



# Board of Scientific Counselors

Office of Research and Development  
United States Environmental Protection Agency

## Second Program Review of the National Exposure Research Laboratory (NERL)

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Final Report of the Subcommittee  
on the Review of NERL

November 19, 2002

## **NOTICE**

This report has been written as part of the activities of the Board of Scientific Counselors (BOSC), a public advisory group that provides objective and independent counsel to the Assistant Administrator for the Office of Research and Development (ORD) of the U.S. Environmental Protection Agency (EPA). The Board is structured to provide a balanced expert assessment of the management and operation of ORD's research programs and its utilization of peer review. This report has not been reviewed for approval by the Agency; and hence, the contents of this report do not necessarily represent the views and policies of the EPA or other agencies in the federal government. Mention of trade names or commercial products does not constitute a recommendation for use.

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## PREFACE

The Board of Scientific Counselors (BOSC) provides objective and independent counsel to the Assistant Administrator of the Office of Research and Development (AA/ORD) on the management and operation of ORD's research programs. The primary functions of BOSC are to: (1) evaluate science and engineering research programs, laboratories, and research-management practices of ORD and recommend actions to improve their quality and/or strengthen their relevance to the mission of the EPA; and (2) evaluate and provide advice concerning the use of peer review within ORD to sustain and enhance the quality of science in EPA.

In spring 2000, at the request of Henry Longest II, AA/ORD, the BOSC undertook peer reviews of the ORD Laboratories and Centers. This request came approximately 4 years after the initial BOSC review of the Laboratories and Centers, which was completed on April 30, 1998. Accordingly, the BOSC began the task of conducting programmatic, as opposed to scientific or technology, reviews of the Laboratories and Centers and proceeded to establish policies and procedures for conducting such reviews. The scheduled reviews occurred as follows:

- ❖ National Risk Management Research Laboratory, August 21-22, 2001, at Cincinnati, OH
- ❖ National Center for Environmental Assessment, October 10-11, 2001, at Washington, DC
- ❖ National Health and Environmental Effects Research Laboratory, October 30-31, 2001, at Research Triangle Park, NC
- ❖ National Exposure Research Laboratory, December 18-20, 2001, at Research Triangle Park, NC
- ❖ National Center for Environmental Research, January 23-24, 2002, at Washington, DC

As constructed, the Laboratory and Center reviews are expected to lead to a better understanding of the strategies employed by the respective Directors in accomplishing their missions, and to a better understanding as to how these strategies are implemented. BOSC also expects to develop a clearer perspective on how the operation of the Laboratories and Centers articulates with the strategic plan of the ORD and relates to the Multi-Year Research Plans (MYPs).

Each Laboratory and Center review consisted of two parts. The first part was a written self-study submitted to the review committee in advance of the date of its review, and the second part was a 2-day site visit conducted by the review committee. In the self-study, Directors were asked to prepare responses to questions aimed at a programmatic assessment of the organization. During the first day of the site visit, the Director made a brief presentation about the organization and was then asked to respond to questions from the review committee about the self-study document. Later, case studies were presented that reflected how the organization successfully addressed a specific issue faced by the Agency. The first day concluded with a poster session or informed interviews attended by staff scientists and other professionals. On the second day, the committee drafted a report that contained its findings and recommendations. At the end of the day, an exit interview was conducted with the Director.

All review teams were organized as Subcommittees of the BOSC and were headed by a chair and vice chair, both members of BOSC. Additional members of the Subcommittee were selected on the

basis of an appropriate technical discipline as well as having broad experience in science and research management, planning, and communication. The Chair of the BOSC attended some reviews as an ex-officio member.

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**LIST OF ACRONYMS**

AA/ORD	Assistant Administrator for the Office of Research and Development
ALD	Assistant Laboratory Director
APG	Annual Performance Goal
AMP	Annual Performance Measure
BOSC	Board of Scientific Counselors
EPA	Environmental Protection Agency
FQPA	Food Quality Protection Act
FTE	Full-Time Equivalent
GPRA	Government Performance and Results Act
HPO	High-Performing Organization
IPA	Interagency Personnel Agreement
MYP	Multi-Year Plan
NCEA	National Center for Environmental Assessment
NCER	National Center for Environmental Research
NERL	National Exposure Research Laboratory
NHEERL	National Health and Environmental Effects Research Laboratory
NIH	National Institutes of Health
NRC	National Research Council
NRMRL	National Risk Management Research Laboratory
OMB	Office of Management and Budget
ORD	Office of Research and Development
PI	Principal Investigator
PM	Particulate Matter
RARE	Regional Applied Research Effort
RCT	Research Coordination Team
REMAP	Regional Environmental Monitoring and Assessment Program
ReVA	Regional Vulnerability Assessment Program
RTP	Research Triangle Park
SEE	Senior Environmental Employment
SES	Senior Executive Service
STAR	Science to Achieve Results

## 1.0 EXECUTIVE SUMMARY

The Board of Scientific Counselors (BOSC) established the Subcommittee for the National Exposure Research Laboratory (NERL) to serve as a resource for the Laboratory. The final report on an initial review of NERL was published on April 30, 1998. This is the second review undertaken by the BOSC. The report for the first review was published in April 1998, and this second review was conducted December 18-20, 2001, at NERL's facilities in Research Triangle Park (RTP), NC.

The initial review of NERL, immediately after the mandated reorganization of EPA's Office of Research and Development (ORD), found that NERL needed to make the following major improvements: (1) develop and implement a long-range strategic plan, (2) balance research efforts between human health effects and ecological effects, (3) develop team approaches to planning and implementing research, (4) decrease management positions and increase science positions, (5) develop strategies to institute a cultural change in the Laboratory consistent with the mission change dictated by the reorganization, (6) develop more effective and more frequent communication with all personnel, and (7) develop strategies for the enhancement of skills or learning of new skills by the research staff.

During this second review, the BOSC found that NERL has made significant progress in most of these areas. Specifically, a detailed strategic plan has been developed that describes how NERL will operate to better serve all of its clients in the foreseeable future, a good balance has been struck between research efforts on health effects and those on ecological effects, management positions have been decreased and scientific positions have been increased slightly, and training has begun at the administrative level on becoming a high-performing organization.

With all of this progress, however, there remain a few areas on which NERL needs to focus some attention. These include benchmarking (within and outside of ORD), developing more effective communication strategies within the Laboratory, developing strategies for replacing its aging workforce, adding social scientists to the workforce, and increasing workforce diversity.

It was clear during the review that NERL is committed to being a first-rate organization that makes significant contributions in the areas of risk assessment and risk management. NERL's steady progress toward team building and high performance will ultimately and quickly lead to the realization of its goal.



## 2.0 INTRODUCTION

In 2000 and 2001, the BOSC created subcommittees for the review of each of ORD's five Laboratories and Centers, including the National Exposure Research Laboratory (NERL). These Subcommittees are intended to serve as resources for the Laboratories and Centers. The NERL Subcommittee's work began with a series of study questions and site visits to update previous reviews and target new issues. The final report of the first BOSC review of NERL was issued on April 28, 1998. This report presents the findings and recommendations of the second NERL review.

The NERL Subcommittee members were Dr. Bonnie McCay, Rutgers University (Chair); Dr. Juarine Stewart, Clark Atlanta University (Co-Chair); Dr. Yoram Cohen, University of California–Los Angeles; Dr. P. Barry Ryan, Emory University; Dr. Edward Liebow, Environmental Health and Social Policy Center; and Dr. Mark Robson, University of Medicine and Dentistry of New Jersey. Dr. Caron Chess, Rutgers University, participated for 1 day of the site visit as a member of the Ad Hoc Communications Subcommittee of the BOSC.

The NERL Subcommittee met with NERL leadership and staff at the Laboratory's headquarters in Research Triangle Park (RTP), NC, December 18-20, 2001. The agenda of the meeting is presented in Appendix A, and a list of the materials distributed to the Subcommittee is included in Appendix B. Directors and Branch Chiefs from the NERL divisions at RTP as well as those from Athens, GA; Las Vegas, NV; and Cincinnati, OH were present at the meeting, as were the RTP-based Principal Investigators (PIs). Separate meetings, including a poster session, were held with PIs, Division Directors, Branch Chiefs, Assistant Laboratory Directors (ALDs), and senior administrators. The NERL staff did an excellent job preparing responses to the self-study questions and carrying out these sessions (see Appendix C for NERL's responses to the self-study questions).

A major charge to the Subcommittee was to examine how NERL had responded to the first review. NERL forwarded its initial response to the April 1998 report to the Assistant Administrator of ORD (AA/ORD) on December 10, 1998. NERL also was a focus of the BOSC review of the PM<sub>2.5</sub> program that was conducted in 1999. To aid in the current review, NERL carried out a self-study that responded to questions posed by the BOSC. The following report is organized around those questions and includes recommendations where appropriate.



## 3.0 LABORATORY REVIEW

### 3.1 Planning and Integration

#### 3.1.1 How does NERL's strategic plan articulate with the ORD Strategic Plan and the EPA Strategic Plan?

The 1998 BOSC review concluded that “NERL needs a Strategic Plan that spells out its priorities.” This Subcommittee found that NERL has been engaged in strategic planning and gone beyond to clearly indicate relationships to and integration with both ORD and EPA. In addition, NERL is engaged in workforce planning and efforts to improve its organizational structure and culture to contribute to ORD's vision, which is “to conduct leading edge research and foster the sound use of science and technology to fulfill EPA's mission to protect human health and safeguard the natural environment.”

Indeed, after the 1997 site visit and before the 1998 review report was completed, NERL developed a research strategy plan and invited the BOSC to review it (see December 10, 1998 response of NERL to the BOSC review). The 1998 NERL Strategic Plan highlighted the role of “exposure” in the risk assessment/risk management paradigm, showing the central role of NERL's areas of scientific research responsibility, both for human exposure and ecosystem exposure, plus its strong emphasis on process and modeling research. The Plan characterized NERL as integrating both “Core Research” and “Problem-Driven Research.” The BOSC did not review the plan at that time, although such a review was requested, and NERL put it on hold to better coordinate with ORD's own strategic planning process.

The NERL Strategic Plan is being updated for external review in late 2002. However, extensive planning has been carried out in relation to the ORD Strategic Plan (2000), aided by the fact that the 1998 NERL research priorities overlap considerably with ORD priorities, which in turn, are related to EPA-wide strategic planning Goals 1 through 10. Table 1-2 in the NERL Self-Study demonstrates these relationships. Planning takes place mainly through the multi-year Program Research Overviews and annual “business plans,” which are nested within the ORD Multi-Year Plans (MYPs). The Program Research Overviews link NERL's task-level research plans to the broader Agency mission, and they are used to update the Laboratory's own strategic plan. In addition, NERL undertook workforce planning and began training of the workforce in the teamwork approach to “high performance organizations,” whereby employees are empowered to identify and address important issues.

**Recommendation 1: The BOSC commends NERL for the extent and quality of its strategic planning. The BOSC recommends that NERL continue its commitment to strategic planning and that it consider, within that effort, developing contingency planning and budgeting to accommodate extraordinary events, such as the September 11, 2001 tragedy, and its aftermath, which included the use of NERL expertise.**

#### 3.1.2 What are NERL's priorities and directions for the next 5 years? Include NERL's research portfolio and multi-year planning efforts.

Following recommendations of the National Research Council (NRC) in its report “Research Opportunities and Priorities in EPA,” NERL has reconfigured its research program to develop and refine exposure science as the base for the Laboratory's work, building on and adapting NERL's

traditional strengths in source and transport. To link pollutant levels to human and ecological effects, models and measurements that support decision-makers need to examine exposures. NERL has embarked on an effort to increase its accountability to its clients and the public. In this regard, NERL adopted its own “bold and audacious” vision statement that underscores the value of empirical research on exposures: “To bring about a revolution in environmental decision-making, such that decisions are based on ‘real’ exposures to humans and ecosystems.”

Confronted with challenges created by the decline in resources over the past 5 years, NERL’s administration has invested in a major effort to make it a “high performing organization” (HPO). Accountability is central to this process, and efforts are being made to improve relationships with clients (see Section 3.1.5 below). It was not clear to the Subcommittee, however, whether the “bottom-up” approach invoked for HPOs will soon engage the PIs.

**Recommendation 2: The BOSC commends NERL for its bold vision and its accomplishments in developing exposure science and increasing accountability. The BOSC also commends NERL for efforts to build a “high performance organization.” Based on concerns expressed by some PIs, the BOSC urges NERL management to develop a more specific process for the participation of NERL PIs in the formulation of the HPO integration strategy and other strategic planning.**

### 3.1.3 How does NERL integrate research across and within its divisions according to the risk paradigm?

Internal integration is central to the planning goals of the Laboratory. NERL is a complex, diverse, and highly dispersed Laboratory of ORD, making integration a major challenge. NERL has six divisions in four locations, and branches of some of the divisions are located in two sites:

Ecosystems Research Division	Athens, GA
Ecological Exposure Research Division	Cincinnati, OH
Molecular & Chemical Research Division	Cincinnati, OH
Environmental Sciences Division	Las Vegas, NV
Atmospheric Sciences Modeling Division	Research Triangle Park, NC
Human Exposure & Atmospheric Sciences Division	Research Triangle Park, NC

Adding to the complexity of NERL is the fact that the Atmospheric Sciences Modeling Division is part of the National Oceanic and Atmospheric Administration’s (NOAA) Air Resources Laboratory.

Integration across and within the divisions and sites of NERL is enhanced by the activities of the ALDs—the ALDs are staff positions rather than line positions—and the Laboratory’s Associate Directors for Human Exposure and Ecological Exposure. Integration involves clearly articulating the complementary roles of each division’s activities and products in relation to others and developing collaborations where appropriate. It relies on the multi-year planning processes, joint planning with Program Offices, ORD, and external partners, and proven success such as integrated work in stressor identification and PM research.

As noted, NERL is in the process of adopting the HPO paradigm as a framework for organizing research administration (planning, communication, and consensus building; assessing client needs



and satisfaction; and performance assessment). The Laboratory's recent emphasis on adopting an HPO management approach, which emphasizes teamwork and customer service, can be seen as a

one of its concrete steps towards insuring that the “risk paradigm” is embraced throughout the entire NERL organization. Attention to the holistic risk paradigm is important because of its role in positioning NERL in relation to the work of other ORD Laboratories and Centers as well as external organizations.

**Recommendation 3: NERL is strongly urged to continue its self-assessment to identify specific ways scientists can work together across division and branch boundaries and remain responsive to client needs.**

3.1.4 How does NERL integrate research with the other ORD Laboratories and Centers according to the risk paradigm?

The risk paradigm is the critical tool for integrating NERL’s work with that of other EPA Laboratories and Centers and key customers. NERL places itself at the “source-to-dose” end of the risk paradigm. At the “source” point, NERL interfaces with the National Risk Management Research Laboratory (NRMRL) concerning source characterization of pollutants and stressors. At the dose end, a major interface is with the National Health and Environmental Effects Research Laboratory (NHEERL), where NERL focuses on pathways of exposure to dose, and NHEERL on dose-response relationships. They all interact with the National Center for Environmental Assessment (NCEA) and the National Center for Environmental Research (NCER), as well as with the Program Offices. Mechanisms of integration include the MYPs, the Research Coordination Teams (RCTs), and the Executive Council.

NERL managers have linked the risk paradigm with the HPO paradigm that emphasizes setting quality goals to meet customer needs and expectations to create “a more integrated, customer-focused research program” (NERL Self-Study, p. 33). A major planning effort, expressed in two “Integration Slides” (3-1 and 3-2 in the NERL Self-Study), involves examining how the scientific work of NERL and its products (“the tool kit”) relate to collaborators within ORD—NCEA, NCER, NHEERL, and NRMRL—to inform risk assessments, environmental forecasting, and other ORD products. These, in turn, have “client applications” in relationship to Program Offices and mandates, such as particulate matter, drinking water, Food Quality Protection Act (FQPA), and hazardous waste delisting.

One slide, the traditional one, shows the directional arrows going from Science and the Tool Kit to Client Applications. The other shows them going back from Client Needs to the Tool Kit and Science. This latter client-driven model can be used to identify gaps in what is being done by NERL. It is a relatively new way of thinking and planning for NERL, and one that is yet to be fully implemented. Both of these slides highlight the guiding values of accountability and the importance of collaboration to serve client needs, which appear to be embraced throughout NERL.

**Recommendation 4: The work of NERL is increasingly client driven. The BOSC applauds this and recommends enhanced efforts to implement planning of research that responds to client needs. It also recommends care to ensure that a portion of the research effort remain devoted to innovative, exploratory research that may not have immediate or direct applicability to client needs.**

### 3.1.5 How does NERL integrate research with EPA's Program and Regional Offices, other federal agencies, and other research centers worldwide?

Relationships with the Regional Offices (and hence with the states) come about primarily through ORD. NERL is an active participant in the ORD programs designed to meet regional needs: for example, through the Regional Environmental Monitoring and Assessment Program (REMAP), Regional Applied Research Effort (RARE), and Regional Methods Programs. Moreover, through ORD's RCTs, NERL's ALDs interact with appropriate Program and Regional Offices to review and prioritize research, and at the Executive Council the Laboratory Director has input into ORD research priorities and budgeting. There are other ways that NERL's research can be "integrated" with, or made known to and perhaps used by, the Regions, including through the work of the Regional Science Councils and a wide diversity of inter-divisional and inter-laboratory committees and workgroups (e.g., the Mid-Atlantic Integrated Assessment). Less formal mechanisms for interaction exist for other federal agencies and international research centers.

Although the Subcommittee detected some frustration among NERL staff at not being able to work more directly with the Regions or the states, especially given the client-driven research management paradigm, the above mechanisms for integration appear extensive and satisfactory.

### 3.1.6 Specifically, how has NERL incorporated social and behavioral science into its research program?

Social and behavioral science are described in the NERL Research Strategy (NERL Research Strategy, 1998, Appendix 2, Section 4.2.2 "Research to improve the scientific basis of human exposure models that represent source-fate-exposure-dose relationships") and in Program Research Overviews as part of current and planned research in human exposure, landscape sciences, the Regional Vulnerability Assessment (ReVA) Program, and the Global Change Research Program.

However, there are few economists and no non-economist social scientists working at the NERL divisions, either as regular employees or as post-doctoral fellows. This appears to be a serious obstacle to NERL's goal of developing exposure science, given the need for psychological, ethnographic, demographic, social, and other social science research to understand activity patterns that affect adult and child exposure, a major research question for human health research. Similarly, the social sciences are critical to efforts to determine and model the forces behind land-use and climate change, a major issue for ecological research. The "human exposures" research staff needs to be enhanced to include expertise on the social, cultural, economic, and psychological determinants of human activity patterns and hence, exposure. The "ecological exposures" research staff also suffers. For example, landscape characterization must incorporate understanding of land tenure and settlement patterns, given the role of anthropogenic sources of environmental change (see, for example, NERL Research Strategy, 1998, Appendix 2, Section 5.2.3, "Regional Vulnerability Assessments"). Finally, meeting the EPA goal of "safe communities" calls for greater research attention to the demographic, social, and political dynamics of human communities that affect their exposures and their responses to threats of exposure.

**Recommendation 5: NERL should define social scientists as priority recruitment targets for both the "human exposures" and the "ecological exposures" efforts. This may be accomplished through post-doctoral fellow recruitment efforts and contracting, but there should be someone with appropriate training on the NERL staff to mentor and coordinate the work of the social scientists.**

#### 3.1.7 How has NERL achieved/maintained a balance between human health and ecological research?

Ecological research receives somewhat more support than human health/exposure research at NERL, grounded as it is in the traditional areas of the transport and fate of environmental pollutants. In fiscal year 2002, the FTE (full-time equivalent) ceiling for ecological research was 203.8 and for human health research the FTE ceiling was 185. Although the FTE level associated with the ecology program is greater than that for health, many of the staff actually contribute significantly to both areas, resulting in a more equalized distribution of talent across the two programs.

Since 1995, human health and exposure research at NERL has increased greatly, and on the whole the human health and ecological research areas are well balanced today. The two areas are linked by NERL process and modeling research and through the interactions of the ALDs and the Associate Directors for Human Exposure and Ecological Exposure.

### 3.2 Research Strengths and Challenges

NERL has provided scientific leadership and high-quality research in many areas, building upon historical expertise in the fate and transport of pollutants; their concentration in the environment; and measurement methods, modeling, and database development. Today, exposure science is the primary focus, but the high-quality research being conducted is not just exposure research per se. It also includes dose reconstruction, time and activity data, and visualization methods. These areas of research are complementary to many major initiatives with EPA, National Institutes of Health (NIH), and other agencies. Exposure science has become a pivotal component in many emerging areas of research, such as genomics, proteomics, biomarkers, and susceptibility. NERL is emerging as a key player in contributing to the science of “assessment” that is the foundation of risk assessment policy.

NERL has undergone a significant revision to its administrative structure, aiming to improve the quality and productivity of the Laboratory’s scientific research. The allocation of funds and personnel to long-term and core research versus short-term and problem-oriented research has always been a struggle for the EPA, and NERL is no exception. The general consensus among PIs is that their abilities to sustain long-term as well as to carry out innovative exploratory research have been adversely affected by the shift of research funding to a competitive extramural grant program and away from cooperative agreements and other extramural arrangements and by limited internal research funding.

**Recommendation 6: NERL should consider restoring funding mechanisms previously used to support exploratory research, such as an Internal Grants Program. As already noted, although problem-oriented and client-focused research should continue to have high priority, a portion of available funding should be devoted to innovative and exploratory research that may not have immediate client applicability. This would help to ensure that the creativity of the scientists is not stifled by the daily performance of routine tasks and could lead to improvement in methodology and the development of new concepts.**

The current NERL strategic integration plan is based on a core research program and problem-driven research fixed by the basic science research areas and Laboratory work units. The NERL administration is commended for its effort to examine whether it is responsive to its “customers.”

It is important to note that the linkages, flow of information, and administration for the current structure of NERL naturally flow from the science areas towards the client applications. It is recognized by the NERL administration that it will be beneficial to adapt the operation of NERL to allow for flow of information, requirements, and “customer orders” in reverse order from clients to the science areas. However, the planning and evaluation of such an approach is at an early stage. It is conceivable that an optimal application of the above approach may require a flexible structure of the science areas and/or work units.

**Recommendation 7: As noted earlier, in the context of the question of the integration with EPA Regions, other federal agencies, and peer institutions worldwide, NERL is urged to conduct a self-evaluation to determine its ability to be flexible in responding to restructuring its science areas/work units or to developing specialty ad hoc work units in response to client needs.**

The NERL Strategic Plan highlights the importance of accountability in relation to the long-term goal of reducing morbidity and mortality. Central to this paradigm are science-based risk management decisions that are, in turn, based on measuring actual exposures. This new approach will require integration of risk assessment, risk management, and accountability. Clearly, the scientific basis to support the above paradigm also will need to be derived from integrated scientific approaches. Although there appears to be a meaningful effort on the part of the NERL administration to reorganize the science leadership to provide the opportunity for more integration, definitive plans for including the PIs in the formulation of the integration process are unclear.

**Recommendation 8: To foster an atmosphere of collaboration and achieve the level of integration sought by NERL, the PIs should be more involved in formulation of the integration process.**

### 3.3 Performance and Communication

Successful scientific performance depends on several factors, including personnel evaluation, the resources at hand to support research programs, ways in which activities are organized to facilitate the exchange of information about long-term priorities and short-term customer needs, and the approach taken to workforce development.

3.3.1 What are the three to five most serious problems identified in the first BOSC review? How has NERL responded to these problems and the BOSC recommendations related to them?

Major changes include the planning noted earlier; in particular, the multi-year planning process and HPO training, which address previous BOSC concerns about the need for “team” approaches to planning and implementing research, clear definition of real clients, and matching NERL scientific capabilities to the needs of strategic initiatives. In addition, there has been a reduction in the percentage of positions that are in pure management, from 11 percent in 1997 to 7 percent in 2001, and an increase in research positions at the M.S. and Ph.D. levels, from 41 to 47 percent, as recommended by the previous BOSC review.

Overall, the FTE ceiling for research has increased from 407 in 1997 to 472 in 2001. However, technical support has decreased from 33 to 31 percent. Although the decrease appears slight, it was mentioned often during the site review, suggesting that its impact may be greater in some areas than

others. The Subcommittee heard about concerns that the emphasis on post-doc hiring often was at the expense of technical support.

Similarly, there have been significant changes in relation to concerns in the previous BOSC review about workforce matters. Over the past year, NERL managers have undergone intensive training in workforce analysis and planning (see Appendix). Moreover, hiring authority has been delegated to the division level, enabling those closer to research activity to have the principal say about hiring priorities (but within declining hiring ceilings). In addition, over the past 3 years, NERL has hired 46 post-docs, both federal and extramural, and post-docs are a major focus of planned efforts to sustain and expand research capability in important areas. There was no evidence that these hirings responded to concerns in the Strategic Plan about diversity and the presence of social sciences in NERL, and the BOSC is concerned about the possibility of lost opportunity in the management of post-doctoral appointments.

The NERL administration has implemented a personnel evaluation approach that is based on a comprehensive assessment that considers scientific contributions and deliverables that meet regulatory and other needs. However, the evaluation system does not provide as clear a ranking as some PIs would like to see implemented. A reward system that includes monetary rewards appears to be favored by NERL PIs, but the impact of such a system is unclear.

#### Resources

NERL's resources have decreased significantly. Static budgets and personnel cost increases have reduced the funds available for research. Expansion of certain program areas without the apparent addition of resources has resulted in a reduction of funds for maintaining established programs. Current (fiscal year 2002) funding for NERL is at \$98 million, down from \$106 million in 1997. There currently are 444 FTEs; this too, is down from approximately 550 in 1997.

NERL's Research Triangle Park operations are moving to a new facility beginning in fiscal year 2002. In addition to upgrading the infrastructure, this facility's construction will allow NERL to consolidate many of its offices in a single location, eliminating informal barriers to collegial exchange and communications between management and research staff. Facility renovations also are slated for NERL's Cincinnati facility in the next several years.

3.3.2 How does NERL communicate its results within the organization, within ORD, within EPA, to outside agencies, and to the outside world?

#### Organizational Structure

In NERL's organizational structure, clear distinctions are made and substantial layers of organizational insulation are found between those laboring in the vineyards and those making decisions. At the top is the Laboratory Director, who is responsible for all activities in NERL. There also is a Deputy Director overseeing administrative and business-related matters. Reporting directly to the Director and Deputy Director are two Associate Laboratory Directors, one for ecological effects and one for human health effects. Their responsibilities include coordination of all activities both in-house and external to NERL in their specific areas.

A group of ALDs, headed by a lead ALD, is responsible for working with the “client” of the Laboratory to ensure that the science serves the needs of these external groups. The ALDs view themselves as the “marketing” group for the Laboratory. All of these individuals report directly to

the Director and form the Office of the Director. The Office of the Director has both inward-looking and outward-looking components, as the ALDs form a link between clients and staff at NERL.

Reporting to the Office of the Director are the several divisions with the associated Division Directors. Each division oversees a general exposure-related scientific research domain. Within each division are various branches, each directed by a Branch Chief. The branches are responsible for specific areas of research under the umbrella of the specific division to which they belong. Individual PIs are affiliated with a specific branch.

The overall management structure of NERL appears highly hierarchical to the outside observer. However, senior Laboratory managers talk about a “matrix” rather than a hierarchy. In a matrix organization, the decision-making process is designed to benefit from many parallel inputs, some from scientists, some from client needs assessments, and some from administrative rules and cost considerations. When resources are scarce and administrative constraints inherent in a federal regulatory agency are substantial, these parallel inputs often conflict with one another.

From the PIs’ vantage point, the matrix is less apparent than the hierarchy. The Subcommittee found that some PIs feel forced to “market” their research to the Laboratory “marketers.” This makes it seem that the ALDs form another layer of individuals to whom the PIs must report rather than sources of information about ORD strategic plans and customer needs and satisfaction.

**Recommendation 9: NERL’s upper management should consider new ways of communicating more clearly with scientific staff, perhaps in small group discussion formats, about the concrete ways in which the benefits of its matrix organizational structure offset the perceived disadvantages of additional resources absorbed by bureaucracy and confusing lines of accountability.**

#### Communication

Communication issues are directly related to NERL’s structural complexity. The Laboratory is making notable efforts at outreach communication, including the fact sheets created by the Las Vegas ecological research group and the efforts of the human exposure research groups to obtain feedback.

The Subcommittee noted divergent perceptions of communication effectiveness at different levels in the Laboratory. Among PIs, for example, communication with the Branch Chiefs is considered effective, but there is a sense that, as messages have to travel to more distant organizational levels, including the ALDs, these messages get filtered so much that information is not getting through. In the other direction, decisions made at the highest level at times appear arbitrary to those working in the trenches. In fairness, those at the lower levels may not appreciate the external and, at times, arbitrary constraints placed on them by, for example, congressional mandate.

The Subcommittee’s meetings with a group of PIs and a group of Division Directors revealed divergent perceptions of communication effectiveness. By and large, PIs had the perception outlined above. Division Directors thought that communication from above and to subordinates was good. However, Division Directors are the first line after the Director’s office, so one would expect a clear line with regular question-and-answer periods. The filtering of “messages” may be built into the responsibilities of Branch Chiefs. According to one Division Director who operated



as a Branch Chief for some time, such filtering may be used, for example, in an effort to spare the PIs some of the administrative “noise” that comes down the pipeline.

**Recommendation 10: NERL should consider offering communications training to Branch Chiefs to achieve more effective information exchanges between upper management and scientific research staff. Branch Chiefs seem to be the critical nexus for such communication.**

### 3.3.3 Workforce Development

#### Research Staff

Clearly, the NERL research staff represents significant and widely recognized talents in the natural, physical, and computational sciences related to human exposures and ecological exposures. NERL’s research staff members have an inherently difficult combination of responsibilities. On the one hand, they must develop and maintain the scientific expertise needed to measure, model, and assess the movement of pollutants from their sources to their receptors. In addition, they must work within the organizational constraints of a federal agency with substantial regulatory responsibilities.

The NERL workforce has decreased steadily over the past 5 years. This decrease has been felt mainly in the number of staff at the technical level. A disconcerting portion of the scientific staff is eligible for retirement in the next few years, and plans for replacing them are subject to budgeting uncertainties.

Additional issues concerning research staff development include the use of contractors as technicians and consultants for high-level expertise (e.g., computer programming, software development), the relatively low number of post-doctoral fellows who are retained, and the significantly limited workforce diversity.

#### Administrative and Support Staff

The Laboratory’s administrative and support staff members have a wide range of responsibilities to serve the missions of NERL and the EPA. The Program Operations Staff, the Laboratory’s principal administrative unit, performs more than 40 widely varying functions, including, in no particular order: overall science quality, financial management, organizational change planning/management, communication with key constituents, facility management, workforce supervision and development, professional development support, computing infrastructure, and health and safety.

Three main challenges are evident in workforce development: recruitment, retention and promotion, and professional development.

#### Recruitment Challenges

NERL’s FTE ceiling has imposed severe hiring limits, although recruitment opportunities are created when vacancies result from retirements, transfers, and so forth. Loss of scientific expertise and institutional memory due to retirement is an important problem. In its most recent self-study,

NERL indicates that a significant portion of its workforce in every goal area is eligible to retire by the end of 2006. The following table provides the projections.

<b>GPRA Goal</b>	<b>Percent of Goal Staff Eligible to Retire by 12/31/06</b>
1 – Clean Air	57
2 – Clean/Safe Water	48
3 – Safe Food	28
4 – Safe Communities	100
5 – Waste Management	48
6 – Global Climate	50
7 – Sound Science	38

One major recruitment mechanism used in recent years has been to support post-doctoral fellows. Their presence refreshes the Laboratory's staff capabilities, and the post-docs often are invited to join the staff at the end of their fellowship term. Some post-doctoral positions are funded by external sources (e.g., the National Science Foundation), while others are funded directly by EPA. The EPA post-doctoral positions count against NERL's FTE ceiling, contributing to the hiring limits faced by the Laboratory. NERL officials would like to have the post-doctoral positions removed from the FTE ceiling.

**Recommendation 11: NERL and EPA should seek approval to remove the federal post-doctoral positions from the FTE count that must comply with OMB ceilings.**

Recruitment efforts also should not lose sight of other targeted positions based on long-term needs identified in strategic planning efforts. Of particular concern is the loss of mid- and upper-level expertise with impending retirements and the importance of programs that would attract high-quality scientific expertise to the replacement positions.

**Recommendation 12: NERL needs to develop a specific plan for using the STAR Fellowship program, or its successor, to help achieve long-term workforce development goals.**

Use of contractors as a way to work around FTE limitations imposed by the Office of Management and Budget (OMB) is an approach that appears to work best for support/tech-level staff. The use of contractors has the advantage of allowing the Laboratory to hire the expertise needed at the time that it is needed and to terminate the services when the project is completed or the research emphasis changes. However, use of contractors also places limits on direct communication with the technical staff and adds to overhead costs for contract administration. When given a choice, the PIs all indicated a desire for an increase in FTEs so that more research technicians could be hired as EPA employees. At the higher skill end (e.g., computer programmers, software developers), inside contractors are used to provide these services. Everyone involved at this level seemed to be satisfied that this system provided the needed expertise for the required time period.

### Activities Aiming to Increase Diversity of Research Staff

NERL needs to increase the ethnic diversity of its research staff. The Subcommittee interacted with only one scientist from an underrepresented ethnic group (e.g., African Americans, Hispanics, Native Americans). When Laboratory managers were queried on this, they told the Subcommittee that there are plans to address this issue, but none could be articulated. This is especially troublesome given the recent hiring of 46 post-doctoral fellows without apparent attention to enhancing diversity.

The Subcommittee acknowledges that this problem is not unique to NERL or the EPA. There are few minority individuals with doctorates in the sciences and it is difficult for the government to compete with private industry for the few who are out there. To begin to overcome this, at least one NERL division has begun to participate in summer internship programs that bring in some of these individuals to expose them to the type of research careers available at the EPA. The EPA itself has an internship requirement as a part of its minority fellowship program. However, the length of time that this program has been in existence is not known and there has been no assessment (as far as the Subcommittee is aware) of the success of this program in increasing the number of minorities who are employed at the EPA. Also, it was noted that the steady decline in federal FTEs decreases the likelihood that they would be hired anyway.

**Recommendation 13: Strategies should be developed to expose budding scientists to the research and career opportunities available in the EPA as a whole, and NERL in particular. This could possibly serve as a “pipeline” for long-term staff development purposes. One NERL division already has begun to use summer internships for undergraduates as a way to introduce NERL research to students.**

### Retention and Promotion Challenges

There are significant challenges involved with retaining post-docs as permanent staff at NERL. These include competitive salaries, the pros and cons of a government science career, geographic location, and uncertain prospects for sustaining long-term research programs and for engaging in exploratory research. The Subcommittee also heard concerns about promotion evaluation. Some PIs and Branch Chiefs thought that there had been a departure from the previous emphasis on publications for promotion of researchers. The GS-14 to GS-15 criteria now reportedly include “quality of science,” “impact of science on Agency mission,” and “individual influence on direction of science.” The extent to which there has been a major shift, and the pros and cons of such a shift are matters of internal debate.

Another challenge is posed by the large aging cohort of researchers, skewed to certain disciplines, and whether they can be replaced with post-docs or others to meet NERL goals. Finally, there are opportunities to increase the diversity of research staff, in light of opportunities presented by anticipated vacancies due to retirement.

**Recommendation 14: NERL’s recruitment efforts to fill anticipated retirement-related vacancies should not lose sight of targeted positions based on diversity and long-term needs identified in strategic planning efforts. NERL needs to develop a specific plan for increasing the ethnic diversity of its scientific research staff.**

### Professional Development—Training

NERL administrators expressed the need to increase utilization of training resources. Advanced training and retraining in research content areas takes place but could be enhanced by further use of the Interagency Personnel Agreement (IPA) mechanism, targeting specific cohorts and disciplines. International training is restricted because of limitations on international travel for government employees. Training for organizational development, management, and administration also takes place, currently with strong emphasis on HPO training. One question is: What is a reasonable timeframe for implementing training and observing the outcomes? Another is: Is there adequate support for the “scientist as manager” transition?

NERL appears to be doing well in compensating and recognizing the performance of staff through civil service, Senior Executive Service (SES), and Senior Environmental Employment (SEE) Program. Whether there are additional rewards for outstanding performance is unknown.

### **3.4 Measures of Success and Future Needs**

3.4.1 What other research organizations (U.S. or international) are similar in purpose and operation? How does NERL’s performance compare to theirs (benchmarking)?

#### Benchmarking

NERL has taken a cautious approach to attempts to compare its performance, or the performance of its units, with others. In the NERL Self-Study (response to Question #13) the perils and inefficiencies of benchmarking were noted as a reason for going slowly and being very thoughtful about it. NERL leadership has recommended that all of the Laboratories and Centers cooperate in developing benchmarks, building upon the work of the NHEERL to come up with a strategy. The Self-Study also describes efforts to transfer “best practices” within NERL as “internal benchmarking.”

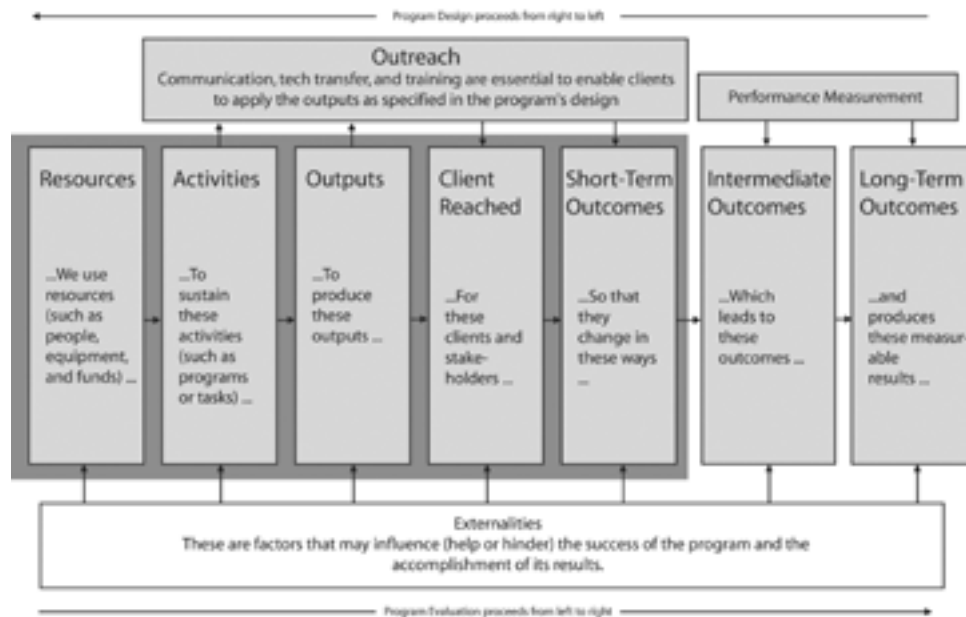
3.4.2 How does NERL measure the efficacy and results of its organization’s performance? Target indicators? Metrics of success? Show quantitative measures of performance.

#### GPRA and the Logic of Program Design and Evaluation

The strategic planning called for by the 1993 Government Performance and Results Act (GPRA) has a much more important role in measuring success for NERL than benchmarking has had. Of particular importance are the draft MYPs “that, for the first time, lay out overall long-term objectives and a series of Annual Performance Goals (APGs) and Annual Performance Measures (APMs) that should provide a framework with which to align [NERL] research to long-term program outcomes.” (NERL Self-Study, reply to Question #16).

A strong effort is being made to ensure that research outputs—such as publications, technologies, and models—are not the only measures of success. Ultimately, success depends on resulting changes in the behavior of “our customers, partners, and the public” or “outcomes.” Consequently, NERL Annual Performance Measures are presented as GPRA results, in terms of specific outputs that are linked to clients, short-term outcomes, intermediate outcomes, and long-term outcomes in a model known as “The Logic of Program Design and Evaluation” (Figure 1). This “Logic” model is

## The Logic of Program Design and Evaluation



an excellent representation of the intended and interactive linkages between Agency work and outcomes for clients and the natural world.

**Recommendation 15:** The BOSC applauds both the caution used in benchmarking and the ambition used in linking outputs to outcomes and strongly recommends that NERL continues to work on how to actually implement these methods of evaluating success. With respect to benchmarking, it urges NERL to continue its efforts to find scientific groups with similar mandates in the United States and elsewhere.

**Recommendation 16:** NERL needs to continue its efforts to actually implement the benchmarking and “Logic” model methods of evaluating success.

### Future Needs

In the future, NERL needs to focus attention on the few areas identified in the report as still needing improvement. These include benchmarking (within and outside of the ORD), developing more effective communication strategies within the Laboratory, developing strategies for replacing its aging workforce, adding social scientists to the workforce, and increasing workforce diversity. The BOSC realizes that the issues with additions to the workforce can only be properly addressed by changes in ORD that will allow NERL to remove post-docs from its FTE ceiling and by an increase in the budget to allow the hiring of addition personnel at a fair market rate.



## 4.0 CONCLUSIONS AND RECOMMENDATIONS

It was clear during the review that NERL is committed to being a first-rate organization that makes significant contributions in the areas of risk assessment and risk management. NERL's steady progress towards team building and high performance will ultimately and quickly lead to the realization of its goal. With all of this progress, there remain a few areas on which NERL needs to focus. These include benchmarking (within and outside of the ORD), developing more effective communication strategies within the Laboratory, developing strategies for replacing its aging workforce, and adding social scientists to the workforce and increasing workforce diversity. The BOSC's recommendations follow.

1. The BOSC recommends that NERL continue its commitment to strategic planning and that it consider, within that effort, developing contingency planning and budgeting to accommodate extraordinary events, such as the September 11, 2001 tragedy, and its aftermath, which included the use of NERL expertise.
2. Based on concerns expressed by some PIs, the BOSC urges NERL management to develop a more specific process for the participation of NERL PIs in the formulation of the HPO integration strategy and other strategic planning. This should help foster an atmosphere of collaboration and achieve the level of integration sought by NERL.
3. NERL is urged to continue its self-assessment to identify specific ways scientists can work together across Division and branch boundaries and remain responsive to client needs.
4. The work of NERL is increasingly client driven. The BOSC applauds this and recommends enhanced efforts to implement planning of research that responds to client needs. It also recommends care to ensure that a portion of the research effort devoted to innovative, exploratory research that may not have immediate or direct applicability to client needs.
5. NERL should define social scientists as priority recruitment targets for both the "human exposures" and the "ecological exposures" efforts. This may be accomplished through post-doctoral fellow recruitment efforts and contracting, but there should be someone with appropriate training on the NERL staff to mentor and coordinate the work of the social scientists.
6. NERL should consider restoring funding mechanisms previously used to support exploratory research, such as an Internal Grants Program. A portion of such exploratory research should remain devoted to innovative research that may not have immediate client applicability.
7. NERL is urged to conduct a self-evaluation to determine its ability to be flexible in responding to restructuring its science areas/work units or to developing specialty ad hoc work units in response to client needs.
8. To foster an atmosphere of collaboration and achieve the level of integration sought by NERL, the PIs should be more involved in formulation of the integration process.
9. NERL's upper management should consider ways of communicating more clearly with scientific staff, perhaps in small group discussion formats, about the concrete ways in which the



benefits of its “matrix” organizational structure offset the perceived disadvantages of additional resources absorbed by bureaucracy and confusing lines of accountability.

10. NERL should consider offering communications training to Branch Chiefs to achieve more effective information exchanges between upper management and scientific research staff.
11. NERL and EPA should seek approval to remove the federal post-doctoral positions from the FTE counts that must comply with OMB ceilings.
12. NERL needs to develop a specific plan for using the STAR Fellowship program, or its successor, to help achieve long-term workforce development goals.
13. NERL should develop strategies to expose budding scientists to the research and career opportunities available in the EPA as a whole, and NERL in particular. This could possibly serve as a “pipeline” for long-term staff development purposes.
14. NERL’s recruitment efforts to fill anticipated retirement-related vacancies should not lose sight of targeted positions based on diversity and long-term needs identified in strategic planning efforts. NERL needs to develop a specific plan for increasing the ethnic diversity of its scientific research staff.
15. The BOSC applauds both the caution used in benchmarking and the ambition used in linking outputs to outcomes, and strongly recommends that NERL continue to work on how to actually implement these methods of evaluating success. With respect to benchmarking, the BOSC urges NERL to continue its efforts to find scientific groups with similar mandates in the United States and elsewhere.
16. NERL needs to continue its efforts to actually implement the benchmarking and “Logic” model methods of evaluating success.

**APPENDIX: NERL Self-Study**