State of California
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 07-2

January 25, 2007

Agenda Item No.: 07-1-4

WHEREAS, the Air Resources Board (ARB) has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705; and

WHEREAS, a research proposal, number 2624-254, entitled "Spatiotemporal Analysis of Air Pollution and Mortality in California Based on the American Cancer Society Cohort," has been submitted by the University of California, Berkeley; and

WHEREAS, the South Coast Air Quality Management District (SCAQMD) has agreed to cosponsor this proposal for a total amount of $375,000; and

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 2624-254 entitled "Spatiotemporal Analysis of Air Pollution and Mortality in California Based on the American Cancer Society Cohort," submitted by the University of California, Berkeley, for a total amount not to exceed $749,976.

NOW, THEREFORE BE IT RESOLVED, that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 2624-254 entitled "Spatiotemporal Analysis of Air Pollution and Mortality in California Based on the American Cancer Society Cohort," submitted by the University of California, Berkeley, for a total amount not to exceed $749,976.

BE IT FURTHER RESOLVED, that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described in Attachment A, in an amount not to exceed $749,976.

I hereby certify that the above is a true and correct copy of Resolution 07-2, as adopted by the Air Resources Board.

/s/

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Lori Andreoni, Clerk of the Board

"Spatiotemporal Analysis of Air Pollution and Mortality in California Based on the American Cancer Society Cohort"

Background
Epidemiologic studies conducted over several decades have provided evidence suggesting that long-term exposure to elevated ambient levels of particulate air pollution is associated with increased mortality. Two U.S. cohort studies, the Harvard Six Cities study and the American Cancer Society (ACS) study came under intense scrutiny in 1997 when the results were used by the U.S. EPA to support new National Ambient Air Quality Standards for PM2.5. A reanalysis was done for these studies that assured the quality of the original data and replicated the original results. Dr. Arden Pope of Bringham Young University and colleagues further analyzed the ACS cohort by adding 10 years of data which doubled the follow-up time to more than 16 years and tripled the number of deaths. In addition, Pope and colleagues added gaseous co-pollutant data and new PM2.5 data to the analysis which had been collected since the enactment of the new air quality standards. This study found a nation wide approximate risk of 6% for each 10 μg/m3 increase in long-term average PM2.5 ambient concentrations for all cause mortality. Currently, there is no statewide health risk for California's general population from particulate and gaseous air pollution on all-cause and cause-specific mortality that is based on the American Cancer Society Cohort. In addition, a growing body of evidence suggests that refinement of exposures, especially to the within-city or intraurban scale, will be associated with larger health effects.

Objective
The objective is to derive detailed assessments of the health effects from particulate and gaseous air pollution on all-cause and cause-specific mortality in California based on the American Cancer Society Cohort. The contractor will also investigate whether specific particle characteristics associate with larger health effects through examination of intrauban gradients in exposure to different particle constituents and sources and whether critical exposure time windows exist in the relationship between air pollution and mortality in California.

Methods
This study will investigate the California ACS cohort of 95,112 subjects and 26,183 deaths from 1982 through 2000. This cohort is widely distributed across the entire state. For the first time the ACS subjects will have their home address geocoded, as compared to the previous studies that have used either metropolitan area of residence or the home zip code to assign exposure. The investigators will not only determine the individual confounding factors, but will also investigate the effects from "contextual" confounding factors. These are neighborhood social confounding variables that represent the social, economic, and environmental settings where the individuals live, work, or spend time. This study will investigate two exposure assessments, one with a more basic model Inverse Distance Weighting (IWD) exposure and, the second more refined that integrates the Land Use Regression with Bayesian Maximum Entropy Kriging model. The initial health effects assessment will rely on IWD model of monthly

PM10, PM2.5, O_3, and NO_2 ambient concentrations. In order to estimate any potential impact from PM2.5 long-term exposures prior to 1999 the investigators will rely on a historical reconstruction PM2.5 concentrations developed by Charlie Blanchard. Investigators will also assign exposures of elemental carbon, organic carbon, metal species, nitrates, and sulfates. These are available through a more limited monitoring network, but the spatial coverage appears sufficient to derive exposure estimates for some of these constituents.

Expected Results
The investigators will: examine whether specific particle characteristics are associated with larger health effects to different particle constituents and sources of exposure, and determine how critical time, duration, and level of air pollution exposure are contributing to death in California. This study will provide a California-wide estimate of death associated to PM2.5 exposure and other co-pollutants.

Significance to the Board
This study will increase our understanding of specific source contributions to death by studying the effects from expressways and ports. This study will supply the first California-wide estimates of death associated to PM2.5 exposure and other co-pollutants derived from a representative adult California population, thus supplying the Air Resources Board (ARB) with a valuable resource for deriving benefits estimates. This information will help strengthen ARB's efforts to implement policies that protect public health.

Contractor:
University of California, Berkeley

Contract Period:
36 months

Principal Investigator (PI):
Michael Jerrett, Ph.D.

Contract Amount:
$749,976

Cofunding:
The South Coast Air Quality Management District is contributing $375,000 to the cost of this study.

Basis for Indirect Cost Rate:
The State and the UC system have agreed to a ten percent indirect cost rate.

Past Experience with this Principal Investigator:
ARB has not contracted with Dr. Jerret previously. However, he has significant experience with spatial aspects of exposure and health effects modeling. He has served as a principal investigator or consultant to many of the leading cohort studies, including: The Children's Health Study and a subsequent National Institute of Health follow up

study, an EPA-STAR grant to examine the role of exposure measurement error in the estimation of health effects; consultant to the California Teacher's Cohort and the Netherlands Nutritional and Cancer Cohort and on a Canadian Institutes of Health Research Cohort study of traffic pollution in relation to mortality. In addition, Dr. Jerret has worked closely with all of the team members since 1999.

Prior Research Division Funding to UCB:

Year	2006	2005	2004
Funding	$963,815	$1,829,446	$715,194

BUDGET SUMMARY

University of California, Berkeley

Spatiotemporal Analysis of Air Pollution and Mortality in California Based on the American Cancer Society Cohort

DIRECT COSTS AND BENEFITS

1.	Labor and Employee Fringe Benefits	$	206,789
2.	Subcontractors	$	474,708[1]
3.	Equipment	$	0
4.	Travel and Subsistence	$	10,000
5.	Electronic Data Processing	$	16,400
6.	Reproduction/Publication	$	0
7.	Mail and Phone	$	0
8.	Supplies	$	6,200
9.	Analyses	$	0
10.	Miscellaneous	$	574

Total Direct Costs $714,671

INDIRECT COSTS

1.	Overhead	$	35,305
2.	General and Administrative Expenses	$	0
3.	Other Indirect Costs	$	0
4.	Fee or Profit	$	0

Total Indirect Costs $ 35,305

TOTAL PROJECT COSTS $749,976

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[1] Subcontractors:

California State University, San Diego	$177,000
University of Ottowa	$184,789
Zev Ross	$ 82,925
New York University	$ 14,997
Bringham Young University	$ 14,997
	$474,708

S U B C O N T R A C T O R S' B U D G E T   S U M M A R Y

Subcontractor: San Diego State University Research Foundation

Description of subcontractor's responsibility: Will lead the spatiotemporal exposure modeling and perform much of the land use regression and all joins to the existing exposure data.

DIRECT COSTS AND BENEFITS

1.	Labor and Employee Fringe Benefits	$ 160,909
2.	Subcontractors	$ 0
3.	Equipment	$ 0
4.	Travel and Subsistence	$ 0
5.	Electronic Data Processing	$ 0
6.	Reproduction/Publication	$ 0
7.	Mail and Phone	$ 0
8.	Supplies	$ 0
9.	Analyses	$ 0
10.	Miscellaneous	$ 0
	Total Direct Costs	$160,909

INDIRECT COSTS

1.	Overhead	$ 16,091
2.	General and Administrative Expenses	$ 0
3.	Other Indirect Costs	$ 0
4.	Fee or Profit	$ 0
	Total Indirect Costs	$16,091

TOTAL PROJECT COSTS   **$177,000**

S U B C O N T R A C T O R S' B U D G E T S U M M A R Y

Subcontractor: University of Ottowa

Description of subcontractor's responsibility: Will coordinate and implement management of the highly confidential data file and the statistical analysis of health effects the Cox and Random effects Cox model.

DIRECT COSTS AND BENEFITS

1. Labor and Employee Fringe Benefits	$	95,121
2. Subcontractors	$	50,598
3. Equipment	$	5,362
4. Travel and Subsistence	$	13,909
5. Electronic Data Processing	$	0
6. Reproduction/Publication	$	0
7. Mail and Phone	$	0
8. Supplies	$	0
9. Analyses	$	0
10. Miscellaneous	$	0

Total Direct Costs $164,990

INDIRECT COSTS

1. Overhead	$	16,499
2. General and Administrative Expenses	$	3,300
3. Other Indirect Costs	$	0
4. Fee or Profit	$	0

Total Indirect Costs $19,799

TOTAL PROJECT COSTS $184,789

S U B C O N T R A C T O R S' B U D G E T S U M M A R Y

Subcontractor: Zev Ross

Description of subcontractor's responsibility: Will expand on the work he is already doing to calibrate land use regressions in southern California to the entire state. He will also work on-site in Atlanta to geocode the 95,112 records available for analysis.

DIRECT COSTS AND BENEFITS

1.	Labor and Employee Fringe Benefits	$	76,000
2.	Subcontractors	$	0
3.	Equipment	$	0
4.	Travel and Subsistence	$	6,925
5.	Electronic Data Processing	$	0
6.	Reproduction/Publication	$	0
7.	Mail and Phone	$	0
8.	Supplies	$	0
9.	Analyses	$	0
10.	Miscellaneous	$	0

Total Direct Costs $82,925

INDIRECT COSTS

1.	Overhead	$	0
2.	General and Administrative Expenses	$	0
3.	Other Indirect Costs	$	0
4.	Fee or Profit	$	0

Total Indirect Costs $82,925

TOTAL PROJECT COSTS $82,925

S U B C O N T R A C T O R S' B U D G E T   S U M M A R Y

Subcontractor: New York University, School of Medicine

Description of subcontractor's responsibility: Will supply guidance on formulating and interpreting the exposure metrics for the speciated analysis.

DIRECT COSTS AND BENEFITS

1.	Labor and Employee Fringe Benefits	$	14,997
2.	Subcontractors	$	0
3.	Equipment	$	0
4.	Travel and Subsistence	$	0
5.	Electronic Data Processing	$	0
6.	Reproduction/Publication	$	0
7.	Mail and Phone	$	0
8.	Supplies	$	0
9.	Analyses	$	0
10.	Miscellaneous	$	0

Total Direct Costs $14,997

INDIRECT COSTS

1.	Overhead	$	0
2.	General and Administrative Expenses	$	0
3.	Other Indirect Costs	$	0
4.	Fee or Profit	$	0

Total Indirect Costs $ 0

TOTAL PROJECT COSTS **$14,997**

SUBCONTRACTORS' BUDGET SUMMARY

Subcontractor: Brigham Young University

Description of subcontractor's responsibility: Will supply expert guidance on the interpretation and analysis of statistical modeling and air pollution epidemiology.

DIRECT COSTS AND BENEFITS

1.	Labor and Employee Fringe Benefits	$	14,997
2.	Subcontractors	$	0
3.	Equipment	$	0
4.	Travel and Subsistence	$	0
5.	Electronic Data Processing	$	0
6.	Reproduction/Publication	$	0
7.	Mail and Phone	$	0
8.	Supplies	$	0
9.	Analyses	$	0
10.	Miscellaneous	$	0

Total Direct Costs $14,997

INDIRECT COSTS

1.	Overhead	$	0
2.	General and Administrative Expenses	$	0
3.	Other Indirect Costs	$	0
4.	Fee or Profit	$	0

Total Indirect Costs $ 0

TOTAL PROJECT COSTS $14,977