The Feasibility of an Environmental Assurance Program in North Carolina

By Julia Logeman
May 2008

Date:_____

Approved:

_____
Dr. Lynn Maguire, Advisor

Masters project submitted in partial fulfillment of the
requirements for the Master of Environmental Management degree in
the Nicholas School of the Environment and Earth Sciences of
Duke University
2008

Abstract

The financial cost of private industry's pollution is often unfairly transferred to the public. Decades can pass between a pollution release and its discovery, making it very difficult for regulators to hold responsible parties accountable. In North Carolina, a prime example of the public shouldering this burden is the primarily publicly financed State Trust Fund for cleaning up after leaking underground storage tanks. One way to ensure polluters pay for remediation is to require financial assurances prior to permitting. There are several mechanisms available that do this, including surety bonds, environmental insurance, and cash accounts signed over to the regulator. In this study, the most commonly used assurance mechanisms were evaluated using a multi-criteria decision analysis and the criteria most important to regulators and industry: contractual strength, verifiability, flexibility, ease of acquisition, and availability/control of funds. These criteria were derived using each party's core objectives. For regulators, these are protecting the environment and the public and doing so in the least costly way. For industry, these are making profit and meeting the necessary environmental regulations in the least costly way, so that they are allowed to do continuing business. Using North Carolina's underground storage tank issue as an example, the mechanisms were then ranked by their performance for each criterion. Surety bonds ranked as the best instrument to meet both parties' needs, providing regulators with a high degree of contractual strength while allowing industry freedom from needing to cover its entire environmental liability up front. Like surety bonds, insurance and letters of credit provide adequate contractual strength and flexibility, but they are not as easily verified by the regulator. Financial self-tests and corporate guarantees were found to be insufficient because they performed at the least preferable level for regulators in all criteria and provided industry with little flexibility. This evaluative framework should prove useful to policymakers as they try to address the unfair liability private industry's pollution creates for the public. A statewide assurance program is a feasible solution to this problem given the satisfactory performance of several assurance instruments.

Table of Contents

List of Tables:

Acknowledgements:

I would like to thank Dr. Lynn Maguire. Her assistance and insight were indispensable. I would also like to thank Hope Taylor-Guevara of Clean Water for North Carolina who helped me shape an ideal into a project.

Introduction

Whether it is driving a car, riding an elevator, or simply walking down the street, we all face a certain amount of risk on a regular basis. The government uses regulations and laws, such as seatbelt laws, to bring these risks down to acceptable levels. Environmental regulators have worked hard over the last several decades to lower the risk from pollution, and result is cleaner air and water. A great deal still needs to be done, however. The public still faces risk – physical and financial – from pollution.

A pollution release triggers a series of several actions: the damage must be assessed and a remediation plan created, approved by regulators, and carried out in practice. Straightforward in theory, this system has not proven to be completely effective, discouraging industry from accounting for the full environmental costs of their actions and too often leaving the public liable for the cleanup. Lengthy legal battles, bankruptcy, and outright abandonment all represent obstacles for regulators to overcome in order to hold polluters financially responsible.

A prime example of this in North Carolina is the problem of leaking underground storage tanks (USTs). These tanks are designed to hold thousands of gallons of oil, gasoline, or diesel fuel, and small leaks can occur from corrosion and improper maintenance (EPA, 2007). These leaks can go undetected for years (most of the state's tank are decades old), leaving the surrounding soil, surface water, groundwater, and ultimately any nearby wells at risk for contamination (EPA, 2007). In 1988, a State Trust Fund, predominantly financed with a portion of the state gasoline tax, was created to reimburse tank owners for the cleanup costs, up to $1.5 million, associated with a leaking UST (NC DENR, 2006). Once a site has been determined to be a threat to public safety,

the Trust Fund authorizes the tank owner to begin remediation and often pays the contractor directly for this work, removing the tank owner from the remediation process. Aside from a $20,000 deductible required by the Trust Fund and a 20% co-pay for costs greater than $1 million, all cleanup activities are paid for by the public, and the tank owner is freed from financial responsibility (NC DENR, 2007).

This situation is not only unfair to the public; it creates a negative incentive for technological innovation (Costanza & Perrings 1990). Polluters can rely on outdated, environmentally risky technology with the assurance that the state will eventually pay for remediation.

Every year, North Carolina spends millions of dollars of taxpayer money to clean up pollution created by private industries. In most cases, this occurs by default – the responsible party cannot be found or is no longer financially solvent. There are some instances where the state assumes liability by design, such as the Underground Storage Tank Trust Fund. In either case, the public unfairly shoulders the financial risk associated with a private enterprise.

Environmental assurances represent one possible solution to this problem. Based on the precautionary principle, which states that regulators should be proactive in pollution prevention, rather than waiting for its ill effects to be proven, assurances require that a potential polluter either provide resources up front to pay for future environmental damages or prove that adequate resources exist (Costanza & Cornwell, 1992; Boyd, 2001). This essentially forces firms to internalize the environmental costs of their actions, creating an incentive to develop and implement less environmentally risky techniques (Ferreira et al., 2004). In fact, because assurances force firms to account for

the uncertainty regarding the environmental effects of their actions, they extend the "polluter pays" principle one step further. This is referred to as the "precautionary polluter pays principle," or 4P approach (Costanza & Cornwell, 1992). Firms, however, would not be unduly punished; any funds unused for environmental damages would be returned upon the expiration of the permit (Costanza & Cornwell, 1992).

This concept is hardly new: environmental bonds were first used in "materials use fees," a familiar example of which is the refunded deposit on recycled glass bottles (Costanza & Perrings, 1990). A small fee is added to the bottle's price, which acts like a deposit, encouraging consumers to recycle the bottles and get their deposits refunded rather than throwing the bottle into the trash or simply littering. This example may seem overly simple, but the key characteristic of the program is that it charges customers in advance of any environmental harm they might cause with the bottle. The burden of proof falls on the customer to prove that no damage was caused by returning the bottle (Costanza & Perrings, 1990). After the success of this program with beverage containers, it was applied to pesticide containers, lead acid batteries, and tires (EPA, 2006).

There are several assurance instruments available currently, including bonds, insurance, trust funds, letters of credit, cash accounts, self-tests, and corporate guarantees (Boyd, 2001). Instruments such as bonds and cash accounts that require actual funds prior to permitting best protect the state and taxpayers because they provide the strongest guarantee that cleanup resources will be available if and when needed (Costanza & Cornwell, 1992). Less stringent forms of assurance such as the letter of credit, self-test, and corporate guarantee do not provide any "hard cash," but instead aim to prove that the company is financially stable enough to undertake the environmental risk (Boyd, 2001).

Firms tend to favor these types of assurances because they impose the fewest financial constraints (Shogren et al., 1992). Trust funds and insurance policies fall between these extremes, their effectiveness depending on their design and implementation (Boyd, 2001).

Various assurance instruments are currently in place in the United States, regulating oil and gas wells, landfills, hazardous waste storage facilities, and hardrock mines, for example. Each of these assurance systems has met with mixed success, however. One of the main concerns regarding assurances revolves around determining the coverage required. Determination of the cost of a "worst-case" scenario is still an inexact science because costs vary between cases and over time (Boyd, 2001). These uncertainties can result in extreme undercoverage, as seen in the US hardrock mining industry, which is believed to have underestimated closure costs by nearly one billion dollars nationally (Kuipers & Carlson, 2000).

A related issue is the effectiveness of those instruments that rely on the firms to report their financial standing. Self-tests and corporate guarantees, especially when firms are allowed to estimate their own financial obligations, have proven to be quite unreliable, leaving the public at risk (Boyd, 2001). Careful examination of a firm's cost estimation and financial standing is necessary for these tools to work effectively, but regulators rarely have the resources to do this (Boyd, 2001).

By determining whether environmental assurances should be used to shift environmental liability from taxpayers to polluters, this study helps bring true polluter accountability within reach. Because current taxpayer liability in North Carolina is quite large – USTs alone represent over 6,000 pollution clean-ups the public will eventually

pay for – increased polluter accountability has the potential to save taxpayers millions of dollars in remediation costs and avoided pollution events every year (NC DENR, 2006).

Objectives:

My objective is to determine whether a statewide environmental assurance program is a feasible solution to the problem of misplaced environmental liability in North Carolina. Specifically, I will demonstrate the costs of pollution cleanups to the public, determine the potential and appropriateness of environmental assurance instruments to properly hold polluters accountable for the damages they cause, and create policy recommendations regarding the implementation of a statewide environmental assurance program.

Methods:

The project was completed in several stages. The first was to examine the current situation in regards to equity in North Carolina, that is, how pollution cleanup costs are shared between polluters and the public. I did this by conducting three case studies of pollution releases in the state to determine to what extent the state is liable for private polluters' risk and the criteria upon which the assurance instruments should be judged. I concentrated primarily on USTs because North Carolina has more than 30,000 active USTs (over 20% of the nation's total), making this a potentially significant source of liability (EPA, 2007). In the case studies, I explained the cause for the pollution release, the remediation actions taken, the cost for these actions, and the amount of this cost that the state of North Carolina has paid for. All of the data for the case studies came from the North Carolina Department of Environment & Natural Resources (NC DENR), which keeps this information in public records.

I conducted an extensive literature review to understand how the most common assurance instruments are designed to work and how they perform when put to practical use. To do this, I looked to both academic articles as well as government- or non-governmental organization-generated reports, such as the National Wildlife Federation's summary report on the use of bonds for hardrock mine reclamation in the western US (Kuipers & Carlson, 2000). By collecting information on the use of assurances both in theory and in practice, I sought to get a better understanding of regulators' and industry's expectations of an assurance program and how well given instruments meet these expectations.

Given the numerous assurance mechanisms available and that polluters and regulators are often at odds over how to handle environmental liability, it would be extremely difficult to decide which instruments were most appropriate to use in a statewide program without a guiding framework. In this study, I used the examples of assurances in practice to generate the core objectives of regulators and industry. I assumed that the public is concerned about decreasing environmental liability without harming the economy and that these concerns will be represented by regulators and industry, respectively. From these objectives, I generated a list of criteria that are most important for the mechanisms to meet. I then conducted a multi-criteria decision analysis (MCDA) to determine which mechanisms best meet the criteria.

A MCDA attempts to optimize decision-making in situations where the problem, like polluter accountability, entails multiple conflicting objectives and a number of potential solutions. Once a problem is defined, a list of available solutions or alternatives is generated. These alternatives can then be systematically evaluated based on a chosen

set of criteria most critical to meeting the stakeholders' objectives (Ferreira et al., 2004). To further strengthen the decision model, the relative importance of each criterion to each stakeholder can be incorporated through the use of weights (Ferreira et al., 2004).

MCDA has been used previously to determine which instruments perform best in the oil-drilling industry (Ferreira et al., 2004). In this 2004 study by Ferreira et al. criteria were generated based on assumptions about the perspectives of key stakeholders, and bond specialists were asked to rank several common instruments on the criteria. The performance of each alternative was evaluated numerically, and weights were included to reflect the relative importance of each criterion. The study found that surety bonds best met the criteria of both regulators and the oil industry (Ferreira et al., 2004). Insurance policies and letters of credit performed acceptably well too, but did not provide regulators with as much protection from liability as did surety bonds (Ferreira et al., 2004).

To demonstrate the efficacy of the MCDA, I applied it to the problem of leaking underground storage tanks, making educated assumptions about the preferences of regulators and industry in this scenario. Then, I created an example list of the most appropriate assurance policies for the UST problem in North Carolina. Based on these results, I created my final policy recommendations on how environmental assurances can be used to correct the current inequity in pollution cleanups.

Background

It is difficult to imagine the amount of money North Carolina spends every year to clean up pollution events. Most of the clean-ups remain low profile, with only the most devastating cases attracting media attention; and, even if someone was interested in this information, the data required is spread throughout several branches of the North

Carolina Department of Environment and Natural Resources (NCDENR). The following case studies are presented to provide the reader with an understanding of what a single leaking underground storage tank can mean for the state in terms of human health effects and displacement, remediation costs, and long-term monitoring.

Case One: Senter Sanders Tractor Corporation

In 1993, a UST leak was discovered at the Senter Sanders Tractor Corporation property, located near Fayetteville Road in Raleigh, North Carolina. Site assessment revealed that the property's soil was contaminated with petroleum products, and monitoring wells that were dug on-site led to the discovery of benzene, toluene, ethyl benzene, xylenes, methyl tertiary-butyl ether (MTBE), and naphthalene in the groundwater (NCDENR, 2007). The contaminated soil was excavated, treated, and disposed of, and free product, the visible petroleum that sits on the groundwater's surface after a release, was passively recovered using a hand skimmer and bailer (NCDENR, 2007). A groundwater pump and treat system, installed in the previous year due to an earlier UST leak, was used from 1993 until 2004, treating a total of nearly three million gallons of groundwater (NCDENR, 2007). Additional monitoring wells were put in place and all wells on the property were tested semi-annually until the UST Trust Fund closed the site in 2005.

This case became difficult to manage because of the site's history and costly errors during the remediation processes. Prior to 1977 the property was home to a gas station, and in 1981 Mr. Senter purchased the property, which had been vacant for four years, and resumed the use of the three existing USTs (NCDENR, 2007). These tanks, which held a combined volume of 5,000 gallons of fuel, were removed in 1989, after

someone suspected that the well water was contaminated and chlorinated solvents were detected (NCDENR, 2007). In 1993, 2-4,000 gallon gasoline storage tanks were removed from the property after another release was detected, however remediation was not fully completed because the contaminated soil was used as backfill after the tanks were excavated (NCDENR, 2007). Human error led to the release of 4,000-5,000 gallons of untreated groundwater back onto the ground in 1997, and after the removal of a 1,000 gallon waste oil UST in 1999, chromium was found in the soil (NCDENR, 2007).

The site's location added further complexity to the remediation process: there were several other groundwater contamination sites nearby, including two other UST leaks and a dry cleaner that had improperly disposed of its solvents. In 1991, a groundwater contamination plume was found to extend at least 50-100 feet down-gradient of the Senter property, however, it is likely that contamination from these other sites, up-gradient of the Senter site, contributed to this as well (NCDENR, 2007). Additionally, there were twelve drinking water wells within 1500 feet of the site, nine of which were in use at the time. Municipal water lines were accessible through the city of Garner, NC, but residents were concerned that this would cause their properties to be annexed, leading to higher taxes (NCDENR, 2007).

Despite these issues and the continued concerns of environmental consultants working on the case, the UST Trust Fund stopped directing work at the site, including groundwater testing and remediation, in 2005 (NCDENR, 2007). The site's permit to discharge treated groundwater was rescinded in 2005, and the issuance of a new permit would be considered "directed work" by the Trust Fund, meaning that all groundwater treatment has permanently ceased even though the site is not yet in compliance with

North Carolina's 2L Groundwater Standards (NCDENR, 2007). Only if the groundwater plume reaches the neighboring residents' wells will the site's risk status warrant additional remediation, according to NCDENR's risk-based assessment process (NCDENR, 2007).

This case is a perfect example of the difficulty regulators face when dealing with pollution events: decades of neglect led to multiple UST leaks on the property, and a long and extremely costly remediation process was eventually hindered by state's need to prioritize its spending on pollution clean-ups. The total remediation cost was $547,688.44. The responsible party, Senter-Sanders Tractor Corporation, however, was liable for only $50,000, the Trust Fund deductible for leaks discovered prior to 1994 (NCDENR, 2007). The remaining $497,688.44, accrued over forty-five claims to the Trust Fund for reimbursement, came from the public's tax dollars (NCDENR, 2007). The Trust Fund system, which relieves tank owners of the vast majority of financial responsibility, does little to encourage responsible tank maintenance and water testing, and the result can be very difficult and expensive clean-ups for the state.

Case Two: Corner Pantry

A 2003 environmental assessment of the Corner Pantry property in Hendersonville, North Carolina, required for a real estate transaction, led to the discovery of petroleum contamination in the soil (NCDENR, 2004). After this discovery, the owner of the UST system began an attempt to determine the source of the leak; however, the owner met little success and no remediation of the site was done. Several months later, someone purchased a home near the Corner Pantry and dug a well 700 feet from the site (NCDENR, 2004). When the owner found that the well water had a strange odor the

water was tested and found to contain MTBE and traces of gasoline constituents (NCDENR, 2004). The UST Section within NCDENR tested several other wells in the vicinity of the site and found pervasive well water contamination that affected "several hundred" people's drinking water and was eventually traced back to the Corner Pantry property (NCDENR, 2004). Further investigation uncovered a plume of groundwater contamination that extended over 1,000 feet to the south and southwest of the Corner Pantry site (NCDENR, 2004). The actual cause of contamination has not been determined, though investigators believe that it's likely a UST leak that went undetected for years (NCDENR, 2004).

The immediate drinking water concerns of residents neighboring the site were addressed with temporary water line hook-ups to uncontaminated wells, filtration systems, and bottled water – all of which are considered "third party claims" and are covered by the Trust Fund (NCDENR, 2004). The long-term remediation plan is to extend Hendersonville's municipal water lines to the affected residents while continuing to test wells before and after this process (NCDENR, 2004). The on-site clean-up will involve remediation systems that vaporize the contaminants in the soil and groundwater (NCDENR, 2004). After the UST owner paid the $20,000 deductible, an initial claim of $24,158 was filed with and paid by the Trust Fund, and an additional claim of $187,045 has been submitted for water line extension (NCDENR, 2004). There are no final cost estimates as yet, although they are predicted to exceed $1 million (NCDENR, 2004).

This is another case where the responsible party could have been held fully liable, but wasn't because of the design of the Trust Fund. The state will pay at least $211,000, over ten times what the tank owner, who likely neglected a leaking tank and caused the

contamination, has paid. The remediation process has been going on for years already, and is likely to continue well into the future. This means that not only will the site not be clean for years to come, but that the state is facing a long-term financial burden. Had a private rather than state-funded assurance mechanism been in place, there would have been more incentive to regularly check the tank for leaks to avoid a major public health threat and clean-up, and the state's obligations would be far fewer and would not represent a financial risk, given that final cost estimates are still unknown.

Case Three: B&B Mini-Mart

A leaking UST was discovered in January 2002 in North Vilas, North Carolina, after a homeowner called Wautauga County Emergency Management complaining of petroleum odors in his home (NCDENR, 2004). The smell was determined to be coming from soil on the homeowner's property that was contaminated from a leaking UST at the B&B Mini-Mart across the highway from the home (NCDENR, 2004). Further investigation of the area found six private wells and a small creek contaminated with benzene, toluene, xylene, MTBE, other gasoline constituents from the UST on the B&B property (NCDENR, 2004).

Remediation included the removal of three underground storage tanks and the closure of a fourth tank on the site as well as the removal of all contaminated soil (NCDENR, 2004). Grossly contaminated groundwater was passively removed and the rest of the contamination was left for "monitored natural attenuation," meaning regular testing and the natural dilution that occurs as the water moves down-gradient (NCDENR, 2004). This plume of contamination was found to extend 1,000 feet down-gradient of the property (NCDENR, 2004). Waterline extension was not feasible in this case, so the

state instead provided new wells, water filtration systems, and bottled water for affected residents (NCDENR, 2004). The resident who originally complained of petroleum odors in his home had to be evacuated while his house was ventilated to reduce benzene vapors. It was over a year before the house was habitable (NCDENR, 2004).

There are no final cost projections available as yet because regular groundwater testing will be needed for several more years; however, the cost thus far is $403,551, including over $80,000 in third party expenses. Third party expenses are the costs of any damages to the public, and in UST cases are usually incurred when drinking water supplies are affected (NCDENR, 2004). When private wells have been contaminated, for example, residents must be provided with bottled water or have their wells attached to a clean water supply. Again, the tank owner was only held responsible for the $20,000 deductible and the state has financed the rest of the remediation. In this case that means the responsible party is paying for less than one quarter – and no more – of the damages his tanks caused other people, and the clean-up is still on-going.

These case studies provide the reader with a greater understanding of what a UST leak entails for the state in terms of remediation and long-term costs. There is no "typical" UST release – the size of the tank, its location, and its proximity to private wells all impact the remediation strategy and the overall cost. Some leaks may cost the state much more than the examples given here while others will likely be less expensive or even free of cost if remediation is not pursued. There are, however, 6,514 backlogged clean-ups, each a site of a confirmed UST leak, awaiting remediation in the state (Table 1). Even if remediation is not pursued on all of these sites, the cumulative financial burden on the state is likely to be enormous. Also, over 130 of these leaks have occurred

in 2007, meaning that one cannot assume that tank failures are a thing of the past. There will almost certainly be clean-ups for the state to fund as long as it is willing to do so.

Table 1. Status of North Carolina's Underground Storage Tanks, March 31, 2007. The Trust Fund Program was established in 1988. All cumulative numbers include data from this year onward (US EPA, 2007).

Total number of active tanks	29,017
Total number of closed tanks	64,942
Confirmed releases in 2007	131
Cumulative confirmed releases	23,942
Cumulative cleanups initiated	22,575
Cleanups completed this year	272
Cumulative cleanups completed	17,788
Total number of backlogged clean-ups	6,514
Total number of Emergency Responses	599
Number of sites at which NCDENR is currently directing work.	33

Literature Review

The following summary is adapted from Boyd 2001: Financial Responsibility for Environmental Obligations: Are Bonding and Assurance Rules Fulfilling Their Promise? Resources for the Future, Discussion Paper 1-42.

A social trap occurs when the optimal decision for an individual conflicts with society's best interests (Costanza & Perrings, 1990). The use of the environment is

fraught with these social traps – what may be the best decision for an individual or firm often results in high costs to society as a whole. The current method of addressing this problem is regulation. In fact, one of the primary principles that US environmental policy is founded on is that polluters should be responsible for the costs their pollution creates (Boyd, 2001). Unfortunately, this is a challenging tenet to uphold in practice, and many polluters are able to avoid responsibility in part or altogether.

Environmental assurances have been created to address both the social trap and the policy problems associated with environmental regulation. There are many types of assurance instruments that have been adapted for specific industries, but the seven major instruments are: bonds, insurance, trust funds, letters of credit, cash accounts, self-tests, and corporate guarantees. The following gives a brief explanation of how each instrument is designed to work and some of its known strengths and weaknesses.

Bonds:

There are two types of bonds that have been suggested: surety bonds, which are currently in use, and cash collateral bonds, which are posted by the polluter directly. Surety bonds are typically bought from an insurance company and only pay out on claims when the purchaser (polluter) has defaulted on its financial responsibilities (Boyd, 2001). The alternative, suggested by Robert Costanza, is a system in which the polluter, prior to receiving a permit to pollute, posts a bond to a regulatory agency in the amount of the worst-case clean-up cost (Costanza & Cornwell, 1992). This money would used for any remediation required, while the unused portion and the interest earned on the investment would be returned to the polluter upon the permit's expiration (Costanza & Cornwell, 1992).

One of the surety bond's greatest strengths is that it allows polluters some flexibility while still providing regulators with a strong assurance of financial responsibility. Potential polluters can choose which company to purchase a bond from and are then only responsible for these payments rather than the entire bond amount. The bonds can be designed so that the regulator is the sole beneficiary in the event of a default, and they cannot be cancelled without giving prior notice to the regulator (Boyd, 2001). A cash collateral bond, such as Costanza has suggested, is more constraining; however, its advantage is that it would ensure that companies unable to meet the financial responsibilities of their actions would either find a less risky way to do business or not receive a permit, rather than pass the risk on to society (Costanza & Cornwell, 1992).

Insurance:

Insurance policies can be bought from private insurance companies, which, for a premium, will compensate the polluter for all clean-up claims covered by the policy. Because insurers want to minimize the risk they take, there is the potential with this scheme for regulators to be relieved of some of their "compliance coaching" duties. Insurance companies could work directly with their customers to decrease the environmental risk associated with their activities or encourage innovation indirectly by requiring higher premiums for riskier activities. In either circumstance, the regulator is less often in the position of being both an advisor and enforcer. The major criticism of environmental insurance is that, depending on how the policy is created, the polluter may not be fully covered. Some policies, for example, do not cover claims submitted outside the coverage period, regardless of whether the actual pollution event occurred during this time (Boyd, 2001). Additionally, in an attempt to reduce their risk, some insurers may

write exclusions into their policies, which can weaken them considerably (Boyd, 2001).

Trust Fund:

Trust funds are a way for money to be collected and held for a specific purpose (Boyd, 2001). There are two main types of trust funds: first-party and third-party. First-party trust funds allow the polluter to retain custody of the money, and because of this, special arrangements need to be made in the trust agreement to allow the regulator to check on the fund's status and to restrict the polluter's access to the funds (Boyd, 2001). More well-suited to an environmental assurance system is the third-party trust fund, which relies on an independent third party to collect, invest, and disburse the funds and names the regulator as the sole beneficiary (Boyd, 2001). These trust funds, however, allow money to be paid in over a period of time, meaning that funds may not be immediately available. To avoid creating long-term or permanent financial strain for the principal (the polluter), the trust's assets would be returned after the obligations specified by the trust agreement have been fulfilled (Boyd, 2001).

Letter of Credit:

Letters of credit are similar to surety bonds, but are guarantees purchased from banks rather than insurance companies. They require that the bank, should the polluter fail to meet certain obligations, pay a third-party beneficiary, the regulator (Boyd, 2001). Only if the polluter defaults on its responsibilities will the bank be held liable. Letters of credit are typically purchased for only a fraction of their face value, making them an appealing choice for potential polluters. Additionally, letters of credit contain safeguards that appeal to regulators: they are granted for only a year at a time and the banks can require collateral or a deposit if the purchaser's financial health is questionable, creating

an incentive for companies to lower their financial risk (Boyd, 2001).

Cash Accounts:

Cash accounts, as the name suggests, entail the polluter putting cash or another form of interest-bearing security into an account made payable to the regulator. This mechanism is similar to Costanza's cash collateral bonds in that it requires the polluter to provide funds directly to the regulator; however, bonds represent a debt security and are similar to an I.O.U., while cash accounts ensure that actual money is signed over to the regulator prior to permitting. If the polluter defaults on its clean-up responsibilities, the account can be liquidated to cover the costs (Boyd, 2001). All unused funds are returned to the polluter after the expiration of the permit. This is a particularly strong type of assurance, assuming that the regulator is made the sole beneficiary; however, few industries support the use of cash accounts because of the financial burden it creates for the polluter.

Self-test:

A self-test is an assurance method that requires companies to demonstrate that they are financially strong enough to undertake the activity being permitted. Typically, a self-test requires several standards be met, such as the company's working capital and net worth must both be greater than the coverage required and a bond rating must be issued (Boyd, 2001). Although this method is very appealing to most large companies, it does not require any actual transfer of funds or contracts to do so, making it a riskier choice for regulators. Because they provide less of a guarantee that costs will be recoverable in the future, some programs have resisted changes proposed by polluters to make self-tests more widely available (Boyd, 2001). At the very least, firms should be required report

any changes in their financial status and to make regular, independently audited financial reports to the regulator (Boyd, 2001).

Corporate Guarantee:

A corporate guarantee allows a polluter to indemnify another firm, usually a parent company, making this firm liable for the coverage requirements in the event that the polluter defaults (Boyd, 2001). These guarantors must pass the same financial tests required by the self-test; and like self-tests, corporate guarantees require no transfer of funds or third parties to be compensated, which garners the support of the regulated community. Corporate guarantees are similar to financial self-tests, however, in that they provide the regulator with the least assurance that funds will actual be available for clean-ups in the future.

Although North Carolina lacks a unified assurance system, there are a handful of industries in the state that are required to have some sort of financial assurance mechanism in place prior to operation. The Landfill Assurance Program, for example, was created by the Financial Assurance Rule .1628, which requires all owners/operators of municipal solid waste landfills to demonstrate that they will have the funds necessary to properly close, provide 30 years of post-closure maintenance, and pay for any corrective action measures required (NC DENR, 2007). The rule went into effect in April, 1994, and allows owners/operators to use one or a combination of six mechanisms to meet the requirements: trust fund, letter of credit, surety bond, insurance, local government financial test, and capital reserve fund. The local government financial test and capital reserve fund are available only for landfills that are owned by a unit of local government (NC DENR, 2007).

Interestingly, the financial assurance requirements for landfills were greatly expanded by the Solid Waste Management Act, which was signed into law in August, 2007, with little complaint from the solid waste industry. The Act requires landfill owners/operators to demonstrate that they have the funds for the "proper design, construction, operation, maintenance, closure, and post-closure monitoring and maintenance of solid waste management facilities and for any corrective action the Department may require during the active life of a facility or during the closure and post-closure periods" (NC DENR, 2007). This alone is not a drastic change; however, an additional $3 million in coverage is required for potential assessment and corrective action that may occur during the landfill's operation or post-closure. According to the North Carolina chapter of the Solid Waste Association of North America, these changes did not garner opposition to the Act because many landfills in North Carolina are owned by large companies that have no trouble meeting assurance requirements and who have a good track record of fulfilling their closure requirements (Drew Isenhour, President, NC Chapter of Solid Waste Association of North America, personal communication, 2007).

Another more recent example of environmental assurance requirements in North Carolina comes from the Governor's Hazardous Materials Task Force, whose recommendations were signed into law in June, 2007 (NC General Assembly, 2007). Following the fire at an Apex, North Carolina, hazardous waste storage facility that released a plume of toxins into the air, the task force was created to find ways to ensure that such storage facilities are safer. Their recommendations included a requirement for all permit holders to demonstrate that they have sufficient funds for "facility closure, post-closure maintenance and monitoring, any corrective action that the Department may

require, and to satisfy any potential liability for sudden and non-sudden accidental occurrences, even if the applicant or permit holder becomes insolvent or ceases to reside, be incorporated, do business, or maintain assets in the State" (NC General Assembly, 2007). Mechanisms allowed to satisfy these requirements include: surety bonds, third-party and corporate guarantees, self-tests, letters of credit, and trust funds, as well as "any other financial instrument" shown to provide at least as much coverage as the mechanisms listed (NC General Assembly, 2007).

The success of these programs is difficult to gauge – landfill owners generally meet their closure requirements and don't use the assurances, while the hazardous waste facility regulations are still too new to pass judgment on.

Environmental assurance mechanisms are being used in a limited way globally and throughout the rest of the US, too. The oil industry, for example, uses assurance systems throughout all phases of oil projects, especially closure and decommissioning (Ferreira & Suslick, 2001). Public pressure drove regulators to adopt assurance requirements, and although these systems can have direct and indirect negative effects on the industry, oil companies did not strongly oppose the change (Ferreira et al., 2004). This is because the systems created all shared one of the most important characteristics to industry: flexibility. Several instruments are available for companies to choose from and they can use a combination of instruments to meet their requirements as well. This allows each individual company to find the least costly way to fulfill their assurance obligations (Ferreira et al., 2004).

A survey of bonding professionals in the industry highlighted some of the other concerns of the industry and regulators (Ferreira et al., 2004). For oil companies, it is

most important for an assurance mechanism to minimize the direct and indirect financial costs, provide a relatively easy way out of the agreement, and be easily acquired (Ferreira et al., 2004). Regulators, on the other hand, are most concerned with an instrument's ability to provide a high level of liquidity in case a polluter defaults, to ease the acquisition of funds, to minimize the amount of oversight necessary, and to maximize the level of compliance by polluters (Ferreira et al., 2004).

The mining industry uses environmental assurances in much the same ways as the oil sector, although success has been more limited in this industry. An industry survey on current assurance practices conducted by the International Council on Mining and Metals found that, while most mining companies understand the purpose of environmental assurances, they believe that improved permitting would be a better way to protect the environment and they find "stricter" forms of assurances such as bonds or insurance to be particularly burdensome (Miller, 2005).

Perhaps more troubling than the industries' lukewarm responses to assurances is how these systems have been implemented in some instances. States in the western US that are home to hardrock mining, for example, have created assurance systems that for the most part can be considered failures. One of the major stumbling blocks in these cases is cost estimation (National Wildlife Federation, 2000). There is no standardized practice for estimating costs, and some states allow mine operators to submit their own cost estimates, which have been consistently low. Costs can be expected to increase between 50 and 500% if the state is left to do the cleanup rather than the mining company, although this is rarely considered in the estimate. This is likely due to the fact that the state would need to hire contractors, which most mining companies avoid by

completing the closure activities with an in-house staff. The presence of acid mine drainage can significantly increase remediation costs as well, although this issue is often ignored until its presence is apparent (Kuipers & Carlson, 2000). A 2000 study conducted by the National Wildlife Federation found that, on average, the bond level for major mines is $4,400/acre but reclamation costs range from $1,000 to more than $50,000/acre, leaving the public with a potentially unfunded total liability of more than one billion dollars across the country as these mines close (Kuipers & Carlson, 2000). Examination of individual state requirements found several alarmingly low standards, including Arizona's grandfathering of all existing mines out of the assurance statute and its use of a mining company's ability to open and operate a mine as a sufficient financial test (Kuipers & Carlson, 2000). Overall, weak standards that fail to address issues such as acid mine drainage, poor regulatory oversight and cooperation between agencies, and the allowance of mining companies to estimate their own costs have left sites seriously under-protected (Kuipers & Carlson, 2000). Given the financial failure of several mining companies in the recent past, this creates tremendous public liability.

Multi-Criteria Decision Analysis

Definition of Criteria

The environmental assurance policies already in use highlight the main objectives of all regulators and industry – those upon which evaluative criteria for an assurance program should be based. Regulators have two basic priorities: protect the environment from degradation and protect the public from the physical and financial harm that this degradation can cause. These examples demonstrate that current assurance policies may

be failing to meet this objective. Additionally, regulators are charged with accomplishing these goals in ways that are least costly to the government and the public. In contrast, industry's primary objective is to operate its business in a way that maximizes profit. To operate a business, the company must obey environmental regulations, so it follows that a secondary objective is to meet environmental regulations in the least costly way.

Combined, these four simple objectives form the basis for the criteria I will use to analyze available assurance mechanisms. The following defines these criteria and the levels of performance for each that assurance instruments may have:

1. Contractual Strength: Because they need to adequately protect the public and the environment from excessive pollution levels and associated remediation costs, regulators would be concerned with the contractual strength of any accepted assurance instrument. This refers to how specific the mechanism is regarding the project in question, the remediation responsibilities of the polluter, the amount of money necessary to cover the associated environmental risk, and whether the company or a third party is contractually responsible for this liability.

Level 1: No specific mention of the project being permitted, the polluter's remediation responsibilities, or the amount financial liability associated with the project is made by the assurance mechanism. Neither the company nor a third party acting on behalf of the company is stated as contractually responsible for this liability. The company's financial stability, typically proven through a series of financial tests or a parent company's indemnity, is the sole focus of the mechanism.

Level 2: The project being permitted is mentioned, but the company's

financial liability, the amount of this liability, and remediation responsibilities are omitted

Level 3: The project being permitted, the polluter's contractual liability, the amount of this liability, and specific remediation responsibilities are clearly defined.

2. Verifiability: Regulators must work with a finite amount of time and money, and it is important that new regulations do not overburden these resources to the detriment of the environment and the public. Verifiability refers to how easy or difficult is it for regulators to verify that assurances obligations are being met.

Level 1: Difficult to verify. Regulators must check with the companies and the notification of any changes/cancellations of the mechanism is not required.

Level 2: No notification is required but the regulator can contact a third party that is liable for the financial risk to expedite the verification process. A third party is any entity, such as a bank or insurance company, which the assurance mechanism holds financially liable in lieu of the polluter for any clean-ups that occur.

Level 3: Notification of any policy changes/cancellations is required and a third party that is liable for the financial risk can be contacted to expedite the verification process

3. Flexibility: Every industry is different, and even within industries, companies vary in size, financial stability, etc. Mechanisms, therefore, should allow for each company to make individual decisions that, while not affecting the overall

assurance provided, tailor the policy to best meet its needs and minimize the associated costs. This flexibility could come in the form of choosing a specific bank, type of bank account, or other third party.

Level 1: Inflexible. The mechanism provides companies with no choices regarding placement of funds or payment schedule. Third parties are not indemnified, so the choice of a specific bank or insurance company, for example, does not exist.

Level 2: Moderately flexible. Some choices are available to the polluter, such as those relating to the placement of funds in a bank or the payment schedule of funds into an account. No third parties are indemnified.

Level 3: Very flexible. Third parties are held liable for the financial risk, and the polluter may choose the specific company or policy to meet its assurance needs in the least costly way.

4. Ease of acquisition: Companies cannot do business if they are in violation of environmental laws, so any assurance mechanism that is excessively difficult or expensive to obtain could put the industry's viability in jeopardy. Conversely, if assurances are too easily obtained, regulators may find that any company, regardless of financial or environmental risk, can meet the requirement, which greatly decreases the amount of protection the mechanisms provide.

Level 1: Mechanism is easily acquired by any company that is currently able to do business and is making a profit. No third parties are involved that could refuse service or impose

prohibitively high fees.

Level 2: Mechanism can be obtained without a third party but requires significant financial strength, the ability to forfeit the entire amount of money required for permitting either upfront or over a very short timeline.

Level 3: Mechanism can only be obtained through a third party, who may refuse service or impose fees that can be increased over time.

5. Availability & control of funds: The easiest way to ensure that the public will not be left to clean up private pollution and to provide incentives to companies to lower the environmental risk of their businesses is to require that the company make remediation funds available prior to permitting. This provides regulators a guarantee that public money will not be needed for remediation. These funds, however, are the most beneficial to this cause if regulators can easily and immediately access them. Conversely, it is most costly for industry to have to put remediation expenses aside prior to the start of a project. If regulators are granted sole access to the funds, companies have no way of protecting their money from being unfairly used in the case of a contested default.

Level 1: No money is made available prior to permitting and no third parties are indemnified for the liability.

Level 2: No money is made available prior to permitting but a third party is being held liable for the agreed upon amount. Some arbitration may be required for these parties to relinquish the funds to regulators.

Level 3: All assurance money is paid out by the company prior to permitting and regulators have access to these funds without authorization of an arbiter or third party.

Application of Criteria to Assurance Instruments:

Using these performance level definitions, I then determined at which level the instruments perform for each criterion (Table 2). For example, based on the above definitions, surety bonds perform at Level 3 for the contractual strength criterion because the bond agreement includes specific definitions of the project being permitted, the amount of liability the bank is taking on, and the remediation standards that the potential polluter must met to ensure that they do not default on their responsibilities. Financial self-tests, on the other hand, perform at Level 1 for contractual strength because the polluter's ability to meet given financial standards does not require specific definition, or even mention of, the project in question, the environmental liability associated with it, or the remediation standards that the polluter must meet. Table 2, void of any specific regulator or industry preferences regarding instruments' performances, can be used by regulators and industries throughout the state to better understand how common assurance instruments may help them meet their objectives and to compare various performances.

These criteria can now be applied to the instruments, providing an evaluation of each instrument's performance for each criterion (Table 2).

One can take away several important conclusions from the instruments' performances.

Table 2. Application of evaluative criteria to assurance instruments. Each instrument's ability to meet a criterion is ranked based on the previously defined performance levels.

Instrument	**Criteria**				
	Contractual Strength	Verifiability	Flexibility	Ease of Acquisition	Availability/Control of Funds
Surety Bond	Level 3: The project, liability & remediation are all specifically stated	Level 3: Notice of policy change required. Third party can be contacted.	Level 3: Very flexible. Companies can choose from several third parties to find best option.	Level 3: Mechanism is only offered by a third party who may charge a fee or refuse service.	Level 2: No money upfront but third parties are indemnified. Arbitration may be necessary.
Insurance	Level 3: The project, liability & remediation are all specifically stated	Level 2: Third party can be contacted, no notice of policy change required.	Level 3: Very flexible. Companies can choose from several third parties to find best option.	Level 3: Mechanism is only offered by a third party who may charge a fee or refuse service.	Level 2: No money upfront but third parties are indemnified. Arbitration may be necessary.
Trust Fund	Level 3: The project, liability & remediation are all specifically stated	Level 2: Third party can be contacted, no notice of policy change required.	Level 2: Moderate. Choices regarding placement of funds into an account are left to company.	Level 2: Can be acquired with the ability to forfeit entire amount of liability upfront or over a short time	Level 3: All assurance money is put aside prior to permitting; regulators have sole access to funds.
Letter of Credit	Level 3: The project, liability & remediation are all specifically stated	Level 2: Third party can be contacted, no notice of policy change required.	Level 3: Very flexible. Companies can choose from several third parties to find best option.	Level 3: Mechanism is only offered by a third party who may charge a fee or refuse service.	Level 2: No money upfront but third parties are indemnified. Arbitration may be necessary.
Cash Account	Level 3: The project, liability & remediation are all specifically stated.	Level 2: Third party can be contacted, no notice of policy change required.	Level 2: Moderate. Choices regarding placement of funds into an account are left to company.	Level 2: Can be acquired with the ability to forfeit entire amount of liability upfront or over a short time.	Level 3: All assurance money is put aside prior to permitting; regulators have sole access to funds.
Self-test	Level 1: Project, liability, remediation not specifically stated. Relies on financial tests.	Level 1: Difficult. Regulators must check with company. Notice of change not required.	Level 1: Inflexible. No choices are left to company. A standard set of financial tests must be passed.	Level 1: Very easy. Any profitable company could acquire this mechanism. No third parties are involved.	Level 1: No money is forfeited upfront and no third parties are indemnified.
Corporate Guarantee	Level 1: Project, liability, remediation not specifically stated. Relies on parent company.	Level 1: Difficult. Regulators must check with company. Notice of change not required.	Level 1: Inflexible. No choices are left to company. The parent company must pass a standard set of financial tests.	Level 1: Very easy. Any profitable company could acquire this mechanism. No third parties are involved.	Level 1: No money is forfeited upfront and no third parties are indemnified.

The first is that financial self-tests and corporate guarantees both provide the least contractual strength; while the rest of the instruments perform equally well on this attribute. This is because neither self-tests nor guarantees specifically state the project being permitted or that the company is financially responsible for meeting certain remediation responsibilities. The other instruments necessitate this level of specificity for the third party contract in the case of surety bonds, insurance, and letters of credit, or a protocol for disbursing the company's funds to the regulator in the case of cash accounts and trust funds.

Another important conclusion can be drawn regarding flexibility. Instruments that indemnify a third party tend to be the most flexible while instruments that require the polluter to put funds aside, pass financial tests, or acquire a corporate guarantee are much less so. This is because there are several third parties that can be chosen from for each third-party based instrument. There are several insurance companies that polluters may choose from, for example, which may provide clients with different policies, charge different premiums, or require different deductibles. The freedom of choice among several third parties can allow polluters to meet their assurance obligations in the least costly way.

This freedom does appear to come with some drawbacks, however. The most flexible instruments, because of their use of an indemnified third party, also tend to be the hardest instruments to acquire. While trust funds and cash accounts can be difficult to acquire because of the amount of money polluters need to put into them, third party instruments can entail high service fees or simply the refusal of service. Indemnified third parties are taking on the polluter's environmental risk and want some protection

from the riskiest projects. This may mean that insurance companies charge higher premiums for riskier projects or banks require a certain amount of collateral for a letter of credit. This provides polluters with a greater incentive to comply with their permits and third parties with some protection from the environmental risk of their clients' projects, but it can also make these instruments more difficult for companies whose projects are considered risky. In some cases this could result in companies being unable to acquire environmental assurances through a third party.

Finally, it is interesting to note that the only instrument to perform uniquely for a criterion was surety bonds, which was the only instrument to reach Level 3 for Verifiability. Though the presence of a third party does facilitate verification in other mechanisms, only surety bonds require that the regulator be notified prior to any policy changes or cancellations.

Application to a Test Case: North Carolina's USTs:

The application of the criteria to available instruments provides an understanding of how each mechanism performs on the criteria most important to meeting regulators' and industries' objectives; however, each parties' preferences regarding the criteria must also be considered to determine which instruments are most appropriate. The preferences of industry and regulators likely vary between industries (a UST owner has different priorities than a landfill owner, for example), as well as among industries (a small-business UST owner is very different from an oil company CEO). It may be that some instruments are preferred by certain industries or companies of a certain size while other instruments are more useful for different industries or companies. These preferences, then, need to be considered on an appropriate scale for each industry that is to be

regulated with environmental assurances in order to determine which instruments should be available. This is beyond the scope of this study; however, I will now demonstrate how this could be done by applying the criteria and the instruments' performances to the problem of leaking USTs in North Carolina. The actual preferences of regulators and UST owners may vary, however the process of ranking the instruments would be the same.

Regulators' Preferences:

Contractual strength: Regulators' primary responsibility is to protect the environment and the public from pollution. The stronger an assurance mechanism is, the easier this is for regulators, so they most prefer the strongest instruments (Level 3) and least prefer the weakest instruments (Level 1).

Verifiability: Regulators must work with finite time and resources, so they most prefer the instruments that require the least monitoring effort, those that are most easily verified (Level 3), and least prefer the instruments that are the hardest to verify (Level 1).

Flexibility: Regulators do not wish to impose any excessive burdens on the industries they regulate because this has the potential to increase the odds that companies will violate their permits as well as negatively impact the economy. Regulators, therefore, would more prefer a high degree of flexibility (Level 3) and least prefer instruments with the lowest flexibilities (Level 1).

Ease of Acquisition: Regulators see assurances as a way to protect the environment, so they would prefer that the acquisition of assurances represents a large enough financial hurdle to discourage any financially unstable or environmentally risky projects from being permitted. They would most prefer instruments that are relatively

difficult to acquire (Level 3) and least prefer the instruments easiest to acquire (Level 1).

Availability/Control of Funds: Once a UST has leaked, regulators want to be able to access assurance funds as quickly and easily as possible so that remediation efforts may begin immediately and that time and money is not wasted in arbitration with the UST owner, hence they would most prefer instruments that give them total control of the funds that are to be put up ahead of permitting (Level 3) and least prefer the instruments that do not make funds available prior to permitting (Level 1).

UST Owners' Preferences:

Contractual Strength: The more contractually strong an assurance mechanism is, the more likely polluters will be held liable for their pollution. This liability, which would otherwise be passed onto the state via the UST Trust Fund, represents a new cost to UST owners. Thus, they would most prefer the least contractually strong instruments (Level 1) and least prefer the most contractually strong instruments (Level 3). This may be somewhat unique to UST tank owners, however, because they are generally small business owners whose business carries a high degree of environmental liability. Larger businesses or corporations may not be as averse to contractually strong assurance requirements.

Verifiability: How easily regulators can verify that companies have met their assurance obligations does not directly affect how costly the assurances will be, but an assurance that is difficult to verify makes it harder for UST owners to prove that they are in compliance with environmental regulations. Since this compliance is necessary to do business, owners would most prefer the instruments that are easiest to verify (Level 3) and least prefer those that are most difficult for regulators to verify (Level 1).

Flexibility: The degree to which an instrument allows UST owners to tailor the policy to its individual needs affects how costly the assurance will be, so UST owners would most prefer very flexible instruments (Level 3) and least prefer very inflexible instruments (Level 1).

Ease of Acquisition: How easily an assurance instrument can be acquired impacts its overall cost to the polluter and how quickly a project can be permitted, so UST owners would most prefer the most easily acquired (Level 1) instruments and least prefer the least easily acquired instruments (Level 3).

Availability/Control of Funds: Money that is put aside for remediation would be unavailable to the tank owner for any other use, so putting assurance funds aside ahead of permitting would represent a large financial burden to UST owners. Indemnifying a third party also represents a cost, so they would most prefer the instruments that do not require either of these actions (Level 1). Indemnifying a third party is less costly than forfeiting the entire assurance amount ahead of time, so these instruments are UST owners' second choices. UST owners would least prefer the mechanisms that require them to sign the entire sum of money over to regulators ahead of time (Level 3).

Figure 1 provides a summary of UST regulator and owner preferences for each criterion. The arrows indicate each party's direction of increasing preference. As the diagram shows, regulator and tank owner preferences conflict on contractual strength, ease of acquisition, and control of funds. The two parties' both prefer high degrees of verifiability and flexibility.

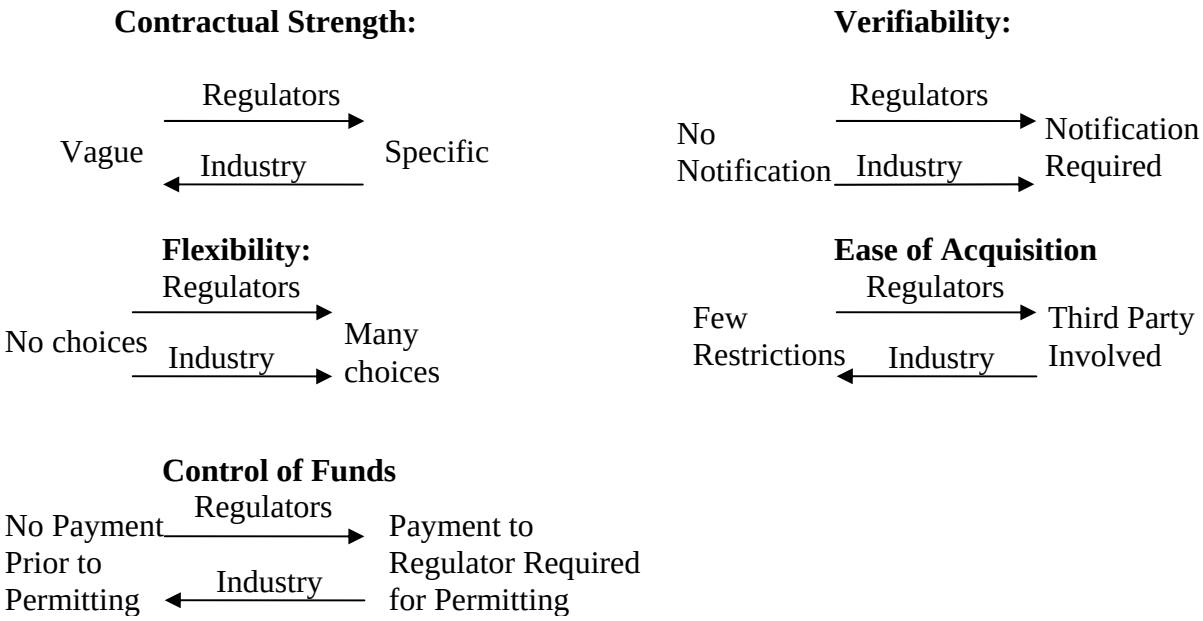

Figure 1. Assumed performance level preferences of UST regulators & owners. Arrows indicate whether preference increases with increasing or decreasing performance level for each criterion.

Figure 2 provides a summary of UST regulator and industry preferences for the various levels of performance for each criterion. "Low" signifies that the regulator or UST owner least prefers this level of performance, "High" that the regulator or UST owner most prefers this level of performance, and "Medium" that the regulator's or UST owner's preference for this level of performance falls between their preferences for the other levels. From this chart, one can get an understanding of which instruments satisfy both parties and which instruments satisfy only one or neither party's preferences. The ideal assurance mechanisms are those that satisfy both regulators and potential polluters, although this may not be possible to accomplish for each criterion because of conflicting interests.

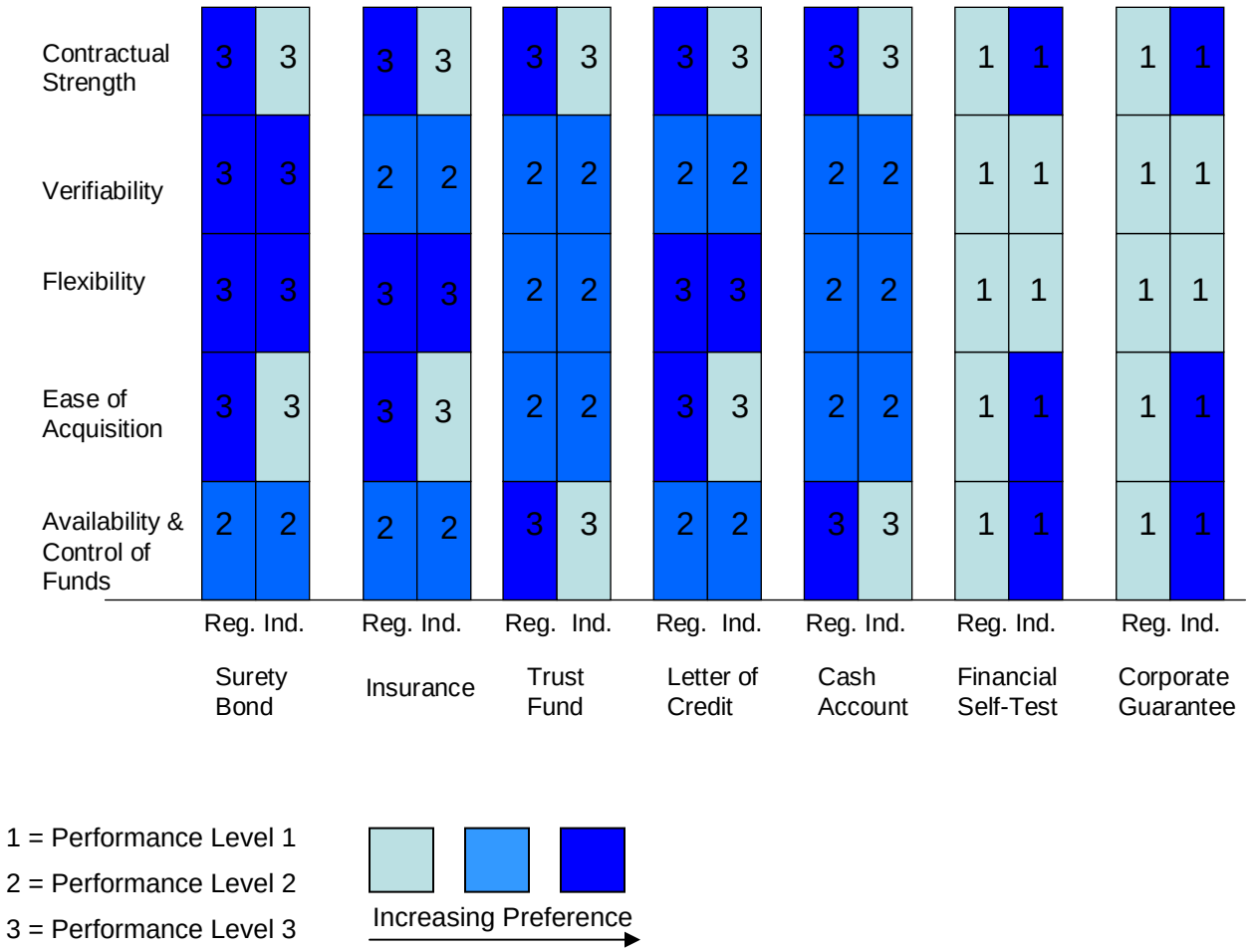

Figure 2. Regulators' and UST owners' assumed preferences for the performance level of each mechanism for each criterion. Performance levels are indicated by the numbers inside each box and strength of preference by the color of the box.

Based on the assumed preferences of UST regulators and owners, it is possible to create a ranked list of assurance mechanisms that are satisfactory to both parties and that should be made available to UST owners. To compare the instruments' overall performances, it may be easiest to follow a few simple guidelines. The first, and perhaps more important, is to eliminate any choices that are consistently least-preferred by a party. The performance level of financial self-tests and corporate guarantees, for

example, were least-preferred by regulators for every criterion. Neither of these instruments should be included in a UST assurance program.

The next guideline is to prioritize mechanisms based on how few "Low" preference scores they received. This ensures that the instruments that received the most "High" and "Medium" preference scores, those that at least partially satisfy regulator and UST owner objectives the most often, are ranked at the top of the list. In this case, all of the remaining instruments have the same number of combined "High" and "Medium" preference scores, so this approach does not provide any additional clarity. Instead, instruments can be ranked by the number of "High" preference scores they received, ensuring that the remaining instruments are ordered by how often they were most-preferred by either party. In this case, surety bonds received the most "High" preference scores, letters of credit and insurance each received the second most "High" scores, and trust funds and cash accounts each received the fewest "High" preferences scores of the remaining instruments.

The final rank, then, for instruments in a UST assurance program are: surety bonds, letters of credit and insurance, and trust funds and cash accounts. Financial self-tests and corporate guarantees should not be used. Again, instrument preferences are likely to vary based on industry and company size, so it is possible that the order may change in different situations, although financial tests and corporate guarantees are likely to be least preferred by most environmental regulators. One way to get a more robust analysis of the parties' preferences is to include weights for each criterion. Weights would incorporate the relative importance of each criterion to a given party, and would thus allow more room for negotiation between parties. If, for example, there were a

criterion that was relatively unimportant to regulators, they may be willing to accept an instrument that performs less well for them on this criterion so long as it performs better on a more important criterion.

Discussion & Final Policy Recommendations:

This study sought to determine whether a statewide environmental assurance program is a feasible solution to the problem of misplaced environmental liability in North Carolina. Specifically, my goals were to use case studies of leaking underground storage tanks in North Carolina to demonstrate the problem polluter unaccountability can pose to the state, to evaluate available environmental assurance instruments based on their ability to meet regulator and industry needs, and finally, to make specific environmental assurance policy recommendations for a statewide program in North Carolina. I was able to meet these goals, highlighting the problem of polluter accountability through UST cases and using a MCDA to create an example ranking of assurance mechanisms. I found that several instruments perform well enough to be used in a mandatory assurance program in North Carolina and potentially throughout the United States.

Although the study of environmental assurances is still very new and thus limited, my findings are similar to the results of a study of assurance instruments in the upstream petroleum sector. The 2004 study by Ferreira et al. examined several of the mechanisms I focused on, as well as instruments more common in the petroleum industry, and designated state funds similar to the UST Trust Fund. Using a survey of bonding specialists, Ferreira et al. (2004) determined which attributes were most important to the key stakeholders and used a multi-criteria decision analysis to create a ranking of the

mechanisms based on their performance on the specified attributes. The study found that surety bonds are the most preferable mechanism among regulators and the petroleum industry, while cash accounts, trust funds, and letters of credit ranked 2nd, 3rd, and 4th, respectively (Ferreira et al., 2004). Interestingly, state designated funds, which essentially maintain the public's liability by relying on government money for remediation, was ranked last because it performed poorly for both regulators and industry.

The results of my study, however, are broader than those of Ferreira et al.'s work. I used the UST industry as an example to illustrate how the final ranking may be affected by industry-specific preferences, but the analysis of each instruments' performance levels for the universally important criteria I selected for my analysis can be used by any industry throughout North Carolina, and potentially throughout the U.S. For example, the agriculture industry involves several environmental risks, and states with large confined animal feeding operations may be able to use the assurance mechanism performance analysis from this study to determine which instruments would be most suitable to address these problems.

Previous studies, primarily conducted several decades ago, have made the opposite argument, that environmental assurances, in particular surety bonds, are infeasible for large-scale application (Shogren et al., 1993). Shogren et al. (1993) argue that the environmental bonding and insurance industries are not capable of meeting the increased demand for their services that would result from a broad environmental assurance requirement. The prospect of an industry taking on more risk than it can financially handle is an unappealing one, as is the notion of exorbitant fees imposed on

the users of environmental assurances to correct this unbalance. These studies, however, are no longer timely. The environmental assurance industry has grown over the last several decades and, as polluter accountability and environmental assurances have grown more popular, the assurance industry has been able to keep pace easily without over-penalizing potential polluters. Politically well-positioned industries, such as mining and oil, would likely have never allowed the passing of the remediation assurance policies that are in place today if the requirements were overly burdensome.

What does this mean for the feasibility of a statewide assurance program in North Carolina? First and foremost, the application to the UST problem demonstrates that there are several viable assurance options available to create a statewide program that adequately meets both regulators' and industry's objectives. Thus, a statewide assurance program is a feasible solution to the problem of misplaced environmental liability in North Carolina in that it would better protect the public and the environment without placing greater burdens on industry than the system in place now. Although the exact ranking of these instruments would need to be determined by incorporating regulator and industry preferences and their relative weights, and will thus vary by industry, there are several important lessons from this demonstration that should shape any assurance program:

First, third-party instruments perform better for both regulators and industry. Surety bonds, insurance, and letters of credit all performed well for both parties, so each should be available in a statewide program, giving companies as many options to choose from as possible.

Second, any instrument that consistently fails for either party should be excluded

from a statewide program. The performances of financial self-tests and corporate guarantees were both least-preferred by regulators and this is unlikely to vary considerably among different regulatory authorities, so neither of these instruments should be included in a statewide assurance program.

Third, cash accounts and trust funds, although particularly reliable types of assurance for regulators, are likely to remain unpopular with industry because of their high costs compared to those of third party instruments. Because of this, a statewide program should not rely solely on cash accounts and trust funds, but instead make them available as part of a suite of options that includes less costly, third party options.

In summary, there are several viable options for a statewide environmental assurance program in North Carolina. If an industry-specific ranking of the mechanisms is desired, regulators and companies simply need to input their own preferences and the corresponding weights on evaluation criteria to create a summary measure of each instrument's performance level. Regardless of an exact ranking order, though, it is important for both regulators and industry to realize that an assurance program is possible and that it can be created to minimize the burden to industry while alleviating the unjust burden of liability the public currently shoulders. The implementation of an assurance program would likely take great time and effort, but it is well worth it when one considers the unnecessary expense the current situation imposes on the government and taxpayers. An assurance program, forcing companies to bear the full weight of their environmental liability, would protect North Carolina residents from unnecessary pollution and the costs of its remediation as well as encourage companies respond to this change by shifting away from environmentally risky projects.

Literary Citations

Boyd, J. 2001. Financial Responsibility for Environmental Obligations: Are Bonding and Assurance Rules Fulfilling Their Promise? Resources for the Future, Discussion Paper 1-42.

Costanza, R. and L. Cornwell. 1992. The 4P Approach to Dealing with Scientific Uncertainty. Environment 34: 1-10.

Costanza, R. and C. Perrings. 1990. A Flexible Assurance Bonding System for Improved Environmental Management. Ecological Economics 2: 57-75.

Ferreira, D.F. and S.B. Suslick. 2001. Identifying potential impacts of bonding instruments on offshore oil projects. Resources Policy 27: 43-52.

Ferreira, D., S. Suslick, J. Farley, R. Costanza, and S. Krivov. 2004. A decision model for financial assurance instruments in the upstream petroleum sector. Energy Policy 32: 1173-1184.

Isenhour, Drew. President, NC Chapter of Solid Waste Association of North America. Personal Communication, 2007.

Kuipers, J.R. and C. Carlson. 2000. Hardrock Reclamation Bonding Practices in the Western United States Summary Report. National Wildlife Federation. Boulder, CO. 46 pgs.

Miller, G. 2005. Financial Assurance for Mine Closure and Reclamation. International Council on Mining and Metals. Ottawa, Canada. 26 pgs.

Natural Resource Defense Council, 1999. Raising Hogs Right: Finding Solutions in North Carolina. Feb. 1, 2008. <http://www.environmentaldefense.org/documents/2538_RaisingHogsRight.pdf>

North Carolina Department of the Environment and Natural Resources. 2004. The Status of Leaking Underground Storage Tanks, the State Cleanup Funds, and the Groundwater Protection Loan Fund. 10 October, 2007. <http://www.wastenotnc.org/ust/ust_main.html>

North Carolina Department of the Environment and Natural Resources. 2006. The Status of Leaking Underground Storage Tanks, the State Cleanup Funds, and the Groundwater Protection Loan Fund. 20 September, 2007. <http://www.wastenotnc.org/ust/docs/AnnualReport2006.pdf>

North Carolina Department of the Environment and Natural Resources. The Leaking Petroleum Underground Storage Tank Cleanup Funds. 6 September, 2007. <http://www.wastenotnc.org/ust/docs/cleanup.pdf>

North Carolina Department of the Environment and Natural Resources. 2007. Financial Assurance for Landfills. 15 September, 2007. <http://www.wastenotnc.org/SWHOME/financial_assurance.asp>

North Carolina Department of the Environment and Natural Resources. 2007. Senate Bill 1492 Ratified Bill. 10 September, 2007. <http://www.ncleg.net/Sessions/2007/Bills/Senate/PDF/S1492v6.pdf>

North Carolina Department of the Environment and Natural Resources. Division of Waste Management. Underground Storage Tank Trust Fund files, Raleigh Regional Office. 7 July, 2007.

North Carolina General Assembly. 2007. Hazardous Materials Task Force Recommendations. 12 September, 2007. <http://www.ncga.state.nc.us/gascripts/billlookup/billlookup.pl?Session=2007&BillID=H36>

Shogren, J.F., J.A. Herrings, and R. Govindasamy. 1993. Limits to environmental bonds. Ecological Economics 8: 109-133.

United States Environmental Protection Agency. Overview of the Federal Underground Storage Tank Program. 6 September, 2007. <http://www.epa.gov/OUST/overview.htm>