AIR TOXICS IN ALLEGHENY COUNTY: SOURCES, AIRBORNE CONCENTRATIONS, AND HUMAN EXPOSURE

A Collaborative Project Between
The Allegheny County Health Department and Carnegie Mellon University

Proposed By:

County of Allegheny, Allegheny County Health Department, Air Quality Program

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Introduction:

This proposal describes an integrated research project to investigate the sources, concentration, and human exposure of air toxics in Allegheny County. The research will be jointly conducted by the Allegheny County Health Department and Carnegie Mellon University. The three-year project will involve both baseline and intensive sampling components focusing on the Neville Island area, mobile source emissions, and background concentrations.

This project is designed in two phases. Phase one is a stand-alone three year study that will be funded by the Allegheny County Health Department using a portion of the Clean Air Fund, and it is intended that it will yield a preliminary hazard assessment by the end of calendar year 2004. Phase two is designed to use EPA grant funding to supplement phase one with additional monitors and analyses.

Objectives:

There are five objectives in the proposed work:

1. Measure airborne concentrations of a large number of gas and particulate air toxics around Neville Island, in Downtown Pittsburgh, and at a background site
2. Estimate human exposure and health risks in the vicinity of sources and at the background location
3. Quantify the contribution of different sources (regional background, industrial, mobile) to airborne concentrations and estimated health risks
4. Establish the relative importance of regional transport versus local sources to air toxics exposures in the County, and
5. Compare air toxic concentrations and estimated health risks in Allegheny County to other areas of the country where adequate data exist.

Work Plan:

The Allegheny County Health Department (ACHD) will be the lead on the baseline sampling effort. Carnegie Mellon University (CMU) will be the lead responsible for experimental design, conducting the intensive sampling, and analysis of the data. The

project is designed to occur in two phases. Use of the Allegheny County Health Department's Clean Air Fund has been approved to support phase one of the project.

Phase One

With phase one funding, the Allegheny County Health Department will purchase two open path spectrometers (UV DOAS), one acoustic wind profiler (sodar) and one air toxics sampler for SUMMA canisters and carbonyl cartridges, including every six day analytical support for one year. A minimum of twelve months of baseline sampling of airborne concentrations will be conducted by the Allegheny County Health Department to determine annual average and seasonal variations in concentrations downwind of Neville Island, in the downtown Pittsburgh area and at a background location.

Phase one will also fund four one month long intensive monitoring campaigns to be conducted by CMU using advanced semi-continuous gas chromatograph mass spectrometry techniques to examine temporal and spatial variations in ambient concentrations and to collect more detailed data for source-receptor modeling. Two intensive sampling campaigns will focus on the Neville Island area and two will focus on mobile source emissions. When practical, the intensives will be collocated with Allegheny County's baseline samplers to compare methods and as a quality assurance measure.

Also included in phase one funding is in depth analysis by Carnegie Mellon University and University of Pittsburgh Graduate School of Public Health. This analysis will cover the areas of data and trends reporting, public health risk analysis and source apportionment. Extensive data analysis will be performed to evaluate human exposure and health risks to air toxics, to determine the contribution of different sources (e.g. industrial versus mobile sources) to this risk, and to compare air toxic concentrations and risk within the county to other areas in the United States.

Phase Two

This proposal for EPA grant funding is requesting support for phase two as a supplement to phase one. Phase two will add support for the project during the period from September 2004 through January 2006. As part of phase two of the project, additional monitors will be deployed by the Allegheny County Health Department, including two additional UV DOAS monitors and three air toxics monitors (SUMMA/carbonyl) including analytical costs. Additional funding is also requested to continue the operation of the phase one baseline samplers through January 2006.

EPA grant funding is also requested for Carnegie Mellon University as a contractor to the Health Department. The additional funding will cover the full time salary of the principal investigator during the phase two funded period, and will also cover the addition of one full time graduate student to oversee field sampling during the intensives. With the additional funding, CMU will have the manpower necessary to be much more flexible in scheduling of the intensives during optimum air quality conditions. Some of the EPA grant funds will also be used to cover supplies and expendables necessary to conduct an additional intensive sampling campaign during the phase two sampling period. Details for the final intensive sample run will be decided after data from the study is analyzed.

Target Compounds

The project is focused on the air toxics listed in Table 1; these compounds were considered by the recent EPA National Air Toxic Assessment (NATA). In addition, airborne metals concentrations are measured by the ACHD as part of their routine monitoring downwind of Neville Island (Avalon site) and these measurements will be included in the risk analysis component of the project to estimate the toxic burden associated with metals. The target air toxics will be measured in combination with a substantial number of ancillary compounds. Taken together, this set represents an optimal group designed to characterize (fingerprint) air toxic emissions from local mobile sources and from Neville Island industrial sources.

Table 1. List of Target Air Toxics

Acetaldehyde	Formaldehyde
Acrolein	Hexachlorobenzene
Acrylonitrile	Hydrazine
Benzene	Methylene chloride
1, 3-butadiene	Perchloroethylene
Carbon tetrachloride	Mercury
Chloroform	Polycyclic organic matter (POM)
1, 3-dichloropropene	Propylene dichloride
1,2 dichloropropane	Ethyl benzene
Diesel particulate matter	Quinoline
Ethylene dibromide	1, 1, 2, 2-tetrachloroethane
Ethylene dichloride	Trichloroethylene
Ethylene oxide	Vinyl chloride
Styrene	Phenol
Ethyl Benzene	Xylenes

The following section describes the instrumentation in more detail. Quantity and funding source is included to avoid confusion.

Baseline Sampling Monitors:

24 Hour Integrated Sampling

(ACHD – 1 sampler + 1 analysis EPA- 3 samplers + 2 analysis)

The Allegheny County Health Department will conduct sampling throughout the study period utilizing SUMMA canisters (USEPA TO-15) for determination of large number of VOCs on the target list, and cartridge samplers (EPA Method TO-11a) to measure carbonyls (formaldehyde, acetone, acetaldehyde). Three such pairs will be added for the total study, while one already exists as part of Allegheny County's air monitoring network. Each site will operate according to the national every-six-day sampling schedule. Accurate, electronic flow controlled sampling devices will be purchased for all four sites to insure optimal data integrity throughout the study.

UV DOAS Monitoring
(ACHD- 2 UV DOAS EPA- 2 UV DOAS)

Four UV DOAS (ultra violet differential optical absorption spectrophotometer) monitors will be operated throughout the study. These open path monitors will be based on a single beam path of optimal length, estimated to be near 400 meters. Each instrument will be configured to measure the following air toxics: benzene, toluene, m,p,o-xylene, ethyl benzene, styrene, phenol, formaldehyde and elemental mercury. In addition, the basic configuration of these instruments includes ozone, sulfur dioxide and nitrogen dioxide. Although this sampling method contains fewer compounds that are on the target list, advantages of this method include parts per trillion sensitivity and the high time resolution of a continuous monitor. Also, the measurement of air toxics over a long path length is a better representation of actual community exposure than single point samplers are capable of providing.

Acoustic Wind Profiler
(ACHD- 1 acoustic wind profiler)

One phased array Doppler Sodar device will be deployed as in integral part of this study. A site will be selected on or near Neville Island, as near as possible to river level. This instrument will continuously measure wind speed, wind direction, vertical motions, turbulence, thermal structure and mixing heights ranging from ten meters up to 1,000 meters. This instrument, coupled with monitoring results and emission inventories from sources on the island, will provide a rich source of information to be included in the dispersion models and in identifying and quantifying source contributions, as described in the following sections.

Intensive Sampling Monitors

GC-MS
(ACHD- 1 GC-MS)

The a semi-continuous gas chromatograph / mass spectrometer (GC-MS) is capable of measuring gas-phase toxics with 20 minute time resolution and a detection threshold for most species of less than 100 parts per trillion (pptv). The GC-MS uses the certified EPA Method 8260B to analyze most of the compounds on the target list. Channel 1 focuses on C_3 to C_6 non-methane hydrocarbons such as alkanes, alkenes, and alkynes. Channel 2 focuses on non-methane hydrocarbons greater than C_6, as well as oxygenated, aromatic, and halogenated VOCs. Channel 1 and Channel 2 use different chromatographic columns and detectors for separation and analysis of the compounds. This instrument will be used in all five intensive campaigns.

TD-GC-MS
(ACHD- 1 TD-GC-MS)

The thermal desorption / gas chromatograph / mass spectrometer system (TD-GC-MS) is capable of measuring a broad suite of particulate-phase organics at the 1-10 ng level. Recent work has identified more than one hundred compounds in ambient samples using thermal desorption GC-MS (TD-GC-MS) including: alkanes, alkanoic acids, cycloalkanes, cycloalkenes, hopanes, steranes, amyrins, aliaphatic alcohols, phenols, phthalates, PAHs, and a variety of other nitrogen and oxygen containing compounds. In

particular the technique has been shown to be well-suited for measurement of particle phase-polycyclic organic matter – one of important target air toxics of this study. A major focus will be compounds that are used as molecular markers for diesel particulate matter. The TD-GC-MS is expected to provide 2-hour averages with new data obtained every four hours. This method will only be employed in the intensives that are focused on vehicle emissions.

Thermal-Optical Carbon Analyzer
(ACHD 1 thermal-optical carbon analyzer)

The Sunset Laboratories in situ thermal-optical carbon analyzer measures organic and elemental carbon (OC/EC). OC/EC concentration measurements should be produced every two hours. This method will only be employed in the intensives that are focused on vehicle emissions.

Additional Integrated Sampling
(ACHD- 3 manual toxics samplers+analysis by CMU)

CMU will conduct additional, manually integrated sampling during the intensives using SUMMA canisters and PUF filters (for mobile source oriented intensives). These sampling methods will be employed during all five intensives.

Sampling Site Selection

The Allegheny County Health Department successfully operates an air monitoring network throughout the County, and pre-established monitoring sites will be used for sampling locations as much as possible during this study. Data from existing monitors will be used as appropriate during the study, and correlations will be closely analyzed. Following is a list of routine monitoring activities planned for operation during the study.

Existing Monitoring Network

- Avalon site: TSP and PM_{10} mass, metals (1 every 6 days), continuous PM_{10} mass, continuous SO_2, continuous H_2S, HAP metals by TSP (1 every six days), BTEX charcoal tube (24 hour samples 1 every 6 days), PM_{10}, and BaP (1 every 6 days), and meteorology (wind speed, direction, ambient temp).
- Stowe: continuous PM_{10} mass, $PM_{2.5}$ FRM mass (1 every 3 days), continuous SO_2, BTEX charcoal tube (24 hour samples 1 every 6 days).
- South Fayette: PM_{10} mass, metals (1 every 6 days), $PM_{2.5}$ FRM mass (1 every 3 days), continuous SO_2, continuous O_3, PM_{10} HiVol filters are analyzed for BaP, and meteorology (wind speed, direction, ambient temp).
- Flag Plaza (Downtown): Continuous PM_{10} mass, continuous CO, toxics sampling (SUMMA canister and carbonyl cartridge, one every six days)
- Courthouse: Continuous CO

Metals analysis will be performed on PM10 filters from Avalon and South Fayette by the County Laboratory. The metals included in this analysis are As, Be, Cd, Ca, Cr(total), Cu, Fe, Mn, Ni, Se, S, V and Zn.

At Avalon, HAP metals by TSP are analyzed by West Virginia DEP as part of Region 3's air toxic network.

Monitoring Downwind of Neville Island

Two sites, Avalon and Stowe, are located downwind of Neville Island, and are situated well for the purpose of accessing community exposure to emissions from this heavily industrialized area. Air toxic sources include chemical processing facilities, bulk storage terminals and a coke production plant. One of these sites will be chosen as a focus for our Neville Island oriented study. The selected site will receive one UV DOAS monitor and will also feature SUMMA canister and carbonyl cartridge baseline sampling every six days. This station will also be the site of at least two intensive monitoring campaigns. The second of these sites will also receive a UV DOAS monitor, and may also receive SUMMA canister and carbonyl cartridge baseline sampling every six days, depending on availability of the sampler (see following paragraph).

Downtown Pittsburgh Monitoring

Two sites, Flag Plaza and Courthouse are situated in the Downtown Pittsburgh area and are considered excellent sites for characterizing mobile source emissions. Flag Plaza is the site of regular SUMMA canister and carbonyl cartridge sampling every six days and it is planed to add a UV DOAS monitor to this site. The courthouse is currently favored by CMU for the mobile source oriented intensives due to the potential high concentration of mobile source pollutants due to trapping of emissions by high buildings, known as the "street canyon effect." The courthouse site is not suitable for installation of the UV DOAS, however. The final location of these intensives has not been decided, but if the decision is made to use the courthouse site, SUMMA canister and carbonyl cartridge baseline sampling every six days will also be conducted there for the duration of the study.

Background Site

The South Fayette monitoring site is situated a western, rural portion of the county and is known to be an excellent upwind background site. This site will receive a UV DOAS monitor and SUMMA canister and carbonyl cartridge baseline sampling every six days will also be conducted there for the duration of the study.

Acoustic Wind Profiler

The phased array Doppler Sodar device will be situated on or near Neville Island, as close as possible to river level. This instrument will operate during the entire study.

Data Analysis

CMU is charged with the task of data analysis for the complete project. The data collected by CMU will be integrated with the data collected by ACHD as part of this proposal and their routine monitoring at the different sites described in the baseline section of the proposal. In particular, airborne concentrations measured by ACHD as part of their routine monitoring will be correlated with the target compounds included in this study. To assist in planning of future air sampling by County personnel, the time scales of variability for each pollutant both background and downwind of major sources will be determined. The airborne concentration data will be evaluated to identify chemical species that are routinely measured and appear to correlate with air toxics. This knowledge will help ACHD better understand community exposure to harmful levels of toxics when these routine measurements become elevated.

Public Health Risk Assessment

To assess the importance of the air toxic concentrations that are measured, CMU in collaboration with *Dr. Bernard Goldstein* at the University of Pittsburgh, School of Public Health will conduct a risk characterization of their implications for public health, and a comparative analysis to results determined for other locations in the United States. A standard environmental health risk assessment involves the systematic estimation of exposure concentrations, doses and health effects of the chemicals of concern.

In this study, the concentrations for each air toxic at each measurement site will be characterized in terms of its median, mean and an upper percentile value. The median and mean values will be used to estimate chronic risks, including those for cancer and other chronic health effects. Cancer estimates will be based on standard exposure and inhalation rate assumptions, along with cancer unit risk estimates for each air toxic for the inhalation pathway. Total cancer risk estimates will be determined by summing the risks from the individual air toxics at each receptor location, and noting which compounds contribute the most at each location. Chronic non-cancer effects will be evaluated using the ratio of predicted doses to reference doses determined for different health endpoints, including neurological, respiratory, cardiovascular, reproductive, developmental, skin, hematological, immunological, renal and hepatic effects. Total risk hazard indices for each health endpoint will be estimated by summing the hazard quotients for each compound that contributes to a given health effect and target organ, and again noting which compounds contribute the most at each location. Upper percentile values will be used to assess likely contributions to acute aesthetic and health effects, including odor, visibility reduction, human discomfort such as eye and respiratory irritation, and if any of the measured values are high enough, other harmful acute health effects.

Using the results from the source apportionment analysis described below, the contributions of different sources to the air toxic concentrations and resulting human exposure and health risks will be assessed. The goal will be to differentiate the relative contribution of three categories, regional transport, local mobile sources, and local industrial sources, to these endpoints. The contribution of regional transport to the airborne concentrations of each toxic species will be assessed by comparing background concentrations with values measured downwind of major sources.

The airborne concentrations measured in and risks estimated for Allegheny County will be benchmarked against those determined in other recent air toxics studies, such as for Louisville, Kentucky, as well as those estimated for urban and non-urban areas throughout the United States by the EPA in their National Air Toxics Assessment (NATA). The NATA study, originally conducted for the year 1996 and currently being updated by the EPA, predicts concentrations, exposures and risks based on emission estimates combined with air pollution fate, transport and exposure modeling. Our estimates for Allegheny County will be compared to these benchmarks both for the concentrations of individual air toxics and for the total and compound-specific risk estimates.

Source Apportionment

CMU will perform detailed source-apportionment to develop source profiles and quantify contribution of different sources to the measurement sites. A combination of statistical and deterministic modeling tools will be used for the source-apportionment analysis.

This effort will allow the risk assessment component of the project to tie the risk estimates back to source classes in addition to compound classes.

Statistical receptor model will be used to relate measured concentrations to their sources without reconstructing dispersion models. Receptor models separate the contribution of different sources using correlations among various pollutants emitted by a given source. These correlations can be viewed as a source fingerprints which are used by receptor model to invert ambient concentrations to determine relative and absolute source strengths. In this project, three different receptor models will be employed: the chemical mass balance (CMB) model, UNMIX, and Positive Matrix Factorization (PMF2).

The chemical mass balance (CMB) model will be used to estimate the diesel particulate matter concentrations using measurements of elemental carbon and several molecular tracers. The CMU team is actively employing the techniques of PAQS to interpret both ambient measurments and data collected in the Squirel Hill tunnel. The instrumentation deployed by CMU at the site will provide highly time resolved measurements of all of the necesary diesel tracer species for this analysis.

The UNMIX and PMF2 receptor models will be used to develop emission profiles and source contributions for the Neville Island area. These are factor analysis models that have been widely applied to interpret air quality data. Unlike the CMB model, these models use statistical factor analysis methods to extract both emission profiles and source strengths from an ambient data set. An important challenge is interpreting the results from the model predictions. In this project we will apply ideas from recent research that utilizes wind direction and wind speed as independent variables in receptor model calculations to establish links between emission profiles and specific sources. In addition we will compare the calculated emission profiles to literature profiles. Recent work by the PAQS and other EPA supersites has demonstrated that highly time resolved data such as that collected here greatly simplifies the application and interpreation of factor analysis based models.

An atmospheric dispersion model such as the Industrial Source Complex Short Term (ISCST3) Gaussian plume model will be used to interpret monitored concentrations in a way that complements the statistic source-receptor analysis. The ISCST3 model determines downwind concentrations based on a Gaussian plume calculation, using hourly meteorological records obtained from nearby weather stations. The model assumes a linear relationship between emission rates and ambient concentrations, so that superposition can be employed for the effects from different sources. There are a number of challenges to applying and interpreting results from a plume model. For example, a key, limiting factor is that, downwind of a source, measured concentrations exhibit substantial variability resulting from turbulent fluctuations whereas Gaussian plume models predict a concentration averaged over these fluctuations. Given the time resolution of the data we will measure, we will resolve many of these turbulent fluctuations. A second key uncertainty is that the time profile of emissions strength from each of the relevant sources will be unknown.

Dispersion modeling will be applied in the following manner. Measured concentrations from the monitoring locations will be classified according to meteorological conditions (i.e. wind direction and atmospheric stability). Time-averaged concentrations are more suitable for comparison with a Gaussian plume model. Second, a set of sources will be invoked with chemical profiles derived from the source-receptor analysis outlined above.

Third, source strength (mass of emissions per time) of each emissions source will be used in conjunction with the Gaussian plume model to fit the observed concentrations. The result of this analysis, therefore, will be estimates of the strengths of emissions sources in the vicinity of our monitoring locations.

Qualifications of Research Team

Allegheny County Health Department, Air Quality Program

The air quality program has been performing ambient air monitoring in Allegheny County for many decades, and possesses a wealth of knowledge and experience not only in air monitoring but also in modeling, planning and data analysis. The Program maintains one of the most complete emission inventories in the nation, which will be drawn upon for the modeling and source apportionment portion of this study. The monitoring section has operated an exemplary, EPA-approved air monitoring program for all of the criteria pollutants, and has worked with instrument manufacturers and laboratories to develop new an innovative air toxics sampling methods, such as successful operation of continuous gas chromatographs in communities impacted by coke batteries for over ten years. Air quality staff has worked closely with the Allegheny County Environmental Laboratory to develop novel sampling and analytical techniques for particle pound metals, benzoalphapyrene, and PM10 speciation.

The air monitoring section is comprised of creative and dedicated personnel who have demonstrated flexibility and perseverance throughout the years, and they are uniquely qualified to take on the new challenges pose by this study.

Darrell Stern, Section Head of Air Monitoring

Mr. Stern will be the main contact and coordinator of the baseline portion of this study. He has worked for the Air Quality Program for 14 years, holding the position of Quality Assurance Supervisor before being named Section Head of Air Monitoring in the year 2001. Primary responsibilities of his current position include supervision air monitoring and source testing staff, technical procedure design and air monitoring network development. His background includes degrees in biological science and secondary education. Before Mr. Stern came to the Health Department he worked as a full time high school biology teacher and as an analytical chemist.

Dr. Allen Robinson

The Principal Investigator from CMU is Dr. Allen Robinson. He is an associate professor in the Departments of Mechanical Engineering and Engineering and Public Policy at Carnegie Mellon University. His research examines the impact of emissions from combustion systems on ambient air quality. Current research areas include chemical and microphysical transformations in plumes, and sampling, analysis and sources of organic particulate matter. He is a co-P.I. of the Pittsburgh Air Quality Study, a large regional air quality study supported by the EPA Supersites program and DOE-NETL. Professor Robinson joined Carnegie Mellon in 1998 after working for two years as a Postdoctoral Fellow at the Combustion Research Facility at Sandia National Laboratories. He received his Ph.D. from the University of California at Berkeley in Mechanical Engineering in 1996.

In addition, project personnel from CMU will include Peter Adams, Cliff Davidson, Neil Donahue, and Mitch Small. The Air Quality group at Carnegie Mellon is highly qualified to conduct the proposed research. The group has a new 2300 square foot laboratory that is fully equipped with more than $1 Million in state-of-the-art instrumentation. The laboratory was used for sample preparation and analysis in the recent $7 Million EPA and DOE-funded Pittsburgh Air Quality Study. All procedures have been documented in a detailed Quality Assurance Plan that has been approved by EPA. The CMU group has worked closely with Allegheny County Health Department on field measurement campaigns and in an advisory capacity. Several dozen graduate students have participated in programs of the Air Quality Group over the past decade. The group has conducted research all over North America as well as in Europe, Asia, and the Arctic regions. This research has resulted in the publication of a number of books and several hundred journal articles.

Bernard D. Goldstein, M.D

Bernard D. Goldstein, M.D., is dean of the University of Pittsburgh Graduate School of Public Health. An environmental toxicologist, his research interests have focused largely on the concept of biological markers in the field of risk assessment.
He has published in the areas of blood toxicity, the formation of cancer-causing substances (free radicals) following exposure to inhalants, various aspects of public health decision-making and global issues in environmental medicine.

Before coming to the University of Pittsburgh, Dr. Goldstein was professor and chairman of the department of environmental and community medicine at the University of Medicine and Dentistry of New Jersey-Robert Wood Johnson Medical School, where he established and directed the largest academic environmental and occupational health program in the United States -- the Environmental and Occupational Health Sciences Institute.

He also has served as an officer with the U.S. Public Health Service and as assistant administrator for research and development at the U.S. Environmental Protection Agency.

Dr. Goldstein received his medical degree from New York University and undergraduate degree from the University of Wisconsin.

Project Timeline:

The project start date is June 1, 2004. Below is a timeline for the project.

	2004		2005				2006				2007	
Activity:	3	4	1	2	3	4	1	2	3	4	1	2
Preparation for field sampling	X											
Baseline monitoring		X	X	X	X	X						
Sampling intensives			X		X	X	X		X			
Data analysis / assessment			X	X	X	X	X	X	X	X	X	X
Preliminary assessment reports					X		X		X			
Prepare Final Report												X

Clean Air Fund Budget

The following table summarizes the initial budget as *supplied by* ***Allegheny County***.

Institution	Total
Carnegie Mellon	791,197
University of Pittsburgh	60,000
ACHD	289,178
Total Project	**1,140,375**

EPA Air Toxic Grant Funding Request

The following proposed budget covers the total funds requested from the ***EPA grant***. EPA funds will be used to cover phase two of a study already initiated using Allegheny County Funds. The total cost analysis for the EPA grant request is presented here, followed by a more detailed budget from Carnegie Mellon University and the Allegheny County Health Department.

EPA Air Toxics Grant Request

Institution	Total
Carnegie Mellon	225,539
ACHD	250,645
Total	**$476,184**

Carnegie Mellon University Portion of EPA Grant Request

	Total Project
Postdoctoral Fellow	$ 54,319
Graduate Student	$ 87,473
Fringe	$ 15,372
Total Personnel	$ 157,164
Materials and Supplies	$ 25,000
Direct	$ 182,164
Indirect	$ 43,375
Total:	**$ 225,539**

Personnel:

Funds are requested to cover the salary and fringe benefits for one post-doctoral fellow for the entire first year of the project and for two months in the second year. This person will be responsible for sample collection and analysis, and the evaluation of the performance of the different instruments used by the study.

Funds are also request to cover the salary and tuition of one graduate student for the entire project. This student will be responsible for the analysis of the data including

estimating risks and comparing results to previous studies. The graduate student will assist the postdoctoral fellow in the sampling in analysis.

Funds are requested to cover the salary for two undergraduate students who will assist in the laboratory work.

Materials and Supplies:

Extensive laboratory experiments will be performed in all years of the project. The requested amount is based on previous experience at Carnegie Mellon University conducting field monitoring campaigns. Major materials and supplies expenses include:

Item	Estimated Cost
Compressed gas standards.	$15,000
Eight Summa Canisters (@$500/each)	$4,000
Replacement / Back Up GC columns	$1,500
GC carrier gas UHP He	$2,500
FID flame gas (H2/O2 mix)	$750
Liquid Nitrogen for cryogenic cooler	$3,000
Equipment maintenance	$3,000

The balance of the requested materials and supplies funds will be used to cover miscellaneous tools, tubing, glassware, software, spare parts for instruments, etc. required for the project. Finally, these funds will costs associated with publishing reports and scientific papers describing the results from the research.

Indirect Costs:

Indirect costs cover the operation and maintenance of the laboratories, libraries, and other facilities used for the research. The indirect costs cover other important costs such as telecommunications (phone, fax, and internet). The rate is Carnegie Mellon rate for Allegheny County funds.

Allegheny County Health Department Portion of the EPA Grant Request

The following proposed budget adds 2 UV DOAS, three combined SUMMA canister/carbonyl cartridge samplers along with analytical support necessary to two of the samplers for 12 months, and to continue to operate the Allegheny County funded monitor phase two of the study period.

Item	Quantity	Unit Cost	Total
Open Path UV DOAS Monitors:			
UV-DOAS open path monitor	2	$59,000	$118,000
Data management system. Includes configured computer and data acquisition and analytical software	2	$8,500	$17,000
24-Hour Integrated Sampler and Laboratory Support:			
SUMMA canister/carbonyl sampler with one canister channel and one carbonyl channel	3	$10,500	$31,500
SUMMA Analysis (EPA TO15)	155	$355	$55,025
Carbonyl Analysis (EPA TO 11A)	155	$104	$16,120
Additional Expenses:			
UV-DOAS supplies (spare bulbs, calibration cylinders, installation materials) Toxics sampler installation (probe lines, inlets)	1	$5,000	$5,000
Personnel:			
Overtime salary for field technicians		Time + 1/2	$8,000
Total:			**$250,645**

Open Path UV DOAS Monitors: The cost estimate of $59,000 per unit is based on a recent quote received by the Department for the Opsis model for the model AR500. The optional calibration bench necessary for calibration and quality assurance will be purchased using Allegheny County funds as shown in the previous section. A computer configured with data management software will be purchased for bout monitors.

24-Hour Integrated Sampler and Laboratory Support: Three sampling devices will be purchased that are capable of simultaneously operating SUMMA canister and carbonyl cartridge samples. The cost estimate of $10,500 per unit is based on a recent price quote for the Atec model 2200 toxics sampler, which has the features as required for this study. Also included in the price estimate is laboratory support to analyze the samples that will be collected every six days. It is intended to use an EPA contract laboratory to perform these analysis and the costs were taken directly from the EPA contract fee schedule. It has been indicated by Region III that the contract laboratories have sufficient supplies of SUMMA canisters and carbonyl cartridges to supply this project at no additional cost.

Personnel:

The price estimate of $8,000 was included to cover additional time that may be required of the ACHD technicians during the installation and operation of the various instruments being introduced during this study. The UV DOAS will be new to the Department, and additional time may be necessary to master the skills necessary to their successful operation. Also, installing the new equipment and collection the various SUMMA canister and carbonyl cartridges may require extra staff hours. Current union contracts call for a compensation based on normal salary multiplied by 1.5.

Materials and Supplies:

A price estimate was included to cover consumable and incidental supplies. Items that will be purchased under this category include supplies for the UV DOAS monitors (certified gas cylinders, replacement bulbs) and supplies necessary to install the air toxics monitors.

Project Cost Summary

Allegheny County Health Department, Clean Air Fund

Institution	Total
Carnegie Mellon	791,197
University of Pittsburgh	60,000
ACHD	289,178
Total	**1,140,375**

EPA Air Toxics Grant Request

Institution	Total
Carnegie Mellon	225,539
ACHD	250,645
Total	**476,184**

Total Project Costs

Institution	Total
Carnegie Mellon	1,016,736
University of Pittsburgh	60,000
ACHD	539,823
Total	**$1,616,559**