1. Information Summary

Project Title: Measuring Air Toxics from Wood Smoke and Mitigating Exposure in Sacramento EJ Communities

Applicant: Sacramento Metropolitan Air Quality Management District (SMAQMD), 777 12th St., 3rd Floor, Sacramento, CA 95814. Contact Brigette Tollstrup, telephone 916-874-4832; fax 916-874-4899, BTOLLSTRUP@airquality.org

Amount Requested: $360,932. Total Project Cost: $515,092
Cost-sharing/in-kind: $154,160   DUNS number. 0264538990000
Start Date: July 1, 2015 End Date: December 30, 2016   RFP Category: (1) Community-scale monitoring

Sacramento Metropolitan Air Quality Management District (SMAQMD) is pleased to respond to the EPA's request for proposal (RFP), Community-Scale Air Toxics Ambient Monitoring (RFP No. EPA-OAR-OAQPS-15-01). SMAQMD proposes to improve its general understanding of issues concerning hazardous air pollutants (HAPs) from sources such as wood smoke, and to develop its capabilities for mitigating any associated environmental justice (EJ) issues from exposure to HAPs. Residential wood smoke is the main source of wintertime $PM_{2.5}$ in Sacramento; and it is strongly suspected to be the main source of some HAPs, including acetaldehyde, acrolein, acetonitrile, and naphthalene. Furthermore, $PM_{2.5}$ data indicates that disadvantaged communities[1] are disproportionately impacted by wood smoke, and therefore the HAPs associated with wood smoke, which presents an EJ issue. The SMAQMD's proposed project will focus on four questions: *(1) What are the concentrations of HAPs in various communities in Sacramento? (2) To what degree does wood smoke contribute to HAPs in these communities? (3) Are disadvantaged communities disproportionately impacted by wood smoke HAPs?; and (4) Are there changes that can be made to SMAQMD's air quality outreach program to reduce HAPs?*

The project scope of work will involve (1) collecting ambient measurements of HAPs, wood smoke markers, and particulate matter (PM); (2) performing community surveys to gather information on wood burning activities; (3) analyzing the ambient data and community survey data (in combination with existing emission inventories) to quantify pollutant concentrations, their interurban (EJ versus non-EJ) variations, and the interurban (EJ versus non-EJ) variations of wood burning activities; and (4) outreach to disadvantaged communities and other stakeholders on any EJ concerns that the study may illuminate related to wood burning and/or HAPs. The key benefits of this project will be a better understanding of air toxics related to wood smoke emissions and how HAPs relate to wood burning behavior in EJ and non-EJ communities; results will help improve outreach efforts to mitigate exposure to air toxics and wood burning activity via SMAQMD's wood burning curtailment program, Check Before You Burn (CBYB).

2. Work Plan

2.1 Basis and Rationale

In 2006, SMAQMD met with a focus group of community representatives as part of Environmental Justice Policy development, facilitated by Dr. Barbara O'Connor from California State University, Sacramento. One of the findings of that focus group was, "Particulate matter reduction, including fireplace and other burning regulations, while important, will be very difficult to implement in environmental justice areas." SMAQMD has conducted several surveys to assess wood burning behavior in Sacramento County and awareness and compliance with our mandatory wood burning curtailment program, CBYB. The most recent survey[2] found that two thirds of residents are aware of their responsibility to check burn forecasts before lighting their fireplace, and 43% of residents are aware of our complaint line, yet SMAQMD statistics show that less than 5% of complaints are from disadvantaged communities, even though $PM_{2.5}$

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[1] Environmental justice areas, here referred to as disadvantaged communities, are defined by a tool created by the California Office of Environmental Health Hazard Assessment (OEHHA). That tool, called CalEnviroScreen 2.0, identifies census tracts disproportionately affected by pollution and whose populations are socioeconomically disadvantaged. (http://www.oehha.ca.gov/ej/pdf/CES20FinalReportUpdateOct2014.pdf).
[2] "2014 Check Before You Burn: Perceptions, Awareness and Compliance" Meta Research, August 12, 2014

concentrations are high in these disadvantaged communities, and are largely driven by wood burning emissions. This suggests that disadvantaged communities are less aware of the CBYB program and don't believe the negative health effects associated with woodsmoke and its HAPs, and/or are less able or likely to complain to authorities.

Wood smoke from residential burning is a major source of $PM_{2.5}$ during the wintertime in Sacramento and is becoming increasingly important due to declining emissions from other sources (e.g., mobile sources). In Sacramento, PM from wood smoke is higher in disadvantaged communities than other communities and it is known to contain many HAPs[3]. Wood smoke toxics include formaldehyde, acetaldehyde, and acetonitrile[4], as well as acrolein, polycyclic organic matter (POM), benzene, and dioxins[5], most of which are listed among EPA's 30 Urban Air Toxics of concern and are leading drivers of risk nationally[6]. Despite the known health effects of HAPs, and that wood burning can be a prominent source of HAPs, the SMAQMD has little quantifiable supporting evidence related to ambient HAPs levels, wood smoke contributions to HAPs, and the suspected resultant EJ issues for its area. The proposed study aims to address this information gap. In addition, the findings will be used to guide further outreach to disadvantaged communities and other stakeholders over any EJ concerns that the study may indicate.

This proposed work meets the requirements specified in the Community Air Toxics Monitoring RFP for community-scale monitoring. Local-scale air toxics gradients that are driven by local-scale wood smoke emissions will be determined to understand exposure to wood smoke air toxics in EJ communities (RFP Section 1a). Regulators can use the quantification of wood smoke emissions on local air toxics to better educate impacted populations and stakeholders and to develop emission reduction strategies (RFP Section 1b). Details on local-scale air pollution and toxics will be combined with detailed survey results on wood burning practices and a comprehensive database of wood smoke violations and complaints, which together can be used to understand health effects (RFP Section 1c). This will be the first study to assess the contribution of wood burning, a known air pollution source, to air toxics in Sacramento. The findings will be used as a baseline to evaluate emissions reductions programs (RFP Section 1d). Results will be compared with a detailed, local-scale emission inventory of air toxics, VOCs and PM, to determine what improvements may need to be made for specific source categories and areas in Sacramento (RFP Section 1e).

2.2 Technical Approach

The technical approach will proceed via four tasks:

1. Conduct enhanced monitoring of air toxics and other related pollutants through an intensive measurement campaign that includes involvement from neighborhood associations, including Southside Park Neighborhood Association and Newton Booth Neighborhood Association.

2. Conduct community surveys to understand wood burning behavior and other factors that may influence exposure to wood smoke HAPs.

3. Analyze ambient measurements and survey data to quantify spatial and temporal characteristics of wood smoke toxics and how these characteristics relate to wood burning behavior and the CBYB program.

4. Conduct outreach to disadvantaged communities and other stakeholders about the CBYB program, and the negative health impacts associated with wood smoke.

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[3] http://www2.epa.gov/urban-air-toxics/urban-air-toxic-pollutants

[4] Holzinger R., Warneke C., Hansel A., Jordan A., and Lindinger W. (1999) Biomass burning as a source of formaldehyde, acetaldehyde, methanol, acetone, acetonitrile, and hydrogen cyanide. *Geophys. Res. Lett.*, 26(8), 1161-1164.; http://www.epa.gov/burnwise/pdfs/EPA-450-2-89-015.pdf

[5] McDonald J.D., Zielinska B., Fujita E.M., Sagebiel J.C., Chow J.C., and Watson J.G. (2000) Fine particle and gaseous emission rates from residential wood combustion. *Environ. Sci. Technol.*, 34(11), 2080-2091. Schauer J.J., Kleeman M.J., Cass G.R., and Simoneit B.R.T. (2001) Measurement of emissions from air pollution sources. 3. C_1 through C_{29} organic compounds from fireplace combustion of wood. *Environ. Sci. Technol.*, 35(9), 1716-1728, May 1. Aurell et al 2012

[6] McCarthy M.C., Hafner H.R., Chinkin L.R., and Charrier J.G. (2007) Temporal variability of selected air toxics in the United States. *Atmos. Environ.*, 41(34), 7180-7194, (STI-2894). Available at http://dx.doi.org/10.1016/j.atmosenv.2007.05.037.

Task 1. Conduct Ambient Monitoring

The measurement program is designed to facilitate determinations of HAPS concentrations, contributions of wood smoke to individual HAPS concentrations, and temporal and spatial patterns of these variables. Three types of sites will be deployed: (1) heavily instrumented sites at one EJ and one non-EJ air monitoring station (Tier 1); (2) moderately instrumented sites at three EJ and one non-EJ community sites (Tier 2); and (3) low-cost AirBeam PM sensors[7] at ~15 EJ community and ~5 non-EJ community sites (Tier 3). **Figure 1** illustrates the locations of Tier 1 sites and the targeted EJ neighborhoods, where Tier 2 and Tier 3 sites will be established. Targeted pollutants include: (1) several EPA-designated toxics that are known components of wood smoke (acetaldehyde, acrolein, acetonitrile, naphthalene)[4]; (2) EPA-designated toxics primarily dominated by mobile sources (benzene and 1,3-butadiene)[8]; (3) black carbon (BC) apportioned into two components[9] —wood burning (BC_{WB}) and fossil fuel BC—; (4) PM mass; and (5) levoglucosan, a unique tracer of wood smoke[10]. Further details about each type of site are as follows.

- **Tier 1 Sites (two)** will support analyses to determine the relationships between wood smoke concentrations and concentrations of PM and HAPs. Two established monitoring stations will be used, the T Street and Del Paso Manor sites. The T Street site is located in an EJ community, while the Del Paso Manor site is located in a non-EJ community. Tier 1 monitoring stations will be enhanced with various special study measurements: canister samples for gaseous air toxics; mini-vol samplers with quartz fiber filters for chemical analysis of levoglucosan, water-soluble organic carbon (WSOC), organic and elemental carbon (OC, EC); multi-wavelength Aethalometers to obtain hourly BC and BC_{WB}; and MetOne beta-attenuation monitors (BAMs) plus AirBeam sensors for PM. Pre-existing instruments routinely measure NO_x, 1-in-3-day speciated $PM_{2.5}$, and meteorological parameters.

- **Tier 2 Sites (four)** will monitor concentrations of HAPs and PM within EJ and non-EJ communities. Tier 2 sites will be equipped with canister samples for gaseous air toxics; multi-wavelength Aethalometers to obtain hourly BC, including BC_{WB}; and AirBeam sensors for PM.

- **Tier 3 Sites (12 to 20)** will provide supplementary data to facilitate the identification of spatial gradients in wood smoke impacts throughout local EJ and non-EJ communities. Three to five low-cost AirBeam PM sensors will be deployed per community, for a total of approximately 12-20 PM sensors.

We will work with local community organizations to identify appropriate locations for the Tier 2 and Tier 3 instrumentation; in the four communities, there will be one Tier 2 and two to four Tier 3 monitoring sites. The monitoring program will proceed from November 2015 through early January 2016, which captures the full extent of the peak wood-burning season. 24-hour canister will be collected on a forecast basis at Tier 1 and Tier 2 sites on days when PM and wood smoke concentrations are expected to be high; filter samples at Tier 1 sites will also be collected on these days. A total of 25 canister and filter sample days are expected. Forecasting is done daily as part of SMAQMD air quality and the CBYB programs. **Table 1** summarizes pollutants, measurement techniques, and measurement frequencies for data to be collected.

The team of SMAQMD and Sonoma Technology, Inc. (STI) will develop and implement quality assurance (QA) practices to ensure high-quality data are collected during the measurement phase to meet project objectives, leveraging QA methods and documentation we have previously developed. Prior to beginning monitoring in November, we will run a multi-day collocated study of the Aethalometers, BAMs, and AirBeam PM sensors. This study will ensure comparable measurements across sites that will be suitable for determining local-scale gradients.

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[7] The AirBeam sensors are low-cost light scattering devices that have been shown to compare well to other $PM_{2.5}$ measurements, see http://www.sonomatech.com/assets/pdfs/AirBeamEvaluation_Oct2014.pdf

[8] Wallace L. (1990) Major sources of exposure to benzene and other volatile organic chemicals. *Risk Analysis*, 10(1), 59-64.

[9] E.g. Sandradewi J., Prévôt A.S.H., Weingartner E., Schmidhauser R., Gysel M., and Baltensperger U. (2008) A study of wood burning and traffic aerosols in an Alpine valley using a multi-wavelength Aethalometer. Atmos. Environ., 42(1), 101-112. Available at http://www.sciencedirect.com/science/article/pii/S1352231007008072

[10] Simoneit B.R.T., Schauer J.J., Nolte C.G., Oros D.R., Elias V.O., Fraser M.P., Rogge W.F., and Cass G.R. (1999) Levoglucosan, a tracer for cellulose in biomass burning and atmospheric particles. *Atmos. Environ.*, 33(2), 173-182.
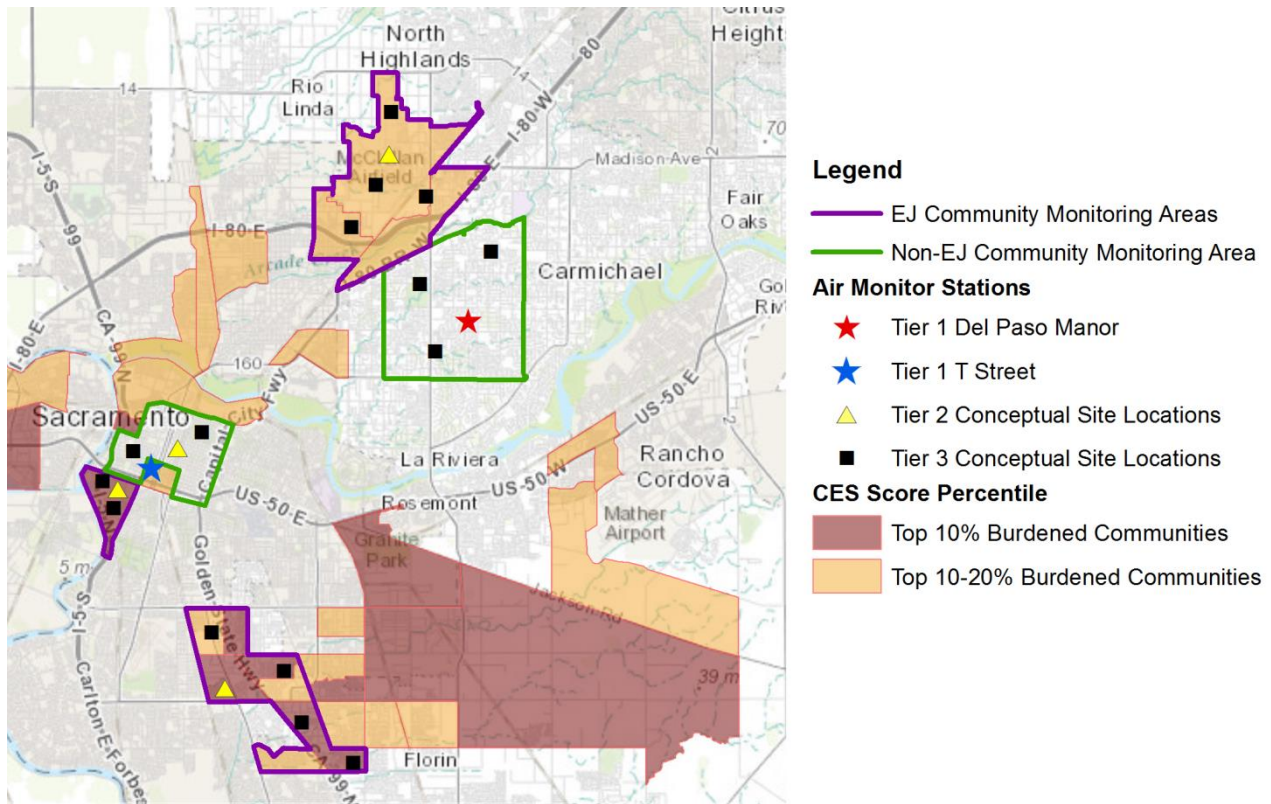
Figure 1. Map of monitoring area: Tier 1 sites (Del Paso Manor, T Street), EJ/burdened communities (orange, maroon), communities targeted for Tier 2 and Tier 3 site locations, and conceptual locations for those sites.

Table 1. Summary of air quality monitoring at Tier 1, 2, and 3 sites. Monitoring would occur between mid-November 2015 and mid-January 2016.

Pollutant	Technique	Frequency	Total N samples	Tier 1	Tier 2	Tier 3	Use
Gaseous Toxics[a]	Canisters; EPA method TO-15 or similar methods	24-hr[c]	25 each at 6 sites	X	X		Quantify individual gaseous toxics of high risk
Levoglucosan[b], WSOC, OC, EC	Quartz fiber filter via mini-vol sampler	24-hr[c]	25 each at 2 sites	X			Apportion & relate PM and toxics from wood smoke
Black carbon, BC_{WB}	Aethalometer	1-hr	Hourly, continuous	X	X		Apportion & relate PM and toxics from wood smoke & other sources
PM mass	MetOne BAM	1-hr	Hourly, continuous	X			Relate PM to air toxics and wood smoke
	AirBeam (low-cost, light scattering)	1-hr	Hourly, continuous	X	X	X	Obtain detailed community scale data, relate to potential air toxics exposure
$PM_{2.5}$ species	SASS sampler	1-in-3 day, 24-hr	~30	X			Quantify trace toxic metals

[a] Toxics measured as part of this work include acetaldehyde, acrolein, naphthalene, acetonitrile, benzene, and 1,3-butadiene. All are listed by EPA as urban toxics and are among the highest health risk drivers nationally.
[b] Levoglucosan is a tracer for wood smoke.
[c] Midday-to-midday samples will be collected to capture peak wood smoke concentrations overnight, and to simplify the ability to take back-to-back 24-hr samples without additional equipment.

Task 2. Conduct Community Surveys

Building on previous SMAQMD work, detailed phone-based community surveys will be performed for approximately 900 cell/land lines in the communities where monitoring will occur, to characterize residential

wood burning behaviors. The survey will be approximately 5-8 minutes, include renters and home owners, be available in up to four languages, and have a 50% incidence rate, i.e., successful "live" phone numbers where someone will be eligible and answer survey questions. Questions will include socioeconomic status, type of heating appliances in the home, typical and/or time-specific wood burning behaviors, and penetration/effectiveness of existing outreach programs concerning wood burning. Survey results will be paired with ambient data to understand the relationship between behaviors and air quality impacts in EJ and non-EJ communities, to help interpret observed spatial and temporal variations in air pollutant concentrations and to inform future community involvement and outreach efforts.

Task 3. Analyze Ambient Measurements and Survey Data (Data Analysis)

The data analysis objectives of the project are to
- Quantify the relationships between levoglucosan and wood smoke PM, BC, and specific air toxics at the Tier 1 sites;
- Use these relationships to estimate wood smoke contributions to air toxic concentrations at community Tier 2 and Tier 3 sites;
- Identify spatial gradients and temporal variations in air toxics and PM concentrations due to wood smoke;
- Examine how concentrations compare to health benchmarks and concentrations nationally;
- Determine if there are excess air toxics concentrations in EJ communities compared to non-EJ urban communities;
- Compare measurements to a local-scale emissions inventory; and
- Examine relationships between air quality data and community survey results concerning wood-burning behaviors.

Three data analysis approaches will be used. First, **time series and spatial analysis** of the survey results, air quality observations, and meteorological data will illuminate (a) spatial and temporal patterns in toxics and PM concentrations and (b) the relationship between wood-burning behavior with wood burning markers, PM and HAPs. Statistical analyses will be organized by monitoring site, meteorological conditions (e.g., temperature), day of week, time of day, status of any wood burning curtailments, and community survey variables to determine which factors are correlated with wood smoke pollutant concentrations. Similar analyses will be done using the 1-in-3-day trace metals data to be collected at Tier 1 sites.

Second, a combination of **statistical apportionment analyses** will be conducted to quantify the contribution of wood smoke to air toxics and PM. Data collected at the Tier 1 sites will be used to determine how levoglucosan and Aethalometer BC_{WB} can predict gaseous air toxics and PM concentrations, via techniques such as multi-linear regression analysis. The Chemical Mass Balance (CMB) model will be applied to the gaseous air toxics data using source profiles of the combustion of different wood types, available from CARB and from the literature[11], and constrain model results using levoglucosan data. While the ratio of levoglucosan to total PM and organic carbon varies with wood type, efficiency of combustion, and whether the wood is flaming or smoldering[12], we can use multiple sets of source profiles to help bound the wood smoke contribution estimates. The relationships between levoglucosan, BC_{WB}, PM, and air toxics data will then be used so that the EJ community PM data can be used to infer air toxics concentrations on a fine, community-level scale. Lastly, ambient concentrations spatially and temporally will be compared with survey data of wood-burning behavior, socioeconomic status, and other metrics, to better understand the link between behavior and observed concentrations.

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[11] Fine P.M., Cass G.R., and Simoneit B.R.T. (2002) Chemical characterization of fine particle emissions from the fireplace combustion of woods grown in the southern United States. *Environ. Sci. Technol.* **36** (7), 1442-1451; Schauer J.J., Kleeman M.J., Cass G.R., and Simoneit B.R.T. (2001) Measurement of emissions from air pollution sources. 3. C_1 through C_{29} organic compounds from fireplace combustion of wood. *Environ. Sci. Technol.* **35** (9), 1716-1728.

[12] Lee T., Sullivan A.P., Mack L., Jimenez J.L., Kreidenweis S.M., Onasch T.B., Worsnop D.R., Malm W., Wold C.E., Hao W.M., and Jeffrey L. Collett J. (2010) Chemical smoke marker emissions during flaming and smoldering phases of laboratory open burning of wildland fuels. *Aerosol Science & Technology*, 44(9), i-v, doi: 10.1080/02786826.2010.499884.

Third, local-scale **model predictions and emission inventories** for $PM_{2.5}$ and air toxics, e.g., NATA predictions, will be reviewed in light of the findings of the preceding analyses. This qualitative evaluation will form the basis of recommendations for further investigating and/or improving the emission inventories and/or air quality models that are used for forecasting and development of state implementation plans (SIPs).

Task 4. Outreach to Stakeholders (Community Collaboration/Outreach)

A committee consisting of interested members from neighborhood associations and possibly other interested groups will be established. We have already engaged two associations, Southside Park Neighborhood Association and Newton Booth Neighborhood Association, for this project, and will engage additional Associations when this project begins. This advisory group will help characterize general housing characteristics in the studied neighborhoods related to wood-burning behavior, and will help select monitoring site locations and/or operate the low-cost AirBeam PM sensors. The study results will provide the associations with useful information about wood smoke in their neighborhoods, and inform our outreach to communities, particularly disadvantaged communities, with wood smoke information and our existing financial incentive programs that reduce wood smoke by paying part of the cost of a cleaner replacement device.

SMAQMD currently facilitates a wide range of outreach programs to support community engagement in local air quality issues, including outreach events and social media efforts. Significant efforts to educate and inform residents and businesses of health impacts related to wood smoke and $PM_{2.5}$ air pollution have been in place in Sacramento County since the CBYB campaign began in 2007. Outreach efforts provide for collaborative information-sharing between the District and Sacramento County residents through sustained community partnerships with more than 1,800 organizations, including environmental groups, businesses, government agencies, community groups, schools, and non-profits. Through this network, air quality and health-related information are disseminated to communities throughout the winter wood smoke season. Efforts include newsletter article distribution and placement of educational materials through our 1,800 partners. News releases and feature stories are routinely placed in dozens of area media outlets throughout the season. These efforts will be expanded to target a broader, more diverse audience of EJ communities, specifically to inform residents of the health effects of wood smoke and its contribution to ambient air toxics. Other marketing tactics, such as community event participation and social media efforts, may also be explored. These could include but are not limited to:

- **Neighborhood Associations.** Work with multiple neighborhood associations in the project study area, including Southside Park Neighborhood Association and Newton Booth Neighborhood Association. These and additional neighborhood associations, plus other groups or individuals interested in having an active role in the study, may participate in an advisory group. They will also help describe general housing characteristics of their neighborhoods related to wood-burning behavior; help identify potential locations for community monitoring sites for the project at a library, school, or other community location; or operate a low-cost monitor, which would be installed in their residential backyards during the project.

- **Survey.** Conduct a comprehensive telephone survey, further described in Task 2, to determine, with statistical confidence, fire frequency and duration, the type of wood burned, the age of homes in which burning takes place, and other demographic information of the communities where monitoring will occur. SMAQMD has successfully conducted survey research on this topic[13].

- **Print Materials.** Increase production of printed outreach materials, such as brochures, community newsletters, fliers, or door hangers, and increase their distribution to neighborhoods in the project area. These materials would feature tips about how to reduce air pollution during the winter months and information about the importance of avoiding wood burning, particularly on high-pollution days when it is illegal to burn. To accommodate the needs of ethnically diverse audiences in EJ communities, materials would be developed in English, Spanish, Russian, and Hmong, the most prominent languages spoken in the targeted communities, based on 2010 census tract data.

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[13] http://www.airquality.org/burncheck/Report2014CBYBPerceptionsAwarenessCompliance.pdf

- **Social Media.** SMAQMD is planning to expand current social media efforts to include a dedicated Facebook page for the CBYB program. If funding allows, as part of this project, we will explore the possibility of setting up a page that is accessible to project participants only, so they can communicate with the District and one another separate from the public at large. Social media such as the Facebook page would provide an opportunity for more community-involved communication, including small surveys, contests, and other interactive efforts allowing dialogue within communities.

- **Paid Advertising.** A targeted print media campaign may be produced for community newspapers in different languages to help reach all residents with public service information related to wood smoke and its health effects. In addition, earned media opportunities could be achieved in newspapers as we tell the story about the study and the community participants.

Reporting and Schedule

We will prepare quarterly, interim, and final reports describing the progress, findings, and lessons learned from the project. All results from data analyses will be documented in formal study reports. Additionally, a journal article will be prepared and submitted to a peer-reviewed journal, and results will be presented at one or more conferences, such as the National Air Quality Conference. Study findings will be shared with other organizations via CAPCOA, NACAA, and WESTAR. **Table 2** summarizes the project schedule.

Table 2. Project schedule and deliverables.

	June-Aug 2015	Sep-Oct 2015	Nov 2015	Dec 2015	Jan 2016	Feb-Apr 2016	May-Aug 2016	Sep-Dec 2016
Monitoring	Detailed study planning	Prepare sites, install equipment	Conduct measurements	Conduct measurements	Complete measurements	Data processing		
Surveys and Outreach	Work with Neighborhood Associations	Prepare surveys	Conduct surveys	Conduct surveys	Conduct surveys	Complete surveys	Present findings to Neighborhood Associations	Present findings to Neighborhood Associations
Data Analysis			Ongoing data QC	Ongoing data QC	Ongoing data QC	Begin analysis	Complete draft analyses	Complete analyses
Reporting	Quarterly progress report	Quarterly progress report			Quarterly progress report	Quarterly progress report	Progress & interim report	Progress & final report

2.3   Project Benefits

Environmental Results: Outcomes, Outputs, Performance Measures

This project supports EPA's 2014-2018 Strategic Plan Goal 1, "Addressing Climate Change and Improving Air Quality," by improving scientific and public understanding of wood-burning impacts. Improved understanding will help reduce wood burning activity and associated ambient HAPs and PM concentrations, leading to decreased exposure and improved health outcomes. Reduced wood burning will also contribute to BC emissions reductions; BC is an important climate-forcing compound that contributes to climate change[14]. Furthermore, our proposed educational materials and outreach efforts can be used by others to reduce toxics exposure in EJ and non-EJ communities outside the Sacramento region.

Outputs: The project will produce numerous outputs, including
- Community-scale HAPs and PM measurements in areas affected by residential wood burning;
- Established relationships between wood burning and HAPS and PM concentrations;
- A public repository (in EPA's Air Quality System Database) of HAPs data to inform future studies;
- Surveys detailing wood-burning practices;
- Improved accuracy of local wood smoke emission inventories;

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[14] E.g., EPA's Report to Congress on Black Carbon

- Time series and spatial analyses to relate wood-burning practices and HAPs concentrations;
- Educational materials describing wood smoke health effects; and
- Progress reports and a final report that document study methods and findings.

Outcomes: The project will achieve short-, mid-, and long-term outcomes, including

- Identification of community-scale HAPs and PM concentrations from wood smoke (*short-term*);
- Improved communication of SMAQMD's wood-burning restrictions (*short-term and beyond*);
- Increased community awareness of health effects from wood smoke HAPs (*mid-term*);
- Reduced wood smoke HAPS, PM, and BC emissions (*short-term and beyond*);
- Reduced health impacts from HAPS exposure in EJ and non-EJ areas (*mid-term and beyond*); and
- Improved understanding and reduced public exposure to wood smoke toxics in other U.S. communities via the sharing of outreach materials and findings (*long-term*).

Performance Measures: Success will be tracked using the following performance measures:

- Improved quantification of the relationships between HAPs, other associated pollutants, and wood burning behavior; this will be evaluated through statistical analysis as part of this project.
- Reductions in air toxics concentrations from wood burning as part of CBYB program; this will be tracked through future surveys and routine measurements.
- Improved compliance rates with wood burning restrictions in EJ and non-EJ areas; this will be tracked through future surveys.
- Improved daily air quality forecasts accuracy for the CBYB program; this will be tracked through annual comparisons of air quality forecasts and observations.

Environmental Justice Impacts

As described in Task 4, above, a number of methods will be employed to inform and communicate with a broad, diverse audience in EJ communities, specifically to inform residents of the health effects of wood smoke and its contribution to ambient HAPs, and the CBYB program. This information should result in less wood burning and exposure to associated HAPs in EJ communities. In addition, through participation in the low-cost measurements, community leaders will become more aware of their environment and the effects that behavior has on the air they breathe. Other marketing activities, such as community event participation and social media efforts, will be expanded to help reach a broader, more diverse audience with health information related to the effects of wood smoke HAPs.

2.4   Programmatic Capability and Past Performance

To successfully complete this project, we propose a comprehensive team of experienced and knowledgeable staff who cover all key project elements. These staff members are from SMAQMD, STI, Prosio Communications, and Meta Research. This team has worked together successfully on many other past projects, including the development and implementation of CBYB and the air quality forecasting and modeling of wood smoke. This strong team has experience in air quality monitoring, HAPs measurements and analysis, air quality forecasting, air pollution processes in Sacramento, and air pollution outreach. A summary of each team member's experience and proposed project role appears in **Table 3**. Biographical paragraphs of these key team members and SMAQMD's competitive bid process for contractor selection, which complies with the federal competitive procurement guidelines referenced in the RFP, are provided in attachments to this grant application.

Table 3. Project roles and experience.

Person	Fields of Expertise	Project Role	Highest Degree / Years of Experience
B. Tollstrup – SMAQMD	Air Quality (AQ) Program Coord.	Principal Investigator	B.S., Chemical Engineering/25
A. Kennard – SMAQMD	AQ Control Measures	Project Manager	B.S., Environ. Engineer/30
J. Lam-Snyder – SMAQMD	Air Monitoring	Air Monitoring Supervisor	B.S., Applied Physics/10
L. Kobza – SMAQMD	AQ Community Outreach	Outreach Manager	B.A., Communication /28

Person	Fields of Expertise	Project Role	Highest Degree / Years of Experience
J. Arno – SMAQMD	AQ Community Outreach	Outreach Specialist	B.A., Journalism/21
L. Prosio – Prosio Comm.	AQ Community Outreach	Outreach Strategist	B.A., Communication; M.B.A./20
J. Hanson – Meta Research	AQ Social Science Research	Survey Manager	M.A., Communication/8
A. Graham – STI	Air Quality Analysis	Lead Scientist	PhD., Chemistry/5
S. Brown – STI	Air Quality Analysis and Monitoring	AQ Analysis Manager	PhD., Atmospheric Science/14
C. MacDonald – STI	Air Quality Analysis and Monitoring	AQ Monitoring Manager	M.S., Meteorology/18
M. McCarthy - STI	Toxic Air Quality Analysis	Senior Scientist	PhD. Chemistry/15

In addition to having a very qualified staff for this project, the SMAQMD has a successful performance record on several EPA grant awards. The District has accounting procedures in place that comply with federal auditing and reporting requirements, including submittal of required, quarterly progress reports. During the past three years, the District has received the federal grants listed in **Table 4** and has reported on our progress towards achieving the outcomes of those agreements with timely progress reports.

Table 4. Federal grants received by SMAQMD in the last three years.

Grantor	Program Name	CFDA #	FFY or Project Period	Status	Award ($)
EPA	Air Pollution Control Program	66.001	2012	Completed	1,412,035
EPA	Air Pollution Control Program	66.001	2013	Completed	1,363,178
EPA	Air Pollution Control Program	66.001	2014	Completed	1,363,178
EPA	Air Pollution Control Program	66.001	2015	Pending	unknown
EPA	National Clean Diesel – Ag Pumps	66.039	2012-2014	Completed	1,097,032
EPA	103 PM 2.5 Monitoring Network	66.034	4/1/10-3/31/14	Completed	892,534
EPA	103 PM 2.5 Monitoring Network	66.034	4/1/14 – 3/31/15	Active	102,634
EPA	National Clean Diesel	66.039	2/1/09 – 6/30/12	Completed	553,360
EPA	Targeted Air Shed	66.202	3/1/11 – 5/31/13	Completed	1,260,630
EPA	DERA Refuse Trucks	66.039	2013 – 2015	Active	527,312
EPA	Near Road Monitoring	66.034	7/1/2012 -5/31/15	Active	200,000
EPA	UP Line Haul	66.039	10/1/2012-03/31/2015	Active	700,000

Our District has developed an experienced finance and technical staff with proven ability to manage grants and contracts efficiently and effectively. Our District is audited annually by an independent auditor and includes analysis as required by U.S. Office of Management and Budget Circular A-133, *Audits of States, Local Governments, and Non-Profit Organizations.* The District has been recognized with awards of Excellence in Financial Reporting by the Government Finance Officers Association.

In addition to the District's successful management of the grants in Table 4, the technical project managers at STI have years of experience directing technical studies and managing projects for SMAQMD, including air quality forecasting and technical support for Spare The Air and CBYB. STI has designed and performed many comprehensive air quality studies in California using continuous monitors and data analysis. Team member Prosio Communications will perform outreach, and consists of professionals who are highly skilled in a variety of communication tactics, including community outreach, media relations, social media, advertising strategies, event planning, partnership development, and multicultural outreach. Team member Meta Research will conduct surveys, and has years of experience directing air quality-related social science research for SMAQMD, including research for the Spare The Air and CBYB campaigns.

2.5   Detailed Budget Narrative

This section provides the proposed project budget showing funds needed to accomplish the project goals and achieve measurable environmental outcomes. **Table 5** provides a detailed breakdown of internal staff costs and contractual costs for the major project activities. The total requested funding is **$360,932**. These funds will be combined with **$154,160** of voluntary cost share of non-federal funds (Table 5) for a total

of **$515,092**. The voluntary cost share is from existing budgeted positions and existing equipment available for use on the project. The voluntary cost share does not rely on federal funds.

Table 5. Cost breakdown by major task.

	#	Annual Salary	FTE %	Federal Funds	Non-Federal Funds
Personnel -Total					**$67,272**
Division Manager	1	$149,538	0.05		$7,477
Program Supervisor	1	$130,094	0.10		$13,009
Program Coordinator	1	$113,177	0.08		$9,054
AQ Specialist	1	$98,283	0.04		$3,931
Assoc Comm & Mktg Spec	1	$98,283	0.28		$27,519
AQ Instrument Specialist	1	$78,525	0.08		$6,282
Fringe Benefits 32% of wages to cover retirement, health benefits, FICA, SUI				0	**$21,527**
Travel				0	0
Equipment – 4 Tier 2 site shelters				$0	**$28,000**
Supplies – Aethalometer tape				$600	0
Contractual Total		**Procurement**			0
25 samples at 6 sites=150 VOC analysis of canister @ $300/samples, including canister rental		Competitive		$45,000	0
25 samples each at 2 sites = 50 filter analyses for levoglucosan @ $300/filter, including mini-vol rental		Competitive		$15,000	0
4 Aethalometers		Sole Source		$12,000	0
20 AirBeam PM monitors		Sole Source		$3,000	**$2,000**
Burning Activity Survey		Competitive		$43,089	0
Field Study/Analysis/Reporting		Sole Source		$227,243	**$10,000**
Public Outreach and Communications		Competitive		$15,000	0
Indirect Charges Federal Negotiated Indirect Cost rate =28.56%				0	**$25,361**
TOTAL FUNDING				$360,932	$154,160
TOTAL PROJECT COST (federal and non-federal)				**$515,092**	

2.6   Leveraging

This project builds on past, current, and future efforts that bring substantial external resources to support the proposed project, including existing models and tools for forecasting, comprehensive community outreach efforts, staff time, computer systems, and equipment. Because of this significant leveraging opportunity, we are very optimistic that this project will provide useful results with the requested EPA funding. Leveraging opportunities to be used in this project are outlined in **Table 6** and total **$681,515**. Because the leveraged funds are from internal resources or existing contracts, the likelihood of all leveraging funds being available for this project is very high.

Table 6. Summary of leveraging.

Project Name / Resource	Leveraged Funds	Source of Funds / Resource	Benefits to This Project
Monitoring/Compliance /Outreach/Existing Contract Management Support Staff	$287,515	SMAQMD internal	Monitoring support for field program, ongoing outreach on wood smoke's health effects and compliance efforts with wood smoke program
Outreach Contract Support	$245,000	SMAQMD internal	Ongoing community outreach on wood smoke program
Daily PM Forecasting	$90,000	SMAQMD/STI internal	Ongoing PM forecasting and mapping
SMAQMD Website Support	$5,000	SMAQMD internal	Web-based wood smoke training classes, and public educational materials on website
2 Aethalometers	$54,000	SMAQMD internal	Monitoring support for field program