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# Inefficient Remediation of Ground-Water Pollution

The principal threat to human health from old waste dumps arises from ingestion of toxic substances in drinking water. Leachate from the dumps enters aquifers. The Evironmental Protection Agency response in attempted remediation is usually to pump and treat the ground water. Approximately 68% of Superfund Records of Decision select ground-water pumping and treating as the final remedy to achieve aquifer restoration. This approach has proven to be ineffective.

A summary of problems of remediation and recommended solutions can be seen in a recent brief review article by Curtis Travis and Carolyn Doty of the Oak Ridge National Laboratory.* Their article points to a recent EPA study involving 19 sites where pumping and treating has continued for up to 10 years. The study concluded that although significant mass removal of contaminants had been achieved, there had been little success in reducing concentrations to target levels. The above authors discuss experiences at the IBM Dayton hazardous waste site in New Jersey where the ground water was contaminated with approximately 400 gallons of chlorinated organic compounds. Initial ground-water concentrations for one of them, perchloroethylene (PCE), was 6132 parts per billion (ppb). Pumping with an average extraction rate of 300 gallons per minute from 1978 to 1984 lowered levels of chlorinated chemicals to below 100 ppb. However, after shutdown of operations in 1984 the concentration of PCE rose to 12,558 ppb in 1988.

Some of the Superfund sites occupy 40 acres and more. The hazardous contaminants at any particular site may be found in widely varying concentrations throughout a heterogeneous subsurface region. The contaminants are adsorbed in varying degrees. Some move almost as fast as ground water. Others travel at a rate 1/10 to 1/30 as fast. Some are almost immobile. With current technology of site investigations, it is not possible to predict movement of the many components or chemical changes that may occur in them during their stay in the dump or movement from it. Some of the authors participating in a recent National Research Council report† suggested that a restoration of quality in many aquifers might not be achieved in less than 100 to 200 years of pumping. With nonaqueous phase liquids that leach very slowly, achievement of drinking water standards could not be achieved at any cost.

The extent of contamination of ground water is certainly much larger than that associated with 1200 Superfund sites. The Office of Technology Assessment has estimated that eventually 10,000 Superfund sites will be identified. A much greater number of municipal and other waste sites present and past are probably steadily contaminating ground water. Large quantities of chemicals have been broadly distributed, and some fractions of them entered moving ground water as long as 20 to 40 years ago. For example, between 1945 and 1984 more than 14 billion pounds of PCE and about 12 billion pounds of trichloroethylene (TCE) were distributed broadly. The PCE was used in garment dry cleaning. Some of the PCE was lost by volatilization, but a fraction of it was discarded in waste dumps or entered the ground elsewhere. The TCE was used as a degreaser in many machine shops. Part of it evaporated, but part went to waste dumps, sometimes in steel barrels that slowly rusted and then leaked. Both chemicals are more dense than water and are partially soluble in it. One barrel of TCE would contaminate 10 billion gallons of water at the level of 5 ppb, the Maximum Contamination Level under the Safe Drinking Water Act.

Some aquifers naturally contain water of such poor quality that it is a waste of attention and money to try to remove synthetic contaminants. The water in some other aquifers is not now being used for human consumption. The present practical solution for water supplies may be to treat water at the time it enters the supply system.

Future emphasis should be given to surveys to determine the extent of ground-water pollution at sites that have not thus far been examined. Emphasis should also be placed on creating improved technologies and better policies in the management of the problem. At existing known sites, priority should be given to attaining plume containment, which can be achieved by pumping at a strategic series of wells. Of high importance is continuing reduction of contaminants in the primary source. There, too, better technology is needed.

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*C. C. Travis and C. B. Doty, *Environ. Sci. Technol.* **24**, 1464 (1990). †*Ground Water and Soil Contamination: Toward Compatible Science, Policy, and Public Perception* (National Academy of Sciences, Washington, DC, 1990).