Appendices

Appendix A

The Research Mission

By Dr. Wilson K. Talley*

Reprinted From EPA JOURNAL, OCTOBER 1975, *VOL. 1, NO. 9*

The fundamental mission of the Environmental Protection Agency isn't hard to state: the achievement and enhancement of a quality environment. Our research contributes to the development of effective pollution control strategies and i n the promulgation of reasonable and scientifically sound environmental standards and regulations.

Some of the basic questions confronting EPA's research program include:

When does a substance in the environment become a "pollutant"?

To what extent should a pollutant be controlled?

What is the best way to eliminate or control the pollutant?

EPA's Office of Research and Development needs the answers to provide timely and valid scientific information and necessary technical tools and control systems.

Phosphates provide a simple illustration of some of the basic questions we are concerned with. As we all know, phosphates are a widely used fertilizer and can play a useful role for man.

However, excess phosphate in our waterways can cause degradation of water quality and lead to fish kills. These results occur because too much phosphate stimulates massive growths of algae and other aquatic vegetation which later die and absorb the oxygen in the water.

So we have the responsibility of determining how much phosphate a lake can tolerate before it suffers from excess algae. Then we have to decide what techniques can be used to deal with this problem most effectively.

These are the types of problems we have been dealing with in the case of Lake Shagawa in northern Minnesota, for example. We have been successful in restoring this badly polluted body of water by drastically reducing the amount of phosphates discharged in wastewater from an advanced waste treatment plant.

SEVEN ACTS

Our research program is authorized by seven separate congressional acts: The Clean Air Act; the Federal Water Pollution Control Act; the recently passed Safe Drinking Water Act; the Solid Waste Disposal Act; the Federal, Insecticide, Fungicide, and Rodenticide Act; the Public Health Service Act; and the Noise Control Act.

Through this legislation, we have available $250 million for research this fiscal year. Of this total, $66 million will support the in-house activities of our staff of 1800 professional and support workers in 15 field units and headquarters. The remainder of the money will support an outside research program—fully integrated with the in-house research—that is carried out through grants and contracts with the academic, research, and industrial communities, as well as through cooperative agreements with other Federal, State, and local agencies.

The ties between the in-house researchers and the EPA-financed external programs are and must be close. The research program exists to support the regulatory role of the Agency, and hence either the researcher or, if the research is extramural, the research manager, has to be available to assist the Agency in developing appropriate regulations and standards, to provide expert advice to policy makers, to provide continuity and direction to the research, and to testify, if necessary, at enforcement actions.

Because of the manner in which the Agency receives its authorizing legislation, the research program for budgetary purposes has been classified along specific media or

*Dr, Wilson K, Talley is Assistant Administrator for Research and Development.

categorical lines such as air, water, pesticides ... But pollution problems seldom restrict themselves to such arbitrary boundaries—pollutants often create spillover effects in other media. And other factors-costs, for instance, and feasibility of alternative strategies—preclude focusing solutions in only one medium. Consequently, environmental research must be integrated.

5-YEAR PLAN

This integration must fit a time frame suited to the schedule of problems and responsibilities we face. So in working out a new structure for the research program, we have shifted our planning from a year-to-year schedule to a 5-year time frame. Each year, we will spell out what we can foresee for the next five—and thus revise this 5-year plan each year. ORD's new organizational structure follows accordingly, and is organized by type of product.

ORD's short-term activities, primarily quality assurance, monitoring, and analytic responses to the immediate needs of other Agency programs, were grouped together under the Office of Monitoring and Technical Support.

The relatively more stable long-term activities, relating to the determination of the human health and ecological effects of pollutants, were organized into the Office of Health and Ecological Effects.

The third component of ORD's mission—meeting legislative and Agency mandates for control or abatement technology—was, because of its size, organized into two groups: The Office of Energy, Minerals, and Industry; and the Office of Air, Land, and Water Use. Our main programs are organized within this framework.

These four offices plan and implement research that can be broken into our 14 major program areas.

Health effects is a base research program, where our scientists work to determine and evaluate health hazards that may arise from pollution from a number of media and categories including air, water, pesticides and radiation. In taking environmental action to protect human health, we regulate exposure to specific contaminants, not their effects. In this way, adverse health effects associated with pollution may be reduced or eliminated rather than treated after the fact.

In developing the data needed to establish exposure/response relationships, we examine how pollutants reach man: i.e., via air, water, food or a variety of routes. In addition to laboratory studies, one of the ways we investigate exposure/response relationships is through observing the health of different population groups.

For example, we are assessing the incidence of illness in swimmers at relatively clean and relatively polluted beaches to determine better how the illness can be correlated to chemical or microbial indicators of water quality. The information obtained will be used to help us develop health criteria for recreational water quality.

Similarly, we are carrying out studies to assist in evaluating existing standards and developing new ones for air quality. Conducted in several locations across the country, these studies are designed to investigate the relationship between air quality and health effects such as respiratory disorders in children, asthmatics, and other population subgroups.

Ecological effects and processes is a research program which determines the effects of air and water pollutants on the structure and function of ecosystems and on subcomponents of such systems. Work is planned and organized along problem area lines; it is directed toward target media—freshwater, marine, and terrestrial--and conducted according to the character of the problem.

Among the studies in progress are those to define and characterize ecosystems; that is, to unravel the myriads of individual ecosystem components and then to understand their dynamic, functional relationships,

To do this, we carry out field studies on natural ecosystems as well as attempt to

simulate ecosystems in the laboratory. With the knowledge gained, we can enhance our capability for accurately determining the impact of existing pollution on the ecological balance and for predicting the damage of increasing pollution.

For example, we are studying the effects of pollutants from a new coal-fired power plant on the wildlife and on the surrounding grasslands in Colstrip, Montana.

We must answer questions such as: what effect will pollutant X have on the plant or animal organisms in an ecosystem ? Will the pollutant impair the organism's ability to reproduce or escape predation? How will the ecosystem be functionally altered if pollution renders a species of plant or animal incapable of surviving ?

Transport and fate of pollutants research produces empirical and analytical techniques to allow relating air and water pollution emissions to ambient exposures. In the atmosphere, we must identify sources, sinks, and transport and transformation processes for gases and particulate. In aquatic environments similar considerations apply. This area also includes effects on visibility, turbidity, rainfall, water quality, and intermedia transfer of pollutants.

To discover feasible control and abatement technology, several programs address various aspects of this complex work.

Waste management program research focuses on the prevention, control, treatment, and management of pollution resulting from community, residential or other nonindustrial activities. This area includes municipal and domestic wastewater, collection/transport systems, land surface runoff, municipal solid wastes and air pollutants. Current research includes the development of improved methods for the processing and disposal of sewage sludge. We are also looking at the possibilities of incinerating the sludge in combination with solid waste and attempting to make use of heat generated in this process.

Water supply activities include research, development, and demonstration necessary to provide a dependable and safe supply of drinking water, and to prevent health damage resulting directly or indirectly from contaminants in drinking water.

For example, new and improved technology is being developed for the removal of infectious agents in drinking water. The problem with using chlorine as a disinfectant is that it produces substances which may be toxic, so we are exploring alternatives to chlorination. These alternatives include the use of ozone and the use of ultraviolet light.

We are also looking at technology for the removal of potentially toxic organic contaminants from drinking waters. One such technique for removal of these organics involves the use of activated carbon. Added to the water in powder or granular form, the carbon acts as a sort of sponge—the organic compounds attach themselves to the carbon which is then removed,

Mineral extraction processing and manufacturing program research is concerned with point sources of air, water, and residues pollution that may arise from the industrial sector of the economy. It is focused on those mining, manufacturing, service, and trade industries which are involved in the extraction, production, and processing of non-energy materials into consumer products. In addition, the environmental problems that can arise from accidental material spills are studied. This research activity supports the technical requirements of the Clean Air Act and Water Pollution Control Act by developing and demonstrating new or improved, cost-effective abatement technology.

Renewable resources program activities encompass the development of total management systems, including predictive methodology, that are to control air, water, and land pollution resulting from the production and harvesting of food and fiber. This area includes the assessment of probable trends in the production of renewable resources and their resulting environmental impact. Major areas of concern include crop production in both irrigated and nonirrigated

lands, forestry practices, and animal production.

Environmental management research looks at environmental management strategies—various comprehensive approaches to integrating all environmental programs in an efficient manner, utilizing land use management as the basic integrating mechanism. For example, methods are being developed to assess the environmental impacts of sewer and transportation systems on community growth. Also, methods for integrating regional air and water quality planning efforts are under way.

Energy extraction and processing technology covers the assessment of problems and development of control techniques to mitigate the environmental impact of the mining and processing of coal and other energy resources. Solid, liquid, and gaseous fuel as well as such non-fossil energy sources as uranium and geothermal sites are considered. The range of problems considered spans the spectrum from assessment of the socio-economic aspects of resources extration and good practice in offshore drilling to abatement of acid mine drainage and coal cleaning.

Energy conversion-utilization technology assessments is the category aimed at assuring adequate energy production from fossil fuels with minimum damage to environmental quality. After assessing environmental impacts, this program identifies, develops, and demonstrates the required pollution control technology for present and emerging energy systems.

For example, our Industrial Environmental Research Laboratory at Research Triangle Park has been developing and demonstrating flue gas desulfurization technology, commonly known as stack gas scrubbers. These units can be used to control sulfur dioxide emissions from stationary sources, with particular emphasis on coal-fired electric power plants.

Integrated technology assessment is required to identify significant technology gaps and provide information for important policy decisions. The assessment must include environmental, energy, economic, and social factors.

Energy health and ecological effects include those research efforts necessary to determine the environmental effects associated with energy extraction, transmission, conversion, and use. With this knowledge, measures can be taken to protect human health and welfare, the ecosystem, and social goals while increasing energy production.

Measurement, techniques and equipment development research provides methods which serve as the Agency's "eyes, ears, and nose." Some of the more immediate needs of the Agency concern environmental monitoring. After all, if we can't be sure a pollutant is there, how are we to control it?

In this program, physical, chemical, and biological principles provide the basis for development of procedures and instruments to measure pollutants. These procedures and instruments are then used by the Agency in its monitoring networks.

As an example of how this program works, we may find that we need to routinely measure a newly identified environmental pollutant such as vinyl chloride. Vinyl chloride is a colorless gas which recently was identified as the industrial chemical responsible for causing a kind of cancer in industrial workers. A procedure to measure vinyl chloride was developed by our monitoring program in cooperation with the regional surveillance and analysis laboratories. This system was used by the regions in a national monitoring survey to evaluate the vinyl chloride problem. The analytical procedure is currently being refined in our laboratories under the measurement, techniques, and equipment development program.

Monitoring quality assurance serves all environmental monitoring activities of the Agency. Its purpose is to assure that monitoring data used to support the Agency's regulatory programs are scientifically sound and legally defensible.

To illustrate this problem area, consider a butcher weighing a piece of meat. If he were to

take the same piece of meat and repeatedly weigh it, each successive weighing would be different from the others. If he used a good balance, these differences would be small and there would be no cause for alarm. However, if the differences were large, the customer could become very distressed.

It is the purpose of the quality assurance program to standardize the measurement procedures to reduce the variations in such successive measurements to acceptable differences. The quality assurance program also provides standard reference materials of certified purity and reference samples of known concentration so that analysts can check the accuracy of their analyses. Quality control guidelines and manuals are developed to assure uniform analytical practices. Finally, the quality assurance program provides for evaluation of laboratories for the adequacy of their facilities and the competencies of their technical personnel.

Technical support is also provided by our research program to other elements of the Agency. This is usually not research per se; it is mainly the application of our findings in all fields, and the lending of our research scientists and our research facilities to other parts of the Agency for their immediate or unusual needs.

These needs may be for technical information, for the evaluation of a particular pollution control problem, for a surveillance or monitoring job in one of the Regions, or perhaps for monitoring and control of an emergency pollution episode. Identification of this function as a distinct activity reflects a determination that we will continue to be responsive to the immediate needs of the Agency.

Taken together, these 14 program areas are the totality of our research program. The specific content of any area is based on a number of fundamental factors.

First and foremost is the full recognition that research serves a support function within the regulatory Agency. Our strategy, specific objectives and priorities should not and cannot stand as entities in and of themselves. Rather, they must derive from those of the Agency in the accomplishment of its total legislative mandate.

The program, then, is one of mission-oriented research and not one of so-called basic research. This is not to say that some very fundamental research is not, in fact, an integral part of our program. It is and must continue to be so because of our responsibility to provide the best scientific data and to develop control systems for pollution problems that are beyond the present state-of-the-art. Further, a most important research function is to anticipate the problems that will emerge in the future and—if we cannot prevent them—tag them so that they will not arrive unheralded.