BOARD MEETING DATE: October 7, 2016 AGENDA NO. 6

PROPOSAL: Recognize Revenue and Appropriate Funds to Engage, Educate and Empower California Communities on Use and Applications of "Low-Cost" Air Monitoring Sensors

SYNOPSIS: The U.S. EPA awarded SCAQMD a nationwide competitive Science to Achieve Results (STAR) research grant to engage, educate and empower California communities on the use and application of "low-cost" air monitoring sensors. SCAQMD staff will work with Sonoma Technology, Inc., researchers at UCLA and other air pollution control districts to develop and implement methodologies and resources for accomplishing the specific objectives of this project. This action is to recognize up to $749,820 in revenue into the General Fund and appropriate up to $670,500 in Science & Technology Advancement's FY 2016-17, FY 2017-18 and FY 2018-19 Budgets to support this work.

COMMITTEE: Technology, September 16, 2016; Recommended for Approval

RECOMMENDED ACTION:
Recognize revenue up to $749,820 into the General Fund, upon receipt, and appropriate up to $670,500 from the General Fund Unassigned (Undesignated) Fund Balance in Science & Technology Advancement's FY 2016-17, FY 2017-18 and FY 2018-19 Budgets (Org 43), Services and Supplies Major Object, as needed (and available) in the Professional & Special Services Account ($560,500) and Lab Supplies Account ($110,000), with the remaining balance ($79,320) already included in Salaries and Employee Benefits within Science & Technology Advancement's Budget.

Wayne Nastri
Acting Executive Officer

MMM:AP:ld

Background
On June 9, 2014, the U.S. EPA, as part of its Science to Achieve Results (STAR) program, solicited applications proposing research on empowering communities and individuals to take action to avoid air pollution exposure, using "low-cost" portable air pollution sensors. Specifically of interest was research on using "low-cost" portable sensors to understand and avoid air pollution exposure, on the ways that communities and individuals interact with air pollution sensors and their data, on methods for understanding and managing the quality of data from air pollution sensors, and on how sensors and sensor networks compare to existing state-of-the-art air quality monitoring methods. About 100 proposals were received by the U.S. EPA in response to this nationwide solicitation, and SCAQMD was awarded one of six available grants to engage, educate and empower California communities on the use and applications of "low-cost" air monitoring sensors.

Proposal
The overarching objective of SCAQMD's proposed three-year project is to provide communities across California with the knowledge necessary to appropriately select, use and maintain "low-cost" sensors and to correctly interpret the collected data. This will be accomplished by pursuing the following four specific aims:

Aim 1: Develop new methods to engage, educate and empower local communities on the use and applications of "low-cost" sensors
SCAQMD's AQ-SPEC staff will work with Sonoma Technology, Inc., Dr. Yifang Zhu's research group at UCLA and other air pollution control districts to develop and implement methodologies and resources for educating California communities on the use of commercially available "low-cost" air pollution sensors. Specific objectives of this part of the project include: a) educate community-based organizations about air sensors, data collection and data interpretation; b) empower community-based organizations to use air sensors to identify local pollution problems; c) enable community-based organizations to produce quality data for wide spread use; and d) empower communities to take action to reduce air pollution and avoid exposure.

To meet these objectives, the team will develop a toolkit containing informational material about sensors and best practices for data collection and interpretation. This toolkit will promote appropriate use of air quality sensors and help community-based organizations use sensors to answer questions about air quality. An important component of this material will be guidance on identifying and framing the problem and designing suitable procedures for using sensors to answer questions that community members may have. A series of workshops will be held to train community-based organizations on how to use the materials in the toolkit to inform interested residents about the use of sensors and interpretation of monitoring data. The toolkit will consist of a guidebook, training videos and a data collection checklist. All three deliverables

will be designed to clearly convey important information in a format and language that is accessible to non-expert users.

The study will be conducted in six communities throughout California, two in Southern California and four in Central and/or Northern California. These communities will be located largely in Environmental Justice (or other polluted) areas and near specific sources of air pollution such as highly trafficked freeways, refineries, airports and ports. We will also seek one or more communities in rural areas for a study of smoke impacts or other pollutants of concern, depending on the availability of appropriate sensor technology. The six communities will be identified during year one of the study with the help of participating agencies and community groups. In each community, we will recruit individuals that are interested in air quality issues, learning more about the use and applications of sensor technologies, and collecting air monitoring data using sensors. Our recruitment efforts will be supported by the Center for Community Action and Environmental Justice (CCAEJ) and by Communities for a Better Environment (CBE). Both of these organizations have a long history of working with local communities and governmental agencies to protect communities and improve air quality, are enthusiastic about our proposed study and have submitted letters in support for this effort.

With help from these partners and others to be developed throughout the project, we will distribute a recruitment questionnaire (with questions on age, gender, education level and willingness to participate in our study) to a large number of subjects to recruit at least 200 eligible study participants across the study areas (i.e., Southern, Central and/or Northern California). All recruiting meetings will include enough time for community members to ask questions and discuss topics of interest and provide take home materials that are written at an appropriate level. All recruited individuals will receive a monitoring sensor to collect air quality data during this study. Compensation will be provided to community members for their participation in an amount not to exceed $100 per participant.

Aim 2: Conduct field and laboratory testing to characterize the performance of commercially available "low-cost" sensors and identify candidates for field deployment
During the first year of this project, a wide variety of commercially available "low-cost" sensors will be tested within SCAQMD's AQ-SPEC. AQ-SPEC will perform a thorough performance characterization of currently available "low-cost" sensors using both field- and laboratory-based testing. Specifically, air quality sensors will be operated side by side with "EPA approved" Federal Reference Method and Federal Equivalent Method (FRM and FEM, respectively) air monitoring equipment, which is routinely used to measure the ambient concentration of gaseous or particle pollutants for regulatory purposes. The testing will be conducted at one or more of SCAQMD's existing air monitoring stations to test sensor overall performance. All sensors will be evaluated in triplicates and for a period of at least two months to provide statistical

information about the comparability with FRM/FEM instruments measuring the same pollutant(s) and their overall performance.

Sensors that demonstrate a nominal level of performance in the field will then be brought back to the AQ-SPEC lab, where a characterization chamber will be used to challenge the sensors with known concentrations of different particle and gaseous pollutants under different temperature and relative humidity levels. Also, in this case, sensors will be evaluated in triplicates to provide statistical information about the comparability with FRM/FEM instruments measuring the same pollutant(s). Based on the testing results, one or more sensor types/models will be selected and deployed in the field to measure specific criteria pollutants and/or air toxics in six different communities as outlined in the next section.

Aim 3: Deploy the selected sensors in multiple California communities and perform a thorough validation and interpretation of the collected data

SCAQMD will work in collaboration with Dr. Yifang Zhu's research group at UCLA, Bay Area AQMD, Sacramento AQMD, Northern Sonoma County APCD and other interested air districts to deploy, operate and maintain the selected air quality sensors in six communities throughout California, two in Southern California and four in Central and/or Northern California. For this purpose, the team will specifically target communities located in Environmental Justice areas and near specific sources of air pollution. Sensors will be selected based on the AQ-SPEC results and on the specific air quality problems affecting the selected communities. For example, some neighborhoods may have potentially high concentrations of air toxics from a nearby petroleum production or refining source and may require VOC monitoring; some may be impacted by agricultural emissions or traffic, and others may be dominated by regional-scale pollutants such as ozone (O_3). Testing conducted by the AQ-SPEC group in the past two years has shown promising results for sensors measuring PM, O_3 and primary combustion products such as CO and nitrogen monoxide (NO). The performance of sensor devices for monitoring VOCs and other air toxics is still not well characterized.

CCAEJ will help us in recruiting two communities in Southern California, while CBE will help us in recruiting four communities in Central and/or Northern California. Both CCAEJ and CBE will be responsible for recruiting community members that may be willing to operate an air quality sensor in their backyards, on the roof of their home or in another secure outdoor location. Sensors will also be deployed at the nearest fixed-site stations that are part of the Southern, Central and/or Northern California air monitoring network to gather comparable air pollution measurements for data evaluation purposes. Based on an estimated average sensor cost of about $1,000 (typically, “low-cost” sensors range in price from $100 to $2500), we anticipate the procurement and deployment of at least 150 air quality sensors across the six selected communities (probably 20 to 30 sensors per community). Measurements will then be taken for a

period of at least one year (and up to 15 months). To the extent possible, measurement periods will be scheduled in a manner that would allow large-scale sharing of the sensors among participating communities and maximize the numbers of sensors deployed in each community. While the sensors are being deployed, SCAQMD will conduct focus groups, interviews and field observation of community members to assess their opinions on how well the sensors work, how easy they are to use, their understanding and ability to interpret the data and their thoughts and impressions about the overall project.

Once validated, this data will be analyzed by UCLA and SCAQMD to characterize spatial and diurnal trends at the six communities, identify potential gradients due to proximity to one or more air pollution sources (e.g., freeways, airports, oil refineries), and assess other factors that may contribute to increasing the ambient levels of the measured pollutant(s) (e.g., meteorology). Given their wide spatial distribution, these highly resolved sensor data could also be used to help predict air pollution concentration throughout Southern, Central, and Northern California using computer models. A comparison between sensor and network data will show how pollutants are distributed spatially around a central-site monitor and how they relate uniquely to fixed-site monitor measurements. The results will be shared with the community participants in terms understandable to those without technical training. The potential distribution and broad spatial coverage of air pollution sensors constitute a major strength of these technologies in helping communities learn more about local air pollution. Voluntary cost-share will be provided by all participating air districts for the purchase of additional air monitoring sensors for community deployment, their operation and maintenance and the analysis of the collected data. Specifically, approximately 100 sensors will be procured, deployed and maintained using direct funding from this proposal and approximately 50 sensors will be purchased and operated with voluntary cost-share from participating air districts.

Aim 4: Communicate the lessons learned to the public and organize outreach activities
Throughout the study, regular public meetings in the six California communities will be organized to share preliminary results and get feedback from community members and study participants. To prepare for and facilitate productive and engaging meetings, we will develop agendas, prepare presentations and share photos/videos from sensor users that demonstrate the operation of their sensors and describe what they learned. We will gather feedback, summarize the results from these meetings and use the information to inform later stages of the project. Data collected, documentation developed and testing results obtained during this project will be organized and posted online as part of the AQ-SPEC website (www.aqmd.gov/aq-spec) and made available for free to educate the public on the capabilities of commercially available sensors and their potential applications. Sensor-related events and workshop information will also be posted on this and other participating air districts' websites. The primary goals for sharing the results from this project with the public are to: a) inform a broad audience about air

pollution; b) provide a valuable resource for communities interested in using sensors to answer questions about air quality; and c) empower individuals and communities to take action to reduce their exposure to air pollution. Sonoma Technology, Inc. (STI), will work with SCAQMD staff to ensure all data and materials from this project are shared with the public in a meaningful way. STI and SCAQMD will work collaboratively to ensure that informative and useful data visualization is incorporated into the AQ-SPEC website, including how to show concentrations on maps, time series comparisons among sensors and participants, and comparisons to health benchmarks and standards to help communities put their data in perspective.

At the end of this three-year study, California Air Pollution Control Officers Association (CAPCOA) will help organize several community workshops throughout California to disseminate study results. SCAQMD staff will work with CAPCOA to develop workshop agendas and presentation content. The workshops will help educate the public on the strengths and limitations of commercially available sensors and help answer the following key questions: (a) Which tools will be most successful in educating communities and building their capacity to effectively use air monitoring sensors and to engage them in using sensor data; (b) Will a community more likely take action to reduce air pollution exposure when sensors and sensor data are made readily available; (c) Which sensors are the most suitable for community use; (d) How does sensor data quality change with time, after sustained use by communities under "real-world" conditions; (e) How do sensor data compare (spatially and temporally) to that of existing monitoring networks; and (f) What value is added by these sensors that we are not getting with the current network data?

Benefits to SCAQMD

The implementation of the four major aims of this project will allow individuals to become more familiar with specific air quality issues affecting their communities and will empower them with the knowledge and experience they need to take action to avoid air pollution exposure, using "low-cost" air pollution sensors. Results from this study will also help governmental organizations and other policymakers to better understand air quality issues at the community level and make better policy decisions to protect the public from the impacts of air pollution.

Resource Impacts

Sufficient funding will be available for this project. The U.S. EPA has authorized funding of $749,820 for this effort and SCAQMD has received an initial award of $400,000. Appropriations for the project will not exceed the current and future award amounts. Cost-share by the SCAQMD and project partners is approximately $1.6 million.