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**SUMMARY, CONCLUSIONS  
AND RECOMMENDATIONS FROM  
REPORT TO  
THE PRESIDENT  
AND  
CONGRESS ON  
NOISE**

**December 31, 1971**

**U.S. Environmental Protection Agency  
Washington, D.C. 20460**

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Preface to this Summary

In accordance with Title IV, PL 91-604, The Noise Pollution and Abatement Act of 1970, the Environmental Protection Agency conducted extensive research and held a series of public hearings on noise. As required by that Act, the Agency submitted to the President and the Congress a comprehensive Report on Noise. The Introduction, Summary and Conclusions of the Report, and a listing of the 15 Technical Information Documents prepared as part of the efforts to develop the Report are contained in this pamphlet.

Pending publication of the Report by the Superintendent of Documents, U.S. Government Printing Office; and of the Technical Information Documents by the National Technical Information Service (Dept. of Commerce), limited copies may be made available to those having an urgent need for the data therein. Requests should be directed to the Environmental Protection Agency (Office of Noise Abatement and Control), Washington, D.C. 20460.

## INTRODUCTION

NOISE, commonly defined as unwanted sound, is an environmental phenomenon to which man is exposed before birth and throughout life. Noise can also be considered an environmental pollutant, a waste product generated in conjunction with various activities of man. Under the latter definition, noise is any sound — independent of loudness — that may produce an undesired physiological or psychological effect in an individual and that may interfere with the social ends of an individual or group. Those ends include all of man's activities — communication, work, rest, recreation, and sleep.

As waste products of his way of life, man produces two general types of pollutants. The general public has become well aware of the first type, the mass residuals (such as associated with air and water pollution) that, to a greater or lesser degree, remain in the environment for extended periods of time. However, only recently has attention focused on the second general type of pollution, the energy residuals such as the waste heat from manufacturing processes that creates thermal pollution of our streams. Energy in the form of sound waves constitutes yet another kind of energy residual, but, fortunately, one that does not remain in the environment for extended periods of time. The total amount of energy dissipated as sound throughout the earth is not large when compared to other forms of energy; it is only the extraordinary sensitivity of the ear that permits such a relatively small amount of energy to adversely affect man and other biological species.

It has long been known that noise of sufficient intensity and duration can induce temporary or permanent hearing loss, ranging from slight impairment to nearly total

deafness. In general, any source of sound producing noise levels of 70 to 80 dBA at the ear can contribute to a pattern of exposure that may produce temporary hearing threshold shifts if exposure is long enough, and this in turn could lead to permanent hearing impairment. In addition, noise can interfere with speech communication and the perception of other auditory signals, disturb sleep and relaxation, be a source of annoyance, interfere with an individual's ability to perform complicated tasks, influence mood, and otherwise detract from the quality of life.

Society has, since antiquity, made attempts to abate and control noise. The Romans enacted perhaps the first prohibitory noise law when, by popular decree, chariot movements were prohibited in the streets of Rome during the night. In England, the first reported court decision concerning noise abatement is dated in the thirteenth century. Today, many communities in the United States have antinoise ordinances, although these statutes vary widely in standards, scope, and degree of enforcement.

With the technological expansion that began during the Industrial Revolution and that has accelerated since World War II, environmental noise in the United States and other industrialized nations has been gradually and steadily increasing, with more geographic areas becoming exposed to significant levels of noise. Whereas noise levels sufficient to induce some degree of hearing loss were once confined mainly to factories and occupational situations, noise levels approaching such intensity and duration are today being recorded on city streets and, in some cases, in and around the home.

There are valid reasons why widespread recognition of noise as a significant environmental pollutant and potential hazard or, as a minimum, a detractor from the quality of life has been slow in coming. In the first place, noise, if defined as unwanted sound, is a subjective experience. What is considered as noise by one listener may be considered desirable by another. Even in the same individual, wanted sound on one occasion may be considered as noise on another.

Secondly, noise has a rapid decay time and thus does not remain in man's environment for extended periods of time, as do air and water pollution. By the time the average individual is spurred to action to abate, control, or, at least, complain about sporadic environmental noise, the noise in many situations may no longer exist.

Thirdly, the physiological and psychological effects of noise on man are often subtle and insidious, appearing so gradually and slowly that it becomes difficult to associate cause and effect. Indeed, to those persons whose hearing may already have been affected by noise, it may not be considered a problem at all.

Further, the typical citizen is proud of this nation's technological progress and is generally happy with the things such progress has given him in the way of rapid transportation, labor-saving devices, and new recreational devices. Unfortunately, many technological advances have been associated with increased environmental noise, and there has been a tendency in large segments of the population to accept the additional noise as part of the price of progress.

The scientific community has already accumulated considerable knowledge concerning noise, its effects, and its abatement and control. In that regard, noise differs from most other environmental pollutants. Generally, the technology exists to control most indoor and outdoor noise. As a matter of fact, this is one instance in which knowledge of control techniques exceeds the knowledge of biological and physical effects of the pollutant. These facts have been brought out in previous Federal reports on this problem such as "Noise: Sound Without Value" (Office of Science and Technology) and "The Noise Around Us" (Commerce Technical Advisory Board, Department of Commerce).

## ORGANIZATION OF THIS REPORT

This report first addresses the effects of noise on living things and property. Reviewed are: human auditory, psychological, physiological, and sociological effects; effects on wildlife and other animals; effects of sonic boom and similar impulsive noises; and physical effects of noise on structures and property.

Chapter 2 deals with the sources of noise and their current environmental impact. Included in this chapter are discussions on community noise; transportation systems; devices such as lawn mowers and chain saws powered by internal combustion engines; noise from industrial plants; construction equipment and operations; household appliance and building equipment noise; and an assessment of the environmental impact of major noise sources.

Chapter 3 discusses present and future control technology for the noise sources discussed in Chapter 2.

Laws and regulatory schemes are dealt with in Chapter 4. Considered are current governmental noise regulations and regulatory schemes and their effectiveness.

Chapter 5 is concerned with government, industry, professional, and voluntary noise control activities.

Chapter 6 presents an assessment of noise concern in other nations. Among items reviewed are legislation and regulations relating to noise sources and noise environments.

Finally, for those unfamiliar with the terminology of acoustics and noise, a glossary is provided.

The emphasis in this report on noise source control technology should not obscure the importance of other noise abatement procedures. A comprehensive, systematic approach to noise abatement should include, in addition to source control, such features as land use planning and zoning, requirements for noise control in building codes, and standards for enforcement of regulations.

The reader of this report is cautioned that the material presented herein is a condensation of the extensive technical and detailed material contained in the appropriate EPA Technical Information Documents and in the transcripts of the public hearings held by the Agency. As a condensation, generalities may occur, although every effort has been made to qualify statements when required for clarity. Those interested in more detail or verification of information sources should consult the appropriate EPA documents, and the specific references cited therein.

## GENERAL OBSERVATIONS AND CONCLUSIONS

### The Character of Noise as an Environmental Problem

That sound and hearing play an important role in human life is a proposition so self-evident it requires no further comment. However, some effects of noise on man, such as interference with sleep and communication or noise-produced irritation and annoyance, are difficult to define and evaluate with objective precision.

Sparse information is available on typical cumulative exposures to noise associated with a variety of sources normally present in most of society's current environment. Much of the information contained in this report is concerned with specific sources, although first efforts have been made to estimate the magnitude of cumulative exposures of typical segments of the U. S. population.

Furthermore, there is a general lack of information on the effects of noise on various living nonhuman organisms. It is evident that under certain conditions there may be some ecological effects, particularly when new noises intrude into wildlife habitats. At the same time, certain species seem to show some adaptation to noise. The present state of knowledge in this area is incomplete.

Reasonable evidence exists of the damaging effects of high intensity noise on inert objects. Physical damage to property from sonic booms generated by aircraft has been repeatedly confirmed. As the scale of intensity decreases, there is insufficient valid data regarding direct structural effects on property. Insofar as the effects of noise on property values are concerned, the evidence remains inconclusive.

The data developed in this report and its supporting documents indicates that noise has an impact on the people in the United States. This impact manifests itself by interfering with speech communication, disturbing sleep, and creating other disturbances of life that lead to annoyances. In addition, some noise levels encountered

in non-occupational situations may also contribute to the risk of incurring hearing impairment. Since the subject of occupational noise has been extensively covered in connection with the Occupational Safety and Health Act, it is dealt with only by reference in this report.

Noise Control Technology and Possible Changes in the Noise Problem to the Year 2000

Current technology and that expected to be available in the next 5 to 10 years indicate that a substantial reduction in the noise from various sources is feasible.

Application of available technology is lagging because of inadequate social, economic, or governmental pressures for noise abatement. Further, there must be a balance between application of technology to noise sources and the other measures required in controlling the total noise environment, such as land use planning and regulation of source use. In this connection the requirements of the National Environmental Policy Act relative to Environmental Impact Statements (Sec. 102(2)C, PL 91-190) and of the Noise Pollution and Abatement Act of 1970 (Title IV, PL 91-604, Sec. 402(c)) provide a basis for noise control associated with both planned and existing Federal activities. Procedures to accomplish these requirements are now being implemented.

The projections of noise impact conducted for this report clearly indicate the need for aggressive efforts at all levels of government. Without such efforts, residual noise levels in typical urban communities can be expected to rise from the 1970 level of slightly over 46 dBA to just under 50 dBA by the year 2000 (the residual level as used in this report is the lower noise level boundary that is exceeded approximately 90 percent of the time). Of more concern is the estimate that the noise energy from highway vehicles would double by the year 2000. On the other hand, the early and vigorous institution of available technology and comprehensive planning, in conjunction with effective enforcement and regulatory schemes, could reduce the residual to

42 dBA and the noise energy from highway vehicles by a ratio of nearly 4.5 to 1. This latter figure takes into account the estimated growth in the number of noise sources.

An additional significant measure of the situation may be obtained by considering the size of noise-impacted land areas near airports and freeways. The total noise impact area in 1970 is estimated at approximately 2000 square miles, and this area could increase to approximately 3300 square miles by the year 2000. The projected increase in the impact of aircraft noise could be reduced through a combination of actions such as the development and use of quieter aircraft engines, changes in aircraft operating procedures, and tighter regulation and enforcement. More work is needed to clearly identify the relationships among the various actions required, their cost, their effect on impacted areas and the benefits that would result. Comparable actions regarding highway vehicles could also reduce the impact of vehicular noise. As with aircraft noise, the relationships among the various actions required and their costs and benefits need additional investigation.

#### Methodologies for Noise Measurement and Evaluation

A considerable variety of methodologies and terminologies are presently used to describe, measure, and evaluate noise. Some of these are complex and confusing even to those well versed in acoustics. This bewildering array of terminology, such as PNdB, EPNdB, NEF and CNEL (see the Glossary for description of these terms) represents efforts on the part of voluntary institutions, members of the professions, and segments of governmental authorities to deal with specific situations, problems of measurement, and needs for evaluation techniques. Many terms have some degree of commonality, if not interchangeability, while others simply are not comparable. Similarly, few, if any, were developed with the idea that they might be incorporated in a statutory procedure for noise abatement and attendant legal and enforcement provisions. Even with existing statutory requirements at Federal, state, and local levels, widely different and sometimes conflicting procedures exist.

This problem is further compounded by differences in scientific semantics associated with noise control and evaluation in the private and quasi-governmental usage. The terms criteria and standards have come to have specific meanings regarding the environment as pertains to air and water pollution and other environmental stresses. These terms are loosely used interchangeably in relation to noise. In most texts and nongovernmental standards documents, they often have the same meaning. There is a clear cut need to develop a uniformly understood, adequate scheme for measurement and evaluation of noise.

#### Economic Implications of Noise and Noise Abatement

Information on the adverse effects of noise and the costs associated with various types of abatement measures are contained in several chapters of this report. In addition, a significant portion of the data developed in the eight public hearings held by the Agency under PL 91-604 relates to economic aspects of the noise problem.

As background material for this report, EPA commissioned a study of the economic impact of noise, which is referenced in the body of the document. However, at this time, the rudimentary state of knowledge regarding costs, benefits, and the impact of abatement expenditures upon the nation's economy make it extremely difficult to perform meaningful economic analysis related to the problem of environmental noise.

In order to evaluate alternative noise abatement strategies, there are three major types of economic factors to be considered. It is desirable to know the magnitude of the benefits derived from proposed actions in terms of damages avoided and positive gains attained. A second factor is the cost of attaining each of the levels of control under study. Finally, an analysis of the impact of these costs upon the economy is needed. With such information, economic analyses can be undertaken to facilitate rational decision-making.

Unfortunately, in the noise area, the currently available data is often imprecise and relates to some limited problem such as the effects of highway noise on property values in selected locations. In general, the data does not exist that would permit good aggregate estimates of the magnitude of noise damage and the cost and impacts of abatement measures.

There is a need for additional research on and analysis of the economic aspects of noise as an environmental problem. More needs to be known about the adverse effects on such factors as health, the quality of life, productivity, and property values; the cost of attaining various levels of control; and the impact of abatement costs on the economy. With a better understanding of these economic considerations, it should be possible in the future to evaluate alternative control strategies and identify cost-effective solutions.

#### **SPECIFICS OF A PROGRAM FOR THE FUTURE**

The material developed in preparing this report, and discussed in detail in supporting documents, is supported in the EPA public hearings on noise and leads to one over-riding conclusion: there is a need for improved and comprehensive efforts at all levels of government for environmental noise control. The local and state governments have the primary responsibilities, in most respects, for the actions necessary to provide a quieter environment. This includes land-use planning and zoning, building codes, use regulations and the necessary enforcement programs. However, there are some functions that are best carried out by the Federal government. The Administration's legislative proposals now being considered by the Congress provide the basis for these needed functions. Specific recommendations to achieve the needed objective of a significant reduction of noise over the next 5 to 10 years are embodied in the following recommendations.

1. Federal Leadership in Noise Abatement and Control

Federal governmental programs relating directly to noise research and control are among the activities of several Federal departments and agencies. There is a need for improved coordination of this effort. To that end, it is recommended that:

- a. The Environmental Protection Agency should provide the leadership and should promote coordination of efforts of the various agencies that would be responsible for their respective activities.
- b. The Federal government should provide leadership in controlling noise associated with its activities.
- c. Programs of technical assistance to states and their political subdivisions for regulations and enforcement should be developed.

2. Standards and Regulations

A regulatory scheme should be established, and accelerated noise abatement efforts should be made by local, state, and Federal governments as follows:

- a. Federal noise emission standards should be established for the principal sources of environmental noise including:
  - (1) Transportation equipment -- including aircraft, for which EPA should have authority to approve FAA standards for regulation of aircraft noise.
  - (2) Construction equipment.
  - (3) Internal combustion powered devices.
- b. Product labeling authority requested in legislative proposals presently being considered is a necessary element in an overall noise abatement and control program.

- c. Uniform noise codes, regulations, and standards should be developed by EPA and other Federal agencies, in accordance with the above-mentioned plan, and should be enacted into law by states and localities. Technical assistance should be provided by EPA on enforcement and other related activities.

3. Research and Analysis Needs

Some investment of effort and funds in noise research has already been made at the Federal level (and to a lesser degree in the private sector as brought out in this report). There remain, however, numerous gaps in knowledge and extensive areas of technical and scientific disagreement that require a continuing research effort. To meet these needs, the following steps are recommended:

- a. Present Federal research and development on specific noise source control should be continued and expanded, but with a more direct focus on environmental aspects. Such a program should directly involve the considerable expertise already existing in the professional and academic community and in industry.
- b. Federally planned, directed, and supported research for improved methodologies of measurement and evaluation are needed. In particular, a critical assessment of a large number of the varying measuring systems and methodologies now in use is required. Simplification, standardization, and interchangeability of data should be the goal of this project.
- c. Continuing efforts to determine the noise exposure of the American public should receive early attention.

- d. Research on physiological and psychological effects of noise should be continued. Such research provides the basis for the necessary criteria documents to be used in setting standards and in formulating state and local regulations.
- e. Analysis of the economic implications and economic impact of noise control is essential in the decision-making process and for the development of realistic standards and should be undertaken as part of the existing EPA investigation of the broader issue of environmental economics.

4. Education and Public Awareness

Although there is awareness of some aspects of the noise problem and control techniques, the typical citizen, while vexed by the intrusion of environmental noise into his life, is generally unaware that methods to alleviate the problem are already at hand. The efforts called for in the above recommendations will lead to the improved information needed to move ahead with effective measures to lessen the impact of noise.

5. Legislative Recommendation

Legislation proposed by the Administration in February 1971 would provide the authority that is needed to meet the problems revealed in the studies leading to this report.

Appendix A

SOURCE DOCUMENT INFORMATION

The Technical Information Documents used as the basis for the preparation of this report are:

NTID300. 1 - Noise From Construction Equipment and Operations, Building Equipment, and Home Appliances, prepared by Bolt, Beranek and Newman under EPA contract 68-04-0047.

NTID300. 2 - Noise From Industrial Plants, prepared by L. S. Goodfriend Associates under contract EPA 68-04-0044.

NTID300. 3 - Community Noise, prepared by Wyle Laboratories under EPA contract 68-04-0046.

NTID300. 4 - Laws and Regulatory Schemes for Noise Abatement, prepared by the George Washington University under EPA contract 68-04-0032.

NTID300. 5 - Effects of Noise on Wildlife and other Animals, prepared by Memphis State University under EPA contract 68-04-0024.

NTID300. 6 - An Assessment of Noise Concern in Other Nations, prepared by Informatics, Inc. under EPA contract 68-01-0157.

NTID300. 7 - Effects of Noise on People, prepared by the Central Institute for the Deaf under EPA contract 68-01-0500.

NTID300. 8 - State and Municipal Non-Occupational Noise Abatement Programs, prepared by the staff of the EPA Office of Noise Abatement and Control.

NTID300.9 - Noise Programs of Professional/Industrial Organizations, Universities and Colleges, prepared by the staff of the EPA Office of Noise Abatement and Control.

NTID300.10 - Summary of Noise Programs in the Federal Government, prepared by the staff of the EPA Office of Noise Abatement and Control.

NTID300.11 - Social Impact of Noise, prepared by the National Bureau of Standards under interagency agreement with the Department of Commerce.

NTID300.12 - Effects of Sonic Boom and Other Impulsive Noise on Structures, prepared by the National Bureau of Standards under interagency agreement with the Department of Commerce.

NTID300.13 - Transportation Noise and Noise From Equipment Powered by Internal Combustion Engines, prepared by Wyle Laboratories under EPA contract 68-04-0046.

NTID300.14 - Economic Impact of Noise, prepared by the National Bureau of Standards under interagency agreement with the Department of Commerce.

NTID300.15 - Fundamentals of Noise: Measurement, Rating Schemes, and Standards, prepared by The National Bureau of Standards under interagency agreement with the Department of Commerce.

To obtain these documents contact the Environmental Protection Agency, Office of Noise Abatement and Control, Washington, D. C. 20460.

Also used in the preparation of this report was testimony obtained at public hearings held by the Office of Noise Abatement and Control under authority of the Noise

Pollution and Abatement Act of 1970 – Title IV to the Clean Air Amendments of 1970 (PL 91-604). The cities in which those hearings were held and their subjects covered are as follows:

Atlanta	Noise in Construction
Chicago	Manufacturing and Transportation Noise (Highway and Air)
Dallas	Urban Planning, Architectural Design; and Noise in the Home
San Francisco	Standards and Measurement Methods, Legislation and Enforcement Problems
Denver	Agriculture and Recreational use Noise
New York	Transportation (Rail and Other), Urban Noise Problems and Social Behavior
Boston	Physiological and Psychological Effects
Washington, D. C.	Technology and Economics of Noise Control; National Programs and their Relations With State and Local Programs.

The transcripts of these hearings may be obtained through the United States Government Printing Office, Superintendent of Documents, after announcement of their availability in the Federal Register.