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# Risk Assessment, Redevelopment, and Environmental Justice: Evaluating the Brownfields Bargain

John S. Applegate
*Indiana University*

# RISK ASSESSMENT, REDEVELOPMENT, AND ENVIRONMENTAL JUSTICE: EVALUATING THE BROWNFIELDS BARGAIN

JOHN S. APPLEGATE*

Brownfields initiatives offer environmental law an opportunity to break out of its usual—and usually very appropriate—role as a constraint on industrial activity, and instead to facilitate the redevelopment of abandoned urban industrial infrastructure and the revitalization of the surrounding communities. Inner cities have decayed as their industries have moved out of the city and into the suburbs, leaving behind a wasteland of abandoned factories and warehouses, environmental degradation, and poverty. Environmental regulation has, in truth, little to do with the original abandonment of urban industrial areas, but it can have a lot to do with the attractiveness of redeveloping them. The environmental remediation obligations that flow from ownership of contaminated property impose serious potential liability on prospective developers.

Specifically, the broad liability and the stringent clean-up requirements of the Comprehensive Environmental Response, Compensation, and Liability Act[1] (CERCLA or Superfund), and to a

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* Professor of Law, Indiana University School of Law-Bloomington. This article is based on a presentation at the University of Kentucky Journal of Natural Resources and Environmental Law 1998 Symposium on Brownfields. I am grateful to the *Journal* and to Professor Michael Healy for the invitation to explore this subject in some detail, and to the participants in the Symposium, particularly William Buzbee, Kirsten Engel, and Wendy Wagner, for many helpful comments and insights. Amanda Prebble provided invaluable research assistance.

[1] Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. §§ 9601-9675 (1994).

Numerically, most brownfields sites will never by addressed by CERCLA, because they are too small to be included on the National Priorities List, and instead are subject to state environmental clean-up, voluntary clean-up, or other environmental laws. Kris Wernstedt & Robert Hersh, *"Through a Lens Darkly"—Superfund Spectacles on Public Participation at Brownfield Sites*, 9 RISK: HEALTH, SAFETY & ENV'T 153, 156 (Spring 1998). This does not change the analysis in this article for a number of reasons. First, placement on the NPL is not a prerequisite to CERCLA liability—there is no lower threshold of liability—so the threat of CERCLA liability does not disappear. *See* United States v. Alcan Aluminum Corp., 990 F.2d 711, 720 (2d Cir. 1993). Second, to the extent that state clean-up laws are not also voluntary clean-up or brownfields redevelopment laws, state laws impose the same threat of liability as CERCLA. Third, state voluntary clean-up and brownfields laws tend to emphasize site-specific risk assessment *more* even than CERCLA does, so risk assessment has a more prominent place. The state role is thoroughly considered in William W. Buzbee, *Brownfields, Environmental Federalism, and Institutional Determinism*, 21 WM. & MARY ENVTL. L. & POL'Y REV. 1, 29-66

lesser extent the Resource Conservation and Recovery Act[2] (RCRA), make reuse of such property a risky venture because it is usually contaminated to a greater or lesser degree with hazardous substances.[3] To the extent that these statutes present a serious obstacle to redevelopment, the relaxation of their clean-up requirements can substantially aid in revitalization efforts.

The exchange, which I call the Brownfields Bargain, between moderated clean-up requirements and economic development is the essence of brownfields initiatives. Many view some relaxation of already strict environmental standards as a small price to pay for urban revitalization, and so brownfields initiatives are supported not only by potential redevelopers, but also by the Environmental Protection Agency[4] (EPA), numerous states,[5] and proposed federal legislation.[6] To be a fair exchange, a bargain must at a minimum exhibit some symmetry between benefits and burdens, and it must be understood by its participants. Just as risk assessment is one of the key tools for relaxing clean-up requirements, it can also be a tool for ensuring that the terms of the Brownfields Bargain are fair.[7]

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(1997); William W. Buzbee, *Remembering Repose: Voluntary Contamination Cleanup Approvals, Incentives, and the Costs of Indeterminate Liability*, 80 MINN. L. REV. 35, 100-116 (1995).

[2] Resource Conservation and Recovery Act, 42 U.S.C. §§ 6901-6992 (1994) [hereinafter RCRA]. *See generally* Susan E. Bromm, *Life After RCRA—It's More Than a Brownfields Dream*, 28 Envtl. L. Rep. (Envtl. L. Inst.) 10031 (1998) (describing application of RCRA to brownfields).

[3] The law applicable to brownfields redevelopment is thoroughly reviewed in Wendy E. Wagner, *Overview of Federal and State Law Governing Brownfields Cleanups*, *in* BROWNFIELDS: A COMPREHENSIVE GUIDE TO REDEVELOPING CONTAMINATED PROPERTY 15-40 (Todd S. Davis & Kevin D. Margolis eds., 1997) [hereinafter BROWNFIELDS: A COMPREHENSIVE GUIDE].

[4] *See* Al Gore, *Preface*, *to* BROWNFIELDS: A COMPREHENSIVE GUIDE, *supra* note 3, at xix-xx (endorsing brownfields redevelopment). The United States Environmental Protection Agency's policy on its Brownfields Initiative is "to empower States, communities, and other stakeholders in economic redevelopment to work together in a timely manner to prevent, assess, safely clean up, and sustainably reuse brownfields." 62 Fed. Reg. 52,720 (1997) (also available electronically at <www.epa.gov/fedrgstr/EPA-WASTE/1997/October/Day-09/f26863.htm>) [hereinafter EPA Policy on Brownfields Initiative].

[5] State brownfields legislation is collected in BROWNFIELDS: A COMPREHENSIVE GUIDE, *supra* note 3 , at 287-681, and Larry Schnapf, *State-by-State Survey of Brownfield and Voluntary Cleanup Programs*, 28 Env't. Rep. (BNA) 2488 (March 7,1998); GENERAL ACCOUNTING OFFICE, GAO/RCED-97-66, SUPERFUND: STATE VOLUNTARY PROGRAMS PROVIDE INCENTIVES TO ENCOURAGE CLEANUPS (April 1997); OFFICE OF TECHNOLOGY POLICY, STATE OF THE STATES ON BROWNFIELDS: PROGRAMS FOR CLEANUP AND REUSE OF CONTAMINATED SITES (1995).

[6] These initiatives are described in Wernstedt & Hersh, *supra* note 1, at 158-59.

[7] "Market outcomes are fair and should not be disturbed if, and only if, local communities are empowered to obtain relevant information, participate in the pertinent regulatory processes, and bargain effectively with developers." Seth D. Jaffe, *The Market's Response to Environmental Inequity: We have the Solution; What's the Problem*, 14 VA. ENVTL. L. J. 655, 660

This Article critically describes the role of risk assessment in brownfields redevelopment initiatives. Part I identifies the risk regulation issues in brownfields redevelopment. There are, in fact, several ways to modify environmental liabilities to encourage redevelopment, and risk assessment relates primarily to one of them—relaxing clean-up requirements through recalculation of the risks posed by the site now and in the future. The Article does not dispute the claim that a relaxation of environmental requirements is an important tool of urban redevelopment or that the benefits of urban redevelopment are worth some such relaxation. Given the high degree of stringency of the otherwise applicable standards and the real human suffering that results from urban decay, the claims are probably true in many, though certainly not all, cases. However, it is critical to understand just how risk assessment affects and does not affect remediation and redevelopment decisions.

Part II reviews the methods of risk assessment and their role in brownfields redevelopment. Risk calculations are highly dependent on assumptions about present and future exposures to hazardous contamination, introducing several important difficulties into the standard analysis. Brownfields sites must be recognized as particular places with particular histories and futures. The relationship of a former industrial site to its neighbors and predictions as to its future are central to any brownfields risk analysis. As in Part I, my objective is not only to describe the relationship between brownfields and risk assessment, but also to clear away the rhetoric that surrounds brownfields initiatives and the role of risk assessment therein. While there is much to be said for brownfields redevelopment and much to be said for modifying risk assessment practices that unnecessarily hinder redevelopment, we must also be candid that the intended effect of these initiatives is to reduce risk estimates without changing the underlying conditions.

Part III examines the principal modifications of risk assessment practice that have been proposed to facilitate brownfields redevelopment. If risk assessments are unduly conservative, they unnecessarily burden redevelopment without materially advancing the protection of human health and the environment. Thus, brownfields proposals seek to make risk estimates more "accurate," in the sense of predicting more precisely the future activities at a brownfields site and assessing the risks posed under those circumstances. In the brownfields

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(1995).

context, this involves the assumption that the site will adopt an industrial or commercial use (*i.e.*, be economically revitalized), either of which presents relatively low risks from residual contamination. The Article also reviews proposals to adopt more realistic default assumptions generally, to avoid worst-case point estimates, to predict or prescribe the future use of the site, and to adopt comparative risk methods.

Since brownfields redevelopment exchanges strict environmental protection for economic development, recalculation of risks to achieve lower clean-up expenses must be approached with caution. Part IV, therefore, concludes the Article with a number of important caveats concerning reliance on more forgiving risk calculations. Reliance on predictions of a site's future is only justified if there is some assurance that the predictions will be realized in the short term and maintained in the long term. No matter how worthy the aspirations for brownfields redevelopment, we must not forget that even the best risk assessors have a clouded crystal ball for predicting the future, and CERCLA's overriding purpose is not economic development but protecting human health and the environment. From this perspective, risk assessment's appropriate role in brownfields redevelopment is to illuminate the real terms of the Brownfields Bargain, so that brownfields decisions are made with full knowledge of their likely consequences.

## I. DEFINING THE ISSUES

### A. Brownfields and the Role of CERCLA

The Environmental Protection Agency (EPA) broadly defines brownfields as "abandoned, idled, or under-used industrial and commercial sites where expansion or redevelopment is complicated by real or perceived environmental contamination...."[8] As such, the United States offers a virtually unlimited supply[9] of brownfields whose redevelopment is, at least in most cases, a worthy governmental objective. It is especially appealing in what might be called the core or paradigm meaning of brownfields, that is, economically disadvantaged urban areas, often with large minority populations, whose revitalization

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[8] U.S. EPA, OFFICE OF PUBLIC AFFAIRS, BASIC BROWNFIELDS FACT SHEET (1995).

[9] Estimates range from 130,000 to 450,000 such sites. GENERAL ACCOUNTING OFFICE, GAO/RCED-95-172, REUSE OF URBAN INDUSTRIAL SITES (1995) (citation omitted).

is one of the great challenges of urban management.[10] The quoted definition is, obviously, much broader than urban redevelopment, but a glance at official justifications makes it clear that decayed urban areas are the central concern and are regarded as the best case for encouraging redevelopment.[11] Just as Love Canal, with its tableau of irresponsible dumping and innocent victims (school children), dominates thinking about Superfund, brownfields call to mind abandoned factories and warehouses in city centers.[12] They no longer provide the economic lifeblood of the community but, abandoned, symbolize the hazards and hopelessness of the inner city. The core brownfields idea, therefore, is that the redevelopment of these abandoned industrial areas would greatly improve, on balance, the lives of those who live near them,[13] and, consequently, that all reasonable efforts should be made to facilitate such redevelopment. Limiting prospective redevelopers' liability for existing environmental contamination is one way to facilitate redevelopment.

The role of environmental regulation in creating brownfields in the first place is uncertain and probably minimal.[14] The movement

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[10] Douglas A. McWilliams, *Environmental Justice and Industrial Redevelopment: Economics and Equality in Urban Revitalization*, 21 ECOLOGY L. Q. 705 (1994); E. Lynn Grayson & Stephen A.K. Palmer, *The Brownfields Phenomenon: An Analysis of Environmental, Economic, and Community Concerns*, 25 Envtl. L. Rep. (Envtl. L. Inst.) 10337 (1995); *see also* ROBERT D. BULLARD, DUMPING IN DIXIE: RACE, CLASS AND ENVIRONMENTAL QUALITY 31-33 (1990).

[11] *See* Gore, *supra* note 4, at xix-xx; EPA Policy on Brownfields Initiative, *supra* note 4.

[12] The toxic soup at Love Canal informed Congress' passage of CERCLA and the federal courts' initial interpretation of the statute in cases like *United States v. Chem-Dyne Corp.* 572 F. Supp. 802 (S.D. Ohio 1983) (determining the scope of liability under CERCLA to include joint and several liability); and *United States v. Wade*, 577 F. Supp. 1326 (E.D. Pa. 1983) (holding that joint and several liability should be imposed upon defendants found to be responsible for creation of hazardous waste under CERCLA). *See* Michael B. Gerrard, *Demons and Angels in Hazardous Waste Regulation: Are Justice, Efficiency, and Democracy Reconcilable?* 92 NW. U. L. REV. 706, 708 (1998).

[13] This picture is crudely drawn, but it is not a caricature. Industrial development is not an unalloyed good, since it can bring pollution and traffic. Some environmental justice advocates object to brownfields redevelopment, since it means that inner city communities are condemned to living in an essentially urban area rather than a residential one. *See* Kirsten Engel, *Brownfields Initiatives and the Requirements of Market-Based, Rights-Based, and Pragmatic Conceptions of Environmental Justice*, Unpublished Topical Outline, Journal of Natural Resources and Environmental Law 1998 Symposium on Brownfields [hereinafter Symposium on Brownfields] (on file with *Journal of Natural Resources and Environmental Law*); McWilliams, *supra* note 10 at 705-783; Deeohn Ferris, *Communities of Color and Hazardous Waste Cleanup: Expanding Public Participation in the Federal Superfund Program*, 21 FORDHAM URB. L. J. 671 (1994); *see also* Wernstedt & Hersh, *supra* note 1, at 160, 165-67 (describing negative effects of redevelopment).

[14] Robert H. Abrams, *Superfund and the Evolution of Brownfields*, 21 WM. & MARY ENVTL. L. & POL'Y. REV. 265, 273 (1997); Buzbee, *supra* note 1, at 5-11.

away from the city centers in the first place began long before liability for environmental clean-up was even imagined, and this migration had to do with the availability of automobile transportation, the attractions of the suburbs, post-war increases in real earnings, and patterns of *de jure* and *de facto* racial segregation.[15] Therefore, simply modifying environmental liability itself cannot bring the industry back. Other incentives—tax abatements, worker training, better schools, and the like—must carry that positive burden.[16] Moreover, redevelopment is only likely to occur where other conditions, such as a convenient location, are favorable.[17] Nevertheless, environmental liability does have a supporting role to play in revitalization, if only because it is an obstacle that can be removed to facilitate redevelopment.

It has been observed for some time that the environmental clean-up requirements of CERCLA and RCRA encourage prospective developers to eschew existing industrial land in city centers in favor of non-industrial (typically agricultural) land at the periphery.[18] Environmental liability attaches to purchasers of and lenders to[19] contaminated property. Unless the purchaser can demonstrate that it is an "innocent landowner"[20] or that the contamination was caused *solely* by an unrelated third party,[21] it is regarded as a "present owner" of the property who is responsible, retroactively, for all of the costs of

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[15] Existing patterns change slowly because it is harder for people of color and poor people to move. ROBERT D. BULLARD, INVISIBLE HOUSTON: THE BLACK EXPERIENCE IN BOOM AND BUST 61 (1987).

[16] For example, liability waivers, no action agreements, cleanup tax credits, and immunity for state voluntary cleanups. *See* Wendy E. Wagner, *Overview of the Law of Brownfields*, Symposium on Brownfields (1998); Kathleen M. Martin, *Siting on Contaminated Property: Development and Cleanup through Public/Private Cooperation*, NAT. RESOURCES & ENV'T, Winter 1993, at 20-23, 53-54.

[17] *See* Wernstedt & Hersh, *supra* note 1, at 168-69.

[18] *See* JAMES BOYD ET AL., THE IMPACT OF UNCERTAIN ENVIRONMENTAL LIABILITY ON INDUSTRIAL REAL ESTATE DEVELOPMENT: DEVELOPING A FRAMEWORK FOR ANALYSIS 28-39 (1994). *See also* McWilliams, *supra* note 10, at 714-732. *But see* Abrams, *supra* note 14, at 278-292 (exploring comparative cost-benefit analysis based on the cost of land, taxes, demolition and removal of debris, the likelihood of zoning approvals, etc., Abrams suggests that regardless of liability under CERCLA, greenfields still possess an economic advantage).

[19] *See* United States v. Fleet Factors Corp., 901 F.2d 1550, 1558 (11th Circ. 1990), *cert denied*, 498 U.S. 1046 (1991) (imposing liability on banks that did not foreclose on property "if its involvement with the management of the facility is sufficiently broad to support the inference that it could affect hazardous waste disposal decisions if it so chose"). *But see* Pub. L. No. 104-208, Div. A, Title II, § 2501, 110 Stat. 3009 (1996) (excluding certain lenders from liability); William W. Buzbee, *CERCLA's New Safe Harbors for Bankers, Lenders, and Fiduciaries*, 26 Envtl. L. Rep. (Envtl. L. Inst.) 10656 (1996) (describing new statutory provisions).

[20] CERCLA § 101(35)(A)-(C).

[21] *Id.* § 107(b)(3).

cleaning it up,[22] regardless of fault, and regardless of its extent of contribution to the problem.[23] Even if the purchaser believes that it can establish innocent landowner status or the third-party causation defense, neither is certain—there are no "safe harbors" in CERCLA[24]—and both must be litigated. Moreover, once the owner knows of the contamination, it must take "reasonable precautions" with the hazardous materials.[25] Whatever precisely "reasonable precautions" means,[26] it cannot be determined definitely in advance of cost recovery litigation, and it may well involve undertaking clean-up oneself. Put bluntly, even if one is an innocent purchaser and could obtain recovery of the clean-up costs from others, who needs the headache? It is much easier to use land that has never had an industrial use. This incentive system helps to perpetuate the doughnut shape of economic development in many American cities. The reduction of CERCLA liability, therefore, can make redevelopment of the urban core more attractive by reducing the disincentive to using these urban industrial lands.

### B. The Role of Risk Assessment in Reducing the CERCLA Disincentive

The CERCLA disincentive to redevelopment could be ameliorated, in the first place, by reducing the scope of the liability that frightens off would-be developers.[27] Adoption of prospective-only liability, a fault-based system, or several-only liability would reduce the potential liability of prospective owners, as would expansion of the

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[22] *Id.* § 107(a)(1), (4)(A)-(D).

[23] *See, e.g.*, United States v. Chem-Dyne Corp., 572 F. Supp. 802 (S.D. Ohio 1983); New York v. Shore Realty Corp., 759 F.2d. 1032 (2d Cir. 1985) (holding that while Congress intended to impose liability on responsible parties irrespective of fault, defendant could escape strict liability through use of third-party defense).

[24] Buzbee, *supra* note 1, at 42-54.

[25] This is an explicit requirement of the innocent landowner and third-party defenses. 42 U.S.C. §§ 9601(35)(A), 9607(b)(3)(a).

[26] *See, e.g.*, United States v. Ottati & Goss, Inc., 630 F. Supp. 1361, 1403-1411 (D.N.H. 1985) (holding that in light of the inherently dangerous activity of the transport and processing of hazardous waste and the ease with which the defendant could determine that a risk to others was involved, by not insuring that their waste was processed properly, the defendants did not take "reasonable precautions" against foreseeable acts or omissions nor exercise reasonable care).

[27] This and other potential reforms of CERCLA to encourage brownfields redevelopment are helpfully surveyed in Frona M. Powell, *Amending CERCLA to Encourage the Redevelopment of Brownfields: Issues, Concerns, and Recommendations*, 53 WASH. U. J. URB. & CONTEMP. L. 113 (1998).

innocent-purchaser and third-party defenses. There is some indication that courts are already doing this, though for reasons other than encouraging brownfields redevelopment.[28] Such reforms seem unlikely to be widely adopted, however, because they are not specific to brownfields, where the arguments for relaxing stringency are strongest, and such reforms would be perceived as a general weakening of CERCLA. The Brownfields Bargain applies to the specific situation in which the benefits of economic redevelopment in the inner city outweigh the reduced protection of health and safety. Therefore, brownfields *per se* cannot justify such fundamental changes in a polluter-pays liability system that enjoys widespread support.

The CERCLA disincentive could also be reduced by requiring less clean-up activity by an otherwise responsible party. The stricter the clean-up standards, the higher the clean-up costs. To give a simplified example, if a concentration of 1 part per million (ppm) of a hazardous contaminant in soil correlates to $1 \times 10^{-6}$ excess cancer risk to those who are exposed to the soil, and $1 \times 10^{-6}$ is the clean-up target for residual risk, then all soil that is contaminated above 1 ppm (say, 1,000,000 cubic meters ($m^3$) of soil, in all) must be removed, at great expense. If 10 ppm correlates to a $1 \times 10^{-5}$ risk, however, one could decide to reduce risk only to that level and accordingly only remove soil above 10 ppm (say, 100,000 $m^3$) at considerably less expense. And so on—if a $1 \times 10^{-4}$ residual risk is acceptable, then only 100,000 $m^3$ of contaminated soil needs to be removed. Reducing the stringency of CERCLA's target or residual risk level would in this way reduce clean-up costs, which would in turn reduce the disincentive to redevelopment.

CERCLA's stringency could be reduced in two ways. The first is to change the substantive legal or regulatory standards[29] themselves. The statutory criteria for clean-up,[30] as translated in the National

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[28] *See, e.g.*, Licciardi v. Murphy Oil U.S.A., Inc., 111 F.3d 396 (5th Cir. 1997) (holding that response action must be "justified" by the extent of the release); United States v. Cello-Foil Prods., Inc., 100 F.3d 1227 (6th Cir. 1996) (requiring intent to dispose as a prerequisite to arranger liability); *In re* Bell Petroleum Servs., Inc., 3 F.3d 889 (5th Cir. 1993) (easing defendant's burden of proving severability of contamination).

[29] Throughout the article, I use clean-up *standards* to refer to legal descriptions of what must be done. "Protective of human health and the environment" and even $1 \times 10^{-4}$ to $1 \times 10^{-6}$ are legal standards that must be met. This is to be distinguished from *requirements* or *stringency*, which refer to the amount of actual clean-up effort that must occur, for example, how many cubic meters of dirt must be removed and treated. Depending on how compliance is calculated, the same legal *standard* may be more or less *stringent* and *require* more or less clean-up activity and expenditure.

[30] 42 U.S.C. § 9621(b),(d)(1994).

Contingency Plan,[31] require EPA to evaluate the conditions prevailing at each specific site according to nine criteria in three tiers:

> • Two *threshold criteria*—"overall protection of human health and environment," and "applicable or relevant and appropriate requirements" (ARARs) of other federal and state laws—must be met in all cases. Overall protectiveness is a risk-based criterion, and EPA interprets it to require a residual risk within the range of $1 \times 10^{-4}$ to $1 \times 10^{-6}$ excess individual risk of cancer.[32] (Harm to the non-human "environment" is also considered, but it tends to be less important, in part because the tools for measuring it are quite crude.) Importantly, this means that "clean-up" does not result in a site that is totally clean in the sense of risk-free or returned to its pre-industrial, "pristine" condition. Rather, as in virtually all toxics statutes, it anticipates the continued existence of a measurable residual risk. Accordingly, in considering the relaxation of clean-up standards, the question is not whether any risk should remain, but how great the remaining risk should be.
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> ARARs were designed to achieve some uniformity of treatment between Superfund and non-Superfund sites and to provide specific guidance for clean-up levels where it is available in other regulatory schemes. The most important sources of ARARs are RCRA and the Safe Drinking Water Act, which govern hazardous waste disposal and groundwater remediation, respectively. The application of these standards is often criticized (quite apart from brownfields issues) as too strict or as inapplicable to abandoned properties. Achievement of drinking water standards is claimed to be unnecessary if the contaminated groundwater is not potable or is otherwise highly unlikely to be used for drinking purposes.[33] It also contributes to a high level of uncertainty in predicting the applicable standards.[34] ARARs may be waived if they are unachievable and the risk-based protectiveness standard can be met.

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[31] 40 C.F.R. § 300.430 (1997).

[32] *See id.* § 300.430(e)(2)(i)(A)(2).

[33] Alex S. Karlin, *How Long is Clean?*, NAT. RESOURCES & ENV'T, Summer 1994, at 7, 48; Elizabeth H. Temkin, *Cleaning Up ARARs: Reflections From the Field*, NAT. RESOURCES & ENV'T, Winter 1992, at 18,51.

[34] Buzbee, *supra* note 1, at 59-61.

• *Balancing criteria*, the second tier, may be traded-off against each other. The balancing criteria include the long-term effectiveness or permanence of the remedy; the reduction of toxicity, mobility, or volume of contamination through the use of treatment; the short-term effectiveness, which is an awkward way of describing the risks of the remedial activities themselves; the ease of implementation of the remedy, that is, its technical and administrative feasibility; and the capital and operational costs of the remedy, specifically the cost-effectiveness of the selected remedy in relation to alternative remedies. The balancing criteria demonstrate a continuing and indeed overriding concern to address the long-term effects of environmental contamination. While long-term effectiveness and permanent treatment are apparently equal balancing criteria, the statute includes clear preferences for remedies that emphasize them.[35] This reflects, of course, a desire to minimize risks to future generations by "fixing" the problem once and for all—an entirely reasonable policy, but (like $1 \times 10^{-6}$ and ARARs) a costly one.

• *Modifying criteria*, state (governmental) acceptance and community (general public) acceptance, may alter the remedy indicated by the above. They are of distinctly lesser importance, coming into play *after* a preferred remedy has been selected. These criteria, as the name suggests, receive little weight in remedy selection,[36] and so they have little effect on cost. However, their potential impact is sufficient to have driven at least one state (Ohio) to develop a secretive brownfields process that avoids public pressure for stringency.[37]

Taken together, these criteria are quite stringent, though they could be modified to be less strict, which would make liability less expensive. Relaxation of CERCLA's standards for redevelopment cases would be in accordance with the Brownfields Bargain, and it would have the

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[35] RCRA mirrors this approach to managing hazardous waste by requiring treatment to specified standards before certain materials can be disposed on land. 42 U.S.C. § 6924(m)(1994).

[36] John S. Applegate, *Beyond the Usual Suspects: The Use of Citizens Advisory Boards in Environmental Decisionmaking*, 73 IND. L. J. 903, 912-13 (1998).

[37] *See* OHIO REV. CODE ANN. § 3746 (Banks-Baldwin 1995), discussed in J. Jeffrey McNealey, *Brownfields Development in Ohio*, Symposium on Brownfields (on file with *Journal of Natural Resources and Environmental Law*).

virtue of candor by making an explicit trade-off between environmental protection and economic development. It would also have the drawback of candor, of course, by acknowledging a willingness to be less than totally protective, which Congress usually tries to avoid in an effort to be all things to all people.[38] It is significant in this connection that the Pennsylvania brownfields statute emphasizes that the legal standards for clean-up do not change for brownfields, even though the statute also clearly anticipates changing the amount of remediation activity that is actually required.[39]

If the legal standards do not change, though, how can one reduce the stringency of CERCLA to make clean-up less burdensome and redevelopment more attractive? The second way is to modify the way that the standard is *calculated.* If the risk calculation is unnecessarily high, then the clean-up will be unnecessarily expensive, and the CERCLA disincentive unnecessarily disheartening. Here (at last) is the role of risk assessment. The higher the assessed risk, the more likely that clean-up activities will be required and the more intensive and expensive the activities will be. Conversely, lower risk estimates will result in less extensive clean-up activities, and hence a more attractive economic prospect for redevelopment.

Risk assessment is the principal method for measuring compliance with CERCLA because risk levels are the ultimate substantive standard under the statute. The degree of clean-up is, in effect, a fine-tuned risk determination. As is described in Part II, risk assessment is a highly inexact science. Many assumptions go into it, and many uncertainties remain. There are thus many choices to be made in risk calculations, and those choices need not be made with the aim of showing the worst-case risk estimate. The type of brownfields initiative that concerns this Article, therefore, is the modification of environmental clean-up requirements by recalculating the risks in a way that lowers the risks.

Such recalculations are not necessarily dishonest (cooking the books), nor is the exchange that they support (the Brownfields Bargain) inherently wrong. The clean-up requirements of federal environmental

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[38] *See* John P. Dwyer, *The Pathology of Symbolic Legislation*, 17 ECOLOGY L. Q. 233 (1990); David Schoenbrod, *Goals Statutes or Rules Statutes: The Case of the Clean Air Act*, 30 UCLA L. REV. 740, 742-56 (1983); Wendy E. Wagner, *The Science Charade in Toxic Risk Regulation*, 95 COLUM. L. REV. 1613, 1615 (1995).

[39] PA. STAT. ANN. tit. 35 §§ 6026.101-6026.908 (1995); Denise K. Chamberlain, *Pennsylvania's Land Recycling Program*, Symposium on Brownfields (on file with *Journal of Natural Resources and Environmental Law*).

laws are quite stringent, so it may well be that the marginal environmental protection is so dearly bought with so little additional benefit that it is hardly worth the extra expense.[40] When positive benefits like redevelopment are added to the balance, insisting on the highest degree of stringency may make little sense. Alternatively, it may be that employing and making health care available to the inner city poor actually improves life expectancies far more than residual contamination reduces them.[41] In either event, however, it is an exchange. As such, the terms of the exchange (*e.g.*, additional risk, jobs created, health care made available) should be clear to those who are affected and those making the decisions. At a minimum, the identities of the groups who are benefitted and those placed at risk should be known in advance. In the brownfields context, therefore, risk assessment should not only be a tool for relaxing clean-up requirements, but also a tool for determining the real terms of the Brownfields Bargain in a given case.

## II. BROWNFIELDS RISK ASSESSMENT

### A. Application of the "Red Book" Paradigm

Risk assessment has become the cornerstone of EPA's regulation of hazardous materials.[42] As its name suggests, risk assessment is a process for calculating the probability of certain malign effects—typically, excess deaths from cancer in humans—caused by exposure to the chemical (or radiological) agent of concern. The methodology can be used both to determine whether an activity involving the chemical or a place contaminated by the chemical requires regulatory attention and to determine how much and what

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[40] The tendency to insist that we go to the logical extreme or chase the "last ten percent" in environmental regulation has been attributed to bureaucratic tunnel vision. *See* STEPHEN BREYER, BREAKING THE VICIOUS CIRCLE: TOWARD EFFECTIVE RISK REGULATION 10-19 (1993) (criticizing regulatory agencies for promulgating arduous standards that result in high costs and low benefits ), and to American legal culture generally, *see* Gerrard, *supra* note 12, at 741.

[41] *See, e.g.*, RISK VERSUS RISK: TRADEOFFS IN PROTECTING HEALTH AND THE ENVIRONMENT (John D. Graham & Jonathan Baert Wiener eds., 1995) [hereinafter RISK VERSUS RISK]; BREYER, *supra* note 40; COMPARING ENVIRONMENTAL RISKS: TOOLS FOR SETTING GOVERNMENT PRIORITIES (J. Clarence Davies ed., 1996).

[42] *See generally* John S. Applegate, *A Beginning and Not an End in Itself: The Role of Risk Assessment in Environmental Decision-Making*, 63 U. CIN. L. REV. 1643 (1995). This is not uncontroversial, *see, e.g.*, Donald T. Hornstein, *Reclaiming Environmental Law: A Normative Critique of Comparative Risk Analysis*, 92 COLUM. L. REV. 562 (1992), but risk is well established.

types of actions should be taken. The latter is most relevant to CERCLA remedy selection, and it is our particular interest here.

The general methodology for risk assessment was set out in the 1983 "Red Book" published by the National Academy of Sciences, *Risk Assessment in the Federal Government: Managing the Process*.[43] The Red Book distinguished between risk management and risk assessment. Risk management is the process of deciding what to do about a risk that has already been identified and characterized. CERCLA's legal standards, for instance, state how the risks of Superfund sites are to be managed, and the Brownfields Bargain is a refinement of risk management. Risk assessment, in contrast, is the predicate calculation of risk on which management decisions are based. The distinction between risk assessment and management has been enthusiastically embraced by those who advocate more "science-based" environmental regulation, because the descriptive phase is seen to be a politically neutral process[44]—"just the facts," so to speak—in contrast to the management phase in which policies and political choices naturally predominate. The argument is made, for example, that it is entirely appropriate under the rubric of risk *management* to decide that a substantial margin of safety should be built into the ultimate standard to cover errors or uncertainties in the assessment or unanticipated occurrences. The assessment phase, in contrast, should simply make the best guesses possible.[45] Critics of the Red Book's quantitative risk

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[43] For general works on risk assessment, *see* NATIONAL RESEARCH COUNCIL, RISK ASSESSMENT IN THE FEDERAL GOVERNMENT: MANAGING THE PROCESS (1983) (the "Red Book"); NATIONAL RESEARCH COUNCIL, SCIENCE AND JUDGMENT IN RISK ASSESSMENT (1994); PRESIDENTIAL/CONGRESSIONAL COMMISSION ON RISK ASSESSMENT AND MANAGEMENT, RISK ASSESSMENT AND RISK MANAGEMENT IN REGULATORY DECISION-MAKING (1997) [hereinafter PRESIDENTIAL/CONGRESSIONAL COMM'N]. EPA's guidance on applying risk assessment in the Superfund context is the multi-part U.S. EPA, RISK ASSESSMENT GUIDANCE FOR SUPERFUND: HUMAN HEALTH EVALUATION MANUAL, OSWER 9285.7-01C (Dec. 1991).

For a good introduction to risk assessment in the brownfields context, as well as a host of other brownfields issues, *see* BROWNFIELDS: A COMPREHENSIVE GUIDE, *supra* note 3.

[44] *See, e.g.*, RISK VERSUS RISK, *supra* note 41, at 260; BREYER, *supra* note 40, at 9-10; H.R. 9, 104th Cong.(1995).

[45] *See* Steven Milloy, *Forward, to* REGULATORY IMPACT ANALYSIS PROJECT, INC., CHOICES IN RISK ASSESSMENT : THE ROLE OF SCIENCE POLICY IN THE ENVIRONMENTAL RISK MANAGEMENT PROCESS, REGULATORY IMPACT ANALYSIS PROJECT, INC. i, xiii (1994) (cataloging the assumptions in risk assessment).

One could debate the allocation endlessly. EPA takes the position, and it is at least a plausible one, that uncertainties are part of the assessment process, and so it is appropriate to fill gaps there with policy-based assumptions. A similar point was raised in *Lead Industries Ass'n, Inc. v. EPA*. The association argued that the "margin of safety" language in the Clean Air Act required EPA to add one and only one margin of safety at the end of its calculations; EPA believed that it could add a margin of safety, often in the form of conservative assumptions, at each step of the assessment process. The court upheld EPA's position. Lead Indus. Ass'n v. EPA, 647 F.2d

assessment paradigm, on the other hand, have pointed out that many policy decisions are implicit in the assessment process, most of which take the form of assumptions to fill data gaps, and that they are unavoidable.[46] In the face of uncertainty, therefore, it is appropriate to build margins of safety into the assessment phase. The current state of the art, reflected in two recent blue-ribbon panel reports on risk assessment,[47] maintains the assessment-management distinction but communicates explicitly the use and choice of assumptions in the assessment phase.

Despite the assessment-management debate, to which we will return, the Red Book's structure for risk assessment has proven quite durable and is the basic model used today. Risk, for these purposes, is the product of the toxic potency of a hazardous material and the amount of exposure to it. The two variables, toxicity and exposure, control the result equally, so that a reduction or increase in either has the corresponding effect on the resulting risk. Consequently, risk reduction can be achieved *either* by reducing the toxicity of the chemical, for example by treating hazardous material to minimize its potency through chemical change or by dilution,[48] *or* by reducing exposure to the material, either by isolating it or by treating it in a way that renders it less mobile in the environment.[49] In some situations, reduction of toxicity is quite feasible, so some form of treatment will tend to have the greatest potential for risk reduction.[50] Such treatment also tends to have permanent effects, hence the CERCLA preference for treatment.[51] In other cases, exposure control will be the more or the only practicable step, for example, with elemental or other materials that cannot be

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1130 (D.C. Cir. 1980).

[46] Hornstein, *supra* note 42, at 565-575; Robert R. Kuehn, *The Environmental Justice Implications of Quantitative Risk Assessment*, 1 U. ILL. L. REV. 103, 115 (1996). *See* Adam M. Finkel, *Comparing Risks Thoughtfully*, 7 RISK: HEALTH, SAFETY & ENV'T 325, 330, 335-338 (1996).

[47] *See* NAT'L RESEARCH COUNCIL, UNDERSTANDING RISK: INFORMING DECISIONS IN A DEMOCRATIC SOCIETY (1996) [hereinafter UNDERSTANDING RISK]; PRESIDENTIAL/CONGRESSIONAL COMMISSION ON RISK ASSESSMENT AND MANAGEMENT, RISK ASSESSMENT AND RISK MANAGEMENT REGULATORY DECISION-MAKING (1997).

[48] Dilution is not a favored form of treatment of hazardous wastes. *See* EPA, Proposed Hazardous Waste Identification Rule, 57 Fed. Reg. 21450 (requiring that for "successful implementation of the land disposal restrictions . . ., dilution be prohibited as a partial or complete substitute for adequate treatment of [hazardous] wastes").

[49] *Cf.* RCRA § 3004(m) (treatment standards); CERCLA § 121(b) ("treatment to reduce toxicity, mobility").

[50] This is the position implicitly taken by the "land ban" for hazardous wastes, RCRA § 3004(d)-(g), which requires treatment of such wastes before they are placed in a disposal facility, the theory being that such materials cannot effectively be isolated forever.

[51] CERCLA § 121(b)(1); RCRA § 3004(d)-(g).

destroyed. A familiar example is asbestos in homes: the risk of removal is sufficiently high that often it is best simply to isolate it, thus eliminating the exposure side of the risk equation. While one may have reservations about the actual efficacy of either toxicity reduction techniques or exposure reduction techniques, *in principle* either is an effective and appropriate way to reduce risk.

The Red Book divided the risk assessment process (toxicity × exposure) into four steps. The first is *hazard identification*. For Superfund purposes, this involves detecting the presence of contaminants at a site and determining whether they are toxic at all. The principal issue is determining the location and volumes of the contaminants of concern, as there are few commonly found contaminants whose essential properties are unknown. The second half of the toxicity determination is *dose response*, which involves determining the potency of the identified substances. This is a major source of uncertainty in risk assessment, as definitive studies of the long-term effects of chemicals are very rare.[52] Rather, assessment of potency usually relies on extrapolations from high doses to low doses because low-dose effects would be too hard to distinguish from background incidence;[53] from animals to humans, because epidemiological studies are expensive and difficult to control;[54] and from chemical to related chemical where data are limited.[55] The potency determination also needs to distinguish among different risk receptors, as in the case of lead, where children are at a far higher risk than adults.[56]

*Exposure assessment* is the other principal factor in measuring risk, and it is the key variable in evaluating the near- and long-term risks of a specific brownfields site. Reduced exposure is the principal difference between the risks of a remediated and an unremediated site

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[52] *See* John S. Applegate, *The Perils of Unreasonable Risk: Information, Regulatory Policy, and Toxic Substances Control*, 91 COLUM. L. REV. 261, 278, 286-87 (1991).

[53] For example, as a result of epidemiology studies conducted on miners in the U.S. in the 1950s, the Atomic Energy Commission set occupational health standards for radon at 100 picoCuries per liter (pCi/l) of air. Arnold W. Reitze, Jr. and Sheryl-Lynn Carof, *The Legal Control of Indoor Air Pollution*, 25 B.C. ENVTL. AFF. L. REV. 247, 276 (1998).

[54] *See, e.g.*, Gulf S. Insulation v. Consumer Prod. Safety Comm'n, 701 F.2d 1137 (5th Cir. 1983) (criticizing use of animal study data).

[55] *E.g.*, Environmental Defense Fund v. EPA, 598 F.2d 62 (D.C. Cir. 1978) (holding that the EPA's toxicity evidence supported the prohibition of the discharge of more-chlorinated PCBs into the nation's waterways even though the dangers posed by less-chlorinated PCBs had not been conclusively ascertained).

[56] Lead Indus. Ass'n v. EPA, 647 F.2d 1130 (D.C. Cir. 1980) (upholding the EPA Administrator's determination of ambient air quality standards for lead based on protecting children from subclinical effects of lead exposure).

whenever the remedial techniques do not reduce toxicity but simply isolate (or leave) the existing contamination. The degree of exposure depends on the amount and location of contamination and the manner in which the human and ecological receptors are exposed. People are exposed to contaminated soil, surface water, and groundwater by direct contact with the skin (*e.g.*, playing in the dirt), by drinking affected water (*e.g.*, from a well), by ingesting dust (*e.g.*, on food or in the air), or by inhalation (*e.g.*, breathing in the vicinity). Inhalation, ingestion, and dermal contact have different risk consequences. Alpha radiation, for example, is not very dangerous through dermal exposure, because the skin shields against the relatively large alpha particles; however, inhalation is extremely dangerous because the lungs are unprotected from this highly energetic form of radiation. The route of exposure is critical to determining risk, and to determine this the risk assessor must trace the toxic material from source to receptor.

The pathway from source to receptor also determines the degree of exposure. To name some of the more obvious exposure pathways,[57] contaminants in the soil at an abandoned industrial site might travel into groundwater as rain or as run-off that percolates through the soil. Groundwater is consumed directly, used to wash or irrigate foods, and used for bathing and showering. Rain and run-off could carry contamination into surface waters, either directly into a nearby stream or indirectly through a drainage system. Food crops grown in contaminated soil and fish living in contaminated surface water can take up the toxic material and then be ingested by humans. Surface contaminants or buried contaminants, which have been disturbed by construction activities, can be inhaled or ingested as dust at or in the vicinity of the site. And the much-maligned notion of children eating dirt[58] is in fact a serious factor in lead absorption in urban areas. A thorough site risk assessment must therefore consider the locations and quantities of the contamination, its mobility in the environment, the

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[57] *See generally* U.S. EPA, RISK ASSESSMENT GUIDANCE FOR SUPERFUND: HUMAN HEALTH EVALUATION MANUEL, (Part D), OSWER 9285.7-01D (1998). An example of an exposure pathway is through fish which play a large role in the diet of some Native Americans. Kuehn, *supra* note 46, at 142. For a discussion on the use of religious lands by minorities, *see* CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION, SCOPING REPORT: NUCLEAR RISKS IN TRIBAL COMMUNITIES (1995). *See also*, Robert Charles Ward, *The Spirits Will Leave: Preventing the Desecration and Destruction of Native American Sacred Sites on Federal Land*, 19 ECOLOGY L.Q. 795 (1992); Rebecca Tsosie, *Tribal Environmental Policy in an Era of Self-Determination: The Role of Ethics, Economics, and Traditional Ecological Knowledge*, 21 VT. L. REV. 225 (1996).

[58] BREYER, *supra*, note 40, at 12 (illustrating the problem of regulating "the last ten percent").

environmental pathways of human exposure, the routes of internal exposure (dermal, inhalation, ingestion), and the quantities of human exposure (dose). All of these factors are subject to a high degree of uncertainty, not because they are unknowable,[59] but because of the volume of required information and the dependence on human behavior patterns.

The questions of human behavior raise the problem of most concern to brownfields. To accurately assess the residual risk, one needs to know how people (or other organisms) will use the brownfields site in order to determine whether and to what extent they will come into contact with the contaminants. Brownfields initiatives have a very specific vision of the future use of the site—*i.e.*, industrial or commercial use—and this tends to present a fairly low exposure profile. It has been argued, therefore, that as a matter of common sense there is little point to assuming greater exposures than are in fact likely, because it unnecessarily increases the cost and feasibility of remediation.[60] This argument has particular force in the brownfields context, where opportunities to reduce clean-up expenses are eagerly sought and industrial or commercial use is the intended result. By assuming an industrial rather than a residential future for the site, exposure values decrease substantially.

Another important aspect of exposure is the distribution of risk.[61] Risk never shows an even distribution throughout the population. It decreases as distance from the site increases, for obvious reasons, and it follows various patterns of contamination and routes of movement through the environment. Who is or may be in contact with the contamination? Are they neighbors? Children? Workers? How far is exposure distributed? What other risks affect the receptors? The full risk consequences of risk distribution involve both the type of hazard (*e.g.*, lead is a particular concern for children) and the contribution of other hazards to which the receptors are exposed.

Numerically, *risk characterization*, the fourth step in risk assessment, is simply dose response × exposure. Given all of the uncertainties and variations in the dose response and exposure

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[59] An exception at the "micro" level is the translation from external exposure of a person or other receptor to the internal dose. This requires a great deal of detailed knowledge of the bioavailability and metabolism of chemicals of concern, much of which either does not exist or is highly uncertain. This problem, however, is not unique to brownfields risk assessment.

[60] Douglas J. Sarno, *Future Use Considerations in the Cleanup of Federal Facilities*, HAZARDOUS MATERIALS CONTROL, May-June 1993, at 20 .

[61] Kuehn, *supra* note 46, at 140-43.

functions, however, a single point estimate is rarely an accurate reflection of the risk. Moreover, when variability or uncertainty results in a range of possible values that straddles orders of magnitude—which is by no means uncommon—there is a real question of what the results mean. The areas of certainty and uncertainty should be clearly delineated, assumptions should be disclosed, and proper metrics (*e.g.*, individual *versus* population risk) should be employed. Thus, risk characterization involves two related problems of expression: how to be accurate and meaningful to a technical audience that must decide what to do about the problem, and how to be accurate and meaningful to a lay audience that is affected by the risk being characterized and should be allowed to contribute to the decision.

Both aspects of this subject have received a great deal of recent attention, particularly in regard to communication with the general public.[62] Good risk communication with the public requires, in addition to the above features, explaining relevant terms and concepts and placing the results in context. The latter point is highly controversial, as it involves comparing disparate risks in some fashion, but it is essential to knowing how seriously a risk should be taken and how much effort and expense should be expended toward addressing it.[63] Comparisons are central to the Brownfields Bargain because the bargain is a trade-off—development for strict protectiveness—and both sides of the bargain need to be understood by decision makers and the affected population. If the idea is to benefit the nearby population, it is important that it be a benefit to them at a price they can accept.

Before leaving risk assessment, we should consider ecological risk. Human health is the most familiar and most employed subject of quantitative risk assessment, but Superfund comprehends "human health *and the environment*."[64] Environmental contamination can have devastating effects on plant and animal life and habitats (*e.g.*, wetlands). The tools for evaluating and characterizing these risks are far less developed than human health risk assessment, but they contain essentially the same elements of identifying the non-human receptors that could be harmed, evaluating the potency of the contaminants, and

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[62] The importance of good risk communication and stakeholder involvement is emphasized in UNDERSTANDING RISK, *supra* note 47, at 23, 37-72.

[63] *See generally* John S. Applegate, *Comparative Risk Assessment and Environmental Priorities Projects: A Forum, Not a Formula*, 25 N. KY. L. REV. 71, 100 (1997); Adam N. Finkel, *A Second Opinion on an Environmental Misdiagnosis: The Risky Prescriptions of Breaking the Vicious Circle*, 3 N.Y.U. ENVTL. L. J. 295, 330-331 (1995); Hornstein, *supra* note 42, at 633.

[64] 42 U.S.C. § 9621(b), (d) (emphasis added). CERCLA also provides for "natural resources damages." § 9607(a)(4)(C), (f).

measuring the routes and levels of exposure.[65] Industrial development often occurs adjacent to wetlands or bodies of water,[66] so a brownfields risk assessment that fails to make a serious effort to characterize non-human effects is seriously deficient.

## B. The Superfund Time Line

Brownfields sites are physical places, not transient activities; they cannot simply be stopped or cut back if environmental problems arise. Also, places have histories and futures, and they are located in a geographical context or setting. Both of these aspects must be considered in assessing a site's present and future risks and in decisions concerning its management. The temporal aspect of "place-ness" can be represented by the following chart showing the life cycle of a Superfund or brownfields site:[67]

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| Pre-industrial Use | Uncontrolled Past | Polluted Present | Remediation | Foreseeable Future ("End State") | Long-Term Stewardship |
|---|---|---|---|---|---|
| Background Risk/Pristine | | Baseline Risks | Transition Risks | Target or Residual Risks | Long-Term Risks |

In the chart, the Pre-Industrial Use constitutes the period before industrial activity and its associated chemical risks existed. This is presumably the risk level indicated by calls to return a site to a "pristine" condition or to a "background" level of risk. The Uncontrolled Past includes the industrial activities that led to the current contamination situation. For brownfields, the important elements of the past, however, go beyond the nature and the extent of past activities. They include, for example, the abandonment of the inner city by industry and the changing economic and demographic profiles of such areas. The Polluted Present is the current

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[65] *See generally* U.S. EPA, FRAMEWORK FOR ECOLOGICAL RISK ASSESSMENT, EPA/630/R-92/001 (Feb. 1992); U.S. EPA, ROLE OF THE ECOLOGICAL RISK ASSESSMENT IN THE BASELINE RISK ASSESSMENT, OSWER Dir. No. 2985.7-17 (Aug. 1994).

[66] *See, e.g.*, STANLEY HEDEEN, THE MILL CREEK: AN UNNATURAL HISTORY OF AN URBAN STREAM 169-75 (1994) (describing the hazardous pollution along a stream that runs through the industrial area of Cincinnati, Ohio).

[67] This is a modified version of John S. Applegate & Steven M. Wesloh, *Short Changing Short-Term Risk: A Study of Superfund Remedy Selection*, 15 YALE J. ON REG. 269, 275 fig.2 (1998).

contamination and configuration of the site, *i.e.*, the brownfield itself. This is the baseline risk posed by the site, and it is the context in which the Brownfields Bargain is proposed.[68] The Remediation Period covers the time during which the activities that are needed to clean it up to the applicable standards are performed. These transitional activities pose their own risks to workers, neighbors, and the natural environment. With brownfields, the principal concerns with remediation are duration, cost, and their effect on the attractiveness of redevelopment.

The Foreseeable Future is the target condition of the required remedial actions. In terms of risk analysis, these are the residual risks at the site. They ought to be significantly lower than the baseline risks, but they are also greater than the Pre-Industrial risks. In terms of actual human activity, this is the period whose characteristics are predicted for the purpose of establishing clean-up levels. And in terms of brownfields, this is the period in which redevelopment is to occur as the result of brownfields incentives. Thus, the Foreseeable Future is the period in which the key elements of the Brownfields Bargain, the residual risk and the economic benefits of redevelopment, are realized. Consequently, much of the discussion of brownfields risk assessment techniques focuses on this part of the life cycle.

Finally, Long-Term Stewardship reminds us that a place goes on forever. A decision to leave long-lived contaminants—metals, radionuclides, elemental contaminants, extremely stable chemicals—in place means that they must be managed, actively or passively, for an indefinite period of time.[69] Such management ("stewardship") can take many forms, from physical controls to continued monitoring to legal restrictions on land use, but it must occur in some form. Otherwise, the site will simply return to a new Uncontrolled Past that needs to be

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[68] There is a lively debate in the environmental justice literature concerning the changes in the demographics of the areas in which undesirable land uses are located. Some have argued that these facilities (usually, it should be noted, waste disposal facilities, which are different from industry in important ways) were originally sited in predominantly minority areas, while others believe that the present predominance of minorities is the result of poor people moving to cheaper (because less desirably located) housing. *See* Vicki Been, *Coming to the Nuisance or Going to the Barrios? A Longitudinal Analysis of Environmental Justice Claims*, 24 ECOLOGY L.Q. 1, 9-56 (1997); Vicki Been, *Locally Undesirable Land Uses in Minority Neighborhoods: Disproportionate Siting or Market Dynamics?*, 103 YALE L.J. 1383, 1383-1406 (1994). Both scenarios affect brownfields decisions: original unfair siting may produce a demand to remedy the earlier injustice, and the present location in a poor or minority neighborhood is the basis for proposing the Brownfields Bargain.

[69] *See* John S. Applegate & Stephen Dycus, *Institutional Controls or Emperor's Clothes? Long-Term Stewardship of the Nuclear Weapons Complex*, 28 Envtl. L. Rep. (Envtl. L. Inst.) 10631 (1998).

remediated. The long-term future is certainly the impetus behind the statutory preference for permanent remedies, for treatment, and for long-term effectiveness. It also responds to the more recently articulated idea of intergenerational equity, the powerful and well-nigh inarguable principle that we ought to visit as few of our own sins on our posterity as possible.[70] However, this time period receives little or no consideration in brownfields risk assessment, in part because exposure predictions at that range can be little more than speculation and so of limited value; in part because redevelopment in the near term is the central focus of brownfields initiatives; and in part because it is an inconvenient reminder that the lesser-protection side of the Brownfields Bargain is sure to extend into the future far longer than the economic development side can be predicted.

The time periods are interrelated parts of the life cycle of a Superfund site. The activities in each time period determine the risk profile of the subsequent periods—or in the case of discontinued stewardship, return us to an earlier point in the cycle. The risks of the polluted present determine the remedial needs. What is done and left undone in remediation determines the risk profile of the foreseeable future.[71] If long-lived contaminants are present, decisions *not* to remove such materials affect the long-term stewardship period. Nevertheless, each period also has a distinct risk profile, and each generation inherits the risks and benefits of the site from the previous generation. To the extent that redevelopment affects more than one period, those differences must be accounted for. Each time period affects different stakeholders in different ways, both positively and negatively. The risks to the neighboring population of the uncontrolled past and polluted present create the need for remedial action, the importance of an economically viable future, and the unfairness of long-term uncertainty. Intensive remediation creates short-term risks to workers and neighbors, but it should lower the long-term risks.[72] Alternatively, a decision to isolate existing contamination by placing a building or parking lot over it may reduce toxic risks for many years, but it may

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[70] NATIONAL ACADEMY OF PUBLIC ADMINISTRATION, DECIDING FOR THE FUTURE: BALANCING ROLES, COSTS, AND BENEFITS FAIRLY ACROSS GENERATIONS (1997); EDITH BROWN WEISS, IN FAIRNESS TO FUTURE GENERATIONS: INTERNATIONAL LAW, COMMON PATRIMONY, AND INTERGENERATIONAL EQUITY (1989).

[71] James T. Hamilton & W. Kip Viscusi, *Human Health Risk Assessments for Superfund*, 21 ECOLOGY L.Q. 573, 582-608 (1994). The remediation period is also implicated by any choice to limit clean-up. However, as a general matter, the less clean-up one does, the lower the remediation risk. *See also* Applegate & Wesloh, *supra* note 67.

[72] *See* Applegate & Wesloh, *supra* note 67, at 275.

simply delay from the foreseeable to the long-term future the time when the contamination leaches into the underlying groundwater. A foreseeable future with redevelopment may reduce exposure from contaminants, but may increase other forms of pollution such as air and water emissions, traffic, and noise.[73]

The distinct risk profiles are also a function of the "place-ness" of a Superfund site: the site has neighbors, and the identity of those neighbors can be important.[74] An industrial site is where it is for a reason, whether it is proximity to other industries, to natural resources, to transportation, or to employees' homes. Conversely, the neighboring sites exist where they are for a reason, such as proximity to the industry that provides them with jobs, customers, suppliers, or any number of other relationships. Accordingly, one must consider the effects of a brownfields site on its neighbors. If they are only other factories, then perhaps one would be less concerned about the risks it imposes because the receptor humans are exposed for a shorter period of time and there is no natural setting to be destroyed or repaired. But if, as the core meaning of brownfields suggests, the factory is in the middle of a poor residential neighborhood, occupied by persons who are already subjected to a number of environmental risks (a superhighway nearby, lead paint in apartments), the significance of additional risks may well be greater.

Risk assessment, in sum, is an important way to measure and characterize the risk half of the Brownfields Bargain, both before and after remediation. Risk assessment helps to understand the nature, severity, and distribution of the contamination at the existing abandoned site, and it helps us to project that understanding into the future to determine residual risks. Risk assessment is central not only to CERCLA's risk-based remedy selection analysis, but it is also an essential part of the understanding of the package of risks and benefits of brownfields redevelopment. It helps to decide, in other words, whether the Brownfields Bargain is a favorable one for the affected

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[73] Wernstedt & Hersh, *supra* note 1, at 165-67.

[74] It is odd that this should be news, since even the ancient institutions of trespass and nuisance law are based on the idea of incompatible neighbors. *Cf.* R. H. Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1, 2 (1960) (describing the reciprocal problems of incompatible uses of property). Environmental law, by contrast, has tended to look at sources of pollution or Superfund sites as individual, decontextualized entities. This has obvious advantages for administration and enforcement purposes, but it is quite unrealistic. Brownfields initiatives are one of several ways in which environmental law is broadening its horizons. Robert Bullard, a leading environmental justice scholar, emphasizes "the politics of place." BULLARD, *supra* note 10, at 25.

persons of today and of the future, and it can provide the basis for meaningful involvement of the public in these decisions. To accomplish these functions, brownfields risk assessment must not be a one-sided analysis, in which the only modifications to the traditional process are designed to show less risk. Rather, it should be an even-handed operation, in which risks are realistically calculated, and uncertainties are candidly acknowledged.

## III. RISK-REDUCING MODIFICATIONS

As we have seen, the role of risk assessment in encouraging brownfields redevelopment is to demonstrate that the present or foreseeable future risks at a particular site are such that a relatively limited remedial response is required, and such a showing would remove or ameliorate an obstacle to redevelopment. Again, the fact that the effect of these uses of, or modifications to, risk assessment reduces the calculated hazard does not, in itself, suggest that they are inappropriate or that they are misuses of risk assessment. If standard practices unnecessarily[75] overstate risk, then it is appropriate to modify them, especially if the practice stands in the way of beneficial redevelopment. But, we must also be candid about it: the purpose and effect of the modifications is the lowering of risk estimates for the purpose of limiting clean-up liability, and so the modifications should be examined with care.

### A. Beyond Unrealistic Assumptions

Coping with uncertainty and lack of sufficient data are perennial difficulties in risk assessment. Some assumptions have to do with the toxicity of substances. It is typical, for example, to assume that a carcinogen has no "threshold" concentration below which it poses no risk of causing cancer. This assumption may or may not be confirmed by existing study data, but the existing data are rarely clear in demonstrating a threshold at very low doses, so the conservative or

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[75] Conservatism or precaution in the face of uncertainty is not an unnecessary overstatement in this sense. It is unnecessary if we know better or if the conservatism is adopted because it is thought to be "costless," that is, there is nothing to be lost by choosing a highly protective value. In the brownfields context, by hypothesis, the price of unnecessary conservatism is lack of economic development. *See* Frank B. Cross, *Paradoxical Perils of the Precautionary Principle*, 53 WASH. & LEE L. REV. 851, 851-925 (1996) (criticizing the overuse of precautionary or conservative assumptions).

precautionary approach assumes that no threshold exists. Likewise, in calculating dose, assumptions are made about the conversion factor for translating the results of animal testing to humans, and, in fact, the use of animal models at all contains the underlying assumption that they are relevant to human effects. These kinds of assumptions are scientifically justified in the sense that there is an empirical or theoretical basis for them and that there is not a clear demonstration to the contrary, but it is also a policy choice to adopt, in the face of uncertainty, the conservative position.[76] It is also a policy choice to adopt multiple conservative assumptions by choosing the conservative assumption each time an area of uncertainty is encountered. The results of multiple conservatism, in the view of critics of the practice, render risk assessments worst-case estimates, which are almost by definition unlikely to be accurate.[77] On the other hand, if we really do not know what the true values are, it is entirely possible that they are all at the worst end of the spectrum.[78] Moreover, the general policy position of precaution and protectiveness is one that, in the abstract at least, Congress and the general public heartily endorse.[79]

Toxicity assumptions are used in brownfields risk assessments, of course, but exposure assumptions are far more important. Brownfields sites are places, and exposure is a particularly important variable in remediation techniques that depend on isolation rather than removal or destruction of hazardous materials. Because of the complexity and multiplicity of exposure pathways, risk assessors must make simplifying assumptions. Often these assumptions respond to uncertainties of the kind addressed in toxicity assumptions, for example, the rates of inhalation and pulmonary absorption of a particular chemical while taking a shower. Variability, though, is more

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[76] COMMITTEE ON RISK ASSESSMENT OF HAZARDOUS AIR POLLUTANTS, NATIONAL RESEARCH COUNCIL, SCIENCE AND JUDGMENT IN RISK ASSESSMENT 173-174, app. N-2 (1994). (explaining justification for conservative assumptions). For good discussions of conservatism, *see* Finkel, *supra* note 46, at 335-339; Hornstein, *supra* note 42; Red Book, *supra* note 43, at 51-85 (discussing the use of "inference guidelines"). For discussion of the reasons for adopting worst-case or upper-bound estimates, *see* Talbot Page, *A Generic View of Toxic Chemicals and Similar Risks*, 7 ECOLOGY. L.Q., 207, 224-225 (1978).

[77] *See, e.g.*, David E. Burmaster & Robert H. Harris, *The Magnitude of Compounding Conservatisms in Superfund Risk Assessments*, 13 RISK ANALYSIS 131 (1993) (criticizing risk assessment as "simplistic policy assumptions" that result in even more conservative risk assessments).

[78] Adam M. Finkel, *Is Risk Assessment Really Too Conservative?: Revising the Revisionists*, 14 COLUM. J. ENVTL. L. 427 (1989); Adam M. Finkel, *A Return to Alchemy*, Envtl. Forum [Envtl. L. Inst.], 15-19 (1996).

[79] *See* Cross, *supra* note 75, at 851.

typical of exposure unknowns. We can test the rate of dermal absorption of a chemical with some degree of accuracy, but it may turn out that it differs significantly among individuals or groups of individuals. Similarly, we can agree that children ingest soil at playgrounds or that adults drink water from a groundwater source, but there will be considerable variation in the amount of soil ingested or water consumed based on the particular habits of each person. The people themselves vary in size and susceptibility. Such variation applies to groups, as well. For example, some segments of the population eat much more fish than others, and so they are exposed to much higher amounts of toxic chemicals in sediments and surface waters.

The standard practice in the face of variability is to choose the conservative or precautionary position, that is, like the toxicity assumptions, exposure assumptions choose to err (if at all) on the side of safety by assuming a relatively high degree of exposure to hazardous substances. Thus, given a range of possible exposure values, the assessor may choose a point estimate that would protect at least 95 or 99 percent of the population. This is often expressed as the maximally exposed individual (MEI), someone whose characteristics are designed to assure that almost no one could be more exposed in the real world. The MEI's relevant characteristics include assumptions such as an occupational or residential use of the site that maximizes contact with the contamination (farming usually tops the list), behavior patterns (occasionally bizarre[80]) that have the same effect, and a lifetime spent at the site or its fence line. To the extent that such hypothetical individuals do not reflect the likely exposure patterns in the foreseeable and long-term futures, such assumptions have been regularly challenged as unsuitable to the "just the facts" approach to risk assessment.

This is the heart of the criticism of conservative assumptions: they are deliberately counterfactual and clearly exaggerate the extent of the risk. They represent the worst, rather than the expected, case.[81]

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[80] *See, e.g.*, Applegate, *supra* note 42, at 1654 (describing the "naked dirt-eating farmer"); BREYER, *supra* note 40, at 12 (children eating dirt in the median strip of an interstate highway).

[81] Karlin, *supra* note 33, at 47-49; HAZARDOUS WASTE CLEANUP PROJECT, EXAGGERATING RISK: HOW EPA'S RISK ASSESSMENTS DISTORT THE FACTS AT SUPERFUND SITES THROUGHOUT THE UNITED STATES (1993) (recommendations for CERCLA reform by an industry group).

This is also a strength, of course. As long as the assumptions and exaggerations are clearly set out, the user of the risk assessment knows that it represents a worst case or upper bound estimate and can weigh the data accordingly. *See* Vincent James Cogliano, *Plausible Upper*

Deliberate inaccuracy does seem a poor basis for policymaking, even though protectiveness is clearly a legitimate motivation. Inaccuracy can also lead to management decisions that are unnecessarily expensive, which is particularly problematic when dealing with finite resources. The effect is exacerbated when the conservative assumption is responsible for cleaning up the "last 10%," the most expensive increment of contamination.[82] From a brownfields perspective, this is a particularly unfortunate consequence of conservatism because it makes potential clean-up liability that much more daunting a prospect for potential developers. It also constrains the risk management decision—whether economic development justifies a lesser level of environmental protection—by attaching risk assessment values to the site that make it very difficult to justify taking any but the most stringent measures. Consequently, brownfields proponents advocate the use of "best estimates" or average values in making assumptions, the effect of which would be to lower risk estimates and to reduce potential clean-up liability. These proposals are usually made in general terms, applicable to all risk assessments,[83] rather than specifically to brownfields. But the benefits to brownfields redevelopment are manifest. Indeed, brownfields proponents and risk assessment reformers tend to overlap, and brownfields are a frequent justification for these general risk assessment reforms.

B. Variability and Risk Ranges

Another response to unduly conservative assumptions in risk assessments is to abandon the practice of using point estimates (*i.e.*, a single value) in favor of ranges of estimates. While toxicity assumptions tend to stem from true uncertainties, exposure estimates tend to yield a range of possible values. Dependent as it is on exposure assessment, therefore, brownfields risk assessment presents a strong case for adopting ways of characterizing the spectrum of possible risk values spectrums that are better than simply choosing a high-end or upper-bound value.

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*Bounds: Are Their Sums Plausible*?, 17 RISK ANALYSIS 77 (1997).

[82] *See* BREYER, *supra* note 40, at 12 (citing United States v. Ottati & Goss, Inc., 900 F.2d 429 (1st Cir. 1990), in which a private party litigated to remove a small amount of highly diluted PCBs and organic compounds at an expenditure of nearly $9.3 million dollars).

[83] As part of the Republican "Contract With America," Title III of H.R. 9, discusses risk assessment. H.R. 9 , 104th Cong. (1995); Senate Bill 333 is limited in scope to risk assessment and the environmental restoration activities of the Department of Energy. S. 333, 104th Cong. (1995).

One way to do this is simply to express risk in terms of ranges rather than particular points. The ranges can be astonishingly broad, covering multiple orders of magnitude.[84] As a general proposition, it seems unexceptionable to urge that, if the fullest expression of the actual risk is that it is a range of risks, a range rather than a point should be conveyed. Decision makers and the public ought not, in theory at least, to make important decisions thinking that the risk is one thing when it might be much higher or lower. From the brownfields perspective, the specific benefit of presenting a risk range is that it moderates the impact of worst-case risk estimates. While a range discloses the upper-bound risk potential, it allows the redeveloper to argue that the risk may be much lower and at a level that is outweighed by the benefits of economic development. These arguments mirror the discussions that surrounded the 1986 revisions of the regulations of the Council on Environmental Quality concerning the use of worst-case scenarios in environmental impact statement regulations.[85] It is appealing to those whose primary concern is risk reduction to characterize the debate in terms of the highest possible risk, just as it is appealing to proponents of redevelopment to minimize risks. However, as was the case with conservative assumptions, the practice of managing the relevant information to suggest a particular outcome tends to replace the real trade-off between environmental and economic values with apparently dispositive data. If the information is not, in fact, so definitive, no good reason exists to impose *sub rosa* a policy judgment through data presentation.

The disadvantage of risk ranges is that they may also convey *less* than is known and thus leave the decision maker or public without useful guidance. While it may be quite accurate to state that the range of possible values covers two or more orders of magnitude, what is one to do with that information? It is a more accurate reflection of a complex and uncertain reality, but it also makes *any* decision more

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[84] The difference among the results of different models of dose-response for the familiar Superfund chemical trichlorethylene (TCE) was memorably described as "not knowing whether [you] have enough money to buy a cup of coffee or pay off the national debt." C. Richard Cothern et. al, *Estimating Risk to Human Health*, 20 ENVTL. SCI. & TECH. 111, 115 (1986).

[85] 51 Fed. Reg. 15618, 15620-24 (1986) (final rule); 50 Fed. Reg. 32234-36 (1985) (proposed rule); Valerie M. Fogleman, *Worst Case Analysis: A Continued Requirement Under the National Environmental Policy Act?*, 13 COLUM. J. ENVTL. L. 53, 58 (1987); Charles F. Weiss, Note, *Federal Agency Treatment of Uncertainty In Environmental Impact Statements Under the CEQ's Amended NEPA Regulation § 1502.22: Worst Case Analysis or Risk Threshold?*, 86 MICH. L. REV. 777 (1988); Robertson v. Methow Valley Citizen's Council, 490 U.S. 332 (1989) (affirming CEQ's rejection of worst case analysis).

difficult to reach and to justify. A further refinement of risk ranges, therefore, seeks to assign probabilities to each part of the range. This can be accomplished through a statistical technique called Monte Carlo analysis.[86] The known variation in the different components of the risk calculation are combined repeatedly in random combinations to get a sense of the most likely final values. The output is a distribution curve showing the relative likelihood of each of a range of values. This helps to determine where in the range of possible values the actual exposure is most likely to lie (or where the 5th, 95th, or 99th percentile lies), but it does not state that it must lie there. Moreover, a distribution can reveal the differences among exposures and risks to highly exposed or highly susceptible populations. This provides more usable information than a single point (whether it is an upper bound or a median point) or an undifferentiated range. Several states permit the use of Monte Carlo analysis in voluntary clean-up programs, and EPA is still in the process of developing a firm policy on the use of ranges of values and Monte Carlo analysis.[87] In principle, there is nothing intrinsically "low" about Monte Carlo analysis; as with other proposed modifications to risk assessment, Monte Carlo analysis is arguably more accurate. But in application it is advocated as a way to temper upper-bound point estimates. Like risk ranges, it supports the argument that mere risk *potential* should not drive the degree of remediation nor determine the terms of the Brownfields Bargain.

C. Future Land Use in Remedy Selection

Remedy selection under CERCLA is determined by reference to the level of residual risk after clean-up activities are complete. Since exposure is an essential element of any risk calculation, this requires the risk assessor to make certain assumptions concerning the activities at the site giving rise to exposure to any remaining hazardous material. Typically, EPA assumes a relatively intensive use of the site, which would be expected to result in a high degree of exposure to any remaining contaminants.[88] As with other assumptions, the purpose of

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[86] For an accessible discussion of Monte Carlo analysis, *see* Susan R. Poulter, *Monte Carlo Simulation in Environmental Risk Assessment—Science, Policy & Legal Issues*, 9 RISK: HEALTH, SAFETY & ENV'T 7 (1998).

[87] U.S. EPA, GUIDING PRINCIPLES FOR MONTE CARLO ANALYSIS 3 (March 1997) EPA/630/R-97/001. *See also* Poulter, *supra* note 86, at 17-19.

[88] GENERAL ACCOUNTING OFFICE, GAO/RCED-94-144, NUCLEAR CLEANUP: COMPLETION OF STANDARDS AND EFFECTIVENESS OF LAND USE PLANNING ARE UNCERTAIN 13-14 (1994) (quoting Congressional testimony of EPA Deputy Administrator).

this conservative choice is to assure that actual exposures will be less and that the public will be better protected. However, the risk assessor could instead assume less exposure-intensive future uses in order to lower the calculated residual risk level. Thus, a major innovation in risk assessment, of importance to brownfields, is the increasing reliance on limited future uses of the site to justify a less intensive type and degree of clean-up than would otherwise be required.[89]

In order of increasingly likely exposure, the different future use categories[90] may be summarized as follows: restricted access (trespassers only), undeveloped green space, developed park, commercial/industrial, and residential/agricultural.[91] Agricultural use of a site involves exposure to the farmer through direct dermal contact with the soil and groundwater (through drinking or irrigating), extended opportunities to inhale contaminated dust or volatilized chemicals, and occasional ingestion either directly or through consumption of dusty food. Residential use has a roughly similar profile because children play in their backyards and adults often garden or do repairs. Industrial or commercial use involves far less potential contact, if only because the concrete slab of a building and the asphalt of a parking lot insulate people from most forms of the contamination. The isolation is not perfect (there are grounds to be mowed and excavations to be undertaken, and groundwater can still be tapped), but it effectively cuts off several routes of exposure. Recreational uses of greenspace involve even less exposure, if only in terms of duration; people (other than parks department employees) spend far less time at recreational sites than at work or home. Even within the recreational category, a hiking trail would involve far less contact with the soil than a baseball diamond. Finally, a highly restricted land use, in which only trespassers or occasional monitors would visit the site, would yield a very low exposure profile, though at the price of permanently underutilized land.

In practice, the great divide in exposure values (and hence risk) falls between commercial or industrial exposures and residential or

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[89] Arguably, consideration of the future use and existing exposure scenarios (as in RBCA and TACO, discussed below) provides greater certainty, and certainly-regardless of the actual requirements-also encourages in redevelopment. Buzbee, *supra* note 1, at 39-41.

[90] Future use for the purposes of calculating risk and remedy selection is not the same as land use planning. Traditional land use planning can be very specific, and it often distinguishes among types of activities within a given category, such as different types of industry. Likewise, while industrial and commercial uses have similar risk exposure profiles, they have entirely different characteristics for the purposes of zoning.

[91] *See* John S. Applegate & Douglas J. Sarno, *FUTURESITE: An Environmental Remediation Game-Simulation*, 28 SIMULATION & GAMING 13 (1997).

agricultural ones, mostly as a result of differences in duration and intensity of contact with soil and groundwater. In the context of Superfund generally, the decision to assess residual risks at the residential level means that more remedial activity will be required to meet the risk-based clean-up standards. The impetus for considering particular future uses was the insight that, although Superfund risk assessments typically assume an intensive use of the property, like farming or residence, to achieve a clean-up that is appropriate for all eventualities, many Superfund sites are industrial areas that have no apparent prospect of use other than industrial or commercial.[92] Since limited uses of that kind limit exposure to contaminated media without the need for extensive remediation, clean-up activities can be *pro tanto* limited. Clean-up to make an industrial site safe for farming, the thinking goes, is clean-up for its own sake. It is a waste of resources, and, in the brownfields context, it unnecessarily discourages redevelopment. Instead, the exposure component of residual risk should be calculated according to the foreseeable future use of the site. EPA currently considers future land use in remedy selection under certain conditions.[93] Many states permit this practice in voluntary clean-up legislation,[94] and consideration of future land use is also a feature of proposed CERCLA reauthorization legislation.[95]

The consideration of future use is integral to brownfields redevelopment for two reasons. First, the whole idea of brownfields redevelopment is predicated on a specific vision of the future use of the property. "Redevelopment," after all, means restoring the presumed future use of the site to an industrial or commercial use.[96] Second, that specific vision of the future use also happens to be a less intensive future use—industrial as opposed to residential—which results in less expected exposure, creating a lower residual risk profile. The lower

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[92] *See* Sarno, *supra* note 60; CLEAN SITES, IMPROVING REMEDY SELECTION: AN EXPLICIT AND INTERACTIVE PROCESS FOR THE SUPERFUND PROGRAM (1990). ROBERT HERSH ET AL., LINKING LAND USE AND SUPERFUND CLEANUPS: UNCHARTERED TERRITORY (RESOURCES FOR THE FUTURE 1996); U.S. DEP'T OF ENERGY, BASELINE ENVIRONMENTAL MANAGEMENT REPORT (BEMR) AT 6-1 to 6-13 (1996) [hereinafter U.S. DOE 1996 BEMR]; U.S. DEP'T OF ENERGY, CHARTING THE COURSE: THE FUTURE USE REPORT (1996) [hereinafter CHARTING THE COURSE].

[93] U.S. EPA, LAND USE IN THE CERCLA REMEDY SELECTION PROCESS, OSWER 9355.7-04 (May 25, 1995), summarized at 60 Fed. Reg. 29595 (1995).

[94] *See generally* BROWNFIELDS: A COMPREHENSIVE GUIDE, *supra* note 3; Schnapf, *supra* note 5, at 2488.

[95] S. 8, 105th Cong. (1998); H.R. 3000, 105th Cong. (1997).

[96] Redevelopment *should* include residential development, but industrial and commercial use provides a larger tax base and it permits less remediation, making it a much more attractive response to brownfields.

risk profile allows the remedy to utilize less intensive measures and to leave more contamination in place, which is less expensive, which means less potential liability, and which reduces an obstacle to brownfields redevelopment.[97] Thus, consideration of the foreseeable future use of the site in the risk assessment process fits hand-in-glove with brownfields redevelopment initiatives, as it captures the essential goal of redevelopment and provides a less hostile environment in which to accomplish it.

D. Rebecca and Taco

Risk-based corrective action—RBCA (pronounced "Rebecca"), for short—replaces generic clean-up standards with a particularized evaluation of the risks posed by a specific site. RBCA receives its name from the corrective action program of RCRA, which for present purposes is the cognate of the Superfund program for hazardous waste treatment, storage, and disposal facilities and underground storage tanks.[98] In both clean-up programs, one of the principal legal obstacles to future-use-based remediation targets is the necessity of complying with the applicable hazardous waste treatment and disposal standards under RCRA, which apply directly to corrective actions and as ARARs to CERCLA projects. Since the RCRA requirements are based on general technical feasibility and are rarely tailored to the site-specific situation, they do not take limited future exposures into account. Many complain bitterly about this stringency.[99] Such requirements are incompatible with the special trade-off situation of the Brownfields Bargain, and to the extent that the generic standards are conservative or precautionary, they unnecessarily burden the remediation of sites that pose relatively modest hazards. Unlike traditional approaches to corrective action that focus on reducing contamination levels below prescribed numerical standards, the RBCA approach concentrates on a site's present and potential risks and seeks to reduce risk to an "acceptable" level of contamination after cleanup based, on expected

[97] Like a proximate cause problem on a Torts examination, the causal chain from future use assumptions to redevelopment is lengthy, but it is direct and foreseeable. Therefore, the adoption of the future use assumption can reasonably be expected to encourage redevelopment, though the magnitude of the effect surely diminishes with each remove.

[98] 42 U.S.C. §§ 6928(h), 6924(v), 6991(b) (1994).

[99] *See* Temkin, *supra* note 33, at 18.

future land use and exposure pathways.[100] The result, in theory, should be more realistic clean-up goals.[101]

Like future use generally, RBCA seems tailor-made for brownfields. It moderates the clean-up demands of RCRA and CERCLA, and it creates a further incentive for commercial or industrial redevelopment of the site. In both cases, risk assessment is central to the process. Detailed risk analysis, and in particular exposure assessment,[102] is the technique that not only replaces a generic approach but also permits the flexibility that the Brownfields Bargain depends upon. This point could not be clearer in the following table of costs of remedial actions provided by a RBCA advocate:[103]

| Site | Original Remedial Cost Estimate | Remedial Cost after RBCA |
|---|---|---|
| Pesticide Formulator | $40,000,000 | $0[104] |
| Solvent Recovery | $2,000,000 | $0 |
| Wood Treatment | $1,000,000 | $0 |
| Fuel Oil Storage | $600,000 | $100,000 |
| Refinery | $2,000,000 | $500,000 |

Clearly, for brownfields purposes, this reduction in potential liability is central to encouraging redevelopment.

One drawback of RBCA is the relatively large expense involved in performing a detailed, site-specific, risk-based analysis instead of a generic one, because risk assessment is not cheap.[105] Enter the so-called Tiered Approach to Corrective Action Objectives (TACO, pronounced

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[100] Gerald W. Phillips, *Rethinking Restoration: Risk Based Corrective Action and the Future of Economic Regulation*, 16 N. ILL. U. L. REV. 659, 665 (1996).

[101] For thorough and enthusiastic discussions of RBCA, *see* James R. Rocco & Lesley Hay Wilson, *The Risk-Based Corrective-Action Process*, *in* BROWNFIELDS: A COMPREHENSIVE GUIDE, *supra* note 3, at 250-67; James P. O'Brien, *The Tiered Approach to Corrective Action Objectives and the Site Remediation Program in Illinois*, 27 Envtl. L. Rep. (Envtl. L. Inst.) 10611 (1997); Michael L. Gargas & Thomas F. Long, *The Role of Risk Assessment in Redeveloping Brownfields Sites*, *in* BROWNFIELDS: A COMPREHENSIVE GUIDE, *supra* note 3, at 214-249. *See also* Phillips, *supra* note 100; Joseph J. Saga, *Risk-Based Cleanup of Contaminated Property*, 58 J. ENVTL. HEALTH 18 (1996); Charan J. Johl et al., *Metals-Laden Soils: Put Risk-Based Remediation to Work*, 1 ENVTL. ENGINEERING WORLD 20 (1995).

[102] *See* Rocco & Wilson, *supra* note 101, at 261-65.

[103] Gargas & Long, *supra* note 101, at 227 tbl.2.

[104] The zero represents the adoption of a "no-action" alternative for clean-up. *Id.*

[105] *Id.* at 225-26 (asserting that the "greater initial cost [of performing a risk assessment] is more than offset by the cost savings in time and money required to gain a release from future regulatory action").

"taco"). In this approach, increasingly detailed levels of risk assessment are undertaken when the more generic assumptions are thought to overstate actual or expected site conditions. In other words, if generic assumptions demonstrate little or no need to undertake remedial activities, then the redeveloper would use them. If, however, they do not demonstrate little or no need to undertake remedial activities and a more detailed analysis would ameliorate the generic requirements, then the further analysis should be undertaken.[106] Proponents of TACO have identified a number of tiers of analysis. Tier 1 analysis involves the implementation of generic cleanup objectives based on conservative risk assessment assumptions. Tier 2 requires site-specific cleanup objectives derived from published formulae and data pertaining to the particular site. If neither tier 1 nor tier 2 is appropriate to site conditions, then tier 3 analysis, which requires that all the formulae and data be taken from site-specific information and that only the "most likely" exposure scenarios be analyzed, can be used to determine "appropriate and cost-effective remedies."[107]

The purpose of TACO is the familiar one of achieving a more accurate or precise estimate of the initial or residual risks associated with a site. The effect is familiar, as well: to avoid less costly clean-up. TACO takes a step closer than RBCA, future use, and adjusted assumptions to the unabashed manipulation of data to achieve a desired conclusion, because its implementation is tied directly to the redeveloper's satisfaction with the results of the risk analysis and not to a more apparently objective criterion like actually expected future use. As Robert Kuehn has observed, in a slightly different context: "The message could not be clearer—why invest in pollution prevention and long-term environmentally sustainable technologies when one can simply develop lower risk assessment numbers."[108] On the other hand, TACO can also be viewed as a straightforward application of value-of-information principles, which caution against the use of analytical techniques whose cost outweighs the marginal utility of the additional knowledge thereby obtained.[109] Attempting precision in risk assessment

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[106] A similar tiered system is in place for the decommissioning of civilian nuclear facilities. Depending on the ability to achieve certain residual levels of public exposure to radioactivity, the site is designated for either unrestricted or restricted future uses. 10 C.F.R.§§ 20.1402-20.1403 (1998). However, where such levels are unachievable, the applicant may adopt an "alternative" level of exposure if specified conditions are met. 10 C.F.R. § 20.1404 (1998).

[107] O'Brien, *supra* note 101, at 10612-14; Rocco & Wilson, *supra* note 101, at 257.

[108] Kuehn, *supra* note 46, at 168.

[109] *See* HOWARD RAIFFA, DECISION ANALYSIS: INTRODUCTORY LECTURES ON CHOICES UNDER UNCERTAINTY (1968); *see also* Applegate, *supra* note 42, at 1648-49.

is of little value if it will make little difference to the regulatory outcome; conversely, seeking precision makes sense if it will save money in the long run. In the latter event, TACO appropriately serves the goals of brownfields redevelopment.

E. Risk Comparisons

Proposed risk reform legislation would require EPA to include in its analysis of proposed rules a comparison of the assessed risks of the activity with "other reasonably comparable risks familiar to and routinely encountered by the general public."[110] The purpose of such comparisons is to place the cancer risks of toxic chemicals in perspective by relating them to activities like driving, swimming, waking up in the morning, and so on.[111] Numerous commentators have advocated risk comparison as an antidote to what they perceive as irrational fears of trivial hazards.[112] For brownfields purposes, risk comparisons are often used to minimize the significance of the baseline and residual risks at a site, from which the public or decision maker is to infer that less intensive remedial action is needed. One description of risk assessment, in the brownfields context, begins with a chart of risks of death from such diverse sources as heart disease, murder, electrocution, tornados, and meteors.[113] Unfortunately, much of the comparative data is of questionable accuracy, rendering the "context" created thereby unreliable.[114] More fundamentally, many of these comparisons are simply tendentious. The risks have nothing to do with each other, they arise from different sources, and they are characterized by wildy different levels of voluntary acceptance, familiarity,

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[110] S. 981, as amended by S. Amdt. 1644 (Feb. 4, 1998) § 624(g). Remediation projects are not "rules" within the meaning of the statute, but the requirement for comparisons could be expanded to include them.

[111] BREYER, *supra* note 40, at 34. *See generally* RISK VERSUS RISK, *supra* note 41.

[112] *See* Cross, *supra* note 75, at 900-906; RISK VERSUS RISK, *supra* note 41, at 16-17; W. Kip Viscusi, *Risk-Risk Analysis*, 8 J. RISK & UNCERTAINTY 5, 12-13 (1994); W. KIP VISCUSI, FATAL TRADE-OFFS: PUBLIC AND PRIVATE RESPONSIBILITIES FOR RISK (1992); BREYER, *supra* note 40.

[113] Gargas and Long, *supra* note 101, at 215 tbl.1.

[114] *See* Gerrard, *supra* note 12, at 727-28 (criticizing the adequacy of data underlying a frequently relied upon table of comparative risks). A similar inquiry into a similar table of comparative regulatory costs resulted in a similar finding that the underlying data were similarly deficient. *See* Lisa Heinzerling, *Regulatory Costs of Mythic Proportions*, 107 YALE L.J. 1981 (1998).

controllability, and associated benefits, all of which are highly relevant to understanding and managing risk.[115]

Some comparisons are useful, however. As noted above in connection with the Superfund life cycle, the actual remediation activities at a site impose their own risks, some of which are quite high relative to the underlying toxic risks of the site. In particular, remediation risks center on the site itself and its immediate surroundings—a consequence of the "place-ness" of a Superfund site. The greater the remediation effort, the greater the remediation risks to the site's neighbors from, for example, transportation and contaminated dust.[116] Therefore, regardless of redevelopment plans, clean-up decisions should take into account the harms of the remedy itself. While it is impossible to devise a simple formula for such a comparison,[117] it is certainly a legitimate consideration in determining the type and extent of the remedy. To the extent that such comparisons would tend in practice to limit rather than expand remediation requirements, they may be attractive to brownfields developers.

A less modest use of risk comparison would consider the risk-reducing effects of redevelopment. First, a redeveloped area (at least in the core sense of brownfields redevelopment, discussed at the outset) would presumably be a "nicer" area because it is less blighted with abandoned buildings and uncontrolled contamination. The residents would have more money as the result of direct employment in the redevelopment effort or indirectly from renewed economic activity in the area. Infrastructure could be restored, more new businesses would enter the local market, and gainfully employed persons would come to dominate the tone of the place—the litany of benefits of revitalization is familiar. This transformation should reduce the risks to the persons in the area by reducing the risk of being injured by crime. Crime is, of course, a mortality risk, and the reduction of this risk would be a genuine improvement in quality of life. Revitalization would also

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[115] *See* Richard H. Pildes & Cass R. Sunstein, *Reinventing the Regulatory State*, 62 U. CHI. L. REV. 1, 43-66 (1995); Hornstein, *supra* note 42, at 584-616; Clayton P. Gillette & James E. Krier, *Risk, Courts, and Agencies*, 138 U. PA. L. REV. 1027, 1070-85 (1990).

[116] Applegate & Wesloh, *supra* note 67, at 319-23; *see also* U.S. DOE 1996 BEMR, *supra* note 95, at 6-13 (discussing Oak Ridge Reservation).

[117] This is in part because the risk data are rarely that precise (as we have seen), and in part because there are many other factors at work that make a direct comparison of short-term clean-up risk and long-term public risk a treacherous business. *See* Applegate & Wesloh, *supra* note 67.

reduce "urban ecological" risks[118] by analogy to the natural ecological risks discussed above. To be sure, aspects of community life like feeling secure, neighborliness, and attractiveness of surroundings are, like their natural counterparts, difficult to quantify, but they contribute strongly to the improvements that would occur as a neighborhood became "nicer" in much the way that clean-up makes a natural environment more desirable.

Second, wealth can reduce many risks to human health. Poverty is very risky because of poor living conditions, poor nutrition, poor access to medical care, and the severe stresses of having no economic security.[119] Some scholars have tried to quantify the components and overall effect of this otherwise fairly obvious point. Some have even calculated mortality effects of loss of income from the cost of the Superfund program.[120] The number of assumptions and generalizations that underlie such precise conclusions are truly heroic, but the underlying point is undoubtedly valid that, all other things being equal, significantly improving people's economic status will enable them to reduce numerous risks to their lives and health.

The reasoning behind the redevelopment-as-risk-reduction argument, then, is that redevelopment improves the risk profile of those who are benefitted by it; therefore, the Brownfields Bargain is likely to be a good deal for them even if less environmental protection is required. This reasoning, obviously, compares very different kinds of risks (crime *versus* chemicals), and it may only restate the truism that it is beneficial to have more money. Nevertheless, this argument directly responds to the concern that all of the other risk assessment modifications that the Article has discussed have the effect of allowing higher residual risks than would otherwise be permitted. It replies that, even if the Brownfields Bargain means a higher residual risk,

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[118] *Cf.* Hanly v. Mitchell, 460 F.2d 640 (2d Cir. 1972) (holding that the aesthetic and quality-of-life aspects of a neighborhood are environmental impacts within the meaning of NEPA); CALIFORNIA COMPARATIVE RISK PROJECT, CALIFORNIA EPA, TOWARD THE 21ST CENTURY: PLANNING FOR THE PROTECTION OF CALIFORNIA'S ENVIRONMENT (May 1994) (incorporating quality of life concerns in its ranking of risks).

[119] *See* Jonathan Bender, *Societal Risk Reduction: Promises and Pitfalls*, 3 N.Y.U. ENVTL. L.J. 255, 278-283 (1995); Frank B. Cross, *When Environmental Regulations Kill: the Role of Health/Health Analysis*, 22 ECOLOGY L.Q. 729, 730-40 (1995). These risks, of course, overlap to some degree with the risks of crime, discussed above.

[120] Viscusi, *supra* note 112, at 12-13. Viscusi and Zeckhauser assert that all risk regulation has this risk-creating effect, since in his view all risk regulation decreases social wealth by the costs of its implementation. W. Kip Viscusi & Richard J. Zeckhauser, *The Fatality and Injury Costs of Expenditures*, 8 J. RISK & UNCERTAINTY 19, 19, 21, 36-39 (1994).

redevelopment is still a net reduction in risk because of the risk-reducing effects of increased wealth and more attractive surroundings.

## IV. NEW APPLICATIONS OF RISK ASSESSMENT

While brownfields proponents often look to risk assessment for relief from environmental burdens on redevelopment that they regard as unnecessary, risk assessment, like all procedures, is and should be a double-edged sword. In Part III, we examined a number of aspects of the risk assessment process that tend to support redevelopment by reducing the calculated risks. In this part, we examine a number of ways in which risk assessment can be used to better reveal the true terms of the Brownfields Bargain. In some cases, these aspects of risk assessment tend to suggest greater risks, and in others they highlight uncertainties in the predictions that underlie the risk calculations.

### A. Cumulative Exposures

That a brownfields site is a place has, as we have seen, several consequences for the exposure elements of its risk profile. There are also important toxicity consequences. Unlike a particular industrial process or point source of pollution, an industrial site is likely to pose multiple toxic threats.[121] Currently, toxicology does not understand with any certainty the cumulative effects of multiple toxic exposures.[122] The effects may be additive, synergistic (*i.e.*, having a combined effect greater than the added effect of both), or even antagonistic (in effect canceling out each other). While synergy is seen in some settings, for example the combined effect of asbestos exposure and cigarette smoking being five times greater than either alone,[123] addition of risks is the normal assumption, but only because there is usually little basis for adopting any particular alternative.[124] The result is that a

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[121] The air and water emissions of a factory taken as a whole can be quite numerous. Indeed, one of the principal objections to the "bubble" concept in controlling air pollution is the difficulty of evaluating the cumulative effects of such sources. *See* Chevron, U.S.A., Inc. v. Natural Resources Defense Council, 467 U.S. 837, 847-848 (1984) (describing environmentalists' objections). Congress explicitly approved such an approach, however, in the 1990 Clean Air Act Amendments. 42 U.S.C. § 7412 (a)(1-4) (1994).

[122] Kuehn, *supra* note 46, at 121.

[123] AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY, CASE STUDIES IN ENVIRONMENTAL MEDICINE: ASBESTOS TOXICITY 4 (1990).

[124] Susan R. Poulter, *Science and Toxic Torts: Is There a Rational Solution to the Problem of Causation?* 7 HIGH. TECH. L. J. 189, 233 (1992); Scott C. Whitney, *Superfund Reform: Clarification of Cleanup Standards to Rationalize the Remedy Selection Process*, 20 COLUM. J.

brownfields site presents a suite of environmental insults to its risk receptors, and the effects of that combination are poorly defined.

As a place, a brownfields site has neighbors. Since the typical brownfields area is a formerly industrial area that shows promise for redevelopment, its neighbors often include other industrial sites that pose similar contamination and pollution problems. For residential neighbors, this possibility raises the spectre of multiple threats to their health. Toxic pollution control legislation is only now beginning to come to grips with the problem of cumulative impacts on particular populations,[125] and EPA recently published guidance on cumulative risk assessment.[126] The guidance itself, and the growing interest in cumulative exposures, are in a large part responses to the environmental justice concerns of highly impacted communities.[127] From this perspective, indeed, brownfields neighbors may be seen as extra-sensitive risk receptors, in the sense that they are exposed to numerous sources of environmental risk from industrial and transportation sources.[128] In radiological health terms, they already have a high body burden of toxic risk, so the cumulative effects are likely to be quite high. There is, accordingly, an urgent need to understand better the combined impact of many sources of environmental risk, one of which is the site to be redeveloped, in assessing brownfields risks.

B. The Perils of Prediction

While uncertainty inheres in many aspects of our understanding of the current risk picture, it is inevitably more pronounced when we attempt to extrapolate into the future, especially the more distant future. The characterization of future exposures, which is central to all exposure assumptions and analyses for brownfields redevelopment, is necessarily an exercise in prediction, and predictions can be faulty on two counts: expectations and control.

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ENVTL. L. 183, 219 (1995).

[125] *See* 33 U.S.C. § 1314 (a)(I)(1994) ("toxic hot spots" under the Clean Water Act); 42 U.S.C. § 7412 (f)(1)(C)(1994) (cumulative effects under the Clean Air Act).

[126] U.S. EPA, SCIENCE POLICY COUNCIL, GUIDANCE ON CUMULATIVE RISK ASSESSMENT. PART 1. PLANNING AND SCOPING (1997).

[127] Kuehn, *supra* note 46, at 106; Ferris, *supra* note 13. *Cf.* Exec. Order No. 12,898, 3 C.F.R. 859 (1995), *reprinted in* 42 U.S.C. § 4321 (1994) ("Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations").

[128] Kuehn, *supra* note 46, at 118-124; *see also* Alfred C. Aman, Jr., *The Earth as Eggshell Victim: A Global Perspective on Domestic Regulation*, 102 YALE L.J. 2107 (1993).

Expectations of what will in fact occur at some point in the future can be flawed. Local and regional planning boards regularly make general predictions of land uses in the near-term future for a variety of purposes, and they are clearly not infallible. Yet, brownfields redevelopment depends on accurately forecasting a specific use (industrial or commercial) for a specific site. The actual realization of such predictions can be encouraged, of course, with incentives like lowering taxes or relaxing clean-up requirements. Even so, predictions are hardly guarantees, because much more than financial and environmental incentives goes into industrial and commercial siting decisions. Therefore, a brownfields risk assessment must disclose to decision makers and to the public the basis for and the weaknesses in its assumption of an industrial or commercial future, as it should with other assumptions and extrapolations.[129]

In addition to incentives, more aggressive measures can be designed to encourage desired uses or to discourage undesirable ones. If the risk assessment underlying a brownfields project assumes that the site will not be used for residential purposes or that the existing contamination will remain isolated from the general public, the only way to have any real confidence that this future will come to pass is for "institutional controls" to be imposed. Institutional controls are active efforts to isolate residual contamination or to mandate or prohibit certain future uses. Legal controls include public ownership, notification, deed restrictions, zoning, and other land use controls.[130] Physical controls include permanent structures, barriers, and engineered disposal facilities.[131] So, for example, a redeveloping community cannot simply advertise the availability and affordability of brownfields lands to encourage industrial use, but the community must also zone it to exclude the considerably more exposure-intensive residential or agricultural uses. Though EPA's approach to institutional controls is

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[129] NATIONAL RESEARCH COUNCIL, SCIENCE AND JUDGMENT IN RISK ASSESSMENT 79-242, 351-354 (1994); PRESIDENTIAL/CONGRESSIONAL COMM'N, *supra* note 47, at iii-iv, 63-101.

[130] John Pendergrass, *Use of Institutional Controls as Part of a Superfund Remedy: Lessons From Other Programs*, 26 Envtl. L. Rep. (Envtl. L. Inst.) 10109 (1996); HERSH ET AL., *supra* note 92, at 65-94; Susan C. Borinsky, *The Use of Institutional Controls in Superfund and Similar State Laws*, 7 FORDHAM ENVTL. L.J. 1 (1995); David F. Coursen, *Institutional Controls at Superfund Sites*, 23 Envtl. L. Rep. (Envtl. L. Inst.) 10279 (1993); Anne D. Weber, *Institutional Controls—An Expedited and Cost-Effective Means for Returning a Superfund Site to Beneficial Use*, 9 J. NAT. RESOURCES & ENVTL. L. 461 (1993-94); George Wyeth, *Land Use and Cleanups: Beyond the Rhetoric*, 26 Envtl. L. Rep. (Envtl. L. Inst.) 10358 (1996); Krista J. Ayers, Comment, *The Potential for Future Use Analysis in Superfund Remediation Programs*, 44 EMORY L.J. 1503, 1523-38 (1995).

[131] Karlin, *supra* note 33, at 49.

guarded,[132] the states already and increasingly rely on the deployment of institutional controls to meet risk targets in voluntary, brownfields, and even involuntary, state-led clean-up programs.[133]

While planning predictions, incentives, and institutional controls can be fairly reliable in the foreseeable future (especially with respect to the first post-remediation developer) the Superfund life cycle reminds us that our concerns do not end there. Many hazardous materials will remain in existence indefinitely. The appropriateness of future use and RBCA as justifications for less intensive clean-up depends absolutely on the long-term operation of institutional controls, and yet the long-term efficacy of such measures is extremely problematic.[134] There is very little experience with the actual long-term integrity and efficacy of physical controls like disposal facilities or markers, to say nothing of the arrangements for monitoring and repairing them. Legal controls like zoning are highly changeable, and deed restrictions are difficult to enforce. Underlying the problem with institutional controls is the difficulty of transmitting information about the hazards of residual contamination or disposal structures over long periods of time.

To evaluate adequately the reliability of such predictions and controls, a decision maker and affected persons must at least know the precise expected future use and the basis for the prediction; the degree of confidence in predictions and the basis therefor; the exact nature of and responsibility (including financial responsibility) for the institutional controls and their enforcement; and how restrictions and obligations are to be documented, recorded, and communicated to future generations. While some of this information may seem far afield from traditional risk assessment, candor requires some discussion of these issues to the extent that the brownfields analysis relies on assumptions regarding the future. It is a poor general policy to unwittingly create a "turnstile" brownfields program in which clean-up is really merely deferral. A turnstile program would also be a particular injustice to nearby neighborhoods, which would be subjected to a cycle

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[132] 40 C.F.R. § 300.430(a)(1)(iii) (1997); U.S. EPA, LAND USE IN THE CERCLA REMEDY SELECTION PROCESS, OSWER 9355.7-04 (May 1995).

[133] *See* ASSOCIATION OF STATE AND TERRITORIAL SOLID WASTE MANAGEMENT OFFICIALS, SURVEY OF STATE INSTITUTIONAL CONTROL MECHANISMS (Dec. 1997); BROWNFIELDS: A COMPREHENSIVE GUIDE, *supra* note 3, at 287-681; Schnapf, *supra* note 5, at 2488, 2496.

[134] HERSH ET AL., *supra* note 92; Coursen, *supra* note 130, at 10280; Wernstedt & Hersh, *supra* note 1, at 171-72; Applegate & Dycus, *supra* note 69.

of hazardous environmental releases, dangerous clean-ups, and industrial pollution.

Risk assessment is a double-edged sword: if conservative assumptions are to be analyzed and replaced where unsupported, ameliorative assumptions should be subject to similar scrutiny. The predictions of the future state of the site go to the heart of the Brownfields Bargain. The exchange of economic value to the community for greater residual risk affects not only the present residents of the area, but also future generations who will inherit the exchange. We cannot very well ask our descendants for their opinion on the appropriateness of the bargain, but at least we can assure ourselves that they too would regard it as a good deal.[135] Risk assessment is the primary framework for this evaluation; if the comparison cannot validly be made, then it calls into question the confidence we should have in the bargain in the first place.

## C. Stakeholder Involvement

Stakeholder involvement is increasingly recognized as essential to the CERCLA clean-up process and to risk assessment generally. It is especially important to the Brownfields Bargain where one is dealing with a place—a locality with neighbors—and the potential health effects are focused on them.[136] In a democratic society the exchange between economic development and risk should not simply be imposed from above.[137] Moreover, because brownfields are often located in areas that have a history of environmental mistreatment and political and economic underrepresentation, brownfields redevelopment raises

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[135] *See* Jeffrey Spear, Note, *Remedy Selection Under CERCLA and Our Responsibilities to Future Generations*, 2 N.Y.U. ENVTL. L.J. 117, 136-144 (1993) (advocating consideration of future generations in CERCLA remedy selection decisions).

[136] This is not, however, the view of the Ohio legislature, which, as noted above, saw fit to allow citizens to be placed at greater risk without their knowing or being able to find out about it. *See* note 37, *supra*.

[137] Former EPA Administrator William Ruckelshaus was presented with the decision whether to impose strict air pollution limitations that would close a huge smelter in Tacoma, Washington, seriously harming its economic base, or whether to permit modified operation. He chose to let the residents of the Tacoma area make that choice between economic well-being and risk. ROBERT B. REICH, THE POWER OF PUBLIC IDEAS (1988); Robert B. Reich, *Public Administration and Public Deliberation: An Interpretive Essay*, 94 YALE L.J. 1617 (1985).

Other reasons for stakeholder involvement, including improved information gathering, are developed in Frances M. Lynn, *Public Participation in Risk Management Decisions: The Right to Define, the Right to Know, and the Right to Act*, 1 RISK: HEALTH, SAFETY & ENV'T 95 (1990); PRESIDENTIAL/CONGRESSIONAL COMM'N, *supra* note 47, at 79-82; Applegate, *supra* note 36, at 947-51.

fairness or environmental justice concerns that can only be addressed through a public process that involves the affected persons.[138] Specifically, the neighbors of a brownfields site are the persons whom the Brownfields Bargain is intended to benefit, and they should be involved in all aspects of the decision to pursue the proposed redevelopment.[139]

Risk assessment can be a tool for evading public involvement by recasting political questions as technical ones and by privileging technical tools to which communities have limited access.[140] The emerging view of risk assessment as a tool for public participation as well as for technical analysis can reverse this effect. As is detailed in the recent reports of the National Academy of Sciences and the Presidential/Congressional Commission on Risk Assessment and Risk Management,[141] brownfields risk assessors should deploy an approach to risk assessment that is broadly inclusive, that invites public participation throughout the process, and that is integrated into decisionmaking. New public participation techniques, such as citizens advisory boards, can be added to existing review-and-comment procedures and technical assistance grants to make meaningful public participation a reality.[142] Risk assessment provides a framework for gathering and presenting the information that the public and decision makers need to make good brownfields decisions. If there is a tendency to overlook environmental protection in the enthusiasm for redevelopment,[143] risk assessment can also help to restore some balance to consideration of the Brownfields Bargain.

### D. Risk Distribution and Environmental Justice

The Brownfields Bargain is a specific trade-off between an environmental risk and an economic benefit. In many ways, this is simply a variation of the fundamental policy question in all

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[138] These issues are thoroughly discussed in Engel, *supra* note 13.

[139] McWilliams, *supra* note 10, at 705-783; Ferris, *supra* note 13.

[140] Kuehn, *supra* note 46, at 129-39.

[141] PRESIDENTIAL/CONGRESSIONAL COMM'N, *supra* note 47 ; UNDERSTANDING RISK, *supra* note 47; NATIONAL RESEARCH COUNCIL, BUILDING CONSENSUS THROUGH RISK ASSESSMENT AND MANAGEMENT OF THE DEPARTMENT OF ENERGY'S ENVIRONMENTAL MANAGEMENT PROGRAM (1994).

[142] Applegate, *supra* note 36.

[143] This phenomenon was observed in Wernstedt & Hersh, *supra* note 1, at 169-70. As a general matter, local governments are for a variety of reasons more directly motivated by development than environmental health concerns.

environmental regulation: "whether the statistical possibility of future deaths should ever be disregarded in light of the economic costs of preventing those deaths."[144] It is undoubtedly the case that in many instances the incremental environmental benefits of a clean-up under the ordinarily applicable CERCLA requirements do not justify the lost opportunity for economic redevelopment. The underlying assumption behind this comparison of environmental risks and economic benefits, however, is that the risk receptors and economic beneficiaries are either the same group of people or they overlap to a substantial degree. In its core meaning, the Brownfields Bargain is predicated on an exchange by inner city brownfields neighbors of environmental protection for economic improvement in those areas.[145] The Brownfields Bargain is a good deal only if those who are accepting the reduced environmental protection also see the economic benefits; it is a bad deal if the same inner city neighborhood, which is already suffering from abandoned industries, must sit by as workers and shoppers from elsewhere drive in and out of the redeveloped facility.[146]

Discussions of environmental justice frequently comment on lack of symmetry between the economic and environmental benefits and burdens of industrial activity. As Richard Lazarus states, "identical recipients are rarely, if ever, the result."[147] Brownfields are, in fact, a cousin of the familiar compensated siting plans that have been advanced as a way to find locations for locally unwanted land uses.[148] When it is simply a matter of compensation for siting, it has not been very successful.[149] Moreover, compensated siting has been controversial because it raises the moral question of the appropriateness of trading

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[144] Industrial Union Dept, AFL-CIO v. American Petroleum Inst., 448 U.S. 607, 672 (1980) (Rehnquist, J., concurring)(the Benzene case). Careful risk assessment may also be important to ensure that minority environmental risk concerns are not overlooked, Kuehn, *supra* note 46, at 160-66.

[145] It is unfortunately true, however, that in many cases the commitment to improving the lot of the neighbors is largely rhetorical, and that the main reason for the redevelopment is to benefit the tax base and the developers. The view taken here is that brownfields promoters should be held to their rhetoric.

[146] In the Industri-Plex situation, for example, one town would receive the economic benefit of redevelopment, while the adjacent town would receive the bulk of the traffic problems. Wernstedt & Hersh, *supra* note 1, at 171.

[147] Richard J. Lazarus, *Pursuing "Environmental Justice": The Distributional Effects of Environmental Protection*, 87 Nw. U. L. Rev. 787, 792 (1993).

[148] There is enormous literature on compensated siting plans. It is conveniently summarized in Vicki Been, *Compensated Siting Proposals: Is It Time to Pay Attention?*, 21 FORDHAM URB. L.J. 787, 792 (1994).

[149] *Id.* at 823-25.

environmental protection for economic redevelopment.[150] Where the community to be compensated is poor, as in the core brownfields context, the voluntariness of the consent to the bargain has been questioned. People who are unemployed will feel compelled to prefer jobs to the environment.[151]

Risk assessment can be used to highlight the risks to workers and the immediate neighborhood of extensive remediation activities; that is, it can focus attraction on distributional as well as clean-up issues.[152] For example, capping and leaving contamination in place, a typical redevelopment-friendly remedy selection, would produce far less dust and truck traffic than excavating and hauling away large volumes of contaminated material. The argument can be made, based on this observation, that the incremental risks of more intensive remediation and the economic benefits to be obtained from redevelopment outweigh the higher residual risk from the contamination remaining in place. This argument has some force because the risks of the remedy tend to focus on the immediate neighborhood, and economic benefit may well tip the balance in favor of trading off short-term economic gain against long-term environmental risks—if a share of the benefits are obtained by the immediate neighborhood. Likewise, the risk benefits of economic well-being may outweigh the risk detriment of contamination remaining in place—again, if the risk receptors and economic beneficiaries are the same. Without a substantial overlap of receptors and beneficiaries, brownfields redevelopment may benefit the redeveloper and may benefit the city's tax base, but it is no more than a cynical scheme to lower environmental standards, externalize environmental costs, and impose them on the already disadvantaged inner city.

The provision of better information about environmental effects is universally recommended as one remedy for environmental justice because better information would both highlight the existence of a problem and provide the basis of remedial legal or political action by

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[150] *Id.* at 787 & nn. 3-4.

[151] *See* BULLARD, *supra* note 10, at 68-70 (explaining the relative lack of concern over the environmental consequences of potential development in Houston's African-American business community); UNITED CHURCH OF CHRIST COMMISSION FOR RACIAL JUSTICE, TOXIC WASTES AND RACE 7 (1987) (expressing concern that "Many racial and ethnic communities have highly depressed economies and alarming unemployment rates, they would be particularly vulnerable.").

[152] Kuehn, *supra* note 46, at 140-43; *see also* Lazarus, *supra* note 147, at 843-48 (recommending that agencies be required to take risk distribution into account).

the affected community.[153] Executive Order 12898, in fact, requires the development of information about "disproportionately high and adverse human health or environmental effects of [federal] programs, policies, and activities on minority populations and low-income populations."[154] In the brownfields context, if such bargains are to occur, the trade-offs need to be better understood.[155] We saw in the RBCA and TACO context that a more complete or sophisticated risk assessment could facilitate redevelopment by moderating clean-up requirements. Completeness and sophistication should work both ways: a brownfields risk assessment should consider not only total risks, but also their distribution in the population. Risk assessment, of course, has no direct role in assuring that the neighbors of a brownfields site receive benefits through increased employment and improved living conditions. However, by identifying the risk receptors with care, it can point out the need to assure an equitable distribution of risks and benefits.

## V. CONCLUSION: RISK ASSESSMENT IS NOT CLEAN-UP

Good reasons exist to modify risk assessments that are unrealistically conservative and unnecessarily impede brownfields redevelopment. If risk is the fundamental standard for clean-up requirements and if risk assessment is the technique for measuring compliance with or deviance from that standard, then redevelopment decisions should be based on reasonable estimates of reasonably expected risks, allowing for a duly precautionary approach to uncertainties. If the result of these modifications to risk assessment practices is the revitalization of urban brownfields, so much the better. But we must remember that risk assessment is no more than a method for calculating compliance with clean-up standards. It is not, as some would have it, a clean-up technology. Actual remediation activities—whether they are strictly necessary or not, whether they pass the point of diminishing returns or not, whether they impose undue remedial risks or not, whether they scare off potential developers or not—do improve the environment at a Superfund site; they provide environmental protection. The lower estimates of a recalculated risk

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[153] One of the earliest studies of environmental injustice emphasized the importance of better environmental information, UNITED CHURCH OF CHRIST, *supra* note 151, at 7, 24-27; *see also* Alice Kaswan, *Environmental Justice: Bridging the Gap Between Environmental Laws and "Justice,"* 47 AM. U. L. REV. 221, 289-98 (1997); Lazarus, *supra* note 147, at 826-27.

[154] Exec. Order 12,898, *supra* note 127, at §§ 1-101 - 1-103, 3-301.

[155] Been, *supra* note 148.

assessment, by contrast, are only valid as long as the assumptions and predictions turn out to be accurate. Moreover, as was discussed in connection with the TACO approach to risk assessments, the idea that risk assessment can *substitute* for clean-up simply breeds the suspicion that all of the risk assessment techniques for facilitating brownfields redevelopment are no more than torturing the proverbial statistics until they tell you what you want to hear.

In the final analysis, risk assessment is nothing more than a valuable tool that helps to make important decisions with environmental consequences. As such, its function is limited to providing useful information to aid in making decisions. It does not make the decisions, and it does not protect people from environmental hazards. Faced with the high cost of environmental clean-up generally, in particular with the desire to reduce the obstacles to redevelopment of the inner city, it is tempting to view recalculation as a solution, in effect eliminating the problem of environmental contamination. But it does no such thing. Risk assessment, instead, should try to tell us the truth about a given situation; it should be a double-edged sword. It is entirely appropriate that risk assessment avoid unrealistic assumptions and that it account for predictions of the future based on economic redevelopment. But it must also disclose the rest of the Brownfields Bargain, that some persons will be placed at a higher risk than they would under non-brownfields circumstances and that predictions of the future are in the nature of assumptions whose validity must be carefully justified. In some cases, the Brownfields Bargain will be a good deal. In other cases, though, a candid risk assessment will show that the long-term risks of leaving contamination in place are too high, too uncertain, or too inequitably distributed to be a responsible bargain for present and future generations.