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A Procedure For Tracking Emissions Growth And Air Quality Maintenance

Final Report

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A PROCEDURE FOR TRACKING EMISSIONS GROWTH AND AIR QUALITY MAINTENANCE

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ABSTRACT

Guidelines to assist state and local agencies in designing information systems to track trends in growth and to assess the potential of a violation of a National Ambient Air Quality Standard within 10 years are described. The information system may be used to reassess the adequacy of State Implementation Plans as required by current federal regulation (40 CFR 51.12(h)). The guidelines are illustrated in two states, Wisconsin and Massachusetts.

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SECTION 1

INTRODUCTION

The U.S. Environmental Protection Agency regulations issued under section 301(a) of the Clean Air Act, Part 51 - Requirements for Preparation, Adoption, and Submittal of Implementation Plans require that:

> 51.12 (h) (1). For all areas of the State, the State Implementation Plan shall, by May 3, 1978, provide for a procedure for the continual acquisition of information used in projecting emissions.
>
> (2). The plan shall provide that at intervals of no more than 5 years, all areas of the State shall be assessed to determine if any areas are in need of plan revisions.
>
> (3). The State shall retain the data gathered and the written assessment made under paragraphs (h)(1) and (h)(2) of this section, and make them available for public inspection and submit them to the Administrator at his request.
>
> (4). The State shall notify the Administrator if an area is undergoing an amount of development such that it presents the potential for a violation of national standards within a period of 20 years.

The goal of this report is to provide information useful to agencies responsible for the development and use of a procedure for implementing these regulations. The objective of the procedures described in the following pages is to enable the identification of those areas where increases in emissions may cause the national ambient air quality standards (NAAQS) to be violated.

The procedures described in this report should be viewed as a typical approach to fulfilling the requirements of the cited regulations. The specific concerns and unique situations in every state or region may dictate greater emphasis and a more detailed analysis in certain areas. For example, areas with the potential of very rapid growth due to the proposed development of a large energy facility can be more adequately assessed for the potential of an NAAQS violation by a specific environmental assessment and, subsequently, the tracking of actual growth versus that projected in the assessment. Moreover, for some areas the procedures outlined in this report may be invalid. The procedures described below are based on air quality planning techniques familiar to every state air pollution agency. Thus, the state agency should be able to assess the validity of this approach in the context of their state and their approach to previous air quality planning programs and modify it as necessary. The procedures are not intended to be a detailed analysis of the air quality problem in an area; rather, they are intended to be a screening tool to identify potential problem areas for more detailed analysis.

The procedures outlined below are designed to be applied in stages. Only a small amount of information is initially acquired. If that information does not indicate a potential violation of standards, then nothing else need to be done. Thus, many areas will only collect growth data on a regular periodic basis and do nothing else. If the information suggests the possibility of emissions growth sufficient to violate the NAAQSs, additional information is acquired. This may be additional analysis, the acquisition of more detailed growth information, or the initiation of ambient air monitoring. This analysis process continues to the point wherein the last stage, a detailed analysis, as described in subpart D of the regulations,* is conducted.

The procedures outlined below are also modular in nature. The nature of the existing data bases, agency resources, and the current State Implementation Plan (SIP) will vary among states and areas of the state.

Some areas have been identified as having problems in maintaining NAAQSs, once attained. This was determined through AQMA designation analysis and subsequent analysis. This analysis included a detailed projection of emissions and modeling of air quality. For these areas, the objective of the guidelines is to determine if, in light of experienced growth and revised growth projections, the SIP is still adequate for maintaining the NAAQSs.

Other areas will not have conducted an analysis of potential future violations. The objective of the guidelines in these areas is to identify the point when expected growth may threaten an NAAQS and when a detailed analysis should be conducted. Further distinctions are made below between areas with and without air quality monitoring and between the level of detail of the analysis of potential future violations (where it has been conducted). Different procedures are outlined for each pollutant.

The growth tracking procedures should be performed on a frequent and periodic basis. The reassessment of the potential of a NAAQS violation should be performed at least once every 5 years. In the intervening years, current growth estimates and projections are acquired and compared with the previous projections. The frequency with which this is done would depend on the kind of data used and how often it is updated, and the amount of growth occurring in a county. If, for example, revised projections are available annually or bianually, the use of the tracking procedures could be linked to the publications of new projections. If current estimates of growth are utilized (with their inevitable 6- to 18-month lag), it seems prudent for this to be done annually, especially if it is a rapidly growing area.

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*Detailed emission projection and simulation modeling of future air quality, as specified in Part 51, Appendix D and generally described in Volumes 7, 12 and 13 of the Guidelines for Air Quality Maintenance Planning and Analysis.

The process of tracking growth trends and assessing their implications on ambient air quality levels should be viewed as an information gathering process which allows one to continually refine the assessment of the air quality problem in an area. It should be part of an anticipatory planning process whereby future air quality problems are identified before they are critical so there is both time to assess the problem and develop or refine a control strategy. It is the antithesis of a reactive process where incomplete information and limited time preclude the development of a comprehensive approach to the problem and where recent events may limit the usefulness or availability of the most effective control strategies. It can be a tool for incorporating the air quality planning program with the plans and programs of the other planning functions in a state; e.g., land use, economic, transportation, and water quality planning, among others.

ORGANIZATION OF THE REPORT

Section 2 presents a detailed introduction to the guidelines and their technical background. Section 3 summarizes the relationship between the subject of this report and other air quality planning programs that monitor growth and its impact on air quality. The guidelines are presented in Section 4. Finally, in Sections 5 and 6, the guidelines are illustrated by application to two States, Wisconsin and Massachusetts. There are several appendices. Appendix A is a suggested condensed emission projection and air quality simulation technique that may be used to further define the air quality impacts of growth before resorting to a detailed analysis such as that required by subpart D. Appendix B is a description of the sources of data required by the guidelines. Appendix C is a summary of existing geographic information systems; i.e., spatially defined data files and analysis and presentation techniques. Where such systems currently exist, they may be used to monitor growth for the purposes of maintaining air quality. In addition, the rapidly advancing state-of-the-art in remote sensing, especially satellite imagery, suggests that such techniques may find wide application for growth tracking in the future. Appendix D is an overview of the planning procedure for the control of CO hot spots. Appendix E describes the basis of certain tables in Section 4.

SECTION 2

OVERVIEW OF GUIDELINES

The basic area considered in these guidelines is the county. This is due principally to the general lack of availability of growth indicators for smaller areas. If indicators are available, a smaller geographical unit may be used. For oxidants, the AQCR is used as the basic geographical unit.

In the suggested procedures, counties with an existing detailed analysis of the effects of emissions growth on air quality acquire current estimates or projections of population, employment, or other appropriate indicators on a regular and periodic basis. If the growth in any of the selected indicators is beginning to significantly exceed the projections in the SIP, a more detailed analysis of emissions growth is required. If this growth is in excess of that projected in the SIP, a definite potential for violating NAAQS may exist. At this point, the existing subpart D analysis is revised to reflect the growth rate experienced to date and to incorporate new projections. Regardless of experienced growth, the subpart D analysis must be revised at least every 5 years to incorporate new 10-year projections of growth indicators.

Counties without a detailed analysis of projected air quality acquire current estimates or projections of population or other readily available parameters on a regular and periodic basis. If the growth rates or absolute values of these parameters exceed certain threshold values, a simplified analysis of projected air quality (a modification of the AQMA designation analysis) is conducted. If this analysis indicates the potential for the violation of an NAAQS exists, a subpart D analysis of projected air quality is recommended.

In the remainder of this section, the guidelines are explained in more detail and the assumptions and limitations cited. Geographic areas of analysis for all pollutants except CO are delineated into four categories: (1) those with an existing detailed projection of emissions and simulation of air quality (such as that required in subpart D of the SIP regulations, the AQMA analysis), (2) those with a less detailed or condensed analysis of projected air quality, (3) those with no current analysis of projected air quality but with air quality monitoring for the pollutant of concern, and (4) those without an anlaysis and without monitoring. The guidelines for carbon monoxide (CO) are explained separately below.

COUNTIES WITH DETAILED GROWTH ANALYSIS

A detailed projection of emissions and simulation of air quality will have been prepared for many counties, most often as part of a nonattainment study or in preparation of an AQMA plan. Detailed projection and simulation are defined, for the purposes of this report, as the procedures outlined in subpart D of the SIP regulations,[1] and generally described in Volumes 7, 12, and 13 of the AQMA guidelines.[2-4] Typically, a new or updated county area source emission inventory would be prepared, the point source inventory may have been validated, and the emission inventory would be projected by using population and employment forecasts or other growth indicators. The particulate matter and sulfur oxide emission inventories would typically be allocated to a subcounty grid system and modeled using the Air Quality Display Model (AQDM). The hydrocarbon and nitrogen oxide emission inventories probably would not have been allocated and air quality would be modeled using, respectively, Appendix J and linear rollback. The outcome of this process will be either a determination that the NAAQSs will not be violated or that they will, in which case control strategies will be developed and implemented.

If population or employment growth (or whatever else was used to project emissions) does not exceed the forecast amount for which control strategies have been developed, theoretically one can assume that the nitrogen oxide and oxidant NAAQSs will not be violated.* The guidelines in this report recommend a collection of the estimated value of the parameters used to project emissions and a comparison with the forecast value. A schematic diagram of the guidelines is shown in Figure 1. If all the parameters are less than forecast, no further action is recommended. If one or more of the parameters is greater than forecast (when more than one parameter was used to project emissions), a rough estimate of the county emissions is prepared. This is compared with the forecast emissions for the year the analysis is being conducted. If the current estimate of emissions is greater than forecast, the next step is to reassess the validity of the forecasted value of the projection parameters for the final year of the detailed growth analysis. (For example, assume a 1975 emission inventory was projected to 1985 using population and employment. In 1978 current estimates of population, employment, and emissions are in excess of what was forecasted for 1978. One must now reassess the validity of the forecasted values of population and employment for 1985.) If indeed the forecasts of the emission projection parameters are invalid, the emission

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*The guidelines for particulate matter and sulfur oxides follow the same procedure as that outlined above for nitrogen oxides and oxidants. However, the growth in the emission projection parameters may be less than forecast and the NAAQSs may still be violated if the growth occurs in a portion of the county where it was unanticipated when the subcounty allocation was performed. To an extent this is also true of growth in hydrocarbon and nitrogen oxide emission inventories even though the detailed emission projection and simulation modeling techniques are insensitive to the location of emissions growth within a county. It is assumed that this situation will not be so severe as to violate the NAAQSs within the 5-year time period between the preparation of new subcounty inventories. Since all new major sources will be subject to the new source review process, this assumption is considered to be reasonable. State or local agencies not willing to make this assumption would then need to keep track of growth on a subcounty basis and maintain a source-receptor file of coefficients to continually assess the effects of both the amount and location of growth on ambient air quality. The availability of information systems for doing so is discussed in Appendix C.

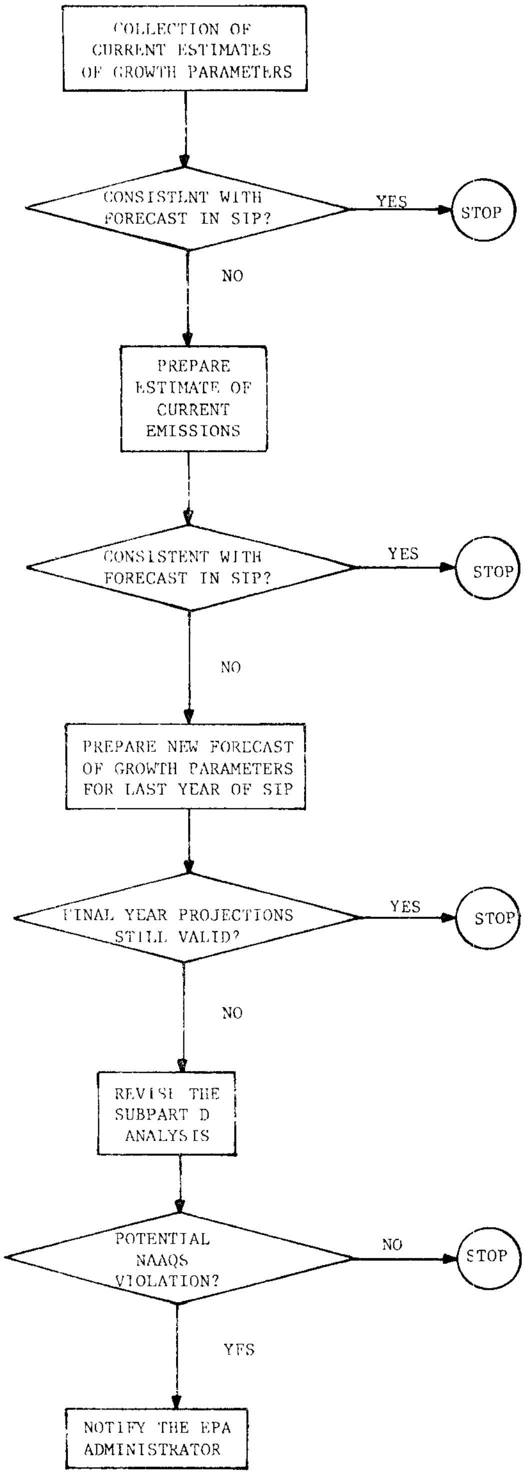

Figure 1. Schematic diagram of guideline procedures with an existing detailed analysis of growth.

projection and air quality simulation should be revised. Notwithstanding the results of the process described above, the detailed projection of emissions should be revised at least every 5 years.

COUNTIES WITH LESS DETAILED ANALYSIS

Growth trends and projected ambient air quality may have been analyzed in some counties with less detail than the process outlined in subpart D. For example, this analysis may have been conducted as part of the AQMA designation analysis. This condensed analysis will most often consist of an update and projection of the county emission inventory using population, total employment (or earnings), and manufacturing employment (or earnings). No subcounty allocation of emissions will have been performed. Air quality will have been forecasted using linear roll-forward, Hanna-Gifford, or Miller-Holtzworth and, in the dase of oxidants, Appendix J.

The procedures suggested in this guideline for this type of county, shown in Figure 2, are very similar to the guideline for counties with a detailed growth analysis. The principal difference is that instead of comparing current estimates of growth parameters with the values forecasted in the subpart D analysis, they are compared with the values for these parameters forecast in the simpler growth analysis that was conducted. Counties for which frequent revisions of demographic and economic projections are made may simply compare the new projections with the old projections instead of keeping track of current estimates. Again, the potential of a future violation of an NAAQS must be reassessed at least every 5 years. Therefore, the condensed analysis should be revised at least every 5 years.* If this analysis indicates a potential violation, the EPA administrator should be notified.

COUNTIES WITHOUT AN ANALYSIS OF PROJECTED AIR QUALITY BUT WITH MONITORING OF AIR QUALITY

In many counties no projection of future air quality will have been conducted. Those that do have monitoring for the pollutant of interest are considered in this subsection while those that do not are considered in the subsequent subsection.

Despite the fact that no analysis has been conducted, the data necessary to do at least a condensed analysis does exist - it remains to be collected and analyzed. The objective of the guidelines in this instance is to suggest a methodology that entials the minimal collection of data necessary to identify areas where the threat of a potential future violation of the NAAQSs is great enough that a condensed analysis of projected air quality is warranted. One of the simplest air quality simulation techniques is linear roll-forward.

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*A suggested procedure for conducting such an analysis is described in Appendix A.

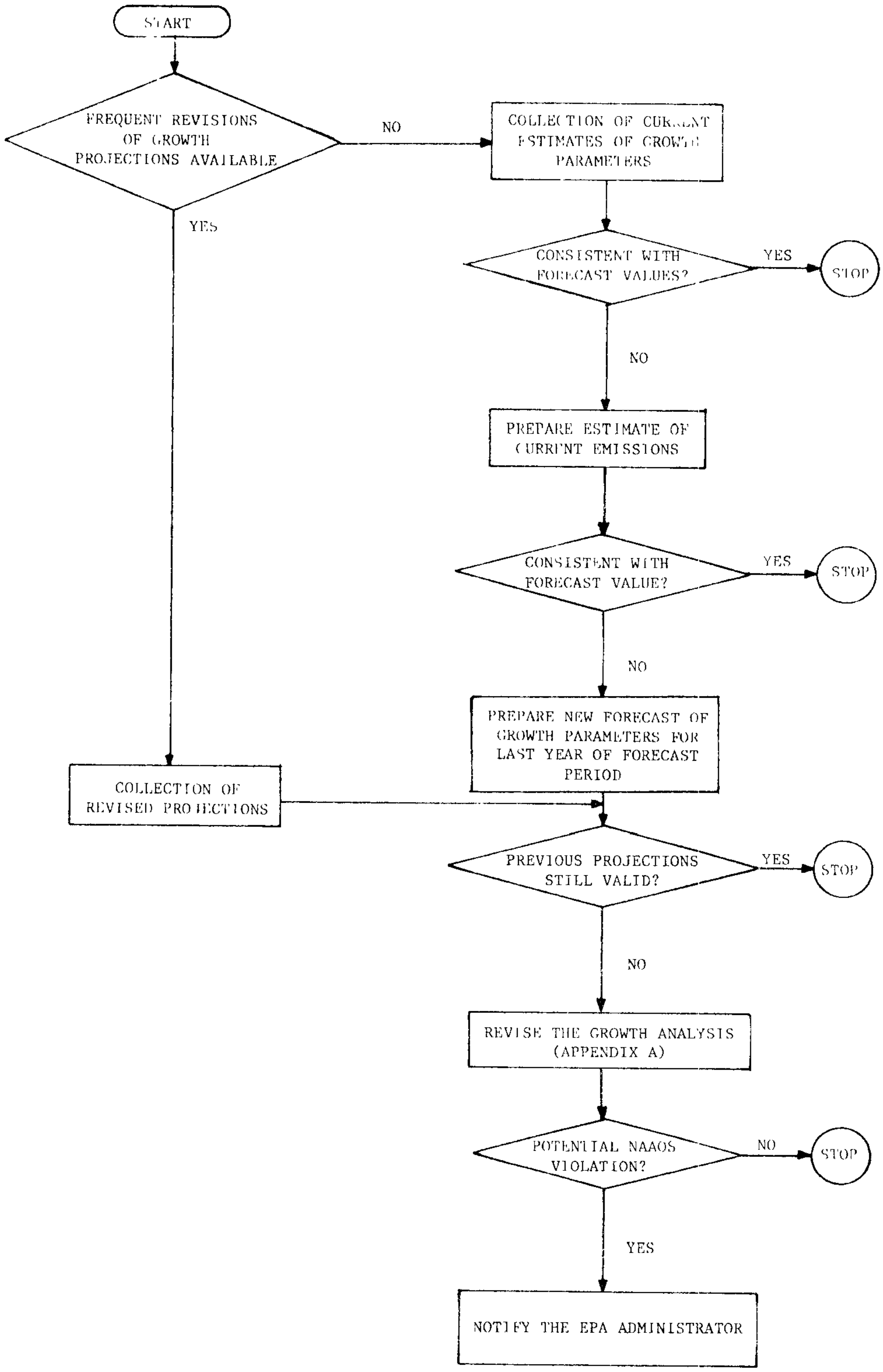

Figure 2. Schematic diagram of guideline procedures for areas with an existing condensed analysis of growth.

This technique is utilized with a crude but conservative* 10-year forecast of emissions to identify areas where additional anlaysis is recommended to assess the potential of a violation of an NAAQS. This methodology is admittedly subject to error; i.e., the situation where no violation is indicated in 10 years, but a more sophisticated analysis would indicate such a violation.

There are two types of error that are of concern. First, the situation where a violation will occur in 10 years at the monitoring site. This situation is not troublesome, as the potential of a violation will eventually be indicated as the analysis (linear roll-forward) is reconducted in subsequent years. The second type of error is where the violation will occur somewhere else in the region; i.e., not at the monitoring station. This situation can only be discovered through the subcounty allocation of emissions and the use of a regional simulation model such as AQDM. State agency personnel performing the analysis should be aware of this limitation and in situations where the monitoring station is unrepresentative, take appropriate action. Note that to the extent new major sources contribute to the violation, the new source review program will help to identify the locations in the county where ambient concentrations are higher than at the monitoring stations.

An schematic diagram of the guideline procedures is shown in Figure 3. The procedure is straightforward. Every 5 years a linear roll-forward projection of air quality is made (described in detail in Section IV). In the intervening years, current estimates or new projections of population and employment are collected. If the current estimates or projections are greater than previous values, a new linear roll-forward must be executed. If the 10-year linear roll-forward forecast of air quality exceeds an NAAQS, a condensed analysis of growth and air quality is prepared (described in Appendix A).

COUNTIES WITHOUT AN ANALYSIS OF PROJECTED AIR QUALITY AND WITHOUT MONITORING

Some counties will have no existing air quality data base and no analysis of growth. Since an accurate determination of the potential of a future violation of an NAAQS requires monitoring and since monitoring is prudent before a SIP revision is called for, the objective of the guidelines for counties in this category is the identification of when monitoring should begin.

Threshold levels of population, employment, and other economic indicators are identified, above which there is a substantial possibility that a violation of an NAAQS may occur in the future. Once a threshold has been exceeded, a condensed analysis of growth and air quality (described in Appendix A) is recommended for particulate matter or sulfur oxides. If the condensed analysis indicates a potential violation, the guidelines recommend initiating monitoring. Since the air quality simulation procedures in the condensed analysis for

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*It is conservative in that emission reductions at existing sources are not considered. If a linear roll-forward projections of air quality indicates a potential NAAQS violation, the next step recommended in the guidelines is essentially repeating the roll-forward analysis with an emission projection that does consider the future emission reductions.

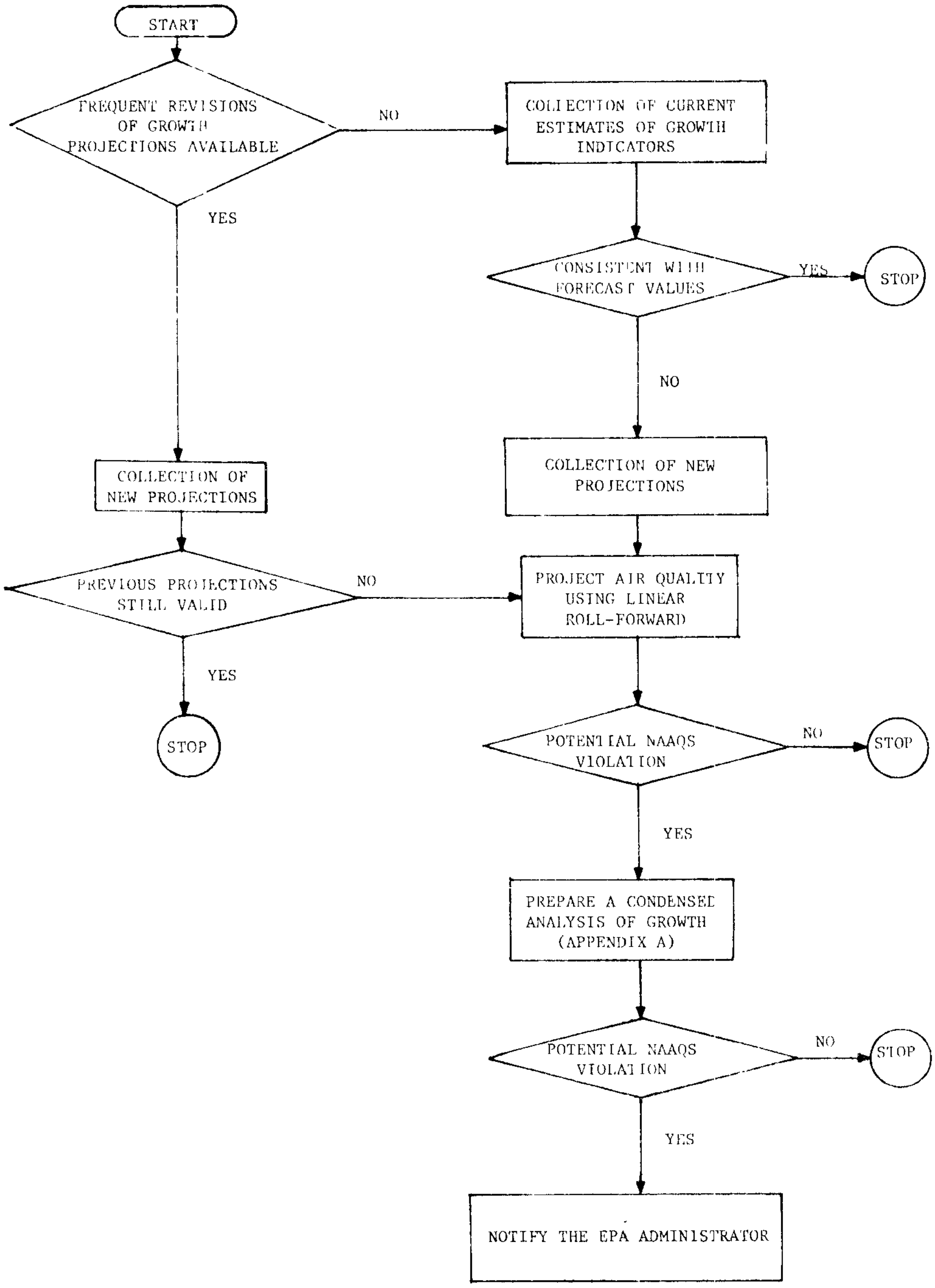

Figure 3. Schematic diagram of guideline procedures for areas without analysis of growth but with monitoring.

nitrogen oxides and oxidants (roll-forward and Appendix J, respectively) require an air quality baseline concentration, the guidelines recommend initiating monitoring for these pollutants once the thresholds have been exceeded. A schematic diagram of this process is shown in Figure 4.

CARBON MONOXIDE

Some counties will have had a detailed analysis of growth and air quality prepared. Typically, CO will have been modeled at existing monitoring stations by rollback based on projected regional vehicles miles traveled (VMT). A detailed projection of average daily traffic (ADT) on major traffic links, in conjunction with area source estimates of VMT on local streets and CO emissions from stationary sources may have been made. Projected CO concentrations will then have been modeled using APRAC-1a[5] or a combination of HIWAY[6] and Hanna-Gifford.[7] While such procedures have limitations in identifying localized CO violations. for the purposes of these guidelines, they are assumed to be sufficiently accurate. Thus, the recommended guideline for counties with a detailed CO analysis is similar to the procedures for counties with a detailed analysis for other pollutants; i.e., the annual collection of the current estimates of the indicators used to project emissions and comparison with their forecasted value.

Most counties will not have had a detailed analysis conducted recently. The annual consistency review of transportation plans in urbanized areas[8] is assumed to identify potential new CO violations associated with planned changes in the highway network. However, this process will not identify all potential CO violations, since many source configurations (e.g., indirect sources) are not encompassed in the 109(j) consistency review. States may wish to institute an annual program for screening promising locations for potential CO violations (as described in Section 4 and Appendix D).

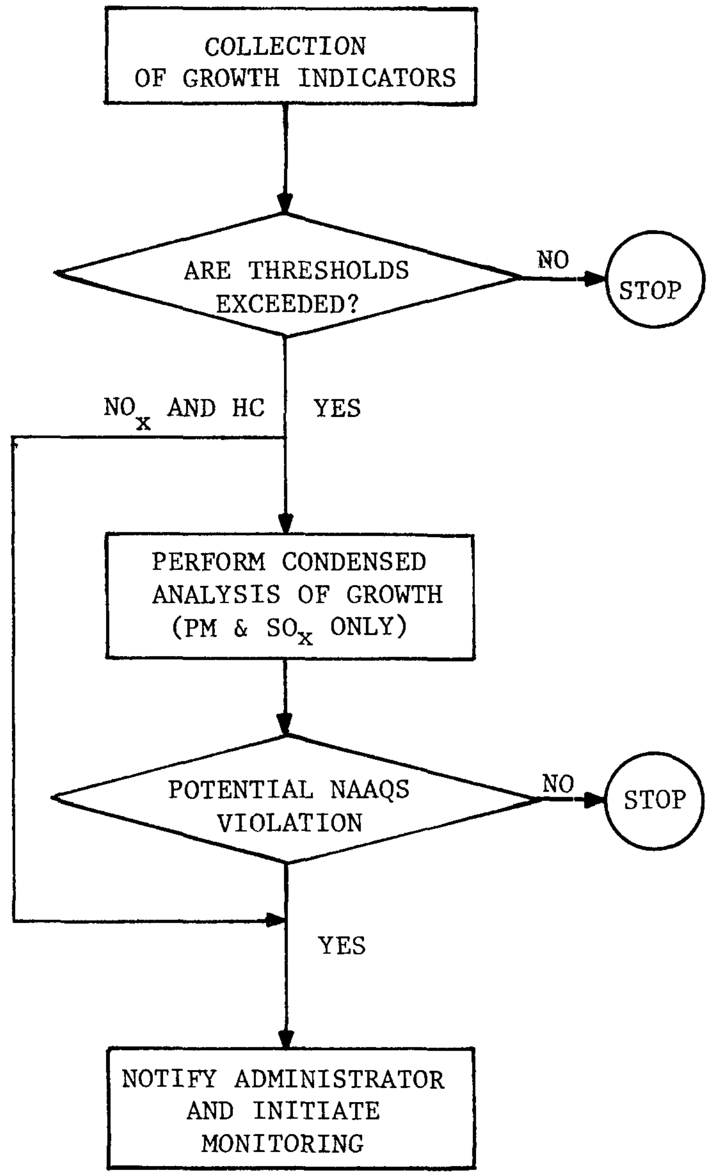

Figure 4. Schematic diagram of guideline procedures for areas without monitoring.

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8. 23 CFR 770.2.

SECTION 3

RELATIONSHIP OF GUIDELINES TO OTHER AIR QUALITY PLANNING PROGRAMS

The guidance offered in this report is intended to suggest possible procedures for identifying those areas for which expected growth may cause a NAAQS to be violated. There are, of course, reasons other than growth which may contribute to a violation of a NAAQS (or continuation of a violation); e.g., changes in the Federal Motor Vehicle Control Program (FMVCP), the noncompliance of stationary sources with compliance schedules, and other situations which may be categorized as nonattainment problems. Such situations are more readily addressed through other components of a comprehensive air quality planning process. Nevertheless, since continuing growth will, at least, exacerbate a violation that is principally a result of another situation, this guidance does consider many of these problems.

There are also several components of the air quality planning process that directly consider the effects of growth; e.g., new source review. The effects on air quality of large new point sources are more expeditiously considered in such programs. The cumulative impact of these sources and other types of growth are necessarily considered in this guidance. The relationship between other components of the air quality planning process and the subject of this report are reviewed below.

STATIONARY SOURCE EMISSION SURVEILLANCE

Each SIP is required to provide for monitoring the status of compliance of stationary sources; viz, "legally enforceable procedures for requiring owners or operators of stationary sources to maintain records of, and periodically report to the State information ... as may be necessary to enable the State to determine whether such sources are in compliance with applicable portions of the control strategy."[1] Thus a state should have the necessary data to monitor the compliance status of stationary sources. EPA has developed the Enforcement Management Subsystem (EMS), an information processing system to aid State agencies in performing this monitoring task.

Whether or not stationary sources are meeting compliance schedules is of importance in making the determination of the potential for a future violation of a NAAQS. For example, slower progress towards compliance by stationary sources than was anticipated during preparation of a subpart D analysis* may now contribute to a future violation that otherwise would not have occurred.

The guidelines in this report do not consider the compliance status of an individual source. Such concerns are properly handled in the enforcement division of the state agency. The guidelines do, at several points, consider the total emission loading in a county due to point sources. For counties for which an analysis of future air quality, such as subpart D, has been conducted, the current estimate of total emissions from point sources is compared with the value forecast in the emissions projection. Thus, in a crude way the projection of emissions from point sources is verified, which includes both growth (new sources and capacity expansion) as well as compliance schedule progress.

PRECONSTRUCTION REVIEW OF NEW STATIONARY SOURCES

Stationary source review (SSR) is one component of new source review (NSR) which, besides SSR, encompasses prevention of significant deterioration (PSD), emission standards for hazardous pollutants (NESHAP), and standards of performance for new sources (NSPS) for selected source categories. Each State is required to establish procedures that will "enable the State or local agency to determine whether the construction or modification of a facility, building, structure, or installation, or combination thereof, will result in violation of applicable portions of the control strategy or will interfere with attainment or maintenance of a national standard either directly because of emissions from it, or indirectly, because of emissions from mobile source activities associated with it."[5] Most states have SSR procedures in their SIP[6] - though in six SIP's EPA has promulgated SSR regulations.[7]

An interpretive ruling to 40 CFR 51.18[7] has indicated that only major sources are required to be reviewed to determine if the proposed source will cause or exacerbate a violation of a NAAQS. A major source is defined as having an allowable emission rate of 100 or more tons per year of particulate matter, sulfur oxides, nitrogen oxides, or nonmethane hydrocarbons and 1000 or more tons per year of carbon monoxide.+ Thus every large new point source (or modification) should be reviewed to determine if it will interfere with the attainment or maintenance of a NAAQS. The air quality analysis should take into account emissions from other previously approved new sources.[8] The emissions of a new source include the secondary or indirect emissions resulting from the facility when they can be accurately quantified and are well defined.[9] For a new source which would exacerbate an existing violation of a NAAQS, approval may be granted only if the source meets the lowest

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*The emissions projection techniques and air quality simulation procedures specified in subpart D, sections 51.42 through 51.51, and generally described in Volumes 7, 12, and 13 of the Guidelines for Air Quality Maintenance Planning and Analysis.[2-4]

+In an advance notice of proposed rule-making[16] amending 40 CFR 51, published concurrently with the interpretive ruling,[7] major sources are tentatively defined as sources with allowable emission rates of 50 tons for pollutants other than CO and 500 tons for CO.

achievable emission rate, all other sources owned or controlled by the owner or operator in the AQCR are in compliance, and emission reductions ("offsets") from existing sources that are generated are greater than the emissions of the new source and provide a positive net air quality benefit. The guidelines in this report do not accurately identify situations where the construction or modification of a major source will lead immediately to a violation of an NAAQS. That situation is adequately handled in SSR. There is, however, a certain parallel between SSR and the 51.12(h) guidelines; while SSR tracks the air quality impacts of major point sources, the guidelines track the growth of all sources and attempt to identify situations where future growth will lead to a potential violation of an NAAQS. SSR, including the offset policy, will provide information on emissions that can be used to maintain an accurate and up-to-date emission inventory.

PREVENTION OF SIGNIFICANT DETERIORATION (PSD)

PSD is another component of NSR. In most SIPs, it currently applies to 19 categories of sources for particulate matter and sulfur oxides.[10*] No source is permitted to be constructed or modified if, in conjunction with the effects of growth and reduction in emissions after January 1, 1975, of other sources, it will violate specified air quality increments. All areas have been initially designated Class II, which specified increments of 10 and 15 $\mu g/m^3$, respectively, in the annual means of particulate matter and sulfur oxides. Allowable increments in the short-term averaging times are also provided. Like SSR, PSD requires an assessment of the impact of the proposed source in conjunction with all sources constructed after January 1, 1975. This includes all sources whether or not they are subject to preconstruction review. It is entirely possible for the increment to be fully consumed by area source growth before the preconstruction review of a source subject to PSD review.

The 51.12(h) guidelines recommend the tracking and projection of emissions growth and air quality trends. This provides a continuing assessment of the PSD increment available for PSD sources. It will also provide some of the information necessary for the preconstruction review of a PSD source. PSD and SSR preconstruction reviews will also lead to more accurate and up-to-date emission inventories; the availability of which will facilitate the tracking and assessment of emissions growth recommended in the 51.12(h) guidelines.

MOTOR VEHICLE SOURCE SURVEILLANCE

Transportation control plans (TCP) are required to contain procedures for obtaining and maintaining data on actual emissions reductions achieved as a result of implementing transportation control measures. In the case of measures involving inspection, maintenance, or retrofit, these data must include the results of an emissions surveillance program designed to determine actual average per vehicle emissions reductions attributable to inspection, maintenance, and/or retrofit. In the case of measures based on traffic flow

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*These limitations of PSD to 19 categories will shortly be changed to reflect recent amendments to the Clean Air Act.

changes or reductions in vehicle use, the data must include observed changes in vehicle miles traveled (VMT) and average speeds. The data must be maintained in such a way as to facilitate comparison of planned and actual efficiency of the transportation control measures.

The maintenance of such data on the implementation of a TCP will allow one to verify the projections of VMT, average speeds, and per vehicle emission rates made in the development of the TCP. Such data is necessary to fulfill the requirements of Section 51.12(h) as well. It should be noted that it is doubtful that all areas with TCPs are carrying out such a motor vehicle source surveillance program. The pending implementation of the Urban Transportation Reporting System (described in Appendix B of this report) by the Federal Highway Administration and Urban Mass Transportation Administration, if successful, should improve this situation with respect to the availability of vehicle use and traffic flow parameters.

CONSISTENCY REVIEW OF TRANSPORTATION PLANS

The 1970 Federal-Aid Highway Act added Section 109(J) to Title 23 U.S.C. and directed the Department of Transportation to develop and promulgate guidelines to assure that highways constructed with federal funds are consistent with any approved plan for implementation of any air quality standard. Subsequently, the Federal Highway Administration (FHWA) published final regulations[12] and guidelines[13] for analysis to assist the FHWA and metropolitan planning organizations (MPO) in implementing the regulations. The 109(J) guidelines list five criteria for determining consistency. MPO transportation plans and programs must:

- not exacerbate any existing violations of the NAAQS
- not contribute to a new violation of the NAAQS
- not delay attainment of the NAAQS
- not interfere with maintenance of the NAAQS
- include all appropriate portions of the SIPs.

An annual determination of consistency between the transportation plan and the SIP, often referred to as the "109(J) review," must be documented and endorsed by the MPO policy board. The guidelines require that both the highway plans and the planning process be reviewed for consistency, and that the FHWA Regional Administrator must consult with the EPA Regional Administrator in these reviews. This review for consistency is one of many items that the FHWA requires to be done to obtain the annual certification of each MPO's planning process. The regulations also specify that a particular highway project cannot be built unless FHWA determines that it is consistent with the SIP. This project determination is to be included in the environmental impact statement for the highway project.

The MPO transportation plans and programs generally include a short range Transportation Improvement Program (10 years) and the long range plan (20 to 25 years). MPOs exist in each urbanized area (generally defined by the Bureau of the Census as metropolitan areas in excess of 50,000 population).

The 109(J) review has not been applied in a uniform manner nationwide. "For a great many MPOs, the air quality analyses on which policy boards have based their determinations are, at best, superficial, and no attempt has been made to integrate the analyses into the planning process."[14] In other areas, substantial progress in implementing the 109(J) review has been made.

In areas without TCP's, the 51.12(h) guidelines in this report rely heavily on the successful implementation of the 109(J) consistency review to identify areas where the CO NAAQSs may be potentially violated. The regulations,[12] in theory, should assure that the planning, location, and construction of highways are consistent with the SIP and, therefore, prevent violations due to transportation plans or highway projects.

INDIRECT SOURCE REVIEW

On June 30, 1975, EPA suspended indefinitely* the indirect source regulations requiring preconstruction reviews of facilities which attract mobile source activity that may violate a NAAQS. It applied to construction, in an SMSA, of a new parking facility of 1,000 cars, a modification of a parking facility which increases capacity by 500 cars, any new highway project with more than 20,000 annual daily traffic (ADT), or modifications of highway facilities which increase ADT by 10,000. It applied to the construction or modification of parking facilities outside SMSA's of, respectively, 2,000 and 1,000 cars. It also applied to the construction or modification of airports.

By 1977, 17 states, two territories, and two local areas have enacted some form of indirect source control regulations; 10 states and one local area are currently implementing their regulations.[15] The scope of these regulations vary - in many cases they closely parallel the suspended EPA regulations. Those states that have adopted indirect source regulations, in conjunction with the requirements of 109(J) review, are thus able to track the growth of most types of development that could lead to a potential violation of the CO NAAQSs.

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*A proposed amendment in Appendix C to the indirect source regulations is expected to be published later this year. It will provide guidelines for the review of highway and airport construction as indirect sources of air pollution.

REFERENCES

1. 40 CFR 51.19(a).

2. Guidelines for Air Quality Maintaining Planning and Analysis, Volume 7: Projecting County Emissions. U.S. Environmental Protection Agency, Research Triangle Park, North Carolina.

3. Guidelines for Air Quality Maintenance Planning and Analysis, Volume 12: Applying Atmospheric Simulation Models to AQMPs. U.S. Environmental Protection Agency, Research Triangle Park, North Carolina.

4. Guidelines for Air Quality Maintenance Planning and Analysis, Volume 13: Allocating Projected Emissions to Sub-County Areas. U.S. Environmental Protection Agency, Research Triangle Park, North Carolina.

5. 40 CFR 51.18(a).

6. OAQPS Guidelines 1.2-046, p. 1. U.S. Environmental Protection Agency, Research Triangle Park, North Carolina.

7. 41 Fed Regist 55525. December 21, 1976.

8. OAQPS Guidelines 1.2-046, p. 40. U.S. Environmental Protection Agency, Research Triangle Park, North Carolina.

9. 41 Fed Regist 55525. Footnote No. 3, December 21, 1976.

10. 40 CFR 52.21.

11. 40 CFR 51.19(d).

12. 39 Fed Regist 44441; see also CFR 770.2. December 24, 1974.

13. Guidelines for Analysis of Consistency Between Air Quality Plans and Programs. FHWA and EPA. Washington, D.C. April 1975.

14. Kurtzweg, Jerry. "Progress in Achieving Consistency Between Transportation and Air Quality Plans," (Presented at the 70th Annual Meeting of A.P.C.A.)

15. S. J. LaBelle, D. A. Seymour, A. E. Smith and M. L. Harbour. The Balance Sheet Technique Volume II - Preconstruction Review of Airports: Review of State Regulations, Projects Affected and Resource Requirements. Argonne National Laboratory, Draft Report of U.S. EPA Office of Transportation and Land Use Policy (January 1977).

16. 41FR55558 (December 21, 1976).

SECTION 4

GUIDELINES FOR IMPLEMENTING 40 CFR 51.12(h)

DEFINITIONS

For particulate matter, sulfur oxides, and nitrogen oxides, the basic area considered in these guidelines is the county. This is due principally to the general lack of availability of growth indicators for smaller areas. If indicators are available, a smaller geographic unit may be used. The following county classification scheme, based on the availability of data, is used. Guidance is given separately for each county class.

- Category 1: County without monitoring - a county without representative permanent monitoring for the pollutant species of concern and without any analysis of growth.

- Category 2: County with monitoring - a county with representative permanent monitoring for the pollutant species of concern and without any analysis of growth.

- Category 3: County with condensed growth analysis - a county for which a condensed analysis of growth and air quality has been conducted; e.g., the AQMA designation analysis.

- Category 4: County with detailed growth analysis - a county for which a detailed analysis of growth and air quality has been conducted; i.e., the analysis specified in subpart D of part 51 of the SIP regulations.

States with many small counties (e.g., independent cities in Virginia) may find it convenient to use multicounty groupings. The procedures outlined in this section are not applicable to very large counties, only a portion of which is settled, such as counties in the western areas of the country. In such cases, the procedures recommend treating a portion of the county (e.g., the incorporated area) as a county equivalent. The decision of which portion of the county to be used should be based on the availability of data and the nature of the air shed.

For oxidants, the basic area considered is the AQCR. This is due to the areawide nature of oxidant pollution. The categorization listed above, based on data availability, is utilized. Carbon monoxide is treated entirely differently, with the emphasis on detecting localized CO violations.

The sources of data utilized in this section are described in Appendix B.

PARTICULATE MATTER AND SULFUR OXIDES - COUNTIES WITHOUT MONITORING (CATEGORY 1)

In the first year of analysis, Step 2 must be performed. Thereafter, the analysis in Step 2 should be revised to reflect new projections at least every 5 years regardless of the outcome of Step 1 in the intervening years. If the county is experiencing negative growth, nothing need to be done.

1. a) <u>If new projections are unavailable</u>

   Acquire the current estimates of county population and employment. Compare the current estimates of each indicator with the forecast value for the current year in the projections used in Step 2. If the current estimates of either indicator is in excess of the forecast amount, a new or revised projection should be prepared and Step 2 revised. Prepare a worst-case estimate by extrapolating the current growth rate 10 years, unless new projections become available.

   b) <u>If new projections are available</u>

   Acquire the new projections of county population and employment. Compare the new 10-year growth rates with the growth rates in the projections used previously in Step 2. If the new growth rate is greater, proceed to Step 2.

2. Prepare a quick worst-case, 10-year projection of the county emission inventory, ignoring compliance schedule progress at existing sources. In the absence of better data, update and project the county emission inventory by multiplying the base year emissions estimate by the larger of the population or employment growth factors (projected value divided by base year value). Estimate the maximum emission density in the county in any square mile area, or, if unable to do so, divide the aggregate county emissions by the settled* area of the county. Estimate ambient air quality using Hanna Gifford to compute the origin cell concentration (Equation (8) of Appendix A of this report).+ If the projected concentration approaches the NAAQS (e.g., 75 percent of the NAAQS), proceed to the next step.

3. Project the emission inventory and model future air quality using the procedure outlined in Appendix A. If the projected air quality approaches the NAAQS (e.g., 75 percent of the NAAQS), proceed to next step.

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*Settled area refers to the urbanized or developed area in the county. If this is unknown or data unavailable, use the incorporated area of the county.

+As described on page 77, it may be appropriate to model large point sources individually.

4. Ambient air quality monitoring should be initiated in the county. In subsequent years, the procedures for a county with monitoring (the following subsection) should be followed. If the results of Step 3 indicated that the projected air quality is in excess of a NAAQS, proceed to the next step.

5. Notify the EPA regional administrator.

PARTICULATE MATTER AND SULFUR OXIDES - COUNTIES WITH MONITORING (CATEGORY 2)

In the first year of analysis, Step 2 should be performed. Thereafter, Step 2 should be revised to reflect new projections at least every 5 years, regardless of the outcome of the previous step in the intervening years. If the county is experiencing negative growth, nothing need to be done.

1. a) If new projections are unavailable

Acquire the current population and employment estimates for the county. If either indicator is in excess of the forecast value for the current year in the projections used in Step 2, a new or revised projection should be prepared and the analysis of Step 2 revised. Prepare a worst-case estimate by extrapolating the current growth rate 10 years, unless new projections become available.

b) If new projections are available

Acquire the new projections of county population and employment. Compare the new 10-year growth rates with the growth rates in the projections used previously in Step 2. If the new growth rate is greater, proceed to Step 2.

2. Project air quality 10 years using the population or employment forecast:

$$\chi_P = G\ (\chi_C - \chi_B) + \chi_B$$

where χ_P = projected air quality level

G = the larger of population and employment 10-year growth factors (i.e., forecast value divided by current value)

χ_C = current air quality level

χ_B = background concentration*

If the projected air quality is near the NAAQS (e.g., 90 percent of the NAAQS), proceed to next step.

3. Project the most recent county emission inventory 10 years using the procedures in Appendix A. Model projected air

*No specific guidance for estimating the background level is given in this report. It is believed that the state or local agency is the best judge of this value. (Note that the estimate of the background level is usually based on the lowest measured annual air quality concentration in the region; i.e., a nonurbanized area away from major sources). It is generally thought of as including the large scale influence of long range transport and, in the case of particulates, naturally occurring particulates.

quality using the procedures outlined in Appendix A. If the projected air quality is in excess of a NAAQS, proceed to the next step.

4. Notify the EPA regional administrator.

PARTICULATE MATTER AND SULFUR OXIDES - COUNTIES WITH CONDENSED ANALYSIS (CATEGORY 3)

Counties falling into this category will have performed an analysis of projected air quality at a level of detail of Appendix A of these guidelines or greater within the past 5 years. If it has not been done in the past 5 years, proceed to Step 2.

1. a) <u>If new projections are unavailable</u>

i. Collect current population and employment estimates (or other indicators used in the condensed analysis). Separately compare the total growth in each indicator with that projected in the analysis of projected air quality. If any indicator has experienced more growth than was projected, proceed to Step 1. a) ii.

ii. Using the experienced growth, estimate the current aggregate emission loading in the county. For example, multiply the fuel combustion area source emissions of the most recent emission inventory by the percent increase in employment, industrial process area source emissions by the percent increase in manufacturing employment, and the solid waste, transportation, and miscellaneous emissions by the percent increase in population. Total the current point source inventory. (Project it forward if it is 1 or 2 years out-of-date). Compare the estimated total emissions in the current year with that expected for the year from the condensed analysis. (Linearly interpolate between the base year emissions and the projection year). Figure 5 is an example of this, showing current emissions greater than were expected in the third year. If total emissions are greater than expected, proceed to Step 1. a) iii.

iii. Assess the validity of final year forecasts of the indicators used to project growth. If they are no longer valid, proceed to Step 2. Ideally, new projections may be prepared which may be compared with the old ones. If this is not the case, ask the organization that prepared the projections if, in light of recent growth, the final year estimates are still valid. (At least one of the indicators has experienced a higher annual growth rate than was forecast). If there is any question as to the validity of the forecast amount for the final year, proceed to Step 2.

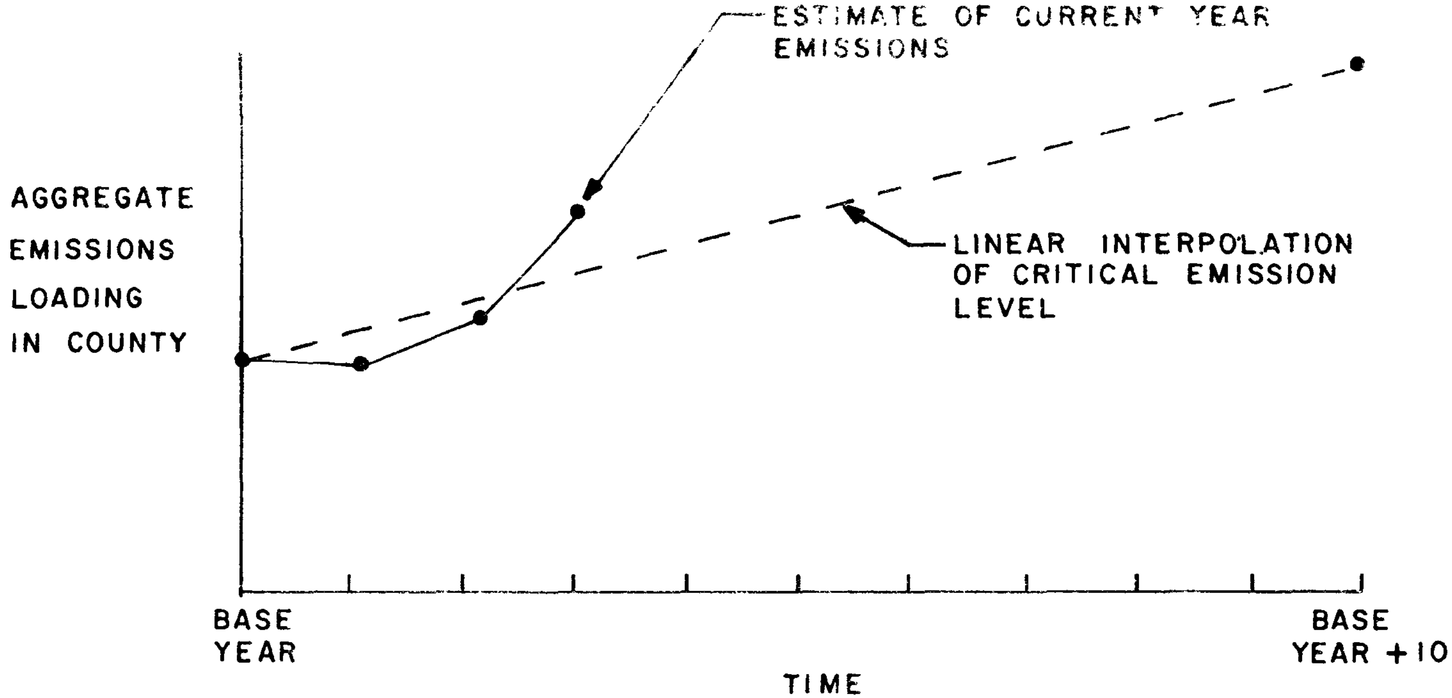

Figure 5. Comparison of estimated current year emissions with that forecast in the condensed analysis.

1. b) <u>If new projections are available</u>

Acquire the new 10-year projections of county employment and population (or other indicators used in the condensed analysis). Compare the new 10-year growth rate with the growth rate in the projections used previously in Step 2. If the new growth rate is greater, proceed to Step 2.

2. Project emissions 10 years, and model air quality using the procedures in Appendix A of this report. If projected air quality exceeds the NAAQS, proceed to Step 3.

3. Notify the EPA regional administrator.

PARTICULATE MATTER AND SULFUR OXIDES - COUNTIES WITH DETAILED ANALYSIS (CATEGORY 4)

Counties falling into this category will have performed a detailed analysis within the past 5 years. If this has not been done within the past 5 years, proceed to Step 4.

1. Acquire the indicators* used to project the emission inventory. Separately compare the total growth experienced in each indicator with that projected in the analysis. Linearly interpolate between the base year and end year of the analysis if necessary. If any indicator has experienced more growth than was projected, proceed to Step 2. In addition, annually compute the total point source emissions and compare the total with that projected in the analysis. If it is greater than anticipated, proceed to Step 2.

2. Using the experienced growth to project the area source emissions, estimate the current aggregate emission loading. Compare that with the expected emission loading for the current year from the analysis. If it is greater, proceed to Step 3.

3. Assess the validity of final year forecasts of the indicators used to project growth. If they are no longer valid, proceed to Step 4. Ideally, new projections will be available which may be comapred with the old ones. If this is not the case, ask the organization that prepared the projections if, in light of recent growth, the final year estimates are still valid. (At least one of the indicators has experienced a higher annual growth rate than was forecast). If there is any question as to the validity of the forecast amount for the final year, proceed to Step 4.

4. Revise the detailed analysis to incorporate the new projections. If the projected air quality exceeds the NAAQS, proceed to Step 5.

5. Notify the EPA regional administrator.

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*See the discussion in Appendix B.

CARBON MONOXIDE - COUNTIES WITH DETAILED ANALYSIS

Counties in this category will have available a recent (less than 5 years old) detailed analysis of growth and air quality. The detailed analysis should be revised at least every 5 years.*

1. As they become available, collect the most recent estimates of the parameters used in the analysis. This may be regional VMT if rollback was used in the analysis or ADT at selected links if a simulation model such as APRAC-1A was used. It may be necessary to collect both parameters if both were used in the analysis. It is also necessary to estimate current stationary source emissions. Compare the current estimates with forecast values. If any of the estimated current values are greater than the forecast values, proceed to Step 2.

2. Reassess the validity of the detailed analysis. If rollback and regional VMT was used, prepare a new forecast of regional VMT and recalculate the rollback based on current monitoring data. If a link-based ADT and a line source model was utilized and only a few links have experienced greater than anticipated growth (or less than anticipated reductions) reevaluate the concentration near the specific links using new ADT projections and hot spot screening techniques. If many links have experienced greater than anticipated growth, the simulation model should be reexecuted using new ADT projections. (The links with the greatest unanticipated growth or in the vicinity of the highest concentrations may be evaluated first using the hot spot screening guidelines.) If a future violation of an NAAQS is indicated, notify the EPA regional administrator.

CARBON MONOXIDE - COUNTIES WITHOUT DETAILED ANALYSIS

It is assumed that the 109(j) consistency review[1] will identify all future potential violations of the CO NAAQS relating to highway projects. There is, of course, the potential for a violation of the CO NAAQSs due to other sources such as those that were covered by indirect source review as well as source configurations that were not included in the definition of indirect sources.+ States may well wish to initiate a continuing program of screening promising locations for potential CO violations. An overview of the CO hot spot planning process is given in Appendix D. For example, every

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*If the county has a TCP, the motor vehicle source surveillance program may provide most of the data and some of the analysis to assess the potential of an NAAQS violation in 10 years.

+See, for example, Croke et al. The Relationship of Automotive Pollutants and Commercial Development. APCA Paper 75-22.6. A typical example would be highway commercial strip development.

year five locations in a county could be evaluated as potential CO hot spots. If a state has not adopted an indirect source regulation, proposed new indirect sources would be an obvious choice for such evaluation. If any potential violations are identified, notify the EPA regional administrator.

OXIDANTS - AQCRs WITHOUT MONITORING (CATEGORY 1)

If a recently prepared 10-year projection of AQCR VMT is easily available, proceed to Step 3.

1. Acquire the estimate of gasoline sales (or state gasoline tax receipts) for the AQCR. If a positive growth is indicated, proceed to next step.*

2. Compute the sales of gasoline per square mile. Project it 10 years by multiplying it by the forecast population growth rate. If it is in excess of the value indicated in Table 1, proceed to the next step.

3. Acquire or prepare a 10-year projection of total VMT in the AQCR. Compute the VMT per square mile. If it is in excess of the value indicated in Table 2, proceed to the next step.

4. Prepare or update a hydrocarbon emission inventory for the AQCR and project it 10 years as outlined in Appendix A. If the nonmethane hydrocarbon emission density is projected to exceed 16.9 tons per square mile, proceed to the next step.

5. Notify the EPA regional administrator. Oxidant monitoring should be initiated.

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*If tax receipts or service station revenues are used, they may have to be adjusted for changes in the price of gasoline or tax rates before comparison with prior years. If gasoline sales data are not available from the state, sales data can be obtained from the Census of Retail Trade every 5 years and updated using population or motor vehicle registration.

TABLE 1. CRITICAL GASOLINE SALES DENSITY TO EXCEED 75 PERCENT OF THE HYDROCARBON STANDARD

Analysis year	Critical level gallons/year/square mile		
	Low altitude	High altitude	California
1986	357,000	327,000	368,000
1987	401,000	388,000	418,000
1988	408,000	396,000	420,000
1989	412,000	404,000	420,000
1990	432,000	422,000	430,000

Assumptions:

- Negligible emissions from stationary sources.
- FMVCP in force in April, 1977 (1.5 g/m 1975-1977; 0.41 g/mi 1978 and later).
- Gasoline Mileage Standards of the Federal Energy Policy and Conservation Act of 1975.
- Hanna-Gifford model origin cell concentration at wind velocity of 1 meter per second, stable atmosphere.
- Twenty-five percent of VMT in peak 3-hour period.
- Supplement 5 emission factors.

Note: The derivation of this table is described in Appendix E. Sufficient information is provided to obtain localized critical values to reflect localized motor vehicle emission factors, inapplicability of the assumptions, and changes in projected motor vehicle emission factors.

TABLE 2. CRITICAL VMT DENSITY TO EXCEED 75 PERCENT OF THE HYDROCARBON STANDARD

Analysis year	Critical level of VMT/square mile millions		
	Low altitude	High altitude	California
1986	7.5	7.0	8.0
1987	9.0	8.5	9.0
1988	9.5	9.0	9.5
1989	10.0	9.5	10.0
1990	10.5	10.5	10.5

Assumptions:

- Negligible emissions from stationary sources.
- FMVCP as of April 1977 (1.5 g/m (1975-1977; 0.41 g/mi 1978 and later).
- Hanna-Gifford model origin cell concentrations at wind velocity of 1 meter per second, stable atmosphere.
- Twenty-five percent of VMT in peak 3-hour period.
- Supplement 5 emission factors.

Note: The derivation of this table is described in Appendix E. Sufficient information is provided to obtain localized critical values to reflect localized motor vehicle emission factors, inapplicability of the assumptions and changes in projected motor vehicle emission factors.

OXIDANTS - AQCRs WITH MONITORING (CATEGORY 2)

1. Acquire the estimate of gasoline sales (or tax receipts) in the AQCR. If a positive growth is indicated, proceed to the next step.

2. Acquire a 10-year or greater population projection. Acquire, from the most recent emission inventory, the proportion of hydrocarbon emissions (P) from light-duty mobile sources. Determine the expected reduction in light-duty motor vehicles emissions (ER) as described in Appendix A.

   If currently below the NAAQS, project air quality using the proportional method:

$$\chi_{future} = \chi_{current} \frac{Pop_{future}}{Pop_{current}} \left[(P)\ (ER) + (1-P) \right]$$

   If currently above the NAAQS, determine the reduction need to achieve the NAAQS using the revisions forthcoming to Part 51 Appendix J. Determine the projected emission reduction:

$$\text{projected emission reduction} = 1 - \left[\frac{Pop_{future}}{Pop_{current}} \left[(P)\ (ER) + (1-P) \right] \right]$$

   If VMT estimates and forecasts are available, they should be used in place of the population estimates or projections. If the projected air quality is above the NAAQS, or if the projected emission reduction is less than that required, proceed to the next step.

3. Perform an air quality analysis as outlined in Appendix A; if the projected air quality exceeds the NAAQS, proceed to Step 4.

4. Notify the EPA regional administrator.

OXIDANTS - AQCRs WITH CONDENSED ANALYSIS (CATEGORY 3)

AQCRs falling into this category will have performed an analysis of projected air quality at a level of detail of Appendix A of these guidelines or greater within the past 5 years. If it has not been done in the past 5 years, proceed to Step 2.

1. a) <u>If new projections are unavailable</u>

   i. Collect current population and employment estimates (or other indicators used in the condensed analysis). Separately compare the total growth in each indicator with that projected in the analysis of projected air quality. If any indicator has experienced more growth than was projected, proceed to Step 2.

   ii. Using the experienced growth, estimate the current aggregate emission loading in the county. For example, multiply the fuel combustion area source emissions of the most recent emission inventory by the percent increase in employment, industrial process area source emissions by the percent increase in manufacturing employment, and the solid waste, transportation, and miscellaneous emissions by the percent increase in population. Adjust the transportation emissions estimate for the effects of the FMVCP. Total the current point source inventory. (Project it forward if it is a year or 2 out of data). Compare the estimated total emissions in the current year with that expected for the year from the condensed analysis. If total emissions are greater than expected, proceed to Step 3.

   iii. Assess the validity of final year forecasts of the indicators used to project growth. If they are no longer valid, proceed to Step 2. Ideally, new projections may be prepared which may be compared with the old ones. If this is not the case, ask the organization that prepared the projections if, in light of recent growth, the final year estimates are still considered valid. (At least one of the indicators has experienced a higher annual growth rate than was forecast.) If there is any question as to the validity of the forecast amount for the final year, proceed to Step 2.

   b) <u>If new projections are available</u>

   Acquire the new 10-year projections of population and employment (or other indicators used in the condensed analysis). Compare the new 10-year growth rate with the growth rate used previously in Step 2. If the new growth rate is greater, proceed to Step 2.

2. Project emissions 10 years, and model air quality using the procedures in Appendix A. If projected air quality exceeds the NAAQS, proceed to Step 3.

3. Notify the EPA regional administrator.

OXIDANTS - AQCRs WITH DETAILED ANALYSIS (CATEGORY 4)

AQCRs falling into this category will have performed a detailed analysis within the past 5 years. If this has not been done within the past 5 years, proceed to Step 4.

1. Acquire the indicators* used to project the emission inventory. Separately compare the total growth experienced in each indicator with that projected in the analysis. Linearly interpolate between the base year and end year of the analysis if necessary. If any indicator has experienced more growth than was projected, proceed to Step 2. In addition, annually compute the total point source emissions and compare the total with that projected in the analysis. If it is greater than anticipated, proceed to Step 2.

2. Using the experienced growth to project the area source emissions, estimate the current aggregate emission loading. Compare that with the expected emission loading for the current year from the analysis. If it is greater, proceed to Step 3.

3. Assess the validity of final year forecasts of the indicators used to project growth. If they are no longer valid, proceed to Step 4. Ideally, new projections will be available which may be compared with the old ones. If this is not the case, ask the organization that prepared the projections if, in light of recent growth, the final year estimates are still considered valid. (At least one of the indicators has experienced a higher annual growth rate than was forecast.) If there is any question as to the validity of the forecast amount for the final year, proceed to Step 4.

4. Revise the detailed analysis to incorporate the new projections. If the projected air quality exceeds the NAAQS, proceed to Step 5.

5. Notify the EPA regional administrator.

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* See the discussion in Appendix B.

NITROGEN OXIDES - COUNTIES WITHOUT MONITORING (CATEGORY 1)

All priority I AQCRs are required to have at least three nitrogen dioxide monitors.[2] If an AQCR initially did not have nitrogen dioxide monitoring, it was classified as priority I if it contained an area whose 1970 urban place population exceeded 200,000.[3] The AQCR, if classified as priority I on the basis of population, could have been reclassified as priority III if measured concentrations were below 110 micrograms per cubic meter.

A statistical analysis* of 1975 nitrogen dioxide concentrations indicated that there is a 99 percent probability of not exceeding the nitrogen oxide standard in a county if the county population is below 800,000 or the population density is below 140 population per square mile. Thus, considering the monitoring requirements, it is likely that few counties with the potential of exceeding the NAAQS will not already have monitoring.

1. As they become available, obtain new 10-year population projections. Determine if the forecast values of county population and county population density per square miel are in excess of 800,000 and 140, respectively. If either is in excess of the indicated value, proceed to the next step.

2. Ambient air quality monitoring should be initiated in the county. In subsequent years, the procedures for a county with monitoring (the following subsection) should be followed. Notify the EPA regional administrator.

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*Two simple ordinary least squares regressions of county population and county population density on county nitrogen dioxide concentrations. Other variables and log and reciprocal transformations were also considered, but were found to provide no additional power in describing nitrogen oxide concentrations.

NITROGEN OXIDES - COUNTIES WITH MONITORING (CATEGORY 2)

In the first year of analysis, Step 2 should be performed. Thereafter, Step 2 should be revised to reflect new projections at least every 5 years, regardless of the outcome of the previous step in the intervening years. If the county is experiencing negative growth, nothing need to be done.

1. a) <u>If new projections are unavailable</u>

Acquire the current estimates of population* and electric utility nitrogen oxide emissions. If either is in excess of the forecast value for the current year in the projection used in Step 2, a new or revised projection should be prepared and the analysis of Step 2 revised. Prepare a worst-case estimate by extrapolating the current growth rate 10 years, unless new projections become available.

b) <u>If new projections are available</u>

Acquire the new 10-year projections of county population* and electric utility emissions. Compare the 10-year growth rate in county population and electric utility emissions with the growth rates used previously in Step 2. If the new growth rate of either is greater, proceed to Step 2.

2. Project air quality using the population and emissions forecast:

$$\chi_P = G\ (\chi_C - \chi_B) + \chi_B$$

$$G = \frac{Q_p}{Q_c} f + \frac{P_p}{P_c} (1-f)$$

where χ_p = projected air quality level

G = projected emissions growth

χ_C = current air quality level

χ_B = background air quality level

Q_p = projected electric utility emissions in 10 years

Q_c = current electric utility emissions

f = proportion of nitrogen oxide emissions from electric utilities in the most recent county emission inventory

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*VMT instead of population may be used if data is available.

P_p = projected county population in 10 years*

P_c = current county population*

If the projected air quality is near the NAAQS (e.g., 90 percent of the NAAQS), proceed to next step.

3. Project the most recent county emission inventory using the procedures in Appendix A. Model projected air quality using the procedures outlined in Appendix A. If the projected air quality exceeds the NAAQS, proceed to next step.

4. Notify the EPA regional administrator.

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*VMT instead of population may be used if data is available.

NITROGEN OXIDES - COUNTIES WITH CONDENSED ANALYSIS (CATEGORY 3)

Counties falling into this category will have performed an analysis of projected air quality at a level of detail of Appendix A of these guidelines or greater within the past 5 years. If it has not been done in the past 5 years, proceed to Step 2.

1. a) <u>If new projections are unavailable</u>

i. Collect current population and employment estimates (or other indicators in condensed analysis). Separately compare the total growth in each indicator with that projected in the analysis of projected air quality. If any indicator has experienced more growth than was projected, proceed to Step ii.

ii. Using the experienced growth, estimate the current aggregate emission loading in the county. That is, multiply the fuel combustion area source emissions of the most recent emission inventory by the percent increase in employment, industrial process area source emission by the percent increase in manufacturing employment, and the solid waste, transportation,* and miscellaneous emissions by the percent increase in population. Adjust the transportation emissions estimate for the effects of the FMVCP. Total the current point source inventory. (Project it forward if it is a year or 2 out of date.) Compare the estimated total emissions in the current year with that expected for the year from the condensed analysis. If total emissions are greater than expected, proceed to Step iii.

iii. Assess the validity of final year forecast of the indicators used to project growth. If they are no longer valid, proceed to Step 2. Ideally, new projections may be prepared which may be compared with the old ones. If this is not the case, ask the organization that prepared the projections if, in light of recent growth, the final year estimates are still valid. (At least one of the indicators has experienced a higher annual growth rate than was forecast.) If there is any question as to the validity of the forecast amount for the final year, proceed to Step 2.

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*VMT should be used to project transportation emissions if it is available.

b) <u>If new projections are available</u>

i. Acquire projections of population, employment, electric utility emissions, and other indicators used in the condensed analysis. Individually compare the new projections of growth rates of each indicator with those of the projections used previously in Step 2. If any one indicator is projected to have a larger growth rate, proceed to Step ii.

ii. Prepare a new 10-year forecast of emissions using the new projections and the procedures in Appendix A. If the new forecast of emissions is greater than that prepared previously in Step 2, proceed to Step 2.

2. Project emissions, and model air quality using the procedures in Appendix A. If projected air quality exceeds the NSAQS, proceed to Step 3.

3. Notify the EPA regional administrator.

NITROGEN OXIDES - COUNTIES WITH DETAILED ANALYSIS (CATEGORY 4)

Counties falling into this category will have performed a detailed analysis within the past 5 years. If this has not been done within the past 5 years, proceed to Step 4.

1. Acquire the indicators used to project the emission inventory. Separately compare the total growth experienced in each indicator with that projected in the analysis. Linearly interpolate between the base year and end year of the analysis if necessary. If any indicator has experienced more growth than was projected, proceed to Step 2. In addition, annually compute the total point source emissions and compare the total with that projected in the analysis. If it is greater than anticipated, proceed to Step 2.

2. Using the experienced growth to project the area source emissions, estimate the current aggregate emission loading. Compare that with the expected emission loading for the current year from the analysis. If it is greater, proceed to Step 3.

3. Assess the validity of final year forecasts of the indicators used to project growth. If they are no longer valid, proceed to Step 4. Ideally, new projections will be available which may be compared with the old ones. If this is not the case, ask the organization that prepared the projections if, in light of recent growth, the final year estimates are still valid. (At least one of the indicators has experienced a higher annual growth rate than was forecast.) If there is any question as to the validity of the forecast amount for the final year, proceed to Step 4.

4. Revise the detailed analysis to incorporate the new projections. If the projected NAAQS exceeds the NAAQS, proceed to Step 5.

5. Notify the EPA regional administrator.

REFERENCES

1. 23 CFR 770.2
2. 40 CFR 51.17
3. 40 CFR 51.3(b)(2)

SECTION 5

ILLUSTRATION OF GUIDELINES IN WISCONSIN

The guidelines presented in Section 4 were tested in two states, Wisconsin, and Massachusetts. In the interim period between the preparation of a draft of the guidelines for use in the illustration and the preparation of this report, the guidelines were revised to reflect comments by individuals in several state agencies and the U.S. Environmental Protection Agency. The guidelines were also revised based on the experience in Wisconsin and Massachusetts. Consequently, the process described in this section does not exactly correspond to the guidelines presented in Section 4. The results of the Wisconsin illustration are summarized below, Massachusetts is treated in the following section.

An AQMA designation analysis was conducted for all SMSAs in Wisconsin, but no detailed AQMA analyses have yet been completed. Thus, for this analysis counties were categorized by the results of the designation analysis and by the availability of monitoring data. The initial exclusions and inclusions are summarized in Table 3. Thus an abbreviated analysis was conducted for most SMSAs for total suspended particulates (TSP); for Milwaukee for sulfur oxides (SO_x), and for Milwaukee, Kenosha, and Racine for oxidants.

The results of the condensed analysis for TSP and SO_x are shown in Table 2. The condensed analysis for oxidants indicated all three SMSAs should be designated.

SUMMARY

The illustration of the guidelines required approximately 1 person week. On the basis of simple roll-forward projections, four counties not currently violating the short term particulate NAAQS were indicated as having the potential for doing so.

The roll-forward analysis did not take into account emission reductions at existing sources due to compliance schedule progress; that is, it only considered the effects of growth. The next step, not performed in this illustration, would be to estimate the projected compliance progress and include the expected emission reduction in the roll-forward analysis. It is expected that the further analysis would indicate that there is no potential for a violation of a NAAQS.

Nine counties currently exceeding the short term particulate NAAQS, one exceeding the 24 hour sulfur oxide standard, and three exceeding the oxidant

TABLE 3. INITIAL INCLUSION/EXCLUSION SUMMARY

SMSA	Part	SO_2	CO	O_x	NO_2
Appleton-Oshkosh, Wi	Nei	Exc	Exc	Exc	Exc
Duluth-Superior, Mn-Wi Douglas County	Nei	Exc	Exc	Exc	Exc
Green Bay, Wi	Nei	Exc	Exc	Exc	Exc
Kenosha, Wi	Nei	Exc	Exc	Nei	Exc
La Crosse, Wi	Nei	Exc	Exc	Exc	Exc
Madison, Wi	Nei	Exc	Exc	Exc	Exc
Milwaukee, Wi	Nei	Nei	Exc	Nei	Exc
Minneapolis-St. Paul, Mn-Wi St. Croix County	Exc	Exc	Exc	Exc	Exc
Racine, Wi	Nei	Exc	Exc	Nei	Exc

Inc - Included automatically
Exc - Excluded automatically
Nei - Neither included or excluded automatically

TABLE 4. AIR QUALITY PROJECTIONS

Wisconsin SMSA's	Base Year	Projected 1985 Air Quality: Sulfur dioxide Arith. Mean	Sulfur dioxide Max. 24-hr.	Sulfur dioxide Max. 3-hr.	Particulate Geom. mean	Particulate Max. 24-hr.	Initial AQMA designations
Appleton-Oshkosh(A)	'72	NR	NR	NR	83	276	Particulates - except Calument County
Duluth-Superior Douglas Co.	'72/ '70	NR	NR	NR	60	99	None
Green Bay	'72	NR	NR	NR	58	197	Particulates
Kenosha	'73	NR	NR	NA	84	186*	Particulate and Oxidants
La Crosse	'71	NR	NR	NA	52	93	None
Madison	'70	NR	NR	NA	69	149	None
Milwaukee	'73	83	552*	969*	95	277*	Particulates, Oxidants and sulfur dioxide
Minneapolis-St. Paul St. Croix Co.	---	NR	NR	NR	NR	NR	None
Racine	'73	NR	NR	NR	95	258*	Particulates and Oxidants
NAAQS's ($\mu g/m^3$)		80	365	1300	75	150	

NR - Not Required, due to exclusion criteria
NA - Not available - Base year data not reported in this sample time
(A) used Winnebago County Monitoring Data - Outagamie County is very similar
*Second highest

standard were shown to have some potential for continuing to exceed the standard in 10 years. It is expected that additional analysis of emission reductions due to compliance schedules would also show that there is no potential of a NAAQS violation in the case of particulate matter and sulfur oxides. This analysis would take approximately 1 person day.

TSP AND SO_x

The category 1 counties for TSP and SO_x (i.e., counties without monitoring data) are shown in Table 5. For the first step, the only data source required was a set of current population estimates and 10-year-or-greater projections. These were obtained from the Wisconsin State Bureau of Program Management. Table 5 presents the results of the analysis, namely which counties are currently experiencing growth and which are projected to continue growing. Two counties, Langlade and Richland, are experiencing population declines and are thus exempt from further analysis.* The current maximum emission densities in the remaining counties were estimated from EPA NEDS and U.S. Bureau of the Census data. These were projected to 1990 using the State of Wisconsin's population projection of the county. Ambient air quality levels were estimated from these projected emission inventories using the modified Hanna-Gifford model as described in Appendix A. A 10-mile-per-hour mean wind speed and stability class D were assumed. As shown in Table 6, all projected concentrations were below 75 percent of the standard, so no further analysis was required.

The category 2 counties, namely, counties with monitoring data, are shown in Table 7. The first four steps in the growth monitoring guidelines were conducted for these counties. The table indicates whether the county is currently experiencing population growth, the projected population growth factor through 1995 (i.e., 1995 population/1976 population), and the results of air quality projections made with these growth factors. Population projections were obtained from the source cited previously, and air quality data were supplied by the state.

Ashland County is experiencing a population decline and is thus exempt from steps 2, 3, and 4. Of the remaining counties, nine are currently violating a NAAQS. The high concentrations in these characteristically rural counties is thought to be due to nearby point sources, principally paper and lumber mills. As these sources achieve compliance, the standards are expected to be met. However, since these counties are expected to experience a relatively high rate of growth (30 to 40 percent), it would be prudent to estimate the combined effects of compliance schedule progress and growth on future air quality. This is the recommended next step in the guidelines, an abbreviated analysis as described in Appendix A.

Aside from the nine counties currently violating a standard, the linear roll-forward analysis has indicated that four counties currently with air

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*The air pollution control agency would still have to monitor the county for PSD increments, and may have to adopt additional regulations to protect the standards as a result of windblown agricultural dust.

TABLE 5. CATEGORY 1 ANALYSES FOR TSP AND SO_2 (STEP 1)

County	Current growth (+/-)	Future growth (+/-)
Adams	+	+
Barron	+	+
Bayfield	+	+
Buffalo	+	+
Burnett	+	+
Chippewa	+	+
Clark	+	+
Crawford	+	+
Dodge	+	+
Dunn	+	+
Florence	+	+
Fond du Lac (SO_2 only)	+	+
Forest	+	+
Grant (SO_2 only)	+	+
Green	+	+
Green Lake	+	+
Iowa	+	+
Iron	+	+
Jackson	+	+
Jefferson	+	+
Juneau	+	+
Kewaunee	+	+
Lafayette	+	+
Langlade	-	NR
Lincoln	+	+
Manitowoc (SO_2 only)	+	+
Marquette	+	+
Menominee	+	+
Monroe	+	+
Oconto	+	+
Pepin	+	+
Polk	+	+
Price	+	+
Richland	-	NR
Rusk	+	+
Sauk	+	+
Sawyer	+	+
Shawano	+	+
Sheboygan (SO_2 only)	+	+
Taylor	+	+
Trempealeau	+	+
Vilas (SO_2 only)	+	+
Washburn	+	+
Waupaca	+	+
Waushara	+	+

Note: NR - Not required

TABLE 6. CATEGORY 1 ANALYSES FOR TSP AND SO_x (STEP 2)

County	1970-1990 growth factor	Emission density (ton/yr/sq mi) 1972 Estimate PM	Emission density (ton/yr/sq mi) 1972 Estimate SO_x	Emission density (ton/yr/sq mi) 1990 Projection PM	Emission density (ton/yr/sq mi) 1990 Projection SO_x	Projected air quality (μg/m³) PM	Projected air quality (μg/m³) SO_x
Adams	1.88	0.3	0.4	0.6	0.8	36.3	8.2
Barron	1.35	6.8	9.7	9.2	13.1	41.1	11.7
Bayfield	1.19	0.7	1.1	0.8	1.3	36.4	8.4
Buffalo	1.16	0.3	0.5	0.3	0.6	36.2	8.2
Burnett	1.72	0.9	1.3	1.5	2.2	36.8	8.6
Chippewa	1.17	13.0	18.5	15.2	21.6	44.5	14.1
Clark	1.13	2.6	3.3	2.9	3.7	37.6	9.0
Crawford	1.10	2.2	3.0	2.4	3.3	37.3	8.9
Dodge	1.22	5.6	6.3	6.8	7.7	39.8	10.2
Dunn	1.14	1.7	2.2	1.9	2.5	37.1	8.7
Florence	1.38	0.4	0.5	0.6	0.7	36.3	8.2
Fond du Lac (SO_2 only)	1.21	NR	24.5	NR	29.6	NR	16.3
Forest	1.32	1.1	1.4	1.5	1.8	36.8	8.5
Grant (SO_2 only)	1.22	NR	38.9	NR	47.5	NR	21.3
Green	1.37	1.5	1.6	2.1	2.2	37.2	8.6
Green Lake	1.14	6.1	10.1	7.0	11.5	39.9	11.2
Iowa	1.10	0.3	0.3	0.3	0.3	36.2	8.1
Iron	1.01	0.8	1.2	0.8	1.2	36.4	8.3
Jackson	1.15	1.5	1.8	1.7	2.1	37.0	8.6
Jefferson	1.36	9.3	10.6	12.6	14.4	43.0	12.0
Juneau	1.22	4.1	5.3	5.0	6.5	38.8	9.8
Kewaunee	1.18	7.5	12.4	8.9	14.6	41.0	12.1
Lafayette	1.20	0.1	0.1	0.1	0.1	36.1	8.0
Lincoln	1.38	5.9	7.5	8.1	10.4	40.5	10.9
Manitowoc (SO_2 only)	1.09	NR	37.9	NR	41.3	NR	19.6
Marquette	1.45	0.9	1.5	1.3	2.2	37.2	8.6
Menominee	1.33	0.6	0.9	0.8	1.2	36.4	8.3
Monroe	1.23	4.0	5.7	4.9	7.0	38.7	10.0
Oconto	1.40	1.6	2.7	2.2	3.8	37.2	9.1
Pepin	1.08	3.1	4.5	3.3	4.9	37.8	9.4
Polk	1.57	4.5	6.4	7.1	10.0	40.0	10.8
Price	1.18	1.4	2.1	1.7	2.5	37.0	8.7
Rusk	1.13	1.1	1.7	1.2	1.9	36.7	8.5
Sauk	1.17	4.0	3.0	4.7	3.5	38.6	9.0
Sawyer	1.66	0.2	0.4	0.3	0.7	36.2	8.2
Shawano	1.23	1.7	2.8	2.1	3.4	37.2	9.0
Sheboygan (SO_2 only)	1.18	NR	55.1	NR	65.0	NR	26.2
Taylor	1.31	1.2	1.8	1.6	2.4	36.9	8.7
Trempealeau	1.15	4.0	5.7	4.6	6.6	38.6	9.9
Vilas (SO_2 only)	1.74	NR	1.4	NR	2.4	NR	8.7
Washburn	1.45	0.4	0.6	0.6	0.9	36.3	8.3
Waupaca	1.30	4.8	8.0	6.2	10.4	39.5	10.9
Waushara	1.37	1.0	1.6	1.4	2.2	36.8	8.6

Note: NR - not required
Assumed background: 36 μg/m³ PM, 8 μg/m³ SO_x
Geometric mean is used for PM
Arithmetic mean is used for SO_x

TABLE 7. CATEGORY 2 ANALYSES FOR TSP AND SO_2 ($\mu g/m^3$)

County	Current growth (+/-)	Projected growth factor	Annual TSP 1976	Annual TSP Projected	24 hr TSP 1976	24 hr TSP Projected	Annual SO_2 1976	Annual SO_2 Projected	24 hr SO_2 1976	24 hr SO_2 Projected
Ashland	–	NR	NR	NR	NR	NR	NR	NR	NR	NR
Columbia	+	1.24	76.3	85.9*	164	194*	14.2	15.7	135	165
Door	+	1.42	13.9	26	76	93	7.7	10	21	26
Eau Claire	+	1.18	40.6	41.4	241	278*	10.4	10.8	33	38
Fond du Lac (TSP only)	+	1.20	56.4	60.4	156	180*	NA	NA	NA	NA
Grant (TSP only)	+	1.20	[illegible]	[illegible]	136	156*	NA	NA	NA	NA
Manitowoc (TSP only)	+	1.09	62.4	64.8	147	157*	NA	NA	NA	NA
Marathon	+	1.31	46.3	49.5	215	270*	51.5	64.9	850	1111*
Marinette	+	1.14	37.8	38.1	143	158*	56.1	62.8	279	316
Oneida	+	1.60	38.9	40.6	134	192*	29.5	42.4	212	334
Pierce	+	1.43	35.3	50	261	358*	11.2	12.6	36	48
Portage	+	1.42	45.9	50	176	234*	11.9	13.6	48	65
Rock	+	1.24	93.4	107.2*	314	380*	20.8	23.8	188	231
Sheboygan (TSP only)	+	1.18	33.3	39	62	68	NA	NA	NA	NA
Vernon	+	1.12	[illegible]	[illegible]	223	245*	51.3	56.5	158	176
Vilas (TSP only)	+	1.62	22.7	37	99	138	NA	NA	NA	NA
Wood	+	1.17	61.5	65.9	375	432*	55.4	63.4	454	530*
NAAQS			75 $\mu g/m^3$		150 $\mu g/m^3$		80 $\mu g/m^3$		365 $\mu g/m^3$	

*Potential violations of NAAQS

Note: NA - not available
NR - not required

Assumed background: 36 $\mu g/m^3$ TSP, 8 $\mu g/m^3$ SO_x

quality near the short-term TSP standard have the potential for violating the standard in the next 10 years. The combined effects of emission reductions at existing sources and growth in emission sources on air quality should also be assessed.

The remaining Wisconsin counties were included in the AQMA designation analysis and hence fall into category 3. Table 8 shows the results of steps 1 and 2 for these counties. Actual growth factors (i.e., current value/base value) for population, total earnings (employment), and manufacturing earnings (employment) are shown in columns 2 to 4, along with the projected growth factors used in the designation analysis, the values in parentheses. Employment and earnings growth factors were taken to be interchangeable for this analysis. The actual growth factors were obtained from the population projections cited previously, and from 1974 County Business Patterns, the latest edition available. Because the designation analysis treated the four-county Milwaukee SMSA as a unit, values for the SMSA were also included in the table.

Dane, Outagamie, Racine, and Winnebago Counties, and the Milwaukee SMSA required no analysis beyond step 1. No projected growth factors were available for St. Croix County;* hence no analysis could be conducted. The remaining counties' growth rates required the aggregate emissions loadings be calculated (step 2). 1974 emissions were thus calculated from the actual growth factors and 1970 emissions data from the designation analysis. These values were compared to projected values obtained by interpolation between 1970 and 1975 values used in the designation analysis.

In three out of the four counties, the current estimate of emissions exceeded the forecast value. Two of these counties are in designated AQMAs; a subpart D analysis is currently being conducted for Brown and Kenosha Counties. No further action is required in these counties; however, it would be prudent to reassess the projections of population and employment being utilized in the subpart D analysis.

LaCrosse County is not in an AQMA. The next step in the guidelines is a reassessment of the validity of the growth projections used in the condensed analysis. It was not possible to do so and no new projections were available. Consequently, it was assumed that the actual 1970 to 1974 growth rate would continue over the next 10 years. Using this as a new projection, the condensed analysis was revised. The results of this analysis indicates that the NAAQSs will not be violated.

OXIDANTS

A designation analysis for oxidants was also conducted for Wisconsin's SMSAs. All areas were automatically excluded from AQMA designation, except for the Milwaukee, Racine, and Kenosha SMSAs. These areas had oxidant concentrations in 1972 above the 320 $\mu g/m^3$ level. Again, detailed AQMA analyses for these areas have not been completed, so that categorization was done on the basis of the designation analysis.

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*The State of Minnesota is presently conducting the AQMA analysis for this county.

TABLE 8 . CATEGORY 3 ANALYSES FOR TSP AND SO_2

County	Population growth factor (1975/1970)	Earnings growth factor (1974/1970)	Manufacturing earnings growth factor (1974/1970)	1974 TSP emissions (ton/year)	1974 SO_2 emissions (ton/year)
Brown	1.07 (1.02)*†	1.21 (1.21)	1.11 (1.19)	13,090 (12,380)*	NR
Dane	1.04 (1.10)	1.17 (1.24)	1.02 (1.20)	NR	NR
Douglas	.99 (1.06)	1.16 (1.19)	1.28 (1.20)*	2,340 (2,340)	NR
Kenosha	1.07 (1.08)	1.30 (1.16)*	1.28 (1.05)*	1,880 (1,670)*	6,280 (5,670)*
LaCrosse	1.03 (1.08)	1.27 (1.22)*	1.01 (1.20)	2,530 (2,450)*	5,570 (5,370)*
Milwaukee	NA‡	NA	NA	NA	NA
Outgamie	1.04 (1.07)	–	–	NR	NR
Ozaukee	NA‡	NA	NA	NA	NA
Racine	1.04 (1.07)	1.18 (1.24)	1.10 (1.23)	NR	NR
St. Croix	1.12 (NA)	1.39 (NA)	1.45 (NA)	NA	NA
Walworth	1.08 (NA)	1.15 (NA)	1.25 (NA)	NA	NA
Washington	NA‡	NA	NA	NA	NA
Waukesha	NA‡	NA	NA	NA	NA
Winnebago	1.01 (1.07)	1.09 (1.23)	1.09 (1.23)	NR	NR
Milwaukee SMSA	1.02 (1.08)	1.07 (1.21)	0.99 (1.19)	NR	NR

*Actual growth exceeds projection

†Actual (projected)

‡Included in Milwaukee SMSA

NA - Not applicable
NR - Not required

Category 1 counties for oxidants are presented in Table 9, along with the projected gasoline sales per square mile for 1990, for all counties project to have positive growth. These values were obtained by projecting 1967 gasoline sales to 1990 by population growth factors. Because no county was projected to exceed the 1990 critical density value, further analysis was not required.

Category 2 counties are presented in Table 10, along with the results of the second step of the growth monitoring analysis. Because current gasoline sales data were not readily available, positive growth was assumed for these counties (step 1). Also, because a county-by-county emission inventory was not readily available, the proportion of HC emissions from light-duty vehicles was obtained from the appropriate AQCR emission inventory in the 1972 NEDS summary.

Because Dane and Wood Counties are not currently violating NAAQS, projected oxidant concentrations were calculated. Both counties are projected to not violate the NAAQS in 1990, and hence are exempt from further analysis. The remaining three counties are currently in violation of the NAAQS, requiring calculations of expected reductions in HC emissions. As the table shows, the projected reductions are less than the required reductions determined from Appendix J. The regional administrator should thus be notified. Dane is an urban county which includes the capitol city, Madison. Wood county is relatively rural.

The remaining counties, shown in Table 11, fall into Category 3 for purposes of this analysis. The table shows projected growth factors used in the designation analysis along with actual growth factors obtained from the same sources as the factors in Table 8. The Milwaukee SMSA is treated as a unit in the designation analysis; hence no values are included for the individual counties contained in it. Furthermore, the growth indicator used to project emissions in the Milwaukee SMSA was average daily travel (ADT). Because automatic traffic recorder data are available on a regular basis for this area, ADT was used as the growth factor in this analysis. Finally, employment growth factors were substituted for earnings as in previous sections of this analysis. As the table shows, the emission projections have not been exceeded.

NITROGEN OXIDES

The entire State of Wisconsin was automatically excluded from AQMP analysis for NO_2. Thus, for this study counties were characterized only by the availability of monitoring data.

Since the threshold levels for Category 1 countines had not been generated at the time of this illustration, the areas which exceed these levels and should initiate monitoring for NO_2 could not be determined.

Category 2 counties for NO_2 are shown in Table 12, along with the results of steps 1 through 4 of the growth monitoring analysis. Two counties, Douglas and Milwaukee, are experiencing negative growth rates. The remaining counties all show positive growth rates, but none show sufficient growth to cause a potential violation of the NAAQS.

TABLE 9. CATEGORY 1 ANALYSES FOR OXIDANTS

County	1990 Gasoline sales density gal/mi²
Adams	2,938
Barron	21,871
Bayfield	2,346
Buffalo	4,123
Burnett	6,462
Calumet	28,514
Chippewa	17,685
Clark	8,064
Crawford	7,316
Dodge	23,298
Door	25,146
Dunn	14,102
Eau Claire	57,633
Florence	NA
Fond du Lac	47,464
Forest	4,430
Grant	16,796
Green	20,111
Green Lake	14,643
Iowa	6,605
Jackson	11,128
Juneau	12,585
Kewaunee	12,325
LaCrosse	68,724
Lafayette	10,511
Lincoln	16,955
Manitowoc	40,232
Marathon	17,923
Marinette	9,738
Marquette	10,110
Menominee	NA
Monroe	27,230
Oconto	11,665
Oneida	2,227
Outagamie	71,363
Pepin	14,094
Pierce	20,300
Polk	20,173
Portage	33,470
Price	3,158
Rock	83,242
Rusk	4,477
St. Croix	26,221
Sauk	20,958
Sawyer	5,474
Shawano	11,715
Sheboygan	62,574
Taylor	8,404
Trempealeau	14,947
Vernon	8,891
Washburn	8,023
Washington	100,948
Waupaca	21,312
Waushara	12,746
Winnebago	106,143

NA - Not available

TABLE 10. CATEGORY 2 ANALYSES FOR OXIDANTS

County	Current X	Population growth factor	Proportion of HC from LDV	Emission reduction from FMVCP	Projected X	Emission reduction required (expected)
Brown	392 $\mu g/m^3$	1.26	0.57	0.09	NA	0.64 (0.39)
Columbia	316 $\mu g/m^3$	1.18	0.57	0.09	NA	0.52 (0.43)
Dane	130 $\mu g/m^3$	1.11	0.57	0.09	69.5	NA
Vilas	252 $\mu g/m^3$	1.45	0.52	0.09	NA	0.35 (0.24)
Wood	152 $\mu g/m^3$	1.14	0.52	0.09	91.8	NA

NA - Not applicable

TABLE 11. CATEGORY 3 ANALYSES FOR OXIDANTS

County	1970 - 1975 Population growth factor	1970 - 1974 Total employment growth factor	1970 - 1974 Manufacturing employment growth factor	1970 - 1975 ADT growth factor	1974 Aggregate emission loading
Kenosha	1.07 (1.08)*	1.30 (1.16)	1.28 (1.05)	NA	7673 (8204)
Milwaukee	NA†	NA	NA	NA	NR
Ozaukee	NA†	NA	NA	NA	NR
Racine	1.04 (1.07)	1.18 (1.24)	1.10 (1.23)	NA	NR
Washington	NA†	NA	NA	NA	NR
Waukesha	NA†	NA	NA	NA	NR
Milwaukee SMSA	NA	NA	NA	1.08 (1.22)	NR

*Actual (projected)

†Included in Milwaukee SMSA

NA - Not available
NR - Not required

TABLE 12. CATEGORY 2 ANALYSES FOR NO_2

County	Current growth	1976 - 1990 Growth factor	1990 Projected annual average concentration
Brown	+	1.26	44.7
Columbia	+	1.18	17.4
Dane	+	1.11	34.9
Door	+	1.32	8.2
Douglas	-	NR	NR
Eau Claire	+	1.14	26.2
Kenosha	+	1.25	31.8
LaCrosse	+	1.10	46.2
Marathon	+	1.24	25.8
Marinette	+	1.11	12.7
Milwaukee	-	NR	NR
Rock	+	1.18	43.3
Vernon	+	1.10	19.7
Wood	+	1.14	33.4

NR - Not required

TIME REQUIREMENTS

Time required to complete the growth monitoring for Wisconsin was distributed approximately as follows. Data collection from state and census bureau sources required about 1.5 person days. Categorizing counties for all pollutants required reviews of the AQMA designation analysis and of monitoring data reports. Total time required was 6 person-hours.

The Category 1 analysis for TSP and SO_2 only required checking growth rates. This was accomplished in about 1 person hour. The Category 2 analysis required somewhat more time to calculate growth factors and to analyze air quality data, a total of about 4 person hours. The Category 3 analyses required the greatest time. Actual growth factors were calculated from population and employment data. (These growth factors were also used in later analyses). Projected growth factors and emissions loadings had to be obtained by interpolation between values used in the designation analysis. Total time required for this category was about 1.5 person days.

The analysis for oxidants required less time than the TSP and SO_2 analysis. Projecting gasoline sales for the category 1 counties occupied the largest block, about 6 person-hours. Calculating projected air quality and/or emission reductions for Category 2 counties required approximately 3 person-hours, as did checking the growth factors used in the designation analysis against actual growth for the Category 3 counties.

The NO_2 analysis required the shortest time period because only two categories were involved and the analysis was relatively simple. Approximately 2 person-hours was spent on each category.

The illustration was terminated at the point where a condensed analysis of the combined effects of growth and compliance schedule progress should be completed for several counties. Up to this point, the illustration required slightly less than 1 person week. The remaining analysis, an abbreviated analysis of growth including the effects of compliance schedules, should take approximately 1 additional person day.

SECTION 6

ILLUSTRATION OF GUIDELINES IN MASSACHUSETTS

A Volume 1 designation analysis was conducted for all SMSAs in Massachusetts in 1974. A detailed AQMA analysis for SO_2 and TSP was also conducted for the entire state. However, this analysis was found to be inadequate in light of subsequent guideline revisions, and a new analysis is currently being performed. Because the new analysis was not complete at the time this illustration of the guidelines was performed, the "old" AQMA analysis has been assumed valid for the purposes of this study. The principal difference in methodology between the two AQMA analyses involves the length of the projection period. Given this situation, a finding that any county requires an AQMA analysis because of unforeseen growth must be recognized as only illustrative, and not directly applicable in practice since a new analysis with revised projections is being prepared.

In the original AQMA designation analysis, all areas of the state were automatically excluded from being designated as AQMAs for NO_x; no recent analysis of growth and air quality is available for this pollutant for any part of the state. Two areas of the state (Boston and Springfield) have transportation control plans (TCP); hence, a detailed analysis has been completed for these areas. The remainder of the state has no recent analysis available for CO and oxidants; except for Boston and Springfield, all areas of the state were originally excluded from consideration as an AQMA for CO and oxidants. However, all areas of the state have subsequently been designated as an AQMA for CO and oxidants. The county categorizations are presented in Table 13.

SUMMARY

The illustration of the guidelines took approximately 2 person weeks. Over half of this time was devoted to the development of data on a county basis. Massachusetts is relatively unique in that counties are unimportant governmental units; consequently, planning data is seldom summarized on a county basis. Most air quality control regions, regional planning districts, and standard metropolitan statistical areas do not follow county boundaries.

The application of the guidelines indicated that the actual growth since the preparation of the projections used in the PM and SO_x subpart D AQMA analysis probably has been quite different than the forecast growth in the projections. Further, the projections are now of questionable validity; new projections have recently been prepared. The application of the guidelines thus indicates that the existing detailed analysis for PM and SO_x should be revised. This is currently being done, albeit for a different reason.

TABLE 13. CATEGORIZATION OF MASSACHUSETTS COUNTIES FOR GROWTH MONITORING ANALYSES

County	Pollutant				
	SO_2	TSP	O_x	NO_2	CO
Barnstable	4	4	1	2	5
Berkshire	4	4	2	2	5
Bristol	4	4	2	2	5
Dukes	4	4	1	1	5
Essex	4	4	4	2	6
Franklin	4	4	2	2	5
Hampden	4	4	4	2	6
Hampshire	4	4	4	1	5
Middlesex	4	4	4	2	6
Nantucket	4	4	1	1	5
Norfolk	4	4	4	2	6
Plymouth	4	4	4	2	5
Suffolk	4	4	4	2	6
Worcester	4	4	2	2	5

Notes:

1 = County without monitoring.
2 = County with monitoring.
3 = County with condensed analysis.
4 = County with detailed analysis.
5 = County without detailed analysis (CO).
6 = County with detailed analysis (CO).

No assessment of the validity of the growth projections for CO could be completed, as no estimates of regional VMT have been prepared since preparation of the TCPs. Estimates of VMT are currently being prepared.

Aside from the areas covered by TCP's, three counties have monitoring for oxidants, all are showing violations of the NAAQS. The analysis conducted to illustrate these guidelines indicates that two of them have the potential for continuing to violate the NAAQS in 10 years. Thus the regional administrator should be notified.

The application of the first steps of the guidelines indicated only one county has the potential for violating the NO_x NAAQS in 10 years. Further analysis indicates that, after considering the effects of the FMVCP, there is not a potential for a violation.

SO_2 AND TSP

As previously noted, AQMA analyses for these pollutants were conducted for the entire state on an AQCR basis. This allowed each county to be placed in category 4. The first step in the growth monitoring analysis for this category involves checking the projections used in the AQMA analysis.

The indicators used for these projections were population, total employment, manufacturing employment, and commercial (nonmanufacturing) employment. Projections of these items were prepared by the Office of State Planning (OSP) for 1978, 1980, and 1985, with 1972 as the base year. Projections were done on a town-by-town basis. It was thus necessary to sum and check these values for the counties.

Updated values for monitoring growth of the indicators were obtained from various sources and are presented in Table 14.* One additional item is called for in Step 1 of the Category 4 analysis, namely total point source emissions for each county. Massachusetts emissions inventories are currently summarized only by AQCRs and thus could not be immediately used. Given the results presented in Table 14, Step 2 of the analysis should be conducted for all counties except Suffolk. This step consists of estimating current area source emissions by applying the actual growth factors for the analysis year, adding point source emissions to compute the county total emission loading, and comparing this value to the loading projected in the AQMA analysis.

*Population was available only through the 1973 Current Population Reports (CPR) issued in June 1975. OSP is producing 1977 estimates (the first official state estimates since 1971) but they will not be completed for some time. Table 14 includes 1973 population projections from the AQMA analyses and 1973 CPR estimates. A comparison of growth factors (i.e., current year/base year) rather than absolute values would have been desirable, to account for possible differences in base year values. However, no CPR estimates were available for 1972. Employment data were available for 1972, 1973, and 1974 from County Business Patterns. (The 1975 edition will be available within 2 to 3 months.) Table 14 presents 1974 growth factors calculated from CBP.

TABLE 14. CATEGORY 4 ANALYSES FOR TSP AND SO_2
ACTUAL (FORECAST)

County	1973 population	1972-1974 total employment growth factor	1972-1974 manufacturing employment growth factor
Barnstable	113,151(104,083)	1.23(1.00)	1.71(0.98)
Berkshire	148,988 (150,770)	1.07(1.02)	1.06(1.02)
Bristol	459,540(443,137)	1.10(1.07)	1.11(1.01)
Dukes	7,050(6,201)	1.11(1.00)	0.76(0.98)
Essex	646,596(653,468)	1.09(1.05)	1.11(1.01)
Franklin	61,177(59,745)	1.06(1.00)	1.17(0.98)
Hampden	460,652(467,539)	1.10(1.02)	1.06(1.01)
Hampshire	135,369(127,801)	1.34(1.01)	1.20(0.98)
Middlesex	1,416,429(1,424,284)	1.12(1.06)	1.07(1.06)
Nantucket	4,303(3,844)	1.18(1.00)	1.22(0.99)
Norfolk	616,172(628,493)	1.16(1.06)	1.13(1.06)
Plymouth	367,177(355,841)	1.15(1.07)	1.22(1.05)
Suffolk	713,415(721,244)	0.95(1.04)	0.81(1.03)
Worcester	649,397(652,918)	1.09(1.05)	1.13(1.01)
Statewide	5,799,416(5,799,368)	1.08(1.05)	1.07(1.03)

However, after considering the wide divergence between the current estimates and forecast values, it is clear that a current estimate of emissions would exceed the forecast amount. Consequently, step 2 was omitted and step 3, the assessment of the validity of the projections of population and employment, was conducted.

New projections of population and employment are currently being prepared. The employment projections are complete, the population projections were not finished at the time of this analysis. The projections were made by regional planning districts which can be aggregated to AQCRs. A comparison of the growth factors obtained from the new and old projections is shown in Table 15. The new projections are quite different from the old projections; therefore, the detailed analysis should be revised to reflect the new projections. As noted earlier, this is currently being done.

OXIDANTS

AQMA analyses for oxidants have not been conducted in Massachusetts. The Metropolitan Boston AQCR and the Springfield portion of the Pioneer Valley AQCR were automatically designated for oxidants because they require transportation control plans. All other areas were automatically excluded due to a lack of monitoring data at that time. Since then more monitoring data has become available and all areas of the state have been designated as AQMAs for CO and oxidants. However the analysis has not yet been completed for these areas.

For this analysis any county of which any portion is included in a designated AQMA is considered to be a Category 4 county. (Worcester County is an exception, as only the Town of Warren is included in the Springfield AQMA.) Three counties, Barnstable, Dukes, and Nantucket, fall under Category 1. The first step in the analysis, collection of county gasoline sales data, is difficult in Massachusetts, because gasoline taxes, a potential source of this information, are paid by suppliers on bulk cargoes. Furthermore, for Dukes and Nantucket Counties, gasoline sales data are not reported in Census documents because of disclosure problems; i.e., a small number of establishments serve each county. Because of this situation, these two counties were excluded from further analysis. It is highly unlikely that these counties have a potential oxidant problem; they consist entirely of Martha's Vineyard, Nantucket, and the Elizabeth Islands.

Gasoline sales data for Barnstable County were obtained from the 1972 County and City Data Book for a base year of 1967. This source reports sales in dollar amounts only. The average price per gallon in 1967 was thus obtained from the Bay State Gas Retailers Association so that sales in gallons could be estimated. A positive growth in sales was assumed, and projected sales for 1986 were determined, using population as a growth indicator. These calculations, and the resulting gallons-per-square-mile figure are shown below. The result is less than the critical value for 1986 obtained from the guidelines, indicating that no further analysis is needed.

$\$16,211,088$ (total gasoline sales) x $\frac{1}{\$0.334}$ (average 1967 price per gallon) x 1.71 (1967 - 1986 population growth factor) x $\frac{1}{393}$ (square miles) = 211,188 gallons/square mile.

TABLE 15. COMPARISON OF 1972-1985 PROJECTIONS

AQCR	1973 projections used in AQMP	Most recent projections (1977)
	Manufacturing	Employment
Berkshire	1.31	0.84
Pioneer Valley	0.97	0.95
Central	1.14	0.86
Merrimack	1.15	0.94
Southeastern	1.00	0.88
Metropolitan Boston	1.30	0.93
	Nonmanufacturing	Employment
Berkshire	1.17	1.33
Pioneer Valley	1.14	1.27
Central	1.43	1.06
Merrimack	1.34	1.25
Southeastern	1.09	1.40
Metropolitan Boston	1.44	1.22

Three counties, Berkshire, Franklin, and Worcester, fall into Category 2. Again, because gasoline sales data required for Step 1 were difficult to obtain, positive growth was assumed. Because all three counties are currently in violation of the NAAQS of 0.08 ppm, the second step of the analysis is to determine whether the expected reduction in HC emissions due to FMVCP will be sufficient to maintain NAAQS for the projection year given projected growth. Table 16 presents the data and results for the three counties in question. The proportion of HC emissions from LDV was obtained from the 1972 NEDS emission summaries for the appropriate AQCRs. Required concentration reductions were determined using Appendix J. Two counties show potential violations of the NAAQS and thus the regional administrator should be notified. Franklain is a rural county; Worcester is predominantly urban.

The remaining Massachusetts counties fall into Category 4. However, the AQMA designations were automatic, and no subpart D AQMA analysis has yet been performed. Thus, no growth monitoring analysis for these counties is possible or actually needed in practice at this time.

$\underline{NO_2}$

As noted above, all counties in Massachusetts were automatically excluded from AQMA analyses for NO_2. Counties are thus categorized by the availability of current monitoring data. The thresholds in Step 2 of the Category 1 analysis had not yet been generated at the time of this analysis, so only the growth in Category 2 counties was reviewed.

Category 2 counties for NO_2 are presented in Table 17, which shows the results of Steps 1 through 4 of the growth monitoring analysis. Only Hampden County is projected to violate the NAAQS of 100 $\mu g/m^3$. It would thus require a condensed analysis as presented in Appendix A. This analysis indicates that the NAAQS will not be violated, principally due to the effects of the FMVCP.

$\underline{CO}$

Counties are placed in two categories for CO, namely those with detailed analyses of traffic and air quality, and those without such analyses. In Massachusetts, two metropolitan areas, namely Boston and Springfield, have transportation control plans. However, the detailed analyses conducted for these plans covered only part of each AQCR. Counties were thus categorized by whether they were in large part included in these analyses. The results are shown in Table 13.

For Category 6 counties the first step in growth monitoring is comparison of current VMT or ADT with values projected in the detailed analysis. These current values are not readily available for Massachusetts, so that no growth monitoring analysis was conducted for Category 6 counties.

TABLE 16. OXIDANT DATA AND CALCULATION RESULTS FOR CATEGORY 2 COUNTIES IN MASSACHUSETTS

County	1976 maximum O_x concentration	Population growth factor 1976-1986	Proportion of HC emissions from LDV	1986 Expected conc. reductions	Required conc. reductions
Berkshire	278 $\mu g/m^3$	1.05	0.55	0.44	0.42
Franklin	400 $\mu g/m^3$	1.06	0.66	0.53	0.65
Worcester	404 $\mu g/m^3$	1.14	0.62	0.46	0.65

TABLE 17. CATEGORY 2 ANALYSES FOR NO_2

County	Current growth	1976-1985 growth factor	1985 projected concentration
Barnstable	+	1.25	87.5
Berkshire	+	1.05	52.5
Bristol	+	1.10	46.2
Essex	+	1.18	59.0
Franklin	+	1.04	49.9
Hampden*	+	1.09	124.3
Middlesex	+	1.09	80.7
Norfolk	+	1.11	64.4
Plymouth	+	1.20	33.6
Suffolk	-	NR	NR
Worcester	+	1.10	83.6

*Currently violating NAAQS.

TIME REQUIREMENTS

Data collection was the most significant time requirement in the analysis, requiring about 1 person week. The reason for this is that most data for Massachusetts are summarized by towns, and county summaries required extensive manual calculations. Approximately 1 person day was also spent in calculating growth factors from disaggregate data. A review of the designation analysis and monitoring data for categorization of counties required about 1 person day. Calculations contained in most tables required only about 4 person hours to complete. Checking the analysis and calculations and preparing a summary report required approximately 3.5 person days, so that the total time spent on the analysis was slightly more than 2 person-weeks.

APPENDIX A

SCREENING METHODS FOR PROJECTING EMISSIONS AND AIR QUALITY

In order to identify those areas of a state that are undergoing an amount of development such that it presents a potential for a violation of the NAAQS within a period of 10 years, it may be necessary, ultimately, to perform a subpart D AQMA analysis; i.e., an analysis following Volumes 7, 8, 12, and 13 of the Guidelines For Air Quality Maintenance Planning and Analysis (hereafter referred to as the "Guidelines"). The following procedures are presented as a screening tool to identify those areas that, though they exceed preliminary screening threshold criteria, would likely be shown in a subpart D analysis to not present a potential for violating the NAAQS.

The following procedure is a modification of those presented in Chapters 4 and 5 of Volume I of the Guidelines, the AQMA designation analysis. It should be considered the minimum level of detail acceptable for such an analysis.

METHODS FOR PROJECTING EMISSIONS

In order to identify those areas that could violate a NAAQS during a 10-year period, it will be necessary to first determine current emissions, project these emissions 10 years (or more than 10 years if a 10-year projection of population, employment, etc., is unavailable). From the projected emissions, air quality can then be estimated by techniques presented and compared with the applicable standards to determine if the area being considered should, in fact, have a subpart D analysis conducted.

Estimating Current Year Emissions

For point sources prepare a source-by-source tabulation of emissions.

For area sources, it is unlikely that an area source inventory is available for the current year. Therefore, the county area source inventory must be updated to reflect both growth since the preparation of the inventory and the application of any applicable control regulations. Determine first the base year emissions from the sources in the area source inventory and then multiply by the following factors to account for growth:

• Fuel combustion	employment or earnings
• Industrial process	manufacturing employment or earnings
• Solid waste	population
• Miscellaneous	population
• Transportation (PM and SO_x)	population or, if available, VMT

It is not necessary to estimate current year transportation emissions for HC and NO_x.

Projecting Emissions 10 Years

For HC and NO_x emissions from transportation sources, the following formula may be used to project emissions 10 years using the existing area source inventory. (It is not necessary to make a calculation to determine the current level of emissions for transportation sources):

$$Q_P = \sum_{i=1}^{N} (Q_B)_i \ (1 + G_i E_i) \qquad (1)$$

where Q_P = Projected emissions in 10 years.

$(Q_B)_i$ = Baseline emission from source category i.

G_i = Growth factor for source category i.

E_i = Emission factor ratio for source category i (see Table A-1).

Project future emissions from current year emissions for all source categories other than transportation using the formula:

$$Q_P = (Q_C)_i \ (1 + D_i E_i) \qquad (2)$$

where Q_P = future emissions from source category i.

$(Q_C)_i$ = current emissions from source category i.

D_i = growth rate of emissions for 10 years for source category i.

E_i = emission factor adjustment for source category i (applied only to industrial process sources - for all other categories E_i = 1.

Growth rates (D in Equation (2)) for 10-year emissions growth are the same as those used to estimate current emissions. That is, the percent increase in total earnings or employment projected for 10 years may be used to project emissions from fuel combustion. The percent increase in manufacturing earnings or employment may be used for industrial processes; the percent increase in population may be used for solid waste emissions, particulate matter and SO_x

TABLE A-1. EMISSION FACTOR RATIOS

	Base year	HC										NO_x									
		Light-duty					Heavy-duty					Light-duty					Heavy-duty				
		1986	1987	1988	1989	1990	1986	1987	1988	1989	1990	1986	1987	1988	1989	1990	1986	1987	1988	1989	1990
Low altitude	1977	0.20	0.16	0.15	0.14	0.12	0.40	0.37	0.36	0.35	0.29	0.25	0.23	0.22	0.19	0.18	1.13	1.13	1.13	1.13	1.13
	1978	0.23	0.18	0.17	0.16	0.13	0.44	0.40	0.39	0.38	0.31	0.28	0.25	0.24	0.21	0.20	1.11	1.11	1.11	1.11	1.11
	1979	0.27	0.21	0.20	0.19	0.16	0.48	0.44	0.43	0.42	0.35	0.32	0.30	0.28	0.25	0.24	1.10	1.10	1.10	1.10	1.10
	1980	0.32	0.25	0.23	0.22	0.19	0.53	0.49	0.47	0.46	0.38	0.38	0.34	0.33	0.29	0.28	1.09	1.09	1.09	1.09	1.09
	1981	0.40	0.30	0.29	0.29	0.28	0.58	0.53	0.52	0.51	0.42	0.45	0.41	0.39	0.34	0.33	1.08	1.08	1.08	1.08	1.08
High altitude	1977	0.18	0.12	0.11	0.10	0.09	0.33	0.32	0.31	0.30	0.25	0.29	0.27	0.25	0.21	0.21	1.60	1.63	1.65	1.66	1.77
	1978	0.20	0.14	0.13	0.12	0.10	0.37	0.35	0.34	0.33	0.28	0.32	0.29	0.28	0.24	0.24	1.51	1.54	1.56	1.58	1.68
	1979	0.23	0.16	0.15	0.14	0.11	0.41	0.39	0.38	0.37	0.31	0.37	0.33	0.32	0.27	0.27	1.40	1.42	1.44	1.46	1.55
	1980	0.28	0.19	0.18	0.16	0.14	0.45	0.44	0.42	0.41	0.35	0.42	0.38	0.36	0.31	0.31	1.31	1.33	1.35	1.36	1.44
	1981	0.35	0.24	0.22	0.20	0.17	0.50	0.48	0.47	0.46	0.38	0.49	0.44	0.42	0.36	0.36	1.23	1.26	1.27	1.28	1.37
California	1977	0.19	0.14	0.14	0.13	0.12	0.40	0.37	0.36	0.35	0.29	0.25	0.24	0.23	0.22	0.22	1.13	1.13	1.13	1.13	1.13
	1978	0.23	0.17	0.16	0.16	0.14	0.44	0.40	0.39	0.38	0.31	0.28	0.27	0.26	0.25	0.25	1.11	1.11	1.11	1.11	1.11
	1979	0.27	0.20	0.19	0.19	0.17	0.48	0.44	0.43	0.42	0.35	0.34	0.32	0.32	0.30	0.30	1.10	1.10	1.10	1.10	1.10
	1980	0.34	0.25	0.24	0.23	0.21	0.53	0.49	0.47	0.46	0.38	0.40	0.38	0.37	0.35	0.35	1.09	1.09	1.09	1.09	1.09
	1981	0.40	0.30	0.29	0.28	0.25	0.58	0.53	0.52	0.51	0.42	0.47	0.45	0.45	0.42	0.42	1.08	1.08	1.08	1.08	1.08

Assumptions: FMVCP as of April 1977, Supplement 5 of AP-42

NOTE: The emission factor ratio is the projection year fleet composite emission factor divided by the base year fleet composite emission factor. Areas where national assumptions for fleet composition, etc. are inappropriate should calculate a localized ratio.

emissions from transportation, and the miscellaneous category. For power plants, it is again recommended that the state contact electric utility companies directly.

An adjustment will be needed to account for control of new industrial process sources because of new source performance standards. Generally, these standards will be more stringent than limitations presently contained in the SIPs. The adjustment needed to account for future new source performance standards would be the ratio of the estimated percent allowable emissions under the future new source performance standards to the percent allowable emissions in the current year. These ratios should be estimated for each county on the basis of its existing industrial mix. Using the point source inventory, determine the proportion of emissions for each process. Use these proportions to determine a weighted average of the E values for each process. This must be done for each pollutant. Bear in mind that the "E" value applies only to industrial process sources. For other source categories, use E = 1.

MODELING AIR QUALITY CONCENTRATIONS

Introduction

This section of the guideline presents information concerning models recommended for use in predicting future air quality, once future emissions have been calculated.

Relating Oxidant Concentration to Hydrocarbon and NO_x Emissions

Appendix J to 40 CFR Part 51 "Requirements for Preparation, Adoption, and Submittal to Implementation Plans" (published in the August 14, 1971 and republished in the November 25, 1971 Federal Register) is being revised. It is anticipated that the revision will allow one to determine the same information, percent reduction required, on the basis of oxidant concentrations and the HC/NO_x ratio.

The revised Appendix J should be used as follows:

1. Project future HC and NO_x emissions as shown in the previous section.

2. Determine the expected emission change by:

$$\text{emission change} = \frac{E_{base} - E_{future}}{E_{base}} \times 100\%$$

3. Determine the required percentage hydrocarbons emission reductions using Appendix J and the highest observed 1-hour oxidant concentration during the baseline year.

4. If R required from Step 3 is greater than R expected from Step 2, the area should be subjected to a subpart D analysis. This will be especially true if the expected emission change is negative.

Analytical Techniques for Other Pollutants-Relating Projected Emissions to Air Quality

Proportional Roll-Forward Model--

Present air quality may be projected 10 years for pollutants other than oxidants and CO (i.e., air quality may be projected for TSP, SO_2, and NO_x) using the proportional roll-forward model as shown in the following formula:

$$\chi_P = \frac{Q_{future}}{Q_{current}} (\chi_C - \chi_B) + \chi_B \qquad (3)$$

where χ_P = projected air quality level

χ_B = background concentration

χ_C = current air quality level

Q_{future} = projected emissions in 10 years

$Q_{current}$ = current year emissions

While the proportional roll-forward technique is a potential means for selecting counties for more detailed analysis, it has several shortcomings which may render it unsuitable, or impossible, to apply. There are:

1. Base year air quality observations are required.

2. The monitoring data must be representative of the area of interest (i.e., a monitor dominated by a single point source or a small number of select sources may result in anomalous predictions.)

3. The meteorology occurring during the base period must be similar to that which is of interest during the period being modeled.

Where the above conditions apply with particular force, it may be appropriate to use the Hanna-Gifford model described in the next section. The model* is based upon the integral of gaussian plume contributions from upwind area sources. The ground level air pollutant concentration (χ) is then given by:

*Hanna, S. R. A Simple Method of Calculating Dispersion From Urban Area Sources. J. Air Poll. Contr. Assoc., 21:774-777, 1971.

$$\chi = \int_0^{\infty} dx \int_{-y_1}^{y_2} \frac{Q_a(x,y)}{\pi U \sigma_y \sigma_z} \exp\left[\frac{-y^2}{2\sigma_y^2}\right] dy \qquad (4)$$

where χ = surface concentration ($\mu g/m^3$)

Q_a - area source strength ($\mu g/m^2/sec$)

U = windspeed (m/sec)

σ_y, σ_z = plume dispersion function (m)

x = distance downwind from the source (m)

y = crosswind distance from the plume centerline (m)

With this assumption that the plumes are narrow (i.e., y_1 and y_2 approach ∞) and that $Q_a(x)$ is a function of x only, Equation (4) becomes:

$$\chi = \int_0^{D} \sqrt{\frac{2}{\pi}} \frac{Q_a}{U \sigma_z} dx \qquad (5)$$

where D = limit of integration (m) for which further contributions is negligible.

To integrate Equation (5) in closed form, the vertical dispersion σ_z is expressed in terms of the power law:

$$\sigma_z = ax^b \qquad (6)$$

If the integration distance is broken into elements of length Δx, the following expression is obtained:

$$\chi = \frac{\sqrt{\frac{2}{\pi}}\left(\frac{\Delta x}{2}\right)^{1-b}}{a(1-b)\,U} \left[Q_0 + \sum_{i=1}^{N} Q_i \left((2i+1)^{1-b} - (2i-1)^{1-b}\right)\right] \qquad (7)$$

where χ = concentration at the center of the receptor square (i = 0) ($\mu g/m^3$)

Q_i = area source strength for upwind square (i) ($\mu g/m^2/sec$)

In many cases the concetration contribution from neighboring square can be neglected so that Equation (7) becomes simply:

$$\chi = \frac{\sqrt{\frac{2}{\pi}} \left(\frac{\Delta x}{2} \right)^{1 - b}}{a(1 - b)U} Q_0 \qquad (8)$$

The application of the Hanna-Gifford model is described in detail in Volume 12 of the "Guidelines." Hanna-Gifford may be used to estimate both short-term and annual average concentrations. It is of importance to note that where relatively large point sources are known to affect the concentrations in a county, it is considerably more accurate to estimate the impact of these sources separately using an appropriate point source model. Volume 10 of the "Guidelines," Reviewing New Stationary Sources, has recently been revised and provides a conveniently methodology for performing this task. In addition, the basic point source dispersion models are available in the UNIMAP system, a computer package that has been installed in several state agencies and which can also be accessed through the EPA regional offices.

APPENDIX B

SOURCES OF DATA

The sources of the data employed the guidelines presented in the previous section are reviewed below. First, the suggested parameters to be used for growth tracking in counties with a detailed analysis are identified. Second, the typical sources of each data item cited in the previous sections is discussed. Finally, the method of collection, frequency, and geographic detail of the more prominent sources are summarized.

PARAMETERS TO BE USED IN COUNTIES WITH DETAILED ANALYSIS

The parameters that are typically used to project emissions growth in a detailed analysis are reviewed first; suggested indicators for tracking growth are then discussed.

Given the relatively complex emission projection in a detailed analysis, it is necessary to simultaneously monitor the growth trends of several indicators. The recommended parameters[1] for projecting emissions are identified in Table B-1. The parameters are delineated into three levels; the level that was chosen for preparing an emissions forecast depended on the availability of resources, required accuracy, and quality of the base year emission inventory. While Table B-1 indicates the parameters that were recommended in Volume 7 of the Guideline for Air Quality Maintenance Analysis and Planning, many states did not necessarily follow its recommendations in detail.

As might be expected, there is as yet little collected information on the use or success of the Volume 7 techniques. Information for several states was collected as part of a forthcoming feasibility study on computerization of the techniques, and the reviews might be described as mixed.[9] Data required by the techniques, especially those from state and local planning agencies, were often nonexistent, incomplete, or in hard to use formats. In at least one state, projections for each AQMA had to be based on "vastly different" data sources.[9] In general, area source data were more difficult to obtain, and cross-checking of sources often revealed contradictions. Point source data collection was straightforward but very time consuming. Many states chose to use data sources other than those suggested or required by Volume 7. However, the Volume 7 recommendations and requirements were generally found to be "as good as" others used by the states.

Due to the apparent variety in projection techniques that were employed by the states in preparing a detailed analysis, it is not possible to specify exactly which parameter should be used to now track the actual growth. The

TABLE B-1. TYPICAL PROJECTION PARAMETERS

Source category	Level 1 parameter	Level 2 parameter	Level 3 parameter
Industrial process	Earnings by 2 digit SIC	Land use/industrial growth studies	Interview
Residential	Population	Land use plans	Land use plans
Commercial/institutional	Commercial/institutional earnings	Land use plans	Interview point source
Industrial (area source)	Manufacturing earnings	Land use plans	Interview point source
Motor vehicles	Population	VMT	VMT by vehicle type
Off highway	Agriculture earnings	Agriculture land use, construction earnings	Agriculture land use, construction earnings
Railroads	Interview	Interviews	Interviews
Vessels	Interviews, DOT nat. proj.	Interviews DOT nat. proj.	Interviews DOT nat. proj.
Marine gasoline	Population	Population	Population
Aircraft	Local airport plans FAA nat. proj.	Local airport plans FAA nat. proj.	Local airport plans FAA nat. proj.
Electrical generation	Interview, FPC data	Interview, FPC data	Interview, FPC data
Gasoline evaporation	Population	VMT	VMT
Solvent evaporation	Population	Population	Population

parameters recommended below are based on the use of the projection technique in Volume 7. Where a state adopted a modified approach to projecting emissions, the appropriate growth tracking parameter should be obvious.

The recommended indicators for tracking growth in counties with detailed analyses are given in Table B-2. The differences between Tables B-1 and B-2 are obvious, primarily occurring because of the unavailability of the parameter that was used to project emissions on an annual basis. A typical example is the use of a land use plan to project emissions. Very few communities annually update their land use inventory. (Those that have a parcel based geographic information system, described in Appendix C, are a prime example of one that would do so). Annual summaries of building permits issued are very easily obtained in most communities or from national sources described later in this section. The building permit provides the same level of detail and accuracy as the land use plan and is thus an appropriate growth indicator.

The indicators in Table B-2 are also grouped by level; these are keyed to the levels in Table B-1. If a county projected growth with a parameter of a certain level, it should attempt to track growth with an indicator of equal or higher level.

An indicator different from the one used to project growth may be used. For example, though earnings were used to project industrial emissions, it may be more convenient to track growth with manufacturing employment. In such cases it is necessary to obtain an estimate of employment for the base year of the analysis so that a growth factor may be constructed. If building permits; i.e., the total floor area approved for construction in building permits, are used to track growth, it is necessary to estimate the total floor area of manufacturing and commercial/institutional establishments in the base year.

In addition to tracking the growth in parameters that were used to project area source emissions, the current aggregate emissions from point sources should be estimated on a regular and periodic basis and compared with the projected point source emissions.

Current regulations require emissions dara for certain sources to be updated on a semiannual basis. These sources include:

- New sources or source modifications resulting in emissions of 100 tons a year of any criteria pollutant (1000 tons a year for CO).
- Sources meeting compliance schedule increments.
- Major source shutdowns.
- Sources subject to continuous monitoring requirements.

In addition, many states require regular renewals of source registrations or permits, at periods ranging from 1 to 5 years, for most major sources. Thus,

TABLE B-2. RECOMMENDED GROWTH TRACKING INDICATORS

Source category	Level 1	Level 2	Level 3
Industrial process	—— Annual update of point source inventory ——		
Residential	Population	Residential building permits	Residential building permits
Commercial/institutional	Commercial/institutional employment	Commercial/institutional building permits	Commercial/institutional building permits
Industrial (area source)	Manufacturing employment	Manufacturing building permits	Manufacturing building permits
Motor vehicles	Population	Vehicle registrations	VMT
Off highway	*	*	+
Railroads	*	Interview	Interview
Vessels	*	Interview	Interview
Marine gas	Population	Population	Population
Aircraft	*	Interview	Interview
Electrical generation	—— Annual update of point source inventory ——		
Gasoline evaporation	Population	Vehicle registrations	VMT
Solvent evaporation	Population	Population	Population

*These sources may be ignored unless they are known to be significant sources in the county of interest.

+A current estimate of emissions should be prepared from recorded sales of gasoline and diesel oil for off-highway uses at the state level and allocated to the county.

point source growth monitoring under these guidelines will usually impose only a minor burden on the responsible agencies.

TYPICAL SOURCES OF DATA ITEMS

The sources of the indicators utilized in the guideline for counties without a detailed analysis are reviewed below.

Current Population Estimates

Estimates of the current populations of a counties are often compiled annually by a state agencies such as the department of public health or education. Annual estimates are also available from the U.S. Bureau of the Census Current Population Reports Series P-25 and P-26. Frequently, the problem will not be obtaining an estimate of the current population but deciding which one of several available ones to use. In such cases the regional planning agency should be consulted.* Current population estimates are usually available with a 6-month time lag.

Population Projections

Ten- and 20-year projections of population by county are commonly made by a state planning agency or commerce department at irregular intervals. Regional planning agencies may have also prepared their own projectors. Utility companies and banks are also occasional sources of this data. Only when regional or state data is unavailable should the BEA OBERS projections be used. Projections are typically revised every 5 years.

Emission Inventories

A recent area source county emission inventory will usually be available. If it is not, the one prepared annually by the National Air Data Branch (NADB) of the Office of Air Quality Planning and Standards may be used.

Employment Estimate

Annual estimates of employment by county are often available from the state employment security department. These estimates may include only employment covered by unemployment insurance and must be adjusted so as to reflect the total employment. The regional or state planning agency will be able to air in this adjustment. Annual employment estimates may also be available from banks, chambers of commerce, or economic development commissions. Care should be taken to adequately adjust whatever estimate is used

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*There are often several single purpose regional agencies in an area besides a multifunctional planning agency; e.g., regional transportation planning agencies, and, of course, the regional air pollution agency. In general, there will be one lead regional agency that provides comprehensive areawide polity planning. Consult the National Association of Regional Councils Directory[2] if the identity of the regional agency is unknown.

so it is compatible with the projections it is compared with. If regional or state sources cannot provide employment data, it can be obtained from Dunn and Bradstreet. Dunn and Bradstreet data is available with essentially no time lag.

Earnings

Estimates of earnings are also often available from the same sources as employment. These estimates will also have to be adjusted for coverage as for constant dollars.

Estimates of Average Daily Traffic (ADT)

ADT estimates on major facilities are made at various intervals by county, regional, and state transporation planning agencies. The regional transportation planning agency should be able to identify the best source of this data, if it has not already compiled it.

Estimates of Regional Vehicle Miles Traveled (VMT)

A regional VMT estimate should be available from the same sources as ADT. In addition, it is proposed that the states and metropolitan planning agencies be required to report this data to the Federal Highway Administration (FHWA) and the Urban Mass Transit Adminstration (UMTA) every 2 years in the Urban Transportation Reporting System. States currently estimate county VMT on a regular basis. Table B-3 presents a list of potential sources of this information in each state.

Gasoline Sales

Sales of gasoline (or gasoline tax receipts) by county can often by obtained from the state revenue office. Six states are known to compile this information, shown in Table B-4.

DETAILED DESCRIPTION OF PROMINENT SOURCES

The data sources can be conveniently grouped into four categories, population, employment, construction and motor vehicle and are summarized in Table B-5. Table B-5 lists the data items, method of collection, frequency, and geographic detail for each source.

Population

Census of Population--
Public Law 94-521, signed in October of 1976, provides for a mid-decade census which will furnace more frequent population counts and updates of the characteristics of the population. The first mid-decade census will be taken in 1985 and will not be as extensive as the decennial census. Table B-6 lists the questions asked of households in the 1960 and 1970 censuses; the 100 percent questions and some sample questions, although which of these and how many of them has not been decided as yet.

TABLE B-3. VEHICLE MILE DATA AVAILABLE IN 1973

State	Extent of data available	Department, name of contact, tel. no.
Alabama	No data on vehicle miles kept by county for all roads	State Highway Dept., Bureau of Research and Development, Mr. Lee Telephone: (205) 269-7312
Alaska	Some data on gasoline sales by county available	State Dept. of Highways, Planning Division Mr. Eberhardt Telephone: (907) 364-2121
Arizona	Annual vehicle mile data by county for state roads only	State Highway Dept., Planning and Survey Division, Mr. Green Telephone: (602) 261-7252
Arkansas	Annual vehicle mile data by county for all roads	Dept. of Highway Planning and Research Division, Mr. Bingam Telephone: (501) 569-2426
California	Biannual vehicle mile data available by county for all roads in "Historical State Highway, County Road and City Street Statistics"	State Dept. of Public Works, Traffic Department, Mr. Bailey Telephone: (916) 445-3127
Colorado	No annual vehicle mile data by county or any related data	Dept. of Highway, Planning and Research Division, Mr. Doland Telephone: (303) 757-9262
Connecticut	No vehicle mile data or related information available on a county level	Dept. of Transportation, Bureau of Planning and Research, Mr. Bark Telephone: (203) 566-2414
Delaware	Annual vehicle mile figures by county for all roads	Bureau of Highway Planning Mr. Shoe Telephone:(302) 678-4343
Florida	Annual gasoline sales figures by county, based on tax receipts, for fiscal year ending in June	Dept. of Transportation, Division of Transportation Planning, Mr. Freggar Telephone: (904) 488-4111
Georgia	Special report on 1971 vehicle mile figures for all roads by county, no material on an annual basis	State Highway Dept., Division of Highway Planning, Mr. Tenkin Telephone: (404) 656-5460
Hawaii	Annual vehicle mile data by county for all roads and annual vehicle registrations by county	Dept. of Transportation, Highway Planning Division, Mr. Uehara Telephone: (808) 548-7655
Idaho	No annual vehicle mile data available, or any related data	State Highway Dept., Planning and Traffic Division, Mr. Sullivan Telephone: (208) 384-2591
Illinois	Vehicle miles figures by county for all roads every 3 years	Division of Highways, Bureau of Research and Development, Mr. Tornton Telephone: (217) 525-7748
Indiana	No data on vehicle miles kept by county or any related data	State Highway Commission Technical Services Telephone: (317) 633-5816
Iowa	Annual vehicle mile data by county for all roads	State Highway Commission, Division of Planning, Mr. Studder Telephone: (515) 296-1306
Kansas	Annual vehicle mile data by county for all roads	State Highway Commission, Planning and Development Division, Mr. Sutton Telephone: (913) 296-3841
Kentucky	Annual vehicle mile data by county for all roads, total of all counties fall appreciably short of statewide total as given in FHWA "Highway Statistics"	Dept. of Highways, Division of Planning Statistical Section, Mr. Blackmore Telephone: (502) 564-2500

(continued)

TABLE B-3 (continued)

State	Extent of data available	Department, name of contact, tel. no.
Louisiana	Annual vehicle mile figures for state roads only in "Annual Report, Louisiana State Highways"	Dept. of Highways, Traffic and Planning Division, Mr. Reeves Telephone: (502) 389-5341
Maine	Vehicle mile totals for all roads by county	Dept. of Transportation, Bureau of Transportation Services, Mr. Picher Telephone: (207) 289-3131
Maryland	State road mileage figures traffic counts for certain roads "Traffic Trends" annual	State Highway Administration Office of Planning, Mr. Cloonan Telephone: (301) 383-4436
Massachusetts	No vehicle mile data or related information available on a county basis	Dept. of Public Works Planning Office, Mr. Genino Telephone: (617) 7275124
Michigan	No data on vehicle mile figures kept by county or related information	Dept. of State Highways, Transportation Planning Division Telephone: (517) 373-2663
Minnesota	No annual vehicle mile data available, or any related data	Dept. of Highways, Traffic Analysis Division, Mr. Gildemister Telephone: (612) 296-3147
Mississippi	Annual vehicle mile data by county for state roads only	State Highway Dept., Traffic and Planning Division, Mr. Livingston Telephone: (601) 354-7172
Missouri	Annual vehicle mile data for state roads only	State Highway Dept., Planning Section, Mr. Klamm Telephone: (314) 751-2825
Montana	Vehicle mile figures by county for all roads; 1969 and 1971 only from special report	State Highway Commission, Planning Survey Div., Mr. Divine Telephone: (406) 449-2564
Nebraska	No data on vehicle miles by county available on any related data	State Highway Dept., Programming and Planning Division Telephone: (402) 477-6012
Nevada	Annual vehicle mile figures by county for all roads; in "Status of Road Systems"	Dept. of Highways, Planning Survey Division, Mr. Ross Telephone: (702) 882-7080
New Hampshire	No vehicle mile data or related information available on a county basis	State Dept. of Public Works Planning and Economics Division, Mr. Lee Telephone: (603) 271-3344
New Jersey	Annual vehicle mile figures by county for state roads only	State Highway Department, Planning Division, Mr. Green Telephone: (609) 292-3530
New Mexico	Annual vehicle mile data by county for all roads in "New Mexico Traffic Survey"	State Highway Dept., Planning and Programming Dept., Mr. Beechum Telephone: (505) 983-7381
New York	No vehicle mile data or related information available on a county level	Dept. of Transportation, Office of Planning and Development, Mr. Tweedis Telephone: (518) 457-5540
North Carolina	No data on vehicle miles kept by county or any related data	State Highway Commission, Dept. of Planning and Research, Mr. Former Telephone: (919) 829-3141
North Dakota	Annual vehicle mile data by county for all roads in "Annual Traffic Report"	State Highway Dept., Planning and Research Division, Mr. Zinc Telephone: (701) 224-2512

(continued)

TABLE B-3 (continued)

State	Extent of data available	Department, name of contact, tel. no.
Ohio	Annual vehicle mile figures by county for state roads only "Ohio Highway Mileage Report"	State Dept. of Highways, Division of Planning and Programming, Mr. Whilkins Telephone: (614) 469-2617
Oklahoma	No data on vehicle miles kept by county or any related data	Dept. of Highways Current, Current Planning Division Telephone: (405) 521-2575
Oregon	Annual vehicle mile data by county for state roads only	Dept. of Transportation, Traffic and Engineering Div., Mr. Owens Telephone: (503) 378-6277
Pennsylvania	Annual vehicle mile figures by county for state roads only	Dept. of Transportation, Bureau of Trans. Planning Statistics, Mr. May Telephone: (717) 787-5983
Rhode Island	No vehicle mile data or related information available on a county level	Dept. of Public Works State Traffic Engineer Telephone: (401) 277-2694
South Carolina	No data on vehicle miles kept by county or any related data	State Highway Dept., Traffic and Planning Division, Mr. Hammand Telephone: (803) 758-3370
Souty Dakota	Annual vehicle mile data by county for all roads	Dept. of Highways, Research and Planning Division Telephone: (605) 224-3278
Tennessee	No data on vehicle miles kept by county or any related data	Dept. of Highways, Research and Planning Bureau, Mr. Werpool Telephone: (615) 741-3687
Texas	Annual vehicle mile data by county for all roads	Dept. of Highways, Research and Planning Bureau, Planning Survey Div., Mr. Wright Telephone: (512) 475-4846
Utah	Vehicle mile data for 1971 only by county for all roads from special traffic study	State Dept., of Highways, Systems Planning Division, Mr. Jester Telephone: (801) 328-5707
Vermont	Vehicle mile totals for all roads by county for 1970 only	Department of Transportation Highway Planning Division, Mr. Leach Telephone: (802) 828-2671
Virginia	No data on vehicle miles kept by county or any related data	State Dept. of Highways, Div. of Traffic and Planning Telephone: (703) 770-2876
Washington	Annual vehicle mile data by county for all roads	State Dept. of Highways, Dept. of Planning and Research, Mr. Cummings Telephone: (206) 753-6005
West Virginia	Vehicle mile figures by county for state roads, special study 1971 only	West Virginia Dept. of Highway Advanced Planning Division, Mr. Brennan Telephone: (304) 348-3113
Wisconsin	Annual vehicle mile data for all roads by county.	Dept. of Transportation, Division of Planning, Mr. Pamperin Telephone: (414) 266-2752
Wyoming	Annual vehicle mile data by county for state roads only	State Highway Dept., Planning and Programming Div., Mr. Caukel Telephone: (307) 777-7552

Note: Annual contact with states that presently produce no relevant data is advisable. It is likely that an increased number of states will adopt methods to tabulate vehicle miles by county in the future.

TABLE B-4. CONTACTS COUNTY SALES OF GASOLINE DATA

State	Contact
Arizona	Mr. Dave Tweedie Gas Tax Auditor 1739 W. Jackson Pheonix, Arizona 85007
Florida	State of Florida Gas Bureau Department of Revenue Tallahassee, Florida (904) 488-7417
Georgia	Curtis B. Molding, Director Motor Fuel Tax Unit Department of Revenue 318 Trinity Washington Building Atlanta, Georgia 30334
Louisiana	Richard L. Clousing, Supervisor Special Fuels Tax Unit Department of Revenue P.O. Box 201 Baton Rouge, Louisiana 70821 (504) 389-6223
Minnesota	James F. Dagen, Director Petroleum Division Minnesota Department of Taxation Centennial Office Building Saint Paul, Minnesota 55101
New Mexico	C. Tampin Bureau of Revenue State of New Mexico Baatan Memorial Building Santa Fe, New Mexico 87501

TABLE B-5. SUMMARY OF NATIONAL AND COMMERCIAL DATA SOURCES

Source	Data	Method of collection	Frequency of issue	Geographic detail below national	Comments
<u>Population</u>					
Department of Commerce, Bureau of the Census					
Census of population	Population: race age sex marital status	Census	Quinquennial	States, counties, SMSA's, cities, census tracts	The first mid-decade/census will be conducted in 1985
	education employment income ethnic origin	Sample			
Current Population Reports					
- Population Estimates and Projections, P-25	Population estimates		Annual	States, counties	State and county population estimates are published in both P-25 and P-26
- Federal State Cooperative Program for Population Estimates, P-26					
<u>Employment</u>					
Department of Commerce, Bureau of the Census					
Census of Manufacturers - Area report	Number of establishments Employees Production workers Manhours Value added Cost of materials Value of shipments Capital expenditures Inventories	Census	Quinquennial (for years ending in "2" and "7")	States, counties, SMSA's, cities	
- Special report					
Location of Manufacturing Plants, Area Sequence	Number of establishments by employment size categories		States, counties		Data sorted by county by 4-digit SIC Available on tape approximately 2 years after Census

TABLE B-5 (continued)

Source	Data	Method of collection	Frequency of issue	Geographic detail below national	Comments
Annual Survey of Manufactures					
- Statistics for States, SMSA's, Large Industrial Counties, and Selected Cities (AS-6)	Number of establishments Employees Payroll Production workers Production wages Production manhours Value added Cost of materials Value of shipments Capital expenditures End-of-year inventories	Survey of 65,000 firms	Annual, except for years ending in "2" and "7"	States, counties, SMSA's, cities	The information is presented - by 4-digit SIC for the state - by county (not by SIC) - by 4-digit SIC for SMSA's - by 4-digit SIC for selected counties
- Employment and Labor Costs for Operating Manufacturing Establishments (AS-8)	Number of employees Payroll			States	
County Business Patterns	Number of establishments Number of employees First quarter payroll Distribution of firms by employment size categories	Treasury Form 941, Schedule A for single establishment firms Mail questionnaires to multi-establishment firms	Annual	States, counties, SMSA's	
Dun and Bradstreet	Number of employees Sales volume	See text		States, counties. Post Office, individual firm	
Economic Information Systems, Inc.	Number of employees Sales volume Estimated consumption Estimated production	Data file constructed from: - census reports - corporate annual reports - industrial directories - engineering manuals	See text	States, counties, Post Office, individual firm	Consumption and production estimated using input/output method; based on

TABLE B-5 (continued)

Source	Data	Method of collection	Frequency of issue	Geographic detail below national	Comments
Construction					
Department of Commerce, Bureau of the Census					
Current Construction Reports					
Housing Authorized by Building Permits - C40	By type of structure: ownership, number of units, value	Information reported by permit issuing places (Form C404)	Monthly, annual	States, SMSA's, permit issuing places	The monthly issue is a survey of 4,000 more active places The annual issue includes all 14,000 permit issuing places
Bureau of Domestic Commerce					
Construction Review	By type of structure: ownership, value	Data collected by Bureau of the Census (C404 reports)	Monthly, annual	States, 22 SMSA's	Residential and nonresidential construction Nonresidential in 13 general categories
Bureau of the Census					
Unpublished data file: CH:D1 Residential and Nonresidential Permit Authorized Construction	By type of structure: number of buildings authorized, value, number of units (residential)	C404 reports	Monthly, annual	States, counties, permit issuing places	Data file for C40 and Construction Review Nonresidential in 14 general categories
McGraw-Hill Information Systems, F.W. Dodge Division					
Dodge Construction Potentials	By 267 project types: ownership, value, square feet, number of stories, number of units (residential)	See text	Monthly, annual	States, counties	Reported on a job by job basis

TABLE B-5 (continued)

Source	Data	Method of collection	Frequency of issue	Geographic detail below national	Comments
Motor vehicle					
Federal Highway Administration and the Urban Mass Transportation Administration					
Urban Transportation Reporting System (proposed)	Highway data:	From states and metropolitan planning organizations		Urban areas	First publication expected in 1979
	road miles		Every 2 years		
	lane miles		Every 2 years		
	vehicle miles of travel		Every 2 years		
	passenger occupancy		Every 4 years		
	CBD cordon measurement		Every 4 years		
	Demographic data:				
	population		Every 2 years		
	dwelling units		Every 2 years		
	employment		Every 2 years		
	passenger vehicle registrations		Every 2 years		
	land areas		Every 2 years		
R.L. Polk and Company					
Motor Statistical Division	Vehicle registrations	From states' records	Monthly, quarterly, annual	States, counties, towns, census tracts	

TABLE B-6. CONTENT OF 1960 AND 1970 CENSUS

Population items	1960, %	1970, %
Relationship to head of household	100	100
Color or race	100	100
Age (month and year of birth)	100	100
Sex	100	100
Marital status	100	100
State or country of birth	25	20
Years of school completed	25	20
Number of children ever born	25	20
Employment status	25	20
Hours worked last week	25	20
Weeks worked last year	25	20
Last year in which worked	25	20
Occupation, industry, and class of worker	25	20
Activity 5 years ago	-	20
Income last year:		
Wage and salary income	25	20
Self-employment income	25	20[a]
Other income	25	20[b]
Country of birth of parents	25	15
Mother tongue	25	15
Year moved into this house	25	15
Place of residence 5 years ago	25	15[c]
School or college enrollment (public or private)	25	15
Veteran status	25	15
Place of work	25	15[d]
Means of transportation to work	25	15
Mexican or Spanish origin or descent	-	5
Citizenship	-	5
Year of immigration	-	5
When married	25	5[e]
Vocational training completed	-	5
Presence and duration of disability	-	5
Occupation-industry 5 years ago	-	5

[a] Single item in 1960; two-way separation in 1970 by farm and nonfarm income.

[b] Single item in 1960; three-way separation in 1970 by social security, public welfare, and all other receipts.

[c] This item is also in the 5-percent sample but limited to State of residence 5 years ago.

[d] Street address included in 1970.

[e] In 1960, whether married more than once and date of first marriage; in 1970, also includes whether first marriage ended by death of spouse.

State and local data is available on computer tape or in these four reports:

PC(1)-A	Number of Inhabitants
PC(1)-B	General Population Characteristics
PC(1)-C	General Social and Economic Characteristics
PC(1)-D	Detailed Characteristics

Publications A and B are based on the 100 percent questions while C and D are based on the sample questions.

Current Population Reports--

State and county population estimates are published in Series P-25, Population Estimates and Projections and in Series P-26 Federal-State Cooperative Program for Population Estimates. The states furnish data on vital statistics and other variables (depending on estimation method) to the Bureau of the Census who calculates and publishes the estimates. Provisional estimates and revisions are published each year. States which do not agree with the estimates prepared under the Federal-State Cooperative Program publish their own estimates in Series P-25. The state contacts for the program are listed in Table B-7.

Employment

U.S. Department of Commerce, Bureau of the Census.

Census of Manufacturers--

The Census of Manufacturers is part of the Economic Census series which is published for the years ending in "2" and "7." Data is provided on the number of establishments, employees, production workers, manhours, payroll, inventories and other measures of industrial activity. The Area Series gives statistics for the states, counties, and SMSA's. The data is listed by 4 digit SIC code for the state, the SMSA's, and selected counties; general statistics (not by SIC code) are given for all the counties.

Available only on computer tape is the Location of Manufacturing Plants, Area Sequence which is part of the Special Reports Series. This data file gives the number of establishments by employment size categories for each 4-digit SIC by county.

The other economic censuses are taken for the retail and wholesale trades, the construction industries, mineral industries, and selected services. Each of these censuses has an area report series which contains data for states, counties, and SMSA's. All include the number of establishments, employees and payroll, as well as other data.

Annual Survey of Manufacturers (ASM)--

The purpose of the ASM is to provide data for the years when the census of Manufactures is not conducted and so the variables contained in the ASM reports are approximately the same as the Census. The ASM sample is comprised of 65,000 firms, including all firms (single- or multi-establishment) with more than 250 employees.

TABLE B-7. FEDERAL-STATE CO-OP PROGRAM CONTACTS

Mrs. Carolyn Sawyer
Center for Business and Economic Research
Graduate School of Business
University of Alabama
Box AK
University, Alabama 35486

Mr. Robert B. Weeden, Director
Office of the Governor
Pouch AD
Juneau, Alaska 99811

Mr. David L. Gale
Alaska Department of Labor
Research and Analysis Section
Box 3-7000
Juneau, Alaska 99801

Mr. Jack Kronenfeld
Department of Economic Security
Bureau of Planning
Post Office Box 6123
Phoenix, Arizona 85005

Dr. Forrest Pollard
Industrial Research and Extension Center
University of Arkansas
Post Office Box 3017
Little Rock, Arkansas 72203

Mr. Nelson Rasmussen
Population Research Unit
State Department of Finance
1025 P Street
Sacramento, California 95814

Mr. Richard Lin
Colorado Division of Planning
520 Centennial Building
1313 Sherman Street
Denver, Colorado 80203

Mr. Robert Odell
Vital Statistics Section
State Health Department
79 Elm Street
Hartford, Connecticut 06115

Mr. Bart Lewis
Bureau of Economic and Business Research
College of Business Administration
University of Florida
Gainesville, Florida 32601

Mr. Ronald Crowe
Office of Planning and Budget
270 Washington Street, S.W.
Atlanta, Georgia 30334

Mr. Robert C. Schmitt
Department of Planning and Economic Development
Post Office Box 2359
Honolulu, Hawaii 96804

Mr. Shigeo Tengan
State Department of Health
Post Office Box 3378
Honolulu, Hawaii 96801

Mrs. Janet Wick
Bureau of Vital Statistics
Idaho Department of Health and Welfare Statehouse
Boise, Idaho 83720

Mr. Clyde A. Bridger
Illinois Department of Public Health
535 West Jefferson Street
Sprinfield, Illinois 62761

Dr. Robert A. Calhoun
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The (AS)-6 series "Statistics for States, SMSA's, Large Industrial Counties and Selected Cities' is the only ASM report with statistics for substate areas. A "large industrial" county is defined as one having more than 5,000 employees. The data included are the number of employees and production workers, value added, cost of materials, value of shipments, capital expenditures, and end-of-year inventories.

Other ASM reports which contain data for states are:

AS-4 Fuels and Electric Energy Used, by Industry Groups

AS-5 Expenditures for New Plant and New Equipment

AS-7 Book Value of Fixed Assets and Rental Payments for Buildings and Equipment

AS-8 Employment and Labor Costs for Operating Manufacturing Establishments

County Business Patterns (CBP)--

CBP reports contain the number of establishments and employees, the distribution of establishments according to employment size categories and the first quarter payroll for all 2-, 3-, and 4-digit SIC codes except agriculture, mining, and public administration. Compiled annually, the data are reported for states and counties with SMSA summaries by 2-digit SIC. The information is obtained from Treasury Form 941, Schedule A (the reporting form for FICA) for single establishment firms and from mail surveys of multi-establishment firms. CBP reports are issued approximately 12 months after the end of the calendar year of reference.

Dun and Bradstreet: Duns Market Identifiers--

Dun and Bradstreet's primary function is a credit clearinghouse. Included among the data they collect on individual firms and establishments is the parent firm, the management personnel, the number of employees, the sales volume, and the SIC codes of the firm. The Dun's information can be provided in a variety of ways, one way being a tabulation by geographic area (the smallest is a zipcode area) and by SIC code(s). It is possible to purchase a computer tape which contains the name, address and other information for every firm in a state or other area (approximately $15,000 for Massachusetts). Another possibility is a hard-copy tabulation of employment or sales volume (in employment size categories) by 4-digit SIC code for each county (approximately $1500 for Massachusetts). An entry is updated when a credit inquiry about the firm is received. If there are no inquiries, the name and address of the firm is checked once a year. Dun and Bradstreet is sometimes slow to pick up new entries and is weak in the retail sector, particularly in recording branches of retail chains. A major advantage of the Dun and Bradstreet information is the availability of data on individual firms since the confidentiality requirements of the Census are not applicable to D & B.

Economic Information Systems, Inc. (EIS)--
EIS collects information from census documents, corporate annual reports, state and industrial directories, and engineering manuals. The data file consists of the names, addresses, and parent companies of all manufacturing establishments and mines having 20 or more employees. Also included in the file are estimates of the consumption and production of the companies. These estimates are obtained from input/output analysis based on the Census data on consumption and shipments. The data file is updated quarterly using the documents listed above and at irregular intervals on some industrial groups with information furnished by EIS clients.

Construction

Current Construction Reports--
Current construction reports provide data on housing units authorized, started, completed, sold, demolished; total value of new construction put in place; data on expenditures for additions, alterations, repairs on private residential units in the United States. Most of this information is published for census regions and occasionally SMSA's.

One exception is publication C-40, Housing Authorized by Building Permits, which gives data for stated, SMSA's, and permit issuing places. The data, which includes the ownership (public and private), the number of units by type of structure (single-family, apartment building, etc.), and the estimated value, is provided by permit issuing places. Approximately 4,000 more active permit places form the basis for the monthly publication while the annual publication includes all 14,000 permit issuing places.

Construction Review--
Construction review, published monthly by the Bureau of Domestic Commerce, contains information furnished by the Bureau of the Census and F. W. Dodge. Most of the data is on a national level including construction put in place, housing starts and completions, and contract awards. Data on residential and nonresidential permit authorized construction is published for states and 22 SMSA's. Nonresidential data is given in the 13 general categories listed in Table B-8.

The information received from the permit issuing places and reported in publications C-40 and Construction Review can be obtained from the unpublished data file CH:D1, "Residential and Nonresidential Permit-authorized Construction." The file, which contains the number of buildings authorized, the estimated value and the number of units for residential construction, is organized by type of structure (in the same categories as C-40 and Construction Review) for each permit place.

The data is available on computer tape and can be procured monthly (at $50 per month), monthly with an annual summary ($650 per year), or in the annual summary alone $$200 per year). A paper copy is available to government users at no charge and contains data for each permit issuing place by type of structure, grouped by county with county and state totals.

TABLE B-8. CATEGORIES OF NONRESIDENTIAL CONSTRUCTION

Amusement and recreational buildings
Churches and other religious buildings
Industrial buildings
Parking garages
Residential garages
Service stations and repair garages
Hospitals and other institutional buildings
Office, bank, and professional buildings
Public works and utilities buildings
Schools and other educational buildings
Stores and other mercantile buildings
Other nonresidential buildings
Structures other than buildings

McGraw-Hill Information Systems Company, F. W. Dodge Division--
The Dodge Construction Potentials (DCP) report, for each construction job, the square feet, the ownership, the value, the number of stories and, for residential construction, the number of units for 267 project types, including industrial construction by 2-digit SIC code.

The DCP data are collected primarily by a staff of reporters who obtain information on new projects from architects, engineers, and major builders. This information is supplemented by the use of newspapers and reports from permit issuing places for projects valued under $50,000 and for less populated areas. Adjustments are made to the file when a project is abandoned or canceled or when specification changes increase the value. Dodge estimates that the DCP cover approximately 96 percent of all construction. The remainder is mostly comprised of "force account" construction, which is work performed by full time crews of industrial firms, utilities and local governments for their own use. There is no size limitation on projects included in the Dodge files.

The DCP are organized by county with category totals specified by the user. Issued monthly with running or annual totals, the DCP are available on computer tape, cards, or print-out. The cost of the DCP varies between $1000 and $1500 for an individual state for the monthly data or an annual total. Previous years' data can be acquired at a 40 percent discount. The DCP for industrial categories alone can be purchased for 10 percent less than the cost of the total data file.

Motor Vehicles

Proposed Urban Transportation Reporting System--

To satisfy the requirements of Section 15(a) of the Urban Mass Transportation Act of 1964 (as amended) and to furnish the information required by the FHWA to administer the Federal Aid Highway Program (23 CFR 1.5) and the Transportation Improvement Program (Federal Register, Vol. 40, No. 181, September 17, 1975, Paragraph 450.120A8vi), a national transportation reporting system has been devised. The highway and vehicle use portion is currently undergoing review by the Office of the Secretary, after which it will be submitted to the Office of Management and Budget for review and publication in the Federal Register. The current expectation of the UMTA is that the Phase I data, listed in Table B-9, will be collected for 1978 for publication during July of 1979. Table B-9 is a summary of the proposed data elements, the anticipated reporting intervals, the areas affected, and the implementation schedule. The data will be collected by state highway departments and metropolitan planning organizations.

R.L. Polk and Company, Motor Statistical Division--

R.L. Polk collects vehicle registration data from states' records. The data is tabulated by make, by model year and by type of vehicle (passenger car, truck, etc.) for domestic and foreign vehicles and is available for new registrations or total registrations monthly, quarterly or annually. The smallest geographic area available is a census tract. R. L. Polk data are available from EPA.

The "By Make By Year" series presents the total registration as of July 1 for the state, counties and cities of more than 2,500 population by make and model year of passenger cars and trucks. The "Three Column Count" series gives the number of passenger cars registered, the number of trucks registered and the total number of vehicles registered by county. R.L. Polk reports are usually furnished in paper copy although other arrangements are possible. The company declined to give a cost estimate because the cost to a state depends on what arrangement Polk has with the state; to some states the data is gratis while to others the cost depends on the number of counties and detail required.

Review of State and Local Data

The various data items collected and compiled by the U.S. Bureau of the Census are also generally available from state sources. The data discussed here, then, are those that are typically collected only by the states or local agencies.

New Source Review--

The most important source of growth information for air quality planning is the review of new air pollution sources. Current regulations call for a state study of any new facility which will emit 100 tons or more of any criteria pollutant per year (1000 tons for CO).[3] The study must determine the impact of the source on ambient air quality and the implications of the source for SIP requirements. A number of states have lower threshold emission values for identifying sources for review. New source review procedures should thus provide the responsible agency with information on major sources.

TABLE B-9. SUMMARY OF PROPOSED DATA ELEMENTS FOR THE URBAN TRANSPORTATION REPORTING SYSTEM

Data element and classification	Reporting interval (years)	MPOs[a] affected	implementation phase
Highway data			
Road miles			
By functional classification	2	All	1
By geographic area[b]	2	All[c]	1
Lane miles of arterials during peak period	2	All	1
By functional classification of arterials			
By number of lanes			
By geographical area[b]			
By 1-way or 2-way direction			
Miles of reversible lanes	2	All	1
Vehicle miles of travel			
By functional classification[d]	2	All	1
By geographic area[b]	2	All[e]	1
By vehicle type	4	-[e]	2
Passenger occupancy	4	-[e]	2
By vehicle type			
By geographic area[b]			
CBD cordon measurement	4	-[f]	2
Passenger occupancy			
Vehicle type			
Traffic volume and congestion	4	-[g]	2
Demographic data			
Population			
By geographic area[b]	2	All[c]	1
Dwelling units			
By geographic area[b]	2	All[c]	1
Employment	2	All[c]	1
By geographic area[b]			
By CBD			
Passenger vehicle registrations	2	All	1
By county located in or containing urbanized area			
By vehicle type			
Land areas	2	All	1
By urbanized area			
By central city			
By central business district			
By federal-aid system boundaries			
Measurement of system performance			
Highway system: land area and dwelling units within travel time contours[h]			
From CBD	2	-[g]	1
From airport	4	-[g]	2
From major non-CBD employment center	4	-[g]	2
From major non-CBD shopping center	4	-[g]	2
Transit system: land area and dwelling units within travel time contours[h]			
From CBD	2	-[g]	1

[a]Metropolitan Planning Organizations.

[b]Geographic areas: central city, outside central city, urbanized area.

[c]Areas with population between 50,000 and 200,000 report only urbanized areas.

[d]Functional type: interstate, freeways and expressways, other principal arterials, minor arterials, collectors, and locals.

[e]Only areas with population of 200,000 or more; a systemwide sampling method will be used.

[f]Only areas with population of 750,000 or more.

[g]Only areas with population of 200,000 or more.

[h]After census figures become available, dwelling units and population within contours will be calculated on a 4-year cycle.

SOURCE: "Proposed Urban Transportation Data Reporting Requirements for States and Metropolitan Planning Organizations," Transportation Research Board, National Academy of Sciences, prepared for the Federal Highway Administration and the Urban Mass Transportation Administration, U.S. Department of Transportation, 1976.

Indirect Source Review--

Federal new source review regulations initially required review of indirect sources; i.e., new facilities associated with high levels of mobile source activity. However, activities under these regulations have been indefinitely suspended, and indirect source review is now a matter of state discretion. Table B-10, which summarizes state data sources, indicates those states with indirect source regulations currently in effect.[4] The regulations are typically based on the size of the facility, and require an analysis of the air quality impacts of mobile activity. Regulations vary from state to state with respect to the sizes and types of facilities subject to review.

Environmental Impact Statements--

A number of states (indicated in Table B-10) require environmental impact statements or assessments for various development activities.[5] The types of development requiring the statements vary from state to state; e.g., all developments with significant environmental impacts, versus public projects above a certain size. Statements typically describe the project and attempt to quantify its environmental impacts. Some states also require development permits for projects having "greater than local impacts."

Economic Development Agencies--

Other potential state sources of growth information are various economic development agencies. These agencies' activities typically include assembling or banking sites for industrial development, and maintaining information on state economic activities. These agencies may also be associated with state universities or chambers of commerce. For example, the Bureau of Business Research at the University of Texas publishes monthly statistics on industrial expansion, including square footage and work force additions.[6]

Public Utility Data--

Another possible data source, though one that shows considerable quality variation from state to state, is public utility customer data. For example, the Baltimore Air Quality Task Force used computerized files of meter types and locations to allocate area source emissions for an air quality maintenance planning analysis.[7] However, the breakdown of customer data by facility types or by subareas is not a standard part of utility reporting and might require special analyses. Further, total area coverage is not guaranteed, as municipal distribution systems which purchase power from utility companies may be exempt from data reporting requirements.

Local Data Sources--

Local governments are usually concerned to some degree with monitoring development, as a large part of their revenue comes from property tax receipts. Hence, local assessment files are a potential source of information that is regularly updated. The usefulness of these data, however, depends on the extent to which they can be easily summarized; i.e., whether they are maintained in a computerized format. The exact extent of computerized assessment files is not known. It is known, however, that only 140 of the approximately 14,000 assessing jurisdictions in the country use computer-assisted assessment

TABLE B-10. STATE PROJECT REVIEW DATA SOURCES

State	Sources: indirect source review	EIS requirements	Development permits or regulations
Alabama	X		
Alaska			
Arizona			
Arkansas			
California		X	
Colorado			X
Connecticut	X	X	
Delaware	X	X	
Florida			X
Georgia			
Hawaii			X
Idaho	X		
Illinois			
Indiana		X	
Iowa			
Kansas			
Kentucky	X		
Louisiana			
Maine	X		X
Maryland		X	
Massachusetts		X	
Michigan		X	
Minnesota	X	X	
Mississippi			
Missouri			
Montana		X	
Nebraska	X		
Nevada	X		
New Hampshire	X		
New Jersey		X	
New Mexico			
New York	X		X
North Carolina	X	X	
North Dakota			
Ohio			
Oklahoma			
Oregon	X		X
Pennsylvania			
Rhode Island			
South Carolina			
South Dakota		X	
Tennessee			
Texas			
Utah		X	
Vermont	X		X
Virginia	X	X	
Washington		X	X
West Virginia	X		
Wisconsin	X	X	
Wyoming			

methods; i.e., calculation of taxes from sales and property data.[8] The actual number of jurisdictions with computerized files might be significantly higher.

It is also important to note that local jurisdictions are the source of building permits reported to the U.S. Bureau of the Census, and that these data are thus fairly readily available.

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APPENDIX C

GEOGRAPHIC INFORMATION SYSTEMS

INTRODUCTION

In monitoring growth for air quality maintenance planning it is important to know both the amount and the spatial characteristics of new development, and to be able to operate with these data in an easy and efficient manner. Therefore, as part of the development of a growth monitoring method, several current geographic information systems were reviewed for their applicability to the problem.

A geographic information system may be defined thusly: a combination of a spatially defined data base and related analysis and presentation techniques that allows the user to study spatial variations in selected data items. These systems may or may not be computerized, but for this study only computerized systems have been reviewed.

A geographic information system typically contains planning-type data items referenced to a geographic coordinate or numbering system; e.g., the extent of a given land use in a given square kilometer. The data are obtained from a number of sources; census data, maps, surveys, assessment records, aerial photography, and satellite imagery may all be used. Because the systems are generally designed for comprehensive planning purposes, a wide range of data is included; viz, physical data such as soil types, slopes, and vegetative cover, that can be used for site planning analyses and water quality planning; cultural data such as land use, historic sites, and planning and zoning classes, that comprise a basic land use planning inventory; and political or civil districts, such as census tracts, townships, and planning districts, that make possible easy retrieval and comparison of data from or for various jurisdictions or purposes.

Raw data are generally classified and compiled as maps at a given scale. The maps are then encoded by grid overlay techniques or by point or line digitization. Actual storage and retrieval techniques vary from system to system and are usually designed for specialized planning purposes. A typical system would include computer mapping and data tabulation packages, allowing the user to apply weights to selected data items or to "search" the data base through conditional commands. For example, the user might want a map of all developable lands zoned for heavy industry. He/she would define "developable" from data items such as surface geology, proximity to roads, and proximity to services and utilities. Resulting sites would then be screened with zoning information, producing a map of all sites meeting the criteria.

In general, the uses of these systems for air quality planning are limited. They provide land-use information that can be used for allocating area source emissions as per the techniques in Volumes 7[1] and 13[2] of the AQMP Guidelines, or by the application of land-use based emission factors. They may also provide topographic information useful for facility siting studies. However, they may be suitable for growth monitoring simply because they contain land-use data that are in some way related to emissions, and can be used to obtain summaries and analyses of these data with relatively little effort. Two factors determine their final suitability, namely, the ease and frequency of system updates, and the degree of detail of system data. Growth monitoring is obviously impossible without regular updates, and lack of detail in the data; e.g., insufficient information on land-use intensities, can severely limit such applications.

A number of systems were identified for preliminary review, and are described in some detail below. The reader should keep in mind that these systems have been designed for planning at different governmental levels and hence reflect different concerns. They may be thought of as falling along a continuum whose end points might be termed "large-area" and "parcel-based" systems. Large area systems are typically used for statewide or regionwide planning. Because of their extent, that a detail must be limited somewhat to keep the data base to a manageable size. Parcel-based systems are used for county or local planning, and contain very detailed data. Thus, a large-area system might contain the amount of land used for multifamily housing in a given square kilometer, while a parcel-based system could include structural characteristics of each multifamily building.

The question of data detail, and hence data collection costs, is central to the problem of system updates. For most purposes, land-use information is the subject of update efforts, as other system data are relatively fixed. For large-area systems, it is generally agreed that remote sensing techniques offer a cost-effective means of obtaining land-use information. However, there are limits to the detail available through remote sensing, and other techniques may be less costly for small areas. Parcel-based systems are typically linked to real estate tax assessment files, which are updated regularly to avoid loss of revenues. Assessment information thus provides a relatively simple means for updating land-use information in these systems.

Regarding data detail and the use of remote sensing techniques, the reader should be aware of the land-use classification system most widely used with remote sensing data. This is the U.S. Geological Survey (USGS) Land Use and Land Cover Classification System.[3] The system is based on the levels of detail available with various remote sensing techniques and the needs of planning agencies. Table C-1 provides a brief summary of the system's characteristics and logic.

Classifications for Levels I and II have been developed by USGS. Classifications for Level III and beyond are developed by each user for his particular purposes. Most air quality planning to date has required land-use data at Level III or higher detail; e.g., number of dwelling units, floor/area ratios.

TABLE C-1. USGS LAND USE AND LAND COVER CLASSIFICATION SYSTEM CHARACTERISTICS

Classification level	Typical data characteristics	Example of classification category
I	LANDSAT or other satellite imagery	Urban or built-up land
II	High-altitude photography at 40,000 feet or above; less than 1:80,000 scale	Residential
III	Medium-altitude photography at 10,000 to 40,000 feet; 1:20,000 to 1:80,000 scale	Single-family units
IV	Low-altitude photography at 10,000 feet or below; more than 1:20,000 scale	Ten dwelling units/hectare
V	Ground surveys; more than 1:2,000 scale	Ten dwelling units/hectare, 5-6 rooms/ dwelling units

The reader should also be aware of the factors affecting the costs of obtaining data by remote sensing techniques. Interpretation is the generally most expensive element of a survey. Resolution, accuracy, and ease of interpretation is a function of photo height. Clearly, the lower the photo height, the greater the data detail and hence the amount of information that must be interpreted. However, higher altitude photography yields less detail and hence increases the difficulty of interpretation. Photo flights thus tend to be custom-tailored to the data needs of the client agency.

The interpreted data must also be ground-checked for accuracy, as interpretation is a somewhat subjective process. A skilled interpreter can generally achieve "ground truth" better than 90 percent if the classification categories are congruent with the data scale and detail.

PRELIMINARY REVIEWS

As noted, a number of systems were originally identified for review. Preliminary reviews of seven* systems were conducted via literature reviews and telephone discussions with the agency personnel responsible for the systems. Characteristics of interest were system applications, the scale, detail, and age of system data, update procedures, data sources, and system costs and funding sources. This section presents a brief description of each system and the review results.

The seven systems reviewed were: the New York State Land Use and Natural Resource Inventory (LUNR); the Maryland Automated Geographic Information System (MAGI); the Fairfax County Urban Development Information System (UDIS); the Charlotte-Mecklesburg Planning Commission Land Use File; the Wilmington Metropolitan Area Planning Council (WILMAPCO) Land-Use File; the New Castle County Automated Environmental Resource Information Systems (AERI); and the San Diego Polygon Information Overlay System (PIOS-II).

Three of these systems, LUNR, MAGI, and UDIS, were selected for more detailed review. The results of these reviews, and of the reviews of three land-use mapping projects relevant to the project concerns, are presented in subsequent sections.

The results of the preliminary review are summarized in Table C-2. The reader should be aware of one point in interpreting the table. Because systems are designed for different purposes, cost comparisons are not especially meaningful. Further, some systems have incurred pilot program and development costs which are not relevant to later systems. Finally, some totals include software development costs while others represent only data collection and computerization costs.

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*Several other systems are under development at this time. Because they are not yet complete or in-use they have not been reviewed. These include the Alabama Resources Information System (ARIS),[4] the Minnesota Land Management Information System (MLMIS),[5] and four systems under development by Environmental Systems Research Institute in California and Pennsylvania.[6]

TABLE C-2. SELECTED GEOGRAPHIC INFORMATION SYSTEM CHARACTERISTICS

System name	Responsible agency	Year system established	Development cost	Development funded by:	Size of study area	Basic data unit	Update frequency	Year current data collected	Air quality planning use
LUNR	New York State Economic Development Board	1968	$800,000	New York, HUD, Appalachian Regional Commission	140,000 km^2	1 km^2	None	1967-68	Yes
MAGI	Maryland Office of State Planning	1974	$200,000	Maryland, HUD, NASA	31,865 km^2	92 acres	As available	1973	No
UDIS	Fairfax County (VA) Office of Research and Statistics	1973	$735,000	Fairfax County, HUD	1,046 km^2	Parcel	Continuous	1976	Yes
Charlotte-Mecklenburg Land Use File	Charlotte-Mecklenburg Planning Commission	1972	$1,200,000	Mecklenburg County, HUD	1,406 km^2	Parcel	Annual	1976	No
Wilmington Land Use File	Wilmington (Del.) Metropolitan Area Planning Council	1976	$100,000	Delaware, New Castle County, HUD	1,134 km^2	Parcel	Annual	1974	No
AERI	New Castle County Areawide Waste Treatment Management Program	1975	$150,000	EPA	1,134 km^2	5.7 acres	As needed	1974	No
PIOS-II	Comprehensive Planning Organization of the San Diego Region	1974	$58,000	San Diego RCOG, HUD UMTA	11,036 km^2	Polygon	2 years	1975	Yes

All the systems contain data that are potentially useful for air quality planning, namely land uses. However, as noted previously, data detail is of some importance, as is the way in which data are coded. For example, a Level III classifibation is of little value for a 1 km^2 grid cell if the cell is assigned a single value representing only the primary land use. Therefore, methods of coding land-use data were examined and are summarized in Table C-3. The adequacy of the data for air quality planning was evaluated by comparison with the data requirements for Volumes 7 and 13 of the AQMP guidelines.

TABLE C-3. LAND-USE CODING TECHNIQUES

System name	Coding technique	Highest classification level	Adequacy for air quality planning
LUNR	Percent of each km^2 with a given land use	III	yes[a]
MAGI	Primary and secondary uses, presence only	III	no
UDIS	Primary land use, with structure characteristics	V	yes
Charlotte-Mecklenburg Land-Use File	Up to five land uses, with structure characteristics	V	yes
WILMAPCO Land-Use File	Primary and secondary uses, with acreages and structure characteristics	V	yes
AERI	Primary, secondary and testiary uses with acreages	III	yes[a]
PIOS-II	Area of each land use stored as a polygon	NA	yes

[a]Additional measures of intensity may be required for some uses.

The New York State Land Use and Natural Resource Inventory (LUNR) contains land use, economic, and physical data for each of the 140,000 square kilometers in New York State. Data were obtained from low-altitude aerial photography flown from 1967 to 1970, from USGS maps, and from state geological and engineering maps and surveys.[7] Development cost of LUNR was approximately $800,000, with $700,000 going to consultants and contractors. Roughly 70 percent of the cost was for airphoto interpretation, with the remaining costs split between the actual photo flights and computerization of the data.[8] Data were coded by a grid overlay technique. Data values are the percentages of were coded by a grid overlay technique. Data values are the percentages of each square kilometer having a certain value or characteristic.[8]

LUNR data are available as airphotos, standard land use maps, computer produced maps, data summaries for user-selected variables and areas, and data tapes. The computer mapping programs allow the user to weight variables and to sort data by using conditional criteria. This allows the user to quickly identify areas with certain characteristics, as is required in critical resource studies or site suitability analyses.

LUNR is currently maintained by the New York State Economic Development Board, and is available to public and private users on a fixed-cost basis. System data and products are available for any or all parts of the state. LUNR has been used most of 10 as a data base for comprehensive planning,[9] but the age of the data tends to limit current applications. LUNR uses are summarized in Table C-4.

Update procedures for LUNR at the statewide level do not currently exist. A pilot project to update data for two counties was funded by the Appalachian Regional Commission, and was recently completed.[10] Other updates have been conducted by local and regional agencies, but there are no current plans for statewide data collection. The problem of updates is discussed in more detail in the following sections.

LUNR land-use data have been used for air quality maintenance planning in a fashion similar to the Volume 7 and 13 techniques.[11] Another project involved application of land-use based emission factors to LUNR data as part of a regional plan evaluation.[12] These applications are discussed in the detailed review in the following section.

The Maryland Automated Geographic Information System (MAGI) contains data for 88,000 separate grid cells, each containing 92 acres (2,000 ft by 2000 ft) comprised of the state of Maryland and its surface waters. The data are divided into three general categories. "Capability variables" are those which determine whether an area can support a given activity. "Suitability variables" are used to determine whether an area <u>should</u> support the activity. "Special Study Variables" are used to extract other data from the system by special-purpose districts.

MAGI data were obtained from 30 different sources, including USGS and Soil Conservation Service Maps and maps and surveys by various state agencies.[13] Initial development cost was approximately $200,000. Development occurred in three phases, with funding in the first and last phases by the state of Maryland and HUD. The second phase, involving software development and a test of the applicability of ERTS data, was funded by NASA.[14]

MAGI data can be output as maps or statistical summaries, and various analysis models are available for data manipulation. These latter are used to identify special features, such as urban centers, from combinations of system data variables.

TABLE C-4. USES OF LUNR INVENTORY PRODUCTS ACCORDING TO TYPES OF RESPONDENTS

Category of respondent	Types of uses										
	Basic land use information file for administrative purposes	Basic land use comprehensive planning purposes*	Examinations of land uses in special zones	Identifications of patterns of specific land uses	Open space & environmental management studies	Project reviews for environmental impact	Special studies & miscellaneous	Instructional uses	Unsuccessful or incomplete uses	No detailed response (usually due to lack of familiarity)	Total
State agencies	3	2	6	4	4	5	2		8	11	45
Regional planning agencies	6	9	3	3			1		2	1	25
County planning agencies	10	18	6	3	5	2	3		1	10	58
Local planning and associated agencies	2	1	1		1		1		2	3	11
Conservation commissions and environmental advisory boards	3			1	13	2	2		8	2	31
Consulting firms and private industry	2	13	4	2	10	16	4		6	9	66
Miscellaneous public and private users	3	4	8	5	5		13	16	9	10	73
Total	29	47	28	18	38	25	26	16	36	46	309

*Areawide land use and development planning.

Source: Reference 9, Table 3.

Current land-use data was obtained from 1973 aerial photography. The present land-use classification system falls between land-use information to only Levels II and III, but coding techniques limit two categories in each grid cell.

MAGI was originally conceived as a data base for preparation of a state land-use plan. Its main uses to date are capability and suitability analyses for state planning projects. The Maryland Energy and Coastal Zone Administration has contracted for the use of MAGI for siting major facilities; e.g., power plants, in the coastal area. Oak Ridge National Laboratory has also used MAGI for tests of the power plant siting program developed by ORNL personnel. Various small-area analyses have also been conducted. Local agencies use the MAGI data, and often update it or collect other data in the same format. The Baltimore Regional Planning Council, for example, will use MAGI to develop sections of its Section 208 Regionwide Water Quality Plan. There are, however, no provisions for entry of these data into state files.

In general, agencies designated for Federal planning functions; e.g., A-95, 3-C, or Section 208 agencies, have used MAGI sparingly, for various reasons. The Metropolitan Washington Council of Governments decided not to use MAGI data because comparable data were not available for the Virginia portion of the metropolitan area.[15] The Baltimore Air Quality Task Force chose not to use MAGI data for AQMP preparation because land-use intensity was not sufficiently detailed.[16] MAGI is discussed in more detail in a subsequent section.

Fairfax County (Va.) Urban Development Information System (UDIS) contains data for approximately 150,000 parcels of land. System data include existing and planned land use, various geographic (district) references, assessment information, zoning information, building permits, building plans, and sewer facilities. Data were obtained from various county sources, including the county real estate assessment file, public works records, and water authority records and aerial photos. The assessment file was previously computerized, simplifying transfer of data to UDIS. Total funding for the development of UDIS was $735,000, with $351,000 from HUD and $384,000 from Fairfax County. It has been estimated that developing a system similar to UDIS in a comparable county would cost approximately, $250,000, with $45,000 for computer costs and $205,000 for administrative and personnel costs.[17]

UDIS data are available to users as standard summary reports, or as maps or tables produced for special needs. The system is designed to provide data useful for numerous planning functions in the most usable format. The purpose of the system is to monitor all relevant aspects of development in Fairfax County.

One of the most valuable aspects of UDIS is its update procedure. Since the system is largely based on the county assessment file, it can be updated almost simultaneously with the assessment data. Furthermore, the assessment file is updated regularly to prevent loss of county revenues. Other information, such as rezoning applications and building permits, is also added on a regular basis. Further, construction progress is monitored through permit and inspection data.

The present applications of UDIS include: "land-use planning, public facility programming, revenue projection, land-use control research and evaluation, population movements, and housing estimating and forecasting." Data are provided to all county offices and various state and regional agencies.

UDIS is discussed in more detail in a subsequent section.

The Charlotte-Mecklenburg (N.C.) Land-Use File is a parcel-based file similar to UDIS. It is also linked to the county assessment file and hence updated annually. It contains data for approximately 125,000 parcels, including five levels of land-use information, structure characteristics, and various location codes.[18]

Development cost for the entire assessment and land-use file system was approximately, $1,200,000, including software. Data coding costs were approximately $1 per parcel. The system was funded by Mecklenburg County and by HUD for comprehensive planning applications.[19]

System data are used by various agencies. The planning commission uses the data base for community development planning. The system has also been used by the Police and Fire Departments. System access is available through a program package which generates summary reports. The planning commission also maintains an in-house programming capability for special applications.

The Wilmington (Del.) Metropolitan Planning Council Land Use File is another parcel-based file. It was developed from county tax maps and computerized files and land-use information. It contains multilevel land use and acreage information, along with parcel numbers and other geographic codes; e.g., traffic zones. Development cost was approximately, $100,000, or about $1 per parcel.

Updates are (or will be) conducted annually from tax records. The tax files are now updated weekly, but no direct link to the land-use file exists. This means that the annual update must be done manually from revised tax maps.

The file is used primarily to produce land-use summaries for comprehensive planning purposes.[20]

The New Castle County Automated Environmental Resource Information System (AERI) is a grid-based file covering the same geographic area as the WILMAPCO Land-Use File. The data base contains information for approximately 49,000 5.7-acre grid cells. The system is designed for water quality planning and hence contains detailed physical and land cover data, as well as land use, utility, and planning and zoning information. Land-use data is coded by predominant and secondary types; i.e., most prevalent and second most prevalent uses in a cell, and the classification scheme corresponds approximately to Level III detail.

Data were obtained from a number of local, state, and federal sources. Land-use data were obtained from special-purpose aerial photography.[21] The total cost of system development and data collection was approximately,

$150,000, funded by EPA through the Section 208 program. The system incorporates software for searching, mapping, and overlaying data files for various analyses. Outputs include two types of maps and data summaries.

The agency hopes to be able to use the system for other planning applications and hence recognizes the need for updating land-use information. At the present time no update procedure has been developed, but an effort is being made to incorporate any authorized subdivisions and rezonings.[22]

The San Diego CPO Polygon Information Overlay System (PIOS-II) contains physical, denographic, and land-use data for San Diego County. The data are encoded as polygons, through line digitization techniques, and may be retrieved in either polygon or grid cell formats.[23] The agency has found that the grid cell format is more useful, especially when three or more data files must be overlaid. System development cost was approximately $55,000 with funding from HUD, UMTA, and the San Diego CPO, which represents the regional council of governments.

PIOS-II land-use data were originally obtained from 1971 aerial photography. These data were updated by comparison with 1975 aerial photos obtained from San Diego County. The CPO recognizes the need to update land-use information, and plans to do so at 2-year intervals, using aerial photos. Various sources of photography were explored, including NASA high-altitude (U-2) flights, but none were found to cover the entire county on a regular basis. Therefore, special-purpose flights will probably be conducted for the updates.[24]

PIOS-II has not been used as a system for air quality planning, but land use and activity summaries prepared from system data have been used to allocate emissions to a grid system for model studies. This effort was conducted as part of the air quality maintenance planning process for San Diego County.[25]

On the basis of the preliminary review, three systems were selected for more detailed study: LUNR, MAGI, and UDIS. LUNR was chosen, even though it is somewhat dated, because of its use in the development of some Air Quality Maintenance Plans (AQMPs) for New York state. Furthermore, methodologies and costs of updating the system have been explored in some detail by Economic Development Board personnel. Finally, LUNR data have been used extensively for various planning purposes and user evaluations of the system are readily available.

MAGI was selected for review because it is a relatively up-to-date statewide system with extensive use. Some data in the system are updated regularly, and others when the data become available from special studies. Maryland State Planning Office personnel have also examined various methods for updating land-use information on a regular basis, including the use of LANDSAT data.

UDIS was selected from the three parcel-based systems largely because of its extensive use. All the parcel systems are derived from tax assessment files and can generate roughly the same outputs. The principal difference is that the UDIS software and reporting formats are somewhat more specialized and hence more costly to operate. However, UDIS has experienced a wider variety of applications and thus has more extensive documentation.

AERI and PIOS-II were not reviewed because of the difficulty in obtaining data within the time and budget constraints of the project.

The detailed reviews concentrated on two aspects of the systems, namely, update procedures which would be needed for growth monitoring, and applications of the systems to air quality planning. The results of these reviews are presented in the following three sections.

NEW YORK STATE LAND USE AND NATURAL RESOURCE INVENTORY

As noted, LUNR was chosen for review because New York State Economic Development Board personnel have examined the problems of system updates in some detail. However, at the present time update procedures for LUNR at the statewide level do not exist. A pilot project for preparing an updated version, the Land-Related Information System (LRIS) was funded by the Appalachian Regional Commission. LRIS was completed for Broome and Tioga Counties (1238 km^2) at a cost of approximately $125,000. LRIS involved substantially more than a simple land-use update, including the collection of detailed physical data. LRIS, however, does <u>not</u> include a computerized data base. Land-use information in LRIS was obtained from orthophoto interpretation at a cost of approximately $60,000, with $37,500 going to preparation of the orthophoto quads and $22,500 to interpretation.[26] Coverage of the entire state by this method was estimated to involve 90 to 100 person years of labor for interpretation alone.[27]

Updates of LUNR have been undertaken by local and regional planning agencies, usually for specific needs. Recent updates have been made possible by the New York State tax mapping program, which is providing airphoto coverage of most of the state in an effort to produce detailed real estate tax maps for the entire state. However, this program is a one-time-only effort.[28] Thus, the main problems in an update are the availability of aerial photography and the cost of extensive field checking. No mechanism exists for incorporating local updates into the statewide system. However, the extensive use of LUNR has made possible the development of a relatively complete USGS Level III classification system for the state.[29]

The prognosis for regular LUNR updates is not good. The system is currently based in an "unstable" (for budget reasons) agency, whose functions are partially duplicated by other agencies; e.g., the tax mapping program. While LUNR data are potentially useful for a number of state planning functions making the costs of an update potentially sharable, there is little coodination of state data needs. A committee has recently been formed for this purpose, but any action is not forthcoming. Most coordination to date has been based on "good interpersonal communication."[30]

As noted previously, LUNR has had a wide range of applications. With regard to this review, it is worth noting that almost 70 percent of LUNR users think that data for "rapid change areas" should be updated at least every 2 years. Further, more than half think statewide updates should be conducted at least every 5 years.[31]

Air quality planning applications of LUNR have been carried out through local and regional agencies, in cooperation with the state Department of Environmental Conservation. A current application is underway in the preparation of the air quality maintenance plan for the Utica-Rome AQMA. The Herkimer-Oneida Comprehensive Planning Program* updated LUNR land-use data to 1975 from airphotos and ground checking. Approximately 1,500 km^2 were updated, at a cost of $11,000. The updated land-use information was then used as a basis for projections, and will be used in conjunction with employment and population data from allocating area source emissions. Emission totals for cities and towns will be allocated by employment and population totals, and then allocated to subareas with the land-use data.[32]

In a previous application, land-use based emission factors were applied to LUNR data as part of an effort to evaluate the air quality impacts of a proposed regional plan for the Rochester area. It was found that the LUNR data lacked sufficient detail on land-use intensities. Consequently, employment and population data were used in a fashion similar to the Utica-Rome applications, and the LUNR data were then used for the final allocation.[33]

In summary, LUNR as it currently exists is not especially useful for growth monitoring, and its data format limits its usefulness for air quality planning in general. Furthermore, updates, even with the current format, are cumbersome and costly at the statewide level. Data collection costs are the major component. Aerial photography is relatively expensive, and the labor and time required for interpretation and field checking are prohibitive for any single application. A cost-benefit analysis of the system has been proposed as part of the effort to coordinate state data needs, and any results will likely affect decisions about updating the system.

MARYLAND AUTOMATED GEOGRAPHIC INFORMATION SYSTEM

As noted previously, the MAGI coding scheme for land-use data limits system applications for air quality planning. However, MAGI is a statewide information system with some update procedures in progress, and hence merits further study.

MAGI data are updated as new data become available; e.g., county land-use plan updates are entered when the plans are formally adopted. Physical data in the system are relatively fixed, but "cultural" data such as land use will be updated as the need arises and the data become available. Plans are currently being made to update MAGI land-use data to 1975, using high altitude aerial photography available from NASA. However, the program which funded the U-2 flights has been terminated and other data sources will be required for later updates of land-use information. The state has not made any commitment to continuing collection of land-use data, and updates will likely be done with data collected for special needs or for other programs.

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*Herkimer-Oneida CPP is the regional planning agency for the Utica-Rome area.

Maryland state planning personnel estimate the cost of a land-use update from mid-altitude aerial photography at about $100,000, split almost evenly between photo acquisition and interpretation. This cost was felt to be reasonable for updates at 3-year intervals, provided that the costs could be spread to all system users.[34] The only problem foreseen was the lag time involved in making the information available; i.e., the relatively long period required for photo interpretation and computerization of the data.[35]

Maryland planning personnel also investigated the possibility of using LANDSAT data for system updates. It was concluded that the satellite data could be used to produce Level I information, but that it could not be used to meet state demands for Level II and III data. It was, however, concluded that the satellite data could be used to indicate those areas where more detailed updates are required; e.g., rapid change areas.[36] It is important to note that "change detection" with LANDSAT in this case means changes from one Level I classification to another. Thus, Level II or higher level changes that are potentially important for air quality planning might not be detected.

In summary, MAGI faces problems very similar to those faced by LUNR in regard to its use for growth monitoring. In fact, the problems involved in the use of remote sensing data for updates seem to limit the application of large-area systems to detailed change detection to a serious degree. The costs of obtaining, interpreting, and ground checking the data, as well as the time involved are substantial. Further, the detail of data available from all but low level aerial photography may not be sufficient for air quality planning purposes

THE FAIRFAX COUNTY URBAN DEVELOPMENT INFORMATION SYSTEM

The level of detail and frequency of updates for UDIS seem to be ideal for growth monitoring for air quality planning. This is not surprising, as the system is designed to provide information on all aspects of land development. Each county agency responsible for some aspect of development provides information to the system on a regular basis. Zoning changes, building permits, and use permits are all monitored, and regular summary reports are produced. All relevant data are updated annually, at a minimum.[37]

The problem with generalized application of the Fairfax system is cost. The level of detail needed for planning in a rapid growth area like Fairfax County is not necessary for community planning in other areas; hence, the cost of establishing such a system in these areas cannot be justified. Further, UDIS and the other parcel systems have been developed in areas already having computerized tax assessment files, thus greatly reducing data collection costs. However, for areas meeting all the qualifications, parcel-based systems are an efficient method for monitoring growth by land-use changes.

UDIS is also used for air quality studies through a process and set of models recently developed for Fairfax County. UDIS provides land use and structure characteristics used to calculate and allocate stationary source emissions by computerized versions of the Volume 7 and 13 techniques. The calculated emission values are stored in a version of the EIS/P&R Subsystem, and can be input to a version of the Air Quality Display Model for concentration calculations. Mobile source emissions are treated in a separate model segment and can be input to a version of the HIWAY model. The models are arranged in stages, allowing the user to check results of one operation before they are input to the next segment. The models were tested in Fairfax County with somewhat mixed results. The HIWAY model segment was modified to handle queuing effects, and yielded satisfactory results. The AQDM tests were less successful, owing to insufficient monitoring data for calibration and the difficulty of separating out the effects of the nearby Washington, D.C. metropolitan area.[38]

LAND-USE MAPPING BY REMOTE SENSING TECHNIQUES

As noted previously, the most effective way of updating land-use information for large areas is by application of remote sensing techniques. Problems with this approach include the costs of obtaining, interpreting, and field checking the imagery, as well as obtaining adequate detail for growth monitoring. Nonetheless, the approach holds some promise. In this section three projects that use remote sensing data for land-use mapping on a more or less regular basis are briefly reviewed.* These are the California Department of Water Resources Land-Use Survey Program, the USGS Land Use and Land Cover Mapping Program, and the USGS Census Cities Experiment in Urban Change Detection.

The California Department of Water Resources is charged with determining water management requirements in the state. Detailed land-use information is essential to determining these requirements. Given the rather rapid rate of growth and change in California, this data must be updated on a regular basis. This is accomplished through the use of aerial photography and field surveys. The aerial photography is used to produce land-use maps on USGS 7.5 minute quadrangle sheets. The acreage of each land-use category for each county, water agency jurisdiction, and similar areas is then computed and stored in a computer readable format. This data can then be retrieved for a wide range of planning purposes. The land-use classification scheme is approximately equal in detail to a Level III scheme.[39]

The survey is budgeted at approximately $350,000/year of which about two-thirds is available for data collection. Funding is obtained solely from the State of California. The intent of the agency is to cover the entire state at 10 to 12 year intervals. Rapid change areas are covered at shorter intervals, averaging about 5 to 6 years. Remote, unchanging areas may be covered at intervals greater than 12 years.[40]

This program represents the only ongoing statewide commitment to monitoring land-use change that was discoeverd in the course of this project. The cost figures could be considered applicable to the use of remote sensing data for growth monitoring for air quality planning. (The land-use categories

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*For a readable summary of USGS services, the EROS data center, and further examples of the use of remote sensing data the reader is referred to the December 1976 issue of Practicing Planner.[44]

are potentially useful, although some additional data on use intensity would be needed.) It seems clear that the costs of covering the entire state on an annual basis would be prohibitive.

The USGS Land Use and Land Cover Mapping Program is an effort to map land use for the entire country at a maximum scale of 1:100,000 using high altitude photography. The program is aimed at establishing baseline data with a uniform classification for general planning purposes. Updates will be done only on a needs basis, but this could mean coverage of urban areas of 5-year intervals. Growth monitoring could thus be a possible goal of the program if rapid growth areas could be identified from other sources. However, the applicability of the data is very limited, as the detail achieved in only a Level II classification. Further, the smallest parcel considered in the program is approximately 10 acres.[41]

An ongoing project which holds more promise is the Experiment in Urban Change Detection conducted by the Geography Program of the USGS. At present, a detailed land-use map of Washington, D.C. has been prepared from LANDSAT multispectral scanner (MSS) data to prove the feasibility of mapping land use. Change detection involved comparison of this map with one produced from high altitude aerial photography taken 3 years earlier. However, change detection by computer comparisons of LANDSAT imagery is feasible and may be attempted in the future.

LANDSAT MSS data provides a minimum resolution of one picture element (pixel) which represents about 1 acre. Land-use classifications are obtained from LANDSAT data through the following process: A part of a LANDSAT scene, usually composed of 2 sets of spectral data, is subjected to cluster analysis, and each pixel is assigned to a cluster having similar characteristics. The resulting cluster data is overlaid on a map of existing land uses, and the land use represented by each picture element is noted. The data are then analyzed statistically to provide a "signature" of spectral values for each land-use category. The computer is then used to produce a land-use classification for each picture element in the complete scene.[42] The process thus allows land-use categories to be defined in a number of ways. The Washington, D.C. study used some 26 land-use spectra categories, cutting across Levels I to III. These categories were combined into 11 land-use categories for final mapping.

The final map was then compared visually with a map produced from high-altitude aerial photography flown at an earlier date. The project was successful at detecting numerous land-use changes across the Washington area. Further, one of the final mapping categories was "disturbed land," allowing for detection of construction activity. (This category can be separated from agricultural land by use of imagery from different seasons.)

The relative costs of producing the two maps are of some interest. The map produced from aerial photography required approximately 2 person-years of effort. Preparation of data used for the LANDSAT map required approximately 3 person-days of effort by skilled analysts, and some computer time. (The map is printed directly from computer data tapes, using a newly developed laser exposure process.) However, two factors that affect the cost should be noted. First, land-use maps at a usable scale; e.g., 1:24,000, must be available for classification of LANDSAT data. Second, the process is in the development stage, involving specially trained personnel and experimental techniques. For example, classification of land uses from clustered LANDSAT data required 8 minutes of computer time on an experimental machine developed for USGS. Classification on an in-use machine such as an IBM 370/66 would require over 20 hours.[43]

In summary, the LANDSAT change detection process offers some promise for eventual application to growth monitoring. However, major problems remain to be resolved. First, and most important, the detail available from LANDSAT data may not be sufficient for growth monitoring for air quality maintenance planning purposes. That is, land-use classification systems such as the USGS Washington categories may be too general for growth monitoring. Further, redefining the categories to be more specific may not be possible; e.g., separating the spectral signatures of commercial and industrial development may not be possible. Generally, the more heavily urbanized the area, the greater the difficulty in separating land uses. This problem has not yet been examined in detail. A second problem is that the process is not yet thoroughly developed, so that costs are difficult to determine. Other methods of growth monitoring may prove more cost-effective; e.g., analysis of building permits or other data already collected on a regular basis.

SUMMARY

None of the geographic information systems reviewed holds promise for statewide growth monitoring at the levels required for air quality planning. Large area systems generally lack sufficient data detail. Furthermore, they face the time and cost problems presented by the use of remote sensing data for system updates. Parcel-based systems are effective for relatively small areas, but the costs of their application to larger areas are prohibitive. Their data detail and update procedures are ideal for growth monitoring, but are generally dependent on links with computerized assessment data. Growth monitoring for large areas with remote sensing techniques does hold promise. However, the problems of cost and detail noted previously, and the experimental nature of sophisticated interpretation techniques limit their application at the present time.

This review has raised four points of potential importance for growth monitoring. First, existing geographic information systems can conceivably serve as sources of baseline data for monitoring land-use changes. Second, those areas with parcel-based systems have a ready source of data that should be applied to growth monitoring. Third, the data sources for parcel-based systems suggest that many localities may already collect adequate data for other purposes. Finally, the possibility of using remote sensing data, especially satellite imagery, in conjunction with other techniques might be worthy of further examination. The USGS experiments have shown that LANDSAT imagery can be used to detect some land-use changes. If the cost and accuracy can be improved, it might be possible to identify "changing" areas which could then be examined in detail by more conventional means.

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APPENDIX D

OVERVIEW OF THE PROCESS FOR CONTROL OF CO HOT SPOTS

Controlling CO hot spots requires several steps: identification of the potential hot spots, detailed analysis of each hot spot, and selection of control measures.

Figure D-1 is a flow diagram for the overall process for selection of CO control measures. Each of the numbered steps will be briefly described.

STEP 1: PRELIMINARY SCREENING

Preliminary screening of roadways and intersections to identify possible CO hot spots is the first task. Preliminary screening procedures use generalized procedures and a minimum amount of traffic data; available data can be used in most cases. To facilitate the rapid screening of many locations, simple charts and nomographs have been developed. The output is simple the identification of potential hot spots; no quantitative estimates of CO concentrations are produced.

STEP 2: VERIFICATION SCREENING

Verification screening is a more detailed manual analysis of locations that are shown by preliminary screening to be potential hot spots. Verification screening uses a larger amount of site-specific data than does preliminary screening, and produces quantitative estimates of CO levels. New traffic data will be needed in many instances.

STEP 3: DETAILED MODELING

Once the hot spots are identified, they are analyzed with detailed analytical models (usually some form of computer model). Modeling provides the base case against which alternatives are judged. Modeling generally requires the collection of new data on traffic, air quality, and meteorology. Modeling reveals the degree of emission reduction that is needed from traffic controls.

STEP 4: IDENTIFICATION OF ALTERNATIVE IMPROVEMENTS

Knowing the amount of CO emissions reduction that is needed, the planner can begin to narrow the choice of control measures by identifying those alternatives that appear capable of meeting the air quality requirements. New (or existing) transportation planning data are obtained at this point, to allow

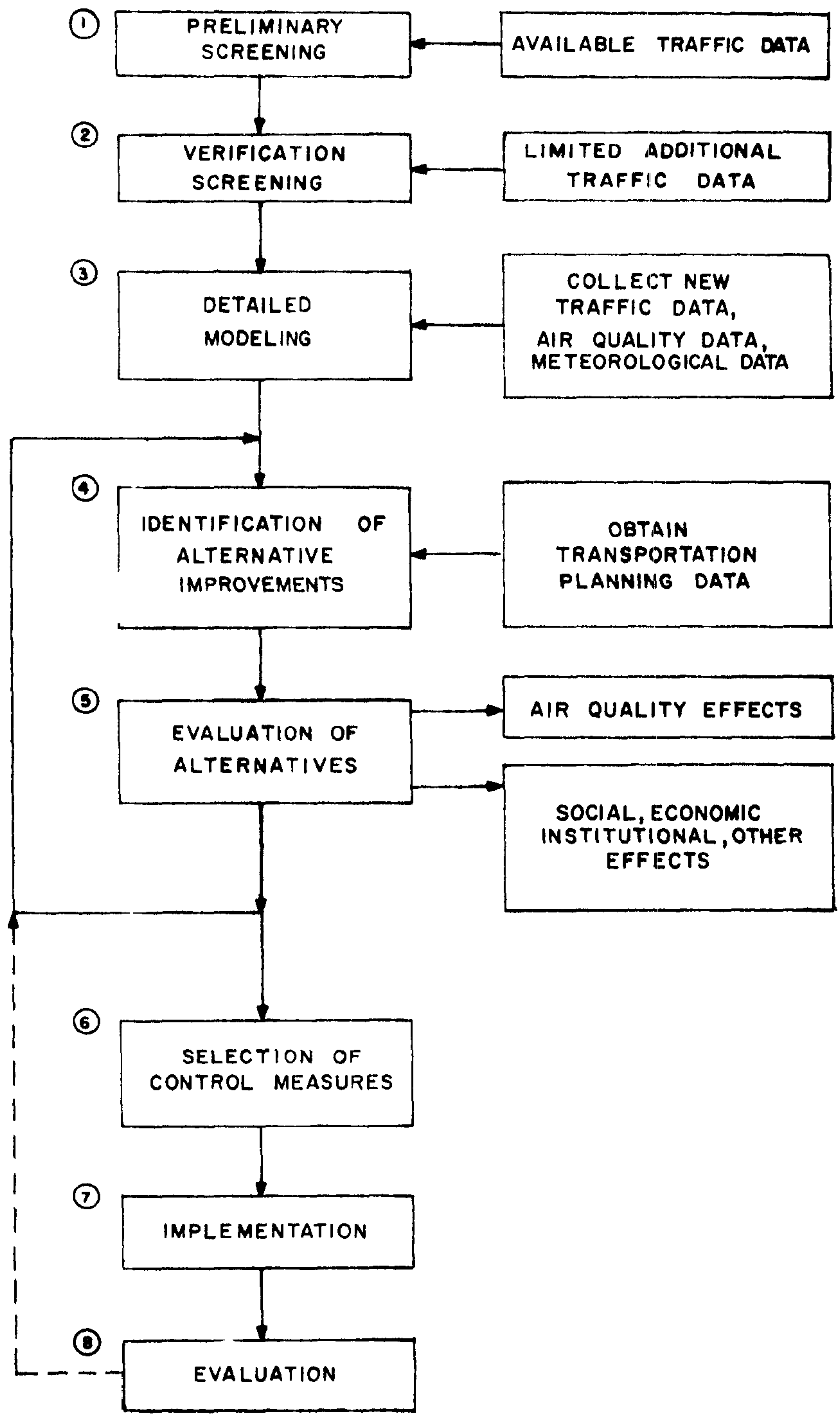

Figure D-1. Decision-making process for selection of CO control measures forecasting emissions in future years and to allow consideration of macro-scale traffic changes when necessary. The alternatives to be evaluated should be capable of achieving the required reduction in emission concentration at each hot spot, after accounting for other mitigating factors such as new vehicle pollution control devices

STEP 5: EVALUATION OF ALTERNATIVES

Evaluation of air quality effects uses the models from Step 3 and determines if the required reductions would be met. For those alternative measures that would satisfy the air quality criteria (only), the other effects are then identified and quantified. If the alternative control measures are inadequate, or if it is prudent to examine additional alternatives because of implementation obstacles that may arise, the process would revert to Step 4 at this point.

STEP 6: SELECTION OF CONTROL MEASURES

Selecting among the alternative measures requires balancing the nonair quality effects (assuming that only those measures that will achieve the required reductions are being considered at this point). The thrust of the choice is to minimize the adverse impacts. For example, the decision might be between two control measures that are similar except that one requires more capital outlay but is more beneficial to fuel consumption. Such choices are commonly made in transportation facility planning.

STEP 7: IMPLEMENTATION

Having selected a measure, it must be implemented. When planning measures, the time to accomplish this step should be considered in all analyses of effectiveness.

STEP 8: EVALUATION

After implementation, the traffic and air quality should be monitored and calculations made to determine if the required reductions in emission concentrations will be achieved. Rarely are planning predictions exact; in some cases it will be necessary to adjust the control measures, or supplement them, in order to (1) meet air quality goals or (2) amelicrate unexpected impacts.

HOT SPOT SCREENING GUIDELINES

The two screening tasks described above (Step 1 and Step 2) have recently been documented[1] in a set of guidelines for the identification and analysis of locations with the potential for experiencing violations of the National Ambient Air Quality Standard for carbon monoxide. These guidelines are designed to identify potential carbon monoxide hot spots, using only data on automobile traffic and thus avoiding the need for time-consuming and costly monitoring of air quality at potential hot spots.

The overall technique is a refinement of a hot spot analysis procedure[2] developed from a previous U.S. Environmental Protection Agency (EPA) report[3] concerning the affects of emissions from proposed indirect sources. The hot spot analysis procedure has also been expanded to provide the capability of accounting for a number of additional conditions beyond those included in the original procedure. At the present time, the hot spot screening procedure does not provide techniques for screening future CO hot spots using projected motor vehicle emission factors. This capability is currently being developed and may be available in the future.

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APPENDIX E

BASIS OF TABLES 1 AND 2

By conservatively assuming no atmospheric transformation of hydrocarbons takes place, the Hanna-Gifford model is assumed to be applicable. The basic Hanna-Gifford model for the origin cell concentration (equation (8) of Appendix A) is as follows:

$$\chi = \frac{\sqrt{\frac{2}{\pi}} \left(\frac{\Delta\chi}{2}\right)^{1-b}}{a\ (1-b)\ u}\ Q_o$$

substituting the following as a worst case situation,

$$a = 0.06$$
$$b = 0.71$$
$$u = 1 \text{ meter/sec}$$

and a 1 square mile cell,

$$\Delta\chi = 1609.3 \text{ meters}$$

one obtains,

$$\chi = 319.17\ Q$$

where χ is expressed in $\mu g/m^3$ and Q is expressed $\mu g/mi^2/sec$. The critical emission density to exceed 75 percent of the NAAQS is:

$$(0.75)\ 160 = 319.17\ Q$$
$$Q = 0.376\ \mu g/m^2/sec$$

or 33.81 tons per square mile per year.

Tables IV-1 and IV-2 assume negligible emissions from stationary sources and, further, that the only significant source is light duty motor vehicles. Twenty-five percent of the VMT is assumed to occur in the peak 3-hour period, thus the equivalent annual emission rate is:

$$33.81 \left(\frac{3 \text{ hours}}{24 \text{ hours}}\right) \left(\frac{100\%}{25\%}\right) = 16.9 \text{ tons/mi}^2\text{/yr}$$

The critical level of annual VMT per square mile in year n is

$$VMT_n = \frac{\left(E_{npstwx} + E_n\right)\left(1.103 \times 10^{-6} \frac{\text{tons}}{\text{g}}\right)}{\left(16.9 \text{ tons/m}^2\text{/yr}\right)}$$

where E_{npstwx} is the composite exhaust emission factor in year n and E_n is the composite evaporative emission factor in year n, both expressed in grams per mile. The critical level of annual gasoline sales density in year n is then simply obtained by:

$$G_n = \frac{VMT_n}{M_n}$$

where M_n is the fleet composite gasoline mileage in year n expressed in miles per gallon.

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16. ABSTRACT

Guidelines to assist state and local agencies in designing information systems to track trends in growth and to assess the potential of a violation of a National Ambient Air Quality Standard within 10 years are described. The information system may be used to reassess the adequacy of State Implementation Plans as required by current federal regulation (40 CFR 51.12(h)). The guidelines are illustrated in two states, Wisconsin and Massachusetts.

17. KEY WORDS AND DOCUMENT ANALYSIS

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AIR POLLUTION FORECASTS URBAN PLANNING REGIONAL PLANNING INFORMATION SYSTEMS	AIR QUALITY MAINTENANCE AIR POLLUTION POTENTIAL IMPLEMENTATION-AIR POLLUTION PLANNING EMISSIONS GROWTH	

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