Appendix D
Attention to Ecological Issues

Despite statutory mandates to protect human health and the environment, ecological issues typically have not received significant consideration in the design or execution of remedial action plans either at Department of Energy (DOE) facilities or at other contaminated sites. It was not until March 1989 that the Environmental Protection Agency (EPA) issued a Superfund guidance document whose purpose was "to provide a scientific framework for designing studies. . that will evaluate pertinent ecological aspects of a site for the Remedial and Removal process. " Among the important ecological considerations, according to the guidance document, are the following:

. living resources at or near the site that require protection,
. effects of site contaminants on those resources, and
• effects of remedial actions (1).

More recently, the EPA Scientific Advisory Board (SAB) recommended that EPA direct as much attention to reducing ecological risks as to reducing health risks because of the inherent value of ecological systems and their strong links to human health (2). The SAB also recommended that EPA should improve the data and analytical methodologies that support the assessment, comparison, and reduction of different environmental risks.

Nine of the ten EPA regions have organized interagency ecological technical assistance groups to help project managers at Superfund sites consider relevant ecological issues during cleanup. In EPA Region III, the group is involved with every Superfund site. In other regions, the programs are just beginning. Groups such as these are necessary because ecological issues are often ignored in the initial planning activities at Superfund sites. According to one group coordinator, it is often impossible to tell from the initial characterization report whether a site is in "a desert or a tropical forest" (3).

Although such comments pertain to Superfund sites in general, not just DOE sites, several ecologists working with DOE facilities have expressed similar concerns. A common fear is that remedial action may do more harm than good because ecologists are not given sufficient input into the decisionmaking process. These ecologists offer several possible explanations for the failure to adequately consider ecological issues in the cleanup process at DOE facilities.

One contributing factor is that, historically, those in management positions at DOE facilities have not given substantial attention to biological issues. In addition, some facilities have been under great pressure from the public and individual States to "do something." Thus, some claim that remedial action is often advocated to quell criticism, without sufficient consideration of how much good it will actually do (4). A third reason that the ecological effects of contamination and remediation have tended to be ignored is that regulations have not usually been interpreted as requiring their consideration (5). Because it is very difficult to obtain remedial action money for projects not mandated by regulations (6), studies in basic ecology are generally not well-tided.

The amount of research being done on the ecological effects of contamination and remediation varies significantly from facility to facility. At Mound Plant, for example, no ecological research is being conducted (7). At Oak Ridge, on the other hand, the effort to study ecological effects related to the cleanup includes a well-established biological monitoring program, as well as ecological risk assessment. Even at Oak Ridge, however, ecologists have had to struggle to be heard (8). Some scientists believe that if the Environmental Sciences Division (ESD) at Oak Ridge had been utilized in the past as it is now, DOE could have avoided many of the credibility problems it faces today (9).

In-depth consideration of the situation at Oak Ridge is useful to provide examples of instances in which ecologists have been heeded and instances in which they have been ignored. It illustrates how the cleanup process is essentially regulation-driven but shows how doing more than is strictly required by regulations can be beneficial in the long run for both economic and environmental reasons.

The cooperative attitude that exists between ESD and the three Oak Ridge facilities with which it works (the Oak Ridge National Laboratory (ORNL), the Y-12 Plant, and K-25) has roots in a 1983 complainant order issued by the Tennessee Office of Health and Environment. The order required the Y-12 Plant to terminate discharges to the S-3 Ponds and close the ponds by March 1984. Although neither the order itself nor existing regulations required biological monitoring, management at the Y-12 Plant anticipated that massive cleanup would soon be required and approached ESD for help. As a result of that request for assistance, a monitoring program was begun to determine the effectiveness of remedial actions taken pursuant to the complainant order (i.e., neutralization and termination of discharges to the S-3 Ponds).

Over the years, monitoring has indicated the effectiveness of those remedial action measures from an ecological standpoint. Although a contaminated groundwater plume remains, the fish population in the upper reaches of Bear

Creek has recovered from a low of zero in 1984 to a high of several hundred in the sampling site nearest the S-3 Ponds in spring 1990. Monitoring has also proved that the main ecological problems in Bear Creek were a result of metal toxicity from the S-3 Ponds. Contamination from the oil landfarm and burial grounds further downstream appear to be ecologically insignificant. A 1985 ESD report advised that a planned 20-acre cap on the oil landfarrn and burial grounds would not improve ecological conditions in Bear Creek and would, in fact, have harmful effects on the terrestrial ecosystem of a ridge that had to be excavated to install the cap. Nevertheless, the cap was installed.

There are instances, however, in which the advice of ESD ecologists appears to have been heeded. They have pointed out the likely adverse ecological effects of pumping and treating groundwater at various sites along Bear Creek. Thus far, although it has been considered, no pumping and treating is planned. ESD scientists note that whereas human health considerations might make pumping and treating desirable, ecological considerations alone would discourage it.

In 1985, ORNL was required to initiate a biological monitoring and abatement program (BMAP) in order to receive a National Pollutant Discharge Elimination System (NPDES) permit. ESD scientists were able to implement a more extensive program than strictly required, by convincing DOE that in view of the impending cleanup, it would be more economical to undertake a program that could both meet NPDES requirements and inform the remedial action process. For example, although compliance with NPDES does not require monitoring of terrestrial ecosystems, data from such monitoring will be important in selecting remedial actions. ESD was able to obtain funds from both the NPDES compliance division and the remedial action division within ORNL. This initial commitment to an extensive monitoring program has been essential to the success of BMAP for two reasons. First, it is much easier to maintain existing funding levels than to obtain new funding. Second, it is impossible to compile adequate information about ecological impacts with 1-to 2-year studies.

One important result of BMAP has been the determination that chlorine is a problem at all Oak Ridge facilities. The large number of chlorinated point source discharges make this a difficult problem to remediate, but it is being addressed. Although 4 years elapsed between documentation of the chlorine problem and initiation of a search for solutions, in this case research on ecological effects informed the cleanup process (10).

The opinions of biological scientists are more highly valued at Oak Ridge now than in the past. The majority of biological research with potential relevance to the cleanup at Oak Ridge is performed by ESD. Of 200 staff scientists in the division, approximately 130 have master's or doctoral degrees, and about 40 percent of the latter are biologists. The staff is supplemented by about 250 visiting researchers (11). The State of Tennessee has acknowledged the ecological expertise that exists in ESD. Recommendations from the State that ESD be utilized more fully gave these environmental scientists the opportunity to be heard at Oak Ridge (12).

Ecological research with potential for informing the cleanup effort is also being done at the Savannah River Site (SRS). The Savannah River Ecology Laboratory (SREL) was officially established in 1961, but its roots go back to the beginning of SRS in 1951:

> At that time, interest in the kinds and numbers of plants and animals that may be affected by local operations spurred the Atomic Energy Commission to request "preinstallation" biological inventories. Scientists from UGA [University of Georgia] conducted censuses that might serve as indicators of future impacts of nuclear production facilities and examined basic ecological principles such as old-field succession, competition in animal and plant communities, and the use of radioactive tracers to chart food chains (13).

Today, 35 doctoral-level biological scientists are permanently employed by SREL; all of them in one way or another are studying the impacts of SRS operations on the environment (14). Approximately 20 of these researchers are also on the faculty at the University of Georgia (13).

The National Research Council's (NRC) Committee to Provide Interim Oversight of the DOE Nuclear Weapons Complex made the following comment in its 1989 report:

> The SRS is a model example of a DOE facility where an ecological culture has been adopted by many managers. Basic ecological research by the Savannah River Ecology Laboratory (SREL), as well as the Savannah River Laboratory, seems well appreciated by DOE and the site contractor management. Long-term, high-quality research along with popular writing and public lectures on the SRS wildlife and environment have obviously had a positive effect not only on plant management but also on public opinion (15).

According to a member of the NRC committee, science is being brought into the decisionmaking process at SRS, and managers there are less likely than those at other facilities to blindly perform remedial actions (16).

Like their counterparts at Oak Ridge National Laboratory, SREL scientists are concerned about the emphasis placed on engineering to the exclusion of biology in preliminary cleanup plans (14). However, more ecological research is being conducted at Savannah River than at most other facilities in the Weapons Complex, and SREL is confident that it will be able to influence the remedial action process there. Although SREL could provide important input into the development of cleanup plans for

the entire DOE Weapons Complex, it is doubtful that SREL will be allowed to have a significant impact on cleanup decisions at the national level.

Oak Ridge and Savannah River are exceptions among DOE facilities in the effort they devote to ecological research. As mentioned earlier, Mound Plant does no such research. No ecologists are employed at the facility, and no ecological studies are being done in conjunction with the decommissioning of several plants there. The Mound Plant, however, covers slightly more than 300 acres, only half of which is used in operations (7). This is a fraction of the size of the Oak Ridge Reservation (about 60 square miles) (17) or the Savannah River Site (about 300 square miles) (18). Other large sites, however, are concerned much less about ecological effects than Savannah River or Oak Ridge. Neither Hanford nor the Idaho National Engineering Laboratory (INEL), both of which are substantially larger in area than SRS (19), has attempted extensive ecological site characterization.

DOE's Ecology and Radioecology Program at INEL is responsible for most of the ecological research done there, although contractors such as EG&G do some work in conjunction with specific remedial action projects (20). The Ecology and Radioecology Program consists of 3 DOE ecologists and about 20 associated university scientists (21). Although selected studies have been done on effects with potential relevance to the cleanup, there appears to be no systematic attempt to inform the cleanup process through ecological studies at INEL (20, 22). The routine monitoring program there is designed primarily to determine radionuclide pathways to human receptors and includes very little biological monitoring. Routine contaminant-level monitoring in animals is limited to game animals obtained from road kills (23).

The research on ecological effects at Hanford is confined to studies of individual operable units, which range in size from roughly 10 to 300 acres. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remedial investigation/feasibility studies are currently underway at about five of the smaller units, all of which are old reactor sites along the Columbia River. Ecological studies at these units consist primarily of monitoring contaminants in deep-rooted plants, small mammals, aquatic plants, and relatively stationary aquatic organisms such as clams and snails. Fish are not studied extensively because their mobility limits their usefulness in characterizing centamination at any particular operable unit. The studies are designed to establish baseline information with which data obtained during remedial action can be compared. Although a sitewide study would be useful, funding is limited to that necessary for the study of individual operable units. Ecological monitoring by Battelle Pacific Northwest Laboratories (PNL) currently involves about one person-year of activity (24).

There are approximately 15 master's or doctoral level ecologists on staff at Battelle PNL, a major DOE contractor at Hanford (25). Most of the research is devoted to using ecological principles to design remediation methods (26). For example, ecologists are involved in a multidisciplinary effort to develop protective baniers for waste sites. As part of the project, ecologists study how plants and animals can interfere with barriers by root intrusion or burrowing and how they can be used to prevent water infiltration into waste sites (27). Other major ecological research at Hanford includes revegetation of salt waste isolation sites and the development of a herbicide that prevents plant root intrusion into waste sites.

Related utility-oriented ecological research is being conducted at Los Alamos National Laboratory (LANL), but virtually no research is going on there. The major ecological research related to the cleanup at LANL involves nonengineering approaches to remediation, such as using evergreens as landfill caps. Native juniper pinions are replacing grass as a means of preventing erosion and controlling water flow because they are very effective in taking up water at the time of the spring snow reek. This helps minimize the amount of water that flows through a waste site and is much less expensive than traditional engineering solutions such as clay caps. In the course of this research at Los Alamos, there has been cooperation with ecologists at Hanford and INEL because of the similar ecology at the three sites (28).

Although great variation exists from facility to facility, it is perhaps not surprising for complexwide managers to be more interested in research that contributes to remedial action than in research that focuses on determining ecological effects. This appears to be true at Savannah River and Oak Ridge as well. Of the four major areas of research in ESD-bioremediation, biological monitoring, biomarkers, and burial ground restoration-the biggest emphasis is on bioremediation. Bioremediation involves the use of microbes to process waste, either in situ or in an above-ground reactor. Within ESD, a significant portion of available funds is spent on engineering sciences because of the expense of building bioremediation reactors (11).

One project being funded with remedial action money was selected from among a series of proposals submitted by SREL and is directed toward restoring an area in which vegetation has been destroyed by thermal discharges. About six ecologists are working on this. SREL hopes to have more projects funded with remedial action money in the coming year (14).

Although research on using ecological principles in remediation is essential, DOE must guard against focusing on methodology and ignoring the consideration of where remedial action is most necessary and where it

might do more harm than good. One way to ensure effective remedial action is to devote sufficient ecological talent to determining where and what the problems are. Ecological information alone cannot determine priorities, but it must be a part of the priority-setting process. Comprehensive studies to identify the ecological effects of contamination or remedial action do cost money, but remedial action itself tends to cost far more. Money spent to determine where problems exist and whether proposed solutions are appropriate, given the alternatives, is well spent if it prevents ineffective (or even detrimental) and expensive "remedial" actions from being undertaken.

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