Report for Recommendation 92-6

The Dormant Noise Control Act and Options to Abate Noise Pollution

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With a Technical Appendix on Noise and Its Effects

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Introduction

In early 1981, the Director of the Office of Noise Abatement and Control (ONAC) at the Environmental Protection Agency (EPA) was informed that the White House Office of Management and Budget (OMB) had decided to end funding of ONAC and that the matter was non-negotiable.[1] Congress' eventual acquiescence in OMB's action was, and remains, unique. Of the 28 environmental and health and safety statutes passed between 1958 and 1980,[2] the Noise Control Act of 1972 (NCA)[3] stands alone in being stripped of budgetary support.

Since Congress did not repeal the NCA when it eliminated ONAC's funding, EPA remains legally responsible for enforcing the regulations it issued under the Act, but without any budget support legislated for that purpose. Moreover, although some of the regulations are now out of date, and others may be inadequate, EPA's lack of budgetary support effectively precludes their amendment. Since the NCA preempts local and state governments from regulating noise sources in many situations, these levels of government may not be able to step into the void created by Congress' decision not to fund EPA.

This report considers the future of noise abatement in the United States and what role EPA should play in that function. Part I describes the history of noise abatement in the United States before ONAC was created, during its tenure, and after its abolition. Part II evaluates the role of local and state governments in noise reduction and EPA's relationship to such efforts. Part III assesses the role of the federal government and EPA in noise reduction.

The report concludes that it would be unfortunate for Congress to maintain the status quo where EPA has ongoing legal duties, but it has no funding to carry them out. Although Congress could eliminate the federal government's responsibilities for noise abatement, the NCA, with modifications, should remain in force. This does not mean, however, that EPA should merely pick up where it left off 10 years ago. Instead of relying primarily on emissions controls as it did previously, EPA should emphasize abatement approaches that rely on local and state activity, on market incentives, and on coordination with

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[1]Interview with Charles Elkins, Assistant to the General Counsel, EPA, in Washington, DC (Nov. 19, 1990).

[2]*See* C. Sunstein, After the Rights Revolution: Reconstructing the Regulatory State (1990) (listing the statutes).

[3]Noise Pollution and Abatement Act of 1972, Pub. L. No. 92-574, 86 Stat. 1234 (1972) (codified as amended at 42 U.S.C. §§4901-4918 (1988).

other agencies, private standard-setting groups, and regulatory agencies in other countries.

I. Noise Abatement in the United States

Noise abatement has come almost full circle in the United States. Prior to the 1970s, there was almost no governmental activity addressed to noise pollution. During the 1970s, all three levels of government were active in abating noise. Since 1981, when ONAC lost its funding, the level of activity at all three levels has been significantly reduced, and although it is greater than prior to the 1970s, it is not significantly greater except in a few areas. This section describes the roller coaster history of noise abatement in this country and its likely effect on the level of noise at this time. The analysis considers noise abatement prior to ONAC, during ONAC, and after ONAC.

A. Noise Abatement Prior To ONAC

In the 1960s, noise pollution was a distant cousin in the family of environmental issues and, as this history will relate, it has remained outside the mainstream of the environmental movement ever since. A massive public opinion survey taken in the early 1970s revealed that the public ranked noise pollution as a serious problem,[4] but noise control advocates were unable to develop the same type of organized constituency that developed to support clean air and water.[5] One reason was that although "air and water pollution was shown actually to kill people," the supporters of noise control could not demonstrate a "direct cause and effect relationship" between excessive noise and death.[6] Advocates also lacked any dramatic illustrations of noise pollution similar to the Cuyahoga river catching on fire, nor did they have someone like Rachael Carson or Barry Commoner to popularize their cause. Because noise

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[4]In a 1973 national survey of housing and neighborhood conditions by the Department of Housing and Urban Development, street noise was cited by 34 percent of the 60,000 respondents as a "condition" in the neighborhood, while 60 percent of those reporting the condition felt it was "disturbing, harmful, or dangerous," and 18 percent felt that it was so "objectionable" that they would "like to move." Address By Kenneth Eldred, Noise At The Year 2000, Fifth International Congress On Noise As An International Problem, Sweden (1988), at 9.

[5]*See* R. Paehlke, Environmentalism and the Future of Progressive Politics (1989) (describing origins of the environmental movement); C. Bosso, Pesticides & Politics: The live Cycle of a Public Issue (1987) (same).

[6]Hilderbrand, *Noise Pollution: An Introduction To The Problem and An Outline For Future Legal Research*, 70 COL. L. REV. 652, 655 (1970).

pollution is produced by hundreds of types of sources, noise control proponents also found it more difficult to arouse public indignation against convenient corporate targets in the way that other environmentalists attacked the automobile industry or chemical manufacturers.[7] Finally, advocates had trouble generating widespread support because of the incidence of noise pollution. Whereas air and water pollution normally affect large areas, only a small proportion of the people in a city or state may be burdened by particular sources of noise, and that burden may have been imposed on them by the other residents who wished to obtain the benefit of a highway, airport, or industry.[8]

Despite these handicaps, noise control advocates made some headway starting in the late 1960s. Prior to that time, local noise regulation was based on legislation or ordinances that prohibited "excessive or unusual" noise, which were difficult to enforce because of their subjective character.[9] Once portable noise measuring equipment became available,[10] local and state governments began to promulgate objective emissions limitations, stated as a maximum number of decibels (dB).[11] At about the same time, Congress authorized the Federal Aviation Administration (FAA) to regulate aircraft noise emissions,[12] enacted the National Environmental Policy Act (NEPA),[13] which required agencies to assess noise impacts as part of environmental impact statements, and directed EPA to establish ONAC and to have it prepare

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[7]*See* Wilson, "THE POLITICS OF REGULATION," in The Politics of Regulation 370 (J. Wilson ed. 1980) (environmental movement succeeded by capitalizing on a crisis, putting opponents on defensive by accusing them of bad acts, and by associating legislation with widely held values like clean air).

[8]Letter from Noral Stewart, Stewart Acoustical Consultants, to David Pritzker, Administrative Conference of the United States (ACUS) (Mar. 12, 1991), at 3. Thus, large metropolitan areas are more likely to have noise abatement programs because noise impacts a majority of the population. In other areas where the impact is on a minority of the residents, they find it difficult to get help from local governments which are afraid of being disadvantaged in the competition for industry by creating regulations that other jurisdictions do not have. *Id.*

[9]Findley & Plager, *State Regulation of Nontransportation Noise: Law & Technology*, 48 S. CAL. L. REV. 209, 254 (1974).

[10]Telephone Interview with Frank Gomez, President, National Association of Noise Control Officials (NANCO) (Dec. 5, 1990).

[11]Findley & Plager, supra note 9, at 253. Noise legislation was passed in Illinois and New York in 1970, in Florida, New Jersey, and North Dakota in 1971, in Hawaii in 1972, and in California in 1973. *Id.*

[12]Pub. L. No. 90-411, 82 Stat. 395 (1968) (codified at 49 U.S.C. §§1431 (1988).

[13]Pub. L. No. 91-190, 83 Stat. 852 (1970) (codified at 42 U.S.C. §§4321-4370 (1988)).

recommendations to Congress within 1 year for further legislation.[14] Congress passed the NCA after receiving that report.[15]

Congress acted despite the lack of significant organized public support for two reasons. First, the railroads, interstate motor carriers, and motor vehicle manufacturers supported the NCA because they were concerned about complying with conflicting state and local regulations.[16] Second, EPA told Congress that 34 million persons were exposed to nonoccupational noise capable of inducing hearing loss, 44 million persons had the utility of their dwellings impacted by transportation and aircraft noise, and 21 million persons had the same problem with construction noise.[17]

Congress intended the NCA to protect all Americans from "noise that jeopardizes their health or welfare."[18] It required EPA to regulate noise emissions from new products used in interstate commerce,[19] coordinate the noise abatement efforts of other agencies,[20] and provide information to the public concerning the noise emission of products.[21] While federal action was "essential to deal with major noise sources in commerce control of which require national uniformity of treatment," Congress intended that the state and cities retain the "primary responsibility for control of noise."[22] Congress therefore preempted state and political subdivisions from imposing their own emission standards on new products that were already regulated by EPA,[23] but it did not preempt them from controlling noise by the use of "licensing,

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[14]Noise Pollution and Abatement Act of 1970, Pub. L. No. 91-604, 84 Stat. 2709 (1970) (codified as amended at 42 U.S.C. §§7641-7692 (1988).

[15]EPA, Report to the President and Congress on Noise (1971).

[16]Interview with Kenneth Feith, Senior Scientist/Advisor, Office of Air and Radiation EPA, in Washington, DC (Nov. 19, 1990) (former ONAC official); Interview with Marshall Miller, in Washington, DC (Nov. 20, 1990) (former EPA General Counsel); Telephone interview with Ralph Hillquist (Jan. 7, 1991) (former General Motors employee).

[17]Senate Committe on Public Works, Environmental Noise Control Act of 1972, S. REP. NO. 1160, 92nd Congress, 2d Sess. 2 (1972); *reprinted in* 1972 U.S. Code Cong. & Ad. News 4655-4698 [hereinafter "Senate Report"]; House Commt. on Interstate and Foreign Commerce, Environmental Noise Control Act of 1972, H. REP. NO. 842, 92nd Congress, 2d Sess. 6 (1972) [hereinafter "House Report"].

[18]42 U.S.C. §4901(b) (1988).

[19]*Id.* §4905.

[20]*Id.* §4903(c).

[21]*Id.* §4907.

[22]*Id.* §4901(3).

[23]*Id.* §4905(e)(1). States and local governments, however, have the option of enforcing the EPA regulations by adopting "identical" limitations as their own laws or ordinances. *Id.*

regulation, or restriction of the use, operation, or movement of any product or combination of products."[24]

This division of authority affected the development of noise abatement in two ways. First, unlike other environmental statutes, such as the Clean Air Act,[25] EPA was given no responsibility to set abatement goals for the states. As a result, ONAC tended to think of its mission as exclusively federal. As the next section will develop, this orientation inhibited state and local efforts at noise abatement during the 1970s. In addition, because EPA did not set mandatory goals for the reduction of noise, states and local subdivisions have no legal responsibility to addresses noise pollution. Political support for noise abatement was also affected. The ambient air pollution limitations set by EPA are a continual public reminder of the harms of air pollution and of the nation's progress in reducing those harms. The lack of any similar goals concerning noise pollution contributes to its low political visibility.

Second, unlike for other environmental statutes, Congress chose not to support state and local abatement efforts with federal program grants for personnel and equipment, although EPA had asked for such support.[26] A

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[24]*Id.* §4905(2). State and localities, however, were completely preempted from regulating the same railroad or motor carrier noise emissions regulated by EPA unless it granted a "special local circumstances" exemption. *Id.* §§4916(c) (railroads), 4917(c) (motor carriers).

[25]Under the Clean Air Act, EPA sets national ambient standards which the states must meet by controlling sources of air pollution (other than mobile sources). 42 U.S.C. §7409-10 (1988). Congress rejected a similar scheme for noise because it "would, in effect, put the federal government in the position of establishing land use zoning requirements on the basis of noise . . . [which] is a function . . . more properly that of the States and their political subdivisions . . . ." House Report, supra note 17, at 9. This reason, however, fails to distinguish air pollution from noise pollution if both are considered to be health measures. The harms caused by noise pollution, like those caused by air pollution, do not change by geographical area. In this circumstance, there is no justification for permitting one geographical area to permit more harm to its citizens than another area. The previous reason, however, is more defensible to the extent that noise abatement is a response to aesthetic or nonhealth concerns, because it permits local aesthetic tastes to dictate the amount of regulation. At the time it passed the Act, however, Congress considered noise to be at least, in part, a health problem. *See* supra notes 16 & 17 and accompanying text.

The politics of the Noise Act may offer a more persuasive explanation of why Congress did not model the Noise Act on the Clean Air Act. The strongest support for the Act were industries that desired federal preemption, supra note 16 & accompanying text, and they had no reason to support legislation that would have forced the states and local governments to regulate nonmobile sources of noise as well. Moreover, some environmentalists, such as Senator Muskie, were afraid that EPA would use preemption to enact weaker abatement requirements than states and local governments. Senate Report, supra note 17, 21-22. This worry may have split support for a more comprehensive effort.

[26]EPA had asked Congress to establish a categorical grants program similar to that established under the Federal Water Pollution Act, which provides grants to localities for

House committee responded that while technical assistance was "desirable," it was neither "necessary or appropriate" to provide categorical program assistance to the states.[27]

B. Noise Abatement During ONAC

The Noise Act assigns EPA the responsibility to promulgate emissions standards, require product labeling, facilitate the development of low emission products, coordinate federal noise reduction programs, assist local and state abatement efforts, and promote noise education and research. Implementation of governmental programs is difficult[28] and measured against this reality, ONAC accomplished a great deal. Yet, like other health and safety programs,[29] ONAC had both successes and failures. Some of the failures were self-induced, but others can be attributed to forces beyond ONAC's control. The following section describes EPA's record in meeting its statutory duties.

1. Regulation of Noise Emissions

The NCA authorizes EPA to regulate noise emissions emitted from products distributed in interstate commerce[30] and from interstate railroads[31] and motor carriers.[32] ONAC promulgated several regulations and identified additional sources of noise that it intended to regulate. Although its regulatory output was not high, ONAC's output was reasonable in light of the constraints under which it operated.

Congress mandated a four-step regulatory process for regulating product noise. The first three steps consist of reports that EPA was required to write within short time deadlines.[33] Within 9 months EPA assessed the effects of noise on the public health and welfare,[34] within 12 months it evaluated what

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equipment purchases and personnel. House Report, supra 17, at 24; *see* H.R. 6002, 92nd Cong., 2d Sess. §102 (1972).

[27]House Report, supra note 17, at 24.

[28]*See* J. Wilson, Bureaucracy: What Agencies Do and Why They (1990).

[29]*See* Shapiro & McGarity, *Reorienting OSHA: Regulatory Alternatives & Legislative Reform*, 6 YALE J. REG. 1, 3 (1989) (health and safety agencies have had limited productivity).

[30]42 U.S.C. §4905.

[31]*Id.* §4916.

[32]*Id.* §4917.

[33]42 U.S.C. §§4904(a)-(b).

[34]U.S. Environmental Protection Agency, Public Health and Welfare Criteria for Noise (1973).

levels of abatement were "requisite" to protect public health and welfare,[35] and within 18 months it identified "major" noise sources and "techniques for reducing noise from those sources.[36] The second report, known as the "Levels Document," and called a "landmark treatise" by one commentator,[37] concluded that an adequate margin of safety required persons to be exposed to no more than a yearly average equivalent sound level of 75 dB for an 8-hour day to prevent hearing loss, and an average equivalent sound level of 55 dB to protect against activity interference.[38]

As a fourth step, Congress required EPA to propose initial regulations for each major noise source for which an emission standard was "feasible" within 18 months of its identification and to promulgate a final regulation within 6 months after the proposed regulation.[39] ONAC during its tenure identified 10 products for regulation, promulgated four regulations (air compressors, motorcycles, trucks, and truck mounted waste compactors) and proposed two regulations (buses and wheel and crawler tractors).[40] No emissions standards were proposed for four of the products identified as noise sources (pavement breakers, power lawn mowers, rock drills, and truck mounted refrigeration units).[41] For both the proposed and final rules, ONAC habitually missed the statutory deadlines, often by several years.[42]

EPA had similar delays in regulating motor carrier and railroad noise emissions. Congress required EPA to propose emission standards for these

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[35]EPA, Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety (1974) [hereinafter cited as "Levels Document"].

[36] EPA, Identification of Products as Major Sources of Noise, 39 Fed. Reg. 22297 (1974).

[37]Suter, *Noise Wars*, TECHNOLOGY REVIEW, Nov./Dec., 1989, at 47.

[38]Levels Document, supra note 35, at 4. EPA indicated that for the most sensitive part of the population the 75-dB level would produce no more than 5 dB noise-induced permanent threshold shift at 4,000 Hz, which is the frequency at which the ear is most easily damaged. *Id.* at 20. EPA also found that an average ambient noise level of 55 dB or more caused interference with communication and annoyance out of doors, *id.* at 3, and an average level of 45 dB had the same effects indoors. *Id.*

[39]42 U.S.C. §4905(a). The deadlines, however, only applied if the major noise sources were in the categories of construction or transportation equipment, motors or engines, or electrical or electronic equipment. *Id.* §§4905(a)-(b). In promulgating emissions standards, EPA had to consider the harm a source posed, the level of reduction in that harm achievable through the application of best available technology, and the cost of compliance. *Id.* §4905(c)(1).

[40]Appendix I *infra*.

[41]*Id.*

[42]*Id.*

noise sources within 9 months and final regulations 6 weeks later.[43] ONAC promulgated one motor carrier standard, which was 1 year late.[44] EPA proposed seven railroad emission standards and promulgated five of them.[45] The American Associations of Railroads (AAR) sued EPA after it was 2 years late promulgating the first standard.[46] Although the D.C. Circuit ordered EPA to promulgate a final regulation for other areas of railroad operations by August 1978,[47] EPA missed the court's deadline by over 2 years.[48]

The statutory deadlines were unrealistic for several reasons.[49] The principle reason was that ONAC faced significant technical problems in developing a regulatory program.[50] ONAC's efforts were also hampered by insufficient funding and staffing in its early and later years,[51] and by a lack of

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[43]42 U.S.C. §§4916(a)(1)-(2) (railroads), 4917(a)(1)(2) (motor carriers). In both cases, EPA was to choose limits that reflected application of the best available technology, taking into account the cost of compliance. *Id.* §§4916(a)(1), 4917(a)(1).

[44]Appendix II *infra*. EPA also proposed, but did not promulgate a standard that would have permitted local regulation of truck yards. *Id.*

[45]Standards were promulgated for locomotives and railcars, switcher locomotives, retarders, locomotive load cell test stands, and car coupling. Appendix II *infra*. Standards were proposed, but not promulgated, for permitting local regulation of rail yards and for railroad property emissions restrictions. *Id.*

[46]Appendix II *infra*.

[47]Association of American Railroads v. Costle, 562 F.2d 1310 (D.C. Cir. 1977).

[48]Appendix II *infra*.

[49]*See* Shapiro & Glicksman, *Congress, the Supreme Court, and the Quiet Revolution In Administrative Law*, 1988 DUKE L. J. 819, 833 (discussing why agencies have difficulty meeting short deadlines).

[50]General Accounting Office, Noise Pollution–Federal Program to Control has been Slow and Ineffective 43 (1977) [cited hereinafter as "Noise Pollution"]. Regulation of railroad emissions was hampered, for example, by the complexity of the rail industry and by the fact that no comprehensive studies of railroad noise existed. Wood, *Traffic Noise Regulation: A Comparative Case Study*, 1979 B.Y.U.L. REV. 461, 495 n.8 (1979). Other significant problems for railroad and other regulations included identification of best available technology and cost of compliance, defining the scope of each standard, and establishing rules for testing the level of noise emissions. *See id.* at 510-561. ONAC was forced to rely on contractors to obtain the technical information required for regulation and this was another source of delay. The contracting process at EPA was slow and it sometimes took up to 1 year to hire a contractor. Interview with Kenneth Feith, in Washington, DC (June 20, 1991).

[51]Letter from Alvin Meyer, Jr. (initial ONAC director), to David Pritzker, ACUS (Mar. 26, 1991), at 2; Feith interview, supra note 50. In EPA's 1975 budget request, the agency's administrator indicated that "we are holding the Noise Program to a low level of growth and consciously stretching out the full implementation of the 1972 Act." Letter from Russell E. Train, Administrator, EPA, to Ray Ash, Director, OMB, *reprinted in Noise Control Act Extension, Hearings on H.R. 5272 Before the Subcomm. on Transportation and Commerce of the House Comm. on Interstate and Foreign Commerce*, 94th Cong., 1st Sess. 43 (1975) [cited

cooperation from EPA administrators, who were sometimes slow to sign off on clearances needed by the program.[52] For example, ONAC's standard for interstate buses sat in Douglas Costle's office, EPA's administrator during the Carter administration, for over 1 year and eventually became a victim of Costle's failure to sign off on any agency regulations during his waning days as administrator. After the Reagan administration took office, the bus standard went unattended by the EPA Administrator for another year.[53] In general, EPA managers did not disregard the noise program, and some were supportive of it, but several appeared to regard noise abatement as less important than the agency's other missions.[54] This last sentiment was also present elsewhere in the agency. For example, one of ONAC's attorneys reports that other EPA attorneys held him in low regard because he was "stuck" representing the noise program.[55]

2. Product Labeling

EPA's second function under the NCA is to mandate labeling for products that emit or reduce noise,[56] but the only labeling regulation ONAC promulgated was for hearing protection devices.[57] The primary reason was that EPA's agenda in noise regulation was dominated by the restrictive legislative deadlines established by Congress for the promulgating of noise regulations.[58] In addition, a person outside the agency believes that the

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hereinafter as *Extension Hearings*"]. Funding for standard setting improved during the middle of the 1970s, but at the end of the decade funding was decreased to support technical problems for state and local governments. Feith interview, *supra*.

[52]Feith interview, supra note 50.

[53]Interview with Ken Feith, EPA, in Washington, DC (Feb. 28, 1991). The standard was subsequently withdrawn after ONAC lost its funding. Appendix I *infra*.

[54]Feith interview; Telephone interview with Fred Mintz, Office of Federal Activities, EPA (Jan. 14, 1991).

[55]Interview with Jeff Cerrar, in Washington, DC (Nov. 19, 1990).

[56]42 U.S.C. §§4907(a)-(b). States and local governments can establish their own labeling requirements only to the extent they do not conflict with EPA's regulations. *Id*. §4907(c).

[57]40 CFR §211 (1990). ONAC invited comments on what criteria should be used to select noise emitting products for a labeling requirement in 1974, 39 Fed. Reg. 42,380 (1974), proposed criteria in June 1977, 42 Fed. Reg. 31,722 (1977), and promulgated criteria in 1979. 44 Fed. Reg. 56210 (1979). At that time it was disbanded, however, ONAC had not yet chosen any products to be labeled although it said it expected to require labels for vacuum cleaners, air conditioners, shop tools, dishwashers, and lawn mowers. Washington Post, June 24, 1977, at E-10, col. 3.

[58]*See supra* note 39 accompanying text.

leadership in the labeling area was less experienced than in other areas of ONAC.[59]

3. Low-Noise-Emission Products

The NCA also ordered government agencies to purchase "low-noise-emission products" (LNEP), defined as products that emit "significantly" less noise than permitted by an applicable emissions standard.[60] Although ONAC took the preliminary steps necessary to effectuate this aspect of the NCA,[61] the office could not do more because the statute authorized EPA to define an LNEP only after it had promulgated an emissions standard for a product. Since at the time ONAC was abolished, it had promulgated emission limits for only four products,[62] little progress was made in stimulating LNEP purchases by the federal government. ONAC, however, was more active in encouraging states and local governments to purchase quieter products through its "Buy-Quiet" program, described in a later section.[63]

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[59]Telephone interview with Ken Eldred, Standards Director, Acoustical Society of America (Dec. 5, 1990).

[60]42 U.S.C. §§4914(3), 4915(c). An agency must give preference to any LNEP that the General Services Administration has established does not cost more than 25% more than the least cost substitute for it, *id.* §4915(c), that does not require extensive maintenance to retain its low-noise qualities, *id.* §4915(d), and that does not involve operating costs significantly in excess of substitute products. *Id.*

[61] The act created a two-step certification process. Within 90 days of receiving an application for certification, EPA must determine whether a product qualifies as a LNEP, and, within 180 days later, it must decide whether the product is a "suitable" substitute for products currently being used by the federal government. *Id.* §4914(5)(F). Although ONAC promulgated procedures for administering the LNEP program in February 1974, 39 Fed. Reg. 6670, 6670 (1971) (codified at 40 C.F.R. §203.4(a)(1) (1978)), it did not quantify what level of reduction in noise would qualify a product as a LNEP or what criteria it would use to determine whether a product was a "suitable substitute." *Id.* at 6670. In May 1977, EPA proposed to define a LNEP as any product that emitted 5dB(A) less than the emissions limit EPA had set for that product. 42 Fed. Reg. 27,442 (1977). EPA's plan was to establish a LNEP level for each product at the time it promulgated an emissions standard for that product. *Id.* at 27,443. Since, however, it had already promulgated a standard for medium and heavy trucks, EPA proposed a LNEP level for these products at this time. *Id.* ONAC did establish an LNEP definition as part of its garbage truck and motorcycle standards. 40 C.F.R. §§205.152(c)(3), Feith Interview, supra note 50.

[62]Appendix I *infra*.

[63]*See infra* note 96 & accompanying text (discussing the "buy-quiet" program).

4. Coordination of Noise Reduction Activities

EPA also had the responsibility to coordinate the programs of other federal agencies relating to noise research and noise control.[64] ONAC engaged in a wide variety of efforts pursuant to this responsibility, and while some of its actions have been criticized, its efforts in this area were substantial.

ONAC engaged in various types of activities that related to the noise programs of other federal agencies. It criticized the Occupational Safety and Health Administration's (OSHA) proposed noise protection rule,[65] chaired the interagency task force responsible for implementing President Carter's "Urban Noise Initiative,"[66] and published reports describing federal research and other actions concerning noise.[67] One of the most important of these established guidelines for considering noise in land use planning and control.[68] Prior to some of this activity, the General Accounting Office (GAO) gave EPA generally low marks for its interagency coordination efforts.[69]

ONAC also engaged in coordination efforts addressed to private industry and international regulators. Towards the end of its tenure, ONAC worked with professional groups and regulated industries concerning development of consensus standards that both the private sector and the government could

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[64]42 U.S.C. §4904(c). Congress gave EPA three duties. First, EPA was to "coordinate" all federal government programs relating to noise control and research. *Id.* §4904(c)(1). Agencies were required to furnish to EPA "such information as [it] may reasonably require" to carry out this function. *Id.* Second, Congress required federal agencies to "consult" with EPA concerning proposed noise regulations, and, if EPA requested, to specify reasons why a proposed regulation should not be revised. *Id.* §4903(c)(2). Finally, EPA was required to publish periodically a report on the status and progress of federal activities relating to noise. *Id.* §4904(c)(3).

[65]5 ENV. REP. (BNA) 1884 (March 28, 1975).

[66]EPA, Noise Control Program: Progress to Date--1980, at 10 (1980) [cited hereinafter as Progress to Date]. Initiatives included soundproofing and weatherization of hospitals and schools, developing noise specifications and reduction incentives in government procurement as part of the "Buy-Quiet" program, writing guidelines for land planning to reduce noise, retrofitting buses to reduce noise, and supporting neighborhood self-help programs. *Id.* Other federal units involved included the Department of Commerce, Department of Defense, Department of Energy, Department of Housing and Urban Development, Department of Transportation, General Services Administration, National Bureau of Standards, and the Veterans Administration. *Id.*

[67]Progress to Date, supra 66, at 28.

[68]Federal Interagency Committee on Urban Noise, Guidelines For Considering Noise In Land Use Planning and Control (1980).

[69]Noise Pollution, supra note 50, at 31.

use.[70] ONAC personnel also served as part of the United States representation at international meetings concerning noise abatement.[71] ONAC also worked on harmonizing domestic and international regulations to reduce economic dislocations for United States firms operating here and abroad,[72] including "extensive coordination" with the EEC.[73]

Despite these efforts, there are some complaints that ONEC could have done a better job of domestic and international coordination. For example, a scientist alleges that although there was "effective" communication between the technical community and ONAC during its early years, ONAC subsequently refused to participate in consensus development activities, and disregarded some or all of their consensus standards after they were devised.[74] An industry official alleges that at an ONAC-sponsored workshop, the regulated industries were unanimous about the need for ONAC to work more closely with them in developing goals and incentives for noise abatement, but that ONAC failed to include what industry said when it published a report of the proceedings.[75] And there are complaints that the behavior of an EPA official at an international meeting offended representatives from other countries and harmed EPA's credibility with them.[76]

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[70]For example, EPA sponsored a workshop at Florida Atlantic University, in Deerfield Beach, Florida, in December 1977, to identify standards needs and a plan for meeting them. Acoustical Society of America, Plan For The Development of Voluntary Standards On Environmental Sound In Response To Federal Agencies' Needs 1 (1978). Those attending included representatives from the Acoustical Society of America (ASA), the American National Standards Institute (ANSI), American Society for Testing and Materials, the Society of Automotive Engineers and several federal agencies, including in addition to EPA, the National Bureau of Standards, General Services Administration, Departments of Labor, Transportation, Health Education and Welfare, and Housing and Urban Development, and the Air Force and Navy. *Id.* at 2.

[71]Progress to Date, supra note 66, at 30-31.

[72]*E.g.*, EPA, A Comparison of Sound Power Levels from Portable Air Compressors Based Upon Test Methodologies Adopted By U.S. EPA and the CEC (1980).

[73]Feith interview, supra note 50.

[74]Telephone interview with Henning Von Gierke, Retired Director, Biodynamics & Biomechanics Division, Aerospace Medical Research Laboratory, United States Air Force (Apr. 19, 1991).

[75]Interview with James DuBois, Chairperson, Noise Task force, Edison Electric Institute, in Chapel Hill, NC (Apr. 18, 1991).

[76]The allegations are that the EPA official who headed the United States delegation to an OECD meeting reportedly made a "fool" of the entire delegation, Von Gierke interview, supra note 74, by the person's arrogant conduct. Eldred interview, supra note 59. According to these allegations, the United States not only lost the opportunity to influence the automobile noise emissions standards being discussed at the meeting, Von Geirke interview, supra note 74, but the atmosphere with European agencies was poisoned for a long time afterward. Eldred interview,

An EPA official notes that such complaints are common from persons in regulated industries and others who are unhappy when an agency does not accept their recommendations. He also disputes the characterization of what happened at the European meeting and denies that EPA has been disabled from effectively representing the United States. He notes that EPA continues to serve as the representative of the State Department at international conferences and receives invitations to contribute to such conferences in Asia as well as Europe.[77]

EPA's other efforts at coordination concerned the FAA's regulation of airport noise.[78] From December 1974 to October 1976, EPA submitted 11 proposals to FAA concerning aircraft noise.[79] Although the FAA did not accept most of these recommendations,[80] this result may not be a fair measure of their impact. By drawing public attention to the adequacy of FAA regulation of aircraft and airport noise, EPA undoubtedly influenced how the FAA proceeded. Moreover, FAA regulation was based on the scientific and technical work done by the EPA concerning the impact of aircraft noise.[81]

5. Assistance of State and Local Noise Control

Prior to 1978, EPA provided only limited support to state and local noise control efforts,[82] primarily because the NCA assigned the agency only limited responsibilities concerning nonfederal noise abatement.[83] In 1978, after congressional oversight hearings revealed that EPA's original mandate was

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supra note 59. A member of that delegation regards this result as "very, very deplorable" because the Europeans had adopted the American technical work on noise, and EPA therefore missed an opportunity to cement close relations with the EEC regulators. Von Gierke interview, supra note 74.

[77]Feith interview, supra note 50.

[78]Congress authorized EPA to propose noise regulations to the Federal Aviation Administration (FAA), which is responsible for regulating aircraft and airport noise, and required the FAA, after holding a public hearing, to adopt EPA's recommendations in whole or in part, or explain its reasons for not doing so. 49 U.S.C. §1431 (c)(1) (1976). If EPA believes that the FAA's action does not protect the public, it may request the FAA to reconsider its conclusions and to report to EPA concerning why its original recommendations were not adopted. *Id.*

[79]Transportation noise, *infra* note 130, at 27.

[80]*Id.* at 27 (FAA accepted one of EPA's 11 proposals and parts of two others).

[81]*See infra* note 363 & accompanying text.

[82]Noise Pollution, supra note 50, 19.

[83]EPA was authorized to advise state and local governments how to train personnel and select enforcement equipment and to prepare model state or local legislation. 42 U.S.C. §4913(2) (1976).

inadequate to foster state and local initiatives,[84] Congress passed the Quiet Communities Act,[85] which authorized ONAC to create a grants program and offer technical assistance to improve state and local noise abatement.[86]

After receiving this new authority, ONAC embarked on an ambitious and innovative program of supporting local and state governments, which for the most part was well regarded. ONAC offered a limited amount of direct financial assistance to a small number of states and cites,[87] but most of its efforts consisted of technical support such as 10 regional technical centers,[88] the ECHO (Each Community Helping Others) program,[89] and over 100 training programs attended by 4,000 noise officials.[90] ONAC also wrote and distributed a model state and local noise ordinance. The former was incorporated by 20 states,[91] while the latter was distributed to over 1,200 communities.[92] The model code has received compliments[93] and criticism for

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[84]*Noise Control Act Oversight: Hearings before the Subcom. on Resource Protection of the Senate Com. on Environment and Public Works*, 95th Cong., 2d Sess. (1978) [cited hereinafter as *Oversight Hearings*]; *see* Senate Comm. on Environment and Public Works, Quiet Communities Act of 1978, S. Rep. No 95-875, 95th Congress, 2d Sess. (1978).

[85]Pub. L. No. 95-609, 92 Stat. 3079 (1978) (codified at 42 U.S.C. §4913).

[86]42 U.S.C. §4913. EPA was authorized to give grants for surveying the extent of local noise problems, planning and developing noise control capacity, developing abatement plans around major transportation facilities, and evaluating techniques for controlling noise. *Id.* §4913(c)(1). EPA was also required to develop a program to assess the extent of Noise Pollution and abatement, to establish regional technical assistance centers, and to provide direct technical assistance. *Id.* §§4913(d)-(f).

[87]During 1979, for example, grants were made to 15 states, Progress to Date, supra note 66, at 1, of between $31,000 and $65,000. Interview with Casey Caccavari, EPA, in Washington, DC (Febr. 28, 1991). Twelve communities received grants for demonstration projects designed to test methods of noise abatement that could be used by other communities. Progress to Date, supra, at 1; *see generally* Center for Public Management, Final Report: Quiet Communities Program Demonstration (March 1982).

[88]Progress to Date, supra note 66, at 1.

[89]The ECHO program consisted of sending local noise abatement personnel to other cities to share their expertise and insights. *Id.* at 1, 3-4.

[90]ONAC held over 100 training sessions for approximately 4,000 state and local officials, served as a clearinghouse for noise control information, and engaged in other activities to support state and local training. *Id.* at 2; Suter, supra note 37, at 47. Other activities included developing training materials, including materials concerning noise measurement, and loaning state and local officials sound level meters and other equipment. Progress to Date, supra note 66, at 2.

[91]Progress to Date, supra note 66, at 2.

[92]Interview with Cassey Caccavari, EPA, in Washington, DC (Nov. 19, 1990).

[93]*E.g.*, Letter from Paul Schomer, Team Leader, Environmental Acoustics Team, Construction Engineering Research Laboratory, Corps of Engineers, Department of the Army, to

being too detailed, impractical, and noncommittal.[94] Concerning these complaints, an EPA official responds that ONAC prepared a 300-page workbook to explain the model ordinance and how it could be tailored to suit the needs of particular cities.[95] Finally, ONAC established a "buy-quiet" program that offered communities model contract specifications for the purchase of low-noise emission products.[96]

6. Noise Education and Research

The NCA also requires EPA to develop and disseminate information and educational materials concerning noise and to sponsor research concerning the effects of noise and the methods by which it can be abated.[97] ONAC was active in both areas, and once again its efforts were for the most part well received.

Beginning in 1976, ONAC's education efforts included establishing a National Information Center for Quiet, producing public service television announcements, designing and distributing teaching materials to school systems and unions,[98] and publishing 260 technical reports concerning noise abatement.[99] The reports have been praised as being useful to health and engineering professionals,[100] and criticized for being uneven in quality and

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David Pritzker, ACUS (Mar. 13, 1991), at 2 (among "most useful products"); Letter from David Lipscomb, Correct Service, Inc., to David Pritzker, ACUS (Mar. 19, 1991), at 2 ("has been used repeatedly").

[94]*E.g.*, Letter from Edwin Toothman, Director, Occupational Health, Health and Safety Services, Bethlehem Steel Corp., to David Pritzker, ACUS (Apr. 1, 1990) ("too detailed and somewhat impractical"); Letter from Fredrick Kessler, FMK Technology, Inc., to David Pritzker, ACUS (Mar. 19, 1991) ("technically flawed" but "did provide . . . starting point"); Letter from Edward DiPolvere, Chief, Office of Noise Control, New Jersey, to David Pritzker, ACUS (undated) (After "legal side of EPA . . . made final version so noncommittal that its value was diminished); Stewart Letter, supra note ("much more comprehensive that most communities ever wanted").

[95]Interview with Casey Caccavari, EPA, in Washington, DC (June 20, 1991).

[96]Progress to Date, supra note 66, at 10.

[97]42 U.S.C. §§(a)-(b).

[98]Progress to Date, supra 66, at 7-8.

[99]Suter, supra note 37, at 47; *see* Environmental Protection Agency, Bibliography of Noise Publications 1972-1982 (undated) [cited hereinafter as Bibliography].

[100]*E.g.*, Comments On The EPA's Office of Noise Abatement and Control, Prepared By George Luz, Bio-Acoustics Division, Environmental Hygiene Agency, U.S. Army (Mar. 22, 1991) ("we continue to consult some of these reports even though they are 15 years old"), *in* Letter from Nelson Lewis, Acoustical Engineer, Bio-Acoustics Division, Environmental Hygiene Agency, U.S. Army, to Alice Suter (Mar. 22, 1991) [cited hereinafter as "Luz Comments"]; Letter from Patrick Carney, President, American Speech-Language Association, to David

technical content.[101] EPA also sponsored research projects to investigate potential health dangers posed by noise and techniques to abate noise more effectively.[102]

C. Noise Abatement After ONAC

EPA's noise abatement activities essentially stopped after ONAC lost its funding. State and local activities also declined. This section proposes an explanation for Congress' decision to eliminate ONAC's funding and describes the status of noise control efforts after its elimination.

1. ONAC's Loss of Funding

Although ONAC's efforts were more successful in some areas than others, it had a record of accomplishment after the first decade of the NCA. ONAC promulgated four product and six transportation noise standards, but it was unable to complete work on standards for six other major noise sources. Although it made little progress in implementing product labeling or the LNEP program, ONAC was quite active concerning coordination, research and education, and support of local and state efforts. While this is a mixed record, it can not be said that it justifies elimination of the program. As noted earlier, government is a difficult business and most other health and safety programs have similar mixed records.

Despite the acceptable nature of ONAC's performance, Congress eliminated funding for the program for three reasons. First, EPA told Congress that ONAC should be disbanded because an austere federal budget required that some current federal programs be eliminated, the benefits of noise control were highly localized, and noise control could be carried out by state and local governments without the presence of a federal program.[103] Why EPA's management acquiesced in OMB's decision is unknown, but the

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Pritzker, ACUS (Apr. 4, 1991), at 5 (EPA publications "still valuable in providing technical assistance on subject"); Letter from Rena Glaser, Past President, National Health Conservation Association (NHCA), to David Pritzker, ACUS (Mar. 29, 1991), at 1 ("did find publications to be extremely valuable"); Letter from Andrew Stewart, President, NHCA (Apr. 3, 1991), at 1 ("several publications of ONAC were extremely helpful and influential"); Kessler Letter, supra note 94, at 1 ("publications proved to be very valuable"); Lipscomb Letter, supra note 93, at 1 ("value and keep close at hand" some ONAC documents).

[101] *E.g.*, Schomer Letter, supra note 93, at 1 ("technical content was mixed and never of the highest level").

[102] Progress to Date, supra note 66, at 11-13.

[103] *Oversight Hearing*, supra note 84, at 59.

decision is consistent with the general deregulatory attitude of Ann Gorsuch and other persons appointed by the Reagan administration to run EPA.[104] It is known that EPA's managers rejected a compromise to fund ONAC at a greatly reduced level. After OMB's initial decision to end funding for ONAC, OMB officials agreed after meeting with lower level EPA officials to fund ONAC at the level of around $1 million to maintain the enforcement of existing regulations. But EPA's management rejected the compromise and decided to eliminate ONAC entirely.[105]

Second, ONAC lacked strong political allies. Those industries that originally supported the NCA in order to obtain federal preemption of conflicting local regulations had accomplished their goal. They told Congress that it could disband ONAC as long as it maintained their preemption.[106] Moreover, as noted earlier,[107] there has never been a well-organized constituency for noise control similar to interest groups supporting other types of environmental protection.[108]

Finally, ONAC might have survived if its critics had not had the garbage truck standard to kick around. In 1979, EPA promulgated a regulation that limited noise emissions from truck-mounted waste compactors.[109] Because the noise reduction was achieved primarily by requiring garbage trucks to run their engines more slowly when they compacted garbage, ONAC considered the standard to be a reasonable response to the problem of noise created when

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[104]*See* J. Lash, A Season of Spoils: The Reagan Administration's Attack on the Environment 28 (1984).

[105]Feith interview, supra note 16.

[106]*Oversight Hearings*, supra note 84, at 2 (Testimony of William H. Dempsey, President, American Association of Railroads) (taking no position whether ONAC should be continued, but favoring federal preemption of state and local noise regulation); *id.* at 124 (Statement of Motor Vehicle Manufacturers Association of the U.S., Inc.) (same); Letter to Senator Slade Gorton from Bennett C. Whitlock, Jr., American Trucking Association, *reprinted in id.* at 128 (same). The railroads and motor carriers gained credibility for this position from the fact that EPA emission standards for these industries are enforced by the Department of Transportation (DOT), which was not put out of business. 42 U.S.C. §§4916(b), 4917(b). These industries, however, did receive some regulatory relief. *See infra* note Section IB3 & accompanying text (discussing weaknesses of railroad and motor carrier regulation).

[107]Supra note 5 & accompanying text.

[108]Ruben, *On Deaf Ears*, Environmental Action, Mar./Apr. 1991, at 17 ("Public apathy about noise made it all the easier for EPA's office to quickly fall under Reagan's budget axe, says [David] Hawkins of the Natural Resources Defense Council.").

[109]44 Fed. Reg. 56524 (1979).

garbage is compacted.[110] Nevertheless, the standard was opposed not only by the regulated industry, which argued it was unnecessary,[111] but also by some local noise administrators,[112] and White House staff,[113] who agreed. ONAC fought back--contending that "if we had been talking about a chemical substance with similar effects, EPA would have regulated with more dispatch and vigor[114]--but it lost the battle when nationally syndicated columnist James Kilpatrick opined, "Metaphorically speaking, if you will forgive me, this is garbage."[115]

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[110]*Id.* at 56526-56527. The agency estimated that the standard would produce a 74 percent decrease in the magnitude of refuse vehicle noise by 1991 and that about 19.7 million persons in cities and densely populated suburbs would benefit. *Id.* at 56532. An EPA official admits, however, that the agency's original plan for testing garbage trucks would have been expensive for the industry, but he maintains that ONAC was working with the industry to solve that problem. Feith interview, supra note 16.

[111]*See e.g.*, *Oversight Hearings*, supra note 84, at 4-6 (Testimony of Richard L. Hanneman, Director, Government and Public Affairs, National Solid Waste Management Association). The industry objected to the standard because not all noise generated by refuse collection is made by the compactor mechanism (the standard did not regulate other parts of the vehicle such as brakes and tires), locally imposed curfews have effectively limited citizen complaints about garbage truck noise, the standard had the effect of preventing trucks from compacting when moving, which reduced their productivity, and EPA had only weak evidence of adverse health effects. *Id.* at 4-5. A former ONAC official denies that the standard would have prevented garbage trucks from compacting when moving. Telephone interview with Fred Mintz, EPA (June 19, 1991).

[112]Jesse Borthwick, the Executive Director of the National Association of Noise Control Office told Congress:

> The problem with refuse collection noise can best be dealt with through local in-use and administrative controls. Reducing compactor noise emission levels 5 or 6 dB will virtually have no effect on reducing the impact of refuse collection in a noise sensitive area during morning hours when background noise levels are low.

Reauthorization of the Noise Control Act of 1972 Before the Subcomm. on Commerce, Transportation, and Tourism of the House Comm. on Energy and Commerce, 97th Cong., 1st. Sess. 27 (1981) [cited hereinafter as ["*Reauthorization Hearing*"].

[113]The Regulatory Analysis Review Group, located in the Carter White House, received more letters from Congress concerning the standard than concerning any other issue in its first 3 years. Clark, *Regulating Garbage Truck Noise--A Quiet Debate Is Getting Louder*, National Journal, November 1, 1980, at 38. A Regulatory Analysis Review Group study initiated in response to these complaints concluded a national standard was inappropriate for noise generated by garbage pickups. *Id.* at 39. The study reasoned that garbage collection noise was primarily a local problem because the desired level of product noise regulation depends on the ability to regulate a truck's pattern of use which varies tremendously among communities. *Id.*

[114]*Id.*

[115]Kilpatrick continued, "Cost and benefits to one side, this petty, stupid, nit-picking regulation based almost entirely upon gauzy conjecture as to 'sleep and activity interference'--offers one more instance of bureaucracy gone berserk." Kilpatrick pointed to successful local

2. Revocation of Pending Standards

Once Congress accepted EPA's request that it stop funding ONAC, the agency had to decide what to do about products that had been identified as significant noise sources because the NCA obligated it to regulate any products so identified.[116] An EPA attorney warned that the agency could not merely withdraw the prior designations because "there is no evidence to suggest that the products in question no longer have the same effects on public health and welfare" recognized when the products were identified as requiring regulation.[117] EPA also rejected withdrawing the prior designations on the basis that state and local governments had shown that they were capable of regulating these products because this reason was outside its legal authority and possibly not true.[118] The agency finally decided to justify its actions on the basis that noise regulation should be temporarily abandoned because of reduced federal tax revenues. In December 1982, EPA withdrew the outstanding product identifications[119] and revoked the emissions standard for garbage trucks.[120] Although EPA was nervous about its deregulation rationale, there was no judicial review.

EPA's justification for its actions is dubious. While the courts will take agency resources into account in responding to citizen suits to enforce time deadlines for rulemaking, lack of resources is only relevant to the amount of additional time the court will give an agency to comply with a deadline--it does not excuse an agency from ever regulating.[121] It is difficult to believe that

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efforts to control garbage collection noise and decided, based on this case, that the entire NCA was superfluous. Kilpatrick, *This Noise Regulation Is Just Garbage*, *reprinted in Reauthorization Hearings*, *supra* note, at 63. Kilpatrick later endorsed the "Buy-Quiet" program as an appropriate governmental response to noise without acknowledging ONAC's role in establishing the program. Kilpatrick, *Reaction From Memphis To Noise Level Column*, *id.* at 62.

[116]Note 39 supra.

[117]Memorandum from Samuel Gutter, Attorney, Air, Noise, and Radiation Division, to Robert Perry, General Counsel, Dec. 1, 1981, at 1.

[118]Memorandum from Robert P. Perry, General Counsel, EPA, to Kathleen Bennett, Assistant Administrator for Air, Noise, and Radiation, Dec. 10, 1981, at 1. EPA's General Counsel warned, that there were "serious risks to this approach, in part, because it relies on factors that the Act does not explicitly permit the Administrator to consider in determining what constitutes a 'major' source of noise, and, in part, because the [justifications] might be difficult to document." *Id.* He might have added that the two justifications were also internally contradictory. If local and state governments established emission standards for the products identified by EPA as major noise sources, the affected manufacturers would likely need federal preemption to protect them from inconsistent and conflicting regulations.

[119]47 Fed. Reg. 54108 (1982).

[120]48 Fed. Reg. 32502 (1983).

[121]*See* Shapiro & Glicksman, supra note 49, at 832-33.

Congress intended that EPA could postpone indefinitely the deadlines specified in the NCA by the simple expedient of withdrawing prior designations because the agency did not consider noise pollution an important problem. After all, the reason that Congress established the deadlines in the first place was to force EPA to regulate in a timely manner.[122]

The Anti-Deficiency Act[123] prohibits government officials from making or authorizing an expenditure or obligation in excess of a congressional apportionment.[124] Although the act might be interpreted to prohibit EPA officials from spending money appropriated for other purposes on implementation of the NCA, EPA has apparently not accepted that interpretation and has continued to carry out certain activities related to the implementation of the NCA.[125] For example, in 1986, EPA amended its regulations regarding noise standards for trucks and motor carriers. EPA has continued its coordination and consultation activities with other federal agencies regarding noise and has continued enforcement activities, albeit at a limited level. EPA has continued to disseminate existing information and educational materials regarding noise control activities.

While EPA may not be prohibited as a legal matter from promulgating standards for the significant noise sources it previously identified, it is effectively prohibited from doing so by the lack of any budget for that purpose. To promulgate new standards, or even amend existing ones, EPA would have to divert agency personnel from other tasks, hire contractors, and absorb other expenses. There is no indication that EPA has sufficient budgetary flexibility to take this step.

3. Enforcement of Existing Regulations

Since revoking the pending standards, EPA's regulatory activity has been limited to enforcement of the existing standards, except for the amendment of

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[122]*See id.* at 830 (Congress intends statutory deadlines to speed agency rulemaking).

[123]33 Stat. 1257 (1905) (codified as amended at 31 U.S.C. §1517 (1988).

[124]*See* National Association of Counties v. Baker, 842 F.2d 369 (D.C. Cir. 1988) (Secretary of Treasury may not disperse funds that were originally appropriated after Congress passed legislation withdrawing the appropriation).

[125]*See* Defendents' Reply in Support of Motion for Judgment on the Pleadings, Ross v. Reilly, W.D. Tenn., Civil Action No. 88-1103 (Sept. 29, 1989), Transportation Noise, *infra* note 138, at 17. If a court did not agree that EPA could expend funds to implement the NCA, it could still hold that until Congress repeals the NCA, EPA is legally obligated to enforce it and must seek funding for that purpose. *Cf.* Tennessee Valley Authority v. Hill, 437 U.S. 153 (1977) (appropriations decisions do not repeal substantive statutory requirements in absence of clear legislative intent that a repeal was intended). Such a decision would have the virtue of forcing Congress either to repeal the NCA or give EPA funds to enforce it.

two standards mentioned above. EPA's enforcement efforts have been hampered in two ways by the elimination of ONAC. First, the agency was forced to drop industry compliance reporting requirements for its product and labeling standards because it did not have any staff to implement them.[126] Lacking any compliance data, EPA can not say whether product manufacturers are abiding by its regulations.[127] Second, EPA has been slow to investigate and enforce existing regulations when violations have been found. For example, EPA has been investigating since 1987 approximately 18 hearing protection device labelers for a range of violations.[128] The investigation has been stalled because EPA has had to borrow staff from other responsibilities and because it has to develop procedures to assess civil penalties for violations of noise regulations.[129] The impact of EPA's limited capacity to enforce its standards is mitigated by the fact that the Department of Transportation (DOT) is responsible for enforcing the transportation noise standards promulgated by EPA. Unlike EPA, DOT has ongoing enforcement programs. Nevertheless, there may also be problems with DOT enforcement.

The Federal Railroad Administration (FRA), located in DOT, is responsible for enforcing EPA's railroad noise standards. It has discontinued routine noise inspections because the rate of compliance has been "extremely" high,[130] but the General Accounting Office (GAO) found that high compliance rates may be explained, in part, by the FRA's practice of not citing any railroad that has made a good faith effort to correct a violation, even if the railroad is still in violation of the standard after the correction is made.[131] Moreover, an EPA official reports that he received a complaint from a person

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[126]When existing regulations were originally be promulgated, EPA required companies to test a certain number of products at random to ensure that they were in compliance with emission standards and to report the results to EPA. *See* 41 Fed. Reg. 57709 (1982) (description of testing and reporting requirements). In December 1982, EPA revoked the reporting requirements because it lacked any staff to review industry compliance. 47 Fed. Reg. 57709 (1982).

[127] One EPA official believes industry compliance remains high where manufacturers retooled production processes to accommodate noise emission standards because of the considerable expense of changing manufacturing methods. Where manufacturers can save money by not complying, however, he has found less compliance. For example, EPA brought an enforcement action against manufacturers of portable air compressors just before ONAC was abolished. Feith interview, supra note .

[128]*Id.*

[129]*Id.*

[130]General Accounting Office, Transportation Noise: Federal Control and Abatement Responsibilities May Need to be Revised 53 (1989) [hereinafter cited as "Transportation Noise"].

[131]NRA takes the position that if a mechanical problem causing noise emissions in excess of a standard is fixed, and a train nevertheless exceeds the standard, there is no violation because the railroad made a good faith effort to comply. *Id.* at 53-54.

living near a railroad that the FRA could not do anything about loud, nighttime noises because inspectors did not work at night.[132]

The Federal Highway Administration (FHWA), also in DOT, has likewise deemphasized enforcement of EPA's noise standards claiming high compliance rates and the burden of other inspection duties.[133] The GAO reports, however, that older trucks may be making excessive amounts of noise because of inadequate maintenance.[134] Moreover, a state noise control official reports that he was asked by local FHWA personnel not to refer any more noise complaints to them because they were under pressure from Washington to undertake different tasks.[135]

The extent of weaknesses in DOT enforcement, if any, is unclear. This does not mean, however, that the enforcement of transportation noise regulations has been unaffected by ONAC's loss of funding. As the next section discusses, although EPA's railroad and motor carrier standards may need to be updated to protect the public adequately, EPA lacks the resources to undertake this task. ONAC's loss of funding may have harmed the public in another manner. FHWA officials told GAO that source controls are "probably the most cost-effective" way to address traffic noise, but without new EPA regulations, DOT will continue to spend millions of dollars for the erection of noise barriers along federal highways.[136]

4. Update of Existing Regulations

ONAC's loss of funding has had another effect besides restricting EPA's enforcement capacity. Because of a lack of funding, EPA can not update existing regulations that have become out of date or that are inadequate. Its labeling, railroad, motor carrier, and product standards may all be out of date.

EPA's noise protection labeling standard has become highly misleading. Scientific studies have demonstrated that persons wearing earplugs receive only 8 to 56 percent of the protection indicated by the Noise Reduction Rating

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[132]Feith interview, supra note 16.

[133]Transportation Noise, supra note 130, at 63-64.

[134]*Id.* at 68. The American Trucking Association concedes that a few motor carriers may not be maintaining their trucks up to EPA standards, but if additional enforcement is needed, it should be done by state and local governments. *Id.* at 68-69. State and local governments, however, are preempted from enforcement activity unless they adopt EPA regulations as their own laws. Note supra 23 & accompanying text.

[135]Telephone interview with Ed DiPolvere, Director, New Jersey Office of Noise Control (Dec. 4, 1990).

[136]Transportation Noise, supra note 130, at 67. Persons interviewed by GAO, including the American Trucking Association, indicated that future reductions in vehicle noise could be achieved by redesign of tires. *Id.* at 69.

(NRR) required by EPA, and that persons wearing earmuffs receive only 35 to 67 percent of the protection indicated by the EPA rating.[137] Recognizing these discrepancies, OSHA was forced to instruct its inspectors to assume that workers receive 50 percent less noise attenuation than indicated by an NRR.[138] An irony is that EPA has floundered for several years trying to force hearing protection manufacturers to comply with the existing labeling requirements.[139]

EPA's railroad standards also need updating. The FRA is powerless to protect some persons from railroad noise because there is no standard prohibiting noise emissions of certain operations,[140] existing standards are effectively unenforceable,[141] or because railroads have been able to exploit a loophole. An example of the latter problem has occurred in Boston where the FRA has been unable to prevent commuter railroads from running extremely loud engines (87 to 90 dB) all night long to keep heaters running in commuter passenger cars.[142] Even where the regulations are applicable, they may be

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[137] Letter from Frank Wilcher, President, Industrial Safety Equipment Association, to Sidney Shapiro (April 1, 1991), at 2; NHCA Letter, supra note 100, at 2 ("NRR is a misleading and essentially useless number for estimating hearing protection effectiveness"); *see* Letter from Elliott Berger, Manager, Acoustical Engineering, Cabot Safety Corp., to David Pritzker, ACUS (April 1, 1991), at 3 (listing studies). The studies indicate that real world attenuation is in the range of 8 to 56% of the NRRs for earplugs and 35 to 67% for earmuffs. Wilcher Letter, supra, at 2. The discrepancies arise because the testing methods required by EPA do not accurately reflect the conditions under which hearing protection equipment is used. Berger Letter, supra, at 3.

The NRRs are inaccurate in two other ways. First, because the NRR gives a single value, consumers are encouraged to compare NRR values in making a purchase. The fact that small differences in NRR values are not statistically significant leads consumers to conclude, erroneously, that small differences in NRRs are important. EPA labeling requirements, however, do not reflect this imprecision. Wilcher Letter, supra, at 3. Second, the EPA-mandated labeling fails to warn consumers that they may receive less protection than the NRR indicates in certain types of workplace situations. *Id.*

[138] OSHA Instruction CPL 2-2.35A, Appendix A (Dec. 19, 1983), at A-1.

[139] *See* supra note 132 & accompanying text (describing EPA's enforcement difficulties).

[140] For example, although EPA has a standard for car coupling, which addresses the noise created when one car bangs into another, it does not have one for slack actions, or the noise created when a train is moved forward to tighten connections between the cars. Interview with Robert Greer, Industrial Hygienist, FRA, in Washington, DC (Febr. 27, 1991).

[141] In some locations, FRA inspectors can not find terrain that matches the conditions established in the regulations for testing noise emissions. *Id.*

[142] The railroads avoid the standard for switching engines, which would prohibit the emissions, by using other types of engines. The railroads are in compliance with the standard for these other engines, because there is a higher emissions limit. There is a higher emissions limit because EPA assumed these other engines would be used in the open country and not sitting in a rail yard. *Id.*

inadequate. An EPA official explains that when the standards were developed, ONAC took into account the economic difficulty of the industry, and now that the industry's situation has improved, the standards may need to be reexamined.[143] Even if the regulations are not inadequate, they are written in a manner that makes them more difficult to perform. A FRA official points out that his agency could be more effective if EPA rewrote its standards to take advantage of the new noise measurement equipment that is now on the market.[144]

Similar problems have cropped up with the motor carrier regulations. For example, inspectors frequently can not perform stationary tests on heavily traveled highways because of high background noise levels, which make it difficult to obtain accurate readings of noise from individual trucks.[145] It is not clear whether EPA could create noise tests that are less time consuming and difficult to perform, but until it receives funding to implement the NCA, it is unable to seek such methods.[146]

Finally, EPA may be able to improve its product standards by switching to sound power as the metric to measure noise emissions. A scientist currently doing research in this field asserts that adoption of this method would improve the accuracy of the standards.[147] Use of this method would also make it possible to conform them to standards adopted by the European Economic

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[143]Transportation Noise, supra note 130, at 54.

[144]Greer interview, supra note 140.

[145]TRANSPORTATION NOISE, supra note 130, at 64. An EPA official responds that because DOT has three other methods to enforce the truck emissions standard, this problem is not disabling. Feith interview, *supra* note 50.

[146]*See* supra Section IC2.

[147]Letter from Robert Hickling, Associate Director for Applied Research, Research Professor of Engineering, National Center for Physical Acoustics, University of Mississippi, to David Pritzker ACUS (Mar. 18, 1991), at 2. Professor Hickling explains:

> It is now possible to conduct indoor tests to measure the sound power of manufactured items such as automobiles. Sound-power tests measure the total noise output of a source, instead of sampling it at a point in space. Manufacturers prefer indoor tests because they are not subject to variations in the weather. Indoor sound-power tests have less variability in test data, making it possible to study noise due to variability in manufacturing, and the underlying mechanisms of noise generation.

Id.

Community (EEC), which rely on sound power measurements.[148] But an EPA official responds that current procedures may be more costeffective.[149]

5. Coordination, Education, and Research

ONAC's loss of funding also ended all but three of its previous coordination, education, and research functions. For example, ONAC was prevented from distributing model building and mechanical codes for noise abatement that it had completed.[150] It was also prevented from distributing technical reports it had completed on grain dryers and minibikes,[151] and from completing a model land planning code for land development surrounding airports.[152] EPA's three remaining efforts involve commenting on Environmental Impact Statements (EISs), participating in an interagency committee, and answering telephone inquiries. While EPA is committed to these actions, its effectiveness is constrained by its lack of resources. EPA comments on proposed FAA regulations[153] and EISs, and claims some success in persuading the FAA to do a better job disclosing noise impacts.[154] An FAA official, however, disputes the usefulness of the EPA input.[155] Whether or not appreciated by the FAA, EPA's efforts in this area are constrained by the fact

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[148] *See* Maling Letter, *infra* note 160, at 2 (product regulations do not have "lasting value" because EPA "never recognized sound power as a measure of noise emissions, and was unwilling to consider international efforts in specification of noise emission); *see infra* note 354 & accompanying text (discussing need for EPA to coordinate domestic and international regulation).

[149] Feith interview, supra note 50.

[150] Caccavari interview, supra note 92.

[151] Interview with Casey Caccavari, EPA, in Washington, DC (June 21, 1991).

[152] *Id.*

[153] Transportation Noise, supra note 130, at 33.

[154] Mintz interview, supra note 54. For example, EPA rated an EIS concerning expansion of air cargo activity at the Toledo airport as unacceptable because it did not adequately disclose how increased noise activity could cause sleep disturbances for persons in the area of the airport. *Id.* After EPA threatened to appeal the adequacy of the EIS to the Council on Environmental Quality, the FAA agreed to revise the document. *Id.*

[155] Interview with Jim Densmore, Director, Office of Environment and Energy, FAA, in Washington, DC (March 1, 1991). Densmore explains that EIS disclosures are based on measure of a day-night average noise level (DNL) and that EPA's objections concern intermittent noises that, when averaged with other noises, would not be reflected in the DNL. He notes that the DNL is widely used and that the FAA has never lost a court case concerning the adequacy of an EIS when it has relied on the DNL. *Id.* The FAA could, however, add a supplemental measure of noise to reflect intermittent noise in the interest of fuller disclosure. *See infra* note 366 & accompanying text.

that one part-time employee is responsible for the EIS reviews and he also has other responsibilities.[156]

EPA is also a member of the Federal Interagency Committee on Noise (FICON). Among its functions, the committee is charged with considering whether agencies like the FAA should change the methods by which they measure noise impacts for EIS purposes.[157] It is not clear whether EPA's participation in the committee is hampered by its lack of noise personnel, but it may be since there are only a few persons left at the agency with a technical background in noise.

EPA also continues to respond to requests for noise information, but the elimination of ONAC has left dissemination of noise information in disarray. One part-time employee is available to respond to requests for information, but he has no extra copies of the documents in his library.[158] While some ONAC reports are publicly available from the National Technology Information Service,[159] local noise control officials and noise control consultants maintain that key ONAC documents are unavailable.[160]

A related problem is that although EPA no longer has a noise office, persons subject to regulation and local regulators still require clarification from time to time. Assisting them has become an increasing problem because industry is selling new types of products that do not match up well with standards that were written 5 to 10 years ago. EPA is able to respond to these inquiries only because it still has a few people left over from the noise

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[156]Mintz interview, supra note 54. One other agency employee, who has another full-time assignment, sometimes also assists in these reviews. Feith interview, supra note 16.

[157]Telephone interview with Fred Mintz, EPA (June 19, 1991); *see infra* note 366 & accompanying text (discussion of possible change in the way that FAA measures noise impacts).

[158]Mintz interview, supra note 54. The employee is forced to photocopy documents in order to distribute them, but because of budget constraints, this method of dissemination is limited. *Id.*

[159]*See* Bibliography, supra note 99.

[160]Letter from George Maling, Jr., Editor, NOISE/NEWS, to David Pritzker, ACUS (Mar. 30, 1990), at 2 ("At one time NBS (now NIST) had a list of EPA publications [but it] is no longer available."); Carney Letter, supra note 100, at 5 ("Since 1982, it has been difficult to track down many of the EPA publications and perhaps they are out of print."); Telephone interview with Clifford Bragdon, Professor of City Planning, Georgia Institute of Technology (Oct. 10, 1990); Gomez interview, supra note 10.

Some ONAC reports and documents were transferred to NANCO, an organization of local noise control officials. They are in the possession of one of its former officers who had to construct a shed in his backyard at his own expense to preserve them. DiPolvere interview, supra note 135; *see* Ruben, supra note 108, at 18 ("Today, the archival information of [ONAC] is stored in a shed in DiPolvere's backyard in Trenton."). But an EPA official claims that the documents transferred to NANCO were duplicates of ONAC files retained by the government or were files that the government was not required to retain. Feith interview, supra note 50.

program. As these key people leave, however, the agency will lose what little noise expertise it has left.[161]

ONAC's loss of funding has another effect. Some of the available ONAC technical information is out of date. For example, ONAC's widely distributed model code is dated because although there is a new generation of noise monitoring equipment which is less expensive and more accurate, the code is not written to take advantage of this breakthrough.[162] Some technical information is also out of date because new types of noise problems have arisen since the information was generated.[163]

6. State and Local Regulation

Regulators and consultants agree there was a significant decline in active state and local noise programs after ONAC was abolished,[164] but there is no reliable data concerning the extent of the decline. EPA officials believe that only a handful of states have on-going noise abatement programs,[165] and available data indicate a decrease in on-going local programs from 300 to 400 in 1981 to 50 to 75 programs today.[166]

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[161]Feith interview, supra note 50; *see also* Luz Comments, supra note 16, at 1 ("Without a central ONAC to which to appeal, we are vulnerable to the vagaries of opinions from persons [in the EPA regions] who do not have professional expertise in noise assessment.")

[162]Maling Letter, supra note 160, at 5; Gomez interview, supra note 10.

[163]Feith, supra note 16. For example, communities are finding that without technical assistance it is difficult to know how to write ordinances to protect home owners from noise that travels along the interior common walls of townhouses and condominiums. Caccavari interview, supra note 92 .

[164]*E.g.*, Bragdon interview, supra note 160; Feith interview, supra note 16; Gomez interview, supra note 10.

[165]Transportation Noise, supra note 130, at 10.

[166]There are two problems in estimating the decline. First, it is not clear how many programs were in existence at the time ONAC was disbanded. In 1981, EPA told Congress that over 1,000 municipalities and 27 states had noise control legislation, but that only 13 states and 160 local communities had "on-going active noise control programs which are enforced today." *Reauthorization Hearings*, supra, note 112, at 35 (Statement of Walter C. Barber, Jr., Deputy Administrator, EPA). A governmental unit is considered to have an on-going effort if one or more employees have noise abatement as a continuing part of their responsibilities. *Id.* There is some evidence, however, that the number of on-going programs may have been higher. In 1981, over 300 communities sent a representative to a conference sponsored by ONAC to plan the transfer of regulatory responsibility to local governments. Unified Industries Inc., A Case Study of The Closing Of A Federal Activity: A Report Prepared for ONAC 3-5 (1982). In addition, the National Association of Noise Control Officials (NANCO) had approximately 400 members at its zenith, although some of these persons were consultants. DiPolvere interview, supra note 135.

Although the number of communities has declined, the scope of abatement efforts has been broadened in the communities that remain active. Whereas early local efforts focused on emissions limitations, noise abatement tools now include land use planning (including zoning, subdivision regulation, and site design review), environmental impact assessment, real estate disclosure requirements (such as requiring sellers to disclose noise levels on their property), and impact fees (based on the level of noise emissions).[167] For example, in California, where there is probably the most noise abatement activity in the country, cities use land use planning (such as specifying that noise sensitive land uses, such as hospitals and schools, be located and designed to reduce noise), development of loop roads to reroute traffic away from neighborhoods, and building codes (such as requiring that new structures must use soundproofing material approved by a city before a building permit is issued).[168]

Except for a few places like California, however, local regulation is in "disarray."[169] Cities apply widely varying approaches to noise abatement, sometimes including unrealistic emissions limitations.[170] This "fragmented noise policy" not only poses a problem for companies subject to more than one set of regulations (such as electrical utilities which operate in two or more different cities), but it makes it generally difficult for the business community to plan future activities.[171]

7. Private Rights of Action

In the absence of effective governmental noise abatement programs, persons adversely affected by noise can seek a tort remedy. The tort system and the regulatory system are two methods by which society can achieve an

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The second problem is estimating the number of current, on-going programs. A report done for EPA in 1990 concluded that of 93 communities that responded to a survey, 76 had some type of on-going program. J. Soporowski, III, *The Status of Key State and Local Noise Control Programs That Served As A Basis For Discontinuing A Federal Program*, Jan. 22, 1990, at 41. The study reasonably inferred that many, if not most, of the 112 municipalities that did not respond to the survey probably no longer had on-going programs. *Id.* The experience of the National Association of Noise Control Officials (NANCO) provides some indirect evidence that there has been a substantial decline in local and state efforts. NANCO membership has declined from a high of approximately 400 persons to its current membership level of 50 persons. DiPolvere interview, supra note 135.

[167]Bragdon interview, supra note 160.

[168]Transportation Noise, supra note 130, at 66.

[169]DuBois interview, supra note 75.

[170]*Id.*

[171]*Id.*

answer to the same question: what mix of environmental pollution and protection is acceptable. Moreover, while the two systems in theory can produce the same answer or result, the environmental movement which started in the 1960s was motivated, in part, by recognition that problems associated with tort remedies made this approach less satisfactory than a regulatory approach.[172] While nuisance law has been used to abate noise pollution,[173] this general lesson holds for noise pollution as well.

The neighbor(s) of a land owner who emits loud noises can seek monetary and/or injunctive relief by alleging that the land owner's activities constitute a "private nuisance," except in the case of railroad and motor carrier noise sources, where tort suits are apparently preempted.[174] To prevail, the plaintiff would have to demonstrate that:

> (1) the noise interfered with the plaintiff's property interest, such as by causing the plaintiff health problems or by limiting some of the ways that the plaintiff's property could be used;[175]
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> (2) the interference with the plaintiff's land use resulted in a significant or substantial harm;[176]

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[172]*See* F. Anderson, D. Mandelker & D. Tarlock, Environmental Protection: Law & Policy 64-65 (1990); Sevinsky, *Public Nuisance: A Common Law Remedy Among The Statutes*, 5 NAT. RES. & ENV. 29, 30 (1990).

[173]*See* W. Rodgers, Handbook on Environmental Law §5.3 (1977).

[174]As noted earlier, the NCA states that a state or local government may not employ any "controls on levels of environmental noise" unless EPA approves.

[175]Restatement (Second) of Torts §§821D-E (1979) [cited hereinafter as "Restatement"]. If the defendant's conduct does not interfere with the use and enjoyment of a plaintiff's property, the plaintiff can allege a "public nuisance." A public nuisance is the unreasonable inference with a right common to the public, such as the public health, safety, and convenience. *Id.* §821B. Most of the elements of private and public nuisances are the same. An individual who brings a public nuisance action, however, must have an injury that is distinguishable from that sustained by other members of the general public. *See* Rothstein, *Private Actions For Public Nuisance: The Standing Problems*, 76 W. VA. L. REV. 453 (1974); Hines, *Nor Any Drop To Drink: Public Regulation of Water Quality*, 52 IOWA L. REV. 186, 198 (1966). Otherwise, the proper party to bring such an action is the public official charged with the responsibility of abating Noise Pollution. Hines, *supra*, at 198.

[176]Restatement, supra note 14, at §821F; W. Rodgers, supra note 12, at 107.

> (3) the defendant either acted with the purpose of causing that harm, or knew (or should have known) that the harm was likely to result from the noise;[177] and
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> (4) the invasion is "unreasonable" because the gravity of the harm of the plaintiff outweighs the utility of the defendant's conduct.[178]

Tort remedies will work satisfactorily only if individuals who are harmed actually sue. But the harm to individual property owners may be too small to merit a law suit, and the transaction costs of joining multiple property owners may prevent a class action. Moreover, even if some plaintiffs are successful, there may be no reduction in the amount of noise pollution since reducing the level of noise is often significantly more expensive than paying out claims to the few plaintiffs who file and successfully maintain nuisance suits. Even if all persons who are actually harmed sue, some will fail because it is often difficult for a plaintiff to prove some elements of actionable nuisance.[179] For example, while scientific evidence may establish that there is a probability that noise causes loss of hearing or other harmful health effects, the same evidence does not prove individual causation.

In addition, since the producers of noise pollution, such as railroad yards, truck terminals, and manufacturing plants, have a considerable amount of economic and social value, the injury to the plaintiff(s) will have to be substantial before a court will decide the fourth element of the nuisance test in favor of a plaintiff.[180] Professor Rodgers reports:

> Thus, the case law stresses the extent and degree of the hurt, with a number of cases declining injunctive relief where the noise was thought to be only sporadic or intermittent, or merely annoying, without constituting a serious health hazard, or speculative, or not "substantial" enough to justify recovery under an objective test of whether it would injure a normal person. . . . Similarly, in determining whether a noise nuisance exists, and particularly in fashioning an

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[177]Restatement, supra note 15, §§822-25.

[178]*Id.* §§826-31. A plaintiff can also establish the invasion is unreasonable if the harm to the plaintiff's land is serious and the financial burden of compensating for this and similar harm to others would not render it unfeasible for the defendant to continue the activity. *Id.*

[179]*See* Rychlak, *Common-Law Remedies For Environmental Wrongs: The Role of Private Nuisance*, 59 MISS L. REV. REV. 657, 681-82 (1989).

[180]*See* W. Rodgers, *supra* note 12, at 118-119; Note, *State Air Pollution Control Legislation*, 9 B.C. INDUS. & COMM. L. REV. 712, 716 (1968).

> appropriate remedy, courts have stressed the value of defendant's enterprise . . . .[181]

Finally, even if a court determines that the defendant's interference with the plaintiff's land is "unreasonable" under the fourth element, courts will apply a second "balancing" test to determine whether to grant injunctive relief,[182] which involves an even more open-ended test concerning the equity of the plaintiff's and defendant's positions. If the court does not grant injunctive relief, plaintiffs are forced to sue again once defendant's activities create additional damages.

In comparison to nuisance suits, regulatory approaches to reducing noise pollution have five advantages. First, noise reduction does not depend on whether plaintiffs have sufficient wealth to bring tort suits. Second, the decision of how much noise pollution should be tolerated is made in one proceeding, open to participation by all interested parties, by decisionmakers with access to relevant scientific and economic expertise. As Professor Hines notes:

> Litigation is fortuitous in its timing, in the type of case that may arise, and in the quality of the presentation that may be made for each side. An effective program of pollution control requires that the control agency possess considerable expertise in the area of regulation and that it have the capacity to plan ahead for anticipated problems. Courts are manifestly not endowed with these features.[183]

Third, a regulatory body is in a position to define clearly what conduct is expected of those who emit noise. By comparison, the tort approach, which involves two ad hoc balancing tests, makes it very difficult to predict the prospects for success in a nuisance action involving industrial pollution.[184]

Fourth, an agency is empowered to control pollution regardless of whether it impacts on a person's property. By comparison, a person can rely on the tort of nuisance only in cases where the person's enjoyment of his or her property is affected.

Finally, an agency is able to administer a flexible program that involves remaining in contact with the regulated parties so that they comply with the agency's orders. By comparison, "[t]he traditional reluctance of courts to

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[181]W. Rodgers, supra note 12, at 559-60.

[182]*See* W. Rodgers, supra note 12, at 118, 120; Rychlak, supra note 18, at 692.

[183]Hines, supra note 14, at 200.

[184]*Id.* at 200-201; Glicksman, *A Guide To Kansas Common Law Actions Against Industrial Pollution Sources*, 33 U. KAN. L. REV. 621, 650 (1985).

issue an affirmative order under equity powers requiring the carrying out of some tasks demonstrates the limited effectiveness of a court centered pollution control program."[185]

The previous analysis does not establish that tort remedies are unimportant in obtaining protection from noise pollution.[186] It does suggest, however, that sole reliance on tort remedies is unlikely to achieve the same degree of protection as a regulatory approach. This is the conclusion that has been reached in every other area of environmental protection, and there appears to be no basis on which noise pollution can be distinguished.

The previous discussion assumes that tort remedies are not preempted by the NCA. The Supreme Court has expressed reluctance to find that state tort remedies are impliedly preempted,[187] and the NCA contains no express preemption provision. Indeed, the NCA seems to preserve common law rights of action.[188] Nevertheless, the courts have held that tort actions in some fields of health and safety are preempted by federal regulation.[189] Were the courts to take that position concerning the NCA, possibly outmoded EPA emission and labeling standards might be raised as a defense.

D. The Current Status of Noise Abatement

With the elimination of ONAC, EPA's regulatory and coordination activities have been reduced to a trickle. Available information indicates that there has been a decline in the number of on-going state and local noise control programs although the magnitude of that decline can not be documented. Nevertheless, when this trend is added to the reduction in EPA's activities, there can be little doubt that there is less governmental activity devoted to abating noise than there was 10 years ago.

What is less clear is how much noise pollution exists at the current time in the United States. The last study of the extent of noise pollution occurred in

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[185]Hines, supra note 14, at 200.

[186]*See* W. Rogers, Environmental Law and Water 29 (2d ed. 1986) (public nuisance law useful adjunct to statutory law in abating pollution).

[187]*See* Silkwood v. Kerr-McGee Corp., 471 U.S. 707 (1985).

[188]Congress empowered citizens to sue to enforce the emissions standards promulgated by EPA, but it also said that it did not intend to restrict "any right which any person (or class of persons) may have under any statute or common law to seek enforcement of any noise standard control requirement. 42 U.S.C. §4911.

[189]*See e.g.*, Cippollone v. Liggett Group, Inc., 789 F.2d 181 (3rd Cir. 1986), *cert. denied* 479 U.S. 1043 (1987).

1980.[190] Nevertheless, "it is safe to assume that noise in communities is increasing."[191] Noise is directly related to population growth and the urban population in the country is increasing at twice the rate of the nonurban population.[192] Moreover, since there has been growth in the airline, trucking, and construction industries, these noise sources have likely increased. Regulation may have mitigated the extent of the increase, but EPA has been effectively disabled from enforcing its standards by budget constraints[193] and there are questions about the adequacy of the standards enforced by DOT.[194] Moreover, there are no federal standards for other noise sources, such as almost all construction noise,[195] and state and local regulation has declined significantly.[196] Moreover, industry research and development concerning the development of quieter products has slowed to a trickle, in part, because of the removal of any meaningful threat of regulation.[197]

EPA should commission a new study to determine the extent of noise pollution in the United States.[198] Although EPA has in the past relied on estimates of the extent of noise pollution,[199] this time it may be better to commission a study that would take actual measurements of ambient noise levels and noise sources. This would not only provide a more accurate baseline for future abatement efforts, but it would give EPA more credibility for restarting implementation of the NCA.[200]

While the exact scope of the need for additional noise abatement is uncertain, health professionals believe that additional regulatory activity is warranted. A consensus development conference held at the National Institute

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[190]Bolt, Beranek & Newman, Noise in America: The Extent of the Problem (July 1981).

[191]Suter, Report To The Administrative Conference, November, 1991 (cited hereinafter as "Suter Report"].

[192]*Id*; *see also*, Letter from Howard Stone, Jr., Executive Director, Self-Help For Hard of Hearing People, Inc (SHHH), to David Pritzker, ACUS (Apr. 19, 1991) ("Without a concentrated effort to prevent it, noise levels will increase.").

[193]*See* supra note 126 & accompanying text (discussion of EPA enforcement).

[194]*See* supra note 131 & accompanying text (discussion of standards enforced by DOT).

[195]Appendix I *infra*. State and local efforts abate some of the noise generated by these sources, although there are reasons to doubt the adequacy of local regulation in many jurisdictions. *See supra* note 164 & accompanying text (discussion of paucity of local noise abatement efforts).

[196]Note supra 164 & accompanying text.

[197]Kessler Letter, supra note 94, at 2.

[198]*See* Letter from William Melnick, Noise Advisory to the Executive Committee, American Academy of Audiology, to David Pritzker, ACUS (Mar. 27, 1991), at 2 ("Relying on data obtained a decade or even 2 decades ago can be misleading.")

[199]*E.g.*, note 190 supra.

[200]Von Gierke interview, supra note 74.

of Health (NIH) in 1990 found that "[h]earing loss from nonoccupational sources is common" and "public awareness of the hazard is low."[201] It concluded that "[i]nconsistent compliance and spotty enforcement of existing government regulations have been the underlying cause for their relative ineffectiveness in preventing NIHL [noise induced hearing loss]" and that a "particular unfortunate occurrence was the elimination of [ONAC] in 1982."[202] The American Academy of Audiology,[203] the American Speech-Language Association,[204] and the National Hearing Conservation Association[205] all agree with the NIH conclusions. And a "Proposed National Strategy for the Prevention of Hearing Loss" published by the National Institute of Occupational Safety and Health (NIOSH) in 1988 calls on Congress to reestablish the type of educational, research, and coordination activities undertaken by ONAC as important elements in a long-term strategy to reduce noise-induced hearing loss.[206]

The health community's support for renewed federal activity is based on research identifying the health and welfare consequences of noise. Proof of noise-induced hearing loss, which has been "extensively researched" and is "no longer controversial," comes from the industrial context, but there is "growing evidence" of hearing loss associated with leisure time activities, loud music, and other sources of nonoccupational noise.[207] Noise has also been implicated in the development or exacerbation of a variety of other health problems, ranging from hypertension to psychosis.[208] Among the ways that noise degrades the quality of life is by contributing to sleep disturbance,[209]

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[201]National Institute of Health, Consensus Statement: Noise and Hearing Loss 16 (1990) [cited hereinafter as "Consensus Statement"]. The statement was prepared by a nonadvocate, nonfederal panel of experts based on presentations by investigators working in the noise area and panel discussions.

[202]*Id.*

[203]Melnick Letter, supra note 198, at 1 ("The noise problem is still with us and continues to affect the living conditions of citizens of the United States.").

[204]Carney Letter, supra note 100, at 1 ("Based on current national health promotion and prevention agendas, reviving the ONAC is not only desirable but necessary.").

[205]NHCA Letter, supra note 100, at 1 ("Renewed activity [concerning the NCA] would provide tremendous benefits for the health and welfare of all Americans.").

[206]National Institute for Occupational Safety and Health, Proposed National Strategies for the Prevention of Leading Work-Related Diseases and Injuries: Part 2, at 56 - 60 (1988) [cited hereinafter as "NIOSH Strategies"].

[207]Suter Report, supra note 191, at 26.

[208]*Id.* at 47-49.

[209]*Id.* at 36. Sleep disturbance can also cause health problems if chronic. *Id.*

interrupting communications,[210] and increasing anxiety and anti-social behavior.[211]

Congress and EPA have a unique opportunity. Enough time has passed that the benefits and detriments of ONAC's approach to noise abatement are now apparent. Assuming that additional abatement efforts are merited, the sections that follow discuss how to shape future abatement efforts in light of ONAC's experiences. Part II considers options for state and local noise abatement and Part III considers options for federal abatement.

II. Options For State and Local Noise Abatement

Local noise abatement has not prospered in the years since ONAC was disbanded. This itself suggests that ONAC's support of an infrastructure for local activity was an important catalyst. Nevertheless, the decline in local activity could also reflect local voters' lack of interest in noise abatement. This section examines the connection between federal support and local effort and concludes that cities and states would become more active in noise abatement if the federal government resumed its infrastructure activities. Congress could locate the responsibility of infrastructure support in some other agency or agencies, but EPA is still the best home for such an effort.

A. Why State and Local Regulation Declined

EPA told Congress that ONAC should be disbanded because an austere federal budget required that some current federal programs be eliminated, the benefits of noise control were highly localized, and noise control could be carried out by state and local governments without the presence of a federal program.[212] These arguments reflected a "rebuttable presumption" in favor of local regulatory programs that guided the Reagan administration.[213] Whenever

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[210]*Id.* at 32. This problem can also be dangerous in some contexts. *Id.*

[211]*Id.* at 46. ("[E]ven modest noise levels can increase anxiety, decrease the incidence of helping behavior, and increase the risk of hostile behavior in experimental subjects.")

[212]*Oversight Hearing*, *supra* note 84, at 59.

[213]Grey, *Regulation and Federalism*, 1 YALE J. REG. 93, 93 (1983). Local programs were favored on the grounds they were more responsive to voters, *id.* at 94 (whereas local government is in "close touch" with its constituents, the federal government is "generally remote from the citizen's day-to-day lives and concerns."), and more efficient in solving local regulatory problems. Local government is more efficient because of the smaller size of its programs, *id.* (whereas local government "can operate modest streamlined programs tailored to meet local needs," federal programs are "often unmanageable in size and rely on unnecessary levels of

possible, the administration sought to return control over "local lifestyles to local decisionmakers."[214]

According to the Reagan federalism philosophy, noise is a local problem because noise pollution does not travel very far and it is quickly dissipated.[215] Accordingly, local regulation is more efficient since local government can more easily respond to different types of local conditions.[216] Requiring local governments to fund their own noise abatement means that they must decide whether this activity is more important than other responsibilities they have. The failure to fund noise abatement activities can therefore be attributed to the low priority given these activities by local governments.[217]

This argument, however, presumes that local citizens are informed about the risks and effects of noise. In fact, the public is generally uninformed about noise impacts.[218] In addition to this problem, the explanation has two other flaws. First, local regulation may become ineffective or inefficient without federal involvement.[219] Noise abatement by local governments is this type of situation. One reason is that ONAC's demise eliminated economies of scale that made noise abatement more affordable for local governments. In addition, by stimulating local noise abatement activity across the country, ONAC

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bureaucracy."), and because reliance on local government "fosters diversity and experimentation." *Id.* at 95. The presumption was rebuttable if local administration conflicted with other important goals, such as when the combined effect of disparate programs created intolerable burdens on interstate commerce. *Id.* at 96.

[214]*Id.* at 98.

[215]*Cf.* Mashaw & Rose-Ackerman, *Federalism & Regulation*, in the Reagan Regulatory Strategy: An Assessment 166 (G. Eads & M. Fix eds. 1984) (local regulation is appropriate for regulatory problems that do not spill over to other jurisdictions).

[216]*Cf. id.* at 118 (federal regulation has diseconomies of scale when regulation requires local information). This was the argument made by critics of EPA's garbage truck regulation. *See* supra note 112 & accompanying text (discussion of garbage truck regulation). Moreover, local governments have a wider variety of regulatory tools with which to address noise problems. *See* supra notes & accompanying text (describing local regulatory tools).

[217]The Reagan administration believed that federal subsidies stimulated local governments to undertake activities that they would not desire to pursue without federal intervention. Palmer & Sawhill, *Overview*, in The Reagan Record: An Assessment of America's Changing Domestic Priorities 16 (J. Palmer & I. Sawhill eds. 1984). It therefore preferred "dual federalism," which assigns each level of government independent and different responsibilities and, to the maximum extent possible, requires each level to find its own sources of funding to meet those responsibilities. Peterson, *The State and Local Sector*, in the Reagan Experiment: An Examination of Economic and Social Policies Under the Reagan Administration 166-67 (J. Palmer & I. Sawhill eds. 1982).

[218]*See* supra note 201 accompanying text.

[219]Mashaw & Rose-Ackerman, supra note 215, at 112, 121-22; *see also* G. Eads & M. Fix, Relief or Reform: Reagan's Regulatory Dilemma 209 (1984).

lessened the concern of cities and states that they would be disadvantaged in the competition for industrial development by addressing their own noise problems. Second, although the Reagan concept of dual federalism envisions that local governments will be given control over local problems, only a partial devolution actually occurred in the case of noise abatement. Because of preemption and related factors, local governments may be prevented, or at least discouraged, from regulating some important local sources of noise.

This section explores these two alternative explanations for the decline in local regulation. It demonstrates that although citizen lack of interest in noise abatement can not be dismissed as an explanation for the decrease in local efforts, the alternative explanations are more persuasive.

1. Infrastructure Support

Professors Mashaw & Rose-Ackerman suggest why the elimination of EPA support was an important factor in the nosedive in local activity. When the federal government creates the information that is used by local governments for their activities, there are significant economies of scale that lower the cost of local activity.[220] ONAC created economies of scale activity in two ways. First, because most communities lack any expertise in noise abatement techniques,[221] ONAC's sponsorship of training programs, intercity information exchange, creation of model ordinances, and so on, offered local governments an inexpensive means to obtain the necessary information and expertise

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[220]Since information relevant to the entire country can be most efficiently created by the federal government, federal participation can obtain economies of scale. Mashaw & Rose-Ackerman, *supra* note , at 118. For example, national institutes can conduct research, develop regulatory technologies, and test the safety of products. *Id.* The diseconomies of scale of producing this type of information on a local level can also be a reason for underregulation by local and state governments. *See infra* note & accompanying text. When no federal program exists to provide such information, each locality must generate it on its own. This not only makes local programs more expensive, it increases the total cost of such programs because of the duplication of local activity.

[221]Luz Comments, supra note 100, at 2; Gomez interview, supra note 10; DiPolvere interview, supra note 135. A government noise researcher explains:

> There were no resources for helping [local regulators] purchase state-of-the-art automated noise monitoring equipment to serve as a labor-multiplier, no experts which they could consult as to whether they were technically correct in their conclusions, and no opportunities for career development. At the same time, noise assessment is too arcane a subject to be left to nontechnical legislators. It is not clear that legislators understood the reasoning behind various aspects of the EPA's model community noise ordinance.

Luz Comments, supra. A local noise official adds that most communities are "afraid" of the technical complexity involved in noise abatement. Gomez interview, supra.

necessary to create and maintain noise programs.[222] Second, ONAC's sponsorship of research created a scientific and technical basis for local and state noise control efforts that has not been replaced. For example, ONAC's "Levels Document" offered local officials authoritative guidance concerning the levels of cumulative noise that posed a danger to local citizens.

The elimination of the federal infrastructure has raised the cost of local noise control to the point where it is no longer affordable for most jurisdictions. Not only is noise abatement more expensive, but the federal infrastructure was eliminated at the same time that state and local governments were hit with significant decreases in federal aid.[223] Noise abatement is but

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[222]*See* NHCA Letter, supra note 100, at 3 ("Without federal technical support and funding, [state and local agencies] are unlikely to operate actively again."); Schomer Letter, supra note 93, at 2 (Demise of technical support "probably contributed more to the loss of state and local programs than did any other factor."); Stewart Letter, supra note 8, at 2 ("History has shown that, except for the largest states and cities, these local and state programs can not survive without support from a central resource.").

After the elimination of ONAC, cities have few inexpensive options to train their employees or otherwise obtain the necessary expertise. In addition, it is difficult for cities to find out about what existing training resources and expertise exist because, with the elimination of ONAC, no organization makes such information available. ONAC had funded programs run by National League of Cities that provided information and updates to its members. Various issues of the League's *Environmental Reporter*, for example, covered noise abatement and control. *See, e.g.*, National League of Cities Environmental Report Oct. 1, 1989; *id.*, Nov. 27, 1978; *id.*, July 29, 1978; *id.*, July 3, 1978. ONAC also published materials that informed cities how to write federal grant applications for funding from other agencies. *See* Environmental Protection Agency, Staff Resources For Noise Control, March, 1978.

[223]The existence of active noise control programs in some locations, such as Los Angeles county, *see e.g.*, Carlton, *When Californians Use Leaf Blowers, Life Is Less Mellow*, Wall St. J., Dec. 4, 1990, at ___ (eastern edition), does not contradict this analysis. Active programs tend to exist either where noise is an especially pressing problem or where programs were ongoing at the time ONAC was abolished. Although the cost of maintaining a program is now higher than before ONAC was abolished, the benefits from the program are also large where noise is a pressing problem. Gomez interview, *supra* note 10. In jurisdictions that had trained personnel prior to the time ONAC was abolished, the cost of maintaining the program is less than the start-up costs for a governmental unit without any preexisting effort. In most of these locations, however, the size of the program has been cut back. DiPolvere interview, supra note 135. Moreover, in many places where a noise program has been retained, it has been folded into some other department, such as the public health department, or the environmental protection department. Although this has preserved the program, noise control usually receives significantly less attention that previously because it is not the primary mission of the department in which it is located. Bragdon interview, supra note 160.

one more victim of the massive shift in the financing of government from the federal government to the states.[224]

Reestablishing a federal infrastructure would increase the number of state and local noise control programs by decreasing the cost of starting and maintaining such programs, and the experiences of local noise control officials bear this out. When an association of California noise control officials has offered inexpensive training sessions, officials from dozens of California municipalities have signed up.[225] There has been similar interest in a NANCO program that certifies government employees as technically capable of running noise control equipment.[226] NANCO hopes to offer these services nationally, but it has been stymied by a lack of resources.[227] In addition, EPA officials[228] and noise consultants[229] report that since ONAC has been abolished, they have received hundreds of telephone calls seeking information about how to implement noise abatement activities.

2. Local Disincentives

Professors Mashaw & Rose-Ackerman also suggest that without federal involvement local regulation may be ineffective because there are local disincentives to regulate stringently.[230] Noise presents this type of problem. As noted earlier, noise often only affects a portion of the population in a city or state, and that burden may have been imposed on them by the other residents who wished to obtain the benefit of a highway, airport, or

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[224]*See* Wright, *The United States*, in Intergovernmental Relations and Public Policy 64-65 (B. Galligan, O. Hughes, & C. Walsh eds. 1990); R. Nathan & F. Doolite, The Consequences of the Cuts: The Effects of the Reagan Domestic Program on State and Local Governments (1983); Hinds, *Strapped, Big Cities Take Painful Steps*, New York Times, Jan. 6, 1991, at Y9 (national edition); Hinds & Eckhom, *80's Leave States and Cities In Need*, New York Times, Dec. 30, 1990, at A1 (national edition).

[225]Gomez interview, supra note 10.

[226]*Id.*

[227]*Id.*

[228]Feith interview, supra note 16.

[229]Bragdon interview, supra note 160.

[230]Local regulation may be ineffective for two reasons. First, local regulators have an incentive to adopt weak regulatory policies when they face a "prisoner's dilemma," *id.* at 117, or a situation where, lacking a mechanism to cooperate, players end up worse off by competing with each other. *See* D. Mueller, Public Choice II 9-10 (1989). State regulation can present a "prisoner's dilemma" because "states may all try to attract businesses to their jurisdictions through tax breaks and regulatory laxness." Mashaw & Rose-Ackerman, supra note 215, at 117. Second, because political jurisdictions have little incentive to produce regulatory benefits that do not accrue to that jurisdiction, they will underregulate problems that affect more than one jurisdiction. *Id.* at 116.

industry.[231] In other legislation, such as the Clean Air Act, Congress spoke to this problem by mandating a minimum floor of protection for all citizens, but the NCA contains no such requirement.[232] Although a similar approach is justified concerning noise,[233] Congress chose not to require a minimum level of protection by states and local governments.

Congress' decision not to fund ONAC had two effects on local disincentives. First, Congress' decision sent a signal to citizens (and their elected leaders) that noise abatement was unimportant. That is, the failure to abate noise that affected some of a community's citizens was unimportant. Second, because ONAC's infrastructure activities stimulated noise abatement activity across the country, it minimized fears that a city or state would be disadvantaged in the competition for economic development by imposing noise abatement requirements.

State and local noise control officials concur in the previous conclusions. Terry Obteska, Manager, Noise Control Program, Air Quality Division, Oregon Department of Environmental Quality, has written the Administrative Conference:

> The demise of the federal program in 1981 has been a disastrous experiment, resulting in the wholesale death of state and local programs. . . .

Dismantlement of the national noise control effort produced predictable results. Without a federal program, the linchpin of the network, it became politically expedient to classify noise pollution as a "nuisance" and cancel programs under the pretext that it was a cost savings measure. Paradoxically, the costs borne by those exposed to airport, highway, railway, and other egregious noise products, if calculated, are by no means insignificant.[234] Mr. Obteska reports that he expects Oregon to eliminate the state's noise control program in the near future in response to the lack of federal support and declining state resources.

A letter from Edward DiPolvere agrees that the lack of any federal program is a key factor in the decision by states to eliminate their own noise control efforts:

> It was clear to me back 10 years ago that once EPA disbanded its ONAC program that the weak State and local programs would soon die. Unfortunately, that was the case; even worse, most strong programs also died within the next

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[231] *See* supra note 8 & accompanying text.

[232] Note supra & accompanying text.

[233] Note 25 supra.

> few years. The New Jersey program was cut in half in 1981 and has just been bumping along since then. The proposed New Jersey budget for 1992 fiscal year which starts in a few months (July 1, 1991) does not include any funding for Noise Control. So one of the longest ongoing and strongest programs will also die. And it's easier for a State to kill a program that has no form of matching subsidy federal funding or stronger link to public risk. In New Jersey we are in a severe budget crisis and many programs are being pinched or curtailed but only [the] Noise Control Program of 25 program classifications is being eliminated altogether.[235]

North Dakota's noise program has had a similar fate, which according to a letter from Dana Mount, Director, Division of Environmental Engineering, North Dakota State Department of Health, can also be attributed to the lack of federal support:

> North Dakota has had an active noise control program since 1971. . . . Since the phase-out of the EPA program, the State has been able to provide an extremely limited budget for noise control. . . .
>
> . . . Due to the State's current financial concerns and shifts in priorities, the State's noise control law was repealed by the Legislature this year and will effectively phase out completely on July 1, 1991.
>
> We believe that there is a need for a strong noise control program within EPA, that includes extensive support for State noise control programs.[236]
>
> Ellwyn G. Brickson, Noise Control Specialist, Environmental Health Division, Orange County, California, tells a similar story: When the EPA reduced their personnel from 175 to 0, the State of California ONAC also reduced the staff from 5 to 0. The biggest reason for decline in noise

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[234]Letter from Terry L. Obteska to David M. Pritzker, ACUS, May 8, 1991.

[235]Letter from Edward DiPolvere to David M. Pritzker, ACUS, May 1, 1991.

[236]Letter from Dana K. Mount to David M. Pritzker, ACUS, June 3, 1991.

> abatement programs is simply a lack of funding. The noise problems are still being discovered.[237]

Peter Nichols, Director of Environmental Health Services, City of Norfolk, Virginia, writes that he was able to start a noise control program because of the training he received from ONAC. He concludes, "The possibility of a federal community noise control program being re-established is exciting . . . I support any efforts to re-establish a federal noise control program."[238]

3. Federal Preemption

Finally, the decline in local noise abatement might be attributed, in part, to federal preemption. The extent of preemption varies concerning product standards, transportation standards, and labeling, but these differences do not affect the conclusion that states and local governments are generally unable to remedy the problem that some of EPA's noise standards are obsolete.

Since the NCA preempts states and political subdivisions from imposing their own emissions standards on new products that are regulated by EPA,[239] these levels of government can not promulgate different emissions standards for air compressors, motorcycles, and medium and heavy duty trucks, which are covered by product standards promulgated by ONAC.[240] State and local governments are not preempted, however, from controlling noise emitted by these sources by the use of other regulatory tools, such as restriction of use, operation or movement, and they can enforce the EPA standards by adopting identical limitations as their own laws or ordinances.[241]

Since EPA regulated only three products, the effects of preemption concerning product regulation are narrow. And EPA's lack of enforcement could be overcome if other levels of government adopted the EPA standards as their own. To the extent that the EPA standards are obsolete, however, local enforcement of EPA's standards would be inadequate. Moreover, alternative methods of enforcement may not work in all circumstances. For example, local noise regulators have complained that EPA's new truck regulations in some cases preempted stricter local emissions regulations.[242] As a result, a city may lack any effective mechanism to abate the noise from delivery trucks. Time and place restrictions could be employed, but it may be impractical to cut

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[237]Letter from Ellwyn G. Brickson to David M. Pritzker, ACUS, May 20, 1991.

[238]Letter from Pete C. Nicholas to David M. Pritzker, ACUS,Apr. 24, 1991.

[239]42 U.S.C. §4905(e)(1).

[240]*See* Appendix I.

[241]42 U.S.C. §4905(e)(1).

[242]*E.g.*, *Reauthorization Hearing*, supra note 112, at 24.

off access to local businesses during business hours. Zoning and land planning restrictions likewise would have no efficacy against mobile sources of noise. The city may also not be able to regulate the warehouse area where the trucks are located. A land owner could be exempt from any change in zoning if the prior use of the land qualifies as a nonconforming use exempt from ex post zoning changes.[243]

States and localities are preempted from regulating the same railroad or motor carrier noise emissions regulated by EPA by any form of regulation (other than an emissions standard identical to the one promulgated by EPA) unless the agency grants a "special local circumstances" exemption permitting local regulation.[244] Since EPA has regulated railroad and motor carrier noise sources extensively,[245] the scope of this preemption is broader than the preemption of product regulation.

Likewise, the consequences for the public of such preemption are also greater. There is evidence that the transportation emissions standards have become obsolete, or are inadequate for other reasons.[246] States and local governments have no regulatory authority to resolve such problems unless EPA grants them an exemption. This solution, however, is problematic for three reasons. First, EPA has established a significant burden of proof to obtain an exemption, which has discouraged cities which have applied from pursuing this option.[247] Second, it is not apparent that EPA has the resources to respond to an application. Finally, EPA would have to turn down any regulatory initiative which placed a significant burden on a railroad or trucker's capacity to operate in interstate commerce. This constraint may limit cities from adopting the most effective noise controls.

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[243]D. Hagman, Urban Planning and Land Development Control Law 146-47 (1975).

[244]42 U.S.C. §§4916(c), 4917(c). In *Baltimore & Ohio Railroad Co* v. *Oberly*, 837 F.2d 108 (3rd Cir. 1988),the Third Circuit held that Delaware was not preempted under the previous statutory language from regulating the noise emitted from trailers on flat cars (TOFCs) because EPA had not regulated this noise source:

> We therefore conclude that section 17(c) means what it says: once a federal noise regulation has taken effect, a state may not regulate (unless it promulgates a standard that is "identical to a [federal] standard," 42 U.S.C. 4916 (c)(1) (1982)), the same rail equipment or facility. Since EPA had regulated neither TOFCs nor noise emissions at property lines, the federal Noise Control Act and the regulations thereunder do not preempt the mere existence of Delaware's regulations of such equipment and facilities.

Id. at 114-15.

[245]*See* Appendix II.

[246]*See* supra Section IC4.

[247]*See infra* Section IIB2.

The NCA also provides for preemption concerning labeling standards. States and local governments can establish their own labeling standards only to the extent they do not conflict with federal standards.[248] There is one federal labeling standard for hearing protection devices, which is misleading because it does not accurately reflect the degree of hearing protection the devices provide under actual conditions of use.[249] But there is no role for state or local governments in addressing the misleading nature of the label. Even if state or local labeling is not preempted, which it appears to be, most local jurisdictions lack the technical and informational capacities to promulgate labeling requirements. Moreover, local labels would lead to substantial confusion for consumers who would find two labels with conflicting information.

In light of the previous preemption, cities may not find it cost effective to start (or maintain) a noise abatement program when they are effectively prevented from addressing some significant local sources of noise. The extent to which federal preemption has actually discouraged starting or maintaining local programs is unknown. It may not be an important factor since the scope of EPA regulation is fairly narrow and many important noise sources remain unregulated.

Some cities, however, may be discouraged from regulating because of industry claims of preemption in cases where such claims are dubious or erroneous.[250] A recent case, where the federal government assisted an industry to make a dubious claim of preemption, illustrates this potential. The government filed a brief in a lawsuit that the American Association of Railroads and two local railroads brought against Delaware which claimed the noise emitted from refrigerated trucks mounted on railroad cars violated the state's noise emission limits.[251] The Third Circuit Court of Appeals cited EPA's brief, which argued the state was preempted from regulating, as the reason for affirming the district court's injunction against state enforcement.[252] But when Delaware appealed the case to the Supreme Court, the Solicitor General told the Court that government's position was legally erroneous and he asked the Court to remand the case back to the Circuit Court for

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[248]42 U.S.C. §4907(c).

[249]*See* supra note 137.

[250]Feith interview, supra note 16 (industry claims of preemption have discouraged local noise initiatives in cases where such claims were dubious).

[251]Appellant's Jurisdictional Statement at 4, Oberly v. Baltimore & Ohio Railroad Co., 479 U.S. 980 (1986) [cited hereinafter as "Jurisdictional Statement"].

[252]Baltimore & Ohio Railroad Co. v. Obey, 782 F.2d 29, 30 (3rd Cir. 1986) (per curiam), *aff'm.* 606 F. Supp. 1340 (D. Del. 1985).

reconsideration.[253] After the remand, the Third Circuit reversed itself and held that Delaware could enforce its regulation.[254]

While it might be expected that the Third Circuit's decision has clarified the power of local governments to regulate some aspects of railroad operations, the matter may still represent a muddle to many localities. An EPA official attributes the lack of local regulatory activity, in part, to the fact that many localities may have not heard about the decision.[255]

C. Policy Options

State and local noise regulation lacks a bright future unless the federal government reestablishes the type of scientific, technical, training, educational,

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[253]Brief for the United States as Amicus Curiae at 6, n.6, Oberly v. Baltimore & Ohio Railroad Co., 479 U.S. 980 (1986). The Solicitor General told the Court that the government's support of the railroad's position had not been approved by high level officials in the Department of Justice or the Solicitor General's Office:

> The court of appeals noted that in an amicus curiae filing made at the court's request, the Environmental Protection Agency agreed that the federal regulations preempt application of state noise regulations . . . . Regrettably, because of a failure of communication, that brief was filed in the court of appeals without having been brought to the attention of either the Assistant Attorney General for Land and Natural Resources or the Solicitor General, and therefore without the former's approval or the latter's authorization.

Id.

[254]Baltimore & Ohio Railroad Co. v. Oberly, 837 F.2d 108, 110 (3rd Cir. 1988). EPA's 1974 railroad noise emission standards covered locomotive operations under stationary and moving conditions and rail car operations. 39 Fed. Reg. 24580 (1974). The D.C. Circuit construed the NCA to require EPA to regulate all railroad "equipment and facilities" including the equipment and facilities omitted by EPA from its regulation. Association of American Railroads v. Costle, 562 F.2d 1310 (D.C. Cir. 1977) EPA promulgated additional standards, 45 Fed. Reg. 1263 (1980), *amended at* 47 Fed. Reg. 14709 (1982) (codified at 40 C.F.R §201 (1990)), but some aspects of railroad operations, including refrigerated trucks, were left unregulated. Because EPA had declined to regulate refrigerated trucks, Delaware contended that it was not preempted from regulating them. Appellant's Brief In Reply To Motion To Affirm, at 3-4, Oberly v. Baltimore & Ohio R.R. Co., 479 U.S. 980 (1986). EPA responded that because it had justified its decision not to regulate additional noise sources on the ground more regulation was "unnecessary" to abate railroad yard noise, it had preempted any local regulation. 782 F.2d at 30. The Third Circuit, however, declined to give EPA's decision preemptive effect because its statements in 1982 did not clearly indicate that this was its intent. 837 F.2d at 115.

[255]Feith interview, supra note 16.

and other "infrastructure" activities that EPA supported at the end of the 1970s. Far from usurping local initiative, federal support is necessary to empower communities to act against noise pollution. It is less clear what actions EPA (or Congress) should take regarding federal preemption, but some reduction in federal preemption appears possible.

1. Infrastructure Support

If the cost of starting and maintaining noise control programs was lowered, cities and states would be more likely to increase their noise abatement efforts. Federal involvement would also lower the national cost of abatement. Moreover, EPA's experience in the 1970s suggests that a worthwhile program could be established at a fairly low cost to the federal government.

The panel of experts convened by NIH[256] and a NIOSH report[257] called for reestablishing the type of infrastructure activities that EPA supported while ONAC operated. This conclusion is supported by noise consultants,[258] health professionals,[259] and local regulators,[260] although there is some disagreement concerning what steps EPA should take. For example, some professionals support establishing a computerized database of technical information that they can easily access,[261] but others believe this would not be a useful step.[262] The

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[256]Consensus Statement, supra note 201, at 21.

[257]NIOSH Strategies, supra note 206, at 57-58.

[258]Letter from Edward Clark, Ostergaard Acoustical Associates, to David Pritzker, ACUS (Mar. 18, 1991) (EPA should underwrite research for quieting noise sources and help develop community noise control criteria or guidelines); Letter from Walter Eversman, Chairman, Noise Control and Acoustics Division, American Society of Mechanical Engineers, to David Pritzker, ACUS (Mar. 27, 1991), at 1 ("ONAC should provide a technical infrastructure which supports governments."); Letter from Kevin Lowther, Member, Board of Directors, Institute of Noise Control Engineering, to David Pritzker, ACUS (Mar. 28, 1991), at 2 (federal government should fund studies that "enhance the database of noise emissions from consumer and industrial equipment"); Letter from Nancy Timmerman, President, Institute of Noise Control Engineering, to David Pritzker, ACUS (Mar. 29, 1991) ("A clearinghouse of information on noise control can be useful."); Maling Letter, supra note 160, at 5 (EPA should rewrite its model noise ordinance, its "Levels Document," support university teaching and research, and publication of technical information.); Stewart, supra note 8, at 6 ("Disgrace" that technical experts must depend "so heavily" on testing and research done by National Research Council of Canada).

[259]Melnick Letter, supra note 198, at 1-2 (noise research is now "almost nonexistent" and "needs to be done"); NHCA Letter, supra note , at 2 (research programs on the general health effects of noise are "invaluable" and "need to be initiated again")

[260]*E.g.*, DiPolvere Letter, *supra* note 94, at 3.

[261]*See e.g.* Letter from Martin Hirschon, President, Industrial Acoustics Co., Inc., to David Pritzker, ACUS (Mar. 8, 1991) (computerized data "could be of great value"); Letter from Kevin Lowther, Member, Board of Directors, Institute of Noise Control Engineering, to David Pritzker,

NIH and NIOSH reports also recommend a comprehensive program of public education concerning noise with special attention directed towards school-age children.[263] And EPA's Scientific Advisory Board (SAB) has noted as a general matter that EPA should improve public understanding of environmental risks as one of its strategies for risk reduction.[264]

Congress would not have to locate federal infrastructure activities in EPA. Two arguments can be made on behalf of location in other agencies. First, some previous management officials in EPA have not been enthusiastic about

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ACUS (Mar. 28, 1991) (computerized database "must be exploited"); Glaser Letter, *supra* note 100. at 2 (computerized database would be a "boon" to professionals); Kessler Letter, supra note 94, at 5 ("If EPA does nothing else, it should assemble and have available databases."); Maling Letter, supra note 160, at 5 ("EPA should maintain a computerized 'noise bulletin'."); Stewart, supra note 8, at 5 ("It would be nice to have a really good computerized database").

[262]Memorandum from David Stephens, Chief of the Acoustics Division, NASA Langley Research Center, to Harvey Hubbard (Mar. 8, 1991), *in* Letter from Harvey Hubbard to David Pritzker, ACUS (Mar. 12, 1991) (computerized database would "not be a productive exercise" for EPA); Melnick Letter, supra note 198, at 2 (computerized database would be "extremely" useful); *but see* Luz Comments, supra note 100, at 3 (no need to duplicate "excellent" computerized databases developed through Air Force funding); Toothman, supra note 94, at 2 (computerized database could be "useful" but should be privately developed).

[263]The NIH group concluded that "[h]igh visibility media campaigns are needed to develop public awareness of the effects of noise on hearing and the means of self-protection. Consensus Statement, supra note 201, at 18. It recommended:

Educational programs should be targeted toward children, parents, hobby groups, public role models, and professionals in influential positions, such as teachers, physicians, audiologists, and other health care professionals, engineers, architects, and legislators. In particular, primary health care physicians and educators who deal with young people should be targeted through their professional organizations. . . .

Id. at 17-18.

The NIOSH study recommended that long-term objectives for information dissemination should include efforts to:

> Inform the public of the need to protect hearing to avoid the biological and social consequences of exposure to noise. All forms of media should be used. In addition, information shall be distributed to large public gatherings, such as state and local fairs, health conventions, etc.

Develop education programs and promote existing programs in primary and secondary schools and in universities for teaching the basic science of sound, including its hazards, and methods of self-protection.

NIOSH Strategies, supra note 206, at 58.

[264]EPA Science Advisory Board, Reducing Risk: Setting Priorities and Strategies for Environemntal Protection 24 (1990) [hereinafter cited as "SAB Report"].

its noise abatement mission.[265] Second, since EPA's primary mission is standard setting, the research and educational aspects of noise abatement would be better served if they were delegated to agencies that had research and education as primary objectives.

There are also good reasons for reestablishing EPA as the home of infrastructure efforts. While some infrastructure activities can be moved to other locations, others are not easily relocated. Congress could give the National Institutes of Environmental Health Sciences responsibility for health-related noise research and some other agency in the Department of Health and Human Services (HHS) the responsibility for public education,[266] but there is no obvious alternative home for infrastructure activities such as producing model ordinances, establishing universal measurement standards, and training enforcement personnel.[267] Congress could establish a new agency, modeled on the National Institute for Occupational Safety and Health (NIOSH), which performs similar functions concerning occupational safety and health, but the small scale of federal activities in this area may not justify a separate agency for that purpose.

In addition, parceling out infrastructure activities would make them less effective than locating them at EPA. If some infrastructure activities remain at EPA, locating others elsewhere would create coordination difficulties. For example, when the NCA was passed, Congress expected that EPA would be able to rely on noise research conducted by other agencies, but EPA found that because the other agencies followed their own research agendas, they produced very little research relevant to EPA's purposes.[268] Moving all infrastructure

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[265] *See* supra note 52 & accompanying text (ONAC received grudging support from EPA, in part, because agency personnel did not view noise abatement as an important element of EPA's mission).

[266] The Department of Education might also play a role in the design of school education programs.

[267] A former director of ONAC recommends that infrastructure activities that could not be assigned to the National Institutes of Environmental Health Sciences be delegated to the National Academy of Engineering/National Research Council or that a National Advisory Commission on noise standards and control be established. Meyer Letter, supra note 51, at 1-2. He also supports assigning responsibility for maintaining a computerized database to the National Bureau of Standards. *Id.* at 2. The former director prefers these arrangements because he distrusts that EPA will be friendly to infrastructure activities. *Id.* at 1. The problem with this recommendation is that parceling out the infrastructure activities would create coordination problems. *See infra* 268 note & accompanying text. Since EPA may have a new attitude concerning infrastructure activities, *see infra* note 271 & accompanying text, it would be better to determine whether EPA will support such activities before they are transferred elsewhere.

[268] *Oversight Hearings*, supra note 84, at 18 (Testimony of David Hawkins, Assistant Administrator for Air and Waste Management, EPA).

functions to a new agency would solve this type of problem, but there would be other coordination difficulties if EPA retains any regulatory functions.[269] OSHA's experience indicates this difficulty. OSHA and NIOSH have had continuous coordination difficulties because the former is located in the Department of Labor and the latter is in HHS.[270]

Finally, EPA may be ready to turn over a new leaf regarding its attitudes towards infrastructure activities, if not noise abatement itself. The Scientific Advisory Board recently called on EPA to recast its mission to include not only a wider variety of environmental hazards, but also a greater variety of regulatory tools.[271] In particular, the SAB recommended that EPA use a welfare risk paradigm that recognizes "social nuisances" such as "odors, noise, and reduced visibility" that may or may not affect human health."[272] The SAB was not suggesting that noise might not also pose a health hazard, but it was saying that EPA should not treat its nonhealth effects as unimportant to environmental protection.[273] The SAB also told EPA that the "most promising strategies for risk reduction encompass a wide range of policy approaches" including scientific and technical measures, provision of information, and cooperation with other agencies.[274]

2. Preemption

Besides reestablishing infrastructure support, EPA should clarify the extent of federal preemption and minimize the scope of it. Clarification will assist local governments to resist erroneous industry claims that cities or states can

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[269]For example, if EPA retains the function of product labeling, it would have to coordinate its activities with the educational efforts of another agency.

[270]Shapiro & McGarity, *Reorienting OSHA: Regulatory Alternatives and Legislative Reform*, 6 YALE J. ON REG. 1, 58-59 (1989).

[271]SAB Report, supra note 264, at 6. A former director of ONAC cautions, however, that "EPA and Administrations (regardless of party) simply will not provide the resources to EPA to implement a federal noise control program within EPA." Meyer Letter, supra note 51, at 1. He recommends therefore that Congress place noise infrastructure activities elsewhere. See note 267 supra (describing recommendation). As related earlier, however, there are disadvantages to giving up on EPA as the home for such efforts. *See* supra note 239 & accompanying text. EPA should therefore be given an opportunity to indicate that it will support such activities, but Congress should monitor the agency's efforts to determine its level of support.

[272]EPA Science Advisory Board, Appendix A; Report of the Ecology and Welfare Subcommittee 34 (1990).

[273]*See* EPA Science Advisory Board, Appendix B: Report of the Human Health Committee 11 (1990) (Comparative risks should be judged according to their risks of contributing to cancer, other adverse health effects, ecological damage, and societal welfare).

[274]EPA Science Advisory Board, Appendix C: Report of the Strategic Options Subcommittee 33 (1990) [cited hereinafter as "Strategic Options"].

not act. Minimizing the scope of preemption will empower local governments to act concerning local problems. While some preemption is unavoidable to protect firms from the costs of complying with inconsistent local regulation, there may be more preemption currently than necessary.

Federal regulation creates scale economies for firms that operate in interstate commerce if a uniform federal standard replaces conflicting state and local regulation,[275] and the preemption provisions of the NCA have such a purpose.[276] The disadvantage of preemption is that it can replace more stringent standards preferred by local governments.[277] But companies that operate in interstate commerce, such as product[278] and vehicle manufacturers,[279] and the railroads,[280] insist that they could not operate efficiently without extensive federal preemption. Nevertheless, some forms of local regulation, such as the erection of noise barriers, would appear to have little or no effect on transportation scale economies.[281] EPA could assist local governments by

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[275]Mashaw & Rose-Ackerman, supra note 215, at 118 ("Uniform national regulation frequently produces economies of scale for private firms in interstate commerce.")

[276]Senate Report, supra note 17, at 7, 19. (1972). Moreover, the drafters understood that more extensive preemption was necessary for railroads and motor carriers. State and local governments may use time and place restrictions, such as zoning or licensing, to address noise emissions from products regulated by EPA, supra note 23, but EPA's approval is required to use these controls concerning railroad and motor carrier noise. Note 24 supra. EPA is authorized to permit local regulation if it is necessitated by special local conditions and local regulation would not be in conflict with EPA's regulation. *Id.* The NCA drafters included EPA approval because of "the need for active regulation of moving noise sources and the burdens placed on interstate carriers of differing State and local controls." Senate Report, supra note 17, at 19.

[277]Preemption was adopted over Senator Muskie's objection that the NCA was a "classic example" of how federal preemption weakens regulation by substituting less stringent federal standards for more stringent state and local regulations. Senate Report, supra note 17, at 21-22. A national association of noise control officials asserts that, as Muskie predicted, EPA standards have replaced, or prevented, stricter regulation of noise sources such as new trucks and motorcycles. Reauthorization Hearings, supra note 1112, at 24, 28 (Testimony of Jesse Borthwick, Executive Director, National Association of Noise Control Officials (NANCO)). An EPA official replies that the regulations adopted by ONAC were as stringent as the NCA permitted. Feith interview, supra note 50.

[278]*E.g.*, *Oversight Hearings*, supra note 84 , at 93-94 (Statement of James Arndt, Deere & Company).

[279]*Id.* at 124-127 (Statement of Motor Vehicle Manufacturers Assoc. of the U.S., Inc.).

[280]*Reauthorization Hearing*, supra note 112, at 2-4 (Statement of William Dempsey, President, American Association of Railroads).

[281]*Noise Control Oversight: Hearings Before The Subcomm. On Resource Protection Of The Senate Comm. on Environment and Public Works*, 95th Cong., 2d Sess. 69 (1978) [cited hereinafter as "*NCA Oversight*"] (Testimony of Larry Blackwood, Illinois Assistant Attorney General). Blackwood contends that some noise control problems created by railroad yards do not

promulgating a standard that would establish criteria for granting special local circumstances exemptions for railroad and truck noise regulation.[282]

III. Options for Rederal Noise Abatement

EPA can assist state and local noise abatement by reestablishing a support infrastructure and narrowing preemption of local regulation. This section evaluates what other abatement responsibility the federal government should undertake and concludes that Congress should fund EPA to implement the NCA, but that the agency should adopt a different regulatory strategy than it used previously.

A. Congressional Options

Congress has three choices concerning the future of the NCA. It must determine whether to continue or repeal it, and, if some or all of the provisions of the NCA are continued, Congress must decide whether EPA, or some other agency, is to be responsible for their implementation.

1. The Future of the NCA

Congress could continue the status quo, repeal the NCA, or fund EPA (or some other agency) to implement it, with or without restrictions on the scope of the agency's jurisdiction. Continuing the status quo saves money, but it also leaves EPA in an untenable position. Because of budget constraints, it can neither effectively enforce existing standards, nor amend them to take account of loopholes and other deficiencies that have been identified. Moreover, continuing the status quo prevents state and local governments, to

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require national uniformity of treatment because they can be solved by changes in equipment or practices, or by installation of noise control barriers, designed for a particular location. *Id.*

[282]EPA could make determinations concerning local exemptions without a standard. *See* 42 U.S.C. §§4916(c), 4917(c) (granting EPA the power to grant local exemptions). Without a standard, however, local governments have the responsibility to produce evidence that a local exemption is justified without prior notice concerning what standards EPA will use to weigh the evidence. Consider the case of Seattle, Washington, which sought a local exemption in response to petitions received from residents in a densely populated neighborhood near railroad switch yards. EPA responded that the noise measurement data supplied by the city was not consistent with the measurement methodology used to establish noise standards, and the city failed to submit a copy of the regulations that it proposed to enact. *See* Transportation Noise, supra note 130 , at 51-52. When EPA has made similar demands on other cities, they have given up obtaining an exemption. Feith interview, supra note 16.

some extent, from filling the regulatory void that the lack of funding has created.

Congress could repeal the NCA, or at least its preemption provisions, and free states and local governments to regulate more strictly, if they wish. But this choice merely recreates the conditions that led to passage of the NCA in the first place. As noted previously, preemption can provide important scale economies for firms that operate in interstate commerce.[283] Thus, unless Congress is prepared to forgo these economies of scale, a federal agency must be funded to enforce and, if necessary, update current regulations.

Congress could fund EPA (or some other agency) only to update and enforce current regulations. Or it could limit federal jurisdiction to regulate in some other manner. For example, the federal government could address only transportation noise.[284] Besides saving money, this approach has the advantage of maximizing the extent to which state and local governments would be free to regulate. Ultimately, however, this approach would be self-defeating. Additional targets for regulation exist,[285] and if state and local governments receive the informational and technical support recommended in the previous section, they will establish additional regulation. Demands by industry for federal preemption will quickly follow and Congress will have accomplished little by failing to have the federal government address these noise sources in the first place.

2. Location of Regulatory Activities

Congress could transfer EPA's regulatory responsibilities to other agencies which have mandates related to the regulation of transportation services and consumer products. But such a rearrangement would not increase the effectiveness of federal efforts.

Locating NCA standard-setting in other agencies has some advantages. Congress could delegate to DOT the authority to establish noise emissions standards for transportation.[286] This change would avoid the coordination problems that arise from splitting the responsibility to abate traffic noise between EPA and DOT, and it would permit DOT to coordinate more easily the use of other highway noise abatement techniques, such as noise barriers, with reliance on emissions controls. Congress could assign to the Consumer

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[283]Note 275 supra & accompanying text.

[284]*See* Transportation Noise, supra note 130 , at 74 (proposing option that EPA be funded to regulate Transportation Noise sources).

[285]*See* supra Section ID.

[286]*See* Transportation Noise, supra note 130 , at 75 (discussing moving responsibility for transportation standard setting to DOT).

Product Safety Commission (CPSC) the regulation of nontransportation products and to OSHA the labeling of hearing protection equipment. Since CPSC's mandate is to protect consumers from dangerous products,[287] the regulation of product noise emissions is congruent with its mission. Delegating to OSHA the responsibility to regulate hearing protection equipment makes sense since most consumers of protection equipment are employers and OSHA's hearing conservation standard depends on the accuracy of the labels used on hearing protection equipment.[288]

There are, however, also good reasons for leaving standard-setting at EPA. First, Congress would lose the synergism that is produced by placing most aspects of noise abatement in EPA. Conversely, dividing up the federal government's abatement activities will create substantial coordination difficulties. Assuming that EPA resumed support of an infrastructure for local regulation, four different agencies (DOT, CPSC, OSHA, and EPA) would be involved in noise abatement under the previous proposals. Second, parcelling out responsibilities to four different agencies will result in at least some duplication of staffing. Third, reassigning EPA's regulatory responsibilities will not necessarily result in more effective regulation since both DOT and CPSC have some liabilities that EPA does not share. For example, to the extent that DOT has responsibilities to promote transportation, as well as regulate it, it may lack the same credibility and motivation in regulating noise that EPA would have.[289] Moreover, CPSC's effectiveness has been questioned over the years.[290]

While there are arguments for locating EPA's regulatory responsibilities in other agencies, the coordination problems that would result counsel against such a step. If the purpose of a reorganization is to make the government's abatement efforts more effective, that result can hardly be accomplished by splintering responsibilities now primarily located in one agency into four different ones. While it is true that EPA managers were not always genial

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[287]15 U.S.C. §2051(b)(1) (1988).

[288]29 C.F.R. §1910.95 (1990).

[289]Transportation Noise, supra note 130 , at 75; *see also* Letter from Sandford Fidell, Lead Scientist, BBN Systems and Technology, to David Pritzker, ACUS (Apr. 1, 1991), at 2 (No other agency besides EPA "has provided a consistent interpretation of noise effects research uncolored by institutional interests"); Stewart Letter, supra note 8, at 3 (Agency "that does not have a conflict of interest is very much needed" since a "first objective" of FAA, FHWA, and HUD "is to set criteria which allow their projects to be built.").

[290]Tobias, *Revitalizing The Consumer Product Safety Commission*, 50 MONT. L. REV. 237 (1989); Adler, *From "Model Agency" To Basket Case--The Case of The Consumer Product Safety Commission*, 41 AD. L. REV. 61 (1989); Schwartz, *The Consumer Product Safety Commission: A Flawed Product of the Consumer Decade*, 51 GEO. WASH. L. REV. 32 (1982); Tobias, *Consumer Agency Falling Down On The Job*, Legal Times, Mar. 20, 1989, at 19, c. 1.

hosts to ONAC, as the prior discussion noted,[291] there are reasons to believe that agency managers will take this responsibility seriously. Moreover, there is no reason to believe that DOT or CPSC would be more committed to noise abatement, or would be more effective as regulators.

B. EPA's Options

Since EPA should retain the responsibility for implementing the NCA, it is important that the agency carefully assess its abatement options. This section evaluates EPA's options for implementing these responsibilities in terms of risk assessment and management, and coordination and oversight.

1. Risk Assessment and Management

Risk assessment is a two part process involving hazard assessment, or determining what degree of harm a noise source poses, and exposure assessment, or estimating the number of persons who will be exposed to harmful or annoying levels of emissions.[292] EPA has previously identified emissions levels that are harmful to health or are disruptive,[293] and its last noise survey, completed in 1981, constituted an exposure assessment.[294] Earlier it was recommended that EPA acquire up-dated exposure data.[295] It should also update its risk assessment to reflect what else has been learned about the health consequences and other effects of noise pollution since 1981.[296]

As part of its risk assessment, EPA should rank significant sources of noise according to their relative risk.[297] Since EPA is unlikely to have funding to

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[291] *See* supra note 271 & accompanying text (discussion of whether EPA will be more interested in noise abatement).

[292] *Cf.* Shapiro, *Biotechnology and the Design of Regulation*, 17 ECOLOGY L.Q. 1, 6-7 (1990) [cited hereinafter as "*Regulation Design*"].

[293] Levels Document, supra note 35.

[294] Bolt Beranek and Newman, Noise In America: The Extent of the Problem (July, 1981).

[295] *See* supra note 200 & accompanying text (recommending that EPA compile new exposure data).

[296] *See* Lipscomb Letter, supra note 93, at 5 (production of a "revised and updated Criteria Document should be one of the first charges to a revived ONAC program"); Maling Letter, supra note 160, at 5 (EPA should "review and rewrite 'Levels Document'").

[297] *See* SAB Report, supra note 264, at 19 (recommending that EPA should reflect "risk-based priorities" in its strategic planning process). Under the relative risk approach recommended by the SAB, *id.* at 16, EPA would also have to compare the risk reduction that could be achieved in noise abatement with its other responsibilities. Since there is no up-to-date data concerning the

pursue more than a few abatement projects, it is important that the agency pursue those noise sources that pose the most significant problems. A former ONAC official concedes that although the noise program had criteria to choose which noise sources required regulation, it did not attempt to rank noise sources chosen for regulation in terms of which should be regulated first.[298]

Risk management involves selecting the most appropriate strategy to reduce emissions to the level required by the agency's mandate.[299] Whereas ONAC thought primarily, if not exclusively, in terms of emissions standards as a regulatory response, any new regulatory program should consider emissions standards as a last resort. Before promulgating an emissions standard, EPA should determine whether market forces, or local or state regulation, can be utilized to reduce product or transportation noise.[300] During its tenure, ONAC did not undertake the type of comprehensive assessment of risk management options recommended here.[301]

a. Market Forces

Market forces have a role to play in noise abatement, but the utility of this approach depends on whether a consumer's choice about how much noise he or she will tolerate also impacts on third parties. This section explains how EPA can expand the use of product labeling and the limitations of this approach.

The extent of noise pollution is a function of the level of consumer demand for quieter products because properly functioning markets will supply the amount of noise abatement demanded by consumers.[302] A market will not function properly, however, if product noise information is expensive to acquire.[303] EPA can lower consumer search costs by educating the public

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extent of noise risks, note 190 supra & accompanying text, it is not clear how the risks associated with noise might compare to other opportunities for risk reduction.

[298]Feith interview, supra note 50.

[299]*Regulation Design*, supra note 292, at 37.

[300]*See* SAB Report, supra note 264, at 21 (EPA should make greater use of all the tools available to reduce risk); Strategic Options, supra note 274, at 33 (same).

[301]Noise Pollution, supra note 50, at 33.

[302]*Cf.* P. Asch, Consumer Safety Regulations: Putting a Price on Life and Limb 33-35 (1988) (properly functioning markets will supply the amount of safety demanded by consumers).

[303]A rational consumer will seek information about a product until the costs of the person's search exceed the expected benefits at the margin. *Id.* at 49. When search costs are high, consumers will demand less safety than when search costs are lower. Lyndon, *Information Economics and Chemical Toxicity: Designing Laws To Produce and Use Data*, 87 MICH. L. REV. 1795, 1815 (1989). A market will also not function properly if the purchasing decisions of individual consumers affect the health of third persons. *See infra* note 318 & accompanying text (discussion of problem of spillover costs).

concerning the potential harms of noise and by promoting noise labeling. Consumers would benefit from labeling that reveals the level of noise emissions, such as labels that specify the amount of noise emitted by appliances, and from labeling that reveals the level of noise suppression, such as labels that specify the extent to which various grades of windows attenuate noise.[304]

Increased noise labeling would not necessarily require EPA regulation. As EPA educates consumers concerning the value of quieter products, some sellers will respond by providing noise information. Nevertheless, because other sellers may limit or lie about the noise information they provide,[305] regulation may be necessary to ensure adequate disclosure. EPA, however, has an important role to play even in cases of voluntary disclosure. EPA can make the voluntary disclosure of information more effective by working with an industry to promote measurement accuracy and to ensure that noise information is provided in a manner that ensures consumers can understand it and use it to compare the performance of products. Uniformity in labeling is particularly important. Consumers are unlikely to be able to use noise labels effectively if product labels for different products use different methods of disclosure.

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[304]*See* Letter from M.G. Prasad, Professor of Mechanical Engineering, Vice-President for External Affairs, Stevens Institute of Technology, to David Pritzker, ACUS (Mar. 29, 1991) (Labeling will have a "positive impact on quality and marketing of products");

Melnick Letter, supra note 198, at 1 ("Labeling products would also provide the public with information which would assist them in making purchasing judgments and serve as a mechanism for an acceptable level of awareness.")

An industry spokesman disagrees concerning the value of labeling because it would be "misleading and ineffective for the average person." Toothman Letter, supra note 94, at 2. This problem, however, could be addressed by linking consumer education programs to product labeling. Moreover, EPA should work with industry to design labeling that is understandable to the average consumer. Finally, some types of consumers, such as industrial purchasers, *see infra* note 312 & accompanying text, or environmentally-sensitive consumers, *see infra* note 313 & accompanying text, would have the sophistication and interest to understand the labeling.

[305]A seller would have an incentive to limit or skew information when its products were louder than its competitors. In this case, if disclosure were made at all, the seller has an incentive to skew the information by revealing it in a manner that makes it difficult for the firm's products to be compared to those of competitors. Beales, Craswell, & Salop, *The Efficient Regulation of Consumer Regulation*, 24 J. L. & ECON. 491 (1981); Nelson, *Information and Consumer Behavior*, 78 J. POL. ECON. 311 (1970), Rothschild, *Models of Market Organization with Imperfect Information: A Survey*, 81 J. POL. ECON. 1283 (1973). The firm might also lie or mislead consumers about the level of noise created by its product. EPA's experience confirms this last possibility. *See* supra note 126 & accompanying text (EPA has found that manufacturer of hearing protection equipment made false claims).

ONAC's experiences with lawn mower noise emissions illustrates the potential of the previous approach as well as some of its pitfalls. Although ONAC declared lawn mowers to be a significant noise source,[306] it agreed to postpone an emissions standard if the industry would engage in voluntary labeling.[307] The labeling program remains in effect today, but consumers have shown little interest.[308] The industry claims that this tepid response indicates that consumers understand that lawn mowers do not pose significant risks,[309] but it is also possible that consumers are not interested in the labels because the disclosure program was implemented at the same time that EPA stopped its efforts to educate consumers about the risks of noise.[310] As noted earlier, an NIH panel has found that consumers are ill-informed about the risks posed by noise.[311] Moreover, even if some consumers would ignore the labels, commercial purchasers[312] and consumers who are sensitive to environmental issues[313] would likely use such information.

Market forces can be used to abate noise emissions in other ways as well. The NCA authorizes EPA to assist other agencies in purchasing quieter products, as an inducement for their creation and manufacture.[314] The usefulness of this approach, however, is limited by the fact that it can not be used for products for which there are no EPA emissions standards.[315] A better approach would be for Congress to authorize EPA to designate low noise products for purchase by the government without the requirement that an

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[306]42 Fed. Reg. 2525 (1977).

[307]Feith interview, supra note 16.

[308]Interview with John Liskey, Director of Statistical and Technical Services, Outdoor Power Equipment Inst., in Alexandria, Va., Dec. 5, 1990.

[309]*Id.*

[310]Other industries have also found little consumer interest in purchasing quieter products. For example, there has been little consumer demand for quieter household products such as vacuum cleaners, dishwashers, and disposals. Eldred interview, supra note 59. By comparison, refrigerator manufacturers have made their product more quiet in response to consumer demands. *Id.* The difference might be explained by how consumers treat occasional versus continuous noise. *Id.* As in the case of lawn mowers, however, consumers are apparently ill-informed about the risks posed by noise, or the possibility that noise can be reduced.

[311]Note 201 supra & accompanying text. Moreover, consumers are generally unaware that consumer products like air conditions have noise ratings that could be used for purposes of comparison shopping. Feith interview, supra note 16.

[312]*See* Stewart Letter, supra note 8, at 4 (buyers of machinery in some industries "are having difficulty obtaining needed information and cooperation from machinery builders").

[313]Glaser Letter, supra note 100, at 2 ("new breed of educated consumer" who "wants to know about environmental hazards" is likely to use noise information).

[314]*See* supra Section IB3.

[315]*See* supra note 61 & accompanying text (describing legal constraints on use of program).

emissions standard exist for such products.[316] EPA could also recommend to Congress and state legislatures that they establish tax or other incentives for companies to reduce noise emissions.[317]

Although market forces have a role to play in noise abatement, not every noise problem is suitable for the previous approaches. Consumer education and labeling empowers consumers to decide for themselves what level of noise protection is appropriate, but if the consumer's choice also impacts adversely on third parties, some form of abatement regulation may be necessary.[318] The problem of lawn mower noise is again instructive. The noise from lawn mowers affects their owners, but it is also heard by others who are nearby. Unless home owners purchase quieter mowers for their own reasons, or at the behest of their neighbors, third parties will be unprotected from lawn mower noise.[319]

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[316]EPA can rely on market forces in this manner, however, even if Congress does not amend the Noise Act. One of ONAC's successes was helping communities purchase quieter products by writing model contract specifications that they could use. *See* supra note 61 & accompanying text (describing EPA's state and local buy quiet program). There are no legal constraints preventing EPA from renewing this approach.

[317]*See* Consensus Statement, supra note 96, at 18 (Incentives for manufactures to design quieter industrial and consumers goods are needed to reduce nonoccupational NIHL).

[318]Since buyers have no incentive to take into account the effect of noise on other persons when they purchase a noise-emitting product, any protection that others receive is a function of the purchaser's desire for less noise. In many cases, third parties will be exposed to loud noises because buyers have little or no interest in reducing the noise of the products they purchase. Individuals who wear hearing protection equipment while running a chain saw, for example, have no incentive to purchase a quieter product unless that option would be less expensive, which is unlikely. Also, the person who purchases a product may not hear the noise it creates. Those persons who manage the nation's railroads typically do not live next to railroad switching yards. In other cases, individuals will be present, but they may be risk takers. Individuals may purchase loud snowmobiles because they are willing to take the risk of possible hearing loss. Finally, some persons simply like noise, such as some motorcycle enthusiasts.

While persons affected by noise could reach an agreement with noise producers concerning the amount of noise they will emit in some cases, *cf.* Coase, *The Problem of Social Cost*, 3 J. L. & ECON. 1 (1960), in most cases such negotiations would be infeasible. Citizens, for example, would not be able to contract with the thousands of truck drivers who passed through their community to reduce their noise emissions. In addition, a market transaction will lead to an economically appropriate amount of pollution only if the person subject to the pollution has good information concerning its effects on human health. Schroeder & Shapiro, *Responses To Occupational Disease: The Role of Markets, Regulation, and Information*, 72 GEO L. J. 1231, 1241 (1984). Since some of the health effects of noise are not well understood, *see* supra note 191 & accompanying text (discussing health effects of noise), relying on market transactions to eliminate third party effects may also be inappropriate.

[319]These third parties will receive protection if home owners decide to seek quieter equipment to protect themselves, but home owners may not purchase quieter mowers. For example, the

Where third party effects exist, it is still possible to rely on market incentives to reduce noise. Instead of promulgating an emissions standard, Congress could authorize EPA to assess a tax on products that exceeded certain noise levels. This approach has been used with some success by some local airport operators,[320] and has received attention generally as a more efficient approach to reducing pollution.[321]

b. State and Local Regulation

Although noise-reduction regulation may be necessary in cases involving an impact on third parties, this does not mean the EPA regulation is necessary. States and local governments have at their disposal under current laws a wide range of regulatory tools--such as landplanning, noise barriers, time and place restrictions--that may not create an impediment on interstate commerce. This fact suggests that EPA should promulgate emissions standards only if local regulation will be ineffective or present a burden on interstate commerce.

The example of lawn mower noise can be used one more time. Although some persons who are informed about noise will purchase quieter lawn mowers, others will not. If the impact of the residual noise on third parties is significant, additional noise reduction will require government action. Whether local regulation will be adequate depends on the nature of the problem. If the problem is largely one of annoyance, a city could implement time and place restrictions. If, however, the noise is sufficiently loud to have significant adverse health effects, some form of emissions regulation could be necessary. Only in this last case would EPA regulation arguably be necessary to protect the public and guarantee uniform national treatment of lawn mower manufacturers.[322]

Evaluating the potential of local regulation has several advantages for EPA. First, it will save scarce EPA resources for noise problems that can not be addressed other than by federal efforts. As a related matter, EPA will be less

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home owner may decide that wearing hearing protection equipment is a less expensive option. Or the buyer may believe that lawn mower noise is sufficient to warrant purchasing a more expensive lawn mower that makes less noise. In such situations neighbors may be able to negotiate with lawn mower owners to reduce their noise exposure, but this result is more unlikely in crowded neighborhoods, where the negotiations would involve dozens of persons who both produce the noise and are subject to it.

[320]Suter, *Wendell Ford's Edsel--Or How To Delight The Lobbyists and Enrage The Citizens*, Sound & Vibration, Jan. 1991, at 5 [cited hereinafter as "*Ford's Edsel*"].

[321]*E.g.*, Sunstein, *Administrative Substance*, 1991 DUKE L.J. ___, ____ (forthcoming).

[322]An emissions standard would not necessarily eliminate the usefulness of labeling. Although the standard would establish a minimum level of protection, labeling would permit consumers to purchase machines that exceeded the minimum standard if they desired.

likely to promulgate standards, like the garbage truck regulation, that are opposed by some local noise officials, without considering the merits of this opposition.[323] Second, it invites EPA to work closely with those officials. Finally, it would permit EPA to integrate its support of an infrastructure for state and local regulation with its priority-setting process. Once EPA decided to rely on local regulatory efforts, it could then design support activities that would assist local governments in achieving the desired noise abatement.

A noise problem might also be addressed through a combination of market incentives and local control. Garbage truck noise illustrates this possibility. Many communities have the option of prohibiting garbage pickup while most residents are sleeping. Where this is not true, such as urban areas where daytime pickup is infeasible, EPA could take another tack. It could write a model contract specification that cities could use to purchase trucks that are lower in noise.

c. EPA Discretion

Although EPA should make emissions standards the regulatory tool of last resort, the NCA may prevent part of this approach. EPA has the discretion under the NCA to require labeling for noise sources whether or not they have been designated as "major" noise sources.[324] The NCA, however, appears to require EPA to regulate any product identified as a "major" noise source, even if state and local regulation might be adequate to protect the public. Under the NCA, once EPA identifies a product to be a "major" noise source, it must promulgate emissions standards within the short time deadlines specified in the act.[325] EPA, however, might avoid this result by defining "major" noise source to mean any source that requires a federal emissions standard for successful abatement or for purposes of preemption.[326] This interpretation

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[323]*See* supra note 112 & accompanying text (garbage truck emissions standard was opposed by local noise officials as unnecessary).

[324]42 U.S.C. §4907(a).

[325]Note 39 supra & accompanying text.

[326]The NCA does not define what constitutes a "major" source of noise. *See* 42 U.S.C. at §§4902, 4904(b)(1). The House Report likewise contains no definition. *See* House Report, supra note 17, at 12-13. The Senate report notes that the concept of "environmental noise" refers to the "overall level of noise in a given area to which individuals are exposed, including the intensity, duration, and character of sounds from all sources." Senate Report, supra note 17, at 6. It also acknowledges that "[i]dentification as a major noise source is the first step in the development of noise emissions standards for particular products." *Id.* This last statement offers some support for the conclusion that a "major" noise source is one that requires a federal emissions standard for successful abatement.

would give EPA the flexibility to pursue noise abatement through alternative methods, while reserving the possibility that the agency would use an emissions standard if other techniques were unsuccessful.[327] If the NCA can not be interpreted in this manner, Congress should amend it to give EPA this flexibility. EPA's implementation of the NCA could also be hindered by the deadlines the NCA sets for promulgating emissions standards. ONAC missed most of these deadlines because they were unrealistically short given the size of its staff and the difficulty of writing the regulations.[328] The wisdom of statutory deadlines is the subject of considerable debate. Deadlines can improve legislative oversight,[329] enable courts to determine more easily when agency action is unreasonably delayed in violation of the Administrative Procedure Act (APA),[330] and mitigate pressures on an agency to move slowly.[331] But, as in the case of the NCA, these advantages are often lost because Congress sets unrealistically short deadlines. A better approach would be to require EPA to set its own rulemaking deadlines and then make these deadlines judicially enforceable.[332] This would permit it to set realistic deadlines,[333] while still holding it accountable.[334]

Moreover, since Congress also authorized EPA to designate a product for labeling if it "emits a noise capable of adversely affecting the public health or welfare," *id.*, §4907(a)(1), it must have anticipated that at least some noise problems could be addressed through the use of labels. This implies that EPA was to have flexibility in choosing its approach.

If Congress did not resolve whether EPA could rely on other forms of abatement in lieu of emissions standards, EPA can write its own definition of "major" noise source as long as it is consistent with the goals and purposes of the Act. Chevron v. Natural Resources Defence Council, 467 U.S. 837 (1984). This construction would be consistent with the Act since it both results in the reduction of noise and preserves EPA's scarce resources to address problems that are intractable to other solutions (or which require federal regulation for purposes of preemption).

[327]It would not, however, justify an indefinite delay in establishing federal standards. Since the goal of the Act is noise abatement, 42 U.S.C. §4901(2), once EPA recognized that other abatement techniques were not working, it would be obligated to identify a problem as a "major" noise source and proceed to regulate it. *See* supra note 121 & accompanying text (arguing that EPA can not postpone permanently the deadlines specified in the Noise Act by de-identifying noise sources because of a lack of money to regulate).

[328]*See* supra note 49 & accompanying text (discussing why ONAC missed its deadlines).

[329]A statutory deadline provides a clear, articulable standard easily used by oversight committees at agency and budget review time. Shapiro & McGarity, supra note 29, at 54. Missed deadlines generate public concern and thereby focus congressional attention on the deadlines. *Id.* at 53 n. 292.

[330]*See* 5 U.S.C. §706(a)(1) (1988) (authorizing agencies to "compel agency action . . . unreasonably delayed").

[331]Shapiro & McGarity, supra note 29, at 56.

[332]Congress could assure further accountability by providing that agency-set deadlines could be extended only for good cause and only for congressionally determined intervals. Finally,

d. Decisionmaking Procedures

EPA should use consensus building procedures, such as advisory committees, workshops, and negotiated rulemaking, to implement the risk assessment and risk management processes recommended above. Because advisory committees can explain complex technical issues, provide peer review for tentative decisions, identify areas of consensus among scientists and engineers, and expand the participation of interested experts and affected citizens in agency decisionmaking,[335] they can improve the credibility of agency decisions, and thereby increase their acceptance.[336] This last advantage might be particularly important since EPA would be attempting to restart a program that received significant criticism from the professional community when it last operated.[337] Some of the same advantages can be obtained in a less formal and structured manner by inviting professionals, members of the regulated industry, public interest groups, and others, to participate in workshops, such as the meetings of local noise officials and noise professionals held late in ONAC's tenure.[338] Such ad hoc arrangements, however, might not be as credible as establishing a permanent advisory committee that could give continuous peer review.[339]

EPA could also use negotiated rulemaking in circumstances where the Conference has recommended that its use can be constructive.[340] EPA has used

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Congress could provide for judicial review of agency-set deadlines to prevent EPA from setting unreasonable long deadlines.

[333]The Administrative Conference suggests that the problem of unreasonable deadlines and adverse effects on agency decisionmaking can be mitigated if the agency set its own deadlines. 1 C.F.R. §305.78-3 (1990), because the deadlines reflect the agency's understanding of its own resources. *See* Shapiro & McGarity, supra note 29, at 56.

[334]If EPA implements the NCA, there is a danger that agency administrators will once again ignore the act as they did previously. While there are reasons for believing this will not happen, note 271 supra & accompanying text, this approach would protect against history repeating itself.

[335]*Cf.* Shapiro & McGarity, supra note 29, at 35.

[336]Shapiro, *Scientific Issues and the Function of Hearing Procedures: Evaluating FDA's Public Board of Inquiry*, 1986 DUKE L.J. 288, 306-07; *But see* Shapiro, *Public Accountability of Advisory Committees*, 1 RISK 189, 190-92 (1990) (describing potential of advisory committees to make administrative process less accountable). EPA has the services of a Science Advisory Board (SAB), *see* Ashford, *Advisory Committees in OSHA and EPA: Their Use In Regulatory Decisionmaking*, 9 SCI.,TECH. & HUM. VALUES 72 (1984) (describing the SAB). which advises the agency as a whole, but SAB members are unlikely to have expertise concerning noise issues.

[337]Von Gierke interview, supra note 74.

[338]Note 70 supra & accompanying text.

[339]Von Gierke interview, supra note 74.

[340]Procedures for Negotiating Proposed Regulations (Recommendation 85-5), 1 C.F.R. §305.85-5 (1990); 82-4, Procedures for Negotiating Proposed Regulations (Recommendation 82-

successfully used this procedure previously to implement its other statutory responsibilities.[341] While negotiated rulemaking works best in certain types of situations, some of the issues that might come up in future noise regulation, such as a standard creating a process for exemptions for local communities to regulate railroad yard noise,[342] appear suitable for this process.[343]

2. Coordination and Oversight Functions

EPA should also resume its coordination and oversight functions. Specifically, it should coordinate the noise abatement activities of other government agencies, facilitate private and international standard setting activities, and rethink the regulatory basis for airport noise abatement.

The importance of coordination of the federal government's noise abatement activities is difficult to judge since the extent of such activities has not been catalogued since ONAC was abolished. Nevertheless, even if the federal government's activities are fairly limited, coordination could extend limited resources by promoting the sharing of information and the elimination of duplication. The Scientific Advisory Board has recommended that EPA in general should do more to foster cooperation among government entities responsible for reducing pollution,[344] and the NIH panel concluded that "reestablishment of a federal agency coordinating committee with central responsibility for practical solutions to noise issues is essential."[345]

EPA also has a role to play concerning national and international standardization activities.[346] The Acoustical Society of America and other

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4), *id.* §305.82-4. Negotiated rulemaking is a structured discussion among all interested parties, often with the aid of a mediator or facilitator, to arrive at a consensus concerning a proposed rule. When the process is successful, an agency can promulgate the proposed rule with substantial savings in time and costs. Administrative Conference of the United States, Negotiated Rulemaking Sourcebook (1990); Harter, *Negotiating Regulations: A Case of Malaise*, 71 GEO. L.J. 1 (1982).

[341]Thomas, *The Successful Use of Regulatory Negotiation by EPA*, 13 Admin. L. News 1 (Fall, 1987), *reprinted in* Sourcebook, *supra* note 340, at 20.

[342]*See* supra note & accompanying text (discussing need for such an exemption).

[343]Procedures for Negotiating Proposed Regulations (Recommendation 82-4), 1 C.F.R. §305.82-4 (1990); *see* Harter, supra note 282, at 42-52 (listing conditions for successful negotiations).

[344]SAB Report, supra note 74, at 23; Strategic Options, supra note 274, at 43 ("Due to EPA's limited jurisdiction, cooperation with other agencies . . . often presents the best opportunities to reduce environmental risks.")

[345]Consensus Statement, supra note 201, at 18.

[346]*See* Administrative Conference of the United States, Federal Agency Interaction With Private Standard Setting Organizations in Health & Safety Regulation (Recommendation 78-4), 1 C.F.R. §305.78-4 (1990) (health and safety regulatory agencies should take advantage of private

similar professional groups have been active for many years in working with the American National Standards Institute (ANSI) to develop consensus standards concerning noise and vibration control.[347] Although ONAC has been criticized for ignoring private standardization activity,[348] there is opposition to governmental involvement in such activity,[349] except to support travel and other expenses of individuals who attend national and international standard-setting conferences.[350] These persons would like the government to support such activities and use the results, but not attempt to influence the outcome.[351]

The problem with limiting EPA's role in this manner is that the membership of most private groups interested in developing consensus standards is largely composed by representatives of noise producers, including governmental noise producers such as the Air Force and Navy.[352] If persons without a vested interest are represented at all, they are represented by a few university professors and consultants.[353] Thus, EPA's participation in such activities might bring additional balance and produce a result that the agency is more likely to be able to use. The same objective might be accomplished if EPA supported the expenses of citizens, professors, or consultants, who are not associated with noiseproducers. Whether or not EPA actively participates in private standard-setting activities, it should work with private organizations

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standard setting activities); NIOSH Strategies, supra note 206, at 57-58 (strategies to reduce noise should include promotion of national standards for noise control, hearing conservation practices, and product noise control through such organizations as American National Standards Institute and Acoustical Society of America).

[347]Timmerman Letter, supra note 258, at 3.

[348]*See* supra note 70 & accompanying text (discussing criticism of ONAC). ONAC embarked on a project to work with professional groups and other government agencies to develop common technical methods near the end of its tenure, but the project was ended when it lost its funding. *See* supra note 70 & accompanying text (discussing ONAC's efforts to work with industry to develop measurement efforts).

[349]*See, e.g.*, Kessler Letter, supra note 94, at 5 (EPA should "encourage" but not "influence" consensus noise standard activities); Maling Letter, supra note 160, at 4 (federal involvement will end up in federal "control"); Toothman Letter, supra note 94, at 2 ("Consensus standards activities are being adequately handled in this country; therefore, there is no need for federal activity.").

[350]*E.g.*, Kessler Letter, supra note 94, at 5; Timmerman Letter, supra note 258, at 3 ("only effective use for federal support" would be for travel expenses).

[351]*E.g.*, Luz Comments, supra note 100, at 3 (standards should be developed by support to ANSI).

[352]Stewart Letter, supra note 8, at 5.

[353]*Id.* Participation is limited because such individuals must usually bear their own expenses. *Id.*

to identify potential projects that would benefit both private industry and the government.

EPA regulations should be congruent with international regulatory standards if possible. This prevents domestic manufacturers from having to meet different regulatory standards in the United States and abroad. Further, it places EPA in a position to work with other regulatory authorities, such as the European Community, in adopting regulatory standards which protect the public, and yet do not serve as trade barriers.[354] ONAC previously engaged in some of these activities.[355]

The final coordination issue is what role, if any, EPA should have concerning airport noise abatement. Since ONAC was abolished, this issue has been complicated by changes in the FAA's regulatory powers. In the waning moments of the 1990 session, Congress forbade airport operators from enacting noise abatement measures concerning the newest generation of airplanes unless they have been approved by the FAA.[356] The legislation was sought by the airlines and air cargo industry because of the proliferation of local noise restrictions including evening and night-time curfews and requirements that aircraft operators pay taxes for emitting noise above specified levels.[357] Citizen groups and local elected officials, who are upset over the bill's passage,[358] have expressed an interest in having EPA

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[354]Letter from Martin Hirschorn, President, Industrial Acoustics Co, Inc., to David Pritzker, ACUS (Mar. 8, 1991) ("highly desirable" to have uniform international standards); Eversman Letter, supra note 258, at 1 (ISO standards are an "excellent" basis for establishing minimum standards for noise emissions); Hickling Letter, supra note 147, at 2 (a primary need is to reconcile noise control in United States with Europe and Japan); Luz Comments, supra note 100, at 9 (EPA should work with private standard-setting groups "to ensure that U.S. products will be competitive in the European market"); Melnick Letter, supra note 198, at 1 (federal assistance could "promote a stronger U.S. presence in the international standards community" and "facilitate" trade).

[355]*See* supra note 72 & accompanying text (discussion of EPA's attempts to harmonize domestic and international standards).

[356]Congress prohibited airport operators from adopting any airport noise or access restriction for Stage 3 aircraft unless the Secretary of Transportation finds that it meets a list of criteria specified by Congress including that the restriction does not pose an "undue burden" on interstate and foreign commerce or on the national aviation system. Aviation Noise and Capacity Act of 1990, §§9302(b), (d). A "stage 3" aircraft is one that meets the strictest of the FAA's regulations limiting aircraft noise emissions.

[357]*Ford's Edsel*, supra note 320.

[358]They assert that the sponsors of the legislation were able to sneak it through Congress during the chaos that accompanied the final days of the session. No public hearings were held, and although committee staffers consulted industry lobbyists during the bill's markup, representatives of airport operators were not consulted. *Id.* They also claim that the legislation gives the FAA unlimited discretion to strike down local noise abatement efforts. They point to

superintend the FAA's implementation of its new powers.[359] The new legislation, however, does not establish any role for the EPA concerning the FAA's new powers. Nevertheless, EPA's authority under the NCA to coordinate federal noise abatement activities would arguably authorize it to participate in the FAA's implementation of its new powers.[360]

EPA can improve aircraft noise abatement, but not by attempting to supervise how the FAA implements its new powers. As the original director of ONAC points out, "It is difficult if not impossible for one federal agency to coordinate another federal agency's programs and actions."[361] EPA and FAA officials disagree concerning whether EPA oversight has increased noise abatement, but one undisputed legacy is FAA's continuing hostility concerning EPA's supervisory efforts.[362] An EPA approach to aircraft noise abatement that avoids direct confrontation with FAA is therefore more likely to be successful.

EPA has such a road open to it. FAA regulatory actions are built on scientific and policy conclusions reached by ONAC before it went out of business. As originally recommended by ONAC,[363] FAA defines areas

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the FAA's authority to veto restrictions that put an "undue burden" on interstate and foreign commerce or on the national aviation system, 1990 Act, supra note 356, §§1904(d)(2)(B), (F), because Congress did not define what it meant by "undue burden." *Congress Approves Landmark Bill Setting Framework For Noise Policy*, 2 AIRPORT NOISE REP. 171, 176 (1990). The FAA, however, has proposed criteria to be used to determine whether to approve local programs. 56 Fed. Reg. 8628 (1991).

[359]Telephone interview with Steve Kramer, President, National Organization to Insure A Sound-Controlled Environment (noise), Jan. 8, 1991; *see also* Kessler Letter, supra note 94, at 3 (EPA should be "strong advocate" for community residents impacted by aircraft noise).

[360]This authority authorizes EPA to request information from the FAA concerning the nature, scope, and results of noise-control programs, and to publish a report concerning the status of efforts by other agencies, including the FAA, to reduce noise. 42 U.S.C. §4904(c)(1), (3). EPA could use the former of these powers to require the FAA to notify it concerning applications by airport operators for approval of noise restrictions, and it could use the latter to discuss the adequacy of the FAA's response to the applications. EPA is also authorized to recommend standards to the FAA for the control of noise. 42 U.S.C. §4903(c)(2). It is not clear how this authority relates to the FAA's new powers, although it may have no connection since the FAA will implement its approval or disapproval of local noise regulations by adjudication.

[361]Meyer Letter, supra note 51, at 2.

[362]ONAC's efforts likely did nudge the FAA into being more protective, note 154 supra & accompanying text, but FAA officials deem EPA's past efforts to be largely unimportant or disruptive. Note 154 supra & accompanying text.

[363]DiPolvere Letter, supra note 94, at 2. ONAC's original work concerning the day-night noise limit (Ldn) emphasized the limitations of the metric and the potential need to supplement it in appropriate cases. Stewart Letter, *supra* note 8, at 2. After was ONAC was disbanded,

impacted by aircraft noise as areas with noise levels of 65 Ldn or greater,[364] but citizens living outside of such areas are often among the most vocal opponents of aircraft noise.[365] Critics claim these complaints reflect the fact that the FAA does not take into account the low residual sound in suburban or semi-rural areas, or the intrusive nature of single events, such as a early morning takeoffs while residents are sleeping.[366] In light of these complaints, EPA should evaluate the adequacy of current measurement methods and determine whether additional or new measures would do a better job than the Ldn 65 metric.

A reevaluation would be a useful for two reasons. First, EPA's results are more likely to be generally accepted since EPA does not share the FAA's institutional conflict of interest.[367] Second, if EPA demonstrates that the scientific and policy basis on which the FAA is proceeding is no longer valid, the FAA would presumably conform its approach to the new metric or risk having its approach overturned in court.

IV. Conclusion

The NCA is by any measure a public policy failure. In the NCA's first decade, EPA had made a reasonable start in implementing the Act, but it was a long way from finishing its noise agenda at the time ONAC was disbanded. Some emissions standards were promulgated, but fewer than the significant noise sources identified by EPA as requiring regulation. Almost no progress was made concerning labeling or purchase by the federal government of low noise products. ONAC made significant strides concerning scientific and technical research, coordination, support of local and state noise abatement, and noise education, but funding was eliminated just as the initial fruits of

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however, the 65 Ldn became an universal measure and ONAC's cautionary warnings were disregarded. *Id.*

[364]Transportation Noise, supra note 130 , at 21.

[365]*See, e.g.*, Letter from Loren Simmer, President, National Airport Watch Group, to David Pritzker, ACUS (Mar. 26, 1991) (majority of noise complaints concerning Minneapolis-St. Paul airport are outside of the 65 Ldn contour).

[366]Letter from Craig Cantoni, President, New Jersey Coalition Against Aircraft Noise, to David Pritzker, ACUS (Mar. 16, 1991), at 1-2.

[367]Letter from Charles Price, Executive Director, National Organization To Insure A Sound-Controlled Environment, to David Pritzker, ACUS (Mar. 5, 1991) (citizen group suggests EPA devise new metric); *see* Cantoni Letter, supra note 366, at 2 (citizen group complains that FAA is one of the most "blatant" examples of the Washington "revolving door"); Timmerman Letter, supra note 258, at 2 (EPA in a position to adopt "balanced approach" that weighs impacts on people against economics and efficiencies).

these labors became apparent. The second decade of the Act has been marked by almost no federal noise abatement activity, and with a marked decline in state and local activity. EPA is barely able to enforce its regulations, and fiscal limitations prevent it from updating them although several are out of date or inadequate to protect the public.

Despite this desolate picture, there has been little public outcry primarily because noise pollution lacks the type of strong, organized public constituency that fights other types of pollution, and because EPA has acquiesced in its lack of funding. In the meantime, noise pollution apparently remains at levels equal or above the last estimate in 1981, when it was significant.

The 10-year hiatus in implementing the NCA gives EPA the time and distance necessary to identify and avoid the mistakes ONAC made. Unlike previously, EPA should consider emissions standards as a last resort to be used only if market-related approaches and state and local regulation are likely to fail. This approach requires EPA to support nonregulatory activities which minimize the need for federal regulation, such as an infrastructure for local abatement and liaison with private standard-setting organizations.

The NCA's goal of a quieter country does not deserve the irresponsible treatment that Congress and the EPA gave it. EPA can redeem itself by showing how a modest program employing thoughtful public policy can improve the health and welfare of its citizens. Such a step would not only reduce noise pollution, but it would speak loudly of EPA's dedication to environmental protection.

Technical Appendix: Noise and Its Effects

Alice H. Suter, Ph.D.

I. Introduction

This report presents an overview of noise and its effects on people. Special emphasis is placed on developments over the past decade, both in terms of noise conditions and noise effects research. By doing so, this report should illustrate some of the reasons for concern about noise problems, which persist after the closing of EPA's Office of Noise Abatement and Control (ONAC).

Noise has a significant impact on the quality of life, and in that sense, it is a health problem in accordance with the World Health Organization's (WHO) definition of health. WHO's definition of health includes total physical and mental well-being, as well as the absence of disease. Along these lines, a 1971 WHO working group stated: "Noise must be recognized as a major threat to human well-being." (Suess, 1973)

The effects of noise are seldom catastrophic, and are often only transitory, but adverse effects can be cumulative with prolonged or repeated exposure. Although it often causes discomfort and sometimes pain, noise does not cause ears to bleed and noise-induced hearing loss usually takes years to develop. Noise-induced hearing loss can indeed impair the quality of life, through a reduction in the ability to hear important sounds and to communicate with family and friends. Some of the other effects of noise, such as sleep disruption, the masking of speech and television, and the inability to enjoy one's property or leisure time also impair the quality of life. In addition, noise can interfere with the teaching and learning process, disrupt the performance of certain tasks, and increase the incidence of antisocial behavior. There is also some evidence that it can adversely affect general health and well-being in the same manner as chronic stress. These effects will be discussed in more detail in the paragraphs below.

II. ONAC's Activities in Noise Effects Research and Criteria

In response to the mandates of Section 5 of the Noise Control Act of 1972, ONAC published *Public Health and Welfare Criteria for Noise* (EPA, 1973a) and *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety* (EPA, 1974a, popularly known as the "Levels Document" for obvious reasons). Also in 1973, ONAC sponsored an international conference in Yugoslavia on the effects of noise, from which voluminous proceedings were published (EPA, 1973b). All of these documents were widely distributed and, although

somewhat dated, are still read and referenced today. Because a considerable amount of research in this area has been conducted over the past 2 decades, these documents would benefit from revision.

In these documents ONAC established dose-response relationships for noise and its effects, and identified safe levels of noise to prevent hearing loss and activity interference. The agency also established the day-night average noise level as a universal descriptor to be used in assessing the impact of community noise.

Section 14 of the Act directs ONAC to conduct or finance research on noise effects, including investigations of the psychological and physiological effects of noise on humans and the effects of noise on animals. Approximately 35 technical reports resulted from these efforts, as well as contractor reports and numerous articles in scientific journals. Some of the more noteworthy examples of EPA's research program were:

- Projects involving the cardiovascular effects of noise at the University of Miami, Johns Hopkins University and the Massachusetts Institute of Technology (Peterson, et al., 1978, 1981, 1983; Hattis and Richardson, 1980; Turkkan et al. 1983).

- A longitudinal study of noise exposure and hearing threshold levels in children conducted by the Fels Institute (Roche et al., 1977).

- An interagency agreement with the U.S. Air Force to study the effects of noise on hearing (e.g., Guignard, 1973; Johnson, 1973; Schori and McGatha, 1978; Suter, 1978).

- A study identifying the sound levels of speech communication in various environments (Pearsons, et al., 1977).

- Two studies at Northeastern University comparing methods for predicting the loudness and acceptability of noise (Scharf et al., 1977; Scharf and Hellman, 1979).

Although much useful information was derived from these programs, some of them were irreparably damaged by the abrupt termination of funding from ONAC that occurred in 1981 and 1982. For one example, the Johns Hopkins study of cardiovascular effects of noise on primates was terminated after testing on only one subject had been completed. For another, the longitudinal

data from the Fels Institute is now of little value after a hiatus of more than a decade.

III. Physical Properties and Measurement of Sound

A. Physical Properties

Noise is often defined as unwanted sound. To gain a satisfactory understanding of the effects of noise, it would be useful to look briefly at the physical properties of sound.

Sound is the result of pressure changes in a medium (usually air), caused by vibration or turbulence. The amplitude of these pressure changes is stated in terms of sound level, and the rapidity with which these changes occur is the sound's frequency. Sound level is measured in decibels (abbreviated dB), and sound frequency is stated in terms of cycles per second, or nowadays, Hertz (abbreviated Hz). Sound level in decibels is a logarithmic rather than a linear measure of the change in pressure with respect to a reference pressure level. A small increase in decibels can represent a large increase in sound energy. Technically, an increase of 3 dB represents a doubling of sound energy, and an increase of 10 dB represents a tenfold increase. The ear, however, perceives a 10-dB increase as doubling of loudness.

Another important aspect is the duration of the sound, and the way it is distributed in time. *Continuous* sounds have little or no variation in time, *varying* sounds have differing maximum levels over a period of time, *intermittent* sounds are interspersed with quiet periods, and *impulsive* sounds are characterized by relatively high sound levels and very short durations.

The effects of noise are determined mainly by the duration and level of the noise, but they are also influenced by the frequency. Long-lasting, high-level sounds are the most damaging to hearing and generally the most annoying. High-frequency sounds tend to be more hazardous to hearing and more annoying than low-frequency sounds. The way sounds are distributed in time is also important, in that intermittent sounds appear to be somewhat less damaging to hearing than continuous sounds because of the ear's ability to regenerate during the intervening quiet periods. However, intermittent and impulsive sounds tend to be more annoying because of their unpredictability.

B. Instrumentation

The instrument for measuring noise is the basic sound level meter or a number of its derivatives, including noise dose meters (usually called dosimeters), integrating sound level meters, graphic level recorders, and community noise analyzers. Improvements in all of these instruments have taken place during the last decade. This is especially true of the computerized dosimeters and integrating meters, which can measure, compute, store, and display comprehensive data on the noise field (Earshen, 1986). These instruments are now able to measure over very wide dynamic ranges and to measure impulsive sounds with a high degree of accuracy.

C. Measurement and Descriptors

Most sound level meters and dosimeters use built-in frequency filters or "weighting networks" in the measurement process. By far the most frequently used filter is the A weighting network, which discriminates against low-frequency and very high-frequency sounds. A weighting approximates the equal-loudness response of the ear at moderate sound levels, and correlates well with both hearing damage and annoyance from noise. A weighting will be assumed throughout this report unless otherwise specified.

Composite measures of noise, such as the equivalent continuous sound level (L_{eq}) and the day-night average sound level (DNL) incorporate A weighting. (The mathematical notation for DNL is L_{dn}.) These levels constitute sound energy averages over given periods of time. The DNL incorporates a 10-dB nighttime penalty from 10:00 pm to 7:00 am, meaning that events occurring during that time are counted as 10 dB higher than they really are. A variant of the DNL that is used in California (and Europe) is the community noise equivalent level (CNEL), which incorporates a 5-dB penalty for evening noise events, as well as the 10-dB nighttime penalty (California Code of Regulations, 1990).

For more than a decade, both the DNL and the simple L_{eq} have been used extensively for assessing the impact of aircraft/airport noise. Recently, however, communities have expressed dissatisfaction with these metrics when used to regulate noise (Wesler, 1990). Metrics that employ averaging fail to describe the disturbance arising from single events, especially low-flying aircraft, unexpected or newly occurring flights, or flights occurring in areas where solitude is at a premium. The sound exposure level (SEL), an event's sound level normalized to one second, is gaining popularity as a supplement to the DNL and the L_{eq} for characterizing single events.

IV. Noise in America

A. Population Trends

The U.S. population has increased an average of 25 million with each census since 1950. According to the World Almanac (1991), the population in 1980 was 226 million and approximately 250 million in 1990. This reflects an increase of nearly 11 percent over the decade, or slightly more than 1 percent per year. At present, 77 percent of the U.S. population lives in the nation's 283 designated metropolitan areas, and the rate of growth in these areas is twice that of nonmetropolitan areas (Bryant, 1991).

Not surprisingly, EPA research indicates that noise levels in communities is directly related to the population density (EPA, 1974b).[1] Because the noise in urban areas generally exceeds that of suburban and rural areas, it is not unreasonable to assume that noise in the U.S. is increasing at least in proportion to the increase in urbanization and more rapidly than the growth of the general population. In addition, noise sources appear to be multiplying at a faster pace than the population.

B. Noise Sources

Figure 1, from EPA's simplified version of the Levels Document, *Protective Noise Levels*, shows the range of sound levels for some common noise sources (EPA, 1978). Most leading noise sources will fall into the following categories: road traffic, aircraft, railroads, construction, industry, noise in buildings, and consumer products.

1. Road traffic noise

In its *Levels Document* (1974), EPA estimated that road traffic noise was the leading source of community noise. EPA's contractors found this to be true in 1981 (EPA, 1981), and there is little reason to believe otherwise today.

Truck transportation, as a convenient and economical means of moving raw materials and consumer goods from place to place, is growing at a faster pace

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[1] The day-night average sound level appears to be proportional to the log of population density in people per square mile (EPA, 1974b).

than the general population. For example, a total[2] of 33.6 million trucks were registered in the U.S. in 1980. That number grew to 45.5 million in 1989, an increase of about 35 percent (American Trucking Assoc., 1991).

Noise from the motors and exhaust systems of large trucks provides the major portion of highway noise impact, and provides a potential noise hazard to the driver as well[3]. In addition, noise from the interaction of tires with the roadway is generated by trucks, buses, and private autos.

In the city, the main sources of traffic noise are the motors and exhaust systems of autos, smaller trucks, buses, and motorcycles. This type of noise can be augmented by narrow streets and tall buildings, which produce a "canyon" in which traffic noise reverberates.

2. Aircraft Noise

Air traffic also appears to be increasing more rapidly than the U.S. population. In 1980, U.S. scheduled airlines flew approximately 255.2 billion passenger miles and 5.7 billion cargo (ton) miles. By 1990, these figures were 457.9 billion and 10.6 billion, respectively (Air Transport Assoc., 1991a). This represents an increase of 79 percent in passenger mileage, and 86 percent in air freight mileage. Air cargo traffic has grown particularly rapidly in the last five years, and will probably continue that trend over the next decade.

By 1989, the quieter "Stage III" airplanes comprised nearly 40 percent of the domestic fleet (Air Transport Assoc, 1991b). By the year 2004, all of the noisier Stage II aircraft must be phased out (Airport Noise and Capacity Act, 1990). This requirement should promote a quieter environment around airports, but the growth of air transportation and the pressing need for airport expansion threatens to offset the benefits of the quieter aircraft.

Nowadays, the problem of low-flying military aircraft has added a new dimension to community annoyance, as the nation seeks to improve its "nap-of-the-earth" warfare capabilities. In addition, the issue of aircraft operations over national parks, wilderness areas, and other areas previously unaffected by aircraft noise has claimed national attention over recent years (Fidell, 1990; Cantoni, 1991; Weiner, 1990; Mouat, 1990).

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[2] The total number of trucks registered includes personal-use as well as commercial trucks of all weight classes.

[3] According to Reinhart (1991) the most common complaint about truck noise is related to problems caused by tampering with the mufflers of trucks using compression brakes. About 5 percent of the heavy trucks surveyed by Reinhart and his colleagues had no functioning muffler, despite the existence of antitampering laws.

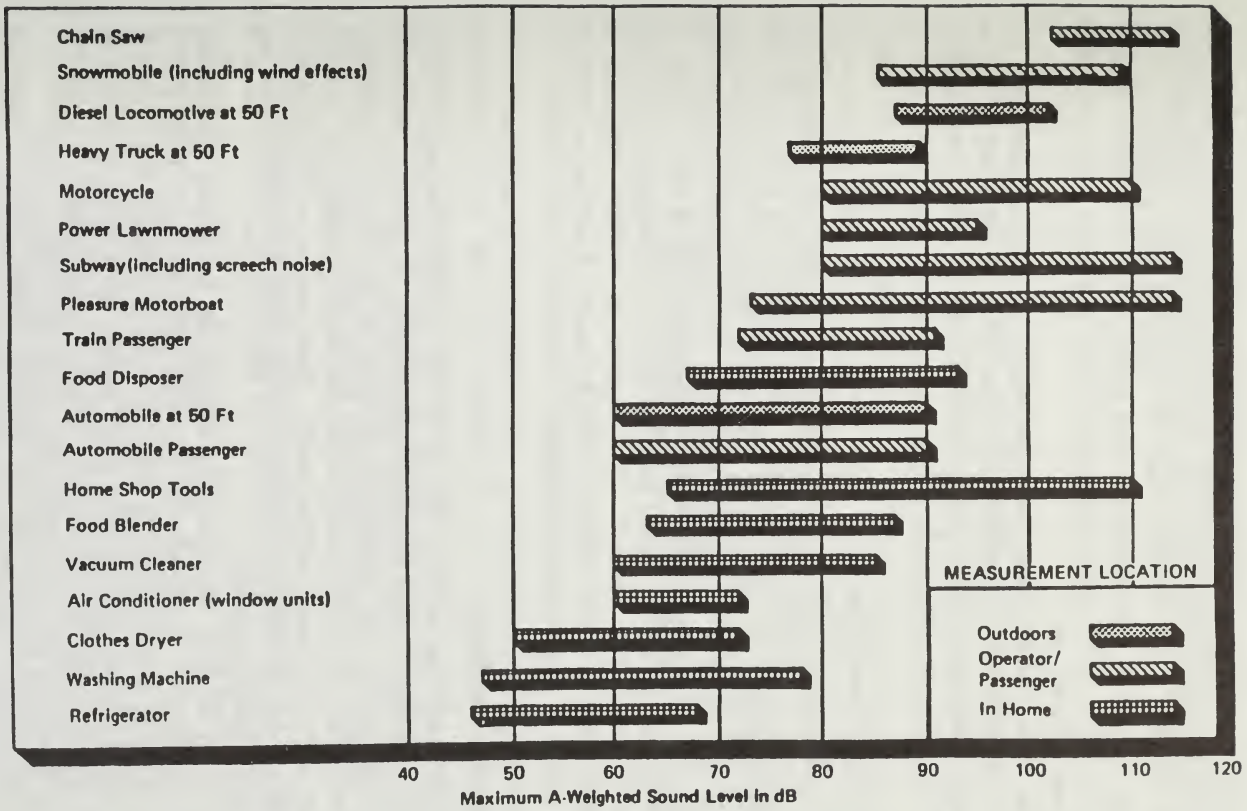

FIGURE 1. TYPICAL RANGE OF COMMON SOUNDS

From Protective Noise Levels (EPA, 1979, p.5)

3. Noise From Railroads

The noise from locomotive engines, horns and whistles, and switching and shunting operations in rail yards can impact neighboring communities and railroad workers. For example, rail car retarders can produce a high-frequency, high-level screech that can reach peak levels of 120 dB at a distance of 100 feet (EPA, 1974), which translates to levels as high as 138 or 140 dB at the railroad worker's ear.

Unlike truck and air transportation, however, rail transportation does not appear to be increasing. According to the Association of American Railroads, the railroad industry loaded 22.1 million freight cars in 1988, down slightly from 22.6 million in 1980 (AAR, 1991).

4. Construction Noise

The noise from construction of highways, city streets, and buildings is a major contributor to the urban scene. Construction noise sources include pneumatic hammers, air compressors, bull dozers, loaders, dump trucks (and their back-up signals), and pavement breakers. The construction industry has done very well over recent years with a value-added GNP of $97.9 billion in 1977, increasing to $247.7 billion in 1989 (Dept. of Commerce, 1991), an increase of about 153 percent. The number of workers employed in construction grew from 4.3 million in 1980 to about 5.2 million in 1990, an increase of nearly 21 percent (BLS, 1991a).

5. Noise in Industry

Although industrial noise is one of the less prevalent community noise problems, neighbors of noisy manufacturing plants can be disturbed by sources such as fans, motors, and compressors mounted on the outside of buildings. Interior noise can also be transmitted to the community through open windows and doors, and even through building walls. These interior noise sources have significant impacts on industrial workers, among whom noise-induced hearing loss is unfortunately common.

The size of the U.S. manufacturing industry has not grown significantly over the last decade. Although the industrial GNP increased from $673.9 billion in 1980 to $969.6 billion in 1990 (in terms of constant dollars) (BLS, 1991b), the workforce has declined from slightly more than 20 million to about 19 million during that period (BLS, 1991c). Consequently, industrially-generated community noise is probably no greater than it was in 1980.

From the worker's perspective the industrial noise problem is still very serious. The Occupational Safety and Health Administration has cut back on the enforcement of occupational noise standards and has allowed the

substitution of hearing protection devices in lieu of engineering controls in many cases (OSHA, 1986). However, it is difficult to know whether noise levels in industry are increasing or decreasing because no comprehensive survey has been performed since the 1976 survey performed by Bolt Beranek and Newman Inc. (BBN, 1976).

6. Noise in Buildings

Apartment dwellers are often annoyed by noise in their homes, especially when the building is not well designed and constructed. In this case, internal building noise from plumbing, boilers, generators, air conditioners, and fans, can be audible and annoying. Improperly insulated walls and ceilings can reveal the sound of amplified music, voices, footfalls, and noisy activities from neighboring units. External noise from emergency vehicles, traffic, refuse collection, and other city noises can be a problem for urban residents, especially when windows are open or insufficiently glazed.

Wetherill (1987) reports that although the lack of soundproofing is the most frequent environmental complaint of apartment dwellers, the knowledge to solve these problems is not being applied. In fact, the quality of construction is steadily declining, and the noise problems are getting worse (Wetherill, 1991).

7. Noise from Consumer Products

Certain household equipment, such as vacuum cleaners and some kitchen appliances, have been and continue to be noisemakers, although their contribution to the daily noise dose is usually not very large. Added to this list would be yard maintenance equipment, such as lawn mowers and snow blowers, which can, at least, cause disharmony with one's neighbors, and power shop tools, which can be hazardous to hearing if used for sufficient periods of time.

One example of a fairly new product is the gasoline-powered leaf blower, with average A-weighted sound levels at the operator's position of 103.6 dB, and maximum levels of 110-112 dB (Clark, 1991). In an extensive review of nonoccupational noise exposures, Davis et al. (1985) report that the manufacturers of household devices have been reluctant to release sound level information. Consequently, it could be difficult to assess the magnitude of the problem and the extent to which noise levels are increasing or decreasing.

Residents of suburban and rural areas are sometimes disturbed by recreational noise sources, such as off-road vehicles, high-powered motor boats, and snowmobiles. Some of these sources, such as snowmobiles, are not as noisy as they were more than a decade ago, due to attention to the problem

by the manufacturers and their trade associations. Others are no less noisy, and possibly more so because noise seems to be generic to the sport. Examples would be motorcycle and car racing, and events like "tractor pulls."

In fact, the allure of noisy recreational activities seems to be considerably greater now than it was a decade or so ago. The technology of sound reproduction has advanced to the point where loudspeakers can faithfully reproduce music and other sounds at levels well above 120 dB. Sporting events use giant digital "applause meters" to measure and display enthusiasm for the more popular team. The extreme in car stereo technology is now the "boom car", with sound levels exceeding 140 dB.[4] Activities like aerobic exercising and ice skating, as well as disco dancing, are accompanied by amplified music played at high sound levels. After summarizing the results of 16 studies of discotheques and rock concerts Clark (1991) reported the geometric mean of the measured sound levels as 103.4 dB. The trend in noise levels for these kinds of activities is definitely upward.

One of the most serious sources of recreational noise is sport shooting, where peak sound pressure levels at the ear can range from about 144 dB up to more than 170 dB[5] (Odess, 1972). In his analysis of this literature, Clark (1991) cites estimates of the number of people responding positively to questions about hunting or target shooting. These estimates range from 14 percent of the general population in Scandinavia and the U.K. (Axelsson et al., 1981; Davis et al., 1985) to nearly 50 percent in the Canadian workforce (Chung et al., 1981), which Clark found to be consistent with estimates from U.S. industry. In a population of rural school children, 45 out of 47 boys and 2 out of 21 girls reported having used guns (Kramer and Wood, 1982).

A subcategory of consumer product noise that deserves mention is noisy toys. A few toys, such as firecrackers, snappers, and cap pistols have been part of the adventurous child's experience for generations. The general assumption is that these toys do not pose a hazard when used occasionally and located at a sufficient distance from the ear.[6] Nowadays, there is a large variety of noisy toys, thanks to the availability of improved technology.

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[4] The International Auto Sound Challenge Association sponsors contests and gives the most points to contestants whose speakers produce the highest sound pressure levels, up to 140 dB. However, levels above that merit no more than 140 points.

[5] A-weighted levels of these weapons would measure somewhat lower, with levels for .22 caliber rifles at about 132-139 dB and shotguns at 150-165 dB. (See Clark, 1991).

[6] Certain European studies, however, have reported as many as 1 percent to 3.7 percent of teenage children suffer hearing losses caused by impulsive noise from toys (Gjaevenes, 1967; Moe, 1966). Noise from cap guns, for example, can exceed peak sound pressure levels of 140 dB (Gjaevenes, 1966; Hodge and McCommons, 1966; Marshall and Brandt, 1973; all as cited by Leroux and Laroche, 1991).

Many of them mimic adult noisemakers, such as amplified toy guitars, child-sized vacuum cleaners, and miniature power saws. Some of these toys generate quite high levels of sound. For example, a baby's squeeze toy (Fay, 1991) and the battery operated siren of a toy police car have both been measured at 110 dB.[7]

In a recent report on noisy toys, Leroux and Laroche (1991) cite studies showing A-weighted noise levels for a toy motor at 107 dB and a child's rattle at 99-100 dB (LNE, 1973). Current Canadian legislation limits the sound output of toys to "one hundred decibels measured at the distance that the product ordinarily would be from the ear of the child using it..." (Act, 1969), but Leroux and Laroche propose that this limit be lowered to an A-weighted level of 75 dB.

C. Numbers of People Exposed to Noise

The fact that people are variously exposed to noise is not surprising. Considering that decibels are measured on a logarithmic scale, however, the magnitude of these variations can be enormous. For example, the average noise level outside an urban apartment can be 1,000 times more intense than in a rural residential neighborhood. Fortunately, this difference will be perceived more like an eight-fold rather than a thousand-fold increase. Figure 2, from EPA's document *Protective Noise Levels*, shows examples of outdoor day-night average sound levels measured at various locations (EPA, 1978).

In 1974, EPA estimated that nearly 100 million Americans lived in areas where the daily average noise levels exceeded its identified safe DNL of 55 dB (EPA, 1974a). Figure 3, from EPA's *Levels Document*, shows the residential noise environment of the U.S. population as a function of the exterior DNL, with separate curves for the freeway and aircraft increments.

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[7] New York audiologist Thomas Fay has measured the noise levels of a variety of children's toys. In doing so he places the sound level meter's microphone quite close to the noise source (from 2 inches to 1/2 inch away), based on his observations of the children at play. (Personal communication, April 1991).

Figure 2

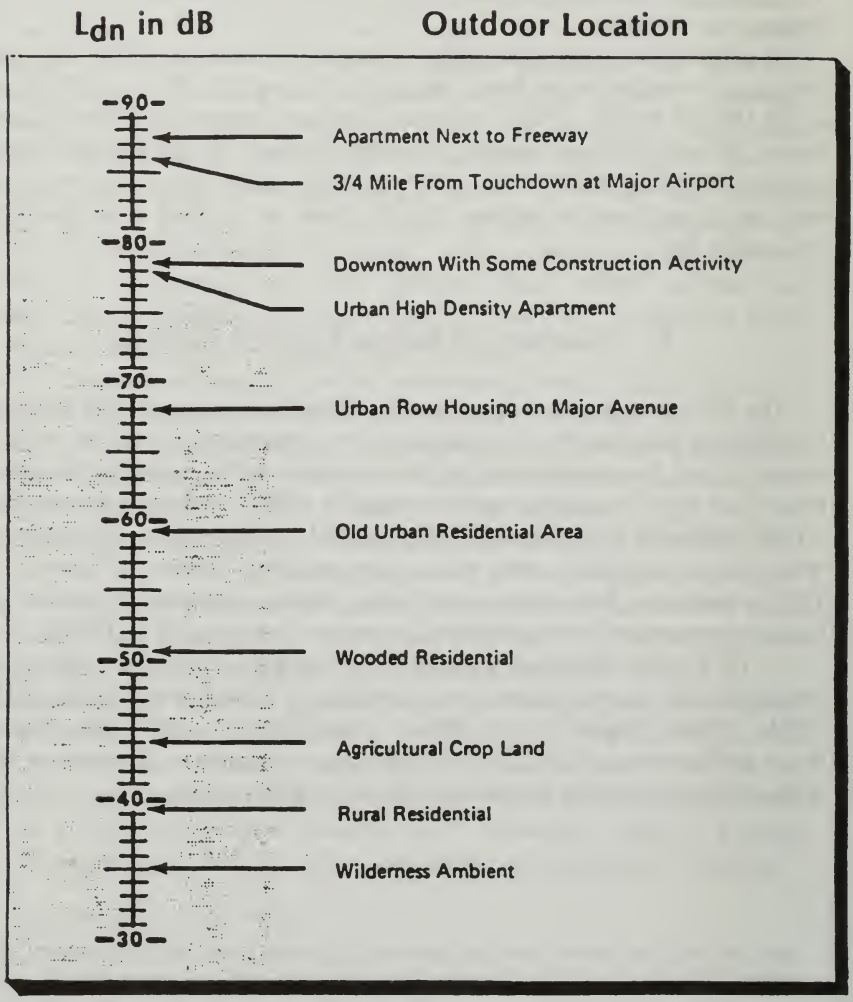

FIGURE 2. EXAMPLES OF OUTDOOR DAY-NIGHT AVERAGE SOUND LEVELS IN dB MEASURED AT VARIOUS LOCATIONS

From Protective Noise Levels (EPA, 1979, p.8)

A few years later EPA contracted with the consulting firm Bolt Beranek and Newman (BBN) to develop more detailed estimates. The resulting report, *Noise in America*, includes a breakdown according to noise exposure source (EPA, 1981). Table I gives the estimated number of Americans exposed to traffic, aircraft, construction, rail, and industrial noise for various DNLs from 55 dB to 80 dB. The authors note that there will be some overlap among populations exposed to different sources, so the numbers across categories are not additive. The far right column represents the total estimated number of people exposed to the combined sources. Although the authors do not give an estimate for the number of people exposed above L_{dn} 55 dB, another authority puts it at 138 million at that time (Eldred, 1990).

These estimates do not represent the results of a national survey. Instead, the authors used data and models available to EPA and BBN at the time. Because of this, some categories of noise exposure are likely to be more accurate than others. They did, however, represent the best available estimates at the time, and because no efforts have been made to update them, they are the best estimates available today.

D. Summary: Noise in America

It is safe to assume that noise in communities is increasing. Noise levels are directly related to population density, and the urban population is increasing at twice the pace of the nonurban population. In addition, the last decade has seen rapid growth in air transportation, trucking, and the construction industries, indicating that noise levels from these sources has most likely increased. The fact that some of these sources have been and continue to be quieted (especially new generations of trucks and aircraft) should mitigate this increase, but the extent of this mitigation will remain unknown until some sort of national survey is performed. Noise from construction continues to be a problem, and it appears that noise inside buildings as well as noise from recreational activities and consumer products is on the rise. Estimates of the number of people exposed to noise at various levels are now somewhat outdated.

Figure 3

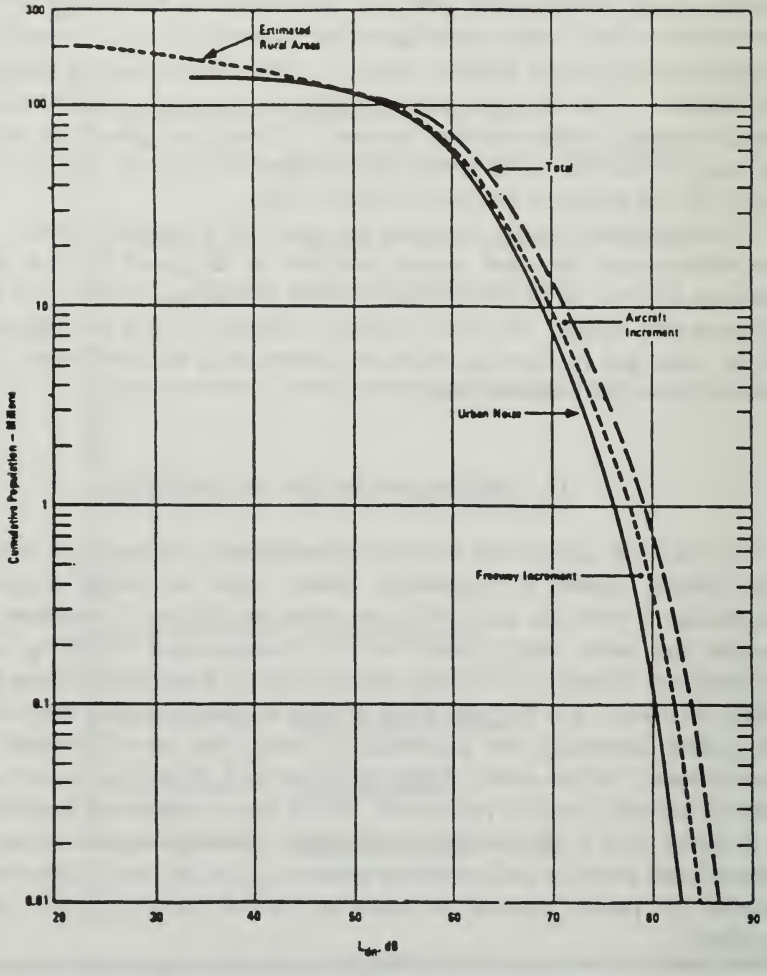

Figure 3. Residential Noise Environment of the National Population As a Function of Exterior Day-Night Average Sound Level[B-5]

From Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety (EPA, 1974a, p.16)

Table 1

Table 1. Summary of U.S. Population Exposed to Various Day-Night Average Sound Levels[1] (or higher) From Noise Sources in the Community.[2] From Noise in America (EPA, 1981, pp. 10 and 15).

DNL	Estimated Number (In Millions) of People in Each Noise Category					
(dB)	Traffic	Aircraft	Construction[3]	Rail	Industrial	Total
> 80	0.1	0.1	—.—	—.—	—.—	0.2
> 75	1.1	0.3	0.1	—.—	—.—	1.5
> 70	5.7	1.3	0.6	0.8	—.—	8.1
> 65	19.3	4.7	2.1	2.5	0.3	27.8
> 60	46.6	11.5	7.7	3.5	1.9	63.6
> 55	96.8	24.3	27.5	6.0	6.9	92.4*

[1] DNL values are yearly averages, outdoors

[2] Note that there is some overlap among populations exposed to different noise sources. For example, some of the 96.8 million people exposed to L_{dn} 55 dB and above from traffic noise are also exposed to aircraft noise

[3] Construction estimates include both residential and nonresidential exposure.

* Distribution of total exposed to all sources starts at L_{dn} 58 dB since the analysis involves combining distributions exposed to 55 dB and above.

V. Effects of Noise

A. Noise-Induced Hearing Loss

Hearing loss is one of the most obvious and easily quantified effects of excessive exposure to noise. Its progression, however, is insidious, in that it usually develops slowly over a long period of time, and the impairment can reach the handicapping stage before an individual is aware of what has happened. While the losses are temporary at first, they become permanent after continued exposure, and there is no medical treatment to counteract the effect. When combined with presbycusis, hearing loss naturally occurring with the aging process, the result is a premature impairment that grows inexorably with age.

According to the U.S. Public Health Service (PHS, 1991), some 10 million of the estimated 21 million Americans with hearing impairments owe their losses to noise exposure (as cited in Carney, 1991). The study goes on to say that it is unclear whether the incidence of hearing impairment has risen in recent years because the necessary studies have not been conducted.

1. Extent of Noise-Induced Hearing Loss from Environmental Sources

Although the major cause of noise-induced hearing loss is occupational, substantial damage can be caused by nonoccupational sources. In addition to the frequently-blamed sources of loud music and shooting, noise-induced hearing loss has been noted in the children of farm families, presumably from the frequent use of tractors (e.g., Broste et al., 1979); general aviation pilots because of the high noise levels emitted by piston aircraft (Anon., 1982); and users of earlier generations of cordless telephones because of the placement of the ring mechanism in the earpiece (Orchik et al., 1985 and 1987).

The prevailing notion among parents is that the hearing threshold levels of children are worse than they used to be because of exposure to loud music. Actually, a recent national survey of 38,000 school children found *better* hearing threshold levels than 30 years ago, but blames the discrepancies on the sampling methods used in the earlier study and the conversion from an older to a newer zero reference level (Lundeen, 1991). There is, however, evidence that the hearing of some young people is being affected by noisy leisure time activities (Axelsson et al., 1987).

Loud music in particular appears to be the cause of hearing impairment and tinnitus in rock musicians. Such luminaries as Pete Townshend and Ted

Nugent[8] have acquired substantial hearing losses and are now campaigning for hearing conservation (Murphy, 1989). Some studies point to a hearing hazard for attendees as well (see in Clark, 1991; Clark and Bohne, 1986; Danenberg et al., 1987).

As mentioned above, probably the greatest nonoccupational hazard to hearing comes from sport shooting. Clark (1991) cites studies of industrial workers by Chung et al. (1981), Johnson and Riffle (1982), and Prosser et al. (1988), showing significantly greater hearing losses among sport-shooters than among their nonshooting counterparts. These losses are almost always characterized by worse hearing in the left ear than the right.

The contribution from nonoccupational sources is called "sociocusis" (a contraction of "socioacusis"). Evidence from primitive societies suggests that the absence of sociocusis explains the large differences in hearing threshold level between these populations and those of the "civilized" nations (Rosen, 1962). Sociocusis, occupational hearing loss, and presbycusis contribute in various proportion to an individual's total hearing impairment. While the contribution of each source may be less than significant, the combination of all three can be enough to produce a handicapping condition. As longevity in the U.S. population increases, the toll of noise-induced hearing loss will become increasingly evident (Carney, 1991).

2. The Handicap of Noise-Induced Hearing Loss

Vowel sounds tend to be low in frequency and high in sound energy, while the consonants are much higher in frequency and have considerably less amplitude. It also happens that consonants provide the primary intelligibility to speech. Because noise damages the ear's ability to perceive high-frequency sounds much earlier and more severely than the low-frequency sounds, individuals with noise-induced hearing loss are at a particular disadvantage in understanding speech.

Individuals with early noise-induced hearing loss often think that other people no longer speak clearly. They soon begin to notice that they have difficulty understanding speech when there is noise in the background, and in groups of people, and that it is hard to identify which person is talking. As the hearing loss progresses, these individuals avoid social occasions and situations where they must listen at a distance, like church and theater. The eventual result can be loneliness and isolation.

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[8] According to Nugent, who has worn an earplug in his right ear since 1967: "My left ear is there just to balance my face, because it doesn't work at all." (Murphy, 1989)

3. The Study of Noise-Induced Hearing Loss

Noise damages the delicate sensory cells of the inner ear, the cochlea. This process can be studied in the laboratory by inducing temporary shifts in hearing threshold level in humans. Over recent years the preferred method of investigation is to produce temporary and permanent threshold shifts in animals, and to study the resulting physiological and anatomical changes in the cochlea, as well as shifts in hearing threshold level. The laboratory allows for strict control of noise level and duration, but the durations are usually relatively short because of the time and expense involved. Also there is some controversy over the extent to which the results can be generalized to humans.

Much of the recent laboratory effort in noise research has focused on the structural and functional basis of noise-induced hearing loss, which has been greatly aided by the electron microscope. Investigators have identified the sensory cell's stereocilia and the rootlets which anchor them as the auditory system's most vulnerable components with respect to noise exposure (Liberman, 1990).

Field studies of noise-exposed workers avoid the problems of species generalization, and the exposure durations can be over many decades. They are usually cross-sectional studies, however, meaning that the current hearing threshold levels are related to noise exposures that have been experienced over many years. Although the current noise measurements may be valid, their validity over prior years usually has to be assumed without benefit of precise data.

4. Risk of Hearing Impairment from Continuous Noise

The methods and results of the major field studies of continuous noise exposure conducted in the late 1960s and early 1970s remain unchallenged. Examples are the studies of Burns and Robinson (1970), Baughn (1973), Passchier-Vermeer (1968), and the U.S. National Institute for Occupational Safety and Health (NIOSH, 1973). Data from these studies have been used by various organizations to estimate the risk of hearing impairment over a working lifetime of exposure to noise. These types of studies have also been used by the EPA to estimate the hazard of nonoccupational noise (Guignard, 1973; Johnson, 1973; EPA, 1973a). The data cited above of Burns and Robinson, Baughn, and Passchier-Vermeer went into EPA's identification of a yearly average exposure level of 70 dB as the safe level, which could be experienced over a lifetime (EPA, 1974a).[9]

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[9] The 70-dB 24-hour average sound level can be interpreted as a 75-dB 8-hour average sound level plus an average sound level during the other 16 hours of less than 60 dB (see EPA's *Levels Document*, p.29, footnote d).

A new international standard (ISO, 1989), which is based mainly on the data of Passchier-Vermeer and Burns and Robinson, contains formulas for assessing the risk of noise-induced hearing impairment and handicap using either a highly screened (for nonoccupational hearing loss) or an unscreened population as a control group. The data and analyses found in these major studies have not been seriously challenged, and remain in use today.

5. Varying and Intermittent Noise

There has been some debate over the best rule for combining noise level and duration to assess the damaging effects of noise, especially varying and intermittent noise. This relationship is often called the doubling rate, or nowadays, the exchange rate. The EPA, as well as most other federal agencies (and most European countries, the United Kingdom, some Canadian provinces) use the equal-energy rule, which incorporates a 3-dB exchange rate. OSHA uses the 5-dB exchange rate, and the U.S. Air Force, uses 4 dB. None of these rules makes any provisions for the temporal order of sounds, although the 5-dB exchange rate supposedly represents a simplification of criteria that take a certain number of intermittencies into account.[10]

Investigations of the relationship between noise level and duration have been conducted over recent years using laboratory animals. The results have confirmed the validity of the equal energy (3-dB) rule for single exposures to continuous noise (Bohne and Pearse, 1982; Ward and Turner, 1982), or when the exposures are broken up into 8-hour, or even 1-hour "workdays", 5 days per week, so long as the sound energy is equivalent (Ward, 1983). There is, however, some benefit to intermittent quiet periods (Ward and Turner, 1982), during which the ear can recover from small, temporary hearing losses. For this reason EPA has adjusted its identified safe level upward by 5 dB[11] since most environmental noise exposures are intermittent in nature. EPA's use of the equal-energy rule and the 5-dB adjustment have not been seriously challenged.

6. Impulse Noise

The effects of impulse noise have been studied extensively over recent years, but there is less agreement on this topic than there is for continuous and intermittent noise. Although there was consensus favoring the 3-dB rule at a 1981 international meeting in England (von Gierke et al., 1981), actual dose-

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[10] The 5-dB rule does not necessarily provide for intermittencies because it allows uninterrupted exposures to continuous noise at high levels. See Suter, 1983.

[11] The identified safe level of 70 dB reflects the incorporation of the 5-dB adjustment.

response relationships are still elusive. The effects of impulse noise do not always follow the 3-dB rule, in that temporal pattern, waveform, and rise time can affect the growth of hearing loss, despite constancy of sound energy (Henderson and Hamernik, 1986).

Frequency also has some bearing on the damage caused by impulse noise, in that low-frequency impulses produce significantly less damage than sounds in the mid-to-high-frequency range (Price, 1983). The ear appears to be most susceptible to impulses with peaks around 4,000 Hz (Price, 1989). Also, there may be a critical level, above which the ear is considerably more at risk because of a change in the response mechanism. On the basis of his research, Price (1981) has suggested a critical level of 145 dB, with a standard deviation of 8 dB.

7. Susceptibility

Evidence from field studies indicates that men incur more hearing loss than women from comparable noise exposures (Burns and Robinson, 1970; Berger et al., 1978; Royster et al., 1980), and that Caucasians appear to be more susceptible than Blacks to noise-induced hearing loss (Royster et al., 1980). Other factors, such as age, preexposure hearing threshold level, general health, and use of alcohol, have not yet proved to be reliable predictors of susceptibility (Ward, 1986), although there is some indication that the use of tobacco may increase susceptibility to noise-induced hearing loss (Barone, et al., 1987; Stark, et al., 1988).

8. Interactions with other Agents

Noise can interact with drugs and industrial agents to produce additive or even synergistic effects on hearing. As expected, the higher the levels of noise and the greater the dose of the other agent, the greater will be the resulting hearing loss. The ototoxic properties of certain drugs, most notably the aminoglycoside antibiotics (the "mycin" drugs), are heightened by exposure to noise. Numerous studies of kanamycin plus noise exposure have revealed additive and some synergistic results (Humes, 1984). High doses of salicylates (aspirin) accompanied by noise exposure can produce temporary hearing losses (McFadden and Plattsmier, 1983), but permanent losses do not seem to occur. Cisplatin, used in cancer chemotherapy, is known to be toxic to the auditory system, and has been shown to interact significantly with noise exposure (Boettcher et al., 1989).

A variety of industrial agents, which can be potent neurotoxins, have been shown to be capable of producing hearing loss (Fechter, 1989). These agents

include heavy metals, such as lead and mercury, organic solvents, such as toluene, xylene, and carbon disulfide, and an asphyxiant, carbon monoxide.

9. Hearing Protectors

As its first (and only) labeling regulation, EPA promulgated a regulation for labeling the attenuation of hearing protection devices (EPA, 1979). The standard required manufacturers to subject their hearing protectors to specific laboratory tests, and to publish a "Noise Reduction Rating" (NRR) on the product's package. The NRR was subsequently adopted by OSHA in its hearing conservation amendment, which required employers to use it in assessing the adequacy of hearing protectors for given noise environments (OSHA, 1981 and 1983). Recent research shows that the NRR greatly overestimates the noise reduction to be achieved by these devices in actual field use.[12] These kinds of findings have led to the formation of a new ANSI working group to investigate alternatives to the current NRR (Berger et al. 1990), and the recommendation that EPA revise its existing labeling regulation (Berger, 1991; Stewart, 1991).

10. Summary: Noise-Induced Hearing Loss

Noise-induced hearing loss is probably the most well-defined of the effects of noise. Predictions of hearing loss from various levels of continuous and varying noise have been extensively researched and are no longer controversial. Some discussion still remains on the extent to which intermittencies ameliorate the adverse effects on hearing and the exact nature of dose-response relationships from impulse noise. It appears that some members of the population are somewhat more susceptible to noise-induced hearing loss than others, and there is a growing body of evidence that certain drugs and chemicals can enhance the auditory hazard from noise.

Although the incidence of noise-induced hearing loss from industrial populations is more extensively documented, there is growing evidence of hearing loss from leisure time activities, especially from sport shooting, but also from loud music, noisy toys, and other manifestations of our "civilized" society. Because of the increase in exposure to recreational noise, the hazard from these sources needs to be more thoroughly evaluated. Finally, the recent evidence that hearing protective devices do not perform in actual use the way laboratory tests would imply, lends support to the need for reevaluating current methods of assessing hearing protector attenuation.

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[12] In a summary of 10 studies, Berger (1983) shows that most hearing protectors in the field provide only one-third to one-half the attenuation that they do in the laboratory.

B. Interference With Communication

Noise can mask important sounds and disrupt communication between individuals in a variety of settings. This process can cause anything from a slight irritation to a serious safety hazard involving an accident or even a fatality because of the failure to hear the warning sounds of imminent danger. Such warning sounds can include the approach of a rapidly moving motor vehicle, or the sound of malfunctioning machinery. For example, *Aviation Safety* (Anon., 1982), states that hundreds of accident reports have many "say again" exchanges between pilots and controllers, although neither side reports anything wrong with the radios.

Noise can disrupt face-to-face and telephone conversation, and the enjoyment of radio and television in the home. It can also disrupt effective communication between teachers and pupils in schools, and can cause fatigue and vocal strain in those who need to communicate in spite of the noise. Interference with communication has proved to be one of the most important components of noise-related annoyance (EPA, 1974a).

In its *Levels Document*, EPA determined that a yearly average day-night sound level of 45 dB would permit adequate speech communication in the home, and a DNL of 55 dB would permit normal communication outdoors at a distance of about 3 meters.[13] These levels also apply to hospitals and educational facilities. Higher average noise levels would be satisfactory for certain nonresidential spaces, such as commercial and industrial facilities, and inside transportation, depending on the degree to which speech communication is critical. Research over the last 20 years has expanded and refined EPA's criteria development in this area, but has not generated any major changes.

1. Prediction of Speech Interference

Methods of predicting the amount of speech that can be communicated in various noise backgrounds have been available for decades. Probably the most popular and respected method is the articulation index (AI) (French and Steinberg, 1947), which requires the measurement or estimation of the spectrum level of both speech and noise in 20 contiguous bands. Over the past 2 decades investigators have suggested adjustments to the AI for 1/3-octave bands, reverberation time, various vocal efforts, etc., and more recently for various degrees of hearing impairment (Humes, et al., 1986 and 1987).

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[13] These levels represent EPA's identification of safe levels of environmental noise to protect the public health and welfare against all adverse effects of noise with the exception of hearing loss.

The speech interference level (SIL) (Beranek, 1954) provides a quick method for estimating the distance at which communication can occur for different levels of vocal effort. The current method involves measuring octave-band sound pressure levels at 500, 1,000, 2,000, and 4,000 Hz and referring to a chart to determine the potential communication distance. The basic chart has been expanded to include such parameters as a broader range of voice levels and provisions for room reverberation (Webster, 1983). Additions to both the AI and the SIL have been proposed by Lazarus (1990), who offers modifications and extensions to account for strain on the part of both talker and listener, and the wearing of hearing protectors.

Another popular method to predict speech communication in a variety of conditions, the speech transmission index (STI), has been developed by a Netherlands research group (Houtgast, 1980; Houtgast and Steeneken, 1983). The STI takes into account room volume and reverberation time, in addition to speech and noise levels, and distance between talker and listener. A more recent outgrowth, the rapid speech transmission index (RASTI), represents a simplified version of the STI intended for field use, and is available in an instrument conforming to an international standard (IEC, 1987).

Finally the sound level meter's A-weighting network can be successfully used to predict speech interference levels. It is easy to use, available on virtually all sound level meters, and effective when the noise spectra are not complex.

2. Criteria for Speech and Warning Signals

In addition to the classic work of Beranek and his colleagues (Beranek et al., 1971), Beranek has recently refined the traditional curves to account for the annoyance due to low-frequency "rumble" (Beranek, 1989). New criteria for determining acceptable background levels of noise in rooms are also offered by Lazarus (1986a, 1986b, 1987, and 1990). Lazarus includes in his criteria a variety of parameters such as: type of room, type of communication, communication distance, vocal effort, quality of speech intelligibility, AI, communication strain, listener's hearing sensitivity, and the use of hearing protectors.

Guidelines for audible warning signals have been developed by Patterson (1982). These guidelines, which were originally created for civil aircraft, were later adapted to helicopters and even stationary workplaces like hospitals (Patterson, 1985; Rood et al., 1985). Another set of guidelines for acoustic warning signals has been developed by Lazarus and Hoge (1986), and is based on the compatibility of signal type with various desired or undesired situations.

Although criteria have not yet been developed for speech recognition involving nonnative listeners, experiments by Florentine (1985) and Nabelek

(1983) indicate that these individuals need more favorable listening conditions (less background noise and reverberation) than their native-language counterparts. These findings have implications for air traffic control systems.

3. The Effect of Hearing Protectors on Speech and Warning Signal Perception

Hearing protectors attenuate both noise and the desired signal by equal amounts in a given frequency band, reducing both to levels where the ear is less likely to distort. This process often improves speech recognition when the level of background noise exceeds 80 to 90 dB. However, because hearing protectors usually provide considerably more attenuation in the high frequencies than in the low frequencies, listeners who have high-frequency hearing losses are at a disadvantage. Many speech sounds and some warning signals will be attenuated beyond the range of audibility. This is especially true of individuals whose losses exceed an average of 30 dB at the audiometric frequencies 2,000, 3,000, and 4,000 Hz (Lindeman, 1976). A potential solution for this problem lies in some newly developed hearing protectors with flat attenuation across the frequency spectrum (Allen and Berger, 1990; Killion et al., 1988). One type of these protectors has already become popular with orchestral musicians (Killion et al., 1988) and even some rock musicians (Cohen, 1990).

Individuals tend to speak more softly when they wear hearing protectors, and consequently, speech communication is degraded when both talker and listener wear these devices (Hoermann et al., 1984). Hearing protectors also interfere with the localization of sounds in space, and this is especially true of the ability to localize sounds in the vertical plane while wearing ear muffs (Noble, 1981). Both ear plugs and ear muffs cause these types of problems, but it appears that they are more pronounced with ear muffs (Howell and Martin, 1975; Abel et al., 1982). These findings can have serious implications for safety in some circumstances.

4. Scholastic Performance

Noise can disrupt communication in the classroom to the extent that the instructional method used in schools close to airports is sometimes nicknamed "jet pause" teaching. Cohen and Weinstein (1981) have reviewed several studies, which, after controlling for socioeconomic factors, indicate that the academic performance of children in quiet schools is better than that of children in noisy schools.

For example, elementary school children on the side of a school facing train tracks performed more poorly on a reading achievement test than children

in classrooms on the quiet side of the school (Bronzaft and McCarthy, 1975).[14] Cohen and Weinstein also discuss research showing that skills, such as auditory discrimination and reading achievement can be adversely affected when children *live* in noisy circumstances, even though their schools may be no noisier than average. These latter studies indicate that interference with communication in the classroom is not the only process at work here. Possible additional explanations include adverse effects on children's information processing strategies and their feelings of personal control[15] (Cohen and Weinstein, 1981).

5. Summary: Interference with Communication

Interference with speech communication and other sounds is one of the most salient components of noise-induced annoyance. The resulting disruption can constitute anything from an annoyance to a serious safety hazard, depending on the circumstance.

Research over the past 2 decades has expanded and refined methods for predicting communication interference, but has not produced any major changes. Numerous adjustments have been suggested for the AI, the SIL has been modified and refined, and a new predictive method, the STI has been added. Criteria for determining acceptable background levels in rooms have also been expanded and refined, and progress has been made on the development of effective acoustic warning signals.

It is now clear that hearing protection devices can interfere with the perception of speech and warning signals, especially when the listener is hearing impaired, both talker and listener wear the devices, and when wearers attempt to localize a signal's source.

Noise can interfere with the educational process, and the result has been dubbed "jet-pause teaching" around some of the nation's noisier airports, but railroad and traffic noise can also produce scholastic decrements.

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[14] Bronzaft reported that in 1978 the city of New York reduced the noise of the elevated train and installed acoustical insulation in the affected classrooms, providing a total reduction in the A-weighted noise level of 6 to 8 dB (Bronzaft, 1981). By 1981, there were essentially no differences in reading achievement between students on the two sides of the school for the classrooms studied.

[15] See also the discussion of noise, performance, and behavior in sections D.4. and D.5. below.

C. Effects of Noise on Sleep

Noise is one of the most common forms of sleep disturbance, and sleep disturbance is a critical component of noise-related annoyance. A study used by EPA in preparing the *Levels Document* showed that sleep interference was the most frequently cited activity disrupted by surface vehicle noise (BBN, 1971). Aircraft noise can also cause sleep disruption, especially in recent years with the escalation of nighttime operations by the air cargo industry. When sleep disruption becomes chronic, its adverse effects on health and well-being are well-known.

1. Assessing Sleep Disturbance

Noise can cause the sleeper to awaken repeatedly and to report poor sleep quality the next day, but noise can also produce reactions of which the individual is unaware. These reactions include changes from heavier to lighter stages of sleep, reductions in "rapid eye movement" (REM) sleep, increases in body movements during the night, changes in cardiovascular responses, and mood changes and performance decrements the next day. The accuracy and efficiency with which these effects are measured has been greatly assisted by the use of contemporary computers. The most popular measurement tool nowadays is electro-encephalography, but other methods, such as electrocardiography, electromyography, and electrooculography are also used, as well as clinical observation, self-assessment surveys, and accelerometry to measure the motion of the bed frame.

As a result of many years of research on the effects of noise on sleep, it is clear that intermittent and impulsive noise is more disturbing than continuous noise of equivalent energy, and that meaningful sounds are more likely to produce sleep disruption than sounds with neutral content. Also, older people are more likely to have their sleep disturbed by noise than younger people. In fact, children appear to be about 10 dB less sensitive to noise-induced sleep disruption than adults (Eberhardt, 1990). Sleep disturbance from noise tends to be greater in the early hours of the morning, when individuals spend more time in lighter sleep stages, and this is particularly true of the elderly.

2. Criteria for Sleep Interference

In the *Levels Document*, EPA identified an indoor DNL of 45 dB, which translates to a nighttime average sound level of 35 dB, as necessary to protect against sleep interference. However, consensus on the levels of noise that can be tolerated without sleep disruption is incomplete at this time. In an attempt to develop a quantitative model for predicting noise-induced sleep interference,

Pearsons et al., (1989) reviewed and analyzed 21 studies. However, the authors were unable to derive dose-response relationships from these studies because of large discrepancies between studies conducted in the laboratory and those conducted in the field.

In a recent review of the noise and sleep research, Griefahn (1990) recommends that the nighttime average sound level be kept below 45 dB in the sleeper's quarters. She cites research by Eberhardt (1987 and 1990; Eberhardt et al., 1987;) and Vallet et al., (1976 and 1990) showing self-reported adverse effects from continual road traffic when the average sound level is 40 dB and physiological responses at an average level of 37 dB. For intermittent road traffic noise, maximum recommended levels for single events (as opposed to average levels) range from 45 to 68 dB, depending on the investigation (Griefahn, 1990). Vallet et al. (1990), recommend maximum outside levels of 65 dB, which, of course, relies on some attenuation by the residence. Griefahn also points out that higher maximum levels can be tolerated if the ambient noise level is not very low, and that the difference between single events and the ambient level should not exceed 8 to 10 dB.

3. After-Effects and Habituation

Numerous recent investigations have revealed after-effects due to noisy nights. Ohrstrom (1983) found mood changes on the day following nights when the average sound level was as low as 35 dB. Adverse effects on performance, such as increased reaction time, have also been measured (Jurriens et al., 1983), and it appears that older peoples' next day performance is more adversely affected by noise than that of younger people (Griefahn and Gros, 1983).

Although people often believe they get used to nighttime noise, physiological tests point to the contrary. Studies have shown that while the subjective response improves with time, cardiovascular responses remain unchanged (Muzet, 1983). Vallet et al. (1990) conclude that habituation is not complete, even after 5 years of exposure to noise.

4. Summary: Effects of Noise on Sleep

Noise-induced sleep interference is one of the critical components of community annoyance. It can produce short-term adverse effects, such as mood changes and decrements in task performance the next day, with the possibility of more serious effects on health and well-being if it continues over long periods.

EPA's identified indoor DNL of 45 dB has not been seriously challenged over the past decade, but consensus in this area is lacking. One problem is

that different experimenters tend to use a variety of descriptors (DNL, L_{eq}, and maximum single-event levels) and a variety of methods for evaluating the effects (EEG, EKG, self-report, etc.). Perhaps one reason for the lack of clear-cut criteria is that this is a complex area to research, requiring considerable time and expense. Another is, of course, a need for more field studies in this area.

D. Effects on Performance and Behavior

EPA did not use the literature on the effects of noise on performance and behavior in the identification of its levels of noise to protect against activity interference. One reason may have been that much of the information at that time related to the occupational setting rather than the general environment. Another may have been the complexity of the topic and the difficulty involved in identifying a single noise level that could apply to a great variety of tasks and conditions. Although these difficulties still pertain, much research has been generated in this area over recent years.[16]

Noise can cause adverse effects on task performance and behavior at work, and in nonoccupational and social settings. These effects are the subject of some controversy, however, since they do not always occur as predicted. Sometimes noise actually improves performance, and sometimes there are no measurable differences between performance in noisy and quiet conditions. The presence and degree of effects depends on a variety of intervening variables.

1. Sensory and Motor Effects

Experiments on the effects of noise on vision have produced conflicting results, with the suggestion of some effects on visual discrimination (Cohen, 1977). There is evidence, however, that high levels of noise can produce shifts in visual field (Parker, et al., 1976, 1978). High levels of noise can affect vestibular function, especially when the presentation to the two ears is asymmetrical (or the level of attenuation is greater in one ear) (Harris, 1968). Impulsive or other sudden loud sounds can produce a startle response that does not completely habituate with repeated, predictable exposures (May and Rice, 1971).

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[16] For a comprehensive review of the effects of noise on job performance, see Suter, 1989.

2. Noise Variables

Sound level is one of the most important parameters when predicting performance effects. The level of noise necessary to produce adverse effects is greatly dependent upon the type of task. Simple tasks remain unaffected at noise levels as high as 115 dB or above, while more complex tasks are disrupted at much lower levels. Until fairly recently, the level of beginning effects was thought to be around 95 dB for most conditions, but a summary of recent research (Jones, 1990) points to effects at much lower levels. Effects on serial reaction tasks have been noted for continuous noise with C-weighted noise levels of 90 dB (Jones, 1983) and for intermittent noise with C-weighted levels of around 80 dB (Lahtela et al., 1986).

Frequency and temporal characteristics also play a part. High-frequency sound is more disruptive than low-frequency sound, and intermittent noise can affect performance more adversely than continuous noise of equivalent energy. Aperiodic intermittencies are more likely to produce adverse effects than regular ones, and impulse noise may be even more disruptive. Again the effects are variable, depending upon task complexity and other factors.

Much of the important research in the effects of noise on performance conducted over the last decade has focused on the effects of irrelevant speech.[17] The adverse effects of irrelevant speech appear to be fairly independent of sound level, at least in the 55-95 dB range, and therefore, are not mitigated simply by attenuating them by 10 dB or so (Jones, 1990). It also appears that irrelevant speech affects processes involving memory (e.g., reasoning, mental arithmetic, and problem solving) rather than attention. With respect to reading tasks, however, meaningful speech is more disruptive than meaningless speech (Jones, 1990). These findings have significance for many modern work and school environments, where information processing and exchange is so important, especially those of the "open plan" variety.

3. Task Variables

Task complexity has been identified in numerous experiments as a crucial determinant of the effects of noise on performance. Noise exposure usually leaves simple routine tasks unaffected, and can even improve performance of monotonous tasks, presumably by elevating one's level of arousal (Broadbent, 1971). Some tasks, such as tracking and jobs requiring intellectual function, can be momentarily disrupted without decrements in overall performance (Broadbent, 1979). But if the noise level is sufficiently high or if the task becomes more complex, noise will have an adverse effect. When two or more

[17] The initial work was performed by Salame and Baddeley (1982, 1983, and 1987), and has been summarized by Jones (1990) at a recent conference in Stockholm.

tasks must be performed simultaneously in a noisy environment, performance on the primary task usually remains unaffected, while performance on the subsidiary task deteriorates (Hockey and Hamilton, 1970; Davies and Jones, 1975; Finkleman and Glass, 1970).

4. After-Effects

It seems that noise can have even greater effects *after* than during exposure. The most common after-effect appearing in the experimental literature is a reduced tolerance for frustration, manifested in a series of experiments as a reduction in willingness to persist in trying to solve insoluble puzzles (Glass and Singer, 1972; Percival and Loeb, 1980). This research also indicates that predictability of the noise signal greatly reduces its adverse after-effects (Glass and Singer, 1972). One study found that the type of noise also influenced the after-effect. Aircraft noise modified to produce sudden onsets and offsets resulted in a lower tolerance for frustration after the exposure than white noise that had been similarly modified (Percival and Loeb, 1980).

5. Effects of Noise on Social Behavior

There is extensive literature concerning the effects of noise on social behavior, and a few examples of this research will be discussed here. Singer et al. (1990) point out that noise has been used as a noxious stimulus in a variety of investigations because it produces the same biological and psychological effects as other stressors. In fact, they observe that the effects of noise combined with perceived control have been frequently demonstrated, and these investigations have also been extended to many other situations where the presence of control reliably moderates the effects of stress.[18]

In a frequently-cited laboratory study, Matthews and Cannon (1975) found that fewer subjects were willing to help someone who had "accidentally" dropped materials when background noise levels were 85 dB than when they were 65 dB. In a subsequent field study, the same results were demonstrated in a background of lawn mower noise, and this time the addition of a cast on the "victim's" arm enhanced helping behavior under quiet conditions, but failed to do so during the noise episodes (Matthews and Cannon, 1975). In another such experiment, Sauser et al. (1978) found that subjects recommended lower salaries for fictitious employees when exposed to A-weighted levels of office noise at 70 to 80 dB than in quiet. Broadbent (1979 and 1983) cites additional evidence suggesting that subjects will give each other increased

[18] Singer et al. (1990) cite the research of Langer and Rodin on the effects of patient control in a nursing home situation.

amounts of shock and noise when they themselves are exposed to noise, and also cites evidence that noise increases anxiety levels (Broadbent, 1983).

As mentioned above, the presence of control, or even perceived control, is one of the most important predictors of adverse behavioral effects. Subjects who perceive that they have control over the noise show significantly greater tolerance for frustration than subjects without control, even if the control is never exercised (Glass and Singer, 1972). In a recent experiment, Singer and his colleagues found that subjects who were told that they had control of an A-weighted, 103-dB noise stimulus showed significantly greater persistence on a difficult task than subjects who had no control or subjects that had control for only part of the experiment (Singer et al., 1990). This finding occurred despite the fact that the subjects with only partial control reported *feelings* of control no different from those with full control. To the extent that these findings can be generalized to populations living in noisy areas, this kind of research may have significant sociological implications.

6. Summary: Effects on Performance and Behavior

Noise can adversely affect task performance in a variety of circumstances. In the past, research in this area has focused mainly on the occupational setting, where noise levels must be sufficiently high and the task sufficiently complex for performance decrements to occur. Recent research implicates more moderate noise levels, especially when speech is the disruptive noise stimulus. Some research indicates that noise can also produce disruptive after-effects, commonly manifested as a reduced tolerance for frustration, and it appears that the presence and timing of control over the noise are critical to the prediction of after-effects. Even moderate noise levels can increase anxiety, decrease the incidence of helping behavior, and increase the risk of hostile behavior in experimental subjects. These effects may, to some extent, help explain the "dehumanization" of today's urban environment.

E. Extra-Auditory Health Effects

Noise has been implicated in the development or exacerbation of a variety of health problems, ranging from hypertension to psychosis. Some of these findings are based on carefully controlled laboratory or field research, but many others are the products of studies that have been severely criticized by the research community. In either case, obtaining valid data can be very difficult because of the myriad of intervening variables that must be controlled, such as age, selection bias, preexisting health conditions, diet, smoking habits, alcohol consumption, socioeconomic status, exposure to other agents, and

environmental and social stressors. Additional difficulties lie in the interpretation of the findings, especially those involving acute effects. For example, if noise raises blood pressure on a temporary basis, will prolonged exposure produce permanent changes? In cases where these effects are permanent but slight, what are the long-term implications? These types of questions and problems have caused this particular area of noise research and criteria development to be very controversial.

1. Theoretical Basis

Noise is considered a nonspecific biological stressor, eliciting a response that prepares the body for action, sometimes referred to as the "fight or flight" response. The physiological mechanism thought to be responsible for this reaction is the stimulation by noise (via the auditory system) of the brain's reticular activating system (Cohen, 1977). Neural impulses spread from the reticular system to the higher cortex and throughout the central nervous system. Noise can, therefore, influence perceptual, motor, and cognitive behavior, and also trigger glandular, cardiovascular, and gastrointestinal changes by means of the autonomic nervous system. Evidence of these effects, however, is not easy to come by. Despite decades of research and probably hundreds of studies, relatively little can be said with much confidence.

2. Effects on Blood Pressure

Probably the most attention has been directed toward cardiovascular effects, especially potential elevations in blood pressure. Many studies of the stressful effects of noise have been conducted on rodents and other laboratory animals. The advantage of these studies is that they offer a greater degree of control and it is possible to have longer exposures than with human subjects. The disadvantages are that there is difficulty generalizing to humans, especially with the smaller animals, the expense involved when larger animals are used, and the prevailing public sentiment against animal experimentation.

EPA sponsored one of the most notable animal studies of noise exposure, in which Peterson and his colleagues performed five sets of experiments on the cardiovascular effects of noise on monkeys (Peterson et al., 1978, 1981, and 1983). The stimulus consisted of A-weighted levels of workplace noise at 85 to 90 dB, and the exposures were as long as 9 months. The results showed significant elevations of both systolic and diastolic blood pressure. The fact that these changes persisted long after exposure cessation argues for a chronic effect, at least in this case. Unfortunately, an attempt to replicate this experiment with another primate model was discontinued for lack of funding

after only two subjects had been exposed (Turkkan, et al., 1983). Relatively few animal experiments have been conducted in this area over recent years.

With respect to laboratory investigations involving human subjects, Rehm (1983) cites six studies showing increases in blood pressure, but questions whether these effects would be permanent. In an attempt to identify more susceptible populations, Michalak et al. (1990) investigated the effects of low-flying aircraft on elderly subjects. Using recorded aircraft sounds, they found significant increases in both systolic and diastolic blood pressure after exposure to the two types of noise, with significantly greater response to the rapid-onset flyover noise. Whether or not these increases would become permanent with protracted exposure is not known.

Field studies of noise and blood pressure among workers or community residents are becoming increasingly popular, but the results are not always consistent. Rehm (1983) has reviewed 14 field studies, mostly of occupational noise exposure, and reports that the majority showed significant increases in either systolic or diastolic blood pressure, or both. Van Dijk et al. (1983), however, reports that six other studies of exposure to occupational noise found no significant differences between exposed and nonexposed groups.

Knipschild and Oudshoorn (1977) avoided some of the pitfalls characteristic of epidemiological studies by examining a population near the Amsterdam airport before and after an increase in exposure to aircraft noise, and comparing it to a nonexposed population nearby. The dependent variable was the purchase of certain prescription drugs: tranquilizers, sleeping pills, antacids, and cardiovascular drugs. The investigators found that the use of these drugs in the nonnoise area was essentially stable, whereas the use of most types of these drugs in the area newly impacted by noise increased steadily over the years investigated. This increase was especially noticeable for antihypertensive drugs.

In a more recent review, van Dijk (1990) analyzed 12 cross-sectional studies, with half of them showing a positive relation between noise exposure and blood pressure, and the others no significant effects. Van Dijk criticizes these kinds of investigations for the following kinds of weaknesses: inadequate description of noise and blood pressure measurements; absence or inadequate control of intervening variables; use of hearing loss as a determinant of exposure magnitude; use of hearing protectors; and questionable interpretation of the results. Part of the problem may be that the investigators often come from only one discipline, when, in fact, a multi-disciplinary team is needed. Thompson and Fidell (1990) recommend the use of prospective or case-control models, rather than the more convenient cross-sectional study, and they stress the importance of adequate sample size. They maintain that because any changes in blood pressure resulting from community noise are likely to be

small, careful controls, large sample sizes, and at least 5 years of exposure to noise would be needed to identify significant effects.

3. Effects on Blood Chemistry

Blood chemistry is also of interest in studies of noise exposure and the cardiovascular system. In the review cited above, Rehm (1983) reports on a series of experiments, both laboratory and field, which show increased levels of the catecholamines epinephrine and norepinephrine. Among them are the series of experiments by Ising and his colleagues (1981a, 1981b, 1981c), showing a connection between noise exposure and magnesium metabolism and humans and animals. According to Rehm, this finding suggests a possible mechanism for cardiovascular effects in that a chronic magnesium imbalance can lead to increased intracellular levels of calcium (in the heart, for instance), which, in turn, can cause vasoconstriction and increases the sensitization for catecholamines.

A large epidemiological study, the Caerphilly and Speedwell Heart Disease Study in England, holds some promise for investigating the effects of road traffic noise (Babisch and Gallacher, 1990). This study of heart disease and a variety of environmental factors uses both the cross-sectional and prospective approaches, and should continue for more than 10 years. The investigators have performed detailed noise exposure measurements. Sample sizes of more than 2,000 men have been drawn from both the Caerphilly and Speedwell communities, and controls for age, socioeconomic factors, family history, body weight, smoking habits, alcohol, and physical activity have been instituted. Initial results (from the cross-sectional study) indicate significant noise related elevations of serum cholesterol and glucose levels, and plasma viscosity, with an absence of significance for blood pressure or any of the other cardiovascular risk factors. The authors point out that all of the effects were slight, but even small increases, should they prove to be real, would be relevant to the public health.

4. Interactions

Several investigators have suggested that aversion to noise may be more highly correlated with health problems than the noise itself. For example, a study by Rehm (1983) found a significant correlation between noise *annoyance* and cardiovascular disorders. Her data also suggest that those with existing health problems are more annoyed by environmental factors, such as noise. Similarly, Rovekamp (1983) found that subjects who described themselves as sensitive to noise showed significantly greater noise-induced increases in peripheral vasoconstriction than their "normal" counterparts. Finally, a recent

study of road traffic and aircraft noise failed to show a significant increase in blood pressure resulting from noise, but did show a correlation between the presence of noise and subjective health complaints (Pulles et al.,1990). Differences in effects between noise and nonnoise groups were dependent upon the subjects' *perceived* control over the noise, but independent of noise level.

5. Other Adverse Effects

Adverse health effects from noise exposure other than cardiovascular effects are even more difficult to isolate. Several studies have investigated the effects of noise on fetal development, with inconclusive results. Some have shown an indication of reduced birth weight or an increase in premature births, but the effects are usually slight, and (except in one case, McDonald et al., 1988), not statistically significant (Rehm and Jansen, 1978; Knipschild et al., 1981).

The effects of noise on documented mental health disorders are likewise inconclusive. Rehm (1990) cites a series of studies showing increased numbers of psychoneurotic and psychosomatic *complaints* due to noise exposure, but whether or not these complaints lead to chronic disfunction or illness is not obvious.

6. Summary: Extra-Auditory Effects

As a biological stressor, noise can influence the entire physiological system. Most effects appear to be transitory, but with continued exposure some effects have been shown to be chronic in laboratory animals. Probably the strongest evidence lies in the cardiovascular effects. However, many studies show adverse effects, while many others show no significant differences between experimental and control populations.

Undoubtedly because of the lack of consistent evidence in this area, EPA could not use data on extra-auditory health effects in its identification of safe levels of environmental noise. Instead, this subject was relegated to a brief discussion in an appendix in the *Levels Document*. Although considerable attention was devoted to this topic at the international conference in Yugoslavia, and some coverage was given in the 1973 Criteria Document, the evidence was far from sufficient and much too complex to enable the formulation of dose-response relationships. Later, EPA did fund some promising research in this area (Hattis and Richardson, 1980; Peterson et al., 1978, 1981, 1983; Turkkan, 1983), some of which has clearly demonstrated adverse cardiovascular effects at noise levels typical of occupational settings.

In the interim, there has been considerable European research activity in this area, but nearly 20 years later, criteria are still lacking. What is available,

however, should give public policymakers as well as noise producers some reason for concern, especially in situations where those impacted by the noise have no control over or *perceive* they have no control over their exposures.

F. Annoyance

Annoyance is the measured outcome of a community's response to survey questions on various environmental and other factors, such as noise exposure. Although annoyance in individuals is sometimes measured in the laboratory, field evaluations of community annoyance are most useful for predicting the consequences of planned actions involving highways, airports, road traffic, railroads, or other noise sources. Factors directly affecting annoyance from noise include interference with communication and sleep disturbance, which have been discussed in earlier sections. Other less direct effects are disruption of one's peace of mind, the enjoyment of one's property, and the enjoyment of solitude. The consequences of noise-induced annoyance are privately felt dissatisfaction, publicly expressed complaints to authorities, and potential adverse health effects, as suggested above.

"Annoyance" has been the term used to describe the community's collective feelings about noise ever since the early noise surveys in the 1950s and 1960s, although some have suggested that this term tends to minimize the impact. While "aversion" or "distress" might be more appropriate descriptors, their use would make comparisons to previous research difficult. It should be clear, however, that annoyance can connote more than a slight irritation; it can mean a significant degradation in the quality of life. This represents a degradation of health in accordance with the WHO's definition of health, meaning total physical and mental well-being, as well as the absence of disease.

1. Predicting Annoyance for Public Policy Purposes

To facilitate the development of criteria and public policy, Schultz (1978) summarized and analyzed a large number of studies of community annoyance from aircraft, road traffic, and railroad noise. As part of this effort, Schultz made several simplifying assumptions, among them that the percentage of the population determined to be "highly annoyed" would be the only parameter plotted as a function of day-night average sound level. The resulting curve portrays annoyance as independent of noise source, and it has been dubbed the Schultz curve.

Recently, Fidell et al. (1991) reanalyzed the original data used by Schultz, adding new data from 11 community noise surveys. The resulting function shows slightly greater annoyance in the range between DNLs of 51 dB and 72

dB, and slightly less annoyance above about a DNL of 76 dB than the original curve. In general, the two curves are fairly close, indicating that the new studies have not drastically altered the prediction of community annoyance, at least when reactions to various noise sources are plotted together. When annoyance from various noise sources is analyzed separately, however, the new data are quite revealing, as will be discussed below.

Although it has been used internationally in the formation of noise policy, the Schultz curve has been the subject of much debate (Kryter, 1982a, 1982b; Griffiths, 1983). For example, Griffiths (1983) criticizes Schultz for treating attitudinal data categorically (highly annoyed or otherwise) rather than scaling it, for failing to analyze the distribution of annoyance, for assuming a fixed threshold for noise-related annoyance, and for choosing such an extreme criterion as highly annoyed. Perhaps because of these reasons, as well as a number of others, researchers and policymakers are beginning to examine alternatives to the Schultz curve for predicting community annoyance from noise.

2. Metrics

The metrics most commonly used to describe the relationship between noise and community annoyance are the equivalent continuous sound level, and the day-night average sound level (DNL), composite ratings based on the A-weighted sound level. The DNL is used almost exclusively for airport planning in the United States, but this practice has recently been called into question. For example, the importance of communication and relaxation in the evening hours has been recognized (in California and occasionally in Europe) by the use of the community noise equivalent level (CNEL), a metric that includes a 5-dB penalty for noises occurring between 7:00 and 10:00 pm as well as the 10-dB nighttime penalty (California Code of Regulations, 1990). In a study of the communities surrounding two French airports, residents expressed the greatest annoyance during the hours between 7:00 and 11:00 pm (Francois, 1977).

Some authorities are considering the use of the sound exposure level (SEL) for evaluating the effects of single events, such as aircraft flyovers (EPA/FAA, 1990). The importance of other parameters are also being considered, such as rise time (or onset time) as an indicator of the annoyance from low-flying military aircraft (Harris, 1989). Officials from the U.S. Forest Service report that their agency has begun to use an aircraft detectability criterion to site recreational facilities (Harrison et al., 1990).

3. Criteria

Community annoyance resulting from noise-induced activity interference was one of the most important considerations in EPA's identification of an outdoor DNL of 55 dB as the "safe" level of environmental noise (EPA, 1974a). Some years later, a Federal Inter-Agency Committee on Urban Noise (FICUN) developed guidelines for considering noise in land-use planning and control (DOT, 1980).[19]

In its noise zone classification table, "minimal" exposures to noise were defined as DNLs below 55 dB, and between DNLs of 55 and 65 dB, the exposures were labeled "moderate." However, all of these exposures were considered "acceptable" according to land-use planning standards specified by the Department of Housing and Urban Development (HUD). No research was cited to support these conclusions. In a footnote, FICUN stated the following:

> HUD, DOT and EPA recognize L_{dn} = 55 dB as a goal for outdoors in residential areas in protecting the public health and welfare with an adequate margin of safety (Reference: EPA "Levels" Document.) However, it is not a *regulatory* goal. It is a level defined by a negotiated scientific consensus without concern for economic and technological feasibility or the needs and desires of any particular community.

The Department of Transportation's Federal Aviation Administration (FAA) has adopted a DNL of 65 as the point above which residential land-use becomes "normally unacceptable." Below this level, the FAA does not require airport authorities to draw noise contours or discuss the impact of airport noise on the surrounding communities for purposes of compatibility planning or to receive grants under the Part 150 program.[20] Thus, public policy decisions, at least on the federal level, have not considered the annoyance of individuals living in the DNL 55-65 dB range.

Recent research confirms the findings of earlier investigations relied upon by the EPA, that annoyance is often generated at day-night average sound levels well below 65 dB (Fidell et al., 1985; Fidell et al., 1991; Hall et al., 1981). Figures 4 and 5 from Fidell et al. (1991) portray the responses from

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[19] FICUN was an ad-hoc interagency panel composed of representatives from EPA, FAA, HUD, the Department of Defense, and the Veterans Administration. In 1990 another such group, the Federal Interagency Committee on Noise (FICON) has been activated (focussing mainly on aircraft noise), but a report has not been published to date.

[20] Part 150 studies are conducted at airports where the noise generated by airport construction or expansion is potentially incompatible with the surrounding community. These studies must follow the procedures set out by Federal Aviation Regulations (FAR) Part 150.

surveys of two mid-sized airports in California: Burbank Airport and the Orange County Airport. The percentage of respondents highly annoyed is depicted as a function of DNL, and compared to the Schultz curve. Both studies show significantly greater numbers of people highly annoyed than would have been predicted by the Schultz curve. For example, at 60 dB, as many as 70 percent of the Burbank population described themselves as highly annoyed and some 40 percent near the Orange County Airport.

Presumably because of this kind of evidence, another interagency task force has convened to discuss the extent to which day-night average sound levels below 65 dB should be taken into account in assessing the impact of aircraft/airport noise, and to examine the possible need for a single-event metric to supplement the DNL (EPA/FAA, 1990).[21]

4. Sources

The sources of noise producing community annoyance are primarily aircraft, road traffic, and railroad noise, although noise from industry, construction, and within buildings can also be problematical. The leading offenders are usually aircraft and road traffic noise, although the hierarchy depends upon many factors, such as urbanization, numbers of noise events, and proximity to the sources. Recent research indicates that, despite equivalent noise levels, some sources of community noise are more annoying than others, providing further indication that the Schultz curve cannot be valid for all circumstances.

Treating annoyance from all sources with one predictive curve provokes the hazards of oversimplification. De Jong (1990a) reports that an analysis of Dutch studies carried out over the previous 15 years showed that aircraft and highway noise produced considerably more annoyance than equivalent levels of train, tramway, and urban road noise (Miedema, 1988). The divergence was particularly pronounced at high noise levels. The fact that aircraft generate more annoyance than surface transportation is portrayed dramatically in the analysis described above by Fidell et al. (1991), where annoyance related to mid-sized airports appears substantially greater than that

[21] The U.S. EPA and FAA put together an interagency agreement to examine the extent to which single-event analyses and information beyond the $L_{dn}=65$ contour provide useful additions to current methods of evaluating potential airport noise impacts. Under this agreement, a contractor would identify eight existing airports and perform a quantitative analysis using existing data. No new annoyance data would be developed.

Figure 4

Relationship of data from Burbank Airport Study to 1978 synthesis (Schultz) curve, showing percentage of respondents highly annoyed as a function of day-night average sound level. (After Fidell *et al.*, 1991).

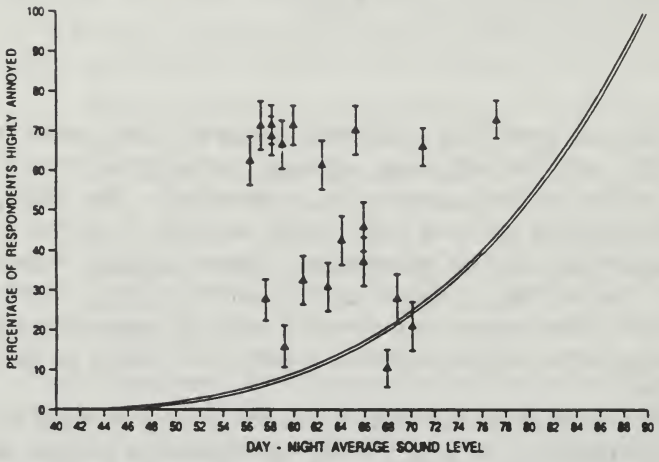
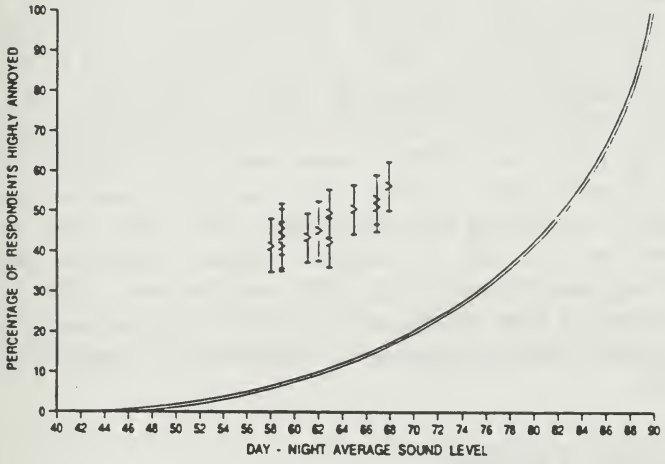


Figure 5

Relationship of data from Orange County Airport Study to 1978 synthesis (Schultz) curve, showing percentage of respondents highly annoyed as a function of day-night average sound level. (After Fidell *et al.*, 1991).



predicted by the Schultz curve, while annoyance from urban sources, such as trains, trams, and street traffic, is considerably less than that predicted by the Schultz curve.[22] Figures 6 and 7, also from Fidell et al. (1991), depict data from British and Swedish railroad studies, showing somewhat less annoyance from these sources in relation to the Schultz curve.

The explanation for these source-related differences is not necessarily that aircraft noise is inherently more annoying than surface transportation noise. It may be related to differences in people's criteria for responding to various noise sources (de Jong, 1990b; Green and Fidell, 1991). Or it may be caused by differences in sensitivity which are actually biologically based.[23] Green and Fidell (1991) point out that this evidence does not discredit the predictive validity of the DNL, but suggest that communities adopt a more sensitive criterion when evaluating the impact of aircraft noise.[24]

Impulse noise also appears to be more annoying than continuous noise of equivalent energy, and various penalties have been proposed ranging from 0 dB at relatively high ambient noise levels of about 67 dB, to 10 dB at ambient levels as low as 35 dB (Rice, 1983). Vos and Smoorenburg (1983) have recommended a formula for computing the impulse noise penalty, taking into account the type of noise source, the signal level, and the ambient noise level.

As de Jong points out (1990b), most people are exposed to some combination of noise sources, posing a very complex predictive problem. Several models for predicting noise annoyance from complex sources have been proposed, but most fail to solve the difficult theoretical problems involved (de Jong cites Berglund et al., 1981, and Miedema, 1985). Among the groups working on these models are the Institute for Sound and Vibration Research in England, and the Netherlands' Organization for Applied Scientific Research, TNO.

5. Nonacoustics Variables

Although it is clear that community annoyance is positively correlated with noise exposure level, other variables also appear to be important, such as ambient noise level, time of day and year, location, and socioeconomic status. None of these other variables, however, is as powerful as the attitude of the residents surveyed. This is a good example of the fact that the human being is

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[22] See also Fidell et al. (1985), Hall et al. (1981), and de Jong (1990).

[23] De Jong (1990b) cites the work of Di Nisi et al. (1987) and Ising, et al. (1981b) to support this theory.

[24] Green and Fidell found a difference of 5.2 dB between the noise levels at which the same percentage of people are highly annoyed by aircraft noise versus noise from surface transportation.

not a black box, where the effect is a simple consequence of the input. In a recent analysis of 280 social surveys, Fields (1990) examined 17 hypotheses as they relate to community annoyance from noise. Besides noise exposure level, the only variables Fields identified as strongly correlated with noise annoyance were the attitudinal hypotheses: (1) fear that the noise source might be a danger to the neighborhood, (2) belief that the noise is preventable, (3) awareness that nonnoise problems are associated with the noise source, (4) stated sensitivity to noise, and (5) belief that the economic activity represented by the source is not important for the community.

6. Habituation

The evidence is fairly clear that so long as the stimulus remains the same, noise annoyance does not subside over time (e.g., Fields, 1990). Griffiths (1983) cites studies showing no habituation for highway noise 4 months to 2 years after the opening of new routes. De Jong (1990) found that annoyance in a previously surveyed community *increased* by 10 percent with no change in noise levels. He suggests that this increase could represent a shift of internal criteria due to increased publicity and other factors, or perhaps an increase in physiological sensitization.

Figure 6

Relationship of data from British Railroad Study to 1978 synthesis (Schultz) curve, showing percentage of respondents highly annoyed as a function of day-night average sound level. (After Fidell *et al.*, 1991).

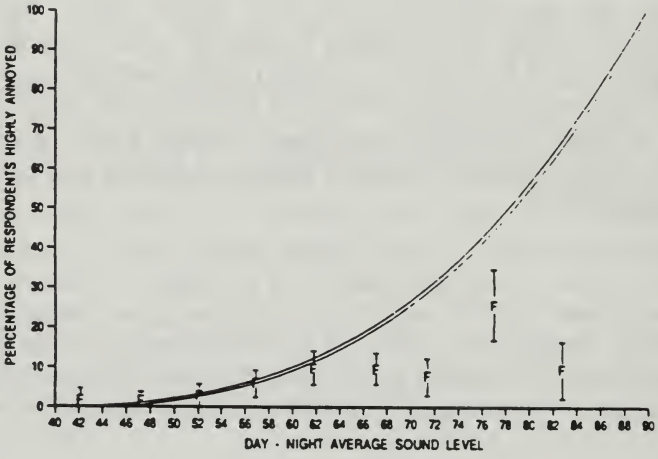
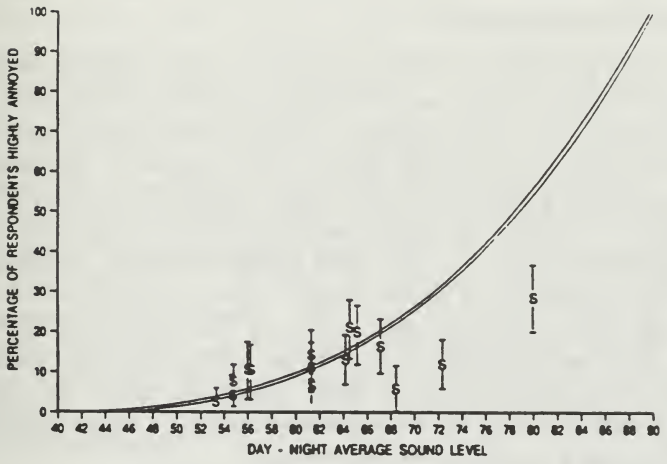


Figure 7

Relationship of data from Swedish Railroad Study to 1978 synthesis (Schultz) curve, showing percentage of respondents highly annoyed as a function of day-night average sound level. (After Fidell *et al.*, 1991).



7. Annoyance and Health

There has been very little study of the effects of noise-related annoyance on general health, although this would appear to be a fertile field. The study mentioned in section E.4. above by Rehm (1983) suggests a relationship between annoyance and cardiovascular disorders. Likewise, another study indicates a connection between noise and subjective health complaints (Pulles, et al., 1990). De Jong (1990a) refers to the recent use in Germany of the concept of "substantial annoyance" as a predictor of possible health damage.[25] He recommends the development of an integrated theory of noise effects "to uncover the relationships among medical, physiological, behavioural, and ecological effects of environmental noise." (de Jong, 1990a, p.520)

8. Summary: Annoyance

Annoyance can be viewed as the expression of negative feelings resulting from interference with activities, as well as disruption of one's peace of mind and the enjoyment of one's environment. Although this reaction can run the gamut of mild irritation to extreme distress, only responses categorized as "highly annoyed" (and greater) have been used to measure the impact of noise on communities. The most respected and widely used criterion to assess community annoyance in the U.S. has been the Schultz curve, although this criterion has been the subject of heated debate. Several recent studies indicate that the Schultz curve underestimates annoyance due to aircraft noise and overestimates annoyance from the noise of urban traffic and trains, leading to the conclusion that annoyance from these categories should be assessed separately. In addition, there has been growing interest in supplementing the traditional DNL with a descriptor for single events.

EPA's *Levels Document* identified the outdoor level to protect against activity interference as a day-night average sound level of 55 dB. This identification was not to be construed as a standard or regulation,[26] but as information to aid states, localities, and the general public. Later, an interagency task force identified average levels between 55 and 65 dB as "acceptable" for purposes of land-use planning. The DNL 65-dB criterion, which has been applied particularly to airport noise assessments, is now being reconsidered by another interagency task force.

There is evidence that impulse noise is more annoying than continuous noise of equivalent energy, and various correction factors have been proposed to account for the difference. In addition, most people are exposed to a

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[25] De Jong cites Jansen (1986).

[26] See Foreword, *Levels Document* (EPA, 1974a).

combination of noise sources, and models for predicting the resulting annoyance are in the formative stages.

The most important variables other than noise exposure level relate to people's attitudes about the noise, such as fear of possible danger, stated sensitivity, and the belief that the noise is preventable. Finally, it appears that noise-related annoyance does not subside over time.

VI. Conclusions

Noise has a significant impact on the quality of American life. There is no evidence that the impact has diminished in the years since ONAC was abolished. Rather, it appears that the impact is at least as great, and most probably greater, than it was 10 years ago, due to population growth, especially in urban areas, and the proliferation of certain noise sources.

A considerable amount of noise effects research has been conducted over the last decade, much of it taking place in the European nations where governmental concern about noise is greater than it is in the United States at this time. These studies have expanded the knowledge base and filled certain gaps. Many of them suggest important interrelationships between the various noise effects that remain largely unexplored. For example, perceived control over noise appears to decrease its adverse effects on the subsequent performance of certain tasks. The concept of control also has a bearing on annoyance from noise, as do several other nonacoustic factors. Annoyance appears to be related to extra-auditory health effects, and chronic sleep interference, which is a component of annoyance, can have adverse effects on health and well-being.

All of these effects are, to a varying degree, stress related. Nowadays there is increasing evidence in the medical literature on the relationship between stress and illness, one which is often exacerbated by lack of control.

Cumulatively, this evidence suggests the potential for a unifying hypothesis that may well explain some of the health effects that have been observed in connection to noise exposure, but have usually been dismissed because of the absence or insufficiency of direct cause and effect relationships. Such a hypothesis, however, can only be validated by a new interdisciplinary approach, one which takes a broader and somewhat different perspective than is currently employed. This approach could very well provide the key to understanding a great deal more about the general impact of noise on society, and the extra-auditory effects in particular.

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