Science of Environmental Justice: Participatory Research and Cumulative Risk

May 24-26, 2004
Boston, Massachusetts

Report of the Regional Science Topic Workshop on the Science of Environmental Justice

ORD REGION

RESEARCH AND DEVELOPMENT

Acknowledgments

We would like to take this opportunity to give special thanks to everyone who played a role in the design, planning, implementation and documentation of the Science of Environmental Justice Working Conference. The event was titled, "Science to Action: Community-based Participatory Research and Cumulative Risk Analysis as Tools to Advance Environmental Justice in Urban, Suburban and Rural Communities," and was co-sponsored by the U.S. Environmental Protection Agency (EPA) New England, EPA Office of Research and Development and Boston University's School of Public Health. This event was a first for EPA and was attended by 275 scientists, policy-makers, academia, non-profit organization leaders and community residents who discussed complex and critical issues facing environmental justice communities across the nation. Each step of the process, from inception to final report creation, required significant energy and we thank all of the individuals that helped us achieve such a successful effort. Boston University, especially the School of Public Health's Department of Environmental Health, was instrumental in crafting the vision of this conference based on their holistic approach to public health protection. EPA New England's Environmental Justice Program, within the Office of Civil Rights & Urban Affairs, and the Urban Environmental Program deserve a special note of thanks for conceptualizing, advocating and leading the planning effort for this unique event. We are also appreciative of EPA New England Regional Administrator Robert W. Varney's ongoing commitment to environmental justice and support for this conference.

One of the most impressive outcomes from the event was raising awareness and understanding among participants and illustrating the need to incorporate community-based participatory research in any scientific approach. We must act to ensure that citizens most in need of environmental and public health protection are directly involved and the direct beneficiaries of sound science, technology and action that achieves measurable environmental and public health results. It is our firm belief and hope that this event is the first of many steps that will lead to an ongoing, national dialogue between representatives from the community, academia, non-profit organizations, EPA policy-makers and scientists. As a result, we have been able to help the agency take a meaningful step toward institutionalizing the principles of environmental justice and have set the stage for finding new ways to reverse environmental injustices and better serve the future needs of communities across the country in the future.

James M. Younger
Director
Office of Civil Rights & Urban Affairs
U.S. EPA New England

David Klauder
Regional Science Liaison Program Manager
Office of Science Policy
U.S. EPA Research and Development

H. Patricia Hynes
Professor of Environmental Health
Department of Environmental Health
Boston University School of Public Health

Credits

Authors:
Boston University School of Public Health: H. Patricia Hynes
EPA Headquarters: Rita Schoeny
EPA New England: Lois K. Adams, Halida Hatic, Robert Hillger and Kristi N. Rea
EPA Region 2: Ariel Iglesias
EPA Region 6: Michael Callahan
West Harlem Environmental Action: Swati Prakash

Peer Reviewers & Planning Committee:
Boston University School of Public Health: H. Patricia Hynes
EPA Headquarters: Dick Garnas, David Klauder, Devon Payne-Sturges and Hank Topper
EPA New England: Lois K. Adams, Kathy Castagna, Anastasia Cunningham, Halida Hatic, Robert Hillger, Michael Joseph, Sandra Padula, Julianne Pardi, Kristi N. Rea, Chau Vu, Davina Wysin and James M. Younger
EPA Region 2: Ariel Iglesias and Terry Wesley
EPA Region 3: Reggie Harris
EPA Region 6: Mike Callahan
EPA Region 7: Pam Johnson and Andri Jovan
University of Massachusetts-Lowell: Joel Tickner
West Harlem Environmental Action: Swati Prakash

Displays and Exhibits:
Connecticut Coalition for Environmental Justice: Dr. Mark Mitchell
EPA Headquarters: Daria Willis
EPA New England: Eugene Benoit, Dan Brown, Paul Carroll, Deborah Cohen, Diane Kelly, Al Wong and Valerie Zartarian
EPA Region 6: Steve Thompson
Lead Action Collaborative: Ryan Torres
Micah's Mission: Jill McElheney
Paicoma Beautiful: Fernando Rejon
South Bronx Clean Air Coalition: Carlos Alicea,
Trust for America's Health: Lois Banks

Special Conference Contributions:
Boston University School of Public Health: Curtis Teixeira,
EPA New England: Marie Dicesare and Christine Foot

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From Science to Action: Community-based Participatory Research and Cumulative Risk Analysis as Tools to Advance Environmental Justice in Urban, Suburban and Rural Communities

Executive Summary

On May 24-26, 2004, U.S. Environmental Protection Agency (EPA) New England, EPA's Office of Research and Development (ORD) and Boston University's School of Public Health (BUSPH) co-sponsored the Science of Environmental Justice (SEJ) Working Conference in Boston, Mass. The title of the conference was: *Science to Action: Community-based Participatory Research and Cumulative Risk Analysis as Tools to Advance Environmental Justice in Urban, Suburban and Rural Communities.* The conference provided an interactive, educational forum and joined together stakeholders from across the country to discuss current efforts in community-based participatory research (CBPR) and cumulative risk analysis that are helping to assess, address and resolve environmental and public health risks in urban, suburban and rural areas. The conference presented methods and facilitated discussion regarding needs and opportunities for EPA and other research entities to invest in innovative scientific paradigms in order to better protect human health and the environment in environmental justice communities.

The conference resulted from the awareness that many vulnerable communities and populations (i.e., communities of color, low-income communities, children, the elderly and subsistence fishers) face higher exposures or risks to their overall health and well-being from environmental sources. Traditional research and risk assessment methods have played an important role in reducing significant environmental health risks to the American public, but must be improved to better protect vulnerable populations and to further reduce residual risks. Achieving environmental justice for every community requires a different scientific approach, one that is rooted in communities and that can incorporate people's social stressors, economic stressors, unique needs and vulnerabilities. This conference proposed that community-based participatory research and cumulative risk assessment can form the core of this new science of environmental justice and explored, in-depth, the definitions, successes, needs and long-term opportunities for integrating this approach into EPA's research agenda.

The SEJ conference brought together 275 individuals, including scientists, technical experts, community and non-profit group leaders, academia and government representatives from 25 states, the District of Columbia, Puerto Rico and the Virgin Islands. The first day of the conference featured a community tour of Chelsea and East Boston, Mass., which set the stage with a real-life context for discussing ways of better assessing cumulative risks and utilizing participatory approaches to research. The conference sessions included plenary panels on community-based participatory research and cumulative risk. Breakout groups focused on ways to incorporate CBPR or cumulative risk approaches to research on the following topics: Air Toxics, Asthma, Children's Environmental Health, Land-based Risks and Water Quality.

Framing Themes: Community-based Participatory Research and Cumulative Risk Assessment

Community-based Participatory Research

Community-based participatory research (CBPR) holds great potential to improve the accuracy, precision, reliability and relevance of data that are designed to represent real-life and to protect human health and the environment. Traditional challenges in environmental epidemiology, exposure assessment or environmental monitoring studies include accurately capturing data that represents a broad range of human activity patterns and taking precise, unbiased measurements. CBPR is defined as research in which "scientists work in close collaboration with community partners involved in all phases of the research, from the inception of the research questions and study design to the collection of data, monitoring of ethical concerns and interpretation of the study results." [1] To this basic definition conference panelists added that CBPR ultimately is about translating research, especially the most relevant and useful science, into better environmental and human health protection and promotion. One panelist stressed three basic principles of the related approach of participatory action research: 1) the participation of the community at every step; 2) equal distribution of power and results among partners; and 3) action-oriented outcomes.

Some specific recommendations for building strong partnerships to conduct CBPR and advance environmental protection included building the scientific capacity of community institutions to engage in research and encouraging long-term collaborations between academic institutions, government agencies and community-based organizations. A panelist from the EPA's Office of Research and Development (ORD) noted that community involvement in ORD research projects was valuable in the design, implementation and actual conduct of studies, and in the analysis and communication of the resulting data. Other panelists noted that community involvement in environmental research becomes crucial for ensuring that public policy makes sense in real life, rather than getting lost in the minutiae of data details, and serves as a public interest counterweight to the increasing private funding of research.

Cumulative Risk Assessment

Traditional risk assessment methods that have been used by the EPA and other regulatory bodies are intended to identify and reduce the greatest risks to human health and the environment, and in many instances these methods have been effective. However, as the environmental justice movement has helped identify, many of these risk assessment approaches have focused on one chemical, media or exposure pathway at a time, or have relied on assumptions that are not validated on a regular basis. The consequence can be approaches to risk assessment that are not effectively protecting all groups.

Cumulative risk assessment (CRA) was defined in this conference as the "analysis, characterization and possible quantification of the combined risks to health and the environment from multiple agents or stressors." Cumulative risk assessment is characterized by its focus on place or populations and investigates the question, "What types of stressors are affecting this population?" It differs from traditional risk assessment methods that focus on specific, individual chemicals or stressors and asks, "What type of threat does this agent pose to human health?"

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[1] Shepard PM, Northridge ME, Prakash S, Stover G. "Advancing Environmental Justice through Community-based Participatory Research." *Environ Health Perspect* 110(suppl 2): 139-140 (2002).

Cumulative risk assessment is notable for its focus on multiple exposures or stressors, its inclusion of non-chemical and nonphysical stressors and its integration of vulnerability or susceptibility factors. An additional development on traditional risk assessment methods is the attempt in CRA to conduct various elements of the assessment process simultaneously, or iteratively, rather than sequentially. The Framework for Cumulative Risk Assessment identifies the basic elements of the cumulative risk assessment process and provides basic guidelines for conducting cumulative risk assessment, although it does not provide specific protocol or methodologies. [2]

The Mississippi River Industrial Corridor has multiple point and area sources of air and water pollution and diverse populations, many of which are characterized by severe health burdens and characteristics that many increase their exposures or susceptibility to environmental health hazards, and was presented as an illustration of why cumulative risk assessment approaches are crucial for protecting the health of all Americans. Three case studies, of the Merrimack Valley in Mass., the industrial community of Chester, Pa., and the local communities of Chelsea and East Boston, Mass., were presented to illustrate some key lessons learned regarding cumulative risk assessment. These lessons included: 1) the need to prioritize prevention and action and recognize that aggregate and multiple risks may never be accurately assessed; 2) that a better integration of quantitative and qualitative data is needed to assess actual risks; and 3) that community involvement and collaborative approaches provide tremendous advantages for the accuracy and applicability of risk assessment and management.

Specific Topics: Air Toxics, Asthma, Children's Environmental Health, Land-based Risks and Water Quality

Air Toxics

Exposure to hazardous air pollutants (HAPs) presents significant environmental justice and public health concerns. Hazardous air pollutants, also known as air toxics, have been associated with many adverse human health effects, including cancers, asthma and other respiratory ailments and neurological problems such as learning disabilities and hyperactivity. Sources of air toxics include industrial emissions from chemical manufacturing, refineries, waste incinerators and smaller stationary facilities (e.g., dry cleaners), emissions from mobile sources (e.g., cars, buses and trucks) and consumer products. This panel presented the results from the EPA's National Air Toxics Assessment, which modeled ambient levels of major hazardous air pollutants for every county in the United States, and the related National Scale Assessment, which calculated resulting risks to human health from these air toxics and characterized the contributions of various emission sources to human exposure and risk. This assessment identified benzene, chromium and formaldehyde as national drivers of cancer risk, and arsenic, 1,3-butadiene, polycyclic organic matter and coke oven emissions as regional drivers of cancer risk in 1996. The National Scale Assessment will be used to address residual risk, or the risk remaining to human populations after the technology-based standards for emissions of hazardous air pollutants have been put into place.

Diesel exhaust was presented as an air toxic of great concern to many environmental justice communities, and the successful community-based participatory research efforts of a community

[2] Framework for Cumulative Risk Assessment. U.S. Environmental Protection Agency, Office of Research and Development, National Center for Environmental Assessment, Washington Office, Washington, DC, EPA/600/P-02/001F, 2003

group in West Oakland, Calif., was described in a case study illustrating best practices in CBPR. One panelist presented study findings linking residential segregation to racial disparities in exposure to air toxics in Southern California. This led to a discussion on the importance of including socioeconomic and political factors, including zoning, land use and transportation investments, in attempts to reduce residual risks. In other words, without understanding how and why greater segregation is linked to higher exposures to air toxics, purely regulatory and technological approaches to reducing air toxics will never be effective in protecting the most highly exposed communities.

Asthma

According to the Centers for Disease Control and Prevention (CDC), 20 million people, including 6.3 million children, have asthma. Asthma has increased sharply across the nation in the past two and a half decades, particularly in large cities. Asthma is particularly a public health crisis for some communities of color and for children, making it a classic environmental justice health challenge. The CDC reports that African-Americans continue to have higher rates of asthma emergency room visits, hospitalizations and deaths than Caucasians. Americans with lower income levels report higher asthma prevalence than those at higher income levels. Examples from schools in Connecticut, public housing in Boston, Mass. and a community-based participatory research project on asthma and air pollution in the South Bronx, New York City, were all presented to illustrate the various cumulative risks that might be contributing to the increased prevalence and the opportunities presented by community-based participatory research to reduce the harsh burden of asthma on the health of communities of color and children. Major research needs identified were:

1) Surveillance on asthma incidence and prevalence at the community-level;
2) Evaluation of the impact of primary prevention of asthma on the overall incidence;
3) Evaluation of the impact of building intervention on the severity and persistence of asthma in homes, daycare facilities and schools;
4) Detailed, multi-factorial exposure assessments of air pollution and social stressors such as violence and a better understanding of how each stressor may magnify the other; and
5) Evaluation of the efficacy of individual and bundled interventions, including interventions on environmental factors, in reducing asthma morbidity.

The value of community knowledge in asthma research was stressed. Evidence was provided to show that engaging communities in challenging inaccurate, and generally unstated, assumptions adds valuable practical knowledge and helps frame research questions in a manner that ensures the greatest chance of environmental health success.

Children's Environmental Health

Children have unique susceptibilities to environmental hazards and often face higher exposure to environmental pollutants. Their rapidly developing bodies, biological systems, differences in physiology and behavior make them vulnerable to environmental insults in ways that adults are not. At the same time, children do not have a defined role in decision-making to protect their health. Risk assessment methods to date have essentially cast children as "tiny adults or big rats," without accurately assessing how environmental agents may be affecting their growth, development and health risks. Children of color are especially at risk for increased exposure to

pollutants such as lead and mercury. One panelist noted the importance of looking at the intersection circles of exposure, family and community in order to most accurately assess environmental risks to children's health. An overview of the National Children's Study was presented describing the Congressionally-mandated, multi-million dollar environmental epidemiology study that will track 100,000 children for 21 years to assess the impacts of environmental exposures on their health. Research results from the Columbia Center for Children's Environmental Health demonstrate that prenatal exposure to some air pollutants and pesticides is associated with decreased birth weight and size, and that "chronic material hardship" significantly exacerbated the effects of environmental tobacco smoke on children's development. This last result illustrates the ways in which nonphysical stressors and exposures can aggravate the adverse impacts of environmental exposures. A panelist from the Lead Action Collaborative in Boston described a community-driven effort to eliminate childhood lead poisoning in Boston. This best practices approach utilized community participation and collaboration efforts to generate data on environmental conditions at an extremely high resolution – lot-by-lot – with sophisticated technological tools or Geographic Information Systems (GIS) to identify and prioritize the highest risk housing in Boston for lead poisoning prevention efforts

Land-based Risks

Low-income and minority communities are often faced with a multiplicity of land-based risks ranging from lead contaminated of soils from lead paint use to pesticide contamination due to agriculture. The cumulative risks associated with the buildup of various chemicals have yet to be fully determined. This panel looked at pesticide contamination in Georgia, lead contamination in Connecticut and the health and environmental impacts associated with industrial-scale animal agriculture in North Carolina. The case of the Woolfolk Chemical Works Superfund site in Fort Valley, Ga., was used to present the concept of "brown houses," which are homes in or near a Superfund site where there is known or perceived contamination – in this case, by arsenic-containing dusts generated at the chemical works site. The Connecticut case study focused on the potential of phytoremediation to reduce accumulated lead in dust in urban soil. Another case study from North Carolina illustrated environmental and human health impacts of industrial animal operations and the local political challenges that can frustrate efforts to prevent and remediate the enormous pollution generated by these operations. A panelist from the EPA Office of Environmental Justice presented a GIS-based assessment and compliance tool that allowed the EPA to incorporate environmental justice considerations into its identification of priority sites requiring environmental enforcement or other actions. A detailed description of the guidelines in EPA's Cumulative Risk Assessment Framework for conducting human health risk assessments at specific contaminated sites was also presented, emphasizing the need for community collaboration at those sites to generate the highest quality data.

One recommendation that emerged from this panel was the need for collaboration between agencies, stakeholders and the community to determine the appropriate structure of response and identify and fill the regulatory gaps. Panelists also emphasized the importance of sustainable solutions that take into consideration both economic and health problems associated with contamination. Finally, they expressed the desire to strengthen partnerships and increase educational awareness within effected communities.

Water Quality

In recent years, water quality problems have become serious environmental issues – particularly for low-income communities and communities of color. In urban, suburban and rural settings

across the United States, these communities have had particularly low access to adequate drinking, surface and sewer water resources. Many people in these communities rely on fish and other seafood as a significant part of their diets and are therefore threatened by a disproportionately high risk of exposure to contamination from substances such as mercury, polychlorinated biphenyls and dioxin, which have entered the aquatic habitat and have bioaccumulated in the fish. Panelists described the EPA's efforts to develop improved surface water sampling methods, more rapid analysis and further health studies to create improved surface water quality indicators. A panelist from the Virgin Islands presented on the challenges of maintaining high drinking water quality and how community-based participatory research had improved drinking water quality. A panelist from EPA's Office of Water described the revisions and improvements to EPA's human health criteria methodology, including more accurate fish consumption estimates and a greater reliance on site-specific conditions rather than default values for assessing risk. The environmental cycling and bioaccumulation of mercury in fish was discussed, and the human health threat created by the consumption of mercury-contaminated fish was noted as a concern for all Americans. Lessons from Puerto Rico in community capacity-building and the development of better communication between regulators and the public were presented. Specific recommendations included: 1) the development of a surveillance system to identify the factors that make various communities vulnerable to environmental contaminants; and 2) the creation of data banks at the community-level to provide practical experience and information to build community capacity to engage in water quality protection efforts.

Recommendations

1) Adopt a precautionary approach to research.

2) Adopt collaborative approaches to research.

3) Incorporate community involvement in all stages of research.

4) Build capacity and empower communities, academic institutions and government agencies to assess and address environmental health risks.

5) Develop place-based, flexible approaches to research and risk assessment.

6) Incorporate socioeconomic factors into risk assessment.

7) Develop a better understanding of vulnerability that includes both physical and nonphysical factors.

8) Create interdisciplinary, holistic approaches to risk assessment, combining quantitative and qualitative data.

9) Promote innovative technologies and research methodologies.

10) Emphasize action to protect communities in the application of research.

Next steps

This working conference represents the beginning of an essential dialogue between critical stakeholders. Three days of discussion cannot integrate all that is needed to develop a new

scientific approach to EPA's research agenda. It was evidenced by conference participants that the need for a paradigm shift is necessary and that the will for action is strong. The current challenge is in finding a way to build an infrastructure that can allow the dialogue that was begun at the conference to continue on a national and regional level throughout the country. EPA has done much to address the issues and concerns facing environmental justice communities, but there is still more that the agency can and must do to protect these vulnerable communities. The agency must maintain a leadership role in keeping this dialogue alive and, furthermore, must demonstrate a way to implement the recommendations contained in this report. One way to translate our collective will into action is to find and support a forum where the same stakeholders that met on a national level can meet on a regional level to focus on specific issues, needs and opportunities for investing in appropriate science and research that meets community needs. As we implement these conference recommendations, community-based participatory research and cumulative risk assessment will become a standard practice within EPA's approach to research and will be integrated into the research agenda and projects across the country.

Acronyms

AHEJC	Arbor Hill Environmental Justice Corporation
ATSDR	U.S. Agency for Toxic Substances and Disease Registry
BPH	Boston Public Housing
BUSPH	Boston University School of Public Health
CAT	Community Assessment Tool
CBPR	Community-based Participatory Research
CCRA	Community-based Comparative Risk Assessment
CCT	Concerned Citizens of Tillery
CDC	Centers for Disease Control and Prevention
CRA	Cumulative Risk Assessment
DDT	dichlorodiphenyltrichloroethane
DEP	Department of Environmental Protection
EJ	Environmental Justice
ETS	Environmental Tobacco Smoke
GIS	Geographic Information Systems
HAP	Hazardous Air Pollutants
HPHI	Healthy Public Housing Initiative
HUD	U.S. Department of Housing and Urban Development
IPM	Integrated Pest Management
LAC	Lead Action Collaborative
MDI	Mental Development Index
NEJAC	National Environmental Justice Advisory Council
NHEERL	National Health and Environmental Effects Research Laboratory
NIH	National Institutes of Health
NOAH	Neighborhood of Affordable Housing
ORD	Office of Research and Development
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
TUR	Toxics Use Reduction
UCHC	University of Connecticut Health Center
U.S. EPA	United States Environmental Protection Agency
WCRG	Woolfolk Citizens Response Group
WE ACT	West Harlem Environmental Action

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Overview

On May 24-26, 2004, EPA New England, EPA's Office of Research and Development (ORD) and Boston University's School of Public Health (BUSPH) co-sponsored the Science of Environmental Justice Working Conference (SEJ). The theme of the conference was: *Science to Action: Community-based Participatory Research and Cumulative Risk Analysis as Tools to Advance Environmental Justice in Urban, Suburban and Rural Communities.* Key topics included Air Toxics, Asthma, Children's Environmental Health, Community-based Participatory Research, Cumulative Risk Analysis, Land-based Risks and Water Quality.

The SEJ Conference was a pioneering effort focused on environmental justice, science and research. It provided a forum in which 275 individuals, including scientists, technical experts, community and non-profit group leaders, academia and government representatives, worked together to provide input on the future of EPA's research efforts. Participants came from 25 states, the District of Columbia, Puerto Rico and the Virgin Islands.

The three-day conference was designed to provide an interactive, educational forum joining together stakeholders from across the country to discuss current efforts in community-based participatory research and cumulative risk analysis that are helping to assess, address and resolve environmental and public health risks in urban, suburban and rural areas.

During the first day of the conference, participants attended a bus tour of Chelsea and East Boston, Mass., which illustrated some of those communities' most pressing environmental concerns. Representatives from two local community-based organizations, the Chelsea Human Services Collaborative and the Neighborhood of Affordable Housing, led the participants through the neighborhoods and highlighted environmental concerns, including lack of open and green space, limited waterfront access, numerous state-designated hazardous waste sites, heavy concentration of industries in a designated port area, traffic and air pollution. The tour provided participants with a first-hand view of the disproportionate environmental burdens that many low-income and minority communities face. It also served as preparation for the formal presentations and working sessions that followed.

The second day of the conference began with a morning plenary session focused on a discussion of cumulative risk assessment in environmental justice communities. An afternoon panel presentation on community-based participatory research complemented the morning discussion and prepared the participants for further dialogue surrounding the direction of research within the agency.

The third and final day of the conference consisted of a morning session of concurrent panel presentations on the following key topics: Air Toxics, Asthma, Children's Environmental Health, Land-based Risks and Water Quality. Participants were actively involved in discussion sessions following the panel presentations to identify key research needs and priorities for future action. Reports were presented from each of the concurrent morning workshops that identified key themes.

Dr. Mildred McClain, Executive Director of Citizens for Environmental Justice in Savannah, Ga., in her closing remarks, both encouraged and challenged all members of the audience to remember their active roles in continuing to move the environmental justice research agenda forward. Dr.

McClain's passionate and eloquent final thoughts served as a call to action for all government agencies, academic institutions and local community-based organizations alike.

This conference successfully achieved an increased awareness of environmental justice within participants, developed recommendations to EPA for new research priorities to promote environmental justice and yielded strategies to translate existing and future research into action and policies that better address environmental justice concerns.

Keynote

H. Patricia Hynes, Professor, Department of Environmental Health,
Boston University School of Public Health, Boston, Mass.

In her opening address, keynote speaker, Professor H. Patricia Hynes wove together four threads of modern environmental history. With 42 years of modern environmentalism behind us, members of government, academia and communities across the nation, gathered to participate in a *working* conference designed to influence the science agenda of the EPA in a manner that reflects the agency's commitment to the principles of environmental justice. We have moved, Hynes asserted, from "environmental protection to environmental justice, from environmental science to the science of environmental justice."

The first thread of modern environmentalism was initiated by the publication of Rachel Carson's book, Silent Spring. Carson's book was inspired by community activism in response to the spraying of DDT, served to bring awareness to concerns over pesticides in the environment and helped create the U.S. EPA and, subsequently, a string of environmental legislation.

The events that took place at Love Canal, N.Y. mark the second thread of modern environmentalism. In 1978, Lois Gibbs was serving as President of the Love Canal Home Owners Association that actively sought the relocation of more than 500 families whose homes had been built upon and contaminated by more than 20,000 tons of chemical waste. Gibbs's personal fight against the chemical waste dumped into the Love Canal launched grassroots activism, and made the link between human and environmental health. In addition, the incident prompted education and action, which shaped the EPA's regulatory role and introduced the concept of community-based participation.

Community residents of Warren County, N.C. launched peaceful protests in 1982 against the siting of a landfill containing polychlorinated biphenyls, commonly called PCBs, and the disproportionate placement of polluting facilities in their predominantly African-American community. This event gave birth to the environmental justice movement, redefined the manner in which hazardous waste facilities are sited, and reflects the third thread of modern environmentalism.

In 1987, the United Church of Christ Commission for Racial Justice commissioned the *Toxic Waste and Race Study* to better understand how and where toxic waste facilities were being located. The study revealed a phenomenon of "environmental racism," or the disproportionate siting and existence of pollution sources in communities of color in the United States. This study led to an introduction to the language of environmental justice and represents the fourth thread of modern environmentalism.

Environmental justice, Hynes stated, has brought a place-based and community-based aspect to environmental protection by introducing the social, economic, cultural and spiritual facets of the environment. Through environmental justice we have learned the following: 1) social and environmental factors together affect a community's vulnerability; 2) partnership models work most effectively; and 3) environmental justice research must embody a bias for action. The National Environmental Justice Advisory Council's (NEJAC) cumulative risk and impacts report discusses how the social and environmental aspects of our lives are not lived separately, yet they are studied that way. Social risks,

Hynes noted, add to environmental risks. The NEJAC report recommends a bias for action, emphasizing that perfect knowledge does not have to exist in order to take action.

In her address, Hynes reminded members of the audience that there is a science of vulnerability and stated, "the science of vulnerability is undermined by those who attempt to divide environmental science into two categories: hard and soft." The attempt to establish a dichotomy between the two sciences is used to favor one science over the other, and often it is the science of the community that is left at a disadvantage.

Health follows a social gradient and inequality cannot be ignored noted Hynes. Community-based participatory research aims to reduce discrimination and inequality. It is value-centered research that incorporates sound science. This method of research serves to join social justice to the enterprise of science. Hynes challenged her audience to contribute to the next generation at work, and to move toward strategic policy outcomes. She called on the wisdom of crowds for ideas and recommendations and concluded that the conference should serve as a model of participation, where government, communities and academia are working together.

Morning Plenary

Assessing and Understanding Cumulative Risk in Environmental Justice Communities

Moderator:

- Michael Callahan, Senior Science Advisor and Office of Research and Development Regional Liaison, EPA Region 6, Dallas, Texas

Panelists:

- Wilma Subra, Louisiana Environmental Action Network, Baton Rouge, La.
- Joel A. Tickner, Lowell Center for Sustainable Production, University of Massachusetts, Lowell, Mass.
- Reginald Harris, Environmental Justice Coordinator and Senior Toxicologist, EPA Region 3, Philadelphia, Pa.
- Roseann Bongiovanni, Director, Chelsea Green Space and Recreation Committee, Chelsea Human Service Collaborative, Chelsea, Mass.
- Stacey Chacker, Director, Community Building and the Environment, Neighborhood of Affordable Housing, East Boston, Mass.

Since the 1970's, traditional risk assessments have often been performed to address chemicals one at a time. Citizens and community organizations have raised questions and concerns about multi-chemical risks from multiple sources, and EPA has responded. In the late 1990s, EPA began researching "cumulative risk assessment (CRA)," or assessment of risks from more than one chemical (and other stressors) acting together. EPA's 2003 report, *Framework for Cumulative Risk Assessment* (Framework), specifically outlines several new issues to be considered for community risk assessment, including population vulnerability, risks from non-chemical stressors and how chemicals and other stressors may interact to change the default dose-response relationships. This plenary session reviewed what is new in the Framework report, and summarized the findings of a subgroup under the National Environmental Justice Advisory Committee (NEJAC) regarding future implementation of the concepts outlined in the Framework. The session included a discussion about vulnerability and other cumulative risk issues, drawing on case studies from six different communities.

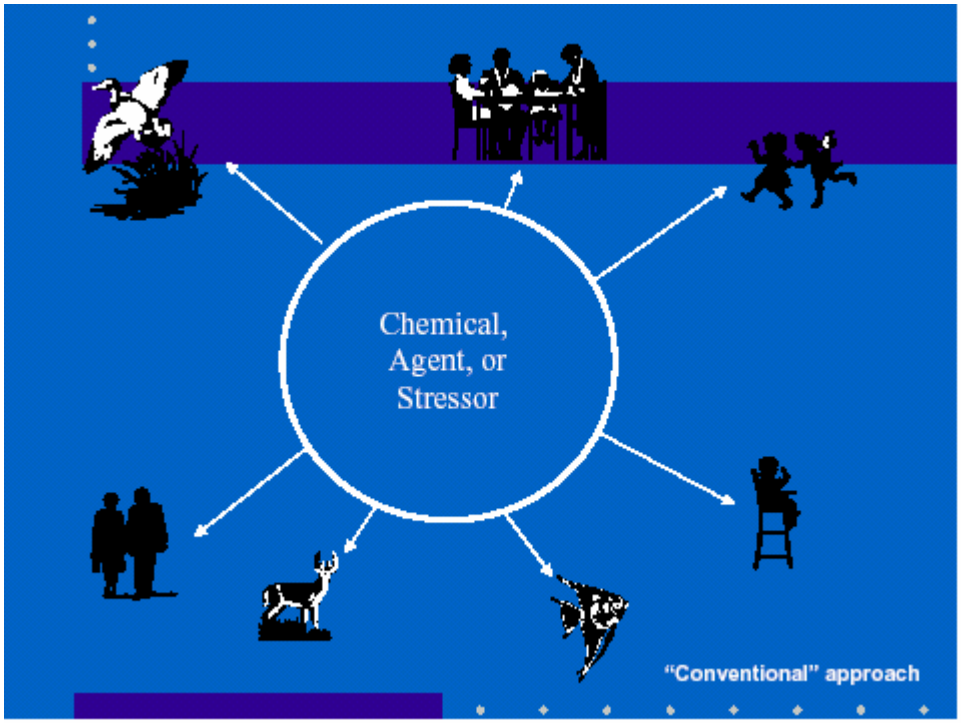
Michael Callahan, Senior Science Advisor and Office of Research and Development Regional Liaison, EPA Region 6, Dallas, Texas

Michael Callahan, Senior Science Advisor and Office of Research and Development Liaison, U.S. EPA, Region 6, discussed CRA theory and applications from a community perspective. According to Callahan, the Framework was four years in the making and involved the work of more than 100 scientists from state agencies, communities, industry, U.S. EPA and non-EPA federal agencies, among others.

Conventional risk assessment begins with chemicals, agents or stressors and follows them to the effected populations ***[Figure 1]***. In contrast, CRA focuses on the population and population segments, and investigates the question, "What types of stressors are affecting the population?" The answer to this question, Callahan noted, does not necessarily involve chemicals alone, but may include physical agents and other stressors.

Callahan provided a brief overview of frameworks vs. guidelines, impacts vs. risks and definitions, and then described the history behind the Framework, features of the Framework and the definition of

Figure 1: Conventional Risk Assessment Approach

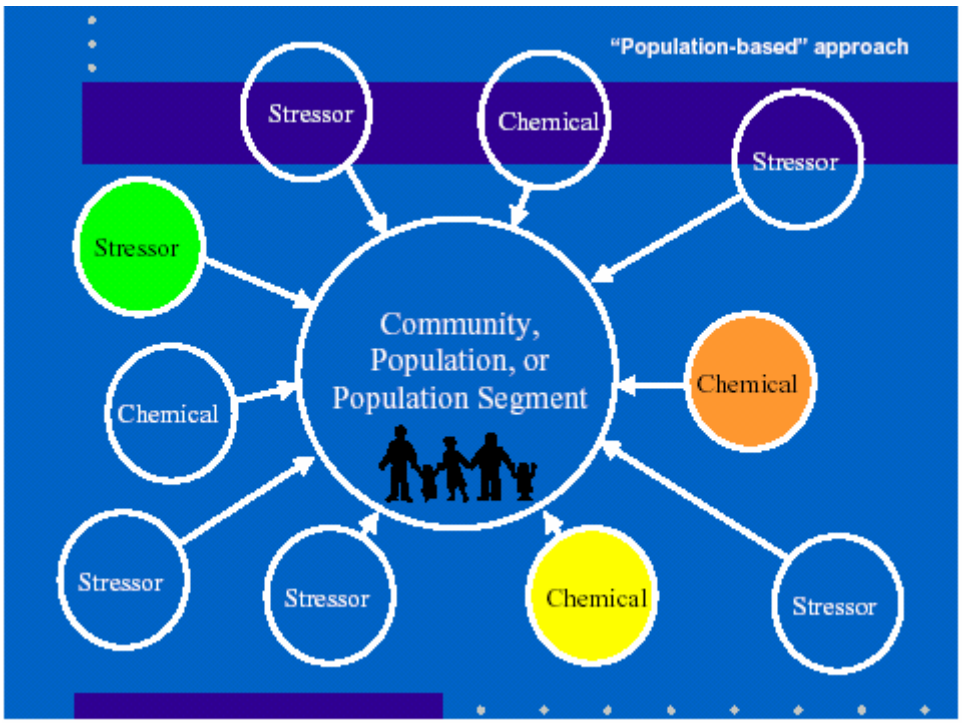


vulnerability that is reflected in the Framework. The Framework, he noted, is not a protocol for how to conduct CRA, but rather a general description of CRA. The guidelines, however, do provide a description of how CRA is to be conducted, and include the boundaries that are not to be exceeded. The terms cumulative impacts and cumulative risk, Callahan noted, are sometimes confusing. He identified impacts as the harmful or adverse effects, and risk as the probability of harm or adverse impacts. Cumulative risk was defined as the combined risks from aggregate exposures to multiple agents or stressors, whereas CRA was defined as an analysis, characterization and possible quantification of the combined risks to health and/or the environment from multiple agents or stressors ***[Figure 2]***.

A brief history of the Framework revealed an increase in community-expressed need for CRA. EPA issued a planning and scoping memo in 1997, and the Framework was begun in 1999. An agency-wide technical panel was established, three external peer involvement meetings were conducted in 2001, EPA Science Advisory Board consultations were held in 2000 and 2001, an additional external peer review

was held in June 2002, a workshop on CRA was held in Dallas, Texas, during November 2002 and the Framework was published in May 2003.

Figure 2: Population-based Risk Assessment Approach



The Framework provides a general description of multiple chemical and non-chemical stressors. It also focuses on population, emphasizes stakeholder participation and discusses the relationship between vulnerability, human health and ecology. The Framework introduced the understanding that when conducting risk assessments different parts of the risk assessment (i.e., effects, dose-response, exposure and characterization) should be addressed simultaneously rather than sequentially. The Framework defines vulnerability as differential susceptibility or sensitivity of individuals and populations, exposure, preparedness and ability to recover. It looks more closely at why two groups exposed to the same stressors react differently, and how the above-mentioned factors change risk.

Callahan shifted his discussion to the current state of science and explored our present knowledge about such things as adding risks across stressors, synergism, vulnerability, non-chemical stressors and, finally, the methods required to do these assessments. While presenting a number of still unanswered questions, he noted that we do have a couple of methods to understand and combine different risks. Some risks can be combined, while others cannot be easily combined due to their differing endpoints (e.g., acute illness vs. death). Callahan said that the common metric approach is used to analyze risks that can be combined and the index approach allows for the listing of risks separately, addressing those risks that cannot be combined. Callahan also noted that the current method of conducting CRA may not adequately address uncertainty, methods or desired endpoints.

The presentation concluded with a discussion of next steps. Callahan suggested that there be continued collaboration with the NEJAC, especially with regard to further understanding and interpreting vulnerability. He also suggested a need to explore additional research in the area of risks associated with non-chemical stressors. Additionally, he noted a number of current and future planned projects such as 2003-2004 case studies, 2004 issue papers on specific topics, a 2004 research agenda and the development of guidelines beginning in 2005.

Wilma Subra, Louisiana Environmental Action Network, Baton Rouge, La.

Wilma Subra, of the Louisiana Environmental Action Network, spoke about the recent NEJAC report entitled *Ensuring Risk Reduction in Communities with Multiple Stressors: Environmental Justice and Cumulative Risks/Impacts* (Report). She highlighted a suggestion in the Report that there be a shift in the speed and pace by which stressors are mitigated that reflects a bias for action. Communities at-risk have expressed concern and anger toward their current conditions, increased susceptibility and vulnerability to environmental harm. She opened with a reflection on the quote, "I am sick and tired of being sick and tired."

In an effort to ensure environmental justice for all, the EPA has asked itself and others, how the agency can best implement the Framework for cumulative risk assessment. The Report acknowledges that environmental risks and impacts are complex and interwoven in EJ communities. This is illustrated, as Subra mentioned, by the Mississippi River Industrial Corridor (Corridor) where exposure to toxic chemicals is compounded by inadequate health care. The Corridor is a largely African-American community that has been burdened by multiple pollution sources, including petrochemical facilities, wastewater facilities, pesticides and burning sugar cane, all of which are contributing to health problems such as cancer and asthma. Unique exposure pathways exist through the air (e.g., from industrial facilities), and through the water (e.g., contaminated drinking and surface water, and contaminated seafood).

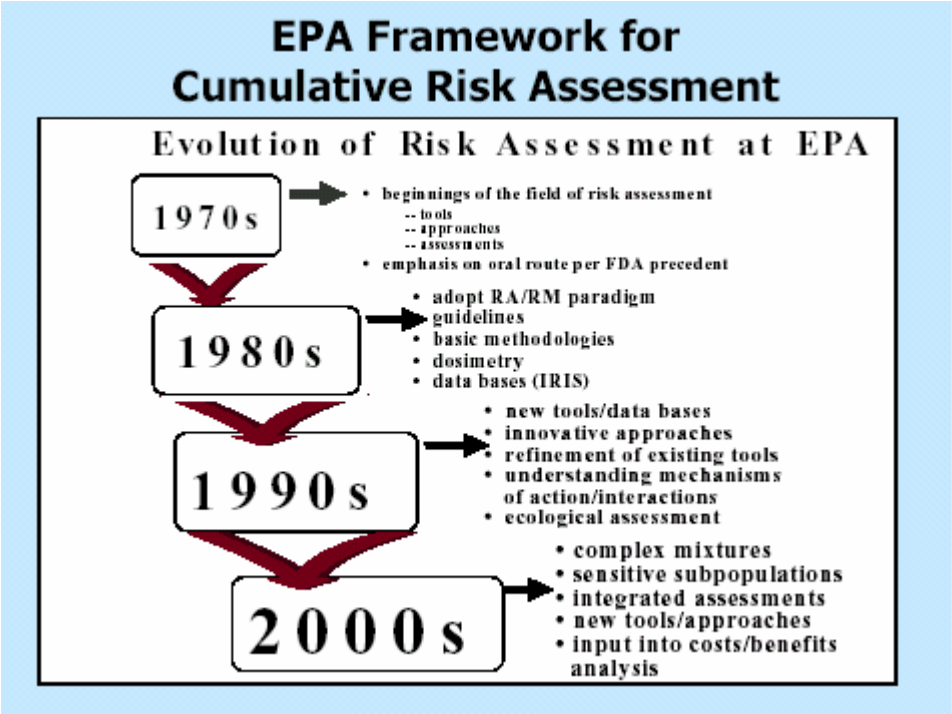
Subra shifted the focus of her presentation to highlight specific examples of the multiple, aggregate and cumulative risks and impacts with which many low-income and minority communities are faced. She focused specifically on discussions of the following four effected communities:

1) Four Corners, St. Mary's Parish, La.
    - Pollution sources include carbon black and the Strategic Petroleum Reserve
2) Vietnamese Fisherman Community, La.
    - Pollution sources include a hazardous waste incinerator and dump sites
3) Kelly Air Force Base, San Antonio, Texas
    - Pollution sources include spills and groundwater contaminants
    - Redevelopment, not cleanup, is driving the process
4) Tar Creek Superfund Site, Okla.
    - Pollution sources include heavy metals and radon gas.

Subra evaluated the conditions in each of these areas, looking at several important criteria: 1) demographics; 2) pollution sources; 3) existing health problems and conditions; 4) unique exposure pathways; 5) community capacity; 6) infrastructure; and 7) social capital.

Subra then outlined the Framework, beginning with an overview of the evolution of EPA risk assessment since 1970. The 1970s saw the development of initial tools and approaches in risk assessment, with a focus on the oral route. In the 1980s, a risk assessment/risk management paradigm and supporting databases (e.g., Integrated Risk Information Systems) were adopted. The 1990s brought a refinement of existing tools and the current decade has seen an evaluation of complex mixtures and sensitive sub-populations ***[Figure 3]***.

Figure 3: EPA Framework for Cumulative Risk Assessment



The Framework exhibits the following attributes:

1) Broad view of risk;
2) Population- and place-based analysis;
3) Comprehensive, integrated assessment of risk;
4) Multiple stressors;
5) Vulnerability includes biological and social factors;
6) Community involvement and partnerships;
7) Planning and problem formulation; and
8) Linkage of RA to RM for community health.

NEJAC's core response to EPA's charge to discuss how to implement the Framework included a recommendation for an adoption of a community-based, collaborative problem-solving model to make the Framework operational in the real life context of EJ issues and, at the same time, provide the surest way to secure sustainable risk reduction and institutionalize a bias for action. In addition, in implementing this model, NEJAC recommended that EPA's process include the following features:

1) Address multiple stressors;
2) Exhibit transparency;
3) Form a coherent framework;
4) Address vulnerability;
5) Incorporate screening, targeting and prioritization tools;
6) Bring about major risk reduction; and
7) Use regulatory authorities to bring recalcitrants to the table.

The environmental justice collaborative problem-solving model includes the following steps: 1) issue identification and strategic goal setting; 2) community capacity-building; 3) consensus building; 4) dispute resolution; 5) multi-stakeholder partnerships; 6) supportive participation by government; 7) sound implementation; and 8) adoption of best practices. This type of community-based, collaborative, participatory research yields benefits such as active collaboration at every research stage, community-driven projects, dissemination of results in a useful language and culturally appropriate research and intervention. Qualitative analysis methods are important in conducting this type of research and they include questionnaires, interviews, trend identification, overlap mapping and Geographic Information Systems (GIS).

Vulnerability is a key concept in understanding the differential impacts of environmental stressors within disadvantaged communities. Vulnerability recognizes that disadvantaged, underserved and overburdened communities come to the table with pre-existing deficits of both a physical and social nature that make the effects of environmental pollution more burdensome. As such, the concept of vulnerability fundamentally differentiates disadvantaged, underserved and overburdened communities from healthy and sustainable communities. Moreover, it provides the added dimension of considering the nature of the receptor population when defining disproportionate risks or impacts. Vulnerable communities differ from healthy communities in several important ways: 1) susceptibility and sensitivity to exposure; 2) preparedness; and 3) their ability to recover. Accordingly, health factors are both an outcome of and contributor to vulnerability within communities.

Joel A. Tickner, Lowell Center for Sustainable Production, University of Massachusetts, Lowell, Mass.

Dr. Joel Tickner, of the Lowell Center for Sustainable Production, provided an academic perspective on Cumulative Risk Assessment. He defined cumulative impacts in a number of ways, first offering the National Environmental Policy Act's definition, "the incremental impact of the action, when added to other past, present and reasonably foreseeable future actions regardless of what agency or person undertakes such actions." He suggested that a broader construction of the problem and a more comprehensive estimation of adverse effects could help refine potential alternatives and mitigation procedures. This perspective addresses long-term sustainability of the resource, background exposures, direct and indirect impacts and is a population-based approach.

Types of cumulative effects addressed include the following:

1) Interactions (i.e., additive and synergistic);
2) Mixtures;

3) Aggregate effects;
4) Acute and/or chronic;
5) Additive to background;
6) Direct and indirect;
7) Single and multiple stressor types; and
8) Complex feedback loops.

Tickner discussed areas where there is concern about cumulative effects, including: 1) poverty and nutrition; 2) mixtures of air contaminants (i.e., sulfates and particulates); 3) lead and nutrition, stress, chemicals and heart disease; 4) chemicals and immune suppression; 5) sprawl, poor nutrition, the lack of exercise and obesity; and 6) global change-induced impacts. He noted that although there is some progress in understanding these issues, the need for more research in these realms is compelling. Tickner emphasized the lack of data with respect to risk assessment, noting in particular insufficient data on toxicity of chemicals in commerce and on exposures, compounded by poor health and disease tracking systems. Tickner noted that in the face of missing data, the implicit default decision is that there is no problem – in other words, lack of data is inappropriately interpreted as lack of toxicity or health impact.

Studies that have been done by the U.S. Geological Survey on pharmaceuticals and personal care products in the environment provide an example of the lack of knowledge and understanding of the potential health implications of complex mixtures. There is very little knowledge or understanding as to what products do once they enter the environment. The lack of data, Tickner suggested, is compounded by limits in science and policy. For example, companies are not required to assess the environmental fate of these substances. There is also a lack of interdisciplinary approaches to find patterns in the evidence, and a focus on quantitative measures has dominated. There is also a lack of explicitness about uncertainties and a reactive focus that promotes the ideas that exposures are inevitable and there are acceptable levels of exposure considered safe until proven dangerous. It also is a slow process, and traditional scientific and regulatory approaches often lead to the conclusion, as a result, that there is, in fact, not a problem. As appropriately stated by John Cairns, Jr., “unrecognized risks are still risks, uncertain risks are still risks and denied risks are still risks.”

Tickner continued his discussion of cumulative risk assessment by examining the case of the Merrimack Valley Waste Facilities. There was community concern about emissions from closely situated waste facilities. The Massachusetts Department of Environmental Protection (DEP) had been focusing on risks from each facility, but the host communities expressed concern about cumulative impacts of the combined operations of the facilities. As a result of these concerns, the DEP conducted a study that considered aggregate air emissions from waste facilities. They did not, however, consider food contamination, or other exposures and stressors. The conclusion was that there was a low risk, but at the same time a great deal of uncertainty.

Tickner provided another example to demonstrate the complexities of assessing cumulative effects and addressing them in policy. He was a member of a DEP’s Science Advisory Board (Board) established to discuss the cumulative effects of waste siting. From the beginning, the waste industry challenged the panel by asking why its industry, not others, was selected for scrutiny. The Board could not come to any clear conclusions about how to assess cumulative risks. For example, the Board only analyzed cumulative air emissions, not ground water, in its analysis, and it was a challenge to even include diesel exposure from diesel-fueled trucks in considering cumulative effects. Based on the Board’s report, the DEP concluded that most relevant tools and methodologies were not adequately developed for use in a

regulatory context. Thus, they assumed that until more defensible tools are available, cumulative effects will not be considered and that there is a need for more health data before taking action. The DEP provided no clear recommendations on cumulative effects analysis and proposed no major changes to the impact assessment guidance.

Tickner concluded that the fundamental DEP response to this CRA challenge was, in short, "We don't know how to do it, and so we're not going to do it." In contrast, one science advisory board member commented that, "It is neither good nor bad science to use all of the information available to protect the health of a potentially impacted community. No community member should be asked to presume that they and their families are safe because of scientific studies that have not yet been done."

Tickner also suggested that we often have distorted priorities by asking, "What happened to prevention?" We tend to ask how bad something is instead of how much we can prevent. Framing the question has a lot to do with the answer ultimately obtained. Given the difficulties in assessing cumulative effects, we should be identifying areas where cumulative effects might occur and look at preventive alternatives. This is critical if we are going to expand the science of environmental justice.

Tickner then contributed another example, this time looking at toxics use reduction (TUR) in Massachusetts. The 1989 Toxic Use Reduction Act called for Massachusetts' manufacturers to reduce the generation of hazardous waste by 50 percent within 10 years through pollution prevention. The underlying attitude was to focus on ways to reduce waste and chemical use in the state rather than operating under the belief that there are acceptable exposures for these chemicals. Those chemicals for which companies must conduct materials accounting and toxics use reduction planning are listed on the basis of evidence of hazard, rather than absolute proof of toxicity, and any amount of exposure is considered too much if it is preventable. The TUR approach quantifies the use of chemicals in firms (their throughput), identifies alternatives and analyzes their feasibility and environmental, health and safety trade-offs. The results of this work showed an impressive 60 percent drop in the generation of toxic waste in the state between 1990 and 2000, a 40 percent reduction in the use of these chemicals and an 80 percent reduction in emissions of these chemicals over the same time period. The benefit to industry of these toxics use reduction efforts was estimated to be roughly $15 million, and the stimulation of new disciplines like green chemistry and product design are additional lasting legacies of these efforts.

Taking the prevention vision a step further, several countries have developed long term environmental health goals. These goals are common in public health, whereby communities or government agencies set aggressive goals of where they want to be – for example eradication of teen smoking or immunization – and back cast, or analyze the steps in both short- and long- term objectives to achieve those goals. This precautionary approach is very different from forecasting, where one predicts how things will be in the future. For example, the Swedish government has established a set of environmental quality objectives in order to leave a better environment for future generations. One objective is the non-toxic environment goal, and committees have been established to determine the steps and policies needed to achieve this goal. Other types of goals include, reducing cumulative exposures, impacts and the use of toxic substances.

Tickner identified three major directions to consider in moving forward: 1) developing a better understanding of vulnerability factors; 2) flagging environmental hazards and situations that could result in cumulative effects; and 3) refining our understanding of the economic and social aspects of community risk. In discussing the first theme – developing a better understanding of vulnerability factors – Tickner

noted that indicators of community health such as general public health and disease status, age and genetic factors, would play an important role and that health tracking efforts are especially important for this. He also noted that exposure measures need to be expanded to better account for background and cumulative exposures. Other vulnerability factors he discussed that vary from individual to individual are susceptibility to given exposures and differential exposures, preparedness and abilities to recover.

Tickner noted the importance of linking the potential for cumulative impacts in a given community to prevention and precautionary approaches to risk. This approach becomes particularly important in the absence of more developed assessment methods and indicators. For example, identifying where communities may be vulnerable to cumulative effects, and developing measures for flagging when cumulative impacts may be occurring. Once flagged, evidence or likelihood of cumulative impacts could be used as a starting point for developing an options analysis for prevention and prioritization. An interesting feature of this precautionary or preventative approach to risk reduction is that the presence of illness or health burdens in a given community, regardless of a proven link to the new activity in question, is sufficient to warrant a precautionary approach. Finally, Tickner noted, a precautionary approach requires community involvement at all stages, echoing sentiments repeated by other speakers at the conference.

On the theme of "Appropriate Science – A New Vision of Science for Policy," Tickner suggested that more appropriate scientific methods for understanding and reducing risks to human health from environmental hazards must be flexible rather than rigid, and must be designed to fit the nature of the problem rather than incorporating a one size fits all attitude. This appropriate science, as distinguished from a traditional emphasis on the ambitious notion of sound science, will integrate and respect both quantitative and qualitative data equally, will involve interdisciplinary approaches and will look at a broader body of knowledge and evidence, including accumulated knowledge and the judgments of a variety of stakeholders. Alternatives assessment would no longer be separated from risk assessment, and early warning systems of continuous monitoring would help attain the goal of detecting and preventing potential harm from a given set of activities in a community.

In conclusion, Tickner commented that cumulative risk assessment will not achieve its promise unless we move beyond the aggregate and risk-by-risk approach, that there will always be lots of uncertainty and that we need to acknowledge it and continue to move forward. He further identified a need to develop quantitative and qualitative tools, good indicators and metrics. Tickner closed by emphasizing that multiple stressors cannot always be quantified, and this further underscores the importance of prevention as a priority approach to protecting human health.

Reginald Harris, Environmental Justice Coordinator and Senior Toxicologist, EPA Region 3, Philadelphia, Pa.

Reginald Harris, of the EPA Region 3, described a case study from Chester, Pa. Residents formally expressed concerns about Chester bearing more than its fair share of environmental insults. The Chester risk assessment project was part of an EPA Region 3 and State of Pennsylvania initiative to characterize exposure in Chester relating to all pathways and to perform risk assessment by qualitative or quantitative means. A 30-day study of EPA's legal authority and a 180-day cumulative risk assessment resulted. Stepped-up enforcement that targeted underground storage tanks also occurred.

Chester is a small community 15 miles south of Philadelphia. It previously housed a shipbuilding plant and a Chrysler automotive plant. In the 1950s, Chester's local industries collapsed, and unemployment soared. The schools and public housing were taken over by the state. Chester had the highest infant mortality rate in the state. In 1997, Chester residents reported soldiers firing off guns in the streets. The Pentagon later confirmed that a live-fire exercise had occurred.

Many waste facilities, incinerators and refineries mark the town's environment. There are many rental housing units containing lead-based paint, and a lot of subsistence fishing despite fish advisories. Drinking water in the area was of poor quality. Many industrial plants and waste treatment facilities are located near residences. Public health outcome data indicated problems with inadequate health care. Mortality rates, especially from breast cancer, were high. The population of the town is 75 percent minority.

As part of the study, compliance with environmental regulations was examined and data were modeled to identify risk sources. Public health information was provided by the public and incorporated into the study. Data had been collected for different programs and agencies, and the databases were of varying quality.

Lists of the chemicals generated from industrial processes were developed. An attempt was made to come up with a comprehensive view of the chemicals' impact on the town's environment. In the study design, data about soils; surface, ground and drinking water; and children's blood lead levels were considered of interest.

Findings included identified hot spots where trucks idled for hours near people's homes. Significant risks for people who fished were identified. 67 percent of the children tested, half of those under age seven, had elevated blood lead levels. Many had extremely high lead blood levels and cancer incidence, and disease and mortality rates were significantly elevated.

The situation fell outside of EPA's traditional investigative and enforcement procedures. A major environmental situation had to be addressed. To meet the challenge, EPA worked with state, local, federal, community and other officials.

Creative financing was employed so community members could address lead paint concerns. The U.S. Centers for Disease Control supplied $2 million for health monitoring and screening. More medical practitioners were brought back into town. The state was encouraged to demolish vacant houses. Waste piles were cleaned up and truck routes were changed to lessen pollution. The effort did not result in a complete solution, concluded Harris, but a good start was made. A wish list of future actions includes enhanced monitoring of facilities and improved coordination between environmental and public health professionals.

Roseann Bongiovanni, **Director, Chelsea Greenspace and Recreation Committee, Chelsea Human Services Collaborative, Chelsea, Mass.**

Stacey Chacker, Director, Community Building and the Environment, Neighborhood of Affordable Housing, East Boston, Mass.

Roseann Bongiovanni, of Chelsea Human Services Collaborative, and Stacy Chacker, of Neighborhood of Affordable Housing (NOAH), gave a presentation entitled, "Chelsea Creek Community-based Comparative Risk Assessment." Their presentation addressed the critical question, "How can risks, given the large number faced by many communities, be prioritized and assessed in terms of importance to the community?"

Bongiovanni spoke on environmental damage to the Boston-area neighborhoods of Chelsea and East Boston, Mass. Chelsea is located in an industrial zone and stores all of nearby Logan Airport's jet fuel and much of New England's heating oil. The nearby town of Revere, Mass., has two major oil storage facilities. Chelsea Creek is one of the most polluted tributaries of Boston Harbor and its waters are not suitable for swimming. Chelsea has a population that is more than 50 percent minority. The area is exposed to fumes from many petroleum sources, and airplanes from nearby Logan Airport fly directly over the communities. Salt mounds containing a cyanide agent are situated along the basin in violation of state law and masses of commuter traffic and trucks pass near or through the communities, adding to the burden of air pollution.

Bongiovanni described how flowers will not grow in yards in the community, and asked why environmental agency executives need hard data about pollution when thousands of residents of towns like Chelsea are obviously affected by pollutants.

Chacker said that activists are working with EPA to develop a local park. They are attempting to turn an oil storage area into a more environmentally friendly facility. They also are opposing companies trying to dump in the area.

It was noted that the problems of Chelsea Creek are being addressed through the Chelsea Creek Restoration Partnership, which is comprised of groups, including the Chelsea Creek Action Group, NOAH, the Urban Ecology Institute and the Chelsea Committee.

The Chelsea Creek Community-based Comparative Risk Assessment (CCRA) project recognized that strong relationships between communities and agencies had to be developed to achieve the desired results of reducing environmental health hazards in the neighborhoods of Chelsea and East Boston. Chacker noted that residents do not have access to scientific data necessary to address their concerns, and that there is a need to gather such relevant data to understand the risks facing local residents. With traditional comparative risk assessments, the final product is a list of priorities based on a scientific evaluation that does not incorporate community involvement or input. In contrast, the goal of the CCRA was to take the best components of traditional risk assessment and add community concerns to define a set of priorities that emerged from both an understanding of human health risks and relevance and concern to the local community.

The issue selection process involved listening to the community about its concerns. The CCRA gathered community input from several hundred residents at meetings and through surveys. The leading issues identified through this process included water quality, air quality, open space, noise, asthma and traffic.

The CCRA executive committee members include NOAH, Chelsea Creek Action Group and the EPA. The committee structure includes a Resident Advisory Committee comprised of volunteers and a Technical Advisory Committee comprised of representatives from government agencies and non-governmental organizations. The four major elements of the CCRA project included: 1) a review and analysis of existing data; 2) the generation of GIS maps for evaluating and understanding data; and 3) a review of current projects or activities in Chelsea and East Boston related to the issue.

The key findings of the CCRA project were that presence and quality of data on environmental and public health issues were insufficient; current federal, state and local regulations did not adequately protect the health of urban residents; actions were needed from local, state and federal government agencies to address data gaps; and actions were needed from local residents to hold government agencies accountable.

As an illustration of these conclusions, Bongiovanni noted that part of the CCRA's early work was to generate an overview of water quality in Chelsea Creek, compare it to federal, state and local water quality regulations and examine existing water quality information and point and non-point pollutant source information. Contaminants of concern include pathogens, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls and heavy metals. This analysis revealed that during the previous decade, there had been only one sampling location along the Creek, and no ongoing sampling for PAHs or heavy metals. Consequently, both the presence and the quality of relevant data needed to protect the health of the river and local residents were notably absent.

At the conclusion of the CCRA project, a set of recommendations to address water quality problems in and near the Chelsea Creek was published. These recommendations included both community actions, such as the development of volunteer programs to supplement state sampling, and personal actions, such as limiting direct contact with water. A select set of longer-term priorities was discussed in this report, such as conducting sediment and water quality sampling, cleaning up the Massachusetts designated 21E hazardous waste sites along the river and creating unpaved surfaces near the river to reduce runoff of chemicals.

Specific recommendation generated by the community included the creation of a Chelsea Creek Task Force headed by EPA, which would be responsible for coordinating information, holding industry accountable to regulations and promoting pollution prevention. Specific reporting and resource requests that were directed to such a task force included a designated EPA contact person to facilitate communication with the community, regular reviews of National Pollution Discharge Elimination System permits and of combined sewer overflow releases, as well as of the combined effects of air and water releases on local health risks and water quality. The task force was also asked to work with state agencies to enforce local laws, to designate resources for sediment and water quality studies and to inform the Chelsea Creek Action Group of enforcement actions.

Chacker and Bongiovanni discussed the lessons learned during the CCRA: 1) that community involvement is critical; 2) information is often missing on the local level; 3) more research and technical expertise is needed; and 4) that identifying action items was crucial to the success of the project. The

presenters concluded that the process generated many questions, instead of the hard data that were thought could immediately be used to address the problems. It was added that it is difficult to speak the language of scientists and regulators when one does not have sufficient information.

Audience Questions, Answers and Discussion

A question and answer session followed with audience members querying the morning panel's participants.

Q: Have you linked up with health care providers concerning the impact of environmentally related diseases on children?

A (by Subra): Lack of access to health care comes up repeatedly in many communities. We try to educate health care providers on the medical conditions and how they are generated.

Q: Has there been a move away from an architectural bias toward functionality and longevity toward human and environmental concerns?

A (Tickner): A strong bias exists in favor of traditional disciplines. Not enough federal money is being spent on prevention.

The panelist noted that his academic program at the University of Massachusetts-Lowell was placed in the School of Engineering. It took ten years for engineers to start using his ideas. The program is now in a health program, where it should have more impact.

Q/Comment: EPA has traditionally not listened to black communities as much as it has to white communities. More community people are needed on the conference panel. Wives and mothers are critical in raising environmental health issues and must be included more often. It is encouraging that EPA seems to have started to think outside the box.

Past exposures, the cost of negative impacts such as the loss of work and debt, and compensation and holding companies and the EPA accountable, must be considered. The commenter said that EPA Region 9 had ignored community concerns, and that police had been called in on her group.

Q: Has there been a follow-up on the blood lead levels of Chester, Pa., children?

A (Harris): Things are getting better but have a long way to go. The town's lead poisoning prevention program has improved matters. The involvement of the community, including screening and education and awareness programs, has also had positive impacts. The Chester model provides the lesson that problems should be addressed proactively and aggressively.

Q/Comment: It would be helpful to have a copy of the NEJAC report.

The commenter also felt that important questions are not being asked. How much risk is acceptable, who gets to decide and who bears the burden? CRA does not address these issues, which – to those in the effected communities – are the critical questions. Often science does not follow common sense because it

quantifies the issue instead of doing something about it. In Chester, it was opined that the state should not have issued permits to pollute.

A (Harris): EPA had looked into state regulations to see if Pennsylvania could prevent issuance of permits in some cases. The state was able to block some environmentally negative actions through other means.

The case of Chester showed that many things are not understood about human health risks, because the polluters had permits that complied with the law, even though there was obviously an environmental crisis.

Q: Haven't federal agencies, according to a recent Inspector General report, failed in enforcing environmental regulations?

A: (Harris): Changes are needed in the ways environmental agencies act and, "We have to stop being molecular police." A conscious change is required throughout society.

Afternoon Plenary

Community-based Participatory Research in Urban, Suburban and Rural Environmental Justice Communities

Moderator:

- Swati Prakash, Director Environmental Health, West Harlem Environmental Action, New York, N.Y.

Panelists:

- Madeleine Kangsen Scammell, Doctoral Student, Department of Environmental Health, Boston University School of Public Health, Boston, Mass.
- Peggy Shepard, Executive Director, West Harlem Environmental Action, New York, N.Y.
- Rebecca Calderon, Director, Human Studies Division, National Health Effects Research Laboratory, EPA Office of Research and Development, Research Triangle Park, N.C.
- Gary Grant, Executive Director, Concerned Citizens of Tillery, Tillery, N.C.
- Steve Wing, Associate Professor, Department of Epidemiology, University of North Carolina School of Public Health, Chapel Hill, N.C.

Since the early 1980s, the national environmental justice movement has called attention to the ways in which traditional approaches to environmental and health research often do not adequately assess or represent communities of color and other disproportionately burdened communities. Community-based participatory research (CBPR), with its emphasis on place-based assessment and the participation of effected community members, has been advanced as one potential approach to research that would better represent these realities and empower community participants in the process. This plenary panel focused on defining the basic elements of CBPR and presenting a few case studies using this approach to deliver environmental health benefits to communities of color. The panel concluded with a discussion on policy implications and long-term needs for maximizing the potential of CBPR to assess and improve environmental health for all communities.

Madeleine Kangsen Scammell, Doctoral Student, Department of Environmental Health, Boston University School of Public Health, Boston, Mass.

Madeline Kangsen Scammell, of the Department of Environmental Health at the Boston University School of Public Health, spoke about the intersecting historical roots of CBPR and the environmental justice movement. She referenced the landmark Supreme Court desegregation decision, Brown vs. Board of Education, that relied on objective evidence provided to the Supreme Court regarding the damage caused by racism in society. Such evidence was provided by Kurt Lewin, a German social psychologist, who is credited with coining the term “action research,” and contributing to the concept of research for social change. Since 1932, the Highlander Research and Education Center, a Tennessee-based popular education and research organization where the civil rights movement also had a home, has taught that

education should be grounded in struggles toward democratic control and has political goals for social change. From the 1960s through the 1990s the participatory action research movement, rooted primarily in the struggle against imperialism in the Third World, stressed the conscientiousness of social scientists in the liberation of the poor from exploitation and oppressive social structures. Scammell ended her talk with remarks by Colombian sociologist Orlando Fals-Borda suggesting the possible cooptation of the concept of participatory action research by academia and academic institutions, and the need for continued attention to the roots and authentic endeavors of participatory action research.

There are three principles of participatory action research:

1) Participation of the community at every step;
2) Equal distribution of power and results among partners; and
3) Action-oriented outcomes or research for change.

Peggy M. Shepard, Executive Director, West Harlem Environmental Action, New York, N.Y.

West Harlem Environmental Action (WE ACT) emerged in 1988 out of community struggles concerning the operation of a sewage treatment plant in the Harlem neighborhood of New York City. The area of concern in North Manhattan consists of 7.4 square miles of land afflicted with multiple environmental exposures. It has a population of 600,000, with the majority being blacks and Latinos.

A Federal Interagency Symposium on Health Research Needs to Ensure Environmental Justice met in 1994 to respond to the disproportionate impact of pollution on disadvantaged communities. Since then, government agencies and foundations have increasingly funded community and university partnerships to conduct CBPR. The partnership between WE ACT and Columbia University is a model of science- and community-based action to advance environmental health policy. This partnership has enabled WE ACT to document that asthma hospitalizations were much higher in northern Manhattan than in other comparable communities; conduct sophisticated research on air pollution and its health effects, especially on children; and train nearly 200 community leaders on the basics of environmental health science. The term “translational research,” as used by the National Institute of Environmental Health Science (NIEHS), describes WE ACT’s approach to research, emphasizing that the purpose of research is to result in or translate to improved health outcomes.

A fundamental tension always exists between research and advocacy, particularly when each side lacks an understanding of the other’s perspective. The political will to get the results desired often must be created through community organizing. Some recommendations for building strong partnerships to enhance public policy and advance environmental protection include the following:

1) Develop multiple institutions within the community;
2) Coordinate ongoing briefings for policy-makers;
3) Conduct community-university cultural exchanges;
4) Think of partnerships as long-term relationships;
5) Foster the empowerment of youth;

6) Develop a core of resident leaders versed in scientific concepts and monitoring tools;
7) House the community research staff at community-based organizations, rather than the university;
8) Provide expert testimony as needed; and
9) Treat translational research as a necessity.

Rebecca L. Calderon, Director, Human Studies Division, National Health Effects Research Laboratory, EPA Office of Research and Development, Research Triangle Park, N.C.

Dr. Rebecca Calderon, of the EPA's Office of Research and Development (ORD), noted that EPA is in reality a public health agency. The ORD has provided a lot of technical assistance to communities. Furthermore, EPA considers special-needs populations – the elderly, children, poor, racial and ethnic groups – analyzing the health of these populations as affected by various factors, including air, drinking water, water quality and pesticides.

In deciding to conduct any study, the ORD considers several factors, including; 1) whether the research meets an agency need, such as supporting regulations or responding to a regional request or is congressionally mandated; 2) whether the study will help advance the state of science; 3) whether ORD has a unique capability to conduct the study; and 4) the overall public health importance of the research. Key areas for community involvement in studies include the design and implementation of the study, as well as analysis and communication of the resulting data.

In terms of study design, ORD seeks community involvement in selecting the site at which the research is to take place, helping identify the appropriate study population and sampling methods and in designing the details of the study itself, particularly regarding the burden imposed by participation requirements.

In terms of study implementation, community involvement is key to resolving such questions as, how to best recruit participants, what language considerations must be taken into account, how to handle any special needs populations and how to best obtain informed consent? In conducting the study itself, the highest quality participation and support from participants will lead to the best data quality. Protocol flexibility is very important.

Finally, it is important communicate results back to study participants as quickly as possible and then to other community members, local and state health officials, the EPA regional office, the EPA program office and, finally, the broader scientific community. Some challenges include explaining uncertainty in results and communicating information about either health effects only or exposures only, which can be difficult to explain to participants if the research did not attempt to look for a link. Other challenges are communicating individual results that have unknown meaning and properly considering ethics related to specimen banking. Creating an obligation to the future is the basis for a bond that EPA makes with the community.

Gary Grant, Executive Director, Concerned Citizens of Tillery, Tillery, N.C.

The Concerned Citizens of Tillery (CCT) organized in 1978 when a county school was slated to close. Halifax County, where the town of Tillery is located, is one of the poorest counties in North Carolina.

Grant noted that institutional racism was and is frequent. The schools there have been very segregated demographically and the predominantly African-American school performs very poorly academically. The county lacks sufficient sewer lines, water lines and paved roads, and 90 percent of the community was still dependent on well water.

It is in this context that a facility for 25,000 hogs was proposed in the Tillery area without regulations governing waste disposal. In 1993, CCT helped to establish a Hog Roundtable**,** a collaboration of grassroots environmental organizations, farmers and other advocacy groups concerned about North Carolina's hog industry and its effect on our environment, health and personal property (the hog industry is described online at: http://members.aol.com/tillery/hog_rt.html)**.** CCT partnered with Steve Wing, instructor at the University of North Carolina's School of Public Health, to provide technical assistance. A long-term relationship with Wing resulted.

Gary Grant, Executive Director of the Concerned Citizens of Tillery, stated that legislators typically desire to be presented with environmental data instead of looking at a situation in "a common-sensical way." He cited an example of a paper company that was going to locate a plant on the banks of the Roanoke River and potentially discharge dioxins into the river, where African-Americans fish. CCT worked to prevent the plant from locating in Halifax unless it adopted the pollution control technology the company was already using in plants located in white communities. For this effort to protect citizens, especially subsistence fishers, the county denied grant money to CCT on the grounds that the organization was opposed to economic development.

Steve Wing, Associate Professor, Department of Epidemiology, University of North Carolina School of Public Health, Chapel Hill, N.C.

Dr. Steve Wing, of the University of North Carolina School of Public Health, began his discussion with the premise that "there is no environmental justice," and referred to Thomas Kuhn's description of the history of science, stating that there is a need for a "revolutionary change in science and society." Wing asserted that the current system of science gave rise to environmental racism, and needed to be dramatically transformed. Wing described current dominant systems of scientific endeavor as having an untenable belief in objectivity, without a focus on people and communities. It was developed by white male elites over the course of the last several centuries, and consequently served the need of government and industry. In contrast, environmental justice does not have its roots in white male European elites, and contained considerable potential to revolutionize the way in which science is applied for the improvement of human and environmental health.

Historically, Wing noted, applications of science had been used for instituting social control in agricultural labor, mines, etc. It had a history of assisting in the establishment of colonial relationships. He commented that government agencies and universities that control science could impose colonial relationships in research that are similar to those that created environmental injustices in the first place. However, despite this context, Wing described community-driven research as offering the prospect of transforming exploitative relationships.

Wing discussed the ways in which values influence the production of scientific knowledge. He gave the example of a GlaxoSmithKline research institute that had recently been placed on the University of North

Carolina campus. Given the underlying profit motive of private businesses like pharmaceutical companies, it seemed reasonable to view this local partnership as being biased by a desire to ultimately sell more pharmaceutical products. A *Chicago Tribune* article was quoted that asserted that the environmental regulations on livestock were devised largely by the livestock industry, in cooperation with EPA. Wing said that the institutions that people serve are often on the wrong side and that they need to be held accountable. The corporations that are the actual polluters provide the EPA with much of its information. Many of the environmental rules are now set up to prove something is harmful rather than safe, betraying a bias towards the generators and primary users of potentially harmful chemicals. To obtain justice, activists need to change the measurement bar and insist that relevant data be generated in and by effected communities rather than by polluters.

Audience Questions, Answers and Discussion

Issues raised during the discussion period included the perceived non-participatory nature of an EPA decision made in a California community. The commenter felt that the agency finalized what it was going to do months in advance and gave the community a voice or input just for show. In addressing the theme of whether community-based and advocacy-based science have their own biases, Wing noted that objectivity is attained by being honest about the research, about the assumptions behind it and the groups that stand to benefit or lose out from it. Unfortunately, he said such an approach does not fit easily into our sound bite culture.

One conference participant noted that the clout of industry can make striking a balance hard when community and profit making industry have conflicting interests, while commenting that EPA regulators get their assignments from politicians, and do not live in the communities. Change has to come from the bottom up. Another participant raised the point that some organizations were criticized for taking “sacred body fluids,” or blood and milk samples from mothers in the community, without giving much back to the community. Grant noted that one community opposed beneficial research because it was not allowed to provide feedback on a grant, and that a community has to be strong enough to say that it will cooperate with research sampling only if it is made part of the planning process. Swati Prakash, of WE ACT, added that a community has a right to say no to research and should state what it wants to get out of the research. Calderon concurred, noting that if a community does not trust the university researchers in question, then it should not collaborate with them.

Another conference participant noted that community laborers, like farm workers, are never included in panels and conferences and that chemicals banned in the United States are just moved to other countries. Prakash noted that workers are often “the canaries in the coal mine” that provide the hard evidence of environmental abuse.

Concurrent Panel Presentations

Air Toxics

Exposure to hazardous air pollutants (HAPs) presents significant public health concerns, and disparities in exposure present potential environmental justice concerns. HAPs, also known as air toxics, have been associated with many adverse human health effects, including cancers, asthma and other respiratory ailments, and neurological problems such as learning disabilities and hyperactivity. Sources of air toxics include industrial emissions from chemical manufacturers; refineries and waste incinerators; smaller stationary facilities such as dry cleaners; and exhaust from mobile sources such as cars, buses and trucks. Air toxics are also found in consumer products, including paints, household cleaners and computer printer cartridges. Emissions from all these diverse sources affect the indoor and outdoor environment. This panel provided an overview of air toxics (e.g., sources, exposure and health effects), research that has documented disparities in exposure, community-based efforts to reduce exposure, and EPA activities to reduce air toxics emissions and health impacts.

Moderator:

- Devon Payne-Sturges, Environmental Health Scientist, Public Health and Environmental Policy Team, National Center for Environmental Economics, EPA Office of Policy, Economics and Innovation, Washington, D.C.

Panelists:

- Ted Palma, Physical Scientist, Risk and Exposure Assessment Group, EPA Office of Air Quality Planning and Standards, Research Triangle Park, N.C.
- Timothy H. Watkins, Assistant Laboratory Director, National Exposure Research Laboratory, EPA Office of Research and Development, Research Triangle Park, N.C.
- Wilma Subra, Louisiana Environmental Action Network, Baton Rouge, La.
- Azibuike Akaba, Community Technical Assistance Coordinator, Committee for West Oakland Revitalization, Oakland, Calif.
- Rachel Morello-Frosch, Assistant Professor, Department of Community Health, Brown Medical School and Center for Environmental Studies, Providence, R.I.

The panelists spoke in turn.

Ted Palma, Physical Scientist, Risk and Exposure Assessment Group, EPA Office of Air Quality Planning and Standards, Research Triangle Park, N.C.

Ted Palma of the EPA's Office of Air Quality Planning and Standards spoke in depth about EPA's National Air Toxics Assessment, and within this broad framework, the National Scale Assessment. The National Scale Assessment is intended to provide EPA, states, tribes and localities with a tool that can be used to identify the specific air toxics of greatest concern within a given area and characterize the

contributions of different emission sources to human exposure and risk. Drawing upon a variety of data, this model yields estimates of county-level human health risks (cancer and non-cancer) across the country. Data on HAP emission sources, ambient pollutant concentrations, personal exposure monitoring data and demonstrated dose-response relationships are incorporated in these simulations.

National Scale Assessments were performed in 1996 and 1999. Both were restricted in scope to chronic average or median inhalation exposures at the U.S. Census tract level. Results of the initial study indicated a limited number of high-impact HAPs at national and regional scales. The more recent study included many more (150 vs. 32) HAPs and some indoor sources. Draft results from the 1999 assessment exhibit estimated risk results similar to those of the 1996 study. Several source categories contribute significantly to estimated cancer and non-cancer risks, though their importance varies by health endpoint. Moreover, county-level risk estimates of cancer are far higher in many areas of the country than suggested in the 1996 study. This is likely a function of including many more HAPs and other refinements in the more recent analysis.

Palma also described some of EPA's efforts to address, as required by statute, residual risk following implementation of controls on major HAP sources. The agency has characterized the source categories that will require additional controls (i.e., coke ovens and dry cleaning), and also plans to propose no further controls for several other categories by, tentatively, the end of 2006. This will pose challenges, in that any new controls must be suited for implementation by the states and tribes, high-risk facilities will need to be targeted without unduly disrupting low-risk ones, and risks that have not been adequately controlled through technological means must be resolved.

In response to questions and comments from workshop participants, Palma indicated that EJ assessments will be performed at the community-level, and that grant funding for such activities (and others) may be available from EPA regional offices. He also stated that EPA is working to overcome some of the limitations of its current models to address long-range air toxics transport.

Timothy H. Watkins, Assistant Laboratory Director, National Exposure Research Laboratory, EPA Office of Research and Development, Research Triangle Park, N.C.

Timothy H. Watkins of EPA's Office of Research and Development (ORD) delivered a primer on air toxics or HAPs, which he described as airborne (gas or particle) pollutants known or expected to cause cancer or other serious health or environmental effects. The Clean Air Act has identified 188 HAPs. A 1999 emission inventory yielded a national estimate of 5.1 million tons of HAPs emitted a year. Area, mobile on-road and major stationary sources all contribute to this total in similar proportions. Having implemented the first phase of technology-based controls on HAP emissions known as maximum achievable control technology standards, EPA is now pursuing risk-based standards to address residual risk through several different initiatives (e.g., the Urban Air Toxics Program and the Mobile Source Program).

In addressing environmental justice concern, Watkins believes, assessing and (where appropriate) reducing exposure is the key to effective risk management. This will require more research to determine the exposures of selected communities to air pollution. Assessing exposure to air toxics, however, is intrinsically difficult. HAPs are numerous and diverse, making them difficult both to monitor and model.

Moreover, exposures vary greatly from place to place, and source-dominated exposures and hot spots are very common for some pollutants. Consequently, exposure assessment must be approached carefully, customized to meet specific objectives and designed to optimally use monitoring or modeling techniques (and oftentimes both).

Watkins believes that air toxics exposure assessment is improving along several fronts, pointing to a new program that includes both community and personal monitoring sites across the country, in addition to efforts to develop new models. Watkins stated that EPA's exposure studies include both indoor and outdoor sources and rely upon empirical data, when available. He also said that uncertainty about air toxics data makes comparisons with the risks posed by criteria pollutants problematic. Finally, while the agency attempts to model the effect of second-hand smoke, this factor is both difficult to address and likely to be less significant than exposure to mobile air pollutant sources.

Wilma Subra, Louisiana Environmental Action Network, Baton Rouge, La.

Wilma Subra of the Louisiana Environmental Action Network addressed chemical releases and air pollutant emissions for the Mississippi River chemical corridor, also known as "Cancer Alley," based on Toxics Release Inventory data. These data showed that pollutants, including the carcinogens benzene, vinyl acetate, styrene and chloroprene released to water, air and land (via underground injection) were common in this area. She also described several problems related to fugitive emissions of air toxics, including ambient air concentrations in excess of criteria pollutant standards, monitoring designs that failed to analyze some of the released chemicals of interest, frequent accidental releases and upset conditions and excessive flaring. As an example, Subra cited documented accidental releases and upset conditions that occurred during an EPA sampling visit in June 1999.

EPA Region 6 shared the data assembled by community groups with the industries involved. The effected companies then implemented a voluntary initiative to reduce accidents and emissions. They targeted several high-priority operating practices and problem areas, most of which involved non-routine operations (e.g., startup and shutdown, malfunctions and upsets and cleanings and turnarounds) and maintenance and repair activities (e.g., finding fugitive leaks). Active EPA and community involvement also led to less use of flaring and unauthorized releases. Collectively, these actions led to substantial air pollutant emissions reductions.

Responding to several questions, Subra indicated that communities should try to understand the experiences of other communities, and then apply that awareness to their specific concerns (e.g., completing odor and symptom logs and associating them with releases such as flaring).

Azibuike Akaba, Community Technical Assistance Coordinator, Committee for West Oakland Revitalization, Oakland, Calif.

Azibuike Akaba of the Committee for West Oakland Revitalization described a project in West Oakland, Calif., that focused on mobile source diesel emissions reduction. He began by stressing that the local area is heavily contaminated due to the presence of heavy industrial activity around six federal Superfund sites and dozens of leaking underground storage tanks in the Port of Oakland, the former Army Base. The area is home to more than 23,000 residents.

The West Oakland Environmental Justice Diesel Emissions Reduction Campaign is part of the Environmental Indicators Project (EIP), which developed 20 variables for measuring the effectiveness of the campaign. Based upon initial results, project leaders decided to focus on one high priority air pollutant and its apparent major source: diesel exhaust particulate matter emissions (PM) from truck traffic. The Diesel Campaign was designed and implemented using a variety of novel techniques that extensively involved members of the community and were participatory in nature. Truck counting conducted by the community was a key element. This represented a direct response to one of the biggest concerns in the community, the perception that large numbers of trucks pass through the neighborhood and yielded important data to more fully inventory and categorize emission sources.

Follow-up work identified two important root causes. One was that many truck drivers become lost, thereby driving more than necessary and, in some residential neighborhoods, needlessly. The other was that drivers often parked and let their trucks idle for extended periods, from half an hour to four hours. Study findings led the community to propose several concrete steps to reduce diesel exhaust emissions and exposures in West Oakland neighborhoods. These included posting better road signs, creating truck stops at the Port of Oakland and regulating and reducing idling inside terminal gates.

Akaba responded to a few questions by clarifying that some of the detailed data used in the Diesel Campaign were obtained from the trucking companies following a lawsuit and, once the Diesel Campaign began, from some companies that voluntarily checked their equipment, providing data on control technology and emissions.

Rachel Morello-Frosch, Assistant Professor, Department of Community Health, Brown University, Brown Medical School and Center for Environmental Studies, Providence, R.I.

Dr. Rachel Morello-Frosch of the Brown Medical School and Center for Environmental Studies delivered a presentation examining the possible linkages between residential segregation, air toxics exposure and associated cancer risks. She began by discussing the challenges of linking air toxics to adverse health outcomes, including the social, political, economic and technological factors that come into play. The main focus of her remarks, however, was the relationship between racial segregation and severe adverse health outcomes (death and morbidity). An association has been persistently reported in health literature. Morello-Frosch postulated the idea that segregation may shape disparities in exposures across demographic groups and, thereby, affects community health. She then outlined her research investigating this hypothesis using EPA's initial 1996 analysis of national community-level or metropolitan statistical area air toxics exposure and corresponding demographic data from the U.S. Census.

Overlaying these two analyses shows that the communities of color with the highest estimated cancer risk also are the most segregated. Moreover, differences across racial groups are smaller for less segregated areas, and greater for more highly segregated areas. Analysis shows that, even after controlling for such factors as housing density and economic deprivation, there appears to be a direct correlation between extent of segregation and estimated cancer risk, both in the aggregate and for each ethnic group represented.

Morello-Frosch concluded that racial segregation plays an important role in the differential distribution of air pollution exposures across diverse communities. She added that her study had some important limitations, some of which might be addressed by future work. These include the absence of data on personal and indoor air exposures, the limited number of pollutants examined and the possibility that exposure conditions may have changed during the eight years since the data were collected. She also suggested that future analyses should examine how zoning, land use patterns, suburbanization and transportation development affect pollution and the distribution of risks among communities of color and the poor.

Responding to questions, Morello-Frosch clarified that many of the variables selected for analysis had been suggested in existing literature. She also agreed that the settlement patterns of recent immigrants in the United States are significant, particularly in urban areas, and should be considered in regional land use planning.

Asthma

Moderator:

- H. Patricia Hynes, Professor, Department of Health, Boston University School of Public Health, Boston University, Boston, Mass.

Panelists:

- Dr. Eileen Storey, Associate Professor, Division of Occupational and Environmental Medicine, and Director, Center for Indoor Environments and Health, University of Connecticut Health Center, Farmington, Conn.
- Dr. MaryJane Selgrade, Chief, Immunotoxicology Branch, Experimental Toxicology Division, National Health and Environmental Effects Research Laboratory, EPA Office of Research and Development, Research Triangle Park, N.C.
- Dr. Jonathon Levy, Assistant Professor, Department of Environmental Health, Harvard School of Public Health, Boston, Mass.
- Marian Feinberg, Health Coordinator, South Bronx Clean Air Coalition, Bronx, N.Y.
- Edna Carrasco, Committee for Boston Public Housing, Boston, Mass.

According to the Centers for Disease Control and Prevention (CDC), 20 million people – including 6.3 million children – have asthma. The CDC also reports that African-Americans continue to have higher rates of asthma emergency room visits, hospitalizations and deaths than do Caucasians, and Americans with lower-income levels report higher asthma prevalence than those at higher income levels. There is a noticeable upward trend in the prevalence of asthma, especially in large cities. This panel addressed the increasing trend of asthma incidence and investigated the various cumulative risks that might be contributing it. Specifically, panelists addressed the effects of building conditions, indoor and outdoor pollution on the prevalence of asthma. All panelists concluded that there needs to be more research on possible factors that contribute to asthma and that information should be made available to the public.

Dr. Eileen Storey, Associate Professor, Division of Occupational and Environmental Medicine, and Director, Center for Indoor Environments and Health, University of Connecticut Health Center, Farmington, Conn.

Dr. Eileen Storey of the University of Connecticut Health Center (UCHC) presented the methods and results of research on asthma incidence, asthma prevalence and building conditions conducted in Connecticut schools with teachers and students. According to her findings, schools are one of the most important indoor environments in which to conduct disease detection, disease prevention through building improvement and disease treatment through school nurses. Her overriding concern is that children who acquire asthma in moldy schools are given medication, the schools are not fixed and children are sent back in. Results from an initial pilot survey of teachers found: 1) the workplace affects the incidence of asthma, with the rate being higher for teachers in large cities vs. rural, suburban and small urban areas; and 2) the asthma rate among teachers correlates directly to building conditions, specifically dampness and mold, and inversely to school district funding. In a study of asthma prevalence among elementary

school children in grades K-5, by surveying school nurses, Dr. Storey found an overall asthma prevalence of 9.7 percent. Children in urban areas and poorer school districts were found to have higher rates of asthma. Overall building-related risk factors were common.

Dr. Storey concluded that further research is needed in three areas: 1) the surveillance of asthma incidence and prevalence at the community-level; 2) the evaluation of the impact of primary prevention on incidence; and 3) the evaluation of the impact of building intervention on the severity and persistence of asthma in homes, daycare facilities and schools.

Dr. MaryJane Selgrade, Chief, Immunotoxicology Branch, Experimental Toxicology Division, National Health and Environmental Effects Research Laboratory, EPA Office of Research and Development, Research Triangle Park, N.C.

Dr. MaryJane Selgrade of EPA's National Health and Environmental Effects Research Laboratory (NHEERL) stated that the trend of increasing asthma prevalence, which is estimated to affect 30 million people by 2020, is too rapid to be caused by genetics. Instead, she believes it is the result of cumulative risks from air pollution; putative factors such as biologics, including cockroaches, endotoxins and dust mites; and hypothetical factors, including obesity and vaccinations. The Office of Research and Development research areas include studies of induction and exacerbation of asthma by air toxics and biologics, susceptibility factors contributing to asthma and risk assessment. Induction, exacerbation and risk assessment receive most of the research resources. The NHEERL themes include: 1) identifying and ranking mold allergens that are suspected to induce asthma; 2) assessing the effect(s) of air pollution on asthma induction; and 3) assessing the effect(s) of air pollution on the exacerbation of asthma. Assays will be developed to predict the ability of pollutants to initiate or exacerbate asthma. The predictive models will then be tested with a prototype pollutant *in vivo*, *in vitro* and in epidemiological studies. The relative potency of other pollutants will be developed using this paradigm.

Dr. Jonathan Levy, Assistant Professor, Department of Environmental Health, Harvard School of Public Health, Boston, Mass.

Dr. Jonathan Levy of the Harvard University School of Public Health presented on the baseline health characteristics of children and their caregivers, a research component of the four-year Healthy Public Housing Initiative (HPHI) Healthy Homes intervention study in Boston. HPHI is a community-city-university partnership with general goals to: 1) improve the home environment and quality of life through Integrated Pest Management (IPM) intervention for residents with asthma in Boston public housing; 2) build capacity in city and community agencies to sustain the efforts from research on intervention findings; and 3) effect national policy on IPM in public housing. Baseline results of lung function, respiratory symptoms, health care and self-reported quality of life were presented for 78 asthmatic children in three Boston public housing developments. Descriptive findings reveal that a large percentage of children were exposed to violence, are overweight and are not properly treated with long-term control medication. Key findings from regression analysis include the following: 1) a moderate relationship between asthma symptoms, household size and smoking; 2) child quality of life strongly related to severity of symptoms; and 3) caregiver quality of life strongly related to child symptom severity and caregiver stress.

Further research is needed to: 1) determine the cause of inadequate medication of persistent asthmatic children in the study; 2) provide a more detailed multi-factorial exposure assessment, including air pollution, stress from violence, indoor allergens, etc.; and 3) evaluate the efficacy of individual and bundled interventions in reducing asthma morbidity.

Marian Feinberg, Health Coordinator, South Bronx Clean Air Coalition, Bronx, N.Y.

Utilizing two examples from community-university partnerships in the South Bronx and Harlem neighborhoods of New York City, Marian Feinberg of the South Bronx Clean Air Coalition conveyed the disparity between community knowledge that is based on observation, investigation and lived experience and that which is based on classical scientific research. Feinberg suggested that the kinds of research and research context that communities want require that government and universities develop relationships that go beyond the boundary of a research project or grant. Furthermore, scientists need to learn the value of community knowledge within the joint research partnership. The knowledge of communities about their health issues, pollution sources, internal dynamics and political base, etc., is invaluable to ensure the accuracy and success of environmental health research. Engaged communities should participate with researchers in developing the research questions and protocol, collecting and interpreting data and formulating conclusions for further research and action. Communities challenge preconceptions of researchers and add valuable practical knowledge of the world that researchers often lack.

Communities want to see more science that not only documents the multiple harms of pollution but also documents the successes of pollution prevention (e.g., improved health outcomes from banning pesticides and reducing exposure). Communities also want more studies of multiple exposures and the impact of social stressors on communities that have environmental stressors. Communities want research framed by the precautionary principle approach to environmental protection and not just self-perpetuating research that leads to more research.

Edna Carrasco, Committee for Boston Public Housing, Boston, Mass.

Edna Carrasco of the Committee for Boston Public Housing (BPH) presented socio-demographic data on residents living in Boston public housing. This population exhibits high percentages of people of color, people in poverty, children and women that are heads of households. Additionally, many are unemployed, in transition from welfare, do not have childcare, lack political power and are alienated from nearby communities. BPH developments are subject to high crime and recently lost their youth programs, which collectively are a vital resource. As for the physical conditions of public housing, buildings generally are in substandard condition because of poor maintenance and a lack of needed skilled trades-people (due to 23 percent cuts in Boston Housing Authority funding from the U.S. Department of Housing and Urban Development over the past four years). Health barriers for public housing residents include: 1) lack of health insurance: 2) use of the emergency room for general health visits; 3) poor asthma management by medical service providers; and 4) high rates of asthma and mental illness. Using photos of housing developments, Carrasco pointed out that many are located near pollution sources, including heavily trafficked highways, exposing residents to disproportionately high indoor and outdoor environmental pollution exposures. In conclusion, Carrasco recommended spending more resources to improve resident access to asthma education and proper health management and to maintain public housing buildings.

Children's Environmental Health

Moderator:

- Kristi N. Rea, Acting Chief of Pesticides, Toxics and Urban Programs, EPA New England, Boston, Mass.

Panelists:

- Daniel Schwartz, Executive Director, Children's Environmental Health Network, Washington, D.C.
- Marianne Suero, Manager, Children's Health Program, and Coordinator, Aging Initiative, EPA Region 5, Chicago, Ill.
- Sarah Keim, Program Office Coordinator, National Children's Study, National Institute of Child Health and Human Development, National Institutes of Health, Bethesda, Md.
- Virginia Rauh, Associate Professor, Department of Population and Family Health, Columbia University Mailman School of Public Health, New York, N.Y.
- Ryan Torres, Director, Lead Action Collaborative, Tufts University, Medford, Mass.

Children have unique susceptibility, often face higher exposure to environmental pollutants and do not have a defined role in decision-making to protect their health. Children of color are especially at risk for increased exposure to pollutants such as lead and mercury. Although their individual voices were not heard during this discussion, all participants were asked to keep children's interests and concerns in mind throughout the session. This panel focused on the opportunities afforded by community-based participatory research and cumulative risk assessment approaches to protect children's health, with a special focus on children of color. The panel began by reviewing the state of the science, highlighting what makes children especially vulnerable to environmental insults, discussing current EPA policy approaches to protecting children's health and reviewing what is known about the current state of children's environmental health. Panelists then highlighted case studies on community-based participatory and cumulative risk approaches to assessing and decreasing environmental health risks for children. All panelists concluded by addressing future research and policy needs and opportunities for protecting children's environmental health and advancing environmental justice.

Daniel Schwartz, Executive Director, Children's Environmental Health Network, Washington, D.C.

Rabbi Daniel Schwartz of the Children's Environmental Health Network was the opening speaker and provided the audience with a common understanding of the broad topic of children's health by sharing some of the key principles of vulnerability. During his overview of "Vulnerability 101," Schwartz identified some common challenges to understanding how children are different from adults with respect to vulnerability. He illustrated that although in the past we tended to think of children as "little, tiny adults or big rats," there is a real need to better understand how children are different along many dimensions (e.g., scale, biological functions and behavior) to truly understand risks to their health. The old model or

view of understanding vulnerability and risk included approaches that assumed children were qualitatively the same as adults; investigated only one pathway and one chemical at a time; and assumed that timing of exposure did not matter.

Schwartz discussed some of the unique aspects of children compared to adults, including the fact that a child transforms from a single cell to an interactive human in a two-year period. There are also real biological differences among children, including neural wiring, immune system and behavior differences. One of greatest challenges he identified in understanding children's health is to look at the intersecting circles of exposure, family and community. Although this approach does not fit well with current medical models of understanding risk and vulnerability, Schwartz stated it is critical to consider because life as a child is "a full contact sport with the universe."

He concluded his presentation by discussing recommendations on how to better understand and protect children's environmental health. Schwartz believes that a cumulative risk approach to children's health with meaningful community involvement is needed. He also urged that the principle of precaution should rule. He suggested that we should take the approach of "start worrying, details to follow," to ensure that we move towards a more holistic health-based standard for all children. Schwartz ended his presentation by reiterating that we need to move towards a whole child approach and make sure that all actors involved do everything they can to make environments safer for all children.

Dr. Marianne Suero, Manager, Children's Health Program, and Coordinator, Aging Initiative, EPA Region 5, Chicago, Ill.

Dr. Marianne Suero of EPA Region 5 addressed three primary objectives: 1) presenting EPA's ongoing approaches to improving children's environmental health; 2) describing data gaps and challenges; and 3) outlining future efforts to fill gaps and meet challenges. Dr. Suero reaffirmed that children are not "little adults," and, in fact, "have windows of vulnerability in development, differences in physiology and differences in behavior." She also reported that former President Clinton first issued an Executive Order on the protection of children from environmental health risks in 1997 and President Bush reauthorized this order in 2001. To respond to this directive, EPA created the Office of Children's Health Protection to make children's health a fundamental agency goal. The Office of Children's Health Protection seeks to achieve this goal by building infrastructure, capacity to institutionalize ideas and increased awareness of environmental hazards that affect children.

Suero highlighted that there is a data gap relating to children's health. She illustrated this gap by stating that what we know is an "ice cube" and what we need to know is a "glacier." EPA is striving to fill some of these data gaps through partnerships with other organizations. Some specific examples of current initiatives underway include the following:

1) "America's Children and the Environment," which uses broad sources of data and measures to help better understand contaminants, body burdens and illnesses;
2) Child-Specific Exposure Factors Handbook;
3) Supplemental guidance for assessing cancer susceptibility;
4) National Children's Study support;
5) Voluntary Children's Chemical Evaluation Program;

6) Toxicity and Exposure Assessment for Children's Health; and
7) Pediatric Environmental Health Specialty Units.

Suero also discussed some of the challenges and barriers within EPA related to children's health. EPA's traditional mission focused more on protecting environmental quality and only recently has focused on protecting public health. Consequently, the resources available to directly support children's health work (e.g. staff, financial resources, training, etc.) are limited and vary each year. Suero concluded by acknowledging that although we have much to learn and there are no quick fixes to improving children's health, it is critical for EPA to do more to ensure the health and safety of all children across the country.

Sarah Keim, Program Office Coordinator, National Children's Study, National Institute of Child Health and Human Development, National Institutes of Health, Bethesda, Md.

Sarah Keim of the National Institutes of Health (NIH) provided an overview of the National Children's Study – a large, long-term study of environmental influences (helpful and harmful) on children's health and development. Although there have been some studies that provide information on current exposure levels to environmental toxins, the thresholds for health effects in children are unknown for many chemical agents. This study is an attempt to fill some of the most critical data gaps that exist related to children's health, with an emphasis on a longitudinal study of children that defines the concept of "environment" broadly to include chemical, physical, behavioral, social and cultural factors.

Keim reported that the study will track approximately 100,000 pregnant women from 30-50 sites across the United States and will collect data on the children before birth through age 21. Keim stated that the National Children's Study will provide:

1) Answers to concerns about known exposures during childhood;
2) Power to determine absence of effects or benefit of exposures to various products important to the economy;
3) Large sample size to apply knowledge of genome;
4) For identification of early life factors that contribute to adult conditions;
5) National resource data to answer future questions by using stored biological and environmental samples and data; and
6) Information feedback to participants and communities.

Keim concluded her presentation by discussing the status of funding the National Children's Study. Although the Children's Health Act of 2000 authorized $18 million in resources, the resources were never appropriated. To date there has been a solid level of funding to support final study design completion and recruitment, and Keim believes that the results will have potentially significant impacts on health outcomes. The implementation of the study is anticipated to begin in fiscal year 2006 and end in fiscal year 2030. The estimated cost of implementation is $100 million per year.

Virginia Rauh, Associate Professor, Department of Population and Family Health, Columbia University, Mailman School of Public Health, New York, N.Y.

Dr. Virginia Rauh of the Columbia University Mailman School of Public Health highlighted some of her research findings at the Columbia Center for Children's Environmental Health. Her research attempts to understand more thoroughly the impact that the complete environment (including home and neighborhood level exposures and socioeconomic factors) has on children's health. Rauh began by illustrating how toxics penetrate the body and how environmental exposures are related to social context. She discussed key points, including that environmental pollutants are disproportionately distributed, environmental risk is often cumulative, both socially and physically toxic exposures are stressful and there is emerging evidence that physically toxic exposures interact with social adversity to exacerbate illness. Rauh reported that the Columbia Center for Children's Environmental Health primarily focuses on ambient air pollution and children's health by examining exposure assessments, biomarkers, clinical outcomes and susceptibility factors. Environmental exposures include air pollutants (e.g., polyaromatic hydrocarbons (PAHs), particulate matter, pesticides and environmental tobacco smoke (ETS)), allergens and metals. Biomarkers include PAH-DNA adducts, pesticides, cotinine, 4-ABP-Hb, immune system changes, lead and mercury. Clinical outcomes include growth and development, neurodevelopment, persistent wheezing, asthma and cancer risk. Susceptibility factors include nutritional deficits, socioeconomic stressors and vitamins A, C and E.

The study hypothesis included three key elements:

1) Prenatal exposure to environmental tobacco smoke will be associated with deficits in early child cognitive development;
2) Chronic exposure to social adversity will be associated with deficits in early child cognitive development; and
3) Chronic exposure to social adversity will exacerbate the harmful effects of environmental tobacco smoke, after adjustment for other biomedical and demographic risks.

The study sample included approximately 226 women aged 18-25, self-identified as African-American or Dominican. Participants were registered for care by the twentieth week of pregnancy and between April 1998 and October 2002 at the New York Presbyterian Medical Center, Harlem Hospital or a satellite clinic. Participants were non-smokers (screened by self-report and validated by sampling), free of diabetes, hypertension, known HIV and documented or reported drug abuse. Participants also resided in the community for at least one year and agreed to share complete antenatal exposure data, antenatal interview, blood samples, birth record and developmental follow-up data. One particularly interesting aspect of the data collection process is that, during the third trimester, women were asked to wear a small backpack containing a personal air monitor during the daytime hours for 2 consecutive days and to place the monitor near the bed at night. The personal air sampling pumps operated continuously over this period, collecting vapors and particles of $\leq$ 2.5 microns in diameter.

Dr. Rauh reported some of the key findings of the study:

1) Prenatal PAH exposure is associated with decreased birth weight and head circumference among African-American infants;

2) Prenatal chlorpyrifos exposure (a non-persistent pesticide) is associated with decreased birth weight among African-Americans and reduced birth length in the total sample;
3) Prenatal ETS exposure occurred in 39.1 percent of the sample of nonsmokers;
4) Detectable inhalation levels of one or more PAHs were found in 100 percent of the sample;
5) Psychological distress was more closely related to material hardship than to the income measure of poverty, suggesting that some of the conditions that accompany poverty may be more important determinants of maternal adjustment than income alone;
6) Prenatal residential ETS exposure was associated with a five-point adjusted mean decrement in 24-month cognitive development score, or using the Bayley Mental Development Index (MDI), in a low-income minority sample.
7) The five-point mean decrement from residential ETS exposure resulted in a two-fold risk of developmental delay (less than 80) on the Bayley MDI;
8) Joint exposure to prenatal ETS in the context of chronic material hardship (unmet basic needs) was associated with a seven-point decrement in 24-month MDI, suggesting that the neurotoxin effects of ETS are exacerbated under conditions of deprivation; and
9) The main effect of ETS was observed for prenatal and not postnatal exposure.

Ryan Torres, Director, Lead Action Collaborative, Tufts University, Medford, Mass.

Ryan Torres of the Lead Action Collaborative (LAC) presented information on a unique campaign bringing together diverse stakeholders in Boston, Mass., to virtually end childhood lead poisoning by 2008, two years ahead of EPA's goal of 2010. Since the passing of the Anti Lead Law in 1978, total childhood lead poisoning cases have dropped across the country but 1 million children nationwide are still poisoned. Many of these cases are concentrated in the lowest-income, most diverse urban areas. The LAC is a partnership of non-profit organizations, foundations, health providers, academic institutions and government agencies working together to address lead poisoning in Boston neighborhoods. During the Fall of 2001, a Geographic Information Systems mapping project with the LAC, Tufts University and EPA New England's Urban Environmental Program was conducted to use available data to identify Boston communities with the highest concentrations of elevated blood levels (Pb >10ug/dl) in children under seven years old. The "Tier 1 Neighborhoods," identified by the study as North and South Dorchester, Roxbury, Hyde Park and Mattapan, showed the highest lead levels in all of Boston and, in fact, contain 70 percent of all lead poisoning cases in the city. While the number of cases in the city as a whole declined 50 percent between 1994 and 1999, Tier 1 Neighborhoods have not experienced such reductions.

Torres stated that this data project put a new face on the lead problem in Boston and helped reshape partner commitments. In November 2001, LAC, EPA and Tufts Institute of the Environment brought together more than 80 legislators, policy-makers, government officials and community leaders at the "Let's End it Here! Summit" held in Boston. What emerged was the "Boston Blueprint to End Childhood Lead Poisoning (Blueprint)," which laid out a detailed strategy to address and eradicate lead poisoning over five years. The Blueprint is made up of six major goals designed to help facilitate a coordinated approach to ending childhood lead poisoning. Torres believes that the Blueprint will work to bring together groups working on lead issues in a collaborative effort that is community driven, promotes

education and creates a unified approach to improve Boston neighborhoods and make homes safe for children.

Torres reported that a key component of the Blueprint was the creation of tools to help better understand the remaining populations at risk in Boston. Two new tools were developed to gather new data and better utilize existing data – the Community Assessment Tool (CAT) and Leadsafehomes.info website. The CAT is used to investigate and document neighborhood conditions on a street-by-street, lot-by-lot basis and identify areas and housing that pose a high risk for lead poisoning. Ryan said that volunteers from the community head out into neighborhoods to identify housing conditions that may indicate a potential for lead poisoning, including peeling or chipping paint, presence of children, type of ground cover and other information. He also said the information will be used and mapped to identify areas in need of assistance and will allow partners working on the Blueprint to focus available efforts on the areas with the greatest needs. The Leadsafehomes.info website was designed by the National Center for Healthy Housing and Abt Associates, who worked with the LAC to create a web-based housing registry and search engine. The website is a powerful tool for targeting lead poisoning prevention efforts in Boston. It provides key information for parents, homeowners, tenants, community groups and policy-makers to maximize the value of lead poisoning prevention efforts and resources. Leadsafehomes.info also provides address-specific information for all of Massachusetts and community-level information about childhood lead poisoning in Boston neighborhoods.

Torres also reported some impressive measurable results from LAC's integrated lead poisoning efforts. He stated that since launching joint targeting efforts, elevated blood lead levels among Boston children have dropped from 1,123 cases in 2001 to 773 cases in 2003. Recent data from the Boston Childhood Lead Poisoning Prevention Program also show that Boston has its first neighborhood with zero lead poisoned children – the Fenway.

Audience Questions, Answers & Discussion

The range and diversity of panel presentations inspired high quality questions and discussion between audience members and panel participants. Audience members recognized that the topic of children's environmental health was incredibly broad and diverse and – although it was challenging to fully address the complexity of the issue – it was important to begin to discuss it critically in terms of research and meaningful community involvement. Audience discussion identified two areas not addressed by the panel that need better attention in the future: 1) mold and mold-related issues; and 2) birth defects and developmental defects tracking.

It was clear from the interaction that not all parts of the country have the same level of infrastructure for working effectively on children's health issues, nor do communities have the same type of relationship working with the Environmental Protection Agency. Some audience members reported hostility from EPA staff working on children's health issues, including lead poisoning prevention. One audience member told a vivid story in which her inquiries to get information about lead poisoning in her community only resulted in police action – not answers. Efforts to improve children's health status across neighborhoods differs greatly, as evidenced by the reaction from one audience member who expressed disbelief at the Lead Action Collaborative's campaign to virtually end childhood lead poisoning by 2008. If the Boston coalition achieves its goal, it will be the first city in the nation to do so and will likely set a tremendous precedent for other communities to replicate its success.

A key theme of many of the questions from the audience included the inability of community residents to be effectively involved and engaged in scientific research – and that it was especially critical to make this happen when children are involved. Many audience members said that they were treated only as research subjects and never asked to engage in defining parameters of studies. Moreover, the results of the studies were not shared with them. Audience members reiterated the importance of engaging, informing and investing long-term in the communities and populations that are research subjects. People in environmental justice communities need much more than is currently provided by standard scientific approaches and methodologies. Although many studies purport to have community involvement, there was much discussion by the audience that these efforts were mostly half-hearted. Many audience members inquired why it was necessary to continue to study some of these children's health problems (e.g., lead poisoning and asthma) when instead we should proceed with solutions.

Important issues that emerged during the discussion period were school siting and how critical it is to ensure that schools are safe and healthy environments for children. It was clear that although there is great community interest and concern, schools do not have a centralized authority that is conducive to collaboration across agencies. Few school-related policies are set at a national level and, in fact, they vary frequently from state to state and community to community. Panel members cited the Healthy Schools Network in New York and the Illinois Healthy Schools Initiative as excellent examples of local efforts trying to make a difference on school siting and health issues in the absence of a coordinating lead federal agency.

Land-based Risks

Moderators:

- Robert Hillger, Senior Science Advisor and Office of Research and Development Regional Liaison, EPA New England, Boston, Mass.
- Ariel Iglesias, Senior Science Advisor and Office of Research and Development Regional Liaison, EPA Region 2, New York, N.Y.

Panelists:

- J. Kyle Bryant, Technical Advisor, Academic Institutions-Communities-Agencies Network, Fayetteville, Ga.
- Gary Grant, Executive Director, Concerned Citizens of Tillery, Tillery, N.C.
- Steven Wing, Associate Professor, Department of Epidemiology, University of North Carolina School of Public Health, Chapel Hill, N.C.
- Nicholas Targ, Counsel, EPA Office of Environmental Justice, Washington, D.C.
- Jack Hale, Executive Director, Knox Parks Foundation, Hartford, Conn.
- Glenn Rice, EPA Office of Research and Development, Washington, D.C.

Low-income and minority communities are oftentimes faced with a multiplicity of land-based risks ranging from lead paint contamination of soils to agricultural pesticide contamination. The cumulative risks associated with the buildup of various chemicals have yet to be fully determined. This panel looked at pesticide contamination in Georgia, lead contamination in Connecticut and the health and environmental impacts associated with industrial-scale animal agriculture in North Carolina. In addition, the panel included of an overview of EPA's draft cumulative risk screening guidance. Panelists emphasized the importance of sustainable solutions that take into consideration both economic and health problems associated with contamination. They also expressed the desire to strengthen partnerships and increase educational awareness within effected communities.

J. Kyle Bryant, Technical Advisor, Academic Institutions-Communities-Agencies Network, Fayetteville, Ga.

J. Kyle Bryant of the Academic-Institutions-Communities-Agencies Network presented an overview of the pesticide contamination issues in Fort Valley, Ga., an agricultural town of approximately 10,000 people, located 100 miles south of Atlanta. The contamination has been attributed to the Woolfolk Chemical Works Superfund site that produced, formulated and packaged organic and inorganic pesticides and herbicides in the community for many years. It is believed that arsenic-containing dusts contaminated the attics of many dwellings in the community. Many of these dwellings may never be tested or remediated, leaving the residents and owners with the potential for both economic and health problems associated with the Woolfolk site. Bryant refers to such residences as "brown houses," which he defines as residential dwellings that exist within Superfund and/or designated Brownfields communities where there is known, or perceived, contamination.

The community is now facing serious redevelopment challenges due to perceived health risks and property devaluation caused by the contamination of several residences surrounding the site. Bryant

contends that residential communities always lose when a nearby Superfund site is being assessed for risk to the surrounding community. According to Bryant, there are regulatory gaps created when federal agencies, like EPA and the U.S. Department of Housing and Urban Development (HUD), fail to coordinate with one another in pursuing successful and sustainable solutions.

Another issue discussed by Bryant was the initial lack of community outreach and engagement by state and federal regulatory agencies. In response to environmental concerns and lack of public participation, a grassroots environmental justice organization called the Woolfolk Citizens Response Group (WCRG) was formed. In 1997, the WCRG helped to spearhead the development of the Woolfolk Alliance, an organization representing over 28 stakeholder groups involved with this Superfund site. The Woolfolk Alliance included representatives from EPA, the U.S. Agency for Toxic Substances and Disease Registry (ATSDR), the city of Fort Valley, remediation contractors, local businesses and citizens' groups, among others.

In his closing remarks, Bryant made several suggestions to lessen the redevelopment challenges associated with brown houses. First and foremost, Bryant suggested that EPA, ATSDR and HUD commission an Interagency Working Group to study the potential health risks, stress and property devaluation within Superfund and Brownfields communities. In addition, he suggested that these respective agencies should work in conjunction with the entire real estate industry (i.e., appraisers, builders, environmental consultants, inspectors, lending institutions and mortgage brokers) to assess due diligence practices, to determine where regulatory gaps lie and to prioritize responses. Lastly, Bryant indicated that there is a serious need to develop community outreach and industry-specific educational tools regarding the brown houses phenomenon.

Jack Hale, **Executive Director, Knox Parks Foundation, Hartford, Conn.**

Jack Hale of the Knox Parks Foundation presented the experience of the Chestnut Street Community in Hartford, Conn., dealing with lead contamination in the soil. The soil contamination was discovered in 1997, when this low-income, minority neighborhood approached the Knox Parks Foundation for assistance in developing a community garden. During the process of developing the garden, the Connecticut Agricultural Experiment Station discovered elevated lead levels in the garden soil. Hale's presentation focused on phytoremediation experiments conducted to remediate the contaminated soil and reduce the lead levels in the top layer. Hale also discussed the community's experience during the removal and replacement of the soil on the surrounding community. He articulated the difficulties faced by the community in learning the science of lead contamination and obtaining technical assistance during the remediation. He also emphasized several questions raised about safety standards, public health and appropriate remediation methods and stressed the need for proper public education.

Hale concluded that communities should be educated about public health considerations, financial feasibility and public policy for dealing with soil contamination. With respect to the science of soil lead contamination, he believe there should be an evaluation of the effectiveness of phytoremediation technologies and the ways in which threshold contamination levels can be appropriately assessed short of formal sampling techniques. Finally, Hale recommended further investigation into ways to reduce lead levels without increasing stress on owners of older urban properties.

Nicholas Targ, Counsel, EPA Office of Environmental Justice, Washington, D.C.

Nicholas Targ of the EPA's Office of Environmental Justice focused on how environmental justice is being considered as part of the statutory and regulatory environmental programs implemented by the EPA. In his remarks, he suggested that the EPA should incorporate environmental justice principles into the tools being developed and utilized by the agency's compliance assurance program. Specifically, Targ discussed the definition of environmental justice used by EPA, the role that environmental justice plays in the implementation of the agency's statutes and the factors considered by the agency with respect to sites and facilities that pose environmental justice concerns when prioritizing environmental actions. To further illustrate his points, he presented a Geographic Information System (GIS)-based assessment and compliance targeting tool that has been developed by EPA to facilitate the incorporation of environmental justice considerations in the prioritization of environmental actions. He explained that EPA targets inspections based on known or possible health issues or multiple stressors, socioeconomic factors and community concerns. Information about the EPA's GIS-based tool can be obtained at: www.epa.gov/compliance/whereyoulive.html.

Glen Rice, Environmental Health Scientist, National Center for Environmental Assessment, EPA Office of Research and Development, Research Triangle Park, N.C.

Glen Rice of the EPA's Office of Research and Development gave an overview of EPA's draft cumulative risk screening guidance. He articulated the typical challenges faced by environmental analysts when defining, understanding and predicting the risk posed by contaminated sites. These challenges are due to the high complexity, variability and uncertainty associated with exposure to multiple chemicals through multiple routes of exposure and the difference in population groups and exposure time frames. Rice also discussed the difficulty posed by these complex processes in the environmental management decision-making. He explained EPA's approach to developing guidance that will facilitates the evaluation of cumulative risk, including the screening process, exposure assessment, interactions analysis and stakeholders' involvement. The stakeholder involvement component included a discussion about the importance of community groups in the planning, scoping and problem formulation steps as well as analytic screening provided in this methodology. Other related EPA efforts include the Framework for Cumulative Risk Assessment (2003) and Planning and Scoping Lessons Learned (2002).

Rice concluded his presentation by outlining the next steps in the development of a cumulative risk screening guidance. He revealed that the final formal guidelines for conducting cumulative risk assessment are expected by 2012. Prior to the issuance of the final guidelines, EPA will develop methods to couple environmental public health data with epidemiological information related to multiple chemicals. Furthermore, improved decision frameworks will be developed that take into consideration cumulative health risks, cultural and economic impacts and environmental and ecological effects, along with human health.

Steve Wing, Associate Professor, Department of Epidemiology, University of North Carolina School of Public Health, Chapel Hill, N.C.

Gary Grant, Executive Director, Concerned Citizens of Tillery, Tillery, N.C.

Dr. Steve Wing of the University of North Carolina School of Public Health and Gary Grant of the Concerned Citizens of Tillery discussed the environmental and human health impacts of industrial animal agriculture, including loss of local land ownership, job loss, transfer of profits out of the region, air and water pollution and threats to quality of life and human health in North Carolina. State and federal data show that these impacts are disproportionately borne by low-income and black communities. Organized efforts to bring about local control of agriculture and reduce environmental and health threats has led to a moratorium on construction of new industrial swine operations but not to remediation of problems with existing operations. Wing and Grant also discussed industrial animal agriculture's contribution to climate change and regional energy imbalance. Lastly, they discussed exposure to hydrogen sulfide, endotoxin, nitrates and pathogens, including community-driven studies of the disproportionate impacts of industrial swine production on low-income and African-American communities in North Carolina.

Water Quality

Moderator:

- Reginald Harris, Env. Justice Coord. & Sr. Toxicologist, EPA Region 3, Philadelphia, Pa.

Panelists:

- Rebecca Calderon, Director, Human Studies Division, National Health Effects Research Laboratory, EPA Office of Research and Development, Research Triangle Park, N.C.
- May A. Cornwall, Board President, Virgin Islands Resource Conservation and Development Council, Inc., St. Thomas, U.S. Virgin Islands
- Rodney Davis, Executive Director, Arbor Hill Environmental Justice Corporation, Albany, N.Y.
- Graciela Ramirez-Toro, Chair, Puerto Rico Subcommittee of the National Environmental Justice Advisory Council, and Director Interamerican University of Puerto Rico Center for Environmental Conservation and Interpretation, San Juan, Puerto Rico

Rebecca Calderon, Director, Human Studies Division, National Health Effects Research Laboratory, EPA Office of Research and Development, Research Triangle Park, N.C.

Dr. Rebecca Calderon of the EPA's Office of Research and Development discussed what is known about the effects of water pollutants on human health in the United States. She discussed the health effects of chemical and microbial contaminants in drinking water for different populations and sensitive groups, including cancers and dermatologic, neurological, cardiovascular and reproductive impacts. She presented the results of a number of epidemiological studies conducted around the world, focusing on three prominent water contaminants: arsenic, disinfection byproducts and microbes. Calderon emphasized the widespread, frequent and costly occurrence of waterborne gastrointestinal illness in the United States and reviewed the recent literature on trends and effectiveness of different intervention strategies.

She then briefly described the major legislative response to water-related disease outbreaks, the Beaches Environmental Assessment and Coastal Health Act of 2000. The Act established the national goal of setting new risk-based water quality guidelines and rapid monitoring methods for recreational waters. In response, EPA is emphasizing development of improved sampling methods, more rapid analysis methods and further health studies with the goal of having new, validated and rapidly available water quality indicators that can be applied to any body of water.

May A. Cornwall, Board President, Virgin Islands Resource Conservation and Development Council, Inc., St. Thomas, U.S. Virgin Islands

May A. Cornwall, of the Virgin Island Resource Conservation and Development Council (Council), described some of the initiatives being conducted to better characterize and protect the drinking water supplies of the U.S. Virgin Islands. Reflecting the importance of storing water in this island environment, her remarks addressed water quality in cisterns, surface and ground water sources.

With regard to cisterns, Cornwall described how the research focus in the U.S. Virgin Islands had evolved. There was an early emphasis on developing standards and methods to support water system expansion. Recent research has indicated a need for improving and maintaining the quality of drinking water stored in cisterns through: 1) appropriate design, construction and operation of cisterns; 2) regular microbial testing; and 3) careful chlorine treatment to control undesirable disinfection byproducts.

Ground water quality concerns apply to both private and commercial wells and are related to high concentrations of such contaminants as bacteria, nitrates/nitrites, hydrocarbons and heavy metals. Sources of these contaminants include spills, agricultural practices and releases from landfills. In response to these concerns, the Council is supplementing ongoing geochemical modeling and ground water reconnaissance with cumulative risk assessment studies.

With regard to surface water quality issues, the major concerns are sedimentation, sewage and septage spills and rum discharges. The research focus in this area is shifting from compliance monitoring and assessment to a broader examination of the sources and impacts of surface water contamination using for example, epidemiological studies. This effort will help develop a better understanding of potential links between farming activities and human health.

Cornwall went on to describe recent efforts to employ community-based participatory research (CBPR) in the Virgin Islands to confront the challenges posed by water quality threats. She cited a number of advantages to this approach, as well as some new research outcomes that it has produced, ranging from new and improved epidemiological studies to implementation of new construction standards for roofs and cisterns.

Rita Schoeny, Senior Science Advisor, EPA Office of Water, Washington, D.C.

Rita Schoeny, of EPA's Office of Water, began by describing the legislative and regulatory framework in which new ambient water quality criteria are developed and then focused her remarks on one specific high-priority water contaminant: mercury.

Schoeny described the extensive revisions and improvements made to EPA's human health criteria methodology, which was completed in 2000. Revisions were made to incorporate the latest science developments in risk assessment and to ensure that the most current agency guidelines and guidance documents were cited and used. The basis for a consistent methodology is twofold: 1) to provide guidance to states and authorized tribes to develop their ambient water quality criteria and standards; and 2) to provide clarity and consistency in the methods EPA uses to develop national criteria. Among the refinements made to the methodology are revised consumption estimates (e.g., for fish), the inclusion of guidelines for establishing acceptable cancer risk and greater reliance upon site-specific conditions rather than default values. In addition, EPA now considers relative source contributions for multiple exposure sources and offers a way to account for all sources of exposure in setting a reference dose or criterion/standard. Bioaccumulation factors are also used where appropriate to incorporate a consideration of uptake through the food chain.

A full text of these documents can be accessed online at:
http://www.epa.gov/waterscience/humanhealth/method/

Turning to specific concerns about mercury, Schoeny presented information on environmental cycling of mercury and its bioaccumulation in fish. She then described EPA's revised approach to setting a standard for the mercury compound of greatest concern: methylmercury. She also discussed mercury advisories, which are issued to the public because of the time lag between controlling the source(s) of mercury releases to water and the eventual decrease in human mercury exposure through consumption of fish. The greatest and most rapid decrease in mercury blood levels may be achieved by reducing fish consumption and by not consuming particular fish species (e.g., swordfish, tuna and mackerel).

Rodney Davis, Executive Director, Arbor Hill Environmental Justice Corporation, Albany, N.Y.

Rodney Davis, of the Arbor Hill Environmental Justice Corporation (AHEJC), described his organization and focused on community impacts from ongoing environmental degradation in an urban watershed in Albany, N.Y. The AHEJC promotes environmental advocacy, education and community and environmental health monitoring. It also seeks to bring public attention to environmental degradation in the Arbor Hill community. AHEJC has supported water quality sampling in Albany and in the Patroon Creek Monitoring, Management and Restoration Program.

Graciela Ramirez-Toro, Chair, Puerto Rico Subcommittee of the National Environmental Justice Advisory Council, and Director Interamerican University of Puerto Rico Center for Environmental Conservation and Interpretation, San Juan, Puerto Rico

Graciela Ramirez-Toro, of the Interamerican University of Puerto Rico, began her remarks by pointing out that while acute illness outbreaks from waterborne sources have decreased dramatically in the United States over the past century, many chronic effects and occasional incidents still occur. She believes that the associated mortality, illness and cost to society can and should largely be prevented.

Ramirez-Toro then described some of the challenges inherent in making the water supply infrastructure more sustainable. A basic cause of some of these challenges, she believes, is poor communication and different cultural perspectives displayed by regulators, politicians and members of communities. This is particularly evident in Puerto Rico. She described surveys that her organization had conducted to measure the knowledge and skill of both government employees and members of the public regarding some specific environmental issues. Survey results reveal a troubling lack of understanding of the fundamental facts required to deal with these issues effectively, even among local government officials whose duties included managing the issues.

In characterizing the prevailing knowledge and attitudes among the public, Ramirez-Toro described the prominence and public health significance of private water systems in Puerto Rico. The island has about 250 small system communities that operate private water systems and most are under ongoing enforcement actions despite millions of dollars spent on education during the last 10 years. Even after these actions, system compliance has not changed significantly. Surveys showed that, among other things, the major strategy for improving public health in this area (connecting with the island-wide water authority's system) had utterly failed because people considered only reliability rather than water quality when making their decisions. Because the water authority's system is widely viewed as unreliable, it had failed to induce a single small community to join its system.

Ramirez-Toro then described some of the major activities her organization undertakes to improve the quality of drinking water provided to low-income communities. These include both formal and informal capacity development through targeted education, research and outreach. The organization also seeks to build data banks at the community-level that provide practical experience as well as information, so as to transfer ability rather than just knowledge. Lastly, the organization is forming environmental justice centers and a surveillance system to identify factors that make the communities vulnerable to contaminants, which can be used in cumulative risk assessment work.

Closing Session

Michael Callahan, Senior Science Advisor and Office of Research and Development Regional Liaison, EPA Region 6, Dallas, Texas

Michael Callahan delivered the closing remarks for the conference and mentioned, among other themes that emerged during the workshop, the perception that science is not about people. He stated that it does not have to be that way. EPA, he suggested, should be challenged to think more holistically about human health and should consider more than just chemical exposures. He also noted that a great deal of discussion had emerged around institutional racism. Callahan stated that he, and others at the EPA, could raise awareness and take appropriate action to do something about this concern.

Callahan offered some perspective on the possible future of risk assessment. He emphasized the fact that risk assessment is a tool, not simply an end in itself. He asked the audience to consider the analogy of a lawn mower. Lawn mowers have disadvantages such as noise and fuel consumption but, at the same time, serve as a good tool to cut the grass. To improve the lawn mower, engineers might add complexity through the application of baffles on the mowers for soundproofing. If a homeowner is asked what he or she really desires, however, her response would be a great looking lawn with no maintenance. The tool, the lawn mower in this case, does not show up in the picture. It is merely the best thing we have at this moment to achieve the homeowner's ultimate goal.

According to Callahan, risk assessment is like the lawn mower. It is the best thing we have at the moment, and have had for the past thirty years, to get to the decision-maker's ultimate goals of determining what is dangerous, what should be dealt with first and what is fair. Again the tool, risk assessment, does not show up in the image we have of what we really desire.

How well is risk assessment doing in answering those types of questions? Callahan opined that the types of questions posed today are much more sophisticated than those introduced thirty years ago. Even with incremental improvements over the past thirty years, there are some things that risk assessment still does not do well. Tools, like consumer products, go through life cycles – beginning in infancy (new products with many kinks) and moving to rapid growth, maturity and, eventually, old age before reaching a state of obsolescence. EPA was in its infancy in the early 1970s, and EPA's type of risk assessment was a new product. Risk assessment took off in the 1980s following the publication of the National Research Council's so-called "red book" on the topic. During the 1990s, however, the questions became more complex and the tool was asked to do more than it could.

Conventional risk assessment is in its mature phase. Marketplace history shows us that it will eventually be replaced by something or some things that are cheaper, faster and will better answer the decision-makers' questions. History shows us that if we are not part of the development of the next generation of tools, then we will not be players in what the future holds. Callahan noted, "Where are the companies that made slide rules today?" He stated that if we want to stay relevant tomorrow, we have to think about the future today. Praising the environmental community, he concluded, "One more thing that history shows us: most really dramatic changes in history have started with a small group of dedicated individuals."

Dr. Mildred McClain, Executive Director, Citizens for Environmental Justice, Savannah, Ga.

Dr. Mildred McClain, Executive Director of Citizens for Environmental Justice, Inc., activist, teacher, leader, friend and fellow advocate, both challenged and inspired conference participants through her passionate and eloquent closing remarks. McClain has advocated for the environmental justice movement and on behalf of low-income and minority populations who have, throughout history, struggled against environmental and social injustices.

The minds, spirits and individual capacity of participants to relate to people, she noted, was fed throughout the course of the three-day working conference. McClain challenged participants to find the next steps within the actions and relentless dedication of themselves, their respective organizations, universities and communities. McClain summarized many of the themes that emerged during the conference. She noted first and foremost that "people are valuable and they have the power to change things."

Partnerships and relationships, she mentioned, are key components to the changes sought. Furthermore, partnerships involve negotiations while relationships are something much more intimate. As such, partnerships should be deeply rooted in honest relationships.

The term capacity-building is often associated with communities, but McClain reminded her audience that we must not only build the capacity of communities and neighborhoods but also of academia, governments, industries and individuals. Community-based participatory research (CBPR) and cumulative risk assessment (CRA) can only be successful if strong partnerships and intimate relationships are truly present and, additionally, if these relationships create active involvement from the community.

McClain stressed that conference follow-ups will only occur if participants take an active role in continuing what the conference has begun. Conferences serve to inspire us to go on a little bit longer, spark our imaginations a little bit higher and motivate us to re-examine what we have learned about our past actions and future goals.

McClain challenged the EPA, as an agency, to acquire more money and more trained staff. At the same time, she pushed others to lobby Congress to provide more money to the EPA. Similarly, she encourages the agency to bring other government agencies to the table and to build and strengthen partnerships with what McClain called "majority institutions."

And finally, McClain vocalized her belief that we must address justice and also racism. Wherever possible, individuals, communities, cities, states, towns, government and academia, must actively fight against all types of racism, including environmental racism. To conclude, where McClain and the conference began, "people are valuable and they have the power to change things." And so, it is in the hands, hearts, actions and voices of each and every participant to create, on a daily basis, the next steps or actions that this conference has served to inspire.

Recommendations

The need to develop a more holistic and integrated approach to understanding and reducing human health risks from environmental exposures was a common theme to emerge from the three-day working conference. Topics that related to the core themes of the conference – cumulative risk assessment and community-based participatory research – were echoed throughout the sessions. These topics included broad issues such as developing better assessments of multiple and cumulative exposure; estimating aggregate, rather than single-source, risk; assessing multi-media exposures and promoting community participation in research. Several speakers noted that the mission of the EPA is to "protect human health and the environment," and emphasized the primacy of a continued focus on health in all agency research strategies. The following more specific recommendations address the EPA's research strategies and approaches to cumulative risk assessment and community-based participatory research and emerged from the presentations and discussions heard at the conference, as well as the continued efforts of the planning committee.

1. Adopt a precautionary approach to research

The need to adopt precautionary, or better safe than sorry, approaches to risk assessment and regulation was emphasized throughout the conference. Joel Tickner, of the Lowell Center for Sustainable Production at the University of Massachusetts-Lowell, suggested that one concrete way to implement precaution would be to ensure that risk assessment is not separated from an assessment of alternatives. A precautionary, or preventative, approach serves to shift the research and risk assessment question from "Is this particular chemical or activity more dangerous than is acceptable?" to "What chemical or activity poses the least harm to human health?" Participants, presenters and moderators communicated the need for the EPA to implement an underlying principle of precaution into all aspects of the agency's research and policy strategies. Professor H. Patricia Hynes, of the Boston University School of Public Health (BUSPH), in her keynote speech, remarked that environmental justice research must embody a bias for action. Eileen Storey, of the University of Connecticut Health Center, noted that children who acquire asthma in moldy schools are given medication and returned to school even though the mold problem has not been addressed. This observation powerfully underscores the agency's need to integrate approaches to risk assessment, which expressly promote principles of prevention and precaution into EPA actions around environmental health issues.

2. Adopt collaborative approaches to research

At the heart of this conference and central to future environmental justice research is the notion of collaboration and cooperation between diverse groups of stakeholders. Collaboration within and between the EPA and the many stakeholders with a vested interest in environmental health and environmental protection can lead to more comprehensive and accurate estimates of risk from environmental exposures and an enhanced ability to reduce these risks. Marian Feinberg, of For A Better Bronx, noted that the kind of research and research context most relevant to environmental justice communities require that government agencies and universities develop relationships that extend beyond the boundary of a research project or grant.

During the plenary session on cumulative risk, Michael Callahan, of EPA Region 6, highlighted the importance of continued collaboration between the EPA's Office of Research and Development and the National Environmental Justice Advisory Council (NEJAC) as it completes its development of cumulative risk assessment methodologies. The NEJAC committee, Callahan noted, is an environmental justice stakeholder group that provides particularly valuable insight into the agency's continued understanding of vulnerability.

Various conference speakers presented models of successful collaboration within environmental justice communities that have led to the identification and reduction of human health risks from local environmental hazards. Peggy Shepard described the community-based participatory research partnership between West Harlem Environmental Action (WE ACT) and Columbia University, which has led to the identification of various hot spots of fine particulate matter and diesel exhaust and appropriate measures to reduce ambient levels of these air pollutants in the communities of color of Northern Manhattan. Similarly, Ryan Torres introduced the Boston Lead Action Collaborative (Collaborative) and emphasized its coordinated approach and community-driven nature. The Collaborative has developed a unified, integrated approach called the "Boston Blueprint to End Childhood Lead Poisoning," which details a strategy to address and eradicate lead poisoning by 2008.

During the plenary session on cumulative risk, Joel Tickner noted that developing accurate cumulative risk methods will require looking at a broad body of evidence, including local knowledge and judgment. Accessing valuable local knowledge through increased collaboration and communication with communities is, as Tickner notes, a necessary component of developing accurate cumulative risk assessment methods.

During a discussion on community-based participatory research, Marian Feinberg, of For a Better Bronx, noted that researchers need to learn the value of community knowledge within the joint research partnership. She emphasized that a community's knowledge about local health issues, pollution sources, internal dynamics and political base is invaluable to the accuracy and success of environmental health research. Rabbi Daniel Schwartz, of the Children's Environmental Health Network, noted the necessary involvement of multiple actors, including community organizations, families, schools and children. Shepard suggested conducting cultural exchanges between community groups, universities and government agencies to encourage and increase collaboration.

A few site-specific recommendations for collaborative opportunities were also identified. J. Kyle Bryant of the Academic Institutions – Communities – Agencies Network described the regulatory gaps that obstructed the effective elimination of pesticide and arsenic contamination from homes in Woolfolk, Ga., following the decades-old operation of a nearby chemical facility. He noted that the EPA, the U.S. Agency for Toxic Substances and Disease Registry and the U.S. Department of Housing and Urban Development had to work together to remediate contamination inside people's homes from an external source of pollution. He also noted that the entire real estate industry (i.e., appraisers, builders, environmental consultants, inspectors, lending institutions and mortgage brokers) should assess due diligence practices, determine where regulatory gaps lie and prioritize responses.

3. Incorporate community involvement in all stages of research

The need for increased community involvement in research and risk assessment methods was another dominant theme to emerge throughout the three-day working conference. This set of recommendations

focuses specifically on increasing the role that community residents play in EPA's research methods. The role of community residents should include planning and design, even when some of the research may not be site-specific. The need for greater transparency and community accessibility to the EPA research agenda was strongly emphasized in many of the conference discussions.

Recommendations to pursue community-based participatory research (CBPR) methods centered on the following basic principles:

1) Involvement of community residents affected by environmental exposures in every stage of research designed to assess and reduce the health impacts of those exposures;
2) Timely and accessible communication of research results to community residents and other stakeholders; and
3) Translation of research into action to improve community and individual health.

In this model, community participation is integral to the success of research. This contrasts with the fixed community input where a research methodology is developed and then community input is sought.

Conference participants also recognized the importance of community engagement in planning for research into both environmental health risks and economic activities that may give rise to environmental hazards. During the CBPR plenary discussion, Gary Grant, of Concerned Citizens of Tillery, noted "a community has to be strong enough to say it will cooperate with research sampling only if it is made part of the planning process." In discussing potential research collaborations between academic institutions and communities, Swati Prakash, of WE ACT, added that a community has a right to say no to research and that a community should state what it wants to get from the research. Dr. Rebecca Calderon, of the National Health Effects Research Laboratory in EPA's ORD, concurred and noted that if a community does not trust the university researchers in question, then it should not collaborate with them.

Examples of successful models of CBPR were given from across the nation. In each case the centralizing of community participation enabled a seamless connection between the realm of risk and exposure assessment with that of risk reduction and health protection. This is a connection that is often difficult to make in national or non-community-based research and risk assessment projects. The examples of successes included community monitoring of air toxics in Oakland, Calif.; monitoring and reduction of diesel exhaust in Harlem, N.Y.; and the identification of priority risks in Chelsea and East Boston, Mass.

During the Asthma panel session, Feinberg commented that engaged communities should participate with researchers in developing the research questions and protocol, collecting and interpreting data and formulating conclusions for further research and action. She noted a key strength of community participation in research is that community members challenge preconceptions of researchers and add valuable practical knowledge that researchers may lack. Audience members at the Children's Environmental Health breakout session concurred, defining community participation in research as their active engagement and involvement in determining the parameters of the study. Equally important is the eventual communication back of the research results.

4. Build capacity and empower communities, academic institutions and government agencies to assess and address environmental health risks

Capacity-building and empowerment of environmental justice communities and other communities, including government agencies and academic institutions, was noted as critical to achieving successful cumulative risk assessment and CBPR activities. Building the long-term capacity and power of effected communities to assess and address environmental health risks is both necessary and valuable. This includes building the technical expertise of communities and their ability to utilize scientific information to effectively reduce risks. Shepard provided specific recommendations for long-term capacity-building within communities, including: fostering the empowerment of youth, developing a core of resident leaders versed in scientific concepts and monitoring tools, housing the community research staff at community-based organizations, providing educational sessions as needed and developing multiple institutions within the community.

Likewise, strategies geared toward achieving long-term capacity for both local, state and federal governmental agencies, academic institutions and the research community in general, are also necessary to the success of cumulative risk assessment and CBPR activities. Madeline Scammell of the Boston University School of Public Health remarked that the equal distribution of power and results among partners is a necessary component of CBPR. Graciela Ramirez-Toro, of the Interamerican University of Puerto Rico, specified that targeted outreach, education and responsive research could help build the capacity of both community members and all those with an interest in environmental protection in Puerto Rico. She noted that, for example, building data banks at the community-level could provide practical experience, as well as information to transfer ability rather than just knowledge.

5. Develop place-based, flexible approaches to research and risk assessment

In her keynote address, Hynes noted that the environmental justice movement has brought a place-based and community-based aspect to environmental protection through the introduction of social, economic, cultural and spiritual aspects of the environment. It is this place-based focus that offers an innovative future for some of EPA's research strategies and agenda. As Timothy Watkins, of the National Exposure Research Laboratory, noted the EPA is already engaged in community monitoring studies to address and improve the assumptions about human activities and average exposures that are made in risk assessment. This approach – of supplementing and verifying model assumptions to ensure they fit a particular context – exemplifies the core of what is needed to truly ensure that all communities enjoy the benefits of environmental protection. Furthermore, it becomes especially appropriate in the case of heavily burdened communities.

The EPA has already made significant progress in developing appropriate data sets and tools for assessing risks for specific subpopulations, such as the EPA's Child-Specific Exposure Factors handbook described by Maryann Suero, of the Children's Health Program in EPA Region 5. This handbook could serve as a model for the development of location-specific exposure factors by estimating (through early and frequent community involvement) actual exposure patterns within particular communities. In this case, cumulative risk assessment can be complemented by a CBPR approach.

Nicholas Targ of the EPA Office of Environmental Justice discussed the resonance between place-based research and place-based inspection and enforcement in his description of environmental justice considerations in compliance assurance activities of the EPA.

6. Incorporate socioeconomic factors into risk assessment

A growing body of environmental health knowledge points to a complex set of interactions between traditional physical and chemical environmental exposures and other exposures such as noise, environmental stressors and socioeconomic factors in contributing to health risk from the environment. Protecting human health from environmental risks increasingly requires a sophisticated understanding of how these nonphysical exposures modify risks.

This is a core component of EPA's Cumulative Risk Framework, and many conference speakers presented their findings on some of these relationships. For example, Dr. Virginia Rauh, of the Columbia Mailman School of Public Health, discussed the ways in which physically toxic exposures interact with social adversity or poverty to contribute to or exacerbate illness in children. Rabbi Daniel Schwartz, of the Children's Environmental Health Network, highlighted the ways that children's environmental health is affected by intersecting circles of exposure, family and community and that optimally protecting the health of this more vulnerable subpopulation requires knowledge of these intersections. Dr. Morello-Frosch, of Brown University Medical School, presented findings from research in Southern California that indicated residential segregation is closely linked to air pollution – notably, that estimated cancer risks from cumulative outdoor air toxics exposures are higher for all demographic groups in highly segregated areas than they are for less segregated areas. Research findings like this, which also illustrate the advantage of interdisciplinary approaches to environmental health research, can help identify previously unconsidered solutions for reducing these risks for all.

7. Develop a better understanding of vulnerability that includes both physical and non-physical factors

Environmental justice considerations have played a key role in identifying that not all people are impacted in the same way by exposure to pollution and environmental degradation. Although there is a great deal of variability between individuals in responses to environmental exposures, there is also variability between large groups of people. A classic example is the fact that people with asthma and other respiratory diseases are more vulnerable to the effects of air pollution than others.

It is recommended that research emphasis be directed toward cultivating a better understanding of additional factors, both physical and nonphysical, that affect an individual's vulnerability. This area could include, for example, research into the ways in which environmental exposures enhance or diminish people's resistance to environmentally-mediated disease. Conference participants were enthusiastic about this recognition in the EPA Cumulative Risk Assessment Framework. Ramirez-Toro suggested that the development of community-based surveillance systems could help identify factors that make communities more vulnerable to contaminants.

8. Create interdisciplinary, holistic approaches to risk assessment, combining quantitative and qualitative data

Committing to the goals of cumulative risk assessment will require the expansion of disciplinary expertise dedicated to environmental health research. Traditionally, fields such as toxicology, biology, medicine, epidemiology, environmental chemistry and physics have dominated the ways we have come to understand how human beings are exposed to and affected by environmental exposures. Yet understanding the subtleties and variations in human activity leading to exposures, or the nonphysical

factors that modify susceptibility to hazardous exposures, clearly requires drawing on fields such as sociology, urban planning and history. Building the capacity of researchers in these fields to make connections to the environmental field becomes crucial. Equally as important is the need to explore the ways in which EPA can broaden its own base of disciplinary approaches to risk assessment and environmental health research through efforts that link offices and groups both within the agency and between agencies.

9. Promote innovative technologies and research methodologies

Several conference participants discussed innovations in data collection and information dissemination that facilitate effective, relevant and applicable research on environmental health risks. Geographic Information Systems and spatial analysis techniques can allow for the identification and prioritization of high-risk communities or geographic areas for protection from environmental hazard. Ryan Torres of the Lead Action Collaborative discussed the use of such techniques in the identification of priority areas for lead paint abatement in the city of Boston, while Nicholas Targ of the EPA Office of Environmental Justice described the development of online geographic information systems tools to facilitate the incorporation of EJ considerations in the prioritization of environmental enforcement actions.

Web-based tools and resources can also serve as an effective means of rapid and comprehensive information sharing. This ease, however, often comes at the cost of accessibility for under-resourced communities.

EPA's work to quantify the benefits of environmental protections can also benefit from CBPR methods, which facilitate a clear and precise articulation of the many ways in which people's lives and health benefit from improvements to environmental quality.

Rebecca Calderon, of the EPA's Office of Research and Development, observed that the EPA has emphasized the development of improved sampling methods (for surface water) and more rapid analysis methods, and that the EPA wants to develop new, validated and rapidly available water quality indicators, which can assist in ensuring that water bodies attain highest levels of quality and that human exposure is limited when water quality is of concern.

10. Emphasize action to protect communities in the application of research

Undoubtedly one theme that resonated throughout the multi-day conference and across the various sessions was the need to connect research to action in order to protect communities at greatest risk of environmental harm. Joel Tickner, of the University of Massachusetts-Lowell, suggested that systems to continuously monitor and identify early warnings of harm could be one way to closely connect data collection and action triggers. Stacey Chacker, of Neighborhood of Affordable Housing, and Roseann Bongiovanni, of the Chelsea Human Services Collaborative, concurred on this point, noting that the need to identify action items emerged as a critical lesson learned from the Chelsea Creek Comparative Risk Assessment project. In describing typical characteristics of CBPR, Madeline Scammell, of the BUSPH, noted the commonality of action-oriented outcomes, or the concept of research for change among practitioners of CBPR. Shepard described the concept of "translational research," or research that can be translated into improvements in health outcomes, and felt that it should be treated as a necessity rather than a fringe possibility.

Many participants noted that at times research and the need for additional data could inadvertently be interpreted as ways to justify delaying action about potential risks. As one audience member of the Children's Environmental Health session asked, "Why is it necessary to continue to study some of these children's health problems when instead we should be proceeding with solutions?"

THE SCIENCE OF ENVIRONMENTAL JUSTICE WORKING CONFERENCE

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FINAL PARTICIPANT LIST

Joshua Abraham
Literacy for Environmental Justice, Bayview-Hunters Point
6220 3rd Street
San Francisco, CA
415-508-0575
415-508-0576
ypge@lejyouth.org

Monica Abreu
Environmental Justice Coordinator
Office of Environmental Justice
NYS Department of Environmental Conservation
625 Broadway, 14th floor
Albany, NY 12233-1500
518-402-8556
518-402-9018
mlabreu@gw.dec.state.ny.us

Lois Adams
Acting Chief, Rhode Island State Unit
EPA, Region I
1 Congress Street
Suite 1100 (CRI)
Boston, MA 02114-2023
617-918-1591
617-918-2064
adams.lois@epa.gov

Azibuike Akaba
Technical Assistance Coordinator
Environmental Division
Coalition for West Oakland Revitalization
920 Peralta Street
Oakland, CA 94607
510-451-2761
azibuike@speakeasy.net

Kathryn Alcántar
Environmental Health Associate
West Harlem Environmental Action, Inc.
271 West 125th St., Suite 308
New York, NY 10027
212-961-1000
212-961-1015
kia2001@columbia.edu

Carlos Alicea
Educator Program development
South Bronx environmental Justice Partnership
346 Brook Ave. Apt.3A
Bronx, NY 10454
718-585-3581
718-742-5770
calicear@yahoo.com

Susana Almanza
Director
PODER
Post Office Box 6237
Austin, TX 78762
512-472-9921
512-472-9922
Poder_tx@sbcglobal.net

ShaKing Alston
Executive Director
New York City Environmental Justice Alliance
115 West 30 Street, suite 709
New York, NY 10001
212.239.8882
212.239.2838
shakinga@comcast.net

Davida Andelman
Director, Community Health
Bowdoin Street Health Center
230 Bowdoin Street
Dorchester, MA 02122
617-754-0027
617-754-0230
dandelma@bidmc.harvard.edu

Doris Anziani
PROGRAM COORDINATOR
Family Service, Inc.
430 N. CANAL ST
LAWRENCE, MA 01841
978-683-9505
978-683-1026
DANZIANI@FAMILYSERVICEINC.COM

Indira Balkissoon
Regional Manager
Environmental Health & Safety
TechLaw, Inc.
90 New Montgomery
Suite 1010
San Francisco, CA 94105
415-281-8730
415-281-8735
ibalkissoon@techlawinc.com

Mary Ballew
Environmental Scientist/HH risk assessment
RCRA Corrective Action
USEPA- New England
1 Congress St.,
Suite 1100/HBT
Boston, MA 02114
617-918-1277
617-918-1291
ballew.mary@epa.gov

Lois Banks
Director of State and Community Relations
Trust for America's Health
1707 H Street, N.W., 7th Floor
Washington, DC 20006
202-223-9870 ext 203
202-223-9871
Lbanks@tfah.org

Thomas Baugh
environmental scientist
Office of the Regional Administrator
EPA, Region IV
61 Forsyth Street SW
(14th floor)
Atlanta, GA 30303
404-562-8275
404-562-8269
baugh.thomasl@epa.gov

Robert Beattie
Director
Environmental Studies Program
University of Massachusetts, Boston
100 Morrissey Boulevard
Boston, MA 02125
617-287-4042
robert.beattie@umb.edu

Myriam Beaulne
Biologist and Environmental Health Organizer
Clean Water Fund
Alliance for a Healthy Tomorrow
165 West Street
New Salem, MA 01355
978-544-3774
myriam_bio@earthlink.net

Marcos Beleche
Director of Organizing
Community Organizing and Resident Resources
Codman Square Neighborhood Development Corporation
587 Washington Street
Dorchester, MA 02124
617-825-4224
617-825-0893
marcos@csndc.com

Andrew Beliveau
Environmental Scientist
Office of Ecosystem Protection
EPA, Region I
1 Congress Street
suite 1100
Boston, MA 02114-2023
617-918-1443
617-918-1291
Beliveau.andy@epa.gov

Miguel Beltran
"El Puente" Brooklyn, NY
71 Clinton Street, Apartment 5
Framingham, MA 01702
508-733-3507
mbeltram58@hotmail.com

Kent Benjamin
EJ Coordinator
Office of Solid Waste and Emergency Response
EPA
1200 Pennsylvania Avenue NW
MC 5101T
Washington, DC 20460
202-566-0185
202-566-0185
benjamin.kent@epa.gov

Eugene Benoit
Indoor Environment Program
EPA, Region I
1 Congress Street, CAP
Boston, MA 02114
617-918-1639
617-918-1505
benoit.eugene@epa.gov

Tricia Bhatia
Intern
Environmental Justice
Project Basic, Inc.
1043 Broad Street
Providence, RI 02905
401-4618760
tlbhatia@hotmail.com

Laura Bickel
Attorney
Environment Department
City of Boston
c/o Professor Manus
New England School of Law, 154 Stuart St.
Boston, MA 02116
617-422-7412
617-422-7453
lbickel@admin.nesl.edu

Lyn Billman-Golemme
American Planning Association
Billman-Golemme Associates
Lyn Billman-Golemme
114 Ruggles Street
Westborough, MA 01581-3525
508-799-0500
billman-golemme@charter.net

Angelica Bonarrigo

Roseann Bongiovanni
Facilitator
Chelsea Green Space and Recreation Committee
300 Broadway
Chelsea, MA 02150
617-889-6080
roseannb@chelseacollab.org

Tracy Brenner
Wolfsdorf Brenner, Inc.
11 Sunset Road
Newton, MA 02456
617-965-4672
twbrenner@aol.com

Alan Brown
EPA, Region I
P.O. Box 5041
Beverly, MA 01915
617-918-1015
brown.alanj@epa.org

Dan Brown
Acting Manager
Air Permits, Toxics and Indoor Programs Unit
EPA, Region I
1 Congress Street, Suite 1100
Boston, MA 02114
617-918-1048
brown.dan@epa.gov

Phil Brown
Professor of Sociology and Environmental Studies
Environmental Studies/Sociology
Brown University
Box 1916
Providence, RI 02912
401-863-2633
401-863-3213
phil_brown@brown.edu

J. Kyle Bryant
Technical Advisor
ACA-NET
12011 Fairway Overlook
Fayetteville, GA 30215
404-210-1652
jkyle15@hotmail.com

Kathy Burns
Senior Health Scientist
Environmental Research Area
Abt Associates
41 Fair Oaks Drive
Lexington, MA 02138
978-502-1665
kmb@alumni.uchicago.edu

Re'Anita Burns
Youth United for Community Action
1848 Bay Road
East Palo Alto, CA 94303
650-322-9165
reanita@youthunited.net

Laura Caballero
Lideres Campesinas
611 Rebecca Street
Pomona, CA 91766
831-206-0333
836-674-1095
liderescampesinas@hotmail.com

Rebecca Calderon
Acting Division Director
Office of Research and Development
EPA, Region IV
MD 58-A, Human Studies Facility
104 Mason Farm Road, Room 152
Chapel Hill, NC 27514
919-966-6209 or 919-966-0617
919-966-6212
calderon.rebecca@epa.gov

Michael Callahan
Senior Science Advisor
EPA, Region VI
1445 Ross Avenue, Suite 1200
Mail Code 6RA-D
Dallas, TX 75202-2733
214-665-2787
214-665-6648
callahan.michael@epa.gov

Chris Camillo
Coordinator
Community Asthma Programs
Hasbro Children's Hospital
Rhode Island Hospital
593 Eddy Street, POB 438
Providence, RI 02903
401.444.3092
401-444-7409
ccamillo@lifespan.org

Edna Carrasco
Committee for Boston Public Housing
100 Terrace Street
Suite B
Roxbury, MA 02120
617-427-3556, x206
617-442-6139
ednacarrasco@yahoo.com

Paul Carroll
EPA
11 Technology Drive
North Chelmsford, MA 01863
617-918-8306
carroll.paulr@epa.gov

Kathy Castagna
Environmental Justice Coordinator
Office of Civil Rights and Urban Affairs
EPA, Region I
1 Congress Street, Suite 1100
Boston, MA 02360
617-918-1429
617-918-1029
castagna.kathleen@epa.gov

Stacey Chacker
NOAH
22 Paris Street
East Boston, MA 02128
617-569-0059, x13
schacker@noahcdc.org

Khan Chao
Environmental Outreach Educator
Center for Family, Work and Community
University of Massachusetts Lowell
600 Suffolk Street
Wannalancit Mill Building
Lowell, MA 01852
978-934-4676
978-934-3026
Khan_Chao@uml.edu

Kizzy Charles-Guzman
Graduate Student, Resource Policy & Administration
School of Natural Resources and Environment
University of Michigan
915 Washington Avenue Apartment 3B
Brooklyn, NY 11225
734-330-5722
kizzycg@umich.edu

Tony Chaves
Environmental Justice Coordinator
Environmental Justice Program
Executive Office of Environmental Affairs
100 Cambridge Street, 9th Floor
Boston, MA 02114
617-626-1009
617-626-1181
Tony.Chaves@state.ma.us

Luz Claudio
Associate Professor
Community and Preventive Medicine
Mount Sinai School of Medicine
One Gustave Levy Place
Box 1057
New York, NY 10029
212-241-3634
212-996-0407
Luz.Claudio@mssm.edu

Birgit Claus Henn
Research Fellow
ASPH
EPA, Region IV
U.S. EPA - MD58C
RTP, NC 27711
919-966-8901
claus.birgit@epa.gov

Nancy Cobb
State of Indiana
2 North Meridian 5-J
Indianapolis, IN 46204
317-234-2273
ncobb@isdh.state.in.us

Deborah Cohen
GIS Coordinator
OARM
EPA, Region I
1 Congress Street, Suite 1100
Boston, MA 02214
617-9181145
617-918-1183
cohen.deborah@epa.gov

Elaine Cohen Hubal
National Exposure Research Laboratory
EPA, Region IV
E205-01
RTP, NC 27711
919-541-4077
hubal.elaine@epa.gov

Maru Colbert
Professor
Engineering
CCE/NEU
One Kendall Square, PMB 172
Cambridge, MA 02139
866-227-7371
ejsig@verizon.net

Gail Conenello
Attorney
Kirkpatrick & Lockhart LLP
One Newark Center
Tenth Floor
Newark, NJ 07102
973-848-4048
973-848-4001
gconenello@kl.com

Nora Conlon
QA Chemist/Region1 Children's Environmental
Health Coordinator
Quality Assurance
EPA Region 1
11 Technology Drive
North Chelmsford, MA 01863
617-918-8335
617-918-8235
conlon.nora@epa.gov

May Cornwall
Research and Grants Administrator
Finance
Virgin Islands Water & Power Authority
Post Office Box 1009
Christiansted
St. Croix, VI 00820
340-773-2250
340-778-8444
may.cornwall@viwapa.vi

Elizabeth Coughlin
President
Merrimack River Watershed Council, Inc.
Merrimack River Watershed Council, Inc.
600 Suffolk Street, 4th floor
Lowell, MA 01854
978-275-0120 x 11
978-275-0125
ecoughlin@merrimack.org

Tyke Crowley
Office of Senator Kerry
1 Bowdian Square
Boston, MA 02114
617-565-8519

Carolyn Crump
Research Assistant Professor
Health Behavior & Health Education, School of Public Health
University of North Carolina
CB# 7506
137 E. Franklin St., Suite 21
Chapel Hill, NC 27599-7506
919-966-5598
919-966-7955
ccrump@email.unc.edu

Scott Darling
Conservation Law Foundation
62 Summer Street
Boston, MA 02110
617-350-0990
617-350-4030
sdarling@clf.org

Nathaniel Davis
Director of Urban Community Environmental Programs
Arbor Hill Environmental Justice Corporation
596 Manning Blvd
Albany, NY 12210
518-463-9760
518-463-0544
ndavis@w-haywoodburns.org

Rodney Davis
Executive Director
Arbor Hill Environmental Justice Corporation
596 Manning Boulevard
Albany, NY 12210
518-483-9760 or 518-426-2924
518-463-0544
rdavis@w-haywoodburns.org

Matt Del Monte
Environmental Planner
Land Use and Environment
Pioneer Valley Planning Commission
26 Central Street
West Springfield, MA 01089
413-781-6045
413-732-2593
mdelmonte@pvpc.org

Cindy Delpapa
Stream Ecologist
Riverways
Massachusetts Fish and Game
251 Causeway Street, Suite 400
Boston, MI 02114
617-626-1545
617-626-1505
cindy.delpapa@state.ma.us

Gina DeMarco
District Manager
Northern Rhode Island Conservation District
17 Smith Avenue
Greenville, RI 02828
401-567-7940
401-949-4436
Gina-DeMarco@ri.nacdnet.org

James Devasunand
Program Assistant
Active Citizens Together Improving Our Neighborhood
417 N.W. 16th Street, Suite 1A
P.O. Box 16
Belle Glade, FL 33430
561-993-9100
561-993-9188
laramorecc@aol.com

Robert Dogan
Community Planner
U.S. Air Force
Headquarters Air National Guard/CEVP
3500 Fetchet Avenue
Andrews AFB, MD 20762-5157
301-836-8859
301-836-8139
robert.dogan@ang.af.mil

Derek Durbin
198 Union Street
Portsmouth, NH 03801
603-770-3315
ddurbin@vermontlaw.edu

Derek Durbin
Environmental Law student
Vermont Law School
PO Box 334
So. Royalton, AK 05068
603-770-3315
ddurbin@vermontlaw.edu

John Durkhiem
Professor
Toxicology
University of North Carolina
32 2nd Ave
Chapel Hill, NC 20034
235-343-4498
jd@unc.edu

Felicia Eaves
Community Assistance Coordinator
Alliance for Healthy Homes
227 Massachusetts Avenue NE
Suite 200
Washington, DC 20002
202-543-1147
202-547-4466
feaves@afhh.org

James Emery
Research Associate
Health Behavior & Health Education, School of Public Health
University of North Carolina
CB# 7506
137 E. Franklin St., Suite 21
Chapel Hill, NC 27599-7506
919-966-7172
919-966-7955
jemery@email.unc.edu

Richard Enander
Supervising Scientist
Technical and Customer Assistance
Rhode Island Department of Environmental Management
235 Promenade Street
Suite 250
Providence, RI 02908
401-222-4700
401 222-3810
renander@dem.state.ri.us

Carlos Evans
77 West Jackson Boulevard (C-145)
Chicago, IL 60615
312-886-2149
evans.carlos@epa.gov

William Farland
Acting Deputy Assistant Administrator for Science
Office of Research and Development
U.S. EPA
8101R
1200 Pennsylvania Avenue, NW
Washington, DC 20460
202-564-6620
202-565-2430
farland.william@epa.gov

Marian Feinberg
South Bronx Clean Air Coalition
541-549 East 138th Street
Suite 2D
Bronx, NY 10454
718-742-5770
sbcac@earthlink.net

Alison Field-Juma
Member
Policy Committee
Mystic River Watershed Association
363 Concord Avenue
Cambridge, MA 02138
617-868-7313
fieldjuma@alumni.tufts.edu

Nigel Fields
National Center for Environmental Research
US Environmental Protection Agency
1200 Pennsylvania Ave, NW
(8723F)
Washington, DC 20460
202-343-9767
202-233-0677
fields.nigel@epa.gov

Steven Fischbach
Community Lawyer/Unit Head
Rhode Island Legal Services
56 Pine Street, 4th Floor
Providence, RI 02903
401-274-2652
401-453-0310
sfischbach@rils.org

Bethany Fleishman
Outreach Fellow
Dartmouth's Toxic Metals Research Program
Dartmouth College
7660 Butler
Hanover, NH 03755
603-650-1543
bethany.j.fleishman@dartmouth.edu

Rosanne Foley
Environmental Health Coordinator
Dorchester Environmental Health Coalition
Health Services Partnership of Dorchester
1452 Dorchester Ave, 4th flr
Dorchester, MA 02122
617-474-1478
617-474-0465
Rosanne.Foley@hspnetwork.org

Christine Foot
GIS Analyst
EPA, Region I/General Dynamics
1 Congress Street, Suite 1100
Boston, MA 02114
617-918-1143
617-918-0143
foot.christine@epa.gov

Patricia Fraser
Associate Physician
Rheumatology
Brigham and Women's Hospital
75 Francis Street
PBB3
Boston, MA 02115
617-732-5348
617-732-5505
pfraser@partners.org

Tasha Frazier
Environmental Justice Assistant
Office of Environmental Justice
EPA, Region II
290 Broadway
26th Floor
New York, NY 10007
212-637-3861
212-637-4943
frazier.tasha@epa.gov

Nan Freeland
Executive Director
North Carolina Environmental Justice Network
112 S. Blount Street
Raleigh, NC 27601
919-515-4525
919-319-8927
nan_freeland@ncsu.edu

George Friedman-Jimenez
Assistant Professor
Environmental Medicine
New York University School of Medicine
650 First Avenue, Room 518
New York, NJ 07666
212 263-6083
george.friedman.jimenez@nyu.edu

Danielle Fuligni
Rhode Island Urban Program Manager
Office of Ecosystem Protection
EPA, Region I
1 Congress Street, Suite 1100
(CPT)
Boston, MA 02114
617-918-1523
617-918-0523
fuligni.danielle@epa.gov

Luis Garden Acosta
CEO and Founder
El Puente
211 S.4th St
Brooklyn, NY 11211
718-302-6443
718-218-8960
lgatoday@aol.com

Richard Garnas
Environmental Scientist
Office of Research and Development
EPA
ORD/OSP (8104R)
1200 Pennsylvania Ave NW
Washington, DC 20460
202-564-6785
202-565-2925
garnas.richard@epa.gov

Catherine Garypie
EPA, Region V
77 West Jackson Boulevard (C-14J)
Chicago, IL 60604
312-886-5825
312-886-0747
garypie.catherine@epa.gov

Catalina Garzon
Graduate Student
Environmental Science, Policy and Management
University of California, Berkeley
1125 East 18th Street #35
Oakland, CA 94606
510/517-1602
510/251-2203
garzcat@uclink.berkeley.edu

Alycia Gilde
Environmental Justice and Project Coordinator
Northeast States for Coordinated Air Use Management
101 Merrimac Street
Boston, MA 02114
617-367-8540 ext. 229
617-742-9162
agilde@nescaum.org

Ellie Goldberg
Green Decade Coalition/Newton & Massachusetts PTA
79 Elmore Street
Newton, MA 02459-1137
617-965-9637
617-965-5407
erg_hk@juno.com

Terri Goldberg
Deputy Director
Northeast Waste Management Officials' Association
129 Portland Street 6th floor
Boston, MA 02114
617-367-8558 x302
617-367-0449
tgoldberg@newmoa.org

Margaret Gordon
West Oakland Environmental Indicators Project
654 13th Street
Preservation Parkway
West Oakland, CA 94607
510-251-1600
510-251-0225
margaretgordon@sbcglobal.net

Gary Grant
Concerned Citizens of Tillery
Post Office Box 61
Tillery, NC 27887
252-826-3017
tillery@aol.com

Jeanie Graustein
Environmental Justice Ministry Coordinator
Office of Urban Affairs
Archdiocese of Hartford
81 Saltonstall Avenue
New Haven, CT 06513
203-777-7279
203-776-3233
jgraustein@oua-adh.org

James Gray
Principal Planner
Community Development
Pioneer Valley Planning Commission
26 Central Street, Suite 34
West Springfield, MA 01089
413-781-6045
413-732-2593
jwgray@pvpc.org

Natasha Greaves
EPA, Region X
1200 6th Avenue OAQ, 107
Seattle, WA 98101
206-553-7079
greaves.natash@epa.gov

Terrence Griffith
Pastor
First African Baptist Church
1608 Christian Street
Philadelphia, PA 19146
215-735-1050
215-735-1887
pastorg@thefabchurch.org

Anjuli Gupta
Center for Environmental Health
528 61st Street
Suite A
Oakland, CA 94609
510-594-9864
510-594-9863
ani@cehca.org

Jack Hale
Executive Director
Knox Parks Foundation
75 Laurel Street
Hartford, CT 06106
860-951-7694
860-951-7244
jackh@knoxparks.org

Loren Hall
Title VI Technical Coordinator
Office of Civil Rights
EPA
1201A
1200 Pennsylvania Ave NW
Washington, DC 20460
202-343-9675
hall.loren@epamail.epa.gov

Arthur Hardy-Doubleday
Operations Manager
The Coalition to Strengthen the Sheldon/Charter Oak Neighborhood
34 Sequasen St
Hartford, CT 06106
860 509-3706
860-509-3711
ahardydoubleday@crec.org

Reginald Harris
Senior Toxicologist/Regional Environmental Justice
Office of Enforcement, Compliance & Environmental
EPA, Region III
1650 Arch Street
3EC00
Philadelphia, PA 19103-2029
215-814-2988 or 856-429-7304
215-814-2905
harris.reggie@epa.gov

Pamela Harting-Barrat
Public Affairs
Office of Site Remediation and Restoration
EPA, Region I
27 Oneida Rd
Acton, MA 01720
617-918-0318
617-918131
harting-barrat.pamela@epa.gov

Halida Hatic
Student
Tufts University
283 Summer St.
Somerville, MA 02144
513-237-6603
Halida.Hatic@tufts.edu

John Healey
School of Public and Environmental Affairs
Indiana University
54 Stacy Street
Randolph, MA 02368
617-571-8081
jhealey@indiana.edu

Wendy Heiger-Bernays
Assistant Professor
Environmental Health, School of Public Health
Boston University
715 Albany St. Talbot 2E
Boston, MA 02118
617 638-4620
whb@bu.edu

Diane Henshel
Consultant and Professor
Indiana University School of Public & Environmental Affairs
Henshel EnviroComm
4121 Cadbury Court
Bloomington, IN 47401
812 345 0944 c
dhenshel@indiana.edu

Elvia Hernandez
Director of Administration
Pacoima Beautiful
11243 Glenoaks Blvd. #3
Pacoima, CA 91331
818-899-2454
818-834-5186
ktaday@pacoimabeautiful.org

Toni Hicks
Conservation Law Foundation
62 Summer Street
Boston, MA 02110
617-350-0990
617-350-4030
thicks@clf.org

Robert Hillger
Moderator & ORD Liaison
Regional Administrators Office
EPA, Region I
RA Office
1 Congress Street
Boston, MA 02114
617-918-1071
Hillger.Robert@epa.gov

Philip Hillman
Divisional V P Health, Safety & Environment
Polaroid Corporation
1265 Main Street
Building W3-3B
Waltham, MA 02451
781-386-0555
781-833-0555
hillmap@polaroid.com

Pearl Hines
Health Educator
Environmental Health Education and Outreach Program
The Commonwealth of Massachusetts
250 Washington Street, 7th Floor
Boston, MA 02108
617-624-5757
617-624-5777
pearl.hines@state.ma.us

Eric Hove
Environmental and Land-use Planner
Pioneer Valley Planning Commission
26 Central Street
West Springfield, MA 01089
413-781-6045
413-732-2593
ehove@pvpc.org

Genevieve Howe
Research Assistant
Environmental Health, School of Public Health
Boston University
715 Albany Street, #T2E
Boston, MA 02118
617-638-5855
617-638-5818
ghowe@bu.edu

Patricia Hynes
School of Public Health
Boston University
715 Albany Street
Boston, MA 02118
617-638-7720
hph@bu.edu

Ariel Iglesias
Regional Science Liaison
EPA Facilities, Region II
Raritan Depot, 2890 Woodbridge Avenue
Mail Code MS100
Edison, NJ 08837-3679
732-452-6426 or 212-637-3585
732-321-4381
iglesias.ariel@epa.gov

Rebecca Incledon
student
Brandeis University
MB 3207 Brandeis University
Waltham, MA 02454
781-254-5897
rebeccai@brandeis.edu

Taran Jefferies
SCEP Intern
Children's Environmental Health
EPA New England
11 Technology Drive
North Chelmsford, MA 01863
617.918.8662
jefferies.taran@epa.gov

Taran Jefferies
SCEP Intern
Children's Environmental Health
EPA New England
11 Technology Drive
North Chelmsford, MA 01863
617.918.8662
jefferies.taran@epa.gov

Viviana Jimenez
summer intern
EPA
PO Box 334
So. Royalton, VT 05068
603 770 3315
vjimenez@vermontlaw.edu

Viviana Jimenez
EPA, Region I
198 Union Street
Portsmouth, NH 03801
613-770-3315
vjimenez@vermontlow.edu

Stacey Johnson-Pridgeon
Connecticut Urban Program Manager
Urban Environmental Program
EPA, Region I
One Congress Street
Suite 1100 (CPT)
Boston, MA 02114-2023
617-928-1552
617 918-1505
johnson.stacey@epa.gov

Michael Joseph
Student Trainee (Environmental Protection)
Urban Environmental Program
EPA, Region I
1 Congress Street, Suite 1100
Boston, MA 02114
617-918-1508
617-918-0508
Joseph.Michael@epa.gov

Andri Jovan

Rhona Julien
Office of Ecosystem Protection
EPA, Region I
1 Congress St
Boston, MA 02110
617-918-1782
julien.rhona@epa.gov

John Kane
Planner
Planning
Boston Housing Authority
52 Chauncy St.
Boston, MA 02111
617-988-4107
617-988-4133
john.kane@bostonhousing.org

Madeleine Kangsen Scammell
Student
Environmental Health, School of Public Health
Boston University
715 Albany St. T2E
Boston, MA 02118
617-638-4454
617-638-5818
mls@bu.edu

Deepti KC
Research Associate
Environmental Health
West Harlem Environmental Action
271 West, 125 Street, Suite 308
New York, NY 10027
212-961-1000
212-961-1015
deepti@weact.org

Meghan Keaney
Environmental Health, School of Public Health
Boston University
7 Paradox Drive
Worcester, MA 01602
508 799-2858
5087559639
megkeaney@yahoo.com

Gavin Kearney
Environmental Justice Attorney
New York Lawyers for the Public Interest
151 West 30th Street, 11th Floor
New York, NY 10001
212-244-4664
212-244-4570
gkearney@nylpi.org

Sarah Keim
Study Coordinator
National Children's Study
National Institutes of Health
6100 Executive Boulevard
Suite 5C01
Bethesda, MD 20892
301-435-6923
301-480-1222
keims@mail.nih.gov

Barbara Kellman
Facilitator
150 Gardner Road
Brookline, MA 02445
617-730-8106
bkellman@rcn.com

Marcus Kohl
Acting Director
Office of Environmental Advocate
Pennsylvania Department of Environmental Protection
Rachel Carson State Office Building
400 Market St., 16th Floor
Harrisburg, PA 17105
717-783-5630
mkohl@state.pa.us

Rita Kornblum
Environmental Health Educator
City of Hartford Health and Human Services
131 Coventry Street
Hartford, CT 06112
860-5471426 ext: 7188
860-722-6719
rkornblum@ci.hartford.ct.us

Kwabena Kyei-Aboagye
EJ and Brownfields Coordinator
Executive Office of Environmental Affairs
EOEA
100 Cambridge Street
Suite 900
Boston, MA 02114
617-626-1165
617-626-1181
Kwabena.Kyei-Aboagye@state.ma.us

Amy Kyle
Research Scientist and Lecturer
School of Public Health
University of California, Berkeley
EHS-SPH MC 7360
140 Warren Hall
Berkeley, CA 94720
510-642-8847
adkyle@berkeley.edu

Jody Lally
Project Manager
School of Health and Environment
University of Massachusetts, Lowell
218 Weed Hall
3 Solomont Way
Lowell, MA 01854
978-934-4270
978-934-3025
Jody_Lally@uml.edu

Cynthia Laramore
Director
Active Citizens Together Improving Our Neighborhood
417 N.W. 16th Street, Suite 1A
P.O. Box 16
Belle Glade, FL 33430
561-993-9100
561-993-9188
laramorecc@aol.com

Gretchen Latowsky
Director
JSI Center for Environmental Health Studies
44 Farnsworth Street
Boston, MA 01867
617-482-9485
617-482-0617
glatowsky@jsi.com

Soonsil Lee
Researcher
Work Environment Department
University of Massachusetts, Lowell
One University Avenue
Lowell, MA 01854
978-452-8550
sleestar@comcast.net

Ira Leighton
EPA, Region I
1 Congress Street
Boston, MA
617-918-1011
leighton.ira@epa.gov

Steven Lenard
Student
Department of Urban Studies and Planning
Massachusetts Institute of Technology
223 Green Street
Apt 2
Cambridge, MA 02139
617-256-4771
srlenard@mit.edu

Stevenq Lenard
Student
Urban Studies and Planning
Massachusetts Institute of Technology
223 Green Street
Apt. 2
Cambridge, MA 02139
617-256-4771
srlenard@mit.edu

Sarah Levinson
Human Health Risk Assessor
Office of Site Remediation and Restoration
EPA, Region I
1 Congress St.
Boston, MA 01890
617-918-1390
617-918-0390
levinson.sarah@epa.gov

Jonathan Levy
Assistant Professor
Department of Environmental Health
Harvard School of Public Health
Landmark Center Room 404K
P.O. Box 15677
Boston, MA 02215
617-384-8808
617-384-8859
jilevy@hsph.harvard.edu

David Long
IT and Web Mgr / Research Assistant
Silent Spring Institute
29 Crafts Street
Newton, MA 02458
617-332-4288 x12
617-332-4284
long@SilentSpring.org

Debbie Lowe
Environmental Justice Coordinator
Cross Media Division
EPA, Region IX
75 Hawthorne Street
CMD-1
San Francisco, CA 94105
415-947-4155
415-947-3562
lowe.debbie@epa.gov

Harry Manasewich
Facilitator
Human Factor Dispute Resolutions
13 Pierce Street
Arlington, MA 02476
781-643-1812
781-643-1812
hfactordr@aol.com

Peter Manus
Professor of Law
New England School of Law
New England School of Law
154 Stuart Street
Boston, MA 02116
617-422-7265
617-422-7453
pmanus@fac.nesl.edu

Gina Margillo
Project Manager
CDHS-EHIB
Fish Contamination Education Collaborative
320 W. 4th Street
Suite 560
Los Angeles, CA 90013
213-620-2586
213-620-6573
gmargill@dhs.ca.gov

Naomi Marmin

Nancy Maxwell
Assistant Professor
Environmental Health, School of Public Health
Boston University
Talbot 223 East
715 Albany Street
Boston, MA 02118
617-638-4448
617-638-4857
nmaxwell@bu.edu

Brian Mayer
Research Assistant
Sociology
Brown University
65 Ramsay Street
Riverside, RI 02915
401-433-3045
Brian_Mayer@brown.edu

Ibrahim Mazman
Boston University
30 Berkshire Street, Apartment 3
Cambridge, MA 02141
imazman@bu.edu

Mildred McClain
Harambee House/Citizens for Environmental Studies
115 Habersham Street
Savannah, GA 31401
912-233-0907
cfej@bellsouth.net

Tammy McDonald
Assistant Professor
Department of Economics
University of Massachusetts, Boston
100 Morrissey Boulevard
Boston, MA 02125
617-287-6964
617-287-6976
tammy.mcdonald@umb.edu

Margaret McDonough
Environmental Scientist
Office of Site Remediation and Restoration
US EPA
One Congress St.
Suite 1100
Boston, MA 02114
617 918 1276
mcdonough.margaret@epa.gov

Jill McElheney
Founder
Children's Environmental Health Ministry
MICAH's Mission
61 Melton Road
Winterville, GA 30683
706-742-7826
706-543-1799
Micahsmission@aol.com

Anne McGahan
Chief Planner
Certification Activities
Boston Metropolitan Planning Organization
10 Park Plaza
Suite 2150
Boston, MA 02116
617-973-7090
617-973-8855
mcgahan@ctps.org

Naomi Mermin
President
Community Consultant
83 Madeline Street
Portland, ME 04103
207 775-1971
NMermin@maine.rr.com

Yvette Mitchell
3121 East 97th Street
Cleveland, OH 44104
216-795-0003
mitchellya@hotmail.com

Tanya Moore
EPA
109 TW Alexander Drive
Durham, NC 27711
919-541-5221
moore.tanya@epa.gov

Rachel Morello-Frosch
Assistant Professor
Department of Community Health, Center for Environmental Studies
Brown University
135 Angell Street
Box 1943
Providence, RI 02912-1943
401-863-9429 or 401-863-3449
401-863-9429
rmf@brown.edu or Rachel_Morello-Frosch@brown.edu

Althea Moses
Acting Director
Enforcement Coordination Office
EPA, Region VII
901 North 5th Street
Kansas City, KS 66101
913-551-7649
913-551-7941
moses.althea@epa.gov

Sean Nagle
Public Health Director
Community Health and Environment
El Puente
211 S.4th St
Brooklyn, NY 11211
718-302-6443
718-218-8960
snagleelpuente@aol.com

Jessica Nelson
School of Public Health
Boston University
22 Cranston, #2
Boston, MA 02130
617-524-2803
jwnelson@bu.edu

Mary Ann Nelson
Chairwoman
Massachusetts Sierra Club
100 Boylston Street, Suite 760
Boston, MA 02116
617-423-5775
617-423-5858
chapter-chair@sierraclubmass.org

Wadner Oge
1L Volunteer
Boston
EPA Region 1
2 Rollins Street,
Boston, MA 02118
617-721-5983
woge@vermontlaw.edu

Maureen O'Neill
Sr. Policy Advisor
EPA, Region II
290 Broadway
26th Floor
New York, NY 10007
212-637-5025
212-637-4943
oneill.maureen@epa.gov

Karla Owens
Regional Team Manager
EPA, Region V
77 W. Jackson Blvd. (T-16J)
Chicago, IL 60604
312-886-5993
312-886-2737
owens.karla@epa.gov

Sandra Padula
Student Trainee
Office of Ecosystem Protection
EPA, Region I
1 Congress Street, Suite 1100
(CPT)
Boston, MA 02114-2023
617-918-1797
617-918-0797
padula.sandra@epa.gov

Kenneth Page
Environmental Justice Officer
Illinois environmental Protection Agency
1021 N. Grand Ave. E. P.O. Box 19276
Springfield, IL 62794-9276
217-524-1284
217-785-8346
ken.page@epa.state.il.us

Ted Palma
Physical Scientist
Office of Air Quality & Planning Standards
EPA, Region IV
MD C404-01
USA EPA Mailroom
Research Triangle Park, NC 27711
919-541-5470
919-541-0840
palma.ted@epa.gov

Marybeth Palmigiano
Environmental Health Program Consultant
Greater Boston Physicians for Social
Responsibility
11 Garden Street
Cambridge, MA 01913
617-497-7440
marybeth227@yahoo.com

Julianne Pardi
Student trainee
Office of Civil Rights and Urban Affairs
EPA, Region I
1 Congress Street, Suite 1100
RAA
Boston, MA 02114
617-918-1068
pardi.julianne@epa.gov

Hiteshri Parikh
Program Analyst
Office of Civil Rights and Urban Affairs
EPA, Region I
1 Congress Street, Mail Stop RAA
Suite 1100
Boston, MA 02114-2023
617-918-1558
parikh.shri@epa.gov

John Paul
Research Environmental Scientist
National Health and Environmental Effects
Research Laboratory
EPA, Region IV
Mail Drop B205-01
RTP, NC 27614
919-541-3160
paul.john@epa.gov

Devon Payne-Sturges
Environmental Health Scientist
OPEI
EPA
Ariel Rios Building, 1200 Pennsylvania Avenue, NW
MC1809T
Washington, DC 20460
202-566-2316
202-566-2363
payne-sturges.devon@epa.gov

Junette Peters
1 Congress Street
Mail code SPP
Boston, MA 02114
617-918-1830
617-918-0830

David Peterson
Attorney
U.S. EPA
Region 1
One Congress Street
Boston, MA 02114
617-918-1891
617-918-1809
peterson.david@epa.gov

Scott Peterson
CHIEF PLANNER
Central Transportation Planning Staff
Boston Metropolitan Planning Organization
10 Park Plaza
Suite 2150
Boston, MA 02116
617-973-7078
SCOTTP@CTPS.ORG

Keith Pezzoli
Professor
Urban Studies and Planning
University of California, San Diego
9500 Gilman Drive
Urban Studies 0517
La Jolla, CA 92117
858-505-8601
kpezzoli@ucsd.edu

Millie Piazza
Graduate Student
Natural Resources & Environment
University of Michigan
720 S State St Apt 309
Ann Arbor, MI 48104
734-615-5957
mpiazza@umich.edu

Hugh Pilgrim
EPA, Region I
1 Congress Street, Suite 1100
Boston, MA 02114
617-918-1843
617-918-0843
pilgrim.hugh@epa.gov

Elyse Pivnick
Vice President
Environment and Community Health
Isles, Inc.
10 Wood Street
Trenton, NJ 08618
609-341-4700
609-393-9513
epivnick@isles.org

Thomas Plant
Director
Boston Childhood Lead Poisoning Prevention Program
Boston Public Health Commission
1010 Massachusetts Avenue
2nd Floor
Boston, MA 02118
617-534-5966
617-534-2372
tplant@bphc.org

Swati Prakash
Environmental Health Director
West Harlem Environmental Action
271 West 125th Street
Suite 308
New York, NY 10027
212-961-1000 x.315
212-961-1015
Swati@weact.org

Juliana Prosperi
General Dynamics/OARM
EPA, Region I
1 Congress Street
Boston, MA 02114
617-918-1154
prosperi.juliana@epa.gov

Richard Rabin
MassCOSH
8 Sawin Street (home)
Arlington, MA 02474
617-969-7177
617-727-4581
rickrabin@rcn.com

Graciela Ramirez-Toro
Director, CECIA - UIPR
Center for Environmental Education
Inter-American University of Puerto Rico
Call Box 5100
San Germán, PR 00683
787-264-1912 x7631
787-892-2089
cecia@prtc.net

Steve Rapp
Engineer
Office of Ecosystem Protection
EPA, Region I
One Congress St. ,Suite 1100
Boston, MA 02114
6179181551
6179180551
rapp.steve@epa.gov

Virginia Rauh
CPFH
Columbia University
60 Haven Avenue
Suite B3
New York, NY 10032
212-305-4177
var1@columbia.edu

Kristi Rea
Team Leader, Urban Environmental Program
Office of Ecosystem Protection
EPA, Region I
1 Congress Street, Suite 1100
(CPT)
Boston, MA 02114-2023
617-918-1595
617-918-2064
rea.kristi@epa.gov

Ellin Reisner
Community Transportation Advocate
STEP -- Somerville Transportation Equity Partnership
51 Mt. Vernon St.
Somerville, MA 02145
617-776-1987
ereisner@rcn.com

Fernando Rejon
Pacoima Beautiful
11243 Glenoaks Boulevard
Suite 3
Pacoima, CA 91331
818-899-2454
818-834-5186
fernando@pacoimabeautiful.org

Glenn Rice
Environmental Health Scientist
National Center for Environmental Assessment
EPA, Region V
(M.S. 190) 26 West M.L. King Dr.
Cincinnati, OH 45268
513/569-7813
513-569-7916
rice.glenn@epamail.epa.gov

Kitty Richards
Grant Coordinator
Office of Environmental Health
Bernalillo County
111 Union Square, SE, Suite 300
Albuquerque, NM 87102
505-314-0338
505-314-0470
krichards@bernco.gov

Donald Rivard
Environmental Management Consultant
Rivard's Resources: IPM
177 Seminole Avenue
Waltham, MA 02451-0859
781-899-5843
781-642-0693
donrivard22@comcast.net

Lisa Rivard
Environmental Management Consultant
Rivard's Resources: IPM
177 Seminole Avenue
Waltham, MA 02451-0859
781-899-5843
781-642-0693
lkr620@comcast.net

Reiniero (Rey) Rivera
Environmental Justice Coordinator
Office of Enforcement and Compliance Assurance
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue NW
(MC- 2201A)
Washington, DC 20460
202-564-1491
202-501-0701
rivera.reiniero@epa.gov

Darryl Roberts Roberts
Legal Intern
Office of Environmental Stewardship
EPA
1 Congress Street , Suite 1100 (SER)
Boston, MA 02114-2023
617-918-1110
617-918-1809
roberts.darryl@epa.gov

Trinidad Rodriguez
Student
9 Blanvon Road #3
Jamaica Plain, MA 02130
617 522 2192
trinidad_rodriguez@hotmail.com

Cora Roelofs
Research Professor
Work Environment Department
University of Massachusetts, Lowell
1 University Ave
Lowell, MA 01854
617 632 3211
Cora_Roelofs@Uml.edu

Marv Rosenstein
Chief, Chemicals Management Branch
Office of Ecosystems Protection
EPA, Region I
1 Congress Street, Suite 1100
Mail Code CMB, 11th floor
Boston, MA 02114-2023
617-918-1631
617-918-1505
rosenstein.marv@epa.gov

Sheryl Rosner

Steven Rudnick
Associate Director
Environmental Studies
University of Massachusetts, Boston
S/1/05
100 Morrissey Blvd
Boston, MA 02125
617 287 7476
steven.rudnick@umb.edu

Mary Russell
Public Health Consultant
7 Bourne St
Kennebunk, ME 04043
617-417-1453
MRussell@GardenGoddesses.com

Ana Lucia Sarcia
Health Educator
Work Environment Department
Lowell Community Health Center
15-17 Warren Street
Lowell, MA 01852
978-746-3084
978-453-8043
anasa@lchealth.org

Rita Schoeny
Headquarters - Office of Water
EPA
Ariel Rios Building
1200 Pennsylvania Avenue, NW
Washington, DC 20002`
202-566-1127
schoeny.rita@epa.gov

Matt Schweisberg

MaryJane Selgrade
Chief Immunotoxicology Branch
National Health and Environmental Effects Research Laboratory
EPA, Region IV
B143-01
U.S. EPA
Research Triangle Park, NC 27711
919-541-1821
919-541-0026
selgrade.maryjane@epa.gov

Peggy Shepard
WE ACT
271 West 125th Street
Suite 308
New York, NY 10027-4424
212-961-1000, x306
Peggy@weact.org

Mary Sherwin
Environmental Analyst
CT Department of Environmental Protection
79 Elm Street
Hartford, CT 06106-5127
860-424-3246
860-424-4081
mary.sherwin@po.state.ct.us

Andrea Simpson
1 Congress Street
Boston, MA 02114
617-918-1738
simpson.andrea@epa.gov

Eduardo Siqueira
University of Massachusetts-Lowell
1 University Avenue
Kitson 200
Lowell, MA 01854
978-934-3147
978-452-5711
carlos_siqueira@uml.edu

MaryBeth Smuts
Regional Air Toxicologist
Air Permits, Toxics and Indoor Programs Unit
EPA, Region I
One Congress St., Suite 1100
Boston, MA 02067
617/918-1512
617/918-0512
smuts.marybeth@epa.gov

Elaine Sokoloff
EPA-NE, R1
1 Congress Street
Suite 1100 (CCT)
Boston, MA 02114-2023
617-918-1557
617-918-2064
sokoloff.elaine@epa.gov

Kerry Souza
Student
Occupational Health Program
Harvard School of Public Health
211 Athens St.
Boston, MA 02127
617-519-7849
ksouza@hsph.harvard.edu

Denise Springborg
Director of Drinking Water Programs
New England Interstate Water Pollution Control Commission
Boot Mills South
100 Foot of John St
Lowell, MA 01852
978-323-7929
978-323-7919
dspringborg@neiwpcc.org

Lawrence Stepenuck
RCAP Solutions
16B Bearckin Neck
Rockport, MA 01966
978-546-6606
lstepenuck@rcapsolutions.org

John Stewart
Associate Professor
Sociology & Environmental Sciences
University of Hartford
200 Bloomfield Ave
West Hartford, CT 06117
860-768-4331
860-768-4080
jstewart@hartford.edu

Meg Stewart
GIS Computing Consultant
Computing and Information Services
Vassar College
124 Raymond Avenue
Box 735
Poughkeesie, NY 12604
845-437-7708
845-437-7577
mestewart@vassar.edu

Eileen Storey
Director
Center for Indoor Environments and Health
University of Connecticut Health Center
263 Farmington Avenue
Dowling North 3rd Floor
Farmington, CT 06030-6210
860-679-2386
860-679-1349
storey@nso.uchc.edu

Wilma Subra
Technical Assistant
Louisiana Environmental Action Network
Post Office Box 9813
New Iberia, LA 70562
337-367-2216 or 225-928-1315
337-367-2217
SubraCom@aol.com

Maryann Suero
Children's Health Program Manager
EPA, Region V
77 W. Jackson Blvd (M/C D-8J)
Chicago, IL 60604-3507
312-886-9077
312-353-3159
suero.maryann@epa.gov

Tonna-Marie Surgeon-Rogers
43A Nathan Ellis Highway
North Falmouth, MA 02556
508-563-7283
tonnamarie2000@yahoo.com

Daniel Swartz
Children's Environmental Health Network
110 Maryland Avenue, NE
Suite 511
Washington, DC 20002
202-543-4033
dswartz@cehn.org

Kim Szeto
Student
18c Paul Place
Boston, MA 02118
617-957-5087
kszeto@wheatonma.edu

Nicholas Targ
Office of Environmental Justice
EPA
Ariel Rios Building, 1200 Pennsylvania Avenue, NW
Washington, DC 20460
202-564-2406
Targ.Nicholas@epa.gov

Gloria Tatum
Bureau Director II
Field Services
Mississippi Department of Environmental Quality
Post Office Box 10385
Jackson, MS 39289
601-961-5011
601-961-5376
Gloria_Tatum@deq.state.ms.us

Peter Taylor
Director
Program in Science, Technology & Values
University of Massachusetts, Boston
Graduate College of Education
100 Morrissey Blvd
Boston, MA 02125
617-287-7636
617-287-7656
peter.taylor@umb.edu

John Terrell
Chair, Environment Group
First Parish Church in Lincoln
P.O. Box 6134
Lincoln, MA 01773
781-259-9341
jterr1@aol.com

Maggie Theroux

Doug Thompson

Steven Thompson
Environmental Scientist
Multimedia Planning and Permitting
EPA, Region VI
1445 Ross Avenue
Mail code: 6PD-A
Dallas, TX 75202
214-665-2769
214-665-6762
thompson.steve@epa.gov

Joel Tickner
Department of Work Environment
University of Massachusetts-Lowell
1 University Avenue
Lowell, MA 01854
978-934-2981
978-934-2025
joel_tickner@uml.edu

Rebecca Tobin
Intern
EPA, Region 1
1940 Commonwealth Ave, #27
Brighton, MA 02135
617-779-0052
tobinre@bc.edu

Aaron Toffler
Attorney
Urban Ecology Institute
355 Higgins Hall
140 Commonwealth Avenue
Chestnut Hill, MA 02467
617-552-1247
617-552-1198
toffler@bc.edu

Ellen Tohn
ERT Associates
Alliance for Healthy Homes
5 Fields Lane
Wayland, MA 01778
508-358-7770
508-358-3071
e.tohn@comcast.net

Ellie Tonkin

Hank Topper

Ryan Torres
Lead Action Collaborative
Tufts Institute of the Environment
210 Packard Avenue
Miller Hall
Medford, MA 02155
617-627-4679
LAC@tufts.edu

Linda Tsang
Environmental Engineer
Office of Ecosystem Protection
EPA, Region I
1 Congress Street
Suite 1100 (CMU)
Boston, MA 02114
617-918-1395
617-918-0395
Tsang.Linda@epa.gov

Godfrey Usochukwu
North Carolina A&T State University
Waste Management Institute
Greensboro, NC 27411
336-334-7030
336-334-7399
uzo@ncat.edu

Dennis Utterback
Environmental Protection Specialist
Office of Research and Development
EPA
1200 Pennsylvania Avenue
mail code 8104R
Washington, DC 20460
202-564-6638
utterback.dennis@epa.gov

Robert Varney
EPA, Region I
1 Congress Street, Suite 1100
Boston, MA 02114
617-918-1012
varney.robert@epa.gov

Kira Ventura
Intern
JSI Center For Environmental Health Studies
44 Farnsworth Street
Boston, MA 01867
617-482-9485
617-482-0617
glatowsky@jsi.com

Rocio Villalobos
Research Analyst/Organizer
Young Scholars for Justice
2217 Garden Street
Austin, TX 78702
512/472-0806
Poder1@sbcglobal.net

Romina Vinoles
Intern
Environmental Justice
Executive Office of Environmental Affairs
100 Cambridge Street
Suite 900
Boston, MA 02114
617-626-1179
romina.vinoles@state.ma.us

Chau Vu
Environmental Scientist
Office of Site Remediation and Restoration
EPA, Region I
1 Congress Street, Suite 1100
(HBS)
Boston, MA 02114
617-918-1446
617-918-1291
vu.chau@epa.gov

Thomas Walker
Project Manager
Office of Civil Rights
EPA
MC 1201A
1200 Pennsylvania Ave., NW
Washington, DC 20460
202-343-9680
Walker.Tom@epa.gov

Tim Watkins
Asst. Laboratory Director - Air and Mercury
National Exposure Research Laboratory, Office of Research and Development
EPA, Region IV
MD-D305-01
USA EPA Mailroom
Research Triangle Park, NC 27711
919-541-5114
919-541-0715
watkins.tim@epa.gov

Julie Watts
Director, Environmental Health Education and Outreach
Massachusetts Department of Public Health
Center for Environmental Health
250 Washington Street, 7th Floor
Boston, MA 01208
617-624-5757
617-624-5777
julie.watts@state.ma.us

Tom Webster
Assistant Professor
Environmental Health, School of Public Health
Boston University
Tablot 2E
715 Albany St.
Boston, MA 02118
617-638-3641
twebster@bu.edu

Philip Weinberg
Department of Environmental Protection
1 Webster Street
Boston, MA 02139
617-292-5972
philip.weinberg@state.ma.us

Lavinia Weissman
Consultant
Work Ecology
111 Perkins Street #164
Jamaica Plain, MA 02130
617-461-0500
ikebana@workecology.com

Karl Wells
Member
North Carolina Fair Share
5000 Sunset Lake Road
Apex, NC 27539
919-362-6067
mwells18@bellsouth.net

Mary Wells
Member
North Carolina Fair Share
5000 Sunset Lake Road
Apex, NC 27539
919-362-6067
mwells18@bellsouth.net

Terry Wesley
ENVIRONMENTAL JUSTICE COORDINATOR
Office of the Regional Administrator
EPA, Region II
290 Broadway
Room 2637
New York, NY 10007-1866
212637-5027
212-637-4943
wesley.terry@epa.gov

Kimberly Wetzel
master's student
Resource Policy & Behavior/Environmental Justice
University of Michigan School of Natural Resources
119 W Mosley Street
Ann Arbor, MI 48103
734-994-8492
kwetzel@umich.edu

Nancy Whit
Executive Director
Pawtucket Citizens Development Corporation
210 West Avenue
Pawtucket, RI 02860
401-726-1173
401-725-3261
nancywhit@pawtucketcdc.com

Johnny White
Community Health Initiative of Parchester Village, Iron Triangle, North
2422 Road 20
Apartment 30JA
San Pablo, CA 94806
510-235-9780
white_johnny@yahoo.com

LaDonna Williams
People for Children's Health and Environmental Justice
P.O. Box 5653
Vallejo, CA 94591
707-712-4088
zzeria@aol.com

Matthew Wilson
Director
Toxics Action Center
29 Temple Place
Boston, MA 02111
617-747-4389
617-292-8057
mwilson@toxicsaction.org

Steve Wing
Associate Professor
School of Public Health
University of North Carolina Epidemiology
2101F Macgavran-Greenberg Hall
CB#7435
Chapel Hill, NC 27599-7435
919-966-7416
919-966-2089
steve_wing@unc.edu

Carol Wood
Acting Deputy Director
OARM
EPA, Region I
1 Congress Street
Suite 1100
Boston, MA 02114-2023
617-918-1902
wood.carol@epa.gov

Tia Woodard
Intern
Office of Ecosystem Protection
EPA, Region I
79 Highland St #2
Roxbury, MA 02119
617-918-1239
617-918-0239
woodard.tia@epa.gov

Jonathan Woodring
Research Study Coordinator
Institute for Community Inclusion
University of Massachusetts, Boston
20 Park Plaza
Boston, MA 02125
617-287-4367
jonathan.woodring@umb.edu

Nerissa Wu
Environmental Health Scientist
Urban Environmental Program
EPA, Region I
1 Congress Street, CPT
Boston, MA 02114
617 918 1312
617 918 0312
wu.nerissa@epa.gov

Davina Wysin
Environmental Justice Specialist
Office of Civil Rights & Urban Affairs
EPA, Region I
1 Congress Street, Suite 1100
Mail Code RAA
Boston, MA 02114
617-918-1020
617-918-0020
wysin.davina@epa.gov

Harold Yates
Senior Community Involvement Coordinator
Office of Enforcement, Compliance & Environmental
EPA, Region III
3EC00
1650 Arch Street
Philadelphia, PA 19126
215-814-5530
215-814-2905
yates.hal@epa.gov

Eli Yewdall
Masters Student
Energy & Resources
University of California, Berkeley
1810 West St #5
Berkeley, CA 94702
510-527-6121
eyewdall@berkeley.edu

James Younger
Director Of Civil Rights and Urban Affairs
New England Office of Civil Rights and Urban Affairs
EPA, Region I
1 Congress Street, Suite 1100
Boston, MA 02203
617-918-1061
617-918-0061
Younger.james@epa.gov

Fred Youngs
Occupational and Environmental Research Chemist
Work Environment Department
University of Massachusetts, Lowell
1 University Avenue
Lowell, MA 01854
978-934-4859
978-452-5711
Fred_Youngs@uml.edu

Richard Youngstrom
Director, Occupational Health
Center for Community-Based Research
Dana-Farber Cancer Institute
One Jimmy Fund Way
Boston, MA 02115
617-632-2190
617-632-4858
ryoungstrom@partners.org

Andrea Zaccardi
EPA Intern
EPA
33 Bay State Rd. Apt 4R
Boston, MA 02215
508-344-7765
AZACCARDI@vermontlaw.edu

Wig Zamore
Synthesizer
MVTF and STEP
13 Highland Ave #3
Somerville, MA 02143
617-625-5630
wigzamore@rcn.com

Valerie Zartarian
environmental engineer
Office of Research and Development
EPA, Region I
1 Congress Street, Suite 1100
Mail Code CAP
Boston, MA 02176
617-918-1541
617-918-0541
zartarian.valerie@epa.gov