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FEDERAL AND STATE AIR QUALITY ENVIRONMENTAL PROTECTION REQUIREMENTS AND SOME ALTERNATIVE PLANS TO MEET THEM

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HIGHWAY
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FEDERAL AND STATE AIR QUALITY ENVIRONMENTAL PROTECTION REQUIREMENTS AND SOME ALTERNATIVE PLANS TO MEET THEM

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INTRODUCTION

During the latter part of 1971 the Research Laboratory was requested to measure air quality along proposed freeway routes and existing freeways. The request resulted in an intensive effort to gain knowledge of methods for analyzing air and to acquire an understanding of the air pollution problems related to highway transportation.

This entry into the air pollution area was necessitated by recent Federal and State requirements for environmental protection. The material which follows will:

1) Present background information on air pollution in relation to motor vehicles, and the effects of vehicle emissions on humans

2) Discuss recent Federal and State requirements for environmental protection that relate to highway construction, and the actions required by the Department to meet those requirements

3) Outline alternative air quality monitoring programs, including equipment and personnel, which the Department might pursue to prepare required air quality impact statements or to check on the claims or surveys of other agencies or individuals.

AIR POLLUTION IN RELATION TO MOTOR VEHICLES

There are several pollutants which automobiles contribute to the atmosphere. They are carbon monoxide, hydrocarbons, oxides of nitrogen, sulfur dioxide, and some particulate matter, including lead. Table 1 shows the millions of tons of air pollutants emitted by motor vehicles and all other sources. The percent of the total air pollution from transportation is shown in parentheses.

TABLE 1
ESTIMATED NATIONWIDE EMISSIONS, 1968[1]
(millions of tons per year)

Source	Carbon Monoxide	Nitrogen Dioxide	Hydro-carbons	Sulfur Dioxide	Particu-lates
Transportation	63.8 (63.8%)	8.1 (39.3%)	16.5 (51.8%)	0.8 (2.4%)	1.2 (4.2%)
Fuel combustion in stationary sources	1.9	10.0	0.7	24.4	8.9
Industrial processes	9.7	0.2	4.6	7.3	7.5
Solid waste disposal	7.8	0.6	1.6	0.1	1.1
Miscellaneous	16.9	1.7	8.5	0.6	9.6
TOTAL	100.1	20.6	32.0	33.2	28.3

[1]From "nationwide Inventory of Air Pollutant Emissions 1968," HEW, Public Health Service, National Air Pollution Control Administration, Raleigh, N.C., August 1970.

The table shows that:

1) Motor vehicles contribute by far the largest share of carbon monoxide in the atmosphere.

2) Over half of the total hydrocarbon load in the atmosphere is due to motor vehicles. The hydrocarbons are emitted by evaporation from the carburator, fuel tank, and crankcase. They are also present in the exhaust due to incomplete combustion of fuel.

3) Motor vehicles are a major contributor of nitrogen dioxide in the atmosphere. A side effect of gasoline combustion in an engine is that the high temperature causes atmospheric oxygen and nitrogen to react, forming oxides of nitrogen.

4) In the case of particulate matter, motor vehicles contribute a rather insignificant share of the total pollution load in the atmosphere. The particulates from motor vehicles include bits of rubber from tire wear, asbestos from brake lining wear, and lead particles from the lead additives in many gasolines.

5) The share of sulfur dioxide due to motor vehicles is very small; it is emitted because of the sulfur content of gasoline.

Data for lead are not included in Table 1, but motor vehicles are responsible for about 15 percent of the total lead pollution in the atmosphere (1).

Overall, it is estimated from Table 1 that in excess of 42 percent of total nationwide air pollution, by weight, is due to motor vehicles.

Effects of Air Pollution on Humans

Carbon monoxide poisons directly; it impairs oxygen transport by hemoglobin in the blood. One hundred parts per million of carbon monoxide in air has been defined as an acceptable level for an 8-hr exposure in industrial situations. Twenty to one hundred parts per million are encountered inside motor vehicles in traffic (2). An extreme value of 500 ppm has been reported inside a vehicle stopped in a traffic jam (3). Carbon monoxide levels well below the 100 ppm acceptable level have been reported to slow the recognition process and to lengthen the reaction time of subjects (4). Thus, carbon monoxide may contribute to highway accidents by lengthening the driver's reaction time in a hazardous situation.

Low concentrations of hydrocarbons, of themselves, do not cause direct human health problems. Likewise, low levels of nitrogen dioxide cause no direct health problems. In the presence of sunlight, however, hydrocarbons combine with oxides of nitrogen to form smog. Smog causes problems for a population in two ways. First, the gray pall of smog hanging over an area causes visibility to be reduced and a significant portion of the population feels shut-in. This may lead to feelings of depression, uneasiness, or other psychological problems (5). Second, clinical effects include irritation of the eyes and mucous membranes, including the lungs (6). This leads to breathing difficulties and possible heart failure. Increased death rates have been correlated with heavy smog periods in a number of U.S. and foreign cities.

Particulates in the air, on being respirated into the lungs over considerable periods of time, lead to emphysema. It should be noted that asbestos particles are very conducive to emphysema (7).

Lead pollution of the atmosphere by vehicle exhaust has not been considered a serious problem. However, recent papers in the literature indicate that significant levels of lead are occurring in the blood of persons in urban areas and that these blood lead levels correlate with traffic volumes in the area of exposure (8, 9). A further increase in the rate of lead intake of these persons, due to vehicle exhaust or other sources, would be expected to bring on the symptoms of lead poisoning.

Sulfur dioxide from motor vehicles is not considered a significant pollutant at this time.

Increasing concern for the environment by legislators and the general public has resulted in legislation on the Federal level to deal with control of air pollution. The next section will detail this legislation and its relation to highway construction activities.

FEDERAL LAWS ENACTED TO DEAL WITH AIR POLLUTION

1969 Environmental Policy Act

This act, signed into law by the President on January 1, 1970, requires that for every proposed action that would significantly effect the quality of human environment, a detailed environmental impact statement must be prepared which includes the following points:

1) The environmental impact of the proposed action
2) Any other unavoidable environmental effects
3) Alternatives to the proposed action.

A draft of this environmental impact statement must be made public and public hearings must be held for receipt of comments. Copies of the draft must also be submitted for Federal comment. A final environmental impact statement must then be prepared by the State Highway agency which includes all comments received, and the disposition of these comments by the State agency.

1970 Clean Air Act

This act called for the establishment of ambient air quality standards by the administrator of the Environmental Protection Agency (EPA). The administrator was also required to set standards of performance for stationary sources of pollution and for motor vehicles. The act requires that states prepare plans for achieving the air quality standards once they are established and for maintaining and enforcing those standards. This law authorizes the EPA administrator to act, if the states do not, and provides powers of enforcement.

A "control strategy" is defined in this act which would employ measures such as those listed below to achieve and maintain national air quality standards.

1) Emission limitations
2) Federal or state emission charges or taxes, or other economic incentives or disincentives
3) Closing or relocation of residential, commercial, or industrial facilities
4) Changes in schedules or methods of operating commercial or industrial facilities or transportation systems
5) Periodic inspection and testing of motor vehicle emission control systems
6) Emission control measures applicable to in-use motor vehicles, including mandatory maintenance, installation of control devices, and conversion to gaseous fuels
7) Measures to reduce motor vehicle traffic, such as commuter taxes, fuel rationing, parking restrictions or staggered working hours
8) Expanded use of mass transportation through measures such as increased frequency, convenience or capacity or by providing special bus lanes on streets and highways
9) Any other land use or transportation control measures
10) Any other variations or alternatives to the above measures.

Table 2 presents the ambient air quality standards developed by the EPA and published in the Federal Register on April 30, 1971. These standards define levels of air quality which the administrator judges are necessary, with an adequate margin of safety, to protect the public health and welfare.

TABLE 2
FEDERAL AIR QUALITY STANDARDS

Pollutant	Concentration Levels
Carbon Monoxide	a) 9 ppm maximum 8-hr concentration, not to be exceeded more than once per year. b) 35 ppm maximum 1-hr concentration, not to be exceeded more than once per year.
Nitrogen Dioxide	0.05 ppm, annual arithmetic mean.
Hydrocarbons	0.24 ppm (not including methane) maximum 3-hr concentration (6:00 to 9:00 a.m.), not to be exceeded more than once per year.

It is important to note that the air quality standards are based on averages of analytical determinations of air quality. For instance, under (a) for carbon monoxide, analytical values over an 8-hr period must be averaged to determine whether the 8-hr period is over 9 ppm. The standard may be met even though a number of the individual determinations are higher than 9 ppm carbon monoxide. In the case of nitrogen dioxide, analytical values averaged over a 1-yr period may be necessary to determine whether or not a location is complying with the air quality standards. This annual mean was adopted because nitrogen dioxide concentrations must be limited in order to reduce the smog forming reaction with hydrocarbons. Similarly, the hydrocarbon levels are kept low to reduce the same smog forming reaction. Methane is excluded from the hydrocarbon total because it does not react to form smog.

Table 3 shows the motor vehicle exhaust emission standards adopted pursuant to this Act.

By January 1, 1975, hydrocarbon emissions are to be reduced by 97 percent and carbon monoxide emissions are to be reduced by 96 percent from previous uncontrolled levels. The effective date of these two requirements may be postponed one year, to January 1, 1976. By January 1, 1976, nitrogen dioxide emissions are also to be reduced by 90 percent from 1971 levels. In addition, it is required that fuel evaporative emissions from the carburetor and fuel tank be reduced to very low levels. Crankcase emissions were reduced to zero starting in 1963 by positive crankcase ventilation systems which recirculate crankcase vapors back through the engine to be burned.

TABLE 3
FEDERAL STANDARDS FOR EXHAUST EMISSIONS FROM GASOLINE FUELED MOTOR VEHICLES
(under 6,000 lb GVW)

Model Year	Hydrocarbons		Carbon Monoxide		Nitrogen Oxides	
	Standard, gm/mile	Reduction from uncontrolled levels, percent	Standard, gm/mile	Reduction from uncontrolled levels, percent	Standard, gm/mile	Reduction from 1971 levels, percent
Pre - 1968 (uncontrolled)	actual emission estimate, 17	---	actual emission estimate, 126	---	none	---
1968 - 1969	7.5	56	70	44	none	---
1970 - 1971	4.6	73	47	63	none, actual level 4.0	---
1972	3.4	80	39	69	none	---
1973 - 1974	3.4	80	39	69	3	25
1975	0.46	97	4.7	96	3	25
1976	0.46	97	4.7	96	0.4	90

The Federal Register of August 14, 1971, set forth EPA requirements by which the states should prepare, adopt, and submit, implementation plans for achieving air quality standards. Table 4 presents the schedule which states should follow in submitting plans to comply with the clean air act.

TABLE 4
FEDERAL REQUIREMENTS FOR IMPLEMENTING AIR QUALITY STANDARDS

April 30, 1971	Air quality standards finalized.
January 30, 1972	State implementation plans due for Federal review.
May 30, 1972	EPA approves or disapproves state plans.
July 30, 1972	State corrects rejected plans.
July 1, 1975	Specified air quality is to be achieved.

1970 Federal Aid Highway Act

Section 136(h) of this act states in part,

> "Not later than July 1, 1972 the Secretary of Transportation, after consultation with appropriate Federal and State officials, shall submit to Congress, and not later than 90 days after such submission, promulgate guidelines designed to assure that possible adverse economic, social and environmental effects relating to any proposed project on any Federal-aid system have been fully considered in developing such project, and that the final decisions on the project are made in the best overall public interest,...

Section 136(i) of this act requires that the Secretary of Transportation,

> "...after consultation with the Administrator of the Environmental Protection Agency, shall develop and promulgate guidelines to assure that highways constructed pursuant to this title are consistent with any approved plan for the implementation of any ambient air quality standard for any air quality control region designated pursuant to the Clean Air Act, as amended."

Guidelines were published in the Federal Register on April 26, 1972 which require that each state prepare a Federally acceptable program (action plan) by October 1, 1973, to show that environmental, social, and economic effects are properly considered in highway planning and construction.

Urban Mass Transportation Assistance Act of 1970

This act amends the Mass Transportation Act of 1964 to place grant and loan applications under the A-95 "review process." Provisions require that the applicant must hold hearings for all interested parties on the economic, social, and environmental impact statements. The Secretary of Transportation ascertains whether adequate public hearings were held and that all harmful environmental impacts were minimized.

The A-95 review process refers to Federal Office of Management and Budget Circular Number A-95. This circular establishes a framework for coordinating and reviewing Federally assisted plans and programs to assure appropriate and timely review by all pertinent state, regional, and local agencies. The process is accomplished through designated state and regional or local clearing houses which must be notified of intent to submit an application for Federal financial assistance. The clearinghouse notifies all potentially interested agencies within its jurisdiction to insure coordination, definition of issues, and their resolution. Air pollution control planning is included within this review process.

State of Michigan Requirements

On September 30, 1971, Governor Milliken directed that State agencies review all major activities within their jurisdiction to determine their effects on the environment. An environmental impact statement must be prepared and submitted to the Inter-Departmental Committee on Water and Related Land Resources. Whenever a Federal environmental impact statement is required, a copy must be forwarded to the Advisory Council for Environmental Quality. The Federal statement may be accepted as fulfilling State requirements or the Council may direct that additional environmental impact evaluation be undertaken.

The State's implementation plan for meeting Federal air quality standards, submitted to Federal officials early in 1972, indicated that no restraints on transportation were necessary, except for the Federal vehicle exhaust emission standards for new vehicles. The Research Laboratory reviewed the State implementation plan in detail and commented on it in a letter from M. N. Clyde to S. F. Cryderman. The Department's official position, in support of the implementation plan, was forwarded to John Soet of the Michigan Department of Public Health by Mr. Stafseth on January 7, 1972. As an addition to the State plan, it was suggested that a program be set up to obtain Federal funds for measuring the exhaust emissions of vehicles using the State's roadways.

In view of the fact that it is a Federal requirement that public hearings be held to review environmental impact statements and that Highway Department disposition of all comments received at such hearings be included in the final environmental statement, the following list is presented as an overview of sources requesting information or sources of problems or complaints on air pollution related to highways.

1) Federal Sources
   - Environmental Impact Statements
   - Federal Highway Administration Guidelines
   - Environmental Quality Commission Guidelines

2) Regional Sources
   - Canada and other States

3) State of Michigan Sources
   - Environmental Impact Statements
   - Air Pollution Control Commission Guidelines

4) Local Government Sources
   - City, county, etc., objection to proposed construction

5) Local Sources - locations sensitive to air pollution
   - Schools
   - Parks
   - Hospitals
   - Special land or building use or buildings adjacent to heavy traffic
   - Zoos

6) Individual Sources
Objections or concerns by individuals or pressure groups.

AIR QUALITY MONITORING AND CONTROL ACTIONS

The following section indicates the type of action that may be required to meet FHWA guidelines pursuant to Section 136 of the Federal Aid Highway Act of 1970, and to provide information needed to prepare the air quality portion of Federal and State environmental impact statements.

The actions outlined below have been extracted from a draft of guidelines prepared by FHWA staff members to begin implementation of Section 136 of the previously discussed Federal Aid Highway Act of 1970. The draft guidelines were presented as information at a Highway Research Board Environmental Workshop in Washington, D. C. during July 1971. Although these guidelines were not subsequently adopted by FHWA, they do show the line of thought likely to be encountered when state action plans are reviewed by FHWA. The guidelines were divided into the project phases of location, design, construction, and operation-maintenance.

I. Location

A. Inventory and Survey

1. For each alternative alignment, identify the pollution-sensitive areas, uses, building, and activities which are likely to be affected. The types most apt to be encountered are those which are occupied by people for more than a short duration.

2. Determine the existing ambient pollution levels for peak annual, 3-hr, and 24-hr average conditions for the areas identified above.

B. Preparation of Pollution Forecasts

As a minimum, pollution forecasts should be based on the best available traffic estimates for five years and twenty years after anticipated approval of construction plans. The traffic estimates should consider that emission from motor vehicles vary by model year and vehicle type. The effects of traffic flow (or lack thereof), running speed, congestion, starts and stops, shall be included, where possible. The 24-hr average and 3-hr peak pollution levels should be forecast.

1. Roadway Pollution Levels

Forecast pollution levels near the roadway surface for representative sections of the project. These pollution levels will be encountered by occupants of motor vehicles.

2. Highway Corridor Effects

Determine the amount of pollutants generated, their concentration in air, and the pattern of dispersion of pollutants in the corridor for each alternative alignment under consideration. Present the computed results as generalized cross-profiles of pollution concentrations.

3. Region-Wide Effects

Determine the regional, sub-regional, metropolitan, or other large scale effects of the project. Compute the percentage increase or decrease in overall pollution levels for those areas where existing or projected pollution levels can be obtained.

C. Analysis of Pollution Forecasts

1. Compare the pollution forecasts with the existing ambient pollution levels and with the air quality standards for the region which includes the project.

2. Determine whether highway associated pollution levels will expose individuals to pollution levels in excess of air quality standards. If so, determine the number of persons involved and the duration of such exposures.

3. Identify those location alternatives which help to reduce pollution. Consider alignment shifts, reduced congestion, grade separation structures, etc.

4. Assess pollution control measures and location alternatives in terms of monetary costs, and social, economic and other environmental impacts.

II. Design

In addition to location phase, refine the pollution forecasts to account for design variations, localized effects, traffic constrictions or other small scale effects.

III. Construction

A. Inventory and Survey--Review the operations, equipment, processes and procedures that can be anticipated during the construction phases which might have an adverse effect on air quality.

B. Analysis and Interpretation--Determine the need for measures to control the adverse effects on air quality.

C. Summary and Presentation--Identify control measures which can be included in the project specifications or construction plans. Some of the types of measures which can be taken include: paving of detours; dust control on haul roads and earthwork operations; dust control of pug mills, concrete plants, asphaltic concrete plants and stone crushers; prohibition of open burning; and control of smoke from asphalt plants.

IV. Maintenance-Operation

Operations measures which reduce traffic congestion will also reduce pollutant emissions from motor vehicles. Improvement measures include progressive traffic signals, one-way streets, prohibition of on street parking (especially during peak flows), speedy removal of disabled vehicles and scheduling of roadway maintenance during off-peak hours.

The following analyses are recommended by the Research Laboratory to provide the data necessary to comply with FHWA requirements, prepare environmental impact statements and to answer other complaints about air pollution related to highway operations.

a) Carbon monoxide
b) Nitrogen dioxide
c) Particulate matter (selected sites). Chemical analysis of particles for lead and other constituents in some cases
d) Methane and total hydrocarbons (may be added at a later date when equipment is available)
e) Sulfur dioxide (selected sites, using an instrument which is also required for determination of nitrogen dioxide).

Additional correlative information needed:

1) Wind speed and direction
2) Temperature

AIR QUALITY MONITORING PROGRAMS

The following section discusses air quality measuring programs which might be employed to acquire data for preparing environmental impact statements, or answering complaints about highway related air pollution.

Three alternative air quality monitoring programs are outlined below. Equipment and personnel requirements for these programs are presented in the Appendix.

Program I

Program I is an absolute minimum effort which may not yield impact statements acceptable to EPA. This program would rely on air quality data and meteorological data that may be available from other agencies. We would make no measurements. In few cases would the necessary data be available for the actual location of proposed construction. Thus, we would have to estimate background pollution levels and meteorological conditions in the actual construction area, and base calculated pollution forecasts on such estimates. Discussion of air quality in our impact statements would necessarily be very limited and very general. We would not have a capability to compare roadway design with air quality or to deal effectively with the complaints or concerns of others. Table 5 compares features of all three air quality monitoring programs.

TABLE 5
COMPARISON OF AIR MONITORING PROGRAMS

Factor	Program I	Program II	Program III
1. Yield data to comply with FHWA guidelines	No	Yes	Yes
2. Facilitate preparation of Environmental Impact Statements	Yes	Yes	Yes
3. Capability for spot checks at selected sites, and in-vehicle measurements	No	Yes	Yes
4. Capability of making wind measurements, correlating wind data	No	Yes, limited	Yes
5. Capabilities of No. 4 plus analyzing wind in sensitive areas	No	No	Yes
6. Computer analysis and storage of data	Yes	Yes	Yes
7. Number of project sites worked on simultaneously	1+	1+	2

TABLE 5 (Cont.)
COMPARISON OF AIR MONITORING PROGRAMS

Factor	Program I	Program II	Program III
8. Regional monitoring during initial planning stage, or faster completion of specific projects	No	No	Yes
9. Post construction monitoring to check accuracy of pollution forecasts	No	No	Yes, limited
10. Measure air quality at selected sites to develop and refine mathematical models to predict dispersion of pollutants for highways.	No	No	Yes, limited

Program II

This would be a marginal program under which air quality and meteorological measurements would be made by the Department. Under this program, wind data for five previous years could be obtained from nearby weather stations and minimal measurements (possibly one year) would be made in the construction area with portable wind stations and correlated with the longer term weather station data. An individual with some training in meteorology would be essential in selecting sites for portable weather stations, collecting and analyzing data, analyzing the topography of the region, and preparing a meteorological report.

Air quality determinations would also be made as follows:

1) In response to complaints about highway related air pollution. This could involve analyzing air inside moving vehicles.

2) During location planning, at corridor sites judged sensitive to pollution and at other representative corridor sites as required to determine existing pollution levels as a basis for forecasting future pollution levels.

Regional and post-construction air quality data would be lacking under this program. The Michigan Department of Health or county health departments may be able to furnish some regional data, but even with the expansion of the State air monitoring network, scheduled through April 1973, it is not expected that data will be available for very many of the locations of interest to this Department.

III Adequate Program

This program would have expanded capabilities over program II as given in Table 5. It would be expected to provide data for at least two environmental statements at a time, and support requests for additional short term tests. Some regional air monitoring could be done, and the accuracy of pollution forecasts could be determined on a limited scale. Calculation techniques would be modified to improve pollution forecasts.

Air Sampling and Testing Procedures

Prior to preparing environmental statements it is recommended that air sampling and wind measurements be carried out for periods of a few days to one month at a time at the sites selected for measurement. Some locations, such as those sensitive to pollution, or high pollution areas, should be remeasured at different seasons of the year to obtain a valid pollution profile.

Testing methods will be those specified as reference methods by the Environmental Protection Agency or methods which have been shown to be generally equivalent to such reference methods. All data will be analyzed by computer and stored for recall as needed. Applicable data from other agencies will also be added to the data bank as it is available. A current study of methods for measuring air pollution being conducted by the American Society for Testing and Materials (ASTM) has two more years to run. It could lead to changes in designated reference methods.

REFERENCES

1. SAE Journal, November 1967, p 48.
2. Archives of Environmental Health, May 1966, p 550.
3. Journal of the Air Pollution Control Association, October 1960, p 385.
4. Environmental Science and Technology, March 1971, p 213.
5. Chemical and Engineering News, June 8, 1970, pp 38 and 50.
6. Archives of Environmental Health, February 1968, p 241.
7. Chemical and Engineering News, June 8, 1970, p 46.
8. Environmental Science and Technology, January 1972, p 31.
9. Archives of Environmental Health, December 1967, p 699.

APPENDIX

Air Monitoring Equipment and Personnel Needs

I. Minimum Program

Equipment

1 - Microfiche Reader	$ 600.00
1 - Microfiche Reader-Printer	$1,750.00

Personnel

1 - Meteorological Technician 05
1 - Clerk Typist 04

II. Marginal Program

Equipment

A. Spot Check Equipment

This equipment will be used for short term analyses in connection with preparation of impact statements, and for analyses needed to respond to complaints about highway related air pollution, including measurements inside moving vehicles.

1 - nitrogen dioxide analyzer, portable	$3,000.00
1 - carbon monoxide tester, portable	200.00
1 - high volume particulate sampler	200.00
1 - unit-wind vane, anemometer, and recorder	3,000.00
1 - ten meter mast for wind measuring equipment	500.00
1 - pump, battery operated, for collecting bags of air for analysis	150.00
Plastic bags for air samples	200.00
Total	$7,250.00

B. Van Type Mobile Air Monitoring Laboratory, includes items listed below:

1 - van body on light truck chassis Includes insulation in body walls, heating and air conditioning systems, auxillary generator for 110V, 60 hz power.	$ 5,500.00
1 - carbon monoxide analyzer (infrared)	4,400.00
1 - nitrogen dioxide analyzer	3,700.00
2 - wind direction and wind speed recorders	6,000.00
2 - ten meter masts for wind equipment	800.00
2 - portable battery operated air sampling pumps	350.00
2 - temperature sensors	140.00
20 - plastic air sample bags	300.00
Data Telemetering System	8,300.00
	$29,490.00

C. Trailer Type Air Monitoring Laboratory, includes items listed below:

1 - 16' trailer shell, with electric heat and air conditioning units	$ 2,000.00
1 - carbon monoxide analyzer (infrared)	4,400.00
1 - nitrogen dioxide analyzer	3,700.00
1 - particulate sampler (paper tape type)	1,000.00
2 - wind speed and direction recorders	6,000.00
2 - ten meter masts for wind equipment	800.00
2 - temperature sensors	140.00
1 - auxillary generator for 110V, 60 hz power	800.00
2 - portable battery operated air sampling pumps	350.00
20 - plastic air sample bags	300.00
1 - Data Telemetering System	8,300.00
Total	$27,790.00

Total Equipment for Marginal Program--$64,530.00

Personnel

2 - Chemist 10

Each of these chemists would be responsible for a mobile air quality monitoring laboratory and the supervision of technicians who would collect air samples and meteorological data and otherwise assist in the operation of the mobile laboratory.

3 - Technician 07

These technicians would assist in moving and operating mobile air quality monitoring laboratories. They would collect air samples in bags and return them to the portable laboratory for analysis. They would also set up and operate wind speed and direction recording devices so that pollution levels could be correlated with wind conditions.

Additional part-time help to move and set-up equipment would also be needed periodically.

III Adequate Program

Add to previous Programs:

Equipment

1 - Trailer Mobile Laboratory (as on previous page but less Particulate Sampler)	$26,790.00
1 - Semi-permanent wind station	3,500.00
Total Additional Equipment	$30,290.00

Personnel

1 - Chemist 10
1 - Technician 07

Additional part-time assistance will be needed periodically.

Time Schedule

Order equipment and begin recruiting personnel for minimum and marginal programs now.

By about January 1973, receive equipment and start assembly of mobile laboratories.

About April 1, 1973, have mobile laboratories assembled and instruments calibrated. Start measurements at highest priority project sites.

July 1, 1974, order equipment and recruit personnel needed for the adequate program.

About September, 1974, air quality forecasts ready for environmental statements on the first of those projects where measurements of air quality must be made.