APPLICATION FOR FEDERAL ASSISTANCE

2. Date 4/13/07

Applicant Identifier

1. TYPE OF SUBMISSION :
Application

Construction
X Non-Construction

☐ Construction
☐ Non-Construction

3. Date received by State

State Application Identifier

4. Date received by federal agency

Federal Identifier

5. APPLICANT INFORMATION

Legal Name: **Commonwealth of Massachusetts Dept. of Environmental Protection**

Organizational Unit: **Bureaus of Waste Prevention**

Address (give city, county, state, and zip code):
One Winter Street, 8th floor Boston, MA 02108.
DUN #0087 493 55 FUNDING OPPORTUNITY # EPA-R1-RCC-2006

Name and telephone number of the person to be contacted on matters involving this application (give area code)
KIM ANDREWS 617-292-5829

6. EMPLOYER IDENTIFICATION (EIN):
0 4 - 6 0 0 2 2 8 4

7. TYPE OF APPLICANT: (enter appropriate letter here) A

A. State H. Independent School District
B. County I. State Controlled Institution of Higher Learning
C. Municipal J. Private University
D. Township K. Indian Tribe
E. Interstate L. Individual
F. Intermunicipal M. Profit Organization
G. Special District N. Other (Specify):

8. TYPE OF APPLICATION:
☒New ☐Continuation ☐ Revision
If Revision, enter appropriate letter(s) in box(es): ☐
A. Increase Award B. Decrease Award
C. Increase Duration D. Decrease Duration
Other Specify:

9. NAME OF FEDERAL AGENCY: **US EPA Region I**

10. CATALOG OF FEDERAL DOMESTIC ASSISTANCE NUMBER TITLE: 66.034

Air Pollution Spatial Trends Data Analysis

12. AREAS AFFECTED BY PROJECT (cities, counties, states, etc.):
State of Mass

13. PROPOSED PROJECT:

Start Date	End Date
7/1/2007	6/30/2009

14. CONGRESSIONAL DISTRICT OF:
a. Applicant: All Congressional Districts
b. Project

15. Estimated Funding:

a. Federal	$199,017
b. Applicant	$
c. State	$
d. Local	$
e. Other	$
f. Program Income	$
g. TOTAL	**$199,017**

16. IS APPLICATION SUBJECT TO REVIEW BY STATE EXECUTIVE ORDER 12372 PROCESS?
a. YES. THIS PREAPPLICATION/APPLICATION WAS MADE AVAILABLE TO THE STATE EXECUTIVE ORDER 12372
PROCESSES FOR REVIEW ON: DATE
b. NO. ☐ PROGRAM IS NOT COVERED BY E.O. 12372
☐ PROGRAM HAS NOT BEEN SELECTED BY STATE FOR REVIEW

17. IS THE APPLICANT DELINQUENT ON ANY FEDERAL DEBT
☐ Yes. If "Yes" attach an explanation. X No

18. TO THE BEST OF MY KNOWLEDGE AND BELIEF. ALL DATA IN THIS APPLICATION/PREAPPLICATION ARE TRUE AND CORRECT, THE DOCUMENT HAS BEEN DULY AUTHORIZED BY THE GOVERNING BODY OF THE APPLICANT AND THE APPLICANT WILL COMPLY WITH THE ATTACHED ASSURANCES IF THE ASSISTANCE IS AWARDED.

a. Name of Authorized Representative: Arleen O'Donnell for
b. Title: Commissioner
c. Telephone Number **(617) 292-5525**

d. Signature of Authorized Representative Bruce B. Warren
e. Date : 4/13/07

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BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY

Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds: Federal (c)	Estimated Unobligated Funds: Non-Federal (d)	New or Revised Budget: NEW Federal (e)	New or Revised Budget: Non-Federal (f)	New or Revised Budget: Total (g)
1. SPATIAL ANALYSIS	66.034	199,017	$	$	$	$199,017
2.						
3.						
4.						
5. TOTALS		199,017	$	$	$	$199,017

SECTION B - BUDGET CATEGORIES

6. OBJECT CLASS CATEGORIES	GRANT PROGRAM, FUNCTION OR ACTIVITY				Total (5)
	1ST YEAR	2ND YEAR	(3)	(4)	FEDERAL TOTAL
a. Personnel	$ 4,000	$ 4,000	$	$	8,000
b. Fringe Benefits	$1,240	1,240			2,480
c. Travel	$ 0	2,000			2,000
d. Equipment	$23,000.00				23,000
e. Supplies	$				
f. Contractual	$77,660	82,335			159,995
g. Construction	0				
h. Other	54	54			108
i. Total Direct Charges (sum of 6a - 6h)					
j. Indirect Charges	1,717	1,717			3,434
k. TOTALS (sum of 6i and 6j)	107,671	91,346	$	$	199,017
7. Program Income			$	$	

SECTION C - NON-FEDERAL RESOURCES

(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e) TOTALS
8.AIR POLLUTION SPATIAL TRENDS DATA ANALYSIS	$199,017	$	$	$199,017
9.				
10.				
11.				
12. TOTAL (sum of lines 8 and 11)	$199,017	$	$	$199,017

SECTION D - FORECASTED CASH NEEDS

	(Total for 1st Year)	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	$49,754	$49,754	$49,754	$49,754	$49,754
14. NonFederal					
15. TOTAL (sum of lines 13 and 14)	$49,754	$49,754	$49,754	$49,754	$49,754

SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT

(a) Grant Program	FUTURE FUNDING PERIODS (Years)			
	(b) First	(c) Second	(d) Third	(e) Fourth
16.	$	$	$	$
17				
18.				
19.				
20. TOTALS (sum of lines 16 - 19)	$	$	$	$

SECTION F - OTHER BUDGET INFORMATION (Attach additional sheets if Necessary)

21. Direct Charges:	22. Indirect Charges:
23. Remarks:	

Narrative Workplan

Project Title: Evaluation of Spatial Gradients and Temporal Trends of Black Carbon in Boston MA.

Category: Analysis of Existing Data

Applicant Information: Massachusetts Dept. of Environmental Protection, Bureau of Waste Prevention

Contact: C. Mark Smith, Ph.D., M.S.
Deputy Director, Office of Research and Standards
Massachusetts Department of Environmental Protection
1 Winter Street, Boston, MA 02108
c.mark.smith@state.ma.us
Phone: 617-292-5509; Fax 617-556-1006

Enabling Legislation:
The Massachusetts Dept. of Environmental Protection (MassDEP) is the lead MA state air pollution control agency as defined in section 302(b) of the Clean Air Act and is eligible to receive grants under section 105 of the Clean Air Act. The General Laws of Massachusetts, Title XVI, Chapter 111: Section 142A-142J (Massachusetts Clean Air Act), provide the specific enabling legislative language designating MassDEP responsible for preventing pollution or contamination of the atmosphere in MA. See: http://www.mass.gov/legis/laws/mgl/111-142a.htm .

Funding Requested: $199,017.00

Total Project Cost: $199,017.00

Project Period: July 1, 2007 to June 30, 2009

Project Narrative and Work Plan:

1. Introduction.

The Massachusetts Dept. of Environmental Protection (MA-DEP), Bureau of Waste Prevention, is applying for a grant to assess the spatial and temporal trends of existing black carbon (BC) data in the metropolitan Boston area. BC has been shown to be a useful indicator of local mobile source aerosol emissions in urban areas (Janssen et al., Atmos. Environ. 1997, 8:1185–1193).

Local mobile sources in large urban areas contribute to elevated levels of a wide range of air toxics pollutants, including PM from both automotive (spark ignition) and diesel vehicles. PM from mobile sources has the potential to be highly toxic, and is thought to be a major factor in the observed PM health effects reported by a wide range of epidemiological studies over the last decade.

From a policy perspective, an improved understanding of both the spatial patterns (gradients) and long-term (8-10 year) temporal trends of "tailpipe" related PM in large urban areas as represented by BC is important both for implementation and assessment of control strategies. It also aids in understanding the exposure dynamics of potential environmental justice-related "hot-spots" such as the Dudley Square area of Roxbury (Boston). Finally, understanding trends and gradients is critical for understanding and improving estimates of exposures used in health effect studies; for example, the Harvard-led EPA Boston PM Center has used MA-DEP air pollution data in several studies over the last decade. However, when a single monitor is used to represent an urban area for locally generated pollutants such as BC, exposure mis-classification can occur; this can bias estimates of health effects toward lower (less hazardous) values (Kunzli et al., EHP 2005, 113:201–206). This project will directly support EPA's Strategic Plan Goals 1.1 (healthier outdoor air) and 1.1.2 (Reduced risk from Toxic air pollutants).

MA-DEP will partner with NESCAUM on this project. NESCAUM staff have a wide range of expertise in data analysis, including assessment of data quality and potential bias or artifacts in BC measurements, the primary metric for this project. NESCAUM also collected much of the data for the 2003 spatial study, and is familiar with the strengths and weakness of that work.

2. Background and Motivation.

In this proposal, we describe an approach for analysis of existing aerosol data (PM2.5 and BC) in the greater Boston MA area that will lead to a better understanding of both urban gradients and temporal trends of BC (locally generated mobile source aerosols, including diesel PM) over the last decade. Quantification of BC spatial gradients and temporal trends are related tasks, since both effect characterization of mobile-source aerosol exposures over space and time. Data sources include monitors at on-going MA-DEP sites and the Harvard School of Public Health's (HSPH) EPA PM-center

The primary metric to be used for this analysis is BC from Aethalometers™, a measurement that is in common use nationally as part of the EPA National Air Toxics Trends Stations (NATTS) program. The Aethalometer is a simple measurement of how dark the aerosol is; the more graphitic carbon soot (primarily from diesel in urban areas but also from spark ignition vehicles), the higher the reported BC concentration in micrograms per cubic meter.

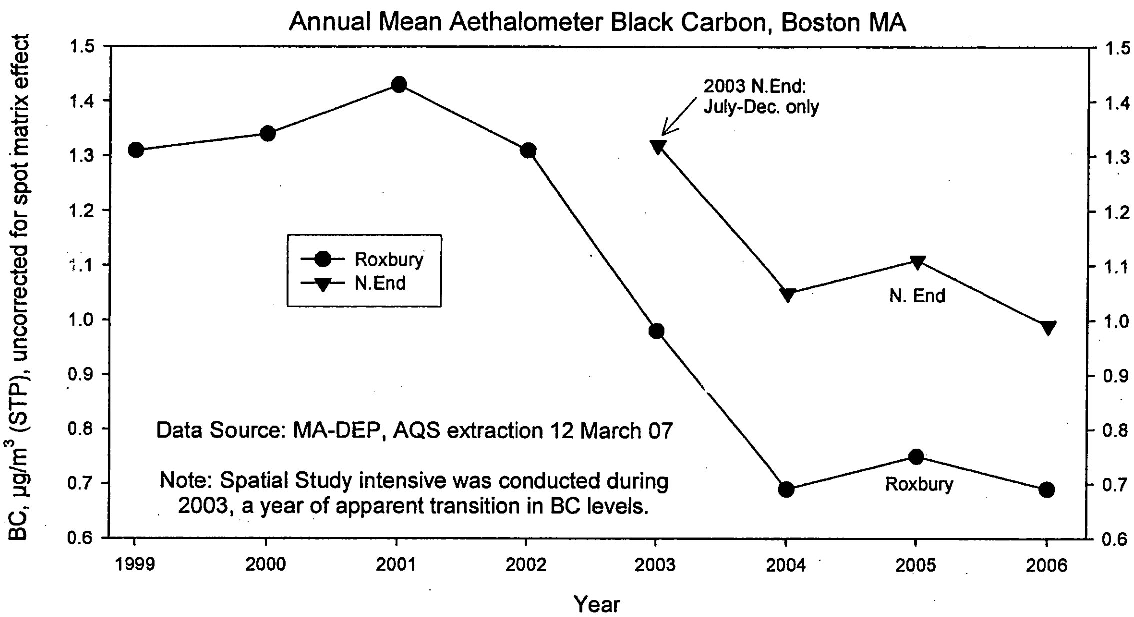
<u>Trend Analysis.</u>
For trend analysis, Boston is unique in having three long-term sites with BC measurements; two are run by MA-DEP (Roxbury and the North End), and one is run by HSPH near Brigham Circle. The North End site started measuring BC in mid-2003; the other two sites started in 1999, making them some of the longest continuously running urban BC sites in the country and providing a unique opportunity for trend analysis with almost a decade of data. All three sites will continue through at least 2008.

Site Descriptions for key BC trend sites.

- The Roxbury MA-DEP site is located one block away from Dudley Square, a busy MBTA commuter bus station. A large "bus barn", the Bartlett yard, was located approximately 300 meters from Dudley Square until it was shut down in 2004. The site is classified as neighborhood scale; probe heights are approximately 4 to 5 meters above ground.
- The North End MA-DEP site is located in a residential neighborhood on the top of a 3-story building, 30-40 meters from the entrance of two traffic tunnels that go to Logan Airport and points north. The probe height is 14 meters above ground.
- The HSPH PM-Center site is near Brigham Circle in Boston, approximately 1.5 km NW of the Roxbury site. However it is approximately 25 meters above street level, making it more of an urban scale site for fine-mode aerosols.

A preliminary evaluation of BC trends using available MA-DEP data is shown in Figure 1, using data extracted from AQS for the two Boston BC sites. It is clear that there was a substantial reduction of BC at the Roxbury site between 2002 and 2004, even with the potential of changing measurement artifacts over this time period. It is not clear from these limited data if the reduction was city-wide or primarily at Roxbury (the 6 months of data from the North End for 2003 are suggestive but not conclusive). It will be one of the goals of this project to determine the spatial scope of the reduction in BC observed at Roxbury by (a) bringing in data from other sites such as HSPH and extending the N.End BC back to 2001 using reflectance analysis on FRM filters, and (b) assessing what control programs may have contributed to the apparently dramatic improvement in air quality both at the Roxbury site and others in downtown Boston.

Figure 1.



Spatial Gradient Analysis.

For the spatial gradient analysis component of this project, we will primarily use one year of BC data collected at 6 sites during 2003 for an initial study conducted by NESCAUM to assess the spatial gradients of BC across the greater Boson metropolitan area. That study was primarily designed to assess the impact of urban mobile-source related hot-spots, and also to define how rapidly the "urban excess" BC dropped off as a function of distance from downtown Boston. Figure 2 shows the site locations. However due to lack of any project funding, only a simplistic and preliminary data analysis was performed, and only on a portion of the entire dataset. The data analyzed also included significant instrument BC artifacts that have not been corrected or accounted for. Still, the analysis performed to date demonstrate both large gradients and the utility of BC as a good indicator for local mobile aerosol sources in urban areas. Figures 3 and 4 below show nine months of BC data for six sites, three in the core urban area, and three further out to a regional background site 36 km NW of Boston. Figure 3 is the distribution of the hourly data, and shows a factor of three in BC concentrations between downtown Boston and a regional background site (Stow MA).

Figure 4 shows the same data as diurnal plots stratified by work and non-workdays. A large morning rush-hour BC peak is present for the urban sites on workdays, but not non-workdays. The only significant difference in local sources between workdays and non-workdays for the 5 am to 9 am morning (rush-hour) period is mobile source activity; this demonstrates that BC dynamics at these core urban sites are due mostly to local primary mobile source emissions. As a result of early analysis of these data, a "saturation" study was also conducted for two months during the summer of 2003 to assess the spatial variability of BC within the urban core - generating a unique data set over a much smaller spatial scale than the year-long project. Analysis of data from these 9 urban sites will also be included in this project.

Figure 2. Six year-long "core" Spatial BC Monitoring Sites.

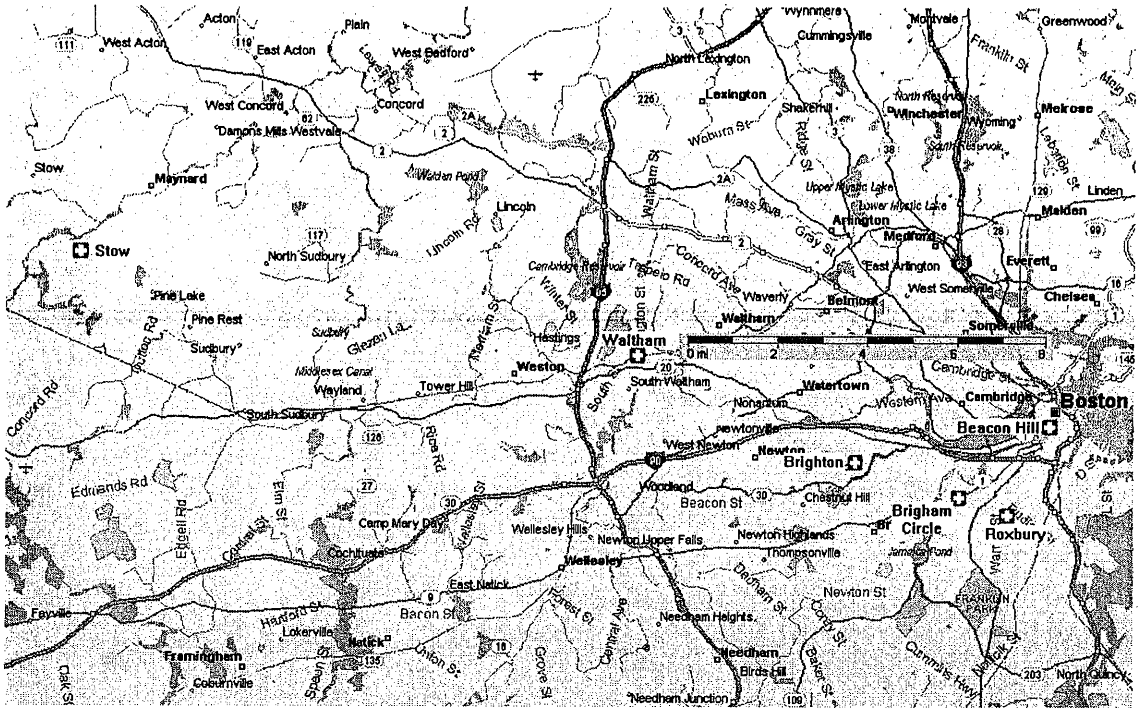


Figure 3. Preliminary Spatial Gradients using uncorrected and incomplete data.

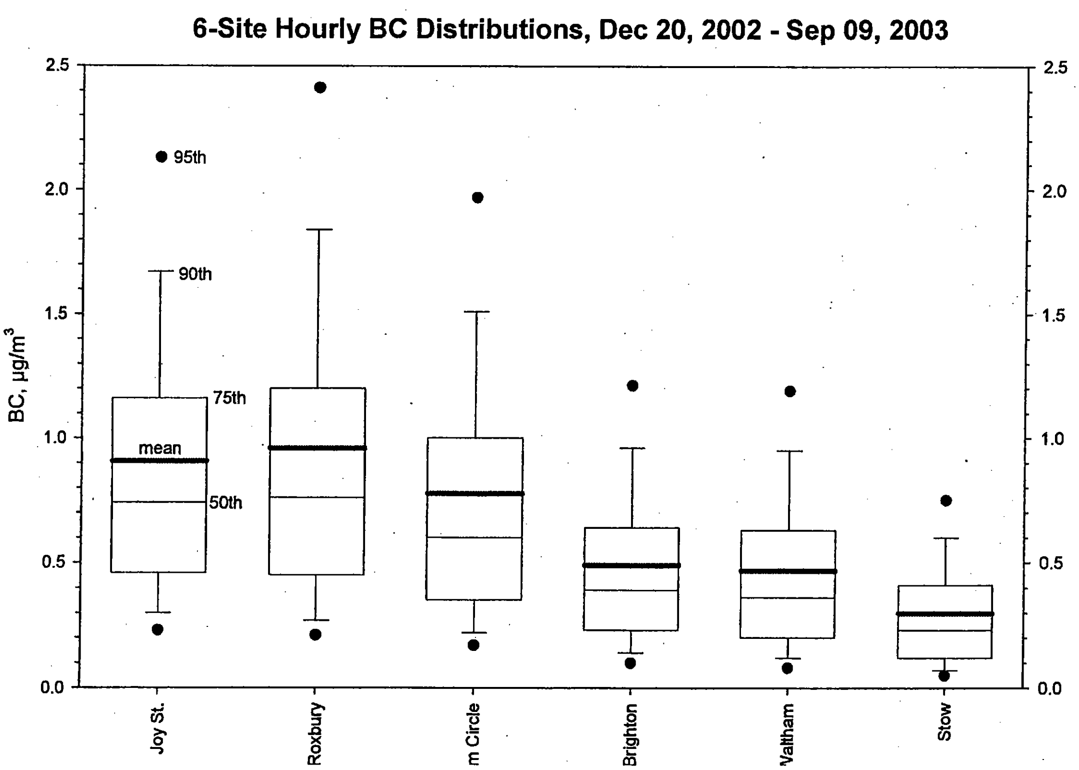
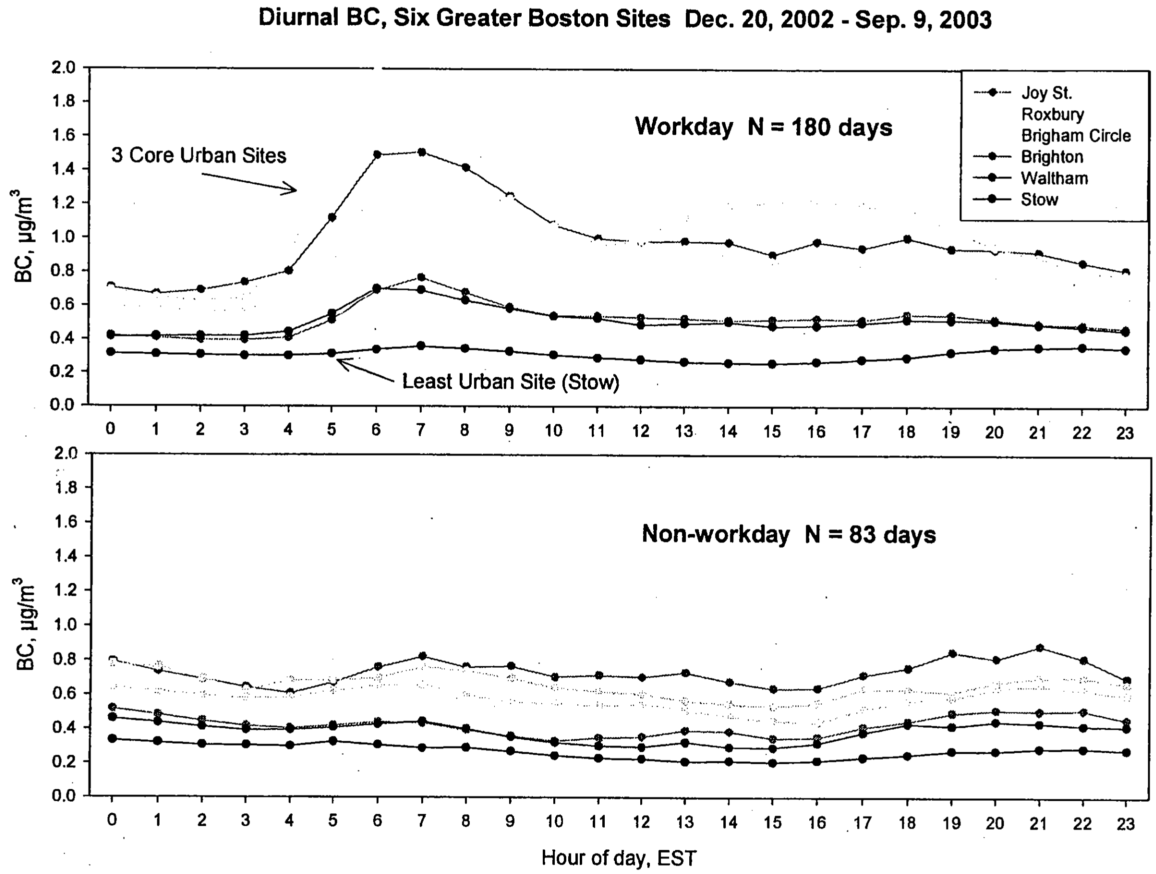


Figure 4.



3. Project Objectives.

This project has two main and related data analysis objectives:

1. To better characterize the spatial gradients of BC as a marker for local mobile source aerosol (primarily diesel) by rigorously analyzing existing BC and PM2.5 data from multiple sites, incorporating known method artifacts and biases in the analysis. An additional objective for this component is to determine how representative the 2003 data is of present-day BC gradients given the substantial drop in BC observed at Roxbury between 2002 and 2004.

2. Analyze data from two MA-DEP and the HSPH site to determine the temporal trend in BC from 2000 to 2008, and to the extent possible determine if the distinct downward trend observed at Roxbury extends to other urban Boston areas. The timing of implementation of various mobile source aerosol reduction strategies in Boston and specifically in Roxbury will be evaluated to see if they are plausible factors in the observed BC downward trend.

These two objectives are related in the sense that if there have been real and substantial improvements in BC concentrations at some sites since 2003 when the spatial gradient study data were collected, how might those trends effect the interpretation of the spatial gradients observed in 2003. For example, is Roxbury BC still elevated compared to HSPH, a more urban-scale site? We will be able to answer those kinds of questions with this analysis.

4. Project Tasks and Deliverables.

Temporal Trend Analysis.

First, we will investigate the long-term trends in BC using data from the two MA-DEP and the HSPH sites. Substantial trends exist for at least some sites as noted earlier. There are four major tasks, framed here as questions to be addressed:

1. Is the trend real, a method or network artifact, or some of each?
2. Assuming it is real, is it statistically significant after any major measurement artifacts are removed?
3. Is the reduction local (e.g., just Roxbury), or did it occur across the urban core of Boston?
4. To what extent can we determine which control measures contributed to the decline in BC?

Artifacts.

As part of the trends analysis, we will investigate possible method artifacts (task #1) in multiple ways. First, using hourly data we can separate out weekdays from weekends and the weekday rush-hour period (5 to 9am local time) from the same time period during weekends. Because there is minimal effect on local mobile source BC during weekends as noted previously, we would expect to see a similar (presumably sharper) drop in weekday rush-hour BC for this stratified trend analysis and minimal or no trend in the weekend BC trend. If a substantial drop is also seen in the weekend trend data (along the lines of the annual trend), that would indicate a method artifact is driving the trend. In addition to being a robust diagnostic tool, this analysis approach will also quantify the trend in sub-daily exposures; we hypothesize that the rush-hour weekday BC trend is substantially stronger than the annual average trend. Quantifying this would also be valuable in the context of health effects assessment. Trends can also be broken down by season, although comparisons between seasons are subject to substantial bias from the Aethalometer's spot matrix effect (discussed in the section on spatial gradient analysis below, since this bias is not a significant factor in analysis of annual BC means).

Other possible artifacts in these trend data include biases between different Aethalometers and Aethalometer configurations (up to 20-30%), and analog data logger offsets (typically no more than 10% of mean BC). These can be investigated and controlled for if necessary, using historical site records and instrument meta-data. Smoothed daily or weekly time-series plots can be used to look for step-function changes in BC, as well as investigate dynamics at the sub-annual level (e.g., if 2003 is a "transition" year for BC, what does the year look like on a monthly or weekly basis?). We will also perform trend analysis on the HSPH BC data set, which was generated independently from MA-DEP (but uses the same measurement method). If these data show a similar trend, then we have increased confidence that the change for the Roxbury site is not driven by artifacts.

Finally, all three sites have daily or third-day PM2.5 gravimetric measurements; these data will be analyzed for trends, but we may not see a significant change in PM2.5 (BC is almost an order of magnitude more specific to local mobile source emissions than neighborhood scale PM2.5). We will evaluate the relationship between Roxbury PM2.5 and other sites during this interval to determine the value of this approach for sites without BC data. There is additional data of interest that is available for all or much of the 9-10 year period of interest. Roxbury also has speciation data from the Speciation and Trends Network (including elemental carbon), as well as CO, NOx, SO2, and NATTS gaseous air toxics data. The HSPH site has filter-based elemental and organic carbon measurements from 2000 through 2005, the core period of interest. To the extent that these supplemental data are useful in supporting the BC trend analysis, these other pollutants will also be analyzed for trends during this time period.

BC Trend Significance.

We will perform various tests of significance on the BC trend data for these three sites (question #2) using various analysis techniques, including those described in EPA web training courses (http://www.epa.gov/quality/trcourse.html). For Roxbury and HSPH, we will have data through much or all of 2008, giving us at least 4 years before and after the apparent 2003 transition year. ANOVA will be performed on the four pre-post 2003 annual means and also on the individual annual means themselves using the underlying hourly data. Since the Roxbury BC drop pre-post 2003 is large, corrections for climatology will not be done unless preliminary analysis indicate that it is necessary to improve the trend estimate of significance. It must be noted here that any statistical assessment of trend significance does not take into account the potential influence of method bias over time; statistical significance is likely to be high simply because "N is large" (the hourly data set has over 8000 observations per year and 9-10 years of data for the Roxbury and HSPH sites). The interpretation of statistical results must incorporate the impact of possible changes in method bias over this time period; the latter is likely more important in assessing how "real"any observed trends may be.

Spatial Scale of BC Trend.

We will determine the spatial scale of the observed Roxbury trend (question #3) using multiple approaches. First, since the HSPH site is less influenced by mid to micro-scale local traffic sources than Roxbury, if a trend of similar magnitude is seen, then the trend is likely to be similar across the Boston core urban area (e.g., within a few km of downtown). Because the HSPH BC data play an important role in understanding the spatial scale of these trends, we need to better understand the effective spatial scale of that site. To accomplish this, NESCAUM will install and operate a MA-DEP Aethalometer near the existing HSPH site (150 meters to the east), but near the major local roadway and about 15 feet above the ground. This siting is consistent with the siting for the other BC sites used in this data analysis. This site will run for approximately 6 months, to capture both cold and warm weather patterns. Data from this site will be compared to both the existing HSPH site and the Roxbury site. Instrument collocations with both existing sites will be performed by NESCAUM to control for inter-instrument bias.

Second, the N.End BC trend is critical to understanding the spatial scale of the BC trend observed at Roxbury. We will estimate missing N.End BC data for 2001 to mid-2003 by analyzing PM2.5 FRM filters from that site by optical reflectance, a surrogate of BC. For this period, every sixth-day samples will be analyzed to generate annual means. To calibrate reflectance measurements to BC, twelfth day samples will be analyzed from mid-2003 through 2004 and compared to the measured BC for the same days. A total of 200 filters will be analyzed at HSPH, where these measurements are done routinely.

Likely role of control programs in observed BC trends.

In attempting to answer question #4 (to what extent can we determine which control measures contributed to the decline in BC?), we will investigate and document various changes that have occurred near both MA-DEP monitoring sites during this time period. The Roxbury site is near a major bus station (Dudley square) and a bus yard for MBTA commuter busses (the Bartlett yard was closed in 2004 and was cited for idling violations in 2002). All MBTA and Boston school busses have been either retrofitted with DPFs or converted to CNG during or around 2004; a detailed time line of all fleet retrofits will be obtained. In the N. End, potential impacts in addition to the change in the Boston bus fleets include the change in local traffic patterns when the last lanes of the expressway were put underground (the Big Dig) in December 2003. This site is near both the Big Dig and a major MBTA bus station (Haymarket). Other possible factors might include enforcement of anti-idling laws, and a decrease in sulfur content of on-road diesel fuel; we will investigate the timing of these factors with respect to observed changes in BC at Roxbury and the other two Boston BC sites.

Analysis of Spatial Gradients of BC

A preliminary analysis of some of the data from the 2003 BC spatial gradient study and additional background information is at: http://www.nescaum.org/documents/allen-spatial-bc.pdf/
Before a rigorous analysis of these data can be performed, the dataset must be corrected for several known artifacts such as between instrument bias and the Aethalometer BC spot matrix effect.

The "spot matrix effect" is a relatively recently recognized problem in the Aethalometer method that introduces both a short term (hourly to daily) variable negative artifact, a strong (factor of two) seasonal bias, and a bias that is a function of the "Maximum Attenuation" setting of the Aethalometer. This artifact can vary from large positive factors to smaller negative factors as a function of the aerosol composition on the instrument's filter spot. For additional information on this artifact, see: http://www.epa.gov/ttn/amtic/files/ambient/2006conference/allenaethalometer.pdf

An important issue to consider is if the spatial gradient study data collected in 2003 is still representative now. Given the apparent large change observed in BC between 2002 and 2004 at the Roxbury site, it is possible that the 2003 spatial study data no longer properly represent present-day BC gradients. The multi-site trends data analysis described above includes components that should allow assessment of the spatial scale of the decrease in BC observed at Roxbury. If we can show that a roughly proportional decrease occurred at multiple sites and especially the HSPH site (more urban scale siting), then we can have reasonable confidence that although the actual concentrations measured in the 2003 spatial study may have decreased, the overall urban spatial gradients have not changed substantially. Annual BC means for the three long-term sites will be assessed to evaluate the stability of the 2003 spatial analysis.

Specific Tasks for Spatial Study Data Analysis:
1. Re-process the entire raw 5-minute 2003 Aethalometer data set for all 12 sites with a new version of Jay Turner's "data masher" program (http://users.seas.wustl.edu/jrturner/aethalometer/). By summer 2007, this program will include corrections that compensate for the "spot matrix effect".
2. Normalize the artifact-corrected BC data to correct for inter-instrument bias. Most of the Aethalometers used in this study were collocated either before or after the study period, but these data have never been evaluated or used to correct study data. In one case, a pair of instruments used in this study was shown to be different by 20%. This is a very significant amount given the objectives of the study; within the urban core, many sites differ by only 20% to 30%.
3. Create a daily mean data set from the corrected hourly data. Analyze the corrected hourly and daily data sets for a wide range of scenarios, including simple annual [or summer] means and diurnal patterns. ANOVA techniques will be used to assess the significance of differences between sites. Correlation matrixes will be created for both hourly and daily BC metrics. Data will be stratified by season and day of week analysis. Event case studies will be analyzed to determine the dynamic behavior and spatial patterns during periods of unusually high urban BC concentrations.
4. Compare the 2003 spot matrix artifact-corrected data for N.End, Roxbury, and HSPH with the original data to assess the extent of bias in the uncorrected data on a monthly basis.
5. Construct a longer BC annual mean record for the N.End site using reflectance analysis on filters.
6. Compare annual means for these three long term sites to assess stability of the 2003 spatial analysis.
7. Collect BC data at a site near the existing HSPH site but close to street level for 6 months to better characterize the spatial scale of the HSPH BC data set. Although this is a data analysis project, this minor monitoring component will substantially enhance the interpretation of the data analysis; since the scope of the monitoring is limited, the added cost is not a substantial portion of the proposed budget.

Deliverables.
Results of the specific data analysis tasks detailed above will be included in quarterly project reports to EPA as they become available. A final project report will summarize all aspects of the analysis, including results and limitations of the analysis. A manuscript suitable for submission to a peer reviewed journal will be written describing the study and its results.

5. Project Timeline and Responsible Parties.

Timelines. We will perform the spatial gradient analysis first, since most of the needed data are already available. We expect this portion of the project to take at least one year. The trend analysis will be done primarily in the second year of the project, since additional data will be available by then, making the analysis more robust.

Responsible Parties. MA-DEP will oversee the data analysis, providing input as needed. The bulk of the actual data analysis will be performed by NESCAUM. Quarterly and final Project Reports will be a joint effort of MA-DEP and NESCAUM, with MA-DEP being responsible for the final content and timely submission of these reports. The journal manuscript preparation will be a shared task between NESCAUM and MA-DEP; again MA-DEP will be responsible for the final manuscript content.

6. Environmental Outputs/Outcomes.

This project will provide new information on two extremely important and related aspects of mobile-source aerosol exposures in the urban Boston area. The spatial gradient component will more clearly define the extent of variation both within the urban core and the "shape" of these elevated exposures over the larger metropolitan scale. This information is critical in understanding where control measures and programs can be most effective in reducing exposure to mobile-source aerosols.

The temporal trend component can not only demonstrate reductions in exposures, but should also be able to identify which programs were major contributors to the substantial observed downward trend in Roxbury BC. This analysis should also be able to demonstrate the extent to which trends are uniform across the urban core, or limited to specific neighborhoods. While it is important to clean up neighborhood "hotspots", our preliminary work showed that the entire urban core can also be considered a mobile-source hotspot. As neighborhood hot-spots are brought under control, reduction of the "urban" hot-spot becomes a higher priority.

Transferability. As additional cities generate BC data sets that are long enough to use for meaningful trend analysis, this work can serve as guidance for trend analysis; issues related to potential artifacts, screening methods, and influence and assessment of control programs can be applied. For urban areas that have more than one site with BC measurements, the spatial gradient analysis techniques used in this project are of use in any major urban area.

7. Roles and Qualifications of MA-DEP (the applicant) and NESCAUM (the sub-grantee project partner)

MA-DEP staff will direct the data analysis and provide oversight of NESCAUM's subcontract. The MA-DEP Office of Research and Standards has staff qualified to assess and direct the subcontractor's work. The MA-DEP Air Branch will also continue to collect BC, PM, and related data at the Roxbury and North End sites for the duration of this project as part of their on-going state air program measurements, and will provide technical and QA/QC review for this project.

NESCAUM will perform the bulk of the data set preparation and subsequent data analysis tasks; they have several staff on their Science and Technology Team with substantial experience in both data quality evaluation and complex data analysis. Senior NESCAUM management staff will oversee the analysis and serve as a liaison to MA-DEP staff on this project.

8. Biographical Information of Key Project Personnel.

<u>MA-DEP:</u>

Dr. C. Mark Smith, Ph.D., M.S. is Deputy Director of the Office of Research and Standards at the Massachusetts Department of Environmental Protection (MassDEP). His areas of expertise include toxicology, environmental indicator monitoring and assessment, risk assessment and environmental policy, particularly related to toxic pollutants. He holds a Ph.D. in the field of Molecular and Cellular Toxicology and a Masters degree in Environmental Management from Harvard University and has published in the areas of environmental policy, genotoxicity, molecular epidemiology, genetic markers of susceptibility and risk assessment. Dr. Smith directs and manages the ORS environmental research and monitoring program, leads MassDEP's multimedia mercury strategy, and has extensive experience managing environmental research projects and contracts.

Mr. Thomas McGrath has worked for the Massachusetts Department of Environmental Protection in the ambient air quality monitoring field for almost 30 years, and has had 23 years experience with ambient air toxics monitoring projects. He has been the MassDEP Air Assessment Branch Chief since 2003. Mr. McGrath has a BS in Public Health, a MS in Environmental Engineering, and is a Licensed Professional Engineer.

NESCAUM:

Dr. Paul J. Miller is Deputy Director of the Northeast States for Coordinated Air Use Management (NESCAUM) in Boston, Massachusetts where he provides technical and policy coordination among the air quality agencies of eight northeastern states. He contributes to all phases of NESCAUM's work, including ozone transport, acid rain, regional haze, mercury, and other air issues. From 1999-2005, Dr. Miller was the Air Quality Program Coordinator with the Commission for Environmental Cooperation in Montreal, Quebec. Dr. Miller has been a Senior Fellow at Princeton University's Center for Energy and Environmental Studies and a Senior Energy Fellow at the W. Alton Jones Foundation in Charlottesville, Virginia. He also was a National Research Council Associate at the Joint Institute for Laboratory Astrophysics, University of Colorado and the National Institute of Standards and Technology, in Boulder, Colorado. Dr. Miller has a Ph.D. in chemical physics from Yale and a law degree from Stanford.

Mr. George Allen is a Senior Scientist at NESCAUM. He received a B.S. in Electrical Engineering from Tufts University in 1974. Mr. Allen is responsible for monitoring and exposure assessment activities across a range of topics, including regional haze, air toxics, on and off-road diesel, and continuous aerosol measurement technologies. He is the author or co-author of more than 30 journal papers on development and evaluation of measurement methods, exposure assessment, and air pollution health effects. Before joining NESCAUM in 2002, Mr. Allen was at the Harvard School of Public Health in Boston for more than 25 years, working on a wide range of EPA and NIH funded air pollution studies, and developing several new techniques for real-time aerosol measurements. Mr. Allen serves on the NACAA Air Monitoring and the EPA AIRNow Steering Committees. He is also a member of the EPA CASAC Ambient Air Monitoring and Methods Subcommittee.

Dr. John Graham is a Senior Scientist at NESCAUM since 2002, after holding positions with the USEPA, CT DEP and US Coast Guard. John developed a keen interest in the environment during his graduate work in the atmospheric sciences at MIT. His research took him to the People's Republic of China, where he measured trace atmospheric gases. This first-hand experience with severe local air pollution motivated John to pursue a career in environmental protection. While at NESCAUM, John has been responsible for investigating air quality issues in the northeast and providing technical advice to the eight NESCAUM member states. His expertise includes fine particulate matter, regional haze, mercury and ozone. With this knowledge, he has authored or contributed to many reports and papers with NESCAUM's Science and Technology Team. John holds a Ph.D. in Atmospheric Science from MIT and an AB in Chemistry from Harvard College.

Mr. Iyad Kheirbek is an Environmental Analyst at NESCAUM, working on a variety of air quality projects including air toxics, criteria air pollutants, public health, and regional haze. Recent projects include an analysis of BART-eligible sources in the Northeast, modeling the health benefits associated with various air quality control programs, development of a conceptual model describing ground level ozone on the east coast, and an analysis of air toxics in the State of Connecticut. Before joining NESCAUM in 2003, Mr. Kheirbek received a M.S. in Environmental Health from the University of Washington School of Public Health. Mr. Kheirbek's work at the University of Washington was focused on developing a personal passive sampler to measure long-term exposures to aldehydes in air. Prior to attending the University of Washington Mr. Kheirbek completed a B.S. in Chemistry and Environmental Science at Tufts University in 1999.

Environmental Results Past Performance.

Under the Performance Partnership Agreement and Grant with the U.S. EPA, MassDEP receives Section 105 funding to operate a statewide network of criteria pollutant monitors that report data to the US EPA Air Quality System (AQS). MassDEP consistently exceeds 90% data capture for the gaseous air pollutants. Part of the monitoring network includes two PAMS monitoring networks (for the Springfield and for the Boston Metropolitan areas); as part of the PAMS network MassDEP also operates the only New England state-owned Upper Air Profiler. MassDEP sends an annual data certification letter to US EPA Region 1, with supporting documentation from AQS, to verify that the network was operated in accordance with 40 CFR 53 and 58 regulations. In FY2006, U.S. EPA Region 1 performed a Technical System Audit of the network; verbal feedback indicated that the Massachusetts monitoring network and its operation is in compliance with the audit criteria.

MassDEP also receives an annual Section 103 grant from US EPA to support the operation of the state's network of Federal Reference Method (FRM), continuous, and speciation PM2.5 samplers. MassDEP had experienced significant data collection problems with the first generation FRM monitors; with technical and financial assistance from US EPA and state bond funds, the network was updated with new equipment and beginning in Calendar Year 2004, MassDEP has been able to meet and surpass the US EPA minimum data captures requirements at all its PM2.5 sites. These data are reported to the AQS.

MassDEP also receives Section 103 Air Toxics funds to support the operation the NATTS site at Harrison Street in Roxbury (Boston). Data are reported to AQS. Using FY06 funds, MassDEP contracted with Cambridge Environmental to undertake a trends analysis of the air toxics data collected at this site, and to compare it with comparable data collected from other NATTS sites, beginning the comparison with NATTS sites in the Northeast, and ultimately, other sites nationally with characteristics, comparable to Roxbury. This project is on-going; results will be shared with US EPA.

Programmatic Capability.

MassDEP has successfully submitted criteria pollutant air quality monitoring data since the 1970's, and has prided itself on exceeding U.S. EPA data completeness criteria, a measure of system and data reliability. Timely completion of annual operating plan deliverables, consistent with QAPPS and SOPs, is a high priority. This includes meeting EPA quarterly reporting requirements and the annual data certification. MassDEP staff are highly experienced and are encouraged to attend training to extent that resources are available. They are exceedingly capable technically, performing not only routine monitoring functions and system maintenance, but also complex diagnostics and creative problem solving. The latter was evidenced in the work that the PM2.5 field staff undertook in addressing the myriad of technical problems associated with the first generation Andersen PM2.5 monitors where staff identified a significant number of fundamental flaws with the equipment and developed solutions, many of which were ultimately adopted by the vendor. With the willingness to deploy and service co-located monitors, pending the network wide replacement of the first generation of PM2.5 monitors, the data collection improved to the point that MassDEP is consistently meeting and/or exceeding data completeness criteria, even for PM2.5.

MassDEP has included in its network Aethalometers, with the first instrument installed in 1999, and now runs a total of three. The field staff have over the years worked cooperatively and successfully with community groups as well as a number of the researchers from the Harvard University and Boston University Schools of Public Health on special air monitoring projects. Individual staff members, independently and/or in conjunction with NESCAUM staff have undertaken their own research, particularly in the area of developing measurements techniques for particular air toxics and correlating data collected by the PM2.5 FRMs and the BAMs.

		BWP		
	AIR POLLUTION SPATIAL TRENDS DATA ANALYSIS BUDGET DETAIL: 2007-2008			
		BUDGET		
LINE NAME	**LINE DETAIL**	**YEAR 1**	**Amount**	TOTAL
PERSONNEL	BASE PAYROLL		**$ 4,000**	$ 4,000
FRINGE BENEFITS	AT 31		**$ 1,240**	$ 1,240
TRAVEL				$ -
CONTRACTUAL			**$ 77,660**	$ 77,660
OTHER				$ -
EQUIPMENT			**$ 23,000**	$ 23,000
	Unemp. Comp PAYROLL)			$ -
	Medicare Surchrge PAYROLL*(.0134)		**$ 54**	$ 54
				$ -
INDIRECT COSTS	IC=payroll + FB x .01212		**$ 635**	$ 635
	DEP IC = PAYROLL +FB x .2064		**$ 1,082**	$ 1,082
TOTAL			**$ 107,671**	$ 107,670
LINE NAME	**LINE DETAIL**	**YEAR 2**	**Amount**	TOTAL
PERSONNEL	BASE PAYROLL		**$ 4,000**	$ 4,000
FRINGE BENEFITS	AT 31		**$ 1,240**	$ 1,240
TRAVEL			**$ 2,000**	$ 2,000
CONTRACTUAL			**$ 82,335**	$ 82,335
OTHER				$ -
EQUIPMENT				$ -
	Unemp. Comp PAYROLL)			$ -
	Medicare Surchrge PAYROLL*(.0134)		**$ 54**	$ 54
				$ -
INDIRECT COSTS	IC=payroll + FB x .01212		**$ 635**	$ 635
	DEP IC = PAYROLL +FB x .2064		**$ 1,082**	$ 1,082
TOTAL			**$ 91,346**	$ 91,345
	GRANT TOTAL FOR 2 YEARS:		**$ 199,017**	