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Removed From The Environment

Deep well injection of industrial waste safely and effectively isolates toxic chemicals from the biosphere. Indeed, in the right geological setting, it is the environmentally preferred method — provided that business is simultaneously minimizing its waste generation. Unfortunately, misperceptions about the program limit its wider use

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On December 16, 1999, then EPA Administrator Carol Browner hosted a celebration marking the 25th anniversary of the Safe Drinking Water Act. Among the many laudatory pronouncements, the agency hailed the crucial role that the statute's program for deep well injection of hazardous waste plays in protecting drinking water, human health, and the ecosystem. EPA declared that underground injection "reduces human exposure to organic and inorganic chemicals and heavy metals by removing them from the environment." Further, deep well injection "eliminates more than nine billion gallons of hazardous waste and a trillion gallons of oilfield waste from the environment each year." Indeed, EPA and other scientific experts have concluded that these liquid wastes are "removed from the environment" — isolated from the biosphere thousands of feet below the earth's surface, where they will remain confined for millions of years. The wastes are even thousands of feet below aquifers that might conceivably supply drinking water in the future.

Yet, while the agency celebrates the success of deep well injection and the Underground Injection Control program that regulates it under the act, others ignore this record and attempt to demonize the practice with unfounded allegations that deep well injection will inherently endanger rather than protect human health. EPA and administrators of state underground injection programs have come under attack, as have the companies that use the technology. But the science, based on more than a decade of safe operation under improved UIC program regulations, does not support these charges. Rather, the facts show that, where proper geology and hydrogeology are available, deep well injection is the preferred method for managing hazardous wastes. Companies that are using it are doing right by society.

Deep well injection should be judged on the merits of the environmental protection benefits it provides and the concomitant environmental management approaches that its users adopt. Deep well injection does not provide a perfect solution that allows industry to slacken the quest for long-term environmental sustainability. Business has the responsibility to move continually toward pollution prevention, seeking source reduction, recycling, and other improvements that will lead to a diminishing role for *all* forms of disposal.

While that quest continues, however, we need to recognize the crucial role that deep well injection can play in providing a safe and effective interim method for disposing of residual wastes, especially those that would pose the greatest risks to society if managed by any other method. It could be used, for example, to dispose of persistent bioaccumulative toxic wastes that might otherwise be discharged to surface waters. In other words, if underground injection is restricted or eliminated, the result will be more danger to the environment, not less.

While deep well injection is not inherently dangerous, it will only be safe if properly done. But one of the strengths of the current Underground Injection Control program is that the regulations were first developed to address any problems experienced by past injection well operations, and then revised specifically to address remaining concerns.

When the UIC program was started after enactment of the Safe Drinking Water Act in 1974, EPA and state officials conducted detailed reviews of the problems associated with injection well operations that predated the federal statute. The agency divided the UIC program into different classes of wells,

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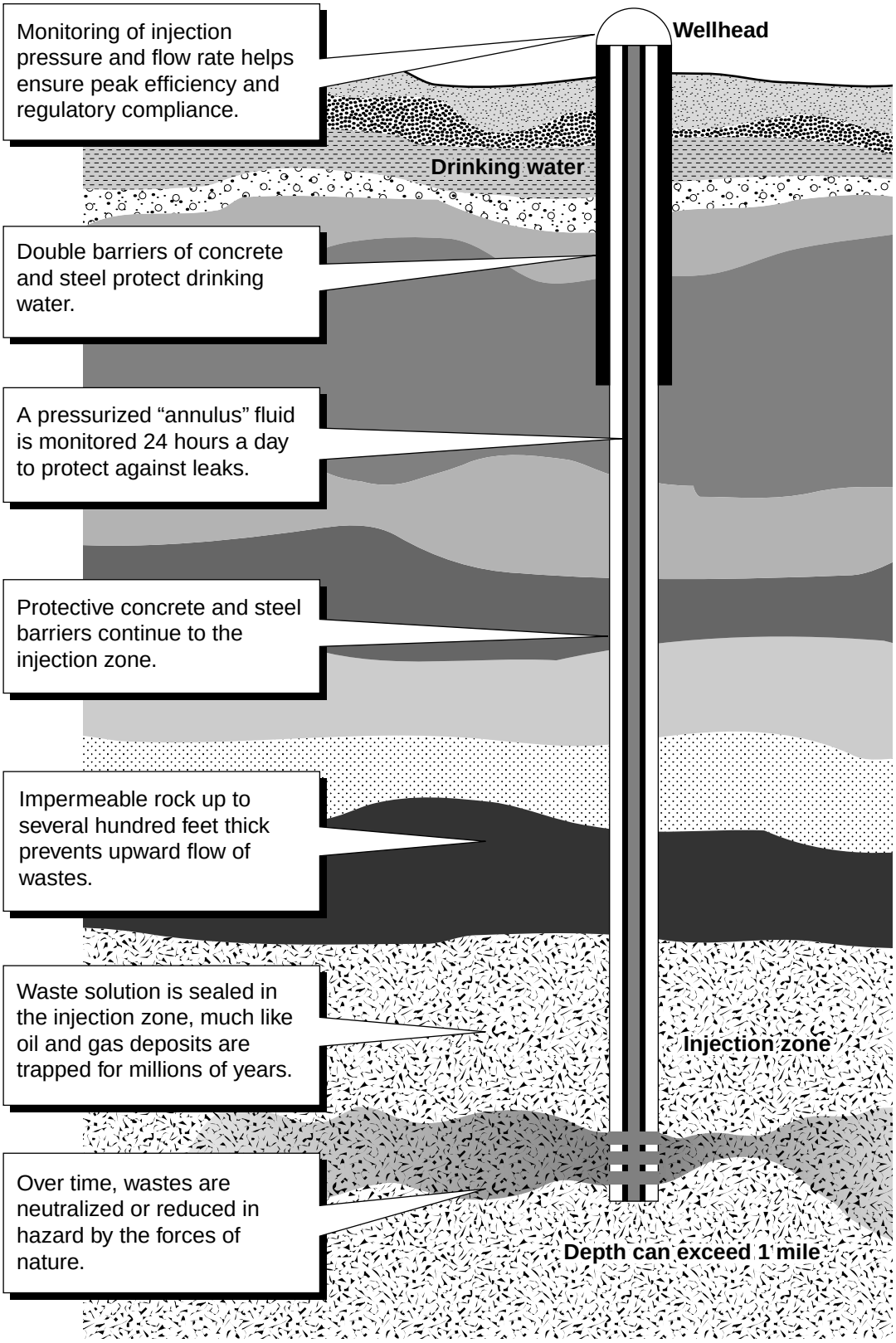
Class I Industrial Deep Well Safeguards



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and geared its regulatory requirements to the types of wells being used and the nature of the fluids being injected. For the Class I deep well injection used by industry for hazardous waste, EPA then conducted a negotiated rulemaking to implement the land-ban provision of the Hazardous and Solid Waste Amendments of 1984, which reauthorized the 1976 Resource Conservation and Recovery Act. This effort included participation by those groups that were most critical of the UIC program, as part of the process to develop revised regulations addressing their concerns. When the effort failed to achieve full consensus in the final stage, the agency nonetheless proceeded to adopt regulatory revisions that addressed each of the key points raised by the critics. EPA promulgated these program revisions in 1988. That was more than a decade ago. Nevertheless, UIC critics continue to cite problems with injection well operations predating implementation of the final regulations as a basis for seeking to prohibit deep well injection today.

Some critics claim that Congress intended to ban all injection of hazardous wastes as part of the 1984 RCRA amendments. But the statute allowed EPA to exempt from the ban any method of land disposal that proves to be protective of human health and the environment, and deep well injection meets the statutory test. Other critics attack isolated portions of the UIC program. An article by Suzi Ruhl published in the September/October 1999 issue of *The Environmental Forum* focuses on the regulation of Class I municipal wells in Florida. But Class I municipal wells are significantly different from Class I industrial wells, which are subject to more stringent siting and construction requirements. Whatever problems are claimed to exist with those wells should not be used as a basis for turning our backs on the use of Class I industrial wells, which have a proven record of safety and effectiveness.

Notwithstanding the strong safety record of Class I industrial wells, and their strict regulation, public acceptance of the technology is mixed. A prime reason is the conflicting signals EPA sends about the program. As noted, the agency declares that underground injection means that hazardous waste is "removed from the environment." But on the other hand, EPA continues to report injected wastes as "released to the environment" under the Toxics Release Inventory program — in much the same way it reports direct emissions to ambient air and discharges to surface water. As a result of this confusing characterization, press reports on the publication of EPA's TRI numbers have inaccurately described Class I injection with terms like "spewing," "dumping," or "discharges to waterways."

Baseless attacks and reporting misnomers cannot change the fact that Class I industrial deep well injection is a fundamentally safe and effective waste management and disposal method that should be adopted wherever the subsurface geology and hydrogeology support its use. Under these circumstances, it is the safest available disposal method for hazardous wastes.

The more closely EPA has examined industrial deep well injection over the years, the more the agency has reconfirmed the viability and effectiveness of properly operated wells as a safe waste management option. The present day use of Class I industrial wells is carefully managed, extensively regulated, closely monitored — and thoroughly studied and evaluated.

Deep well injection involves the disposal of industrial wastewaters thousands of feet below the earth's surface into deep, porous, permeable sand and rock formations. As EPA noted in its 1985 *Report to Congress on Injection of Hazardous Waste*, mandated by HSWA to examine land disposal of hazardous wastes by injection, these wastes will remain isolated and contained by impermeable confining layers "for geologic time" — i.e., for millions of years. EPA concluded in the preamble of the 1988 *Federal Register* notice for the improved regulatory program mentioned earlier that, once the geologic receiving formation has stabilized following injection, there is little or no possibility that injected wastes will ever move vertically upward out of the injection zone. Class I industrial wells are also designed to inject industrial wastewater far below any potentially usable sources of drinking water. Just in case, however, Congress prohibited any underground injection that would carry contaminants into underground sources of drinking water at levels that would require substantial additional treatment beyond that already necessary to render the water fit for human consumption.

The design of the wells under the 1988 regulations is also state-of-the-art. (See diagram, opposite.) The wells are built with re-

dundant containment systems and extensively monitored to prevent any loss of injected fluids. For environmental safety, Class I injection regulations require a well within a well — analogous to the double-hull arrangement on modern oil tankers. Regulations also require monitoring of injection pressure and the pressure of the protective fluid between the well casing and injection tube, which means that any leaks during injection would be immediately detected. Class I hazardous injection wells have alarm systems used to shut down injection operations should any loss of well integrity occur. This monitoring supplements the strict testing of construction integrity and mechanical operating integrity that wells must undergo before initial operation and periodically throughout the life of a well.

Beginning with the 1985 report and continuing through numerous other studies, the agency has analyzed voluminous scientific information on deep well injection. EPA has also conducted meticulous site-by-site reviews of Class I hazardous wells through its review of "no migration" demonstrations, which get their name from the requirement to show that a well qualifies for a land disposal ban exemption because there will be no migration of hazardous constituents from the injection zone for as long as the wastes remain hazardous. EPA concluded that chemical and physical mechanisms will render wastes nonhazardous within 10,000 years, but some facilities have demonstrated more efficient detoxification mechanisms. These comprehensive and site-specific studies caused the agency to conclude in 1991 that "Class I underground injection wells are safer than virtually all other waste disposal practices."

EPA-sponsored studies have also determined that deep well injection is a low health risk waste management option when compared to other methods. In 1989, the Office of Solid Waste and Emergency Response conducted a comparative risk project using panels of experts to compare the risks associated with various activities involving potentially toxic chemicals. The panels ranked risks from different waste management practices based on six factors: acute exposure health risks; chronic health risks from acute events; other health risks; groundwater sources affected; welfare effects (e.g., wildlife, materials, quality of life); and ecological risks. Based on input from the individual panels, the plenary panel developed consensus rankings to identify overall risk levels of the various waste management practices. The experts gave hazardous waste injection the lowest risk ranking.

The Health Effects Workgroup in that study concluded that Class I injection presents low health risks based on "extensive experience with the technology" — and that further regulation of Class I injection should not be a priority. The workgroup stated: "Underground injection had been of substantial concern to OSWER in the past, at least in part because of *suspected* health risks. [Emphasis in original.] Existing information does not appear to support this assessment, and substantial regulatory efforts in those areas should not be a priority based on health considerations."

The safety and effectiveness of deep well injection has also been reaffirmed when examined on Capitol Hill. Even when Congress passed HSWA in 1984, establishing a presumptive ban on the land disposal of hazardous wastes, key congressional leaders noted the need to distinguish between land disposal "techniques that can be environmentally sound and those that cannot." As noted earlier, HSWA authorized EPA to exempt from the ban any method of land disposal that proves to be protective. Deep well injection was singled out on the floor of the Senate as the one technique expected to meet the RCRA Section 3004(d-g) statutory test for protection of human health and the environment by demonstrating, "to a reasonable degree of certainty, that there will be no migration of hazardous constituents out of the disposal unit or injection zone for as long as the wastes remain hazardous."

Even so, eight years later, after EPA had established the HSWA land disposal restrictions (LDR) exemption program through which operators of many of the Class I hazardous waste wells had successfully demonstrated that continued operation of their wells would indeed be protective of human health and the environment, the House Commerce Committee's Oversight and Investigations Subcommittee launched an inquiry into the LDR exemption process. In October 1992, Chairman John Dingell (D-Michigan) sent EPA a long list of detailed interrogatories eliciting information about the Class I UIC program and, more specifically, about the LDR "no migration" demonstration process for Class I wells. His letter emphasized that Con-

gress had intended to ban land disposal and admonished EPA against treating the LDR exemption process "as a broad loophole" to allow continued use of injection wells.

In addition to extracting reams of information about the Class I UIC program (including the names, educational experience, and professional background of every person involved in reviewing the no-migration exemption petitions filed by Class I injection well operators), Dingell also requested the General Accounting Office to conduct an investigation of the program. Such double-barreled investigations had become a favorite method by the powerful congressman for focusing public scrutiny on EPA regulatory programs.

The agency responded to Dingell's interrogatories with scientific and technical data and information detailing every aspect of the Class I UIC regulatory program. EPA documented the thorough and highly technical nature of the no-migration petition demonstrations provided by Class I hazardous waste injection well operators — a process that some wells failed to survive and that caused other operators to modify significantly their operations. In addition, the agency commissioned a comprehensive assessment of purported "well failures" cited in the congressional interrogatories. The results of that study, delivered to Congress in 1993, found no contamination of drinking water resources resulting from the operation of any industrial Class I well since the advent of the program. In fact, the only cases of suspected fluid movement into underground sources of drinking water since EPA's initial UIC rules became effective involved the previously mentioned Florida Class I municipal wells, which are not subject to the same requirements as Class I industrial wells.

The information EPA provided to Dingell was turned over to the GAO, which found no basis for allegations that the no-migration exemption process was a sham. After initially examining the voluminous and thoroughly documented petitions, GAO did not attempt to second-guess the agency's decision-making. More importantly, it became obvious from the GAO study that injection well operators had been put through a rigorous scientific and technical review, which some operators had been unable to survive. Any notion of an agency rubber stamp was entirely baseless.

GAO conducted a thorough management audit of the UIC program that lasted almost two years and carried investigators into two regions (Region 6 in Dallas, and Region 5 in Chicago), EPA headquarters in Washington, and the states of Louisiana, Michigan, and Texas. In the end, GAO did not find an agency treating the LDR exemption provisions like a loophole. Instead, it declared, in auditor's jargon, that EPA was "progressing in implementing the 1984 amendments" and that "EPA strengthened its oversight of each region's underground injection control program." GAO essentially gave the Class I UIC program a clean bill of health, citing only minor enforcement concerns which were addressed and largely resolved even before the investigation was completed.

Considering the probing questions that initiated the congressional investigation, GAO's failure to find any major problems requiring correction provided a strong reaffirmation of the Class I program. These positive findings helped support passage of the Land Disposal Program Flexibility Act of 1996 to amend the land-ban provisions of RCRA. That legislation also drew support from the actions of OSWER, which recognized Class I injection as a safe, effective, and environmentally protective hazardous and nonhazardous waste management technology in connection with the development of the final set of LDR rules that addressed RCRA "characteristically hazardous wastes" — those that are ignitable, corrosive, toxic, or reactive. In the *Federal Register* preamble to its court-ordered proposal to impose additional restrictions on the injection of wastes

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already rendered nonhazardous (or "decharacterized") prior to injection, OSWER acknowledged that "the risks addressed by this rule, particularly UIC wells, are very small relative to the risks presented by other environmental conditions or situations."

In testimony before the House on the LDR relief legislation, Solid Waste Director Michael Shapiro confirmed this assessment. Additional support was provided by EPA Region 6 Water Division Director Myron Knudson, who called deep well injection "extremely safe." He testified: "It has been used for about 30 years now, and since the Safe Drinking Water Act was put in place and since the regulations, there have been no problems with the injection wells." In response to questions concerning how Class I injection wells can be explained to the public, Knudson replied: "We sit down and have to spend several hours to convince some people, but the truth is it is very safe, and in fact, it is probably the most environmentally safe way you can dispose of waste." The House Report on the legislation highlighted EPA's assessment, emphasizing that the "potential health risks from Class I injection wells are extremely low."

The 1996 RCRA legislation provided specific relief from the land ban for both Class I injection wells and wastewater treatment systems regulated under the Clean Water Act for the management of decharacterized wastewater. The bill passed both houses of Congress with overwhelming bipartisan support on the basis that the imposition of LDR requirements on nonhazardous Class I wells injecting decharacterized waste would impose huge costs with little or no corresponding environmental benefit. (And EPA's projected annual cost to industry of up to $800 million for imposing hazardous well requirements on the injection of nonhazardous wastes at 154 facilities tends to belie any notion that deep well injection is a "cheap" waste management alternative.) Although environmental groups and some members of the hazardous waste treatment industry opposed the legislation, the basic premise of the injection well provision — that Class I injection wells are adequately regulated and present very low risks — was never seriously challenged. The legislation clearly reflects a level of congressional comfort that deep well injection can continue to provide a viable method for managing wastes.

Nevertheless, the 1992 congressional inquiry disclosed the potential for public misunderstanding of the Class I UIC program. EPA responded by publishing informational brochures highlighting some of its scientific conclusions and risk assessments. In *Class I Injection Wells and Your Drinking Water*, EPA summarizes the safety and effectiveness of deep well injection by stating, "Injecting wastes in Class I wells is safer than burying them in landfills, storing them in tanks, or burning the waste in incinerators." This was one of several favorable EPA statements that legislators quoted verbatim in supporting the 1996 LDR program relief legislation.

Even with these repeated confirmations of the safety and effectiveness of Class I industrial deep well injection, the technology still struggles to maintain acceptance. One of the principal reasons for this problem is the confusing way in which the information about deep well injection is reported to the public under the Toxics Release Inventory. The TRI program requires businesses to report annually on "releases to the environment" of some 650 listed chemicals and chemical categories and requires reporting on the methods used for the management of wastes containing these chemicals. Class I injection is grouped with direct discharges to air, surface water, and land, thereby creating the impression that Class I wells also discharge wastes directly into the human environment.

The truth about deep well injection is far different, which is why EPA concluded under the Superfund and RCRA programs that "emplacement of liquids into an injection zone through a Class I well does not constitute a release from a solid waste management unit but rather constitutes migration within the solid waste management unit." Yet the agency resists adopting a similar reading for TRI reporting, apparently for fear of losing jurisdiction to require any TRI reporting of Class I injection — something the operators and regulators of Class I wells have not sought. Based on its Superfund/RCRA interpretation, EPA should be very comfortable classifying deep well injection as a waste management method rather than a release to the environment.

EPA has recognized that the potential exists for the data in TRI to be mischaracterized, and the agency has taken a number of steps intended to improve public understanding of the TRI data. Beginning in 1993 in con-

junction with its annual publication of the TRI data, EPA provided explanations aimed at improving knowledge of how the data should be viewed. EPA reiterated that "Class I underground injection wells are safer than virtually all other waste disposal practices."

From 1993 through 1997, EPA also presented its data on environmental releases in two different formats — one that included injected wastes in the total and one that presented as releases only those to air, water and land. EPA noted that "substantial questions have been raised about whether Class I injection wells are properly viewed as a direct environmental discharge." EPA presented the alternative rankings to "help the public focus on releases of greatest concern in their communities" and did so "because releases to properly designed and constructed Class I injection wells have much lower exposure potentials than other, more direct forms of release."

In 1997, EPA modified the TRI reporting form to create an entirely separate reporting category for Class I "to distinguish Class I injection well data from data for other classes of injection wells in a way that makes that distinction clear for the public." But this change still seems to fall short of effectively communicating the critical message that EPA presents in its annual TRI release: "Injection of toxic chemicals into properly designed and constructed Class I wells will result in substantially lower exposure potential than more direct forms of environmental release. These wells are designed to entomb liquid wastes for at least 10,000 years."

The continuing problem of public misunderstanding has been particularly felt by the Ground Water Protection Council, the association of state UIC and groundwater protection programs and administrators. In a 1996 letter to the Office of Management and Budget, the GWPC urged EPA to change the way it reports Class I injection under the TRI because the present approach "undermines public confidence in the UIC program and the permits that states and EPA issue to Class I wells only after concluding that the wells will be constructed and operated in a manner that protects human health and the environment by protecting drinking water resources." Because of the confusion that TRI reporting creates, GWPC has noted that "state UIC and TRI officials are constantly called upon to defend the permitting of Class I wells and to explain why the operation of these wells serves to protect rather than threaten community environments and to reduce community risks by substituting for discharges to surface waters." The organization also wrote a letter to EPA declaring that "as public officials charged with the responsibility of protecting human health and the environment, we have great difficulty understanding how it could serve any legitimate purpose to tell the public that these wastes are being released to the environment after we have made the determination — after detailed, site-specific technical review — that these wastes will remain safely isolated from the environment."

Such a change would not withhold any information about Class I injection, as some have charged. Instead, it would have EPA report Class I injection data in a category that identifies it as a waste management method rather than as a direct release to the environment. GWPC has emphasized that this approach "would (1) recognize the inherent protectiveness of Class I injection while (2) fully informing the public about the amounts of wastes that are injected through Class I wells." The alternative reporting would eliminate the confusion over the environmental fate of injected wastes while continuing public reporting of the quantities of toxic chemicals in injected waste streams to ensure the community right to know about the quantities of wastes being disposed.

Citizen activists have also decried the confusion that is created by the present TRI reporting scheme and have urged that "a dif-

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ferent class of reporting be established for deep well injection that would not require such a discharge to be classified as a 'release to the environment.'" James Blackburn, an environmental lawyer representing citizens and municipalities in Texas, made this recommendation expressing the belief that "the reporting requirements under the TRI are leading to poorly considered decisionmaking that is increasing the actual risk associated with 'discharges' to the environment." He cited an example where a manufacturing facility had, in his view, "made the decision to abandon the deep well injection and to convert to wastewater treatment and surface water discharge" and had done so "due to the TRI reporting requirements and associated bad publicity that comes from EPA characterizing this form of disposal as a release to the environment." As a result, he concluded that "coastal fishermen and women and residents will actually be exposed to more dangerous pollution than would be the case if deep well injection were continued."

Opposition to industrial deep well injection has come in several different forms, but none that proves sustainable. Concerns that have been expressed in the past about perceived threats posed by deep industrial injection wells have been fully addressed and resolved by EPA's current regulatory program. Some of these concerns are simply outdated and have been addressed by stronger regulatory requirements. Others result from presumed cause and effect relationships that have been shown to be false upon closer examination.

For instance, EPA, GAO, and GWPC investigated questions raised about possible aquifer contamination as a result of old well operation problems. All of these incidents predate current UIC regulations by many years. Problematic wells in Chalmette, Louisiana; Erie, Pennsylvania; and Beaumont, Texas, were all drilled and taken out of commission before the UIC program was begun following the enactment of the Safe Drinking Water Act in 1974. EPA's 1986 report on well noncompliance episodes concluded that the incidents at all three of these facilities would not have occurred under today's UIC standards. As EPA has noted more recently, for Class I industrial wells, "there are no documented problems with the effectiveness of the UIC regulations."

The EPA study examined every reported well failure alleged to have caused underground drinking water contamination and concluded: "It is obvious that groundwater contamination resulting from Class I operations has been very insignificant when compared to other forms of land disposal. More importantly, the few cases of groundwater contamination could have been avoided with proper design and construction and if the current more stringent UIC standards had been in effect at that time." EPA further summarized the results of these studies in 1991, noting that, wherever any leakage had occurred, "the construction, monitoring, and [mechanical integrity testing] requirements of the current regulations would have either prevented the observed failure or detected its occurrence in time to prevent significant leakage."

More importantly, after conducting a comprehensive review in 1992 and 1993, EPA concluded: "Since 1988 there have been only a few minor operational problems associated with Class I hazardous wells." These have largely been related to surface operations, and none has resulted in a release to the environment. The detailed review of all operational problems revealed none that involved fluid movement into an aquifer and no post-1988 failures by Class I industrial wells subject to TRI reporting that involved fluid movement outside the well itself.

More recently, critics of Class I injection have pointed to the events surrounding a commercial hazardous waste management facility located in Winona, Texas, that included Class I injection wells among its operating units. Public dissatisfaction and the organization of a strong community activist group were traceable to complaints triggered by odors and regulatory violations associated with air emissions and hazardous waste management in surface units. Opponents of the facility used the public hearings on injection well permits, no-migration demonstrations, and modifications as forums in which to attack all aspects of the facility operation. Local citizens opposed permits and sought closure of the facility because of releases and emissions from surface operations at the facility, but no problems were attributed directly to the operation of the wells and no failures of the wells occurred. Indeed, although the facility was eventually closed, the wells were repermitted and are still being operated to facilitate cleanup efforts at the site.

In sum, it is clear that Class I industrial deep well injection is a safe and effective waste management and disposal method that should be adopted — consistent with pollution prevention and natural resource conservation programs — in areas where geology and hydrogeology support its use. Where appropriate, it will be the safest method of disposal for residual waste liquids. Neither the technology nor those companies that use deep well injection should be denigrated, for it is a safe and effective method that protects human health and the environment.

Instead, more should be done both to improve public understanding of Class I industrial injection and, more importantly, to maximize the public benefits that can be realized from the use of this safe and effective waste management method. First, companies should always consider deep well injection as an acceptable method for the management of residual liquid waste streams that remain following implementation of effective pollution prevention programs. If the geology supporting the use of deep well injection is available, companies should conduct the necessary and appropriate investigations to support the effective use of the technology and ensure that it is implemented consistent with public natural resource conservation and protection programs.

Second, government at all levels should ensure the availability of adequate resources to implement the UIC program responsibilities of environmental agencies. This includes the resources necessary at the state or federal level to conduct timely and effective reviews of UIC permit applications, LDR no-migration exemption petitions and demonstrations, modifications, and revisions, along with any other programmatic demonstrations that operators need to submit. Government resources also must be available for effective implementation, oversight, and enforcement of the Class I UIC program.

Third, Class I injection well data, particularly as collected under the TRI, should be reported in a different way to avoid misleading the public into believing that properly injected wastes pose a threat. Continuing the current approach of reporting TRI numbers to the public as if deep well injection is a direct release into the environment perpetuates false incentives to abandon Class I wells in favor of waste management methods that may be less protective. Class I injection numbers should be reported to the public in a way that clearly communicates the substantially lower exposure potential than with direct releases to ambient air and water and to the land surface.

Fourth, public and private pollution prevention and environmental protection resources should be directed on a priority basis to the discontinuation or reduction of activities that might result in direct human or environmental exposure rather than to discontinuing injection activities that pose a comparatively negligible threat to human health and the environment. Many operators of Class I industrial deep wells are implementing pollution prevention programs to reduce the generation and disposal of wastes — including wastes that are disposed of through deep well injection. Where wastes cannot be eliminated, however, the highest priority should be assigned to minimizing releases to the human environment by reducing direct discharges to air, water, and land — the environment.

Finally, as both government and the private sector move forward to implement assessments, plans, and programs for protecting watersheds and source waters, Class I deep well injection should be considered as one of the methods available for ensuring success. Its proven capability to "remove from the environment" industrial hazardous waste provides a valuable tool for meeting the goal of protecting public health and the ecosystem for generations to come. •

But business still has the responsibility to move continually toward pollution prevention, seeking source reduction, recycling, and other improvements that will lead to a diminishing role for all forms of disposal.