample Type : Sample
Comments :
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 12 2005 00:45 pm
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		233,604.4	P	---	---	---	-
V	51	45	7.553970	P	8.657 ppb	4.04	0.90	3
Mn	55	72	66.51908	P	15.77 ppb	3.71	0.90	3
Ni	60	72	57.61380	P	78.41 ppb	4.77	0.90	3
Zn	66	72	1,798.960	A	3,632 ppb	0.82	0.90	3
Ge	72		63,614.44	P	---	---	---	-
Pb	208	209	21.26128	P	19.32 ppb	1.71	0.90	3
Bi	209		399,664.0	P	---	---	---	-

End of Report

Wed Jul 13 09:53:23 2005

Quantitation Report - Summary

File Name : 011SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1211A.B\011SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71205.C
Acq Time : Jul 12 2005 11:43 am
Sample Name : #21
Sample Type : Sample
Comments :
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 12 2005 00:45 pm
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		223,977.4	P	---	---	---	-
V	51	45	12.46345	P	14.44 ppb	2.33	0.90	3
Mn	55	72	44.55944	P	10.59 ppb	2.43	0.90	3
Ni	60	72	66.17962	P	90.09 ppb	0.86	0.90	3
Zn	66	72	68.62447	P	136.7 ppb	7.21	0.90	3
Ge	72		60,490.37	P	---	---	---	-
Pb	208	209	18.09706	P	16.32 ppb	3.25	0.90	3
Bi	209		389,468.9	P	---	---	---	-

End of Report

Wed Jul 13 09:54:14 2005

Quantitation Report - Summary

File Name : 012SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1211A.B\012SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71205.C
Acq Time : Jul 12 2005 11:47 am
Sample Name : #22
Sample Type : Sample
Comments :
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 12 2005 00:45 pm
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		218,890.4	P	---	---	---	-
V	51	45	1.384121	P	1.384 ppb	19.10	0.90	3
Mn	55	72	18.30049	P	4.385 ppb	1.85	0.90	3
Ni	60	72	56.66957	P	77.12 ppb	4.25	0.90	3
Zn	66	72	260.5855	P	524.5 ppb	3.63	0.90	3
Ge	72		60,093.70	P	---	---	---	-
Pb	208	209	7.094130	P	5.900 ppb	3.06	0.90	3
Bi	209		384,629.6	P	---	---	---	-

End of Report

Wed Jul 13 09:54:50 2005

Quantitation Report - Summary

File Name : 013SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1211A.B\013SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71205.C
Acq Time : Jul 12 2005 11:50 am
Sample Name : #23
Sample Type : Sample
Comments :
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 12 2005 00:45 pm
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		220,764.1	P	---	---	---	-
V	51	45	5.219990	P	5.906 ppb	7.68	0.90	3
Mn	55	72	49.13161	P	11.67 ppb	0.53	0.90	3
Ni	60	72	56.00429	P	76.21 ppb	3.50	0.90	3
Zn	66	72	56.12295	P	111.4 ppb	5.71	0.90	3
Ge	72		60,477.03	P	---	---	---	-
Pb	208	209	11.62402	P	10.19 ppb	2.15	0.90	3
Bi	209		389,575.2	P	---	---	---	-

End of Report

Wed Jul 13 09:55:28 2005

Quantitation Report - Summary

File Name : 014SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1211A.B\014SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71205.C
Acq Time : Jul 12 2005 11:54 am
Sample Name : #24
Sample Type : Sample
Comments :
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 12 2005 00:45 pm
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		215,837.4	P	---	---	---	-
V	51	45	2.006730	P	2.118 ppb	4.97	0.90	3
Mn	55	72	52.43413	P	12.45 ppb	1.83	0.90	3
Ni	60	72	51.48304	P	70.04 ppb	4.26	0.90	3
Zn	66	72	1,310.146	A	2,645 ppb	2.57	0.90	3
Ge	72		61,165.18	P	---	---	---	-
Pb	208	209	9.103383	P	7.803 ppb	2.11	0.90	3
Bi	209		374,691.1	P	---	---	---	-

End of Report

Wed Jul 13 09:56:14 2005

Quantitation Report - Summary

File Name : 015SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1211A.B\015SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71205.C
Acq Time : Jul 12 2005 11:58 am
Sample Name : #25
Sample Type : Sample
Comments :
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 12 2005 00:45 pm
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS	Conc.	RSD(%)	Time(sec)	Rep
Sc	45		210,611.1 P	---	---	---	-
V	51	45	1.013557 P	0.9474 ppb	49.42	0.90	3
Mn	55	72	36.55660 P	8.696 ppb	4.87	0.90	3
Ni	60	72	53.52796 P	72.83 ppb	3.80	0.90	3
Zn	66	72	129.3355 P	259.3 ppb	8.24	0.90	3
Ge	72		58,608.52 P	---	---	---	-
Pb	208	209	8.249506 P	6.994 ppb	2.75	0.90	3
Bi	209		357,186.3 P	---	---	---	-

End of Report

Wed Jul 13 09:57:00 2005

Quantitation Report - Summary

File Name : 016SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1211A.B\016SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71205.C
Acq Time : Jul 12 2005 12:02 pm
Sample Name : #26
Sample Type : Sample
Comments :
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 12 2005 00:45 pm
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		234,503.0	P	---	---	---	-
V	51	45	0.9526800	P	0.8756 ppb	10.14	0.90	3
Mn	55	72	49.20822	P	11.68 ppb	3.95	0.90	3
Ni	60	72	57.03391	P	77.62 ppb	3.08	0.90	3
Zn	66	72	1,081.953	A	2,184 ppb	1.80	0.90	3
Ge	72		61,322.96	P	---	---	---	-
Pb	208	209	10.58472	P	9.206 ppb	3.02	0.90	3
Bi	209		366,153.7	P	---	---	---	-

End of Report

Wed Jul 13 09:57:41 2005

Quantitation Report - Summary

File Name : 017SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1211A.B\017SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71205.C
Acq Time : Jul 12 2005 12:06 pm
Sample Name : #27
Sample Type : Sample
Comments :
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 12 2005 00:45 pm
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		225,020.4	P	---	---	---	-
V	51	45	0.9593742	P	0.8835 ppb	22.52	0.90	3
Mn	55	72	46.75146	P	11.10 ppb	1.46	0.90	3
Ni	60	72	54.56706	P	74.25 ppb	3.83	0.90	3
Zn	66	72	2,236.264	A	4,516 ppb	5.64	0.90	3
Ge	72		60,969.25	P	---	---	---	-
Pb	208	209	11.89202	P	10.44 ppb	6.05	0.90	3
Bi	209		386,242.9	P	---	---	---	-

End of Report

Wed Jul 13 09:58:19 2005

Quantitation Report - Summary

File Name : 018SMPL.D#
File Path : C:\ICPCHEM\1\DATA\05G1211A.B\018SMPL.D\
Method : C:\ICPCHEM\1\METHODS\71205.M
Calibration : C:\ICPCHEM\1\CALIB\71205.C
Acq Time : Jul 12 2005 12:10 pm
Sample Name : #28
Sample Type : Sample
Comments :
Prep Dilution : 1.00
Auto Dilution : Undiluted
Total Dilution : 1.00
Operator Name: Larisa
Acq Mode : Spectrum
Cal Title : Environmental samples
Cal Type : External Calibration Method (Unweighted)
Last Calib : Jul 12 2005 00:45 pm
Bkg File : --------
Bkg Rejected Masses: --------
Interference Correction : ON
Blank File : --------

Element	Mass	IS	CPS		Conc.	RSD(%)	Time(sec)	Rep
Sc	45		227,669.3	P	---	---	---	-
V	51	45	0.9404450	P	0.8612 ppb	28.62	0.90	3
Mn	55	72	49.68129	P	11.80 ppb	2.73	0.90	3
Ni	60	72	52.74110	P	71.76 ppb	4.40	0.90	3
Zn	66	72	146.6308	P	294.2 ppb	1.75	0.90	3
Ge	72		60,761.11	P	---	---	---	-
Pb	208	209	9.833510	P	8.495 ppb	2.23	0.90	3
Bi	209		378,364.4	P	---	---	---	-

End of Report

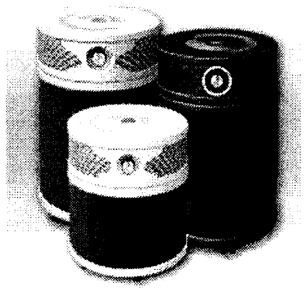
Wed Jul 13 09:59:07 2005

APPENDIX I

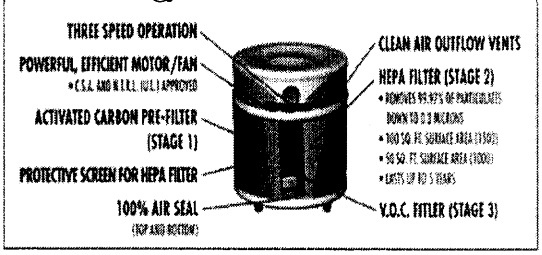
HEPA FILTER AIR CLEANER

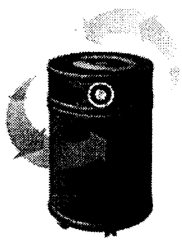
Introductory information and operating instructions on the Allergy Solutions Air Cleaner and its internal filtering mechanism. The Newark Preschool Council Administrators and Health Coordinators chose this air cleaner to be purchased and installed in the East and South Ward preschool classrooms with the most asthmatic children in attendance.

Indoor Particulate Air Pollution Abatement Equipment



Allergy Solution AS1000 model





HEPA Filter Air Cleaners

[purchased and installed in Terrell Holmes and Greater Abyssinian II preschool classrooms]

- **Uses filter & fan to trap particles**
- **Removes air-borne particulates, dust, pollen, mold, bacteria & other air particles**
- **Uses powerful & efficient motor /Fan**
- **Removes 99.97% of particulates down to (0.3µ)**
- **Cleans/purifies area up to 1000 square feet**
- **Activated Carbon "Pre-Filter" removes large particulates which eliminates costly HEPA filter changes - *Stage 1***
- **100 SQ Ft. of HEPA media allows filtration with NO ozone released at traceable amounts - *Stage 2***
- **Air is vented upward forcing room air to circulate**
- **VOC filter removes hazardous chemicals from cleaners, solvents and carpets- *Stage 3***

Allergy Solution Air Cleaner has a 3-Stage process for air purification of a room.

The pre-filter for Stage 1;

HEPA filter for State 2; and

VOC filter for Stage 3

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