Transportation in the Border Environment

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PREFACE

Mexico has now surpassed Japan as the United State' second largest export distribution nation in 1997—continuing to accelerate its trade since 1995. The North American Free Trade Agreement (NAFTA) passed in 1992 gave new impetus for viewing Mexico as a stronger trading partner for the United States and its Border States.

New Mexico has historically understood the economic interdependence and the benefits of collaboration with its Mexican neighbor states in the interest of the public's health, ecosystem protection, and open market development. Once a territory of Mexico, both New Mexico and the Mexican Border States have a shared common language and have integrated Spanish colonial laws in their modern systems of government.

Now the New Mexico *frontera* faces new transborundary challenges, which if effectively addressed, can ensure increased economic gains and quality of life for its people. The demographics are changing rapidly with the population growing about twenty-five percent over the past five years and project to double in the next twenty. Ciudad Juarez, only a few short miles from the New Mexico/Texas border, is now one of the five largest cities in Mexico, housing some of the highest concentrations of maquiladora companies along the entire US/Mexico Border.

It is with this backdrop that the Research Bureau of the New Mexico State Highway and Transportation Department requested the ATR Institute to compile and research the transportation and air quality issues along the New Mexico/Mexico border. Realizing the interrelationships between transportation systems and environment, particularly air quality, the Research Bureau understood the importance of gaining a clear picture of the New Mexico border region if economic growth, increased trade, and quality of life were to flourish in the state.

The ATR Institute thanks David Albright, Research Bureau Chief, for his direction and vision in sponsoring this research. Michelle Skrupskis, Research Supervisor, provided her creative ideas to ATR Institute authors. Kristan Cockerill, ATR Institute Graduate Student Intern, is to be thanked as the principal author of the report, and for her development of the "Air Quality Matrix" featured in the research.

The work is insightful. The ATR Institute is pleased to have had the opportunity to produce this seminal research work for the Research Bureau.

Judith M. Espinosa
Director
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I. Introduction

In recent years numerous reports and studies have clearly identified strong links between transportation and environmental quality. For example, it is widely recognized that automobiles are a primary source of air pollution throughout much of the United States. Recent collaborations between federal environmental and transportation agencies indicate that these links are crucial. In New Mexico, efforts to address transportation related environmental concerns are confounded by our location on an international border. Because U.S. agencies do not control all of the variables, such as the emission levels allowed for automobiles, addressing border environmental issues poses unique challenges to transportation and environmental officials. These challenges have far reaching ramifications into economic, social and political spheres, as the debate surrounding environmental issues and the North American Free Trade Agreement (NAFTA) demonstrated.

In recognizing the potential long-term ramifications related to transportation planning and programs in New Mexico, the New Mexico State Highway and Transportation Department (NMSHTD) funded this effort to begin to identify and address issues related to transportation and the border environment. The NMSHTD called upon the ATR Institute (ATRI) to conduct a study that would cover four broad areas: air quality research, dust control, monitoring, and policy development. Based upon the NMSHTD request, ATRI staff conducted a thorough literature review and developed a unique matrix that documents pertinent research efforts related to transportation and air quality in the border region. This matrix was designed to be a stand-alone document and is written as such, although it is inserted in its appropriate place within this final report.

Once the matrix was completed, the researchers documented its potential value in meeting regulatory requirements and provided more in-depth analysis on one area of particular concern in the region, which is fugitive dust. Using the findings from the literature review, the researchers also provide suggestions for alternative methods for monitoring border environmental conditions and their relevance to transportation.

Finally the ATR Institute designed a framework which the NMSHTD could employ to develop a sound policy to address transportation related environmental issues not only along the state's southern border but also throughout the state. Because the findings supported an approach focused heavily on improving communication and contacts with other agencies, the researchers also provide an appendix which lists other agencies involved with transportation and/or environmental issues along the U.S.- Mexico border.

This report documents this research process and provides NMSHTD with a valuable resource for continuing their efforts to address air quality issues along the border and for devising a sound policy that serves the agency and the residents of New Mexico.

II. New Mexico/Mexico Border Air Quality

Border Air Quality Research Matrix

The ATR Institute (ATRI) has culled various sources to gather data and other information pertinent to transportation related air quality issues along the Mexico-New Mexico border. This information has been compiled into a large matrix that can be sorted by any available data point. Because air sheds do not respect political boundaries, this matrix includes numerous studies from all along the border which have relevance to air quality in southern New Mexico. This collection of sources and information is not exhaustive, but does reflect a thorough review of available literature and contacts with numerous organizations pursuing border related environmental research. Items were selected for inclusion based upon research location (proximity to the border), applicability to transportation concerns, and relevance to policy development.

For ease in organizing, the reports and documents are divided into five institutional categories: federal government, New Mexico government, environmental assessments, academic, and other. Some of the literature summarized overlaps categories. The government agencies often fund the academic research, for example. The category determination was made based primarily upon the source of the information. For example, if the EPA published the document, it is categorized as a federal source, even if another organization actually conducted the research. Within each of these categories, the individual documents are listed by sub-organization if applicable.

All of the documents reviewed have been assigned an identification code that corresponds to the Code column on the attached matrices. The matrices are sorted by subject matter, by year, and by identification code. For each entry on any given matrix there is a corresponding summary provided in this text. The summaries of each project or publication include the matrix identification code, pertinent and available bibliographic information, and a summary of the goals and/or results of the project or publication. Where available, project cost information is provided.

Some of the documents reviewed are bibliographies, compendia, or other forms of compiled information. To ensure accuracy in referencing, these compilations are treated as the primary source and are given an identification code. Any pertinent studies or publications discussed within the compilation is listed as a sub-source and is not given a separate identification code. For example, the Federal Railroad Administration has published an excellent bibliography on environmental externalities related to transportation. This bibliography is given an identification code and is included in the matrices. Some of the individual publications highlighted in the bibliography are summarized in the text as sub-sources, but are not listed as individual entries in the matrices.

Reading the Matrices

For ease in using the matrices as quick references, each entry includes abbreviated information about the document or study. Following are the descriptions for each of the matrix data points.

Code This is the identification code which corresponds to the major category of the item and to the codes in the textual summaries.

- A Academic
- E Environmental Assessment
- F Federal Government
- N New Mexico Government
- O Other.

Cat 1 Each matrix entry is categorized according to its primary focus. Following are the various categories and their characterization.

Climate	The primary focus of the research or study was climatological data or information
EA	These are specific environmental assessments for projects in the New Mexico border region
Model	The project or effort was focused on developing, assessing or modifying models and/or modeling tools
Social	These efforts focus on policy issues and/or collaboration and coordination among various entities
Source	These projects gathered information on specific contaminants and/or specific emission sources

Cat 2 This column provides more specific information on the project's focus and lists for example, specific climatological attributes researched or specific contaminants studied. Most of the key words used in this column should be self-explanatory. Following are the contaminant abbreviations.

All	all criteria contaminants assessed (O_3, CO, NO_2, SO_2, PM10, Pb)
CO	carbon monoxide
HC	hydrocarbons
NO_2	nitrogen dioxide
NOx	nitrogen oxides
O_3	ozone
Pb	lead
PM	particulate matter
SO_2	sulfur dioxide
VOC	volatile organic compounds

Date This is the year in which the research began, or the year that a document was published.

Location This column provides the primary area assessed by the research or project. Following are the place abbreviations used.

EP	El Paso
CJ	Ciudad Juarez
SP	Sunland Park, NM
LA	Los Angeles, CA
AZ	Arizona
CA	California
NM	New Mexico
TX	Texas
MX	Mexico
Border	Research is applicable to overall border region

Source This section lists the organization responsible for the document or study. Following are the full names of the acronyms used.

ASU	Arizona State University
CARB	California Air Resources Board
CEC	Commission for Environmental Cooperation
CSU	Colorado State University
DOT	Department of Transportation
DRI	Desert Research Institute
EPA	Environmental Protection Agency
FRA	Federal Railroad Administration
ITESM	Instituto Tecnologico y de Estudios Superiores de Monterrey
JAC	Joint Advisory Committee on Paso del Norte Air Quality
LANL	Los Alamos National Laboratory
NCVECS	National Center for Vehicle Emissions Control and Safety
NMAQB	New Mexico Air Quality Bureau
NMIMT	New Mexico Institute of Mining and Technology
NMSHTD	New Mexico State Highway and Transportation Department
NMSU	New Mexico State University
SDSU	San Diego State University
SNL	Sandia National Laboratories
TNRCC	Texas Natural Resource Conservation Commission
TRB	Transportation Research Board
TRIP	Transboundary Resource Inventory Program
UD	University of Denver
UT	University of Utah
UTEP	University of Texas at El Paso
WGA	Western Governors' Association

Other names refer to specific consulting firms or are self explanatory.

Investigator For those projects that identify principal investigator (s), they are listed by last name.

Highlights This simply provides a one line summary of the project's focus or results.

Federal Government Sources

Several federal agencies including the Environmental Protection Agency and the Department of Transportation have conducted research and compiled documents on environmental issues related to the border region and related to transportation. Several of the transportation specific documents are not focused solely on the border region, but because they are government sponsored, they are included as potential resources for the state government to pursue or emulate in developing policy.

Environmental Protection Agency

F01 EPA. 1993. National Air Toxics Information Clearinghouse (NATICH): Ongoing Research and Regulatory Development Projects. (Sept). EPA 153/R-93-042.

This clearinghouse provides information on research and regulatory activities to facilitate tech transfer and communication. The abstracts included in the publication are typically for ongoing work and as such do not include findings. This is an excellent resource, however, for identifying research on specific topics. Most pertinent to this study is a project to summarize all information concerning vehicle-related air toxics. See F11.

F02 EPA. 1995. Compendium of EPA Binational and Domestic U.S./Mexico Activities. EPA 160-B-95-001 (June).

F02 EPA. 1996. US-Mexico Border XXI Program: 1996 Implementation Plans (October).

Note: The Compendium and the Border XXI documents contain duplicate information and so are combined under one identification number.

Ciudad Juarez-El Paso-Sunland Park Air Programs

This project includes advanced monitoring, emissions inventory development, modeling and identifying innovative emissions controls. To do this, researchers have established a five-station monitoring network in Cd. Juarez and 17 monitoring sites in El Paso for nitrogen oxides, ozone, carbon monoxide, sulfur dioxide, particulates, lead, as well as wind speed/wind direction and other meteorological parameters. The project also involves operating a hot-spot monitor, collecting upper air wind speed and wind direction data, refining existing emissions inventories, utilizing advanced technologies to estimate Juarez mobile source emissions, improving Juarez industrial emissions inventory, adapting EPA's PM-10 dispersion model for use in the area, developing a work plan for collecting data on ozone and other pollutants, and promoting widespread community involvement. In pursuit of this final goal, the project supports the Joint Air Quality Improvement Committee in its efforts. See O4.

Cost: The following grants have been awarded to support this project:

	FY95	FY96
Texas Natural Resource Conservation Commission	$539,000	339,900
City of El Paso	$200,000	275,000
New Mexico Environment Department	$100,000	33,818
Environmental Defense Fund	$30,000	60,000
DOE	$60,000	0
Contractor support	$639,800	632,400

The Compendium and Border XXI publications also document projects similar to the one described above to gather necessary data to develop effective air quality management programs in the Tijuana-San Diego/Mexicali-Imperial Valley, Ambos Nogales, Agua-Prieta-Douglas, and Brownsville/Laredo areas.

Technology Transfer Center

Through the Centro de Informacion Sobre Contaminacion de Aire (CICA) EPA provides a technology transfer center which includes access to EPA technical expertise through a Spanish-language hotline; specific technical assistance on particular air related problems; and Spanish language versions of technical documents.

Cost: FY95 $247,000 FY96 $100,000

Big Bend Air Quality Study and Carbon I-II ADVACATE Feasibility Study

Emissions Inventory Methodology Pilot Project

The Big Bend effort was intended to determine the likely impact from the Mexican Carbon I-II power plants on Big Bend National Park and to study the applicability of ADVACATE (dry scrubbing technology) to Carbon I-II. The Emissions Inventory project is an effort to better understand what sources potentially contribute to regional haze on the Colorado Plateau, which includes the Grand Canyon. These projects are necessary because air pollution from a variety of sources is greatly affecting visibility in many of the national parks.

Cost: FY94 $95,770 FY96 $300,000 (both to the National Park Service)

F03 U.S.-Mexico Border Environmental Indicators Report. 1997. draft document. www.epa.gov/usmexicoborder (Jun 25).

EPA released its draft of the document U.S.-Mexico Border Environmental Indicators for public comment in June 1997. The draft says that the Air Workgroup will concern itself with the following pollutants: CO, Pb, SO2, NO2, O3, PM-10 and VOCs. The draft also presents the four key indicators which the Air Working Group will use to inform regulatory agencies and the public as to the conditions of the air quality in any given area along the border. These indicators are:

1. Ambient air concentrations of the criteria pollutants in each sister city.
2. Areas that have exceedances of the ambient air standards.
3. Number of exceedances of each standard.
4. Emissions of pollutants.

F09 Record, Frank A. and Lisa A. Baci. 1980. Evaluation of Contribution of Wind Blown Dust from the Desert to Levels of Particulate Matter in Desert Communities. Environmental Protection Agency, EPA-450/2-80-078 (August).

This effort utilized existing data to determine the impact of wind-blown dust on desert cities trying to attain total suspended particle (TSP) requirements. The findings include that dust emanating from undisturbed desert surfaces contributes very little to the TSP issue. When the desert surface is disturbed by human activities, then TSP violations are quite likely. In the areas assessed, unpaved roads were a primary contributor to TSP and in most cases, increased population correlated with increases in TSP quantities.

F10 Kemp, Mary. undated. El Paso/Juarez Saturation PM-10 Study: December 8, 1989-December 18, 1989. Environmental Protection Agency 906-R-92-001.

This study was designed “to test a saturation PM-10 monitor, to characterize PM-10 concentrations in previously unmonitored areas of El Paso, to determine the adequacy of the current PM-10 network, and to establish a foundation for future joint U.S./Mexico studies.” The researchers concluded that the saturation monitor is an excellent screening tool for characterizing PM-10 concentrations, but will not likely be designated as a reference monitor. Results from the monitors show high PM-10 levels from the unmonitored areas in El Paso and Cd. Juarez, especially near La Hacienda restaurant which is only 200 feet from the border. Researchers recommended installing a reference monitor to ensure attaining the

National Ambient Air Quality Standard. Researchers also concluded that cooperative efforts such as this one are valuable as educational tools.

F11 Environmental Protection Agency. 1993. Motor Vehicle-Related Air Toxics Study. Technical Support Branch, Emission Planning and Strategies Division, Office of Mobile Sources, Office of Air and Radiation, EPA-420-R-93-005, (April).

This extensive report provides details on pollutants emitted from motor vehicles, both road and non-road sources. In response to requirements in the Clean Air Act, this report summarizes what is known about the following vehicle-related air toxics: benzene, formaldehyde, 1,3-butadiene, acetaldehyde, diesel particulate matter, gasoline particulate matter, and gasoline vapors. The focus of the study is on carcinogenic risk. The document provides aggregate cancer risk scenarios for each pollutant and describes how pollutant levels might change by using alternative fuels.

United States Army

F12 Gebhart, Dick L. and Thomas A. Hale. 1997. Evaluation of Dust Control Agents at Fort Campbell, Kentucky. U.S. Army Construction Engineering Research Laboratories Technical Report 97-69 (April).

Researchers applied three different dust control products to graded segments of three unsurfaced roads. Each road also included an untreated segment as a control. Using oil coated collection pans and videographic images, researchers assessed the level of dust control on four different dates over three months. The results showed that all treatments were effective for 30 days, but that between 30 and 90 days the effectiveness was reduced. The researchers overall conclusion was that calcium chloride provided good dust control over a wide range of conditions for 90 days or longer.

F13 Gebhart, Dick L., Thomas A. Hale, and Kim Michaels-Busch. 1996. Dust Control Material Performance on Unsurfaced Roadways and Tank Trails for Training Area Maintenance. US Army Environmental Center Technical Report (September).

Researchers applied five dust control products to three roads in .3 mile segments. Each road also included an untreated section as a control. Using oil coated pans and videographic images, researchers collected data on two different dates over two months. The results showed that all of the treatments were 50% better than the control area. The overall conclusion was that calcium chloride was slightly more effective than the other treatment products.

Los Alamos National Laboratory

F04 Barr, S., W.G. Buttler, D.A. Clark, W.B. Cottingame, and W.E. Eichinger. 1994. Lidar-Observed Wind Patterns in the Mexico-New Mexico-Texas Border Region. Lidar/Environmental Applications. Los Alamos National Laboratory. (9-11 September).

Following six ozone exceedances in the Sunland Park area and in anticipation of increased traffic and development in the area, various state and national agencies collaborated to conduct a study using Light Detection and Ranging (LIDAR) and Laser Doppler Velocimeter (LDV) to assess air quality issues on the Mexico, Texas and New Mexico borders. The specific objectives were to provide a data set which could be used to determine the effects of local meteorology and terrain upon pollution transport in the El Paso/Juarez/Sunland Park air shed; to provide base-line measurements for assessing the environmental impact of anticipated development; and to demonstrate the effectiveness of lidar remote sensing technology for air quality measurements. The investigators found that lidar and LDV measurements are remarkably consistent with each other, and therefore lidar is an effective tool for assessing air quality. The research also found that the low mixed layer height combined with the wind from the south and east likely causes the brown cloud near Las Cruces. Additionally, the report notes that because of the way in which ozone forms and the characteristics of the air movement near Sunland Park, efforts to assess the ozone problem must consider an area many kilometers to the south and east of Sunland Park. This effort found that the air above the urban areas of Sunland Park originates in El Paso and Juarez.

Sandia National Laboratories

F14 Einfeld, Wayne and Hugh W. Church. 1995. Winter Season Air Pollution in El Paso-Ciudad Juarez. Sandia National Laboratories prepared for the Environmental Protection Agency. SAND95-0273 (March).

This document provides a summary of air quality studies completed in the El Paso-Ciudad Juarez area over a 20 year span. It then presents information on a winter PM-10 study conducted by Sandia National Laboratories (SNL) under an agreement with the EPA. Results from this review and winter study include the following: industrial stationary sources are not a major contributor to PM; vehicle emissions in Cd. Juarez are on average three times those of vehicles in El Paso; vehicle miles traveled in El Paso are about three times those in Cd. Juarez; winter PM-10 levels are highest in the Cd. Juarez-El Paso downtown areas and in general increase toward Mexico; winter stagnation and complex terrain limit pollutant dilution; crustal sources (e.g. unpaved roads) contribute 38% and vehicles contribute 19% to PM-10 levels in the area.

Following are relevant studies included in the SNL review that are not already summarized in this ATRI report:

Bath, C.R (ed.). 1983. "Vehicles and Air Pollution in El Paso-Cd. Juarez." Center for Inter-American and Border Studies, University of Texas at El Paso, El Paso, TX.

This report features articles by several authors discussing a lack of correlations among topography, climatology, and traffic and various sites in the El Paso-Ciudad Juarez area; CO releases at international bridge crossings; using CALINE 3 to model CO levels near UTEP; the history of CO measurements in El Paso; CO grab sample studies finding "hot spots"; and CO levels near Fort Bliss.

Energy Technology Consultants. 1983. "Identification of the Sources of Total Suspended Particulates and Particulate Lead in the El Paso Area by Quantitative Microscopic Analysis: Volume I and Volume II." Murrysville, PA.

This study found that 50-85% of the total suspended particulates are from urban soil sources. This effort also concluded that analysis by microscopic analysis and by elemental tracer techniques were in agreement.

McElroy, J. 1990. "1989 El Paso-Juarez Particulate Pollutant Transport Study." Environmental Monitoring Systems Laboratory, Environmental Protection Agency.

Researchers conducted an airborne lidar study to ascertain the suspended particulate problem in the area and to select sites for a PM-10 monitoring study. The research combined lidar backscatter measurements with ground based aerosol concentration measurements and found that the two were often inconsistent at identical sites. They also discuss why these inconsistencies might exist. The study also provides specific information on using lidar effectively in predicting CO and PM-10 levels.

McDonald, C., M. Paganini, F. Romero, C. Becerra. 1990. "Study of Upper Air Winds in El Paso During an Air Stagnation Event (Visibility and Extinction Measurements)." Electrical Engineering Department, University of Texas at El Paso.

Ballard, H.N., M. Izquierdo, C. Tate, G. Romero, M. Paganini, C. Becerra, J. De La Reza. 1990. "Study of Upper Air Winds in El Paso During an Air Stagnation Event with Aerosol Measurements as Related to Visibility." Electrical Engineering Department, University of Texas at El Paso.

Using three measurement processes (tethered balloon, ground based, and camera) researchers document temperature inversions and indirect measurement of aerosol burden in the vertical dimension. These data are compared to lidar measurements taken concurrently. The camera based data were used to estimate extinction values.

Gray, H.A., C.A. Emery, M.P. Ligocki. 1991. "Modeling Program for the PM-10 State Implementation Plan Development for the El Paso/Ciudad Juarez Airshed." Systems Applications International.

This effort provided EPA with suggestions for modeling approaches to develop the state implementation plan. At least 15 models were reviewed and the researchers concluded that a dispersion model such as UAM in conjunction with a receptor model would be most effective. They also note that the lack of source information from Mexico is likely to be a problem in any modeling effort.

Stedman, D.H. 1993. "Interim Report on Vehicle Measurements in El Paso, Texas and Juarez Mexico" and "Second Interim Report on the [El Paso-Cd. Juarez] Remote Sensing Study." University of Denver.

Researchers developed an infrared remote sensing unit that can measure CO2, CO and hydrocarbon tailpipe emissions. Results from this remote sensing was that CO and HC emissions in Cd. Juarez are roughly three times those in El Paso.

Energy and Environmental Analysis, Inc. 1993. "A Version of the MOBILE5 Emission Factors Model with User-Revisable Input Data Files."

The consultants revised the MOBILE5 code so that it would apply to Cd. Juarez vehicles.

Texas Transportation Institute. 1994. "Ciudad Juarez MOBILE5 Data Collection."

Researchers gathered data on the Cd. Juarez vehicle fleet to yield better MOBILE5 inputs.

Department of Transportation

F05 Federal Railroad Administration. 1993. Environmental Externalities and Social Costs of Transportation Systems—Measurement, Mitigation and Costing: An Annotated Bibliography. (August).

This bibliography provides summaries of books, journal articles, conference papers, and other publications that all pertain to transportation and the environment. Listings in the General section include information on conducting cost-benefit analyses that incorporate all costs including effects from air pollution and other environmental impacts. The bibliography also includes one section on air pollution related publications. Following are some of the most pertinent summaries from this section:

"Health Effects of Tropospheric Ozone," Morton Lippman, Environmental Science and Technology, Vol. 23, No. 12, 1991.

This paper discusses ozone variation indoors and outdoors and finds that ozone concentrations are actually lower in the vicinity of heavy motor vehicle traffic. This is because the chemical interactions right near heavy traffic simply result in ordinary oxygen. But, in areas away from the traffic ozone concentrations will increase. Researchers also note that there is little data on chronic effects of human exposure to ozone. The paper concludes that ozone formation can be controlled only by reducing ambient air concentrations or hydrocarbons of NOx.

"Changing Ozone, Evidence for a Perturbed Atmosphere," Stuart A. Penkett, Environmental Science and Technology, Vol. 25, No. 4, 1991.

This article discusses the loss of stratospheric ozone which blocks UV rays and the increase in ground level ozone, which damages vegetation. It notes that this shift in concentrations will influence temperature profiles.

Transport Policy and the Environment, European Conference of Ministers of Transport (ECMT), ECMT 1989 Ministerial Sessions, prepared in cooperation with the Organization for Economic Cooperation and Development (OECD), Paris, France, 1990.

This report describes differences in exhaust characteristics between gasoline and diesel engines and it details what share these emissions contribute to overall man-made pollutants. The report also notes that any actions to encourage alternative modes of transport will require political will and a major information campaign. It recommends that any effort to harmonize taxes and charges in international road freight transport should consider the environmental damage from such traffic.

Rethinking the Ozone Problem in Urban and Regional Air Pollution, Committee on Tropospheric Ozone Formation and Measurement, National Research Council, National Academy of Sciences, Washington, DC 1992.

The Committee's findings include that current emissions inventories significantly underestimate anthropogenic emissions of VOCs. They also found that while alternative fuels can improve air quality, this does not alleviate the problem associated with the fact that as vehicles age their emissions increase.

Meeting Mobility and Air Quality Goals: Strategies that Work, Jon Kessler and William Schroer (draft paper) USEPA, Office of Policy Analysis, February 10, 1993.

Discusses the interaction between meeting air quality standards and revising transportation demand. The authors suggest that it may be necessary to go beyond traditional measures. Suggestions include "feebates" for low emission, high mileage cars; increased fleet turnover to get older cars off the roads; financing roads through VMT taxes; congestion pricing; re-evaluating need for parking; expanding telecommuting.

Searching for Solutions, A Policy Discussion Series, Transportation and Air Quality, US DOT, Federal Highway Administration, Office of Policy Development No. 5, Washington DC, August 1992.

This paper concludes that significant reductions in mobile source emissions through reductions in travel would be hard to achieve without fundamental changes in US policy regarding transportation pricing and land use.

Changing by Degrees: Steps to Reduce Greenhouse Gases, Office of Technology Assessment, Washington DC 1991.

In response to a Congressional inquiry about reducing CO2 emissions, OTA reported that 32% of US CO2 emissions are from transportation. The specific percentages are as follows: autos, 43%; light trucks, 20%; heavy trucks, 14%; aircraft, 14%; rail and marine combined 7%; and non-oil based, 2%.

Region-Wide Toll Pricing: Impacts on Urban Mobility, Environment; and Transportation Financing, Anthony Kane, Patrick DeCoria-Souza, Congestion Pricing Symposium, US DOT Washington DC June 1992.

Working from the basis that ISTEA provides incentives for congestion pricing strategies, this paper suggests that highway tolls can be used to reduce congestion and air pollution and that they appear to be more politically acceptable than other pricing mechanisms.

F06 US Department of Transportation. 1993. Intermodal Technical Assistance Activities for Transportation Planners. (August).

F06 US Department of Transportation. 1994. Intermodal Technical Assistance Activities for Transportation Planners and Policymakers. (December).

These documents provide summaries of courses, reports and other publications to assist planners in addressing various transportation-related issues. In the section on air quality, there are several items relevant to this project.

FHWA, Evaluation of "Mobile" Vehicle Emission Model, September 1993.

This report evaluates the EPA's MOBILE model with emphasis on its utility in evaluating transportation activities.

NHI, Fundamentals of Air Quality for Highway Planning and Project Development, available since 1993.

This course covers all aspects of transportation planning and project development with regard to regulatory requirements, analysis techniques, emissions trends and characteristics, and atmospheric and meteorological conditions of concern.

EPA and FHWA, Transportation and Air Quality Planning Guidelines.

This document provides guidance for meeting the National Ambient Air Quality Standards.

EPA and FHWA, Vehicle Miles Traveled (VMT) Forecasting and Tracking Guidelines

This guidance material assists agencies in meeting the National Ambient Air Quality Standard requirements regarding VMT forecasting and tracking.

NHI, Environmental Training Center

The Center provides training to transportation agency personnel to enable them to manage the environmental process, including integrating environmental considerations into policies and procedures and meeting all requirements.

FTA, FHWA, NARC. NARC Clean Air Project

This effort helps planners coordinate DOT and EPA activities related to air regulations.

NHI. Project Development and Environmental Documentation

This course explains the development process for federal-aid transportation projects and includes information on environmental permitting requirement*s and interagency coordination.*

FRA. Transportation and the Environment

The Federal Railroad Administration has published an annotated bibliography which includes publications covering topics related to policy and transportation issues relevant to the environment**.**

F07 US Department of Transportation, Federal Highway Administration. 1994. Workshop on Transportation Air Quality Analysis. NHI Course No. 15265. FHWA- HI-94-011 (Sept).

This document is the actual course book for an NHI course. The course provides instruction on various items including modeling, monitoring, forecasting, and planning.

Transportation Research Board

F08 Cottrell, Wayne D. 1992. Comparison of Vehicular Emissions in Free-Flow and Congestion Using MOBILE4 and Highway Performance Monitoring System. Transportation Research Record: Air Quality, Environment and Energy. Transportation Research Board No. 1366.

This study compares free-flow condition emissions with congested condition emissions. The researchers conclude that the MOBILE4 model assumes that the amounts of cruising, acceleration, deceleration, and idling (driving cycle elements) during the tests are applicable to all driving situations. This research found that an ideal model would integrate exhaust emission estimates with ambient traffic conditions to account for differences in time spent in the four stages of the driving cycle. Such a model would be better suited to quantifying and comparing free-flow and congested conditions. This study noted that CO and HC emissions are greater in congestion than in free-flow traffic in urban areas, but NOx emissions are lower. Therefore, efforts to ease congestion will likely reduce CO and HC emissions, but may increase the NOx levels.

New Mexico Government Sources

The Air Quality Board within the State of New Mexico Environment Department provides data and other information on air quality along the border.

Air Quality Bureau, New Mexico Environment Department

N01 Air Quality Bureau. New Mexico Air Quality 1991-1993. Environment Department, State of New Mexico.

Researchers have used a unique measurement technique for each criteria and non-criteria pollutant.

PM-10: For 24 hours air is drawn through a quartz filter which prevents particles greater than 10 microns from entering. The concentration of PM-10 is calculated by the difference in weight gained by the filter, divided by the volume of air sampled. Samples are taken everyday, every other day or every sixth day depending on the site.

SO2: The AQB uses EPA approved pulsed fluorescence based monitors which monitor continuously.

CO: Monitoring utilizes non-dispersive infrared spectrometry.

O3: AQB uses continuous ultra-violet photometric monitors to assess ground level ozone levels. AQB does not measure stratospheric ozone.

NO2: AQB utilized chemiluminescent monitors.

Pb: Total suspended matter samplers are used to collect TSP and these samples are analyzed by atomic absorption spectroscopy to determine the ambient lead concentrations in the air.

TSP: Every sixth day samples are collected for a 24 hour period by drawing air through glass fiber filters via a high volume sampler. TSP (Total Suspended Particles) is calculated by dividing the weight of particulate collected on the filter by the volume of air sampled.

The data from 1991-1993 show that in general, there has been a trend for ground level ozone to increase while lead has decreased. The other criteria pollutants show fluctuations throughout the years without any discernible trend. The document provides data for various New Mexico localities for the criteria pollutants.
This Annual Report also includes a special study of the ozone situation in Dona Ana County. In 1992 and 1993 La Union exceeded the ozone limit once in August 1993 and Sunland Park experienced 5 exceedances in September 1992, August and November 1993. The researchers assume that the ozone exceedances are simply extensions of the ozone problem centered in El Paso and Cd. Juarez. The data show that the patterns of the New Mexico exceedances very closely match the pollutant patterns in El Paso. The data also show that ozone concentrations occur at low wind speeds, but not when the wind is completely calm. The wind patterns reflect that the source is likely the El Paso area. The data also show that the ASARCO industrial plant is not likely an ozone contributing source.

Environmental Assessments

Along the New Mexico-Mexico border there have been several transportation projects in recent years which required environmental assessments. Six of the most pertinent EAs are summarized here. All concluded that the specific project for which they were conducted would have no adverse impacts on local air quality.

E01 New Mexico State Highway and Transportation Department (NMSHTD). 1988. Environmental Assessment for State Road 11-Mexico Border. F-013-1(21) (Oct).

The conclusions from this EA state that because other studies for projects with projected low traffic rates showed no expected environmental impacts, this project should have no significant impact.

E02 Wilson & Company. 1992. Santa Teresa Transportation and Environmental Study: Environmental Assessment. (December).

This environmental assessment was completed for the Artcraft road extension in the Santa Teresa, NM area. The section on air quality concludes that the Artcraft extension will ultimately reduce air pollution in the area. Using EPA's MOBILE 4.1 emissions model and the California Line Source Dispersion Model, researchers estimated hourly CO concentrations at potentially affected "receptor" locations. The 1991 one-hour and eight-hour CO concentrations range from 4.9 to 6.3 and from 3.0 to 3.8 respectively.

E03 Marron Taschek Knight, Inc. 1993. Environmental Assessment for Santa Teresa Border Crossing Station. Prepared for the State of New Mexico General Services Department and United States General Services Administration (July).

The FHWA and EPA accepted a conformity finding with regard to this project because the planned transportation network will help reduce mobile emissions in the area. Results from MOBILE 4.1 and CALINE3 show that CO levels will not exceed or approach the NAAQS by the year 2010. Additionally, this EA finds that the traffic associated with the border crossing is not expected to create adverse impacts from ozone, hydrocarbons, NOx or PM10.

E04 Bohannan-Huston, Inc. and Taschek Environmental Consulting. 1995. Environmental Assessment: Extension of Sunland Park Drive, Dona Ana County, New Mexico. Prepared for the New Mexico State Highway and Transportation Department. (May).

This assessment noted that Anthony, NM was a potential nonattainment area for PM10 but that the sources appeared to be natural. The investigators used EPA's MOBILE5a and CAL3QHC to model CO dispersion. They concluded that the project would not lead to increases which would violate the NAAQS standards. The air quality section of this assessment concluded that the overall effects of the project were not substantial and that it was likely that the project would improve air quality by reducing congestion and delay.

E05 Molzen-Corbin and Associates and Taschek Environmental Consulting. 1996. Environmental Assessment for New Mexico 273 Improvements, Dona Ana County, New Mexico. Prepared for the New Mexico State Highway and Transportation Department in cooperation with The Federal Highway Administration.

This project is included in the TIP that the El Paso MPO prepared for the Sunland Park area. The addition of SOV lanes is justified because "they would help reduce future congestion created by locally generated traffic." Modeling efforts with MOBILE5 and CAL3QHC show that CO concentrations will increase slightly without the proposed project because traffic will increase regardless and without the improvement, congestion will worsen. Although not required to address ozone issues within the confines of a specific project, the EA notes that the El Paso conformity analysis shows that hydrocarbons and NOxs will decline in the area in the future because of more efficient transportation system. It is anticipated that PM10 levels will increase with or without the project. Overall the EA concludes that the project poses no significant human or environmental impacts.

E06 JHK & Associates. 1996. Environmental Assessment for Proposed Improvements to NM 478 (Anthony to Mesilla Park). Prepared for the Federal Highway Administration and the New Mexico State Highway and Transportation Department. (July).

This assessment concluded that the air quality at the north end of the project will improve following this project. The area under consideration lies outside the designated nonattainment area that surrounds Sunland Park and therefore the requirements for a non-attainment area do not apply. Finally, the assessment concluded that particulate matter in the Anthony area, which was a nonattainment area, would be reduced as a result of the project.

Academic Sources

Academic institutions represent the greatest source for research on border air quality issues with relevance to transportation. Specifically, the Southwest Center for Environmental Research and Policy (SCERP) provides excellent information on this topic. This consortium of universities has produced numerous studies which contribute to our understanding of air issues along the border. Most of the studies listed here were culled from the SCERP database that is available through the Internet. Because this effort is concerned with transportation related air quality issues, we did not include SCERP projects which focused on stationary sources.

Because academic funding is often year to year, projects are often divided into single-year efforts with continuations should funding become available. Many of the projects listed below are multi-year efforts, but each funded phase is treated as a separate effort and is granted its own identification number. The following summaries are organized by the institution. This document includes the most current information that was available through electronic means. For those projects that are still ongoing, or that have not updated their electronic report, the information from available abstracts is presented.

Arizona State University

A01 "Monitoring Air Pollution in Natural Areas of the Southwest," Dr. Thomas Nash, III, Arizona State University

(1991-1992)**--**This project was designed to identify lichen species in Baja California compared with Southern California which may have use as air monitoring tools. The researchers tested several species as to their sensitivity to SO_2 and determined the relationship between moisture and ion deposition. The results found that one particular species, *Evernia prunastri*, is the most sensitive to sulfur dioxide. Other species were also assessed at various concentrations of SO_2. The point of this research is that by using lichen sensitivity as a guide, we may better be able to identify when air quality is most adverse.

A02 "Airshed Models in Arid Regions" Dr. Neil Berman, Arizona State University

(1991)**--**This initial effort analyzed PM-10 measurements and the wind field in Nogales to determine how to proceed with additional study. See A03-A06.

A03 "PM10 Air Quality in Nogales," Dr. Neil S. Berman, Arizona State University

(1992)**--**This effort demonstrated that by using a combination of synoptic climatology in conjunction with physical modeling, researchers can identify meteorological characteristics of high pollution and local surface wind fields for Nogales. The point is to show that this technique can be used as a cost effective adjunct or even a substitute for large field studies or numerical models. See A04-A06.

A04 "PM-10 Air Quality in Nogales," Neil S. Berman, Dept. of Chemical, Biological, and Materials Engineering, Arizona State University

(1993)**--**The goal of this ongoing effort is to use synoptic classification, numerical modeling and physical modeling to identify sources of air toxics and small particulate matter in complex terrain and to determine population exposures to these air pollutants. Using these techniques, researchers should be able to identify characteristics of high pollution areas and times as well as identify "hot spots" with long term exposure potential. From their efforts, researchers found that six components explained 81% of the variation in the data. Four were clearly identified; air temperature and dew point; east-west and north-south wind scalar; pressure; and cloud cover. Components 5 and 6 are less clear although diurnal changes are identifiable. Researchers also found that three air mass profiles for high-pollution days had relatively similar characteristics. They have large diurnal temperature variations, dry air-mass, and light winds. This effort did identify a potential "hot spot" in Nogales, Arizona and they are attempting to refine their analysis to confirm this finding. See A03-A06.

A05 "PM-10 Air Quality in Ambos Nogales," Neil S. Berman and Anthony J. Brazel, Arizona State University

(1994)--In this continuing project, researchers were attempting to contribute to the data bank of knowledge about how pollutants move in an area with complex terrain. They used a grid point dispersion model and a synoptic index for the Nogales region with data from 1973 to 1993. The results show that high pollution days had low surface wind speeds, low cloud cover, and a large diurnal temperature range. To determine the correct parameters in the Diagnostic Wind Model, the researchers developed a synoptic index for Phoenix for 1948-1993. The researchers concluded that more work needs to be done to develop proper scaling for three dimensional valley wind flow, as their results could not be transferred to another valley. These efforts found that the highest pollutant concentrations in the US are at most 40% of those in Mexico. This research is documented in several graduate theses. See A03-A06.

A06 "Physical Modeling of Drainage in the Rio Grande River Basin," Dr. H.J.S. Fernando, Arizona State University

(undated)--This project was intended to develop physical models to assess the effects of diurnal heating and cooling on wind systems in complex terrain. The El Paso region was selected for study. Researchers developed a "long ridge model" to approximate the Franklin Mountain region. Unfortunately the model was not sufficiently sturdy to provide reliable results. The information gathered in this effort was transferred to efforts in the Nogales area. See A03-A05.

A07 "U.S.-Mexico Air Quality Climate," Dr. Anthony Brazel, Arizona State University

(1991-1992)--Using the Temporal Synoptic Index (TSI) approach, researchers constructed a database of long-term synoptic climatology for the U.S.-Mexico border region. This was one of several projects to look at border climate issues with the TSI approach that combined forces to do comparative analysis. The goal is to provide an understanding of the frequency and magnitude of atmospheric conditions on a regional scale, as such data are needed as inputs to dispersion models.

A08 "Airborne Particles Along the Arizona-Sonora Border," Dr. Peter Buseck, Arizona State University

(1991)--The goal of this project was to characterize the particles in the ambient aerosol along the Arizona-Sonora border and to distinguish background from anthropogenic sources. From the samples taken in Douglas, Nogales and Tombstone, researchers grouped the results into a fine and a coarse fraction. Within the fine fraction, 39% was anthropogenic and within the coarse fraction, 10% was anthropogenic. Among these particles, sources were listed as unpaved roads, construction, fly ash, and cement. These were likely originating from a lime processing plant, or large scale construction. Other emissions were likely from a copper smelter. See A09.

A09 "Airborne Particles Along the Arizona-Sonora Border," Peter Buseck and James Anderson, Center for Environmental Studies, Arizona State University.

(1994)--This continuation project was designed to address source identification, transport and fate of aerosol particles. The researchers developed a superior receptor model which was then used to analyze bulk PM10 data. The results showed that from a 1988 Nogales AZ site, the two main sources in the fine fraction were a sulfur source and traffic on unpaved roads. In samples from Douglas, Nogales, and Tombstone in 1991, the dominant components in the fine fraction were $(NH4)2SO4$ (60%) and particles from traffic on unpaved roads. The coarse fraction was dominated by wind-blown dust and dust suspended by traffic on unpaved roads. In 1992 in Nogales fly ash was the largest source, with traffic on unpaved roads and waste incineration also contributing.

A10 "Analysis of Upper Air Climatology to Support Research on Air Quality of the U.S.-Mexican Borderlands," Anthony J. Brazel, Arizona State University.

(1994)--This project was designed to improve the data bank needed to effectively apply air quality models. The goal was to specify meteorological and climatological related information for modeling air flow in the Nogales area. More specifically this effort was interested in variations in temperature and wind in the boundary layer zone. The results found that in low flow cases and for diurnally varying wind in line with local topography in the El Paso region, that boundary layer wind profiles were consistently different below terrain obstacle height, as compared to above that level in the free air. Temperature profiles revealed strong inversions, particularly in the morning below the 200-400m above ground level. Additionally, this work found excellent correlations among various data sources and the researchers concluded that UTEP's Doppler Radar and Radio Acoustic sounder (DRRAS) data and the National Weather Service (NWS) surface observations may be sufficient for most applications in specifying the extremely low level inversion characteristics of the boundary layer environment.

A11 "Complex-Terrain Airshed of El Paso-Ciudad Juarez-Sunland Park Basin: Flow and Dispersion," Neil S. Berman, Arizona State University

(1997 abstract)--The goal of this effort is to test a new non-equilibrium sub-model for vertical mixing. Collaborating with Mexican investigators, this effort hopes to determine vertical mixing differences on slopes versus in the river valley in El Paso and Juarez.

Colorado State University

A12 "A Characterization of Border Vehicles: Emissions and Maintenance Profile, Cost Effective Repair, and Air Quality Impact," Lenora Bohren and Birgit Wolff, National Center for Vehicle Emissions Control and Safety, Colorado State University

(1994)-- Goals of research were to characterize vehicles crossing the border; determine vehicle mechanical condition; perform diagnostics on polluting vehicles; report emissions reductions after repairs on "gross" polluting vehicles; develop owner/vehicle maintenance profiles; and finally to develop a database to analyze vehicle distribution, fleet emissions characteristic; and diagnostic and maintenance/ repair costs.

In general the remote sensing results showed that CO emissions are a greater problem on the Zaragosa Bridge than HC emissions. For idle emissions, 46% of vehicles had excessive HC and 41% had excessive CO emissions. More of the vehicles originating in Juarez exceeded the emissions than vehicles from El Paso. Surveys found that motorists are truly concerned about clean air, but they do not necessarily understand what maintenance is needed to ensure clean air. About one in four of the participants had tampered with their vehicles' emissions systems. Juarez residents were more likely to tamper with more items at a higher frequency than El Paso residents.

A43 "Characterizing Border Vehicles in Mexicali," Lenora Bohren, National Center for Vehicle Emissions Control and Safety (NCVECS), Colorado State University

(1997 summary)--Following upon the success of the effort to assess border vehicle characteristics in the El Paso-Cd. Juarez region, NCVECS conducted a similar study in the Mexicali area. Preliminary results correlate with the findings from the El Paso-Cd. Juarez area study. Formal results should be available within a year.

A44 Sanders, Thomas G., Jonathan Q. Addo, Alex Ariniello, and William F. Heiden. 1997. "Relative Effectiveness of Road Dust Suppressants." <u>Journal of Transportation Engineering</u> 123:5 (393-397).

Researchers compared fugitive dust emissions from an unpaved road treated with three different dust suppressants. One segment of the road was left untreated as a control. Additionally, the researchers measured the total aggregate loss from the road surface. A total of 15 dust sampling measurements were taken using the "Dustometer" developed at CSU. This device is a small box containing a vacuum pump and a filter that can be attached to the bumper of a vehicle and thereby collects dust as the vehicle travels the roadway. This effort concluded that the suppressants do substantially reduce fugitive dust. Under this experiment's high temperature and low humidity conditions, the lignosulfonate was the most effective. Additionally, the treated sections reflects 42-61% reduction in total aggregate loss compared to the control section. The researchers also calculated that a road requires a average daily traffic rate of at least 120 to make dust suppressants cost effective.

A45 Addo, Jonathan Q., and Thomas G. Sanders. 1995. Effectiveness and Environmental Impact of Road Dust Suppressants. Mountain-Plains Consortium, Colorado State University, (March).

This study concluded that the Dustometer was a precise and inexpensive dust measuring device. The researchers concluded that lignin produced less dust than other treatments, although all treated sections were superior to no treatment. This effort also showed that $MgCl_2$ lost the least aggregate of all the treated sections, followed by lignin. Researchers also conducted a cost comparison and found that treating a road with lignosulfonate or chloride compounds saves 30-46 percent over untreated roads. The environmental analysis showed no detrimental contaminant levels in runoff.

Instituto Tecnologico y de Estudios Superiores de Monterrey

A13 "Seasonal Characterization of Inorganic Contaminants Associated to Suspended Particle Matter and Evaluation of its Possible Effects on Children's Respiratory Health in Nuevo Laredo, Mexico," Enrique Vogel Martinez, Instituto Tecnologico y de Estudios Superiores de Monterrey.

(1995 abstract)--This effort hypothesizes that respiratory health effects may be magnified by the presence of certain chemical substances with the particulate matter. Researchers will use 24 metals and 16 polycyclic aromatic hydrocarbons to indicate chemical pollution carried in particulate matter.

New Mexico Institute of Mining and Technology

A14 "Reactive Atmospheric Organic Compounds in the El Paso, Texas - Ciudad Juarez, Mexico Airshed," Carl J. Popp and Randal S. Martin, New Mexico Institute of Mining and Technology

(1995)--This project proposed to quantify atmospheric concentrations and seasonal and diurnal behavior of various organic compounds in the El Paso air shed. Researchers conducted to field studies, one in winter and one in summer with samples collected from existing monitoring stations in both El Paso and Cd. Juarez. Findings for regulated compounds included average readings as follows:

	El Paso		**Cd Juarez**	
	sum	win	sum	win
CO (ppm)	1.7	1.6	.5	1.1
O3 (ppb)	31	12.3	35.2	15
NO (ppb)	18.8	54.7	--*	15
NO2 (ppb)	30.5	42	--*	33.7

*equipment failure, no readings

Researchers note that the observed time of day differences in compound levels between El Paso and Cd Juarez may be attributable to culture differences (i.e. peak traffic times). Spikes in winter levels of NO and NO2 within Cd Juarez likely reflect heating practices and seasonal meteorology. The ozone patterns are quite similar for both cities in summer and winter. This research also provides data on non-regulated species.

New Mexico State University

A15 "Technology Transfer: Air Quality Control and Pollution Prevention in the Border Region," Soumen Ghosh, New Mexico State University

(1994)**--**Researchers conducted surveys in Cd Juarez to determine individual willingness to pay for technology or products to improve air quality and to determine industries' willingness to comply with air pollution standards in the border region. Conclusions of report note that similar research needs to be conducted on the El Paso side. Notable results:

Households with autos are less willing to pay for air pollution control
62% seem more concerned with aesthetic aspects of air pollution than with health issues
93% said at least one member of household has health problems related to air pollution
Issues of public/private efforts/management are important
Citizens would prefer to have NGOs deal with air quality than the government
Indications that there is a willingness to decrease hours on unpaved roads
There is a conscious effort, particularly among maquila plants to abide by air quality standards
Maquila plant managers do not view air pollution as a serious issue

A16 "Spanish Translation of EPA Air Monitoring Training Courses with Attention to the Cultural Values of Border Peoples," Bonnie Daily and Erin Ross, New Mexico State University

(1994)**--**As the title implies, this project resulted in several manuals and videotapes being translated and dubbed into Spanish. Such projects are often difficult due to the technical nature of the text and differences in cultures.

A17 "Protection of Visibility and Air Quality at Big Bend National Park," Richard Okrasinski and Jose M. Serna, Physical Science Laboratory, New Mexico State University.

(1994)**--**The goal of this project was to analyze atmospheric data from Big Bend National Park and at cities in the park's vicinity to determine the diurnal, seasonal, and spatial characteristics of the atmosphere within the area. Existing data from 1988 for surface wind, temperature, humidity in 16 cities in the area and from 7 radiosonde sites combined with similar data collected in 1991-93 in Big Bend were analyzed statistically to assess variation in conditions and visibility. The general conclusion was that visibility at Big Bend is best in January and poorest in late summer. Additionally, there was significant diurnal variation with poorest visibility in early morning before dawn and best visibility in late afternoon. This effort identified specifics in seasonal variation in wind patterns. See A18**-**A19.

A18 "Trajectory and Model Analysis of Wind Flow into Big Bend National Park," Richard Okrasinski, New Mexico State University

(1996 abstract)**--**This is a continuation of efforts to assess the reduction in visibility at Big Bend. Researchers plan to use trajectory analysis and wind modeling to provide a more detailed characterization of the wind flow in the area. The effort will use the National Park Service atmospheric model, CALMET, and the Department of Defense models HOTMAC/RAPTAD to produce gridded wind fields of the region. The models will be executed for several days with simultaneous runs so that the results from various models using the same data can be compared. See A17, A19.

A19 "Investigation of Point Source Emissions Effects on Air Quality at Big Bend National Park Using GIS," Richard J. Okrasinski, New Mexico State University

(1997 abstract)**--**Reduced visibility in the Big Bend National Park area prompted researchers to attempt to identify exact sources for pollutants in the region. This effort will use geographical, pollutant emission, meteorological and climatological data in a GIS system to visualize and analyze the transportation and concentration of various pollutants in the area. This is a continuation of A18.

A20 "SCERP Sponsorship of BECC Workshops," Erin Ross, New Mexico State University

(1995-6)**--**Researchers secured participation of SCERP investigators in workshops designed to promote private sector participation in the BECC project proposal process. Workshops were held in Brownsville, Phoenix, San Diego, and Albuquerque throughout 1995 and 1996.

A21 "Characterization of Border Vehicles: An Expanded Border Vehicle Emission, Maintenance and Willingness to Pay Profile," Soumen Ghosh, New Mexico State University

(1996 abstract)**--**This study plans to concentrate its efforts on the border between Calexico and Mexicali and will collect data on 500 light-duty vehicles. The abstract is written to be a companion effort to A12.

A22 "Measurements of Air Quality in Cd. Juarez, Chih., Mexico," Charles W. Bruce, New Mexico State University

(1997 abstract)**--**The researchers plan to conduct an in situ measurement and analysis program consisting of near-ground level surveys and vertical profiles for a comprehensive catalogue of molecules and particulates. This effort builds on a US Army funded study which focused on periods of heavy air contamination. This continuation will assess all-hours, and all sectors of the city. This data will contribute to an improved database which can be used for risk assessments and modeling.

A46 Kennedy, Bruce, Jose Serna, James Pridgen, Damian Kessler, Richard Okrasinski, James Moran, Gary Steele, John Fox, and Richard Savage. 1994. <u>Border Area Air Quality Study 8-11 September 1994</u>. Physical Science Laboratory, New Mexico State University and US Army Research Laboratory, White Sands Missile Range, NM (November).

This collaborative effort was designed to assess meteorological effects on pollution transport and to provide a baseline to examine NAFTA induced increases in traffic in Dona Ana County. This effort did produce a large volume of meteorological data that provides evidence that ozone may be transported from the El Paso area into southern New Mexico. The data, however, also include unexplained localized deviations in wind direction. Carbon monoxide measurements were taken which could provide baseline information for future efforts. The technology used during this effort clearly demonstrated the viability of using government-developed technology in local air pollution assessment projects.

San Diego State University

A23 "Sources of Air Pollution Along the Border: Analysis of Data, Databases, and Information," Alan Sweedler and Paul Ganster, San Diego State University

(1994)**--** The project established a database that identifies and characterizes principal sources of air pollution along the border. This effort focused on power generating and transportation sectors, including documenting quantities and types of fuels used, and profiles of transportation fleets. Most data were gathered in the California/Baja California region and the study concluded that mobile sources account for the majority of emissions in the San Diego-Tijuana area. Unleaded fuel is largest single type of fuel consumed in Baja California. In 1995 almost 700,000 diesel trucks crossed into CA. The research goal was to provide reliable information so that emission rates can be estimated and better policy for reducing emissions and pollution can be generated. This project recommends establishing an Internet accessible border information source.

A24 "An Integrated Cross-Border Geographic Information System for the San Diego - Tijuana Interface," Richard Wright and Ernst Griffin, San Diego State University

(1994)--This is a cross category, multi-year effort. The goals included developing a GIS database associated with the Tijuana River watershed; assisting in developing uniform data standards for border GISs; investigating options for sharing data across the border; modeling air pollution in the Tijuana area using remote sensing and GIS techniques; analyzing the impact of urban expansion within the study area on air quality, and downstream water demand, quality and pollution; modeling multiple species preserve designs; and training researchers in border GIS research. The first year of the effort resulted in recommendations on GIS data standards, an inventory of border GISs along the California-Baja California section, and an enhancement and integration of existing databases. In the second year, researchers integrated a GIS system in the San Diego/Tijuana region; began efforts to estimate the spatial characteristics of vehicle generated PM; began modeling air quality issues related to industrialization; began amassing data to provide a historical trend of land use and population growth for Tijuana; mapped vegetation on the Mexican side following the model already completed in the US; and researchers have worked closely with their Mexican counterparts to discuss data sharing, integration, and standards.

A25 "SCERP Environmental Program Facilitation with the EPA Border Offices in El Paso and San Diego, and the Border Environment Cooperation Commission and the Presentation of Community Border Forums," Paul Ganster, Frank Medeiros and Cliff Metzner Coordinators, San Diego State University.

(1994)--Investigators prepared briefings for communities on air pollution and other environmental issues. The goal is to provide resources to enable SCERP institutions to work with the EPA Border Offices and with BECC on outreach activities.

A26 "Modeling Emissions from Heavy-Duty Trucks in the California-Baja California Border Region," Alan Sweedler, San Diego State University

(1997 abstract)--Because heavy duty trucks (>8,500 pounds) are a significant source of particulate matter and because truck traffic along the border has increased since NAFTA, researchers plan to develop a modeling method for estimating emissions. This effort will include gathering pertinent information on truck fleets such as age, make, model, vehicle miles traveled, average speed, zero mile emission levels and deterioration rates.

Texas A & M University

A27 Knowles, William E. and George B. Dresser. 1995. Urban Airshed Model Sensitivity to Mobile Source Emissions. Texas Transportation Institute, Texas A & M University. Prepared for the Texas Department of Transportation (October).

This study was based on the hypothesis that the Urban Airshed Model (UAM) is sensitive to large changes in mobile source emissions, but that there was little evidence as to it's sensitivity to small changes. This effort provided a preliminary conclusion that UAM is not sensitive to small changes in mobile source emissions. Additionally, this study found that it is possible that UAM sensitivity varies among non-attainment areas. This document provides emission levels for non-attainment areas in Texas for VOCs, NOx and CO. In the El Paso area, mobile sources are the dominant emission sources. Mobile sources comprise 40.3% of all VOC emissions, 51.2% of NOx emissions, and 95.8% of CO emissions in El Paso.

University of Arizona

A47 Comrie, Andrew. 1996. An All-Season Synoptic Climatology of Air Pollution in the U.S.-Mexico Border Region. Professional Geographer 48:3 (237-251).

This paper analyzes climatological issues related to air pollution along the border. Most specifically, it looks at atmospheric circulation in the border region and the relationships between synoptic conditions and ground-level ozone. It identified six characteristic circulation patterns and presents seasonal and region-wide variations in ozone which correlate with climatic patterns.

University of Denver

A42 Zhang, Yi, Donald H. Stedman, Gary A Bishop, Stuart P. Beaton, and Paul L. Guenther. 1996. "On-Road Evaluation of Inspection/Maintenance Effectiveness." Environmental Science & Technology (30): 1445-1450.

The researchers examined the relationship among centralized and decentralized I/M programs and declines in CO and HC emissions in several US cities, including El Paso. They conclude that I/M programs have not met EPA predicted results and that therefore there is little reason to assume that enhanced I/M programs would be any more successful.

University of Texas at El Paso

A28 Gingerich, Willard P. (ed.) 1981(?). Air Quality Issues in the El Paso/Cd. Juarez Border Region. Center for Inter-American Studies University of Texas at El Paso Occasional Papers #5.

This document pulled together several papers on various aspects of air quality along the border.

Herbert, Jacqueline S., Robert M. Canderlaria, and Howard Applegate. "A Survey of Total Suspended Particulates and Heavy Metal Levels in the Ambient Air of El Paso, Texas from 1972 To 1979."

Researchers collected 3,778 samples from four locations and examined them for contaminants. From 1972-1975 researchers sampled every third or fourth day on a 24-hour basis. From 1975-1979 they sampled for a 24 hour period every sixth day. Testers used a digestion process and analysis by atomic absorption spectroscopy. The results showed elevated pollutant levels at sites east of Paisano Drive (located near the Texas, New Mexico border) in the first and fourth quarter of each year and elevated levels to the west in the second and third quarters. Levels of TSP, lead, zinc, cadmium and arsenic are generally consistent despite increases in population and registered vehicles.

Applegate, Howard. "Carbon Monoxide Concentrations in El Paso for 1977."

Researchers divided CO emissions into three broad categories: local, those emissions from vehicles driving in El Paso; federal, CO emitted by vehicles waiting to pass through customs and federally registered vehicles driving on Fort Bliss; foreign, CO emitted in Cd. Juarez. This effort was an exercise in estimation, no measurements were taken on Fort Bliss or in Cd. Juarez. Researchers used vehicular data and applied EPA's Mobile Source Emission Factors to calculate emissions for 1977. These were then compared to CO measurements gathered in El Paso. The results show that high concentrations appear in El Paso at 0800 and 1700 hours, correlating to traffic moving to and from work. Using traffic data from the Texas Highway Department, information from officials at Fort Bliss, and information about Cd. Juarez in the literature, researchers "conservatively" estimated that 17% of the CO emitted in the area are from sources over which El Paso has no jurisdiction. This conclusion is based in part on the fact that 2000 hours reflects a peak in emissions without any concurrent rise in traffic in the US, but does reflect an increase in traffic in Cd. Juarez.

Jones, Andrew D. "Transportation-Air Pollution Interaction: Factors & Strategies."

This paper provides a discussion of several variables which impact emissions. Jones' figures include data showing how speed affects various pollutant concentrations.: hydrocarbon emissions increase as speed decreases, but nitrogen oxides increase as speed increases. He notes that higher altitude results in higher emissions and that vehicle aging results in higher CO emissions. Applied specifically to El Paso, the author notes that the average age of vehicles in El Paso is higher than the rest of the nation and at the time Jones' paper was written there was no procedure to prevent pollution controls tampering.

A29 "Upper Atmosphere Wind and Temperature Profile Data for the El Paso-Juarez Airshed," Jack Smith, Electrical and Computer Engineering, University of Texas at El Paso

(1993-1994)--This project's goal was to gather temperature profiles at 800 meters above ground level and wind profiles at 3 kilometers above ground level in the El Paso-Cd. Juarez area. Data were collected hourly for one year using pulsed Doppler radar to measure wind characteristics and acoustic wave and radar pulses to measure temperature. The data gathered were used in a comparison to demonstrate the capability of lidar to measure wind fields in April 1994. All of the data have been saved on disk and are being correlated with and compared to National Weather Service balloon gathered data and Texas Natural Resource Conservation Commission (TNRCC) ground sensor data. See A30-A31.

A30 "Upper Atmospheric Wind and Temperature Profile Data for the El Paso/Ciudad Juarez Airshed," Jack Smith, University of Texas at El Paso

(1994-1996)--This is a continuation of A29. Data were gathered continuously since the project started in FY 1993 until Jan 1996 when a storm damaged radar antennas. Researchers can produce graphical hard copies of daily wind profile and temperature data. This effort has shown that ground clutter can affect the accuracy and resolution of the wind profiles at the lower altitudes (100m to 500m). Above 500m the results from this effort compare well with those from other independent measurements. Therefore, researchers developed and installed a ground clutter filter, which greatly improved the performance of the radar at lower altitudes. This effort found that radar performance varied seasonally. During the summer profiles at higher altitudes were obtained. A very practical result of this research is that it could help planners in determining the most appropriate location for industrial development based on air migration patterns which would minimize the effects of pollutants. See A29 and A31.

A31 "Upper Atmosphere Wind and Temperature Profile Data for the El Paso - Juarez Airshed," Jack Smith, University of Texas at El Paso

(1995 abstract)--This continues the work done for A29 and A30. The researchers propose to continue developing the database for temperature and wind profiles and to correlate their measurements with National Weather Service data and local ground sensor readings. The data are being formatted for use as inputs to computer models.

A32 "Quantitative Analysis of Dynamic Video Images and Static Images of the El Paso Del Norte Air Basin: Years 1992 - 1994," Charles Turner, University of Texas at El Paso

(1995 abstract)--Using more than three years of video and static image data acquired in the Paso del Norte air shed, researchers intend to produce quantitative, cost effective information about air quality in areas where there are no monitoring stations, and to represent the opportunity for retrospective air quality assessment in these areas. As a check for accuracy, the information extracted from the raw image data will be compared by multiple correlation analysis to wind direction, wind velocity, ozone, nitrogen oxides, carbon monoxide, and particle concentration measurements from SEDESOL and TNRCC monitoring stations. See A33.

A33 "Transborder Visibility Analysis: Quantitative Analysis of Dynamic, Multi-Site Video Images of the Paso Del Norte Airshed: Years 1995 - 1996," Charles Turner, University of Texas at El Paso

(1996 abstract)--As a continuation of an effort using existing video and static image data from the Paso del Norte air shed, this project proposes to get triangulation information by adding two new camera and four new dynamic PM-10 monitoring stations to calibrate visibility indices; to improve the understanding of how to cost effectively use this method for extracting quantitative information from areas with no monitoring stations; and to continue the retrospective air quality assessment in areas without monitoring stations. From the initial efforts, researchers concluded that it is possible to do quantitative contrast analysis of points in video images and that this is a useful indicator of visibility impairing, respirable particles arising and being transported. Additionally, researchers found that light scattering properties of the ambient aerosol in other urban areas are highly correlated with the dominant respirable size fraction that have aerodynamic diameters in the range of visible light. Calibrating the Paso del Norte ambient aerosol with retrospective study images also shows correlation PM-10 data from existing monitoring stations. See A32.

A34 "Identity, Elemental/Isotopic Composition, and Origin of Particulates in El Paso-Juarez Air, 1968-1998" Nicholas E. Pingitore Jr., University of Texas at El Paso.

(1997 abstract)--Researchers propose to examine and analyze contemporary and older ambient air filter samples collected in El Paso and Cd. Juarez over a 30 year period. From the samples, researchers will determine the concentrations and sites of toxic metals in the particulate matter; establish the origin of toxic natural and anthropogenic particulates; and trace the evolution over the past 30 years of the suite of particulates in the air shed.

A48 Gray, Robert, Jesus Reynoso, Conrado Diaz Q., and Howard Applegate. 1989. <u>Vehicluar Traffic and Air Pollution in El Paso-Cd. Juarez</u>. Texas Western Press, The University of Texas at El Paso.

This book provides an overview of the pollution concerns in the El Paso-Cd. Juarez area, the influences of topography and climate, and the role of traffic on air quality in the region. It includes data on numbers of vehicles, fuel kinds and sources, vehicle age, and emissions. It then presents information on the El Paso area state implementation plan and the inspection and maintenance program. Additionally, the Afterward includes a discussion of the social and political issues related to the continued air quality problems in the region.

University of Utah

A35 "Air Pollution Transport Dispersion & Scavenging," Dr. Jack Geisler, University of Utah

(undated)--By modifying a Department of Meteorology developed computer model, the researchers were able to successfully show the evolution of a pattern of a passive tracer released at three sites along the border. The results showed, for example, that in the El Paso region there was little topographically induced circulation acting to transport the tracer out of the region.

A36 "Field Evaluation and Monitoring of Air Pollutant Levels," Dr. Henk Meuzelaar & Dr. Neil Arnold, University of Utah

(1991-1992)--The goal of this project was to develop a fully automated instrumentation for mass spec characterization of VOCs and POM in air; to collect and analyze aerosol samples along the border; and to develop advanced pattern recognition techniques to study source characterization, identification and apportionment of POM samples. The researchers utilized a miniature mass spectrometer and a mobile sampling laboratory to collect and analyze air in Nogales and Calexico/Mexicali areas. The ability to collect and analyze in the field is deemed important because it should allow for shorter collection times while maintaining accurate results. The results showed that the field collection was a viable approach, and the samples revealed a complex suite of organic components present in the gas phase as well as adsorbed on inhalable particulates of airborne aerosols.

Using various statistical tools, researchers were able to distinguish among petroleum, diesel, and plant origin sources. In the Nogales area, auto emissions and wood burning were the two dominant pollution sources. Aerosol samples from Calexico showed a strong correlations among wind direction, velocity, and aerosol concentrations.

A37 "Geographic Information Systems Development," George Hepner, University of Utah

(1994)--This project consisted of creating and then using GIS databases to model location and potential movement pathways for industrial and agricultural contaminants. In the Ambos Nogales study area investigators developed a vulnerability analysis with the assistance of emergency response officials. The model was designed to simulate dense gaseous contaminants correlated with demographic characteristics related to vulnerability. The results from their test identified the nearest evacuation shelters and shortest paths for evacuation along the street network under conditions of increased congestion. These databases have been used by EPA, other SCERP investigators, and local officials.

A38 "Analysis of Environmental Lead in the El Paso - Ciudad Juarez Area," Anthony Suruda, M.D., Department of Family and Preventive Medicine, School of Medicine, University of Utah.

(1994)--This effort was designed to assess lead exposure among indigent pregnant women in the El Paso-Cd. Juarez area. Researchers conducted air sampling in Mexican neighborhoods and for 72 hours from the roofs of community health clinics. The results showed that all house dust samples as well as the clinic samples were below EPA recommended guidelines.

A39 "Characterization and Dynamics of Air Pollutants in the Southeastern Mexico -US Border Area," Henk Meuzelaar, University of Utah

(1995-1996)--Researchers performed chemical speciation and source apportionment of VOCs as well as chemical and biological characterization and source apportionment of PM10 at monitoring locations in the Brownsville-Matamoros, McCallen-Reynosa area. See A40.

A40 "Characterization and Dynamics of Air Pollutants in the Southeastern Mexico-US Border Area," Henk Meuzelaar, University of Utah

(1997 abstract)--This project continues efforts from 1995-1996 in which researchers performed physical, chemical, and biological measurements at four sites along the border. For the second and final phase measurements will be taken at 24 different sites on both sides of the border. The general goal is to help establish a better baseline picture of the border and its pollutants. See A39.

A41 "Vertical Measurements and Profiling Ozone, Ozone Precursors, Biogenic VOC Emissions, and Airborne Toxics; Emissions Transportation Using Balloons," Steven Watson, University of Utah

(1996 abstract)--This project will use hot air balloon platforms at 200 to 2500 feet above ground level to determine if ozone or its precursors is stratified at discrete elevations. Additionally, aircraft will fly in relatively high regions of the mixing layer for three to four hours on days in which an ozone violation is probable. This information will complement EPA's ozone field study.

Other Sources

The literature review for this project uncovered several sources for data and information on border air quality that did not fit well into the categories already described. These sources include interest groups, consortia, state agencies, consulting firms, and an advisory committee.

O01 Texas Natural Resources Conservation Commission (TNRCC). 1996. Air Quality in Texas-El Paso. www.tnrcc.texas.gov. (April 16).

TNRCC has published air monitoring reports for several years (1992-1995) which summarize their monitoring program and provide information on levels of ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, lead, respirable particulate matter and acid rain. The data is collected through the Community Air Toxics Monitoring Network and includes monitoring stations throughout Texas.
The El Paso region has exceeded the standards for PM, ozone, and CO in recent years. They are in attainment for SO2, NO2, and Pb. In response to the ozone violations El Paso used a TNRCC developed model to show that if only US emissions were considered, the city could reach attainment. Ozone data collected from 1984 through 1994 does not reveal any clear trends in concentrations or in the number of exceedance days. In 1990 El Paso had the fourth highest CO eight hour reading in the nation. But the 1984 through 1994 data indicate a decline in the eight hour average concentrations and the number of exceedances per year. El Paso did not violate the CO standard in 1994.

002 Snow, Carl, Bill Gill, Sandeep Kishan, Lenora Bohren, Carlos Rincon, Horacio Gonzalez, and Ken Knapp. 1997. Development of a Mobile Emissions Factor Model for Ciudad Juarez, Chihuahua. Presentation at the Air & Waste Management Association's 90th Annual Meeting & Exhibition, Ontario, Canada, (8-13 June).

This collaborative project combined training and model revision to gather data and better estimate emissions in Cd. Juarez. Using the data from this project, researchers developed MOBILE5 Juarez, a modified version of MOBILE5a that better reflects conditions in Cd. Juarez. This effort also provided training to Mexican scientists and engineers in using the models and in obtaining reliable field data.

O03 Roberts, Paul T., Dana L. Coe, Timothy S. Dye, Scott E. Ray, and Mark Arthur. 1996. Summary of Measurements Obtained During the 1996 Paso del Norte Ozone Study. Prepared by Sonoma Technology, Inc. for the Environmental Protection Agency, Region 6. Final Report STI-996191-1603-FR (Sept).

Study objectives included collecting meteorological and air quality data to support modeling and to improve the understanding of what influences high ozone concentrations. The researchers added down-wind sites to existing air monitoring sites in the Paso del Norte region. Based on daily meteorological and air quality forecasts, researchers decided whether to conduct intensive or supplemental sampling. Intensive operations meant that aircraft and surface sampling occurred simultaneously. On nine separate days, researchers collected intensive measurements of hydrocarbons and carbonyls.

In a presentation to the Joint Advisory Committee on Air Quality Improvement in the Paso del Norte region, researchers reported that mixing height is a function of time. In the day, heat produces mixing heights up to about 3,000 feet and overnight there are inversions. Typical meteorological conditions during high ozone concentrations included neutral synoptic gradients; maximum temperatures of 90 F; calm morning winds and clear morning skies. They found no evidence that high ozone concentrations could be left over from the previous day to mix with new emissions. They did find that a slow rise in mixing height was associated with high ozone concentrations and that tight clouds of ozone did not disperse horizontally until they were mixed vertically.

O04 Joint Advisory Committee on Air Quality Improvement for Cd. Juarez, Chihuahua/ El Paso, Texas/ Dona Ana County, New Mexico.

(1996-1997)--The advisory committee has been active in integrating Continuous Ambient Monitoring Stations (CAMS) managed by Texas, New Mexico, and Cd. Juarez agencies. In 1997 phone lines were installed to allow real time data collection. The data is available as the Indice Mexicano de Calidad del Aire or as the Pollution Standard Index.

O05 Parsons Brinckerhoff. Undated. <u>Initial Site Alternatives Analysis for the Camino Real Intermodal Center: Final Report</u>. Submitted to the New Mexico State Highway and Transportation Department.

In identifying potential specific sites for the Camino Real facility, this consulting firm discussed various environmental impacts related to the potential sites. The air quality section discussed all regulated contaminants and the effects of climatological factors on air quality. The researchers summarized data from the monitoring stations in the Santa Teresa area and in the El Paso Cd. Juarez area. The report concludes that the air quality relevant to the potential Camino Real sites is primarily affected by El Paso-Ciudad Juarez conditions and that the primary concern for this project is ozone. It also concludes that the facility has the potential to improve air quality in the El Paso area by reducing congestion, but at the same time the emissions in the immediate facility area will increase.

O06 Transboundary Resource Inventory Program. 1996. Terms of Reference for Cooperative Development of an Air Quality Impact Information System for the NAFTA Transportation Corridor (Dec 20).

Since NAFTA passed, it is expected that truck traffic in the border region will increase, and hence air quality will deteriorate. To alleviate this potential, the Transboundary Resource Inventory Program (TRIP) is coordinating a project to share information and establish methods for technical cooperation along the NAFTA corridor; to identify effected air sheds; to assess availability of monitoring data; and to develop GIS system for handling air quality data and to operate models. As of February 1997, researchers had completed a conceptual design of the GIS component and much of the work on establishing cooperative relationships. An interim report is expected in October 1997 and the final report will be available in early 1998.

Cost: $54,000 over 12 months

O07 Annual Mobile Source Clean Air Conference. Hosted by the National Center for Vehicle Emissions Control and Safety, Colorado.

Every September the National Center for Vehicle Emissions Control and Safety (NCVECS) hosts a conference in Colorado to address issues related to mobile source emissions. This meeting is devoted to providing practical information to state and local governments about mobile source emission regulations, problems and solutions. An EPA representative attends each year to brief the participants on current and upcoming regulatory issues related to mobile emission sources.

O08 Weaver, Christopher S. and Douglas B. McGregor. 1997. <u>Limiting Locomotive Emissions in California: Technology, Cost-Effectiveness, and Regulatory Strategy</u>. California Air Resources Board Research Note No. 97-4, www.arb.ca.gov/rd/resnotes/notes/1997/97-4.htm (February).

This effort assessed several measures designed to reduce emissions from locomotives, including diesel engine modifications, replacing or rebuilding diesel locomotives with low-emitting designs, modifying diesel fuel, using diesel exhaust after treatment devices, reducing fuel consumption, using alternative fuels, and electrifying the railways. The researchers found that the most cost-effective approach would be to convert locomotives to dual-fuel systems (diesel and liquefied natural gas). This study concluded that the dual fuel approach could reduce NOx emissions by 70 percent.

O09 Western Governors' Association. 1997. Mexico Emissions Inventory Methodology.

The Western Governor's Association has sponsored a multi-phase project to assess Mexico emissions. The first two phases are complete, while the third and fourth are ongoing. The first phase reviewed existing emissions data and developed a methodology and implementation plan. The second phase included developing manuals and courses (capacity building). The third phase began testing the inventory methodology in Mexicali. The fourth phase includes obtaining computing resources; performing technical studies related to emissions, including vehicle emissions; and completing the inventory methodology testing in Mexicali. The project emphasizes training efforts and collaboration with other agencies and studies.

Total Cost for Phase IV: $686, 200

O10 Western Governors' Association. 1996. Transportation Futures For the West: The Western Governors' Association's Task Force's Actions to Increase Efficient Passage of Freight Through the U.S.-Mexico Border.

The WGA has begun a study to improve efficiency in border crossings for freight. Part of this effort includes identifying information gaps concerning numbers of vehicles and wait times at ports of entry. Where data gaps exist, the WGA will work with border states to develop estimates of this information and will then coordinate with air quality programs to estimate emission levels.

O11 Rincon, Carlos. undated. Comparison of Vehicle Emissions and Maintenance Programs in El Paso, TX and Cd. Juarez, Chihuahua, Mexico. Prepared for Peter Emerson and Christine Shaver. Environmental Defense Fund.

This brief compilation includes data from various sources and presents several tables showing the emission standards for El Paso and for Ciudad Juarez as well as the number of vehicles reported for each city. It also includes separate tables showing emission test results from both cities (although it is not clear if or how the tables can be compared). The document also provides citations for regulations in Chihuahua, Mexico related to auto emissions.

O12 Foley, Graham, Stephen Cropley, George Giummarra. 1996. Road Dust Control Techniques: Evaluation of Chemical Dust Suppressants' Performance. ARRB Transport Research Ltd. Special Report 54 (October).

This document provides an overall review of the effectiveness of dust suppressants. Because it compiled research from all over the world, some of the compounds tested are not applicable to efforts in the US (i.e. waste oil). The report concludes the following: organic non-bituminous products work well in arid areas but following rain will gradually leach; chlorides provide the best overall performance for temperate and semi-humid climates; petroleum based products work well in arid climates; and electro-chemical products work well in all climates and are least likely to leach. Overall the report concludes that dust suppressant depends upon good construction and maintenance procedures; mechanical stabilization; and chemical dust suppressants. It also notes that at less than 50 vehicles per day, suppressants are not likely cost effective.

O13 Watson, John, Judith Chow, John Gillies, Hans Moosmuller, C. Fred Rogers, David DuBois, and Jerry Derby. 1996. Effectiveness Demonstration of Fugitive Dust Control Methods for Public Unpaved Roads and Unpaved Shoulders on Paved Roads. Desert Research Institute prepared for the California Regional Particulate Air Quality Study (CRPAQS) (December 31).

Researchers conducted experiments from July 1995 to August 1996 to assess PM 10 emission rates and suppressant effectiveness on unpaved roads. The research method involved utilizing upwind and downwind source profiles combined with meteorological data. Additionally this effort assess the mechanical properties of the treated surfaces. The researchers applied four suppressants to one road in one-third mile segments. The results showed that the polymer emulsion mixture and non-hazardous crude-oil-containing materials were most effective and exceeded 80% suppression 12 months after application. Emission rates ranged from zero to 2.9 pounds of PM10 per vehicle-mile-traveled at speeds of 25 mph and zero to 5.0 pounds of PM10 per vehicle-mile-traveled at speeds of 35 mph.

O14 Roads and Transportation Association of Canada. 1987. Guidelines for Cost Effective Use and Application of Dust Palliatives.

This document provides an overview of the most commonly used dust suppressants including hydroscopic and deliquescent chemicals; petroleum based products; and organic non-bituminous binders. The authors also provide guidelines for assessing whether using these suppressants would be cost effective. The authors suggest that an average daily traffic rate of 500 is required to achieve cost effectiveness. The document then provides suggestions for obtaining and applying palliatives.

O15 Booz, Allen & Hamilton, Inc. undated. <u>Locomotive Emission Study</u>. Prepared for the California Air Resources Board.

This report is the product of a 1987 California bill which authorized the California Air Resources Board together with the California railroad industry to study locomotive emissions. The researchers found that locomotive operations contribute 4.65% of total mobile source NOx emissions and 2.54% of total mobile source SOx emissions. They are less significant contributors to hydrocarbon, carbon monoxide and particulate matter. This report also reviewed candidate technologies for reducing locomotive emissions and concluded that emission testing standards, railroad electrification, retrofitting, and alternative fuels were the technologies that deserved more attention. They also concluded that changing operating procedures could lower locomotive emissions by about 10%.

O16 Commission for Environmental Cooperation (CEC). 1995. <u>Air Monitoring and Modeling in North America: Mexico</u>. Prepared by Corporacion Radian, S.A. De C.V. (August).

Commission for Environmental Cooperation (CEC). 1995. <u>Background Document: Air Monitoring and Modeling Workshop September 21, 1995</u>. Prepared by Science & Policy Associates, Inc. (September 6).

The Commission for Environmental Cooperation has embarked upon a project to coordinate air quality monitoring and modeling throughout North America. According the documents prepared for a September 1995 meeting, these efforts are intended to not only create monitoring and modeling networks for air quality, but to integrate this work with other ecological study monitoring. The Corporacion Radian study documents the actual status of air quality monitoring and modeling in Mexico. The emphasis is on consistent data gathering and cross boundary data compatibility. The Science & Policy Associates report presents the models used in the US and a summary of existing monitoring in the U.S. as of 1995.

O17 California Air Resources Board. 1994. <u>Organic Gases in Los Angeles Area Air: Analysis of the SCAQS Database</u>. Research Note No. 94-9 (June).

This study assessed the ambient nonmethane organic gas (NMOG) database from the 1987 Southern California Air Quality Study (SCAQS). Results showed less NMOG variation than expected, NMOG measurements did not agree well with emission inventory calculations, organic gas photochemical oxidation appears to result in a large amount of carbonyl species formation, and carbonyl compounds with more than four carbons were more prevalent than expected.

O18 California Air Resources Board. 1994. <u>Assessing Pollution Transport Aloft with 915-MHz Radar Wind Profilers</u>. Research Note 94-21 (November).

Researchers concluded that radar wind profilers (RWP) can monitor winds aloft as well as the height to which the atmosphere is mixed. There efforts found that there is continuous air flow throughout California's air transport routes. They also found that there is the potential not only for transporting pollutants between air basins, but also for recirculating pollutants within a basin. One limitation to the RWPs is that birds in flight can interfere with the signal, but these errors can be filtered from the data set.

O19 California Air Resources Board. 1990. The Southern California Air Quality Study. Research Note No. 90-3 (January).

In 1987 California conducted intensive sampling to create a comprehensive air quality and meteorological database for the South Coast Air Basin. Researchers represented ten organizations including both public and private interests. They gathered data on all criteria contaminants.

O20 California Air Resources Board. 1990. Characterization of Particulate Emissions from Selected Sources in California. Research Note No. 90-2 (January).

Researchers collected PM-10 data from 40 sources in California, including diesel trucks and road dust. The results note that diesel emissions contribute to the fine fraction ($<1\ \mu m$) with organic carbon, sulfur and sulfate. Unpaved roads contribute dust which is characterized as coarse ($>2.5\ \mu m$) and contains natural elements (AL, SI, MG, K, Ca, and Fe) as well as organic carbon.

O21 Roberts, Paul, Clinton MacDonald, Hilary Main, Timothy Dye, Dana Coe, and Tami Haste. 1997. Analysis of Meteorological and air Quality Data for the 1996 Paso Del Norte Ozone Study prepared by Sonoma Technology, Inc. for the Environmental Protection Agency Region 6. STI-997330-1754-FR (September).

This study was developed to better understand the chemical and physical processes contributing to high ozone concentrations in the El Paso region. Using the database gathered in the 1996 field study (see O03), researchers performed various tasks related to meteorological information and assessing historical information to validate the data set. The researchers developed a conceptual model of the high ozone episodes in the region that includes their findings concerning synoptic meteorological conditions as well as air quality and meteorological characteristics. Their conclusions also include information on VOC speciation and VOC-limited and NOx-limited conditions.

Regulatory Issues

One of the primary goals of any environmental policy or program is to ensure compliance with applicable local, state and federal regulations. All environmental regulations have direct or indirect impacts upon transportation. The Intermodal Surface Transportation Efficiency Act (ISTEA) reflects this understanding, as it requires transportation planners and agencies to consider environmental issues. Perhaps in response to the 1990 Clean Air Act Amendments (CAAA), which include numerous transportation related provisions, ISTEA strengthened the links between transportation and air quality planning (Wayson 1992; DOT 1993 ISTEA Fact Sheets). The importance of this integration cannot be overemphasized. Integrating requirements and planning saves resources, avoids duplication and helps to reduce sites for conflict.

The New Mexico-Mexico Border Air Quality Matrix developed for this project promises to be an invaluable tool for transportation planners in New Mexico as they strive to meet air quality requirements. Data needed to complete environmental documentation can be culled from the studies and reports described in the matrix. With this information, the agency may not have to hire consultants to gather or generate this data and hence can avoid paying consulting fees. Additionally, in cases where consultants are needed for other reasons, the matrix can provide the contractors with necessary data which will avoid bias problems related to contractor generated data and can save the agency time and money.

While the matrix provides a great deal of information, it also reflects that there is still much to be learned about air pollution sources, behavior, and the impacts from transportation related efforts. Clearly, this matrix can help the agency avoid duplicating research efforts that have already been accomplished and at the same time it can identify areas where perhaps the agency is in a position to conduct or support research projects. In sum, the matrix will enable the agency to identify and/or acquire accurate, reliable data that will improve environmental documentation efforts along the border and hence help to ensure consistent regulatory compliance while at the same time potentially reducing consulting costs.

The agency may have the opportunity to utilize the benefits of this matrix as it begins to meet the most recent air quality regulations. In September 1997, new ozone and particulate matter regulations became effective which make it even more imperative that the agency clearly establish its environmental policy to ensure compliance. The new $PM_{2.5}$ (particulate matter) standards state that the annual arithmetic mean must be less than or equal to 15 $\mu g/m^3$ and the 24-hour average must be less than or equal to 65 $\mu g/m^3$. The PM_{10} annual standard remains at 50 $\mu g/m^3$ and the 24 hour standard remains at 150 $\mu g/m^3$ (although the form of this standard did change to a 99th percentile concentration-based form). The new ozone regulations are based upon an 8-hour standard of .08 parts per million.

These regulations are more stringent, and include the distinct possibility that current attainment areas would be classified as non-attainment under the new standards. Should this happen, it could have ramifications for any border area projects. If an area is declared a non-attainment zone, then the state must prove that a proposed project is in conformity with the overall state plan (NMEIB 1994). This would require more resources and time compared to projects proposed within attainment areas.

Along the border, study after study concludes that vehicles are a dominant cause of air pollution (See matrix entries A08, A09, A14, A27, A36). This pollution takes the form of direct emissions from the vehicles and the form of dust from driving on unpaved roads. Given that this is the case, these new regulations will clearly have ramifications for transportation planning and project implementation. Dust from unpaved roads has been and will continue to be a serious concern for meeting PM_{10} standards. Vehicle exhaust generates smaller particles and contributes to ground-level ozone production and will likely be a compliance concern under the new $PM_{2.5}$ and new ozone regulations.

The studies and reports reviewed for this project provide little information directly applicable to the new regulations. What they do provide is important background information and starting points for continued research into transportation-related air quality assessment and improvement. These continued efforts will further our understanding of the sources and characteristics of these various contaminants. This information can then help the agency devise plans and projects that will be in conformance with all air quality regulations and State Implementation Plans.

The rest of this report provides some tools that can help ensure that NMSHTD remains abreast of and prepared for air quality regulations that will impact transportation plans and projects along the Mexico-New Mexico border.

III. Dust Control

Perhaps the greatest air quality problem along the New Mexico-Mexico border is particulate matter. Several of the studies reviewed in the matrix conclude that dust from unpaved roads is a primary source for air pollution along the entire US-Mexico border. To put this issue into perspective, consider that in Dona Ana County alone there are 1,028 miles of unpaved county maintained roads and 11 miles of unpaved state roads (Koglin 1997; Dona Ana County Roads Dept. 1997). These numbers do not include local or private roadways within the county. Dust related literature reviewed for this project included descriptions of why dust is so problematic. These reasons include that dust:

- contributes to loss/degradation of road pavement material which increases maintenance needs/costs
- blocks pavement drainage systems
- decreases safety for road users (decreases visibility)
- creates higher vehicle operating costs (harms structural and mechanical components)
- reduces quality of life for residents near roads
- contributes to water source sedimentation
- can be harmful to crops, natural vegetation, wildlife, livestock
- contributes to human health problems (respiratory ailments, allergies)
- contributes to air quality regulation violations

Sources: RTAC 1987; Addo and Sanders 1995; Foley et al. 1996; Gebhart et al. 1996; Watson et al. 1996

As the border population and subsequent traffic levels increase, controlling dust may become a significant concern for the NMSHTD. If New Mexico fails to meet PM standards and acquires non-attainment zones due to dust from unpaved roads, the costs, including federal penalties, could be considerable. It is feasible that the costs incurred in trying to achieve compliance (monitoring equipment, man hours, logistical requirements), as well as the costs in human health and environmental impacts would be greater than the costs incurred by developing and implementing a program to control dust along border region roads before they create a non-attainment situation.

There are many private sector companies selling products designed to control dust. Yet, there has been little research conducted on the effectiveness of the various components, the relative costs, and the potential environmental effects. This review uncovered relatively few studies that compare various dust palliatives and found even fewer studies documenting environmental effects from any of the dust control products. Industry spokespersons and the researchers contacted for this study all agreed that more research is needed.

From the research that is available, the following dust control methods are described as most commonly used.

Reducing vehicle speeds is a low-tech way to reduce the levels of dust generated. Various studies clearly demonstrate that less dust is generated at lower speeds (Addo and Sanders 1995; Watson et al. 1996; Foley et al. 1996).

Mechanical stabilization involves changing the physical properties of the unpaved surface. Foley et al. (1996) write that this is typically accomplished by creating a soil comprised of well-graded gravel-sand mixture with a small amount of clayey fines. Their studies show that this pavement material alone can reduce dust by up to 25% and it increases the life expectancy of applied suppressants.

Bound paving (concrete, asphalt, and sprayed seal) is the most effective method for controlling dust. According to Foley et al. (1996), for roadways that are not prone to deform or rut and have good drainage, spray sealing can be cost competitive with dust suppressants. Under other road conditions, the costs of bound paving could be considerable.

Chemical dust suppressants come in several forms, all of which have been shown to reduce dust to varying degrees on unpaved roads. Some suppressants (lignosulphonates, oil-based products, and electro-chemicals) also act as stabilizing agents. Following are brief descriptions of types of suppressants commonly available:

Hygroscopic and deliquescent (chlorides; salts)
These agents work by attracting and trapping moisture from the air to hold dust to the road surface. They are therefore quite sensitive to the levels of relative humidity. Sodium chloride (NaCl) ceases to function at below 70% relative humidity and calcium chloride (CaCl) and magnesium chloride (MgCl) cease to function below 30 to 40% relative humidity, depending on the temperature (Addo and Sanders 1995; Foley et al. 1996). For an arid climate like New Mexico's, this may preclude using chlorides as suppressants. Foley et al. (1996) conclude, however, that an early morning dew can work to "recharge" the salts allowing them to provide reasonably effective control in less humid conditions. Benefits of the chlorides are that their effectiveness can increase with repeated applications and they can be applied as a surface spray or as solid flakes. Disadvantages in addition to the humidity requirements include that salt does corrode metal and can often be slippery when wet. Because these products are salt-based, they have the potential to negatively impact water quality as well as plant and animal life in the vicinity.

Organic non-bituminous binders (lignin sulphonates, molasses, pine tar, tall oil pitch)
These agents are typically industrial wastes and they act as suppressants by adhering to and gluing soil particles together. They are effective in most climate types, but because they are water soluble they can be washed out when it rains. They are biodegradable, so pose no discernible environmental threat. Some lignin compounds can be corrosive to aluminum. Typically, these binders are mixed in place on road surfaces.

Petroleum based binders (waste oils, tars, bituminous emulsions)
These binders create agglomerations of fine dust particles. These are seldom used because of environmental concerns and in fact EPA regulations prohibit the use of some petroleum products as dust control agents (Foley et al. 1996).

Electro-chemical stabilizers (sulphonated petroleum, enzymes)
This type of stabilizer works by removing adsorbed water from the soil which " decreases air voids and increases compaction" (Foley et al. 1996). They are very dependent upon the type of road material to which they are applied and application is time consuming, requiring up to 20 days following application to be effective. The literature reviewed provided no discussion of potential environmental effects.

Polymers (PVC, PVA)
Polymers work by cementing soil particles together and are reported to be very effective in dry climates (Foley at al. 1996). Recent studies show that some polymer emulsion products establish a durable surface coating on unpaved road which contributes to long-term (12+ months) dust suppression (Watson et al. 1996). Polymer products are marketed under various trade names, each with a unique composition. Therefore, differences in research results could be attributed to differences in the specific polymer mixture. Again, the literature did not provide information on potential environmental impacts from these products.

Table 1 shows selected results reported for suppressants which achieved at least a 50% suppression rating relative to an untreated section of road through the end of their particular test period. The column entries reflect the suppression percentage achieved and the duration reported. The "**---**" mark indicates that the product was tested but did not provide 50% suppressant level compared to an untreated road surface.

Table 1 Suppressant Test Results

Report	Calcium Chloride	Magnesium Chloride	Polymer	Soybean product	Lignin	Biocatalyst	Non-haz oil
Gebhart 97	87% 90 days		---	63% 90 days			
Gebhart 96*	50% 66% 60 days		---	--- 66% 60 days	50% 66% 60 days		
Addo 95+	50-70% 120 days	50-70% 120 days			50-70% 120 days		
Watson 96			80% 11 mths			---	53% 11 mths

* This study covered research at two different sites. For each entry the first percentage reflects the first site and the second percentage the second site.

\+ This study reports only a range of suppressant effectiveness in percentage format, but notes that lignin was the most successful.

Costs

The motivation for pursuing a dust control program would be long-term cost savings for the agency and the state as well as improving environmental conditions by reducing particulate matter. The literature reviewed here all indicates that under certain conditions, using dust suppressants is cost effective. Sanders et al. (1997) conclude that treated roads realize a 28-42% reduction in maintenance costs compared to untreated roads. Foley et al. (1996) provide three scenarios to compare the overall costs of road treatment and maintenance. Scenario one includes maintaining typical practices of initial wet-mixing, shaping, watering and rolling of in-situ pavement material. Scenario two includes treating the road with a dust suppressant and scenario three includes applying a bituminous seal. Table 2 shows the results of comparing these three strategies.

Table 2 Cost Comparison for Road Treatment and Maintenance Scenarios

Strategy	Equivalent Annual Cost ($\$/m^2$)
1. Existing practice	$2.85
2. Dust suppressant	$2.97
3. Bituminous seal	$1.88

The conditions and caveats to this comparison are several. First of all, the above table reflects a 6% discount rate so that Foley et al. (1996) could compare costs for each scenario calculated over the lifetime of the effort. Scenarios two and three have significant front-end costs which scenario one does not have. On the other hand, the annual maintenance for scenario one is consistent across time, whereas the maintenance requirements for scenarios two and three decrease with time. This assessment also assumed that the roadway in question had sufficient strength and appropriate physical characteristics to support the seal (scenario three). Should the road not have these characteristics, then it is possible that the long-term economic benefits of sealing the road could not be realized. The literature review also showed that the average daily traffic (ADT) rates contribute to the economic feasibility of any dust suppressant effort. Research from the various studies shows a minimum of 100 to 125 ADT is needed to make dust control cost-effective (Foley et al. 1996; Sanders et al. 1997). Additionally, because there are so many confounding variables (e.g. climate, geology, vehicle type and speed) researchers recommend conducting a test on the specific roads to be treated to assess performance under specific conditions. This would necessarily incur costs for scenarios two and three that are not included in Table 2.

Other comparative issues not included in the Table 2 figures are those related to human health and the environment. Numerous health-based studies have documented correlations between particulate matter levels and respiratory ailments (Brown 1994; Consumer Reports 1997; EPA 1997). While correlations do not necessarily indicate causal relationships, the evidence is strong enough that it formed the basis for EPA's decision to strengthen the PM regulations.

Additionally, several of the dust control studies reviewed note the negative impacts that dust has on roadside vegetation, wildlife, and water sources. For example, Gebhart and Hale (1997) cite several studies which conclude that dust buildup on vegetation can lead to decreased ability to photosynthesize and hence decrease growth rates. This in turn can lead to increased erosion, as there is less plant material to hold the soil in place. In a desert region like New Mexico, plant loss is a serious concern, because re-vegetating an area can take years. Increased erosion also creates sedimentation problems for streams and wetlands. The border region does include some significant wetland areas and this is therefore an issue to be addressed when considering the costs and benefits of dust control measures.

As Table 2 reveals, the equivalent annual costs for scenarios one and two are comparable. Yet, scenario two may actually be more desirable because for roughly the same maintenance costs as an untreated road, it would reduce or eliminate many of the problems affiliated with fugitive dust. Obviously, scenario three would also provide these dust control benefits. Decision-makers, however, must resist the impulse to view dust suppressants as a panacea. While suppressing dust definitely provides environmental benefit, this benefit must be weighed against any potential negative environmental effects. It is imperative that decisions concerning a dust control program designed under the auspices of an environmental policy consider the benefits of dust control in concert with any potential detrimental environmental effects from the control products themselves. Additionally, there is the potential for regulatory concerns connected with suppressant use. Depending on the control product or process selected, it is feasible that the agency would be required to complete federal, state or local requirements (e.g. an environmental assessment) documenting potential environmental impacts.

As Addo and Sanders (1995) note, there has been little or no research conducted on the environmental affects of dust suppressants currently in use. Because many of the suppressants are salt based, Addo and Sanders present a summary of the environmental research conducted on deicing agents which are also salt based. The results from the deicing studies vary, but do indicate that the potential exists for these salt compounds to have deleterious effects on water quality and plant and animal life along the road sides. In their research, however, Addo and Sanders (1995) found no significant levels of metals or ions in runoff from suppressant treated roads. One explanation for this difference is the rate of loss experienced for dust suppressants versus deicing materials. While the limited information available indicates that the benefits of using suppressants potentially outweigh the negatives, it is also clear that more research is needed. In addition to the potential negative impacts of properly applied suppressants, the decision to use suppressants should also consider unforeseen spills, misapplications, and other potential accidents. In recognizing this, Foley et al. (1996) include the following guidelines for applying suppressants in the most environmentally friendly manner:

- ensure that the suppressant is within acceptable toxicity, strength and/or acidity levels
- apply sparingly, according to recommended dilution and application rates
- apply only to areas requiring treatment. Over-application may substantially increase runoff and consequent soil and/or waterway contamination
- two or three light applications may be more effective than one heavy application

- place suppressants onto or into moist pavement material
- compact the pavement material to reduce evaporation and prevent leaching
- avoid application during adverse weather conditions which might dilute, leach or transport suppressants away from the intended site.

Summary

Obviously, dust control is a complex issue. As noted here, there is evidence that roads that generate high levels of dust contribute numerous negative effects to human health and the environment as well as harm the roadways and vehicles themselves. There is also reason to believe that using some chemical dust suppressants may have negative environmental impacts. The limited information available implies that the benefits from using suppressants outweigh the potential negative ramifications. Clearly, the effectiveness of various suppressants as well as their potential health and environmental impacts are areas ripe for continued research.

One of the significant benefits of suppressing dust is the potential for cost savings. But, the cost effectiveness reported in the literature is predicated on specific conditions under which suppressants are applied. The bottom line is that making a decision regarding dust suppressants would require a case by case analysis of the costs and benefits for any particular road. With additional research to clarify the full range of impacts, the potential is great for using dust suppression to reduce costs and at the same time improve environmental conditions and maintain or achieve compliance with environmental regulations.

IV. Alternative Monitoring Methods

Meeting environmental requirements requires monitoring the environment to better understand existing conditions and to identify any changes in those conditions. Typically, when discussing air quality, the term “monitoring” connotes the technical efforts to collect and analyze air samples. The monitors are designed to capture certain categorical pollutants. The technical monitoring process includes taking readings from monitors at specific locations at specific times to quantify the amount of contaminant in a given sample. The process is repeated often to gather long-term, reliable data that can be compared across time and from place to place. The literature review for this effort identified numerous courses offered and reports written for transportation planners to help them meet air quality requirements. These resources include information on technical monitoring methods (F06, F07)[1]. This technical definition is, however, a limited and limiting approach to monitoring. There are, in fact, several facets to what one might categorize as monitoring. In developing an environmental policy framework, it is important to address not only the technical, measurement based idea of monitoring, but it is also crucial to be aware of the policy and the regulatory aspects of monitoring. In addition to technology based monitoring, state agencies benefit greatly from remaining abreast of trends and changes in policy and regulatory issues related to air quality (or any environmental issue). This section discusses these three unique, but intertwined facets of monitoring (technical, policy, and regulatory) and provides examples of innovation in monitoring as identified in the literature review.

Technical

Clearly, any effort designed to better understand environmental conditions must rely on consistent, accurate data. Monitoring border air quality in the traditional, technical sense is the topic of numerous studies. In terms of actual techniques or measurement methods, the literature provides several examples of innovation. Researchers at Arizona State University employed a very unique mechanism by using lichen sensitivity to various contaminants as an air monitoring tool (A01). A Los Alamos National Laboratory study concluded that LIDAR (Light Detection and Ranging) technology is an effective remote sensing tool to assess air quality in the border region (F04). A project at the University of Utah developed a field capable technique for collecting and analyzing air, which allows for shorter collection times while maintaining accuracy (A36).

Much of the research reviewed for this report is focused on using various modeling techniques and “number crunching” exercises to assess border air quality. Researchers at Arizona State University have completed several projects that combined synoptic climatology with physical modeling techniques to identify various characteristics of pollution. This approach could potentially be used in place of large field studies or numerical models, but requires further research (A03, A04, A05, A06). Investigators at San Diego State University are using GIS technology to improve the quality and quantity of data on border conditions (A24). Perhaps one of the most crucial efforts in recent years has been a project at University of Texas at El Paso that is using video and static images to assess air quality in areas without monitoring stations. Efforts to date have shown that it is possible to use these images to quantify visibility impairing, respirable particles rising and being transported in the El Paso area (A32, A33).

Because auto emissions are a dominant contributor to border air pollution, several research projects are trying to improve efforts to monitor and estimate these mobile emissions. An effort begun in 1997 at San Diego State University expects to gather pertinent information on heavy duty trucks to allow for better estimation of emissions (A26). A Texas Natural Resources Conservation Commission (TNRCC) project assessed emissions in Ciudad Juarez and adjusted the EPA MOBILE model to better reflect conditions in Juarez (O02). At Colorado State University, researchers completed a study to characterize vehicles crossing the border into the U.S. They found that more than 40% of the vehicles produced excessive emissions and that drivers lacked information about proper maintenance procedures that would reduce emissions (A12). Such findings demonstrate that there are issues related to air quality, which are not going to be identified nor addressed solely through technical monitoring efforts.

1 Throughout the rest of this document, references of this type refer to the entries in the Air Quality Matrix.

Policy

Monitoring can encompass a much broader definition than the technical means by which we measure air quality. It is also important to monitor those trends and activities which serve as harbingers or precursors to formal policy. For example, the lack of knowledge about proper auto maintenance could prompt decision makers to pursue a policy of incorporating auto maintenance education into transportation planning and/or border crossing procedures. This could have far reaching implications for transportation planners and project designers.

Technical and historical information can play an important role in developing and monitoring policy. Researchers at the University of Texas at El Paso began a project in 1997 to analyze air filters over the preceding 30-year period to determine the concentrations and sites of various contaminants (A34). This information has the potential to help air quality managers adjust technical monitoring techniques and to realign policy to better match the data regarding improvements or deterioration in air quality. In this example, technical information and policy are interacting. Having solid technical information can enable agencies to promote responsible, feasible policies.

At the same time, technical information is only part of the equation in developing policy. From the literature review conducted to prepare this report, it is clear that many of the researchers involved in assessing border air quality recognize that understanding attitudes, political realities, economics, and other non-technical items are crucial to developing sound policy and successful programs. Several of the documents reviewed discuss the idea directly, or imply that without fundamental changes in transportation policy and significant informational campaigns, we will not see improvements in air quality (F05, A15, A16,). By constantly monitoring attitudes and trends in policy at local, state and national levels, the NMSHTD can ensure that its policies and procedures are reflecting current realities.

One way to monitor policy is to establish strong relationships with other agencies and organizations. For example, the New Mexico Environment Department (NMED) Air Quality Bureau coordinates the technical monitoring program for the state. If NMSHTD were to actively engage the NMED in dialogue, the NMSHTD could easily remain informed about the latest issues in air quality that may have ramifications for transportation within the state. Additionally, it can be valuable to establish relationships with cities and states that are already addressing serious air quality concerns. Through solid communication efforts, NMSHTD can perhaps learn from programs and policies that other border states have implemented and avoid “reinventing the wheel.” For example, the California Department of Transportation’s Environmental Department has published an Environmental Handbook for use in all transportation projects (CALTRANS 1995). Agencies in Texas and California have embarked on collaborative efforts with their Mexican counterparts (SANDAG 1997; TNRCC 1996; TxDOT 1996). As New Mexico border populations grow, NMSHTD may be able to glean valuable information from the Texas and California experiences. Communication and cooperation can be key tools for any agency seeking to address environmental issues within the policy arena. Appendix A provides descriptions and contact information for several agencies and organizations with which NMSTHD should consider forming relationships and alliances.

Regulatory

Closely related to policy issues are the regulatory processes with which the NMSHTD must comply. The concept of monitoring regulatory processes can be crucial to maintaining regulatory compliance. Numerous environmental and public interest groups have long recognized the value and the power of monitoring the legislative process at local, state and federal levels to ensure that their input is received and considered in a timely fashion. It behooves the NMSHTD to monitor activities ongoing in the state and federal legislatures with regard to air quality and other environmental issues. Not only does this provide the agency with opportunities to give input to the regulatory process, but it allows the department to be prepared to meet requirements well ahead of regulatory promulgation. Nothing in the literature directly addresses this concept of regulatory monitoring, but there are numerous organizations that regularly monitor legislation and actively provide input. For example, the Air Working Group within EPA's Border XXI Program[2], provides input to the EPA for structuring and promulgating air quality regulations that affect the border region. The NMED participates in a Joint Advisory Committee that provides input to the Air Working Group. The notion of establishing cross agency relationships discussed in the Policy section is applicable here as well. At the federal level, the Clean Air Act and the Intermodal Surface Transportation Efficiency Act have created a situation that encourages cross-departmental coordination and cooperation. As reflected in the publication, *Clean Air Through Transportation*, to meet all of the requirements in both sets of regulations, the agencies involved in promulgating and enforcing these regulations must work together (DOT and EPA 1993). This approach is perhaps even more important at the state level where funding is often quite limited. By opening communication channels with the NMED, the NMSHTD can remain well informed about proposed regulations that may impact transportation planning or projects.

There are numerous agencies and organizations that closely follow and contribute to legislation at all levels. One forum for interacting in the regulatory monitoring arena is the Annual Mobile Source Clean Air Conference sponsored by the National Center for Vehicle Emissions Control and Safety (NCVECS). This conference is devoted to practical presentations of mobile source air quality issues. Each year the EPA attends and presents the most current information available on this topic. State and local governmental officials from throughout the country attend to remain abreast of the latest regulatory developments.

As noted, public interest groups are quite effective at employing this regulatory monitoring tactic. It could be quite beneficial to the state for the NMSHTD to develop a relationship with those organizations that closely follow air quality regulatory developments. By establishing and maintaining open communication channels with these agencies and organizations, NMSHTD can remain abreast of regulatory issues and can directly or indirectly (through the NMED) provide input as to the potential impact that proposed legislation may have on transportation in the state.

Benefits to Alternative Modes of Monitoring

As discussed within each of the three sections, technical, policy and regulatory monitoring work in concert to assist transportation decision-makers in meeting their requirements and in serving the public interest. Maintaining access to reliable, accurate technical data allows for the most informed decisions. Closely monitoring policy and regulatory issues at the local, state and federal levels allows decision makers to provide input into the various processes and to perhaps provide technical data to better inform decisions. Remaining abreast of regulatory issues enables the agency to develop plans and programs to meet new regulations in a timely fashion and thereby maintain its compliance status even as more stringent regulations are promulgated. Clearly, this approach also meets agency goals for public service.

2 This Air Working Group and other media-oriented working groups were originally established under the 1983 La Paz Agreement between Mexico and the United States to improve environmental conditions in the border region.

V. Policy Framework for the Border Environment

"The Clean Air Act and ISTEA set forth challenging goals which become even more challenging when taken together"
DOT & EPA 1993

Both ISTEA and CAA include provisions for addressing transportation related environmental concerns. It is really not feasible to conduct transportation planning or project implementation without employing an environmental policy, even if that policy is entirely undocumented and unintentional. It is more effective, however, to plan and implement within the confines of a clearly articulated environmental policy. This project has illuminated three necessary components to developing an environmental policy for the NMSHTD. These components are policy philosophy, public involvement, and procedures. Decisions made about the first (philosophy) will greatly determine the scope and magnitude of the other two. This section provides a description of the two major philosophical options that seem most pertinent to the NMSHTD and follows with discussions about public involvement and procedures which are integral to any agency's environmental policy.

Framework Philosophy Options

Do Nothing Option

As with any policy, there is always the option to maintain the status quo and simply wait until there is a demand for a reaction. There are advantages and disadvantages to such an approach. The greatest advantage is that it requires no additional thought, manpower or investment compared to current processes and policies. With regard to the border, it is possible that future changes in regulations will require NMSHTD to react. It is a valid option to simply wait and see what happens and then develop a plan or program to meet specific issues as they arise.

Perhaps the greatest disadvantage to "doing nothing" is that by simply waiting, environmental conditions may worsen to a point where draconian measures are required to address them. Implementing the Do Nothing option as environmental policy makes it more likely that the agency will be caught off guard by legislative or judicial action and hence, potentially subject to penalties for non-compliance. Being required to implement a program, plan, or policy under strict, regulatory demands may be more expensive and time consuming than employing a more proactive policy in the first place. Incurring such resource demands would certainly not be in the agency's or the public's best interest.

Prevention-based Option

A second philosophical possibility for developing a policy is to take a more proactive, prevention-based approach toward border region environmental impacts related to transportation. This option allows for varying levels of proactivity along a continuum. At all levels, however, communication is the focal point for a policy framework that steps beyond the Do Nothing option. Each of the potential policy frameworks described here begin with and revolve around improved communication and coordination. A policy focused on prevention may include communication as minimal and simple as coordination meetings between NMSHTD and the NMED once every three or four months. At the other end of the spectrum, a prevention based policy may be as expansive as conducting joint planning efforts with other states in both the US and Mexico. Following are three policy models, each progressively more proactive, which would be applicable to the NMSHTD. This tiered approach allows for incremental additions and improvements to the policy as funding, requirements and desires change.

A. Information Exchange

At a minimal level, a preventive environmental policy for border area transportation would include efforts to ensure that information within the agency is well coordinated and that information from other state and federal agencies is regularly gathered and processed. Internal coordination is essential to ensuring that environmental issues are considered at every stage of transportation planning and implementation. The Environmental Handbook produced by the California Department of Transportation Environmental Department provides an example of a policy that emphasizes internal coordination (CALTRANS 1995). There are several ways to establish or improve internal attention to environmental issues. Briefings from Directors and other high level officials within the agency can instill an organization-wide environmental ethic. At a more intensive level, there are numerous courses and workshops offered to transportation agency personnel that focus on environmental responsibilities. For example, the National Highway Institute offers several courses focused on meeting air quality requirements (DOT 1993; DOT 1994). Providing the opportunity for agency personnel from throughout the organization, not just the environmental office, to attend such courses is one way to ensure that individuals and entire sections gain an awareness of their role in helping the agency to meet its environmental obligations.

In addition to an emphasis on internal communication and coordination, a prevention-based policy requires external, two-way communication efforts. As discussed in Section IV, it behooves the NMSHTD to remain abreast of pending or potential policy and regulatory issues. The most efficient and effective way to do this is to develop a strong relationship with the agencies that are directly involved in creating and implementing environmental policy and regulation. These relationships form the core of a basic prevention oriented environmental policy. Should the NMSHTD choose to implement this approach, it would be most efficient and effective to utilize already existing opportunities for interaction. For the NMSHTD to remain abreast of air quality issues the most obvious source for interaction is the New Mexico Air Quality Board (AQB). More specifically, to remain abreast of air quality issues along the border, the most obvious place for interaction is with the Joint Advisory Committee for Improvement of Air Quality in the Paso del Norte airshed (JAC). Establishing a relationship requires no more than requesting coordination meetings between an NMSHTD representative and a JAC and/or AQB representative. To ensure policy and regulatory monitoring consistency and capability, such meetings should happen at least bi-annually and perhaps quarterly. Such a policy would ensure awareness of potential policy and regulatory developments which would allow the agency to prepare for timely compliance with any new requirements. It would allow NMSHTD to inform the AQB or the JAC of any potential transportation-based ramification that proposed policy and regulatory changes might cause. In terms of actual project development and implementation, this approach could include asking the NMED to conduct courtesy reviews to identify potential environmental concerns with proposed NMSHTD projects and programs.

Key Elements

- *Internal communication and coordination*
- *Information sharing with state and affiliated environmental agencies*

B. Coordination and Program Development

At a slightly higher level of proactivity, the NMSHTD could implement a policy that includes not only gathering information to ensure that the NMSHTD is well informed, but would add a coordination component to the relationship between the NMSHTD and the NMED and other state and federal agencies. For example, the NMED and the NMSHTD could work together to develop plans and programs that would lead to environmentally sound transportation plans and projects. Because the NMED is the state expert on environmental legislation, coordinating efforts with the NMED staff would be a tremendous asset to the NMSHTD in developing projects that are less likely to run afoul of the regulations and would promote sustainable transportation efforts.

Such a policy could include goals for not only meeting regulatory requirements to reduce impacts, but would go beyond compliance to implement programs that could actually improve air quality or prevent air degradation in the first place. This would provide the state with tremendous flexibility when and if more stringent regulations are promulgated. This policy approach could include developing criteria which any proposed project must meet to be considered sustainable and in the best interests of the public and the environment. The criteria used to select projects for the Border Environmental Cooperation Commission (BECC) and the transportation related goals established by the community group, Sustainable San Francisco, could serve as generic models for establishing specific policy goals (BECC 1996; Sustainable San Francisco 1996).

Key Elements

- Internal communication and coordination
- Information sharing with state and affiliated environmental agencies
- *Full planning and project coordination across agencies*
- *Developing plans and projects to actively prevent and reduce environmental degradation*

C. Expanded Coordination and Program Development

This far end of the prevention-based policy continuum provides for fully collaborative efforts to ensure environmentally sound transportation planning and project implementation. It builds upon intra-state coordination efforts and expands this approach to encompass inter-state efforts, perhaps including Mexican states. Because other border states have greater population bases along the border, they have been addressing some of these environmental issues for years. Under this most proactive policy approach, the NMSHTD could collaborate with agencies in other states to address transportation related environmental issues. It is also possible that this collaboration could extend to communities and states on the Mexican side of the border. For example, the San Diego Council of Governments (SANDAG) has established a joint planning program with Tijuana (SANDAG 1997). This is a very progressive approach and should help provide for sustainable solutions to transportation questions in the region. In Texas, the Texas Natural Resource Conservation Commission has participated in state-to-state information sharing projects with their Mexican border states (TNRCC 1996). Additionally, Carl Snow (1997) of the TNRCC reports that his agency is in dialogue with San Diego to learn about their experience with cross border planning. The Texas Department of Transportation (TxDOT) is also involved with cross-border information sharing and planning projects through the Border Technology Exchange Program (TxDOT 1996). Working in conjunction with NMED and other state agencies, the NMSHTD could tap the experience in Texas to proceed with cross state and cross border projects in the southeastern portion of the state.

There are of course options that don’t require full-blown joint planning which are still collaborative and proactive. For example, as discussed in Section III, it may be desirable for the NMSHTD to reduce dust from unpaved roads by applying palliatives or paving. This has the potential to be a cross-border project. One possibility is to create “sweat equity” efforts, whereby NMSHTD, perhaps in conjunction with other state agencies, provides the capital and equipment for a project and the community provides the labor. The BECC has successfully used this approach to meet border environmental challenges (BECC 1996b). A policy that allows for such efforts would be highly progressive and flexible enough to adapt when changes in regulations or requirements were promulgated.

The single greatest benefit to such broad-based collaboration is that the resulting programs and projects should be sustainable and they would likely already be in compliance with any future regulations or would be able to rapidly achieve compliance. Such a proactive approach would necessarily demonstrate a commitment to the public interest in providing sustainable transportation.

Key Elements

- Internal communication and coordination
- Information sharing with state and affiliated environmental agencies
- Full planning and project coordination across agencies
- Developing plans and projects to actively prevent and reduce environmental degradation
- *Extend collaboration and coordination efforts to other states, possibly including Mexican states.*

Public Involvement

Regardless of the philosophical bent of the policy framework, ISTEA and other regulations require public involvement in making transportation decisions. This interaction is necessary and important. The approach and level of effort devoted to public involvement can be placed on a continuum from simply meeting existing procedural requirements to full collaboration with communities in developing and implementing projects, programs and research efforts. It is logical that the policy philosophy selected will greatly determine the level of public participation. For example, if the NMSHTD selects the Do Nothing policy philosophy, then the public participation efforts will likely be the minimum needed to comply with existing regulations. This typically includes a public comment period on draft project proposals and perhaps a public meeting concerning the project.

On the other hand, should the NMSHTD select a prevention oriented framework, then the level of public participation might increase and complexify as the framework moves along the continuum described in the Prevention philosophy section. The Prevention-based policy philosophy assumes that working with the public at the front end of any project will allow the agency to stay in full compliance with all requirements, and will potentially avoid disagreements and contention in the long run. By ensuring public support for projects and efforts, the agency can potentially avoid errors, complaints, and lawsuits.

There is, of course, nothing which would prevent the agency from adopting the Do Nothing policy option and simultaneously invoking public involvement programs that go beyond procedural requirements. It would, however, violate the spirit of the Prevention-based philosophy to limit public participation to strictly procedural requirements.

The literature review revealed several publications available on the importance of public participation related to transportation efforts (DOT and EPA 1993; FHA 1994; Dittmar 1996). There is, however, little information available on effective public participation efforts specific to the border region. Unique issues in this area with regard to public participation include the current low population density along most of the New Mexico-Mexico border and the fact that any projects effect not just New Mexico, but residents of another country. This is an area that deserves more attention and research if the NMSHTD opts to pursue a prevention oriented policy with subsequently more intensive public involvement efforts.

Procedures

Regardless of the environmental policy framework implemented, the key component to success will be ensuring sound procedural processes. Procedural efforts include acquiring and maintaining access to accurate, reliable information and data; maintaining the ability to interpret incoming data; and ensuring that appropriate measures are taken to allow the data to be used successfully to meet deadlines and requirements. Because of its reactive nature, the Do Nothing policy approach is even more reliant on having sound procedures in place than is the Prevention-based approach. Both approaches, however, can only be successful if procedural issues are addressed adequately.

The first requirement for employing sound procedures is to ensure data integrity. For data to have a solid reputation they should be from a peer-reviewed process and ideally be generated independent of the agency and/or project. In general, data from academic or government sources is considered more reliable than data from private sector sources.

Secondly, the agency must ensure that it has procedures in place to continuously acquire new data. When the NMSHTD is pursuing or investigating a potential project it is imperative that they have appropriate and current data available to them. Gathering information is incredibly time consuming and therefore, it is most effective and efficient to continuously identify and acquire information rather than attempting to gather all pertinent information on a case by case basis or under crisis conditions. For example, in completing this project, agencies were contacted multiple times to try and identify and then receive relevant information. Over the course of eight months, the researchers placed hundreds of phone calls and e-mails seeking information. In some cases, the agency or person contacted never responded to requests. In circumstances where time is of the essence, this approach will simply not work. By continuously tracking and gathering information, NMSHTD personnel will then have immediate access to data and information.

The recent ATRI effort to re-establish the library at the NMSHTD could greatly aid the agency in tracking pertinent information. The New Mexico-Mexico Border Air Quality Matrix developed for this effort will also help meet this procedural issue. As noted in Section II, one significant benefit of this matrix is that the agency can use it to identify pertinent air quality information and perhaps avoid the need to hire consultants. In cases where a consultant is still needed, the agency could require that the contractors utilize the matrix to identify relevant information and thereby avoid duplicating work. Such a policy could save the agency resources both in terms of time and money. Of course, to be of long-term use, the matrix must be continually monitored and updated as new research is identified or completed.

Once data are acquired, there must be someone within the agency or readily accessible to the agency that is qualified to interpret the data. There must be technical people available who can understand the research effort that created the data, who understand the results from the research and can translate those results into meaningful information for the agency. Without this follow-up procedure, it is a waste of time and resources to gather data and information.

Finally, there must be procedures in place to ensure that the data and information gathered can be successfully employed when needed on various plans, programs, or projects. The suggestions in Sections IV for improving communication and coordination within and among various agencies are crucial to ensuring that data are utilized successfully. Again, the re-establishment of a library with a qualified librarian can help here. Librarians can easily track particular issues and provide periodic updates to appropriate staff people. Additionally, coordination efforts between agencies such as the NMSHTD and NMED can bring the procedural issues full circle. By working closely with the NMED, the NMSHTD can acquire independent data and information with which to make decisions on various plans or projects. The coordination with the NMED will help ensure that what the NMSHTD proposes is feasible and in the best interests of the agency, the environment, and the public.

Summary

The authors believe that the need for an environmental policy is clear. The actual policy framework, however, can be designed from among an infinite number of possibilities. This document has presented an overarching approach to developing a policy that would include three key components: an overarching philosophy, public involvement, and sound procedures. Determining the desired philosophical approach is the key to actually designing and implementing any policy. This report focused on two broad philosophies, the Do Nothing approach, which is an automatic option in any policy process and a prevention-based option, which is more proactive. Within the second philosophical approach there is a continuum which provides the agency with maximum flexibility to develop a policy that allows the agency to meet current and future needs.

VI. Conclusion/Recommendations

This research process affirmed and documented that air quality (and other environmental issues) cannot be segregated from transportation issues. The current and predicted regulatory situation will increasingly require transportation planning and project implementation to consider environmental issues throughout the process. This report has emphasized the desirability of establishing a firm, clearly articulated environmental policy to address this situation. Following are specific recommendations for the agency to begin to address its environmental obligations.

1. Prepare and disseminate a written, prevention-based policy. The intent of this policy should be to begin to increase levels of communication and coordination within the NMSHTD and between NMSHTD and other agencies and organizations. At a minimum this policy should include the following:

   - a short, but specific philosophy statement
   - a concise listing of the expectations/responsibilities for agency personnel in meeting environmental requirements
   - a clearly defined description of the necessary procedures related to environmental compliance tied to the expectations/responsibilities defined for agency personnel
   - concrete goals with specified timeframes for the agency to meet (e.g. The agency will hold meetings with representatives from the NMED on a quarterly basis to review transportation related environmental issues).

2. Establish a New Mexico Five-Year Border Transportation Plan which would include guidelines for coordination among relevant state agencies and would document the anticipated needs for addressing transportation-related air quality issues along the border.

3. Create a study group to research the feasibility/desirability of employing dust control measures along the border. This could serve as a pilot project for testing the communication and coordination functions within the overarching environmental policy.

4. Pursue funding through ATRI and the Research Bureau (including support for the re-established library/librarian) to continue conducting pertinent literature reviews and matrix updates as well as providing avenues for information dissemination.

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Web Site Bibliography

Arizona-Mexico Commission	www.azcentral.com/community/asmex
Border Environment Cooperation Commission	cocef.interjuarez.com
California Air Resources Board	www.arb.ca.gov
Centro de Informacion sobre Contaminacion de Aire	www.epa.gov/oar/oaqps/cica
Commission for Environmental Cooperation	www.cec.org
Desert Research Institute	www.dri.edu
National Law Center for Inter-American Free Trade	www.natlaw.com
San Diego Council of Governments	www.sandag.cog.ca.us
Southwest Center for Environmental Research and Policy	www.civil.utah.edu/scerp
Texas Natural Resource Conservation Commission	www.tnrcc.texas.gov
Texas Natural Resources Information System	www.tnris.state.tx.us
Transboundary Resource Inventory Program	www.glo.state.tx.us/infosys/gis/trip/gen_info.html
U.S. Mexico Border XXI Program	www.epa.gov/usmexicoborder
Western Governor's Association	www.westgov.org

Appendix A

Relevant Agencies and Organizations

Any coherent, progressive policy can benefit greatly from solid, consistent relationships within and among agencies and organizations. In Section III of this report the authors suggest that one alternative form of monitoring is to remain abreast of developments within the policy and regulatory arenas. One way to do this is to improve communication channels and practices both internally and externally. For example, within the NMSHTD the Office of International Programs, the Environmental Section and all planning sections should regularly confer with each other to ensure that programs and projects along the border are well coordinated long before the construction stage. Such internal communication can greatly reduce the potential for conflict.

In addition to improving internal communication and coordination, it behooves the NMSHTD to form relationships with various agencies and organizations to learn what approaches they are using and/or pursuing relevant to transportation related environmental issues. Immediately following this introduction are descriptions of the agencies and organizations external to NSHTD that were most pertinent to this research effort. These organizations can provide information and data relevant to potential policy developments and concerns. Following the summary is a simple listing of the agencies and web sites contacted in completing this study. Like the literature review, this list is by no means exhaustive, but does provide an overview of the resources available.

Perhaps the most crucial agency with which NMSHTD should better coordinate is the **New Mexico Environment Department (NMED).** This agency is responsible for managing all environmental issues within the state and works to closely follow policy and regulatory issues at the state and federal level. By establishing a working relationship with the NMED staff, the NMSHTD can receive timely and pertinent information on upcoming issues, regulations, or requirements that may impact the department. Through the NMED, the NMSHTD could remain abreast of specific issues emanating from federal programs. Most relevant to air quality issues, the NMED participates in the **Joint Advisory Committee for the Improvement of Air Quality for Cd. Juarez, Chihuahua/El Paso, Texas/Dona Ana County, New Mexico (JAC).** This committee develops and presents recommendations for preventing and controlling air pollution in the border region to the Air Work Group within EPA's **Border XXI Program**.

It is of course possible for the NMSHTD to form direct relationships with the federal agencies involved in border environmental issues which may impact transportation issues. For example, **EPA's Border XXI Program** coordinates efforts and disseminates information related to improving the border environment. The information is typically categorized according to the various working groups (e.g. air, water, pollution prevention). Additionally, EPA has established the **Centro de Informacion sobre Contaminacion de Aire (CICA)** which provides technical assistance/guidance for border air quality issues/projects. CICA staff can answer specific questions concerning air quality issues via e-mail on their Web page. Their focus is on stationary sources, but data are available on-line concerning various pollutants and processes.

Because other border states are more heavily populated than New Mexico, they have granted more attention to efforts to address transportation and environmental issues in the border region. By establishing relationships with agencies in other states, NMSHTD can learn from experiences elsewhere and hopefully avoid "reinventing the wheel." For example, the **California Department of Transportation (CALTRANS) Environmental Department** has published an Environmental Handbook which forms the basis for all branches of the agency to meet environmental requirements throughout the life span of a project from planning to implementation. Working on both sides of the border, the **San Diego Council of Governments (SANDAG)** has some progressive border programs related to transportation, including a joint planning effort with Tijuana. GIS information from both Tijuana and San Diego is available to produce maps showing land use and transportation corridors on both sides of the border. The State of Baja California has placed a staff engineer at SANDAG to learn how transportation planning agencies are organized and function. It is possible that in the future there will be efforts to develop coordinated highway and major road plans between the two governments. This is an example of an effort which may provide valuable insight to New Mexico for addressing transportation and environmental issues as the population and subsequent traffic along the Mexico/New Mexico border increases. The **Texas Natural Resources Conservation Commission (TNRCC)** is Texas' lead agency for executing environmental policy and includes an Office of Border Affairs. They have implemented several state-to-state joint activities with Mexican states including cooperative air monitoring programs and information sharing efforts. TNRCC is also in dialogue with SANDAG to learn how the joint planning efforts are progressing**.**

In the more immediate future, working across US state lines may be desirable and necessary. Currently, the most pressing environmental issues facing New Mexico are at the confluence of the Texas, New Mexico and Mexico borders near El Paso. The **Texas Department of Transportation (TxDOT)** has a Standing Committee on Border Affairs which has a mission to "promote effective communication among TxDOT offices, divisions and districts to identify border issues, needs and opportunities..." Should the NMSHTD choose to implement the Prevention-based policy option described in this report, the TxDOT committee may be able to provide advice and recommendations. The TNRCC also provides opportunities for interaction. Like the NMED, the TNRCC is a member of the Joint Advisory Committee for the Improvement of Air Quality for Cd. Juarez, Chihuahua/El Paso, Texas/Dona Ana County, New Mexico. They are a partner in an EPA granted effort to monitor air quality from both stationary and mobile sources along the border. By working with both the NMED and the TNRCC, perhaps through the Joint Advisory Committee, the NMSHTD can have access to timely and relevant information concerning environmental issues, specifically air quality issues along the border.

There are numerous organizations that can provide relevant data to NMSHTD regarding environmental conditions. For example, the **Texas Natural Resources Information System (TNRIS)** is a clearinghouse and referral center for natural resources data. They have computerized files available on water resources, geology, census, and other natural resources spatial data. Its sub-component, the **Texas/Mexico Borderlands Data and Information Center** was established in 1993 to provide natural resource and demographic data for and to both sides of the border. Data available include water quality and quantity, weather data, maps, aerial photos, satellite imagery, census information, and GIS digital files. The **California Air Resources Board** has numerous studies available that can be requested from their web site. While completing this project, the single source to which the researchers were most often referred was the **Southwest Center for Environmental Research and Policy (SCERP)**. Congress created this university consortium in 1990 to conduct applied environmental research in the border region. New Mexico State University is the NM representative. Literally hundreds of project descriptions are available on the SCERP web site.

Another source for relevant information and current research is the **National Center for Vehicle Emissions Control and Safety (NCVECS)** at Colorado State University. This center was originally established by the EPA to assist states in developing their vehicle emissions control programs. NCVECS has since grown beyond that mandate and recently began venturing into international issues. Additionally, NCVECS hosts the Annual Mobile Source Clean Air Conference. This meeting is held every September in Colorado and is geared to providing state and local governments with practical information concerning mobile source air quality issues. EPA attends each year to present the latest information from the regulatory arena.

The following list includes the organizations described here as well as others that may have information of interest to the NMSHTD efforts to develop an environmental policy.

New Mexico Contacts

New Mexico Environment Department (NMED)
Harold Runnels Building
1190 St. Francis Drive
P.O. Box 26110
Santa Fe, NM 87502
800-879-3421
http://www.nmenv.state.nm.us

Joint Advisory Committee on Air Quality Improvement for Cd. Juarez, Chihuahua/El Paso, Texas/Dona Ana County, New Mexico.

New Mexico JAC contacts:

Cecilia Williams
Manager-Air Quality Bureau
New Mexico Environment Department
P.O. Box 1160
Santa Fe, NM 87521
505-827-0042

George Avalos
Director-Transportation Department
430 S Main Street
Las Cruces, NM 88001
505-525-6619

Other State Contacts

Texas Department of Transportation

http://www.state.tx.us/insdtdot

Texas Natural Resource Conservation Commission (TNRCC)

Border Affairs
12100 Park 35 Circle
Bldg E
Austin, TX 78753
512-239-1480
http://www.tnrcc.texas.gov

Transboundary Resource Inventory Program (TRIP)
Secretariat
1700 North Congress
Austin, TX 78701-1495
512-305-8996
http://www.glo.state.tx.us/infosys/gis/trip/gen_info.html

Texas Natural Resources Information System (TNRIS)
http://www.tnris.state.tx.us

Texas/Mexico Borderlands Data and Information Center
http://www.twdb.state.tex.us

San Diego Council of Governments (SANDAG)
401 B Street
Suite 800
San Diego, CA 92101
619-595-5300
http://www.sandag.cog.ca.us

California Department of Transportation (CALTRANS)
P.O. Box 942773
Sacramento, CA 95814
916-654-5266
http://www.dot.ca.gov

California Air Resources Board
Office of Communications
2020 L Street
Sacramento, CA 95814
916-322-2990
http://www.arb.ca.gov

Federal Contacts

Border XXI Program
US Environmental Protection Agency
San Diego Border Liaison Office
610 West Ash Street
Suite 703
San Diego, CA 92101
http://www.epa.gov/usmexicoborder

Centro de Informacion sobre Contaminacion de Aire (CICA)
Attn: CTC (MD-12)
US Environmental Protection Agency
Research Triangle Park, NM 27711
919-541-1800
http://www.epa.gov/oar/oaqps/cica

Border Environmental Cooperation Commission (BECC)
P.O. Box 221648
El Paso, TX 79913
http://cocef.interjuarez.com

Commission for Environmental Cooperation (CEC)
393, St-Jacques Ouest
Bureau 200
Montreal, Quebec
Canada H2Y 1N9
514-350-4348
http://www.cec.org

Academic and Other Contacts

National Center for Vehicle Emissions Control and Safety (NCVECS)
970-491-7240
http://www.colostate.edu/Depts/NCVECS/ncvecs.html

Southwest Center for Environmental Research and Policy (SCERP)
http://www.civil.utah.edu/scerp

National Law Center for Inter-American Free Trade
111 S Church Avenue Suite 200
Tucson, AS 85701-1629
520-622-1200
http://www.natlaw.com

Desert Research Institute
P.O. Box 60220
Reno, NV 89506
702-673-7312
http://www.dri.edu

Western Governors Association
600 - 17th Street
Suite 1705 South Tower
Denver, CO 80202-5452
303-623-9378
http://www.westgov.org

Surface Transportation Policy Project (STPP)
1100 - 17th Street NW Tenth Floor
Washington, DC 20036
202-466-2636
http://www.transact.org

US Mexico Border Regional Environmental Information System
http://begss1.beg.utexas.edu:8888/