



Fairbanks North Star Borough

Office of the Mayor

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October 8, 2008

Mr. Robert J. Meyers
Principal Deputy Assistant Administrator
Office of Air & Radiation
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, N. W.
Room 5406 ARN, MC-6101A
Washington, D.C. 20460

Re: PM_{2.5} Boundary

Dear Mr. Meyers:

Thank you for taking the time to meet with me and listen to the concerns of the Fairbanks North Star Borough with respect to the proposed PM_{2.5} boundaries. As we discussed, our Borough is committed to working with EPA to protect the health and safety of our citizens. Effective resolution of the PM_{2.5} problem begins, of course, with ensuring boundary lines that encompass the issues, sources and geographic locations that contribute to the problem. There are; however, undisputed, significant gaps in the current available data necessary to identify these issues, sources and geographic locations. Resolving this data gap through the adoption of an overly expansive boundary presents a considerable future risk of wasting limited resources on efforts providing no benefit to air quality.

Our request for an extension, therefore, is not made to delay addressing the problem but rather to ensure prompt, cost-effective resolution. Accordingly, our Borough will commit to over 2.6 million dollars in the next six months to develop the necessary technical information to support an informed boundary decision so that future resources can be confidently committed to solving the PM_{2.5} problem in our community. Because this money will be spent to monitor meteorology and PM_{2.5} chemical species concentrations at key locations along the periphery of the proposed areas to measure the actual influx of PM_{2.5} it will provide valuable assistance to EPA's ongoing planning process. Attached as Exhibit A is a full discussion of how these funds will be spent collecting the best data possible to better understand our airshed so that an appropriate boundary can be drawn using accurate and scientifically based information. Moreover, while we have a tentative plan, we are open to EPA's suggestions and comments as to how this money can best be spent to solve the current data gap.

In addition to the data gap, we have significant concerns with the accuracy of the information that was available to EPA when it made its proposed modification to the

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recommended boundary. In this regard, I committed in our conversation to providing you with some up-to-date information concerning activity both south of the Tanana River and in the eastern portion of the proposed boundary. Attached as Exhibit B is a map showing the population density of the Fairbanks North Star Borough. As you will see, the density drops to zero in the area south of the river. With respect to the eastern boundaries which encompass Fort Wainwright and Eielson AFB, I would note that new data, submitted by these military installations, indicates that EPA significantly overestimated the contributions of these bases to the problem. Neither base is, in 2008, a major source of PM_{2.5}.

Furthermore, EPA appears to have utilized the Google Earth Emissions Database, which erroneously places the Healy Coal Plant, actually located well outside the Fairbanks North Star Borough boundaries, in northeast Fairbanks and identifies Pump Station #8 (misabeled as #9) as a point source even though this Pump Station in April 2008, turned in its stationary permit when it effectively shut down in April. Finally, much of the remaining population along the eastern boundary is "off-road" seasonal cabins used for hunting, fishing and other recreational uses.

In closing, I want to assure you that the Fairbanks North Star Borough remains committed to working with EPA to solve an admittedly serious air quality issue in our community. We, along with the State, Eielson Air Force Base, the University of Alaska Fairbanks, and the EPA ORD have committed significant sums that will be expended this winter towards ensuring that EPA will have the best available, current data upon which to make a defensible and supportable boundary decision that ensures proper and efficient direction of future resources. We look forward to working with you to achieve that goal.

Sincerely,



Jim Whitaker
Mayor

cc: Alice Edwards
Acting Director, Air Quality Division
Alaska Department of Environmental Conservation

Elin D. Miller
Regional Administrator, Region 10
United States Environmental Protection Agency

Douglas S. Fuller
Birch, Horton, Bittner and Cherot



October 3, 2008

Fairbanks North Star Borough 2008-09 Air Quality Monitoring Workplan

Prepared by James Conner, FNSB Air Quality Specialist

The Fairbanks North Star Borough (FNSB), in conjunction with the State Department of Environmental Conservation (DEC), the University of Alaska Fairbanks, and others, has developed and begun to implement a detailed program of intensive field measurements and analysis of PM_{2.5} concentrations and related aerometric measurements that are designed to, among other things, **provide an objective, technically defensible basis for defining (or refining) the new PM_{2.5} nonattainment area boundary; determine (to the extent practicable) the contribution to elevated PM_{2.5} concentrations from the major suspected mobile and stationary sources; and Investigate and document potential high PM_{2.5} concentration locations (“hot spots”) and their cause(s).**

A supplemental monitoring program commenced with the 2007-08 winter season (prior to availability of funding) and will be expanded and run through the 2008-09 winter season. During this supplemental period we also supported the EPA ORD RARE Grant effort to model the meteorology in the Tanana Valley in the 2007-08 season and intend to continue that support this winter.

In the 2007-08 monitoring season the FNSB and DEC began to address the spatial extent as best we could and learned a great deal as a result. Within our group we have long-time Fairbanks residents with many years of experience observing the pollution in the Fairbanks area. This experience led us to concentrate our efforts on the Metropolitan areas (within the Metropolitan Planning Organization or MPO boundary) of Fairbanks and North Pole in order to address public health concerns and better assess the extent of the problem. With the news of a greatly expanded EPA proposed non-attainment area in August 2008 we revisited and reprioritized our efforts to monitor further southeast, north, and west of the MPO boundary in order to assess the emissions and sources in the extended area.

During the initial supplemental program we logged hundreds of miles, driving 4-8 hours/day, over three months, with a mobile PM_{2.5} monitor. We also operated three new fixed monitoring sites and deployed one mobile site to 11 different locations. (This mobile site/trailer was paid for with an EPA Assistance Grant for monitoring Carbon Monoxide and is now being used to investigate the PM_{2.5} issue.)

For this upcoming winter season (2008-09) we will continue and expand the programs from last year in order to address the proposed extensions to the south, west, and east of the Fairbanks MPO boundaries:

- We are continuing the mobile monitoring and estimate we will log over 40,000 miles of particle concentrations throughout the season.

- We are adding an additional fixed site in North Pole bringing our total to five, and we are adding instruments to the fixed sites including meteorological towers and chemical speciation monitors that will help us identify chemical species and from whence they came.
- We have selected four site locations for our mobile monitoring station with meteorological and chemical speciation instruments to assess any influx from the West, North, and Southeast of Fairbanks and southeast of North Pole (North of Eielson) through these sites. This effectively adds four new sites for this winter.
- We are coordinating with Eielson AFB monitoring efforts. They are setting up a monitoring site at the north end of the base and we will share data from this winter with them.
- We are also placing a digital surveillance system on the ridge, north of Fairbanks, that will capture images of the entire area every 5 minutes. From this vantage point the plumes from the five major power generating facilities (including Eielson AFB, Ft. Wainwright, North Pole, Fairbanks, and the University) and the thousands of plumes from Fairbanks homes are all visible. These plumes present clear airflow tracers that will help us to understand the diurnal and prevailing flows on days when we have exceedances.
- We have also established a contract with the University to acquire boundary layer and meteorological data at a new site northwest of Fairbanks that will help define the dynamics of the inversion layer.
- Lastly we are planning public outreach and education efforts that will help the public understand the scope of the problem and why the non-attainment area is what it is and thereby promote “buy-in.”

These efforts will be funded with the \$2.64M in Congestion Mitigation and Air Quality (CM/AQ) from State DOT/PF and are described more fully in the attached Statements of Work (*Characterizing the Areal Extent, Severity and Vehicular vs. Stationary Contributions to PM_{2.5} Air Quality Standard Violations in Fairbanks* and *Characterizing the Areal Extent, Severity and Vehicular vs. Stationary Contributions to PM_{2.5} Air Quality Standard Violations in Fairbanks Second Increment of Phase 2 – Winter 2008-09*) approved by the Fairbanks Metropolitan Planning Organization.

Characterizing the Areal Extent, Severity and Vehicular vs Stationary Contributions to PM_{2.5} Air Quality Standard Violations in Fairbanks

Summary

Fairbanks currently experiences 25-30 winter days per year with measured PM_{2.5} concentrations in excess of the (new) 24-hour average National Ambient Air Quality Standard. However, almost no definitive information exists about the areal extent, severity and specific source contributions to these elevated health-threatening concentrations*. Suspected emissions sources of PM_{2.5} and its precursors include: local space heating (burning of distillate oil, wood, and waste lubricating oil), Diesel- and gasoline-powered vehicles, and local or regional coal-burning, but the contribution from each is ill-defined at present.

This project will support an integrated two-year monitoring program and analysis effort that is designed to:

1. Provide an objective, technically defensible basis for defining (or refining) the new PM_{2.5} nonattainment area boundary;
2. Provide sufficient limited-term monitoring (including mobile measurements) and analysis at various sites to test the downtown site for confirmation of elevated concentrations; find the site that best characterizes Fairbanks PM_{2.5};
3. Determine (to the extent practicable) the contribution to elevated PM_{2.5} concentrations from the major suspected mobile and stationary sources; and
4. Investigate and document potential high PM_{2.5} concentration locations ("hot spots") and their cause(s).

This project is critically needed for the following reasons:

- Excessive PM_{2.5} concentrations have been linked to increased human mortality and morbidity;
- Fairbanks exceeds the new NAAQS for PM_{2.5} by about a factor of two;
- Fairbanks is very likely to be declared a nonattainment area by the USEPA and, shortly thereafter, will be required under federal law to develop and implement a State Implementation Plan (SIP) to achieve and maintain the standard;
- FNSB and DEC will need these results to craft and implement an effective PM_{2.5} SIP and to help monitor progress toward the PM_{2.5} standard; and

* The 24-hour average NAAQS for PM_{2.5} was recently revised downward by the USEPA from 65 to 35 µg/m³

- Assessment of the contribution of motor vehicles to elevated PM_{2.5} concentrations also bears on future policy regarding the existence and form of the vehicle inspection and maintenance program in Fairbanks.

Fairbanks North Star Borough is the originator and responsible party for this project.

Background

Fairbanks North Star Borough, in consultation with DEC and others, has developed and begun to implement a detailed program of intensive supplemental field measurements and analysis of PM_{2.5} concentrations and related aerometric measurements that are designed primarily to address the objectives listed above. The supplemental program will commence with the 2007-08 winter season and be expanded and run through the 2008-09 winter season. During this intensive study period the number of fixed monitoring sites for PM_{2.5} and associated measurements is being expanded from the current single site downtown to a total of four fixed sites in Fairbanks. In addition a movable trailer has been instrumented for PM_{2.5} and other measurements, including CO to help document motor vehicle contributions. This trailer will be deployed intermittently at up to ten additional locations both within and outside Fairbanks proper (to help identify NA boundaries). The total of thirteen new monitoring sites, which include several that are expected to be strongly traffic-influenced locations, have already been identified, equipment procurement and preparation is currently underway, and logistics are currently being arranged to secure and maintain the sites. What are needed now to guarantee the success of the expanded monitoring effort and significantly and improve the understanding of the motor vehicle contribution to PM_{2.5} concentrations are the supplemental elements specified below.

FNSB urgently needs this project in order to develop effective strategies to reduce PM_{2.5}, which has been measured in Fairbanks in recent years at twice the level of the NAAQS.

Study Elements

This project will consist of the following elements:

Element 1 - ADEC Monitoring Support (\$220,000)

The heart of FNSB's project is a greatly expanded but limited-term intensive monitoring campaign covering two winter periods, Phases 1 and 2, respectively, with associated data analysis and reports from each. The expanded monitoring entails setting up and operating 3 additional stationary monitoring sites and 10 intermittently-operated sites over a period of up to two years. This element provides the essential ADEC staff support and expenses (including travel and per diem), consumables (filters, gases, etc.), to allow the use of ADEC-provided equipment and other equipment. It also provides aspects of the associated QC/QA support.

Most of the (ADEC-owned) equipment for the supplemental stationary monitoring sites has already been identified and construction of the trailers has been substantially completed. The ADEC-owned equipment is being made available to the project by ADEC as in-kind support, i.e. at no cost to the project. Similarly, most of the labor support from FNSB staff will be provided to the project as in-kind support. A fractional increment of additional staff support (0.5 FTE/yr) is also needed by FNSB and will be provided under this element.

Barring any unanticipated extensions of the project, all of the supplemental monitoring for this project, which is identified herein as "limited-term", will be concluded at the end of Phase 2 and all equipment borrowed from ADEC will be returned at that time. As a result, no on-going maintenance charges are anticipated beyond Phase 2, and no residual land ownership issues are expected for this or any other element of the project.

Element 2 – Saturation Study with Aerosol Particle Size Measurement (\$210,000)

This element will assemble and deploy monitoring systems that can measure the spatial distribution of PM_{2.5} concentrations in and around downtown Fairbanks with a focus on determining which areas experience elevated concentrations and which areas and sources contribute to the concentrations recorded at the downtown monitoring site. By identification of these sources, particularly the distinction between mobile and stationary sources, and documenting the transport pathways, the source attribution can be better understood.

Two separate monitoring systems will be needed to accomplish these goals. The first will require the purchase, shipment and other expenses associated with procuring an Aerosol Particle Sizer to measure the size distribution of particles in the ambient air. Size distribution is a key parameter in determining the health threat posed by particles, their lifetime in the atmosphere, and it may also provide critical insights into the sources, secondary formation and removal of atmospheric PM in Fairbanks. The second will involve the deployment of MiniVol portable air samplers to collect additional filter measurements of PM_{2.5} concentrations at locations throughout the Fairbanks area.

Given the lead time constraints required to obtain and operate the Aerosol Particle Sizer, it is expected that deployment will occur late in the 2007-08 winter and measurements will be limited. Following analysis of all collected monitoring data in the 2007-08 winter, a detailed plan will be prepared for deployment of this instrument during the 2008-09 winter.

MiniVol samplers are currently available from ADEC; however, their power systems will need to be reconfigured for cold temperature conditions in Fairbanks. These samplers will only be deployed in trailers during the 2007-08 winter to obtain a limited set of measurements that will be used to confirm their performance (through comparisons with collocated instruments) under cold temperature conditions. Following analysis of the data collected during the 2007-08 winter, a detailed plan will be prepared for the deployment of these samplers during the 2008-09 winter.

Along with the measurement program will be quality control procedures designed to help ensure the integrity of data as it is being collected.

Element 3 – Mobile monitoring survey (\$50,000)

A study of ambient PM_{2.5} concentrations recorded along roadways throughout Fairbanks is needed to support an assessment of whether motor vehicles are a significant source of PM_{2.5} emissions during winter months. This study will be conducted in two phases. The first a pilot study, funded under this element, will be conducted during the 2007-08 winter and involve the operation of two instrumented vehicles over pre-selected routes during intensive study periods (e.g., episodes with high PM_{2.5} concentrations, etc.). Based on an analysis of the data collected under this element, a second more intensive study will be conducted under a separate effort during the winter of 2008-09.

Using two vehicles that are instrumented for mobile measurement of PM_{2.5} concentrations, this element will begin to collect the information needed for the spatial assessment of PM_{2.5} distributions. Specifically, these vehicles will be equipped with: a portable DataRAM4 air sampler and appurtenances (for sample line heating, size fractionation, power conversion, etc.), geographical position systems (to track the location of all measurements), and a data logging programmable interface controller and other equipment as appropriate. Vehicles equipped with these systems will be operated in the winter of 2007-08 during periods of predicted air stagnation and low temperature to evaluate on-road vs other concentrations, the aerial extent of elevated PM_{2.5} concentrations and the effects of local sources (including the identification of PM_{2.5} “hot spots”).

The concept for such a mobile sampling program was successfully demonstrated in Fairbanks (under spring sampling conditions) in a DEC-sponsored study in early in 2007.

Element 4 – Data Analysis and Reporting Support (\$170,000)

All of the data collected in the above-described elements require analysis in order to obtain meaningful findings to address the study objectives. This element will provide analytical support of all of the data collected for QC, data archiving, and data analysis and will provide:

1. New, more technically defensible nonattainment area boundaries for Fairbanks PM_{2.5};
2. Results of a test of the downtown site for confirmation of elevated concentrations and a technically supported recommendation for the most suitable site for long-term PM_{2.5} monitoring;
3. Data to support improved estimates of the contribution to elevated PM_{2.5} concentrations from the major suspected mobile and stationary sources, with a focus on distinguishing mobile emission factors for different types of vehicles under a variety of environmental conditions and operating modes, and
4. Analysis of measurement data addressing high PM_{2.5} concentration locations (“hot spots”) and their cause(s).

Characterizing the Areal Extent, Severity and Vehicular vs Stationary Contributions to PM_{2.5} Air Quality Standard Violations in Fairbanks Second Increment of Phase 2 – Winter 2008-09

Summary

Fairbanks currently experiences 25-30 winter days per year with measured PM_{2.5} concentrations in excess of the (new) 24-hour average National Ambient Air Quality Standard. However, almost no definitive information exists about the areal extent, severity and specific source contributions to these elevated health-threatening concentrations*. Suspected emissions sources of PM_{2.5} and its precursors include: local space heating (burning of distillate oil, wood, and waste lubricating oil), Diesel- and gasoline-powered vehicles, and local or regional coal-burning, but the contribution from each is ill-defined at present.

This project will support an integrated monitoring program and analysis effort that is designed to:

1. Provide an objective, technically defensible basis for defining (or refining) the new PM_{2.5} nonattainment area boundary;
2. Provide sufficient limited-term monitoring (including mobile measurements) and analysis at various sites to test the downtown site for confirmation of elevated concentrations; find the site that best characterizes Fairbanks PM_{2.5};
3. Determine (to the extent practicable) the contribution to elevated PM_{2.5} concentrations from the major suspected mobile and stationary sources; and
4. Investigate and document potential high PM_{2.5} concentration locations ("hot spots," roadways, point sources, neighborhoods, etc) and their cause(s).

This project is critically needed for the following reasons:

- Excessive PM_{2.5} concentrations have been linked to increased human mortality and morbidity;
- Fairbanks exceeds the new NAAQS for PM_{2.5} by about a factor of two;
- Fairbanks is very likely to be declared a nonattainment area by the USEPA and, shortly thereafter, will be required under federal law to develop and implement a State Implementation Plan (SIP) to achieve and maintain the standard;
- FNSB and DEC will need these results to craft and implement an effective PM_{2.5} SIP and to help monitor progress toward the PM_{2.5} standard; and

* The 24-hour average NAAQS for PM_{2.5} was recently revised downward by the USEPA from 65 to 35 µg/m³

- Assessment of the contribution of motor vehicles to elevated PM_{2.5} concentrations also bears on future policy regarding the existence and form of the vehicle inspection and maintenance program in Fairbanks.

Fairbanks North Star Borough is the originator and responsible party for this project.

Background

Fairbanks North Star Borough, in consultation with DEC and others, has developed and begun to implement a detailed program of intensive supplemental field measurements and analysis of PM_{2.5} concentrations and related aerometric measurements that are designed primarily to address the objectives listed above. The supplemental measurements commenced with the 2007-08 winter season and will be expanded and continued through the 2008-09 and 2009-10 winter seasons. During this intensive study period the number of fixed monitoring sites for PM_{2.5} and associated measurements is being expanded from the current single site downtown to a total of four fixed sites in Fairbanks. In addition a movable trailer has been instrumented for PM_{2.5} and other measurements, including CO to help document motor vehicle contributions. This trailer will be deployed intermittently at up to ten additional locations both within and outside Fairbanks proper (to help identify NA boundaries). The total of thirteen new monitoring sites (at 10th site as of March 4th), which include several that are expected to be strongly traffic-influenced locations, have already been identified, equipment procurement and preparation is currently underway, and logistics are currently being arranged to secure and maintain the sites. What are needed now to guarantee the success of the monitoring effort and significantly improve the understanding of the motor vehicle contribution to PM_{2.5} concentrations are the supplemental elements specified below.

FNSB urgently needs this project in order to develop effective strategies to reduce PM_{2.5}, which has been measured in Fairbanks in recent years at more than twice the level of the NAAQS.

Given the magnitude of the resources requested it is useful to place this effort in the context of other research efforts. The most straightforward comparison is with previous motor vehicle carbon monoxide (CO) research studies conducted in Alaska. At least 8 separate research studies, costing in excess of \$2 million were conducted between 1999 and 2007. Those studies were required to characterize CO emission rates under Alaskan operating conditions because testing programs conducted by EPA rarely if ever addressed temperatures below +20°F. Unlike CO, however, PM_{2.5} is far more complex as it is composed of both directly emitted particles and particles formed in the atmosphere. Thus, it is necessary to not only measure and characterize PM_{2.5} emissions but emissions from precursor pollutants as well. An additional complexity of PM_{2.5} is that it has no dominant emissions source. Unlike CO where research dollars could be focused exclusively on a single source, it will be necessary to measure and characterize emissions from multiple sources to place motor vehicle emissions in perspective.

Another advantage for CO was that numerous studies had been conducted in earlier years to support the siting of monitor sites and provide insight into the temporal and spatial

distribution of emissions throughout the nonattainment area. Until this winter, the Borough had only collected measurements of PM_{2.5} at a single location in downtown Fairbanks. Considerable effort will be required to collect comparable sets of measurements at other locations throughout the area and provide insight on a par available for CO.

Another point of comparison is with research efforts conducted in other parts of the country to characterize PM_{2.5} emission sources. California has conducted extensive research programs in individual air basins as well as an inter basin assessment of the transport of particulates and precursor emissions under the California Regional Particulate Air Quality Study (CRPAQS) research program. In other parts of the country multiple states have banded together in regional PM_{2.5} assessments conducted by the Lake Michigan Air Directors Consortium (LADCo), the Mid-Atlantic Regional Air Management Association, etc. Unfortunately, differences in geography and climactic conditions limit the utility of insights gained in these studies to Fairbanks. As outlined below, considerable effort will be required to assess source significance under cold temperature conditions.

Study Elements

Phase 1 of this multi-year study commenced in the summer of 2007 and put in place a series of preliminary and pilot studies conducted in the winter of 2007-08. Phase 2, which is planned for winters of 2008-09 and 2009-10, comprises the main data collection effort and consists of two funding increments. The first increment, totaling \$1.0 million, has already been approved to support the following project elements:

1. ADEC Monitoring Support (\$220k) – covers staff, audit, travel and filter measurement expenses for the winters of 07/08 and 08/09
2. Saturation Study with APS Measurements (\$210k) – purchase aerosol sizing unit, deploy Minivol samplers in winters of 07/08 and 08/09 and cover technical staff position for one year
3. Mobile Monitoring (\$50k) – purchase two DataRAM samplers and use to collect samples in the pilot study
4. Data Analysis and Reporting (\$170k) – Assemble, screen and analyze monitoring data collected in winter 07/08 and document results; and
5. Neighborhood Characterization (\$350) – instrument two vehicles and operate in neighborhoods throughout the Borough during winter 08/09 to assess extent of PM_{2.5} concentrations and identify hotspots/sources

The second increment of the 2008-09, which requires funding of about \$1.24 million, consists of nine elements. These elements are listed below followed by summary descriptions of each.

6. Support for Expanded Monitoring (\$240k) – provides Borough staffing for instrument installation, operation and data retrieval in support of all Phase 2 projects

7. Plume following (\$300k) – instrument one vehicle with a DataRAM, CO₂ analyzer, and GPS to collect data on source emissions (both by following vehicles and in fixed locations) during the winter of 08/09
8. Procure Equipment and Deploy APS unit (\$110k) – procure additional PM_{2.5} monitors, obtain replacement instrumentation for the meteorological tower and use aerosol particle sizer to collect data on source-specific size distributions of PM emissions during the winters 08/09 and part of 09/10.
9. Measure Vehicle Emissions (\$200) – Conduct cooperative study with the USEPA to deploy PEMS (portable emissions monitoring systems) units to measure tailpipe emissions of vehicles operating on the road and on the dynamometer in Fairbanks during the winter of 08/09 (includes cost of upgrading cold temperature test facility)
10. Chemical Mass Balance Study (\$50k) – fund collection and analysis of filter measurements collected during winter 08/09
11. Measure Space Heating Emissions (\$75k) – measure emissions from a representative sample of space heating systems.
12. Data analysis (\$150k) – Assemble, screen, and analyze monitoring data collected in winter 07/08 and 08/09 and document results
13. Part-time Support (\$50k) – cover part-time labor expenses, and
14. Integration/Coordination (\$65k) – assess implications of data collected, identify sources for control, target PR initiatives, and conduct public forum with UAF and other state and local groups.

Element 6 – Support for Expanded Monitoring (\$240,000)

Additional staff will be required to procure, assemble, test and deploy the monitoring systems specified in the Phase 1 and 2 study elements. Additional staff time will also be needed to maintain the operation of the new monitoring systems as well as collect, quality assure, organize and interpret the data they provide. This element will provide resources to support the conduct of Elements 1, 2, 3, 8, and 14. It will also provide the additional staff time required to procure and support firms with specialized expertise needed to conduct the remaining study elements.

This element will provide resources for the Borough to fund 3 man-years FTE (full time equivalent) over the period when these study elements are conducted.

Element 7 – Plume Following (\$300,000)

The objective of this element is to quantify and compare on-road PM_{2.5} emission rates (e.g. grams of PM_{2.5} emitted per gallon of fuel burned) from the major vehicle types in the Alaskan fleet (gasoline- and Diesel-powered, light-, medium- and heavy-duty) under real-world Alaskan winter conditions. This element will use similar on-board measurement equipment to that used in Element 1, but will supplement those PM_{2.5} measurements with sensitive equipment to measure CO₂ concentrations in dilute exhaust plumes, and with other equipment. Additional parts of this element include measurement with USEPA portable emissions monitoring equipment (Element 9, below), on-road vehicle-following plume measurement experiments (using both PEMS-equipped target

vehicles and the instrumented “chase” vehicle), dynamometer testing with PM measurement of selected PEMS-equipped vehicles, and a significant analytical element to calculate and compare the measurements and put them in the context of typical on-road emissions in winter in Fairbanks.

In part 1 of this study, an EPA-provided portable emission measurement system(s) (PEMS) will be installed on a sample of up to five procured test vehicles, covering a range of gasoline- and Diesel-powered vehicles. In a series of on-road experiments (similar to pilot work done in 2007), these vehicles will be targeted by a plume-following chase vehicle, but in this case, their emissions as measured by both systems will be compared. The ‘chase vehicle’ will be equipped somewhat similarly to the instrumented vehicles in Element 1, except that a sensitive CO₂ measurement device and an operator data entry terminal will be added to the suite of instruments, a 2-person drive team will be used, and all drives will be video-taped (to aid in subsequent data interpretation). This equipment setup will provide a capability to sample dilute vehicle plumes on a second-by-second basis while traveling on-road. The CO₂ measurements will be used to confirm when a plume is present, calculate the dilution factor, and infer tailpipe concentrations. By additionally recording vehicle type and, specifically, whether a vehicle is gasoline- or Diesel-powered, and estimating the carbon weight fraction and density of each fuel (from survey information), and invoking certain assumptions about carbon mass balance and the stoichiometry of fuel combustion, it then becomes possible to calculate the instantaneous and time-averaged emission factors for each vehicle (expressed as grams of PM_{2.5} emitted per gallon of fuel burned).

Also under part 1 of this study, a subset of the target vehicles having PEMS will be tested at the Borough’s Low Temperature Testing Facility which is equipped with a Realtime electric chassis dynamometer and equipment to measure gaseous pollutant measurements. (The dynamometer is capable of accommodating light-duty vehicles and smaller medium-duty vehicles that are loaded lightly). For this project, the exhaust sampling facilities will be upgraded to also allow continuous PM_{2.5} concentration measurements in the dilute exhaust plume (similar to pilot work done in 2007) for comparison with the PEMS. This part of the project is intended to provide additional information to help evaluate both the PEMS and on-road emissions measurement capability of the plume-following instrumented vehicle.

In part 2 of this study, the same instrumented chase vehicle will be used for on-road ‘plume following’ of a statistical sample of pre-defined target vehicle types on-road in Fairbanks under a variety of winter temperature conditions. On-road data collection will be conducted over approximately a one-month period during the winter of 2008-09, and is designed to provide average measurement results for the sample of vehicles described under conditions of cruising (on an approximately level grade) and acceleration (or grade-induced simulated acceleration mode). Efforts will be made both through target selection/deselection protocols and by analysis of individual plumes to avoid or minimize potential interferences from other vehicles and other plumes.

This project will require a setup phase of incorporating and adapting hardware into vehicles, a period of on-road deployment and data collection, and subsequently a significant analytical phase to compute and compare gram per gallon emission rates. The

final product will be a report of the relative emissions from gasoline- and Diesel-powered vehicles in Fairbanks in the winter for a range of vehicle types with documentation of the equipment and methods used.

Element 8 – Procure Equipment and Deploy APS Unit (\$110,000)

Funds allocated to this study element will be used to procure two additional Federal Reference Method (FRM) monitors and replace instrumentation in the meteorological tower. The FRM monitors are needed to characterize PM_{2.5} concentrations at other locations within the Borough. The instrumentation for the meteorological tower is needed to ensure reliability and performance at lower temperatures.

In the first increment of funding, Element 2 provided for purchase of an aerosol particle sizing instrument or APS (such as TSI Model 3321) that can be used to measure the size distribution and number of particles within each particle size bin. Understanding the size distribution of particles is critical to understanding their effects on human health, as well as helping to understand and document their emission sources and their atmospheric transformations and lifetimes. This element will use the purchased APS instrument during parts of both the Neighborhood Characterization Study (Element 5 from the first funding increment) and (possibly) the Plume Following Study (Element 7, above) to obtain particle size distributions at a wide range of ambient air sampling locations that includes both stationary source and mobile source impacted sites. The funding will provide for study element design, equipment configuration and installation in test vehicles, equipment operation by an on-board operator, data retrieval and compilation, and reporting.

Element 9 – Measure Vehicle Emissions (\$200,000)

The contribution of motor vehicles to ambient PM_{2.5} concentrations in Fairbanks is only poorly understood, in part because PM_{2.5} emissions from the Alaska fleet of light-through heavy duty vehicles that are powered by gasoline and Diesel have not been measured recently under Alaska winter conditions*. Available data from controlled USEPA laboratory studies and relatively cold dynamometer studies in Kansas City and elsewhere indicated large increases in PM emissions as temperatures decline, but those studies did not use Alaska vehicles and generally did not test below 20F (although they did show exponentially increasing emissions as temperatures decreased). The average winter temperature in Fairbanks in January is -10F, but temperatures below -40F are not uncommon, and the highest concentration PM_{2.5} episodes observed to date in Fairbanks tended to occur at the lowest temperatures (below the temperature range of previous emission measurements). This element will complement the Plume Following Study (Element 7, above) and provide for the direct measurement of vehicle exhaust emissions using one or more EPA-owned portable emissions monitoring systems (PEMS).

Under this element, the USEPA is expected to provide one or more PEMS monitoring systems which will be retrofitted to a series of common light-, medium-, and heavy-duty

* Few of the earlier studies in Fairbanks included PM measurements, most included only light-duty gasoline vehicles, and most used only higher sulfur fuels (not the low sulfur gasoline and Diesel fuel that is currently used by all on-road Alaskan vehicles).

vehicles powered by gasoline or Diesel engines. EPA is expected to provide the PEMS units themselves, transport of the units (along with all associated equipment) to and from Fairbanks, and make provision with its contractor to provide the necessary support to configure, install, operate and remove the PEMS from a series of test vehicles. Element 9 is intended to provide needed support for the EPA effort by designing the PEMS comparison study, selecting and procuring representative Fairbanks test vehicles, operating the chassis dynamometer and upgraded testing equipment at the Borough's low temperature test facility in Fairbanks to provide a comparative measurement of exhaust PM emissions to the PEMS, analysis of all of the results and reporting.

Element 10 – Chemical Mass Balance (\$50,000)

Chemical mass balance (CMB) is one of the foundations of modern source apportionment and a means by which air pollution source types may be quantitatively reconciled with the mix of chemical constituents measured at one or more receptor sites. For several winter seasons, FNSB has collected samples of ambient PM_{2.5} using a filter-based measurement technique that allows for the chemical analysis of filters, and it has contracted for such analyses. In order to calculate the fraction of PM_{2.5} from each of the contributing source types, it is necessary to develop an emissions profile for each source type and apply CMB analysis. Other elements listed herein will do the former (although this element may include supplemental filter analyses, if required), and this element will do the latter by compiling data, conducting the analysis, and reporting results from the analysis.

Element 11 – Measure Space Heating Emissions (\$75,000)

Measurements of space heating emissions are required to place the magnitude of motor vehicle emissions in perspective. A testing protocol will be developed to measure exhaust emissions from a representative sample of space heating systems currently deployed within the Borough. A literature review will be conducted to determine the ability of existing measurements to accurately represent the mixture of technologies and operating conditions in Fairbanks. Based on the results of that effort, a testing protocol will be selected to measure exhaust emissions, including PM_{2.5}, from a range of heating systems that characterize systems and fuels used in the community. The data collected will be analyzed to determine pollutant specific emission rates. Those results will be combined with available information on fuel use to estimate pollutants emitted within the Borough.

Element 12 – Data Analysis (\$150,000)

Data collected in all of the elements require analysis in order to obtain meaningful findings to address the study objectives. This element will provide analytical support, including data archiving, and data analysis for all of the data collected. Subject to the success of data collection, the analysis will provide:

1. New, more technically defensible nonattainment area boundaries for Fairbanks PM_{2.5};

2. Results of a test of the downtown site for confirmation of elevated concentrations and a technically supported recommendation for the most suitable site for long-term PM_{2.5} monitoring;
3. Data to support improved estimates of the contribution to elevated PM_{2.5} concentrations from the major suspected mobile and stationary sources, with a focus on distinguishing mobile emission factors for different types of vehicles under a variety of environmental conditions and operating modes, and
4. Analysis of measurement data addressing high PM_{2.5} concentration locations (“hot spots”) and their cause(s).

Element 13 – Part-time Support (\$50,000)

Additional staff time will be needed to supplement existing Borough staff, planned staff additions, DEC and contractor support in order to successfully complete the planned study elements. Part-time support will be needed for a variety of efforts, including: regularly collecting data from ambient and meteorological monitors that are not accessible by either telephone or the internet; ordering spare parts; assembling datasets for analysis; ferrying equipment; conducting literature reviews, etc. Funds allocated under this element will be used to hire UAF staff and students, as well as other personnel located in Fairbanks to aid the conduct of the study as needed.

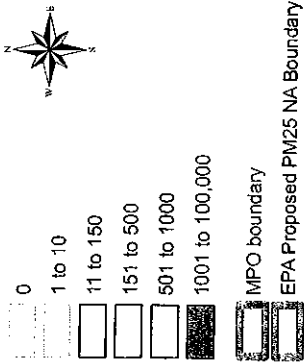
Element 14 – Integration/Coordination (\$65,000)

The overall objective of this effort is to collect measurements of ambient concentrations and source specific emission rates to characterize relative source contributions to monitored values. With this insight it will be possible to determine the contribution of on-road vehicles relative to other sources and identify opportunities for mitigation of vehicle emissions. Under this study element, the results of the data analysis will be integrated with other information sources available (e.g., source specific activity rates, air quality modeling, etc.) to update emission inventory estimates and assess monitor specific impacts. Findings from this analysis will then be placed in perspective through comparisons with other studies (e.g., a literature review, discussions with relevant UAF, DEC and EPA staff, etc.), discussions with affected industries (i.e., sources determined to be significant), presentations before the Assembly and public information initiatives as appropriate. The results of these efforts will be used to define options for source specific control.

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FAIRBANKS NORTH STAR BOROUGH

Population Density - 2000 Census
Persons Per Square Mile



Prepared by Fairbanks North Star Borough
Department of Community Planning TD
October 2, 2008

Exhibit B

