Community-Scale Air Toxics Ambient Monitoring

1. SUMMARY INFORMATION

Title: **Improving Diesel Particulate Matter Exposure Assessment for Vulnerable Populations in the Portland Metropolitan Area**

Applicant: State of Oregon Department of Environmental Quality (DEQ), Air Quality Division
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Funding Request: $466,276 *Total Cost:* $694,265 *Project Period:* 9/1/2017– 9/30/2019 *DUNS:* 809579709

2. NARRATIVE PROPOSAL WORK PLAN

A. BASIS AND RATIONALE. Diesel exhaust poses a serious risk to public health and the environment in Oregon, with the costs of exposure impacts estimated at over $3 billion annually. EPA data indicate that 200 to 400 Oregonians die each year from diesel health effects and that **diesel risks in Oregon are among the nation's highest**. The Portland region faces significantly higher exposure risks, due to population density, extensive development activities, and its role as a global freight corridor. According to Oregon Department of Environmental Quality (DEQ) estimates, over half of the diesel equipment in use in this state is based in or moves through the Portland region. The Portland Air Toxics Solutions (PATS) modeling study conducted by Oregon DEQ in 2011 showed that, regionally averaged, levels of diesel exhaust need to be reduced by at least 86 percent to reach Oregon's clean air goal or benchmark for diesel particulate matter (DPM). In response to information on diesel emissions, **there is a high level of community, local government, and legislative discussion and concern about how to reduce diesel risk, particularly for the most vulnerable populations**.

Oregon is requesting 25 months of EPA support (Sept. 1, 2017 to Sept. 30, 2019) in the Community-Scale Monitoring category. The proposed project, "Improving Diesel Particulate Matter Exposure Assessment for Vulnerable Populations in the Portland Metropolitan Area," will study the public health impacts of poorly characterized diesel emission sources, with particular attention to the potentially significant adverse exposure effects for vulnerable populations, e.g., low-income residents, communities of color, youth, seniors. As noted in Oregon Health Authority Health Impact Assessments (2013, 2014), these groups are more likely to be affected by air pollution and limited transportation options that contribute to chronic health diseases such as asthma, cancer, heart disease, diabetes, and stroke.

DEQ's environmental justice analysis for air toxics in the Portland area showed that minority and low-income populations are disproportionately impacted by diesel engine exhaust from both on-road and construction equipment. It is likely that there are even more significant exposures for vulnerable populations in close proximity to diesel sources that are not well understood in the current PATS model – for example, emissions from marine shipping (Kotchenruther 2013), construction activity, railyards, and distribution centers using older drayage vehicles. A comprehensive ground-truthing of model predictions is necessary to improve understanding of diesel exposure in the Portland metro area.

DEQ has recently collaborated with Portland State University (PSU) and Reed College on diesel monitoring and emission characterization projects. Both of these institutions have specific faculty expertise and capacity in diesel emissions monitoring that will allow them to take a lead in research and analysis. PSU's preliminary studies in downtown Portland indicate that modeled diesel particulate matter levels (2-5 ug/m3) are between 2-10 times higher than black carbon observations (0.5- 1 ug/m3) (Orlando et al. 2016). **Discrepancies between models and measurements of this toxic pollutant underscore the need to improve characterization of key diesel emission sources for better particulate source apportionment that will support spatially resolved health impact analyses, identify appropriate mitigation actions, and inform Oregon's current legislative and regulatory policy discussions.** The project research team and collaborating organizations have a shared commitment to community engagement and environmental justice goals, as well as extensive experience in collaborating with community-based intermediaries and advocacy organizations, with a wide range of stakeholder groups (including local neighborhoods, communities of color, business/industry, government agencies, education and health), and with various initiatives working to advance air quality science and pursuing complementary objectives and outcomes. **The project will leverage synergistic metro-area air toxics research, community engagement, and diesel environmental justice capacity-building initiatives.** These include (a) joint support from the PSU Institute for Sustainable Solutions (ISS), City of Portland,

and Multnomah County for a novel, in-depth study of toxic metals air pollution with filter samplers at six metro-area sites identified by prior research and in discussion with public health agencies and neighborhood organizations; (b) Bringing Research Engagement, and Action To a Healthier Environment in Oregon (BREATHE Oregon), a partnership between ISS, Neighbors for Clean Air (NCA), and the Northwest Environmental Defense Center at Lewis & Clark Law School to link the scientific assessment data with legal/systems analysis and community outreach so residents and policymakers have the information needed to make informed decisions to improve air quality in Portland and statewide; (c) Portland's designation as an EPA Region 10 Making a Visible Difference (MVD) Community, involving 30 agencies and nonprofit organizations in joint work focused on environmental justice and diesel air toxics. In March 2017, this community held an all-day Environmental Justice Workshop in Portland with over 100 attendees (including nonprofit organizations, concerned citizens, academics, and state, county, and EPA representatives) to identify needs and issues related to air toxics, with a high priority on diesel emissions.

B. TECHNICAL APPROACH. *Overview:* The proposed community-scale monitoring project is a collaboration involving Oregon DEQ, PSU and Reed College research faculty, and local government partners with a shared interest in science-based solutions and mitigation approaches addressing the issue of diesel particulate pollution (e.g., Oregon Health Authority, City of Portland Bureau of Planning and Sustainability, Multnomah County Health Department). Project objectives, outputs, and intended outcomes will build on the Portland Air Toxics Solutions (PATS 2012) model and are congruent with the air quality goal and objectives 1.1 and 1.2 outlined in EPA's 2014-2018 Strategic Plan.

Project Timeline (25 months, Fall 2017 to Fall 2019)

Key Activities/ Outputs	Year 1 (Sept 1, 2017 – August 31, 2018)												Year 2 (Sept 1, 2018 – Sept 30, 2019)												
	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S
Identify areas of high vulnerability																									
Create source profiles																									
Monitor two priority sites																									
Analyze data & prepare reports																									
Engage diverse stakeholders																									
Share results with stakeholders and community																									

Objective 1: To identify regions of high vulnerability (exposure, sensitivity, and adaptive capacity) to diesel particulate matter (DPM).

Task 1.1: Build off the current collaboration between PSU and the City of Portland Bureau of Planning and Sustainability (BPS) and the DEQ PATS environmental justice analysis by developing specific vulnerability components – based on the Vulnerability Scoping Diagram (VSD, Polsky et al. 2007). These components of vulnerability (Exposure, Sensitivity, and Adaptive Capacity) will be linked to region-specific datasets that allow us to ensure high standards of data quality.

Task 1.2: The specific measures of vulnerability will be overlaid using spatial analysis, and we will identify places within those communities most impacted by the challenges of air pollution. Those locations will serve as a means for conducting the monitoring plan, as described in Objective 2.

The project will begin by characterizing vulnerable populations specific to the Portland metro region. We define vulnerability as those factors contributing to individual and community exposure to diesel pollutants over time. Our conceptualization of human vulnerabilities includes the extent to which specific human sensitivities may exacerbate exposure, and the capacity of those communities to garner the resources necessary to meet their basic needs (Anand & Gasper 2007, Lankao & Qin 2011). These specific factors build on a year-long effort sponsored by the Bullitt Foundation that has brought together multiple private and public stakeholders, resulting in a suite of identified factors affecting community vulnerability, including induced social factors (e.g., age, education, income, pre-existing health condition), and conditions in the built environment (e.g., vegetation, physical orientation of homes, proximity to diesel emissions).

We are currently gathering and analyzing the social and built environment datasets, and by September 2017 (EPA project start) will be able to further refine our analysis using several recently acquired datasets. One significant and emerging dataset that will assist in defining vulnerability to diesel is a digital surface model, which will be created through analysis of the 250 kilohertz Light Detection and Ranging (LiDaR) dataset. This high-resolution dataset will provide insights about the physical design, orientation of buildings, and land cover types that are known to affect exposure.

A central project aim is to build community-driven solutions to reduce exposure to dangerous air pollution from diesel engines in the most vulnerable populations. Drawing on BREATHE Oregon's work, the project team will build culturally relevant community engagement models. North Portland, East Multnomah County, and Washington County are all geographic areas with high levels of black carbon related to combustion. The relationship between the Neighbors for Clean Air BREATHE Oregon team and community-based partners such as Living Cully/Verde, APANO (Asian Pacific American Network of Oregon), OPAL Environmental Justice, and Centro Cultura of Washington County will be key in achieving our aim (see attached letters). Following the creation of the Cleaner Air Oregon initiative by the governor in April 2016, NCA and Verde helped ensure that new rules incorporated community-based environmental justice policy by working to engage the most impacted communities to be a central part of the policy and planning process from inception to implementation. Neighborhoods are affected by different types of cumulative pollution; air quality solutions in one Portland neighborhood will thus look different from another, tailored to the pollution and health impacts faced in each.

Objective 2: To quantitatively assess the relative contributions of emissions sources to diesel particulate matter levels in regions of high vulnerability identified in Objective 1.

Through Portland Air Toxics Solutions (PATS 2012), Oregon DEQ identified several significant diesel emission sources that are poorly characterized in emissions inventories, specifically, marine vessels, rail activity, distribution centers, and construction sites. These sources have disproportionate impact on vulnerable populations and environmental justice communities. In order **to improve understanding of the impact of these sources on vulnerable communities the project will conduct a study to**:

1. **Characterize** the source profiles for significant diesel sources with high emission uncertainty;
2. **Monitor ambient particulate matter** and **gaseous pollutants** at priority monitoring sites in **four vulnerable communities**;
3. **Assess** the relative contributions of diesel sources to particulate matter using positive matrix factorization; and
4. **Improve air toxics modeling** (PATS) of particulate matter using study analysis. (Tasks 3 and 4 are discussed in the Data Analysis section.)

Task 2.1*:* A review of the recent literature indicates that disentangling and assessing the diesel emission contributions from the four different priority source types is achievable through multi-prong air sampling and analysis (Masiol et al. 2016, Kotchenruther 2017, Cao et al. 2016, Larson et al. 2017, Ran et al. 2016, Jaffe et al. 2014). Our approach involves monitoring continuous black carbon, size distribution, and gaseous pollutants in order to distinguish between diesel sources types and other PM sources. In addition, detailed volatile organic compounds and metals in particulate matter will be analyzed for 24-hour samples to aid in source profiling. **By analyzing concentration, optical properties of PM, composition, size distribution, and temporal patterns in close proximity to representative sources, we will produce source profiles for the targeted diesel emissions sources (marine vessels, rail, distribution center, construction site)**. The characterization sites will be monitored for 30 days continuously. These profiles will be used for source attribution in the source apportionment analysis for Task 2.3 from the field campaigns in Task 2.2.

Task 2.2: **Field monitoring campaigns (Table 1) will be conducted within four priority monitoring neighborhoods identified in Objective 1.** These are likely to be areas that are impacted by multiple sources. Monitoring sites within each priority neighborhood will be chosen based on representativeness and logistical considerations. Two instrument trailers designed by DEQ will be used. PSU and Reed College will be primarily responsible for deployment, data collection, and analysis with calibration and quality assurance support from DEQ. Four sites will be monitored for two months continuously each in fall/winter (low inversions, wood smoke) and summer (stagnation, high temperatures) when highest exposures to particulate matter are expected for a total of four months over one year with the measurement suite listed in Table 1. The data gathered from the field campaigns will be used to inform the communities about the types of sources impacting their air quality as well as to ground-truth the source-oriented DEQ PATS model.

Table 1. Species to be monitored at PM characterization sites and priority monitoring sites.

Measured Parameter	**Technique**	**Sampling Interval**	**Averaging Interval**
PM 2.5/10 (mass)	Nephelometry	continuous	5 minutes
Particle size distribution (10nm to 10um)	SMPS+OPS	continuous	15 min
Black Carbon	7 λ Aethalometer	continuous	15 min
PM 2.5 filter mass	IMPROVE	every 3 days	24 hours
Metals in Ambient Particulate Matter	EPA IO 3.3	every 3 days	24 hours
VOC	EPA TO-15	every 3 days	24 hours
CO2	IR spectrom	continuous	5 min
CO	IR spectrom	continuous	5 min
NOx	chemilum.	continuous	5 min
SO2	fluorescence	continuous	5 min
Meteorological data (wind speed/direction/temp/RH)	various	continuous	5 min

C. DATA ANALYSIS. Our **data analysis objectives** are to assess the relative contributions of various diesel sources to particulate matter at receptor sites (four priority monitoring sites, Task 2.2). We will employ both positive matrix factorization (Paatero 1997) and temporal correlation (Cooper & Watson 1980) to improve air toxics modeling of diesel particulate matter. We aim to refine both the source apportionment among *different* sources of DPM, and to refine understanding of the fraction of total particulate matter mass at each site that is due to DPM. This analysis will inform mitigation strategies.

Task 2.3*:* We will conduct receptor analysis with ambient data collected in Task 2.2 using positive matrix factorization (Hopke 1991, Paatero 1994, Song 2001) and source profiles characterized in Task 2.1. The goal of receptor analysis is to solve the chemical mass balance equation below between measured species and source profiles.

$$x_{ij} = \sum_{k=1}^{p} g_{ik} f_{kj} + e_{ij}$$

Where x_{ij} is the measured *j*th species concentration or size bin concentration in the *i*th sample, f_{kj} is the concentration of the *j*th species in the material emitted by the source *k*, g_{ik} is the contribution of the *k*th source to the *i*th sample and e_{ij} is the portion of the measurements that cannot be fitted. PMF analysis optimizes the values of *g* and *f* to minimize e_{ij}, the residual. Positive matrix factorization (PMF) is useful where source profiles are not known *a priori* but interpretation of factors will be greatly enhanced by source analysis work in Task 2.1.This approach has been comprehensively described by Paatero and Tapper (1994) and Paatero (1997). We will utilize EPA PMF 5.0 using the continuously sampled parameters in Table 1. Our data collection includes both composition of gaseous pollutants and particulate matter mass, elemental carbon composition as well as particle size distribution. This approach has been successfully utilized for source apportionment studies of urban aerosols (Kim et al. 2004, Ogulei et al. 2006, Masiol et al. 2016). Elemental analysis of particulate matter will be used to confirm PMF results. **Source characterization analysis will help confirm source factors in the PMF analysis. With this source validation, we can isolate source-specific DPM factors (e.g., rails, marine diesel, and construction equipment)**. The interdisciplinary PSU/Reed research team will be responsible for conducting this analysis, with support from Oregon DEQ.

In addition to conducting source apportionment receptor modeling, we will use summary statistics and time series to investigate temporal (5 minute, day of week, diurnal) and spatial variability in the data. In particular, peak times and locations of diesel exposure will be identified by wind direction analysis with conditional probability function (Kim et al. 2003) for focused impacts analysis. Combined with PMF results, this will be used to identify sources of greatest risk for targeted emissions reductions activities.

***Task 2.4*:** **We will update the PATS model based on the source apportionment assessment from the four field sites. Vulnerability assessment measures will be integrated with the PATS model. This integration will support creation of an online tool that allows DEQ and other public regulatory agencies to identify those areas and populations that have the lowest quality air and most vulnerable populations.**

The datasets constitute acute areas of individual and community vulnerability and will be integrated with the refined source apportionment of diesel and the factors. Using spatial analysis (GIS and LiDaR) we will overlay those vulnerability factors, such as land use, zoning, EPA's Toxic Release Inventory sites, socio-demographics (age, income, etc.), and built environment (building orientation and age, tree canopy, etc.), with a refined assessment of diesel pollutants in the study region. Together these factors will provide a 'diesel surface' similar to the one produced by Oregon DEQ (Figure 1), describing highly granular information of locations where potential exposure to pollutants will generate greatest vulnerability to specific populations. Although current DEQ maps are not validated with empirical measures, which can create challenges in developing policies and programs, they provide the foundation for further refining the links between exposure to diesel, and disproportionately impacted communities. Such approaches to link risk, exposure, and harms to economic and social capacities of cities integrates vulnerability with resilience, an area of growing interest (Walker & Salt 2010, Folke et al. 2010).

Another anticipated project outcome is to provide online platforms that can assist air pollution control agencies in targeting and reducing community-scale exposure to diesel pollutants. As part of an update to the existing PATS model, we propose developing a spatially explicit online platform that integrates the vulnerability datasets with the refined source apportionment assessment. One objective of the online platform is to enable communities to evaluate the extent to which different institutional, social, and built environment factors can be altered as a means to reduce exposure to the most affected communities in the region. We will build on our ongoing vulnerability assessment (the aforementioned Bullitt Foundation-sponsored project), that will result in identifiable measures for reducing exposure, including rezoning land use, expanding vegetation, awareness campaigns, and policies that change operational procedures for rail, marine, and construction sources of diesel pollutant. These measures will be provided through a set of slider-bars that can be manipulated by stakeholders (see Section E: Community Collaboration/Outreach) to evaluate strategies most effective in specific areas of the region.

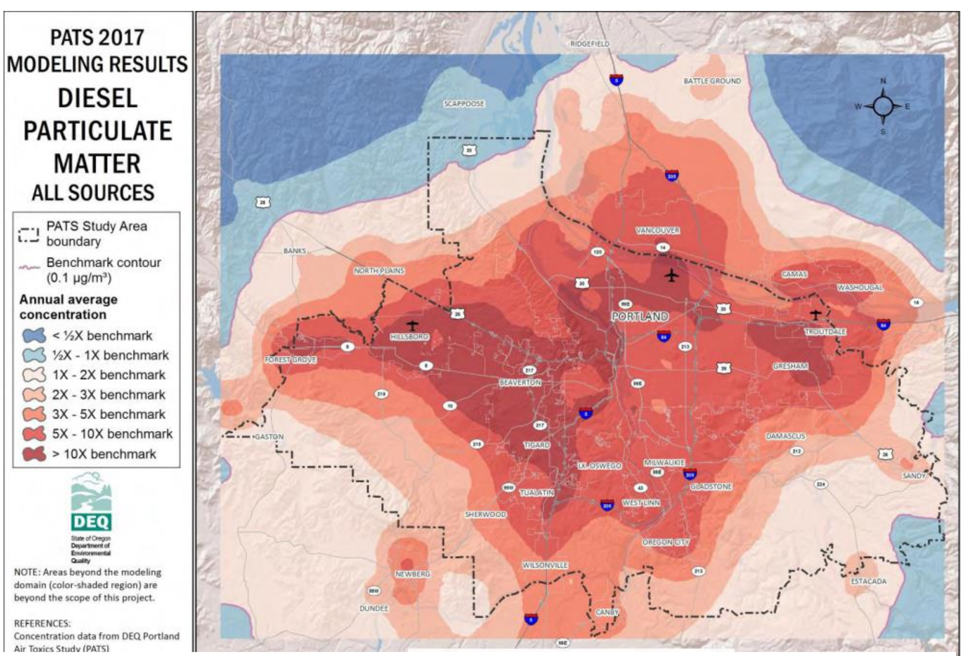

Figure 1. Modeled diesel concentrations based on emission factors derived from mobile emission factors and spatial allocation estimates for marine, rail, construction, and freight distribution centers

Using improved emissions estimates for construction, marine, rail, and freight drayage categories, DEQ will be able to re-run and update its PATS model to better understand diesel impacts in the Portland area. As part of the PATS model, DEQ developed specific emission reduction targets and recommendations for each category. Refined information about emissions and risk from each category will allow DEQ to update emission reduction targets, respond to community requests for information on diesel impacts, and propose more specific and effective emission reduction measures and mitigation strategies.

D. <u>ENVIRONMENTAL JUSTICE IMPACTS</u>. Oregon DEQ's 2012 PATS included a sophisticated environmental justice analysis, using four different methods (visual inspection through GIS mapping, cumulative distribution analysis, impact assessments in high-minority and low-income areas, and multivariate linear regression modeling to examine relationships between several factors). The analysis demonstrated the existence of disproportionate impacts from air toxics on minority and low-income populations in the Portland area, and is being used to set short-term objectives for reducing emissions from mostly diesel on-road heavy-duty engines and mostly diesel construction engines. For example, Hispanic, Asian, and African American populations are disproportionately impacted by emissions from construction and non-road engines; residents of all races living below the poverty line are disproportionately affected by car and truck pollutants (including diesel) and by industrial and business sources. This environmental justice analysis provides an important first step in planning short-, mid-, and long-term diesel emission reductions in the Portland region, and a foundation for improving communication around public health risks and supporting collaborative control and mitigation strategies involving the communities and populations affected. **This project will leverage the expertise and resources of various organizations working to achieve environmental justice goals, improve urban air quality, support Cleaner Air Oregon and the Oregon Clean Diesel Initiative, guide policy decisions/regulations, and engage diverse stakeholders in evaluating social, institutional, and urban design measures aimed at improving the adaptive capacity of communities that are significantly affected by diesel air pollutants.**

The broad-based EPA-sponsored MVD Steering Committee is working to build environmental justice capacity toward the goal of reduced diesel pollution and strengthened local and state air quality regulations. Neighbors for Clean Air (NCA) serves on this steering committee and through BREATHE Oregon is creating a collaborative environment to learn about air quality, diesel emissions, health impacts, and tools to assess cumulative risk in environmental justice (EJ) communities. BREATHE Oregon will work with nonprofit environmental and community advocacy groups in developing a varied set of education, outreach, communication, and collaboration tools, and connect them with PSU student interns to carry out outreach, education, and information-gathering activities around EJ and air quality policy. The goal is to build expertise and capacity to establish health-based air quality standards in Oregon, especially for marginalized communities of color and low-income communities most affected by diesel air pollution. Oregon will receive more than $85M from the 2016 Volkswagen emissions settlement agreement, with $68M targeted to diesel emission reductions; this project will help ensure that the voices of diverse EJ communities inform use of this fund. EJ outcomes are thus embedded in the project's community collaboration and outreach plan described below. The project will support collaborative partnerships with several area nonprofit organizations with the requisite skills and demonstrated capacity (NCA, OPAL, Verde, APANO, Centro Cultural) to facilitate community engagement and EJ workshops; the participating co-investigators have extensive experience in developing and monitoring these types of subaward partnership agreements, which will comply with Oregon DEQ and EPA requirements. This effort was launched on March 15, 2017, when NCA, EPA, Oregon DEQ, PSU, Multnomah County, and the Oregon Health Authority co-sponsored a one-day community engagement and capacity-building workshop on environmental justice and air toxics in the Jade District that included the Chair of the Governor's Environmental Justice Task Force, the Multnomah County Chair, Senior EPA Environmental Justice Policy Advisor Charles Lee, and other local, state, and national EJ leaders.

E. <u>COMMUNITY COLLABORATION/OUTREACH</u>. As described in Objective 1, a central project aim is to translate the scientific analysis to socially and politically feasible strategies for reducing diesel pollutants, and related exposure, especially among those most vulnerable to degraded air quality. As part of BREATHE Oregon, three workshops will be created to build community knowledge among Portland's underserved, economically distressed, and environmentally burdened residents about the layers of air pollution in their neighborhoods, and assist with linking to successful models and campaign strategies from other areas. NCA will build on its BREATHE Oregon collaboration with the nonprofit organization Verde in Portland's low-income Cully neighborhood, which focused on industrial pollution, to develop a broader engagement across the Living Cully community initiative (which braids together environmental and anti-poverty investments). The project will also build on community engagement work around air quality already in place through the Greening the Jade Project (involving APANO and OPAL in Portland's Jade District), and a Washington County collaboration with Centro Cultura to achieve reductions in wood smoke from residential heating. Community members will use PSU and DEQ maps and EPA data to describe environmental health in the metro area in new ways that blend lived experiences with the pollution data. The integration of scientific and community-based knowledge will provide a foundation for further engagement. The scientific knowledge will include spatially explicit descriptions of vulnerable populations who have an increased risk of exposure to black carbon related to combustion. The combination of socio-demographic US Census information for vulnerability measures with geographic areas that have relatively higher levels of black carbon (based on empirical measurements) will provide a scientifically robust description of environmental health impacts. In addition, **NCA will lead the BREATHE Oregon team in conducting technical assistance and community workshops based on the spatially explicit description of the exposure of vulnerable populations to black carbon. These maps will serve as the basis for developing popular education tools for validating and incorporating community voices that are central to any Oregon policies around air pollution moving forward (also see Objective 2, Task 2.4). Finally, NCA will identify key diesel pm reduction opportunities and facilitate information sharing between the community, the research partners, and decision makers.** The new state-of-the-art Data Visualization Studio in PSU's Institute for Sustainable Solutions will support these outreach and education activities, with capacities including large-scale data and image visualization, data-sharing, video-conferencing, integrative data modules, and MondoPad™-equipped collaborative workspaces.

F. <u>ENVIRONMENTAL RESULTS</u>. *<u>Outputs</u>:* Over 25 months, this study will identify four Portland-area regions of high vulnerability to diesel particulate matter; establish a communication forum to engage affected communities and stakeholders; and, through monitoring and analysis, assess the relative contributions of emissions sources to diesel particulate matter.

<u>Quantitative and qualitative outcomes</u>:

- **Mapping of four areas of high population vulnerability to diesel emissions** (short-term outcome). These areas will serve as **case studies and potential mitigation pilot areas** to inform diesel risk management work statewide (mid-term outcome).
- **New knowledge** on emission signatures for marine shipping, rail, drayage trucking, and construction engines and diesel emission factors (mid-term outcomes).
- **Further modeling analysis** leading to calculation of annual average concentrations which can be compared to Oregon's diesel clean air benchmark, allowing DEQ and partners to better characterize the current risk to the public and vulnerable populations (mid-term outcome).
- **Specific emission and health risk information** that will allow DEQ, legislators, and local governments to understand the most effective ways to **reduce and mitigate health impacts from diesel emissions** (mid-term and long-term outcome).

The *<u>performance measure</u>* is the level diesel particulate concentrations are above Oregon's health benchmark. Oregon adopted its diesel particulate benchmark in 2006, so it does not include consideration of recent World Health Organization findings that diesel particulate is a known carcinogen. DEQ is working with its Air Toxics Science Advisory Committee to update the Oregon diesel benchmarks.

G. <u>PROGRAMMATIC CAPABILITY & PAST PERFORMANCE</u>. Oregon DEQ has the organizational capacity and highly qualified staff required to manage the proposed community-scale air toxics ambient monitoring project, oversee timely completion of grant-funded activities and required reports, and ensure that project results inform continued collaboration, planning, and community outreach beyond the federal grant period. Brief biosketches are attached for the following DEQ personnel: Sarah Armitage, Senior Air Quality Planner; Anthony Barnack, Ambient Air Monitoring Coordinator; Kevin Downing, Oregon Clean Diesel Initiative; Tom Roick, Air Quality Monitoring Manager. Biosketches are also attached for the three co-investigators from PSU and Reed College who will provide extensive interdisciplinary expertise in urban air quality monitoring and measurement, health impact exposure vulnerability analysis, and community/stakeholder engagement: Linda George, Ph.D., Professor of Environmental Sciences and Management, PSU School of the Environment; Vivek Shandas, Ph.D., Associate Professor, Nohad A. Toulan School of Urban Studies and Planning, Sustaining Urban Places Research Lab Director, and Institute for Sustainable Solutions Research Director; and Juliane Fry, Ph.D., Associate Professor of

Chemistry and Environmental Studies, Reed College. Oregon DEQ has received and successfully completed numerous federal assistance agreements and has considerable experience in managing air monitoring projects including air toxics monitoring grants. In 2004 DEQ was awarded and successfully managed a $495,000 air toxics grant to fund a multi-site monitoring study. In 2011 and 2012 DEQ was awarded EPA funding totaling over $1 million, involving matching funds of over $3.9 million, for three diesel emission reduction projects, focused on Cargo Handling Exhaust Control Upgrades/Dray Truck Replacement, Repowering Towboat Engines on the Columbia River, and Marine Engine Repowers on the Columbia River. All have been completed successfully, with progress and final reports submitted on time. Oregon DEQ consistently complies with grant programmatic and administrative conditions, meets grant objectives, provides data and progress reports on a timely basis, and submits final technical reports. In addition to the staff listed above, who will provide the technical expertise and direct experience required to manage federally funded projects effectively, Oregon DEQ also has accounting, budgeting, and information systems staff who consistently demonstrate strong project management skills and a commitment to meeting all federal grant assistance agreement requirements. Table 2, below, lists five of the federal air quality monitoring grants Oregon DEQ has managed effectively during the past three years. In each case, DEQ complied with all contract management and reporting requirements.

Table 2. List of Federally Funded Grants & Cooperative Agreements Within Last Three Years.

Title	Grant ID#	Last Amended
Oregon $PM_{2.5}$ Monitoring Network	XA-01J14701	2016
NATTs Monitoring Network – Portland & La Grande	XA-00J83701	2014
NATTs Monitoring Network – Portland & La Grande	XA-01J22201	2016
EPA, Diesel Emission Reduction Act: School Bus Replacement Project	DS-00J88701	2016
EPA, Diesel Emission Reduction Act: Cargo Handling Exhaust Control Upgrades/Dray Truck Replacement	DE-83581701, 66.040	2015

H. DETAILED BUDGET NARRATIVE	EPA
Personnel:	**$43,825**
(2) Natural Resource Specialist 4 AA, AD, Step 9, Location-H&R. 2.5-months @ $7,021/month, (1) Natural Resource Specialist 3 AA, AD, Step 9, Location-LAB, 1.63-months @ $4,373/month, (1) Chemist 3 AA, AD, Step 9, Location-LAB, 3-months @ $6,389/month	
Fringe Benefits are calculated at a rate of 7.65% for all positions	**$22,351**
Equipment:	**$34,695**
Two 6’ by 8’ single-axel mobile project trailers will be fitted with monitoring and computer equipment, electrical wiring and circuits, heating and cooling equipment, etc. ($6,000 each trailer. 1 Ecotech CO trace level monitor EC9330T ($11,625/ea), 1 Ecotech SO2 trace level monitor(s) EC9850T ($10,070/ea), standard gases, $1,000.	
Supplies:	**$335**
Typical office/lab supplies (e.g., paper, pens, staples, printer ink, and other miscellaneous desktop items) are estimated at $47/month over 7.13 months to support the specialist position.	
Other:	**$579,92**
Employee Training (7.13 months @$42 per FTE)	$359
Telecommunications (7.13 months @ $91 per FTE)	$666
Data Processing (7.13 months $3/month per FTE, for mainframe, server, peripheral, and computer processing support)	$104
Laboratory Equipment Services ($28,000 of program-specific laboratory costs, e.g., electricity install and use, site rental fees, filters for URG/SASS).	$28,000
Other Services @ $937/month for 7.13 months, for office equipment rental, field supplies (e.g., sampling supplies, spare parts, rental equipment, general lab supplies such as gases, chemicals, glassware, paper towels, lab coats), other miscellaneous supplies (e.g., vehicular).	$6,847
Expendable Property ($20) and IT Expendable Property ($34) are reusable items purchased for under $5,000 (with a useful life beyond a year), e.g., computers/software, office furniture	$460
Special Payments to Other Government Units (Portland State University)	$483,562
PSU Personnel costs ($198,249 total) include one month of salary each year for principal investigator George and one month summer and academic year support for Co-PI Shandas, plus salary/fringe (.34 FTE) for two graduate research assistants ($149,142 + $18,983 fringe). Equipment includes a particle sizer ($80,000). Services and supplies ($198,249 total) include tuition remission for the GRAs ($44,749); Geospatial technology services ($20,000); community workshop facilitation contracts	

($3,500 each x 4 x 2 years = $28,000); conference and travel expenses ($4,000); PolicyMap software/data services ($10,000); ADAPT software ($5,000); material and supplies ($4,000); participant incentives ($1,000); printing/publishing ($1,500); indirect costs at 48.5% on MTDC, excluding tuition and equipment ($117,188).	
Special Payments to Non-Government Units (Reed College)	$59,925
Personnel costs over the two-year project will include Co-PI Fry (one month salary each year), plus student support ($9,000), totaling $32,465 with fringe benefits; plus $3,000 for supplies and $3,000 for travel; plus indirect costs at 67%.	
Oregon DEQ Overhead/Indirect (19.85% of total, PS+fringe)	**$13,136**
Total Project Cost	**$694,265**

I. LEVERAGING. Part of Oregon's innovative risk-based air toxics program, the Portland Air Toxics Solutions project is the detailed emission inventory and local scale dispersion model for the Portland area, developed between August 2009 and October 2011 by Oregon DEQ in collaboration with the Portland Air Toxics Solutions Advisory Committee, comprising diverse stakeholders. This groundbreaking 2012 report greatly advanced our knowledge of air toxics in Portland, allowed DEQ to estimate expected concentrations for 19 pollutants projected for 2017, and has informed potential reduction strategies and priorities. The additional community-scale diesel monitoring and analysis outlined in this EPA proposal will be informed by PATS, including GIS data on land use and transportation, source allocation at census block group level, and demographic layers including income and minority status. In addition to partnering with PSU and Reed on project design, communications, and analysis, DEQ staff will contribute significant staff hours using proposed monitoring analysis results to revise diesel emission inventories and modeled diesel particulate concentrations.

DEQ expects that improved risk information on diesel emissions will also lead to additional emission reduction efforts under Oregon's Clean Diesel Program. For over 15 years, DEQ's Clean Diesel lead has provided assistance and incentives to fleet operators statewide for retrofits and cleaner engines. Through this work, DEQ has established a strong presence in the business community and will rely upon its many existing partnerships for communications and additional emission reduction efforts. Since 2005, DEQ has collected black carbon data in the Portland area at six monitoring sites established to assess regionally representative levels but not designed to assess diesel impact on vulnerable communities. DEQ has collected particulate speciation data at three monitoring sites since 2002. Investigators will incorporate historic and ongoing black carbon and particulate speciation data into this study. The continued operation of the following DEQ particulate, black carbon, and air toxics monitors located in the Portland metro area will complement the proposed diesel monitoring project.

Project collaboration with an interdisciplinary team of researchers from PSU and Reed College will allow this project to leverage years of air quality monitoring and modeling expertise, data collection and analyses conducted for the Portland area, recent works to characterize diesel emissions, and innovative approaches focused on community-based environmental stewardship, decision support systems and spatially explicit tools for neighborhood sustainability, and assessment of urban planning and design policies on the grand challenge of air pollutants and their adverse effects on human health. PSU co-investigators George and Shandas are presently using the Portland-area air toxics inventory data with geospatial demographic information to assess disproportionate impacts of air toxics and the health care costs associated with exposure (Rao et al. 2014). Reed co-investigator Fry is currently using PMF5.0 to assess source profiles using data collected in an industrial area near the Reed campus. We anticipate also partnering with the newly announced Reed College Social Justice Research and Education Fund to support students working on this project throughout the academic year.

As mentioned, this project builds on research funded by the Bullitt Foundation, the spatial analysis capacities (GIS and LiDaR) described in Section C, and the new two-year air toxics metal study supported by $62,500 provided through PSU's ISS with matching contributions from partners at the City of Portland and Multnomah County (combined total $125,000). BREATHE Oregon is supported by a $250,000 grant to ISS from the Meyer Memorial Trust; Drs. George and Shandas are key investigators. The approximately $68M VW emission settlement fund targeted to diesel emissions reduction will also provide important leverage opportunities. As described in attached letters, the project will leverage planning and health-related data collected by the city Bureau of Planning and Sustainability, Multnomah County, and Oregon Health Authority. Various organizations representing policy, environmental advocacy, and communities of color will participate in project workshops and support information dissemination and community engagement activities (see attached letters). Leveraged expertise, initiatives, and resources will support development of the broad network needed to ensure that the project achieves its aims during and beyond the federal grant period.

J. <u>EXPENDITURE OF AWARDED GRANT FUNDS</u>. Oregon DEQ will provide dedicated financial staff to assure that strict purchasing, contract, and grant expenditure requirements are followed in the administration of the project. Oregon DEQ maintains an operating budget with regular forecasts and updates to ensure efficient, effective, and timely expenditure of grant and other funds. Subgrantees will be required to enter into detailed agreements specifying invoicing, documentation, accounting and reporting to control and justify all grant expenditures. In addition, DEQ and subgrantees will conduct regular coordination and status update meetings including expenditure progress reports. PSU and Reed researchers, the DEQ air quality project lead, and the DEQ fiscal coordinator will work together closely to ensure that grant funds are spent according to the project plan and agreed-upon timelines, in compliance with all federal requirements. (Also see Section G. describing Oregon DEQ institutional capacity.)

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