Environment and Natural Resources Trust Fund
2016 Request for Proposals (RFP)

Project Title: **ENRTF ID: 136-E**

Improving Health and Environment by Mitigating Airborne Pollutants

Category: E. Air Quality, Climate Change, and Renewable Energy

Total Project Budget: $ 630,614

Proposed Project Time Period for the Funding Requested: 3 years, July 2016 to June 2019

Summary:

This project quantifies and maps primary emissions of toxic airborne pollutants, traces their effects on air quality, identifies ecosystem and human exposure, and develops policy recommendations.

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Location

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

The visual depicts the cycle of air pollution from vehicle emissions, to atmospheric dispersion, to environmental and human exposure.

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ TOTAL	_____%

PROJECT TITLE: Improving Health and Environment by Mitigating Airborne Pollutants

I. PROJECT STATEMENT

This project directly addresses the LCCMR call to develop "[i]nnovative approaches to air quality improvement that reduce impacts on human health, the environment, or natural resources, such as by reducing and mitigating airborne contaminants including PAHs (polycyclic aromatic hydrocarbons)" by developing mitigation strategies for the primary source of airborne emissions, transportation. A switch from coal, oil and wood to natural gas in power production and home heating has reduced stationary toxic emissions since the 1950s. Today, the majority of MN airborne emissions result from vehicle exhaust. Sediments from MN lakes indicate that after a decades-long decrease, PAH contamination in lakes has been rising since the 1980s[1], in parallel with increasing vehicle traffic. Road transportation was identified as the reason for the recent increase in MN PAH levels and is known to be the primary source of most toxic emissions within MN urban environments, as well as the fastest increasing source in suburban and rural locations.

While vehicles are the fastest growing source of air pollution in MN, current estimates of traffic emissions are extremely uncertain. Emissions of toxic pollutants, such as particulate matter (PM), nitrogen oxides (NO_x) and PAHs, depend strongly upon vehicle technologies and driving patterns, thus requiring emissions to be determined for conditions specific to MN. These three pollutants lead to premature human and wildlife deaths when inhaled, and cause unsafe concentrations for ecosystems when deposited by rain. Currently, transportation analyses can predict travel times and congestion levels, but cannot accurately determine where and when emissions occur. This limits our ability to identify and avoid dangerous air quality and impacts. Thus, this project will

1) ***Quantify*** statewide emissions from transportation, the primary source of toxic airborne PAH, PM and NO_x;
2) ***Understand*** the resulting air quality and impact on environment and human exposure; and
3) ***Develop*** strategies to reduce human exposure and deposition rates of pollutants into the environment.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Develop Advanced Maps of Transportation Activity throughout MN **Budget: $137,518**

This activity quantifies movements of vehicles within the transportation network for the Twin Cities and Greater MN. We use scheduled activity locations (jobs, homes, etc.) as origins and destinations and consider the activity times at those locations (e.g. office hours). Given these space and time constraints, vehicle movements are determined based on the minimum travel time within the transportation network. This work will provide vehicle numbers and speed profiles specific to MN roadways, and, critically, the space and time patterns of traffic flow.

Outcomes	Completion Date
1. Database of MN origins and destinations for roadways with maximum speeds.	January 2017
2. Map of vehicle movements through space and time between origins and destinations.	July 2017
3. Output speed profiles roadways at given times, and aggregated over the day.	July 2018

Activity 2: Quantify MN Toxic Emissions from Transportation **Budget: $167,392**

Using movements from Activity 1, fuel use and emissions will be determined for the specific vehicle makeup of the MN fleet. An extensive database of vehicle fuel consumption and noxious emissions (PM, NO_x, PAHs) will enable us to simulate dynamic emissions specific to conditions within MN (cold weather, driving patterns, etc.). The time and location of emissions will be mapped for each season. Together, activities 1 and 2 will reveal the impacts of vehicle technologies, travel demand, and route choice on toxic emissions from MN vehicles.

Outcome	Completion Date
1. Database of MN vehicle fuel consumption and emissions characteristics.	January 2017
2. Map of statewide air pollutant (PAH, NO_x, PM) emissions based on Activity 1 driving patterns.	January 2018
3. Prioritized list of interventions for reduction of transportation emissions.	July 2018

[1]Van Metre, P. C.; Mahler, B. J.; Furlong, E. T., Urban Sprawl Leaves Its PAH Signature. *Environmental Science & Technology* **2000,** *34* (19), 4064-4070.

Activity 3: Map Air Quality Impacts of Emissions **Budget: $162,170**

We will use a state-of-the-art atmospheric air quality model with a newly developed PAH platform to interpret MN transportation emission estimates in terms of their implications for air pollution within MN. The work will:

Outcome	Completion Date
1. Validate predicted contaminant levels with available measurements in order to test the accuracy of the new emission estimates.	January 2018
2. Map the atmospheric distribution of critical air contaminants such as PM, NO_x, and PAHs in terms of human exposure and deposition to MN ecosystems.	July 2018
3. Pinpoint the hotspot locations with the highest amounts of the above air pollutants and identify the most important emission sources in each case.	January 2019

Activity 4: Quantify Human and Ecosystem Exposure to Toxic Pollution **Budget: $153,413**

This activity uses the pollution concentrations from Activity 3 to quantify pollutant exposure for MN ecosystems and for individuals (including exposure while traveling and off-road exposure). Exposure of travelers to pollutants will be estimated based on Activity 1's traffic data, while exposure for stationary individuals will be based on pollution levels at their locations. Deposition of pollution within MN environments will be mapped based on the removal rate of each contaminant from the atmosphere. This will provide a more accurate understanding of pollution exposure for humans and the environment within MN.

Outcome	Completion Date
1. Match trajectories of individuals with pollutant levels through space and time.	July 2017
2. Accumulate each individual's pollution exposure over the day.	January 2018
3. Map human pollution inhalation exposure, find hot spots, identify problematic locations.	July 2018
4. Map environmental exposure by deposition from atmospheric pollution.	June 2019

Activity 5: Mitigation Strategies **Budget: $10,122**

After the modelling analysis, a series of mitigation options will be explored that identify emission control strategies with the highest potential for reducing air pollution, human exposure and ecosystem degradation.

Outcome	Completion Date
1. Develop mitigation scenarios based on insights from Activities 1-4.	January 2019
2. Quantify emissions reductions, air quality improvements, exposure reduction and ecosystem impacts based on mitigation scenarios.	May 2019
3. Report mitigation scenarios and impacts to LCCMR and wider community.	June 2019

III. PROJECT STRATEGY

A. Project Team/Partners

Univ. of Minnesota will house the project with four graduate students, developing expertise in Activities 1-4. Asst. Prof. Y. Song, in the Dept. of Geography, Environment and Society, has interests in spatio-temporal transportation modelling, and leads Activity 1. Prof. D. Levinson and Asst. Prof. A. Boies from the Dept. of Civil, Environment and Geo- Engineering have expertise in transportation planning, travel behavior and energy use, and will lead Activities 4 and 2, respectively. Assoc. Prof. D. Millet in the Dept. of Soil, Water and Climate, has expertise in atmospheric pollution, and will lead Activity 3. The Univ. of MN Center for Transportation Studies (CTS) will coordinate all for Activity 5.

B. Project Impact and Long-Term Strategy

This project will be the first ever to combine traffic prediction, vehicle emissions, air quality and exposure. Doing so will allow us to deliver a set of specific actions that can lower human and environmental exposure to toxic pollutants. The reduction strategies will be disseminated by CTS through a website and published reports.

C. Timeline Requirements

This proposed research will occur over 36 months from July 2016 to June 2019. The four primary activities will be staggered to ensure delivery of data across activities at specified times as outlined above.

2016 Detailed Project Budget

Project Title: Improving Health and Environment by Mitigating Airborne Contaminants

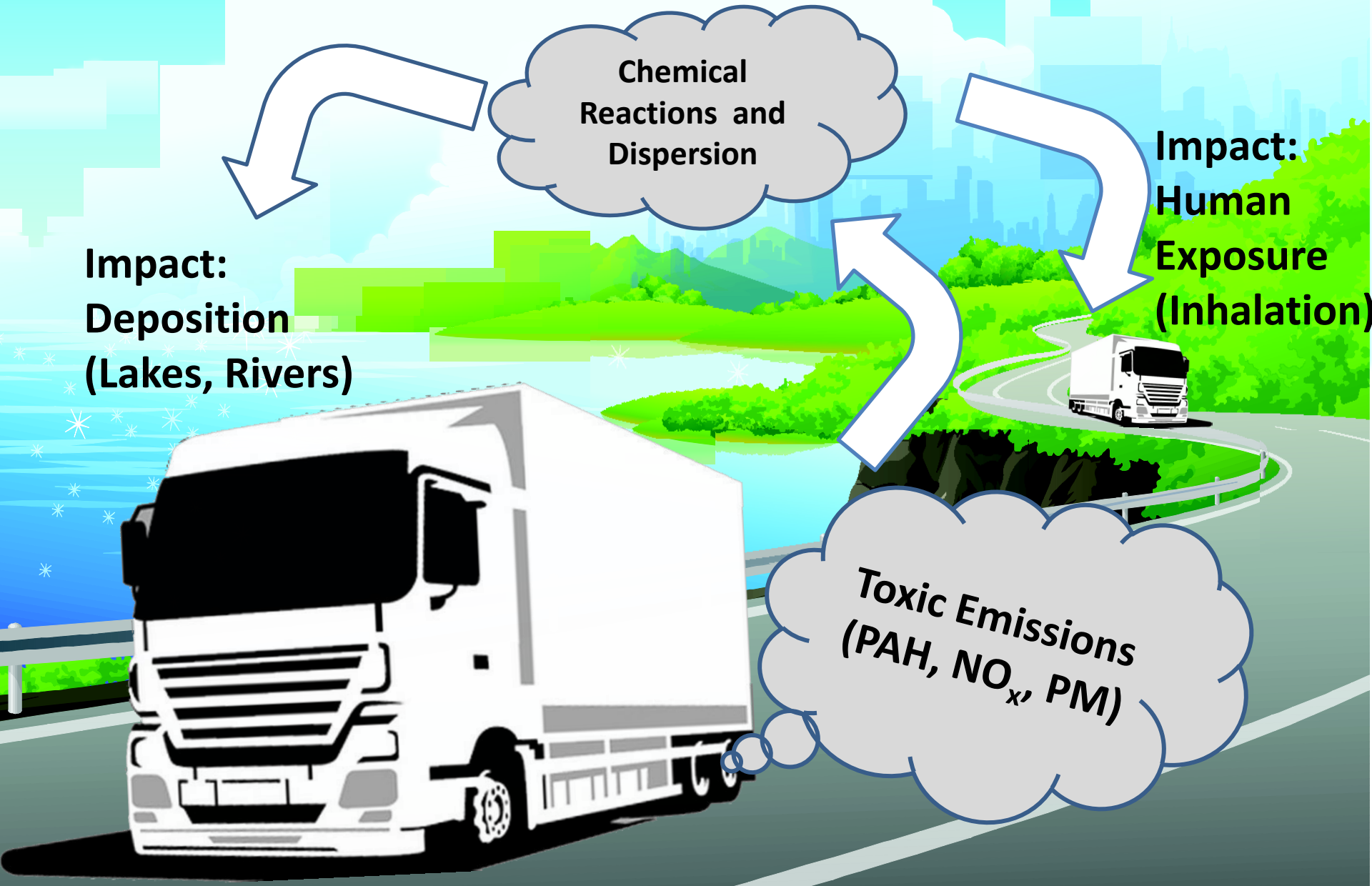
IV. TOTAL ENRTF REQUEST BUDGET *3* **years**

BUDGET ITEM *(See "Guidance on Allowable Expenses", p. 13)*	**AMOUNT**
Personnel:	
Asst. Prof Adam Boies, Principle Investigator (5.5% 9-month academic salary and 1 month summer salary) for 3 years.	$ 61,535
Prof. David Levinson, Co-Investigator (1 month summer salary) for 3 years	$ 56,313
Assc. Prof. Dylan Millet, Co-Investigator (1 month summer salary) for 3 years	$ 47,556
Asst. Prof. Ying Song, Co-Investigaor (1 month summer salary) for 3 years	$ 31,661
Brenda Thomas, Project Manager (5% time for 3 years) to manage deliverable compliance	$ 10,924
Graduate research assistant, Activity 1: UMN Department of Geography, Environment and Society (50% RA for 2 years)	$ 101,672
Graduate research assistant, Activity 2: UMN Department of Civil, Environmental and Geo-Engineering (50% RA for 2 years)	$ 101,672
Graduate research assistant, Activity 3: UMN Department of Soil, Water and Climate (50% RA for 2 years)	$ 101,672
Graduate research assistant, Activity 4: UMN Department of Civil, Environmental and Geo-Engineering (50% RA for 2 years)	$ 101,672
Additional Budget Items:	
Edit and publication of final report	$ 3,712
Develop a website to host the maps/tools/reports	$ 4,225
Equipment/Tools/Supplies:	
Computer (50% high processing power computer cost), 4 × $1,000 for Activity 1-4	$ 4,000
Software and database costs (4 × $1,000 for Activity 1-4)	$ 4,000
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 630,614

V. OTHER FUNDS *(This entire section must be filled out. Do not delete rows. Indicate "N/A" if row is not applicable.)*

SOURCE OF FUNDS	**AMOUNT**	**Status**
Other Non-State $ To Be Applied To Project During Project Period:	NA	
Other State $ To Be Applied To Project During Project Period:	NA	
In-kind Services To Be Applied To Project During Project Period:	NA	
Funding History:	$ 4,959,716	
$300,000 - NSF, 2008-2010, "BRIDGE, Behavioral Response to the I-35W Disruption: Gauging Equilibration		Closed
$517,531 - NSF, 2012-2015, "Measuring the Environmental Costs of Space-time Prisms in Sustainable Transportation Planning"		Closed
$462,185 - NSF, 2009-2013, "Top-Down Constraints on North American Biogenic VOC Emissions from Tall Tower Measurements and Lagrangian Modeling"		Closed
$3,680,000 - EPSRC, 2011-2014, "Energy Efficient Cities Initiative"		Closed
Remaining $ From Current ENRTF Appropriation	NA	

Improving Health and Environment by Mitigating Airborne Pollutants



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Responsibilities include build and strengthen existing research-related programs and initiatives of CTS, directs the Center's coordinated research program, leads the design and delivery of sponsored programs and projects, builds partnerships between sponsors and University faculty and staff, and supports activities to attract funding for transportation research; and participate in the overall development of the Center through evaluating new initiatives, recommending project team assignments and supervising and mentoring staff.

Responsible for directing the Center's coordinated research program. Provide strategic direction on program development and delivery. Guide and position University researchers for external funding opportunities. Serve as liaison between University researchers and sponsors when issues arise and facilitate resolution of the issues when appropriate.

Pursue business development opportunities that attract funding for transportation research by identifying funding opportunities; facilitating connections and building partnerships between new sponsors and University faculty and staff; and communicating and promoting University expertise. Serve as a technical resource for select topics and/or researcher area of expertise, to the level needed for development activities, including assisting with proposal/work plan development in response to funding opportunities. Coordinate with PIs to identify capabilities, uniqueness of expertise, emerging issues and topics, key stakeholders and sponsors, results of past research, and potential impact of future research.

Guide communication of research-in-progress and research results. Collaborate with the Communications and Information Group to identify outreach opportunities for research-in-progress and the dissemination of research results. Encourage the transfer of research results into practice through sharing implementation ideas with research councils, partnerships and other external groups. Direct the collection and communication of research performance data to describe and highlight successes of the research program. Review research-related content of the Center's key outreach and communication publications.

Convene and facilitate stakeholders to align interests and establish shared directions and goals for other programs and projects. Collaborate with the Financial Strategy and Operations Group to determine budget requirements. Work with Program Development and Delivery Group and Communications and Information Group to identify project team members who will deliver the projects.

Center for Transportation Studies, University of Minnesota
Center for Transportation Studies (CTS) is a catalyst for transportation innovation through research, education, and outreach. CTS strives for excellence in five areas: strengthening University expertise, championing formal education, fostering ideas and knowledge development, initiating stakeholder and public participation, and promoting applied problem solving.