

NERC - Corvallis Laboratories



Office of Research and Development

Summary of Missions, Needs, Resources,
Accomplishments, and Trends

June, 1974

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Accomplishments, and Trends**

June, 1974

Compiled by the Program Coordination Staff of the National Environmental
Research Center at Corvallis, Oregon. Free copies are available through:

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MISSIONS OF NERC-CORVALLIS

The National Environmental Research Center at Corvallis, Oregon, carries out research programs on the ecological effects of pollution. Emphasis is on developing scientific information for establishment of standards to protect the environment.

In efforts to broaden its scope, NERC-Corvallis is increasingly carrying out research on a total environmental scale to develop the scientific basis for determining the ecological consequences of all aspects of environmental pollution.

The mission is to develop a full and thorough understanding of the many complex interrelationships among specific components of the ecological system. Major programs of the nine NERC-Corvallis associated laboratories are designed to:

- Conduct research and development programs on eutrophication and lake restoration, and on the fate of pollutants in marine waters.
- Provide support on whole-system ecology research to increase the understanding of environmental stress relationships among the life-supporting media of air, land, and water.
- Develop the scientific basis for establishment of water quality standards for fresh waters.
- Develop the scientific basis for establishment of water quality standards for marine waters.
- Investigate the effects of organic chemicals on aquatic life.
- Develop the scientific basis for establishment of water quality standards for cold climates.
- Develop the scientific basis for predicting the fate of pollutants that enter fresh surface waters and for assessing the potential exposure of human and aquatic life to these pollutants.
- Develop fundamental scientific information for the treatment, control, and prevention of pollution from wastewater.
- Develop the scientific basis for establishment of water quality standards for the Great Lakes.

Facility and Budget

The Center's management offices, located in Corvallis, Oregon, direct the research of nine associated laboratories in eight states.

Laboratories are located in Corvallis, Oregon; Duluth, Minnesota; Narragansett, Rhode Island; Gulf Breeze, Florida; College, Alaska; Athens, Georgia; Ada, Oklahoma; and Grosse Ile, Michigan.

The current annual NERC-Corvallis budget of approximately \$32 million covers in-house research programs at the associated laboratories and field stations, contracts, grants, and interagency agreements (see following table).

Summary of Funded Research for FY-74 (By Laboratory)

Laboratory	In-House (\$K)	Extramural* (\$K)	Total (\$K)
AERL	651	671	1,322
GIL	506	1,942	2,448
GBERL	679	512	1,191
NERL	879	1,466	2,345
NMWQL	1,434	1,279	2,713
NWQL	2,058	531	2,589
PNERL	2,970	3,743	6,713
RSKERL	992	3,401	4,393
SERL	1,667	2,135	3,802
Total	11,836	15,680	27,516

*Grants, Contracts and Interagency Agreements

Professional Research Staff

The Center's professional research staff, which comprises individuals from varied disciplines, currently numbers approximately 350. The staff is particularly strong in the biological sciences, enabling NERC-Corvallis to carry out research into the effects and processes of environmental pollution (see chart on following page).

Professional Staff

Discipline	B.S.	B.A.	M.S.	M.A.	Sc.D.	Ph.D.	Total
Biological & Agricultural Sciences	63	17	34	5	1	41	161
Chemistry	40	9	13			27	89
Engineering	27		26		1	12	66
Health Fields			4			2	6
Mathematical Sciences	2		1				3
Physical Sciences	6	4	2			3	15
Other	2	2	3	2			9
Total	140	34	81	7	2	85	349

ARCTIC ENVIRONMENTAL RESEARCH LABORATORY

COLLEGE, ALASKA

DIRECTOR: MR. RICHARD W. LATIMER

Arctic Environmental Research Laboratory

Director: Mr. Richard W. Latimer

Mission

The laboratory has the responsibility for providing the data necessary for environmental protection in cold climate areas. This includes: (A) conducting research on the interrelationships between cold-dominated environments and their indigenous organisms and conducting studies relating to the effects of man-induced factors on arctic and subarctic ecosystems. (B) conducting research including development and demonstration of technology, necessary for the control of environmental pollution in cold climates.

Need and Supporting Legislation

AERL was one of seven laboratories authorized by Congress in the Federal Water Pollution Control Act Amendments of 1961 (PL 87-88) and reauthorized as Sec. 104 (e) (PL 92-500) in 1972. The legislation recognizes that there are unique problems associated with environmental protection in cold climate areas that can best be solved through a laboratory program in Alaska.

Sec. 113 (PL 92-500) authorized the "Alaska Village Demonstration Projects" to "demonstrate methods to provide for central community facilities for safe water and elimination or control of pollution in those native villages of Alaska without such facilities." These projects require a wide range of environmental health considerations and provide the basis for technology research application in Alaska.

The generally pristine environments in Alaska and the technological innovations necessary to protect these environments while developing needed resources makes it imperative that the Agency maintain a viable research program in Alaska.

Capabilities and Program Implementation Approach

AERL has strong expertise in freshwater aquatic ecology and environmental engineering in cold climates.

Research is implemented by a blend of intramural and extramural resources.

FY-74 Resources by Task Type

	<u>C</u>	<u>E</u>	<u>F</u>	<u>A</u>	<u>Total</u>
Number	11	4	0	16	21
\$1000s	391	280	0	651	1,322
% Funds	30	21	0	49	100

Current Program and Resources

	<u>FY-74 Funds (\$1000s)</u>
Freshwater Ecology	346
Marine Ecology	100
Municipal Technology	<u>876</u>
Total	1,322

Major Accomplishments to Date

- Developed design criteria for biological waste treatment processes under cold climate conditions.
- Identified the phenomena of low winter dissolved oxygen in Alaskan rivers; the extent and environmental implications.
- Evaluated wastewater disinfection at low temperatures using chlorine and lime.

- Developed toxicity data for crude oil on some indigenous Alaskan organisms at low temperatures.
- Identified automotive emissions produced at sub-zero temperatures from various types of fuels and emission control devices.
- Developed aquatic ecosystem model for subarctic streams.
- Demonstrated the central facility concept for providing a safe water supply, toilets, bathing, laundry, and waste disposal for Alaskan native villages.
- Enhanced understanding of the role of microorganisms in cold climate ecology including the survival of enteric bacteria in rivers under low temperature conditions.

Program Trends

The research program at the Arctic Environmental Research Laboratory has in the past been oriented towards meeting immediate waste treatment needs in Alaska and baseline data collection for an understanding of the unique arctic and subarctic ecosystems. The present program has emphasized fate and effect studies of various pollutants from man's activities in cold climates and applied State-of-the-Art technology to meet environmental health problems in remote rural communities. Future research will be heavily oriented towards the environmental impact of resource development (oil, gas, lumber, metals, etc.) in the arctic and subarctic. Ecological research will have to move into the predictive mode in order to properly assess environmental impact before it occurs. Environmental engineering will continue to play an important role in applying technological advancement to cold climate areas.

Arctic Environmental Research Laboratory
Professional Staff

Discipline	B.S.	B.A.	M.S.	M.A.	Ph.D.	Total
Biological Sciences		1	1		1	3
Chemistry	2		1			3
Engineering	5					5
Physical Sciences					1	1
Other				2		2
Total	7	1	2	2	2	14

GROSSE ILE LABORATORY
GROSSE ILE, MICHIGAN
DIRECTOR: DR. TUDOR T. DAVIES

Grosse Ile Laboratory

Director: Dr. Tudor T. Davies

One of the Grosse Ile Laboratory's primary missions is planning, managing and conducting a research program to evaluate the impact of human activity on large lakes.

Large Lakes Branch

Chief: Nelson A. Thomas

The Large Lakes Branch plans and conducts field, laboratory and extramural studies to define the behavior and the effect of pollutants on large lake systems. Studies describe the system processes and problems pertinent to the Great Lakes in order to establish a scientific basis for the establishment of Great Lakes water quality criteria and waste discharge control.

This includes: (a) Predictive models of chemical, physical and biological processes affecting pollution of large lakes. (b) Assessment of pollution problems in the Great Lakes. (c) Determination of ecological stresses caused by power generating plants in large lakes. (d) Development of guidelines for dredging operations and spoil disposal.

Another important function is the laboratory's association with the International Joint Commission Research Advisory Board and upper lakes reference studies.

Need and Support Legislation

--The primary basis for large lakes research is the need to protect and enhance water quality, especially the Great Lakes:

--Section 104 (A) (1) "...conduct and promote the coordination and acceleration of research, investigations, ...surveys, and studies relating to the causes, effects, extent, prevention, reduction, and elimination of pollution..."

--Section 104 (A) (2) "...render technical services to pollution control agencies..."

--Section 104 (A) (3) "Conduct...public investigations concerning the pollution of any navigable waters and report on the results of such investigations..."

--Section 104 (B) (6) "Collect and disseminate...basic data on chemical, physical, and biological effects of varying water quality..."

--Section 104 (F) "The Administrator shall conduct research and technical development work, and make studies, with respect to the quality of the waters of the Great Lakes, including an analysis of the present and projected future water quality of the Great Lakes under varying conditions of waste treatment and disposal."

--Technical support is provided under Section 108 (A) and (D) which provide for demonstration of pollution control programs on the Great Lakes.

--In addition, the need to protect and enhance Great Lakes research is further emphasized in "Great Lakes Water Quality Agreement between the United States and Canada" signed by President Nixon and Prime Minister Trudeau on April 15, 1972.

Sections supporting large lakes research:

1. Annex 2 Control PF Phosphorus
10 - "...shall continue to monitor the extent of eutrophication in the Great Lakes system and the progress being made in reducing or preventing it. They shall consult periodically to exchange the result of research and to pursue proposals for additional programs to control eutrophication."
2. Text of reference to the International Joint Commission to study pollution problems of Lake Huron and Lake Superior.
3. Terms of reference for the establishment of a research advisory board.

Capabilities and Program Implementation Approach

The Large Lakes Branch provides strong expertise in research on physical, chemical and biological processes in large lakes, especially the fate of pollutants.

Research is implemented through cooperative studies with Canadian and United States agencies. The large lakes research is mainly an extramural program with a small but important in-house activity.

FY-74 Resources by Task Type

See attached chart.

Major Accomplishments

IFYGL

--Published annual reports (2/30/74).

--All field work completed (7/1/73).

--Data 50% analyzed (1/1/74).

--Coarse grid nutrient-chlorophyll model (1/1/74).

Thermal

--Issued fish egg entrainment report for two power plants (5/1/72).

--Issued zooplankton entrainment report on Monroe, Michigan, power plant (9/1/73).

Dredging

--Final report on impact (3/1/74).

--Annual report on chemistry (3/1/74).

Nutrients

--Algal assay, Lake Michigan (10/1/73).

--Transmitted dissolved oxygen and water temperature data via satellite from Lake Erie (12/1/73).

IJC

--Research Advisory Board annual report (1/15/74).

--Prepared 1973 Lake Erie Water Quality Section of the Quality Board report (1/25/74).

ICMSE

--Issued proceedings (12/1/73).

Upper Lakes Reference Study

--Prepared local effects reports and project summaries (1/8/74).

Program Trends

The research conducted by the Large Lakes Program has produced data for the formulation of an eutrophication mathematical model for Lake Ontario. These models will be modified to simulate changes in waste discharges and the resultant effect for the other Great Lakes.

Studies will be conducted to provide verification of the simulations and to provide more definitive kinetic data for the models.

Programs will be maintained on Lake Erie and developed for the other lakes to assess the effectiveness of nutrient control measures implemented on the Great Lakes. An increased emphasis will be placed on the study of the fate and effect of hazardous materials and the determination and significance of rural and diffuse source pollutant inputs.

Activities will be continued on developing criteria for thermal discharges to large lakes. The program will continue to conduct research on the impact of dredging and dredged spoils disposal.

Large Lakes Branch

Professional Staff

Discipline	B.S.	Ph.D.	Total
Biological Sciences	1		1
Chemistry		1	1
Engineering	1		1
Physical Sciences		1	1
Total	2	2	4

FY-74 Resources by Task Type

<u>Program Area</u>	<u>Man Years</u>	<u>Inhouse</u>		<u>Contracts</u>		<u>Grants</u>		<u>Total of All Resources</u>	
		<u>\$</u>	<u>%</u>	<u>\$</u>	<u>%</u>	<u>\$</u>	<u>%</u>	<u>\$</u>	<u>%</u>
25ADS Thermal	1.0	27	34			52	66	79	4
25ADX Dredging	1.0	25	23			85	77	110	6
25ADR Nutrient	1.0	30	6			419	94	449	24
21AKP Modeling	1.7	223	43			300	57	523	28
21BAZ Ref. Studies	0	106	15	50	7	556	78	712	38
Tech. Services	.3	13	100					13	.1
		424	22	50	3	1,412	75	1,886	

Hydrologic Modification

Program Element Director: Dr. Tudor T. Davies

Mission

The mission of the Hydrologic Modification Program is to define the national significance of major hydrologic modifications including construction, dredging, landfill, and water resources development. The program will provide the required control technology required to meet the 1983 water quality goals. Control technology will be demonstrated in the four climate areas of the United States.

Need and Supporting Legislation

The need to demonstrate control technology for construction activities is supported by Section 105 (B):

"(B) The Administrator is authorized to make grants to any state, or states or interstate agency to demonstrate, in river basins or portions thereof, advanced treatment and environmental enhancement techniques to control pollution from all sources, within such basins or portions thereof, including non-point sources, together with instream water quality improvement techniques."

The need to determine the significance of hydrologic modification and a determination of the State-of-the-Art in the effectiveness of available control is covered by Section 104 (1):

"(1) In cooperation with other Federal, state, and local agencies, conduct and promote the coordination and acceleration of, research, investigations, experiments, training, demonstrations, surveys, and studies relating to the causes, effects, extent, prevention, reduction and elimination of pollution."

Capabilities and Program Implementation Approach

Capability of program design and implementation with expertise in geological and engineering practices. The research is through a mixture of grants and contracts.

FY-74 Resources by Task Type

	<u>C</u>	<u>RG</u>	<u>IA</u>	<u>IH</u>	<u>Total</u>
Number	--	1	--	1	2
\$1000s	--	230	--	20	250
% Funds	--	92	--	8	100

Current Programs and Resources

	<u>FY-74 Funds</u> <u>\$1000s</u>
Field demonstration of effect erosion control	230
Program development	<u>20</u>
Total	250

Major Accomplishments

--Initiated sediment erosion control demonstration at Columbia, Maryland (5/73).

--Intitiated comprehensive assessment of national hydrologic modification (10/73).

Program Trends

The Hydrologic Modification Program is proceeding to define the signifiante of construction, dredging, landfill, and water resources development activities, including an evaluation of cost effectiveness, applicability and new technology required.

Research is continuing under an evaluation of available effective technology to control pollution from construction activities. The control of pollution resulting from construction activities through the application of new technology will be demonstrated in the East, Southeast, Southwest and Northern Plains. An evaluation of these demonstrations will provide for determination of the effectiveness of techniques from a scientific and economic viewpoint.

Hydrologic Modification

Professional Staff

Discipline	Ph.D.	Total
Physical Sciences	.2	.2
Total	.2	.2

Heavy Industrial Sources Branch

Chief: Dr. Hugh B. Durham

Mission

The Heavy Industrial Sources Branch at the Grosse Ile Laboratory has national responsibility for the implementation and/or support activities related to a research, development and demonstration program for the abatement of water pollution caused by the discharge of wastes from the following industries:

- Iron and steel.
- Ferroalloy.
- Machinery and transportation equipment manufacture.
- Fabricated metal products.

The primary goal of the program is to obtain proven methods of treatment or abatement for all waste discharges from these industries at reasonable costs.

The ultimate goal of the program is to develop alternate economical treatment techniques and waste treatment or abatement systems directed toward closed loop systems having maximum water reuse and by-product recovery.

Need and Supporting Legislation

Congress and the Executive Branch have placed the primary burden upon industry to control its pollution. However, the Industrial Pollution Control Program was established by Congress to assist industry toward developing and refining the operational treatment technology necessary to prevent pollution by industry.

Section 105 (C) of PL 92-500/1972 states that in order to carry out the purposes of Section 301 (effluent limitations) of this act, the Administrator is authorized to make grants and enter into contracts with persons for research and demonstration projects for the prevention of pollution of any waters by industry including, but not limited to, the prevention, reduction and elimination of the discharge of pollutants.

Major Accomplishments

--Pilot study of sulfuric acid pickle liquor waste treatment by continuous ion exchange (9/69).

- A full scale treatment of wastewater - waste oil mixtures from steel strip cold mills (2/70).
- Demonstration of a full scale treatment facility for the lime treatment of rinse waters from hydrochloric acid pickling of steel strip (2/71).
- A pilot demonstration of an electromembrane process for regenerating acid from spent sulfuric acid pickling liquor (3/71).
- A pilot demonstration on the biological removal of carbon and nitrogen compounds from coke plant waste ammonia liquor (4/73).
- A full scale demonstration for recovery of sulfuric acid and ferrous sulfate from waste pickle liquor including rinse water (11/73).
- A survey of water pollution control practices in the carbon and alloy steel industry (2/73).
- A pilot scale demonstration on the treatment and recovery of fluoride industrial wastes (12/73).
- A pilot scale demonstration on the regeneration of chromated aluminum deoxizer solutions (12/73).
- Initiated a full scale demonstration on the complete treatment of coke plant waste ammonia liquor - project to be completed 2/75 (6/71).
- Initiated a full scale demonstration of a closed-loop system for the regeneration of spent hydrochloric acid pickle liquor (3/73).

Capabilities and Program Implementation Approach

The Heavy Industrial Sources Program provides strong expertise in chemical and engineering processes where a systems approach must be taken in connection with environmental matters. Research is implemented through extramural grant resources with primary emphasis toward closed loop water systems.

FY-74 Resources by Task Type

Program Area 1BB036	Man Years	In-House		Contract		Grants		Total
		\$K	%	\$K	%	\$K	%	\$K
21AZN	2.0	50	14	--	--	300	86	350
Technical Assistance	0.5	12	--	--	--	--	--	12
	2.5	\$62	14%			\$300	86%	\$362 K

Program Trends

A full scale demonstration of a closed water recirculating system for an integrated steel mill of intermediate size (resulting in zero discharge) is possible in the next five to six years. The major bar to this accomplishment is the lack of sufficient grant funds for a project of this magnitude.

A pilot scale demonstration of aircraft wastewater recycling is probable in two years.

A full scale system to eliminate waterborne discharges from a steel mill-high speed halogen tin line is probable in two years.

Heavy Industrial Sources Branch

Professional Staff

Discipline	M.S.	Ph.D.	Total
Chemistry		1	1
Engineering	1		1
Total	1	1	2

GULF BREEZE ENVIRONMENTAL RESEARCH LABORATORY

GULF BREEZE, FLORIDA

DIRECTOR: DR. THOMAS W. DUKE

Gulf Breeze Environmental Research Laboratory

Director: Dr. Thomas W. Duke

Mission

The Gulf Breeze Environmental Research Laboratory plans and conducts research on the ecological effects on the marine environment of biological and synthetic pesticides, other synthetic hazardous organics and chlorine. Specific responsibilities include the development of information essential for the registration and control program in supporting data for the development of water quality criteria to protect the aquatic life in marine and estuarine environments.

Need

Research on the ecological effects of toxic pollutants on marine environment.

Supporting Legislation

Federal Water Pollution Control Act PL 92-500:

-- Section 101(a)(2) -- One of the primary objectives of this Act is to attain "water quality which provides for the protection and propagation of fish, shellfish and wildlife...."

-- Section 104(a)(1) -- "... conduct and promote the coordination and acceleration of research, investigation, experiments, training, demonstrations, surveys, and studies relating to the causes, effects, extent, prevention, reduction and elimination of pollution.

-- Section 104(e) -- "The Administrator shall establish, equip and maintain field laboratories and research facilities ... for the conduct of research."

-- Section 104(n)(1) -- "The Administrator shall ... conduct and promote, and encourage contributions to, comprehensive studies of the effects of pollution, including sedimentation in the estuaries and estuarine zones of the United States on fish and wildlife..."

-- Section 403(c)(b) "... the effect of (ocean) disposal of pollutants on marine life including the transfer, concentration and dispersal of their by-products through biological, physical, and chemical processes; changes in marine ecosystem diversity, productivity, and stability; and species and community population changes."

Marine Protection, Research and Sanctuary Act of 1972. PL 92-532:

-- Section 102(a)(d) -- (Consider) "the effect of (ocean) dumping on marine ecosystems..."

Federal Environmental Pesticide Control Act of 1972. PL 92-516:

-- Section 20(a) -- "The Administrator shall undertake research, including research by grant or contracts with other Federal Agencies, University, or others as may be necessary to carry out the purpose of this Act.

Capabilities and Program Implementation Approach

GBERL has strong expertise in marine toxicology, ecology, physiology and chemistry of pesticides, and bioassay.

FY-74 Resources by Task Type

	<u>C</u>	<u>RG</u>	<u>IH</u>	<u>Total</u>
Number	3	5	34	42
<hr/>				
\$1000s	200	312	679	1191
<hr/>				
% Fund	17	26	57	100
<hr/>				

Current Program and Resources

	<u>FY-74 Funds (\$1000s)</u>
Effects of Hazardous Organics	858
Effects of Specific Biotic and Abiotic Factors on Estuarine Ecosystem	183
Dynamics of an Estuary as a Natural Ecosystem	<u>150</u>
Total	1191

Major Accomplishments to Date

- Determination in 1968 that mirex (a chlorinated hydrocarbon used as a fire ant bait) was toxic to crabs and extensive bioassays showed its toxicity to young or adult of many estuarine organisms.
- Discovery in 1969 of a polychlorinate biphenyl, Aroclor[®] 1254 (PCBs are organic compounds used in industrial processes) in the biota, sediment and water of estuarine areas near Pensacola, Fla., and subsequent studies documented the toxicity of this and other PCBs to marine life.
- Measurement of acetylcholinesterase activity in the central nervous system of fishes is used routinely to indicate the extent of poisoning by organophosphates.
- Investigated the role of microorganisms in the degradation of various chemicals in estuarine environments, as well as the role of these chemicals in the inhibition of microbial growth.
- Discovered nuclear polyhedrosis virus in Florida pink shrimp in August, 1972.
- Two chronic bioassays on all life history stages of the sheeps-head minnow and two chronic tests on communities developed from planktonic larvae have been completed in flowing seawater systems.
- Two scientists presented testimony (Oct., 1973) at the Aldrin/Dieldrin hearings before EPA's Administrative Law Judge, H. L. Perlman. Six investigators presented testimony (Jan. and Mar., 1974) at the Mirex hearings before Judge D. H. Harris in Washington, D. C.

Program Trends

- Development of water quality data for use in setting water quality criteria, particularly in litigation for the Office of Enforcement and General Counsel.
- Methodology to determine microbial metabolism of pesticides in the marine environment.
- Refine bioassay techniques and broaden the knowledge of interactive effects of other pollutants and that of pesticides.
- Make a thorough assessment of alternate approaches for controlling pests such as use of synthetic and natural juvenile mimicking hormones and use of viruses.
- Development of strong programs on the effect of chlorination of domestic and industrial sewage on estuarine organisms.
- Define natural ecosystems for structure or function and predict the effect of perturbation by pollutants.

Gulf Breeze Environmental Research Laboratory
Professional Staff

Discipline	B.S.	B.A.	M.S.	Ph.D.	Total
Biological Sciences	9	1	3	6	19
Chemistry			1	1	2
Total	9	1	4	7	21

NATIONAL ECOLOGICAL RESEARCH LABORATORY

CORVALLIS, OREGON

DIRECTOR: DR. NORMAN R. GLASS

National Ecological Research Laboratory

Director: Dr. Norman R. Glass

The National Ecological Research Laboratory is responsible for a wide range of research on the effects of air, water, and terrestrial pollutants on total ecosystems. It is also EPA's primary laboratory for ecological studies in support of secondary air quality standards.

Ecological Effects of Air Pollution

Project Leader: Dr. Lawrence C. Ranieri

Mission

The mission of this program is to conduct, coordinate and monitor air pollution effects research needed to support scientific basis of national secondary air quality standards and control of other air pollutants. Effects of specific gaseous and particulate air pollutants on vegetation, animal, soils and whole ecosystems are investigated through:

Ambient field studies and surveys.

Controlled field studies.

Greenhouse screening.

Controlled growth chamber exposures.

Physiological and biochemical analysis.

Need and Supporting Legislation

Section 103(f)(1) of the Clean Air Act states that "The Administrator shall give special emphasis to research on the short- and long-term effects of air pollutants on public health and welfare."

Section 103(f)(1)(B) further adds that "He shall conduct an accelerated research program - to improve knowledge of the short-and long-term effects of air pollutants on welfare." "Welfare" is defined explicitly in the Clean Air Act Title III -- General, under Section 302(h) as "Including, but is not limited to, effect on soils, water, crops, vegetation, manmade materials, animals, wildlife, weather, visibility, and climate, damage to and deterioration of property and hazards to transportation, as well as effects on economic values and on personal comfort and well-being."

A systematic approach to assuring the adequacy of environmental standards requires assessment of specific and pollutant interaction effects on single biotic communities, as well as whole ecosystems population indices.

Capabilities and Program

Implementation Approach

This program has professional strength in whole systems research, biological sciences, and ambient (field) ecological studies.

Emphasis is placed upon inhouse activities in field, greenhouse and laboratory research dealing with parts of and whole bioenvironmental systems.

FY-75 Resources By ROAP/Task Type

<u>21ALR</u>	<u>IH</u>	<u>RG</u>	<u>IA</u>	<u>C</u>	<u>Total</u>
NUMBER	8	5	5	2	20
\$1000s	288	212	190	155	845
% Funds	34	25	22	19	100
<u>21ALU</u>	<u>IH</u>	<u>RG</u>	<u>IA</u>	<u>C</u>	<u>Total</u>
Number	11	4	1	7	23
\$1000s	196	200	20	153	569
% Funds	35	35	3	27	100
<u>21ALS</u>	<u>IH</u>	<u>RG</u>	<u>IA</u>	<u>C</u>	<u>Total</u>
Number	3	1	1	2	8
\$1000s	44	60	30	246	380
% Funds	12	16	8	64	100
<u>21BBK</u>	<u>IH</u>	<u>RG</u>	<u>IA</u>	<u>C</u>	<u>Total</u>
Number	7	1	0	0	8
\$1000s	101	50	0	0	151
% Funds	67	33	0	0	100

<u>P.E. Totals</u>	<u>IH</u>	<u>RG</u>	<u>IA</u>	<u>C</u>	<u>Total</u>
Number	29	11	7	11	58
\$1000s	629	522	240	554	1945
% Funds	32	26	15	27	100

Major Accomplishments To Date

- Established the significance of air pollution effects on important agricultural crops (1955-1968).
- Developed data base and documentation on scientific basis for particulate matter secondary air quality standards (1/69).
- Developed data base and documentation on scientific basis for sulfur secondary air quality standards (3/69).
- Developed data base and documentation on scientific basis for hydrocarbons secondary air quality standards (3/70).
- Developed data base and documentation on scientific basis for photochemical oxidants secondary air quality standards (3/70).
- Developed data base and documentation on scientific basis for carbon monoxide secondary air quality standards (3/70).
- Developed data base and documentation on scientific basis for nitrogen oxides secondary air quality standards (1/71).
- Established National Ecological Research Laboratory (1/73).
- Contributed to revision of secondary air quality standard for sulfur oxides (9/73).
- Published more than 80 scientific papers on air pollution effects.

Program Trends

- Delineation of gaseous air pollutant interaction effects.
- Expansion of work in whole systems impact (soils, plant, animals) of gaseous and particulate pollutants.
- Improvement of knowledge on biological consequences, fate and transformation of common gaseous and fine particulate air pollutants.

- Quantification of national crop losses attributable to air pollution.
- Development of predictive models for determining long-term impacts of air pollutants on terrestrial ecosystems.

National Ecological Research Laboratory
Pesticide Effects on Terrestrial Environments

Project Leader: Dr. Allen S. Lefohn

Mission

The primary mission of this program is establishment of suitable data gathering protocols and assays to determine the ecological effects and transport of selected pesticide compounds in simulated plant/animal ecosystems and models.

Need and Supporting Legislation

Under FIFRA, as amended, the Environmental Protection Agency must provide testing protocols to the manufacturers of pesticides for the specific purpose of assessing the ecological impact of these chemicals on man and his environment.

Capabilities and Program Implementation Approach

This program has experience and professional strength in microcosm design and operation and in biological sciences.

Emphasis is on the use of laboratory microcosms to simulate trophic levels in natural ecosystems.

FY-75 Resources By ROAP/Task Type

<u>21BCJ</u>	<u>IH</u>	<u>RG</u>	<u>IA</u>	<u>C</u>	<u>Total</u>
Number	3	10	0	0	13
\$1000s	45	80	0	0	125
% Funds	36	64	0	0	100
<u>21BCK</u>	<u>IH</u>	<u>RG</u>	<u>IA</u>	<u>C</u>	<u>Total</u>
Number	3	10	0	0	13
\$1000s	35	40	0	0	75
% Funds	45	55	0	0	170

<u>21BCL</u>	<u>IH</u>	<u>RG</u>	<u>IA</u>	<u>C</u>	<u>Total</u>
Number	15	2	0	0	7
\$1000s	190	130	0	0	320
% Funds	60	40	0	0	100

Major Accomplishments To Date

As of March, 1974, the program has designed and tested one microcosm.

Program Trends

- Development of standard simulation systems.
- Testing of a series of representative alternate pesticide compound types.
- Prediction of bioaccumulation in ecosystem components (soils, animals, and vegetation).
- Following transport of a stressant through a simulated ecosystem.
- Identification of by-products.
- Identification of degradation rates.
- Identification of where to look for effect anomalies.

National Ecological Research Laboratory
Ecological Effects of Energy Producing Activities

Project Leader: Dr. Allen S. Lefohn

Mission

The primary goal of this program is to provide a scientific basis for minimizing the bioenvironmental impact associated with energy producing activities. Initial thrust will focus on the assessment of air pollution effects of proposed coal fired power plant on: (1) energy flow; (2) nutrient cycling; (3) species composition and diversity; and (4) physiologic and behavioral response.

Need and Supporting Legislation

New pending legislation related to national energy production will require associated safeguards to assure that optimal decisions are made which take into account crucial environmental impacts. Work accomplished by NERL will document the bioenvironmental aspects of these decisions.

Capabilities and Program Implementation Approach

This program has professional strength in whole systems research, biological sciences, and field ecological studies. Emphasis is placed upon inhouse conduct of field study at a proposed coal-fired power plant site in eastern Montana.

FY-74 Resources By ROAP/Task Type

<u>21BCI</u>	<u>IH</u>	<u>RG</u>	<u>IA</u>	<u>C</u>	<u>Total</u>
Number	7	3	0	1	11
\$1000s	250	100	0	50	400
% Funds	63	25	0	12	100

Major Accomplishments To Date

- Design and assemblage of mobile laboratory facility.
- Field site selection.
- Experimental design.

Program Trends

- Incorporation and integration of physical sciences and monitoring input capabilities within EPA.
- Coordination with regional, state and local government and educational/ research institutions.
- Plans for, and selection of, second field study site.

NATIONAL MARINE WATER QUALITY LABORATORY

NARRAGANSETT, RHODE ISLAND

DIRECTOR: DR. ERIC D. SCHNEIDER

National Marine Water Quality Laboratory

Director: Dr. Eric D. Schneider

Mission

NMWQL is charged with the responsibility for developing legally defensible and enforceable criteria for protection of marine and estuarine ecosystems. The mandate is a broad one covering all classes of pollutants alone and in combinations that might be introduced into the territorial waters of the United States and its possessions. This requires:

- Development of reliable and meaningful measures of organism and community response.
- Determination of desirable ranges of major environmental variables.
- Standardization of bioassay methodology.
- Measurement of response to pollutants.
- Application of the above to formulation of criteria and monitoring methods in response to long-term EPA objectives and enforcement problems of immediate concern.

Capabilities and Program Implementation Approach

NMWQL has strong expertise in chemistry, biology, oceanography, and biometrics.

In-house primary programs are strongly supported by closely supervised extramural effort.

FY-74 Resources by Task Type

	C	RG	IA	IH	Total
Number	3	19	1	26	49
\$1000s	330	936	13	1,434	2,713
% Funds	11	34	4	51	100

Current Programs and Resources

	<u>FY-74 Funding (\$1000s)</u>
Criteria for Heavy Metals	362
Effect of Oils	519
Ecological Requirements	1,175
Biological Techniques	307
Ecological Assessment of Ocean Disposal	<u>350</u>
Total	2,713

Need and Supporting Legislation

The programs of the laboratory are mandated and supported by Section 104 of the Federal Water Pollution Control Act by, and Section 102a Ocean Dumping Bill PL 92-532.

Major Accomplishments to Date

- Demonstration of harmful effects of nitrilotriacetic acid in marine waters (12/70).
- Publication of methods for assessment of relative toxicity of oil dispersant materials (8/71).
- Successful support of several actions to prevent environmental damage by thermoelectric generating plants such as Turkey Point, Cedar Bayou and Rome Point (6/71 to 3/74).
- Report to Congress on effects of waste oils (1/74).
- Demonstration of the feasibility of control of bioassay conditions in real time or delayed concert with environmental variations (8/73).
- Instituted standard collection techniques and quality control procedures for experimental organisms (8/72).
- Determined temperature requirements for Mytilus edulis, Acartia tonsa, Acartia clausi, and Pseudopleuronectes Americanus (6/73).
- Demonstrated previously undocumented damage to biota at DuPont dump site (3/74).
- Published temperature and dissolved oxygen criteria for marine waters and reviewed criteria document (4/74).

- Published method for using adenosine triphosphate as an indicator of stress on plankton populations (2/74).
- Published report on effects of chlorine on marine plankton during power plant passage (6/74).

Program Trends

The onset of the energy crisis demands research on ecological effects of expansion of use of fossil and nuclear fuels. New NMWQL emphasis in this area will involve all teams.

Increasing pressures for use of the oceans as disposal sites will call for greatly expanded efforts in documentation of effects and fate of disposed materials and in validating enforceable monitoring and siting methods.

Research in support of criteria for various hazardous materials and effluents will continue unabated, but will probably emphasize applicable methodology and quality control because of the great number of materials which are of concern.

As the Agency becomes increasingly aggressive in pursuing its enforcement mandate, we expect to be called upon more frequently to testify in support of criteria and to develop data in support of specific actions.

Expanded demands such as projected above cannot be met by a no-growth agency. Increasingly effective communication with NOAA and AEC will be required in order to carry out our mandate. In addition to intra-NERC cooperation being assured by the "lead lab" approach, expertise in other NERCs related to chemical methodology and quality control will have to be available.

Probable Outputs

- Report on short-term effects of water-soluble oil fractions (FY-75).
- Bioassay methods for ocean disposal permit program revised (FY-75).
- Report on biological availability of contaminants in sewage sludge and dredge spoil (FY-75).

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- Publication of interim methods for assessing in situ effects of spoil disposal (FY-75).
- Complete contribution to national estuary study (FY-75).
- Publish report of conference/workshop to reassess ocean disposal criteria and methods manual (FY-76).
- Complete evaluation of applicability of short-term bioassay methods to mixed wastes (FY-76).

National Marine Water Quality Laboratory

Professional Staff

Discipline		B.S.	B.A.	M.S.	M.A.	Ph.D.	Total
Biological Sciences	6	5	3	7	2	10	33
Chemistry		1				3	4
Health Fields	1						1
Mathematical Sciences			1			1	2
Other	3		1				4
Total	10	6	5	7	2	14	44

NATIONAL WATER QUALITY LABORATORY

DULUTH, MINNESOTA

DIRECTOR: DR. DONALD I. MOUNT

National Water Quality Laboratory

Director: Dr. Donald I. Mount

Mission

The National Water Quality Laboratory generates water quality criteria data, through research, to establish water quality standards for the protection of freshwater uses. These uses include agricultural, industrial, recreational, public water supply and freshwater aquatic life.

NWQL also provides technical assistance to Federal and state agencies for the interpretation and inclusion of these data into appropriate water quality standards for the protection of water use.

Need and Supporting Legislation

Need for research on the effects of pollutants and environmental requirements of freshwater fish, other freshwater life and wildlife are reflected in PL 92-500:

-- "It is the national goal that whenever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water be achieved by July 1, 1983"; (Section 101(a)(2)).

-- "It is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited"; (Section 101(a)(3)).

PL 92-500 states the following responsibilities of the Administrator:

-- ... In the development of such comprehensive programs due regard shall be given to the improvements which are necessary to conserve such waters for the protection and propagation of fish and aquatic life and wildlife, recreational purposes, and the withdrawal of such waters for public water supply, agricultural, industrial and other purposes (Section 102(a)).

-- Establish national programs for the prevention, reduction, and elimination of pollution (1)... including studies relating to the causes, effects and extent... of pollution (Section 102(a)(1)).

-- Provide improved methods and procedures to identify and measure the effects of pollutants (Section 104(d)(2)).

-- Develop...the...scientific knowledge...indicating the kind and effects...expected from the presence of pesticides in the water in varying quantities. (Section 104(l)(1)).

-- ...Conduct...studies of the effects and methods of control of thermal discharges (Section 104(t)).

-- Shall publish a proposed effluent standard for such pollutant or combination of pollutants which shall take into account the toxicity of the pollutant...(Section 307(a)(2)).

The need for providing research findings and technical assistance to Federal and state agencies is also outlined in PL 92-500. It states that the Administrator shall:

-- Collect and disseminate...basic data on chemical, physical, and biological effects of varying water quality...(Section 104(b)(6)).

-- At least once every three years states shall hold public hearings to review and modify water quality standards (Section 303(c)(1)).

-- Such standards shall be established taking into consideration their use and value for public water supplies, propagation of fish and wildlife, recreational, agricultural, industrial and other purposes...(Section 303 (c)(1)).

-- Shall develop... and from time to thereafter revise criteria for water quality accurately reflecting the latest scientific knowledge (Section 304(2)(1)).

-- Shall develop...information on the factors necessary for the protection and propagation of shellfish, fish, and wildlife for classes and categories of receiving water...(Section 304(a)(2)(B)).

FY-74 Resources by Task Type

	<u>C</u>	<u>RG</u>	<u>IA</u>	<u>IH</u>	<u>Total</u>
Number	5	8	0	51	64
\$1000s	255	276	0	2058	2589
% Funds	10	11	0	79	100

Current Programs and Resources

	<u>FY-74 MY</u>	<u>FY-74 Funds (\$1000)</u>
Effects of synthetic organics	12.4	397.2
Short cut methods for criteria	12.1	366.0
Biological test methods development	3.4	176.2
Bioassay technical support	4.5	290.2
Effects of oil(s)	2.8	88.4
Temperature and dissolved oxygen	10.1	556.0
Air supersaturation effects	6.0	180.0
Effects of heavy metals	9.7	283.0
Tolerance levels of ammonia	0.0	40.0
Complex effluent criteria	6.5	212.0
Technical assistance	5.5	170.5

Major Accomplishments to Date

- Developed laboratory procedures and culture techniques for testing through one generation freshwater fish and other freshwater organisms including: brook trout, bluegill and green sunfish, fathead minnows, flagfish, Gammarus, Daphnia, and midge (Tanytarsus).
- Developed culture and testing procedures for the different life stages of several additional aquatic life species.
- Determined the effects of toxicants on and environmental requirements of one or more aquatic life species through a complete life cycle for copper; cadmium; nickel; chromium III and VI; mercury (HgCl_2 and H_3CHgCl); lead; zinc; DDT; malathion; parathion; diazinon; Guthion; lindane; captan; sevin; 2, 4-D B; methoxychlor; PCB 1242, 48, 54, 60; atrazine; toxaphene; mirex; treflan; phthalates; pesticide solvents; chlordane; endosulfan; heptachlor; acrolein; waste oil; flocculants and flotation reagents; NTA; dissolved gasses including oxygen, air, hydrogen sulfide, ammonia, sulfur dioxide, chloramines; and temperature.
- Completed laboratory and field tests showing the extreme toxicity of chlorinated municipal and industrial effluents. Identified and measured the toxicity of 25 compounds formed by the chlorination of wastes.
- Determined that selected persistent toxicants are bioaccumulated directly from water at concentrations which have no observable effect on the organism but result in residues which are toxic to consumers.
- Determined the presence and quantities of toxicants at previously unmeasurable concentrations.
- Conducted validation tests for laboratory determined criteria data showing the laboratory one-generation toxicity tests for copper are valid in a natural stream.

-- Determined that certain physiological and biochemical responses recorded during short-term exposures (changes in activity, respiratory rate, cough frequency, blood constituents, enzyme activity levels, etc.) can be correlated with effects observed during long-term, chronic exposures.

-- Developed techniques and apparatus necessary to expose adult Pacific salmon for long periods to regionally important pollutants, such as supersaturated water, heavy metals, and high water temperatures.

-- Provided technical support in the Reserve Mining case, which involved many field studies in Lake Superior, laboratory research, report writing and various aspects of the court activity. NWQL has contributed 9.1 man-years of effort during the past 18 months. Ecological damage was shown to result from this single discharge into Lake Superior and a serious public health menace (asbestos) uncovered.

-- At the request of Region V (Chicago), NWQL completed a comprehensive review of the literature on chlorine toxicity and developed criteria for intermittent and continuous discharge of chlorinated effluents. These criteria are used in the design and operation of antifouling systems for many of the new power generating systems. These recommendations have also resulted in the establishment of the Disinfection Policy Task Force to develop short- and long-term EPA policy.

-- NWQL has been assigned important responsibilities in recent EPA functions:

1. The review of the freshwater section of the proposed USEPA Criteria for Water Quality, and
2. The direct participation in court hearings on the effluent standards for toxic substances.
3. The preparation of criteria documents.

-- NWQL reviewed and summarized the very cumbersome temperature criteria put together by the National Academy of Science (Blue Book) committee in order to recommend requirements for many species of fish and other freshwater life. These criteria have been incorporated into the USEPA proposed water quality criteria document.

Program Trends

- Development of additional test methods for the rapid evaluation of toxicant effects on economically important freshwater fish.
- Development of testing of toxicants to more closely simulate environmental exposures and stresses. This includes mixtures of toxicants, pulsating concentrations, avoidance, effluents, and combinations of adverse environmental requirements with pollutants.
- Increased emphasis on bioaccumulation of toxic persistent compounds by freshwater aquatic life and the effects on final consumers.
- Striving for field verification of criteria data through establishment of data bank where valid water quality monitoring data may be compared with natural population data, and through studies utilizing limited ecosystem field sites.
- Predictive modeling of toxicity and bioaccumulation in order that fewer tests may be performed in order to characterize chemical compounds.
- Increased emphasis on economically important fish, particularly salmon, to further investigate the effects and extent of heavy metal, air supersaturation and temperature pollution.
- The development of biological criteria for receiving waters, mixing zones, and effluents will require more attention not only in generating these criteria but in the necessary support of them.
- Many state and Federal agencies are developing the capability of conducting various types of bioassay testing under laboratory, industrial, and mobile trailer conditions. Requests for assistance and training are becoming more frequent and will require preparation of manuals and probably increased training program participation.
- With the adoption of standards, court challenges have increased dramatically. Technical assistance to EPA attorneys will determine whether or not these standards are upheld. Renumeration for providing this technical assistance must be provided to the laboratory since the scientists who are actually involved in research are now being assigned to these non-research activities.

National Water Quality Laboratory
Professional Staff

Discipline	B.S.	M.S.	Ph.D.	Total
Biological Sciences	20	15	11	46
Chemistry	7	1	5	13
Engineering	2			2
Mathematical Sciences			1	1
Other		1		1
Total	29	17	17	63

PACIFIC NORTHWEST ENVIRONMENTAL RESEARCH LABORATORY

CORVALLIS, OREGON

DIRECTOR: DR. NORBERT A. JAWORSKI

Pacific Northwest Environmental Research Laboratory

Director: Dr. Norbert A. Jaworski

The Pacific Northwest Environmental Research Laboratory is a multi-purpose facility responsible for research in five major areas:

- Coastal Pollution
- Eutrophication and Lake Restoration
- Eutrophication Survey
- Thermal Pollution
- Industrial Wastes

PNERL also has a centralized Laboratory Services Branch which provides analytical and computer services to the laboratory's other research programs.

Industrial Wastes Branch

Chief: James R. Boydston

Mission

The Industrial Wastes Branch of the Pacific Northwest Environmental Research Laboratory has the responsibility for directing and implementing all field, laboratory, and extramural research activities of Program Element 1BB037 (Food, Paper, and Other Industrial Sources).

The Branch is organizationally allied with the Industrial Pollution Control Division, Office of Environmental Engineering, Office of Research and Development.

The major goal of this program is the development and demonstration of new or improved methods for the treatment and/or abatement of water pollution and other environmental stresses caused by discharge of waste from a variety of "soft" industrial sources.

These sources include, but are not limited to, paper and allied products, food and kindred products, stone, clay, and glass products, wood products, and other miscellaneous industrial sources. The ultimate in waste control will be complete recycle and reuse at minimum cost of nonconsumptive water used in industrial processes.

In the immediate past, the Branch has been primarily concerned with the development and demonstration of secondary treatment processes. This technology has now been advanced to the state where present research efforts are concentrated on the development of tertiary treatment processes to permit waste recycling and the development of process modifications

to reduce or eliminate waste discharges and to develop useful by-products.

The Branch also provides technical assistance relating to the effect of industrial waste on water quality and industrial pollution abatement through advice for in-plant control and/or treatment of industrial effluents to other research programs and regulatory sections of EPA, to other Federal agencies, state and municipal governments, and to private firms and industries.

A special effort by program personnel is technical assistance in the development of effluent guidelines as part of the Refuse Act Permit Program.

Need and Supporting Legislation

The need for research activities by the Industrial Wastes Branch is outlined in the Federal Water Pollution Control Act as amended (PL 92-500):

- Sec 101(a): It is the national goal that the discharge of pollutants into the navigable waters be eliminated by 1985.
- Sec 301(b): ...There shall be achieved...by July 1, 1977... application of the best practicable control technology currently available.
- Sec 105(c): The Administrator is authorized to...make grants and enter into contracts with persons for research and demonstration projects for prevention of pollution of any waters by industry.

FY-74 Budget

Food, Paper, and Other Industrial Sources

<u>ROAP</u>	<u>Title</u>	<u>In-House</u> <u>-\$-</u>	<u>Extramural</u> <u>-\$-</u>	<u>Total</u> <u>-\$-</u>	<u>Man</u> <u>Years</u>
AZX	Pulping Processes	74.0	628.0	702.0	2.5
AZY	Paper & Paperboard	31.0	44.0	75.0	1.0
AZZ	Lumber & Wood Prod.	43.0	45.0	88.0	1.5
BAA	Meat Processing	69.0	99.0	168.0	1.5
BAB	Fruits & Veg. Proc.	72.0	368.0	440.0	2.0
BAC	Grain & Beverages	34.0	91.0	125.0	1.0
BAD	Dairy, Seafood, Misc.	47.0	310.0	357.0	1.5
AXL	Tech. Assistance	100.0	0.0	100.0	4.0
AAG	Tech. Transfer	24.0	0.0	24.0	1.0
BAE	Misc. Industries	42.0	0.0	42.0	0.6
BAF	Joint Munic./Ind.	<u>36.0</u>	<u>0.0</u>	<u>36.0</u>	<u>0.6</u>
		\$572.0	\$1585.0	\$2157.0	\$17.2

NOTE: The program is totally extramural. Research and demonstration grants are used exclusively to develop technology to meet program objectives. In-house funds listed are solely for the support of program staff engaged in grants monitoring and technical assistance.

Approved Extramural Tasks for FY-74

<u>\$K</u>	<u>Tasks</u>
20	Estimating water quality requirements for pulping processes.
308	Demonstrate closed loop kraft process.
300	Demonstrate complete sulfite pulping recycle.
34	Research - removal of dyes from paper wastes.
10	Estimating water quality requirements for paper manufacturing.
45	Developing treatment systems for wood preserving wastes.
49	Inplant reduction of wastes from meat packing processes.
50	Paunch waste recovery or utilization in meat packing plants.
70	Develop by-products from vegetable processing solid wastes.
80	Demonstrate low waste generation blanching - white potatoes.
88	Demonstrate low liquid waste blanching - vegetables.
40	Demonstrate low water cleaning process - leafy green vegetables.
60	Demonstrate low water cleaning processes - root crops.
30	Develop unit process water quality requirements - beet sugar.
91	Demonstrate treatment and reuse - wine production.
123	Demonstrate dissolved air flotation - seafood processing wastes.
168	Demonstrate enzymatic column conversion - cheese whey.
19	State of art study on miscellaneous foods.
<u>\$1585K</u>	

Major Accomplishments (Food Processing)

State of the Art Reports on:

Potato Processing	10/69
Sugarbeet Processing	7/71
Seafood Processing	4/70
Fruit & Vegetable Processing	8/71
Dairy Wastes	3/71
--Activated Sludge - Fruit Processing (Snokist)	10/69
--Activated Sludge - Potato Processing (R. T. French)	12/70
--"Dry Caustic" Peeling of Tree Fruit (Pilot Plant)	12/70
--"Dry Caustic" Peeling of Potato (Full-Scale)	4/74
--"Dry Caustic" Peeling of Peaches (Full-Scale)	5/74
--U. F. & R. O. on Cheese Whey (Pilot Plant)	7/71
(Full-Scale)	4/74
--Fermentation (Fungal) of Cheese Whey (Pilot Plant)	5/74
(Animal Feed)	
--Food Symposia FY-70	
--"Waterless" Vegetable Blanching (Pilot Plant) NCA	3/74
University of Wisconsin	

Major Accomplishments (Paper and Forest Industries)

--Reverse Osmosis Processing of Dilute Pulp & Paper	2/72
--Pulp and Paper Mill Sludge Utilization and Disposal	5/73
--A Color Removal and Fibrous Sludge Disposal Process for the Kraft Paper Industry	9/73
--State of the Art Review of Pulp and Paper Industry	4/73
--Ultrafiltration Processes for Color Removal from Kraft Mill Effluents	11/73
--Influence of Log Rafting on Water Quality	2/73

--Joint Treatment of Municipal Sewage and Pulp Mill Effluent 7/70

Program Trends (Food Processing)

- Demonstrate Best Available Treatment (BAT) - Meat Packing.
- Demonstrate BAT - Fruit & Vegetable Processing.
- Demonstrate Zero Discharge - Cane Sugar Processing.
- Demonstrate BAT - Grain Milling.
- Demonstrate BAT - Beverage Industry.
- Demonstrate Best Practicable Treatment (BPT) - Seafood Processing.
- Demonstrate BAT - Dairy Products.

Program Trends (Paper and Forest Industries)

- Demonstrate BAT - Sulfite Pulping.
- Demonstrate BAT - Kraft Pulping.
- Demonstrate BAT - Neutral Sulfite - Semi-Chemical Pulping.
- Demonstrate - Paper & Paperboard
- Demonstrate BPT - Wood Products.

Much of the required waste strength reduction will be accomplished by changes in unit processes rather than effluent treatment. No major technical difficulties are expected in achieving BAT, but the accomplishment of closed cycle processing will require a greatly expanded research effort.

The technology required keeps changing as new processes are developed, new products marketed, and the value of by-products recovered changes. Most present funding is in the area of technology refinement and demonstration. More basic research needs to be supported to develop the required new technology.

Funding levels will have to be significantly increased if the legislated deadlines are to be met. Coordination with municipal and industrial programs at NERC-Cincinnati is highly desirable.

Industrial Wastes Branch

Professional Staff

Discipline	B.S.	M.S.	Ph.D.	Total
Biological Sciences	1		1	2
Engineering	1	10	1	12
Total	2	10	2	14

Pacific Northwest Environmental Research Laboratory

Coastal Pollution Branch

Chief: Dr. Donald Baumgartner

Mission

Research on the behavior and effects of pollutants in the marine environment is the primary mission of PNERL's Coastal Pollution Branch. Major research areas are related to:

- Effluent criteria for ocean outfalls.
- Marine water quality effects caused by ocean outfall discharges nonpoint sources.
- Assessment of ecosystem alterations caused by pollutants.
- Predictive techniques and models for pollutant dynamics and resulting ecosystem alterations.
- Water pollution problems especially related to marine coastal areas of the Pacific and Arctic Oceans.

Need and Supporting Legislation

- Public Law 92-500, the "Federal Water Pollution Control Act Amendments of 1972."
- Public Law 92-532, the "Marine Protection Research and Sanctuaries Act of 1972."

FY-74 Resources

	<u>In-House (K)</u>	<u>Contracts (K)</u>	<u>Extramural (K)</u>
Technical Assistance	\$110	-	-
ROAP 21AIS	328	-	\$357
ROAP 21AIS-A	20	\$130	-
ROAP 21AIT	<u>75</u>	<u>-</u>	<u>140</u>
TOTALS	\$533(K)	\$130	
% of Totals	46%	11%	43%

Primary Program Thrust for FY-74

--The development and establishment of scientific criteria for ocean dumping and discharge of waste effluents through ocean outfalls. These criteria are those necessary to preclude detectable detrimental impact on the marine biota and on any of man's use of the marine resource.

--The development of monitoring concepts for ocean dumping and outfall discharges to coastal waters to insure compliance with the established criteria and regulations. Primary attention is directed to development of quantitative methods for assessing alteration to benthic communities.

--The development and testing of predictive models and mechanisms which quantitatively describe the physical, chemical, and ecological interactions between polluting substances and environmental factors of marine ecosystems.

These models and mechanisms will describe and predict the polluting source, the routes and rates of movement, storage points, rates of accumulation, transformations and transformation rates, as well as climatologically- and geographically-affected ecological interactions. Polluting substances include organic compounds, inorganic species such as heavy metals, and pathogenic organisms.

Polluting sources include: (1) municipal and industrial wastes; (2) dredge spoils and other solids; (3) atmospheric gasses, aerosols, and particles; (4) accidental spills; and (5) terrestrial drainage.

Major Accomplishments

Demonstration of the widespread distribution of taconite tailings in Lake Superior as a result of Reserve Mining Company discharge. Reports prepared as testimony in the Federal court case.

Application of the techniques developed in the taconite study (above) to the analysis of trace elements in tar balls, a persistent residue from petroleum pollution of the sea to demonstrate the possibilities of this technique to subsequent ecological research and monitoring activities; NAA was also applied to nanogram levels of molybdenum in lake waters (10/73).

Development of a procedure for following kraft mill effluents in marine waters based on fluorescence procedures (7/71).

Development of an aerial technique for the analysis of outfall discharges.

Preparation of sections of the EPA Ocean Dumping Analytical Methods Manual. Sections prepared wholly or in part by this Program include:

- a. Chemical methods.
- b. Bioassay procedures.
- c. Particle size analyses.
- d. Marine macrobenthos; methods for sampling and analysis.
- e. Sampling methods for trace metal-trace organics analyses of marine waters and sediments.

Development of a computer model to predict dilution and height of rise of buoyant wastes discharged to quiescent marine waters (9/71).

Development of a mathematical simulation model for predicting the physical fate of barged liquid and particulate wastes (10/73).

Development of a two-layer coastal circulation model for the New York Bight Area, including coverage of both inner and outer harbor areas.

Partial completion of baseline study at proposed experimental sludge dumping site in the New York Bight. Progress reports cover the development of analytical methodology, an assessment of chemical parameters of source material and deposition site sediments, and the quantitative characterization of the biota of the site which represent a "healthy" benthic community and a good indicator for monitoring and assessing the effect of dumping. Physical data, i.e., currents, salinity, temperature, etc., will be covered in subsequent reports.

Development of highly sensitive procedures, based on neutron activation analysis, to analyze trace materials in marine sediments resulting from discharge of sewage sludge. A report has been prepared (10/73).

Program Trends

Program objectives change slightly in FY-75, with an increased emphasis on pipeline discharges and marine phytoplankton dynamics. New work will be initiated to determine the best use of bio-mathematical indices of community structure and population dynamics as criteria for determining the "health" of marine ecosystems.

Coastal circulation mathematical models will be refined and applied to new geographical areas such as the east coast of Florida, the Los Angeles Bight, and Valdez, Alaska. Where possible, the model's capability to simulate sedimentation and biochemical interactions will be advanced.

The barged discharge simulation model will be evaluated in the field for three types of wastes--sewage sludge, dredge spoils, and liquid industrial wastes. The latter two field evaluations will be joint interagency effects with Corps of Engineers and NOAA groups.

Criteria related work will include a continued effort to determine the chemical behavior of sludge, biotic uptake rates of heavy metals and other trace compounds; ionic and organic interactions; general behavior of heavy metals in coastal ecosystems; and the movement and accumulation of chlorinated hydrocarbons with ecological significance in Puget Sound and in the Los Angeles and New York Bights. The objectives and approach defined and outlined in FY-75 ROAP's include specific pollutants that could not be supported in past years.

A good start on describing the dynamics of fjords - circulation and flushing times - will have been made. This work is presently being performed with Puget Sound as the verification base, but the results will be applicable to Alaskan and New England fjords as well. Concurrently, the dynamics of ecosystems are being investigated with a view as to what factors control or initiate plankton blooms.

Coastal Pollution Branch

Professional Staff

Discipline	B.S.	B.A.	M.S.	Ph.D.	Total
Biological Sciences	1	1		1	3
Chemistry	1			2	3
Engineering			4	1	5
Mathematical Sciences			1		1
Physical Sciences	3				3
Total	5	1	5	4	15

Pacific Northwest Environmental Research Laboratory

Eutrophication Survey Branch

Chief: Dr. Jack H. Gakstatter

Mission

When the Survey was established in late 1971, the mission was to determine the location, severity and extent of eutrophication in the nation's lakes and impoundments which act as receiving waters for waste water treatment plant effluents and to assist states and municipalities in implementing effective controls for phosphate-induced eutrophication where such controls have not already been instituted.

However, the passage of the 1972 Federal Water Pollution Control Act Amendments during October 1972 dramatically altered the complexion of the Survey's critical premises.

Of greatest importance, states were given the responsibility under Sec. 106 reports, Sec. 303(e) basin plans, and Sec. 314(a) lake restoration to classify lakes, identify eutrophic lakes, define the causes and nature of lake pollution and develop procedures for eutrophication control.

This newly designated state responsibility usurped the singular responsibility of the Survey and its related program to perform these functions.

For this reason, the goals and objectives of the Survey were rewritten during December, 1972, to be directly supportive of the newly amended Water Bill.

The objective of the Survey then became development of knowledge on nutrient sources, concentration, and threat to selected fresh-water lakes as a basis for recommendations leading to comprehensive national, regional and state management practices relating to nutrient controls from point and non-point sources.

Needs and Supporting Legislation

Supporting legislation for the program is primarily Sec. 104(a)(3) "conduct in cooperation with State Water Pollution Control Agencies and other interested agencies, organizations and persons, public investigations concerning the pollution of any navigable waters, and report on the results of such investigations."

Survey data will be useful in satisfying needs of State Water Pollution Agencies and EPA in several areas specifically designated in the Water Bill; Sec. 106 reports, Sec. 202(3) basin plans, Sec. 208 non-point source control plans, Sec. 303(c)(e) basin plans and water quality standards revisions, Sec. 305(b) non-point source assessment, and Sec. 314(a) lake classification.

Financial Resources

<u>ROAP#</u>	<u>In-House (K)</u>	<u>Interagency Agreement (K)</u>	<u>Other</u>
25AJX (Nutrient Loading)	\$529	450	0
25AKM (Limiting Nutrient)	107	62	0
25ALP (Land Use)	41	0	0
25ALD (Lake Survey NERC-Las Vegas)	1,000	0	0
Totals	\$1,677 K (77%)	512 K (23%)	0

Primary Program Thrust in FY-74

Data evaluation--A large portion of the program effort will be devoted to analyzing and evaluating data collected from 220 lakes and associated watersheds sampled during 1972-73 in ten states east of the Mississippi River.

Sample analysis--Significant effort will be devoted towards analyzing stream, sewage plant effluent and lake samples generated by on-going sampling programs in the eastern portion of the United States.

Initiating new sampling programs--NERC-Las Vegas will initiate lake sampling in ten states between the Mississippi River and the Rocky Mountains. PNERL will initiate stream and sewage treatment plant sampling in all 21 states (except Hawaii and Alaska) during FY-1974 and early FY-1975.

Program responsibilities are divided between NERC-Corvallis (PNERL) and NERC-Las Vegas.

Major Accomplishments

- Lake sampling initiated by NERC-Las Vegas in New York State (May, 1972).
- Stream sampling by the National Guard initiated in Vermont by PNERL (July, 1972).
- National Guard stream sampling programs initiated in all 27 states east of the Mississippi River (July, 1973).
- Algal assay analysis completed for 202 lakes sampled in 1972 (September, 1973).
- Lake sampling program completed by NERC-LV in all 27 states east of the Mississippi River (November, 1973).
- Analysis completed for 29,000 lake samples and 25,000 stream and sewage plant effluent samples from sampling program in eastern United States (January, 1974).
- Preliminary reports completed for 36 lakes and their associated watersheds (January, 1974).

Program Trends (Projected Accomplishments)

Completion of approximately 650 individual reports on lakes and reservoirs throughout the contiguous United States. Each report addresses itself to trophic states, nutrient loadings, limiting nutrient and vulnerability to eutrophication.

Completion of 18 regional reports which are overviews of all individual reports within geographical areas with similar characteristics. Each report will address itself to common characteristics of trophic condition, non-point source nutrients, land use, limiting nutrients and vulnerability to eutrophication within a specific area.

Development of nutrient runoff factors which can be applied to various land use types and which take into consideration soil type, climate, slope, etc. The factors would be used to predict non-point source nutrient contributions.

Development of regional water quality criteria (loadings or concentrations) for nutrients based upon data accumulated by the Survey.

Development or substantiation of the relationship between nutrient loadings, nutrient concentration, lake morphometry and lake trophic conditions.

The existing program depends upon continued cooperative efforts between NERC-Corvallis, NERC-Las Vegas and Headquarters staff, each of which plays a specific role in accomplishing overall program objectives.

Eutrophication Survey Branch

Professional Staff

Discipline	B.S.	M.S.	Ph.D.	Total
Biological Sciences	7	4	2	13
Chemistry	7	1		8
Engineering	1	1		2
Mathematical Sciences	2			2
Physical Sciences	2			2
Total	19	6	2	27

Pacific Northwest Environmental Research Laboratory

Thermal Pollution Branch

Chief: Frank H. Rainwater

Thermal Pollution Technology

Mission

The mission of PNERL's Thermal Pollution Technology Program is development of viable pollution control technology for the electric power industry to provide (industry wide) a basis for establishing, improving and implementing required effluent standards. The approach involves water recycle/reuse and terminal waste stream treatment.

Need and Supporting Legislation

Section 301 requires that the Administrator promulgate effluent limitation for point sources, other than publicly owned treatment works.

Section 306 requires that the Administrator promulgate Federal standards of performance for new sources, requiring best available demonstrated control technology, processes, operating methods, or other alternatives.

Section 316(c) stipulates that the thermal specifications of a discharge permit are valid for ten years.

FY-74 Resources

	<u>IH (K)</u>	<u>CW (K)</u>	<u>EW (K)</u>	<u>DD (K)</u>
Technical Assistance	\$40	--	--	--
ROAP 21AZU	93	94	64	109
ROAP 58AAK	10	--	--	--
	<u>\$143 (K)</u>	<u>---</u>	<u>---</u>	<u>---</u>

Primary Program Thrust for FY-74

Meet immediate demands of PL 92-500, external to primary PE mission, in respect to (a) engineering and economic feasibility of backfitting various cooling devices to existing power plants and (b) engineering and economic assessment of once-through discharge modification for adverse impact control.

Develop advanced methodology for blowdown reduction and/or quality control, including, potentials for recycle/reuse.

Characterize SO_x scrubber water effluents and investigate potential handling and treatment.

Major Accomplishments To Date

--Determined and/or demonstrated engineering feasibility and associated economic, energy, land water resource penalties of a variety of alternatives to once-through cooling (1971).

--Explored long range potentials of advanced power generating systems, including thermoelectric generators, gas turbines for central stations and submerged nuclear plant (June, 1971).

--Demonstrated agricultural use of waste heat including frost protection, row and spray irrigation, subsoil heating and greenhouse horticulture (August, 1973).

--Developed and demonstrated low-level drift measurement instrumentation (October, 1971).

--Provided substantial support to the Agency in formulating decisions and policy regarding control of pollutants in power industry. Exemplified through review of 90 + EIS, and assistance to Permits Branch and Effluent Guidelines Division.

--Characterized liquid waste streams in electric power generation and started development of effluent quality control and recycle/reuse systems. Continuing.

--Surveyed the water related implications of geothermal steam development and coal gasification.

Program Trends

The major trend is downward, with FY-75 positions reduced from five to three, and extramural commitments limited to one possible demonstration. Trends include:

--Demonstrate engineering and economic feasibility of dry cooling towers for relatively small electric generating plants.

--Assess potential water recycle/reuse systems in power generation, hopefully leading to demonstration. Continue cooperation with RTP or stack gas technology.

--Have in hand selected examples of proven technology for recycle/reuse.

--Initiate research for elimination of discharge of pollutants from the Water Supply Industry -- a new ROAP for FY-75 in PE 1BB036. Extramural funding from Joint Municipal/Industrial program at RSKERL.

--Energy needs and effort still uncertain.

Thermal Pollution Technology

Professional Staff

Discipline	B.S.	M.S.	M.A.	Total
Engineering	2	1		3
Other			$\frac{1}{2}$	$\frac{1}{2}$
Total	2	1	$\frac{1}{2}$	$3\frac{1}{2}$

Thermal Pollution Research

Mission

The mission of PNERL's Thermal Pollution Research Program is to provide the scientific-engineering-economic base for control of thermal pollution.

Need and Supporting Legislation

Section 104(t) directs the Administrator to "...conduct continuing comprehensive studies of the effects and methods of control of thermal discharges...available technology, economic feasibility...total impact on environment considering...water quality, air quality, land use, and effective utilization and conservation of freshwater and other natural resources...minimizing adverse effects and maximizing beneficial effects..."

Section 303D requires a determination of max daily thermal load for waters for which compliance with effluent standards will not meet water quality standards. This necessitates improvements in sophistication of heat budget treatment.

Section 316(a) provides for case-by-case exemption to effluent standards for heat if it can be demonstrated that such standards are more stringent than necessary to protect biota. This requires hydraulic and heat budget modeling.

Section 316(b) requires that location, design, construction, and capacity of cooling water intake structures reflect best technology available for minimizing environmental impact.

FY-74 Resources

	<u>IH (K)</u>	<u>EW (K)</u>	<u>CW (K)</u>
Technical Assistance	\$27	--	--
ROAP 21AJH	106	65	35
	<u>\$133 (K)</u>		

Primary Program Thrust FY-74

FY-74 is a year of wrap-up and new starts. Primary program thrust include:

--Complete analytical-lab development of fluid dynamic models for predicting thermal plume behavior, culminating in reports (1) Workbook on Thermal Plume Prediction, Volume II, Surface Discharges (IH), and (2)

Critical Analysis of Temperature Prediction Models for Large Hydrologic Systems (Grant).

- Start evaluation and perfection of cooling tower vapor plume models, with emphasis on field verification. Involves in-house project at Turkey Point, Florida, and grant to U. of Colorado.

- Satisfy Section 303D need through contract to improve statistical reliability of stream temperature prediction.

- Start fluid dynamic research on cooling water intake design and operation for Section 316(a).

Major Accomplishments

- Provided scientific and engineering expertise in waste heat management to regulatory arms of EPA and state environmental agencies needed in support of adversary proceedings and promulgation of water quality and effluent standards. Continuing.

- Developed and perfected predictive models for thermal behavior in freshwater and marine environment. Submerged discharges July, 1972; surface discharges March, 1974.

- Assessed the potentials for beneficial uses of waste heat (September, 1970) and (under PE 1BB392) demonstrated agricultural uses including frost protection, row and spray irrigation, subsoil heating, and greenhouse horticulture (August, 1973).

- Developed guidelines for biological surveys at proposed heat discharge sites (April, 1970).

Program Trends

- Quantify secondary environmental effects of cooling systems (continue coordination with RTP on meteorology and NERL on drift).

- Report(s) on water use alternatives in coal conversion facilities (continue coordination with Region VIII, NGPRP).

- Develop design and operating criteria for large scale (cooling) water intake structures (coordinate with NWQL).

- Field verify predictive plume models and assess water quality impacts of alternative large scale heat control systems (Section 316(a) data).

- Impact ecological modeling in math, statistics, and fluid dynamics (NWQL & NMWQL)

--Support Toxic and Hazardous Materials program and OEGC in litigation involving water quality and effluent criteria.

--Periodic submission of reports to the Congress required by Section 104(t).

--Energy needs and effort still uncertain.

Thermal Pollution Research

Professional Staff

Discipline	M.S.	M.A.	Ph.D.	Total
Engineering			3	3
Physical Sciences	$\frac{1}{2}$			$\frac{1}{2}$
Other		$\frac{1}{2}$		$\frac{1}{2}$
Total	$\frac{1}{2}$	$\frac{1}{2}$	3	4

Pacific Northwest Environmental Research Laboratory

Eutrophication and Lake Restoration Branch

Chief: Thomas E. Maloney

Mission

The Eutrophication and Lake Restoration Branch is responsible for the development, direction, coordination and review of research and development programs on a National scale to provide for the control of accelerated eutrophication and methodology for lake restoration. Its primary objectives are to:

- Develop an understanding of the eutrophication process.
- Develop methods for monitoring eutrophication conditions and for predicting the impact of nutrient sources on eutrophication.
- Develop technology to control and reverse eutrophication processes.
- Establish the practicability of using this technology through pilot and demonstration scale application.

The Branch also provides consultation and technical assistance to other research programs and regulatory sections of EPA; other Federal agencies; state and municipal governments; and to universities, private firms, and industries.

Supporting Legislation

The supporting legislation for the intra-extramural research are Sections 104(a); 106, Appendix A; and 314(a) of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500).

Resources

A. ROAP 21AIY - The determination of Lake Restoration Procedures:

<u>Allowance Cat.</u>	<u>Funding (K)</u>	<u>% of Total</u>	<u>PMY</u>
AA-3	\$572	53	--
EA-3	461	43	--
CA-3	15	1	--
FA-3	<u>35</u>	<u>3</u>	<u>--</u>
Totals	\$1083K	100	16.0

Implementation

ERLB will evaluate effectiveness of various manipulations as lake restoration procedures. These include research and demonstrations on point source nutrient removal, nutrient diversion, nutrient inactivation aeration and weed harvest.

B. ROAP 21AJA - Predictive Models for the Eutrophication Process:

<u>Allowance Cat.</u>	<u>Funding (K)</u>	<u>% of Total</u>	<u>PMY</u>
AA-3	\$99	92	--
CA-3	5	4	--
EA-3	<u>4</u>	<u>4</u>	<u>--</u>
Totals	\$108 (K)	100	0.3

Implementation

Emphasis has been placed upon development of an adequate, readily accessible data file for Shagawa Lake and upon development of mathematical models to simulate biological (particularly algal) activity in the lake and to simulate recovery of the lake.

C. ROAP 21AJE - Development of Techniques to Measure Nutrients from Diffuse Sources:

<u>Allowance Cat.</u>	<u>Funding (K)</u>	<u>% of Total</u>	<u>PMY</u>
AA-3	\$52	60	--
EA-3	<u>35</u>	<u>40</u>	<u>--</u>
Totals	\$87 (K)	100	1.0

Implementation

Emphasis is on the development of laboratory and/or field methods for quantitatively describing the nutrient contribution from diffuse sources.

D. ROAP 21AJF - Development of Methods for Assessing and Categorizing the Potential Eutrophication of Natural Waters.

<u>Allowance Cat.</u>	<u>Funding (K)</u>	<u>% of Total</u>	<u>PMY</u>
AA-3	\$189	66	--
EA-3	<u>97</u>	<u>34</u>	<u>--</u>
Totals	\$286	100	6.3

Implementation

Emphasis is on the development, evaluation and promulgation of laboratory and field techniques for measuring, predicting and categorizing the response of aquatic ecosystems to specific additions or reductions of nutrients.

Major Accomplishments

- Developed provisional algal assay procedure (2/69).
- Conducted eutrophication - biostimulation assessment workshop (6/69).
- Conducted workshop on modeling the eutrophication process (10/69).
- Evaluated impact of nitrilotriacetic acid (NTA) on the eutrophication process (10/70).
- Completed evaluation of phosphorus removal pilot plant at Ely, Minnesota (10/70).
- Established significance of phosphorus in the eutrophication process (2/71).
- Evaluated aeration as a lake restoration procedure (5/71).
- Developed cooperative project with U.S. Forest Service to restore Diamond Lake, Oregon (5/71).
- Completed design of advanced waste treatment plant at Ely, Minnesota (6/71).
- Completed standardization of algal assay procedure for studying eutrophication problems (8/71).
- Completed evaluation of induced soil percolation to remove nutrients from wastewater (5/72).
- Completed evaluation of weed harvesting as a lake restoration technique (12/72).

--Completed evaluation of potential effects of campground wastes on ultra-oligotrophic Waldo Lake, Oregon (2/73).

--Prepared report to Administration, Region X, on the predicted effect of elimination of smelter wastes upon the growth of algae in the Spokane River Basin (2/73).

--Reviewed revised phosphorus control goals and criteria for Region V (3/73).

--Full-scale advanced waste treatment plant at Ely, Minnesota became operational (4/73).

--Completed preliminary mathematical model for Shagawa Lake, Minnesota (8/73).

--Conducted workshop on modeling the eutrophication process (9/73).

--Completed reduction of limnological data on Shagawa Lake, Minnesota, prior to point source phosphorus removal (12/73).

Program Trends

In the next two to five years, the following will probably be accomplished:

--Evaluation of the effects of the advanced waste treatment (phosphorus removal) plant at Ely, Minnesota, upon the recovery of Shagawa Lake will be completed.

--A final report summarizing the state-of-the-art of all lake restoration methods will be published.

--Evaluation of alum, a nutrient inactivant, to restore Twin Lakes, Ohio, will be completed.

--Evaluation of nutrient diversion as a method to restore Lake Sallie, Minnesota, will be completed.

--The present mathematical model for Shagawa Lake will be expanded and revised and the results applied to other lake systems.

--The capability for prediction of time course for the restoration of lakes will be refined.

--Sediment - water nutrient interchange models will be developed.

--Testing and evaluation of model development aimed at an increased understanding of lake metabolism and the effects of manipulation will be continued.

--A final report on the laboratory evaluation of nutrient inactivation will be completed.

--Reports on the field testing of several of the most promising nutrient inactivants will be completed. These will include the effectiveness and practicability of specific inactivants as well as methodology for operational use.

--Management alternatives for eutrophic ecosystems where nutrients cannot be controlled will be developed.

--The effect of nutrient interception and diversion on Diamond Lake, Oregon will be evaluated.

--It will be demonstrated how algal assays can be used to aid enactment of realistic critical nutrient criteria in river systems.

--Interaction of industrial, agricultural and domestic waste effluents upon the growth of plankton algae in a multiple use river system will be evaluated.

--Development and laboratory and field evaluation of a marine assay procedure to study eutrophication problems will be completed.

--The practical utilization of the algal assay procedure in predicting the enrichment or inhibitory characteristics of wastewater from non-point sources will be evaluated.

There are certain technical bars to the accomplishment of some of the above. In general, for example, mathematical models require (1) formulation of relationships between compartments or elements and (2) estimation of the magnitude of forcing functions and values of coefficients.

The more complex the model, the greater the number of relationships and coefficients necessary. There have always been technical barriers to obtaining the necessary data for complete validation of the relationships and coefficients.

The projection of funds on the FY-75 EROS's do not allocate resources for extramural support of ROAP 21AJA, which is concerned with modeling. This will cause delay in the development of mathematical models.

Development of management alternatives for eutrophic ecosystems when nutrients cannot be controlled will not be carried out unless ROAP 21AIZ is approved.

A major problem exists in developing full-scale restoration programs. While we are able to develop and evaluate lake restoration techniques through the laboratory and pilot-scale level, resources are not available to carry out full-scale demonstrations.

Section 314(a) of PL 92-500 provides funds to States for lake restoration. It is unlikely that these funds will become available in the near future. Even if they do, however, there is no provision to obtain good baseline data prior to a manipulation or to continue to obtain data after the manipulation is carried out. Without such data, a restorative procedure cannot be properly scientifically evaluated.

Coordination with other NERC-Corvallis laboratories and other government agencies would aid in the achievement of our goals. For example, we are highly dependent upon interagency agreements with the U.S. Geological Survey to obtain necessary hydrologic data for Shagawa Waldo and Diamond Lakes.

Also, cooperative effort with the Army Corps of Engineers would be most helpful in evaluating the use of dredging as a lake restoration procedure. This is already being investigated.

The utilization of the mathematical modeling capability at SERL as well as the financial resources available at the Grosse Ile Laboratory would hasten our accomplishments in mathematical modeling.

Eutrophication and Lake Restoration Branch

Professional Staff

Discipline	B.S.	B.A.	M.S.	M.A.	Ph.D.	Total
Biological Sciences	3	2	3	3	3	14
Chemistry	2		1			3
Engineering	1	1				2
Mathematical Sciences	1		1			2
Total	7	3	5	3	3	21

Pacific Northwest Environmental Research Laboratory

Laboratory Services Branch

Chief: Daniel F. Krawczyk

Mission

Services is the mission of the Laboratory Services Branch. Routine chemical analyses, computer assistance, electronic repair--modification, and routine glass repair -- glassblowing are the areas of service within the realm of LSB.

Since the Agency does not have unlimited resources to provide an unlimited supply of analytical chemical, computer, and electronic technicians, specialists are available to each of the programs that require an intermittent use of these special services.

This pooling of resources into a manageable unit is the other alternative to each program operating independently. This type of an approach is not new in the "Industrial World" but is used frequently in governmental operations.

This methodology used by the Laboratory Services Branch is that which has been documented in the literature. Our purpose is not research in methodology, but the use of accepted and modified techniques in support of research needs.

Resources and Program Implementation

The Laboratory Services Branch has nine professional and four technical permanent positions as well as one clerical permanent position. The work force also includes a variable level of work study, stay in school, and temporary employees. The work load generated by the various research programs governs the number of non-permanent employees.

There are 40 people working in the Laboratory Services Branch at this time; this is equivalent to 21.5 man weeks of effort per week. The total budget for FY-73 was 406 thousand dollars. The total budget for FY-74 is 381 thousand dollars.

One of the tools for managing, tracking and scheduling samples and reporting data is the SHAVES system. SHAVES is a sampling-handling and verification system that combines routine chemical and microbiological analysis with a programmed computer operation to achieve a businesslike approach in laboratory management.

The computer is used as a tool to produce bench sheets to catalog data and to provide data summaries, weekly production information, schedules, and backlog information. The SHAVES program enables the laboratory manager to monitor production and costs. SHAVES is very flexible and rarely goes more than a month without some change to improve some phase of operation. The more routine the operation becomes, the more valuable SHAVES is as a tool.

A modified version of SHAVES is now being used by the Shagawa Lake Eutrophication Control Project. Copies of the basic data are mailed to Corvallis. The keypunching, verification, correction of errors, and input into the computer file are done at Corvallis.

The staff located in Corvallis who are responsible for the Shagawa Lake study can then assist the personnel on site at Ely, Minnesota, in evaluating and modeling the data output.

In the case of the Shagawa Lake study where a minimum number of people is involved in the collection and analysis of data, the verification, input, and cataloging phases of SHAVES have been found to be of value.

Major Accomplishments

Corvallis analyzed approximately 30,000 samples from all sources conducting approximately 220,000 analyses during calendar year 1973. When comparing calendar year 1972 with 1973, the sample load has approximately tripled and the analytical load has approximately quadrupled.

Production in the automated section continues to increase from 15.2 analyses per man hour in the first quarter of FY-74, to 19.4 per man hour in the second quarter to 21.9 per man hour thru the first seven weeks of the third quarter.

The use of production line techniques has brought down the average cost of an average analysis from \$5.93 per test in FY-72 to \$1.75 per test thru the first half of FY-74.

The computer section provides service to other programs, and, excepting the development of SHAVES for the Laboratory Services Branch, its accomplishments are achievements in behalf of others. The computer section has:

- generated data reduction and reporting systems for algal assays.

--participated in building models of thermal pollution, along with extensive plot programs for their output; participated similarly with models for coastal pollution.

--assisted the administrative programs of the NERC in operating or developing administrative support systems in areas of financial management, property and personnel.

--represented NERC-Corvallis on agency-wide task forces.

--performed countless data reduction tasks for the staff of NERC-Corvallis.

A major accomplishment as reported in a Program Highlights Newsletter is the "Automated, Computer-Controlled, Chemical Analytical System." This unique scheduling system including data capture and monitoring of AQC information has been provided for the automated section of LSB by the computer section.

SHAVES has been just as valuable for the Ely operation as for the Corvallis unit. During calendar year 1973 at Ely, approximately 2,300 samples were collected on which 29,000 analyses were run.

Laboratory Services Branch

Professional Staff

Discipline	B.S.	M.S.	Total
Chemistry	4	1	5
Engineering	2		2
Other		2	2
Total	6	3	9

ROBERT S. KERR ENVIRONMENTAL RESEARCH LABORATORY

ADA, OKLAHOMA

DIRECTOR: MR. WILLIAM C. GALEGAR

Robert S. Kerr Environmental Research Laboratory

Director: William C. Galegar

The Robert S. Kerr Environmental Research Laboratory is a multi-purpose laboratory conducting in-depth research in three primary areas:

- Treatment and control of wastes related to petroleum and petrochemical industries, agriculture, and mining.
- Ground water pollution.
- Water quality control research.

Water Quality Control Branch

Chief: Dr. Curtis C. Harlin, Jr.

Mission

The mission of the Robert S. Kerr Environmental Research Laboratory's Water Quality Control Branch is research to develop and demonstrate technology for controlling water pollution by means other than conventional treatment. Primary objectives are:

- Development of design and operating criteria for treatment and disposal of wastewaters using soil systems.
- Development and demonstration of unique, non-conventional biological systems for treatment of point-source pollutants.
- Reduction or elimination of the effects of non-point source pollutants.
- Development of engineering systems for use in streams, lakes and reservoirs to improve water quality.
- Research to control pollution from industries by non-treated methods.

Need and Supporting Legislation

Soil Treatment Research and Development - PL 92-500, Sec. 101(a)(1), Sec. 104(a)(1), Sec. 104(d)(1), Sec. 105(a)(2), Sec. 105(d)(2), Sec. 304(b)(1).

Develop Biological Systems - PL 92-500, Sec. 104(a)(1), Sec. 104(d)(1), Sec. 105(a)(2), Sec. 105(d)(2), Sec. 318.

Stream, Lake and Reservoir Water Quality Research - PL 92-500, Sec. 104(a)(1), Sec. 104(d)(3), Sec. 104(n)(1), Sec. 104(S), Sec. 105(b), Sec. 105(d)(1), Sec. 115.

Control of Pollutants from Industry - PL 92-500, Sec. 104(a)(1), Sec. 104(b)(2), Sec. 104(b)(3), Sec. 104(b)(4), Sec. 104(b)(7).

FY-74 Resources Summary

<u>Task Type</u>	<u>Amount (K)</u>	<u>% of Total</u>
In-House	\$ 275	21.2
Contracts	35	2.7
Grants	<u>988</u>	<u>76.1</u>
Total	\$1,298 (K)	100.0

Primary Program Thrust, FY-74

--Research, development, and demonstration of soil systems for wastewater treatment.

--Development of biological systems for control of water quality.

Major Accomplishments To Date

--Developed design and operating data for treatment of cannery wastewaters by soil treatment (October, 1970).

--Developed reservoir destratification systems (additional work sponsored since this date) (December, 1970).

--Developed engineering methodology for river and stream reaeration (February, 1972).

--Developed model phosphate-free home laundry detergents (June, 1972).

--Laboratory development of methods for controlling mercury in bottom deposits (March, 1973).

--Published a catalog of manufactured products having water pollution potential (June, 1973).

--Compiled existing design and operating information for wastewater treatment and reuse by land application (November, 1973).

--Assisted OWPO in preparation of guidelines for soil treatment systems (January, 1974).

--Disseminated information on soil treatment systems through workshops, seminars, and conferences (July, 1968; September, 1971; June, 1972; August, 1972; May, 1973).

Program Trends

The major emphasis in the program in the next two to five years will undoubtedly be research and development of land application systems. During this period, design and operating criteria should be completed for the crop irrigation mode, development of criteria for the infiltration-percolation mode should be well advanced, and the overland flow mode should be in the full-scale development phase.

The single, most important barrier to achieving these objectives is the lack of information on public health effects. This can be overcome by greatly increasing EPA commitment of resources to this program, through EPA's health effects programs, or by cooperative arrangement with other Governmental agencies (i.e., Department of Agriculture, Corps of Engineers, National Institute of Health).

There is a developing interest in utilization of wastewater for beneficial uses for the production of food and fiber by such means as crop irrigation, aquaculture, and hydroponics. The program has had a small funding in these areas which, from present indications, will see a modest increase in FY-75.

Within the next five years, a good start can be made in aquaculture if funds become available. The Office of Water Program Operations is interested in this technology as a possible means of upgrading lagoon effluents.

Professional Staff

Discipline	B.S.	M.S.	Sc.D.	Ph.D.	Total
Biological Sciences		1		1	2
Chemistry	1				1
Engineering	1		1	1	3
Physical Sciences		1			1
Total	2	2	1	2	7

Robert S. Kerr Environmental Research Laboratory

Subsurface Environment Branch

Chief: Jack W. Keeley

Mission

The mission of RSKERL's Subsurface Environment Branch is research for developing technical information and technology applicable to the protection or restoration of groundwater resources. Primary objectives are:

- To define national groundwater pollution problems.
- To advance the state of knowledge relating to the transport process of pollutants in the subsurface environment.
- To develop decision criteria relating to waste disposal practices including subsurface waste injection.
- To prepare models for groundwater basin management.

Need and Supporting Legislation

Comprehensive Programs, Investigations, and Guidelines - PL 92-500, Sec. 102(a), Sec. 104(a), Sec. 304(a)(2), Sec. 304(e).

Groundwater Monitoring - PL 92-500, Sec. 104(a)(5).

Groundwater Protection - PL 92-500, Sec. 105(e)(2), Sec. 202(b)(2); Pending Safe Drinking Water Act, Sec. 1206.

FY-74 Resources Summary

<u>Task Type</u>	<u>Amount (K)</u>	<u>% of Total</u>
In-House	\$199.4	54.5
Grant	100.6	27.5
Contract	<u>66.0</u>	<u>18.0</u>
Total	\$366.0 (K)	100.0

Primary Program Thrust FY-74

- National groundwater utilization and pollution problems report.

- Septic tank design criteria.
- Subsurface environmental measuring techniques.
- Second National Groundwater Quality Symposium.

Major Accomplishments To Date

From the Branch's bibliography containing 31 items, the following were selected as significant accomplishments:

- Design and construction of groundwater sampling equipment which has been duplicated several times (March, 1968).
- Developed new technique to determine aquifer storage (January, 1969).
- Evaluated Corps of Engineers saltwater detention structures using radiotracers (December, 1969).
- Research relating to revised state statutes regulating saltwater disposal (June, 1970).
- Groundwater reclamation by selective pumping (1971).
- Testimony before the Senate Subcommittee on Air and Water Pollution covering subsurface waste disposal (April, 1971).
- Research relating to EPA's position on NTA (November, 1971).
- First National Groundwater Quality Symposium (August, 1971).
- New techniques to identify groundwater pollution sources (1973).
- A definition of subsurface biological activity (September, 1973).
- Groundwater pollution problems defined for the southwestern (1971), south central (1973), North Atlantic (1974), and northwestern (1974) states.

Program Trends

Major emphasis in the Branch for the next few years will include a continuing effort to outline groundwater utilization and pollution problems until the continental United States and Hawaii and Alaska are adequately discussed in report form.

A major thrust will continue and will be increased to define the subsurface environment as a pollution receptor. This will include both the development of new drilling and sampling techniques and investigations of the transport processes of pollutants in this environment.

Considerable effort will be given to the recalcitrants of pollutants moving from waste treatment facilities to groundwater. This work will result on design and construction criteria.

A strong working relationship has developed between our Branch and the Air and Water Programs. This relationship will be strengthened in the future by working closely together on common goals.

Subsurface Environment Branch

Professional Staff

Discipline	B.S.	M.S.	Ph.D.	Total
Biological Sciences		1		1
Chemistry	1		2	3
Engineering		2		2
Total	1	3	2	6

Robert S. Kerr Environmental Research Laboratory

Treatment and Control Technology Branch

Chief: Marvin L. Wood

Mining Sources Section

Mission

The Mining Wastes Section of the Treatment and Control Technology Branch of the Robert S. Kerr Environmental Research Laboratory is responsible for the conductance of intra- and extramural research efforts under Program Element 1BB040, EROS-ROAP No. 21BDV, Problem Assessment and Plan Development for Active Ores, Minerals, and Non-Coal Fuel Mining Operations.

Areas of national environmental concern included under ROAP 21BDV are the determination of the extent and magnitude of pollution occurrence from non-coal mining operations, and the development of successful mining waste treatment technologies in the following categories: minerals, ores, non-coal fuels, oil shale, and off-shore operations.

Need and Supporting Legislation: Public Law 92-500

Sediment pollution control--Section 104,(n)(1).

Grants for R&D--Section 105.

Mine water pollution control demonstrations--Section 107.

Mine-related sources of pollution--Section 208(G).

Best practical (1977) and best available control technology--
Section 301.

Mining Waste guidelines--Section 304(e)(B).

FY-74 Resources Summary

<u>Task Type</u>	<u>MY</u>	<u>Amount</u>	<u>% of Total</u>
In-House	4.0	\$100K	100

Primary Program Thrust, FY-74

Due to the great number of minerals, ores, and non-coal fuels currently being mined in the United States, a study comprising 60 of these substances was conducted to establish a priority rationale matrix for the expenditure of research monies. A more detailed study will be initiated in FY-74 to determine the magnitude of pollution occurrence for each of the top 12 elements.

Completion of FY-73 State-of-the-Art documents delayed due to the assignment of section personnel to higher-priority projects within EPA.

Major Accomplishments To Date (Extramural)

--14010 ENW - Microbiological Removal of Iron from Mine Waters. EPA Report (9/72).

--14020 EHW - North Fork Alluvial Decontamination Project. Final report is under review.

--14020 FVW - Brine Disposal Treatment Practices Relating to the Oil Production Industry. Report under final review.

--14030 EDB - Water Pollution Potential of Spent Oil Shale Residues. EPA Report (12/71).

Major Accomplishments To Date (In-House)

--Oil Production--Research Needs and Priorities Report - Forwarded to Headquarters for review.

--Pollutional Problems and Research Needs for an Oil Shale Industry - Report is being updated prior to submission for publication.

--State-of-the-Art: Sand and Gravel - Report is under initial review.

--State-of-the-Art: Uranium Mining, Milling, and Refining Industry - Report has been completed and is ready for publication.

--Sealants for Mine Tailings Pond - Report has been written and is under initial review.

--Report: Priority Rationale Matrix for Minerals, Ores, and Fuels - Study has been completed and circulated within EPA confines (9/73).

Program Trends

--Report: Research Priority Rationale Matrix for Minerals, Ores, and Non-Coal Fuels.

--Report: Magnitude of Pollution Occurrence for Ores, Minerals, and Non-Coal Fuels.

--Report: R&D Control Technology Plan for Mining.

--Report: Current Treatment Technologies for Non-Metallic Minerals.

- Report: Pollution Potential of Off-Shore Mining Operations.
- Report: R&D Control Technology Plan for Off-Shore Mining Operations.
- Coordination: Inter-NEEC coordination with Cincinnati would be beneficial.

Mining Sources Section
Professional Staff

Discipline	B.S.	M.S.	Ph.D.	Total
Biological Sciences			1	1
Chemistry	1	1		2
Total	1	1	1	3

Agricultural Wastes Section

Mission

The Agricultural Wastes Section, Treatment and Control Technology Branch, has the responsibility for implementing and directing intramural, field, and extramural research activities in the National Animal Feedlot Wastes and National Irrigation Return Flow Programs.

Animal Feedlot Wastes

Major goals of the National Animal Feedlot Wastes R&D Program are to define the animal waste problem and its real and potential pollutional effects; to determine technically deficient areas of control; to conduct and stimulate research, development and demonstration of practical and to disseminate available and new pollution control technology to other EPA programs, other federal and state agencies, and to the industry.

The program is designed to meet immediate as well as long range needs for the application and evaluation of techniques, equipment, recycle and reuse systems, and for ultimate waste disposal. The program recognizes the interrelationship of solid, liquid, and gaseous wastes and their treatment/control and disposal technology.

Irrigation Return Flow

The major goal of the National Irrigation Return Flow R&D Program is research on practical and economically acceptable means to control the pollutant (i.e., salinity, nutrients, sediments, pesticides) contribution of irrigated agriculture to our surface and groundwater resources. This can be stated in several more specific objectives as follows:

- Gain knowledge relative to prediction techniques, management practices, and treatment/control measures that may be applied to water quality problems of irrigation return flow.

- Evaluate the effect of present irrigation practices on salt loads entering the river systems, particularly through groundwater drainage systems.

- Demonstrate that improved farm water management offers feasible means of minimizing salt and nutrient degradation of return flow without sacrificing crop yields.

- Develop recommendations and guidelines on irrigation practices, methods, and systems which would have the greatest effect of reducing pollutant contributions in return flow while maintaining an acceptable salt balance in the crop root zone.

Need and Supporting Legislation

Authority for the activities of the Agricultural Wastes Section is found in the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500).

Section 104(p) specifically refers to "...a comprehensive study and research program to determine new and improved methods and the better application of existing methods of preventing, reducing, and eliminating pollution from agriculture, including the legal, economic, and other implications of the use of such methods."

Section 105(e) authorizes "...grants for research and demonstration projects with respect to new and improved methods of preventing, reducing, and eliminating pollution from agriculture..." as well as the dissemination of such information to encourage and enable the adoption of such methods by the agricultural industry.

Information generated by these R&D activities will be additionally useful to other EPA programs having responsibilities to publish information guidelines (Sec. 304), establish effluent limitations and standards (Sec. 301 and 306), identify and evaluate the nature and extent of non-point sources of pollutants and the processes, procedures, and methods to control pollution from such sources (Sec. 304(e)).

FY-74 Resources Summary

<u>Task Type</u>	<u>Man Years</u>	<u>Amount (K)</u>	<u>% of Total</u>
In-House			
IRF	3.3	\$88	5.5
AF	3.3	83	5.2
Extramural Grants			
IRF	--	900	56.1
AF	--	512	31.9
Technical Asst.	<u>0.9</u>	<u>22</u>	<u>1.3</u>
Totals	7.5	\$1,605 (K)	100.0

Major Accomplishments To Date (Irrigation Return Flow)

- "Characteristics and Pollution Problems of Irrigation Return Flow." State-of-the-Art report by Utah State University Foundation (5/69).
- "Research Needs for Irrigation Return Flow Quality Control." Water Pollution Control Research Series No. 13030 (11/71).
- "National Irrigation Return Flow Research and Development Program." Water Pollution Control Research Series No. 13030 GJS (12/71).
- "Managing Irrigated Agriculture to Improve Water Quality." Proceedings of National Conference held at Grand Junction, Colorado (May 16-18, 1972).
- "Evaluation of Canal Lining for Salinity Control in Grand Valley, Colorado." Environmental Protection Technology Series No. EPA-R2-72-047 (October, 1972).
- "Techniques for Nitrate Removal from Agricultural Drainage" were studied at the Interagency Agricultural Wastewater Treatment Center, Firebaugh, California, during a four-year period from 1968 through June, 1971.
- "Selected Irrigation Return Flow Quality Abstracts 1968-1969." Reports No. EPA-R2-72-094 (October, 1972), and EPA-R2-73-271 (June, 1973).
- "Prediction Modeling for Salinity Control in Irrigation Return Flows." EPA-R2-73-168 (March, 1973).

Major Accomplishments (Animal Feedlot Wastes)

- Comprehensive State-of-the-Art report, "Pollution Implications of Animal Wastes - A Forward Oriented Review" (July, 1968).
- Conference Proceedings, "Agricultural Practices and Water Quality," 13040 EYX (11/69).
- "Characteristics of Wastes from Southwestern Cattle Feedlots," 13040 DEM (01/71).
- "Closed System Waste Management for Livestock," 13040 DKP (06/71).
- "Evaluation of Beef Cattle Feedlot Waste Management Alternatives" 13040 FXG (11/71).
- "Characteristics of Rainfall Runoff from a Beef Cattle Feedlot" EPA-R2-72-061 (September, 1972).

--"Beef Cattle Feedlot Site Selection," EPA-R2-72-129 (November, 1972).

--"Bibliography of Livestock Waste Management," EPA-R2-73-157 (February 1973).

--Conference Proceedings with ANCA "Environment Protecting Concepts of Beef Cattle Feedlot Wastes Management" (August, 1973).

Program Trends (Irrigation Return Flow)

--Completion and field verification of the prediction model developed by the Bureau of Reclamation for EPA (Interagency Agreement).

--Workshop to assess the validity and usefulness of the USBR model as a prediction tool for irrigation return flow quality and quantity.

--Conference on the use of modeling to manage irrigation for salinity control in return flows (first generation management models and their usefulness).

--Completion of first "total package salinity control project" in the upper Colorado River Basin, including evaluation of various salinity control measures studied (first generation "best practicable control technology").

--Complete State-of-the-Art report on scientific irrigation scheduling as a tool to increase water use efficiency and decrease salinity discharges from irrigated areas.

--Complete evaluation of legal constraints and western water law with regard to implementation of salinity control technology, including recommended changes to reduce such constraints.

--Complete studies relating to economic and institutional constraints to improve management with recommendations on how these may best be overcome.

--First generation management manual for implementation of demonstrated technology for control of pollutant discharges from irrigated areas.

--Conference on implementation of "best practicable control technology" for irrigation return flow.

Major Accomplishments (Animal Feedlot Wastes)

--Completion of the R&D work on land disposal of animal waste will result in a State-of-the-Art and a user's manual for land disposal management. Additional studies are underway to determine the pollution potential of the natural runoff from areas of land disposal.

--Develop reuse process to convert animal wastes into synthesis gas for use in the production of ammonia. Other reuse systems are also being investigated at this time and include conversion to various building materials.

--Develop, with the assistance of the industry, refeeding systems utilizing animal wastes as roughage and/or a protein source. A major effort will be evaluating all such systems as to their effect on the environment, as compared to the more conventional methods of animal waste disposal.

--Develop and publish a series of waste management manuals for animal producers by species type. The complexity of the industry, climatic variations, and the wide range of housing and confinement systems dictate the development of several different management systems to solve the animal waste problems.

--The problem on non-point source or non-feedlot produced animals will be investigated in order to establish the potential pollution of range or pasture animals. The second phase of this program will be the development, if necessary, of control and management methods for this problem.

Agricultural Wastes Section

Professional Staff

Discipline	B.S.	M.S.	Ph.D.	Total
Biological Sciences	1	1	2	4
Engineering		1	1	2
Total	1	2	3	6

Industrial Wastes Section

Mission

The National Petroleum-Organic Chemicals Wastes Section, Treatment and Control Technology Branch, has responsibility for implementing and directing intramural, field and extramural research activities in the subject sub-elements of Program Element 1BB036.

The major goal is total environmental control by identification of the concerned industries' waste characteristics and the development and demonstration of applicable, economically feasible treatment methods; dissemination of collected information, technical assistance efforts to federal, state, and industrial segments, analyzing "split samples" with grantees, and participating in effluent guideline meetings are included in the major goal.

Need and Supporting Legislation

Section 101(a)(6) of PL 92-500 states, "It is the national policy that a major research and demonstration effort be made to develop technology necessary to eliminate the discharge of pollutants into the navigable waters, waters of the contiguous zone, and the oceans."

Section 104(a)(1, 2, 3, 4, 6), summarily establish national programs for the prevention, reduction and elimination of pollution through research investigation, demonstration, studies, and technical assistance.

Section 104(B)(6) concerns the collection and dissemination of basic data on chemical, physical, and biological effects of varying water quality pertaining to pollution.

Section 105(i)(1) is directed to research studies, experiments, and demonstrations for the removal of oil from any waters.

Section 104(M)(1) relates to the disposal of waste oil, biological effects, and potential marketing of such oil.

Section 105(a)(1) is directed to the demonstration of new or improved methods of preventing, reducing, and eliminating the discharge into waters of pollutants from sewers which carry storm water or both storm water and pollutants.

Section 105(c)(1&2) provides for "conduct in the EPA" and research and demonstration projects for the prevention of pollution of any waters by industry.

Section 105(d)(1,2,3) provide for a practical application of waste management methods, advance waste treatment, and improved identification methods.

FY-74 Resources Summary

<u>Task Type</u>	<u>Amount (K)</u>	<u>Man Years</u>
In-House	\$ 225	9.0
Contracts	17	-
Grants	782	-

Major Accomplishments To Date

- State-of-the-Art - Refining/Petrochemical Wastewaters.
- Petroleum Refinery Wastewater Characterization.
- Organic Chemicals Wastewater Survey.
- Oily Sludge Disposal by Soil Treatment.
- Solids Disposal by Incineration.
- Multi-Media Filtration for Solids Removal.
- Activated Carbon Treatment of Storm and Refinery Process Water.
- Activated Carbon Treatment of Refinery Process Water.
- Demonstration of Activated Carbon Treatment of API Separator Effluent and Biological Treatment Effluent.
- Biological Treatment of Refinery and Petrochemical Wastes
- Wastewater Treatment Costs for Petroleum Refinery/Organic Chemicals.

Program Trends

- More extensive wastewater characterization to define problem areas.
- Investigation of process unit treatment schemes.
- Demonstration of physical and chemical treatment systems.
- Dissolved solids removal for wastewater reuse/recycle within the industrial complex.
- In-plant management techniques.

Industrial Wastes Section

Professional Staff

Discipline	B.S.	M.S.	Ph.D.	Total
Chemistry		3		3
Engineering	2		1	3
Total	2	3	1	6

SOUTHEAST ENVIRONMENTAL RESEARCH LABORATORY

ATHENS, GEORGIA

DIRECTOR: DR. DAVID W. DUTTWEILER

Southeast Environmental Research Laboratory

Director: Dr. David W. Duttweiler

The Southeast Environmental Research Laboratory is responsible for research programs on methodology for analyzing pollutants, the control of pollution from agriculture and agriculturally related industries, and freshwater ecology.

Agro-Environmental Systems Branch

Chief: Dr. H. Page Nicholson

Mission

The primary mission of the Agricultural Sources Pollution Control Research Program is development of engineering or management systems to control pollution from poultry production, aquaculture, and runoff from agricultural and forest lands.

Control technology under development for runoff pollution consists of mathematical models that describe dynamically the behavior and movement of agricultural chemicals, biodegradable organics, pathogens, heavy metals and air pollution fallout into surface or ground waters.

Treatment systems integrated with agronomic utilization and complete recycle technology are being developed for poultry production and aquaculture.

Need and Supporting Legislation

P.L. 92-500 authorizes:

--Investigation of methods to control the release of pesticides into the environment...and alternatives thereto (Sec. 104-1).

--Efforts to determine new and improved methods and better application of existing methods of preventing, reducing, and eliminating pollution from agriculture (Sec. 104-p).

--An accelerated effort to develop, refine and achieve practical waste management methods applicable to non-point sources pollution including elimination of runoff from in-place or accumulated sources (Sec. 105-d).

The above research will satisfy or support the satisfaction of needs expressed elsewhere in the law as follows:

--Area-wide waste treatment management planning is required (Sec. 208) as are grants to State or interstate agencies for demonstrations, on a river basin scale, of advanced treatment and environmental enhancement techniques to control pollution from all sources including non-point (Sec. 105-b). Sec. 208-b-F specifically calls for a process to identify agriculturally and silviculturally related non-point sources pollution, including runoff from manure disposal areas, and from land used for livestock and crop production and the setting forth of procedures to control such sources.

--The Administrator is directed to issue guidelines for identifying and evaluating the nature and extent of non-point sources of pollution and methods to control pollution resulting from agricultural and silvicultural activities, including runoff from fields, crops and forest lands (Sec. 304-e-A).

Resources Summary

ROAP & Subject 1BB039	\$1000		Authorized
	FY-74	% Total FY-74	Permanent MY FY-74
21AYP Formulate, Field Verify Pesticide & Nutrient Runoff Mathe- matical Model	677.5	100	3.9
In-house - 8 Tasks	237.5	35	
IAG - 2	140.0	21	
Contracts - 2	185.7	27	
Grants - 3	114.3	17	
21BBV Criteria Develop- ment for Agricultural Chemical Usage	45.0	100	0.5
In-house - 1 Task	12.5	28	
IAG - 1	32.5	72	
21AYU Waste Treatment & Disposal Systems for Poultry Wastes	165	100	0.2
In-house - 1 Task	5	3	
Demonstration - 2	160	97	
Tech. Asst. - 6 Tasks	13	100	0.5
Totals	900.5		5.1

Major Accomplishments To Date

Agricultural Runoff Models:

- Completed pesticide problem evaluation and definition studies, (6/69) which were precursor to a significant proportion of EPA's current fate, effects and control oriented research and operating programs on pesticide pollution of water.
- Fundamental adsorption-desorption kinetics studies of selected pesticides on clay minerals and bottom sediments completed (6/70).
- Definition of static pesticide model (6/69).
- Pesticide model revised to incorporate dynamics of single runoff events (4/72).
- Initial design, installation, and calibration of environmental monitoring and runoff collection equipment to obtain field data for model development (9/72).
- Computer software development and data reduction, analysis, and distribution of all data to model development contractors (9/73).
- First pesticide model, field tested in the Piedmont (2/74).
- Begin plant nutrient model development data collection (4/74).
- Complete negotiations with ARS for development and criteria for agricultural chemicals usage (12/73).

Waste Treatment and Disposal Systems for Poultry Wastes and Aquaculture:

- National conference on agricultural wastes at Cornell University, (2/72).
- Final report on development and demonstration of nutrient removal from animal wastes (7/72).
- Interim report on design parameters for dairy and poultry waste treatment systems (3/74).
- State-of-art on water pollution implications of commercial catfish production (3/74).

Program Trends

Agricultural Runoff Models:

- Agricultural chemicals users manual (6/75), based on available information.
- Cost-benefit analysis of recommended soil erosion control practices (1/76).
- Verified pesticide runoff model for Piedmont and Great Lakes Basin, including users manual (9/76); same for nutrients (3/77).
- Model extended to biodegradable organics, pathogens and heavy metals (6/77).
- Verified pesticide and nutrient watershed models for corn belt and coastal plains (7/79).
- Initial evaluation of gross basin model in Piedmont (12/77).
- Users manual for pesticide and nutrient (including animal manures) based on information from watershed models, gross basin model, and evaluation of management practices (6/78).
- Use completed gross basin model to determine which conservation (management) practices should be used (7/79).
- Verified gross basin model in Piedmont (12/79).

Pollution from Silvicultural Activities:

- Guidelines for determining pollutant loading functions for forested watersheds in the Northwest and Southeast (6/75).
- Develop and test a watershed model to establish loading functions and to determine effectiveness of control options; integrate into agricultural runoff models (6/76).
- Develop and test a model for forested basins (6/77).

Treatment/Disposal Poultry Wastes:

- Complete development studies for chemical and physical treatment of poultry waste (6/74).

--Complete development studies for biological treatment/land disposal of poultry wastes (9/74).

--Complete demonstration of refeeding study (9/74).

--Complete demonstration of biological treatment/land disposal (2/75).

Agro-Environmental Systems Branch

Professional Staff

Discipline		B.S.	B.A.	M.S.	Ph.D.	Total
Biological Sciences	3	1	1		2	7
Chemistry	7	1			3	11
Engineering				2	1	3
Other	2					2
Total	12	2	1	2	6	23

Southeast Environmental Research Laboratory

Heavy Industrial Sources Research

Project Leader: Dr. Robert R. Swank

Mission

AESB has national responsibility for all waste abatement research and development activities for the two major industrial categories of PE 1BB036 directly related to agriculture -- specifically, Agricultural Chemical (Pesticides and Fertilizers) and Textile Mill Products Manufacturing.

The principal charge under this responsibility is to develop and demonstrate in concert with the manufacturers improved or new waste abatement technologies responsive to the EPA goal of a "clean environment," that is, achieving within economically practical limits a multimedia "zero" pollutant discharge posture, by 1985.

Within the framework of this overall goal, AESB is also responsible for providing the necessary technology base for legislatively mandated interim objectives for pesticide, fertilizer, and textile manufacturing and processing operations to include:

--Process specification and demonstration in support of defining Best Practicable Control Technology and corresponding Effluent Limits for July 1977 implementation.

--Develop, demonstrate, and document Best Available Control Technology --both open and closed cycle -- with its corresponding Effluent Limits for July 1983 implementation.

--Research, develop, demonstrate, and document multimedia, closed cycle technologies pursuant to Total Environmental Control objectives for 1985 implementation. These activities will stress: new production processes and/or products to avoid pollution; byproduct recovery and reuse (including wastewater and brines); and waste conversion or energy recovery systems on the multi-plant, multi-industry, and regional scale.

Other important functions of the AESB industrial research staff must include:

--Technology Transfer and implementation--not only technology developed by AESB, but that applicable from other OR&D programs; e.g., inorganic chemicals, organic chemicals, hazardous material, joint municipal-industrial, etc.

--Technical assistance to allied OR&D programs.

--Technical support and "expert" backup for EPA regions, Office of Enforcement, and all other EPA operating programs.

--Coordinator for "Fate and Effect" studies to quantify and/or verify the environmental benefits to be achieved from candidate treatment processes prior to their full-scale implementation.

Need and Supporting Legislation

The primary basis for controlling environmental pollution continues to be the protection of human health and welfare. The industries for which AESB has control R&D responsibility are in themselves crucial to Man's welfare -- the production of his food and clothing.

On the other hand, the manufacturing wastes and residues involved often entail severe environmental hazards -- eutrophics, toxic substances, and persistent food chain contaminants or inhibitors.

Based upon these observations, the AESB industrial staff recognizes a special obligation to construct an R&D plan which insures the proper balance between "environmental protection" and maximum food and fiber output.

The authorization for and specific legislative requirements (level of control and implementation schedule) to be achieved by the AESB industrial R&D program is delineated in the Clean Water Act as amended in 1972 (PL 92-500/72).

It is in the overall context of the Act, its various sections and supporting documents, and the observations above that the AESB Mission have been derived and is being executed for its assigned industrial elements.

Capabilities and Program Implementation Approach

Strong expertise in: biological treatment of high strength industrial wastes (Sanitary Engineering); physical-chemical wastewater (brine) treatment--both removal and in situ degradation for refractory or color components (Sanitary and Chemical Engineering); and organic residue conversion-degradation-destruction process technology (Chemical Engineering).

Research is implemented almost entirely via extramural demonstration grants supported by contracts and research grants to non-profit institutions.

FY-74 Resources

	<u>DG</u>	<u>RG</u>	<u>C</u>	<u>MIRS</u>	<u>IH</u>	<u>Total</u>
Number	5	1	2	1	12	21
\$1000s	437.2	55.0	82.8	21.9	155.0	751.9
% Funds	58.2	7.3	11.0	2.9	20.6	100

Current Programs and Resources

	<u>FY-74 Funds (\$1000s)</u>
Pesticides	255.0
Agricultural Chemicals Manufacturing Fertilizers	150.0
Textile Mill Products Manufacturing	296.9
Technical Assistance Activities	37.0
Technology Transfer Activities	13.0
Total	<u>751.9</u>

Major Accomplishments To Date

--Completion of initial waste survey and treatment process evaluation studies for the AESB assigned industries.

--Completion of demonstration and process specification and identification activities for definition of Best Practicable Control Technology for the assigned industries.

--Identification of candidate Best Available Control Technology processes, both open and closed cycle, and initiation of development and demonstration activities in support of final definition and implementation.

--Identification of promising modular treatment processes suitable for eventual closed cycle Best Available Control Technology application or accelerated implementation as a result of stringent "hazardous-toxic" materials regulation and integrable with other media control techniques to meet Total Environmental Control requirements for the assigned industries. Research, development, and demonstration activities have been initiated for these processes and ROAPs restructured to emphasize coordinated multi-media development and phased development of open cycle processes suitable for modification to achieve closed loop status.

--Initiation of Technology Transfer activities in assigned industries to accelerate industrial implementation and make technology available to allied industrial operations.

--Initiation of coordinated "Pollutant Identity" and "Fate and Effects" studies for treated (open cycle BAT processes) effluents during the waste treatment process development cycle to verify environmental compatibility before full-scale implementation is attempted.

Program Trends

The industrial waste abatement R&D program of AESB is currently in transition from one technology regime to another as indicated by the Accomplishments List. Early emphasis of the program involved "making biological treatment work" on a case-by-case basis.

Funding was sporadic, coming often in surges on a supplemental appropriation, so "idea funding" as opposed to coordinated research was prevalent. Passage of PL 92-500/72 and initiation of the ROAP system has stabilized both funding levels and research targets.

Consequently, the AESB effort is shifting to a coordinated research plan emphasizing advanced physical-chemical systems for closed cycle Best Available Treatment and/or Total Environmental Control requirements.

By-product recovery and water recycle-reuse are being stressed to the maximum extent. Residue conversion processes, energy recovery techniques, integrated multi-media control systems, and even multi-plant integrated systems are now being investigated.

Processes potentially applicable to achieving an accelerated "zero" posture for those products coming under the hazardous-toxic substances regulation have been identified and appropriate process research initiated.

In summary, it is fair to state that the AESB industrial program will become even more broadly based as efforts to achieve a multi-media "zero" posture are accelerated in the next five years.

Coordinated efforts with "Air," "Fate and Effects," "Solid Waste," and "Hazardous Materials" are now being planned and initiated to insure the AESB assigned industries can comply with both the general EPA goal of a clean environment by 1985 and the detailed Congressional compliance schedules.

Southeast Environmental Research Laboratory

Freshwater Ecosystems Branch

Chief: Dr. Walter M. Sanders, III

Mission

The Freshwater Ecosystems Branch develops the scientific basis for predicting the fate of pollutants entering fresh surface waters. The program examines the distribution, the pathways, and rates of movement, accumulation and degradation of pollutants including the chemical, physical, and biological factors which influence these phenomena.

Both physical and mathematical simulation models are used to study the interrelationships between competing transport and degradation processes in order to predict the net "fate and impact" of specific pollutants. Technical assistance is also provided to EPA operating programs and to OEGC.

Need and Supporting Legislation

Current knowledge within EPA and the scientific community is considered grossly inadequate to meet the intent of P.L. 92-500 regarding the transport, distribution, accumulation and persistence of pollutants in fresh surface waters. Research on the following subjects is required to meet EPA functional needs:

Specific Mandated Functions (P.L. 92-500):

- Research on improved methods and procedures for identifying and measuring the effects of pollutants in fresh surface waters (Sec. 104(d)(2)).
- Development of improved methods and procedures to identify and measure the effects of pollutants on the chemical, physical, and biological integrity of water (Sec. 105(d)(3)).
- Development and publication of water quality criteria based on pollution effects of humans, plants, animals; transport processes; and ecological effects (Sec. 304(a)(1), especially Sec. 304(a)(1)(B)).
- Publication of information on factors necessary to restore and maintain the chemical, biological, and physical integrity of waters (Sec. 304(a)(2)).
- Publication of a list of toxic pollutants for which effluent standards will be established (Sec. 307(a)).

Discretionary research function (P.L. 92-500):

- Grants for basic freshwater ecosystem research (Sec. 104(r)).
- Grant for "River Study Centers" (Sec. 104(s)).

For general water pollution control and water quality management:

- Ability to predict quantitatively the transport, distribution, transformation, and impact of persistent pollutants, or pollutants accidentally spilled into surface waters.
- Classification of pollutants according to their mode of transport, persistence, and ecological impact, and identification of processes characteristic of pollutant classes.
- For water pollutants of greatest significance, information about the mechanisms, kinetics, and products of their degradation.
- Ability to predict the effects of geographic and climatic variations on the fate of pollutants in fresh surface waters.

Resources and Program Implementation

In-house expertise exists for conducting research and monitoring research grants and contracts in the following areas:

- Bacterial degradation.
- Fungal degradation.
- Organo-chemical degradation.
- Photochemical degradation.
- Product identification.
- Ecosystem model development.
- Aquatic ecosystem simulation to determine net effects of competing transport and degradation processes and evaluating predictive mathematical models.

FY-74 Resources

	<u>IH</u>	<u>RG</u>	<u>IA</u>	<u>C</u>	<u>UF*</u>	<u>Total</u>
\$1000s	614.5	220.0	30.0	-	300.0	1164.5
% Funds	52.8	18.8	2.6	-	25.8	100.0

*Unobligated Funds

Current Resource Allocations

	<u>FY-74 Funds (\$1000s)</u>
Biological Degradation Research	208.0
Chemical Degradation Research	195.0
Transport and Distribution Research	40.0
Ecosystem Simulation	220.5
Mathematical Model Development	95.0
Non-Point Source Modeling	300.0
Technical Assistance & Program Management	106.0
Total	<u>1164.5</u>

Major Accomplishments To Date

--Characterization of the role of attached stream-bottle slime bacteria in the uptake and degradation of organic substances (1969).

--Development of micro-electrode techniques for measuring dissolved oxygen and micro-turbulence in and near boundary layers and measurement within a zone of 15 microns (1971).

--Quantification of the carbon and phosphorus requirements of the blue-green algae, Anacystis nidulans (1970).

--Development of a direct method for measuring the reaeration in rivers and streams (1972).

--Determination of uptake and distribution of ¹⁴C-Labeled Dieldrin and DDT in fish through both diet and direct water routes (1970-1971).

- Development of method for separating fish brain proteins on acrylamide gel for electrophoretic studies (1968).
- Development of method for in situ embedding attached biological communities and examination by electron microscopic techniques to determine community structures, spatial relationships and attaching mechanisms (1969).
- Characterization of carbon cycling through simple autotrophic-heterotrophic community (1971).
- Development of continuous flow experimental stream channel systems at AEC, SERL facility for transport and distribution studies for NTA and mercury (1971).
- Development, installation, and testing of Aquatic Ecosystem Simulator including automated analytical instrumentation and data processing (1973).
- Studies of the chemical and photochemical reactions of organomercurials in water (1972).
- Detailed bacterial degradation studies of Atrazine, Captan, Carbaryl, Diazinon, Malathion, Methoxychlor (1972).
- Detailed chemical and degradation studies of Carbaryl, Diazinon, Butoxyethyl Ester of 2,4-D, Malathion, Methoxychlor, and Parathion (1974).
- Study of the transport and distribution of two levels of mercuric-ion added continuously to experimental stream channels for 15 months (1972-1974).
- Development of ecosystem submodels for phytoplankton growth; chemical equilibrium; temperature response; heterotrophic growth; zooplankton growth and predation; fish growth and predation; and nitrification (1973-1974).
- Assembly and manipulation of third generation aquatic ecosystem models.

Program Trends

This program area is one of several within NERC-Corvallis that is grossly underdeveloped with respect to Agency need in executing the Congressional mandates of P.L. 92-500. It is expected that the forthcoming hearing on Section 307(a) will focus attention on the inadequacy of existing data and programs on the fate and transport of pollutants. Thus, this program should receive renewed emphasis within a two-to-five year period.

The program should maintain its current in-house scientific competence in biological, organo-chemical and photochemical degradation research and should add expertise in the areas of physical transport (sorption, vaporization, water solubilities, etc.) and inorganic speciation and transformations. In-house activities should be confined to identifications of significant "fate" processes and interactions of high priority pollutants and the "crank turning" for the growing lists of materials requiring criteria documents should be done by contract organizations.

Since both the physical and mathematical simulation and modeling activities serve as integrating functions for "fate" processes dominant in any environment, these in-house activities must be strengthened. Also, the capability of field test and evaluate predictive models within major biomes must be developed.

Since this program is currently working cooperatively with OEGC, OAWP, OPP, OTS, PE 1BA021, 1BA027, 1EA435, and others, efficient program coordination at each level is required. The main impediment to the satisfactory accomplishment of program objectives is "too many demands with too few resources."

Freshwater Ecosystem Branch

Professional Staff

Discipline		B.S.	M.S.	Ph.D.	Total
Biological Sciences	1	3	1	2	7
Chemistry	1	3		2	6
Engineering	1			1	2
Mathematical Sciences				1	1
Physical Sciences	2				2
Other	2				2
Total	7	6	1	6	20

Southeast Environmental Research Laboratory

Analytical Chemistry Branch

Chief: William T. Donaldson

Mission

The Analytical Chemistry Branch plans and conducts research and development of techniques for identifying and measuring chemical environmental pollutants. Emphasis is on advanced instrumentation having high sensitivity, specificity, and reliability.

Need and Supporting Legislation

The 1972 Federal Water Pollution Control Act Amendments (Public Law 92-500) contains specific directives, under Section 304(g), to develop methods for identification and measurement of pollutants in support of the National Pollutant Discharge Elimination Systems.

The 1972 Marine Protection, Research, and Sanctuaries Act (Public Law 92-532) provides for similar action in support of regulations pertaining to ocean dumping.

Throughout the mandates for research under PL-500 there are implied needs for development of improved methods for identification and measurement of pollutants. The necessity for development of this technology is obvious to any scientist or engineers engaged in research. Further elaboration is superfluous.

FY-74 Resources

	<u>C</u>	<u>RG</u>	<u>IA</u>	<u>IH</u>	<u>Total</u>
Number	2	9	1	36	48
\$1000s	37	259	60	629	985
% Funds	4	26	6	64	100

The professional staff, listed in the attached summary, provides expertise in organic mass spectrometry, spark source mass spectrometry, molecular spectroscopy, neutron activation analysis, gas liquid and liquid-liquid chromatography, electroanalytical techniques, nuclear magnetic resonance spectroscopy, and optical emission spectrometry. Major thrusts of the current program are in:

- Identification of specific organic compounds.
- Multi-element analysis.
- Speciation.
- Confirmatory techniques.

Major Accomplishments

- Development of a system (gas-chromatograph-mass spectrometry-computer) that identifies volatile organic compounds in water at concentrations down to 0.1 $\mu\text{g}/\ell$ at a cost as low as \$10 per identification.
- Establishment of two multi-element techniques that can identify and quantitate all of the naturally-occurring chemical elements simultaneously at concentrations as low as 1 $\mu\text{g}/\ell$ in water and 1 mg/kg in sediments.
- Completed a comprehensive characterization of organic chemicals in kraft pulp mill waste effluent.
- Demonstrated the applicability of gas chromatography mass spectrometry and high-pressure ion exchange chromatography to the identification of organic components in municipal waste.
- Developed a GC-Fourier transform infrared spectrometric technique for obtaining infrared spectra of compounds as they flow from a gas chromatograph.
- Developed an improved pulse-differential polarographic method for the measurement of NTA in sewage.

Program Trends

The development of a multi-element technique that can be applied in field laboratories at moderate cost is a major goal during the next few years. Plasma-excited optical emission and x-ray fluorescence are prime candidates for water and sediments respectively.

Comprehensive chemical characterization of waste from petroleum refineries, textile mills, metal plating plants and pesticide manufacturing plants will provide information to expand spectral libraries for computer identification of pollutants and provide information for programs concerned with fate, effects and treatment and control of pollutants. This program will be coordinated closely with research programs for those studies listed above.

Better concentration and separation techniques for organic pollutants will be developed, and emphasis will be placed on development of techniques to separate and identify polar organic compounds and less volatile organic compounds.

Analytical Chemistry Branch

Professional Staff

Discipline		B.S.	Ph.D.	Total
Chemistry	2	11	7	20
Other	2			2
Total	4	11	7	22