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Preventing Bhopal: "Dead Zones" and Toxic Death Risk Index Taxes

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I. INTRODUCTION

On December 5, 1984, a pesticide manufacturing plant leaked highly toxic methyl isocyanate (MIC) and the resulting cloud of gas killed over 2,000 people and injured more than 200,000 others living in the shantytowns of Bhopal, India.[1] While no toxic accident in the United States has approached the magnitude of Bhopal, a 1988 United States Environmental Protection Agency (EPA) study found that 11,048 accidental releases of extremely hazardous substances occurred between 1982 and 1986.[2] These accidents caused 309 deaths, 11,341 injuries and the evacuation of 464,677 people from homes and jobs.[3] The EPA estimated that seventeen of these accidents could have caused *more* damage than Bhopal if climate and other factors had been different.[4] Fred Millar, director of the Environmental Policy Institute's Toxic Chemical Safety and Health Project, has argued that millions of Americans are at risk from

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[1] *See* Richard Schwadron, *The Bhopal Incident: How the Courts have Faced Complex International Litigation*, 5 B.U. INT'L L.J. 445, 445 (1987). A number of commentators have discussed the Bhopal accident and ensuing litigation. *See generally* Rajeev Dhavan, *For Whom? And for What? Reflections on the Legal Aftermath of Bhopal*, 20 TEX. INT'L L.J. 295 (1985); Marc Galanter, *Legal Torpor: Why So Little Has Happened in India After the Bhopal Tragedy*, 20 TEX. INT'L L.J. 273 (1985) [hereinafter Galanter, *Legal Torpor*]; Marc Galanter, *When Legal Worlds Collide: Reflections on Bhopal, the Good Lawyer, and the American Law School*, 36 J. LEGAL EDUC. 292 (1986) [hereinafter Galanter, *Legal Worlds*]; Jeffrey O'Connell, *Bhopal, the Good Lawyer, and the American Law School: A Torts (and Insurance) Professor's Perspective*, 36 J. LEGAL EDUC. 311 (1986).

[2] S. REP. NO. 228, 101st Cong., 2d Sess. 134 (1989), *reprinted in* 1990 U.S.C.C.A.N. 3385, 3519.

[3] Evacuation data was reported only for about one-half of the recorded events, so actual figures may be much higher. Seventy percent of the accidents occurred at stationary facilities; thirty percent were transportation related. *Id.*

[4] *Id.* at 135.

chemicals such as hydrofluoric acid, which is widely used by oil refineries to boost the octane levels of unleaded gas.[5]

To prevent catastrophic accidents, government must create incentives to encourage industry to substitute less harmful chemicals or store smaller quantities of toxic materials. This Article examines two methods for industry to internalize the social costs associated with reducing the risks of toxic accidents. First, the Article proposes a new type of incentive system called a toxic death risk index tax that would tax a user of extremely hazardous chemicals based upon how many people might be injured in case of a foreseeable accidental release. This Article will argue that such a tax is necessary because the tort liability system does not force firms to internalize the full costs of their activities because of the possibility that a firm may file for bankruptcy and not pay the full costs of an accident. In addition, this Article examines the neglected issue of mitigating the consequences of accidents and argues in favor of requiring buffer zones around facilities using extremely hazardous substances to reduce the number of potential injuries in adjacent residential areas. The buffer zone is another method of internalizing social costs. The tax and buffer proposals are interrelated because one method of reducing tax liability is for a firm to buy more buffer land.

Both proposals depend upon firms conducting risk assessments that determine how many adjacent residents may be affected by an accidental air release. To understand the issue of accidental release risk assessment, one must become familiar with federal and state legislative efforts since Bhopal. As a result of the Bhopal disaster and other toxic accidents in the United States, Congress in 1986 enacted the Emergency Planning and Community Right-to-Know Act (EPCRA) as Title III to the Superfund Amendment and Reauthorization Act (SARA).[6] EPCRA contains important provisions relating to a community's right-to-know about which chemicals are being used and to

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[5] *See Environmental Group Warns of Bhopal-Scale Acid Risk Facing 68 U.S. Communities, Millions of People*, Daily Report for Executives (BNA) No. 233, at A-5 (Dec. 7, 1987), *available in* LEXIS, Nexis library, Drexel file [hereinafter *Environmental Group Warns*]. In 1990, Congress amended Section 112(n)(6) of the Clean Air Act to require the Administrator of the EPA to complete a study regarding the potential hazards of hydrofluoric acid and to make recommendations about the reduction of such hazards. 42 U.S.C.A. § 7412(n)(6) (West Supp. 1992).

[6] Superfund Amendment and Reauthorization Act of 1986 (SARA), Pub. L. No. 99-499, §§ 301-330, 100 Stat. 1613, 1729 (1986) (codified at 42 U.S.C. §§ 11001-11050 (1988)).

emergency planning[7], but fails to address, at least directly, the prevention of toxic accidents.[8]

In 1990, Congress finally addressed the issue of preventing toxic accidents, although this Article will argue that Congress did not go far enough. Delaware, New Jersey, and, to a lesser extent, California had already moved toward a preventative approach by adopting risk management programs.[9] As part of the 1990 Clean Air Act Amendments, Congress mandated that the EPA promulgate rules by November 15, 1993, to prevent accidental releases of extremely hazardous substances and to require users of such materials to prepare risk management programs to minimize releases.[10] Neither state nor federal risk prevention programs, however, place sufficient emphasis on economic incentives or on minimizing the consequences of any accidents that do take place.

This Article will demonstrate that the EPA in conjunction with state and local zoning officials should require a buffer zone, which is sometimes called a "dead zone" or "greenbelt," to surround the perimeter of facilities that cannot reduce their use of extremely hazardous substances to safe levels. In particular, this Article will discuss a computer based mapping technique called Geographic Information Systems (GIS) that can determine the likely plume of various hypothetical releases and therefore can be used to determine the size of the dead zone necessary to protect residential areas from a particular facility.[11] It is impossible to prevent all toxic accidents. Accordingly, one must plan to minimize the number of lives lost as a result of a chemical disaster. This Article is primarily concerned with residents who live near a facility that uses hazardous materials rather than with occupational safety. Improving occupational safety is a worthy goal, but that complex subject demands a separate discussion beyond the scope of this Article.[12] Fundamentally, it is

[7] *See* § 301(a)-(c), 42 U.S.C. § 11001(a)-(c); *see also* Robert F. Blomquist, *The Logic and Limits of Public Information Mandates Under Federal Hazardous Waste Law: A Policy Analysis*, 14 VT. L. REV. 559, 571-72 (1990).

[8] *See* JAMES T. O'REILLY, EMERGENCY RESPONSE TO CHEMICAL ACCIDENTS: PLANNING AND COORDINATING SOLUTIONS 124-25, 142 (1987).

[9] *See, e.g.*, Hazardous Materials Management, CAL. HEALTH & SAFETY CODE §§ 25531-25541 (West Supp. 1992); Extremely Hazardous Substances Risk Management Act, DEL. CODE ANN. tit. 7, §§ 7701-7718 (Supp. 1990); Toxic Catastrophe Prevention Act, N.J. STAT. ANN. §§ 13:1K-19 to -31 (West 1991).

[10] Clean Air Act Amendments of 1990, § 112(r), 42 U.S.C.A. § 7412(r) (West Supp. 1992).

[11] *See infra* notes 121-33 and accompanying text.

[12] In July 1990, the United States Occupational Safety and Health Administration (OSHA) published a notice of proposed regulations regarding the process safety management of highly hazardous chemicals. 55 Fed. Reg. 29150 (1990) (to be codified at 29 C.F.R. § 1910.119) (proposed July 17, 1990). Section 304 of the 1990 Amendments to the Clean Air Act, however, established specific requirements that the Secretary of Labor

critical to keep residents of a community from living in the likely path of a toxic cloud of gas. Most likely, fewer people would have died at Bhopal if the Union Carbide pesticide plant had created a substantial buffer zone.

There are two major ways to encourage or require users of extremely hazardous substances to create buffer zones around their facilities. First, government regulations can require users to create a buffer zone if their facilities pose an unreasonable risk. A general problem with government regulation, however, is that it may be economically inefficient. This Article will argue that relatively new computer programs that can predict the likely dispersal patterns of toxic gas in case of an accident can enable government regulators to calculate the optimal size of a buffer zone for an individual facility in a cost efficient manner. This Article will examine the feasibility of using overlay zoning and performance standards to establish buffer standards and then discuss whether such requirements may constitute a taking of private property without just compensation.

Some commentators might argue that government regulation is unnecessary because a properly designed liability regime would create incentives for hazardous material operators to purchase greenbelt land to establish a dead zone. If there is a substantial risk, however, that a firm causing a catastrophic accident will become bankrupt and as a result not pay the full costs of the accident then firms may not purchase as much buffer space as is socially desirable. Thus, government intervention may be necessary if users of extremely hazardous substances are not fully internalizing the potential costs of accidental releases. Even if government intervention is necessary, however, there is an alternative to bureaucratic "command and control" regulation.

As an alternative to using zoning regulations to create dead zones, the government could use economic incentives such as pollution charges, or marketable permit systems to discourage pollution or to encourage the

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had to meet and required that the Secretary issue regulations by November 15, 1991. Pub. L. No. 101-549, tit. III, § 304, 104 Stat. 2576 (codified at 29 U.S.C.A. § 655 (West Supp. 1992)). This statute requires the Secretary of Labor to work with the Administrator of the EPA in developing a chemical process safety standard designed to protect employees from hazards associated with accidental releases of highly hazardous chemicals in the workplace. 29 U.S.C.A. § 655(a). The 1990 Amendments to the Clean Air Act impose a reciprocal duty on the part of the Administrator of the EPA to work with the Secretary of Labor and OSHA. Section 112(r)(1) of the 1990 Amendments to the Clean Air Act imposes a general duty on users of extremely hazardous substances to identify hazards to the same extent as section 654 of Title 29. 42 U.S.C.A. § 7412(r)(1). The Administrator of the EPA in promulgating regulations for accident prevention relating to extremely hazardous substances must utilize the expertise of the Secretary of Labor and coordinate EPA's regulations with those of OSHA. *See* 42 U.S.C.A. § 7412(r)(7)(B)(i), (D). The interrelationship between OSHA regulations and section 112(r) of the Clean Air Act is beyond the scope of this Article.

substitution of less hazardous substances.[13] This Article proposes a new type of incentive system called a toxic death risk index tax, which would tax users of extremely hazardous substances based upon the number of people that would likely be killed or injured in the case of an accident. A toxic death risk index tax would be different from current pollution taxes that impose a uniform tax on each unit of pollution and instead would be based upon the actual risk created by a polluter. An individualized toxic death risk index tax would create incentives for users to reduce their use of extremely hazardous substances, to substitute less hazardous materials, and to use more buffer land. It is important to note that the proposed tax would depend upon good hazard assessment studies of potential releases at a facility and that such studies would also serve as the basis for zoning decisions.

Section II of this Article will examine EPCRA, state risk management statutes, and Section 112(r) of the 1990 Clean Air Act Amendments. In Section III, this Article will discuss whether zoning authorities should require buffer zones around hazardous facilities and whether the zones can survive likely takings challenges. Section IV will explore whether the present liability regime is likely to encourage firms to acquire the socially efficient amount of buffer space without some type of government intervention. Section V will propose a toxic death risk index tax.

II. EPCRA, STATE RISK MANAGEMENT STATUTES AND SECTION 112(r)

Section II will examine the factors that led Congress to adopt EPCRA and explore the provisions in that statute relating to emergency planning. Next, this Section will discuss risk management statues adopted in New Jersey, California, and Delaware. Delaware and California encourage the use of buffer zones to some extent when users create their risk management plans, but neither state requires zoning officials to consider emergency planning issues or buffer zones. Congress mandated risk management planning in enacting the accidental release prevention provisions in Section 112(r) of the 1990 Clean Air Act Amendments, but failed to address the role of economic incentives or buffer zones.

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[13] There is a vast literature arguing that economic incentives are more efficient than "command and control" bureaucratic regulation. *See generally* Bruce Ackerman & Richard B. Stewart, *Reforming Environmental Law*, 37 STAN. L. REV. 1333 (1985); Robert W. Hahn, *An Evaluation of Options for Reducing Hazardous Waste*, 12 HARV. ENVTL. L. REV. 201 (1988); Robert W. Hahn & Robert N. Stavins, *Incentive-Based Environmental Regulation: A New Era from an Old Idea?*, 18 ECOLOGY L.Q. 1 (1991); Clifford S. Russell, *Economic Incentives in the Management of Hazardous Wastes*, 13 COLUM. J. ENVTL. L. 257 (1988); Richard B. Stewart, *Controlling Environmental Risks Through Economic Incentives*, 13 COLUM. J. ENVTL. LAW. 153 (1988).

A. *Background to EPCRA*

The tragedy at Bhopal alerted the American public to the dangers of toxic air releases. In addition, a number of serious incidents in the United States demonstrated that the potential for a similar catastrophic accident existed in this country. Perhaps the most dramatic accidental release occurred in August 1985 at the Union Carbide facility in Institute, West Virginia, which was the only plant in the United States that manufactured the same MIC pesticide involved at Bhopal.[14] In the wake of Bhopal, Union Carbide temporarily shut down the Institute plant's MIC operations, but renewed production after performing safety tests and installing a computer system designed to monitor the path of any accidental air toxic release.[15] Despite these precautions, a potentially toxic cloud of aldicarb oxime, an intermediate reactant used in combination with MIC to produce an insecticide, leaked from the facility, drifted into a residental neighborhood, and caused at least 135 people to seek medical treatment for eye, throat, and lung irritation.[16] Union Carbide officials did not notify local authorities until between ten to twenty minutes after they detected the leak because their computer model indicated that the gas would not go beyond the plant boundaries.[17]

While there was never any danger that the gas released would produce the same ghastly effects that MIC had at Bhopal, the Institute accident played a major role in convincing Congress to enact EPCRA.[18] Furthermore, in 1985,

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[14] *See* Jayne S.A. Pritchard, Comment, *A Closer Look at Title III of SARA: Emergency Planning and Community Right-to-Know Act of 1986*, 6 PACE ENVTL. L. REV. 203, 203–04 (1988); *Steam in Chemical Storage Tank Named As Likely Cause of Union Carbide Accident*, 16 ENV'T REP. (BNA) 635 (Aug. 16, 1985) [hereinafter *Union Carbide Accident*]; *see also* Alan Hall et al., *A Backlash is Threatening Chemical Makers*, BUS. WK., Dec. 24, 1984, at 60 (after Bhopal, Union Carbide temporarily shutdown its Institute plant—the only manufacturer of MIC in United States).

[15] *See* Edward J. Joyce, *To stop another Bhopal; In the wake of Bhopal, chemical manufacturers are turning to computers to ensure safety . . . with mixed results*, 32 DATAMATION, Mar. 1, 1986, at 40, *available in* LEXIS, Nexis library, Omni file (discussing Union Carbide's purchase of computer system for Institute plant).

[16] *See id.*; Pritchard, *supra* note 14, at 203; *Union Carbide Accident*, *supra* note 14, at 635.

[17] *See* Joyce, *supra* note 15, at 40; Pritchard, *supra* note 14, at 203; *Union Carbide Accident*, *supra* note 14, at 635. Union Carbide officials and the manufacturer of the computer system defended the performance of the computer model on the grounds that the operator of the computer incorrectly selected MIC as the chemical that had leaked and therefore obtained incorrect results. Joyce, *supra* note 15, at 40.

[18] *See* Pritchard, *supra* note 14, at 203–04; *Carbide Accident May Speed Controls, Right-to-Know, Emergency Response Rules*, 16 ENV'T REP. (BNA) 635 (Aug. 16, 1985) [hereinafter *Carbide Accident May Speed Controls*].

an EPA study revealed that more than 6,900 accidents involving spills or releases of toxic chemicals had occurred in the past five years, including 135 deaths and 1,500 injuries.[19] The study indicated that approximately three-quarters of the accidents occurred in facilities using a chemical and that the balance took place while a transporter was in control of the substance.[20]

In 1985, no federal agency had clear statutory authority for toxic releases or emergency planning.[21] Several statutes gave the United States Environmental Protection Agency (EPA) authority to respond to imminent hazards.[22] In addition, the Hazardous Material Transportation Act gave the federal Department of Transportation (DOT) response authority for releases that occurred during transportation.[23]

In the wake of the Bhopal tragedy and Institute incident, the EPA took the position that existing statutes provided the agency with adequate authority, that no new regulatory program was necessary to address the issue of accidental releases of toxic materials, and that its role should be limited to assisting local communities that voluntarily choose to develop emergency response procedures.[24] To encourage municipalities to establish emergency plans, the EPA created the voluntary Chemical Emergency Preparedness Program (CEPP), as part of the agency's "Air Toxics Strategy," a program designed to address accidental releases of acutely toxic substances into the air.[25] In the face of overwhelmingly negative publicity, the Chemical Manufacturers Association sponsored the Community Awareness and Emergency Response (CAER) program to encourage industry to develop emergency response plans with the cooperation of local communities.[26]

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[19] *See* Pritchard, *supra* note 14, at 204; *Draft EPA Study Counts 6,900 Releases Of Acutely Toxic Chemicals In Five Years*, 16 ENV'T REP. (BNA) 1022, at A-9 (Oct. 9, 1985) [hereinafter *Draft EPA Study*].

[20] *See* Pritchard, *supra* note 14, at 204; *Draft EPA Study*, *supra* note 19, at 1022.

[21] *See* Pritchard, *supra* note 14, at 204–05.

[22] *See id.* at 205 n.12. The following statutes provided the EPA with imminent and substantial hazard authority: the Federal Insecticide, Fungicide and Rodenticide Act § 6d(c), 7 U.S.C. § 136d(c) (1982 & Supp. IV 1986); Toxic Substances Control Act § 7, 15 U.S.C. § 2606 (1982); Clean Water Act § 504, 33 U.S.C. § 1364 (1982); Safe Drinking Water Act § 1431, 42 U.S.C. § 300i (1982 & Supp. IV 1986); Resource Conservation and Recovery Act § 7003, 42 U.S.C. § 6973 (1982 & Supp. IV 1986); Clean Air Act § 303, 42 U.S.C. § 303, 42 U.S.C. § 7603 (1982); and Comprehensive Environmental Response, Compensation, and Liability Act §§ 104, 106, 42 U.S.C. §§ 9604, 9606 (1982 & Supp. IV 1986).

[23] 49 U.S.C. § 1811 (1982); *see also* Pritchard, *supra* note 14, at 205.

[24] *See* Pritchard, *supra* note 14, at 205.

[25] 50 Fed. Reg. 51,451 (1985); *see* Pritchard, *supra* note 14, at 205–06.

[26] *See* Pritchard, *supra* note 14, at 206 n.19; Randal Schumacher, *The Chemical Industry Replies; Making America's Safest Industry Safer*, N.Y. TIMES, May 18, 1986, § 3,

Congress did not view voluntary efforts by the EPA or industry as adequate to address public concerns about safety or the adequacy of emergency planning and in 1986 enacted EPCRA.[27]

B. *EPCRA*

The Emergency Planning and Community Right-to-Know Act contains two separate programs.[28] First, Subtitle A, "Emergency Planning and Notification," requires the establishment of state and local emergency planning and response committees, mandates that these committees prepare emergency response plans, and requires private industry to notify the appropriate local committee when an emergency release occurs.[29] Second, Subtitle B, "Reporting Requirements," requires industry to provide extensive information to the public about chemical usage, chemical properties, manufacturing, and environmental releases.[30] In addition, Subtitle C contains general provisions relating to trade secret protection, public access to information, enforcement, and citizen suits.[31] This Article will not address Subtitle C issues.

Subtitle A requires each governor to appoint a State Emergency Response Commission, which in turn must designate emergency planning districts and local emergency planning committees (LEPCs).[32] There are approximately 3,500 LEPCs in this country.[33] Each LEPC must prepare an emergency response plan that identifies facilities within the district at which any of approximately 400 statutorily designated "extremely hazardous substances" are

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at 2 (Chemical Manufacturers Association official acknowledges public safety fears and discusses CAER and other industry safety efforts).

[27] *See* Pritchard, *supra* note 14, at 206.

[28] *Id.*

[29] Superfund Amendment and Reauthorization Act of 1986 (SARA) §§ 301–305, 42 U.S.C. §§ 11001–11005 (1988); *see* Pritchard, *supra* note 14, at 206–07; *see also* Blomquist, *supra* note 7, at 571–72; Peter A. Dauzvardis, Comment, *Developments In Chemical Emergency Planning Legislation: Toward a Comprehensive Response Program in Ohio*, 17 CAP. U. L. REV. 143, 156–57 (1987); Usha Wright, New Jersey Developments, *New Jersey and Federal Initiatives to Prevent Toxic Catastrophes*, 41 RUTGERS L. REV. 1435, 1444–45 (1989).

[30] §§ 311–313, 42 U.S.C. §§ 11021–11023 (1988); *see* Blomquist, *supra* note 17, at 571–72; Pritchard, *supra* note 14, at 207.

[31] §§ 312–330, 42 U.S.C. §§ 11041–11050 (1988); *see* Pritchard, *supra* note 14, at 207.

[32] 42 U.S.C. § 11001(a)–(c); *see* Blomquist, *supra* note 7, at 572; Dauzvardis, *supra* note 29, at 156–57; Wright, *supra* note 29, at 1445–46.

[33] *See* Fred Millar, *The Beginnings of Chemical Control*, 5 ENVTL. F. 26, 26 (Oct. 1988).

used in "threshold planning quantities."[34] The statute requires such facilities to provide extensive information to the LEPC.[35] EPCRA mandates that the plan establish reporting procedures, name community and facility coordinators, identify available emergency equipment, create training programs, and provide for an evacuation plan.[36] In addition, the plan must include "[m]ethods for determining the occurrence of a release, and the area or population likely to be affected by such releases."[37] This Article will later discuss that last issue in more depth. Finally, Subtitle A mandates that facilities immediately notify a LEPC whenever there is the release of a "reportable quantity" of an extremely hazardous substance or a hazardous substance as defined by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA).[38]

Subtitle B's community right-to-know provisions address a different category of chemicals from those regulated by Subtitle A's emergency planning provisions.[39] The community right-to-know provisions require users to disclose information about thousands of toxic substances that are less acutely toxic than the Subtitle A extremely hazardous substances, but it is important to recognize that the Subtitle B substances may still pose serious long term health risks.[40] This Article will not discuss the community right-to-know provisions in depth because it is primarily concerned with acute health impacts rather than with chronic health risks. It is worth noting, however, that the Monsanto Chemical Company announced in 1988, the deadline for reporting emissions, that by 1992 it would reduce its toxic emissions by ninety percent, from twenty million to two million pounds annually.[41] Monsanto officials acknowledged that public concerns about safety were an important factor in the company's decision.[42] While voluntary reduction efforts are laudable, firms are more likely to reduce

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[34] 42 U.S.C. §§ 11002(a)(2), 11003(c) (1988). The list of extremely hazardous substances—originally containing 402 substances—is contained in 40 C.F.R. Part 355, Appendix A. The EPA later deleted forty substances from the list. *See* 52 Fed. Reg. 48,072, 48,075 (Dec. 17, 1987); 53 Fed. Reg. 5574 (Feb. 25, 1988); *see also* Blomquist, *supra* note 7, at 572 n.59.

[35] 42 U.S.C. § 11002(c); *see* Dauzvardis, *supra* note 29, at 158.

[36] 42 U.S.C. § 11003(c).

[37] *Id.*

[38] *Id.* § 11004; *see also* CERCLA, §§ 102, 103(a), 42 U.S.C. §§ 9602, 9603(a) (1988) (respectively, defining "hazardous substance" and defining CERCLA notification provisions); *see* Blomquist, *supra* note 7, at 572–73; Dauzvardis, *supra* note 29, at 158.

[39] *Compare* 42 U.S.C. § 11002(a)(2) (Subtitle A-extremely hazardous substances) *with* 42 U.S.C. § 11023(c) (toxic chemicals subject to EPCRA). *See generally* Dauzvardis, *supra* note 29, at 158–59.

[40] *See generally* 42 U.S.C. § 11023(c); Dauzvardis, *supra* note 29, at 158–59.

[41] *See* Millar, *supra* note 33, at 26.

[42] *Id.*

use of hazardous chemicals or substitute less harmful ones if economic incentives encourage them to do so.

While the EPA and industry had already taken some steps toward voluntary emergency planning, EPCRA represented a step forward by requiring every state to establish planning districts, LEPCs and a plan for each district. EPCRA, however, does not directly address the prevention of accidents.[43] Accordingly, some states have taken steps to require risk management and prevention programs that seek to minimize the likelihood of a toxic accident.[44]

C. *State Programs*

Delaware, New Jersey, and, to a lesser extent, California have taken the lead among states in supplementing EPCRA with their own risk prevention statutes.[45]

1. *New Jersey*

In January 1986, several months before Congress adopted EPCRA, New Jersey enacted the Toxic Catastrophe Prevention Act (TCPA), which requires the chemical industry to conduct risk assessments of their facilities and authorizes the New Jersey Department of Environmental Protection (NJDEP) to determine the level of acceptable risk.[46] EPCRA does not impose a detailed risk assessment requirement, but one commentator has suggested that the federal statute may achieve similar results by requiring public disclosure of information relating to chemical management.[47] TPCA, however, goes further than EPCRA by granting the NJDEP authority to review a registrant's risk management plan and to determine whether the plan is acceptable.[48] If the NJDEP recommends changes in the registrant's risk management plan, the parties may enter into a consent decree.[49] If the parties cannot reach agreement, the commissioner of NJDEP, after providing notice, holding a hearing and promulgating written findings of fact, may issue an administrative order

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[43] *See* O'REILLY, *supra* note 8, at 124–25, 142. *See also supra* note 8 and accompanying text.

[44] *See supra* note 9 and accompanying text.

[45] *See supra* note 9 and accompanying text.

[46] N.J. STAT. ANN. §§ 13:1K-19 to -31 (West 1990); *see* Wright, *supra* note 29, at 1436. In 1991, the New Jersey Department of Environmental Protection was redesignated as the New Jersey Department of Environmental Protection and Energy. *See Reorganization Plan* No. 002-1991, set out under New Jersey Statutes Ann. § 13:1D-1 (West 1991).

[47] *See* Wright, *supra* note 29, at 1436.

[48] N.J. STAT. ANN. § 13:1K-23(a). *See generally* Wright, *supra* note 29, at 1438.

[49] N.J. STAT. ANN. § 13:1K-23(b); *see also* Wright, *supra* note 29, at 1438.

requiring changes to the plan.[50] In issuing such an order, the NJDEP must consider issues such as "cost-effectiveness, extraordinarily hazardous accident risk reduction effectiveness and technical feasibility . . . ."[51]

If a facility lacks an acceptable risk management plan, the NJDEP has the authority to send a third party consultant to conduct an "Extraordinarily Hazardous Substance Accident Risk Assessment."[52] The facility owner may offer three potential candidates, but the NJDEP has the final authority over the selection of the consultant and the scope of the work plan.[53] The owner of the subject facility must pay for all the costs of the risk assessment.[54] TCPA's requirement that the owner of a hazardous facility pay for the services of an independent contractor is very important. One of the most serious problems with toxic substance regulation is that government agencies are too often dependent upon information provided by industry or industry's consultants and frequently such data is biased or even fraudulent.[55] In an era of limited government funding, it makes sense to require industry to pay for independent risk assessments. As this Article will discuss, Section 112(r) of the 1990 Clean Air Act Amendments will require industry to perform such risk assessments.

TCPA gives the NJDEP authority to order the facility to undertake a risk reduction plan that identifies risks that must be abated and requires that the agency consider in reviewing such a risk reduction plan the probable consequences of an accidental release at a particular facility in light of the potentially exposed population and the gravity of the consequences.[56] In the event that the facility fails to develop an acceptable risk reduction plan, the statute provides the agency with authority to order a facility to shut down operations posing an identified risk until the risk reduction plan has been implemented.[57] Of course, TCPA provides an affected facility owner with the opportunity to appeal a cease-and-desist order and the full panoply of administrative due process.[58]

NJDEP has acknowledged that the cost of complying with TCPA's risk assessment procedures may cause some small businesses to cease operations,

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[50] N.J. STAT. ANN. § 13:1K-23(c).

[51] *Id.*

[52] *Id.* § 13:1K-25; *see also* Wright, *supra* note 29, at 1438–39.

[53] N.J. STAT. ANN. §§ 13:1K-24 to -26; *see also* Wright, *supra* note 29, at 1349.

[54] N.J. STAT. ANN. § 13:1K-25; *see also* Wright, *supra* note 29, at 1349.

[55] *See* ROGER W. FINDLEY & DANIEL A. FARBER, CASES AND MATERIALS ON ENVIRONMENTAL LAW 479, 484 (3d ed. 1991) (discussing fraudulent data involving pesticides); Bruce Ingersoll, *Research Data Allegedly Faked At Cyanamid*, WALL ST. J., Feb. 10, 1992, at B1 (discussing Food and Drug Administration's vulnerability to scientific fraud).

[56] N.J. STAT. ANN. § 13:1K-26(a); *see also* Wright, *supra* note 29, at 1439.

[57] N.J. STAT. ANN. § 13:1K-26(a); *see also* Wright, *supra* note 29, at 1439.

[58] N.J. STAT. ANN. § 13:1K-26(b); *see also* Wright, *supra* note 29, at 1439–40.

but has taken the position that such economic costs are necessary to protect the environment and public health.[59] In 1987, NJDEP estimated that the initial capital cost of compliance for a small business could range from $5,000 to one million dollars, and that the annual cost of compliance for a small business could be as much as a quarter-million dollars.[60] Clearly, the costs of performing adequate risk assessment and reduction plans can be high, but the risks to the public are too great to be ignored.

2. *California*

In 1986, California also adopted legislation requiring certain hazardous substance users to submit risk management and prevention plans (RMPP).[61] Unlike TCPA, the California statute does not provide for the use of independent consultants, although it does allow an administering agency to impose fees to cover the agency's costs in reviewing a plan.[62] California law provides for certification of plans and the mandatory correction of deficiencies, but does not specifically authorize an agency to issue a cease-and-desist order if it determines that a facility is too risky.[63] On the whole, the California statutory scheme appears to be less ambitious than TCPA.[64]

In 1988, however, California adopted an additional provision that requires each RMPP to consider the proximity of the facility to schools, residential areas, general acute care hospitals, long-term health care facilities, and child day care facilities.[65] This statute does not specifically require the use of buffers, but may encourage facility operators to consider the purchase of greenbelt or dead zone land. This Article will argue that a stronger approach than simply requiring a facility to consider the proximity of sensitive population areas is needed.

3. *Delaware*

In 1988, Delaware became the third state to adopt a statute mandating that users of extremely hazardous substances establish a risk management program and the first to apply planning requirements to flammables, combustibles and

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[59] *See* Wright, *supra* note 29, at 1440 (citing 19 N.J. Reg. 1687, 1690 (1987)).

[60] *Id.*

[61] CAL. HEALTH & SAFETY CODE § 25534 (West Supp. 1992).

[62] *Id.* § 25535.2.

[63] *Id.* § 25535.

[64] *Compare* N.J. STAT. ANN. §§ 13:1K-19 to -31 *with* CAL. HEALTH & SAFETY CODE §§ 25531-25541.

[65] CAL. HEALTH & SAFETY CODE § 25534.1.

explosives.[66] The statute allows consideration of buffer zones exceeding 100 meters in determining the potential release quantity of an extremely hazardous substance that might be involved in a catastrophic event.[67] Thus, while the Delaware statute does not require buffer zones, the scheme may encourage a user to purchase buffer land if the facility owner is concerned about whether state officials will approve its risk management plan.[68]

The New Jersey, California, and Delaware statutes go beyond EPCRA by focusing on risk management and the prevention of accidents. Delaware's statute specifically recognizes the significance of buffer zones, and California's requirement that risk plans consider the distance to sensitive population areas may indirectly encourage facility owners to buy greenbelt land.[69] None of these statutes, however, requires local zoning authorities or planning officials to consider risk management and prevention in determining the location of new facilities. In Section III, this Article will examine to what extent zoning and planning officials should play a role in siting facilities potentially subject to catastrophic accidents.

D. *Section 112(r)*

Section 112(r) of the 1990 Clean Air Act Amendments establishes the objective of preventing or at least minimizing accidental releases of extremely hazardous substances.[70] The Act, however, does not create economic

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[66] Extremely Hazardous Substances Risk Management Act, DEL. CODE ANN. tit. 7, §§ 7701–7718 (1990 Supp.); *see* REPORT OF THE GOVERNOR'S COMMISSION, THE STORAGE AND USE OF HAZARDOUS AND TOXIC MATERIALS [hereinafter GOVERNOR'S COMMISSION] VII-12 (Dec. 17, 1990 Report to Richard F. Celeste, Governor of Ohio) (Eula Bingham, Chairperson of the Commission).

[67] *See* DEL. CODE ANN. tit. 7, §§ 7705(11), 7708(a) (Supp. 1990); GOVERNOR'S COMMISSION, *supra* note 66, at VII-12.

> Instead of being outwardly directed toward the external environment of a facility, the zone is inwardly directed into the facilities. Toxic and flammable extremely hazardous substances are limited by quantity. Larger quantities are permitted as distances from the boundary to the potential release point increase. For example, the distance multiplier for a substance whose potential release point is 750 meters is 37.01 for a toxic substance, 37.50 for a flammable substance, and 421.88 for an explosive substance.

GOVERNOR'S COMMISSION, *supra* note 66, at VII-12.

[68] *See generally* DEL. CODE ANN. tit. 7, § 7708(a) (allowing state officials to reconsider the registration quantity in light of the buffer zones).

[69] CAL. HEALTH & SAFETY CODE § 25534.1 (West Supp. 1992); DEL. CODE ANN. tit. 7, §§ 7705(11), 7708(a).

[70] 42 U.S.C.A. § 7412(r)(1) (West Supp. 1992).

incentives to achieve its goals, nor does it specifically address the use of buffer zones.

The statute imposes a general duty on users of these substances to prevent releases, and to minimize the consequences of accidental releases that take place.[71] Section 112(r)(7)(B)(i) requires the Administrator of the EPA to promulgate rules concerning accidental releases by November 15, 1993.[72] These regulations require users of more than a threshold amount of a regulated substance to prepare, and to implement a risk management program, and to provide a prompt response to any such releases.[73] In addition, Section 112(r)(6) establishes a Chemical Safety and Hazard Investigation Board (CSHIB), which is modeled after the National Transportation Safety Board, to investigate the cause of any serious accidental release, to issue reports recommending measures to reduce the likelihood of accidental releases, and to issue regulations relating to its investigatory powers.[74]

By November 15, 1992, Section 112(r)(3) requires the Administrator of the EPA to promulgate an initial list of 100 substances that can cause serious injury if accidently released.[75] In compiling this list, the EPA may refer to the approximately 360 substances listed under Section 302 of EPCRA, but the agency is not limited by that list.[76] Congress has mandated that the initial list of 100 include seventeen substances listed in the statute.[77] The Administrator of the EPA must establish threshold quantities for each of these substances.[78]

By November 15, 1993, the Administrator of the EPA must issue regulations designed to prevent accidental releases.[79] The EPA is required to consider the expertise of the Secretaries of Transportation and Labor in promulgating these regulations.[80] These regulations must address monitoring techniques, emergency response procedures, training methods, inspections, storage, and operations.[81]

Section 112(r)(7)(B)(ii) requires the EPA to issue regulations mandating that users of threshold amounts of listed substances prepare and implement a

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[71] *Id.*

[72] *Id.* § 7412(r)(7)(B)(i).

[73] *Id.* § 7412(r)(7)(B)(ii).

[74] *Id.* § 7412(r)(6); S. REP. NO. 228, 101st Cong., 2d Sess. 206 (1990), *reprinted in* 1990 U.S.C.C.A.N. 3385, 3591 (Board modeled after National Transportation Safety Board).

[75] 42 U.S.C.A. § 7412(r)(3).

[76] *Id.*; S. REP. NO. 228, 101st Cong. 2d Sess. 211 (1990), *reprinted in* 1990 U.S.C.C.A.N. 3385, 3596 (360 EPCRA substances).

[77] 42 U.S.C.A. § 7412(r)(3).

[78] *Id.* § 7412(r)(5).

[79] *Id.* § 7412(r)(7)(B)(i).

[80] *Id.*

[81] *Id.*

risk management plan.[82] The plan must include a hazard assessment to determine the potential impact of an accidental release of any substance.[83] Most importantly for the purposes of this Article, this assessment must include an estimate of potential release quantities and a "determination of downwind effects, including potential exposures of affected populations."[84] The Senate Report accompanying this legislation explains that a hazard assessment analyzes the "consequences (death, injury, or property damage) which would likely occur in the event of an accidental release."[85] In addition, the Senate Report observes that the hazard assessment can assist the user and local, state and federal governments in preventing accidents, in preparing response plans, and in developing accident prevention programs.[86] Furthermore, the assessment must include a previous release history of the past five years.[87]

A user must register its risk management plan with the EPA.[88] Also, the user must file its plan with CSHIB, the state in which the source is located, and any local agency having responsibility for planning for or responding to an accidental release.[89] A LEAP would appear to fit the definition of a local agency, and a zoning or planning board could be such a local agency if the board defined its responsibilities to include accidental releases. Under Section 303(d)(3) of EPCRA, LEPCs are entitled to obtain information from facilities "necessary for developing and implementing the emergency plan," and sometimes to obtain internal hazard assessments.[90] The Clean Air Act Amendments of 1990, however, clearly require industry to prepare hazard assessment plans. The user must release the plan to the public except to the extent to which it includes trade secrets as defined in Section 7414(c) of Title 42.[91] Finally, the Administrator of the EPA must establish an auditing system to review regularly every plan.[92]

The Senate Report indicates that the primary goal of Section 112(r) is to prevent accidental releases and that mitigating accidents is only a secondary goal.

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[82] *Id.* § 7412(r)(7)(B)(ii).

[83] *Id.* § 7412(r)(7)(B)(ii)(I).

[84] *Id.*

[85] S. REP. NO. 228, 101st Cong., 2d Sess. 206 (1990), *reprinted in* 1990 U.S.C.C.A.N. 3385, 3591.

[86] *Id.*

[87] *Id.*

[88] 42 U.S.C.A. § 7412(r)(7)(B)(iii).

[89] *Id.*

[90] *See* 42 U.S.C. § 11003(d)(3) (1988); Millar, *supra* note 33, at 26.

[91] Millar, *supra* note 33, at 26; *see also* 42 U.S.C.A. § 7414(c) (West Supp. 1992).

[92] 42 U.S.C.A. § 7412(r)(7)(B)(iii).

> Systems and measures which are effective in preventing accidents are preferable to those which are intended to minimize the consequences of a release. Measures which entirely eliminate the presence of potential hazards (through substitution of less harmful substances or by minimizing the quantity of an extremely hazardous substance present at any one time), as opposed to those which merely provide additional containment, are most preferred.[93]

The preventation of accidents should be the first step taken in a risk management plan. The statute, however, does not establish incentives to encourage industry to substitute less harmful substances or use smaller quantities. To some extent, industry may reduce the risk of accidental releases because of adverse publicity or pressure from government officials or the public. For instance, the LEPC in Washington, D.C. determined that a large release of chlorine from tank cars stored at the city's water-treatment plant could result in a forty-mile toxic-gas cloud, and as a result the plant manager agreed to reduce the on-site stock of these tank cars from ten to four.[94] If the costs of reducing risks are high, however, firms may resist substitution or reduction measures unless there are economic incentives or regulatory mandates.

Even if prevention is the primary goal, the EPA and industry should not neglect the use of mitigating measures. In some instances, it may be difficult to eliminate the risk of a serious accident despite economic incentives or government regulation. For example, a plant producing 300 tons of chlorine a day cannot operate with a two pound inventory.[95] Accordingly, the agency should require mitigating measures whenever a significant risk remains. The Senate Report mentions that some "post-release mitigation measures includ[e] water curtains, liquid containment and cover systems and measures to prevent fire and explosion."[96] This Article proposes that the EPA require buffer zones around facilities using extremely hazardous substances where mitigating measures such as those mentioned in the preceding sentence are insufficient to protect populated areas adjacent to a user. The EPA should mandate the buffer requirements through rulemaking and then delegate their implementation to state agencies or local planning and zoning officials.

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[93] S. REP. NO. 228, 101st Cong., 2d Sess. 208-09 (1990), *reprinted in* 1990 U.S.C.C.A.N. 3385, 3594.

[94] Joani Nelson-Horchler, *Right-to-Know Is on the Grow*, INDUSTRY WEEK, at 48, *available in* LEXIS, Nexis library, Mags file.

[95] Stuart Diamond, *E.P.A. Lists Dangers of More Than 400 Chemicals*, N.Y. TIMES, Dec. 17, 1985, at A18 (quoting Frank B. Friedman, vice president of Occidental Petroleum).

[96] S. REP. NO. 228, *supra* note 93, at 242, *reprinted in* 1990 U.S.C.C.A.N. 3385, 3626.

A serious issue is whether it is feasible to require a buffer zone whenever a company uses extremely hazardous substances. For example, in October 1989, an ethylene explosion equivalent to ten tons of TNT and measuring nearly four on the Richter scale occurred at a Phillips Petroleum Company plastics plant in Texas.[97] The explosion killed at least twenty-two people and was felt fifteen miles away.[98] Should the EPA require Phillips and other manufacturers to place a buffer zone several miles wide around similar plastics factories? The cost of doing so might be prohibitive, although not enough facts are available to decide for sure. In some circumstances, an evacuation plan might be a suitable replacement for a buffer zone if the gas will move slowly enough to accomodate the movement of residents. In August 1985, however, Union Carbide failed to notify residents in Institute, West Virginia of a gas leak because its computer model erroneously indicated that the gas would not escape the plant boundaries.[99] In 1987, after an accident at a Marathon Oil facility leaked gaseous hydrogen fluoride, local authorities evacuated 3,000 residents downwind into the cloud.[100] Accordingly, evacuation plans are not necessarily an adequate substitute for a buffer zone and in some cases the public safety may demand that a plant close or relocate to a less populated area. It is possible that some companies might take greater steps at reducing toxic supplies or substituting less toxic materials if regulations force them to create adequate buffer zones.

III. PERFORMANCE ZONINGS , GIS AND EXACTIONS

Local communities can use their zoning or planning powers to create greenbelts or dead zones around users of extremely hazardous substances. This analysis assumes that some industries must continue to use extremely hazardous substances, although there may be effective substitutes for some substances. Furthermore, the analysis excludes zoning ordinances that ban some or all extremely hazardous substances from one community because such a prohibition simply shifts the problem to another community.

There are two basic approaches to creating buffer zones. First, a legislature or zoning board can create a fixed buffer zone for all users of a large class of hazardous substances. In 1991, the San Diego City Council enacted an ordinance that requires child care centers to be located at least 150 or 1000 feet

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[97] Robert Abrams, *Bhopal Memory Mandates Preventative Action Here*, N.Y.L.J., Jan. 17, 1990, at 40 (Abrams is Attorney General of New York).

[98] *Id.*

[99] *See supra* notes 14–17 and accompanying text.

[100] *See Environmental Group Warns*, *supra* note 5, at A-5.

away from hazardous materials depending on the type and volume.[101] Delaware encourages a buffer zone greater than one hundred meters.[102]

A more complicated second approach would require zoning and planning authorities to use information from a user's Section 112(r) hazard risk assessment to determine the appropriate buffer zone for each facility. Computer technology now exists that can determine individual buffer zones for a particular facility at a reasonable cost. Individual buffer assessments should be more efficient than rigid buffer assessments that may be larger than necessary, although individual assessments may be less efficient in setting up and administering. This Article will attempt to assess the overall efficiency of individual buffer assessments. In addition, this Article will examine whether buffer requirements constitute a taking of private property without compensation in violation of the Fifth and Fourteenth Amendments. While mandatory buffer zones could raise constitutional problems, a well-designed buffer program need not.

A. *Introduction*

In 1927, the United States Supreme Court in *Gorieb v. Fox*[103] upheld a street setback requirement in a residential area because it separated residences from the noise of the street, improved the attractiveness of residential environments, and ensured the availability of light and air.[104] Since *Gorieb*, numerous courts have upheld the constitutionality of setback and yard requirements, although in certain circumstances such provisions may constitute a taking of property if they excessively restrict the area available for building.[105] Thus, zoning boards frequently impose a type of buffer requirement, setbacks, and the question is whether they can and should apply this concept to users of extremely hazardous substances.

Municipal zoning powers have been applied with a mixed record of success in regulating polluters, use of hazardous substances, and exploitation of environmentally sensitive lands. Several commentators have argued that zoning frequently does not protect environmentally sensitive land because most ordinances focus primarily on economic and social values.[106] In particular,

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[101] Report from the Environmental Health Coalition to the Committee on Public Services and Safety of the City Council of the City of San Diego 2 (June 24, 1991) [hereinafter San Diego Report] (on file with author).

[102] *See* DEL. CODE ANN. tit. 7, §§ 7705(11), 7708(a) (1991); *see also supra* notes 66–68 and accompanying text.

[103] 274 U.S. 603 (1927).

[104] DANIEL R. MANDELKER, LAND USE LAW § 5.53 (2d ed. 1988 & Supp. 1991).

[105] *Id.*

[106] *See, e.g.*, LANE KENDIG, PERFORMANCE ZONING 3 (1980); Daniel R. Fredland, *Environmental Performance Zoning: An Emerging Trend?*, 12 URB. LAW. 678, 679 (1980);

land use and zoning requirements generally do not include the risk posed by industries using hazardous substances in areas adjacent to or within residential, recreational, or densely populated areas.[107] As a result, zoning and planning officials have failed to stop users of such substances from locating in areas where there is a clear danger to the community.[108]

B. *Performance Zoning*

Several commentators have advocated the use of overlay zoning and performance standards to protect environmentally sensitive lands.[109] Overlay zones impose additional requirements in an existing zoning district, for example, a residential or industrial zone, and generally preempt conflicting underlying zoning regulations.[110] Within an overlay zone, zoning officials can establish special regulations, which are often referred to as performance standards, to regulate noise, odor, smoke, or toxic material.[111] In addition, overlay zones have been used to protect environmentally sensitive land including agricultural land, river corridors, floodplain areas, quarries and sea shore areas as well as historic buildings and districts.[112] Many municipalities have adopted some type of overlay zoning and a number of court decisions have upheld the basic principle of employing overlay zones, although some courts have invalidated the application of particular performance standards in

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Arthur E. Palmer, *Environmentally Based Land Use Planning and Regulation*, 2 PACE ENVTL. L. REV. 25, 26–27 (1984); Robert J. Blackwell, Comment, *Overlay Zoning, Performance Standards, and Environmental Protection After* Nollan, 16 B.C. ENVTL. AFFAIRS L. REV. 615, 615 (1989).

107 San Diego Report, *supra* note 101, at 2.

108 *See id.*

109 *See generally* Fredland, *supra* note 106, at 678–99; Robert E. Manley, *A Cincinnati Strategy for Environmental Quality Overlay Zones*, 7 URB. LAW. 96 (1975); Blackwell, *supra* note 106, at 615–59. *See also* Frederick W. Acker, Note, *Performance Zoning*, 67 NOTRE DAME L. REV. 363 (1991) (discussing various performance zoning approaches).

110 *See generally* Blackwell, *supra* note 106, at 629–30. Overlay zoning "derive[s] its name from being drawn on tracing, mylar, or other translucent paper which was then placed or 'laid over' the official zoning map. D. CALLIES & R. FRELICH, CASES AND MATERIALS ON LAND USE 80 (1986). *See also* Blackwell, *supra* note 106, at 629 n.110.

111 *See generally* 3 R. ANDERSON, AMERICAN LAW OF ZONING § 16.11 (2d ed. 1977); Blackwell, *supra* note 106, at 636 n.168. There is a distinction between overlay zones, which delineate the areas to be preserved, and performance standards, which regulate specific processes that may affect an area. *See* Blackwell, *supra* note 106, at 636–37.

112 *See generally* Blackwell, *supra* note 106, at 631–34.

specific circumstances.[113] Performance zoning can be applied to the problem of creating flexible buffer zones to minimize the impact of catastrophic air releases.

Commentators have made a distinction between primitive standards that prohibit offensive nuisances and precision standards that are based on quantifiable scientific data.[114] Currently, most performance standards are still of the primitive type because of the expenses associated with developing scientific models to set precision standards, and the further expenses involved in implementing them.[115] For example, a number of communities have applied primitive performance standards in industrial zones to control "offensive" smoke.[116]

While precision performance standards are more costly, there are significant advantages in basing zoning requirements upon scientific evidence. One commentator has suggested that scientific performance standards are less vulnerable to takings challenges because such requirements are clearly related to a rational state purpose.[117] In addition, from a policy standpoint scientific

[113] For cases approving overlay zoning, see State v. Zack, 674 P.2d 329, 332 (Ariz. 1983) (upholding "offensive vibration" standard); Terino v. Town of Hartford, 538 A.2d 160 (Vt. 1987); DeCoals, Inc. v. Board of Zoning Appeals, 284 S.E.2d 856 (W. Va. 1981) (upholding ordinance that regulated dust and noise). For cases disapproving particular applications of a performance standard, see Beaver v. Borough of Johnsonburg, 410 F. Supp. 556 (W.D. Pa. 1976) (no criteria); Lithonia Asphalt Co. v. Hall County Planning Comm'n, 364 S.E.2d 860 (Ga. 1988) (vagueness).

[114] *See* Blackwell, *supra* note 106, at 638–39.

[115] *See generally* MANDELKER, *supra* note 104, at § 5.29 ("Administration is expensive and difficult . . . ."). There are some examples of how to create precision performance standards. For instance, the Soil Conservation Service has developed a scientific model to measure the volume of runoff of a proposed development based upon storm flow records. *See* Blackwell, *supra* note 106, at 639. Furthermore, the American Planning Association has developed technical methodology to compute minimum road widths for planning purposes. *See* KENDIG, *supra* note 106, at 330.

[116] *See, e.g.*, State v. Zack, 674 P.2d 329, 332 (Ariz. 1983) (upholding ordinance regulating "offensive vibration[s]"); Chicago v. Reuter Bros. Iron Works, Inc., 75 N.E.2d 355, 358 (Ill. 1947) (upholding ordinance prohibiting "disagreeable or offensive" noise or fumes from manufacturing plants); DeCoals, Inc. v. Board of Zoning Appeals, 284 S.E.2d 856 (W. Va. 1981) (upholding ordinance regulating dust and noise). *See generally* DANIEL R. MANDELKER, LAND USE PLANNING § 5.29 (2d ed. 1988 & Supp. 1991); Blackwell, *supra* note 106, at 637 n.175; Fredland, *supra* note 106, at 680–81 n.11.

[117] *See* Blackwell, *supra* note 106, at 648–49; *infra* notes 132–39 and accompanying text. While acknowledging that the Supreme Court's decision in Nollan v. California Coastal Commission, 483 U.S. 825 (1987), which in some ways appears to make it easier for property owners to claim that government regulation effects a taking of private property without just compensation, raises doubts about the constitutionality of primitive standards, Blackwell argues that courts should read *Nollan* narrowly and generally uphold the viability of primitive standards. *See generally* Blackwell, *supra* note 106, at 644–59. Implicit in his

standards are better than zoning requirements based on educated guesses that could be seriously flawed, although scientific models can be wrong.[118] Furthermore, precision performance standards are less likely to be abused by communities afflicted with the Not-In-My-Backyard (NIMBY) syndrome. People who oppose, for example, the siting of a new municipal solid waste dump in their community often have good reasons for their position, but sometimes they simply want to place a needed public facility whose benefits outweigh its costs in another person's backyard.[119] Because precision performance standards are based on some type of quantifiable scientific data, imperfect though it may be, such standards are less subject to abuse than a primitive performance standard prohibiting, for example, "excessive" smoke or noise.[120]

Until recently, it would have been expensive for a local government to establish zoning criteria for flexible buffer zones because of the costs involved in creating a risk assessment plan at each user. Any given community might well hestitate in becoming the first municipality to require its industry to spend significant amounts of money to determine the downwind impacts of an accidental release when a company could relocate to another community. Section 112(r) mandates that users establish risk management plans that determine downwind effects and requires the release of that information to the public.[121] Thus, Section 112(r) will provide communities with the information that they need to make intelligent zoning decisions about users of extremely hazardous waste.

A user could calculate the necessary size of a buffer zone itself or a zoning official could make a determination based on the downwind effects section of a user's risk assessment report. There are a variety of computer programs available for users of extremely hazardous substances that can calculate

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analysis, however, is the assumption that precision standards have a much better chance of surviving a takings challenge. *Id.*

[118] It is important, however, to recognize the limits of science and risk assessments. *See, e.g.*, Donald T. Hornstein, *Reclaiming Environmental Law: A Normative Critique of Comparative Risk Analysis*, 92 COLUM. L. REV. 562, 571–72 (1992).

[119] There is an extensive literature discussing the NIMBY phenomenon. *See, e.g.*, MICHAEL O'HARE ET AL., FACILITY SITING AND PUBLIC OPPOSITION vii (1983); Denis J. Brion, *An Essay on LULU, NIMBY, and the Problem of Distributive Justice*, 15 B.C. ENVTL. AFFAIRS L. REV. 437, 437–38 (1988); Orlando E. Delogu, *"NIMBY" is a National Problem*, 35 S.D.L. REV. 198, 198 (1990); Bradford C. Mank, *The Two-Headed Dragon of Siting and Cleaning Up Hazardous Waste Dumps: Can Economic Incentives or Mediation Slay the Monster?*, 19 B.C. ENVTL. AFFAIRS L. REV. 239, 272 (1991).

[120] For a discussion of the differences between precision and primitive performance standards, see *supra* notes 114–19 and accompanying text.

[121] 42 U.S.C.A. § 7412(r)(7)(B)(ii)(I) (downwind effects), (iii) (public information).

downwind effects.[122] One type of computer program called the Geographic Information Systems (GIS) allows zoning officials to calculate the size of a buffer zone needed to surround a given facility.

The author is engaged in an interdisciplinary study at the University of Cincinnati using GIS to create a model that maps the location of users of extremely hazardous substances in a study area and indentifies likely dispersion patterns of toxic air pollutants under various conditions of atmospheric stability, wind direction and air temperature depending upon changes in the climate.[123] GIS involves a combination of computer mapping and data base analysis.[124] A GIS program can plot and simultaneously review multiple layers of spatial information.[125] According to Professor Samuel V. Noe of the School of Planning at the University of Cincinnati, GIS can help answer "what if" questions about the release of hazardous chemicals.[126]

> What if three new plants using toxic chemicals are concentrated upwind of a densely populated region; exactly which neighborhoods are at risk from the new plants? What if a toxic chemical is released when the wind is blowing 5 miles per hour northeasterly? What if two plants release hazardous chemicals at the same time in an overlapping area?[127]

A GIS program can also predict the risk that a hazardous waste spill at a given location will reach an underground aquifer that provides public drinking

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[122] *See generally* Joyce, *supra* note 15, at 40.

[123] The University of Cincinnati Department of Environmental Health, School of Planning, and College of Law are engaged in an interdisciplinary project to use GIS to improve the siting of hazardous users in Southwestern Ohio. The Ohio Hazardous Substance Research, Education and Management Institute has sponsored this research. *See* HAZARDOUS SUBSTANCE FACILITY SITES IN METROPOLITAN REGIONS: AN INTEGRATED APPROACH TO RISK ASSESSMENT, PLANNING AND CONFLICT RESOLUTION [hereinafter CINCINNATI STUDY] (Bradford C. Mank, Samuel V. Noe, Jon Reid, Principal Investigators) (Draft Report September 1991). The preliminary version of this study has modeled the comparative risk of the accidental release of hazardous chemicals by industries in the study area. *Id.* There are articles discussing the general use of GIS in planning and mapping. *See, e.g.*, Kenneth Budd, *Unleashing TIGER: A GIS Database for the United States*, PROFESSIONAL SURVEYOR, September/October 1989, at 16–17 (describing how U.S. Census Bureau planned to use GIS technology in 1990 Census); Kenneth J. Duker, *Geographic Information Systems and Computer-Aided Mapping*, AM. PLAN. ASS'N J., Summer 1987, 383, 383–90.

[124] Marianne Cianciolo, *GIS Center Debuts with Chamber Project*, UNIVERSITY CURRENTS (University of Cincinnati Employees Newsletter), Jan. 10, 1992, at 4.

[125] *Id.*

[126] *Id.*

[127] *Id.*

water.[128] Preventing hazardous substances spills is crucial because once groundwater is contaminated it may be impossible to restore its purity.[129]

GIS technology can assist a municipality in planning the types and locations of industry to minimize the risk to residential populations.[130] A GIS program can include information on existing and projected patterns of both industrial and residential growth.[131] GIS technology should allow planners to identify both present and potential conflicts between industrial and residential uses.[132] For instance, a community could bar a new hazardous waste facility from a certain location because of its proximity to a residential area or refuse to allow a residential subdivision to expand near a user of highly toxic chemicals. In some cases, a buffer zone around either a new hazardous substances user or residential zone will be sufficient to protect the public health. Based upon experience with other environmental statutes, it will be easier to prevent the construction of a new facility than to shut down an existing one, both because it is more difficult to eliminate existing jobs than to prevent the creation of new ones and because shutting down an existing facility may result in a successful takings challenge. Even in the case of existing facilities, it may be worthwhile to make a hazardous substance facility a nonconforming use so that it may be eventually extinguished. Even if communities are not willing to bar new high risk users because of the tax dollars they bring, GIS or other computer models can improve emergency planning by predicting which residential areas would need to be evacuated in case of a catastrophic release, although such models are not perfect because of potential uncertainties involving the amount of chemical released or weather conditions.[133]

Using GIS or other computer models to calculate the optimal buffer zone for a particular facility would probably involve more administrative expense than simply using a fixed buffer standard.[134] On the other hand, flexible buffer zones would be more efficient in allocating land resources than using a predetermined fixed buffer standard because a flexible buffer zone would be the optimal size for a user, although there may be some problems if a user's use of a chemical changes dramatically and it needs a larger or smaller buffer zone.

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[128] CINCINNATI STUDY, *supra* note 123, at Introduction.

[129] *See* Mank, *supra* note 119, at 284 n.256; David Stipp, *Super Waste?: Throwing Good Money at Bad Water Yields Scant Improvement*, WALL. ST. J., May 15, 1991, at A1; *Policy on Remedy Selection to Address 'Impracticable' Ground Water Cleanups*, 22 ENV'T REP. (BNA) 1363, 1363-64 (Sept. 27, 1991).

[130] CINCINNATI STUDY, *supra* note 123, *passim.*

[131] *Id.*

[132] *Id.*

[133] *See generally id.*; Joyce, *supra* note 15, at 40 (discussing limitations of computer model used by Union Carbide at Institute, West Virginia). Interview with Professor Samuel V. Noe, University of Cincinnati, School of Planning in Cincinnati, Ohio (July 8, 1991).

[134] *See supra* notes 101-02 and accompanying text.

Once the EPA implements the risk assessment requirements of Section 112(r), the administrative cost differential between establishing fixed buffer categories and creating flexible buffer zones for each user should be considerably less.

An important question is whether federal, state, or local officials should implement buffer requirements. The federal government should take the lead in requiring national buffer standards because individual states or communities will be reluctant to impose regulations that might lead industry to relocate to another part of the country with less regulation, but the EPA should delegate implementation of buffer requirements to municipalities, which have traditionally exercised zoning and land use powers. Before Congress enacted Section 112(r), it would have been too costly for most communities to assume the expense of planning flexible buffer zones. For instance, in 1986, the San Diego Public Services and Safety Committee directed the city's Planning Department to investigate rezoning businesses to prevent toxic catastrophes, but the Department took no action because of a lack of resources and perhaps because of a fear of losing industry.[135] Once Section 112(r) forces users to release to the public hazard assessment plans that include information about the downwind impacts of a potential catastrophic accident, the public may put pressure on community leaders to address this problem, but any individual municipality may still be reluctant to impose buffer requirements because its leaders fear the loss of business and tax revenues to other communities.

National environmental legislation is more effective than state and local regulation because pollution does not respect political boundaries and because states may compete for industry by minimizing the costs of local regulation. In enacting the 1977 Amendments to the Clean Air Act, Congress sought in part to protect states in "nonattainment" areas, primarily in developed eastern and midwestern states, from losing industry to states in attainment with the Clean Air Act, primarily rural western states, by imposing "prevention of significant deterioration" in so-called "clean air states."[136] National environmental

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[135] *See* San Diego Report, *supra* note 101, at 2 (Planning Board alleged lack of resources for investigation).

[136] *See generally* Clean Air Act Amendments of 1977, Pub. L. No. 95-95, 91 Stat. 685 (codified as amended at 42 U.S.C. §§ 7401–7642 (1988)). The primary provisions relating to prevention of significant deterioration are contained in Sections 160 through 169. 42 U.S.C. §§ 7470–7479 (1988). The reasons that Congress enacted prevention of significant deterioration requirements in the 1977 Amendments to the Clean Air Act are extremely complex, but one factor was to prevent the loss of industry from non-attainment states and to stop industry from relocating to "clean air areas" to avoid pollution control expenses. *See* A. STANLEY MEIBURG, PROTECT AND ENHANCE: "JUDICIAL DEMOCRACY" AND THE PREVENTION OF SIGNIFICANT DETERIORATION OF AIR QUALITY 264–65 (1991) (Representative James Florio of New Jersey candidly admitted that one purpose of prevention of significant deterioration was to protect jobs in heavily polluted states.).

legislation has the advantage of preventing states with lax environmental requirements from luring industry from states with stringent laws.

Accordingly, the EPA should require users of extremely hazardous substances to establish buffer zones if their hazard assessment plans pursuant to Section 112(r) demonstrate an excessive risk to adjacent residents. Congress should enact appropriate legislation if the agency fails to address the issue of mitigating accidents. The EPA, however, should consider delegating implementation of this buffer program to state environmental agencies and they in turn should delegate this issue to local zoning and planning authorities because zoning has traditionally been a local issue. The EPA and state environmental agencies can provide technical assistance to local communities and should supervise implementation of buffer programs.

In cases in which a buffer zone affects more than one community, a state environmental protection agency may wish to take a more active role in making sure that one municipality does not neglect the interests of another. Air pollutants do not respect political boundaries. In the past, the Clean Air Act and the EPA have done a poor job in controlling interstate air pollution even though each state implementation plan (SIP) is supposed to take into account the impact of a pollution source state upon a receiving state.[137] Spillover or interboundary pollution issues are difficult to resolve because they are polycentric problems involving multiple parties from both the public and private sectors.[138] A local community may be upset if buffer requirements significantly reduce the industrial tax base in that community, but substantially benefit residents of a neighboring community. When the benefits and burdens of buffer zones are not equally shared among adjacent communities, a state

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[137] Sections 110(a)(2)(E) and 126 of the 1970 Clean Air Act were designed to combat interstate air pollution. 42 U.S.C. §§ 7410(a)(2)(E), 7426 (1988). Several receiving states brought lawsuits claiming that the EPA had approved source state SIPs that did not adequately address interstate air pollution problems, but courts generally rejected those claims in deference to the agency's expertise. *See generally* New York v. EPA, 852 F.2d 574 (D.C. Cir. 1988), *cert. denied*, 489 U.S. 1065 (1989); New York v. EPA, 710 F.2d 1200 (6th Cir. 1983); New York v. EPA, 716 F.2d 440 (7th Cir. 1983). "It seems clear that, as construed by the courts, the [Clean Air] Act allowed EPA to ignore the problem of interstate pollution as long as it wanted." ROGER W. FINDLEY & DANIEL A. FARBER, CASES AND MATERIALS ON ENVIRONMENTAL LAW 374 (3d ed. 1991); *see also* Bruce M. Kramer, *Transboundary Air Pollution and the Clean Air Act: An Historical Perspective*, 32 U. KAN. L. REV. 181 (1983); Kay M. Cridea, Note, *Interstate Air Pollution: Over a Decade of Ineffective Regulation*, 64 CHI.-KENT L. REV. 619 (1988). Title IV of the 1990 Amendments to the Clean Air Act attempts a new approach to the problem of interstate air pollution by setting specific allowances of sulfur dioxide emissions by utilities. *See* 42 U.S.C.A. §§ 7651–7651o (West Supp. 1992).

[138] *See* Joseph P. Tomain, *Distributional Consequences of Environmental Regulation: Economics, Politics, and Environmental Policymaking*, 1 KAN. J. L. & PUB. POL'Y 101, 103 (1991) (polycentric nature of environmental problems).

may wish to impose a concept called tax base sharing that has been applied to redistribute municipal tax revenues on a regional basis, generally from affluent suburbs to poor central cities.[139] Tax base sharing has worked well in a seven county area including St. Paul and Minneapolis, Minnesota, but no other major region has adopted this concept despite considerable discussion of its merits because it is difficult to convince wealthy municipalities to share with less affluent ones even though these communities are highly interdependent.[140] Even if a state is unwilling to adopt tax base sharing, it may wish to establish a mediation process in which neighboring communities can work together to balance some of the costs and benefits of pollution control.[141]

In Section V, this Article proposes the creation of a toxic death risk index tax. Proceeds from the tax could be allocated to communities that will bear a disproportionate loss of industry because of buffer requirements.

C. *Takings and Buffer Zones*

Users of extremely hazardous substances may use the takings clause of the Fifth and Fourteenth Amendments to challenge buffer requirements. A carefully designed buffer program can withstand such a challenge.

Takings jurisprudence is notoriously muddled and confusing, although various commentators have attempted to formulate consistent principles.[142] In

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[139] *See* Jack L. Dustin et al., *Tax Base Sharing: The Potential and Experience, in* TAX BASE SHARING: AN EVALUATION OF ITS USE AND ITS POTENTIAL IN THE STATE OF OHIO 3, 6–14 (Jack L. Dustin ed., 1990); Mank, *supra* note 119, at 284–85 n.259; Note, *Minnesota's Metropolitan Fiscal Disparities Act—An Experiment in Tax Base Sharing*, 59 MINN. L. REV. 927 (1975). I wish to thank Charles Ellison and Sam Noe of the University of Cincinnati's School of Planning for alerting me to the concept of tax base sharing.

[140] *See generally* Dustin et al., *supra* note 139, at 6–14.

[141] *See generally* Mank, *supra* note 119, at 272–84 (discussing how mediation can be used to resolve environmental conflicts).

[142] There is an enormous literature concerning takings jurisprudence. *See, e.g.*, Susan E. Looper-Friedman, *Constitutional Rights as Property?: The Supreme Court's Solution to the "Takings Issue,"* 15 COLUM. J. ENVTL. L. 31 (1990); Margaret Jane Radin, *The Liberal Conception of Property: Cross Currents in the Jurisprudence of Takings*, 88 COLUM. L. REV. 1667 (1988); Carol M. Rose, *Property Rights, Regulatory Regimes and the New Takings Jurisprudence—An Evolutionary Approach*, 57 TENN. L. REV. 577 (1990). Commentators have frequently acknowledged the conflicting rationales in the Supreme Court's takings doctrine. *See, e.g.*, Andrea L. Peterson, *The Takings Clause: In Search of Underlying Principles, Part I—A Critique of Current Takings Clause Doctrine*, 77 CALIF. L. REV. 1299, 1304 (1989) ("[I]t is difficult to imagine a body of case law in greater doctrinal and conceptual disarray."); Natasha Zalkin, Comment, *Shifting Sands and Shifting Doctrines: The Supreme Court's Changing Takings Doctrine and South Carolina's Coastal Zone Statute*, 79 CALIF. L. REV. 205, 232 (1991) ("The takings doctrine is unclear today, and, if the literature is to be believed, it has never been clear in the entire course of

Penn Central Transportation Co. v. New York City, a 1978 decision, the United States Supreme Court admitted that it had been unable to develop a "set formula" for deciding takings cases.[143] In his dissenting opinion in *Nollan v. California Coastal Commission*, a 1987 case, Justice Stevens observed that "[e]ven the wisest lawyers would have to acknowledge great uncertainty about the scope of this Court's takings jurisprudence."[144] The resignations of Justices Brennan and Marshall and their replacement by Justices Souter and Thomas may signal a turn to a consistently "conservative," pro-property owner jurisprudence, although it is dangerous to apply labels because different "conservative" judges may take quite dissimilar approaches in analyzing complex questions of law.[145] Despite the uncertainities surrounding takings jurisprudence, this Article will attempt to provide some guidance concerning whether an ordinance requiring dead zone buffers is likely to constitute a taking of private property without just compensation.

Professor Humbach has argued that existing-use zoning requirements that preserve land in its pristine or current state do not necessarily violate the takings clause as long as the owner can derive some economic value from the land even though the owner would gain a greater profit if the land were developed.[146] There are similarities between existing-use zoning and potential dead zone buffer ordinances because in some circumstances a hazardous substances user might need to maintain a park-like area around its facility to serve as a buffer zone, although, as this Article will later discuss, it is not essential to use pristine land for a dead zone buffer. Professor Humbach relies heavily upon the United States Supreme Court's decision in *Penn Central*, which upheld a landmark preservation law that restricted further development of Grand Central Station, and implicitly restricted its owners to the Terminal's existing use, because the law allowed the owner to recover a reasonable return

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recorded history.") Various commentators have tried to develop a comprehensive rationalization of takings law, but none has been accepted by a majority of judges or other scholars. *See, e.g.*, RICHARD A. EPSTEIN, TAKINGS: PRIVATE PROPERTY AND THE POWER OF EMINENT DOMAIN (1985) (essentially libertarian approach); John J. Costonis, *Presumptive and Per Se Takings: A Decisional Model for the Taking Issue*, 58 N.Y.U. L. REV. 465 (1983) (unjust burden test); Frank I. Michelman, *Property, Utility, and Fairness: Comments on the Ethical Foundations of "Just Compensation" Law*, 80 HARV. L. REV. 1165 (1967) (utilitarian approach); Andrea L. Peterson, *The Takings Clause: In Search of Underlying Principles, Part II—Takings as Intentional Deprivations of Property Without Moral Justification*, 78 CALIF. L. REV. 55 (1990) (moral wrong test).

143 438 U.S. 104, 124 (1978).

144 483 U.S. 825, 866 (1987) (Stevens, J., dissenting).

145 *See generally* Zalkin, *supra* note 142, at 235.

146 *See generally* John A. Humbach, *Law and a New Land Ethic*, 74 MINN. L. REV. 339 (1989) (existing-use zoning). *See also* Jon A. Kusler, *Open Space Zoning: Valid Regulation or Invalid Taking*, 57 MINN. L. REV. 1, 2–8 (1972) (open space zoning).

on its legitimate investment-based expectations.[147] He argues that the Supreme Court's decision in *Nollan* is consistent with *Penn Central* because the *Nollan* court indicated that the state could have denied a permit altogether if the construction of their house "substantially impede[d]" state interests.[148] Humbach's article suggests that it is possible to read Supreme Court takings jurisprudence in such a manner as to uphold a greenbelt ordinance or an expansive deadzone ordinance.

Some insight concerning whether zoning regulations requiring buffer zones are likely to constitute a taking of private property can be developed by looking at takings cases involving government regulation of wetlands and coastal areas. In 1972, the Wisconsin Supreme Court in *Just v. Marinette County*[149] took into account emerging evidence about the ecological importance of wetlands and concluded that state wetland regulations did not constitute a taking of private property without just compensation because the owners were only entitled to the value of the land in its natural state and not its worth if it were filled and developed. Courts have divided over the extent that wetlands regulations may limit development, but the trend in state courts has been to allow fairly extensive wetland regulation as long as there is some flexibility for limited development on adjacent non-wetland areas.[150]

In the Federal Circuit Court of Appeals and United States Claims Court, however, there has been a recent trend toward favoring property owners in takings challenges.[151] In 1981, the United States Court of Claims in *Deltona*

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147 *See* Humbach, *supra* note 146, at 351–53 (discussing Penn Central Transp. Co. v. New York City, 438 U.S. 104, 136 (1978)).

148 *See id.* at 353–54 (discussing Nollan v. California Coastal Comm'n, 483 U.S. 825, 837 (1987)). In *Nollan*, the Supreme Court held that requiring the owners of beach front property to provide an easement allowing the public to cross their land to enhance visual and psychological access to the beach in order to obtain a building permit constituted a taking of private property because the condition did not advance a substantial state interest. The Court also set forth the related principles that land use regulations must advance a substantial government interest and that there be a nexus between the land use regulation and the state's land use goals. *See generally* Blackwell, *supra* note 106, at 644–48; Steven J. Lemon et al., Comment, *The First Applications of the* Nollan *Nexus Test: Observations and Comments*, 13 HARV. ENVTL. L. REV. 585, 602–04 (1989); Peter F. Neronha, *A Constitutional Standard of Review for Permit Conditions, Exactions and Linkage Programs:* Nollan v. California Coastal Commission, 30 B.C. L. REV. 903, 933–34 (1989).

149 201 N.W.2d 761 (Wisc. 1972).

150 *See generally* Rowe v. Town of North Hampton, 553 A.2d 1331 (N.H. 1989) (upholding wetlands regulation); Carter v. South Carolina Coastal Council, 314 S.E.2d 327 (S.C. 1984) (upholding wetlands regulation).

151 *See, e.g.*, Yancey v. United States, 915 F.2d 1534 (Fed. Cir. 1990) (awarding compensation for farmers' lost profits resulting from turkey quarantine); United Nuclear Corp. v. United States, 912 F.2d 1432 (Fed. Cir. 1990) (awarding compensation because Interior Department deferred to Navajo Tribe veto of uranium mining plan); Roger J.

Corp. v. United States[152] rejected a takings claim when wetlands regulations prevented the plaintiff from realizing its investment-backed expectations for a portion of property it had purchased because the parcel as a whole retained significant value. In a 1990 case involving similar facts, the Chief Judge of the Claims Court, Loren Smith, who was appointed in 1985 by President Reagan, awarded the developer $2.68 million plus interest because wetland regulations prevented the owner from building houses on 12.5 acres of wetland that were the last undeveloped portion of a parcel the company bought in 1956 for $300,000.[153]

In *Lucas v. South Carolina Coastal Council*, the United States Supreme Court reversed and remanded a South Carolina Supreme Court decision that had upheld a South Carolina statute that sought to protect beach and dune systems by barring the construction of permanent structures on such property.[154] The South Carolina Supreme Court had ruled that, under the *Mugler v. Kansas*[155] line of cases, when a regulation is designed to prevent "harmful or noxious uses" of property akin to public nuisances, no compensation is owing under the Takings Clause regardless of the regulation's effect on the property's value.[156] In his five-person majority opinion, Justice

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Marzulla & Nancie G. Marzulla, *Regulatory Takings in the United States Claims Court: Adjusting the Burdens That in Fairness and Equity Ought to Be Borne by Society as a Whole*, 40 CATH. U. L. REV. 549 (1991); Keith Schneider, *Environment Laws Face a Stiff Test From Landowners*, N.Y. TIMES, Jan. 20, 1992, at A1, A8. Presidents Reagan and Bush appointed every judge on the current Claims Court and all but two of the circuit judges on the Federal Circuit, although there are four senior circuit judges appointed by Democratic presidents. *See* 943 F.2d XXX-XXXII (Judges of the Courts, with dates of appointment).

[152] 657 F.2d 1184 (Ct. Cl. 1981), *cert. denied*, 455 U.S. 1017 (1982).

[153] Loveladies Harbor, Inc. v. United States, 21 Cl. Ct. 153 (1990). The United States government is appealing this decision. Jim Carlton, *'Takings' Cases Don't Always Favor Takers*, WALL. ST. J., Nov. 10, 1992 at B1, B8.

[154] Lucas v. South Carolina Coastal Council, 112 S. Ct. 2886 (1992); *see also* Marcia Coyle, *Property Revival: Economic Rights Gurus Look to High Court*, NAT'L L.J., Jan. 27, 1992, at 1, 42 (discussing *Lucas* and other takings cases before Supreme Court).

[155] A long line of United States Supreme Court cases had applied "harmful or noxious use" principles to sustain against due process and takings clause challenges legislation enjoining a property owner from activities akin to public nuisances, but which may not have constituted a nuisance under the state's common law. *See, e.g.*, Goldblatt v. Hempstead, 369 U.S. 590 (1962) (law effectively preventing continued operation of quarry in residential area); Miller v. Schoene, 276 U.S. 272 (1928) (order to destroy diseased cedar trees to prevent infection of nearby orchards); Hadacheck v. Sebastian, 239 U.S. 394 (1915) (law barring operation of brick mill in residential area); Mugler v. Kansas, 123 U.S. 623 (1887) (law prohibiting manufacture of alcoholic beverages).

[156] Lucas v. South Carolina Coastal Council, 404 S.E.2d 895, 899-902 (S.C. 1991) (applying *Mugler* line of noxious use cases), *rev'd*, 112 S. Ct. 2886 (1992).

Scalia concluded that the South Carolina Supreme Court had erred in applying the "harmful or noxious use" principle to decide this case because the *Mugler* line of cases simply represented the United States Supreme Court's "early formulation of the police power justification necessary to sustain (without compensation) *any* regulatory diminution in value."[157] Justice Scalia argued "that the distinction between regulation that 'prevents harmful use' and that which 'confers benefits' is difficult, if not impossible, to discern on an objective, value-free basis" and that "it becomes self-evident that noxious-use logic cannot serve as a touchstone to distinguish regulatory 'takings'—which require compensation—from regulatory takings that do not require compensation."[158] Accordingly, Justice Scalia concluded that "the legislature's recitation of a noxious-use justification cannot be the basis for departing from our categorical rule that total regulatory takings must be compensated."[159] The *Lucas* decision seeks to clarify takings jurisprudence by establishing a *per se* rule that whenever regulation denies all economically beneficial or productive use of land, that regulation constitutes a taking unless the state is simply restricting land use based upon background principles of nuisance and property law.[160]

The *Lucas* decision suggests that buffer regulations may be constitutionally suspect if they deprive landowners of all economic value in their land, although in some circumstances the nuisance exception may justify such a restriction. Zoning officials cannot justify a buffer requirement by simply stating a legislative goal of preventing a harmful use. The *Lucas* decision, however, does not resolve the issue whether a court should look at the impact of a restriction on the owner's use of the parcel as a whole or the buffer zone alone.[161] Thus, it is unclear whether buffer legislation requiring property

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[157] Lucas v. South Carolina Coastal Council, 112 S. Ct. 2886, 2898-99 (1992). Chief Justice Rehnquist, Justices White, O'Connor, and Thomas joined Justice Scalia's majority opinion. Justice Kennedy concurred in the judgment and filed a separate opinion that stated that "[t]he common law of nuisance is too narrow a confine for the exercise of regulatory power in a complex and interdependent society." *Id.* at 2903. Justices Blackmun and Stevens filed separate dissenting opinions. Justice Souter filed a separate statement in which he stated that he would dismiss the writ of certiorari in this case as having been improvidently granted. *Id.* at 2925.

[158] *Id.* at 2899 (Scalia, J.).

[159] *Id.*

[160] *Id.* at 2899-2902.

[161] In a footnote, Justice Scalia specifically stated that it was unclear whether a regulation requiring a developer to leave 90% of a rural tract in its natural state deprived the owner of all economically beneficial use of the burdened portion of the tract, or merely diminished the value of the tract as a whole. *Id* at 2894 n.7. He argued that the "uncertainty regarding the computation of the denominator in our 'deprivation' fraction has produced inconsistent pronouncement by the Court." *Id.* Justice Scalia suggested that "[t]he answer to this difficult question may lie in how the

owners to maintain a natural buffer that has no economic value around land that has economic value would constitute a taking pursuant to *Lucas*. Clearly, however, a legislature can require a buffer zone that advances important public interests if the property owner can earn at least some economic value from that land.

Preservation of greenbelt space is a worthy goal. Aesthetically, it would be preferable if users of extremely hazardous substances preserved or restored parkland around their facilities. An effective buffer, however, could simply consist of a parking lot or a portion of a plant that does not contain extremely hazardous substances. A dead zone does not have to be a greenbelt. Buffer requirements can be consistent with profitable economic use. Thus, no matter how the United States Supreme Court resolves the muddle relating to regulatory takings, zoning officials should feel confident about imposing buffer zones that are rationally related to the risk of a toxic accident, but any ordinance that requires such a user to preserve or restore pristine greenbelt land may be constitutionally suspect.

IV. LIABILITY AND DEAD ZONES

Is it necessary to enact zoning ordinances to create buffers around users of extremely hazardous substances? An economist might argue that the potential threat of liability from toxic accidents will lead such users to create dead zones without government regulation. To some extent, the threat of liability and resident complaints have already led certain companies to purchase a buffer of greenbelt land.[162] There seem to be three transaction cost problems with letting the market perform this allocation. First, residents and even local officials lack adequate information. Section 112(r) may at least partially address the information gap by requiring users to release information about potential downwind effects of toxic accidents to the public; however, the public may still lack the expertise to fully evaluate this data. Second, there may be a lack of equality of bargaining power between industry and the public. Third, there may be significant costs in aggregating residents to bargain with industry.

The existence of the federal bankruptcy code, however, may distort the market for buffer space. Under present commercial and bankruptcy law,

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owner's reasonable expectations have been shaped by the State's law of property—*i.e.*, whether and to what degree the State's law has accorded legal recognition and protection to the particular interest in land with repect to which the takings claimant alleges a dimunition in (or elimination of) value." *Id.* For the purposes of this Article, the answer under Justice Scalia's analysis may depend on whether a particular use of an extremely hazardous chemical constitutes a nuisance under a state's common law.

[162] *See* Caleb Solomon, *Big Payoff: How a Neighborhood Talked Fina Refinery Into Buying It Out*, WALL. ST. J., December 10, 1991, at A1, A5 (discussing how oil refineries purchase greenbelt land).

secured creditors have priority over tort claimants.[163] Professors Henry Hansmann and Reinier Kraakman have argued in favor of unlimited shareholder liability for corporate torts because of evidence that business firms are reorganizing to exploit limited liability to avoid damage claims.[164] This Article proposes a solution in the specific area of extremely hazardous chemical accidents that would address at least some of their more general concerns about corporate tort liability without the need for abandoning limited shareholder liability. A discussion of their proposals is beyond the scope of this Article.

A user of extremely hazardous substances may spend less money on buffers than is socially desirable because of the possibility that it will file for bankruptcy if the costs of a catastrophic release exceed its assets. There are good theoretical reasons to believe that tort liability rules will not achieve optimal efficiency if actors know that they will not have to internalize the costs of negligent behavior because they can file for bankruptcy.[165] It is important to

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[163] *See* 11 U.S.C. § 507 (1988) (classes of unsecured creditors entitled to priority does not include tort claimants); 11 U.S.C. § 726(a), (b) (1988) (holders of "allowed unsecured claims" who are not entitled to priority pursuant to 11 U.S.C. § 507 share pro rata in remaining assets of bankrupt firm); David W. Leebron, *Limited Liability, Tort Victims and Creditors*, 91 COLUM. L. REV. 1565, 1637, 1643–49 (1991) (discussing disadvantageous position of tort claimants during bankruptcy proceedings). The lower priority of tort victims in comparison to secured creditors raises serious fairness issues because tort victims generally do not have the opportunity to negotiate before an accident with the firm that caused the injury to secure a higher priority during bankruptcy proceedings unlike unsecured contractual creditors who presumably had the opportunity to negotiate a better deal, or to otherwise reduce the risk of loss that might take place as the result of the firm filing bankruptcy. *Id.* at 1601. The issue of whether product liability tort claimants should be treated as contractual is beyond the scope of this Article. *Id.* at 1601 n.114. Professor Leebron argues that the issue of unfairness exists for "classes of tort victims who had no contractual relationship with the firm that caused their injury, no ability to force the firm to internalize costs (other than ex post through tort law), and no ability to alter their behavior toward the firm inflicting the tort risk." *Id.* These conditions would usually apply to victims of catastrophic accidents such as Bhopal. One might argue that victims could have chosen to live in an area without such risks, but the use of such chemicals is so widespread in the United States that moving is not a practical alternative for most people. *See Environmental Group Warns*, *supra* note 5, at A-5 (documenting widespread use of extremely hazardous chemicals in numerous communities in the United States).

[164] Henry Hansmann & Reinier Kraakman, *Toward Unlimited Shareholder Liability for Corporate Torts*, 100 YALE L.J. 1879, 1880–81 (1991); *see also* Leebron, *supra* note 163, *passim* (evaluating proposals for unlimited shareholder liability for corporate torts and suggesting more limited liability approach than Hansmann & Kraakman).

[165] *See* Jeffrey Kahane, Note, *Encouraging Safety Through Insurance-Based Incentives: Financial Responsibility for Hazardous Waste*, 96 YALE L.J. 403, 405–07 nn.4–5 (1986) (ordinary tort liability only deters accidents that would not force a firm into

recognize, however, that the bankruptcy hypothesis rests upon two assumptions that may not be true. First, a firm must have access to information that demonstrates that bankruptcy will save it money in the event of a major toxic accident and in the real world an actor may not have perfect information about either the risks of an accident or the outcome of bankruptcy proceedings. Second, the hypothesis that firms will deliberately underinvest in safety because of bankruptcy ignores the possibility of non-economic motives such as good citizenship.

There is evidence, however, suggesting that firms handling hazardous materials consciously place hazardous activities in separate subsidiaries to insulate assets in the event of major lawsuits that may lead to bankruptcy.[166] Two economists in a study found that a very large proportion of small firms entering all hazardous industry between 1967 and 1980 were motivated primarily by a desire to avoid liability for consumer, employee, and environmental harms.[167] One would expect that the incentives to avoid liability are even greater since Congress enacted CERCLA in 1980 to force firms to internalize the costs of abandoned hazardous waste.[168] Indeed, a number of cases have addressed to what extent parent corporations can insulate themselves from CERCLA liability by placing hazardous activities within subsidiaries.[169]

Of course, evidence that firms handling certain types of hazardous materials seek to avoid liability by placing hazardous activities within subsidiaries does not necessarily prove that firms potentially subject to a catastrophic accident comparable to Bhopal are following the same strategy, but there are indications that such firms are not fully internalizing the risks of such accidents. The fact that a 1988 EPA study found that more than 11,000 toxic accidents had occurred between 1982 and 1986 and that these accidents had caused 309 deaths, 11,341 injuries, and the evacuation of more than 464,000 people suggests that firms during this period were not allocating sufficient

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bankruptcy). *See generally* Lewis A. Kornhauser & Richard L. Revesz, *Apportioning Damages Among Potentially Insolvent Actors*, 19 J. LEGAL STUD. 617 (1990); William M. Landes, *Insolvency and Joint Torts: A Comment*, 19 J. LEGAL STUD. 679 (1990); Mark J. Roe, *Bankruptcy and Mass Tort*, 84 COLUM. L. REV. 846 (1984).

166 *See* Hansmann & Kraakman, *supra* note 164, at 1881.

167 Al H. Ringleb & Steven N. Wiggins, *Liability and Large-Scale, Long-Term Hazards*, 98 J. POL. ECON. 574 (1990).

168 *See generally* Mank, *supra* note 119, at 243–48 (discussing far-reaching scope of CERCLA liability).

169 *Compare* United States v. Kayser-Roth Corp., Inc., 910 F.2d 24 (1st Cir. 1990) (holding parent corporation liable under CERCLA because it exercised pervasive control over subsidiary), *cert. denied*, 111 S. Ct. 957 (1991) *with* Joslyn Mfg. Co. v. T.L. James & Co., 893 F.2d 80 (5th Cir. 1990) (holding that parent corporation was not owner/operator under CERCLA for actions of subsidiary), *cert. denied*, 111 S. Ct. 1017 (1991).

resources to safety.[170] When users file hazard assessment reports pursuant to Section 112(r), there will be additional empirical evidence upon which to judge whether a significant number of users are underinvesting in buffer land.

Whether a particular accident would cause a specific user to file for bankruptcy depends upon all the circumstances. It may be helpful, however, to discuss what might have happened if the Bhopal accident had occurred in the United States. A 1988 EPA study suggested that seventeen accidents between 1982 and 1986 could have been worse than Bhopal under different climate and operating conditions.[171] Under Indian tort law principles, which are far less generous than tort law in most American jurisdictions, Union Carbide paid a $470 million settlement to the Indian Government for the cost of compensating the victims of Bhopal.[172] Professor Marc Galanter has argued that Indian tort law and its legal system were totally inadequate to handle a mass disaster tort action like Bhopal and that the action should have been heard in an American court under American principles of tort law.[173] American tort lawyers brought 145 different multi-billion dollar claims in seven forums, but the Judicial Panel on Multidistrict Litigation joined the plaintiffs and consolidated these cases in the federal district court in the Southern District of New York.[174] Judge Keenan granted Union Carbide's motion to dismiss the action based upon the doctrine of *forum non conveniens* and the Second Circuit affirmed his decision.[175] Before Judge Keenan granted his motion, Union Carbide offered

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[170] *See supra* notes 2–4 and accompanying text.

[171] S. REP. NO. 228, 101st Cong., 2d Sess. 135 (1989), *reprinted in*, 1990 U.S.C.C.A.N. 3385, 3520.

[172] Insurance covered only about $200 million of Union Carbide's $470 million settlement with the Indian Government. Shyam Divan & Armin Rosencranz, *The Bhopal Settlement*, 1989 ENVTL. POL'Y & L. 166, 169, *reprinted in*, THOMAS J. SCHOENBAUM & RONALD H. ROSENBERG, ENVIRONMENTAL POLICY LAW 1263, 1269 (2d ed. 1991).

[173] *See generally* Galanter, *Legal Torpor*, *supra* note 1, at 273–94; Galanter, *Legal Worlds*, *supra* note 1, at 292–310. *But see* O'Connell, *supra* note 1, at 311–16 (arguing Bhopal action properly brought in Indian courts because American tort law imposes excessive costs on defendants). Divan and Rosencranz argue that the settlement of $470 million, which amounts to about $14,600 for each of the deceased, was relatively favorable in comparison to Indian tort awards for automobile victims, and that American lawyers would have skimmed off as much as forty percent of any settlement in an American court. *See* Divan & Rosencranz, *supra* note 172, at 168–69. They acknowledge, however, that the Indian justice system was poorly equipped to handle the Bhopal litigation. *Id.* at 167–68. Divan and Rosencranz believe the settlement was sufficiently high to deter future negligence without choking off foreign investment. *Id.* at 169.

[174] Lisa Moscati Hawkes, Parens Patriae *and the Union Carbide Case: The Disaster at Bhopal Continues*, 21 CORNELL INT'L L.J. 181, 181–83 (1988).

[175] *In re* Union Carbide Corp. Gas Plant Disaster, 634 F. Supp. 842, 866 (S.D.N.Y. 1986), *aff'd in part and mod. in part*, 809 F.2d 195 (2d Cir. 1987), *cert. denied*, 484 U.S. 871 (1987).

$358 million as a settlement and the plaintiff's executive committee was willing to accept, but the Government of India refused the offer as inadequate.[176] Because of significantly lower wages in India and the problems with that country's tort and legal system, the eventual $470 million settlement was perhaps not unexpectedly low.[177] If a comparable accident in lives lost and injuries had occurred at Union Carbide's Institute, West Virginia facility, then Union Carbide might have been forced into bankruptcy, despite its several billion dollars in assets, especially if a jury entered a large punitive damages award.[178]

The availability of bankruptcy protection is likely to cause at least some firms to underinvest in safety because they may not bear the full costs of a tort accident. For example, there is some evidence that owners or operators of land disposal facilities for hazardous waste exercise less due care than is socially desirable because the EPA estimates that there is a twenty-five to thirty percent possibility that such a firm will petition for bankruptcy within the next fifty years.[179] Furthermore, the Ringleb and Wiggins study shows that between 1967 and 1980 large numbers of small firms entered hazardous sectors of the economy and argues that this evidence indicates that small firms are at an advantage because less assets are at risk in the event of a liability judgment resulting in bankruptcy.[180]Users of extremely hazardous substances subject to catastrophic accidents may be less likely to plan on using the bankruptcy code than owners of land disposal facilities because toxic air releases that cause significant damage are unusual events whereas land disposal facilities are so likely to become contaminated that the Resource Conservation and Recovery Act of 1976 (RCRA), as amended, requires operators to have closure and post-closure plans.[181] It is reasonable to assume, however, that users of extremely hazardous substances are aware of the possibility of a worst case accident and take into account the possibility of filing for bankruptcy protection.

[176] *See* Hawkes, *supra* note 174, at 181–82.

[177] *See* Divan & Rosencranz, *supra* note 172, at 168–69.

[178] Some commentators thought that if an American jury had awarded a significant punitive damages award in the Bhopal case, Union Carbide might have been forced into bankruptcy. *See* Dhavan, *supra* note 1, at 296; Schwadron, *supra* note 1, at 447–48.

[179] *See* Joseph L. Cosetti & Jeffrey M. Friedman, *Midlantic National Bank, Kovacs and Penn Terra: The Bankruptcy Code and State Environmental Law—Perceived Conflicts and Options for the Trustee and State Environmental Agencies*, 7 J.L. & COM. 65, 68 (1987); Lynn Tadlock Manolopoulos, Comment, *A Congressional Choice: The Question of Environmental Priority in Bankrupt Estates*, 9 UCLA J. ENVTL. L. & POL'Y 73, 77–78 (1990).

[180] *See* Ringleb & Wiggins, *supra* note 167, at 590–93.

[181] RCRA requires a land disposal facility to have a permit that addresses closure of the facility and post-closure monitoring of the waste. *See* 42 U.S.C. § 6924(p) (1988) (requiring closure and post-closure ground water monitoring). *See generally* 40 C.F.R. §§ 262, 263, 264 (1990).

Is it possible to use insurance requirements to force users of extremely hazardous substances to bear the full costs of their activities? Several federal environmental statutes contain financial responsibility requirements that are designed to force responsible parties to internalize the cost of high risk activities rather than shift their cost to third parties through insolvency, although none is designed to address catastrophic air releases.[182] In theory, insurers can act as surrogate regulators by policing the activities of their policyholders without the need for direct government regulation.[183] There is evidence, however, that financial responsibility requirements for hazardous waste owners or operators under RCRA[184] have not worked well because insurers have been generally unwilling to write policies when the risk of liability is so uncertain and because self-insurance financial tests have been inadequate.[185] After the Bhopal disaster, insurance companies moved to increase the cost of liability insurance and considered eliminating it altogether for chemical makers that are potentially subject to similar accidents.[186] Thus, while insurance requirements can play a role in forcing firms to internalize the costs of toxic accidents, it would be unduly optimistic to assume that financial responsibility requirements can totally replace government regulation when it is

[182] The following federal environmental statutes contain financial responsibility requirements: the Clean Water Act, 33 U.S.C. § 1321(p)(1) (1988); the Deepwater Port Act, 33 U.S.C. § 1517(l) (1988); the Surface Mining Control and Reclamation Act, 30 U.S.C. § 1257(f) (1988); the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. § 9608(a)-(b) (1988). *See* Steven W. Black, Comment, *The Fact and Fiction of Financial Responsibility for Hazardous Waste Management*, 17 ECOLOGY L.Q. 581, 581 (1990).

[183] *See* Black, *supra* note 182, at 583 (RCRA financial requirements seek to use insurers as surrogate regulators).

[184] 42 U.S.C. § 6924(a)(6) (1988).

[185] *See generally* Black, *supra* note 182, at 581-620; Jonathan R. Nash, *Environmental Law: An Economic Approach to the Availability of Hazardous Waste Insurance*, 1991 ANN. SURV. AM. L. 455, 467-69 (General Accounting Office report showed impaired pollution insurance market during mid-1980s). *But see* Greg Steinmetz, *Insurers Discover Pollution Can Bolster Bottom Line*, WALL ST. J., Aug. 19, 1992, at B4 (Insurers are more willing to write environmental policies for low risk firms than during 1980s, but environmental liability insurance is still the most difficult type of commercial insurance to obtain.). A number of land disposal facilities apparently closed, however, because they could not meet financial responsibility, monitoring, and other requirements. *See* Hahn, *supra* note 13, at 223. In November 1985, when financial responsibility and monitoring requirements became mandatory conditions for a final permit, only 492 out of approximately 1600 land disposal facilities applied for a final permit. *Id.* Hahn suggests that government regulators consider whether the high entry barriers created by financial responsibility and liability rules may be counter productive by excessively limiting the number of facilities equipped to handle waste disposal. *Id.*

[186] *See* Alan Hall et al., *A Backlash Is Threatening Chemical Makers*, BUS. WK., Dec. 24, 1984, at 60.

unclear that insurers are willing to write policies for such risks and government regulators may be unwilling to impose stringent self-insurance financial tests that might force numerous firms to close down.

V. A TOXIC DEATH RISK INDEX TAX

Numerous commentators have argued that economic incentives should be used in place of or in addition to bureaucratic "command and control" regulation.[187] For example, Professors Ackerman and Stewart have argued that the EPA's efforts to control pollution by mandating that each major industry adopt the best available control technology (BAT) have created a morass of bureaucratic regulation and costly litigation.[188] In controlling air pollution, commentators favoring economic incentives have discussed using various approaches including marketable permits, effluent charges, offsets, bubbles and banking.[189]

A different type of economic incentive, based on the risk of a toxic catastrophe rather than actual pollution levels, can serve to regulate this area. If the possibility of bankruptcy and inadequacies in insurance requirements leads users of extremely hazardous substances to underinvest in preventative or mitigating measures, then a tax should be imposed that forces the user to internalize these costs. A toxic death risk index tax would tax a user to the extent that an accidental release is likely to cause death or injuries. It is true that it might be difficult to calculate this risk and translate that risk into a workable tax system, but Section 112(r)'s requirement that users prepare a hazard assessment plan can provide the initial basis for calculating such a tax. If the administrative costs of calculating this tax are too high or it is too politically difficult to tax risk rather than actual harm, then Congress and the EPA should impose the buffer requirements discussed in Section III of this Article.

All existing economic incentive systems are too general in the sense that they seek to regulate based upon national, area-wide or industry-wide harm to the environment rather than the specific risk created by an individual plant. In the past, it may have been too expensive to design individual control strategies for each plant or smokestack, but Section 112(r) requires users of extremely hazardous substances to prepare hazard assessment plans that can serve as the basis for individual control either through zoning or by a toxic death risk index tax. In the next century, it may become feasible to extend individual control

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[187] *See supra* note 13 and accompanying text.

[188] *See generally* Ackerman & Stewart, *supra* note 13.

[189] *See generally* Robert W. Hahn & Gordon L. Hester, *Marketable Permits: Lessons For Theory and Practice*, 16 ECOLOGY L.Q. 361 (1989).

strategies to other pollution areas, but that issue is beyond the scope of this Article.

A number of commentators have advocated that the EPA establish a marketable permit system in which the agency would set a limit on the total amount of a given type of pollution and then allot allowances or conduct periodic auctions in which polluters would purchase marketable permits to emit pollution for a limited period of time.[190] A polluter that reduced its emissions below the allotted amount would be able to sell or lease its surplus permits to other polluters or perhaps use them to offset excess emissions in its other plants.[191] The EPA would have to monitor the amount of pollution actually emitted and penalize violators.[192] Title IV of the 1990 Clean Air Act Amendments adopts a marketable permit system to control sulfur dioxide emissions, which are a major cause of "acid rain," by granting pollution allowances to major utilities.[193] By 2000, the Act will limit allowances so that utilities can emit no more than 8.9 million tons of sulfur dioxide, which is a reduction of approximately ten million tons from pollution levels before Congress enacted the statute.[194]

Ackerman and Stewart admit that a marketable permit system based on national or regional pollution goals does not address the problem of local "hot spots" in which there is a relatively high concentration of particular pollutants in a small area within a larger pollution control region.[195] Their first response is that technology based command and control regulation does not necessarily do a better job at controlling local hot spots than a marketable permit system. They point out that existing federal laws designed to address sources that comply with applicable BAT requirements but still cause an excessive amount of local environmental damage have not been implemented in an effective manner.[196] Ackerman and Stewart then try to show ways in which a marketable permit system could attempt to address local hot spots. The EPA could limit trading within certain air pollution control regions, but Ackerman and Stewart acknowledge that existing regional lines, which often follow state lines, are "extremely insensitive to ecological realities."[197] They recommend that any statute implementing a marketable permit system require the agency to reexamine existing regional boundaries; however, Ackerman and Stewart

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[190] *See, e.g.*, Ackerman & Stewart, *supra* note 13, at 1347; Hahn & Stavins, *supra* note 13, at 8–10.

[191] *See* Hahn & Stavins, *supra* note 13, at 8.

[192] *See* Ackerman & Stewart, *supra* note 13, at 1347.

[193] 42 U.S.C.A. § 7651(b) (West Supp. 1992).

[194] *Id.*

[195] *See* Ackerman & Stewart, *supra* note 13, at 1350–51.

[196] *Id.* at 1350 n.43.

[197] *Id.* at 1350.

concede that the EPA probably should put off solving the problem of hot spots until it successfully gets a marketable permit system working.[198]

Commentators have proposed various solutions to the problem of addressing hot spots within a system of marketable permits.[199] One possible approach is a zoned emission permit system that uses small geographic zones and prohibits trading among zones, but this system does little to alleviate the hot spot problem, contrary to initial expectations, and significantly increases the costs of abatement.[200] Trading rules would prohibit certain trades if a trade increased the level of a particular pollutant beyond legal limits.[201] Imposing trading rules increases the cost of trading, depending upon the type of rules, but the cost may still be significantly less than a command and control approach.[202]

In addition to marketable permits, there are other types of emission trading such as "offsets," which require new sources to obtain emission credits from existing sources in the same area to offset their new emissions; "netting," which involves internal trading within a plant only; "bubbles," which involves the concept of placing an imaginary bubble over a multisource plant and regulating the total emissions from all the sources within the bubble rather than each individual source; and "banking," which allows a firm to save emission credits for future use.[203] None of these methods of emissions trading addresses the issue of hot spots, although offsets can reduce the amount of pollution within a defined region if the new source must obtain more than one emission credit from existing sources for each unit of new pollution. In general, there are higher costs when government regulators impose restrictions on trading as a means to control local pollution problems.[204]

Effluent charges seek to internalize the external costs of pollution by imposing a fee or tax on every unit of pollution discharged into the environment.[205] Critics of effluent charges point out that government regulators rarely know the precise reduction in pollution that a tax will cause and thus a charge system will not necessarily reduce pollution to the socially desired level.[206] Several European nations use water pollution charge systems, but American industry has successfully blocked effluent charges for economic

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198 *Id.*

199 *See generally* TOM H. TIETENBERG, EMISSIONS TRADING: AN EXERCISE IN REFORMING POLLUTION POLICY 60–92 (1985) and sources therein.

200 *Id.* at 74–78.

201 *Id.* at 80–86.

202 *Id.*

203 *See* Hahn & Hester, *supra* note 189, at 371–72.

204 *See generally id.* at 376–80, 380–96 (providing examples).

205 *See* Hahn & Stavins, *supra* note 13, at 7–8.

206 *Id.* at 8.

reasons.[207] To date, uniform effluent charges have been imposed on a particular class of pollutants on a national or regional basis.[208]

Commentators have criticized effluent charge systems imposing uniform charges because such an approach does not take into account the differing impact a given discharge may have on different areas of the environment.[209] To control groundwater pollution, a proposed DRASTIC effluent charge system would be based on both the damage unit value of a particular discharge and the vulnerability of groundwater to contamination in the area of discharge.[210]

This Article's proposal for a toxic death risk index tax differs from current economic incentive programs because the tax would be based on the risks of potential environmental harm rather than actual pollution amounts. Taxing a firm on future harm is justifiable to the extent that the liability system and potential government penalties fail to force a firm to internalize the full costs of a catastrophic accident because of the possibility of filing for bankruptcy. There are theoretical reasons to believe that firms may underinvest in preventing or mitigating accidental air releases because of the possibility of filing bankruptcy, but the EPA will not begin to acquire the empirical evidence it needs to assess this issue until users of extremely hazardous substances begin to file hazard assessment reports under Section 112(r) of the Clean Air Act.[211]

While it would be helpful to have the data from the hazard assessment plans that users will have to file in the near future, it is still possible to imagine some of the problems the EPA would confront in creating a toxic death risk

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[207] *Id.* at 7–8.

[208] *See generally* Lawrence Ng, Note, *A DRASTIC Approach to Controlling Groundwater Pollution*, 98 YALE L.J. 773, 787 (1989) (discussing effluent charge systems in West Germany, Canada, and France and proposing new variable charge approach for groundwater).

[209] *See* Clifford S. Russell, *What Can We Get From Effluent Charges?*, 5 POL'Y ANALYSIS 155, 164–68 (1979); Ng, *supra* note 208, at 787 n.106.

[210] *See* Ng, *supra* note 208, at 787–89. The acronym DRASTIC refers to the following factors: Depth to water; Recharge; Aquifer media; Soil media; Topography; Impact of the vadose zone; and Conductivity of the aquifer. *Id.* at 788. The DRASTIC relative ranking scheme uses a combination of weights and ratings to produce a numerical value, called the DRASTIC Index, which allows for the ranking of areas according to groundwater contamination vulnerability. *Id.* There are some similarities between the DRASTIC Index and the type of information a GIS system or another computer model must assess in determining the Toxic Death Risk Index. There are major differences, however, between the two indexes because DRASTIC is concerned with the impact of *continuous* water pollution whereas the Toxic Death Risk Index must predict the possibility of a catastrophic accident that at some future time will release an uncertain amount of toxic air pollutants into a climate environment that changes day to day. Implementing DRASTIC would likely be complicated, but the Toxic Death Risk Index presents even more complicated prediction and modelling problems.

[211] *See supra* notes 82–92 and accompanying text.

index tax. One obvious problem is that users would have an incentive to underreport the quantities of extremely hazardous substances that they use and the risk of accidental releases.[212] The answer to that problem is that the EPA needs to monitor the accuracy of hazard assessment plans if it is to fulfill the congressional mandate in Section 112(r) of the Clean Air Act of preventing catastrophic releases. The EPA would be more likely to do a good job monitoring these reports if a portion of the monies from the tax went to the agency budget.[213]

There is also the problem of whether the tax should be based upon a worst case scenario or the most likely scenario for an accidental release. Industry and the EPA will inevitably disagree about what is the most likely or worst case scenario for a given plant and a particular extremely hazardous substance. This Article suggests a weighted system that would take into account scenarios ranging from worst case to best case.

In virtually all cases, society may not know the precise risks of a chemical, especially the long term risks. For example, there is a fierce scientific debate about the carcinogenic risks of dioxin.[214] For the purposes of a toxic death risk index tax, it may be sufficient to base the tax on risks that are well established. For instance, it is well established that MIC causes death.[215]

The biggest obstacles to the proposed tax are the administrative and transaction costs of computing the tax, and monitoring the accuracy of each user's hazard assessment plan. Many of these costs would be required in any case when the EPA implements Section 112(r). Users will have to file hazard assessment plans regardless of the proposals in this Article. It is likely, however, that there would be additional costs in implementing either this Article's zoning or toxic death risk index tax. While the requirements in Section 112(r) of the Clean Air Act should advance the goal of preventing toxic accidents, this Article's zoning and tax proposals would insure that the EPA, local communities and industry have the proper incentives or enforcement tools to carry out the job. The EPA's poor record in addressing toxic air pollution prior to 1990 led Congress to enact the major changes in the 1990 Clean Air

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[212] Users of hazardous substances may seek to avoid government regulation or taxation by illegally disposing of such materials. *See generally* Hahn, *supra* note 13, at 211, 214–21; Russell, *supra* note 13, at 264–66. One possible solution is a deposit-refund system that would pay a user for returning a spent hazardous substance. *See* Russell, *supra* note 13, at 266–71 (discussing European deposit-refund systems).

[213] In the context of marketable permits, Professors Ackerman and Stewart have argued that the EPA would do a more effective job monitoring emissions if the agency received some of the proceeds from auctioning emission permits. *See* Ackerman & Stewart, *supra* note 13, at 1361–62.

[214] *See* Jeff Bailey, *Dueling Studies—How Two Industries Created a Fresh Spin on the Dioxin Debate*, WALL. ST. J., Feb. 20, 1992, at A1, A6.

[215] *See supra* note 1 and accompanying text.

Act Amendments.[216] Accordingly, it seems wise to give the agency the incentive of gaining a portion of the proposed tax revenues so that the EPA really does its job this time.

VI. CONCLUSION

The use of buffer zones and the risk tax are intended to supplement the Clean Air Act's regulation of hazardous air pollutants. The Senate Bill, No. 1630, that eventually was enacted as the 1990 Clean Air Act Amendments originally contained a provision that would have allowed producers of hazardous air pollutants to create dead zones around their factories and buy out nearby property owners rather than comply with the most stringent portions of the bill.[217] The 1990 Amendments establish an initial list of 189 hazardous air pollutants (HAPs) and require the EPA over a period of ten years to promulgate an emissions standard for each category that will require each polluter to install the maximum achievable control technology (MACT).[218] The Amendments also establish the possibility that the agency will impose a second, more stringent set of health based standards if the Administrator of the EPA determines that the MACT standard for a particular category of HAPs does not provide "an ample margin to protect the public safety."[219] For carcinogens, the Senate Report accompanying the Amendments required the EPA to promulgate two residual risk standards.[220] First, the agency must set a standard which would reduce the lifetime excess cancer risks to the individual most exposed to

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[216] The Senate Report accompanying the 1990 Clean Air Act Amendments stated:

> Very little has been done since the passage of the 1970 Act to identify and control hazardous air pollutants. In the nineteen year history of the Clean Air Act, just eight substances have been listed as hazardous air pollutants: asbestos, beryllium, mercury, vinyl chloride, radionuclides, inorganic arsenic, benzene, and coke oven emissions. NESHAPS (National Emission Standards for Hazardous Air Pollutants) have been promulgated for sources of only seven of these pollutants. Meanwhile the states collectively have regulated over 700 hazardous air pollutants.

S. REP. NO. 101-228, 101st Cong., 2d Sess. 3 (1989), *reprinted in* 1990 U.S.C.C.A.N. 3385, 3389.

[217] *See* Michael Kranish, *Industrial Pollution Escaping Regulation*, BOSTON GLOBE, Mar. 18, 1990, National/Foreign, at 1; Eliza Newlin, States News Service, Mar. 27, 1990, at 1, *available in* LEXIS, Nexis Library.

[218] *See* 42 U.S.C.A. § 7412(b), (d) (West Supp. 1992); S. REP. NO. 228, 101st Cong., 2d Sess. 148 (1989), *reprinted in* 1990 U.S.C.C.A.N. 3385, 3533.

[219] *See* 42 U.S.C.A. § 7412(f)(2) (West Supp. 1992); S. REP. NO. 228, 101st Cong., 2d Sess. 148 (1989), *reprinted in* 1990 U.S.C.C.A.N. 3385, 3533.

[220] S. REP. NO. 228, 101st Cong., 2d Sess. 148 (1989), *reprinted in* 1990 U.S.C.C.A.N. 3385, 3533.

the chemical over seventy years to less than one in a million, although case-by-case exceptions are possible.[221] Section 112(f)(2)(A) specifically incorporates the one in a million standard.[222] The Senate Report also contains a second, less stringent standard to eliminate all lifetime cancer risk greater than one in ten thousand and mandates that "the source must shut down" if it cannot comply with this standard.[223] The dead zone proposal would have allowed a company that could not meet this one in ten thousand standard even after receiving an extension of time to buy out residents rather than shutting down, although the polluter would have to comply with the MACT standard.[224]

Senators Albert Gore and Frank Lautenberg were successful in passing an amendment to delete the dead zones proposal based on their argument that it was wrong to force residents to relocate to allow a polluter to exceed emission standards.[225] Senator Gore stated that the Natural Resources Defense Council had performed a study finding that at least seventy-eight plants in twenty-five states would have been eligible to buy out residents.[226] He argued that the buyouts typically would be unfair to residents because the company's pollution would have already severely reduced the value of the property.[227] As an example, Senator Gore observed that the Georgia Gulf Corporation in 1988 had bought out residents of Revilletown, Louisiana and had destroyed that community when tests showed high levels of vinyl chloride in children.[228] For the purposes of this Article, the Revilletown incident is evidence that users of toxic chemicals will create a buffer zone if the risk of liability is high enough.

From a purely economic point of view, an argument can be made that the buyout provision made sense because otherwise a company would be forced to shut down at probably much greater expense than the cost of relocating residents. From a moral and political perspective, Senators Gore and Lautenberg made a strong argument that it was wrong to force people out of

221 *See* 42 U.S.C.A. § 7412(f)(2)(A) (West Supp. 1992); S. Rep. No. 228, 101st Cong., 2d Sess. 148 (1989), *reprinted in* 1990 U.S.C.C.A.N. 3385, 3533.

222 42 U.S.C.A. § 7412(f)(2)(A) (West Supp. 1992). The one in ten thousand standard is meant to be less stringent than the one in a million standard, but Congress intended that the lower standard be enforced more strictly by the EPA. *See generally* 136 CONG. REC. S4689, 4689 (Apr. 20, 1990) (statement of Sen. Sanford); 136 CONG. REC. S3738, 3739–42 (Apr. 13, 1990) (statement of Sen. Symms, who was critical of residual risk requirements).

223 S. REP. NO. 228, 101st Cong., 2d Sess. 148 (1990), *reprinted in* 1990 U.S.C.C.A.N. 3385, 3533. There was a possibility of a five year extension. *Id.*

224 *See* Kranish, *supra* note 217, at 1; Newlin, *supra* note 217, at 1.

225 *See* 136 CONG. REC. S17,120, S17,123 (1990) (statement of Sen. Gore); 136 CONG. REC. S3580, 3581–82 (1990) (statements of Sens. Gore, Lautenberg and vote on amendment to delete dead zone provision).

226 136 CONG. REC. S3580, 3581 (1990).

227 *See* 136 CONG. REC. S17,123 (1990); 136 CONG. REC. 3580, 3581 (1990).

228 *Id.*

their homes because a company could not meet a statutorily mandated emissions standard.

The buffer zone proposed here is different from the dead zone provision in the Senate bill because a polluter would be required to comply with all environmental requirements. A buffer zone to protect residents against an accidental release is different from a dead zone that allows a polluter to exceed *continuously* required emission limits. To create an acceptable buffer zone, a company might wish to purchase land from residents, but this Article's proposal would allow such buyouts to occur only on a voluntary basis. If a company could not buy the necessary buffer space on a voluntary basis, this Article proposes that the EPA restrict or shut down the company's operations. Buffers should protect residents rather than allow polluters to exceed normal pollution standards and force out residents.

This Article advocates a two-pronged approach to preventing toxic catastrophes. First, the EPA should establish economic incentives to encourage users of extremely hazardous substances to reduce their use of such chemicals, to substitute less harmful chemicals and to use mitigating measures such as dead zone buffers. This Article proposes a toxic death risk index tax to accomplish these goals. Second, it is essential that local zoning and emergency response officials insure that residents are protected as well as possible from the consequences of a toxic air release. In particular, this Article argues that the EPA should adopt regulations requiring local zoning boards to enforce buffer requirements when industry is unable to reduce risk to residents by using less harmful substances. These proposals may seem contradictory in the sense that one uses economic incentives while the other imposes government regulation, but they are interrelated. First, zoning officials can determine whether the tax is sufficiently high to force users to purchase adequate buffer lands. Second, tax revenues can be used to compensate communities that lose industry because of buffer requirements. Together, this Article's buffer and tax proposals would reduce the likelihood of a tragic accident on the scale of Bhopal.

In the long run, society must better separate industry and residents. Buffer zones and risk taxes can initiate this separation process by encouraging industry to either relocate to less risky areas or to buy out residents if the costs of relocation are prohibitive.