ESTIMATING U.S. ENVIRONMENTAL POLLUTION LIABILITIES BY SIMULATION

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Things should be made as simple as possible, but not any simpler. —Albert Einstein

Abstract

The application of computer simulation to the estimation of environmental pollution costs for inactive hazardous waste sites is presented. The various modules of the pollution costs simulation model (PCSM) are described, with the flow of costs traced from remedial action at EPA and state-administered sites through to insureds in the form of potentially responsible parties (PRPs), and finally to the application of coverage defenses. Methods are presented for using precision (credibility) estimates for state averages, and for projecting costs for an insurance portfolio based on sampling proportions. Countrywide results are presented, including the characterization of variability and comparisons to published insurance industry estimates of ultimate loss and expenses.

1. INTRODUCTION

The pollution costs simulation model (PCSM) described in this paper represents in many respects a work in progress. The remediation of pollution at inactive hazardous waste sites in the United States possesses a life cycle whose components are undergoing continual change as regards their attributes and durations. A model designed to estimate the associated costs or liabilities of remediation must first learn to walk, or crawl. It is natural to expect that, over time, changes and enhancements will be made to such a model.

This paper describes the status of the PCSM at a point in time: the PCSM will have undoubtedly changed by the time this paper is read. The purpose of this paper is therefore to present the approach to solving these estimation problems through the application of simulation techniques and actuarial principles.

The model is used to perform two tasks. The first is a country-wide estimate for all environmental pollution costs and ultimate liabilities to the U.S. insurance market for abandoned sites. The second is its application to a specific portfolio of insurance contracts in order to determine the liabilities to an individual insurer or reinsurer.

It is assumed that the reader has some familiarity with the history of the creation of environmental pollution liabilities through the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), Superfund Amendments and Reauthorization Act of 1986 (SARA), and other federal, state, or local laws. A thorough discussion of the governing laws and of the history and evolution of pollution liabilities in the U.S. will not be offered in this paper. The interested reader is directed to several references that will serve to provide any needed background.

2. DESIGN OF MODEL

The PCSM is designed to trace and simulate the sequential flow of pollution liabilities from the creation of costs at an individual hazardous waste site to the estimation of insurance liabilities at a contract (policy) level. The PCSM is best characterized as an exposure model of insurance liabilities and costs, since it is based on the construction of a model that attempts to measure the insurable loss of a set of risks and then apply policy conditions in order to estimate insured losses. The model does this through the estimation of population parameters and their interaction through modeling of the constituent databases. This process creates an "exposure measure"[1] that relates the expected values and under-

[1]The term "exposure measure" reflects the usage afforded by [1, p. 5].

lying distributions of the associated random variables, starting with site remediation costs and ending with the potential attachment of insurance coverage. There are no actual insured losses used in the construction of the PCSM as presented in this paper.

This form of exposure model is in sharp contrast to an extrapolation, regression, or any other model which makes projections into the future based on historical patterns and observations of actual insured losses. Those types of models are normally applied directly to empirical observations related to the liabilities being estimated.

One population invoked by the PCSM is the totality of inactive hazardous waste sites, where the great majority of the constituent sites do not have cleanup costs specifically associated with them. Some of these sites may be or may become National Priority List (NPL) sites in the future, and can be expected to command tens of millions of dollars in cleanup costs. Tens of thousands of these sites are state sites or will be sites arising under individual state supervision that do not have costs separately identified for them.

Another population is composed of those entities identified as potentially responsible parties (PRPs), which are presumed to form the bulk of what might better be termed ultimately responsible parties because they originally created the pollution. There are undoubtedly many more entities beyond those identified to date that will bear the cost for cleanup.

The PCSM constructs random variables that model costs at the site level and that model the sharing of these costs among known PRPs. Such estimates of costs in turn create exposures to loss for policies that afford insurance to PRPs. The expectations and uncertainties of the costs modeled by the PCSM are aggregated across sites, PRPs, and the policy or incurred years over which insurance has been provided, and then extended to the entire population of known sites in order to derive estimates of ultimate cleanup costs and insured liabilities.

The statistical foundation of the PCSM is directly reflected by the measures and distributions introduced throughout the model that reflect the uncertainty associated with each cost estimate element.

The estimation of pollution liabilities from U.S. locations utilizes the inactive hazardous waste site information identified by the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS), as well as those identified or estimated by state and territory site lists or data bases. The latter sources contain sites that did not originate with the EPA through CERCLIS. Over time, these lists will expand to include sites that originated in CERCLIS, but have been referred to individual state or local authorities for supervision and further remedial action.

The PCSM estimates cleanup costs (Capital, sometimes referred to as Remediation, and Operation and Maintenance costs) as well as transaction costs (including allocated and unallocated loss adjustment expenses for insurance coverage purposes) for non-federal sites.[2] The term "cost" will often be used to refer to "cleanup costs" while "loss adjustment expense" has been reserved for transaction costs.

The PCSM performs five separate tasks in distinct, self-contained modules during each iteration of a simulation. The first module simulates individual site cleanup costs for each of the approximately 40,000 sites on the CERCLIS database (Section 3 of this paper). The second module assigns a share of each site's liability to each PRP for those sites identified with PRPs on the Site Enforcement Tracking System (SETS)[3] database (Section 4). The third module applies state specific estimated probabilities

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[2]These sites are also referred to as "private sites" (see for example [15, p. 9]) although there are private entities identified as potentially responsible parties on federal sites.

[3]SETS is no longer the term used to identify this information as the EPA has restructured its data bases, thereby integrating information that may have been provided by separate sources. The term is used here for historical reference and to convey the existence of such information.

of coverage defenses being upheld and state specific probabilities of exposure triggers in order to establish insurable costs or liabilities (Section 5). The fourth module associates loss adjustment expense with PRP cleanup costs and distributes both the individually determined PRP insurable costs and loss adjustment expense across years of potential insurance coverage (Sections 6 and 7). The fifth module performs different tasks depending on whether the PCSM is being used for a countrywide simulation or a portfolio simulation. For the countrywide simulation it estimates the costs for those sites found only on state lists (all non-CERCLIS sites in a state) or relegated to state enforcement from the CERCLIS database (Section 8). For an insurance portfolio it evaluates the potential indemnification afforded by the policies and coverages contained within (Section 9).

Any additional cost elements or modifications to any component of cost estimates associated with environmental pollution liabilities that are not specifically mentioned are not estimated by the PCSM. These include consideration of third party liabilities, collateral suit defendants, Natural Resource Damage claims, and orphan shares. As the goal of this paper is to convey concepts and approaches, such limitations of the PCSM as presented herein should not detract from the achievement of that goal.

3. SITE COST ESTIMATES

Individual site cost estimates are performed for those sites contained on the CERCLIS data base. The primary source of cost information for an individual site in CERCLIS is contained in the Records of Decisions (RODs) issued by the United States Environmental Protection Agency (EPA). Specific cost information is available for only a small portion of these sites.

The estimation of site costs from RODs information is worthy of a paper in and of itself. One of the author's associates who contributed to the construction of the PCSM (Steven Finkelstein) has written such a paper [2]. One key issue addressed therein is the extraction of cost information from the RODs in a manner that allows the transformation of present value costs, as shown in the RODs, into undiscounted (nominal) values. However, an in-depth analysis of RODs reveals other issues including the identification of interim RODs (that presumably will be supplemented by final RODs), amendment RODs, the emergence of future RODs applicable to additional operable units for a site, and the translation of cost estimates from the date of preparation (issuance) for a ROD to the time actual construction (remediation) begins. The results of Finkelstein's analysis of RODs costs are presented here in the form of cleanup costs and associated present value factors without further explanation.

Exhibit 1 contains the distribution of CERCLIS sites at the time the PCSM was constructed according to Active/Archived, Site Status, RODs information, and PRP information. Some sites actually have more than one ROD issued while those identified as Archived, or No Further Remedial Action Planned (NFRAP), are unlikely to rise to the NPL. One of the ingredients to the model is, therefore, an estimate of the respective probabilities that a Non-NPL CERCLIS site may become an NPL site in the future. It was assumed that only the balance of Non-NPL active sites are eligible. All other sites, including all archived sites, would be subject to state or local authority. Indeed, some of these sites may not require any cleanup as evidenced by the statistics shown in Exhibit 2.

The simulation of site costs is preceded by an analysis of costs by site that results in the construction of two fundamental data bases:

- Sites with Variable Cost Estimates—contains information on those CERCLIS sites where more than one cost estimate was provided in the RODs for one or more of a site's operable units.
- Sites Without Variable Cost Estimates—contains those CERCLIS sites with a single value of cost estimates from the

RODs for each of its operable units or those CERCLIS sites with no specific cost information.

Appendix A describes how these databases were used to construct site cost variability parameters. These parameters include both the analysis of the distribution of cleanup costs on a site basis, as well as the variability or uncertainty of the cleanup costs for a single site.

The variability of site costs is in addition to the EPA default accuracy guideline of −30% to +50% of the published RODs costs [16, pp. 2–10]. Costs were randomized uniformly down to −30% or uniformly up to +50% and then normalized back to unity by dividing by 1.05, the expected value of the random variable so created[4] during each iteration of the PCSM.

Appendix B includes the derivation of the frequency of future NPL sites and the associated average site costs by state and category (NPL or state authority). It is of great value to identify site characteristics that can be used in a predictive manner for estimating cleanup costs for those sites that currently do not carry such information. There were very few site characteristics sufficiently populated for this purpose at the time the PCSM was constructed. State name was always available and useful to the extent it reflected differences among states resulting from differing industrial or economic development and attitude to cleanup standards and enforcement. Precision weighting of average site cleanup costs that employed estimates of variance was used in a manner consistent with actuarial estimates of credibility.

With these preliminary analyses completed, the sequence of steps employed by the PCSM to simulate a site cost during each iteration is as follows:

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[4]The expected value below unity is .85, while above unity it is 1.25, which results in an expected value of 1.05 when they are equally weighted.

1. For Sites With Variable Cost Estimates:
   a) Randomly determine an EPA accuracy factor between −30% and +50%, or between .7 and 1.5, normalized to unity for each separate cost. This is typically applied to each individual total ROD present value cost.
   b) Multiply each individual ROD total present value cost by its random EPA accuracy factor.
   c) Divide by the corresponding present value factor to obtain nominal costs.
   d) Add the individual nominal costs for each ROD to determine a total undiscounted site cleanup cost.
2. For Sites Without Variable Cost Estimates:
   a) Randomly determine an EPA accuracy factor between −30% and +50%, or between .7 and 1.5, normalized to unity.
   b) Randomly determine a site cost uncertainty relativity as described in Appendix A.
   c) Randomly assign NPL status to an individual eligible active CERCLIS site by state, assigning state authority status otherwise.
   d) Assign state authority status to all non-eligible (archived) CERCLIS sites.
   e) Apply the individual ROD total present value cost if applicable; otherwise, apply the corresponding present value average state NPL site cost or the present value average state authority site cost according to site assignment.
   f) Multiply by the random EPA accuracy factor and site cost uncertainty relativity and, if a ROD cost was not used, also apply a normalized random factor from the

TABLE 1

SIMULATION PROCEDURE FOR SITES WITHOUT VARIABLE COST ESTIMATES

Is this an NPL site?	Y	Y	Y	N	N	N
Does site have ROD present worth costs?	Y	Y	N	Y	Y	N
Does site (ROD) have specific PV Factor?	Y	N	N	Y	N	N
EPA accuracy factor	X	X	X	X	X	X
Site cost uncertainty	X	X	X	X	X	X
Average NPL site cost for state			X			
Average state authority site cost for state						X
Site variability normalized factor			X			X
ROD present worth cost	X	X		X	X	
Default PV Factor		X	X		X	X
Specific site (ROD) PV Factor	X			X		

distribution of site cleanup costs to recognize differences among site cleanup costs as described in Appendix A.

g) Divide by the estimated present value factor when available to determine the nominal (undiscounted) site cost; otherwise, divide by the separately determined average present value factor (see Appendix B).

The decision logic table above summarizes the process for simulating costs for sites without variable cost estimates. The questions on the left are answered for each site from top to bottom and left to right, until the bottom of a column is reached in the upper half of Table 1. The actions applied to a site are then identified with an “X” in that column in the bottom half of the table. Note that the first question in the table is answered after randomly assigning NPL or state authority status to the individual eligible active CERCLIS site as referred to in item 2.c) above.

One important reason for performing the simulation of costs at the site level is to provide the starting point of ground-up losses, which is used to estimate insurable losses for excess of loss coverages. It is proper actuarial procedure to compare the expected value of losses in excess of the attachment point for excess of loss coverage; it is not proper to compare the expected value of ground-up losses to the attachment point for excess of loss coverage.

The simulation of ground-up losses therefore contributes to the characterization of the uncertainty of pollution costs in the aggregate, as well as providing the vehicle to properly estimate insurable losses for excess of loss coverage.

4. LIABILITY SHARES FOR POTENTIALLY RESPONSIBLE PARTIES

The estimate of individual liability shares for PRPs is perhaps the most difficult function performed by the PCSM. Actual shares are found in settlements that are contained in litigation files, claim files, or other records, all of which are proprietary in nature. The only public information that is available for some CERCLIS sites is the actual name of a PRP from which the total number of PRPs identified to date can be determined.[5] This is subject to change, as Finkelstein's paper clearly shows how PRPs emerge both prior and subsequent to the attainment of NPL status for an individual site [2]. The analysis is based on the date a site attained NPL status and the dates of the notification letters for the associated PRPs. Indeed, Exhibits 1-F and 1-H show that only 558 sites have PRP information out of a total of 803 sites with RODs cost information, and Exhibit 1-G shows that a total of 1,191 sites have PRP information.

The Beta distribution was employed as a modeling tool to vary PRP shares by utilizing the only available crude measure of total number of PRPs. This modeling of shares was performed in lieu of assigning equal shares to all PRPs for a site. Equal shares would appear to be a reasonable assumption, due to the

[5] The information presented in this paper related to PRPs is derived from the February 1997 version of SETS.

joint and several nature of the retroactive liability associated with pollution cleanup and the lack of any further information on the financial ability of the member PRPs to fund the cleanup efforts. Variable shares were modeled through the Beta distribution in order to simulate the phenomenon of *de minimis* PRP shares. Appendix C presents the theory behind the structure of the Beta distribution used for this purpose.

This module of the PCSM assigns a share to each PRP from the appropriate Beta distribution for the site, and then normalizes the shares so that they add to unity. Although this estimate may exhibit a large degree of uncertainty for any individual PRP at an individual site, it should offer reasonable results when considering a portfolio of sites and PRPs as would be the case from an insurance perspective. The process is performed as described in Appendix C. No attempt is made to reduce PRP shares for orphan shares, which should be considered a conservative assumption. However, this may not be so conservative as experience accrues for the funding of pollution costs. It may very well be the case that the application of joint and several liability theories serves to erode the limited savings offered by reduction for the recognition of orphan shares,[6] resulting in a re-normalizing of shares among PRPs.

Those sites without PRP information are provided an estimate of the total number of PRPs based on an analysis of Site Category. This information can be used when a portfolio provides specific information that relates a PRP to a site for which no such information appears on SETS.

One final consideration that has not been specifically modeled is the emergence of future PRPs at a given site. This should serve to reduce the shares of those PRPs currently identified at a site. Future PRPs also encompass the naming of collateral suit defendants. This phenomenon would reflect both reductions to

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[6]One estimate of these shares is 18% [23, p. 33].

existing shares as well as increases resulting from the naming of a PRP as a collateral suit defendant at another site.

These latter considerations from the preceding paragraph impact the equity of allocating pollution liability exposure among PRPs rather than the total estimate of pollution costs. Such equity considerations clearly have the greatest bearing on the analysis of an individual insurance portfolio.

5. INSURANCE COVERAGE DEFENSE

The extent to which casualty insurance coverages provide indemnification for pollution claims is a phenomenon that varies with the period of time a given policy was in force. Case law has been established to varying degrees by state that has upheld or denied policy exclusions or conditions. The strongest defenses are those associated with the Absolute Pollution Exclusion introduced formally by ISO, Inc. beginning in 1986, with filings introduced among the various states over time.

The PCSM employs a Coverage Defense Module (CDM) that translates the information related to coverage exclusions or conditions into subjective estimates of probabilities that any specific coverage defense by the insurer will be upheld. The initial version of this module was based on a review of two publications ([13] and [14]).

The creation of these probabilities was founded on the basic principle that the higher the level of state court in which a ruling has been rendered, the higher the probability that the ruling will be upheld and applied in similar situations. The initial probabilities based on the type of court were as follows: 95% for supreme courts, 75% for appellate courts and 60% for any district or circuit courts. The tempering at 95% of the highest court rulings for a state supreme court was used to eliminate absolute certainty for the outcome of any particular coverage defense, thereby permitting the possibility of conditions that might cause an exception for a given situation from that state's ruling. Probabilities were also selected considering the number of cases related to the coverage defense that were similar, and the age of the cases reviewed for a particular coverage defense.

These two final inputs to the probability selections enable the CDM to be dynamic, accounting for changes in court decisions over time. Such an approach permits different probabilities depending on when site cleanup costs are estimated or when pollution insurance claims are settled. The approach can apply different levels of likely success for a coverage defense for sites with cost estimates in the past versus those sites with yet to be determined costs and shares. Another approach is to reflect the phenomenon of when insurance claims are actually presented to carriers and when they, in turn, are denied or, alternately, judged to be valid and thereby represent indemnifiable losses.

The choice of state (venue) for any particular combination of site and PRP must also be considered. The possible choices include at least the state of domicile of the insurer, the state of incorporation or domicile of the PRP, and the location of the site. The PCSM was run using the state of the site's location, on the assumption that the state has a controlling, vested interest in the remediation of property within its jurisdiction and because the location of a risk (site) is often the controlling element for the settlement of insurance claims. In the case of pollution, the author has been advised that the state of incorporation or domicile of the PRP is often used, but the issue of proper venue selection is far from settled. In specific portfolio applications, the venue itself has been simulated by the author from several plausible candidates.

The PCSM incorporates the CDM by randomly determining for each site and PRP whether or not there will have been a successful defense (a favorable outcome to the insurer) for each category analyzed for the particular state. A favorable outcome to the insurer translates to no indemnification for cleanup costs proper. Each such random determination is made by performing a Bernoulli trial (BT), with success measured by the probabilities described earlier. The interaction of several defenses must also be considered, that is, the possibility that an insurer will move to deny coverage based on several exclusions contained in the policy language. It was not practical, and perhaps not possible, during the design of the CDM to perform such an analysis of all possible interactions. Instead, a hierarchy was employed that placed greatest emphasis on the pollution exclusions and at most one other defense, *viz.*, Cleanup Costs as Damages. Three separate time periods were considered, responding to changing coverage wording, to execute the planned hierarchy:

1. 1972 and prior used the BT for Cleanup Costs as Damages defense (i.e., cleanup costs are not considered damages and should therefore not be indemnified). The default probability for Cleanup Costs as Damages was used if the state did not have a ruling.

2. 1973 through 1986 considered several defenses by employing the following hierarchy:

    a) If there was a decision on the pollution exclusion requiring a "sudden and accidental event" that predated the Absolute Pollution Exclusion, and the BT resulted in no coverage, then no other defense was considered.

    b) If the result described in a) was to provide coverage (i.e., the defense was denied), then the BT of the Cleanup Costs as Damages defense was used if available, and if not available the BT using the default probability for Cleanup Costs as Damages was used.

    c) If there was no ruling on the pollution exclusion, then the BT of the Cleanup Costs as Damages defense was used if available, and if not available the BT using the default probability for Cleanup Costs was used.

3. 1987 and subsequent focused on precedents for the Absolute Pollution Exclusion where available:

a) If the state supreme court made a ruling upholding the Absolute Pollution Exclusion, then the BT for successful denial of coverage used a probability of 95%.

b) If the result of a) was to provide coverage, then the BT of the Cleanup Costs as Damages defense was used if available, and if not available the BT using the default probability for Cleanup Costs as Damages was used.

c) If there was a lower level ruling and BT indicated no coverage, then that result was used.

d) If there was a lower level ruling and the result of c) was to provide coverage then (similar to b) above) the BT of the Cleanup Costs as Damages defense was used if available, and if not available the BT using the default probability for Cleanup Costs as Damages was used.

e) If there were no rulings on the Absolute Pollution Exclusion, the BT of the Cleanup Costs as Damages defense was used if available, and if not available the BT using the default probability for Cleanup Costs as Damages was used.

The following decision logic table (Table 2) summarizes the process used to determine a successful coverage defense, and operates in similar fashion to Table 1. The abbreviations used below are PE for pollution exclusion (sudden and accidental), APE for Absolute Pollution Exclusion, and, as used in the preceding discussion, BT for performing a Bernoulli trial.

The default cleanup cost defense probability was based on the average for those states that had respective rulings for these defenses. The reference “State (or default)” in Table 2 refers to the use of the specific state ruling if available, and using the default probability if not available.

TABLE 2

SIMULATION PROCEDURE FOR COVERAGE DEFENSE MODULE

Coverage 1972 or prior?	Y	N	N	N	N	N	N	N	N
Coverage 1973–1986?		Y	Y	Y	N	N	N	N	N
Coverage after 1986?					Y	Y	Y	Y	Y
PE ruling for state?		Y	Y	N					
PE BT results in “no coverage”?		Y	N						
APE state supreme court ruling?					Y	Y	N	N	N
APE state lower court ruling?							Y	Y	N
APE BT results in “no coverage”?					Y	N	Y	N	N
No cleanup costs indemnification		X			X		X		
State (or default) cleanup costs as damages BT	X		X	X		X		X	X

6. TRIGGER THEORIES AND ALLOCATIONS

Four policy trigger theories are included in the CDM: exposure (operation), manifestation, continuous, and injury-in-fact. As in the case of policy coverage defenses, case law has also established the degree to which policies are triggered over time. In addition to the analysis of rulings within a state, the findings from U.S. District Courts were also considered in determining trigger probabilities.

The identification of policies triggered is the fundamental prerequisite which establishes the basis upon which insurable exposure can be measured. To say that a set of policies are triggered under a particular theory means that they respond jointly and severally to the pollution loss or claim. It is another matter to measure each policy’s exposure to the pollution loss on a relative basis (i.e., how much each policy contributes to the final total indemnification). To employ the actual strategies used in pollution claim settlements to allocate coverage among insurers and policies, obtaining coverage charts for the universe of PRPs would be necessary. Coverage charts describe the commercial insurance and self-insurance programs for an insured over time.

Instead, the PCSM assigns indemnified losses and loss adjustment expenses across years based on a simulation of the trigger applied to that site and PRP combination. In the case of a manifestation trigger, only one year is involved. The year associated with manifestation is based on the date of a special notice letter, or general notice letter if the former is not applicable.

The PCSM uses a simple method of allocating pollution losses over time according to the coverage trigger simulated. It is based on the analysis of a large sample of claims at the insured and site level that provided exposure (operation) dates and date of notice to the insurer. This permitted the estimation of the distribution of exposure to pollution loss over time for exposure and continuous triggers. Valid actual dates were employed wherever possible, while simulated dates from the distribution of known valid dates were employed for CERCLIS sites without dates and on an aggregate basis for each set of state sites.

The continuous trigger distribution was translated to a conditional basis based on the manifestation year described earlier.[7] The manifestation year serves as the endpoint for continuous trigger assignments.

The resulting exposure and continuous trigger distributions were heavily weighted towards more recent years, paralleling the increased coverage afforded insureds in general as time goes by. This approach tends to create an element of conservatism to the industry estimates as greater exposure is be generated from the more recent years that afford greater insurance coverage.

The injury-in-fact trigger used the continuous trigger distribution, normalized between the first discovery date of pollution at a site and the notice date to a PRP pertaining to either a special or general letter from the EPA. This approach represents a conservative assumption as regards industry estimates, because it places the earliest date of injury at the first discovery date

[7] A more precise method would have been to decompose the distributions conditional on discovery dates, albeit with limited empirical information to do so.

of pollution rather than the earliest default operation date of 1950.

An alternative for measuring operation periods is to simply employ the operation dates of a site for those sites with RODs containing cost estimates. This does not provide for variation among PRPs for their involvement at a site. These dates and time periods must also be extrapolated over the entire population of hazardous waste sites.

The PCSM does not employ an All Sums, or "Fountain"[8] trigger. This trigger tends to create large concentrations of losses for a single insured in a single year. The losses may then be allocated or shared among other insurers or reinsurers considered to be exposed to such losses through settlement of the pollution claims. There is less case law precedent on this trigger at the state level in comparison to other triggers, thereby preventing a reliable simulation of this relatively infrequently invoked trigger. However, the trigger is indeed employed by some specific PRPs and against some insurers.

7. LOSS ADJUSTMENT EXPENSE

The concept of duty to defend deals with whether or not an insurer will incur legal expenses and other loss adjustment expenses (LAE) for a pollution claim, even though there is no indemnification due to a successful coverage defense. Case law on this subject is quite varied. The PCSM employed a conservative assumption by including all LAE as costs to the insurance industry.

A summary of the LAE analysis is presented in Exhibit 3. It is based on analyses performed by the Rand Institute [9]. The PCSM simulated the specific LAE to cleanup costs ratio uniformly within the ranges of 23.5% to 29.9%, and 29.9% to 37.0%, with equal probability associated with the lower and

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[8]For example, see [8, p. 122].

upper range. The simulated value was balanced to the estimated average of 29.9% by dividing by the uniform average of 30.25% (i.e., the average of the expectation below and above the mean) in a manner analogous to the procedure employed for the EPA accuracy factor discussed earlier in Section 3.

Another Rand Institute study [10, p. 51ff] also includes information that correlates total site transaction costs with the number of PRPs. An enhancement to the modeling of LAE would be to include such variation with the additional constraint that the simulated average balance to, or be consistent with, the original estimate of the mean LAE to cleanup costs ratio.

8. COUNTRYWIDE RESULTS

In order to obtain countrywide results, the contribution from state sites must be estimated. The PCSM based these estimates on the frequency and cost figures contained in Exhibit 2. The state severities were also used for those CERCLIS sites that were deemed to be excluded from NPL status, either through simulation or through identification as NFRAP. Note that these individual sites were simulated according to the form of the distribution of site costs described earlier, but specific state average severities were employed.

Exposure triggers were weighted according to the expectation for each trigger by state, rather than selecting a single trigger for each iteration or for each state site. Costs were allocated over time based on the simulation of default dates. Each iteration of the PCSM performed one random selection by state for average site cost, each trigger default date, and the ratio of LAE to cleanup costs.

Exhibit 4 shows the estimates of pollution losses and the allocation over time. The distribution of insurance coverages was censored at 1950 (i.e., the contributions to exposure for years prior to 1950 were added into 1950). It could be argued that some relevant coverage would have been provided by commercial general liability policies as early as 1940. However, although the author is aware of exposure for one type of site (manufactured gas plants) where exposure is claimed to exist as far back as the 1840s, it is extremely unlikely that any property and casualty policies provided indemnification that far in the past.

A few remarks concerning Exhibit 4 are in order. First and foremost is the magnitude of the estimate. It is approximately $70 billion (the total of the columns from all three pages of Exhibit 4), which is higher than the $56 billion estimate published in "BestWeek."[9] The difference is likely understated as the "BestWeek" estimate presumably includes third party bodily injury claims and Natural Resource Damage claims.

Second, a comparison between the simulated mean of total cleanup costs to indemnified costs indicates that very close to 50% of costs were not insured as a result of the application of the parameters contained in the CDM. This compares with the 40% reduction in insurable costs disclosed by "BestWeek"[10] associated with successful coverage defense.

Third, no underlying limits were introduced, which would have served to reduce the estimates. This is a conservative PCSM assumption. The author has witnessed insurance settlements that belie the conventional wisdom associated with the introduction of underlying deductibles, self-insured retentions, or the use of underlying limits for excess coverages. Underlying limits have specific application to the analysis of reinsurance portfolios.

Fourth, the estimate of pollution losses over time permits one to perform a more refined exposure analysis lacking specific insured information for a portfolio.[11] For example, a market share

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[9]See [21, p. P/C 6] and [22, p. 4].

[10]See [20, p. P/C 7] where Insurers' Liability %, footnote D, refers to "settlements and cases won by insurers."

[11]This is in lieu of another possible estimate based on the use of actual pollution claims, which the author has developed in a manner to remove the bias introduced by the emergence of the potentially most serious claims in the insured portfolio (nominally those related to NPL sites).

approach uses premiums as the exposure medium which can be matched against the relevant pollution estimates for the exposed years.

Finally, the simulation of costs at the state level for non-CERCLIS sites tends to contribute greater variation than that afforded by individual site simulation that is performed using CERCLIS.

9. PORTFOLIO APPLICATIONS

The countrywide analysis and simulation form the kernel of the estimation for a specific portfolio. The simulation for a portfolio is streamlined somewhat by the initial restriction of sites to those matched to the PRPs embedded in the portfolio. Specific information on such items as trigger theories, dates of operation, or PRP shares are used wherever possible at the site and PRP level.

The simulated costs by PRP, site, and year are normally matched to the coverage parameters of the policies issued for that insured. The parameters can usually be limited to an attachment point, limit or layer of coverage, and participation when direct excess insuranceor reinsurance is involved. Other coverage parameters can also be included such as aggregate retentions for excess policies. Deductibles can also be employed, although it is the author's experience that a limited amount of deductible coverages for Other Liability were offered through the mid 1980s.

The identification of the PRPs in the portfolio and the matching to those contained in SETS is the most time-consuming effort in a portfolio application. It is further complicated by the need to consider the aggregation of costs for a single insured due to liability derived from subsidiaries, and the alternate identification of an insured through aliases. The simulation proper is then seen as employing one of two possible representations of the portfolio. The first is where an exhaustive identification and matching of insureds and PRPs has been made that characterizes the portfolio. The other is where a sample of insureds within the portfolio has been identified.

In the case of a complete characterization of the portfolio, the extrapolation to an ultimate basis needs to consider the expected costs on sites that have not been specifically associated with the known PRPs identified in the portfolio. This would include estimates related to sites found only on state lists and the potential for future NPL sites to be associated with the PRPs in the portfolio. It is also prudent in such circumstances to include additional costs related to RODs to be issued in the future on known NPL sites related to portfolio PRPs. Discussion of such estimates in further detail is beyond the scope of this paper.

For the case where a sample of the portfolio has been simulated, Appendix D contains the derivation of a scalar that permits the extrapolation of the simulation results to the entire portfolio. Under these conditions the estimate will be biased downwards due to the inability to identify all PRPs embedded in a portfolio as discussed in Appendix D. This method may be enhanced by including some element of a market share exposure analysis as alluded to earlier.

10. WHERE DO WE GO FROM HERE?

There is a great deal of uncertainty surrounding the ultimate cost of pollution cleanup from inactive hazardous waste sites in this country. Unfortunately, the model presented herein, as well as any other, will for some considerable length of time suffer from model specification error of immeasurable magnitude.

The degree to which there are repeatable occurrences or events from which to base projections varies among the components and processes underlying the phenomenon of pollution cleanup. On the one hand, it took a study of only 18 Superfund sites to provide enough material for the Rand Institute to publish a leading work in this area. On the other hand, there are on the order of 1,000 CERCLIS sites with varying degrees of complete cost information; with such varying circumstances, the estimated averages must by necessity have a great deal of uncertainty.

There is considerable uncertainty in extrapolating any averages, as many of the site characteristics that could serve as predictive elements in a model are lacking from publicly available information. For example, it is of limited predictive value to employ average site cleanup costs by standard industry classification (SIC) if the thousands of sites that remain without cleanup costs are not identified by SIC.

At the end of the day, the task at hand is to project activities and costs that will take place in the future, without the familiar historical information that actuaries might use in development (extrapolation) estimates, regression models, or other methods of estimation that rely to varying degrees on the observation of actual insurance losses. Indeed, there is anecdotal evidence to show that cost figures from RODs turn out to be quite different from actual expenditures,[12] thereby casting additional doubt on the reliability of some of the harder numbers that underlie these analyses. The costs of remedial investigations and feasibility studies also increase costs and, if the decision by the California Supreme Court in the Aerojet-General case on December 29, 1997 sets a precedent, such costs will be subject to indemnification by insurance companies. Indeed, that decision also affects how pollution losses would trigger insurance policies over time when self-insurance is involved.

The point of this brief discussion is that there are many signs indicating higher ultimate paid costs, and very few that point in the other direction. The continuation of perceived downward trends in remediation costs may be altogether uncertain if funding for the requisite continued research is discontinued, or if there

[12] According to an article on page B-1 from *The Philadelphia Inquirer* of August 14, 1997, the GEMS Landfill in New Jersey will require $62 million in capital costs to cleanup, well in excess of any readily available estimates from RODs and elsewhere that are on the order of $27 million in capital costs.

are disincentives for insureds to engage in voluntary cleanup efforts at reduced costs. In addition, the distribution of losses over time for indemnification by insurance policies is a phenomenon that continues to undergo change.

From an insurance perspective, the focus of the balance sheet is on liabilities. Given an estimate of ultimate insured costs, the question that remains to be answered is how much is there left to be paid? From an economic perspective, the timing of those payments should provide insight as to their present value.

The matching of payments and ultimate costs cannot be done by simply subtracting payments to date from the ultimate estimates. It is more proper to subtract expected payments from ultimates. Failure to do so can lead to erroneous results such as in the GEMS Landfill case alluded to earlier in a footnote. Further, there is some uncertainty as to the reliability of properly matching payments against these liabilities. At a minimum this is caused by the lack of separate identification of such early costs in the records of insurers. Models could be created to fabricate an answer, but it is a topic that requires further research for resolution.

Finally, some concerted efforts may be needed to obtain updated and reliable information on state administered sites [24]. The evidence so far indicates substantial costs from this source, yet the level of available information does not approach that available for many NPL sites. Indeed, the volume of such data, if available, would present a challenge to its use in the same manner as that employed for NPL sites.

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EXHIBIT 1-A

Site Characteristics and Cost Analyses by State
CERCLIS Source: Archive
Number of Sites
NPL Status

State ID	NPL Site	Deleted NPL	Final NPL	Removed NPL	NFRAP Federal	NFRAP Not Federal	Total
AK	.	.	.	.	131	130	261
AL	.	.	.	.	12	563	575
AR	.	.	.	1	5	343	349
AS	.	.	.	.	2	4	6
AZ	.	.	.	2	18	699	719
CA	.	.	.	8	92	2,434	2,534
CM	.	.	.	.	.	6	6
CO	.	.	.	.	35	408	443
CT	.	.	.	.	2	327	329
DC	.	.	.	.	10	10	20
DE	.	.	.	.	1	221	222
FL	.	.	.	2	34	552	588
GA	.	.	.	.	11	723	734
GU	.	.	.	.	10	3	13
HI	.	.	.	6	20	104	130
IA	.	.	.	.	1	402	403
ID	.	.	.	1	67	134	202
IL	.	1	.	3	3	1,284	1,291
IN	.	5	.	2	2	1,433	1,442
KS	.	.	.	.	2	339	341
KY	.	.	.	.	4	487	491
LA	.	.	.	.	14	525	539
MA	.	.	.	.	8	516	524
MD	.	.	.	.	11	309	320
ME	.	.	.	.	8	103	111
MI	.	6	1	5	11	1,495	1,518
MN	.	12	.	.	2	407	421
MO	.	.	.	.	7	906	913
MS	.	.	.	2	6	374	382
MT	.	.	.	.	16	177	193
NC	.	.	.	.	8	687	695
ND	.	.	.	.	7	58	65
NE	.	.	.	.	4	235	239
NH	.	.	.	.	3	62	65
NJ	2	.	.	.	23	926	951
NM	.	.	.	.	30	266	296

EXHIBIT 1-A

(Continued)

State ID	NPL Site	Deleted NPL	Final NPL	Removed NPL	NFRAP Federal	NFRAP Not Federal	Total
NN	.	.	.	.	.	83	83
NV	.	.	.	.	18	157	175
NY	.	.	.	.	51	1,059	1,110
OH	.	.	.	1	9	1,078	1,088
OK	.	.	.	1	10	664	675
OR	.	.	.	.	30	337	367
PA	.	.	.	.	12	2,486	2,498
PR	.	.	.	.	8	179	187
RI	.	.	.	.	2	119	121
SC	.	.	.	.	5	378	383
SD	.	.	.	.	7	77	84
TN	.	.	.	.	9	580	589
TT	.	.	.	.	2	32	34
TX	.	.	.	.	35	2,367	2,402
UT	1	.	.	1	18	163	183
VA	.	.	.	.	7	440	447
VI	.	.	.	.	1	25	26
VT	1	.	.	.	2	69	72
WA	.	.	.	2	37	550	589
WI	.	2	.	1	3	336	342
WQ	.	.	.	.	.	1	1
WV	.	.	.	.	7	497	504
WY	.	.	.	.	16	121	137
Total	4	26	1	38	909	29,450	30,428

EXHIBIT 1-B

SITE CHARACTERISTICS AND COST ANALYSES BY STATE
CERCLIS SOURCE: ACTIVE
NUMBER OF SITES
NPL STATUS

State ID	NPL Site	Deleted NPL	Final NPL	Federal Not NPL	Proposed NPL	Not Federal Not NPL	Removed NPL	Total
AK	1	1	7	46	.	49	.	104
AL	.	1	12	15	1	110	.	139
AR	.	1	12	2	.	42	2	59
AS	.	1	.	.	.	1	.	2
AZ	3	1	10	11	.	162	.	187
CA	14	3	90	100	4	424	6	641
CM	.	1	.	.	.	2	.	3
CO	.	1	16	11	2	132	1	163
CT	18	1	15	3	.	409	.	446
DC	.	.	.	8	.	9	1	18
DE	.	2	18	2	.	30	3	55
FL	1	7	55	10	2	405	3	483
GA	.	1	15	6	1	243	1	267
GU	.	.	2	12	.	.	.	14
HI	6	.	4	22	.	37	.	69
IA	5	4	16	15	1	189	6	236
ID	4	1	8	17	2	29	.	61
IL	7	.	38	9	3	339	.	396
IN	.	.	30	9	1	157	1	198
KS	1	5	10	7	1	202	1	227
KY	.	.	20	13	.	90	.	123
LA	.	.	14	3	3	70	.	90
MA	7	1	30	9	.	459	.	506
MD	.	2	13	45	3	72	1	136
ME	.	.	12	.	.	88	.	100
MH	.	.	.	.	.	1	.	1
MI	.	4	71	9	2	148	1	235
MN	.	2	29	2	1	53	.	87
MO	16	1	22	29	.	347	2	417
MQ	.	.	.	1	.	.	.	1
MS	.	2	1	5	2	58	1	69
MT	.	.	8	8	1	31	1	49
NC	.	1	23	25	.	176	1	226
ND	.	.	2	1	.	7	.	10
NE	19	.	10	18	.	122	2	171
NH	8	.	18	2	.	107	.	135

EXHIBIT 1-B

(Continued)

State ID	NPL Site	Deleted NPL	Final NPL	Federal Not NPL	Proposed NPL	Not Federal Not NPL	Removed NPL	Total
NJ	6	9	106	10	.	669	2	802
NM	.	1	10	17	1	61	.	90
NN	.	.	.	.	.	68	.	68
NV	.	.	1	10	.	17	.	28
NY	.	10	78	11	1	521	.	621
OH	.	1	34	7	4	212	.	258
OK	.	.	10	18	1	106	1	136
OR	6	2	10	11	1	45	.	75
PA	.	10	100	16	2	394	2	524
PR	.	.	9	4	1	72	.	86
RI	24	.	12	7	.	150	.	193
SC	.	1	26	8	.	140	.	175
SD	.	.	3	1	1	23	.	28
TN	.	1	17	18	1	260	1	298
TT	.	1	.	.	.	4	.	5
TX	.	5	26	21	1	175	2	230
UT	.	.	12	4	4	122	2	144
VA	.	2	25	37	.	166	1	231
VI	.	.	2	1	.	8	.	11
VT	4	.	8	.	.	64	.	76
WA	52	10	48	24	2	43	.	179
WI	.	.	40	20	.	92	.	152
WQ	.	.	.	1	.	.	.	1
WV	.	1	6	1	1	57	1	67
WY	.	.	3	1	.	23	.	27
Total	202	98	1,217	723	51	8,292	46	10,629

EXHIBIT 1-C

SITE CHARACTERISTICS AND COST ANALYSES BY STATE
TOTAL
NUMBER OF SITES
NPL STATUS

State ID	NPL Site	Deleted NPL	Final NPL	Federal Not NPL	Proposed NPL	Not Federal Not NPL	Removed NPL	NFRAP Federal	NFRAP Not Federal	Total
AK	1	1	7	46	.	49	.	131	130	365
AL	.	1	12	15	1	110	.	12	563	714
AR	.	1	12	2	.	42	3	5	343	408
AS	.	1	.	.	.	1	.	2	4	8
AZ	3	1	10	11	.	162	2	18	699	906
CA	14	3	90	100	4	424	14	92	2,434	3,175
CM	.	1	.	.	.	2	.	.	6	9
CO	.	1	16	11	2	132	1	35	408	606
CT	18	1	15	3	.	409	.	2	327	775
DC	.	.	.	8	.	9	1	10	10	38
DE	.	2	18	2	.	30	3	1	221	277
FL	1	7	55	10	2	405	5	34	552	1,071
GA	.	1	15	6	1	243	1	11	723	1,001
GU	.	.	2	12	.	.	.	10	3	27
HI	6	.	4	22	.	37	6	20	104	199
IA	5	4	16	15	1	189	6	1	402	639
ID	4	1	8	17	2	29	1	67	134	263
IL	7	1	38	9	3	339	3	3	1,284	1,687
IN	.	5	30	9	1	157	3	2	1,433	1,640
KS	1	5	10	7	1	202	1	2	339	568
KY	.	.	20	13	.	90	.	4	487	614
LA	.	.	14	3	3	70	.	14	525	629
MA	7	1	30	9	.	459	.	8	516	1,030
MD	.	2	13	45	3	72	1	11	309	456
ME	.	.	12	.	.	88	.	8	103	211
MH	.	.	.	.	.	1	.	.	.	1
MI	.	10	72	9	2	148	6	11	1,495	1,753
MN	.	14	29	2	1	53	.	2	407	508
MO	16	1	22	29	.	347	2	7	906	1,330
MQ	.	.	.	1	.	.	.	.	.	1

EXHIBIT 1-C

(Continued)

State ID	NPL Site	Deleted NPL	Final NPL	Federal Not NPL	Proposed NPL	Not Federal Not NPL	Removed NPL	NFRAP Federal	NFRAP Not Federal	Total
MS	.	2	1	5	2	58	3	6	374	451
MT	.	.	8	8	1	31	1	16	177	242
NC	.	1	23	25	.	176	1	8	687	921
ND	.	.	2	1	.	7	.	7	58	75
NE	19	.	10	18	.	122	2	4	235	410
NH	8	.	18	2	.	107	.	3	62	200
NJ	8	9	106	10	.	669	2	23	926	1,753
NM	.	1	10	17	1	61	.	30	266	386
NN	.	.	.	.	.	68	.	.	83	151
NV	.	.	1	10	.	17	.	18	157	203
NY	.	10	78	11	1	521	.	51	1,059	1,731
OH	.	1	34	7	4	212	1	9	1,078	1,346
OK	.	.	10	18	1	106	2	10	664	811
OR	6	2	10	11	1	45	.	30	337	442
PA	.	10	100	16	2	394	2	12	2,486	3,022
PR	.	.	9	4	1	72	.	8	179	273
RI	24	.	12	7	.	150	.	2	119	314
SC	.	1	26	8	.	140	.	5	378	558
SD	.	.	3	1	1	23	.	7	77	112
TN	.	1	17	18	1	260	1	9	580	887
TT	.	1	.	.	.	4	.	2	32	39
TX	.	5	26	21	1	175	2	35	2,367	2,632
UT	1	.	12	4	4	122	3	18	163	327
VA	.	2	25	37	.	166	1	7	440	678
VI	.	.	2	1	.	8	.	1	25	37
VT	5	.	8	.	.	64	.	2	69	148
WA	52	10	48	24	2	43	2	37	550	768
WI	.	2	40	20	.	92	1	3	336	494
WQ	.	.	.	1	.	.	.	.	1	2
WV	.	1	6	1	1	57	1	7	497	571
WY	.	.	3	1	.	23	.	16	121	164
Total	206	124	1,218	723	51	8,292	84	909	29,450	41,057

EXHIBIT 1-D

Site Characteristics and Cost Analyses by State
CERCLIS Source: Archive
Sites with Rod Costs
NPL Status

State ID	NPL Site	Deleted NPL	Final NPL	Removed NPL	NFRAP Federal	NFRAP Not Federal	Total
AK	.	.	.	.	.	.	.
AL	.	.	.	.	.	.	.
AR	.	.	.	.	.	.	.
AS	.	.	.	.	.	.	.
AZ	.	.	.	.	.	.	.
CA	.	.	.	1	.	.	1
CM	.	.	.	.	.	.	.
CO	.	.	.	.	.	.	.
CT	.	.	.	.	.	.	.
DC	.	.	.	.	.	.	.
DE	.	.	.	.	.	.	.
FL	.	.	.	.	.	.	.
GA	.	.	.	.	.	.	.
GU	.	.	.	.	.	.	.
HI	.	.	.	.	.	.	.
IA	.	.	.	.	.	.	.
ID	.	.	.	.	.	.	.
IL	.	.	.	.	.	.	.
IN	.	2	.	.	.	.	2
KS	.	.	.	.	.	.	.
KY	.	.	.	.	.	.	.
LA	.	.	.	.	.	.	.
MA	.	.	.	.	.	.	.
MD	.	.	.	.	.	.	.
ME	.	.	.	.	.	.	.
MI	.	1	1	.	.	.	2
MN	.	6	.	.	.	.	6
MO	.	.	.	.	.	.	.
MS	.	.	.	.	.	.	.
MT	.	.	.	.	.	.	.
NC	.	.	.	.	.	.	.
ND	.	.	.	.	.	.	.
NE	.	.	.	.	.	.	.
NH	.	.	.	.	.	.	.
NJ	.	.	.	.	.	.	.
NM	.	.	.	.	.	.	.

EXHIBIT 1-D

(Continued)

State ID	NPL Site	Deleted NPL	Final NPL	Removed NPL	NFRAP Federal	NFRAP Not Federal	Total
NN	.	.	.	.	.	.	.
NV	.	.	.	.	.	.	.
NY	.	.	.	.	.	.	.
OH	.	.	.	.	.	.	.
OK	.	.	.	.	.	.	.
OR	.	.	.	.	.	.	.
PA	.	.	.	.	.	.	.
PR	.	.	.	.	.	.	.
RI	.	.	.	.	.	.	.
SC	.	.	.	.	.	.	.
SD	.	.	.	.	.	.	.
TN	.	.	.	.	.	.	.
TT	.	.	.	.	.	.	.
TX	.	.	.	.	.	.	.
UT	.	.	.	.	.	.	.
VA	.	.	.	.	.	.	.
VI	.	.	.	.	.	.	.
VT	.	.	.	.	.	.	.
WA	.	.	.	.	.	.	.
WI	.	.	.	.	.	.	.
WQ	.	.	.	.	.	.	.
WV	.	.	.	.	.	.	.
WY	.	.	.	.	.	.	.
Total	.	9	1	1	.	.	11

EXHIBIT 1-E

Site Characteristics and Cost Analyses by State
CERCLIS Source: Active
Sites with Rod Costs
NPL Status

State ID	NPL Site	Deleted NPL	Final NPL	Federal Not NPL	Proposed NPL	Not Federal Not NPL	Removed NPL	Total
AK	.	.	1	.	.	.	.	1
AL	.	1	8	.	.	.	.	9
AR	.	1	8	.	.	.	.	9
AS	.	.	.	.	.	.	.	.
AZ	.	.	5	.	.	.	.	5
CA	.	3	48	.	.	.	3	54
CM	.	.	.	.	.	.	.	.
CO	.	1	11	.	.	.	1	13
CT	.	1	5	.	.	.	.	6
DC	.	.	.	.	.	.	.	.
DE	.	1	9	.	.	.	.	10
FL	.	4	33	.	.	.	.	37
GA	.	.	9	.	.	.	.	9
GU	.	.	.	.	.	.	.	.
HI	.	.	.	.	.	.	.	.
IA	.	3	12	.	.	2	3	20
ID	.	.	4	.	.	.	.	4
IL	.	.	18	.	.	.	.	18
IN	.	.	18	.	.	.	.	18
KS	.	1	3	.	.	.	.	4
KY	.	.	13	.	.	.	.	13
LA	.	.	7	.	.	.	.	7
MA	.	1	17	.	.	.	.	18
MD	.	.	7	.	.	.	.	7
ME	.	.	6	.	.	.	.	6
MH	.	.	.	.	.	.	.	.
MI	.	4	43	.	.	.	.	47
MN	.	1	16	.	.	.	.	17
MO	.	.	13	.	.	.	1	14
MQ	.	.	.	.	.	.	.	.
MS	.	1	1	.	.	.	.	2
MT	.	.	7	.	.	.	1	8
NC	.	.	19	.	.	.	.	19
ND	.	.	2	.	.	.	.	2
NE	.	.	4	.	.	.	.	4
NH	.	.	13	.	.	.	.	13

EXHIBIT 1-E

(Continued)

State ID	NPL Site	Deleted NPL	Final NPL	Federal Not NPL	Proposed NPL	Not Federal Not NPL	Removed NPL	Total
NJ	.	5	74	.	.	.	.	79
NM	.	.	7	.	.	.	.	7
NN	.	.	.	.	.	.	.	.
NV	.	.	.	.	.	.	.	.
NY	.	5	52	.	.	1	.	58
OH	.	.	24	.	.	.	.	24
OK	.	.	9	.	.	.	.	9
OR	.	1	5	.	.	.	.	6
PA	.	6	62	.	.	.	.	68
PR	.	.	6	.	.	1	.	7
RI	.	.	8	.	.	.	.	8
SC	.	1	15	.	.	.	.	16
SD	.	.	1	.	.	.	.	1
TN	.	1	11	.	.	.	.	12
TT	.	.	.	.	.	.	.	.
TX	.	3	20	.	.	.	.	23
UT	.	.	8	.	.	.	.	8
VA	.	1	15	.	.	.	.	16
VI	.	.	.	.	.	.	.	.
VT	.	.	2	.	.	.	.	2
WA	.	4	20	.	.	1	.	25
WI	.	.	25	.	.	.	.	25
WQ	.	.	.	.	.	.	.	.
WV	.	1	3	.	.	.	.	4
WY	.	.	.	.	.	.	.	.
Total	.	51	727	.	.	5	9	792

EXHIBIT 1-F

SITE CHARACTERISTICS AND COST ANALYSES BY STATE
TOTAL
SITES WITH ROD COSTS
NPL STATUS

State ID	NPL Site	Deleted NPL	Final NPL	Federal Not NPL	Proposed NPL	Not Federal Not NPL	Removed NPL	NFRAP Federal	NFRAP Not Federal	Total
AK	.	.	1	.	.	.	.	.	.	1
AL	.	1	8	.	.	.	.	.	.	9
AR	.	1	8	.	.	.	.	.	.	9
AS	.	.	.	.	.	.	.	.	.	.
AZ	.	.	5	.	.	.	.	.	.	5
CA	.	3	48	.	.	.	4	.	.	55
CM	.	.	.	.	.	.	.	.	.	.
CO	.	1	11	.	.	.	1	.	.	13
CT	.	1	5	.	.	.	.	.	.	6
DC	.	.	.	.	.	.	.	.	.	.
DE	.	1	9	.	.	.	.	.	.	10
FL	.	4	33	.	.	.	.	.	.	37
GA	.	.	9	.	.	.	.	.	.	9
GU	.	.	.	.	.	.	.	.	.	.
HI	.	.	.	.	.	.	.	.	.	.
IA	.	3	12	.	.	2	3	.	.	20
ID	.	.	4	.	.	.	.	.	.	4
IL	.	.	18	.	.	.	.	.	.	18
IN	.	2	18	.	.	.	.	.	.	20
KS	.	1	3	.	.	.	.	.	.	4
KY	.	.	13	.	.	.	.	.	.	13
LA	.	.	7	.	.	.	.	.	.	7
MA	.	1	17	.	.	.	.	.	.	18
MD	.	.	7	.	.	.	.	.	.	7
ME	.	.	6	.	.	.	.	.	.	6
MH	.	.	.	.	.	.	.	.	.	.
MI	.	5	44	.	.	.	.	.	.	49
MN	.	7	16	.	.	.	.	.	.	23
MO	.	.	13	.	.	.	1	.	.	14
MQ	.	.	.	.	.	.	.	.	.	.

EXHIBIT 1-F

(Continued)

State ID	NPL Site	Deleted NPL	Final NPL	Federal Not NPL	Proposed NPL	Not Federal Not NPL	Removed NPL	NFRAP Federal	NFRAP Not Federal	Total
MS	.	1	1	.	.	.	.	.	.	2
MT	.	.	7	.	.	.	1	.	.	8
NC	.	.	19	.	.	.	.	.	.	19
ND	.	.	2	.	.	.	.	.	.	2
NE	.	.	4	.	.	.	.	.	.	4
NH	.	.	13	.	.	.	.	.	.	13
NJ	.	5	74	.	.	.	.	.	.	79
NM	.	.	7	.	.	.	.	.	.	7
NN	.	.	.	.	.	.	.	.	.	.
NV	.	.	.	.	.	.	.	.	.	.
NY	.	5	52	.	.	1	.	.	.	58
OH	.	.	24	.	.	.	.	.	.	24
OK	.	.	9	.	.	.	.	.	.	9
OR	.	1	5	.	.	.	.	.	.	6
PA	.	6	62	.	.	.	.	.	.	68
PR	.	.	6	.	.	1	.	.	.	7
RI	.	.	8	.	.	.	.	.	.	8
SC	.	1	15	.	.	.	.	.	.	16
SD	.	.	1	.	.	.	.	.	.	1
TN	.	1	11	.	.	.	.	.	.	12
TT	.	.	.	.	.	.	.	.	.	.
TX	.	3	20	.	.	.	.	.	.	23
UT	.	.	8	.	.	.	.	.	.	8
VA	.	1	15	.	.	.	.	.	.	16
VI	.	.	.	.	.	.	.	.	.	.
VT	.	.	2	.	.	.	.	.	.	2
WA	.	4	20	.	.	1	.	.	.	25
WI	.	.	25	.	.	.	.	.	.	25
WQ	.	.	.	.	.	.	.	.	.	.
WV	.	1	3	.	.	.	.	.	.	4
WY	.	.	.	.	.	.	.	.	.	.
Total	.	60	728	.	.	5	10	.	.	803

EXHIBIT 1-G

Site Characteristics and Cost Analyses by State
Sites with PRPs Identified
NPL Status

State ID	NPL Site	Deleted NPL	Final NPL	Federal Not NPL	Proposed NPL	Not Federal Not NPL	Removed NPL	NFRAP Federal	NFRAP Not Federal	Total
AK	.	1	2	.	.	1	.	.	.	4
AL	.	1	8	.	.	2	.	.	3	14
AR	.	1	9	.	.	1	1	.	1	13
AS	.	1	.	.	.	.	.	.	.	1
AZ	.	1	7	.	.	2	.	2	2	14
CA	1	2	45	.	2	8	2	1	30	91
CM	.	1	.	.	.	.	.	.	.	1
CO	.	1	12	.	1	14	1	.	10	39
CT	.	1	11	.	.	1	.	.	2	15
DC	.	.	.	.	.	.	.	.	.	.
DE	.	.	17	.	.	.	1	.	.	18
FL	1	6	43	.	.	2	.	.	1	53
GA	.	1	11	.	.	8	.	.	7	27
GU	.	.	.	.	.	.	.	.	.	.
HI	.	.	.	.	.	1	.	.	.	1
IA	.	3	9	.	.	12	3	.	.	27
ID	.	1	6	.	2	.	.	.	.	9
IL	.	1	18	.	1	23	.	.	2	45
IN	.	2	19	.	.	12	.	.	4	37
KS	.	4	7	.	.	5	.	.	1	17
KY	.	.	12	.	.	1	.	.	.	13
LA	.	.	9	.	.	1	.	.	.	10
MA	.	1	20	.	.	3	.	.	1	25
MD	.	1	9	.	.	.	.	.	.	10
ME	.	.	8	.	.	4	.	.	1	13
MH	.	.	.	.	.	.	.	.	.	.
MI	.	5	39	.	.	29	1	.	16	90
MN	.	4	12	.	.	3	.	.	.	19
MO	.	.	12	.	.	17	1	.	2	32
MQ	.	.	.	.	.	.	.	.	.	.

EXHIBIT 1-G

(Continued)

State ID	NPL Site	Deleted NPL	Final NPL	Federal Not NPL	Proposed NPL	Not Federal Not NPL	Removed NPL	NFRAP Federal	NFRAP Not Federal	Total
MS	.	2	.	.	1	3	2	.	3	11
MT	.	.	8	.	.	.	1	.	3	12
NC	.	1	16	.	.	8	.	.	8	33
ND	.	.	1	.	.	.	.	.	.	1
NE	.	.	6	.	.	1	.	.	.	7
NH	.	.	16	.	.	5	.	.	.	21
NJ	.	2	37	.	.	1	.	.	.	40
NM	.	.	8	.	1	.	.	.	.	9
NN	.	.	.	.	.	1	.	.	.	1
NV	.	.	1	.	.	1	.	.	.	2
NY	.	4	28	.	.	3	.	.	.	35
OH	.	1	22	.	.	35	.	.	6	64
OK	.	.	6	.	1	.	.	.	2	9
OR	.	2	6	.	.	.	.	.	1	9
PA	.	3	84	.	1	1	1	.	2	92
PR	.	.	1	.	.	.	.	.	1	2
RI	.	.	8	.	.	1	.	.	.	9
SC	.	1	17	1	.	2	.	.	2	23
SD	.	.	2	.	1	1	.	.	2	6
TN	.	1	6	.	.	2	.	.	1	10
TT	.	1	.	.	.	1	.	.	.	2
TX	.	4	20	.	1	1	1	.	2	29
UT	.	.	8	.	.	9	.	.	4	21
VA	.	2	17	.	.	.	1	.	1	21
VI	.	.	.	.	.	.	.	.	.	.
VT	.	.	8	.	.	.	.	.	1	9
WA	.	1	19	.	.	3	.	.	1	24
WI	.	.	20	.	.	8	1	.	8	37
WQ	.	.	.	.	.	.	.	.	.	.
WV	.	1	3	.	.	1	1	.	3	9
WY	.	.	2	.	.	3	.	.	.	5
Total	2	65	715	1	12	241	18	3	134	1,191

EXHIBIT 1-H

Site Characteristics and Cost Analyses by State
Sites with PRPs and ROD Costs
NPL Status

State ID	NPL Site	Deleted NPL	Final NPL	Federal Not NPL	Proposed NPL	Not Federal Not NPL	Removed NPL	NFRAP Federal	NFRAP Not Federal	Total
AK	.	.	.	.	.	.	.	.	.	.
AL	.	1	7	.	.	.	.	.	.	8
AR	.	1	6	.	.	.	.	.	.	7
AS	.	.	.	.	.	.	.	.	.	.
AZ	.	.	5	.	.	.	.	.	.	5
CA	.	2	26	.	.	.	1	.	.	29
CM	.	.	.	.	.	.	.	.	.	.
CO	.	1	9	.	.	.	1	.	.	11
CT	.	1	5	.	.	.	.	.	.	6
DC	.	.	.	.	.	.	.	.	.	.
DE	.	.	9	.	.	.	.	.	.	9
FL	.	3	28	.	.	.	.	.	.	31
GA	.	.	8	.	.	.	.	.	.	8
GU	.	.	.	.	.	.	.	.	.	.
HI	.	.	.	.	.	.	.	.	.	.
IA	.	3	9	.	.	.	2	.	.	14
ID	.	.	3	.	.	.	.	.	.	3
IL	.	.	12	.	.	.	.	.	.	12
IN	.	1	14	.	.	.	.	.	.	15
KS	.	1	3	.	.	.	.	.	.	4
KY	.	.	10	.	.	.	.	.	.	10
LA	.	.	6	.	.	.	.	.	.	6
MA	.	1	16	.	.	.	.	.	.	17
MD	.	.	6	.	.	.	.	.	.	6
ME	.	.	5	.	.	.	.	.	.	5
MH	.	.	.	.	.	.	.	.	.	.
MI	.	5	30	.	.	.	.	.	.	35
MN	.	3	9	.	.	.	.	.	.	12
MO	.	.	6	.	.	.	1	.	.	7
MQ	.	.	.	.	.	.	.	.	.	.

EXHIBIT 1-H

(Continued)

State ID	NPL Site	Deleted NPL	Final NPL	Federal Not NPL	Proposed NPL	Not Federal Not NPL	Removed NPL	NFRAP Federal	NFRAP Not Federal	Total
MS	.	1	.	.	.	.	.	.	.	1
MT	.	.	7	.	.	.	1	.	.	8
NC	.	.	14	.	.	.	.	.	.	14
ND	.	.	1	.	.	.	.	.	.	1
NE	.	.	4	.	.	.	.	.	.	4
NH	.	.	12	.	.	.	.	.	.	12
NJ	.	2	31	.	.	.	.	.	.	33
NM	.	.	7	.	.	.	.	.	.	7
NN	.	.	.	.	.	.	.	.	.	.
NV	.	.	.	.	.	.	.	.	.	.
NY	.	1	23	.	.	.	.	.	.	24
OH	.	.	19	.	.	.	.	.	.	19
OK	.	.	5	.	.	.	.	.	.	5
OR	.	1	4	.	.	.	.	.	.	5
PA	.	2	56	.	.	.	.	.	.	58
PR	.	.	.	.	.	.	.	.	.	.
RI	.	.	6	.	.	.	.	.	.	6
SC	.	1	11	.	.	.	.	.	.	12
SD	.	.	1	.	.	.	.	.	.	1
TN	.	1	6	.	.	.	.	.	.	7
TT	.	.	.	.	.	.	.	.	.	.
TX	.	3	19	.	.	.	.	.	.	22
UT	.	.	5	.	.	.	.	.	.	5
VA	.	1	13	.	.	.	.	.	.	14
VI	.	.	.	.	.	.	.	.	.	.
VT	.	.	2	.	.	.	.	.	.	2
WA	.	1	14	.	.	1	.	.	.	16
WI	.	.	18	.	.	.	.	.	.	18
WQ	.	.	.	.	.	.	.	.	.	.
WV	.	1	3	.	.	.	.	.	.	4
WY	.	.	.	.	.	.	.	.	.	.
Total	.	38	513	.	.	1	6	.	.	558

EXHIBIT 1-I

Site Characteristics and Cost Analyses by State
Present Worth
Average
NPL Status

State ID	NPL Site	Deleted NPL	Final NPL	Federal Not NPL	Proposed NPL	Not Federal Not NPL	Removed NPL	NFRAP Federal	NFRAP Not Federal	Total
AK	.	.	467,300	.	.	.	.	.	.	467,300
AL	.	1,283,333	28,996,964	.	.	.	.	.	.	25,917,672
AR	.	61,000	12,006,993	.	.	.	.	.	.	10,679,660
AS	.	.	.	.	.	.	.	.	.	.
AZ	.	.	17,660,300	.	.	.	.	.	.	17,660,300
CA	.	817,667	22,835,876	.	.	.	8,088,920	.	.	20,562,377
CM	.	.	.	.	.	.	.	.	.	.
CO	.	7,681,600	14,549,994	.	.	.	58,240,000	.	.	17,382,426
CT	.	263,000	11,345,400	.	.	.	.	.	.	9,498,334
DC	.	.	.	.	.	.	.	.	.	.
DE	.	466,147	15,111,456	.	.	.	.	.	.	13,646,925
FL	.	2,122,756	7,353,448	.	.	.	.	.	.	6,787,968
GA	.	.	6,305,637	.	.	.	.	.	.	6,305,637
GU	.	.	.	.	.	.	.	.	.	
HI	.	.	.	.	.	.	.	.	.	.
IA	.	2,578,633	2,459,398	.	.	13,179,500	3,424,600	.	.	3,694,073
ID	.	.	37,078,259	.	.	.	.	.	.	37,078,259
IL	.	.	13,391,110	.	.	.	.	.	.	13,391,110
IN	.	102,000	17,125,433	.	.	.	.	.	.	15,423,090
KS	.	1,638,456	7,313,338	.	.	.	.	.	.	5,894,618
KY	.	.	10,859,015	.	.	.	.	.	.	10,859,015
LA	.	.	26,362,248	.	.	.	.	.	.	26,362,248
MA	.	391,500	19,996,597	.	.	.	.	.	.	18,907,425
MD	.	.	8,481,334	.	.	.	.	.	.	8,481,334
ME	.	.	8,415,750	.	.	.	.	.	.	8,415,750
MH	.	.	.	.	.	.	.	.	.	.
MI	.	5,441,862	15,853,174	.	.	.	.	.	.	14,790,796
MN	.	6,550,213	5,341,116	.	.	.	.	.	.	5,709,102
MO	.	.	15,474,164	.	.	.	8,306,000	.	.	14,962,152
MQ	.	.	.	.	.	.	.	.	.	.

EXHIBIT 1-I

(Continued)

State ID	NPL Site	Deleted NPL	Final NPL	Federal Not NPL	Proposed NPL	Not Federal Not NPL	Removed NPL	NFRAP Federal	NFRAP Not Federal	Total
MS	.	2,000,000	14,180,000	.	.	.	.	.	.	8,090,000
MT	.	.	23,918,597	.	.	.	11,515,500	.	.	22,368,210
NC	.	.	10,754,436	.	.	.	.	.	.	10,754,436
ND	.	.	2,123,625	.	.	.	.	.	.	2,123,625
NE	.	.	17,861,517	.	.	.	.	.	.	17,861,517
NH	.	.	11,915,482	.	.	.	.	.	.	11,915,482
NJ	.	584,272	28,159,892	.	.	.	.	.	.	26,414,600
NM	.	.	6,950,802	.	.	.	.	.	.	6,950,802
NN	.	.	.	.	.	.	.	.	.	.
NV	.	.	.	.	.	.	.	.	.	.
NY	.	15,183,580	16,959,324	.	.	35,100,000	.	.	.	17,119,013
OH	.	.	20,425,537	.	.	.	.	.	.	20,425,537
OK	.	.	30,183,849	.	.	.	.	.	.	30,183,849
OR	.	6,707,400	3,833,041	.	.	.	.	.	.	4,312,101
PA	.	3,605,500	15,361,822	.	.	.	.	.	.	14,324,500
PR	.	.	3,661,910	.	.	8,987,800	.	.	.	4,422,752
RI	.	.	9,872,522	.	.	.	.	.	.	9,872,522
SC	.	1,032,000	7,710,604	.	.	.	.	.	.	7,293,192
SD	.	.	882,813	.	.	.	.	.	.	882,813
TN	.	990,627	13,907,438	.	.	.	.	.	.	12,831,037
TT	.	.	.	.	.	.	.	.	.	.
TX	.	1,836,333	25,480,049	.	.	.	.	.	.	22,396,086
UT	.	.	17,143,887	.	.	.	.	.	.	17,143,887
VA	.	292,000	14,670,931	.	.	.	.	.	.	13,772,248
VI	.	.	.	.	.	.	.	.	.	.
VT	.	.	7,125,650	.	.	.	.	.	.	7,125,650
WA	.	3,232,125	19,368,497	.	.	6,900,000	.	.	.	16,287,938
WI	.	.	9,020,730	.	.	.	.	.	.	9,020,730
WQ	.	.	.	.	.	.	.	.	.	.
WV	.	1,014,000	13,037,000	.	.	.	.	.	.	10,031,250
WY	.	.	.	.	.	.	.	.	.	.
Total	.	3,911,259	16,403,531	.	.	15,469,360	12,069,098	.	.	15,410,316

EXHIBIT 1-J

SITE CHARACTERISTICS AND COST ANALYSES BY STATE
NOMINAL COST
AVERAGE
NPL STATUS

State ID	NPL Site	Deleted NPL	Final NPL	Federal Not NPL	Proposed NPL	Not Federal Not NPL	Removed NPL	NFRAP Federal	NFRAP Not Federal	Total
AK	.	.	767,763	.	.	.	.	.	.	767,763
AL	.	2,374,500	46,415,568	.	.	.	.	.	.	41,522,116
AR	.	112,866	34,594,560	.	.	.	.	.	.	30,763,261
AS	.	.	.	.	.	.	.	.	.	.
AZ	.	.	30,563,571	.	.	.	.	.	.	30,563,571
CA	.	1,408,865	39,132,318	.	.	.	12,349,402	.	.	35,126,827
CM	.	.	.	.	.	.	.	.	.	.
CO	.	13,496,520	24,371,771	.	.	.	99,552,758	.	.	29,318,366
CT	.	445,131	20,108,342	.	.	.	.	.	.	16,831,140
DC	.	.	.	.	.	.	.	.	.	.
DE	.	812,746	26,144,967	.	.	.	.	.	.	23,611,745
FL	.	3,996,810	14,062,275	.	.	.	.	.	.	12,974,116
GA	.	.	14,930,349	.	.	.	.	.	.	14,930,349
GU	.	.	.	.	.	.	.	.	.	.
HI	.	.	.	.	.	.	.	.	.	.
IA	.	4,676,223	5,311,589	.	.	18,720,801	5,974,392	.	.	6,656,626
ID	.	.	67,505,812	.	.	.	.	.	.	67,505,812
IL	.	.	22,973,090	.	.	.	.	.	.	22,973,090
IN	.	180,613	31,098,616	.	.	.	.	.	.	28,006,816
KS	.	2,773,107	12,351,631	.	.	.	.	.	.	9,957,000
KY	.	.	19,031,256	.	.	.	.	.	.	19,031,256
LA	.	.	47,050,720	.	.	.	.	.	.	47,050,720
MA	.	738,864	32,947,010	.	.	.	.	.	.	31,157,669
MD	.	.	14,648,928	.	.	.	.	.	.	14,648,928
ME	.	.	14,626,718	.	.	.	.	.	.	14,626,718
MH	.	.	.	.	.	.	.	.	.	.
MI	.	7,992,494	28,797,108	.	.	.	.	.	.	26,674,188
MN	.	17,042,931	9,508,811	.	.	.	.	.	.	11,801,804
MO	.	.	26,291,361	.	.	.	14,771,486	.	.	25,468,513
MQ	.	.	.	.	.	.	.	.	.	.

EXHIBIT 1-J

(Continued)

State ID	NPL Site	Deleted NPL	Final NPL	Federal Not NPL	Proposed NPL	Not Federal Not NPL	Removed NPL	NFRAP Federal	NFRAP Not Federal	Total
MS	.	4,272,786	24,723,408	.	.	.	.	.	.	14,498,097
MT	.	.	34,822,980	.	.	.	33,480,232	.	.	34,655,136
NC	.	.	18,955,149	.	.	.	.	.	.	18,955,149
ND	.	.	3,685,611	.	.	.	.	.	.	3,685,611
NE	.	.	31,484,483	.	.	.	.	.	.	31,484,483
NH	.	.	20,470,613	.	.	.	.	.	.	20,470,613
NJ	.	962,901	48,938,205	.	.	.	.	.	.	45,901,793
NM	.	.	13,140,628	.	.	.	.	.	.	13,140,628
NN	.	.	.	.	.	.	.	.	.	.
NV	.	.	.	.	.	.	.	.	.	.
NY	.	28,256,708	29,422,226	.	.	59,407,183	.	.	.	29,838,732
OH	.	.	42,433,077	.	.	.	.	.	.	42,433,077
OK	.	.	51,813,119	.	.	.	.	.	.	51,813,119
OR	.	14,571,916	6,841,917	.	.	.	.	.	.	8,130,250
PA	.	6,882,585	27,419,561	.	.	.	.	.	.	25,607,475
PR	.	.	6,306,889	.	.	14,477,208	.	.	.	7,474,077
RI	.	.	17,528,495	.	.	.	.	.	.	17,528,495
SC	.	1,872,027	14,962,700	.	.	.	.	.	.	14,144,533
SD	.	.	1,682,826	.	.	.	.	.	.	1,682,826
TN	.	1,693,331	23,315,219	.	.	.	.	.	.	21,513,395
TT	.	.	.	.	.	.	.	.	.	.
TX	.	3,378,845	48,302,380	.	.	.	.	.	.	42,442,788
UT	.	.	28,397,784	.	.	.	.	.	.	28,397,784
VA	.	573,345	24,437,711	.	.	.	.	.	.	22,946,188
VI	.	.	.	.	.	.	.	.	.	.
VT	.	.	12,364,261	.	.	.	.	.	.	12,364,261
WA	.	5,573,490	30,875,449	.	.	11,794,540	.	.	.	26,063,899
WI	.	.	15,726,999	.	.	.	.	.	.	15,726,999
WQ	.	.	.	.	.	.	.	.	.	.
WV	.	1,876,163	20,343,405	.	.	.	.	.	.	15,726,594
WY	.	.	.	.	.	.	.	.	.	.
Total	.	7,655,068	29,013,618	.	.	24,624,107	21,512,526	.	.	27,296,966

EXHIBIT 1-K

SITE CHARACTERISTICS AND COST ANALYSES BY STATE
NON-FEDERAL NPL SITES ONLY
ESTIMATED NOMINAL COST
AVERAGE
NPL STATUS

State ID	Deleted NPL	Final NPL	Total
AL	2,374,500	57,706,560	49,801,980
AR	112,866	34,594,560	30,763,261
AZ	.	33,974,328	33,974,328
CA	1,408,865	38,489,931	36,017,860
CO	13,496,520	25,706,217	24,485,247
CT	445,131	20,108,342	16,831,140
DE	812,746	29,347,048	26,176,570
FL	3,996,810	14,062,275	12,974,116
GA	.	14,475,330	14,475,330
IA	4,676,223	5,311,589	5,184,516
ID	.	68,814,810	68,814,810
IL	.	22,546,175	22,546,175
IN	180,613	31,098,616	28,006,816
KS	2,773,107	12,351,631	9,957,000
KY	.	18,475,011	18,475,011
LA	.	47,050,720	47,050,720
MA	738,864	31,503,896	29,694,188
MD	.	14,335,113	14,335,113
ME	.	13,215,305	13,215,305
MI	7,992,494	28,797,108	26,674,188
MN	19,681,607	8,985,890	12,194,605
MO	.	16,710,321	16,710,321
MS	4,272,786	24,723,408	14,498,097
MT	.	34,822,980	34,822,980
NC	.	18,703,327	18,703,327
ND	.	3,685,611	3,685,611
NE	.	31,484,483	31,484,483
NH	.	19,524,436	19,524,436
NJ	962,901	50,405,342	47,152,550
NM	.	14,949,158	14,949,158
NY	28,256,708	29,828,770	29,688,407
OH	.	42,039,226	42,039,226
OK	.	55,356,542	55,356,542
OR	14,571,916	7,180,084	8,658,451

EXHIBIT 1-K

(Continued)

State ID	Deleted NPL	Final NPL	Total
PA	6,882,585	27,918,993	26,006,593
PR	.	6,306,889	6,306,889
RI	.	20,153,130	20,153,130
SC	1,872,027	14,451,264	13,612,648
SD	.	1,682,826	1,682,826
TN	1,693,331	9,215,398	8,463,191
TX	3,378,845	48,302,380	42,442,788
UT	.	18,928,753	18,928,753
VA	573,345	26,094,620	24,393,201
VT	.	12,364,261	12,364,261
WA	575,650	33,481,827	31,288,082
WI	.	15,726,999	15,726,999
WV	1,876,163	25,883,999	17,881,387
Total	7,792,408	29,091,665	27,457,750

EXHIBIT 1-L

Site Characteristics and Cost Analyses by State
Non-Federal NPL Sites Only
Estimated Nominal Cost
Standard Deviation
NPL Status

State ID	Deleted NPL	Final NPL	Total
AL	.	100,877,180	94,432,769
AR	.	51,201,687	49,254,653
AZ	.	21,799,843	21,799,843
CA	1,234,692	51,234,240	50,334,315
CO	.	18,837,644	18,175,147
CT	.	17,153,003	17,315,332
DE	.	39,533,419	38,183,729
FL	4,554,291	18,633,258	17,899,421
GA	.	13,813,427	13,813,427
IA	3,148,575	6,315,871	5,729,550
ID	.	93,384,505	93,384,505
IL	.	25,947,713	25,947,713
IN	144,468	23,172,572	23,895,760
KS	.	9,454,497	9,084,531
KY	.	27,828,592	27,828,592
LA	.	35,783,012	35,783,012
MA	.	29,116,665	29,162,812
MD	.	16,428,029	16,428,029
ME	.	4,197,908	4,197,908
MI	8,891,659	35,821,430	34,591,694
MN	16,656,700	13,731,904	15,077,081
MO	.	17,940,591	17,940,591
MS	.	.	14,460,773
MT	.	35,140,676	35,140,676
NC	.	21,042,609	21,042,609
ND	.	577,386	577,386
NE	.	46,406,366	46,406,366
NH	.	15,541,107	15,541,107
NJ	1,702,904	109,423,261	106,431,308
NM	.	14,756,017	14,756,017
NY	52,413,553	38,296,275	39,157,075
OH	.	40,106,569	40,106,569
OK	.	79,989,582	79,989,582
OR	.	7,974,755	7,656,721

EXHIBIT 1-L

(Continued)

State ID	Deleted NPL	Final NPL	Total
PA	5,105,863	37,916,318	36,661,725
PR	.	3,617,667	3,617,667
RI	.	17,108,656	17,108,656
SC	.	24,593,799	23,920,706
SD	.	.	.
TN	.	7,584,365	7,535,871
TX	1,650,193	57,319,885	55,471,504
UT	.	13,778,021	13,778,021
VA	.	32,381,314	31,891,620
VT	.	17,044,091	17,044,091
WA	.	38,743,582	38,288,823
WI	.	13,016,710	13,016,710
WV	.	6,327,381	14,565,139
Total	17,610,317	49,742,140	48,371,328

Abbreviation: Delt = Deleted

EXHIBIT 1-M

Site Characteristics and Cost Analyses by State
Estimate of Final Disposition of CERCLIS Sites

State ID	Estimated Future NPL Sites	NPL Eligible Sites	Eligible Sites Not Becoming NPL	Current NPL Sites	Proposed NPL Sites	CERCLIS NFRAP State Sites
AK	4.22	49	44.78	8	0	130
AL	6.86	110	103.14	13	1	563
AR	6.86	42	35.14	13	0	343
AS	0.53	1	0.47	1	0	4
AZ	5.80	162	156.20	11	0	699
CA	49.07	424	374.93	93	4	2,434
CM	0.53	2	1.47	1	0	6
CO	8.97	132	123.03	17	2	408
CT	8.44	409	400.56	16	0	327
DC	0.00	9	9.00	.	0	10
DE	10.55	30	19.45	20	0	221
FL	32.71	405	372.29	62	2	552
GA	8.44	243	234.56	16	1	723
GU	0.00	0	0.00	2	0	3
HI	2.11	37	34.89	4	0	104
IA	10.55	189	178.45	20	1	402
ID	4.75	29	24.25	9	2	134
IL	20.58	339	318.42	39	3	1,284
IN	18.47	157	138.53	35	1	1,433
KS	7.91	202	194.09	15	1	339
KY	10.55	90	79.45	20	0	487
LA	7.39	70	62.61	14	3	525
MA	16.36	459	442.64	31	0	516
MD	7.91	72	64.09	15	3	309
ME	6.33	88	81.67	12	0	103
MH	0.00	1	1.00	.	0	.
MI	43.26	148	104.74	82	2	1,495
MN	22.69	53	30.31	43	1	407
MO	12.14	347	334.86	23	0	906
MQ	0.00	0	0.00	.	0	.
MS	1.58	58	56.42	3	2	374
MT	4.22	31	26.78	8	1	177
NC	12.66	176	163.34	24	0	687
ND	1.06	7	5.94	2	0	58
NE	5.28	122	116.72	10	0	235
NH	9.50	107	97.50	18	0	62

EXHIBIT 1-M

(Continued)

State ID	Estimated Future NPL Sites	NPL Eligible Sites	Eligible Sites Not Becoming NPL	Current NPL Sites	Proposed NPL Sites	CERCLIS NFRAP State Sites
NJ	60.68	669	608.32	115	0	926
NM	5.80	61	55.20	11	1	266
NN	0.00	68	68.00	.	0	83
NV	0.53	17	16.47	1	0	157
NY	46.43	521	474.57	88	1	1,059
OH	18.47	212	193.53	35	4	1,078
OK	5.28	106	100.72	10	1	664
OR	6.33	45	38.67	12	1	337
PA	58.04	394	335.96	110	2	2,486
PR	4.75	72	67.25	9	1	179
RI	6.33	150	143.67	12	0	119
SC	14.25	140	125.75	27	0	378
SD	1.58	23	21.42	3	1	77
TN	9.50	260	250.50	18	1	580
TT	0.53	4	3.47	1	0	32
TX	16.36	175	158.64	31	1	2,367
UT	6.33	122	115.67	12	4	163
VA	14.25	166	151.75	27	0	440
VI	1.06	8	6.94	2	0	25
VT	4.22	64	59.78	8	0	69
WA	30.60	43	12.40	58	2	550
WI	22.16	92	69.84	42	0	336
WQ	0.00	0	0.00	.	0	1
WV	3.69	57	53.31	7	1	497
WY	1.58	23	21.42	3	0	121
	707.0	8,292		1,342	51	29,450

EXHIBIT 1-N

Site Characteristics and Cost Analyses by State
Decomposition of Cleanup Costs on Nominal (Undiscounted) Basis

State ID	Total	Known NPL Costs Info	Proposed, Future, NPL Without RODs Costs	Future State Sites From CERCLIS	Known and Suspected State Sites
AK	319,489,408	0	302,208,213	16,260,421	1,020,774
AL	800,243,696	448,217,823	346,932,805	5,093,068	0
AR	793,396,579	276,869,346	317,127,538	134,274,180	65,125,515
AS	42,730,706	0	41,142,605	1,588,101	0
AZ	1,567,135,332	169,871,642	380,810,759	471,423,694	545,029,237
CA	5,852,798,216	1,836,910,841	2,819,368,495	1,196,518,880	0
CM	43,795,977	0	41,142,605	2,653,372	0
CO	2,532,673,723	293,822,963	460,969,706	1,777,881,054	0
CT	1,221,951,570	100,986,839	463,353,987	258,348,791	399,261,954
DC	11,655,672	0	0	6,746,714	4,908,958
DE	873,297,123	261,765,698	593,984,617	17,546,808	0
FL	2,350,861,512	480,042,297	1,399,494,011	471,325,204	0
GA	991,724,244	130,277,969	373,503,457	340,019,537	147,923,281
GU	54,930,528	0	53,865,257	1,065,271	0
HI	246,615,130	0	164,570,421	49,318,319	32,726,390
IA	584,505,779	77,767,735	153,357,978	206,111,312	147,268,753
ID	691,232,055	275,259,240	350,124,976	56,193,554	9,654,285
IL	2,725,877,804	405,831,149	1,256,700,805	413,278,839	650,067,010
IN	1,842,145,754	560,136,321	1,030,338,116	251,433,534	237,783
KS	2,833,456,839	39,828,001	331,837,839	1,152,182,330	1,309,608,668
KY	1,082,270,483	240,175,141	477,323,344	201,140,050	163,631,948
LA	918,648,361	329,355,043	564,049,050	25,244,267	0
MA	1,490,890,190	534,495,385	878,774,882	77,619,923	0
MD	652,692,269	100,345,791	446,525,668	56,789,192	49,031,617
ME	318,235,836	79,291,833	207,749,057	20,801,183	10,393,764
MH	355,090	0	0	355,090	0
MI	4,118,381,348	1,307,035,217	2,274,047,991	537,298,141	0
MN	2,906,326,828	280,475,913	956,689,197	237,828,746	1,431,332,972
MO	4,735,016,944	217,234,172	558,038,707	1,820,468,365	2,139,275,700
MQ	0	0	0	0	0
MS	413,171,342	28,996,194	105,341,631	152,836,918	125,996,600

EXHIBIT 1-N

(Continued)

State ID	Total	Known NPL Costs Info	Proposed, Future, NPL Without RODs Costs	Future State Sites From CERCLIS	Known and Suspected State Sites
MT	505,140,507	243,760,857	189,432,845	53,833,697	18,113,108
NC	1,295,409,231	355,363,204	469,722,304	301,946,448	168,377,275
ND	46,565,796	7,371,221	4,706,911	22,706,163	11,781,500
NE	647,312,745	125,937,933	331,028,329	124,893,704	65,452,779
NH	730,842,884	253,817,669	379,479,281	56,637,947	40,907,987
NJ	12,893,111,192	3,725,051,465	2,808,335,071	494,821,378	5,864,903,278
NM	1,417,017,757	104,644,104	252,408,433	575,205,279	484,759,941
NN	53,618,620	0	0	53,618,620	0
NV	124,994,895	0	41,142,605	61,598,345	22,253,945
NY	4,693,766,786	1,692,239,204	2,304,957,769	544,555,733	152,014,080
OH	2,694,289,058	1,008,941,427	1,039,116,496	451,509,116	194,722,018
OK	716,930,669	498,208,881	216,360,424	2,361,364	0
OR	632,186,956	51,950,703	191,737,787	133,396,259	255,102,207
PA	5,606,039,050	1,768,448,294	2,948,889,901	887,925,859	774,996
PR	244,242,446	37,841,332	77,069,843	87,441,492	41,889,779
RI	579,759,859	161,225,043	276,174,165	93,271,066	49,089,584
SC	962,217,773	217,802,372	638,460,199	105,955,201	0
SD	341,710,585	1,682,826	130,812,764	34,946,971	174,268,025
TN	498,660,443	101,558,298	232,611,772	81,093,105	83,397,269
TT	53,738,503	0	41,142,605	12,595,897	0
TX	5,068,348,941	976,184,131	759,667,084	2,884,224,472	448,273,254
UT	1,740,513,108	151,430,026	365,378,710	686,632,206	537,072,165
VA	1,887,896,556	390,291,224	723,705,515	773,899,818	0
VI	93,628,487	0	82,285,211	11,343,277	0
VT	581,932,996	24,728,522	233,301,964	45,728,198	278,174,312
WA	2,775,542,143	750,913,962	1,975,469,916	49,158,266	0
WI	1,304,403,133	393,174,966	909,049,392	2,178,775	0
WQ	355,090	0	0	355,090	0
WV	541,352,396	71,525,548	192,602,352	195,408,523	81,815,974
WY	196,907,228	0	123,427,816	50,570,940	22,908,473
	91,944,942,173	21,589,085,765	35,287,851,183	18,839,458,067	16,228,547,158

EXHIBIT 2

STATE-ADMINISTERED CLEANUP STATISTICS

State ID	Total Sites	State Sites With Costs	Average State Site Cost	Total Cost State Sites	PRP Sites With Costs	Average PRP Site Cost	Total Cost PRP Sites	Known and Suspected Sites	Identified as Needing Attention
AL	69	26	7,308	190,000	0	0	0	650	125
AK	41	38	95,161	3,616,104	3	9,899	29,697	1,347	1,347
AS	3	0	0	0	0	0	0	.	.
AZ	76	54	231,929	12,524,140	7	2,802,228	19,615,593	1,620	400
AR	.	.	.	0	0	0	0	398	45
CA	850	223	407,141	90,792,505	0	0	0	4,809	1,079
CO	11	1	3,200,000	3,200,000	0	0	0	225	225
CT	642	0	0	0	0	0	0	2,440	649
DE	185	18	69,750	1,255,500	0	0	0	280	120
DC	.	.	.	0	0	0	0	30	0
FL	36	25	487,394	12,184,849	0	0	0	1,023	656
GA	.	.	.	.	.	.	.	904	82
GU	.	.	.	.	.	.	.	.	.
HI	.	.	.	.	.	.	.	200	25
ID	.	.	.	.	.	.	.	59	0
IL	906	375	167,227	62,710,275	138	461,948	63,748,843	5,000	950
IN	79	10	168,113	1,681,128	1	1,000	1,000	2,500	200
IA	.	.	.	.	.	.	.	900	200
KS	183	2	83,500	167,000	14	2,349,000	32,886,000	609	324
KY	.	.	.	.	.	.	.	1,000	600
LA	101	24	41,062	985,483	0	0	0	690	136
ME	70	29	89,742	2,602,516	2	367,500	735,000	419	92
MD	378	8	77,469	619,750	6	236,178	1,417,066	463	198
MA	3,089	33	77,390	2,553,857	0	0	0	7,500	4,500
MI	2,662	496	321,021	159,226,580	0	0	0	.	2,764
MQ	.	.	.	.	.	.	.	.	.
MN	414	89	127,562	11,353,000	89	912,045	81,172,000	3,000	215
MS	110	0	0	0	0	0	0	770	156
MO	44	3	42,667	128,000	5	2,218,000	11,090,000	1,475	200
MT	214	3	253,333	760,000	1	250,000	250,000	277	240
NN	.	.	.	.	.	.	.	.	.
NE	15	0	0	0	0	0	0	400	200

EXHIBIT 2

(Continued)

State ID	Total Sites	State Sites With Costs	Average State Site Cost	Total Cost State Sites	PRP Sites With Costs	Average PRP Site Cost	Total Cost PRP Sites	Known and Suspected Sites	Identified as Needing Attention
NV	34	0	0	0	0	0	0	136	136
NH	.	.	.	.	.	.	.	250	250
NJ	5,996	32	974,329	31,178,532	1,083	288,565	312,516,209	20,000	6,500
NM	58	2	67,500	135,000	1	5,000,000	5,000,000	278	182
NY	556	.	.	.	.	.	.	929	793
NC	873	0	0	0	0	0	0	1,029	801
ND	.	.	.	.	.	.	.	72	0
CM	.	.	.	.	.	.	.	.	.
OH	86	0	0	0	0	0	0	1,190	406
OK	40	29	2,951	85,590	0	0	0	767	162
OR	307	0	0	0	0	0	0	1,559	218
PI	.	.	.	.	.	.	.	.	.
PA	41	26	304,615	7,920,000	1	200,000	200,000	100	50
PR	.	.	.	.	.	.	.	256	256
RI	97	0	0	0	0	0	0	300	40
SC	42	35	201,034	7,036,201	0	0	0	550	120
SD	674	0	0	0	0	0	0	1,065	241
TN	244	43	51,175	2,200,526	29	155,829	4,519,053	1,270	198
TX	200	13	701,077	9,114,000	3	2,783,333	8,350,000	821	66
TT	.	.	.	.	.	.	.	.	.
UT	31	4	32,597	130,389	2	7,000,000	14,000,000	220	0
VT	.	.	.	.	.	.	.	1,700	931
VI	.	.	.	.	.	.	.	.	.
VA	21	2	1,250,000	2,500,000	0	0	0	2,015	363
WQ	.	.	.	.	.	.	.	.	.
WA	1,220	131	83,545	10,944,364	0	0	0	1,364	932
WV	.	.	.	.	.	.	.	500	0
WI	1,849	183	5,131	939,021	0	0	0	4,000	565
WY	.	.	.	.	.	.	.	140	0
	22,547	1,957		438,734,309	1,385		555,530,461	79,499	28,938

EXHIBIT 3

Environmental Analysis
Estimated Share of Clean-Up Cost as a Share of Insurable Costs

Terminology

a. Total Costs include cleanup cost and total transaction costs.[13]
b. Total Transaction Costs include declarative judgment (DJ) costs and all other (non-DJ) costs.
c. DJ Costs represent money spent relating to coverage disputes which would not be recoverable under insurance.
d. Non-DJ Transaction Costs are the total transaction costs excluding DJ costs. They include the cost of negotiating with other PRPs and the government.
e. Insurable Costs are the sum of the cleanup cost and non-DJ transaction costs.

Calculation

			Low Estimate	Average Estimate	High Estimate
(1)	Total Transaction Costs as a Percentage of Total Costs[13]:		19.0%	23.0%	27.0%
(2)	Total Transaction Costs Between 1981 & 1991	$ 27.7 M			
(3)	Total Declarative Judgment (DJ) Costs Between 1981 & 1991	$ 1.7 M			
(4)	Total Non-DJ Transaction Costs Between 1981 & 1991: [= (2) − (3)]	$ 26.0 M			
(5)	Total Non-DJ Costs as a Percentage of Total Transaction Costs Between 1981 & 1991: [= (4)/(2)]	93.9%			
(6)	Total Non-DJ Transaction Costs as a Percentage of Total Costs: [= (1) × (5)]		17.8%	21.6%	25.3%
(7)	Total Cleanup Cost Between 1981 & 1991	$106.4 M			
(8)	Total Costs Between 1981 & 1991: [= (2) + (7)]	$134.1 M			
(9)	Total Insurable Costs Between 1981 & 1991: [= (4) + (7)]	$132.4 M			
(10)	Ratio of Total Costs to Insurable Costs: [= (8)/(9)]	1.013			
(11)	Non-DJ Transaction Costs as a Percentage of Insurable Costs: [= (6) × (10)]		18.1%	21.9%	25.7%
(12)	Selected Percentage: Non-DJ Transaction Costs as a Percentage of Insurable Costs:			20.0%	
(13)	Selected Percentage: Cleanup Cost as a Percentage of Insurable Costs: [= 1 − (12)]			80.0%	
(14)	Selected Percentage: ALAE as a Percentage of Cleanup Costs: [= (12)/(13)]			25.0%	

[13] Data in (1) thru (4) and (7) are taken from Rand's "Private Sector Cleanup Expenditures and Transaction Costs at 18 Superfund Sites" 1993 Study [9].

EXHIBIT 4-A

Countrywide Estimates of Cleanup Costs and Insurance Liabilities Contribution from CERCLIS Sites without PRP Information

Incurred Year	Expected Insured Indemnity	Expected Insured Total LAE
1950	78,360,396	25,838,315
1951	85,610,965	28,257,789
1952	92,024,753	30,388,337
1953	99,721,482	32,956,994
1954	105,716,880	34,887,819
1955	129,700,309	42,911,990
1956	146,961,720	48,589,293
1957	166,175,314	54,927,640
1958	171,891,171	56,725,636
1959	210,012,887	69,420,829
1960	264,283,372	87,621,264
1961	263,778,913	87,324,648
1962	276,911,959	91,483,972
1963	358,320,407	118,354,873
1964	369,920,913	122,378,740
1965	431,886,515	142,733,936
1966	456,064,014	150,810,116
1967	528,178,899	174,313,437
1968	581,024,191	191,998,746
1969	611,209,148	201,852,426
1970	705,690,931	232,725,476
1971	782,649,316	258,557,443
1972	984,303,036	325,372,395
1973	705,151,793	355,230,931
1974	778,481,015	391,476,355
1975	830,139,894	417,893,986
1976	849,086,161	427,854,594
1977	906,657,766	456,487,688
1978	1,047,241,843	529,244,881
1979	1,365,183,212	842,360,896
1980	1,648,470,477	1,140,641,841
1981	1,497,911,940	1,056,043,450
1982	1,111,473,699	839,552,938
1983	986,442,947	793,599,638
1984	896,240,561	740,260,761

EXHIBIT 4-A

(Continued)

Incurred Year	Expected Insured Indemnity	Expected Insured Total LAE
1985	1,036,923,734	903,666,858
1986	747,843,073	673,930,936
1987	422,947,296	600,408,790
1988	605,131,121	486,803,933
1989	558,482,291	477,068,174
1990	474,707,704	385,374,777
1991	392,718,395	311,488,374
1992	352,867,772	277,026,963
1993	190,365,131	151,231,576
1994	139,281,095	112,522,165
	25,444,146,412	14,980,602,621

EXHIBIT 4-B

Countrywide Estimates of Cleanup Costs and Insurance Liabilities Contribution from State Sites without PRP Information

Incurred Year	Expected Insured Indemnity	Expected Insured Total LAE
1950	23,336,106	8,338,011
1951	25,358,564	9,039,625
1952	27,319,522	9,792,835
1953	29,493,937	10,612,216
1954	31,424,145	11,171,526
1955	37,357,631	13,569,170
1956	42,677,906	15,412,940
1957	48,439,574	17,333,095
1958	50,945,064	18,187,952
1959	61,135,128	21,986,674
1960	73,584,559	27,080,882
1961	75,871,208	27,244,333
1962	81,126,395	29,032,359
1963	104,268,905	37,911,136
1964	108,219,776	39,031,999
1965	125,524,641	45,205,169
1966	133,200,244	47,697,450
1967	155,302,630	55,737,992
1968	171,400,936	61,819,904
1969	179,870,661	64,908,772
1970	208,434,792	74,959,018
1971	230,057,736	82,897,716
1972	283,594,912	102,583,930
1973	261,068,409	113,006,054
1974	290,285,859	126,562,599
1975	310,339,209	133,725,246
1976	320,278,029	137,549,183
1977	348,810,469	147,153,365
1978	394,125,435	167,697,746
1979	402,299,968	191,363,415
1980	425,953,289	243,573,494
1981	393,416,023	264,859,819
1982	364,515,316	322,284,348
1983	307,133,799	305,130,024
1984	245,790,016	247,413,545

EXHIBIT 4-B

(Continued)

Incurred Year	Expected Insured Indemnity	Expected Insured Total LAE
1985	221,688,995	308,149,067
1986	167,065,353	242,846,713
1987	147,908,737	207,374,914
1988	100,667,233	178,889,358
1989	114,491,815	196,030,899
1990	103,059,409	179,970,529
1991	56,352,816	104,414,807
1992	80,054,797	121,425,425
1993	47,295,950	56,371,520
1994	28,727,347	24,120,406
	7,439,273,244	4,851,467,183

EXHIBIT 4-C

Countrywide Estimates of Cleanup Costs and Insurance Liabilities Contribution from CERCLIS Sites with PRP Information

Incurred Year	Expected Insured Indemnity	Expected Insured Total LAE
1950	36,124,737	11,703,776
1951	39,506,765	12,817,427
1952	42,448,887	13,762,347
1953	46,031,092	14,925,567
1954	48,753,261	15,791,902
1955	60,158,527	19,509,852
1956	68,064,319	22,068,248
1957	76,910,460	24,920,014
1958	79,313,796	25,698,288
1959	97,223,613	31,532,778
1960	123,313,666	40,014,747
1961	122,378,154	39,685,575
1962	128,044,863	41,521,841
1963	165,888,464	53,808,145
1964	171,093,073	55,490,106
1965	199,990,444	64,901,402
1966	210,998,983	68,455,395
1967	244,062,943	79,115,842
1968	268,320,314	87,024,981
1969	282,348,869	91,501,124
1970	325,723,414	105,569,161
1971	362,557,962	118,592,271
1972	457,508,944	149,594,461
1973	269,598,311	162,800,201
1974	297,117,698	179,762,071
1975	316,655,982	191,861,349
1976	323,322,688	196,260,119
1977	344,114,604	209,185,673
1978	399,958,117	248,706,334
1979	417,433,372	284,561,602
1980	455,593,706	348,004,661
1981	442,254,551	348,295,107
1982	521,449,186	465,396,433
1983	395,828,330	340,207,552
1984	384,771,459	336,795,444

EXHIBIT 4-C

(Continued)

Incurred Year	Expected Insured Indemnity	Expected Insured Total LAE
1985	329,896,771	397,563,712
1986	379,020,264	350,773,713
1987	157,298,911	238,182,926
1988	241,992,415	156,616,132
1989	245,765,651	187,123,419
1990	233,338,009	190,450,997
1991	185,971,174	128,735,547
1992	194,457,021	141,657,392
1993	131,508,517	79,163,605
1994	137,295,225	93,503,327
	10,461,407,514	6,463,612,567

APPENDIX A

MEASURING SITE COST VARIABILITY

There are two sources of site variability that were analyzed. The first is that caused by differences among sites (i.e., the distribution of site cleanup costs). The second is the variability in the cleanup cost associated with the uncertainty in cleanup costs at the site level. Note that the latter is in addition to the EPA accuracy guidelines of −30% to +50%.

To measure the first source of variability, a distribution of cleanup costs was needed. The chosen source was the average present worth by site from the RODs prepared by the EPA. These costs are not at nominal values. Nominal, or undiscounted values, need to be estimated from present worth values, thereby introducing additional uncertainty which detracts from the precision of the measurement of variability that is sought.

The RODs costs were extracted directly from the text of these documents. Where a range of costs was indicated then the average was chosen, with a single cost effectively representing the average for the particular site.

The RODs used at the time covered the time period from 1987 to approximately the end of 1993, with a few RODs actually issued prior to 1987. In order to combine these data on a consistent cost basis, parameters were extracted from the University of Tennessee study [15, p. 15]. The specific parameters were a 2% trend in RODs cost annually plus a 46% increase in costs to represent cost growth as measured by the same study.[14] The average present worth values were trended by 2% from the year of the date the ROD was issued to 1997. The results were then averaged by site, as there are many sites with multiple RODs.

[14]This uniform factor could have been omitted as it would not have affected the shape of the distribution nor the estimated value of σ. A colleague of the author advised as to the potential misleading nature of this cost growth factor due to a mismatching of actual paid costs and expected costs.

Figure A-1 presents the resulting histogram for the 803 sites included in the analysis. The statistic graphed is the natural logarithm of the average present worth by site. Figure A-2 presents a normal probability distribution plot for the same distribution using the observed mean of 15.8135 and standard deviation of 1.506764. Based on this plot and visual inspection of the histogram, it was assumed that these costs could be reasonably described by a lognormal distribution with a coefficient of variation (CV) determined by the standard deviation:

$$\mathrm{CV} = (e^{\sigma^2} - 1)^{1/2} = (e^{1.506764^2} - 1)^{1/2} = 2.9466 \qquad \text{(A.1)}$$

Most importantly, the resulting CV was chosen to apply to the estimated average site cost by state. This was accomplished by multiplying the average cost by a randomly sampled value from the lognormal distribution (with the chosen CV of 2.9466 and a mean of unity) every time a CERCLIS site cost was generated as a state enforced site. Since the mean of the lognormal is equal to $e^{\mu+(\sigma^2/2)}$, the value of μ is solved directly as -1.135169 in order to have a mean of 1 for the underlying σ of 1.506764.

To measure the second source of variability, an analysis was performed of those RODs that contained either a range of estimates or several alternate cost estimates. These ranges are separate and distinct from alternative remedies, and represent contingencies and additional uncertainties with regard to cleanup cost estimates.

Figure A-3 presents a histogram of the relativities. The relativities are measured by comparing a cost estimate to the average for the ROD. A frequency is assigned to each estimate that represents the reciprocal of the number of estimates in that ROD. In this fashion, the relativities from each ROD receive a total frequency (weight) of unity. The resulting histogram is not symmetric because there are RODS with three or four estimates.

Exhibit A-1 presents the table underlying the histogram. The empirical relativities were used as shown when modeling the variability of all site costs that did not have more than one cost estimate (as described in Section 3).

FIGURE A-1

DISTRIBUTION OF SITE COSTS

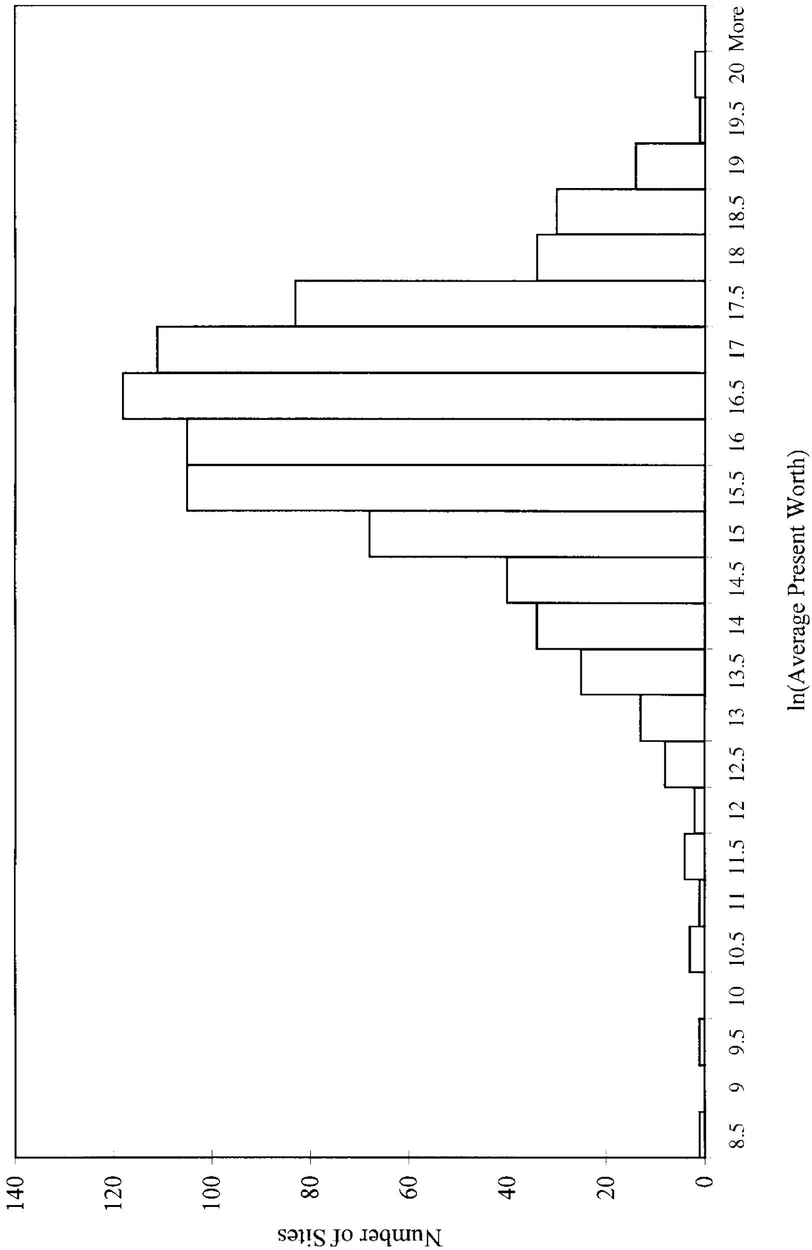

FIGURE A-2

NORMAL PROBABILITY PLOT

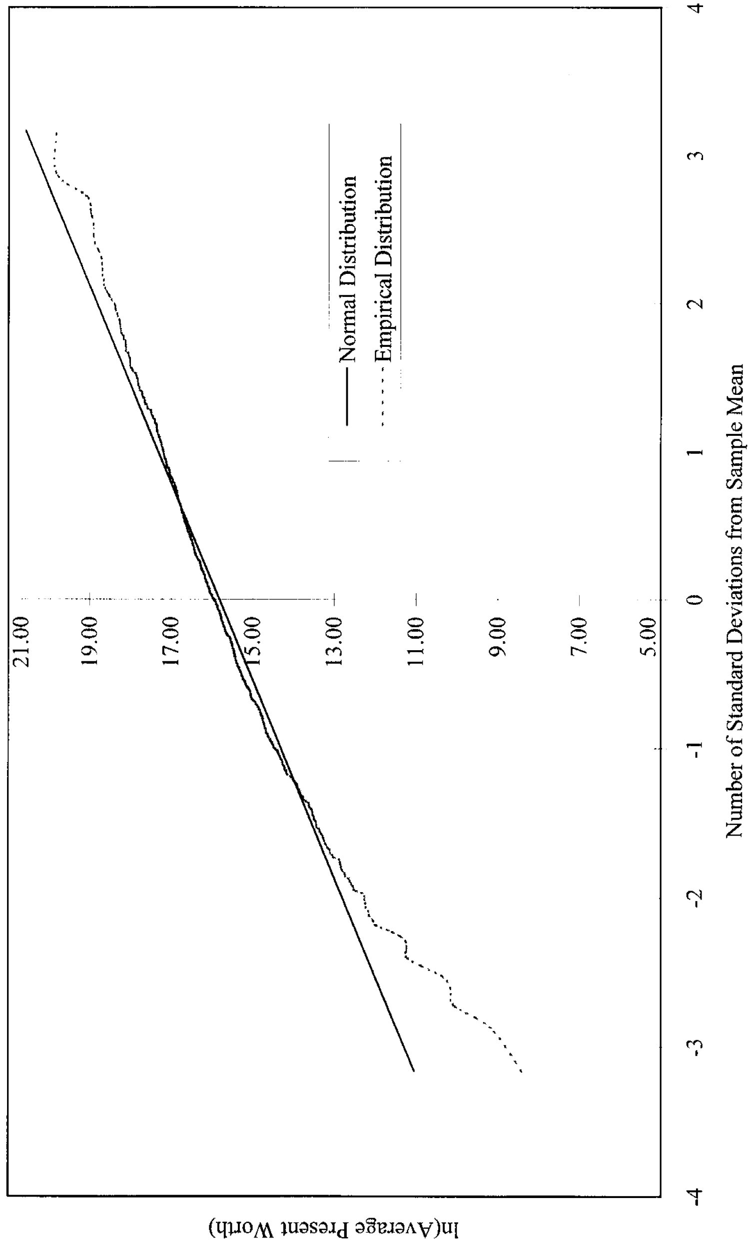

FIGURE A-3

DISTRIBUTION OF RELATIVITIES FOR MULTIPLE COST RODS

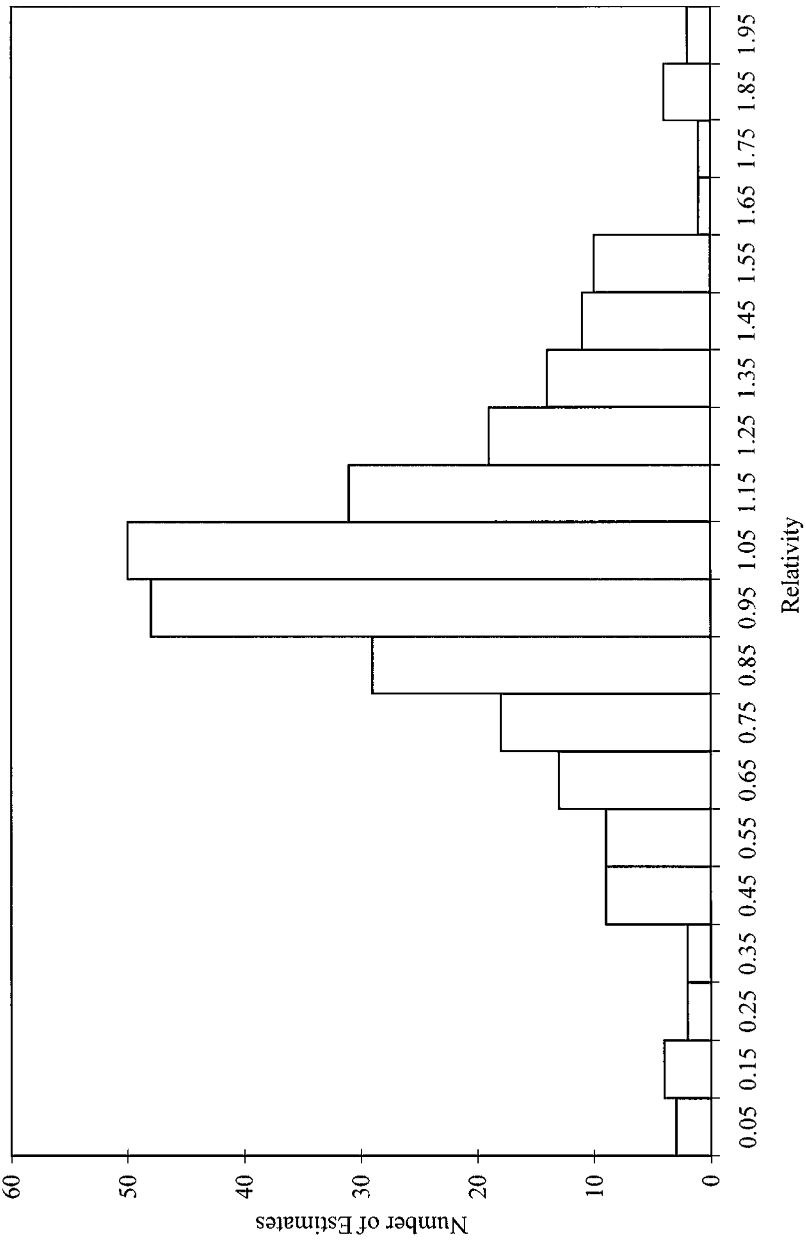

EXHIBIT A-1

Analysis of Relativities for Multiple Cost RODs

Relativity to Unity	Number of Estimates	Cumulative Number of Estimates	Cumulative Distribution of Relativity
0.05	3	3	0.0107
0.15	4	7	0.0250
0.25	2	9	0.0321
0.35	2	11	0.0393
0.45	9	20	0.0714
0.55	9	29	0.1036
0.65	13	42	0.1500
0.75	18	60	0.2143
0.85	29	89	0.3179
0.95	48	137	0.4893
1.05	50	187	0.6679
1.15	31	218	0.7786
1.25	19	237	0.8464
1.35	14	251	0.8964
1.45	11	262	0.9357
1.55	10	272	0.9714
1.65	1	273	0.9750
1.75	1	274	0.9786
1.85	4	278	0.9929
1.95	2	280	1.0000
		Weighted Average Relativity	1.000357

APPENDIX B

ESTIMATING AVERAGE SITE COSTS AND FREQUENCIES BY STATE

The initial steps in this analysis involved obtaining an understanding of the distribution of CERCLIS sites according to several characteristics. Exhibit 1 contains the tables that provide the requisite descriptive summaries.

The distribution by CERCLIS Source indicates that the great majority of sites are on the Archive file (30,428 out of a total of 41,057). All but 69 of these have been identified as NFRAP by the EPA. The other 69 sites were identified as NPL sites and have apparently been removed due to cleanup or other reasons.[15] All of these NFRAP sites are assumed to be subject to remediation under the respective state authorities.

Of the 10,629 Active sites, 1,217 are active NPL sites, 51 are proposed NPL sites, 202 are sites identified or associated with NPL sites, 98 are deleted NPL sites, 46 have been removed from the NPL, and 723 are Federal non-NPL sites. This leaves a balance of 8,292 sites that are non-Federal sites that are eligible for assignment to the NPL in the future.

The estimate of the ultimate number of NPL sites was chosen as 2,100. This selection was based on work performed by the University of Tennessee [15, p. 3] and the American Academy of Actuaries [18, p. i]. It was assumed that the future emergence of NPL sites would conform to the existing NPL distribution of sites by state. This assumption was based on the reasoning that state characteristics differ in their reflection of long-time industrial and manufacturing use or, alternatively, rapid industrialization and development since the Second World War are causal factors in the emergence of NPL sites by state to date.

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[15] One site is actually shown as an active NPL site.

Likewise, when addressing the estimate of future average NPL cleanup costs by site, it is these same states' densities of sites that are likely to affect the inclusion of sites by state underlying that average. Individual state average cleanup costs for NPL sites were precision (credibility) weighted with overall countrywide estimates in order to estimate future average NPL cleanup costs by site as described below.

Exhibit 1 also contains information on the distribution of RODs with cost information, as well as the average present worth and average nominal cost of cleanup. All of the 803 sites discussed in Appendix B have been associated with NPL sites at one time or another. The estimated nominal costs are based on the analysis of present worth values by RODs and the direct estimate of undiscounted values. The default value of .672 for the present value factor[16] was used when insufficient information was available for a ROD to perform this estimate specifically. Values were trended to 1997 at an annual inflation rate of 2%, as performed in the analysis described in Appendix B.

The values used for the estimation of future NPL cleanup costs weres based on the nominal costs for non-Federal Deleted and Final NPL sites. The averages and the standard deviation of these costs are shown on Exhibit 1. The following notation applies to the estimation of the future average NPL cleanup cost and estimate of the number of future NPL sites by state:

μ_i = average (mean) of the nominal non-Federal Deleted or Final NPL cleanup costs for state *i*,

μ_{CW} = the average of the state means of the nominal non-Federal Deleted or Final NPL cleanup costs,

σ_i = standard deviation of nominal non-Federal Deleted or Final NPL cleanup cost for state *i*,

[16]This value is the average present value factor obtained after removing outlier factors of .4 or less and of .95 or greater.

σ_{CW} = standard deviation of the state averages (mean) of the nominal non-Federal Deleted or Final NPL cleanup costs,

z_i = precision weight (credibility) estimated for state i average,

$\hat{C}_i$ = precision-weighted estimate of future average NPL cleanup cost for state i,

$\hat{M}_i$ = final balanced estimate of future average NPL cleanup cost for state i,

NPL_i = current number of NPL sites for state i. This is composed of CERCLIS sites identified as Deleted or Final NPL sites (NPL Status D or F) for non-Federal sites,

P_i = number of Proposed NPL sites for state i (NPL Status P),

Q_i = number of sites eligible for future NPL status for state i, defined as sites with current NPL Status of Q (non-Federal and not NPL), and

FNPL_i = estimated number of future NPL sites for state i.

The precision-weighted estimates of the mean future NPL site cleanup cost are estimated as follows:

$$z_i = \frac{\frac{1}{\sigma_i^2}}{\frac{1}{\sigma_i^2} + \frac{1}{\sigma_{CW}^2}}, \qquad \text{and} \tag{B.1}$$

$$\hat{C}_i = z_i \cdot \mu_i + (1 - z_i) \cdot \mu_{CW}. \tag{B.2}$$

The estimated means were balanced to the overall country-wide average by uniformly applying the ratio of the average countrywide NPL cleanup cost to the weighted average of the state-estimated average future NPL cleanup cost, using the number of NPL sites by state as weights:

$$\hat{M}_i = \hat{C}_i \cdot \frac{\sum_{\forall i} \mu_i \cdot \mathrm{NPL}_i}{\sum_{\forall i} \hat{C}_i \cdot \mathrm{NPL}_i}. \tag{B.3}$$

At the time of the analysis, Guam had two NPL sites and no site eligible for future NPL status. With this restriction in mind, the number of future NPL sites for Guam was set at zero while for all other states it was estimated by:

$$\mathrm{FNPL}_i = \frac{\mathrm{NPL}_i}{\sum_{\forall i} \mathrm{NPL}_i - 2} \cdot \left(2100 - \sum_{\forall i} \mathrm{NPL}_i - \sum_{\forall i} P_i\right). \tag{B.4}$$

The value of 2100 represents the estimated ultimate number of NPL sites referred to earlier. The frequency with which a status Q site becomes a future NPL site is the ratio of FNPL_i to Q_i by state.

The last input to the estimation process is provided by the limited aggregate information provided on state- and territory-administered cleanup efforts. Exhibit 2 shows the aggregate information obtained from [11] and [12]. Integrating this information with the cost information obtained from the RODs text made use of three important observations from review of this EPA state and territory study:

- Federal Total Costs averaged \$1.669 million per site at that time but the expected future average is expected to be \$25 million [11, p. ES-10].
- The average state cost is \$300,000 and the average PRP cost is \$401,000 [11, p. ES-8], the latter representing approximately one-quarter of the aforementioned Federal cost.
- The total cost for the states is \$1.205 billion on 3,395 sites [11, p. ES-8].

It is important to note that these are actual paid costs that comprise a portion of ultimate total cleanup costs, the latter including operation and maintenance costs. This phenomenon is likely to influence the translation of average costs to an ultimate basis for federal NPL sites to a greater extent than sites subject to state-administered cleanup efforts. It is certainly an aspect that may point to a downward bias in total cost estimates.

This cost information includes enforcement as well as voluntary cleanup efforts, creating an average that will likely tend to be understated. Furthermore, there may be sites where both the state and PRP costs are involved, yet only one of the parties reported its costs. This would also tend to understate any average cost estimates.

The data by state as they appear in Exhibit 2 appear incomplete, and countrywide statistics were used in the estimation process. Specifically, the following identity was employed:

$$\text{Total Cost} = \text{State Average} \times \text{State Sites} + \text{PRP Average} \times \text{PRP Sites}. \tag{B.5}$$

Based on the national data summary from the EPA state and territory study [11, p. ES-8], there were a total of 3,395 sites countrywide, 2,167 state sites, and 1,385 PRP sites, the latter two quantities adding to 3,552. This relationship between the number of "total" countrywide sites (3,395 being less than 3,552, or what appears to be "the sum of its parts") reflects the fact that there is an overlap between the state sites and the PRP sites (i.e., there are sites that carry both state and PRP costs). The scalar reflecting this ratio (i.e., 3,395/3,552) was applied to the sum of the state and PRP sites by state in order to better estimate the total number of true separate and distinct sites.

Given the estimate of the number of sites by state, the average cost per site is estimated as the total cost divided by the total number of sites by state. For those states without state and PRP site count information, the countrywide average was used

($1,205,531,234/3,395 sites). The PRP insurable share is estimated as the ratio of the PRP cost to the total cost by state. For states without this cost information, the countrywide average was used ($555,530,464/$1,205,531,234). Note that this component of the model derives the insurable cost from state sites similar to the CERCLIS estimate that includes non-Federal sites only.

The average state site cost is multiplied by the applicable CERCLIS sites that do not become future NPL sites (NFRAP sites plus the remaining eligible sites that do not become future NPL sites) in order to estimate the total cleanup costs associated with state-administered programs. This average is not greater than the estimated average state PRP site cost, therefore permitting a measure of conservatism in some states for those sites arising from CERCLIS. The average state PRP site cost is multiplied by the sum of the number of known or suspected sites by state and the expected number of future state sites. The latter quantity is implied by the difference between the total sites and the estimated true number of sites, derived from the application of the countrywide site scalar mentioned above.

The dollar amounts included in this study are in nominal dollars. Average costs derived from these data are therefore not present value estimates, but rather nominal (undiscounted) costs at the level of the years in which they were spent. No inflation adjustments were made to the average cost estimates for future cleanup costs.

The final results for insurable costs are shown in Exhibit 4. The total cleanup costs were simulated with a mean of $87.9 billion. The histogram of the results is displayed in Figure B-1. The effects of the simulation from the CDM are to reduce the cleanup costs that are indemnified by approximately 50%. Given an average LAE factor to cleanup cost of 29.9% from Exhibit 3, the expected value estimate of total insured costs is approximately $73.4 billion. This compares with the simulated mean of $69.6 billion contained within the histogram of the results displayed in Figure B-2.

FIGURE B-1

SIMULATED DISTRIBUTION OF UNDISCOUNTED CLEANUP COSTS

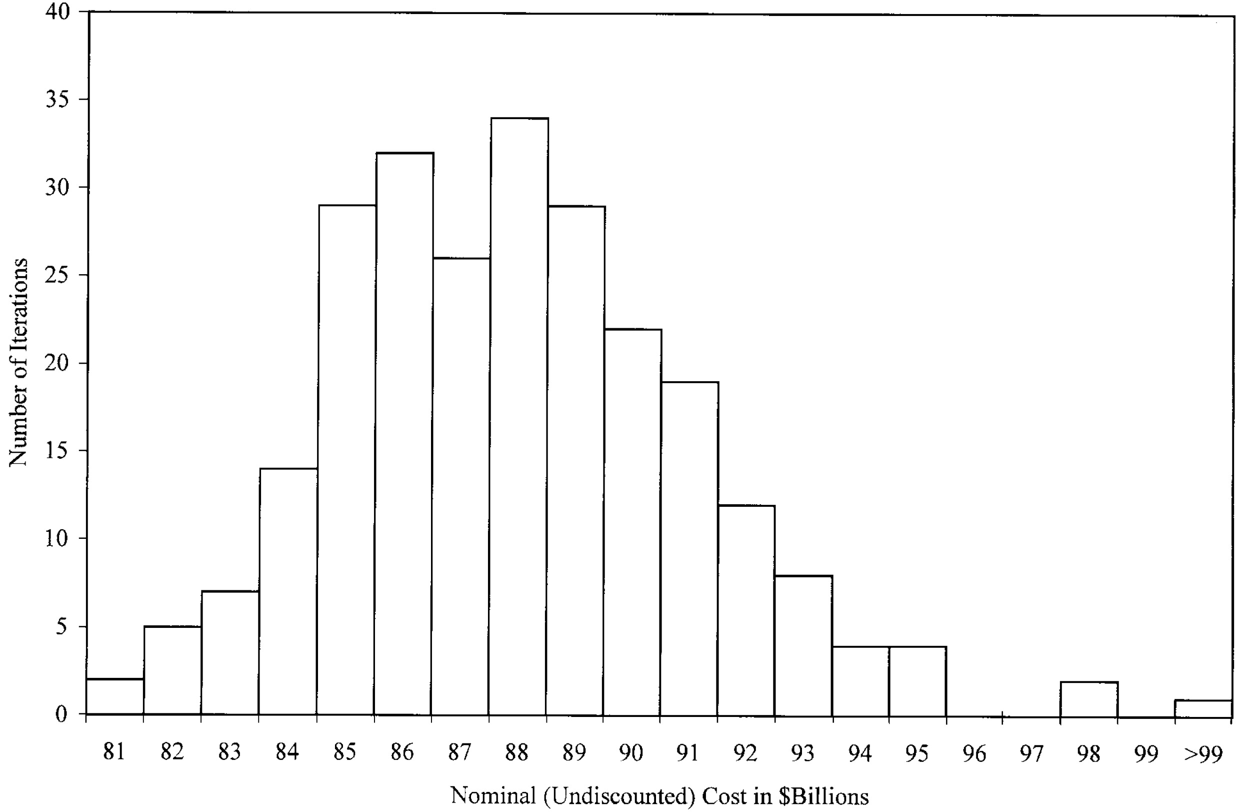
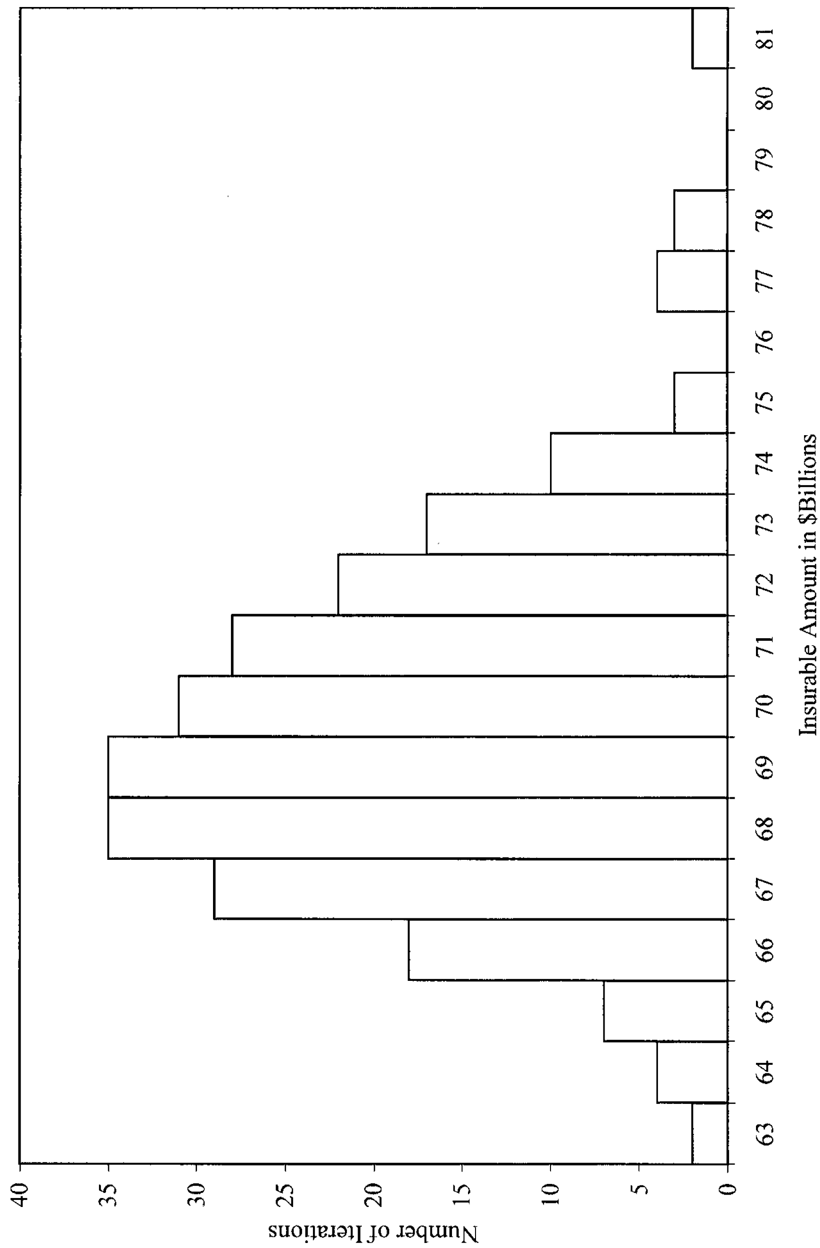


FIGURE B-2

SIMULATED DISTRIBUTION OF INSURABLE INDEMNITY LOSSES & LAE



APPENDIX C

PRP SHARES

Shares have been assigned to PRPs in one of two different ways when estimating pollution liabilities using the PCSM. In some instances, a specific share was obtained from information contained in the claim files of an insurer or reinsurer when performing a portfolio analysis. In all other cases a simulated share was assigned to a PRP by using a Beta distribution. The total of all shares for a site is balanced to unity, including both simulated and specific shares. The remainder of this appendix will discuss the simulation of PRP shares that is used for the industry estimate.

The Beta distribution used in the simulation has the following form:

$$B(x,\alpha,\beta) = \frac{\int_0^x t^{\alpha-1}(1-t)^{\beta-1}dt}{\beta(\alpha,\beta)},$$

$$\text{where} \quad \beta(\alpha,\beta) = \frac{\Gamma(\alpha)\Gamma(\beta)}{\Gamma(\alpha,\beta)}. \tag{C.1}$$

The mean of this distribution is set equal to the reciprocal of the number of PRPs. In order to afford higher probabilities at or near zero, α is equal to the reciprocal of the number of PRPs whenever the number of PRPs is greater than one. The reason for creating higher probabilities at or near zero is to afford a simulation of the *de minimis* shares phenomenon. This phenomenon results from the incidence of many PRPs on a site that have been determined to be minor (*de minimis*) contributors to the pollution at the site. Setting α equal to the reciprocal of the number of PRPs results in a value less than unity, thereby providing the sought after shape of the distribution—a large mode at zero (0% share) and a much smaller secondary mode at unity (100% share).

TABLE C-1

BALANCED SIMULATED AND SPECIFIC SHARES

Individual PRPs	Beta Distribution Simulated Share	Balanced Share
1	0.2000	0.2000
2	0.8526	0.5644
3	0.0003	0.0002
4	0.0001	0.0001
5	0.2535	0.1678
6	0.0000	0.0000
7	0.0000	0.0000
8	0.0130	0.0086
9	0.0632	0.0418
10	0.0258	0.0171
Total Excluding PRP-1	1.2085	1.0000

If we let n be the number of PRPs and M be the mean of the Beta distribution, then we have the following relationships:

$$M = \frac{\alpha}{\alpha + \beta} = \frac{1}{n}, \qquad \alpha = \frac{1}{n}, \qquad \text{and} \qquad \beta = \frac{n-1}{n} = 1 - \alpha.$$

This distribution is used for each site for which shares were simulated during each iteration of the PCSM simulation for a portfolio. To illustrate the process for ten PRPs on a site, the Table C-1 reproduces a sample iteration for ten PRPs with the introduction of a fixed known share of 20% for PRP-1. PRP-1 represents a specific share assignment encountered during a portfolio analysis as mentioned earlier.

Each of the nine other PRPs have shares simulated with a total excluding PRP-1 determined. The parameters of the Beta distribution in this case are $\alpha = .1$ and $\beta = .9$. The shares of these other nine PRPs are then balanced to produce unity when including the known fixed share of PRP-1. Note that this particular example includes several PRPs with *de minimis* shares.

APPENDIX D

Derivation of Scalars For Samples

When estimating ultimate pollution losses for a portfolio, it is necessary to determine a scalar that can be applied to the costs simulated by the PCSM. This is because only a sample of sites and PRPs exists for the simulation employed for any portfolio. In the cases where there does not exist an exhaustive list of PRPs and policies exposed to pollution liabilities, which will often be the case, a pro-rata scalar can be used of the following form:

$$Ins_T(P) = \frac{CU_T}{CU_N(S)} \cdot Ins_N(S). \qquad \text{(D.1)}$$

The scalar represents the ratio shown on the right-hand side of the formula above. This ratio will vary from one portfolio to another. The following notation will be employed to show how this scalar is derived:

$CU_X(Y)$ = total cleanup and operation and maintenance costs relating to portfolio Y of potentially responsible parties (PRPs) from subset X of all sites (cleanup costs),

$Ins_X(Y)$ = Insured costs related to portfolio Y of PRPs from subset X of all sites,

N = NPL and CERCLIS (national) sites with potentially responsible parties (PRPs) information,

T = all sites countrywide, including CERCLIS and state- and territory-administered sites, and

S = national sites included in the sample employed by the PCSM.

If the PRP portfolio is not designated in a term, then the entire population of PRPs is implied. In this presentation, the value of P refers to the PRPs associated with the portfolio under analysis.

The value of S refers to the sample (subset of the portfolio) of PRPs that is used in the simulation model.

It is important to note that often not all underlying insureds embedded in the portfolio can be identified. The insureds from primary policies can frequently be identified over a long period of time, although the volume of names can become overwhelming from an analytical perspective and perhaps less reliable for older policy periods. Usually, all the direct excess policies and facultative reinsurance contracts within a portfolio can be matched to the EPA SETS (albeit with no accounting of aliases and subsidiaries); however, the underlying insureds identified for excess of loss and proportional reinsurance treaties represent samples based on the identification of PRPs through an audit or review of claim files, or as captured from their identification on actual reported claims. The simulation therefore employs a sample (subset) of all national sites and their PRPs to which the portfolio is exposed, incorporating only those PRPs that could be identified from the total set of PRPs embedded in the portfolio.

The use of a PRP sample implies that an estimate of the total insured costs for the portfolio can be extrapolated from the simulated costs for the sample by employing two ratio estimates. The first ratio results when the cleanup costs of all national sites is compared to the cleanup costs from the sample. This first ratio is applied to the insured costs from the sample to derive the estimated national cleanup cost for sites associated with the portfolio. The national cleanup cost is then used to determine portfolio insured costs arising from all sites countrywide (population) by applying the second ratio. This second ratio compares all sites' countrywide insured costs to national sites' insured costs. The equation representing this estimate is:

$$Ins_T(P) = \frac{CU_N}{CU_N(S)} \cdot Ins_N(S) \cdot \frac{Ins_T}{Ins_N}. \qquad \text{(D.2)}$$

This formula can be rewritten by rearranging terms as:

$$Ins_T(P) = \frac{Ins_N(S)}{CU_N(S)} \cdot Ins_T \cdot \left(\frac{CU_N}{Ins_N}\right). \qquad \text{(D.3)}$$

It is assumed that the ratio of cleanup costs to insured costs is the same for national sites as it is for all sites, that is:

$$\left(\frac{CU_N}{Ins_N}\right) \approx \left(\frac{CU_T}{Ins_T}\right). \qquad \text{(D.4)}$$

Note that this assumption presumes that the insurance coverage of insureds is commensurate with their hazard. As an example, a corporate entity that is not a Fortune 500 company may purchase insurance that attaches at a lower amount due to its smaller self-insurance capacity. However, that smaller entity's involvement at a site with lower cleanup costs could still result in an insured loss commensurate with, say, a Fortune 500 company's share of costs at an NPL site.

The formula now reduces to:

$$Ins_T(P) = \frac{Ins_N(S)}{CU_N(S)} \cdot Ins_T \cdot \left(\frac{CU_N}{Ins_N}\right). \qquad \text{(D.5)}$$

Cancellation of total sites' insured costs results in the scalar equation cited earlier:

$$Ins_T(P) = \frac{CU_T}{CU_N(S)} \cdot Ins_N(S). \qquad \text{(D.6)}$$

The scalar used for any given portfolio is the ratio from the simulation of all sites' countrywide cleanup costs to the sampled national sites' cleanup costs.